



**MID-STATES
CORRIDOR**

APPENDIX I – THREATENED AND ENDANGERED SPECIES IMPACTS

Mid-States Corridor Tier 1 Environmental Impact Statement

Prepared for
Indiana Department of Transportation
Mid-States Corridor Regional Development Authority

NOVEMBER 23, 2021

UPDATED MARCH 6, 2023

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THREATENED AND ENDANGERED SPECIES DESCRIPTIONS

The following substantive changes have been made to this section since the Draft Environmental Impact Statement (DEIS) was published:

- During the Screening of Alternatives, preliminary Alternative R was evaluated before being removed from further consideration. Alternative R consists of upgrading US 231 from I-64 to I-69. Many comments on the DEIS requested further consideration of an upgrade of US 231 in addition to the five alternatives presented in the DEIS. In response to these comments, this FEIS further evaluates the costs, impacts and benefits of Alternative R. See Section 2.5.1 for details about Alternative R.
- Multiple comments were received from local officials in Loogootee and Martin County about the alignment of Alternative P in Martin County, in particular in the vicinity of Loogootee. The DEIS showed Alternative P with an alignment west of Loogootee. Portions of this alignment are in Daviess County. These comments requested modifications to Alternative P to bring it through or to the east of Loogootee.

In response to these comments, three additional variations of Alternative P have been added in Martin County. All variations of Alternative P are within Section of Independent Utility (SIU) 4. See Section 2.7 for a discussion of Tier 2 sections for all alternatives. Alternative P with these variations has been designated as Refined Preferred Alternative P (RPA P). It is evaluated separately from any alternative considered in the DEIS. A single variation of RPA P will be selected in Tier 2 studies for SIU 4. See Section 2.5.2 for details about the variations of RPA P near Loogootee.

Proximity Analysis Summary

Table 1 summarizes the results of the proximity analysis for the Alternatives (excluding the Local Improvements) based on the U.S. Fish & Wildlife Service (USFWS) and Indiana Department of Natural Resources (IDNR) species occurrence data sets. Similarly, **Table 2** summarizes the results of the proximity analysis for the Local Improvements only. The results are presented to provide a general idea as to the number and type of species that are either within, or in the general vicinity of the proposed alternatives and variations. Included in the table are the USFWS federal status, IDNR state status, as well as the global and state element ranks from the Nature Conservancy ranking system. The following definitions are provided for the various federal and state status designations and the Nature Conservancy ranking codes.

Federal Status

- **Endangered** – Any species which is in danger of extinction throughout all or a significant portion of its range.
- **Threatened** – Any species which is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range.



- **Candidate** – Species that have sufficient information on biological vulnerability and threats to support a proposal for listing as endangered or threatened, but for which preparation and publication of a proposal is precluded by higher priority listing actions.
- **12-Month Proposed Listing and Proposed Critical Habitat Review (12M PLPCH)** – 12-month finding of a petition to list a species. If listing is warranted, proceed with a concurrent proposed listing rule and proposed critical habitat designation, if critical habitat is prudent and determinable.
- **Discretionary Proposed Listing and Proposed Critical Habitat Review (Discretionary PLPCH)** – Status review undertaken at the discretion of the Service. Results of the review may be to propose listing, make a species a candidate for listing, provide notice of a not warranted candidate assessment, or other action as appropriate.

State Status

Vertebrates and Mussels

- **Endangered** – Any animal species or subspecies whose prospects for survival or recruitment within the state are in immediate jeopardy or are likely within the foreseeable future to become so due to: 1) destruction, drastic modification, or severe curtailment of the habitat of the wildlife, 2) overutilization of the wildlife for scientific, commercial, or sporting purposes, or 3) effect on the wildlife of disease, pollution, or predation, or natural or manmade factors affecting the prospects of survival or recruitment within Indiana.
- **Special Concern** – An animal species requiring monitoring because of known or suspected vulnerability, limited abundance, or distribution in Indiana or a change in legal status or required habitat of the species of animal has occurred.

Invertebrates

- **Endangered** – A species whose prospects for survival or recruitment within Indiana are in immediate jeopardy, and is in danger of disappearing from the state, where: 1) a species may occur in Indiana is classified as endangered by the federal government, 2) is biologically dependent on a threatened or endangered plant species, or 3) a species is known from fewer than five sites in Indiana.
- **Threatened** – A species which is likely to become endangered within the foreseeable future, where: 1) a species may occur in Indiana is classified as threatened by the federal government, 2) is biologically dependent upon a rare or threatened plant species, or 3) a species is known from 6-10 sites in Indiana.
- **Rare** – A species where problems of limited abundance or distribution in Indiana are known or reasonably suspected, where: 1) a species is known to be rare in Michigan, Ohio, Illinois, or Kentucky, or 2) a species is biologically dependent upon a rare plant species.

Plant

- **Endangered** – A species believed to be native to Indiana with 5 or fewer occurrences in Indiana or that is otherwise currently at the brink of extinction.



- **Threatened** – A species believed to be native to Indiana with 6-20 occurrences in the state, or that is of conservation concern, or that is otherwise likely to become endangered within the foreseeable future.

Nature Conservancy Ranking System

- **G1** – Critically imperiled globally because of extreme rarity (5 or fewer occurrences or very few remaining individuals or acres) or because of some factor(s) making it especially vulnerable to extinction.
- **G2** – Imperiled globally because of rarity (6-20 occurrences or few remaining individuals or acres) or because of some factor(s) making it very vulnerable to extinction throughout its range.
- **G3** – Either very rare and local throughout its range or found locally (even abundantly at some of its locations) in a restricted range (e.g., a single western state, a physiographic region in the East) or because of other factors making it vulnerable to extinction throughout its range; with the number of occurrences in the range of 21-100.
- **G4** – Apparently secure globally; although it may be quite rare in parts of its range, especially at the periphery.
- **G5** – Demonstrably secure globally; although it may be quite rare in parts of its range, especially at the periphery.
- **G?** or **GNR** – Species has not yet been ranked.
- **T** – Element ranks containing a "T" indicate that the infraspecific taxon is being ranked differently than the full species
- **Q** – Elements containing a "Q" in the global portion of its rank indicates that the taxon is of questionable, or uncertain taxonomical standing, e.g., some authors regard it as a full species, while others treat it at the subspecific level.
- **S1** – Critically imperiled in the state because of extreme rarity (5 or fewer occurrences or very few remaining individuals or acres). Elements so ranked are often restricted to very specialized conditions or habitats and/or restricted to an extremely small geographical area of the state. Also included are elements which were formerly more abundant, but because of habitat destruction or some other critical factor of its biology, they have been demonstrably reduced in abundance. In essence, these are elements for which, even with intensive searching, sizable additional occurrences are unlikely to be discovered.
- **S2** – Imperiled in the state because of rarity (6-20 occurrences). Historically many of these elements may have been more frequent but are now known from very few extant occurrences, primarily because of habitat destruction. Diligent searching may yield additional occurrences.
- **S3** – Rare in state with 21-100 occurrences (plant species and ecological communities in this category have only 21-50 occurrences). Includes elements which are widely distributed in the state but with small populations/acreage or elements with restricted distribution, but locally abundant. Not yet imperiled in state but may soon be if current trends continue. Searching often yields additional occurrences.
- **S4** – Apparently secure in state, with many occurrences.



- **S5** – Apparently secure in state, with many occurrences.
- **SH** – Elements of historical occurrence in the state. Despite some searching of historical occurrences and/or potential habitat, no extant occurrences are known. Since not all the historical occurrences have been field surveyed, and unsearched potential habitat remains, historically ranked taxa are considered possibly extant, and remain a conservation priority for continued field work with the expectation they may be rediscovered.
- **B** – Refers to the breeding population of the element in the state.

TABLE 1. ALTERNATIVE PROXIMITY ANALYSIS SUMMARY FOR FEDERAL AND STATE LISTED SPECIES DIVIDED BY SECTION

Taxon	Species	Common Name	USFWS Status	IDNR Status	Global Heritage Rank ²	State Heritage Rank	DEIS										Alt R	FEIS				
							Alternative B		Alternative C		Alternative M		Alternative O		Alternative P			RPA P				
							Sec 2	Sec 3	Sec 2	Sec 3	Sec 2	Sec 3	Sec 2	Sec 3	Sec 2	Sec 3		Alt P1	Alt P2	Alt P3	Alt P4	
Mammal	<i>Lasiurus borealis</i>	eastern red bat		special concern	G3G4	S4										1 mile	1 mile	1 mile	1 mile	1 mile		
	<i>Myotis austroriparius</i>	southeastern bat		special concern	G4	SH						2 mile										
	<i>Myotis grisescens</i>	gray bat	endangered	endangered	G4	S1	1 mile	2 mile	1 mile	2 mile	1 mile	1 mile	1 mile		1 mile		1 mile	1 mile	1 mile	1 mile		
	<i>Myotis lucifugus</i>	little brown bat	discretionary PLPCH	endangered	G3	S2								Align		1 mile	1 mile	1 mile	1 mile	1 mile		
	<i>Myotis septentrionalis</i>	northern long-eared bat	endangered	endangered	G1G2	S2S3		2 mile		2 mile		1 mile		1 mile		1 mile	1 mile	1 mile	1 mile	1 mile		
	<i>Myotis sodalis</i>	Indiana bat	endangered	endangered	G2	S1	1 mile	1 mile		2 mile		1 mile		2 mile		1 mile	1 mile	1 mile	1 mile	1 mile		
	<i>Nycticeius humeralis</i>	evening bat		endangered	G5	S1		1 mile								1 mile	1 mile	1 mile	1 mile	1 mile		
	<i>Perimyotis subflavus</i>	tri-colored bat	12M PLPCH	endangered	G2G3	S2S3								Align		1 mile	1 mile	1 mile	1 mile	1 mile		
	<i>Sorex fumeus</i> ¹	smoky shrew		special concern	G5	S2																
	<i>Sorex hoyi</i> ¹	pygmy shrew		special concern	G5	S2																
Bird	<i>Taxidea taxus</i>	American badger		special concern	G5	S2		1 mile	1 mile	2 mile	1 mile	Align	1 mile		1 mile	1 mile	Align	1 mile	1 mile	1 mile		
	<i>Buteo platypterus</i>	broad-winged hawk		special concern	G5	S3B							2 mile									
	<i>Cistothorus platensis</i>	sedge wren		endangered	G5	S3B	2 mile		2 mile		2 mile		2 mile		2 mile		1 mile	2 mile	2 mile	2 mile		
	<i>Haliaeetus leucocephalus</i>	bald eagle	delisted	special concern	G5	S2	1 mile	1 mile	1 mile		1 mile	1 mile	1 mile		1 mile	1 mile	1 mile	1 mile	1 mile	1 mile		
	<i>Helminthos vermivorm</i>	worm-eating warbler		special concern	G5	S3B						2 mile										
	<i>Ixobrychus exilis</i>	least bittern		endangered	G4G5	S3B	2 mile	1 mile	2 mile		2 mile		2 mile		2 mile		Align	2 mile	2 mile	2 mile		
	<i>Lanius ludovicianus</i>	loggerhead shrike		endangered	G4	S3B	1 mile	1 mile	Align	1 mile	Align	1 mile	1 mile	2 mile	Align	Align	1 mile	Align	Align	Align		
	<i>Mniotilta varia</i>	black-and-white warbler		special concern	G5	S1S2B									1 mile	1 mile	1 mile	1 mile	1 mile	1 mile		
	<i>Nyctanassa violacea</i>	yellow-crowned night-heron		endangered	G5	S2B				1 mile		1 mile		1 mile		1 mile	1 mile	1 mile	1 mile	1 mile		
	<i>Rallus elegans</i>	king rail		endangered	G4	S1B	2 mile			1 mile		1 mile		1 mile	1 mile	1 mile	Align	1 mile	1 mile	1 mile		
<i>Sternula antillarum athalassos</i> ¹	interior least tern	delisted	endangered	G4T3Q	S1B																	
Fish	<i>Tyto alba</i>	barn owl		endangered	G5	S2	1 mile		1 mile	1 mile	1 mile	1 mile	1 mile	1 mile	1 mile	1 mile	2 mile	1 mile	1 mile	1 mile		
	<i>Acipenser fulvescens</i>	lake sturgeon	12M PLPCH	endangered	G3G4	S1					1 mile	1 mile			1 mile	1 mile						
	<i>Amblyopsis hoosieri</i>	Hoosier cavefish	12M PLPCH	endangered	G2	S1								1 mile								
Reptile	<i>Etheostoma maculatum</i>	spotted darter		special concern	G2G3	S2S3						1 mile				1 mile	2 mile	2 mile	2 mile	2 mile		
	<i>Agkistrodon piscivorus leucostoma</i>	western cottonmouth		endangered	G5T5	S1			1 mile		1 mile		1 mile		1 mile		1 mile	1 mile	1 mile	1 mile		
	<i>Nerodia erythrogaster neglecta</i>	copperbelly water snake		endangered	G5T3	S2	1 mile		1 mile		1 mile		1 mile		1 mile		Align	1 mile	1 mile	1 mile		
	<i>Opheodrys aestivus</i>	rough green snake		special concern	G5	S3			1 mile		1 mile		1 mile		1 mile		1 mile	1 mile	1 mile	1 mile		
<i>Terrapene carolina carolina</i> ¹	eastern box turtle		special concern	G5T5	S3																	
Amphibian	<i>Acris blanchardi</i>	Blanchard's cricket frog		special concern	G5	S4			2 mile		2 mile		2 mile		2 mile		1 mile	2 mile	2 mile	2 mile		
	<i>Lithobates areolatus circulosus</i>	northern crawfish frog		endangered	G4T4	S2		1 mile							1 mile	1 mile	1 mile	1 mile	1 mile	1 mile		
Mussel	<i>Necturus maculosus</i>	common mudpuppy		special concern	G5	S2						2 mile				1 mile						
	<i>Cyrogenia stegaria</i>	eastern fanshell mussel	endangered	endangered	G1Q	S1	Align	Align	Align	Align	Align	Align	1 mile	1 mile	Align	Align	Align	Align	Align			
	<i>Epioblasma rangiana</i> ¹	northern riffleshell		endangered	G1	S1																
	<i>Epioblasma triquetra</i> ^{1,3}	snuffbox	endangered	endangered	G3	S1																
	<i>Obovaria subrotunda</i>	round hickorynut	threatened	endangered	G4	S1	1 mile	Align				1 mile		2 mile		1 mile	2 mile		2 mile			
	<i>Plethobasus cyphus</i>	sheepnose	endangered	endangered	G3	S1						1 mile		1 mile		1 mile	1 mile	2 mile	2 mile			
	<i>Pleurobema clava</i> ³	clubshell	endangered	endangered	G1G2	S1	1 mile	Align				1 mile		2 mile		1 mile	2 mile	2 mile	2 mile			
	<i>Pleurobema cordatum</i>	Ohio pigtoe		special concern	G4	S2		2 mile	Align	Align	Align	Align	2 mile	1 mile	Align	Align	Align	Align	Align			
	<i>Pleurobema plenum</i>	rough pigtoe	endangered	endangered	G1	S1						1 mile		1 mile		1 mile	1 mile	2 mile	2 mile			
	<i>Potamilus capax</i>	fat pocketbook	endangered	endangered	G2	S1	Align	Align	Align	Align	Align	Align	1 mile	1 mile	Align	Align	Align	Align	Align			
	<i>Ptychobranthus fasciolaris</i>	kidneyshell		special concern	G4G5	S2						2 mile										
	<i>Simpsonaias ambigua</i>	salamander mussel	12M PLPCH	special concern	G3	S2			2 mile			1 mile				2 mile	2 mile	2 mile	2 mile			
	<i>Theliderma cylindrica</i> ³	rabbitsfoot	endangered	endangered	G3G4	S1		2 mile				1 mile		2 mile		1 mile	2 mile	2 mile	2 mile			
	<i>Toxolasma lividum</i>	purple lilliput		special concern	G3Q	S2						2 mile										
	<i>Villosa lienosa</i>	little spectaclecase		special concern	G5	S3						2 mile		2 mile		1 mile	1 mile	1 mile	1 mile			
Snail	<i>Fontigens cryptica</i> ¹	hidden springs snail		endangered	G1	S1																
Springtail	<i>Arrhopalites whitesidei</i> ¹	Whiteside's springtail		endangered	G?	S1																
	<i>Isotoma anglicana</i> ¹	a springtail		watch list	G?	S?																
	<i>Onychiurus reluctus</i>	a springtail		watch list	G?	S4								Align								
	<i>Pseudosinella aera</i> ¹	cave obligate springtail		endangered	G4	S1																
	<i>Pseudosinella collina</i> ¹	hilly springtail		rare	GNR	S2?																
	<i>Pseudosinella fonsa</i>	Fountain Cave springtail		threatened	G3G4	S2								Align								
<i>Sinella alata</i> ¹	a springtail		watch list	G5	S4																	

Taxon	Species	Common Name	USFWS Status	IDNR Status	Global Heritage Rank ²	State Heritage Rank	DEIS										FEIS				
							Alternative B		Alternative C		Alternative M		Alternative O		Alternative P		Alt R	RPA P			
							Sec 2	Sec 3	Sec 2	Sec 3	Sec 2	Sec 3	Sec 2	Sec 3	Sec 2	Sec 3		Alt P1	Alt P2	Alt P3	Alt P4
	<i>Sinella cavernarum</i>	a springtail		watch list	G5	S3								Align							
	<i>Tomocerus missus</i> ¹	relict cave springtail		watch list	G4	S1															
Butterfly/ Moth	<i>Danaus plexippus</i>	monarch butterfly	candidate	no status	G4	S4S5B															
Beetle	<i>Atheta annexa</i> ¹	rove beetle		watch list	G5	S4															
	<i>Dryobius sexnotatus</i>	six-banded longhorn beetle		threatened	G?	S2							1 mile								
	<i>Pseudanophthalmus shilohensis mayfieldensis</i> ¹	Monroe cave beetle		endangered	G1G2T1T2	S1S2															
	<i>Pseudanophthalmus stricticollis</i>	Marengo cave ground beetle		watch list	G4	S3							1 mile								
	<i>Pseudanophthalmus youngi</i>	Young's cave ground beetle		rare	G3G4	S2							2 mile								
Mayfly	<i>Ephemerella excrucians</i> ¹	lowlands spiny crawler mayfly		watch list	G5	S3															
	<i>Spinadis simplex</i> ¹	Wallace's deepwater mayfly		endangered	G2G4	S2															
Millipede	<i>Conotyla bollmani</i>	Bollman's cave millipede		watch list	G5	S3							2 mile								
Crayfish/ Amphipod	<i>Crangonyx indianaensis</i> ¹	Indiana cave amphipod		watch list	G3	S3															
	<i>Crangonyx packardi</i>	Packard's cave amphipod		watch list	G4	S3						1 mile	1 mile								
	<i>Orconectes inermis testis</i> ¹	a trolobitic crayfish		rare	G5T3	S3															
	<i>Orconectes inermis</i>	ghost crayfish		watch list	G5T4	S3						Align	Align								
Ostracod	<i>Pseudocandona jeanneli</i>	Jeannel's cave ostracod		endangered	G2	S1							1 mile								
	<i>Sagittocythere barri</i>	Barr's commensal cave ostracod		watch list	G5	S3S4						2 mile									
Arachnid	<i>Apochthonius indianensis</i>	Indiana cave pseudoscorpion		endangered	G1G2	S1						2 mile	1 mile								
	<i>Porrhomma cavernicola</i>	Appalachian cave spider		endangered	G5	S2							2 mile								
Flatworm	<i>Sphalloplana weingartneri</i>	Weingartner's cave flatworm		watch list	G4	S3							1 mile								
Plant	<i>Asplenium bradleyi</i>	Bradley's spleenwort		endangered	G4	S1							2 mile								
	<i>Calycocarpum lyonii</i> ¹	cup-seed		threatened	G5	S2															
	<i>Chelone obliqua var. speciosa</i>	rose turtlehead		watch list	G4T3	S3						2 mile									
	<i>Eupatorium album</i> ¹	white thoroughwort		rare	G5	S3															
	<i>Hottonia inflata</i>	featherfoil		threatened	G4	S2			1 mile	1 mile	1 mile	1 mile	1 mile	1 mile	1 mile	1 mile	1 mile	1 mile	1 mile		
	<i>Hymenocallis occidentalis</i>	Carolina spider-lily		watch list	G4?	S3			2 mile	2 mile	2 mile	2 mile	2 mile	2 mile	1 mile	2 mile	2 mile	2 mile	2 mile		
	<i>Itea virginica</i>	Virginia willow		endangered	G4	S1			1 mile	1 mile	1 mile	1 mile	1 mile	1 mile	1 mile	1 mile	1 mile	1 mile	1 mile		
	<i>Limnobiium spongia</i>	American frog's-bit		endangered	G4	S1			1 mile	1 mile	1 mile	1 mile	1 mile	1 mile	2 mile	1 mile	1 mile	1 mile	1 mile		
	<i>Ludwigia decurrens</i> ¹	primrose willow		watch list	G5	S3															
	<i>Nothoscordum bivalve</i>	crow-poison		rare	G4	S3						2 mile									
	<i>Panax quinquefolius</i>	American ginseng		watch list	G3G4	S3								2 mile	2 mile	2 mile	2 mile	2 mile	2 mile		
	<i>Poa paludigena</i>	bog bluegrass		rare	G3G4	S3	2 mile	2 mile	2 mile	2 mile	2 mile	2 mile	2 mile	2 mile	2 mile	2 mile	2 mile	2 mile	2 mile		
	<i>Rhexia mariana var. mariana</i> ¹	Maryland meadow beauty		threatened	G5T5	S1															
	<i>Spiranthes vernalis</i>	grassleaf ladies'-tresses		watch list	G5	S3							1 mile								
	<i>Styrax americanus</i>	American snowbell		rare	G5	S3	1 mile	1 mile	1 mile	1 mile	1 mile	1 mile	1 mile	1 mile	1 mile	1 mile	1 mile	1 mile	1 mile		
State endangered							12	12	13	7	14	14	13	19	14	16	25	24	25	25	25
State threatened							0	0	1	0	1	0	1	2	1	0	1	1	1	1	1
State rare							2	0	2	0	2	1	1	1	2	0	2	2	2	2	2
State special concern							1	4	5	2	5	11	5	3	5	8	11	10	10	10	10
Watch list							0	0	1	0	1	0	0	0	0	0	0	0	0	0	0
State species total							15	16	22	9	23	26	20	25	22	24	39	37	38	38	38
Federal endangered							5	6	3	4	3	8	3	7	3	7	8	8	8	8	8
Federal threatened							0	1	0	1	0	1	0	1	0	1	1	1	1	1	1
Federal candidate, 12M PLPCH, discretionary PLPCH, and proposed threatened							1	2	0	0	1	3	0	4	1	5	5	4	5	5	5
Federal species total							6	9	3	5	4	12	3	12	4	13	14	13	14	14	14

¹ Indicates species of IDNR interest for the Mid-States Corridor project where known records are beyond 2 miles from any of the alternatives.

² Rounded Global Status

³ Federally endangered mussel species identified through IDNR coordination response, but not included in USFWS coordination response as an Endangered Species Act Section 7 species of concern.

TABLE 2. LOCAL IMPROVEMENT PROXIMITY ANALYSIS SUMMARY FOR FEDERAL AND STATE LISTED SPECIES

Taxon	Species	Common Name	USFWS Status	IDNR Status	Global Heritage Rank ²	State Heritage Rank	Alternative B,C,M,O,P, RPA P, R			Alternative C,M,O,P, RPA P, R		Alternative M,P, RPA P, R		Alternative P, RPA P, R		Alternative B			Alternative M		Alternative O					
							LI-1	LI-2	LI-3	LI-4	LI-5	LI-6	LI-7	LI-8	LI-9	LI-10	LI-11	LI-12	LI-13	LI-14	LI-15	LI-16	LI-17	LI-18		
							US 231	US 231	US 231	US 231	US 231	US 231	US 231	US 231	US 231	SR 56	SR 257	SR 257	SR 450	SR 450	SR 56	SR 56	SR 145	US 150		
							Section 2	Section 2	Section 2	Section 2	Section 2	Section 3	Section 3	Section 3	Section 3	Section 2	Section 2	Section 3	Section 3	Section 3	Section 3	Section 3	Section 3	Section 3		
Mammal	<i>Lasiurus borealis</i>	eastern red bat		special concern	G3G4	S4																				
	<i>Myotis austroriparius</i>	southeastern bat		special concern	G4	SH																				
	<i>Myotis grisescens</i>	gray bat	endangered	endangered	G4	S1	2 miles																			
	<i>Myotis lucifigus</i>	little brown bat	discretionary PLPCH	endangered	G3	S2																		Align		
	<i>Myotis septentrionalis</i>	northern long-eared bat	endangered	endangered	G1G2	S2S3																				
	<i>Myotis sodalis</i>	Indiana bat	endangered	endangered	G2	S1																				
	<i>Nycticeius humeralis</i>	evening bat		endangered	G5	S1																				
	<i>Perimyotis subflavus</i>	tri-colored bat	12M PLPCH	endangered	G2G3	S2S3																				
	<i>Sorex fumeus</i> ¹	smoky shrew		special concern	G5	S2																				
	<i>Sorex hoyi</i> ²	pygmy shrew		special concern	G5	S2																				
<i>Taxidea taxus</i>	American badger		special concern	G5	S2																					
Bird	<i>Buteo platypterus</i>	broad-winged hawk		special concern	G5	S3B																				
	<i>Cistothorus platensis</i>	sedg wren		endangered	G5	S3B		1 mile																		
	<i>Haliaeetus leucocephalus</i>	bald eagle	delisted	special concern	G5	S2	2 miles			2 miles	2 miles		2 miles	1 mile												
	<i>Helmitheros vermivorm</i>	worm-eating warbler		special concern	G5	S3B																				
	<i>Ixobrychus exilis</i>	least bittern		endangered	G4G5	S3B		Align	2 miles																	
	<i>Lanius ludovicianus</i>	loggerhead shrike		endangered	G4	S3B	1 mile			2 miles	2 miles		1 mile				2 miles	1 mile	1 mile							
	<i>Mniotilta varia</i>	black-and-white warbler		special concern	G5	S1S2B																				
	<i>Nyctanassa violacea</i>	yellow-crowned night-heron		endangered	G5	S2B				1 mile	2 miles															
	<i>Rallus elegans</i>	king rail		endangered	G4	S1B		Align	2 mile																	
	<i>Sternula antillarum athalassos</i> ¹	interior least tern	delisted	endangered	G4T3Q	S1B																				
<i>Tyto alba</i>	barn owl		endangered	G5	S2	2 mile	2 mile																		1 mile	
Fish	<i>Acipenser fulvescens</i>	lake sturgeon	12M PLPCH	endangered	G3G4	S1																				
	<i>Amblyopsis hoosieri</i>	Hoosier cavefish	12M PLPCH	endangered	G2	S1																				
Reptile	<i>Etheostoma maculatum</i>	spotted darter		special concern	G2G3	S2S3																				
	<i>Agkistrodon piscivorus leucostoma</i>	western cottonmouth		endangered	G5T5	S1				1 mile	2 miles															
	<i>Nerodia erythrogaster neglecta</i>	copperbelly water snake		endangered	G5T3	S2		Align	1 mile	1 mile	2 miles															
	<i>Opheodrys aestivus</i>	rough green snake		special concern	G5	S3				1 mile	2 miles															
	<i>Terrapene carolina carolina</i> ¹	eastern box turtle		special concern	G5T5	S3																				
	<i>Acris blanchardi</i>	Blanchard's cricket frog		special concern	G5	S4				1 mile	2 miles															
Amphibian	<i>Lithobates areolatus circulosus</i>	northern crawfish frog		endangered	G4T4	S2																				
	<i>Necturus maculosus</i>	common mudpuppy		special concern	G5	S2		2 mile	1 mile	1 mile																
Mussel	<i>Cyprogenia stegaria</i>	eastern fanshell mussel	endangered	endangered	G1Q	S1																				
	<i>Epioblasma rangiana</i> ¹	northern riffleshell		endangered	G1	S1																				
	<i>Epioblasma triquetra</i> ^{1,3}	snuffbox	endangered	endangered	G3	S1																				
	<i>Obovaria subrotunda</i>	round hickorynut	proposed threatened	endangered	G4	S1																				
	<i>Plethobasus cyphus</i>	sheepnose	endangered	endangered	G3	S1																				
	<i>Pleurobema clava</i> ³	clubshell	endangered	endangered	G1G2	S1																				
	<i>Pleurobema cordatum</i>	Ohio pigtoe		special concern	G4	S2																				
	<i>Pleuroblema plenum</i>	rough pigtoe	endangered	endangered	G1	S1																				
	<i>Potamilus capax</i>	fat pocketbook	endangered	endangered	G2	S1																				
	<i>Ptychobranchius fasciolaris</i>	kidneyshell		special concern	G4G5	S2																				
	<i>Simpsonaias ambigua</i>	salamander mussel	12M PLPCH	special concern	G3	S2																				
	<i>Theliderma cylindrica</i> ³	rabbitsfoot	endangered	endangered	G3G4	S1																				
	<i>Toxolasma lividum</i>	purple lilliput		special concern	G3Q	S2																				
<i>Villosa lienosa</i>	little spectaclecase		special concern	G5	S3																					
Snail	<i>Fontigens cryptica</i> ¹	hidden springs snail		endangered	G1	S1																				
Springtail	<i>Arrhopalites whitesidei</i> ²	Whiteside's springtail		endangered	G?	S1																				
	<i>Isotoma anglicana</i> ¹	a springtail		watch list	G?	S?																				
	<i>Onychiurus reluctus</i>	a springtail		watch list	G?	S4																			2 miles	



Species Descriptions

Mammals

Indiana bat (*Myotis sodalis*)

The Indiana bat was listed as endangered under the Endangered Species Preservation Act of 1966 on March 11, 1967 (USFWS 1967). On September 24, 1975, the USFWS proposed to determine critical habitat for the bat (USFWS 1975b). Subsequently, critical habitat was designated on September 24, 1976 (USFWS 1976b) and corrected/augmented on September 22, 1977 (USFWS 1977). The draft Indiana Bat Recovery Plan was released on April 16, 2007 (USFWS 2007a) and the species underwent a 5-year status review dated July 26, 2011 (USFWS 2011a). The species was designated as state endangered by the IDNR in the second amendment of the NRC roster listing May 1, 1992 (Natural Resource Commission 1992, IDNR 2020a).

USFWS: Endangered
IDNR: Endangered
Global Rank: G2
State Rank: S1

The Indiana bat is a small bat with brown to gray fur (Mumford and Whitaker 1982, Thomson 1982, USFWS 2007a) similar in appearance to the little brown bat (*M. lucifugus*) and northern long-eared bat (*M. septentrionalis*) but can be distinguished based on differences in the foot morphology, fur color, ear length, and presence/absence of a calcar (Thomson 1982, USFWS 2007a).

The Indiana bat range extends from Alabama and Georgia north to New Hampshire and west through Michigan to Iowa, Missouri, and Oklahoma (Thomson 1982). Observations in Florida and Wisconsin are considered accidental, and the species is likely absent from these states (Thomson 1982). Distribution includes cavernous limestone areas and areas just to the north in the Midwestern and eastern United States (Thomson 1982).

Indiana bats emerge from hibernation from mid-March to mid-May, depending on latitude (USFWS 2007a), and may linger near the hibernacula or fly around the entrance for a few days before migrating in a behavior known as spring staging (Thomson 1982, USFWS 2007). Pulses of spring migration are associated with spring storms and increased temperatures (Pettit and O'Keefe 2017). Females (and some males) migrate up to 357 miles from winter habitat (Rockey et al. 2013), where they join with other pregnant females to form groups known as maternity colonies. Within these maternity colonies, females give birth to a single pup per year in early June and the pup begins flying by early July (Thomson 1982, Hayssen et al. 1993). Most males stay near the hibernacula, and frequently change home ranges (Brack 1983, Whitaker and Brack Jr. 2002). Migration back to the hibernacula begins in August and continues through early October with weather conditions such as high winds, rain, and cold temperatures serving as cues to initiate migration (Pettit and O'Keefe 2017). From mid-August to late-October, large numbers of bats fly in and out and around the entrances to caves and mines (i.e., swarming) (Humphrey and Cope 1976, Cope and Humphrey 1977) and typically engage in mating during this period (Thomson 1982). In some instances, bats are just using the caves as stopover sites, while others ultimately settle in for hibernation (Humphrey and Cope 1976, Cope and Humphrey 1977). Females often enter hibernation shortly after arriving at the hibernacula, whereas males may travel some distance out onto the surrounding landscape and even leave the entrance for a time, presumably to rest (Chenger et al. 2007). Indiana bats enter hibernation no later than November, although as early as mid-October in northern latitudes (USFWS 2007a).

Typical summer roosting habitat consists of dead or dying trees with loose bark, although bats are occasionally found in cracks, crevices, and anthropogenic structures such as bat boxes (Kurta 2004). The



preference is for trees with loose, sloughing bark, regardless of species (Kurta 2004). Roosting habitat may be upland forest or riparian areas, and maternity colonies may use a variety of tree species (Britzke et al. 2003), although roosts are typically very large (16 inches diameter at breast height) trees with substantial solar exposure and 20–80 percent canopy closure (Humphrey et al. 1977, Gardner et al. 1991b, Kurta et al. 1993). Trees used by Indiana bats not associated with a maternity colony are typically smaller and less shaded than maternity roosts (Brack et al. 2004, Kurta 2004). Individuals and colonies show strong fidelity to roosting and foraging areas over many years (Kurta and Murray 2002, Kurta et al. 2002, Whitaker and Sparks 2008).

