APPENDIX K-4

Biological Assessment

Clarification Note: This document was completed before the development of Central Alternative 1B Modified (Selected). However, FHWA submitted a letter to USFWS dated June 10, 2021 (Appendix H-7) stating that the design modifications do not require the re-initiation of consultation with USFWS in accordance with the BO guidelines (see Appendix K-5 for the BO).

Biological Assessment for Multiple Species at the I-69 Ohio River Crossing Project

Evansville, IN and Henderson, KY

July 16, 2020

Prepared by:
Stantec Consulting Inc.

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EXECUTIVE SUMMARY

The Federal Highway Administration (FHWA), Indiana Department of Transportation (INDOT), and Kentucky Transportation Cabinet (KYTC) propose to construct, operate, and maintain a new section of Interstate 69 (I-69) from Henderson, KY to Evansville, IN.

The project is part of a larger, national proposal to connect the three North American trading partners of Canada, the United States, and Mexico by an interstate highway through the states of Michigan, Indiana, Kentucky, Tennessee, Mississippi, Arkansas, Louisiana, and Texas. The purpose of the I-69 Ohio River Crossing (ORX) project is to: provide cross-river system linkage and connectivity between I-69 in Indiana and I-69 in Kentucky that is compatible with the National I-69 Corridor; develop a solution to address long-term cross-river mobility; provide a cross-river connection that reduces traffic congestion and safety; and, improve safety for cross-river traffic. Seventeen species listed under the Endangered Species Act (ESA) are historically or presently known to be present in the project corridor, and therefore may be affected. The Ohio River was identified as potential habitat for 13 mussel species, and a presence/absence survey for these species was conducted in 2018. A single sub-fossil shell of Fat Pocketbook (*Potamilus capax*) was found near a deposition area within the project site. Additionally, 2015 surveys on the Ohio River yielded multiple sites with Sheepnose (*Plethobasus cyphyus*) present, suggesting low density populations could exist within this project area. Based on these surveys, KYTC is reasonably certain that listed mussels are present in low numbers within the project area, consequences from the project could have adverse effects to listed mussels, and such effects vary by species. As a result, a determination of “may affect, not likely to adversely affect” has been made for all listed mussel species except Fat Pocketbook and Sheepnose (Table ES-1).

After the field investigations were completed, USFWS began considering an additional mussel, Longsolid (*Fusconaia subrotunda*) for listing. It is expected that prior to construction of this project, a listing decision will be made for this species under the ESA. Eleven live Longsolid mussels were found within the mussel bed area of the project site. Chapter 8 of this report will provide a separate analysis of this species due to its pending listing decision.

The I-69 Ohio River Crossing (ORX) project construction will result in the loss of 45.8 acres (33.6 in Kentucky and 12.2 in Indiana) of “Known Maternity Habitat” for the Indiana bat (*Myotis sodalis*), which includes roosting, foraging, and commuting habitat for the species. Known Maternity Habitat is defined by the U.S. Fish and Wildlife Service (USFWS) as suitable summer habitat located within a determined distance (5 miles of a capture location or 2.5 miles of documented roost tree for Indiana Bats) of an occurrence record for the species. Additionally, restrictions for habitat removal activities as outlined in Section 4(d) of the Endangered Species Act, also known as the 4(d) rule for the Northern Long-eared Bat (*Myotis septentrionalis*) is within 150 feet of a known maternity roost and within 0.25 mile of a hibernation site. This leads to a “may affect, is likely to adversely affect” determination for the Indiana Bat and a “may affect, is likely to adversely affect” for the Northern Long-Eared Bat, however take is not prohibited due to the 4(d) rule. The Gray Bat is not known to be present in the project corridor. However, because of recent acoustical bat data collected near the Henderson County Airport, and the wide-ranging foraging habits of the species, KYTC is reasonably certain the species is present in low numbers. Due to conservation measures implemented into the project and the use of the most recent Programatic Agreement between KYTC and UFWS. and lack of impacts to roost habitat, the effect determination for the Gray Bat is "may affect, not likely to adversely affect."

Based on current river conditions (no sand bars, gravel bars, or islands) within the I-69 ORX project corridor, the USFWS did not recommend any surveys for Least Tern nests. The lack of nesting colonies within the project corridor eliminates the potential for an adverse effect from the incidental take of adult nesting birds and their eggs, or chicks. Because habitat conditions could appear if flow conditions change and other stressors are discountable, an effect determination of "may affect, not likely to adversely affect" is warranted.

The proposed route for the I-69 alignment is described in Chapter 2. Chapter 3 of this biological assessment (BA) provides a brief description of the federally listed species, their life history, and preferred habitat. Chapter 4 describes species surveys that occurred prior to the writing of this BA. Chapter 5 presents an analysis of effects anticipated for each species. Chapter 6 describes proposed conservation measures for each species group. Conclusions and effect determinations are summarized in Chapter 7.

This BA provides the information necessary for USFWS to assess the effect of the project on federally listed species as listed in the table below.

Table ES-1. Summary of Effect Determinations for proposed I-69 listed species

SPECIES	SCIENTIFIC NAME	FEDERAL STATUS[1]	EFFECT DETERMINATION
Indiana Bat	*Myotis sodalis*	Endangered	May affect, is likely to adversely affect
Gray Bat	*Myotis grisescens*	Endangered	May affect, not likely to adversely affect
Northern Long-Eared Bat	*Myotis septentrionalis*	Threatened	May affect, is likely to adversely affect
Least Tern	*Sternula antillarum*	Endangered	May affect not likely to adversely affect.
Clubshell	*Pleurobema clava*	Endangered	May affect, not likely to adversely affect
Fanshell	*Cyprogenia stegaria*	Endangered	May affect, not likely to adversely affect
Fat Pocketbook	*Potamilus capax*	Endangered	May affect, is likely to adversely affect
Northern Riffleshell	*Epioblasma rangiana*	Endangered	May affect, not likely to adversely affect
Orangefoot Pimpleback	*Plethobasus cooperianus*	Endangered	May affect, not likely to adversely affect
Pink Mucket	*Lampsilis abrupta*	Endangered	May affect, not likely to adversely affect
Catspaw	*Epioblasma obliquata*	Endangered	May affect, not likely to adversely affect
Ring Pink	*Obovaria retusa*	Endangered	May affect, not likely to adversely affect
Rough Pigtoe	*Pleurobema plenum*	Endangered	May affect, not likely to adversely affect
Spectaclecase	*Margaritifera monodonta*	Endangered	May affect, not likely to adversely affect
Sheepnose	*Plethobasus cyphyus*	Endangered	May affect, is likely to adversely affect

SPECIES	SCIENTIFIC NAME	FEDERAL STATUS[1]	EFFECT DETERMINATION
Rabbitsfoot	*Theliderma cylindrica*	Threatened	May affect, not likely to adversely affect
Snuffbox	*Epioblasma triquetra*	Endangered	May affect, not likely to adversely affect

1. USFWS 2018a

ABBREVIATIONS

ABBREVIATION	DEFINITION
Ac	Acre
BA	Biological Assessment
BMP	Best Management Practice
CWA	Clean Water Act
DBH	Diameter at Breast Height
DEIS	Draft Environmental Impact Statement
DOT	Department of Transportation
EA	Environmental Assessment
EIS	Environmental Impact Statement
ESA	Endangered Species Act
FHWA	Federal Highway Administration
GRNWR	Green River National Wildlife Refuge
IDEM	Indiana Department of Environmental Management
IGWS	Indiana Geological & Water Survey
IDNR	Indiana Department of Natural Resources
INDOT	Indiana Department of Transportation
KDEP	Kentucky Department of Environmental Protection
KGS	Kentucky Geological Survey
KSNPC	Kentucky State Nature Preserves Commission
KWA	Kentucky Waterway Alliance
KYTC	Kentucky Transportation Cabinet
MCDI	Mainstream Commercial Divers Inc.
MSL	Mean Sea Level
NOI	Notice of Intent
NWI	National Wetlands Inventory
ORX	Ohio River Crossing
RM	River Mile
USACE	U.S. Army Corps of Engineers
USDA	U.S. Department of Agriculture
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
WNS	White Nosed Syndrome
WOTUS	Waters of the U.S.

CHAPTER 1 – INTRODUCTION

1.1 PURPOSE AND OBJECTIVES OF BIOLOGICAL ASSESSMENT

This Biological Assessment (BA) is prepared in compliance with Section 7 of the ESA and 50 CFR 402.12, Biological Assessments. The purpose of this BA is to assess potential effects of construction, operation, and maintenance of the proposed I-69 Ohio River Crossing (ORX) project, located in Henderson, KY and Evansville, IN to federally endangered, threatened and proposed (listed) species, and Critical Habitat, if present. The BA will address potential effects to several different federally listed species based on information available to this date through literature review, previous surveys, and expert opinion. Determinations will be reassessed if new information becomes available.

The objectives of this BA are as follows:

- Comply with the requirements of Section 7(a) of the ESA of 1973. Compliance includes tasks that directly avoid and minimize negative effects to listed species (Section 7(a)(2)), and involvement in programs for the conservation of listed species (Section 7(a)(1)).
- Document and review the most current literature pertinent to life history, distribution, habitat, populations, declines, and recovery goals of listed species.
- Evaluate potential adverse effects that construction, operation, and maintenance of the I-69 ORX project may have on listed species.
- Determine conservation measures that will be implemented to avoid or minimize adverse effects to these species.
- Include a Conference Analysis considering the potential listing of a mussel, the Longsolid (*Fusconaia subrotunda*).

1.2 PROJECT PURPOSE AND NEED

The project is part of a larger, national proposal to connect the three North American trading partners of Canada, the United States, and Mexico by an interstate highway through the states of Michigan, Indiana, Kentucky, Tennessee, Mississippi, Arkansas, Louisiana, and Texas. The purpose of the I-69 ORX project is to: provide cross-river system linkage and connectivity between I-69 in Indiana and I-69 in Kentucky that is compatible with the National I-69 Corridor; develop a solution to address long-term cross-river mobility; provide a cross-river connection that reduces traffic congestion and safety; and, improve safety for cross-river traffic. Four primary needs have been identified for the project:

- Lack of National I-69 Corridor system linkage
- High cost of maintaining cross-river mobility on existing facilities
- Unacceptable levels of service for cross-river traffic
- High-crash locations in the I-69/US 41 corridor

For additional information on each of the above primary needs refer to Chapter 2 of *the Draft Environmental Impact Statement* (DEIS) published on December 14, 2018.

1.3 CONSULTATION HISTORY SINCE PROJECT REINITIATION – JUNE 30, 2016

March 6, 2017, the USFWS commented that the I-69 ORX project is within the range of the endangered Indiana Bat (*Myotis sodalis*), the Gray Bat (*Myotis grisescens*), the Sheepnose (*Plethobasus cyphyus*), the Fat Pocketbook (*Potamilus capax*), and the threatened Northern Long-Eared Bat (*Myotis septentrionalis*) (Section 8.2.2 Interagency Advisory Committee section of DEIS).

June 26, 2017, a meeting (WebEx) was held with Kentucky Transportation Cabinet (KYTC) Frankfort Office, USFWS' Indiana and Kentucky Field Offices, Stantec, Federal Highway Administration (FHWA), and Indiana Department of Transportation (INDOT) present. This meeting was held to discuss endangered, threatened, and rare species survey requirements for the I-69 ORX project to ensure the project maintains compliance with Section 7 of the ESA. Prior to this meeting, on June 20, 2017, the USFWS Frankfort, KY and Bloomington, IN Field Offices held a conference call to discuss and clarify several issues. It was determined the KY Field Office would assume the lead for consultation. It was also agreed upon by the two offices that the Programmatic Biological Assessment "Effects on the Indiana Bat Associated with Transportation Projects in Kentucky" and associated Programmatic Conservation Memorandum of Agreement for the Indiana Bat, which allows a 20-mile buffer for projects outside Kentucky, and the associated Imperiled Bat Conservation Fund (IBCF) could be used for the entire I-69 ORX project corridor. However, the typical tree clearing restrictions in Indiana (no clearing of trees > 3 inches diameter at breast height (DBH) is allowed from April 1 to September 30) will be required. Mitigation rates for IBCF were discussed. It was determined that no additional bat surveys were needed since the Northern Long-eared Bat and Indiana Bat were known to occur within the project corridor. In Kentucky, KYTC and USFWS recommended a search of mines, sinkholes, and bridges for roosting Gray Bats, and assumes they are likely present on the landscape. They also require installation of specific erosion and sediment control measures to reduce impacts to aquatic organisms, especially freshwater mussels. The USFWS determined that current river conditions within the project corridor do not necessitate a Least Tern nest survey, but if river conditions change to be more conducive (the presence of bars, sandy banks, and/or islands), then a survey would be needed. Mussel surveys and timing of these operations were discussed.

July 18, 2017, an email from Robin McWilliams-Munson (USFWS-Bloomington, IN Field Office) to Dan Miller (Parsons), which copied Phil DeGarmo (USFWS-Frankfort, KY Field Office), verified the meeting notes from June 26, 2017 were accurate with the clarification that some of the questions were not specific to the Bloomington Field Office, but for the USFWS in general (tern and mussel surveys, etc.). It was also noted that the bat habitat mitigation cost for property in Indiana was much higher than in Kentucky.

September 11, 2017, I-69 ORX Section 7 Meeting; Mussel Survey Approach was held at the KYTC office in Frankfort, Kentucky. Participants at the meeting included representatives from the USFWS-Frankfort Field Office, Parsons, Stantec, KYTC, and FHWA. The purpose of this meeting was to discuss if mussel surveys/habitat assessments were needed for the project, and if so, methods for how these should be completed. It was determined that since the US 41 bridges may be removed, that the "worst case" scenario (removing both bridges) would be assumed. Therefore, mussel surveys would be conducted at two locations; Central Alternative 1 and at the crossing for both West Alternatives 1 and 2 (at the existing bridges and potential new crossing). The use of side-scanning sonar to obtain habitat data was discussed. It was determined that it alone would not eliminate the need for mussel surveys but could reduce the size of the survey area based on the habitat results. After discussions concerning the side-scanning sonar survey effort, the USFWS suggested that side-scan sonar and field verification of substrate be conducted in 2017, due to benefits and the likelihood that it could help direct and refine recommendations throughout the process. The USFWS determined that the project team should complete side-scan sonar surveys 300 meters downstream and 100 meters upstream of the impact areas, an approach that has been used on other bridge projects. It was determined that a side-scan sonar survey would be completed in 2017 to determine potential mussel habitat and where it occurs, and based on the results, a full mussel survey would be completed in 2018.

March 6, 2018, an email from Phil DeGarmo (USFWS-Frankfort Field Office) to Dan Prevost, which copied Robin McWilliams-Munson (USFWS-Bloomington Field Office), Tim Foreman (KYTC), David Harmon (KYTC), Eric Rothermel (FHWA), Jennifer Garland and Lee Andrews (USFWS-Frankfort Field Office), notified the project team that USFWS had reviewed the Screening Report supplement and didn't have any additional comments at that time. The USFWS commented that they appreciated avoidance efforts at Eagle Slough and the Vigo mitigation site and requested an update on the status of field work for mussels.

May 24, 2018, the Interagency Advisory Committee (IAC), including the USFWS, used buses to tour the I-69 ORX project corridor and discuss various issues related to the project. Stops during the tour included one at the twin bridges on the north side of Ohio River. At this stop, biologists from Parsons and Stantec discussed the use of existing bridges by bats and nesting birds with Phil DeGarmo (USFWS). A stop along the Ohio River next to Green River Road provided an opportunity to discuss the potential for freshwater mussels in portions of the project corridor based on side-scanning sonar data. This site visit by USFWS provided them an opportunity to understand the habitats present within the I-69 ORX project corridor.

July 16, 2018, an I-69 ORX meeting was held at KYTC's office in Frankfort, Kentucky to discuss the mussel survey study plan. Participants included representatives from Parsons, Stantec, USFWS, KYTC, and FHWA. Stantec provided a description of the proposed study plan for surveying of mussels in the project area. USFWS stated that the methods involve a likelihood of presence survey, given that not every mussel in the disturbance area will be collected. USFWS will make a determination based on the quality of the mussel beds present and diversity of species collected as to whether listed mussels are likely present. USFWS stated that the survey area (including buffers) should cover all the disturbance footprint including scour, hydraulic alteration, and temporary pier construction. Parsons stated that removal of the US 41 bridge(s) would potentially involve dropping the structure into the river and removing it. Leroy Koch (USFWS) stated that if piers are placed in "unsuitable" habitat that USFWS probably wouldn't require relocation. USFWS stated that survey crews could terminate individual cell surveys if habitat was clearly unsuitable, and that if high density beds are present (10-12 species), extra effort may be necessary. Phil DeGarmo (USFWS) concurred that the proposed study plan should be enough to make an effects determination. Leroy Koch (USFWS) agreed that the proposed methods appeared to be sufficient. The conclusions of the meeting were that: Parsons would provide the bridge scour analysis used for the Louisville bridges, USFWS would provide preliminary comment on the proposed mussel survey study plan, Stantec would revise the study plan to incorporate extra effort in high density beds and the ability to terminate surveys in unsuitable habitat, and Stantec would enlarge the search areas in the vicinity of piers if the scour analysis suggested it.

August 7, 2018, a coordination meeting with USFWS was held in the Evansville Project Office to discuss the proposed Green River National Wildlife Refuge (GRNWR). Participants at the meeting included representatives from the USFWS, Parsons, KYTC, FHWA-Indiana, FHWA-Kentucky, and Indiana Department of Transportation (INDOT). The purpose of this meeting was to discuss the status of the proposed GRNWR. Meeting participants reviewed maps from the 2001 Environmental Assessment (EA) showing the planned location of the new refuge. The group discussed possible effects of the new refuge on the I-69 ORX project. It was determined the group developing the plans and NEPA documents for the proposed GRNWR was aware of the proposed I-69 ORX project, and the refuge would have no effect on the project. Meeting participants discussed how to ensure that the GRNWR EA document will accommodate the I-69 corridor, since the final right of way plans have not been prepared. Parsons provided some general information about anticipated impacts to wetlands, streams, and bat habitat for each of the DEIS alternatives. It was pointed out that each of these impacts would require mitigation, which could potentially use areas identified by USFWS for inclusion in the refuge.

December 17, 2018, an I-69 ORX meeting was held at KYTC's office in Frankfort, KY to discuss the survey efforts and findings from the recent mussel survey, and to determine what it means to Section 7 consultation for the project. Participants at the meeting included representatives from the USFWS, Stantec, Parsons, KYTC, and FHWA-Kentucky. Cody Fleece (Stantec) provided an overview of the mussel survey area and methods for both the new crossing and the existing US 41 bridges location. Due to an unusually wet fall, the river was well above normal flow for this time of the year, which increased stream velocity and prevented surveys from occurring near the center of the channel. The survey efforts used side-scan sonar data to map distribution of substrate types and focused efforts on the best available mussel habitat. The survey area was divided into search cells and consisted of the survey area plus upstream and downstream buffers. Searches were scheduled in 100 percent of "suitable" substrates and 50 percent of those substrates deemed as "potentially unsuitable" for listed species. It was stated that abnormally high rainfall in September and October resulted in river conditions that were unsuitable for surveying for extended periods. High flow conditions and associated dangerous currents in the river allowed for approximately 47 percent (108/231) of all scheduled search cells to be sampled, but 74 percent of cells deemed suitable habitat were completed. Survey efforts identified live mussels in the majority of cells identified as suitable substrate (50 of 92 survey cells). Mussels were only present in four of 17 sampled unsuitable habitat cells. No live, federally listed species were found during survey efforts. Leroy Koch (USFWS) agreed with the team assessment of survey and findings and thought a determination in regard to listed mussels could be made from data available. The group discussed several mitigation options, but USFWS wanted to involve others at their office in these discussions. The team agreed to meet at the USFWS Frankfort, Kentucky Field Office and discuss potential mitigation options to reduce effects to all mussel species and determine the content and format of a Biological Assessment.

December 19, 2018, a meeting with USFWS at the Frankfort, Kentucky Field Office to continue coordination between the I-69 ORX Project Team and USFWS. Attendees discussed the mussel survey results, which found no listed species, but did identify a mussel bed within the project footprint which would affect Section 7 consultation. Participants at the meeting included James Kiser and Cody Fleece (Stantec), Nathan Click (KYTC), Leroy Koch, Lee Andrews, and Phil DeGarmo (USFWS). Stantec lead a discussion of the mussel survey methods and results. Based on the information provided on December 17, 2018, the USFWS concluded adverse effects were not likely and that formal consultation is not warranted, but a determination of “may affect, not likely to adversely affect” is warranted. Since no federally listed species were found, no mussel relocation is necessary. USFWS would like to see conservation measures included in the BA, with specific measures coordinated between KYTC, USFWS, and other agencies.

January 29, 2019, an email from Robin McWilliams-Munson (USFWS-Bloomington, IN Field Office) to Juliet Port (Parsons) asked if the project team has a breakdown of forest impacts in Indiana. Stantec took previous mapping and calculated acres of forest impacts for each of the states and made a new table. This was requested by USFWS so potential habitat for listed bats could be determined.

March 25, 2019, submitted first draft Biological Assessment to the Frankfort, KY field office of USFWS for review.

March 5, 2020, a meeting with Phil DeGarmo (USFWS) at KYTC’s office in Frankfort, KY to discuss the first draft Biological Assessment review comments from both the Kentucky and Indiana USFWS Field Offices. In addition to Phil, participants at the meeting included representatives from Stantec, Parsons, KYTC, and INDOT. Review of the first draft BA also included new changes to federal regulations on how effects to species should now be addressed and presented within the document.

April 8, 2020, a phone/WebEx meeting was used due to social distancing and travel restrictions related to the COVID-19 virus. This WebEx meeting was attended by Phil DeGarmo (USFWS), Nathan Click (KYTC), Dan Prevost (Parsons), James Kiser (Stantec), and Josh Adams (Stantec). The purpose of this WebEx meeting was to discuss the revised approach to the project’s Section 7 review/approval. Based on the comments received from USFWS at the March 5, 2020 meeting and subsequent discussions with KYTC, the Project Team decided to resubmit the Biological Assessment with a recommended finding of May Affect, Likely to Adversely Affect, requesting formal consultation and a Biological Opinion. It was decided to also submit analysis of potential impacts on the Longsolid (*Fusconaia subrotunda*), a species expected to be formally proposed by USFWS for listing by the time Section 7 consultation is completed, requesting a Conference Opinion from USFWS for the species.

CHAPTER 2 – PROPOSED ACTION

2.1 PROJECT DESCRIPTION

The FHWA, INDOT, and KYTC issued a revised Notice of Intent (NOI) in the *Federal Register* on February 13, 2017 for the preparation of an Environmental Impact Statement (EIS) for the I-69 ORX project in the Evansville, IN and Henderson, KY area, which is part of the National I-69 Corridor that extends between Mexico and Canada. An NOI was previously issued for the project on May 10, 2001. Under that NOI, a DEIS was completed in 2004, but the project was subsequently suspended in 2005.

For the new DEIS that was published in the *Federal Register* on December 14, 2018, the project area extends from I-69 (formerly I-164) in Indiana on the south side of Evansville (i.e., northern terminus) across the Ohio River to I-69 (formerly Edward T. Breathitt Pennyrile Parkway) at the KY 425 interchange southeast of Henderson, KY (i.e., southern terminus) (Figure 2-1). The section of Edward T. Breathitt Pennyrile Parkway between KY 351 and KY 425 that was not re-designated as I-69, was recently re-designated as US 41. The western limit of the project area is parallel to and extends a maximum of about 2,000 feet west of US 41. The eastern limit of the project area extends about 1,500 feet to 3.4 miles east of US 41. Currently, I-69 does not cross the Ohio River, and the only cross-river access between Evansville and Henderson is limited to US 41, which is classified as a principal arterial and does not meet interstate design standards.

Based on the project's purpose and need, an initial range of alternatives was developed, evaluated, and screened using secondary source and preliminary survey data, and input from the public and federal, state, and local agencies. As a result of the alternative screening process, three build alternatives, plus the No Build Alternative, were carried forward for more detailed evaluation in the DEIS. The three build alternatives were called West Alternative 1, West Alternative 2, and Central Alternative 1 (Figure 2-2). Two tolling scenarios were developed for Central Alternative 1, designated Central Alternative 1A, which would toll both the new I-69 bridge and the northbound US 41 bridge, and Central Alternative 1B, which would toll only the new I-69 bridge. Based on a comparison of impacts and costs, the DEIS identified Central Alternatives 1A and 1B as the Preferred Alternatives. The following is a description of Central Alternatives 1A and 1B, which, aside from the tolling scenario, are physically identical.

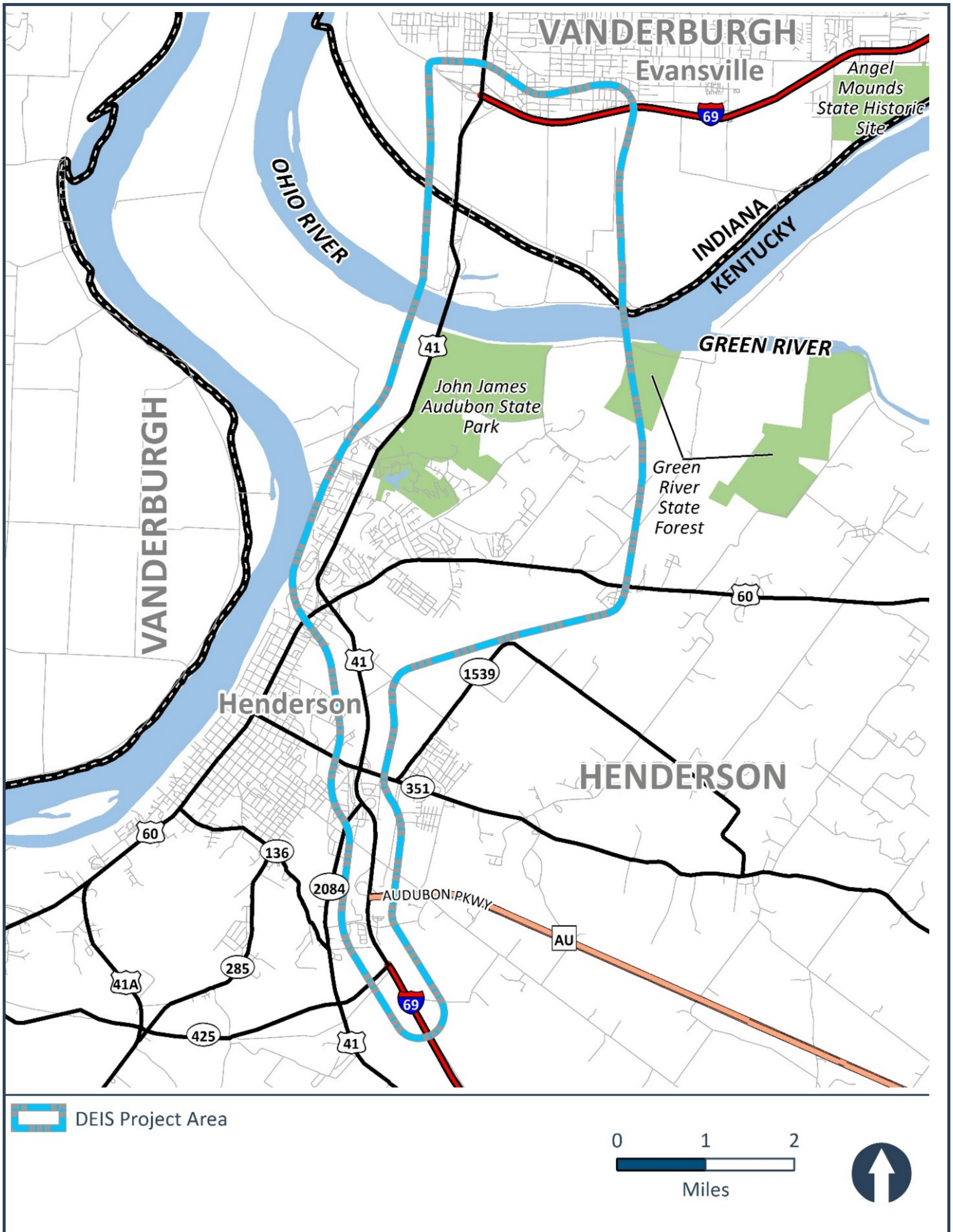

Figure 2-1. DEIS Project Area

Central Alternatives 1A and 1B would include a new bridge approximately 7,600 feet long over the Ohio River and associated floodway, located approximately 1.5 miles east of the existing US 41 bridges. The new Ohio River bridge would include four lanes, and would be wide enough to carry six lanes in the future, if needed, by restriping the lanes on the bridge. The approach roadways would be four lanes wide. The northbound US 41 bridge would be retained for vehicular traffic, and the southbound US 41 bridge would be removed. The northbound US 41 bridge, which has two lanes, would be converted from a one-way bridge to a two-way bridge for local traffic. The I-69 bridge would be tolled under either Preferred Alternative; the decision whether to toll the remaining US 41 bridge has not been made. Other than transitions to the single two-lane US 41 Ohio River bridge, there would be no changes to US 41 through the commercial strip. North of the Ohio River, US 41 would transition back to a four-lane facility.

Central Alternatives 1A and 1B would use rural design standards and include a depressed grass median outside of the bridge limits. The total length of Central Alternatives 1A and 1B is 11.2 miles, which includes 2.8 miles of existing US 41.

