APPENDIX G-1

Noise Impact Analysis

Clarification Note: This document was completed before the development of Central Alternative 1B Modified (Selected); therefore, the alternative is not included in the document. Applicable information regarding Central Alternative 1B Modified (Selected) is provided in Appendix G-2 *Noise Impact Analysis Addendum* and the FEIS.

November 2018

NOISE IMPACT ANALYSIS REPORT

I-69 Ohio River Crossing Project

Evansville, IN and Henderson, KY

OHIO RIVER CROSSING

Noise Impact Analysis

I-69 Ohio River Crossing Project
Evansville, IN and Henderson, KY

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CHAPTER 1 – PROJECT INTRODUCTION

1.1 NOISE IMPACT ANALYSIS INTRODUCTION

The change in traffic that results from introduction of a new highway and/or reconstruction of an existing highway presents the potential for noise impacts on adjacent properties. The purpose of this Noise Impact Analysis is to determine whether those impacts exist for this project based on the preliminary design. This analysis includes evaluating existing noise levels, predicting existing noise levels, predicting build noise levels, and when impacts occur, evaluating whether abatement measures are likely.

This analysis was conducted in accordance with Federal Highway Administration's (FHWA) 23 CFR Part 772 – *Procedures for Abatement of Highway Traffic Noise and Construction Noise*, Indiana Department of Transportation's (INDOT) *Traffic Noise Analysis Procedure* effective July 1, 2017 (INDOT 2017), and Kentucky Transportation Cabinet's (KYTC) *Noise Analysis and Abatement Policy* effective July 1, 2015 (KYTC 2015).

1.2 PROJECT DESCRIPTION

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

For the new DEIS that is being prepared for the I-69 ORX project, the project area extends from I-69 (formerly I-164) in Indiana on the south side of Evansville (i.e., northern terminus) across the Ohio River to I-69 (formerly Edward T. Breathitt Pennyrile Parkway) at the KY 425 interchange southeast of Henderson, KY (i.e., southern terminus) (**Figure 1.2-1**). The section of Edward T. Breathitt Pennyrile Parkway between KY 351 and KY 425 that was not re-designated as I-69 was recently re-designated as US 41. The western limit of the project area is parallel to and extends a maximum of about 2,000 feet west of US 41. The eastern limit of the project area extends about 1,500 feet to 3.4 miles east of US 41. Currently, I-69 does not cross the Ohio River and the only cross-river access between Evansville and Henderson is via US 41, which is classified as a principal arterial and does not meet current interstate design standards.

One of the first steps in the EIS process for the I-69 ORX project was the scoping phase which included the development of the project's purpose and need. As a result of this analysis, the following project needs have been identified:

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

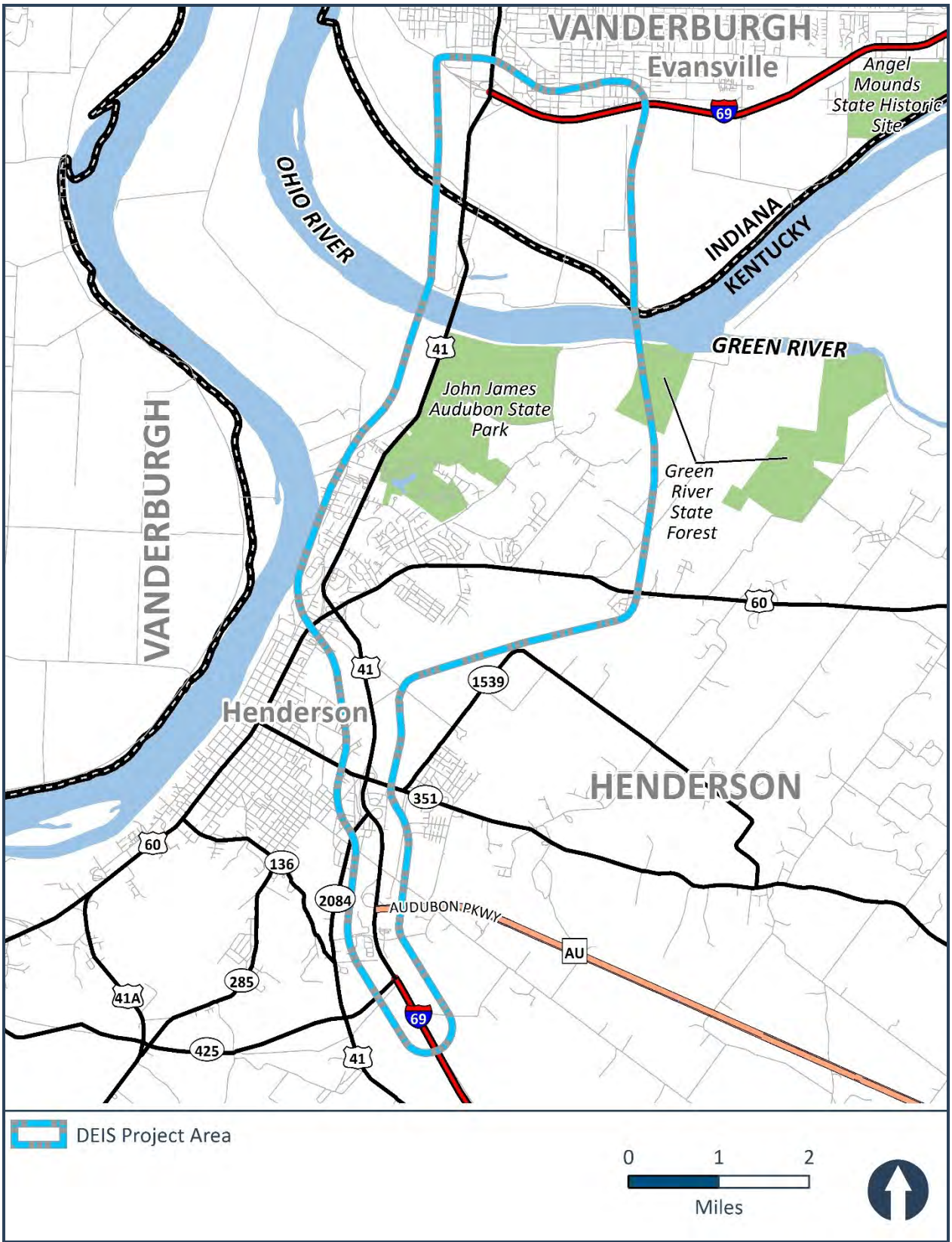

Figure 1.2-1. DEIS Project Area

Based on these needs, the project's purpose is:

- Provide cross-river system linkage and connectivity between I-69 in Indiana and I-69 in Kentucky that is compatible with the National I-69 Corridor
- Develop a solution to address long-term cross-river mobility
- Provide a cross-river connection that reduces traffic congestion and delay
- Improve safety for cross-river traffic

Based on the project's purpose and need, an initial range of alternatives was developed, evaluated, and screened using secondary source and windshield survey data, and input from the public and federal, state, and local agencies. Because the range of alternatives was developed based on conceptual designs, they were referred to as corridors. Each corridor was evaluated on the degree to which it meets the purpose and need; its potential social, environmental, and economic impacts; and its conceptual cost. In addition to the No Build Alternative, the following five corridors were developed based on alternatives previously presented in the 2004 *Interstate 69 Henderson, Kentucky to Evansville, Indiana Draft Environmental Impact Statement* (INDOT, and KYTC 2004) and the 2014 *I-69 Feasibility Study, Henderson, Kentucky, SIU #4, Final* (KYTC 2014).

- West Corridor 1 (Based on Alternative 7 from the 2014 Feasibility Study)
- West Corridor 2 (Based on Corridors F and G from the 2004 DEIS and Alternatives 5 and 6 from the 2014 Feasibility Study)
- Central Corridor 1 (Based on Alternative 1a from the 2014 Feasibility Study)
- Central Corridor 2 (Based on the Preferred Alternative 2 from the 2004 DEIS)
- East Corridor (Based on Alternative 3 from the 2004 DEIS)

The results of the evaluation of these corridors were presented in a *Screening Report* (INDOT and KYTC 2017) completed on July 28, 2017 that recommended three corridors — West Corridor 1, West Corridor 2, and Central Corridor 1 — be carried forward for more detailed evaluation in the DEIS, in addition to the No Build Alternative. In the *Screening Report*, for West Corridors 1 and 2, it was assumed that both US 41 bridges would be taken out of service for vehicular use and the new I-69 bridge would have six lanes. For Central Corridor 1, it was assumed that both US 41 bridges would remain open and the new I-69 bridge would have four lanes. The EMPO regional traffic model was used to determine that six lanes of total cross-river capacity is sufficient for the region through 2045 (see Section 3.3 of the Screening Report Supplement in Appendix B-2). However, the report stated that the future use of the existing US 41 bridges and corresponding number of lanes on the new I-69 bridge for each corridor would be subject to further evaluation.

Following the *Screening Report*, preliminary designs were then developed within these corridors based on public and agency input, assessment of potential environmental and right-of-way impacts, and results of a traffic analysis. Follow-up studies were conducted regarding the location and configuration of interchanges, the disposition of and long-term maintenance costs for the existing US 41 bridges, and tolling scenarios with resulting traffic patterns. This included the

development, evaluation, and screening of the following three different US 41 and I-69 bridge scenarios for each of the three corridors.

- Build a six-lane I-69 bridge for all cross-river traffic and remove both US 41 bridges from vehicular use.
- Build a four-lane I-69 bridge and retain one US 41 bridge for local traffic.
- Build a four-lane I-69 bridge and retain both US 41 bridges for local traffic

The results from this next level of evaluation of the project corridors were presented in a *Screening Report Supplement* (INDOT and KYTC 2018), dated January 2018. The *Screening Report Supplement* identified the best bridge scenario for each corridor and the following alternatives to be carried forward for detailed evaluation in the DEIS and this Noise Impact Analysis.

- No Build Alternative: required by NEPA to serve as a baseline for comparison
- West Alternative 1: four lanes on the new I-69 bridge and retain one of the existing US 41 bridges
- West Alternative 2: six lanes on the new I-69 bridge and take both existing US 41 bridges out of service
- Central Alternative 1: four lanes on the new I-69 bridge and retain one of the existing US 41 bridges

Following the *Screening Report Supplement*, it was determined that the northbound US 41 bridge would be retained and the southbound US 41 bridge would be removed for West Alternative 1 and Central Alternative 1 and both bridges would be removed for West Alternative 2. The three recommended DEIS build alternatives are shown in **Figure 1.2-2** and described in greater detail in the following sections. More detailed figures of the three recommended DEIS build alternatives is provided as Figure 1 through 3 in Appendix A.

Consistent with the Evansville Metropolitan Planning Organization's fiscally-constrained Metropolitan Transportation Plan, tolling I-69 will be a key part of the financing for this project. The toll policy will define toll rates for different vehicle types and will be developed with the federally required financial plan prior to construction. The NEPA process will not determine the toll policy but will evaluate, and document in the DEIS, the environmental consequences associated with tolling being a part of the project.

For most impact categories, the DEIS will evaluate potential impacts that would result from the placement of tolls on both the I-69 bridge and the remaining northbound US 41 bridge. This would provide a "reasonable worst case" in terms of potential impacts associated with increased traffic volumes on I-69 for most impact categories. However, because these two toll scenarios could alter the distribution of traffic between I-69 and US 41 and, therefore, affect noise levels, both scenarios were analyzed in this report. For purposes of evaluation, it was assumed that toll rates would be similar to the Louisville, KY metropolitan area bridges for the I-65 and KY 841/ SR 265 Ohio River Crossings (i.e., $2.00 for cars, $5.00 for medium trucks, and $10 for large

trucks). Both projects are located in metropolitan areas within the same geographical region and have comparable total costs.

1.2.1 West Alternative 1

West Alternative 1 would include a new I-69 bridge approximately 5,400 feet long over the Ohio River and associated floodway that would be located approximately 70 feet west of the existing southbound US 41 bridge. The new bridge would include four lanes, with the capacity to expand to six lanes in the future, if needed, by restriping the lanes on the bridge; therefore, it would not require additional right-of-way or major construction. The rest of the alternative would also include four lanes but without the capacity to expand to six lanes by restriping lanes. The northbound US 41 bridge would be retained and the southbound US 41 bridge would be removed. The northbound US 41 bridge that would be retained, which has two lanes, would be converted from a one-way bridge to a two-way bridge for local traffic. Most of West Alternative 1 would utilize rural design standards, including a grass median; however, through Henderson, it would utilize urban design standards and include a narrower median with a concrete barrier. West Alternative 1 would begin on existing I-69 in Indiana just east of the US 41 interchange and become the through movement for I-69. Connections to US 41 to the north and Veterans Memorial Parkway to the west would be provided. The alternative would include a bridge to carry I-69 over Waterworks Road and Nugent Drive while local access to Waterworks Road and Ellis Park would be maintained by US 41.

In Kentucky, the alternative would include a bridge to carry I-69 over Stratman Road, with local access to Stratman Road and Wolf Hills Road provided by US 41 and the local bridge. The alternative would continue south and run parallel to and approximately one block west of US 41 and the Henderson commercial strip. There would be no changes to US 41 through this area. An interchange would be constructed at Watson Lane to provide highway access to the commercial strip and adjacent residential areas. An overpass (no interchange) would be provided at Barker Road to maintain connection to residential areas west of the alternative. A local access road with a sidewalk would be provided on the west side of the alternative between Barker Road and Atkinson Park. The alternative would then continue south and tie into the existing four-lane, fully-controlled access section of US 41 south of the US 60 interchange. The US 60 interchange would be modified to provide connections to and from existing US 41, US 60, and I-69. US 41 (formerly named the Edward T. Breathitt Pennyrile Parkway) south of US 60 to KY 425, where I-69 in Kentucky currently ends, would be modernized to meet interstate standards through improvements to ramps and merge areas. The total length of West Alternative 1 is 11.1 miles, which includes 2.9 miles of existing US 41.

1.2.2 West Alternative 2

As with West Alternative 1, West Alternative 2 would include a new I-69 bridge approximately 5,400 feet long over the Ohio River and associated floodway that would be located approximately 70 feet west of the existing southbound US 41 bridge. The new I-69 bridge for West Alternative 2 would include six lanes and both of the existing US 41 bridges would be removed. The sections of the alternative north of the new bridge to Waterworks Road and south of the new bridge to

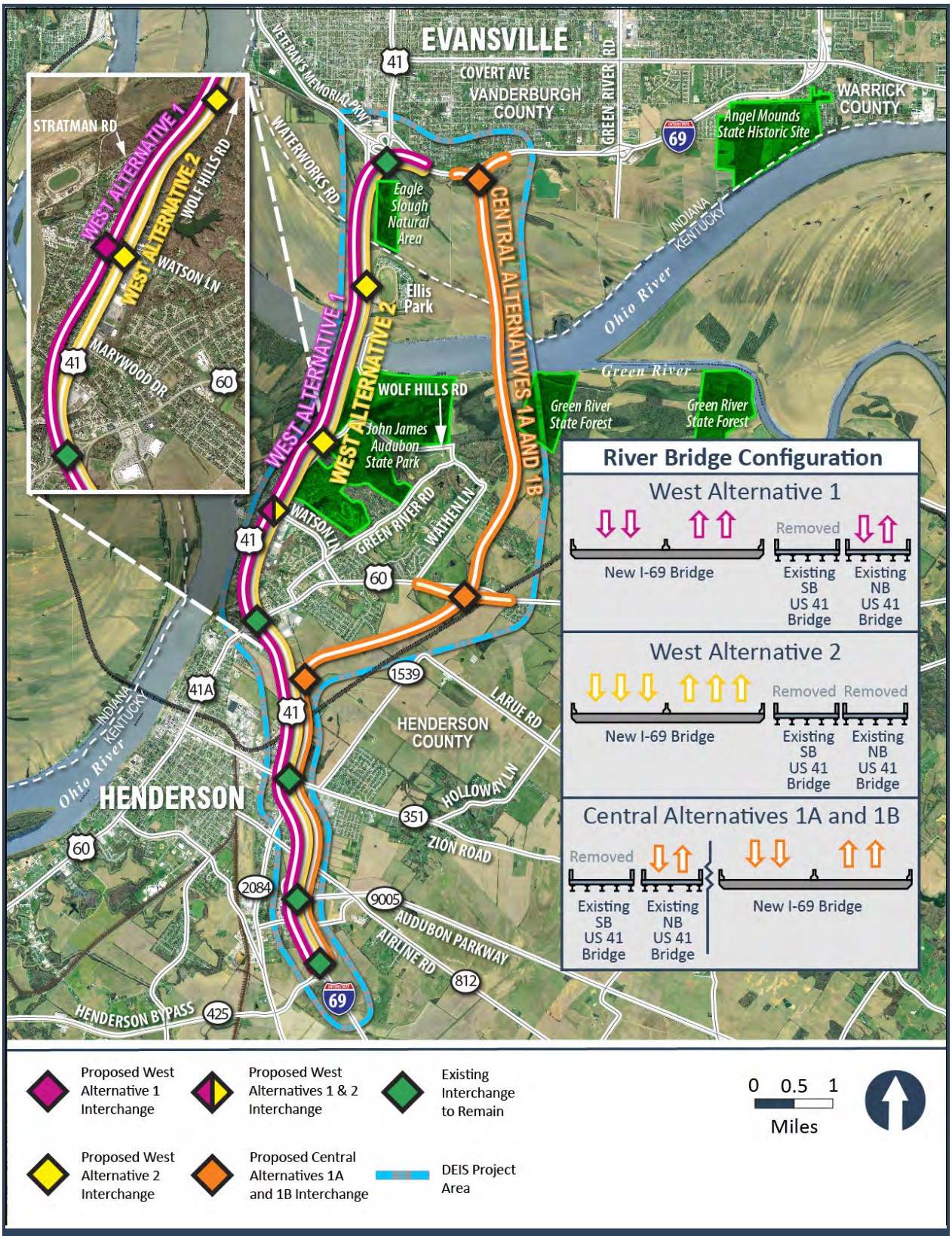

Figure 1.2-2. DEIS Alternatives

US 60 would also be six lanes. South of US 60, the alternative would transition from six lanes to the existing four lanes on US 41. Most of West Alternative 2 would utilize rural design standards, including a grass median; however, through Henderson, it would utilize urban design standards and include a narrower median with a concrete barrier. Similar to West Alternative 1, West Alternative 2 would begin on existing I-69 in Indiana just east of the US 41 interchange and become the through movement for I-69. Connections to US 41 to the north and Veterans Memorial Parkway to the west would be provided. From the US 41/I-69 interchange to Ellis Park, the alternative would follow the existing US 41 alignment. An overpass bridge would carry Waterworks Road over I-69 and an interchange would be provided at Ellis Park.

In Kentucky, the alternative would follow existing US 41 through the Henderson commercial strip, with local access provided via a reconstructed US 41, which would function as a frontage road, located adjacent to and east of the alternative. The reconstructed US 41 would include two lanes plus a center, two-way left turn lane and a new sidewalk on the east side. There are currently no sidewalks along US 41 in this area. An interchange would be provided at Stratman Road/Wolf Hills Road and at Watson Lane. At the Watson Lane interchange, US 41 would be relocated approximately 300 feet to the east to provide adequate spacing between the interchange and the US 41/Watson Lane intersection. An overpass (no interchange) would be provided at Rettig Road to maintain connection to residential areas west of the alternative. In addition, a shared-use path would be provided on the west side of the new interstate. The alternative would continue south, within the US 41 corridor, to the existing US 60 interchange, which would be modified to provide connections to and from existing US 41, US 60, and I-69. The existing four-lane section of US 41 (formerly named the Edward T. Breathitt Pennyrile Parkway) south of US 60 to KY 425, where I-69 in Kentucky currently ends, would be modernized to meet interstate standards through improvements to ramps and merge areas. The total length of West Alternative 2 is 11.0 miles, which includes 2.9 miles of existing US 41.

1.2.3 Central Alternatives 1A and 1B

Central Alternative 1 is described in the DEIS as two alternatives, Central Alternatives 1A and 1B. They are physically the same alternative, but differ with respect to tolling. Central Alternative 1A would toll both the I-69 and the US 41 bridges, and Central Alternative 1B would toll only the I-69 bridge. The tolling differences would result in differences in traffic volumes on I-69 and US 41 and therefore would have differences in noise impacts. Central Alternatives 1A and 1B would both include a new I-69 bridge, approximately 7,600 feet long over the Ohio River and associated floodway, located approximately 1.5 miles east of the existing US 41 bridges. The new I-69 bridge would include four lanes, with the capacity to expand to six lanes in the future, if needed, by restriping the lanes on the bridge; therefore, it would not require additional right-of-way or major construction. The rest of the alternatives would also include four lanes but without the capacity to expend to six lanes by restriping lanes. The northbound US 41 bridge would be retained and the southbound US 41 bridge would be removed. The northbound US 41 bridge that would be retained, which has two lanes, would be converted from a one-way bridge to a two-way bridge for local traffic. There would be no changes to US 41 through the commercial strip. Central Alternatives 1A and 1B would utilize rural design standards and include a depressed grass median outside of the bridge limits.

Central Alternatives 1A and 1B both begin at existing I-69 in Indiana, approximately 1 mile east of the US 41 interchange. The alternatives would continue south across the Ohio River just west of a gas transmission line. They would remain just west of the gas transmission line near the Green River State Forest, then turn southwest where an overpass would be provided to carry the access road for the gas transmission line over the alternatives. The alternatives would continue south to US 60 where an interchange would be provided. As part of the US 60 interchange, US 60 would be relocated approximately 400 feet south, which would require a new bridge over the CSX Railroad east of the interchange. The alternatives would continue southwest and connect with US 41 via an interchange approximately 1 mile south of the US 60 interchange. From the alternatives' interchange with US 41 to KY 425, the existing four-lane US 41 would be modernized to meet interstate standards through improvements to ramps and merge areas. The total length of Central Alternatives 1A and 1B is 11.2 miles, which includes 2.8 miles of existing US 41.

CHAPTER 2 – POLICY AND GUIDELINES

FHWA noise standards, *Procedures for Abatement of Highway Traffic Noise and Construction Noise, 23 CFR 772 [1]*, require that noise abatement measures be considered when traffic noise impacts are identified for Type 1 Federal projects. The noise standards define Type 1 projects as:

1. The construction of a highway on new location; or,
2. The physical alteration of an existing highway where there is either:
   - Substantial Horizontal Alteration. A project that halves the distance between the traffic noise source and the closest receptor between the existing condition to the future build condition; or,
   - Substantial Vertical Alteration. A project that removes shielding therefore exposing the line-of-sight between the receptor and the traffic noise source. This is done by either altering the vertical alignment of the highway or by altering the topography between the highway traffic noise source and the receptor; or,
   - The addition of a through-traffic lane(s). This includes the addition of a through-traffic lane that functions as a HOV lane, High-Occupancy Toll (HOT) lane, bus lane, or truck climbing lane; or,
   - The addition of an auxiliary lane, except for when the auxiliary lane is a turn lane; or,
   - The addition or relocation of interchange lanes or ramps added to a quadrant to complete an existing partial interchange; or,
   - Restriping existing pavement for the purpose of adding a through-traffic lane or an auxiliary lane; or,
   - The addition of a new or substantial alteration of a weigh station, rest stop, ride-share lot or toll plaza.

If a project is determined to be a Type I project per § 772.5 then the entire project area as defined in the environmental document is a Type I project.

The proposed project qualifies as a Type 1 project, and therefore this study has been prepared in accordance with FHWA noise standards, as well as INDOT's *Traffic Noise Analysis Procedure* (INDOT 2017) and KYTC's *Noise Analysis and Abatement Policy* (KYTC 2015). The following tasks were performed:

- Identification of noise-sensitive areas: Identify specific areas within the study area (500 feet from the edge of pavement) with land uses that are sensitive to highway traffic noise
- Determination of existing sound levels: Measurement/modeling of existing sound levels at noise sensitive receivers/receptors to characterize the existing noise environment in the study area

- Determination of future sound levels: Prediction of future, design year, and worst-hour sound levels for the No Build Alternative and proposed Build Alternatives
- Discussion of INDOT and KYTC criteria for determining noise impacts
- Determination of traffic noise impacts: Determination of noise impacts based on the increase in existing sound levels, as well as design year sound levels for the proposed Build Alternatives
- Noise abatement evaluation: Evaluation of noise abatement for areas determined to be impacted by the project along the proposed Build Alternatives
- Discussion of construction noise associated with the proposed Build Alternatives

Each of these analytical steps is discussed herein.

2.1 TRAFFIC NOISE TERMINOLOGY

Traffic noise levels are expressed in terms of the hourly, A-weighted equivalent sound level in decibels (dB[A]). A sound level represents the magnitude of the rapid air pressure fluctuations caused by sources such as traffic that are heard as sound. A decibel (dB) is a unit signifying the amount of pressure fluctuation equivalent to the faintest sound the young human ear can hear.

The A-weighting refers to the amplification or attenuation of the different frequencies of the sound (the pitch) to correspond to the way the human ear "hears" these frequencies. A 9 – 10 dB increase in sound level is typically judged by the listener as twice as loud as the original sound, while a 9 – 10 dB reduction is judged as half as loud.

Because most environmental sound fluctuates from moment to moment, it is standard practice to condense data into a single level called the equivalent sound level (L_{eq}). The L_{eq} represents a steady sound level that would contain the same amount of sound energy as the actual time-varying sound evaluated over the same time period. The L_{eq} averages the louder and quieter moments, but gives much more weight to the louder moments in the averaging. For traffic noise assessment purposes, L_{eq} is typically evaluated over the 1-hour period with the greatest amount of noise generated per 24-hour period. Doubling the number of noise sources (i.e., vehicles) will increase the hourly equivalent sound level by approximately 3 dB, which is usually the smallest change in hourly equivalent A-weighted traffic noise levels that people can perceive.

The first step in any noise impact analysis is identification of areas where there is potential for increased traffic noise levels as a result of the project, called Noise Sensitive Area(s) (NSA). Receptors are then identified within the NSA's. A receptor is a discrete or representative location of a noise sensitive area for any of the land uses listed in **Table 2.3–1**. Receptors are represented in the noise modeling software by a receiver point. At some locations, such as a park, cemetery or multi-family dwelling unit, a single receiver can represent multiple receptors within the model. Traffic noise levels are predicted for each receiver and that result is used for each receptor it represents. While the noise value for each receiver is used to determine impacts, the number of benefited receptors is considered when analyzing for noise abatement.

2.2 IDENTIFICATION OF NOISE SENSITIVE AREAS

NSAs were identified throughout the project's study area. For modeling purposes, though, the study area was divided into five Noise Sensitive Areas (NSA) as described below. Per INDOT noise policy (INDOT 2017), NSAs contain all lands within 500 feet of the proposed edge of pavement for each project alternative. When impacts were found at 500 feet, the NSA was extended to include 800 feet. They are:

- NSA 1 – All alternatives north of the Ohio River
- NSA 2 – West Alternatives 1 and 2 from the Ohio River to the US 60 interchange
- NSA 3 – All alternatives from US 60 interchange to US 41 (KY 351 to KY 425)
- NSA 4 – Central Alternatives 1A and 1B from the Ohio River to the US 60 interchange
- NSA 5 – All alternatives along US 41(KY 351 to KY 425)

2.3 IDENTIFICATION OF RECEPTORS AND RECEIVERS

Once NSAs were known, noise receptors within each NSA were identified and their land use noted according to Activity Category (AC), as described in **Table 2.3–1**. In the five NSAs for this project, receptors include residential (AC B), recreational (AC C), places of worship (AC D), medical facilities (AC D), a hotel (AC E), and emergency services (AC F).

Table 2.3–1. Activity Category Descriptions

ACTIVITY CATEGORY	ACTIVITY DESCRIPTION
A	Lands on which serenity and quiet are of extraordinary significance and serve an important public need and where the preservation of those qualities is essential if the area is to continue to serve its intended purpose.
B[1]	Residential.
C[1]	Active sport areas, amphitheaters, auditoriums, campgrounds, cemeteries, day care centers, hospitals, libraries, medical facilities, parks, picnic areas, places of worship, playgrounds, public meeting rooms, public or nonprofit institutional structure, radio stations, recording studios, recreation areas, Section 4(f) sites, schools, television studios, trails, and trail crossings.
D	Auditoriums, day care centers, hospitals, libraries, medical facilities, places of worship, public meeting rooms, public or nonprofit institutional structure, radio studios, recording studios, schools, and television studios.
E[1]	Hotels, motels, offices, restaurants/bars, and other developed lands, properties or activities not included in A–D, or F.
F	Agriculture, airports, bus yards, emergency services, industrial, logging, maintenance facilities, manufacturing, mining, rail yards, retail facilities, shipyards, utilities (water resources, water treatment, electrical), and warehousing.
G	Undeveloped lands that are not permitted.

[1] Includes undeveloped lands permitted for this activity category

Source: *Procedures for Abatement of Highway Traffic and Construction Noise*

A receiver point was placed in the model to represent the identified receptors. In some cases, a single receiver would represent multiple receptors. For residential receivers, the number of

receptors represented by each receiver was determined by examining the number of dwellings in the vicinity of the receiver that were located in similar proximity to the roadway.

For certain land uses, such as cemeteries and recreational areas, the number of receptors was determined based on Equivalent Residences (ER), a value calculated in accordance with INDOT' and KYTC noise policies. INDOT and KYTC noise policies provide equations, shown in **Figure 2.3–1** and **Figure 2.3–2** respectively, for the calculation of ER:

$$\left(\frac{Daily\ \#\ of\ Users}{2.52\ people\ on\ average\ per\ household}\right) X \begin{pmatrix} Percentage\ of\ Property \\ Within\ 500\ feet \end{pmatrix} = \text{Equivalent Residences}$$

Figure 2.3–1. INDOT's Equivalent Residences Formula

$$ER = \left(\frac{X\ Persons}{2.5\ persons\ per\ avg\ household}\right)\left(\frac{X\ hour\ avg\ weekly\ use}{168\ hours\ per\ week}\right) = \text{Equivalent Residences}$$

$$ER = \left(\frac{X\ Persons}{2.5\ persons\ per\ avg\ household}\right)\left(\frac{X\ hour\ avg\ daily\ use}{24\ hours\ per\ day}\right) = \text{Equivalent Residences}$$

Figure 2.3–2. KYTC's Equivalent Residences Formulas

Due to the large number of receivers/receptors identified for this project, a naming convention was established to help represent their location within the study area. Receivers were named by their state location, NSA, roadside level, and street identification, and were numbered accordingly. The 'roadside level' describes the side of the road on which the receiver is located, with '01' being the farthest away from the proposed alternative, and '02' being closer. The street identifications use the first three letters of the street name and then one letter of the abbreviated road type (e.g., "S" for street). **Figure 2.3–3** provides an explanation of the naming convention, and a legend of each street ID used is provided in **Table 1 of Appendix B**.

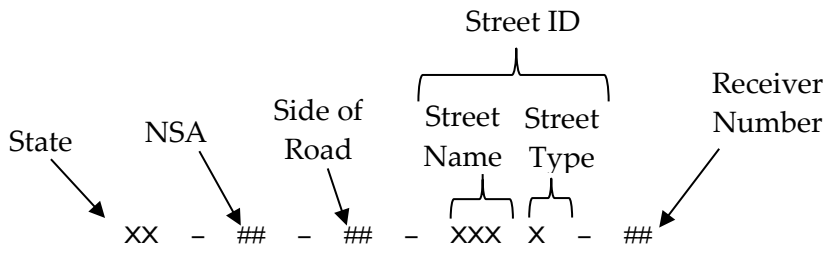

Figure 2.3–3. Receiver Naming Convention

2.4 CRITERIA FOR DETERMINING TRAFFIC NOISE IMPACTS

Noise impacts are determined by comparing future project sound levels: (1) to a set of Noise Abatement Criteria (NAC) for a particular land use category, and (2) to existing sound levels.

2.4.1 Noise Abatement Criteria

FHWA noise standards (contained in 23 CFR 772), as well as INDOT and KYTC noise policies, state that traffic noise impacts require consideration of abatement when worst-hour sound levels approach (within 1 dB[A] L_{eq}) or exceed the NAC listed in **Table 2.4–1**. Noise impacts will be identified and noise abatement will be considered if design year sound levels at the Category B and C land uses are 66 dB(A) or higher or if the design year sound levels at the Category E land uses are 71 dB(A) or higher.

Table 2.4–1. Noise Abatement Criteria

ACTIVITY CATEGORY (AC)	L_{EQ} (1H) DB(A)	EVALUATION LOCATION
A	57	Exterior
B[1]	67	Exterior
C[1]	67	Exterior
D	52	Interior
E[1]	72	Exterior
F	—	—
G	—	—

[1] Includes undeveloped lands permitted for this activity category

Source: *Procedures for Abatement of Highway Traffic and Construction Noise*

2.4.2 Substantial Increase Definition

FHWA, INDOT, and KYTC noise standards also define impacts to occur if there is a substantial increase in design year sound levels compared to existing sound levels. INDOT's criteria defines a substantial noise increase as an increase of 15 dB(A) or more over the existing noise level. KYTC's criteria uses 10 dB(A) or more over the existing noise level as it's criteria for substantial noise increase. Noise abatement will be considered when noise impacts are identified due to a substantial increase in existing sound levels.

2.5 NOISE ABATEMENT EVALUATION

Abatement is evaluated when a receiver is predicted to result in a noise impact by approaching or exceeding the NAC or substantially exceeding the existing noise level. For noise barriers to be included in the project plans for the impacted noise analysis areas, they must be determined to be both feasible and reasonable in accordance with INDOT's and KYTC's noise policies.

2.5.1 Noise Barrier Feasibility

When determining the acoustic feasibility of a proposed noise abatement measure, INDOT considers whether the measure achieves a 5 dB(A) reduction at a majority (greater than 50 percent) of the impacted receivers. KYTC's policy determines the acoustic feasibility of a proposed noise abatement measure by whether the measure provides a substantial reduction (5 dB[A]) for, at a minimum, three impacted receptors. Noise abatement is not considered feasible when there are less than three impacted receptors.

Engineering or constructability issues may render an abatement measure infeasible if the barrier would pose overriding safety (visibility issues) or maintenance (drainage and right-of-way access) problems as determined by the American Association of State Highway and Transportation Officials (AASHTO) *Green Book*, *Roadside Design Guide*, or *Manual of Uniform Traffic Control Devices* (MUTCD).

FHWA's Traffic Noise Model, Version 2.5 (TNM 2.5) software was used to assess whether a potential noise barrier would meet the feasible criteria. Each potential noise barrier must also pass a "reasonableness" test as described below.

2.5.2 Noise Barrier Reasonableness

If a barrier is determined to be feasible, then the barrier is assessed for reasonableness in accordance with either INDOT or KYTC criteria, depending on the location of the wall.

For INDOT, potential noise abatement must meet the following criteria to be considered reasonable. If any of the criteria are not met, noise abatement measures would not be constructed.

- Consideration and Obtaining Views of Residents and Property Owners: The views of the benefited receptors and property owners would be considered in determining the reasonableness of noise barriers. The concerns and opinions of the property owner and the unit occupants would be balanced with other considerations in determining whether a barrier is appropriate for a given location.
- Cost-effectiveness: To determine cost effectiveness, the estimated cost of constructing a noise barrier (including installation and additional necessary construction such as foundations or guardrails) would be divided by the number of benefited receptors (those who would receive a reduction of at least 5 dB[A]). A base material and design cost of $25,000 or less per benefited receptor is currently considered to be cost-effective. Development in which a majority (more than 50 percent) of the receptors were in place prior to the initial construction of the roadway in its current state (functional classification) will receive additional consideration for noise abatement. The cost-effectiveness criteria used for these cases will be 20 percent greater (currently $30,000 per benefited receptor).
- INDOT Design Goal for Noise Abatement: The noise reduction design goal for Indiana is 7 dB(A) for a majority (greater than 50 percent) of the benefited first row receptors.

KYTC has similar criteria for noise abatement reasonableness. If any of the criteria are not met, noise abatement measures would not be constructed.

- Desires of Benefited Receptors: The views of the benefited receptors and property owners would be considered in determining the reasonableness of noise barriers. When the majority of benefited receptors and property owners engaged through the public involvement process are opposed to construction of a noise barrier, KYTC will give deference to these opinions in making a final determination regarding the reasonableness of the measure regardless of whether the proposal satisfies all other criteria for consideration. Where the majority of the benefited receptors and property owners involved in the public involvement process are in support of noise barrier construction,

and the proposal satisfies all other criteria for consideration outlined in KYTC's noise policy, KYTC shall incorporate the abatement measures into the project.

- Noise Reduction Design Goal: KYTC' s noise reduction design goal is 7 dB(A) for a minimum of 50 percent of front row benefited receptors.
- Cost Effectiveness: The total cost of a noise barrier is estimated based on an average cost of $30 per square foot of barrier wall, as outlined in KYTC's 2015 *Noise Analysis and Abatement Policy* (KYTC 2015). This cost is then divided by the total number of benefited receptors as determined by the TNM 2.5 barrier analysis, to determine a total "cost per benefited receptor" (CBR). KYTC has established a CBR of $35,000 as a reasonable maximum threshold for this value. Locations where the CBR exceeds this threshold value would not be considered cost effective; locations where the CBR is less than this threshold would be cost effective.

2.5.3 Structural Noise Barrier Analysis Methodology

A structural noise barrier was evaluated to assess the likeliness for noise impact mitigation when noise sensitive receptors were identified as impacted from a build alternative as described in Section 2.4. Each structural noise barrier was evaluated in accordance with the feasibility and reasonableness criteria outlined above and these criteria provide a framework for assessing the barriers modeled in TNM 2.5.

1. Each modeled barrier was evaluated for feasibility, in accordance with INDOT and KYTC policies, to determine if further analysis was necessary. Every barrier analyzed met the feasibility requirements;
2. Next, each barrier was evaluated for its ability to provide 7 dB(A) of attenuation for first row benefited receptors, in accordance with the design goals of INDOT and KYTC. If no combination of wall length and height could meet this criterion then the analysis was concluded and the barrier with the greatest attenuation was recorded and presented in this report. If the design goal was achieved, then the cost-effectiveness criterion was evaluated and optimized;
3. If a structural noise barrier design was found to meet the design goal, then the cost of the barrier was compared to the number of benefited receptors and compared to the reasonableness criterion for cost-effectiveness. If the barrier was not cost-effective, then the wall length and/or height was increased to increase the number of benefited receptors. If there was still no cost-effective barrier, the analysis continued by looking for a smaller sub–set of the analysis area that might meet the reasonableness criteria. This barrier optimization was performed to try and find a combination of wall length and/or height that would meet the cost-effectiveness criteria. In these instances, the barrier was then optimized for benefited receptors and checked against the cost-effectiveness criterion. If the barrier was still not cost-effective, the barrier that was closest to meeting the criteria was recorded and is presented in this report.

4. If a structural noise barrier was found to meet all the feasibility and reasonableness criteria, then the barrier analysis was completed, and that barrier was recorded and presented in this report.

The structural noise barrier analyses presented in this highway traffic noise impact are preliminary in nature and were evaluated to identify locations where structural noise barriers are likely based on the current design and traffic model without considerations of final design criteria that may limit the lengths or locations of structural noise barriers (such as drainage features and sight distance requirements). These preliminary structural noise barrier analyses are utilized for comparing the likeliness of barrier mitigation for noise sensitive receptors by build alternative.

If a build alternative is selected as the Preferred Alternative, then each location where a structural noise barrier was assessed will be re–evaluated based on the current design and the traffic volumes for the selected tolling scenario. Barriers determined to be likely following the re-evaluation of the Preferred Alternative will then require public involvement as described in the reasonableness criteria of INDOT and KYTC's noise policies.

2.6 CONSTRUCTION NOISE

It is expected that for construction in Indiana, construction procedures shall be governed by INDOT's *Standard Specifications* latest issue (INDOT 2018). Similarly, construction in Kentucky shall be governed by KYTC's latest issue of *Standard Specifications for Road and Bridge Construction* and any applicable supplements issued (KYTC 2012). The contractor will be bound by each state's standard specifications to observe any noise ordinance in effect within the project limits.

To date, no concern has been expressed by local residents, local officials, or resource agencies regarding construction noise.

2.7 OUTREACH TO LOCAL OFFICIALS

There are tracts of undeveloped land adjacent to the proposed project. INDOT and KYTC encourage the local governments with jurisdiction over these lands, as well as potential developers of these lands, to practice noise compatibility planning to avoid future noise impacts.

The following language is included in INDOT's noise policy:

> INDOT understands that it is in a unique position to provide outreach to local government and county planning units. INDOT also understands that it is the local government or county that has the power to regulate land development. INDOT is willing to help the local government by providing expert guidance on noise-related issues. This can include recommendations on setbacks, how to interpret noise studies that have been provided for FHWA projects, and other general noise concerns so that noise impacts are minimized for areas that are being developed. (INDOT 2017)

The following language is included in KYTC's noise policy:

> Coordination with and providing information to local officials is critical to a developing a comprehensive approach to creating livable communities adjacent to highways. Impacts of highway traffic noise can be reduced through a program of shared responsibility. Requests to approve land use changes adjacent to the highways should consider the current and predicted traffic noise. Approval of land uses adjacent to a highway that are particularly noise sensitive should be an informed decision and should only occur after careful consideration. Thus, where local government exercises control over land development through planning and zoning ordinances, KYTC shall share predicted noise levels along highway corridors and techniques that can be used to minimize highway noise related impacts to adjacent properties. KYTC shall provide this information to local officials for all Type I projects developed within these local jurisdictions. (KYTC 2015)

There are also two guidance documents on noise compatible land use planning that are available from FHWA: *The Audible Landscape: A Manual for Highway Noise and Land Use* (FHWA 1974) and *Entering the Quiet Zone: Noise Compatibility Land Use Planning* (FHWA 2002).

Table 2.7–1 presents design year sound levels for areas along the proposed alternatives where vacant and possibly developable lands exist. Noise predictions were made at distances between 50 feet and 500 feet from the edge of pavement of the closest travel lane, at–grade, for the design year 2045. As indicated, sound levels within 100 feet of the edge of pavement of the nearest travel lane exceed the NAC of 66 dB(A). Sound levels beyond 200 feet of the edge of pavement of the nearest travel lane do not exceed the NAC. The values in **Table 2.7–1** do not represent predicted levels at every location at a particular distance back from the roadway. Sound levels will vary with changes in terrain and will be affected by the shielding of objects such as buildings. This information is being included to make local officials and planners aware of anticipated highway noise levels so that future development will be compatible with these levels. More development, particularly commercial development, may occur in the project area after completion of the project, but will most likely be consistent with neighborhood land use and zoning restrictions.

Table 2.7–1. Undeveloped Lands Sound Levels

DISTANCE FROM ROADWAY (FT.)	NOISE LEVEL (DB[A])
50	73.5
100	70.2
200	65.4
300	62.4
400	60.3
500	58.5
600	57.3
700	56.2
800	54.9

CHAPTER 3 – EXISTING ANALYSIS AND MODEL VALIDATION

Noise measurements were conducted October 25 – 31, 2017 and January 24, 2018 at noise-sensitive land uses in the study area and within 500 feet of the proposed alignments. Short–term, 10–minute noise measurements at all locations were conducted during meteorologically appropriate periods (i.e., no rain, wind less than 10 miles per hour [mph]). These measurements were conducted to provide field–measured levels along the existing roadways in the study area to utilize in model validation within TNM 2.5. Once validated, the model was used to predict existing noise levels for all receivers along existing roadways.

For receivers within 500 feet of the project alternatives but located farther than 500 feet from the existing roadways, where modeling of an existing noise level was unsuitable, ambient noise readings were taken. Ambient readings were taken at several locations along the proposed alternatives to represent varying existing noise conditions. These ambient readings were then applied to nearby receivers and used for comparison with predicted values to determine if there were any substantial increases in noise levels associated with the proposed alternatives. See **Figure 2.7–1** for field noise measurement locations and **Appendix C** for Noise Monitoring Field Sheets. The tables provided in **Appendix B** summarize existing sound levels at measurement locations and the predicted values from TNM 2.5.

A Rion NL–20 sound meter and a Rion NC–73 sound level calibrator were used for all noise measurements (See **Appendix D** for noise meter calibration certification). Locations for model validation were selected from receptors that were within a 500–foot distance from both the proposed alternatives and the existing roadway.

Traffic projections were provided for a base year of 2015 and future design year of 2045 for the project. Base and future traffic data were divided into individual roadway segments and turn movements, and included the percentage of traffic composed of trucks for each segment. Both a.m. and p.m. design hour volumes were provided; the p.m. design hour volume was used in future sound level calculations, as it carried an overall higher number of vehicles, therefore representing a worst-case traffic noise scenario. These projections include traffic volumes for the "design hour" (DHV). These design hour traffic projections were used for the noise analysis since they represent the highest number of vehicles expected to travel in a given hour and would, therefore, represent the worst noise hour.

Design year traffic projections were used for the noise analysis, including peak hour volumes and percent trucks. The design speed of the roadway was used to determine the speed for each modeled roadway segment. The predicted design year sound levels for the impacted receivers for each alternative are discussed in the following section. Results are summarized in **Appendix B** and the TNM 2.5 files used for this analysis are included in an electronic attachment.

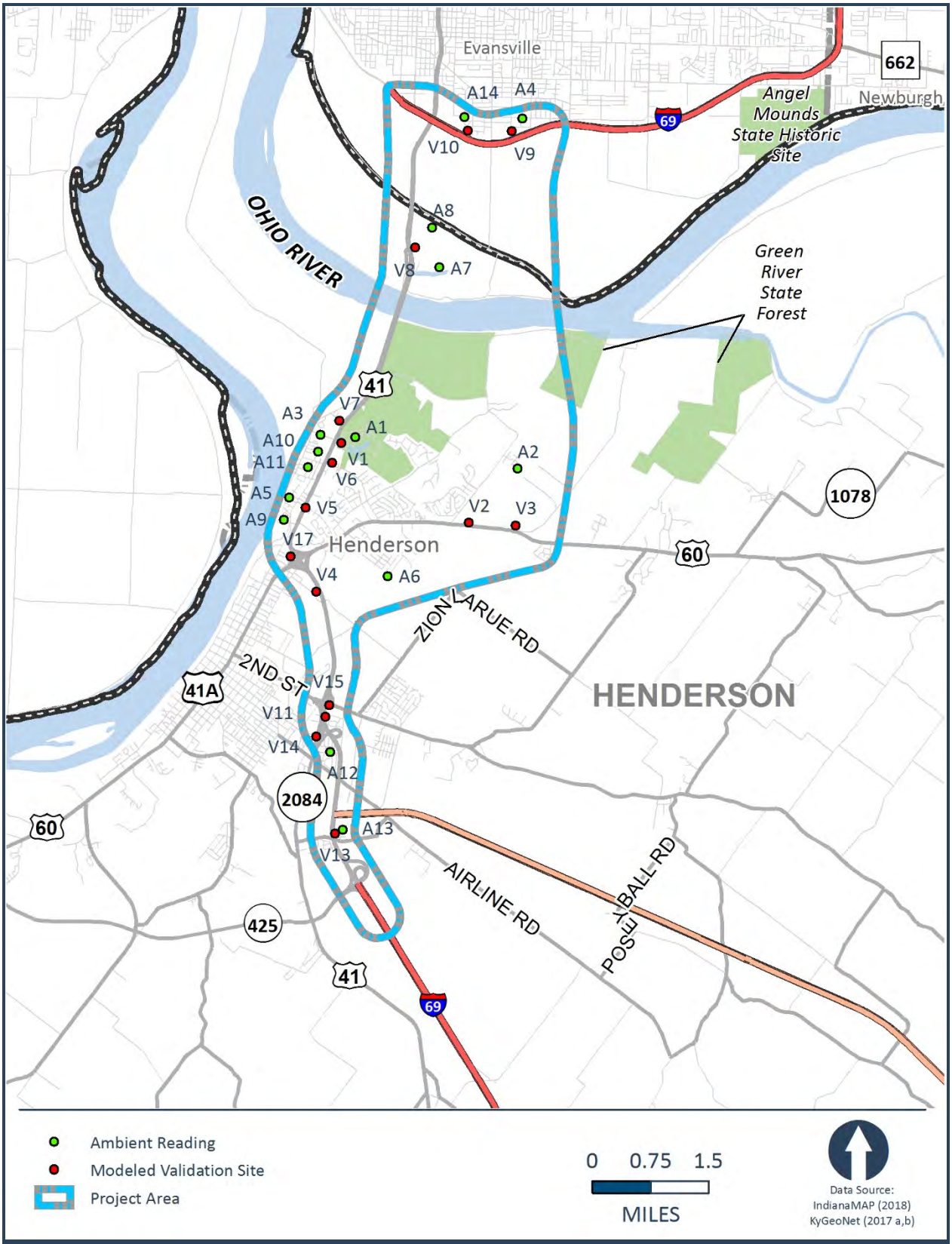

Figure 2.7–1. Field Noise Measurement Locations

3.1 MODEL VALIDATION

The TNM 2.5 model was used for predicting existing and future noise levels for the No Build and proposed alternatives. These noise levels were validated for the study area. Validation involved obtaining noise measurements at a few selected points near the existing roadway while making simultaneous vehicle classification counts and estimating travel speed. The traffic counts were then converted to hourly volumes. These volumes, along with the estimated travel speeds, were entered into a TNM 2.5 model created for the project area. After measurements were made, the field crew drove primary roads with the traffic to identify locations where observed speeds differed substantively from the posted legal speed limits and adjusted the model accordingly. Adjustments were made at validation measurements 2, 3, 13, and 16. It was observed that operational speed was greater than the posted speed limits for validation points 2, 3, and 16 and was lower for measurement 13. Modeled levels were compared to the measured levels, and if they were within 3 dB(A) of the measured levels, the model was said to be validated. The predicted values for all validation receivers were found to be within 3 dB(A) of the field measured values. A summary of noise level validation results is provided in **Table 3.2–1**. With validated results, the TNM 2.5 model was used to predict values for receivers in the immediate vicinity of the roadways based on existing traffic data for the facility.

Table 3.2–1. Noise Level Validation Summary

RECEIVER	DESCRIPTION	START TIME	MEASURED SOUND LEVEL DB(A)	MODELED SOUND LEVEL DB(A)	VALIDATION SUCCESSFUL?
Validation 1	Recreational	8:00 a.m.	56.5	58.9	Yes
Validation 2	Residential	9:24 a.m.	56.5	57.5	Yes
Validation 3	Residential	9:00 a.m.	56.0	53.0	Yes
Validation 4	Residential	4:20 p.m.	59.9	62.7	Yes
Validation 5	Commercial	8:07 a.m.	70.9	70.6	Yes
Validation 6	Residential	8:30 a.m.	54.2	56.3	Yes
Validation 7	Residential	9:00 a.m.	63.4	60.6	Yes
Validation 8	Recreational	2:51 p.m.	59.7	57.4	Yes
Validation 9	Residential	2:55 p.m.	50.4	47.6	Yes
Validation 10	Residential	3:25 p.m.	59.2	59.5	Yes
Validation 11	Residential	4:05 p.m.	70.9	68.5	Yes
Validation 13	Residential	8:00 a.m.	65.6	68.4	Yes
Validation 14	Commercial	8:35 a.m.	62.4	61.1	Yes
Validation 15	Residential	2:45 p.m.	66.6	66.4	Yes
Validation 16	Residential	3:20 p.m.	60.9	57.9	Yes
Validation 17	Residential	3:52 p.m.	61.4	61.9	Yes

3.2 EXISTING SOUND LEVELS

Prior to analyzing the proposed build alternatives, existing US 41 was modeled to establish the existing noise levels in the project area. Existing sound levels can be seen in the tables included in **Appendix B**. Locations of modeled receivers are provided in **Appendix A.**

3.3 NO BUILD ALTERNATIVE

Existing levels from the validated TNM 2.5 model were compared to the values predicted by the TNM 2.5 model for the No Build Alternative to assess the potential for highway traffic noise impacts. The TNM 2.5 model was used to predict sound levels for the No Build Alternative by using the validated existing noise model with the design year (2045) traffic utilized in place of the existing traffic volumes. Posted legal speed limits and adjusted speed limits, to account for traffic speeds exceeding the legal posted speed limits during field observation, were used. Predicted no build values were compared to sound level results from the build alternatives to evaluate if adjustments in the reasonableness criteria were warranted. Based on the predicted no build results, no adjustments were required. **Table 2** of **Appendix B** summarizes results of the No Build Alternative noise analysis.

