



KENTUCKY TRANSPORTATION CABINET

STATEWIDE PLANNING KY 36 CORRIDOR STUDY ITEM NO. 9-80101

Final Report • August 2022



(This page intentionally left blank)

Executive Summary

The Kentucky Transportation Cabinet (KYTC) in collaboration with Bath County, Kentucky elected officials and stakeholders, identified the KY 36 corridor east of I-64 as a priority corridor for assessing safety and mobility needs and evaluating potential improvements. WSP USA Inc. (WSP) was contracted by KYTC to perform a planning study to identify potential improvement concepts along the KY 36 corridor. The study area, shown in **Figure ES-1**, extends from I-64 to KY 965 (Hart Pike), mile point (MP) 13.394 to MP 17.104. The study includes both short- and long-term improvement strategies that KYTC may use for further project development and implementation. The objective of the KY 36 Corridor Study is to develop and evaluate conceptual improvements to improve safety and connectivity from I-64 to KY 965 (Hart Pike) in Bath County.

The project team identified goals for the study based on the transportation challenges in the area. The goals of the study are to:

- ▶ Identify and evaluate the existing conditions, challenges, and opportunities with regard to safety, traffic operations, and roadway geometrics.
- ▶ Develop a list of conceptual improvements to address the identified challenges and opportunities.
- ▶ Evaluate the expected performance of the proposed conceptual improvements considering safety, traffic operations, environment, right-of-way, and cost.
- ▶ Engage local elected officials (LEOs), stakeholders, and the general public to identify areas of concern and potential improvements.
- ▶ Develop and document a list of recommended short- and long-term improvements based on the technical evaluation and feedback from the project team, LEOs, stakeholders, and the public.

Committed Projects

There are five projects included in Kentucky's 2022–2028 Enacted Highway Plan (Six Year Plan), and ten projects in the vicinity of the study area in the KYTC Continuous Highway Analysis Framework (CHAF) database:

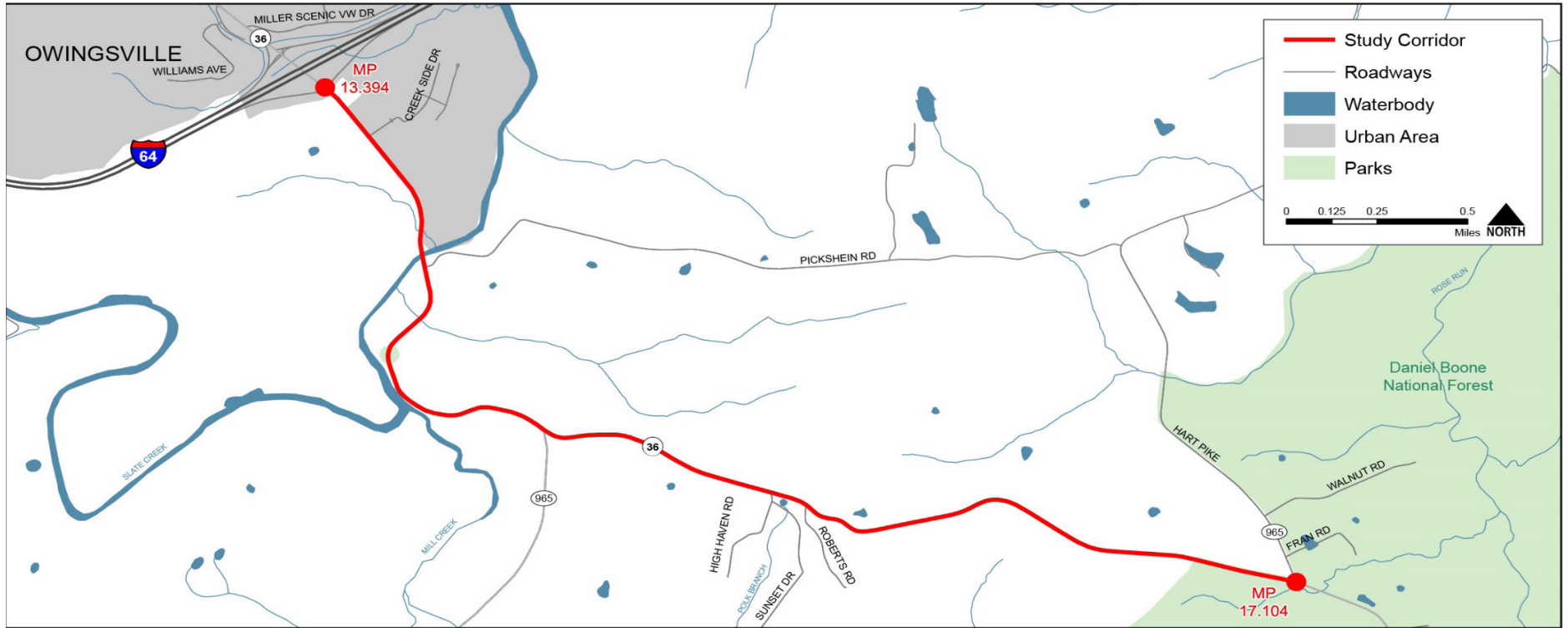
Kentucky's Six Year Plan Projects

- ▶ Item Number 09-80101.00: Improve safety on KY 36 from the intersection with I-64 to the intersection of KY 965 including the curves known as Clear Creek Furnace and Thomas Hill (SPP) R: 2023 \$2,250,000; U: 2026 \$1,840,000; C: 2027 \$23,520,000 (this project)
- ▶ Item Number 09-80102.00: Improve safety and operational efficiency on KY 36 from north of Mariella Drive to the intersection of Old KY 36 (SPP) R: 2025 \$425,000; U: 2024 \$1,320,000; C: 2026 \$4,000,000
- ▶ Item Number 09-3204: Bike and Ped Facility: TAP funds: 2019: Upgrade 320 feet of sidewalk on KY 36 (MP 11.995 - MP 12.055) to ADA compliance in Owingsville (2016BOP).
- ▶ Item Number 09-8811.00: Reconstruct KY 36/928 Intersection MP 8.0 to MP 8.23
- ▶ Item Number 09-8404.00: Reconstruct (spot improvement) along KY 965 0.8-mile south of KY 36.

CHAFs

- ▶ IP20000070: KY 36 MP 11.283 to MP 11.847 Reconstruction
- ▶ IP20000071: KY 36 MP 17.600 to MP 18.719 Reconstruction
- ▶ IP20080509: KY 36 MP 10.300 to MP 11.250 Spot Improvement
- ▶ IP20080510: KY 36 MP 6.970 to MP 11.847 Reconstruction
- ▶ IP20150068: KY 36 MP 13.394 to MP 17.104 Reconstruction (this project)
- ▶ IP20150162: KY 965 MP 6.6 to MP 8; KY 965 MP 8-8; KY 36 MP 14.88 to MP 17.1 New construction from Kendall Springs Road to Bath County High School in Owingsville
- ▶ IP20150223: KY 965 MP 7.147 to MP 7.247 Reconstruction
- ▶ IP20170051: KY 36 MP 12.300 to MP 12.993 Safety Hazard Elimination
- ▶ IP20190176: KY 36 MP 18.600 to MP 18.900 Spot Improvement
- ▶ IP20200013: KY 36 MP 0.891 to MP 11.845 Safety Hazard Elimination

Figure ES1: KY 36 Study



Existing Conditions

A detailed inventory of the existing physical and geometric design characteristics along KY 36 was completed. KY 36 is classified as a rural major collector throughout the study area. The speed limit along KY 36 is 55 miles per hour (mph) for most of the study area but drops to 45 mph near and through the I-64 interchange. Lane widths are 10 feet and shoulder widths are one foot for most of the corridor.

KY 36 has 26 horizontal curves in the study area, 18 of which do not meet the design criteria for horizontal curves for the given design speed. Although the study area speed limit is primarily 55 mph, the design speed for the existing horizontal curves range from 30-55 mph and an advisory speed sign typically accompanies each curve with an advisory speed of less than 55 mph. Several segments where advisory speeds are posted have design speeds that exceed those advisory speeds. Superelevation transition overlaps can cause issues for vehicles driving at the design speed as the vehicle in motion has not had enough time to recover to the normal crown before the next curve begins. Eight superelevation transition overlaps exist in the KY 36 study area.

There are 47 total vertical curves (sags or crests) in the KY 36 study area, 22 of which do not meet the minimum stopping sight distance or headlight sight distance (495 feet for a design speed of 55 mph). Two passing zones exist in the study area that exceed the minimum passing distance of 900 feet at 55 mph. The maximum vertical grade for a rural highway is 7%. Three sections along the study area have a vertical grade greater than 7%.

The corridor contains only one structure at MP 13.95, passing over Slate Creek. It is a 226-foot, three span structure in fair condition with two ten-foot travel lanes and four-foot shoulders.

There is no known pedestrian activity along KY 36. Cyclist activity exists along a western section from Pickshein Road to KY 965 (Preston Road) but is nonexistent within the rest of the study area. The surrounding area hosts an Amish community who occasionally use the section of road from I-64 to KY 965 (Preston Road).

Traffic Volume and Operations

A traffic analysis was performed addressing four major topics: traffic volumes, traffic operations, travel speeds, and traffic safety. The traffic volume work included examining historical and existing (2021)

traffic volumes as well as forecasting future traffic to the design year of 2045.

Traffic volumes were projected to the 2045 design year and include projections for Average Annual Daily Traffic (AADT), Design Hourly Volume (DHV), and truck volumes. The 2045 AADT volumes range from a low of 2,700 vehicles per day (VPD) between KY 965 (Hart Pike) and KY 965 (Preston Road) to a high of 6,750 vpd between Creek Side Drive and the I-64 Eastbound ramps. The DHVs, Average Annual Daily Truck Traffic (AADTT), and Truck DHVs all follow the same pattern of increasing by segment the closer the segment is to the I-64 interchange.

A traffic operational analysis was conducted to determine capacity and Level of Service (LOS). For rural major collector highways in rolling terrain, LOS C is an acceptable LOS according to the AASHTO Green Book. The analysis was completed for the no-build scenario on KY 36 with both existing (2021) and future (2045) traffic. Under existing traffic conditions (2021) study area segments operate at LOS A or B. Due to the modest expected traffic growth and relatively low existing volumes, all segments are predicted to continue operating at LOS A or B in the future analysis year (2045) as well. The volume to capacity (v/c) ratios would increase but would still be well under the capacity of a two-lane highway. Therefore, capacity is not a current issue and is not anticipated to be an issue in the design year.

Intersection turning movement counts at four study intersections (I-64 Eastbound (EB) Ramp, Creek Side Drive, KY 965 (Preston Road), and KY 965 (Hart Pike)) were obtained by KYTC District 9 to evaluate intersection level traffic operations and to develop updated AADT estimates. The counts indicated an AM peak hour occurring between 7:15am and 8:15am and a PM peak hour occurring between 4:30pm and 5:30pm. The directional truck Design Hour Volumes (DHVs) ranged from a low of 15 trucks per hour between KY 965 (Preston Road), and KY 965 (Hart Pike) to a high of 30 trucks per hour between the I-64 EB ramps and Creek Side Drive. The intersections were analyzed using Synchro Version 11 (HCM 6th Edition) analysis software to evaluate the AM and PM peak hours. All four intersections currently operate at an acceptable LOS (C or better), with the delay values increasing at the intersections closer to I-64. The 2045 analysis yielded one intersection movement, the EB I-64 Ramp approach to KY 36, that dropped from LOS C to LOS D in the PM peak. All other intersection movements remained within the LOS A to C range.

Travel speeds along a corridor are an indicator of how a roadway facility is operating. KYTC provided 2019 HERE speed data for the KY 36 study area, which was used to determine typical operating speeds throughout the day. Travel speeds by location were compared to crash locations to determine if any crash trends were present. Speeds for the corridor were generally below the posted speed limit of 55 mph. At various points along the corridor, horizontal and vertical curves with design and advisory speeds fall well below the posted speed limit. Crashes were overlaid on a graph that included the 85th-percentile speeds in each direction during the AM and PM peak hours, the posted speed limit, design speeds (horizontal and vertical curvature), and advisory speeds (through curves), making it apparent that drivers traveling above the curve advisory speeds may be contributing to some of the crashes experienced on the corridor.

Safety

A historical crash analysis was performed to examine traffic safety trends and to identify potential safety issues on KY 36 within the study area. Within the five-year (2016 – 2020) analysis period, 63 crashes were reported in the study area. A breakdown of the crashes by severity found one fatal crash and two serious injury crashes (4.8% combined) over the five-year period. Most crashes (50, 79.4%) were property damage-only crashes.

An examination of the crashes by manner of collision showed most crashes in the study area (36, 57.1%) were single vehicle crashes. A further investigation of the single vehicle crashes showed the majority involved a vehicle leaving the roadway and striking an

embankment/rock cut/ditch (41.7%). In single vehicle crashes, 53% occurred when the pavement was wet.

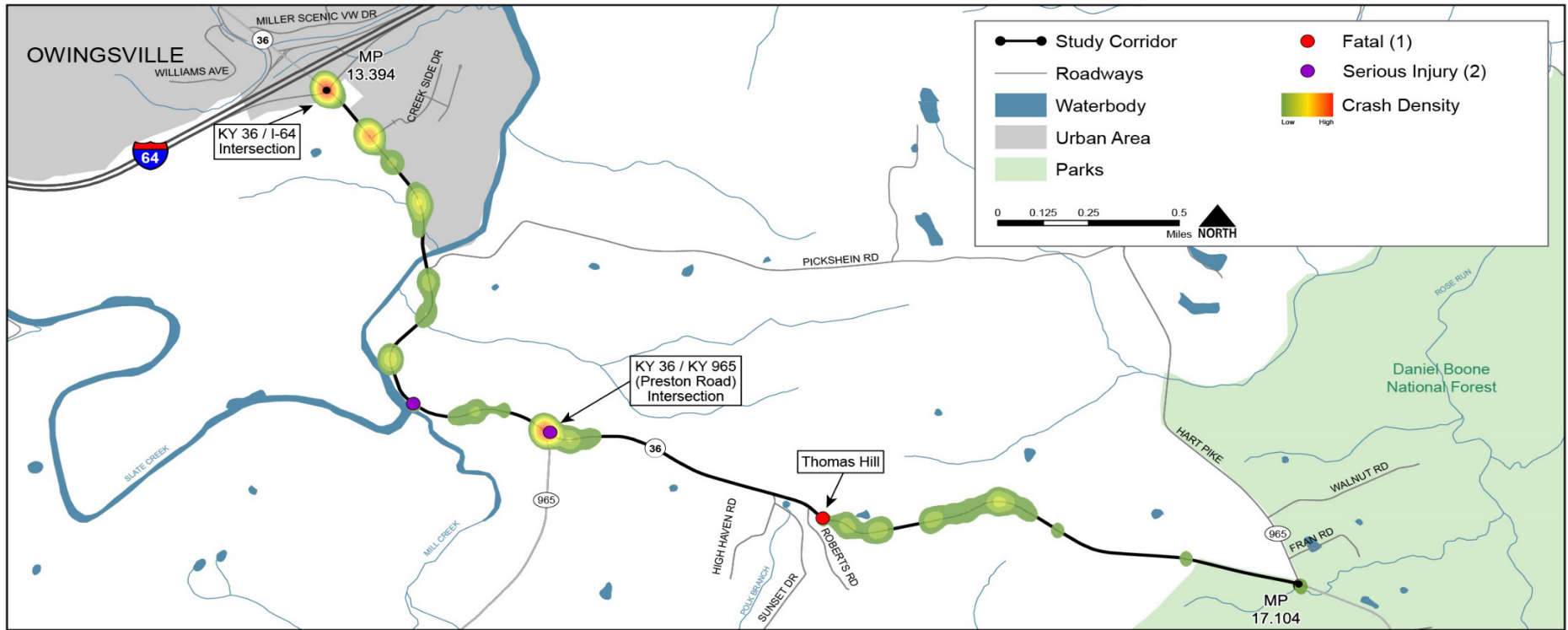
The location and density of crashes within the KY 36 study area was also examined as illustrated in **Figure ES-2**. Crash density was generally highest in locations of horizontal/vertical curvature deficiencies or at intersections. The fatal and serious injury crashes occurred in areas with geometric deficiencies, such as at Thomas Hill, or at intersections that have limited sight distance, such as at the KY 36 / KY 965 (Preston Road) intersection.

KY 36 segment crash rates were calculated using the 2016-2020 crash data and traffic volumes during this period. The crash rates were compared to statewide rural two-lane highway average crash rates¹. The analysis showed that within the study area KY 36 experienced a higher-than-average number of crashes per 100 million vehicle miles (MVM) traveled compared to similar type facilities throughout Kentucky.

In summary, a comparison of crash rates within the study area shows that KY 36 experiences more crashes than other rural two-lane roadways in the state. However, when variables such as lane width, shoulder width, traffic volume, and roadway curvature are considered, the Excess Expected Crashes (EEC) analysis based on the Highway Safety Manual indicates KY 36 is experiencing fewer crashes than would be expected on a similar type facility. The review of historic crashes has also shown relationships exist between high crash segments/intersections and locations with geometric deficiencies and potentially limited sight distance.

1 Analysis of Traffic Crash Data in Kentucky 2015-2019, Research Report KTC-20-32/KSP2-20-1F

Figure ES2: KY 36 Crash Density Map (2016-2020)



Environmental

Data were collected for an Environmental Overview (EO) based on existing geographic information system (GIS) datasets, state and federal agency databases, literature research, and archival data. Desktop research was performed to identify and locate areas of importance or concern that lie within a 500-foot buffer along KY 36 from I-64 EB to KY 965 (Hart Pike) including a larger bump out area from Pickshein Road to just east of the KY 965 (Preston Rd.) intersection near High Haven Road.

The natural environment reviewed for the EO included ecological resources, threatened and endangered species, and important habitats. The potential to encounter natural environment resources are considerable. The nature of improvement concepts considered as part of this study limit the potential impacts to these resources, since most improvements will occur within existing right-of-way and within previously disturbed areas.

The human environment reviewed included air quality and noise issues; Environmental Justice (EJ) / socioeconomic data; land use / farmland; hazardous materials; and historic and archaeological resources. The Gateway Area Development District (GADD) prepared the KY 36 Corridor (I-64 to KY 965/Hart Pike): Bath County Socioeconomic Study to assess EJ populations. The report used 2019 U.S. Census Bureau American Community Survey (ACS) data. The GADD report indicated there are concentrations of poverty, low median household income, minorities, persons over the age of 65, and persons with a disability across Block Groups 2, 3, and 4 of the study area.

Geotechnical

KYTC provided a geotechnical overview of the study area that includes information about the topography and drainage, stratigraphy, soils and unconsolidated materials, geologic structures and hazards, and mines and quarries in the study area vicinity. The overview found small-scale geotechnical concerns that may impact spot improvements or alignment changes.

Development and Evaluation of Potential Improvement Concepts

In addition to project team meetings between the Consultant Team, KYTC, and the ADD, outreach for this project included a meeting with local elected officials, a public survey, and coordination with resource agencies. Using the existing conditions, traffic and safety analysis, along with input from

the local elected officials, an initial list of potential improvement concepts was developed and presented to the project team. Certain options were removed from consideration based on feasibility and a high-level analysis of impacts, and further guidance was provided by KYTC Central Office Planning and District 9 on the remaining options.

The initial list of improvement concepts was refined based on the feedback from the project team to a more refined list for a detailed evaluation. Each potential improvement concept was evaluated with respect to safety, right of way impacts, environmental impacts, and cost estimates. A predictive safety analysis was performed to estimate the potential reduction in crashes over a 20-year period that each improvement concept could provide, then a high-level benefit/cost analysis was conducted to determine the value each improvement concept provided. The project team decided which improvement concepts to carry forward into future project phases based on the benefit/cost analysis, in addition to making some minor modifications to certain concepts.

Recommendations

The final list of improvement concepts recommended for further development is shown in **Table ES-1**. Project sheets were created for each improvement concept on that list that provide information on the issues identified, the improvement concept, the safety benefits, and a cost estimate that includes Design, Right of Way, Utilities, and Construction (DRUC) costs. Upon completion of this study, selected recommended improvement concepts will be moved through project development. The evaluation performed in this study gave the district enough information to prioritize recommendations, therefore a formal categorization of short-term vs. long-term and low-, medium-, and high-priority is not needed. There are funds for future project development phases of this corridor in Kentucky's Six-Year Plan.

Table ES1: Final List of Recommended Projects

MP	Project Sheet	Description	Total Cost 2022 (\$)	Design Cost 2022 (\$)	Right of Way Cost 2022 (\$)	Utility Cost 2022 (\$)	Construction Cost 2022 (\$)	ROW req'd (acres)	Benefit / Cost	Total 20-Year Reduction	Environmental
13.4	A	Remove channelization of RT at I-64 EB off-ramp / move signs / clear brush	\$44,000	\$4,000	\$0	\$0	\$40,000	0	3.7	26.0	None
13.5	B	Improve vertical geometrics at Creekside and add SB LT Lane	\$386,500	\$26,500	\$35,000	\$60,000	\$265,000	0.87	0.8	11.1	Archaeological Survey, EJ (minority, disabled)
13.5-14.0	C/N	Add edge-line rumble strips and remove passing zone between Pickshein & Sav A Lot	\$31,000	\$0	\$0	\$0	\$31,000	0	0.1	0.7	None
14.1	D	Install advisory speed sign	\$2,500	\$0	\$0	\$0	\$2,500	0	1.3	1.2	None
14.2-14.8	E	Add chevrons and upgrade to solar flashing advisory speed sign around the curve / improve guard-rail and add reflectors / pavement markers and/or thermoplastic paint / 6" paint	\$50,000	\$0	\$0	\$0	\$50,000	0	7.5	6.1	None
14.9	F	F1 (Formerly G-1, remove KY 36 realignment)-Realign KY 965 to the west; F2 (Formerly F-5) - Realign KY 965 to the east; F3 (formerly H with a modification) - Shave back hillside on curve to meet sight distance and realign KY 965	F1: \$353,700 F2: \$774,400 F3: \$463,100	F1: \$21,500 F2: \$61,200 F3: \$30,500	F1: \$87,200 F2: \$61,200 F3: \$117,600	F1: \$30,000 F2: \$40,000 F3: \$10,000	F1: \$215,000 F2: \$612,000 F3: \$305,000	F1: 2.19 F2: 1.53 F3: 2.94	F1 = 1.5 F2 = 1.4 F3 = 1.2	F1 = 8.1 F2 = 23.4 F3 = 8.1	Archaeology Survey, 100 yr. floodplain, EJ (minority, disabled)
15.6-15.9	G	Add chevrons / solar flashing advisory speed sign / pavement markers and/or thermoplastic paint / 6" paint	\$30,000	\$0	\$0	\$0	\$30,000	0	199.5	4.5	None
15.6-15.9	H	Realign Thomas Hill to improve vertical and horizontal geometrics	\$1,074,400	\$89,600	\$68,800	\$20,000	\$896,000	1.72	16.9	9.6	Archaeology Survey, Bat habitat (trees), Black Shale, EJ (minority, disabled)
16.1-16.3	I	Add solar flashing advisory speed sign / pavement markers and/or thermoplastic paint / 6" paint around curve	\$30,000	\$0	\$0	\$0	\$30,000	0	1.7	5.3	None
System	J	Widen cross section to 11' lanes with 2' paved shoulders / Realign curves to 45 mph design speed / Add guardrail, safety headwalls at culverts, and/or extend culverts / 6" Thermoplastic Striping / Proper curve warning sign placement and chevron placement / Fix super on bridge over Slate Creek / Realign Pickshein Road for better sight distance / Replace pipes under gravel driveways and improve slope stability / Reduce skew of Hart Pike intersection	\$9,758,100	\$687,100	\$1,400,000	\$800,000	\$6,871,000	35	0.1	45.4	Archaeological Survey, Slate Creek (OSRW), Bat Habitat (trees) Bath County Park 4(f) and 6(f) resource, Bourbon Iron Works NRHP listed, Slate Creek OSRW, erosion control, mussels, 100 yr floodplain, Bat habitat (trees), Old Field Cemetery, black shale, Potentially NRHP Eligible Undetermined Structure (BH 472-476), EJ (minority, disabled)



Table of Contents

Executive Summary	ES-1
1 Introduction	1
1.1 Study Area.....	1
1.2 Committed & Proposed Projects.....	3
1.3 Study Objective.....	3
1.4 Study Process.....	3
1.5 Study Goals	4
2 Existing Conditions.....	5
2.1 Roadway Geometrics	5
2.1.1 Functional Classification, Roadway System Designation, and Truck Routes	5
2.1.2 Speed Limit.....	5
2.1.3 Lane, Shoulder, and Median Width	5
2.1.4 Horizontal Alignment.....	5
2.1.5 Vertical Alignment	6
2.1.6 Roadside Characteristics	6
2.2 Intersections and Access Points.....	15
2.2.1 Intersection Skew and Sight Distance.....	15
2.3 Structures.....	15
2.4 Bicycle, Pedestrian, and Amish Activity	15
3 Traffic Volumes and Operations.....	17
3.1 Existing (2021) Volumes.....	17
3.1.1 2021 DHV and AADT Volumes.....	17
3.1.2 2021 Intersection Volumes	18
3.1.3 Truck Volumes	20
3.2 Future (2045) Volumes.....	20
3.2.1 Traffic Growth Rate	20
3.2.2 2045 Volumes.....	20
3.3 Traffic Operational Analysis.....	22
3.3.1 Segment Traffic Operational Analysis.....	22
3.3.2 Intersection Operational Analysis	24
3.4 Corridor Speeds	25