Central Alternatives 1A and 1B begin at existing I-69 in Indiana, approximately 1 mile east of the I-69/US 41/Veterans Memorial Parkway interchange. The alternative would continue south across the Ohio River just west of a gas transmission line. It would remain just west of the gas transmission line near Green River State Forest, then turn southwest where an overpass would be provided to carry the access road for the gas transmission line over the alternative. The alternative would continue south to US 60 where an interchange would be provided. As part of the US 60 interchange, US 60 would be relocated approximately 400 feet south, which would require a new bridge over the CSX Railroad east of the interchange. The alternative would continue southwest and connect with US 41 via an interchange approximately 1 mile south of the US 60 interchange. From the alternative's interchange with US 41 to KY 425, the existing four-lane US 41 would be modernized to meet interstate standards through improvements to ramps and merge areas.

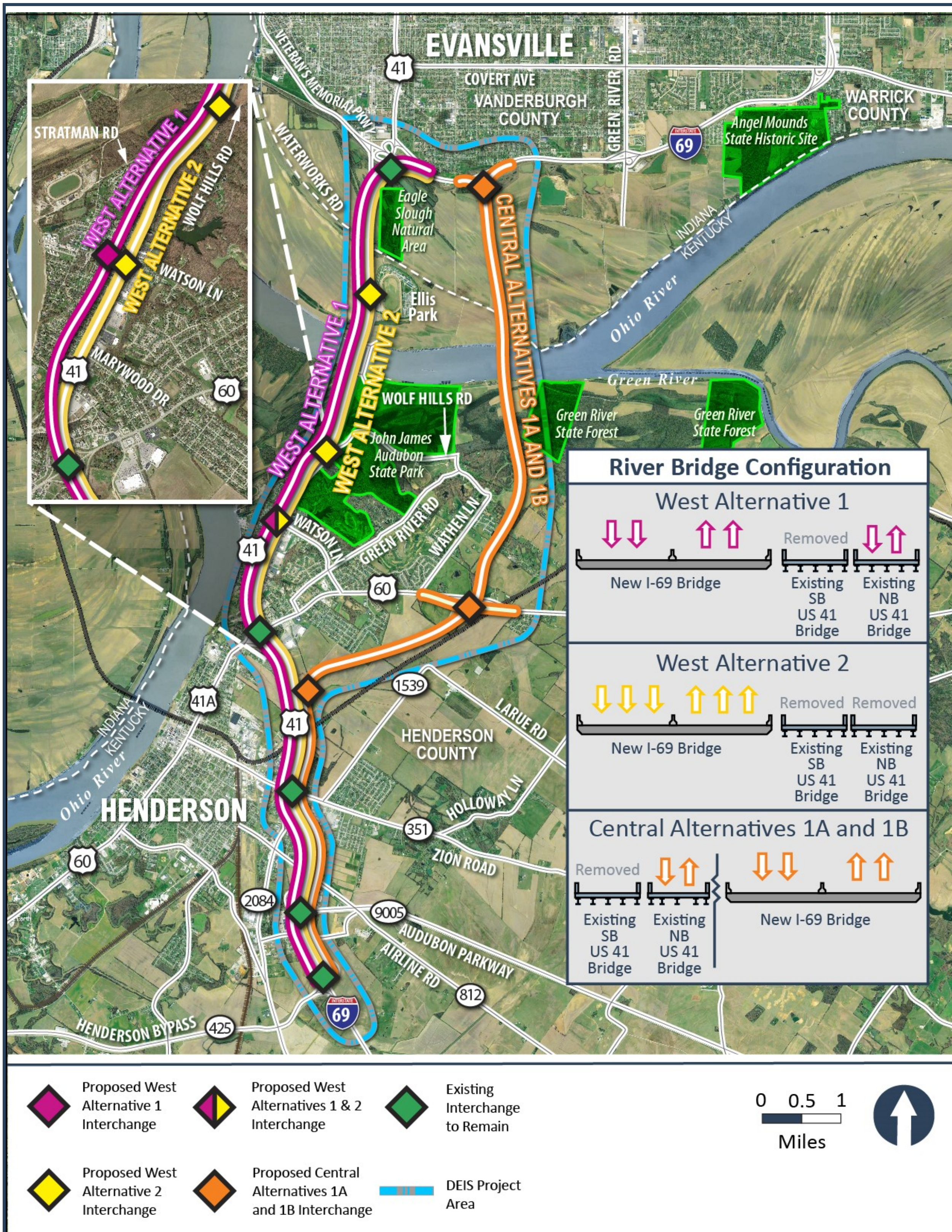

Figure 2-2. DEIS Alternatives

2.2 ENVIRONMENTAL SETTING & ACTION AREA

2.2.1 Environmental Setting

The proposed I-69 ORX project study area begins on the south side of the city of Evansville, located in Vanderburgh County, Indiana and extends south across the Ohio River into the city of Henderson, located in Henderson County, Kentucky. At its northern terminus, the study area falls within the Boonville Hills physiographic region. This region is composed of low elevation rolling hills to the north, flattening out into low-level floodplains near the Ohio River to the south. Across the river into Kentucky, the study area is located within the Western Coalfields physiographic region (Atwood 1940). This region, like the Boonville Hills physiographic region, is composed of low elevation rolling hills with large and wide expanses of floodplain along and adjacent to the banks of the Ohio River. Outside of the urban, commercial, and residential portions of Evansville and Henderson, land use in the area is dominated by a mixture of farmland, forests, and coal mining, particularly strip mining.

Physiographic Regions

While the majority of the study area falls within the lower elevations of each physiographic region where it is dominated by large expanses of bottomland forest, floodplains, and sloughs, slightly higher elevations can be found on the extreme northern and southern edges, as it extends onto the plateau. The study area is located on the Evansville South, Indiana and Henderson, Kentucky United States Geological Survey (USGS) 7.5-minute Topographic Quadrangles.

According to Braun (1950), the study area falls into the Hill Section (Shawnee physiographic area) of the Western Mesophytic Forest Region. The Kentucky portion of the study area is further classified by Braun as part of the Western Coal Fields, and the Indiana portion is simply described as “the Hill Section in Indiana.” Braun’s treatments of these forest areas generally describe the upland forests in this region as mixed mesophytic forest type on northern slopes and oak or oak-hickory forest on drier slopes and ridges. However, in keeping with the transitional nature of the Western Mesophytic Forest Region, lowland valley areas adjacent to the Ohio River differ substantially. Bottomland forests in the “wide flat silt-filled” valleys along the Ohio and Green Rivers consist of trees such as cottonwood (*Populus deltoides*), pin oak (*Quercus palustris*), swamp white oak (*Q. bicolor*), sugarberry (*Celtis laevigata*), silver maple (*Acer saccharinum*), sweetgum (*Liquidambar styraciflua*), and bald cypress (*Taxodium distichum*). These alluvial valleys act as extensions of the Mississippi alluvial plain and make up a large part of the study area.

Major Drainages

The project area lies within the Ohio River watershed. The Ohio River is 981 miles long and flows through six states: Pennsylvania, Ohio, West Virginia, Kentucky, Indiana, and Illinois. These states collaborate with the Ohio River Valley Water Sanitation Commission (ORSANCO), an interstate water pollution control agency, to monitor and assess the river (ORSANCO 2016). The river basin stretches across a 203,940-square-mile area within which over 30 million people reside. There are 33 drinking water utilities that use the river, supplying drinking water to approximately 5 million people. The river has an average depth of 24 feet and an average width of 0.5 mile (ORSANCO 2016). The Ohio River is a series of pools connected by 19 high-lift locks and dams installed by the United States Army Corps of Engineers (USACE) for navigational purposes. The dams maintain a minimum river depth, regulate flow, and affect water quality and aquatic communities of the river. The project area is within the pool between river miles 776.1 and 846.0, bounded by Newburgh Locks and Dam upstream and John T. Myers Locks and Dam on the downstream end (ORSANCO 2016). There is no watershed management plan for the Ohio River. According to the Biennial Assessment of Ohio River Water Quality Conditions - 2010 - 2014, deciduous forests cover most of the land in the Ohio River watershed. Major land uses include pasture, row-crop agriculture, and urban development. Indiana and Kentucky are dominated by agriculture (ORANSCO 2016). Highly populated regions of the river are characterized by residential, commercial, and industrial land use types. Nonpoint source pollution from both urban and agricultural areas is a large contributor to degraded water quality in the river. Several point source pollution issues, such as combined sewer overflows, also exist along the Ohio River. There are approximately 580 permitted discharges into the Ohio River (ORSANCO 2016). The northern portion of the project area drains to Pigeon Creek, which has a drainage area of 375 square miles, and includes Evansville (ORSANCO 2016). For watershed planning purposes, it is combined to form the Highland-Pigeon Creek watershed, which drains approximately 526 square miles in Indiana. According to the Watershed Management Plan for the Highland-Pigeon Watershed, permitted discharges include municipal wastewater treatment plants, industrial discharges, and combined sewer overflows. Major nonpoint sources of pollutants to the watershed are row crop agriculture, mined lands, and urban runoff (Indiana Department of Environmental Management [IDEM] 2018). The other significant tributary watershed within the project area is the Canoe Creek – Ohio River watershed in Henderson County, KY. This watershed drains approximately 182 square miles and discharges directly into the Ohio River west of the project area in Henderson.

The Green River is not within the project area, but flows into the Ohio River just upstream of the project site, influencing biotic assemblages and substrates that extend into the project area. The Green River drains more of Kentucky's land area than any other river, flowing for approximately 379 miles from East to West (Haag & Cicerello 2016). Mussel fauna in the lower Green River are dominated by large river species. A 1989 locality for Sheepnose exists at the confluence of the Green and Ohio Rivers, along with a 1996 record for Kentucky Species of Special Concern Longsolid (Kentucky State Nature Preserves Commission [KSNPC] 2017, Appendix K-1 DEIS). Additionally, a single Fat Pocketbook was found on October 3, 2008 in the Ohio River approximately 2 miles upstream from the confluence of the Green River and has also been found approximately 4.5 miles downstream of the project area (KSNPC 2017). The substrate ground-truthing survey conducted in 2018 showed suitable mussel substrate along the southern edge of the project area in the Central alignment (Stantec 2018a). At least some of that bed material likely originated in the Green River. While outside the project area, the Green River influences the mussel populations within impact areas via flow, substrate supply, and source populations.

USACE, under Section 404 of the Clean Water Act (CWA), regulates Waters of the U.S. (WOTUS), which include federally jurisdictional wetlands, streams, and other surface waters (USEPA 2017). To identify regulated water resources within the project area, a *Waters of the U.S. Technical Report* was prepared, which included a desktop analysis of published data including National Wetlands

Inventory (NWI) maps, USGS topographic maps, and aerial photography. An approximately 300-foot-wide corridor was surveyed along the proposed alternatives with the study corridor widened at proposed interchanges. From June to October 2017, field data were collected to identify and map surface water resources. Full stream delineations and habitat assessments were not conducted, but sufficient evidence was collected to provide informed guidance for the DEIS. A formal delineation and WOTUS report have been conducted and prepared for the preferred alternatives. Regulatory background and detailed survey information are provided in the *Waters of the U.S. Technical Report* (DEIS 2018, Appendix J-1). Field surveys resulted in the identification of 197 streams. Eight streams are perennial, with Eagle Creek, the Ohio River, and North Fork Canoe Creek being the most notable. Seven streams are intermittent and include Mound Slough and Sugar Creek. The jurisdictional perennial and intermittent streams comprise less than 8 percent of all the streams identified. In addition, there are 182 ephemeral streams/channels. Streams in the project area are illustrated in the detailed mapping provided in Appendix C of the *Waters of the U.S. Technical Report*. They are also shown on the Environmental Features maps in Appendix A of the DEIS.

Ohio River Habitat

A study was conducted to verify substrate classification of acoustic side-scan sonar data for the Ohio River within the project area. In November 2017, Mainstream Commercial Divers Inc. (MCDI) collected acoustic side-scan sonar data to map substrate types and evaluate its suitability for mussel habitat. In December 2017, Stantec conducted ground-truthing of this data to inform the formal mussel survey (Stantec 2018a). The side-scan sonar survey indicated eight substrate types, while the field verification generally confirmed these classifications. Much of the habitat appeared to be shifting sands, deemed unsuitable for mussels. However, multiple stable habitats did appear within the project area, mainly in the Central corridor along the southern half of the river. The Central Alternatives 1A and 1B corridor contained coarse gravel/cobble/hardpan /bedrock, which was revealed to contain the highest abundance of mussels during the mussel survey (Stantec 2018b). This corridor also contained predominantly sand on the northern half, with both littoral zones being silt/clay. The western corridor was predominantly sand, with silt/clay and some fine sand/coarse gravel along the littoral zones. MCDI also provided bathymetric data for the project area, helping facilitate the mussel survey and revealing the West Alternatives 1 and 2 corridors to be about 10 feet deeper on the southern side than anywhere else in the project area (Stantec 2018a).

Geology

INDIANA

In Indiana, the project area lies within the Southern Hills and Lowlands physiographic region, specifically the Booneville Hills area (Gray 2001), as shown on Figure 2-1 of the *Phase I Environmental Site Assessment* report in Appendix I-1 of the DEIS. The project area is located on the floodplain of the Ohio River. Elevations range from approximately 360 feet above mean sea level (MSL) near the state boundary to approximately 400 feet above MSL at the existing I-69/US 41/Veterans Memorial Parkway interchange (USGS 2016). The project area is underlain by the Patoka, Shelburn, and Carbondale formations that are upper to middle Pennsylvanian-age bedrock. The general geology of Indiana is shown in Figure 2-4 of the *Phase I Environmental Site Assessment*. The Carbondale Formation forms the uppermost bedrock in southern Vanderburgh County. Within the project area this formation is approximately 100 feet below grade (Indiana Geology and Water Survey [IGWS] 2017). This formation consists primarily of shale and sandstone, with lesser amounts of siltstone, limestone, and coal. The Carbondale Formation includes four of the five most productive coal seams in Indiana (Camp 1999).

KENTUCKY

Henderson County is within the Western Kentucky Coal Field physiographic province (Kentucky Geological Survey [KGS] 2001), as shown on Figure 2-5 of the *Phase I Environmental Site Assessment*. The broad floodplain along the Ohio River is covered with sloughs and marshes with elevations ranging from 350 to 370 feet above MSL. South of the floodplain the terrain is rolling. The greatest local relief and the highest elevations are found in the bluffs adjacent to the floodplain. The highest elevation in the county, 588 feet above MSL, is in Wolf Hills, a neighborhood of Henderson, KY (Carey 2005). The Pennsylvanian-aged Shelburn and Patoka Formations are the uppermost bedrock formations in northern Henderson County. These strata are comprised of shale, sandstone, siltstone, coal, and limestone and are almost completely covered by overburden soils (Moore 2009). The depths to bedrock are greatest within the ancient bedrock valley beneath the current Ohio River floodplain. The bedrock valley comprises moderately to steeply sloped valley walls with soil depths to about 115 feet within the project area. The bedrock depths in upland areas can be relatively shallow based on the varying thickness of the overlying loess and lacustrine deposits (Haase 2011).

Karst Features

A desktop study was conducted to identify the potential for karst features, such as caves and sinkholes, within the project area. No mapped karst features were identified. While dissolution features may be present within carbonate bedrock layers, within the project area in Indiana, the bedrock is covered by approximately 100 feet of unconsolidated alluvial and outwash deposits (IGWS 2017). The project area is outside of designated karst areas in both Kentucky and Indiana (KGS 2014 and INDOT 2017). Based on the bedrock lithology and the relatively thick overburden soils, the surface expression of shallow karst features is not anticipated.

Abandoned underground mines are often associated with areas having some topographic relief in the Western Coalfield. A single underground mine was mapped by Kentucky Division of Mine Safety within the proposed project corridor in the Wolf Hills Region (KYDMS 2019). This area was visited by Stantec biologist and no openings to the underground mine workings were observed, but some areas of browning vegetation and a sunken area provide potential evidence of previous openings.

2.2.2 Action Areas

The action area is defined as all areas to be affected directly or indirectly by the construction of the project (Federal Action) and not limited to the footprint of the project. The action area for this route includes bottomland hardwood forest, mixed deciduous forest, wetland scrub-shrub, upland scrub-shrub, old field, open water, riverine, maintained and mowed areas, residential, agricultural row crops, and commercial paved areas. Table 2-1 shows the amount of acreages of various habitats to be directly affected by the proposed project. This table is from the *Endangered, Threatened, and Rare Species Habitat Assessment and Wildlife Technical Report*, which can be found in Appendix K-1 of the DEIS.

Table 2-1. Habitat types and acreage of construction for Central Alternatives 1A and 1B (Preferred).

HABITAT TYPE	CENTRAL ALTERNATIVES 1A AND 1B (ACRES)	
	INDIANA	KENTUCKY
Bottomland Hardwood Forest	12.2	8.7
Mixed Deciduous Forest	0.0	24.9
Wetland Scrub-shrub	3.4	0.3
Upland Scrub-shrub	0.0	4.8
Old Field	12.4	19.1
Open Water	13.3	0.0
Riverine	0.0	4.3
Maintained and Mowed Areas	0.7	7.1
Residential	0.0	6.1
Agricultural Row Crops	54.1	181.3
Habitat Total	96.1	256.7
Non-habitat (Commercial and Paved)	9.4	16.1

The construction of a new bridge and potential demolition of one of the existing bridges will primarily affect agricultural row crops, wetland scrub-shrub (riverbank), and a section of the river, while the remaining roadway construction will affect various acreages of all the remaining habitat types as shown in Table 2-1. Direct and indirect environmental effects to all of these habitat types are expected during project construction. Project-related environmental effects include habitat destruction and/or alteration/conversion, erosion, siltation, sedimentation, scour, earth disturbance, and temporary and permanent hydrologic alteration.

The associated roadway construction connecting the Ohio River bridge with existing I-69 in Evansville on the north side of the river and I-69 in Henderson on the south side of the river may impact acreages of various non-riverine habitats listed in Table 2-1. A description of each of these habitats can be found in Chapter 4 of the *Endangered, Threatened, and Rare Species Habitat Assessment and Wildlife Technical Report*. The greatest impact will be to agricultural row crops, which make up approximately 71 percent of the habitats impacted by the Preferred Alternatives. Due to the evolution of bridge construction plans and discussions with agencies involving indirect effects associated with river bottom scour from bridge piers, the amount of acreage of riverine habitat has increased since the preparation of the *Endangered, Threatened, and Rare Species*

Habitat Assessment and Wildlife Technical Report. Species impact acreages reported in Appendix K-1 of the DEIS have also been modified to better reflect bridge construction plans and indirect effects. Two pier location options have been considered: one that provides a single navigation channel, and one that provides two navigation channels. Construction of the two navigational channel design will affect 8.8 acres of aquatic habitat in the Ohio River. The single navigational channel design would affect less acreage of Ohio River habitat. This BA will use the two navigational channel design for the effects analysis to provide conservative estimates of impacts. Physical impacts related to I-69 bridge construction include areas in the river where piers will be installed (0.39 ac), areas around these pier locations where barges will spud (mooring midchannel using removable steel pilings attached to the barge) (8.46 ac), steel pilings from causeway installation (4.16 ac), and fill along both riverbanks (1.41 ac) (Figure 2-3). Additional impacts of bridge construction total an estimated 5.75 acres of scouring and hydrology changes resulting from pier installation and 330 acres of downstream water quality impacts such as increased suspended solids (Figure 2-4). Impact areas from the US 41 bridge removal total an estimated 28.8 acres and include the downstream area where deconstructed bridge sections will potentially be dropped into the river prior to removal (27.1 ac) as well as the area immediately around the piers that will potentially be removed via explosives (1.74 ac) (Figure 2-5). Indiana Bat habitat that will be impacted by the project includes 45.8 acres, including 33.6 acres in Kentucky and 12.2 acres in Indiana which includes bottomland hardwood forest and mixed deciduous forest listed in Table 2-1 (Figure 2-6 to Figure 2-9).

