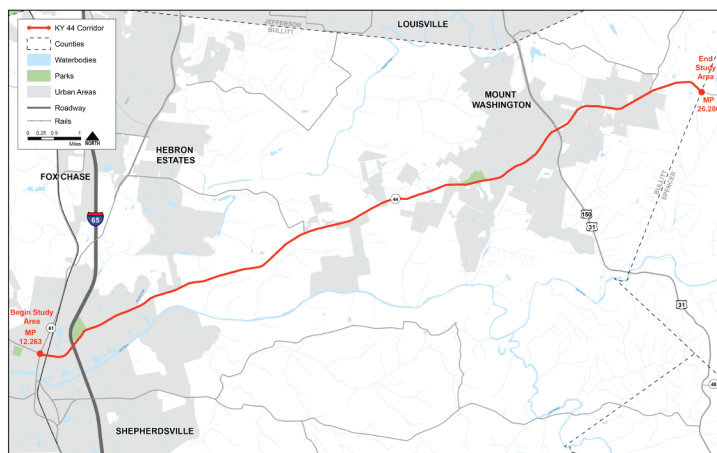




## KENTUCKY TRANSPORTATION CABINET

# KY 44 PROGRAMMING STUDY

Final Report, March 2023





# Executive Summary

Over the years, the Kentucky Transportation Cabinet (KYTC) has developed various design concepts for most of the 14-mile section of the KY 44 corridor between KY 61 in Shepherdsville and the Spencer County line east of Mt. Washington. Improving KY 44 is expected to be a costly undertaking, take many years to complete, and have to be constructed in sections.

KYTC contracted with WSP USA in March of 2022 to perform a data-driven review of all previous design decisions along the corridor and develop a prioritized plan for moving forward. The purpose of this analysis is to make sure KYTC and its partners are on track to use KYTC resources efficiently, at the right locations, and in the right order. The study team was also tasked with identifying innovative traffic flow and safety improvement opportunities also known as Transportation System Management and Operations (TSMO), that may not have been investigated in the past. Some of these improvements could be implemented relatively quickly and may provide noticeable congestion relief and safety benefits prior to completion of major full-corridor improvements. Consideration should also be given to inclusion of TSMO solutions in any ultimate improvement projects. This study also developed Performance Based Flexible Solutions (PBFS) and incorporated those into a project priority programming scheme for the KY 44 corridor.

## Highway Plan and Other Active Roadway Projects

KYTC provided a list of active and proposed projects in the study area vicinity, shown in Figure ES-1. There are six projects along the corridor vicinity programmed in Kentucky's 2022-2028 Enacted Highway Plan (Highway Plan). KYTC also provided a list of Local Public Agency (LPA) projects also active in the study area.

### Highway Plan Projects\*

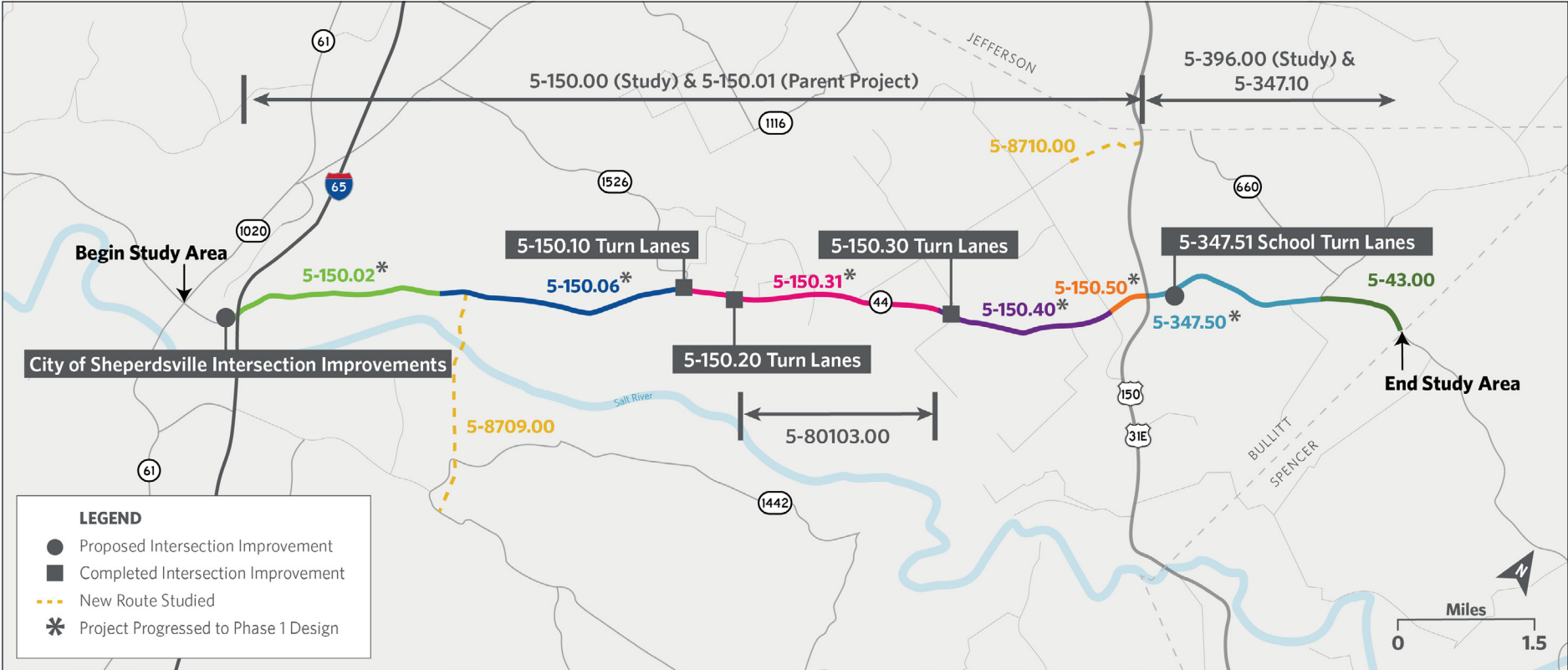
- ▶ 5-43.00: Reconstruct KY 44 from KY 1319 (Kings Church Road) to Spencer County line – (State Construction Funds [SPP]) | D 2022 \$1,200,000; R 2023 \$1,000,000; U 2024 \$850,000; C 2025 \$5,350,000 – Total \$8,400,000
- ▶ 5-150.02: Reconstruct KY 44 from I-65 to Chimney Rock Drive – (SPP) | D 2025 \$2,080,000; R 2026 \$7,640,000; U 2027 \$9,790,000; C 2028 \$19,430,000 – Total \$38,940,000
- ▶ 5-150.50: Reconstruct KY 44 from United States Route (US) 31EX to US 31E – (SPP) | D authorized; R 2023 \$1,630,000; U 2024 \$580,000; C 2025 \$1,883,000 – Total \$4,093,000
- ▶ 5-347.50: Reconstruct KY 44 from US 31E to KY 1319 (Kings Church) – (SPP) | D 2022 \$1,300,000; R 2025 \$4,500,000; U 2026 \$1,700,000; C 2027 \$13,200,000 – Total \$20,700,000
- ▶ 5-347.51: New Turn Lanes in front of Bullitt East High School – (Federal Statewide Transportation Program Flex Funds [STPF]) | D, R, U & C authorized. Let to construction November 2022.
- ▶ 5-80103.00: Reconstruct KY 44 from Bogard Lane to Armstrong Lane – (SPP) | D 2022 \$2,300,000; R 2025 \$4,700,000; U 2026 \$6,600,000; C 2027 \$14,600,000 – Total \$28,200,000

\*D: Design, R: Right-of-Way, U: Utilities, C: Construction

### Local Public Agency Projects

- ▶ 5-347.10: Widening of KY 44 from 2 to 4 Lanes in Bullitt County from US 31E to KY 1319 (Kings Church Road) and a 3 Lane Section from KY 1319 (Kings Church Road) to the Spencer County line – KIPDA federal STBG-SLO | \$1,130,000 D funds authorized; no other phases programmed or identified – D5 assisting Bullitt County LPA with design
- ▶ No SYP: KY 44/Adam Shepherd Pkwy Intersection Improvements – City of Shepherdsville - Local funds only | In Design with Construction anticipated 2025.

Figure ES-1: Recently Constructed, Proposed and Programmed Projects





## Existing Conditions

The KY 44 corridor’s current conditions were evaluated with respect to roadway geometrics, existing number of intersections and access points, bicycle and pedestrian activity, safety, travel speeds, and traffic operations. KY 44 has a two-lane cross-section through a majority of the study corridor with exceptions in the Shepherdsville and Mt. Washington areas. Additionally, there are 536 unsignalized access points throughout the study area, as well as nine signalized intersections, mostly in Shepherdsville and Mt. Washington.

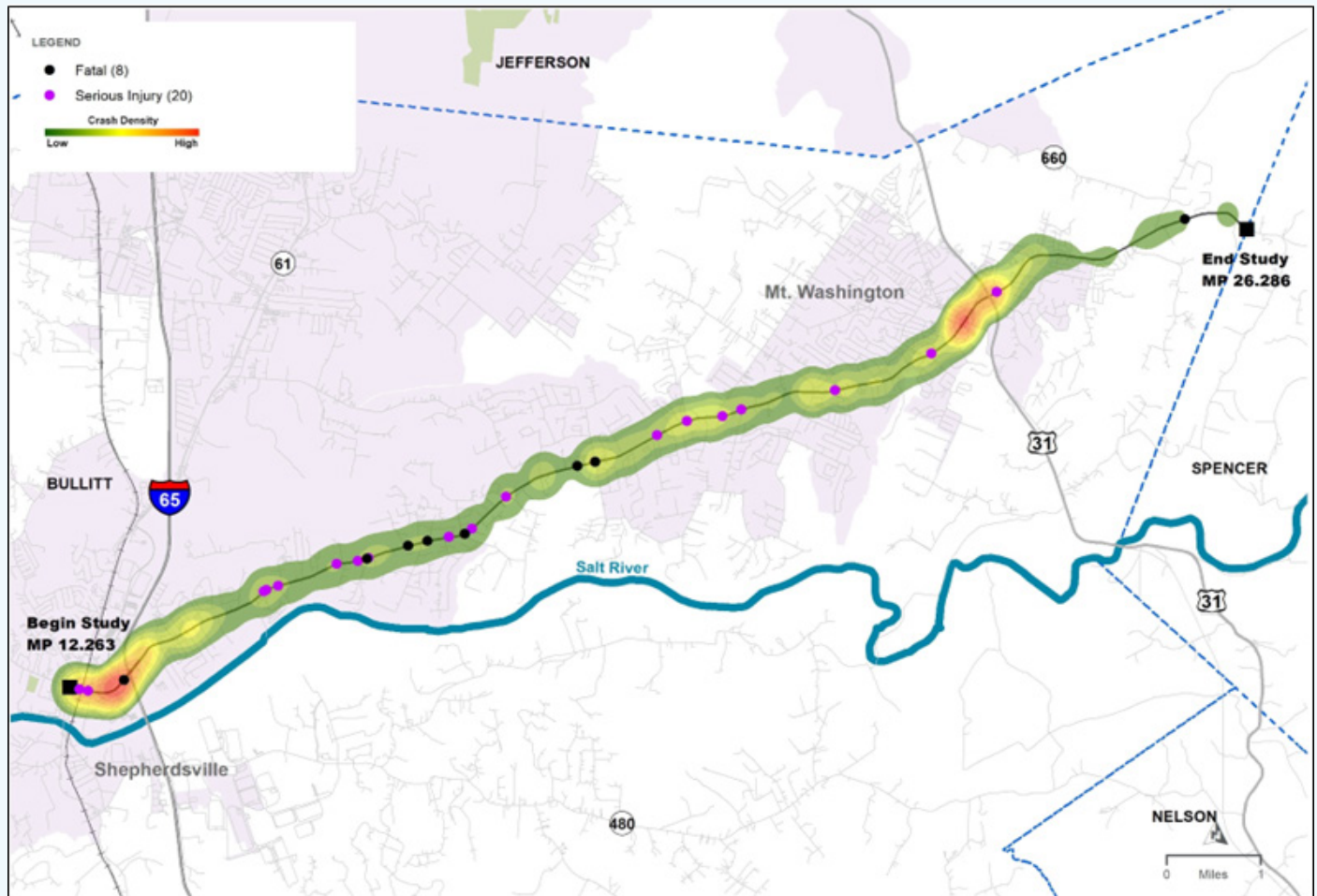
A historical crash analysis was performed to examine traffic safety trends and to identify safety issues along KY 44. The density of crashes along the KY 44 study corridor was plotted to show areas with higher concentrations (**Figure ES-2**), and where fatal and serious injury crashes occurred.

Operating speeds were analyzed temporally and geographically to assess the efficiency of traffic flow along KY 44 and to determine locations where differences in speed occur, which present the potential for an increase in crashes. The data showed the 85th percentile speeds were generally at or below the posted speed limit; indicating excessive speeding does not appear to be an issue in the study area.

## Traffic Operations

A traffic analysis was performed to establish baseline existing traffic volumes for 2022 and to forecast future growth out to 2045. The forecast accounted for previous studies, projects, traffic forecasts, and known planned developments and permits in the study area. This extensive accounting resulted in the most accurate growth rate based on all available data. The updated growth rate was then applied to project future volumes in the study area.

Figure ES-2: KY 44 Crash Density Map (2017 – 2021)

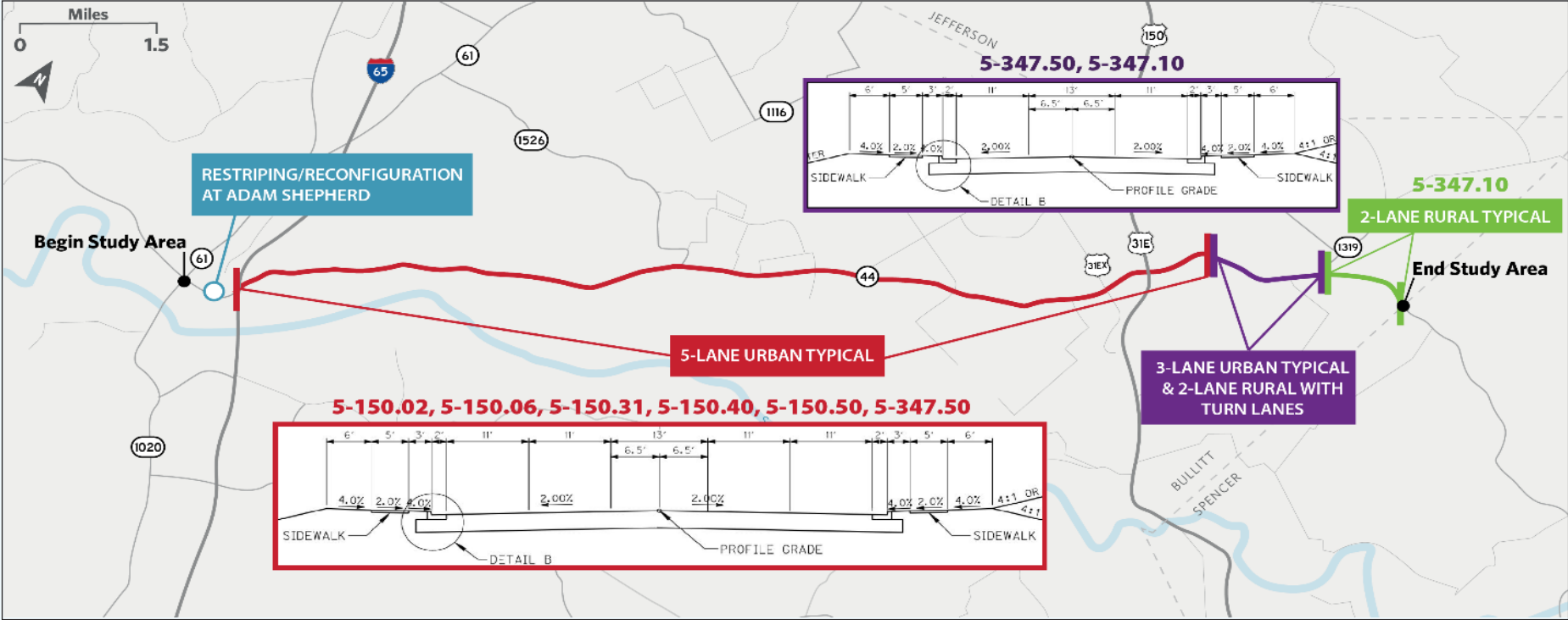


### Existing Phase 1 Design Projects

Five sections of KY 44 from I-65 to US 31E were advanced to Phase 1 Design (preliminary engineering) as Item No. 5-150.01, which resulted from the 2006 KY 44 Alternatives Study<sup>1</sup> (Item No. 5-150.00). The design called for an urban five-lane typical section with 11-foot travel lanes, a 13-foot two-way left-turn lane (TWLTL), curb and gutter, and five-foot sidewalks on both sides of the road (see green section in figure below). Phase 1 Design was also completed from US 31E to KY 1319 (Kings Church Road), Item No. 5-347.50. This section was designed with 11-foot travel lanes and a 13-foot TWLTL in both an urban five-lane segment from US 31E to Love Avenue and a three-lane urban segment from Love Avenue to Winning Colors Drive (see Figure ES-3: Red section). Both segments included curb and gutter with five-foot sidewalks on each side. A rural two-lane or three-lane segment was designed for Winning Colors

Drive to KY 1319 (Kings Church Road). The easternmost section of KY 44 in Bullitt County (Item No. 5-43.00) from KY 1319 (Kings Church Road) to the Spencer County line has not yet completed Phase 1 design (see purple section in figure below). Estimated cross-section and total cost to improve this segment were initially developed in KYTC's 2012 KY 44 Corridor Study<sup>2</sup> (Item No. 5-396.00). Note that Bullitt County and KYTC are currently working to develop a Phase 1 design concept covering this area using STBG-SLO funds under LPA project 5-347.10. That project spans the project limits of both 5-347.50 and 5-43.00. Although 5-347.10 cross-sections are still in development, they are generally expected to be consistent with those already established for project 5-347.50 and the 5-396.00 study. **Figure ES-3** shows a summary of the Phase 1 Design typical sections proposed for the KY 44 corridor.

Figure ES-3: Summary of Phase 1 Design on KY 44



1 2006 KY 44 Alternatives Study (5-150.00)  
 2 2012 KY 44 Corridor Study (5-396.00)

## Corridor Concepts Incorporating PBFS and TSMO Solutions

The project team investigated ways to optimize performance of the Existing Phase 1 Design concepts through the consideration of PBFS and TSMO concepts. The PBFS approach seeks a design concept that will meet the goals and the purpose and need of a project but with minimum impact and cost. An example would be the widening of a corridor in specific localized areas that are justified by data rather than a wholesale widening along its entire length. Examples of TSMO solutions include coordinating traffic signal timing along a series of intersections, minimizing access points in busy/overcrowded areas, mitigating congestion at bottleneck locations, and providing opportunities for real-time traveler advisory information. It is anticipated that the proposed PBFS concepts will be considered for incorporation into the Existing Phase 1 designs as they advance toward construction. Similarly, it is anticipated that identified TSMO concepts might be considered for incorporation into the Existing Phase 1 designs or be considered separately for immediate or near-term implementation. Both represent opportunities to deliver relief to the travelling public more quickly and at a potentially lower cost.

### Short-Term Solutions and TSMO Strategies

1. Improved traffic signal operations - Replace the current standard traffic signal controllers (model 170) with advanced traffic signal controllers (model 2070) and install advanced vehicle detection hardware at 12 traffic signals along the project corridor. Benefits include improved detection of vehicles at intersections; enhanced (real-time) traffic count collection and ability to coordinate traffic signals through the corridor leading to reduced wait times and congestion. Enhanced data collection will also better inform designers of traffic conditions as they work to advance larger roadway improvement projects in the corridor. KYTC is currently upgrading the traffic signal controllers and has identified \$200,000 in TSMO funding to install the advanced vehicle detection hardware at the signalized intersections. This work by state forces is anticipated to be complete by Summer 2023. Once signal upgrades are complete, KYTC anticipates entering into a Traffic Engineering Services contract to analyze existing conditions and identify opportunities to optimize throughput at each intersection, prepare and implement individual signalized intersection optimization and corridor-wide signal coordination plans, and monitor improvements while making data available for future design projects. The estimated fee for this work is \$80,000.
2. Coordination on local projects - The planned lane reconfiguration/restriping work at the Adam Shepherd Parkway intersection being done by the City of Shepherdsville will benefit from more accurate intersection turn data, potentially improving the current design. The current Item 5-347.50 design work east of US 31E near Mt. Washington would also benefit from more accurate signal data. This data will be available with the updated signal control equipment mentioned above.
3. Initiate a more detailed study of the crash history for the interior portion of the study area between Chimney Rock Drive and Fisher Lane/Armstrong Lane – These segments had fewer crashes than others in the study corridor, however, several of the intersections have Excess Expected Crashes (EEC) higher than zero, and the crashes were more serious (fatal and serious injury). There are also several schools in this area and stakeholders noted a desire for safer operations at the school entrances. Engaging KYTC's Highway Safety Improvement Program (HSIP) branch may provide mitigating safety countermeasures in the near term before the proposed segment cross-sections are fully built out. The estimated fee for this HSIP study is \$200,000 to \$300,000. Future construction costs would be determined in the study. The analysis would also include recommendations regarding potential funding sources.
4. Implementation of ITS devices – ITS devices can provide information to travelers to inform trip making, which improves safety and reduces congestion, particularly in the event of an incident. There are four locations on the KY 44 corridor where implementing ITS devices would help drivers make informed decisions about their route:
  - ▶ West of KY 61 – placing a dynamic message sign to alert drivers of incidents along I-65 would allow them to detour from I-65 and use KY 61 instead.
  - ▶ Approaching I-65 – placing a travel time information sign on either side of I-65 with information on the travel time to Louisville would allow drivers to decide if they want to take I-65 to Louisville or choose an alternate route.

- ▶ East of KY 1526 – placing a dynamic message sign on the westbound lane of KY 44 to alert drivers to any incidents in Shepherdsville or along I-65 would allow them to detour using KY 1526.

The estimated cost for these devices is \$75,000 per sign, or \$300,000 total.

### PBFS Options

As project data was analyzed and Project Team and stakeholder feedback reviewed, the concepts

developed for existing Phase I Designs were re-examined for opportunities to apply KYTC’s latest PBFS, TSMO, and Complete Streets initiatives. **Table ES-1** shows three new PBFS corridor concepts as well as a TSMO and Urban Strategies concept. Based on the recently released KYTC Complete Streets, Roads, and Highways Manual (2022), the Project Team agreed to recommend a five-foot sidewalk on the north side of KY 44 and a ten-foot multi-use path on the south side throughout the corridor.

**Table ES-1: KY 44 Corridor Concept Features**

Corridor Concepts	Concept Features
Option 1 - Existing Phase I Design	<ul style="list-style-type: none"> <li>- Adds maximum capacity for majority of corridor</li> <li>- Provides through-travel lanes with continuous left turn lane</li> <li>- Three-lane section east of Love Avenue also provides through-travel lanes</li> <li>- No proposed changes west of I-65</li> </ul>
Option 2 - PBFS Design A	<ul style="list-style-type: none"> <li>- Adds five-lane capacity in congested segments near Shepherdsville and Mt. Washington</li> <li>- Three-lane cross-section for most of the corridor interior while still providing through-lanes</li> <li>- Three-lane section from Love Avenue to KY 1319 (Kings Church Road); two lanes to Spencer County line</li> </ul>
Option 3 - PBFS Design B	<ul style="list-style-type: none"> <li>- Four or Five lanes in more congested segments east of KY 1526 (Bells Mill Road) to Stringer/Louise</li> <li>- Three-lane cross-section from near the Bullitt Central High School area to KY 1526 (Bells Mill Road) still provides through-lanes</li> <li>- Three-lane section from Winning Colors to KY 1319 (Kings Church Road) provides through-lanes</li> <li>- Four or five lanes from US 31E to Winning Colors. Four lanes with median reduces crashes.</li> <li>- Three-lane cross-section in dense residential area west of Mt. Washington to reduce ROW impacts.</li> </ul>
Option 4 - TSMO & Urban Strategies	<ul style="list-style-type: none"> <li>- Three-lane cross-section for most of corridor to reduce costs while providing through-travel lanes</li> <li>- Option for five-lane section for short segments in Shepherdsville and Mt. Washington for worst congestion</li> <li>- Optional four-lane section with raised median in Shepherdsville and Mt. Washington to reduce crashes</li> <li>- Three-lane section from Winning Colors to KY 1319 (Kings Church Road) provides through-lanes</li> <li>- Closely examine widening in urban areas to verify it actually reduces congestion/improves LOS</li> <li>- Dynamic message and traveler information signs</li> <li>- Utilize access management in urban areas</li> <li>- Signal upgrades and optimization to reduce congestion, especially in urban areas</li> <li>- Streetscape improvements in Shepherdsville and Mt. Washington</li> <li>- Improve crosswalks to be ADA compliant at signalized intersections in urban areas</li> <li>- Consider mid-block crossings in some locations in urban areas</li> </ul>



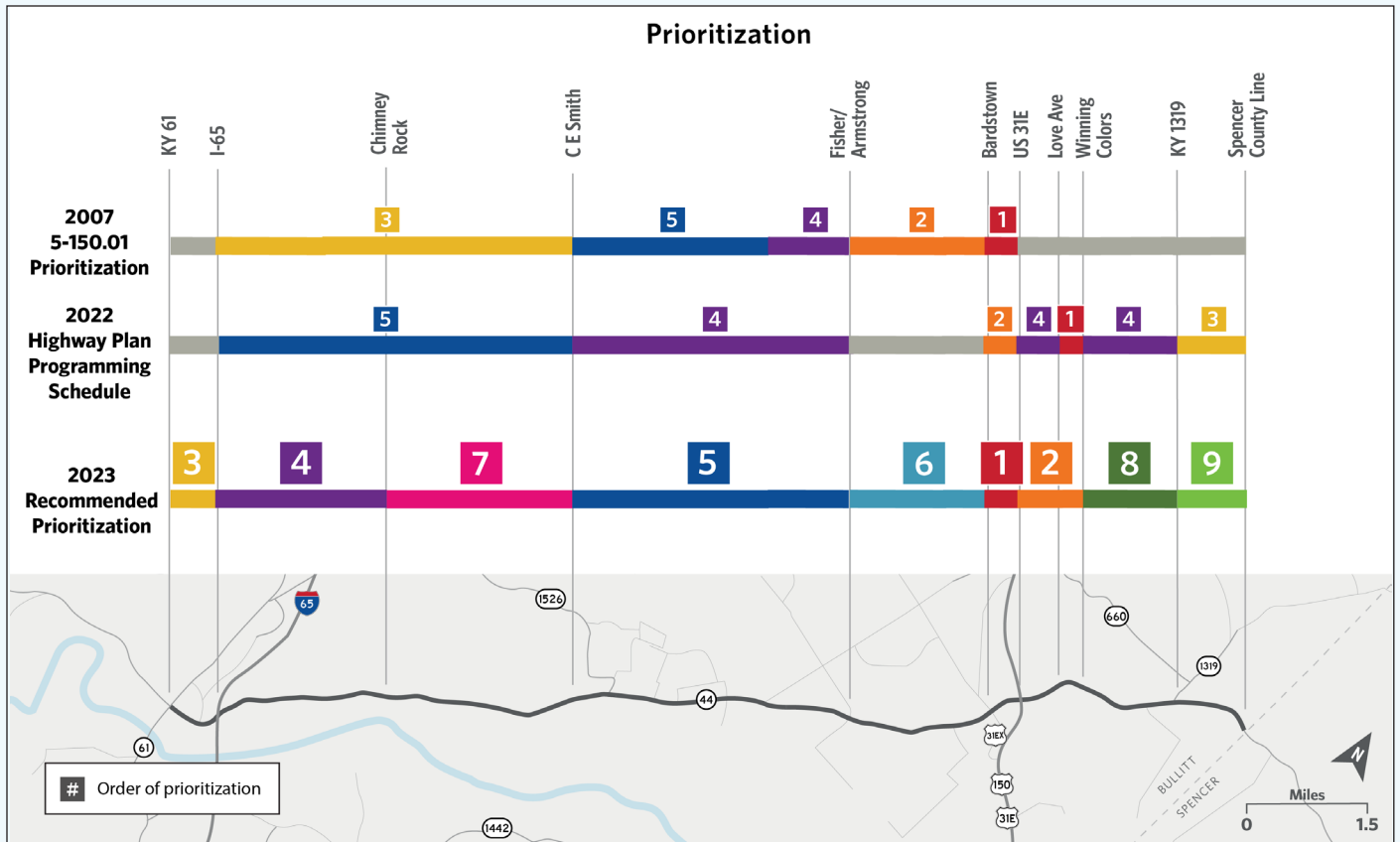
For each of the concepts (including the Existing Phase 1 Design), traffic operations, safety, and travel time savings were analyzed. Cost estimates (including design, right-of-way, utilities, and construction) were developed, and right-of-way impacts identified. This evaluation showed locations where traffic might operate at an acceptable Level of Service (LOS) with a reduced cross-section at both the segment and intersection level. While the Existing Phase 1 design's five-lane section is satisfactory from a traffic operations standpoint, the added weaving that five lanes allow, especially at intersections, often creates additional conflicts, potentially reducing safety benefits below that of a three-lane section or four-lane section with a raised median. The interior of the corridor, where the PBFS options propose three- and four-lane sections, is also the location of the majority of injury and fatal crashes. Though the Existing Phase 1 Design has the greatest travel time savings, all PBFS and TSMO options provide some level of travel time savings through the corridor. Right-of-way acquisition is the same between the Existing Phase 1 Design and PBFS Option 2 and is slightly higher for PBFS Option 3, however the PBFS options reduce the required relocations which lowers overall right-of-way costs. The PBFS and TSMO options align the construction costs to the demonstrated need for capacity, while

measurably improving safety and travel times through the corridor. After review of the above evaluations, it was apparent the highest value recommendation may be a corridor concept that is a combination of parts of two or more of the concepts. The project team strongly recommends that each of these concepts be considered for incorporation into the current proposed design as each segment advances toward construction.

### Project Prioritization

Based on the identified needs along the corridor, traffic and safety analyses, right-of-way impacts, overall cost, travel times, the evaluation of existing and potential new network connections, and input from stakeholders, the Project Team developed a prioritization plan for existing construction segments. **Figure ES-4** shows the prioritization that was determined for the breakout sections of 5-150.01 (top row) that was proposed in 2007, the prioritization of projects shown in the current *Highway Plan* based on initial year of construction, and the proposed order of priority based on the analyses from this study (bottom row). NOTE: Gray sections indicate the section was not considered in that prioritization and does not indicate a lower priority.

Figure ES-4: Proposed KY 44 Corridor Project Prioritization



## Recommendations and Programming

The final list of improvement strategies for the study was developed based on Project Team and stakeholder feedback, as well as the criteria used to evaluate all Corridor Concepts (see **Table ES-1**). After evaluation of the options, it was apparent the best corridor

recommendation is a combination of parts of two or more of the concepts, with a mix of TSMO and PBFS features depending on the segment needs. **Table ES-2** gives a description of the recommendation for each segment along with cost estimates. **Figure ES-5** shows the options recommended for each segment.