CHAPTER 4 – CENTRAL ALTERNATIVES 1A AND 1B RESULTS

The Central Alternatives 1A and 1B models were analyzed from the beginning of the project in Indiana to just south of the CSX Railroad in Kentucky. From this point south, Central Alternative 1 joins West Alternatives 1 and 2 and follows existing US 41. The area analyzed for noise impacts under the Central Alternative 1 model is shown in **Figure 4.1–1**. The proposed improvements south of the CSX Railroad are the same for each build alternative so a separate analysis was performed for this segment. Those results are referred to as "US 41 (KY 351 to KY 425)"and are presented in **Chapter 7.** The models for Central Alternatives 1A/1B and US 41 (KY 351 to KY 425) were extended over 1,500 beyond their last receptor and they slightly overlapped with each other. The two models shall be combined for a full analysis of Central Alternatives 1A and 1B.

The Central Alternatives 1A and 1B model was analyzed for two potential tolling scenarios of the Ohio River crossing. One scenario, which is defined as Central Alternative 1A, included tolling both the proposed I-69 bridge and an existing US 41 crossing. The second scenario, which is defined as Central Alternative 1B, included tolling only on the proposed I-69 crossing, with the existing US 41 bridge remaining toll-free. **Table 3 of Appendix B** provides results of noise readings and impacts for each receiver under both tolling scenarios.

4.1 CENTRAL ALTERNATIVE 1A – TOLLING BOTH CROSSINGS

4.1.1 IMPACT DETERMINATION ANALYSIS

There were 239 receivers analyzed for Central Alternative 1A model under the scenario of tolling both crossings. Of the 239 receivers, 172 would be impacted. These resulted in 178 impacted receptors, 41 that exceeded the NAC criteria, 71 that would experience a substantial increase in noise levels over the existing levels (15 dB[A] or more in Indiana or 10 dB[A] or more in Kentucky), and 66 that would exceed the NAC criteria and also experience a substantial increase in noise levels.

The Green River State Forest was not included in the analysis because there are no trails, picnic areas, or other common use areas within or near the study.

4.1.2 NOISE ABATEMENT EVALUATION

Once all impacts were known, they were analyzed to determine locations where a detailed noise abatement evaluation would be necessary. Six clusters of impacted receivers were identified, two in Indiana and four in Kentucky, and an evaluation was performed for each. Figures for each cluster evaluated are included and show only the receivers and barrier wall included in that evaluation. Clusters are identified as analysis areas in **Figure 4.1–1** and are labeled by a landmark or significant street in the area. TNM results for the detailed noise abatement evaluations are included in **Appendix E**.

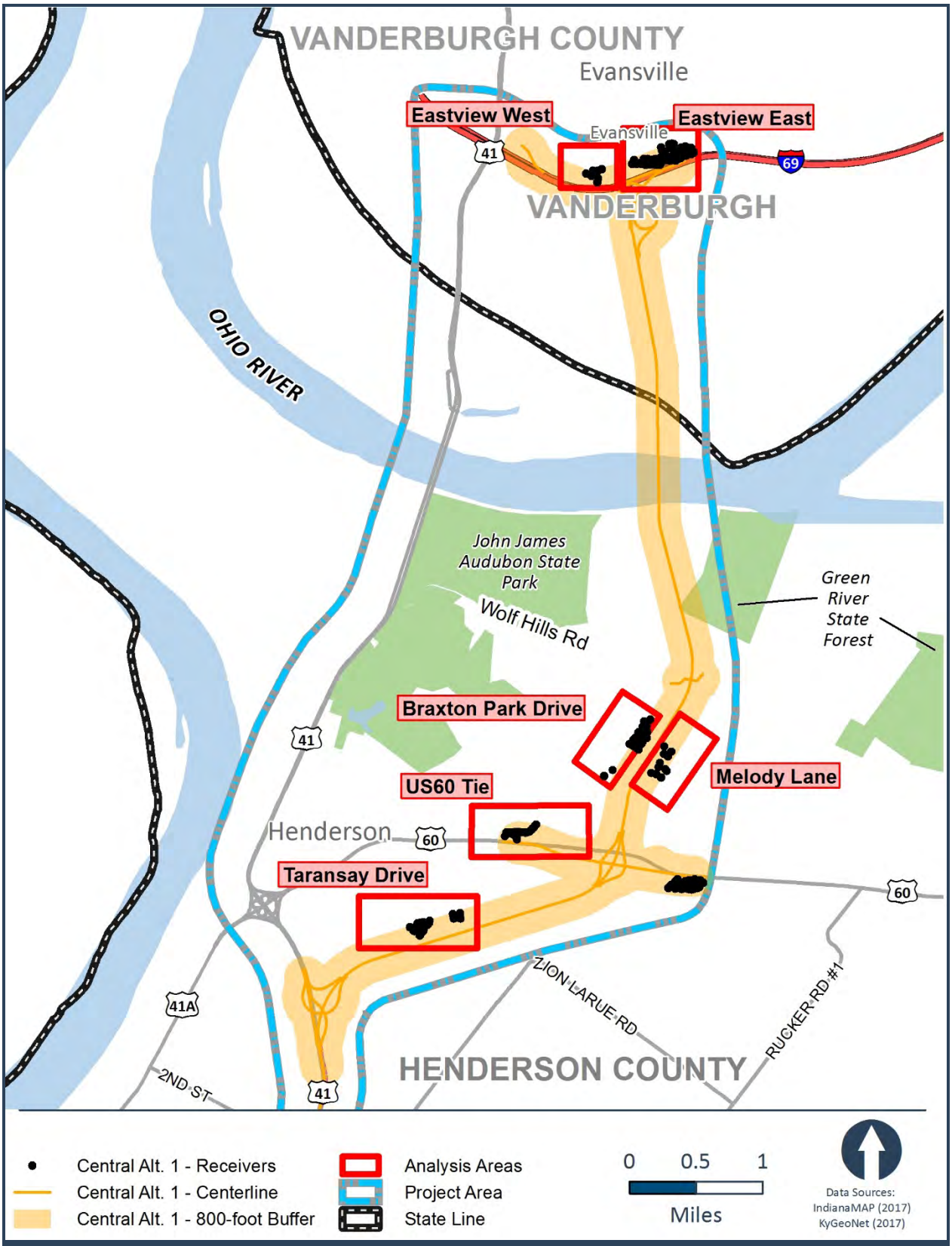

Figure 4.1–1. Central Alternative 1A Noise Impact Analysis Areas

All remaining receivers not identified within an analysis area in **Figure 4.1–1** were not impacted and noise abatement evaluations were not required.

4.1.3 Analysis Area – Taransay Drive

This analysis area consisted of single family homes near Taransay Drive. Modeled receivers, modeled structural noise barrier location, and the receiver's attenuation level thresholds are presented in **Figure 4.1–2**. Sound level results, including existing, predicted, and predicted with barrier, are presented in **Table 7 of Appendix B**. This table also identifies the number of receptors represented by the receiver, front row receiver/receptors, and an impact summary.

Barrier Summary

A single barrier of 3,679 feet in length and average height of 19.89 feet was predicted to benefit 24 of 24 receptors (23 modeled receivers). The barrier demonstrates that it was possible to achieve a 5 dB(A) reduction at three or more impacted first-row receptors, meeting KYTC's feasibility criteria. The cost of the modeled barrier was $2,196,000, for a cost-effectiveness ratio of $91,000 per benefited receptor. This value is above KYTC's cost-effectiveness criterion of $35,000 per benefited receptor and therefore the modeled barrier does not meet KYTC's reasonableness threshold. The barrier provided 7 dB(A) of attenuation for 7 of the 12 first row benefited receptors (58.3 percent). This is above the 50 percent design goal threshold per KYTC's noise policy and therefore the barrier meets this reasonableness criterion.

The wall presented is the structural noise barrier that meets the design goal but did not meet the cost-effective ratio criterion. Only receivers within 800 feet from the pavement edge were assessed. Only receivers within 800 feet of the pavement edge were included in this assessment. If this alternative is chosen as the Preferred Alternative, additional receptors will be included in the re-evaluation to determine the maximum number of benefited receptors. Although this will reduce the cost-effective ratio, it would take 39 more receptors (for a total of 63 benefitted receptors) to meet the $35,000 cost-effectiveness criterion. With the assessed receptors already approaching the 5 dB(A) reduction required to be considered benefited, it is unlikely that an additional 39 receptors will achieve the 5 dB(A) reduction.

Table 4.1–1. Central Alternative 1A Barrier Description – Taransay Dr. (Toll Both Crossings)

BARRIER DESCRIPTION	NO. OF IMPACTED RECEPTORS / TOTAL RECEPTORS	BARRIER LENGTH (FT)	AVERAGE BARRIER HEIGHT (FT)	BARRIER AREA (SQ FT)	BARRIER COST @ $30/SQ FT
A Single Barrier on the East Side of Central Alt. 1A	24 / 24	3,679	19.89	73,192	$2,196,000

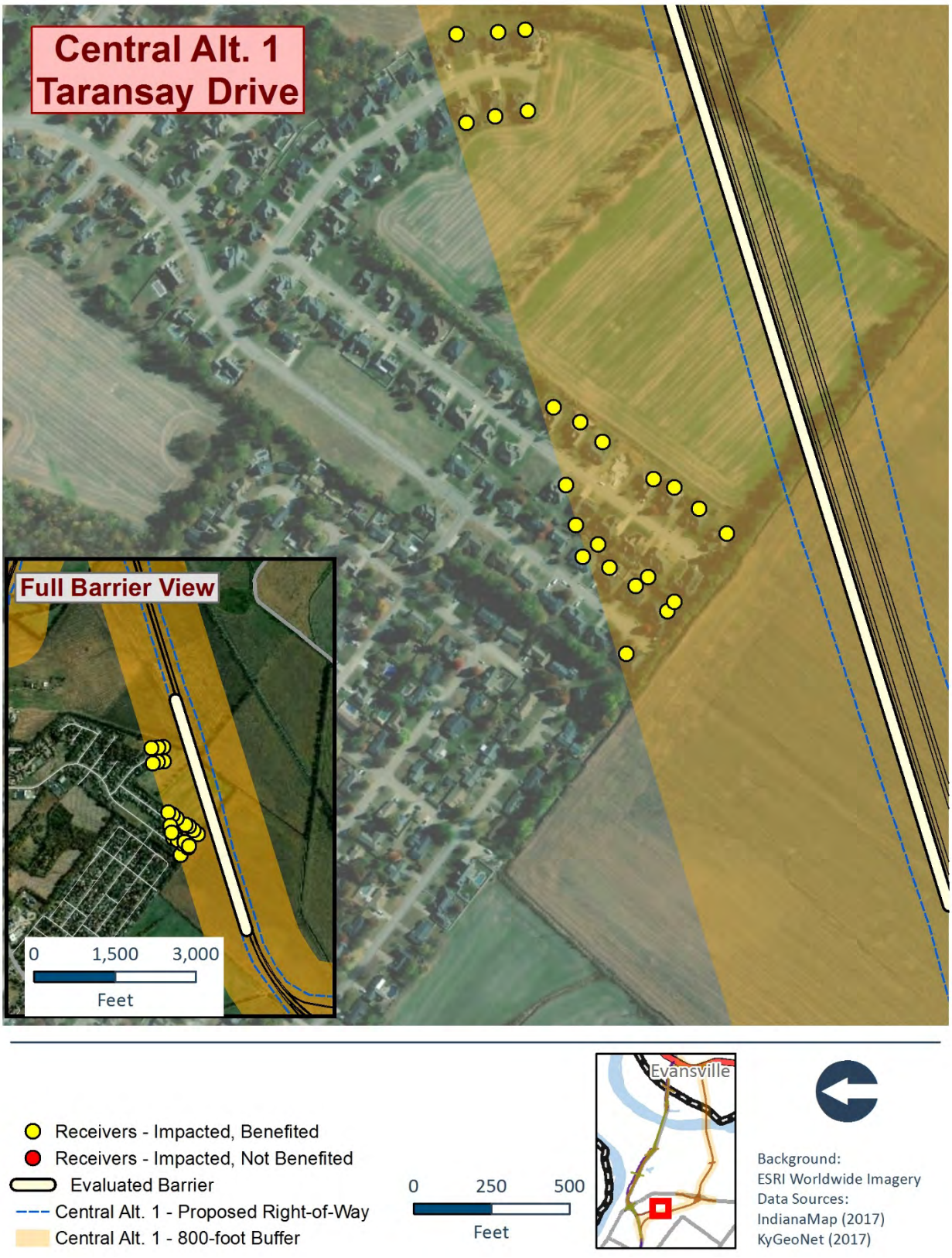

Figure 4.1–2. Central Alternative 1A Barrier Analysis – Taransay Drive (Toll Both Crossings)

Table 4.1–2. Central Alternative 1A Barrier Summary – Taransay Dr. (Toll Both Crossings)

IS THE BARRIER FEASIBLE?	NO. BENEFITED AND COST PER BENEFITED	IS THE BARRIER COST EFFECTIVE?	NO. OF 1ST–ROW BENEFITED / NO. OF 1ST–ROW BENEFITED W/ 7 DB(A) OR GREATER ATTENUATION (%)	DOES THE BARRIER MEET THE DESIGN GOAL?
Yes	24 Benefited; $91,000/Benefited	No	12 / 7 58.3	Yes

STATEMENT OF LIKELIHOOD

Based on the current project design and traffic projections, structural noise barriers are not reasonable in accordance with KYTC's noise policy and are not likely for this location.

ANALYSIS AREA – US 60 TIE

This analysis area consisted of single family homes and multi-family dwelling units just west of the I-69 ramps to US 60 near the US 60 and KY 414 (Wathen Lane) intersection. Modeled receivers, modeled structural noise barrier location, and the receiver's attenuation level thresholds are presented in **Figure 4.1–3**. Sound level results, including existing, predicted, and predicted with barrier, are presented in **Table 8 of Appendix B**. This table also identifies the number of receptors represented by the receiver, front row receiver/receptors, and an Impact summary.

BARRIER SUMMARY

The combination of barrier walls was 20.00 feet in height, totaled 2,207 feet in length, and would benefit 16 of 39 receptors (30 receivers). The barrier demonstrated that it was possible to achieve a 5 dB(A) reduction at three or more impacted first-row receptors, meeting KYTC's feasibility criteria. Due to the layout of homes along US 60 and KY 414, each location was considered a first-row receptor for this analysis. The cost of the modeled barrier was $1,324,000, for a cost-effectiveness ratio of $83,000 per benefited receptor. This value is above KYTC's cost-effectiveness criterion of $35,000 per benefited receptor and therefore the modeled barrier does not meet KYTC's reasonableness threshold. The barrier did not provide 7 dB(A) of attenuation for any of the first row benefited receptors (0.0 percent). This is below the 50 percent design goal threshold per KYTC's noise policy and therefore the barrier did not meet this reasonableness criterion.

There was only one impacted receiver identified in TNM 2.5 modeling but it represented a multi–residential unit and therefore a barrier analysis was necessary. In the assessment of the barrier, it was necessary to remove barrier panels that span entrances that provide local access to US 60. The reduction in attenuation with the necessary removal of these barrier segments resulted in no barrier combination of length and height that would provide 7 dB(A) attenuation at any receptor.

Table 4.1–3. Central Alternative 1A Barrier Description – US 60 Tie (Toll Both Crossings)

BARRIER DESCRIPTION	NO. OF IMPACTED RECEPTORS / TOTAL RECEPTORS	BARRIER LENGTH (FT)	AVERAGE BARRIER HEIGHT (FT)	BARRIER AREA (SQ FT)	BARRIER COST @ $30/SQ FT
A Single Barrier on the West Side of Central Alt. 1A	3 / 39	2,207	20.00	44,130	$1,324,000

Figure 4.1–3. Central Alternative 1A Barrier Analysis – US 60 Tie (Toll Both Crossings)

Table 4.1–4. Central Alternative 1A Barrier Summary – US 60 Tie (Toll Both Crossings)

IS THE BARRIER FEASIBLE?	NO. BENEFITED AND COST PER BENEFITED	IS THE BARRIER COST EFFECTIVE?	NO. OF 1ST–ROW BENEFITED / NO. OF 1ST–ROW BENEFITED W/ 7 DB(A) OR GREATER ATTENUATION (%)	DOES THE BARRIER MEET THE DESIGN GOAL?
Yes	16 Benefited; $83,000/Benefited	No	39 / 0 0.0	No

STATEMENT OF LIKELIHOOD

Based on the current project design and traffic projections, structural noise barriers are not reasonable in accordance with KYTC's noise policy and are not likely for this location.

ANALYSIS AREA – BRAXTON PARK DRIVE

This analysis area consisted of single family homes near Braxton Park Drive. Modeled receivers, modeled structural noise barrier location, and the receiver's attenuation level thresholds are presented in **Figure 4.1–4**. Sound level results, including existing, predicted, and predicted with barrier, are presented in **Table 9 of Appendix B**. This table also identifies the number of receptors represented by the receiver, front row receiver/receptors, and an impact summary.

BARRIER SUMMARY

A single barrier of 3,444 feet in length, with an average height of 19.16 feet was predicted to benefit 31 of 35 receptors (34 modeled receivers). The barrier demonstrates that it was possible to achieve a 5 dB(A) reduction at three or more impacted first-row receptors, meeting KYTC's feasibility criteria. The cost of the modeled barrier was $1,980,000, for a cost-effectiveness ratio of $64,000 per benefited receptor. This value is above KYTC's cost-effectiveness criterion of $35,000 per benefited receptor and therefore the modeled barrier does not meet the KYTC's reasonableness threshold. The barrier provided 7 dB(A) of attenuation for five of the nine first row benefited receptors (55.6 percent). This is above the 50 percent design goal threshold per KYTC's noise policy and therefore the barrier meets this reasonableness criterion.

A structural noise barrier was identified that could meet the design goal but was not reasonable based on the cost-effectiveness criterion. Multiple iterations of length and height were evaluated to increase the number of benefited receptors or reduce cost. Any barrier that met the design goal did not meet the reasonable cost-effectiveness criterion.

Table 4.1–5. Central Alternative 1A Barrier Description – Braxton Park Dr. (Toll Both Crossings)

BARRIER DESCRIPTION	NO. OF IMPACTED RECEPTORS / TOTAL RECEPTORS	BARRIER LENGTH (FT)	AVERAGE BARRIER HEIGHT (FT)	BARRIER AREA (SQ FT)	BARRIER COST @ $30/SQ FT
A Single Barrier on the West Side of Central Alt. 1A	35 / 35	3,444	19.16	65,996	$1,980,000

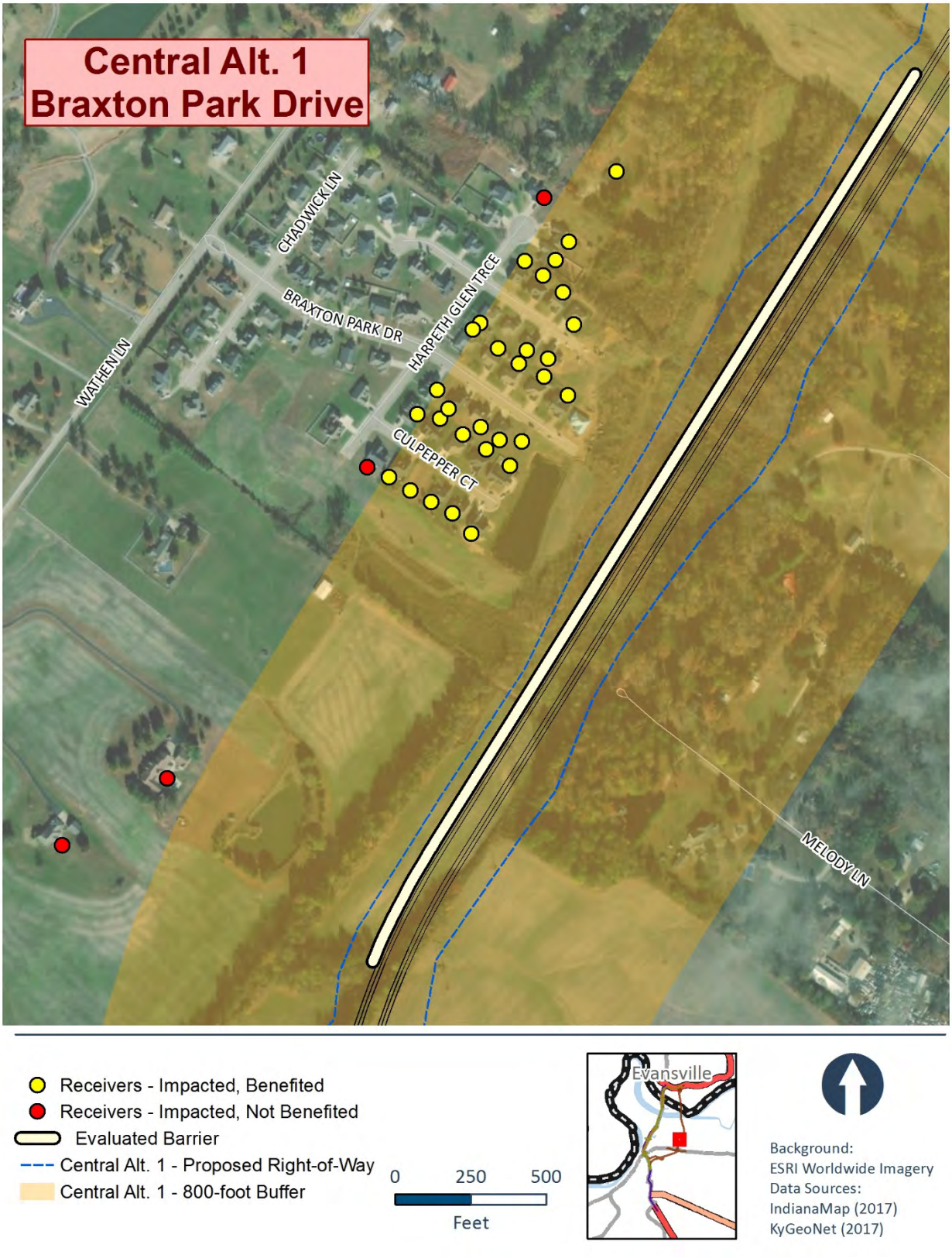

Figure 4.1–4. Central Alternative 1A Barrier Analysis – Braxton Park Dr. (Toll Both Crossings)

Table 4.1–6. Central Alternative 1A Barrier Summary – Braxton Park Dr. (Toll Both Crossings)

IS THE BARRIER FEASIBLE?	NO. BENEFITED AND COST PER BENEFITED	IS THE BARRIER COST EFFECTIVE?	NO. OF 1ST–ROW BENEFITED / NO. OF 1ST–ROW BENEFITED W/ 7 DB(A) OR GREATER ATTENUATION (%)	DOES THE BARRIER MEET THE DESIGN GOAL?
Yes	31 Benefited; $64,000/Benefited	No	9 / 5 55.6	Yes

STATEMENT OF LIKELIHOOD

Based on the current project design and traffic projections, structural noise barriers are not reasonable in accordance with KYTC's noise policy and are not likely for this location.

4.1.4 ANALYSIS AREA – MELODY LANE

This analysis area consisted of single family homes near Melody Lane. Modeled receivers, modeled structural noise barrier location, and the receiver's attenuation level thresholds are presented in **Figure 4.1–5**. Sound level results, including existing, predicted, and predicted with barrier, are presented in **Table 10 of Appendix B**. This table also identifies the number of receptors represented by the receiver, front row receiver/receptors, and an impact summary.

BARRIER SUMMARY

A single barrier of 2,617 feet in length, with an average height of 18.20 feet was predicted to benefit 8 of 11 receptors (11 modeled receivers). The barrier demonstrated that it was possible to achieve a 5 dB(A) reduction at three or more impacted first-row receptors, meeting KYTC's feasibility criteria. The cost of the modeled barrier was $1,430,000, for a cost-effectiveness ratio of $179,000 per benefited receptor. This value is above KYTC's cost-effectiveness criterion of $35,000 per benefited receptor and therefore the modeled barrier does not meet the KYTC's reasonableness threshold. The barrier would provide 7 dB(A) of attenuation for two of the four first row benefited receptors (50.0 percent). This meets the 50 percent design goal threshold per KYTC's noise policy and therefore the barrier met this reasonableness criterion.

A long and tall structural noise barrier was able to meet the design goal but the relatively few number of residences in this area limit the number of benefited receptors and therefore for any wall meeting the design goal, attaining a cost-effectiveness ratio that would meet the reasonableness criteria is not achievable based on the current design and modeled traffic.

Table 4.1–7. Central Alternative 1A Barrier Description – Melody Ln. (Toll Both Crossings)

BARRIER DESCRIPTION	NO. OF IMPACTED RECEPTORS / TOTAL RECEPTORS	BARRIER LENGTH (FT)	AVERAGE BARRIER HEIGHT (FT)	BARRIER AREA (SQ FT)	BARRIER COST @ $30/SQ FT
A Single Barrier on the East Side of Central Alt. 1A	11 / 11	2,617	18.20	47,659	$1,430,000

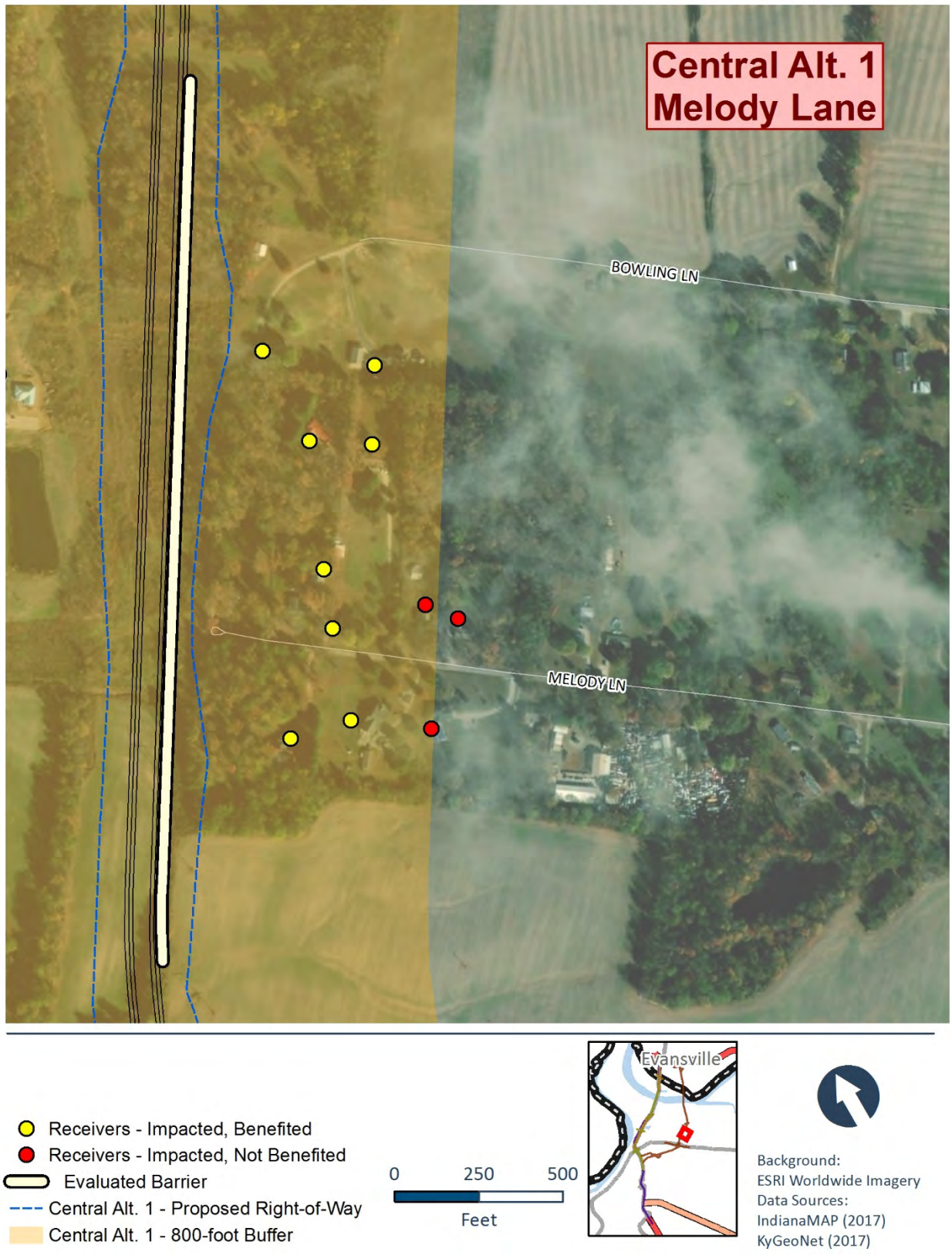

Figure 4.1–5. Central Alternative 1A Barrier Analysis – Melody Ln. (Toll Both Crossings)

Table 4.1–8. Central Alternative 1A Barrier Summary – Melody Ln. (Toll Both Crossings)

IS THE BARRIER FEASIBLE?	NO. BENEFITED AND COST PER BENEFITED	IS THE BARRIER COST EFFECTIVE?	NO. OF 1ST–ROW BENEFITED / NO. OF 1ST–ROW BENEFITED W/ 7 DB(A) OR GREATER ATTENUATION (%)	DOES THE BARRIER MEET THE DESIGN GOAL?
Yes	8 Benefited; $179,000/Benefited	No	4 / 2 50.0	Yes

STATEMENT OF LIKELIHOOD

Based on the current project design and traffic projections, structural noise barriers are not reasonable in accordance with KYTC's noise policy and are not likely for this location.

ANALYSIS AREA – EASTVIEW EAST

This analysis area consisted of single family homes in the Eastview East area. Modeled receivers, modeled structural noise barrier location, and the receiver's attenuation level thresholds are presented in **Figure 4.1–6**. Sound level results, including existing, predicted, and predicted with barrier, are presented in **Table 11 of Appendix B**. This table also identifies the number of receptors represented by the receiver, front row receiver/receptors, and an impact summary.

BARRIER SUMMARY

A combination of barriers was analyzed that totaled 3,213 feet in length and averaged 21.72 feet in height. It was predicted to benefit 51 of 95 receptors (93 modeled receivers). The barriers demonstrated that it was possible to achieve a 5 dB(A) reduction at a majority (greater than 50 percent) of the impacted receptors, meeting INDOT's feasibility criteria. The cost of the modeled barriers was $2,093,000, for a cost-effectiveness ratio of $41,000 per benefited receptor. This value is above INDOT's cost-effectiveness criterion of $25,000 per benefited receptor and therefore the modeled barriers do not meet INDOT's reasonableness threshold. The barriers would provide 7 dB(A) of attenuation for 8 of the 16 first row benefited receptors (50.0 percent). This equals the 50 percent design goal threshold per INDOT's noise policy and therefore the barriers meet this reasonableness criterion.

This analysis area was originally modeled with a single barrier along the existing I-69, but the attenuation levels were less than 5dBA (Leq) for all receivers. Evaluations of the alternative design and the noise model revealed that the I-69 flyover ramp, that takes vehicles back to US 41, was elevated above the modeled barrier and was contributing noise to the receptors even though the roadway segments were beyond the distance that FHWA has validated the model to accurately predict noise. A barrier was placed on this ramp structure and the result was that a short portion of barrier, along with additional barrier height for the modeled barrier along the existing I-69, provided attenuation that allowed the barrier combination to meet the design goal, however the barriers did not meet the cost-effectiveness criterion. Due to the distances of the flyover ramp from the receptors and the validity of sound contributions at these distances, noise

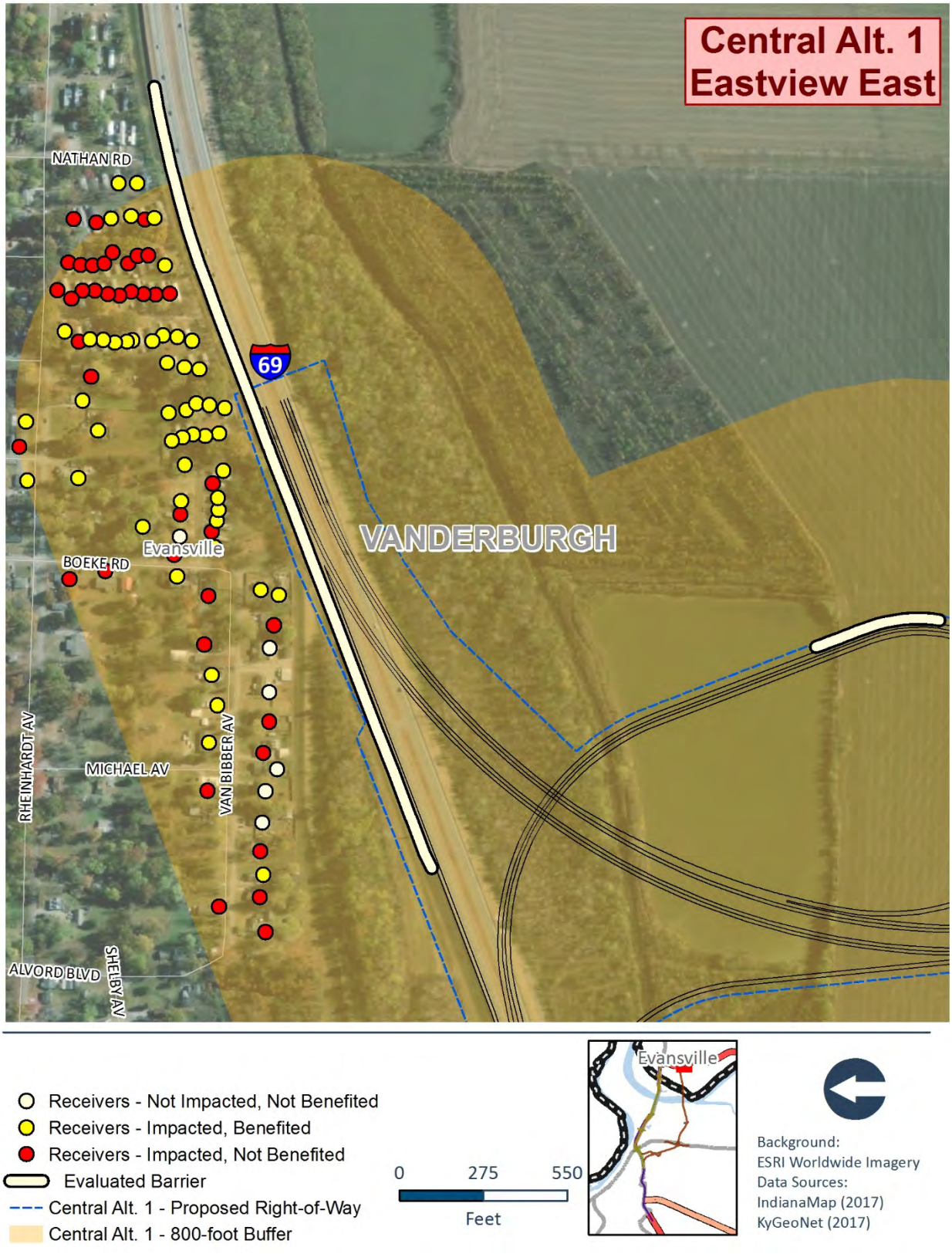

Figure 4.1–6. Central Alternative 1A Barrier Analysis – Eastview East (Toll Both Crossings)

barriers on this structure will not be evaluated for the FEIS if this alternative is identified as the preferred alternative. This analysis generated a modeled barrier combination that was the most effective according to the TNM2.5 model but still did not meet the cost-effectiveness criterion.

Table 4.1–9. Central Alternative 1A Barrier Description – Eastview East (Toll Both Crossings)

BARRIER DESCRIPTION	NO. OF IMPACTED RECEPTORS / TOTAL RECEPTORS	BARRIER LENGTH (FT)	AVERAGE BARRIER HEIGHT (FT)	BARRIER AREA (SQ FT)	BARRIER COST @ $30/SQ FT
A Combo Barrier on the North Side of Central Alt. 1A	89 / 95	3,213	21.72	69772	$2,093,000

Table 4.1–10. Central Alternative 1A Barrier Summary – Eastview East (Toll Both Crossings)

IS THE BARRIER FEASIBLE?	NO. BENEFITED AND COST PER BENEFITED	IS THE BARRIER COST EFFECTIVE?	NO. OF 1ST–ROW BENEFITED / NO. OF 1ST–ROW BENEFITED W/ 7 DB(A) OR GREATER ATTENUATION (%)	DOES THE BARRIER MEET THE DESIGN GOAL?
Yes	51 Benefited; $41,000/Benefited	No	16 / 8 50.0	No

STATEMENT OF LIKELIHOOD

Based on the current project design and traffic projections, structural noise barriers are not reasonable in accordance with the INDOT's noise policy and are not likely for this location.

ANALYSIS AREA – EASTVIEW WEST

This analysis area consisted of single family homes in the Eastview West area. Due to the elevation change caused by I-69 bridging over Weinbach Avenue, predicted noise levels were higher for receptors further away from the road. Modeled receivers, modeled structural noise barrier location, and the receiver's attenuation level thresholds are presented in **Figure 4.1–7**. Sound level results, including existing, predicted, and predicted with barrier, are presented in **Table 12 of Appendix B**. This table also identifies the number of receptors represented by the receiver, front row receiver/receptors, and an impact summary.

BARRIER SUMMARY

A single barrier of 10,816 feet in length, with an average height of 20.00 feet was predicted to benefit zero of nine receptors (9 modeled receivers). The barrier demonstrated that it was not possible to achieve a 5 dB(A) reduction at a majority (greater than 50 percent) of the benefited receptors, meeting INDOT's feasibility criteria. The cost of the modeled barrier was $6,490,000. With no benefited receptors, the modeled barrier does not meet INDOT's reasonableness threshold. The barrier provided 7 dB(A) of attenuation for none of the 3 first row benefited receptors (50.0 percent). This is below the 50 percent design goal threshold per INDOT's noise policy and therefore the barrier does not meet this reasonableness criterion.

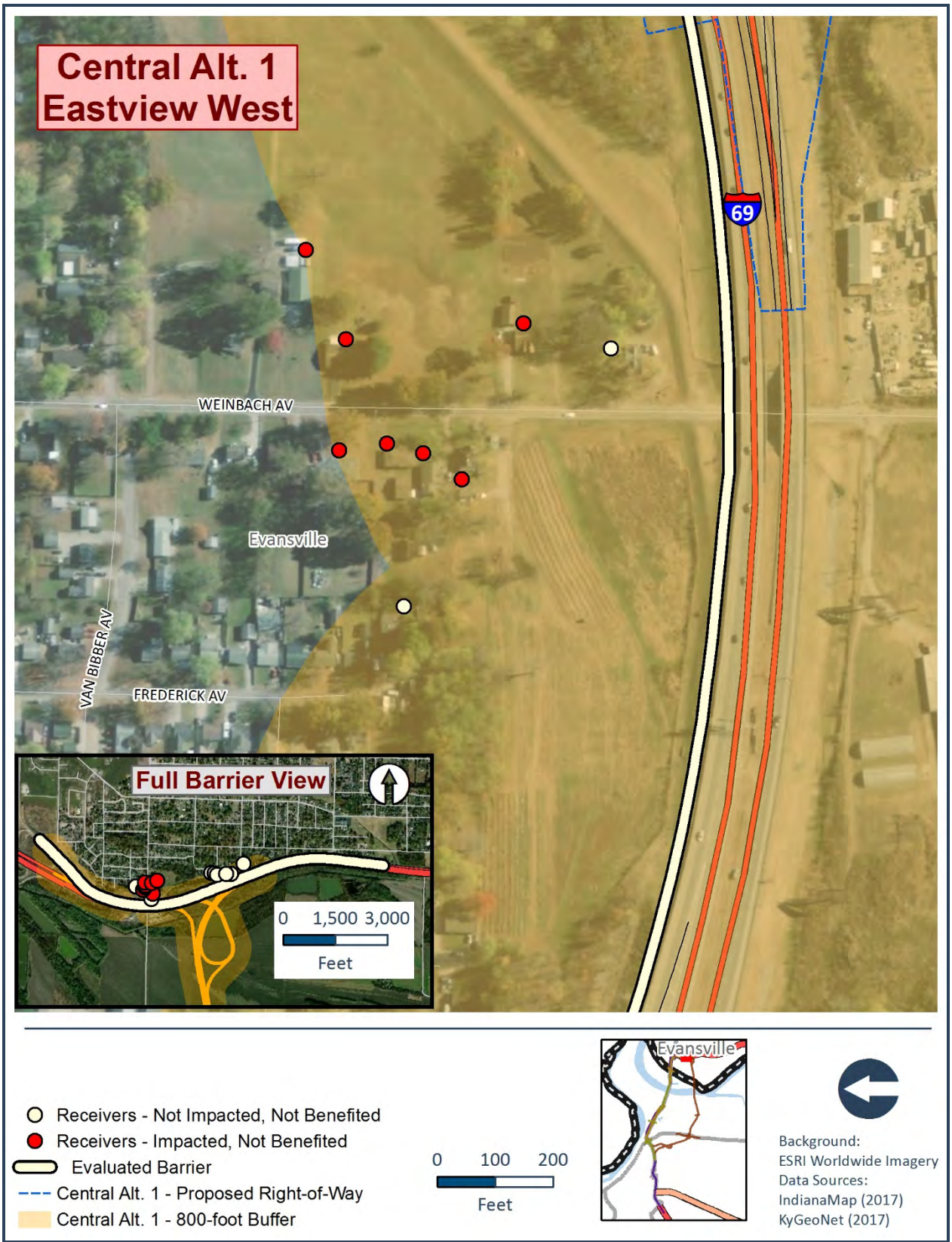

Figure 4.1–7. Central Alternative 1A Barrier Analysis – Eastview West (Toll Both Crossings)

Table 4.1–11. Central Alternative 1A Barrier Description – Eastview West (Toll Both Crossings)

BARRIER DESCRIPTION	NO. OF IMPACTED RECEPTORS / TOTAL RECEPTORS	BARRIER LENGTH (FT)	AVERAGE BARRIER HEIGHT (FT)	BARRIER AREA (SQ FT)	BARRIER COST @ $30/SQ FT
A Single Barrier on the North Side of Central Alt. 1A	7 / 9	10,816	20.00	216,319	$6,490,000

Table 4.1–12. Central Alternative 1A Barrier Summary – Eastview West (Toll Both Crossings)

IS THE BARRIER FEASIBLE?	NO. BENEFITED AND COST PER BENEFITED	IS THE BARRIER COST EFFECTIVE?	NO. OF 1ST–ROW BENEFITED / NO. OF 1ST–ROW BENEFITED W/ 7 DB(A) OR GREATER ATTENUATION (%)	DOES THE BARRIER MEET THE DESIGN GOAL?
No	0 Benefited; —	No	0 / 0 0.0	No

STATEMENT OF LIKELIHOOD

Based on the current project design and traffic projections, structural noise barriers are not reasonable in accordance with the INDOT's noise policy and are not likely for this location.

4.1.5 BARRIER SUMMARY

Six noise barrier analyses, two in Indiana and four in Kentucky, were performed for Central Alternative 1A. None of the barriers evaluated meet the feasibility, reasonableness, and the design goal criteria required by the states' noise policies. Therefore, no structural noise barrier is proposed for Central Alternative 1A.

4.1.6 STATEMENT OF LIKELIHOOD

No structural noise barrier was determined to be both feasible and reasonable for any impacted receptors. No additional abatement measures will be considered for Central Alternative 1A.

4.2 CENTRAL ALTERNATIVE 1B – TOLLING I-69 ONLY

4.2.1 IMPACT DETERMINATION ANALYSIS

There were 231 receivers analyzed with Central Alternative 1B under the scenario of tolling only the I-69 crossing. Of the 231 receivers, 67 would be impacted. These resulted in 71 impacted receptors, three that exceeded the NAC criteria and 68 that would experience a substantial increase in noise levels over the existing level (15 dB[A] or more in Indiana, 10 dB[A] or more in Kentucky). No receptor both exceeded the NAC criteria and experienced a substantial increase in noise levels. All impacted receivers are in Kentucky. The number of impacted receptors under this scenario is less than when tolling both crossings due to the percent trucks forecasted for this scenario. Traffic forecasts estimate similar DHV for both tolling scenarios, but the percent trucks

is much higher when tolling I-69 only (around 10% compared to 1-2% when tolling both crossings).

The Green River State Forest was not included in the analysis because there are no trails, picnic areas, or other common use areas within or near the study.

4.2.2 Noise Abatement Evaluation

Once all impacts were known, they were analyzed to determine locations where a detailed noise abatement evaluation would be necessary. For this tolling scenario, impacted receivers were identified in four of the six clusters labelled in **Figure 4.1–1**. A noise abatement evaluation was performed for these four clusters, all of which are located in Kentucky. The two clusters in Indiana, Eastview East and Eastview West, did not contain impacted receivers/receptors under this tolling scenario and therefore no evaluation was performed. Figures for each cluster evaluated are included and show only the receivers and barrier wall included in that evaluation. TNM results for the detailed noise abatement evaluations are included in **Appendix E**.

All remaining receivers not identified within an analysis areas in **Figure 4.1–1**, including the Green River State Forest measurement taken at 800-feet, were not impacted and noise abatement evaluations were not required.

4.2.3 Analysis Areas

Analysis Area – Taransay Drive

This analysis area consisted of single family homes near Taransay Drive. Modeled receivers, modeled structural noise barrier location, and the receiver's attenuation level thresholds are presented in **Figure 4.2–1**. Sound level results, including existing, predicted, and predicted with barrier, are presented in **Table 13 of Appendix B**. This table also identifies the number of receptors represented by the receiver, front row receiver/receptors, and an impact summary.

Barrier Summary

A single barrier of 4,500 feet in length, with an average height of 19.47 feet was predicted to benefit 21 of 24 receptors (23 modeled receivers). The barrier demonstrates that it was possible to achieve a 5 dB(A) reduction at three or more impacted first-row receptors, meeting KYTC's feasibility criteria. The cost of the modeled barrier was $2,628,000, for a cost-effectiveness ratio of $109,000 per benefited receptor. This value is above KYTC's cost-effectiveness criterion of $35,000 per benefited receptor and therefore the modeled barrier does not meet KYTC's reasonableness threshold. The barrier provided 7 dB(A) of attenuation for 7 of the 12 first row benefited receptors (58.3 percent). This is above the 50 percent design goal threshold per KYTC's noise policy and therefore the barrier meets this reasonableness criterion.

The wall presented is the structural noise barrier that meets the design goal but did not meet the cost-effective ratio criterion. Only receivers within 800 feet of the pavement edge were included in this assessment. If this alternative is chosen as the Preferred Alternative, additional receptors will be included in the re-evaluation to determine the maximum number of benefited receptors.

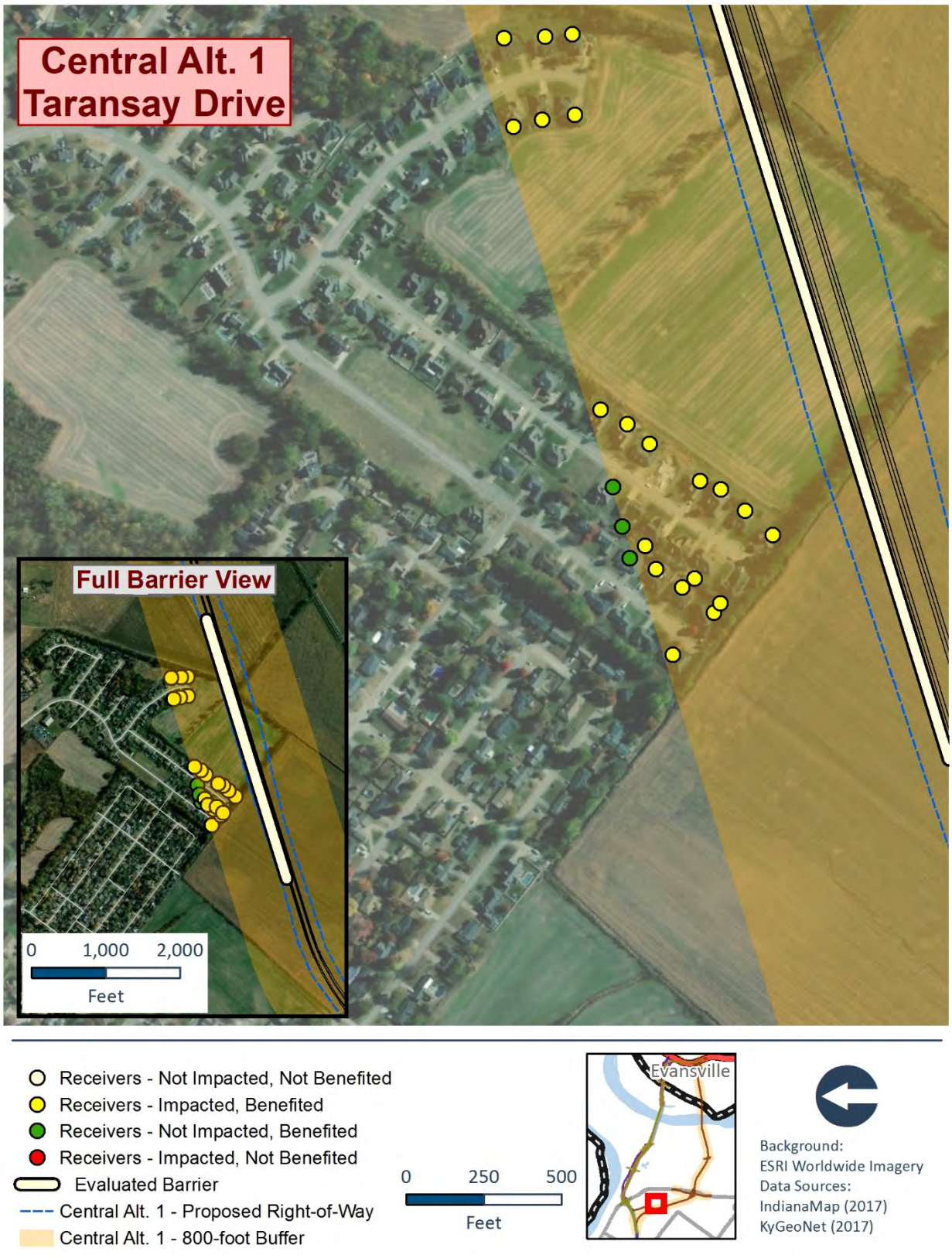

Figure 4.2–1. Central Alternative 1B Barrier Analysis – Taransay Drive (Toll I-69 Only)

Although this will reduce the cost-effective ratio, it would take 39 more receptors (for a total of 63 benefitted receptors) to meet the $35,000 cost-effectiveness criterion. With the assessed receptors already approaching the 5 dB(A) reduction required to be considered benefited, it is unlikely that an additional 39 receptors will achieve the 5 dB(A) reduction.