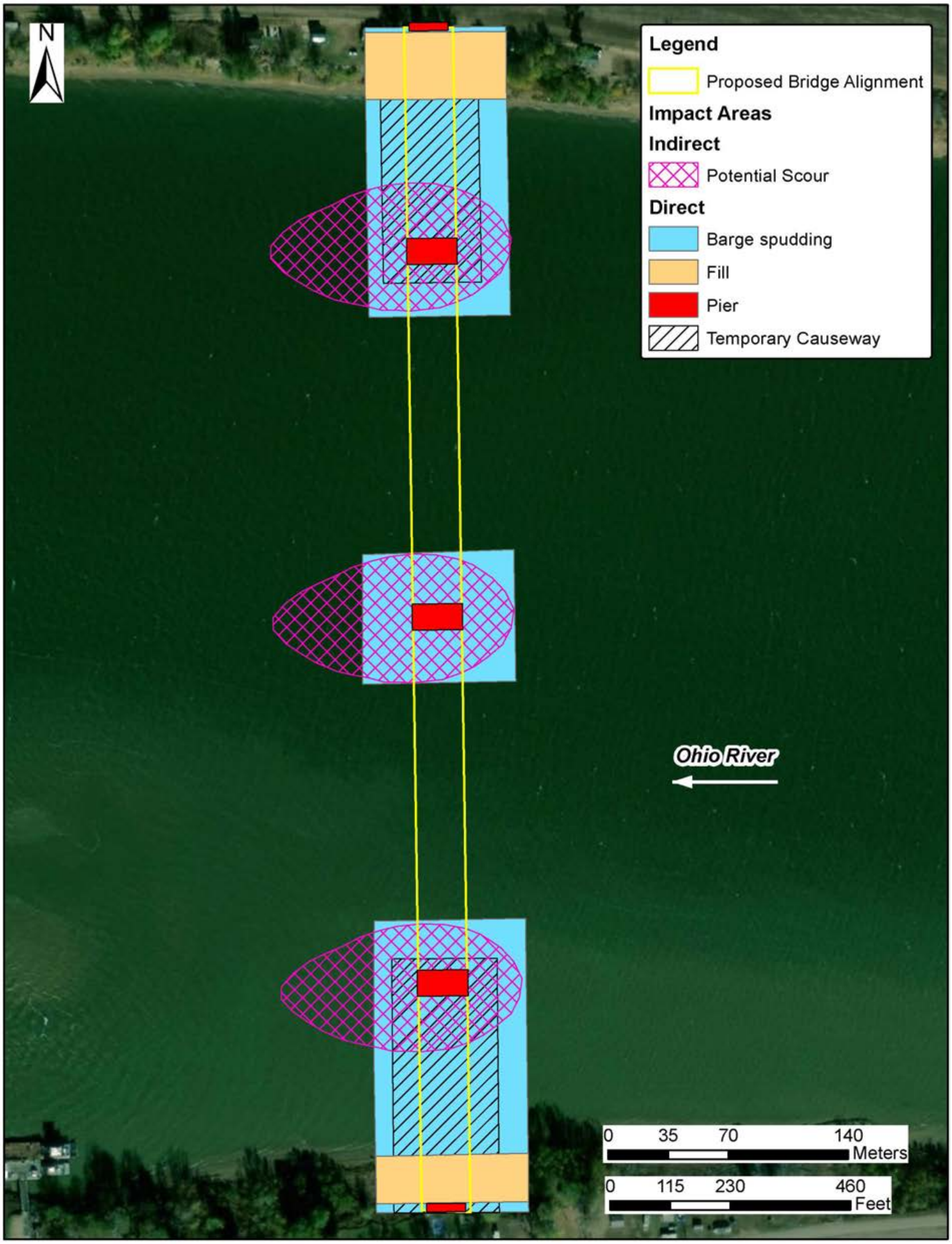

Figure 2-3. Affected Area Central Alternatives 1A and 1B

Figure 2-4. Downstream Adverse effects Central Alternatives 1A and 1B

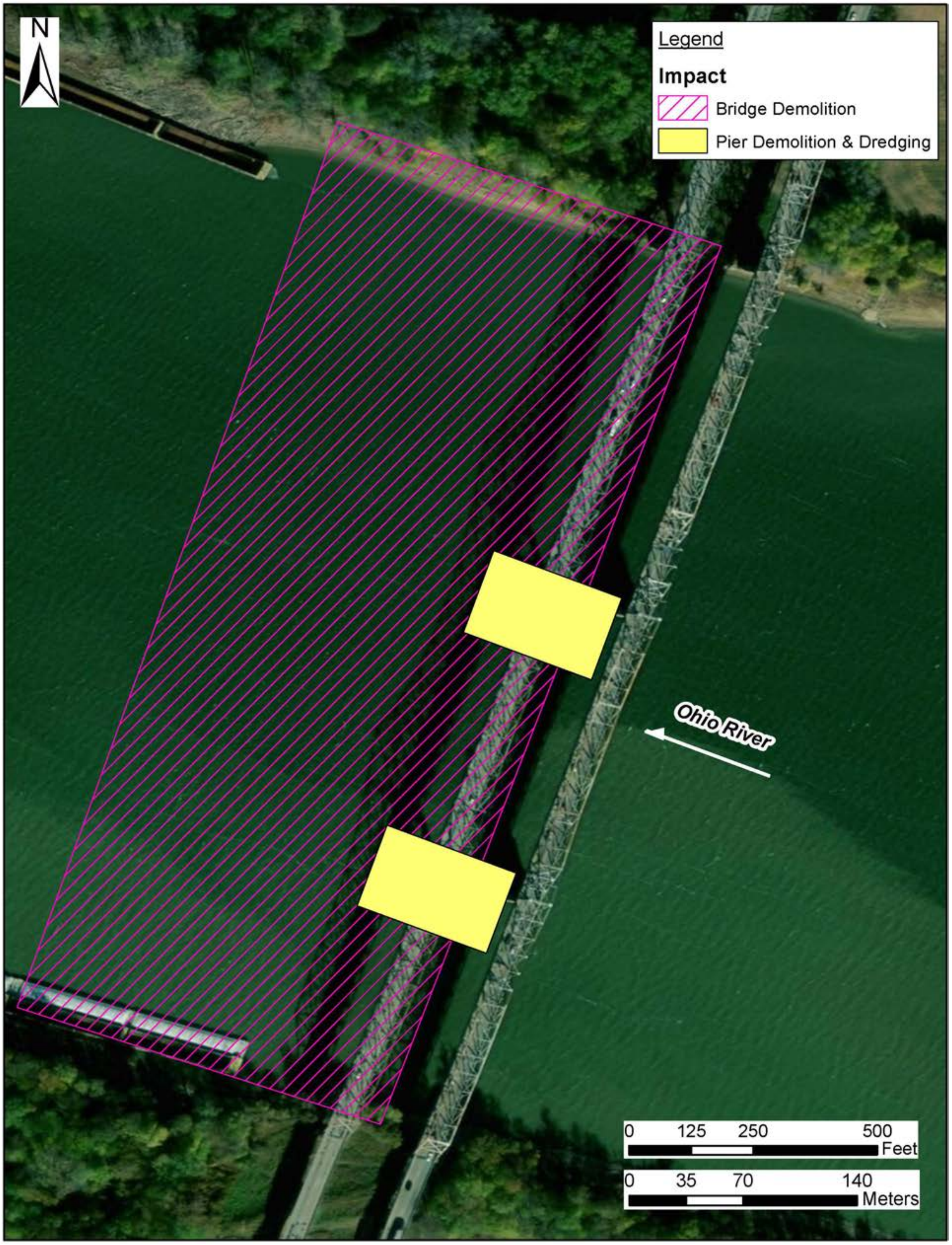

Figure 2-5. Area Affected by Bridge Demolition

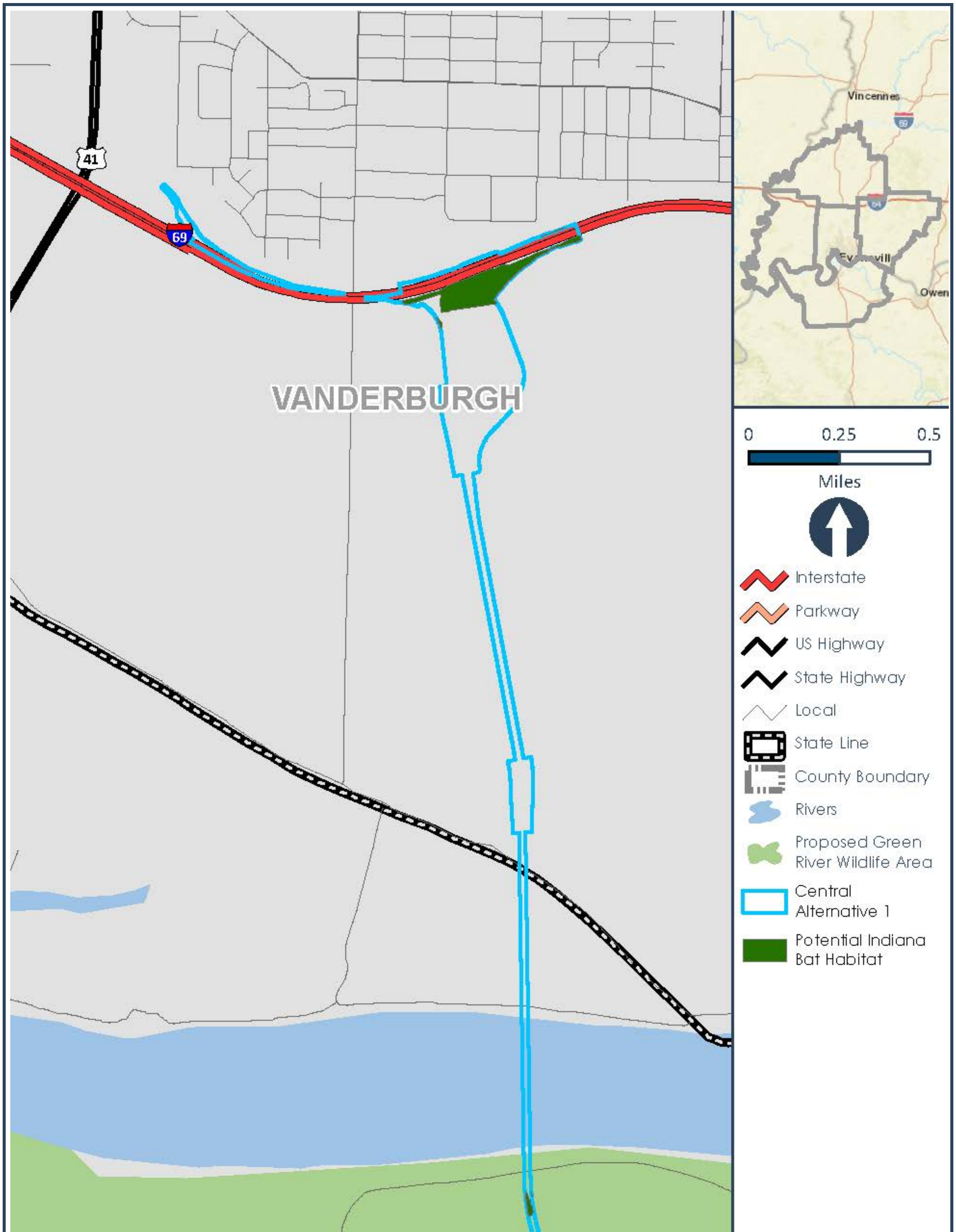

Figure 2-6. Area of Bat Habitat Impacted – Central Alternatives 1A/1B

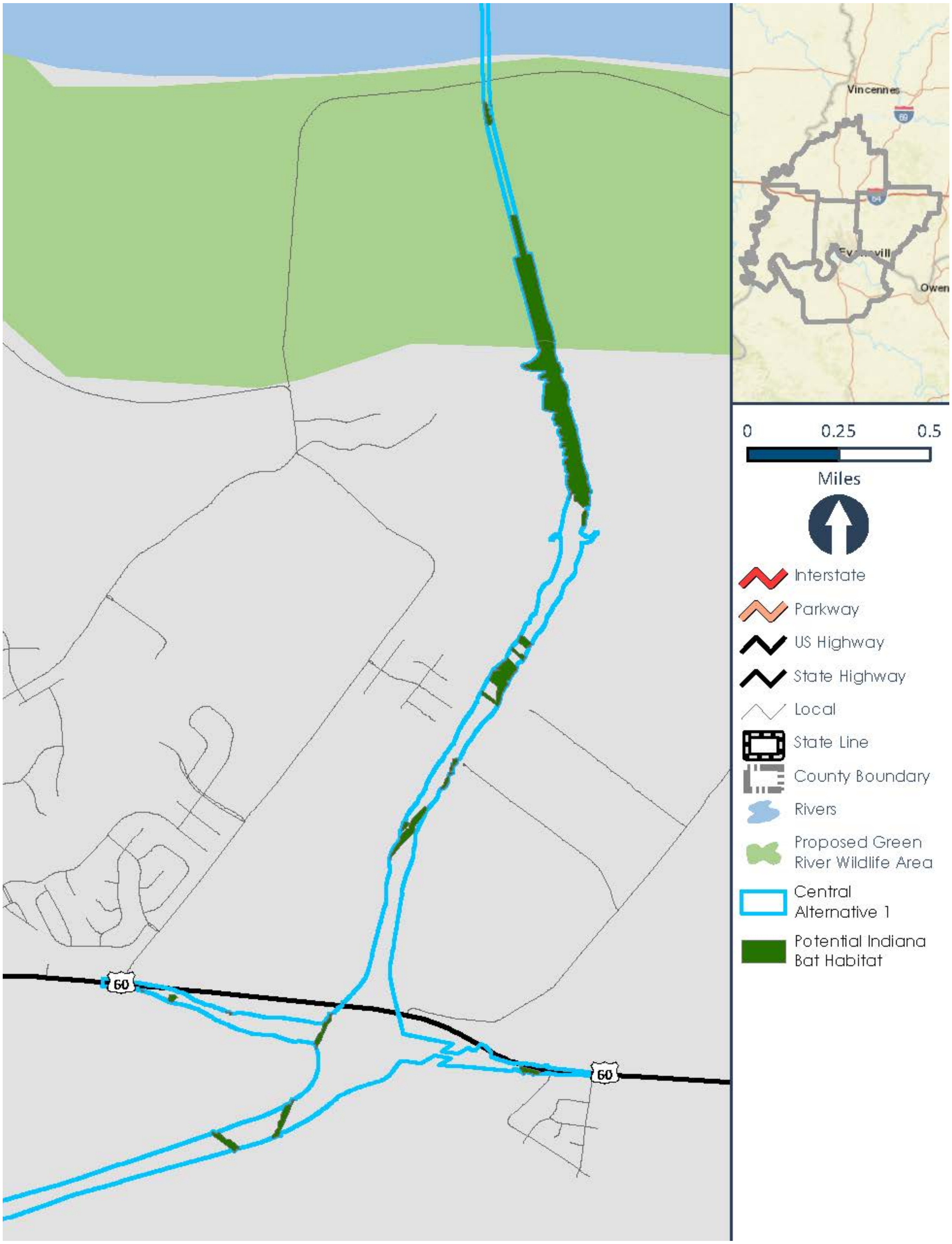

Figure 2-7. Area of Bat Habitat Impacted – Central Alternatives 1A/1B

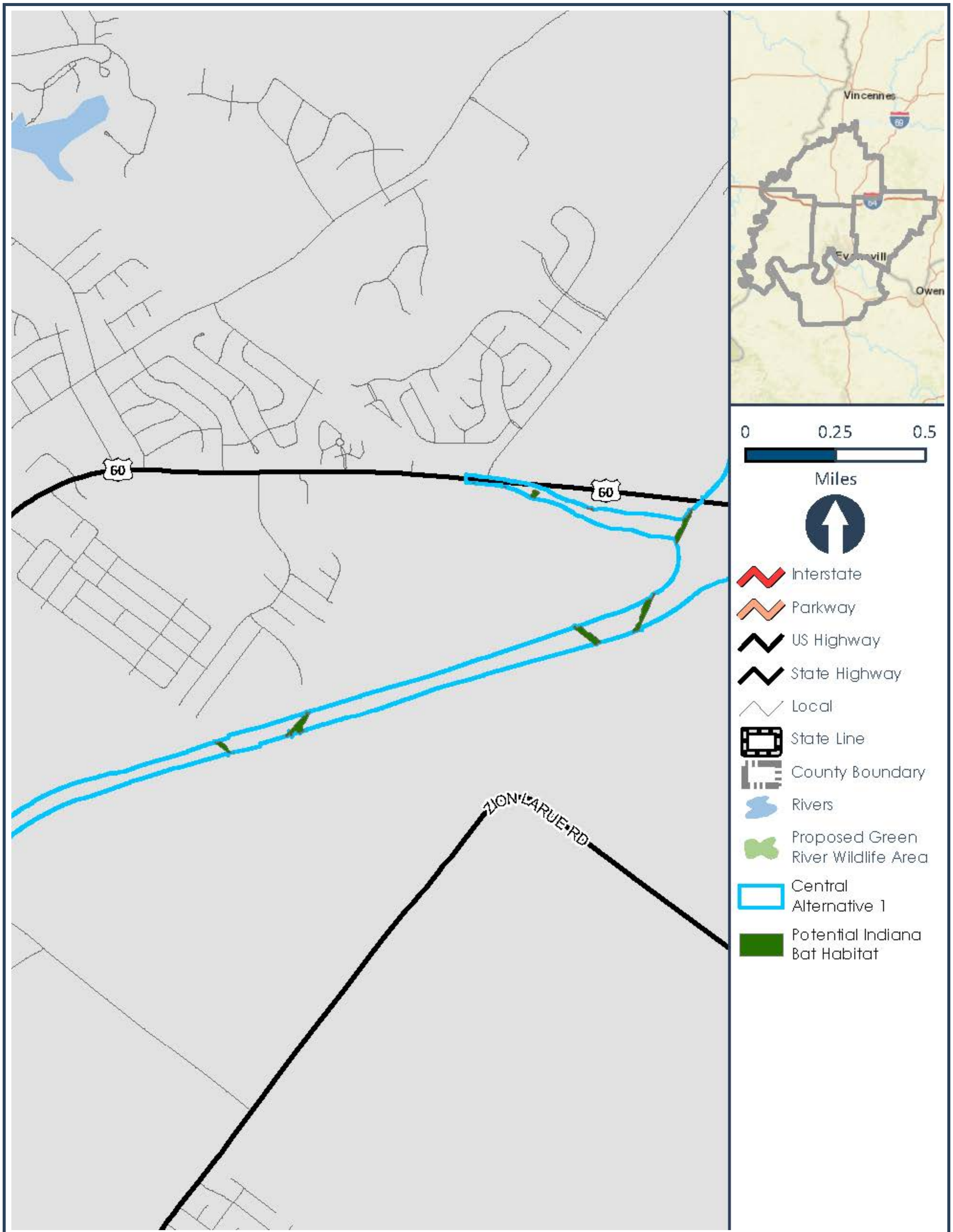

Figure 2-8. Area of Bat Habitat Impacted – Central Alternatives 1A/1B

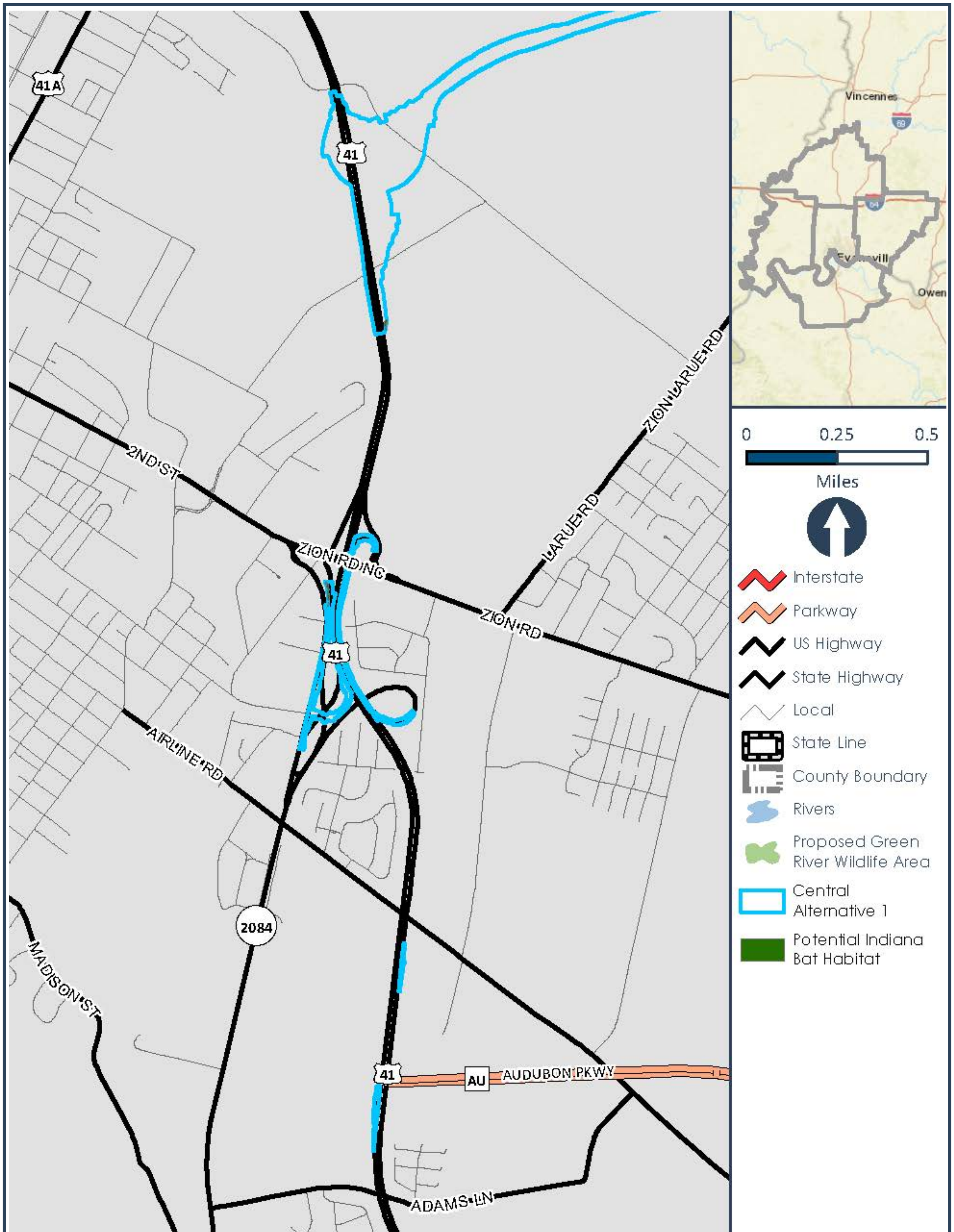

Figure 2-9. Area of Bat Habitat Impacted – Central Alternatives 1A/1B

CHAPTER 3 – LISTED SPECIES INFORMATION

3.1 IDENTIFICATION OF LISTED SPECIES

Initial identification of federally listed species with the potential of occurring within the I-69 ORX study area was obtained by reviewing the Henderson County, KY and Vanderburgh County, IN endangered, threatened, and rare species lists maintained by the KSNPC and the Indiana Department of Natural Resources - Division of Nature Preserves (IDNR-DNP), respectively (KSNPC 2015, IDNR 2017a). Data included in the *Report of Endangered, Threatened, and Special Concern Plants, Animals, and Natural Communities for Henderson County, Kentucky* was current as of December 2015 (KSNPC 2015), while data included in the online report entitled *Indiana County Endangered, Threatened and Rare Species List, County: Vanderburgh* was current as of February 11, 2016.

The USFWS's Information for Planning and Consultation (IPaC) online system was reviewed to identify the federally listed species known or expected to occur within the I-69 ORX study area. This data source provided an additional eight species, including five freshwater mussels, one bird, and two bats. Discrepancy in the state lists and USFWS's IPaC was most likely due to expectations of a species occurring within the I-69 ORX study area versus the species known to occur within the two counties. Table 3-1 contains all of the USFWS listed species potentially occurring within the I-69 ORX project corridor (USFWS 2018).

From the original list of species (Table 3-1), the American burying beetle (*Nicrophorus americanus*) was removed from further analysis because it was considered historic from within the I-69 ORX project counties. All of the remaining species in Table 3-1 were initially reviewed for habitat and distribution within or near the I-69 ORX project corridor. Habitat assessments for all of these species were completed and described in the *Endangered, Threatened, and Rare Species Habitat Assessment and Wildlife Technical Report*, which can be found Appendix K-1 in the DEIS. Due to the potential occurrence of the Gray Bat (*Myotis grisescens*), and the known occurrence of the Indiana Bat (*Myotis sodalis*) and the Northern Long-Eared Bat (*Myotis septentrionalis*) within the I-69 ORX project corridor, which is shown as " Known Summer 1 Habitat" as outlined on the USFWS maps in the *Revised Conservation Strategy for Forest-Dwelling Bats in the Commonwealth of Kentucky* dated June 2016, the three bat species are reasonably certain to be present. Habitat assessments and communications with USFWS on June 20, 2017 determined the current river conditions within the project corridor didn't provide adequate conditions for the Least Tern (*Sternula antillarum*) to nest, but the species could periodically visit the area for foraging. Even though only three species of mussel, the Sheepnose (*Plethobasus cyphyus*), Fat Pocketbook (*Potamilus capax*), and the Rabbitsfoot (*Theliderma cylindrica*), were recently found near the project corridor, all of the mussel species in Table 3-1 were further evaluated since surveys would be completed within the project corridor. No designated critical habitat or excellent quality natural communities were identified for any of the listed species within the I-69 ORX Central Alternatives 1A and 1B.

Table 3-1. USFWS Listed Species Identified from Various Sources as Potentially Occurring Within the I-69 ORX Project Corridor, Vanderburgh County, IN and Henderson County, KY.

TAXONOMIC GROUP	SPECIES SCIENTIFIC NAME	SPECIES COMMON NAME	FEDERAL STATUS
Mussel	*Cyprogenia stegaria*	Fanshell	Listed Endangered
Mussel	*Epioblasma obliquata*	Catspaw	Listed Endangered
Mussel	*Epioblasma rangiana*	Northern Riffleshell	Listed Endangered
Mussel	*Epioblasma triquetra*	Snuffbox	Listed Endangered
Mussel	*Lampsilis abrupta*	Pink Mucket	Listed Endangered
Mussel	*Margaritifera monodonta*	Spectaclecase	Listed Endangered
Mussel	*Obovaria retusa*	Ring Pink	Listed Endangered
Mussel	*Plethobasus cooperianus*	Orangefoot Pimpleback	Listed Endangered
Mussel	*Plethobasus cyphyus*	Sheepnose	Listed Endangered
Mussel	*Pleurobema clava*	Clubshell	Listed Endangered
Mussel	*Pleurobema plenum*	Rough Pigtoe	Listed Endangered
Mussel	*Potamilus capax*	Fat Pocketbook	Listed Endangered
Mussel	*Theliderma cylindrica*	Rabbitsfoot	Listed Threatened
Insect	*Nicrophorus americanus*	American burying beetle	Listed Endangered
Bird	*Sternula antillarum*	Least Tern	Listed Endangered
Mammal	*Myotis grisescens*	Gray Bat	Listed Endangered
Mammal	*Myotis septentrionalis*	Northern Long-Eared Bat	Listed Threatened
Mammal	*Myotis sodalis*	Indiana Bat	Listed Endangered

3.2 SPECIES STATUS

This section discusses the range-wide status of the listed species, as well as presents information relevant to formulating a biological opinion. This information will include the species life history, habitat and distribution, and the effects of past human and natural factors that have led to the status of the species. Nomenclature for freshwater mussels follows Williams et al. (2017).

3.2.1 Mammals

Three different mammals, all bat species, have the potential to be affected by construction of I-69. Surveys were not performed for these species, however, their range overlaps with the project footprint and may be present. All three of these species are assumed to be present within the project corridor. The species are described in greater detail below.

Indiana Bat

The Indiana Bat (*Myotis sodalis*) was listed as being in danger of extinction under the Endangered Species Preservation Act of 1966 on March 11, 1967 (32 FR 4001). When this act was amended in 1973 and renamed the ESA, the Indiana Bat was listed as endangered. Critical habitat was designated in 1977, and a draft recovery plan was released by USFWS in 2007 (42 FR 47840 – 47845, USFWS 2007a).

The Indiana Bat is a small, brownish bat with blackish wings (Kurta 1995) similar in appearance to the Little Brown Bat and the Northern Long-Eared Bat. The Indiana Bat can be distinguished from these two species based on the following characteristics: (1) the Indiana Bat has smaller feet and shorter hairs on its toes (the hairs do not extend beyond the toenails); (2) the Indiana Bat has a distinct keel on the calcar, a spur on the membrane between the foot and the tail; and (3) the Indiana Bat has a pinkish colored pug-nose (Mumford and Whitaker 1982, Whitaker and Hamilton 1998).

HABITAT

During the winter, the Indiana Bat generally hibernates in caves, although abandoned mines, abandoned railroad tunnels, and even a hydroelectric dam have also been used (USFWS 2007a). The range of the Indiana Bat includes much of the eastern United States. It occurs from Iowa, Oklahoma and Wisconsin, northeast to Vermont, and south to northwestern Florida and northern Arkansas (Barbour and Davis 1969). The majority of the wintering population occurs within the limestone cave region of Indiana, Kentucky, and Missouri. As of the 2019 survey period, 537,297 Indiana Bats were estimated range-wide, and hibernacula were documented in 17 states, including Alabama, Arkansas, Georgia, Illinois, Indiana, Kentucky, Michigan, Missouri, New Jersey, New York, North Carolina, Ohio, Pennsylvania, Tennessee, Vermont, Virginia, and West Virginia. Critical Winter Habitat was designated in 1977 and includes 11 caves and two non-coal mines, including six in Missouri, two each in Indiana and Kentucky; and one each in Illinois, Tennessee, and West Virginia (42 FR 47840 – 47845, USFWS 2007a). Currently, the 10 largest hibernacula include seven caves and three mines located in Missouri, Illinois, Indiana, Kentucky, and New York (USFWS 2019a). In winter, Indiana Bats are typically found in dense clusters on the ceilings and walls of hibernacula where winter temperatures are 37.4 – 45.0˚ F (3.0 – 7.2^0 C). Sites containing populations where temperatures are outside this range have shown population declines (Tuttle and Kennedy 2002). Stable low temperatures allow Indiana Bats to maintain a low rate of metabolism and conserve fat reserves through the winter until spring emergence (Humphrey 1978, Richter et al. 1993). As with temperature, relative humidity of hibernacula also determines hibernation site suitability for Indiana Bats. According to Hall (1962), Humphrey (1978), and LaVal et al. (1976), humidity at roost sites during hibernation is usually above 74%, but below saturation.

Summer distribution of the Indiana Bat occurs throughout a wider geographic area than winter distribution. The core summer range includes southern Iowa, northern Missouri, northern Illinois, northern Indiana, southern Michigan, and western Ohio. The presence of Indiana Bats in a particular area during the summer appears to be determined largely by the availability of suitable natural roost structures. Suitable roost trees are characterized by condition (live or dead), the amount of exfoliating bark, the tree's exposure to solar radiation, its relative location to other trees, and availability of a permanent water source and foraging areas (USFWS 2007a). Dead trees with a combination of loose, exfoliating bark, cracks, and crevices are preferred as maternity roosts; however, live trees are often used as secondary roosts depending on microclimate conditions (USFWS 2007a). Over 30 species of trees have been documented as maternity roosts, but 87 percent of these are various ashes (*Fraxinus* spp.), elms (*Ulmus* spp.), hickories (*Carya* spp.), maples (*Acer* spp.), poplars (*Populus* spp.), and oaks (*Quercus* spp.) (Kurta 2004). Roost trees are typically located within 1,600 feet of a perennial or intermittent stream (Gardner et al. 1996). According to the USFWS (2017), any forest where trees equal to or greater than five inches diameter at breast height (DBH) are present is considered to have potential roosting habitat for the Indiana Bat. In addition, any suitable roost tree (trees meeting the above criteria) within 1,000 feet of a larger forested area could be considered potential roosting habitat for the Indiana Bat (USFWS 2017).

LIFE HISTORY

The Indiana Bat annually repeats a cycle of six life history events: (1) spring "staging" period upon its emergence from hibernation, (2) spring migration, (3) summer birthing, (4) fall migration, (5) fall "swarming" prior to hibernation, and (6) hibernation (USFWS 2007a).

Indiana Bats begin to arrive at their hibernacula as early as late July and may continue through September and early October, with the number of bats at the hibernacula peaking in September to early October (Brack 1983, Cope and Humphrey 1977). Upon arrival the bats engage in a behavior known as fall swarming. Swarming is characterized by large numbers of Indiana Bats coming together in a mating frenzy at the entrances of hibernacula before hibernating (Cope and Humphrey 1977). Sperm is transferred to the females during swarming, but ovulation and fertilization of eggs are delayed until after the end of hibernation in spring (Guthrie 1933 in USFWS 2007a). By late September, many females begin hibernation, and swarming bats are predominantly male.

The Indiana Bat emerges from hibernation from March through May and engages in spring staging before migrating to its summer habitat. Female bats start to leave hibernacula in late March – early April and peak emergence occurs in mid-April with few or no females remaining in early May; while most males leave the hibernacula by mid-May (Cope and Humphrey 1977, LaVal and LaVal 1980). During the spring staging period, the bats begin their feeding forays, and some copulation may also occur (Whitaker and Hamilton 1998). Once on their summer range, female Indiana Bats will form maternity colonies usually consisting of less than 100 individuals (Britzke et al. 2003), typically under the bark of dead or dying trees (USFWS 2010).

The Indiana Bat may travel several miles from day roosts to foraging areas. Gardner et al. (1991) found that individuals from an Illinois maternity colony traveled 2.5 miles to foraging areas. In fragmented habitat, bats will use hedge rows and other features on the landscape as travel ways between foraging areas and day roosts (Murray and Kurta 2004). Rather than crossing open habitats (e.g., pasture land, open water, agricultural fields) the Indiana Bat will increase travel distance by 55 percent in Michigan to take advantage of the protective cover of tree-lines (Murray and Kurta 2004). Known to forage in both upland and floodplain forest (Brack 1983, Humphrey et al. 1977, LaVal and LaVal 1980, Gardner et al. 1991, Kiser and Elliott 1996), Indiana Bats are opportunistic foragers, feeding on a variety of small insects. Diets of Indiana Bats vary between habitats, geographic locations, season, sex, and age of the bat (Kurta and Whitaker 1998, Brack and LaVal 1985, Belwood 1979). Sparks and Whitaker (2004) summarized food habit studies conducted over 30 years and determined that an Indiana Bat's diet consisted primarily of insects belonging to the orders Diptera (flies), Lepidoptera (moths) and Coleoptera (beetles), but when locally abundant, Trichoptera (caddisflies) and Hymenoptera (wasps and ants) may be the predominant food. Several pest species including mosquitoes (Diptera: Culicidae), Asiatic oak weevil (*Cyrtepistomus castaneus*), spotted cucumber beetle (*Diabrotica undecimpunctata*), and Hessian fly (*Mayetoila destructor*) are also consumed by Indiana Bats when locally abundant (Sparks and Whitaker 2004, Kurta and Whitaker 1998, Kiser and Elliott 1996).

Foraging activity is usually interrupted by periods of rest, referred to as night roosting. Most Indiana Bats apparently use trees as night roosts (Butchkoski and Hassinger 2002, Murray and Kurta 2004), although they do occasionally use bat boxes (Burchkoski and Hassinger 2002), and concrete bridges (Kiser et al. 2002). Night roosting is any time a bat stops flying during the night. The purpose of night roosts is to provide bats a resting place between foraging bouts, promote digestion and energy conservation, provide retreats from predators and inclement weather, provide places to ingest food transported from nearby feeding areas, function as feeding perches for sit-and-wait predators, and serve as a place to promote social interactions and information transfer (Ormsbee et al. 2007).

Threats

The Indiana Bat faces several threats. Human activity, such as alterations of caves and cave entrances (hibernation habitat) alter air flow, temperatures, and humidity levels (USFWS 2007a). These changes can make once hospitable caves less suitable. Other threats include flooding, either due to natural or human activity, loss of forested habitat that supports foraging and maternity areas, vandals, and white-nose syndrome (WNS) (USFWS 2007a, Johnson and King 2018). WNS is a disease in North America that is caused by a fungus that thrives within cold, humid caves. It has a high mortality rate in several hibernating bat species, especially in the northeastern U.S. (Whitenosesyndrome.org 2019).

Gray Bat

The USFWS listed the Gray Bat (*Myotis grisescens*) as an endangered species on April 28, 1976, and the bat received protection under the ESA of 1973 (41 FR 17736 – 17740). Several years following its listing, a Gray Bat recovery plan was developed by biologists (i.e. the recovery team), which outlined habitat requirements, critical habitat, potential causes for declines, and recovery objectives. The recovery plan was reviewed and published by the USFWS in 1982 (Brady et al. 1982).

The Gray Bat was described as a separate species in 1909 from specimens collected at Nickajack Cave, Marion County, Tennessee (Decher and Choate 1995). The Gray Bat can be distinguished from other *Myotis* species by its long forearm, typically 1.57 to 1.81 inches (40 – 46 mm), the attachment of wing membrane to the ankle rather than on the foot, its uniformly gray from base to tip pelage, and a distinctive notch in the inside curve of each toenail (Brady et al. 1982, Whitaker and Hamilton 1998).

Habitat

The Gray Bat roosts in cave-like environments, usually made of limestone, year-round. Summer maternity caves trap warm air, in the range of 57.2 – 77.0˚ F (14 – 25˚ C) and have high ceilings (Brady et al. 1982). Along with temperature, some researchers have found maternity colonies to have high humidity, which may also be an important parameter (Elder and Gunier 1981).

Maternity colonies are usually located less than 2.5 miles (4 kilometers [km]) from waterbodies for foraging (Tuttle 1976). Tuttle (1976) found Gray Bat maternity colonies ranging from 0.0 to 4.1 miles (0.0 to 6.6 km) distance from major sources of water. There have been rare instances of Gray Bats using manmade structures for maternity roosting. One maternity colony was found in a storm sewer in Pittsburg, Kansas, another in a similar storm sewer in Illinois, and one using an abandoned barn in Missouri (Gunier and Elder 1971, Elder and Gunier 1978). According to the recovery plan, 30 different caves are listed as Priority One maternity colony sites with eight in Missouri, six each in Alabama and Tennessee, four in Kentucky, three in Florida, two in Arkansas, and one in Illinois (Brady et al. 1982).

Male Gray Bats and nonreproductive females form bachelor colonies, which can be found using separate chambers of maternity roosts or can form roosts in separate caves (Gunier and Elder 1971, 1978, Tuttle 1979).