Figure ES-5: Recommended Corridor Concepts

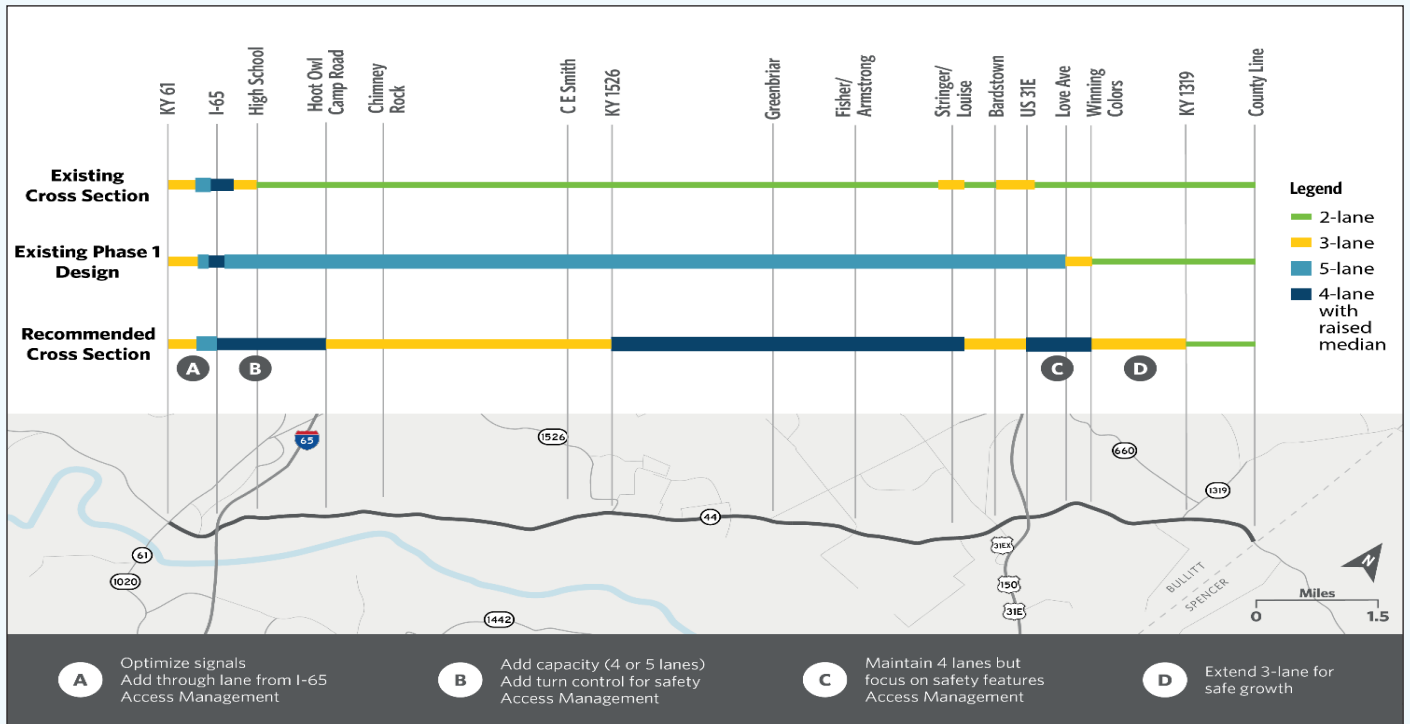


Table ES-2: Recommendations for KY 44

Priority	Segment Begin	Segment End	Item No.	Description	Design	ROW	Utilities	Construction	Total	Highway Plan Cost (Existing Phase 1 Design)
1	US 31 EX (Bardstown Road)	US 31E	5-150.50	3-lane urban section with 5' sidewalk on north side and 10' multi-use path on south side.	\$495,000	\$1,635,000	\$2,760,000	\$4,439,000	\$9,329,000	\$4,093,000
2	US 31E	Winning Colors Drive	5-347.50 - Section 1 (formerly 5-347.51*)	4-lane urban divided section with turn lanes and 5' sidewalk on north side and 10' multi-use path on south side.	\$700,000	\$980,000	\$3,300,000	\$7,000,000	\$11,980,000	\$10,571,000
3	KY 61	I-65	N/A	Maintain existing 3-lane urban cross-section from KY 61 to Hester Street; transition to a 4-lane urban cross-section with a median between Hester Street and Adam Shephard Parkway; expand to a five-lane urban cross-section from Adam Shephard Parkway to I-65, extending the exit ramp from I-65 southbound onto KY 44 to connect to the right turn lane into Adam Shephard Parkway; 5' sidewalk on north side and 10' multi-use path on south side.	\$130,000	\$125,000	\$800,000	\$1,300,000	\$2,355,000	N/A
4	I-65	Chimney Rock Drive	5-150.02	4-lane urban section from I-65 to Hoot Owl Camp Road; 3-lane urban section with TWLTL from Hoot Owl Camp Road to Chimney Rock; 5' sidewalk on north side and 10' multi-use path on south side.	\$1,277,000	\$369,000	\$2,759,000	\$12,314,000	\$16,719,000	\$38,940,000
5	CE Smith Lane	Armstrong Lane	5-150.31	3-lane urban section with TWLTL from CE Smith Road to KY 1526; 4-lane divided cross-section with a raised median and turn lanes from KY 1526 to Armstrong Lane; 5' sidewalk on north side and 10' multi-use path on south side.	\$2,010,000	\$6,097,000	\$11,526,000	\$18,041,000	\$37,674,000	\$33,280,000
6	Armstrong Lane	US 31 EX (Bardstown Road)	5-150.40	4-lane urban divided cross-section with a raised median and turn lanes from Armstrong Lane to Stringer Lane; 3-lane urban section from Stringer Lane to US 31ES (Bardstown Road); 5' sidewalk on north side and 10' multi-use path on south side.	\$1,560,000	\$3,372,000	\$6,926,000	\$10,644,000	\$22,502,000	\$28,073,000
7	Chimney Rock Drive	CE Smith Lane	5-150.06	3-lane urban section with TWLTL from Chimney Rock to CE Smith Road and 5' sidewalk on north side and 10' multi-use path on south side.	\$1,005,000	\$525,000	\$7,248,000	\$9,105,000	\$17,883,000	\$26,845,000
8	Winning Colors Drive	KY 1319	5-347.50 - Section 2 (formerly 5-347.56)	4-lane urban cross-section and 5' sidewalk on north side and 10' multi-use path on south side.	\$342,000	\$503,000	\$1,133,000	\$3,425,000	\$5,403,000	\$10,129,000
9	KY 1319	Spencer County Line	5-43.00	2-lane rural cross-section with 5' sidewalk on north side and 10' multi-use path on south side; includes right of way for ultimate 3-lane section.	\$137,000	\$537,000	\$927,000	\$1,901,000	\$3,502,000	\$8,400,000

\*Prior to 2018, Item Number 5-347.51 was "KY-44 SECTION 1 FROM US 31E EASTWARD TO PARKLAND TR/WINNING COLORS DRIVE (2008BOPC)". In the 2018 Highway Plan, the Item Number was reallocated to "NEW TURN LANES IN FRONT OF BULLITT EAST HIGH SCHOOL. (BREAKOUT FROM 5-347.50) (18CCN)". The turn lane project went to construction in 2022. If this section advances in a future Highway Plan, a unique Item Number (other than 5-347.51) will need to be assigned.

## Network Connection Analyses

In addition to evaluating PBFS and TSMO potential solutions, new connecting roadways and improvements to existing roadways that intersect KY 44 were reviewed to determine their feasibility and ability to relieve traffic on KY 44. Four connector routes were modeled using the KIPDA Travel Demand Model in a 2040 traffic scenario. The results of the analyses showed the following:

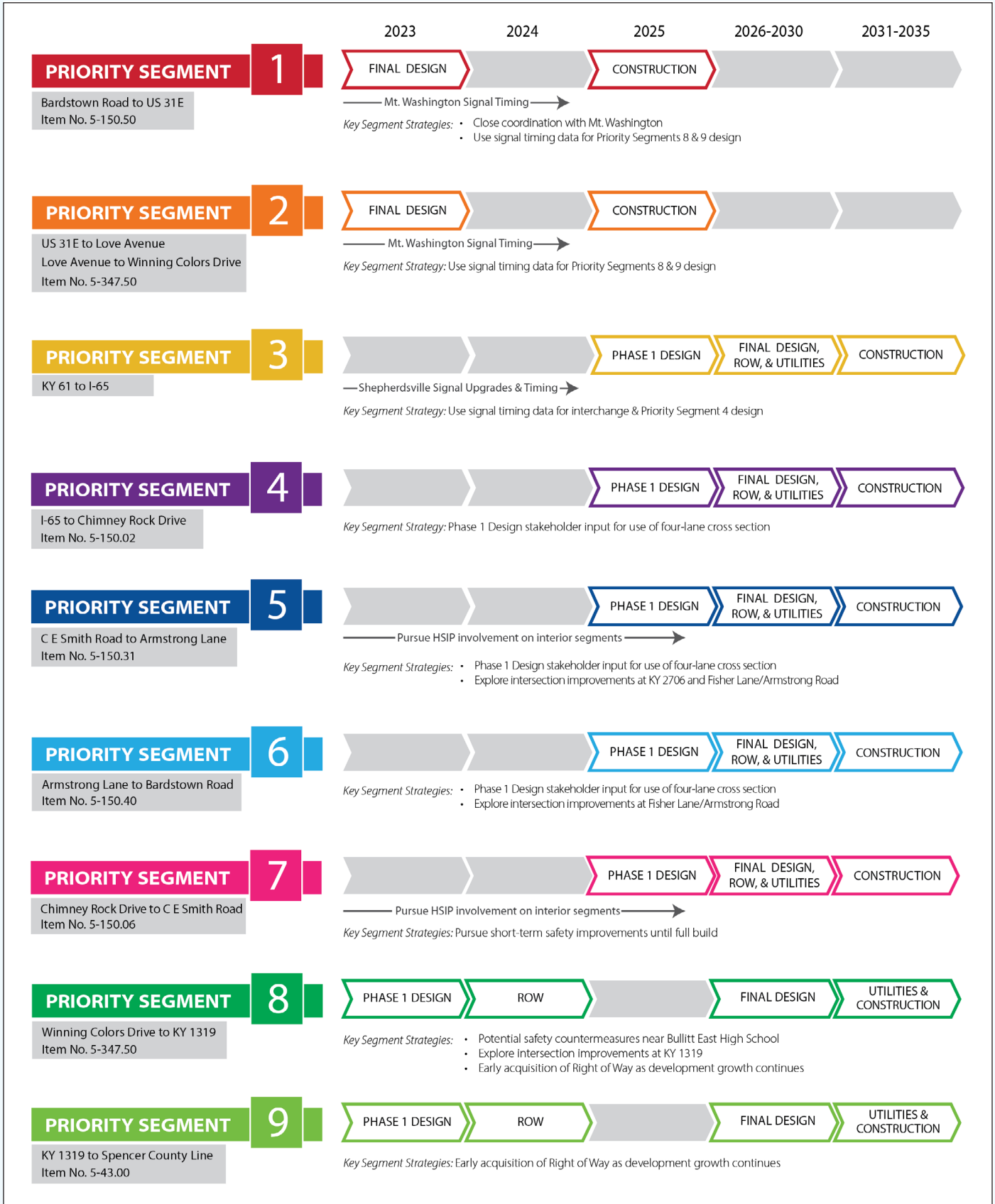
- ▶ Constructing a northwest bypass of Mt. Washington by improving and extending KY 2706 (Greenbriar Road) to connect to US 31E north of Mt. Washington is expected to reduce traffic volumes on KY 44 between KY 2706 and US 31E by 15%, enhancing the viability of a three-lane facility through this area. An initial study was performed under KYTC Item 5-8710.00, but additional evaluation of this concept is recommended.
- ▶ Constructing a new interchange at I-65 north of Shepherdsville and improving the KY 1526 corridor is expected to slightly reduce traffic in Shepherdsville near the existing I-65 interchange. This will, however, also increase traffic on KY 44 in the vicinity of the KY 1526 intersection making a three-lane facility through this area less feasible. Further study of a new interchange at this location is recommended.

## Implementation

The recommendations from this study were developed into an implementation plan that shows the priorities and interdependency of the projects, as well as a proposed timeline. **Figure ES-6** is a timeline graphic that shows the order of the prioritized segments broken down by phase of work. This includes additional work linked to some of the segments, such as signal upgrades and optimization and pursuit of KYTC HSIP assistance.



Figure ES-6: Implementation Timeline for KY 44 Projects/Segments



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# 1 Introduction

The Kentucky Transportation Cabinet (KYTC) in collaboration with Bullitt County, Kentucky elected officials and stakeholders, identified the Kentucky Route (KY) 44 corridor between Shepherdsville and Mount (Mt.) Washington as a priority corridor for assessing existing project designs, safety, and mobility needs, and recommending prioritized potential improvements. WSP USA Inc. (WSP) was contracted by KYTC to perform a programming study to identify prioritized design concepts along the KY 44 corridor. Members of the Project Team included KYTC District 5, KYTC Central Office Division of Planning, the Kentuckiana Regional Planning and Development Agency (KIPDA) and the WSP Consultant Team which includes HDR Inc. (HDR) and Taylor Siefker Williams Design Group (TSW).

The KY 44 corridor study area is shown in **Figure 1**. The study area begins at KY 61 (Mile Post [MP] 12.263) in the west and extends to the Spencer County line (MP 26.286) in the east. Over the years, KYTC has developed various design concepts for most of the KY 44 corridor between KY 61 in Shepherdsville and the Spencer County line east of Mt. Washington. Improving KY 44 is expected to be a costly undertaking and take many years to complete. It will likely have to be constructed in sections. This programming study will review existing projects, validate design assumptions, investigate ways to optimize performance through Transportation System Management and Operations (TSMO) and Performance Based Flexible Solutions (PBFS) concepts, and develop a project priority programming scheme for the KY 44 corridor.

## 1.1 Recently Constructed, Committed, and Proposed Projects

KYTC provided a list of recently constructed, committed, and proposed projects in the study area vicinity, shown in **Figure 2**. The following sources were used to identify active and proposed projects:

- ▶ Kentucky's 2022-2028 Enacted Highway Plan (Highway Plan)
- ▶ KYTC Statewide Transportation Improvement Program (STIP) 2021-2024
- ▶ KIPDA Metropolitan Transportation Plan (MTP)
- ▶ KIPDA Transportation Improvement Program (TIP)

### 1.1.1 Recently Constructed Projects

Recently constructed projects on KY 44 include the following:

- ▶ 5-150.10 – Reconstruct KY 44 at KY 1526 (Bells Mill Road) Intersection; Let to Construction 2015
- ▶ 5-150.20 – Reconstruct KY 44 at Bogard Lane/ Lloyd Lane Intersection; Let to Construction 2017
- ▶ 5-150.30 – Reconstruct KY 44 at Armstrong/Fisher Lane; Let to Construction 2014

Figure 1: KY 44 Study Area

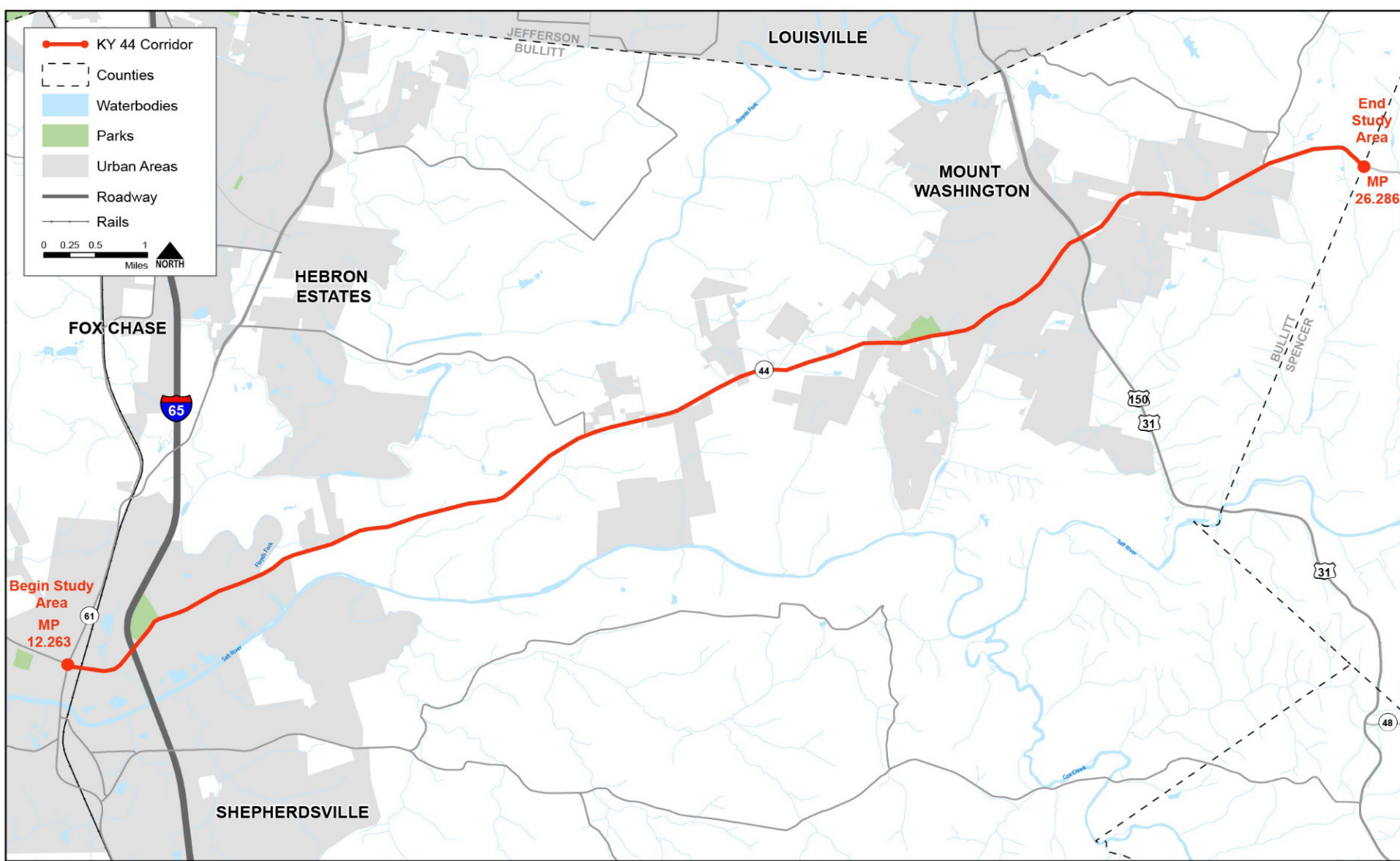
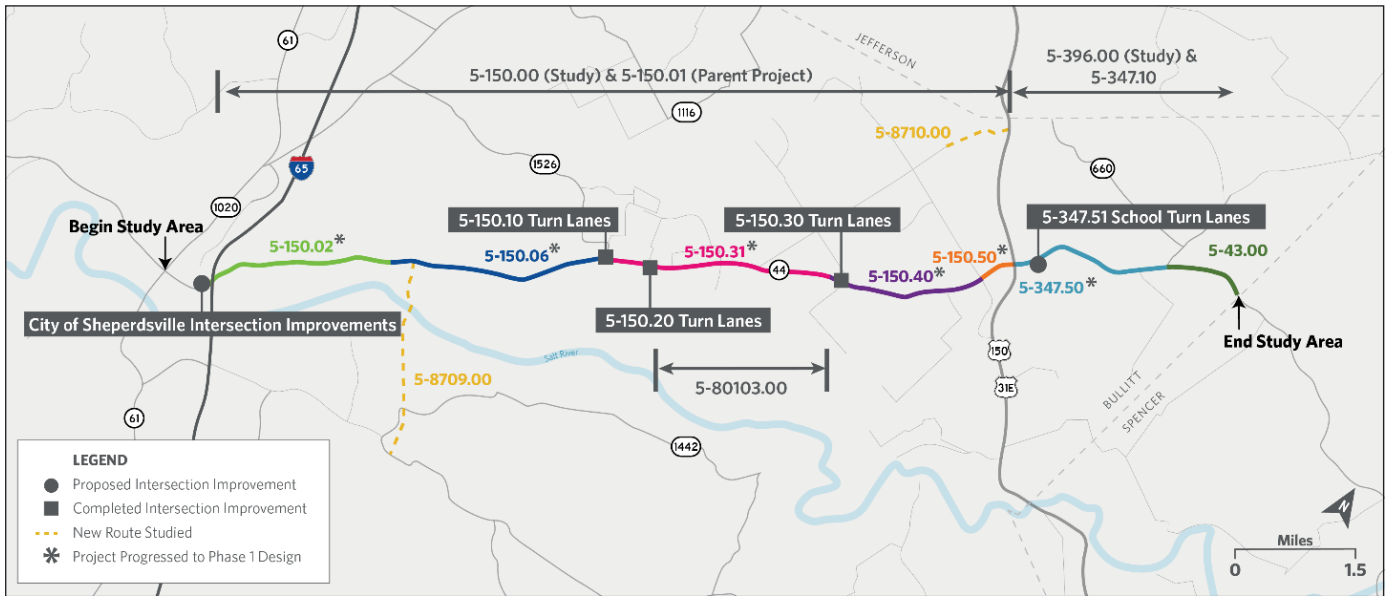


Figure 2: Recently Constructed, Proposed, and Programmed Projects



### 1.1.2 Programmed & Proposed Projects

There are six projects in the study area vicinity included in the *Highway Plan*. Item No. 5-347.51 was let to construction in November 2022 and has a primary completion date of August 31, 2023. The other five projects are the Existing Phase 1 Design projects evaluated in this study:

#### Highway Plan Projects\*

- ▶ 5-43.00: Reconstruct KY 44 from KY 1319 (Kings Church Road) to Spencer County line – (State Construction Funds [SPP]); D 2022 \$1,200,000; R 2023 \$1,000,000; U 2024 \$850,000; C 2025 \$5,350,000 – Total \$8,400,000
- ▶ 5-150.02: Reconstruct KY 44 from I-65 to Chimney Rock Drive – (SPP); D 2025 \$2,080,000; R 2026 \$7,640,000; U 2027 \$9,790,000; C 2028 \$19,430,000 – Total \$38,940,000
- ▶ 5-150.50: Reconstruct KY 44 from United States Route (US) 31EX to US 31E – (SPP); D authorized; R 2023 \$1,630,000; U 2024 \$580,000; C 2025 \$1,883,000 – Total \$4,093,000
- ▶ 5-347.50: Reconstruct KY 44 from US 31E to KY 1319 (Kings Church Road) – (SPP); D 2022 \$1,300,000; R 2025 \$4,500,000; U 2026 \$1,700,000; C 2027 \$13,200,000 – Total \$20,700,000
- ▶ 5-347.51: New Turn Lanes in front of Bullitt East High School – (Federal Statewide Transportation Program Flex Funds [STPF]); D, R, & U authorized; C 2022 \$1,022,000 – Total \$1,022,000 Let to construction November 2022.

- ▶ 5-80103.00: Reconstruct KY 44 from Bogard Lane to Armstrong Lane – (SPP) | D 2022 \$2,300,000; R 2025 \$4,700,000; U 2026 \$6,600,000; C 2027 \$14,600,000 – Total \$28,200,000

\*D: Design, R: Right-of-way, U: Utilities, C: Construction

#### KIPDA Metropolitan Transportation Plan Projects

- ▶ KIPDA ID 417: CHAF: Section 1 -1 from I-65 to Chimney Rock Drive (06CNN). CHAF ID: IP20150318. Additional Considerations: Propose two added lanes per CHAF database. – Total \$43,568,000; This corresponds with Item No. 5-150.02.
- ▶ KIPDA ID 497: Improve safety and reduce congestion on KY 44 between the I-65 interchange and the KY 61 intersection. Consider access management, pedestrian facilities and grade separated rail crossing. IP20130129. – Total \$11,545,000
- ▶ KIPDA ID 2613: Section 5 – From US 31EX to US 31E. (2008BOPC). Project length is 0.45 miles. IP20150201. – Total \$5,000,000; This corresponds with Item No. 5-150.50.
- ▶ KIPDA ID 2916: Widen KY 44 from two to four lanes from US 31E to KY 1319 (Kings Church Road) and a three-lane section from KY 1319 (Kings Church Road) to Spencer County line. – Total \$43,300,000; This corresponds with Item No. 5-43.00 and 5-347.50.
- ▶ KIPDA ID 2918: Reconstruct KY 44 from Bogard Lane to Armstrong Lane (2020CCN). Improvements may include additional travel lanes and a continuous center turn lane. – Total \$2,820,000; This corresponds with Item No. 5-80103.00.



## KIPDA Transportation Improvement Program Projects

- ▶ KIPDA ID 1925: CHAF: New turn lanes in front of Bullitt East High School (Breakout from 347.50) (18CCN). CHAF ID: IP20150154. – (STBG-State) | C 2023 \$ 1,836,450; *This corresponds with Item No. 5-347.51.*
- ▶ KIPDA ID 2916: Widen KY 44 from two to four lanes from US 31E to KY 1319 (Kings Church Road) and a three-lane section from KY 1319 (Kings Church Road) to Spencer County line. -- (STBG-MPO and CRRSAA-MPO) | D 2021 \$1,000,000; *This corresponds with Item No. 5-347.10.*
- ▶ KIPDA ID 2613: Reconstruct KY 44 from US 31EX to US 31E. (2008BOPC). Project length is 0.45 miles. IP20150201. – (State) | R 2024 \$1,550,000; U 2024 \$550,000; *This corresponds with Item No. 5-150.50.*
- ▶ KIPDA ID 2918: Reconstruct KY 44 from Bogard Lane to Armstrong Lane (2020CCN). Improvements may include additional travel lanes and a continuous center turn lane. – (SPP) | D 2023 \$2,300,000; R 2025 \$4,700,000; *This corresponds with Item No. 5-80103.00.*

## Local Public Agency Projects

- ▶ 5-347.10: Widening of KY 44 from 2 to 4 Lanes in Bullitt County from US 31E to KY 1319 (Kings Church Road) and a 3 Lane Section from KY 1319 (Kings Church Road) to the Spencer County line – KIPDA federal STBG-SLO | \$1,130,000 D funds authorized; no other phases programmed or identified – D5 assisting Bullitt County LPA with design
- ▶ No SYP: KY 44/Adam Shepard Pkwy Intersection Improvements – City of Shepherdsville - Local funds only | In Design with Construction anticipated 2025.

## 1.2 Study Objective

The objective of the KY 44 Programming Study is to review existing projects, validate design assumptions, investigate ways to optimize performance through TSMO and PBFS concepts, and incorporate those into a project priority programming scheme for the KY 44 corridor from KY 61 in Shepherdsville to the Spencer County line.

## 1.3 Study Process

The study process consists of the following major elements:

- ▶ Identify the goals of the study.
- ▶ Examine the existing conditions, past studies/projects, and identify areas with safety concerns.
- ▶ Develop an updated traffic forecast in conjunction with the forecast being performed for Item No. 5-347.50.
- ▶ Evaluate the Existing Phase 1 Designs.
- ▶ Develop potential PBFS and TSMO improvement strategies.
- ▶ Explore potential new network connections.
- ▶ Evaluate the improvement strategies based on the study goals.
- ▶ Provide a list of short-term and long-term (PBFS and TSMO) improvement strategies and prioritized programming plan.

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

## 1.4 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:

- ▶ Provide an updated traffic forecast that incorporates previous studies, projects, forecasts, and known planned developments and permits.
- ▶ Recommend PBFS and TSMO solutions that enhance safety and improve mobility at a reduced cost from the Existing Phase 1 Designs.
- ▶ Identify and recommend network connections to improve connectivity and evaluate the impacts to the KY 44 corridor.
- ▶ Program and prioritize identified projects and improvement concepts along the KY 44 corridor.
- ▶ Share the purpose of the study and proposed recommendations with local officials and stakeholders and consider their input.

# 2 Existing Conditions

To evaluate the existing conditions along KY 44, a detailed inventory of the existing physical and geometric design characteristics was completed using the following sources:

- ▶ KYTC Highway Information System (HIS) data
- ▶ Highway Plan projects, and local studies
- ▶ Kentucky Transportation Center (KTC) Crash Data Analysis Tool (CDAT) and Kentucky State Police (KSP) data
- ▶ HERE speed data
- ▶ StreetLight speed and traffic volume data
- ▶ Strava Metro 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

The KY 44 study area begins in Shepherdsville at the KY 61 intersection, continuing eastbound through the commercial zones and has a varying cross section until South Lakeview Drive, where the corridor turns into a three-lane section, including two travel lanes and a two-way left-turn lane (TWLTL). The lane widths vary between 11 feet and 12 feet and the shoulder widths vary from six feet to ten feet within the Shepherdsville area. The three-lane section extends until North Maple Street, where the corridor becomes a two-lane roadway and lane widths alternate between 10 feet and 11 feet. The two-lane section has intermittent turn lanes at major, signalized intersections, and a typical paved shoulder width of two feet throughout the residential areas. A passing zone is located along this section. The two-lane section continues eastbound until entering the Mt. Washington urbanized commercial area, where KY 44 transitions back to a three-lane roadway with a TWLTL, a two-foot paved shoulder, varying lane widths of 10 feet and 11 feet, and intermittent turn lanes at major intersections. After continuing through the US 31E/US 150 (Mt. Washington Bypass) intersection, KY 44 continues eastbound as a two-lane, 11 foot lane width roadway until the Spencer County line. The posted speed limit in the study area ranges from 35 to 55 miles per hour (mph) with the lower speed limits occurring in the Shepherdsville and Mt. Washington areas.



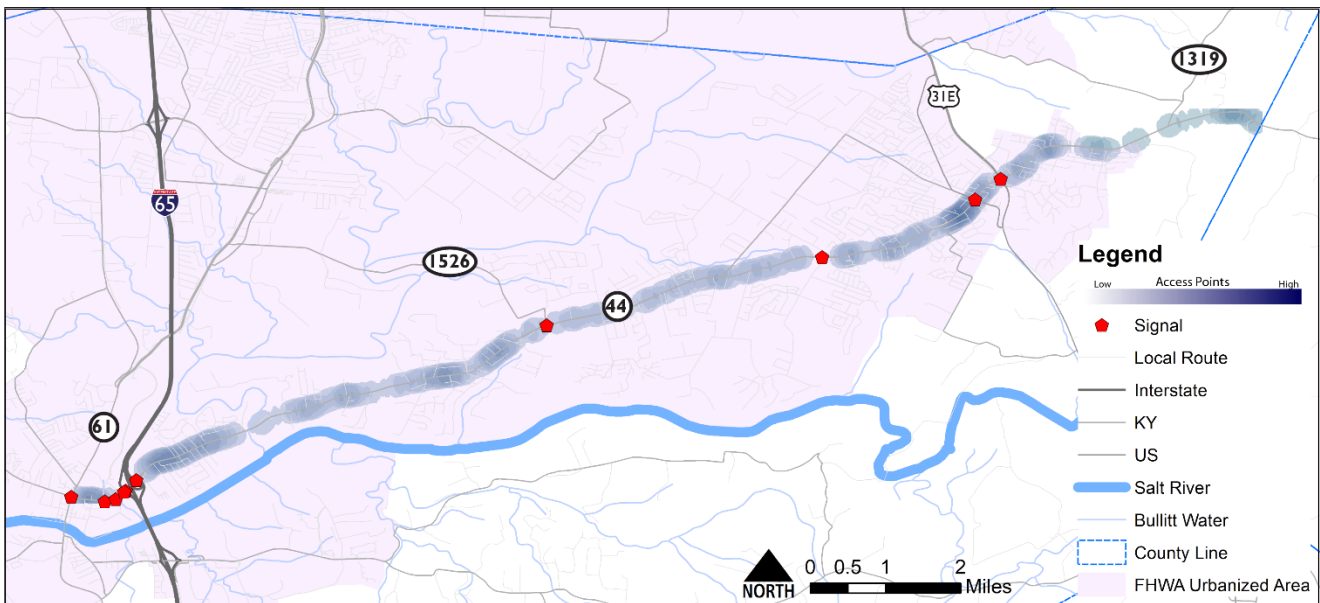
## 2.2 Intersections and Access Points

Access points are prevalent across the KY 44 study corridor. There are 536 unsignalized access points on both sides of KY 44 with concentrations in commercial zones and some residential areas. Nine signalized intersections also exist along the KY 44 study corridor, specifically concentrated in Shepherdsville and Mt. Washington. Below is a list of the signalized intersections and **Figure 3** highlights the concentration of access points and signalized intersections.

