



Appendix G10. Habitat Surveys for Rare Insects, Amphibians, and Reptiles



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Habitat Surveys for Rare Insects, Amphibians, and Reptiles

West Lake Corridor Project

Federal Transit Administration
and
Northern Indiana Commuter
Transportation District

March 2018



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Acronyms and Abbreviations

CMAP	Chicago Metropolitan Agency for Planning's
CN	Canadian National Railway
et al.	and others
FEIS	Final Environmental Impact Statement
FR	Federal Register
FTA	Federal Transit Administration
GPS	global positioning system
IDNR	Illinois Department of Natural Resources
INDNR	Indiana Department of Natural Resources
MED	Metra Electric District
NEPA	National Environmental Policy Act
NICTD	Northern Indiana Commuter Transportation District
NIRPC	Northwestern Indiana Regional Planning Commission
NYSDEC	New York State Department of Environmental Conservation
Project	West Lake Corridor Project
spp.	Multiple species
SSL	South Shore Line
TPSS	traction power substation
USFWS	United States Fish and Wildlife Service



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Executive Summary

The Federal Transit Administration and the Northern Indiana Commuter Transportation District (NICTD) are conducting the environmental review process for the West Lake Corridor Project (Project) in Lake County, Indiana, in accordance with the National Environmental Policy Act (NEPA) and other regulatory requirements. The purpose of the current study is to determine whether building a 9-mile southern extension of the existing NICTD South Shore Line (SSL) between Dyer and Hammond, Indiana, would negatively affect any of the following the following species of concern: Blanding's turtle (*Emydoidea blandingii*), northern leopard frog (*Lithobates pipiens*), and Karner blue butterfly (*Lycaeides melissa samuelis*).

The Project team addressed these concerns by completing a multi-step analysis. First, desktop analyses were used to determine whether the landscape contains large areas of high suitability habitat for any of the target species. Second, biologists conducted in-field assessments of habitat for each of the species. Habitat assessments for insects were completed on May 1 and 2, 2017, by an insect biologist (entomologist). Habitat assessments for amphibian and reptile species were completed on May 9 and 10, 2017, by biologists that specialize in these species (herpetologists). During habitat assessments, biologists walked assessable properties looking for habitat features required for the life cycles of each of the target species. For the butterfly, these include the plant on which eggs are laid and on which the resulting young feed as they grow. The butterfly feeds at flowering plants that produce substantial amounts of nectar. The turtle and frog are wetland-dependent species.

The desktop review indicated that habitat for the target species was virtually nonexistent in the Project footprint and consisted of multiple fragmented areas associated with parks, rights-of-way associated with existing railroad tracks, and riparian areas along the Calumet River. Field assessment verified this observation across all target species, and the potential habitat observed was often of low to marginal quality (that is, the types of habitats animals use when moving between areas of higher-quality habitat).



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1 Introduction

The Federal Transit Administration (FTA) and Northern Indiana Commuter Transportation District (NICTD) are conducting the environmental review process for the West Lake Corridor Project (Project) in Lake County, Indiana, in accordance with the National Environmental Policy Act (NEPA) and other regulatory requirements. A Final Environmental Impact Statement (FEIS) is being prepared as part of this process, with FTA as the federal lead agency and NICTD as the local project sponsor responsible for implementing the Project under NEPA.

1.1 Purpose of Report

The purpose of this report is to provide information regarding rare insects, amphibians, and reptiles that may occur within the Project footprint. Location and habitat quality was mapped for each of these species and compared to the construction footprint.



1.2 Project Description

The environmental review process builds on NICTD's prior West Lake Corridor studies that examined a broad range of alignments, technologies, and transit modes. The studies concluded that a rail-based service between the Munster/Dyer area and Metra's Millennium Station in downtown Chicago would best meet the transportation needs of the northwest Indiana area. Thus, NICTD advanced a Preferred Build Alternative (referred to as the FEIS Preferred Alternative) for more detailed analysis in the FEIS. NEPA also requires consideration of a No Build Alternative to provide a basis for comparison to the Build Alternative.

1.2.1 No Build Alternative

The No Build Alternative is defined as the existing transportation system, plus any committed transportation improvements included in the Northwestern Indiana Regional Planning Commission's (NIRPC) *2040 Comprehensive Regional Plan* (NIRPC 2011) and the Chicago Metropolitan Agency for Planning's (CMAP) *GO TO 2040 Comprehensive Regional Plan* (CMAP 2014) through the planning horizon year 2040. It also includes capacity improvements to the existing Metra Electric District (MED) line and Millennium Station, documented in NICTD's *20-Year Strategic Business Plan* (NICTD and Regional Development Authority 2014).

1.2.2 FEIS Preferred Alternative

The Project is an approximate 9-mile southern extension of the existing NICTD SSL between the town of Dyer and city of Hammond, Indiana. Traveling north from the southern terminus near Main Street at the Munster–Dyer municipal boundary, the Project would include new track operating at grade on a separate right-of-way to be acquired adjacent to the CSX Transportation Monon Subdivision rail line in Dyer and Munster. The Project alignment would be elevated from 45th Street to the Canadian National Railway (CN) Elsdon Subdivision rail line at Maynard Junction. North of the CN line, the Project alignment would return to grade and join with the



publicly owned former Monon Railroad corridor in Munster and Hammond, Indiana, and continue north. The Project would relocate the existing Monon Trail pedestrian bridge crossing over the Little Calumet River and build a new rail bridge at the location of the former Monon Railroad bridge. The Project alignment would cross under Interstate 80/94 (I-80/94) and continue north on the former Monon Railroad corridor to Sibley Street. From Douglas Street north, the Project would be elevated over all streets and rail lines using a combination of retaining walls, elevated structures, and bridges. The Project would terminate just east of the Indiana Harbor Belt at the state line, where it would connect with the SSL. Project trains would operate on the existing MED line for the final 14 miles, terminating at Millennium Station in downtown Chicago.

Four new stations would be constructed along the alignment; Munster/Dyer Main Street, Munster Ridge Road, South Hammond, and Hammond Gateway Stations. Each station would include station platforms, parking facilities, benches, trash receptacles, bicycle racks, and other site furnishings. Shelter buildings would only be located at the Munster/Dyer Main Street and Hammond Gateway Stations. The Project would include a vehicle maintenance and storage facility with a layover yard and traction power substation (TPSS) to power the overhead contact system, located just south of the Hammond Gateway Station, west of Sheffield Avenue. Additional TPSSs would be located at the South Hammond Station parking lot and Munster/Dyer Main Street Station. The TPSS would be enclosed to secure the electrical equipment and controls, with a footprint of about 20 feet by 40 feet.

2 Environmental Setting

The Project is located in Indiana, but adjacent to the Indiana–Illinois border. During the Draft EIS process, both the Indiana Department of Natural Resources (INDNR) and the Illinois Department of Natural Resources (IDNR) provided rare species reviews for the Project. These departments identified one amphibian, one reptile, and one insect species of concern that have the potential to occur in the Project footprint. Examination of all of each of these species also provides regional context. These species are described below.

2.1 Blanding’s Turtle

2.1.1 Description

Blanding’s turtle is a semi-aquatic species that can be recognized by its elongate and domed black or gray shell with yellow or white dots or flecks (Harding 1990). The pattern and number of these dots or flecks vary between individuals, but the scales on the carapace are typically smooth. The length of the carapace averages 7 to 9 inches ([New York State Department of Environmental Conservation] NYSDEC 2016), though Harding (1990) states that shell length can exceed 10.5 inches. The chin and throat of this turtle are bright yellow, and the lower shell (plastron) is yellow featuring symmetrical dark blotches (NYSDEC 2016). The plastron is hinged to allow Blanding’s turtle to completely enclose itself in its shell, but this hinge does not allow Blanding’s turtle to shut itself as tightly as box turtles (*Terrapene*) are able to (NYSDEC 2016). Harding (1990) noted that some Blanding’s turtles in Michigan were observed with practically nonfunctional hinges.



Photo credit: J. Harding

2.1.2 Distribution and Status

Blanding’s turtle is known to occur as far west as central Nebraska, and it ranges eastward through Minnesota, Iowa, and across the Great Lakes Region in the United States and Canada. Its primary range reaches as far east as northern New York, though relict populations exist in southern New York, New England, and Nova Scotia (Harding 1990; Minton 2001a; NYSDEC 2016). Development of wetland habitats for human use has reduced population numbers across the turtle’s range (Harding 1990; NYSDEC 2016). Other threats to this species include collection for the pet trade, being struck by cars, and disease (Harding 1990; NYSDEC 2016).

The species is considered rare by most state and provincial agencies whose jurisdictions overlap the turtle’s range. In Canada, the species is listed in two distinct population segments under the Species At Risk Act; the Nova Scotia population is considered endangered, and the Great Lakes population in Quebec and Ontario are considered threatened.

The Center for Biodiversity petitioned USFWS to list Blanding’s turtle as endangered or threatened under the Endangered Species Act on July 11, 2012. On July 1, 2015, USFWS

Federal Register Documents

[56 FR 58804–58836](#); November 21, 1991: ETWP; Animal Candidate Review for Listing as Endangered or Threatened Species

[59 FR 58982–59028](#); November 15, 2014: ETWP; Animal Candidate Review for Listing as Endangered or Threatened Species

[80 FR 37568–37579](#); July 1, 2015: 90-Day Findings on 31 Petitions

(80 Federal Register [FR] 37568–37579) announced that the petition provided substantial information that listing might be justified and initiated a status review to determine whether listing under the Endangered Species Act is warranted.

2.1.3 Regional Occurrence

Because of the loss of suitable habitat and increased road mortality, Blanding’s turtles are listed as endangered in both Indiana and Illinois. In Indiana, their range is limited to the northern third of the state, with only a few isolated sightings in the central part of Indiana. In Illinois, the species is known to occur in the northern half of the state.

2.1.4 Natural History

Minton (2001a) states that Blanding’s turtle will alternate between marsh, pond habitat and lake habitats, seeking shallow water with a depth of less than 2 feet. Other observations have also been made at slow-running streams and drainage ditches, and less commonly in the main channels of rivers or other fast-moving water bodies (Minton 2001a; NYSDEC 2016). The willingness of this turtle to make overland trips between different wetlands or between wetlands and nesting sites results in large numbers being killed on roads each year (Harding 1990).

Harding (1990) provided information regarding reproduction in the species. Mating occurs in the water, with most observations recorded in April and May but also continuing throughout the summer and into early fall. Nesting begins in early June and lasts throughout the month. Females can travel great distances from the water to find suitable nesting grounds, where they dig a shallow nest and deposit 6 to 21 eggs that are then buried and left to incubate. Depending on temperature and moisture conditions, the eggs usually hatch within 45 to 80 days. Hatchlings typically leave the nest in late August and early September, though some are known to overwinter.

Blanding’s turtle is carnivorous and predominantly feeds while submerged (Harding 1990). Prey includes snails, aquatic insects, crayfish, and fish (Minton 2001a), and Harding (1990) states that Blanding’s turtle will also feed on carrion (dead animals) if it is not overly decayed. Harding (1990) and Minton (2001a) both state that the stomach contents of Blanding’s turtles have been documented to include vegetable matter, though much of this might have been due to accidental ingestion.

2.2 Northern Leopard Frog

2.2.1 Description

The northern leopard frog (*Lithobates pipiens*) is a slender frog that has a narrow head and that reaches 2 to 3 inches in length as an adult. It is usually brown, green, or tan with a white ventral surface, and has dark spots with white margins on its dorsal surface (Minton 2001b). Often, these spots are larger than the frog’s eye. The roundness of the spots helps distinguish this species from the similar pickerel frog (*L. palustris*), and the lack of dark spotting on the tympanum helps distinguish this species from two other leopard frogs found in the Midwest: the southern leopard frog (*L. sphenocéphala*) and the plains leopard frog



Photo credit: A. Hoffman

(*L. blairi*). Other identifying marks include a dark spot on the snout and an unbroken dorsolateral ridge (a raised, white, line-like structure that separates the back and side of the frog) (Minton 2001b).

2.2.2 Distribution and Status

The northern leopard frog ranges from the Hudson Bay region in northeast Canada to the south and west, to about the Trans-Pecos Region of Texas, and to the south and east along the Appalachians to Virginia. In Indiana and Illinois, the species is found across the northern one-third of the state, with southern leopard frogs being abundant across the rest of the state (Minton 2001b; Phillips et al. 1999). Leopard frogs are a complex group of species (Hillis 1988), with several former subspecies of *L. pipiens* having been elevated to as new species during the past 40 years. Thus, much of the older literature pertains to these other species.

Northern leopard frogs were once abundant across large expanses of North America but now appear to be declining across much of this range (Rorabaugh 2005). The decline likely has multiple causes including both direct and indirect impacts from chemical contamination (King et al. 2007; McDaniel et al. 2008; Rorabaugh 2005; Shenoy et al. 2009), fragmentation of landscapes once dominated by wetlands that are now dominated by roads (Bouchard et al. 2009), and agriculture (Kolozsvary and Swihart 1999; Rorabaugh 2005).

2.2.3 Regional Occurrence

In Indiana, northern leopard frogs were abundant across the northern two-thirds of the state until about 1970, when the population began to decline (Minton 2001b). As a result of this decline, the northern leopard frog is now considered a Species of Special Concern in Indiana. During early coordination, INDNR stated that the species was recorded within 150 feet of the Project's construction footprint in 1993. In Illinois, the species remains widespread across the northern part of the state, though population densities can change markedly between years (Phillips et al. 1999).

2.2.4 Natural History

A detailed review of all aspects of the species biology is available (Rorabaugh 2005).

Northern leopard frogs hibernate in a variety of aquatic conditions including hiding among rocks and root wads, within the entrances to springs, and under silt (Cunjak 1986; Dole 1965a; Rorabaugh 2005). In early spring, frogs of both sexes move to breeding pools, which are typically areas of permanent still water (Dole 1965a). Males produce calls that sound like deep snores interspersed with "clucking" sounds (Phillips et al. 1999).

Fertilization is external, with females producing clusters of eggs that might contain several hundred to several thousand eggs (Minton 2001b; Rorabaugh 2005). Metamorphosis takes 3 to 4 months, during which time the tadpoles feed heavily on algae (Dole 1965a; Minton 2001b). Exposure to pesticides during this time can lead to increased mortality and slower growth (Shenoy et al. 2009).

After mating, frogs begin to move from waterways to the surrounding landscape, including uplands (Dole 1965b; Minton 2001b; Phillips et al. 1999). When out of the water, the frogs move mostly at night and spend their days in small areas, called forms, where they have trampled the vegetation (Dole 1965b). During periods of rain, individual frogs will move rapidly and cover large expanses of land that are inhospitable when dry (Rorabaugh 2005).

Occupancy of this species is directly related to the presence of suitable, permanent wetlands (Kolozsvary and Swihart 1999), though the species forages extensively on land (Minton 2001b). Main prey items include insects, slugs, snails (for large adults), and other frogs (Minton 2001b).

2.3 Karner Blue Butterfly

2.3.1 Description

The Karner blue butterfly (*Lycaeides melissa samuelis*) is a small butterfly with a wingspan of about 1 inch. Male and female butterflies differ in appearance (USFWS 2008). Males display silver or dark blue colors on the top sides of their wings, and the margins are narrow and black. The top sides of wings for females are grayish-brown on the outer portions of the wings, but the coloration gradually becomes bluer toward the inner portions of the wings. Females also differ by displaying irregular bands of orange crescents inside a narrow black border on the top sides of the wings. Both male and females, however, do have a gray underside of the wings with scattered black spots circled with white and a continuous band of orange crescents along the edges of the wings.



Photo credit: P. Delphey

2.3.2 Distribution and Status

Karner blue caterpillars feed exclusively on the leaves of the wild lupine plant (*Lupinus perennis*), and Karner blue butterfly adults feed on the nectar from flowering lupine plants and other forbs (USFWS 2008). Because of these restrictions, the species is found only in the northern range of the wild lupine plant. It is most widespread in Wisconsin, but it is also known to occur in Indiana, Michigan, Minnesota, New Hampshire, New York, and Ohio (USFWS 2008).

The Karner blue butterfly was listed as endangered under the Endangered Species Act in 1992. Habitat loss and/or alteration are considered the predominant causes of decline, in addition to large-scale disturbances due to wildfire and unusual weather, pesticide use, and, to a lesser extent, collection of individuals.

The Karner blue butterfly is also listed as endangered at the state level in Minnesota, New York, New Hampshire, Indiana, and Ohio. It is listed as threatened in Michigan and is a species of special concern in Wisconsin.

2.3.3 Regional Occurrence

The Karner blue butterfly has historically been reported in eight counties in Indiana (USFWS 2003). A number of second-brood adults have been found in two counties in particular, Lake and Porter, associated with medium- to high-quality habitat at the Indiana Dunes National Lakeshore (USFWS 2003). Seventeen subpopulations were estimated to occur at the Indiana Dunes National Lakeshore, and additional habitat known to support the Karner blue butterfly is known in West Gary (USFWS 2003). Reintroduction of Karner blue butterflies began in 2001 in West Gary.

Federal Register Documents

[57 FR 2241-2247](#); January 21, 1992: ETWP; Proposed Listing: Endangered

[57 FR 59236-59244](#); December 14, 1994: ETWP: Determination of Endangered Status

[68 FR 54913-54914](#); September 19, 2003: Approved Recovery Plan

[82 FR 18156-18158](#); April 17, 2017: 5-Year Status Review



2.3.4 Natural History

The Karner blue butterfly has two broods each year (USFWS 2008). Caterpillars typically hatch in April from eggs laid the previous year. Caterpillars pupate about mid-May, and adults emerge from the cocoon-like chrysalis at the end of May or early June. This brood of adults mate and lay eggs in June. The eggs of the second brood hatch in 1 week, and caterpillars feed for about 3 weeks until they pupate. The second brood of adults appear in July, and, after mating, this brood will lay eggs that will not hatch until April of the following year.



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3 Methods

3.1 Desktop Review

The Project team used the 2011 National Landcover Database (Homer et al. 2015), publicly available aerial photographs, United States Geological Survey topographic maps, USFWS National Wetland Inventory maps, and field notes of Project team members familiar with the region to complete a desktop review. This review identified target areas for the field survey and facilitated the Project team's understanding of how the Project footprint connects to the surrounding landscape. The desktop review was performed by senior biologists with extensive experience with amphibians and reptiles in Indiana (Dr. Dale W. Sparks) and extensive regional experience (Dr. Robert P. Jean). All surveys included not only the Project footprint, but also a buffer that was used to provide data about the surrounding landscape (and thus information about potential environmental effects of Project changes). The composite of all areas surveyed is thus termed the environmental survey area.

3.2 In-field Mapping

Map layers were loaded on a global positioning system (GPS)-enabled tablet computer used to assist in field surveys and collect data. While in the field, biologists were able to selectively interact with these map layers (that is, turn layers on and off or zoom in or out) and create a real-time map layer that recorded the locations of resources as they were identified. The tablet computer also allowed biologists to link these map layers to other data including habitat segments, disturbance conditions, and locations and identifications of rare species from previous studies. Mapped locations were linked to text descriptions and representative photographs.

3.3 Field Surveys and Habitat Assessments

3.3.1 Pedestrian Surveys

The Project team biologists completed pedestrian surveys on August 3 and 4, 2016, for amphibians and reptiles and on May 1 and 2, 2017, for insects. All pedestrian surveys were completed using a meander search technique within the environmental survey area. The biologists focused their efforts on areas that could provide unique or high-quality habitat (Goff et al. 1982) and walked the survey boundary searching for habitat features (for example, wetlands, crayfish burrows, basking areas, permanent water, flowering forbs, host plant species, or grassy openings) with the potential to support one or more of the target species.

The field surveys for amphibians and reptiles were performed by a herpetologist (Mr. Timothy Brust) who has a USFWS-issued recovery permit for the eastern massasauga and INDNR-issued permits for other amphibians and reptiles and by an experienced assistant (Ms. Sarah Messer). The field habitat assessments for insects were performed by a senior entomologist, Dr. Robert Jean, assisted by three biologists familiar with local plants and insects (Mr. Joe Johnson, Ms. Kate Lucier, and Mr. Lincoln Oliver). Résumés of qualified surveyors are provided in **Appendix A**.

3.3.2 Driving Surveys

Biologists performed driving surveys in areas that were highly developed and were likely to have only scattered patches of quality habitat. Biologists drove through these areas during periods of low traffic flow to identify any areas with potentially suitable habitat and visited any suitable habitat on foot.

3.3.3 Habitat Characterization

Biologists identified and described general habitat types using the GPS-enabled tablet computer. Each habitat segment received a qualitative ranking of habitat quality on a 4-point scale (high, medium, low, or no habitat) appropriate to each species. Photographs were taken, and detailed notes for each habitat segment were recorded. If target species was found during the survey, the location was marked with flags and mapped with the GPS-enabled tablet computer with sub-meter accuracy.

3.3.3.1 *Blanding's Turtle*

Access to a permanent water source is required for an area to be considered suitable for Blanding's turtles. Habitat is further classified as high, moderate, low, or no potential based on the presence or lack of:

- Basking habitat (that is, emergent structures in open canopy)
- Potential nesting areas, especially those with loose or sandy soil

High-quality habitat includes grassy marshes, bogs, roadside ditches, woodland ponds, and slow-moving streams that provide resources necessary for basking, foraging, and reproduction.

Moderate-quality habitat segments include permanent water sources fragmented by development, and vegetated areas near permanent water sources that Blanding's turtles can use to travel between areas.

Low-quality habitat segments are characterized as those areas through which Blanding's turtles might travel but that have no direct access to permanent water.

Areas categorized as offering no potential habitat lack permanent water bodies and appropriate structure.

3.3.3.2 *Northern Leopard Frog*

Northern leopard frogs require permanent water sources that must be close in order for habitat to be considered suitable. Habitat is further classified as high, moderate, low, or no potential based on the presence or lack of:

- Connectivity to wetlands
- Proximity to grassland areas that can be used for foraging

High-quality habitats include grassy marshes, bogs, roadside ditches, woodland ponds, and slow-moving streams that provide resources necessary for foraging and reproduction.

Moderate-quality habitat segments include permanent water sources fragmented by development and vegetation near permanent water sources that northern leopard frogs can use in the summer to forage.

Low-quality habitat segments are characterized as those areas through which northern leopard frogs might travel but that have no direct access to permanent water.

Areas categorized as offering no potential habitat lack permanent water bodies and foraging areas.

Although railroad corridors and highways might provide basking areas for target species, road mortality is a concern for most of these species (as discussed in **Chapter 2**). For this reason, these features are not considered suitable for any of the two target amphibian and reptile species.

3.3.3.3 Karner Blue Butterfly

Karner blue butterflies require the presence of host plants (wild lupine, which is used by larvae) and the availability of other forb species for nectar resources (used by adults) for habitat to be considered suitable. Habitat is classified as having high, moderate, low, or no potential based on the presence and number of host plants and the availability of other forb plants for nectar.

High-quality habitat includes a high density of wild lupine plants per square meter in addition to the presence of several other forb species on which adult butterflies can nectar.

Moderate-quality habitat includes more-sparsely-distributed lupine (three or fewer wild lupine per square meter) as well as some availability of other plants for nectar.

Low-quality habitat might have some wild lupine present, but in very low density.

Areas with no suitable habitat do not contain any individuals of the host plant (wild lupine).



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4 Results

4.1 Desktop Review

The Project team performed desktop reviews for the Project between April 14 and September 11, 2017, to evaluate changes in the Project design. The desktop reviews revealed that the majority of the habitat within the environmental survey area was to some extent developed, and ranged between open and high-intensity development. However, the desktop review also identified several additional ground-cover classifications (emergent herbaceous wetlands, woody wetlands, and open water) within the environmental survey area. Most such areas were associated with the rights-of-way for existing railroad infrastructure, public spaces including parks, or the floodplain of the Calumet River.

4.2 In-field Mapping

The Project team herpetologists completed pedestrian surveys of the survey area on May 9 and 10, 2017. The Project team entomologists completed field work on May 1 and 2. The results of these surveys are presented in **Table 4.2-1** and **Table 4.2-2** (respectively) and mapped in **Appendix B**, and representative photographs are included in **Appendix C**. The acreage for each habitat type that would be permanently and temporarily affected by the Project is indicated in the last two columns of **Table 4.2-1** and **Table 4.2-2** and shown in **Appendix B**.

Table 4.2-1: Habitat Data for Target Reptile and Amphibian Species

Segment	Blanding's Turtle	Northern Leopard Frog	Land Classification	Amount of Habitat within Environmental Survey Area (acres)	Amount of Habitat within Project Footprint (acres)	
					Permanent Workspace	Temporary Workspace
HP001	None	None	Developed, high intensity	4.15	1.33	—
HP002	None	None	Developed, high intensity	6.03	4.43	—
HP003	None	None	Developed, medium intensity	36.72	32.06	—
HP004	Low	Low	Developed, high intensity	0.07	0.02	—
HP005	None	None	Developed, open space	0.37	0.09	0.08
HP006	None	None	Developed, open space	0.04	0.01	0.01
HP007	None	None	Developed, open space	0.53	0.14	0.14
HP008	None	None	Developed, open space	0.91	0.21	0.01
HP009	None	None	Developed, high intensity	0.13	0.02	< 0.01



Segment	Blanding's Turtle	Northern Leopard Frog	Land Classification	Amount of Habitat within Environmental Survey Area (acres)	Amount of Habitat within Project Footprint (acres)	
					Permanent Workspace	Temporary Workspace
HP010	None	None	Developed, high intensity	1.61	0.35	0.36
HP011	None	None	Developed, open space	2.83	1.78	0.11
HP012	None	None	Developed, high intensity	0.48	0.14	0.13
HP013	None	None	Developed, high intensity	1.48	0.12	0.21
HP014	None	None	Developed, high intensity	0.41	0.19	0.06
HP015	None	None	Developed, high intensity	1.08	0.45	0.18
HP016	None	None	Developed, high intensity	0.13	0.05	—
HP017	None	None	Developed, high intensity	6.22	5.44	—
HP018	None	None	Developed, open space	0.91	0.72	—
HP019	None	None	Developed, high intensity	0.51	0.06	—
HP020	None	None	Developed, high intensity	1.38	0.91	—
HP021	None	None	Developed, high intensity	0.07	0.05	—
HP022	None	None	Developed, high intensity	0.65	0.43	—
HP023	None	None	Developed, high intensity	0.09	0.06	—
HP024	None	None	Developed, high intensity	1.55	1.02	—
HP025	None	None	Developed, high intensity	0.13	0.08	—
HP026	None	None	Developed, high intensity	1.29	1.04	—
HP027	None	None	Developed, high intensity	0.98	0.10	—
HP028	None	None	Developed, high intensity	2.40	1.95	—
HP029	None	None	Developed, medium intensity	0.15	0.10	—



Segment	Blanding's Turtle	Northern Leopard Frog	Land Classification	Amount of Habitat within Environmental Survey Area (acres)	Amount of Habitat within Project Footprint (acres)	
					Permanent Workspace	Temporary Workspace
HP030	None	None	Developed, high intensity	0.05	—	—
HP031	None	None	Developed, high intensity	25.87	16.07	—
HP032	None	None	Developed, medium intensity	0.39	0.27	—
HP033	None	None	Developed, high intensity	15.03	12.03	—
HP034	None	None	Developed, medium intensity	0.98	0.85	0.04
HP035	Low	Low	Developed, medium intensity	0.31	0.23	0.01
HP036	None	None	Open water	0.64	0.43	0.04
HP037	None	None	Developed, open space	3.32	2.75	—
HP038	None	None	Deciduous forest	6.50	3.82	—
HP039	None	None	Developed, high intensity	2.12	1.80	—
HP040	None	None	Deciduous forest	2.26	0.79	—
HP041	None	Low	Developed, high intensity	4.73	4.02	—
HP042	None	None	Deciduous forest	2.21	1.31	—
HP043	None	None	Developed, high intensity	1.93	0.97	0.09
HP044	None	Moderate	Deciduous forest	3.03	1.51	0.07
HP045	None	None	Woody wetlands	0.18	0.07	—
HP046	None	None	Developed, high intensity	1.10	0.50	0.06
HP047	None	None	Shrub/scrub	0.14	0.00	—
HP048	None	None	Developed, high intensity	6.38	0.71	1.02
HP049	None	Moderate	Developed, high intensity	1.34	0.39	0.03



Segment	Blanding's Turtle	Northern Leopard Frog	Land Classification	Amount of Habitat within Environmental Survey Area (acres)	Amount of Habitat within Project Footprint (acres)	
					Permanent Workspace	Temporary Workspace
HP050	None	None	Emergent herbaceous wetlands	1.57	1.15	0.28
HP051	None	None	Developed, open space	0.44	0.23	0.02
HP052	None	Moderate	Developed, high intensity	0.82	0.09	0.05
HP053	None	None	Emergent herbaceous wetlands	5.91	3.18	1.16
HP054	None	None	Developed, open space	2.44	1.38	< 0.01
HP055	None	None	Developed, medium intensity	0.91	0.06	0.16
HP056	None	None	Developed, high intensity	26.96	20.82	—
HP057	None	Low	Cultivated crops	0.66	0.59	—
HP058	None	None	Emergent herbaceous wetlands	13.45	13.04	< 0.01
HP059	None	Low	Developed, medium intensity	0.04	0.04	—
HP060	None	Low	Developed, medium intensity	2.01	2.01	—
HP061	None	None	Emergent herbaceous wetland	0.04	0.00	—
HP062	None	None	Developed, high intensity	0.11	0.02	—
HP063	None	None	Developed, medium intensity	0.05	0.01	—
HP064	None	None	Developed, medium intensity	1.64	0.78	—
Total				208.86*	143.28	4.32

Source: ESI 2017.

^a Totals might not equal sums due to rounding.