On a landscape scale, Indiana bats prefer forested habitat for foraging and commuting (Murray and Kurta 2004, Menzel et al. 2005, Sparks et al. 2005, Bergeson et al. 2013, Womack et al. 2013). Openings and edges of forests allow Indiana bats to fly around foliage surfaces, including over and below the tree canopy in upland and riparian forested areas and along edges of forests (Humphrey et al. 1977, Gardner et al. 1991a, Brown and Brack 2003, Sparks et al. 2004). In these habitats, the most common insect prey includes moths (*Lepidoptera*), beetles (*Coleoptera*), true flies (*Diptera*), wasps and flying ants (*Hymenoptera*), and caddisflies (*Trichoptera*) (Tuttle et al. 2006), although diet varies by age, gender, habitat type, time of year, lunar cycle, and geographic location (Brack 1983, Brack and LaVal 1985, Murray and Kurta 2002, Tuttle et al. 2006).

Hibernacula are typically caves and abandoned mines (Thomson 1982), although a few individuals use a hydroelectric dam in Michigan (Kurta et al. 1997). Large, complex hibernacula offer Indiana bats a variety of thermal conditions and a buffer against sudden temperature changes (Tuttle and Kennedy 2002, Brack 2007). Indiana bats cluster in groups of 250 or more in areas with cool and stable temperatures of 41–50° F (Thomson 1982) and noticeable airflow. Indiana bats periodically arouse from hibernation. The duration between each arousal decreases as temperature of the hibernacula increases (Brack and Twente 1985, Park et al. 2000), but is typically between 12–15 days (USFWS 2007).

Indiana bat hibernacula are assigned priority numbers based on the number of individuals using the feature (USFWS 2007a).

- Priority 1 current or historical population of greater than 10,000 bats
- Priority 2 current or historical population between 1,000 and 10,000 bats
- Priority 3 current or historical population between 50 and 1,000 bats
- Priority 4 current or historical observations of fewer than 50 bats

Critical habitat for the Indiana bat includes 11 caves and 2 abandoned mines in Illinois, Indiana, Kentucky, Missouri, Tennessee, and West Virginia (USFWS 1976b). In Indiana, critical habitat includes a cave in Monroe County and a cave in Crawford County.

Historically, disturbance of winter hibernacula was the most significant cause of decline for Indiana bats, although loss of summer habitat was also an issue (Johnson et al. 1998, USFWS 2007a).

Currently, White Nose Syndrome (WNS) is considered the primary threat to Indiana bats, as populations in hibernacula throughout the range have suffered dramatic declines since onset of the fungus (USFWS 2019). The estimated population of Indiana bats since 1985 peaked at over 664,000 bats in 2007; which is coincidentally the year WNS was detected in New York State (King 2019). Since 2007, the range-wide population has experienced a 19.2 percent decrease. Indiana has experienced a 22 percent decline (over 53,000 bats) in population from a peak of 238,068 in 2007 to under 18,848 in 2019. Although Indiana



has far fewer hibernacula than other states (Kentucky, Missouri, Tennessee) it still supports the second largest population (34.4 percent) after Missouri (36.3 percent).

POTENTIAL FOR IMPACT

Within the Mid-States Corridor study area, USFWS data includes multiple records for Indiana bat hibernacula, roosts, and capture locations. **Figure 1** graphically summarizes this data using a 10-mile buffer for Priority 1 and 2 hibernacula, a 5-mile buffer for Priority 3 and 4 hibernacula, a 5-mile buffer for bat captures, and 2.5-mile buffer for known roosts. **Figure 2** illustrates the approximate total acreage range of forest habitat within the working alignment for each alternative, the approximate acreage range of forest habitat within the known maternity colony limits for each alternative, and the approximate acreage range of forest habitat within the hibernacula zone. Alternatives B, M, P, RPA P, and R are within one mile of a previously documented Indiana bat record. Based on this general assessment, Alternatives M and O have the greatest potential for adverse impacts to Indiana bat habitat within the study area. None of the alternatives would encroach upon known Priority 1 or 2 hibernacula zones; however, Alternative O and Local Improvements 17 and 18 would traverse through Priority 3 or 4 hibernacula zones. Based on available USFWS data, only Alternatives B, C, and Local Improvement 12 would traverse previously documented maternity colony habitat.



FIGURE 1. INDIANA BAT HIBERNACULA, ROOST, AND CAPTURE SUMMARY

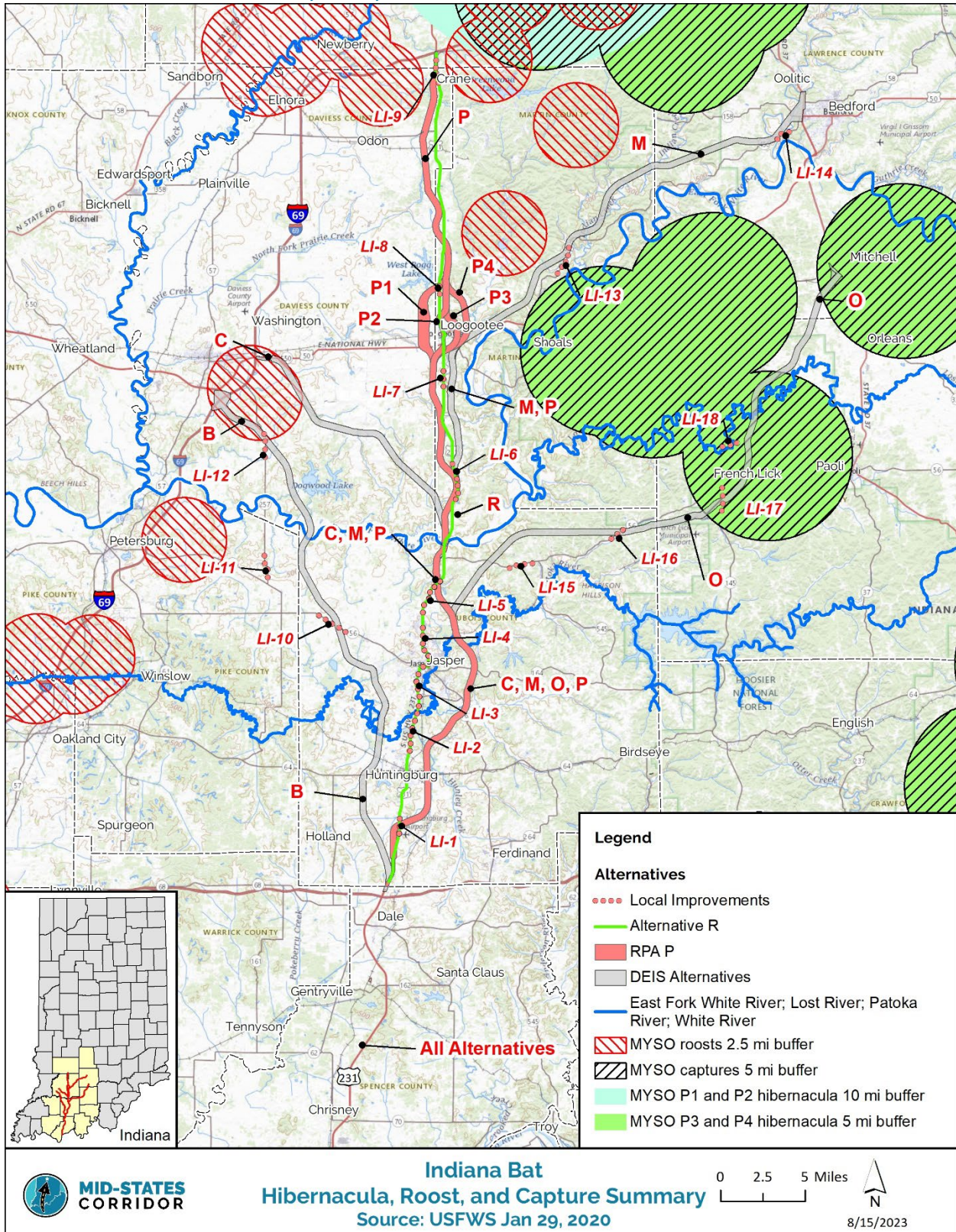
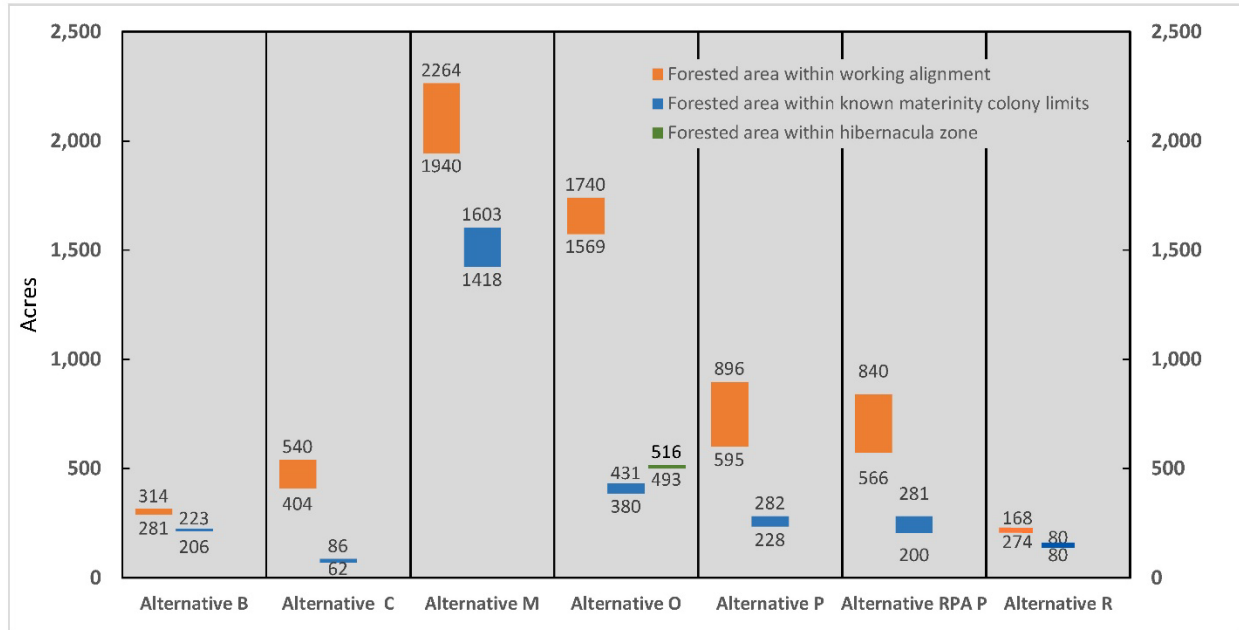




FIGURE 2. FORESTED AREA WITHIN WORKING ALIGNMENT OF ALTERNATIVES, MATERNITY COLONY LIMITS AND HIBERNACULA ZONE FOR INDIANA BAT



Northern long-eared bat (*Myotis septentrionalis*)

On October 2, 2013, the USFWS issued a 12-month finding that the northern long-eared bat warranted consideration for listing as endangered/threatened under the Endangered Species Act, but that critical habitat was not determinable at the time (USFWS 2013b). On December 2, 2013, the comment period for listing the northern long-eared bat was extended to January 2, 2014 (USFWS 2013c). Subsequently, the northern long-eared bat was listed as threatened with an interim 4(d) rule on April 2, 2015 (USFWS 2015b). The final 4(d) rule was issued on January 14, 2016 (USFWS 2016a). On April 27, 2016, the USFWS concluded that critical habitat for the northern long-eared bat was not prudent (USFWS 2016b). On March 23, 2022, a proposed rule to reclassify the northern long-eared bat as endangered was published (USFWS 2022a). On November 30, 2022, the northern long-eared bat was elevated to endangered status (USFWS 2022b) with the final rule becoming effective on March 31, 2023. The species was designated as state special concern by the IDNR in the fourth amendment of the NRC roster listing August 1, 2007 (Natural Resources Commission 2007), but elevated to endangered in the ninth amendment of the NRC roster listing on November 28, 2018 (NRC 2018, IDNR 2020a).

USFWS: Endangered
IDNR: Endangered
Global Rank: G1G2
State Rank: S2S3

The northern long-eared bat is a small brownish bat that differs from the Indiana bat and little brown bat slightly in terms of coloration and foot morphology; however, the most striking feature of northern long-eared bats are its long ears (0.7 inch), which extend past the muzzle when laid forward, and a long and thin tragus (0.4 inch) (Whitaker and Mumford 2009). Longevity is estimated to be as much as 18.5 years (Hall et al. 1957), with the greatest recorded age of 19 years (Kurta 1995).

Northern long-eared bats range from the northwestern border of Florida north into Canada from Saskatchewan to Labrador and as far westward as Montana (Caceres and Barclay 2000). Within Indiana,



USFWS and IDNR summer records of northern long-eared bats occur throughout the lower $\frac{3}{4}$ of the state, but are less common in the northern counties (Lake, LaPorte, Porter, St. Joseph, DeKalb, Starke, Jasper, Allen, Wells, Cass, Carrol, Tippecanoe, and Benton). Known hibernacula for the species is largely centered in the karst caves located in Greene, Monroe, and Lawrence counties; however, scattered occurrences to the south and southeast include Martin, Crawford, Harrison, Jefferson, Jennings, and Washington counties, as well as a few records as far north as Vermillion and Parke counties.

Northern long-eared bat hibernacula are typically caves and mines, with large passages and entrances, relatively constant and cooler temperatures, high humidity, and no air currents. They typically roost in small crevices or cracks in cave or mine walls and to a lesser extent in features such as abandoned railroad tunnels and storm sewers (Goehring 1954), hydroelectric dams (Kurta and Teramino 1994), aqueducts (French 2012 unpublished), or other “unsuspected retreats” where caves and mines are not present. The species has shown a high degree of philopatry (using the same site repeatedly) for a hibernaculum. They are commonly found in hibernacula with the little brown bat, big brown bat (*Eptesicus fuscus*), tri-colored bat, and Indiana bat. Movement between hibernacula and flights in and out of mines and caves in southern Indiana have been observed throughout the winter (Whitaker and Mumford 2009).

Around March, male and female bats emerge from hibernation and exhibit spring staging where they fly in and out of caves to feed and congregate before migrating to summer habitat. Northern long-eared bats exhibit significant weight loss, as much as 41 to 43 percent loss (Whitaker and Hamilton 1998) during hibernation. The northern long-eared bat is typically not considered a long-distance migratory species, with summer roosts usually within 35 to 55 miles of hibernacula, although distances from 5 to 168 miles have been documented (Griffin 1945; Lowe 2012, Nagorsen and Brigham 1993).

Females are already pregnant when they arrive at their summer habitat where they typically roost in clusters (i.e., colonies) underneath bark or in cavities or crevices of live trees and dead snags (Sasse and Pekins 1996, Lacki and Schwierjohann 2001, Carter and Feldhamer 2005, Garroway and Broders 2008, Krynak 2010, Timpone et al. 2010, USFWS 2015b). Maternity groups tend to favor larger trees greater than 12 inches in diameter (Garroway and Broders 2008); however, single bats may use trees as small as 3 inches in diameter. Males and non-reproductive females may also roost in cooler locations, such as caves and mines during the summer (Barbour and Davis 1969), as well as anthropogenic structures, such as buildings, barns, a park pavilion, sheds, cabins, under eaves of buildings, behind window shutters, and in bat houses (Adams et al. 2015, Amelon and Burhans 2006; Barbour and Davis 1969; Cope and Humphrey 1972; Joe Kath, personal communication, April 9, 2013; Mumford and Cope 1964; Stein and White 2016, Timpone et al. 2010; Whitaker and Mumford 2009, Whitaker et al. 2006,) and under bridges (Carter and Feldhamer 2005). Canopy cover at northern long-eared bat roosts ranges from 56 percent (Timpone et al. 2010) to greater than 84 percent (Lacki and Schwierjohann 2001). Females tend to roost in more open areas than males, likely because of the increased solar radiation, which aids in pup development (Perry and Thill 2007). Roosts are typically lower in the canopy, and they typically occupy forests with greater clutter than many sympatric species (Caceres and Barclay 2000, USFWS 2015b).

Their gleaning feeding behavior suggests an ability to easily maneuver around obstacles (Foster and Kurta 1999; Menzel et al. 2002a). Their diet consists mainly of true flies (*Diptera*), beetles, (*Coleoptera*), and moths (*Lepidoptera*) (Caceres and Barclay 2000, Brack and Whitaker 2001, Whitaker and Mumford 2009c, USFWS 2015b)



The northern long-eared bat is comparable to the Indiana bat in terms of summer roost selection but appears to be more opportunistic (Carter and Feldhamer 2005; Timpone et al. 2010). A small amount of overlap in roost selection might occur between these two species (Foster and Kurta 1999; Timpone et al. 2010). Northern long-eared bats appear to roost more frequently on upper and middle slopes than on lower slopes, suggesting a preference for higher elevations and increased solar heating (Lacki and Schwierjohann 2001). Northern long-eared bats switch roosts often (Sasse and Pekins 1996), typically every 2 to 3 days (Carter and Feldhamer 2005; Foster and Kurta 1999; Owen et al. 2002; Timpone et al. 2010). Reasons for switching might be temperature, precipitation, predation, parasitism, and ephemeral roost sites (Carter and Feldhamer 2005). They have also been found roosting under bridges in Illinois (Feldhamer et al. 2003).

Maternity colonies, consisting of females and pups, are generally small, numbering from about 30 (Whitaker and Mumford 2009) to 60 individuals (Caceres and Barclay 2000). Gestation is approximately 60 days (van Zyll de Jong 1985) and females give birth to a single pup in late May or early June (Caire et al. 1979; Easterla 1968; Whitaker and Mumford 2009), although this can occur as late as July (Whitaker and Mumford 2009). Juveniles are volant (able to fly) within 21 days of birth (Krochmal and Sparks 2007; Kunz 1971). Males are reproductively inactive until late July; with testes descending in most males during August and September (Amelon and Burhans 2006; Caire et al. 1979).

With the onset of fall and cooler temperatures, males return to the caves so they are at the entrances when females and juveniles arrive later. Fall swarming serves several functions, including the uniting of sexes together for mating. Elevated hormone levels trigger males to mate with females during this period. Hibernating females store sperm until spring, exhibiting delayed fertilization. Limited mating might also occur in the cave in winter and in the spring. It is unknown whether juvenile females mate their first autumn. Fall swarming is also a period when bats feed and gain weight, thus building up fat (energy) to help them survive hibernation. When temperatures are 50°F or less, the bats typically stay inside caves.

Since its discovery in New York in 2006, WNS has spread rapidly throughout the eastern and Midwestern United States and eastern Canada, causing unprecedented mortality in bats hibernating in caves and mines (including the northern long-eared bat) in the eastern United States (USFWS 2015b). WNS is the principal reason the northern long-eared bat was listed as threatened by the USFWS (USFWS 2015b). Based on hibernacula studies, northern long-eared bat has suffered estimated losses of up to 93–98 percent in certain areas of the northeastern United States since 2005 (Turner et al. 2011). Other less prominent factors contributing to population decline include the loss of winter and summer habitat and direct mortality at wind energy sites (USFWS 2015b).

POTENTIAL FOR IMPACT

Within the Mid-States Corridor study area, USFWS data includes multiple records for northern long-eared bat hibernacula, roosts, and capture locations. **Figure 3** graphically summarizes this data using a 5-mile buffer for hibernacula, a 3-mile buffer for bat captures, and a 1.5-mile buffer for known roosts. Roost data for the northern long-eared bat available through the USFWS is still generally lacking throughout Indiana since the species was just first listed under the Endangered Species Act in 2015, and prior to listing there was no requirement to conduct radio telemetry to locate roosts. As such, most of the roost data was generated through agency and university research. **Figure 4** illustrates the approximate acreage range of forest habitat within the working alignment, the approximate acreage range of forest habitat within the known maternity colony limits, and the approximate acreage range of



forest habitat within the hibernacula zone. Alternatives M, O, P, RPA P, and R are within one mile of a previously documented northern long-eared bat record. Based on this general assessment, Alternatives M and O have the greatest potential for adverse impacts to northern long-eared bat habitat within the study area. Alternatives M including Local improvement 14 and Alternative O including Local Improvement 18 would traverse known northern long-eared bat hibernacula zones in Lawrence County. None of the alternatives would traverse any previously documented northern long-eared bat maternity colony habitat areas.



FIGURE 3. NORTHERN LONG-EARED BAT HIBERNACULA, ROOST, AND CAPTURE SUMMARY

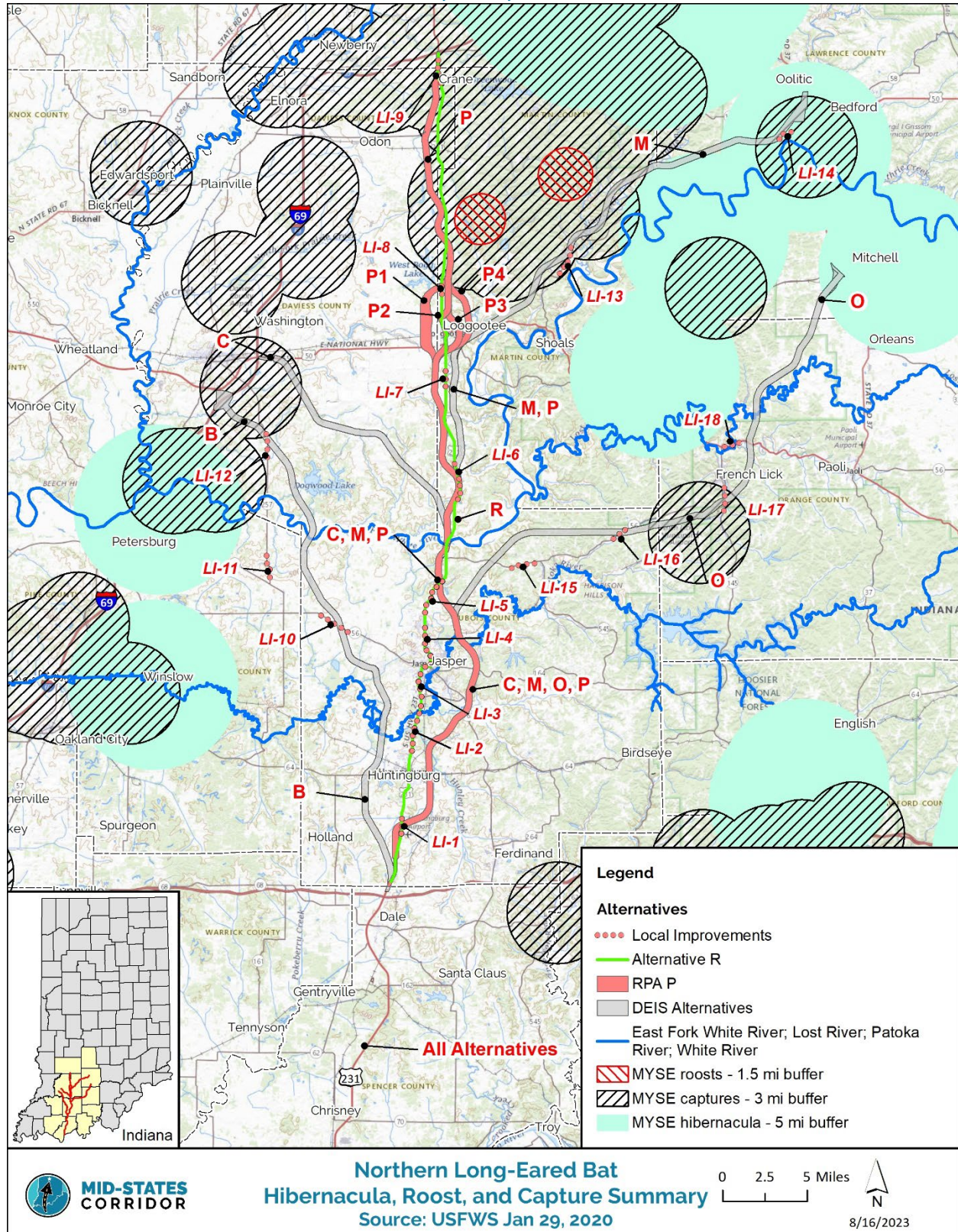
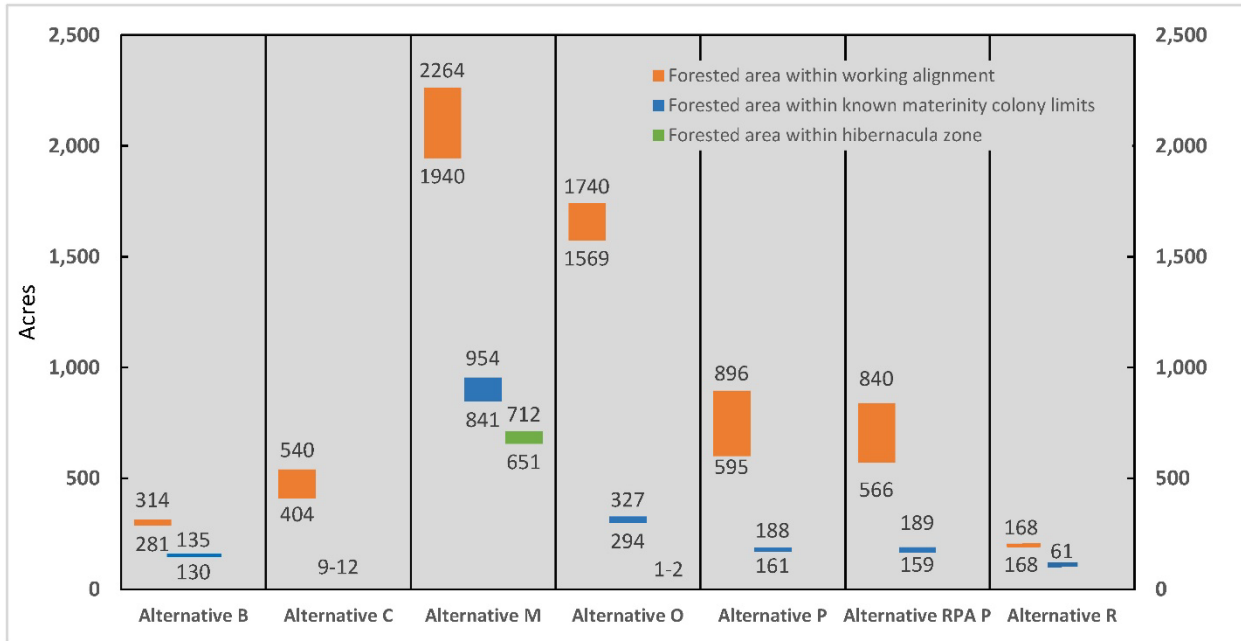




FIGURE 4. FORESTED AREA WITHIN WORKING ALIGNMENT, MATERNITY COLONY LIMITS AND HIBERNACULA ZONE FOR NORTHERN LONG-EARED BAT



Gray bat (Myotis grisescens)

On April 21, 1975, the USFWS proposed listing the gray bat as endangered or threatened under the Endangered Species Act (USFWS 1975a). On April 28, 1976, the gray bat was listed as endangered (USFWS 1976a). A 5-year review of the gray bat was published on July 8, 2014 (USFWS 2014). The species was designated as state endangered by the IDNR in the second amendment of the NRC roster listing May 1, 1992 (NRC 1992, IDNR 2020a).

USFWS: Endangered
IDNR: Endangered
Global Rank: G4
State Rank: S1

The gray bat is one of the larger members of the *Myotis* genus and can be distinguished from other species by their large size (0.35 ounces, 1.6-1.8 inch forearm), unique ankle morphology, and monochromatic fur (Decher and Choate 1995). Gray bat longevity can exceed 14 to 17 years (Harvey et al. 2011); however, juvenile mortality can be substantial especially during the period when bats are learning to fly (Tuttle 1976a).

The distribution extends as far north as southern Indiana (Brack et al. 1984), as far west as southeastern Kansas (Choate and Decher 1996), and as far east as western North Carolina and Virginia (Decher and Choate 1995). Because it is nearly an exclusive cave-dwelling species, the gray bat is most abundant in the karst regions of Missouri, Arkansas, Kentucky, Tennessee, and Alabama (Barbour and Davis 1969). The species is also a well-known migrant and occasionally occurs many miles outside its normal range (Stihler and Brack 1992, Tuttle et al. 2005). In Indiana, spring, summer, and fall capture data are largely confined to the Ohio River border counties of Spencer, Perry, Crawford, Harrison, Floyd, and Clark, with additional older records in Lawrence and Jennings counties. However, acoustic call data suggests possible presence in southwest, south central, and west central Indiana. Gray bat presence in Indiana is considered to be limited to summer habitat with no known winter cave hibernacula colonies.



Male gray bats emerge from winter hibernation in early March and begin migration to summer habitat with females following shortly thereafter in late March. During the migration between winter and summer caves, gray bats stop at well-defined sites known as transient caves through April. By mid-May females have moved to maternity caves and males to bachelor roosts. Gray bats of all ages and sexes occur at both the maternity and transient caves in July and August, marking the swarming stage of the annual cycle. Migration to winter hibernacula from summer roosts begins in August and lasts through early November (Missouri Department of Conservation 2000). Mating occurs soon after adults arrive at the hibernaculum. Females begin hibernation immediately afterward, while males and juveniles will remain active for an additional several weeks. By the beginning of November, all bats are usually hibernating.

Gray bats use different caves for both winter hibernation and summer roosting, although some gray bats are also known to use storm sewers (Harvey and McDaniel 1988, Decher and Choate 1995), bridges (Johnson et al. 2002, Cervone and Yeager 2016), quarries, mines (Brack et al. 1984), and other man-made buildings and tunnels (Elder and Gunier 1978, Evans and Drilling 1992, Missouri Department of Conservation 2016). Gray bats are philopatric to their same hibernacula, summer caves, and even migratory stop-over sites each year (LaVal and LaVal 1980). Gray bat hibernacula are often vertical caves with domed rooms where cold air enters and then gets trapped. Temperatures within these areas typically range between 43 to 52° F (Tuttle 1976a; 1979). Gray bats form large, irregular clusters and have a distinctive loose armed position. In summer, females and pups form maternity colonies in caves with subterranean water sources and domed ceilings capable of trapping warm air with temperatures between 57 to 79° F (Tuttle 1976a). Maternity colonies are often within 0.6 to 2.5 miles of surface water sources (Tuttle 1976b, USFWS 1997c). Male gray bats form bachelor colonies in the summer, though many do not roost separately until females give birth to a single pup in late May or early June (USFWS 1982).

Foraging habitat for the gray bat typically includes streams, lakes, or wetland features, where gray bats can forage for aquatic and terrestrial flying insects (Tuttle 1976b, LaVal et al. 1977, USFWS 1982, Clawson and Titus 1992, Best and Hudson 1996, Missouri Department of Conservation 2000). Specific macro-habitat characteristics of waterways and adjacent areas may vary in importance among different gray bat colonies (Moore et al. 2017). Forest areas surrounding caves, and flyways are also important foraging habitat for gray bats (Tuttle 1979), particularly juveniles (Brack and LaVal 2006). Individual gray bats may travel 12 to 21 miles to forage, depending on available habitat and colony size (LaVal and LaVal 1980). However, increased distances to foraging areas may lead to a decreased rate of growth by the pups (Tuttle 1976a). Gray bats commonly prey on caddisflies (*Trichoptera*), beetles (*Coleoptera*), and moths (*Lepidoptera*), and to a lesser extent stone flies (*Plecoptera*), may flies (*Ephemeroptera*), and true flies (*Diptera*) (Brack and LaVal 2006).

Gray bats were initially listed as endangered because of their sensitivity to disturbance, which may lead them to abandon caves or move to areas that provide protection, but also lower quality microhabitats (Tuttle 1975; 1979). As with other *Myotis* bat species, the gray bat is also susceptible to WNS infection. Additional threats to populations include adverse modification of caves, disturbance of bats in the caves, impoundment of waterways, chemical contamination, and climate change (USFWS 2009a). Reduction in insect prey through deforestation in foraging areas has the potential to affect gray bat populations. Flooding of caves used by gray bats resulting from waterway impoundments (USFWS 1982) can have adverse effects on roosting habitat, and organochloride pesticides have been cited as having adverse biological effects (Geluso et al. 1976, Clark et al. 1978).



POTENTIAL FOR IMPACT

While there are currently no known summer caves used by gray bats within the Mid-States Corridor study area, summer foraging habitat for the species is potentially available as evidenced by the multiple acoustic detections in Perry, Dubois, Pike, Daviess, Martin, and Lawrence counties. However, it is not known if these gray bat acoustic detections were visually verified. The Ohio River and its major tributaries, the Patoka River, and the East Fork White River are the principal flight corridors within the project area that the gray bat would likely use for movements. There are, however, acoustic records of the gray bat in the southern portion of Dubois County near the alignments of the Mid-State Corridor alternatives that are associated with much smaller order stream features. Therefore, each of the alternatives is considered to have the potential, albeit minor, to impact gray bat foraging habitat.