Signalized Intersections along the KY 44 Study Corridor:

- ▶ KY 61
- ▶ Hester Street
- ▶ Adam Shepherd Parkway
- ▶ I-65 Southbound
- ▶ I-65 Northbound
- ▶ KY 1526 (Bells Mill Road)
- ▶ Fisher Lane/Armstrong Lane
- ▶ US 31EX (S. Bardstown Road)
- ▶ US 31E/US 150 (Mt. Washington Bypass)

Figure 3: Access Point Density on KY 44

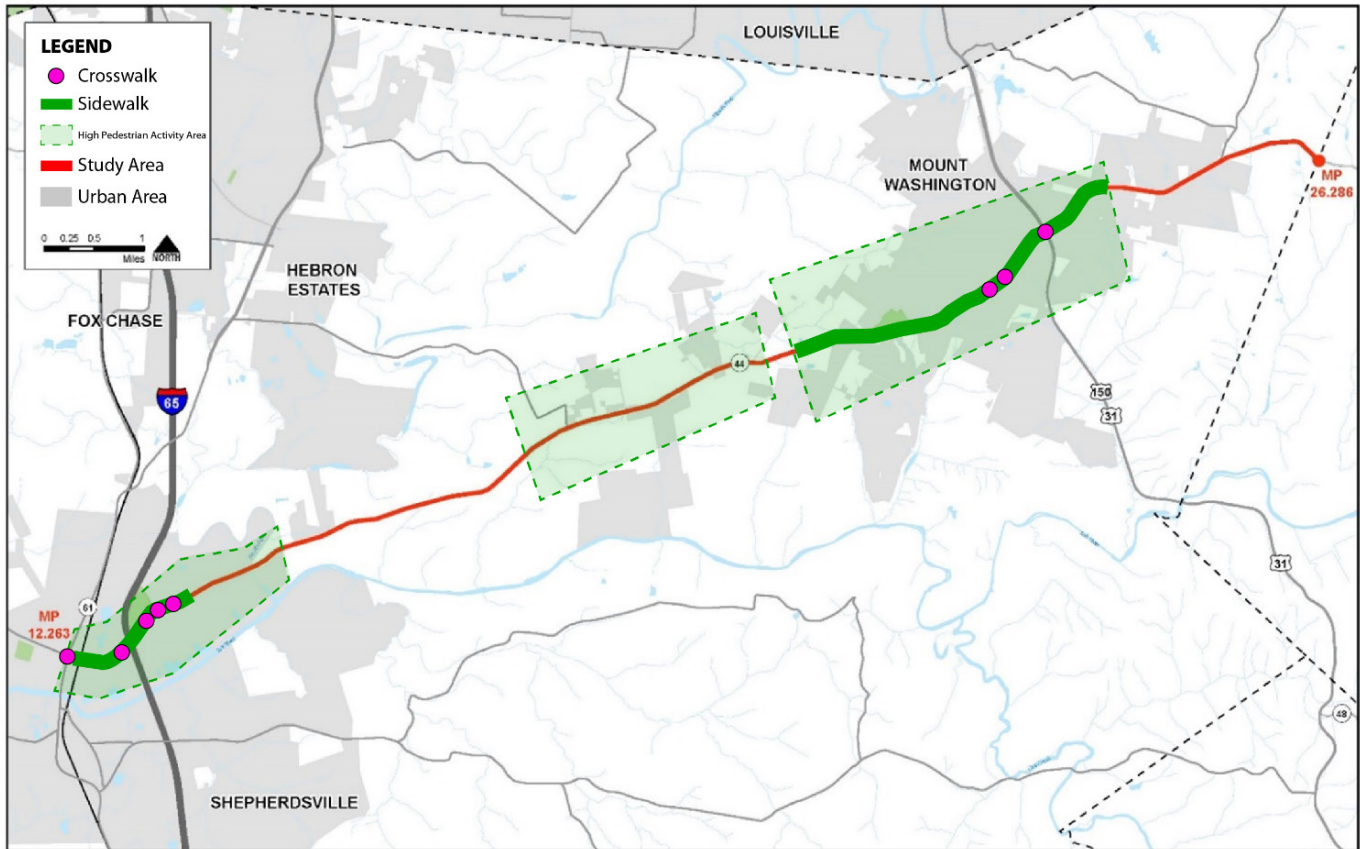


## 2.3 Bicycle and Pedestrian Activity

Sidewalks are present within the Shepherdsville and Mt. Washington urbanized areas only. Some gaps exist within the Shepherdsville area, including the area between KY 61 and the CSX railroad crossing, as well as over I-65 as there is a sidewalk across the north side of the bridge but no pedestrian facilities along the south side. Sidewalk widths do not meet Americans with Disabilities Act (ADA) compliance of at least five feet in sections within the Mt. Washington sidewalk network. Crosswalks are available at urbanized signalized intersections and select mid-block locations. There is no bicycle infrastructure along the KY 44 corridor.

Bicycle and pedestrian activity is limited along KY 44 due to the limited bicycle/pedestrian infrastructure, but activity is high within the urbanized areas and the residential communities immediately adjacent to KY 44. Most of the schools along KY 44 do not have bicycle/pedestrian infrastructure connecting to or crossing KY 44. **Figure 4** shows the existing bicycle and pedestrian infrastructure as well as areas of high bicycle and pedestrian activity based on Strava data.

Figure 4: KY 44 Bicycle and Pedestrian Facilities and Activity



## 2.4 Safety

### 2.4.1 Historic Crash Analysis

A historical crash analysis was performed to examine traffic safety trends and to identify potential safety issues along KY 44. The crash data was derived using information from the Kentucky Transportation Center (KTC) Crash Data Access Tool (CDAT) database. Five years of data (2017 to 2021) were used in the analysis and are presented throughout the rest of this chapter. Within the five-year analysis period, 1,694<sup>1</sup> crashes were reported. Of these, 1,398 were property damage only crashes (82.5%). There were eight fatal crashes, 20 serious injury crashes, and 114 minor injury crashes reported over the five-year study period.

The density of crashes along the KY 44 study corridor was plotted to show locations with higher concentrations of crashes. The locations of fatal and serious injury crashes were overlaid on this map. Three areas were identified (**Figure 5**) as having higher concentrations of crashes and higher numbers of fatal and serious injury crashes.

- ▶ In Shepherdsville from KY 61 (MP 12.215) to Bullitt Central High School (MP 13.592) with 542 total crashes occurring.
- ▶ In Mt. Washington between Woodlake Drive (MP 22.103) and Cornell Avenue (MP 23.952) with 456 total crashes occurring.
- ▶ Middle study area between Douglas Lane (MP 15.552) and KY 2706 (Greenbriar Road) (MP 19.895) with 310 total crashes occurring. Although the concentration of crashes was not as high, the numbers of fatal and serious injury crashes were higher than other locations along KY 44.

<sup>1</sup> Three crashes of unknown severity were reported in the study area and are not included in this analysis.

An examination of the type of crashes along KY 44 is presented in **Figure 6**. Approximately 52% (875 crashes) of the crashes in the study area were rear end crashes, followed by 367 angle (21.7%), and 178 single vehicle (10.5%) crashes. The head-on crash category involved the highest proportion (40.7%) of fatal and injury crashes (1 fatal, 3 serious injury, 7 minor injury) compared to other crash types. It was also noted that commercial vehicles were involved in 2.2% of all reported crashes, which is a lower percentage than their proportion of traffic volume on KY 44 (6.8% trucks).

With there being 536 access points and nine signalized intersections along KY 44, intersection and driveway related crashes were reviewed. The Project Team reviewed crashes within a 400-foot buffer around intersections and within 50 feet of driveways to determine if crashes were concentrated around access points. Angle, rear end, opposing left turn, and sideswipe-opposite direction crashes that occurred within these buffer areas were examined since these types most represent intersection related crashes.

The results showed that approximately 60% of all crashes (1021 crashes) occurring at an intersection or entrance/driveway, with a majority of 657 being rear end crashes (64.3%) followed by 300 angle (29.4%) crashes.

The effect that weather events and pavement condition had on crashes were investigated. 1481 crashes occurred in clear or cloudy conditions (67% and 20.3% respectively). There were 1373 crashes that occurred under dry conditions (81.1%).

Bicycle and pedestrian related crashes were also reviewed. No crashes involving bicyclists were recorded within the analysis period. However, fourteen pedestrian related crashes were recorded. Of these crashes, one fatal, one serious injury, seven minor injury and three possible injury crashes were noted. Nine of the fourteen crashes involving a pedestrian occurred at night. **Figure 7** shows the location of these pedestrian crashes.



Figure 5: KY 44 Crash Density Map (2017 – 2021)

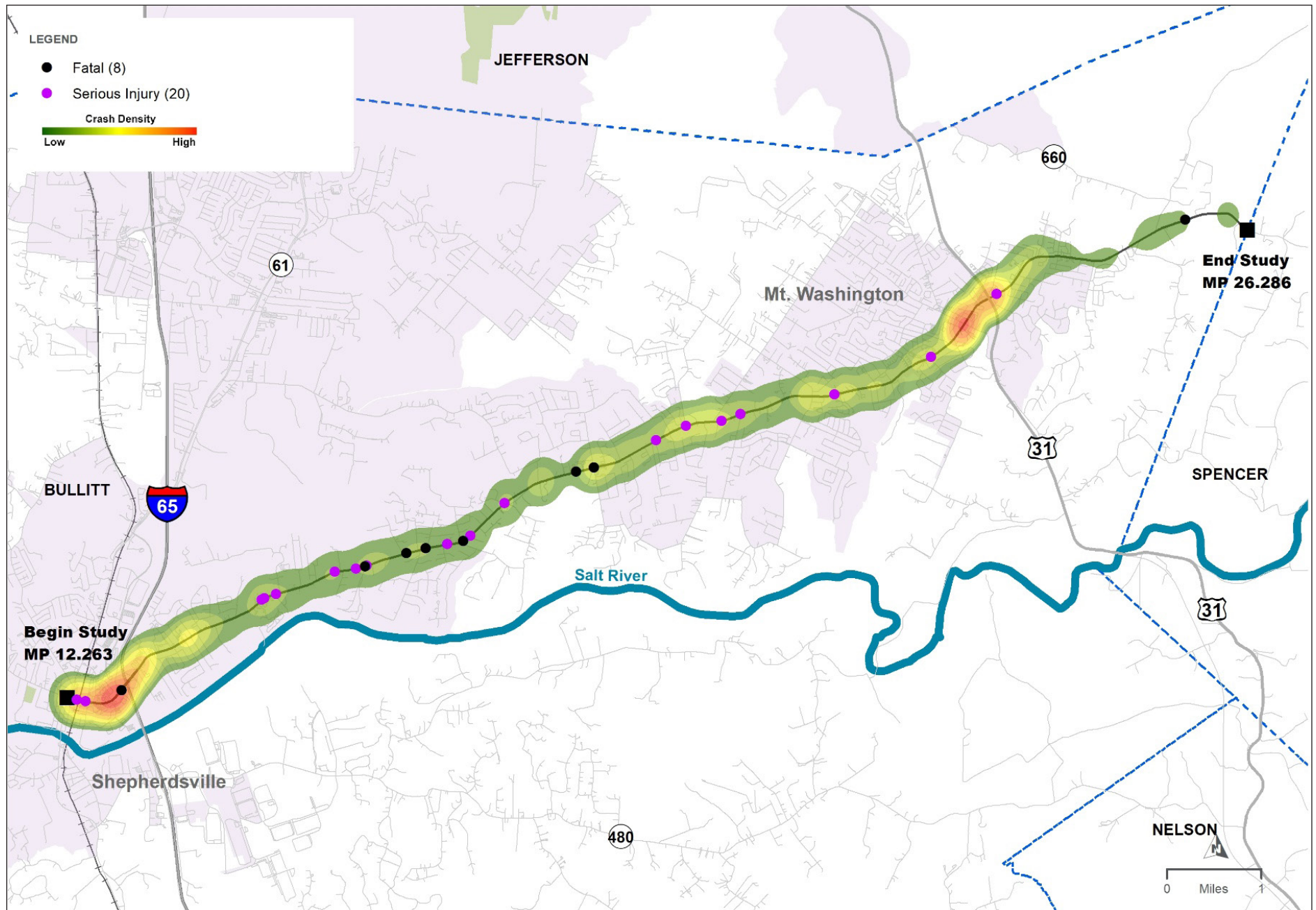


Figure 6: KY 44 Crash Type (2017 – 2021)

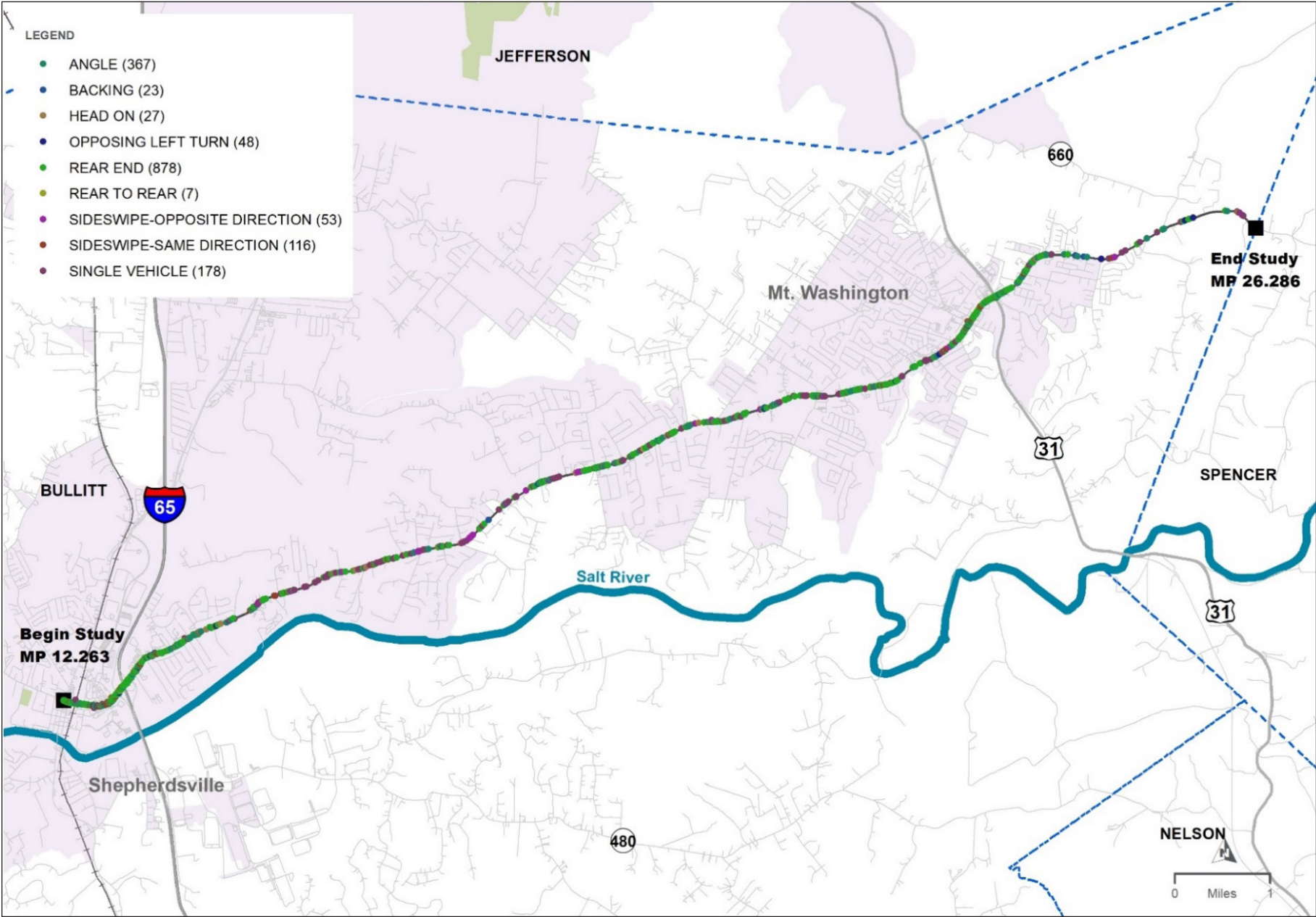
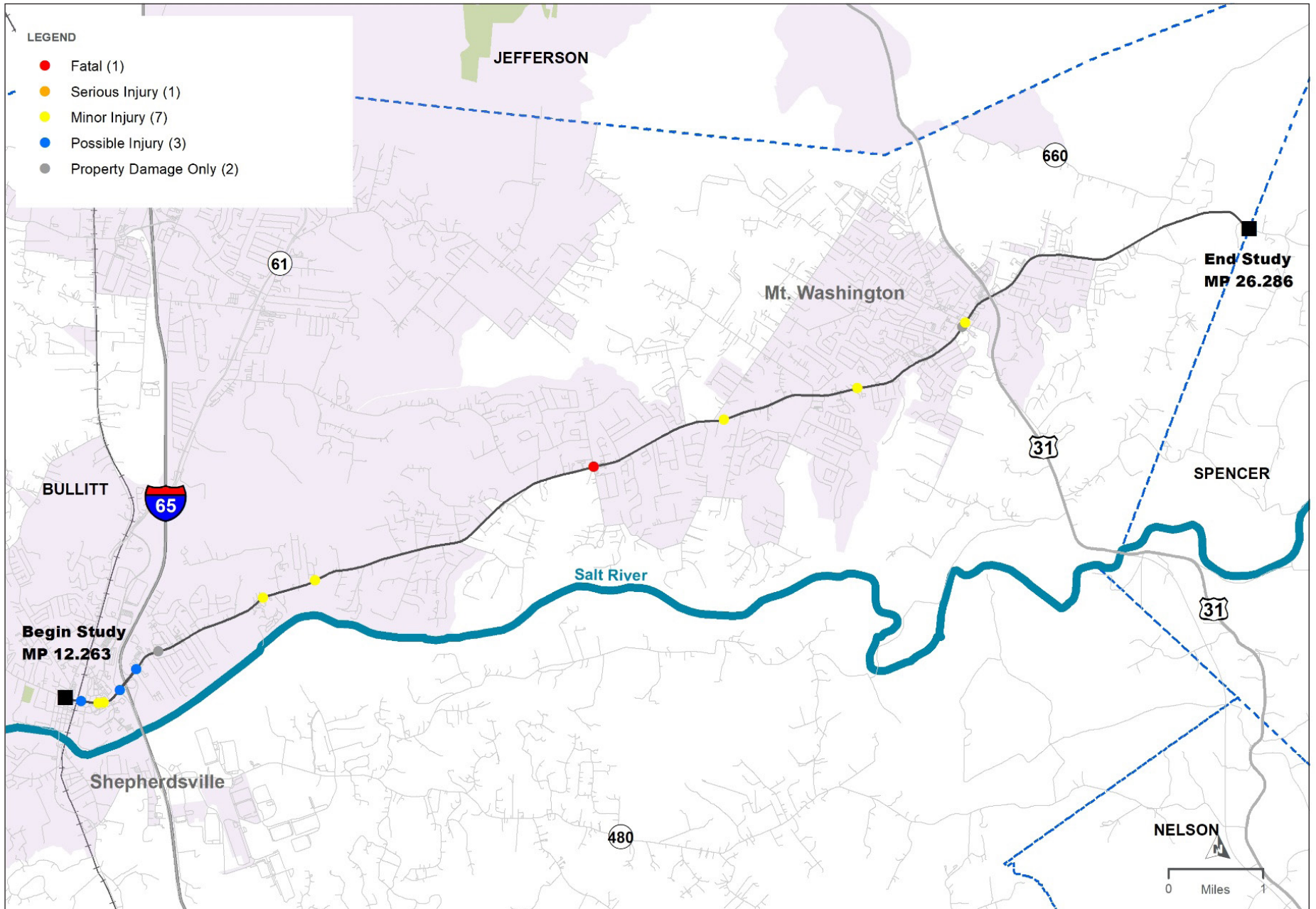




Figure 7: KY 44 Pedestrian Crashes (2017 – 2021)





### 2.4.2 Intersection Crash Rates

Crash rates were calculated for the KY 44 study intersections using the 2017 – 2021 crash data and corresponding traffic volumes. Crash rates provide a way to identify higher crash locations by normalizing the frequency of crashes by exposure to traffic (per million of entering vehicles [MEV], for intersections) and by comparing the intersection crash rates to other intersections within the study area. The average intersection crash rate for the study area is 1.41 crashes per MEV. Seven intersections equaled or

exceeded this average crash rate. These intersections include the I-65 southbound ramp (crash rate of 5.39), Adam Shepherd Parkway (4.44), US 31EX (2.97), KY 61 (2.64), I-65 northbound ramp (1.78), Carpenter Street (1.74), and US 31E (1.41). **Table 1** provides study intersection crash rates.

**Table 1: KY 44 Intersection Crash Rates (2017 - 2021)**

Intersection Name	Intersection Crash Rate <sup>1</sup>	Intersection Name	Intersection Crash Rate <sup>1</sup>
KY 44 at KY 61	2.64	KY 44 at Lloyd Lane/Bogard Lane	1.11
KY 44 at Carpenter Street	1.74	KY 44 at Bethel Church Road	1.01
KY 44 at Adam Shepherd Parkway	4.44	KY 44 at KY 2706 (Greenbriar Road)	0.66
KY 44 at I-65 Southbound Ramp	5.39	KY 44 at Fisher Lane	1.27
KY 44 at I-65 Northbound Ramp	1.78	KY 44 at US 31EX	2.97
KY 44 at South Lakeview Drive	1.13	KY 44 at US 31E	1.41
KY 44 at Bullitt Central High School	0.14	KY 44 at KY 1319 (Kings Church Road)	0.87
KY 44 at Highland Court	1.28	KY 44 at Tollview Drive	0.97
KY 44 at Lees Valley Road	0.88	KY 44 at Highland Springs Drive	0.68
KY 44 at Boardwalk Avenue	0.79	KY 44 at Woodlake Drive	0.40
KY 44 at Dennis Drive / Sunview Drive	0.35	KY 44 at KY 2674 (Stringer Lane)	0.42
KY 44 at KY 1526 (Bells Mill Road)	0.57	KY 44 at Oakbrooke Drive	1.02

<sup>1</sup> Per million entering vehicles

### 2.4.3 Excess Expected Crashes

KYTC and KTC have developed a statistical approach for evaluating safety performance and ranking safety needs based on the *Highway Safety Manual (HSM)* methods. That approach involves the calculation of Excess Expected Crashes (EEC) for highway segments and intersections. EEC is based on crash prediction models that estimate the number of crashes expected on a highway segment of a given type and length and with certain geometric conditions. It represents the number of excess crashes a segment is experiencing compared to other highways of its type, adjusting for traffic volumes and a statistical correction. EEC is positive when more crashes are occurring than expected and negative when fewer crashes are occurring than expected.

**Figure 8** shows positive and negative total EEC (including fatal, injury, and property damage only) segments on KY 44. Positive EEC segments are present in Shepherdsville west of I-65, in Mt. Washington approaching the US 31E intersection, and in the far eastern study area east of the KY 1319 (Kings Church Road) intersection. Positive and negative total EEC intersections are spread throughout the KY 44 study area but are more concentrated in Shepherdsville and Mt. Washington (see **Figure 9**). Overall the segments performed with a positive EEC in the fatal and injury crash category but exhibit negative EEC in the property damage only category.

Figure 8: KY 44 Segment Total Excess Expected Crashes (2017-2021)

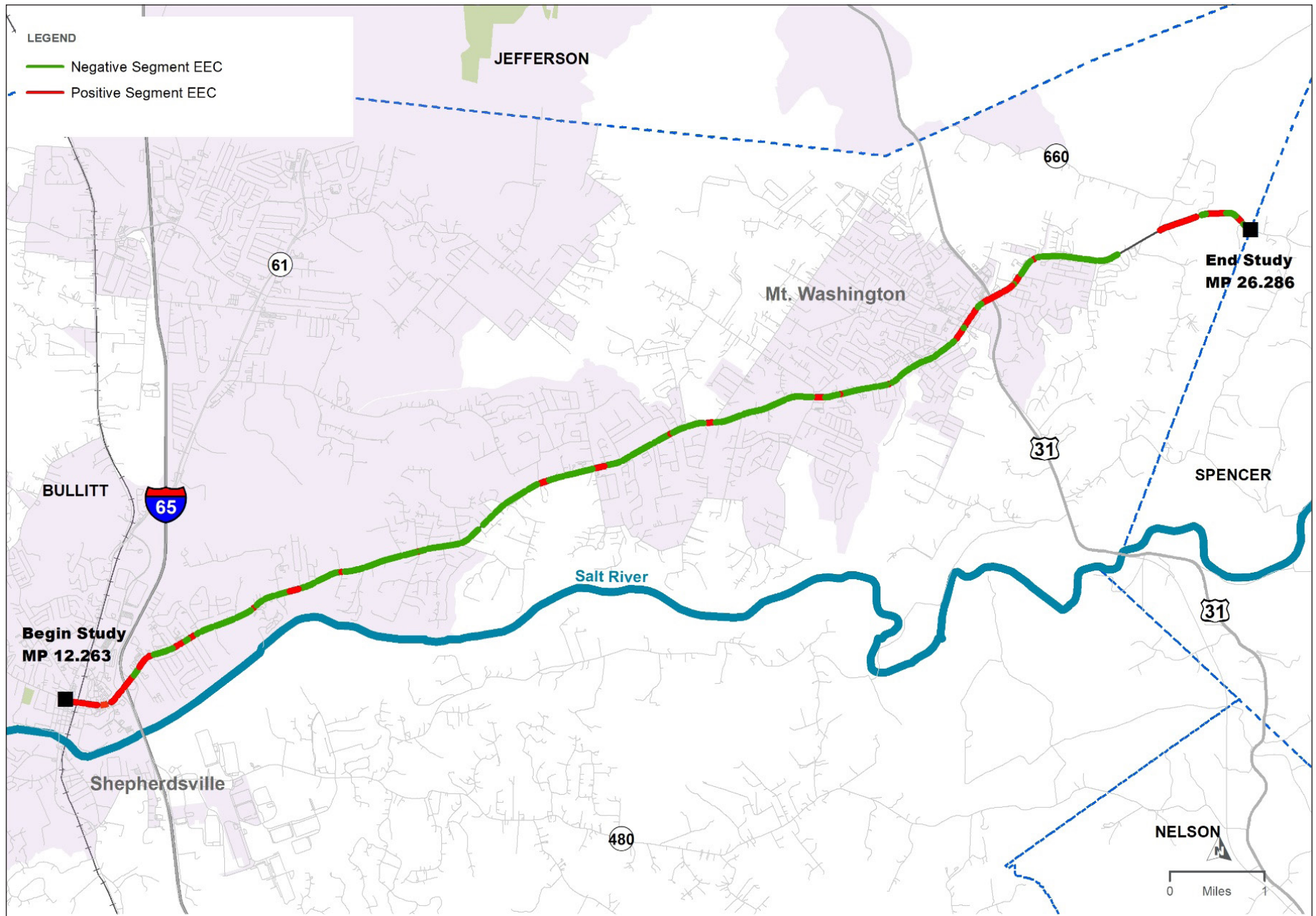
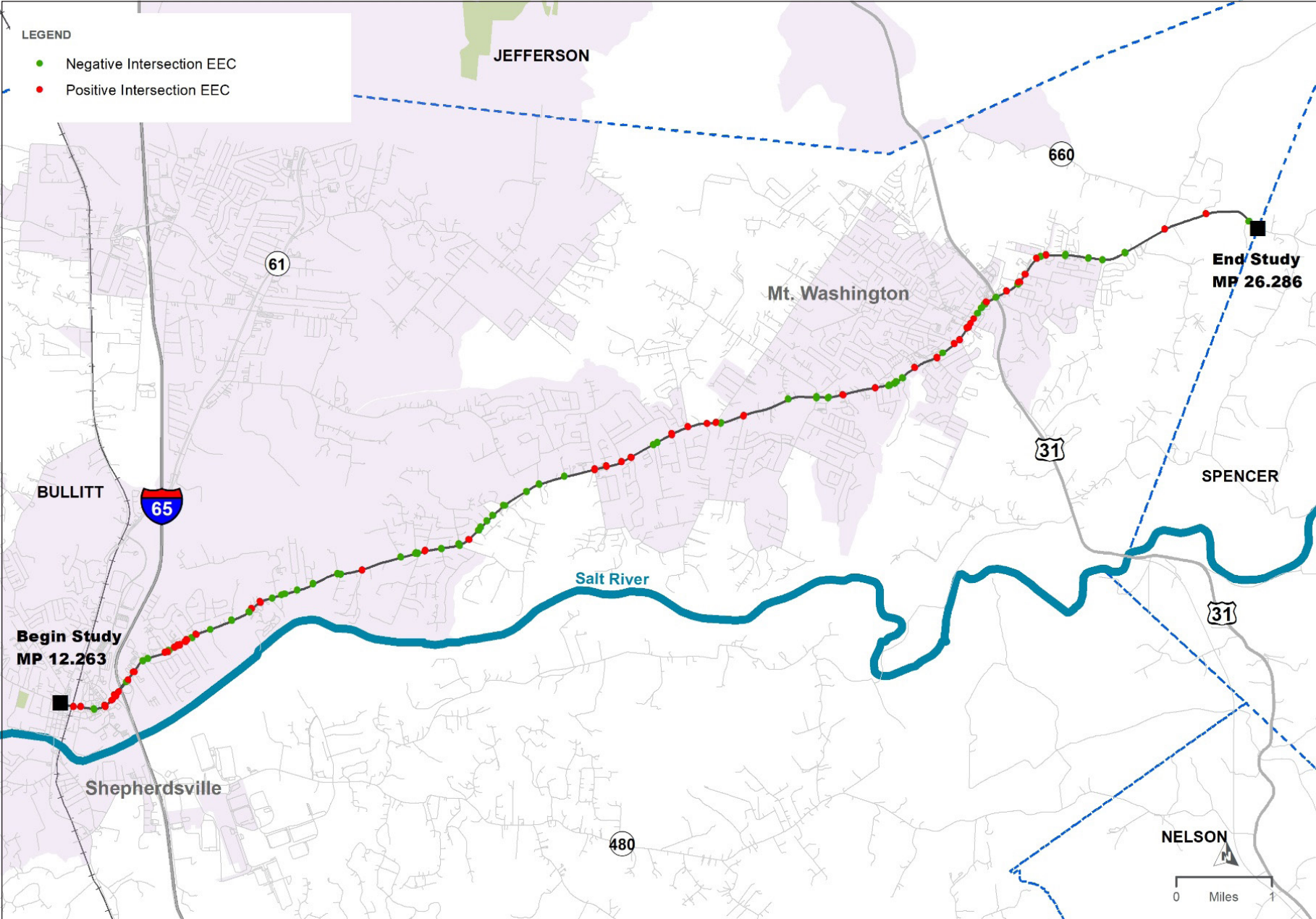


Figure 9: KY 44 Intersection Total Excess Expected Crashes (2017-2021)





## 2.4.4 Summary of Safety Issues & Use of Safety Data

Overall, KY 44 in the study area exhibits a lower safety performance than similar type facilities in Kentucky with regards to fatal and injury crashes. This is also demonstrated by the number of intersections with a positive EEC value for all crashes. Along KY 44, the majority of crashes occur at intersections. There are three areas of concern along KY 44 that have higher concentrations of crashes and higher proportions of fatal and injury crashes. The first of these locations is in Shepherdsville between KY 61 and Bullitt Central High School. The second location is in Mt. Washington between Woodlake Drive and Cornell Avenue, and the third location is in the middle of the study area between Douglas Lane and KY 2706 (Greenbriar Road). Of the three areas, this middle section has the highest number of fatal and injury crashes. Additional detailed safety analysis can be found in **Appendix B**.

## 2.5 Corridor Speeds

Travel speeds can be an indicator of how a roadway is operating. Under normal operating conditions, drivers typically travel at or near the posted speed limit. Locations with typical operating speeds less than the posted speed limit can indicate a geometric deficiency, such as a tight radius curve, or the lower speeds could be the result of intersection delay, such as vehicles

slowing down at a traffic signal, or vehicles having to slow down for other entering and exiting vehicles from entrances. KYTC provided 2019 HERE speed data for the KY 44 study area. The speed data were used to determine typical operating speeds throughout the day, including in the AM and PM peak hours.