4	Safety	27
4.1	Historic Crash Analysis.....	27
4.2	Excess Expected Crashes.....	30
4.3	Summary of Safety Issues & Use of Safety Data.....	33
5	Environmental Overview	35
5.1	Natural Environment.....	35
5.2	Human Environment.....	37
6	Geotechnical Overview	39
7	Stakeholder Outreach	41
7.1	Local Elected Officials and Stakeholders Meeting	41
7.2	Public Survey	41
7.3	Project Team Meeting #1.....	41
7.4	Project Team Meeting #2.....	41
7.5	Resource Agency Coordination.....	42
8	Development of Potential Improvement Concepts	43
9	Evaluation of Potential Improvement Strategies	47
10	Study Recommendations	49
10.1	Project Sheets.....	49
11	Next Steps	49
11.1	Contacts	49



Figures

Figure ES1: KY 36 Study.....	ES-2
Figure ES2: KY 36 Crash Density Map (2016-2020)	ES-5
Figure 1: KY 36 Study Area	2
Figure 2: Study Process	4
Figure 3A: KY 36 Existing Conditions	7
Figure 3B: KY 36 Existing Conditions.....	8
Figure 3C: KY 36 Existing Conditions.....	9
Figure 3D: KY 36 Existing Conditions	10
Figure 3E: KY 36 Existing Conditions.....	11
Figure 3F: KY 36 Existing Conditions	12
Figure 3G: KY 36 Existing Conditions	13
Figure 4: Roadside Edge Ratings.....	14
Figure 5: 2021 AADT; DHV and Turning Movement Counts.....	19
Figure 6: 2045 AADT; DHV and Turning Movement Counts.....	21
Figure 7: KY 36 85th Percentile Speeds.....	26
Figure 8: Crash Severity by Location (2016-2020).....	28
Figure 9: Manner of Collision by Time of Day (2016-2020).....	29
Figure 10: KY 36 Crash Density Map (2016-2020).....	31
Figure 11: Areas with Positive (Poor) and Negative (Good) Excess Expected Crashes (EEC)	32
Figure 12: Study Area Existing Environmental Conditions	36
Figure 13: Geologic Formations in the Study Area	39

Tables

Table ES1: Final List of Recommended Projects.....	ES-7
Table 1: KY 36 Study Area Historical Count Station Data	18
Table 2: Level of Service Ranges for Two-Lane Highways	22
Table 3: 2021 Segment LOS and V/C	23
Table 4: 2045 Segment LOS and V/C	23
Table 5: Level of Service Ranges for Two-way Stop-controlled Intersections	24
Table 6: KY 36 2021 Intersection LOS and Delay.....	24
Table 7: KY 36 2045 Intersection LOS and Delay.....	25
Table 8: KY 36 Crash Severity (2016-2020).....	27
Table 9: KY 36 Crashes by Manner of Collision (2016-2020)	27
Table 10: Single Vehicle Crashes by Type (2016-2020)	29
Table 11: KY 36 Crash Rate Data	30
Table 12: Initial List of Potential Improvement Concepts	44
Table 13: Refined List of Potential Improvement Concepts for Detailed Evaluation	48
Table 14: Final List of Recommended Projects	50

Appendices

APPENDIX A EXISTING CONDITIONS

APPENDIX B..... KY 36 TRAFFIC FORECAST REPORT

APPENDIX C..... KY 36 TRAFFIC OPERATIONS METHODOLOGY

APPENDIX D KY 36 CRASH AND SPEED PLOTS

APPENDIX E ENVIRONMENTAL OVERVIEW

APPENDIX F GEOTECHNICAL OVERVIEW

APPENDIX G STAKEHOLDER OUTREACH

APPENDIX H CONCEPTUAL DESIGNS FOR DETAILED EVALUATION

1 Introduction

The Kentucky Transportation Cabinet (KYTC) in collaboration with Bath County, Kentucky elected officials and stakeholders, identified the KY 36 corridor east of I-64 as a priority corridor for assessing safety and mobility needs and evaluating potential improvements. WSP USA Inc. (WSP) was contracted by KYTC to perform a planning study to identify potential improvement concepts along the KY 36 corridor. The study area extends from I-64 to KY 965 (Hart Pike), mile point (MP) 13.394 to MP 17.104. The study includes short- and long-term improvement strategies that KYTC may use for further project development and implementation.

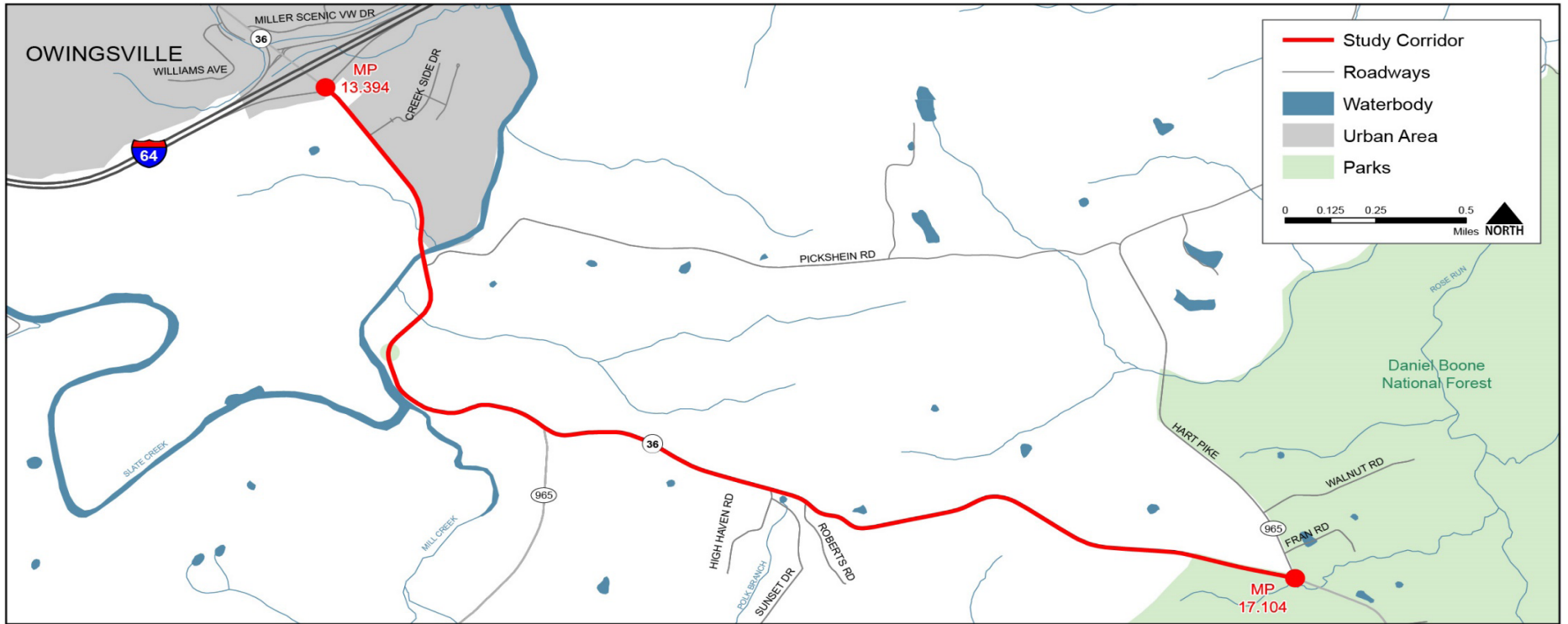
Members of the project team included KYTC District 9, KYTC Central Office Division of Planning, and the WSP Consultant Team which includes HDR and TSW.

The objective of the KY 36 Corridor Study is to develop and evaluate conceptual improvements to enhance safety and connectivity from I-64 to KY 965 (Hart Pike) in Bath County.

1.1 Study Area

The KY 36 study area is shown in **Figure 1**. The study area begins at I-64 (MP 13.394) in the west and extends to KY 965 (Hart Pike, MP 17.104) in the east.

Figure 1: KY 36 Study Area



1.2 Committed & Proposed Projects

There are five projects included in Kentucky's 2022–2028 Enacted Highway Plan (Six Year Plan), and ten projects in the vicinity of the study area in the KYTC Continuous Highway Analysis Framework (CHAF) database:

Kentucky's Six Year Plan Projects

- ▶ Item Number 09-80101.00: Improve safety on KY 36 from the intersection with I-64 to the intersection of KY 965 (Hart Pike) including the curves known as Clear Creek Furnace and Thomas Hill (SPP) R: 2023 \$2,250,000; U: 2026 \$1,840,000; C: 2027 \$23,520,000 (this project)
- ▶ Item Number 09-80102.00: Improve safety and operational efficiency on KY 36 from north of Mariella Drive to the intersection of Old KY 36 (SPP) R: 2025 \$425,000; U: 2024 \$1,320,000; C: 2026 \$4,000,000
- ▶ Item Number 09-3204: Bike and Ped Facility: TAP funds: 2019: Upgrade 320 feet of sidewalk on KY 36 (MP 11.995 - MP 12.055) to ADA compliance in Owingsville (2016BOP).
- ▶ Item Number 09-8811.00: Reconstruct KY 36 / KY 928 Intersection MP 8.0 to MP 8.23
- ▶ Item Number 09-8404.00: Reconstruct (spot improvement) along KY 965 0.8-mile south of KY 36.

CHAFs

- ▶ IP20000070: KY 36 MP 11.283 to MP 11.847 Reconstruction
- ▶ IP20000071: KY 36 MP 17.600 to MP 18.719 Reconstruction
- ▶ IP20080509: KY 36 MP 10.300 to MP 11.250 Spot Improvement
- ▶ IP20080510: KY 36 MP 6.970 to MP 11.847 Reconstruction

- ▶ IP20150068: KY 36 MP 13.394 to MP 17.104 Reconstruction (this project)
- ▶ IP20150162: KY 965 MP 6.6 to MP 8; KY 965 MP 8-8; KY 36 MP 14.88 to MP 17.1 New construction from Kendall Springs Road to Bath County High School in Owingsville
- ▶ IP20150223: KY 965 MP 7.147 to MP 7.247 Reconstruction
- ▶ IP20170051: KY 36 MP 12.300 to MP 12.993 Safety Hazard Elimination
- ▶ IP20190176: KY 36 MP 18.600 to MP 18.900 Spot Improvement
- ▶ IP20200013: KY 36 MP 0.891 to MP 11.845 Safety Hazard Elimination

1.3 Study Objective

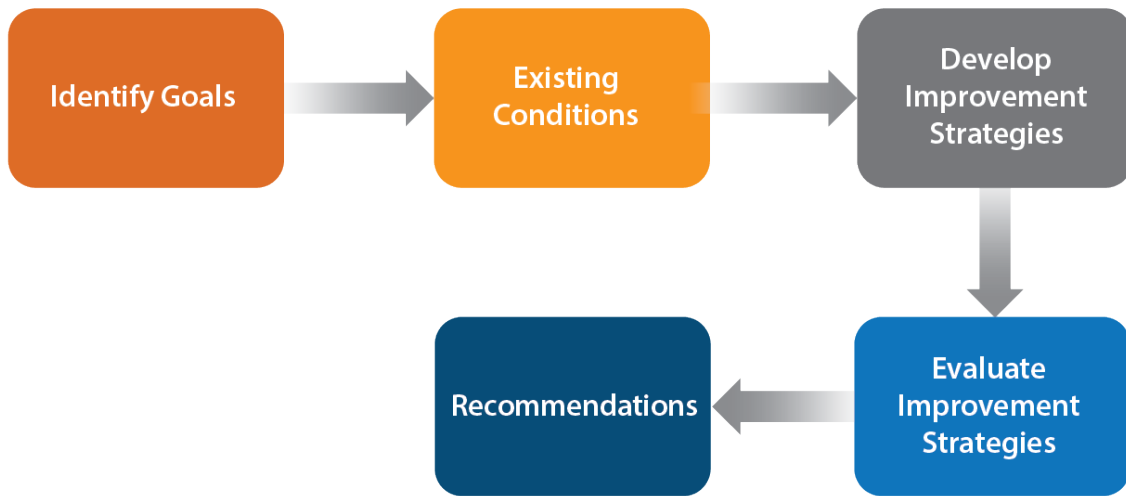
The objective of the KY 36 Corridor Study is to develop and evaluate conceptual improvements to improve safety and connectivity along the KY 36 corridor from I-64 to KY 965 (Hart Pike) in Bath County.

1.4 Study Process

The study process consists of five major elements (Figure 2):

1. Identify the goals of the study
2. Examine the existing conditions and identify areas with safety concerns
3. Develop potential improvement strategies
4. Evaluate the improvement strategies based on the study goals
5. Provide a list of short-term and long-term improvement recommendations

Figure 2: Study Process



The subsequent chapters of this report detail these steps, with additional information provided in the appendices as referenced.

1.5 Study Goals

The project team identified goals for the study based on the transportation challenges in the area. The goals of the study are to:

- ▶ Identify and evaluate the existing conditions, challenges, and opportunities with regard to safety, traffic operations, and roadway geometrics.
- ▶ Develop a list of conceptual improvements to address the identified challenges and opportunities.
- ▶ Evaluate the expected performance of the proposed conceptual improvements considering safety, traffic operations, environment, right-of-way, and cost.
- ▶ Engage local elected officials (LEOs), stakeholders, and the general public to identify areas of concern and potential improvements.
- ▶ Develop and document a list of recommended short- and long-term improvements based on the technical evaluation and feedback from the project team, LEOs, stakeholders, and the public.

2 Existing Conditions

To evaluate the existing conditions along KY 36, a detailed inventory of the existing physical and geometric design characteristics was completed using the following sources:

- ▶ KYTC Highway Information System (HIS) data
- ▶ KYTC record plans and bridge inspection reports
- ▶ Google Earth aerial imagery and Street View
- ▶ Field review

This chapter summarizes the existing conditions analysis. Supplemental supporting data are provided in **Appendix A**.

2.1 Roadway Geometrics

An inventory of roadway characteristics was completed to identify factors contributing to safety mobility, and connectivity issues along KY 36.

2.1.1 Functional Classification, Roadway System Designation, and Truck Routes

KY 36 is classified as a rural major collector throughout the study area. KY 36 is not part of the National Highway Freight Network (NHFN) but does intersect I-64 which is part of the NHFN. KY 36 is part of the Kentucky Highway Freight Network (KHFN) and is considered a Designation 4, meaning the Average Annual Daily Truck Traffic (AADTT) is less than 500 for local access or regional connections. The maximum truck weight permitted along KY 36 is 80,000 pounds.

2.1.2 Speed Limit

The speed limit along KY 36 is 55 miles per hour (mph) for most of the study area. The speed limit drops to 45 mph near and through the I-64 interchange. Advisory speeds are posted along the study area in several places where the roadway geometrics do not meet the 55 mph design speed, typically for sections with sharper curves and compound curves.

2.1.3 Lane, Shoulder, and Median Width

Lane widths are 10 feet for most of the corridor. A 12-foot lane width is present on the approach to the I-64 interchange. The HIS shows shoulder widths to be three feet wide with the pavement type listed as asphalt combination, meaning the shoulder is partially paved and partially unpaved. The paved portion of the shoulders varies but is typically one foot wide for most of the study area. The shoulder width changes to 10 feet at the I-64 interchange. Medians are not present in the study area.

2.1.4 Horizontal Alignment

The minimum rate of cross slope applicable to the traveled way is determined by drainage needs. Cross slopes are added to help mitigate roadway conditions during rain, snow, or ice events. According to the KYTC Highway Design Manual, the typical cross slope value for a rural collector roadway is 2% on normal pavement. The normal crown of the study area is 2%.

KY 36 has 26 horizontal curves in the study area. Of the 26 curves, 18 do not meet the design criteria for horizontal curves for the given design speed. Although the study area speed limit is primarily 55 mph, the design speed for horizontal curves range from 30-55 mph and an auxiliary speed sign typically accompanies each curve with a design speed of less than 55 mph. A complete list of the horizontal curves is shown in **Appendix A**.

Superelevation transition overlaps can cause issues for vehicles driving at the design speed as the vehicle in motion has not had enough time to recover to the normal crown before the next curve begins. Eight superelevation transition overlaps exist in the KY 36 study area. **Figures 3A-3G** show the existing conditions for the corridor and indicate the horizontal curvature for each curve.

2.1.5 Vertical Alignment

The 2018 Green Book Tables 3-35 and 3-37 state that the stopping sight distance for crest vertical curves and the headlight sight distance for sag vertical curves is 495 feet for a design speed of 55 mph.

There are 47 total vertical curves in the KY 36 study area and 22 vertical curves do not meet the minimum stopping sight distance or headlight sight distance.

The 2018 Green Book Table 3-4 shows the criteria for passing sight distance. For a design speed of 55 mph, the standard passing sight distance is a minimum of 900 feet. Two passing zones exist in the study area and both exceed the minimum distance of 900 feet.

The maximum vertical grade for a 55 MPH rural highway is 7% per the Green Book Table 5-4. Three sections along the study area have a vertical grade over 7%. **Figures 3A-3G** show the vertical grades on the plan and profile sheets.

2.1.6 Roadside Characteristics

The roadside edge rating system was developed by the project team with clarity and simplicity being the priorities. The rating was performed by the consultant team consists of five levels. The length and percent of the corridor with the given level was determined:

- ▶ Recoverable (1.28 miles, 17.3%)
- ▶ Virtually Recoverable (2.16 miles, 29.2%)
- ▶ Moderately Recoverable (1.70 miles, 23%)
- ▶ Virtually Non-Recoverable (0.56 miles, 7.6%)
- ▶ Non-Recoverable (0.65 miles, 8.8%).

Guardrail locations were also evaluated (1.05 miles, 14.2%). The evaluation was performed using GoPro footage of the study area. A map of the ratings across the study area along with existing guardrail is shown in **Figure 4**. The 2011 Roadside Design Guide and the KYTC Highway Design Manual provide guidance on the application and situation of guardrail placement. According to the 2020 KYTC Standard Drawings and Active Sepias, any new guardrail shall be installed at a height of 31 inches at the edge of the paved shoulder. The previously accepted height for guardrail was 27 inches, and KYTC has allowed this guardrail to remain on some Resurfacing, Restoration, and Rehabilitation (3R) Projects. Throughout the KY 36 study area, approximately 5,600 feet of guardrail exists with approximately 82% of the guardrail heights at 26 inches or less.

Figure 3A: KY 36 Existing Conditions

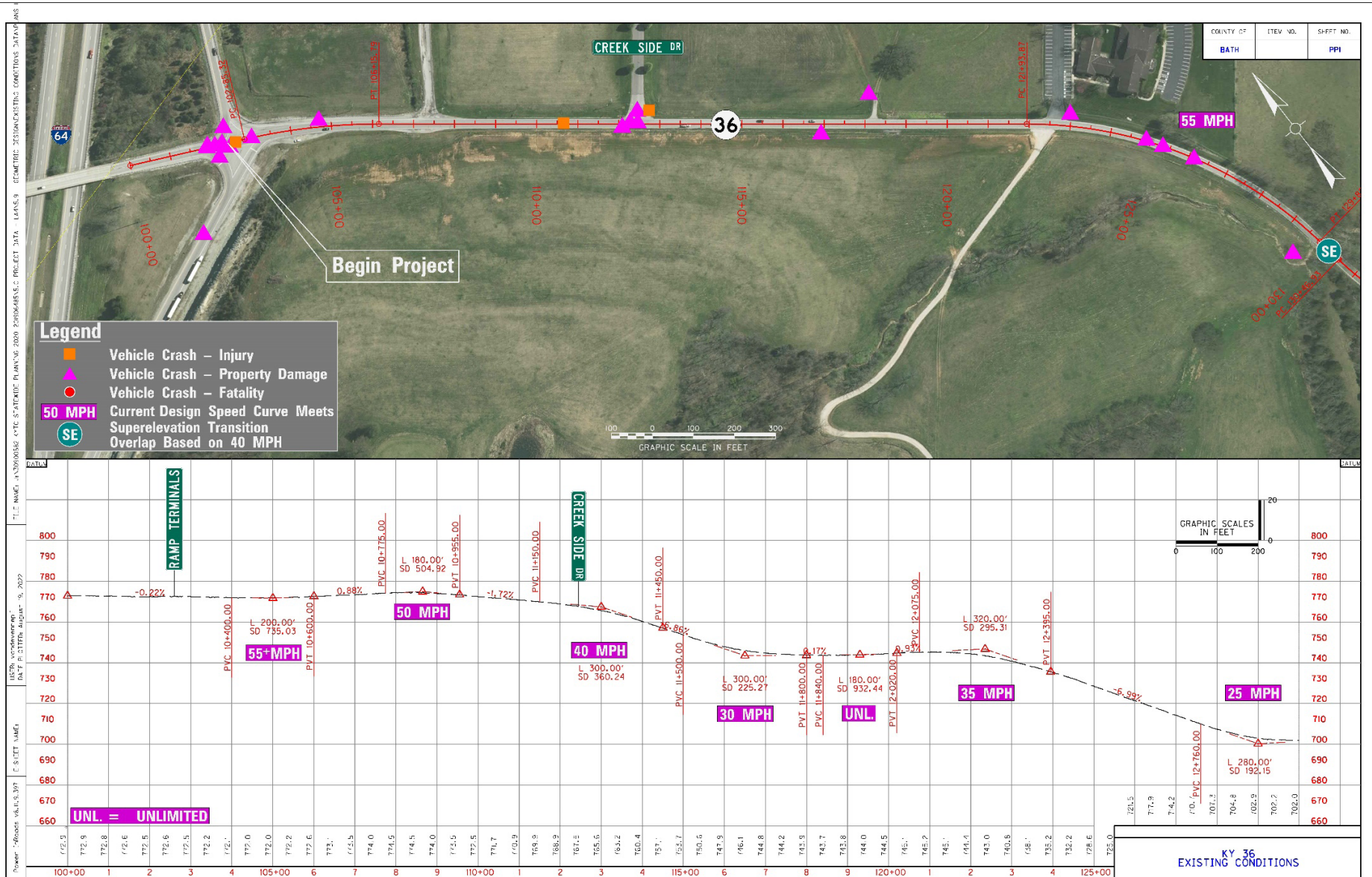
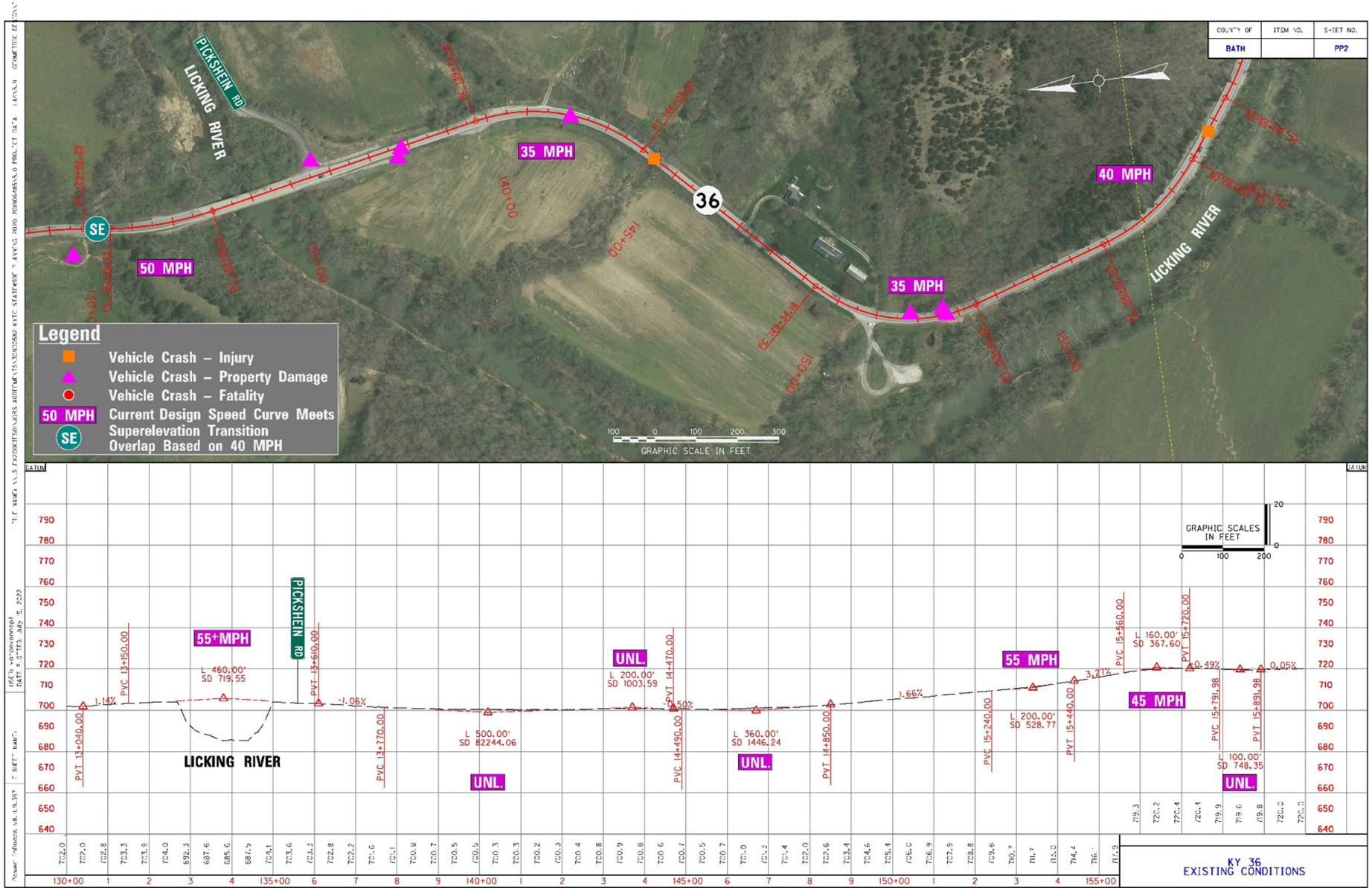


