

Pembroke Corridor Study

Christian County

Item Number: 2-381.00

March 2018

FINAL

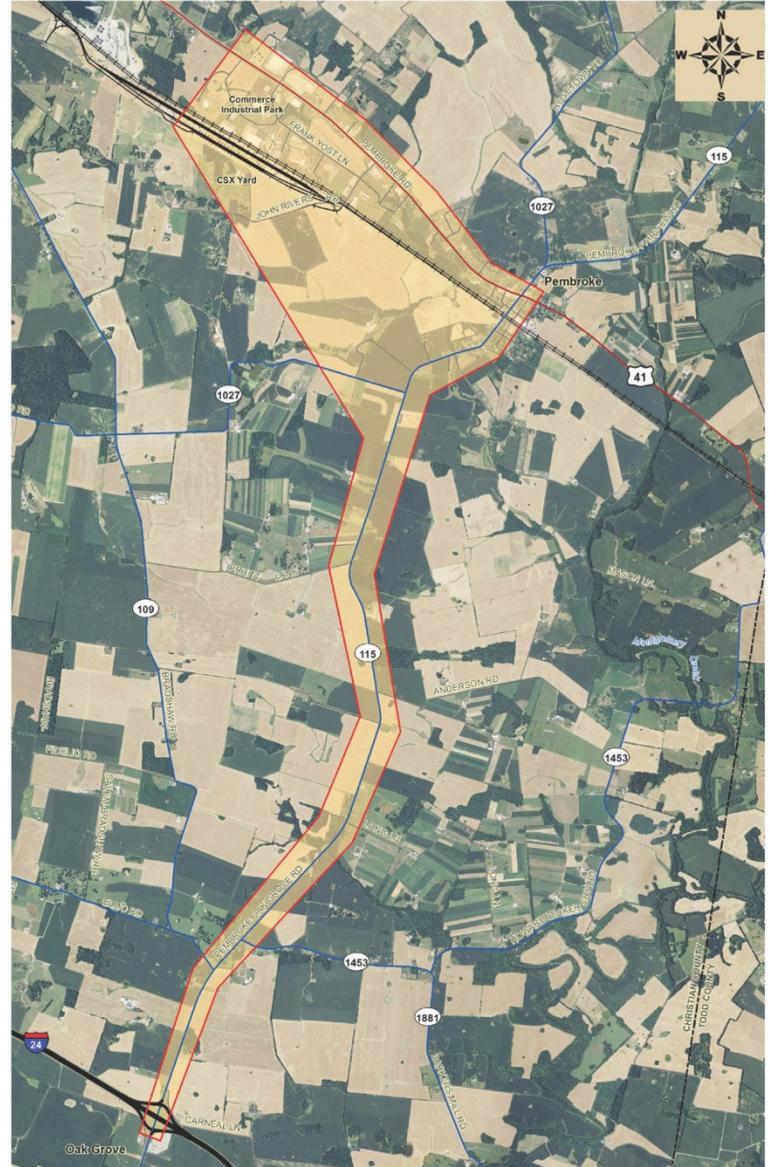
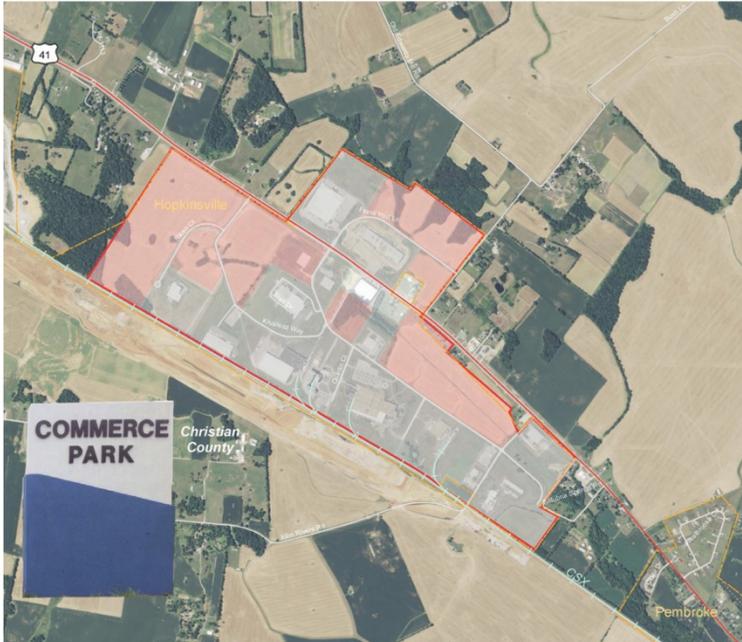


Table of Contents

EXECUTIVE SUMMARY.....	ES 1
1.0 INTRODUCTION.....	1
1.1 Study Area.....	4
1.2 Project History.....	4
2.0 HOPKINSVILLE-CHRISTIAN COUNTY COMPREHENSIVE PLAN.....	6
2.1 Draft Land Use Element.....	6
2.2 Draft Transportation Element.....	6
3.0 EXISTING CONDITIONS.....	8
3.1 Roadway Characteristics.....	8
3.1.1 US 41.....	8
3.1.2 KY 115.....	10
3.2 Roadway Geometrics.....	11
3.2.1 US 41.....	11
3.2.2 KY 115.....	12
3.2.3 US 41 / KY 115 Intersection.....	17
3.3 Structures.....	18
3.4 CSX Trains.....	20
3.5 Bicycle Accommodations.....	20
3.6 Pedestrian Accommodations.....	22
3.7 Transit.....	22
3.8 Known Utilities.....	22
3.9 Crash History.....	22
3.9.1 Crash History by Crash Type.....	23
3.9.2 Crash History by Manner of Collision.....	25
3.9.3 Crash History of Semi-Tractor Trailers.....	25
3.9.4 Crash History at Railroad Crossings.....	25
3.9.5 High-Crash Spots.....	27
4.0 TRAFFIC ANALYSIS – EXISTING (2016) AND FUTURE (2040).....	30
4.1 2016 Traffic Counts.....	30
4.2 Travel Times.....	31
4.3 2016 Traffic Operations.....	33
4.4 Year 2040 Traffic Forecasts.....	35
4.4.1 Growth Rates for Design Year 2040.....	35
4.4.2 No Build Year 2040 ADT and LOS.....	38
5.0 ENVIRONMENTAL OVERVIEW.....	41
5.1 Natural Environment.....	41
5.1.1 Ecological Resources.....	41
5.1.2 Threatened and Endangered Species.....	43

5.1.3	Prime Farmland	43
5.1.4	Geotechnical Overview	43
5.1.5	Karst Potential	45
5.2	Human Environment.....	46
5.2.1	Land Use	46
5.2.2	Socioeconomic Review	47
5.2.3	Noise	51
5.2.4	Air Quality.....	51
5.2.5	Hazardous Materials	52
5.2.6	Historic Architectural Resources (Section 106).....	53
5.2.7	Archaeological Resources.....	53
5.2.8	Land and Water Conservation Fund (LWCF)—Section 6(f).....	54
5.2.9	Public Parks	54
5.2.10	Agricultural Districts.....	54
5.2.11	Conservation Easements	54
6.0	INITIAL MEETINGS	55A
6.1	First Project Team Meeting	55A
6.2	First Local Officials/Stakeholders Meeting	55A
7.0	PURPOSE AND NEED STATEMENT	57
8.0	CONCEPT DEVELOPMENT	61
8.1	Typical Sections	61
8.2	Second Project Team Meeting	62
8.2.1	No Build/Do Nothing	62
8.2.2	Concept A—Improve/Widen US 41 (Long-Term).....	64
8.2.3	Concept B—Pembroke Connector (Long-Term)	64
8.2.4	Concept C – Improve/Widen KY 115 (Long-Term)	65
8.2.5	Concept A_I—Improve US 41/KY 115 Intersection (Short-Term).....	66
8.2.6	Concept D—Replace KY 115 Bridge (Short-Term).....	66
8.3	Concept Evaluation	67
8.4	National Environmental Policy Act (NEPA) Documentation Requirements	67
9.0	2040 TRAFFIC ANALYSIS OF BUILD CONCEPTS.....	70
10.0	RESOURCE AGENCY COORDINATION AND FINAL MEETINGS	73
10.1	Resource Agency Coordination	73
10.2	Second Local Officials/Stakeholders Meeting	75
10.3	Public Meeting	75
10.4	Final Project Team Meeting.....	77
11.0	FINAL CONCEPTS, COST ESTIMATES, AND EVALUATION MATRIX	79
11.1	Cost Estimates	81
11.2	Evaluation Matrix and Benefit/Cost Analysis	82
12.0	CONTACTS / ADDITIONAL INFORMATION.....	90

List of Tables

Table ES 1: Cost Estimates for Final Improvement Concepts.....	ES 6
Table 1: Existing Roadway Characteristics.....	9
Table 2: KY 115 Vertical Sight Distance Issues.....	12
Table 3: Structure Inventory.....	18
Table 4: Train Crossing Statistics.....	20
Table 5: US 41 and KY 115 Crashes.....	23
Table 6: High-Crash 0.1 Mile Spots.....	27
Table 7: Travel Time Comparison.....	31
Table 8: 2016 Segment Traffic Analysis.....	34
Table 9: 2016 Intersection Traffic Analysis.....	35
Table 10: 2040 No Build Intersection Traffic Analysis.....	38
Table 11: 2040 No Build Segment Traffic Analysis.....	38
Table 12: Ecological Resources.....	41
Table 13: Federally Listed Species Potentially Occurring in Christian County.....	43
Table 14: Potential UST/Hazmat Sites.....	52
Table 15: 2040 Build Segment Traffic Analysis.....	71
Table 16: 2040 Build Intersection Traffic Analysis.....	71
Table 17: Resource Agency Coordination.....	73
Table 18: Public Meeting and Local Officials Survey Results.....	76
Table 19: Cost Estimates for Final Improvement Concepts.....	81
Table 20: Evaluation Matrix.....	83

List of Figures

Figure ES 1: Study Area Location in Christian County.....	ES 1
Figure ES 2: US 41/KY 115 Intersection Looking North.....	ES 2
Figure ES 3: Final Improvement Concepts.....	ES 4
Figure 1: Study Area Location in Christian County.....	2
Figure 2: Study Area – Pembroke Corridor Study.....	3
Figure 3: 2016-2022 Highway Plan and Project Identification Form (PIF) Projects.....	5
Figure 4: Commerce Park and Study Area – Existing Land Use Map 2012.....	7
Figure 5: US 41 Looking South near John Rivers Road.....	8
Figure 6: US 41 looking South near Culvert.....	8
Figure 7: US 41 Looking North near Walnut Street.....	8
Figure 8: US 41 Looking North at KY 115.....	8
Figure 9: KY 115 Looking South approaching I-24.....	10
Figure 10: KY 115 Looking South from Pembroke Elementary School.....	10
Figure 11: KY 115 Looking North toward Bridge.....	10
Figure 12: KY 115 Looking South in Pembroke.....	10
Figure 13: US 41 North near Minute Mart at MP 2.850.....	11
Figure 14: Horizontal Curve on KY 115 at MP 9.55 near Rosedale Cemetery.....	12
Figure 15: Number of Lanes and Lane Widths.....	13
Figure 16: Shoulder Widths.....	14