Operating speeds were analyzed temporally and geographically to assess the efficiency of traffic flow along KY 44 and to determine where speed differentials occur. These differentials in travel speed, usually at a congested intersection, present the potential for an increase in crashes to occur. Speeds on KY 44 are generally higher in the middle of the study area, where there is more distance between traffic signals and the traffic volumes are lower. Speed on KY 44 near the I-65 interchange in Shepherdsville and near the US 31E intersection in Mt. Washington tend to be lower. This lower speed is likely attributable to higher access point densities and the presence of several traffic signals. **Figures 10** and **11** show the 85th percentile speeds in each direction along the corridor and the posted speed limit, which ranges from 35 mph to 55 mph. Given that 85th percentile speeds generally are at or below the posted speed limit, excessive speeding does not appear to be an issue in the study area. **Appendix C** provides additional speed graphs.

Figure 10: KY 44 Eastbound 85th Percentile Speeds

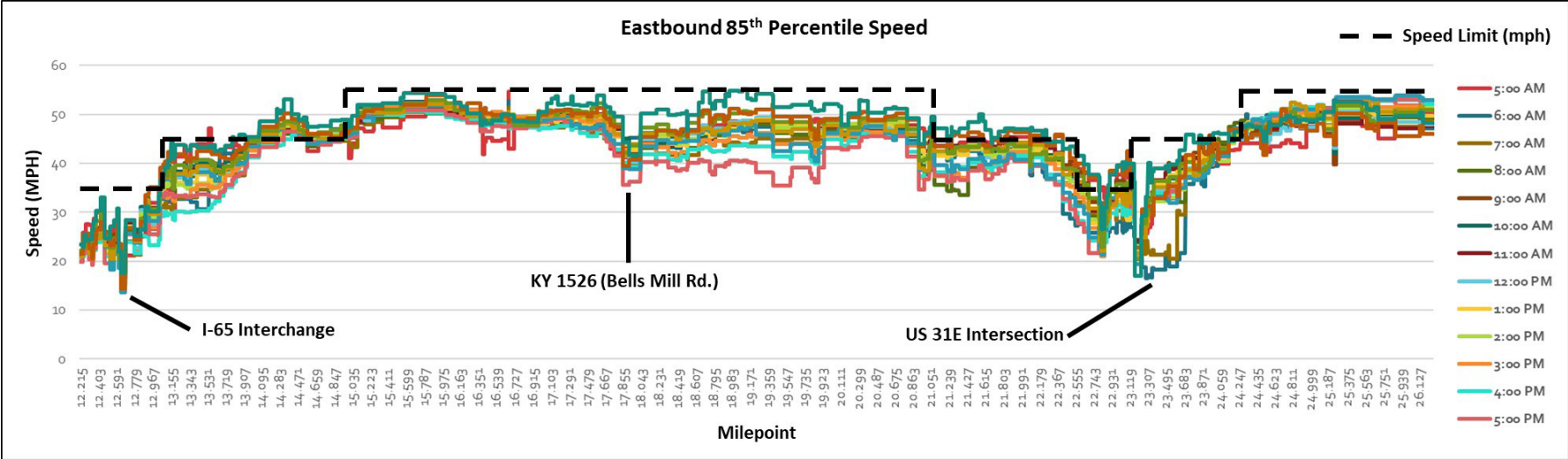
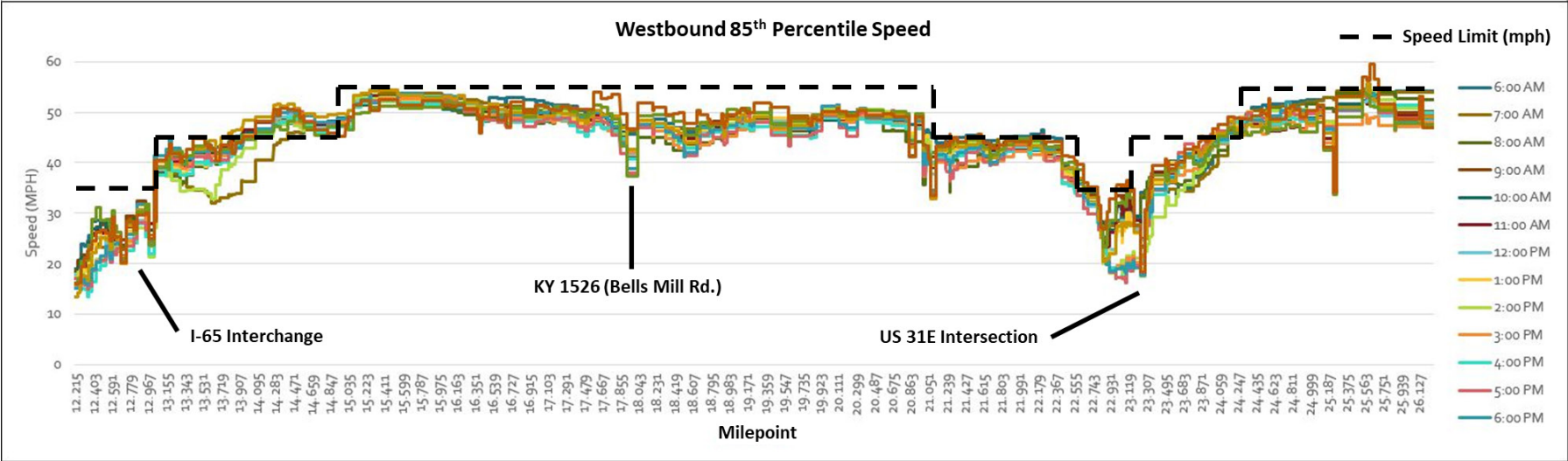


Figure 11: KY 44 Westbound 85th Percentile Speeds



## 2.6 Traffic Analysis

A traffic analysis was performed to establish baseline existing traffic volumes for 2022 and to forecast future growth out to 2045, including future No-Build and Build (Existing Phase 1 Design Projects). Previous studies, projects, traffic forecasts, and identified planned developments and permits were reviewed to determine an appropriate growth rate for the study area. The analysis of Existing Phase 1 Design projects is found in the next chapter. The traffic operations analysis included a capacity screening to identify any

operational issues in 2022 or the 2045 No-Build and Build scenarios. The KY 44 Traffic Forecast Report is available in **Appendix D**. The output from the traffic analyses is available in **Appendix E**.

For the analysis, KY 44 was divided into segments A through I based on the location of count stations as well as identification of logical sections for other aspects of analysis (**Figure 12**). Once the segments were analyzed, growth rates were aggregated into three sections.

Figure 12: KY 44 Corridor Analysis Segments and Growth Sections



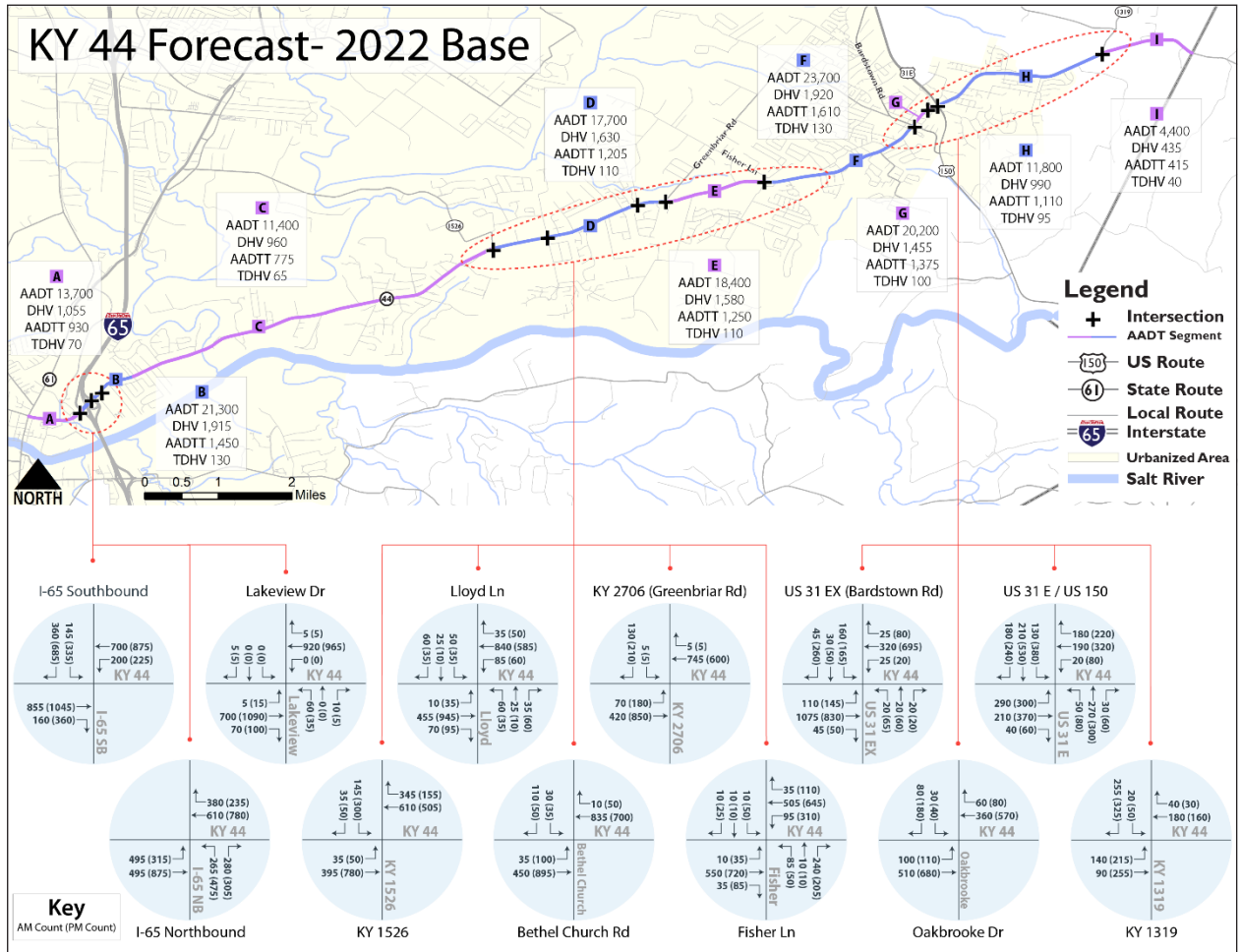
### 2.6.1 Existing 2022 Volumes

KYTC provided the historical count data for each count station, as well as 48-hour traffic count data for the year 2022. **Figure 13** highlights the 2022 Annual Average Daily Traffic (AADT) and Design Hourly Volumes (DHV). The count station AADTs were rounded to the nearest 100, the K-Factors came from the 48-hour counts to attain AM and PM DHV, and the daily truck percentage at each count station was used for daily truck volume as well as AM/PM hourly truck volume.

The scope of this study did not include the collection of new turning movement counts for the base year; rather, previous year counts from the traffic data of prior studies and forecasts were used. These counts were grown to the base year using the study area average historical growth rate (1.21%). **Figure 13** also shows the base year turning movement intersection volumes.



Figure 13: KY 44 Base Segment and Intersection Volume



### 2.6.2 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 calls for forecasts to 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.

The growth rates were developed based on four factors:

- ▶ Historical traffic growth
- ▶ Travel demand models (Kentucky Statewide Model (KYSTM), KIPDA Travel Demand Model, and Hardin Meade Travel Demand Model)
- ▶ Projected population growth
- ▶ Growth rates from previous planning studies, traffic forecasts, design projects, and recent encroachment permits/developments

The Project Team determined three sections would be evaluated for different growth rates due to capacity to build, zoning, etc. Growth rates for KY 44 were developed in coordination with those being used in the Reconstruct KY 44 from US 31E to KY 1319 (Item No. 5-347.50) project's Traffic Forecast and were approved by the KYTC Central Office Modal Branch.

The Project Team also determined a No-Build and Build growth rate for each section. The sections of KY 44 evaluated were: US 61 to I-65 Northbound ramps, I-65 Northbound ramps to US 31, and US 31 to the Spencer County line. The No-Build and Build growth rates are shown in **Table 2**.

**Table 2: KY 44 Build and No-Build Growth Rates**

Segment	No-Build (%)	Build (%)
Section 1 KY 61 to I-65	0.25	0.25
Section 2 I-65 to US 31E	1.00	2.00
Section 3 US 31E to Spencer County line	2.25	2.70

Figures 14 and 15 highlight the 2045 No-Build and Build intersection and segment forecasts.

**Figure 14: 2045 No-Build Forecast**

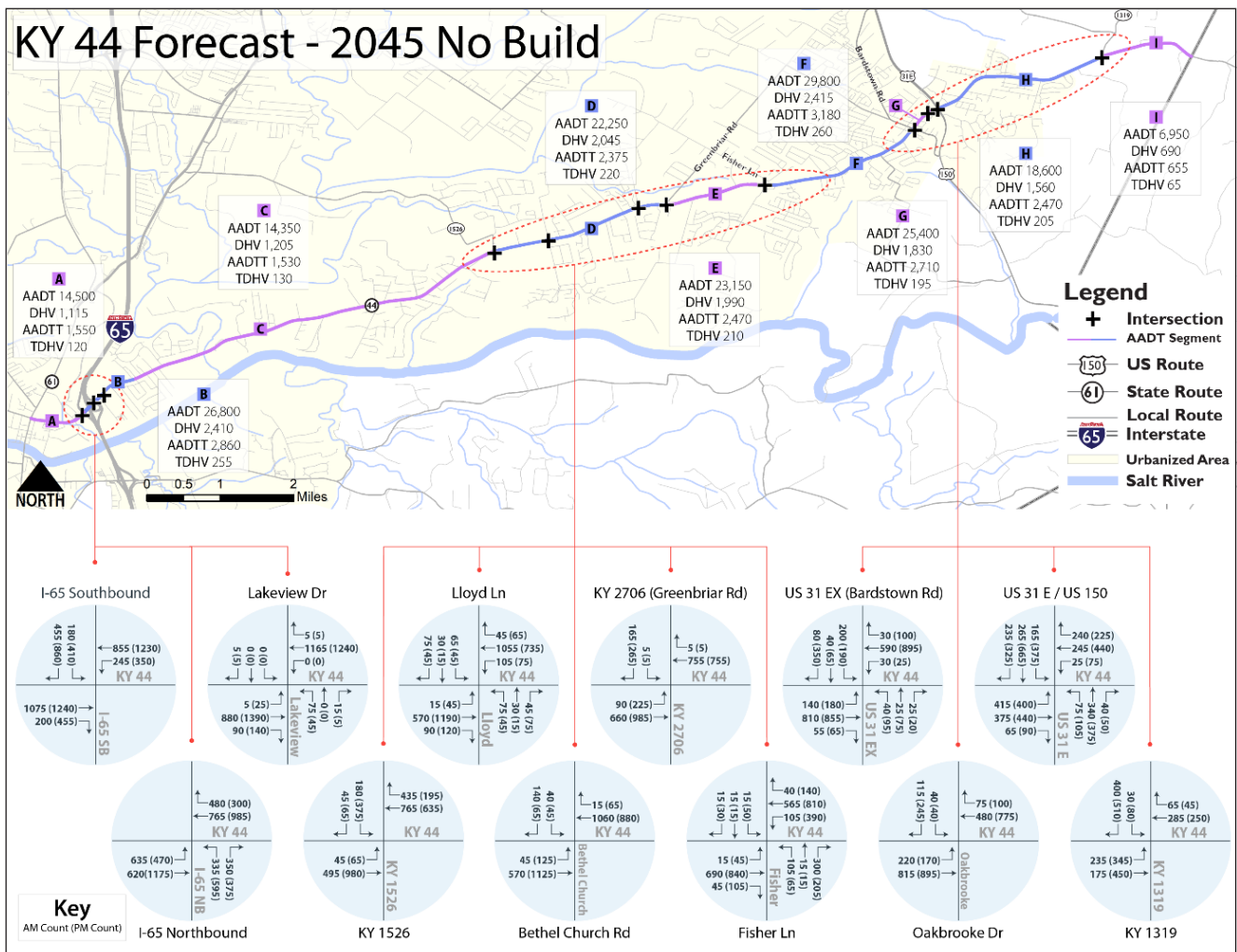
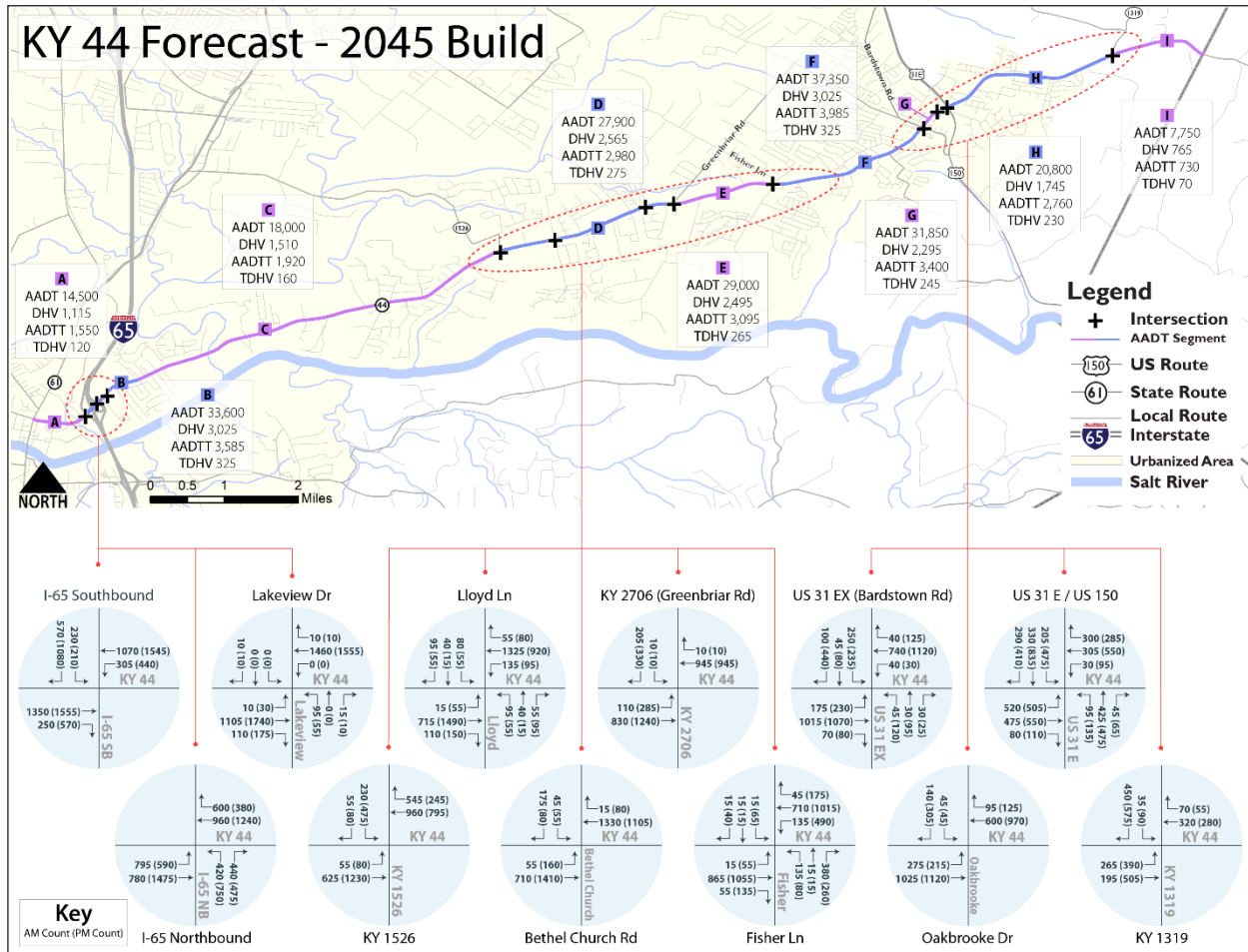


Figure 15: 2045 Build Forecast



## 2.7 Traffic Operational Analysis

The traffic operational analysis was conducted using HCS 7 and Synchro software, which are based on the *Highway Capacity Manual (HCM)*, 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.

At intersections, LOS is a measure of average operating conditions during an hour. It is based on average delay per vehicle for a specified time period. **Table 3** provides LOS criteria for signalized intersections.

**Table 3: LOS Criteria for Signalized and Unsignalized Intersections**

LOS	Signalized – Average Control Delay (sec/veh)	Unsignalized – Average Control Delay (sec/veh)	LOS Description
A	≤ 10	≤ 10	Free Flow
B	> 10 and < 20	> 10 and < 15	Slight Delays
C	> 20 and < 35	> 15 and < 25	Acceptable Delay
D	> 35 and < 55	> 25 and < 35	Tolerable Delay
E	> 55 and < 80	> 35 and < 50	Intolerable Delay
F	> 80	> 50	Forced Flow/Congestion

KY 44 is classified as an urban minor arterial from KY 61 (MP 12.263) to Twin Eagles Parkway (MP 24.799) and a rural minor arterial from Twin Eagles Parkway (MP 24.799) to the Spencer County line (MP 26.286). The AASHTO Green Book guidelines suggest that rural arterials be designed to operate at LOS C and urban arterials to LOS D. Since there is anticipated future development in the study area, the Project

Team determined it was best to use LOS D as the acceptable level of operation. For the purposes of the operational analysis, KY 44 was considered a multi-lane highway from MP 12.220 to MP 13.160 and considered a two-lane highway from MP 13.16 to MP 26.29. **Table 4** provides LOS criteria for the segment analysis.

**Table 4: LOS Criteria for Two-Lane and Multi-Lane Highways**

LOS	Two-Lane Highway Density (vehicles/mi/ln)	Multi-Lane Highway Density (pc/mi/ln)
A	≤ 2.0	≤ 11
B	> 2.0 and < 4.0	> 11 and < 18
C	> 4.0 and < 8.0	> 18 and < 26
D	> 8.0 and < 12.0	> 26 and < 35
E	> 12.0	> 35 and < 45
F	Demand Exceeds Capacity	> 45

Using the criteria listed above, intersection and segment analyses were completed for both existing (2022) and future (2045) traffic along KY 44.

### 2.7.1 Intersection Results

**Figures 16** and **17** summarize the HCM calculated intersection delay from the Synchro analysis of AM and PM 2022 Existing and 2045 No-Build conditions. In this analysis, only signal timing/phase improvements are made at the KY 44 intersections with the I-65 ramps. KY 44/Lloyd Lane/Bogard Lane becomes a signalized intersection in the No-Build scenario because this intersection will become signalized in Spring of 2023. Adjusting the signal control operations of the traffic signal at KY 44/KY 1526 (Bells Mill Road) from operating in free to a

coordinated plan and optimizing the timing improves the LOS to an acceptable level (LOS D) through 2045. The KY 44 intersections at Bethel Church Road, Greenbriar Road, Fisher Lane, US 31 EX, and KY 1319 (Kings Church Road) all drop from an acceptable LOS in the Base condition to LOS E or F in the 2045 No-Build condition.

### 2.7.2 Segment HCS Results

**Figures 16** and **17** summarize the Base AM and PM HCS results alongside the intersection results from Synchro. The PM peak operates at a worse LOS than the AM, and in both peaks, KY 44 from South Lakeview Drive to Melwood Drive and KY 1526 (Bells Mill Road) to US 31E experience the worst LOS.

Figure 16: 2022 Existing AM Intersection and Segment HCS Results

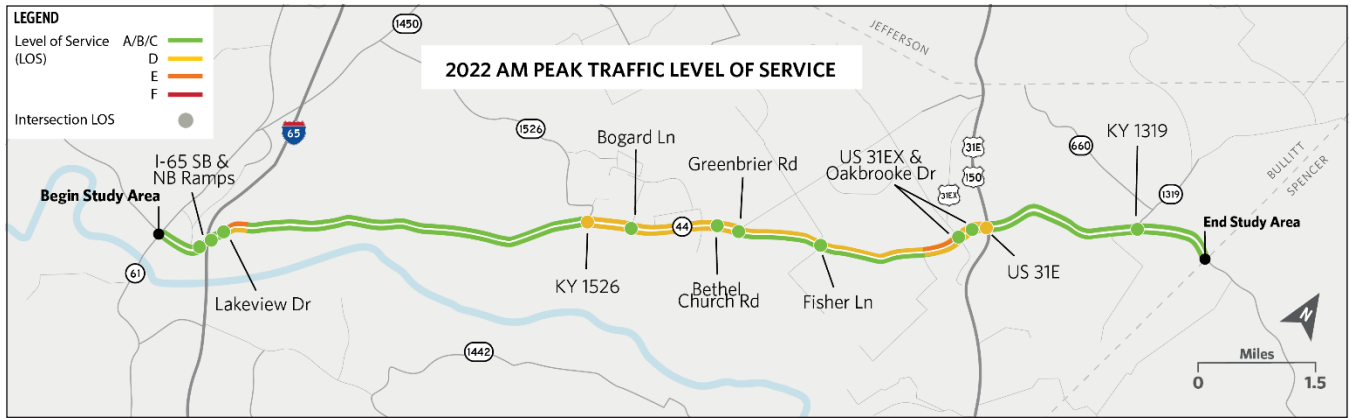
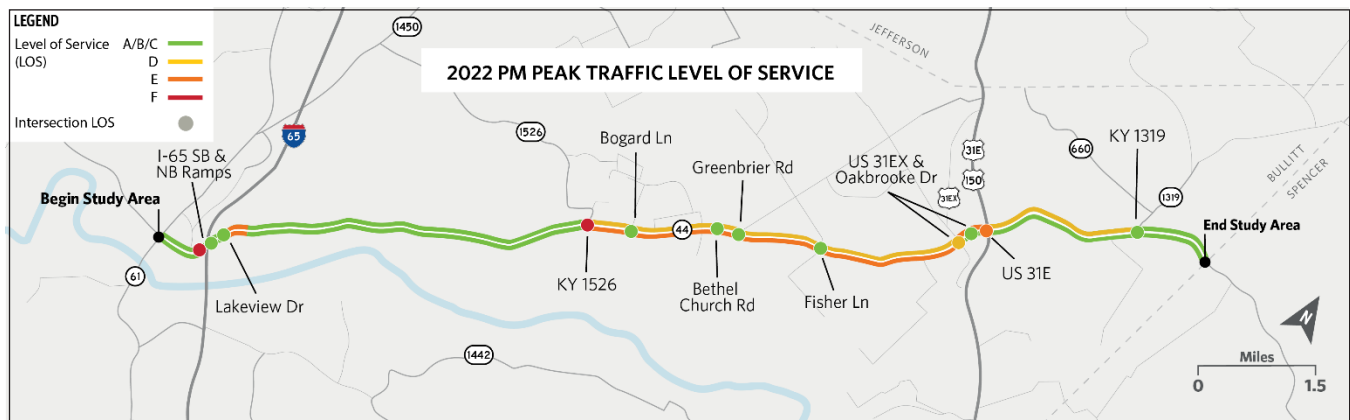


Figure 17: 2022 Existing PM Intersection and Segment HCS Results



Figures 18 and 19 summarize the 2045 No-Build AM and PM intersection and segment HCS results. As expected, conditions appear to deteriorate in the future as traffic volumes increase, with the portion of

KY 44 between KY 1526 (Bells Mill Road) and KY 1319 (Kings Church Road) and the segment from South Lakeview Drive to Melwood Drive operating at LOS E in both peaks.

Figure 18: 2045 No-Build AM Intersection and Segment HCS Results

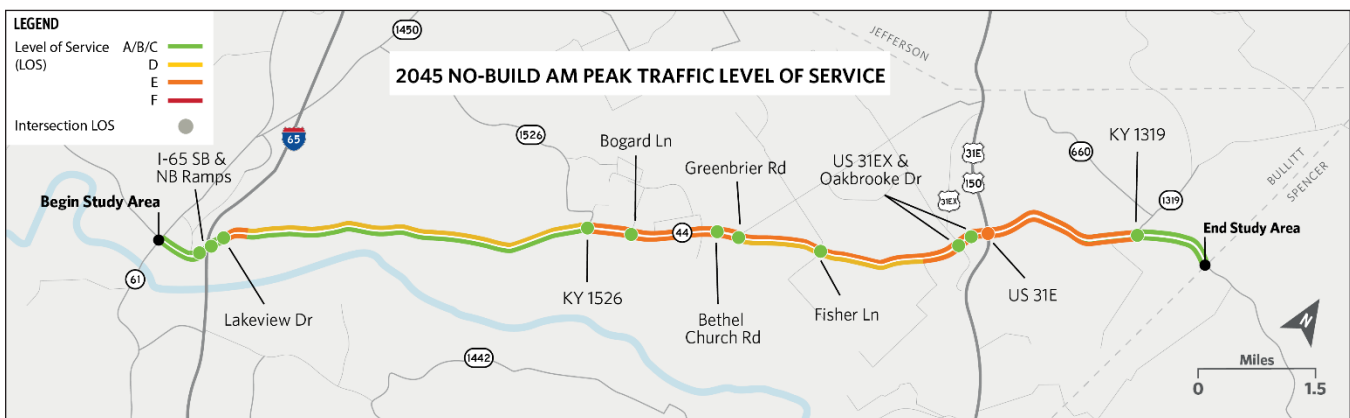
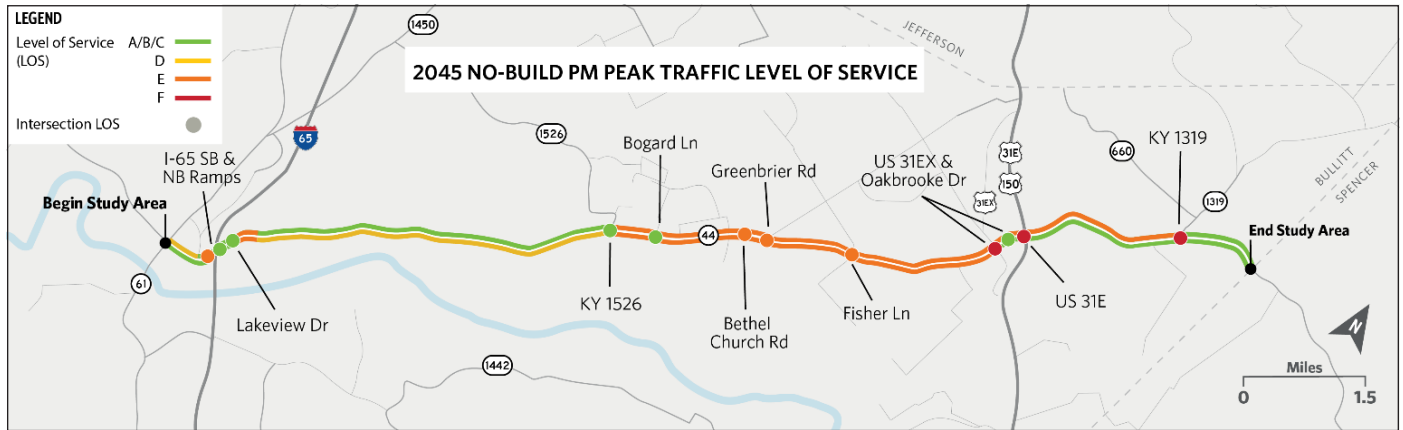




Figure 19: 2045 No-Build PM Intersection and Segment HCS Results



### 2.7.3 Intersection and Segment Sensitivity Analysis

A sensitivity analysis was performed on the intersections and segments that operated at LOS D or better in the 2022 Base condition and dropped to LOS E or worse under the 2045 No-Build conditions. This

analysis was used to determine the five-year range in which the intersection operations fail if the road is not improved. The PM peak hour was used for the analysis as it experiences the poorest LOS. The results are shown in **Tables 5 and 6**.