Figure 3B: KY 36 Existing Conditions



COUNTY OF	ITEM NO.	SHEET NO.
BATH		PP2

Figure 3C: KY 36 Existing Conditions

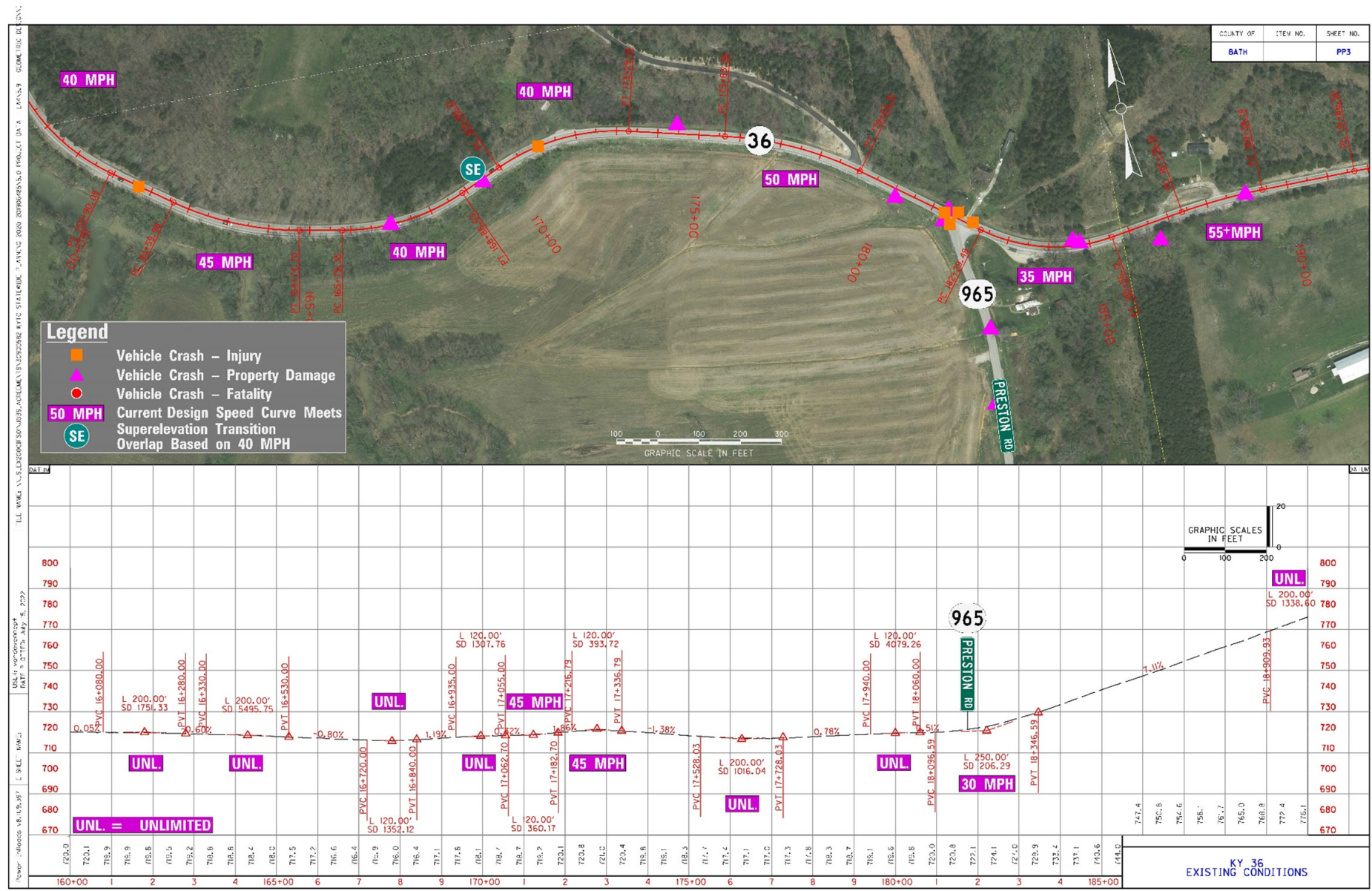


Figure 3D: KY 36 Existing Conditions

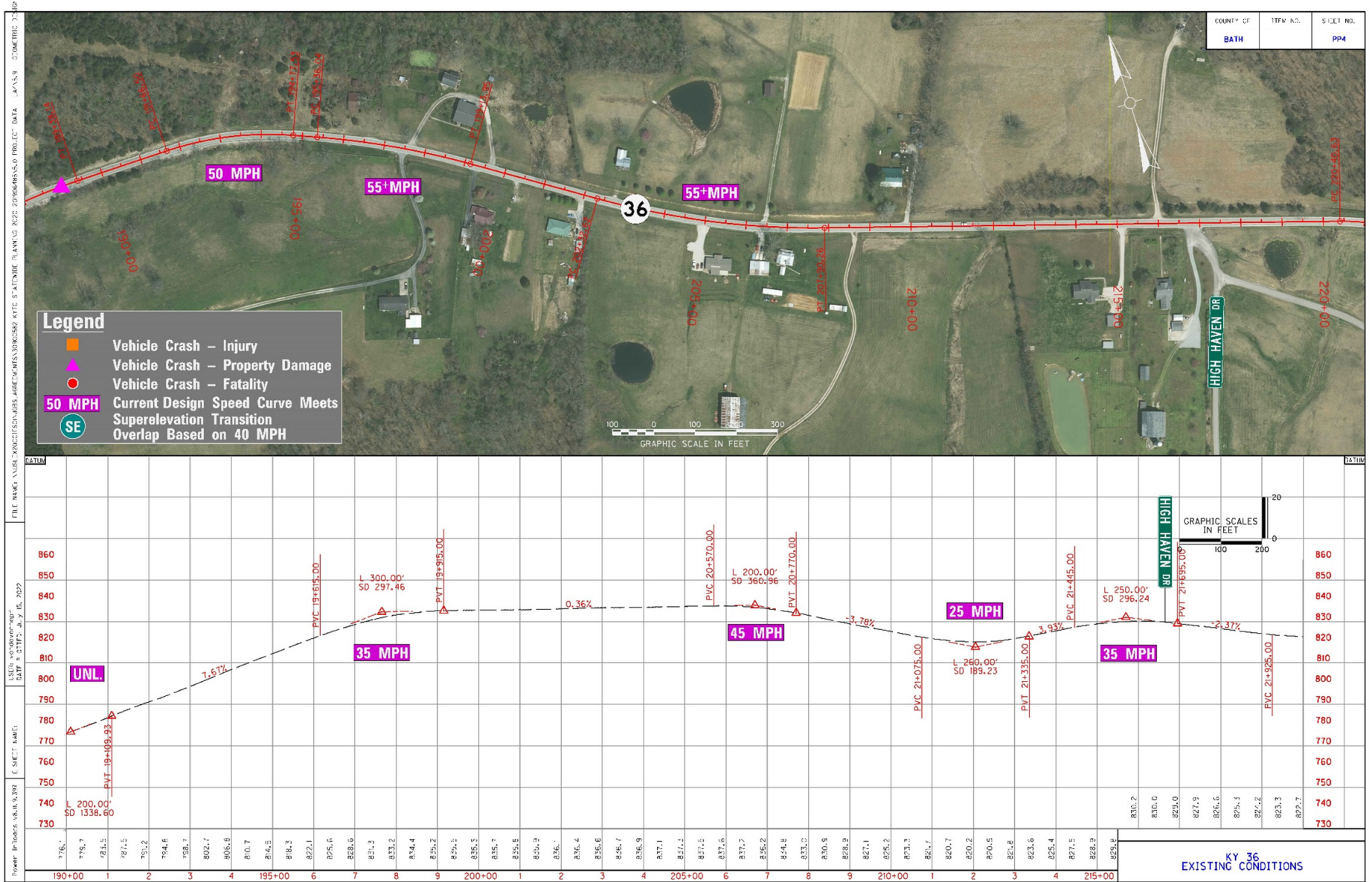


Figure 3E: KY 36 Existing Conditions

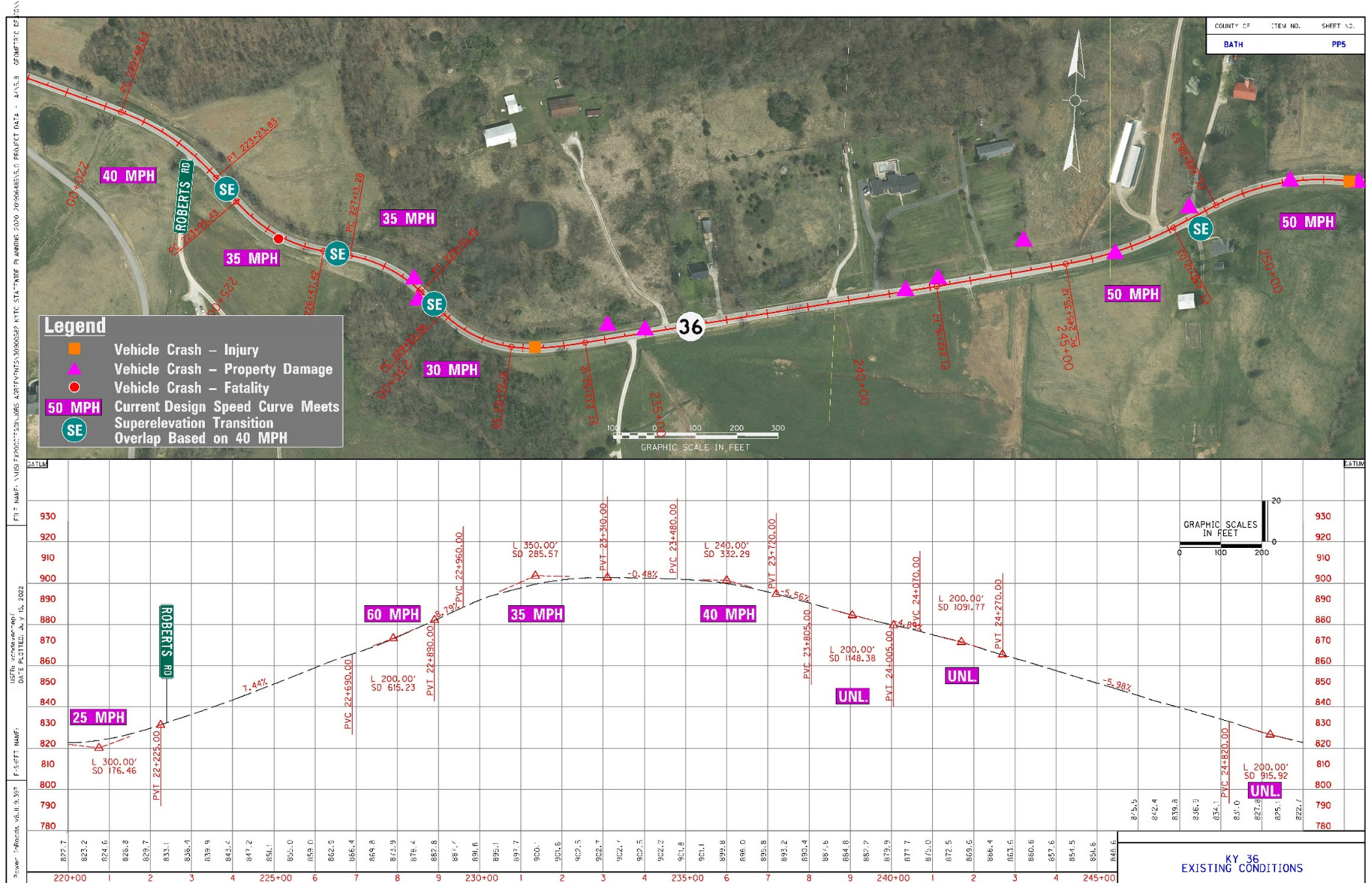


Figure 3F: KY 36 Existing Conditions

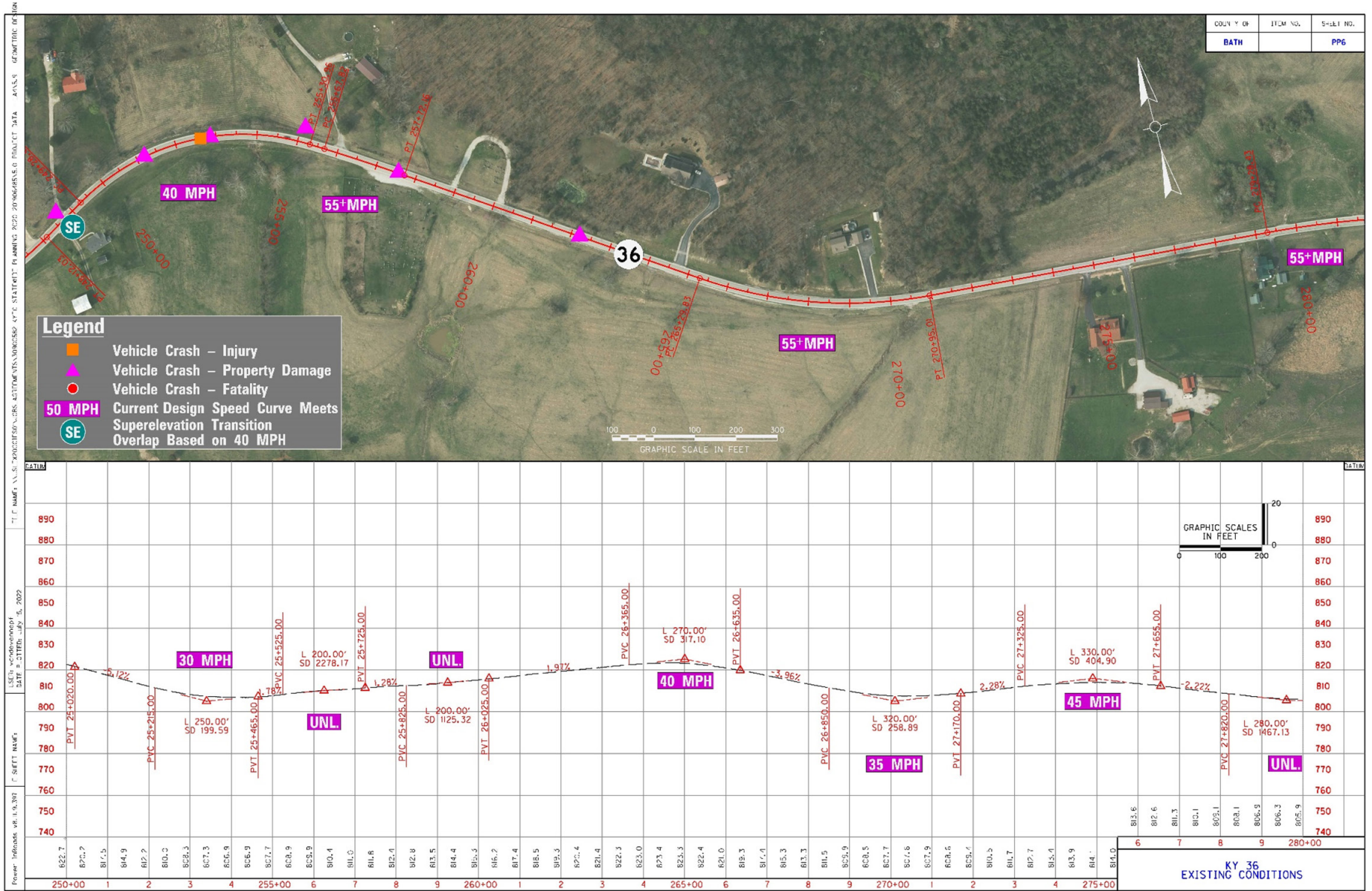
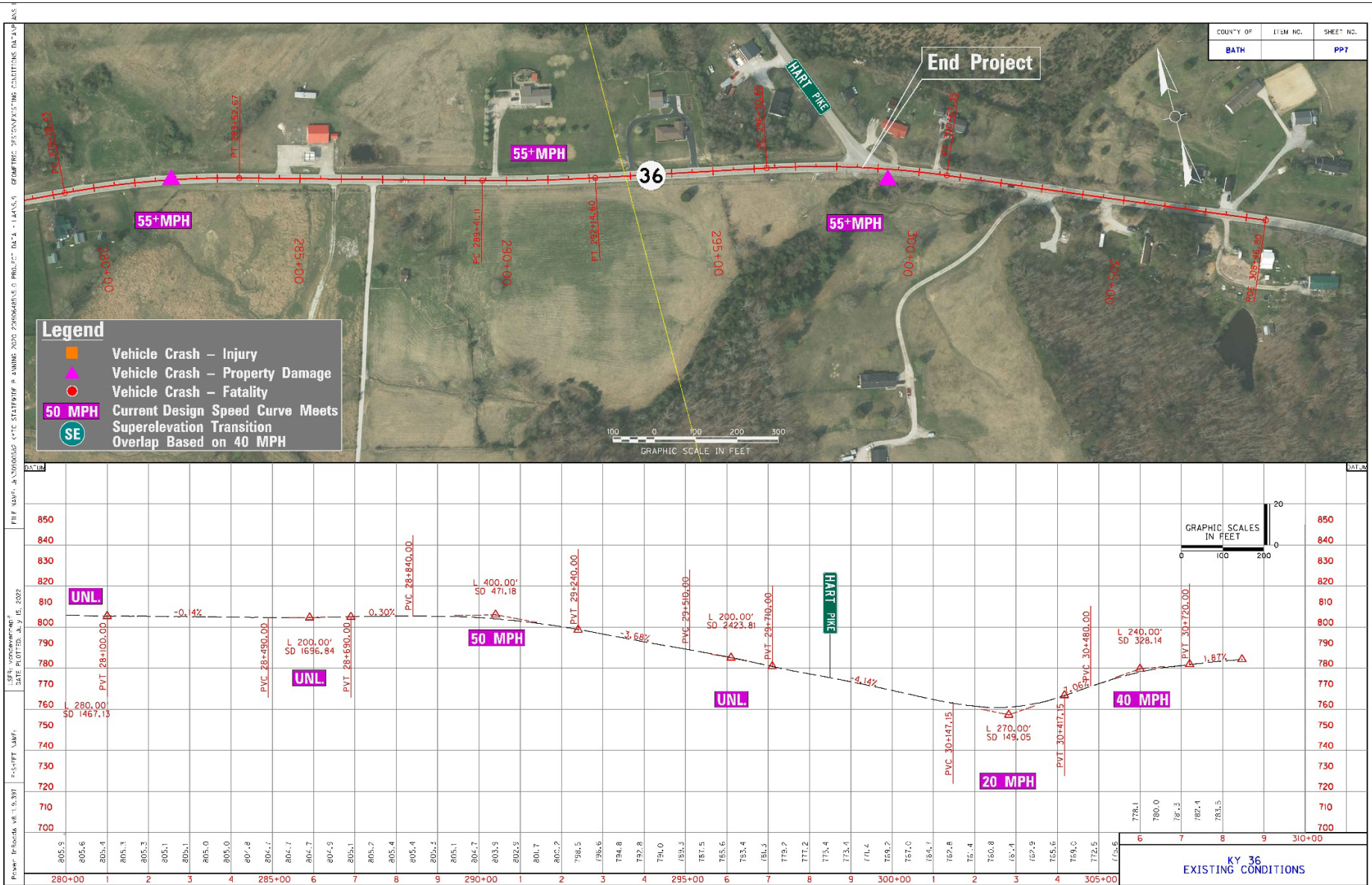


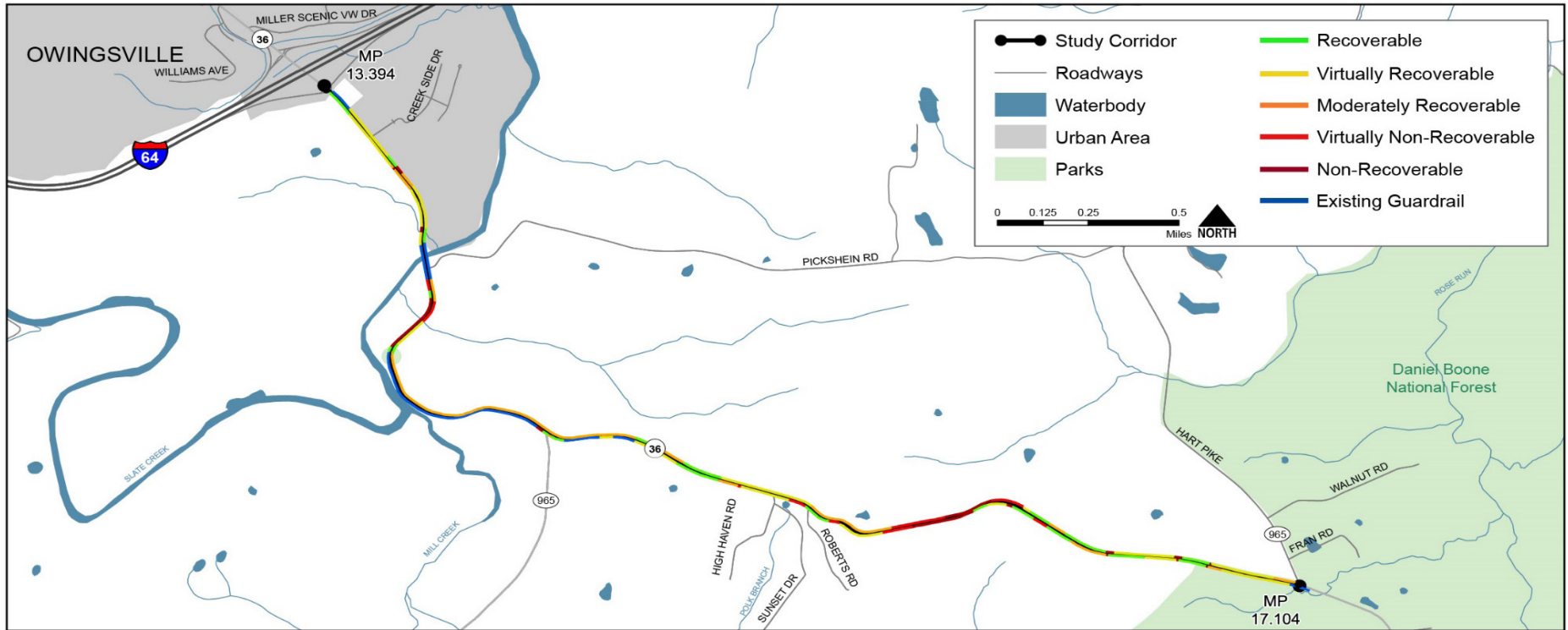
Figure 3G: KY 36 Existing Conditions



COUNTY OF	ITEM NO.	SHEET NO.
BATH		PP7



Figure 4: Roadside Edge Ratings



2.2 Intersections and Access Points

There are 46 total access points along KY 36, 40 driveways and 5 selected intersections including the I-64 eastbound (EB) ramp, Creek Side Drive, Pickshein Road, KY 965 (Preston Road), and KY 965 (Hart Pike). Most of the access points are towards the eastern end of the study area.

2.2.1 Intersection Skew and Sight Distance

The 2018 Green Book Table 9-7 highlights the design criteria for intersection sight distance, which is 610 feet for a 55 mph facility and 500 feet for a 45 mph facility. The 2018 Green Book Table 9-5 highlights the adjustment factors when the approach grade is higher than 3%. A 55 mph facility with an approach grade of -6% has an adjustment factor of 1.2 and all other adjustment factors where the approach grade is greater than 3% are 1.1. Objects within the departure sight triangles shown in Figure 9-17 in the 2018 Green Book may affect the intersection sight distance negatively.

Using the guidance referenced above, the intersections along the study corridor were evaluated. The I-64 intersection has sight distance issues due to vegetation, guardrail, and barrier walls. The intersection is also wide enough that left turning vehicles and right turning vehicles can be side by side at a skew, limiting sight distance in both directions. The Creek Side Drive intersection has a limited sight distance issue toward the east due to the vertical curve. The Pickshein Road intersection has a limited sight distance issue toward the west due to the bridge and vegetation. The KY 965 (Preston Road) intersection is skewed and has limited intersection sight distance on the east leg of KY 36 due to the hillside and vegetation. The KY 965 (Hart Pike) intersection has limited sight distance on the west side due to vegetation.

2.3 Structures

The only structure along the study corridor passes over Slate Creek. It was identified through KYTC's Bridge Data Miner as Bridge ID 006B00070N between MP 13.95 and 13.99. It was built in 1981 and is rated in Fair condition with a sufficiency rating of 93.4. It is a 226-foot, three span structure with two lanes and no sidewalks. The lanes are 10 feet each with four-foot shoulders and there is no median. The National Bridge Inventory Deck Rating, Superstructure Rating, and Substructure Ratings are 6, 6, and 7, respectively. The bridge is not structurally deficient or obsolete.

2.4 Bicycle, Pedestrian, and Amish Activity

Based on data from Strava, District 9 personnel, local officials, and field observations, there is no pedestrian activity along KY 36. Cyclist activity exists along the section from Pickshein Road to KY 965 (Preston Road) but is nonexistent within the rest of the study area. Strava indicated there is some cyclist usage along portions of KY 965 (Preston Road) and Pickshein Road.

According to District 9 personnel, the surrounding area hosts an Amish community who occasionally use the section of road from I-64 to KY 965 (Preston Road).



(This page intentionally left blank)

3 Traffic Volumes and Operations

The traffic analyses addressed four major topics: traffic volumes, traffic operations, travel speeds, and traffic safety. The first three topics are covered in this chapter, while traffic safety is presented in the next chapter. The traffic volume work included examining historical and existing (2021) traffic volumes as well as forecasting future traffic to the design year of 2045. The traffic operations analysis included a capacity screening to determine if there are any operational issues currently or if any are expected by 2045. An intersection level analysis was also conducted to examine intersection operations in 2021 and 2045.