Figure 17: Roadway Geometrics 15

Figure 18: Percent No Passing 16

Figure 19: US 41/KY 115 Intersection 17

Figure 20: KY 115 North Approaching 17

Figure 21: US 41/KY 115 Intersection Sidewalk and Close-up of Damaged Water Main Cover 17

Figure 22: KY 115 Functionally Obsolete 18

Figure 23: Structures 19

Figure 24: KY 115/CSX Crossing 20

Figure 25: Bicyclist along KY 115 20

Figure 26: Strava Heat Map - Bicycle Activity 21

Figure 27: Existing Sidewalks 22

Figure 28: Crash History by Crash Type 24

Figure 29: Crash History by Manner of Collision 26

Figure 30: KY 115 High-Crash Spot No. 2 28

Figure 31: High-Crash 0.1 Mile Spots (CCRF>1) 29

Figure 32: 2016 Traffic Count Locations 30

Figure 33: Travel Time Paths 32

Figure 34: LOS Definition 33

Figure 35: 2016 ADT, AM/PM Peak Hour Intersection Movements, Delay, and LOS 36

Figure 36: CCTDM Subarea 37

Figure 37: 2040 No Build AADT, AM/PM Peak Hour Intersection Movements, Delay, and LOS 40

Figure 38: Environmental Overview 42

Figure 39: Prime Farmland 44

Figure 40: Amish Buggies on KY 115 (left), and Amish Farms (right) 46

Figure 41: Hispanic or Latino Origin Population Percentage 47

Figure 42: Study Area Census Block Group Boundaries 48

Figure 43: Racial Minority Population Percentage 49

Figure 44: Age 65 and over Population Percentage 49

Figure 45: Below Poverty Level Population Percentage 50

Figure 46: Disabled Population Percentage 50

Figure 47: Limited English Proficiency Population Percentage 51

Figure 48: Agricultural Districts 55

Figure 49: Recent Commerce Industrial Park Growth 57

Figure 50: Existing Commerce Industrial Park 58

Figure 51: Commerce Industrial Park Expansion 58

Figure 52: US 41/KY 115 Intersection Looking North 59

Figure 53: US 41 and KY 115 Widening Concepts A and C—Typical Section 61

Figure 54: Pembroke Connector/US 41/KY 115 Connector (Concept B) Typical Section 62

Figure 55: Initial Improvement Concepts Considered and Presented to LO/S 63

Figure 56: KY 115 Alternative Tie-In 64

Figure 57: Concepts Advanced for Detailed Evaluation 69

Figure 58: 2040 Build AADT, AM/PM Peak Hour Intersection Movements, Delay, and LOS 72

Figure 59: Final Improvement Concepts 80

Figure 60: Concept A – Improve/Widen US 41 84

Figure 61: Concept C – Improve/Widen KY 115.....85
 Figure 62: Concept A-to-B2 – Improve/Widen US 4186
 Figure 63: Concept B (B1 or B2) - Pembroke Connector87
 Figure 64: Concept C-to-B - Improve/Widen KY 115.....88
 Figure 65: Concept A_I1 - Improve US 41/KY 115 Intersection89
 Figure 66: Concept D - Replace KY 115 Bridge89

List of Appendices (CD Inside Back Cover)

- Appendix A: Pedestrian & Bicycle Consideration Review
- Appendix B: Crash History
- Appendix C: Traffic Forecast and Model Amendment Report
- Appendix D: Pembroke Corridor Study Report Addendum
- Appendix E: Environmental Overview
- Appendix F: Geotechnical Overview
- Appendix G: Pembroke Socioeconomic and Environmental Justice (E.J.) Report
- Appendix H: UST/Hazmat EDR DataMap Area Study
- Appendix I: Project Team Meeting Summaries
- Appendix J: Local Officials/Stakeholder Meeting Summaries
- Appendix K: Public Meeting Summary
- Appendix L: Resource Agency Coordination Responses
- Appendix M: Cost Estimates

CD to KYTC

Archaeological Overview (confidential)

EXECUTIVE SUMMARY

The Kentucky Transportation Cabinet (KYTC) initiated a corridor planning study in June 2016 to analyze access from Interstate 24 (I-24) in Christian County to the Industrial Park (Commerce Park) located northwest of the city of Pembroke, Kentucky on US 41 (**Figure ES 1**).

This planning study is not the first effort by the KYTC to address transportation needs in the area. The Pembroke Corridor Study is identified in Kentucky's Fiscal Year (FY) 2016–FY 2022 Highway Plan as three projects with SPP or SP funding: Item Numbers 2-381.00 (SPP), 2-8953.00 (SP), and 2-8954.00 (SP).

However, as a result of state spending exceeding revenues since FY 2014, KYTC has introduced the “Pause-50 Plan,” designed to slow or delay the start of new projects in order to pay current expenditures, recuperate lost revenue and rebuild KYTC's funding base. Item Number 2-381.00 currently has (SPP) funding and is delayed as a result of “Pause-50.” Item Numbers 2-8953.00 and 2-8954.00 currently have State Project (SP) funding. SP is unavailable in the current Highway Plan.

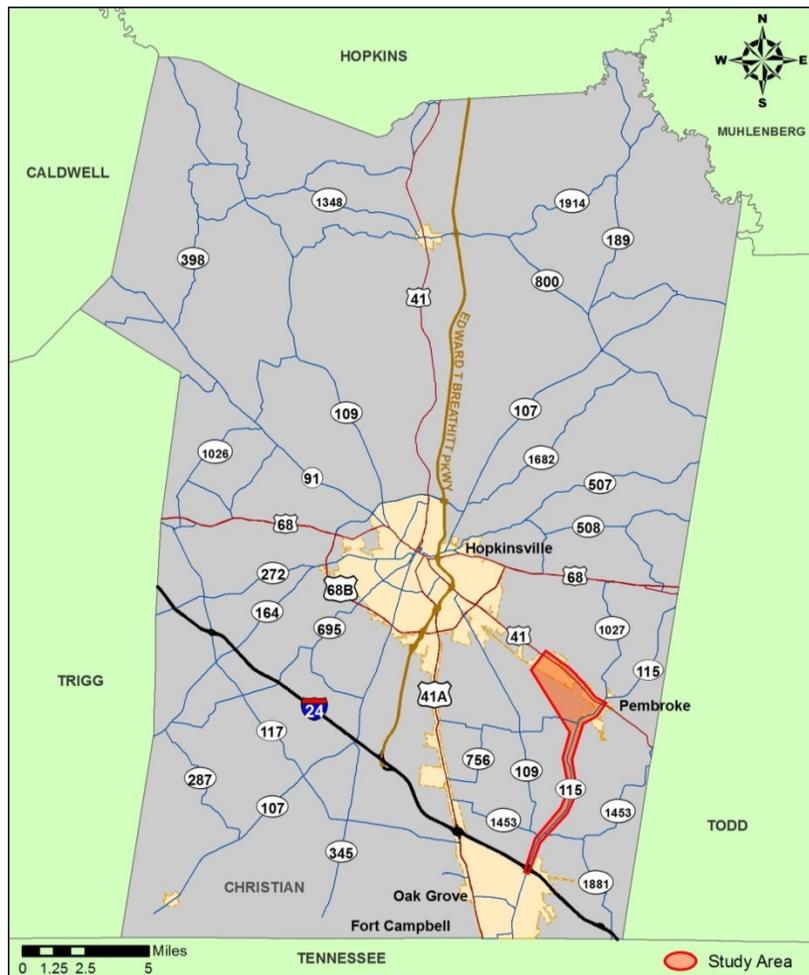


Figure ES 1: Study Area Location in Christian County

Five KYTC PIF projects are within or partially within the study area but not listed in the 2016-2022 Highway Plan, each taken into account during this study.

The project team was composed of KYTC Central Office and District 2 staff, the Pennyriple Area Development District (PADD), and Qk4 consultants. The team studied existing conditions, developed a Purpose and Need Statement, engaged the local officials/ stakeholders and public, completed traffic analyses, conducted an environmental overview, and studied various concepts.

Purpose and Need

The **purpose** of this project is to improve safety and mobility of traffic, especially freight traffic, to and from I-24 and Commerce Park.

In recent years Christian County and Hopkinsville have been successful in recruiting new industries to the Hopkinsville Industrial Park and the newly expanded Commerce Park, both on US 41 (Pembroke Road) northwest of Pembroke. According to 2016 data from the Kentucky Cabinet for Economic Development, larger industries in the Commerce Park include Martinrea, T. RAD North America, Continental Mills Inc., and PTC Seamless Tube Corporation, for a combined total of over 1,500 employees. Currently, the Commerce Park has 10 or more active industrial facilities and 766 acres available for industrial expansion. *The Hopkinsville – Christian County Comprehensive Plan (HCCCP) Draft Land Use Element* identifies the Pembroke industrial area as “accounting for a large percentage of (Hopkinsville’s) industrial land,” and calls for expanded industrial growth in the Pembroke area.

The **need** for the project is based on the following existing conditions and future plans:

- 1) Commerce Park is expanding.
- 2) KY 115 is a narrow, two-lane road assigned truck weight classification “A,” 44,000 pounds maximum allowable gross weight, on the Kentucky Highway Freight Network. KY 115 connects I-24 and US 41, both of which are classified “AAA,” 80,000 pounds maximum. Consequently, KY 115 experiences a high volume of heavy truck traffic it is not designed to accommodate.
- 3) The US 41/KY 115 intersection in Pembroke is skewed and has substandard turning radii, especially for large vehicles, as shown in **Figure ES 2**.



Figure ES 2: US 41/KY 115 Intersection Looking North

- 4) During off-peak times with no train disruptions, the average field-measured travel time for the most direct connection from Commerce Park to I-24 (Exit 89 at KY 115) is 12.7 minutes. The Christian County Travel Demand Model study corridor travel time is similar at 11.9 minutes. However, day-to-day predictability of travel time in the study corridor is inconsistent due to large farm equipment, semi-tractor trailers carrying agriculture

products, school buses, slow moving Amish buggies, and limited passing opportunities result in lower travel speeds, platooning.

- 5) CSX operated a railyard south of the Commerce Park until it was abruptly closed in May 2017. Prior to closure, the at-grade railroad crossing on KY 115 posed geometric challenges and travel time delays. In an observed 48-hour period, 51 trains crossed KY 115, blocking traffic from 1:51 to 15:23 minutes in peak hours. The average disruption was 3:43 minutes per train, with the maximum disruption lasting nearly 38 minutes (off-peak hours).
- 6) KY 115 bridge over Montgomery Branch (MP 9.910) is narrow, functionally obsolete, and a high-crash location.

Study goals are twofold: (1) where feasible improve traveling safety, to include Amish horse and buggy and large farm equipment; and (2) advance relevant HCCCP transportation elements that support continued growth for the area.