Table 4.2–1. Central Alternative 1B Barrier Description – Taransay Dr. (Toll I-69 Only)

BARRIER DESCRIPTION	NO. OF IMPACTED RECEPTORS / TOTAL RECEPTORS	BARRIER LENGTH (FT)	AVERAGE BARRIER HEIGHT (FT)	BARRIER AREA (SQ FT)	BARRIER COST @ $30/SQ FT
A Single Barrier on the East Side of Central Alt. 1B	24 / 24	4,500	19.47	87,596	$2,628,000

Table 4.2–2. Central Alternative 1B Barrier Summary – Taransay Dr. (Toll I-69 Only)

IS THE BARRIER FEASIBLE?	NO. BENEFITED AND COST PER BENEFITED	IS THE BARRIER COST EFFECTIVE?	NO. OF 1ST–ROW BENEFITED / NO. OF 1ST–ROW BENEFITED W/ 7 DB(A) OR GREATER ATTENUATION (%)	DOES THE BARRIER MEET THE DESIGN GOAL?
Yes	21 Benefited; $109,000/Benefited	No	12 / 7 58.3	Yes

STATEMENT OF LIKELIHOOD

Based on the current project design and traffic projections, structural noise barriers are not reasonable in accordance with KYTC's noise policy and are not likely for this location.

ANALYSIS AREA – US 60 TIE

This analysis area consisted of single family homes near the intersection of US 60 and KY 414 (Wathen Lane), which is just west of the I-69 ramps to US 60. Modeled receivers, modeled structural noise barrier location, and the receiver's attenuation level thresholds are presented in **Figure 4.2–2**. Sound level results, including existing, predicted, and predicted with barrier, are presented in **Table 14 of Appendix B**. This table also identifies the number of receptors represented by the receiver, front row receiver/receptors, and an impact summary.

BARRIER SUMMARY

The combination of barrier walls totaled 2,207 feet in length, 20.00 feet in height, and would benefit 20 of 39 receptors (30 modeled receivers). The barriers demonstrated that it was possible to achieve a 5 dB(A) reduction at three or more impacted first-row receptors, meeting KYTC's feasibility criteria. The cost of the modeled barriers was $1,324,000, for a cost-effectiveness ratio of $66,000 per benefited receptor. This value is above KYTC's cost-effectiveness criterion of $35,000 per benefited receptor and therefore the modeled barrier does not meet KYTC's reasonableness threshold. Due to the layout of homes along US 60 and KY 414, each location was considered a first-row receptor for this analysis. The barrier provided 7 dB(A) of attenuation for

Figure 4.2–2. Central Alternative 1B Barrier Analysis – US 60 Tie (Toll I-69 Only)

two of the 39 first row benefited receptors (5.1 percent). This is below the 50 percent design goal threshold per KYTC's noise policy and therefore the barrier does not meet this reasonableness criterion.

There was only one impacted receiver identified in the TNM 2.5 modeling but it represented a multi–residential unit and therefore a barrier analysis was necessary. In the assessment, it was necessary to remove barrier panels that spanned entrances that provided local access to US 60. The reduction in attenuation with the removal of these barrier segments resulted in no barrier combination of length and height that would provide 7 dB(A) attenuation at any receptor.

Table 4.2–3. Central Alternative 1B Barrier Description – US 60 Tie (Toll I-69 Only)

BARRIER DESCRIPTION	NO. OF IMPACTED RECEPTORS / TOTAL RECEPTORS	BARRIER LENGTH (FT)	AVERAGE BARRIER HEIGHT (FT)	BARRIER AREA (SQ FT)	BARRIER COST @ $30/SQ FT
A Single Barrier on the West Side of Central Alt. 1B	3 / 39	2,207	20.00	44,130	$1,324,000

Table 4.2–4. Central Alternative 1B Barrier Summary – US 60 Tie (Toll I-69 Only)

IS THE BARRIER FEASIBLE?	NO. BENEFITED AND COST PER BENEFITED	IS THE BARRIER COST EFFECTIVE?	NO. OF 1ST–ROW BENEFITED / NO. OF 1ST–ROW BENEFITED W/ 7 DB(A) OR GREATER ATTENUATION (%)	DOES THE BARRIER MEET THE DESIGN GOAL?
Yes	20 Benefited; $66,000/Benefited	No	39 / 2 5.1	No

STATEMENT OF LIKELIHOOD

Based on the current project design and traffic projections, structural noise barriers are not reasonable in accordance with KYTC's noise policy and are not likely for this location.

ANALYSIS AREA – BRAXTON PARK DRIVE

This analysis area consisted of single family homes near Braxton Park Drive. Modeled receivers, modeled structural noise barrier location, and the receiver's attenuation level thresholds are presented in **Figure 4.2–3**. Sound level results, including existing, predicted, and predicted with barrier, are presented in **Table 15 of Appendix B**. This table also identifies the number of receptors represented by the receiver, front row receiver/receptors, and an impact summary.

BARRIER SUMMARY

A single barrier of 4,276 feet in length, with an average height of 20 feet was predicted to benefit 30 of 35 receptors (34 modeled receivers). The barrier demonstrated that it was possible to achieve a 5 dB(A) reduction at three or more impacted first-row receptors, meeting KYTC's feasibility criteria. The cost of the modeled barrier was $2,566,000, for a cost-effectiveness ratio of $86,000 per benefited receptor. This value is above KYTC's cost-effectiveness criterion of $35,000 per benefited receptor and therefore the modeled barrier does not meet KYTC's reasonableness

Figure 4.2–3. Central Alternative 1B Barrier Analysis – Braxton Park Dr. (Toll I-69 Only)

threshold. The barrier provided 7 dB(A) of attenuation for two of the nine first row benefited receptors (22.2 percent). This is below the 50 percent design goal threshold per KYTC's noise policy and therefore does not meet this reasonableness criterion.

No barrier evaluated was able to meet the design goal reasonableness criterion. The absolute predicted noise levels (without barrier) were lower under Central Alternative 1B. This generated sound levels that were relatively low (in the 50 dB[A] range) and these low values were more difficult to attain a 7 dB(A) reduction than higher absolute levels. Therefore, while Central Alternative 1A was able to meet the design goal, it was not possible for this scenario based on the current design and these modeled traffic volumes.

Table 4.2–5. Central Alternative 1B Barrier Description – Braxton Park Dr. (Toll I-69 Only)

BARRIER DESCRIPTION	NO. OF IMPACTED RECEPTORS / TOTAL RECEPTORS	BARRIER LENGTH (FT)	AVERAGE BARRIER HEIGHT (FT)	BARRIER AREA (SQ FT)	BARRIER COST @ $30/SQ FT
A Single Barrier on the West Side of Central Alt. 1B	34 / 35	4,276	20	85,527	$2,566,000

Table 4.2–6. Central Alternative 1B Barrier Summary – Braxton Park Dr. (Toll I-69 Only)

IS THE BARRIER FEASIBLE?	NO. BENEFITED AND COST PER BENEFITED	IS THE BARRIER COST EFFECTIVE?	NO. OF 1ST–ROW BENEFITED / NO. OF 1ST–ROW BENEFITED W/ 7 DB(A) OR GREATER ATTENUATION (%)	DOES THE BARRIER MEET THE DESIGN GOAL?
Yes	30 Benefited; $86,000/Benefited	No	9 / 2 22.2	No

STATEMENT OF LIKELIHOOD

Based on the current project design and traffic projections, structural noise barriers are not reasonable in accordance with KYTC's noise policy and are not likely for this location.

ANALYSIS AREA – MELODY LANE

This analysis area consisted of single family homes near Melody Lane. Modeled receivers, modeled structural noise barrier location, and the receiver's attenuation level thresholds are presented in **Figure 4.2–4**. Sound level results, including existing, predicted, and predicted with barrier, are presented in **Table 16 of Appendix B**. This table also identifies the number of receptors represented by the receiver, front row receiver/receptors, and an impact summary.

BARRIER SUMMARY

A single barrier of 4,229 feet in length, with an average height of 20.00 feet was predicted to benefit nine of 11 receptors (11 modeled receivers). The barrier demonstrated that it was possible to

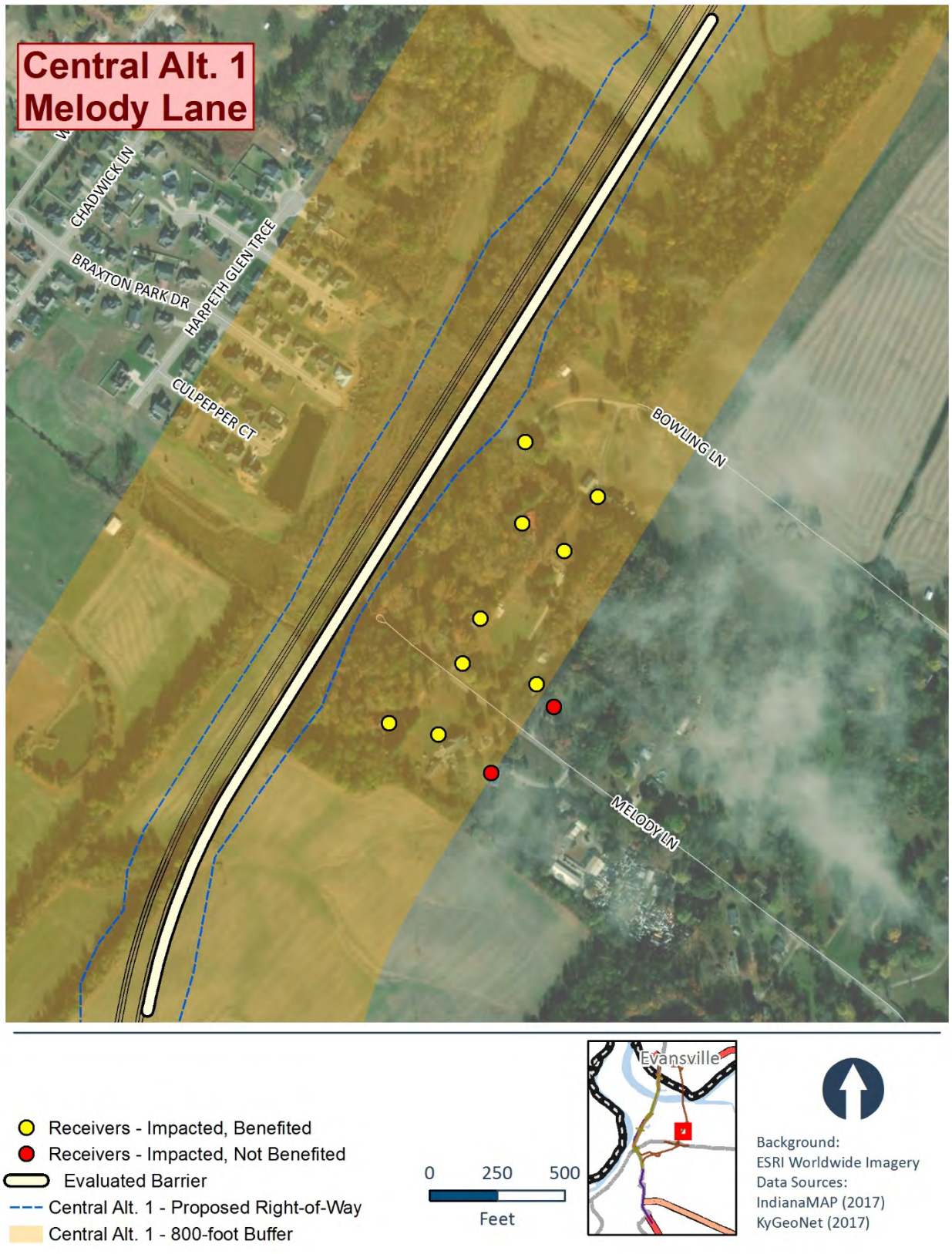

Figure 4.2–4. Central Alternative 1B Barrier Analysis – Melody Ln. (Toll I-69 Only)

achieve a 5 dB(A) reduction at three or more impacted first-row receptors, meeting KYTC's feasibility criteria. The cost of the modeled barrier was $2,538,000, for a cost-effectiveness ratio of $282,000 per benefited receptor. This value is above KYTC's cost-effectiveness criterion of $35,000 per benefited receptor and therefore the modeled barrier does not meet KYTC's reasonableness threshold. The barrier provided 7 dB(A) of attenuation for one of the four first row benefited receptors (50.0 percent). This does not meet the 50 percent design goal threshold per KYTC's noise policy and therefore the barrier does not meet this reasonableness criterion.

No barrier evaluated was able to meet the design goal reasonableness criterion. The absolute predicted noise levels (without barrier) were lower under Central Alternative 1B. This generated sound levels that were relatively low (in the 50 dB[A] range) and these low values are more difficult to attain 7 dB(A) reduction than higher absolute levels. Therefore, while Central Alternative 1A was able to meet the design goal, it was not possible for Central Alternative 1B based on the current design and these modeled traffic volumes.

Table 4.2–7. Central Alternative 1B Barrier Description – Melody Ln. (Toll I-69 Only)

BARRIER DESCRIPTION	NO. OF IMPACTED RECEPTORS / TOTAL RECEPTORS	BARRIER LENGTH (FT)	AVERAGE BARRIER HEIGHT (FT)	BARRIER AREA (SQ FT)	BARRIER COST @ $30/SQ FT
A Single Barrier on the East Side of Central Alt. 1B	11 / 11	4,229	20.00	84,585	$2,538,000

Table 4.2–8. Central Alternative 1B Barrier Summary – Melody Ln. (Toll I-69 Only)

IS THE BARRIER FEASIBLE?	NO. BENEFITED AND COST PER BENEFITED	IS THE BARRIER COST EFFECTIVE?	NO. OF 1ST–ROW BENEFITED / NO. OF 1ST–ROW BENEFITED W/ 7 DB(A) OR GREATER ATTENUATION (%)	DOES THE BARRIER MEET THE DESIGN GOAL?
Yes	9 Benefited; $282,000/Benefited	No	4 / 1 25.0	No

STATEMENT OF LIKELIHOOD

Based on the current project design and traffic projections, structural noise barriers are not reasonable in accordance with KYTC's noise policy and are not likely for this location.

ANALYSIS AREA – EASTVIEW EAST

When tolling I-69 only, there would be no receptors in the Eastview East area that exceed noise criteria or experience a substantial increase of 15 dB(A). Therefore, no structural noise barrier analysis for Central Alternative 1B would be required for Eastview East.

ANALYSIS AREA – EASTVIEW WEST

When tolling I-69 only, there would be no receptors in the Eastview West area that exceed noise criteria or experience a substantial increase of 15 dB(A). Therefore, no structural noise barrier analysis for Central Alternative 1B would be required for Eastview West.

4.2.4 BARRIER SUMMARY

Four noise barrier analyses, all in Kentucky, were performed for Central Alternative 1B. None of the barriers evaluated met the feasibility, reasonableness, and the design goal criteria required by KYTC's noise policy. Therefore, no structural noise barrier is proposed for Central Alternative 1B.

4.2.5 STATEMENT OF LIKELIHOOD

No structural noise barrier was determined to be both feasible and reasonable for any impacted receptors on Central Alternative 1B under the toll I-69 only scenario. No additional abatement measures would be considered for Central Alternative 1B.

CHAPTER 5 – WEST ALTERNATIVE 1 RESULTS

As with the Central Alternatives 1A and 1B model, the West Alternative 1 model was analyzed from the beginning of the project in Indiana to just south of the CSX Railroad in Kentucky. The area analyzed for noise impacts under West Alternative 1 is shown in **Figure 5.1–1.** The proposed improvements south of the CSX Railroad are the same for each build alternative so a separate analysis was performed for this segment. Those results are referred to as "US 41 (KY 351 to KY 425)" are presented in **Chapter 7**. The models for both West Alternative 1 and US 41 (KY 351 to KY 425) were extended over 1,500 beyond their last receptor and they slightly overlapped with each other. The two models shall be combined for a full analysis of West Alternative 1.

West Alternative 1 was also analyzed for two potential tolling scenarios for the Ohio River crossings. **Table 4 of Appendix B** provides the noise impact results for receivers for both tolling scenarios of West Alternative 1.

5.1 WEST ALTERNATIVE 1 – TOLL BOTH CROSSINGS

5.1.1 IMPACT DETERMINATION ANALYSIS

There were 561 receivers analyzed with the West Alternative 1 model under the scenario of tolling both crossings. Of the 561 receivers, 55 would be impacted. These resulted in 88 impacted receptors, 47 that exceeded the NAC criteria, 39 that would see a substantial increase in noises levels over the existing levels (15 dB[A] or more in Indiana, 10 dB[A] or more in Kentucky), and two that would exceed the NAC criteria and also experience a substantial increase in noise levels.

5.1.2 NOISE ABATEMENT EVALUATION

Once all impacts were known, they were analyzed to determine locations where a detailed noise abatement evaluation would be necessary. There are five clusters of receivers/receptors in Kentucky where impacts were identified, and a noise abatement evaluation was performed. Figures for each cluster evaluated are included and show only the receivers and barrier wall included in that evaluation. There are three clusters of receivers in Indiana but there were no impacts and therefore no noise abatement evaluation was required. These clusters are identified as analysis areas in **Figure 5.1–1**. TNM results for the detailed noise abatement evaluations are included in **Appendix E**.

All receivers outside of the analysis areas in **Figure 5.1–1** were not impacted and noise abatement evaluations were not required.

5.1.3 ANALYSIS AREA

ANALYSIS AREA – RICHARDSON AVENUE

This analysis area consisted of single family homes and medical facilities near Richardson Avenue, including the Redbanks short–term rehabilitation and Alzheimer's care facility.

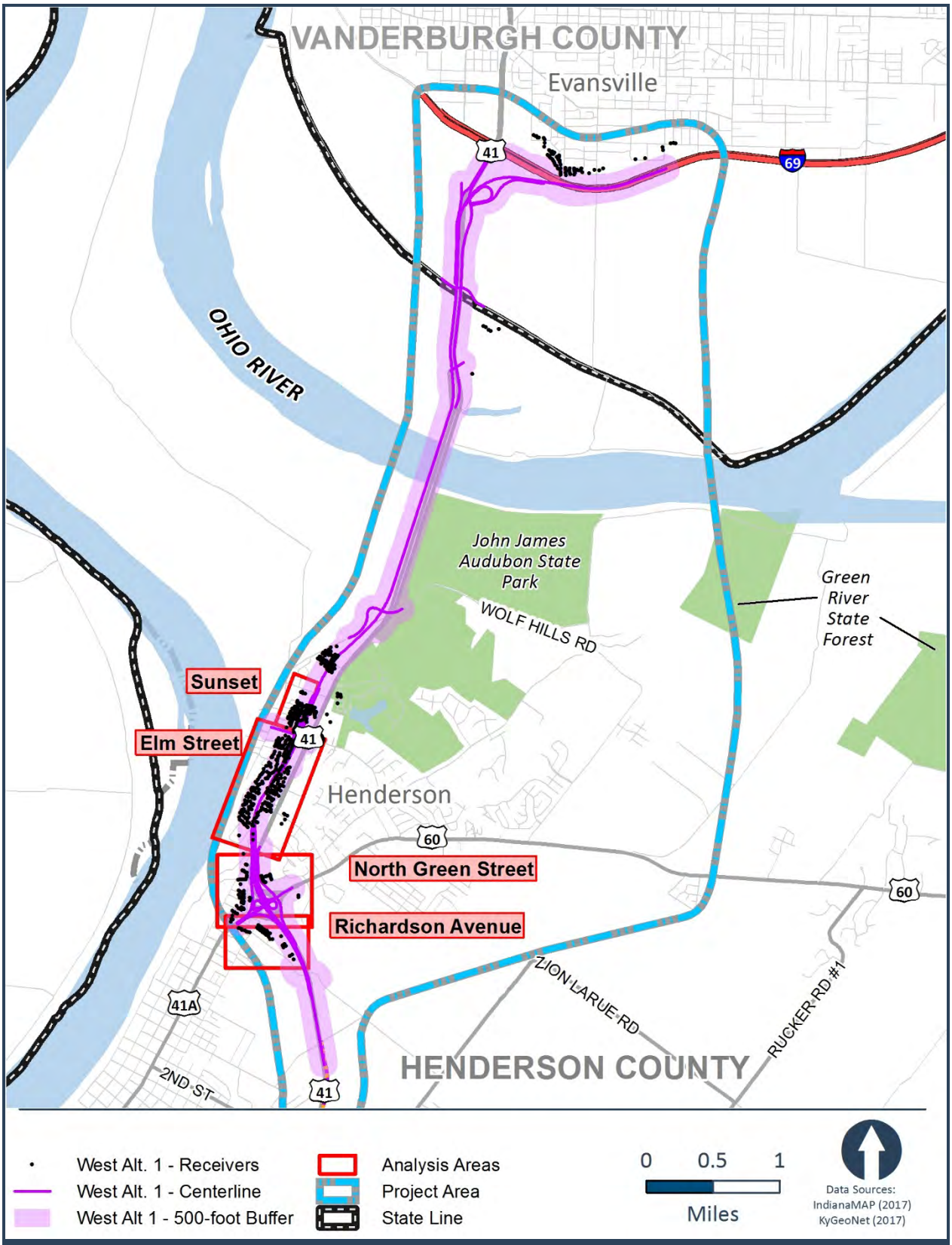

Figure 5.1–1. West Alternative 1 Noise Impact Analysis Areas

Modeled receivers, modeled structural noise barrier location, and the receiver's attenuation level thresholds are presented in **Figure 5.1–2**. Sound level results, including existing, predicted, and predicted with barrier, are presented in **Table 17 of Appendix B**. This table also identifies the number of receptors represented by the receiver, front row receiver/receptors, and an impact summary.

BARRIER SUMMARY

A single barrier of 3,360 feet in length and a height of 20.09 feet was predicted to benefit 89 of 107 receptors (37 modeled receivers). The barrier demonstrated that it was possible to achieve a 5 dB(A) reduction at three or more impacted first-row receptors, meeting KYTC's feasibility criteria. The cost of the modeled barrier was $2,206,000, for a cost-effectiveness ratio of $25,000 per benefited receptor. This value is below KYTC's cost-effectiveness criterion of $35,000 per benefited receptor and therefore the modeled barrier meets KYTC's reasonableness threshold. The barrier would provide 7 dB(A) of attenuation for 78 of the 87 first row benefited receptors (89.7 percent). This is above the 50 percent design goal threshold per KYTC's noise policy and therefore the barrier also meets this reasonableness criterion.

Table 5.1–1. West Alternative 1 Barrier Description – Richardson Avenue (Toll Both Crossings)

BARRIER DESCRIPTION	NO. OF IMPACTED RECEPTORS	BARRIER LENGTH (FT)	AVERAGE BARRIER HEIGHT (FT)	BARRIER AREA (SQ FT)	BARRIER COST @ $30/SQ FT
A Single Barrier on the West Side of West Alt. 1	17 / 107	3,360	20.09	73,517	$2,206,000

Table 5.1–2. West Alternative 1 Barrier Summary – Richardson Avenue (Toll Both Crossings)

IS THE BARRIER FEASIBLE?	NO. BENEFITED AND COST PER BENEFITED	IS THE BARRIER COST EFFECTIVE?	NO. OF 1ST–ROW BENEFITED / NO. OF 1ST–ROW BENEFITED W/ 7 DB(A) OR GREATER ATTENUATION (%)	DOES THE BARRIER MEET THE DESIGN GOAL?
Yes	89 Benefited; $25,000/Benefited	Yes	87 / 78 89.7	Yes

STATEMENT OF LIKELIHOOD

Based on the current project design and traffic projections, a structural noise barrier is reasonable and feasible in accordance with KYTC's noise policy and is likely for this location.

ANALYSIS AREA – NORTH GREEN STREET

This analysis area consisted of single family homes and apartment/condominium buildings near North Green Street. Modeled receivers, modeled structural noise barrier location, and the receiver's attenuation level thresholds are presented in **Figure 5.1–3**. Sound level results,

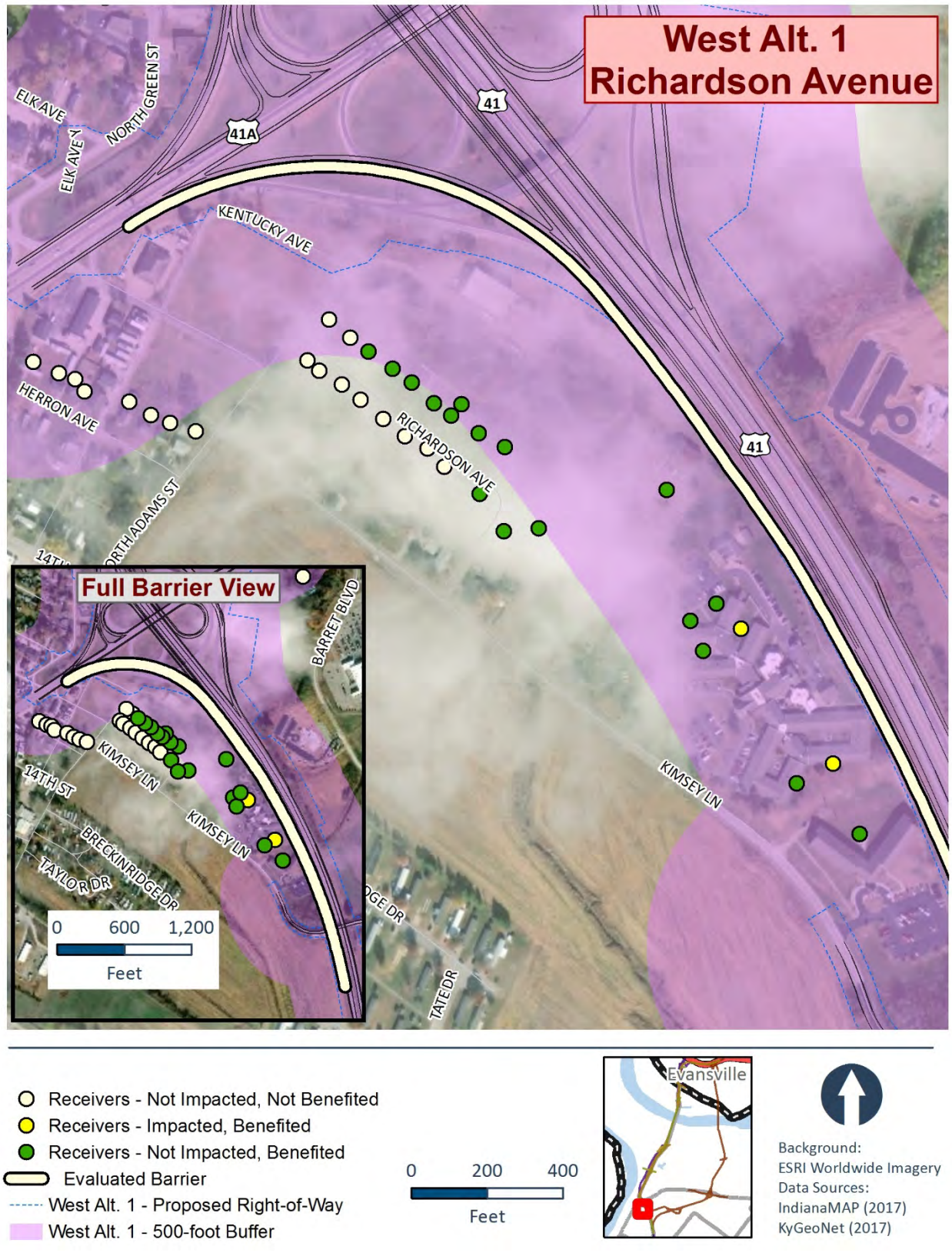

Figure 5.1–2. West Alternative 1 Barrier Analysis – Richardson Avenue (Toll Both Crossings)

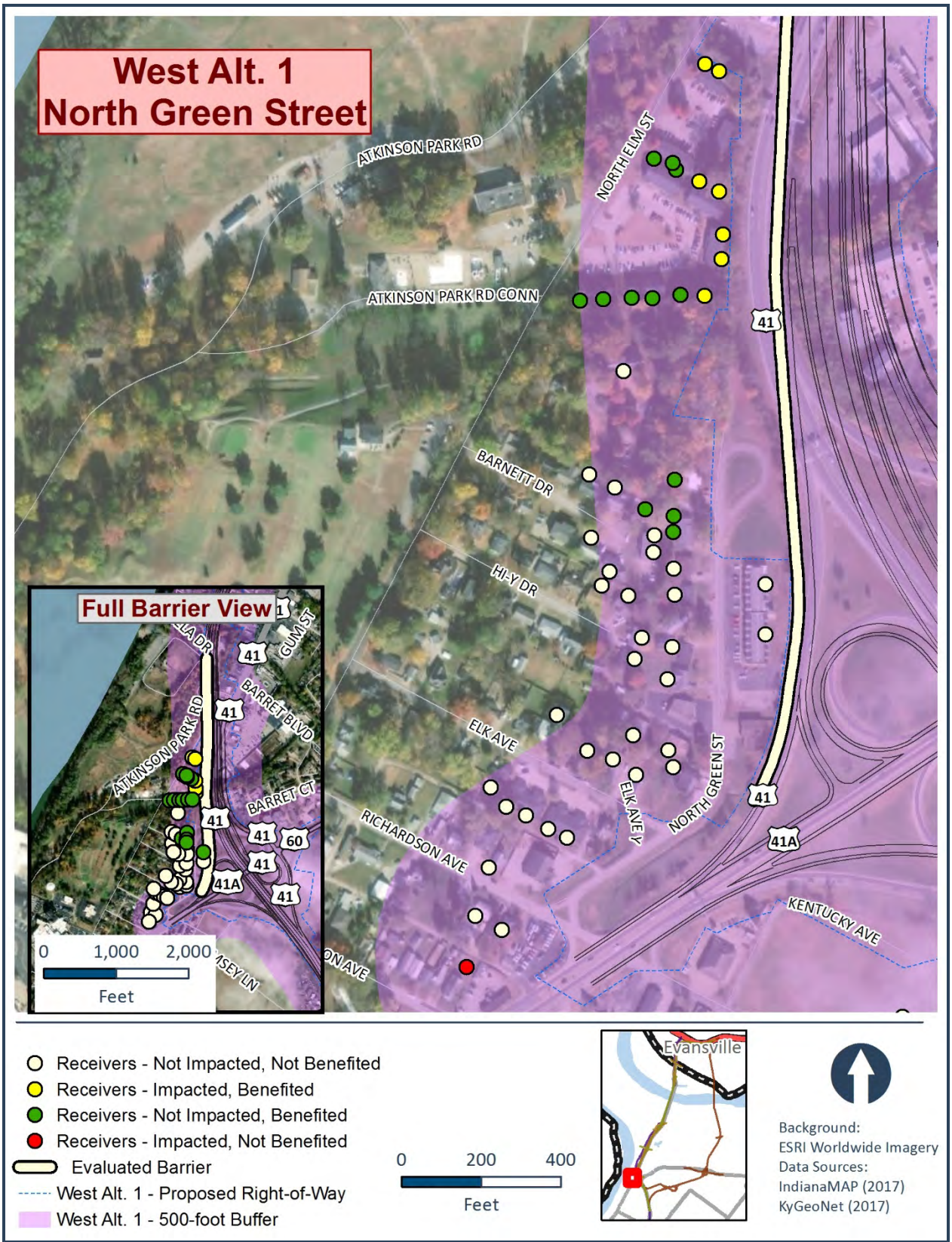

Figure 5.1–3. West Alternative 1 Barrier Analysis – North Green Street (Toll Both Crossings)

including existing, predicted, and predicted with barrier, are presented in **Table 18 of Appendix B**. This table also identifies the number of receptors represented by the receiver, front row receiver/receptors, and an impact summary.

BARRIER SUMMARY

A single barrier of 2,920 feet in length with an average height of 19.94 feet was predicted to benefit 89 of 139 receptors (53 modeled receivers). The barrier demonstrated that it was possible to achieve a 5 dB(A) reduction at three or more impacted first-row receptors, meeting KYTC's feasibility criteria. The cost of the modeled barrier was $1,747,000, for a cost-effectiveness ratio of $20,000 per benefited receptor. This value is below KYTC's cost-effectiveness criterion of $35,000 per benefited receptor and therefore the modeled barrier meets KYTC's reasonableness threshold. The barrier would provide 7 dB(A) of attenuation for 24 of the 40 first row benefited receptors (60.0 percent). This is above the 50 percent design goal threshold per KYTC's noise policy and therefore the barrier would also meet this reasonableness criterion.

Table 5.1–3. West Alternative 1 Barrier Description – North Green Street (Toll Both Crossings)

BARRIER DESCRIPTION	NO. OF IMPACTED RECEPTORS / TOTAL RECEPTORS	BARRIER LENGTH (FT)	AVERAGE BARRIER HEIGHT (FT)	BARRIER AREA (SQ FT)	BARRIER COST @ $30/SQ FT
A Single Barrier on the West Side of West Alt. 1	19 / 139	2,920	19.94	58,233	$1,747,000

Table 5.1–4. West Alternative 1 Barrier Summary – North Green Street (Toll Both Crossings)

IS THE BARRIER FEASIBLE?	NO. BENEFITED AND COST PER BENEFITED	IS THE BARRIER COST EFFECTIVE?	NO. OF 1ST–ROW BENEFITED / NO. OF 1ST–ROW BENEFITED W/ 7 DB(A) OR GREATER ATTENUATION (%)	DOES THE BARRIER MEET THE DESIGN GOAL?
Yes	89 Benefited; $20,000/Benefited	Yes	40 / 24 60.0	Yes

STATEMENT OF LIKELIHOOD

Based on the current project design and traffic projections, a structural noise barrier is reasonable and feasible in accordance with KYTC's noise policy and is likely for this location.

ANALYSIS AREA – ELM STREET

This analysis area consisted of single family homes and apartment/condominium buildings near Elm Street. Modeled receivers, modeled structural noise barrier location, and the receiver's attenuation level thresholds are presented in **Figure 5.1–4**. Sound level results, including existing, predicted, and predicted with barrier, are presented in **Table 19 of Appendix B**. This table also identifies the number of receptors represented by the receiver, front row receiver/receptors, and an impact summary.

Figure 5.1–4. West Alternative 1 Barrier Analysis – Elm Street (Toll Both Crossings)

BARRIER SUMMARY

A single barrier of 2,680 feet in length with an average height of 15.97 feet was predicted to benefit 71 of 75 receptors (56 modeled receivers). The barrier demonstrated that it was possible to achieve a 5 dB(A) reduction at three or more impacted first-row receptors, meeting KYTC's feasibility criteria. The cost of the modeled barrier was $1,284,000, for a cost-effectiveness ratio of $18,000 per benefited receptor. This value is below KYTC's cost-effectiveness criterion of $35,000 per benefited receptor and therefore the modeled barrier meets KYTC's reasonableness threshold. The barrier would provide 7 dB(A) of attenuation for 12 of the 15 first row benefited receptors (80.0 percent). This is above the 50 percent design goal threshold per KYTC's noise policy and therefore the barrier would also meet this reasonableness criterion.

Table 5.1–5. West Alternative 1 Barrier Description – Elm Street (Toll Both Crossings)

BARRIER DESCRIPTION	NO. OF IMPACTED RECEPTORS / TOTAL RECEPTORS	BARRIER LENGTH (FT)	AVERAGE BARRIER HEIGHT (FT)	BARRIER AREA (SQ FT)	BARRIER COST @ $30/SQ FT
A Single Barrier on the West Side of West Alt 1	11 / 75	2,680	15.97	42,794	$1,284,000

Table 5.1–6. West Alternative 1 Barrier Summary – Elm Street (Toll Both Crossings)

IS THE BARRIER FEASIBLE?	NO. BENEFITED AND COST PER BENEFITED	IS THE BARRIER COST EFFECTIVE?	NO. OF 1ST–ROW BENEFITED / NO. OF 1ST–ROW BENEFITED W/ 7 DB(A) OR GREATER ATTENUATION (%)	DOES THE BARRIER MEET THE DESIGN GOAL?
Yes	71 Benefited; $18,000/Benefited	Yes	15 / 12 80.0	Yes

STATEMENT OF LIKELIHOOD

Based on the current project design and traffic projections, a structural noise barrier is reasonable and feasible in accordance with KYTC's noise policy and is likely for this location.

ANALYSIS AREA – SUNSET LANE

This analysis area consisted of single family homes and apartment/condominium buildings near Sunset Lane. Modeled receivers, modeled structural noise barrier location, and the receiver's attenuation level thresholds are presented in **Figure 5.1–5**. Sound level results, including existing, predicted, and predicted with barrier, are presented in **Table 20 of Appendix B**. This table also identifies the number of receptors represented by the receiver, front row receiver/receptors, and an impact summary.

Figure 5.1–5. West Alternative 1 Barrier Analysis – Sunset Lane (Toll Both Crossings)

BARRIER SUMMARY

A single barrier of 4,502 feet in length with an average height of 16.89 feet was predicted to benefit 90 of 140 receptors (126 modeled receivers). The barrier demonstrated that it was possible to achieve a 5 dB(A) reduction at three or more impacted first-row receptors, meeting KYTC's feasibility criteria. The cost of the modeled barrier was $2,281,000 for a cost-effectiveness ratio of $25,000 per benefited receptor. This value is below KYTC's cost-effectiveness criterion of $35,000 per benefited receptor and therefore the modeled barrier meets KYTC's reasonableness threshold.

The barrier would provide 7 dB(A) of attenuation for 24 of the 29 first row benefited receptors (82.8 percent). This is above the 50 percent design goal threshold per KYTC's noise policy and therefore the barrier would also meet this reasonableness criterion.

Table 5.1–7. West Alternative 1 Barrier Description – Sunset Lane (Toll Both Crossings)

BARRIER DESCRIPTION	NO. OF IMPACTED RECEPTORS / TOTAL RECEPTORS	BARRIER LENGTH (FT)	AVERAGE BARRIER HEIGHT (FT)	BARRIER AREA (SQ FT)	BARRIER COST @ $30/SQ FT
A Single Barrier on the West Side of West Alt. 1	38 / 140	4,502	16.89	76,027	$2,281,000

Table 5.1–8. West Alternative 1 Barrier Summary – Sunset Lane (Toll Both Crossings)

IS THE BARRIER FEASIBLE?	NO. BENEFITED AND COST PER BENEFITED	IS THE BARRIER COST EFFECTIVE?	NO. OF 1ST–ROW BENEFITED / NO. OF 1ST–ROW BENEFITED W/ 7 DB(A) OR GREATER ATTENUATION (%)	DOES THE BARRIER MEET THE DESIGN GOAL?
Yes	90 Benefited; $25,000/Benefited	Yes	29 / 24 82.8	Yes

STATEMENT OF LIKELIHOOD

Based on the current project design and traffic projections, a structural noise barrier is reasonable and feasible in accordance with KYTC's noise policy and is likely for this location.

5.1.4 BARRIER SUMMARY

Four noise barrier analyses, all in Kentucky, were performed for West Alternative 1 under the scenario of tolling both crossings. All four barriers evaluated met the feasibility, reasonableness, and the design goal criteria required by the state's noise policy. Therefore, structural noise barriers are proposed for West Alternative 1 under this scenario.

5.1.5 STATEMENT OF LIKELIHOOD

Four structural noise barriers were determined to be both feasible and reasonable for impacted receptors. Further abatement measures would be considered for West Alternative 1 under this proposed scenario.

5.2 WEST ALTERNATIVE 1 – TOLL I-69 ONLY

5.2.1 IMPACT DETERMINATION ANALYSIS

There were 561 receivers analyzed for West Alternative 1 under the scenario of tolling only the I-69 crossing. Of the 561 receivers, 60 would be impacted. This resulted in 101 impacted receptors, 59 that exceeded the NAC criteria, 39 that would experience a substantial increase in noises levels over the existing levels (15 dB[A] or more in Indiana, 10 dB[A] or more in Kentucky), and three that would both exceed the NAC criteria and experience a substantial increase in noise levels.

5.2.2 NOISE ABATEMENT EVALUATION

Once all impacts were known, they were analyzed to determine locations where a detailed noise abatement evaluation would be necessary. Four clusters of impacts, all in Kentucky, were identified and an evaluation was performed for each. Figures for each cluster evaluated are included and show only the receivers and barrier wall included in that evaluation. Clusters are identified as analysis areas in **Figure 5.1–1** and are labeled by a landmark or significant street in the area. TNM results for the detailed noise abatement evaluations are included in **Appendix E**.

All receivers outside of the analysis areas in **Figure 5.1–1** were not impacted and noise abatement evaluations were not required.

5.2.3 ANALYSIS AREAS

ANALYSIS AREA – RICHARDSON AVENUE

This analysis area consisted of single family homes and medical facilities near Richardson Avenue, including the Redbanks short–term rehabilitation and Alzheimer's care facility. Modeled receivers, modeled structural noise barrier location, and the receiver's attenuation level thresholds are presented in **Figure 5.2–1**. Sound level results, including existing, predicted, and predicted with barrier, are presented in **Table 21 of Appendix B**. This table also identifies the number of receptors represented by the receiver, front row receiver/receptors, and an impact summary.

BARRIER SUMMARY

A single barrier of 3,340 feet in length and a height of 20.00 feet was predicted to benefit 87 of 107 receptors (37 modeled receivers). The barrier demonstrated that it was possible to achieve a 5 dB(A) reduction at three or more impacted first-row receptors, meeting KYTC's feasibility criteria. The cost of the modeled barrier was $1,994,000, for a cost-effectiveness ratio of $23,000 per benefited receptor. This value is below KYTC's cost-effectiveness criterion of $35,000 per benefited receptor and therefore the modeled barrier meets KYTC's reasonableness threshold. The barrier would provide 7 dB(A) of attenuation for 78 of the 85 first row benefited receptors (91.8 percent). This is above the 50 percent design goal threshold per KYTC's noise policy and therefore the barrier would also meet this reasonableness criterion.

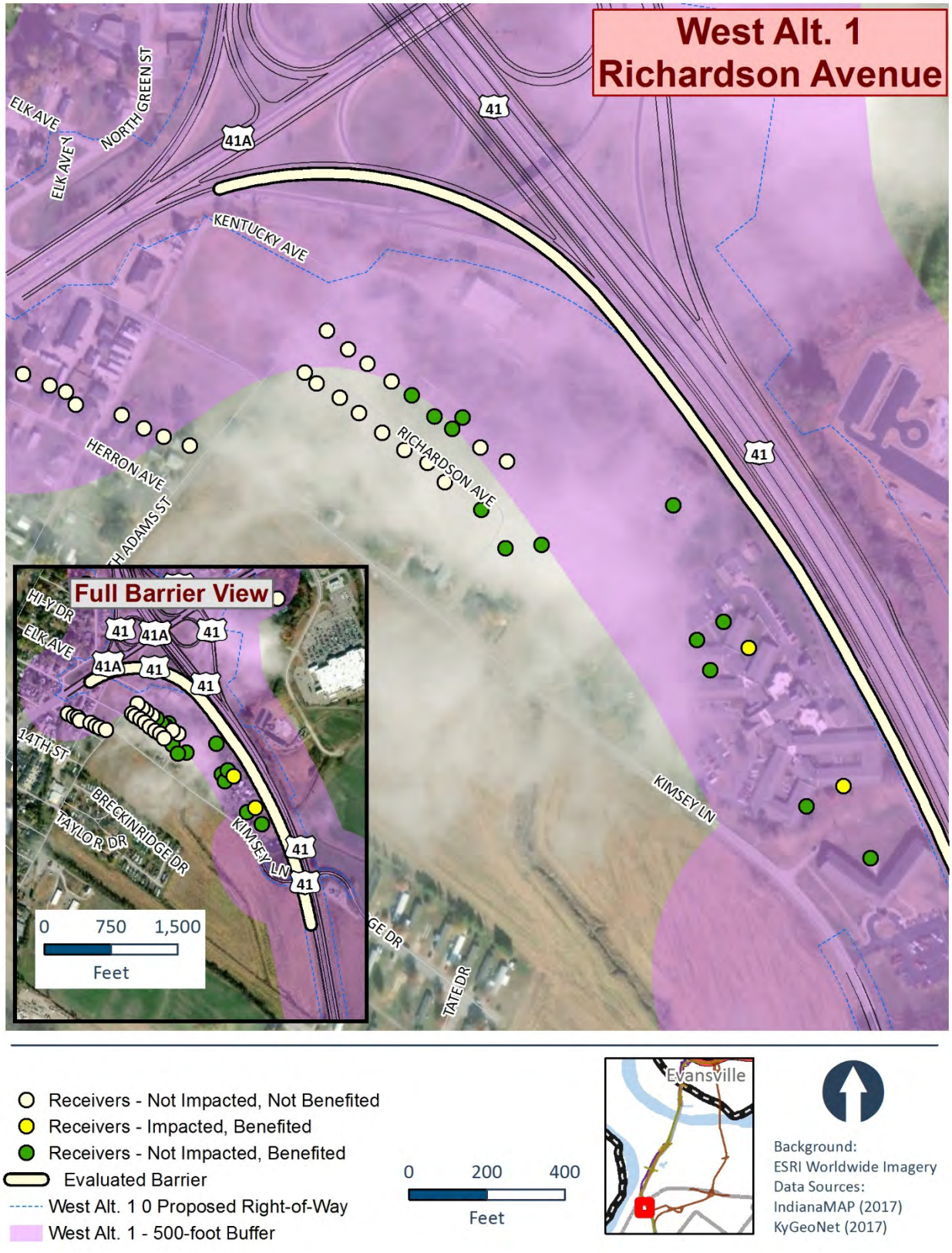

Figure 5.2–1. West Alternative 1 Barrier Analysis – Richardson Avenue (Toll I-69 Only)

Table 5.2–1. West Alternative 1 Barrier Description – Richardson Avenue (Toll I-69 Only)

BARRIER DESCRIPTION	NO. OF IMPACTED RECEPTORS / TOTAL RECEPTORS	BARRIER LENGTH (FT)	AVERAGE BARRIER HEIGHT (FT)	BARRIER AREA (SQ FT)	BARRIER COST @ $30/SQ FT
A Single Barrier on the West Side of West Alt. 1	17 / 107	3,340	20.00	66,477	$1,994,000

Table 5.2–2. West Alternative 1 Barrier Summary – Richardson Avenue (Toll I-69 Only)

IS THE BARRIER FEASIBLE?	NO. BENEFITED AND COST PER BENEFITED	IS THE BARRIER COST EFFECTIVE?	NO. OF 1ST–ROW BENEFITED / NO. OF 1ST–ROW BENEFITED W/ 7 DB(A) OR GREATER ATTENUATION (%)	DOES THE BARRIER MEET THE DESIGN GOAL?
Yes	87 Benefited; $23,000/Benefited	Yes	85 / 78 91.8	Yes

STATEMENT OF LIKELIHOOD

Based on the current project design and traffic projections, a structural noise barrier is reasonable and feasible in accordance with KYTC's noise policy and is likely for this location.

ANALYSIS AREA – NORTH GREEN STREET

This analysis area consisted of single family homes and apartment/condominium buildings near North Green Street. Modeled receivers, modeled structural noise barrier location, and the receiver's attenuation level thresholds are presented in **Figure 5.2–2**. Sound level results, including existing, predicted, and predicted with barrier, are presented in **Table 22 of Appendix B**. This table also identifies the number of receptors represented by the receiver, front row receiver/receptors, and an impact summary.

BARRIER SUMMARY

A single barrier of 3,240 feet in length and with an average height of 19.73 feet was predicted to benefit 77 of the 139 receptors (52 modeled receivers). The barrier demonstrated that it was possible to achieve a 5 dB(A) reduction at three or more impacted first-row receptors, meeting KYTC's feasibility criteria. The cost of the modeled barrier was $1,917,000, for a cost-effectiveness ratio of $25,000 per benefited receptor. This value is below KYTC's cost-effectiveness criterion of $35,000 per benefited receptor and therefore the modeled barrier meets KYTC's reasonableness threshold. The barrier provided 7 dB(A) of attenuation for 24 of the 28 first row benefited receptors (85.7 percent). This is above the 50 percent design goal threshold per KYTC's noise policy and therefore the barrier would also meet this reasonableness criterion.

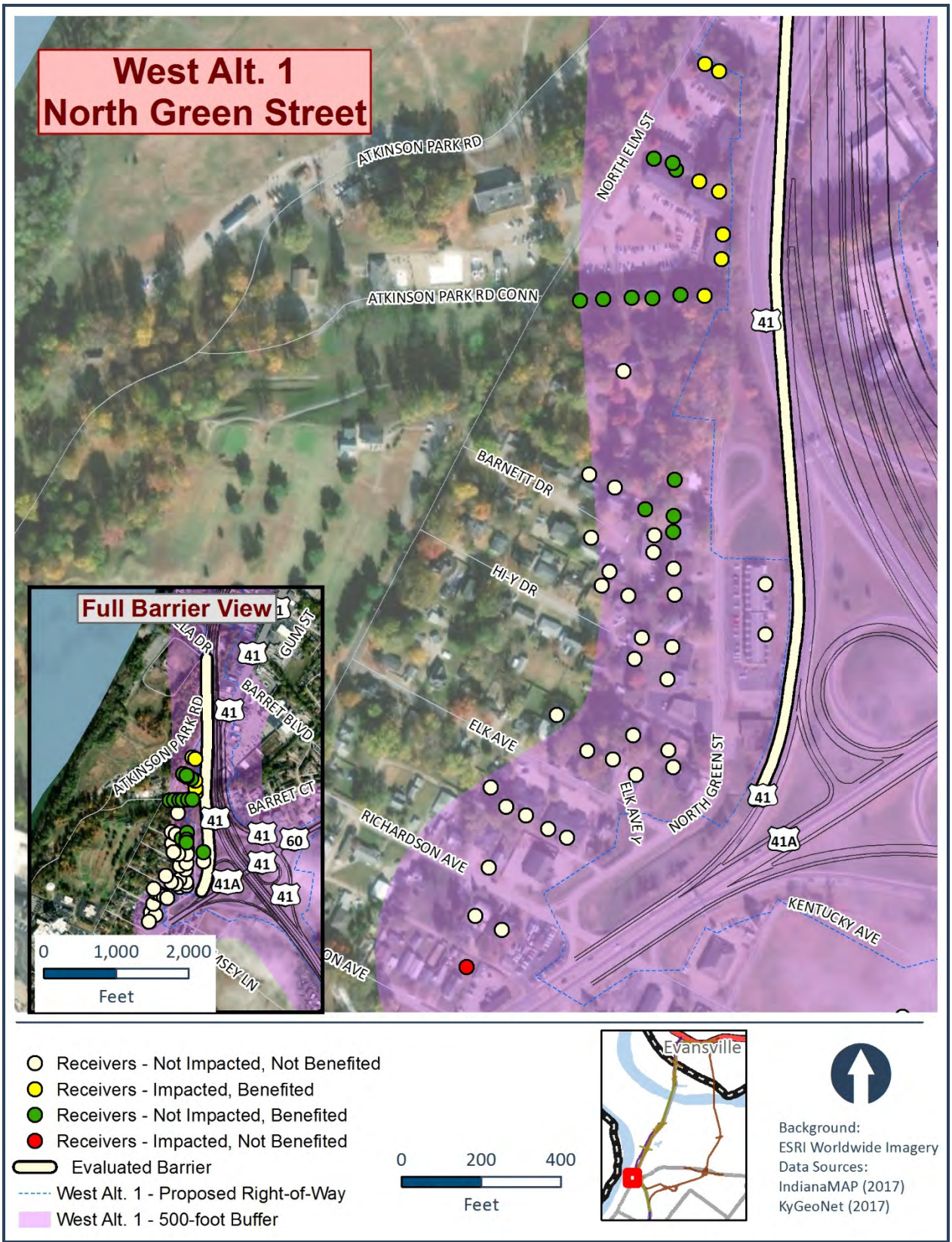

Figure 5.2–2. West Alternative 1 Barrier Analysis – North Green Street (Toll I-69 Only)

Table 5.2–3. West Alternative 1 Barrier Description – North Green Street (Toll I-69 Only)

BARRIER DESCRIPTION	NO. OF IMPACTED RECEPTORS / TOTAL RECEPTORS	BARRIER LENGTH (FT)	AVERAGE BARRIER HEIGHT (FT)	BARRIER AREA (SQ FT)	BARRIER COST @ $30/SQ FT
A Single Barrier on the West Side of West Alt. 1	30 / 139	3,240	19.73	63,910	$1,917,000

Table 5.2–4. West Alternative 1 Barrier Summary – North Green Street (Toll I-69 Only)

IS THE BARRIER FEASIBLE?	NO. BENEFITED AND COST PER BENEFITED	IS THE BARRIER COST EFFECTIVE?	NO. OF 1ST–ROW BENEFITED / NO. OF 1ST–ROW BENEFITED W/ 7 DB(A) OR GREATER ATTENUATION (%)	DOES THE BARRIER MEET THE DESIGN GOAL?
Yes	77 Benefited; $25,000/Benefited	Yes	28 / 24 85.7	Yes

STATEMENT OF LIKELIHOOD

Based on the current project design and traffic projections, a structural noise barrier is reasonable and feasible in accordance with KYTC's noise policy and is likely for this location.