Table 5: PM Intersection Delay Sensitivity Analysis

Section	Segment LOS between 2022 & 2045 No-Build	KY 44 Intersection	Anticipated Year of Failure(LOS E or F)
2	D	Bethel Church Road	2045
	D/E	Greenbriar Road	2045
	E	Fisher Lane/Armstrong Lane	2040
	F/G	US 31EX/Bardstown Road	2025
3	H/I	KY 1319 (Kings Church Road)	2035

Table 6: 2022 to 2045 Segment Sensitivity Analysis

Section	Segment	Count Station ID	Begin Segment	End Segment	Anticipated Year of Failure(LOS E or F)
2	D	035	KY 1526 (Bells Mill Road)	KY 2706 (Greenbrier Road)	2040
	E	C34	KY 2706 (Greenbrier Road)	KY 2674 (Stringer Road)	2045
	F	C28	KY 2674 (Stringer Road)	US 31EX	2025
3	H	002	US 31E	KY 1319 (Kings Church Road)	2025



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# 3 Existing Phase 1 Design Projects

## 3.1 Overview of Existing Phase 1 Design Typical Sections

Five sections of KY 44 from I-65 to US 31E were advanced to Phase 1 Design (preliminary engineering) and identified as Item No. 5-150.01. This resulted from the KY 44 Alternate Study (Item No. 5-150.00)

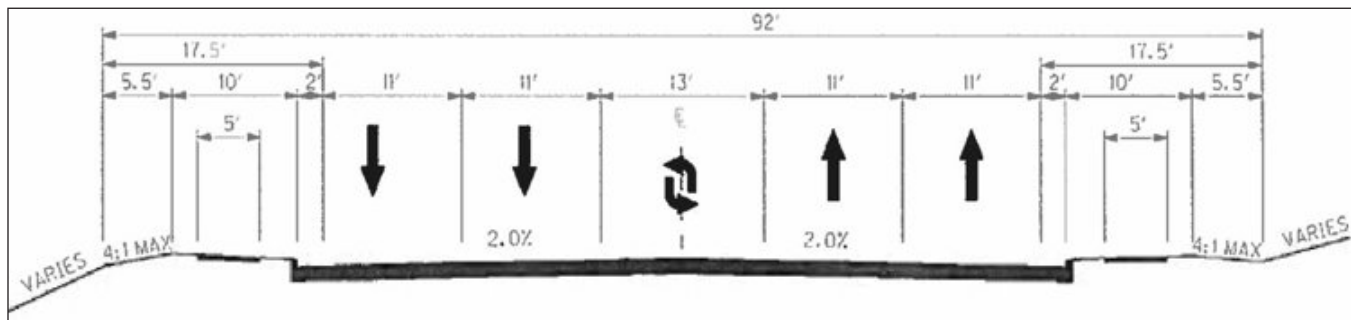
completed in 2005. The design called for a five-lane typical section with 11-foot travel lanes, a 13-foot TWLTL, curb and gutter, and five-foot sidewalks on both sides of the road (see **Figure 20**). **Table 7** shows the segments with associated cost and the priority that was assigned for each in the Design Executive Summary of 5-150.01 by the Project Team.

**Table 7: Item No. 5-150.01 KY 44 Phase 1 Design Summary**

Item No./Segment	Begin	End	Total Cost*	Priority**
5-150.02	I-65	Chimney Rock Drive	\$28,055,000	3
5-150.06	Chimney Rock Dr.	CE Smith Road	\$26,845,000	5
5-150.31	CE Smith Rd.	Armstrong Lane	\$33,280,000	4
5-150.40	Armstrong Lane	US 31 EX	\$28,073,000	2
5-150.50	US 31 EX	US 31E	\$3,965,000	1
Total	I-65	US 31E	\$120,218,000	-

\*In 2012 – 2015 Dollars      \*\*From Design Executive Summary

**Figure 20: Item No. 5-150.01 Phase 1 Design Typical Section from I-65 to US 31E**



Phase 1 Design was also completed for the most eastern section of KY 44 from US 31E to KY 1319 (Kings Church Road), Item No. 5-347.50. This section was designed with 11-foot-wide travel lanes and a 13-foot wide TWLTL in both a five-lane segment from

US 31E to Love Avenue (see **Figure 21**), and a three-lane segment from Love Avenue to Winning Colors Drive (see **Figure 22**). The design also included curb and gutter with five-foot-wide sidewalks on both sides in both the three-lane and five-lane segments. A rural

two-lane or three-lane segment was designed for Winning Colors Drive to KY 1319 (Kings Church Road) with turn lanes at Twin Eagles Parkway, East Sanders

Lane, and KY 1319 (Kings Church Road). Costs by segment are shown in **Table 8** below.

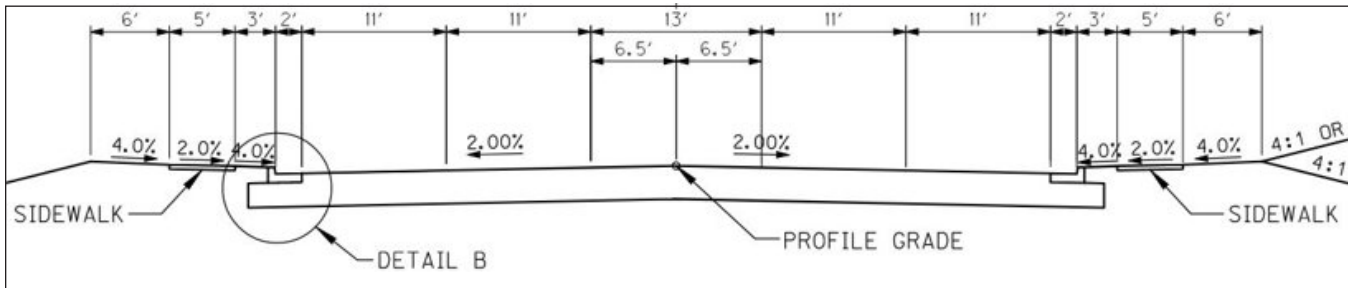
**Table 8: Item No. 5-347.50 KY 44 Phase 1 Design Summary**

Item No./ Segment	Begin	End	# of Lanes-Typical Section	Total Cost**
5-347.51	US 31E	Love Avenue	5-Urban	\$6,840,839
5-347.51	Love Avenue	Winning Colors Drive	3-Urban	
5-347.56	Winning Colors Drive	KY 1319 (Kings Church Road)	2-Rural*	\$6,555,220
Total	US 31E	KY 1319 (Kings Church Road)	-	\$13,396,059

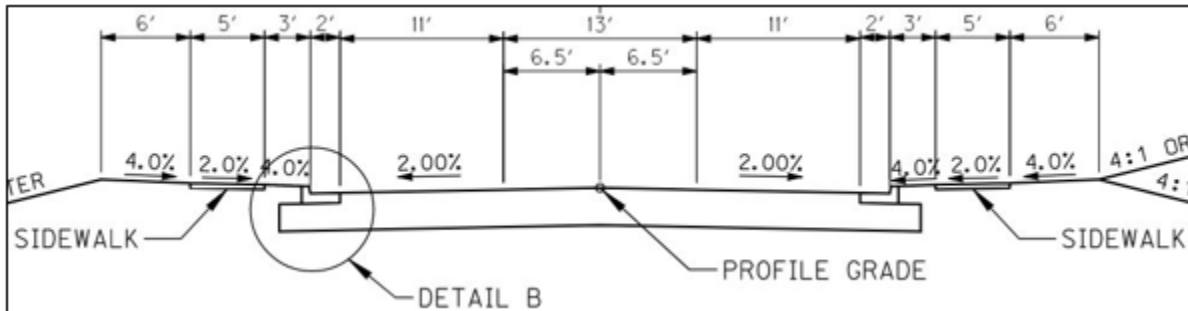
\*Turn lanes at Twin Eagle Parkway, East Sanders Lane, and KY 1319 (Kings Church Road)

\*\* in 2009 dollars

**Figure 21: Item No. 5-347.50 Phase 1 Design Five-Lane Typical Section**



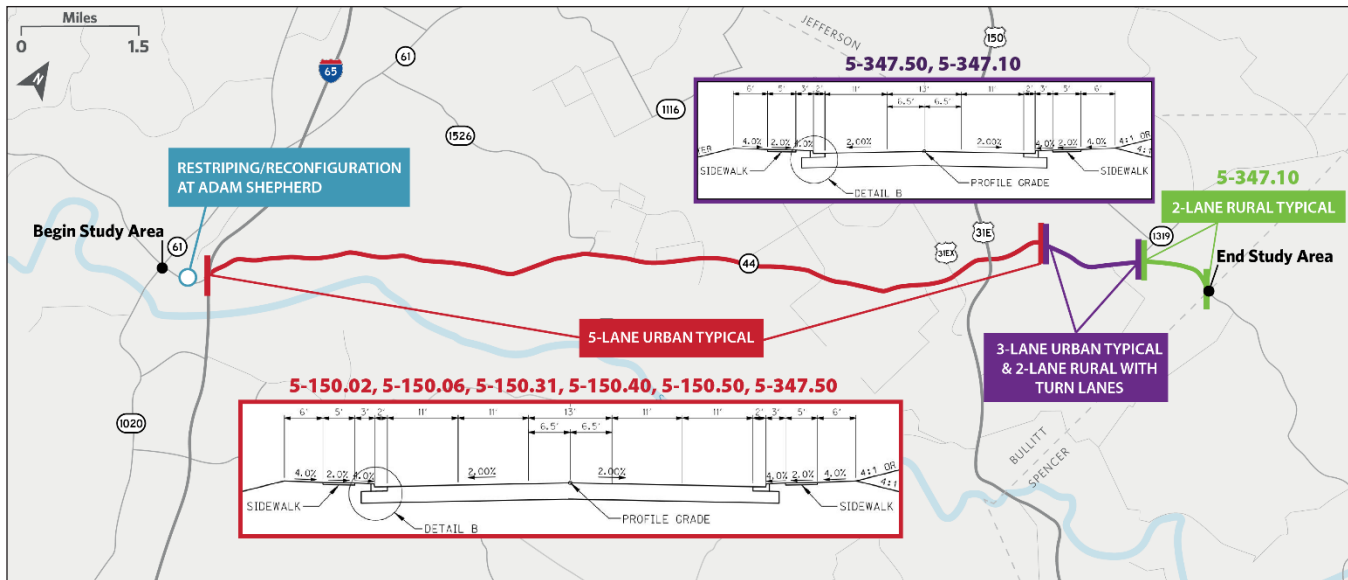
**Figure 22: Item No. 5-347.50 Phase 1 Design Three-Lane Typical Section**



The final KY 44 section, Item No. 5-43.00 from KY 1319 (Kings Church Road) to the Spencer County line has no geometric elements finalized in Phase 1 Design. The estimated total cost in the Highway Plan is \$8,400,000. This section was recently advertised

for design services as 5-347.10 with the same project limits. **Figure 23** shows a summary of the Phase 1 Design elements proposed for the KY 44 study corridor.

Figure 23: Summary of Existing Phase 1 Design on KY 44



To obtain a more current estimate of costs for the study, the Project Team updated the original (2009 to 2015) cost estimates for both the 5-150.01 and 5-347.50 projects by applying inflation factors. The updated cost estimates appear in **Tables 9** and **10**.

Table 9: Updated Cost Estimates for 5-150.01 KY 44 Design

Segment	Begin	End	Original Total Cost	Total Cost*
5-150.02	I-65	Chimney Rock Drive	\$28,055,000	\$39,870,000
5-150.06	Chimney Rock Drive	CE Smith Road	\$26,845,000	\$38,440,000
5-150.31	CE Smith Road	Armstrong Lane	\$33,280,000	\$49,800,000
5-150.40	Armstrong Lane	US 31 EX	\$28,073,000	\$33,310,000
5-150.50	US 31 EX	US 31 E	\$3,965,000	\$4,470,000
Total	I-65	US 31 E	\$120,290,000	\$165,890,000

\* Costs are estimates from the original 5-150.00 Study, updated for inflation to 2022 dollars

Table 10: Updated Cost Estimate for 5-347.50 KY 44 Design

Segment	Begin	End	# of Lanes	Original Total Cost	Total Costs*
5-347.50	US 31E	Love Avenue	5-Urban	\$6,840,839	\$10,698,772
5-347.50	Love Avenue	Winning Colors Drive	3-Urban		
5-347.50	Winning Colors Drive	KY 1319 (Kings Church Road)	2-Urban	\$6,555,220	\$10,252,076
Total	US 31E	KY 1319 (Kings Church Road)	--	\$13,396,059	\$20,950,848

\* Costs are estimates from the original 5-347.50 Phase 1 Design, updated for inflation to 2022 dollars



### 3.2 2045 Phase 1 Design Traffic

A traffic analysis was performed to evaluate the performance of the Existing Phase 1 Design, using the 2045 Build traffic volumes developed in the KY 44 Traffic Forecast Report done as a part of this study (Appendix C). Figure 15 in Section 2.6.2 highlights the segment and intersection volumes used for the evaluation of Build conditions. The growth rates used to arrive at 2045 Build volume were higher between I-65 and the Spencer County line than the growth rates for 2045 No-Build based on the available capacity of the widened road and anticipated development. The section between KY 61 and I-65 is considered “mostly developed” and there are no plans for widening the roadway, therefore the No-Build and Build growth rates are the same. Final growth rates are shown in Table 2.

### 3.3 2045 Phase 1 Design Traffic Analysis Results

HCS 7 and Synchro 11 were used to evaluate segment and intersection operations, respectively. The corridor was split into additional segments to provide a more data driven analysis based on logical changes in geometry and traffic volumes. Table 11 shows the segments used for the 2045 Build analysis.

Table 11: KY 44 2045 Build Traffic Analysis Segments

Begin Segment	End Segment
KY 61	I-65
I-65	Hoot Owl Camp Road
Hoot Owl Camp Road	KY 1526 (Bells Mill Road)
KY 1526 (Bells Mill Road)	KY 2706 (Greenbriar Road)
KY 2706 (Greenbriar Road)	Fisher Lane
Fisher Lane	KY 2674 (Stringer Lane)
KY 2674 (Stringer Lane)	US 31EX
US 31EX	US 31E
US 31E	Love Avenue
Love Avenue	Winning Colors Drive
Winning Colors Drive	KY 1319 (Kings Church Road)
KY 1319 (Kings Church Road)	Spencer County line

Table 3 shows the LOS criteria for signalized and unsignalized intersections, and Table 4 shows the LOS criteria for two-lane and multi-lane highways. Intersection and Segment results of the 2045 AM and PM Build traffic analyses are shown in Figures 24 and 25. Other files from the traffic analysis can be found in Appendix E.

Upgrading the KY 44 study area network to implement the full Phase 1 Design improves the LOS to acceptable levels along the entirety of Section 2 (I-65 northbound to US 31E). Section 3 (US 31E to Spencer County line) operates at LOS D or better, except for the segment between KY 1319 (Kings Church Road) and Love Avenue which operates at LOS E.

Figure 24: 2045 Build AM Intersections and Segments LOS

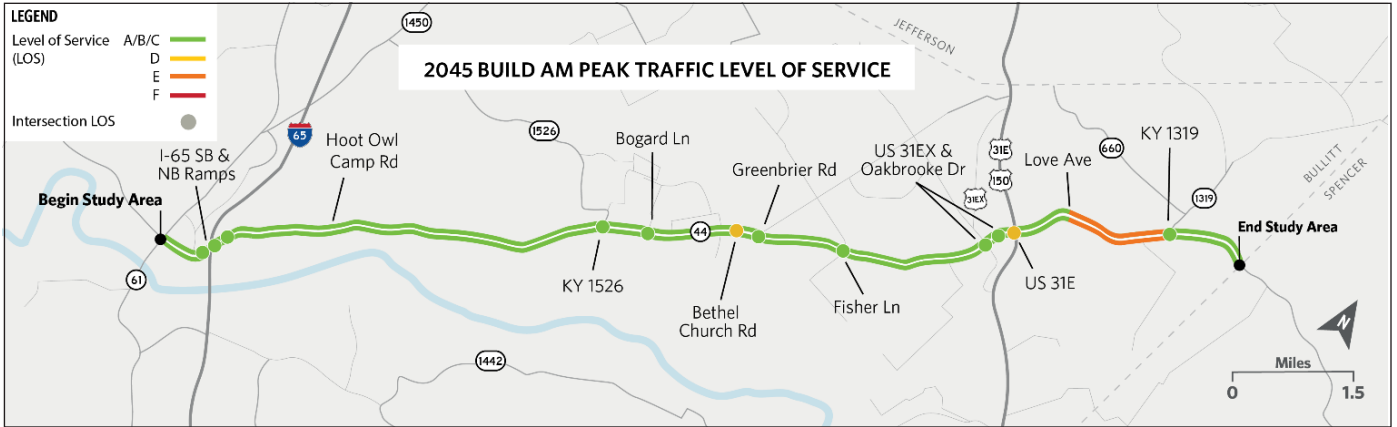
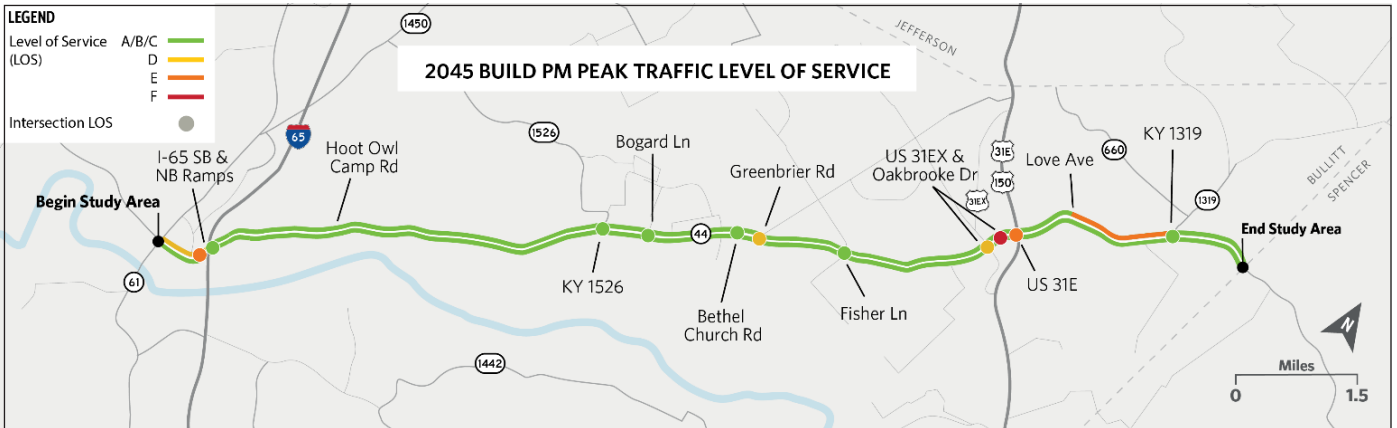


Figure 25: 2045 Build PM Intersections and Segments LOS



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# 4 Corridor Concepts Incorporating PBFS & TSMO Solutions

The project team was tasked to investigate ways to optimize performance of the Existing Phase 1 Design concepts through the consideration of PBFS and TSMO concepts. The PBFS approach seeks a design concept that will meet the goals, purpose, and need of a project but with minimum impact and cost. An example would be the widening of a corridor in just some localized areas that are justified by data rather than a wholesale widening along its entire length. TSMO programs are defined by the Federal Highway Administration (FHWA) as “...a set of integrated strategies to optimize the performance of operations on existing infrastructure through implementation of multimodal, cross-jurisdictional systems, services, and projects designed to preserve capacity and improve security, safety, and reliability of a transportation system. In simplest terms, TSMO is a way to address reliability, mobility, and congestion by utilizing strategies rather than only building out of congestion.”<sup>2</sup> Examples of TSMO solutions include coordinating traffic signal timing along a series of intersections, minimizing access points in busy areas, mitigating congestion at bottleneck locations and providing opportunities for real-time traveler advisory information.

It is anticipated that the PBFS concepts proposed here will be considered for incorporation into the Existing Phase 1 Designs as they advance toward construction. Similarly, it is anticipated that TSMO concepts identified might be considered for incorporation into the Existing Phase 1 Designs or be considered separately for immediate or near-term implementation. Both represent opportunities to

deliver relief to the travelling public more quickly and at a potentially lower cost.

The evaluation of the Existing Phase 1 Designs suggests from a capacity standpoint that a reduction in the number of through lanes at some locations may be acceptable. It may also be prudent to examine alternatives to the proposed five-lane section with a TWLTL that might provide additional safety benefits. During the development of this study, a number of TSMO and PBFS applications were considered, including:

- ▶ Signal upgrades and optimization,
- ▶ Using signal data to optimize intersection operations and better inform design,
- ▶ Reducing the number of lanes where they are not needed for capacity,
- ▶ Utilizing a three-lane section to allow continuous flow on through-lanes,
- ▶ Utilizing a four-lane cross-section with raised median to reduce crashes significantly,
- ▶ Adding a continuous lane at the I-65 southbound exit to Adam Shepherd Parkway,
- ▶ Reducing right-of-way acquisition in constrained areas where LOS can't be improved, and
- ▶ Separating bicyclists and pedestrians from vehicular traffic for increased safety.

When developing corridor and cross-section concepts for evaluation, it was important to integrate TSMO and PBFS concepts to evaluate the full benefits and savings they might achieve.



## 4.1 Initial Corridor Concepts

### 4.1.1 Basis of Concept Development

The genesis of this study was a desire to both validate the need for added capacity throughout the corridor and to assure that the order of construction of future projects would best serve the needs of the corridor. Besides a No-Build alternative, the concept used as a basis for comparison for any newly developed concepts was the work done in the 2005 KY 44 Alternate Study (Item No. 05-150.00) described in **Section 3**. Several spot improvement recommendations from this study have moved forward to construction including intersection improvements to add turn lanes and signalization. Using inflation factors, this study updated the estimated costs calculated for the 2005 study (total cost \$120M) and found the updated total to be \$160M in 2022 dollars. This updated estimate indicated to the Project Team that costs savings would be beneficial if they could be achieved.

The development of additional concepts for this study utilized many important findings from the traffic operations analysis, capacity analysis, and safety analysis performed, including:

- ▶ Capacity constraints exist today in several areas.
- ▶ Capacity constraints would exist under a five-lane Build scenario in 2045.
- ▶ Right-of-way is constrained in the more dense and urban areas of the corridor.
- ▶ Through movements are constrained for most of the corridor due to the existing two-lane cross-section.
- ▶ The KY 44 corridor has several key connecting/intersecting roadways that bring traffic into and out of the study area, displaying natural change points in capacity.
- ▶ Crashes in the slower-speed more congested areas are dominated by sideswipes and rear-ends.

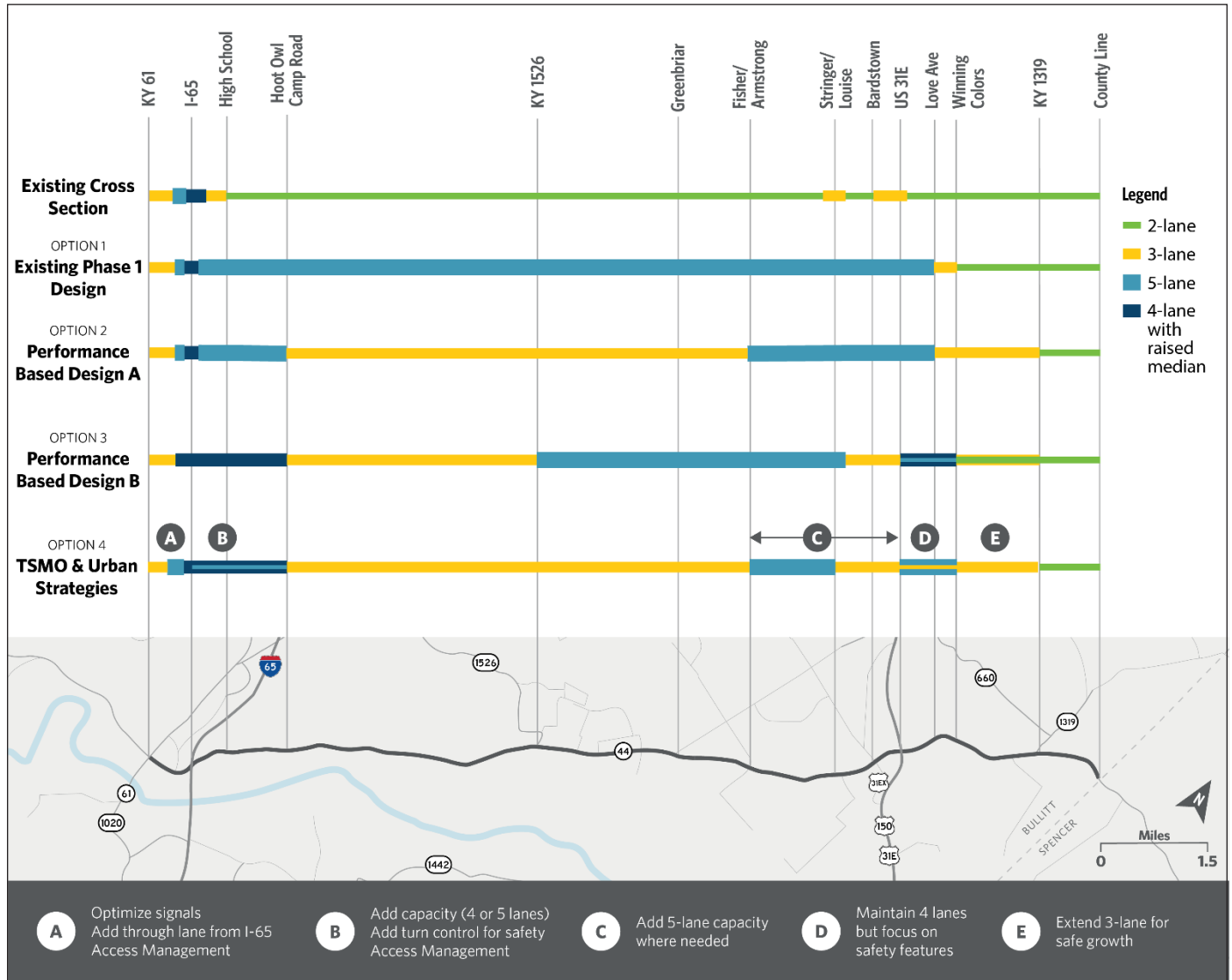
- ▶ Crashes in the higher-speed interior of the corridor include most of the fatalities in the last five years.
- ▶ New commercial development is strong in parts of Shepherdsville and Mt. Washington.
- ▶ Some intersections operate ineffectively in only one or two directions, not necessarily on the through movement on KY 44.
- ▶ Traffic signal equipment is either not current technology, or is not programmed to optimize intersection performance, either alone or with adjacent signals.
- ▶ Bicyclist and pedestrian activities are present in most parts of the corridor

Since the existing two-lane cross-section does not allow through movements while making left turns, the examination of a three-lane section (two-lanes and a TWLTL) provides a minimum cross-section enhancement while markedly improving operations. The comparison of this minimum cross-section enhancement to a full-build five-lane cross-section was key to analyzing how best to meet the needs of the project.

### 4.1.2 Initial Corridor Concepts

**Figure 26** is a graphical representation of the existing corridor, the Existing Phase 1 Design from KYTC Item No. 5-150.01, and three initial options the Project Team developed. The three new options were conceived to emphasize certain aspects of KY 44's operational characteristics that were clarified during examination of LOS and capacity analyses, safety and speed analyses, right-of-way constraints, and more detailed examination of how key intersections operated. The goal was to analyze each regarding how well they addressed the needs of KY 44, then further refinements would be made toward an eventual recommended cross-section and order of implementation.

Figure 26: Initial Corridor Concepts



Option 2, Performance Based Design A, utilized a three-lane cross-section that would improve through-traffic while saving on construction and right-of-way costs. Option 3, Performance Based Design B, built on Option 2 by utilizing a four-lane cross-section in the urban areas to improve safety, but also extended a five-lane cross-section through more of the corridor where traffic volume indicated there may be a need. Flexibility was offered in Option 3 in two segments: from US 31 E to Winning Colors, either a four-lane or a three-lane cross-section could be used, and

from Winning Colors Drive to KY 1319 (Kings Church Road), either a three-lane, or a two-lane cross-section could be used. Option 4, TSMO & Urban Strategies attempted to maximize the use of PBFS and TSMO strategies, in addition to focusing on solving issues in the more-dense urban areas. Option 4 maximizes the use of a three-lane cross-section, optimizes signal systems in the two urban areas, provides dynamic messaging and traveler information signs, and utilizes four-lane cross-sections where needed to improve safety and provide access management.

**Table 12** provides more detailed breakdown of the features of each Option and what needs they address.

**Table 12: KY 44 Corridor Concept Features**

Corridor Concepts	Concept Features
Option 1 - Existing Phase I Design	<ul style="list-style-type: none"> <li>- Adds maximum capacity for majority of corridor.</li> <li>- Provides through-travel lanes with continuous left turn lane.</li> <li>- Three-lane section east of Love Avenue also provides through-travel lanes.</li> <li>- No proposed changes west of I-65.</li> </ul>
Option 2 - PBFS Design A	<ul style="list-style-type: none"> <li>- Adds five-lane capacity in congested segments near Shepherdsville and Mt. Washington.</li> <li>- Three-lane cross-section for most of the corridor interior while still providing through-lanes.</li> <li>- Three-lane section from Love Avenue to KY 1319 (Kings Church Road), two lanes to County line.</li> </ul>
Option 3 - PBFS Design B	<ul style="list-style-type: none"> <li>- Four or Five lanes in more congested segments east of KY 1526 (Bells Mill Road) to Stringer Lane.</li> <li>- Three-lane cross-section from near the Bullitt Central High School area to KY 1526 (Bells Mill Road) still provides through-lanes.</li> <li>- Three-lane section from Winning Colors to KY 1319 (Kings Church Road) provides through-lanes.</li> <li>- Four or five lanes from US 31E to Winning Colors. Four lanes with median reduces crashes.</li> <li>- Three-lane cross-section in dense residential area west of Mt. Washington to reduce ROW impacts.</li> </ul>
Option 4 - TSMO & Urban Strategies	<ul style="list-style-type: none"> <li>- Three-lane cross-section for most of corridor to reduce costs while providing through-travel lanes</li> <li>- Option for five-lane section for short segments in Shepherdsville and Mt. Washington for worst congestion.</li> <li>- Optional four-lane section with raised median in Shepherdsville and Mt. Washington to reduce crashes.</li> <li>- Three-lane section from Winning Colors to KY 1319 (Kings Church Road) provides through-lanes.</li> <li>- Closely examines widening in urban areas to verify it actually reduces congestion/improves LOS.</li> <li>- Dynamic message and traveler information signs.</li> <li>- Utilize access management in urban areas.- Signal upgrades and optimization to reduce congestion, especially in urban areas.- Streetscape improvements in Shepherdsville and Mt. Washington.</li> <li>- Improve crosswalks to be ADA compliant at signalized intersections in urban areas.</li> <li>- Consider mid-block crossings in some locations in urban areas.</li> </ul>

### 4.1.3 Bicycle and Pedestrian Facilities

As described in **Section 2.3**, sidewalks are generally available within the Shepherdsville and Mt. Washington urban areas, however gaps exist through much of the rest of the corridor. The presence of numerous schools, residences, and small businesses does create walking and biking traffic through the entirety of the corridor. Additionally, stakeholders indicated a high interest in adding safe walking and biking areas, noting that wheelchair accessibility would be used by residents near KY 44 as well.

The recently released KYTC Complete Street Guide (2022) recommends bicycle and pedestrian facilities be considered during every planning study. KYTC

prepared a bike/ped coordination review, which is included in **Appendix F**. In accordance with the recommendations from that review, and to provide safe, accessible active transportation to connect the communities along the corridor, the Project Team agreed to recommend a five-foot sidewalk on the north side of KY44 and a ten-foot multi-use path on the south side. These additions were added to all corridor concepts and included when estimating right-of-way and construction costs. Additionally, ADA compatible crossings should be provided at all signalized intersections in the urban areas of the corridor, and streetscape improvements should be considered in Shepherdsville and Mt. Washington.