Development of Concepts

Community outreach helped guide the study, particularly in identifying potential issues and developing concepts. Over the course of the study, the project team held three project team meetings, two local officials/stakeholders meetings, and one public meeting.

While some concepts were removed from further consideration during the planning process, this document concludes by presenting and comparing information on a set of viable concepts to be carried forward—no prioritized recommendations are made.

Improvement concepts were developed within two corridors that meet the study's purpose and need. **Corridor 1** begins on KY 115 at I-24, heads north to Mason Lane (MP 10.000) and the intersection of KY 115 with US 41, then continues west along US 41 to Salubria Springs Road (MP 4.000) to the Commerce Park. **Corridor 2** also starts on KY 115 at I-24, heads north to near KY 1027, before transitioning northwest on a new connector between KY 115 and US 41 southwest of Pembroke, to US 41 turning northwest to end near the Commerce Park. Two long-term and two short-term improvement concepts are in Corridor 1, and three long-term concepts are in Corridor 2. The short-term concepts were developed as standalone, low cost spot improvements to geometric deficiencies at three high-crash spots. These locations are illustrated on **Figure ES 3** and described below:

Corridor 1 Concepts—Improve existing routes US 41 and KY 115 in the study area.

- ➡ **Concept A (Long-Term):** Improve/Widen US 41 from the KY 115 intersection westward to northwest of Salubria Springs Road near the Commerce Park.
- ➡ **Concept C (Long-term):** Improve/Widen KY 115 from near I-24 to near Mason Lane (north of the KY 115 bridge) in Pembroke. This project also includes replacing the KY 115 bridge over Montgomery Branch (**Spot Concept D**).

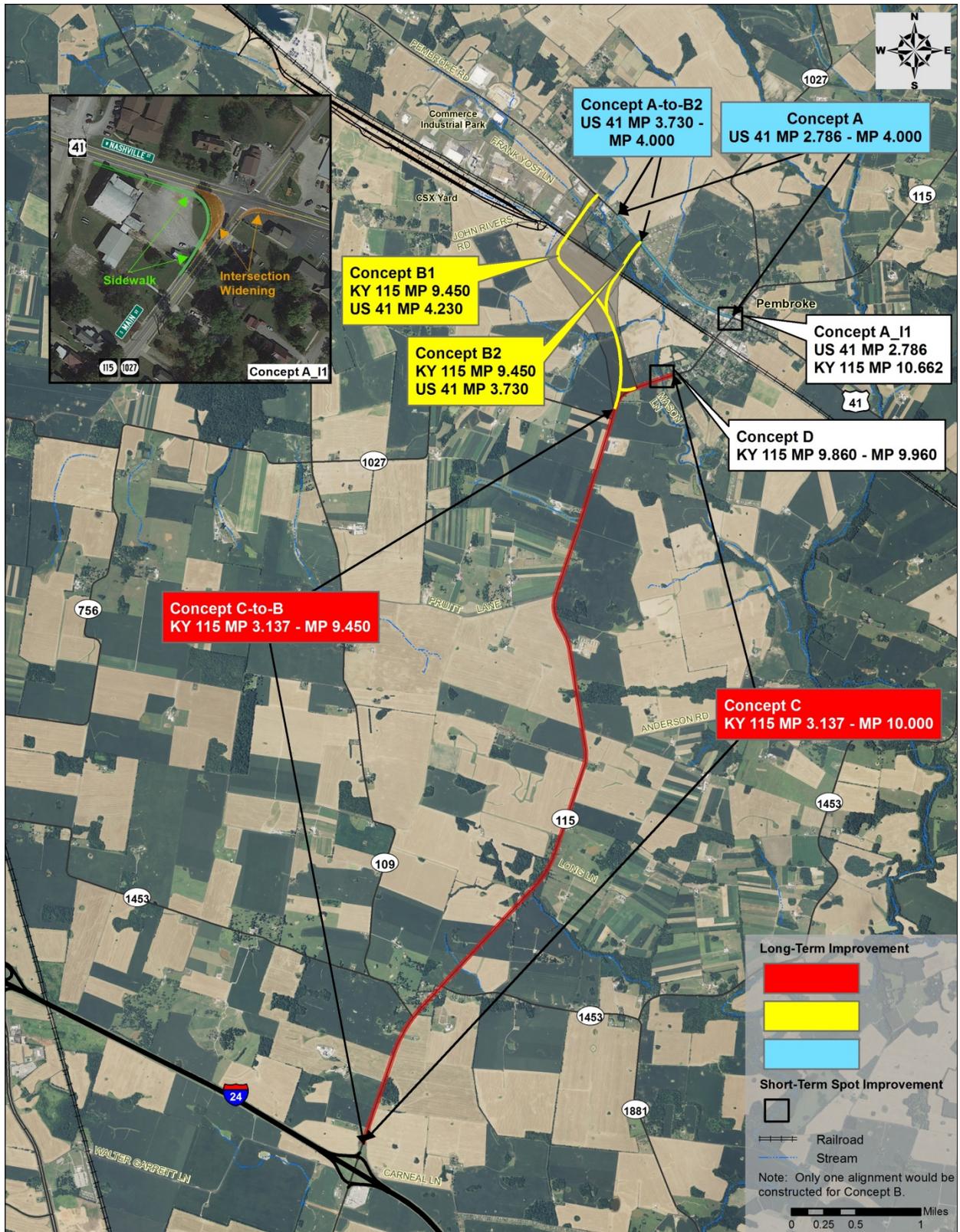


Figure ES 3: Final Improvement Concepts

Corridor 2 Concepts—Construct a new connector between KY 115 and US 41 northwest of Pembroke that bridges over the CSX railroad; and, to and from the connector improve/widen KY 115 from I-24 north and US 41 west to Salubria Springs Road near the Commerce Park.

- ➡ **Concept A-to-B2 (Long-term):** Improve/Widen US 41 as it approaches Pembroke Connector Concept B2.
- ➡ **Concept B (B1 or B2) (Long-term):** Construct US 41/KY 115 Pembroke Connector on new alignment.
- ➡ **Concept C-to-B (Long-term):** Improve/Widen KY 115 from near I-24 north to Pembroke Connector.

Spot Concepts—Construct standalone, low cost spot improvements at high-crash locations.

- ➡ **Concept A_I1 (Short-term):** Improve US 41/KY 115 intersection.
- ➡ **Concept D (Short-term):** Replace KY 115 bridge over Montgomery Branch.

Cost Estimates

Phased cost estimates for each improvement concept are shown in **Table ES 1**. Open Roads Concept Station was used to create 3D conceptual road and bridge models of each corridor concept. A five foot digital elevation model, derived from LiDAR collected as part of Kentucky's Aerial Photography and Elevation Data, was used as existing terrain. Conceptual design models generated quantities of high-cost construction items including earthwork, pavement, and structures. Construction costs were tabulated using the KYTC District 2 average unit bid prices. The KYTC District 2 assisted with right-of-way and utility cost estimates based on conceptual model disturb limits. Cost estimates for widening KY 115 (Concept C) are based on the best-fit alignment.

Table ES 1: Cost Estimates for Final Improvement Concepts

Type	Corridor	Improvement Concept (Description)	Length (miles)	Design	Right-of-Way	Utilities	Construction	Total	
				Dollars					
Long-Term	(1)	A (Widen US 41)	1.214	\$300,000	\$2,750,000	\$1,750,000	\$3,000,000	\$7,800,000	
		C (Widen KY 115 and Bridge Replacement)	6.863	\$1,500,000	\$2,500,000	\$4,250,000	\$14,900,000	\$23,150,000	
	(2)	A-to-B2 (Widen US 41 to Pembroke Connector B2)		0.270	\$70,000	\$600,000	\$400,000	\$630,000	\$1,700,000
		B (Pembroke Connector)	B1*	1.909	\$1,100,000	\$1,000,000	\$500,000	\$11,000,000	\$13,600,000
			B2*	1.365	\$900,000	\$500,000	\$500,000	\$8,500,000	\$10,400,000
		B1** (Shared-Use Path)		1.909	\$370,000	\$140,000	\$70,000	\$3,620,000	\$4,200,000
		B2** (Shared-Use Path)		1.365	\$260,000	\$70,000	\$70,000	\$2,600,000	\$3,000,000
		C-to-B (Widen KY 115 to Pembroke Connector)		6.313	\$1,400,000	\$2,300,000	\$3,900,000	\$13,400,000	\$21,000,000
Short-Term	Spot	A_11 (US 41/KY 115 Intersection)	0.100	\$25,000	\$100,000	\$150,000	\$100,000	\$375,000	
		D (KY 115 Bridge Replacement)	0.100	\$100,000	\$40,000	\$70,000	\$900,000	\$1,110,000	

* Does not include cost associated with optional Shared Use Path (SUP).

** Assumes widening bridge over railroad for SUP and not reducing bridge shoulders to accommodate.

1.0 INTRODUCTION

The Kentucky Transportation Cabinet (KYTC) initiated the Pembroke Corridor Study, KYTC Item Number 2-381.00, to analyze access and evaluate transportation improvement options, primarily for freight, from Interstate 24 (I-24) to the newly expanded Commerce Industrial Park (Commerce Park), along US 41 northwest of the city of Pembroke in Christian County. The study includes an examination of US 41 between Tinsley Drive (MP 2.535) in Pembroke and Krusteaz Way (MP 5.758) northwest of the Commerce Park; and KY 115 from Walter Garrett Lane (MP 2.663) south of the I-24 interchange to just north of US 41 (MP 10.662)—a combined distance of approximately 11.5 miles. **Figures 1 and 2** show the Pembroke Corridor study area context in Christian County and its location in Pembroke, respectively.

This planning study is not the first effort by the KYTC to address transportation needs in the area. The Pembroke Corridor Study is identified in Kentucky's Fiscal Year (FY) 2016–FY 2022 Highway Plan and on Project Identification Forms (PIFs) as three projects:

- **Item No. 2-381.00, PIF No. 02 024 C0000 9.00:** Construct a new connector from KY 115 south of Pembroke to US 41 near the industrial park (Commerce Park). Future phases identified as State Priority Project (SPP) funds are: 2019 design \$1.0 million, 2020 right-of-way \$300,000, 2021 utilities \$700,000 and 2022 construction \$12.0 million.
- **Item No. 2-8954.00, PIF No. 02 024 D0115 2.00:** Improve and widen KY 115 from I-24 to Anderson Road (MP 2.900–MP 6.870). Design has \$1.3 million of State Projects (SP) funds (not available) and is scheduled for 2022.
- **Item No. 2-8953.00, PIF No. 02 024 D0115 3.00:** Improve and widen KY 115 from Anderson Road to just south of Pembroke (MP 6.870–9.625). Design has \$1.0 million of State Project (SP) funds (not available) and is scheduled for 2021.