ANALYSIS AREA – ELM STREET

This analysis area consisted of single family homes and apartment/condominium buildings near Elm Street. Modeled receivers, modeled structural noise barrier location, and the receiver's attenuation level thresholds are presented in **Figure 5.2–3.** Sound level results, including existing, predicted, and predicted with barrier, are presented in **Table 23 of Appendix B**. This table also identifies the number of receptors represented by the receiver, front row receiver/receptors, and an impact summary.

BARRIER SUMMARY

A single barrier of 2,280 feet in length and with an average height of 15.30 feet was predicted to benefit 67 of the 75 receptors (56 modeled receivers). The barrier demonstrated that it was possible to achieve a 5 dB(A) reduction at three or more impacted first-row receptors, meeting KYTC's feasibility criteria. The cost of the modeled barrier was $1,046,000, for a cost-effectiveness ratio of $16,000 per benefited receptor. This value is below KYTC's cost-effectiveness criterion of $35,000 per benefited receptor and therefore the modeled barrier meets KYTC's reasonableness threshold. The barrier would provide 7 dB(A) of attenuation for 12 of the 15 first row benefited receptors (80.0 percent). This is above the 50 percent design goal threshold per KYTC's noise policy and therefore the barrier would also meet this reasonableness criterion.

Figure 5.2–3. West Alternative 1 Barrier Analysis – Elm Street (Toll I-69 Only)

Table 5.2–5. West Alternative 1 Barrier Description – Elm Street (Toll I-69 Only)

BARRIER DESCRIPTION	NO. OF IMPACTED RECEPTORS / TOTAL RECEPTORS	BARRIER LENGTH (FT)	AVERAGE BARRIER HEIGHT (FT)	BARRIER AREA (SQ FT)	BARRIER COST @ $30/SQ FT
A Single Barrier on the East Side of West Alt. 1	11 / 75	2,280	15.30	34,879	$1,046,000

Table 5.2–6. West Alternative 1 Barrier Summary – Elm Street (Toll I-69 Only)

IS THE BARRIER FEASIBLE?	NO. BENEFITED AND COST PER BENEFITED	IS THE BARRIER COST EFFECTIVE?	NO. OF 1ST–ROW BENEFITED / NO. OF 1ST–ROW BENEFITED W/ 7 DB(A) OR GREATER ATTENUATION (%)	DOES THE BARRIER MEET THE DESIGN GOAL?
Yes	67 Benefited; $16,000/Benefited	Yes	15 / 12 80.0	Yes

STATEMENT OF LIKELIHOOD

Based on the current project design and traffic projections, a structural noise barrier is reasonable and feasible in accordance with KYTC's noise policy and is likely for this location.

ANALYSIS AREA – SUNSET LANE

This analysis area consisted of single family homes and apartment/condominium buildings near Sunset lane. Modeled receivers, modeled structural noise barrier location, and the receiver's attenuation level thresholds are presented in **Figure 5.2–4**. Sound level results, including existing, predicted, and predicted with barrier, are presented in **Table 24 of Appendix B**. This table also identifies the number of receptors represented by the receiver, front row receiver/receptors, and an impact summary.

BARRIER SUMMARY

A single barrier of 4,685 feet in length with an average height of 16.51 feet was predicted to benefit 93 of the 140 receptors (125 modeled receivers). The barrier demonstrated that it was possible to achieve a 5 dB(A) reduction at three or more impacted first-row receptors, meeting KYTC's feasibility criteria. The cost of the modeled barrier was $2,321,000 for a cost-effectiveness ratio of $25,000 per benefited receptor. This value is below KYTC's cost-effectiveness criterion of $35,000 per benefited receptor and therefore the modeled barrier meets KYTC's reasonableness threshold. The barrier would provide 7 dB(A) of attenuation for 24 of the 30 first row benefited receptors (80.0 percent). This is above the 50 percent design goal threshold per KYTC's noise policy and therefore the barrier would also meet this reasonableness criterion.

Figure 5.2–4. West Alternative 1 Barrier Analysis – Sunset Lane (Toll I-69 Only)

Table 5.2–7. West Alternative 1 Barrier Description – Sunset Lane (Toll I-69 Only)

BARRIER DESCRIPTION	NO. OF IMPACTED RECEPTORS / TOTAL RECEPTORS	BARRIER LENGTH (FT)	AVERAGE BARRIER HEIGHT (FT)	BARRIER AREA (SQ FT)	BARRIER COST @ $30/SQ FT
A Single Barrier on the West Side of West Alt. 1	39 / 140	4,685	16.51	77,354	$2,321,000

Table 5.2–8. West Alternative 1 Barrier Summary – Sunset Lane (Toll I-69 Only)

IS THE BARRIER FEASIBLE?	NO. BENEFITED AND COST PER BENEFITED	IS THE BARRIER COST EFFECTIVE?	NO. OF 1ST–ROW BENEFITED / NO. OF 1ST–ROW BENEFITED W/ 7 DB(A) OR GREATER ATTENUATION (%)	DOES THE BARRIER MEET THE DESIGN GOAL?
Yes	93 Benefited; $25,000/Benefited	Yes	30 / 24 80.0	Yes

STATEMENT OF LIKELIHOOD

Based on the current project design and traffic projections, a structural noise barrier is reasonable and feasible in accordance with KYTC's noise policy and is likely for this location.

5.2.4 BARRIER SUMMARY

Four noise barrier analysis, all in Kentucky, were performed for West Alternative 1 under the scenario of tolling only the I-69 crossing. All four of the barriers evaluated meet the feasibility, reasonableness, and the design goal criteria required by KYTC's noise policy. Therefore, structural noise barriers are proposed for West Alternative 1 with the proposed scenario to only toll the I-69 crossing.

5.2.5 STATEMENT OF LIKELIHOOD

Four structural noise barriers were determined to be both feasible and reasonable for impacted receptors for this alternative. Additional abatement measures would be considered for West Alternative 1 under the scenario to only toll the I-69 crossing.

CHAPTER 6 – WEST ALTERNATIVE 2 RESULTS

Similar to the West Alternative 1model, the West Alternative 2 model was analyzed from the beginning of the project in Indiana to just south of the CSX Railroad in Kentucky. The area analyzed for noise impacts under West Alternative 2 is shown in **Figure 6.2–1**. From this point south, West Alternative 2 joins West Alternative 1 and Central Alternatives 1A and 1B and follows along the existing US 41. The improvements south of the CSX Railroad are the same for each build alternative so a separate analysis was performed for this section. Those results are referred to as "US 41 (KY 351 to KY 425)" are presented in **Chapter 7**. The models for both West Alternative 2 and US 41 (KY 351 to KY 425) were extended over 1,500 beyond their last receptor and they slightly overlapped with each other. The two models shall be combined for a full analysis of West Alternative 2.

West Alternative 2 only has one tolling scenario, the tolling of the new I-69 bridge over the Ohio River. **Table 5 of Appendix B** provides the results for the West Alternative 2.

6.1 IMPACT DETERMINATION ANALYSIS

There were 447 receivers analyzed with the West Alternative 2 model. Of the 447 receivers, 43 would be impacted. These include 39 that exceeded the NAC criteria, one that would experience a substantial increase in noises levels over the existing levels (15 dB[A] or more in Indiana, 10dB[A] or more in Kentucky), and three that would both exceed the NAC criteria and experience a substantial increase in noise levels.

6.2 NOISE ABATEMENT EVALUATION

Once all impacts were known, they were analyzed to determine locations where a detailed noise abatement evaluation would be necessary. Five clusters of impacts, all in Kentucky, were identified and an evaluation was performed for each. Figures for each cluster evaluated are included and show only the receivers and barrier wall included in that evaluation. Clusters are identified as analysis areas in **Figure 6.2–1** and are labeled by a landmark or significant street in the area. TNM results for the detailed noise abatement evaluations are included in **Appendix E**.

All receivers outside of the analysis areas in **Figure 6.2–1** were not impacted and noise abatement evaluations were not required.

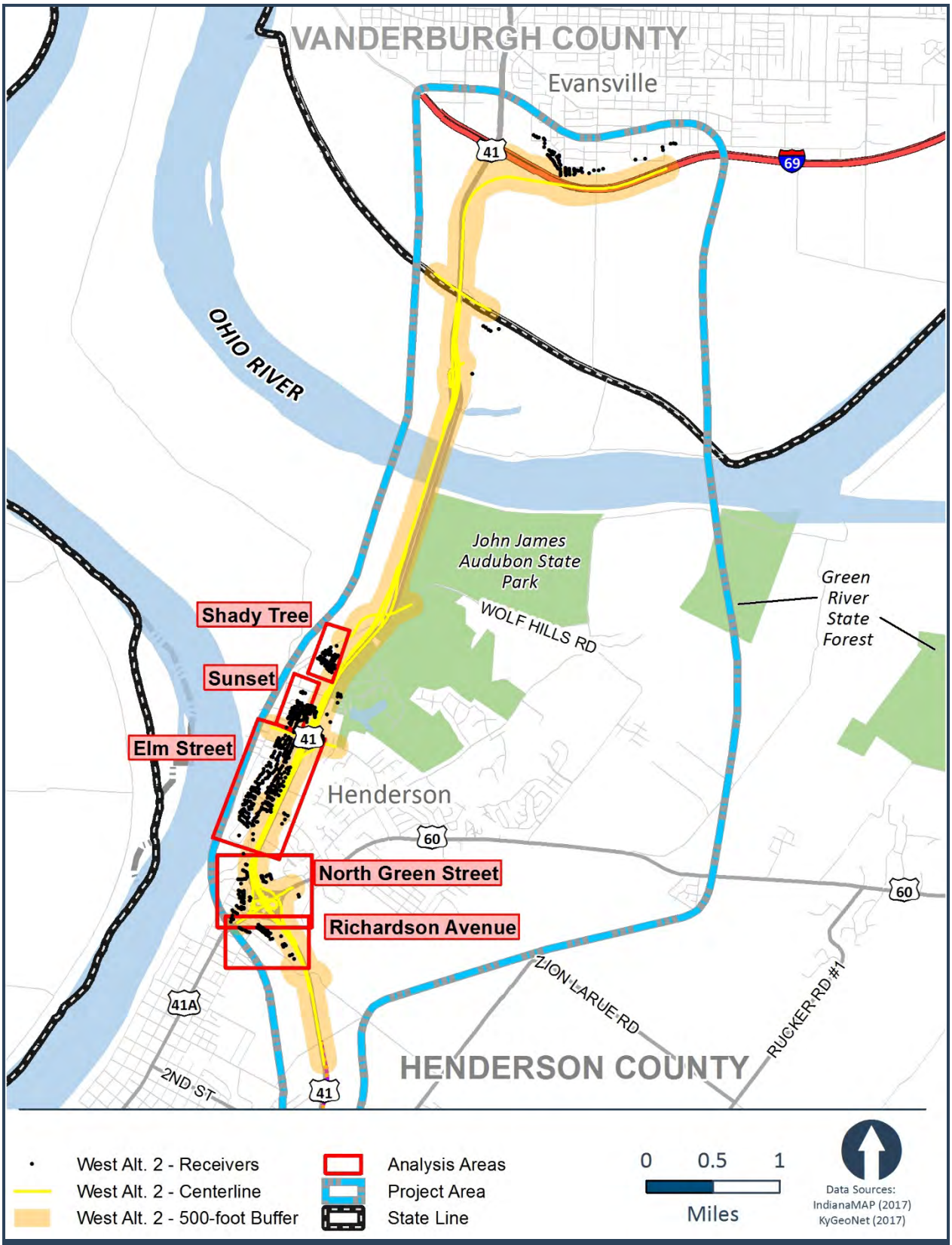

Figure 6.2–1. West Alternative 2

6.2.1 Analysis Areas

Analysis Area – Richardson Avenue

This analysis area consisted of single family homes and medical facilities near Richardson Avenue, including the Redbanks short–term rehabilitation and Alzheimer's care facility. Modeled receivers, modeled structural noise barrier location, and the receiver's attenuation level thresholds are presented in **Figure 6.2–2**. Sound level results, including existing, predicted, and predicted with barrier, are presented in **Table 25 of Appendix B**. This table also identifies the number of receptors represented by the receiver, front row receiver/receptors, and an impact summary.

Barrier Summary

A single barrier of 1,798 feet in length with an average height of 17.45 feet was predicted to benefit 78 of the 107 receptors (36 modeled receivers). The barrier demonstrated that it was possible to achieve a 5 dB(A) reduction at three or more impacted first-row receptors, meeting KYTC's feasibility criterion. The cost of the modeled barrier was $941,000, for a cost-effectiveness ratio of $12,000 per benefited receptor. This value is below KYTC's cost-effectiveness criterion of $35,000 per benefited receptor and therefore the modeled barrier meets KYTC's reasonableness threshold. The barrier would provide 7 dB(A) of attenuation for 43 of the 78 first row benefited receptors (55.1 percent). This is above the 50 percent design goal threshold per KYTC's noise policy and therefore the barrier would also meet this reasonableness criterion.

Table 6.2–1. West Alternative 2 Barrier Description – Richardson Avenue

BARRIER DESCRIPTION	NO. OF IMPACTED RECEPTORS / TOTAL RECEPTORS	BARRIER LENGTH (FT)	AVERAGE BARRIER HEIGHT (FT)	BARRIER AREA (SQ FT)	BARRIER COST @ $30/SQ FT
A Single Barrier on the West Side of West Alt. 2	12 / 107	1,798	17.45	31,365	$941,000

Table 6.2–2. West Alternative 2 Barrier Summary – Richardson Avenue

IS THE BARRIER FEASIBLE?	NO. BENEFITED AND COST PER BENEFITED	IS THE BARRIER COST EFFECTIVE?	NO. OF 1ST–ROW BENEFITED / NO. OF 1ST–ROW BENEFITED W/ 7 DB(A) OR GREATER ATTENUATION (%)	DOES THE BARRIER MEET THE DESIGN GOAL?
Yes	78 Benefited; $12,000/Benefited	Yes	78 / 43 55.1	Yes

Statement of Likelihood

Based on the current project design and traffic projections, a structural noise barrier is reasonable and feasible in accordance with KYTC's noise policy and is likely for this location.

Figure 6.2–2. West Alternative 2 Barrier Analysis – Richardson Avenue

Analysis Area – North Green Street

This analysis area consisted of single family homes and apartment/condominiums buildings, near North Green Street. Modeled receivers, modeled structural noise barrier location, and the receiver's attenuation level thresholds are presented in **Figure 6.2–3**. Sound level results, including existing, predicted, and predicted with barrier, are presented in **Table 26 of Appendix B**. This table also identifies the number of receptors represented by the receiver, front row receiver/receptors, and an impact summary.

Barrier Summary

A single barrier of 2,342 feet in length with an average height of 17.81 feet was predicted to benefit 50 of the 96 receptors (41 modeled receivers). The barrier demonstrated that it was possible to achieve a 5 dB(A) reduction at three or more impacted first-row receptors, meeting KYTC's feasibility criteria. The cost of the modeled barrier was $1,251,000, for a cost-effectiveness ratio of $25,000 per benefited receptor. This value is below KYTC's cost-effectiveness criterion of $35,000 per benefited receptor and therefore the modeled barrier meets KYTC's reasonableness threshold. The barrier would provide 7 dB(A) of attenuation for 29 of the 41 first row benefited receptors (70.7 percent). This is above the 50 percent design goal threshold per KYTC's noise policy and therefore the barrier would also meet this reasonableness criterion.

Table 6.2–3. West Alternative 2 Barrier Description – North Green Street

BARRIER DESCRIPTION	NO. OF IMPACTED RECEPTORS	BARRIER LENGTH (FT)	AVERAGE BARRIER HEIGHT (FT)	BARRIER AREA (SQ FT)	BARRIER COST @ $30/SQ FT
A Single Barrier on the West Side of West Alt. 2	11 / 105	2,342	17.81	41,706	$1,251,000

Table 6.2–4. West Alternative 2 Barrier Summary – North Green Street

IS THE BARRIER FEASIBLE?	NO. BENEFITED AND COST PER BENEFITED	IS THE BARRIER COST EFFECTIVE?	NO. OF 1ST–ROW BENEFITED / NO. OF 1ST–ROW BENEFITED W/ 7 DB(A) OR GREATER ATTENUATION (%)	DOES THE BARRIER MEET THE DESIGN GOAL?
Yes	50 Benefited; $25,000/Benefited	Yes	41 / 29 70.7	Yes

Statement of Likelihood

Based on the current project design and traffic projections, a structural noise barrier is reasonable and feasible in accordance with KYTC's noise policy and is likely for this location.

Figure 6.2–3. West Alternative 2 Barrier Analysis – North Green Street

Analysis Area – Elm Street

This analysis area consisted of single family homes near Elm Street and Watson Lane. Modeled receivers, modeled structural noise barrier location, and the receiver's attenuation level thresholds are presented in **Figure 6.2–4**. Sound level results, including existing, predicted, and predicted with barrier, are presented in **Table 27 of Appendix B**. This table also identifies the number of receptors represented by the receiver, front row receiver/receptors, and an impact summary.

Barrier Summary

A single barrier of 3,406 feet in length and an average height of 14.33 feet was predicted to benefit 48 of the 100 receptors (100 modeled receivers). The barrier demonstrated that it was possible to achieve a 5 dB(A) reduction at three or more impacted first-row receptors, meeting KYTC's feasibility criteria. The cost of the modeled barrier was $1,464,000, for a cost-effectiveness ratio of $31,000 per benefited receptor. This value is below KYTC's cost-effectiveness criterion of $35,000 per benefited receptor and therefore the modeled barrier meets KYTC's reasonableness threshold. The barrier would provide 7 dB(A) of attenuation for 15 of the 24 first row benefited receptors (62.5 percent). This is above the 50 percent design goal threshold per KYTC's noise policy and therefore the barrier would also this reasonableness criterion.

Table 6.2–5. West Alternative 2 Barrier Description – Elm Street

BARRIER DESCRIPTION	NO. OF IMPACTED RECEPTORS / TOTAL RECEPTORS	BARRIER LENGTH (FT)	AVERAGE BARRIER HEIGHT (FT)	BARRIER AREA (SQ FT)	BARRIER COST @ $30/SQ FT
A Single Barrier on the West Side of West Alt. 2	25 / 100	3,406	14.33	48,814	$1,464,000

Table 6.2–6. West Alternative 2 Barrier Summary – Elm Street

IS THE BARRIER FEASIBLE?	NO. BENEFITED AND COST PER BENEFITED	IS THE BARRIER COST EFFECTIVE?	NO. OF 1ST–ROW BENEFITED / NO. OF 1ST–ROW BENEFITED W/ 7 DB(A) OR GREATER ATTENUATION (%)	DOES THE BARRIER MEET THE DESIGN GOAL?
Yes	48 Benefited; $31,000/Benefited	Yes	24 / 15 62.5%	Yes

Statement of Likelihood

Based on the current project design and traffic projections, a structural noise barrier is reasonable and feasible in accordance with KYTC's noise policy and is likely for this location.

Figure 6.2–4. West Alternative 2 Barrier Analysis – Elm Street

ANALYSIS AREA – SUNSET MOBILE HOME PARK

This analysis area consisted of single family homes near the Sunset Mobile Home Park. Modeled receivers, modeled structural noise barrier location, and the receiver's attenuation level thresholds are presented in **Figure 6.2–5**. Sound level results, including existing, predicted, and predicted with barrier, are presented in **Table 28 of Appendix B**. This table also identifies the number of receptors represented by the receiver, front row receiver/receptors, and an impact summary.

BARRIER SUMMARY

A single barrier of 1,695 feet in length and an average height of 15.34 feet was predicted to benefit 21 of the 50 receptors (50 modeled receivers). The barrier demonstrates that it was possible to achieve a 5 dB(A) reduction at three or more impacted first-row receptors, meeting KYTC's feasibility criteria. The cost of the modeled barrier was $780,000, for a cost-effectiveness ratio of $37,000 per benefited receptor. This value is above KYTC's cost-effectiveness criterion of $35,000 per benefited receptor and therefore the modeled barrier does not meet the KYTC reasonableness threshold. The barrier would provide 7 dB(A) of attenuation for 3 of the 5 first row benefited receptors (60.0 percent). This is above the 50 percent design goal threshold per KYTC's noise policy and therefore the barrier would meet this reasonableness criterion.

Multiple iterations of barrier length and/or height were evaluated to gain benefited receptors to reduce the number cost-effectiveness ratio below the reasonableness threshold. No barrier design evaluated was both cost reasonable and met the design goal.

Table 6.2–7. West Alternative 2 Barrier Description – Sunset Mobile Home Park

BARRIER DESCRIPTION	NO. OF IMPACTED RECEPTORS / TOTAL RECEPTORS	BARRIER LENGTH (FT)	AVERAGE BARRIER HEIGHT (FT)	BARRIER AREA (SQ FT)	BARRIER COST @ $30/SQ FT
A Single Barrier on the West Side of West Alt. 2	15 / 50	1,695	15.34	25,993	$780,000

Table 6.2–8. West Alternative 2 Barrier Summary – Sunset Mobile Home Park

IS THE BARRIER FEASIBLE?	NO. BENEFITED AND COST PER BENEFITED	IS THE BARRIER COST EFFECTIVE?	NO. OF 1ST–ROW BENEFITED / NO. OF 1ST–ROW BENEFITED W/ 7 DB(A) OR GREATER ATTENUATION (%)	DOES THE BARRIER MEET THE DESIGN GOAL?
Yes	21 Benefited; $37,000/Benefited	No	5 / 3 60.0	Yes

STATEMENT OF LIKELIHOOD

Based on the current project design and traffic projections, structural noise barriers are not reasonable in accordance with KYTC's noise policy and are not likely for this location.

Figure 6.2–5. West Alternative 2 Barrier Analysis – Sunset Mobile Home Park

Analysis Area – Shadytree Mobile Home Park

This analysis area consisted of single family homes near the Shadytree Mobile Home Park. Modeled receivers, modeled structural noise barrier location, and the receiver's attenuation level thresholds are presented in **Figure 6.2–6**. Sound level results, including existing, predicted, and predicted with barrier, are presented in **Table 29 of Appendix B**. This table also identifies the number of receptors represented by the receiver, front row receiver/receptors, and an impact summary.

Barrier Summary

A single barrier of 1,812 feet in length with an average height of 16.76 feet was predicted to benefit 38 of the 39 receptors (39 modeled receivers). The barrier demonstrated that it was possible to achieve a 5 dB(A) reduction at three or more impacted first-row receptors, meeting KYTC's feasibility criteria. The cost of the modeled barrier was $911,000, for a cost-effectiveness ratio of $24,000 per benefited receptor. This value is below KYTC's cost-effectiveness criterion of $35,000 per benefited receptor and therefore the modeled barrier meets KYTC's reasonableness threshold. The barrier would provide 7 dB(A) of attenuation for 6 of the 12 first row benefited receptors (50.0 percent). This equals the 50 percent design goal threshold per KYTC's noise policy and therefore the barrier would also meet this reasonableness criterion.

Portions of this barrier overlap with the Sunset Mobile Home Park barrier previously analyzed. Both barriers met the reasonable and feasible criteria independently. During the re-evaluation of barriers for the Preferred Alternative, the cost of the overlapping segments would be removed from the analysis.

Table 6.2–9. West Alternative 2 Barrier Description – Shadytree Mobile Home Park

BARRIER DESCRIPTION	NO. OF IMPACTED RECEPTORS / TOTAL RECEPTORS	BARRIER LENGTH (FT)	AVERAGE BARRIER HEIGHT (FT)	BARRIER AREA (SQ FT)	BARRIER COST @ $30/SQ FT
A Single Barrier on the West Side of West Alt. 2	9 / 39	1,812	16.76	30,373	$911,000

Table 6.2–10. West Alternative 2 Barrier Summary – Shadytree Mobile Home Park

IS THE BARRIER FEASIBLE?	NO. BENEFITED AND COST PER BENEFITED	IS THE BARRIER COST EFFECTIVE?	NO. OF 1ST–ROW BENEFITED / NO. OF 1ST–ROW BENEFITED W/ 7 DB(A) OR GREATER ATTENUATION (%)	DOES THE BARRIER MEET THE DESIGN GOAL?
Yes	38 Benefited; $24,000/Benefited	Yes	12 / 6 50.0	Yes

Figure 6.2–6. West Alternative 2 Barrier Analysis – Shadytree Mobile Home Park

STATEMENT OF LIKELIHOOD

Based on the current project design and traffic projections, a structural noise barrier is reasonable and feasible in accordance with KYTC's noise policy and is likely for this location.

6.3 BARRIER SUMMARY

Five noise barrier analyses, all in Kentucky, were performed for West Alternative 2. Four of the five barriers evaluated met the feasibility, reasonableness, and the design goal criteria required by the state's noise policy. These four structural noise barriers are proposed for West Alternative 2. The fifth noise barrier did not meet the cost-effectiveness criterion and therefore is not proposed.

6.4 STATEMENT OF LIKELIHOOD

Four structural noise barriers were determined to be both feasible and reasonable for impacted receptors and further abatement measures would need to be considered for this alternative.

CHAPTER 7 – US 41 (KY 351 TO KY 425) RESULTS (ALL ALTERNATIVES)

Beginning just south of the CSX Railroad to the project end near KY 425, where I-69 in Kentucky currently ends, all three proposed build alternatives follow existing US 41. The existing four–lane section of US 41 (formerly named the Edward T. Breathitt Pennyrile Parkway) would be modernized to meet interstate standards. Since each alternative would follow the existing alignment, a separate analysis was performed for this segment. The segment analyzed for noise impacts under US 41 (KY 351 to KY 425) is shown in **Figure 7.2–1**. The model was extended over 1,500 feet from the last receptor. Results shall be combined with previous models discussed for a full analysis of Central Alternatives 1A and 1B, West Alternative 1, and West Alternative 2.

Only one tolling scenario was analyzed for US 41 (KY 351 to KY 425). Traffic numbers for the two tolling scenarios did not provide enough difference to warrant separate analyses. Therefore, the higher of the two scenarios, tolling both crossings, was considered the 'worst-case' scenario and its traffic data was used. **Table 6 of Appendix B** provides the results for the US 41 (KY 351 to KY 425) analysis for each build alternative.

7.1 IMPACT DETERMINATION ANALYSIS

There were 332 receivers analyzed with the US 41 (KY 351 to KY 425) segment that cover each build alternative and both tolling scenarios. Of the 334 receivers, 76 would be impacted. These include 76 that exceeded the NAC criteria, zero that would experience a substantial increase in noises levels over the existing levels (10 dB[A] or more in Kentucky), and zero that would exceed the NAC criteria and experience a substantial increase in noise levels.

7.2 NOISE ABATEMENT EVALUATION

Once all impacts were known, they were analyzed to determine locations where a detailed noise abatement evaluation would be necessary. Three clusters of impacts were identified, and an evaluation was performed for each. Figures for each cluster evaluated are included and show only the receivers and barrier wall included in that evaluation. Clusters are identified as analysis areas in **Figure 7.2–1** and are labeled by a landmark or significant street in the area. TNM results for the detailed noise abatement evaluations are included in **Appendix E**.

There were two impacted receivers located along KY 2084 and just west of the proposed roadway not included in any of the three clusters. These receivers are both single dwelling units and therefore represent two impacted receptors. Noise abatement was considered but a detailed noise abatement evaluation was not necessary since KYTC's feasibility criteria could not be satisfied. All remaining receivers outside of the analysis areas in **Figure 7.2–1** were not impacted and noise abatement evaluations were not required.

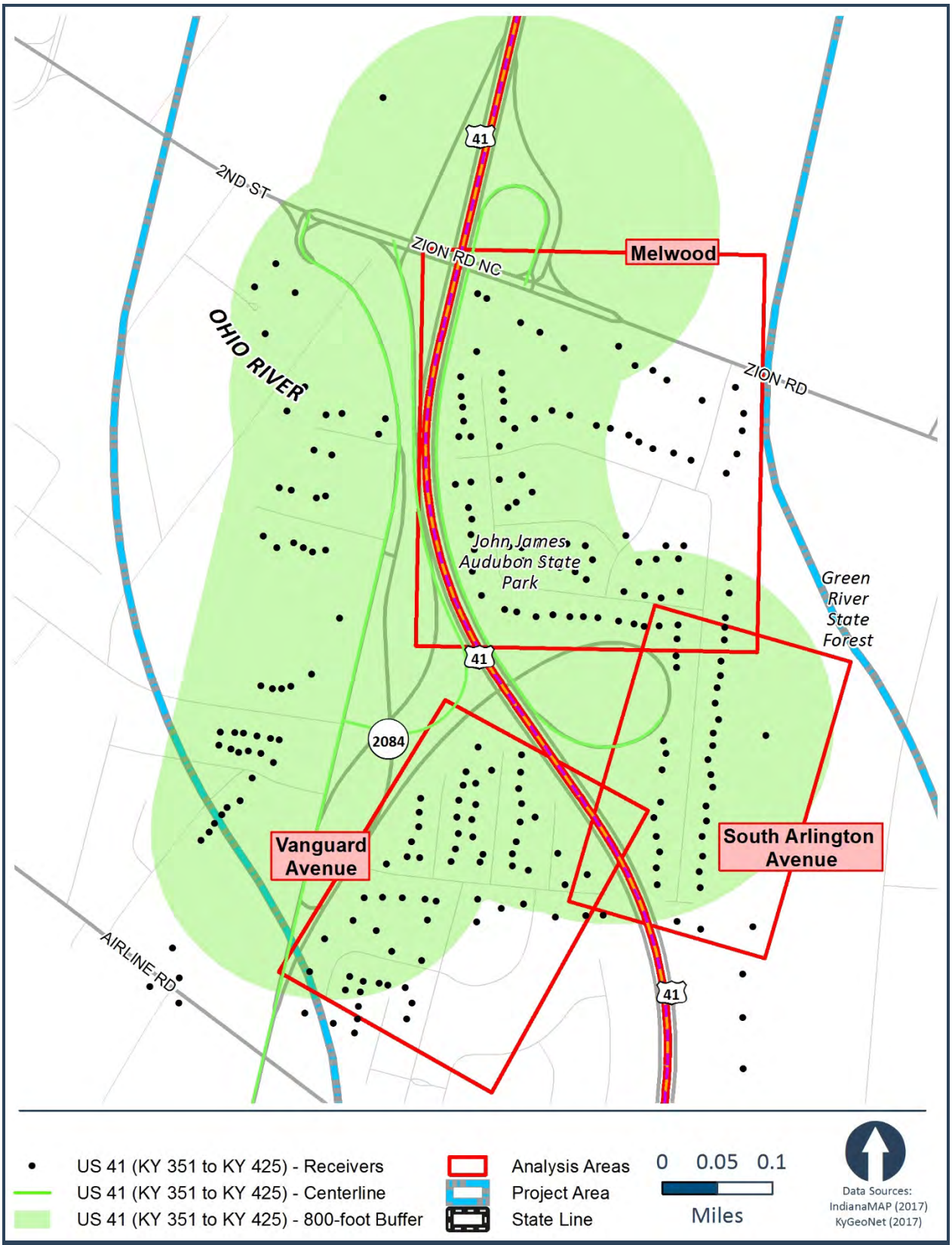

Figure 7.2–1. US 41 (KY 351 to KY 425) (All Alternatives)

7.3 ANAYSIS AREAS

ANALYSIS AREA – SOUTH ARLINGTON DRIVE

This analysis area consisted of single family homes near South Arlington Drive. Modeled receivers, modeled structural noise barrier location, and the receiver's attenuation level thresholds are presented in **Figure 7.3–1**. Sound level results, including existing, predicted, and predicted with barrier, are presented in **Table 30 of Appendix B**. This table also identifies the number of receptors represented by the receiver, front row receiver/receptors, and an impact summary.

BARRIER SUMMARY

A combination of barriers totaling 2,050 feet with an average height of 14.61 was predicted to benefit 22 of 32 receptors (32 modeled receivers). The barrier demonstrated that it was possible to achieve a 5 dB(A) reduction at three or more impacted first-row receptors, meeting KYTC's feasibility criteria. The cost of the modeled barrier was $899,000, for a cost-effectiveness ratio of $41,000 per benefited receptor. This value is above KYTC's cost-effectiveness criterion of $35,000 per benefited receptor and therefore the modeled barrier does not meet the KYTC reasonableness threshold. The barrier would provide 7 dB(A) of attenuation for 8 of the 10 first row benefited receptors (80.0 percent). This is above the 50 percent design goal threshold per KYTC's noise policy and therefore the barrier would also meet this reasonableness criterion.

Table 7.3–1. US 41 (KY 351 to KY 425) Barrier Description – South Arlington Drive

BARRIER DESCRIPTION	NO. OF IMPACTED RECEPTORS / TOTAL RECEPTORS	BARRIER LENGTH (FT)	AVERAGE BARRIER HEIGHT (FT)	BARRIER AREA (SQ FT)	BARRIER COST @ $30/SQ FT
A Combo Barrier on the East Side of US 41(KY 351 to KY 425)	10 / 32	2,050	14.61	29,952	$899,000

Table 7.3–2. US 41 (KY 351 to KY 425) Barrier Summary – South Arlington Drive

IS THE BARRIER FEASIBLE?	NO. BENEFITED AND COST PER BENEFITED	IS THE BARRIER COST EFFECTIVE?	NO. OF 1ST–ROW BENEFITED / NO. OF 1ST–ROW BENEFITED W/ 7 DB(A) OR GREATER ATTENUATION (%)	DOES THE BARRIER MEET THE DESIGN GOAL?
Yes	22 Benefited; $41,000/Benefited	No	10 / 8 80.0	Yes

STATEMENT OF LIKELIHOOD

Based on the current project design and traffic projections, a structural noise barrier is feasible but is not cost effective in accordance with KYTC's noise policy and is not likely for this location.

Figure 7.3–1. US 41 (KY 351 to KY 425) Barrier Analysis – South Arlington Drive

Analysis Area – Melwood Drive

This analysis area consisted of single family homes near Melwood Drive. Modeled receivers, modeled structural noise barrier location, and the receiver's attenuation level thresholds are presented in **Figure 7.3–2**. Sound level results, including existing, predicted, and predicted with barrier, are presented in **Table 31 of Appendix B**. This table also identifies the number of receptors represented by the receiver, front row receiver/receptors, and an impact summary.

Barrier Summary

A single barrier of 1,900 feet in length with an average height of 17.64 was predicted to benefit 45 of 94 receptors (86 modeled receivers). The barrier demonstrated that it was possible to achieve a 5 dB(A) reduction at three or more impacted first-row receptors, meeting KYTC's feasibility criteria. The cost of the modeled barrier was $1,005,000, for a cost-effectiveness ratio of $22,000 per benefited receptor. This value is below KYTC's cost-effectiveness criterion of $35,000 per benefited receptor and therefore the modeled barrier meets KYTC's reasonableness threshold. The barrier would provide 7 dB(A) of attenuation for 15 of the 21 first row benefited receptors (71.4 percent). This is above the 50 percent design goal threshold per KYTC's noise policy and therefore the barrier would also meet this reasonableness criterion.

Table 7.3–3. US 41 (KY 351 to KY 425) Barrier Description – Melwood Drive

BARRIER DESCRIPTION	NO. OF IMPACTED RECEPTORS / TOTAL RECEPTORS	BARRIER LENGTH (FT)	AVERAGE BARRIER HEIGHT (FT)	BARRIER AREA (SQ FT)	BARRIER COST @ $30/SQ FT
A Barrier on the East Side of US 41 (KY 351 to KY 425)	29 / 86	1,900	17.64	33,516	$1,005,000

Table 7.3–4. US 41 (KY 351 to KY 425) Barrier Summary – Melwood Drive

IS THE BARRIER FEASIBLE?	NO. BENEFITED AND COST PER BENEFITED	IS THE BARRIER COST EFFECTIVE?	NO. OF 1ST–ROW BENEFITED / NO. OF 1ST–ROW BENEFITED W/ 7 DB(A) OR GREATER ATTENUATION (%)	DOES THE BARRIER MEET THE DESIGN GOAL?
Yes	45 Benefited; $22,000/Benefited	Yes	21 / 15 71.4	Yes

Statement of Likelihood

Based on the current project design and traffic projections, a structural noise barrier is reasonable and feasible in accordance with KYTC's noise policy and is likely for this location.

Figure 7.3–2. US 41 (KY 351 to KY 425) Barrier Analysis – Melwood Drive

7.3.2 Analysis Area – Vanguard Avenue

This analysis area consisted of single family homes near Vanguard Avenue. Modeled receivers, modeled structural noise barrier location, and the receiver's attenuation level thresholds are presented in **Figure 7.3–3**. Sound level results, including existing, predicted, and predicted with barrier, are presented in **Table 32 of Appendix B**. This table also identifies the number of receptors represented by the receiver, front row receiver/receptors, and an impact summary.

Barrier Summary

A single barrier of 1,219 feet in length with an average height of 16.98 was predicted to benefit 38 of 85 receptors (65 modeled receivers). The barrier demonstrated that it was possible to achieve a 5 dB(A) reduction at three or more impacted first-row receptors, meeting KYTC's feasibility criteria. The cost of the modeled barrier was $621,000, for a cost-effectiveness ratio of $16,000 per benefited receptor. This value is below KYTC's cost-effectiveness criterion of $35,000 per benefited receptor and therefore the modeled barrier would meet KYTC's reasonableness threshold. The barrier would provide 7 dB(A) of attenuation for 11 of the 11 first row benefited receptors (90.1 percent). This is above the 50 percent design goal threshold per KYTC's noise policy and therefore the barrier would also meet this reasonableness criterion.

Table 7.3–5. US 41 (KY 351 to KY 425) Barrier Description – Vanguard Avenue

BARRIER DESCRIPTION	NO. OF IMPACTED RECEPTORS / TOTAL RECEPTORS	BARRIER LENGTH (FT)	AVERAGE BARRIER HEIGHT (FT)	BARRIER AREA (SQ FT)	BARRIER COST @ $30/SQ FT
A Barrier on the West Side of US 41(KY 351 to KY 425)	15 / 84	1,219	16.98	20,703	$621,000

Table 7.3–6. US 41 (KY 351 to KY 425) Barrier Summary – Vanguard Avenue

IS THE BARRIER FEASIBLE?	NO. BENEFITED AND COST PER BENEFITED	IS THE BARRIER COST EFFECTIVE?	NO. OF 1ST–ROW BENEFITED / NO. OF 1ST–ROW BENEFITED W/ 7 DB(A) OR GREATER ATTENUATION (%)	DOES THE BARRIER MEET THE DESIGN GOAL?
Yes	38 Benefited; $16,000/Benefited	Yes	11 / 11 100.0	Yes

Statement of Likelihood

Based on the current project design and traffic projections, a structural noise barrier is reasonable and feasible in accordance with KYTC's noise policy and is likely for this location.

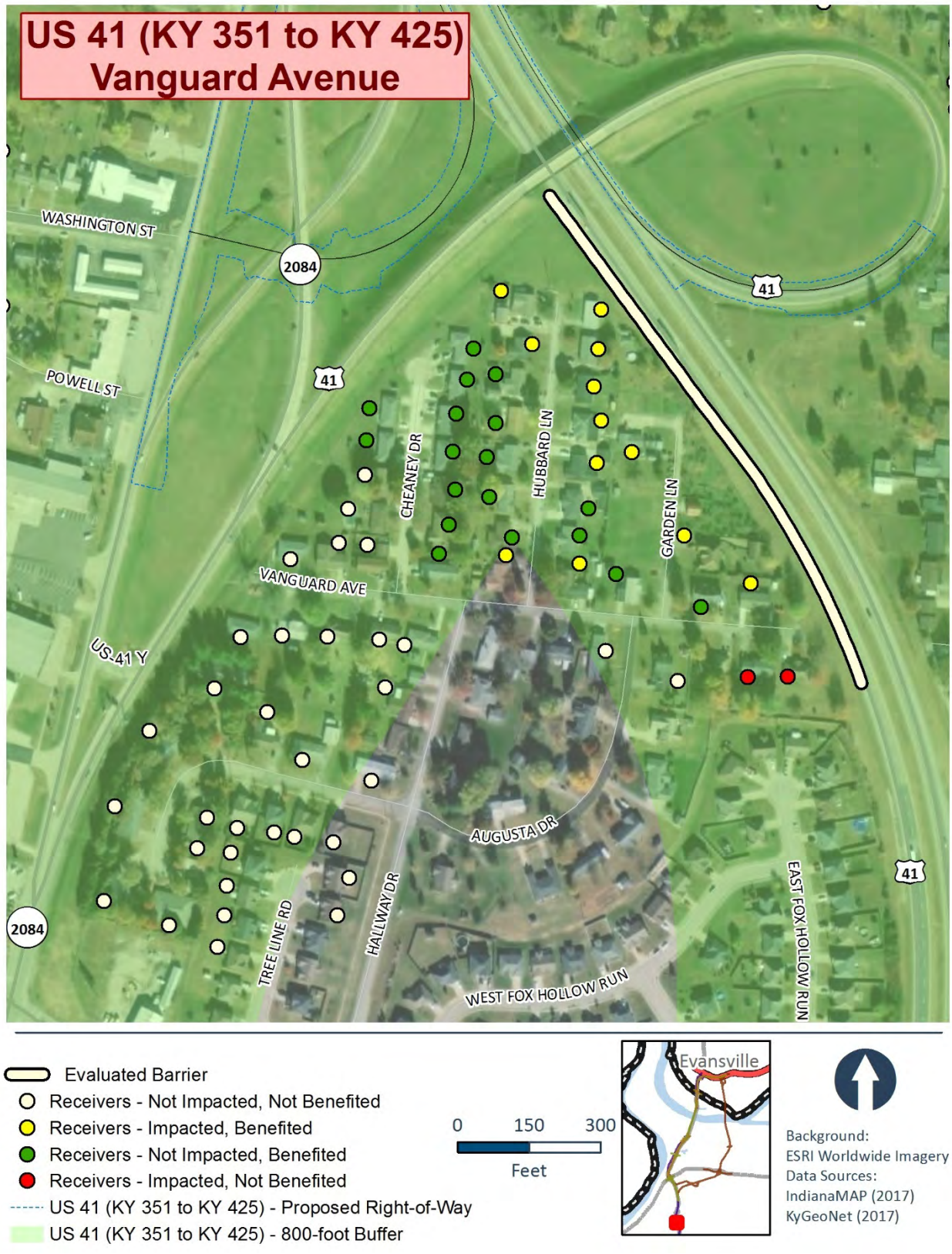

Figure 7.3–3. US 41 (KY 351 to KY 425) Barrier Analysis – Vanguard Avenue

7.4 BARRIER SUMMARY

Three noise barrier analysis were performed for the US 41 (KY 351 to KY 425) segment that covers each build alternative and tolling scenario. Two of the barriers evaluated met the feasibility, reasonableness, and design goal criteria required by the state's noise policy. Therefore, structural noise barriers are proposed for US 41 (KY 351 to KY 425).

7.5 STATEMENT OF LIKELIHOOD

Two structural noise barriers were determined to be both feasible and reasonable for impacted receptors. Further abatement measures would need to be considered for this segment.

CHAPTER 8 – SUMMARY

8.1 DIRECT IMPACTS

8.1.1 SUMMARY OF BARRIER ANALYSES

Table 8.1–1 below summarizes barriers analyzed and whether they would be likely based on the preliminary design and barrier analyses for each alternative. Also provided is the estimated cost of each likely barrier. The total number of walls and proposed cost for each build alternative is also provided.

Table 8.1–1. Summary of Barrier Analyses

BARRIER LOCATION	FEASIBLE?	COST EFFECTIVE?	MEET DESIGN GOAL?	LIKELY BASED ON PRELIM. BARRIER ANALYSIS?	PROPOSED COST
Central Alternative 1A (Toll Both Crossings)					
Taransay Dr.	Yes	No	Yes	No	—
US 60 Tie	Yes	No	No	No	—
Braxton Park Dr.	Yes	No	Yes	No	—
Melody Ln.	Yes	No	Yes	No	—
Eastview East	Yes	No	Yes	No	—
Eastview West	No	No	No	No	—
Central Alternative 1B (Toll I-69 Only)					
Taransay Dr.	Yes	No	Yes	No	—
US 60 Tie	Yes	No	No	No	—
Braxton Park Dr.	Yes	No	No	No	—
Melody Ln.	Yes	No	No	No	—
West Alternative 1 (Toll Both Crossings)					
Richardson Ave.	Yes	Yes	Yes	Yes	$2,206,000
North Green St.	Yes	Yes	Yes	Yes	$1,747,000
Elm St.	Yes	Yes	Yes	Yes	$1,284,000
Sunset Lane	Yes	Yes	Yes	Yes	$2,281,000
West Alternative 1 (Toll I-69 Only)					
Richardson Ave	Yes	Yes	Yes	Yes	$1,994,000
North Green St.	Yes	Yes	Yes	Yes	$1,917,000
Elm St.	Yes	Yes	Yes	Yes	$1,046,000
Sunset Lane	Yes	Yes	Yes	Yes	$2,321,000
West Alternative 2					
Richardson Ave.	Yes	Yes	Yes	Yes	$941,000
North Green St.	Yes	Yes	Yes	Yes	$1,251,000

BARRIER LOCATION	FEASIBLE?	COST EFFECTIVE?	MEET DESIGN GOAL?	LIKELY BASED ON PRELIM. BARRIER ANALYSIS?	PROPOSED COST
Elm St.	Yes	Yes	Yes	Yes	$1,464,000
Sunset Mobile Home Park	Yes	No	Yes	No	—
Shadytree Mobile Home Park	Yes	Yes	Yes	Yes	$911,000
US 41 (KY 351 to KY 425) (All Alternatives, Both Tolling Scenarios)					
South Arlington Dr.	Yes	No	Yes	No	—
Melwood Dr.	Yes	Yes	Yes	Yes	$1,005,000
Vanguard Ave.	Yes	Yes	Yes	Yes	$621,000
Total Number of Walls and Cost Per Alternative					
Central Alternative 1A (Toll Both Crossings)				2 Walls / $1,627,000	
Central Alternative 1B (Toll I-69 Only)				2 Walls / $1,627,000	
West Alternative 1 (Toll Both Crossings)				6 Walls / $9,144,000	
West Alternative 1 (Toll I-69 Only)				6 Walls / $8,905,000	
West Alternative 2				6 Walls / $6,194,000	

8.1.2 Statement of Likelihood – If Likely

Based on noise studies completed to date, it was determined that noise abatement is likely, but not guaranteed, at the locations listed in **Table 8.1–1**. Noise abatement recommended at these locations is based upon preliminary design costs and design criteria. Noise abatement in these locations would reduce noise levels to meet the design goals as described in INDOT and KYTC's noise policies. Estimated costs range from $1.6 to $9.1 million. A re-evaluation of the noise barrier likelihood for a Preferred Alternative would occur prior to the FEIS. The barrier will be further evaluated prior to final design. If during the re-evaluation it is determined that conditions have changed such that noise abatement would not be feasible and reasonable, the abatement measures might not be provided. The final decision on the installation of any abatement measure(s) would be made upon the completion of the project's final design and the public involvement process. The viewpoints of the benefited residents and property owners would be sought and considered in determining the reasonableness of highway traffic noise abatement measures for proposed highway construction projects. Highway traffic noise considerations will be considered in on-going public involvement activities for the I-69 ORX project.

8.1.3 Statement of Likelihood – If Not Likely

Based on the noise studies thus far accomplished, several locations have been identified where noise abatement is not likely. Noise abatement measures that were studied at these locations were based upon preliminary design costs and design criteria. Noise abatement has not been found to be both reasonable and feasible. A re-evaluation of the noise analysis for the Preferred Alternative will occur prior to the FEIS. If during the re-evaluation it is determined that conditions have

changed such that noise abatement is feasible and reasonable, the abatement measures might be provided. The final decision on the installation of any abatement measure(s) will be made upon the completion of the project's final design and the public involvement processes. The viewpoints of the benefited residents and property owners are a major consideration in determining the reasonableness of highway traffic noise abatement measures for proposed highway construction projects. These viewpoints will be determined and addressed during the environmental phase of project development. The will and desires of the public are an important factor in dealing with the overall problems of highway traffic noise. INDOT and KYTC will incorporate highway traffic noise consideration in on-going activities for public involvement in the highway program, i.e., and will re-examine the residents' and property owners' views on the desirability and acceptability of abatement during project development.

8.1.4 NEXT STEPS

The structural noise barrier analyses presented in this highway traffic noise impact are preliminary in nature and were evaluated to identify locations where structural noise barriers are likely based on the current design, traffic model without considerations of final design criteria that may limit the lengths or locations of structural noise barriers (such as drainage features and sight distance requirements). These preliminary structural noise barrier analyses are utilized for comparing the likeliness of barrier mitigation for noise sensitive receptors by build alternative.

If a build alternative is selected as the Preferred Alternative, then each location where a structural noise barrier was assessed will be re-evaluated based on the current design and the traffic volumes for the selected tolling scenario. The findings from those analyses will be incorporated into the Final Environmental Impact Statement. Final barrier analyses and determinations of feasibility, reasonableness, and engineering considerations will occur as a part of final design. Locations that are identified as likely at that time will have public involvement phases to assess the views of the affected and benefited residents.

8.2 INDIRECT AND CUMULATIVE IMPACTS

Indirect impacts are impacts caused not by the subject project, but rather by another action or actions that have an established relationship or connection to the project. These induced actions are those that would not or could not occur except for the implementation of a project, and cumulative impacts include the total effect on a human community due to past, present, and future activities or actions of federal, non-federal, public, and/or private entities.