Table 4.2-2: Habitat Data for Target Insect Species

Host Plant Segment	Karner Blue Butterfly	Comments	Amount of Habitat within Environmental Survey Area (acres)	Amount of Habitat within Project Footprint (acres)	
				Permanent Workspace	Temporary Workspace
HAP001 ^a	None	Many forbs available, though mostly invasive plants; some nesting potential; no overwintering potential.	40.06	27.77	—
HAP002	None	Stream of low quality.	0.25	0.20	< 0.01
HAP003	None	Lots of nectar sources, but mainly invasive species: honey-suckle, garlic mustard, plantains, goldenrods, dandelion, coronilla, mulberry, etc.; old railroad line; clover (<i>Melilotus</i>).	3.78	3.30	—
HAP004	None	Wetland.	1.39	0.88	—
HAP005	None	Weedy trees along old railroad track with many invasive flowering plants.	3.22	3.22	—
HAP006	None	No comments.	1.55		—
HAP007	None	Open area with many blooming forbs but mainly turf grass.	3.71	2.96	0.58
HAP008	None	Open area and retention pond/wetland with several flowering plants; low potential for rusty patched bumble bee foraging.	2.04	1.20	0.07
Total			56.00 ^b	39.54 ^c	0.66 ^c

Source: ESI 2017.

^a A single instance of wild geranium (*Geranium maculatum*) was observed in HAP001. The presence of this single plant does not significantly affect the suitability determination for any of the target insect species.

^b Remaining 152.86 acres within the environmental survey area are considered to be unsuitable habitat for any target insect species.

^c Remaining 107.41 acres within the Project footprint are considered to be unsuitable habitat for any target insect species.

4.3 Field Surveys and Habitat Assessments

Under the No Build Alternative, no adverse permanent or temporary impacts on Blanding's turtle, northern leopard frog, or Karner blue butterfly would occur as a result of the Project.

Impacts to Blanding's turtle, northern leopard frog, and Karner blue butterfly as a result of the FEIS Preferred Alternative are described in the sections below.

4.3.1 Blanding's Turtle

Almost the entirety of the environmental survey area (208.48 acres, or more than 99 percent) has no suitable habitat for Blanding's turtles (**Table 4.2-1** and **Appendix B**). Low-quality habitat is present in about 0.37 acre (less than 1 percent).

About 0.26 acre of low-quality habitat for Blanding's turtles is within the Project footprint with all but 0.01 acre being permanently impacted (**Table 4.2-1** and **Appendix B**). Construction would impact 69 percent of all low-quality habitat identified within the environmental survey area.

4.3.2 Northern Leopard Frog

The majority (195.86 acres, or about 94 percent) of the Environmental Survey Area contains no suitable habitat for northern leopard frogs (**Appendix B, Table 1**). Low-quality habitat is present in about 7.16 acres (about 3 percent of the survey corridor) of the Environmental Survey Area, and moderate-quality habitat is present in 5.84 acres (about 3 percent).

About 6.92 acres of low-quality habitat for northern leopard frogs are within the Project Footprint (**Appendix B, Table 1**), and 4.31 of these acres will be permanently impacted. Construction will permanently impact is about 60 percent of all low-quality habitat identified within the Environmental Survey Area. About 1.99 acres of moderate-quality habitat would be permanently converted to a transportation use (about 44 percent of all moderate-quality habitat).

4.3.3 Karner Blue Butterfly

No evidence of wild lupine was identified within the Environmental Survey Area (**Appendix C, Table 2**). Therefore, no impacts to suitable Karner blue butterfly habitat are expected.



5 Mitigation

5.1 Long-term Operating Effects

The No Build Alternative would not result in any direct impacts on Blanding's turtle, northern leopard frog, or Karner blue butterfly and, therefore, would not require mitigation.

Though some potential habitat within the FEIS Preferred Alternative was found for Blanding's Turtle and the northern leopard frog, INDNR does not have any record of these species within the Project Area or foresee any impacts to these species as a result of the Project. No mitigation is proposed. There is no suitable habitat for the Karner blue butterfly in the Project footprint. No mitigation is proposed.

5.2 Short-term construction Impacts

Under the No Build Alternative, no construction impacts on Blanding's turtle, the northern leopard frog, or Karner blue butterfly would occur since the Project would not be built.

Construction impacts as a result of the FEIS Preferred Alternative include removal of habitat for Blanding's turtle and the northern leopard frog.



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6 Conclusion

On May 1 and 2, 2017, the Project team entomologists performed field surveys within the 208.86-acre environmental survey area surrounding the proposed construction footprint. The Project team herpetologists performed field surveys on May 9 and 10, 2017, in the same area. The field surveys confirmed that the majority of the environmental survey area, and by extension the proposed construction footprint, is within a range of open to highly developed areas.

A total of 13.00 acres of this 208.86-acre environmental survey area were determined to provide some level of habitat for Blanding's turtles or northern leopard frogs. Of these acres, 7.08 acres are within the Project footprint with 6.89 of these acres being permanently impacted.

The requisite host plants for Karner blue butterfly larvae are absent from the environmental survey area, so this species is not considered to be present.



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7 References

- Bouchard, J., A.T. Ford, F.E. Eigenbrod, and L. Fahrig. 2009. "Behavioral Responses of Northern Leopard Frogs (*Rana pipiens*) to Roads and Traffic: Implications for Population Persistence." *Ecology and Society* 14: 1–10.
- Chicago Metropolitan Agency for Planning. 2014. *GO TO 2040 Comprehensive Regional Plan*.
- Cunjak, R.A. 1986. "Winter Habitat of Northern Leopard Frogs, *Rana pipiens*, in a Southern Ontario Stream." *Canadian Journal of Zoology* 64: 255–257.
- Dole, J.W. 1965a. "Spatial Relations in Natural Populations of the Leopard Frog, *Rana pipiens* Schreber, in Northern Michigan." *The American Midland Naturalist* 74: 464–478.
- Dole J.W. 1965b. "Summer Movements of Adult Leopard Frogs, *Rana pipiens* Schreber, in Northern Michigan." *Ecology* 46: 236–255.
- ESI. 2017. Data and analysis prepared for the West Lake Corridor FEIS.
- Goff, F.G., A. Dawson, and J. Rochow. 1982. "Site Examination for Threatened and Endangered Plant Species." *Environmental Management* 6: 307–316.
- Harding, J.H. 1990. "Blanding's turtle, *Emydoidea blandingii*." *Tortuga Gazette* 26: 3–4.
- Hillis, D.M. 1988. "Systematics of the *Rana pipiens* Complex: Puzzle and Paradigm." *Annual Review of Ecology and Systematics* 19: 39–63.
- Homer, C.G., J.A. Dewitz, L. Yang, S. Jin, P. Danielson, G. Xian, J. Coulston, N.D. Herold, J.D. Wickham, and K. Megown. 2015. "Completion of the 2011 National Land Cover Database for the Conterminous United States—Representing a Decade of Land Cover Change Information." *Photogrammetric Engineering and Remote Sensing* 81: 345–354.
- King, K.C., J.D. McLaughlin, A.D. Gendron, B.D. Pauli, I. Giroux, B. Rondeau, M. Boily, P. Juneau, and J.D. Marcogliese. 2007. "Impacts of Agriculture on the Parasite Communities of Northern Leopard Frogs (*Rana pipiens*) in Southern Quebec, Canada." *Parasitology* 134:2063-2080.
- Kolozsvary, M.B. and R.K. Swihart. 1999. "Habitat Fragmentation and the Distribution of Amphibians: Patch and Landscape Correlates in Farmland." *Canadian Journal of Zoology* 77:1288-1299.
- McDaniel, T.V., P.A. Martin, J. Struger, J. Sherry, C.H. Marvin, M.E. McMaster, S. Clarence, and G. Tetreault. 2008. "Potential Endocrine Disruption of Sexual Development in Free-Ranging Male Northern Leopard Frogs (*Rana pipiens*) and Green Frogs (*Rana clamitans*) from Areas of Intensive Row Crop Agriculture." *Aquatic Toxicology* 88: 230–242.



- Minton, S.A., Jr. 2001a. "Blanding's Turtle (*Emydoidea blandingii* Holbrook)." In *Amphibians and Reptiles of Indiana*, Revised Second Edition, 180–183. Indianapolis, Indiana: Indiana Academy of Science. 404 pp.
- Minton, S.A., Jr. 2001b. "Northern Leopard Frog (*Rana pipiens*)." In *Amphibians and Reptiles of Indiana*, Revised Second Edition, 137–140. Indianapolis, Indiana: Indiana Academy of Science. 404 pp.
- NICTD and Northwest Indiana Regional Development Authority. 2014. *20-Year Strategic Business Plan*.
https://www.in.gov/rda/files/Strategic_Business_Plan_20140528_Final.pdf.
- NIRPC. 2011. *2040 Comprehensive Regional Plan: A Vision for Northwest Indiana*.
<http://www.nirpc.org/2040-plan>.
- NYSDEC. 2016. "Blanding's Turtle Fact Sheet." Albany, New York: New York State Department of Environmental Conservation, Endangered Species Unit.
- Phillips, C.A., R.A. Brandon, and E.O. Moll. 1999. "Northern Leopard Frog." In *Field Guide to Amphibians and Reptiles of Illinois*, 134–135. Champaign, Illinois: Illinois Natural History Survey. 282 pp.
- Rorabaugh, J.C. 2005. "*Rana pipiens* Schreber, 1782, Northern Leopard Frog." In *Amphibian Declines: The Conservation Status of United States Species*, edited by M. Lannoo, 570–577. Berkeley and Los Angeles, California: University of California Press. 1094 pp.
- Shenoy, K., B.T. Cunningham, J.W.R. Enfroe, and P.H. Crowley. 2009. "Growth and Survival of Northern Leopard Frog (*Rana pipiens*) Tadpoles Exposed to Two Common Pesticides." *Environmental Toxicology and Chemistry* 28:1469–1474.
- USFWS. 2003. Final Recovery Plan for the Karner Blue Butterfly (*Lycaeides melissa samuelis*). Fort Snelling, Minnesota: United States Department of the Interior, Fish and Wildlife Service, Midwest Regional Office. 273 pp.
- USFWS. 2008. "Karner Blue Butterfly (*Lycaeides melissa samuelis*)." Fort Snelling, Minnesota: United States Department of the Interior, Fish and Wildlife Service, Midwest Regional Office. 2 pp.



Appendix A. Résumés of Qualified Surveyors



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ENVIRONMENTAL SOLUTIONS & INNOVATIONS, INC.

Résumé

Dale W. Sparks, Ph.D.

EDUCATION

Ph.D., Biology, Indiana State University, 2003. Dissertation: "How does urbanization impact bats?"

M.S., Biology, Fort Hays State University, 1996. Thesis: "Distribution, Natural History, Conservation Status, and Biogeography of Bats in Kansas"

B.S., Biology, Murray State University, 1993.

PROFESSIONAL CERTIFICATIONS

Certified Wildlife Biologist: The Wildlife Society, 2012

Certified Senior Ecologist: Ecological Society of America, 2012

Qualified Indiana Bat Surveyor: Commonwealth of Pennsylvania

ODOT Ecological Training, 2013



QUALIFICATIONS AND EXPERIENCE

Dr. Sparks is a wildlife biologist involved in a variety of terrestrial ecology research positions involving herpetology, ornithology, and mammalogy and has extensively studied bats and their habitat. Many of Dr. Sparks' projects concern federally endangered Indiana bats (*Myotis sodalis*) and the federally threatened northern long-eared bat (*M. septentrionalis*). He is experienced in many ecological field techniques, including: species identification, habitat assessment, trapping, netting, radio-telemetry and tracking, guano analysis, and GPS/GIS, mapping and orientation. Dr. Sparks has extensive experience conducting acoustic sampling including assisting in the collection of reference calls, site selection for both obtaining quantity (i.e. a measure of activity) or quality (i.e. those that can be identified) of recordings. He routinely identifies bat calls collected during a project using both quantitative (using the most current and approved analysis programs available) and qualitative (visual) analysis. Dr. Sparks visually reviews call sequences in light of known error rates and the temporal pattern of detection and rates the confidence that a particular species was detected. Dr. Sparks regularly serves as a peer reviewer for scientific journals upon the submission of acoustic surveys.

Dr. Sparks directed long-term studies in support of a Biological Assessment (Sec. 7 of the ESA) and a Habitat Conservation Plan (Sec. 10) associated with developments at the Indianapolis International Airport and the near-by Six-Points highway project, respectively. Studies included mist-net, acoustic monitoring, population estimates using both emergence counts and DNA-based approaches, and radiotelemetry studies, requiring coordination with state, federal, and local agencies. These combined projects were the first large-scale mitigation for loss of summer habitat for the Indiana bat and they have produced some of the most definitive research on the interaction of the Indiana bat with human developments, with many resulting publications that bear the name of Dr. Sparks.

Dr. Sparks is an experienced public speaker, having taught university-level courses, presented educational lectures to the public, and presented technical papers to professional organizations. Dr. Sparks serves as a technical advisor to U.S. Fish and Wildlife Service for summer habitat conservation and population characteristics of the endangered Indiana bat. He has recently been added to a USFWS group working to develop forest management practices for the northern long-eared bat. He is also a member of the Indiana Department of Natural Resources Mammal Technical Advisory Committee and chairs the Legislation and Regulations Committee of the American Society of Mammalogists.

Dr. Sparks has authored and co-authored numerous papers, poster and oral presentations, and book chapters and is a technical reviewer for Biological Conservation, Journal of Wildlife Management; Journal of Mammalogy; American Midland Naturalist, Acta Theriologica, Northeastern Naturalist, Landscape and Urban Planning, The Southwestern Naturalist; The Prairie Naturalist; Urban Naturalist, USFWS Indiana Bat Recovery Plan; and the National Science Foundation.

SPECIALIZED TRAINING IN ACOUSTIC ANALYSIS

Robbins Invitational Workshop hosted by Dr. Lynn W. Robbins of Missouri State University. Subjects included: Recognition of false-positives during presence/probable absence surveys, comparison of error rates and types among the three candidate software packages, addressing problem identifications, simultaneous comparison of multiple acoustic monitoring instruments, and ethical considerations of biological consulting (note Dr. Sparks present the ethics talk). 2014

Introduction to Acoustic Monitoring Studies by C. Ryan Allen of Bat Call Identification Inc. Subjects included: basic operation of bat detectors, study design, use of identification software, USFWS guidelines, and a specific review of techniques and equipment used by ESI. 2013

Identification of Eastern Bat Calls Using Quantitative Techniques by Dr. Justin G. Boyles of the University of Pretoria, South Africa. Subjects included: operation and navigation within the Analook Software, Identification of eastern bats including all federally-listed species east of the Rocky Mountains. 2010

PROJECT EXPERIENCE

Lead Technical Scientist – Lake States Forest Management Habitat Conservation Plan (HCP) for Bats: 2015-Present. Lead Technical Scientist for an HCP designed to allow forest management in the presence of four bat species impacted by White Nose Syndrome (Indiana, northern long-eared, little brown, and tri-colored bats). Responsible for developing landscape-level models of bats and how these species are impacted by forest management practices in the states of Minnesota, Wisconsin, and Michigan.

Lead Technical Scientist – Pennsylvania Game Commission and Pennsylvania Department of Conservation and Natural Resources, Pennsylvania State Lands Bat

and Forestry HCP: 2013-Present. Lead Technical Scientist for Pennsylvania state forest lands HCP and NEPA documentation for Indiana and northern long-eared bats.

Project Manager – Indiana Department of Transportation, Interstate 69, Pre- and Post-construction Surveys: 2010-Present. Completed long-term monitoring of bat responses to highway development, as well as additional studies aimed at pre-construction compliance efforts. Completed summer mist net surveys for federally endangered Indiana bat along final ROW for Sections 1, 2, 3, 5, and 6, and tracked multiple bats to roosts. Completed quantitative (using programs) and qualitative (visual) analysis of bat calls collected during the project.

Lead Chiropteran Scientist – Midwest Energy HCP, Environmental Impact Statement: 2015-Present. Evaluated impacts of developing more than 51,000 megawatts of wind energy across an eight-state region. Evaluated potential impacts to three species of bats covered by the HCP as well as all other bats in the region. Evaluation included development of models to estimate mortality of bats that were used to compare four alternatives. Further managed biologists responsible for completing similar analyses for aquatic macroinvertebrates and surface waters.

Project Manager/Technical Lead – EQT, Multiple Gas Well Pads and Pipelines: 2012-Present. Directed detailed habitat assessments, general habitat evaluations, and portal searches for Indiana and Virginia big-eared bats on multiple proposed projects throughout Wetzel and Doddridge counties in West Virginia. Responsible to client for all aspects of project management and interaction with USFWS.

Project Manager – NextEra Energy, Wind Resource Area: 2010-2016. Completed Tier I and Tier II analysis of bat impacts for proposed wind energy facility in Fayette, Rush, and Henry counties, Indiana. Phase III studies (field surveys) for bats were initiated in 2011 and completed in 2014. Studies resulted in capture and telemetry of Indiana bats associated with four maternity colonies, as well as multiple colonies of northern long-eared bats. Compliance measures for this facility are awaiting final decision on potential addition of the northern long-eared bat to the endangered species list.

Project Manager – NextEra Energy, Wind Resource Area: 2011-2016. Managed mist netting, acoustic surveys, and telemetry for federally endangered Indiana bat within 23,468.7-acre wind resource area in Jay and Randolph counties, Indiana. Completed take model and portions of HCP under Section 10 of the ESA. Coordinated with prime consultant and completed associated reporting.

Project Manager – American Electric Power, Wyoming-Jackson's Ferry 765 kV Transmission Line: 2012-2016. Directed monitoring effort associated with upland ponds and artificial roosts as required under a Biological Opinion issued by USFWS. Conducted quantitative (using programs) and qualitative (visual) analysis of bat calls collected during the project.

Project Manager – Indiana Michigan Power Company, Endangered Species Compliance Efforts: 2015-Present. Worked closely with IM's environmental coordinator and USFWS to avoid take of listed bats for multiple projects in both Indiana and Michigan. Compliance measures ranged from identifying means to avoid impacts to suitable habitat to permitting removal of suitable habitat within areas of known

occurrence for federally threatened northern long-eared bat within weeks after the species was listed. Produced multiple reports and coordinated repeated changes in study design across three USFWS offices. Responsible for all aspects of project management and reporting.

Project Manager – AEP Ohio Power Company, Endangered Species Compliance Efforts: 2016. Worked closely with AEP's environmental coordinator and USFWS to avoid take of listed bats for multiple projects throughout Ohio. Compliance measures ranged from identifying means to avoid impacts to suitable habitat to completing mist-net surveys. Produced appropriate technical reports and coordinated repeated changes in study design with USFWS offices. Responsible for all aspects of project management and reporting.

Lead Technical Scientist – Dominion Transmission, Atlantic Coast Pipeline: 2015-2016. Completed habitat assessment for state-listed southeastern bats and eastern subspecies of Rafinesque's big-eared bat along portions of approximately 564-mile interstate natural gas pipeline system in Virginia and North Carolina in 2015. Studies consisted of desktop analysis, field verification, and exploratory mist-net surveys at four sites. No southeastern *Myotis* or Rafinesque's big-eared bats were captured, but 30 – 40 were observed roosting under a highway bridge within the survey corridor. Assisted in management of additional studies in 2016 in West Virginia and North Carolina.

Project Manager – Ohio Department of Natural Resources, Lewisburg Mine: 2014-2016. Coordinated efforts and performed counts of hibernating bats in Lewisburg Mine. The mine is currently distinguished as a Priority 2 and the largest Indiana bat hibernaculum in Ohio. Identified and counted all bats and recorded microclimate data for large portion of the mine, coordinated with federal and state agencies and the landowner, and organized volunteer participation.

Project Manager – EQT, Equitrans Expansion Project: 2015-Present. Directed rare, threatened, and endangered species studies along portions of proposed natural gas pipeline traversing Allegheny, Washington, and Greene counties, Pennsylvania and Wetzell County, West Virginia. Efforts included assisting prime environmental contractor in completing agency correspondence to identify and address natural resource issues. Issues included: surveys for federally protected bats during both summer (netting and telemetry) and winter (assessment and trapping of mine portals); surveys for freshwater mussels; studies of rare plants along the line; and compliance measures for a newly-listed species (rusty patched bumble bee). Also assisted client in responding to information requests from agencies including FERC. Responsible for all aspects of project management and reporting.

Lead Technical Scientist – Rice Energy, Odin Pipeline: 2015. Completed Biological Assessment (BA) for Indiana and northern long-eared bats within 109.5-acre project area for proposed 7.5-mile dual natural gas pipeline system in Monroe County, Ohio. Turned BA around within short timeframe to accommodate projects tight schedule and need to obtain permission for tree removal before winter clearing.

Lead Technical Scientist – Beaver Excavating Company, Jewett Interchange Railway Improvement: 2015. Coordinated Indiana and northern long-eared bat studies for

proposed 90-acre mine development site in Harrison County, Ohio. Prepared conservation measures and Biological Assessment.

Project Manager – Northern Indiana Commuter Transportation District, South Shore Commuter Rail Line: 2016. Managed habitat assessment studies for Massasauga rattlesnake, Kirtland's snake, northern leopard frog, and spotted turtles along a 22-mile railway expansion in Lake, Porter, and LaPorte counties of Indiana. Studies were completed as part of Environmental Impact Statement and required coordination with the client; multiple state, federal, and local agencies; and four other members of the consulting team.

Project Manager – Northern Indiana Commuter Transportation District, West Side Line: 2016-Present. Managed habitat assessment studies for Massasauga rattlesnake, Kirtland's snake, northern leopard frog, spotted turtles, and Karner blue butterflies along a railway expansion in Lake County, Indiana, and Cook County, Illinois. Studies were completed as part of Environmental Impact Statement, and required coordination with the client; multiple state, federal, and local agencies; and four other members of the consulting team.

Senior Technical Scientist – Ameren, Mark Twain Maywood to Zachary Transmission Line: 2016. Provided technical review and assistance with impacts assessment and ESA compliance after more than 70 Indiana bats were captured along proposed electrical line project in Adair, Knox, Shelby, Schuyler, and Marion counties Missouri.

Project Manager – Port of Cincinnati Development Authority, 2100 Section Road Redevelopment: 2016. Completed site visit and avoidance and minimization plan for endangered bats at the site of a former factory in Hamilton County, Ohio resulting from last-second request for ESA compliance. Coordinated with client and USFWS.

Project Manager – Home Road Improvement, Delaware County, Ohio: 2016. Managed mist netting surveys for federally endangered Indiana bat and federally threatened northern long-eared bat at proposed highway expansion. Responsible to the client for all financial and technical aspects of the project.

Lead Technical Scientist – EQT, Ohio Valley Connector Pipeline: 2015-2016. Conducted analysis of best available science aimed at determining the time when northern long-eared bats move from trees to caves. Worked directly with environmental lead and outside council to help identify and address legal and biological requirements under ESA.

Lead Technical Scientist – Clermont County Park District, East Fork State Bicycle Trail: 2016. Provided technical review and supervision of site visit and avoidance and minimization plan for endangered bats at a site where an abandoned road was being converted into a bicycle path.

Project Manager – Invenergy Wind Development, Wind Resource Area: 2016-Present. Managed freshwater mussel surveys for seven stream crossings within a 23,000-acre wind resource area in Hardin County, Ohio. Coordinated with prime consultant and completed associated reporting.

Project Manager – Indiana Forest Alliance, Ecoblitz: 2016. Used mist nets, acoustic monitoring, and telemetry to study rare bats within area client would like removed from active timber harvest. Explained ESA compliance requirements, silvicultural techniques, and bat sampling efforts to members of this grass roots group. Coordinated between the client, INDR's Division of Forestry, and USFWS.

Senior Technical Scientist – Arkansas Electric Cooperative, Gainesville Transmission Line: 2016. Provided technical review and assistance with impacts assessment for proposed electric line in Greene County, Arkansas.

Team Leader – Minnesota Department of Natural Resources, Beltrami State Forest Bat Census: 2016. Used mist nets and acoustic monitoring to study bats within the state forest. Coordinated with the client, and USFWS.

Team Leader – USFWS, Ozark Plateau National Wildlife Refuge Bat Census: 2016. Used mist nets, harp traps, and acoustic monitoring to study bats swarming at caves within the refuge. Worked directly with USFWS and Oklahoma DNR staff.

Project Manager – Kentucky Transportation Cabinet (KYTC), 68/80 Cadiz Bypass: 2014. Designed and conducted field surveys of bats using bridges over two streams within area considered known occupied habitat for Indiana, gray, and northern long-eared bats in Trigg County, Kentucky. Assessed 23 karst features for their potential to support protected bats. Documented presence of federally endangered gray bat and assisted KYTC in completing section 7 consultation with USFWS. Responsible for all aspects of project management and reporting.

Biologist – RW Orange County, Sterling Forest Resort: 2014. Completed visual review of all call sequences identified as federally endangered species during quantitative analysis, and supplied final decision about presence or absence of Indiana and northern long-eared bats for acoustic monitoring study in Orange County, New York. Indiana bats were deemed likely present and a Biological Assessment was in preparation at the time the state failed to issue a gaming license to the client.

Lead Technical Scientist – Ohio Department of Transportation, Sunday River Mitigation Site: 2014-2015. Evaluated potential of existing stream mitigation site to provide suitable mitigation for the endangered Indiana bat. Provided analysis of best available science which included confidential distributional data maintained by the U.S. Forest Service and the Ohio Department of Natural Resources, publicly available mine maps, field surveys to locate and observe bat activity at mine openings, as well as evaluation of extensive acoustic monitoring. Data indicated that 1) the site was within multiple protective buffers associated with both summer and winter roosts of Indiana bats, 2) mine openings on the site connect directly to underground voids known to be used by hibernating bats, including the Indiana bat, and 3) the site is used throughout the year by Indiana bats and several other bats severely affected by White Nose Syndrome. The site is now an accepted mitigation site.

Project Manager – Confidential Client, Electric Transmission: 2014-2016. Retained by council to supervise surveys for multiple rare plants along three alternate proposed linear and multiple potential area-based sites. Worked directly with council to provide a

confidential assessment of potential impacts along all proposed alternatives. Responsible for all aspects of project management and reporting.

Project Manager – Common Ground Capital, Conceptual Mitigation Plan: 2015. Developed conceptual mitigation for Indiana and northern long-eared bats related to project designed to connect wind energy sites in Oklahoma with Memphis, Tennessee by crossing the length of Arkansas.

Biologist – Kinder Morgan, Pad L & Pad G Pipelines: 2015. Helped client develop novel approach to addressing potential presence of migrating northern long-eared bat along two proposed pipelines in Pittsburgh County, Oklahoma. To meet client's timeline constraints, ESI completed acoustic surveys and then processed, analyzed (both qualitatively and quantitatively), and provided the client with results within hours of completion of fieldwork.

Biologist – Confidential Client, Crystal Cave Telecommunications Tower: 2015. Helped client develop a study that illustrated a raptor nest on a communications tower had been abandoned in order to demonstrate avoidance of take pursuant to Migratory Bird Treaty Act and allow restoration of the tower.

Biologist – RW Orange County, Resorts World Hudson Valley Project: 2014. Completed visual review of all call sequences identified as federally endangered species during quantitative analysis, and supplied final decision about presence or absence of Indiana and northern long-eared bats for acoustic monitoring study in Orange County, New York. Acoustic data indicate that neither species was present.

Project Manager – Dominion Transmission, Jetersville to Ponton 115 kv Transmission Line: 2015. Completed presence and absence surveys for smooth coneflower along 8-mile transmission line and multiple access roads in Amelia County, Virginia. Responsible for all aspects of project management and reporting.

Project Manager – Marathon Oil, Grayling Well Pad: 2015. Supervised collection and analysis of acoustic data at 4 acoustic monitoring stations and associated reporting within one week for proposed oil pad in Crawford County, Michigan. Responsible for all aspects of project management and reporting.

Project Manager – Rice Energy, Beta McNichols to Parry and Beta Parry to Cholak Pipelines: 2015. Completed mist netting at 29 sites for total of 179 complete net nights along two proposed natural gas pipelines in Greene County, Pennsylvania. Netting resulted in capture of 265 bats representing six species, including federally threatened northern long-eared bat. Ten northern long-eared bats and a single evening bat were subsequently radio-tagged and tracked to roosts. Completed searches for potential hibernacula. Responsible for all aspects of project management and reporting.

Project Manager – Columbia Gas Transmission, Tri-County Bare Steel Replacement Project: 2015. Completed summer mist net surveys in accordance with Multi-Species Habitat Conservation Plan for proposed replacement and modernization of 32 miles of natural gas pipeline. Surveys resulted in capture of 111 bats including 33 federally threatened northern long-eared bats. Radio-tagged four northern long-eared bats and tracked to roosts where emergence counts were completed. Responsible for all aspects of project management and reporting.

Project Manager – NextEra Energy, Wind Resource Area: 2015. Managed mist netting surveys for federally endangered Indiana bat and federally threatened northern long-eared bat within wind resource area in Osborne County, Missouri.

Biologist – Confidential Client, Kansas Expressway Expansion: 2015. Assisted client in understanding regulatory requirements under the Endangered Species Act and how these requirements intersect with the National Environmental Policy Act relative to a highway expansion project.

Field Supervisor – Eclipse Resources, Madzia Well Pad: 2014. Completed portal searches and mist net surveys for federally endangered Indiana bat in Harrison County, Ohio. No Indiana bats were captured and no portals were located.

Project Manager – SUNOCO, 9-Mile Pipeline Improvement: 2014. Supervised emergence counts for Indiana bats at proposed stream crossing site along the Clinton River in Rochester, Michigan. No bats were observed and the project was able to proceed within 48 hours of the first field survey. Responsible for all aspects of project management and reporting.