3.1 Existing (2021) Volumes

The existing traffic volume analysis included developing Average Annual Daily Traffic (AADT) volumes, design hour volumes (DHV), and truck percentages. The project team selected 2021 as the baseline analysis year. Details for the volume forecasting work are presented in the KY 36 Traffic Forecast Report found in **Appendix B**.

Current and historical AADT information was obtained from KYTC for KY 36 count stations within, and adjacent to, the study area. Counts for the I-64 ramps at the interchange and for intersecting segments of KY 965 were also obtained. To determine if the COVID-19 pandemic impacted typical traffic volumes, hourly counts from 2020 and early 2021 were compared to 2019 or earlier counts. This comparison showed that volumes in 2020 were 25% lower, and volumes in 2021 were 2% lower than the 2019 or earlier traffic counts. It appears that traffic decreased in 2020, but generally returned to approximate pre-COVID-19 pandemic levels in 2021.

3.1.1 2021 DHV and AADT Volumes

2021 DHV

Intersection turning movement counts from 2021 were used to develop existing KY 36 DHV. The DHVs were calculated by taking an average of the traffic entering and exiting the two intersections at either end of a segment and selecting the volume from the highest peak hour, which occurred in the PM peak. DHVs increased from east to west approaching the I-64 interchange. The resulting KY 36 2021 DHVs (**Figure 5**) range from a low of 250 vehicles per hour (vph) between KY 965 (Hart Pike) and KY 965 (Preston Road) to a high of 570 vph between Creek Side Drive and the I-64 EB ramps.

2021 AADT Volumes

The AADT volumes were calculated by applying a K factor (**Table 1**) to the calculated DHV for each segment. AADT volumes also increased from east to west approaching the I-64 interchange. The resulting KY 36 2021 AADT volumes (**Figure 5**) range from a low of 2,500 between KY 965 (Hart Pike) and KY 965 (Preston Road) to a high of 6,000 between Creek Side Drive and the I-64 EB ramps. The resulting volumes correspond with the historical KYTC count data.

Table 1: KY 36 Study Area Historical Count Station Data

Count Station	County	Route	Begin Milepoint	End Milepoint	Count Year	AADT	K Factor	D Factor	% SU Truck	% Combo Truck	% Total Trucks
006292	Bath	KY 36	13.279	14.882	2017	4,114	9.5	56	4.69	2.03	6.72
006290	Bath	KY 36	14.882	17.104	2018	2,070	9.9	57	4.69	2.03	6.72

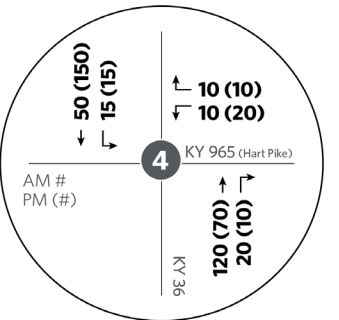
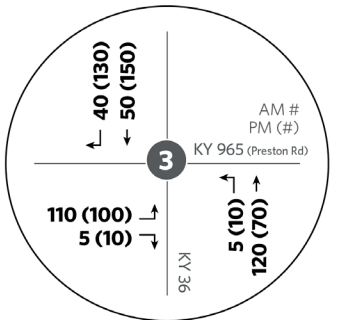
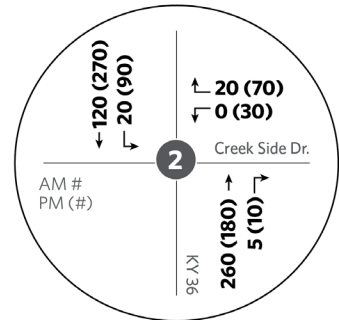
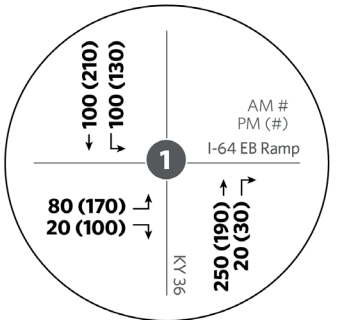
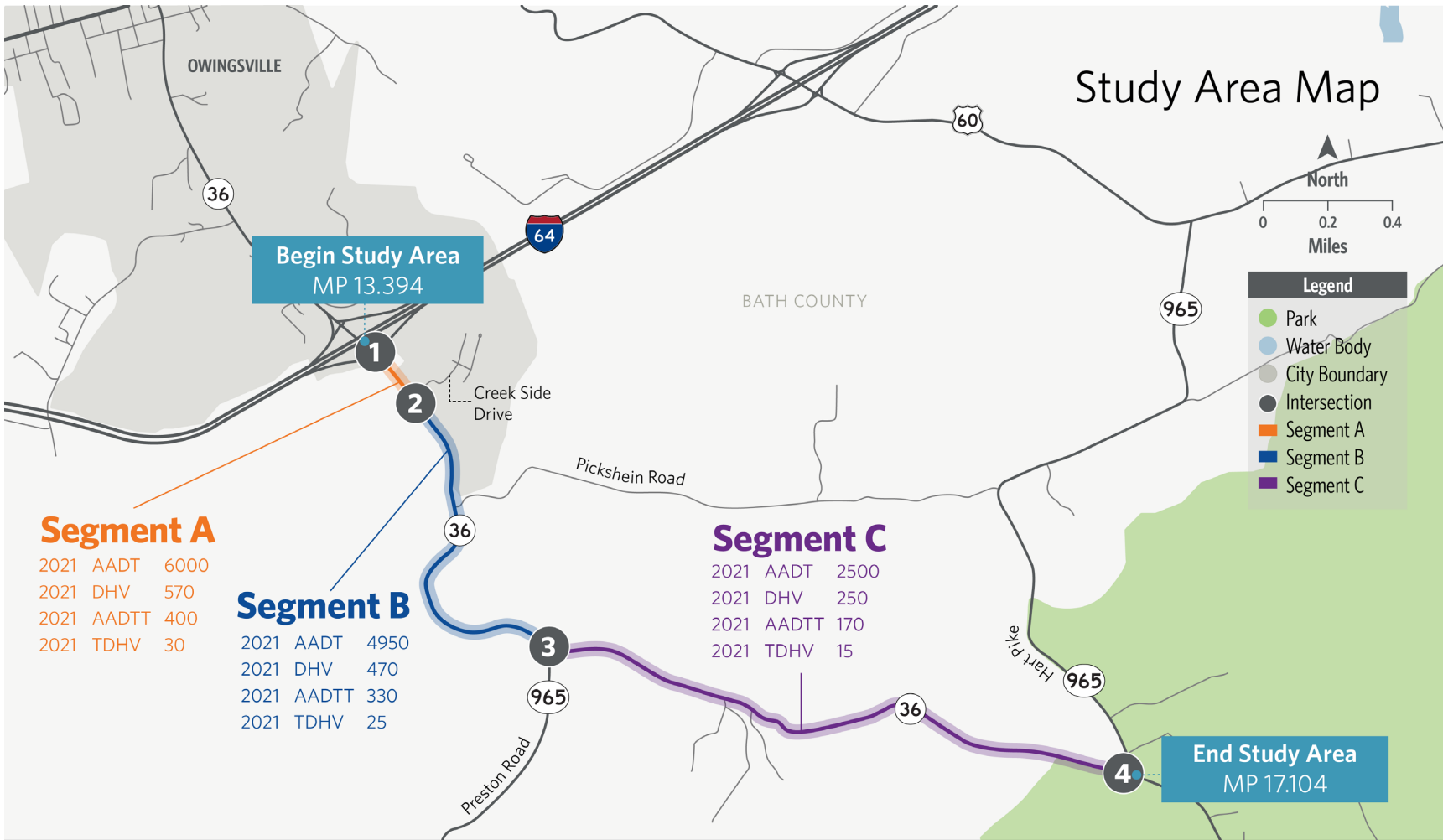
3.1.2 2021 Intersection Volumes

Intersection turning movement counts at four of the study intersections were obtained to evaluate intersection level traffic operations and to develop updated AADT estimates (as described above). These counts were conducted by District 9 staff in October 2021 at the following four KY 36 intersections.

- ▶ I-64 EB Ramp
- ▶ Creek Side Drive
- ▶ KY 965 (Preston Road)
- ▶ KY 965 (Hart Pike)

A review of the 2021 intersection turning movement counts indicated they were consistent with expectations based on historical counts. The 2021 counts did not appear to be impacted by travel pattern changes due to COVID-19 pandemic. The counts indicated an AM peak hour occurring between 7:15am and 8:15am and a PM peak hour occurring between 4:30pm and 5:30pm. **Figure 5** shows intersection turning movement volumes rounded to the nearest 10 vph.

Figure 5: 2021 AADT; DHV and Turning Movement Counts



3.1.3 Truck Volumes

Truck data was obtained from KYTC to estimate 2021 Average Annual Daily Truck Traffic (AADTT) and truck DHVs (TDHV) for each segment of KY 36. The truck percentage used to estimate AADTT was 6.72% and the truck percentage used to estimate truck DHVs was 0.52% of the AADT. AADTTs ranged from a low of 170 trucks per day between KY 965 (Hart Pike) and KY 965 (Preston Road) to a high of 400 trucks per day between Creek Side Drive and the I-64 EB ramps. The directional truck DHVs ranged from a low of 15 trucks per hour between KY 965 (Hart Pike) and KY 965 (Preston Road) to a high of 30 trucks per hour between Creek Side Drive and the I-64 EB ramp (**Figure 5**).

3.2 Future (2045) Volumes

Traffic volumes were projected to the 2045 design year to be consistent with American Association of State Highway and Transportation Officials (AASHTO) policy which indicates that forecasts should be at least 20 years beyond the year in which the project plans, specifications, and estimates for construction are approved. The forecast includes projections for AADT, DHV, and truck volumes. Details for the volume forecasting work are presented in the KY 36 Traffic Forecast Report in **Appendix B**.

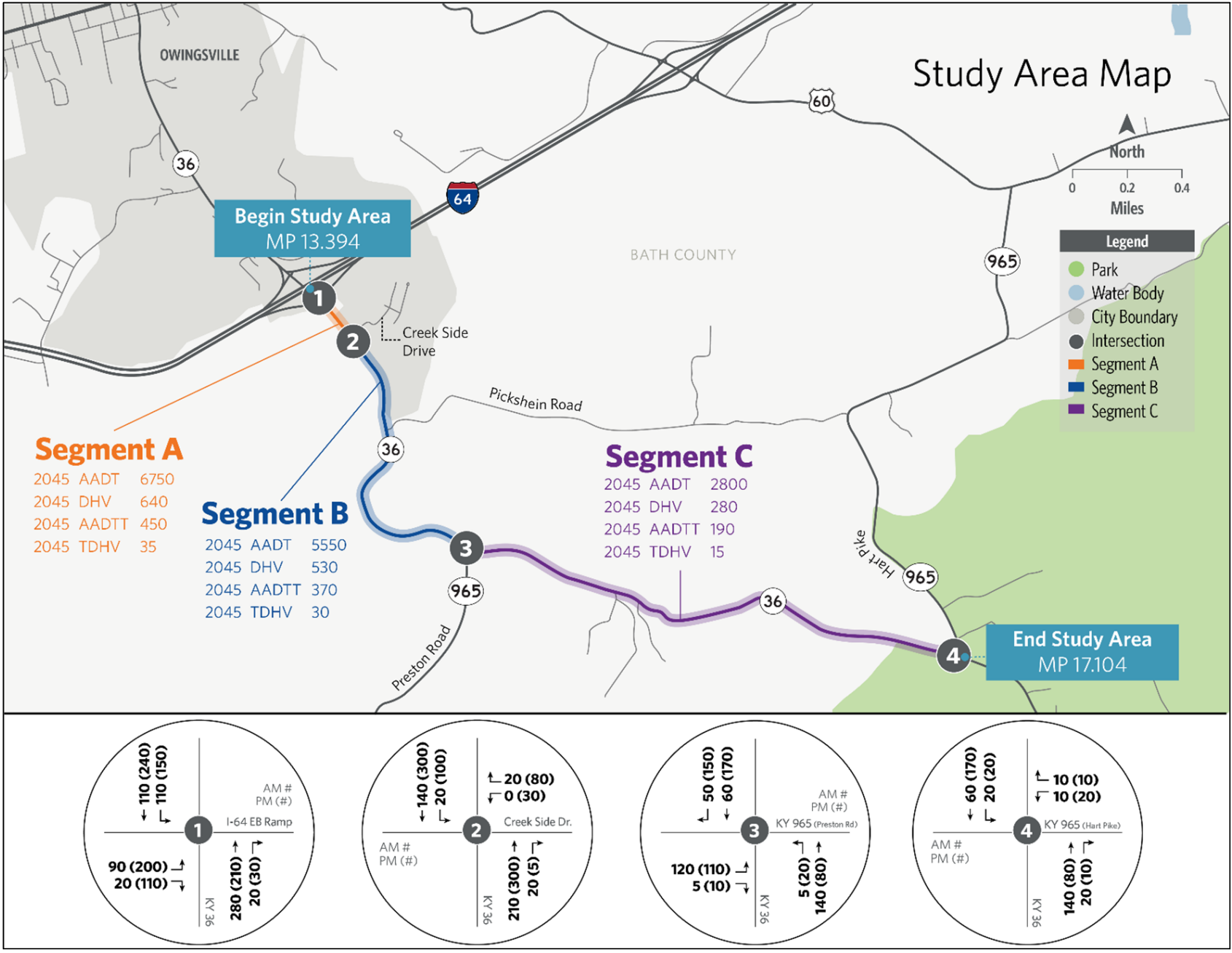
3.2.1 Traffic Growth Rate

The traffic growth rate was based on three factors: historical traffic growth, Kentucky Statewide Traffic Model (5971_KYSTMv19) forecasts, and projected population growth. The historical traffic growth on KY 36 declined slightly between 2009 and 2018 at a rate of -0.1% per year. The Kentucky Statewide Traffic Model (5971_KYSTMv19) projected 0.31% growth on the corridor over the next 25 years. The projected population growth within Bath County is expected to be 0.37% per year. Given declining historical growth along with modest projected model growth and population growth, a 0.5% annual growth rate for AADT, DHV, and truck volumes was selected for the study. This growth rate is sufficient to examine traffic operational performance in the study area over the next 25 years.

3.2.2 2045 Volumes

The projected 2045 AADT, DHVs, and truck volumes are presented in **Figure 6**. The AADT volumes range from a low of 2,800 between KY 965 (Preston Road) and KY 965 (Hart Pike) to a high of 6,750 between Creek Side Drive and the I-64 EB ramps. The DHVs, AADTT, and Truck DHVs all follow the same pattern of increasing by segment the closer the segment is to the I-64 interchange.

Figure 6: 2045 AADT; DHV and Turning Movement Counts



3.3 Traffic Operational Analysis

The traffic operational analysis was conducted using the Highway Capacity Manual, 6th Edition methods to determine capacity and Level of Service (LOS). Highway LOS is a qualitative measure that is used to describe the operating conditions of a roadway or intersection based on factors such as speed, travel time, maneuverability, delay and safety. It is characterized by an A to F scale with A representing the best operating conditions and F representing the worst. For rural major collector highways in rolling terrain, as KY 36 is classified, the AASHTO Green Book guidelines suggest that these type facilities be designed to a LOS C. The analysis was completed for the no-build scenario on KY 36 with both existing (2021) and future (2045) traffic. A more in-depth explanation of the traffic operational analysis can be found in **Appendix C Traffic Methodology Report**.

3.3.1 Segment Traffic Operational Analysis

The KY 36 study area was broken down into three segments for analysis. Each segment was analyzed using the two-lane highway analysis method from the Highway Capacity Manual (HCM) 6th Edition as implemented by the HCS7 software. 2019 HERE speed data was used to determine free flow speeds used in the HCS7 analysis. The AM and PM peak periods in each direction were analyzed to determine the LOS, follower density, and volume-to-capacity ratios (v/c). LOS thresholds for two-lane highways are based on the follower density represented by followers/mi/ln and the range of LOS values falls into two groupings depending on the posted speed limit. With the free flow speeds being available within the study area, the HCS software used the under 50 mph LOS range of values to determine LOS even though this is less than the statutory posted speed limit of 55 mph. This better represents to traffic and characteristics of the KY 36 corridor. **Table 2** provides the LOS range for two-lane highways operating under 50 mph.

Table 2: Level of Service Ranges for Two-Lane Highways

LOS	Follower Density (follower/mi/ln)
A	≤ 2.5
B	>2.5 – 5.0
C	>5.0 – 10.0
D	>10.0 – 15.0
E	> 15.0
F	Demand exceeds capacity ¹

¹ The capacity of a two-lane highway under base conditions is 1,700 passenger cars per hour in one direction of travel, with a maximum of 3,200 passenger cars per lane in both directions. Level of Service F occurs when demand flow in one or both directions exceed the segments capacity. From Highway Capacity Manual 6th Edition.

Under existing traffic conditions (2021) the three KY 36 study segments operate at LOS A or B. As shown in **Table 3**, each segment is well under capacity. Due to the modest expected traffic growth and relatively low existing volumes, all three segments are predicted to operate at LOS A or B in the future analysis year

(2045) as well. The v/c ratios would increase but would still be well under the capacity of a two-lane highway. The results (**Table 4**) show that within the KY 36 study area, capacity is not a current issue and is not anticipated to be an issue in the design year.

Table 3: 2021 Segment LOS and V/C

Segment	Description	LOS				V / C				Follower Density*			
		NB		SB		NB		SB		NB		SB	
		AM Peak	PM Peak	AM Peak	PM Peak	AM Peak	PM Peak	AM Peak	PM Peak	AM Peak	PM Peak	AM Peak	PM Peak
A	I-64 EB Ramp to Creek Side Drive	B	A	A	B	0.19	0.15	0.09	0.21	3.3	2.3	1.1	3.9
B	Creek Side Drive to KY 965 (Preston Road)	B	A	A	B	0.18	0.12	0.08	0.18	3.0	1.5	0.9	2.9
C	KY 965 (Preston Road) to KY 965 (Hart Pike)	A	A	A	A	0.09	0.05	0.04	0.10	1.2	0.5	0.4	1.4

*in followers/mile/lane

Table 4: 2045 Segment LOS and V/C

Segment	Description	LOS				V / C				Follower Density*			
		NB		SB		NB		SB		NB		SB	
		AM Peak	PM Peak	AM Peak	PM Peak	AM Peak	PM Peak	AM Peak	PM Peak	AM Peak	PM Peak	AM Peak	PM Peak
A	I-64 EB Ramp to Creek Side Drive	B	B	A	B	0.22	0.17	0.11	0.24	4.0	2.7	1.3	4.7
B	Creek Side Drive to KY 965 (Preston Road)	B	A	A	B	0.20	0.13	0.09	0.20	3.6	1.8	1.1	3.5
C	KY 965 (Preston Road) to KY 965 (Hart Pike)	A	A	A	A	0.10	0.06	0.05	0.11	1.5	0.6	0.4	1.8



3.3.2 Intersection Operational Analysis

Four of the study intersections were analyzed using Synchro Version 11 (HCM 6th Edition) analysis software to evaluate the AM and PM peak hours. All four intersections are controlled by two-way stop-control (TWSC) on the side-street approaches. The LOS for a TWSC intersection is evaluated for

each minor street movement (stop condition) and for major street left turning movements. No overall intersection LOS is given since the major street through movements are assumed to experience very little delay. **Table 5** provides the LOS range for TWSC intersections.

Table 5: Level of Service Ranges for Two-way Stop-controlled Intersections

LOS*	Average Total Delay (s)
A	0 - 10
B	>10 - 15
C	>15 - 25
D	>25 - 35
E	>35 - 50
F	>50

*Where $v/c > 1.0$ LOS = F

As shown in **Table 6**, all four of the KY 36 intersections evaluated currently operate at an acceptable LOS, with the delay values increasing at the intersections closer to I-64. The 2045 analysis yielded one intersection movement that dropped from LOS C to

LOS D. The EB I-64 ramp to KY 36 is predicted to operate at LOS D during the PM peak hour in 2045. All other intersection movements remained within the LOS A to C range (see **Table 7**).

Table 6: KY 36 2021 Intersection LOS and Delay

Intersection	Movement	LOS		Delay (s)	
		AM	PM	AM	PM
KY 36 at I-64 EB Ramp	EB	C	C	16.9	19.7
	SB LT	A	A	8.2	7.9
KY 36 at Creek Side Drive	WB	B	B	10.2	11.7
	SB LT	A	A	8.0	7.8
KY 36 at KY 965 (Preston Road)	EB	A	B	8.7	12.0
	NB LT	A	A	7.4	7.9
KY 36 at KY 965 (Hart Pike)	WB	A	A	9.6	9.8
	SB LT	A	A	7.6	7.4

EB=Eastbound, WB=Westbound, NB=Northbound, SB=Southbound, LT = Left Turn

Table 7: KY 36 2045 Intersection LOS and Delay

Intersection	Movement	LOS		Delay (s)	
		AM	PM	AM	PM
KY 36 at I-64 EB Ramp	EB	C	D	20.3	27.4
	SB LT	A	A	8.4	8.0
KY 36 at Creek Side Drive	WB	B	B	10.5	12.5
	SB LT	A	A	8.1	7.9
KY 36 at KY 965 (Preston Road)	EB	A	B	8.7	12.9
	NB LT	A	A	7.4	8.0
KY 36 at KY 965 (Hart Pike)	WB	A	B	9.8	10.1
	SB LT	A	A	7.6	7.5

EB=Eastbound, WB=Westbound, NB=Northbound, SB=Southbound, LT = Left Turn

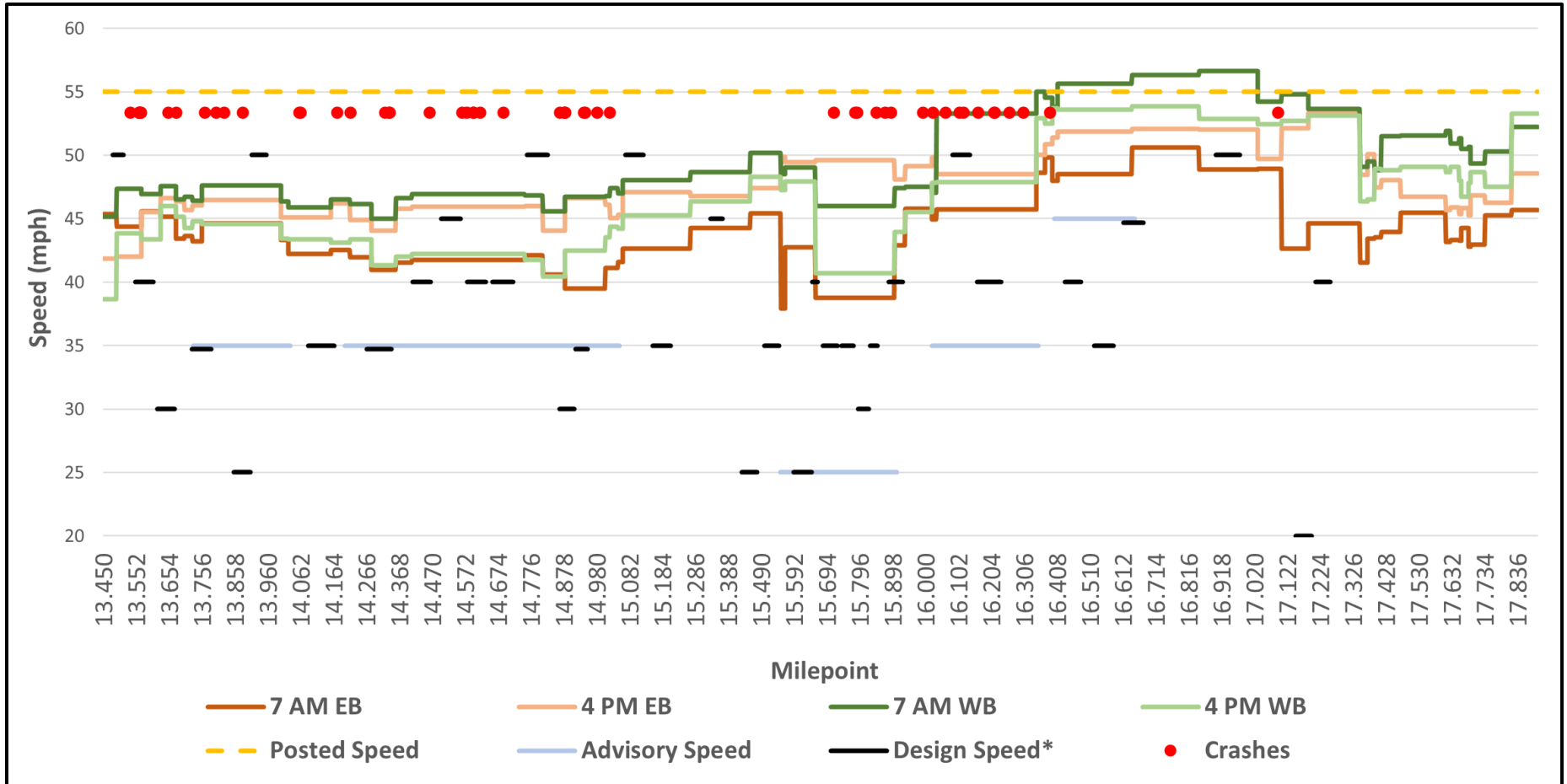
3.4 Corridor Speeds

Travel speeds are an indicator of how a roadway facility is operating. Under normal operating conditions, drivers on a two-lane highway would typically be traveling close to the posted speed limit. Locations with typical operating speeds below the posted speed could indicate a geometric deficiency, such as a curve with a tight radius, or the lower speeds could be the result of intersection related delay and / or congestion along the roadway itself. To aid in the evaluation, KYTC provided 2019 HERE speed data for the KY 36 study area. The speed data was used to determine typical operating speeds throughout the day, including peak traffic hours and off-peak hours. Travel speeds by location were compared to the location of crashes to determine if crash trends were present.