The highway traffic noise analysis utilizes design year (2045) traffic generated by the constructed roadway network accounts for the presence of I-69. In the areas along West Alternatives 1 and 2 2 and the US 41 (KY 351 to KY 425) upgrades, no indirect or cumulative impacts are anticipated due to the level of development present in these areas and the existing traffic patterns. Should Central Alternative 1A or 1B be selected as the Preferred Alternative it would be reasonably foreseeable that development of the areas adjacent to the new I-69 facility that are currently undeveloped may add additional vehicle trip near noise sensitive receptors and therefore may indirectly induce additional noise in these areas.

CHAPTER 9 – REFERENCES

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APPENDIX A

Figures

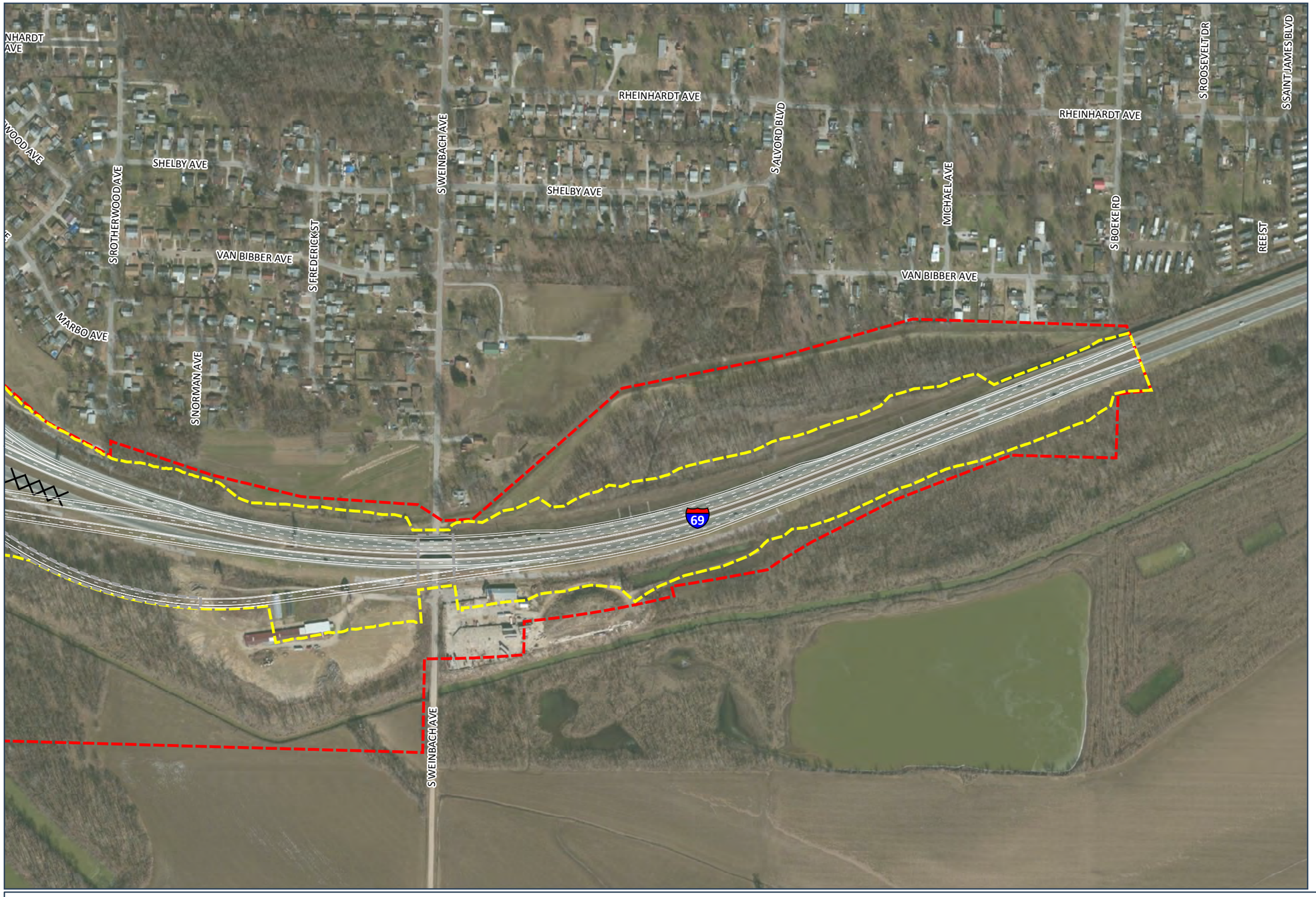
West Alternative 1

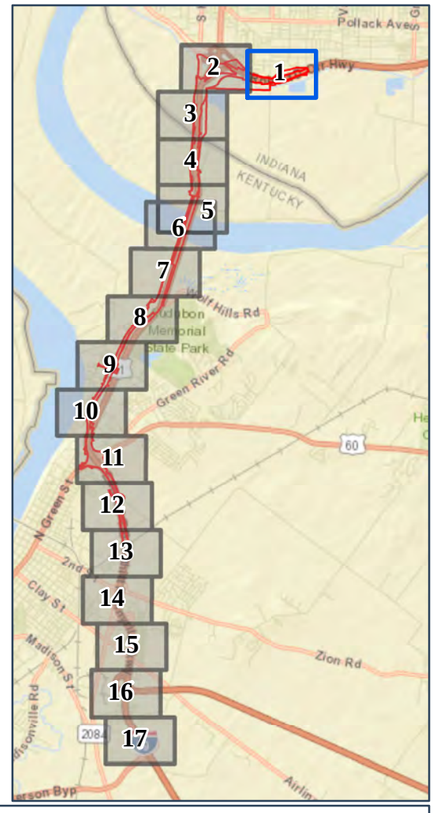
Figure 1 – Sheet 1 of 17

ORX 69 OHIO RIVER CROSSING

0 400 800 Feet

1 Inch = 400 Feet



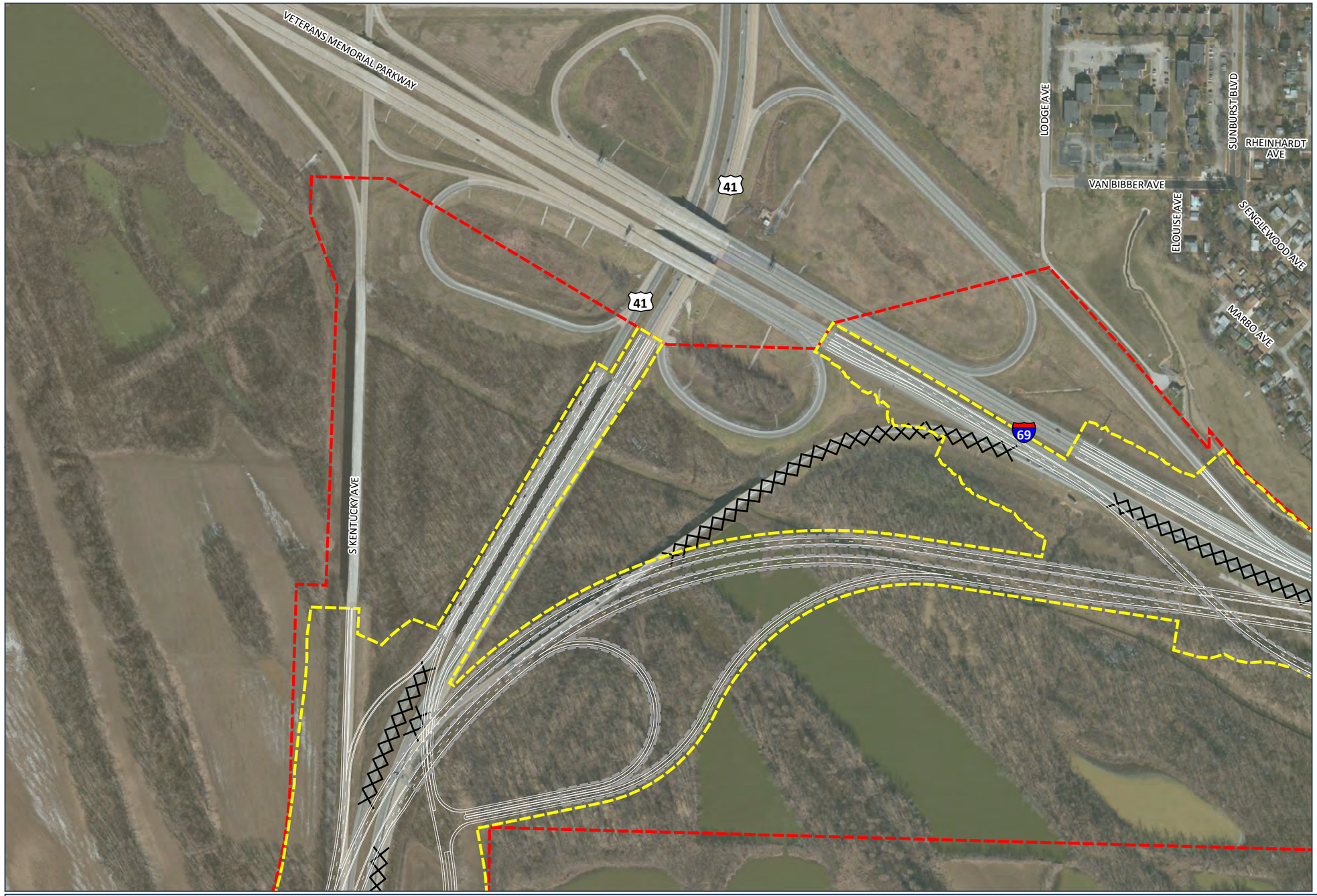


- Construction Limits
- Preliminary Right-of-Way
- Bridge Deck
- Removed Roads

West Alternative 1

Figure 1 – Sheet 2 of 17

OHIO RIVER CROSSING



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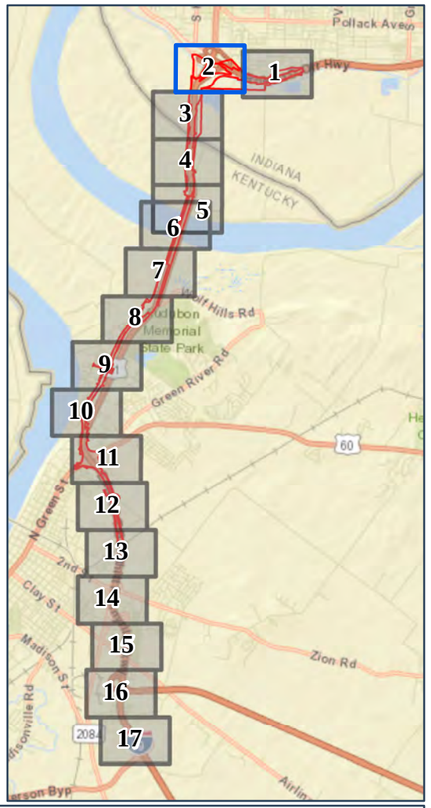
1 Inch = 400 Feet



- Construction Limits
- Preliminary Right-of-Way
- Bridge Deck
- Removed Roads

West Alternative 1

Figure 1 – Sheet 3 of 17

OHIO RIVER CROSSING

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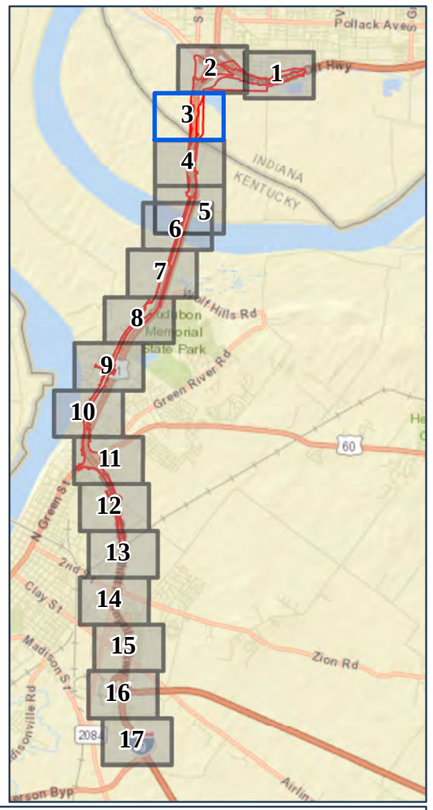
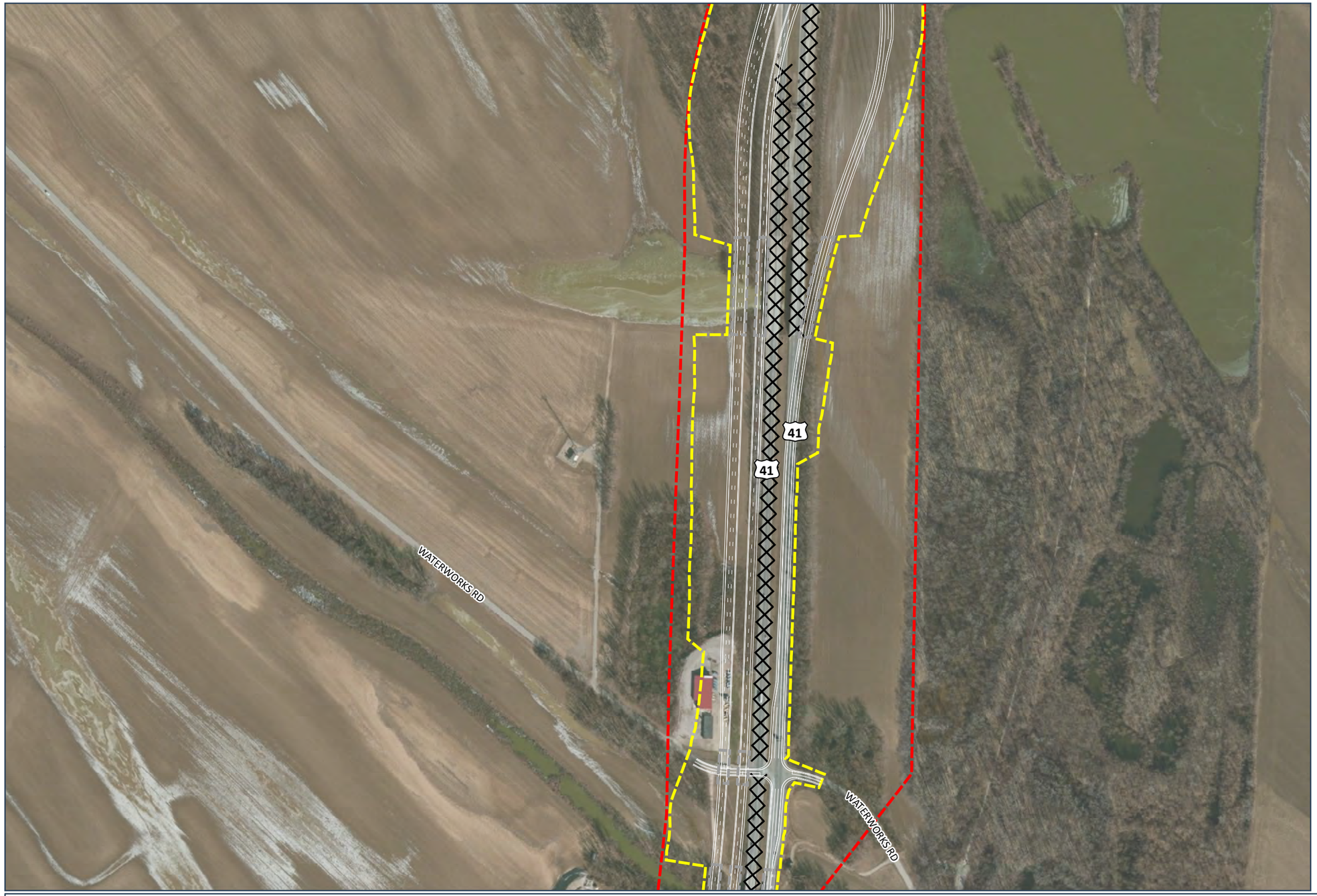
1 Inch = 400 Feet





- Construction Limits
- Preliminary Right-of-Way
- Bridge Deck
- Removed Roads

West Alternative 1

Figure 1 – Sheet 4 of 17

ORX 69 OHIO RIVER CROSSING

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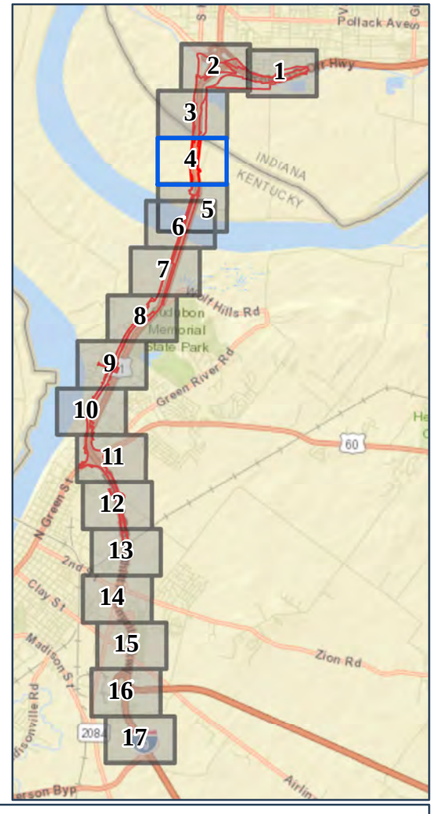
1 Inch = 400 Feet



- Construction Limits
- Preliminary Right-of-Way
- Bridge Deck
- Removed Roads

West Alternative 1

Figure 1 – Sheet 5 of 17

ORX 69 OHIO RIVER CROSSING

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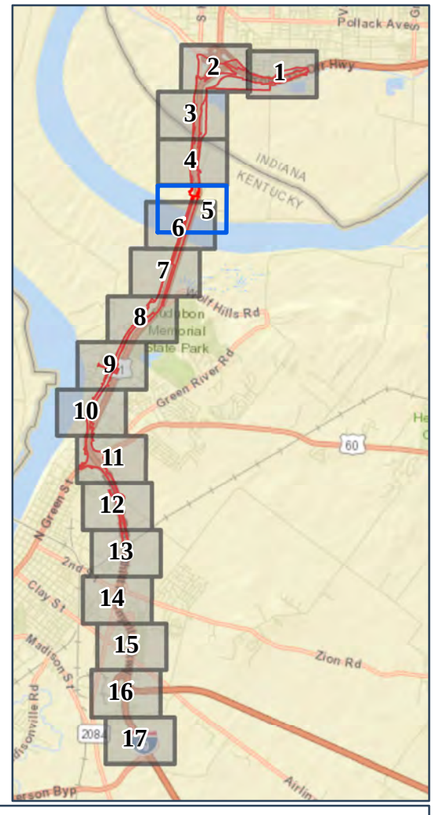
1 Inch = 400 Feet



Construction Limits

Preliminary Right-of-Way

Bridge Deck

Removed Roads

West Alternative 1

Figure 1 – Sheet 6 of 17

ORX 69 OHIO RIVER CROSSING

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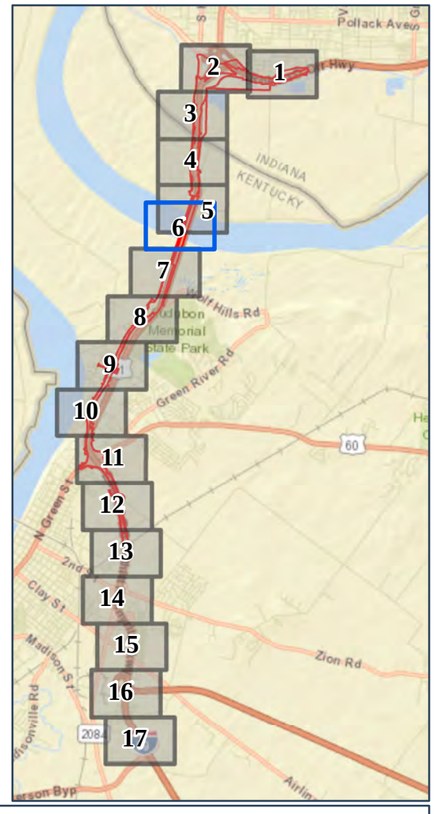
1 Inch = 400 Feet

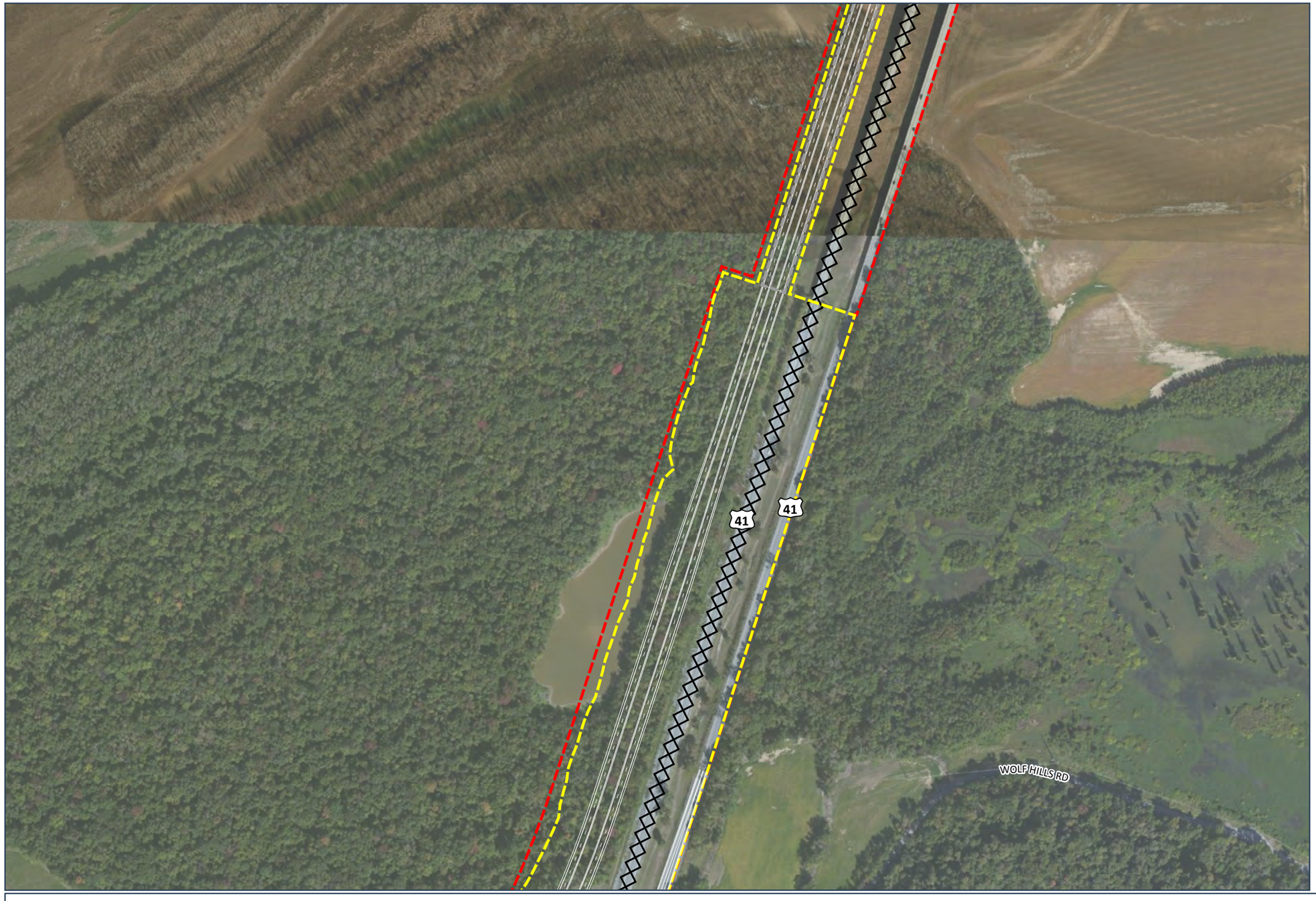


- Construction Limits
- Preliminary Right-of-Way
- Bridge Deck
- Removed Roads

West Alternative 1

Figure 1 – Sheet 7 of 17

ORX 69 OHIO RIVER CROSSING



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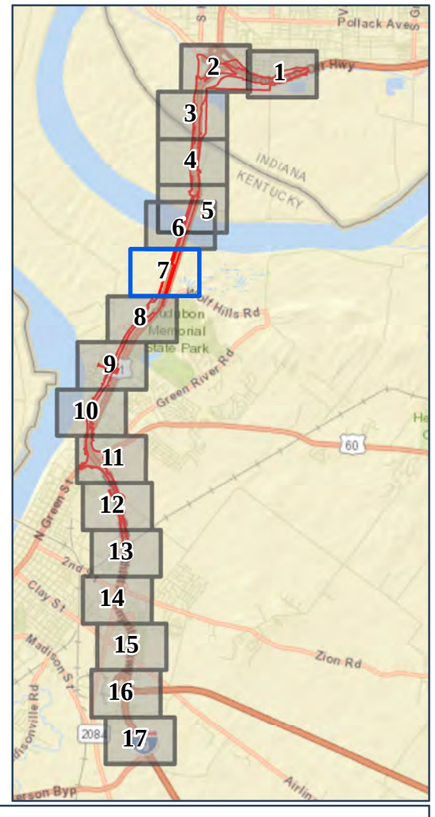