Little brown bat (Myotis lucifugus)

A status review by Kunz and Reichard (2010) initiated a proactive review by the USFWS for the potential need to afford the little brown bat federal protection. The resulting USFWS status review focused on the eastern subspecies and their severe population declines attributed to WNS (Tinsley 2016), but determined that listing the species was not warranted at that time. The species is currently undergoing a “discretionary status review” for proposed listing and proposed critical habitat scheduled for fiscal year 2023 (USFWS 2019d). The species was originally designated as state special concern by the IDNR in the fourth amendment of the NRC roster listing August 1, 2007 (NRC 2007), but elevated to endangered in the ninth amendment November 28, 2018 (NRC 2018, IDNR 2020a).

USFWS: Discretionary PLPCH
IDNR: Endangered
Global Rank: G3
State Rank: S2

The little brown bat is a small bat with variable fur coloration ranging from pale to dark brown, often described as “dark sooty brown through paler golden” on their backside and “pallid, to yellowish or olive brown” on their underside (Fenton and Barclay 1980, Kunz and Reichard 2010). Other identifying characteristics include toe hairs that extend well beyond the toenails, an unkeeled calcar (Barbour and Davis 1969, Kunz and Reichard 2010), and a glossy sheen to the fur and membranes. Longevity of little brown bats up to 30 years has been documented from banding studies (Keen and Hitchcock 1980). As with other similar species, little brown bat juvenile mortality is high (Tuttle and Stevenson 1982) with relatively low survival rates for first-year bats (Humphrey and Cope 1976, Frick et al. 2010).

The little brown bat is widely distributed across North America from central Alaska to central Mexico (Harvey et al. 1999). Prior to arrival of WNS, the largest colonies were found in the northeastern and Midwestern United States (Davis and Hitchcock 1965, Kunz and Reichard 2010), where some hibernacula contained tens to hundreds of thousands of individuals (Kunz and Reichard 2010). The southern edge of their distribution is limited by the lack of caves, whereas the northern edge of the range is likely defined by a limited number of suitable hibernacula and the longer length of the hibernation season (Humphries et al. 2002, Humphries et al. 2006). Most little brown bats stay within 62 miles of their hibernacula, although some make longer migrations.

In early spring (March to April), bats emerge from subterranean winter habitat hibernation and enter a behavior known as “staging” when some mating occurs (Whitaker and Rissler 1992a; 1992b). During the spring (April to June), little brown bats migrate from hibernacula to trees and a wide variety of anthropogenic structures during summer (Humphrey and Cope 1976). Summer habitat is occupied April through August when pregnant females form maternity colonies that typically contained 300 to 1200 bats before WNS (Humphrey and Cope 1976), and males (and non-reproductive females) roost singly or



in small groups called bachelor colonies. Most pups are born in early June and begin flying in early July. Prior to entering hibernation (September to October), little brown bats “swarm” or fly repetitively around entrances of caves and mines (Fenton 1970). Most bats will mate during this time (Kurta 2008). Little brown bats hibernate September through April on the ceilings of caves and mines where they often form loose, irregular clusters that contain hundreds of bats.

Most little brown bat roosts use anthropogenic structures such as bat boxes, buildings, and bridges; although some bats roost in the cavities or under the bark of dead or dying trees (Humphrey and Cope 1976, Boyles et al. 2009). Trees used by maternity colonies tend to be very large and either dead or dying. Male roosts are much more varied and include virtually any place a bat can hide itself such as rock crevices, tree hollows, loose bark, bat boxes and small openings in buildings (Humphrey and Cope 1976, Boyles et al. 2009). Although a few bats roost as far away as 6.2 miles, most roost within the immediate vicinity of the hibernacula during swarming (Lowe 2012). Little brown bats often commute within corridors in open flyways (streams, woodland trails, small infrequently used roads, and possibly utility corridors) between foraging and roosting habitat (Brown and Brack 2003). Foraging habitat is primarily associated with aquatic resources and along forest edge (Belwood and Fenton 1976, Anthony and Kunz 1977, Fenton and Bell 1979, Barclay 1991, Barclay and Brigham 1991, Kunz and Reichard 2010, Bergeson 2012, Bergeson et al. 2013). Cool, stable, underground caverns are used for hibernation (called hibernacula). As little brown bats hibernate, their body temperatures drop to near cave temperatures (average temperature 45°F) with high humidity. (Barbour and Davis 1969, Humphrey and Cope 1976, Kurta 2008, Brack et al. 2010). Bats with low fat reserves select colder temperatures to maximize energy conservation, whereas bats in better condition select warmer temperatures to minimize other costs of hibernation (Boyles et al. 2007). WNS has forced bats to select colder, more variable sites (Johnson et al. 2016).

In 2005, this species was abundant, but it is now all but extinct across large areas of the Northeast (Dzal et al. 2010, Frick et al. 2010, Tinsley 2016). WNS is now the principal cause of decline having reduced the eastern population an average of 97 percent (Tinsley 2016). Wind turbine strikes and barotrauma (injuries from drastic air pressure changes at turbine blades) are the secondary threat to little brown bats with as many as 107,000 killed at wind turbines between 2000 and 2011 (Arnett and Baerwald 2013). Pesticides are a lesser threat, but persistent organic pollutants have been found in lethal concentrations in little brown bats (Fenton and Barclay 1980, Kannan et al. 2010). Loss of important hibernacula can have regional effects, and removal of summer roosts (both trees and structures) can reduce local abundance (Whitaker et al. 2002).

POTENTIAL FOR IMPACT

The Indiana Natural Heritage Data Center lacks occurrence records for the little brown bat throughout most of the Mid-States Corridor study area except in Daviess, Greene, and Monroe counties where summer mist net surveys were conducted for I-69. Within Martin and Lawrence counties there are three cave hibernacula records for the species within the past 20 years in the heavily forested landscape between the Lost River and the East Fork White River (between Alternatives M and O). A fourth cave hibernacula record is immediately proximal to Alternative O in Dubois County. While roost and foraging habitat for the species is available within the riparian corridors in the western portion of the survey area, suitable habitat is less plentiful along Alternatives B, C, and to a lesser extent Alternatives P, RPA P, and R.



Tricolored bat (*Perimyotis subflavus*)

On June 14, 2016 the USFWS received a petition from the Center for Biological Diversity and Defenders of Wildlife to list the tricolored bat as an endangered or threatened species and to designate critical habitat for the species under the Endangered Species Act (Center for Biological Diversity and Defenders of Wildlife 2016). Subsequently, on December 20, 2017, the USFWS published a 90-day finding that the petition presented credible evidence that listing the species may be warranted (USFWS 2017). The species was originally designated as state special concern by the IDNR in the fourth amendment of the NRC roster listing August 1, 2007 (NRC 2007), but elevated to endangered in the ninth amendment November 28, 2018 (NRC 2018, IDNR 2020a).

USFWS: 12M PLPHC
IDNR: Endangered
Global Rank: G2G3
State Rank: S2S3

The tricolored bat (formerly eastern pipistrelle, *Pipistrellus subflavus*) is the smallest of the resident Indiana bats with a weight of 0.14-0.28 ounces and a 1.3-1.4 inch forearm length (Kurta 2008). Its name is derived from the triple color band hairs (dark at base, yellow in middle, dark at tip) (Kurta 2008, Wisconsin Department of Natural Resources 2013). It is distinguished from similar *Myotis* species (little brown bat, Indiana bat, and northern long-eared bat), by its smaller size, red forearms, tricolored fur, heart-shaped face, half-furred tail membrane, and brown-colored ears. Tricolored bat longevity is not as long as other *Myotis* species like the little brown bat but has been documented as long as 14.8 years (Kurta 2008). Pre-flight mortality has been observed to be as much as 50 percent (Hoying and Kunz 1998).

The tricolored bat range extends from the Yucatan Peninsula to Nova Scotia, New Brunswick (Broders et al. 2001), and Quebec, and east to the Atlantic Ocean. More recently, the species has expanded across the High Plains (Damm and Geluso 2008) and into the Intermountain West region, including Texas and New Mexico (Sparks and Choate 2000, Geluso et al. 2005, White et al. 2006, Valdez et al. 2009). In Indiana, tricolored bats are largely limited to the southern half of the state from Vermillion County south (Whitaker et al. 2007).

Tricolored bats emerge from hibernation in April or early May and are observed to migrate as much as 85 miles (Griffin 1940) to summer habitat after a brief spring staging phase, although most migrations are short (Boyles et al. 2008). They are considered to be one of the last species to exit and one of the earliest to enter hibernation. During migration, tricolored bats make regular use of roosts on buildings and in leaf clusters (Whitaker 1998, Whitaker et al. 2014). These “pre-maternity” colonies may serve as an extended staging period away from the hibernacula, an assembly point for members of a maternity colony, or multiple other functions. From August to October tricolored bats undergo swarming (Boyles et al. 2008) where they can be observed flying in and out of caves and mines (Humphrey and Cope 1976, Cope and Humphrey 1977) prior to entering hibernacula.

Although tricolored bats frequent building structures for staging assembly, they primarily use clusters of dead leaves for summer maternity roost colonies, but may also be found in live leaf foliage, lichens, patches of pine needles caught in tree limbs, buildings, caves, and rock crevices (Humphrey 1975, Veilleux et al. 2003, Veilleux and Veilleux 2004a; 2004b, Veilleux et al. 2004, Perry and Thill 2007). Oak and maple trees are preferred by tricolored bat maternity colonies presumably because the ends of the branches tend to have many leaves (Veilleux et al. 2003; Veilleux et al. 2004, Perry and Thill 2007), and thus maternity colonies are more often associated with upland rather than bottomland forest.

Tricolored bats vary their roost position in the canopy and landscape depending on reproductive condition; reproductive female bats roost lower in the canopy and farther from forest edges than non-



reproductive females. The lower position in the canopy and greater distances from the forest edge may reduce wind exposure and allow for more stable temperatures (Veilleux and Veilleux 2004b). The average size of a woodlot containing a maternity colony in suburban Indianapolis was 123.6 acres. Woodlots 12.4 acres or less were not used (Helms 2010).

Maternity colonies are generally small in number. Maternity colonies in buildings tend to give birth between May and July and contain 7-29 bats (Whitaker 1998). However, colonies roosting in foliage give birth in late June in Indiana (Veilleux and Veilleux 2004a), and the number of bats sharing a leaf cluster varies from 1-13 individuals. Gestation is typically 44 days (Wimsatt 1945), and females produce twin pups. Juveniles are volant at 3 weeks and act as adults around 4 weeks old (Hoying and Kunz 1998). Most males roost in the same types of leaf clusters used by female tricolored bats (Veilleux and Veilleux 2004a), although they tend to roost at lower heights than females (16.4 feet above the ground) (Perry and Thill 2007).

Generally, tricolored bats prefer wooded habitats near water (Whitaker and Mumford 2009) where they prey via aerial hawking on *Homoptera*, *Hemiptera*, *Diptera*, and *Lepidoptera* (Brack and Whitaker 2004, Whitaker 2004, Caylor 2011). Preferred habitats for foraging included forest, old field, grasslands, and agriculture; but transportation corridors, low and high density residential, commercial, industrial, and water are also used. Tricolored bats (especially pregnant females) have a low wing aspect ratio, which makes them highly maneuverable, but also less energy efficient as fliers (Norberg and Rayner 1987). They are able to forage in complex woodlands with more vertical structure and are considered clutter-adapted. Their low wing aspect ratio limits their ability to travel long-distances, with the maximum distance reported between foraging and roosting areas being 2.7 miles in Indiana (Veilleux et al. 2003).

Rapid declines associated with WNS have negatively affected hibernating tricolored bat populations in northeastern states during the past decade (Turner et al. 2011). In the absence of WNS it is unlikely the tricolored bat would be a national conservation priority. Other stressors identified include mortality from tree removals associated with a variety of activities (logging, energy extraction, and development), closure of occupied hibernacula, deaths from other diseases, losses at wind energy sites, and environmental contaminants (Center for Biological Diversity and Defenders of Wildlife 2016). The tendency of tricolored bats to occupy a wide variety of hibernacula makes them especially likely to become entombed during mine closures (Whitaker and Stacy 1996). As with the Indiana bat, chemical contamination may kill bats directly or lead to sublethal effects that eventually lead to death or reduced reproduction (Eidels et al. 2016). Collisions with wind turbine blades and barotrauma at wind energy sites in the Midwest is estimated to result in the take of 51,389 tricolored bats between 2016 and 2061 (USFWS 2016c).¹

POTENTIAL FOR IMPACT

Records for the tricolored bat in the Indiana Natural Heritage Data Center are largely from the I-69 project in Pike, Daviess, Greene, and Monroe counties, and within the Crawford Upland region in Lawrence, Orange, and Crawford counties. One record is within Alternative O; however, Alternatives M and O both have a greater potential for impacts to tricolored bats than Alternatives B, C, P, RPA P, and R.

¹ DEIS Midwest Wind Energy Multi-Species Habitat Conservation Plan. Prepared by U.S. Fish and Wildlife Service. EIS 20160078.



Evening bat (*Nycticeius humeralis*)

The evening bat designated as state endangered by the IDNR in the second amendment to the NRC roster listing May 1, 1992 (NRC 1992, IDNR 2020a).

IDNR: Endangered
Global Rank: G5
State Rank: S1

Evening bats range from Texas to Nebraska in the west, as far north as Michigan (Kurta et al. 2005), and from Pennsylvania to Florida in the east. The evening bat is one of the most locally abundant bat species in the southeastern United States. Outside this core range it can be locally abundant and may be increasing in both abundance and distribution. Most summer captures are near or over streams and rivers, and in Indiana appears to be associated with larger streams and rivers (Whitaker and Gummer 2003, Whitaker et al. 2007).

Prior to the 1990s, maternity colonies of evening bats in Indiana were known only from buildings, but later studies revealed widespread use of trees in summer (Duchamp et al. 2004, Whitaker et al. 2007). Hibernacula are unknown, but in southern Missouri, some banded individuals remained in the same area in summer and winter, occupying different hollow trees (Boyles and Robbins 2006). During periods of extreme cold they may burrow into leaf litter (Boyles et al. 2005).

Evening bats feed extensively on beetles, wasps, moths, leafhoppers, flies, and ants including agricultural pests (Whitaker and Clem 1992, Wilkinson 1992a, Carter et al. 1998, Feldhamer et al. 2001, Geluso et al. 2008). In central Indiana, Brack (1985) caught evening bats foraging in the canopy layer of an open, grazed upland woodlot and Duchamp et al. (2004) reported that the species foraged selectively in agricultural and wooded areas. Lactating females sometimes fail to return to the maternity roost and therefore day roost at alternate locations (Clem 1993), and there is evidence that females nurse unrelated pups (Watkins and Shump 1981, Wilkinson 1992b). Boyles and Robbins (2006) documented possible winter foraging by bats, but subsequent examination of stomach contents and fecal material indicated evening bats are drinking, not feeding, in winter (Dunbar et al. 2007).

POTENTIAL FOR IMPACT

Records for the evening bat in the Indiana Natural Heritage Data Center are largely from the I-69 project in Gibson, Pike, Daviess, and Greene counties. Within suitable habitat of larger stream drainages, this species can be quite common. Although there are no records for the species in Dubois, Martin, or Lawrence counties, and only one record in Orange County, its presence along the East Fork White River and Patoka River is likely. Each of the Mid-States Corridor alternatives have the potential to traverse evening bat habitat.

Southeastern bat (*Myotis austroriparius*)

The southeastern bat was originally designated as state endangered by the IDNR in the second amendment to the NRC roster listing May 1, 1992 (NRC 1992) but was subsequently changed to special concern in the fourth amendment of the NRC roster listing August 1, 2007 (NRC 2007, IDNR 2020a).

IDNR: Special Concern
Global Rank: G4
State Rank: SH

Southeastern bats occur throughout the southeastern United States from eastern Texas and Oklahoma, northward to southern Indiana, eastward to the Atlantic coast and southward to central Florida (Jones and Manning 1989, Humphrey and Gore 1992). In Indiana, small numbers of southeastern bats once hibernated in Wyandotte and other caves of southern Indiana, but most individuals were collected by early naturalists. There have been no verified observations in Indiana for many years, although summer colonies are known from adjacent areas of Kentucky and Illinois (Whitaker and Mumford 2009).



In summer, colonies of southeastern bats are most often found in the hollow boles of large trees with basal openings (Mirowsky 2004) and these roosts may be shared with Rafinesque's Big-eared Bat (*Corynorhinus rafinesquii*). Ammonia concentrations in such roosts can become high enough to bleach the gray-brown fur of southeastern bats bright orange. Roosting and foraging is typically restricted to bottomland hardwoods, thus leading to southeastern and Rafinesque's Big-eared bats both being called swamp bats.

POTENTIAL FOR IMPACT

Southeastern bat records in the Indiana Natural Heritage Data Center system are few and scattered. Within the Mid-States Corridor study area, records are confined to Lawrence County and a single record in Greene County north of I-69. With the exception of a single 1986 record on the East Fork White River near Bedford, all of the local records are from the 1950s and 1960s. The East Fork White River record is greater than one mile, but less than two miles from Alternative M new alignment and approximately one mile from Local Improvement 14.

Eastern red bat (*Lasiurus borealis*)

The eastern red bat was designated as state special concern by the IDNR in the ninth amendment of the NRC roster listing November 1, 2018 (NRC 2018, IDNR 2020a).

IDNR: Special Concern Global Rank: G3G4 State Rank: S4
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The eastern red bat ranges from the United States-Canadian border south to the Gulf Coast and west to the Front Range of the Rocky Mountains. It is abundant throughout the Mid-States Corridor study area. Eastern red bats primarily roost in foliage throughout the year. During intense periods of cold weather, eastern red bats may move to the ground and roost in leaf litter. Based primarily on mortality documented at wind energy sites, the USFWS has begun an informal status review of the species to determine if a formal Endangered Species Act status review should be initiated to assess if protection is warranted.

POTENTIAL FOR IMPACT

Records for the eastern red bat in the Indiana Natural Heritage Data Center are largely from the I-69 project in Pike, Daviess, Greene, and Monroe counties. However, this species is still relatively abundant within suitable habitat throughout the state and is likely present in many portions of the Mid-States Corridor study area. It is expected that all the alternatives have potential for varying degrees of impacts to roosting and/or foraging habitat.

Smokey shrew (*Sorex fumeus*)

The smoky shrew was designated as state special concern by the IDNR in the fourth amendment of the NRC roster listing August 1, 2007 (NRC 2007, IDNR 2020a).

IDNR: Special Concern Global Rank: G5 State Rank: S2
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The smoky shrew is a medium-sized (Laerm et al. 2007) to large shrew (Owen 1984), with a long, pointed snout, dark gray to brownish hair on the back and slightly paler color to silvery hair underneath with a bicolor tail (Laerm et al. 2007, Owen 1984). Diet consists of larvae and adult insects, arachnids, chilopods, annelids, and gastropods (Laerm et al. 2007), as well as small quantities of plant material (Owen 1984). Smoky shrews reach maturity at one year and are capable of 2-3 litters per year with 2-8 young per litter (Laerm et al. 2007). Depending on location within their range, males become reproductively active from early March through early April, while females typically



become active slightly later, mid-March through April (Owen 1984). Longevity is relatively short at 14-17 months (Owen 1984).

The smoky shrew ranges from southeastern Canada, northeastern United States, down to Georgia and the western two-thirds of Kentucky (Caldwell et al. 1982). It occurs predominantly in the Appalachian Mountains at higher elevations and portions of the Interior Low Plateau (Laerm et al. 2007, Owen 1984) and extends into eastern and middle Kentucky (Caldwell et al. 1982). The smoky shrew was first documented in Indiana at the Harrison-Crawford State Forest and in Crawford County in 1981 (Caldwell et al. 1982). Published Indiana records of the smoky shrew (Perry, Crawford, Harrison, Clark, Orange, Martin, Monroe, Brown, and Johnson counties) are primarily from investigations in the early 1980's within the Hoosier National Forest and various state forest properties (Caldwell et al. 1982, Cudmore and Whitaker 1984). These occurrences are within the unglaciated portions of the Crawford Upland and Mitchell Plain regions of Indiana; considered to be extensions of the Pottsville and Dripping Springs Escarpments in Kentucky, where the pygmy shrew had previously been recorded (Caldwell et al. 1982). It can be abundant in Appalachian Mountain forest communities (Laerm et al. 2007). However, records of the species in Indiana suggest that it is less prevalent since this is the northern extent of its range in the Midwest.

Range-wide habitat varies from red spruce-Fraser fir, northern hardwood, cove hardwood, white pine-eastern hemlock, oak hickory, and mixed pine-hardwood (Laerm et al. 2007). In Indiana, habitat is described as shady and damp coniferous or hardwood forests (Hamilton and Whitaker 1979), moist ravines and wooded slopes with downed logs and deep humus layer (Cudmore and Whitaker 1984), or thick litter (Hamilton 1940). Forest floor structure such as woody debris, colluvial talus, emergent rocks, considerable leaf litter, damp mossy-covered rocks, and brush are regarded as valuable components of smoky shrew habitat (Laerm et al. 2007, Owen 1984). Most smoky shrew habitats in Indiana are dry to mesic in sugar maple and Christmas fern dominated areas (Cudmore and Whitaker 1983). Although the smoky shrew is also known from bogs and swamps (Owen 1984), it is not known to occur within bog habitat in northern Indiana. In Kentucky, they seldom occur in annually-inundated riparian forest habitat (Owen 1984). The smoky shrew often inhabits areas with other shrews (pygmy shrew (*Microsorex hoyi*), short-tailed shrew (*Blarina brevicauda*), masked shrew (*Sorex cinereus*) and southeastern shrew (*Sorex longirostris*)) (Laerm et al. 2007), as well as North American least shrew (*Cryptotis parva*), woodland vole (*Microtus pinetorum*), and white-footed mouse (*Peromyscus leucopus*) (Caldwell et al. 1982). However, the pygmy shrew seems to occur in slightly more variable vegetation habitat (Cudmore and Whitaker 1984).

Excluding natural predation by bobcats, foxes, hawks, owls and weasels, direct habitat loss is the most noteworthy threat to the species; however, the smoky shrew is reported to be tolerant of silviculture management and prescribed burning practices provided moist ground conditions are maintained (Laerm et al. 2007).

POTENTIAL FOR IMPACT

Indiana Natural Heritage Data Center records for the smoky shrew within the Mid-State Corridor study area include Monroe, Martin, Orange, Crawford, and Perry counties. The 1983 record from eastern Martin County is just under 5 miles from Alternative M and Local Improvement 13, and is the closest known occurrence to any of the alternatives; however, this record is on the opposite side of the East Fork White River than Alternative M.



Pygmy shrew (*Sorex hoyi*)

The pygmy shrew (previously *Microsorex hoyi*) was designated as state special concern by the IDNR in the fourth amendment August 1, 2007 (NRC 2007, IDNR 2020a).

IDNR: Special Concern Global Rank: G5 State Rank: S2
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The pygmy shrew is the smallest terrestrial mammal in North America weighing 2-4 grams and is characterized by a long tail and snout, brown to reddish pelage, minute eyes, and bi-colored tail (Ford et al. 2007). This species is differentiated from masked (*S. cinereus*) and southeastern (*S. longirostris*) shrews by presence of minute fifth and compressed third upper unicuspid which originally were misclassified and has led to descriptions of the species under genus *Microsorex* (Diersing 1980, Junge and Hoffman 1981, Genoways 1985a).

Northern most distribution of the species includes Alaska and Northwest Territories of Canada and extends across southern Canada down into the Midwest and eastern United States, as far south as Georgia. More isolated populations are found in the Rocky Mountains of Wyoming and Colorado (Beauvais and McCumber 2006). While pygmy shrews are geographically widespread, they are locally difficult to detect leading to under-estimates of occupancy and difficulty estimating density (Beauvais and McCumber 2006, Urban and Swihart 2011, Ford et al. 2000). First records of the species in Indiana were documented within mesic oak-dominated (*Quercus* sp.) forest of Harrison-Crawford Forest and since have been found in the southern half of the state generally in, but not limited to, mature hardwood forest (Caldwell et al. 1982, Cudmore and Whitaker 1984, Urban and Swihart 2011). Like other *Sorex* species, pygmy shrews are insectivorous with high metabolism and forage in leaf litter (Genoways 1985, Beauvais and McCumber 2006). The species is tolerant to a wide variety of habitats, habitat management techniques, and prey species, which makes it resilient even though it is prey for an extensive array of predator species (Ford et al. 1997, Ford et al. 2000, Cudmore and Whitaker 1984, Feldhamer et al. 1993).

POTENTIAL FOR IMPACT

Indiana Natural Heritage Data Center records for the pygmy shrew within the Mid-State Corridor study area are scattered and include Monroe, Lawrence, Orange, Dubois, Crawford, and Perry counties from the 1980s. However, the closest of these (northern Lawrence County) is greater than six miles from Alternative M.

American badger (*Taxidea taxus*)

The American badger was originally designated as state threatened by the IDNR in the second amendment of the NRC roster listing May 1, 1992 (NRC 1992) but was subsequently changed to special concern in the fourth amendment of the NRC roster listing August 1, 2007 (NRC 2007, IDNR 2020a).

IDNR: Special Concern Global Rank: G5 State Rank: S2
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The American badger is a medium-sized mammal with dark brown to black pelage and white striping, short limbs and tail, side bodied, and long foreclaws matching the semi-fossorial nature of the species (Genoways 1985b). American badger is distributed across the southern portion of British Columbia through Ontario down into central Mexico. The species eastern-most distribution covers most of Ohio and Indiana and the distribution covers the central and western half of the United States (Long 1973, Genoways 1985b). The species is widely distributed across Indiana and there are recorded known occurrences for most counties; however, the species is uncommon across Indiana (Berkley and Johnson 1998).



American badgers are associated with grassland and prairie habitat but are also found in a variety of open and forested habitats from alpine to deserts (Sullivan 1996, Genoways 1985b). This species is carnivorous, preying on small mammals, reptiles, fish, insects, and birds but has also been known to eat seeds and grain (Sullivan 1996). American badgers are semi-fossorial living in and building burrows as well as digging out prey. This trait creates habitat for other species, including burrowing owls, and is a source of small-scale disturbance for prairie habitats and soil (Sullivan 1996, Olendorff and Stoddart 1974). Potential threat to the species includes habitat loss and conflict with humans. While American badgers are known to associate in croplands in the eastern portion of their range, badgers prefer natural prairie land cover types and the degradation or fragmentation of similar land cover types pose a threat to the species (Duquette et al. 2014).

POTENTIAL FOR IMPACT

Indiana Natural Heritage Data Center records of the American badger occur throughout the Mid-States Corridor study area. The majority of these are from the 1980s and 1990s, with the most recent occurrence from 2003. There are occurrences in Dubois, Daviess, and Lawrence counties within one mile of each or the alternatives, but greater than one mile from any of the Local Improvements.

Birds

Interior least tern (*Sternula antillarum*)

The final rule to list the interior least tern as federally endangered under the Endangered Species Act was published on May 28, 1985 (USFWS 1985) and became effective June 27, 1985. The *Recovery Plan for the Interior Population of the Least Tern (Sterna antillarum)* (USFWS 1990b) was released on October 19, 1990. A 5-year review that included the interior least tern announced on November 6, 1991 (USFWS 1991) indicated the endangered status for the species was still warranted. A subsequent 5-year review in 2013 concluded that the species met established criteria for delisting consideration (USFWS 2013d). On October 24, 2019, a proposed rule to delist the interior least tern was published (USFWS 2019a). The species was designated as state endangered by the IDNR in the second amendment NRC roster listing May 1, 1992 (NRC 1992, IDNR 2020a).

USFWS: Delisted IDNR: Endangered Global Rank: G4T3Q State Rank: S1B
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At the time of listing, the interior least tern (*Sterna antillarum athalassos*) was considered to be one of three New World subspecies of the eastern least tern (*Sterna antillarum antillarum*). More recently, genetic studies and a sufficiently high rate of genetic exchange between the interior least tern and the eastern least tern concluded that the interior least tern does not warrant subspecies designation and represents a population of the eastern least tern. Additionally, the American Ornithologist's Union changed the genus of least terns to *Sternula* based on previously published information (USFWS 2019a).

Least terns are the smallest birds of the *Laridae* family (terns, gulls, and skimmers) and are largely white with gray back and wing surfaces, black caps, a black eye stripe, and a black-tipped yellow bill.

Habitat for the least terns includes sand and gravel bars, beaches, salt flats, and dikes along freshwater inland rivers and marine shorelines in open areas mostly devoid of vegetation (Castrale et al. 1998, USFWS 2019). Nests are formed in crushed stone, gravel, shells, sand, and silt (Castrale et al. 1998). Breeding in Indiana was first reported in 1986 at the PSI power plant in western Gibson County near the Wabash River (Castrale et al. 1998). Their diet consists primarily of various small fish (piscivore), but occasionally may include a variety of aquatic invertebrate organisms (Castrale et al. 1998, USFWS 2019a).



The North American breeding range of the least tern includes the eastern and gulf coast from Maine to Texas and Mexico. The interior least tern population includes the central United States from Montana and North Dakota, south to Texas and Louisiana, and as far east as southern Indiana. Specifically, the interior least tern population is largely confined to the shoreline habitats along or near the Missouri, Mississippi, Red, Arkansas, Rio Grande, and lower Ohio River systems (Castrale et al. 1998, Palmer-Ball 1996) with nesting sites in 18 states (USFWS 2019a). In Indiana, many records of the interior least tern are from Gibson Lake and the immediate surrounding area, including multiple parcels of land where habitat has been constructed specifically for interior least tern breeding. Other occurrences include multiple sand/gravel bars along the Wabash River in Gibson and Posey counties, a constructed lake in eastern Gibson County, Goose Pond Fish and Wildlife Area in Greene County, Ohio River floodplain in Dearborn County, Ohio River shoreline in Spencer County, and a cooling pond for an industrial plant in south Spencer County near the Ohio River. Winter range extends from the Texas Gulf Coast south into northern South America (USFWS 1990b).

On occasion, two broods may occur in the summer, although in most instances nesting late in the season is the result of one-year-old birds or a second attempt by a pair that were unsuccessful earlier in the season (Palmer-Ball 1996). Clutch sizes can vary from 1-4 eggs, although typically 2-3 (Palmer-Ball 1996, USFWS 2019a). Nests are constructed on the ground in open areas as shallow depressions in sand or gravel, typically on bars along major rivers, and often placed within drift debris for concealment. However, some nesting has been documented in sand deposits of agricultural fields when high water levels on rivers render sand and gravel bars inaccessible (Palmer-Ball 1996), and other anthropogenic features like dredge spoil, sand pits, and rooftops (USFWS 2019a), providing they are within proximity of aquatic food sources. Interior least terns are colonial, although nesting colony size can vary considerably from a few pairs to over 1,000 birds. In August, migration patterns typically follow the major rivers along which they breed to the Mississippi River continuing south to the Gulf Coast and joining with the Atlantic and Gulf Coast eastern least tern populations where they either overwinter or proceed farther south (USFWS 2019a).

Reasons for decline are attributed to significant changes to large river systems resulting from locks and dams, flooding, vegetation encroachment on sand bars, nest destruction by wildlife, and predation by mammals, other birds, domesticated and feral dogs and cats, and catfish (Castrale et al. 1996, USFWS 2019a). Palmer-Ball (1996) noted that dams constructed on the Ohio River substantially raised water levels and adversely altered previous suitable breeding habitat. Predation of eggs and adults is also a cause of mortality (USFWS 2019a). This is mostly recognized as a natural factor in population dynamics, but interior least terns rely on egg camouflage and avoidance behaviors to reduce mortality and employ adaptive strategies to relocate colonies in an effort to reduce predation pressure.

At the time of its listing, the interior least tern population was estimated at 722 birds in 1984. Through increased survey efforts, the range-wide estimate was revised to 8,859 adults in 1995, and further increased to over 17,591 comprising 489 colonies in 2005 (USFWS 2019a). No population or subpopulation has experienced extirpation since listing in 1985. The increased range and population numbers over the last 35 years is attributed to potential immigration from more abundant least tern populations along the Gulf Coast, managing water flows and modifying construction activities by the U.S. Army Corps of Engineers, and its adaptation to, and exploitation of anthropogenic habitats (USFWS 2019a). While much of this increase has been experienced in the lower Mississippi River, more current bird counts on the Missouri, Platte, Red, Arkansas, and Wabash rivers since 2016 also support increases in the range-wide population elsewhere that exceed the 7,000 recovery plan goal. U.S. Army Corps of



Engineers strategies and programs to protect waters and habitats cover approximately 80 percent of the interior least tern range.