However, as a result of state spending exceeding revenues since FY 2014, KYTC has introduced the “Pause-50 Plan,” designed to slow or delay the start of new projects in order to pay current expenditures, recuperate lost revenue and rebuild KYTC's funding base. Item Number 2-381.00 currently has State Priority Project (SPP) funding and is delayed as a result of “Pause-50”. Item Numbers 2-8953.00 and 2-8954.00 currently have State Project (SP) funding. SP funding is unavailable in the current Highway Plan.

Five KYTC PIF projects are within or partially within the study area but not listed in the 2016 Highway Plan:

- **PIF No. 02 024 B0041 1.00:** Reduce congestion and improve access on US 41 from KY 115 at Pembroke to the five-lane section near John Rivers Road (MP 2.786–MP 4.400). Estimated total project cost is \$3.65 million.
- **PIF No. 02 024 B0041 1.10:** Reduce congestion on US 41 at KY 115 intersection in Pembroke (MP 2.786–MP 2.886). Estimated total project cost is \$2.0 million.
- **PIF No. 02 024 D0115 6.00:** Address safety and congestion issues at the KY 115/truck stop intersection near I-24 (MP 2.55–MP 2.75). Estimated total project cost is \$2.7 million.

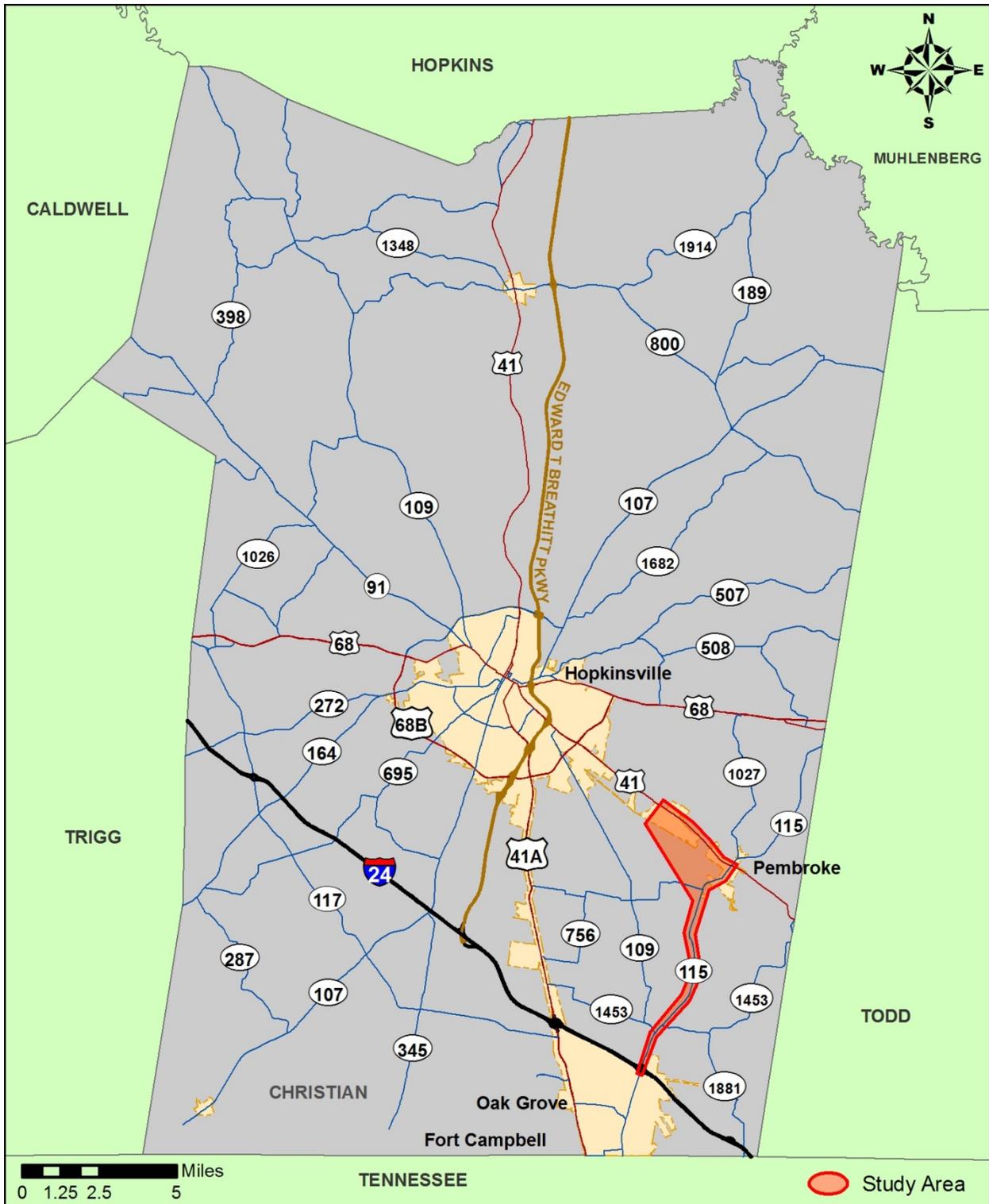


Figure 1: Study Area Location in Christian County

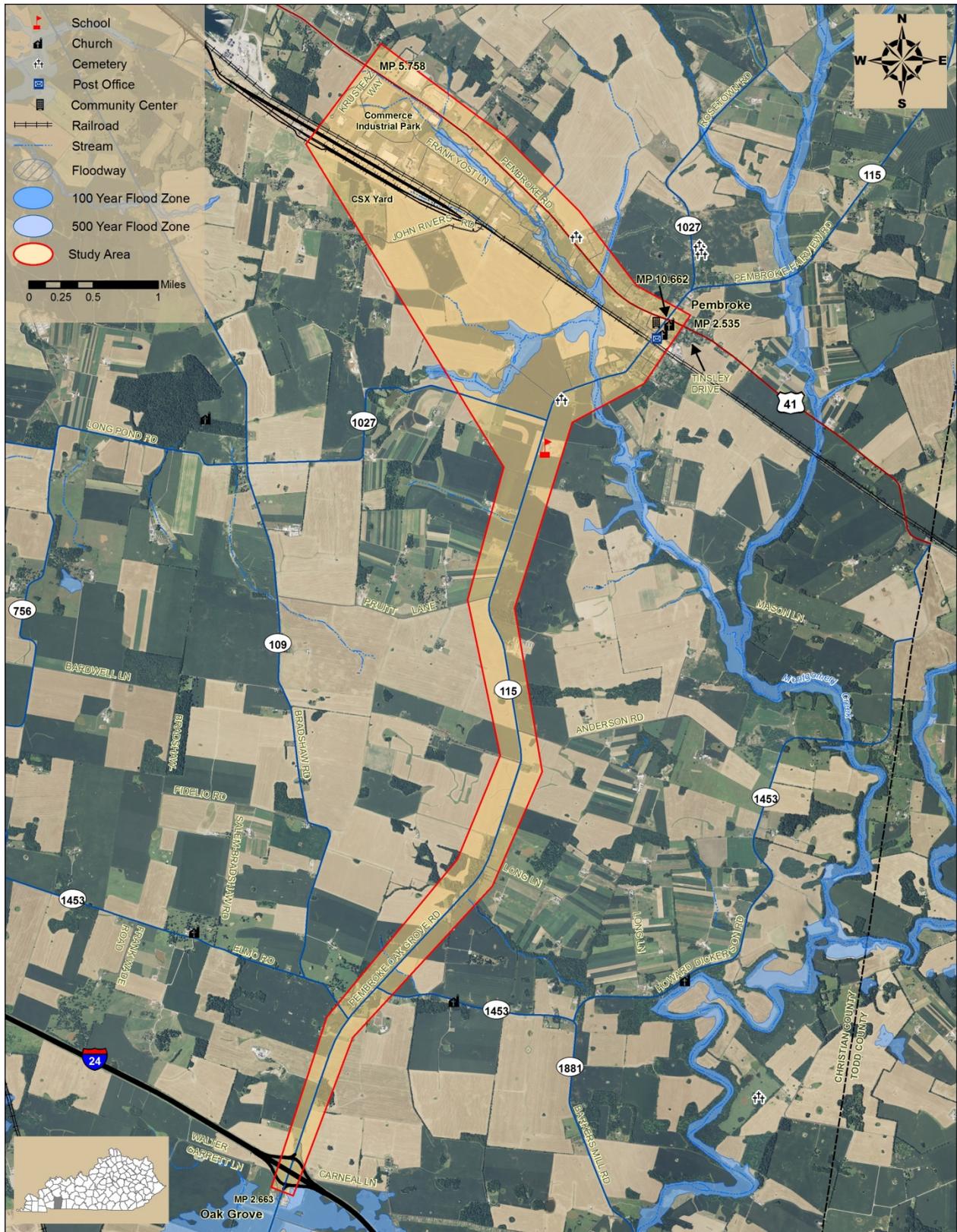


Figure 2: Study Area – Pembroke Corridor Study

- **PIF No. 02 024 D0115 4.00:** Reconstruct KY 115 from the proposed Pembroke Connector south of Pembroke to US 68 north of Pembroke (MP 9.625–MP 16.260). Estimated total project cost is \$19.3 million.
- **PIF No. 02 024 D1453 1.00:** Address congestion and safety concerns on KY 1453 from US 41A to KY 115 (MP 0.000–MP 3.689). Estimated total project cost is \$14.2 million.

The Kentucky 2016 Highway Plan and PIF projects are illustrated in **Figure 3**.

1.1 Study Area

The study area begins south of the I-24/KY 115 interchange at Walter Garrett Lane and continues north along KY 115 approximately 8.0 miles to the intersection of US 41. On US 41 it starts 700 feet southeast of the KY 115 intersection in Pembroke, and continues northwest approximately 3.5 miles to the Commerce Park at Krusteaz Way. A large wedge area is included southwest of Pembroke from the industrial park and CSX rail yard to south of Pembroke Elementary School on KY 115. This section includes the area needed to examine improvements associated with the proposed US 41/KY 115 Connector (Pembroke Connector), KYTC Item No. 2-381.00 and PIF 02 024 C0000 9.00.

The study area surrounding Pembroke is predominantly rural and agricultural, with an abundance of prime farmland. The primary location of industrial activity is along US 41 extending northwest toward Hopkinsville. This area includes industrial and commercial development intermixed with rural residential and agricultural land uses. KY 115 provides a south-north connection between industrial areas along I-24 and US 41. KY 115 also links the communities of Pembroke, Oak Grove, and Fort Campbell Military Installation.

1.2 Project History

As early as 1996, the Hopkinsville-Christian County Planning Commission identified a need for a new connector from US 41 at the industrial park to KY 115 south of Pembroke. This connector was referred to as “Pembroke Bypass.” The last project-specific KYTC *Statewide Transportation Plan (FY 1999–FY 2018)*¹, adopted December 1999 identified a long range plan for new routes. One of the new routes was identified as a New Connector from US 41 at Industrial Park approximately 1.0 mile west of Pembroke to KY 115 south of Pembroke (described as “Pembroke Bypass” by Hopkinsville-Christian County Planning Commission in June 1996). The project as a new route was approximately 2.5 miles long with an estimated total project cost of \$10.0 million.