Field Assistant – Cincinnati/Northern Kentucky International Airport, Gunpowder Creek and Elijah Creek Drainage Basin Maintenance: 2014. Completed nine net nights of surveys for Indiana and gray bats at each of two sites in Boone, County Kentucky. No endangered bats were captured. Prepared report and interacted with client.

Biologist – Hawks Nest Hydro, Hawks Nest and Glen Ferris Hydroelectric Developments: 2013. Completed visual review of all call sequences identified as federally endangered species during quantitative analysis.

Biologist – Consol Pennsylvania Coal Company, Bailey Mine Crabapple Overland Belt: 2013-2014. Completed visual review of all call sequences identified as federally endangered species during quantitative analysis. Based on known error rates and patterns, temporal and spatial clustering of identified sequences, and biology of the species, determined the likelihood that a species was or was not present at those sites where potential bat calls were detected.

Project Manager – Spectra Energy, Ohio Pipeline Expansion Network: 2013-2014. Managed summer and winter bats surveys along approximately 75 miles of alternate routes in five counties in Ohio. Assisted client in addressing regulatory concerns following proposed listing of the northern long-eared bat.

Project Manager – PVR Marcellus Gas Gathering, Ohio River Pipeline: 2013-2014. Completed summer mist netting and portal searches for Indiana and northern long-eared bats along approximately 75 miles of alternate routes in eastern Ohio. The northern long-eared bat, proposed for federal listing by USFWS, was captured at multiple locations, and coordination was undertaken under section 10 of the ESA.

Project Manager – Forest Preserve District of Kane County, Bat Inventory: 2011 and 2013. Managed summer bat mist net and acoustic surveys at four forest preserves in Kane County, Illinois. Coordinated with client and completed associated reporting. Completed quantitative (using programs) and qualitative (visual) analysis of bat calls collected during the project.

Project Manager – Cartersville Ranch: 2013 and 2012. Managed project involving summer mist netting and acoustic surveys on 1800-acre privately owned ranch in Bartow County, Georgia. Responsible for client and agency coordination, reporting, and budget. Completed quantitative (using programs) and qualitative (visual) analysis of bat calls collected during the project.

Project Manager – Coal Mines in eastern Kentucky: 2013. Managed summer bat mist net and acoustic surveys, as well as assessment of portals at four proposed coal mines. One site contained over 100 mining features that were assessed as potential habitat for Indiana and Virginia big-eared bats. Ten of these openings were rated as potentially suitable and thus were trapped. No endangered bats were captured.

Biologist – Spectra Energy, TEAM 2014: 2012-2014. Supervised pre-construction surveys and mitigation design for Allegheny woodrats and eastern small-footed bats along 3 gas pipeline loops in Pennsylvania. Responsible for quality control of data and coordination among ESI, client, and the Pennsylvania Game Commission.

Field Supervisor – CNX Gas Company, NBL 39 Well Site: 2013. Completed summer mist netting and portal searches for Indiana bats on proposed well pad site in Noble County Ohio.

Project Manager – Indiana Michigan Power Company, Greater Fort Wayne Area Reliability Improvements: 2013. Completed habitat evaluation in Allen County, Indiana to determine whether a 7.8-acre forested area along Pleasant Run Creek contained suitable Indiana bat habitat.

Project Manager – EQT, NILO S002 and NILO-D001 pipelines: 2012. Managed project involving detailed habitat assessments and portal searches for suitable small-footed bat habitat for two projects in Elk and McKean counties, Pennsylvania, respectively. Responsible for field team coordination, client and agency coordination, reporting and budget.

Project Manager – Sunoco Pipeline, Tiffin-Easton Pipeline: 2012. Completed summer mist netting surveys for bats and massasauga rattlesnakes along 82-mile pipeline project in Seneca, Huron, Ashland, and Wayne counties, Ohio. Responsible for all aspects of project including field work, client and agency coordination, reporting and budget.

Project Manager – Sunoco Pipeline, Fostoria Connection Pipeline: 2012. Completed summer mist netting surveys on 48-acre site in Wood and Hancock counties, Ohio. Responsible for all aspects of project including field work, client and agency coordination, reporting and budget.

Project Manager – Confidential Client, Wind Resource Area: 2011. Completed acoustic surveys of bats using combination of detectors on MET towers and ground-based detectors at a site in Huron County, Michigan. Responsible for project management and data analysis.

Project Manager – Confidential Client, Wind Resource Area: 2011. Implemented a mortality study on a site containing 20 turbines along 3-mile stretch of Backbone

Mountain in Garrett County, Maryland. Managed project including development of survey protocol.

Project Manager – Confidential Client, Wind Resource Area: 2011. Completed habitat assessment for potential use by endangered bats on 45,293-acre site in Sanilac and Lapeer Counties, Michigan as part of Tier II analysis.

Project Manager – Confidential Client, Wind Resource Area: 2011. Managed endangered bat mist net and acoustic surveys and telemetry within 19,926-acre wind resource area in Seneca and Crawford counties, Ohio. Coordinated with prime consultant and completed associated reporting.

Project Manager – Confidential Client, Wind Resource Area: 2011. Managed endangered bat mist net and acoustic surveys and telemetry within 39,607-acre wind resource area in Seneca and Sandusky counties, Ohio. Coordinated with prime consultant and completed associated reporting.

Project Manager – Confidential Client, Wind Resource Area: 2011. Managed endangered bat mist net and acoustic surveys within 8151-acre wind resource area in Darke County, Ohio. Coordinated with prime consultant and completed associated reporting.

Biologist – American Electric Power, Bonnyman-Softshell 138kV Transmission Line: 2011. Completed summer mist netting survey along 19.6-mile transmission line in Perry and Knott counties, Kentucky. Responsible for mist net site set up and habitat assessment, bat identification, morphometric processing, and implementation of White Nose Syndrome protocols.

Biologist – American Electric Power, Wyoming-Jackson's Ferry 765 kV Transmission Line: 2004-2009. Participated in mist net surveys at three wildlife mitigation ponds along transmission line ROW in Virginia.

Project Manager – Confidential Client, Wind Resource Area: 2010. Completed bat sampling, using mist netting and ground-based acoustic detectors, on site proposed to contain 100-130 wind turbines, in Montgomery and Boone counties, Indiana.

Project Manager – Confidential Client, Wind Resource Area: 2010. Completed summer mist netting and associated acoustic studies for endangered bats on 61,256-acre, 300-megawatt wind energy generation facility in Wells, Adams, Blackford, and Jay counties, Indiana. Contributing author to Habitat Conservation Plan including development of new and comprehensive technique of estimating take.

Biologist – Equitrans, Sunrise Pipeline: 2010. Completed Indiana bat summer mist net survey in Greene County, Pennsylvania, and Doddridge, Marion, Harrison, Taylor, and Wetzel counties, West Virginia.

Project Manager – Burr Oak Wind Resource Area: 2010. Completed desk-top analysis of bat impacts for proposed wind energy facility in Marshall and Fulton counties, Indiana.

Project Manager – Fayette Wind Resource Area: 2010. Completed desk-top analysis of bat impacts and phase II surveys for bat habitat for proposed wind energy facility in Fayette, Rush and Henry counties, Indiana.

Biologist – Duke Energy, Lawrenceburg Road Site: 2010. Completed summer mist net survey for federally endangered Indiana bat on 220-acre parcel near confluence of the Great Miami and Ohio rivers in Hamilton County, Ohio.

Biologist – Confidential Client: 2010. Prepared Protection and Enhancement Plan for federally endangered Indiana bats in partial mitigation for construction at mine in Greene County, Pennsylvania.

Biologist – Entergy, James A. FitzPatrick Nuclear Power Plant: 2009. Completed data analysis for Indiana bat habitat evaluation for expanding nuclear facility in Oswego County, New York. Coauthored technical report.

Biologist – Indiana Department of Transportation, SR 641 Bypass (Phases III and IV): 2009. Author for Biological Assessment to investigate effects along approximately six miles of proposed new roadway in Vigo County, Indiana.

Biologist – Metropolitan Sewer District of Greater Cincinnati, Mt. Airy Forest Sewer Replacement: 2009. Analyzed habitat quality measurements taken during surveys for federally endangered Indiana bat, cave salamander, hellbender, and running buffalo clover on 1469-acre urban forest in Hamilton County, Ohio.

Biologist – Confidential Client, Wind Resource Area: 2009. Completed technical report sections for endangered species studies and biological assessment at 84 windmill, 250-megawatt capacity wind farm on an island in the Great Lakes in Jefferson and Oswego counties, New York.

Biologist – Consol Pennsylvania Coal Company, Bailey Mine: 2009. Author for Biological Assessment to investigate effects of coal refuse disposal on Indiana bats. Responsible for analysis of effects of coal mining related to competition of Indiana bats to both other bats and conspecifics, effects of acid mine drainage, and groundwater.

Project Manager – The Conservation Fund: 2009-2010. Managed project involving multiple field teams to complete AnaBat studies across the eastern range of the Indiana bat in nine states. Studies include examination of species distribution in potentially impacted areas and forest condition surveys. Coordinate and oversee field work (including on-site visits to ensure sampling QA/QC), interpret collected data, and coordinate with client, resource agencies, and landowners.

Field Supervisor – AES Sparrows Point LNG Terminal and Mid-Atlantic Express Pipeline: 2009. Completed endangered bat surveys along the 88-mile Sparrows Point LNG Terminal and Mid-Atlantic Express Pipeline in Baltimore, Hartford, and Cecil counties, Maryland and Lancaster and Chester counties, Pennsylvania. Responsible for mist net site set up and habitat assessment, bat identification, morphometric processing and implementation of White Nose Syndrome protocols.

Research Scientist – Indianapolis International Airport: 1997-2009. Directed mitigation project for Sec. 7 and Sec. 10 (HCP) of ESA including conducting artificial roosts studies and directing mist-net and AnaBat surveys. Studies required extensive use of

radiotelemetry and coordination of mitigation activities with state, federal, and local agencies, directing field work, interviewing and hiring student workers, and preparing final reports. In addition, provided assistance to the airport on a variety of wildlife management issues ranging from crop deprivation to animal hazards at the airfield and on local roadways.

Project Manager – Interactions with Bats and Roadways: 2004-Present. Used combination of radio-telemetry data, direct field observation of bats crossing roads, and behavioral models in an effort to understand the impacts of roadways on bats.

Project Manager – Community Structure and Behavior of Small Mammals along Interstate Highways: 2007. Used Sherman live traps to capture small mammals in medians and along roadsides of Interstate 70 in eastern Illinois. Between trapping sessions, behavioral approaches were used to compare the perceived habitat quality between roadsides and medians. In this study area, highways provided high-quality habitat for a community of small mammals comparable with that found in local nature preserves.

Project Manager – Comparison of Traditional and Molecular Techniques to Estimate Summer Indiana Bat Colony Sizes: 2006-2008. Directed field work and conducted regular emergence counts at known roost trees of Indiana bats at least twice per week in effort to determine colony sizes. Results were used for further study and were compared with mark-recapture estimations obtained by developing and using DNA signatures of individual bats in manner similar to traditional mark-recapture analysis.

Project Manager – Food Resources of Bats across an Urban/Rural Gradient: 2005-2008. Supervised research project in which GIS was used to select points within landscape classes that were later sampled for insects. Captured insects were compared to those eaten by Indiana bats from this site and to the diets of other species in Indiana. Findings indicated urban areas provide sufficient food for bats; however, telemetry data indicated rare use of urban areas when rural habitats were available.

Project Manager – Nocturnal Habitat of the Eastern Red Bat (*Lasiurus borealis*) at an Urban/Rural Interface: 2003-2004. Supervised research project using radio-telemetry, and GIS to examine habitat selection by eastern pipistrelles near the Indianapolis Airport. Work resulted in the only published use of radio-telemetry to track free-ranging eastern red bats during migration.

Project Manager – Diet of Black and Turkey Vultures in a Forested Landscape. Directed research project involving identification of hair, scale, and bone fragments within pellets of black and turkey vultures. Data were then combined with movement data to inform Bird Avoidance Models.

Project Manager – Habitat Use by a Juvenile Hoary Bat at an Urban/Rural Interface: 2004. Used radio-telemetry and GIS techniques to provide insight into the behavior of a rarely captured species.

Project Manager – Nocturnal Habitat Selection by the Federally Endangered Indiana Bat (*Myotis sodalis*) at an Urban/Rural Interface: 2002. Used combination of radio-telemetry and GIS to examine Indiana bat habitat selection near the Indianapolis Airport.

Project Manager – Comparison of Habitat Selection by Big Brown and Evening Bats at the Indianapolis International Airport: 2001. Supervised research project involving use of radio-telemetry and GIS to compare habitats used by evening bats (a locally endangered species) and big brown bats (locally abundant) near the Indianapolis Airport. Published field data were the first to support the hypothesis that loss of foraging habitat is a primary cause of endangerment for bats.

Project Manager – Changes in Fish Community Structure along an Urban to Rural Gradient in an Indianapolis Stream: 2002. Completed fish sampling at 10 sites on multiple occasions to demonstrate changes in community structure (using Index of Biological Integrity and species richness).

Project Manager – Amphibians and Reptiles of the Indianapolis International Airport: 2001-2002. Completed reptile and amphibian surveys at the Indianapolis Airport using field observation techniques ranging from searching under debris to modified frog call routes to detect herps throughout an urban and rural matrix.

Research Associate – Sternberg Museum of Natural History: 1994-1996. Completed state-wide survey of bats of Kansas including capturing and preparing specimens, recruiting and directing volunteer field assistants, interacting with landowners, conducting public education programs, reexamining existing specimens, photographing bats, and preparing reports for publication. QMC Models 1 and 2 bat detectors were also used to detect echolocation signals.

Project Director – Indiana State University, Hardwood Ecosystem Experiment: 2006-2008. Initiated protocols for determining effects of timber harvest on bats and other species in Morgan-Monroe and Yellowwood State Forests. Completed mist netting surveys including net site reconnaissance, bat habitat assessments; mist net set-up, bat handling and identification, and AnaBat surveys. Also directed multiple research projects involving fish, herp, and insect surveys and several studies that examined wildlife response to highways.

Wildlife Technician – Kansas Department of Wildlife and Parks: 1994-1995. Aided in efforts to understand decline of ring-necked pheasant in Kansas. Sampled agricultural habitats for evidence of use by pheasants, song birds, and short-eared owls.

AmeriCorps Volunteer – USDA Natural Resources Conservation Service: 1995-1996. Provided assistance in Hays Kansas and surrounding area to help restore habitats damaged by historic floods in 1993.

Wildlife Technician – Kentucky Department of Fish and Wildlife Resources: 1993. Aided in efforts to reintroduce peregrine falcons in Kentucky including growth and behavior monitoring, general public and media liaison, and arranging for treatment and conducting first aid for injured falcons.

Wildlife Technician – USDA Forest Service: 1992. Completed surveys of federally-threatened northern spotted owls and several species of local conservation concern in the Pacific Northwest including: northern goshawks, red-legged frogs, and Townsend's big-eared bats.

Coordinator – Murray State University Student Chapter of The Wildlife Society Raptor Rehabilitation Center: 1991-1993. Supervised day-to-day operation of student-run rehabilitation center including supervising and training volunteers, administering first aid to injured birds, coordinating treatment with veterinarian, presenting public education programs, and coordinating education program at the National Museum of the Boy Scouts of America.

Wildlife Technician – U.S. Forest Service, McKenzie River District: 1992. Completed surveys for spotted owls, goshawks, Townsend's big eared bats, and red-legged frogs.

PUBLICATIONS

Oyler-McCance, S. J., J. A. Fike, P. M. Lukacs, D. W. Sparks, T. J. O'Shea, and J. O. Whitaker Jr. Tentatively Accepted. Using non-invasive fecal DNA to investigate colony dynamics of the endangered Indiana bat (*Myotis sodalis*).

Gonzalez-Olimon, G., J. R. St. Juliana, and D. W. Sparks. 2016. Highway medians and roadsides can support diverse small-mammal communities. *American Midland Naturalist*, 176:282-288.

Damm, J. P., D. W. Sparks, and J. O. Whitaker, Jr. 2016. Bat-species diversity at an urban-rural interface: dominance by one species in an urban area. *Urban Naturalist* 8:1-8.

Damm, J. P., D. W. Sparks, and J. O. Whitaker, Jr. 2014. Sex ratios of the big brown bat, *Eptesicus fuscus*, at an urban-rural interface. *Proceedings of the Indiana Academy of Science*, 123:43-48.

Brack, V., Jr., D. W. Sparks, and T. M. Pankiewicz. 2013. White noses and windmills and worms! Oh My! *Bat Research News*, 54:47-51.

Sheets, J. J., J. E. Duchamp, M. K. Caylor, L. D'Acunto, J. O. Whitaker Jr., V. Brack Jr., and D. W. Sparks. 2013. Habitat use by bats in two Indiana forests prior to silvicultural treatments for oak regeneration. Pages 203-217 *in* The Hardwood Ecosystem Experiment: a framework for studying responses to forest management (R. K. Swihart, M. R. Saunders, R. A. Kalb, G. S. Haulton, C. H. Michler, eds.) General Technical Report NRS-P-108. U.S. Department of Agriculture, Forest Service, Northern Research Station. Newtown Square, Pennsylvania.

Sheets, J. J., J. O. Whitaker Jr., V. Brack Jr., and D. W. Sparks. 2013. Bats of the hardwood ecosystem experiment before timber harvest: assessment and prognosis Pages 191-202 *in* The Hardwood Ecosystem Experiment: a framework for studying responses to forest management (R. K. Swihart, M. R. Saunders, R. A. Kalb, G. S. Haulton, C. H. Michler, eds.) General Technical Report NRS-P-108. U.S. Department of Agriculture, Forest Service, Northern Research Station. Newtown Square, Pennsylvania.

Bennett, V., D. W. Sparks, and P. A. Zollner. 2013. Modeling the indirect effects of road networks on the foraging activities of endangered bats. *Landscape Ecology* 28:1-13.

- Weber, T. C. and D. W. Sparks. 2013. Summer habitat identification of an endangered bat, *Myotis sodalis*, across its eastern range of the USA. *Journal of Conservation Planning* 9:53 – 68.
- Francl, K.E, T.K. Canniff, R.C. Bland, D. W. Sparks, V. Brack, Jr. 2012. Quantifying wing damage of summer bats in the northeastern United States. *Journal of the Pennsylvania Academy of Science* 86: 38-42.
- Francl, K. E., W. M. Ford, D. W. Sparks, and V. Brack, Jr. 2012. Capture and reproductive trends of summer bat communities in West Virginia: assessing the impact of white nose syndrome. *Journal of Fish and Wildlife Management* 3:33-42.
- Damm, J. P., K. R. Pearman, N. S. Gikas, D. W. Sparks, and J. O. Whitaker, Jr. 2011. Mammals of the Indianapolis International Airport conservation properties, Hendricks County, Indiana, *with* county records. *Proceedings of the Indiana Academy of Science* 120:96--103.
- Gikas, N. S., D. W. Sparks, J. O. Whitaker Jr., and J. S. Johnson. 2011. New ectoparasite records for bats in West Virginia and a review of previous records. *Northeastern Naturalist* 18:527–533.
- Sparks, D. W., K. Francl, and V. Brack, Jr. 2011. Indexing at different scales: A response to Reichard et al. *Journal of Wildlife Diseases* 47: 1052-1053.
- Timpone, J., K. Francl, D. W. Sparks, V. Brack, Jr., and J. Beverly. 2011. Bats of the Cumberland Plateau and Ridge and Valley Provinces, Virginia. *Southeastern Naturalist* 10:515-528.
- Francl, K., D. W. Sparks, V. Brack, Jr., and J. Timpone. 2011. White-nose syndrome and wing damage index scores among summer bats in the northeastern United States. *Journal of Wildlife Diseases* 47:41-48.
- Zurcher, A. A., D. W. Sparks, and V. J. Bennett. 2010. Why the bat did not cross the road. *Acta Chiroptologica*, 12:337-340.
- Judy, D. J., D. W. Sparks, J. O. Whitaker, Jr., and C. M Ritz. 2010. Unusual migratory behavior by an Indiana bat (*Myotis sodalis*). *Proceedings of the Indiana Academy of Science*, 119:99-100.
- Judy, D. J., D. W. Sparks, J. O. Whitaker, Jr., and S. Oyler-McCance. 2010. Bat guano is useful for more than diet studies. *Proceedings of the Indiana Academy of Science*, 119:95-98.
- Karns, D. R., D. G. Ruch, R. D. Brodman, J. S. Castrale, J. R. Gammon, P. E. Rothrock, D. W. Sparks, and J. R. Stahl. 2010. Results of a BioBlitz at Wesselman Woods Nature Preserve, Vanderburgh, County, Indiana. *Proceedings of the Indiana Academy of Science*, 119:4-6.
- Duchamp, J. E., D. W. Sparks, and R. K. Swihart. 2010. Exploring the nutrient hotspot hypothesis at trees used by bats. *Journal of Mammalogy*, 91:48-53.
- Sparks, D. W., V. Brack, Jr., J. O. Whitaker, Jr., and R. Lotspeich. 2009. Reconciliation ecology and the Indiana Bat at Indianapolis International Airport, Chapter 3. *In*

- Airports: Performance, Risks, and Problems, (P. B. Larauge and M. E. Castille, eds.) Nova Science Publishers, Inc., Hauppauge, New York.
- Sparks, D. W., 2008. Escape behavior of northern long-eared bats (*Myotis septentrionalis*) following diurnal disturbance. Proceedings of the Indiana Academy of Science, 117: 203-209.
- Whitaker, J. O., Jr., and D. W. Sparks. 2008. Roosts of Indiana bats (*Myotis sodalis*) near the Indianapolis International Airport (1997-2001). Proceedings of the Indiana Academy of Science, 117:193-202.
- Kelly, N. E., D. W. Sparks, T. L. DeVault, and O. E. Rhodes, Jr. 2007. Diet of black and turkey vultures in a forested landscape. Wilson Journal of Ornithology, 119:267-270.
- Krochmal, A. R. and D. W. Sparks. 2007. Timing of birth and estimation of age for juvenile *Myotis septentrionalis* and *Myotis lucifugus* from west-central Indiana. Journal of Mammalogy, 88:649-656.
- Walters, B. L., C. M. Ritzi, D. W. Sparks, and J. O. Whitaker, Jr. 2007. Foraging behavior of the eastern red bat (*Lasiurus borealis*) at an urban-rural interface. American Midland Naturalist, 157:365-373.
- Tuttle, N. M., D. P. Benson, and D. W. Sparks. 2006. Diet of *Myotis sodalis* (Indiana bat) at an Urban/Rural Interface. Northeastern Naturalist, 13:435-442.
- Whitaker, J. O., Jr., D. W. Sparks, and V. Brack, Jr. 2006. Use of artificial roost structures by bats at the Indianapolis International Airport. Environmental Management, 38:28-36.
- Walters, B. L., C. M. Ritzi, D. W. Sparks, and J. O. Whitaker, Jr. 2006. Timing of migration by eastern red bats (*Lasiurus borealis*) through central Indiana. Acta Chiroptologica, 8:259-263.
- Tuttle, N. M., D. W. Sparks, and C. M. Ritzi. 2005. Extralimital record of the gray bat (*Myotis grisescens*) in Indiana. Bat Research News, 46:147.
- Sparks, D. W., J. O. Whitaker, Jr, and C. M. Ritzi. 2005. Foraging ecology of the endangered Indiana bat. Pp 15-27 *In* Indiana Bats and Coal Mining, A Technical Interactive Forum (K. C. Vories and A. Harrington, eds). Office of Surface Mining, U.S. Department of the Interior, Alton, Illinois.
- Sparks, D. W., C. M. Ritzi, J. E. Duchamp, and J. O. Whitaker, Jr. 2005. Foraging habitat of the Indiana bat (*Myotis sodalis*) at an urban-rural interface. Journal of Mammalogy, 86:713-718.
- Sparks, D. W., C. M. Ritzi, and B. L. Everson. 2005. Nocturnal behavior and roosting ecology of a juvenile *Lasiurus cinereus* near Indianapolis, Indiana. Proceedings of the Indiana Academy of Science, 114:70-72.
- Ulrey, W. A., D. W. Sparks, and C. M. Ritzi. 2005. Bat communities in highly impacted areas: comparing Camp Atterbury to the Indianapolis Airport. Proceedings of the Indiana Academy of Science, 114:73-76.

- Ritzi, C. M., B. C. Bartells, and D. W. Sparks. 2005. Food habits and ectoparasites of Elliot's short-tailed shrew (*Blarina hylophaga*) from Kansas. *The Southwestern Naturalist*, 50:88-93.
- Whitaker, J. O., Jr., D. W. Sparks, and V. Brack, Jr. 2004. Bats of the Indianapolis International Airport Area, 1991-2001. *Proceedings of the Indiana Academy of Science* 113:151-161.
- Sparks, J. K. F., B. J. Foster, and D. W. Sparks. 2004. Utility pole used as a roost by a northern myotis, *Myotis septentrionalis*. *Bat Research News*, 45:94.
- Duchamp, J. E., D. W. Sparks, and J. O. Whitaker, Jr. 2004. Foraging-habitat selection by bats at an urban-rural interface: comparison between a successful and a less successful species. *Canadian Journal of Zoology*, 82:1157-1164.
- Ritzi, C. M., B. L. Everson, B. J. Foster, J. J. Sheets, and D. W. Sparks. 2004. Urban ichthyology: changes in the fish community along an urban-rural creek in Indiana. *Proceedings of the Indiana Academy of Science*, 113:42-52
- Foster, B. J., D. W. Sparks, and J. E. Duchamp. 2004. Urban Herpetology II: Amphibians and Reptiles of the Indianapolis International Airport Conservation Properties. *Proceedings of the Indiana Academy of Science*, 113:53-59.
- Foster, B. J., D. W. Sparks, and J. E. Duchamp. 2003. Urban Herpetology I: new distribution records of amphibians and reptiles from Hendricks County, Indiana. *Herpetological Review*, 34:395.
- Sparks, D. W., K. C. Chapman, and C. M. Ritzi. 2003. Additional ectoparasitic records of bats from Kansas. *Prairie Naturalist*, 35:49-52.
- Sparks, D. W., M. T. Simmons, C. L. Gummer, and J. E. Duchamp. 2003. Disturbance of roosting bats by woodpeckers and raccoons. *Northeastern Naturalist*, 10:105-108.
- Sparks, D. W., and E. W. Valdez. 2003. Food habits of *Nyctinomops macrotis* at a maternity roost in New Mexico, as indicated by analysis of guano. *Southwestern Naturalist*, 48:132-135
- Ritzi, C. M., and D. W. Sparks. 2002. New ectoparasite records for the rock squirrel (*Spermophilus variegatus grammurus*) in Socorro County, New Mexico. *Southwestern Entomologist*, 27:257-262.
- Ritzi, C. M., and E. W. Valdez, and D. W. Sparks. 2002. New host and locality records of bat ectoparasites from Arizona and New Mexico. *The Southwestern Naturalist*, 47:453-456.
- Sparks, D. W., and J. R. Choate. 2000. Distribution, natural history, conservation status, and biogeography of bats in Kansas. Pp: 173-228 *In Reflections of a naturalist: papers honoring professor Eugene D. Fleharty* (J. R. Choate, ed.), Fort Hays Studies, Special Issue 1: 1-241.
- Sparks, D. W., K. J. Roberts, and C. Jones. 2000. Vertebrate predators on bats in North America North of Mexico. Pp: 229-241 *In Reflections of a naturalist:*

papers honoring professor Eugene D. Fleharty (J. R. Choate, ed.), Fort Hays Studies, Special Issue 1: 1-241.

- Sparks, D. W., A. G. Burr, M. N. Bass, and G. A. Liggett. 1999. New county distribution records of amphibians and reptiles from southwestern Kansas. *Herpetological Review*, 30:120-121.
- Sparks, D. W., J. R. Choate, and R. J. Winn. 1999. Observations on reproduction in three species of bats. *The Prairie Naturalist*, 31:245-248.
- Sparks, D. W., J. A. Laborda, and J. O. Whitaker, Jr. 1998. Bats of the Indianapolis International Airport as compared to a more rural community of bats at Prairie Creek. *Proceedings of the Indiana Academy of Science*, 107:171-179.
- Sparks, D. W., and J. R. Choate. 1996. New distribution records of mammals from Kansas. *The Prairie Naturalist*, 27:185-192.
- Sparks, D. W., and J. R. Choate. 1995. Attempted predation on a short-tailed shrew by a common grackle. *The Kentucky Warbler*, 71:48.

EDUCATIONAL PUBLICATIONS

- Sparks, D. W., C. J. Schmidt, and J. R. Choate. 2011. Bats of Kansas. Publication Number 5, Indiana State University Center for North American Bat Research and Conservation. 62 pp.
- Brack, V. Jr., D. W. Sparks, J. O. Whitaker Jr., B. L. Walters, and A. Boyer. 2010. Bats of Ohio. *Occasional Papers of the Center for North American Bat Research and Conservation*, 4:1-92.
- Beilfuss, M., D. W. Sparks, and K. Henman. 2008. Echolocation (Can you tell where the sound is coming?). *The Hoosier Science Teacher*, 33:84-86.
- Whitaker, J. O., Jr., V. Brack, Jr, D. W. Sparks, J. B. Cope, and S. Johnson. 2007. Bats of Indiana. *Occasional Papers of the Center for North American Bat Research and Conservation*, 1:1-59.
- Beilfuss, M., D. W. Sparks, and K. Henman. 2007. The Indiana Bat. *The Hosier Science Teacher*, 32:69-71.