In 1985, the USFWS identified the threats to the interior least tern as: modification and loss of habitat loss and curtailment of range (Factor A), predation and disturbance of local colonies (Factor C), and inadequacy of State or Federal mechanisms to protect its habitat at the time (Factor D). Based on the extent of range-wide population increase since listing in 1985 and assessment of the effectiveness of conservation strategies and management programs implemented by the U.S. Army Corps of Engineers, cooperative agency management groups (Tern and Plover Conservation Partnership), adaptive management plans (Platte River Recovery Implementation Program), and habitat conservation plans (Duke Energy Corporation Gibson Generating Station), the USFWS concluded that the interior least tern has met/exceeded the recovery plan goals and no longer meets the Endangered Species Act definition of endangered or threatened species (USFWS 2019a). The USFWS considers the species to be highly redundant and resistant to catastrophic events and resiliency to threats due to metapopulation dynamics. Although the species has been delisted under the Endangered Species Act, protection and conservation of the species are still afforded through the Migratory Bird Treaty Act (MBTA), Executive Order 13186 (Responsibilities of Federal Agencies to Protect Migratory Birds), Civil Works Ecosystem Restoration Policy of 1999 (U.S. Army Corps of Engineers), Clean Water Act, Fish and Wildlife Coordination Act, National Environmental Policy Act, and various state laws (USFWS 2019a).

POTENTIAL FOR IMPACT

Indiana Natural Heritage Data Center records for the interior least tern within the Mid-States Corridor study area are limited to southern Spencer County along the Ohio River and a single record in western Greene County. While one of the Spencer County records is proximal to US 231 in Section 1 for all the alternatives, these alternatives do not propose any changes to the existing four-lane divided highway facility in this section.

Bald eagle (*Haliaeetus leucocephalus*)

The bald eagle first received protection in the United States under the Bald Eagle Protection Act in 1940 (USC 668-668d) which was later amended in 1962 to include the golden eagle and retitled the Bald and Golden Eagle Protection Act. It was among the first species to be listed as endangered on March 11, 1967 under the Endangered Species Preservation Act of 1966 (32 FR 4001,) and the subsequent Endangered Species Act of 1973. On February 14, 1978, the USFWS changed the classification from endangered to threatened for Michigan, Minnesota, Wisconsin, Oregon, and Washington (USFWS 1978). On July 12, 1995, the final rule to reclassify the bald eagle as threatened throughout the lower 48 states was published (USFWS 1995). The USFWS originally proposed to delist the bald eagle throughout the United States on July 6, 1999 (USFWS 1999). The final rule to delist the bald eagle under the Endangered Species Act was published on July 9, 2007 (USFWS 2007b) and became effective August 8, 2007. Although the bald eagle has been delisted from the Endangered Species Act of 1973, it is still afforded protection under the Bald and Golden Eagle Protection Act and the Migratory Bird Treaty Act of 1972 as outlined in the National Bald Eagle Management Guidelines (USFWS 2007c). The bald eagle was originally designated as state endangered by the IDNR in the second amendment to the NRC roster listing May 1, 1992 (NRC 1992) but was subsequently changed to special concern in the fifth amendment to the NRC roster listing February 1, 2012 (NRC 2012, IDNR 2020a).

USFWS: Delisted IDNR: Special Concern Global Rank: G5 State Rank: S2



The bald eagle is the largest of the raptors in the United States and adults are easily recognized by their telltale white head and tail feathers. Males and females are identical in appearance. Maturity is reached at four to five years. The body of an adult bird is three to three and one-half feet in length, and the wingspan is six to seven and one-half feet. Indiana's Bald Eagle Restoration Program has tracked many bald eagles around the Monroe Reservoir.

Recovery of the bald eagle in the United States is evidenced by the increase in the estimated number of breeding pairs from 487 in 1963 to 9,789 in 2007. At the time of delisting in 2007, it was estimated that 68 bald eagle breeding pairs were present in Indiana. From 1985 to 1989, 73 eaglets obtained from Wisconsin and Alaska were released at Lake Monroe as part of the Bald Eagle Reintroduction Program administered through the Indiana Nongame and Endangered Wildlife Program. From subsequent annual eagle surveys from 1989 through 2007, nesting territories in Indiana increased from 2 to 84, with 64 successful nests yielding 121 fledglings. From additional survey data, it was estimated that there were as many as 350 nesting territories in the state in 2020.

Breeding habitat for bald eagles includes isolated large bodies of clear, clean water (i.e., lakes, bays, marshes, rivers) with adjacent mature, tall trees for nesting and roosting. Lakes with more than seven miles of shoreline have been reported as primary breeding habitat (Peterson 1991). Nests are constructed in the upper crotch of living or dead trees. Branches are added to the nest year after year prior to breeding. Eagles may also build nests in multiple trees and alternate between nests from year to year. Nests are usually located within one mile of water (Peterjohn and Rice 1991) and within open forests. Eagles mate for life, but do not begin to nest until they are 4-5 years old, and often select sites close to where they were raised as young. The life span of a bald eagle is quite long, living up to 48 years in captivity and 21 years in the wild. However, in 2015 IDNR biologists documented one of the eaglets released at Monroe Lake in 1988, making her 27 years old. The National Bald Eagle Management Guidelines (USFWS 2007c) provide a generalized life cycle timeline for the northern United States periods of nest building, egg laying/incubation, hatching/rearing, and fledging. Typically, in the Midwest, April represents the time when bald eagles are incubating eggs or eggs are hatching.

The National Bald Eagle Management Guidelines (USFWS 2007c) and Appendix E of the Northern States Bald Eagle Recovery Plan (USFWS 1983) each designate sensitive or critical periods for nesting bald eagles. Descriptions of the four periods from the Northern States Bald Eagle Recovery Plan are:

1. Most critical period. Prior to egg laying bald eagles engage in courtship activities and nest building. During this and the incubation periods they are most intolerant of external disturbances and may readily abandon the area. The most critical period for disturbances therefore extends from approximately one month prior to egg laying through the incubation period.
2. Moderately critical period. This includes approximately one month prior to the above period and about four weeks after hatching. Prior to the nesting season individual pairs of eagles vary considerably in time of return to the nest site or, if permanent residents, the time they begin to come into physiological condition for breeding and become sensitive to disturbance. After hatching the chicks are quite vulnerable to inclement weather and need frequent brooding and feeding. Disturbance can keep adults from nests and, depending on the weather and length of time involved, may cause weakening or death of chicks. The adults are quite protective of the nest site as long as one or more healthy chicks are present. Thus, disturbance at this time is less critical, although still potentially detrimental, than during the pre-laying and incubation period.



3. Low critical period. This period extends from the time chicks are about one month of age until approximately six weeks after fledging. During this time, adults are still quite attached to nesting areas but tolerate moderate amounts of human presence. Restrictions should be decided on a case-by-case basis.
4. Not critical period. The existence of this period depends on whether adults are permanent residents in their nesting areas. In most regions, adults leave the vicinity for a few weeks or months each year. During the time they are gone one need be concerned only with activities that alter the habitat in ways that would make it unsuitable for future nesting.

Table 3 describes the sensitivity of bald eagles to disturbances at specific life stage activities.

TABLE 3. NESTING BALD EAGLE SENSITIVITY TO HUMAN ACTIVITIES

Activity	Sensitivity to Human Activity	Comments
Courtship and nest Building	Most sensitive period; likely to respond negatively	Most critical time period. Disturbance is manifested in nest abandonment. Bald eagles in newly established territories are more prone to abandon nest sites.
Egg laying	Very sensitive period	Human activity of even limited duration may cause nest desertion and abandonment of territory for the breeding season.
Incubation and early nestling period, up to 4 weeks	Very sensitive period	Adults are less likely to abandon the nest near and after hatching. However, flushed adults leave eggs and young unattended; eggs are susceptible to cooling, loss of moisture, overheating, and predation; young are vulnerable to elements.
Nestling period, 4 to 8 weeks	Moderately sensitive period	Likelihood of nest abandonment and vulnerability of the nestlings to elements somewhat decreases. However, nestlings may miss feedings, affecting their survival.
Nestlings 8 weeks through fledging	Very sensitive period	Gaining flight capability, nestlings 8 weeks and older may flush from the nest prematurely due to disruption and die.

The National Bald Eagle Management Guidelines (USFWS 2007c) establish eight temporary impact categories based on the nature of the disturbance and presence of landscape buffers. Road construction activities are classified as Category A intrusions. **Table 4** from the guidelines provides the USFWS recommended restrictions for activities proximal to bald eagle nests.

TABLE 4. RECOMMENDED ACTIONS FOR CATEGORY A INTRUSIONS TO BALD EAGLE NESTS

	<i>If there is no similar activity within 1 mile of the nest</i>	<i>If there is similar activity closer than 1 mile from the nest</i>
<i>If the activity will be visible from the nest</i>	660 feet. Landscape buffers are recommended.	660 feet, or as close as existing tolerated activity of similar scope. Landscape buffers are recommended.
<i>If the activity will not be visible from the nest</i>	330 feet. Clearing, external construction, and landscaping between 330 feet and 660 feet should be done outside breeding season.	330 feet, or as close as existing tolerated activity of similar scope. Clearing, external construction and landscaping within 660 feet should be done outside breeding season.



POTENTIAL FOR IMPACT

IDNR has records of numerous nests within the Mid-States Corridor study area, most of which are along or near the East Fork White River, Patoka River, and Lost River. Additionally, there are nesting records from Patoka Lake, Little Pigeon Creek Wetland Conservation Area near Gentryville, Huntingburg Lake west of the town, Buffalo Pond Nature Preserve north of Jasper, Glendale Fish and Wildlife Area, West Boggs Lake, Flat Creek Lake, Prairie Creek Lake, and several locations at Naval Support Activity (NSA) Crane. Previously documented nests are proximal to the common alignments for all alternatives in Dubois County. Additional documented sites are within one mile of Alternative B in Daviess County, Alternatives P, RPA P, and M in Martin County, and Alternative P and RPA P, including Local Improvement 8, in Daviess County. There are likely other discovered and undiscovered bald eagle nests each year that have not been disclosed to the IDNR, and therefore not included in Indiana Natural Heritage Center Data.

Sedge wren (Cistothorus platensis)

The sedge wren was originally designated as state rare by the IDNR in the second amendment to the NRC roster listing May 1, 1992 (NRC 1992), but was subsequently changed to endangered in the third amendment to the NRC roster listing January 1, 2005 (NRC 2007, IDNR 2020a).

IDNR: Endangered
Global Rank: G5
State Rank: S3B

The sedge wren is a small elusive passerine bird that feeds on a variety of insects and spiders while hopping across the ground (Castrale et al. 1998, The Cornell Lab [no date], Kaufman 1996). Its breeding range extends from the southern portions of Canadian provinces (Saskatchewan through Quebec) to as far south as Missouri, Illinois, Indiana, and Ohio (Herkert et al. 2021), and to a lesser extent into Kentucky and Virginia (Castrale et al. 1998, Kaufman 1996). In Indiana, breeding is less common in the south-central and southeastern portions of the state but has been noted in southwestern Indiana where suitable habitat is available (Castrale et al. 1998). However, even within its known breeding range, local presence can be erratic and irregular from year to year (Palmer-Ball 1996). Sedge wrens prefer wet meadows and the edges of marshes and bogs within mixed grasses and sedges, but are also known from upland fields, weedy pastures, and dry grasslands, as well as reclaimed coalmine fields (Castrale et al. 1998, Palmer-Ball 1996). Nests are globular structures of grasses and sedges, lined with softer material (fine grass, animal hair, feathers), include a side entrance, and are constructed within three feet of the ground (Palmer-Ball 1996, Kaufman 1996). Males often built several incomplete nests (“dummy nests”) to detract from real nests (Castrale et al. 1998, Palmer-Ball 1996, Kaufman 1996). Clutch size varies from 3-8 (Herkert et al. 2021, Kaufman 1996) and sedge wrens sometime exhibit double brooding. Sedge wrens winter in the Gulf and lower Atlantic coastal states, Mexico, and Central America (Herkert et al. 2021). Loss of native grassy prairie habitat is the primary threat to the species. IDNR records within the Mid-States Corridor study area include a suburban field north of Huntingburg and a rural East Fork White River floodplain field in Lawrence County.

POTENTIAL FOR IMPACT

There are only three Indiana Natural Heritage Data Center records for the sedge wren within the Mid-States Corridor study area (Dubois, Lawrence, and Greene counties). The 1999 Dubois County record north of Huntingburg is just over one mile from Alternative B (west of Huntingburg/Jasper) and just over one mile from Alternative C, M, O, P, and RPA P (east of Huntingburg/Jasper), but is immediately adjacent to Local Improvement 2 for all of the alternatives and Alternative R.



Least bittern (*Ixobrychus exilis*)

The least bittern was originally designated as state rare by the IDNR in the second amendment to the NRC roster listing May 1, 1992 (NRC 1992) but was subsequently changed to endangered in the third amendment to the NRC roster listing January 1, 2005 (NRC 2007, IDNR 2020a).

IDNR: Endangered
Global Rank: G4G5
State Rank: S3B

The small, narrow-bodied heron breeds across the eastern United States and isolated areas in the western United States where it inhabits freshwater and brackish wetlands with dense, emergent vegetation, such as cattails (*Typha*), sedges (*Carex*), and bulrush (*Scirpus*), interspersed with open water (Poole et al. 2020). In Indiana, the least bittern is found in all regions with greatest occurrence in the northwestern portion of the state (Castrale et al. 1998). Least bittern forage for prey, primarily small fish and aquatic invertebrates, at the water's surface by clinging to emergent plants. Least bittern breed between late April and July with the peak time of feeding young coinciding with the emergence of aquatic insects (Orians 1980.). Nests are constructed by males and placed just above the water in well-concealed tall, dense wetland vegetation, often within a few meters of open water. Nest density can be high with as many as 15 nests per 2.5 acres in high quality habitat (Poole et al. 2020). Clutch size ranges from 2-6 eggs.

Loss and degradation of palustrine habitat due to invasions of nonnative plants (e.g., purple loosestrife, *Lythrum salicaria*; common reed, *Phragmites australis*) and diminished water quality are chief issues facing the species (Poole et al. 2020). If wetlands remain undisturbed and unpolluted, least bittern can tolerate human presence making features such as water impoundments potentially important nesting habitat.

POTENTIAL FOR IMPACT

While there are several Indiana Natural Heritage Data Center occurrences of the least bittern in Warrick County, there are only two records in Daviess and Dubois counties within the general vicinity of any alternatives for the Mid-States Corridor study area. The Dubois County record from 2000 is between Huntingburg and Jasper, just over one mile from Alternative B (west of Huntingburg/Jasper) and over one mile from Alternatives C, M, O, P, RPA P (east of Huntingburg/Jasper) and Local Improvement 3. However, Local Improvement 2 and Alternative R are immediately adjacent to this species account. The Daviess County record from 1985 is within one mile of Alternative B north of the East Fork White River.

Loggerhead shrike (*Lanius ludovicianus*)

The loggerhead shrike was designated as state endangered by the IDNR in the second amendment to the NRC roster listing May 1, 1992 (NRC 1992, IDNR 2020a).

IDNR: Endangered
Global Rank: G4
State Rank: S3B

The loggerhead shrike is a robin-size, blue-gray, white, and black songbird with a dark facial mask. The head is relatively large in proportion to its body and its thick beak has a small hook with tomial teeth. White wing patches that contrast with the bird's black wings are conspicuous and aid observers in identification while in flight. Males and females typically look similar and have an overall length between 7.8 and 9.8 inches and weight between 1.2 and 1.8 ounces. Loggerhead shrikes are predatory and hunt from natural and man-made perches, often perched with a horizontal body posture. Shrikes fly from a perch and swoop low to capture prey, which often is then impaled on a thorn or barbed wire fence (Cade and Woods 1997).



This predatory passerine selects open areas dominated by herbaceous vegetation interspersed with scattered trees and/or shrubs (Cade and Woods 1997). Loggerhead shrikes use a variety of open habitats, including pastures, hayfields, roadsides, orchards, and large forest openings. Southern Indiana harbors the greatest number of breeding individuals; shrikes are absent from large portions of the state, especially the east-central and northeastern Indiana (Castrale et al. 1998).

Habitat often includes dense woody cover for nesting and is adjacent to open areas dominated by herbaceous vegetation where foraging occurs. A mosaic of habitat types is important for maximizing foraging efficiency and providing adequate cover for nesting. Proximity to shrub/forest habitats may also be important during winter (Blumton 1989). Perch density is an important attribute, where birds in areas with higher perch density and perches of varying heights typically have smaller territory sizes and are in better condition (Yosef 2020). Other features that increase visibility of prey, such as areas with bare soil and shorter herbaceous vegetation, may provide more appropriate conditions for loggerhead shrikes (Blumton 1989, Yosef and Grubb 1993). Because shrikes lack talons, they often use thorns and/or barbed wire to impale and cache prey and select habitat where these features occur.

Nesting substrate is another critical component of habitat. Due to the wide geographic distribution of loggerhead shrike, nest tree and shrub species can differ greatly from one part of its range to another. The nesting season generally occurs from April to the end of July. Nests are placed in a shrub or tree and are constructed from available materials (e.g., twigs, bark, forbs) nearby, with soft material placed inside. Typically, 5-6 eggs are laid and incubated for 15-20 days. Young fledge between 17 and 21 days. Juvenile shrikes leave the parents' territory at approximately 10-13 weeks (Blumton 1989).

Loggerhead shrikes are found across much of North America. Loggerhead shrikes are partial migrants with some individuals, mostly in the northern extent of its range including Indiana, migrating to the southern portion of their range for winter, while others remain as year-round residents. Migrating loggerhead shrikes leave for their wintering grounds between September and November and return to breeding grounds between March and late April. For individuals that occupy the same area year-round, territory size may increase and/or birds may use specific areas more in winter than during the breeding/nesting season (Blumton 1989, Gawlik and Bildstein 1993).

Large-scale changes in land-use, including conversion of pastures and hayfields to row crops, loss of hedgerows, and increased use of pesticides threaten populations in the Midwest and Northeast (Yosef 2020).

POTENTIAL FOR IMPACT

There are in excess of 120 Indiana Natural Heritage Data Center records of the loggerhead shrike within the counties comprising the Mid-States Corridor study area. A large number of these are in western Dubois County and throughout Daviess County. Several are within one mile of all the alternatives in Section 2 (including Local Improvement 1), with a few in the general vicinity of Alternatives B, C, P, RPA P, and R in Section 3 (including Local Improvements 7 and 11). There are no records within the general vicinity of Alternatives M and O through the Crawford Upland.

Yellow-crowned night-heron (Nyctanassa violacea)

The yellow-crowned night heron was designated as state endangered by the IDNR in the second amendment to the NRC roster listing May 1, 1992 (NRC 1992, IDNR 2020a).

IDNR: Endangered Global Rank: G5 State Rank: S2B
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Yellow-crowned night-heron is a regular breeder along the Atlantic and United States Gulf coasts extending inland following reaches of major waterways, a regular but local breeder in the Midwest, and a casual breeder north into Michigan and Ontario (Watts 2020). While summer surveys only documented the species in the southern third of the state, this species can be easily overlooked due to its nocturnal nature but has been detected in most regions of Indiana (Castrale et al. 1998).

Onset of breeding ranges from early March to early May, depending on latitude and availability of prey (Watts 2020). Inland breeders generally construct a nest platform of sticks in wooded areas near wetlands. Nests may be used for many years, with some nests being reoccupied by pairs after years of vacancy.

Yellow-crowned night herons forage at night along riparian and wetland habitats with high concentrations of crustaceans (e.g., crayfish), a favorite prey. The recent spread of rusty crayfish (*Faxonius rusticus*), a pollution-tolerant species, may have increased prey availability since native crayfish have been affected by poor water quality (Rodewald et al. 2016). Loss of wetlands reduces available habitat and can be particularly detrimental to isolated breeding populations. This species is generally less sensitive to anthropogenic disruptions than other wading birds and may frequently nest near human habitations (Watts 1995).

POTENTIAL FOR IMPACT

Indiana Natural Heritage Data Center records are sparse within the Mid-States Corridor study area and largely limited to the Patoka River, East Fork White River, and Naval Support Activity (NSA) Crane in northern Martin County. A Dubois County record from 1983 at Buffalo Pond Nature Preserve is within one mile of Alternatives C, M, O, P, RPA P, and R to the northeast of Jasper.

King rail (*Rallus elegans*)

The king rail was designated as state endangered by the IDNR in the second amendment to the NRC roster listing May 1, 1992 (NRC 1992, IDNR 2020a).

IDNR: Endangered Global Rank: G4 State Rank: S1B
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Measuring 21-25 inches, the king rail is the largest of all North American rails. The king rail is a locally common breeder in freshwater and brackish marshes along and near the Atlantic and United States Gulf coasts and a sparsely distributed breeder in freshwater marshes throughout eastern North America (Pickens and Meanley 2020). In the Midwest, breeding season occurs between May and August. Nest platforms are constructed by males and placed just above the water or ground within suitable habitat. Both sexes assist with incubation of between 9 and 12 eggs for approximately 3 weeks (Pickens and Meanley 2020). Young follow parents for several weeks before learning to acquire food on their own. Individuals forage amongst dense plant cover and open water for prey, including crustaceans, aquatic and terrestrial insects, fish, and frogs.

Draining of wetlands and alterations in hydrologic regimes in the eastern United States, have reduced the amount of breeding habitat contributing to population declines, particularly for inland birds. (Pickens and Meanley 2020). Encroachment of woody vegetation and monocultures of invasive, nonnative plants can degrade quality of habitat for the species.

POTENTIAL FOR IMPACT

Indiana Natural Heritage Data Center records for the king rail are limited to four scattered occurrences in Pike, Dubois, Lawrence, and Greene counties. The Dubois County 2000 record at Barnes-Seng Wetland Conservation Area along the Patoka River between Huntingburg and Jasper is between one and two miles from Alternative B to the west and Alternatives C, M, O, P, and RPA P to the east around



Huntingburg/Jasper, but is immediately adjacent to Local Improvement 2 and Alternative R. An older 1977 record near Bedford is within one mile of Alternative O.

Barn owl (*Tyto alba*)

The barn owl was designated as state endangered by the IDNR in the second amendment to the NRC roster listing May 1, 1992 (NRC 1992, IDNR 2020a).

IDNR: Endangered
Global Rank: G5
State Rank: S2

The barn owl is a medium-sized owl measuring between 29-44 inches in length and can be found worldwide on all continents except Antarctica (Marti et al. 2020). In North America, distribution is variable throughout the species' range with populations at the northern edge being limited by the severity of winters (Marti et al. 2020). Barn owls select primarily open habitats including pastures, hayfields, grasslands, and wet meadows, with available natural or human-made nest cavities. Prime habitat is often abundant in small mammals including voles (*Microtus* sp.) which make up the majority of barn owl diets. In Indiana, barn owls are generally more common in the southern portion of the state (Castrale et al. 1998). The breeding season is relatively long, beginning in May and lasting as late as October. Clutch size varies greatly from 3-11 eggs, averaging 5-6 eggs at Indiana's latitude, that are incubated between 4-5 weeks. Barn owls begin incubation as soon as the first egg is laid meaning that the age of chicks can differ dramatically. Often, older chicks are better able to take prey items from adults and out-compete younger chicks resulting in an average of three to four fledged chicks (Marti et al. 2020).

Barn owls were once common across the Midwest, including Indiana, but cleaner farming practices including widespread use of pesticides, larger fields without hedge rows, and fewer outbuildings have eliminated most suitable habitat (Marti et al. 2020). In addition, barn owls face a variety of other threats, including collisions with vehicles, illegal shooting, use of rodenticides, particularly cold winters, and summer droughts. Conservation agencies, including IDNR, promote the installation of properly constructed nest boxes in expansive open habitats to support this state-endangered owl (Castrale et al. 1998).

POTENTIAL FOR IMPACT

There are approximately 50 barn owl Indiana Natural Heritage Data Center records within the Mid-States Corridor study area. Distribution is generally throughout most of the counties included in the study area. There is at least one record within one mile of each of the alternatives (except Alternative R) in Sections 2 and Section3 of the Mid-States Corridor study area.

Broad-winged hawk (*Buteo playtypterus*)

The broad-winged hawk was designated as state rare/special concern by the IDNR in the second amendment to the NRC roster listing May 1, 1992 (NRC 1992, IDNR 2020a).

IDNR: Special Concern
Global Rank: G5
State Rank: S3B

The broad-winged hawk is a small raptor that feeds on mammals as large as squirrels, amphibians, reptiles (including small turtles), other birds, and sometimes fish, crayfish, insects and other invertebrates (Castrale et al. 1998, Kaufman 1996). It hunts from perches under the canopy along the edge of the woods or near water (Kaufman 1996). Its breeding range extends throughout the southern territories of Canada and includes the entire eastern United States south to the Gulf Coast and west to Minnesota and eastern Texas (Castrale et al. 1998, The Cornell Lab [no date], Kaufman 1996). In Indiana, breeding is less common in northern Indiana and most frequent in the unglaciated regions of southcentral Indiana (Castrale et al. 1998). Habitat consists of larger, heavily forested, deciduous (oak-



hickory) or mixed coniferous-deciduous (pine-hardwood) upland tracts, including forest edges formed by roads, powerlines, or timber harvest (Castrale et al. 1998, Palmer-Ball 1996, The Cornell Lab [no date]). It has previously been considered the second most abundant hawk of the Hoosier National Forest (Castrale et al. 1998). Nests are small and constructed of sticks with finer material located in the crotch of a branch of a deciduous tree usually in the lower third of the canopy (Palmer-Ball 1996, Kaufman 1996, The Cornell Lab [no date]). Clutch size is typically 2-3 (Castrale et al. 1998, Kaufman 1996). Large flocks including other raptor species form for spring and fall migration (The Cornell Lab [no date]). Loss of forest habitat or fragmentation is the primary threat to the species, although vehicle strikes are documented, particularly in the southern wintering range (The Cornell Lab [no date]).

POTENTIAL FOR IMPACT

The Indiana Natural Heritage Data Center records for the broad-winged hawk are generally confined to the eastern half of the Mid-States Corridor study area, with the exception of a few records on the Patoka River in Pike County. A cluster of multiple records within Hoosier National Forest in Lawrence, Orange, and Dubois counties are in the general vicinity of Alternative O, with the closest less than two miles distance.

Worm-eating warbler (Helmitheros vermivorus)

The worm-eating warbler was designated as state rare/special concern by the IDNR in the second amendment to the NRC roster listing May 1, 1992 (NRC 1992, IDNR 2020a).

IDNR: Special Concern Global Rank: G5 State Rank: S3B

The worm-eating warbler is a migratory species that breeds in large, mature deciduous and mixed deciduous-coniferous forests across the eastern United States (Vitz et al. 2020). Worm-eating warblers are area-sensitive, requiring large tracts of forest for breeding. The species occurs primarily in the interior portions of more extensive, older forests of the south-central hill country of Indiana (Castrale et al. 1998). Similarly, in Ohio, the southern and eastern, unglaciated portions of the state support most of the breeding population (Rodewald et al. 2016).

In the Midwest, nesting occurs between mid-May and late July (Rodewald et al. 2016). Four to six eggs are incubated for approximately 14 days until hatching (Vitz et al. 2020). Cup nests are placed on the ground with dense understory shrubs and robust leaf litter, often on forested hillsides.

As with other area-sensitive species, forest fragmentation that increases “edge effects” (e.g., increased risk of nest predation) reduces suitability of habitat for worm-eating warblers. The expansion of nonnative earthworms has been implicated in the reduction of available leaf litter in forests of the Upper Midwest, which may threaten to degrade habitat quality (Rodewald et al. 2016).

POTENTIAL FOR IMPACT

Indiana Natural Heritage Data Center records for the worm-eating warbler within the Mid-States Corridor study area are largely in the southern portion (Warrick, Spencer, Dubois, Perry, and Crawford counties), but include three records from 1987 to 2006 in northeast Martin County, one of which is less than 2 miles to the north of Alternative M and Local Improvement 13.

Black-and-white warbler (Mniotilta varia)

The black-and-white warbler was designated as state rare/special concern by the IDNR in the second amendment to the NRC roster listing May 1, 1992 (Natural Resources Commission 1992, IDNR 2020a).

IDNR: Special Concern Global Rank: G5 State Rank: S1S2B



The black-and-white warbler is a migratory denizen of mature and secondary deciduous and mixed deciduous-coniferous forests across much of the eastern and Midwestern United States extending north into Canada as far west as British Columbia (Kricher 2020). In Indiana, the species is more commonly associated with forests in the southern portion of the state (Castrale et al. 1998).

The black-and-white warbler displays a unique foraging habit among wood warblers, gleaning prey from the bark of trees in a manner similar to that of a nuthatch, often moving down a tree head-first. This ground-nesting wood warbler typically places a nest at the base of a tree or shrub where it is well concealed. Egg laying can begin as early as April in southern portions of the species' range and go as late as July in northern portions. Females lay 4-5 eggs and incubate them between 10 and 12 days. Upon hatching chicks are fed by both parents. Nestlings fledge between 8 and 12 days following hatching and are monitored by parents until they become more skilled fliers.

Forest fragmentation threatens viable breeding populations of this forest-interior sensitive species (Askins and Philbrick 1987). Past use of certain pesticides (i.e., chlorinated hydrocarbons that have since been banned in the United States) may have had a negative impact on the species; wintering individuals, however, may still be exposed to such pesticides (Kricher 2020).

POTENTIAL FOR IMPACT

Indiana Natural Heritage Data Center records for the black-and-white warbler are sparsely scattered throughout the Mid-States Corridor study area from western Pike County to Crawford County in the south and Monroe County in the north. However, only one 1987 occurrence of the species at Naval Support Activity (NSA) Crane is proximal (less than one mile) from Alternative P, RPA P, and Alternative R.

Fish

Lake sturgeon (*Acipenser fulvescens*)

The lake sturgeon was designated as state endangered by the IDNR in the second amendment to the NRC roster listing May 1, 1992 (NRC 1992, IDNR 2020a).

USFWS: 12M PLPHC IDNR: Endangered Global Rank: G3G4 State Rank: S1

The lake sturgeon is known from the Great Lakes-St. Lawrence River, Hudson Bay, and Mississippi River watersheds in large rivers and lakes and is increasingly rare further in the range (Center for Biological Diversity 2018, Page et al. 2011). Where found, lake sturgeon is in close association with mud, sand, and gravel substrates in 16-30 feet of water, a common feature of large rivers (Page et al. 2011). While seasonality of the species is loosely understood, they are thought to seek deeper waters during the summer months (Center for Biological Diversity 2018). The species is potamodromous and exhibits spawning migrations that can exceed 124 miles and has strong natal site affinity (Ontario Ministry of Natural Resources 2011). Spawning sites are in the upper reaches of large river systems and feature fast currents and cobble/boulder substrates (Kerr et al. 2011). Spawning sites are often at the base of waterfalls or anthropogenic dams (a notable threat to the species) that prevent continued upstream movement (Kerr et al. 2011).

The species, like other sturgeon, has bony plates (i.e., scutes) covering portions of its body and can reach 5 feet in length (Simon 2011). The species is an opportunistic predator specialized for benthic prey (e.g., mollusks, crayfish, dipterans, leeches, fish eggs), but has been known to consume other fishes (Center



for Biological Diversity 2018). Interestingly, the lake sturgeon is a host for glochidia parasites from many mussel species (prey items), including the endangered hickorynut mussel (*Obovaria olivaria*).

POTENTIAL FOR IMPACT

The Indiana Natural Heritage Data Center GIS data identifies approximately 42 miles of the East Fork White River downstream of Williams Dam in Lawrence County as the known habitat range of the lake sturgeon. None of the alternatives would span this reach of the river; however, Alternative M and Local Improvement 13 parallels the East Fork White River floodplain to the north and is as close as 0.3 mile to the river east of Loogootee. RPA P is also within one mile of this river reach.

Hoosier cavefish (*Amblyopsis hoosieri*)

The northern cavefish (*Amblyopsis spelaea*) was designated as state endangered by the IDNR in the second amendment to the NRC roster listing May 1, 1992 (NRC 1992). Due to the change in the taxonomic designation of the Indiana population of Hoosier cavefish (*Amblyopsis hoosieri*), the listing was updated by IDNR in the seventh amendment to the NRC roster listing October 1, 2015 (NRC 2015, IDNR 2020a).

USFWS: Candidate
IDNR: Endangered
Global Rank: G2
State Rank: S1

The Hoosier cavefish is a cave obligate from the Crawford-Mammoth Cave Uplands and Mitchell Plain carbonate rock layers and ranges from the Ohio River in the south to the East Fork White River in the north (Chakrabarty et al. 2014). The species is known from 68 caves and 6 springs from the Lower White River, Lower East Fork White River, Patoka River, and Blue River-Sinking River watersheds (Chakrabarty et al. 2014). The species is found in larger underground streams where water remains year-round and typically in areas of low flows (i.e., pools, glides) with large breakdown and/or crevices present (McCandless 2005, Niemiller and Poulson 2010). *Amblyopsis* cavefishes are reported from water depths ranging from 0.3 to over 6.6 feet deep and in proximity to a range of substrate classes (e.g., sand, gravel, boulder) (Poulson 1963, Niemiller and Poulson 2010). To prevent eviction from the cave by high flow events, cavefishes use low/no flow areas (i.e., eddies) behind large breakdowns in and around crevices to stay in place (Niemiller and Paulson 2010).

The Hoosier cavefish, like many other cavefishes, is devoid of pigment, lacks eyes, and the myomeres are visible from the exterior (Chakrabarty et al. 2014). While typically present in low numbers (approximate density of 0.005/ft²), individual cave surveys have reported counts ranging from one to several hundred individuals (Trajano 2001). The species' ability to access phreatic conduits and other areas inaccessible by humans precludes accurate population estimates (Lewis 2002). Copepods, isopods, amphipods, and even crayfish are document prey items for the species, a top predator in its environment (Paulson 1963, Niemiller and Paulson 2010).