¹ http://www.e-archives.ky.gov/pubs/transportation/statewide_plan_1999-2018.pdf

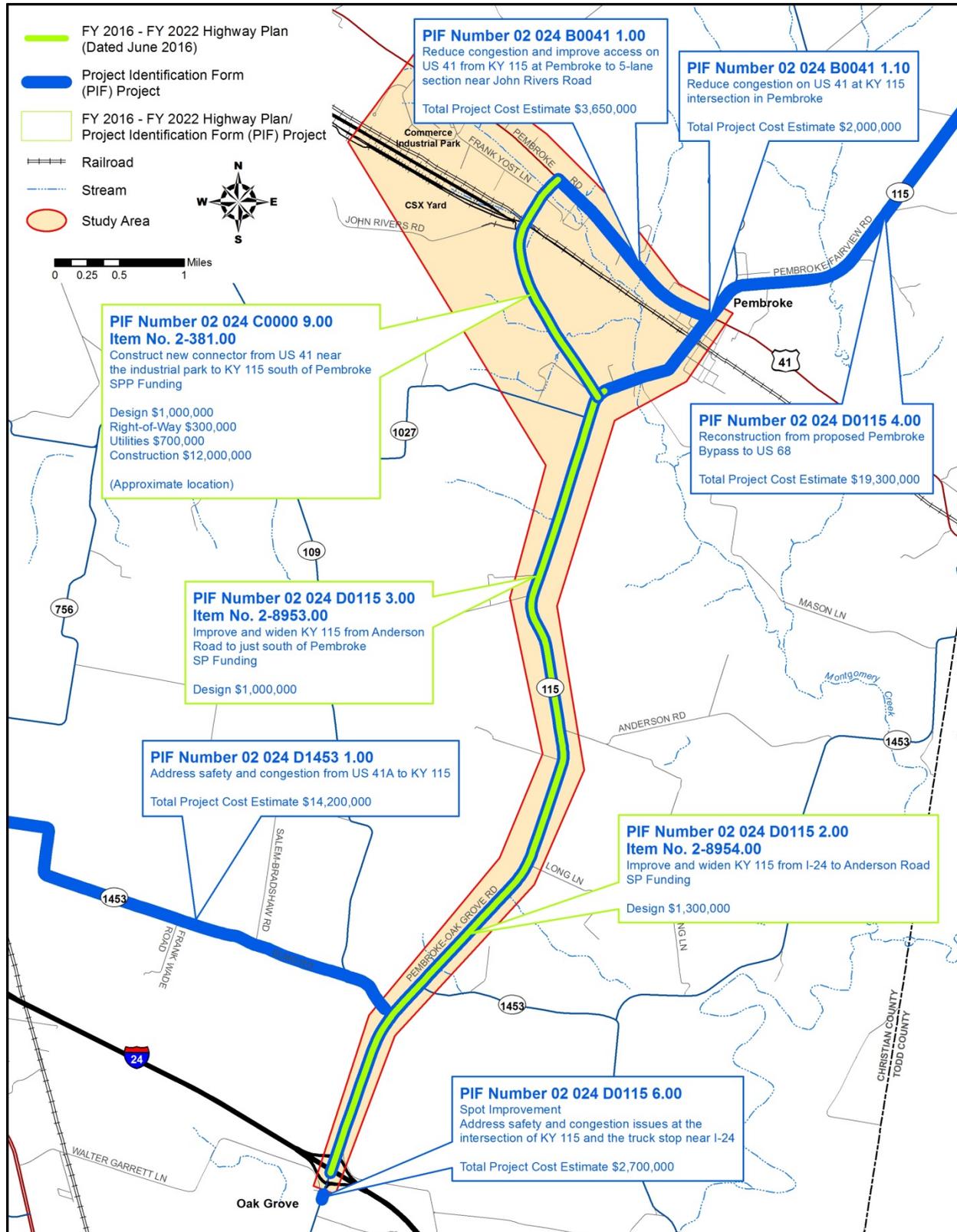


Figure 3: 2016-2022 Highway Plan and Project Identification Form (PIF) Projects

2.0 HOPKINSVILLE-CHRISTIAN COUNTY COMPREHENSIVE PLAN

The Hopkinsville City Council and Christian County Fiscal Court adopted the *Preliminary Draft Hopkinsville-Christian County Comprehensive Plan (HCCCP) Goals and Objectives* in 2013. The *Draft Land Use Element* was added to HCCCP in 2014, followed by the *Draft Transportation Element* in 2015, both of which address issues germane to this corridor study.

2.1 Draft Land Use Element

The *Draft Land Use Element* incorporates the HCCCP's land use goals and objectives. Land use ordinances, subdivision regulations, and growth initiatives rely on the land use element. In addition, the land use element assists in review of public facility placement, guides private land use decision-making, and delineates the community's growth policy.

The *Draft Land Use Element* includes 2012 land use maps depicted in **Figure 4**. As shown in the Commerce Park inset, most of the park's land use is heavy industrial (dark purple), while the majority of the study area surrounding Pembroke is primarily agricultural use (light green) or undeveloped. Land uses listed in the legend but not shown on the map are not included in the area

2.2 Draft Transportation Element

The *Draft Transportation Element* incorporates HCCCP's transportation goals and objectives, several of which are identified in the Pembroke Corridor Study purpose and need:

- A. *To improve access to I-24 in Christian County*
- B. *To examine improvements to facilitate movement of vehicles and reduce congestion*
- C. *To provide alternatives to reduce heavy freight traffic within congested areas [by] constructing a truck bypass route near Pembroke along US 41 and KY 115.*

Much of the information contained in the HCCCP is drawn from existing transportation and land use plans. These plans include the *Highway Plan*, the KYTC's *Unscheduled Needs List*, the *1998 Hopkinsville Metropolitan Area Long Range Transportation Plan*, and the *2013 Small Urban Area Study (2013 SUA)*. While study area projects identified in the *Highway Plan* are contained within the HCCCP, they were not listed as "priority projects." The 2013 SUA did not recommend any projects in the study area. PIF and *Highway Plan* projects identified in **Figure 3** are representative of the projects in the draft comprehensive plan.

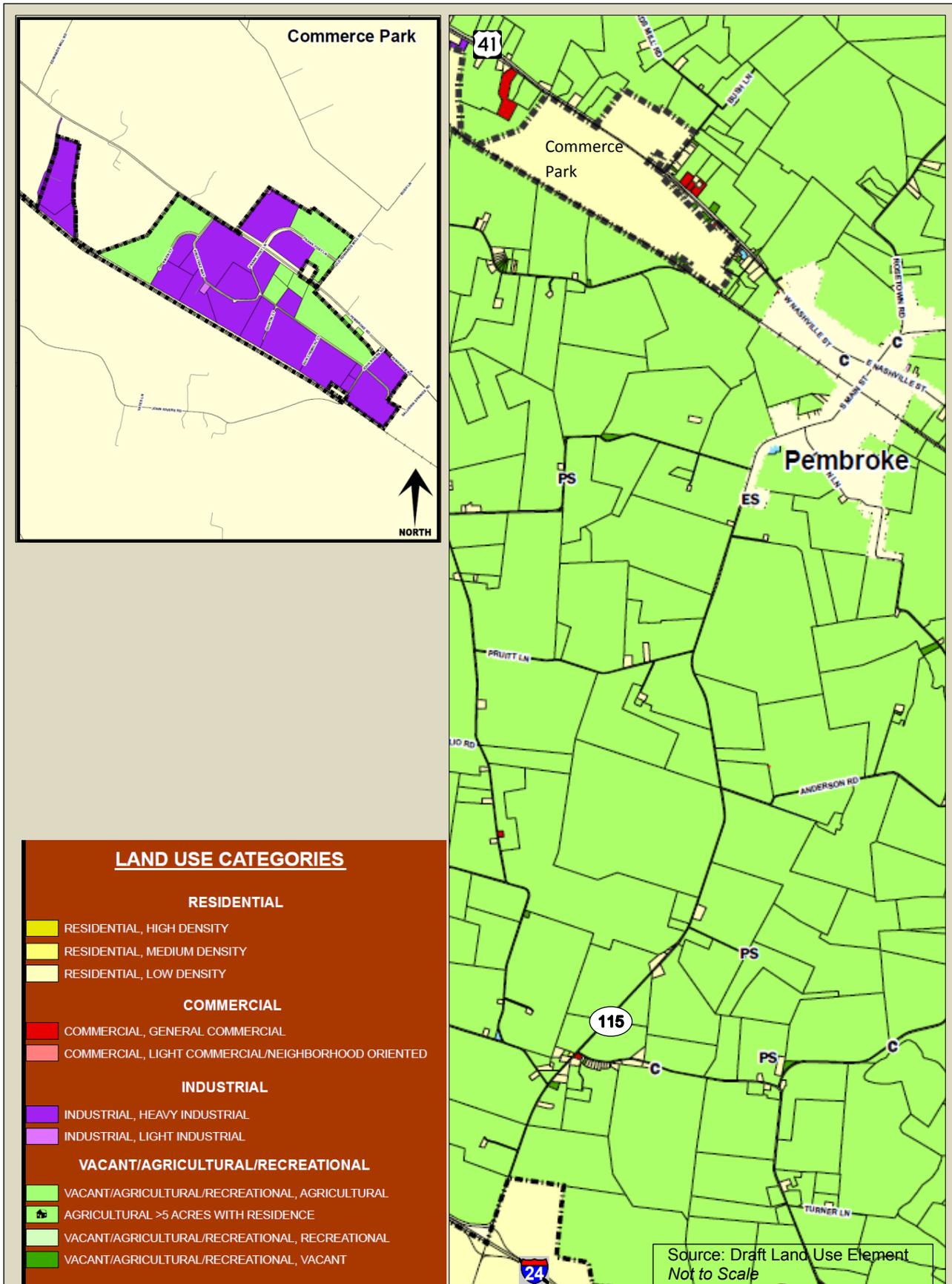


Figure 4: Commerce Park and Study Area – Existing Land Use Map 2012

3.0 EXISTING CONDITIONS

Existing conditions related to mobility and physical characteristics of the corridor are described in the following sections: Roadway Characteristics, Roadway Geometrics, Structures, CSX trains, Bicycle and Pedestrian Accommodations, Transit, Known Utilities and Crash History.

3.1 Roadway Characteristics

Roadway characteristics were obtained from the KYTC's Highway Information System (HIS) database, existing plans, and field reviews. Characteristics of US 41 and KY 115 including functional classifications, posted speed limits, and truck routes, are listed in **Table 1**.

3.1.1 US 41

US 41 (Pembroke Road) is functionally classified as a Minor Arterial with a speed limit of 35 miles per hour (mph) within the city limits transitioning to 55 mph from MP 3.160 to MP 3.344 near Walnut Street. A flashing signal is located at the intersection of KY 115. No traffic signals or stop signs are along US 41 in the study area. Average annual daily traffic (AADT) volumes on US 41 in 2016 were between 2,200 and 9,050 vehicles per day (vpd). US 41 is listed on the Kentucky Highway Freight Network (Tier 3) and has a truck weight class of "AAA" signifying a maximum gross truck weight of 80,000 pounds. The average annual daily truck (AADT) percentages on US 41 ranged from 11.6 mid-corridor to 21.5 east of the KY 115 intersection. **Figures 5-8** show existing conditions along US 41.