Winter caves for Gray Bat hibernation are typically deep and vertical with descending floors, deep pits, or large entrances that allow cold winter air inside (Brady et al. 1982, Elliot 2007). The caves trap cold air underground and are expansive. The temperature range in a Gray Bat winter hibernation cave is approximately 42.8 – 51.8˚ F (6 – 11˚ C) (Brady et al. 1982). The Gray Bat arrives at caves used as hibernacula during September and October each year. Bats typically form dense clusters of up to several thousand individuals on cave ceilings and walls (Sealander and Heidt 1990, Hall 1962).

The Gray Bat is restricted in distribution to the limestone-karst areas of the eastern and southern United States (Hall 1981, Hall and Wilson 1966, Brady et al. 1982). The only major Gray Bat hibernacula in Kentucky are found near Mammoth Cave National Park. These three caves contain approximately 350,000 bats and represent more than 99 percent of Kentucky's winter Gray Bat population (Mike Armstrong, USFWS, unpublished data). Based on data received from KSNPC (2017) and IDNR (2017), the Gray Bat has not been captured in Henderson County, KY, or Vanderburgh County, IN. However, acoustic data recorded from near the Henderson County Airport (KSNPC 2017) indicates that this species may be present. In addition, a Gray Bat from Vanderburgh County was submitted to the rabies laboratory (Whitaker and Mumford 2009). Currently, no maternity roost or hibernaculum are known to occur from this portion of Kentucky and Indiana.

LIFE HISTORY

Copulation in Gray Bats occurs in late fall prior to hibernation (Sealander and Heidt 1990, Barbour and Davis 1969). Once mating has occurred, the females immediately go into hibernation. This timeframe can vary from the beginning of September to the beginning of October. Copulation is energetically expensive for male Gray Bats. For this reason, the males remain active for several weeks after females to replenish fat reserves for hibernation. Most Gray Bats will be congregated in their hibernacula by early November (Brady et al. 1982).

Gray Bats emerge from hibernation beginning in late March until approximately mid-May, beginning with adult females. Yearlings of both sexes leave the hibernacula next, followed by adult males (Brady et al. 1982, Whitaker and Hamilton 1998). Gray Bats are known to disperse distances ranging from a few miles/km to a maximum of 398 miles (640 km) from their hibernacula (Elder and Gunier 1978). One study found the average distance to be 35 miles (57 km) and the maximum distance 157 miles (253 km) (Colaskie et al. 2018).

Gray Bats emerge from caves or other roosts at dusk to forage for insects. Gray Bats most often forage over bodies of water (reservoirs and streams) (LaVal et al. 1977). Sealander and Heidt (1990) and LaVal et al. (1977) found that Gray Bats usually forage below treetop height, sometimes as low as 6.56 feet (two meters) or lower. LaVal et al. (1977) also suggested that while Gray Bats will forage over small, permanently flowing streams, they more typically forage over larger streams. Tuttle (1979) estimated that a maternity colony of 250,000 bats may consume as much as a ton of insects each night.

Insects consumed by the Gray Bat vary depending on geographic location and season. A study in Kentucky found Gray Bats feeding on 11 families of insects from nine orders. The most common orders included Coleoptera (beetles), Trichoptera (caddisflies), Diptera (flies), and Lepidoptera (moths) (Lacki et al. 1995). Rabinowitz and Tuttle (1982) found slightly different food choices at a study site in eastern Tennessee. Based on fecal pellets, it appears that the Gray Bats in this area fed largely on Coleoptera, Diptera, and Lepidoptera as well. However, along with the three orders previously mentioned, Ephemeroptera (mayflies), Hemiptera (true bugs), and Trichoptera parts were also found in small percentages below the maternity roost. Through experimentation, the authors of this study found that some food items, such as Ephemeroptera, are highly digestible and not often found in fecal pellet dissection. It is theorized that Ephemeroptera and other soft bodied insects are also part of the Gray Bat diet, but they are under-represented in fecal analysis (Rabinowitz and Tuttle 1982, Whitaker et al. 2001). Overall, Gray Bats appear to be primarily opportunistic feeders, feeding on the most abundant aquatic insects available at the time (Lacki et al. 1995, Whitaker et al. 2001).

THREATS

Due to Gray Bats being year-round cave dwellers, they are vulnerable to human disturbances, such as the alteration of caves and cave openings, and flooding caused by manmade impoundments. Improperly gated caves and people breaking into caves remain threats to hibernacula and especially to maternity colonies (USFWS 2009). Pollution and pesticides in waterways continues to be a threat to Gray Bats, due to their dependence on aquatic insects. Pesticide residues continue to be found in guano and in the carcasses of dead bats (Sasse 2005). While some species of cave-dwelling bats are susceptible to WNS, such as the Indiana Bat, there have not been any known mass die-offs of Gray Bats (Powers et al. 2016). The fungus has been found on Gray Bat tissues, but they have not shown negative effects (Turner et al. 2011, Powers et al. 2016).

Northern Long-Eared Bat

On April 2, 2015, the USFWS listed the Northern Long-Eared Bat (*Myotis septentrionalis*) as threatened under the ESA with an interim rule under the authority of section 4(d) (80 FR 17973-18033). On January 14, 2016, the USFWS published the final Northern Long-Eared Bat designation as threatened with the section 4(d) rule throughout its geographic range (81 FR 1900-1922).

The Northern Long-Eared Bat is distinguished by its long ears and sharply tipped tragus, especially when compared to other *Myotis* species. They are a medium-sized bat of about 3 to 3.7 inches (77-92 millimeters) in total length, with a wingspan of 9.1 to 10.2 inches (23-26 centimeters [cm]). The fur color ranges from medium to dark brown on the back, and tawny to pale-brown on the underside (WDNR 2017).

HABITAT

The Northern Long-Eared Bat uses a wide variety of forested habitats for roosting, foraging and traveling (USFWS 2014). Foster and Kurta (1999) found female Northern Long-Eared Bats summer roosting in silver maples (*Acer saccharinum*) and green ashes (*Fraxinus pennsylvanica*), and to a lesser extent, red maples (*Acer rubra*). Another study conducted in Ohio found Northern Long-Eared Bats to use oak species (*Quercus* spp.) more commonly than others, including white oak (*Quercus alba*) and northern red oak (*Quercus rubra*). Other roost tree species used by Northern Long-Eared Bats included sugar maple (*Acer saccharum*), black locust (*Robinia pseudoacacia*), white ash (*Fraxinus alba*), and black walnut (*Juglans nigra*) (Krynak 2010). This species has also been found roosting in man-made structures such as artificial bat houses, the shudders of houses, warehouses, and barns (Whitaker and Hamilton 1998). Roosting habitat includes forested areas with live trees and/or snags (USFWS 2014). The Northern Long-Eared Bat has been documented using snags equally or more often than live trees (Foster and Kurta 1999, Krynak 2010). USFWS (2014) considers any tree with a DBH of equal to or greater than three inches (7.6 cm) to be potential habitat for Northern Long-Eared Bats.

Winter habitat includes underground caves and cave-like structures such as mines, railroad tunnels, hydroelectric dams, and houses (Whitaker and Hamilton 1998, USFWS 2014). Most often, Northern Long-Eared Bats are found in smaller numbers in caves or mines with other species of bats. They are typically found in cracks and crevices individually or small clusters, rather than in clusters on ceilings or walls (Whitaker and Hamilton 1998, Brack 2007). In a limestone mine in Ohio, Northern Long-Eared Bats are found in warm areas of the mine with stable temperatures. The three areas with the highest concentrations of Northern Long-Eared Bats had average temperatures of 47.3° F (8.5° C), 47.7° F (8.7° C), and 50.7° F (10.4° C) and an overall average of 48.4° F (9.1° C) (Brack 2007).

The Northern Long-Eared Bat is found throughout the eastern and midwestern U.S. and southern Canada. In the United States, it ranges from Maine south to central North Carolina along the Atlantic coast, extending west into eastern Oklahoma and north into North Dakota and eastern Wyoming and Montana. In the south, the Northern Long-Eared Bat extends into parts of Georgia, Alabama, Mississippi, and Louisiana (USFWS 2014). Historically, the eastern portion of the Northern Long-Eared Bats range has held its greatest abundance (Caceres and Barclay 2000), and numbers in the southern and western portion of the bats range are considered naturally low (USDA 2006). In Kentucky, the Northern Long-Eared Bat is either known from or thought to likely occur in every county in the state (USFWS 2016). Until the appearance of WNS, the species was the most frequently captured bat in forested mountainous habitats in eastern Kentucky (James Kiser, unpublished data). According to Whitaker and Mumford (2009), the Northern Long-Eared Bat probably occurs throughout Indiana but seems rare in the northern portion of the state. Based on data received from KSNPC (2017) and Whitaker and Mumford (2009), the Northern Long-Eared Bat has been captured in both Henderson County, KY, and Vanderburgh County, IN.

LIFE HISTORY

This species breeds in late summer and early fall, approximately mid-August through mid-November (USFWS 2014, 2015). Males arrive first at hibernacula and swarm the entrances and when females arrive, copulation occurs. Females will store sperm during hibernation and after they awake in spring, an egg is fertilized. Females give birth to one pup, and, depending on the location of the maternity roost, this can occur from late May through late July (USFWS 2015).

Foraging habitat for Northern Long-Eared Bats includes forested areas with linear features (USFWS 2014). Thalken et al. (2018) found strong positive correlations between female Northern Long-Eared Bat roosts and three landscape parameters: roads, water features, and upland mesic forests. Fenton and Bogdanowicz (2002) found the Northern Long-Eared Bat to use two alternating foraging strategies: gleaning and aerial foraging. Gleaning can be used to take prey from the ground or off of vegetation and aerial foraging takes prey "on the wing" or in flight (Fenton and Bogdanowicz 2002). Whitaker and Hamilton (1998) theorize that Northern Long-Eared Bats are Lepidoptera specialists, due to their relatively large ears and results of guano dissections. Other insects found in stomach contents and guano dissections include Hemiptera, Hymenoptera (wasps), Diptera, Ephemeroptera, Hemiptera, and Trichoptera, Coleoptera, and Araneae (spider) (Whitaker and Hamilton 1998).

THREATS

The main threat and the reason the Northern Long-Eared Bat was federally listed is WNS (USFWS 2015). Northern- Long-Eared Bat was common prior to the spread of WNS, and was only listed after precipitous declines following the spread of the disease.

3.2.2 Birds

Least Tern

The interior population of the Least Tern (*Sternula antillarum*) was listed as endangered under the ESA on June 27, 1985 (50 FR 21784). The availability of the interior Least Tern's preferred nesting habitat, infrequently flooded but un-vegetated sandbars, had sharp declines after the impoundment of most large rivers in the central United States for navigation and flood control. Although coastal populations are relatively stable, interior populations along major rivers within Arkansas, Colorado, Illinois, Indiana, Iowa, Kansas, Kentucky, Louisiana, Mississippi, Missouri, Montana, Nebraska, New Mexico, North Dakota, Oklahoma, South Dakota, Tennessee, and Texas were specifically listed due to this reduction of suitable nesting habitat and subsequent decline in breeding populations (USFWS 1990b).

HABITAT AND LIFE HISTORY

Interior Least Terns are small piscivorous birds in the Laridae family of the order Charadriiformes. Like most members of these taxa, interior Least Terns are a colonial nesting species. Their preferred nesting habitat consists of bare sand areas, particularly sandbars associated with larger, un-channelized rivers. However, other natural and man-made habitats are used including river levees, salt flats, dredge spoil locations, and even rooftops. The suitability of bare sand areas for nesting habitat has been characterized by four primary variables (Lott et al. 2013): height above water level, distance from woody vegetation over two meters high, relative lack of herbaceous vegetation, and the availability of prey within 6.21 miles (10 km) (Sherfy et al. 2012).

Interior Least Terns arrive on nesting grounds in late April, with most nesting completed by late May through mid-June. Each nest consists of a shallow, unlined scrape containing a clutch of two to three buff-colored eggs with brown spots (Barbour et al. 1973). Colony sizes vary greatly depending on the size and quality of available nesting habitat, but may consist of up to 13,000 birds (Lott et al. 2013) with larger colonies being more susceptible to predation than smaller colonies (Burger 1984). Within a colony, individual nest spacing may vary between several to hundreds of meters (USFWS 1990b). Foraging for small fishes, their primary prey item, generally occurs within a maximum of 6.21 miles (10 km) of the nest site (Sherfy et al. 2012).

In the past, interior Least Terns were documented in southwestern Kentucky at Reelfoot Lake (unclear nesting status) and frequently using Ballard County Wildlife Management Area during the breeding season, "apparently nesting on sandbars in the rivers." Additionally, they were noted as being seen occasionally at Kentucky Lake and Lake Barkley during migration, particularly below Kentucky Dam (Barbour et al. 1973). In addition to confirmed breeding along the Mississippi River in Carlisle, Hickman, and Fulton Counties, confirmed breeding in McCracken County and probable breeding in Livingston County along the lower Ohio River, small numbers have been documented as far upstream as Louisville on the Ohio River. Until 1953, prior to impoundment of the Ohio River, a nesting colony of up to 30 pairs was located in Union County on an island in the Ohio River, and in 1967, there was a failed nesting attempt at the Falls of the Ohio in Jefferson County, IN (Palmer-Ball 1996). In 1986, a single nest was discovered on a dike in a cooling pond impoundment at the Gibson Station power plant near the Wabash River in Gibson County, Indiana. Since that time, the population has expanded within the Gibson Station site and to other nearby areas including the Cane Ridge Wildlife Area (part of Patoka River National Wildlife Refuge), Tern Bar Slough Wildlife Conservation Area, the Wabash River, and agricultural fields nearby (Hayes and Pike 1999). Based on data provided by KSNPC (2017) and IDNR (2017), no sites are known from within the I-69 ORX project area. Additionally, the nearest known nesting site is further than the 6.21-mile (10 km) foraging range for this species, making the area unlikely to provide foraging habitat for nesting terns.

3.2.3 Mussels

Clubshell

The Clubshell (*Pleurobema clava*) is a moderately inflated, elongate, and triangular shaped freshwater mussel. The shell's periostracum is tan, yellowish, or greenish and becoming darker with age (Watters et al. 2009). Juvenile Clubshell are characterized by bold green stripes that form a checkboard pattern (Watters et al. 2009). The pattern is often lost in adults, but some bold green coloration usually remains. Nacre of the shell is porcelain white with some iridescent posteriorly. The Clubshell was listed as endangered by the USFWS on January 22, 1993 (58 CRF 13).

Habitat

Habitat for the Clubshell includes a variety of riverine environments ranging from large rivers to smaller channel streams, but not penetrating far into headwaters (Haag and Cicerello 2016). The Clubshell occurs in clean coarse sand, gravel, and cobble, where it may bury several inches into the substrate (Watters et al. 2009). It appears to be more common in the downstream ends of riffles and islands, but typically away from depositional areas and lentic environments. Historically, the Clubshell was widely distributed in the Ohio River basin and occurred in most of the major drainages (USFWS 1994). Its distribution is now restricted to roughly 13 populations in the Ohio River and Lake Erie Basins.

Life History

Male mussels release sperm into the water column and females downstream use their gills to filter it from the water. Eggs remain in the female's gills, which function as marsupia, until they mature into glochidia. To complete the reproductive cycle, glochidia must attach to the gills or fins of a host fish until metamorphosis is finished and they drop to the streambed (USFWS 1991). The Clubshell is a short term brooder, and eggs appear in May with glochidia developing in June and July (Watters et al. 2009). Clubshell is defined as having an equilibrium life history strategy, with a long-life span, late sexual maturity, short brooding period, and generally low fecundity (Haag 2012). Females infect fish hosts by release of a white conglutinate that is perceived as a prey item. O'dee and Watters (2000) found that glochidia placed on Central Stoneroller (*Campostoma anomalum*), Striped Shiner (*Luxilus chrysocephalus*), Blackside Darter (*Percina maculata*), and Logperch (*P. caprodes*) successfully metamorphosed in a laboratory setting, thus possibly representing natural hosts.

Threats

According to Haag and Cicerello (2016), the Clubshell is intolerant of impoundments and populations in larger rivers were likely eliminated by dams. With the exception of one unsubstantiated recent record from the Ohio River in Meade County by Clarke (1995) cited in Haag and Cicerello (2016), the species has not been seen in the Ohio River in over 100 years. Based on data provided by KSNPC (2017) and IDNR (2017), no sites are known from within the I-69 ORX project area. This species was not detected in the project area by Stantec (2018a).

Broad threats to freshwater mussels are generally consistent among species. Historically, dams and stream channelization in the early part of the 20th century led to largescale impoundment of navigable rivers in the US, with over 75,000 dams existing today (Graf 1999). These dams shift habitats from lotic to lentic, and completely change flow regimes, often destroying mussel habitat (Haag 2012). Free flowing large rivers in the United States are a rarity. This, combined with a wide variety of other impacts, such as municipal and industrial pollution, channelization, and agricultural runoff have contributed to mussel community declines. As a result of these processes throughout the mid 1900's, many mussel populations became small and isolated, which makes them highly susceptible to stochastic processes. Modern day isolated populations of mussels are highly impacted by environmental stochasticity, such as drought or extremely high flows. These small, isolated populations are also susceptible to demographic stochasticity (Haag 2012). The complex mussel life cycle has many stages for failure to occur, and when applied to a small population, can be catastrophic for recruitment. Combine these two processes, and it can be difficult for small populations to maintain themselves. Specific modern-day threats to mussels continue to include anthropogenic impacts. Chronic impacts from industrial pollution continue to degrade habitat (Diamond et al. 2002). Poor agricultural practices and destruction of riparian zones contribute to negative terrestrial inputs to mussel habitat (Williams et al. 1993). Invasive species, specifically *Dreissena* species have been shown to have detrimental effects on mussel communities (Strayer 1999a). Additionally, Haag (2012) provides examples of numerous enigmatic declines, where communities undergo curtailed recruitment or mortality with no apparent cause.

Fanshell

The Fanshell (*Cyprogenia stegaria*) was described as a distinct species by Rafinesque in 1820 from specimens collected in Ohio (Parmalee and Bogan 1998). The Fanshell grows to 3-4 inches and is characterized by fine green dots and dashes that are sometimes bundled into broken rays on the shell, as well as shingle-like growth rings and knobs on the anterior half of the shell (Cicerello and Schuster 2003). On June 21, 1990, the Fanshell was listed as endangered under the ESA (Federal Register 55: 25591).

HABITAT

Habitat for the Fanshell includes a gravel and coarse sand substrate in relatively deep water with moderate currents of medium to large rivers (Bates and Dennis 1985, Gordon and Layzer 1989). Viable populations in Tennessee are restricted to unimpounded sections of the Clinch River where the mussel is found at water depths less than 3 feet (0.9 m) in coarse sand and gravel substrate (Parmalee and Bogan 1998). In Kentucky on the Green River, Cicerello and Hannan (1990) found the Fanshell in swift flowing riffles and the area immediately above (upstream) where water reaches depths of 3.3 ft (1 m), and flows over sand, gravel, and occasionally cobble substrate. Based on historical records, the Fanshell is strictly an Ohioan or interior basin species. The Fanshell’s historic distribution in Kentucky includes the Ohio River mainstream, lower Tennessee and Clark’s Rivers, lower Cumberland River, lower and upper Green River, Barren River, Salt River, upper Cumberland River below Cumberland Falls, Kentucky River, Licking River, Tygarts Creek, and Big Sandy River (Cicerello et al. 1991). As of 1991, extant populations in the Commonwealth only occurred in short sections of the Green and Licking Rivers, Rolling Fork, and in the lower Tennessee River below Kentucky Lake Dam where it was reintroduced (Haag and Cicerello 2016). Based on information obtained from KSNPC (2017) and maps in Haag and Cicerello (2016), no sites occur within the project area. However, the Fanshell was recovered from the Angel Mounds State Historic Site along the north bank of the Ohio River, 2.5 miles west of Newburgh, Vanderburgh County, IN.

LIFE HISTORY

Food habits of the Fanshell are unknown, but it probably consumes microscopic detritus, diatoms, phytoplankton, and zooplankton from the water (USFWS 1991). The Fanshell is bradytictic, meaning females are gravid in August, contain glochidia in September, and releases them from May to July the following year (Parmalee and Bogan 1998). Haag (2012) classifies Fanshell as having an Equilibrium life strategy, with a long life span, late age at sexual maturity, relatively low fecundity, and a moderate body size. Fanshell uses a conglutinate to achieve encystment on host fish (Watters 2008). Watters et al. (2009) described some of the reported fish hosts for the Fanshell glochidia: Mottled Sculpin (*Cottus bairdi*), Banded Sculpin (*Cottus carolinae*), Tangerine Darter (*Etheostoma aurantiaca*), Greenside Darter (*Etheostoma blennioides*), Snubnose Darter (*Etheostoma simoterum*), banded darter (*Etheostoma zonale*), Blothchside Logperch (*Percina burtoni*), Logperch (*Percina caprodes*), and Roanoke Darter (*Percina roanoka*).

THREATS

Habitat alteration, especially impoundments, navigation facilities, channel dredging, sand and gravel mining, sedimentation, and water pollution, has eliminated the species from most of its range, either directly affecting the species, or reducing its fish host. According to Jones et al. (2003), less than 10 percent of the Fanshell's historic range is still occupied, and where it is still present, only small sections of the rivers contain reproducing populations. (USFWS 1991).

Fat Pocketbook

Fat Pocketbook (*Potamilus capax*) has a large (five inches), rounded to somewhat oblong, and greatly inflated, thin to moderately thick shell. The shell's periostracum is smooth and very shiny, yellow, yellowish-tan, or olive in color without rays and becoming dark brown in older individuals (Cummings and Mayer 1992). The nacre of the shell is white, sometimes tinged with pink or salmon. The USFWS proposed the Fat Pocketbook as an endangered species on September 26, 1975 (Federal Register 40(188):44329-44333). A final listing occurred on June 14, 1976 (Federal Register 41(115):24062-24067).

HABITAT

Early habitat information was based upon scattered collection sites and general field observations. Parmalee (1967) reported the Fat Pocketbook from sand and mud bottoms, in flowing water a few inches to more than eight feet in depth. Bates and Dennis (1983) found the species in sand, mud, and fine gravel substrates in the St. Francis River, Arkansas. Conversely, Clarke (1985) reported this species primarily from sand substrates in the St. Francis River. Historically, the Fat Pocketbook was probably more common in large river sloughs and oxbows having a silt substrate (Miller and Payne 2005). Such habitat was more common near the mouth of rivers prior to man-induced modifications such as locks, dams, levees, channel maintenance, and bank protection measures. Ahlstedt and Jenkinson (1991) reported that Fat Pocketbook was most likely to be found in a mixture of sand, clay, and silt, which they referred to as "sticky mud." Based on the presence of dense populations of Fat Pocketbook in the St. Francis watershed, Arkansas, the species appears to be tolerant and even show a preference for depositional areas. This recent information tends to show the species is not lotic as previously thought by the USFWS (1989). Miller and Payne (2005) determined that man-made ditches, existing bayous, sloughs, and streams within the St. Francis Watershed, provide suitable habitat for the Fat Pocketbook. In western Kentucky, Haag, and Cicerello (2016) describe the Fat Pocketbook's habitat as medium-sized to large rivers in depositional backwater areas along shore, behind wing dams, or in side channels and sloughs.

Based on historical records, the Fat Pocketbook was found in larger rivers within the Mississippi River drainage from Arkansas and Mississippi north to Minnesota and Wisconsin, and west to eastern Missouri and Iowa, and within the Ohio River upstream to near the mouth of the Green River in Kentucky and Indiana (Haag and Cicerello 2016). However, most records for the species appear to occur within three population centers, including the upper Mississippi River above St. Louis, Missouri, the Wabash River in Indiana, and the St. Francis River in Arkansas (Bates and Dennis 1983, USFWS 1989). According to the USFWS (1989) and Miller and Payne (2005), the largest extant population of Fat Pocketbook is in the St. Francis River and its associated canals and sloughs.

In Kentucky, the Fat Pocketbook has been reported from the Mississippi River, the Ohio River mainstem up to near the mouth of Green River, and the lower Cumberland, Green, Clarks, and Tradewater Rivers (Haag and Cicerello 2016). Populations in the lower Ohio River appear to be large and healthy, and together with the large population in the Wabash River may form one single metapopulation. Individual Fat Pocketbooks have been found in the Ohio River just upstream of the project area, approximately 2 miles upstream from the mouth of the Green River and have also been found approximately 4.5 miles downstream of project area (KSNPC 2017). The site upstream of Green River is located in Henderson County, KY at river mile 782.3 and was documented on October 3, 2008.

LIFE HISTORY

Gravid Fat Pocketbooks have been observed from June to October, which indicates the species is bradytictic (Ortmann 1914 as cited in USFWS 1989). Gravid mussels were reported to have mature glochidia between June 6-20 in Missouri, but had released glochidia sometime between then and August 13-22 (Barnhart & Roberts 1997). Fat Pocketbook glochidia are reported to be rather small (0.105 x 0.185 mm), spined, and ax-head or hatchet-shaped (Utterback, 1916 cited in Oesch 1984). Fat Pocketbook is described as having an Opportunistic life history strategy, with a short lifespan, young age at sexual maturity, and moderate to high fecundity (Haag 2012). The host fish for Fat Pocketbook is Freshwater Drum (*Aplodinotus grunniens*) (Cummings and Mayer 1992).

THREATS

Fat Pocketbook generally faces similar threats to those described in Section 3.2.3 for the Clubshell.

Northern Riffleshell

Northern Riffleshell (*Epioblasma rangiana*) was first described as a distinct species by Lea in 1838 from a specimen found near Poland, Ohio, which most likely was from the Mahoning River (Watters et al. 2009). The Northern Riffleshell is a medium sized mussel (up to 2.75 inches or 70 mm in length) with a greenish, yellow to tan colored shell. The shell's periostracum has numerous radiating dark green rays. The shell nacre is white, iridescent, and very thin posteriorly and extending along the margins (Watters et al. 2009). The Northern Riffleshell was listed as endangered without critical habitat on February 22, 1993 by USFWS (Federal Register 58(13): 5638-5642).

Habitat

Habitat for the Northern Riffleshell is variable. The Northern Riffleshell occurs in riffle areas with swift currents in a substrate of coarse sand and gravel to a substrate of firmly packed fine gravel, typically in shallow (few inches to six feet deep) water (Parmalee and Bogan 1998). Based on historical records, the Northern Riffleshell was once widespread, although only locally common, in Ohio, Pennsylvania, Michigan, Ontario, Indiana, Illinois, Kentucky, and possibly Tennessee (Williams et al. 1993). The present day distribution as illustrated by the USFWS Recovery Plan (USFWS 1994) is greatly restricted and includes only Fish Creek along the Indiana/Ohio border, Big Darby Creek, the Detroit River near the Michigan/Ontario border, the upper Green River in Kentucky, the Elk River in West Virginia, and the Alleghany River, French Creek, and LeBoeuf Creek in Pennsylvania (USFWS 1994). Surveys in some of the aforementioned locations yielded only fresh dead valves or live individuals occurring in low densities. In Kentucky, the Northern Riffleshell's historic distribution includes the Ohio River mainstem, upper Green River, Salt River, Kentucky River, and Licking River (Cicerello et al. 1991). According to Haag and Cicerello (2016), all natural populations of the Northern Riffleshell in Kentucky appears to be extirpated. If naturally occurring populations do occur in Kentucky, they would be in free-flowing sections of the Green River. Northern Riffleshell was reintroduced at four locations in the Licking River during 2013 and 2014 (Haag and Cicerello 2016). Based on data provided by KSNPC (2017) and IDNR (2017), no sites for this species are known from within the I-69 ORX project area.

Life History

The Northern Riffleshell is bradytictic and Watters et al. (2009) report that gravid females have been observed from September to June of the following year. Females remain buried in the substrate until brooding, which occurs during the winter and spring when they move to the surface of the substrate. Females of this species parasitize fish by trapping them between their valves, "inflating" a mantle gasket around the head of the fish, and pumping glochidia onto the fish (Watters et al. 2009). This behavior reportedly may last for 5 to 10 minutes. O'dee and Watters (2000) determined that glochidia encysted on Banded Darter (*Etheostoma zonale*), Bluebreast Darter (*Etheostoma camarum*), and Brown Trout (*Salmo trutta*) successfully metamorphosed in a laboratory setting. Brown trout is an exotic species whose geographic range overlaps minimally with Northern Riffleshell due to restrictive thermal habitat requirements. Therefore, its potential to serve as a viable host may be limited. This species is categorized as having a Periodic life history, categorized as a moderate lifespan, low to moderate age at sexual maturity, moderate to high growth rate, and an intermediate reproductive strategy between r-selection and k-selection (Haag 2012).

Threats

In addition to the general threats described previously, McNichols et al. (2011) found that higher quality host fish for Northern Riffleshell result in higher metamorphosis rates, and that these higher quality fish may be restricted in abundance or range due to being endangered themselves. Lower quality hosts that are more abundant are relied on for glochidia infestation, resulting in overall lower recruitment.