POTENTIAL FOR IMPACT

Indiana Natural Heritage Data Center records indicate that the Hoosier cavefish is largely confined to the karst/cave region of the Crawford Upland in Lawrence and Orange counties within the Mid-States Corridor study area. Current distribution lacks records of the species north of the East Fork White River. Locally it occurs in the Henshaw Bend, Town of Bryantsville, South Fork Beaver Creek, Half Moon Lake, and Mill Creek watersheds of the East Fork White River and the Dry Branch-Lost River and Sulphur Creek-Lost River watersheds of the Lost River drainage. Alternative O traverses both Lost River watersheds.



Spotted darter (*Etheostoma maculatum*)

The spotted darter was originally designated as state endangered by the IDNR in the second amendment to the NRC roster listing May 1, 1992 (NRC 1992) but was subsequently changed to special concern in the fourth amendment to the NRC roster listing August 1, 2007 (NRC 2007, IDNR 2020a).

IDNR: Special Concern
Global Rank: G2G3
State Rank: S2S3

During a 2011 species assessment, the USFWS summarized available information on distribution and natural history. The spotted darter ranges from New York south to West Virginia and west to Kentucky. In Indiana, extant populations of spotted darters are thought to be restricted to the Blue River and East Fork White River. Historically, the species was also known from the Tippecanoe River and likely also occurred in the Ohio and Wabash Rivers as well.

Like many other darters, spotted darters inhabit riffles and runs of streams. Unlike most other darters, spotted darters are restricted to deep riffles and runs in larger river systems where they live among and under larger rocks and boulders. The rocks trap organic materials that are consumed by small invertebrates such as midges, stoneflies, caddisflies, and mayflies, which in turn are consumed by spotted darters. Spotted darters spawn in May and June with spawning grounds located at the heads of riffles. Wedge-shaped clusters of up to 350 eggs are deposited beneath large, flat rocks. Male darters then guard these eggs until they hatch. Spotted darters are sensitive to the rocks becoming buried in silt and to changes in water chemistry, which could result from highway construction.

POTENTIAL FOR IMPACT

The Indiana Natural Heritage Data Center identifies approximately 37 miles of the East Fork White River downstream of Williams Dam in Lawrence County as the known habitat range of the spotted darter within the Mid-States Corridor study area. However, a 1999 record on the East Fork White River several miles downstream of the US 231 Bridge suggests the species local range likely includes a larger portion of the river. Alternatives C, M, P, RPA P, and R would span the East Fork White River at the current US 231 Bridge location, potentially within the habitat range of the spotted darter.

Reptiles

Western cottonmouth (*Agkistrodon piscivorus leucostoma*)

The western cottonmouth was originally designated as threatened by the IDNR in the second amendment to the NRC roster listing May 1, 1992 (NRC 1992), but subsequently elevated to endangered in the fourth amendment to the NRC roster listing August 1, 2007 (NRC 1992, IDNR 2020a).

IDNR: Endangered
Global Rank: G5T5
State Rank: S1

Cottonmouths are denizen of the Deep South with the western subspecies ranging north from Mississippi to southern Illinois and west to Texas and Missouri. Historically, cottonmouths were known from two sites in Indiana (Minton 2001). A population once occupied the rocky bluffs along the Ohio River at the junction of Harrison and Crawford counties, although this may have been snakes translocated to the site (Indiana Herp Atlas 2021a). A second, population was located in a swamp near Jasper in Dubois County (Minton 2001), but no snakes have been observed in the past decade (Indiana Herp Atlas 2021a). Thus, cottonmouths are likely extirpated from the state.

Minton (2001) provided an overview of the ecology of the species in Indiana. In summer, cottonmouths are associated with aquatic habitats, especially swamps. Cottonmouths feed on a wide variety of vertebrates including amphibians, other snakes, occasional turtles, and fish (especially catfish) from the



bulk of the diet. Cottonmouths are ambush predators that bask in the sun by day and hunt at night. Prey items that get within striking range are quickly dispatched by the potent hemotoxic venom. When threatened, cottonmouths tend to hold their position, coil into a striking position, and gape their mouths displaying the white mouth from whence the name derives. Bluffs and rocky areas near swamps likely provide hibernacula.

POTENTIAL FOR IMPACT

Indiana Natural Heritage Data Center records include a single occurrence of the cottonmouth within the Mid-States Corridor study area from the Buffalo Pond Nature Preserve in Dubois County in 2000. Alternatives C, M, O, P, and RPA P east of Huntingburg/Jasper are aligned immediately east of the Buffalo Pond Nature Preserve, while Local Improvement 4 for these alternatives and Alternative R is less than one mile from the species records.

Copperbelly water snake (*Nerodia erythrogaster neglecta*)

In 1997, the USFWS listed copperbelly water snakes that occur north and east of Indianapolis under the ESA as a threatened Distinct Population Segment (DPS). Populations in other areas are not listed but are protected by a conservation plan. Copperbelly water snakes within the region addressed by this document are addressed by a conservation plan. The copperbelly water snake was originally designated as threatened by the IDNR in the second amendment to the NRC roster listing May 1, 1992 (NRC 1992), but subsequently elevated to endangered in the fourth amendment to the NRC roster listing August 1, 2007 (NRC 1992, IDNR 2020a).

IDNR: Endangered Global Rank: G5T3 State Rank: S2

The copperbelly water snake once occupied a wide swath of the Midwest, ranging from the confluence of the Tennessee and Ohio rivers north and east along major tributaries of the Ohio and into the wetland mosaic that once covered much of northern Indiana and Ohio and adjacent portions of Michigan. Copperbelly water snakes are relatively common in swamps associated with the Ohio, Wabash, and Muscatatuck Rivers (Minton 2001).

The copperbelly water snake hibernates in underground dens (primarily abandoned crayfish burrows) from October until late April or early May (USFWS 2008). After arousing from torpor, the species then migrates to nearby wetlands where it begins its active period (foraging and mating). Mating occurs in the early spring as males seek out females and form mating balls around them. Live young are born in fall, but average litter size is not well understood (USFWS 2015a).

Frogs and tadpoles make up the majority of the diet, although salamanders and small fish also are taken (Roe et al. 2003, USFWS 2015a). The species prefers to forage in vernal pools where amphibians congregate which also reduces competition with predatory fish. In turn, the copperbelly water snake is eaten by egrets, herons, turtles, large fish, raptors, skunks, and opossums with annual mortality rates reaching 70-80 percent (USFWS 2008). This predation rate increases as habitat fragmentation reduces the vegetative cover used by snakes moving between adjacent wetlands (Roe et al. 2003, Roe et al. 2006, Lee et al. 2007). Road construction and associated development can lead to habitat fragmentation and cause direct mortality when snakes are killed on roads.

POTENTIAL FOR IMPACT

Excluding multiple records of the copperbelly water snake from the Patoka River area in Pike County, Indiana Natural Heritage Data Center records in the Mid-States Corridor study area include a few scattered occurrences from 1967 to 2015 in wetland floodplain habitat along the East Fork White River



(Buffalo Pond Nature Preserve and Barnes-Seng Wetland Conservation Area) and at Wening-Sherritt Seep Springs Nature Preserve in Dubois County. Alternatives C, M, O, P, RPA P east of Huntingburg/Jasper are aligned immediately east of the Buffalo Pond Nature Preserve. Local Improvements 2 and 3 for all of the Alternatives and Alternative R are in close proximity to the records of the species at the Barnes-Seng Wetland Conservation Area.

Rough green snake (*Opheodrys aestivus*)

The rough green snake was designated as state rare/special concern by the IDNR in the second amendment to the NRC roster listing May 1, 1992 (NRC 1992, IDNR 2020a).

IDNR: Special Concern Global Rank: G5 State Rank: S3
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Rough green snakes range from New Jersey south and west to Texas (Natural Heritage 2007). In Indiana, the species ranges from the glacial boundary in Vigo County south and east to Dearborn County (Indiana Herp Atlas 2021b).

Rough green snakes are forest snakes associated with dry woodlands and thickets where they are typically observed climbing through branches 3-15 feet above the ground in summer (Minton 2001). In spring and fall, the species is more often seen on the ground and crossing roads and trails. Eggs are laid in spring or early summer and hatch in late summer to early fall. Rough green snakes in Indiana consume a variety of arthropods, although long-horned grasshoppers, caterpillars, crickets, and spiders are the most frequently observed food items. Road construction and associated development can lead to forest fragmentation and cause direct mortality when snakes are killed on roads.

POTENTIAL FOR IMPACT

Indiana Natural Heritage Data Center records for the rough green snake are sparsely scattered throughout the Mid-States Corridor study area but show no general distribution pattern relative to physiographic region or major floodplain versus upland habitat. Alternatives C, M, O, P, RPA P, and R are within one mile of the record at the Buffalo Pond Nature Preserve occurrence, with the remaining records greater than two miles from all of the alternatives.

Eastern box turtle (*Terrapene carolina carolina*)

The eastern box turtle was designated as state special concern by the IDNR in the fourth amendment to the NRC roster listing August 1, 2007 (NRC 2007, IDNR 2020a).

IDNR: Special Concern Global Rank: G5T5 State Rank: S3
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Eastern box turtles have a wide geographic distribution in the eastern and central United States from northeastern Massachusetts to Georgia and west to Michigan, Illinois, and Tennessee (Conant 1998). Significant declines in the population sizes for this species have been reported across the historical distribution area. Habitat destruction and fragmentation, disease, vehicle collisions and capture for the pet trade are likely causes for the dramatic population and demographic declines across its range (Kimble et al. 2014).

The species is almost exclusively terrestrial but may soak in pond or stream edges or burrow under leaf litter or logs during hot, dry weather (Conant 1998). Eastern box turtles preferred habitat will vary based on environmental factors including temperature, humidity, and vegetative cover. Preferred macrohabitats include upland and lowland deciduous forests (Kapfer et al. 2013). Eastern box turtles are omnivorous and feed generally on a varied diet of berries, fruits, insects, or carrion (Conant 1998).



POTENTIAL FOR IMPACT

The Indiana Natural Heritage Data Center only includes a few records of the eastern box turtle in Dubois, Daviess, Martin, Greene, Lawrence, and Orange counties. Although the species is experiencing declines, it is more common in available forested habitat throughout the Mid-States Corridor study area than Data Center representation suggests. Alternatives M and O have a greater potential for encroachment upon eastern box turtle habitat due to the larger amount of forest habitat present in the eastern portion of the study area.

Amphibians

Northern crawfish frog (*Lithobates areolatus circulosus*)

The northern crawfish frog (*Rana areolata circulosa*) was originally designated as threatened by the IDNR in the second amendment to the NRC roster listing May 1, 1992 (NRC 1992) but elevated to endangered in the fourth amendment to the NRC roster listing August 15, 2007 (NRC 2007). In the fifth amendment to the NRC roster listing February 1, 2012, the name was updated to *Lithobates areolatus* (NRC 2012, IDNR 2020a).

IDNR: Endangered Global Rank: G4T4 State Rank: S2

The northern crawfish frog inhabits the grasslands and prairies distributed throughout the south-central United States, the eastern Great Plains, and portions of the Midwest. Indiana is at the northern and eastern edges of its distribution. Most historic observations place the species in the western part of the state ranging from Benton County to the Ohio River with an isolated population occurring in the Big Oaks National Wildlife Refuge in southeast Indiana. It is unknown if this population is introduced or natural. Populations in southwestern Indiana are scattered and clustered, with some being found in emergent and semi-permanent wetlands. It is speculated that the species was supported in this eastern portion of its range by non-forested flood plains and grassy river valleys; eastward expansion could have been facilitated by natural disturbances from wildfires and bison movement (Engbrecht and Lannoo 2010).

The species was added to Indiana's State Endangered Species list in 1988 due to population declines; however, the true status of this species is difficult to ascertain due to their short calling season and fossorial nature (Engbrecht and Lannoo 2010). Declining population trends are most likely attributed to the conversion of grassland and prairie to agricultural land use and successional forest growth in previously open areas (Hoffman 2010).

Due to its cryptic nature, characteristics of its life history remain mysterious. The northern crawfish frog is heavily dependent on burrowing crayfish for shelter from predators and weather, but details of this association are still poorly understood (Engbrecht and Lannoo 2012, Hoffman 2010). Their breeding season typically occurs in a span of approximately 2 weeks in March when temperatures range between 53-65 °F (Hoffman 2010). They can spend the other 10-11 months in and around their chosen burrow, emerging to the worn patch of soil outside of the burrow, known as the feeding platform, to consume insects and arachnids. Individuals may spend years or their entire lives inhabiting the same burrow (Engbrecht and Lannoo 2012).

POTENTIAL FOR IMPACT

Indiana Natural Heritage Data Center records for the northern crawfish frog are concentrated in three general locations within the Mid-States Corridor study area: southwest Daviess County west of Glendale FWA, northeastern Daviess and south-central Greene counties, and Goose Pond FWA. The populations



in southwest Daviess County are in close proximity to Alternative B and Local Improvement 12 (within one mile), while the northeast Daviess County populations are near Alternatives P, RPA P, R, and Local Improvement 9.

Blanchard's cricket frog (*Acris blanchardi*)

Blanchard's cricket frog was designated as special concern under the name northern cricket frog (*Acris crepitans*) by the IDNR in the fourth amendment to the NRC roster listing August 1, 2007 (NRC 2007). In the seventh amendment to the NRC roster listing October 7, 2015, the name was updated to Blanchard's cricket frog (*Acris blanchardi*) (NRC 2015, IDNR 2020a).

IDNR: Special Concern Global Rank: G5 State Rank: S4
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Blanchard's cricket frog has a historically wide distribution from Texas north to South Dakota, east to central Ohio, and south to Arkansas and Louisiana. However, there have been continuous dramatic declines in populations of this species in the northern half of its range resulting in extirpation of some populations in suitable habitat, while other similar amphibian species have not shown the same reductions (Gamble et al. 2008). Several northern Midwest states have documented declines and extirpations, and it is thought the species has disappeared from northern Indiana (Russell et al. 2002).

Blanchard's cricket frog is a small, semi-aquatic species which exhibits both diurnal and nocturnal activity (Youngquist and Boone 2014). This amphibian is mainly associated with mesic habitats but is known to use dry, upland habitats during dispersal (Youngquist and Boone 2014). Preferred habitat includes open canopy habitats and individuals are less commonly found in densely forested patches (Youngquist and Boone 2014). Blanchard's cricket frogs are found to hibernate terrestrially and communally in gravel beds along streams, burrows in the soil, and in cracks within dry mud. Most breeding occurs from late May to early June but can continue later in the season in southern portions of its distribution (McCallum et al. 2011). Blanchard's cricket frog is an opportunistic feeder consuming mostly terrestrial arthropods and any other fauna that is of a suitable size for consumption (Johnson and Christiansen 1976).

While it is unclear the exact cause of these declines, factors that may play a key role include climate change, successional changes in open habitats, and environmental pollutants (Russell et al. 2002).

POTENTIAL FOR IMPACT

The majority of the Indiana Natural Heritage Data Center records for Blanchard's cricket frog are from the Patoka River National Refuge several miles west of the alternatives, or within the Hoosier National Forest to the east and southeast of the alternatives. However, a 2000 occurrence of the species is documented from the Buffalo Pond Nature Preserve, less than 2 miles west of Alternatives C, M, O, P, and RPA P and east of Local Improvement 4 and Alternative R.

Common mudpuppy (*Necturus maculosus*)

The common mudpuppy was designated as state rare/special concern by the IDNR in the second amendment to the NRC roster listing May 1, 1992 (NRC 1992, IDNR 2020a).

IDNR: Special Concern Global Rank: G5 State Rank: S2
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Historical accounts note this species as widely distributed and abundant with an ability to exist in diverse habitats throughout the eastern and northern United States and southern Canada (Stejneger and Barbour 1923; Bishop 1926; Reigle 1967). Habitat observations include rivers, streams, and lakes, with nests noted where adequate cover exists, such as under large, flat rocks over mixed substrate (Bishop 1926). However, much of the life history information relating to habitat



preference, home range, seasonal movement, and population structure is unknown due to detection difficulty (McDaniel et al. 2009; Murphy et al. 2016). Lentic populations have been noted with reproductive adults migrating to inflowing tributaries to nest and spawn in cool, shallow riffle habitat (Pope 1944). These large-bodied salamanders are the only known host for salamander mussel (*Simpsonaias ambigua*) glochidia, a species of state concern. High breeding site fidelity has been noted in the species due to chemical secretions that also provide olfactory cues that aid in hunting and predator avoidance (Parzefall et al. 1980).

Lampricides have been extensively used in tributaries throughout the Great Lakes drainage since 1958 to control invasive sea lamprey populations (Matson 1990; Grunder et al. 2021). Unfortunately, mudpuppies are reportedly as sensitive to sea lamprey pesticides as the target species (Hubert 2003), which may be a significant factor in purported declines (Hoffman et al 2014). Overharvesting and habitat decline due to poor water quality and siltation are referenced as additional threats contributing to noted population declines (Hoffman et al. 2014).

POTENTIAL FOR IMPACT

Indiana Natural Heritage Data Center records for the mudpuppy within the Mid-States Corridor study area include the Patoka River (Dubois County) and the East Fork White River (Martin and Lawrence counties). While there are no local records of the species at the alternative crossings of the East Fork White River, its presence in these areas is possible. In response to the DEIS, a local naturalist has provided information indicating the presence of the mudpuppy within First Creek downstream of US 231 that is not included within the IDNR Natural Heritage Data Center records. The Patoka River record is downstream of Alternatives C, M, O, P, and RPA P, upstream of Alternative B, and within one mile of Local Improvements 3 and 4, and Alternative R. While the specific location of the mudpuppy in First Creek provided by the commenter is not within the RPA P corridor, its close proximity to the alternative warrants additional field investigation during Tier 2 investigations.

Mussels

Fanshell (Cyprogenia stegaria)

The fanshell was listed as federally endangered by the USFWS on June 21, 1990 (USFWS 1990). The species was designated as state endangered by the IDNR in the second amendment to the NRC roster listing May 1, 1992 (NRC 1992, IDNR 2020a).

USFWS: Endangered
IDNR: Endangered
Global Rank: G1Q
State Rank: S1

The fanshell has a medium sized, thick, circular to triangular shell that rarely exceeds 3.2 inches in length. The exterior of the shell is a dull yellowish or tan color overlain with broad green rays. The shell sculpture is coarse with distinct, concentric growth rings covered by numerous small pustules or bumps, particularly on the posterior or rear half of the shell. The fanshell has a porcelain white nacre (inner shell covering) often iridescent on the posterior of the shell (Watters et al. 2009).

The fanshell is found throughout the Ohio River system including the Tennessee and Cumberland rivers (Watters et al. 2009). Reproductively viable populations are now believed to inhabit only the Clinch River (Virginia) and the Green and Licking rivers (Kentucky) (USFWS 2003). In the Mid-States Corridor study area, historical fanshell records are known from Monroe, Lawrence, Martin, Dubois, Daviess, Pike, and Greene counties (IDNR 2020c).



The fanshell mussel inhabits medium to large rivers in areas of moderate current with stable gravel and sand substrates (Watters et al. 2009). It buries itself leaving only the edge of the shell and siphons exposed. Dam and reservoir construction, as well as dredging, negatively affect fanshell mussels and suitable habitats (USFWS 1997b). In mid- to late-summer, females expel glochidia into the water current via a spiral orange or pink worm-like conglutinate (packets of glochidea trailed out in the stream current and attached to the mussel by a clear strand), meant to attract a passing fish. When the fish host attacks, the larva attach to the gills, fins, or body of the fish “host” (Watters et al. 2009). Potential fish hosts include a variety of sculpins (*Cottidae*) and darters (*Percidae*) (Watters et al. 2009).

POTENTIAL FOR IMPACT

The USFWS and the Indiana Natural Heritage Data Center include multiple records of live and freshly-dead fanshell mussels throughout the East Fork Whitef River in the Mid-States Corridor study area. Based on this data, the USFWS considers the entire reach of the East Fork White River from its confluence with the White River upstream to Williams Dam in Lawrence County as potential suitable habitat for the mussel. Alternatives C, M, P, RPA P, and R would each cross the river at the existing US 231 Bridge where the fanshell has been recorded less than one mile upstream in 1990. Alternative B would cross the East Fork White River near the Pike/Dubois County line where USFWS have a freshly-dead specimen recorded within four miles downstream in 1999 and IDNR has a subfossil specimen of the fanshell recorded less than one mile upstream in 2010.

Sheepnose (*Plethobasus cyphus*)

The sheepnose was listed as endangered by the USFWS on March 13, 2012 (USFWS 2012b). On June 9, 2019, USFWS agreed to designate critical habitat for sheepnose by 2024 (The Center for Biological Diversity 2019). The species was designated as state endangered by the IDNR in the second amendment to the NRC roster listing May 1, 1992 (NRC 1992, IDNR 2020a).

USFWS: Endangered
IDNR: Endangered
Global Rank: G3
State Rank: S1

The sheepnose has a medium-sized, elongate and ovate shell which seldom exceeds 5.5 inches in length. Overall, the shell is thick and moderately inflated. Identifying characteristics of the species include a row of large tubercular knobs on the center of the valve, extending from the hinge of each valve, toward the ventral ridge (the bottom of the shell opposite the hinge), and a broad, shallow depression running posterior to the knobs (Watters et al. 2009). The exterior of the shell is yellow and waxy in younger individuals and adults are reddish-yellow to brown with dark concentric rings (USFWS 2012d). The interior of the shell is usually white but may be pinkish to cream colored (Watters et al. 2009). Sexual dimorphism is not apparent in this species (Butler 2002).

Historically, the sheepnose was considered widespread throughout the Mississippi and Ohio river drainages. Extant populations of the sheepnose are known from 14 states: Alabama, Illinois, Indiana, Iowa, Kentucky, Minnesota, Mississippi, Missouri, Ohio, Pennsylvania, Tennessee, Virginia, West Virginia, and Wisconsin (Butler 2002). The sheepnose is eliminated from two-thirds of the total number of streams where it was historically known (26 streams currently compared to 77 streams historically). In Indiana, the sheepnose occurs in the Ohio, Wabash, Tippecanoe, and Eel rivers (Butler 2002) and is considered extirpated from the White River system (Butler 2002). In the Mid-States Corridor study area, historic records of sheepnose are known from Lawrence, Martin, Perry, Spencer, and Warrick Counties (IDNR 2020c).

The sheepnose is primarily a large river species but occurs in a variety of habitats ranging from sandy mud and gravel in larger rivers to coarse sand and gravel in smaller streams (Butler 2002). The



sheepnose is tachytictic; eggs develop in June, and glochidia appear in July (Ortmann 1919). Glochidia are discharged in pink or red, narrow, oval-shaped conglomerates (Ortmann 1919). The glochidia conglomerates are expelled in an unbroken line resembling small worms to attract fish hosts. Fish hosts eat the conglomerate and become infested with glochidia that attach to the fish host gills, fins, or body. Sauger (*Sander canadensis*) is the only known host under wild conditions (Surber 1913, Wilson 1914), but in the laboratory glochidia are able to successfully develop while parasitizing multiple species of minnows (Watters et al. 2005, Wolf et al. 2012, Hove et al. 2015). Sheepnose longevity is estimated at 30 years old (Watters et al. 2009).

Habitat loss and degradation are the primary threats to this species (USFWS 2012d).

POTENTIAL FOR IMPACT

The USFWS and the Indiana Natural Heritage Data Center include multiple records for the sheepnose (live, historical, and subfossil) for the East Fork White River in eastern Martin and western Lawrence counties within the Mid-States Corridor study area. Based on this data, the USFWS considers the entire reach of the East Fork White River in Martin County to Williams Dam as potential suitable habitat for the mussel. None of the alternatives would cross this reach of the river; however, Alternative M and Local Improvement 13 would parallel the river to the north as close as 0.3 mile. Alternatives O, P, and RPA P are within one mile of the East Fork White River.

Clubshell (*Pleurobema clava*)

USFWS listed the clubshell as endangered across the entire range on January 22, 1993 (USFWS 1993). The species was designated as state endangered by the IDNR in the second amendment to the NRC roster listing May 1, 1992 (NRC 1992, IDNR 2020a).

USFWS: Endangered
IDNR: Endangered
Global Rank: G1G2
State Rank: S1

The clubshell is a small to medium sized mussel, that reaches lengths of 3 inches, but averages 1.0-1.5 inches (USFWS 1994, Watters et al. 2009). The shell is moderately thick, triangular, and becomes moderately inflated and elongated as individuals age. The periostracum, a thin organic coating or "skin" around the outermost layer of the mussel's shell, is brownish-yellow to light brown, with distinct green rays. The rays may be thick blotches or thin lines, usually interrupted at growth lines, and may disappear in older individuals (USFWS 1994, Watters et al. 2009).

Historically, clubshell are known from 10 states in the Ohio River basin: Alabama, Illinois, Indiana, Kentucky, Michigan, New York, Ohio, Pennsylvania, Tennessee, and West Virginia (USFWS 2019b). In Indiana, the clubshell is found in Fish Creek of the St. Joseph River, and the Tippecanoe River. In 2015, stock from the Allegheny River were introduced into the Eel, Tippecanoe, and Vermillion rivers (USFWS 2019b). In the Mid-States Corridor study area, historical records of clubshell are known from Monroe, Lawrence, Martin, Dubois, Crawford, Daviess, Pike, and Greene counties (IDNR 2020c).

The clubshell is found in clean, coarse sand and gravel in runs where it can burrow several inches beneath the surface, often just downstream of a riffle. The species cannot tolerate mud or slack-water conditions and is susceptible to siltation (USFWS 1994). Clubshell are tachytictic; eggs appear in May and glochidia, parasitic larva of freshwater mussels, develop in June and July and are discharged as white conglomerates (packets of glochidea trailed out in the stream current and attached to the mussel by a clear strand) (Watters et al. 2009). To survive, glochidia, when released from the female, must come in contact with a host fish. Clubshell fish hosts include the central stoneroller (*Campostoma anomalum*),



striped shiner (*Luxilus chrysocephalus*), logperch (*Percina caprodes*), and blackside darter (*Percina maculata*) (Watters et al. 2009). Adults may live up to 20 years (Watters et al. 2009).

POTENTIAL FOR IMPACT

The Indiana Natural Heritage Data Center includes scattered records for the clubshell (historical and weathered dead) throughout the East Fork White River in the Mid-States Corridor study area. Based on this data, the IDNR considers the entire Martin County reach of the East Fork White River to Williams Dam in Lawrence County as potential suitable habitat for the mussel. None of the alternatives would cross this reach of the river. However, Alternative B would cross the East Fork White River near the Pike/Dubois County line where IDNR has a historical 2010 record of the clubshell within the corridor.

Rough pigtoe (*Pleurobema plenum*)

The rough pigtoe was listed as federally endangered across the entire range in June 1976 (USFWS 1976c). The species has been designated as state endangered by the IDNR since the second amendment to the NRC roster listing May 1, 1992 (NRC 1992, IDNR 2020a).

USFWS: Endangered
IDNR: Endangered
Global Rank: G1
State Rank: S1

The rough pigtoe is a medium-sized, triangular-shaped mussel with a shell reaching lengths of 4 inches (Watters et al. 2009). Juvenile mussels may have green rays and the nacre ranges from white to light pink in color (Watters et al. 2009).

Rough pigtoe mussels were once found from Pennsylvania south to Alabama and west to Kansas (Ahlstedt 1984), but extant populations are now restricted to the Clinch, Tennessee, Green, and Barren Rivers of Kentucky and Tennessee (USFWS 2007d). Historically, the species also occurred in the Wabash River Drainage of Indiana. A single individual was captured in the East Fork White River of Martin County in 1992. The species is likely extirpated from Indiana (Fisher 2006).

The rough pigtoe occurs in large rivers with stable substrates of sand and silt (USFWS 2007d). The rough pigtoe is tachytictic; females become gravid in spring and release glochidia in late summer and fall (Ahlstedt 1984). Host fish for rough pigtoe glochidia remain unknown (Ahlstedt 1984).

POTENTIAL FOR IMPACT

The USFWS and the Indiana Natural Heritage Data Center include multiple live records for the rough pigtoe for the East Fork White River in eastern Martin and western Lawrence counties within the Mid-States Corridor study area. Based on this data, the USFWS considers the entire reach of the East Fork White River in Martin County to Williams Dam in Lawrence County as potential suitable habitat for the mussel. None of the alternatives would cross this reach of the river; however, Alternative M and Local Improvement 13 would parallel the river to the north as close as 0.3 mile. Alternatives O, P, and RPA P are within one mile of this reach of the East Fork White River.

Fat Pocketbook (*Potamilus capax*)

The fat pocketbook was listed as federally endangered on June 14, 1976 (USFWS 1976) as a result of population declines (USFWS 1989). The species was designated as state endangered by the IDNR in the second amendment to the NRC roster listing May 1, 1992 (NRC 1992, IDNR 2020a).

USFWS: Endangered
IDNR: Endangered
Global Rank: G2
State Rank: S1

The fat pocketbook mussel has a large, oval shell reaching lengths of 5.1 inches (Watters et al. 2009). Overall, the shell is thin, shiny, and extremely inflated. The exterior of the



shell is yellow to brown with wide, annular growth rings, while the interior is white with a deep beak cavity (Watters et al. 2009).

At present, fat pocketbooks are only known to survive in the lower Ohio, Wabash, and Cumberland rivers (USFWS 1997a). In Indiana, the fat pocketbook occurs in the Ohio River and Wabash River mainstems. Within the Mid-States Corridor study area, historical records of fat pocketbook are known from Dubois, Daviess, and Pike counties (IDNR 2020c).

The fat pocketbook occurs in large rivers in sand and sandy silt (Dennis and Stewart 1989) and shows a preference for backwater habitats and other flow refugia habitats (Watters et al. 2009). The fat pocketbook is bradyctytic; females become gravid throughout the late summer and fall. Fertilized eggs overwinter in the marsupium and glochidia are discharged in the spring in white conglutinates. The fat pocketbook is a host specialist on the freshwater drum (*Aplodinotus grunniens*) (Watters et al. 2009). The fat pocketbook is fast growing, and longevity is expected at only 4-5 years (Watters et al. 2009).

POTENTIAL FOR IMPACT

The USFWS and the Indiana Natural Heritage Data Center include scattered records for the fat pocketbook (live and freshly-dead) throughout the lower portion of the East Fork White River in the Mid-States Corridor study area. Based on this data, the USFWS considers the reach from the White River confluence to the Lost River confluence as suitable habitat for the mussel. Alternatives C, M, P, RPA P, and R would each cross the river at the existing US 231 Bridge. Alternative B would cross the East Fork White River near the Pike/Dubois County line where USFWS and IDNR have a 2010 freshly-dead record of the fat pocketbook within the corridor.

Rabbitsfoot (*Theliderma cylindrica*)

The rabbitsfoot (previously *Quadrula cylindrica*) was listed as federally threatened by the USFWS on September 17, 2013 (USFWS 2013a). In 2015, USFWS designated critical habitat for rabbitsfoot in 31 areas where the mussel is found, comprising approximately 1,437 river miles in Alabama, Arkansas, Indiana (Tippecanoe River in Carroll, Pulaski, Tippecanoe, and White counties), Illinois, Kansas, Kentucky, Mississippi, Missouri, Ohio, Oklahoma, Pennsylvania, and Tennessee (USFWS 2015c). The species was designated as state endangered by the IDNR in the second amendment to the NRC roster listing May 1, 1992 (NRC 1992, IDNR 2020a).

USFWS: Endangered
IDNR: Endangered
Global Rank: G3G4
State Rank: S1

The rabbitsfoot is a medium to large mussel reaching an approximate length of 5 inches. The shell is elongated and rectangular, squared-off posteriorly and rounded anteriorly, (Watters et al. 2009) and is straw-colored, light yellowish or greenish with numerous dark green streaks, chevrons, or triangular spots (Parmalee and Bogan 1998). Shells range from densely covered in pustules or bumps and irregularly ribbed to almost smooth. A line of heavy knobs extends down the posterior edge of the shell on all individuals. The interior of the rabbitsfoot shell is porcelain white with a deep, wide beak cavity (Watters et al. 2009).

Rabbitsfoot is found within the Mississippi and Ohio drainages including the Tennessee and Cumberland rivers and the western Lake Erie drainage (Watters et al. 2009) and is now extirpated from approximately 64 percent of its historical range. While declining range-wide, recruitment and population viability are consistently sustained in 11 large, extant river populations (8 percent of historical or 22 percent of extant distribution) and limited recruitment and distribution are sustained in another 17 river populations although numbers declined (USFWS 2013a). In Indiana, the rabbitsfoot is found in the Eel,



Tippecanoe, and Ohio rivers (USFWS 2009b). In the Mid-States Corridor study area, historic rabbitsfoot records are known from Monroe, Lawrence, Martin, Perry, Spencer, Daviess, Pike, and Greene counties (IDNR 2020c).