Figure 5: US 41 Looking South near John Rivers Road



Figure 6: US 41 looking South near Culvert



Figure 7: US 41 Looking North near Walnut Street



Figure 8: US 41 Looking North at KY 115

Table 1: Existing Roadway Characteristics

Route	Beginning Milepoint	Beginning Feature	Ending Milepoint	Ending Feature	Length (miles)	Federal Functional Classification	ADT (year)	Truck %	Speed Limit (mph)	Number of Lanes	Lane Width (feet)	Shoulder Width (feet) and Type
US 41	2.535	Tinsley Drive	2.786	KY 115	0.251	Minor Arterial	2200 (2014)	21.5	35	2	10	4 Combination
	2.786	KY 115	3.006	Walnut St.	1.239		6150 (2016)	11.6				
	3.006	Walnut St.	4.025	Salubria Springs Rd.					0.355	55	2*	
	4.025	Salubria Springs Rd.	4.173	Salubria Springs Rd.	0.584		12	10 Paved				
	4.173	Salubria Springs Rd.	4.380	Lanes Change					0.794	9050 (2016)	13.2	
	4.380	Lanes Change	4.396	John Rivers Rd.	0.584		12	10 Paved				
	4.396	John Rivers Rd.	4.964	Old Edwards Mill Rd.					0.794	9050 (2016)	13.2	
	4.964	Old Edwards Mill Rd.	5.397	Frank Yost Ln.	0.794		9050 (2016)	13.2				
5.397	Frank Yost Ln.	5.758	Krusteaz Way	0.794		9050 (2016)			13.2			
KY 115	2.663	Walter Garrett Ln.	2.800		I-24 EB Ramps		0.238	Minor Arterial		6200 (2013)	8.4	45
	2.800	I-24 EB Ramps	2.877	I-24 Overpass								
	2.877	I-24 Overpass	2.901	Urban/Rural Boundary								
	2.901	Urban/Rural Boundary	3.000	I-24 WB Ramps	0.236	Major Collector	3580 (2016)	7.8	55	2	9 Paved	
	3.000	I-24 WB Ramps	3.137	Carneal Ln.								
	3.137	Carneal Ln.	4.173	KY 109	1.036	5.202	2390 (2016)	10.7	55	9	4 Combination	
	4.173	KY 109	4.515	KY 1453								
	4.515	KY 1453	5.778	Long Ln.	0.554	Major Collector	2730 (2016)	11.2	35	11	6 Combination	
	5.778	Long Ln.	9.375	KY 1027								
	9.375	KY 1027	9.805	Speed Limit Change	0.594	Major Collector	2730 (2016)	11.2	25	11	3 Stabilized	
	9.907	Speed Limit Change	9.929	Mason Ln.								
	9.929	Mason Ln.	10.443	Railroad Crossing	0.594	Major Collector	2730 (2016)	11.2	25	11	0 Curbed	
	10.443	Railroad Crossing	10.465	Maple St.								
	10.465	Maple St.	10.523	East Cherry St./West Cherry St.	0.139	Major Collector	2730 (2016)	11.2	25	15	4 Stabilized	
	10.523	East Cherry St./West Cherry St.	10.581	Shoulder Change								
10.581	Shoulder Change	10.662	US 41	0.293	Minor Collector	1940 (2016)	5.8	35	9	4 Stabilized		
10.662	US 41	10.955	KY 1027									

* Includes a 14-foot Middle Continuous Left-Turn Lane.

3.1.2 KY 115



Figure 9: KY 115 Looking South approaching I-24



Figure 10: KY 115 Looking South from Pembroke Elementary School



Figure 11: KY 115 Looking North toward Bridge



Figure 12: KY 115 Looking South in Pembroke

From I-24 north to US 41, KY 115 is a two-lane road functionally classified as a Major Collector (Rural). The posted speed limit near I-24 is 45 mph and transitions to 55 mph near Carneal Lane. Between KY 1027 and Mason Lane, the speed limit reduces to 45 mph. Near Mason Lane it reduces to 35 mph until Hopson Street. From that point through the downtown area to US 41, the speed limit lowers to 25 mph.

The 2013 ADT on KY 115 was 6,200 vpd, in the vicinity of I-24, 2,390 vpd approaching Pembroke, and 2,730 vpd in Pembroke. Truck traffic percentages ranged from 7.8 to 11.2%.

KY 115 is on the Kentucky Freight Network (Tier 3) and has a truck weight class of “A” signifying a maximum gross truck weight of 44,000 pounds.

Figures 9 through 12 show existing conditions along KY 115, including no passing and passing zones, the narrow bridge over Montgomery Branch at MP 9.910, and Amish horse and buggy on KY 115 in Pembroke.

3.2 Roadway Geometrics

3.2.1 US 41

Roadway plans for US 41 were reviewed to identify substandard conditions in the study area. The AASHTO Green Book² recommends a minimum traveled way width of 24 feet or two 12-foot lanes on arterial and collector roadways with an ADT over 2,000 vpd (Green Book Table 6-5 and 7-3). On roadways to be reconstructed, such as US 41 and KY 115, an existing 22-foot traveled way may be retained where the alignment is satisfactory and no crash pattern suggests the need for widening.

Within the study area limits, US 41 transitions east to west from two, to three, to five lanes:

- Tinsley Drive at the eastern study area limit, through the KY 115 intersection, west to Salubria Springs Road: two 10-foot lanes, which is less than the recommended lane widths in the Green Book.
- Salubria Springs Road eastern intersection to John Rivers Road: two 12-foot lanes and one 14-foot, two-way left-turn lane (TWLTL).
- John Rivers Road, east of Commerce Park entrance, west to Krusteaz Way: four 12-foot lanes and one 14-foot, two-way left-turn lane (TWLTL).

Shoulders are 10 feet wide and paved along the three-lane and five-lane sections; and four feet wide, two feet of which is paved, along the two-lane section.

US 41 horizontal curves are less than 3.4 degrees. Approaching KY 115, the vertical alignment has grades less than or equal to 2.4%; however, a field review identified three locations along US 41 with sight distance³ issues:

- Westbound at US 41/KY 115 intersection (MP 2.786)
- Near Minute Mart (MP 2.850) (**Figure 13**)
- North of Walnut Street (MP 3.050)



Figure 13: US 41 North near Minute Mart at MP 2.850

Per HIS, 50% to 74% of the two-lane and three-lane sections of US 41 have no passing.

² American Association of State Highway and Transportation Officials (AASHTO)—*A Policy on Geometric Design of Highways and Streets*, 2011 Sixth Edition, commonly referred to as “Green Book.” The book contains current design research and practices for highway and street geometric design.

³ Sight distance is the length of roadway ahead visible to the driver. The available sight distance should be sufficiently long to enable a vehicle traveling at or a near the design speed to stop before reaching a stationary object in its path.

3.2.2 KY 115

As-built record drawings were not available for KY 115; therefore, field reviews were conducted and supplemented with HIS information to assess roadway geometrics.

Through the I-24 interchange to Carneal Lane, KY 115 lanes are 11 feet wide and shoulders are nine feet wide and paved. From Carneal Lane north to near Mason Lane in Pembroke, HIS lists lane widths as nine feet and “combination (paved/graded) shoulder” widths as four to six feet, for a total roadway width of 26 to 30 feet. During field reviews, total paved traveled way width was recorded as 20 to 21 feet. Lack of striping to delineate shoulders necessitated approximating a roadway having nine-foot paved lanes, one- to one-and-a-half-foot paved shoulders, and one- to two-foot graded shoulders in most locations, for a total roadway width of 22 to 25 feet. Note, in some gently sloped locations graded/grass shoulder widths were found to be five feet, while in other spots along the corridor there were no graded/grass shoulders, primarily due to steep drop-offs at the edge of pavement.



Figure 14: Horizontal Curve on KY 115 at MP 9.55 near Rosedale Cemetery

Horizontally, KY 115 appears to meet minimum design criteria with the exception of three curves. One sweeping curve at Rosedale Cemetery (MP 9.55) (**Figure 14**) has approximately the minimum required radius of 960 feet, assuming 8.0% superelevation. Two additional curves have sight distance issues near MP 8.0 at Pruitt Lane.

Eight vertical curve locations where sight distance may be a problem were identified through a field review. Locations are listed in **Table 2**. According to HIS, 50% to 74% of KY 115 has no passing.

Table 2: KY 115 Vertical Sight Distance Issues

MP	Location Description
4.320	Between KY 109 and KY 1453
4.540	North of KY 1453
5.500	South of Long Lane
7.000	North of Anderson Road
7.310	Midway between Anderson Road and Pruitt Lane
7.390	Midway between Anderson Road and Pruitt Lane
8.400	Between Pruitt Lane and KY 1027 (Long Pond Road)
8.420	Midway between Anderson Road and Pruitt Lane

For both US 41 and KY 115, lane and shoulder widths are indicated in **Figure 15** and **Figure 16**, respectively; grades, and horizontal and vertical curves are displayed in **Figure 17**; and percent no-passing locations are in **Figure 18**. Note, the referenced 75% no passing is the roadway section in Pembroke.