## 4.2 Evaluation of Corridor Concepts

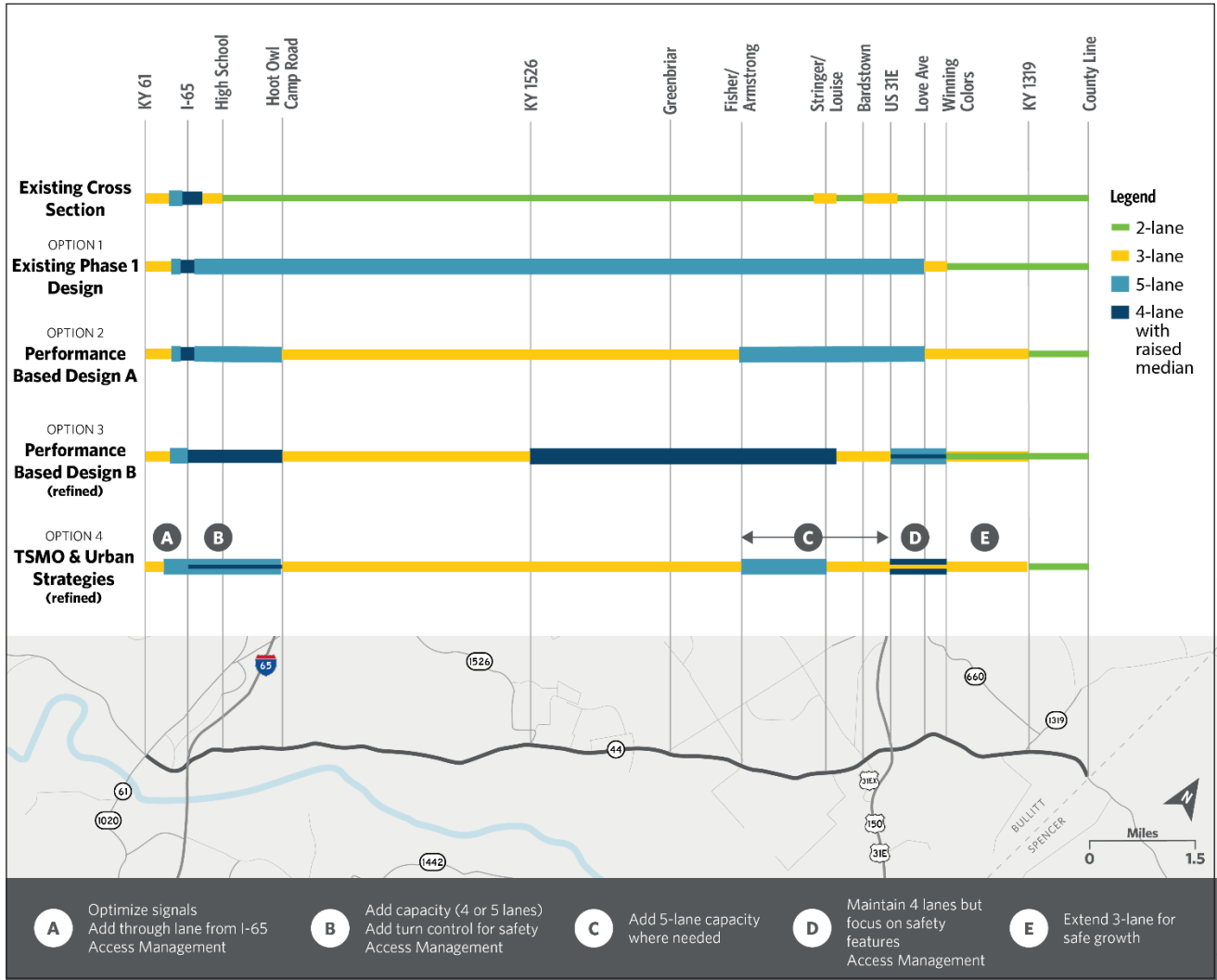
The evaluation of the corridor concepts has several dimensions:

1. Overall, it is important to understand how well a three-lane cross-section would operate as compared to a five-lane cross-section.
2. The needs of the corridor must be clearly defined. These needs can include capacity, level of service, safety, continuity of travel, travel time, mobility, and others.
3. Identify constraints that may affect choosing certain solutions at the segment or corridor level.
4. Since the corridor concepts vary by segment, the different solutions applied to each segment should also be studied regarding how well they address the needs at those points.

For each of the concepts (including the Exiting Phase 1 Design), traffic operations, safety, and travel time savings were analyzed. Cost estimates (including design, right-of-way, utilities, and construction) were developed, and right-of-way impacts investigated.

As project data was analyzed and Project Team and stakeholder feedback reviewed, the initial corridor concepts developed were refined to better address the needs of the project. Refinements included adding a four-lane cross-section with a median to improve safety for Option 3 – Performance-Based Design B (from I-65 to Hoot Owl Camp Road, and from KY 1526/Bells Mill Road to Stringer Lane), recognizing a greater desire to address growth in certain areas, and a desire for attention to safety near the schools along the corridor. **Figure 27** shows the refined corridor concepts. The Traffic and Operations Analysis and Predictive Safety Analysis presented in **Section 4.2.1** and **4.2.2** use these refined concepts.

Figure 27: Refined Corridor Concepts



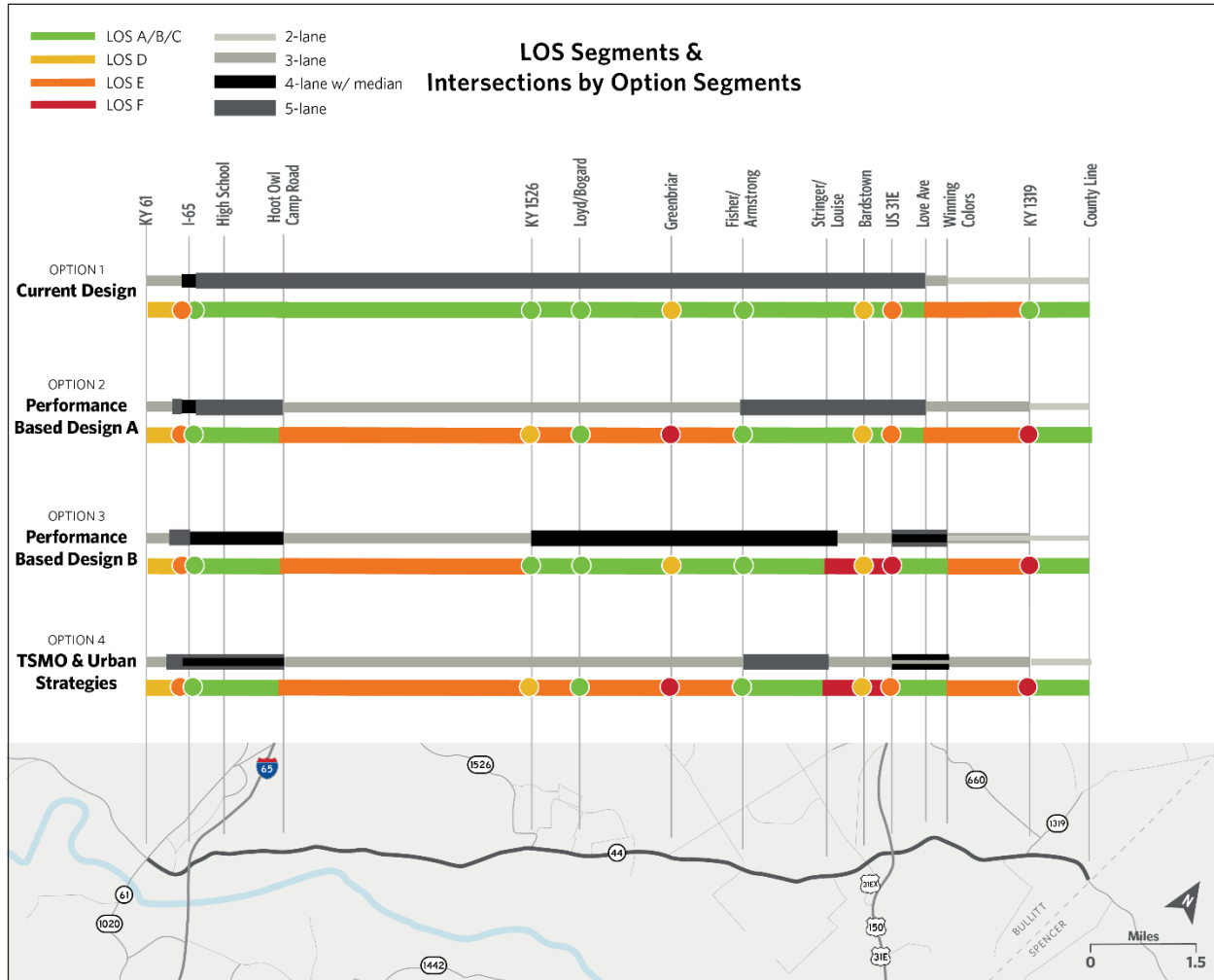
### 4.2.1 Traffic and Operations Analysis

HCS 7 and Synchro 11 were used to evaluate segment and intersection operations, respectively, for each option. **Figure 28** shows a summary of the operational analysis along the corridor. The traffic analysis shows LOS E for the segments with a three-lane cross-section; however, this is the result of the methodology for evaluating three-lane sections, in which the LOS E is a result of percent time spent following other

vehicles, and not necessarily a failure of capacity. The section of KY 44 between Hoot Owl Camp Road and KY 1526 does not exceed the capacity of a three-lane facility in the 2045 Build scenario. The PBFS and TSMO options operate as well as the Existing Phase 1 design west of Hoot Owl Camp Road, and Option 3 operates at a similar LOS as the current design between KY 1526 and Stringer Lane.



Figure 28: Evaluation of Level of Service



### 4.2.1.1 Interior Intersection Analysis

With the development of the PBFS and TSMO concepts, the Project Team felt it was important to test the sensitivity of the interior intersections from KY 1526 (Bells Mill Road) to Fisher Lane/Armstrong Lane, to see how they would operate with a three-lane section and at what year the intersections would fail in that scenario.

The Existing Phase 1 Design traffic analysis results showed that in 2045, each of the five intersections

operate at LOS D or better. A three-lane with TWLTL cross-section was then used to test three scenarios: 2035 with No-Build growth rate (1%), 2045 with No-Build growth rate (1%), and 2045 with Build Growth rate (2%). The assumption is that the added capacity from the buildout would naturally grow the demand within the area; therefore, in a partial build scenario along the corridor, volume growth between the No-Build and Build would be assumed.

Figure 29 shows that by 2035, assuming the No-Build growth rate of this project and a three-lane with TWLTL cross-section, each intersection would operate at an acceptable LOS. Figure 30 confirms this to be true through 2045 under the No-Build conditions. The difference between these two results is that more approaches and movements are beginning to fail by this time. Figure 31, showing the partial build but using the Build growth rate, indicates that two intersections have incurred failure, but most

approaches and movements at each intersection are operating at an acceptable LOS. These results show that failure at the KY 1526 (Bells Mill Road) and Fisher Lane/Armstrong Lane intersections will occur somewhere between the No-Build and Build growth rate scenarios, and that the other intersections will operate at an acceptable LOS in 2045 if a three-lane section is chosen.

Figure 29: 2035 Partial Build (3-Lane with TWLTL) Analysis (1% Growth Rate)

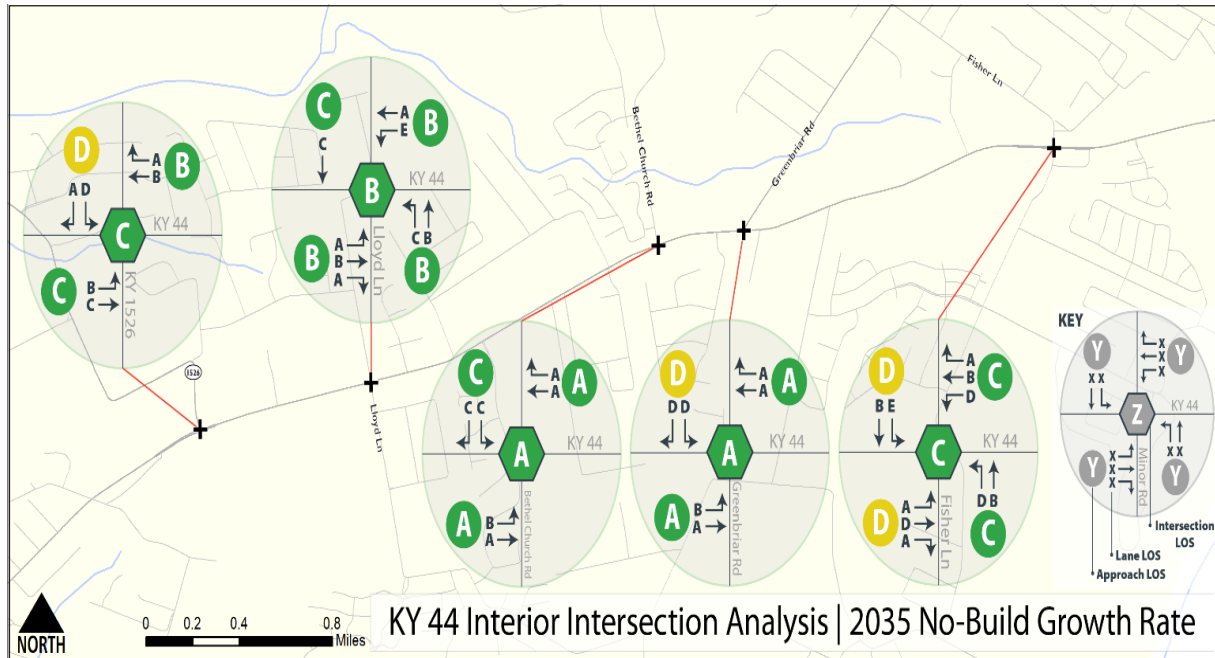


Figure 30: 2045 Partial Build (3-Lane with TWLTL) Analysis (1% Growth Rate)

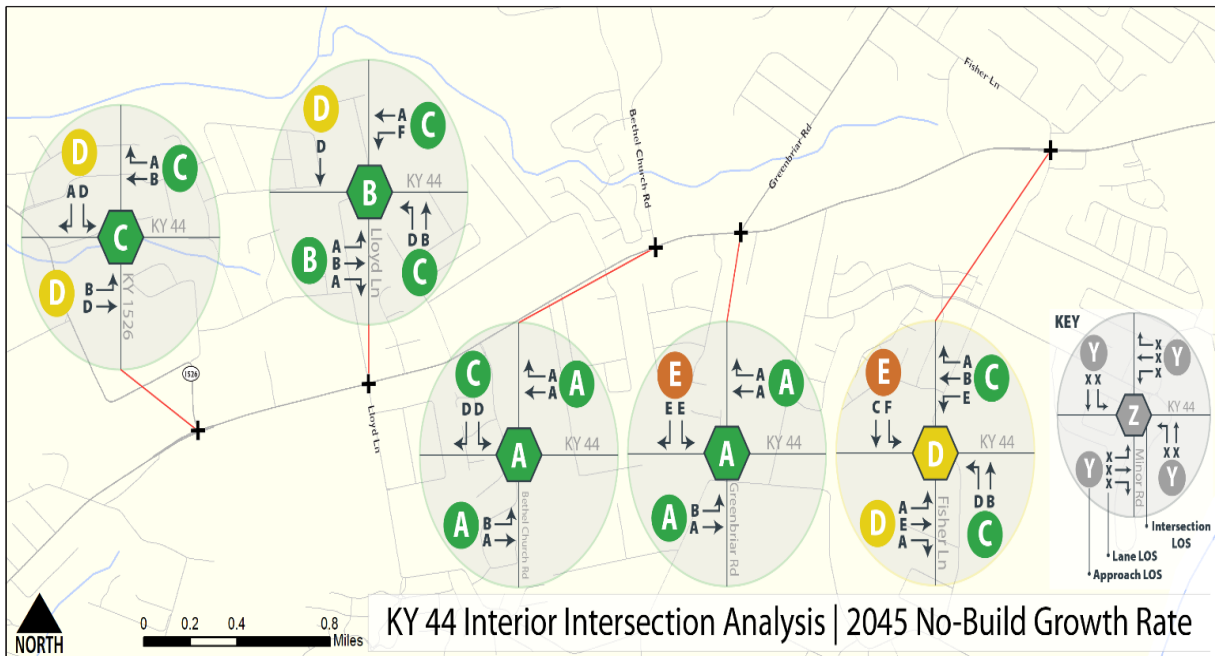
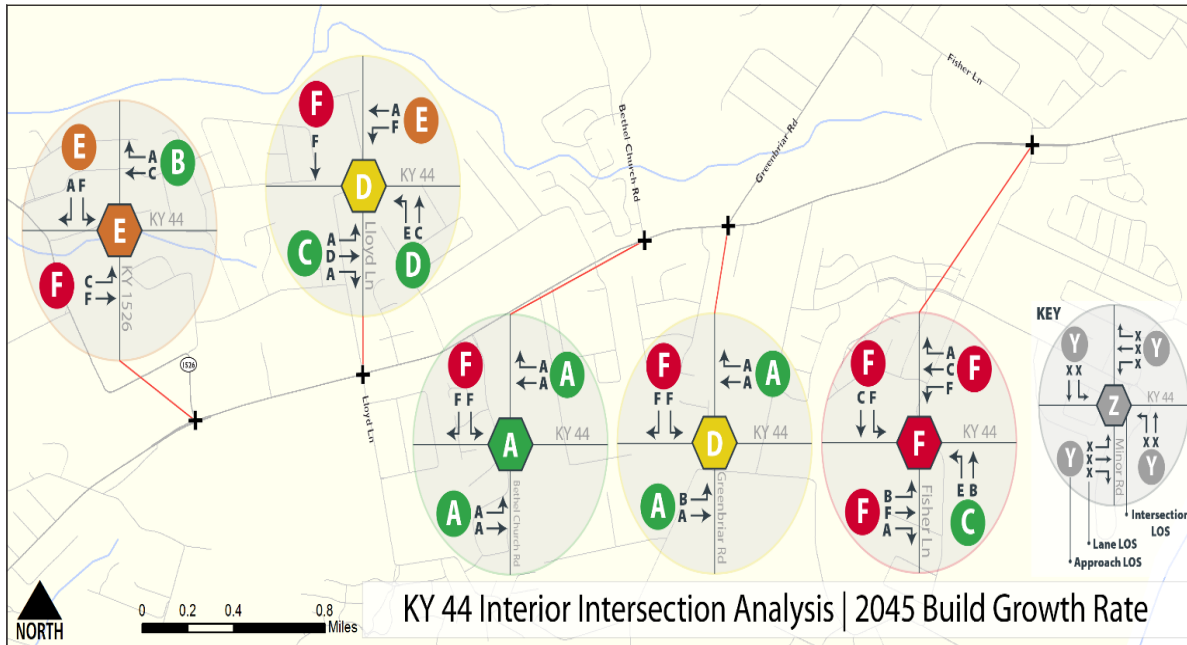


Figure 31: 2045 Partial Build (3-Lane with TWLTL) Analysis (2% Growth Rate)



### 4.2.2 Predictive Safety Analysis

A simplified predictive safety analysis was performed to compare the safety performance of the different typical sections proposed. The Highway Safety Software (HSS) tool included in HCS 2022 software was used to perform this analysis. **Appendix B** provides the HSS output files. A representative existing two-lane typical section was analyzed to serve as a baseline for comparison to the other proposed typical sections. A representative location using an urban three-lane with TWLTL, urban four-lane with a raised median, urban five-lane with TWLTL, and an urban five-lane with TWLTL including access management (this reduced the number of access points) was analyzed. Predicted crashes were calculated for each of these typical sections. The percentage that fatal and injury crashes are reduced for each typical section evaluated compared to existing conditions is shown in **Figure 32**.

Compared to the existing lane configurations on KY 44, the urban four-lane divided with a raised median provided the greatest safety benefit, resulting in a

54% reduction in crashes. This is due to the reduction in conflict points and less opportunities for crashes to occur. The urban three-lane with a TWLTL also provided a safety benefit, reducing crashes by 28%. This is due to the TWLTL providing a deceleration area for left turning vehicles to perform this movement outside the through lanes and matches *Highway Safety Manual* predictions. The urban five-lane typical section is expected to increase crashes by 18%, due to an increased number of conflict points with additional lanes and longer gaps in time needed for vehicles to safely make a turning movement. Given this predicted increase in expected crashes for the five-lane with TWLTL typical section, another five-lane with TWLTL typical section was modeled with a reduced number of access points (50% less access points). This resulted in a 9% increase in crashes compared to existing conditions.

Figure 32: Reduction in Crashes by Typical Section

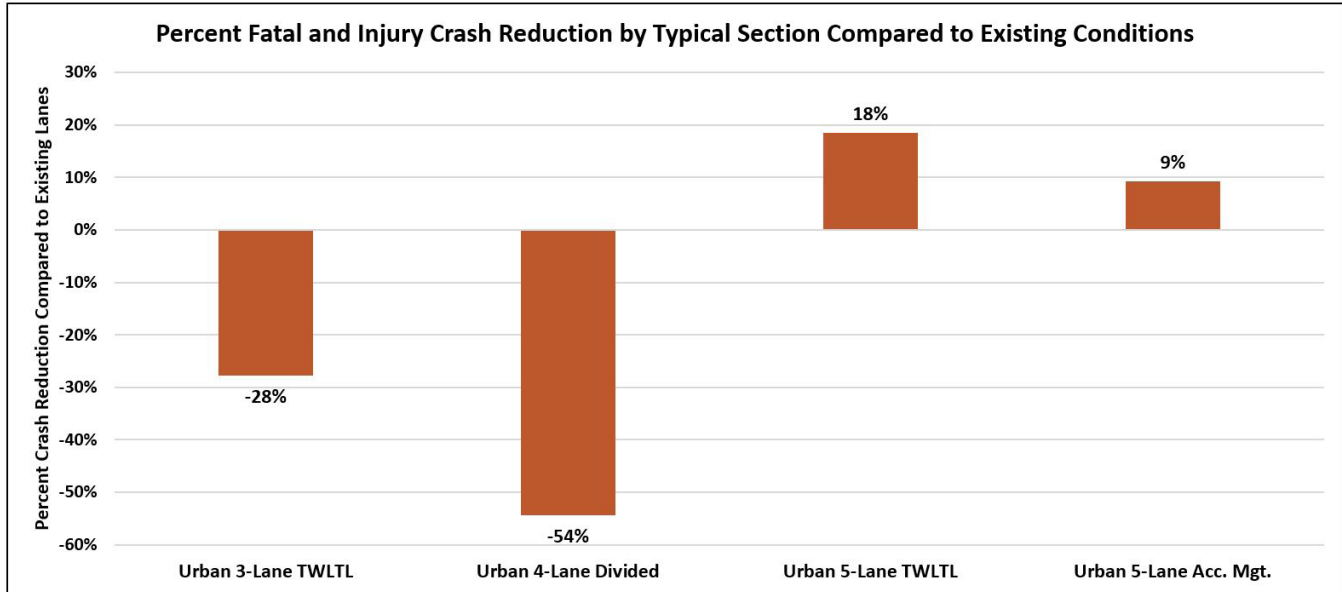
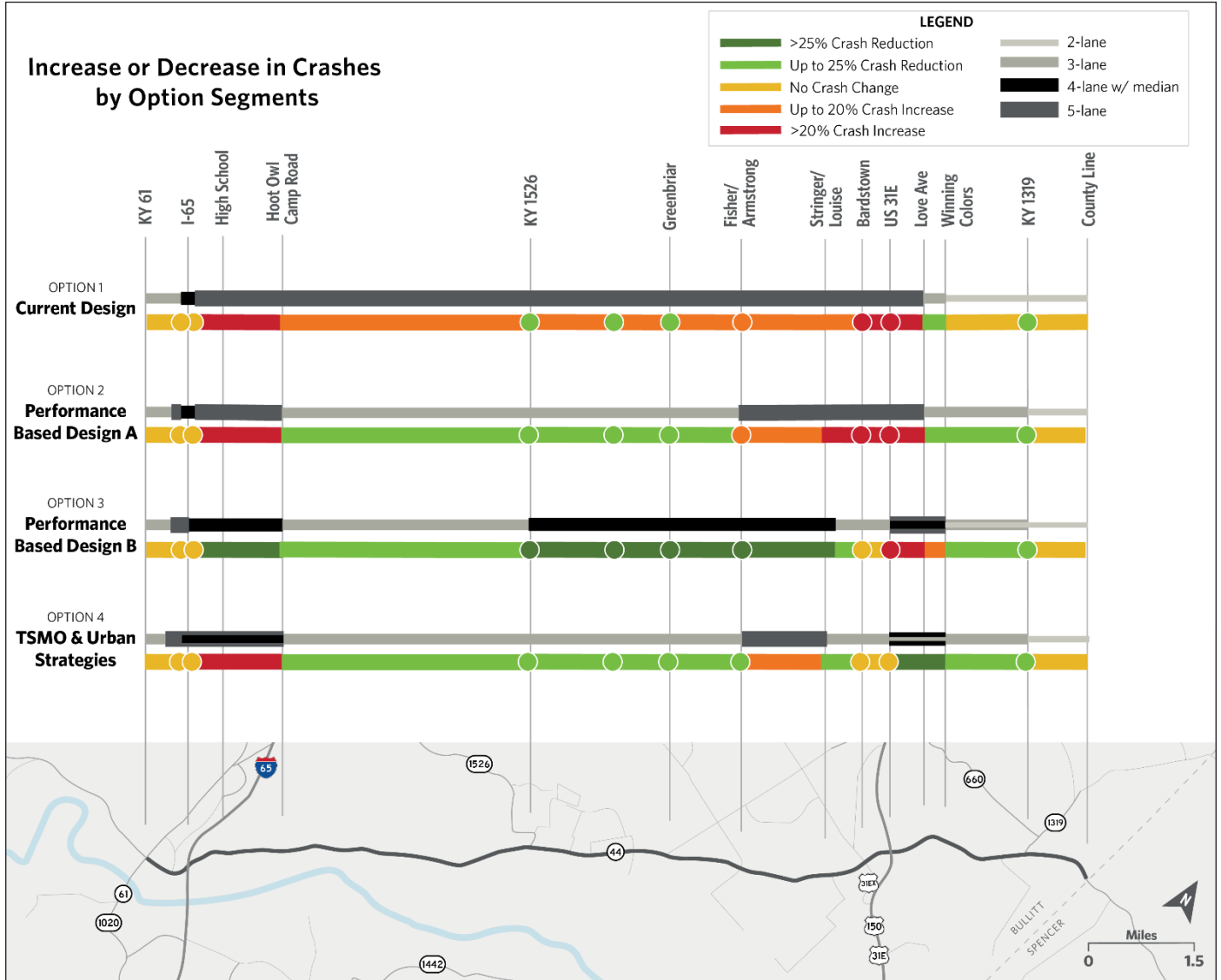


Figure 33 shows the percent change in safety performance for fatal and injury crashes within each segment and study intersection compared to existing conditions in the design year 2045. Where two typical

sections are shown as options for a segment the worst case (highest increase in crashes) is presented in the figure.

Figure 33: Evaluation of Expected Change in Crashes



### 4.2.3 Travel Time Savings

A travel time analysis was completed for the study area to estimate the travel time benefits in the design year of 2045. **Appendix E** provides additional travel time analysis information. Travel times were calculated using the segment length and speed output from HCS 2022 combined with intersection delay from Synchro 11. This analysis was validated by comparing to travel times derived using SimTraffic 11. It was assumed that traffic signals would have optimized timing plans in place. The following five scenarios were analyzed.

- ▶ No-Build – Existing KY 44 Number of Lanes
- ▶ Option 1 – Existing Phase 1 Design (KY 44 widening from current design projects)
- ▶ Option 2 – Performance Based Design A
- ▶ Option 3 – Performance Based Design B
- ▶ Option 4 – TSMO and Urban Strategies



**Table 13** shows the travel time along KY 44 in minutes, from KY 61 at the west end of the study area to the Spencer County line at the eastern terminus. The baseline No-Build travel times range from 25 to 30 minutes.

Option 1 (five-lanes with TWLTL between I-65 and US 31E) is predicted to have the largest travel time reduction compared to the No-Build, with a decrease of approximately 4 to 6 minutes (14% to 21%).

Option 2 is predicted to decrease the travel times by approximately 2 to 5 minutes (8% to 15%). Option 3 is similar to Option 2 with expected decreases of 2 to 4 minutes (6% to 15%). Option 4 (TSMO and Urban Strategies) would have the fewest capacity enhancements and would decrease the end-to-end travel time by 3 minutes or less (1% to 10%).

Greater travel time savings are experienced in the eastbound direction compared to westbound and the PM peak experiences a greater travel time savings compared to the AM peak. The largest travel time reductions are expected in Shepherdsville in the vicinity of the I-65 interchange and in Mt. Washington from KY 2706 (Greenbriar Road) to east of Bullitt East High School near Love Avenue/Winning Colors Drive. These two areas have the most delay (slowest average speeds) and therefore offer the greatest opportunity for improving travel times.

The simulation indicated that the original results were valid, with the additional finding that there may be substantial delay savings possible in the PM peak hour with the implementation of improvements at the key intersections of KY 44 at Adam Shepherd Parkway, the I-65 southbound ramp, and at US 31EX (Bardstown Road).

At Adam Shepard Parkway and the I-65 southbound ramp potential improvements could include a better connection between the off-ramp and Adam Shepard Parkway, a triple left from Adam Shepard Parkway with a new outside lane to I-65 southbound and possibly all the way to I-65 northbound. The bridge over I-65 is wide enough to accept three lanes eastbound. In addition, the traffic signals at and near the interchange could be upgraded with regards to traffic detection and possibly even demand responsive timing if the equipment and operations were modified to support it.

At KY 44 and US 31EX (Bardstown Road), the improvements could include the use of restricted left turns in conjunction with a quadrant intersection design that would use other streets in the grid to facilitate some of the lower volume left turns. That improvement would require intersection and street upgrades in downtown Mt. Washington. Upgraded signal timing and coordination would also be a key part of this approach.

**Table 13: 2045 Travel Time Results (HCS and Synchro)**

Scenario	Total Travel Time (min)				Change in Travel Time (min)				% Change in Travel Time			
	Eastbound		Westbound		Eastbound		Westbound		Eastbound		Westbound	
	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM
No-Build	25.3	30.2	24.8	27.8	-	-	-	-	-	-	-	-
Option 1	21.7	23.9	21.3	23.0	-3.6	-6.3	-3.5	-4.8	-14.3	-21.0	-14.2	-17.3
Option 2	23.4	25.7	23.1	24.9	-1.9	-4.5	-1.7	-2.9	-7.7	-14.8	-6.9	-10.3
Option 3	23.8	25.8	23.4	25.2	-1.5	-4.4	-1.5	-2.5	-5.9	-14.7	-5.9	-9.1
Option 4	25.0	27.2	24.5	26.0	-0.3	-3.0	-0.4	-1.8	-1.3	-9.8	-1.5	-6.4

Negative values represent a savings/reduction in travel time compared to No-Build scenario

### 4.2.4 Right-of-Way Impacts

For each option, acres of right-of-way required and property acquisition (how many properties would require a relocation) were quantified. The costs of

these impacts are shown in **Table 14** but are also included the total project costs shown in **Table 15** below.

**Table 14: Corridor Concept Right-of-Way Impacts**

Corridor Concepts	Potential Right-of-Way Impacts		
	Amount (Acres)	Number of Relocations	Cost (2022\$)
Option 1 – Existing Phase 1 Design	20	20	\$16.2 M
Option 2 – PBFS Design A	20	17	\$11.9 M
Option 3 – PBFS Design B	25	15	\$13.7 M
Option 4 – TSMO & Urban Strategies	15	7	\$6.9 M

### 4.2.5 Costs

Cost estimates, shown in **Table 15**, for each corridor concept were developed in 2022 dollars using recent

unit costs from construction bid tabs. Construction costs were used for the evaluation, which included costs for engineering, right-of-way, and utilities.

**Table 15: Corridor Concept Cost Estimates**

Corridor Concepts	Total Costs (2022 \$)
Option 1 – Current Design	\$132 M
Option 2 – PBFS Design A	\$115 M
Option 3 – PBFS Design B	\$124 M
Option 4 – TSMO & Urban Strategies	\$107 M

*\*Estimated total costs for this stage did not utilize those developed for the prior 2005 (5-150.00) KY 44 Alternate Study but were developed independently with current KYTC estimating data. These estimates do not include any intersection realignments.*

## 4.3 Summary of PBFS and TSMO Solutions

The evaluation of the PBFS and TSMO solutions show that there are locations where traffic can operate at an acceptable level with a reduced cross-section, at both the segment and intersection level. While a five-lane section is good from a traffic operations standpoint, it is not as safe as a three- or four-lane section. The interior of the study corridor, where the PBFS options propose three- and four-lane sections are where the majority of injury and fatal crashes occurred in the timeframe analyzed. Though the Existing Phase 1 Design has the greatest travel time savings, all

three PBFS and TSMO options do provide travel time savings through the corridor. Right-of-way acquisition is the same between the Existing Phase 1 Design and PBFS Option 2 and is slightly higher for PBFS Option 3, however the PBFS options reduce the required relocations which lowers overall right-of-way costs. The PBFS and TSMO options align the construction costs to the demonstrated need for capacity, while measurably improving safety and travel times through the corridor. After review of the evaluations, it became apparent that the best recommendation may be a corridor concept that is a combination of parts of two or more of the concepts the Project Team had developed.