POSTER AND ORAL PRESENTATIONS

- Sparks, D. W. and V. Brack, Jr.: 2011. Lewisburg Mine, Preble County Ohio. Presented at 2013 Ohio Bat Working Group, December 9, Columbus Ohio.
- Sparks, D. W., V. Brack, Jr., K. Francl, J. Boyles. 2012. Will the evening bat (*Nycticeius humeralis*) become the dominant tree-roosting bat of the Midwest following White Nose Syndrome? Presented at the 42nd North American Symposium on Bat Research, October 24-27, San Juan, Puerto Rico.
- Sparks, D. W. and V. Brack, Jr.: 2011. Conservation and Management of Habitat for Maternity Colonies of the Indiana bat: Possibilities for Transportation Projects. Presented at 2011 International Conference on Ecology and Transportation: Sustainability in Motion. August 21-25, Seattle, Washington.

- Francl, K.E., J. Timpone, D. W. Sparks, and V. Brack, Jr. 2010. Tracking White-nose Syndrome in summer bat communities – spatial and temporal patterns in the eastern United States. Presented at joint meeting of the Virginia Chapters of The Wildlife Society and American Fisheries Society, Wirtz, VA.
- Carter, T. C. and D. W. Sparks. The future of bats and wind, the pending storm. Presented to Midwest Bat Working Group.
- Brack, V., Jr., D. W. Sparks, and J. O. Whitaker, Jr. 2009. Landscape Scale Movements of Maternity Colonies of the Indiana bat Through Time: Examples and Possibilities. Paper Presented To: National Military Fish and Wildlife Federation.
- Lebsack, W. A., and D. W. Sparks. 2008. Things that go bump in the night: nocturnal activity and information transfer of an Indiana bat colony. Poster Presented To: North American Bat Research Symposium and Indiana Academy of Science.
- Gonzalez-Olimon, G., J. R. St. Juliana, and D. W. Sparks. 2008. Small mammal communities along highways: species composition and behavior. Poster Presented To: American Society of Mammalogists.
- Gonzalez-Olimon, G., J. R. St. Juliana, W. A. Mitchell, and D. W. Sparks. 2007. Small mammal antipredator behavior in highway triangles, medians, and road sides in selected areas in Terre Haute, IN. Poster Presented To: Indiana Academy of Science.
- Farrell Sparks, J. K., D. W. Sparks, and V. Brack, Jr. 2007. Utility poles as bat roosts. Poster Presented to: American Society of Mammalogists.
- Tuttle, N. M. and D. W. Sparks. 2007. Indiana bats may be avoiding urban habitats for reasons other than prey availability. Poster Presented to: American Society of Mammalogists and American Society of Mammalogists (2006).
- Sheets, J. J. D. W. Sparks, V. Brack, Jr., and J. O. Whitaker, Jr. 2007. Bats of Indiana State Forests. Poster Presented To: American Society of Mammalogists.
- Helms, J. S., D. W. Sparks, and J. O. Whitaker, Jr. 2007 Nocturnal behavior and roosting ecology of *Perimyotis subflavus* (Eastern Pipistrelle) near Indianapolis International Airport. Poster Presented To: American Society of Mammalogists, Indiana Academy of Science (2006), and North American Bat Research Symposium (2006)
- Judy, D. J., D. W. Sparks, and J. O. Whitaker. 2006. Obtaining fecal samples under Indiana bat roosts: a word of caution. Poster Presented to: American Society of Mammalogists.
- Sparks, D. W., C. M. Ritzi, and B. L. Everson. 2005. Nocturnal Behavior and Roosting Ecology of a juvenile *Lasiurus cinereus* near Indianapolis, Indiana. Poster Presented to: American Society of Mammalogists.
- Tuttle, N. M., D. P. Benson, and D. W. Sparks. 2005. Diet of the endangered Indiana bat at an urban/rural interface near Indianapolis, Indiana. Poster Presented to: American Society of Mammalogists.

- Everson., B. L., C. M. Ritzi, Sparks, D. W., and J. O. Whitaker, Jr. 2005. Foraging behavior of eastern red bats in central Indiana. Poster Presented to: American Society of Mammalogists.
- Kelly, N. E., D. W. Sparks, T. L. DeVault, and O. E. Rhodes, Jr. 2005. Diet of black and turkey vultures in a forested landscape. Poster Presented to: Indiana Academy of Science.
- Sparks, D. W. and J. O. Whitaker, Jr. 2004. Batboxes and Indiana bats a conundrum. Poster Presented to: Midwest Fish and Wildlife Conference.
- Everson., B. L., C. M. Ritzi, Sparks, D. W., and J. O. Whitaker, Jr. 2004. Foraging behavior of eastern red bats in central Indiana. Poster Presented to: Indiana Academy of Science.
- Sparks, D. W. and J. O. Whitaker, Jr. 2004. Why batboxes are not the answer for managing Indiana bats. Poster Presented to: Indiana Academy of Science.
- Tuttle, N. M. J. O. Whitaker, Jr., D. P. Benson, and D. W. Sparks. 2004. Food habits of Indiana bats at the Indianapolis International Airport. Poster Presented to: Indiana Academy of Science.
- Everson., B. L., C. M. Ritzi, Sparks, D. W., and J. O. Whitaker, Jr. 2004. Foraging behavior of eastern red bats in central Indiana. Poster Presented to: Indiana Academy of Science.
- Sparks, D. W., and E. W. Valdez. 2001. Food habits of *Nyctinomops macrotis* as indicated by analysis of guano. Poster presented to: Southwestern Association of Naturalists.
- Valdez, E. W. and D. W. Sparks. 2001. Food habits of the western small-footed myotis (*Myotis ciliolabrum*) in New Mexico. Poster presented to: Southwestern Association of Naturalists.
- Sparks, D. W., and J. A. Laborda. 1999. Orientation of northern myotis (*Myotis septentrionalis*) following release in daytime. Poster presented to: North American Bat Research Symposia and American Society of Mammalogists.
- Zurcher, A. A., D. W. Sparks, and V. J. Bennett. 2008. Why the bat did not cross the road. Paper Presented To: Indiana Academy of Science.
- Gikas, N. S, W. A. Lebsack, and D. W. Sparks. 2008. Information sharing about roosting areas by Indiana bats (*Myotis sodalis*). Paper Presented To: Indiana Academy of Science.
- Gonzalez-Olimon, G., J. R. St. Juliana, and D. W. Sparks. 2008. Small mammal communities along highways: species composition and behavior. Paper Presented To: Indiana Academy of Science.
- Helms, J. S., D. W. Sparks, and J. O. Whitaker, Jr. 2008. Nocturnal behavior and roosting ecology of *Perimyotis subflavus* (Eastern Pipistrelle) near Indianapolis International Airport. Paper Presented To: American Society of Mammalogists.

- McGuire, M. A., D. W. Sparks, Virgil Brack, Jr., and John O. Whitaker, Jr. 2007. Indiana bats and roadways: size does matter. Presented to: Indiana Academy of Science.
- Sparks, D. W., M. A. McGuire, Virgil Brack, Jr., and John O. Whitaker, Jr. 2007. Indiana bats and roadways: size does matter. Presented to: American Society of Mammalogists.
- Sparks, D. W., B. J. Foster, and J. K. F. Sparks. 2006. Roosting ecology and colony dynamics of northern myotis (*Myotis septentrionalis*) in a managed forest. Presented to: Indiana Academy of Science and American Society of Mammalogists.
- Boyles, J. G., D. J. Judy, D.W. Sparks, and G. S. Bakken. 2006. Seasonal changes in thermal conductance of fur in small mammals. Presented to: American Society of Mammalogists.
- Tuttle, N. M. and D. W. Sparks. 2006. Indiana bats may be avoiding urban habitats for reasons other than prey availability. Presented to: Indiana Academy of Science.
- Judy, D. J., D. W. Sparks, and J. O. Whitaker, Jr. 2005. Obtaining fecal samples under Indiana bat roosts: a word of caution. Presented to: Indiana Academy of Science.
- Bast, M. D., M. S. Burt, . DW. Sparks. 2005. Prey selection within a Southeastern Missouri Bat Community. Presented to: Truman State University Research Showcase.
- Sparks, D. W., C. M. Ritzi, and J. O. Whitaker, Jr. 2004. What do Indiana myotis do when they lose a roost. Presented to: American Society of Mammalogists.
- Sparks, D. W., C. M. Ritzi., B. L. Everson. 2003. The Indiana bat as an umbrella species for wildlife near Indianapolis. Presented to: Indiana Academy of Science.
- Everson., B. L., C. M. Ritzi, Sparks, D. W., and J. O. Whitaker, Jr. 2003. Foraging behavior of eastern red bats, *Lasiurus borealis*, in central Indiana. Presented to: Indiana Academy of Science.
- Sparks, D. W., C. M. Ritzi, Joseph E. Duchamp, and J. O. Whitaker, Jr. 2003. Foraging ecology of the Indiana myotis at the Indianapolis International Airport. Presented to: American Society of Mammalogists
- Sheets, J. J., C. M. Ritzi., B. L. Everson, B. J. Foster, S. S. Nard, and D. W. Sparks. 2002. Fishes of the Indianapolis International Airport, Marion and Hendricks Counties, Indiana. Presented to: Indiana Academy of Science.
- Everson, B. L., Sparks, D. W., C. M. Ritzi., and J. E. Duchamp. 2002. Foraging behavior of Indiana bats at the Indianapolis International Airport. Presented to: Indiana Academy of Science.
- Nard, S. S., B. J. Foster, Sparks, D. W., and J. E. Duchamp. 2002. Urban Herpetology: Amphibians and Reptiles of the Indianapolis International Airport. Presented to: Indiana Academy of Science.

- Sparks, D. W., J. E. Duchamp, and C. M. Ritzi. 2002. Comparison of the roosting ecology of *Myotis septentrionalis* and *Nycticeius humeralis*. Presented to: American Society of Mammalogists
- Duchamp, J. and D. W. Sparks. 2002. Movement across a rural/suburban gradient, a comparison of foraging in *Nycticeius humeralis* and *Eptesicus fuscus*. Presented to: American Society of Mammalogists
- Sparks, D. W., J. E. Duchamp, and C. M. Ritzi. 2001. Do cavity-roosting bats partition roosts? Presented to: Indiana State University Graduate/Undergraduate Research Showcase.
- Sparks, D. W., A. R. Krochmal, and W. A. Mitchell. 2001. Comparison of the reproductive biology of the northern myotis (*Myotis septentrionalis*) and the little brown myotis (*Myotis lucifugus*) in Indiana. Presented to: Indiana Academy of Science.
- Duchamp, J. and D. W. Sparks. 2001. Habitat preference of the evening bat, *Nycticeius humeralis*, in a developing urban area. Presented to: Indiana Academy of Science.
- Farrell, J. K., B. J. Foster, and D. W. Sparks. 2001. Roosting habitat of the northern myotis *Myotis septentrionalis* at the Indianapolis International Airport. Presented to: Southwestern Association of Naturalists and Indiana State University Graduate/Undergraduate Research Showcase.
- Sparks, D. W., and A. R. Krochmal. 2001. Evidence for geographic variation in birth size of *Myotis lucifugus*. Presented to: Indiana State University Graduate/Undergraduate Research Showcase.
- Sparks, D. W., and A. R. Krochmal. 2000. Growth and Development of (*Myotis lucifugus*) in Poland, Indiana. Presented to: North American Bat Research Symposia.
- Farrell, J. K., D. W. Sparks, and B. J. Foster. 2000. Vegetation surrounding the roosts of *Myotis septentrionalis*—a preliminary analysis. Presented to: Indiana Academy of Science.
- Sparks, D. W., and A. R. Krochmal. 2000. Development of (*Myotis lucifugus*) in Poland, Indiana with comments on geographic variation. Presented to: Indiana Academy of Science.
- Sparks, D. W., B. J. Foster, and J. O. Whitaker, Jr. 1999. Behavioral correlates of swarming bats. Presented to: American Society of Mammalogists
- Farrell, J. K., D. W. Sparks, and J. A. Laborda. 2000. Preliminary analysis of the vegetation surrounding the roosts of *Myotis septentrionalis*. Presented to: Indiana State University Graduate/Undergraduate Research Showcase. Winner (JKF): Outstanding Undergraduate Presentation (Science).
- Sparks, D. W., T. S. Crowe, and A. R. Krochmal. 2000. Patterns of growth and development of little brown myotis (*Myotis lucifugus*) at Poland, Indiana.

Presented to: Indiana State University Graduate/Undergraduate Research Showcase.

- Sparks, D. W., B. J. Foster, and J. O. Whitaker, Jr. 1999. Notes on bats swarming at Copperhead Cave. Presented to: Indiana Academy of Science.
- Sparks, D. W., J. A. Laborda, and P. A. Zollner. 1998. Orientation of northern myotis following release in daytime. Presented to: Indiana State University Graduate/Undergraduate Research Showcase.
- Sparks, D. W., J. A. Laborda, and P. A. Zollner. 1998. Orientation of northern myotis following release in daytime. Presented to: Indiana Academy of Science.
- Sparks, D. W., and J. R. Choate. 1998. Impacts of settlement on three species of bats in status of bats in Kansas. Presented to: American Society of Mammalogists and Indiana State University Graduate/Undergraduate Research Showcase.
- Sparks, D. W., and J. R. Choate. 1997. Impacts of settlement on the distribution and conservation status of bats in Kansas. Presented to: Indiana Academy of Sciences
- Sparks, D. W., and J. R. Choate. 1995. Preliminary notes on the distribution and biogeography of bats in Kansas. Presented to: American Society of Mammalogists.
- Sparks, D. W., and J. R. Choate. 1995. Preliminary notes on the distribution and biogeography of bats in Kansas. Presented to: Southwestern Association of Naturalists.
- Sparks, D. W. 2008. Demography of the endangered Indiana bat. Presented to: USFWS Indiana Bat Demographic Model Rapid Prototyping and Structured Decision Making Workshop, National Conservation Training Center.
- Sparks, D. W. 2007. How Biologists Use Museum Specimens. Presented to: Department of Forestry and Natural Resources, Purdue University.
- Sparks, D. W. 2007. Indiana Bats and Urbanization—Lessons Learned at the Indianapolis International Airport. Presented to: Department of Forestry and Natural Resources, Purdue University and Center for Urban and Environmental Change, Indiana State University, Department of Geography, Geology, and Anthropology.
- Sparks, D. W. 2006. Over-view of the Indianapolis Airport Project: What is the Benefit of Research for the Regulated? Presented to American Association of State Transportation Officials workshop on Indiana Bats.
- Sparks, D. W. 2005. Landscape ecology of the endangered Indiana bat. Presented to: Indiana Bat Survival Workshop, National Conservation Training Center.
- Sparks, D. W. 2005. Natural history of the endangered Indiana bat. Presented to: Indiana Bat Survival Workshop, National Conservation Training Center.

- Sparks, D. W., J. O. Whitaker, Jr, and C. M. Ritz. 2004. Foraging ecology of the endangered Indiana bat. Presented to: Indiana Bats and Coal Mining, An Interactive Technical Forum.
- Sparks, D. W. 2004. Bats and Urbanization Near Indianapolis, Indiana. Presented to: Murray State University Wildlife and Fisheries Society.
- Sparks, D. W. C. M. Ritz, and J. O. Whitaker, Jr. 2004. Managing a forest bat in the suburban jungle: conserving the Indiana myotis near Indianapolis. Presented to: Second Bats and Forest Symposium (Section on Managing Indiana Bats).
- Sparks, D. W. 2003. How does urbanization impact bats? Presented as: Sternberg Museum Lecture Series.
- Sparks, D. W. , and T. P. Simon. 2002. Managing small collections. Presented to: Indiana Academy of Science.
- Sparks, D. W. 2002. Reproductive biology of the northern myotis. Presented to: Department of Life Sciences, Indiana State University.
- Sparks, D. W. 2000. Copulation, growth, development, and roosting ecology of the northern myotis, *Myotis septentrionalis*. Presented to: Ball State University Student Wildlife Society.
- Sparks, D. W. 1998. Distribution, conservation status, and historical biogeography of bats in Kansas. Presented to: Department of Life Sciences, Indiana State University.
- Sparks, D. W. 1998. Orientation of northern myotis, *Myotis septentrionalis*, following release in Daytime. Presented to: Department of Biology, Fort Hays State University.

PROFESSIONAL AFFILIATIONS

American Society of Mammalogists, Life member
Southwestern Association of Naturalists, 1994
Society for Conservation Biology, 1996-2006
The Wildlife Society, 2000-Present



ENVIRONMENTAL SOLUTIONS & INNOVATIONS, INC.

Résumé

Robert P. Jean, Ph.D.

EDUCATION

Ph.D., Ecology/Entomology, Indiana State University, 2010. Dissertation: “Studies in bee diversity in Indiana: the influence of collection methods on species capture, and a state checklist based on museum collections”

M.A., Ecology, Indiana State University, 2002. Thesis: “The pollinator fauna of two spring wildflowers of Midwestern deciduous forest, *Erigenia bulbosa* and *Claytonia virginica*”

B.S., Life Sciences, Indiana State University, 1998

A.S., Biological Education, Lake Land College, 1995

PROFESSIONAL CERTIFICATIONS

NEPA Refresher Course, INDOT, 2017

Bat Investigations for Field Personnel, INDOT University, 2016

National Environmental Policy Act (Initial Training), INDOT University, 2016

National Environmental Policy Act (NEPA) – Categorical Exclusion Course, INDOT and FHWA, 2016

Metals Stabilization: Concept to Completion, MSECA

Incremental Sampling Method, MSECA

Manufactured Gas Plant Coal Tar Remediation, MSECA

QUALIFICATIONS AND EXPERIENCE

Dr. Jean is an authority in pollination biology, a specialty requiring proficiency in both plant and insect identification. The focus of his studies includes bees, their habitat, and their relationships to various plant species. Over the last fifteen years, he has become a recognized expert in the identification and taxonomy of bees, with particular emphasis on species of the eastern U.S. He frequently designs and implements survey protocols and is currently advising several state agencies and the U.S. Fish and Wildlife Service on appropriate survey protocols for the endangered rusty patched bumble bee (*Bombus affinis*) and he holds a federal recovery permit for the species. He routinely conducts workshops on native bees and how to attract them. His credentials include assisting with development of matrix-driven bee genus and species identification guides, a teaching tool available for use on the internet. Over the course of his career, Dr. Jean collected, observed, identified, and processed well over 100,000 pollinators including numerous listed species: more than 50 rusty patched bumble bees; 100 regal fritillaries (*Speyeria idalia*); 3 karner blue butterflies (*Lycaeides melissa samuelis*); and hundreds of individuals in the bee genus *Hylaeus*. Additionally he holds a federal permit for karner blue butterfly and Mitchell’s Satyr butterfly (*Neonympha mitchelli mitchelli*).

Much of Dr. Jean’s botanical experience centers on surveying rare plant communities such as prairies, glades, barrens, black oak savannas, dunes, and deciduous forests, and the rare plants found within them. On multiple occasions during his tenure at the Missouri Department of Conservation and Indiana Dunes National Lakeshore, Dr. Jean located

previously unknown populations of rare plants. His broad experience with rare plants includes such species as eastern and western fringed prairie orchid, Virginia sneezeweed (*Helenium virginicum*), Missouri bladderpod (*Lesquerella filiformis*), Mead's milkweed (*Asclepias meadii*), decurrent false aster (*Boltonia decurrens*), and many *Trillium* species. Concurrent with plant surveys, Dr. Jean collects data on forests throughout the U.S., documenting tree species, invasive species cover, and suggesting management regimes designed to achieve a variety of goals ranging from wildlife habitat to aesthetic beauty. His expertise also encompasses addressing invasive plant management concerns including identification and management plan development, implementation, and monitoring.

In addition to pollinators and plant species, Dr. Jean's experience also includes the federally endangered American burying beetle (*Nicrophorus americanus*) and he holds a federal recovery permit for the species. He completed a four-year study for American burying beetle at multiple sites in western Missouri in an attempt to locate populations of this species, as well as document the presence and local abundance of other species of Silphidae, including other burying beetles. He designed a four-year monitoring program, prepared annual reports, and identified over 120,000 insects collected in traps. In 2006, he introduced over 100 pairs of American burying beetles to Waterloo Wildlife Area in Ohio. As part of this project, he handled, sexed, matched pairs by size, attached bee tags for later identification, and appropriately transported the beetles from the St. Louis Zoo to the wildlife area.

Dr. Jean is an experienced public speaker, having taught university-level courses, presented educational lectures to the public, and presented technical papers to professional organizations. He also authored and co-authored numerous papers and presentations.

PROJECT EXPERIENCE

Project Manager – Michigan State University, Bee Identifications: 2015-Present. Lead insect taxonomic consultant for bees on project entitled "Integrating Native Bees into Sustainable Pollination Strategies for Specialty Crops". Project examines pollinators to specialty crops such as cranberries, blueberries, apples, watermelon, and almonds throughout the U.S., including California, Michigan, Maine, Pennsylvania, and Florida. Examined and identified all taxa of bees (Hymenoptera: Apoidea). Additionally, served as liaison between project team and other taxonomists with specialties for species that are among the most challenging to identify. The project is part of a five-year, multimillion dollar USDA-NIFA SCRI grant; and is leading to numerous scientific publications and public outreach on pollinator importance and crop production and pollination.

Project Manager – Pennsylvania State University, Bee Identifications: 2015-Present. Lead insect taxonomist on project researching Andrenid bees in Pennsylvania. Provided identifications on over 4,000 bees in the genus *Andrena*. Documented and verified at least three bee species previously undocumented in Pennsylvania. Identifications will advance knowledge of bees pollinating apple orchards in Pennsylvania, and of diversity of bees in general. These findings will be published and identifications will be used in future publications and to correct identification errors in past publications. In addition, all

specimens were labeled with determination labels comprising a valuable natural history collection for Pennsylvania.

Team Lead – Lake States Forest Management Habitat Conservation Plan (HCP): 2016. Provided consultation on rare, threatened, and endangered insects, in particular the rusty patched bumble bee, and implication for HCP.

Taxonomic Consultant – Center for Native Grassland Management, Bee Identifications: 2016. Provided identification and databasing of approximately 5,250 bees (Hymenoptera: Apoidea) from Pennsylvania, Tennessee, and Kansas. Identifications are being used to determine the effects of biofuel grasses on pollinator communities.

Taxonomic Consultant – University of Maine, Bee Identifications: 2016. Provided identification of approximately 2000 bees (Hymenoptera: Apoidea).

Team Lead – Confidential Client, HCP: 2016. Researched habitat requirements and status of rare, threatened, and endangered plants and insects for inclusion or exclusion of HCP.

Team Leader – Indiana Academy of Sciences, Goose Pond Fish and Wildlife Area Bioblitz, Greene County, Indiana: 2016. Team lead for bees. Collected, identified, and databased approximately 500 specimens. Paper in press.

Team Leader – Reconnecting Our Waterways, Indianapolis Urban Bioblitz, Marion County, Indiana: 2016. Team lead for bees. Collected, identified, and databased approximately 100 specimens. Paper in press.

Team Leader/Field Supervisor – Dominion, Atlantic Coast Pipeline: 2016. Desktop evaluation, field habitat assessments (i.e., walkthroughs), and surveys for suitable habitat to support multiple taxa in the George Washington National Forest along proposed pipeline route in Virginia. Seven dragonflies and damselflies; three beetles; and nineteen butterfly, skipper, and moth species were identified for study. Surveys resulted in discovery of rare Maureen's Minute moss beetle (*Hydraena maureenae*) and potentially adds two new county records for this species. Authored forester sensitive insect report for client.

Project Manager – NatureServe / Indiana Department of Natural Resources, Botanical Survey: 2016. Completed surveys for American ginseng at 18 sites in Indiana. Mapped populations, collected DNA samples from individuals, and wrote report.

Wetland Delineator – UTI, Oregon Lateral: 2016. Completed aquatic resource delineation, sampled vegetation, and evaluated areas near water withdrawal for potential wetlands.

Project Manager – EQT, Equitrans Expansion Project: 2015-2016. Completed rare, threatened, and endangered plant surveys in Pennsylvania and West Virginia. Two-hundred ninety species belonging to 82 plant families and 213 genera were identified.

Biologist – MVP, Mountain Valley Pipeline: 2015-2016. Completed rare plant surveys with focus on pinnate-lobed coneflower along proposed 300-mile long natural gas pipeline traversing 17 counties in Virginia and West Virginia. Specifically addressed all federal and state listed plants, as well as St. Francis's Satyr.

Biologist – American Electric Power, Bland Area Improvement: 2015-2016. Completed rare plant surveys with focus on rock skullcap along 7-mile 138 kV transmission rebuild project in Bland and Wythe counties, Virginia and Mercer County, West Virginia. Authored section of Biological Assessment and Biological Evaluation for plants and insects.

Biologist – Energy Transfer Partners, Revolution Pipeline: 2015. Completed rare plant surveys and wetland delineations for proposed 40-mile, 30-inch diameter pipeline traversing Butler, Beaver, and Washington counties in Pennsylvania.

Biologist – Eureka Hunter Pipeline, Multiple Pipeline Projects: 2015 Completed wetland delineations along three segments (Pyles-Miller-Pitman, Moser, and Stadler) of a natural gas pipeline in Ohio.

Biologist – Indiana Department of Transportation, Interstate 69, Pre- and Post-construction Surveys: 2015. Completed acoustic surveys for federally endangered Indiana and federally threatened northern long-eared bats along final ROW for Section 3, and potential ROW for section 6.

Team Leader – The Nature Conservancy, et al., Kankakee Sands and Conrad Savanna Bioblitz, Newton County, Indiana: 2012. Team lead for bees. Collected, processed, identified, and databased approximately 500 specimens. Produced several new county records.

Biologist – St. Mary-of-the-Woods, Pollinator Monitoring Program: 2011-2013. Collected, processed, identified, and databased approximately 1,000 bees.

Team Leader – Indiana Academy of Sciences, Goose Pond Fish and Wildlife Area Bioblitz, Greene County, Indiana: 2010. Team lead for bees. Collected, identified, and databased approximately 1000 specimens. Paper published.

Field Ecologist/Entomologist – U.S. Geologic Survey, Indiana Dunes National Lakeshore: 2010. Completed research on the pollination web at Howe's Prairie in Porter County, Indiana. Inventoried both plant and bee communities of the park and set up monitoring program for pollinators including Karner Blue butterflies. Assisted with design and implementation of studies. Collected approximately 5,000 bee specimens and prepared specimens and pollen for identification. Identified and databased all plant and bee specimens. Also completed plant and pollinator inventory focused on pitcher plants and yellow and pink lady slipper orchids at Pinhook Bog.

Biologist – The Nature Conservancy: 2009. Completed inventory of flowering plants and pollinators on the Four Canyons Natural Area in Ellis County, Oklahoma. Two new bee species were collected during the study.

Biologist – Equitrans, Big Sandy Pipeline: 2007. Completed Indiana bat potential roost tree and habitat assessments in Carter, Lawrence, Johnson, and Floyd counties, Kentucky.

Assistant Natural History Biologist – Missouri Department of Conservation: 2006-2009. Sampled for rare plant and insect species using aerial nets, pan traps, and vane traps in multiple natural and conservation areas in Missouri. Preserved, pinned, labeled, and identified approximately 8,000 insects. Developed sampling regime and database for specimens. Also completed surveys focused on federally threatened Meads milkweed,

western prairie fringed orchid, and Missouri bladderpod. Participated in greater prairie chicken release.

Field Researcher – St. Louis Zoo: 2006-2009. Sampled for carrion beetles including federally endangered American burying beetle (*Nicrophorus americanus*) in multiple conservation areas in Missouri. Completed sampling using pit fall traps and blacklights. Designed four-year monitoring program, prepared annual reports and identified over 120,000 insects collected in traps. Sampling for ABB attracted other beetle species including dung beetles, hide beetles, tiger beetles, and rove beetles. All were tallied and identified.

Assistant Natural History Biologist – Missouri Department of Conservation: 2006-2009. Completed rare plant and insect inventories on Wahkontah Prairie in St. Clair and Cedar counties, Missouri. Surveys focused on pollinators, plant-insect interactions, and federally threatened Mead's milkweed.

Field Researcher – St. Louis Zoo: 2006-2009. Completed insect inventories on WahKonTah Prairie in St. Clair and Cedar counties, Missouri. Surveys focused on federally endangered American burying beetle.

Assistant Natural History Biologist – Missouri Department of Conservation: 2006, 2008-2009. Completed rare plant and insect surveys on Linscomb Wildlife Area, Taberville Prairie Conservation Area, and Schell-Osage Conservation Area (2006 only) in St. Clair County, Missouri. Surveys focused on pollinators and plant-insect interactions.

Field Researcher – St. Louis Zoo: 2006, 2008-2009. Completed insect surveys on Linscomb Wildlife Area, Taberville Prairie Conservation Area, and Schell-Osage Conservation Area (2006 only) in St. Clair County, Missouri. Surveys focused on federally endangered American burying beetle.

Assistant Natural History Biologist – Missouri Department of Conservation: 2006, 2008-2009. Completed rare plant and insect surveys on Sky Prairie and Monegaw Prairie Conservation Areas in Cedar County, Missouri. Surveys focused on pollinators and plant-insect interactions.

Field Researcher – St. Louis Zoo: 2006, 2008-2009. Completed insect surveys on Sky Prairie and Monegaw Prairie Conservation Areas in Cedar County, Missouri. Surveys focused on federally endangered American burying beetle.

Assistant Natural History Biologist – Missouri Department of Conservation: 2006, 2008. Completed rare plant and insect surveys on Osage Prairie in Vernon County, Missouri. Surveys focused on pollinators and plant-insect interactions.

Field Researcher – St. Louis Zoo: 2006, 2008. Completed insect surveys on Osage Prairie in Vernon County, Missouri. Surveys focused on federally endangered American burying beetle.

Assistant Natural History Biologist – Missouri Department of Conservation: 2006. Completed rare plant and insect surveys on Osage, Ripgut, and Stillwell Prairies in Vernon County, Missouri. Surveys focused on pollinators and plant-insect interactions.