Rabbitsfoot is primarily an inhabitant of small to medium sized streams and some large rivers. The species usually occurs in shallow water areas along stream banks and adjacent runs and shoals where water velocity is reduced. Specimens sometimes occupy deep water runs and are reported in 9-12 feet of water. Preferred bottom substrates generally include gravel and sand (Parmalee and Bogan 1998). Rabbitsfoot are tachytictic and females develop eggs from June to August. Glochidia are released in August as tan to orange, narrow, oval-shaped conglutinates (Watters et al. 2009). During laboratory trials, Waters et al. (2009) observed metamorphosis of juveniles on rainbow darters (*Etheostoma caeruleum*) and striped shiners (*Luxilus chrysocephalus*). Rabbitsfoot longevity is estimated at 20 years (Watters et al. 2009).

POTENTIAL FOR IMPACT

The Indiana Natural Heritage Data Center includes multiple records of the rabbitsfoot (weathered dead, subfossil, and historical) for the East Fork White River within the Mid-States Corridor study area; however, these records represent weathered or subfossil occurrences. The USFWS considers the rabbitsfoot to only be extant within the Ohio River in the Mid-States Corridor project area and is therefore not of concern regarding impacts resulting from any of the alternatives. The IDNR identifies a short 14-mile reach of the East Fork White River in Martin County. None of the alternatives would cross this reach.

Round hickorynut (*Obovaria subrotunda*)

In recent years, the round hickorynut has suffered steep population declines and was recently listed as threatened by USFWS effective April 10, 2023 (88 FR 14794). The species was originally designated as state rare/special concern by the IDNR in the second amendment to the NRC roster listing May 1, 1992 (NRC 1992), but subsequently elevated to endangered in the sixth amendment of the NRC roster listing February 1, 2014 (NRC 2014, IDNR 2020a).

USFWS: Threatened IDNR: Endangered Global Rank: G4 State Rank: S1
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The round hickorynut mussel has a small to medium and nearly circular shell averaging 1.75 inches in length. Shells are moderately thick and compressed, exhibit broad growth rings, and fine green rays in younger individuals (Watters et al. 2009). The exterior of the shell is brown with a distinct yellowish-brown posterior, while the interior is usually white with an iridescent posterior (Watters et al. 2009).

The species occupies the Ohio, Tennessee, Mississippi, and Cumberland drainages, as well as the Lake Erie drainage including Ontario (Fisheries and Oceans Canada 2013). In Indiana, round hickorynut is found in the Eel River, Wabash River, and tributaries to the White River. In the Mid-States Corridor study area historic records of round hickorynut are known from Greene and Monroe counties (IDNR 2020c).

The round hickorynut occurs in all stream sizes and occurs in variety of habitats ranging from sandy mud to coarse gravel (Watters et al. 2009). The round hickorynut is bradytictic; eggs are fertilized by September, but glochidia overwinter in the female marsupia (Ortmann 1919, Watters et al. 2009). The round hickorynut uses darters as hosts (Fisheries and Oceans Canada 2013). Round hickorynut longevity is estimated at 12 years (Watters et al. 2009).



POTENTIAL FOR IMPACT

The Indiana Natural Heritage Data Center includes multiple records of weathered and historical specimens of the round hickorynut in the Martin and Lawrence County portions of the East Fork White River. IDNR considers multiple reaches of the river in these counties as potential habitat for the round hickorynut. None of the alternatives would cross the river in these areas; however, Alternative B would cross the East Fork White River near the Pike/Dubois County line where IDNR has a 2010 weathered dead record of the round hickorynut within the corridor.

Salamander mussel (Simpsonaias ambigua)

In recent years the salamander mussel has suffered steep population declines and is currently under review for federal listing (USFWS 2011b). The species was designated as state rare/special concern by the IDNR in the second amendment to the NRC roster listing May 1, 1992 (NRC 1992, IDNR 2020a).

USFWS: Candidate
IDNR: Special Concern
Global Rank: G3
State Rank: S2

The salamander mussel has a small, ovate shell reaching approximately 2 inches in length. The shell is thin and compressed with a dull brown exterior lacking rays or distinctive features. The interior of the shell is white with a wide, shallow beak cavity (Watters et al. 2009).

Salamander mussels occupy the Ohio and Mississippi drainages from Minnesota down to Arkansas. The species is also found in southern Ontario and the Lake Erie drainage (Roe 2003). In Indiana, the salamander mussel occurs in tributaries of the Wabash River, Tippecanoe River, Maumee River, and White River, particularly in Sugar and Graham creeks. In the Mid-States Corridor study area, historic records of salamander mussels are known from Martin, Crawford, Daviess, and Pike counties (IDNR 2020c).

The salamander mussel is found in medium to small streams almost exclusively under large boulders, also the preferred hiding places of mudpuppies (Roe 2003, Watters et al. 2009). The salamander mussel is a bradyctictic (long-term brooder); eggs are fertilized in the fall but glochidia overwinter in the female marsupia (Barnhart et al. 1998, Watters et al. 2009). The salamander mussel is only known to parasitize an aquatic salamander, the mudpuppy (*Necturus maculosus*) (Roe 2003, Watters et al. 2009). The salamander mussel has an estimated longevity of 10 years (Watters et al. 2009).

POTENTIAL FOR IMPACT

The Indiana Natural Heritage Data Center includes three live or fresh-dead records of the salamander mussel within the East Fork White River in Martin County. Based on these occurrences, IDNR has identified three short reaches of the river as potential habitat for the species. None of the alternatives would cross any portion of the East Fork White River where the salamander mussel is known to occur.

Northern riffleshell (Epioblasma rangiana)

The northern riffleshell (previously *Epioblasma torulosa rangiana*) was listed as endangered by the USFWS on January 22, 1993 (USFWS 1993). In 2015, reintroductions of northern riffleshell from Allegheny River stock occurred in the Tippecanoe and Vermilion rivers (USFWS 2019e). The species was designated as state endangered by the IDNR in the second amendment to the NRC roster listing May 1, 1992 (NRC 1992, IDNR 2020a).

USFWS: Endangered
IDNR: Endangered
Global Rank: G1
State Rank: S1

The northern riffleshell mussel has a medium-sized shell reaching approximately 2.5 inches in length. The outline is irregularly ovate and elliptical. Females are generally larger than males with a rounded posterior edge of the shell to accommodate glochidia (USFWS 2019e). The exterior of the shell ranges



from brown to tan with numerous green rays, while the interior of the shell is white, with a wide, moderately deep beak cavity (Watters et al. 2009).

Historically, the northern riffleshell occurred in Illinois, Indiana, Kentucky, Michigan, Ohio, Pennsylvania, West Virginia, and western Ontario, Canada. In Indiana, historical and/or current northern riffleshell records occur in the Maumee River, St. Mary's River, St. Joseph River, Fish Creek, Wabash River, White River, East Fork White River, Big Blue River, Flat Rock River, Conns Creek, Brandywine Creek, Vermilion River, Wildcat Creek, Tippecanoe River, Eel River, and Mississinewa River (USFWS 2019e).

The northern riffleshell occurs in medium and large streams, preferring runs with bottoms composed of firmly packed sand and fine to coarse gravel. Although apparently preferring shallow water, the species is occasionally found in water depths of 6 feet. The northern riffleshell buries itself to the posterior margin of the shell; however, females may be more exposed, especially during breeding season. Northern riffleshell are bradytictic breeders. From September to June, females display a white mantle lure to attract a host (Watters et al. 2009). When a predator bites the lure, the female closes both valves on the predator and releases glochidia into the mouth, gills, and fins of the fish. Known host fish include members of the darter (*Percidae*) and scuplin (*Cottidae*) families (Watters et al. 2009). Developed juvenile mussels drop off the host fish and may live up to 15 years (Watters et al. 2009).

POTENTIAL FOR IMPACT

The Indiana Natural Heritage Data Center includes a single weathered shell record of the northern riffleshell from the East Fork White River in Martin County. Although the species is considered federally endangered by the USFWS, the agency considers it to be extirpated from the East Fork Whiter River and therefore not a species of concern for the Mid-States Corridor study area.

Snuffbox (Epioblasma triquetra)

The USFWS listed snuffbox as endangered on February 14, 2012 (USFWS 2012a). On June 9, 2019, USFWS agreed to designate critical habitat for snuffbox by 2024 (The Center for Biological Diversity 2019). The species was designated as state endangered by the IDNR in the second amendment to the NRC roster listing May 1, 1992 (Natural Resources Commission 1992, IDNR 2020a).

USFWS: Endangered
IDNR: Endangered
Global Rank: G3
State Rank: S1

The snuffbox is a medium-sized freshwater mussel averaging 2.5 inches, with a maximum length of 2.76 inches. Females are generally smaller than males, only reaching about 1.7 inches. The shell is thick and inflated. Beaks are in the middle of the shell and turn inward over a distinct lunule (i.e., hinge cover) (Parmalee and Bogan 1998). The posterior ridge is well defined, and the posterior slope is steep and flat, with radial striations (Williams et al. 2008). Externally, the snuffbox shell is usually pale/greenish yellow with patterns of dark green areas and broken radiating rays composed of dots and dashes (Parmalee and Bogan 1998).

Snuffbox typically occur in shoal habitat with stable sand and cobble substrates. Habitat encompasses small to medium-sized streams with swift moving water, although populations have been recorded in Lake Erie and larger rivers (Roe 2002a, Watters et al. 2009). Snuffbox are often completely buried beneath substrate and collected in 2-24 inch deep water (Watters et al. 2009). The snuffbox mussel is sensitive to river impoundment, siltation, and disturbance due to its requirement for clean, swift current and relative immobility as an adult (Carman and Goforth 2004). Snuffbox are bradytictic breeders. In April and May females burrow to the surface and although no lure was observed, gape their shells to



attract a host (Watters et al. 2009). When a predator bites the snuffbox mantle, the female closes both valves on the predator and releases glochidia into the mouth, gills, and fins of the fish. Known host fish include members of the darter (*Percidae*) and scuplin (*Cottidae*) families (Watters et al. 2009). After completing the parasitic stage, snuffbox longevity is estimated at approximately 10-15 years. (Carman and Goforth 2004, Watters et al. 2009).

POTENTIAL FOR IMPACT

Snuffbox is the most widely distributed member of the genus *Epioblasma* with a historical range including the Great Lakes system and the Mississippi River system from western New York, west to Nebraska and eastern Kansas, south to northern Alabama and Mississippi. The species is now thought to persist in only 40 percent of its historical range, and is considered extinct in Iowa, Kansas, New York, and Mississippi (Roe 2002a). In Indiana, the snuffbox mussel is found in the Pigeon, Salamonie, Muscatatuck, and Tippecanoe rivers, as well as Sugar, Buck, and Graham creeks (Butler 2007, USFWS 2018) of the White River system. In the Mid-States Corridor study area, historic records of snuffbox are known from Martin, Crawford, and Greene counties (IDNR 2020c).

Ohio pigtoe (*Pleurobema cordatum*)

The Ohio pigtoe was designated as state special concern by the IDNR in the second amendment to the NRC roster listing May 1, 1992 (NRC 1992, IDNR 2020a).

IDNR: Special Concern Global Rank: G4 State Rank: S2
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The Ohio pigtoe mussel has a medium to large sized, triangular shell reaching lengths of 5.1 inches (Roe 2002b, Watters et al. 2009). Overall, the shell is thick and defined by a deep depression running through the center of the shell. The exterior of the shell is brown to black and younger individuals may display fine green rays, while the interior is usually white with an iridescent posterior and a deep beak cavity (Watters et al. 2009).

In Indiana, the Ohio pigtoe occurs in the Ohio River mainstem and its large tributaries, particularly the Wabash. Within the Mid-States Corridor study area, the Ohio pigtoe has been documented from Warrick, Spencer, Perry, Crawford, Dubois, Lawrence, Martin, Daviess, Greene, and Pike counties (IDNR 2020c).

The Ohio pigtoe occurs in large rivers of the Mississippi and Ohio drainages where moving water passes over stable sand and gravel substrate (Roe 2002b, Watters et al. 2009). Ohio pigtoe is a tachytictic breeder. Eggs appear in April, females are gravid from May through September, and glochidia are expelled in a non-elastic conglutinate (Ortmann 1919, Watters et al. 2009). Based on the taxonomic diversity of hosts, the Ohio pigtoe is assumed to be a host generalist. Known hosts include: creek chub (*Semotilus atromaculatus*), brook stickleback (*Culaea inconstans*), rosefin shiner (*Lythrurus ardens*), and bluegill (*Lepomis macrochirus*) (Roe 2002b, Watters et al. 2009). The Ohio pigtoe lives approximately 30 years (Watters et al. 2009).

POTENTIAL FOR IMPACT

The Indiana Natural Heritage Data Center includes live and fresh-dead records of the Ohio pigtoe along the East Fork White River in Daviess/Pike, Martin, and Lawrence counties. IDNR considers most of the Martin County and Martin/Dubois County reaches of the river as potential habitat for the species. This reach includes the existing US 231 Bridge location where Alternatives C, M, P, RPA P, and R would cross the river. Alternative B would cross the East Fork White River less than 5 miles upstream of a 1999 record.



Kidneyshell (*Ptychobranchnus fasciolaris*)

The kidneyshell was designated as state endangered by the IDNR in the fourth amendment to the NRC roster listing August 1, 2007 (NRC 2007, IDNR 2020a).

IDNR: Special Concern
Global Rank: G4G5
State Rank: S2

The kidneyshell mussel has a medium to large sized, elongate shell that reaches lengths of 5.1 inches (Watters et al. 2009, Fisheries and Oceans Canada 2013). Overall, the shell is thick and compressed. The exterior of the shell is yellowish-brown with distinct broken green rays (Watters et al. 2009, Fisheries and Oceans Canada 2013), and the interior is usually white with an iridescent posterior (Watters et al. 2009).

The kidneyshell occurs throughout the Ohio drainage in Alabama, Illinois, Indiana, Kentucky, Michigan, Mississippi, New York, Ohio, Pennsylvania, Tennessee, Virginia, and West Virginia. Kidneyshell is also found in southern Ontario and the Lake Erie drainage (Fisheries and Oceans Canada 2013). In Indiana, it is found in the East Fork White River and its tributaries, Tippecanoe River, Little Blue River, and St. Joseph River (Cordeiro 2009). In the Mid-States Corridor study area, historical records of kidneyshell are known from Lawrence, Dubois, Crawford, Daviess, Pike, and Greene counties (IDNR 2020c).

The kidneyshell inhabits streams of all sizes and is usually found in sand and gravel substrate (Watters et al. 2009). It typically prefers riffles in moderate to swift flowing water (Watters et al. 2009). Kidneyshell are bradyctictic; eggs are fertilized in August and are developed by September but glochidia overwinter in the female marsupia (Ortmann 1919, Watters et al. 2009). The kidneyshell is a darter (*Percidae*) host specialist and its glochidia are dispersed in packets mimicking insect larvae that infect the host fish when it consumes the packet (Watters et al. 2009, Fisheries and Oceans Canada 2013). Kidneyshell mussels may live for more than 30 years (Watters et al. 2009).

POTENTIAL FOR IMPACT

The Indiana Natural Heritage Data Center includes multiple scattered records of the kidneyshell for the East Fork White River in Daviess/Dubois, Martin, and Lawrence counties. With two exceptions, these represent weathered dead, subfossil, or historic occurrences. None of the alternatives would cross the East Fork White River where the kidneyshell has previously been reported; however, there are records of the species both upstream and downstream of the US 231 Bridge, so there is potential for the species to occur where Alternatives C, M, P, RPA P, and R would cross the river.

Purple Lilliput (*Toxolasma lividum*)

The purple lilliput is currently under review for federal listing (USFWS 2011b). The species was designated as state rare/special concern by the IDNR in the second amendment to the NRC roster listing May 1, 1992 (NRC 1992, IDNR 2020a).

IDNR: Special Concern
Global Rank: G3Q
State Rank: S2

The purple lilliput mussel has a small to medium sized, elongate oval shell that thickens in adults and reaches 4.72 inches in length. Females of the species are inflated posterior to accommodate glochidia. Externally, the shell ranges from black to tan or greenish with numerous green rays, while the interior of the shell is bright purple with a wide, shallow beak cavity (Watters et al. 2009).

The purple lilliput occupies a wide distribution in the eastern United States, inhabiting the Ohio River, White River (Arkansas), and Arkansas River drainages (Roe 2002c). It is found throughout Indiana in tributaries of the Wabash River, Ohio River, and White River (Cordeiro 2011). In the Mid-States Corridor study area, historic records of purple lilliput are known from Lawrence and Martin counties (IDNR 2020c).



Purple lilliput are typically found in stable sand and gravel beds of small to medium sized streams (Roe 2002c, Watters et al. 2009). The purple lilliput is bradyctictic and a host generalist. It exudes a white conglutinate eaten by a wide range of host fishes (Watters et al. 2009). Purple lilliput longevity is estimated at 15 years (Watters et al. 2009).

POTENTIAL FOR IMPACT

The Indiana Natural Heritage Data Center records for the purple lilliput are limited to three weathered dead occurrences on the East Fork White River in Martin County several miles upstream of the Lost River confluence. None of the alternatives would cross this reach of the river.

Little spectaclecase (*Villosa lienosa*)

The little spectaclecase was designated as state rare/special concern by the IDNR in the second amendment to the NRC roster listing May 1, 1992 (NRC 1992, IDNR 2020a).

IDNR: Special Concern Global Rank: G5 State Rank: S3
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The little spectaclecase mussel has a small- to medium-sized, elongate oval shell reaching 2.75 inches in length. Females of the species are inflated posterior to accommodate glochidia. The exterior of the shell ranges from black to yellowish-green, while the interior of the shell is usually white with a broad, shallow beak cavity (Watters et al. 2009).

The little spectaclecase has a wide distribution in the eastern United States from Texas and Georgia to northern Illinois and Ohio. In Indiana, it is found in the Middle Fork North Branch Vermillion River and tributaries to the Wabash River, East Fork White River, and Muscatatuck River. In the Mid-States Corridor study area, historic records are from Monroe, Lawrence, Martin, Orange, Crawford, Perry, and Greene counties (IDNR 2020c)

The little spectaclecase is found in small streams in sandy silt and clay (Watters et al. 2009). The little spectaclecase is assumed to be a bradyctictic breeder and host generalist, but glochidia transformation to juveniles was observed on only four fish species: brown bullhead (*Ameiurus nebulosus*), channel catfish (*Ictalurus punctatus*), bluegill (*Lepomis macrochirus*), and largemouth bass (*Micropterus salmoides*) (Ortmann 1919, Watters et al. 2009). Little spectaclecase longevity is estimated at 13 years (Watters et al. 2009).

POTENTIAL FOR IMPACT

The Indiana Natural Heritage Data Center includes sparse records of the little spectaclecase from the East Fork White River, Boggs Creek, and Lick Creek. None of the alternatives would cross the East Fork White River upstream of the Lost River confluence. However, Alternative M would cross Boggs Creek less than 5 miles downstream of the 2003 record and Alternative O would cross Lick Creek within 4 miles downstream of the 2018 record.

Snails

Hidden Springs Snail (*Fontigens cryptica*)

The hidden springs snail is not listed as endangered or threatened in the NRC roster but has been designated as an endangered species by IDNR Division of Nature Preserves (IDNR 2020a).

IDNR: Endangered Global Rank: G1 State Rank: S1

Like other members of the genus *Fontigens*, the hidden springs snail is a freshwater micromollusk (less than 0.08 inch length) associated with karst springs. To date, two



individuals have been collected alive: the type specimen from Clarke County, Indiana (Hubricht 1963) and a specimen from Bernheim Arboretum and Research Forest in Kentucky (Liu et al 2021). Both live specimens were found under large, flat rocks at the entrances of small springs (Liu et al., 2021). Thus, the species is assumed to be restricted to karst habitats near metropolitan Louisville. Dry shell material associated with this snail has also been found mixed into forest litter in several areas near Louisville, Kentucky. Difficulty locating this species have led to it being called the world’s most cryptic snail (Dillon 2019).

POTENTIAL FOR IMPACT

The single 1988 Crawford County record for the hidden springs snail from the Indiana Natural Heritage Data Center is greater than 25 miles from any of the alternatives, including local improvements, and is not within any watersheds that would potentially be affected by the project.

Springtail

Whiteside’s springtail (Pygmarhopalites whitesidei, formerly Arrhopalites whitesidei)

The Whiteside’s springtail was designated as state endangered by the IDNR in the tenth amendment to the NRC roster listing March 11, 2020 (NRC 2020, IDNR 2020a).

IDNR: Endangered
Global Rank: G?
State Rank: S1

This species was known as *Arrhopalites whitesidei* until Vargovitsh (2009) split the genus, reassigning Whiteside’s springtail to *Pygmarhopalites*. Whiteside’s springtail is unpigmented and eyeless (Jacot 1938) and considered widespread throughout the eastern United States (Lewis et al. 2003; Zeppelini et al. 2009). However, literature reports of it are rare and limited to a checklist of Indiana Collembola (Waltz and Hart 1996), one cave in Illinois, five Missouri caves (Lewis et al. 2003), one cave in Arkansas (Slay and Graening 2009), and one cave in Alabama (Peck 1995). Life history information and literature noting potential threats are lacking for this and other springtail species.

POTENTIAL FOR IMPACT

The single 2001 Lawrence County record for Whiteside’s springtail from the Indiana Natural Heritage Data Center occurs in the Bryantsville Karst Area south of the East Fork White River. None of the alternatives or associated local improvements would traverse this watershed and it is not within any watershed that would potentially be affected by the project. Alternative M is locally north of the East Fork White River and Alternative O locally drains south into the Lost River.

A cave obligate springtail (Pseudosinella aera)

This cave obligate springtail was designated as state endangered by the IDNR in the sixth amendment to the NRC roster listing February 1, 2014 (NRC 2014, IDNR 2020a).

IDNR: Endangered
Global Rank: G4
State Rank: S1

Distribution of this species is known throughout North and South America, with most occurrences confined to eastern North America (Christiansen and Culver 1987; Araujo De Lilma and Zeppelini 2015). Although rare in Indiana, localities within the Interior Plateau region of Indiana represent the northernmost distributional range (IDNR 2005; Soto-Adames and Taylor 2013). Commonly found in subterranean habitats, this species has been recorded in cliff slopes and forested hilltops in Brazil (Lima and Zeppelini 2015) and is regarded as poorly adapted to caves (Soto-Adames and Taylor 2013). Life history information and literature noting potential threats are lacking for this and



other springtail species. Potential threats would include increased human visitation in the event roads and trails are constructed near entrances.

POTENTIAL FOR IMPACT

The single 2002 Lawrence County record for this springtail from the Indiana Natural Heritage Data Center occurs in the Half Moon Lake watershed south of the East Fork White River. Surface drainage is to the East Fork White River; however, subsurface karst connections down gradient to the Lost River may be possible. None of the alternatives or associated local improvements would traverse this watershed and the species is not within any watershed that would potentially be affected by the project. Alternative M is locally north of the East Fork White River and Alternative O locally drains south into the Lost River.

Fountain Cave springtail (*Pseudosinella fonsa*)

The Fountain Cave springtail was designated as state threatened by the IDNR in the third amendment to the NRC roster listing January 1, 2005 (NRC 1992, IDNR 2020a).

IDNR: Threatened
Global Rank: G3G4
State Rank: S2

The Fountain Cave springtail is endemic to southern Indiana and one cave in southeastern Ohio (Christiansen and Bellinger 1996). This cave obligate species is rare where found and is only known from about 20 locations (Lewis 2002d, Lewis and Lewis 2008). Collection records note this species inhabiting nutrient-rich organic matter, including detritus and mammal droppings (Lewis 2002d). While Fountain Cave springtail feeding habits are not known specifically, organic matter is generally the preferred diet of springtails. As with any cave-dwelling detritivore, potential threats include alterations to groundwater quantity, quality, flow regimes, and terrestrial landscape alterations that would significantly decrease leaf-litter inputs.

POTENTIAL FOR IMPACT

The Indiana Natural Heritage Data Center includes six records of Fountain Cave springtail from three watersheds within the Mid-States Corridor study area. The Town of Bryantsville watershed would not be traversed by any of the alternatives or associated local improvements. However, the Davis Creek-Patoka River watershed in Dubois County and the French Lick Creek watershed of the Lost River in Orange County where the species has been documented would be traversed by Alternative O and Local Improvements 15, 16, and 17.

Hilly springtail (*Pseudosinella collina*)

The hilly springtail was originally designated as state endangered by the IDNR in the third amendment to the NRC roster listing February 1, 2005 (NRC 2005), but subsequently changed to rare in the sixth amendment to the NRC roster listing February 1, 2014 (NRC 2014, IDNR 2020a).

IDNR: Rare
Global Rank: GNR
State Rank: S2?

Hilly springtail is similar to a European springtail (*Pseudosinella d'uodecimpunctata*) and some earlier literature may use that nomenclature (Christiansen 1960). The species is a small springtail with a total length of approximately 1 mm and the morphology can be highly variable between sites with the number of eyes ranging from 10-12 and differing amounts of pigmentation occurring between populations (Christiansen 1960). Hilly springtail has a wide distribution in the United States in and near caves from Massachusetts south to Florida and west to Missouri (Christiansen 1960). The true distribution of most springtails in Indiana is likely unknown due to limited and inefficient sampling



(Waltz and Hart 1996). Thus, in Indiana, hilly springtail should be considered a possible resident of all karst regions of southern Indiana.

Hilly springtail is a troglophile but is also capable of surviving on the surface (Reeves 2000). As with other springtails, hilly springtail is a detritovore. Road development could affect hilly springtail by changing flow regimes within caves or by adding polluted runoff.

POTENTIAL FOR IMPACT

The Indiana Natural Heritage Data Center includes five scattered records of the hill springtail within the Mid-States Corridor study area. The Sams Creek and Log Creek-Lick Creek watersheds of the Lost River would not be traversed by any of the alternatives. However, the French Lick Creek watershed would be crossed by Alternative O and Local Improvement 17 down gradient of a 2002 record of the species from the Hoosier National Forest.

A springtail (Isotoma anglicana)

The springtail is not listed as endangered, threatened, or rare in the NRC roster listing, but has been designated as a watch list species by IDNR Division of Nature Preserves (IDNR 2020a).

IDNR: Watch List
Global Rank: G?
State Rank: S?

Distribution of *Isotoma anglicana* is unknown due to taxonomic confusion (Fjellberg 2003) as *I. anglicana* is nearly morphologically identical to *I. mackenziana*. Besides distributional patterns, these two species can only be differentiated from other closely related springtails by a skilled taxonomist using microscopic investigation of juvenile forms. It is likely any records from Indiana, or elsewhere in North America, are misidentified *I. mackenziana*. *I. mackenziana* is small, up to 0.11-0.16 inches, with long, serrated macrochaetae. Lewis and Lewis (2008) reported this species from leaf litter near the cave entrance and noted sparse collections from Indiana; however, there are no data to suggest *I. anglicana* or *I. mackenziana* are cave obligate species. Potential threats would include increased human visitation in the event roads and trails are constructed near entrances.

POTENTIAL FOR IMPACT

The single 2000 Lawrence County record for this springtail from the Indiana Natural Heritage Data Center occurs in the Town of Bryantsville watershed south of the East Fork White River. None of the alternatives or associated local improvements would traverse this watershed and it has not been documented from within any watershed that would potentially be affected by the project. Alternative M is locally north of the East Fork White River and Alternative O locally drains south into the Lost River.

A springtail (Onychiurus reluctus)

The springtail is not listed as endangered, threatened, or rare in the NRC roster listing, but has been designated as a watch list species by IDNR Division of Nature Preserves (IDNR 2020a).

IDNR: Watch List
Global Rank: G?
State Rank: S4

Pomorski et al. (2009) redescribed *O. reluctus* into four new species of *Onychiurus* described from caves. One of the new species described from Indiana, *O. relictoides*, is named from the very similar *O. reluctus*. Type specimens of *O. relictoides* originate from J.J.'s sister cave in Lawrence County. Pomorski et al. (2009) state that *O. relictoides* "is very similar to *O. reluctus* but can be distinguished both on the pseudocellar formula and the absence of truncate macrochaetae on the abdomen." *O. relictoides* is white, 0.04-0.06 inch long, and requires microscopic examination by a skilled taxonomist for accurate species identification. Like many other cave invertebrates, this species has a poorly understood life history and distribution. This statement is as true for *O. relictoides* as it is



for *O. reluctus*. It is unlikely *O. reluctus* and *O. reluctoides* are sympatric. However, it is unknown whether it is appropriate to reassign all previous *O. reluctus* records in Indiana to *O. reluctoides* or whether both species occur in the state occupying distinct geographical habitats, niches, or geographical habitats within caves. Potential threats would include increased human visitation in the event roads and trails are constructed near entrances.

POTENTIAL FOR IMPACT

The Indiana Natural Heritage Data Center includes six records of this springtail from three watersheds within the Mid-States Corridor study area. The Town of Bryantsville watershed would not be traversed by any of the alternatives or associated local improvements. However, the Sulphur Creek watershed of the Lost River in Orange County would be traversed by Alternative O near the cave where it was identified in 1994. The French Lick Creek watershed would also be crossed by Alternative O down gradient of multiple circa 2000 records of the species from the Hoosier National Forest. Local Improvements 17 and 18 are also located in the French Lick Creek and Sulphur Creek-Lost River watersheds, respectively.

A springtail (Sinella alata)

This springtail was originally designated as rare by the IDNR in the third amendment to the NRC roster listing February 1, 2005 (NRC 2005) but was subsequently removed in the sixth amendment to the NRC roster listing February 1, 2014 (NRC 2014). It has been designated as a watch list species by IDNR Division of Nature Preserves (IDNR 2020a).

IDNR: Watch List
Global Rank: G5
State Rank: S4

This insect, sometimes referred to as the Indiana cave springtail, is known only from approximately 30 caves and is endemic to Indiana’s southcentral and southeastern karst regions (Lewis 2002e). The springtail is eyeless, unpigmented, has a maximum length of about 0.09 inch, and requires a specialist to identify. Collections are associated with nutrient-rich organic matter, including detritus and mammal droppings (Lewis 2002e). Little else is known about this springtail. Potential threats would include increased human visitation in the event roads and trails are constructed near entrances.

POTENTIAL FOR IMPACT

The Indiana Natural Heritage Data Center includes multiple records of this springtail from several watersheds within the Mid-States Corridor study area. Some of these occurrences are in southeast Orange County or Crawford County and are considerable distance from the alternatives or associated local improvements. There are four records within 5 miles of the alternatives. The Town of Bryantsville and Half Moon Lake watersheds of the East Fork White River are south of the river and would not be affected by Alternative M or associated local improvements. Similarly, the Water Run-Lost River watershed south of the Lost River would not be traversed or affected by Alternative O or associated Local Improvements. The French Lick Creek watershed would be crossed by Alternative O and Local Improvement 17 down gradient of a 2002 record of the species from the Hoosier National Forest.

Cavernicolous springtail (Sinella cavernarum)

This springtail was originally designated as threatened by the IDNR in the third amendment to the NRC roster listing February 1, 2005 (NRC 2005) but was subsequently removed in the sixth amendment to the NRC roster listing February 1, 2014 (NRC 2014). It has been designated as a watch list species by IDNR Division of Nature Preserves (IDNR 2020a).

IDNR: Watch List
Global Rank: G5
State Rank: S3



This eyeless springtail reaches a length of about 0.1 inch and can be found only in caves where it inhabits nutrient-rich organic matter, including detritus and mammal droppings (Lewis 2002c). The cavernicolous springtail is white, although occasionally found with red pigment granules. Distribution is sporadic from Missouri to Pennsylvania. From north to south, distribution records extend from southcentral and southeastern Indiana karst to Tennessee (Lewis 2002c). Like many others, this species has a poorly understood life history and distribution making it challenging to surmise potential threats.

POTENTIAL FOR IMPACT

The Indiana Natural Heritage Data Center includes numerous records of this springtail from several watersheds within the Mid-States Corridor study area. There are eight records within 5 miles of the alternatives. The Town of Bryantsville and Half Moon Lake watersheds of the East Fork White River are south of the river and would not be affected by Alternative M or associated local improvements. The Mill Creek watershed of the East White River is east of SR 37 and would not be traversed by any of the alternatives or associated local improvements. The Grassy Creek-Lost River watershed is north of Alternative O but would not be traversed by the alternative or associated local improvements. The Davis Creek-Patoka River watershed would be traversed by Alternative O and Local Improvement 16 near the cave where it was identified in 2002. The French Lick Creek watershed would also be crossed by Alternative O and Local Improvement 17 down gradient of three 2000-2002 records of the species from the Hoosier National Forest.

Relict Cave Springtail (*Tomocerus missus*)

This relict cave springtail was designated as endangered by the IDNR in the third amendment to the NRC roster listing February 1, 2005 (NRC 2005) but was subsequently removed in the sixth amendment to the NRC roster listing February 1, 2014 (NRC 2014). It has been designated as a watch list species by IDNR Division of Nature Preserves (IDNR 2020a).

IDNR: Watch List Global Rank: G4 State Rank: S1

Species of the genus *Tomocerus*, including *T. missus*, have been described and recognized under the genus *Lethemurus* (Yosii 1970, Soto-Adames and Taylor 2013, Chang et al. 2016) and generally include iridescent coloration. Relict cave springtail is a cave-dwelling species and, like many species of springtail, can only be differentiated from other similar species by microscopic features.