Speeds for the study area were generally under the posted speed limit of 55 mph. From MP 13.45 to 16.35, the 85th-percentile speeds were typically between 40 and 50 mph. From MP 16.35 to 17.4, the 85th-

percentile speeds ranged between 50 and 55 mph, before dropping again to between 40 and 50 mph east to the end of the project. At various points along the study area there are horizontal and vertical curves with design and advisory speeds that fall well below the posted speed limit. As shown in **Figure 7** and in more detail in **Appendix D** the crashes were overlaid on a graph that included the 85th-percentile speeds in the EB and WB directions during the AM and PM peak hours, the posted speed limit, design speeds (horizontal and vertical curvature), and advisory speeds (through curves). Once the crashes were overlaid with speeds it became apparent that drivers traveling above the curve advisory speeds may be contributing to some of the crashes experienced on KY 36. Given that operating speeds are generally lower than the current posted speed limit, and that high speeds (relative to the design and advisory speeds) may be contributing to poor safety performance, additional study and field verification of travel speeds may be warranted, including investigating the process for lowering the speed limit.

Figure 7: KY 36 85th Percentile Speeds



EB = Eastbound, WB = Westbound

* Both vertical and horizontal design speeds are shown

4 Safety

4.1 Historic Crash Analysis

A historical crash analysis was performed to examine traffic safety trends and to identify potential safety issues on KY 36 within the study area. The crash data was derived from data obtained from the Kentucky State Police (KSP) database. Five years of data (2016 to 2020) were used in the analysis. It should be noted that the crash data from 2020 (during the COVID-19 pandemic) appeared to have similar crash

characteristics as the previous years and was included in the analysis.

Within the five-year analysis period, 63 crashes were reported in the study area. A breakdown of the crashes by severity is presented in **Table 8** and is shown in **Figure 8**. As shown, there was 1 fatal crash and 2 serious injury crashes (4.8% combined) over the five-year period. Most crashes (50, 79.4%) were property damage-only crashes.

Table 8: KY 36 Crash Severity (2016-2020)

Severity of Crash	Crashes	Percent
Fatal Injury (K)	1	1.6%
Serious Injury (A)	2	3.2%
Minor Injury (B)	2	3.2%
Possible Injury (C)	8	12.6%
Property Damage Only (O)	50	79.4%
Total	63	100.0%

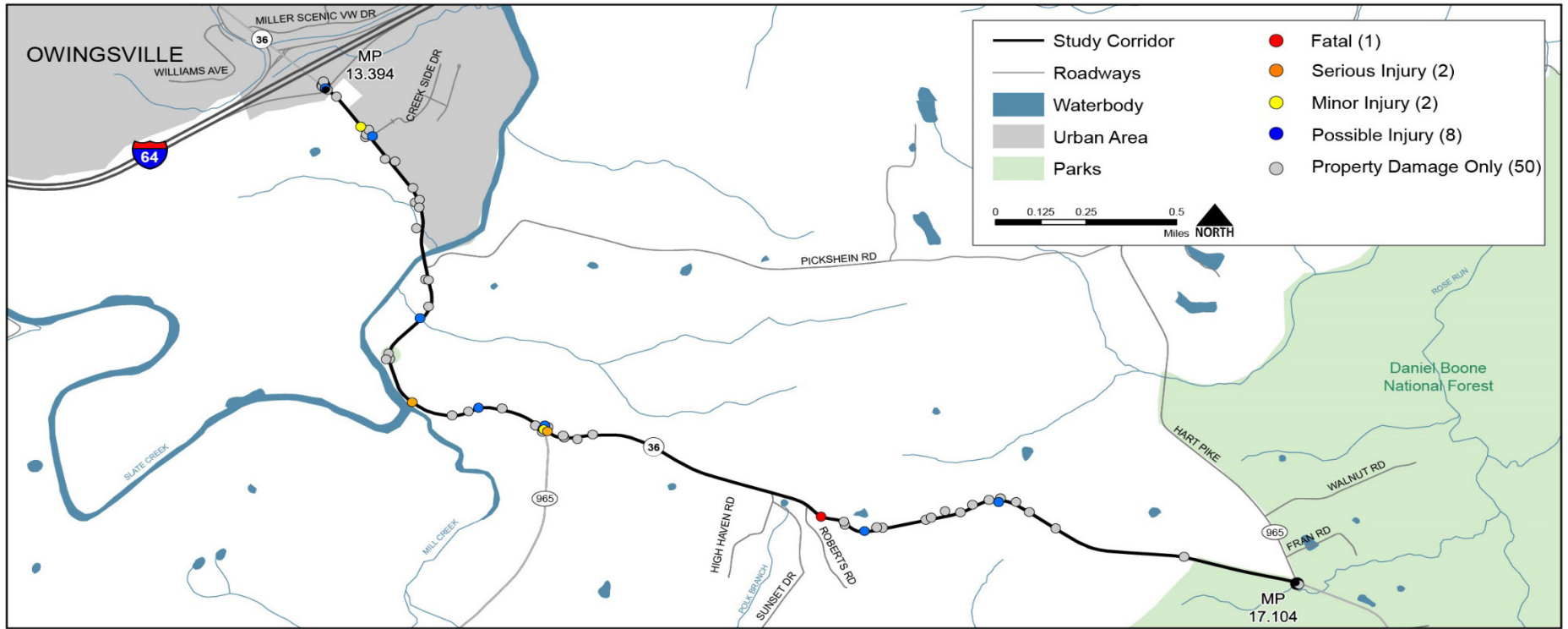
An examination of the crashes by manner of collision is presented in **Table 9**. Most crashes in the study area (36, 57.1%) were single vehicle crashes. This is consistent with the low volume rural nature of the study area. Rear-end crashes and angle crashes were the other two major crash categories. Single vehicle crashes had the highest average severity of

all the categories with three of the 36 involving a fatality or injury (1 fatal, 1 severe injury, and 1 minor injury). It was also noted that commercial vehicles were involved in only two crashes (3.2% of all reported crashes), which is a lower percent than their proportion of traffic volume on KY 36.

Table 9: KY 36 Crashes by Manner of Collision (2016-2020)

Manner of Collision	Crashes	Percent
Single Vehicle	36	57.1%
Rear End	11	17.5%
Sideswipe, Same Direction	1	1.6%
Angle	8	12.7%
Sideswipe, Opposite Direction	4	6.3%
Head On	2	3.2%
Opposing Left Turn	1	1.6%
Total	63	100.0%

Figure 8: Crash Severity by Location (2016-2020)



A further investigation of the single vehicle crashes, **Table 10**, showed a majority involved a vehicle leaving the roadway and striking an embankment / rock cut / ditch (41.7%). Wet pavement appeared to be a factor

in single vehicle crashes with 53% of these crashes occurring when the pavement was wet.

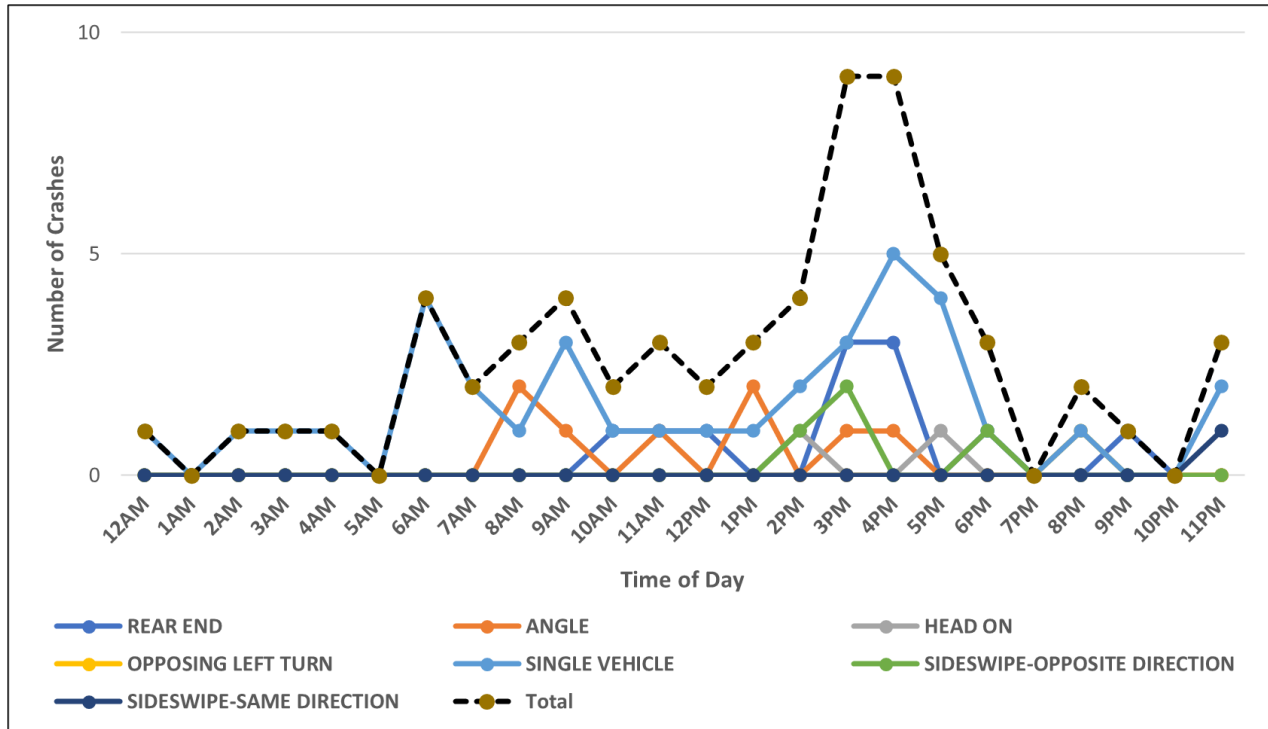
Table 10: Single Vehicle Crashes by Type (2016-2020)

Category	Single Vehicle Crashes	Percent Single Vehicle	Single Vehicle Wet Pavement Related	Percent Wet Pavement Related
Animal, Deer	3	8.3%	0	0%
Embankment, Rock Cut, Ditch	15	41.7%	10	66.7%
Overtaken	1	2.8%	0	0%
Fixed Object	4	11.1%	0	0%
Other On Shoulder	5	13.9%	4	80%
Other	8	22.2%	5	62.5%
Total	36	100.0%	19	53%

A review of crashes by time of day, **Figure 9**, shows that crashes peak in the afternoon, with the largest

number of crashes occurring between 3:00PM and 5:00PM.

Figure 9: Manner of Collision by Time of Day (2016-2020)



The location and density of crashes within the study area was also examined as illustrated in **Figure 10**. Crash density was generally highest in locations of horizontal / vertical curvature deficiencies or at intersections. The figure below specifies a few locations of high crash density in the study area. The fatal and serious injury crashes occurred in areas with geometric deficiencies, such as at Thomas Hill, or at intersections that have limited sight distance, such as at the KY 36 / KY 965 (Preston Road) intersection.

KY 36 segment crash rates were calculated using the 2016-2020 crash data and traffic volumes during this period. The crash rates were compared to statewide rural two-lane highway average crash rates². The analysis showed that KY 36 within the study area experienced a higher than average number of crashes per 100 million vehicle miles traveled (MVM) compared to similar type facilities throughout Kentucky. **Table 11** provides further crash rate analysis details.

Table 11: KY 36 Crash Rate Data

Count Station	County	Route	Begin MP	End MP	Count Year	AADT	# of Crashes	Crash Rate*	Statewide Average Crash Rate*	Ratio
006292	Bath	KY 36	13.279	14.882	2017	4,114	39	324	218**	1.48
006290	Bath	KY 36	14.882	17.104	2018	2,070	24	286	218**	1.31

*Rate per 100MVM

**Average statewide crash rate (5-year average) for two-lane rural highways per 100MVM for all crash severities

During the investigation of specific design issues, the historic crash data along with speed data were used to help identify potential safety related issues. This crash data were also used to determine the predicted safety benefits of improvement concepts and is presented in Chapter 7 of this report.

4.2 Excess Expected Crashes

KYTC and the Kentucky Transportation Center (KTC) have developed a more refined statistical methodology based on the Highway Safety Manual (HSM) to rank highway safety needs. Excess Expected Crashes (EEC) is based on a crash prediction model that estimates the number of crashes expected on a roadway segment of a given type and length. It represents the number of excess crashes a segment has experienced

compared to other roadways of its type, adjusting for traffic volumes, physical characteristics (for two-lane highways), and the actual crash history. EEC is positive when more crashes have occurred than were expected and negative when fewer crashes occurred than were expected.

The EEC values for KY 36 were obtained from KYTC and are color coded on **Figure 11**. KY 36 experiences a mixture of positive and negative EEC values. Positive EEC values (higher than expected crashes) are located in areas of geometric deficiencies and at intersections. Generally, the study area experiences a negative EEC value of -21.72 indicating it experiences fewer than the expected number of crashes.

Figure 10: KY 36 Crash Density Map (2016-2020)

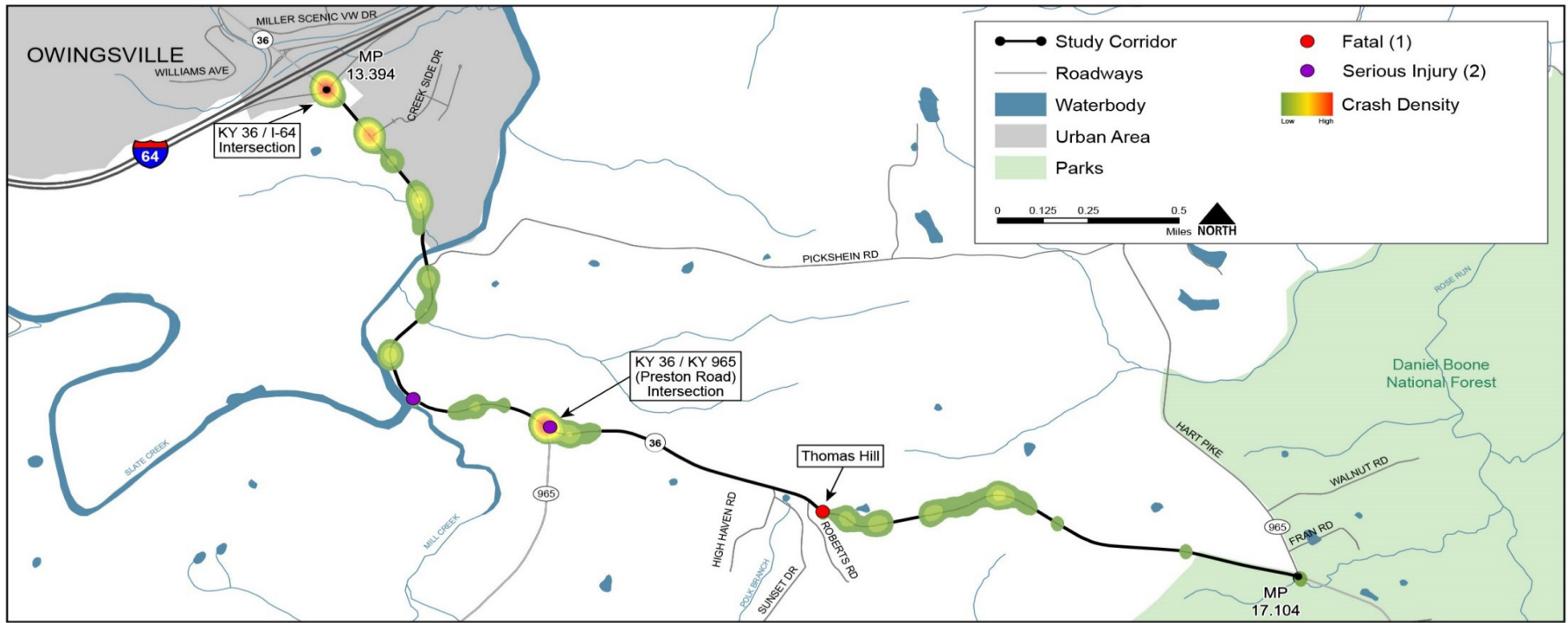
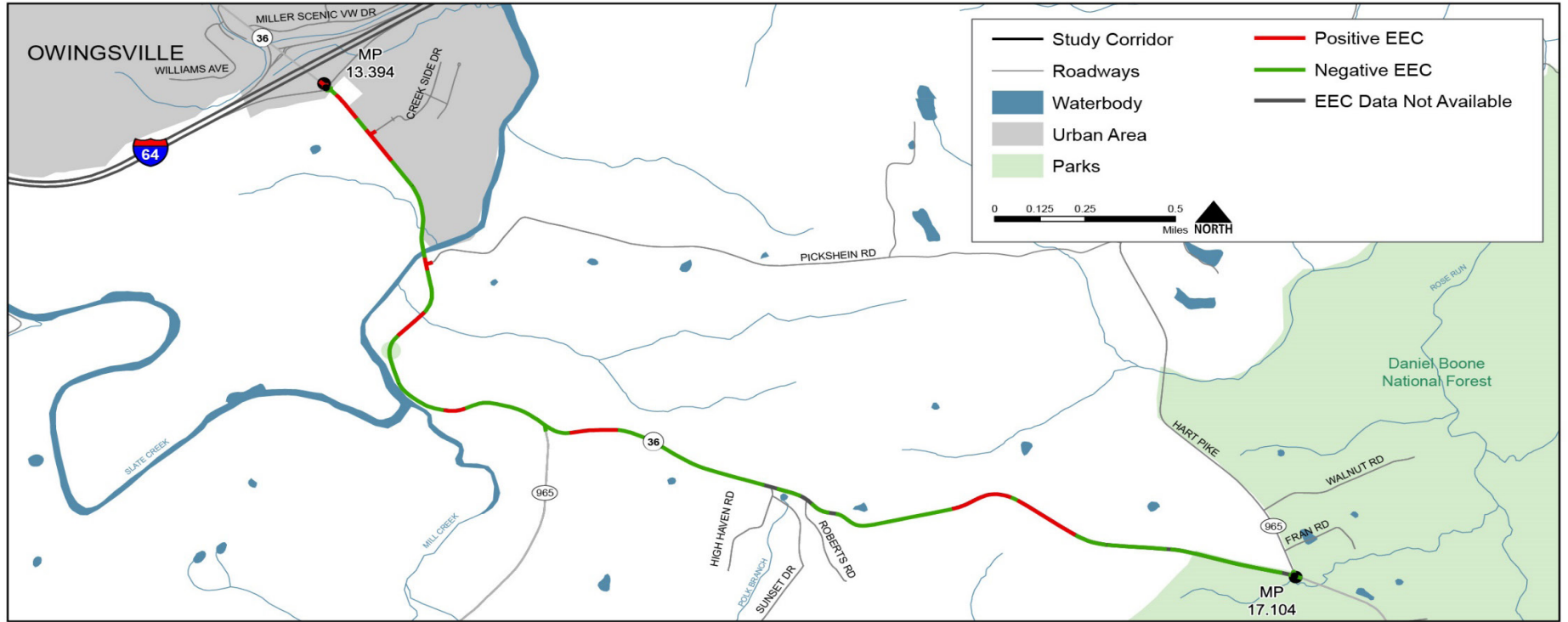




Figure 11: Areas with Positive (Poor) and Negative (Good) Excess Expected Crashes (EEC)



It was observed that the crash rate of KY 36 is above the statewide average (Table 11), but the EEC analysis showed fewer crashes than expected. The reason for this result is that the EEC analysis takes into account the narrow shoulders and sharp curves. (Note: EEC calculations for non-two-lane highways often do not take into account specific highway characteristics due to data limitations.) When compared to all two-lane highways across the state (including those that are straight and flat) the study area crash rate is above the average. However, the EEC analysis takes into consideration some of the key highway characteristics and the historical crash data to come up with an expected value. The highway is performing well compared to the resulting expected value. This does not mean that no safety improvements are warranted, but that the highway is operating well given its current configuration.

Breaking EEC down by intersection or segment reveals that both have experienced fewer crashes than expected. These results indicate that overall, KY 36 is operating better than would be predicted for a rural two-lane highway with similar traffic volumes. One caveat to the EEC data is that there are a few small segments between KY 965 (Preston Road) and KY 965 (Hart Pike) that do not have calculated EEC values.

4.3 Summary of Safety Issues & Use of Safety Data

A comparison of crash rates within the study area shows that KY 36 experiences more crashes than other rural two-lane roadways in the state. However, when variables such as lane width, shoulder width, traffic volume, and roadway curvature are considered, the EEC analysis indicates KY 36 is experiencing fewer crashes than would be expected on a similar type facility. The review of historic crashes has also shown that relationships exist between high crash segments / intersections and locations with geometric deficiencies and potentially limited sight distance. The review of speed data has yielded a relationship between locations where drivers are traveling in excess of the advisory speeds and an increase in crashes. The results for potential safety improvements at these locations are explored later in this report. The crash data, EEC information, and crash rates (calculated using the crash and volume data) were all used to evaluate the deficient locations and the possible improvements. An investigation was performed to determine if there was a relationship between a design issue (See Chapter 2) and safety.

(This page intentionally left blank)

5 Environmental Overview

Data were collected for an Environmental Overview (EO) based on existing geographic information system (GIS) datasets, state and federal agency databases, literature research, and archival data. Desktop research was performed to identify and locate areas of importance or concern that lie within a 500-foot buffer along KY 36 from I-64 to KY 965 (Hart Pike) including a larger bump out area from Pickshein Road to just east of the KY 965 (Preston Road) intersection near High Haven Road. Once resources were identified (**Figure 12**), those resources were considered within the context of improvement concepts and the potential for those concepts to impact the identified resources. The detailed EO is attached as **Appendix E**.

The EO considers resources in the following categories: ecological resources (i.e., streams, wetlands, and floodplains); threatened and endangered species and important habitats; air quality and noise issues; Environmental Justice (EJ) / socioeconomic data; land use; hazardous materials; and historic and archaeological resources.

A key consideration for all improvement concepts was whether they occur outside of existing right-of-way. Those occurring outside of existing right-of-way or creating ground disturbance have greater potential to impact natural and socioeconomic resources. Concepts ultimately chosen during the design phase will require in-depth analysis and review to provide National Environmental Policy Act (NEPA) location approval (NEPA documentation) before transitioning to future phases of project development.

5.1 Natural Environment

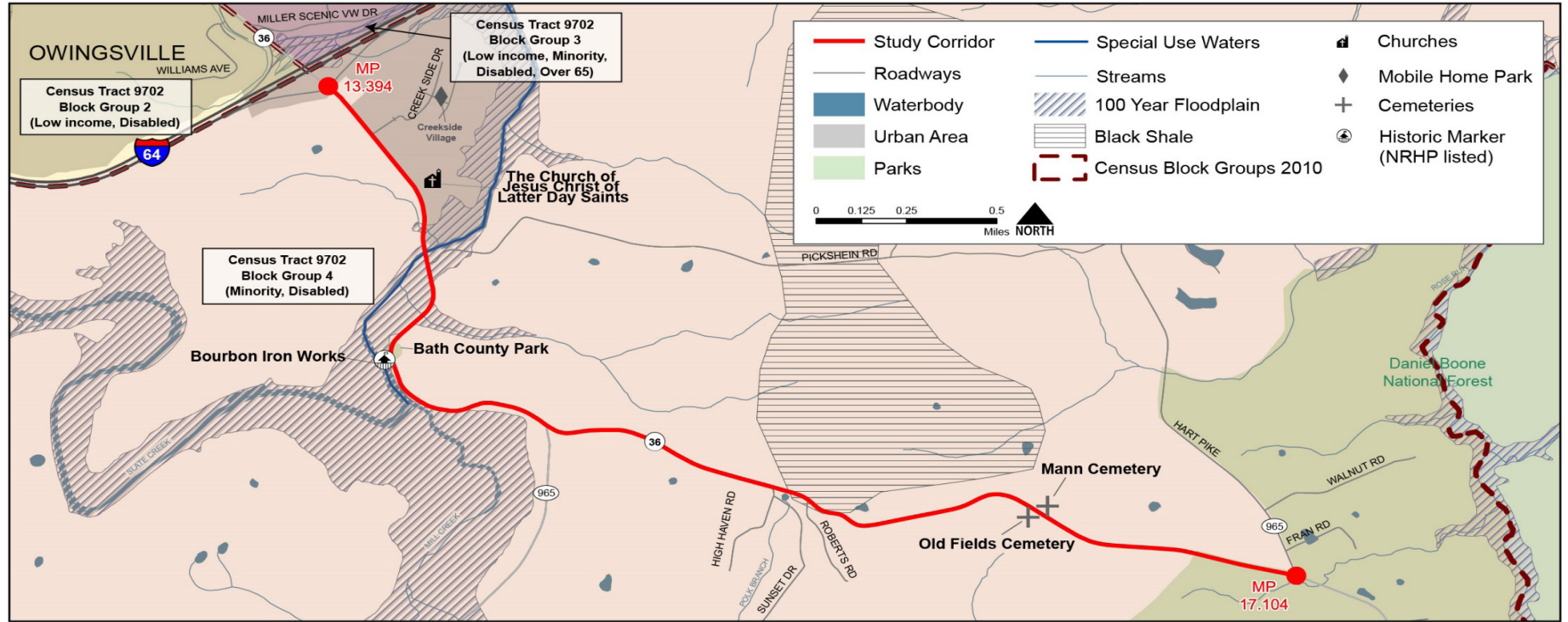
The natural environment includes ecological resources, threatened and endangered species and important habitats. The potential to encounter natural environment resources is considerable. The desktop review identified that potential habitats for threatened and endangered species are found throughout the study area. Similarly, five stream crossings including Slate Creek and Mill Creek, were readily identifiable within GIS datasets. Both Slate Creek, which is an Outstanding State Resource Water (OSRW), and Mill Creek have associated floodplains within the study area. Wetland areas were not identified on National Wetland Inventory (NWI) mapping, although farm

ponds are scattered throughout the study area and NWI mapping should be considered limited in its coverage. The study area near its eastern terminus includes portions of the Daniel Boone National Forest, which is an important habitat area. Finally, portions of the study area are underlain by black shale which can negatively affect aquatic resources when exposed to air and water.