Orangefoot Pimpleback

The Orangefoot Pimpleback (*Plethobasus cooperianus*) was described as a distinct species by Lea in 1834 from specimens collected in the Ohio River (Parmalee and Bogan 1998, USFWS 1984a). The Orangefoot Pimpleback is a medium sized (up to 3.54 inches or 90 mm) mussel with a moderately thick, oval to somewhat triangular and moderately inflated shell (Watters et al. 2009). The shell surface contains irregular pustules often concentrically elongated on the posterior 50 to 60 percent of the shell. Additionally, the posterior slope contains a few curving pustules. The shell surface, or periostracum has numerous fine green rays on yellow to tan background coloration in juveniles, but these rays are often lost as the shell becomes reddish-brown in adults (Watters et al. 2009). The Orangefoot Pimpleback was listed by USFWS as an endangered species in September 1975 (Federal Register 40(188):44329-44333). A final listing occurred on June 14, 1976 (Federal Register 41(115):24062-24067).

HABITAT

The Orangefoot Pimpleback is a big river species, occupying sand and coarse gravel substrates in water depths ranging from 12 to 18 feet (Parmalee and Bogan 1998). Yokley (1972) also reported the species from clean gravel, free of silt, in the Tennessee River. According to the USFWS (1984a), the species has been found in the lower Ohio River in sand and gravel at water depths of 15 to 29 feet. However, Bogan and Parmalee (1983) think the species lived in shallower riffle and shoal sections of the Tennessee, Cumberland, and Ohio Rivers. If true, the occurrence of the species in deeper water may be an artifact of habitat alteration.

Based on historical records, the Orangefoot Pimpleback is strictly an Ohioan or Interior Basin species. Historically, it occurred throughout the Tennessee, Cumberland, and Ohio River drainages (USFWS 1984a). According to Williams et al. (1993), the species occurred in Alabama, Illinois, Indiana, Kentucky, Ohio, Pennsylvania, and Tennessee. Apparently, the Orangefoot Pimpleback was once common in the Ohio River between St. Mary's and Marietta, in the Wabash River, and in the Cumberland River (USFWS 1984a). As of 1984, the Orangefoot Pimpleback was known from only three rivers, including the Cumberland, Tennessee, and lower Ohio Rivers. According to the USFWS (1984a), the largest concentration of this species occurs in the Tennessee River an undetermined distance below Pickwick Dam.

In Kentucky, the Orangefoot Pimpleback's historic distribution includes the Ohio River mainstem, lower Tennessee and Clark's Rivers, lower Cumberland River, lower and upper Green River, Barren River, Salt River, and upper Cumberland River below Cumberland Falls (Cicerello et al. 1991). Based on data provided by KSNPC (2017) and IDNR (2017), no sites are known from within the I-69 ORX project area. This species was not detected in project area surveys (Stantec 2018b).

LIFE HISTORY

Based on two gravid females found during early June in the Cumberland River, the Orangefoot Pimpleback is considered tachytictic (Parmalee and Bogan 1998). Yokley (1972) also observed an individual with charged gills in August, which further supports the species as a tachytictic breeder. The host for Orangefoot Pimpleback is unknown (Watters et al. 2009), however recent studies on the closely related Sheepnose (*Plethobasus cyphyus*) revealed it to be a cyprinid specialist (Hove et al. 2016). Therefore, the best assumption is that Orangefoot Pimpleback would use similar hosts. Orangefoot Pimpleback uses an Equilibrium life history strategy, with late reproductive maturity (5-27 years) and a long lifespan (>25 years) (Haag 2012, Hove et al. 2016).

THREATS

Habitat alteration, especially impoundments, navigation facilities, channel dredging, sand and gravel mining, sedimentation, and water pollution, has eliminated the species from most of its range in Kentucky. Extant populations occur only in the short free-flowing section of the lower Ohio River, McCracken and Ballard Counties and lower Tennessee River below Kentucky Lake in free-flowing sections (Livingston and Marshall Counties) (Haag and Cicerello 2016).

Pink Mucket

Pink Mucket (*Lampsilis abrupta*) is a medium sized mussel with a smooth yellow or yellowish-green shell with faint green rays (USFWS 1985). The shells of the Pink Mucket are somewhat inflated and valves become thick and heavy in mature individuals, which can reach lengths of 4.72 inches (120 mm) (Parmalee and Bogan 1998). The Pink Mucket was listed as endangered by the USFWS on June 14, 1976 (USFWS 1985).

HABITAT

The Pink Mucket typically inhabits medium to large rivers. Preferred substrates include sand, gravel, and mud in slower moving waters and rocky ledges in higher velocity flows (Watters et al. 2009). Williams et al. (2008) indicates the Pink Mucket occurs in free-flowing reaches of larger rivers, and occasionally found in large creeks in gravel with sand where currents keep silt washed away from the mussels. Historically, the Pink Mucket had a widespread distribution occurring in at least 25 rivers and tributaries, including the Ohio River, Kanawha River, Green River, and Mississippi River. Based on information obtained from KSNPC (2017) and maps in Haag and Cicerello (2016), no sites occur within the project area, but the Pink Mucket was recovered from the Angel Mounds State Historic Site along the north bank of the Ohio River, 2.5 miles west of Newburgh, Vanderburgh County, IN.

LIFE HISTORY

Females become gravid in August and glochidia appear in September. This species is bradytictic: brooding of the glochidia lasts through the winter; glochidia are discharged in June (Parmalee and Bogan, 1998, Watters et al. 2009). Pink Mucket females have a spotted mantle flap, which is thought to mimic a fish eyespot and attract host fish (USFWS 1985). Laboratory studies have confirmed several hosts for the Pink Mucket: Largemouth Bass (*Micropterus salmoides*), Smallmouth Bass (*Micropterus dolomieu*), Spotted Bass (*Micropterus punctulatus*), White Crappie (*Pomoxis annularis*), Walleye (*Sander vitreus*), and Sauger (*S. canadensis*) (Barnhart et al. 1997, Williams et al. 2008). The Freshwater Drum (*Aplodinotus grunniens*) may also be a host for the Pink Mucket based on its use by *Lampsilis higginsi* (Williams et al. 2008, Parmalee and Bogan 1998, USFWS 1985). Pink Mucket most likely has a Periodic life history strategy, living up to 25 years old with a moderate body size (Haag 2012, Watters et al. 2009).

THREATS

Besides the previously listed threats that all mussel species are exposed to, Pink Mucket is especially impacted due to inhabiting only a fraction of its historical range, losing thousands of miles of large river habitat due to habitat degradation (USFWS 2016b). Other threats are exacerbated by the fact that this species is restricted to isolated pockets of a historically large range.

Catspaw

The Catspaw (*Epioblasma obliquata*) is a medium sized, ovate freshwater mussel with a thick to heavy shell. The shell's periostracum is tan or dark brown with radiating, darker, green rays that are more prominent on the posterior side of the shell. The nacre is a deep purple color that often fades to white at the margins of the shell. Specimens, particularly from the Ohio River, have been found with a mauve or entirely white nacre (Watters et al. 2009). The Catspaw was listed as endangered by the USFWS on July 10, 1990 (50 CRF 17).

HABITAT

Habitat for the Catspaw is restricted to gravel and sand substrates in main-channel shoals, primarily in large streams (Haag and Cicerello 2016). It lives completely buried in the substrate, with females moving to the surface to release glochidia. Females, at this time, have been found on stream margins in shallow water. Historically, the Catspaw was common in the Ohio River, and Cumberland River systems. Only a single remaining population of Catspaw is known, in Killbuck Creek, a relatively small stream in Ohio, where individuals are found in riffle and run habitats with a mixture of sand, gravel, and cobble substrate in relatively swift to nearly still water (Watters et al. 2009). Based on information obtained from KSNPC (2017) and maps in Haag and Cicerello (2016), no sites occur within the project area, but the Catspaw was recovered from the Angel Mounds State Historic Site along the north bank of the Ohio River, 2.5 miles west of Newburgh, Vanderburgh County, IN.

LIFE HISTORY

The Catspaw is bradytictic, with gravid females found from September to April of the next year (Hoggarth et al. 1995, Watters et al. 1998). Categorized by Haag (2012) as having a Periodic life history strategy, Catspaw has a small adult body size (up to 70mm) and live to 20-25 years (Watters et al. 2009). Watters et al. (1998) reports potential host fish for the Catspaw based on metamorphosis of glochidia in a laboratory setting as Rock Bass (*Ambloplites rupestris*), Mottled Sculpin (*Cottus bairdi*), Stonecat (*Noturus flavus*), Blackside Darter (*Percina maculata*), and Logperch (*Percina caprodes*).

THREATS

Catspaw is intolerant of impoundments, and dams have drastically altered the nature of stream and river systems in all of its original range (Haag and Cicerello 2016). Successful propagation of this mussel has allowed small numbers of individuals to be reintroduced into several rivers, but none of these sites are near the I-69 ORX project area.

Ring Pink

The Ring Pink (*Obovaria retusa*) was described as a distinct species by Lamarck in 1819, but he erroneously gave the type locality as Nova Scotia. Type locality information was corrected in 1969 by Johnson to be the Ohio River at Cincinnati (Parmalee and Bogan, 1998). The shell of Ring Pink is medium-sized (up to 3.15 inches or 80 mm in length) with pale yellowish-green to tan periostracum, heavy to massive, and rounded or square with prominent umbo (Watters et al. 2009). The nacre is unique in this mussel with pale to dark purple in the middle, including the hinge and teeth, and abruptly changing to white at the pallial line. The USFWS proposed the Ring Pink, formerly known as golf stick pearly mussel, as an endangered species on March 07, 1989 (Federal Register 54(43): 9529-9533). A final listing occurred on September 29, 1989 (Federal Register 54(188): 40109-40112).

HABITAT

The Ring Pink is characterized as a large river species (Bates and Dennis 1985, Bogan and Parmalee 1983), but it has been found occupying sand and gravel substrates in as little as two feet of water (Neel and Allen 1964). According to Parmalee et al. (1982), the Ring Pink inhabits deep stretches of rivers with swift current and coarse sand and gravel substrates. With the exception of a fresh dead specimen found near Lock and Dam 6 on the Green River, Kentucky, individuals taken from this river have mostly been found in shallow water with good current (Cicerello and Hannan 1990).

Based on historical records, the Ring Pink is strictly an Ohioan or Interior Basin species. Historically, it was widely distributed throughout the Cumberland, Ohio, and Tennessee River drainages (USFWS 1990a). According to Williams et al. (1993), the species occurred in Alabama, Illinois, Indiana, Kentucky, Ohio, Pennsylvania, Tennessee, and West Virginia. In Kentucky, the Ring Pink's historic distribution includes the mainstem Ohio River, lower Tennessee and Clark's Rivers, lower Cumberland River, lower and upper Green River, Barren River, upper Cumberland River below Cumberland Falls, and Kentucky River (Cicerello et al. 1991, Haag and Cicerello 2016). As of 2016, it is thought the only extant population of Ring Pink occurs in a short section of the Green River in Warren, Edmonson, and Hart counties (Haag and Cicerello 2016). Based on information obtained from KSNPC (2017) and maps in Haag and Cicerello (2016), no sites occur within the project area, but the Ring Pink was recovered from the Angel Mounds State Historic Site along the north bank of the Ohio River, 2.5 miles west of Newburgh, Vanderburgh County, IN.

LIFE HISTORY

Gravid Ring Pink mussels have been observed in late August (Ortmann 1909 and 1912 as cited in USFWS 1990a). The presence of eggs in females during August and gravid females with glochidia in September makes the species a bradytictic breeder (Parmalee and Bogan 1998). Haag (2012) reports *Obovaria* species to have Periodic life history strategies. Ring Pink glochidia are reported to be rather large and hookless, which indicate they attach to fish gills. The host fish for Ring Pink is unknown (Parmalee and Bogan 1998, Watters 1994), however, a closely related species, Hickorynut (*O. olivaria*) uses the Shovelnose Sturgeon (*Scaphirhynchus platorynchus*) as a host (Watters 1994).

THREATS

According to USFWS (1990a), the distribution and reproduction capabilities of this species has been seriously impacted by the construction of impoundments on the larger rivers it once inhabited. As with other listed mussels, habitat alteration has eliminated the species from most of its range in Kentucky.

Rough Pigtoe

The Rough Pigtoe (*Pleurobema plenum*) is a medium sized (up to 3.54 inches or 90 mm) mussel with a rather thick, moderately inflated, triangular shaped shell. The shell's periostracum is coarse, with a satin finish, and tan, yellowish, or reddish brown in color and becoming darker with age (Watters et al. 2009). The periostracum of juvenile Rough Pigtoe often have green stripes that are often lost in adults. Nacre of the shell is porcelain white, rarely with rose flush, and with some iridescent posteriorly. The Rough Pigtoe (*Pleurobema plenum*) was listed as endangered without critical habitat on June 14, 1976 by the USFWS (Federal Register 41(115):24062-24067).

HABITAT

Although Rough Pigtoe's can become established in small rivers or head water stretches of medium-sized rivers, they are typically found in large rivers, in firmly packed gravel and sand substrates (Parmalee and Bogan 1998). They may also occur in stable muddy, sand, and cobble of large rivers and their impoundments (Watters et al. 2009). According to Haag and Cicerello (2016), the Rough Pigtoe is endemic to the Ohio River basin where it occurred historically throughout the Ohio River and its larger tributaries from the confluence of the Tennessee River upstream to Pennsylvania. In Kentucky, the Rough Pigtoe's historic distribution included the Ohio River mainstream, lower and upper Green River, Barren River, upper Cumberland River below Cumberland Falls, Kentucky River, and Licking River (Cicerello et al. 1991). Current distribution of this species is restricted to the Tennessee River mainstem and the upper Clinch River in Tennessee, and the Green River and the Barren River in Kentucky, and possibly in the Cumberland River (USFWS 1984b, Haag and Cicerello 2016). Based on data provided by KSNPC (2017) and IDNR (2017), no sites are known from within the I-69 ORX project area.

LIFE HISTORY

The Rough Pigtoe appears to be tachytictic with gravid females having been found in May (Watters et al. 2009). Host fish species are unknown for the Rough Pigtoe (USFWS 1984b, Watters et al. 2009). Rough Pigtoe probably exhibits an Equilibrium life history strategy (similar to other *Pleurobema*'s), as it's been shown to live to 30 years.

THREATS

A lack of research on this species exists, most likely because it is exceedingly rare (USFWS 2007b). However, the broad threats to the other mussel species listed in this BA would also be impacting Rough Pigtoe.

Spectaclecase

The Spectaclecase (*Margaritifera monodonta*) is a large, elongate mussel (up to 9 inches in length) with a curved shell that is somewhat inflated, providing them with their common name. The species typically has poorly developed teeth, white nacre, and dark coloration with roughened surface (Baird 2000). The Spectaclecase is unique in that it's in the Margaritiferidae family. Spectaclecase was listed in March 2013 by the USFWS as a federally listed endangered species (USFWS 2012a).

Habitat

Historically, the Spectaclecase mussel was found throughout the Mississippi River system except in the upper Missouri River, the uppermost sections of the Ohio River, the Cumberland and Tennessee Rivers, and in the lowland tributaries in the Mississippi Delta regions of Mississippi and Louisiana. Spectaclecase was historically known in at least 44 streams in 15 states but has been reduced today to 19 streams in 11 states (USFWS 2011). In the Ohio River basin, the species is known from the confluence with the Mississippi River upstream to West Virginia (Haag and Cicerello 2016). Based on data provided by KSNPC (2017) and IDNR (2017), there are no known sites for this species within the I-69 ORX project area.

The Spectaclecase is more a habitat-specialist than most mussel species: they are typically found in large rivers, sheltered from the main force of the current. They have been found in substrates ranging from mud and sand, to gravel, cobble, and boulders, but large aggregations have been found under slab boulders or bedrock shelves (Baird 2000, Parmalee and Bogan 1998).

Life History

The Spectaclecase does not reach sexual maturity until 10 – 11 years of age. Spectaclecase mussels have the smallest glochidia known for any North American mussel (0.0024 inches) (Baird 2000); these glochidia are released in the form of conglutinates – gelatinous containers with numerous glochidia inside. These released larvae must attach to the gills or fins of a specific host, usually a fish, to complete development into a juvenile mussel. Known fish hosts include the Bigeye Chub (*Hybopsis amblops)* and Shorthead Redhorse (*Moxostoma macrolepidotum*) (Baird 2000).

The high life span and age at maturity of the Spectaclecase aligns with the equilibrium life history strategy. However, their extremely high fecundity contradicts the equilibrium life history theory and is more similar to opportunistic species. This combination of life history strategies is unique to the Margaritiferidae.

Threats

The Spectaclecase generally faces similar threats to those described in Section 3.2.3 for the Clubshell.

Sheepnose

The Sheepnose (*Plethobasus cyphyus*) was first described as a distinct species by Rafinesque in 1820 from specimens collected at Falls of the Ohio (Haag and Cicerello 2016). The Sheepnose has an oblong and slightly inflated shell that can be up to 5 inches in length. The shell surface is mostly smooth with a row of knobs/tubercles on the center of valve, which may become worn down in older specimens. The periostracum has no rays and is often yellowish color, but may also become dark brown with age (Cummings and Mayer 1992). The Sheepnose was listed in March 2013 by the USFWS as a federally listed endangered species (USFWS 2012a).

HABITAT

The Sheepnose primarily inhabits medium to large rivers in shallow areas with moderate to swift current that flows over gravel or mixed sand and gravel substrate (Cummings and Mayer 1992). It has also been found in habitats composed of mud, cobble and boulders, and in large rivers it may be found in deep runs (USFWS 2012b). During flood conditions, Sheepnose will likely occur within flow refuges, where shear stress and particle movement is low (Strayer (1999b).

Even though the Sheepnose is found across the Midwest and Southeast, according to Parmalee and Bogan (1998), it has been extirpated throughout much of its former range or reduced to isolated populations. The Sheepnose was historically found in 77 different streams, but now is reduced to only 26. It is known to occur within the Ohio River from the confluence with the Mississippi River upstream to Pennsylvania, including extant populations in western Kentucky and southern Indiana (Haag and Cicerello 2016). The populations in the lower Ohio River may be contiguous with those in the lower Tennessee and Green Rivers (Haag and Cicerello 2016). Based on data provided by KSNPC (2017) and IDNR (2017), no sites are known for the Sheepnose from within the I-69 ORX project area, but one pre-1990 site is located at the mouth of the Green River (Appendix K-1 DEIS). Additionally, the species was represented by shells recovered from the Angel Mounds State Historic Site along the north bank of the Ohio River, 2.5 miles west of Newburgh, Vanderburgh County, IN. Recently, a Sheepnose was found near the I-69 ORX project, in the Ohio River (river mile 783.4) upstream from the confluence of the Green River (Koch, pers. comm. 2017).

LIFE HISTORY

Sheepnose is a short-term brooder, spawning and releasing young within a few weeks during the summer between mid-May and early August (Watters et al. 2009). The species is defined as having an Equilibrium life history strategy, with a long life span, late sexual maturity, short brooding period, and generally low fecundity (Haag 2012). Field and laboratory observations suggest that Sheepnose are a host specialist, predominantly using only members of the cyprinid family and occasionally a few other fish species as hosts (Haag 2012). Laboratory studies by Wolf et al. (2012) and Hove et al. (2015) found transformation of juveniles on 12 different minnow species, including a topminnow, and 29 cyprinid and six non-cyprinid species, respectively.

THREATS

The Sheepnose generally faces similar threats to those described in Section 3.2.3 for the Clubshell.

Rabbitsfoot

The Rabbitsfoot (*Theliderma cylindrica*) is an elongate rectangular mussel that attains a maximum length of approximately 6 inches (150 mm) The periostracum is green to yellowish with many green upside-down triangular markings of varying sizes and is generally smooth. In adults, these markings may be represented as rays or streaks of green. Pustules on the shell may be a lighter color. (Watters et al. 2009). The Rabbitsfoot was listed as federally threatened by the USFWS on September 17, 2013 (50 CFR 17).

HABITAT

The Rabbitsfoot occurs in sand and gravel substrate in creeks and small rivers with high water quality. Though it may be found in main-channel mussel beds with other species, it typically occurs in more specialized habitat in slack water adjacent to current, where it is often found unburied along the water's edge. Alternatively, in big rivers, like the lower Tennessee, the Rabbitsfoot is found in 9 to 12 feet of water (Parmalee and Bogan 1998). Historically, the species was probably uncommon range-wide, but may have been locally common in some streams. In the Ohio River basin, the Rabbitsfoot ranges from the junction with the Mississippi River upstream to Pennsylvania. In the Mississippi River watershed, the species ranges from Missouri to northern Louisiana and west to Oklahoma and Kansas. Within the Great Lakes basin, the range includes the Maumee River system (Haag and Cicerello 2016). This species is only marginally tolerant of impoundment and has been extirpated in most large rivers, with localized populations surviving in the lower Ohio River. Two records of Rabbitsfoot in the Ohio River upstream of the project area near Owensboro exist after 1990. However, only four populations are currently known in the state of Kentucky and these do not include any populations in the Ohio River (Haag and Cicerello 2016). Based on data provided by KSNPC (2017) and IDNR (2017b), no sites are known from within the I-69 ORX bridge footprint, but one historic site (1982) is located in the Ohio River between river miles 784.6 and 786.7 (Appendix K-1 DEIS). Additionally, the species was represented by shells recovered from the Angel Mounds State Historic Site along the north bank of the Ohio River, 2.5 miles west of Newburgh, Vanderburgh County, IN.

LIFE HISTORY

The Rabbitsfoot is tachytictic. Females brood between May and late August and release glochidia in August. Glochidia are released as tan to orange conglutinates (Ortmann 1919 cited in Watters et al. 2009) that are consumed by fish hosts. Rabbitsfoot exhibit seasonal movement towards shallow water during brooding season to increase fish host exposure. Rabbitsfoot is defined as having a Periodic life history strategy, with a moderate to high growth rate, low to intermediate life span, age at maturity, and fecundity (Haag 2012). Watters et al. (2009) identified the Rainbow Darter (*Etheostoma caeruleum*) and Striped Shiner (*Luxilus chrysocephalus*) as potential hosts based on metamorphosis of glochidia in a laboratory setting, however Haag and Cicerello identify Rabbitsfoot as a host specialist on minnows (2016). Fobian (2007) studied potential fish hosts in several basins west of the Mississippi River and found that the same species exhibited differential susceptibility to infestation from basin to basin. Comprehensive studies on potential fish hosts for Rabbitsfoot have yet to be conducted for fish species occurring east of the Mississippi River. Nonetheless, several western species that have been confirmed as hosts are also known to occur east of the Mississippi, including the Spotfin Shiner (*Cyprinella spiloptera*), Emerald Shiner (*Notropis atherinoides*), Rosyface Shiner (*Notropis rubellus*), and Striped Shiner (*Luxilus chrysocephalus*).

THREATS

Rabbitsfoot generally faces similar threats to those described in Section 3.2.3 for the Clubshell.

Snuffbox

The Snuffbox (*Epioblasma triquetra*) was listed as proposed endangered on November 2, 2010 by the USFWS (Federal Register 75 (211):67552-67583). A final ruling was effective on March 15, 2012, which listed the snuffbox as federally endangered (Federal Register 77(30):8632—8665).

HABITAT

Snuffbox prefers gravel and sand substrates in a wide variety of upland streams. It occurs in large rivers to small streams, but not far into headwaters (Haag & Cicerello 2016). This species is often found completely buried beneath substrate (Watters et al. 2009).

Snuffbox has the largest range of any species in the genus *Epioblasma*, known to 16 states and one Canadian province (Williams et al. 1993). Habitat destruction and fragmentation of existing populations has now limited Snuffbox's range to 79 streams and lakes in 14 states and Ontario, a 62 percent decline in range (USFWS 2012d).

Historically, this species was widespread in the Ohio River and all its major drainages in Kentucky from the Cumberland River to Tygarts Creek (Haag & Cicerello 2016). Currently Snuffbox is known in 40 of its 107 historical sites in the Ohio River Drainage, and 73 of 208 total streams rangewide (Butler 2007). It is absent from the Lower Green River, and the Tennessee River in Kentucky (but not in the lower reaches).

LIFE HISTORY

Snuffbox, like all members of the *Epioblasma* genus, uses the Periodic life history strategy characterized by low to moderate fecundity, long-term brooding of young, small adult size, early age at maturity, and a moderate length life span (Haag 2012). Eggs appear in female snuffboxes in September and glochidia shortly thereafter (Watters et al. 2009). Brooding of glochidia lasts through the winter until April or May. Snuffbox is known to infest potential hosts by trapping the head of the fish between the valves and pumping glochidia through to the fish's gills (Barnhardt 2010). Snuffbox has been identified to use both sculpin and darter species as fish hosts, with logperch recognized as the most common host (Watters et al. 2009, Butler 2007).

THREATS

Research indicates the lock and dam structures on the Ohio River have severely impacted Snuffbox populations, as habitat becomes unsuitable with flow regime changes (Butler 2007). It's estimated that more than 65% of Snuffbox's historical habitat is no longer suitable for the species (Butler 2007). Population fragmentation resulting from other impacts has made it difficult for the species to recover to historic levels. Genetic divergence of the species between watersheds makes possible conservation efforts increasingly complex (Zanatta & Murphy 2008).

CHAPTER 4 – SPECIES SURVEY SUMMARY

Habitat assessments were completed for the federally listed bats, mussels, and the Least Tern. Habitat assessments for all of the listed species were identified and described in the *Endangered, Threatened, and Rare Species Habitat Assessment and Wildlife Technical Report*, which can be found Appendix K-1 in the DEIS.

4.1 BATS

The I-69 ORX project corridor is located within the range of three federally listed bats, including the endangered Indiana Bat, the endangered Gray Bat, and the threatened Northern Long-Eared Bat.

Due to the potential occurrence of the Gray Bat (*Myotis grisescens*), and the known occurrence of the Indiana Bat (*Myotis sodalis*) and the Northern Long-Eared Bat (*Myotis septentrionalis*) within the I-69 ORX project corridor, which is shown as " Known Summer 1 Habitat" as outlined on the USFWS maps in the *Revised Conservation Strategy for Forest-Dwelling Bats in the Commonwealth of Kentucky* dated June 2016, the three bat species are reasonably certain to be present within the project corridor. The most recent approved programmatic agreement between KYTC and USFWS replaces "Known Summer 1 Habitat" for both Indiana and Northern Long-Eared Bat with "Known Maternity Habitat " for just the Indiana bat (*Myotis sodalis*), which includes roosting, foraging, and commuting habitat for the species. Known Maternity Habitat is defined by the U.S. Fish and Wildlife Service (USFWS) as suitable summer habitat located within a determined distance (5 miles of a capture location or 2.5 miles of documented roost tree for Indiana Bats) of an occurrence record for the species. Additionally, restrictions for habitat removal activities as outlined in the 4(d) rule for the Northern Long-eared Bat (*Myotis septentrionalis*) is 150 feet of known occupied maternity roost and 0.25 mile of hibernation site. The habitat assessment identified approximately 45.8 acres, including 33.6 acres in Kentucky and 12.2 acres in Indiana, of potential summer roosting habitat within Central Alternatives 1A/1B for the Indiana Bat, which was confined to bottomland hardwood forest and mixed deciduous forest, representing 20.9 acres and 24.9 acres, respectively. No summer roosting habitat was identified within the project corridor for the Gray Bat, but approximately 21.4 acres of preferred foraging habitat is present, including 13.3 acres of open water (ponds), 4.3 acres of riverine (Ohio River), and 3.7 acres of wetland scrub-shrub.

No caves occur within or near the project corridor that could provide summer roosting habitat for the Gray Bat, and or winter hibernation for all three of these bats. Stantec biologists completed field assessments at the only known abandoned underground mine site within the project corridor, which was located within the Wolf Hills community in Henderson County. No openings were discovered during visual surveys conducted between August 11 and 12, 2018. Potential evidence of a former opening was discovered at 6151 West Timberland Court near the bottom of a wooded slope at the base of a driveway, but it is not accessible to bats. In addition to surveying for abandoned mines, nine bridges and overpasses were surveyed for day-roosting bats, specifically the three listed species, as all three have been found to use bridges. Three of these structures were found to support the Big Brown Bat (*Eptesicus fuscus*). No listed bats were found using any of these structures, but due to quick colonization by bats, these structures will be rechecked prior to construction, if construction starts more than 2 years from the initial survey date (August 12, 2018).

4.2 LEAST TERN

Due to the river conditions within the project corridor and the absence of nesting habitat (e.g., sand bars), the USFWS did not recommend surveys for the Least Tern, and are reasonably certain the species is absent during nesting periods in the project corridor. However, USFWS did indicate that if river conditions change prior to project construction and available sandy habitat did become present, then future surveys would be needed. It is unlikely that the Least Tern uses the project corridor based on the lack of unvegetated and seldom-flooded sandbars. Some sand and gravel bar habitats exist along the Ohio River, but are often flooded. Also, the nearest known nesting records are more than 6.21 miles from the study area, which is the maximum documented foraging distance for nesting Least Terns (Hayes & Pike 1999, IDNR 2017b). Individual Least Terns may forage in the shallow waters of rivers and ponds during migration, so the project area is considered very low potential habitat but is within the species range.