This species is known to occur in Kentucky, Missouri, Alabama, Indiana, Virginia, Colorado, Arkansas, and Tennessee (Slay and Graening 2009; Soto-Adames and Taylor 2013; TDEC 2016). A wide distribution across unconnected cave systems suggests this springtail can migrate through protected surface leaf litter (Soto-Adames and Taylor 2013). The springtail is only known from three caves in Indiana, within the Blue River area (Lewis et al., 2003). Unfortunately, literature is remarkably void of information regarding the life history of the relict cave springtail.

POTENTIAL FOR IMPACT

The single 2002 Lawrence County record for this springtail from the Indiana Natural Heritage Data Center occurs in the Town of Bryantsville watershed south of the East Fork White River. None of the alternatives or associated local improvements would traverse this watershed and it is not known from any watershed that would potentially be affected by the project. Alternative M is locally north of the East Fork White River and Alternative O locally drains south into the Lost River.



Butterfly/Moth

Monarch butterfly (*Danaus plexippus plexippus*)

The monarch butterfly was petitioned by the Center for Biological Diversity, Center for Food Safety, Xerces Society for Invertebrate Conservation, and Dr. Lincoln Brewer to list the monarch butterfly as threatened under the Endangered Species Act on August 26, 2014. On December 17, 2020, USFWS determined the monarch butterfly warrants listing under the Endangered Species Act but is precluded by higher priority species resulting in its designation as a candidate species (USFWS 2002). The FWS maintained the monarch butterfly on its most recent candidate notification of review, 87 FR 26152 (May 3, 2022). The species is not currently afforded a state status for Indiana (IDNR 2020a).

USFWS: Candidate
IDNR: Watch List
Global Rank: G4
State Rank: S4S5B

The United States is home to three populations of monarch butterflies, two migratory and one non-migratory population. The non-migratory population resides in southern Florida and does not participate in an annual migration. The other two populations (eastern and western) participate in an annual migration from their over-wintering to breeding habitats. The smaller, western monarch butterfly population overwinters along the California coast and migrates east toward the Rocky Mountain Range to its summer breeding habitat (Jepsen et al. 2015). The much larger, eastern monarch butterfly population overwinters in mountaintops of central Mexico and migrates to its summer breeding habitat in northern United States, east of the Rocky Mountains, and southern Canada. Both eastern and western populations produce multiple generations before migrating to their overwintering habitat (Jepsen et al. 2015).

Summer breeding habitat is associated with the range of milkweeds (flowers of the *Asclepias* genus), the host plant which monarch butterflies are dependent upon for egg incubation and as a larval food source (Jepsen et al. 2015). As an adult, monarch butterflies can forage on milkweeds and any other nectar producing flower; making monarch butterflies both specialist (via reproductive host plant) and generalist (via foraging tendencies) pollinators (Jepsen et al. 2015).

Monarch butterflies have experienced mass declines in populations over the past two decades. The continued decline in monarch butterfly populations has largely been attributed to the increased use of glyphosate-based herbicides (i.e., Roundup®), neonicotinoid insecticides, chemical runoff from roadways, and the conversion of grasslands into urban and agricultural land uses (Pleasants and Oberhauser 2013, Jepsen et al. 2015)

POTENTIAL FOR IMPACT

The Indiana Natural Heritage Data Center does not currently include any records for the monarch butterfly. Similarly, the USFWS has not provided any specific distribution data for the species since it is not as yet listed under the Endangered Species Act. Because its distribution is generally synonymous with the range of the common milkweed, habitat is expected to occur throughout the Mid-States Corridor project area since this plant is often ubiquitous in right-of-ways, as well as other natural and disturbed habitats. Therefore, all the alternatives and associated local improvements are considered to have potential to affect monarch butterfly habitat.



Beetle

Monroe cave beetle (*Pseudanophthalmus shilohensis mayfieldensis*)

The Monroe cave beetle was designated as endangered by the IDNR in the third amendment to the NRC roster listing February 1, 2005 (NRC 2005, IDNR 2020a).

IDNR: Endangered
Global Rank:
G1G2T1T2
State Rank: S1S2

Monroe cave beetle is an obligate cave species whose range is restricted to the karst areas of Lawrence, Monroe, and southeast Owen counties, Indiana (Lewis and Lewis 2008). The species is found along streams, both underground and newly emerged, where it hides under stones and on mud bands (Lewis and Lewis 2008). Monroe cave beetle is one of more than 150 similar species that are distributed in karst regions throughout karst areas of the eastern United States all of which are blind scavengers of cave systems (Niemiller et al. 2017).

POTENTIAL FOR IMPACT

The Indiana Natural Heritage Data Center only includes records for the Monroe cave beetle in Monroe and Owen counties, more than 15 miles from any of the alternatives and associated local improvements. However, its previously documented occurrence from Lawrence County could be of concern for Alternative M.

Six-banded longhorn beetle (*Dryobius sexnotatus*)

This six-banded longhorn beetle was designated as threatened by the IDNR in the third amendment to the NRC roster listing February 1, 2005 (NRC 2005, IDNR 2020a).

IDNR: Threatened
Global Rank: G?
State Rank: S2

Six-banded longhorn beetles are found from southwest Pennsylvania west to northeast Kansas and south to Louisiana (Global Biodiversity Information Facility 2021a). Since 1967 the species has been recorded in the following Indiana counties: Hamilton, Wayne, Orange, and Clay (Global Biodiversity Information Facility 2021a).

Larvae of this stunning black and yellow beetle tunnel through and feed on the heartwood of maples, basswoods, beeches, and elms (Perry et al. 1974). Basswood and maple appear to be the primary hosts and larvae may feed for two to three years in a tree—even long after the tree has died. Biologists have recently described a pheromone that is used to attract other individuals, especially males attracting females for mating (Diesel et al. 2017). Use of this pheromone may provide a better means of assessing populations of this otherwise rarely detected species. Other than potentially fragmenting forest habitat, six-banded longhorn beetles are too poorly known to speculate on the potential impacts of highway development on the species.

POTENTIAL FOR IMPACT

The Indiana Natural Heritage Data Center includes two records for the Mid-States Corridor study area, excluding a southern Perry County occurrence. The Dubois County population near the East Fork White River from the Friends Creek-East Fork White River watershed would not likely be affected by any of the alternatives or associated local improvements. However, the Lawrence County population near the Lost River in the Sulphur Creek-Lost River watershed is in close proximity to Alternative O, but not near any local improvements.



Young's cave ground beetle (*Pseudanophthalmus youngi*)

Young's cave ground beetle was originally designated as endangered by the IDNR in the third amendment to the NRC roster listing February 1, 2005 (NRC 2005) but was subsequently changed to rare in the sixth amendment to the NRC roster listing February 1, 2014 (NRC 2014, IDNR 2020a).

IDNR: Rare
Global Rank: G3G4
State Rank: S2

Beetles of the genus *Pseudanophthalmus* include mainly cave-dwelling species including Young's cave ground beetle. The Young's cave ground beetle is endemic of the south-central Indiana karst region, known from 18 caves (Lewis 2002j). Worms found in cave mudbanks are generally the primary diet of beetles from this genus. This obligate cave beetle is found in riparian areas of cave streams, indiscriminately dispersed on rocky or muddy substrates. Current threats are considered limited due to the relatively stable nature of cave riparian habitats and management practices to preserve karst resources on public land within the beetle's range, including caves within the Hoosier National Forest and Spring Mill State Park in Indiana. Knowledge of the species in privately owned caves is limited due to commercial operations and gating which restricts entrance to these systems. The Young's cave ground beetle usually co-occurs with the Marengo Cave ground beetle.

POTENTIAL FOR IMPACT

The Indiana Natural Heritage Data Center includes multiple records of Young's cave ground beetle within the Mid-States Corridor study area in Lawrence, Orange, and Crawford counties. Those within 10 miles of the alternatives include populations within the South Fork Beaver Creek, Town of Bryantsville, Sheeks Lake-East Fork White River, and Mill Creek watersheds of the East Fork White River. None of these watersheds south of the East Fork White River would be traversed by Alternative M, which is located north of the river. Within the Lost River drainage, the Dry Branch-Lost River and French Lick Creek watersheds would be traversed by Alternative O and Local Improvement 17.

Rove beetle (*Atheta annexa*)

This rove beetle was originally designated as endangered by the IDNR in the third amendment to the NRC roster listing February 1, 2005 (NRC 2005) but was subsequently removed from the sixth amendment NRC roster listing February 1, 2014 (NRC 2014). It has been designated as a watch list species by IDNR Division of Nature Preserves (IDNR 2020a).

IDNR: Watch List
Global Rank: G5
State Rank: S4

The rove beetle can be distinguished from all other cave-dwelling rove beetles by the yellow-brown bicolored abdomen and long pubescence on the dorsum of head (Klimaszewski and Peck 1986). This species is widely distributed with records throughout Canada and the United States south to Florida, east to New York, and west to Wyoming (Klimaszewski et al., 2016). This species of rove beetle was described as one of the most common species of Aleocharinae collected in caves in the eastern United States (Klimaszewski and Peck 1986). Microhabitat collections associated with *A. annexa* presence within caves includes bat guano, organic debris, fungi near cave entrances, raccoon (*Procyon lotor*) dung, and woodrat (*Neotoma* sp.) nests (Klimaszewski and Peck 1986; Reeves 2000). Given the wide distribution and prevalence of the species, imminent threats are unknown at this time.

POTENTIAL FOR IMPACT

The Indiana Natural Heritage Data Center includes two records of the rove beetle within the Mid-States Corridor study area. The Lawrence County population is within the Town of Bryantsville watershed south of the East Fork White River and would not be traversed by any of the alternatives or associated local improvements. Alternative M is locally north of the East Fork White River. The Orange County



population in the French Lick Creek watershed would be crossed by Alternative O and Local Improvement 17 down gradient of the record from the Hoosier National Forest.

Marengo cave ground beetle (Pseudanophthalmus stricticollis)

The Marengo cave ground beetle was originally designated as threatened in the third amendment to the NRC roster listing February 1, 2005 (NRC 2005) but was removed in the sixth amendment NRC roster listing February 1, 2014 (NRC 2014). It has been designated as a watch list species by IDNR Division of Nature Preserves (IDNR 2020a).

IDNR: Watch List
Global Rank: G4
State Rank: S3

Beetles of the genus *Pseudanophthalmus* include mainly cave-dwelling species including the Marengo cave ground beetle. Nomenclature for the Marengo cave ground beetle has followed a confusing path, complicating conservation and status ranking efforts. The full suite of synonyms includes *Pseudanophthalmus eremita stricticollis*, *Pseudanophthalmus tenuis stricticollis*, *Pseudanophthalmus jeanneli*, *Pseudanophthalmus tenuis jeanneli*, *Pseudanophthalmus tenuis blatchleyi*, and *Pseudanophthalmus morrisoni* (Lewis 2002f). This beetle is endemic to southern Indiana, known from the western part of the Blue River basin extending into the East Fork White River drainage (Lewis 2002f). Worms found in cave mudbanks are generally the primary diet of beetles from this genus. This obligate cave beetle is found in riparian areas of cave streams, indiscriminately dispersed on rocky or muddy substrates. Current threats are considered limited due to the relatively stable nature of cave riparian habitats and management practices to preserve karst resources on public land within the beetle’s range, including caves within the Hoosier National Forest and Spring Mill State Park in Indiana. Knowledge of the species in privately owned caves is limited due to commercial operations and gating which restricts entrance to these systems.

POTENTIAL FOR IMPACT

The Indiana Natural Heritage Data Center includes numerous records of the Marengo cave ground beetle within the Mid-States Corridor study area. The East Fork White River drainage records are all from watersheds south of the river (Hendshaw Bend-East Fork White River, Town of Bryantsville, Half Moon Lake, and Mill Creek) and would not be traversed by any of the alternatives or local improvements. Two of the four Lost River drainage watersheds with Marengo cave ground beetle populations (Dry Branch-Lost River and French Lick Creek) would be traversed by Alternative O and Local Improvement 17.

Mayfly

Wallaces' deepwater mayfly (Spinadis simplex)

This Wallaces’ deepwater mayfly was designated as endangered by the IDNR in the third amendment to the NRC roster listing February 1, 2005 (NRC 2005, IDNR 2020a).

IDNR: Endangered
Global Rank: G2G4
State Rank: S2

Wallaces’ deepwater mayfly is associated with deep water rivers from Ontario south to Georgia and west to Kansas (McCafferty 2000). Wallaces’ deepwater mayfly prefers large, fast-flowing, and deep rivers where nymphs live among wood, rocks, or other hard materials located above a sandy bottom (Wisconsin Department of Natural Resources 2020). Emergence of this mayfly tends to occur in the mornings of June and July (Neuswanger 2021a).



POTENTIAL FOR IMPACT

The Indiana Natural Heritage Data Center include two records of Wallaces’ deepwater mayfly within the Mid-States Corridor study area from the Friends Creek and the Beech Creek-East Fork White River watersheds of the East Fork White River. Alternatives C, M, O, P, RPA P, R, and Local Improvement 7 would traverse the Friends Creek watershed west of the East Fork White River in Martin County but have little potential to affect this population. Similarly, Alternative M would traverse the Beech Creek-East Fork White River watershed along the northern edge and not likely affect the population located along the southern boundary of this watershed.

Lowlands spiny crawler mayfly (*Ephemerella excrucians*)

The lowlands spiny crawler mayfly is not listed as endangered, threatened, or rare in the NRC roster listing, but has been designated as a watch list species by IDNR Division of Nature Preserves (IDNR 2020a).

IDNR: Watch List
Global Rank: G5
State Rank: S3

The lowlands spiny crawler mayfly is found throughout North America north of Mexico, although the only record in Indiana since 1937 was obtained near where SR 57 crosses the East Fork White River (Global Biodiversity Information Facility 2021b), updated molecular techniques including the use of eDNA may allow more detailed assessments to occur (Wilcox et al 2018).

Little information is available about the lowlands spiny crawler mayfly in the technical literature, although summary information is available (Neuswanger 2021b). Lowlands spiny crawlers are associated with stream riffles where vast numbers of nymphs may occur under and around rocks. The species is considered one of the most important foods of trout in the western United States due to the wide range of the species and emergence events that can be prolonged over multiple weeks, occur in both spring and fall, and produce many individuals. Large, prolonged emergences are primarily western phenomena, as eastern emergences, including those in Indiana, tend to be shorter and less intense.

POTENTIAL FOR IMPACT

The single 1974 record of the lowland spiny crawler mayfly within the Mid-States Corridor study area is along the East Fork White River within the Friends Creek-East Fork White River watershed in Martin County. Alternatives C, M, O, P, RPA P, R, and Local Improvement 7 would traverse the Friends Creek watershed west of the East Fork White River in Martin County but have little potential to affect this population.

Millipede

Bollman’s cave millipede (*Conotyia bollmani*)

Bollman’s cave millipede is not listed as endangered, threatened, or rare in the NRC roster listing, but has been designated as a watch list species by IDNR Division of Nature Preserves (IDNR 2020a).

IDNR: Watch List
Global Rank: G5
State Rank: S3

This species reaches 0.5 inch, has triangular eyes with 20-22 ocelli (Lewis 2002a), and is generally unpigmented when found in cave environments (Shear 1971). Although there are unlikely to be sympatric millipedes of similar description within the range, they can only be differentiated from other similar species by microscopic features (Lewis 2002a).

While little is known specifically about this species, the diet of a millipede of the same genera consists of wood and fungal particles (Shear 1971). The Bollman’s cave millipede inhabits moist areas and is known primarily from caves including riparian cave areas, on or near woody debris, detritus, or underneath



rocky substrate (Lewis 2002a, Shear 1971). This millipede is endemic to south-central Indiana including Orange, Martin, Lawrence, Monroe, and Owen counties (Shear 1971). Lewis (2002a) reports the ubiquitous presence of this species from caves in the East Fork White River drainage and absence from caves in the Blue River drainage. At present, the exotic invasive millipede *Oxidus gracilis* is the biggest threat to native millipede populations (Lewis 2002a).

POTENTIAL FOR IMPACT

The Indiana Natural Heritage Data Center includes numerous records of Bollman’s cave millipede from the karst watersheds in eastern Dubois, Lawrence, and Orange counties. The Henshaw Bend, Town of Bryantsville, South Fork Beaver Creek, and Half Moon Lake watersheds south of the East Fork White River would not be traversed by any of the alternatives or associated local improvements. Two of the three Lost River drainage watersheds (Dry Branch-Lost River and French Lick Creek) which support several populations would be crossed by Alternative O and Local Improvement 17.

Crayfish/Amphipod

A troglobitic crayfish (Orconectes inermis testii)

This troglobitic crayfish is not listed as endangered, threatened, or rare in the NRC roster listing but has been designated as rare by IDNR Division of Nature Preserves (IDNR 2020a).

IDNR: Rare
Global Rank: G5T3
State Rank: S3

The Hoosier cave crayfish, a subspecies of northern cave crayfish (*Oconectes inermis*), is a cave obligate associated with Mississippian limestone. This subspecies exists in a relatively small area, predominately Monroe County, near Bloomington (Hobbs III 1975, Simon 2001). This species shares an intergrading population with the Indiana cave crayfish (*Orconectes inermis inermis*) within Shiloh Cave (Hobbs and Barr 1972). The species is also stream obligate and is found primarily within stream pools and areas of low flow with mud or silt substrates and along stream banks (Hobbs and Barr 1972, Hobbs, III 1981, Lewis 2002g). The crayfish can persist in areas where water levels just barely submerge individuals and in stagnant areas (Lewis 2002g). Hoosier cave crayfish have demonstrated overlapping home ranges within approximately 35 feet of stream reach (Hobbs, III 1981, Lewis 2002g).

The crayfish is easily distinguishable from its habitat due to a lack of pigmentation, resulting in a white appearance, and is distinguishable from its conspecific species due to its lack of spines on the carapace and rostrum (i.e., smoother appearance) (Hay 1891). Individuals are rarely greater than 2 inches in length (Lewis 2002g). Hobbs, III’s (1981) mark and recapture study in Mayfield’s Cave estimates densities of over 66 individuals in a 984-foot-long stream passage.

POTENTIAL FOR IMPACT

With the exception of a single record in southeastern Lawrence County, all of the occurrences of this crayfish are from Monroe and Greene counties within the Mid-States Corridor study area. The 2006 Lawrence County record is from the Rock Lick Branch-East Fork White River watershed and would not be traversed by any of the alternatives or associated local improvements.

A troglobitic crayfish (Orconectes inermis inermis)

This troglobitic crayfish is not listed as endangered, threatened, or rare in the NRC roster listing, but has been designated as a watch list species by IDNR Division of Nature Preserves (IDNR 2020a).

IDNR: Watch List
Global Rank: G5T4
State Rank: S3



The Indiana cave crayfish, a subspecies of northern cave crayfish, is a cave obligate associated with Mississippian limestone and ranges from the intergrading population with Hoosier cave crayfish near Bloomington in the north down to, but not in, the Mammoth Cave system (Kentucky) in the south (Hobbs, III 1975). The species is a stream obligate with overlapping home ranges of approximately 66 feet of stream reach and may be found on the banks very near the stream (Hobbs, III 1978, Lewis 2002g). This species is commonly found in pools and areas of low flow with mud or silt substrates (Hobbs and Barr 1972, Hobbs, III 1978). The crayfish can persist in areas where water levels just barely submerge individuals and in stagnant areas (USDA 2002).

The crayfish is easily distinguishable from its habitat due to a lack of pigmentation, resulting in a white appearance, and is distinguishable from its conspecific species by the spines on the carapace and rostrum (i.e., rougher appearance) (Hay 1891). Individuals are rarely greater than 2 inches in length (USDA 2002). Hobbs, III's (1978) mark and recapture study in Pless' Cave estimates densities of one crayfish per 1.1 foot of stream passage but indicates this value is highly variable (e.g., gradient, substrates, and food supply). The same study indicates the highest population densities are observed in areas of low flow with mud/silt/sand substrates with excessive organic detritus (food).

POTENTIAL FOR IMPACT

The Indiana Natural Heritage Data Center includes numerous records for this crayfish that extend through Lawrence and Orange counties south into Crawford and Harrison counties. Two of the eight watersheds in the East Fork White River drainage (Crooked Creek-East Fork White River and Goose Creek-Salt Creek) that support populations of this species would be traversed by Alternative M and Local Improvement 14. Similarly, two of the six watersheds in the Lost River drainage (Sulphur Creek-Lost River and Dry Branch-Lost River) that support populations would be traversed by Alternative O.

Indiana cave amphipod (*Crangonyx indianensis*)

The Indiana cave amphipod is not listed as endangered, threatened, or rare in the NRC roster listing, but has been designated as a watch list species by IDNR Division of Nature Preserves (IDNR 2020a).

IDNR: Watch List Global Rank: G3 State Rank: S3

Indiana cave amphipod was redescribed from *C. gracilis* as a new species in 1997 by Zhang and is endemic to the southern karst region of Indiana. The species range from 0.4-0.8 inch long, is not considered troglomorphic, has well-developed and distinctly pigmented eyes, and body coloration is light gray to pale yellow (Zhang 1997). Indiana cave amphipod is a cave-associated species that is found in springs, underground pools, and underground streams from Indiana to Kansas (Zhang and Holsinger 2003, Lewis and Lewis 2008). Like other members of the genus *Crangonyx*, Indiana cave amphipod is likely a consumer of detritus, especially dead leaf material, and microfauna dependent upon detritus (Wellborn et al 2015). Collections of this amphipod in surface springs and under rocks in shallow cave streams indicate it is susceptible to changes in flow regimes, including increased sedimentation and interstitial filling of benthic habitats.

POTENTIAL FOR IMPACT

Excluding records in Monroe and Greene counties, the Indiana Natural Heritage Data Center includes a single 2006 record of the Indiana cave amphipod from Lawrence County within the Mid-States Corridor study area. This occurrence is east of SR 37 in the Rock Lick Branch-East Fork White River watershed and would not be traversed by any of the alternatives or associated local improvements.



Packard's cave amphipod (*Crangonyx packardii*)

The Packard's cave amphipod is not listed as endangered, threatened, or rare in the NRC roster listing but has been designated as a watch list species by IDNR Division of Nature Preserves (IDNR 2020a).

IDNR: Watch List
Global Rank: G3
State Rank: S3

A non-exhaustive list of synonyms for this species includes *C. gracilis packardii* and *Eucrangonyx packardii*. Zhang (1997) noted several undescribed species misidentified as *C. packardii* and commented that "earlier references to literally all *Crangonyx* from caves in the Interior Low Plateaus region" were referenced as *C. packardii*. Identification requires laboratory dissection and examination under a compound microscope by a specialist in amphipod taxonomy (Lewis 2002i). This amphipod inhabits caves, springs, seeps, and wells (Zhang 1997). This species prefers interstitial stream gravel within caves, making it easy to overlook using many common sampling techniques. Dispersal through deep karst groundwater conduits, shallow epikarst groundwater, and hyporheic zones afford this species a wide range (Lewis 2002i). Distribution includes southern Indiana through Kentucky and west to eastern Kansas (Lewis 2002i).

In Indiana, populations have been extirpated from known spring and cave locations due to environmental contamination and habitat destruction, including domestic waste contamination, confined animal feeding operation runoff, pesticides, and solid waste (Lewis 2002i). Herbicides, fertilizers, and road runoff, including accidental hazardous spills or intentional applications such as road salt, also pose potential threats. However, sedimentation from surface runoff and groundwater alterations can be widespread and often insidious, posing the greatest threats to a species whose niche is confined within the hyporheic zone. Altered flow regime and sediment transport capacity can result in fine sediments filling interstitial zones limiting Packard's cave amphipod available habitat. Lewis (2002i) provides an extensive synopsis of potential threats to the species.

POTENTIAL FOR IMPACT

The Indiana Natural Heritage Data Center includes numerous records for Packard's cave amphipod throughout southern Lawrence and Orange counties within the Mid-States Corridor study area. Alternative M would not traverse the headwaters portion of the Crooked Creek-East Fork White River watershed, which supports a population of the amphipod. Alternative O would cross two of the five Lost River drainage watersheds where the species has been documented, namely Dry Branch-Lost River and French Lick Creek. The Dry Branch-Lost River would be of particular concern based on the number and distribution of records within this watershed.

Ostracods

Jeannel's cave ostracod (*Pseudocandona jeanneli*)

Jeannel's cave ostracod is not listed as endangered, threatened, or rare in the NRC roster listing but has been designated as endangered by IDNR Division of Nature Preserves (IDNR 2020a).

IDNR: Endangered
Global Rank: G2
State Rank: S1

Microcrustaceans such as *P. jeanneli* are easy to, and often are, overlooked in cave bio-inventories. The ostracod was initially discovered in Marengo Cave, Crawford County, and then remained unreported until it was inadvertently discovered sixty years later in Wyandotte Cave, Crawford County (Lewis and Lewis 2009). Using plankton sampling methods and equipment, subsequent targeting and intensive sampling has led to additional discoveries, including one cave within the non-karst, Central Lowland region in northern Indiana (White County). Other occurrences in Indiana's



southern karst region were recorded from caves in Monroe, Orange, Washington, Lawrence, and Crawford counties and a handful of caves along the Cumberland escarpment, including one in Pulaski County, Kentucky, and six along the southern border of Tennessee. Despite the range expansion, the species is still not considered common throughout its range and the ostracod is only known from 18 localities. The rarity of the species could be an artifact of sampling inefficiency and due to the species' transience in groundwater; thus, the species is likely to be discovered at additional sites with targeted, refined sampling efforts. Although little is known about the natural history of this species, many ostracods are known to be highly sensitive to environmental changes and serve as bioindicators for anthropogenic impacts, including metals pollution from various runoff sources and motor vehicle emissions (Shuhaimi-Othman et al., 2011; Ruiz et al., 2013).

POTENTIAL FOR IMPACT

The Indiana Natural Heritage Data Center includes scattered records of Jeannel's cave ostracod in Lawrence and Orange counties within the Mid-States Corridor study area. Crawford County records are in the far eastern portion of the county and far removed from the alternatives and associated local improvements. The Lawrence County occurrence is within the Half Moon Lake watershed of the East Fork White River drainage and would not be traversed by any of the alternatives or associated local improvements. The Orange County occurrence is from the French Lick Creek watershed, which would be crossed by Alternative O and Local Improvement 17 south of the Lost River.

Barr's commensal cave ostracod (Sagittocythere barri)

Barr's commensal cave ostracod is not listed as endangered, threatened, or rare in the NRC roster listing but has been designated as a watch list species by IDNR Division of Nature Preserves (IDNR 2020a).

IDNR: Watch List Global Rank: G5 State Rank: S3S4

Barr's ostracod is a commensal parasite commonly associated with two cave-obligate crayfishes, Indiana and Hoosier crayfishes, and less commonly with the cavespring crayfish (*Cambarus tenebrosus* [= *C. laevis*]) in Indiana (Hobbs, III 1975). Within Indiana, this ostracod is restricted to Mississippian limestones ranging from the Kentucky border to just north of Bloomington and is known from 22 caves (Hobbs III 1975). Additionally, the species is also known from Alabama, Kentucky, and Tennessee (Hobbs III 1975).

This ostracod was originally described as a parasite and haemophage but research by Hobbs III et al. (1967) revealed the commensal relationship with crayfishes. Barr's ostracod, like other ostracods, feed on fine particulate organic matter on the crayfish's exoskeleton and are limited to regions of the crayfish where attachment structures are present (i.e., setae and grooves) (Hobbs III et al. 1967). Infection rates averaged approximately 19 ostracods per *Orconectes inermis* crayfish and approximately 26 ostracods per cavespring crayfish (Hobbs III 1975).

POTENTIAL FOR IMPACT

The Indiana Natural Heritage Data Center includes scattered records of Barr's commensal cave ostracod through Greene, Monroe, Lawrence, and Orange counties within the Mid-States Corridor study area. Alternative M would traverse one of the four watersheds that support populations within the East Fork White River drainage, namely the Goose Creek-Salt Creek watershed at Bedford. Conversely, Alternative O or any associated local improvements would not traverse either of the Lost River drainage watersheds (Log Creek-Lick Creek and Mill Creek) or the Fudge Creek-Patoka River watershed in Orange County.



Arachnids

Indiana cave pseudoscorpian (*Apochthonius indianensis*)

The Indiana cave pseudoscorpian was designated as endangered by the IDNR in the eleventh amendment to the NRC roster listing November 25, 2020 (NRC 2020, IDNR 2020a).

IDNR: Endangered
Global Rank: G1G2
State Rank: S1

Muchmore (1967) originally described *A. indianensis* as a cavernicolous species with slightly reduced eyes and total length of 0.07 inch. The species can only be distinguished from its closest relatives by microscopic inspection. Indiana cave pseudoscorpian is known only from two caves in Lawrence County (Muchmore 1994). Little is known about the life history of *A. indianensis*, but like other cave-dwelling pseudoscorpions, this species feeds on other cave-dwelling arthropods and insects. One can infer potential threats to the Indiana cave pseudoscorpian from threats that led to the federal listing of the endangered Tooth Cave pseudoscorpion (*Tartarocreagris texana*). Primary threats included development activities with the potential to alter groundwater infiltration and runoff contaminated with sediment, pesticides, and fertilizers (USFWS 1988). Increased human visitation and the increased likelihood of foot traffic and trampling are significant threats relevant to all cave invertebrates. Olson (2013) contributes the widening of SR 37 near Bedford, and the associated engineered runoff and human visitation as the direct causes of significant habitat destruction to the Doghill-Donahue Cave System, one of the two known locations of *A. indianensis*.

POTENTIAL FOR IMPACT

The Indiana Natural Heritage Data Center shows that all known records of the Indiana cave pseudoscorpion for the state are within the Mid-States Corridor study area in Lawrence and Orange counties. Alternative M would traverse the upper headwater portion of the Crooked Creek-East Fork White River, but not the Town of Bryantsville or the Mill Creek watersheds of the East Fork White River. The Dry Branch-Lost River watershed would be traversed by Alternative O north of the Lost River.

Appalachian cave spider (*Porrhomma cavernicola*)

The Appalachian cave spider was designated as endangered by the IDNR in the eleventh amendment to the NRC roster listing November 25, 2020 (NRC 2020, IDNR 2020a).

IDNR: Endangered
Global Rank: G5
State Rank: S2

The Appalachian cave spider is a true troglobite, completing its entire life cycle in caves. (Miller 2005). Nomenclature for this species has changed several times, with synonyms including: *Willibaldia cavernicola*, *Linyphia incerta*, *Troglohyphantes cavernicola*, *Porrhomma emertoni*, and *Porrhomma caverniculum* (Lewis 2002b). Miller (2005) most recently redescribed this widespread species and noted records mostly condensed to the Ridge and Valley ecoregion from Maryland south to Georgia with sporadic records in Indiana, Kentucky, and Missouri. It is rarely encountered in Indiana and is known only from caves within the East Fork White River drainage (Lewis 2002b). This spider reaches approximately 0.08 inch and is described as having an orange cephalothorax, white abdomen, and small colorless eyes with the middle pair sometimes absent (Lewis 2002b). The Appalachian cave spider is often found on decaying organic matter, such as woody and leafy debris. Although feeding habits for this species are unknown, spiders from this family construct horizontal sheet webs with vertical trip lines to trap insects and can survive for months without feeding (Lewis 2002b). Potential threats would include increased human visitation in the event roads and trails are constructed near entrances.



POTENTIAL FOR IMPACT

The Indiana Natural Heritage Data Center indicates that the majority of the known records of the Appalachian cave spider for the state are within the Mid-States Corridor study area in Lawrence and Orange counties. Neither the Town of Bryantsville nor Mill Creek watersheds of the East Fork White River drainage which support populations of this species would be traversed by Alternative M or any associated local improvements. However, the Dry Branch-Lost River watershed would be traversed by Alternative O north of the Lost River.

Flatworm

Weingartner's cave flatworm (*Sphalloplana weingartneri*)

Weingartner's cave flatworm is not listed as endangered, threatened, or rare in the NRC roster listing, but has been designated as a watch list species by IDNR Division of Nature Preserves (IDNR 2020a).

IDNR: Watch List
Global Rank: G4
State Rank: S3

The flatworm is blind, unpigmented, semi-transparent, with white specks endemic to southern Indiana (Kenk 1970). In describing the species first detected in Bronson's Cave, Spring Mill State Park (Lawrence County), Kenk (1970) mentions that most troglobitic planarians are confined to individual cave systems. Another record from adjacent Monroe County, within pool habitat, was reported by Lewis and Lewis (2008). The single specimen collected in Bronson's Cave that served as Kenk's (1970) holotype was 0.2 inch long and found alongside the flatworm *Phagocata gracilis*. Identification requires anatomical examination under a microscope by a specialist familiar with planarian taxonomy.

POTENTIAL FOR IMPACT

The Indiana Natural Heritage Data Center includes numerous records of Weingartner's cave flatworm within the karst regions of Martin, Lawrence, and Orange counties in the Mid-States Corridor study area. None of the five East Fork White River drainage watersheds (Henshaw Bend-East Fork White River, Town of Bryantsville, Half Moon Lake, Rock Lick Branch-East Fork White River, and Mill Creek) known to support populations of this species would be traversed by Alternative M or any associated local improvements. However, Alternative O and Local Improvement 17 would traverse two of the five Lost River drainage watersheds (French Lick Creek and Dry Branch-Lost River) that support populations of this species.

Plants

Bradley's spleenwort (*Asplenium bradleyi*)

Bradley's spleenwort was designated as state endangered by the IDNR in the initial NRC roster listing February 1, 1992 (NRC 1992, IDNR 2020b).