The nature of improvement concepts considered as part of this study limit the potential impacts to these resources, since most will occur within existing right-of-way and within previously disturbed areas. The items below provide a brief summary of the potential natural environment impacts to consider as a result of some of the conceptual improvements which are described in Section 10 of this document. (*See Note page 36)

- ▶ **Concepts F1, F2, F3:** Realign KY 965 (Preston Road) to the west; shave back hillside on curve to meet sight distance requirements and realign KY 965 (Preston Road) (MP 14.9) – This improvement has the potential to impact the 100-year floodplain and bat habitat (trees).
- ▶ **Concept H:** Realign Thomas Hill to improve vertical and horizontal geometrics (MP 15.6-15.9) – Bat habitat (trees) may be impacted by this conceptual improvement; black shale, which can negatively impact aquatic resources, has potential to be exposed by construction activities.
- ▶ **Concept J:** Systemwide improvements which include the following: widen cross-section to 11-foot lanes with 2 foot paved shoulders / Realign curves to meet 45 mph design speed / Add guardrail, safety headwalls at culverts, and / or extend culverts / 6 inch Thermoplastic Striping / Proper curve warning sign placement and chevron placement / Fix superelevation on bridge over the Slate Creek / Realign Pickshein Road for better sight distance / Replace pipes under gravel driveways and improve slope stability / Reduce skew of KY 965 (Hart Pike) intersection - these various system improvements create potential for impacts to Slate Creek (OSRW) and associated mussel habitat, bat habitat (trees), 100 year floodplain, and black shale. Impacts will require use of erosion controls where impacts may occur.

Figure 12: Study Area Existing Environmental Conditions



5.2 Human Environment

The human environment includes air quality and noise issues; EJ / socioeconomic data; land use / farmland; hazardous materials; and historic and archaeological resources. As with the natural environment, the potential for the improvement concepts to impact human made considerations is limited by the fact that most improvements would likely occur within existing right-of-way or within previously disturbed areas. However, conceptual improvements do create impacts, particularly where right-of-way may be required, for cultural resources including National Register of Historic Places (NRHP) listed (Bourbon Iron Works) and potential NRHP Eligible (Undetermined Structure BH 472-476) sites along with potential archaeological resources. These sites may also be Section 4(f) resources. Similarly, the publicly-owned Bath County Park is both a Section 4(f) (public park protected by Section 4(f) of the USDOT Act of 1966) and Section 6(f) (public park receiving Land and Water Conservation funds) resource. EJ populations are also a consideration relative to minority, low-income, elderly, limited English proficiency, and disabled populations in the study area.

The Gateway Area Development District (GADD) prepared the KY 36 Corridor (I-64 to KY 965 / Hart Pike): Bath County Socioeconomic Study to assess EJ populations that must be considered in any future NEPA document. The report used 2019 U.S. Census Bureau American Community Survey (ACS) data. The GADD reported data for the U.S., Kentucky, Bath County and the three census tract block groups (CT BG) that include the study area. BGs are all within CT 9702. The GADD Socioeconomic Study, which can also be found in **Appendix E**, noted the following:

- ▶ There is a concentration of poverty, low median household income, persons over the age of 65, and persons with a disability in Block Group 3 of the study area.
- ▶ There are significant poverty and low-income populations in Block Groups 2 and 3 compared to the national and state populations.
- ▶ There are larger minority populations in Block Groups 3 and 4 compared to the county and regional populations.
- ▶ There are significant disabled populations in Block Groups 2, 3, and 4 compared to the national and state populations.

The items below provide a brief summary of the potential human impacts to consider relative to some of the conceptual improvements. Conceptual improvements not included in the list are not anticipated to lead to impacts to the human environment.*

- ▶ **Concept B:** Improve vertical geometrics at Creek Side Drive and add SB Left Turn Lane (MP 13.5) – Conceptual improvements may require an archaeological survey and consideration of EJ populations.
- ▶ **Concepts F1, F2, F3:** Realign KY 965 (Preston Road) to the west; shave back hillside on curve to meet sight distance and realign KY 965 (Preston Road) (MP 14.9) – This improvement has potential to necessitate an archaeology survey and consideration of EJ populations.
- ▶ **Concept H:** Realign Thomas Hill to improve vertical and horizontal geometrics (MP 15.6-15.9) – Conceptual improvements at this location may necessitate an archaeological survey and consideration of EJ populations.
- ▶ **Concept J:** Systemwide improvements which include the following: widen cross-section to 11' lanes with 2' paved shoulders / Realign curves to meet 45 mph design speed / Add guardrail, safety headwalls at culverts, and/or extend culverts / 6" Thermoplastic Striping / Proper curve warning sign placement and chevron placement / Fix superelevation on bridge over the Slate Creek / Realign Pickshein Road for better sight distance / Replace pipes under gravel driveways and improve slope stability / Reduce skew of KY 965 (Hart Pike) intersection – The various system improvements create potential for impacts necessitating an archaeological survey; consideration of Bath County Park which is a Section 4(f) and 6(f) resource; consideration of the Bourbon Iron Works NRHP listed site and the potential NRHP Eligible Undetermined Structure (BH 472-476); consideration of the Old Field Cemetery, and potential for impacts to EJ populations.

*Note: Conceptual improvements not included in the bulleted lists for the *Natural Environment* and *Human Environment* discussions above are not anticipated to lead to environmental impacts but would need to be evaluated during any future project development.



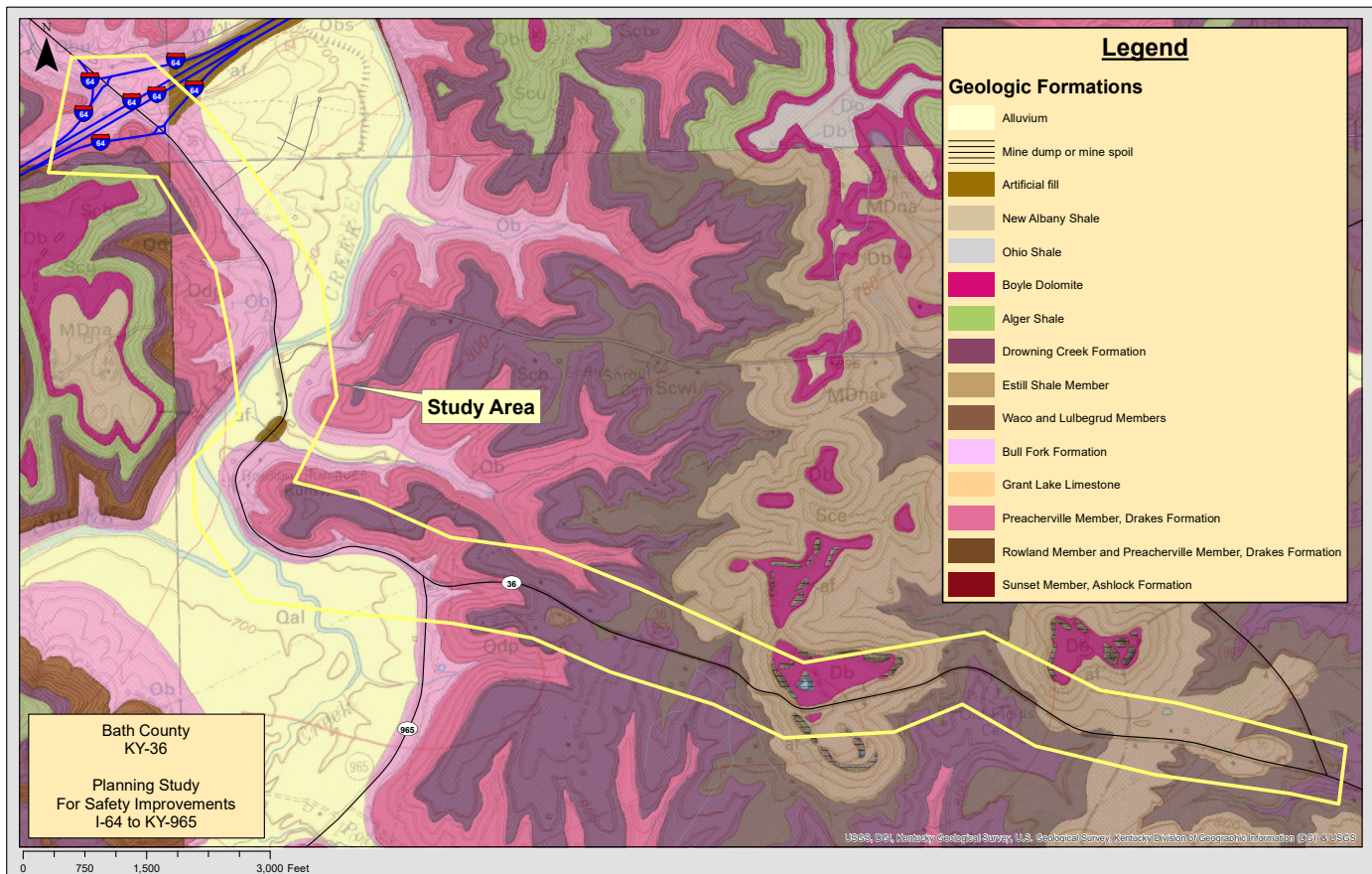
(This page intentionally left blank)

6 Geotechnical Overview

KYTC provided a geotechnical overview of the study area, included in Appendix F. The overview includes information about the topography and drainage, stratigraphy, soils and unconsolidated materials, geologic structures and hazards, and mines and quarries in the study area vicinity. Figure 13 shows geologic formations in the study area buffer. The overview found small-scale geotechnical concerns that may impact spot improvements or alignment changes. These include:

- ▶ A detailed geotechnical exploration for areas involving widening existing cuts or creating new cut slopes.
- ▶ Special consideration for embankments due to unstable fill slopes.
- ▶ Stabilization to accommodate saturated, soft, or unstable soils.
- ▶ Inventory of water wells and springs.
- ▶ Treatment of any ponds within construction limits.
- ▶ A detailed geotechnical exploration of any areas mined for Iron Ore prior to 1894.
- ▶ Consideration for the embankment on the south side of KY 36 between MP 14.4 and 14.5 which experienced a landslide in 1997 and continues to move.

Figure 13: Geologic Formations in the Study Area



(This page intentionally left blank)

7 Stakeholder Outreach

In addition to project team meetings between the Consultant Team, KYTC, and the ADD, outreach for this project included a meeting with local elected officials, as well as coordination with resource agencies. To obtain feedback from the general public, a survey was conducted. Meeting minutes for all meetings can be found in **Appendix G**, along with the responses agencies and public survey..

7.1 Local Elected Officials and Stakeholders Meeting

The project team reached out to LEOs to obtain feedback about known issues along the corridor. An LEO meeting was held at the Bath County Fiscal Court on December 1, 2021 at 10:00am. Attendees included the Judge Executive, representatives of the Bath County School Board, Bath County Emergency Management, Bath County Sherriff, and the Owingsville Police Department. The project team shared an overview of existing conditions throughout the study area and received valuable feedback from the LEO about areas of concern and high priority for improvements.

7.2 Public Survey

A public survey was created using MetroQuest to obtain feedback from the general public regarding priorities and concerns along the corridor, as well as opportunities for improvement. The survey was open between December 1, 2021, and January 23, 2022. A link to the survey was posted on the District 9 website. Additionally, the Bath County Emergency Management Department generated a one call to share the website with citizens in the area, and other local officials helped promote the survey through their channels of communication. A Facebook boost was used on January 11, 2022, to increase visibility of the

survey. There were 392 responses to the survey. The top concerns along the corridor were the Creekside Drive intersection, the curve around the Slate Hill Furnace, the KY 965 (Preston Road) intersection, the Thomas Hill curve, and another curve between MP 16.1 and 16.3. More detailed results from the survey can be found in **Appendix G**. The project team used information gathered from the survey to develop potential improvement concepts.

7.3 Project Team Meeting #1

After receiving feedback from the LEOs, the project team developed an initial list of potential improvement concepts. These were presented at the first project team meeting on February 9, 2022, at 10:00am. KYTC provided feedback on the concepts presented and held an internal meeting to further discuss which projects to group together, which to evaluate as standalone projects, which to evaluate as part of an overall corridor improvement concept, and which to remove from further consideration. This feedback was used by the consultant team to further refine the improvement concepts and perform a detailed evaluation.

7.4 Project Team Meeting #2

A second project team meeting was held on April 27, 2022, at 9:00am. This was a hybrid virtual and in person meeting. The purpose of this meeting was to present the detailed evaluation of the refined list of potential improvement concepts. The project team provided feedback on which projects to advance and which to remove from further phases of project development.

7.5 Resource Agency Coordination

Resource agency coordination was important for the study and included coordinating with state, local, and federal agencies to obtain feedback on any known resources or constraints in the study area that may impact future phases of project development. A project summary and maps to summarize the traffic and safety conditions, as well as environmental overview were provided to the Resource Agencies so they could provide comment. Resource Agency / Stakeholder Listing and Agency response comments are included in Appendix G.

- ▶ Kentucky Energy and Environment Cabinet, Department for Environmental Protection – Response from Louanna Aldridge, Staff Assistant in the Office of the Commissioner. Provided aggregated responses from the Division of Enforcement, Division of Water, Division of Waste Management, Division for Air Quality, and Kentucky Nature Preserves. No concerns were expressed but Slate Creek was pointed out as an Outstanding State Resource Water, and the area has a high likelihood of Karst.
- ▶ Kentucky Energy and Environment Cabinet, Department of Natural Resources, Division of Conservation – Response by Courtney Skaggs. No comments or objections.
- ▶ Kentucky Department of Natural Resources, Division of Conservation – Response from Paulette Akers. No purchase of agricultural conservation easements or agricultural districts in the area of potential the construction.
- ▶ Cabinet for Health and Family Services (CFHS), Division of Prevention and Quality Improvement – Response from Troy Hearn, Health Program Administrator. Troy provided a very detailed Health Impact Assessment.
- ▶ Energy and Environment Cabinet, Department of Natural Resources, Division of Forestry – Response from Brandon Howard. There are no development or conservation plans in the area.
- ▶ Energy and Environment Cabinet, Office of Kentucky Nature Preserves – Response from Alexis Schoenlaub. There are no endangered, threatened or special concern plants or animals, or exemplary communities in the study area.
- ▶ Kentucky Department of Parks – Response from Ron Vanover. No concerns since there are no state parks in the study area.
- ▶ U. S. Army Corps of Engineers, Louisville District – Response from Norma Castillo Condra. Requested longitude and latitude for the project by no concerns were conveyed, and advised that a Department of the Army permit may be required since Slate Creek qualifies as a “water of the U.S”.
- ▶ Kentucky Airport Zoning Administration, Department of Aviation – Response from Brad Schwandt. No jurisdiction or airway safety issues are present in the study area.
- ▶ Kentucky State Police, Division of Commercial Vehicle Enforcement – Response from Major Nathaniel Day. No concerns were expressed.
- ▶ United States Department of Agriculture, Kentucky Natural Resources Conservation Service – Response from C. Gregory Stone. No concerns were expressed.

8 Development of Potential Improvement Concepts

Using the existing conditions, traffic and safety analysis, along with input from LEOs and the public survey, an initial list of potential improvement concepts was developed and presented to the project team. *A high-level analysis of each concept was performed, determining the following:*

1. **Time Frame:** Short-term or long-term
2. **Cost:** Low, medium, or high
3. **Safety:** Existing safety concerns
4. **Right-of-Way:** Potential need for right-of-way
5. **Stakeholder Input:** Location of concern identified by stakeholders
6. **Environment:** Potential environmental issues (if any)

During the first project team meeting the team decided not to move forward with certain options based on the information presented and discussed (meeting minutes are included in **Appendix G**). Additionally, the KYTC Central Office Planning and District 9 teams met to provide guidance on any additional concepts to exclude from further analysis, which to move forward and group together, and which might be included as part of an overall corridor improvement project but should not be considered as standalone concepts. This list is shown in **Table 12**. Following the initial screening by the project team, the concept designations / nomenclature were revised for future evaluation.

Table 12: Initial List of Potential Improvement Concepts

Concept	MP	Description	Don't proceed forward, document as look at but eliminated from consideration.	Proceed forward with further investigation.	List as recommendations with larger full corridor project(s).	Group as one recommendation.
1	13.4	Remove channelization of RT at I-64 EB off-ramp / move signs / clear brush		X		!
2	13.4	Roundabout at I-64 EB Off Ramp	X			
3	13.5	Close the gravel access road at Sav A Lot	X			
4	13.5	Remove the 55 mph speed limit sign before Creekside, keep 45 mph speed limit	X			
5	13.5	Improve vertical geometrics at Creekside		X	X	!
6	13.5	SB Left Turn Lane		X	X	!
7	13.5-14.0	Widen shoulders to 2' paved, add rumble strips, remove passing zone between Pickshein & Sav A Lot		X	X	
8	14	Fix super on bridge - should be in a transition	X		X	
9	14	Realign Pickshein Road for better sight distance	X		X	
10	14.1	Solar flashing advisory speed sign		X		
11	14.1-14.2	Widen / build up shoulder / flatten out side slope	X			
12	14.2-14.8	Add chevrons and upgrade to solar flashing advisory speed sign around the curve / improve guardrail and add reflectors / pavement markers and/or thermoplastic paint / 6" paint		X		
13	14.2-14.8	Improve vertical and horizontal geometrics around the curve / reduce design speed (green alignment)		X		\$
14	14.8-15.0	Realign KY 965 and improve alignment to the east on the teal blue alignment		X		\$
15	14.0-15.2	Realign KY 36 in front of house (fixes 965 and alignment immediately to the east). Full realignment of hill on purple alignment		X		\$
16	15.2	Realign KY 36 behind house (fixes 965 and alignment immediately to the east). Full realignment of hill on blue alignment		X		\$
17	14.7-15.2	Realign KY 36 to remove sharp curve and tie in 965 (behind two houses) on orange alignment		X		\$
18	14.9	Realign KY 965 to the west (intersection in agricultural field)		X		%

*The various symbols in the "Group as one recommendation" column show which concepts should be grouped together. Concepts with the same symbol should be moved forward as one concept.

Table 12: Initial List of Potential Improvement Concepts (cont'd)

Concept	MP	Description	Don't proceed forward, document as look at but eliminated from consideration.	Proceed forward with further investigation.	List as recommendations with larger full corridor project(s).	Group as one recommendation.
19	14.9	Realign KY 965 slightly to the west and roundabout intersection. Improve KY36 line of sight	X			
20	14.9-15.0	Shave back hillside on inside of curve to meet sight distance		X		%
21	13.5-15.0	Widen shoulders to accommodate Amish (could add center rumbles)	X		X	
22	15.1	Improve 35 mph crest curve at top of hill	X		X	
23	15.5	Improve 25 mph sag curve (flooding issues?)	X		X	
24	15.6-15.9	Add chevrons / solar flashing advisory speed sign / pavement markers and/or thermoplastic paint / 6" paint		X	X	&
25	15.6-15.9	Realign Thomas Hill to improve vertical and horizontal geometrics		X	X	&
26	15.9-16.2	Replace pipes under gravel driveways and improve slope stability		X	X	#
27	16.14	Improve Drainage at driveway		X	X	#
28	16.1-16.3	Add solar flashing advisory speed sign / pavement markers and/or thermoplastic paint / 6" paint around curve		X	X	#
29	16.1-16.3	Widen shoulders and provide roadside recovery around curve		X		#
30	16.1-16.3	Realign curve		X		#
31	17.1	Clear back brush / add intersection warning signage at Hart Pike		X		
32	17.1	Reduce skew of Hart Pike intersection	X		X	
33	System	Reduce Speed Limit to 45 mph throughout	X			
34	System	6" Thermoplastic Striping	X		X	
35	System	Widen cross section to 11' lanes with 2' paved shoulders		X	x	
36	System	Add guardrail, safety headwalls at culverts, and/or extend culverts	X		x	
37	System	Proper curve warning sign placement and chevron placement	X		x	

*The various symbols in the "Group as one recommendation" column show which concepts should be grouped together. Concepts with the same symbol should be moved forward as one concept.



(This page intentionally left blank)

9 Evaluation of Potential Improvement Strategies

The initial list of improvement concepts was shortened based on the feedback from the project team to a more refined list for a detailed evaluation. Each potential improvement concept was evaluated with respect to safety, right of way impacts, environmental impact, and cost estimates. **Table 13** shows the results of the evaluation, including construction costs for each option (in 2022 dollars), the amount of right of way required (in acres), the benefit / cost ratio based on predicted safety benefit, the safety method using Crash Modification Factor (CMF) or Safety Performance Function (SPF), estimated percentage of crashes reduced, the 20-year total crash reduction, and environmental impacts. This information was shared with the project team at the second project team meeting, along with conceptual drawings for each, which are provided in **Appendix H**.

A predictive safety analysis was performed to estimate the potential reduction in crashes over a 20-year period that each improvement concept could provide. This analysis used one of two approaches: 1) a CMF was directly applied to applicable historic crashes or 2) KTC's two-lane highway SPF was used to estimate a change in crashes that was then applied to the historic crashes. The safety performance of

concepts that changed the roadway geometrics, such as horizontal or vertical alignment, lane width, or shoulder width were evaluated using the SPF for rural two-lane highways developed by KTC³. For the SPF analysis, the predicted crashes with and without the proposed improvement were compared to estimate the number of crashes prevented over a 20-year period. The CMF analysis approach was used for improvement options that could not be estimated using the SPF method. For these improvements, applicable CMFs were identified from the Highway Safety Manual or the CMF Clearinghouse⁴. The CMFs were used to estimate the number of crashes prevented over a 20-year period.

A simple benefit cost analysis was conducted to determine the value each improvement concept provided. This analysis used the predicted 20-year crash reduction, and the construction cost estimates. The value of crashes prevented in **Table 13** were based on United States Department of Transportation (USDOT) average crash cost (in 2019 dollars) by crash severity. Crashes and construction costs were all inflated to the same year for an equal comparison of both variables.

3 "Safety Analysis for SHIFT Implementation" by Reginald R. Souleyrette, Riana Tanzen et al. (uky.edu)
4 <http://www.cmfclearinghouse.org/>

Table 13: Refined List of Potential Improvement Concepts for Detailed Evaluation

MP	Project Sheet	Description	Construction Cost 2022 (\$)	ROW req'd (acres)	Benefit / Cost	Safety Method*	CMF / Severity	CMF ID	Overall Crash Reduction %	Total 20-Year Reduction	Environmental
13.4	A	Remove channelization of RT at I-64 EB off-ramp / move signs / clear brush	\$40,000	0	0.6	CMF	0.92 All Crashes	8866	8%	5	None
13.5		Remove the 55 mph speed limit sign before Creekside, keep 45 mph speed limit									
13.5	B	Improve vertical geometrics at Creekside and add SB LT Lane	\$265,000	0.87	0.9	CMF	0.56 All Crashes	253	44%	11	Archaeological survey
13.5-14.0	C/N	Widen shoulders to 2' paved, add rumble strips, remove passing zone between Pickshein & Sav A Lot	\$522,000	2.5	0.0	CMF	0.87 All Crashes	5164, 5162	13%	4	Archaeological Survey, Slate Creek OSRW, erosion control, mussels, 100 yr floodplain
14.1	D	Solar flashing advisory speed sign	\$5,000	0	0.3	CMF	0.82 All Crashes	2431	18%	1	None
14.2-14.8	E	Add chevrons and upgrade to solar flashing advisory speed sign around the curve / improve guardrail and add reflectors / pavement markers and/or thermoplastic paint / 6" paint	\$50,000	0	5.6	CMF	0.82 All Crashes	2431	18%	6	Bath County Park 4(f) and 6(f) resource, Bourbon Iron Works NRHP listed, 100 yr floodplain
14.2-15.2	F	F1-Realign KY 36 behind house (fixes 965 and alignment immediately to the east); F2-Realign KY 36 in front of house (fixes 965 and alignment immediately to the east); F3-Improve vertical and horizontal geometrics around the curve / reduce design speed; F4-Realign KY 36 to remove sharp curve and tie in 965 (behind two houses) on orange alignment; F5-Realign KY 965 and improve alignment to the east;	F1: \$3,019,000 F2: \$2,720,000 F3: \$2,017,000 F4: \$4,543,000 F5: \$612,000	F1: 12.6 F2: 15.7 F3: 1.83 F4: 11.44 F5: 1.53	F1 = 0.8 F2 = 0.4 F3 = 0.3 F4 = 0.2 F5 = 1.8	SPF - Rural 2Lane	N/A	N/A	F1 = 22% F2 = 11% F3 = 4% F4 = 9% F5 = 10%	F1 = 63 F2 = 33 F3 = 12 F4 = 27 F5 = 36	Archaeological Survey, Bat habitat (trees); Bath County Park 4(f) and 6(f) resource, Bourbon Iron Works NRHP listed, 100 yr floodplain
14.9	G	Realign KY 965 to the west - 2 options	G1: \$1,280,000 G2: \$1,571,000	G1: 3.4 G2: 9.3	G1 = 0.4 G2 = 0.4	SPF - Rural 2Lane	N/A	N/A	G1 = 6% G2 = 5%	G1 = 17 G2 = 14	Archaeological Survey, 100 yr floodplain
14.9-15.0	H	Shave back hillside on inside of curve to meet sight distance	\$78,000	0.75	0.0	CMF	0.82 All Crashes	6868	18%	1	Archaeological Survey, Bat habitat (trees)
15.6-15.9	I	Add chevrons / solar flashing advisory speed sign / pavement markers and/or thermoplastic paint / 6" paint	\$30,000	0	149.5	CMF	0.82 All Crashes	2431	18%	4	None
15.6-15.9	J	Realign Thomas Hill to improve vertical and horizontal geometrics	\$896,000	1.72	15.9	SPF - Rural 2Lane	N/A	N/A	3%	9	Archaeological Survey, Bat Habitat (trees), Black Shale geology, Noise Screening Tool
16.1-16.3	K	Add solar flashing advisory speed sign / pavement markers and/or thermoplastic paint / 6" paint around curve	\$30,000	0	1.3	CMF	0.82 All Crashes	2431	18%	5	None
16.1-16.3	L	Widen shoulders and provide roadside recovery around curve; Realign Curve	Widen: \$422,000 Realign: \$624,000	Widen: 0.59 Realign: 1.39	Widen = 0.2 Realign = 0.1	SPF - Rural 2Lane	N/A	N/A	Widen = 3% Realign = 5%	Widen = 7 Realign = 14	Archaeological Survey, Old Fields Cemetery Potentially NRHP Eligible Structures, Black Shale geology, Noise Screening tool
17.1	M	Clear back brush / add intersection warning signage at Hart Pike	\$10,000	0	0.1	CMF	0.86 All Crashes	5188	14%	1	Bat Habitat (Trees)
System	N	Widen cross section to 11' lanes with 2' paved shoulders / Realign curves to 45 mph design speed / Add guardrail, safety headwalls at culverts, and/or extend culverts / 6" Thermoplastic Striping / Proper curve warning sign placement and chevron placement / Fix super on bridge over the Licking River / Realign Pickshein Road for better sight distance / Replace pipes under gravel driveways and improve slope stability / Reduce skew of Hart Pike intersection	\$6,871,000	35	0.1	CMF	0.81 All Crashes	5176, 5178	19%	28	Archaeological Survey, Slate Creek OSRW, Bat Habitat (trees) Bath County Park 4(f) and 6(f) resource, Bourbon Iron Works NRHP listed, Slate Creek OSRW, erosion control, mussels, 100 yr floodplain, Bat habitat (trees), Old Field Cemetery, Potentially NRHP Eligible Sites
13.5-15.0	N2	Widen shoulders to accommodate Amish (could add center rumbles)	\$5,470,000	X	0.1	CMF	0.77 All Crashes	5164	23%	23	Archaeological Survey, Slate Creek OSRW, Bath County Park 4(f) and 6(f) resource, Bourbon Iron Works NRHP listed, 100 yr floodplain, Bat Habitat (trees)

*Indicates the predictive safety analysis method used to determine the overall crash reduction percentage and overall 20-year reduction in crashes.