Figure 16: Shoulder Widths

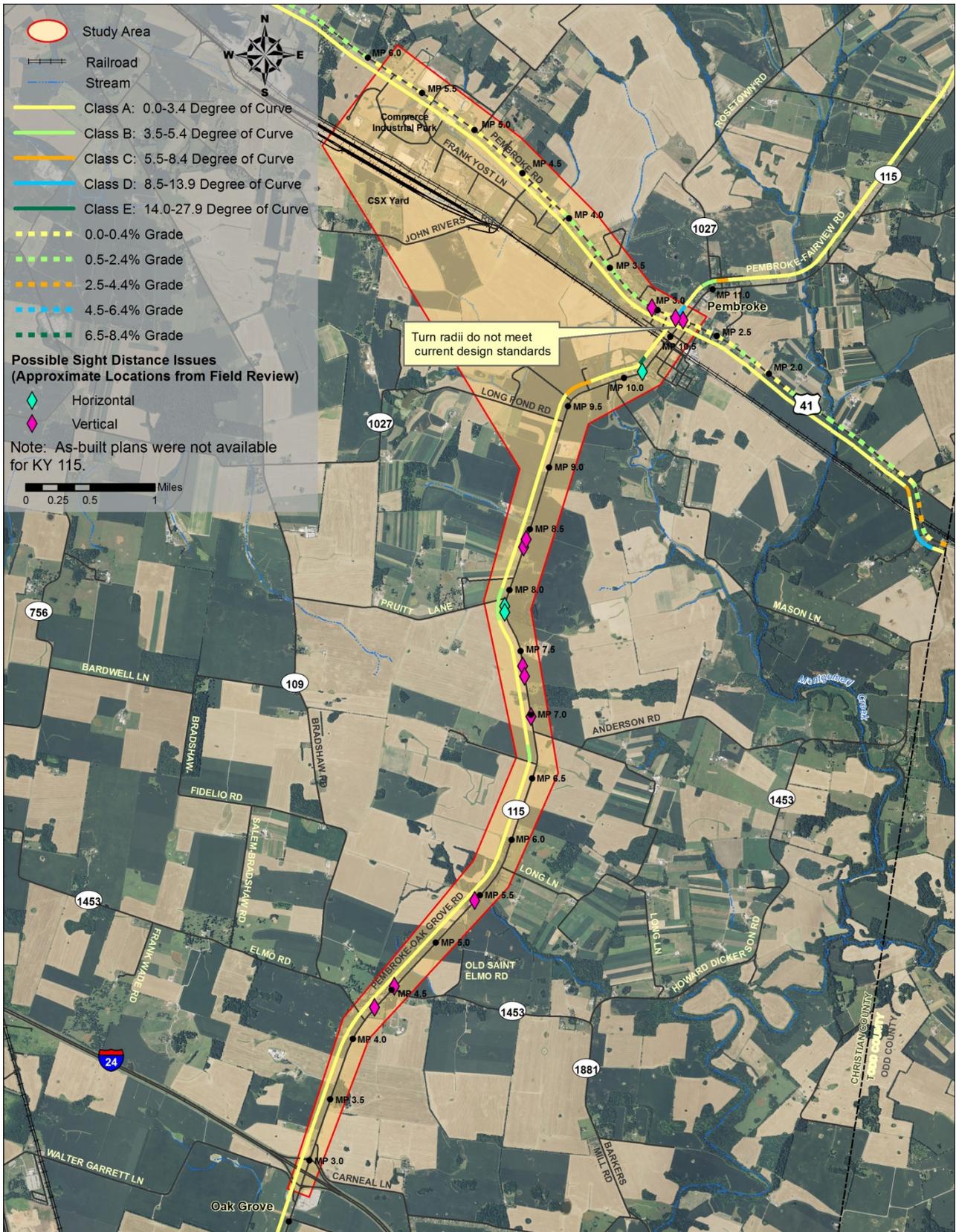


Figure 17: Roadway Geometrics

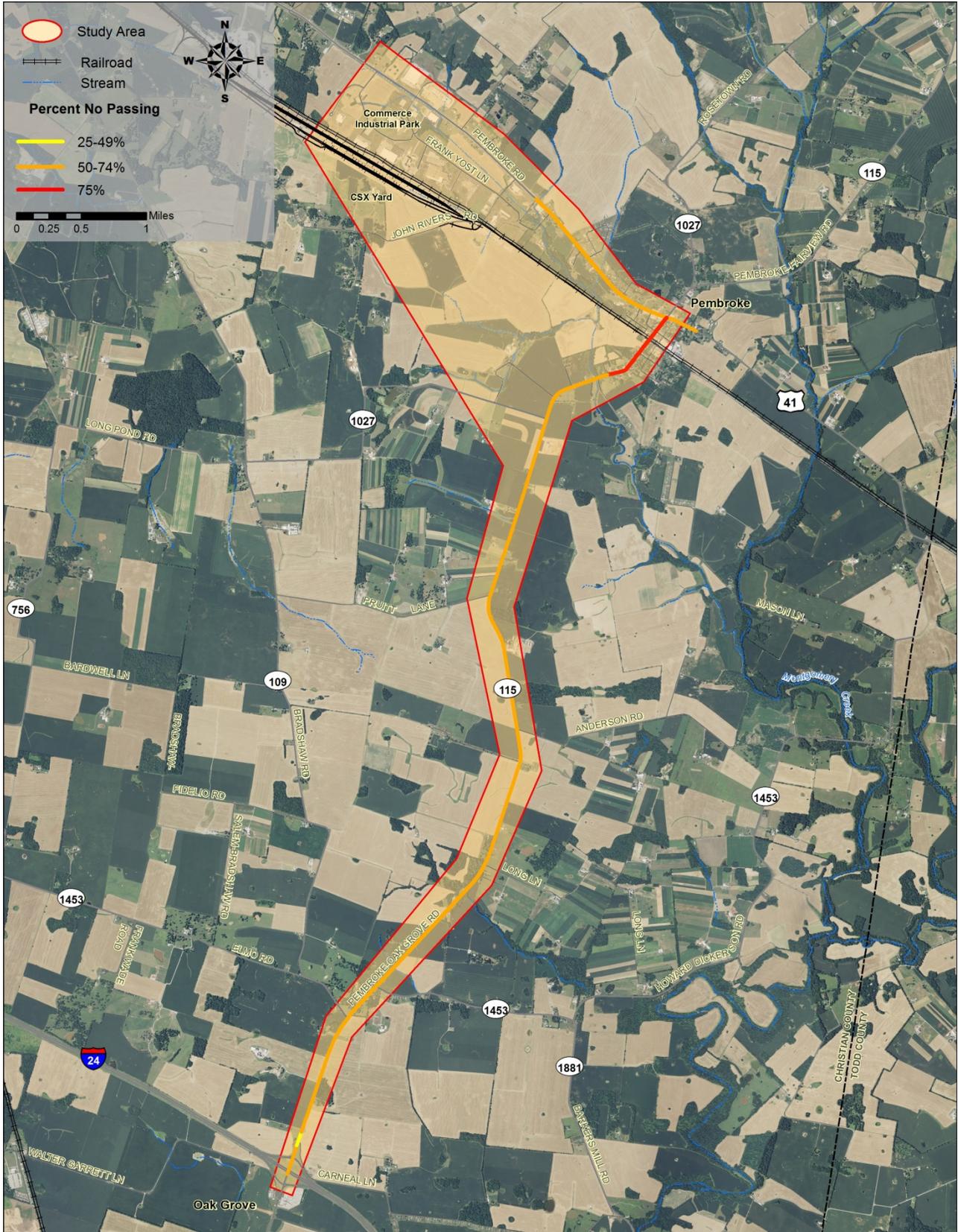


Figure 18: Percent No Passing

3.2.3 US 41 / KY 115 Intersection

The US 41/KY 115 intersection is skewed with turning radii of 50 feet, which can impair the



Figure 19: US 41/KY 115 Intersection

ability of large trucks to negotiate turning movements. **Figure 19** shows a semi-tractor trailer blocking the northbound lane and facing oncoming traffic while completing a right turn from US 41 to KY 115.

The original stop bar in **Figure 20**, has been replaced by one closer to US 41 to improve sight distance at the intersection. Vehicles at the closer stop bar conflict with semi-tractor trailers that must swing wide to make right turns.



Figure 20: KY 115 North Approaching US 41/KY 115 Intersection

Visible in **Figure 21** is the degraded condition of the sidewalk and water main cover damaged by large trucks negotiating the turn. The other three right-turn movements at this intersection have the same issue; however, the eastbound-to-southbound movement is most problematic due to the high volume of right-turning vehicles: 74 in the AM and 96 in the PM peak hours.



Figure 21: US 41/KY 115 Intersection Sidewalk and Close-up of Damaged Water Main Cover

3.3 Structures

The study area has four structures: two culverts along US 41 (MP 3.420 and MP 4.150) and two bridges along KY 115 (MP 2.900 and MP 9.910).

In accordance with federal standards, bridges are inspected every two years to evaluate their conditions and other elements. A sufficiency rating—a numeric score from 0 to 100 describing the sufficiency of the bridge to remain in service—is calculated during each inspection. The higher the sufficiency rating a bridge has, the better the condition of the bridge. A bridge considered functionally obsolete indicates the bridge has older features not meeting today’s design standards. For example, a functionally obsolete bridge may not be wide enough or tall enough to accommodate current vehicle sizes, weights, and traffic volumes.

Bridges are considered structurally deficient if significant load carrying elements are found to be in poor condition due to deterioration and/or damage, or the adequacy of the waterway opening provided by the bridge is determined to be extremely insufficient to the point of causing overtopping with intolerable traffic interruptions. Bridges considered structurally deficient or functionally obsolete with a sufficiency rating of less than 50.0 are regularly considered for funding to replace or rehabilitate. Those with a sufficiency rating of 80.0 or less are regularly considered for funding to rehabilitate.

Built in 1935, the KY 115 bridge at MP 9.910, is a narrow, two-lane structure in a high-crash spot. Narrow width—20 feet curb to curb—causes conflicts when opposing vehicles, such as a semi-tractor trailer and a car, attempt to cross the bridges simultaneously. This bridge is not considered structurally deficient, but is rated functionally obsolete and has a sufficiency rating of 65.8. **Figure 22** shows a large truck in relation to the narrow bridge. Culverts on KY 41 and the KY 115 bridge at MP 2.900 meet current design standards, as **Table 3** indicates. Structure locations are illustrated in **Figure 23**.



Figure 22: KY 115 Functionally Obsolete Bridge at MP 9.910

Table 3: Structure Inventory

Bridge No.	024B00131N	024B00026N	024B00025N	024B00024N
Route	KY 115	KY 115	US 41	US 41
MP	2.900	9.910	3.420	4.150
Features Intersected	I-24	Spring Creek (Montgomery Branch)	Swamp Slough	Swamp Slough
Location	1 mile south of Jct. of KY 109	0.80 mile south of Jct. of US 41	0.60 mile northwest of Jct. KY 115	1.3 mile northwest of Jct. KY 115
Year Built	1974	1935	1942	1942 Reconstructed 2007
Description	2-span Steel Continuous Stringer/Girder	2-Span Concrete T Beam	2-Span Concrete Culvert	2-Span Concrete Culvert
Length (feet)	250.00	56.10	29.00	21.00
Width from Curb to Curb (feet)	33.79	20.00	38.71	0.00
Sufficiency Rating	91.0	65.8	85.1	86.7
Structurally Deficient	No	No	No	No
Functionally Obsolete	No	Yes	No	No