4.3 MUSSELS

Stantec conducted a freshwater mussel survey from October 9-15, and 27-31, 2018 on the Ohio River between Evansville, IN and Henderson, KY (Stantec 2018b). A cell-based methodology was developed from previous habitat assessments using side-scanning sonar data and approved by USFWS, encompassing the search of 231 individual 20-meter by 20-meter cells within the area proposed for direct impacts along with buffers adjacent to this area. Searches were conducted along the preferred Central Alternatives 1A/1B alignment as well as the proposed West Alternatives 1 and 2 alignments (including areas where US 41 bridges may be demolished). Due to high flows and low water temperatures, only 108 of the 231 scheduled cells were surveyed. During the 47.07 search hours, total collections included 452 live mussels from 20 species, along with 154 spent shells including an additional four species (

Table 4-1 and Table 4-2). Species of special designation that were collected during the survey include one spent subfossil shell specimen of the federally endangered Fat Pocketbook, two spent shells of Kentucky Endangered Pyramid Pigtoe (*Pleurobema rubrum*), one spent shell of Kentucky Endangered Pocketbook (*Lampsilis ovata*), and 11 live and 11 spent shells of Kentucky Special Concern and potential federal candidate Longsolid (*Fusconaia subrotunda*).

Table 4-1Mussel habitat was considerably better (both according to side-scan sonar (Stantec 2018a) and diving observations) on the Central Alternatives 1A/1B alignment. Three hundred and ten (310) of the total 452 live mussels came from the fifteen cells in the "gravel/cobble/hardpan/bedrock" substrate category, all in the Central Alternatives 1A/1B alignment. No live federally listed species were found during the 2018 mussel survey. However, 11 Long-solid mussels were found during survey efforts.

Table 4-1. Collected Mussels in the Central Alternatives 1A and 1B Alignment during the Freshwater Mussel Survey, October 2018

SPECIES COMMON NAME	SPECIES	ALIVE	FRESH DEAD	WEATHERED	SUBFOSSIL	TOTAL
Mucket	*Actinonaias ligamentina*	-	-	1	-	1
Threeridge	*Amblema plicata*	40	-	16	6	62
Wartyback	*Cyclonaias nodulata*	12	-	1	5	18
Pimpleback	*Cyclonaias pustulosa*	6	-	2	-	8
Purple Wartyback	*Cyclonaias tuberculata*	1	-	-	-	1
Elephantear	*Elliptio crassidens*	1	-	5	-	6
Butterfly	*Ellipsaria lineolata*	-	1	-	-	1
Wabash Pigtoe	*Fusconaia flava*	1	-	-	-	1
Longsolid	*Fusconaia subrotunda*[1,2]	11	-	10	1	22
Fragile Papershell	*Leptodea fragilis*	6	-	-	-	6
Black Sandshell	*Ligumia recta*	4	-	3	2	9
Yellow Sandshell	*Lampsilis teres*	-	-	1	-	1
Washboard	*Megalonaias nervosa*	12	1	14	22	49
Threehorn Wartyback	*Obliquaria reflexa*	16	-	3	4	23
Pink Heelsplitter	*Potamilus alatus*	8	-	5	6	19
Fat Pocketbook	*Potamilus capax*[1,3,6]	-	-	-	1	1
Ohio Pigtoe	*Pleurobema cordatum*[4]	2	-	2	-	4
Round Pigtoe	*Pleurobema rubrum*[1,3,5]	-	-	-	2	2
Mapleleaf	*Quadrula quadrula*	5	-	4	2	11
Ebonyshell	*Reginaias ebenus*	242	1	70	4	317
Monkeyface	*Theliderma metanevra*	3	-	3	-	6
TOTAL		370	3	141	54	568

Source: Stantec 2018b Table Notes: 1. IN State Endangered 2. KY Special Concern 3. Endangered 4. IN State Species of Special Concern 5. Federal Species of Management Concern. 6. Federal Endangered

Table 4-2. Collected Mussels in the West Alternatives 1 and 2 Alignments during the Freshwater Mussel Survey, October 2018.

SPECIES COMMON NAME	SPECIES	ALIVE	FRESH DEAD	WEATHERED	SUBFOSSIL	TOTAL
Threeridge	*Amblema plicata*	19	-	3	-	22
Wartyback	*Cyclonaias nodulata*	3	-	-	-	3
Pimpleback	*Cyclonaias pustulosa*	7	-	-	-	7
Purple Wartyback	*Cyclonaias tuberculata*	1	-	-	-	1
Elephantear	*Elliptio crassidens*	-	-	1	-	1

SPECIES COMMON NAME	SPECIES	ALIVE	FRESH DEAD	WEATHERED	SUBFOSSIL	TOTAL
Butterfly	*Ellipsaria lineolata*	1	-	-	-	1
Wabash Pigtoe	*Fusconaia flava*	-	-	1	1	2
Plain Pocketbook	*Lampsilis cardium*	2	-	-	-	2
Fragile Papershell	*Leptodea fragilis*	3	-	-	-	3
Pocketbook	*Lampsilis ovata*	-	-	-	1	1
Black Sandshell	*Ligumia recta*	2	-	2	-	4
Yellow Sandshell	*Lampsilis teres*	1	-	1	-	2
Washboard	*Megalonaias nervosa*	4	-	-	-	4
Hickorynut	*Obovaria olivaria*	1	-	-	-	1
Threehorn Wartyback	*Obliquaria reflexa*	14	-	-	-	14
Pink Heelsplitter	*Potamilus alatus*	15	-	4	1	20
Mapleleaf	*Quadrula*	6	2	1	-	9
Ebonyshell	*Reginaias ebenus*	3	-	-	-	3
TOTAL		82	2	13	3	100

Source: Stantec 2018b

CHAPTER 5 – EFFECTS ANALYSIS

Below are the anticipated actions and their consequences to listed species resulting from the construction, operation, and maintenance of the proposed I-69 ORX as well as the removal of the US 41 bridge carrying south bound traffic. Exact construction plans have not yet been developed, therefore effects identified in the assessment may change. A conservative approach was taken in the assessment including all potential consequences from expected actions despite the possibility of some not being included in final construction plans. Based on the information discussed in Sections 3 and 4.3, multiple species are not expected to be within the project area. Sheepnose and Fat Pocketbook are both reasonably certain to occupy areas within the project area where they may be exposed to adverse effects from project actions. The remaining eleven species are therefore considered to have an effect determination that the project "may affect, not likely to adversely affect" them based on the absence of evidence that they would exist within the project site (Table 5-1).

Table 5-1. Mussel species considered to have a project "may affect, not likely to adversely affect" determination

Species	Scientific Name	Federal Status[1]	Effect Determination
Clubshell	*Pleurobema clava*	Endangered	May affect, not likely to adversely affect
Fanshell	*Cyprogenia stegaria*	Endangered	May affect, not likely to adversely affect
Northern Riffleshell	*Epioblasma rangiana*	Endangered	May affect, not likely to adversely affect
Orangefoot Pimpleback	*Plethobasus cooperianus*	Endangered	May affect, not likely to adversely affect
Pink Mucket	*Lampsilis abrupta*	Endangered	May affect, not likely to adversely affect
Catspaw	*Epioblasma obliquata*	Endangered	May affect, not likely to adversely affect
Ring Pink	*Obovaria retusa*	Endangered	May affect, not likely to adversely affect

Species	Scientific Name	Federal Status[1]	Effect Determination
Rough Pigtoe	*Pleurobema plenum*	Endangered	May affect, not likely to adversely affect
Spectaclecase	*Margaritifera monodonta*	Endangered	May affect, not likely to adversely affect
Rabbitsfoot	*Theliderma cylindrica*	Threatened	May affect, not likely to adversely affect
Snuffbox	*Epioblasma triquetra*	Endangered	May affect, not likely to adversely affect

1. USFWS 2018a

5.1 Proposed Actions

5.1.1 Tree Removal & Grubbing

Construction of the I-69 alignment and bridge approaches would begin with clearing and grubbing of trees, brush, and other vegetation within the clearing limits of the project alignment. Tree removal may occur prior to grubbing to accommodate tree clearing restrictions without requiring site stabilization. Disposal of clearing and grubbing material may consist of a combination of the following approved methods: disposal or recycling of material legally off the project area, reusing chipped material as mulch, burning, or burying of material on site.

5.1.2 Causeway Construction

Temporary causeways are likely to be needed in the river to facilitate construction of the bridge piers. As design plans are not finalized, exact plans for causeway construction are unknown. Probable construction includes two temporary fixed causeway bridges constructed of steel piling driven into the river bed. Causeways will be built outside of the bridge alignment, on one side to provide access from the causeway. Transverse "legs" going from this main causeway will provide access to build pier foundations. This causeway design is beneficial over fill-based causeways as impacts are confined to the smaller footprint of the steel pilings. Additionally, the cross-sectional area of the river will remain unimpeded, whereas a fill causeway would change hydrodynamic conditions at and downstream of the causeway potentially affecting aquatic habitats via elevated velocities and bed scour. Relatively small amounts of fill will be used on/near the banks for the transition onto the causeway and for pier construction on land.

5.1.3 Bridge Construction

The preferred alternatives for I-69 include construction of a new Ohio River bridge on the new alignment. While the exact construction methods for the bridge have not been finalized, construction will likely include one of the following:

- Use of drilled shaft foundations and waterline footings for the bridge piers to minimize in-stream construction work.
- In lieu of drilled shafts and waterline footings, the contractor may use caissons or cofferdams at pier locations to allow for work in dry conditions.

Each bridge will have a disturbance footprint up to 15,000 ft^2 (three piers at 5,000 ft^2 each). Approximately 6,500 ft^2 of disturbance will occur in the coarse gravel, cobble, hardpan/bedrock habitat, which was defined as suitable mussel bed habitat in the 2018 mussel survey. Approximately 3,500 ft^2 impacted by the midchannel pier will be on hardpan/bedrock habitat, and the entire 5000 ft^2 of the northern pier will impact sand habitat (Figure 5-1). Excavation of the drilled shafts will be accomplished using an auger, drilling bucket, rock auger, belling bucket or similar tool depending on soil conditions and presence of rock. Drilling machines will be mounted on a carrier such as a crane, excavator, crawler or truck and operated from drilling platforms or barges. Depending on soils, shafts may be partially to fully cased in steel, and casings may be temporary or permanent. Casing will be installed to the appropriate depth using either an oscillator or rotator, and once casings are installed, the shaft will be filled with water or slurry to prevent collapse as the shafts are excavated. Following excavation of the shaft, a reinforcing cage constructed of rebar will be placed in the drill shaft and then concrete will be pumped into the shaft, displacing the water or slurry in the shaft. Drilled material will be disposed of offsite and will not enter waterways. Piers will be installed either on waterline footings or at the river/substrate interface, with concrete poured in dry conditions facilitated by the caissons/cofferdams. All efforts will be made to keep any water contaminated by the pours from entering the river. Any contaminated water will be extracted and either treated or disposed properly. Once piers are installed, construction can proceed on the bridge with little to no impact on instream features.

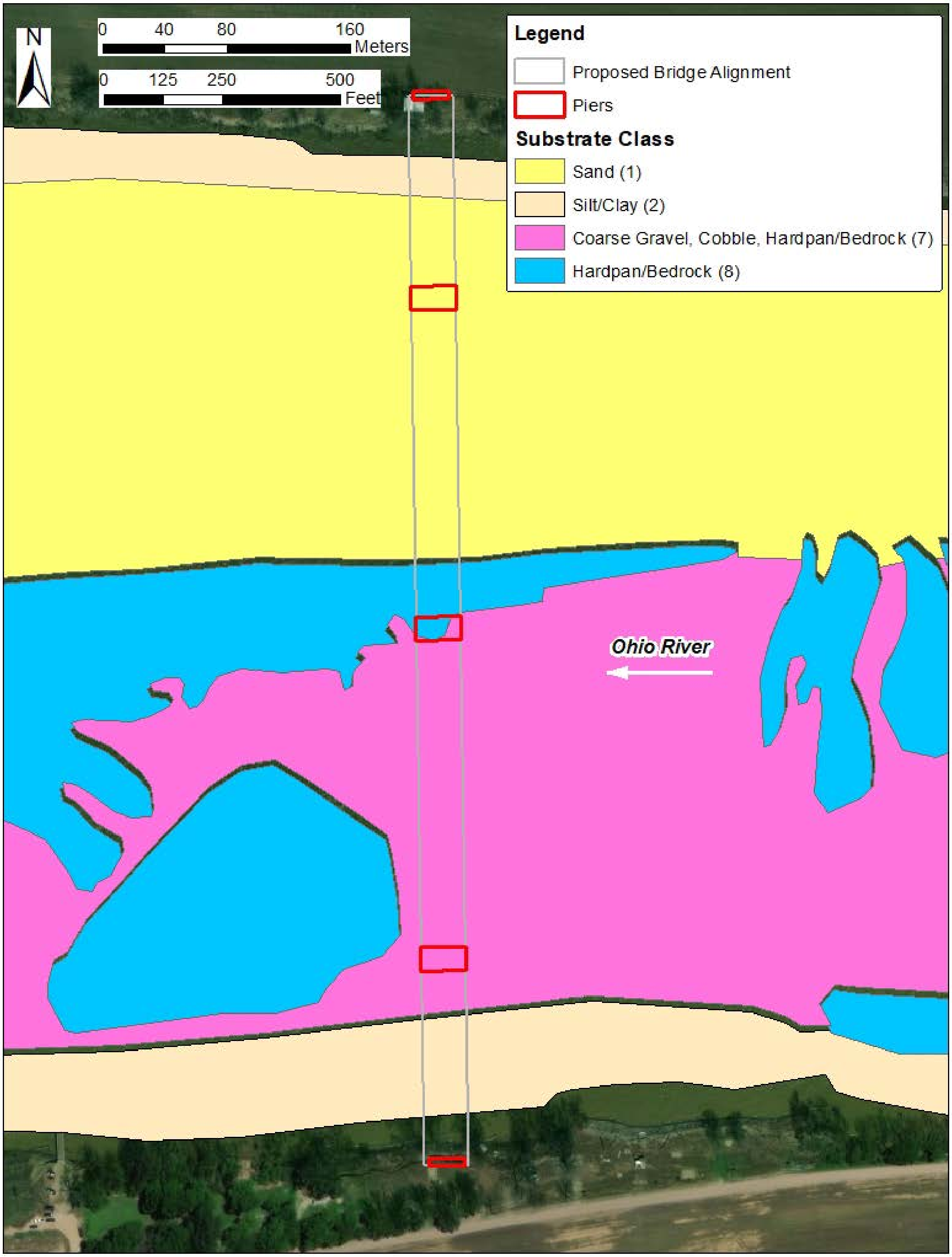

Figure 5-1. I-69 Bridge Pier Impacts on Substrate

5.1.4 Roadway Construction

Following clearing and grubbing activities, construction of the roadway embankment would begin using approved rock and excavated materials to bring the roadbed up to final grade. Roadway construction on the new I-69 bridge should not involve any impacts to instream features. Other portions of roadway construction may require filling wetlands to bring existing conditions up to necessary road grade. Roadway construction will also affect numerous perennial, intermittent, and ephemeral streams. These features may be straightened and channelized for short distances to allow for construction. They will be permanently routed either under bridges or through culverts depending on stream size. Detailed construction plans are still in the development stages.

5.1.5 US 41 Bridge Demolition

One existing US 41 bridge will be taken out of service. The existing asphalt/concrete roadway on the bridge will be removed without impacts to the river below, with waste being trucked off the bridge to an upland location for disposal. The bridge superstructure (not including the roadway), which is made up of a steel truss superstructure and concrete piers, potentially would be removed using a controlled explosive demolition technique and may have impacts to the river. The controlled explosive demolition technique involves the use of small explosive charges at key structural components of the bridge to induce a controlled collapse. This approach will result in dropping the steel superstructure in sections into the river where it will then be lifted out of the river for disposal.

5.1.6 US 41 Pier Removal

Following removal of the roadway and steel superstructure, the remaining concrete piers will be removed with wire saws, barge-based jackhammers, or explosives to the water's surface. The underwater portion of the piers may be demolished using wire saw or explosives and may require dredging of the river bottom for concrete debris.

5.1.7 Staging Areas

Staging, refueling, and clean-up areas will be constructed a minimum of 100 feet away from the normal water line or bank of jurisdictional waters of the U.S. or waters of the State (streams, wetlands, ponds, etc.). Equipment cleaning/staging areas will be lined to prevent groundwater seepage and will include drainage controls to filter runoff through vegetated areas and with sediment control structures located between the staging area and receiving water-bodies; thereby minimizing the potential for impacts to jurisdictional waters such as sedimentation and pollution. Fuel and other petroleum products for construction equipment would be stored in the staging area and best management practices (BMPs) on contaminants would minimize the potential for fuel spills and contamination.

Measures to control and minimize erosion and water quality impacts from construction activities will incorporate BMPs, standard erosion control measures and other measures included in the INDOT Standard Specifications and Special Provisions and the KYTC Standard Specifications for Road and Bridge Construction will provide the basis of the erosion control plan.

5.2 ADVERSE EFFECTS – INDIANA AND NORTHERN LONG-EARED BAT

5.2.1 Tree Removal

Harm/Harass Individuals – The removal or cutting of trees greater than 3.0 inches DBH during the spring, summer, or autumn (April 1 – November 15) could result in the removal of an occupied roost tree. Non-volant juvenile bats are normally confined to maternity roost trees which have a much larger DBH. If maternity trees are removed while containing non-volant juvenile bats, then individuals could be killed. The felling of an occupied tree has been documented on three different occasions, and in all cases some of the bats in the tree were either killed or injured (USFWS 2007a, Belwood 2002). Tree removal restrictions, especially waiting to remove trees after juvenile bats are able to fly, will prevent/reduce the potential for a direct take of a bat. Trees having a DBH greater than 3.0 inches will not be removed from the Indiana portion of the project between April 1 and September 30. Tree removal will be restricted on the Kentucky portion of the project to a time period outside of when juvenile bats are unable to fly, which is normally from June 1 – July 31. Tree cutting the remaining portion of the year could still result in the incidental take of a roosting bat. However, this potential take will be mitigated following the guidance provided in the most recent programmatic agreement between the Federal Highway Administration (FHWA), KYTC, and the Service's Kentucky Field Office, which allows for use of the IBCF for forest habitat removal for the entire I-69 ORX project corridor.

5.2.2 Winter Habitat Alterations

Harm/Harass Individuals – The removal or damage of any structure providing winter hibernacula for bats could result in a direct take of bats. However, no caves, mines, sinkholes, or other underground structures are present within the I-69 ORX project corridor that could be used by hibernating bats. No affects to hibernating bats are expected due to the lack of habitat.

5.2.3 Forest Habitat Loss

Habitat Loss – Removal of forested habitat within the I-69 ORX project corridor would affect current and future Indiana Bat roosting, foraging, and commuting habitat within a fragmented landscape. Some trees or snags that could be suitable roosting habitat will likely be removed during construction, and suitable foraging corridors may be altered or removed. Because bats exhibit philopatry to summer roosts, especially maternity roost trees, potential exists for pregnant females to suffer stress while searching for a new roost tree. Loss of habitat could also reduce capacity to support local populations. Based on the *Endangered, Threatened, and Rare Species Habitat Assessment and Wildlife Technical Report*, which can be found in Appendix K-1 of the DEIS, approximately 45.8 acres of potential summer roosting habitat for the Indiana Bat would be eliminated within Central Alternatives 1A/1B. This summer habitat is confined to bottomland hardwood forest and mixed deciduous forest, representing 20.9 acres and 24.9 acres, respectively. All of these 45.8 acres are within the " Known Maternity Habitat" habitat. These same 45.8 acres along with an additional 4.8 acres of upland scrub-shrub, resulting in 50.6 acres of summer roosting habitat, was identified within the Central Alternatives 1A/1B for the Northern Long-Eared Bat. Adverse effects are not expected to the Northern Long-eared Bat because project actions are not located within 150 feet of a known roost tree, or within 0.25 miles of a known hibernaculum, thus the activities of the project meet the 4(d) rule for the species. Additionally, it's expected the I-69 ORX project construction may have adverse indirect effects on the Indiana Bat due to the loss of 45.8 acres of summer roosting, foraging, and commuting habitat (33.6 acres in Kentucky and 12.2 acres in Indiana). However, this adverse effect will be mitigated following KYTC's Programmatic Agreement, which allows for use of the IBCF for forest habitat removal for the entire I-69 ORX project corridor.

5.2.4 Water Quality Degradation

Any of the previously described actions that affect water quality have the potential to impact any of the listed bat species. Water quality degradation can impair water sources used by bats for hydration, as well as limiting production of insect biomass used by bats as food. Temporary effects on water quality could occur during construction, which may cause short-term indirect effects on foraging Indiana and Northern Long-Eared Bats during spring, summer, and autumn. Construction would start by removing trees, which may be outside the dry season due to tree clearing restrictions in Indiana. It is also possible that grubbing of scrub-shrub and non-forested habitats may occur throughout the year, including the rainy season. Both grubbing and construction could cause erosion, if not managed properly with sediment and erosion control methods. The project will follow the standards established by the EPA's NPDES program. Specific NPDES compliance procedures, as outlined by the state jurisdictional authority, will be followed and implemented by all project parties, including project sponsors and contractors. The Indiana Bat prey selection contains a variety of species, and both species are known to forage in a variety of habitat types (Kurta & Whitaker 1998). Small myotid bats, such as the Indiana Bat, are often considered a selective opportunistic forager and should be able to locate additional aquatic and/or terrestrial insects (Belwood & Fenton 1976, Fenton & Morris 1976, Vaughan 1980). Since potential impacts from sedimentation will be restricted to within the project corridor, the Indiana Bat and Gray Bat could relocate and move upstream or downstream to forage for aquatic insects. If needed, either species could also temporarily switch to other habitat types for foraging. Any effect from water quality degradation on foraging bats would be a short-term consequence that is discountable. As with other adverse effects associated with the Indiana Bat and Gray Bat, the consequences will be mitigated through the use of the most recent programmatic agreement

5.3 ADVERSE EFFECTS – GRAY BAT

Harm/Harass Individuals – The removal or disturbance of a known hibernacula, maternity roost sites, or bachelor sites, such as limestone caves, sinkholes, abandoned underground mines, or any other underground structure that could provide hibernation and/or summer roosting habitat could result in the direct take of individual bats. Additionally, the disturbance and/or alterations to highway bridges that may be used by roosting Gray Bats during the spring, summer, and autumn could also have an adverse direct effect on the Gray Bat. Due to the lack of underground structures that could provide appropriate conditions for hibernating, and/or maternity roost for the Gray Bat, the project is not expected to have any direct effects on the Gray Bat. In addition, no Gray Bats were found using any of the existing bridges or overpasses within the project corridor, thus no direct effects are expected for roosting Gray Bats under bridges. As a conservation measure to reduce potential for future take, all of these bridge structures will be checked again when construction gets closer because many species, including the Gray Bat, can colonize bridges quickly. No adverse direct effects to the Gray Bat are expected from the construction of the I-69 ORX project.

The only effects from the I-69 ORX project to the endangered Gray Bat that are likely to occur later in time consist of degraded foraging habitat and prey availability. Preferred foraging habitat for the Gray Bat consists of aquatic ecosystems, primarily streams, rivers, impoundments, and associated wetland and riparian vegetation. Habitat and prey availability are both associated with water quality. Temporary effects on water quality during construction within the project corridor, especially Eagle Creek, Canoe Creek, and Ohio River, could reduce local insect populations. This could cause the Gray Bat to consume more terrestrial insects or shift foraging activity to other similar nearby aquatic environments. As discussed in Section 5.2.4, numerous water quality protective measures will be incorporated into the construction plans that will avoid and minimize impacts to aquatic resources. The effects of temporary changes in water quality are likely to be discountable, and very unlikely to happen because of incorporated conservation measures. However, if they occur the consequences are covered under the most recent programmatic agreement.

5.4 ADVERSE EFFECTS – LEAST TERN

Harm/Harass Individuals – the destruction of nesting areas, especially during the nesting season would lead to a direct take of the Least Tern. However, the Ohio River within the I-69 ORX project corridor doesn't currently contain any available nesting habitat, so the project will have discountable consequences on nesting Least Terns. Based on conversations with USFWS, if the river conditions change prior to project construction and sandy beaches or islands become present due to changes in river flow and/or drought, surveys may be needed or recommended by USFWS to ensure this habitat is not being used for nesting. A project commitment would be to add nest surveys in future should changes in the river occur and suitable habitat becomes present. No adverse effect is expected from the project on nesting Least Terns.

The nearest known Least Tern nesting area is located greater than 6.2 miles from I-69 ORX project corridor (Hayes & Pike 1999, IDNR 2017b). Since 6.2 miles is the maximum documented foraging distance for nesting Least Terns (Sherfy et al. 2012), the I-69 ORX project corridor is outside of the foraging area for nesting birds, thus no future effects from construction of the project on foraging habitat is expected. It is possible that future consequences on foraging activities of migrating terns could occur from disturbances along the river associated with construction of the project, but these are expected to be discountable because of the large amount of similar river habitat available adjacent to the project corridor. The project is not expected to have any adverse consequences on the Least Tern.

5.5 ADVERSE EFFECTS – MUSSELS

Due to the mussel survey within the action area finding Fat Pocketbook (as a subfossil shell) and surveys in surrounding areas finding Sheepnose, and known sites for both species occurring upstream and downstream of the I-69 ORX project, KYTC is reasonably certain that listed mussels are present in low numbers within the project area and consequences from the project could have adverse effects to listed mussels and such effects vary by species. Consequences from the project and all adverse effects on mussels will be examined as a component of calculating anticipated take of listed species by using the best available data (Third Rock Consultants 2020, Lewis Environmental Consulting 2015, Stantec 2018b).

5.5.1 Crushing Mussels

Mussel shells can be adversely affected by the project actions as a result of being physically crushed when still alive. The crushing of mussel shells can be related to natural weathering or predation, but also caused by placement of fill or heavy machinery associated with construction activities (Badra 2011). Mussels could be crushed during construction activities, including the dropping of the US 41 bridge into the Ohio River, removal of the superstructure from the river, falling concrete from pier demolition and removal, the installation of causeway bridge supports, spudding of barges, barges nosing onto shore to anchor, and the installation of new piers for the I-69 bridge.

5.5.2 Stranding Mussels During Dewatering

Another adverse effect to any listed freshwater mussels present in the action area would be stranding on dry land from the dewatering activities associated with construction. Waterline footings, caissons or cofferdams at pier locations will be dewatered. Any mussels in that area will be stranded in the substrate as water is pumped out and/or replaced by concrete. Freshwater mussels have developed behavioral adaptations to stage changes in streams such as drought conditions but have no defense against permanent stranding (Seth et al. 2004, Cooper 2011). Mussels have behavioral mechanisms to deal with emersion: tracking, burrowing, and tracking then burrowing (Gough et al. 2012). Tracking is a behavioral response where mussels move on top of the substrate away from the receding water levels in an attempt to avoid emersion. This response would be futile in the event that a cofferdam is used, as the mussels would be unable to pass through into the wetted portion of the river. Burrowing involves mussels burying themselves in the substrate to find thermal refuge and avoid desiccation. Burrowing would potentially leave mussels vulnerable to being crushed or entrapped in the substrate when piers are installed. Tracking then burrowing is a combination of the two previous behavioral responses and would have the same outcome as previously described.

5.5.3 Entrapment of Mussels in Substrate

Adverse effects to mussel species may result from entrapment of mussels in substrate as concrete for piers is poured at the bottom of the Ohio River. Additionally, as riprap/fill is installed on riverbanks and around piers, mussels may be entrapped. The result of entrapment most likely would be reduced recruitment at best, and mortality at worst. Mussels entrapped in substrate would be unable to reproduce, as multiple components of the mussel life cycle would be disrupted.

5.5.4 Increased Suspended Sediments

Short term increases in suspended sediments are expected during multiple phases of construction. When the US 41 bridge is dropped into the Ohio River during demolition, sediments on the river bottom will be mobilized, increasing turbidity and reducing mussel filtration capacity. When the piers from the US 41 bridge are demolished using explosives, and pieces are dredged from the river bottom, sediment will most likely enter the water column. Installation of drilled shafts, cofferdam or caisson structures, as well as the deposition of riprap may also cause increases in suspended sediments. This effect will be felt downstream while sediments have sufficient time to settle out of the water column. Intermittent exposure to high levels of suspended solids has been shown to decrease clearance rates (filtration) of mussels (Aldridge et al. 1987) impacting feeding ablilty. During extended exposure to elevated total suspended solids, female mussels were shown to forgo reproductive cycles (Gascho Landis et al. 2012). However, the impacts seen during this project will most likely be localized and short in duration, resulting in no long term impacts on mussels.

5.5.5 Removal from Aquatic Habitat

Dredging is potentially going to be used to remove particles of the US 41 pier that fall into the river during demolition. If this occurs, dredging will most likely need to be used to remove those concrete fragments. During this, there is the chance that freshwater mussels could be removed from the river bottom alongside concrete particles. As described in Section 4.3, the overall density of mussels in the western alignment was relatively low, so risk of this impact is also low.

5.5.6 Hydrologic Changes/Sedimentation

Installation of drilled shafts and cofferdam/caisson structures will change local hydrology around pier locations. This may result in scouring of sediments in that area, increasing turbidity and suspended sediments. This could impact mussels immediately downstream, and until sediments have sufficient time to settle out of the water column. Installation of turbidity curtains may be used around cofferdam/caisson structures or where pilings for causeways are installed. This could result in changes to water velocity and may cause increased sedimentation within silt fences where suspended solids can settle from the water column.