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# 5 Potential Network Connections

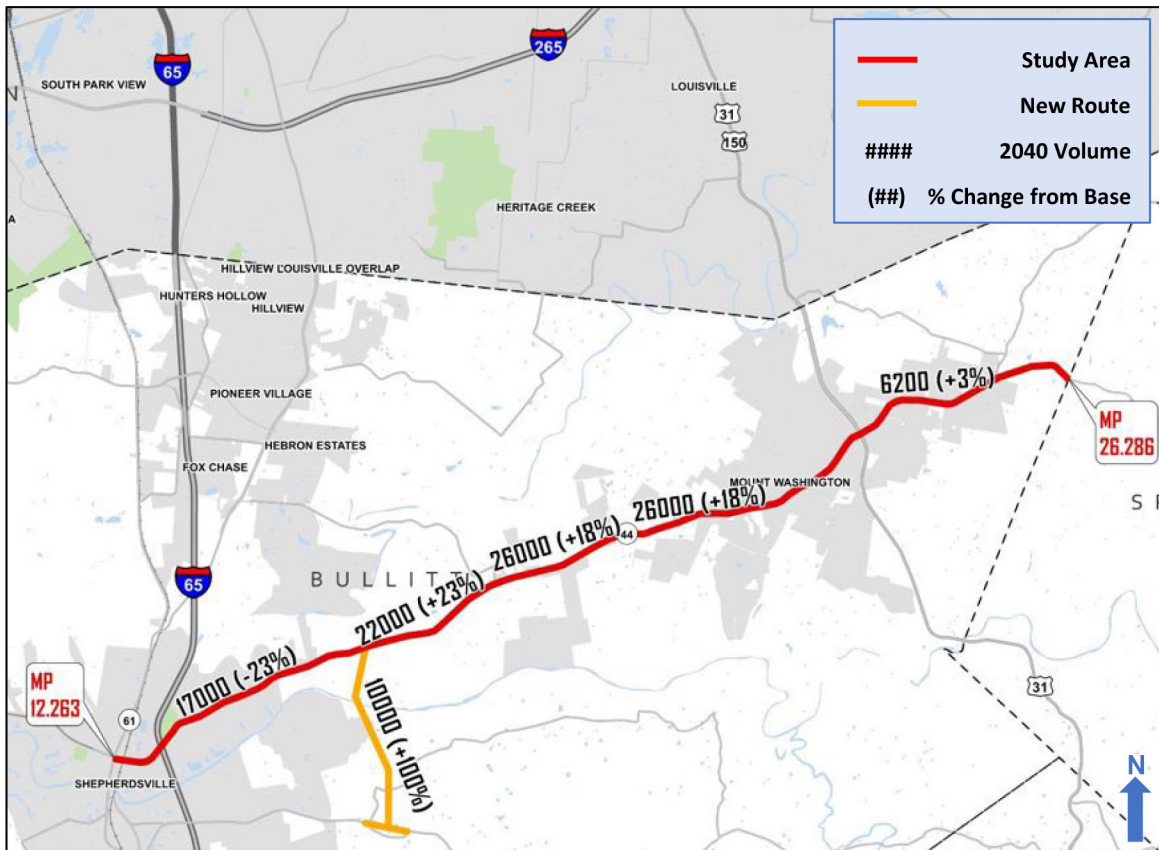
New connecting roadways and improvements to existing intersecting roadways along KY 44 were reviewed to determine their feasibility and ability to relieve traffic on KY 44. Four non-KY 44 connector routes were modeled using the KIPDA Travel Demand Model in 2040. The results of this analysis are discussed in the following sections.

## 5.1 KY 480 to KY 44 Connector

The first potential network connection explored was derived from two previous studies, the KY 44 to KY 480 Connector Study (KYTC Item No. 5-8709.00, 2014) and the Go Bullitt Transportation Study (2010).

The potential alignment, shown in **Figure 34**, would connect at Watergate Drive on KY 44 and extend south to KY 480 east of KY 1442 (Ridge Road). A two-lane rural facility was modeled. This potential north-south route connecting KY 44 to KY 480 would carry approximately 10,000 vehicles per day in 2040. Traffic on KY 44 west of the new connector would decrease by approximately 23%. Traffic east of the new connector on KY 44 would increase by 23%. This would result in a possible reduction in the number of lanes needed on KY 44 west of the new connector but increase the number of lanes needed on KY 44 to the east.

Figure 34: Potential KY 480 to KY 44 Connector

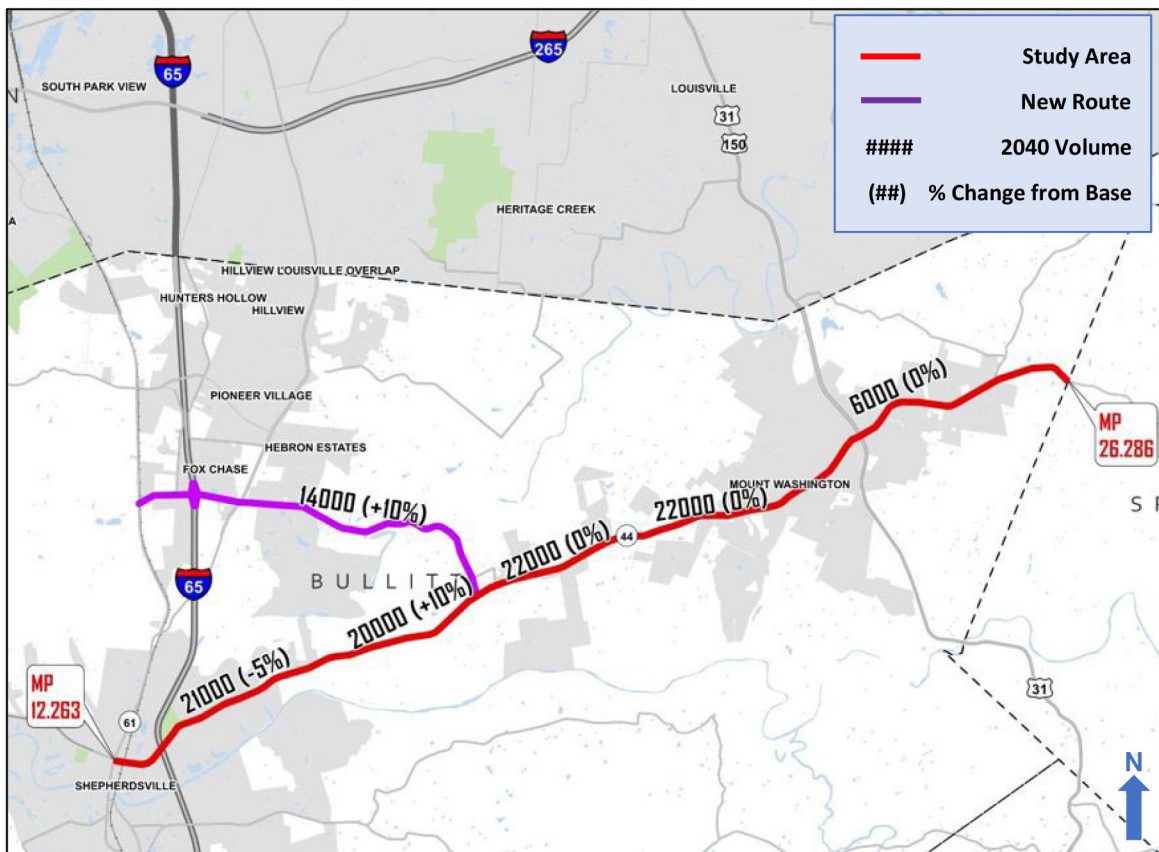


## 5.2 KY 1526 (Bells Mill Road) Improvements with a New I-65 Interchange

Potential Improvements to KY 1526 (Bells Mill Road), including a new interchange at I-65 north of Shepherdsville, offers a new northbound connection to the interstate that could relieve traffic in Shepherdsville. This improvement would include extending KY 1526 (Bells Mill Road) from KY 61 to KY 1020 (Coral Ridge Road), with a new

interchange at I-65, shown in **Figure 35**. Roadway geometrics on KY 1526 (Bells Mill Road) would also be improved. KY 1526 (Bells Mill Road) would continue to be a rural two-lane facility and would carry approximately 14,000 vehicles per day in 2040. Traffic in Shepherdsville would decrease slightly, but KY 44 traffic volumes just to the west of KY 1526 (Bells Mill Road) would increase. This connection is not expected to reduce the number of future lanes needed on KY 44.

Figure 35: Potential Improvements to KY 1526 (Bells Mill Road) with New I-65 Interchange



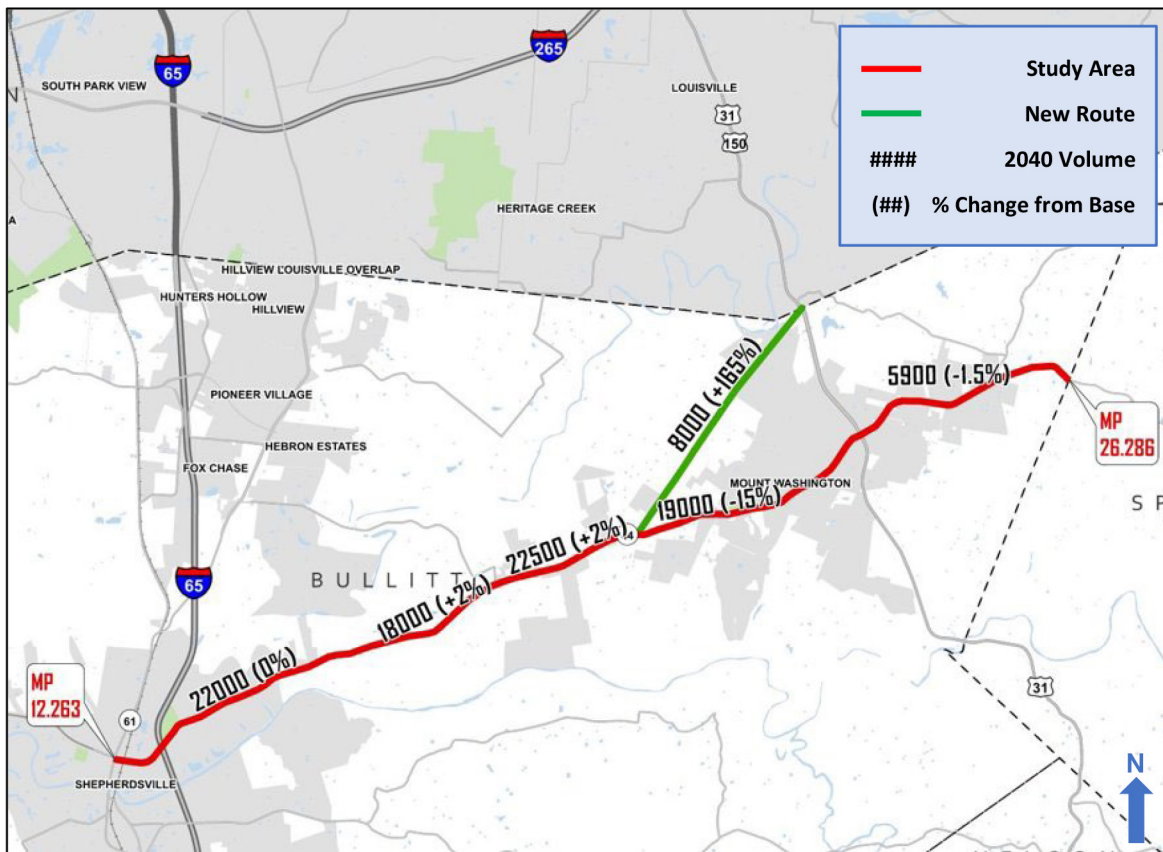


### 5.3 Northwest Mt. Washington Bypass

A potential connection northwest of Mt. Washington between KY 2706 (Greenbriar Road) and US 31E is currently in the KIPDA MTP. Of the four potential network connections analyzed, this connection provides the greatest amount of relief for KY 44 traffic in the Mt. Washington area, without significantly increasing the volume of traffic along other parts of KY 44. This facility would include a combination of two-lane and three-lane roadway and improve KY 2706 (Greenbriar

Road) between KY 44 and Landis Lane, shown in Figure 36. Traffic volume west of KY 2706 (Greenbriar Road) is minimally affected (2% increase) by the new northwest connection, but traffic volumes east of KY 2706 (Greenbriar Road) would be reduced by approximately 15%. This reduction in traffic volumes on KY 44 could potentially reduce the number of lanes needed in the future in Mt. Washington. Several right-of-way and environmental constraints exist at the northern terminus of this concept between Floyds Fork and residential development that would need to be addressed to improve the feasibility of this concept.

Figure 36: Potential Northwest Mt. Washington Bypass

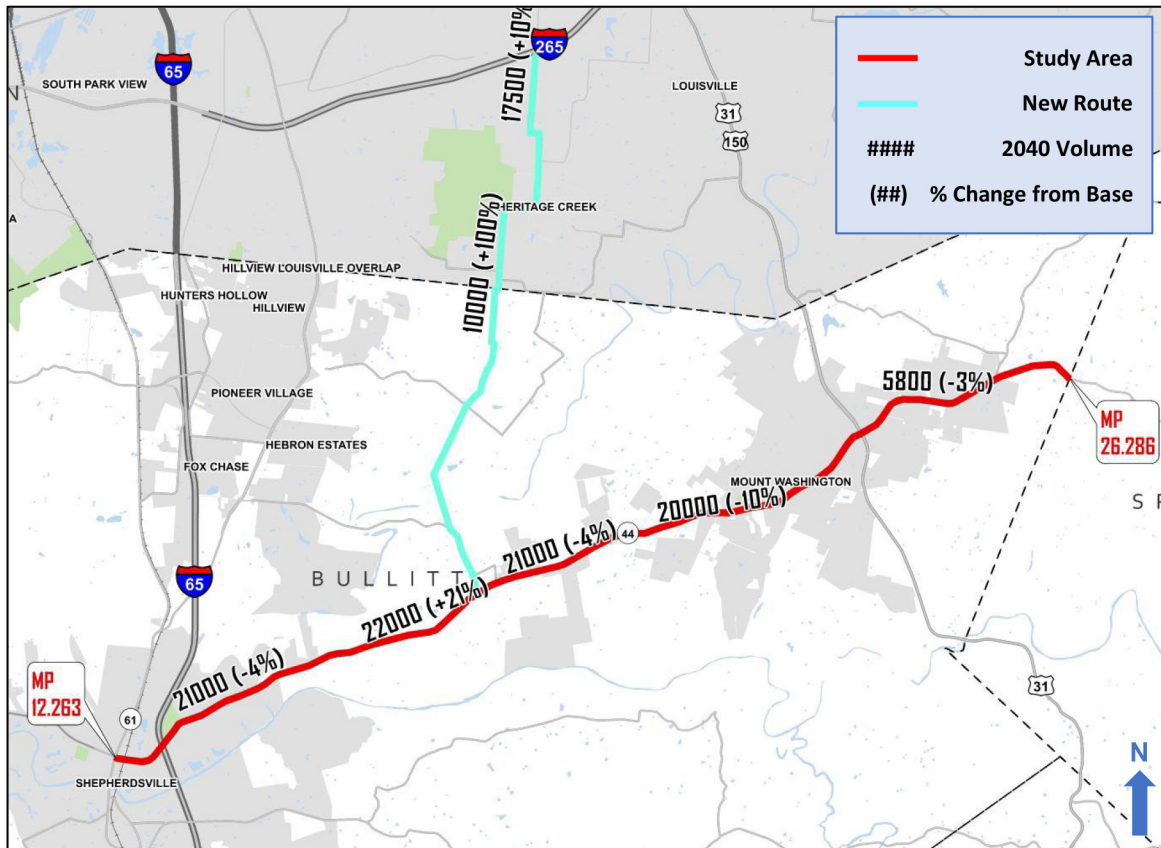


## 5.4 North-South Connector to I-265

A potential new north-south connector roadway into Jefferson County was evaluated as described in the Go Bullitt Transportation Study (2010). This connector would improve the KY 1526 (Bells Mill Road) corridor near KY 44, provide a new route connecting to Cedar

Creek Road, and ultimately have access to I-265 at the KY 864 (Beulah Church Road) interchange, as shown in **Figure 37**. This roadway would be a two-lane rural facility and carry approximately 10,000 vehicles per day in 2040. Traffic volumes in Mt. Washington and Shepherdsville would decrease slightly, but volumes on KY 44 just to the west of this new route would increase by 21%.

Figure 37: Potential North-South Connector to I-265



## 5.5 Summary

Based on this analysis, it was determined that constructing a northwest bypass of Mt. Washington by improving and extending KY 2706 (Greenbriar Road) to connect to US 31E north of Mt. Washington is expected to reduce traffic volumes on KY 44 between KY 2706 and US 31E, enhancing the viability of a three-lane facility through this area. An initial study was performed under KYTC Item 5-8710.00 which identified right-of-way and environmental challenges at the northern end. Additional evaluation of this concept is recommended.

Additionally, constructing a new interchange at I-65 north of Shepherdsville and improving the KY 1526 corridor is expected to slightly reduce traffic in Shepherdsville near the existing I-65 interchange. This will, however, also increase traffic on KY 44 in the vicinity of the KY 1526 intersection making a three-lane facility through this area less feasible. Further study of a new interchange at this location is also recommended.

# 6 Stakeholder Outreach

## 6.1 Project Team Meetings

In addition to Project Team meetings between the Consultants, KIPDA, and KYTC, outreach for this study included a meeting with local elected officials (LEOs) and stakeholders. Meeting minutes can be found in **Appendix G**.

### 6.1.1 Project Team Meeting #1

The first Project Team Meeting was held on July 14, 2022, at 1:00 PM. This was a hybrid virtual and in-person meeting. The purpose of this meeting was to present the existing conditions along the KY 44 corridor, including traffic volumes, corridor speeds, safety, existing geometrics, and a summary of the Existing Phase 1 Designs. KYTC provided feedback that growth rates for traffic forecasts need to be coordinated with other concurrent efforts. The Project Team decided to discuss the growth rates further in a separate meeting.

### 6.1.2 Growth Rate Meeting

The Project Team convened on August 1, 2022, at 11:00 AM to discuss growth rates for the study area corridor. The goal of the meeting was to decide on growth rates for the traffic forecasts and modeling for the study, in coordination with recently completed traffic forecasts for District 5 projects 5-347.50 and 5-347.10. KYTC provided feedback on the proposed growth rates for three sections along the corridor. This feedback was used by the consultant team to develop the traffic forecast.

### 6.1.3 Project Team Meeting #2

A second Project Team Meeting was held on September 28, 2022, at 10:00 AM. The purpose of the meeting was to present the results of the traffic forecasts and modeling and introduce alternative PBFS and TSMO concepts for the corridor. KYTC provided feedback on the potential concepts. The consultant team was directed to create an evaluation framework to support cost and prioritization decisions. The Project Team also decided to move forward with a Stakeholder Meeting prior to another Project Team Meeting.

### 6.1.4 Local Elected Officials & Stakeholders Meeting

The Project Team contacted LEOs and community stakeholders to obtain feedback on proposed programming concepts along the KY 44 corridor. A meeting was held at the Shepherdsville City Hall on November 4, 2022, at 10:30 AM, and included a virtual option. Attendees included state senators and representatives, the Bullitt County Judge Executive and staff, local mayors, school officials, and local government public works and economic development staff.

The LEOs and stakeholders provided valuable input on issues, priorities, and concepts. Safety, volume/LOS, and quality of life were the primary issues identified by the attendees. Commentary on safety issues importantly focused on schools, with young drivers and heavy drop off and pick up traffic as major concerns. Attendees suggested focusing on intersections near and entrances to schools by adding turn lanes and signals.

The ability for emergency response vehicles to reach crashes was also noted as a concern. One attendee commented that the county had purchased a four-wheel drive ambulance to go off the road to reach incidents. A concern with medians affecting emergency response access was noted.

Attendees were asked to prioritize the sections of the corridor. Most ranked the eastern and western ends of the corridor highest with lower priority given to the middle of the corridor between KY 1526 (Bells Mill Road) and KY 2674 (Stringer Lane). Attendees noted that local officials had worked with state legislators to prioritize the segments as they appear in the current *Highway Plan* and this prioritization was important to them.

In terms of cross-sections, there was consensus that a three-lane section in the middle of the corridor was appropriate. There was also general agreement that a three-lane or four-lane with median improvement would be acceptable over a five-lane section. Opinions ranged from liking the more cost effective, community-friendly option of three or four lanes to also being concerned that the growth along the corridor would outweigh the benefits of lower cost options.

Overall, the LEOs and stakeholders confirmed that the KY 44 corridor operates as part of a larger community network, particularly linking the cities with Louisville. The corridor does not operate solely as a through highway. Safety was consistently the top concern voiced by attendees.

Survey results and comments from the meeting are included in **Appendix F**.

### 6.1.5 Project Team Meeting #3

The third and final Project Team Meeting was held on November 17, 2022, at 10:00 AM. The consultant team presented proposed concepts that had been evaluated for safety, cost, and mobility, along with a prioritization of sections of the corridor.

The consultant team further evaluated the potential concepts that were presented at Project Team Meeting #2 and to the LEOs and stakeholders. Safety and

congestion, based on both the data and feedback from stakeholders, were selected as the primary factor for determining segment priority. The Project Team agreed on the approach and asked for focus on how the programming recommendations should be implemented. Additional information to be addressed in the study includes:

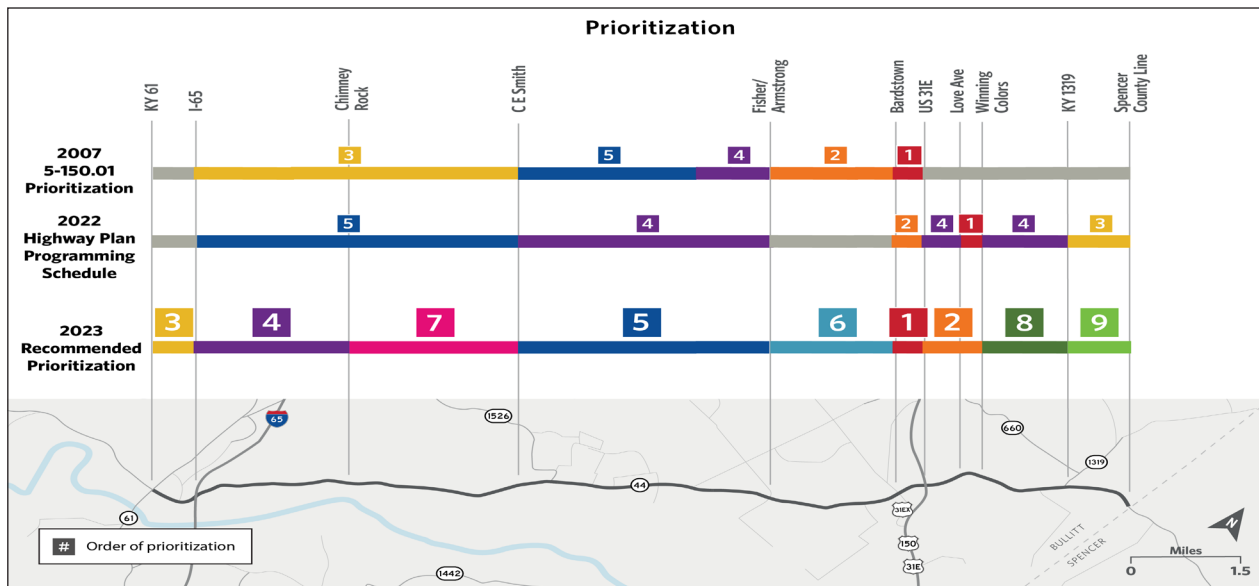
- ▶ Based on stakeholder input, a recommendation to improve KY 44's major connecting network roadways such as KY 1526 (Bells Mill Road) and KY 2706 (Greenbriar Road),
- ▶ An adjustment to make the segment from US 31E to Love Avenue a higher priority,
- ▶ Clarification of the process that led from the initial concepts to the hybrid recommended concept, and
- ▶ A specific list of recommended short-term strategies.

# 7 Project Prioritization

Based on the identified needs along the corridor, traffic and safety analyses, right-of-way impacts, overall cost, travel times, the evaluation of potential new network connections, and input from stakeholders, the Project Team developed a prioritization plan for existing construction segments. **Figure 38** shows the

original prioritization that was determined for the breakout sections of Item No. 5-150.01 (top row), the prioritization of projects in the *Highway Plan* based on initial year of construction, and the proposed order of priority based on the analyses from this study (bottom row).

**Figure 38: Proposed KY 44 Corridor Project Prioritization**



Note: Gray sections indicate the section was not considered in that prioritization and does not indicate a lower priority.

The details behind each segment’s prioritization follows:

**Priority Segment 1:** This segment was prioritized first based on combined high safety issues and projected 2045 LOS of E and F at the segment and intersections (see **Figures 16, 17, 24, 25**). It is also relatively low cost to implement, and data collected from the upgraded signal controllers could be used to optimize and inform both Segments 1 and 2. Stakeholder support was high to implement this section quickly.

**Priority Segment 2:** This segment was prioritized second for several reasons. It shares the same high safety needs and projected LOS E as Segment 1 and would make sense to design in continuity with Segment 1. Also, currently there is regular congestion westbound, as well as strong stakeholder support.

**Priority Segment 3:** This segment was prioritized **third** based on high safety needs and projected intersection

LOS of E, relatively low costs, and the timeliness of utilizing data from updated signal controllers to optimize and inform ongoing Shepherdsville-led projects. Adding a continuous lane from the I-65 SB Ramp to Adam Shepherd Parkway will lead to both safety and LOS improvements. It is worth noting that this high-growth segment did not have any planned KYTC projects and was not part of the 2005 KY 44 Alternate Study (Item No. 05-150.00).

**Priority Segment 4:** This segment was prioritized fourth based mostly on high safety issues throughout, but also because of its continuity with Segment 3. The western portion of the segment is also projected to have LOS of E. Stakeholders noted numerous concerns including the entrance to the Bullitt Central High School and higher levels of bicycle and pedestrian activity in the area.



**Priority Segment 5:** This segment was prioritized fifth based on overall moderate safety need, poor roadway segment level of service (LOS throughout of E). It has recent intersection improvements including turn lanes and signalization (5-150.10 and 5-150.20) that will support better safety and LOS performance in the near term. It is recommended, though, that consideration be given to requesting KYTC's Highway Safety Improvement Program (HSIP) branch assess the crashes in this section.

**Priority Segment 6:** This segment was prioritized sixth because it has very similar characteristics to Segment 5 but may have slightly higher ROW costs.

**Priority Segment 7:** This segment was prioritized seventh because it has a projected LOS of D throughout and the safety needs are concentrated to a few areas. While the segment's number of crashes is relatively high, they are constrained to a concentrated area that is better suited to a short-term, focused HSIP strategy.

**Priority Segment 8:** This segment is prioritized eighth for construction based on low safety needs compared to the other segment. LOS is projected to be C or E in 2045, depending on direction. Based on stakeholder input, though, and because business and residential growth near this segment continues, it is recommended that Phase 1 design and right-of-way acquisition commence earlier to permit an eventual widening.

**Priority Segment 9:** This segment was prioritized ninth for construction based on combined low safety needs, and traffic operations of LOS C or better. Similar to Segment 8, Phase 1 Design and right-of-way acquisition should be prioritized earlier to secure right-of-way prior to the development that is being planned in the area.

# 8 Recommendations & Programming

The final list of improvement strategies for the study was developed based on Project Team and stakeholder feedback, as well as the criteria used to evaluate the corridor concepts: safety, traffic operations, LOS, right-of-way required, and implementation costs. Corridor concepts were created, evaluated and chosen to provide cost savings, while also improving safety, travel time, and traffic operations. Short-term/TSMO, corridor-wide, and network connection recommendations were made.

## 8.1 Short-Term Solutions and Strategies

When examining each segment of the KY 44 study corridor some issues stood out as either urgent on their own, or as important first steps to increase the amount of traffic data available for early design efforts.

### 8.1.1 Improved Traffic Signal Operations

Replace current standard traffic signal controllers (model 170) with advanced traffic signal controllers (model 2070) and install advanced vehicle detection hardware at traffic signals along the project corridor. Benefits include improved detection of vehicles at intersections; enhanced (real-time) traffic count collection and ability to coordinate traffic signals through the corridor leading to reduced wait times and congestion. Enhanced data collection will also better inform designers of traffic conditions as they work to advance larger roadway improvement projects in the corridor.

KYTC is currently upgrading the traffic signal controllers and has identified \$200,000.00 in TSMO funding to install the advanced vehicle detection hardware at the following intersections. This work by state forces is anticipated to be complete by Summer 2023.

- ▶ KY 44 @ KY 61
- ▶ KY 44 @ Hester Street
- ▶ KY 44 @ Adam Shepherd Pkwy

- ▶ KY 44 @ I-65 SB
- ▶ KY 44 @ I-65 NB
- ▶ KY 44 @ KY 1526
- ▶ KY 44 @ Bogard/Lloyd (currently under construction)
- ▶ KY 44 @ Armstrong/Fisher
- ▶ KY 44 @ US 31EX
- ▶ KY 44 @ US 31E
- ▶ US 31 E @ Oakbrooke Dr
- ▶ US 31 E @ Bardstown Rd/US 31E

Once signal upgrades are complete, KYTC anticipates entering into a Traffic Engineering Services contract to perform the following services, with an estimated fee of \$80,000.

- ▶ Analysis of existing conditions and identification of opportunities to optimize throughput at each intersection.
- ▶ Prepare and implement individual signalized intersection optimizations and corridor-wide signal coordination plans.
- ▶ Monitor improvements and make data available for future design projects.

### 8.1.2 Coordination on Area Projects

The planned lane reconfiguration/restriping work at the Adam Shepherd Parkway intersection being done by the City of Shepherdsville will benefit from more accurate intersection turn data, potentially improving the current design. The current Item 5-347.50 design work east of US 31E near Mt. Washington would also benefit from more accurate signal data. This data will be available with the updated signal control equipment mentioned above.

### 8.1.3 Initiate a More Detailed Study of the Crash History for the Interior Portion of the Study Area

The interior portion of the study area between Chimney Rock Drive and Fisher Lane/Armstrong Lane had fewer crashes than others in the corridor, however, several of the intersections have Excess Expected Crashes (EEC) higher than zero, and the crashes were more serious (fatal and serious injury). There are also several schools in this area and stakeholders noted a desire for safer operations at the school entrances. Engaging KYTC's HSIP branch may provide mitigating safety countermeasures in the near term before the eventual segment cross-sections are fully built out. The estimated fee for this HSIP study is \$200,000 to \$300,000. Future construction costs of any proposed improvements would be determined in the study. The analysis would also include recommendations regarding potential funding sources.

### 8.1.4 Implementation of ITS Devices

ITS devices can provide information to travelers to inform trip making, which improves safety and reduces congestion, particularly in the event of an incident. There are four locations on the KY 44 corridor where implementing ITS devices would help drivers make informed decisions about their route:

- a. West of KY 61 – placing a dynamic message sign to alert drivers of incidents along I-65 would allow them to detour from I-65 and use KY 61 instead.
- b. Approaching I-65 – placing a travel time information sign on either side of I-65 with information on the travel time to Louisville would allow drivers to decide if they want to take I-65 to Louisville or choose an alternate route.
- c. East of KY 1526 – placing a dynamic message sign on the westbound lane of KY 44 to alert drivers to any incidents in Shepherdsville or along I-65 would allow them to detour using KY 1526.

The estimated cost for these devices is \$75,000 per sign, or \$300,000 total.