IDNR: Endangered
Global Rank: G4
State Rank: S1

Bradley's spleenwort is a member of the *Aspleniaceae* (spleenwort) family resulting from a cross between the mountain spleenwort (*Asplenium montanum*) and the ebony spleenwort (*Asplenium platyneuron*). This evergreen perennial fern is typically found growing in acidic humus (weathered sandstone residuum and organic decomposing plant material) in crevices exposed to the sun or in partially shaded areas of overhanging sandstone and granite cliffs but is lacking in limestone-based cliff areas (Barnes and Frances 2004, Hill 2003, Wherry 1995). These areas are typically dry but remain moist to wet during the winter and spring reproductive period (Hill 2003). It is considered as a component species of the Chert Ozark Dry Cliff Sparse



Vegetation, Sandstone Dry Cliff Sparse Vegetation, and the Sandstone Midwest Moist Cliff Sparse Vegetation plant associations (Faber-Langendoen 2001).

Reproduction is via spore dispersal that develop into gametophytes upon which eggs are fertilized by sperm if suitable moist conditions are present (Hill 2003). Following successful fertilization, sporophytes (the common fern form of the plant) take root in a crevice where a root mass develops to secure the plant. In some instances, gametophyte eggs of Bradley's spleenwort can become fertilized by sperm from other adjacent spleenworts, giving rise to various sterile hybrids (Hill 2003). The reproductive potential of Bradley's fern is considered low due to the specific and narrow tolerances of conditions required for new plants to become established. Because limited microhabitat is typically present, an individual plant may only yield a single successful offspring within its lifetime (Hill 2003). Under prolonged dry, hot, or cold periods, this fern can remain dormant for long periods (Hill 2003). Bradley's spleenwort has a coefficient of conservatism value of 10 (Rothrock 2004) indicating that the species is restricted to remnant landscapes that appear to have suffered very little post-settlement trauma.

Because of the unique tight crevice habitat for this fern and its low tolerance of competition with vascular plants, there are usually no other plant associates, and it is typically only found with other spleenwort ferns, lichen, and moss accumulations (Hill 2003). Limiting factors for sustainability and expansion of the species include suitable bedrock substrate, nutrients from soil, extent of shading from forest canopy and vine encroachment, moisture availability during dry periods, and extreme temperatures (Hill 2003).

Bradley's spleenwort has a spotty distribution through 18 states in the Midwest, southeast, and northeast United States (Hill 2003). Bradley's spleenwort is limited to the Shawnee Hills and plateau of south-central Indiana and is only known from two locations in Dubois and Crawford counties on Hoosier National Forest and Harrison Crawford State Forest properties. The sandstone overhang and sandstone cliff habitats where Bradley's spleenwort is found are considered high quality habitats and targeted for protection in Indiana. Potential threats to the species include quarrying or strip mining of its habitat, pollutants and herbicides used in the uplands atop the bluffs and cliffs, clearing of vegetation on the bluffs above the plants reducing available nutrients, densely closed canopy cover and heavy growth of vines on the rock faces resulting in too much shade, prolonged drought, recreational disturbance from hikers on trails and rock climbers, and over-collecting (Hill 2003).

POTENTIAL FOR IMPACT

The single known population of Bradley's spleenwort in Dubois County from 1984 is greater than one mile, but less than two miles from Alternative O, and just under one mile from Local Improvement 16 in the Davis Creek-Patoka River watershed.

Virginia willow (Itea virginica)

Virginia willow was designated as endangered by the IDNR in the second amendment to the NRC roster listing May 1, 1992 (NRC 1992, IDNR 2020b).

IDNR: Endangered Global Rank: G4 State Rank: S1

Virginia willow is a member of the *Iteaceae* (sweetspire) family and is the only *Itea* species known in North America (Morin 2020). This small to medium-sized shrub is an obligate wetland species of wet woods and swamps (Kurz 2009), specifically bald-cypress and red maple-black gum swamps in Kentucky (Jones 2005), along stream beds and in floodplains where it can form thickets (Conner 2004a). In Indiana, plant associates include sweet gum, swamp chestnut oak, black gum, crossvine, green arrow arum, and giant sedge (Homoya 1982). It is



tolerant of shade conditions but proliferates in full sun (Conner 2004a). Thickets provide cover for wildlife, a food source for birds and butterflies, and erosion control on slopes and wet locations (Conner 2004a). Virginia willow is considered as a component species of several Midwest plant associations (Faber-Langendoen 2001). Those associations noted for Indiana include: Woolgrass Bulrush – Tall Flat Panicgrass – Short-bristle Horned Beaksedge – Threeway Sedge Herbaceous Vegetation, Buttonbush / Eastern Rose-mallow Shrubland, Swamp-loosestrife Seasonally Flooded Shrubland, Red Maple - Water Locust Planetree – Pumpkin Ash Forest, and Bald-cypress – Water Tupelo / Swamp-privet – Planetree Forest, (Faber-Langendoen 2001).

Virginia willow distribution includes all of southeastern United States from Florida to Texas, the Atlantic coast north to New Jersey and Pennsylvania, and the Midwest into southern Missouri, Illinois, and Indiana (USDA-NRCS 2021). Southern Indiana (Pike, Dubois, and Harrison counties) represents the northern extent of its range in the Midwest. Virginia willow has a coefficient of conservatism value of 10 (Rothrock 2004) indicating that the species is restricted to remnant landscapes that appear to have suffered very little post-settlement trauma.

Henry's Garnet is the most popular of the many cultivars of this species used in horticultural landscape plantings (Russ and Williamson 2019) because of its attractive fall red foliage (Conner 2004a).

POTENTIAL FOR IMPACT

Of the five populations included in the Natural Heritage Data Center system, two are located in Dubois County, near a seep spring southwest of Haysville and in a lowland forest at Buffalo Flat (Homoya 1982). The Haysville site is less than two miles from Alternative C and less than 1.5 miles from Local Improvement 5. The Buffalo Flat site is approximately one mile from Alternatives C, M, O, P, RPA P, and R, and less than one mile from Local Improvement 4.

American frog's-bit (*Limnobium spongia*)

American frog's-bit was designated as endangered by the IDNR in the third amendment to the NRC roster listing January 1, 2005 (NRC 2005, IDNR 2020b).

IDNR: Endangered Global Rank: G4 State Rank: S1

American frog's-bit is a member of the *Hydrocharitaceae* (tape-grass or frog's-bit) family and is the only *Limnobium* species known in North America (Haynes 2020). This true aquatic plant has floating and emersed leaves and inhabits shoreline areas of streams, bayous, and lakes with slow-moving water (Haynes 2020). It is considered as a component species of the Bald-Cypress / Lesser Duckweed Forest plant association (Faber-Langendoen 2001). The spongy floating leaves can form thick mats on the water surface causing problems for boats, fish, and water infrastructure (California Invasive Plant Council [no date]). American frog-bit seeds serve as valuable food source for aquatic fowl, including green wing teal, pintail ducks, mallards, golden-eye ducks, old squaw ducks, ringneck ducks, and wood ducks (Les and Capers 1999).

Its range includes the Atlantic coastal plain south of New Jersey and the Mississippi drainage as far north as southern Illinois; however, a disjunct population reported from northern Indiana in Lake County has never been substantiated (Catling and Dore 1982). Although the species is native to North America, it can display aggressive growth becoming a nuisance within its southern range (Les and Capers 1999) and is considered invasive in the Early Detection and Distribution Mapping System (EDDMapS) (Swearingen and Barger 2016). American frog's-bit has a coefficient of conservatism value of 10 (Rothrock 2004) indicating that the species is restricted to remnant landscapes that appear to have suffered very little post-settlement trauma.



POTENTIAL FOR IMPACT

The only confirmed occurrence of the species in Indiana is from a 2020 record at the Buffalo Pond Nature Preserve in Dubois County and represents one of the furthest northern records in the Midwest. It is unknown if this represents a stable reproducing population, or an occasional occurrence introduced by waterfowl. Although this extreme northern occurrence of the species makes it rare in Indiana, it is quite common in select areas throughout the southern portion of its range. The Buffalo Pond Nature Preserve record is less than one mile west of Alternatives C, M, O, P, RPA P, and R, and approximately one mile east of Local Improvement 4.

Cup-seed (Calycocarpum lyonii)

Cup seed was designated as state threatened by the IDNR in the initial NRC roster listing February 1, 1992 (NRC 1992, IDNR 2020b).

IDNR: Threatened Global Rank: G5 State Rank: S1S2

Cup-seed is a climbing perennial vine of the *Menispermaceae* (moonseed) family. It ranges throughout southeastern United States as far west as Oklahoma and Nebraska, and as far north as Illinois and Indiana. Cup-seed typically occurs in deciduous forest habitats along the banks of rivers, small streams, low woods, and swampy areas (Rhodes 2020, USDA [no date]). Cup-seed has a coefficient of conservatism value of 7 (Rothrock 2004) indicating that the species occurs in high-quality remnant plant communities that appear to endure some disturbance from time to time.

POTENTIAL FOR IMPACT

Because southern Indiana represents the northern extent of the cup-seed range, Indiana records are limited to locations along the Ohio River and Wabash River in Perry, Spencer, Posey, and Gibson counties. Excluding Section 1 south of I-64, there are no known occurrences of cup-seed elsewhere within the Mid-States Corridor study area.

White thoroughwort (Eupatorium album)

White thoroughwort was originally designated as state endangered by the IDNR in the second amendment to the NRC roster listing May 1, 1992 (NRC 1992) but was subsequently designated state threatened by the IDNR in the third amendment to the NRC roster listing January 1, 2005 (NRC 2005, IDNR 2020b).

IDNR: Threatened Global Rank: G5 State Rank: S3

White thoroughwort is a perennial forb of the *Asteraceae* (aster) family. It ranges throughout the southeastern United States along the Atlantic coast to New York, southwest to eastern Texas, and as far north at southern Indiana and Ohio. Habitat is typically dry woodlands but has also been found in roadside and powerline corridors. In the south where it is more frequent, it occurs in open to semi-shaded landscapes such as sandhills, longleaf-pine savannas, evergreen scrub oak sand ridges, pine flatwoods, old fields, flatwoods, hammocks, seepage slopes, pine-palmetto flatwoods, and longleaf pinelands (Coastal Plain Plants [no date]). White thoroughwort has a coefficient of conservatism value of 4 (Rothrock 2004) indicating that the species is typically associated with remnant plant communities but tolerates significant to moderate disturbances.

POTENTIAL FOR IMPACT

White thoroughwort is largely known from Ohio River border counties of Perry and Harrison; however, there are occurrences of the species from the hilly woodland habitat of Orange County documented within the last 25 years. The 1991 occurrence of the species within remnant barrens and old fields in



Perry County is considered a range extension into Indiana from known populations in Hardin County, Kentucky (Homoya et al. 1995). The Orange County records are more than four miles to the northwest of Alternative O and associated local improvements.

Featherfoil (*Hottonia inflata*)

Featherfoil was designated as state threatened by the IDNR in the second amendment to the NRC roster listing May 1, 1992 (NRC 1992, IDNR 2020b).

IDNR: Threatened Global Rank: G4 State Rank: S2

Featherfoil is an annual obligate aquatic forb of the *Primulaceae* (primrose family) with a submerged stem and roots that eventually weaken and break, leaving the plant to free-float on the surface of still or slow-moving waters (Hill 2007). It is found in shallow pools, ditches, canals, swamps, ponds, bayous, sloughs, lakes, and sinkhole ponds (Hill 2007, USDA-USFS [no date]). Beaver ponds are a particularly favorable habitat for featherfoil (Hill 2007, USDA-USFS [no date]). In Indiana, it occurs most commonly in bald cypress-swamp cottonwood forest communities.

Unlike many herbaceous plants, featherfoil germinates in the fall/winter within mud covered by shallow water and forms inflated flower stalks in the spring when waters warm up (Hill 2007). It can also reportedly reproduce vegetatively, particularly in the northern populations (Hill 2007). Seed dispersal is via mallards, wood ducks, and beaver (Hill 2007, USDA-USFS [no date]). Featherfoil is not always persistent where it is found and may be absent for several years, then suddenly reappear in the same location (Hill 2007).

It is considered as a component species of the Comosa Sedge – Decomposite Sedge – Threeway Sedge - Stalked Water-horehound Herbaceous Vegetation, Buttonbush / Eastern Rose-mallow Shrubland, and Bald-Cypress – Swamp Cottonwood Forest plant associations (Faber-Langendoen 2001). Typical plant associates of featherfoil in Indiana include red maple, sweetgum, swamp cottonwood, overcup oak, pin oak, bald cypress, buttonbush, swamp rose, small beggarticks, twoheaded water-starwort, yellow water buttercup, hemlock waterparsnip, duckmeat, duckweed, lizards tail, greater marsh St. Johnswort, floating mannagrass, and sensitive fern (Hill 2007). Featherfoil has a coefficient of conservatism value of 10 (Rothrock 2004) indicating that the species is restricted to remnant landscapes that appear to have suffered very little post-settlement trauma.

Featherfoil occurs sporadically throughout the eastern United States in 28 states from Maine to South Carolina, and east Texas to southern Illinois. In Indiana where featherfoil is at the northern extent of its range, it is known from Dubois, Pike, Posey, Scott, and Vanderburgh counties, and historically from Floyd and Gibson counties (Hill 2007). The IDNR Natural Heritage Data Center also includes a record from Clark County. Due to its unique habitat preferences, it is typically only locally abundant where found. Principal threats to the species are draining of wetlands, loss of beaver ponds (the ideal preferred habitat), vegetation competition (common reed), agricultural activities (herbicide and fertilizer runoff), and high-water flooding (Hill 2007, USDA-USFS [no date]).

POTENTIAL FOR IMPACT

Occurrences of featherfoil within the Mid-States Corridor study area are limited to the Patoka River area in Pike County and the Buffalo Pond Nature Preserve west of Alternatives C, M, O, P, RPA P, and R, and east of Local Improvement 4.



Crow-poison (*Nothoscordum bivalve*)

Crow-poison was designated as state threatened by the IDNR in the second amendment to the NRC roster listing May 1, 1992 (NRC 1992, IDNR 2020b).

IDNR: Threatened
Global Rank: G4
State Rank: S3

Crow-poison is a perennial forb of the *Alliaceae* (onion) family but was formerly placed in the *Liliaceae* (lily) family. Although related to the onion, it lacks the characteristic onion odor. Aside from the introduced *Nothoscordum gracile* (South America), crow-poison is the only member of this genus in the United States. Various habitats have been described including barrens, granite outcrops, low sandy woods, meadows, open wood, prairies, pastures, roadsides, and rocky glades (Baskin and Baskin 1979, Jacobsen and McNeal Jr. 1993). It is considered as a component species of the Sugar Maple – Northern Red Oak – Bitternut Hickory / Common Pawpaw Forest plant associations (Faber-Langendoen 2001). It is tolerant of extremely dry conditions during the summer (Baskin and Baskin 1079).

Crow-poison reproduces via seeds as well as bulblets that break off of the bulb underground (Baskin and Baskin 1979). Reportedly, the Cherokee would develop a poison from this plant to kill crows feeding on their corn crops (Ozarkedge [no date]). Crow-poison has a coefficient of conservatism value of 6 (Rothrock 2004) indicating that the species is typically associated with remnant plant communities but tolerates significant to moderate disturbances.

POTENTIAL FOR IMPACT

Crow-poison range includes the southeast, Midwest and south-central United States from southeastern Virginia, southern Ohio, southern Indiana, central Illinois, eastern Kansas and Nebraska to Florida and Texas (Baskin and Baskin 1979). In Indiana, it is found primarily in counties along the Ohio River (Posey, Warrick, Perry, Crawford, and Harrison) with isolated populations in Martin, Lawrence, and Greene counties). Within the Mid-States Corridor study area, crow-poison associated with the East Fork White River in Martin County is within two miles of Alternative M along the East Fork White River. The population in Lawrence County east of SR 37 is more than three miles from Alternative O.

Bog bluegrass (*Poa paludigena*)

Bog bluegrass was originally designated as state rare by the IDNR in the second amendment to the NRC roster listing May 1, 1992 (NRC 1992), but was subsequently designated state threatened by the IDNR in the tenth amendment to the NRC roster listing March 11, 2020 (NRC 2020, IDNR 2020b).

IDNR: Threatened
Global Rank: G3G4
State Rank: S3

Bog bluegrass is a perennial grass of the *Poaceae* (grass) family. In Indiana, habitat for the short and slender bog bluegrass is described as seep springs, seepage swamps, or fens with highly organic (muck) saturated soils (Homoya 1988). Woody shrubs and trees associated with the Wening-Sherrit Seep occurrence site in Dubois County include black chokeberry, winterberry, spicebush, southern arrowwood, poison sumac, smooth alder, black gum, tulip poplar, red maple, swamp cottonwood, green ash, swamp white oak, swamp chestnut oak, and sweetgum (Homoya 1988). Common herbaceous plant associates in Indiana include skunk cabbage, marsh marigold, fowl-meadow grass, swamp saxifrage, swamp betony, showy lady's slipper, and various *Carex* sedges (Homoya 1988). Bog bluegrass has a coefficient of conservatism value of 10 (Rothrock 2004) indicating that the species is restricted to remnant landscapes that appear to have suffered very little post-settlement trauma.



POTENTIAL FOR IMPACT

Until 1982 when it was rediscovered at a site in Dubois County, bog bluegrass was believed to have been extirpated from Indiana (Homoya 1988). In Indiana, it is now found infrequently scattered throughout the state, but is most common in the northern counties along the Michigan border in the Northern Lakes, Central Till Plain, and Northwestern Morainal natural regions (Homoya 1988). Dubois County remains the southernmost occurrence of the species in the state and the only unglaciated occurrence (Homoya 1988). This also generally represents the southernmost extent of its range in the Midwest. One occurrence is within an isolated woodland more than one mile east of Alternative B. A second occurrence is associated with a larger woodland tract less than two miles from Alternative C and Local Improvement 5.

Maryland meadow beauty (*Rhexia mariana* var. *mariana*)

Maryland meadow beauty (*Rhexia mariana*) was originally designated as state endangered by the IDNR in the second amendment to the NRC roster listing May 1, 1992 (NRC 1992) but was subsequently designated state threatened (*Rhexia mariana* var. *mariana*) by the IDNR in the third amendment to the NRC roster listing January 1, 2005 (NRC 2005, IDNR 2020b).

IDNR: Threatened
Global Rank: G5T5
State Rank: S1

Maryland meadow beauty is a perennial forb of the *Melastomataceae* (meadow beauty) family. It occurs in dry to moist habitats associated with sandhills, savannas, flatwoods, meadows, marshes, ditches, bogs, thickets, ponds and swales (Namestnik 2018). Its range extends from Massachusetts, south throughout Florida, west to eastern Texas and Oklahoma, and north to southeast Missouri, southern Illinois, and southern Indiana. However, disjunct populations occur in the Great Lakes region, namely Michigan and most recently (2014 and 2018) it has been discovered in the Indiana Dunes area in Porter and LaPorte counties (Namestnik 2018). Maryland meadow beauty has a coefficient of conservatism value of 5 (Rothrock 2004) indicating that the species is typically associated with remnant plant communities but tolerates significant to moderate disturbances.

POTENTIAL FOR IMPACT

Within the Mid-States Corridor study area, populations of Maryland meadow beauty have been documented in southern Spencer, southern Pike and western Daviess counties. While there are occurrences of the species in close proximity to US 231 along Section 1 in Spencer County; there are no proposed improvements for this portion of Alternatives B, C, M, O, P, RPA P, and R. There are no known occurrences of the species proximal to the alternatives or associated local improvements north of I-64.

American snowbell (*Styrax americanus*)

American snowbell was designated as state threatened by the IDNR in the second amendment to the NRC roster listing May 1, 1992 (NRC 1992, IDNR 2020b).

IDNR: Threatened
Global Rank: G5
State Rank: S3

American snowbell is a perennial, deciduous, wetland shrub of the *Styracaceae* (storax) family and is one of just two species of the genus *Styrax* that occur in Indiana. The closely related *Styrax grandifolia* is designated as endangered in Indiana. Habitat for the American snowbell includes poorly-drained acidic soils of wet woods, swamps, marsh edges, floodplains, oxbow lakes, and stream banks with shade (Connor 2004b, Edgin and Mankowski 2013, Lenahan 2009, Missouri Botanical Garden [no date]). It is considered as a component species of three different plant associations in the Midwest, but none are considered to be present in Indiana (Faber-Langendoen 2001). In Illinois,



tree associates include pin oak, green ash, silver maple, swamp cottonwood pumpkin ash, bald cypress, overcup oak, and tupelo (Connor 2004b, Edgin and Mankowski 2013).

This species is commonly used as an ornamental landscape planting due to its tolerance of dry soil conditions and cold seasonal temperatures (Lenahan 2009). Listed pollinators include honeybees, bumblebees, and the monarch butterfly (Lenahan 2009), and it is the preferred food source of the promethea moth (Connor 2004b). American snowbell has a coefficient of conservatism value of 8 (Rothrock 2004) indicating that the species occurs in high-quality remnant plant communities that appear to endure some disturbance from time to time.

Principal threats to Illinois populations are listed as habitat conversion, hydrology alteration (draining or inundation), woody encroachment, and canopy alteration resulting in too much or too little sun (Connor 2004b, Edgin and Mankowski 2013).

POTENTIAL FOR IMPACT

American snowbell range includes southeastern United States from Virginia to Florida, west to eastern Texas, and north to southeastern Missouri, southern Illinois, southern Indiana, and southern Ohio (Connor 2004b, Edgin and Mankowski 2013). Southern Indiana (Posey, Warrick, Gibson, Pike, and Dubois counties) generally represents the northern extent of the species in the United States; however, there are disjunct populations of American snowbell along the Kankakee River in northwestern Indiana. Within the Mid-States Corridor study area, American snowbell appears to be largely confined to the Patoka River and Hunley Creek floodplains in Pike and Dubois counties. There are two known occurrences of the species north (Buffalo Pond Nature Preserve) and south of Jasper within one mile of Alternatives C, M, O, P, RPA P, and R, and Local Improvements 2 and 4. A third population is located within one mile of Alternative B north of the Patoka River.

Rose turtlehead (*Chelone obliqua* var. *speciosa*)

Rose turtlehead is not listed as endangered, threatened, or rare in the NRC roster listing, but has been designated as a watch list species by IDNR Division of Nature Preserves (IDNR 2020b).

IDNR: Watch List Global Rank: G4T3 State Rank: S3

Rose turtlehead is a perennial forb of the *Scrophulariaceae* (figwort or snapdragon) family but has been placed in the *Plantaginaceae* (plantain) family by some authors. Rose turtlehead prefers wet habitats including wet woods, alluvial swamp forests, marshes, stream/creek banks, seeps, and the edges of ponds and lakes (NatureServe 2021). Plant associates listed for Michigan populations include eastern cottonwood, honey locust, American elm, red ash, boxelder, silver maple, black willow, silky dogwood, buttonbush, prickly ash, sandbar willow, highbush blueberry, riverbank grape, poison ivy, sensitive fern, common nettle, false nettle, great blue lobelia, blue joint, white snakeroot, fringed loosestrife, late goldenrod, and Virginia wild-rye (Penskar and Crispin 2010).

The range of the rose turtlehead is centered in the Midwest and extends from Minnesota and Iowa south to northeast Arkansas, east into Illinois, Kentucky, and Indiana, and north into southern Michigan. In Indiana, it occurs largely within the central and southwestern portion of the state. Rose turtlehead has a coefficient of conservatism value of 8 (Rothrock 2004) indicating that the species occurs in high-quality remnant plant communities that appear to endure some disturbance from time to time.

POTENTIAL FOR IMPACT

In southwestern Indiana, the majority of the records for rose turtlehead are associated with the Wabash River and White River floodplains. However, there are scattered populations along the Patoka River



(Pike County), East Fork White River (Martin and Lawrence counties), and South Fork Prairie Creek (Daviess County). The nearest documented population of rose turtlehead is greater than one mile from Alternative M and less than one mile from Local Improvement 13.

Carolina spider-lily (Hymenocallis occidentalis)

Carolina spider-lily was originally designated as state rare by IDNR in the second amendment to the NRC roster listing May 1, 1992 (NRC 1992) but was removed from the list in the third amendment to the NRC roster listing January 1, 2005 (NRC 2005). It is currently listed as a watch list species by IDNR Division of Nature Preserves (IDNR 2020b).

IDNR: Watch List
Global Rank: G4?
State Rank: S3

Carolina spider-lily is a bulbous perennial forb of the *Amaryllidaceae* (amaryllis) family. Typical habitat is mucky soils associated with bald cypress swamps and swampy low-lying forests. The post oak flatwoods in Posey and Spencer counties include wet depressions with typical vegetation including Carolina spider-lily, swamp oval sedge, narrow-leaved cattail sedge, Buxbaum’s sedge, low woodland sedge, sweet woodreed, false indigo bush, deciduous holly, white doll’s daisy, blackfoot quillwort, smooth false buttonweed, purple fringeless orchid, and woodland pinkroot (Aldrich and Homoya 1983, Homoya 2006). Blatchley (1908) also included it with several other decidedly wet species typical of the Austroriparian flora in southern Indiana.

Its showy flowers make Carolina spider-lily popular for inclusion in wet horticultural landscape gardens, but it can also be grown on mesic upland areas. Carolina spider-lily is one of the few tropical/subtropical spider-lily species tolerant of colder climates. In the United States, its range is limited to the Gulf Coast states (Texas, Louisiana, Alabama, and Florida), north into Georgia, Arkansas, Tennessee, Kentucky, Missouri, southern Illinois, and southern Indiana. Mark and Gordon (2004) suggest that Carolina spider-lily reaches its northern limit in Posey County (Twin Swamps); however, more recent records show that it occurs as far north as Dubois County. Carolina spider-lily has a coefficient of conservatism value of 9 (Rothrock 2004) indicating that the species occurs in high-quality remnant plant communities that appear to endure some disturbance from time to time.

POTENTIAL FOR IMPACT

Indiana distribution of Carolina spider-lily is confined to the southwest portion of the state in Posey, Gibson, Warrick, Spencer, and Dubois counties (Deam 1940, USDA-NRCS 2021). However, the IDNR Indiana Natural Heritage Data Center includes only a single occurrence from Dubois County for the entire state. The Dubois County record is from the Barnes-Seng Wetland Conservation Area between Jasper and Huntingburg, approximately one mile from Alternatives C, M, O, P, RPA P, and R east of Jasper, and immediately adjacent to Local Improvement 2 along US 231.

Primrose willow (Ludwigia decurrens)

Primrose willow was originally designated as state threatened by IDNR in the second amendment to the NRC roster listing May 1, 1992 (NRC 1992) but was removed from the list in the third amendment to the NRC roster listing January 1, 2005 (NRC 1992). It is currently listed as a watch list species by IDNR Division of Nature Preserves (IDNR 2020b).

IDNR: Watch List
Global Rank: G5
State Rank: S3

Primrose willow is an annual forb of the *Onagraceae* (evening primrose) family and an obligate wetland species reported in emergent wetlands, herbaceous wetlands, ditched wetlands, mudflats, and oxbows/lakes (Whitaker et al. 2012). It is considered as a component species of the Spring Witch-hazel –



Pale Dogwood – Shrubby St. John’s–wort Shrubland plant association that occurs in loose cobble of upper scour zones in small to medium streams or on bedrock shelves or alluvial silt of larger streams and rivers (Faber-Langendoen 2001). Primrose willow is often considered a competitive weed in rice fields and is regarded as an obnoxious weed in California (USFWS 2021, USDA 2021).

The range of primrose willow includes the Atlantic states from Pennsylvania south to Florida, Gulf coast states to east Texas, and north into southeast Missouri, southern Illinois, southern Indiana, and southern Ohio. A few populations in central Illinois represent the northernmost occurrences of this species. It is relatively common in southern states, but not in Indiana where it reaches its northern extreme along the Ohio River border counties. Primrose willow has a coefficient of conservatism value of 4 (Rothrock 2004) indicating that the species is typically associated with remnant plant communities but tolerates significant to moderate disturbances.

POTENTIAL FOR IMPACT

Within the Mid-States Corridor study area, populations of primrose willow have been documented in southern Spencer, southern Perry, and western Pike counties. While there are occurrences of the species in close proximity to US 231 along Section 1 in Spencer County, there are no proposed improvements for this portion of Alternatives B, C, M, O, P, RPA P, and R. There are currently no known occurrences of the species proximal to the alternatives or associated local improvements north of I-64.

American ginseng (*Panax quinquefolius*)

American ginseng is not listed as endangered or threatened in the NRC roster, but has been designated as a watch list species by the IDNR Division of Nature Preserves (IDNR 2020b).

IDNR: Watch List Global Rank: G3G4 State Rank: S3

American ginseng is a perennial forb of the *Araliaceae* (ginseng) family generally located in rich mesic mixed mesophytic forests with a diverse canopy, an open or sparse shrub layer, and an affinity for north and east facing slopes (Kauffman 2006). Habitats described for American ginseng in Indiana include ridgetop woods in Wayne County (Ruch et al. 2008) and woodland ravines in Crawford County dominated by sugar maple, American beech, red maple and umbrella magnolia (Badger and Jackson 1983). It is considered as a component species of the Sugar Maple – Ash – American basswood / Blank Sweet-cicely – Blue Cohosh Forest plant association on rich, mesic to wet-mesic areas on flat to rolling terrain with somewhat poorly to well-drained soils in northern hardwood forests; however, this plant association is not considered to be present in Indiana (Faber-Langendoen 2001). Typical plant associates in the Midwest include tulip poplar, basswood, white ash, sugar maple, American beech, white oak, red oak, yellow buckeye, black cherry, red maple, eastern hemlock, pawpaw, hornbeam, witch hazel, spicebush, bladdernut, blue cohosh, black cohosh, spring beauty, squirrel corn, American trout lily, bloodroot, foamflower, bethroot, and large-flowered trillium (Kauffman 2006).

The United States range includes the northeast, southeast (excluding Florida), Midwest, Great Lakes, and Gulf Coast as far west as Louisiana, South Dakota and Minnesota. It occurs throughout Indiana but is generally lacking in the Tipton Till Plain region of north-central Indiana. American ginseng has a coefficient of conservatism value of 7 (Rothrock 2004) indicating that the species occurs in high-quality remnant plant communities that appear to endure some disturbance from time to time.

American ginseng is routinely harvested for medicinal purposes. In Indiana, the harvest season is from September 1 to December 31 and does not require a license to harvest plants that meet IDNR criteria on



private property but does require a dealer's license to purchase these plants for resale (American Herbal Products Association [no date]). The export/trade of ginseng is regulated through international treaty (Convention on International Trade in Endangered Species of Wild Fauna and Flora).

POTENTIAL FOR IMPACT

In Indiana, American ginseng occurs in many forests of suitable habitat. However, within the general vicinity of the alternatives the Natural Heritage Data Center includes only six records from Spencer, Martin, and Lawrence counties. The nearest record is approximately 1.5 mile east of Alternatives P, RPA P, and R within NSA Crane. Based on natural regions, Alternatives M and O have the greatest potential to traverse habitat that supports this species.

Grassleaf ladies'-tresses (*Spiranthes vernalis*)

Grassleaf ladies'-tresses was originally designated as state threatened by IDNR in the second amendment to the NRC roster listing May 1, 1992 (NRC 1992) but was removed from the list in the third amendment to the NRC roster listing January 1, 2005 (NRC 2005). It is currently listed as a watch list species by IDNR Division of Nature Preserves (IDNR 2020b).

IDNR: Watch List Global Rank: G5 State Rank: S3

Grassleaf ladies'-tresses is a perennial forb of the *Orchidaceae* (orchid) family. General habitat for this orchid consists of dry to moist meadows, dune hollows, prairies, old fields, roadsides, cemeteries, and lawns (Romero-Gonzalez et al. 2020). In Iowa, historic habitat has been described as swampy pastures, meadows, bogs, fresh and coastal salt marshes, low wet pine barrens and flatwoods, swamps, floodplain areas, low prairies and savannahs, sandy beaches and dune areas, open wood, and hammocks (Niemann 1975). Within the sand prairie and Missouri valley habitats in Iowa, dominant associates include big bluestem, little bluestem, sandreed, peach-leaved willow, black willow, and eastern cottonwood (Niemann 1975). Grassleaf ladies'-tresses has a coefficient of conservatism value of 3 (Rothrock 2004) indicating there is little or no confidence that its inhabitation signifies remnant conditions. General threats to orchids include habitat loss through land clearing for agriculture, reduction in historic pollinators, and private collecting for ornamental arrangements (Melton 2020).

POTENTIAL FOR IMPACT

Grassleaf ladies'-tresses range includes much of the eastern United States from New Hampshire to Florida, west to Texas and southeast South Dakota, and north into Michigan. In Indiana, it is largely limited to south-central counties (Dubois, Crawford, Perry, Lawrence, Washington, Harrison, Jennings, Scott, and Clark). Within the Mid-States Corridor study area, there are only two records of the species. The Dubois County occurrence is associated with the Patoka River in the vicinity of Patoka Lake greater than four miles south of Alternative O and Local Improvement 16. The Lawrence County record is south of Mitchell immediately adjacent to Alternative O.