5.5.7 Water Quality Impacts

Construction activities could result in accidental spills of hazardous materials into the surrounding environment (USEPA 2016). Spills can damage both surface and ground water, resulting in a degradation of consumable water sources for surrounding species, and be detrimental for aquatic species, including mussels and their host fish. Due to mussels' filter feeding behavior, freshwater mussels can be exposed to chemicals via ingestion, with chemicals in the water column directly impacting mussel gills, mantle, and kidneys. Bioaccumulation in tissues appears to be metal dependent (Naimo 1995). Impacts can be reduced or avoided by following equipment servicing and operating guidelines, proper siting and use of staging areas, removing and property treating or disposing any water associated with the concrete pours, and using containment spill and herbicide use plans.

Chemicals such as pesticides and herbicides used in right of ways and medians to control vegetation adjacent to transportation facilities can bioaccumulate in species tissue over time. Salt and chemicals used for road maintenance can become a part of runoff, which would negatively affect water quality and degrade habitat. Road salt has been shown to impact freshwater mussel glochidial life stages, potentially inhibiting recruitment (Gillis 2011). Bivalves have also been shown to readily bioaccumulate metals associated with road traffic (Zimmerman et al. 2002).

These impacts would most likely be felt by mussels downstream of the I-69 bridge. The previously mentioned changes to hydrology and scouring around newly installed piers will most likely result in short term increases in suspended solids as substrates around the piers reach a new equilibrium.

5.5.8 Mortality and Stress of Potential Host Fish

Both explosive blasting to remove existing US 41 piers and potential impacts to substrate related to installation of the I-69 piers and causeways will most likely result in increased stress levels or mortality of fish inhabiting adjacent areas. Fish may be impacted directly during detonation of explosives, resulting in mortality, and death of any attached glochidia. During the installation of causeways and during pier construction, vibrations may be felt or heard throughout the water column, also impacting fish, increasing stress levels (Wysocki et al. 2006, Gutreuter et al. 2006). Impacts on fish are important because numerous species of fish in the Ohio River host mussel glochidia for transformation into juveniles. The collection of smaller size classes of non-listed mussels during the 2018 mussel survey indicate that active recruitment within the project area is occurring, indicating that this fish host/mussel interaction is present in the project area (Stantec 2018b). Therefore, impact to host fish population size or condition decrease opportunities for encystment on a proper host fish. Additionally, any already encysted fish that are impacted by construction related stressors would also have an adverse consequence on the mussel glochidia. This could have long term effects on overall recruitment of mussels in the project area. Finally, new fish communities may inhabit these areas once piers are removed and new water velocity and habitat cover are introduced. If this occurs, potential fish hosts for resident mussels may no longer inhabit areas where encystment previously occurred.

5.5.9 Changes to Hydrology/Scouring

The area surrounding the new I-69 piers will be subject to continual impacts from scouring and changing hydrology as river waters divert around the piers. This hydrological impact will scour the substrate around the piers, most likely sorting for larger sediment sizes (if not entirely riprapped to protect piers). This can impact mussels by prohibiting colonization by species that prefer smaller sediment sizes. However, this may create habitat for species that can tolerate larger sediment sizes, such as Spectaclecase (USFWS 2014b). Altered velocity patterns may influence which fish species use habitats around the piers, potentially creating a disconnect between resident mussels and their preferred fish hosts.

CHAPTER 6 – CONSERVATION MEASURES

Construction, operations, and maintenance activities will follow the conditions of the federal and state permits and abide by FHWA, INDOT, and KYTC standards and agreements. Erosion and sediment control BMPs will be installed prior to the start of earth disturbing activities to include tree removal, will be phased and modified during construction, and post construction BMPs will be maintained.All research and monitoring will be done in cooperation with IDNR, KYDNR, and USFWS. Actions and research/monitoring results will be effectively communicated to the parties involved in protection and conservation of endangered species. Open communication and partnerships will be sought at every reasonable opportunity to further coordination of conservation efforts.

6.1 BATS

The potential construction impacts to the Indiana Bat summer habitat will be addressed through the most recent programmatic agreement. which will dictate mitigation requirements for construction impacts (KYTC 2012, USFWS 2012c). The USFWS confirmed through coordination that the programmatic agreement would be applied in both states, with the exception that Indiana tree clearing restrictions would be followed within Indiana (DEIS Appendix H-7). Potential impacts to Indiana, Gray, and Northern Long-Eared Bats can be mitigated through the below list of conservation measures.

The proposed I-69 ORX project requires removal of approximately 45.8 (33.6 acres in Kentucky and 12.2 acres in Indiana) acres of "Known Maternity Habitat", which includes summer roosting and foraging habitats for the Indiana Bat. Based on the information provided in the BA, no adverse consequences to suitable winter habitat for any of the listed bat species are expected to occur due to lack of habitat. In lieu of a presence/absence survey, KYTC, INDOT, and FHWA is assuming presence of these species in the forested habitat and have determined that the action "may affect, is likely to adversely affect" the Indiana Bat. KYTC proposes to account for potential adverse effects to the Indiana bat and its habitat through the processes identified in most recent programmatic agreementbetween FHWA, KYTC, and USFWS's Kentucky Field Office. It is expected that the I-69 ORX project construction may have adverse effects on the Indiana Bat due to the loss of 45.8 acres of summer roosting, foraging, and commuting habitat. However, this potential take will be mitigated following the guidance provided in the KYTC's Programmatic Agreement, which allows for use of the IBCF for forest habitat removal for the entire I-69 ORX project corridor. If the project's final design and construction impacts less than 45.8 acres of Indiana Bat habitat then less mitigation will be required.

6.1.1 Tree Clearing Restrictions

The most recent programmatic agreement indicates in Tier 2 that a standard avoidance and minimization measure is seasonal clearing within the dates of October 15 through March 31. However, KYTC has indicated they would prefer to utilize the most recent programmatic agreement and adhere to feasible tree cutting restrictions as determined by project needs.

Tree clearing within the Indiana portion of the project corridor for trees having a 3 inch or greater DBH will not be allowed between April 1 and September 30 when they could possibly be occupied by bats. Adhering to seasonal tree clearing in both Indiana and Kentucky reduces the potential for adverse effects to Northern Long-Eared Bats and Indiana Bats while they are in tree roosts. Gray Bats are not tree roosting bats, therefore, this conservation measure would not affect the species (Brady et al. 1982).

6.1.2 Other Potential Bat Habitat (Highway Structures)

Bridges and overpasses within the I-69 ORX project corridor were surveyed for bat use, and no listed bats were found. However, to reduce potential for future take of roosting Indiana, Northern Long-Eared, and Gray Bats using highway structures (bridges and overpasses), all of the structures within the project corridor will be checked again, if construction occurs 2 years or more from when the initial survey was completed, which was on August 12, 2018.

6.1.3 Erosion and Sediment Controls

As discussed in Section 5.2.4, numerous water quality protective measures will be incorporated into the construction plans that will avoid and minimize impacts to aquatic resources. Construction will follow IDEM and KDEP erosion and sediment control requirements. The requirements include the use of measures that will avoid and minimize impacts to aquatic resources. Measures will be inspected weekly and after rain events and will be repaired or replaced as required. Measures will be adjusted to the phase of construction. Temporary measures will not be removed until the location is stabilized. Permanent measures will remain in place post construction. These methods will help prevent negative impacts to the main source of Gray Bat forage, which is aquatic insects (Brady et al. 1982). Indiana Bats also forage on some species of aquatic insects; therefore, this conservation measure would benefit them (Sparks and Whitaker 2004).

6.2 LEAST TERN

Future surveys will be completed for nesting Least Terns if low water allows for suitable habitat to become available within the project corridor. Changes in the river caused by drought, etc., could occur before or during the project's construction. Therefore, if suitable habitat (such as a sandbar or a shoal) becomes present during the project development process and/or construction, surveys will be completed to ensure this habitat is not being used for nesting.

6.3 MUSSELS

6.3.1 Erosion and Sediment Controls

A Stormwater Pollution Prevention Plan (SWPPP) will be developed and approved by INDOT, KYTC, IDEM, and KDEP prior to construction. BMPs will be used. Erosion and sediment control measures are typically put in place as a first step in construction and maintained throughout construction. Temporary Seeding and mulch are used to reduce erosion and sedimentation damage by means of stabilizing a disturbed area where additional work is not scheduled for at least seven (7) calendar days

6.3.2 Equipment Maintenance, Cleaning, Fueling, and Monitoring Plan

A plan will be developed to prevent equipment related impacts from reaching waterways within the project area. Staging, refueling, and clean-up areas will be constructed a minimum of 100′ away from the normal water line or bank of jurisdictional WOTUS or waters of the State (streams, wetlands, ponds, etc.). Specific protection details will be described in this plan and will help reduce the risk of fluids from equipment leaking into waterways. Fuel and other petroleum products for construction equipment would be stored in the staging area and BMPs on contaminants would minimize the potential for fuel spills and contamination. The contractor is required to provide a spill response plan, which will be enacted if spills do occur, including sedimentation events into waterways (DEIS 2018). Additionally, equipment will be monitored during construction operations for any oil, hydraulic, or fuel leaks. If leaks arefound, construction using that equipment will be halted until leaks can be fixed. All effluent from upland staging areas will be filtered using a variety of BMPs prior to confluence with any waterbodies.

6.3.3 Catch Barges for US 41 Roadway Removal

The existing southbound US 41 bridge across the Ohio River is scheduled for removal as part of project construction. This will involve removal of the roadway from the bridge structure prior to bridge demolition. This action will be conducted in a way that prevents impacts to waterways and mussel habitat. Catch barges (using spuds to moor in place underneath the existing bridge) will be used underneath sections of the bridge/roadway as they are demolished. This will minimize any falling debris from entering the waterway. As the roadway is demolished it will be removed by trucks over the remaining bridge to an offsite, upland storage area.

6.3.4 Demolition & Recovery of US 41 Bridge

The demolition and recovery of the US 41 bridge will be done such as to minimize impacts to the surrounding aquatic environment. Final decisions will be made by the contractor; however, recent experience on similar projects, such as the 2013 demolition of the Milton-Madison Bridge, suggests that explosives may be used to demolish the bridge during a navigation stoppage, followed by the use of barge-mounted equipment to remove the debris from the river bed.

6.3.5 US 41 Pier Removal

Existing piers will be removed to just above the water line using wire saws, jackhammers or explosives with barge work platforms arranged to limit material falling into the Ohio River. Pier material below the waterline will either be removed using wire saws or explosives and dredged from the river bottom. If dredging is used to remove pier material, a floatingturbidity curtain may be used to limit downstream sedimentation by allowing for longer residence times that facilitate localized settling of suspended sediments.

6.3.6 Upland Storage of Bridge Materials

In order to ensure bridge materials do not spill into the Ohio River, all materials (new for I-69 and removed for US 41) will be stored at an upland staging area away from the normal water line or bank of jurisdictional waters of the U.S. or waters of the State.

6.3.7 Barge Spud Location Restrictions

To minimize impacts to Ohio River substrates, barges and other boat traffic will be restricted to deploying spuds within impact areas around causeways and piers. This will isolate substrate impacts to a smaller footprint.

6.3.8 Concrete Pouring

Concrete will be poured in a manner to avoid spills into the Ohio River. Piers will be constructed either incased drilled shafts, precast waterline footing platforms or in the dry, with caissons or cofferdams, preventing concrete spills into the river, while facilitating proper installation. If concrete spills occur, the resident engineer (following protocols outlined in the SWPPP) will halt construction and notify relevant agencies. Any contaminated water or slurry will be disposed of offsite.

6.3.9 Environmentally Sensitive Area Minimization Procedures

River bottom areas of high environmental quality have been delineated prior to construction, with work conducted in these areas minimized as much as possible (Figure 6-1). These areas will include the suitable mussel habitat located on the southern side of the river, as noted in the *Substrate Groundtruthing Report* (Stantec 2018a). Every reasonable effort shall be taken to minimize the adverse impact of the construction on mussels, fish, wildlife, and natural areas.

6.3.10 Revegetation of Riparian Areas & Limited Use of Riprap

During the design phase, consideration will be given to using alternative armoring materials and may include portions of dry land under bridge openings that would normally be armored with riprap. The use of bio-engineering techniques to provide natural armoring of stream banks will be considered and implemented where practicable. Installation of riprap would be limited to areas necessary to protect structure integrity. If riprap is required to protect erodible slopes, it will be installed outside the stream bed and between the toe of slope and the ordinary high water mark where possible. Design plans will include the planting of native woody and herbaceous vegetation to stabilize stream banks except for areas under bridges.

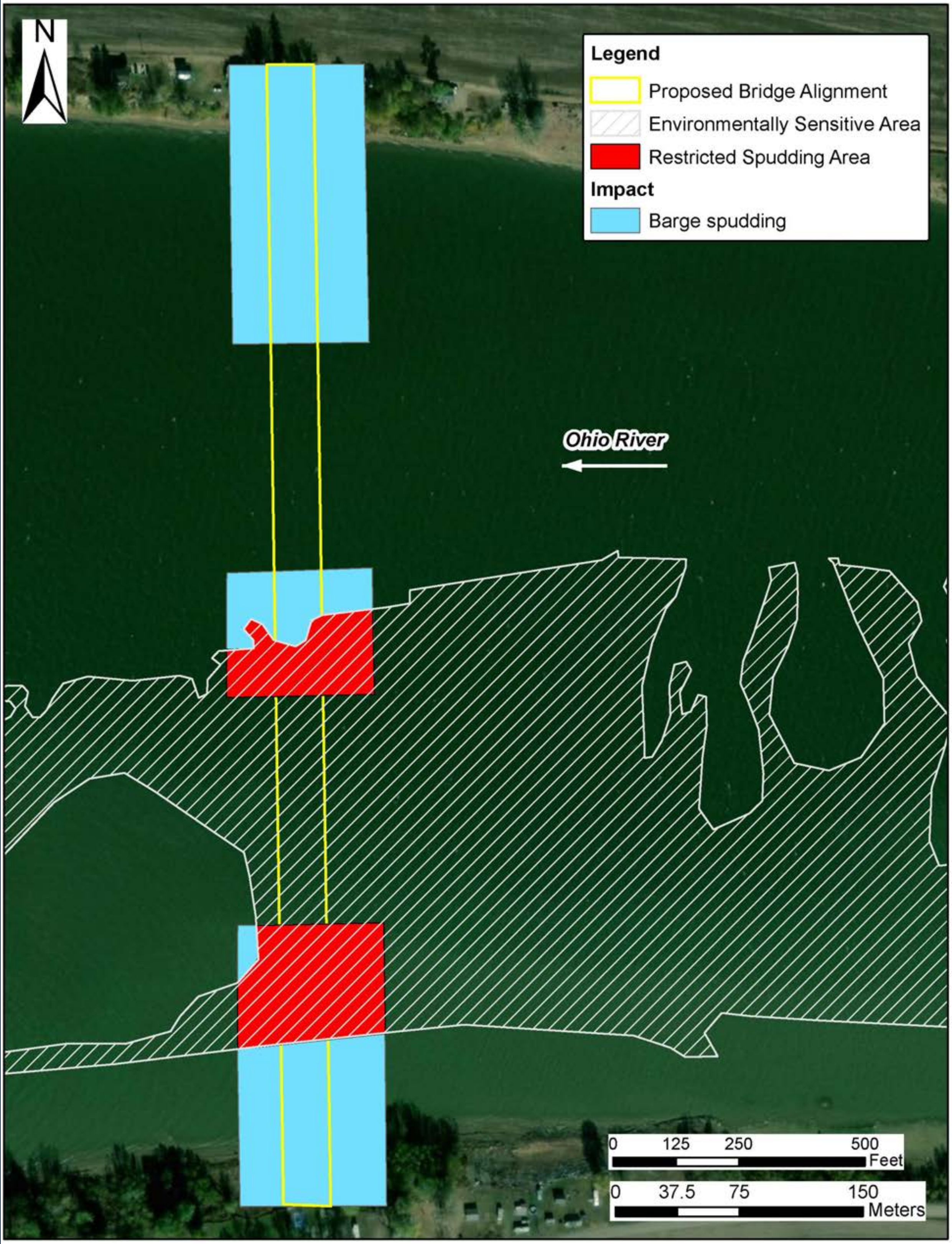

Figure 6-1. Environmentally Sensitive Areas

6.3.11 Monetary Contributions to Conservation

FHWA, INDOT and KYTC are committed to making a monetary contribution to support the recovery of the freshwater mussel species and minimize aquatic habitat impacts from the project actions. Because some of the proposed actions of this project may result in adverse effects to all mussel species, specifically their reproductive capacity during construction, funds may be used for propagation, monitoring, research, or other tasks that benefit native freshwater mussels historically found in this section of the Ohio River. These funds may address two species of conservation need, Longsolid (*Fusconaia subrotunda*) and Elephantear (*Elliptio crassidens*), both of which were found in the project area (Stantec 2018a). These funds may also address Fat Pocketbook and Sheepnose, the two federally listed mussels most likely to occur in the project area.

CHAPTER 7 – EFFECT DETERMINATIONS

The information contained within this biological assessment allows for a comprehensive analysis of proposed actions, subsequent adverse effects, and conservation measures to mitigate for effects on the species which are either known from within the action area or historically found near the action area. While thirteen species of mussels were identified during IPaC review, after surveys were completed and the composition of nearby beds were examined, only two listed mussel species were considered in the effects determination of this document. Based on the project and activities associated with the implementation, and known threats to the listed species, stressors have been identified for each species. Each stressor is presented below and discussed in detail on how they affect the listed mussels by using a Stressor-Exposure-Response pathway. The pathway contains the stressor, activity that causes the stressor, affected resource, exposure location and time, species response, relevant conservation measure, effective pathway, and type of effect. Table 7-1 outlines the effects determinations for the species potentially impacted by the I-69 ORX project.

Table 2-1. Effects Determinations for I-69 ORX Species

SPECIES	SCIENTIFIC NAME	FEDERAL STATUS[1]	EFFECT DETERMINATION
Indiana Bat	*Myotis sodalis*	Endangered	May affect, is likely to adversely affect
Gray Bat	*Myotis grisescens*	Endangered	May affect, not likely to adversely affect
Northern Long-Eared Bat	*Myotis septentrionalis*	Threatened	May affect, is likely to adversely affect
Least Tern	*Sternula antillarum*	Endangered	May affect, not likely to adversely affect.
Clubshell	*Pleurobema clava*	Endangered	May affect, not likely to adversely affect
Fanshell	*Cyprogenia stegaria*	Endangered	May affect, not likely to adversely affect
Fat Pocketbook	*Potamilus capax*	Endangered	May affect, is likely to adversely affect
Northern Riffleshell	*Epioblasma rangiana*	Endangered	May affect, not likely to adversely affect
Orangefoot Pimpleback	*Plethobasus cooperianus*	Endangered	May affect, not likely to adversely affect
Pink Mucket	*Lampsilis abrupta*	Endangered	May affect, not likely to adversely affect
Catspaw	*Epioblasma obliquata*	Endangered	May affect, not likely to adversely affect
Ring Pink	*Obovaria retusa*	Endangered	May affect, not likely to adversely affect
Rough Pigtoe	*Pleurobema plenum*	Endangered	May affect, not likely to adversely affect
Spectaclecase	*Margaritifera monodonta*	Endangered	May affect, not likely to adversely affect
Sheepnose	*Plethobasus cyphyus*	Endangered	May affect, is likely to adversely affect
Rabbitsfoot	*Theliderma cylindrica*	Threatened	May affect, not likely to adversely affect
Snuffbox	*Epioblasma triquetra*	Endangered	May affect, not likely to adversely affect

1. USFWS 2018a

7.1 MUSSELS

The project actions discussed in Section 5.1 may result in adverse effects to mussels (Section 5.5). Combining those actions and effects with the conservation measures designed to minimize and mitigate (Section 6.3) results in an effect pathway that can be analyzed to help determine potential incidental take of listed species within the action area. This section will discuss these pathways and their implications.

7.1.1 Effect Pathways

Construction of the I-69 bridge and removal of the US 41 bridge will involve numerous actions (5.1) that cause physical disturbance or physical impacts to freshwater mussels (5.5), specifically Sheepnose and Fat Pocketbook, the two species most likely to exist within the project area. These effects all affect the physical ability for mussels to survive and reproduce. Specifically, the crushing of mussels (mortality), entrapment (reduced fecundity), stranding (potential mortality), and removal (mortality) effects will have negative impacts on local populations. The sessile nature of mussels makes them especially prone to these types of physical disturbances, especially crushing, entrapment, and removal (Badra 2011). Mussels do have mechanisms for escaping stranding in low water situations, however the dewatering events during this project will occur within cofferdams or similar structures, rending these escape mechanisms useless (Seth et al. 2004, Cooper 2011). Multiple conservation measures are scheduled to take place to reduce the scope of these impacts. Combined with the overall small footprint of these effects, the overall effect on mussels should remain small. There are anticipated effects on both Fat Pocketbook and Sheepnose at the I-69 construction site, as there is suitable habitat ('mussel bed habitat' and silt/clay). At the US 41 bridge removal site, there is no 'mussel bed habitat' therefore it is not expected that Sheepnose would be found within that area. There is silt/clay habitat that Fat Pocketbook is known to utilize, therefore adverse effects are limited to this species in that area.

Effects Pathway – Sheepnose and Fat Pocketbook #1	
Activity: Construction of new I-69 bridge, causeway construction, demolition of existing US 41 bridge, US 41 pier removal	
Stressor	Physical forces – crushing, entrapment, stranding, and removal of mussels
Exposure (Temporal)	During demolition of the existing US 41 bridge and construction of the I-69 bridge
Exposure (Spatial)	Impact areas for both the I-69 bridge piers and the removal of the US 41 bridge
Resource Affected	All mussels present, including adults and juveniles
Individual Response	• Mussels can be crushed by falling debris during bridge removal or demolition of existing piers or from spudding barges, resulting in mortality.

	• Mussels may be entrapped underneath the newly installed I-69 bridge piers. • Mussels may become stranded when cofferdams are dewatered. • Mussels may be removed from their habitat if they are bycatch during dredging operations.
Relevant Conservation Measures	• Barge spud location restrictions will limit exposure to mussels within the action area. • The demolition and recovery plan for the US 41 bridge and piers should minimize take of species within the adverse effect area of that bridge. This includes potential use of a floating turbidity curtain and catch barges to prevent material from demolition of the US 41 bridge from entering the water where possible. • The concrete pouring plan should reduce impacts to within the pier construction area. • Measures will be put into place to minimize impacts to the 'mussel bed' area to reduce impacts specifically within this area.
Effect Pathway	When construction takes place, physical adverse effects may crush, desiccate, entrap, or strand freshwater mussels within the project area. Numerous conservation measures are in place to minimize these possibilities, but all are not avoidable.
Effect Type	Adverse effects, harm, or mortality for Fat Pocketbook at the US 41 bridge. Adverse effect for Fat Pocketbook and Sheepnose at the I-69 bridge construction site.

Water quality may be adversely effected by the actions associated with both the US 41 and I-69 construction. These impacts will be felt by all mussels, including the expected Fat Pocketbook and Sheepnose, within the project areas and downstream until effects are attenuated. The impact most likely to effect mussels is the increase in suspended solids in the water column. As sediment is impacted within the project site, it will be stirred into the column and may take a long time/distance to settle out. However, these impacts will be similar to those experienced by resident mussels during high flow events following rainfall, where turbidity and suspended solids are high. The project impacts should be smaller in size, and shorter in duration than those seen during high flow events. Due to this, the effects of increased suspended solids and subsequent declines in water quality are expected to have minimal adverse effect on mussels. Additional water quality impacts may include any spills of toxic chemicals into the Ohio River during construction. Due to mussels being filter feeders, this can cause mortality of mussels, as they uptake everything in the water that surrounds them, with no way to avoid toxic chemicals (Zimmerman et al. 2002). However, numerous conservation measures are in place to reduce these adverse effects including fueling and maintenance activities taking place away from the Ohio River, traditional spill prevention plans, and sedimentation and erosion plans.

Effects Pathway – Sheepnose and Fat Pocketbook #2	
Activities: Demolition of existing US 41 bridge & construction of I-69 bridge	
Stressor	Water quality degradation
Exposure (Temporal)	During demolition of the existing US 41 bridge and construction of the I-69 bridge
Exposure (Spatial)	Action area including impact areas for both the I-69 bridge piers and the removal of the US 41 bridge, and immediate areas down river
Resource Affected	All mussels present
Individual Response	• Mussels will be exposed to increased suspended solids during any construction activities that disturb the river bottom. • Any spills during construction could cause localized toxic conditions for mussels.
Relevant Conservation Measures	• Erosion and sediment controls should keep terrestrial impacts from causing increases in suspended solids in the river. • Equipment maintenance and refueling occurring away from the river should prevent impacts to mussels. • Equipment impacting aquatic resources by fuel or other fluid spills would be minimized by following the project specific spill prevention plan. • Revegetation of riparian areas will minimize surface runoff impacting the river. • Installation of appropriate protective measures until riparian areas have sufficient permanent vegetative cover or other permanent cover is in place. • Concrete pouring techniques should limit chemical impacts to the river by containing them within the proposed cofferdams or similar structures. Water contaminated by the pour will not be allowed to return to the river.
Effect Pathway	When construction actions are taking place there may be water quality degradation to the action area. This will impact mussels due to their sessile nature. Water quality issues may cause mortality, decreased recruitment, or decreased ability to feed.
Effect Type	Adverse effects, harm, or mortality within the project area for Fat Pocketbook and Sheepnose.

Freshwater mussel species have specific habitat requirements (e.g. substrate, flow, fish presence etc.) for survival (Haag 2012). Hydraulic components to habitat are thought to be critical for mussel presence (Allen & Vaughn 2010). Specifically, shear stress and substrate broadly determine mussel species and richness. This project will alter the hydraulic regime around the US 41 piers that are scheduled to be removed, as well as the I-69 piers which will be newly installed. As flows are (or are not) diverted around piers, the velocity, and subsequently shear stress on mussels in the substrate are altered. In placed were velocities increase, there may be scouring events that remove smaller substrates. In locations where velocities decrease there may be sedimentation as smaller substrates (sand/silt) fall out of the water column and settle. These types of changes may alter where within the project area mussels are able to safely inhabit without risk of being moved downstream during high flow events. There are no conservation measures available to minimize or mitigate this effect. However, the overall area of impact for these effects is relatively small.

Effects Pathway – Sheepnose and Fat Pocketbook #3	
Activities: Demolition of US 41 piers & construction of I-69 piers	
Stressor	Hydrology changes
Exposure (Temporal)	Permanent
Exposure (Spatial)	Impact areas for both the I-69 bridge piers and the removal of the US 41 piers.
Resource Affected	All mussels present
Individual Response	• Mussels will be exposed to changing hydraulic conditions following the removal of the US 41 piers. These piers may be providing flow refuge for mussels that exist on the downstream side. Removal of the piers will change local hydrology and may make conditions unsuitable for habitation. • Mussels downstream of the proposed I-69 piers will face new scouring patterns of substrate as water flows around the new piers. This could cause localized habitat to become unsuitable for resident mussels.
Relevant Conservation Measures	• None
Effect Pathway	There are no conservation measures to prevent the localized changes in hydrology. Mussels in these areas will either be swept downstream as scouring and velocities increase in their existing habitat, or they will be subject to lower flows than normal, potentially reducing fish host interactions and food availability.
Effect Type	Adverse effects, harm, or mortality within the project area for Fat Pocketbook and Sheepnose.

The aforementioned adverse effects can also have tertiary impacts on mussels via their effect on fish hosts. Freshwater mussels rely on fish as hosts for their glochidial larvae to transform into juvenile mussels. Therefore, the presence and ability for mussels to interact with fish is critical for sustained reproduction of mussel communities. It is expected that fish will leave areas of impact during construction (i.e. explosive pier demolition) but return following completion of construction. There is potential for mussels to be stranded in areas that were suitable prior to construction, but after adverse effects (e.g. pier removal) conditions are no longer preferable for fish hosts. This may cause a disconnect between mussels in these areas and their preferred fish host, potentially decreasing recruitment of mussels. However, the overall area exposed to this potential scenario is limited, and not likely to adversely effect a significant number of mussels.

Effects Pathway – Sheepnose and Fat Pocketbook #4	
Activities: Demolition of existing US 41 bridge & construction of I-69 bridge	
Stressor:	Reduced host fish interactions
Exposure (Temporal)	During demolition of the existing US 41 bridge, construction of the I-69 bridge, and permanently, especially if occurs during mussel reproduction season
Exposure (Spatial)	Impact areas for both the I-69 bridge piers and the removal of the US 41 bridge.
Resource Affected	Reproductive mussels and mussel host fish
Individual Response	• Fish hosts may be killed during explosive demolition of existing US 41 bridge piers • Fish hosts may avoid areas that were previously occupied by US 41 piers and the newly constructed I-69 piers due to changes in flow regime.
Relevant Conservation Measures	Catch barges preventing falling US 41 roadway particles from reaching the river will be used where possible to minimize impacts on fish within the impact area.
Effect Pathway	As conditions surrounding removed/new piers change, fish will flee the area to find suitable habitat. This can cause a disconnect for sessile mussels who no longer have a fish host for their glochidia, leading to decreased recruitment.
Effect Type	Insignificant and Discountable

7.1.2 Effect Determination

Based on recent surveys on this section of Ohio River, including those for this project by Stantec (2018), and those up and down river conducted by Lewis Environmental Consulting (2015), extensive literature search, and coordination with the USFWS, the FHWA, INDOT, and KYTC are reasonably certain that only two species of listed mussel, the Sheepnose and Fat Pocketbook, occur within the I-69 ORX project action area. Even though mussel surveys for this project failed to document live listed mussels, the existing mussel bed species composition and densities along with spent shells found during previous surveys indicate these two listed species are reasonably certain to be present in low numbers. Based on existing data, the Fat Pocketbook has been found just upriver from the mouth of the Green River, and the Sheepnose was documented in 2015 by Lewis Environmental Consulting in numerous beds closer to Owensboro, Kentucky. If present within the I-69 ORX project action area, implementation of the project may have an adverse consequence on individual mussels via the pathways described in Section 7.1.1.