- Construction Limits
- Preliminary Right-of-Way
- Bridge Deck
- Removed Roads

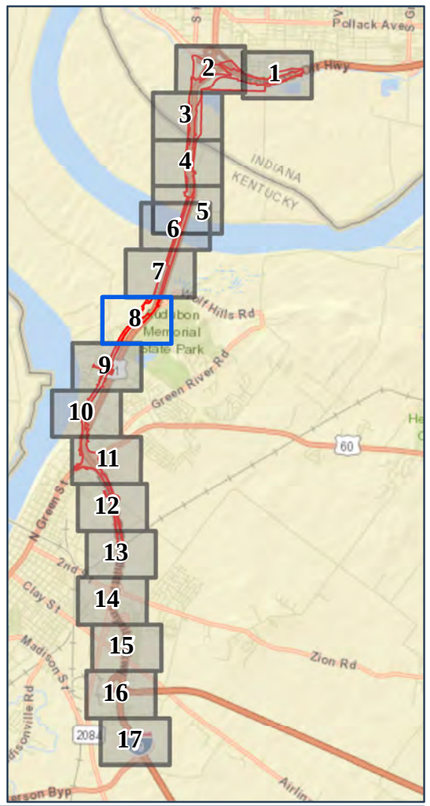
West Alternative 1

Figure 1 – Sheet 8 of 17

OHIO RIVER CROSSING

0 400 800 Feet

1 Inch = 400 Feet



- Construction Limits
- Preliminary Right-of-Way
- Bridge Deck
- Removed Roads

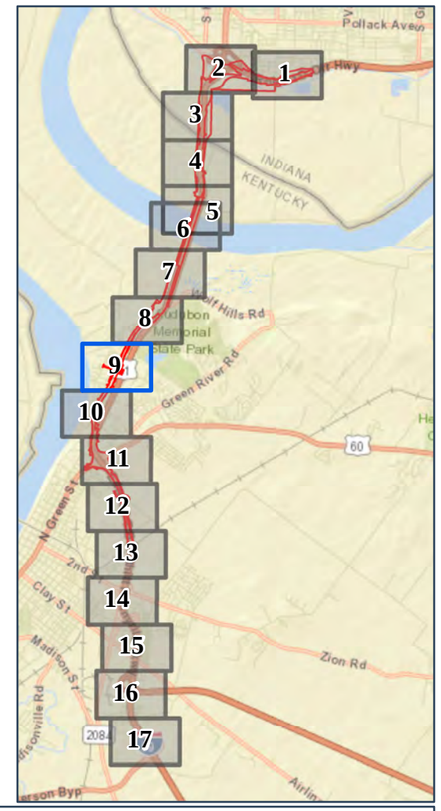
West Alternative 1

Figure 1 – Sheet 9 of 17

OHIO RIVER CROSSING

0 400 800 Feet

1 Inch = 400 Feet



- Construction Limits
- Preliminary Right-of-Way
- Bridge Deck
- Removed Roads

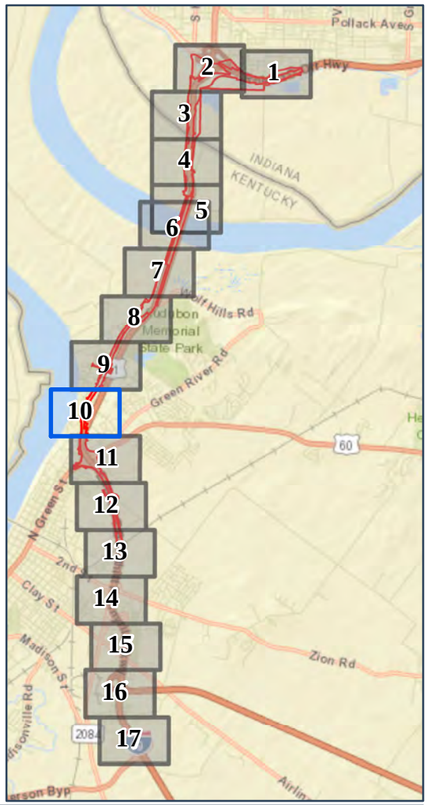
West Alternative 1

Figure 1 – Sheet 10 of 17

OHIO RIVER CROSSING

0 400 800 Feet

1 Inch = 400 Feet

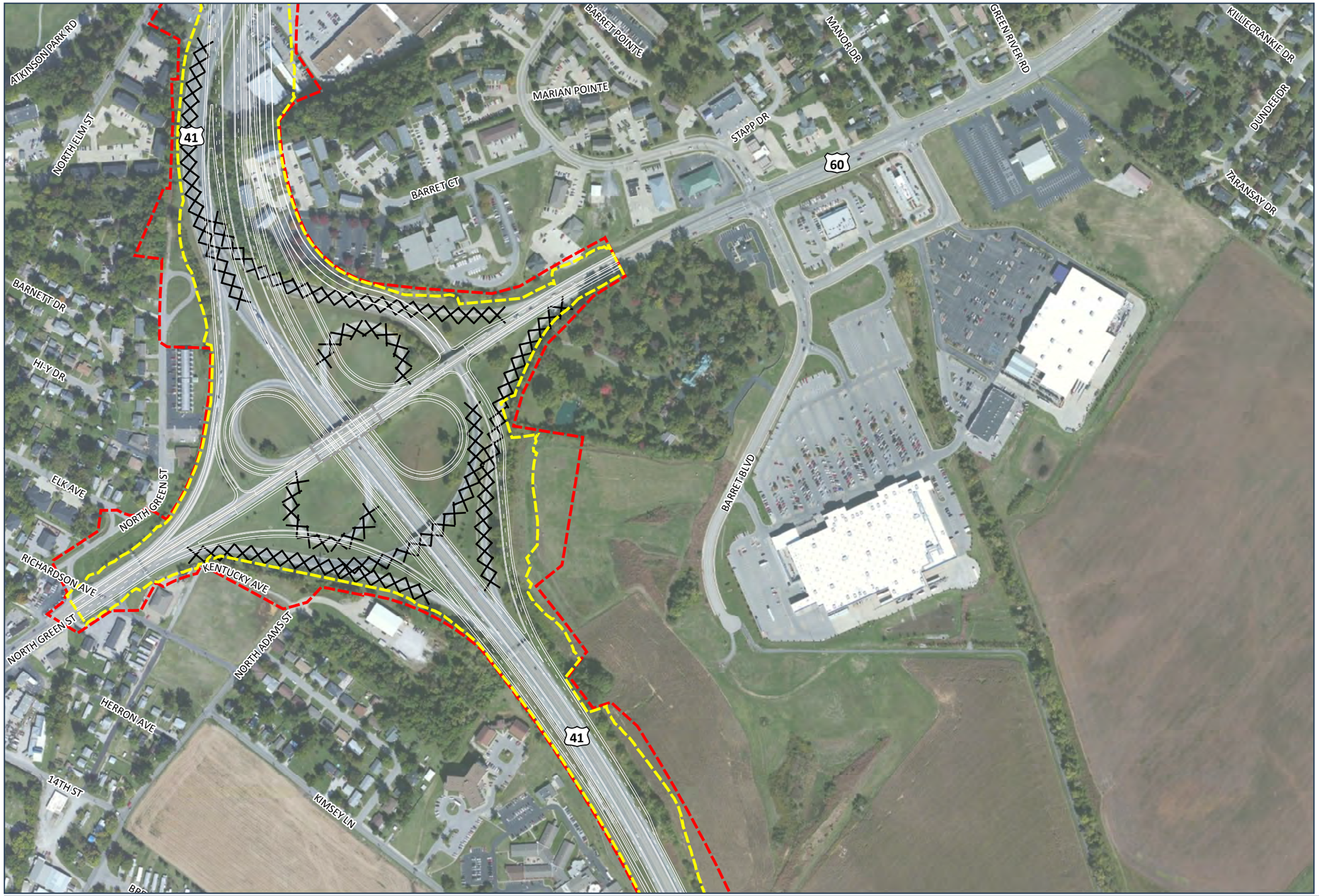


- Construction Limits
- Preliminary Right-of-Way
- Bridge Deck
- Removed Roads

West Alternative 1

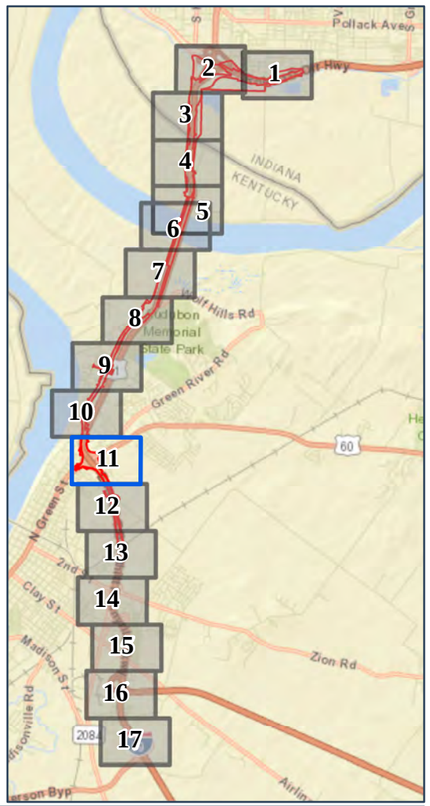
Figure 1 – Sheet 11 of 17

ORX 69 OHIO RIVER CROSSING



0 400 800 Feet

1 Inch = 400 Feet



- Construction Limits
- Preliminary Right-of-Way
- Bridge Deck
- Removed Roads

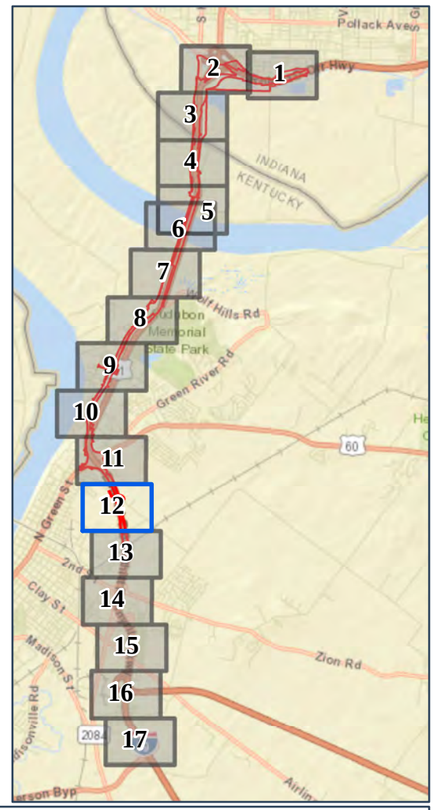
West Alternative 1

Figure 1 – Sheet 12 of 17

ORX 69 OHIO RIVER CROSSING

0 400 800 Feet

1 Inch = 400 Feet

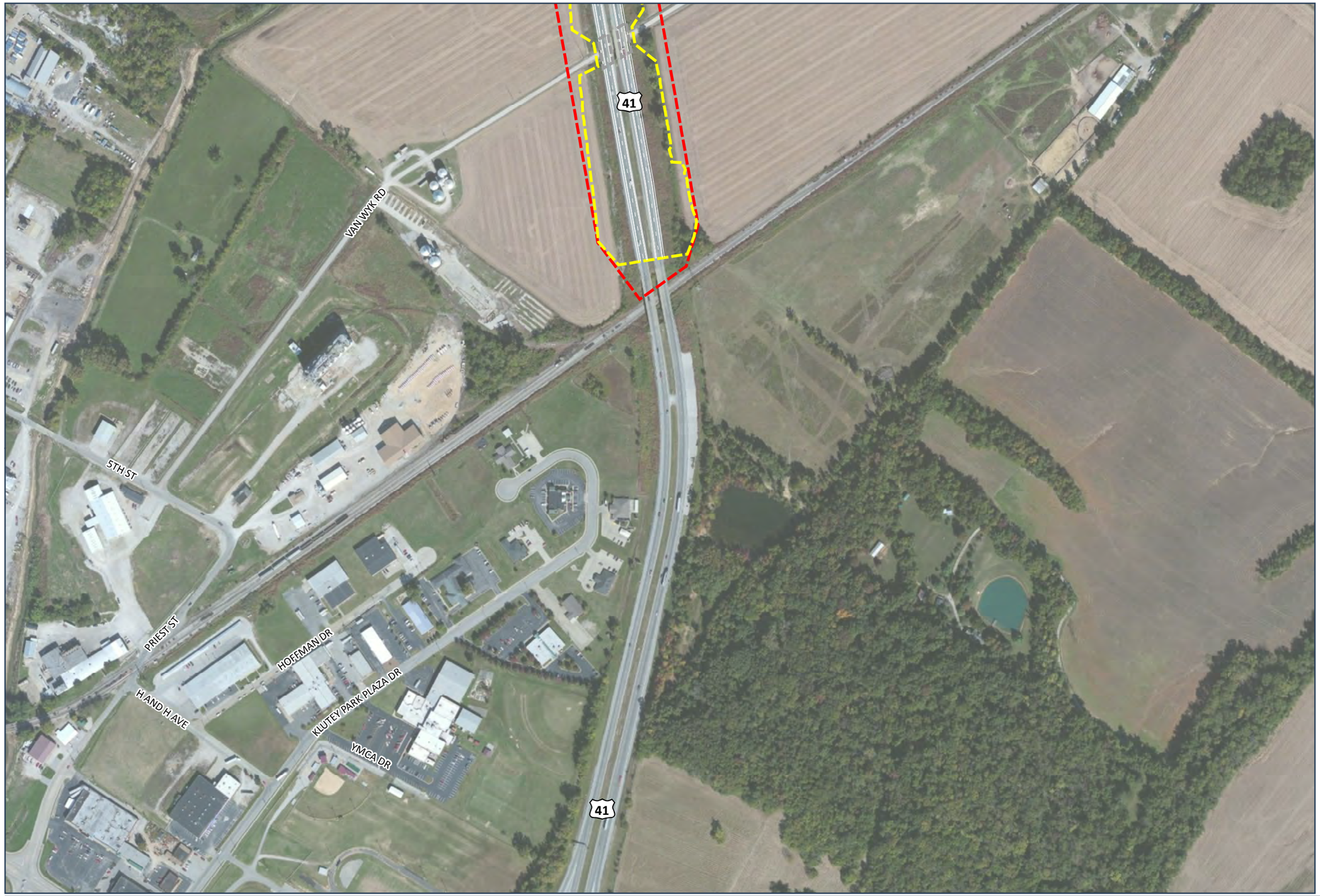


- Construction Limits
- Preliminary Right-of-Way
- Bridge Deck
- Removed Roads

West Alternative 1

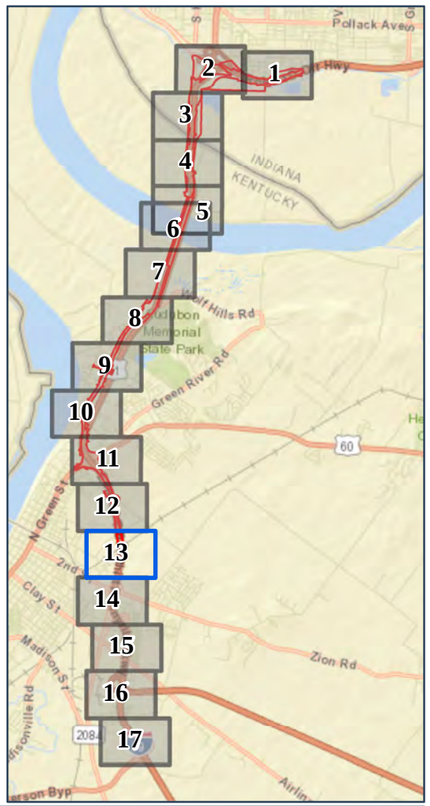
Figure 1 – Sheet 13 of 17

OHIO RIVER CROSSING



0 400 800 Feet

1 Inch = 400 Feet



- Construction Limits
- Preliminary Right-of-Way
- Bridge Deck
- Removed Roads

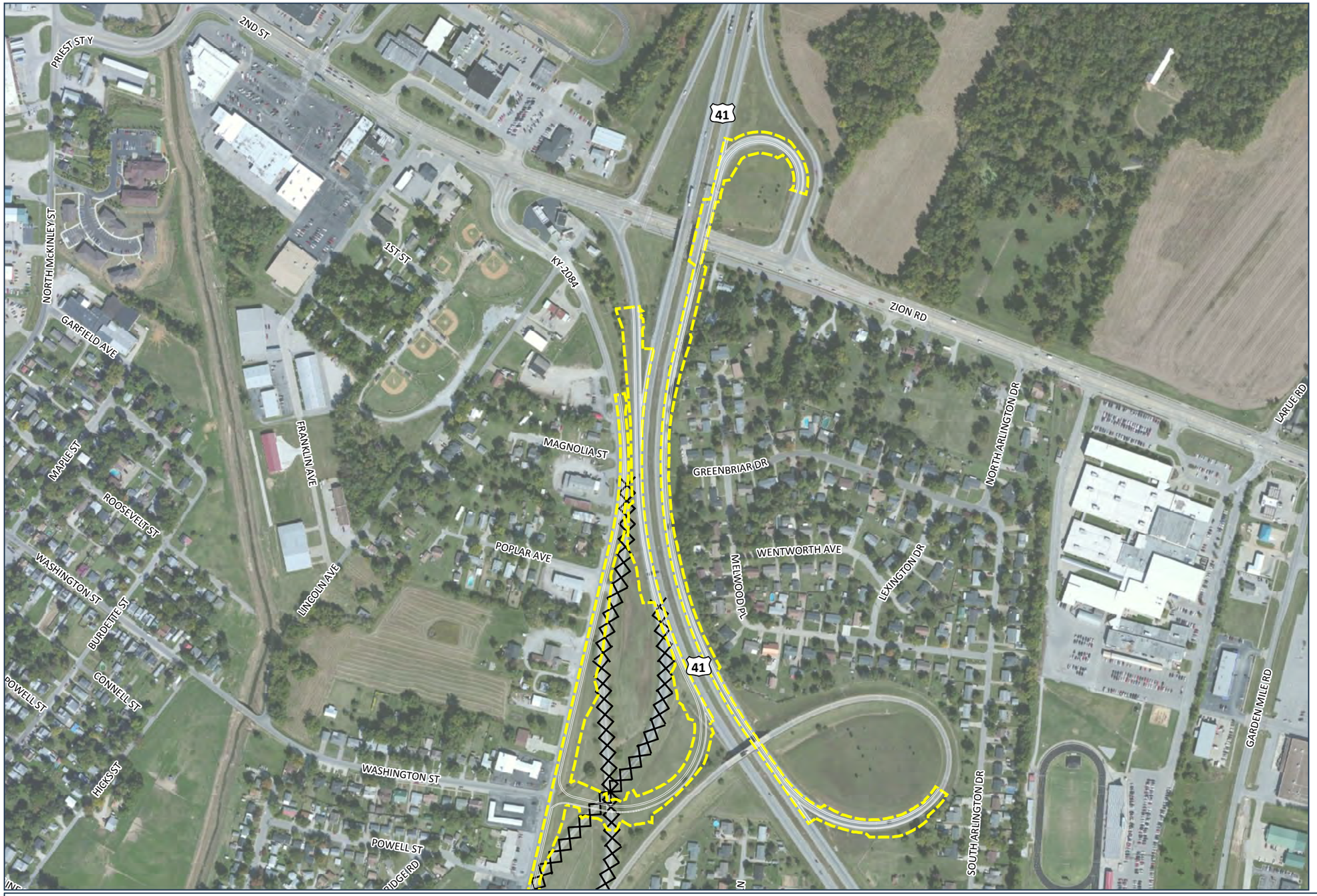
West Alternative 1

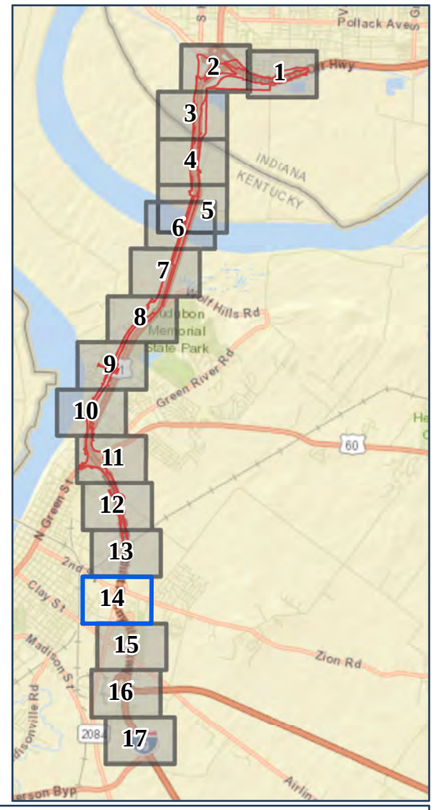
Figure 1 – Sheet 14 of 17

ORX 69 OHIO RIVER CROSSING

0 400 800 Feet

1 Inch = 400 Feet





- Construction Limits
- Preliminary Right-of-Way
- Bridge Deck
- Removed Roads

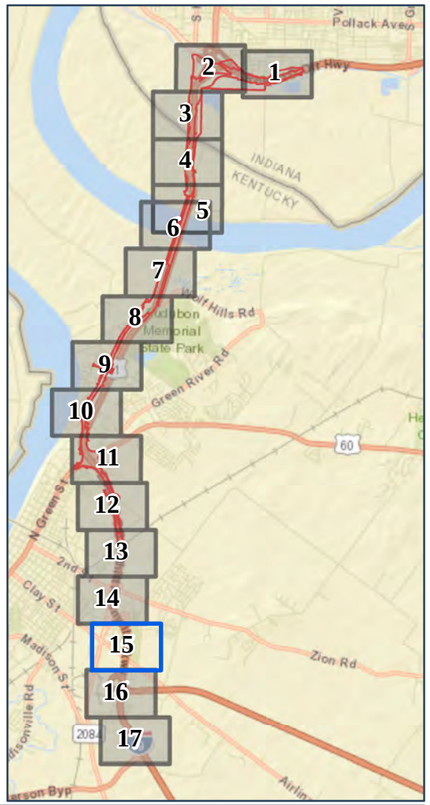
West Alternative 1

Figure 1 – Sheet 15 of 17

ORX 69 OHIO RIVER CROSSING

0 400 800 Feet

1 Inch = 400 Feet



- Construction Limits
- Preliminary Right-of-Way
- Bridge Deck
- Removed Roads

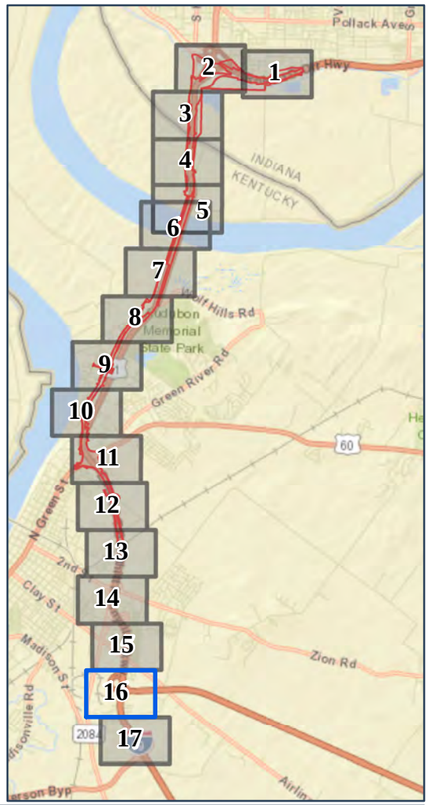
West Alternative 1

Figure 1 – Sheet 16 of 17

OHIO RIVER CROSSING

0 400 800 Feet

1 Inch = 400 Feet

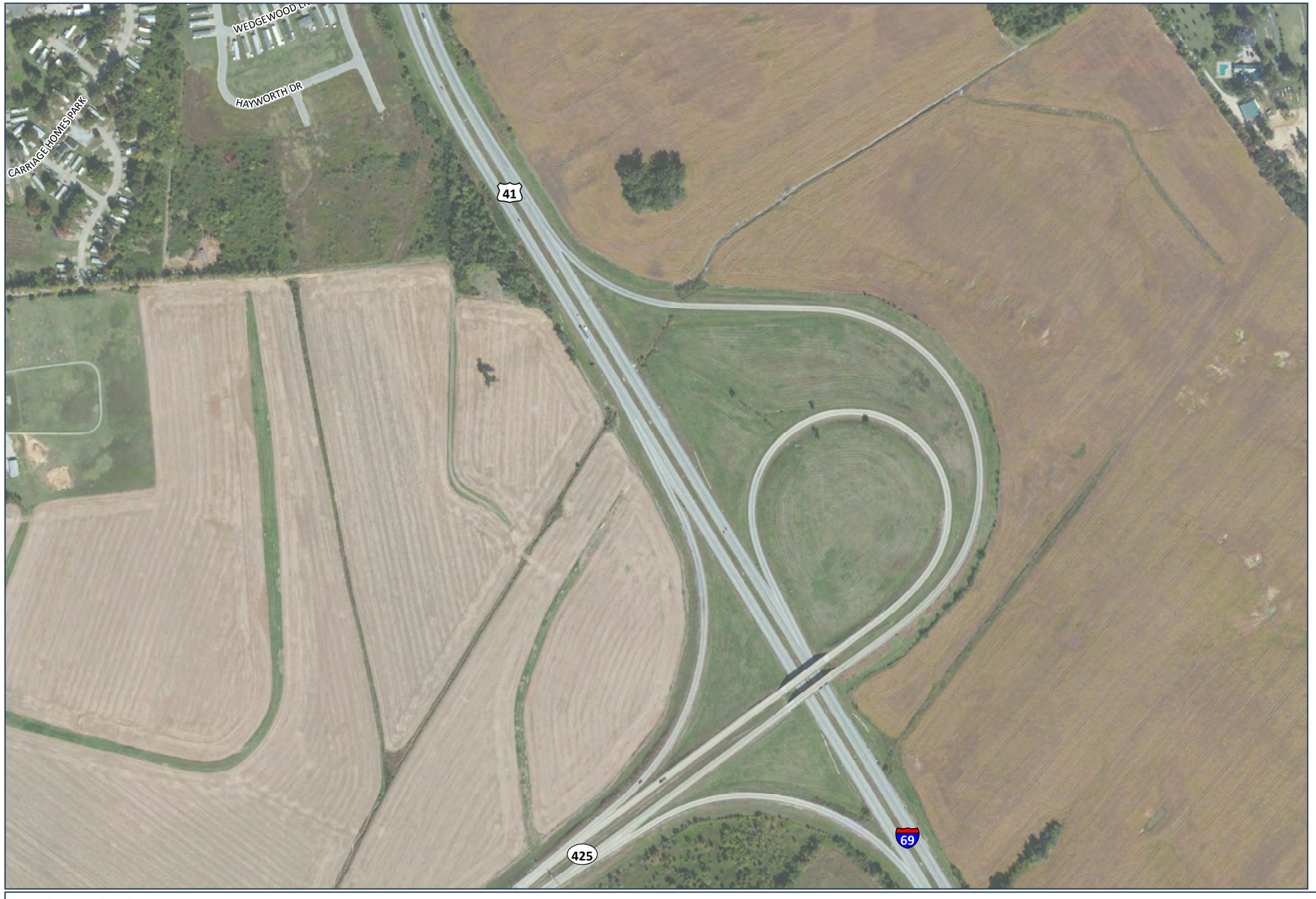


- Construction Limits
- Preliminary Right-of-Way
- Bridge Deck
- Removed Roads

West Alternative 1

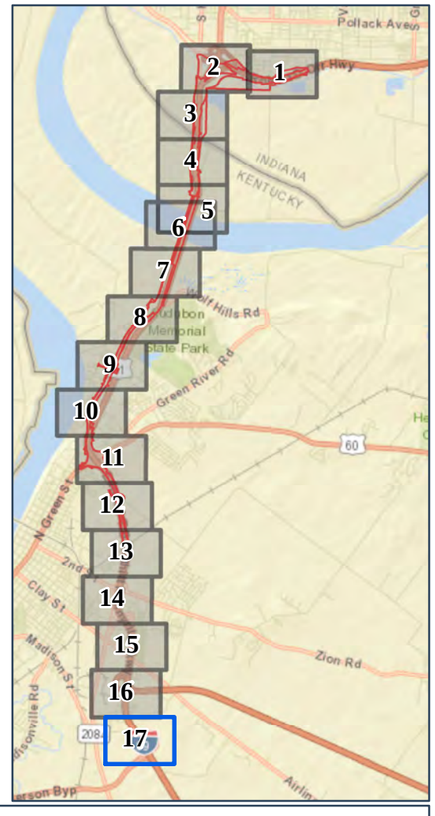
Figure 1 – Sheet 17 of 17

OHIO RIVER CROSSING



0 400 800 Feet

1 Inch = 400 Feet



- Construction Limits
- Preliminary Right-of-Way
- Bridge Deck
- Removed Roads

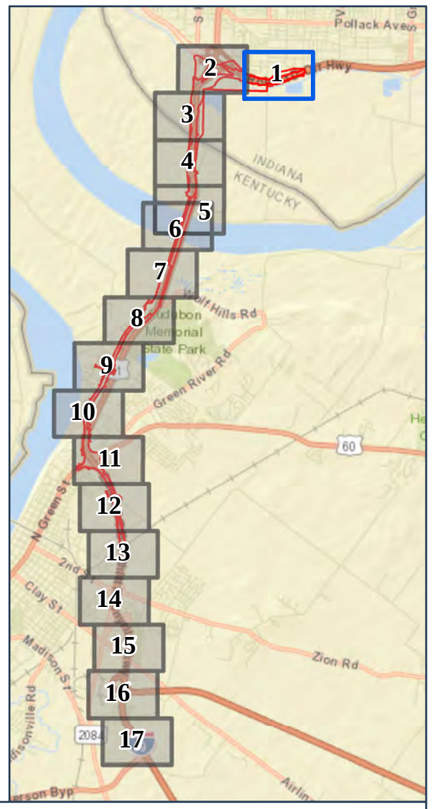
West Alternative 2

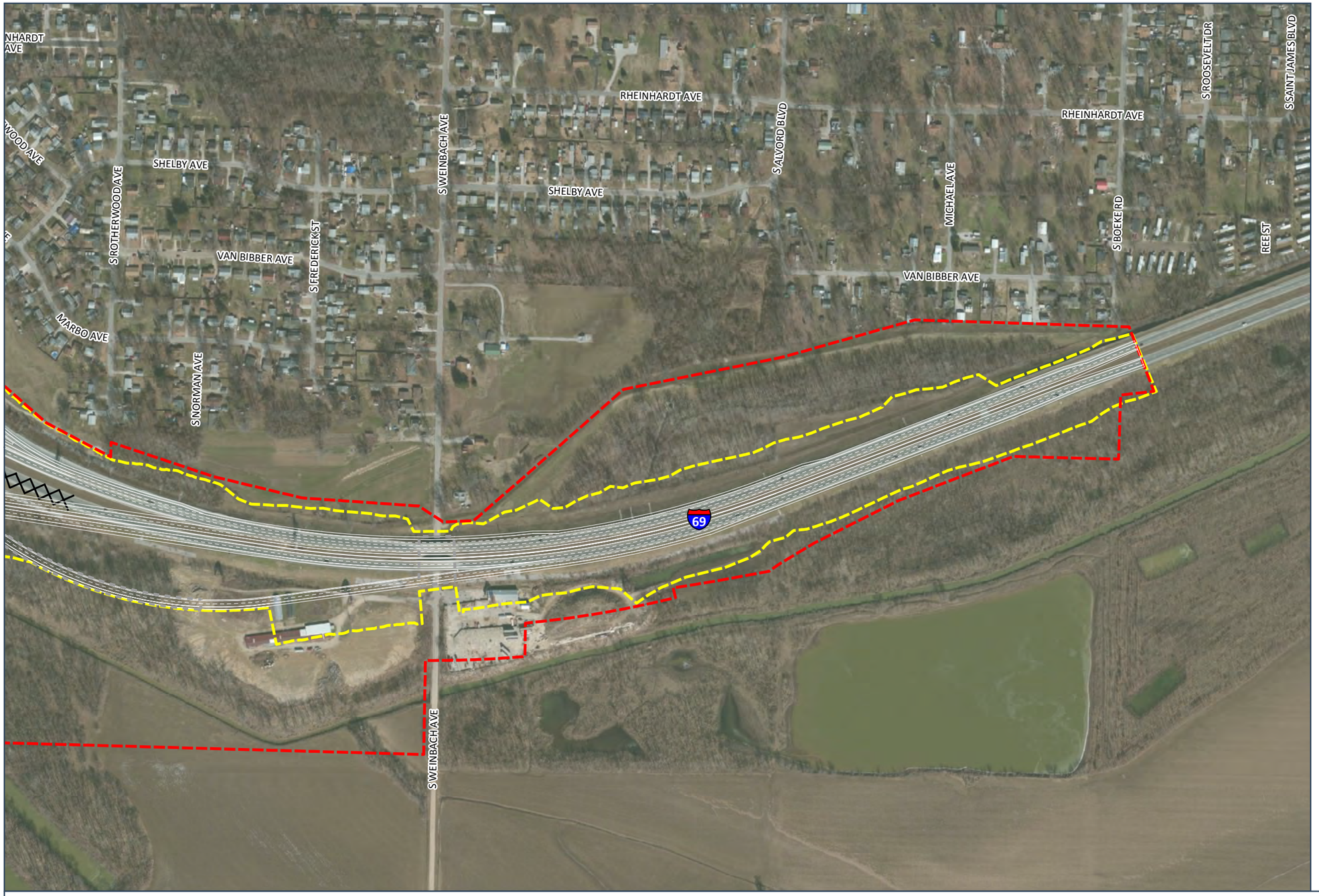
Figure 2 – Sheet 1 of 17

ORX 69 OHIO RIVER CROSSING

0 400 800 Feet

1 Inch = 400 Feet



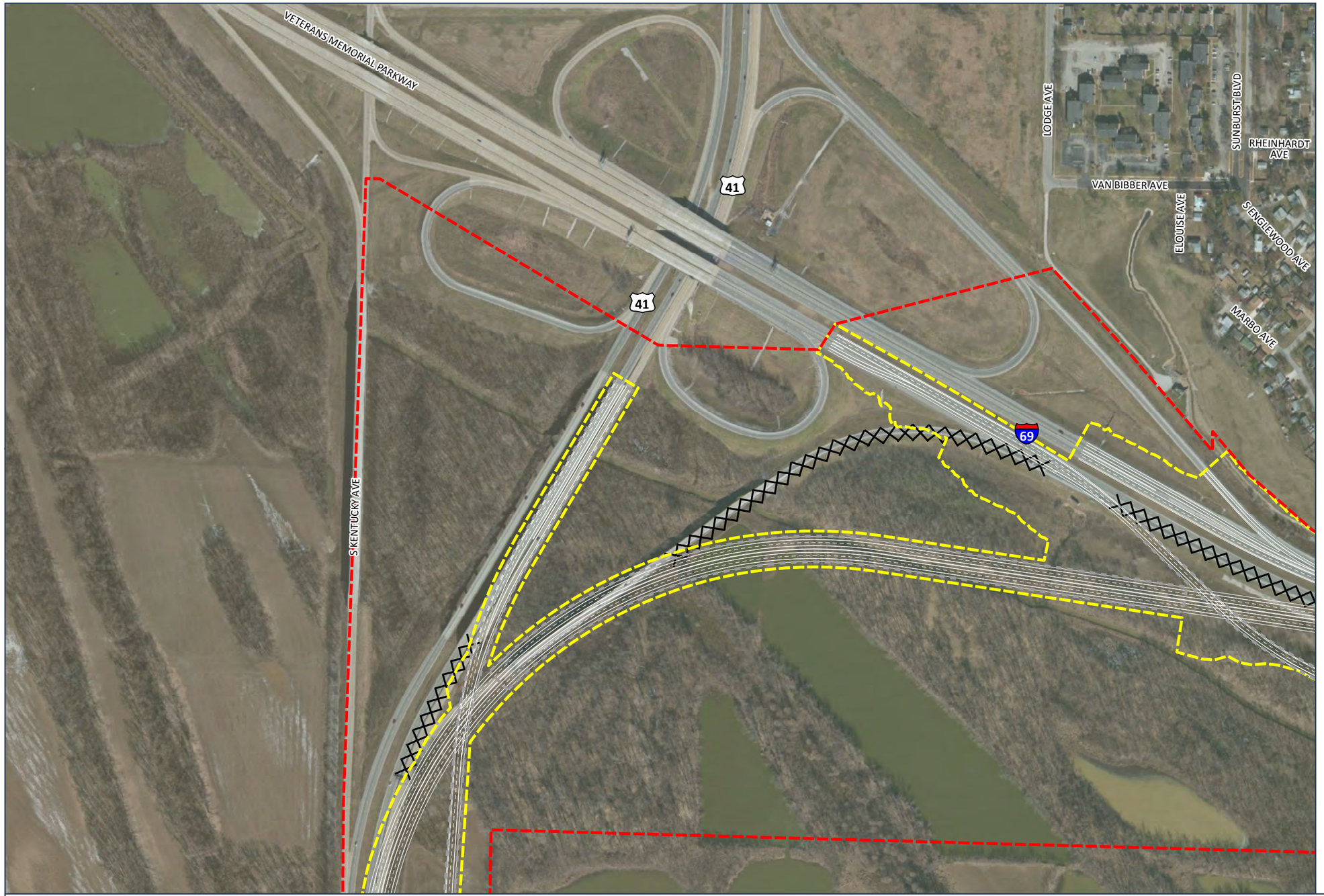


- Construction Limits
- Preliminary Right-of-Way
- Bridge Deck
- Removed Roads

West Alternative 2

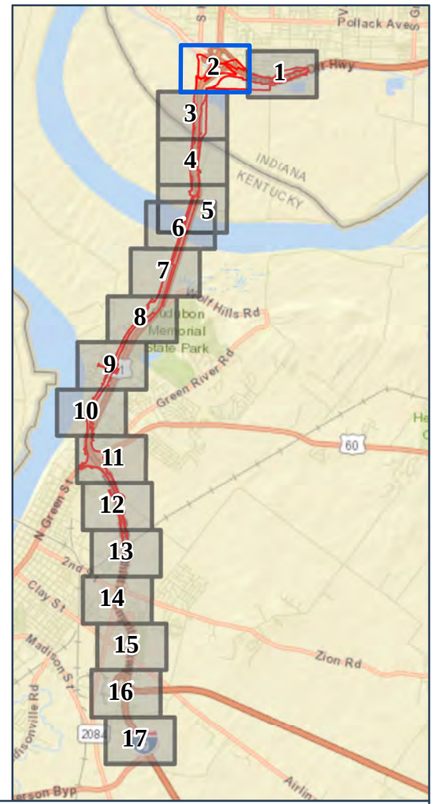
Figure 2 – Sheet 2 of 17

ORX 69 OHIO RIVER CROSSING



0 400 800 Feet

1 Inch = 400 Feet



Construction Limits
Preliminary Right-of-Way
Bridge Deck
Removed Roads

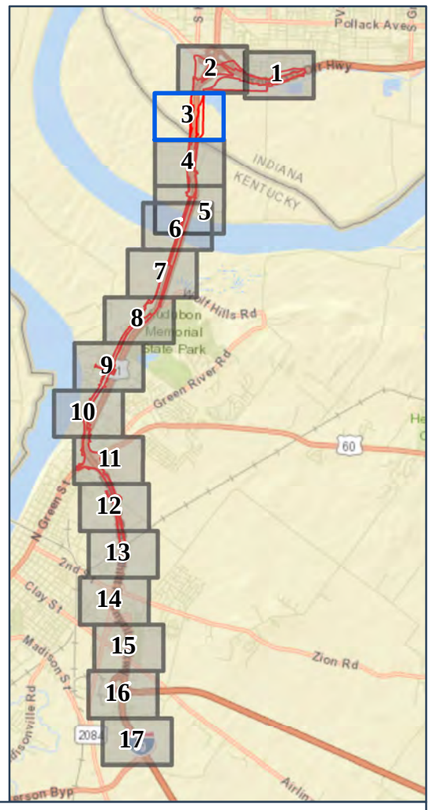
West Alternative 2

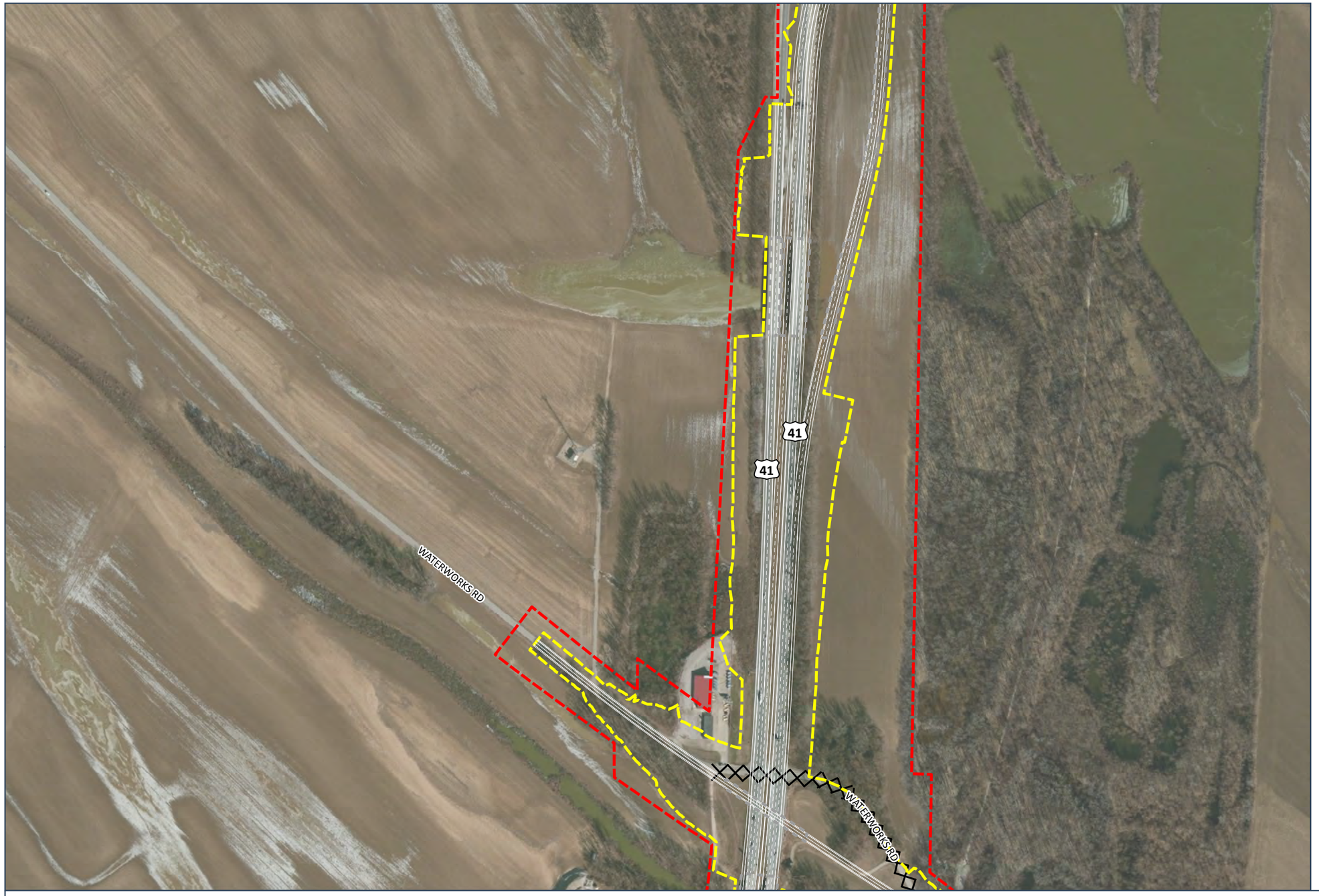
Figure 2 – Sheet 3 of 17

OHIO RIVER CROSSING

0 400 800 Feet

1 Inch = 400 Feet





Construction Limits
Preliminary Right-of-Way
Bridge Deck
Removed Roads

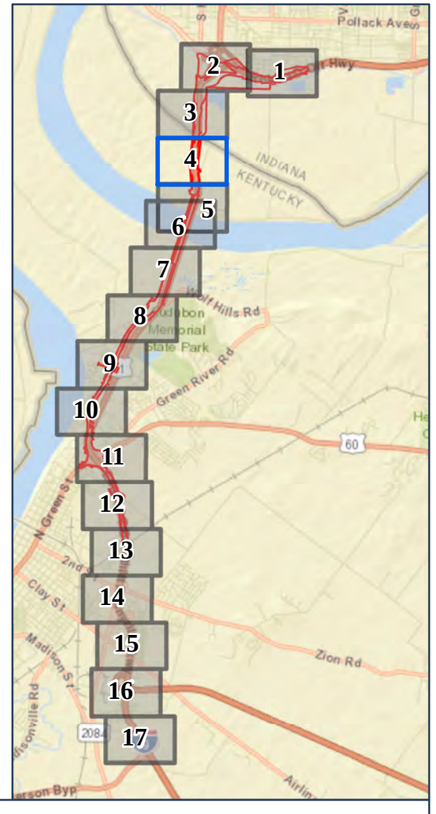
West Alternative 2

Figure 2 – Sheet 4 of 17

ORX 69 OHIO RIVER CROSSING

0 400 800 Feet

1 Inch = 400 Feet

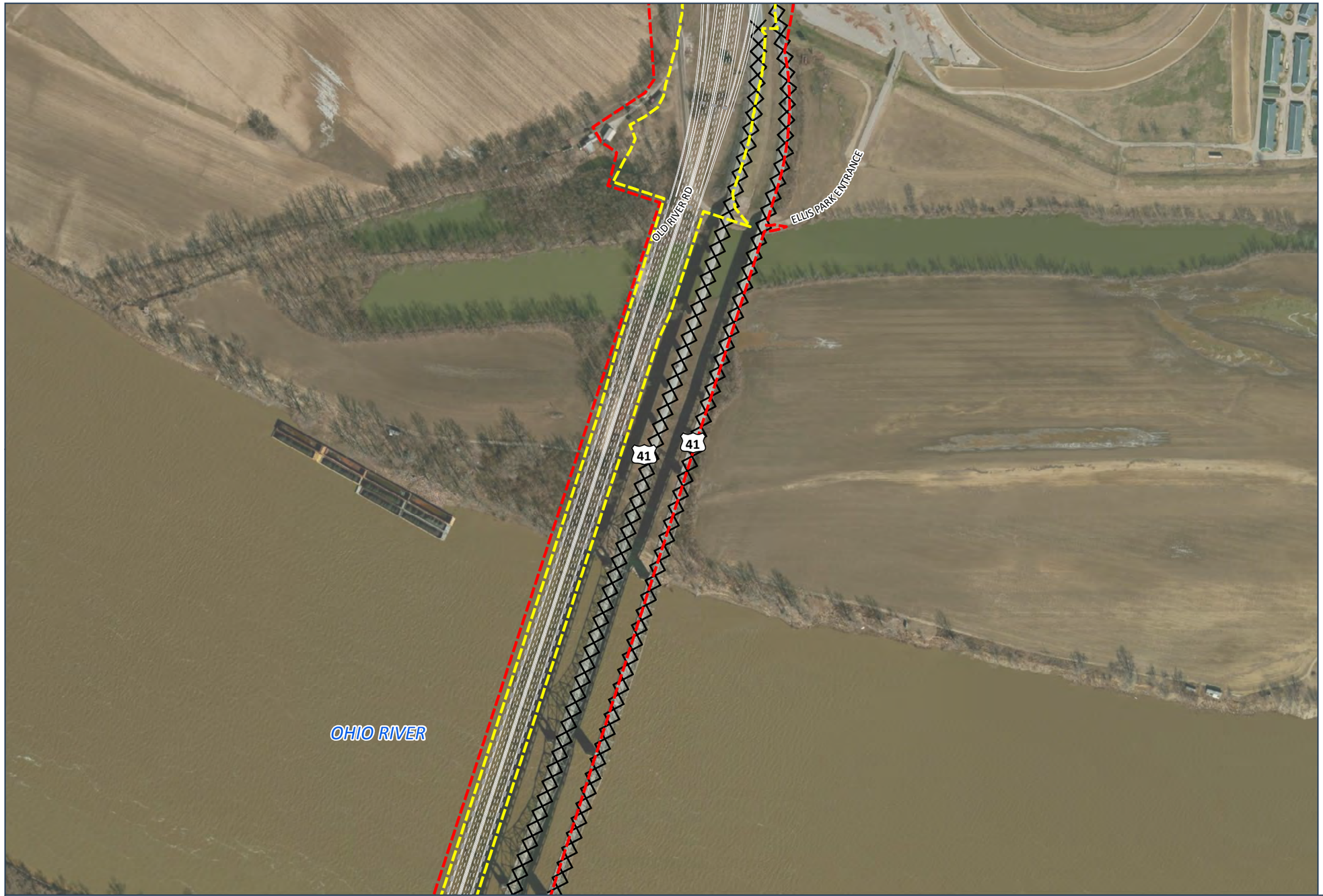


Construction Limits
Preliminary Right-of-Way
Bridge Deck
Removed Roads

West Alternative 2

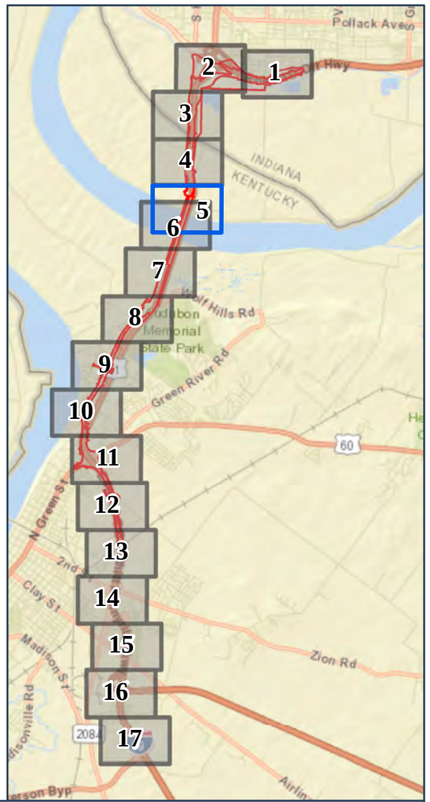
Figure 2 – Sheet 5 of 17

ORX 69 OHIO RIVER CROSSING



0 400 800 Feet

1 Inch = 400 Feet



Construction Limits
Preliminary Right-of-Way
Bridge Deck
Removed Roads

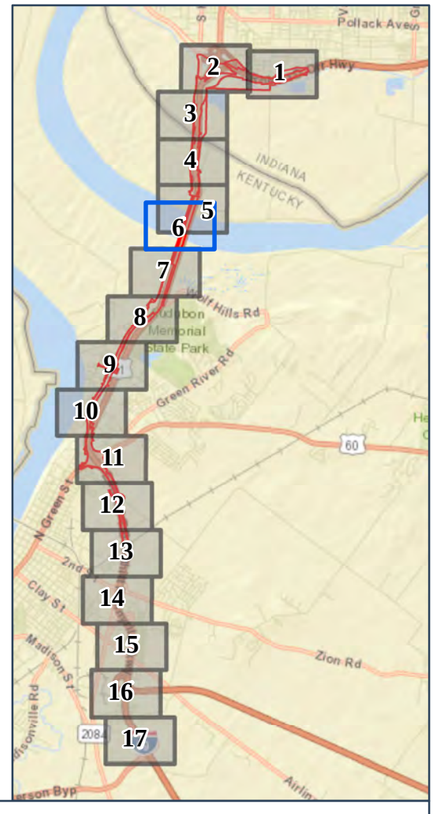
West Alternative 2

Figure 2 – Sheet 6 of 17

OHIO RIVER CROSSING

0 400 800 Feet

1 Inch = 400 Feet



Construction Limits
Preliminary Right-of-Way
Bridge Deck
Removed Roads

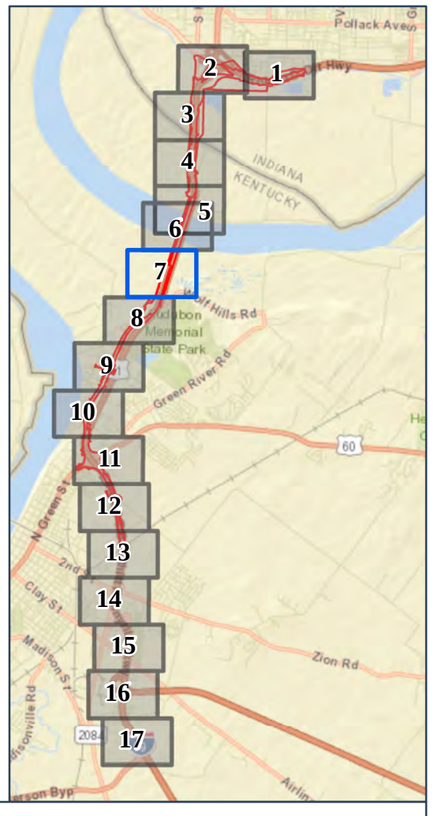
West Alternative 2

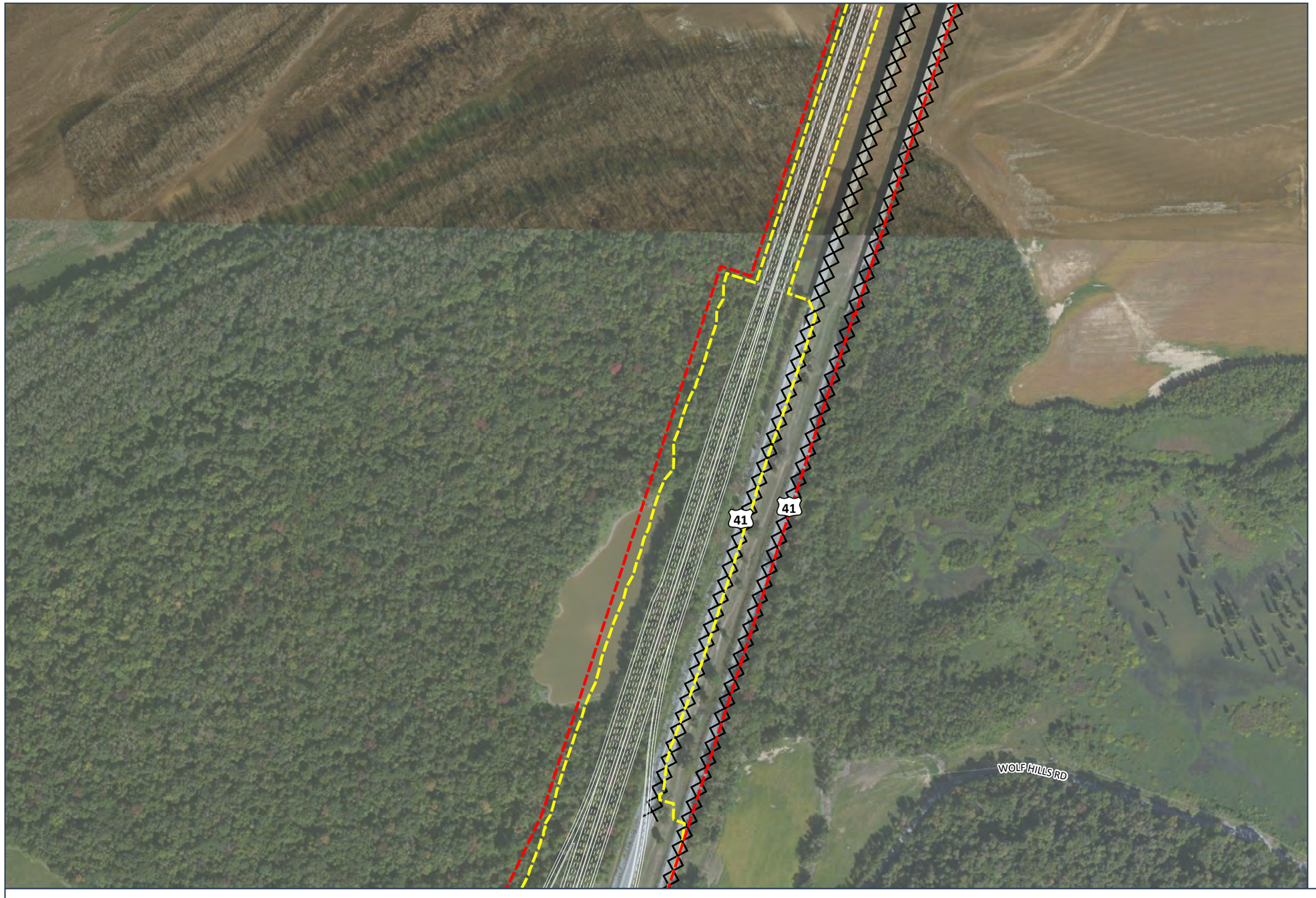
Figure 2 – Sheet 7 of 17

OHIO RIVER CROSSING

0 400 800 Feet

1 Inch = 400 Feet





Construction Limits
Preliminary Right-of-Way
Bridge Deck
Removed Roads

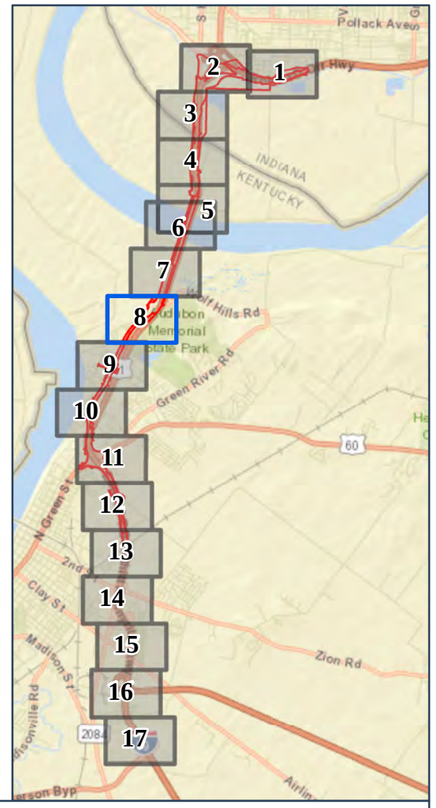
West Alternative 2

Figure 2 – Sheet 8 of 17

ORX 69 OHIO RIVER CROSSING

0 400 800 Feet

1 Inch = 400 Feet



- Construction Limits
- Preliminary Right-of-Way
- Bridge Deck
- Removed Roads

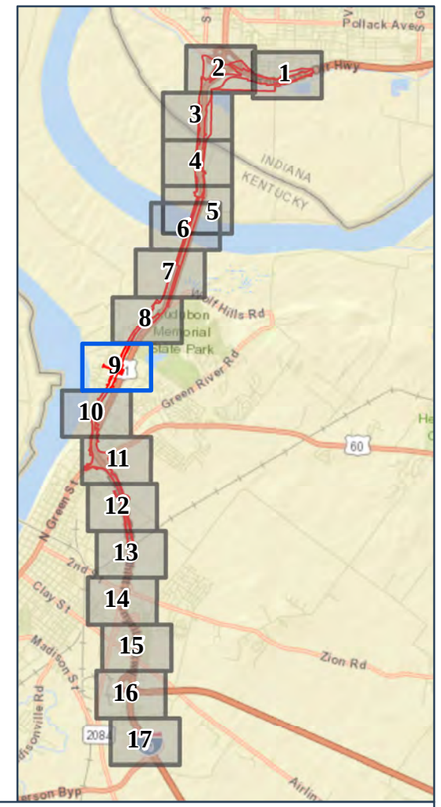
West Alternative 2

Figure 2 – Sheet 9 of 17

ORX 69 OHIO RIVER CROSSING

0 400 800 Feet

1 Inch = 400 Feet



Construction Limits
Preliminary Right-of-Way
Bridge Deck
Removed Roads

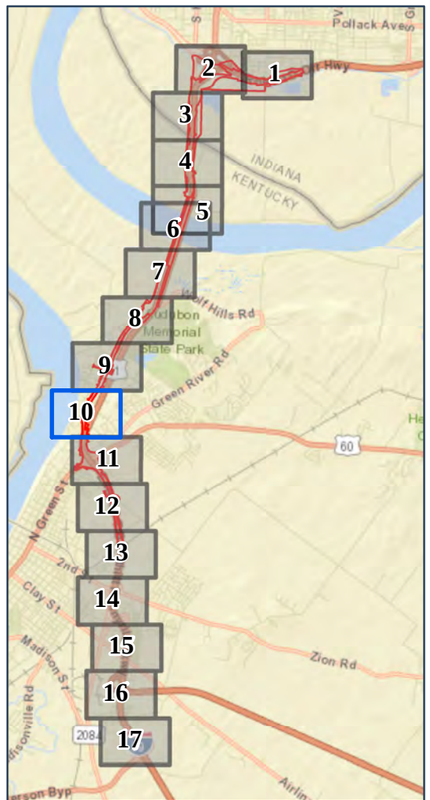
West Alternative 2

Figure 2 – Sheet 10 of 17

ORX 69 OHIO RIVER CROSSING

0 400 800 Feet

1 Inch = 400 Feet



- Construction Limits
- Preliminary Right-of-Way
- Bridge Deck
- Removed Roads

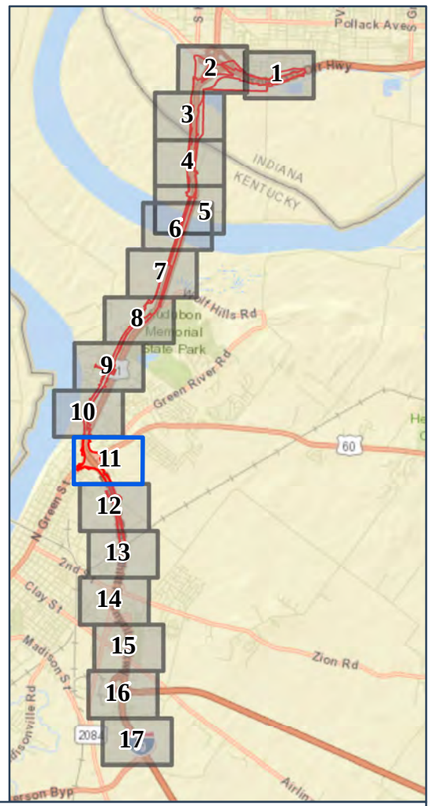
West Alternative 2

Figure 2 – Sheet 11 of 17

ORX 69 OHIO RIVER CROSSING

0 400 800 Feet

1 Inch = 400 Feet



- Construction Limits
- Preliminary Right-of-Way
- Bridge Deck
- Removed Roads

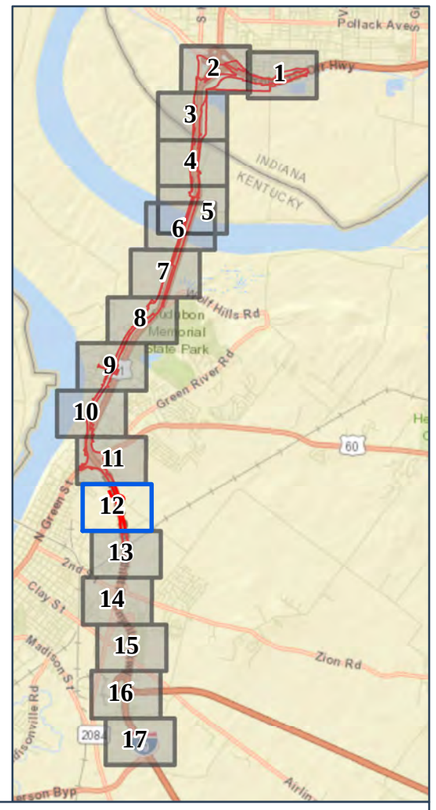
West Alternative 2

Figure 2 – Sheet 12 of 17

ORX 69 OHIO RIVER CROSSING

0 400 800 Feet

1 Inch = 400 Feet



- Construction Limits
- Preliminary Right-of-Way
- Bridge Deck
- Removed Roads

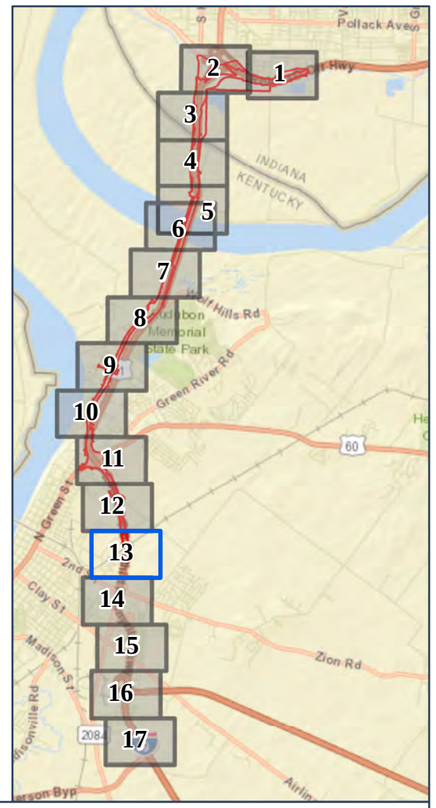
West Alternative 2

Figure 2 – Sheet 13 of 17

OHIO RIVER CROSSING

0 400 800 Feet

1 Inch = 400 Feet



Construction Limits
Preliminary Right-of-Way
Bridge Deck
Removed Roads

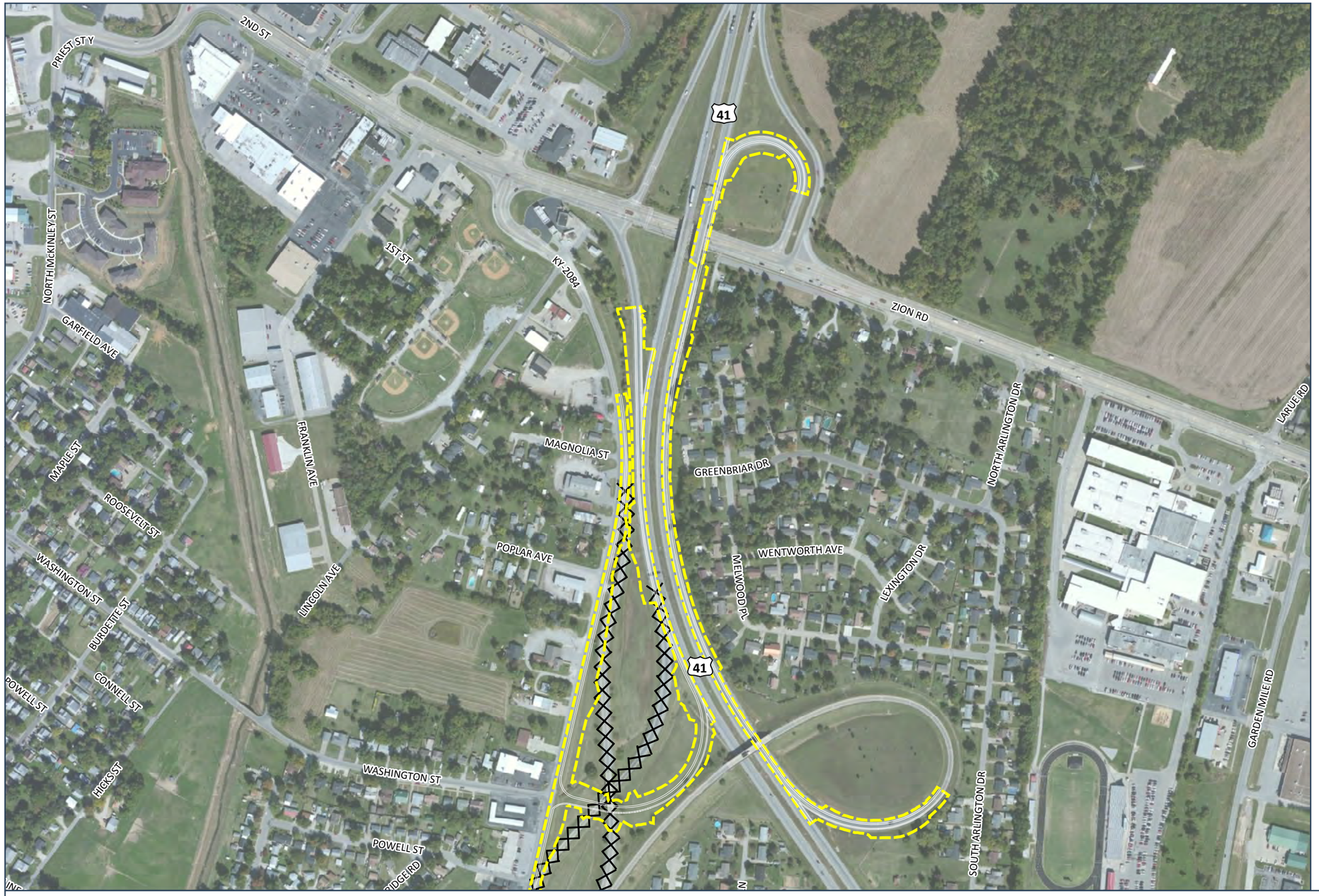
West Alternative 2

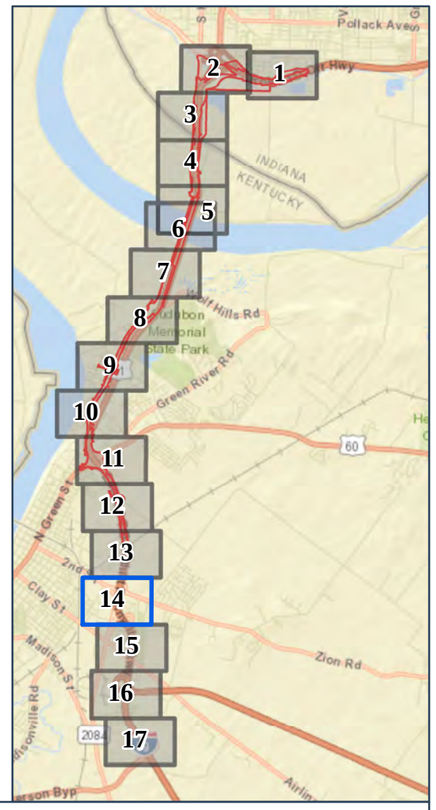
Figure 2 – Sheet 14 of 17

ORX 69 OHIO RIVER CROSSING

0 400 800 Feet

1 Inch = 400 Feet





- Construction Limits
- Preliminary Right-of-Way
- Bridge Deck
- Removed Roads

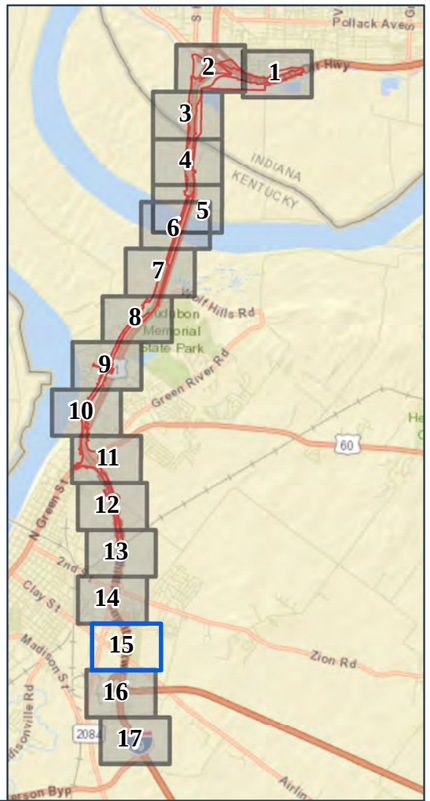
West Alternative 2

Figure 2 – Sheet 15 of 17

ORX 69 OHIO RIVER CROSSING

0 400 800 Feet

1 Inch = 400 Feet



Construction Limits
Preliminary Right-of-Way
Bridge Deck
Removed Roads

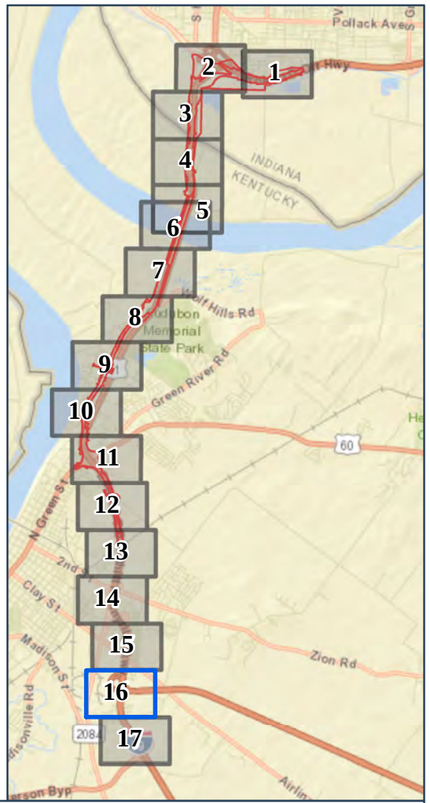
West Alternative 2

Figure 2 – Sheet 16 of 17

ORX 69 OHIO RIVER CROSSING

0 400 800 Feet

1 Inch = 400 Feet

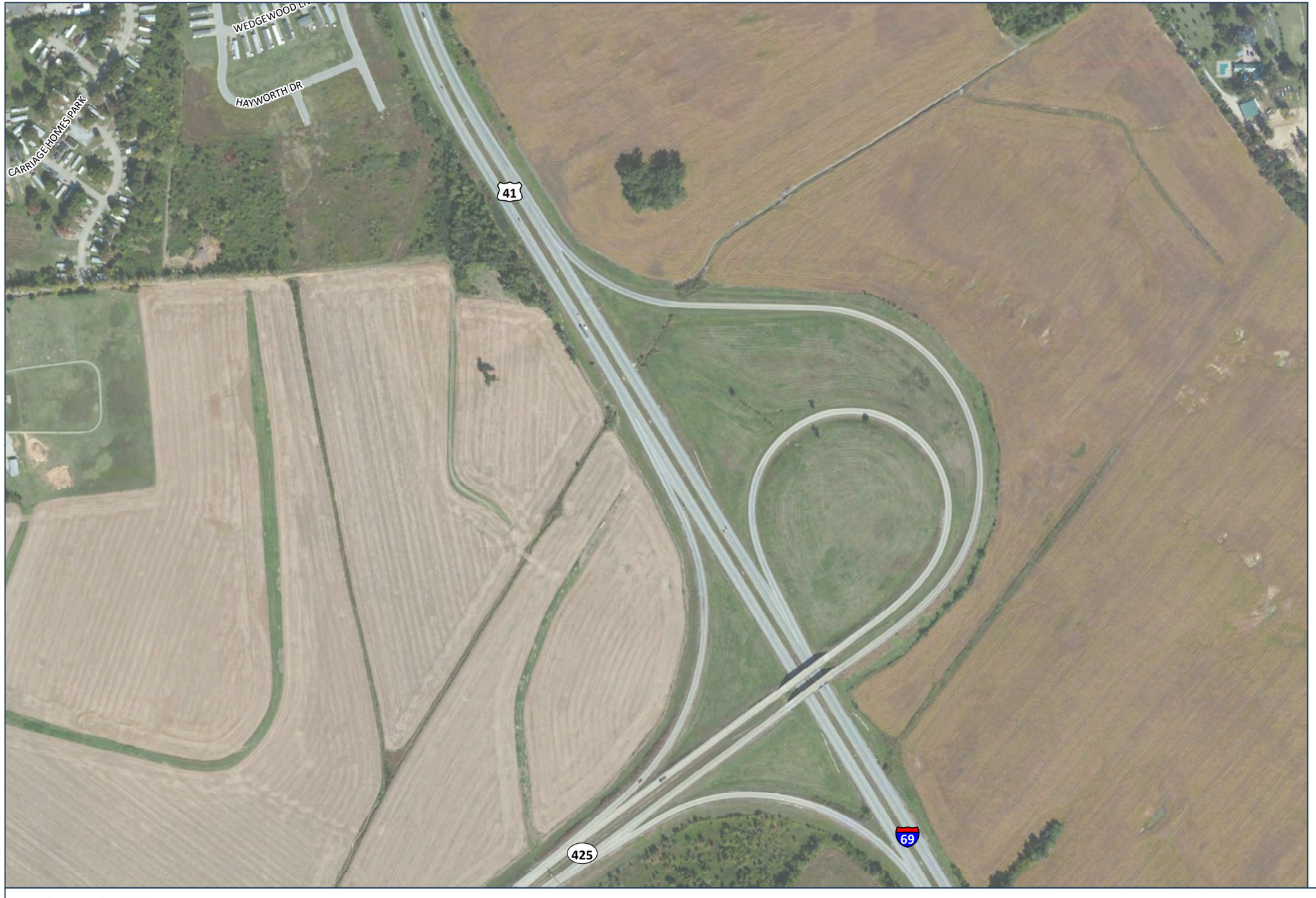


- Construction Limits
- Preliminary Right-of-Way
- Bridge Deck
- Removed Roads

West Alternative 2

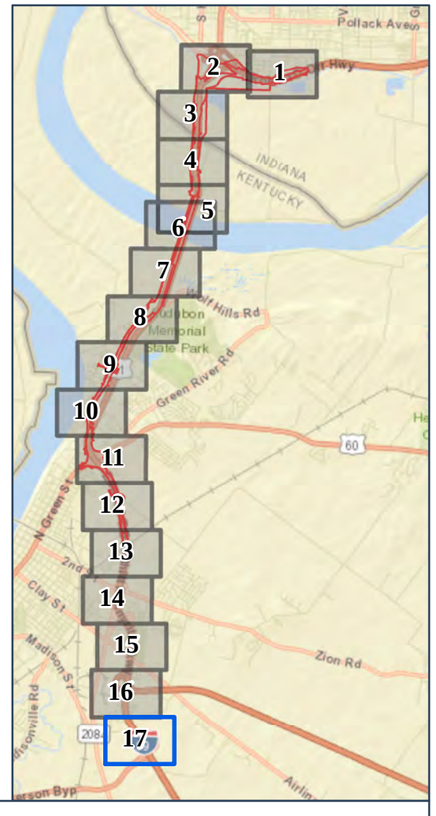
Figure 2 – Sheet 17 of 17

ORX 69 OHIO RIVER CROSSING



0 400 800 Feet

1 Inch = 400 Feet



Construction Limits
Preliminary Right-of-Way
Bridge Deck
Removed Roads

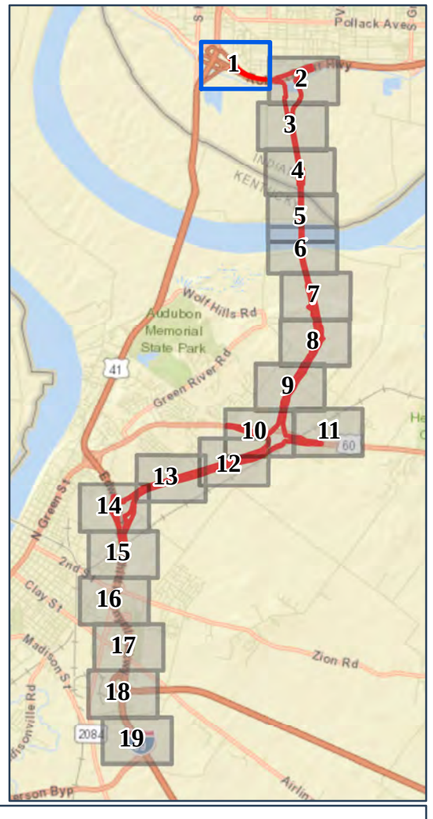
Central Alternative 1 (Preferred)