Field Researcher – St. Louis Zoo: 2006. Completed insect surveys on Osage, Ripgut, and Stillwell Prairies in Vernon County, Missouri. Surveys focused on federally endangered American burying beetle.

Assistant Natural History Biologist – Missouri Department of Conservation: 2006. Completed rare plant and insect surveys on Rocky Barrens Conservation Area, Greene County, Missouri. Surveys focused on federally threatened Missouri bladderpod.

Assistant Natural History Biologist – Missouri Department of Conservation: 2006. Completed rare plant and insect surveys on Caney Mountain Conservation Area in Ozark County, Missouri. Surveys focused on pollinators and plant-insect interactions.

Field Researcher – St. Louis Zoo: 2006. Completed insect surveys on Caney Mountain Conservation Area in Ozark County, Missouri. Surveys focused on federally endangered American burying beetle.

Assistant Natural History Biologist– Missouri Department of Conservation: 2007. Completed rare plant and insect surveys on Grand Trace Conservation Area, Pawnee Prairie, Wayne-Helton Wildlife Area, and Dunn Ranch Prairie in Harrison County, Missouri. Surveys focused on pollinators and plant-insect interactions.

Field Researcher – St. Louis Zoo: 2007. Completed insect surveys on Grand Trace Conservation Area, Pawnee Prairie, Wayne-Helton Wildlife Area, and Dunn Ranch Prairie in Harrison County, Missouri. Surveys included federally endangered American burying beetle.

Biologist – Confidential Client: 2007. Completed survey for threatened or endangered plant species in association with proposed construction of ethanol plant in Clark County, Illinois.

Biologist – The Nature Conservancy: 2005. Completed inventory of savanna plants and pollinators on the Kitty Todd Nature Preserve and Oak Openings in Lucas County, Ohio.

Curator – Indiana State University: 2001-2008. Maintained insect collection of approximately 150,000 specimens. Preserved and pinned specimens. Maintained data base containing over 30,000 insect specimens for research purposes.

Curator – Indiana State University: 2006. Maintained mammal collection in the vertebrate collection. Identified, prepared, and catalogued specimens in university data base.

Biologist – Confidential Client: 2005. Performed emergence counts of bats at the Indianapolis Airport. Studies were conducted to help determine whether bats were using trees scheduled for removal in association with road development project near the airport.

Biologist – Smith Cemetery: 2002-2003. Completed multi-year survey to document prairie remnant persistence in Vermillion County, Indiana.

Biologist – Indiana Department of Natural Resources: 2002. Completed inventory for savanna species remnants at Jasper-Pulaski Fish & Wildlife Area in Jasper County, Indiana.

Biologist – Illinois Department of Natural Resources: 2001-2002. Completed plant and pollinator inventory on Hooper Branch Savanna in Kankakee County, Illinois. Studies focused on savanna dependent species such as goat's rue, lupine, etc.

Biologist – The Nature Conservancy: 2000-2002. Completed 3-year plant and pollinator inventory of Ober Savanna in Starke County, Indiana. Studies focused on savanna dependent species such as goat's rue, lupine, etc.

Biologist – The Nature Conservancy: 2000-2002. Completed 3-year plant and pollinator inventory of Prairie Border, NIPSCO Savanna, and Stoutsburg Savanna in Jasper County, Indiana. Studies focused on savanna dependent species such as goat's rue, lupine, etc.

Biologist – The Nature Conservancy: 2000-2002. Completed 3-year plant and pollinator inventory of Conrad Station Savanna in Newton County, Indiana. Studies focused on savanna dependent species such as goat's rue, lupine, etc.

Biologist – Completed research on pollination ecology of spring wildflowers in west-central Indiana forests: 1999-2001. Studies involved relationships between visitation rates and species richness of bees and flies that visit early spring wildflowers and size of the forest in which they occurred. Performed vegetation sampling and recorded phenology of flowering plants. Over 11,000 bees identified, prepared, catalogued, and entered in a database.

Biologist – Completed plant inventory on Kieweg Woods, Morris Landsbaum Woods, Riley Lock, and Jackson Schnyder Nature Preserve in Vigo County, Indiana: 1998-2002.

PUBLICATIONS

Jean, R.P. and S. Messer. In preparation. New county records for the rare Maureens Hydraenan Minute Moss Beetle (Hydraenidae: *Hydraena maureenae* Perkins, 1980) in Virginia, USA. Preparing to submit to Northeastern Naturalist.

Holland, J. and R. P. Jean. In preparation. Results of a biodiversity survey in Indianapolis, Marion County, Indiana. Preparing to submit to Proceedings of the Indiana Academy of Science.

Jean, R. P. and P. E. Scott. In preparation. Characterizing bee communities of Midwestern black oak savannas: a comparison of net and bowl-trap collections. Preparing to submit to Journal of the Kansas Entomological Society.

Jean, R. P., P. E. Scott, J. Ascher, and R. Grundel. In preparation The bees of Indiana. Preparing for submission to Journal of the Kansas Entomological Society.

Lettow, M. C., L. A. Brudvig, C. A. Bahlai, J. Gibbs, R. Jean., and D. A. Landis. Bee Community Responses to a Gradient of Oak Savanna Restoration. Submitted to Restoration Ecology December 2016.

Jennifer A. Selfridge, C. T. Frye, J. Gibbs, and R. Jean. The Bee Fauna of Inland Sand Dune Communities in Worcester County, Maryland. Submitted to Northeastern Naturalist March 2017.

Ruch, D., J. D. Holland, and R. P. Jean. Results of a biodiversity survey at Goose Pond Fish and Wildlife Area, Greene County, Indiana. Submitted to Proceedings of the Indiana Academy of Science January 2017. LeBuhn, G, S. Droege, E. Connor, B. Gemmill-Herren, R. P. Jean, S. Potts, G. Frankie, R. Minckley, D. Roubik, F.

- Parker, K. Wetherill, E. Kula. 2015. Evidence based conservation: reply to Tepedino et al. *Conservation Biology* 29(1): 283-285.
- Colla, S. R.J. S. Ascher, M. Arduser, J. Cane, M. Deyrup, S. Droege, J. Gibbs, T. Griswold, H. G. Hall, C. Henne, J. Neff, R. P. Jean, M. G. Rightmyer, C. Sheffield, M. Veit, and A. Wolf. 2012. Documenting Persistence of Most Eastern North American Bee Species (Hymenoptera: Apoidea: Anthophila) to 1990–2009. *Journal of the Kansas Entomological Society* 85 (1): 14-22.
- LeBuhn, G., S. Droege, E. Connor, B. Gemmill-Herren, R. P. Jean, S. Potts, G. Frankie, R. Minckley, D. Roubik, F. Parker, K. Wetherill, J. Cane, T. Griswold, E. Kula. 2012. Detecting insect pollinator declines on regional and global scales. *Conservation Biology* 27: 113-120.
- Karns, D. R., D. G. Ruch, B. Simpson, B. Feaster, L. Sterrenburg, A. Bellian, B. E. Fisher, D. Gorney, J. D. Holland, R. P. Jean, W. W. Jones, W. McCarty, W. N. McKnight, W. L. Murphy, S. Naestnik, L. P. Tedesco, and J. O. Whitaker, Jr. 2012. Results of a biodiversity survey at Goose Pond Fish and Wildlife Area, Greene County, Indiana. *Proceedings of the Indiana Academy of Science* 121 (1): 45-53.
- Grundel, R., K. J. Frohnapple, R. P. Jean, and N. B. Pavlovic. 2011. Effectiveness of bowl trapping and netting for inventory of a bee community. *Journal of the Kansas Entomological Society* 40 (2): 374-380.
- Grundel, R., R. P. Jean, K. J. Frohnapple, J. Gibbs, G. A. Glowacki, and N. B. Pavlovic. 2011. A Survey of Bees (Hymenoptera: Apoidea) of the Indiana Dunes and Northwest Indiana. *Journal of the Kansas Entomological Society* 84: 105-138.
- Grundel, R., R. P. Jean, K. R. Frohnapple, G. A. Glowacki, P. E. Scott, and N. B. Pavlovic. 2010. Floral and nesting resources, habitat structure, and fire influence bee distributions across an open-forest gradient. *Ecological Applications* 20(6): 1678-1692.
- Bioblitz of Goose Pond Fish and Wildlife Area, Greene County Indiana June 16-17 2010. Published online at <http://www.indianaacademyofscience.org/Events-Meetings/BioBlitz-Archive.aspx>
- Jean, R. P. 2005. Quantifying a rare event: Pollen theft by honey bees from bumble bees and other bees (Apoidea: Apidae, Megachilidae) foraging at flowers. *Journal of the Kansas Entomological Society* 78 (2): 172-175.

PRESENTATIONS

- 2017 How to attract native pollinators. Joint presentation with Stephanie Schuck. Indiana Academy of Science, Indianapolis, March 25.
- 2017 Native bees on the brink: An introduction to the bees of Indiana with an emphasis on rusty patched bumble bee. Indiana Department of Natural Resources, Turkey Run State Park, February 3.
- 2017 Native bees on the brink: An introduction to the bees of Indiana and how to attract them. Wabash Valley Audubon Society, Terre Haute, IN January 18.

- 2015 Native bees and their conservation. Wabash Valley Audubon Society, Terre Haute, IN, February 15.
- 2014 Native bees and how to attract them. Illinois State Beekeepers Association, Springfield IL, November 8.
- 2013 Presented workshop on bee identification for the ASPIRE team on Jan 19 in Gainesville, Florida. The ASPIRE team is a group of scientists (myself included) that have recently received a large grant to study the pollinators of many crop species across the U.S., how to manage native bees and attract them to agricultural areas and to develop public outreach to share the information we gain from these studies.
- 2013 The bees of Indiana and how to attract them. Purdue University, West Lafayette, IN.
- 2013 Bee management in forested systems, Tri-State Woodland Workshop in Southern IN.
- 2010 Bee diversity of black oak savanna remnants in Indiana. Natural Areas Conference Pollinator Symposium, Osage Beach, MO.
- 2008 Bee sampling methods and the differences between sampling with nets and pan traps. "Pollinator Conference: Information for Action." UMASS, Amherst, MA; Oct. 3-4. Can be viewed online at <http://www.millersriver.net/pollen/>
- 2005 The bees of Indiana with a focus on the bees of black oak savannas. Master Naturalist Program, Mt. Ayr, IN
- 2004 Inventorying biodiversity while restoration proceeds: native bee communities of black oak sand savannas "Restoration Ecology: current research and the future." The Wildlife Society, Bloomington, IN

INVITED BEE AND INSECT IDENTIFICATION WORKSHOPS

- 2016 "The bees of the Midwest and how to attract them", July 20; Purdue Extension, Kokomo, IN.
- 2016 "Native bees on the brink: how to attract native pollinators with native plants", June 11; Sustaining Nature and Your Land Day, Bloomington, IN.
- 2016 "Bee monitoring workshop" for the Missouri Department of Conservation; May 23, Cuivre River State Park, Troy, MO.
- 2016 "Native pollinators and forest management practices" for the Natural Resources Conservation Service and Clay County Soil & Water Conservation District, May 21, Terre Haute, IN.
- 2016 "An introduction to bee diversity and bee conservation status" for the National Association of Conservation Districts; January 13, Indianapolis, IN.
- 2015 "Native bees and their conservation", February 15; Wabash Valley Audubon Society, Terre Haute, IN.

- 2014 “Native bees and how to attract them”, November 8; Illinois State Beekeepers Association, Springfield IL.
- 2014 “Insect communities of tall grass prairies” for the Missouri Department of Conservation; July 21-25, Schell-Osage, El Dorado Springs, MO.
- 2013 “The bees of the Midwest”; Noon Optimist Club, Clinton, IN.
- 2013 “The bees of Indiana and how to attract them”; Purdue University, West Lafayette, IN.
- 2013 “Bee management in forested systems”; Tri-State Woodland Workshop in Southern Indiana.
- 2009 “How to identify insects in the Natural Communities of Missouri” for the Missouri Department of Conservation; July 20-23, Shaw Nature Preserve, Grays Summit, MO.
- 2009 Native Bee Identification, Ecology, Research and Monitoring; May 4-8; National Conservation Training Center, Shepherdstown, WV; Course CSP2225; 30 students; Co-instructors-Mike Arduser, Sam Droege, and Jason Gibbs.
- 2009 “How to catch and identify a bee”; February 9-13; Patuxent Wildlife Refuge, Beltsville, MD; 14 students; co-instructor-Sam Droege
- 2008 “How to catch and identify a bee”; December 1-5; Patuxent Wildlife Refuge, Beltsville, MD; 14 students; co-instructor-Sam Droege
- 2008 Native Bee Identification, Ecology, Research and Monitoring; March 24-28; National Conservation Training Center, Shepherdstown, WV; Course CSP2225; 14 students; co-instructor-Sam Droege.
- 2008 “How to catch and identify a bee”; February 4-8; Patuxent Wildlife Refuge, Beltsville, MD; 15 students; co-instructor-Sam Droege
- 2007 “How to catch and identify a bee”; December 10-14; Patuxent Wildlife Refuge, Beltsville, MD; 12 students; co-instructor-Sam Droege
- 2007 “How to catch and identify a bee”; April 16-20; Patuxent Wildlife Refuge, Beltsville, MD; 12 students; co-instructor-Sam Droege
- 2007 “How to catch and identify a bee”; February 5-9; Patuxent Wildlife Refuge, Beltsville, MD; 12 students; co-instructor-Sam Droege
- 2004 “How to identify the bees of Indiana: The Bee Workshop”, Indiana Academy of Science, Anderson, IN

PROFESSIONAL AFFILIATIONS

Ecological Society of America

Indiana Academy of Science

Midwestern States Environmental Consultants Association

Our Green Valley Alliance for Sustainability – Board Member 2011-2014 – Education Committee

TREES Inc. – Board Member 2012-2015 – Keep Terre Haute Beautiful Committee and
Big Trees Committee
Ouabache Land Conservancy – Board of Directors 2013-present
White Violet Center for Eco-Justice – Advisory Board 2015-present



ENVIRONMENTAL SOLUTIONS & INNOVATIONS, INC.

Résumé

Timothy J. Brust

EDUCATION

M.S., Biology/Herpetology, Marshall University, 2013

Master's Thesis: *The Dietary Preference of the Queen Snake (Regina septemvittata)*

B.S., Biology, concentration in Ecology, Virginia Military Institute, 2011

CERTIFICATIONS AND TRAINING

USFWS Eastern Massasauga Rattlesnake Surveyor List for Ohio

OSHA 10 Hour General Industry Safety Certification

PADI Open Water Diver Certification

Ohio Boater Education Certificate

QUALIFICATIONS AND EXPERIENCE

Mr. Brust assists with a variety of wildlife research and management activities including: fish, crayfish, aquatic invertebrates, mammals and herpetological surveys. He is federally permitted for eastern massasauga rattlesnake and experienced with implementation of various state and federal survey protocols. He holds an Indiana Scientific Collection License for reptiles and amphibians, including Blanding's and spotted turtles. His specialties include field collection, species handling, morphometric processing and identification, and data entry and analysis. Mr. Brust's field experience includes:

- Herpetology studies using drift fences, cover boards, funnel traps, hoop traps, dip netting, road search, palpation and eye shine. He is experienced handling venomous snakes including pit vipers, vipers and elapids and handling crocodylians, including the endangered American crocodile, American alligator, and spectacled caiman. His experience also includes habitat assessments and surveys for a variety of salamanders including the federally listed Cheat Mountain salamander.
- Ichthyology studies using electrofishing equipment and techniques (backpack units and boat shocking), hauling, loading, unloading, and driving boats, equipment set up and tear down
- Mammalogy studies using mist nets for bats and Sherman trap lines for small mammals, morphometric processing and data entry.
- Astacology studies using crayfish field collecting techniques.

Mr. Brust's professional field experience predominantly focuses on herpetology, specifically snakes and salamanders. He is an active member of the herpetological scientific community and currently involved in organizing and establishing a new Ohio chapter in the Midwest region of Partners for Amphibian and Reptile Conservation (PARC).

PROJECT EXPERIENCE

Field Supervisor – Dominion, Atlantic Coast Pipeline: 2015-2016. Completed herpetological surveys along portions of a 554-mile long natural gas transmission mainline and associated laterals in West Virginia and Virginia. Assessed habitat for potential breeding areas and conducted field surveys for state-listed eastern tiger and Mabee's salamander in Virginia. Led trapping efforts in suitable habitat areas and successfully trapped 33 juvenile tiger salamanders. Participated in surveys for federally listed Cheat Mountain salamander in West Virginia. Surveys were completed by turning over natural cover objects or walking trails on rainy nights and yielded two individuals. Additionally, contributed to surveys for green salamander, Roanoke logperch, freshwater mussels, and Neuse River waterdog. To date, captured 42 Neuse River waterdogs.

Biologist – EQT, Mountain Valley Pipeline: 2015-2016. Participated in surveys for multiple terrestrial and aquatic species along a 300-mile long natural gas pipeline traversing twelve counties in West Virginia and six counties in Virginia. Tasks included freshwater mussel habitat assessments and field surveys, bat mist netting and radio telemetry, and bog turtle habitat assessments and field surveys.

Biologist – Spectra Energy, NEXUS Gas Transmission: 2015-2016. Completed desktop habitat assessment and presence/absence field surveys for the eastern Massasauga rattlesnake along portions of proposed 250-mile, 36-inch diameter natural gas transmission pipeline originating in Columbia County, Ohio and extending through Ohio to Wayne County, Michigan. Additionally, contributed to freshwater mussel surveys.

Field Supervisor – Northern Indiana Commuter Transportation District, South Shore Line Double Track Initiative: 2016. Assisted Dr. Jennifer W. Moore and completed pedestrian surveys for eastern Massasaugas, spotted turtles, Kirtland's snakes, and northern leopard frogs along a 22-mile stretch of railroad along the Calumet Trail in Porter County Indiana. No reptiles or amphibians were encountered.

Field Supervisor – Columbia Gas, WB XPress Pipeline: 2016. Completed timber rattlesnake survey along existing pipeline right-of-way in the Monongahela National Forest in Randolph and Pendleton counties, West Virginia. Thirteen timber rattlesnakes and two northern copperheads were observed.

Biologist – Rice Energy, Raider to Dr. Awkward Pipeline: 2016. Completed habitat assessment for eastern hellbender at proposed pipeline crossing of North Fork Captina Creek in Belmont County, Ohio.

Biologist – Strike Force East, Marauder Phase II Pipeline: 2016. Completed habitat scoping to determine the presence of suitable habitat for freshwater mussels and eastern hellbenders along Captina Creek in Belmont County, Ohio.

Biologist – Spectra/Texas Eastern Transmission, Ohio Pipeline Energy Network: 2016. Completed occupancy survey for hellbenders along portions of 75.8-mile natural gas pipeline in Ohio.

Biologist – Confidential Client, Emergency Response: 2016. Participated in Phase II freshwater mussel survey within the Markland Pool of the Ohio River. Project was warranted by an inadvertent discharge of diesel fuel and encompassed over 10.3 miles of underwater transect surveys. It is the largest, contiguous, and standardized mussel survey known to occur in the Ohio River.

Biologist – Ohio Department of Transportation, HEN-109 Bridge Replacement: 2016. Completed freshwater mussel surveys and relocation efforts on the Maumee River in Henry County, Ohio.

Biologist – Ohio Department of Transportation, Bank Stabilization: 2016. Completed freshwater mussel surveys within the Racine Navigational Pool of the Ohio River in Meigs County, Ohio and Jackson County, West Virginia.

Biologist – Eckart-America Corporation, Streambank Stabilization: 2016. Completed freshwater mussel relocation efforts along the Grand River in Lake County, Ohio.

Biologist – Dominion Transmission, Bank Stabilization: 2016. Completed freshwater mussel Phase I and Phase II surveys and relocations along South Fork Fishing Creek in Wetzel County, West Virginia.

Biologist – Ergon, Barge Mooring Structures Installation and Bank Stabilization: 2016. Completed freshwater mussel relocation efforts along the Ohio River in Washington County, Ohio.

Biologist – Columbia Gas Transmission, WB Xpress: 2015. Completed walkthrough habitat assessment and field surveys for the federally threatened Cheat Mountain salamander along portions of a 28.7-mile natural gas transmission project in West Virginia. Nine Cheat Mountain salamanders were observed during occupancy surveys.

Biologist – Confidential Client, Recreational Boat Dock: 2015: Completed federally endangered freshwater mussel surveys for proposed recreational boat dock along the Allegheny River in the City of Pittsburgh in Allegheny County, Pennsylvania.

Biologist – StatOil, Surface Water Intake: 2015. Completed freshwater mussel surveys for on Sunfish Creek approximately 0.6 mile from its confluence with the Ohio River in Monroe County, Ohio.

Biologist – Clarion Midstream, Project Entropy: 2015. Completed freshwater mussel surveys at the crossing of the Allegheny River in Clarion County, Pennsylvania for a proposed natural gas pipeline. Survey resulted in the capture of 134 live individuals of eight species include the federally endangered northern riffleshell, clubshell and rayed bean.

Biologist – EQT / EQM Midstream OPCO, MOSA D002, MOSA D003, and MOSA S036 Pipelines: 2015. Completed freshwater mussel surveys and relocations at seven crossings of Arnold Creek in Doddridge County, West Virginia for various natural gas pipeline projects.

Biologist – Dominion, Supply Header Project: 2015. Completed freshwater mussel surveys at three crossings of South Fork Fishing Creek in Wetzel County, West Virginia

and one crossing of McElroy Creek in Doddridge County, West Virginia of a proposed 36.7-mile natural gas pipeline loop.

Biologist – Confidential Client: 2014 – 2015. Assisted with the implementation of a conservation program for the American crocodile (*Crocodylus acutus*) in southern Florida. Conducted hatchling and nest surveys and general population surveys.

Biologist – University of Florida: 2014 – 2015. Volunteer for the Everglades Invasive Reptiles and Amphibian Monitoring Program (EIRAMP) in Everglades National Park. Detected and removed invasive reptiles, as well as established densities of native reptiles, amphibians and mammals.

Biologist – Confidential Client: 2012 – 2013. Assisted with fish population surveys on multiple rivers in West Virginia. Collected tissue samples and conducted seining and electrofishing.

Research Assistant – Confidential Client: 2009 – 2010. Assisted with surveys to locate roosting habitat for the eastern small-footed bat (*Myotis leibei*) in southern New Hampshire. Assisted with mist net set up, species identification, morphometric processing and radio-telemetry studies.

PUBLICATIONS

Hawes, M.E., T. J. Brust. 2009. Roosting habits of male eastern small-footed bats (*Myotis leibei*) in New Hampshire. *New Horizons* 4:97-102.

PRESENTATIONS

Roosting Habits of Male Eastern Small-Footed Bats (*Myotis leibei*) in New Hampshire. Timothy Brust. Eastern Bat Working Group Meeting and Mammal Colloquium. Louisville, KY. Presented 2011.



ENVIRONMENTAL SOLUTIONS & INNOVATIONS, INC.

Résumé

Sarah J. Messer

CERTIFICATIONS AND TRAINING

Method 9 and Method 22

Wetland Delineation

8-Hour SafeLand USA Basic Orientation, 2016

NCTC Wetland Plant Identification, 2014

Swamp School for Wetland Delineation, 2013

Benthic Macroinvertebrate Surveying and Rapid Bioassessment Protocol Methods (WVDEP), 2012

West Virginia Division of Natural Resources Fish Identification

QUALIFICATIONS AND EXPERIENCE

Ms. Messer participates in a variety of aquatic and terrestrial wildlife projects and research in the eastern, mid-western, and southern U.S. Her field experience, serving as assistant or team leader, includes surveys focused on amphibians, reptiles, mussels, fish, and benthic macroinvertebrates. Of particular note, on the Atlantic Coast Pipeline project, in both Virginia and North Carolina, Ms. Messer personally (under supervision of permitted biologists) identified approximately six spotted turtles in the wild. Her experience, both professionally (under supervision of permitted biologists) and on her own time, includes surveys for numerous federal and state listed species such as: eastern massasauga (under direct supervision of Dr. Jennifer Moore) and timber rattlesnakes; corn snake; wood turtle; Argentinian tegu; Neuse River waterdog; hellbenders; Cheat Mountain, Mabee's, tiger, and green salamanders; American alligator; and American crocodile. Ms. Messer observed Blanding's turtles in captivity at Three Lakes Nature Center and Aquarium, in Richmond, Virginia. The facility is operated by Tom Thorp, currently the chair of Project Bog turtle an initiative of the North Carolina Herpetological Society

In addition to wildlife surveys, Ms. Messer completes water sampling for toxicity testing and compliance, stormwater compliance, sanitary system compliance, water sampling for mercury, opacity testing, and data collection. She also completes stream/wetland delineations, permitting, and mitigation associated with Marcellus Shale oil and gas production.

She is familiar with species handling, morphometric processing, field photography, and data entry and analysis, and is proficient with the following field techniques and equipment:

- Habitat Assessments for tiger, green, Cheat Mountain, and Mabee salamanders, eastern massasauga and timber rattlesnakes; Blanding's and bog turtles, northern long-eared, eastern small-footed, and Indiana bats
- Species surveys using existing debris, coverboards, eyeshine, dip netting, road searches, observation at basking sites, and minnow traps,
- Pit tagging

- Radio-telemetry (snakes and bats)
- Fish surveys using seigning, backpack electro-shockers for sampling smaller streams, bank shockers for moderate size streams, and tote barge for sampling larger streams and small rivers.
- Surface water sampling
- Benthic invertebrate sampling using kick-net and dip-net
- Method 9 and Method 22 measures for pollutants, dust haze, or smoke
- HGM High Gradient Stream Surveys
- Stream/wetland delineation, permitting, and mitigation

PROJECT EXPERIENCE

Field Assistant – NICTD South Shore Comuter Rail Line Improvement and Expansion: 2017. Habitat and species surveys along the line from Chicago, Illinois to South Bend, Indiana. Species included: federally-threatened eastern massasauga rattlesnake, Blanding's turtle, and northern leopard frog.

Field Assistant – Dominion, Atlantic Coast Pipeline: 2015-2017 Completed field surveys along portions of 554-mile natural gas transmission mainline and associated laterals in West Virginia and Virginia. Surveys focused on freshwater mussels; Neuse River waterdogs; Roanoke logperch; Carolina madtom; spiny crayfish; and tiger, Mabee's, green, and Cheat Mountain salamanders. Additionally, completed surveys for fish and butterflies and moths on George Washington National Forest. Observed diamondback terrapins in Virginia.

Field Assistant – Columbia Gas Transmission, WB Xpress: 2015-2017. Completed walkthrough habitat assessment and field surveys for the federally threatened Cheat Mountain salamander along portions of a 28.7-mile natural gas pipeline in Randolph and Pendleton counties, West Virginia. Nine Cheat Mountain salamanders were observed during occupancy surveys. An additional 10 Cheat Mountain salamanders were observed in 2017. Timber rattlesnake telemetry and pit tagging studies are in progress.

Team Leader – Columbia Gas Transmission, Line WB-3 Integrity Pipeline: 2016. Completed Cheat Mountain salamander habitat assessment along portions of a natural gas transmission line in Tucker County, West Virginia.

Field Assistant – Ohio Department of Transportation, HEN-109 Bridge Replacement: 2016. Assisted with mussel relocations for bridge demolition and replacement on Maumee River in Henry County, Ohio.

Field Assistant – Koppers, Maintenance Dredging: 2016. Assisted with survey for federally endangered Roanoke logperch on the Roanoke River in Salem, Virginia.

Field Assistant – Dominion, Atlantic Coast Pipeline: 2016: Completed mist net survey, portal search, and harp trapping for listed bat species along portions of 554-mile natural gas pipeline in Virginia and West Virginia.

Field Assistant – American Electric Power, Multiple Transmission Lines: 2016. Completed summer mist netting for listed bat species in West Virginia.

Field Assistant – American Electric Power, Hanging Rock Transmission Line Rebuild: 2016. Performed habitat walkthrough for listed bat species in Lawrence and Scioto counties, Ohio.

Field Assistant – EQT/ EQM Gathering OPCO, F1146 Pipeline Replacement: 2016. Completed emergency wetland determination for pipeline replacement in Gilmer County, West Virginia.

Field Assistant – Eclipse Resources, Craig Miller Well Pad: 2016. Assisted with aquatic resources delineation for proposed well pad in Monroe County, Ohio

Team Leader – Spectra Energy, NEXUS Gas Transmission: 2015-2016. Team Lead on field surveys for eastern massasauga rattlesnake along portions of proposed 250-mile natural gas transmission pipeline originating in Columbia County, Ohio and extending through Ohio to Wayne County, Michigan.

Field Assistant – MVP, Mountain Valley Pipeline: 2015-2016. Participated in surveys for multiple terrestrial and aquatic species along portions of 300-mile natural gas pipeline traversing twelve counties in West Virginia and six counties in Virginia. Surveys focused on freshwater mussels, bog turtles, birds, plants, and listed bat species.

Field Assistant – EQT / EQM Midstream OPCO, MOSA D002, MOSA D003, and MOSA S036 Pipelines: 2015. Completed freshwater mussel surveys and relocations at seven crossings of Arnold Creek in Doddridge County, West Virginia for multiple natural gas pipelines.

Field Assistant – JKLM Energy, Goodwin Quarry Freshwater Impoundment: 2015. Completed surveys for aquatic invasive species at freshwater impoundment in the Allegheny River floodplain of Potter County, Pennsylvania.

Field Assistant – StatOil, Surface Water Intake: 2015. Completed freshwater mussel survey and relocations on Sunfish Creek approximately 0.6 mile from its confluence with the Ohio River in Monroe County, Ohio. Because of zero underwater visibility conditions, mussel survey was completed via tactile searches.