Fat Pocketbook (*Potamilus capax*)

Fat Pocketbook was detected in the project area as a subfossil shell. This presence, combined with multiple known localities of this species within the vicinity of the project area suggests that they are reasonably certain to occur in the project action area in low numbers and readily affected by the effect pathways described in Section 7.1.1. Therefore, the effect determination for Fat Pocketbook is "**may affect, likely to adversely affect.**"

TAKE ESTIMATION

Due to the only Fat Pocketbook specimen found during project specific freshwater mussel surveys being a subfossil shell, it is necessary to use available data to estimate incidental take of this species that may occur due to this project. The Fat Pocketbook is most common in the St. Francis watershed in Arkansas, where Clark found densities of between one and seven individuals per 1,000m^2 (1985). Similarly, Miller & Payne found densities between 6.1 and 10.8 per 1,000m^2 (2005). However, these densities most likely are not comparable to the I-69 ORX project action area, as Miller & Payne describe that these densities are highly unlikely in the Ohio and Wabash Rivers (2005). Cummings et al. found nine live Fat Pocketbook in the Lower Wabash River, representing six percent of the total abundance in the basin, but failed to report densities. A recent survey (2015 & 2017) on the Cumberland River near the confluence with the Ohio River yielded densities of approximately 0.001 Fat Pocketbooks per square meter (Third Rock Consultants 2020). To account for differences between the Cumberland River site and the I-69 ORX project action area, the density of overall mussels will be used to differentiate total mussel bed quality. The Cumberland site had an overall mussel density of 0.07 mussels per square meter, or seven times more than the 0.013 mussels/m^2 found at the I-69 ORX Project site within Fat Pocketbook habitats.

Suitable habitat for Fat Pocketbook in the project area includes all of the 'mussel bed' habitat as defined in the 2018 mussel survey report, along with the silt/clay banks of the river where substrate was found to be stable enough to support mussels (Stantec 2018b, Figures 7-1 & 7-2). While sand substrate is known to yield Fat Pocketbook, the sand substrates in the center of the river are believed to be too unstable to support mussels. Bathymetric surveys revealed waveform patterns in the sand which suggest a highly mobile riverbed, which was confirmed during mussel survey dive operations (Stantec 2018a). Figures displaying abundance by cell during the 2018 mussel survey show a distinct decline in mussel abundance at the transition from shoreline silt/clay habitat to the midchannel sand habitats. The portion of the project action area where adverse consequences could occur is made up of these two habitats totaling 365,738 m^2. Therefore, take is estimated using total habitat (365,738 m^2) multiplied by the estimated density (0.001/m^2) divided by the difference in habitat quality (0.07 divided by 0.013 = 5.3). This results in an estimated 68 Fat Pocketbooks that may be adversely affected by project actions. Due to the varying nature of the types of effects the action will have (Section 5.5), expected mortality of Fat Pocketbooks would be much lower than 68. Harm to the Fat Pocketbook due to bridge construction and the removal of the existing bridge would result in the mortality of approximately 10 live Fat Pocketbooks. The remaining 58 Fat Pocketbook calculated in the take estimate may or may not occur down river of the I-69 ORX project construction area, and they may or may not be subject to water quality changes from sediment. These short-term, low magnitude water quality changes may not reach levels of mortality.

Sheepnose (Plethobasus cyphyus)

Sheepnose was not detected in the project area during 2018 mussel surveys. However, its presence and relatively high abundance at upstream sites during a 2015 survey make it possible that this species went undetected (Lewis Environmental Consulting). Sheepnose was found at the Owensboro North bed (approximately 23 miles upstream of the I-69 project) at relative abundances of 0.03% of the total bed community. That site was the closest bed surveyed to the I-69 ORX project area. Meanwhile approximately 49 miles upstream at the Anderson Island bed, a total of 12 Sheepnose were found during qualitative searches, representing 0.17% of the total community. Three of the Sheepnose were found during transect surveys, allowing for density calculations. The total Anderson Island bed had mussel densities of approximately 3.21 mussels/m^2, while Sheepnose were found at rates of 0.0036/m^2. This presence suggests that they may be present and readily affected by the effect pathways described in Section 7.1.1. Therefore, the effect determination for Fat Pocketbook is "**may affect, likely to adversely affect.**"

TAKE ESTIMATION

A take estimation for Sheepnose is determined using data from the 2015 Survey of the Ohio River where multiple sites held this species. Suitable habitat for Sheepnose within the I-69 ORX project area totals 147,044 m^2 (Figure 7-2), all habitat is at the new bridge location. Using the density of mussels found during transect surveys at the Anderson Island bed (0.0036/m^2) an estimate of 527 Sheepnose would be expected if the mussel bed were of similar quality to Anderson Island. However, mussel densities in the 2015 survey at Anderson Island bed were 58 times greater than those found in the I-69 ORX project area. Therefore, after dividing 527 Sheepnose by 58 to account for mussel bed quality, we would expect 8 Sheepnose within the project area for I-69 ORX project action area. Therefore, the estimated take for Sheepnose due to the adverse effects of I-69 ORX project is 8 individual Sheepnose.

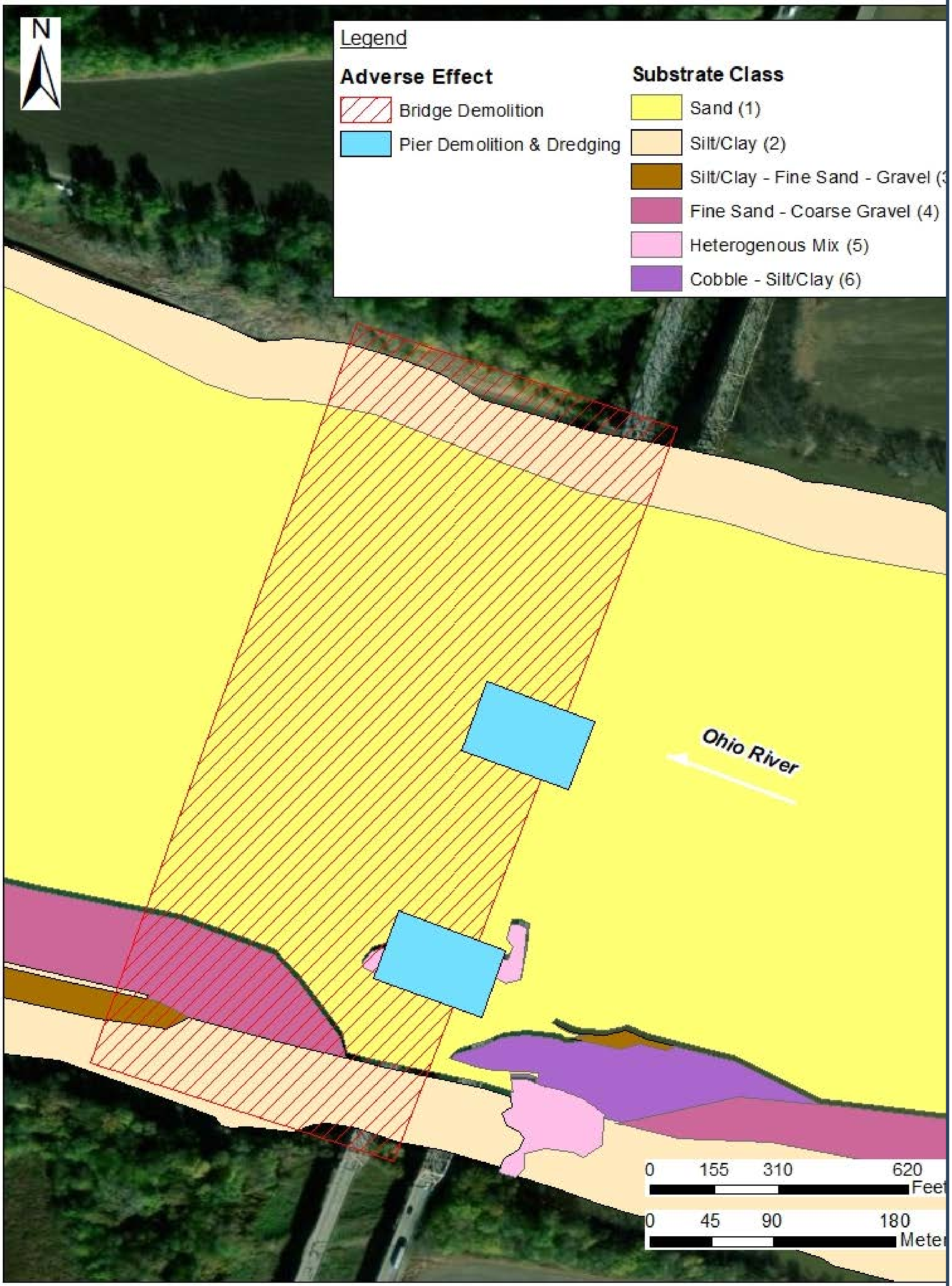

Figure 7-1. Adverse Effect Area for the US 41 Bridge & Pier Demolition and Removal

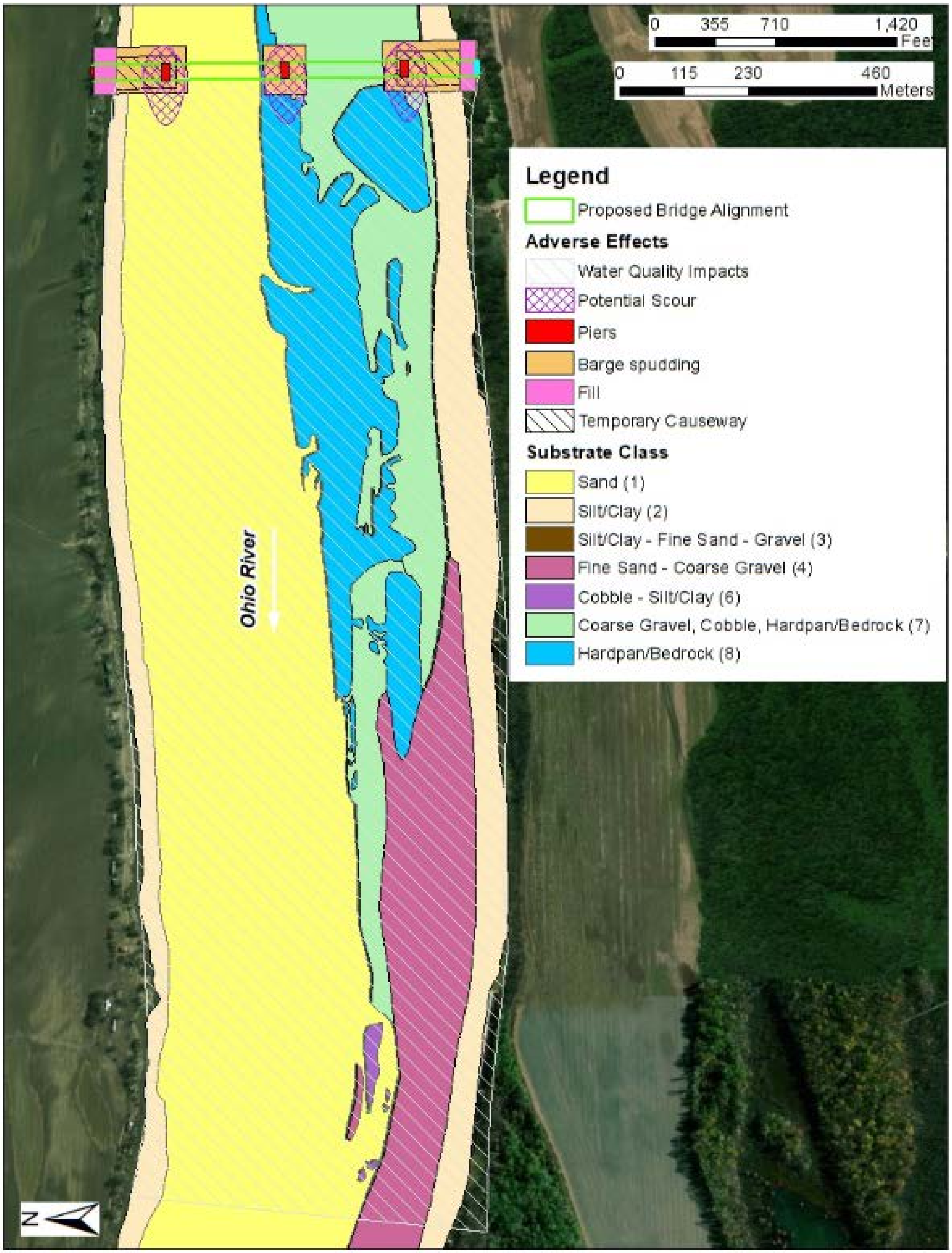

Figure 7-2. Adverse Effect Area for the I-69 Bridge Construction

7.2 BATS

Indiana and Northern Long-Eared Bats are known from within/adjacent to the project corridor during the summer. No potential hibernacula were found within the project corridor and nine bridges/overpasses checked for roosting bats failed to identify resident Indiana, Northern Long-Eared, or Gray Bats.

It is expected the I-69 ORX project construction may have adverse effects on the Indiana Bat due to the loss of 45.8 acres of " Summer 1" habitat, which is considered summer roosting, foraging, and commuting habitat. Tree clearing dates incorporated into the conservation measures will reduce the potential for incidental take of non-volant bats.

Mitigation for adverse effects associated with seasonal tree clearing has been previously provided for KYTC and FHWA projects, as described and identified in the most recent programmatic agreement between FHWA, KYTC, and the Service's Kentucky Field Office.

With the use of this programmatic agreement and contribution to the Imperiled Bat Conservation Fund, the formal effects determination for the Indiana Bat from constructing the proposed project is a "**may affect, likely to adversely affect.**"

The northern long-eared bat is not currently known from within the project corridor; however, the presence of suitable habitat makes it reasonably certain that the species is present in the project action area. KYTC has determined that the proposed action is located greater than 0.25 mile from any known northern long-eared bat hibernacula and greater than 150 feet from any known northern long-eared bat maternity roost trees. These conditions are considered to be consistent with and addressed via the northern long-eared bat final 4(d) rule and the USFWS's January 5, 2016 Intra-Service Programmatic Biological Opinion on the final 4(d) rule for the northern long-eared bat. The KYTC proposes to utilize the 4(d) rule to address adverse impacts to the northern long-eared bat from the action.

The Gray Bat is not currently known from within the project corridor. However, because of recent acoustical bat data collected near Henderson, and the wide-ranging foraging habitats of the species, KYTC is reasonably certain the species is present in low numbers within the I-69 ORX project action area.

No caves, sinkholes, abandoned mines, or other underground structures that can support hibernating, or maternity colonies of Gray Bats were found within the I-69 ORX project corridor. In addition, surveys for roosting bats at the nine bridges and overpasses along the corridor failed to locate any Gray Bats.

With the incorporation of stringent sediment and erosion control methods as outlined elsewhere in the BA, it is expected that water quality effects on aquatic insects used as prey by the Gray Bat are likely to be discountable, and very unlikely to happen because of incorporated conservation measures, and having minimal adverse effects. Therefore the formal effects determination for the Gray Bat from constructing proposed I-69 ORX project is a "**may affect, not likely to adversely affect.**"

7.3 LEAST TERN

Based on current river conditions (no sand bars, gravel bars, or islands) within the I-69 ORX project corridor, the USFWS did not recommend any nest surveys. The lack of nesting colonies within the project corridor eliminates the potential for an incidental take of adult nesting birds, chicks, and their eggs.

The nearest known Least Tern nesting area is located greater than 6.2 miles from I-69 ORX project corridor. Since 6.2 miles is the maximum documented foraging distance for nesting Least Terns, the I-69 ORX project corridor is also outside of the foraging area for nesting birds, thus no adverse effects from construction of the project on foraging habitat is expected.

Though unlikely, it is possible adverse effects on foraging activities of migrating terns could occur from disturbances along the river associated with construction of the project, but these are expected to be discountable because of the large amount of similar river habitat available adjacent to project corridor. Therefore the formal effects determination for the Least Tern is a "**may affect, not likely to adversely affect.**"

7.4 CUMULATIVE EFFECTS

Cumulative effects include the effects of future state, tribal, local, or private actions that are reasonably certain to occur in the action area considered in this BA. Future unrelated federal actions are not considered as they would require their own Biological Assessments associated with Section 7 of the ESA. Appendix M-1 of the DEIS outlines cumulative and indirect effects of the project. There are currently five future projects reasonably foreseeable within the project area. None of these projects should impact the Ohio River, and therefore will not have adverse consequences on listed mussels. Four of the five projects would potentially impact forest, farmland, wetlands, and streams. Impacts from past and future projects would not exceed 8% of the existing acreage of any of these land classes (DEIS Appendix M-1).

CHAPTER 8 – LONGSOLID CONFERENCING ANALYSIS

Many projects such as I-69 ORX take many years from the time environmental baseline analysis starts and initial alternative routes are designed to the completion of final design and environmental permitting. This lengthy process along with delays created by funding and initiation of construction often require many document revisions and amendments, including the Biological Assessment and Biological Opinion. Revisions of the documents along with re-initiation of Section 7 consultation is often required when major project components change, new information concerning previously addressed listed species is obtained, when a new species is listed, or Critical Habitat is designated. The conferencing analysis and subsequent opinion is a formal process to reduce timely delays in project planning and implementation by evaluating consequences to species formally proposed for listing under the Endangered Species Act.

The Longsolid (*Fusconaia subrotunda*) is one of those species that has been monitored for decades and currently show substantial declines range-wide with only 60 of the 162 original populations still in existence (USFWS 2019b). Populations in the mainstem of the Ohio River in Kentucky are no different with only 4 of the 15 pre-1990 sites still thought to have Longsolid mussels (maps from Haag and Cicerello 2016). These steep declines in populations led the USFWS to complete a *Species Status Assessment Report for the Longsolid Mussel (Fusconaia subrotunda)*, which provided the basis for determining if the species should be proposed for listing under the ESA. Due to the expectation this species will be formally proposed within the near future and because the I-69 ORX project contains a population of the mussel, this Conferencing Analysis has been prepared and information provided below will assist in making a final jeopardy determination for the species.

8.1 SPECIES INFORMATION STATUS

Longsolid (*Fusconaia subrotunda*) is a somewhat round mussel of medium size (up to 110mm) varying between inflated and compressed shell morphs. Juveniles have a distinct green ray pattern near the umbo, but this is often lost with age (Watters et al. 2009). Longsolid is listed as state endangered in Indiana and as special concern in Kentucky (IDNR 2017a, KSNPC 2015). Longsolid was petitioned for listing under the ESA on September 27, 2011 (Federal Register 76(187), 59836-59862). A Species Status Assessment was published in January 2019 (USFWS 2019b). An ESA listing decision by USFWS is expected prior to the start of construction.

8.1.1 Habitat

This species is relatively endemic to the Ohio River basin, occurring throughout the Ohio River and in large tributaries from the Tennessee River up to Pennsylvania and was potentially historically found in the Maumee River basin of western Lake Erie (Watters et al. 2009). In Kentucky, the Longsolid was formerly broadly distributed throughout the Ohio River and its larger tributaries however, due to habitat loss resulting from impoundment through the creation of a series of locks and dams, it is now extremely rare in the Ohio River. Prior to Stantec's (2018) study only a single record post-1990 existed near the project area (Haag & Cicerello 2016). The species is now only known to exist at 60 of its 162 historical populations (USFWS 2019b). The Longsolid is restricted to main-channel habitats in medium to large rivers. The Longsolid is found in gravel and sand and is typically a small component of existing mussel beds (Haag and Cicerello 2016). Longsolid is known to inhabit depths in large rivers in excess of 20 feet (USFWS 2019b).

8.1.2 Life History

Longsolid is a slow growing species that is believed to live to ages of 25-50 depending on environmental conditions (USFWS 2019b). Longsolid is a short-term brooder, with females gravid from June through August. Glochidia are released in red to pink cylinders within a composite conglutinate (Watters et al. 2009). Its host fish is unknown, however it is likely a minnow host specialist, like other *Fusconaia* species (Haag and Cicerello 2016).

8.1.3 Threats

Longsolid generally faces similar threats to those of other species. Due to a lack of studies on Longsolid's life history traits, only generalized summaries of threats to other mussels can be assumed to also impact this species (USFWS 2019b). Broad threats to freshwater mussels are generally consistent among species. Historically, dams and stream channelization in the early part of the 20th century led to largescale impoundment of navigable rivers in the US, with over 75,000 dams existing today (Graf 1999). These dams shift habitats from lotic to lentic, and completely changed flow regimes, often destroying mussel habitat (Haag 2012). Free flowing large rivers in the United States to this day are a rarity. This, combined with a wide variety of other impacts, such as municipal and industrial pollution, channelization, and agricultural runoff have contributed to mussel community declines. As a result of these processes throughout the mid 1900's, many mussel populations became small and isolated, which to this day makes them highly susceptible to stochastic processes. Modern day isolated populations of mussels are highly impacted by environmental stochasticity, such as drought or extremely high flows. These small, isolated populations are also susceptible to demographic stochasticity (Haag 2012). The complex mussel life cycle has many stages for failure to occur, and when applied to a small population, can be catastrophic for recruitment. Combine these two processes, and it can be difficult for small populations to maintain themselves. Specific modern-day threats to mussels continue to include anthropogenic impacts. Chronic impacts from industrial pollution continue to degrade habitat (Diamond et al. 2002). Poor agricultural practices and destruction of riparian zones contribute to negative terrestrial inputs to mussel habitat (Williams et al. 1993). Invasive species, specifically *Dreissena* species have been shown to have detrimental effects on mussel communities (Strayer 1999a). Additionally, Haag (2012) provides examples of numerous enigmatic declines, where communities undergo curtailed recruitment or mortality with no apparent cause. The synergistic nature of the threats to the Longsolid has resulted in loss of 63 percent of historical populations (USFWS 2019b).

8.2 EFFECTS ANALYSIS

In an effort to analyze if the effects of the proposed action will jeopardize the continued existence of the Longsolid, the information below will examine the local population, Ohio River Drainage, and rangewide populations of Longsolid.

Longsolid was found within the project area during 2018 freshwater mussel surveys. Eleven live individuals were found along the southern side of the central corridor (Figure 8-1). The population of Longsolid within the project area is the only known population within the Highland-Pigeon Management Unit (USFWS 2019b). Prior to the 2018 survey by Stantec this population was last documented in 1996 at the mouth of the Green River. Survey data from 1996 are unavailable, however shell specimens are accessioned into the Ohio State Museum of Biological Diversity, with species identification confirmed by Dr. David Stansbery. Haag and Cicerello (2016) showed this record and described it as one of only two populations in the lower Ohio River. This population appears to be disjunct from populations in the Lower Green River, which have been documented most recently approximately 65 river miles upstream in Pool 2 of the Green River (Lewis Environmental Consulting 2011). It also appears to be disjunct from the other lower Ohio River population, which occurs west of Paducah approximately 165 river miles downstream from the I-69 ORX project area mussel bed.

The ‘mussel bed’ habitat that exists in and near the project area totals 365,300 m^2 (Figure 8-2). Despite the 1996 record at the mouth of the Green River, bathymetric surveys did not find suitable habitat in that area in 2017 (Stantec 2018). 2018 mussel surveys in the area calculated Longsolid densities at 0.0018 individuals per square meter, resulting in a total population estimate of 658 individuals within the entire ‘mussel bed habitat’ seen in Figure 8-2. The total amount of ‘mussel bed’ habitat expected to be adversely eafected by the project is approximately 147,044 m^2. This area, based on densities of 0.0018 individuals per square meter, expected to hold 265 Longsolid. The estimated take of 265 individuals represents 40 percent of the total population in ‘mussel bed’ habitat located in and adjacent to the project area (Figure 8-2). However, mortality of Longsolid due to project actions is expected to be significantly lower than the ‘take’ estimate. Adverse effects caused by project actions will have a different magnitude and duration, with significant differences in resulting consequences. The total area of mussel bed habitat that will be exposed to significant physical alteration of habitat (e.g. pier installation, barge spudding, scouring, causeway installation) is approximately 10,900 m^2, influencing 20 Longsolid. The remaining Longsolid (N = 245) may be subject to adverse effects of lesser magnitude such as water quality degradation via increased turbidity or low duration effects such as chemical pollution exposure. Due to the limited high magnitude impacts to the Longsolid population in the Ohio River at the project site it is believed that the project action will not jeopardize the continued existence of this population or the species at large, especially considering this population was only based on a spent shell prior to the current survey.

Figure 8-1. Location within the I-69 ORX project corridor where the 11 Longsolid were found during 2018 survey efforts

Figure 8-2. Mussel bed habitat where estimates of Longsolid population was calculated in the I-69 ORX project action area where new bridge is planned

Comparison of the I-69 ORX project Longsolid population to other populations is needed to determine if the adverse consequences to the population from the project meets the level for jeopardizing the continued existence of the species as required under ESA Conferencing. Currently there are 39 extant populations in the Ohio River Basin from western Kentucky northeast to New York and Pennsylvania, down from 102 historically (USFWS 2019). Of these extant populations, 77 percent are categorized as having a low population condition by USFWS. These populations are small, restricted, with no evidence of recruitment, and questionable resiliency (USFWS 2019). The two main strongholds for this species as defined by USFWS are the populations in the Little Kanawha and the Upper Green Rivers. West Virginia Division of Natural Resources has a long-term monitoring site at Burning Springs that had an estimated historic population size of 2,083 individuals, which grew to 4,750 individuals in 2016 (WVDNR 2016). Significant impacts to this management unit have been noted since 2011 and are expected to increase. The Upper Green River management unit includes numerous populations along approximately 500 km of occupied river length. With high quality management units containing such large overall areas and population sizes, magnitudes larger than that seen within the I-69 ORX project site, it is believed the project action will not jeopardize the continued existence of this species within the Ohio River basin.

In addition to the Ohio River basin populations, there is currently one remaining population in the Cumberland River basin, down from 10 historically. There are currently 20 remaining populations in the Tennessee River basin, with 26 historic populations extirpated. It is also extirpated completely from the Great Lakes Basin. The Upper Clinch management unit is the highest quality in the Tennessee River basin, with high densities of Longsolid at multiple sites. The Kyles Ford population was estimated to be 3,978 individuals in 1994 and was reported to have densities of 1.7 individuals/m^2 in 2017 (Ahlstedt et al. 2017). Ahlstedt et al. also reported Longsolid densities to be 1.4 individuals/m^2 at Brooks island (2017). The Lower Cumberland-Old Hickory Lake management unit is the only remaining locality for live Longsolid in the Cumberland River basin. Hubbs (2012) reported catch per unit efforts of 0.05 Longsolid/hour at river mile 292-300 and 0.1 individuals/hour at river miles 281-291. This compares to the 0.23 Longsolid per hour found during the 2018 survey of the project area (Stantec 2018). The population of Longsolid in the vicinity of the I-69 ORX bridge project represents a small proportion of the overall individuals remaining in the wild. The expected mortality due to project actions is also a small proportion of the overall estimated take. Comparing the consequences of the project action to range-wide populations, the adverse effects to Longsolid due to the I-69 ORX project are not expected to jeopardize the species.

With this population representing the entirety of the species locations within the Highland-Pigeon Management Unit, one would expect some loss of genetic viability with 40 percent of the population adversely affected, but no current evidence exists to suggest intra-specific genetic divergence has occurred within this species. The recent (<150 years) impounding of the Ohio River and hypothesized isolation of Ohio River drainage populations would not provide enough time for speciation, although there is very little gene flow between populations. All existing populations of Longsolid are impacted by impoundments in some way and this is thought to be a contributing factor to the isolated nature of numerous populations. The Ohio River becoming impounded and switching from lotic systems to more lentic has shifted habitats towards being unsuitable for Longsolid. Gordon and Layzer found that this species preferred coarse gravel and cobble (as also found by Stantec 2018) in larger rivers (1989). However, Ostby found that in the Clinch River, Virginia that Longsolid were most associated with slow, deep habitat with low shear stress (2005), which may suggest that Longsolid may be able to persist in lentic conditions if substrates are suitable. The tremendous amount of flow from the Green River coming into the Ohio River just upstream from the I-69 ORX project area and mussel bed may be providing benefits with the current keeping the substrate clean of sediment and maintaining stable water temperatures and other physiochemical conditions.

The establishment of critical habitat for the species would only occur once the species is listed and the 2019 Species Status Assessment for Longsolid does not list recommendations for critical habitat. However, critical habitat is expected to be determined if USFWS determines that listing is warranted and will be proposed under section 4 of the Endangered Species Act (76 FR 59836 59862). The disjunct nature of this population relative to the majority of existing higher quality populations would suggest that this habitat will not be considered critical habitat. Based on the presence of many larger populations scattered throughout the species range, and the adverse consequences from the I-69 ORX project affecting only 40 percent of a bed not even known to be extant prior to 2018, it is believed the degradation and/or potential loss of the 265 individuals, or 40 percent of the bed would not cause a trend toward extinction. Therefore the I-69 ORX project will not jeopardize the continued existence of Longsolid.

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