Figure 3 – Sheet 1 of 19

OHIO RIVER CROSSING

0 400 800 Feet

1 Inch = 400 Feet



- Construction Limits
- Preliminary Right-of-Way
- Bridge Deck
- Removed Roads

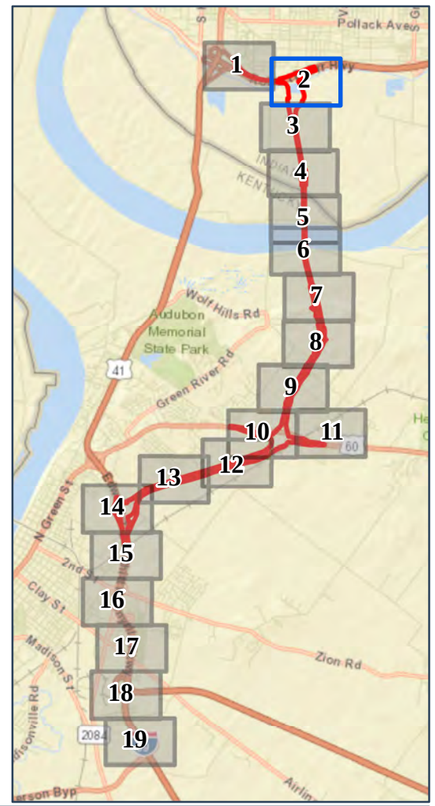
Central Alternative 1 (Preferred)

Figure 3 – Sheet 2 of 19

OHIO RIVER CROSSING

0 400 800 Feet

1 Inch = 400 Feet



- Construction Limits
- Preliminary Right-of-Way
- Bridge Deck
- Removed Roads

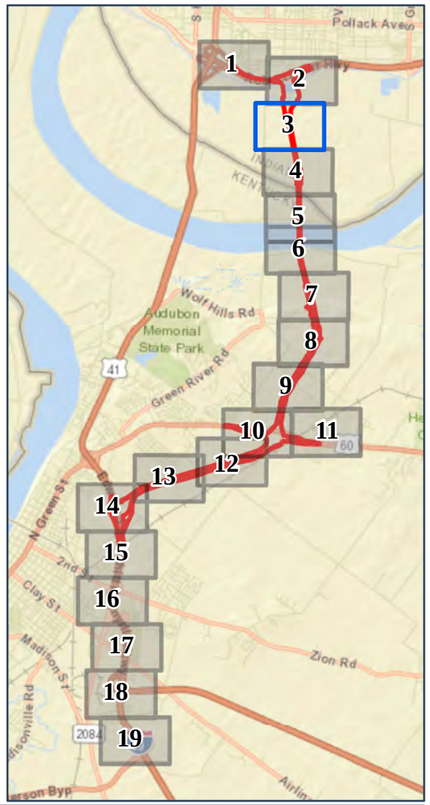
Central Alternative 1 (Preferred)

Figure 3 – Sheet 3 of 19

OHIO RIVER CROSSING

0 400 800 Feet

1 Inch = 400 Feet



- Construction Limits
- Preliminary Right-of-Way
- Bridge Deck
- Removed Roads

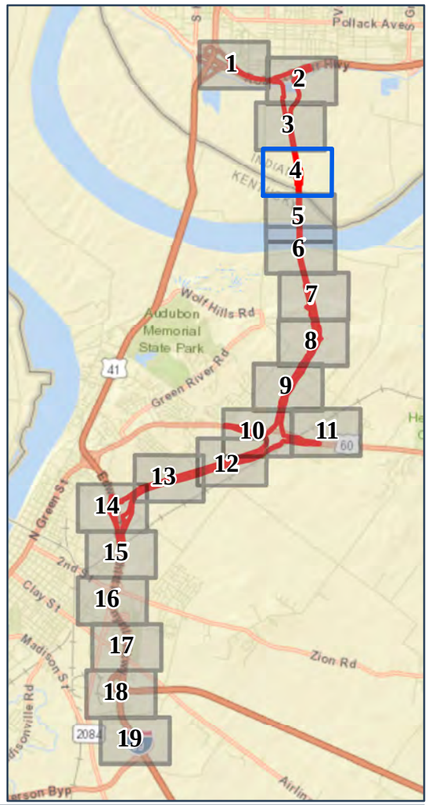
Central Alternative 1 (Preferred)

Figure 3 – Sheet 4 of 19

OHIO RIVER CROSSING

0 400 800 Feet

1 Inch = 400 Feet



- Construction Limits
- Preliminary Right-of-Way
- Bridge Deck
- Removed Roads

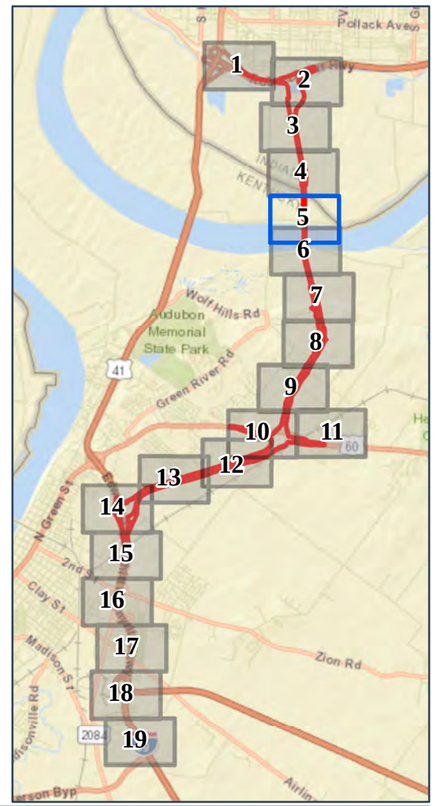
Central Alternative 1 (Preferred)

Figure 3 – Sheet 5 of 19

OHIO RIVER CROSSING

0 400 800 Feet

1 Inch = 400 Feet

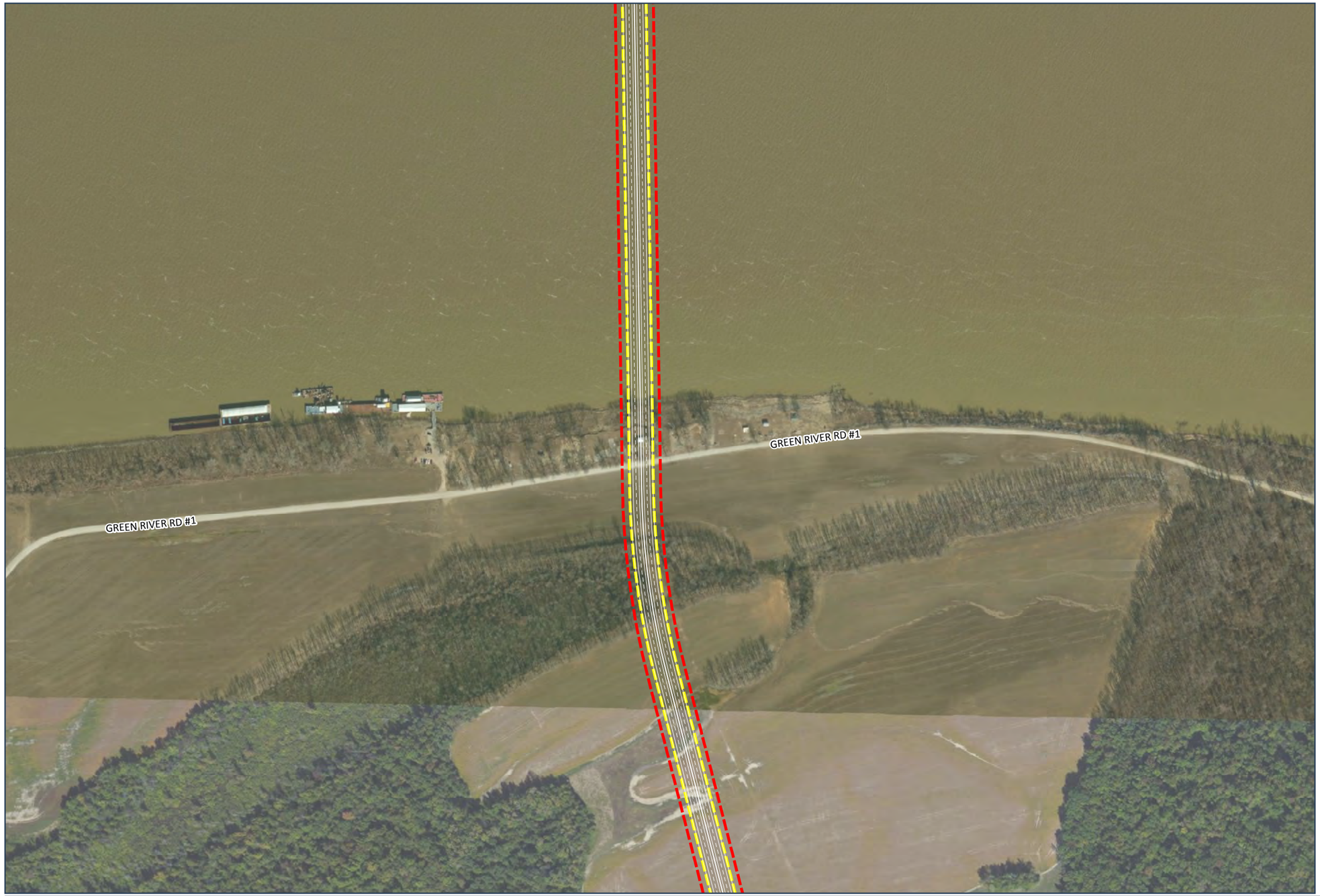


- Construction Limits
- Preliminary Right-of-Way
- Bridge Deck
- Removed Roads

Central Alternative 1 (Preferred)

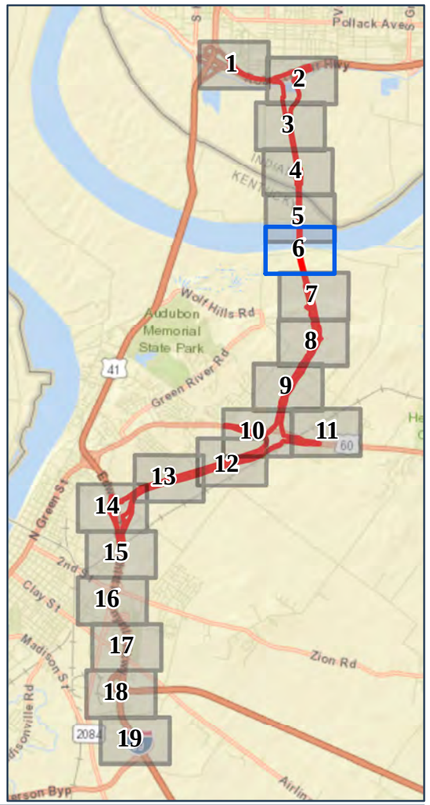
Figure 3 – Sheet 6 of 19

OHIO RIVER CROSSING



0 400 800 Feet

1 Inch = 400 Feet



- Construction Limits
- Preliminary Right-of-Way
- Bridge Deck
- Removed Roads

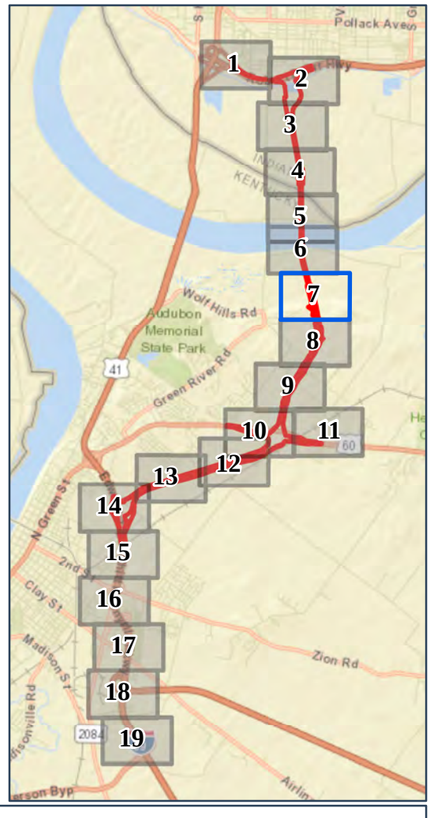
Central Alternative 1 (Preferred)

Figure 3 – Sheet 7 of 19

OHIO RIVER CROSSING

0 400 800 Feet

1 Inch = 400 Feet

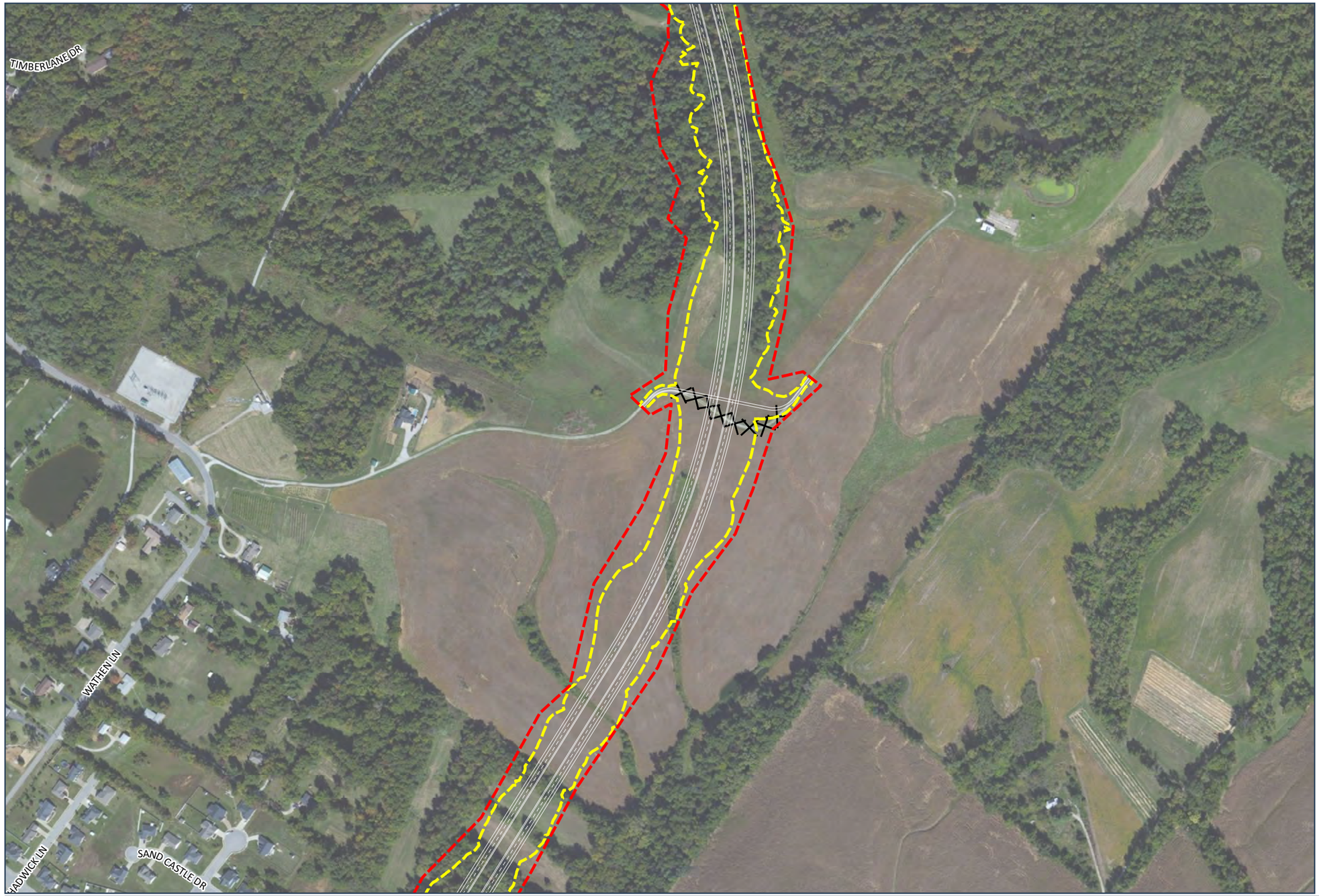


- Construction Limits
- Preliminary Right-of-Way
- Bridge Deck
- Removed Roads

Central Alternative 1 (Preferred)

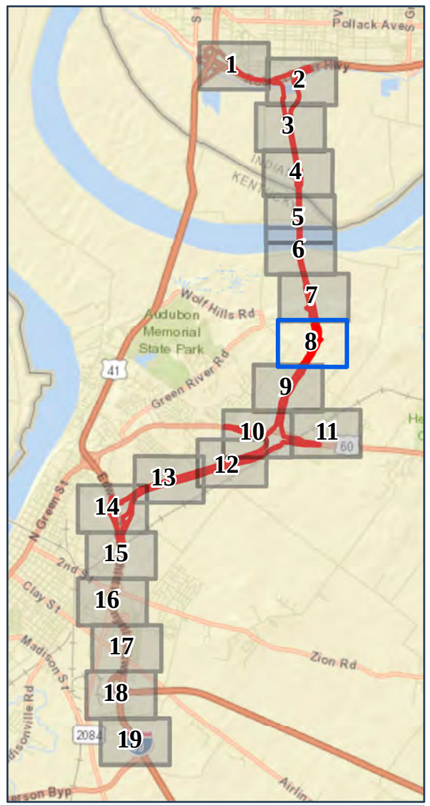
Figure 3 – Sheet 8 of 19

OHIO RIVER CROSSING



0 400 800 Feet

1 Inch = 400 Feet

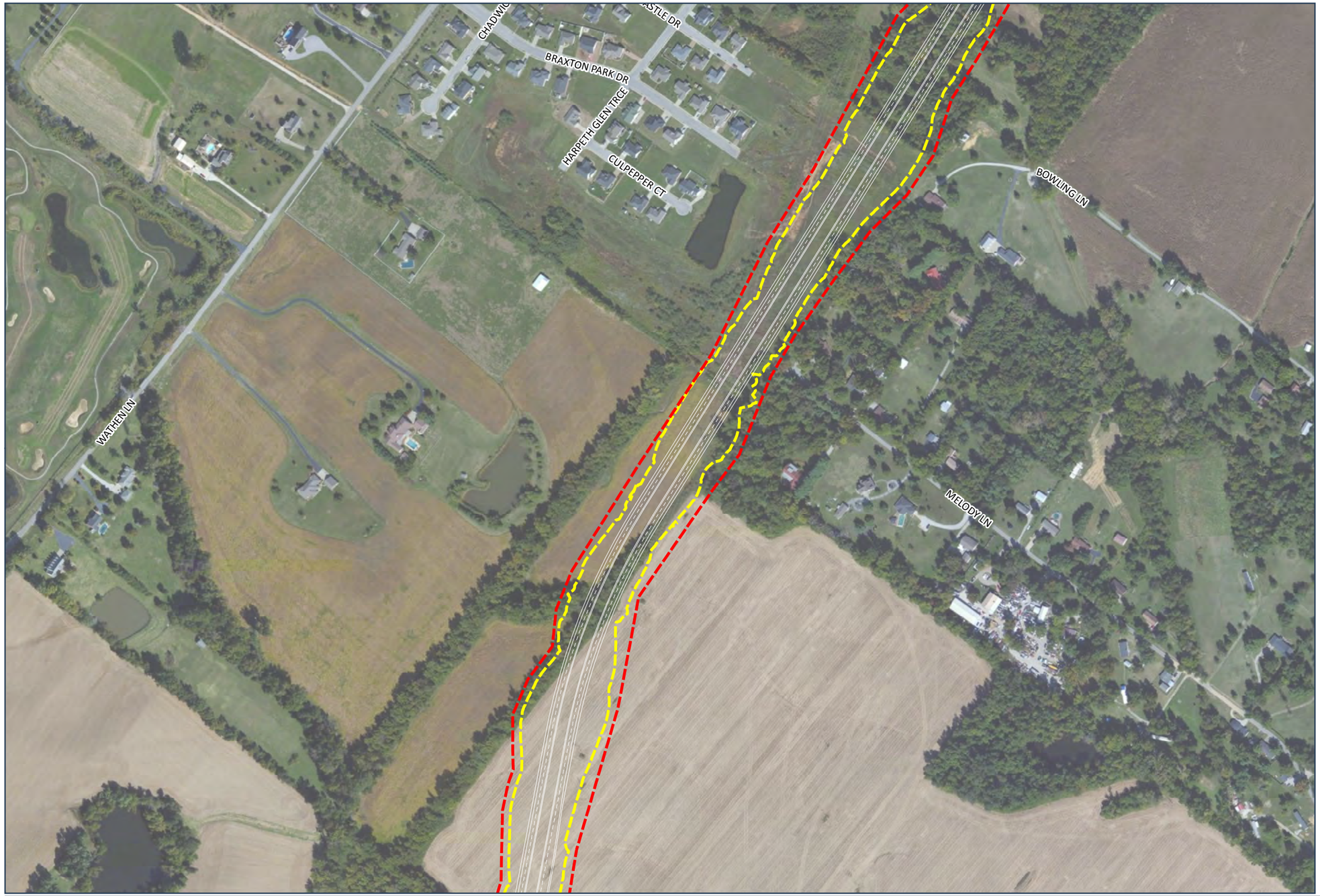


- Construction Limits
- Preliminary Right-of-Way
- Bridge Deck
- Removed Roads

Central Alternative 1 (Preferred)

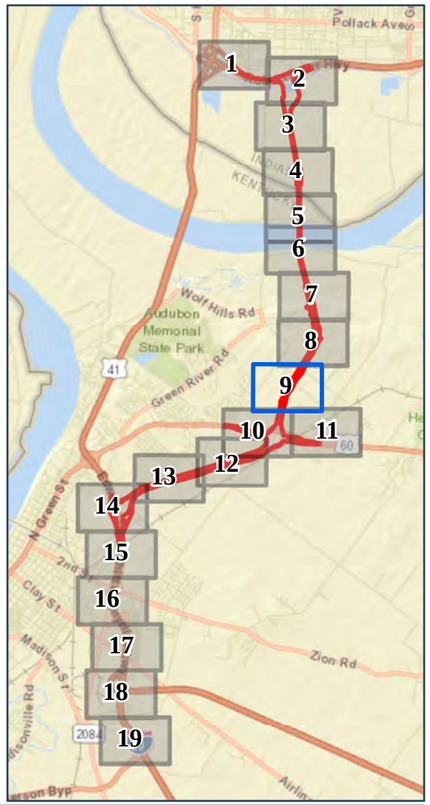
Figure 3 – Sheet 9 of 19

OHIO RIVER CROSSING



0 400 800 Feet

1 Inch = 400 Feet



- Construction Limits
- Preliminary Right-of-Way
- Bridge Deck
- Removed Roads

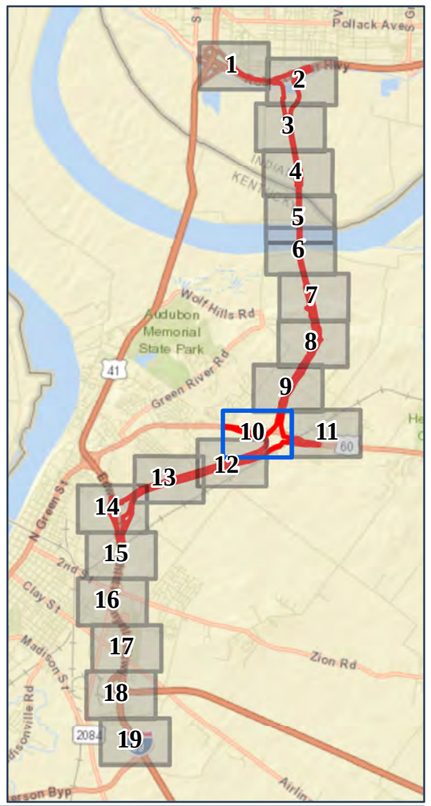
Central Alternative 1 (Preferred)

Figure 3 – Sheet 10 of 19

OHIO RIVER CROSSING

0 400 800 Feet

1 Inch = 400 Feet



- Construction Limits
- Preliminary Right-of-Way
- Bridge Deck
- Removed Roads

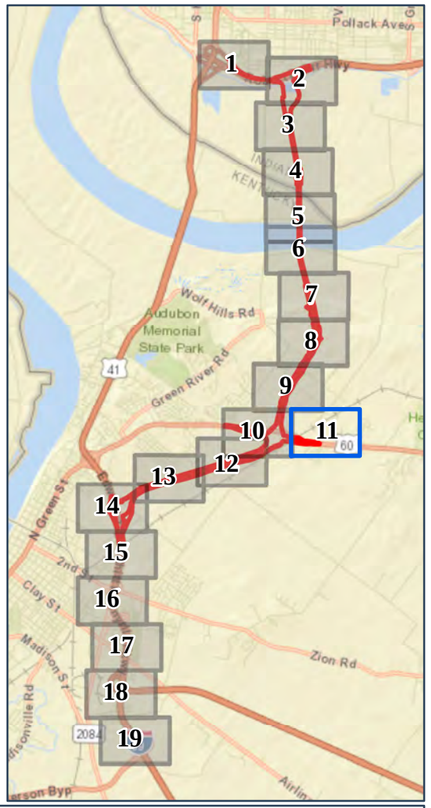
Central Alternative 1 (Preferred)

Figure 3 – Sheet 11 of 19

OHIO RIVER CROSSING

0 400 800 Feet

1 Inch = 400 Feet

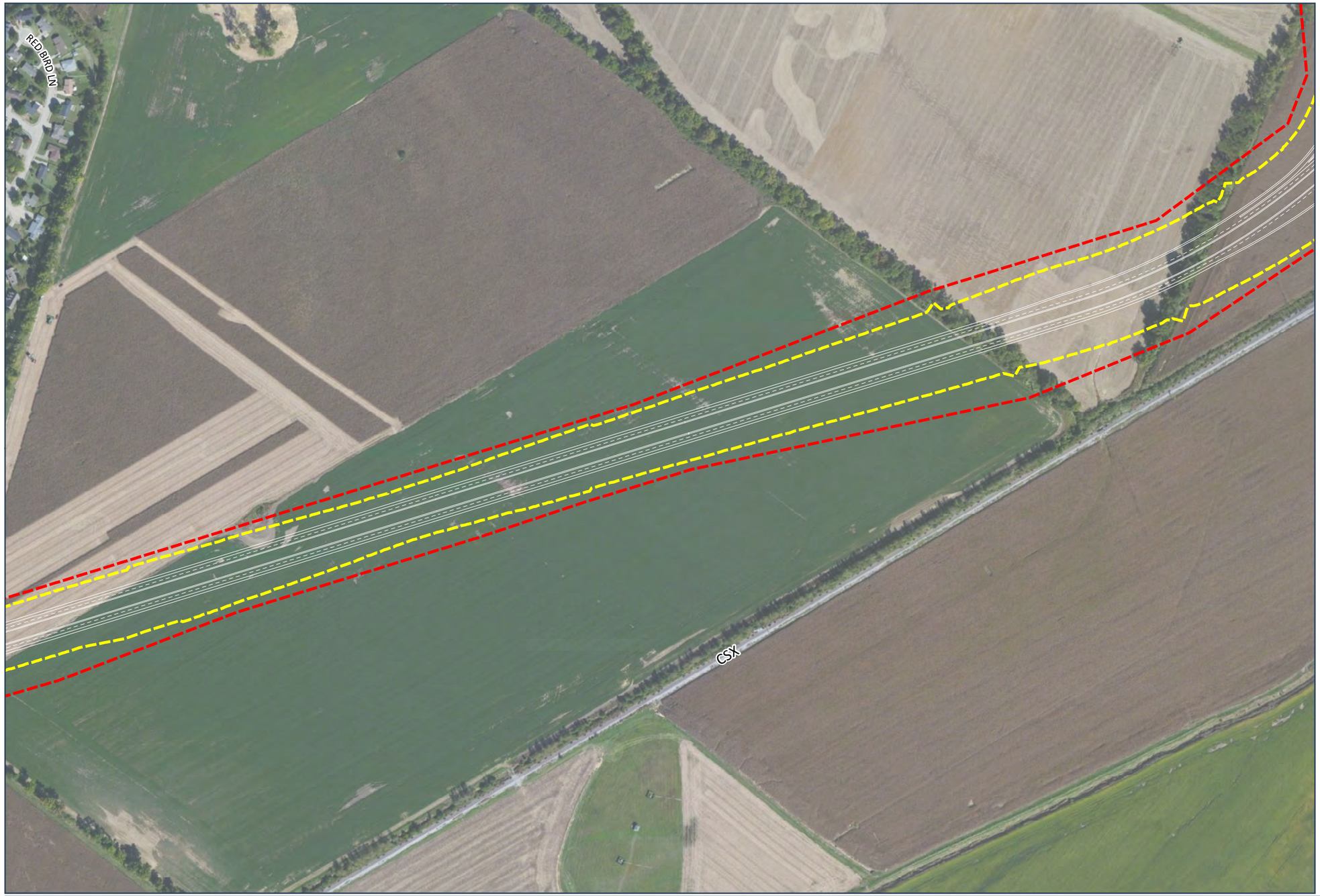


- Construction Limits
- Preliminary Right-of-Way
- Bridge Deck
- Removed Roads

Central Alternative 1 (Preferred)

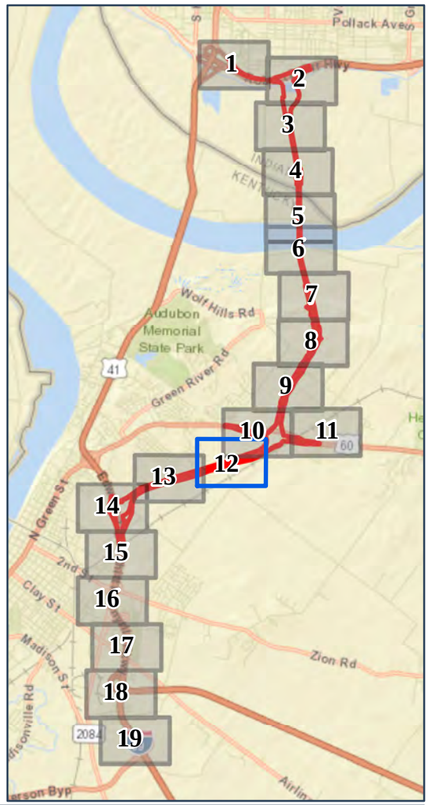
Figure 3 – Sheet 12 of 19

OHIO RIVER CROSSING



0 400 800 Feet

1 Inch = 400 Feet

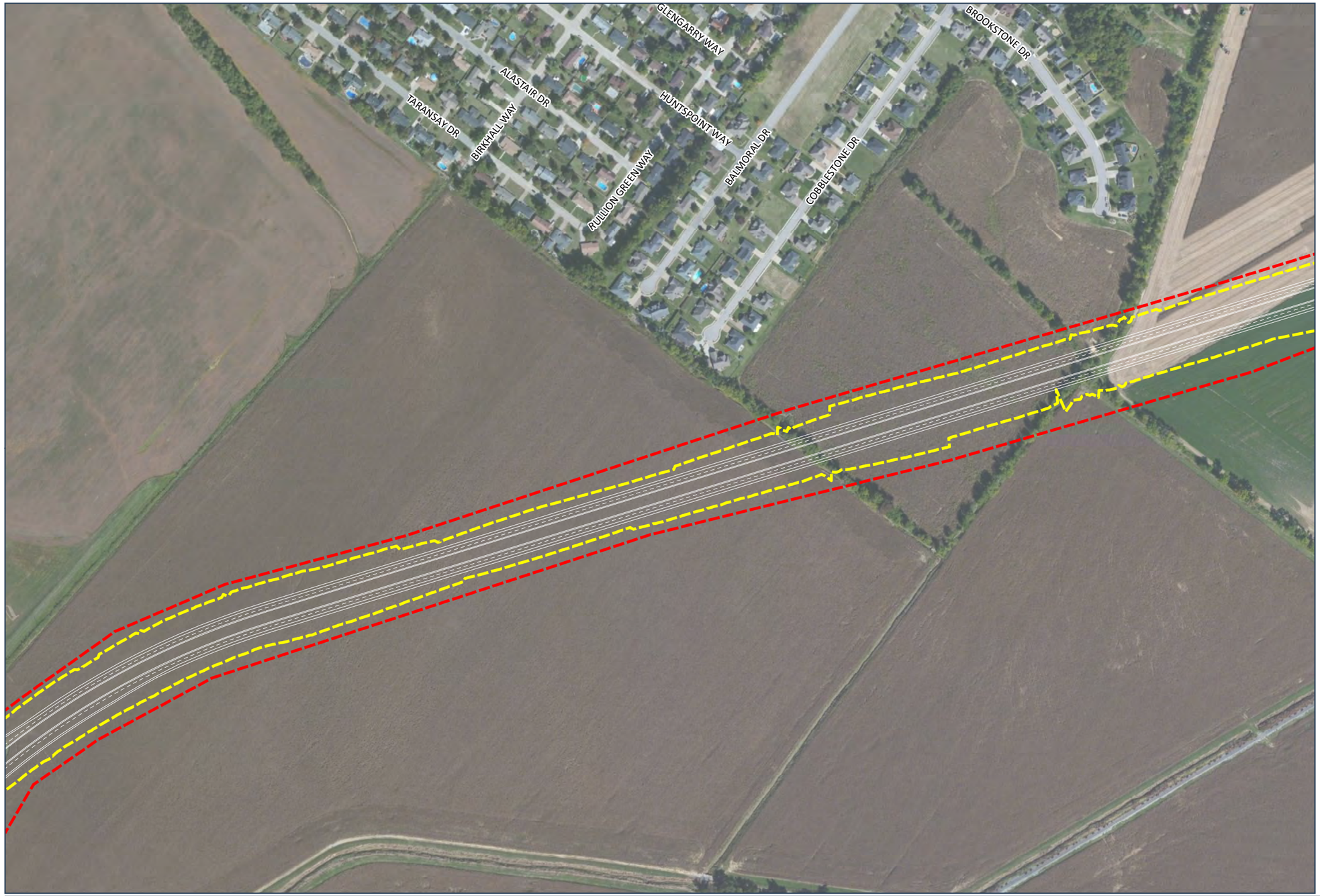


- Construction Limits
- Preliminary Right-of-Way
- Bridge Deck
- Removed Roads

Central Alternative 1 (Preferred)

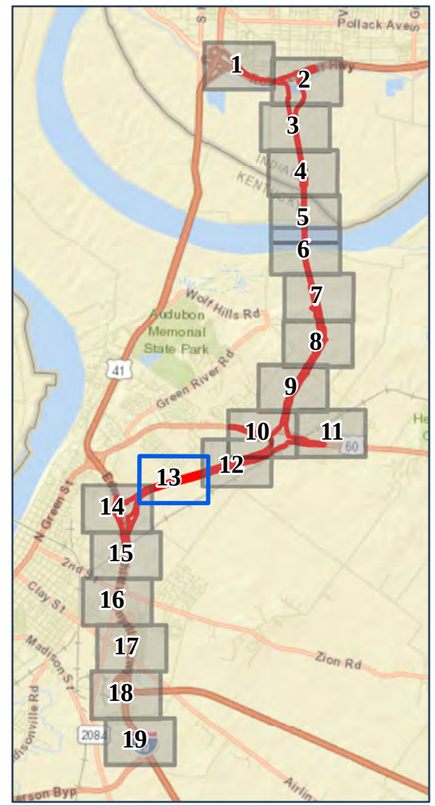
Figure 3 – Sheet 13 of 19

OHIO RIVER CROSSING



0 400 800 Feet

1 Inch = 400 Feet

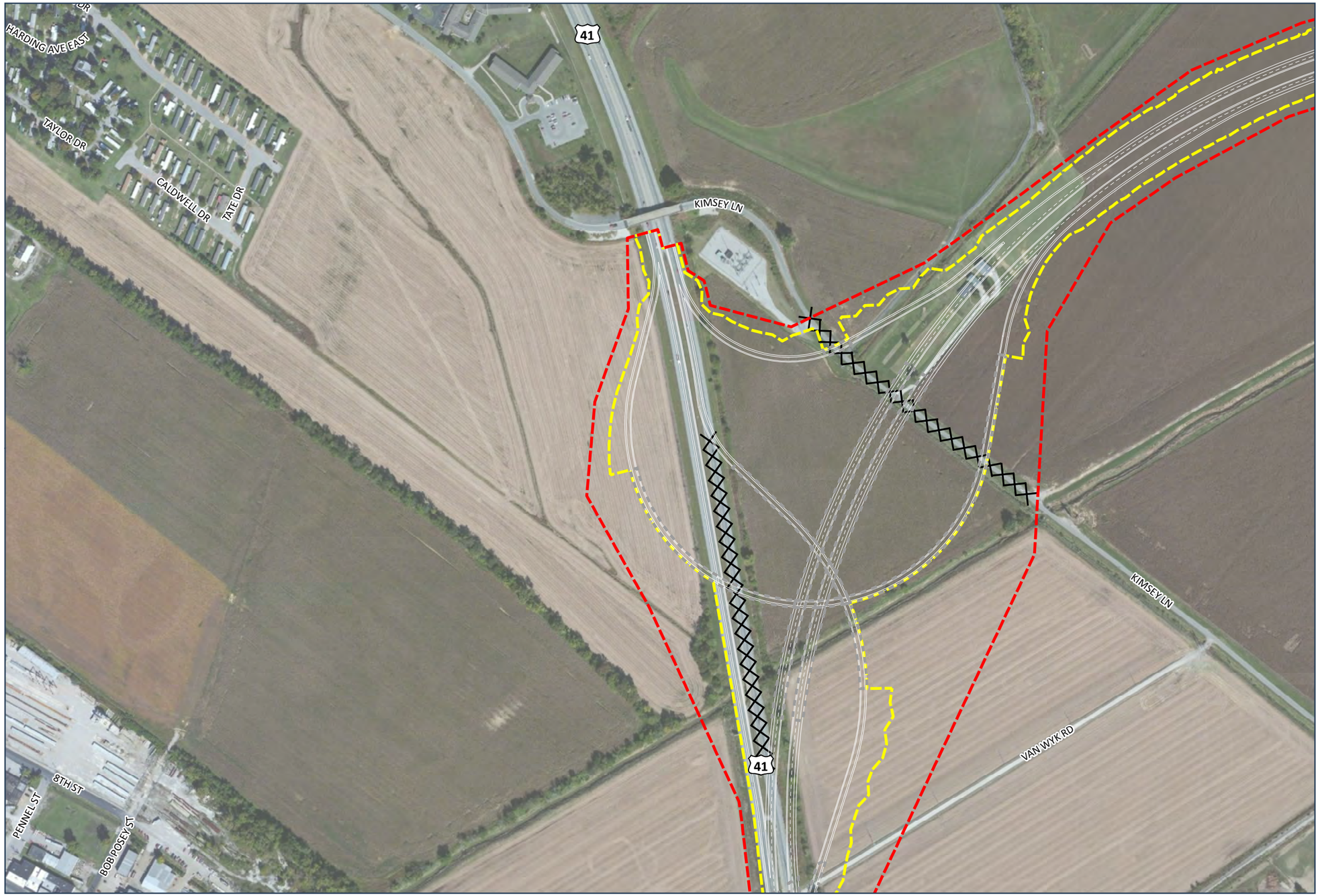


- Construction Limits
- Preliminary Right-of-Way
- Bridge Deck
- Removed Roads

Central Alternative 1 (Preferred)

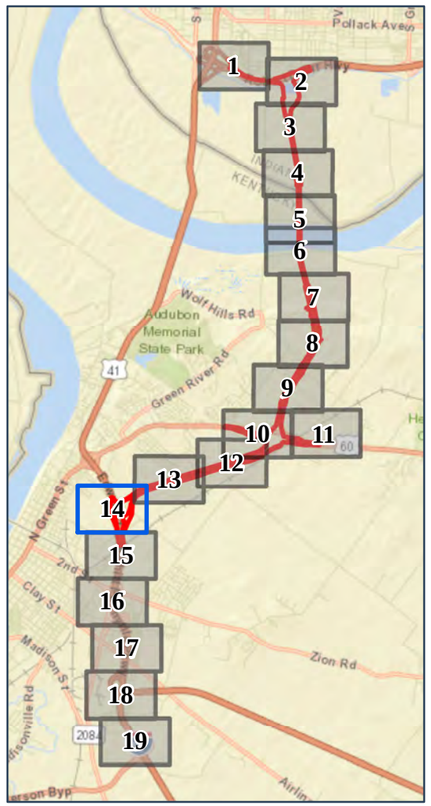
Figure 3 – Sheet 14 of 19

ORX 69 OHIO RIVER CROSSING



0 400 800 Feet

1 Inch = 400 Feet

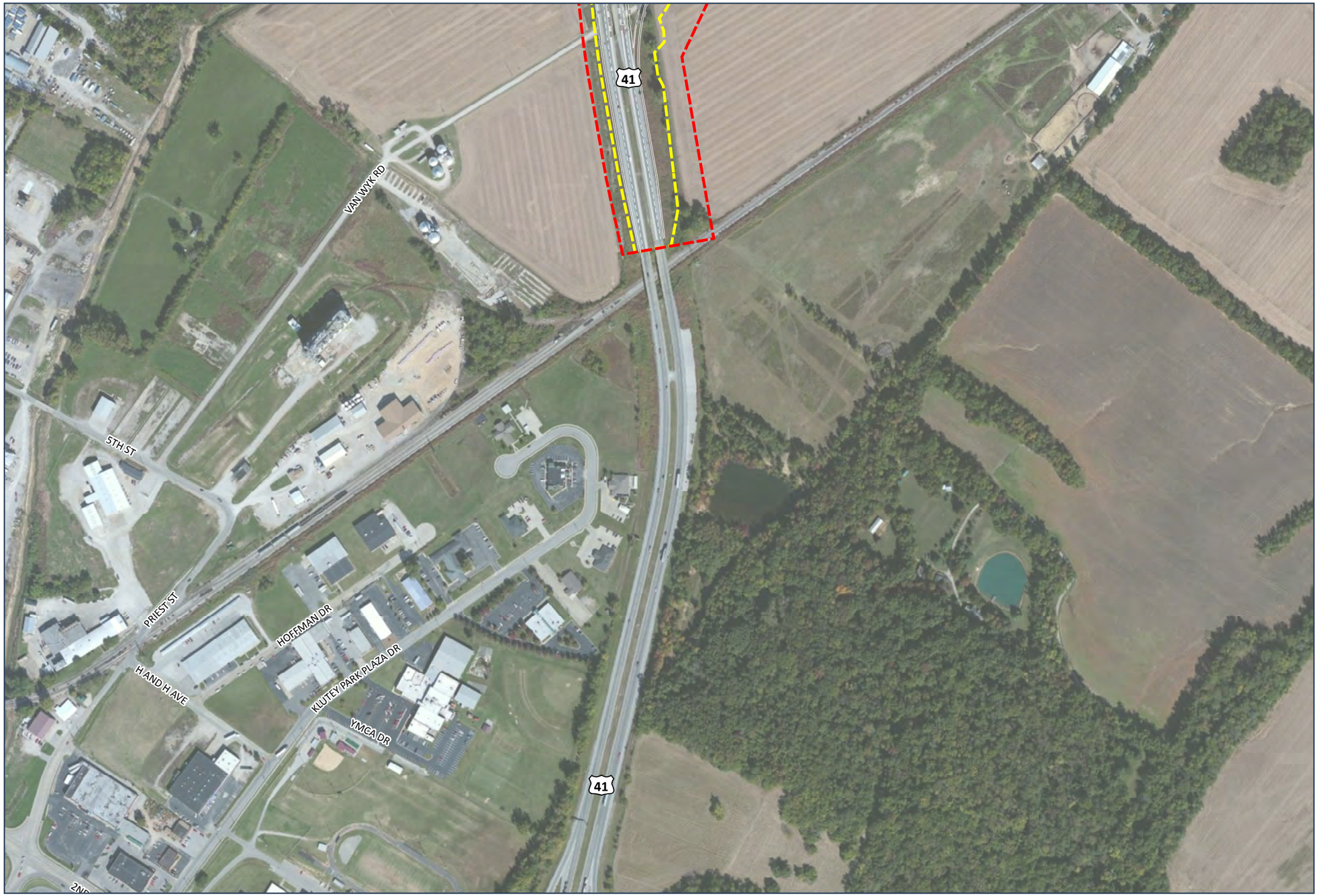


- Construction Limits
- Preliminary Right-of-Way
- Bridge Deck
- Removed Roads

Central Alternative 1 (Preferred)

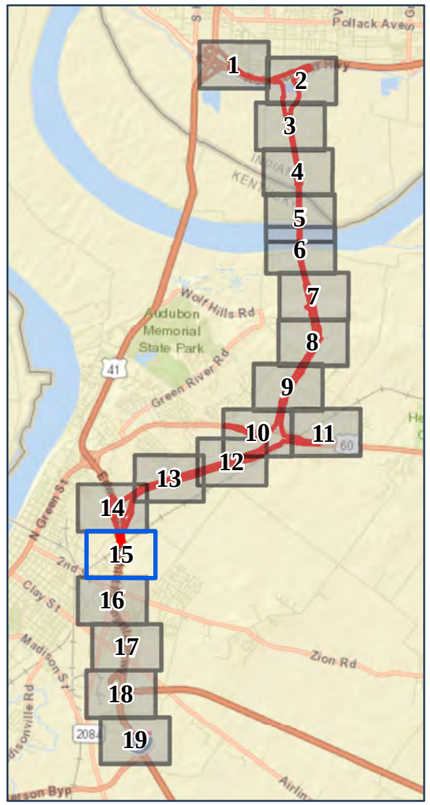
Figure 3 – Sheet 15 of 19

OHIO RIVER CROSSING



0 400 800 Feet

1 Inch = 400 Feet

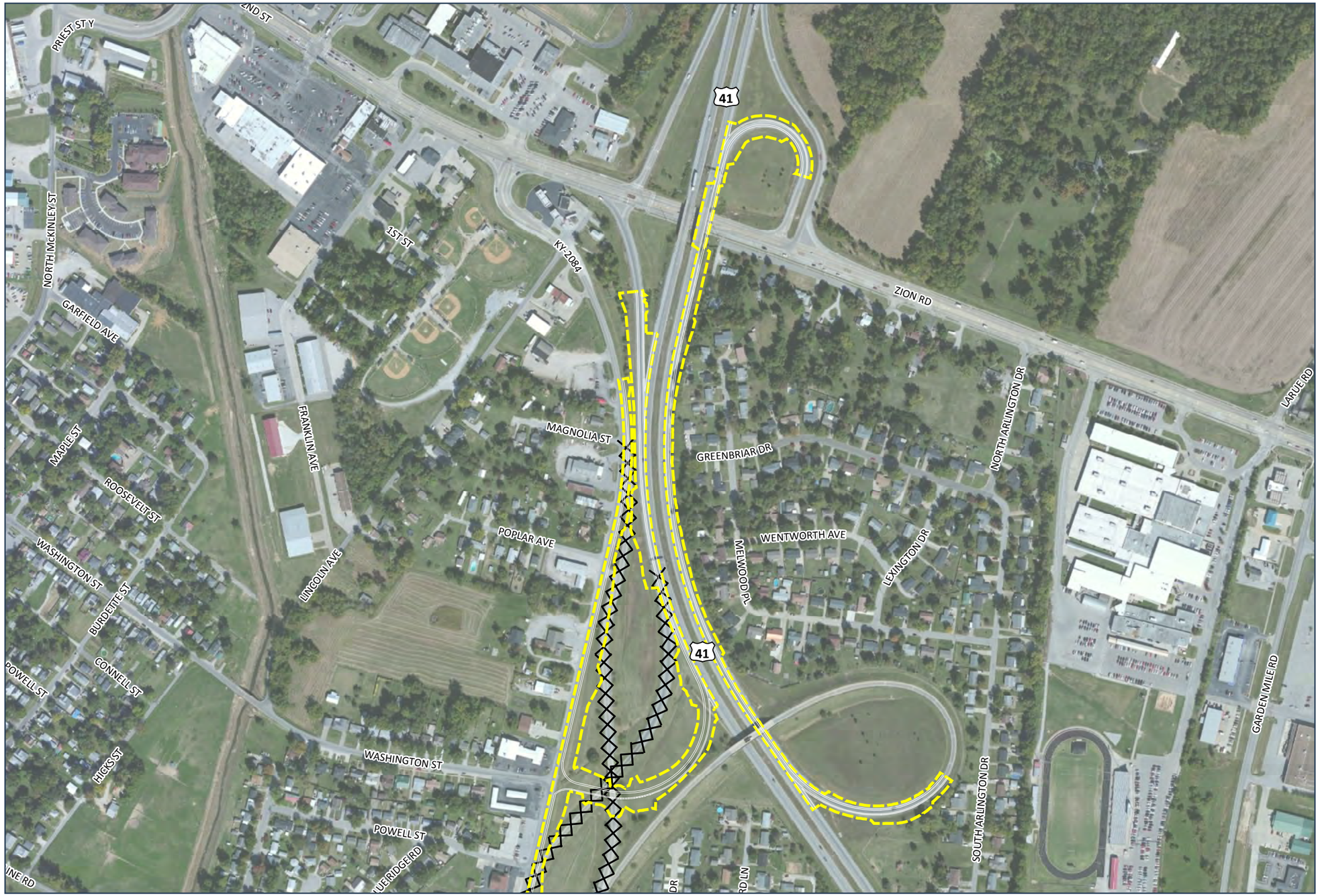


- Construction Limits
- Preliminary Right-of-Way
- Bridge Deck
- Removed Roads

Central Alternative 1 (Preferred)