Field Assistant – Energy Transfer, Revolution Pipeline: 2015. Completed aquatic resource screening for proposed 40-mile, 30-inch diameter pipeline in Butler, Beaver, Allegheny, and Washington counties, Pennsylvania. Identified and delineated 178 wetlands, 338 streams, and 9 ponds. Also observed state species of special concern wood turtle during wetland survey efforts.

Field Assistant – Eureka Hunter Pipeline, Stalder Pipeline: 2015. Completed aquatic resource delineations in Monroe County, Ohio.

Field Assistant – Eureka Hunter Pipeline, Moser Pipeline: 2015. Completed aquatic resource delineations Monroe County, Ohio.

Field Assistant – Eureka Hunter Pipeline, Pyles-Miller-Pitman Pipeline: 2015. Completed aquatic resource delineations in Monroe County, Ohio.

Team Leader – Confidential Clients, Field Studies: 2006-2015. Completed multiple biological studies and sampling involving fish and benthic macroinvertebrates. Also performed water sampling, stream/wetland delineation, permitting, and mitigation,

regulated and permit compliance for various coal, quarries, and oil and gas facilities using Method 9 and Method 22, and High Gradient Stream Surveys (a relatively new protocol developed by the U.S. Army Corps of Engineers for quantifying the condition of ephemeral or intermittent headwater streams)

Kathryn “Kate” Lucier

Environmental Biologist



A wetland and stream biologist for Lochmueller Group (Lochgroup), Kate is an environmental scientist with more than 5 years of experience collaborating with private industry, regulators, and consultants in environmental compliance, wetland reclamation, and research ecology. Her responsibilities include all appropriate field studies and documentation in wetland delineations, mitigation and/or monitoring, permitting for wetlands and streams, and GIS analysis and mapping.

Before joining Lochgroup, Kate pursued her master's at the University of Windsor which led her to gain extensive wetland ecology experience in the wetlands of the Athabasca oil sands region in Northeastern Alberta. Her research within the Athabasca oil sands focused on the invertebrate fauna of fens and marshes, and the impacts of wetland hydrologic zonation on invertebrate assemblages. Practical applications of her research resulted in the creation of wetland sampling regimes and novel sampling techniques for sampling peat-forming wetlands. Kate's work continues to advise industry staff, consultants, and researchers attempting reclamation of peat-forming wetlands.

REPRESENTATIVE PROJECT EXPERIENCE

State Road 37 Improvement Project, City of Fishers – Lead field biologist responsible for conducting wetland delineations and stream assessments along project corridor. Wrote water resources determination report and assisted with the NEPA process at the Environmental Assessment (EA) level. Roles included extensive GIS mapping, data management, and calculation of project impacts to water resources. Preliminary permitting determinations. Project ongoing.

EIS, I-69, Bloomington to Indianapolis for INDOT – Field Biologist responsible for conducting field studies including waters investigations to identify water resources in the project corridor. Specific field tasks included wetland delineation, streams assessments, and summer mist netting to survey for the federally endangered Indiana bat and federally threatened Northern long-eared bat. Involvement in NEPA process at EIS level: drafted chapters for DEIS including chapters on natural environment, water resources, wildlife considerations, and forest impacts as well as accompanying appendices. Assisted with public involvement and public meetings.

Seymour District Slide Correction Projects, INDOT – Lead field biologist responsible for wetland field studies for slide correction projects. Specific field tasks included wetland delineation and stream assessment, GIS mapping, and evaluation of project area for Threatened and Endangered Species (TES), including evaluation of potential bat habitat and inspection for endangered plant species.

Spring Mill Road Small Structure Replacement, Sub-consultant, City of Carmel – Lead Field biologist responsible for wetland determination and stream assessment for small structure replacement and stream realignment project. Wrote water resources determination report with GIS mapping and impact calculation for water resources. Environmental concerns included wetland boundary determination within floodplain in order to determine impacts from stream alignment.

On-Call Environmental Services for INDOT, Crawfordsville District – CE documents and supplemental documentation. This includes natural resource assessments (streams and wetlands), Section 106 issues, Section 4(f), Section 6(f) issues, coordination with agencies, and preliminary permitting activities. Projects have included:

- » **US 231 Intersection Safety Improvements, Montgomery County, for INDOT, Crawfordsville District** – Environmental Biologist for safety improvements along US 231 that involved road widening and the addition of designated left-turn lanes. Completed field investigations of the project area and completed the Waters of the US determination report. Major environmental concerns included minimizing impacts to the delineated wetlands.
- » **SR 142 Small Structure Replacement, Morgan County, for INDOT, Crawfordsville District** – Environmental Biologist for the replacement of the small structure over an unnamed tributary to Snake Creek. Completed the Waters of the US determination report. Major environmental concerns included impacts to the unnamed tributary and jurisdictional roadside ditches.



WITH THE FIRM SINCE
2015

YEARS OF EXPERIENCE
5 years

EDUCATION
M.Sc., Wetland Ecology/Entomology, University of Windsor, Ontario, Canada, 2014

Thesis: Relative Distribution and biomass of Invertebrates in fens and marshes in the boreal region of Northeastern Alberta.

B.Sc., Biological Science, Minor in Agriculture, University of Alberta, Alberta, Canada, 2008

CERTIFICATION
Certified Wetland Delineator (State of Minnesota)

INDUSTRY ASSOCIATION
Society of Wetland Scientists (SWS member)

Indiana Association of Environmental Professionals (INAEP Corporate Member)

» **SR 39 Bridge Replacement, Boone County, for INDOT, Crawfordsville District** – Environmental Biologist for the replacement of a bridge over Sugar Creek. Completed the Waters of the US determination Report. Major environmental concerns included impacts to Sugar Creek and delineated wetlands.

» **SR 63 Exit Ramp Bridge, Vermillion County, for INDOT, Crawfordsville District** – Environmental Biologist for the rehabilitation of an exit ramp bridge over Little Raccoon Creek. Completed field investigation and Waters of the US determination report. Major environmental concerns included impacts to the Little Raccoon Creek.

On-Call Environmental Services for INDOT, Seymour District – Assisted with CE documents and supplemental documentation. This includes natural resource assessments (streams and wetlands), Section 106 issues, Section 4(f), Section 6(f) issues, coordination with agencies, and preliminary permitting activities. Projects have included:

» **SR 156 Slide Correction Projects, Ohio County, for INDOT, Seymour District** – Environmental Biologist for the rehabilitation of The Ohio River Scenic Highway. Completed field investigations and Waters of the US determination report. Major environmental concerns included delineation of isolated wetlands within roadside ditches. As a result of successive slides, these culverts were damaged and are no longer effective at conveying roadside drainage, thus wetlands were formed.

On-Call Environmental Services for INDOT, Vincennes District – Assisted with CE documents and supplemental documentation. This includes natural resource assessments (streams and wetlands), Section 106 issues, Section 4(f), Section 6(f) issues, coordination with agencies, and preliminary permitting activities. Projects have included:

» **SR 61 Bridge Maintenance & Scour Protection, Warrick County, for INDOT, Vincennes District** – Field Biologist for the rehabilitation of a bridge over Koehler Ditch. Completed field investigation and Waters of the US determination report. Major environmental concerns included impacts to the Koehler Ditch.

SR 252 Road Improvement Mitigation Site, Johnson County, for INDOT, Seymour District – Drafted and submitted the Construction in a Floodway (CIF) permit for submittal to the Indiana Department of Natural Resources. Project involved erosion control on bank of Flatrock River and restoration of forested wetland by means of tree planting.

CONTINUING EDUCATION

Grasses, Rushes, and Sedges, Botanic Training Institute, June 6-8, 2016

Wetland Plant Identification, Biotic Consultants, May 4-6, 2016

Redefining Waters of the United States, Wetland Training Institute, August 18, 2015

Editing in ArcGIS, Minnesota Department of Natural Resources, September 2014

Introduction to ArcGIS, Minnesota Department of Natural Resources, September 2014

5-day Wetland Delineation Course, Wetland Delineation Certification Program, September 15-19, 2014

Lincoln is an Environmental Scientist for Lochmueller Group (Lochgroup). His duties in this role include stream and wetland assessments, preparation of NEPA documents, GIS, floral/faunal investigations, among other tasks. Lincoln's passion for the environment dates back to his childhood where he developed a stark interest for wildlife, the catalyst for a career in the environmental field.

Lincoln previously worked as a wildlife technician for Purdue University, Virginia Tech, and the University of Georgia at the Savannah River Ecology Lab. As a wildlife technician in various locations, Lincoln assisted in the data collection and analysis in a variety of wildlife studies on species such as the eastern hellbender, feral pigs, wood ducks, vultures, and cotton mice.

In his free time, Lincoln continues his passion for wildlife and the environment through hobbies such as birding, herping, and wildlife photography.

REPRESENTATIVE PROJECT EXPERIENCE

I-69 Tier 2 EIS, Evansville to Indianapolis, Indiana, for INDOT - Assisted in the mist netting and radio-telemetry for the Indiana Bat monitoring pre-, during, and post-construction in Sections 4, 5, and 6 of I-69. 2014–Present

I-69 Section 4 & 5 Mitigation, Evansville to Indianapolis, Indiana, for INDOT – Assisted in the baseline plot layout, monitoring of tree plantings, and construction monitoring of 25 sites associated with impacts. 2014–Present

SR 61 Boonville Bypass Wetland Stream and Floodway Mitigation, Spencer County, Indiana, for INDOT – Assisted in the identification, design, and mitigation plan for the 50 acre mitigation site to address requirements of Section 404 and 401 and Construction in a Floodway permits. Site designs included excavation, planting plans and specifications. 2015

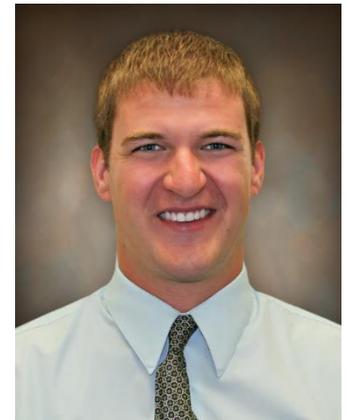
SR403 Bridge Replacement Floodway Habitat Mitigation, Clark County, Indiana, for INDOT– Assisted in the location and design of a 10 acre mitigation site to compensate for floodway impacts associated with the SR 403 Bridge Replacement over Silver Creek to address the construction in a floodway permit. Site design included rerouting drain tile, planting plans, and incorporation of a forested wetland to return beneficial hydrology to the site. 2015 - Present

I-64 Pipe Liners, NEPA Documentation, Posey, Vanderburgh, Warrick, Gibson, Dubois, Spencer, and Crawford, Indiana, for INDOT, Vincennes District – Assisted in the NEPA documentation for pipe liners in 12 I-64 small structures. The need for this project is due to the deteriorating conditions to of each culvert, respectively. The purpose of the project is to provide a hydraulically adequate and structurally sufficient structure that maintains vehicular traffic over 12 waterways. Each location represented unique conditions in regard to the waterway, existing condition of the structure, and proposed pipe liner alternatives. 2015-2016

CE, SR61 over Koehler Ditch, Boonville, Indiana, for INDOT, Vincennes District – Assisted in the NEPA documentation for SR 61 bridge maintenance and scour protection. The need for the project is due to the deteriorating condition of the bridge surface and overlay as well as the substrate erosion around bridge piers. The purpose of the project is to provide a structurally sufficient structure that provides safe vehicular crossing at this location. (DES 1173355) 2015

- **CE, SR 66 Bridge over Honey Creek, Washington County, Indiana, for INDOT, Vincennes District** – Assisted in the NEPA documentation for SR 66 bridge deck overlay and scour protection. The project area included a sinking stream basin of Honey Creek and adjacent karst features. Maintenance of the SR 66 bridge is due to deteriorating conditions of the existing bridge and scour beneath.

US68/KY80 Mitigation Monitoring, Trigg County, Kentucky, for Kentucky Transportation Cabinet (KYTC) – Assisted in the 4th and 5th year monitoring of 5 mitigation sites for impacts to streams, wetlands, and upland forests associated with construction of US68/KY80 through land between the Lakes Trigg County, Kentucky. Duties associated with monitoring included assessment of



WITH THE FIRM
Since 2014

YEARS OF EXPERIENCE
3

EDUCATION
BS, Wildlife, Department of Forestry and Natural Resources, Purdue University, West Lafayette, Indiana, 2013

REGISTRATION
Scientific Purpose

plantings, wetland delineations, and documentation of invasive species, and preparation of yearly monitoring reports to ensure the sites were meeting the required performance standards. 2014 – 2015

CONTINUING EDUCATION

Wetland Plant Identification, Biotic Consultants, 2014 and 2015

Roadway Environmental Impacts and Mitigation, Forester University Webinar, November 2014



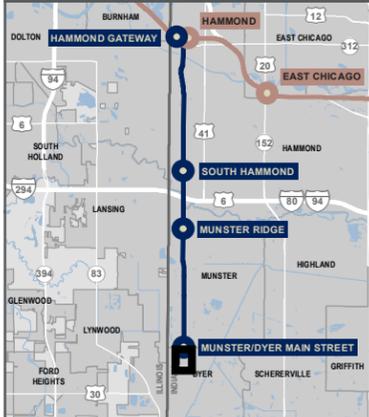
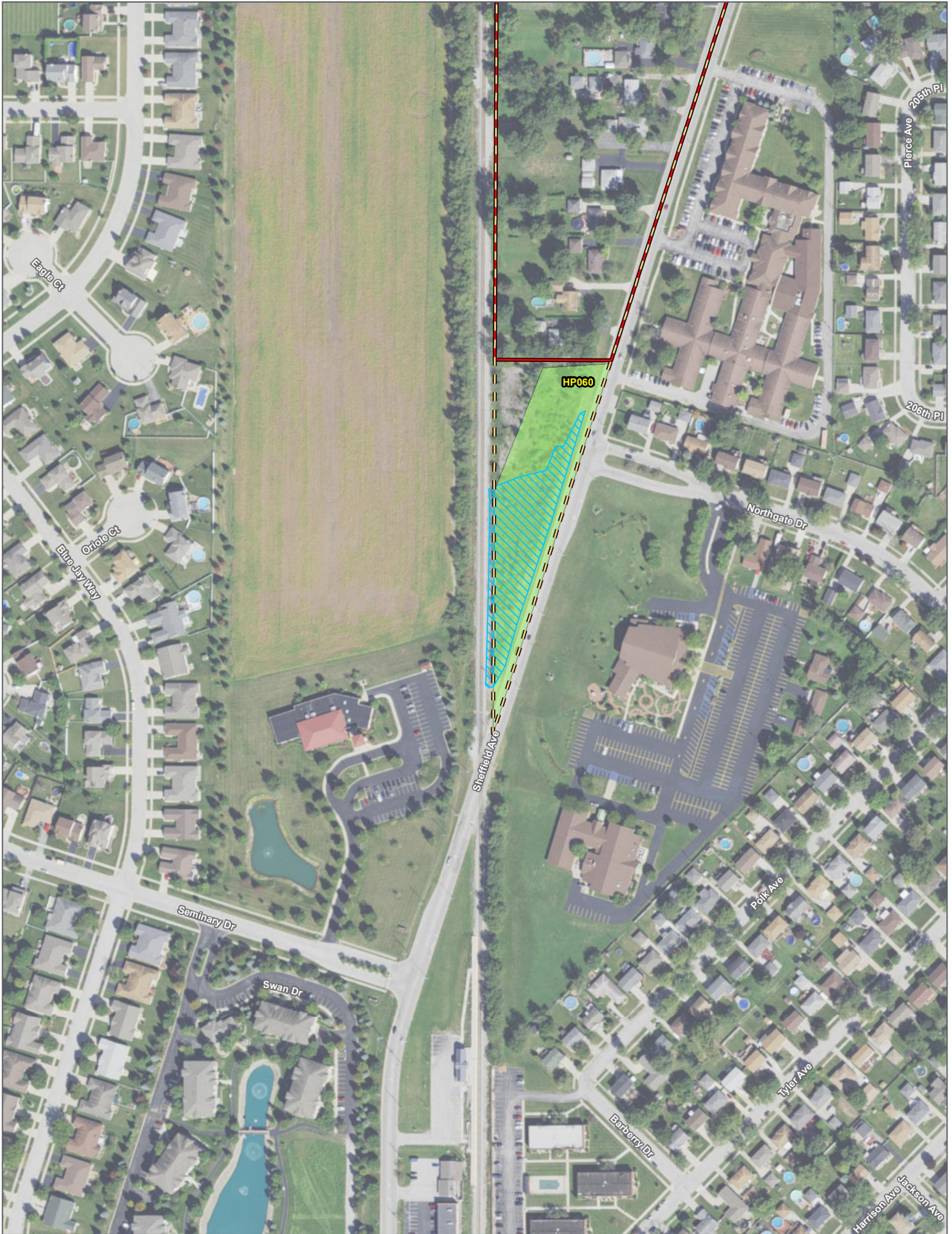
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Appendix B. Identified Potential Habitat for Target Amphibian, Reptile, and Insect Species



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- Existing Station
- Proposed Station
- Existing South Shore Line
- FEIS Preferred Alternative
- Milepost
- Milepost Stationing
- Environmental Survey Area
- Project Footprint

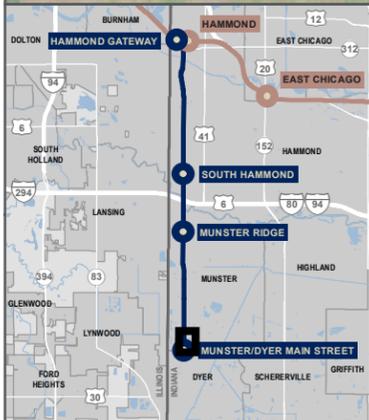
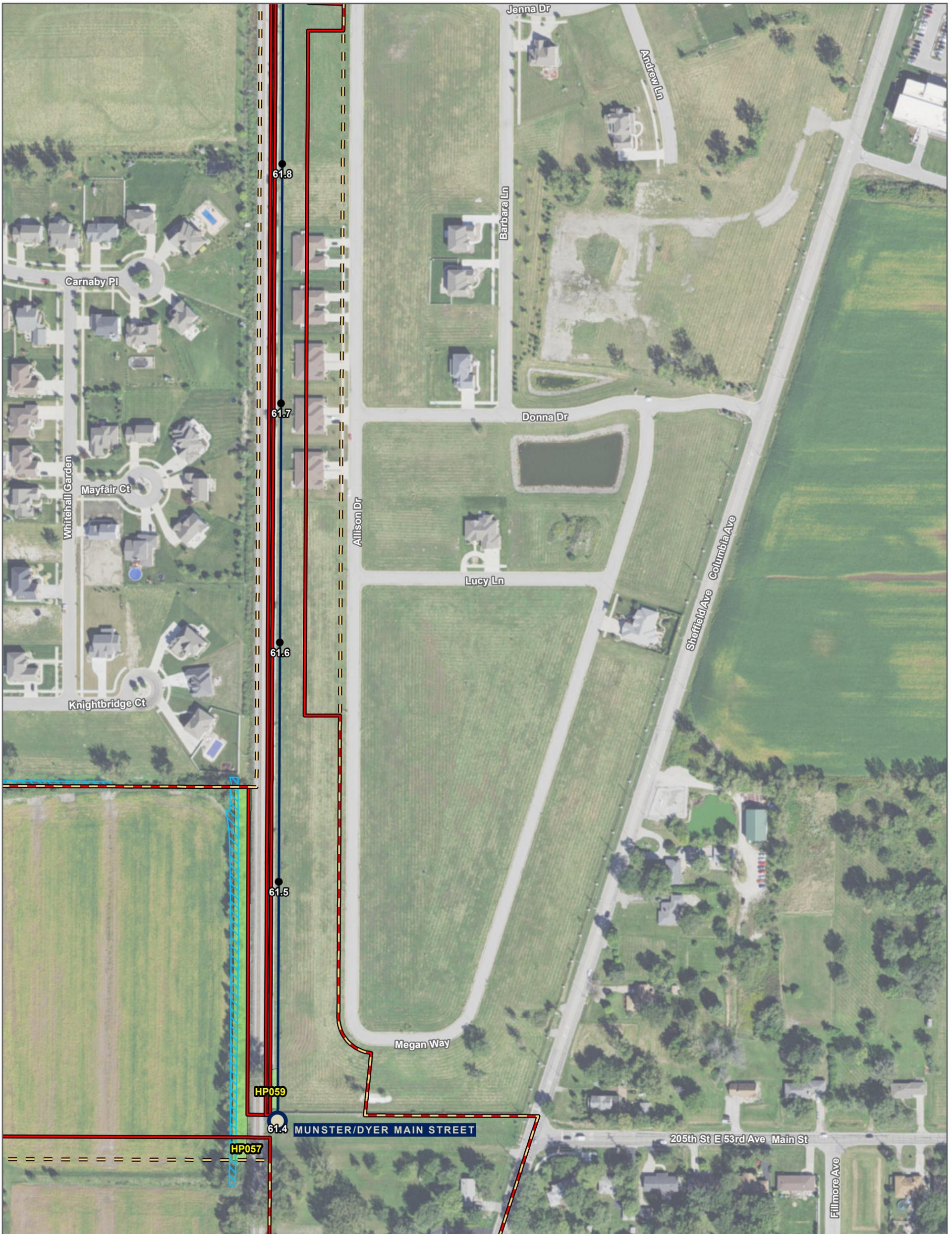
- Blandings Turtle Habitat Patch Quality**
- High
 - Moderate
 - Low
- Northern Leopard Frog Habitat Patch Quality**
- High
 - Moderate
 - Low

- Delineated Wetlands
- Note: No suitable habitat for the Karner blue butterfly in the environmental survey area.*

IDENTIFIED POTENTIAL HABITAT FOR TARGET AMPHIBIAN AND REPTILE SPECIES

0 FEET 200

SHEET 1 OF 18
Data for Reference Only

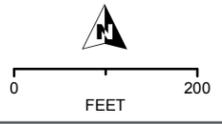


- Existing Station
- Proposed Station
- Existing South Shore Line
- FEIS Preferred Alternative
- Milepost
- Milepost Stationing
- Environmental Survey Area
- Project Footprint

- Blandings Turtle Habitat Patch Quality**
- High
 - Moderate
 - Low
- Northern Leopard Frog Habitat Patch Quality**
- High
 - Moderate
 - Low

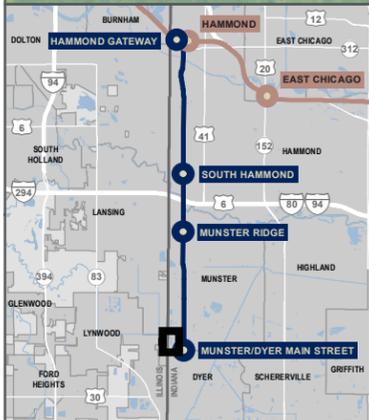
Delineated Wetlands

IDENTIFIED POTENTIAL HABITAT FOR TARGET AMPHIBIAN AND REPTILE SPECIES



Note: No suitable habitat for the Karner blue butterfly in the environmental survey area.

BACKGROUND SOURCE: ESRI, DIGITALGLOBE, GEOEYE, EARTHSTAR GEOGRAPHICS, CHESIAIRBUS DS, USDA, USGS, AEROGRIID, IGN, AND THE GIS USER COMMUNITY
DATA SOURCES: Environmental Systems Research Institute, Indiana Department of Environmental Management, National Resource Commission, Northern Indiana Commuter Transportation District, U.S. Geological Survey, U.S. Department of the Interior, U.S. Fish & Wildlife Service

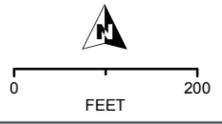


- Existing Station
- Proposed Station
- Existing South Shore Line
- FEIS Preferred Alternative
- Milepost
- Milepost Stationing
- Environmental Survey Area
- Project Footprint

- Blandings Turtle Habitat Patch Quality**
- High
 - Moderate
 - Low
- Northern Leopard Frog Habitat Patch Quality**
- High
 - Moderate
 - Low

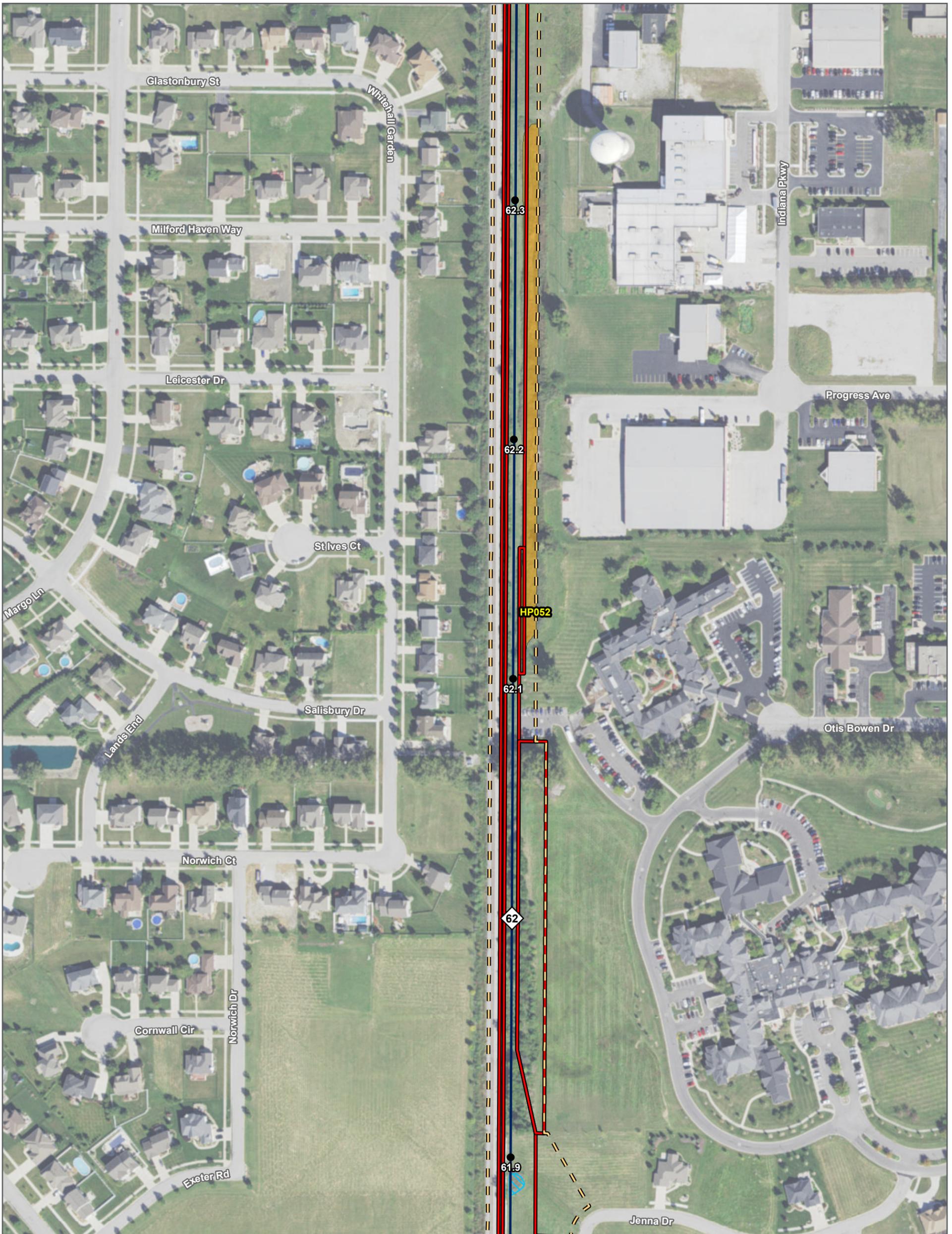
Delineated Wetlands

IDENTIFIED POTENTIAL HABITAT FOR TARGET AMPHIBIAN AND REPTILE SPECIES



SHEET 3 OF 18
Data for Reference Only

Note: No suitable habitat for the Karner blue butterfly in the environmental survey area.