## 8.2 Corridor Recommendations and Phasing

After evaluating the corridor concepts, it became apparent that the best recommendation is a combination of the concepts developed, with a

mix of TSMO and PBFS features depending on the segment needs. **Figure 39** shows the recommended cross-sections and **Table 16** summarizes the concept improvements for each of the nine prioritized segments.

Figure 39: KY 44 Recommended Corridor Concepts

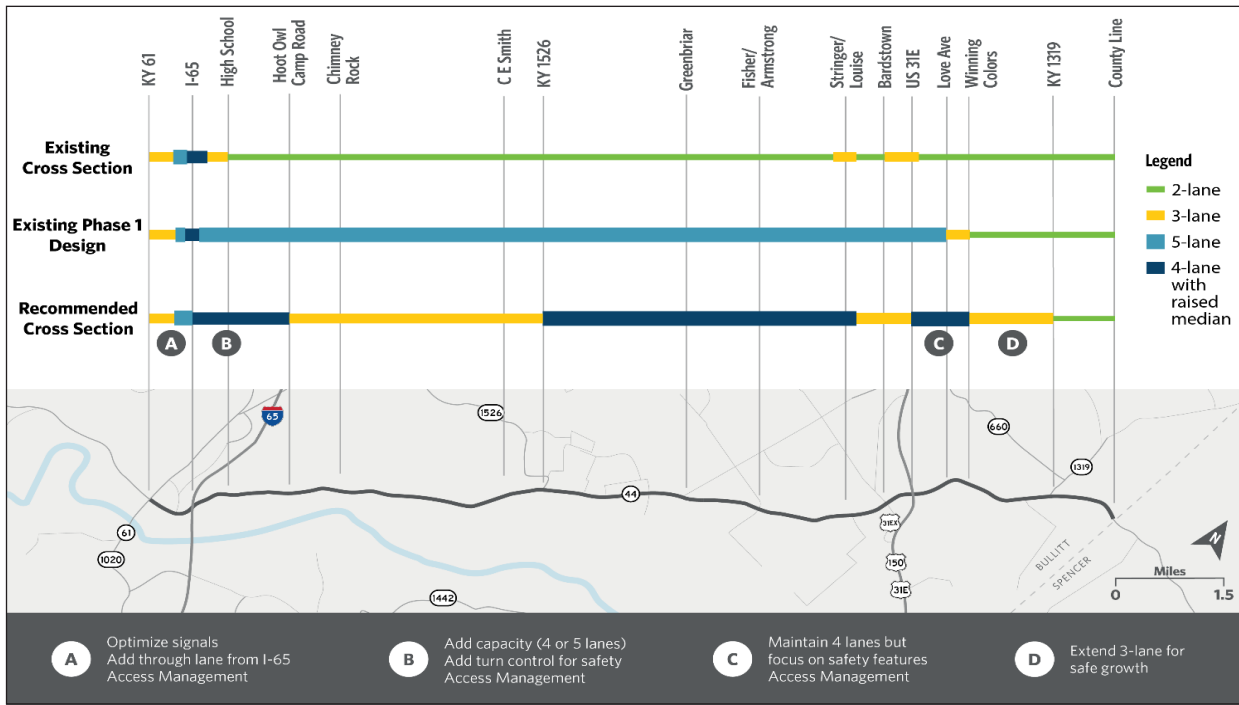


Table 16: Recommendations for KY 44

Priority	Segment Begin	Segment End	Item No.	Description	Design	ROW	Utilities	Construction	Total	Highway Plan Cost (Existing Phase 1 Design)
1	US 31 EX (Bardstown Road)	US 31E	5-150.50	3-lane urban section with 5' sidewalk on north side and 10' multi-use path on south side.	\$495,000	\$1,635,000	\$2,760,000	\$4,439,000	\$9,329,000	\$4,093,000
2	US 31E	Winning Colors Drive	5-347.50 - Section 1 (formerly 5-347.51*)	4-lane urban divided section with turn lanes and 5' sidewalk on north side and 10' multi-use path on south side.	\$700,000	\$980,000	\$3,300,000	\$7,000,000	\$11,980,000	\$10,571,000
3	KY 61	I-65	N/A	Maintain existing 3-lane urban cross-section from KY 61 to Hester Street; transition to a 4-lane urban cross-section with a median between Hester Street and Adam Shephard Parkway; expand to a five-lane urban cross-section from Adam Shephard Parkway to I-65, extending the exit ramp from I-65 southbound onto KY 44 to connect to the right turn lane into Adam Shephard Parkway; 5' sidewalk on north side and 10' multi-use path on south side.	\$130,000	\$125,000	\$800,000	\$1,300,000	\$2,355,000	N/A
4	I-65	Chimney Rock Drive	5-150.02	4-lane urban section from I-65 to Hoot Owl Camp Road; 3-lane urban section with TWLTL from Hoot Owl Camp Road to Chimney Rock; 5' sidewalk on north side and 10' multi-use path on south side.	\$1,277,000	\$369,000	\$2,759,000	\$12,314,000	\$16,719,000	\$38,940,000
5	CE Smith Lane	Armstrong Lane	5-150.31	3-lane urban section with TWLTL from CE Smith Road to KY 1526; 4-lane divided cross-section with a raised median and turn lanes from KY 1526 to Armstrong Lane; 5' sidewalk on north side and 10' multi-use path on south side.	\$2,010,000	\$6,097,000	\$11,526,000	\$18,041,000	\$37,674,000	\$33,280,000
6	Armstrong Lane	US 31 EX (Bardstown Road)	5-150.40	4-lane urban divided cross-section with a raised median and turn lanes from Armstrong Lane to Stringer Lane; 3-lane urban section from Stringer Lane to US 31ES (Bardstown Road); 5' sidewalk on north side and 10' multi-use path on south side.	\$1,560,000	\$3,372,000	\$6,926,000	\$10,644,000	\$22,502,000	\$28,073,000
7	Chimney Rock Drive	CE Smith Lane	5-150.06	3-lane urban section with TWLTL from Chimney Rock to CE Smith Road and 5' sidewalk on north side and 10' multi-use path on south side.	\$1,005,000	\$525,000	\$7,248,000	\$9,105,000	\$17,883,000	\$26,845,000
8	Winning Colors Drive	KY 1319	5-347.50 - Section 2 (formerly 5-347.56)	4-lane urban cross-section and 5' sidewalk on north side and 10' multi-use path on south side.	\$342,000	\$503,000	\$1,133,000	\$3,425,000	\$5,403,000	\$10,129,000
9	KY 1319	Spencer County Line	5-43.00	2-lane rural cross-section with 5' sidewalk on north side and 10' multi-use path on south side; includes right of way for ultimate 3-lane section.	\$137,000	\$537,000	\$927,000	\$1,901,000	\$3,502,000	\$8,400,000

\*Prior to 2018, Item Number 5-347.51 was "KY-44 SECTION 1 FROM US 31E EASTWARD TO PARKLAND TR/WINNING COLORS DRIVE (2008BOPC)". In the 2018 Highway Plan, the Item Number was reallocated to "NEW TURN LANES IN FRONT OF BULLITT EAST HIGH SCHOOL. (BREAKOUT FROM 5-347.50) (18CCN)". The turn lane project went to construction in 2022. If this section advances in a future Highway Plan, a unique Item Number (other than 5-347.51) will need to be assigned.

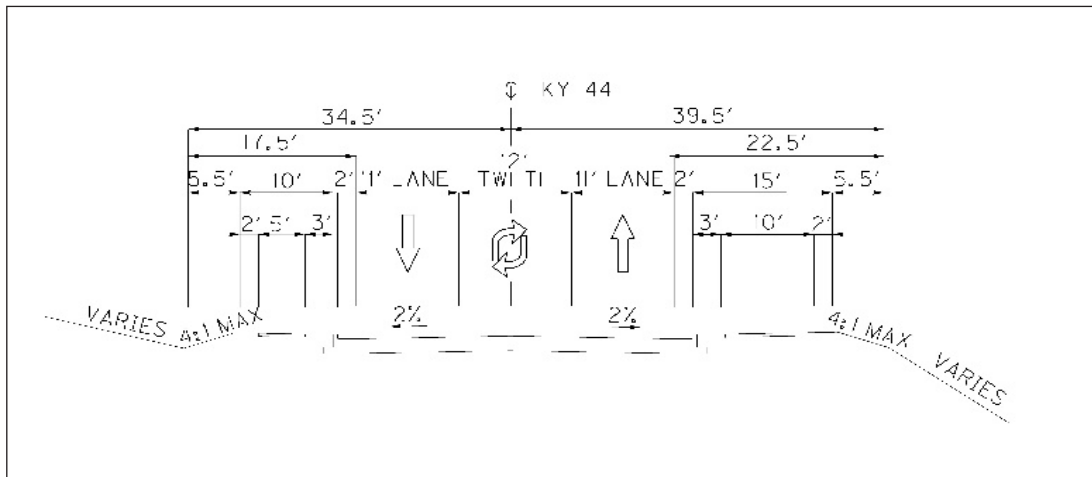


## 8.2.1 US 31EX (Bardstown Road) to US 31E – Priority #1

This segment corresponds to Item No. 5-150.50, which recommended a five-lane urban cross-section with five-foot sidewalks on each side. Based on the evaluation of the PBFS concepts, a three-lane section is recommended along with improved signalization

(see **Section 8.1**) in recognition of the constrained right-of-way. This is part of Option 3 – Performance Based Design B. A five-foot sidewalk is assumed on the north side and a ten-foot multi-use path on the south side throughout this section. The recommended typical section is shown in **Figure 40**.

**Figure 40: Typical Section for the Three-Lane Segment from US 31EX (Bardstown Road) to US 31E**



For implementation, Phase 1 Design would be revisited immediately. KYTC District 5 would schedule the upgrade of any remaining 170 traffic controllers, as well as upgrade detection equipment, as described in **Section 8.1**. A coordinated signal timing plan should be developed as well. If implemented immediately, final design could begin in 2023, with construction occurring in 2025.

## 8.2.2 US31E to Winning Colors Drive – Priority #2

This segment corresponds with the existing Phase 1 Design from Item No. 5-347.51, which recommended a five-lane cross-section from US 31E to Love Avenue, and a three-lane cross-section from Love Avenue to Winning Colors Drive, with five-foot sidewalks on each side. Phase 1 Design of this segment is currently being revisited. Based on the traffic operations analysis, the higher density of crashes, as well as stakeholder desire for better safety, it is the recommendation of this study that a four-lane typical section with a raised median be explored in that effort, from US 31E to Winning Colors Drive. A five-foot sidewalk on the north side and a ten-foot multi-use path on the south side throughout this section is recommended for consistency with the rest of the corridor.

This ongoing Phase 1 Design is utilizing a forecast that was developed with the same growth rates used for this study. If the updated signal controllers and detection can be installed immediately, additional data collected can be used to inform the design of this section. Upon completion of Phase 1 Design, final design could begin in 2023, with construction occurring in 2025.

## 8.2.3 KY 61 to I-65 – Priority #3

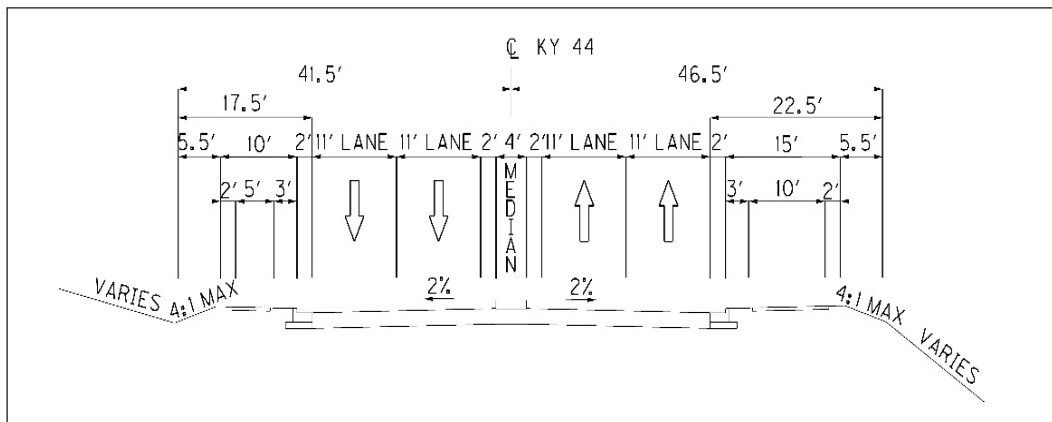
While this segment is not part of the existing 5-150.00 project, it was identified as a high priority as part of this study due to the safety and operational needs, the timeliness of ongoing coordination with Shepherdsville-led projects, and the relatively low cost. For this segment, it is recommended to update the existing three-lane cross-section from KY 61 to Hester Street to a three-lane urban section (see **Figure 40**), transition to a four-lane urban cross-section with a median between Hester Street and Adam Shepherd Parkway to improve safety (**Figure 41**), and finally, expand to a five-lane urban cross-section from Adam Shepherd Parkway to I-65. While Adam Shepherd Parkway to I-65 is technically five lanes, the exit ramp from I-65 southbound onto KY 44 would be extended to connect to the right turn lane into Adam Shepherd Parkway, creating a better continuous movement

and reducing backups on the I-65 southbound ramp. A five-foot sidewalk is assumed on the north side and a ten-foot multi-use path on the south side. This recommendation is taken from Option 4 – TSMO and Urban Strategies.

These cross-sections are recommended along with improved signalization (see **Section 8.1**). With

four existing un-coordinated signals from the I-65 southbound ramp to KY 61, there is opportunity not only to improve intersection and corridor operations, but to collect signal data that can be utilized for more informed roadway design.

**Figure 41: Four-Lane Typical Section from Hester Street to Adam Shepherd Parkway**



For implementation, Phase 1 Design should begin in 2025 and include a more detailed study of the turning movements required from Hester Street to the beginning of the I-65 bridge since the median restricts movements. Final design, right-of-way acquisition, and utility phases could begin between 2026 and 2030, with construction occurring in 2031 to 2035. In the immediate future, KYTC District 5 will need to schedule the upgrade of any remaining 170 traffic controllers, as well as upgraded detection equipment. A coordinated signal timing plan should be created to improve traffic flow.

#### 8.2.4 I-65 to Chimney Rock Drive – Priority #4

The Existing Phase 1 Design associated with Item No. 5-150.02 recommended a five-lane urban cross-section in this segment with a five-foot sidewalk on both sides. Based on the analysis performed in this study, it is recommended the segment from I-65 to Hoot Owl Camp Road become a four-lane urban roadway (the bridge over I-65 is included in this segment and already is a four-lane divided cross-section), as shown in **Figure 41**. From Hoot Owl Camp Road to Chimney Rock Drive, a three-lane urban section with TWLTL (**Figure 40**) would be used since volumes are lower. East of the I-65 northbound ramps, a five-foot sidewalk is assumed on the north

side and a ten-foot multi-use path on the south side. This recommendation is taken from Option 3 – Performance Based Design B. Improved signalization (see **section 8.1**) is also recommended. This cross-section is favorable compared to a five-lane cross-section in terms of safety, while also providing the same capacity of a five-lane section. When combined with improved signal timing, traffic operations will improve as well.

For implementation, updating Phase 1 Design could begin in 2025 and include a more detailed study of the turning movements required east of the I-65 northbound ramps since the median restricts movement. Final design, right-of-way acquisitions, and utilities could begin between 2026 and 2030, with the construction phase following in 2031 to 2035. In the near term, KYTC District 5 should schedule the upgrade of any remaining 170 traffic controllers, as well as upgraded detection equipment. The coordination of the I-65 northbound ramp traffic signals with those west of the I-65 bridge will help extend the signal timing strategy into more of the corridor.

### 8.2.5 CE Smith Lane to Armstrong Lane – Priority #5

The Existing Phase 1 Design concept, associated with Item No. 5-150.31 is a five-lane cross-section with five-foot sidewalks on both sides. The updated traffic analyses and forecast project lower existing and future traffic volumes between CE Smith Lane and KY 1526 (Bells Mill Road), resulting in the recommendation of a three-lane section with center TWLTL (see **Figure 40**). East of KY 1526 (Bells Mill Road), traffic volumes require additional through lanes. Due to a number of serious and fatal crashes in this segment, a four-lane urban cross-section with a raised median is recommended from KY 1526 (Bells Mill Road) to Armstrong Lane (see **Figure 42**). As with Priority Segment 4, the four-lane cross-section with median provides improved safety compared to a five-lane cross-section, while providing the same capacity as a five-lane section, as well as access management. This concept was part of Option 3 – Performance Based Design B. A five-foot sidewalk is assumed on the north side and a ten-foot multi-use path on the south side.

For implementation, updating Phase 1 Design could begin in 2025 and include a more detailed study of the segment's intersection turning movements since the median will restrict movement. Final design, right-of-way acquisition, and utilities could begin between 2026 and 2030, followed by the construction phase in 2031 to 2035.

Additional short-term strategies are recommended that can improve certain intersection operations and perhaps address serious crashes more quickly. The turning movements of several intersections between I-65 and US 31 EX were more closely examined (see **Section 4.2.1.1**). KY 44's intersections with KY 2706 (Greenbriar Road) and Fisher Lane/Armstrong Road were found to operate poorly in one or more directions. The Project Team discussed the potential use of innovative intersections. No specific concepts were decided upon, but it was agreed that improvements to the deficient turn movements would improve long term corridor operations. Consideration should be given to requesting KYTC's HSIP program to examine the crash data in this segment in more detail.

### 8.2.6 Armstrong Lane to US 31EX (Bardstown Road) – Priority #6

The Existing Phase 1 Design concept, associated with Item No. 5-150.40 is a five-lane cross-section with five-foot sidewalks on both sides. As with Priority

Segments 4 and 5, the four-lane cross-section with median provides improved safety compared to a five-lane cross-section, while also providing the same capacity as a five-lane section and improving access management. Due to a number of serious and fatal crashes in this segment, a four-lane urban cross-section with a raised median is recommended from Armstrong Lane to Stringer Lane, similar to Priority Segment #4 (see **Figure 41**). Due to the constrained right of way and high number of access points, a three-lane section is recommended from Stringer Lane to US 31EX (Bardstown Road), similar to Priority Segment #1 (see **Figure 40**). These cross-sections were part of Option 3 – Performance Based Design B. A five-foot sidewalk is assumed on the north side and a ten-foot multi-use path on the south side.

For implementation, updating Phase 1 Design could begin in 2025 and include a more detailed study of the segment's intersection turning movements since the median will restrict movement. Final design, right-of-way acquisition, and utilities could begin between 2026 and 2030, followed by the construction phase in 2031 to 2035.

### 8.2.7 Chimney Rock Drive to CE Smith Lane – Priority #7

The Existing Phase 1 Design associated with Item No. 5-150.06 recommended a five-lane cross-section and five-foot sidewalks on both sides. The updated traffic analyses and forecast found lower existing and projected traffic volumes in this section, resulting in the recommendation of a three-lane urban section with continuous left turn lanes. This better matches the lower traffic volumes at a much lower cost while still allowing left turns since a TWLTL is available (see **Figure 40**). In this higher-speed segment, providing a TWLTL may also mitigate some serious crashes. This recommendation is taken from Option 3 – Performance-Based Design B. A five-foot sidewalk is assumed on the north side and a ten-foot multi-use path on the south side.

For implementation, updating Phase 1 design could begin in 2025. Consideration should be given to requesting KYTC's HSIP program to examine the crash data in this segment in more detail. Final design, right-of-way acquisition, and utility phases could occur between 2026 and 2030 with construction taking place in 2031-2035.

### 8.2.8 Winning Colors Drive to KY 1319 – Priority #8

In the Existing Phase 1 Design work done under 5-347.56, a two-lane rural cross-section was recommended from Winning Colors Dr. to KY 1319 (Kings Church Road). No sidewalks were recommended on either side of KY 44. Phase 1 Design of this segment is currently being revisited, along with Priority Segment #2. Based on the traffic operations analysis as well as stakeholder desire for increased safety, it is the recommendation of this study that a four-lane typical section with a raised median be explored in that effort. A five-foot sidewalk on the north side and a ten-foot multi-use path on the south side throughout this section is recommended for consistency with the rest of the corridor.

For implementation, the Phase 1 Design underway should continue so that right-of-way acquisition can begin in 2024, before much of the anticipated development in this area is completed. The turn movement of KY 1319 (Kings Church Road) onto KY 44 was found to operate poorly in the future, and an intersection study should be performed in the near term to determine whether turn lanes or other enhancements will help the intersection function well long-term. Final design could begin in 2026 to 2030, however the utility and construction phases won't be needed until further out in the years 2031 to 2035, as the additional capacity will not be needed until then.

### 8.2.9 KY 1319 to Spencer County Line – Priority #9

In the prior Phase 1 Design prior planning study work done under 5-396.00, a two-lane rural cross-section was recommended from Winning Colors Dr. to KY 1319 (Kings Church Road), with no change from KY 1319 (Kings Church Road) to the Spencer County line (also two-lanes). No sidewalks were recommended on either side of KY 44. Based on the analysis performed in this study, a two-lane rural cross-section with improved shoulders is recommended from KY 1319 (Kings Church Road) to the Spencer County line. This would also provide the right-of-way needed to accommodate a three-lane section in the future if it becomes needed. A five-foot sidewalk is assumed on the north side and a ten-foot multi-use path on the south side.

For implementation, the Phase 1 Design should begin immediately so that right-of-way acquisition can begin in 2024, before much of the anticipated development in this area is completed. Final design could begin in 2026 to 2030, however the utility and construction phases won't be needed until further out in the years 2031 to 2035, as the additional capacity will not be needed until then.

## 8.3 Network Connection Recommendations

Of the four potential new network connections that were analyzed as part of this study, two were recommended for further study. The first is the northwest bypass of Mt. Washington, improving and extending KY 2907 (Greenbriar Road) to connect to US 31E north of Mt. Washington. Traffic volumes on KY 44 between KY 2907 and US 31E would be expected to be reduced by 15% resulting in the feasibility of a three-lane facility in this area. An initial study was performed under KYTC Item 5-8710.00 which identified right-of-way and environmental challenges at the northern end. Additional evaluation of this concept is recommended.

The second is constructing a new interchange at I-65 north of Shepherdsville and improving the KY 1526 corridor, which is expected to slightly reduce traffic in Shepherdsville near the existing I-65 interchange. This will, however, also increase traffic on KY 44 in the vicinity of the KY 1526 intersection making a three-lane facility through this area less feasible. Further study of a new interchange at this location is recommended.

The Project Team and stakeholders both expressed support investigating the necessary scope to improve KY 44's existing major high-volume connections, KY 1526 (Bells Mill Rd.) and KY 2706 (Greenbriar Rd) to improve both geometry and pavement condition.

## 8.4 KY 44 Implementation Summary

The recommendations from this study were developed into an implementation plan that shows the priorities and interdependency of the projects, as well as a proposed timeline. Some key principles that guided the implementation recommendations are:

1. As a project that includes TSMO options, some of the immediate recommendations include signalization upgrades and optimization. Once timing plans are implemented, the data collected will help guide the scope of roadway design work throughout the corridor.
2. This programming study did not include the public engagement normally performed in Phase 1 Design work. Some important design choices still remain that would include future public engagement. Examples include acceptance of a four-lane cross-section that would support better access management, but restrict turn movements while improving safety, and adopting urban cross-sections less than five lanes in order to reduce right-of-way acquisition.
3. The two urban areas (Shepherdsville and Mt. Washington) have very interdependent transportation issues (turning lanes, access management, opportunities for other improved linkages, etc.). Also, each city can conduct their own projects without relying on KYTC. Those reasons combined indicate coordination between the municipalities and KYTC will help the projects work together.

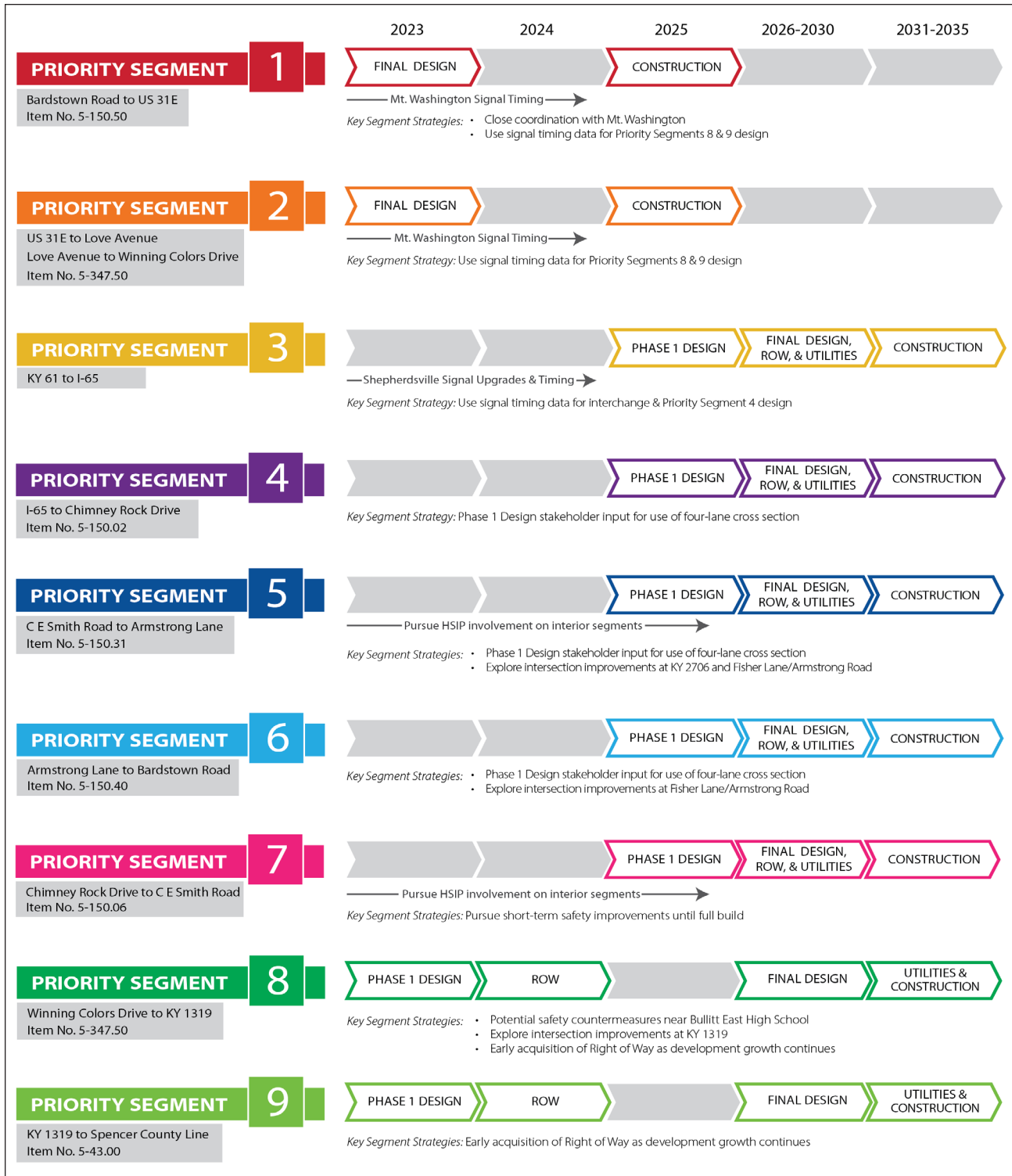
**Figure 42** is a timeline graphic that will help to show the order of the recommended prioritized segments broken down by phase of work. Included is important work that is linked to some of the segments such as signal upgrades and optimization and pursuit of KYTC HSIP assistance.

To arrive at the implementation timeline for each priority segment the Project Team first studied the projects currently funded in the *Highway Plan*. These are heavily weighted toward construction funds being spent in 2026 and beyond. Next, the segments that are either planned or newly added by this study were added to that analysis.

The guidelines used to recommend programming were (a) design work and right-of-way acquisition should be started or continued so that segments are ready for construction when funding is available and (b) annual spending on this important corridor should be between \$5M and \$15M per year. Additionally, early right-of-way acquisition was recommended for Priority Segments 8 and 9 since preserving right-of-way for known growth will be important to keep long-term costs low as well as provide for sufficient roadway and sidewalk width.



Figure 42: Recommended Implementation Timeline for KY 44



# 9 Federal IIJA Grant Program Emphasis Analysis

The Infrastructure Investment and Jobs Act (IIJA), also known as the Bipartisan Infrastructure Law (BIL), was passed by Congress in late 2021 and created several new competitive grant programs for funding critical transportation projects across the country<sup>3</sup>. These grant programs have different focus areas and address a variety of transportation needs.

Given the importance of KY 44 to the region, it is a good candidate for receiving IIJA funding from one or more Federal grant programs. Several potential grant programs that could apply are discussed below.

**Regional and Local Project Assistance** - This grant program is similar to the current United States Department of Transportation (USDOT) RAISE grant program. It is designed for projects that offer local and regional transportation and quality of life benefits. The maximum that can be requested is \$25 million. It could be used to fund a high priority portion of the corridor upgrade. Specifically, it could be used to secure funds for the key areas at either end of the corridor (Priorities 1, 2, or 3). These sections would provide both operational and safety benefits that would likely exceed the project costs allowing it to achieve a benefit/cost ratio over 1.0. **This program is a good fit for several parts of the corridor.**

**Safe Streets and Roads for All (SS4A) Program<sup>4</sup>** - KIPDA is currently waiting to hear on USDOT acceptance of an application for SS4A planning grant. If that is approved, then this corridor would be evaluated as part of that work and high priority areas could be grouped and sponsored by KIPDA, Bullitt County, or one of the cities for implementation grant funding. The high crash severity center portion of the corridor could be a good section (possibly Priority Section 5) to advance through this program to an implementation grant. The SS4A program is not open to state government, so KYTC could not apply, but KYTC could help support the effort for key safety projects.

**Active Transportation Infrastructure Investment Program** - This program would be a good candidate for securing funding to support improved pedestrian and bicycle facilities in the corridor. In particular, a shared use path could be funded in part using these funds if a demonstrated need and safety benefits could be documented. This program may be more difficult to coordinate with the overall plan as the shared use path location would need to be selected such that it would work with the ultimate roadway typical section.

**Strengthening Mobility and Revolutionizing Transportation (SMART) Grant Program<sup>5</sup>** - Given the importance of the traffic signals at either end of the corridor, this grant program may be applicable. Upgrading equipment, including detectors and even system level traffic detection could be pursued, however, the technology may not be advanced enough to be competitive enough to secure funding. Therefore, a decision could be made to use one or both ends of the corridor as a demonstration area for connected vehicle technology - with drivers having the opportunity to add in-vehicle technology that communicates with the traffic signals. One additional option would be to use this grant program to fund new safety and dynamic message sign technology in the corridor.

<sup>3</sup> Bipartisan Infrastructure Law Grant Programs | US Department of Transportation

<sup>4</sup> Safe Streets and Roads for All (SS4A) Grant Program | US Department of Transportation

<sup>5</sup> Fact Sheet: The Strengthening Mobility and Revolutionizing Transportation (SMART)

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# 10 Next Steps

This study helped develop understanding of the importance and interconnectedness of the KY 44 corridor and identify a prioritized list of PBFS and TSMO solutions. For those reasons, a more comprehensive list of next steps is provided here.

- ▶ Traffic signal upgrades and timing, along with detection upgrades, is an important first step to improve intersection operations as well as begin collecting data to improve upcoming/ongoing design projects.
- ▶ There is current funding available in the *Highway Plan* for Items 5-347.50, 5-43.00, 5-150.02, 5-150.50, 5-347.51, and 5-80103.00. The results of this study should be shared with any staff or consultants involved, and the scope of the projects should be re-examined.
- ▶ Arrange specific meetings with officials from the

cities of Shepherdsville and Mt. Washington to discuss working together to integrate the results of the study with their priority municipal projects.

- ▶ Share the finalized study report with stakeholders and KIPDA in anticipation of the upcoming *Highway Plan* process.
- ▶ Initiate discussion with the KYTC HSIP branch to assess the corridors appropriateness for HSIP attention and funding.
- ▶ Seek additional funding sources through the suggested grant programs.

## 10.1 Contacts

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