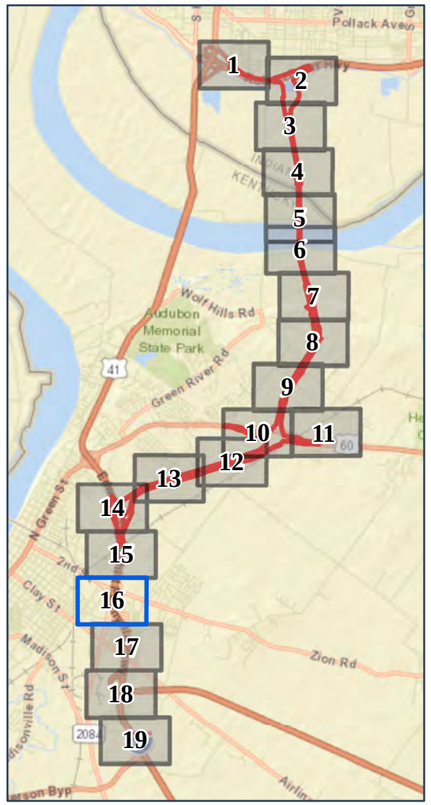
Figure 3 – Sheet 16 of 19

ORX 69 OHIO RIVER CROSSING



0 400 800 Feet

1 Inch = 400 Feet



- Construction Limits
- Preliminary Right-of-Way
- Bridge Deck
- Removed Roads

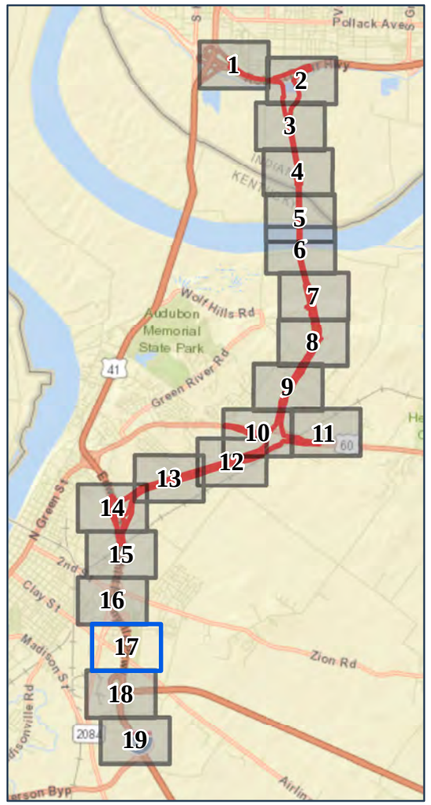
Central Alternative 1 (Preferred)

Figure 3 – Sheet 17 of 19

ORX 69 OHIO RIVER CROSSING

0 400 800 Feet

1 Inch = 400 Feet



- Construction Limits
- Preliminary Right-of-Way
- Bridge Deck
- Removed Roads

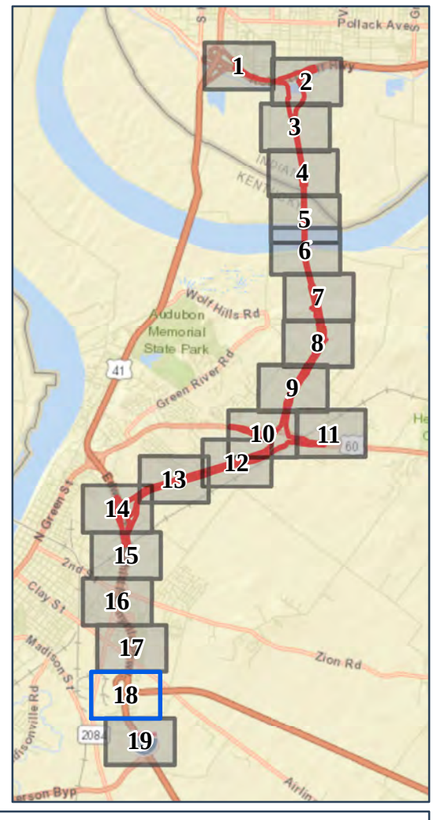
Central Alternative 1 (Preferred)

Figure 3 – Sheet 18 of 19

ORX 69 OHIO RIVER CROSSING

0 400 800 Feet

1 Inch = 400 Feet

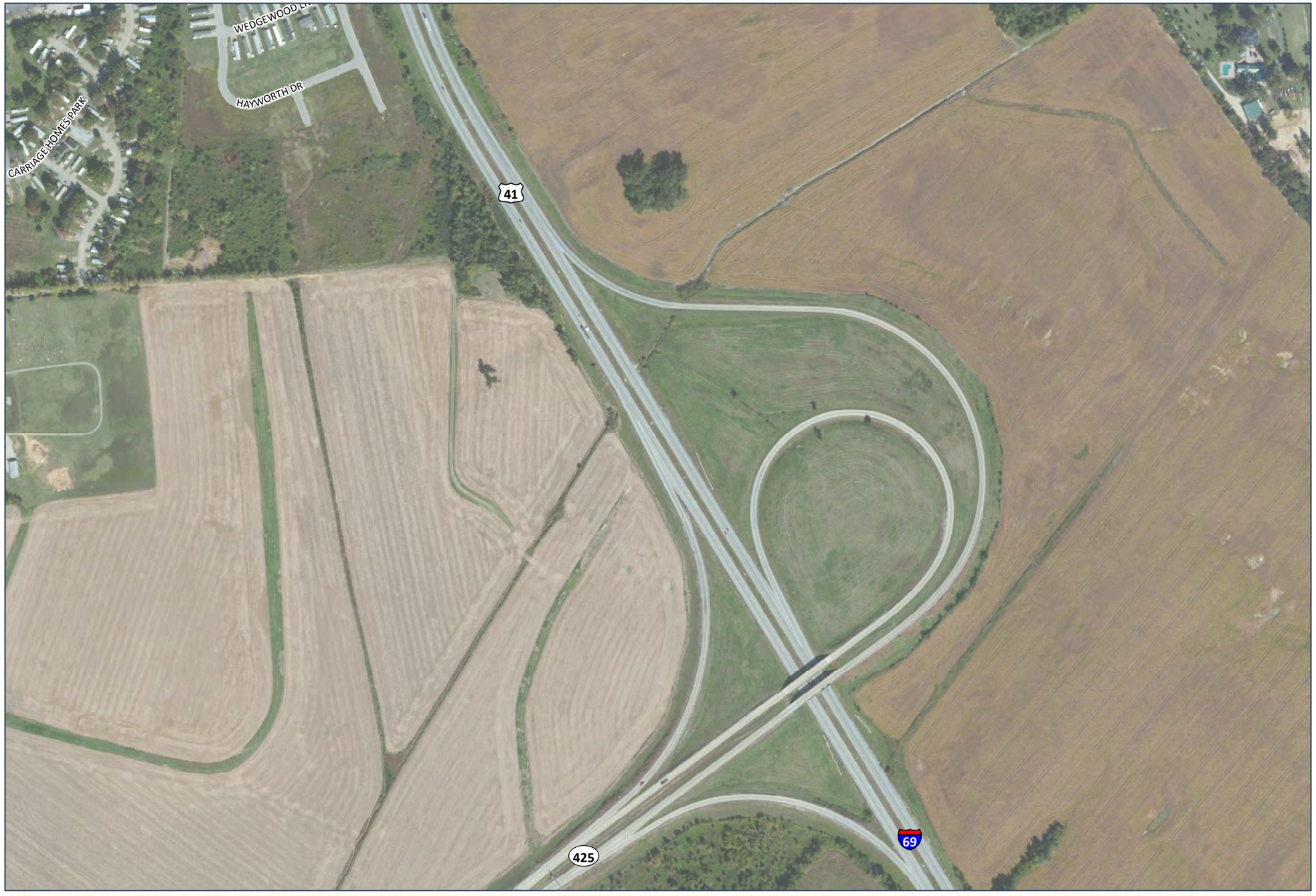


- Construction Limits
- Preliminary Right-of-Way
- Bridge Deck
- Removed Roads

Central Alternative 1 (Preferred)

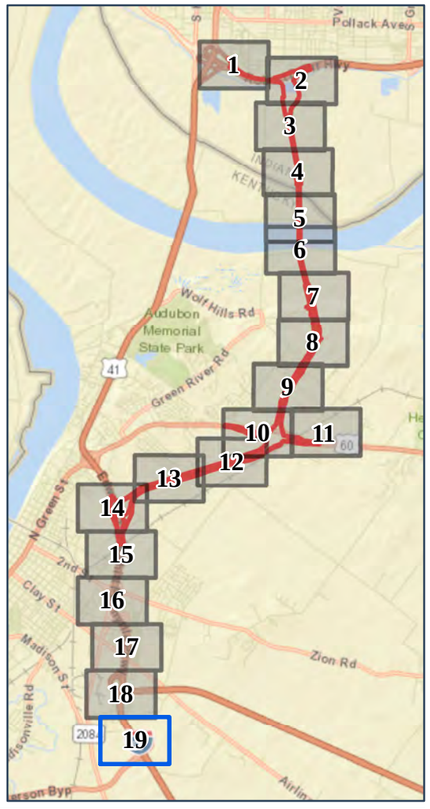
Figure 3 – Sheet 19 of 19

ORX 69 OHIO RIVER CROSSING



0 400 800 Feet

1 Inch = 400 Feet



- Construction Limits
- Preliminary Right-of-Way
- Bridge Deck
- Removed Roads

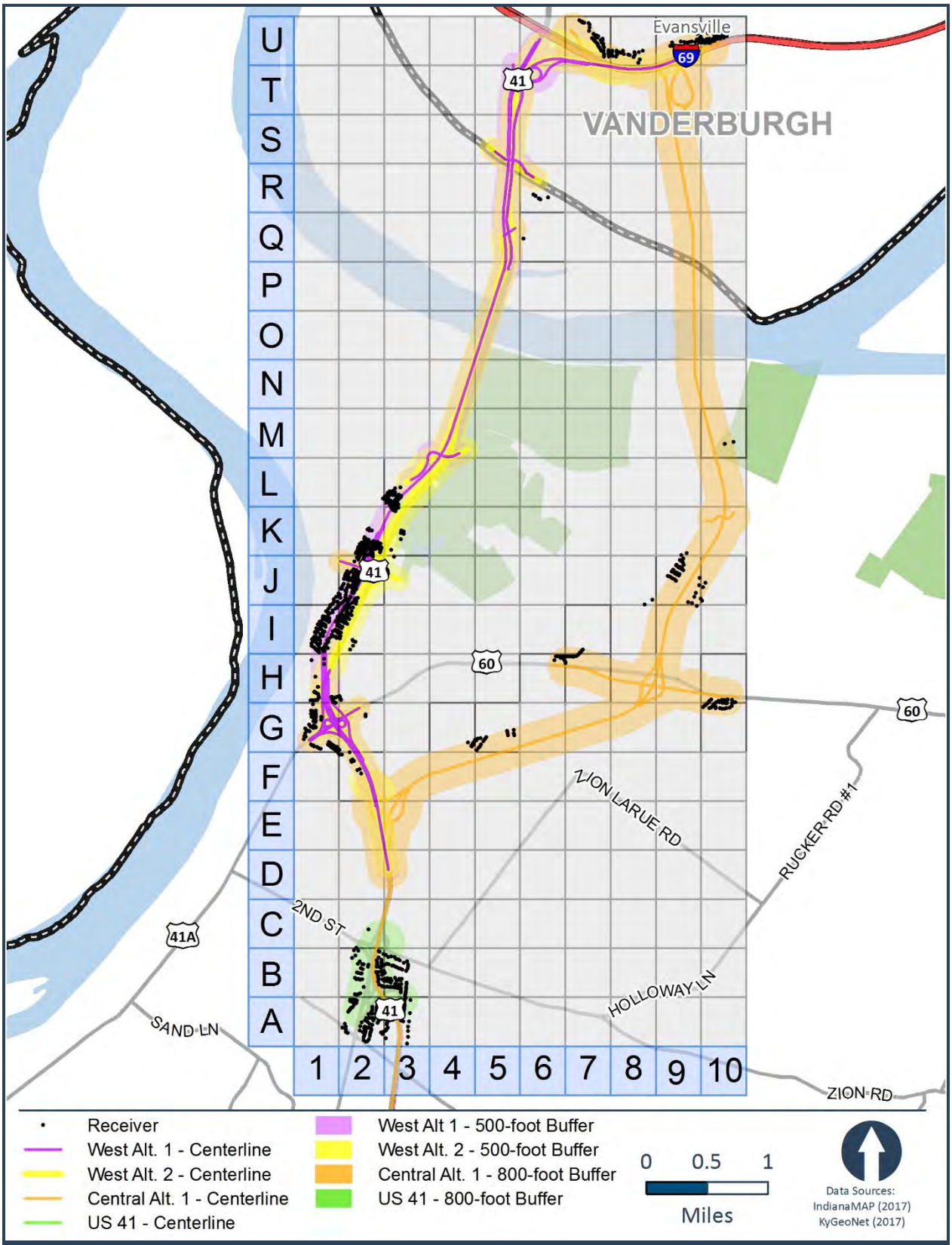


Figure 4. Index Map

Figure 5. Map A2

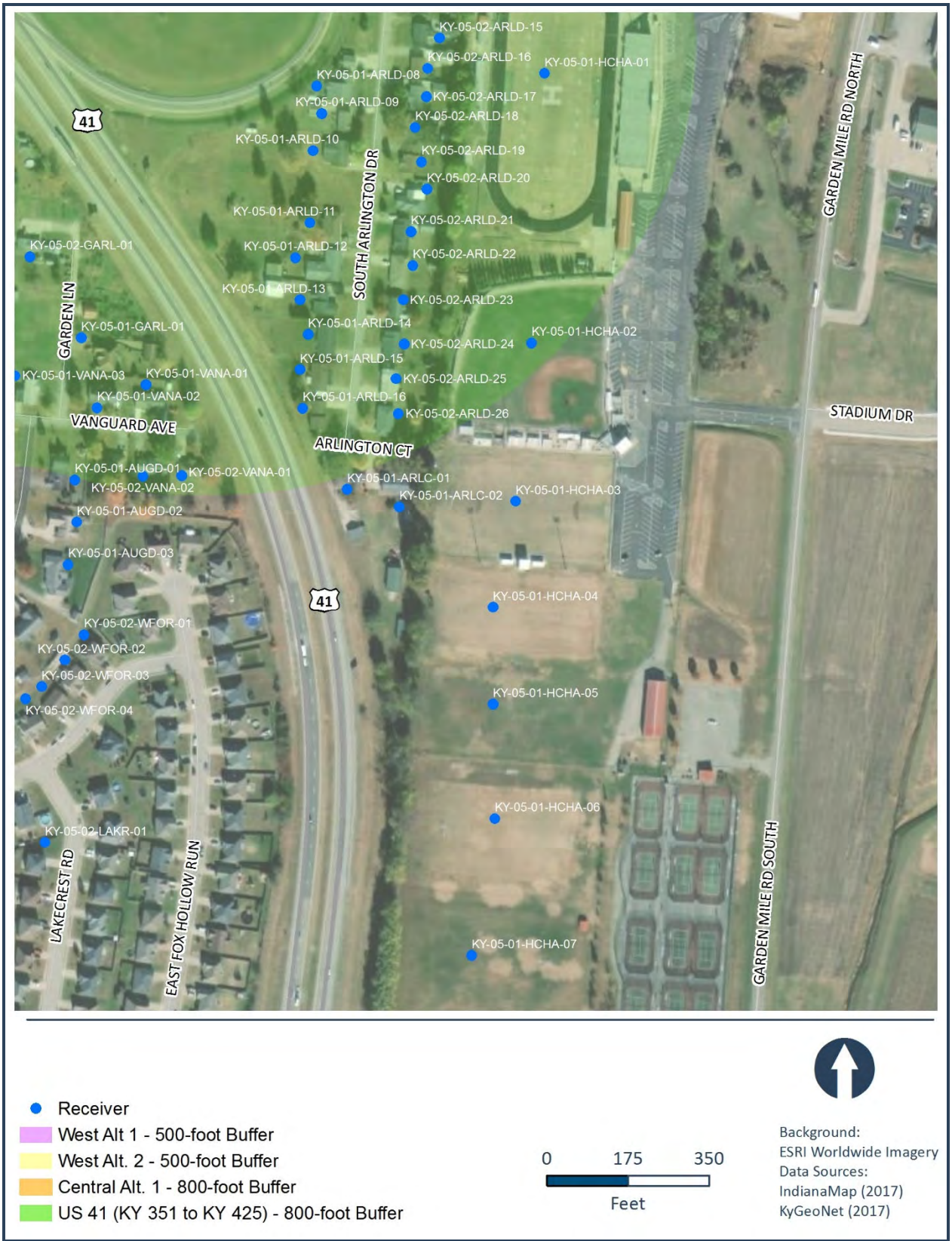


Figure 6. Map A3

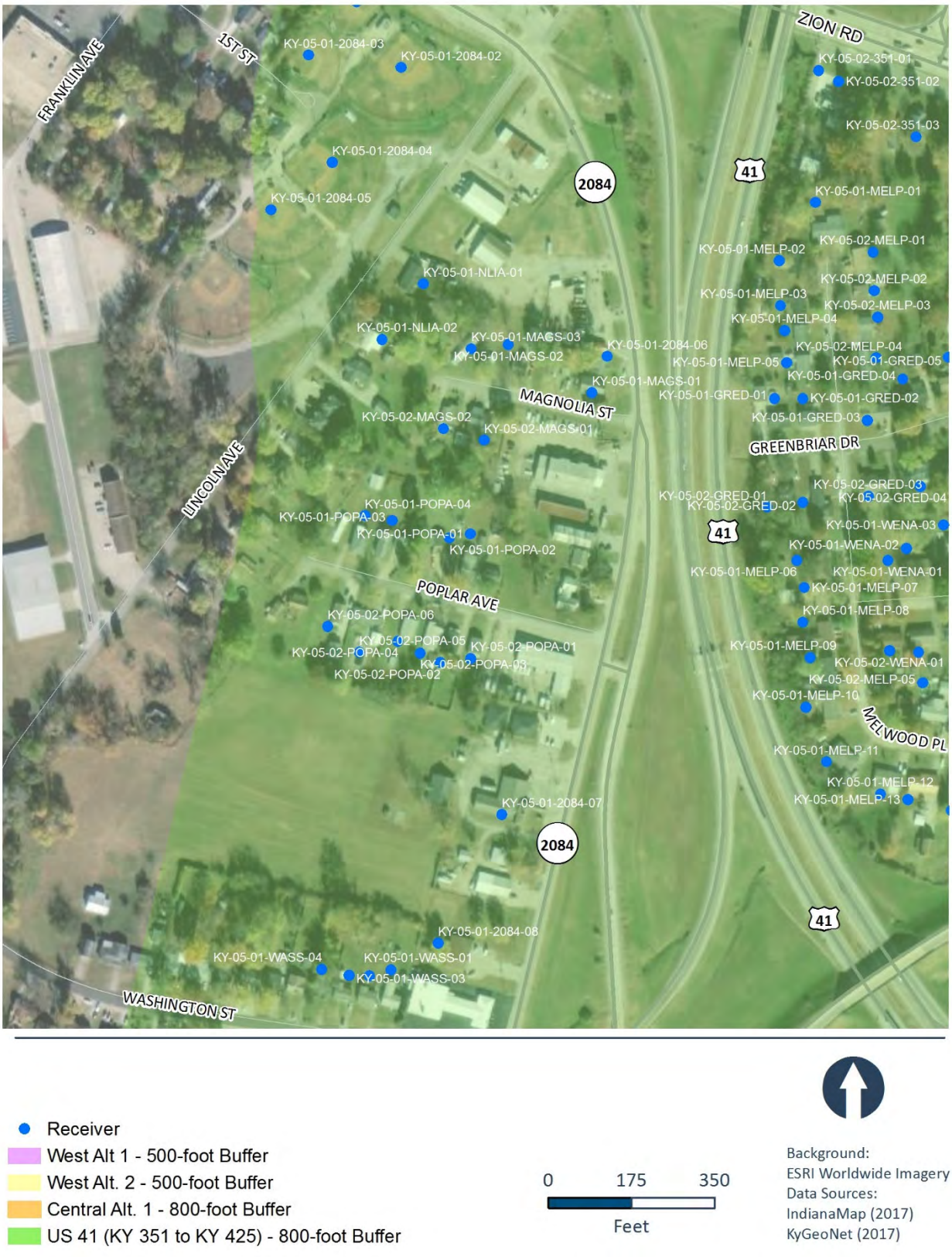


Figure 7. Map B2

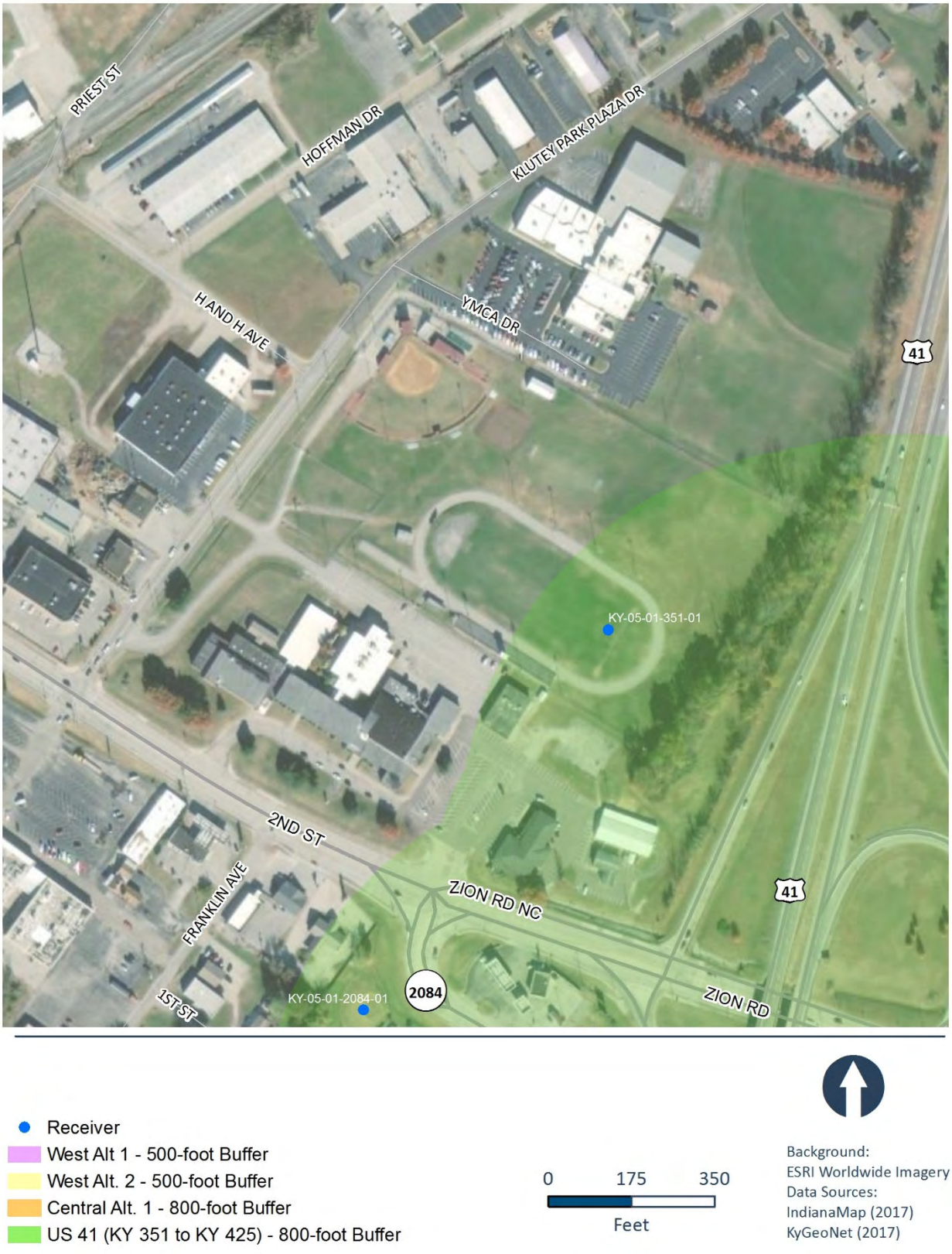


Figure 8. Map C2

Figure 9. Map F1

Figure 10. Map F2

Figure 11. Map G1

Figure 12. Map G2

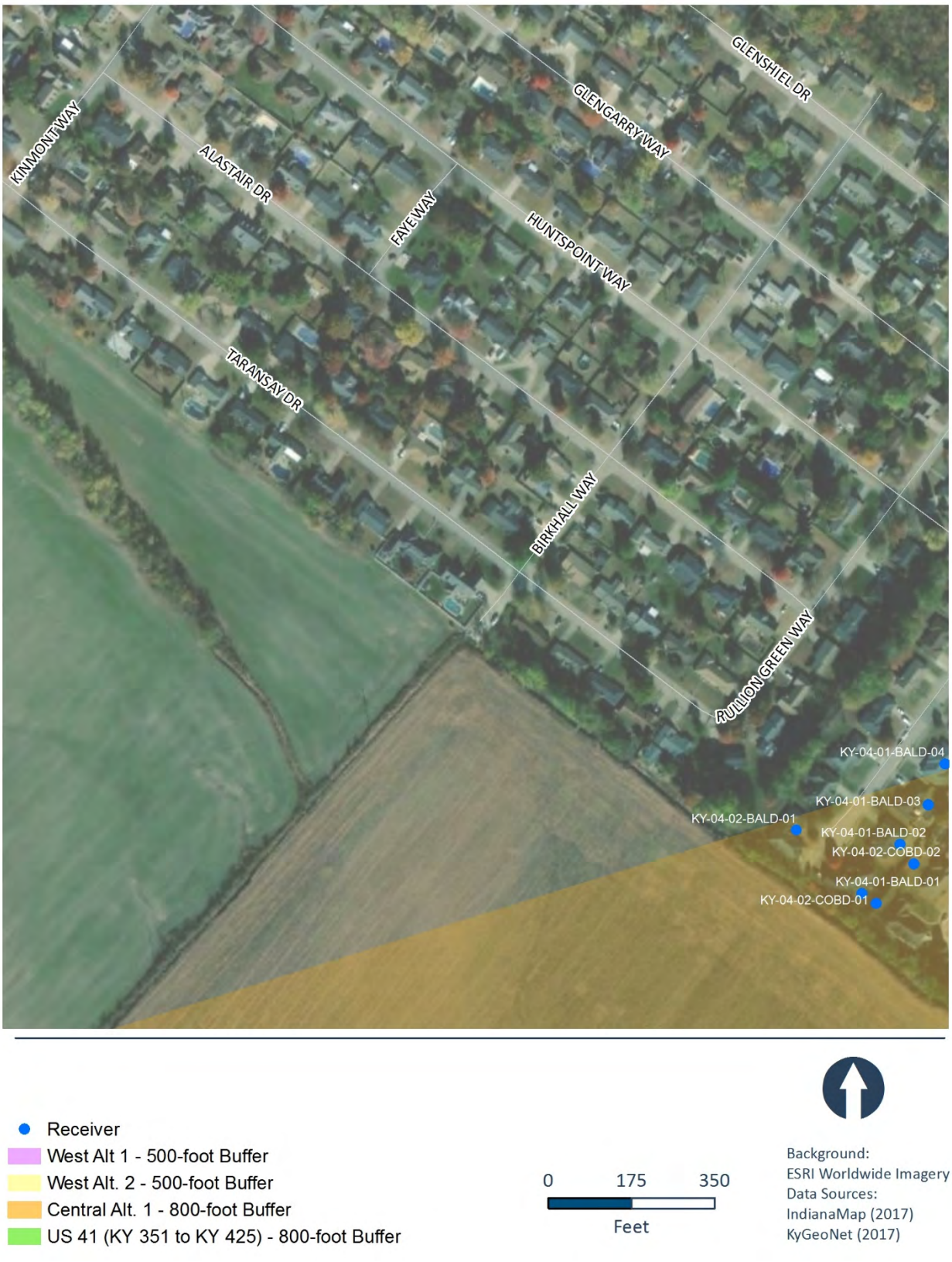


Figure 13. Map G4

Figure 14. Map G5

Figure 15. Map G10

Figure 16. Map H1

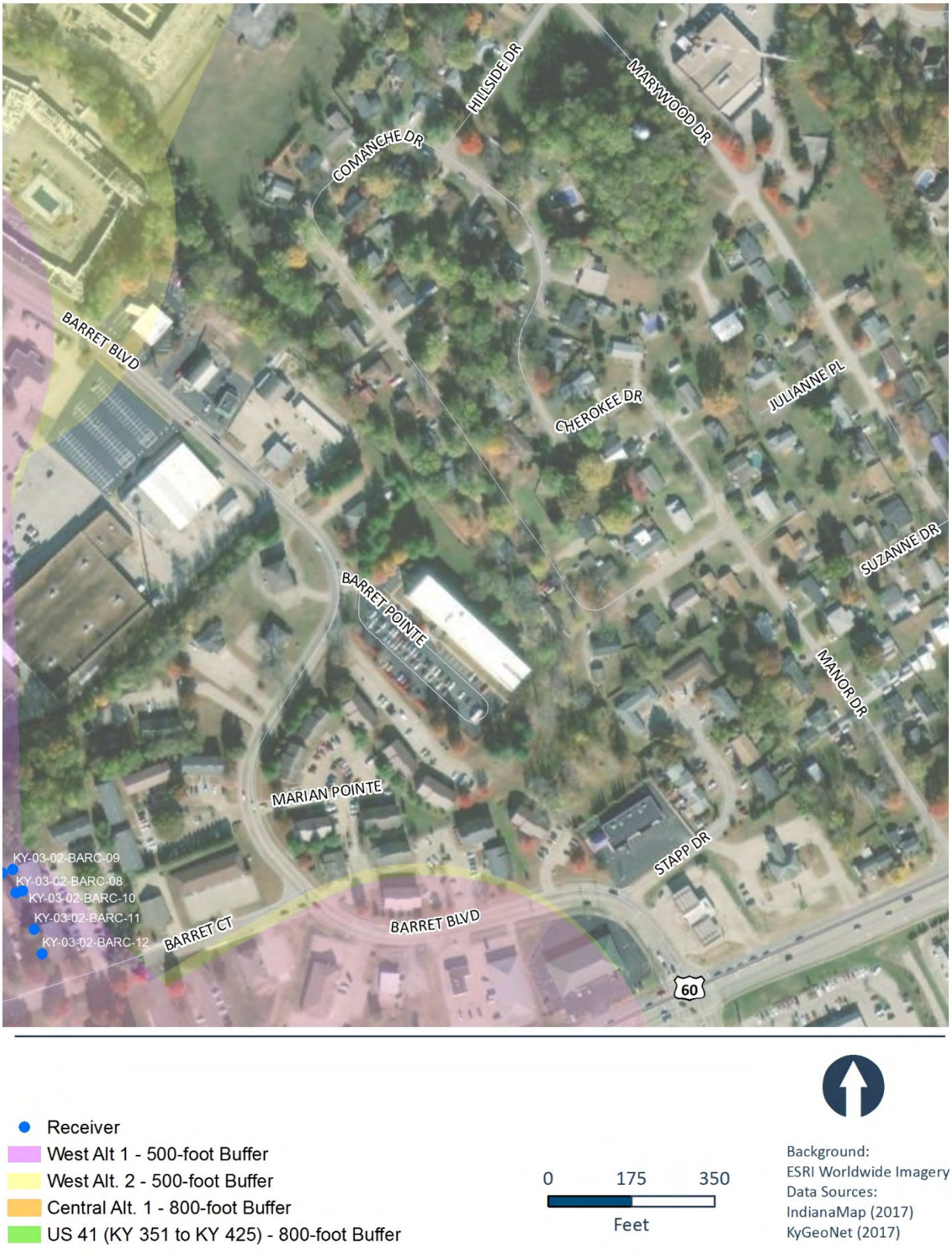


Figure 17. Map H2

Figure 18. Map H6

Figure 19. Map H7

Figure 20. Map H10

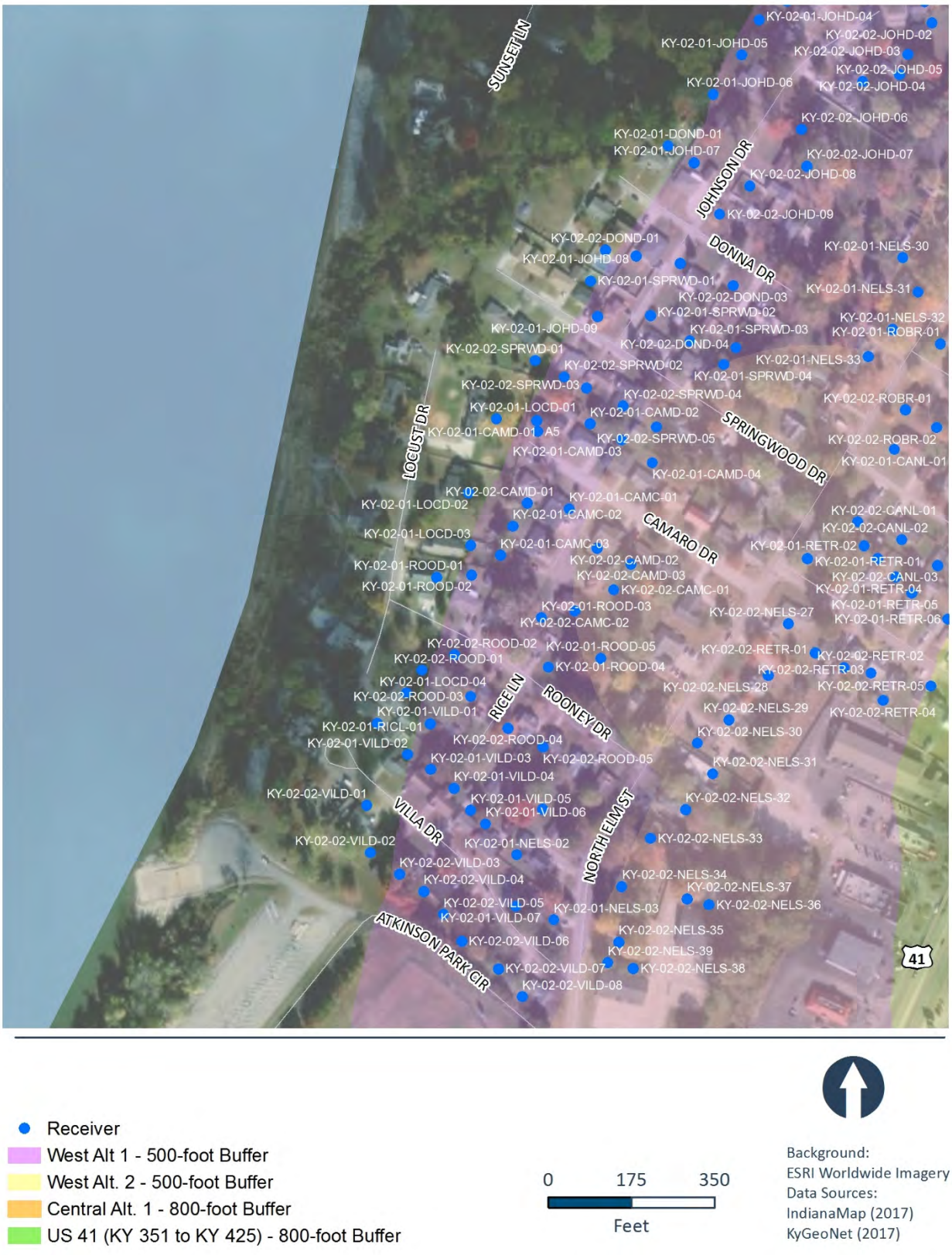


Figure 21. Map I1

Figure 22. Map I2

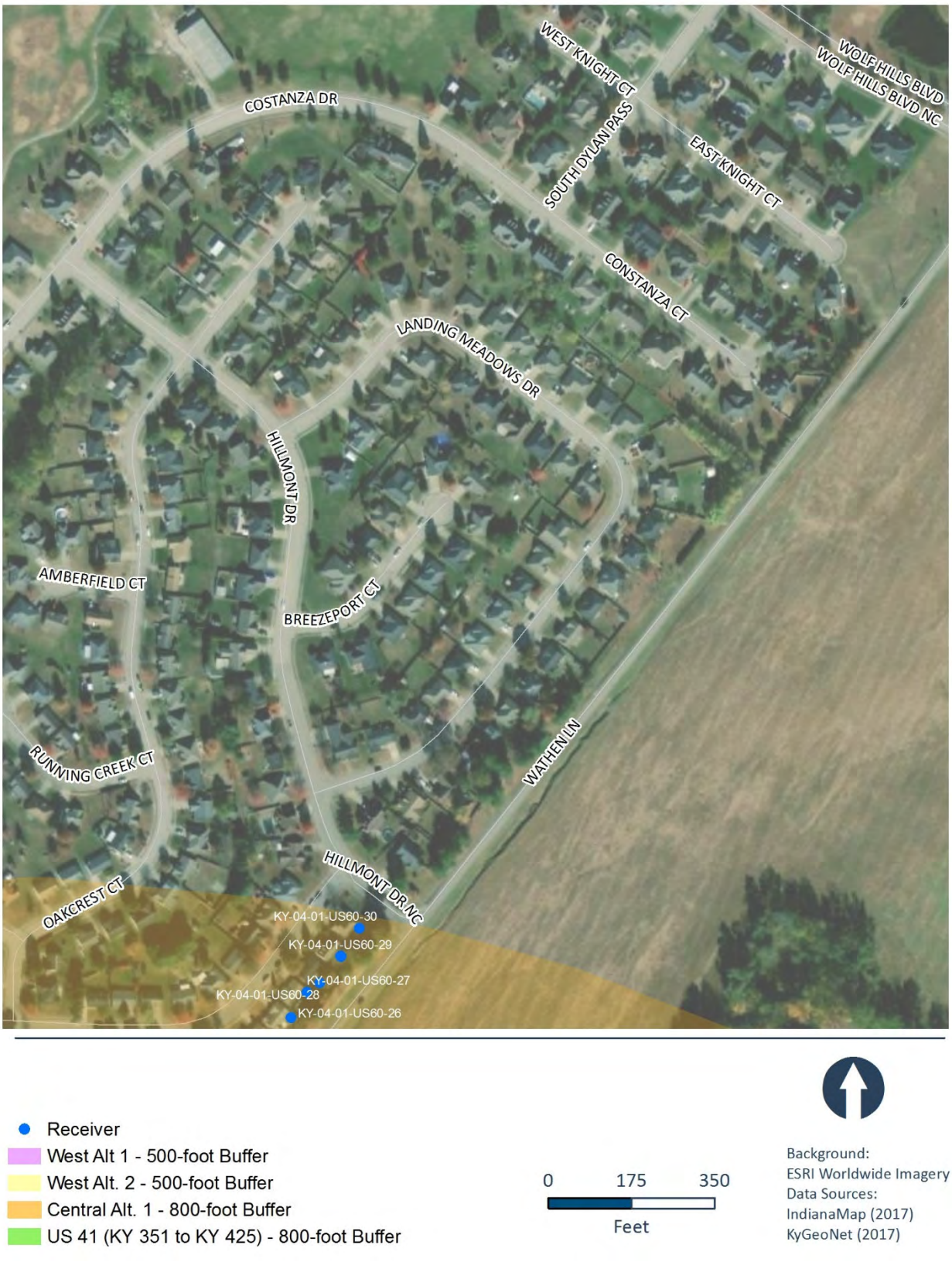


Figure 23. Map I7

Figure 24. Map I9

Figure 25. Map J1

Figure 26. Map J2

Figure 27. Map J3

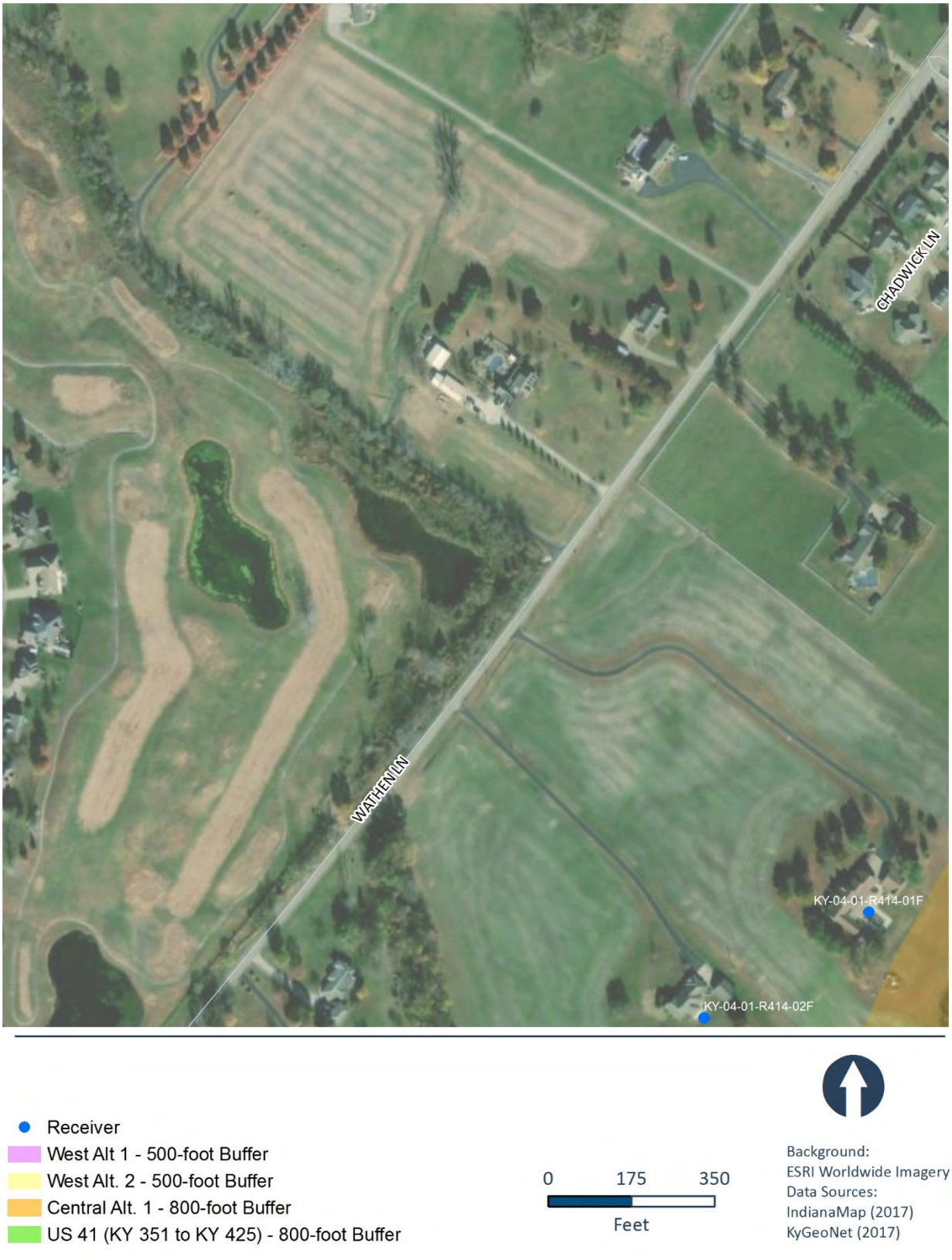


Figure 28. Map J8

Figure 29. Map J9

Figure 30. Map J10

Figure 31. Map K2

Figure 32. Map K3

Figure 33. Map L3

Figure 34. Map M10

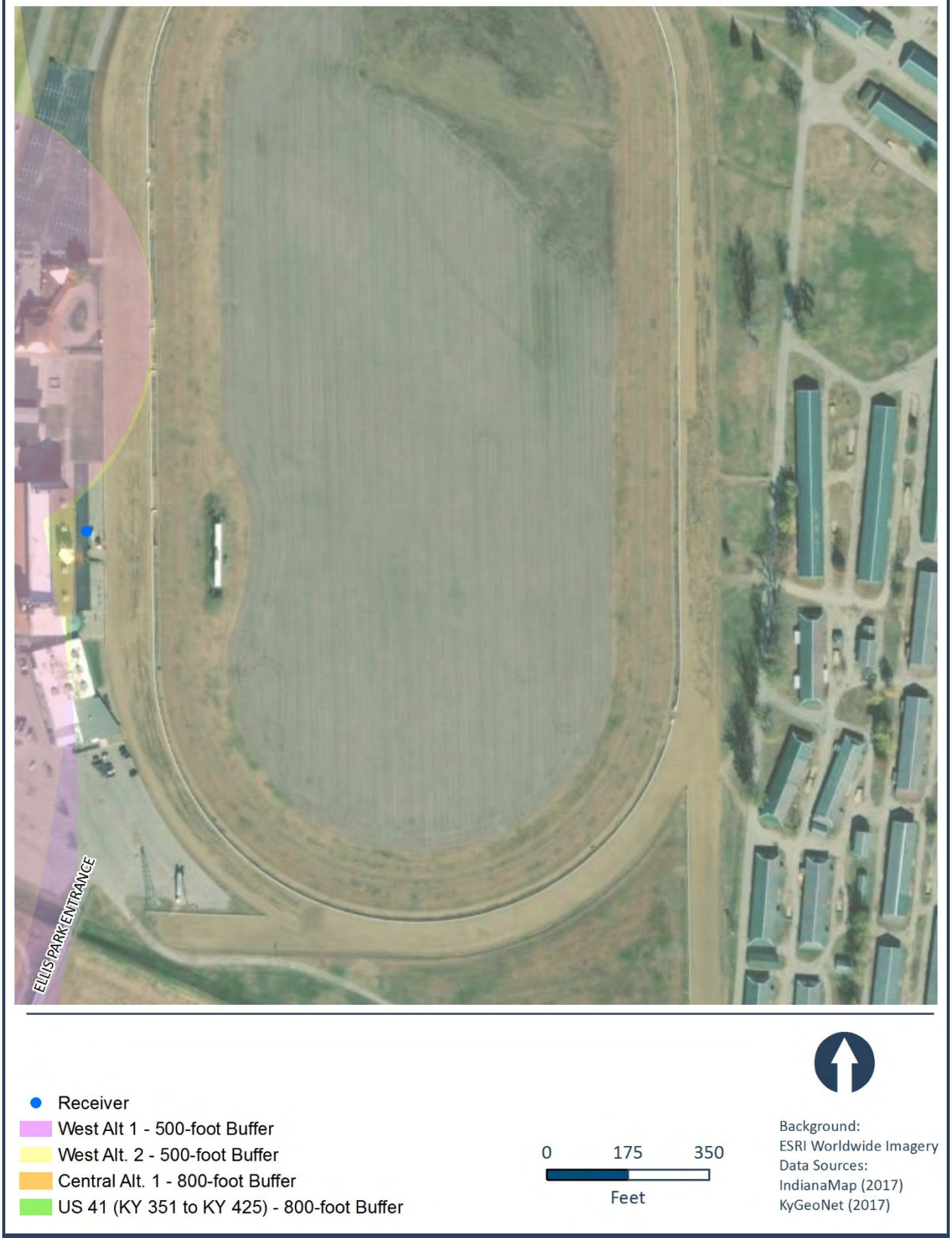


Figure 35. Map Q6

Figure 36. Map R6

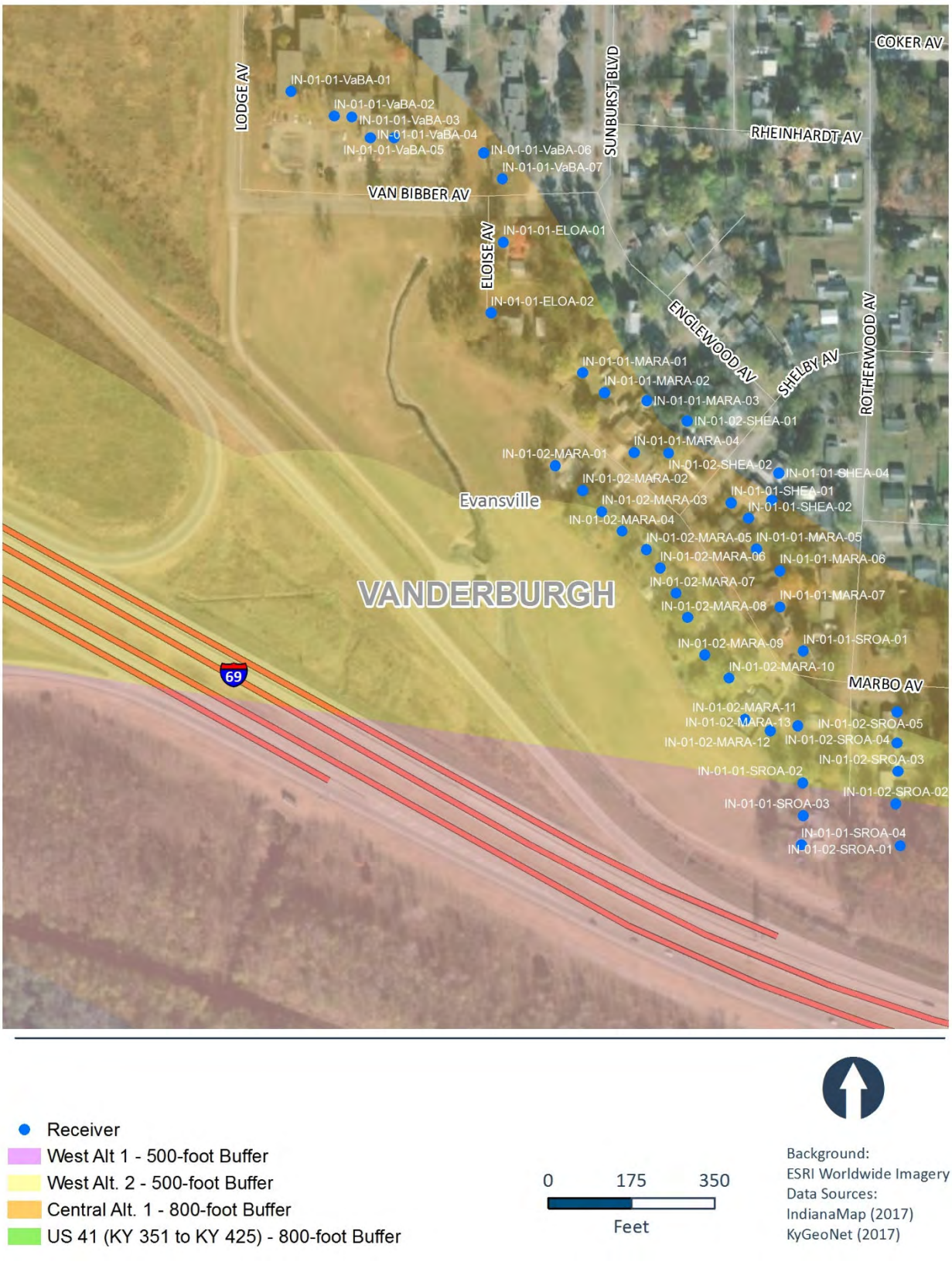


Figure 37. Map U7

Figure 38. Map U8

Figure 39. Map U9

Figure 40. Map U10