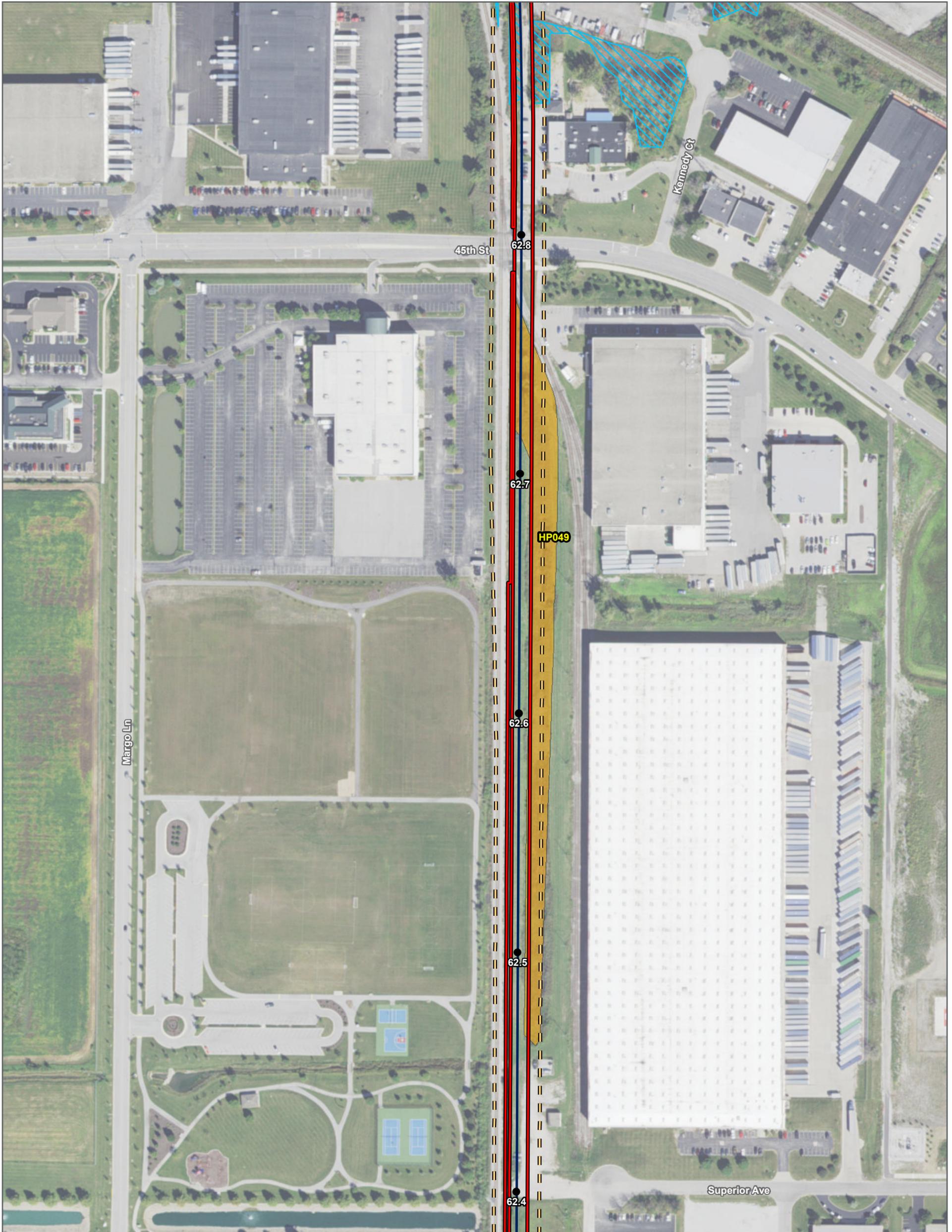
<ul style="list-style-type: none"> Existing Station Proposed Station Existing South Shore Line FEIS Preferred Alternative Milepost Milepost Stationing Environmental Survey Area Project Footprint 	<p>Blandings Turtle Habitat Patch Quality</p> <ul style="list-style-type: none"> High Moderate Low <p>Northern Leopard Frog Habitat Patch Quality</p> <ul style="list-style-type: none"> High Moderate Low 	<ul style="list-style-type: none"> Delineated Wetlands
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IDENTIFIED POTENTIAL HABITAT FOR TARGET AMPHIBIAN AND REPTILE SPECIES

0 200
FEET

SHEET 4 OF 18
Data for Reference Only

Note: No suitable habitat for the Karner blue butterfly in the environmental survey area.

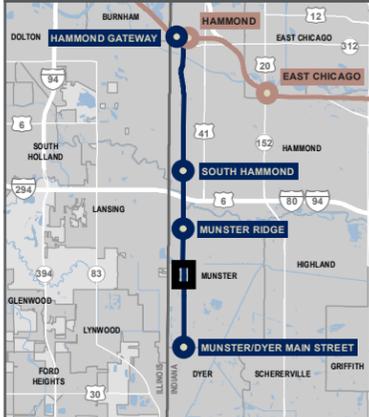
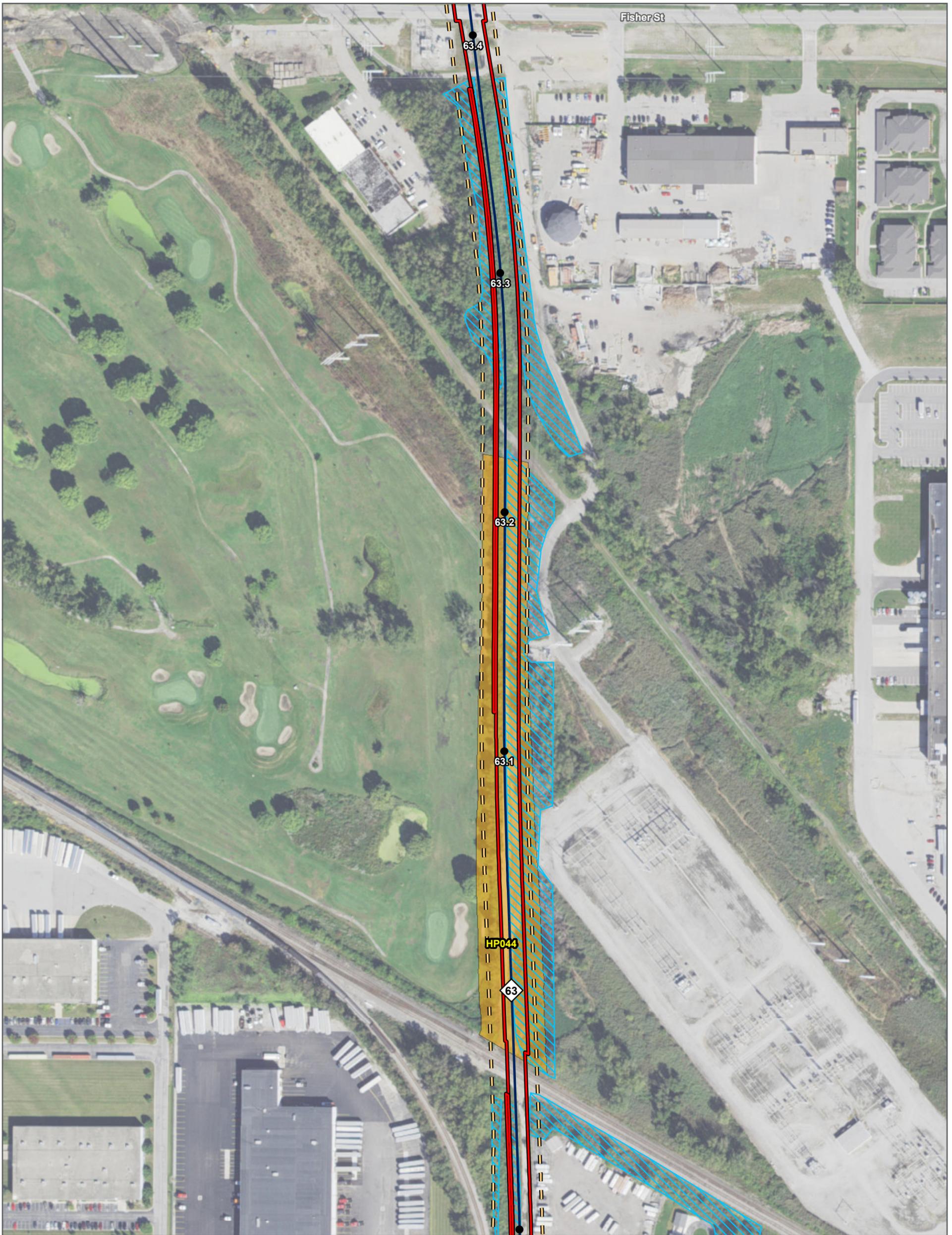


<ul style="list-style-type: none"> Existing Station Proposed Station Existing South Shore Line FEIS Preferred Alternative Milepost Milepost Stationing Environmental Survey Area Project Footprint 	<p>Blandings Turtle Habitat Patch Quality</p> <ul style="list-style-type: none"> High Moderate Low <p>Northern Leopard Frog Habitat Patch Quality</p> <ul style="list-style-type: none"> High Moderate Low 	<ul style="list-style-type: none"> Delineated Wetlands
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IDENTIFIED POTENTIAL HABITAT FOR TARGET AMPHIBIAN AND REPTILE SPECIES

SHEET 5 OF 18
Data for Reference Only

Note: No suitable habitat for the Karner blue butterfly in the environmental survey area.



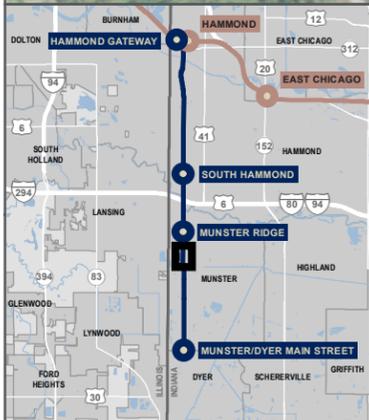
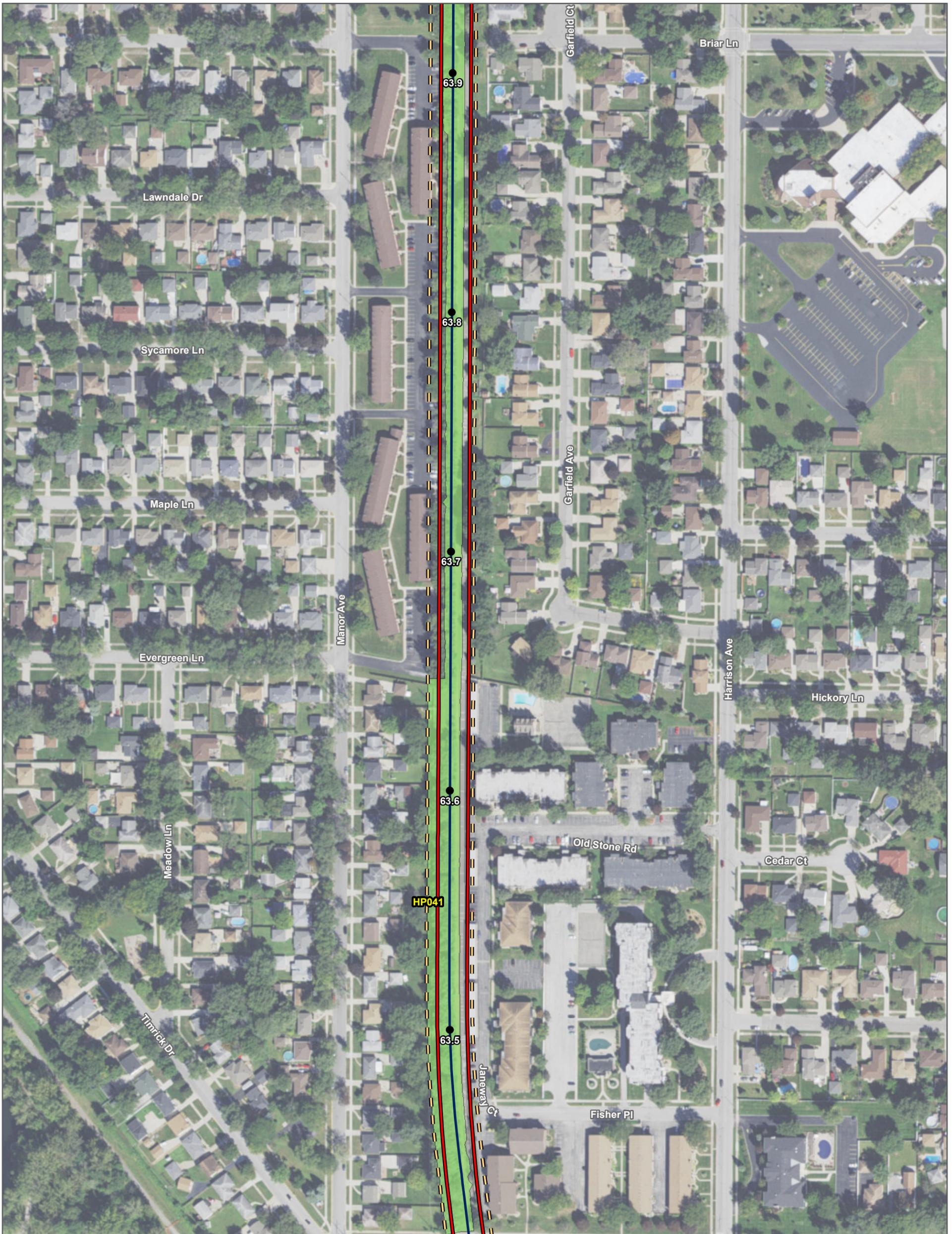
<ul style="list-style-type: none"> Existing Station Proposed Station Existing South Shore Line FEIS Preferred Alternative Milepost Milepost Stationing Environmental Survey Area Project Footprint 	<p>Blandings Turtle Habitat Patch Quality</p> <ul style="list-style-type: none"> High Moderate Low <p>Northern Leopard Frog Habitat Patch Quality</p> <ul style="list-style-type: none"> High Moderate Low 	<ul style="list-style-type: none"> Delineated Wetlands
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IDENTIFIED POTENTIAL HABITAT FOR TARGET AMPHIBIAN AND REPTILE SPECIES

0 FEET 200

SHEET 6 OF 18
Data for Reference Only

Note: No suitable habitat for the Karner blue butterfly in the environmental survey area.



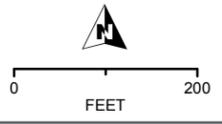
- Existing Station
- Proposed Station
- Existing South Shore Line
- FEIS Preferred Alternative
- Milepost
- Milepost Stationing
- Environmental Survey Area
- Project Footprint

- Blandings Turtle Habitat Patch Quality**
- High
 - Moderate
 - Low
- Northern Leopard Frog Habitat Patch Quality**
- High
 - Moderate
 - Low

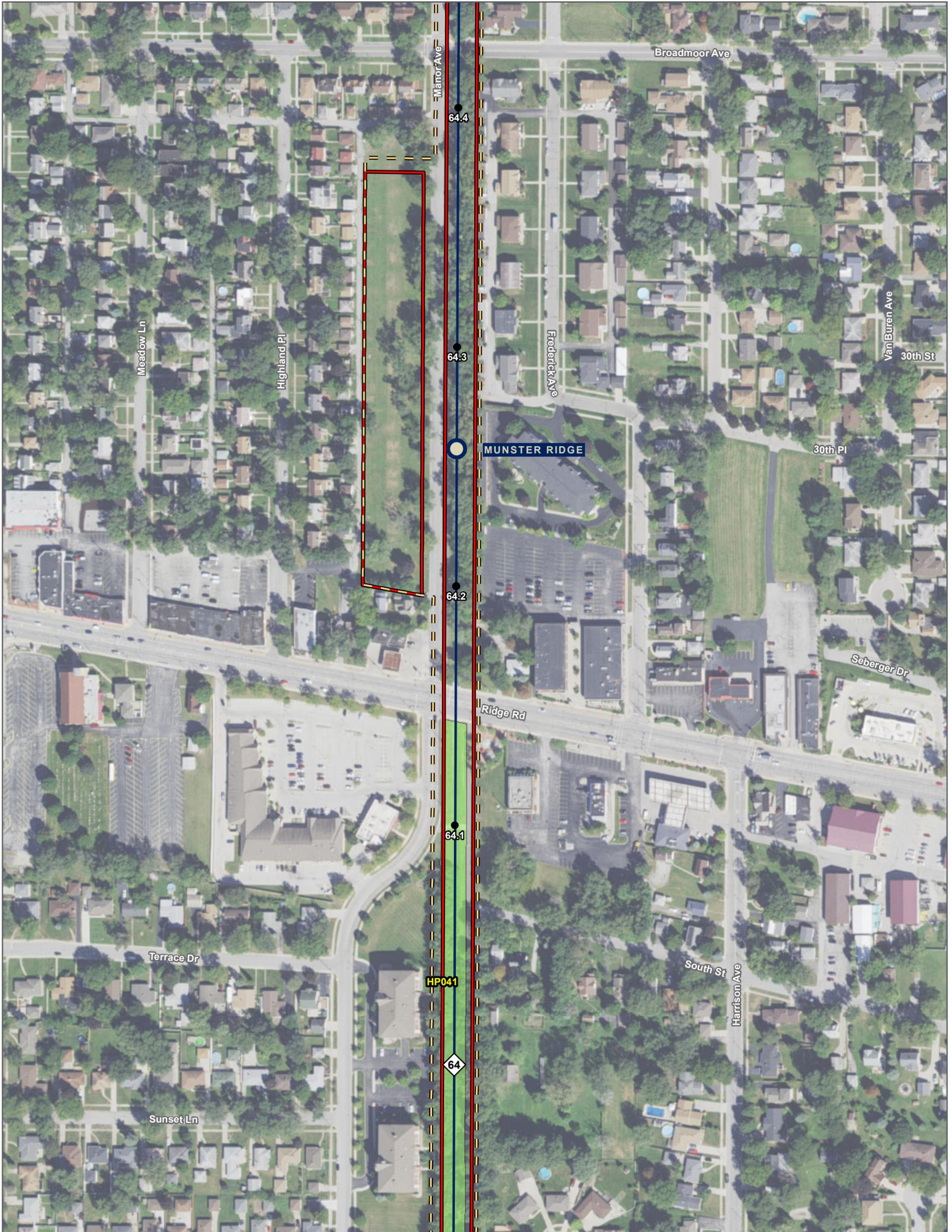
Delineated Wetlands

Note: No suitable habitat for the Karner blue butterfly in the environmental survey area.

IDENTIFIED POTENTIAL HABITAT FOR TARGET AMPHIBIAN AND REPTILE SPECIES



BACKGROUND SOURCE: ESRI, DIGITALGLOBE, GEOEYE, EARTHSTAR GEOGRAPHICS, CHESIAIRBUS DS, USDA, USGS, AEROGRIID, IGN, AND THE GIS USER COMMUNITY
DATA SOURCES: Environmental Systems Research Institute, Indiana Department of Environmental Management, National Resource Commission, Northern Indiana Commuter Transportation District, U.S. Geological Survey, U.S. Department of the Interior, U.S. Fish & Wildlife Service



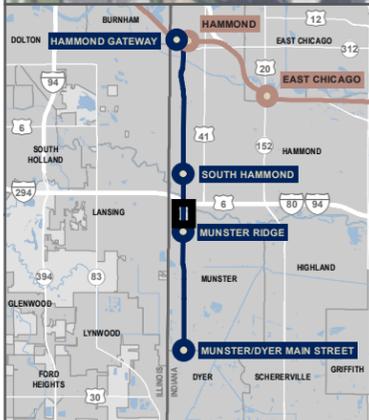
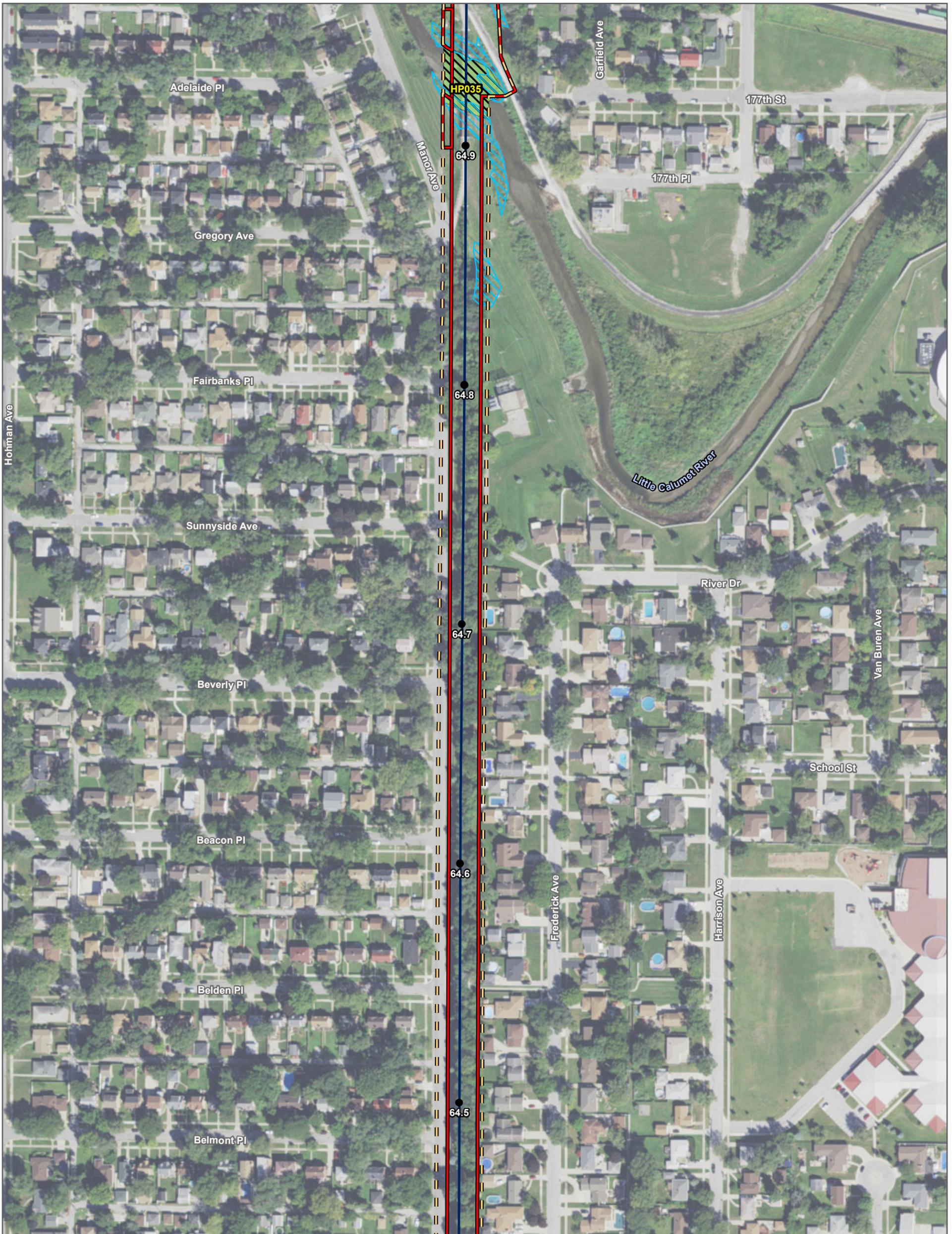
<ul style="list-style-type: none"> Existing Station Proposed Station Existing South Shore Line FEIS Preferred Alternative Milepost Milepost Stationing Environmental Survey Area Project Footprint 	<p>Blandings Turtle Habitat Patch Quality</p> <ul style="list-style-type: none"> High Moderate Low <p>Northern Leopard Frog Habitat Patch Quality</p> <ul style="list-style-type: none"> High Moderate Low 	<ul style="list-style-type: none"> Delineated Wetlands
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IDENTIFIED POTENTIAL HABITAT FOR TARGET AMPHIBIAN AND REPTILE SPECIES

0 200
FEET

SHEET 8 OF 18
Data for Reference Only

Note: No suitable habitat for the Karner blue butterfly in the environmental survey area.



<ul style="list-style-type: none"> Existing Station Proposed Station Existing South Shore Line FEIS Preferred Alternative Milepost Milepost Stationing Environmental Survey Area Project Footprint 	<p>Blandings Turtle Habitat Patch Quality</p> <ul style="list-style-type: none"> High Moderate Low <p>Northern Leopard Frog Habitat Patch Quality</p> <ul style="list-style-type: none"> High Moderate Low 	<ul style="list-style-type: none"> Delineated Wetlands
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IDENTIFIED POTENTIAL HABITAT FOR TARGET AMPHIBIAN AND REPTILE SPECIES

0 FEET 200

SHEET 9 OF 18
Data for Reference Only

Note: No suitable habitat for the Karner blue butterfly in the environmental survey area.



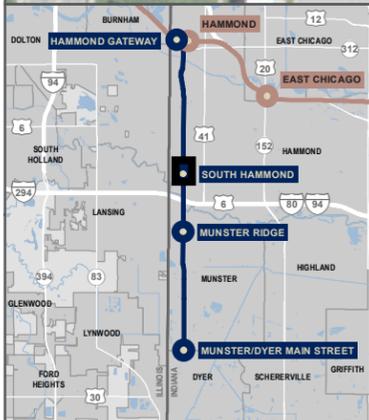
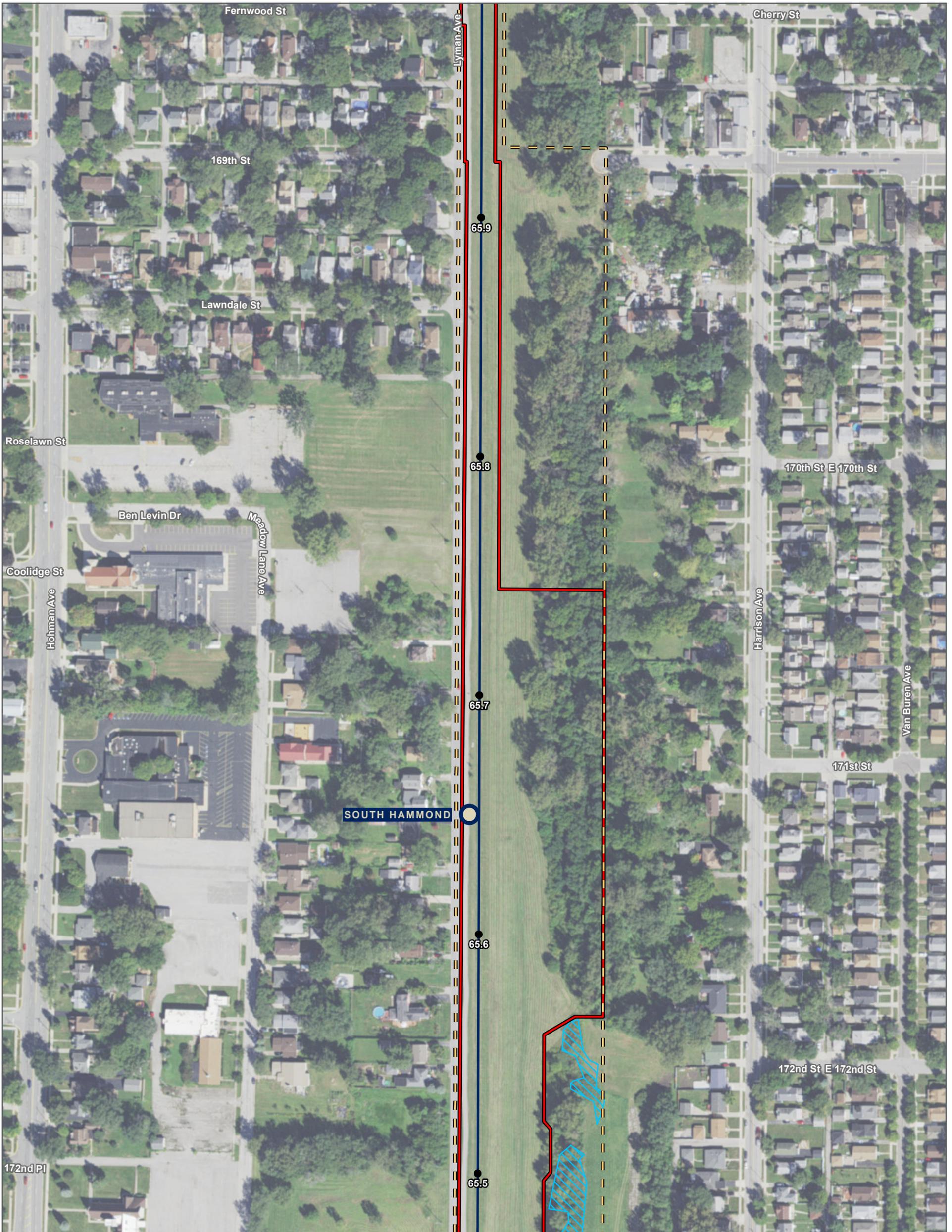
<ul style="list-style-type: none"> Existing Station Proposed Station Existing South Shore Line FEIS Preferred Alternative Milepost Milepost Stationing Environmental Survey Area Project Footprint 	<p>Blainings Turtle Habitat Patch Quality</p> <ul style="list-style-type: none"> High Moderate Low <p>Northern Leopard Frog Habitat Patch Quality</p> <ul style="list-style-type: none"> High Moderate Low 	<ul style="list-style-type: none"> Delineated Wetlands
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IDENTIFIED POTENTIAL HABITAT FOR TARGET AMPHIBIAN AND REPTILE SPECIES

0 FEET 200

SHEET 10 OF 18
Data for Reference Only

Note: No suitable habitat for the Karner blue butterfly in the environmental survey area.