10 Study Recommendations

After discussing the refined list of potential improvement concepts, the project team decided which concepts to recommend for future project development, in addition to making some minor modifications to certain concepts. One modification included updating the benefit / cost of these refined improvement concepts by using recently published USDOT crash costs in 2020 dollars. The final list of concepts to move forward is shown in **Table 14**.

10.1 Project Sheets

Project sheets were created for each improvement concept that was recommended for future project development. Project sheets provide information on the issue identified, the improvement concept, the

safety benefits and a cost estimate that includes Design, Right of Way, Utilities and Construction (DRUC) costs. Upon completion of this study, selected recommended improvement concepts will be moved through project development. The evaluation performed in this study gave the district enough information to prioritize recommendations, therefore a formal categorization of short-term vs. long-term and low-, medium-, and high-priority is not needed. There are funds for future project development phases of this corridor in Kentucky's *Six-Year Plan*.

Project sheets can be found on pages 51-61. Project sheet E is missing.

11 Next Steps

There is funding available for the next phases of this project in the biennium of the *Six Year Plan*. KYTC District 9 will determine which of the recommended improvement concepts should be moved forward to the design phase based on the available funding.

11.1 Contacts

Written requests for additional information should be sent to the KYTC Division of Planning Director, 200 Mero Street, Frankfort, Kentucky 40622.

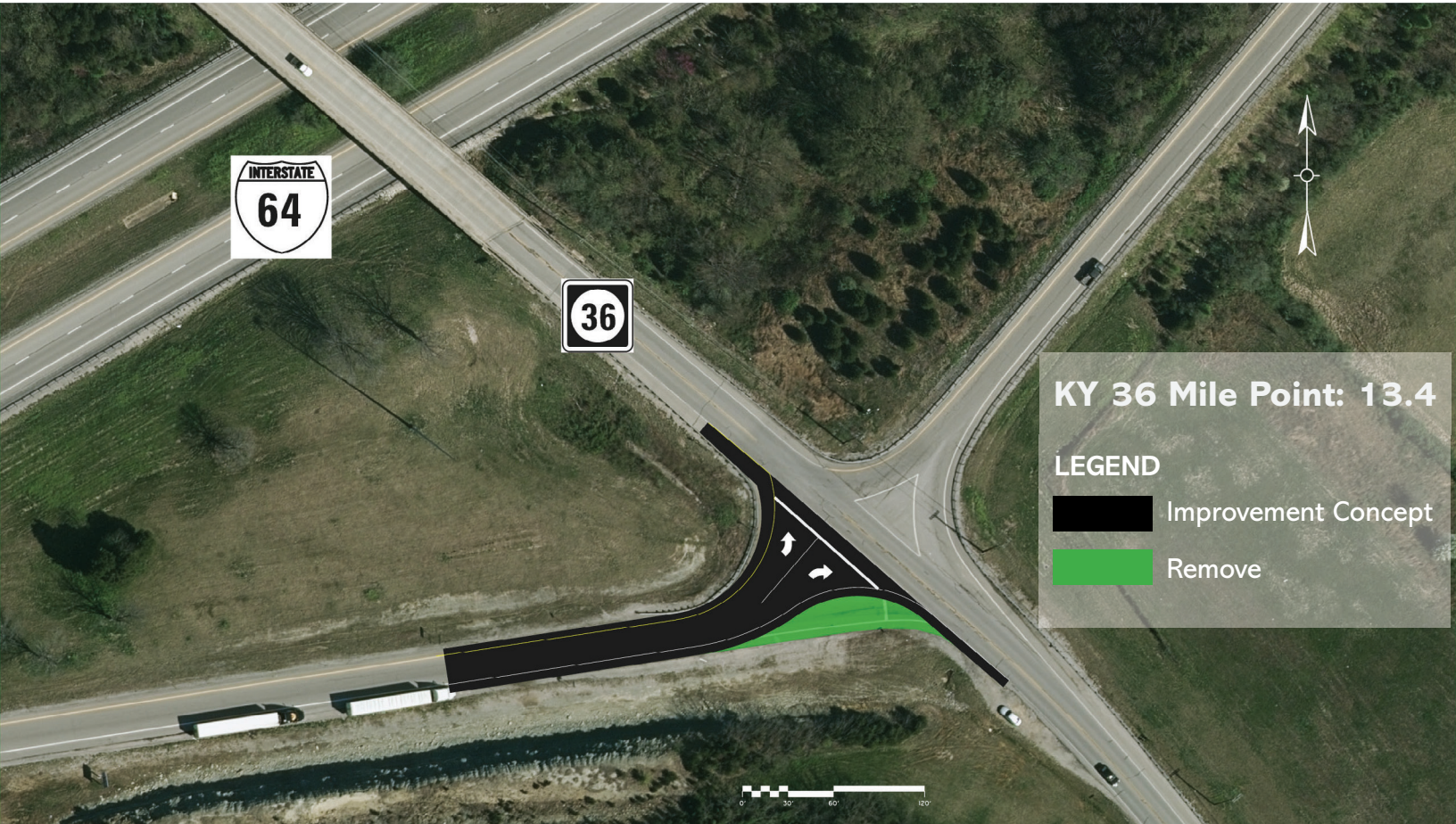
Table 14: Final List of Recommended Projects

MP	Project Sheet	Description	Total Cost 2022 (\$)	Design Cost 2022 (\$)	Right of Way Cost 2022 (\$)	Utility Cost 2022 (\$)	Construction Cost 2022 (\$)	ROW req'd (acres)	Benefit / Cost	Total 20-Year Reduction	Environmental
13.4	A	Remove channelization of RT at I-64 EB off-ramp / move signs / clear brush	\$44,000	\$4,000	\$0	\$0	\$40,000	0	3.7	26.0	None
13.5	B	Improve vertical geometrics at Creekside and add SB LT Lane	\$386,500	\$26,500	\$35,000	\$60,000	\$265,000	0.87	0.8	11.1	Archaeological Survey, EJ (minority, disabled)
13.5-14.0	C/N	Add edge-line rumble strips and remove passing zone between Pickshein & Sav A Lot	\$31,000	\$0	\$0	\$0	\$31,000	0	0.1	0.7	None
14.1	D	Install advisory speed sign	\$2,500	\$0	\$0	\$0	\$2,500	0	1.3	1.2	None
14.2-14.8	E	Add chevrons and upgrade to solar flashing advisory speed sign around the curve / improve guardrail and add reflectors / pavement markers and/or thermoplastic paint / 6" paint	\$50,000	\$0	\$0	\$0	\$50,000	0	7.5	6.1	None
14.9	F	F1 (Formerly G-1, remove KY 36 realignment)-Realign KY 965 to the west; F2 (Formerly F-5) - Realign KY 965 to the east; F3 (formerly H with a modification) - Shave back hillside on curve to meet sight distance and realign KY 965	F1: \$353,700 F2: \$774,400 F3: \$463,100	\$21,500 \$61,200 \$30,500	\$87,200 \$61,200 \$117,600	\$30,000 \$40,000 \$10,000	\$215,000 \$612,000 \$305,000	2.19 1.53 2.94	1.5 1.4 1.2	8.1 23.4 8.1	Archaeology Survey, 100 yr. floodplain, EJ (minority, disabled)
15.6-15.9	G	Add chevrons / solar flashing advisory speed sign / pavement markers and/or thermoplastic paint / 6" paint	\$30,000	\$0	\$0	\$0	\$30,000	0	199.5	4.5	None
15.6-15.9	H	Realign Thomas Hill to improve vertical and horizontal geometrics	\$1,074,400	\$89,600	\$68,800	\$20,000	\$896,000	1.72	16.9	9.6	Archaeology Survey, Bat habitat (trees), Black Shale, EJ (minority, disabled)
16.1-16.3	I	Add solar flashing advisory speed sign / pavement markers and/or thermoplastic paint / 6" paint around curve	\$30,000	\$0	\$0	\$0	\$30,000	0	1.7	5.3	None
System	J	Widen cross section to 11' lanes with 2' paved shoulders / Realign curves to 45 mph design speed / Add guardrail, safety headwalls at culverts, and/or extend culverts / 6" Thermoplastic Striping / Proper curve warning sign placement and chevron placement / Fix super on bridge over Slate Creek / Realign Pickshein Road for better sight distance / Replace pipes under gravel driveways and improve slope stability / Reduce skew of Hart Pike intersection	\$9,758,100	\$687,100	\$1,400,000	\$800,000	\$6,871,000	35	0.1	45.4	Archaeological Survey, Slate Creek (OSRW), Bat Habitat (trees) Bath County Park 4(f) and 6(f) resource, Bourbon Iron Works NRHP listed, Slate Creek OSRW, erosion control, mussels, 100 yr floodplain, Bat habitat (trees), Old Field Cemetery, black shale, Potentially NRHP Eligible Undetermined Structure (BH 472-476), EJ (minority, disabled)

KENTUCKY 36 CORRIDOR STUDY

BATH COUNTY, KY

PROJECT SHEET A



COST \$44,000

D \$4,000

R \$0

U \$0

C \$40,000



BENEFIT/COST RATIO: 3.7

RIGHT-OF-WAY REQUIRED?: NO

CRASH REDUCTION: 8.5%

TOTAL 20-YEAR REDUCTION: 26.0 CRASHES

ENVIRONMENTAL CONSIDERATIONS: NO

PURPOSE

ENHANCE SAFETY AND INCREASE
INTERSECTION SIGHT DISTANCE.

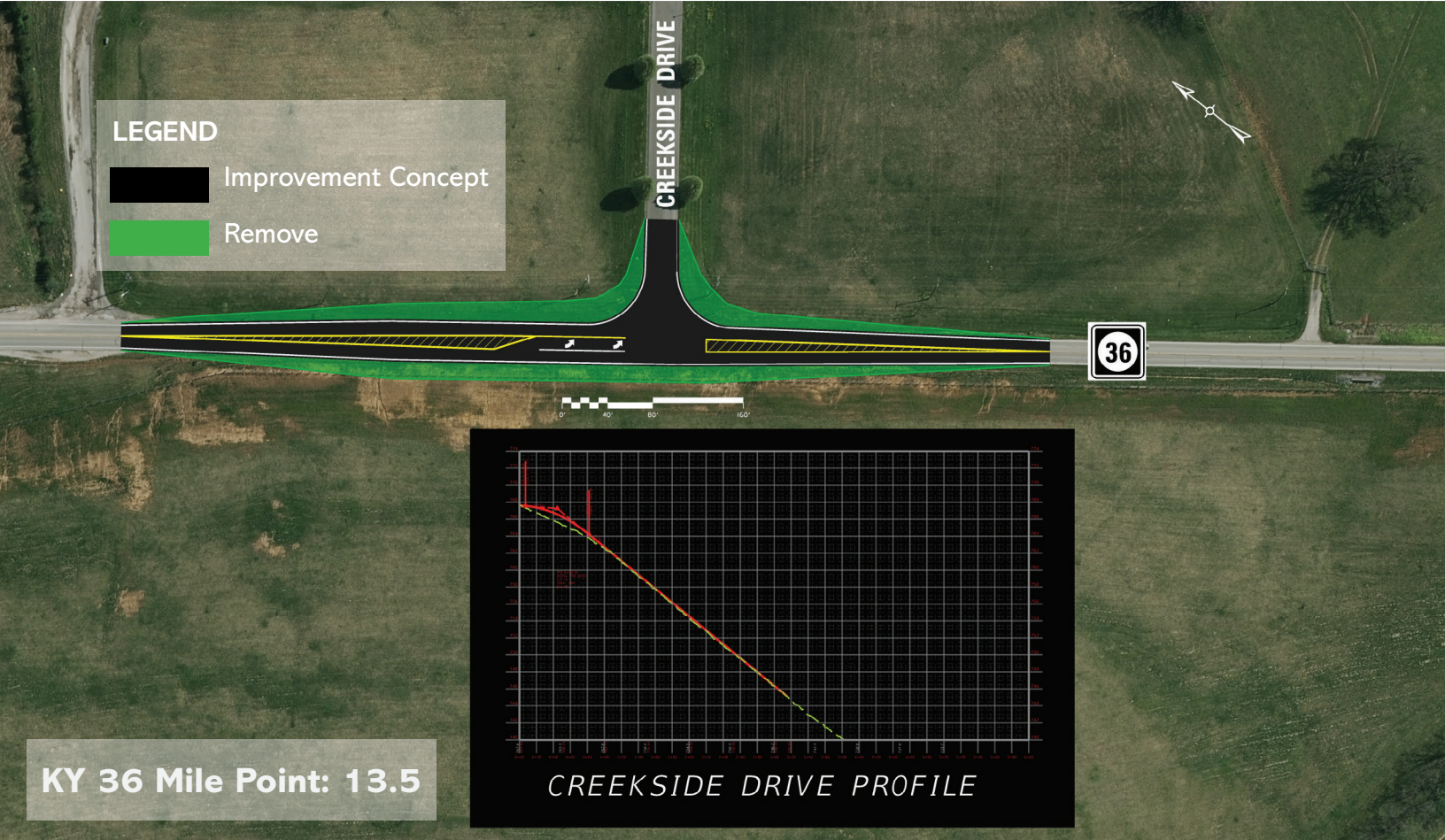
NEED: The I-64 eastbound off-ramp has issues with intersection sight distance due to guardrail, vegetation, and other vehicles caused by the current channelization. By removing channelization, trimming back vegetation, moving signage and placing the stop bar closer to KY 36, the improved intersection stopping sight distance will increase safety. Crashes are predicted to be reduced by 8.5% through this potential improvement concept.

ACTION: REMOVE CHANNELIZATION AT THE I-64 EASTBOUND RAMP, MOVE STOP BAR AND SIGNAGE, AND TRIM BACK VEGETATION

KENTUCKY 36 CORRIDOR STUDY

BATH COUNTY, KY

PROJECT SHEET B



COST \$386,500

D \$26,500

R \$35,000

U \$60,000

C \$265,000



BENEFIT/COST RATIO: 0.8

RIGHT-OF-WAY REQUIRED?: 0.87 ACRES

CRASH REDUCTION: 3.6%

TOTAL 20-YEAR REDUCTION: 11.1 CRASHES

ENVIRONMENTAL CONSIDERATIONS:
Archaeological Survey,
Environmental Justice (Minority, Disabled)

PURPOSE

Reduce crashes at the Creekside Drive intersection.

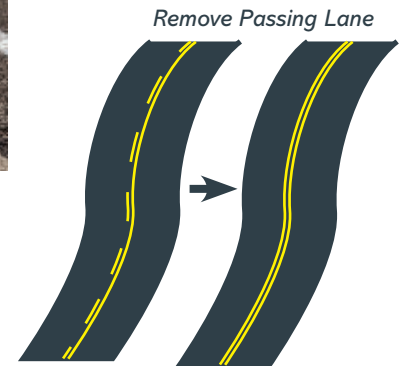
NEED: The Creekside Drive intersection has been a location with safety issues due to stopping sight distance on both KY 36 and Creekside Drive. Due to high traffic volumes, this intersection warrants a left turn lane from KY 36 onto Creekside Drive. The addition of a left turn lane in the southbound direction and improving vertical geometrics on Creekside Drive approaching KY 36 will help to reduce crashes for vehicles turning in or out of Creekside Drive.

ACTION: IMPROVE VERTICAL GEOMETRY OF CREEKSIDE DRIVE APPROACH; ADD SB LT LANE ON KY 36

KENTUCKY 36 CORRIDOR STUDY

BATH COUNTY, KY

PROJECT SHEET C



**KY 36 Mile Point:
13.5-14.0**

PURPOSE

Reduce roadway departure and head on crashes.

NEED: The addition of edge-line rumble strips help to mitigate roadway departure crashes by 16% per the CMF Clearinghouse. Edge-line rumble strips alert drivers that they are nearing the edge of pavement and may veer off of the road, and alert drowsy drivers as well.

KYTC District 9 will look into the removal of the passing zone from Save A Lot to Pickshein Road. Historic crash data does not indicate there are crashes due to passing, however passing zone sight distance is limited, and head on crashes tend to be more severe.

By adding edge-line rumble strips and removing the passing zone, a total of 0.2% of crashes could be mitigated, which is approximately 0.7 crashes over 20 years and a benefit/cost ratio of 0.1.

ACTION: ADD EDGE-LINE RUMBLE STRIPS AND REMOVE PASSING ZONE BETWEEN PICKSHEIN ROAD & SAVE A LOT

COST \$31,000



D \$0
R \$0
U \$0
C \$31,000

BENEFIT/COST RATIO: 0.1

RIGHT-OF-WAY REQUIRED?: 2.5 ACRES

CRASH REDUCTION: 0.2%

TOTAL 20-YEAR REDUCTION: 0.7 CRASHES

ENVIRONMENTAL CONSIDERATIONS: NO

KENTUCKY 36 CORRIDOR STUDY

BATH COUNTY, KY

PROJECT SHEET D



COST \$2,500



D \$0
R \$0
U \$0
C \$2,500

BENEFIT/COST RATIO: 1.3

RIGHT-OF-WAY REQUIRED?: NO

CRASH REDUCTION: 0.4%

TOTAL 20-YEAR REDUCTION: 1.2 CRASHES

ENVIRONMENTAL CONSIDERATIONS: NO

PURPOSE

Improve curve safety where the design speed is lower than the overall speed limit.

NEED: Advisory speed signs are used to alert drivers of a curve that requires a decreased speed to navigate the curve safely.

By adding advisory speed signs, a total of 0.4% of crashes could be mitigated, which is approximately 1.2 crashes over 20 years and a benefit/cost ratio of 1.3.

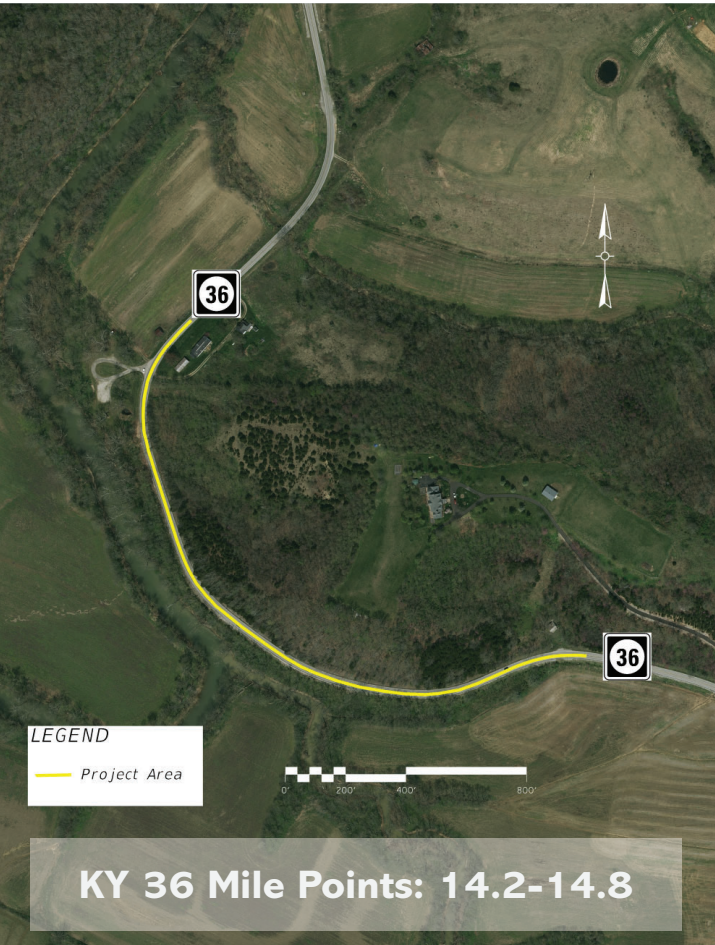
ACTION: INSTALL ADVISORY SPEED SIGNS

Project sheet E is missing.

KENTUCKY 36 CORRIDOR STUDY

BATH COUNTY, KY

PROJECT SHEET E



PURPOSE

Improve safety around the curve through signage and increased visibility.

NEED: The curve around the Slate Hill Furnace is a high crash area. Horizontal curvature that does not meet the design speed of the road is a contributing factor. Upgrading warning signage and adding safety features to improve visibility creates a better driving environment. By ensuring that drivers can see and use safety features in all conditions, drivers are more likely to understand the road conditions and safely control their vehicle.

With the addition of chevrons, solar flashing advisory signs, reflectors, and pavement markers as well as improving guardrail, a total of 2.0% of crashes could be mitigated. This is approximately 6.1 crashes over 20 years for this segment and a benefit/cost ratio of 7.5.

ACTION: ADD CHEVRONS AND UPGRADE TO SOLAR FLASHING ADVISORY SPEED SIGN AROUND THE CURVE / IMPROVE GUARDRAIL AND ADD REFLECTORS / PAVEMENT MARKERS AND/OR THERMOPLASTIC PAINT / 6" PAINT

COST \$50,000



D \$0
R \$0
U \$0
C \$50,000

BENEFIT/COST RATIO: 7.5

RIGHT-OF-WAY REQUIRED?: NO

CRASH REDUCTION: 2.0%

TOTAL 20-YEAR REDUCTION: 6.1 CRASHES

ENVIRONMENTAL CONSIDERATIONS: NO

KENTUCKY 36 CORRIDOR STUDY

BATH COUNTY, KY

PROJECT SHEET F1



COST \$353,700



D \$21,500
R \$87,200
U \$30,000
C \$215,000

BENEFIT/COST RATIO: 1.5

RIGHT-OF-WAY REQUIRED?: 2.19 ACRES

CRASH REDUCTION: 2.6%

TOTAL 20-YEAR REDUCTION: 8.1 CRASHES

ENVIRONMENTAL CONSIDERATIONS:
Archaeology Survey, 100 yr. floodplain,
Environmental Justice (minority, disabled)

PURPOSE

Improve safety and reduce crashes at the KY 36 and KY 965 (Preston Road) intersection.