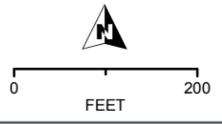


- Existing Station
- Proposed Station
- Existing South Shore Line
- FEIS Preferred Alternative
- Milepost
- Milepost Stationing
- Environmental Survey Area
- Project Footprint

- Blandings Turtle Habitat Patch Quality**
- High
 - Moderate
 - Low
- Northern Leopard Frog Habitat Patch Quality**
- High
 - Moderate
 - Low

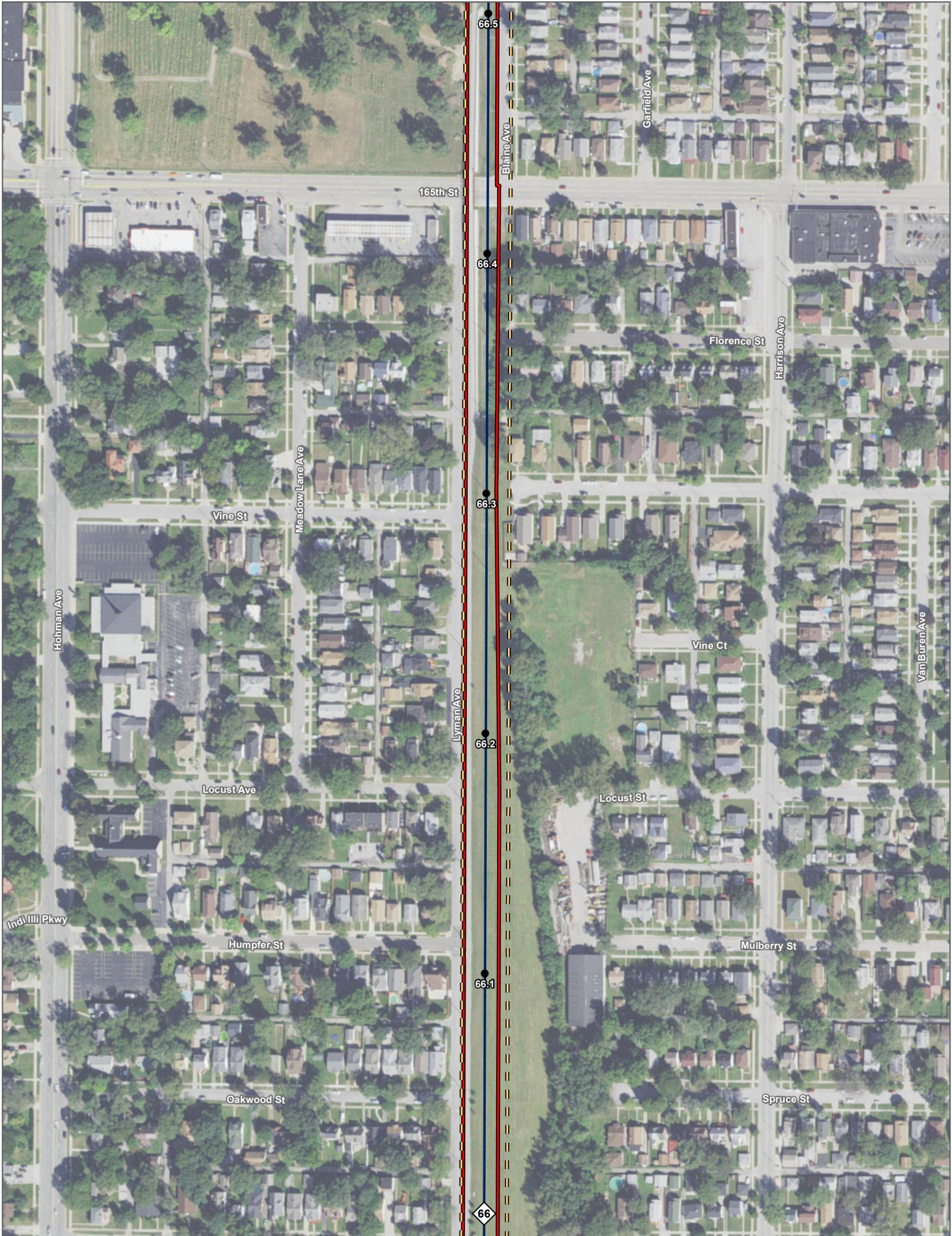
Delineated Wetlands

IDENTIFIED POTENTIAL HABITAT FOR TARGET AMPHIBIAN AND REPTILE SPECIES



SHEET 11 OF 18
Data for Reference Only

Note: No suitable habitat for the Karner blue butterfly in the environmental survey area.



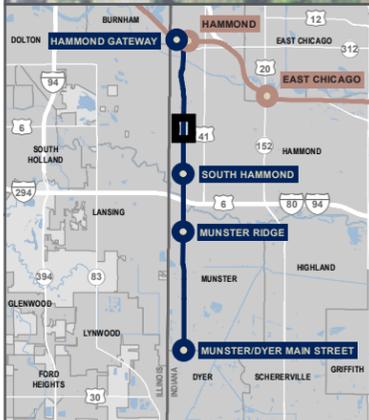
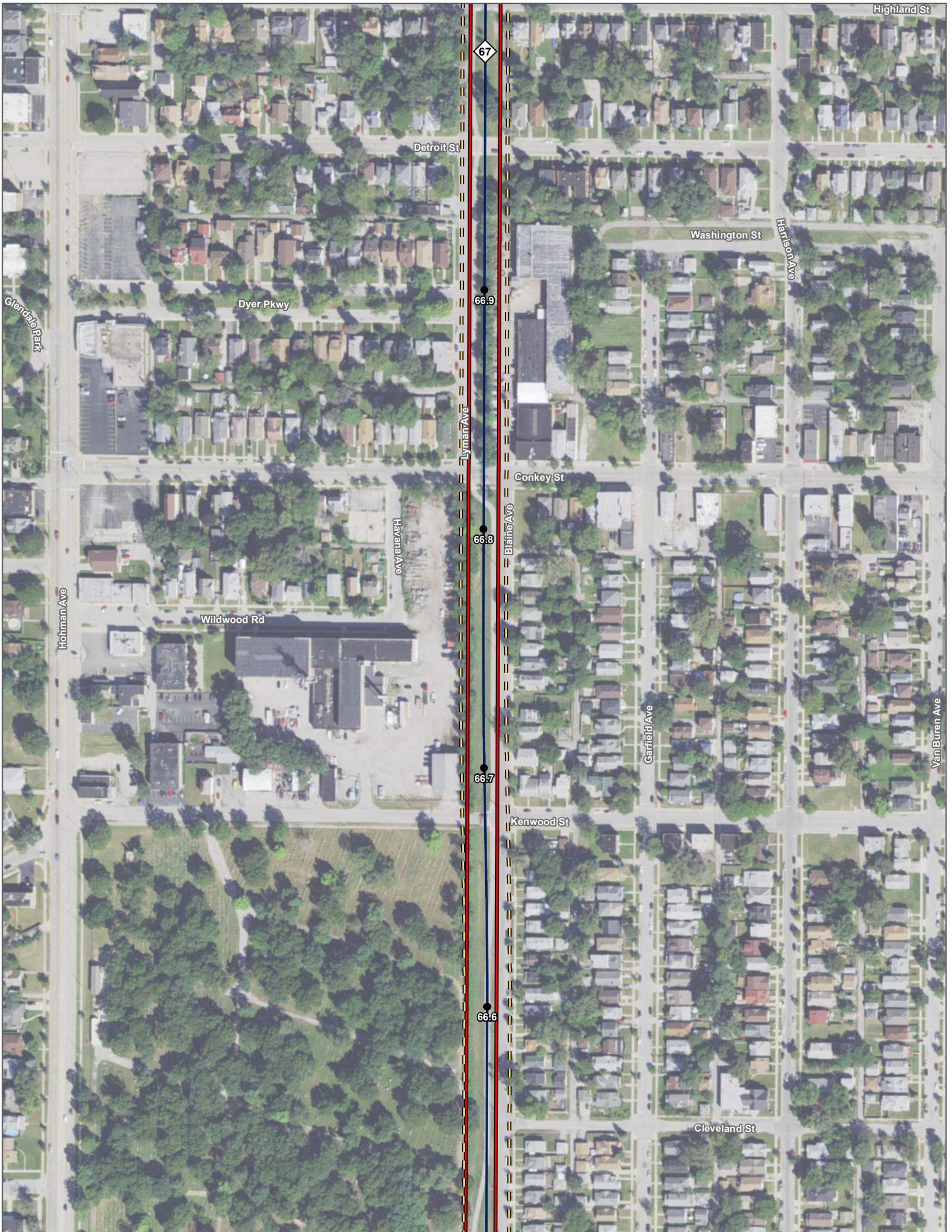
<ul style="list-style-type: none"> Existing Station Proposed Station Existing South Shore Line FEIS Preferred Alternative Milepost Milepost Stationing Environmental Survey Area Project Footprint 	<p>Blandings Turtle Habitat Patch Quality</p> <ul style="list-style-type: none"> High Moderate Low <p>Northern Leopard Frog Habitat Patch Quality</p> <ul style="list-style-type: none"> High Moderate Low 	<ul style="list-style-type: none"> Delineated Wetlands
--	--	--

IDENTIFIED POTENTIAL HABITAT FOR TARGET AMPHIBIAN AND REPTILE SPECIES

0 200
FEET

SHEET 12 OF 18
Data for Reference Only

Note: No suitable habitat for the Karner blue butterfly in the environmental survey area.



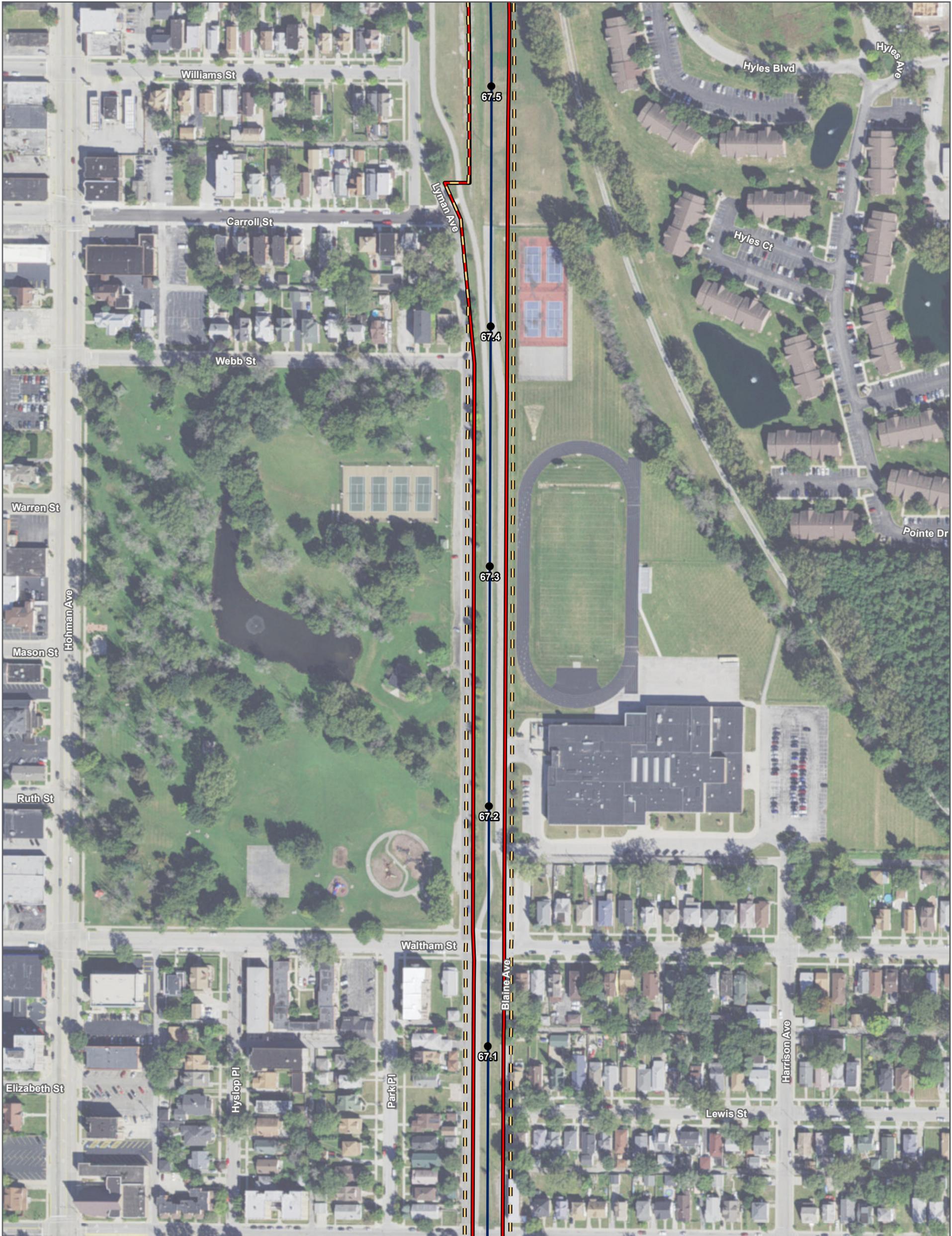
<ul style="list-style-type: none"> Existing Station Proposed Station Existing South Shore Line FEIS Preferred Alternative Milepost Milepost Stationing Environmental Survey Area Project Footprint 	<p>Blandings Turtle Habitat Patch Quality</p> <ul style="list-style-type: none"> High Moderate Low <p>Northern Leopard Frog Habitat Patch Quality</p> <ul style="list-style-type: none"> High Moderate Low 	<ul style="list-style-type: none"> Delineated Wetlands
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IDENTIFIED POTENTIAL HABITAT FOR TARGET AMPHIBIAN AND REPTILE SPECIES

0 FEET 200

SHEET 13 OF 18
Data for Reference Only

Note: No suitable habitat for the Karner blue butterfly in the environmental survey area.



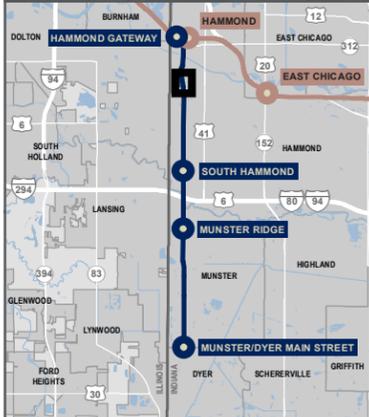
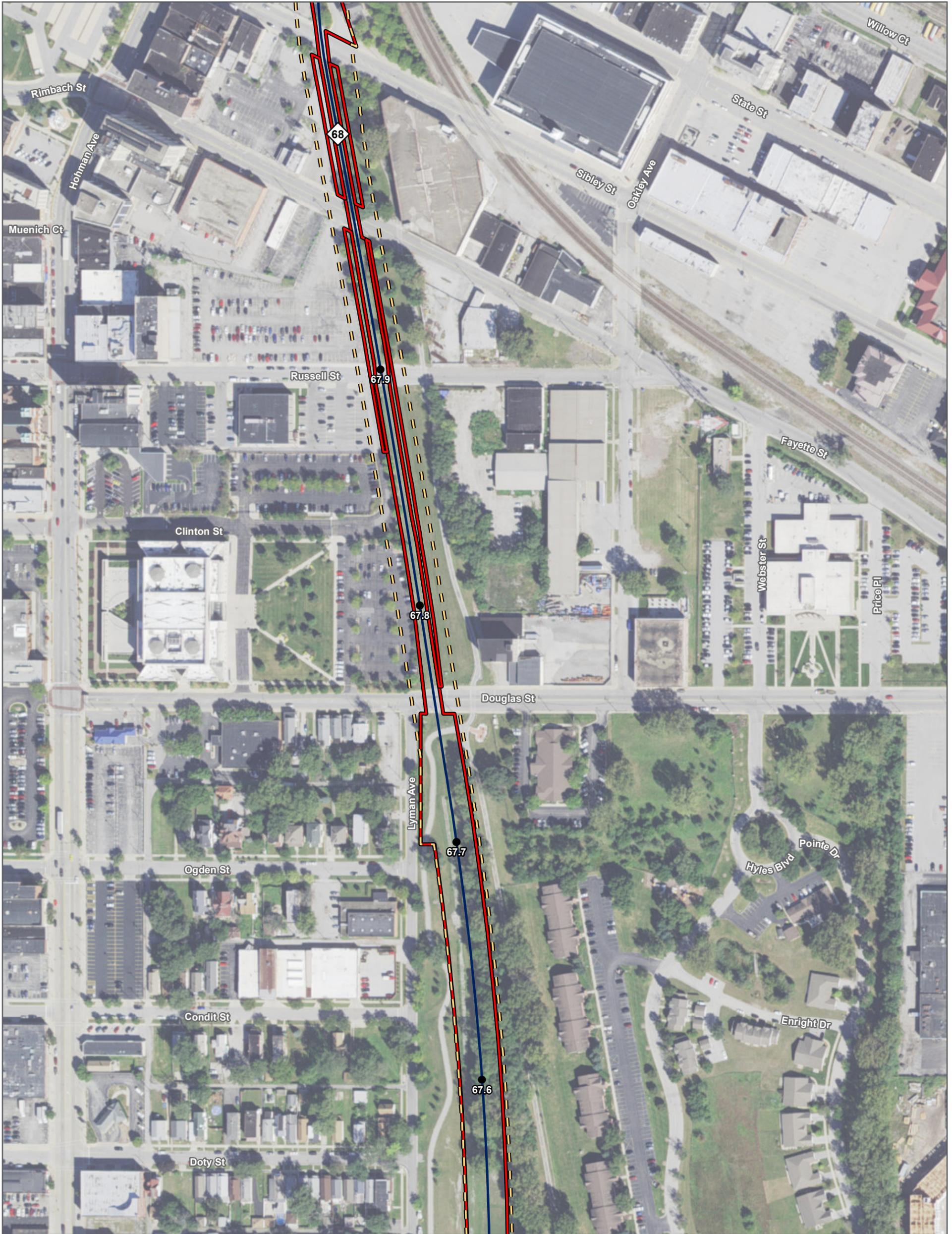
<ul style="list-style-type: none"> Existing Station Proposed Station Existing South Shore Line FEIS Preferred Alternative Milepost Milepost Stationing Environmental Survey Area Project Footprint 	<p>Blandings Turtle Habitat Patch Quality</p> <ul style="list-style-type: none"> High Moderate Low <p>Northern Leopard Frog Habitat Patch Quality</p> <ul style="list-style-type: none"> High Moderate Low 	<ul style="list-style-type: none"> Delineated Wetlands
--	--	--

IDENTIFIED POTENTIAL HABITAT FOR TARGET AMPHIBIAN AND REPTILE SPECIES

0 200
FEET

SHEET 14 OF 18
Data for Reference Only

Note: No suitable habitat for the Karner blue butterfly in the environmental survey area.



- Existing Station
- Proposed Station
- Existing South Shore Line
- FEIS Preferred Alternative
- Milepost
- Milepost Stationing
- Environmental Survey Area
- Project Footprint

- Blainings Turtle Habitat Patch Quality**
- High
 - Moderate
 - Low
- Northern Leopard Frog Habitat Patch Quality**
- High
 - Moderate
 - Low

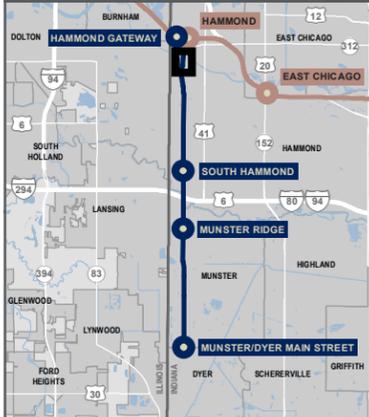
- Delineated Wetlands

IDENTIFIED POTENTIAL HABITAT FOR TARGET AMPHIBIAN AND REPTILE SPECIES

0 FEET 200

SHEET 15 OF 18
Data for Reference Only

Note: No suitable habitat for the Karner blue butterfly in the environmental survey area.

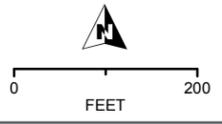


- Existing Station
- Proposed Station
- Existing South Shore Line
- FEIS Preferred Alternative
- Milepost
- Milepost Stationing
- Environmental Survey Area
- Project Footprint

- Blainings Turtle Habitat Patch Quality**
- High
 - Moderate
 - Low
- Northern Leopard Frog Habitat Patch Quality**
- High
 - Moderate
 - Low

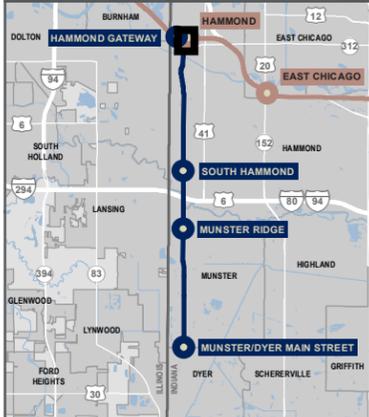
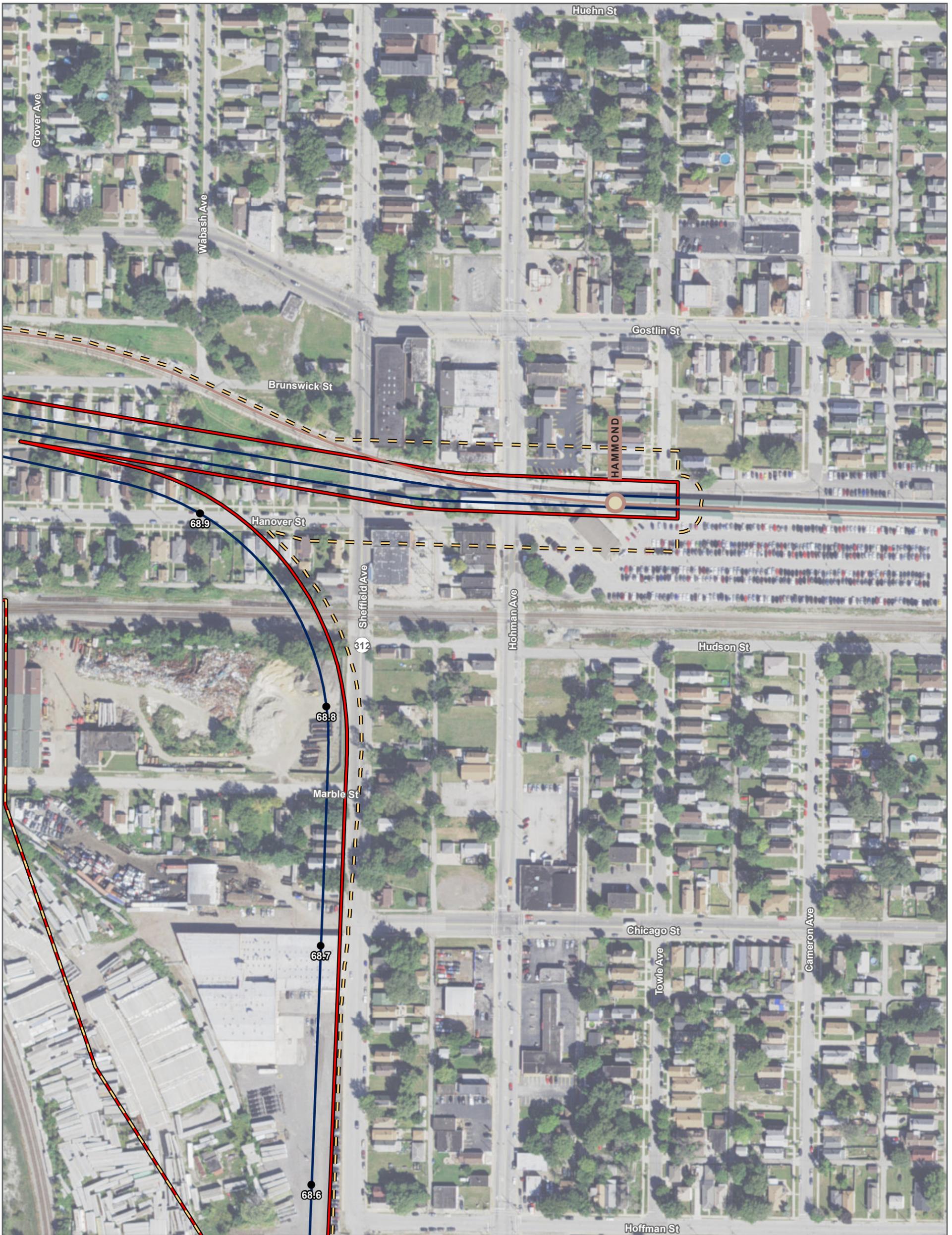
Delineated Wetlands

IDENTIFIED POTENTIAL HABITAT FOR TARGET AMPHIBIAN AND REPTILE SPECIES



SHEET 16 OF 18
Data for Reference Only

Note: No suitable habitat for the Karner blue butterfly in the environmental survey area.



- Existing Station
- Proposed Station
- Existing South Shore Line
- FEIS Preferred Alternative
- Milepost
- Milepost Stationing
- Environmental Survey Area
- Project Footprint

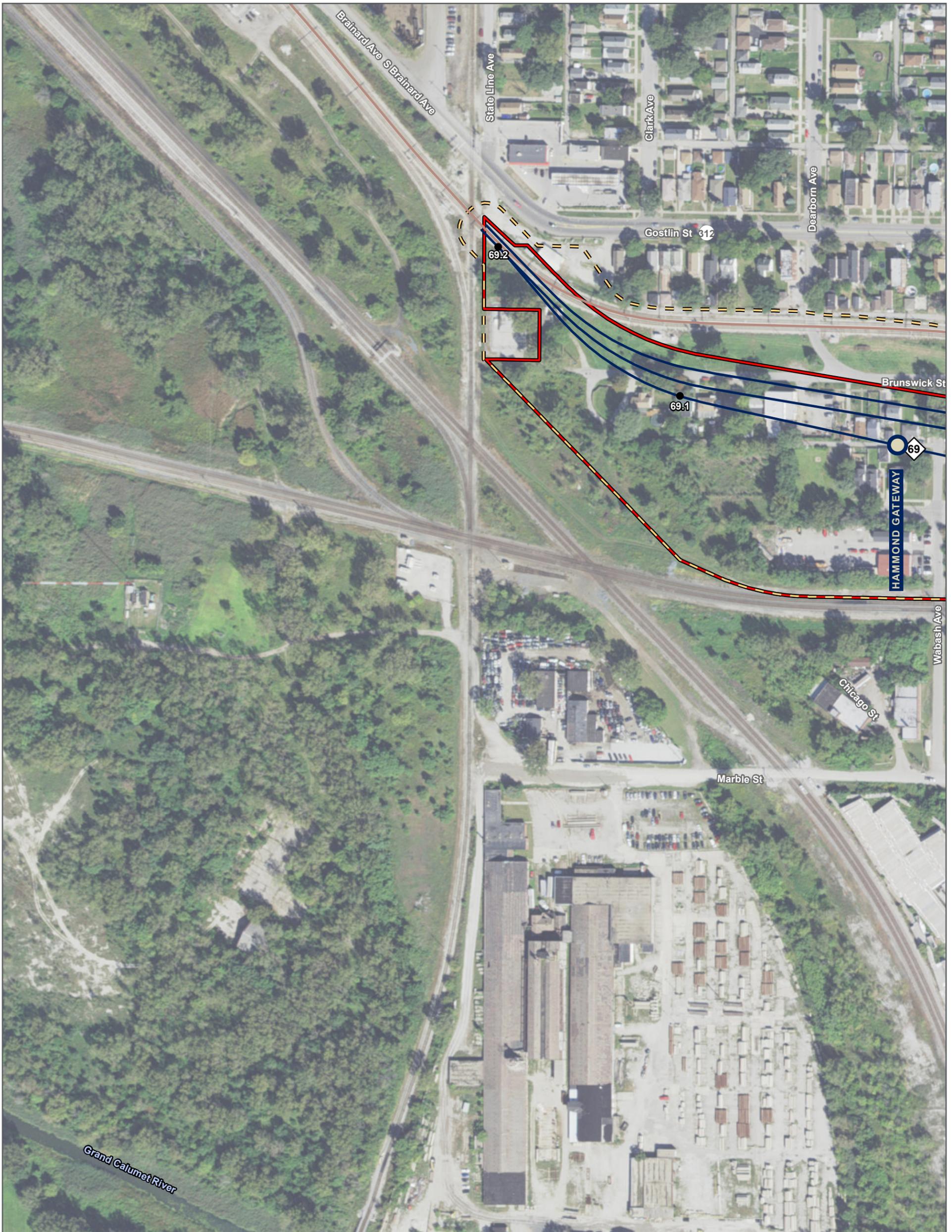
- Blainings Turtle Habitat Patch Quality**
- High
 - Moderate
 - Low
- Northern Leopard Frog Habitat Patch Quality**
- High
 - Moderate
 - Low

- Delineated Wetlands
- Note: No suitable habitat for the Karner blue butterfly in the environmental survey area.*

IDENTIFIED POTENTIAL HABITAT FOR TARGET AMPHIBIAN AND REPTILE SPECIES

0 FEET 200

SHEET 17 OF 18
Data for Reference Only



<ul style="list-style-type: none"> Existing Station Proposed Station Existing South Shore Line FEIS Preferred Alternative Milepost Milepost Stationing Environmental Survey Area Project Footprint 	<p>Blandings Turtle Habitat Patch Quality</p> <ul style="list-style-type: none"> High Moderate Low <p>Northern Leopard Frog Habitat Patch Quality</p> <ul style="list-style-type: none"> High Moderate Low 	<ul style="list-style-type: none"> Delineated Wetlands
--	--	--

IDENTIFIED POTENTIAL HABITAT FOR TARGET AMPHIBIAN AND REPTILE SPECIES

0 FEET 200

SHEET 18 OF 18
Data for Reference Only

Note: No suitable habitat for the Karner blue butterfly in the environmental survey area.



Appendix C. Representative Photographs



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Segment HP001



Segment HP002



Segment HP003



Segment HP004



Segment HP010



Segment HP012



Segment HP017



Segment HP024



Segment HP028



Segment HP029



Segment HP030



Segment HP031



Segment HP032



Segment HP033



Segment HP036



Segment HP037



Segment HP041



Segment HP043



Segment HP045



Segment HP046



Segment HP047



Segment HP048



Segment HP049



Segment HP050



Segment HP051



Segment HP052



Segment HP053



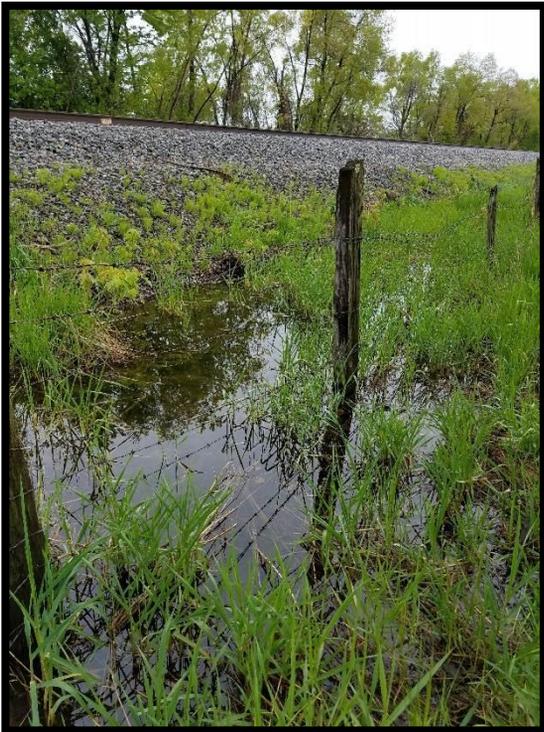
Segment HP054



Segment HP056



Segment HP057



Segment HP059



Segment HP060



Segment HAP001



Segment HAP002



Segment HAP003



Segment HAP004



Segment HAP006