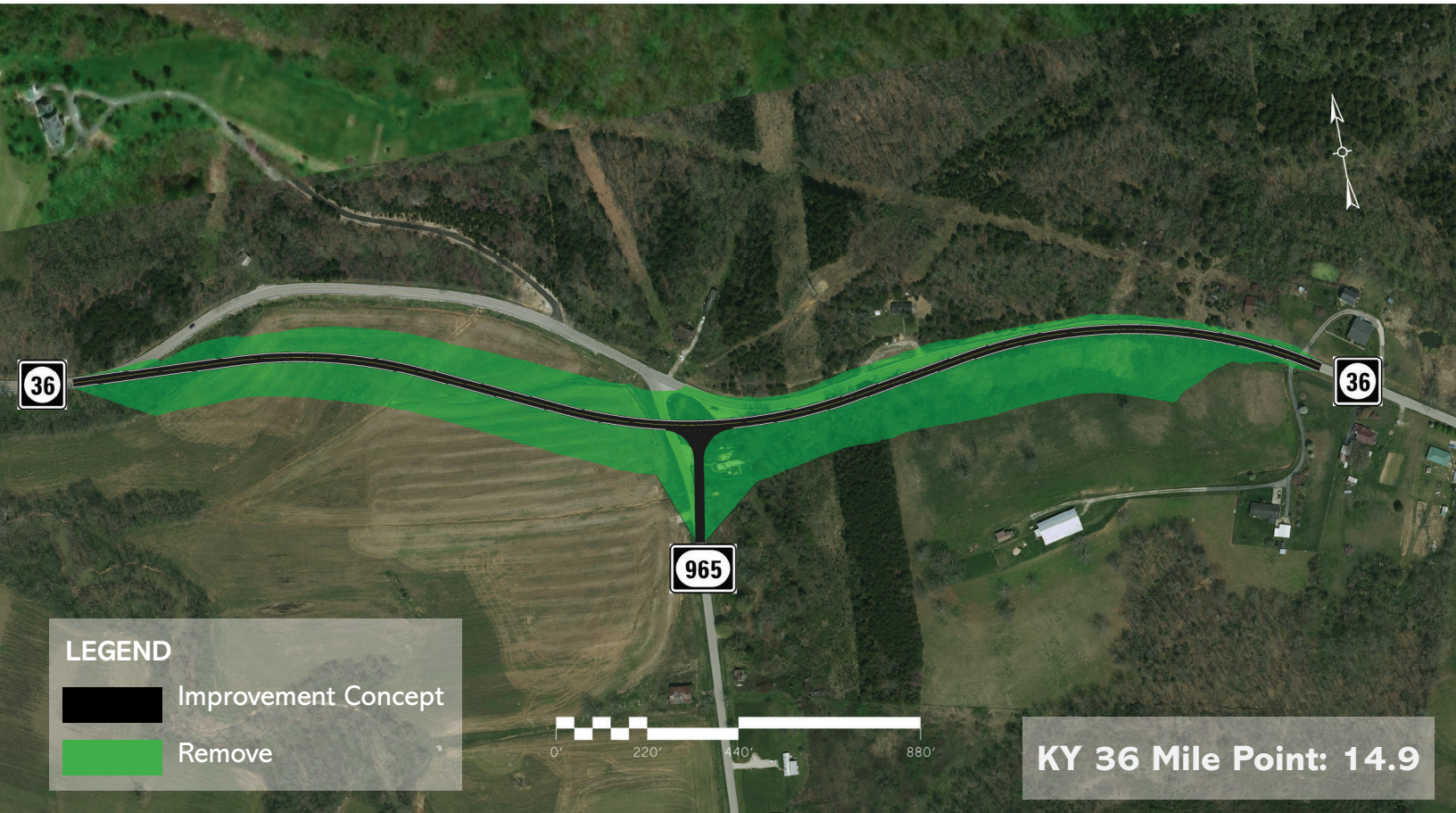
NEED: The intersection of KY 36 and KY 965 (Preston Road) is a high crash location, with multiple injury and property damage crashes in recent years. Realigning the intersection to 90 degrees and further away from the curve on KY 36 will improve the sight distance at the intersection. This improvement is expected to reduce crashes by 2.6%, approximately 8.1 crashes over 20 years, and a benefit/cost ratio of 1.5.

ACTION: REALIGN KY 965 (PRESTON ROAD) TO THE WEST

KENTUCKY 36 CORRIDOR STUDY

BATH COUNTY, KY

PROJECT SHEET F2



COST \$774,400



D \$61,200
R \$61,200
U \$40,000
C \$612,000

BENEFIT/COST RATIO: 1.4

RIGHT-OF-WAY REQUIRED?: 1.53 ACRES

CRASH REDUCTION: 7.6%

TOTAL 20-YEAR REDUCTION: 23.4 CRASHES

ENVIRONMENTAL CONSIDERATIONS: Archaeology Survey, 100 yr. floodplain, Bat Habitat Environmental Justice (minority, disabled)

PURPOSE

Improve safety and reduce crashes at the KY 36 and KY 965 (Preston Road) intersection.

NEED: The intersection of KY 36 and KY 965 (Preston Road) is a high crash location, with multiple injury and property damage crashes in recent years. Realigning the intersection to 90 degrees as well as realigning the curvature along KY 36 will improve the sight distance at the intersection. This improvement is expected to reduce crashes by 7.6%, approximately 23.4 crashes over 20 years, and a benefit/cost ratio of 1.4.

ACTION: REALIGN KY 965 (PRESTON RD) TO THE EAST AND REALIGN KY 36 CURVATURE

KENTUCKY 36 CORRIDOR STUDY

BATH COUNTY, KY

PROJECT SHEET F3



COST \$463,100



D \$30,500
R \$117,600
U \$10,000
C \$305,000

BENEFIT/COST RATIO: 1.2

RIGHT-OF-WAY REQUIRED?: 2.94 ACRES

CRASH REDUCTION: 2.6%

TOTAL 20-YEAR REDUCTION: 8.1 CRASHES

ENVIRONMENTAL CONSIDERATIONS: Archaeology Survey, 100 yr. floodplain, Bat Habitat, Environmental Justice (minority, disabled)

PURPOSE

Improve safety and reduce crashes at the KY 36 and KY 965 (Preston Road) intersection.

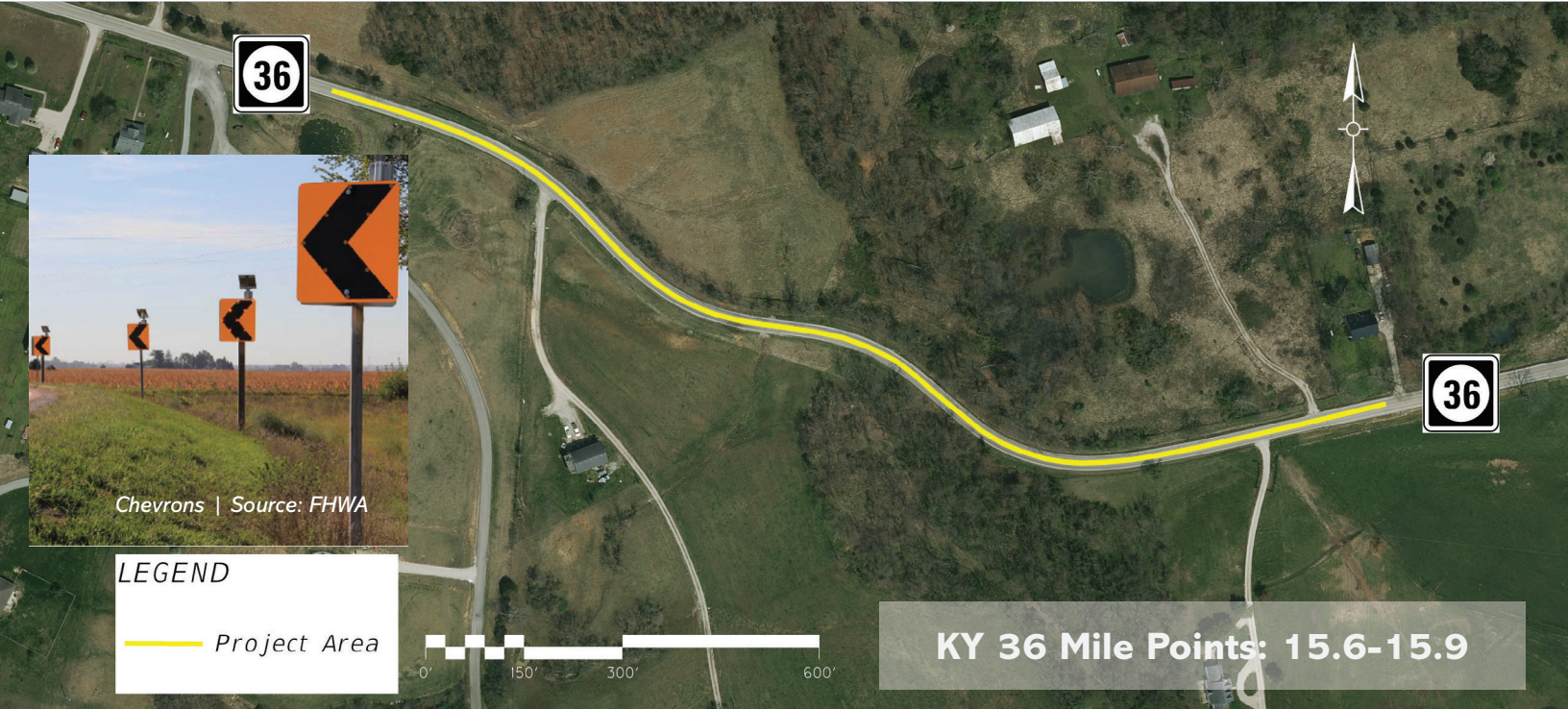
NEED: The intersection of KY 36 and KY 965 (Preston Road) is a high crash location, with multiple injury and property damage crashes in recent years. Realigning the intersection to 90 degrees, shifting to the east, and shaving back the hillside on the north side of KY 36 will improve the sight distance at the intersection to help reduce crashes. This improvement is expected to reduce crashes by 2.6%, approximately 8.1 crashes over 20 years, and a benefit/cost ratio of 1.2.

ACTION: SHAVE BACK HILLSIDE ON CURVE TO IMPROVE SIGHT DISTANCE AND REALIGN KY 965 (PRESTON ROAD)

KENTUCKY 36 CORRIDOR STUDY

BATH COUNTY, KY

PROJECT SHEET G



COST \$30,000



D \$0
R \$0
U \$0
C \$30,000

BENEFIT/COST RATIO: 199.5

RIGHT-OF-WAY REQUIRED?: NO

CRASH REDUCTION: 1.5%

TOTAL 20-YEAR REDUCTION: 4.5 CRASHES

ENVIRONMENTAL CONSIDERATIONS: NO

PURPOSE

Improve curve safety features.

NEED: The curve at Thomas Hill has a steep grade, does not meet the 55 mph design speed for vertical or horizontal curves, and has three superelevation transition overlaps back-to-back. There have been multiples crashes in recent years, including an injury crash and a fatality.

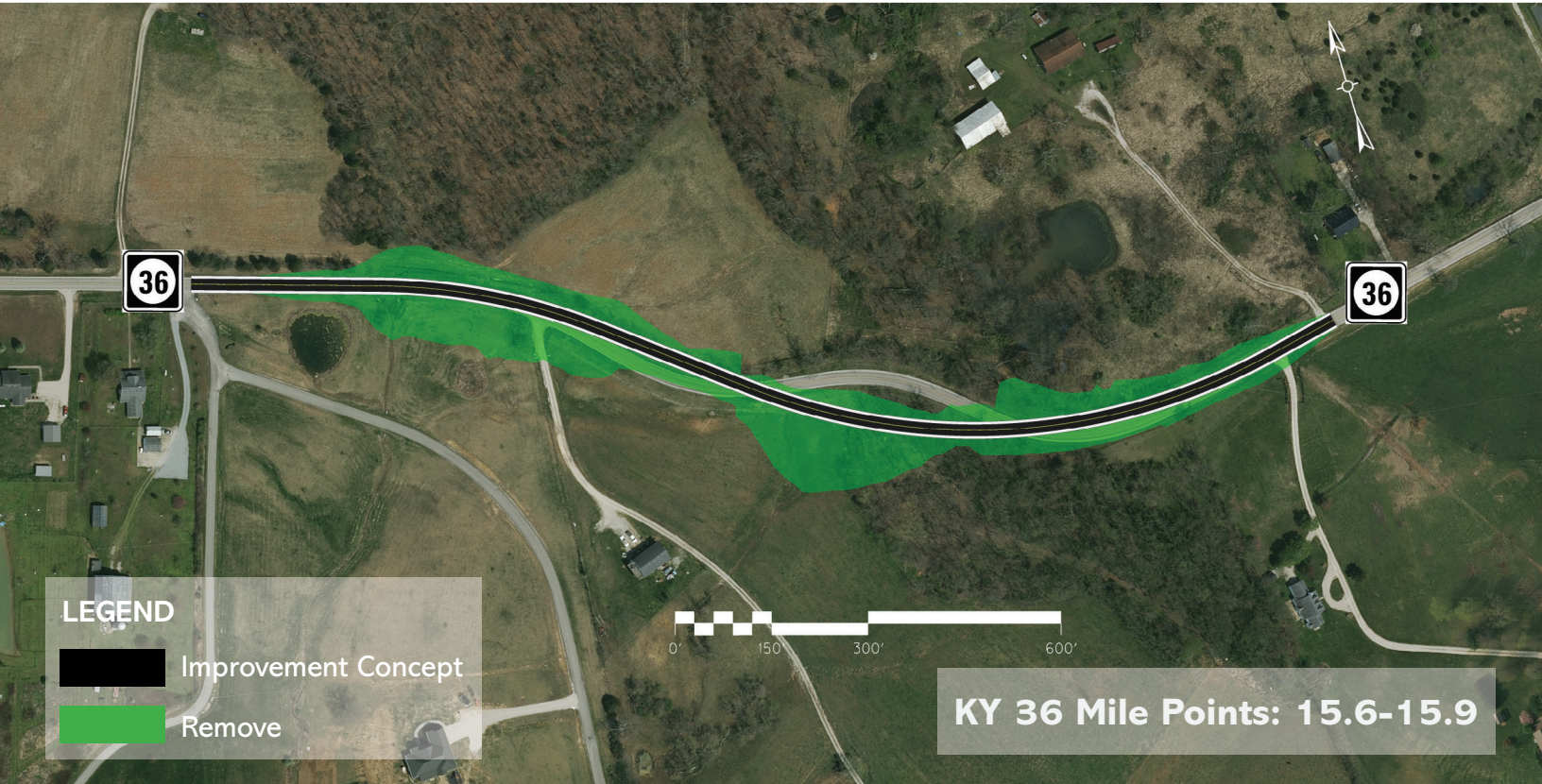
With the addition of chevrons, solar flashing advisory signs, reflectors, and pavement markers as well as improving guardrails, a total of 1.5% of crashes could be mitigated. This is approximately 4.5 crashes over 20 years for this segment and a benefit/cost ratio of 199.5.

ACTION: ADD CHEVRONS / SOLAR FLASHING ADVISORY SPEED SIGN / PAVEMENT MARKERS AND/OR THERMOPLASTIC PAINT / 6" PAINT

KENTUCKY 36 CORRIDOR STUDY

BATH COUNTY, KY

PROJECT SHEET H



COST \$1,074,400



D \$89,600
R \$68,800
U \$20,000
C \$896,000

BENEFIT/COST RATIO: 16.9

RIGHT-OF-WAY REQUIRED?: 1.72 ACRES

CRASH REDUCTION: 3.1%

TOTAL 20-YEAR REDUCTION: 9.6 CRASHES

ENVIRONMENTAL CONSIDERATIONS: Archaeology Survey, Bat habitat (trees), Black Shale, Environmental Justice (minority, disabled)

PURPOSE

Improve roadway geometrics and safety.

NEED: The curve at Thomas Hill has a steep grade, does not meet the 55 mph design speed for vertical or horizontal curves, and has three superelevation transition overlaps back to back. There have been multiples crashes in recent years, including an injury crash and a fatality.

Realigning Thomas Hill and designing all curves for a consistent 45 mph design speed will improve safety along this segment of roadway. This will mitigate 3.1% of crashes, which is approximately 9.6 crashes over 20 years, and a benefit/cost ratio of 16.9.

ACTION: REALIGN THOMAS HILL TO IMPROVE VERTICAL AND HORIZONTAL GEOMETRICS

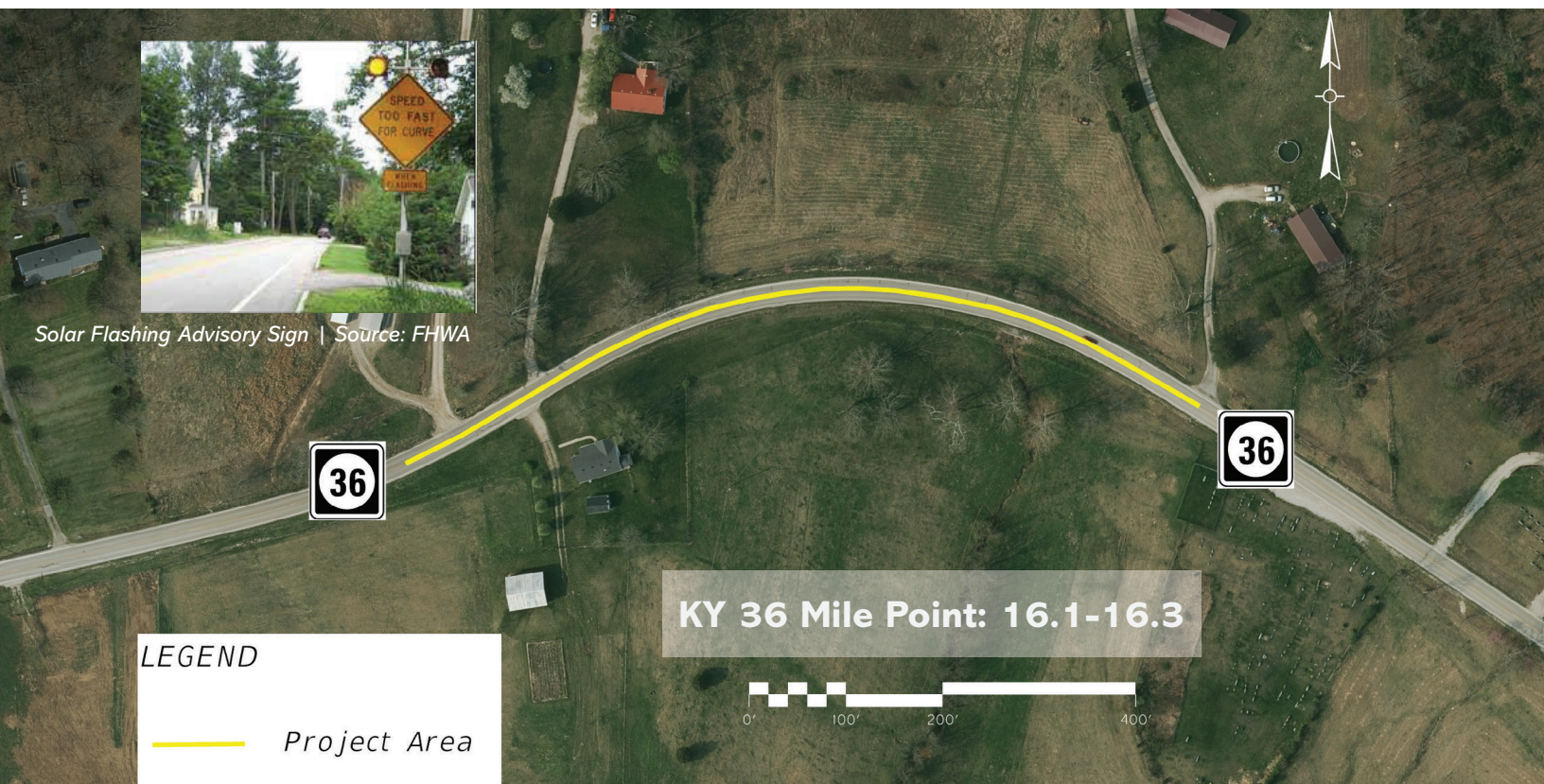
KENTUCKY 36 CORRIDOR STUDY

BATH COUNTY, KY

PROJECT SHEET



Solar Flashing Advisory Sign | Source: FHWA



LEGEND

 Project Area

COST \$30,000



D \$0
R \$0
U \$0
C \$30,000

BENEFIT/COST RATIO: 1.7

RIGHT-OF-WAY REQUIRED?: NO

CRASH REDUCTION: 1.7%

TOTAL 20-YEAR REDUCTION: 5.3 CRASHES

ENVIRONMENTAL CONSIDERATIONS: NO

PURPOSE

Improve safety and reduce crashes.

NEED: There have been numerous crashes along the curve between MP 16.1 and 16.3 in recent years, including an injury crash. Vertical and horizontal curvature that does not meet the 55 mph design speed cause safety issues for vehicles traversing this section of KY 36.

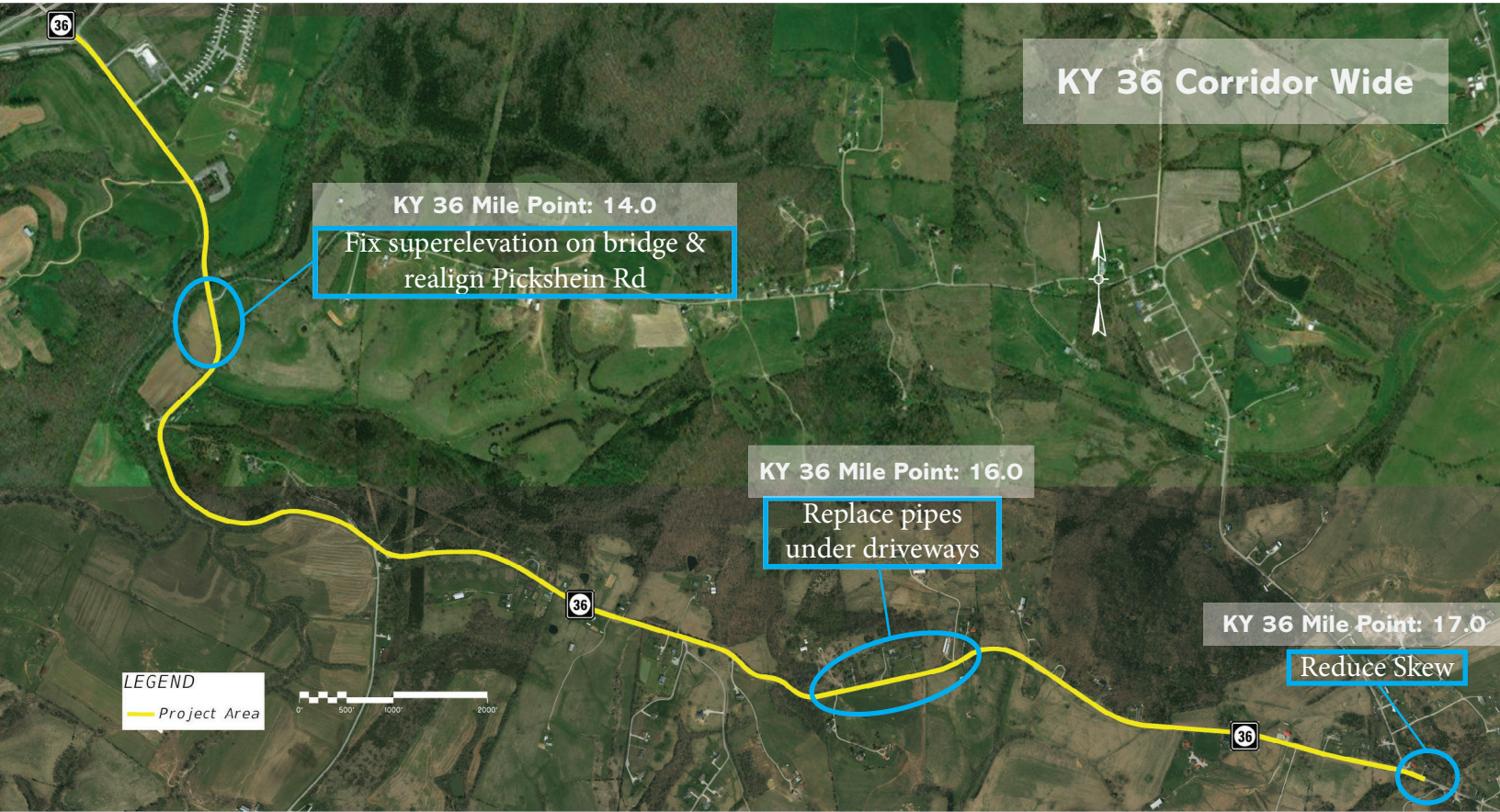
With the addition of solar flashing advisory signs, reflectors, and pavement markers as well as improving guardrails, a total of 1.7% of crashes could be mitigated, which is approximately 5.3 crashes over 20 years for this segment and a benefit/cost ratio of 1.7.

ACTION: ADD SOLAR FLASHING ADVISORY SPEED SIGN / PAVEMENT MARKERS AND/OR THERMOPLASTIC PAINT / 6" PAINT AROUND CURVE

KENTUCKY 36 CORRIDOR STUDY

BATH COUNTY, KY

PROJECT SHEET J



COST \$9,758,100



D \$687,100
R \$1,400,000
U \$800,000
C \$6,871,000

BENEFIT/COST RATIO: 0.1

RIGHT-OF-WAY REQUIRED?: 35 ACRES

CRASH REDUCTION: 14.8%

TOTAL 20-YEAR REDUCTION: 45.4 CRASHES

ENVIRONMENTAL CONSIDERATIONS:

Archaeological Survey, Slate Creek (OSRW), Bat Habitat (trees) Bath County Park 4(f) and 6(f) Resource, Bourbon Iron Works NRHP Listed, Slate Creek OSRW, Erosion Control, Mussels, 100 yr Floodplain, Bat Habitat (trees), Old Field Cemetery, Black Shale, Potentially NRHP Eligible Undetermined Structure (BH 472-476), Environmental Justice (minority, disabled)

PURPOSE

Improve safety and roadway geometrics throughout the KY 36 study corridor.

NEED: There are multiple improvement concepts that would work together to improve safety and roadway geometrics along the KY 36 corridor. Implementing these improvements along the corridor is predicted to mitigate 14.8% of crashes, which is approximately 45.4 crashes over 20 years, and a benefit/cost ratio of 0.1.

ACTION: CORRIDOR-WIDE IMPROVEMENTS ALONG KY 36

- Widen cross section to 11' lanes with 2' paved shoulders
- Realign curves to 45 mph design speed
- Add guardrail, safety headwalls at culverts, and/or extend culverts
- 6" thermoplastic striping
- Proper curve warning sign placement and chevron placement
- Fix superelevation on bridge over the Licking River
- Realign Pickshein Road for better sight distance
- Replace pipes under gravel driveways and improve slope stability
- Reduce skew of Hart Pike intersection

(This page intentionally left blank)