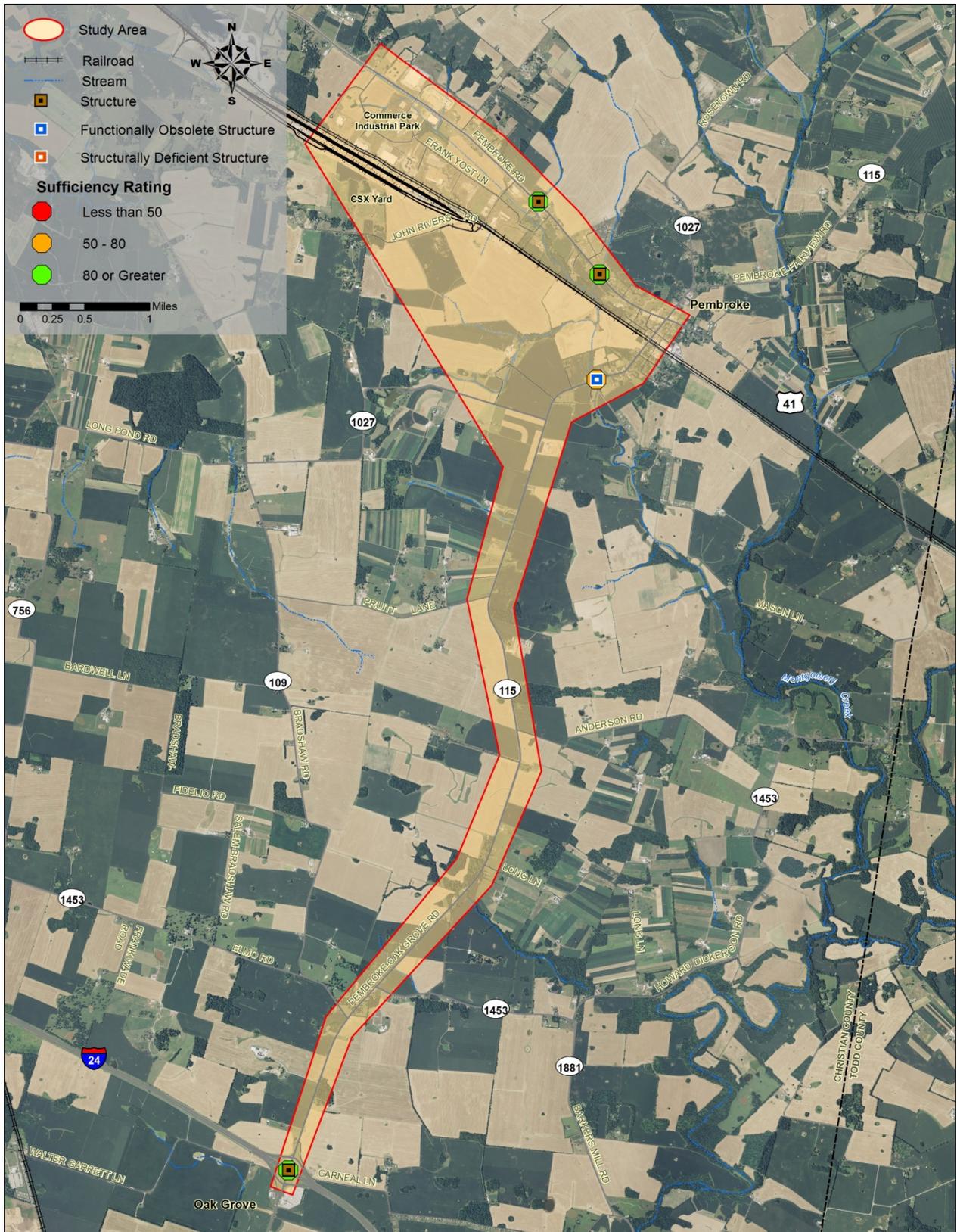


Figure 23: Structures

3.4 CSX Trains

CSX opened a 280-acre Casky Rail Yard in 2015 at 6512 John Rivers Road south of Commerce Park. The facility was closed May 31, 2017. When the facility was open, CSX staged trains for inspection, safety checks, and fueling. Trains still operate over the mainline and the tracks and equipment in the yard remain in place. As of this study, future use of the rail yard is not known.

At the KY 115 (Main Street) train crossing (**Figure 24**) in Pembroke, 51 trains were counted over a 48-hour period (**Table 4**) during September 2016. Average disruption to KY 115 during observed hours was almost four minutes, with maximum disruption being nearly 38 minutes. The local fire chief stated the train yard contributed to traffic delays because trains exited the yard slowly and accelerated slowly through the intersection. Trains had been known to block the intersection for 45 minutes at a time.

Closure of the yard is assumed to have alleviated much of the lengthy, train-caused delays cited by local officials/stakeholders and the public; however, occasional delays at the crossing remain a consideration in the analysis of traffic on KY 115.

Table 4: Train Crossing Statistics

Hours Observed	48
Train Crossings	51 (25/day)
AM Peak Period Crossings 7-9	5
PM Peak Period Crossings 3-6	10
Average Disruption (minutes)	3:43
Maximum Disruption (minutes)	37:51
AM Peak Period Average Disruption (minutes)	4:58
PM Peak Period Average Disruption (minutes)	5:49
Peak Period Minimum Disruption (minutes)	1:51
Peak Period Maximum Disruption (minutes)	15:23
All - 85th percentile	7:44



Figure 24: KY 115/CSX Crossing

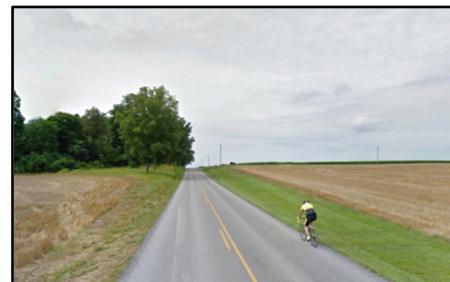


Figure 25: Bicyclist along KY 115

3.5 Bicycle Accommodations

No local bicycle master plan exists for the project area. Currently, no separate bicycle accommodations exist along US 41 or KY 115 (**Figure 25**). However, the Mayor of Pembroke has requested bicycle use facilities be considered with future planning and construction in this area. A Strava global heat map⁴ for current bicycle activity shows a moderate to high use for on-road bicycling in the area. Heavier orange lines show routes most frequently used such as KY 115 through Pembroke to Long Pond Road (**Figure 26**).

⁴ Strava is a data service locating where people ride and run. Millions of GPS-tracked activities are uploaded to Strava every week from around the globe. These activities create billions of data points that, when aggregated, enable deep analysis and understanding of real-world cycling and pedestrian route preferences. Strava users track their rides and runs with a smartphone or with a GPS device.

A KYTC review of bicycle accommodations, using a Bicycle Comfort Index (BCI)⁵ (**Appendix A**) shows US 41 rates “D” on a grading scale from “A” to “F,” which indicates US 41’s compatibility with bicycling is “moderately low.” KY 115 and a Pembroke Connector rate “C.”

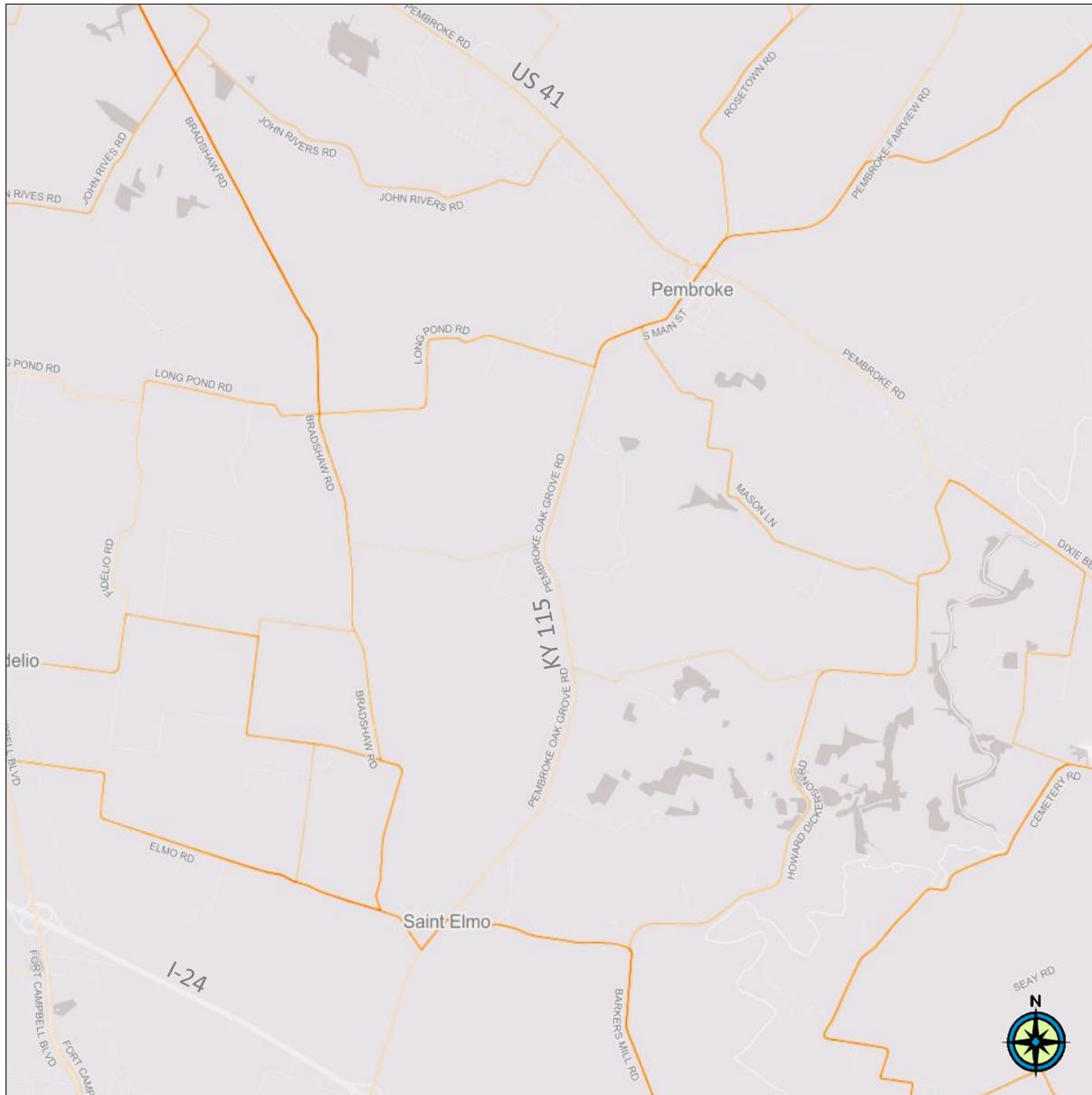


Figure 26: Strava Heat Map - Bicycle Activity

⁵ <http://transportation.ky.gov/Bike-Walk/Documents/Bicyclists%20Comfort%20Index.pdf>

3.6 Pedestrian Accommodations

Sidewalks are located in Pembroke along US 41 between Walnut Street and east of Tinsley Drive (east of the study area); along KY 115 (Main Street) from US 41 south to the railroad crossing; and between the railroad crossing and Mason Lane. Existing sidewalks are illustrated with black lines on **Figure 27**. Strava global heat map for running shows no activity. KYTC's *Pedestrian & Bicycle Consideration Review* is in **Appendix A**.

The KYTC and City of Pembroke have initiated a Local Public Agency (LPA) project to improve/add new sidewalk at the Community Center and park in the southwest quadrant of the US 41/KY 115 intersection. The project includes new sidewalk along approximately 800 feet of KY 115 (South Main Street) from US 41 to south of the park property.



Figure 27: Existing Sidewalks

3.7 Transit

Hopkinsville Transit, operated and administered by Pennyriple Allied Community Services (PACS), provides bus service to and from Commerce Park on the transit's "Red Route" along US 41, making four stops: TRAD/Siemer Milling, Martinrea, and the intersections of Frank Yost Lane and John Rivers Road. Transit service is not provided into Pembroke or along KY 115.

3.8 Known Utilities

Known utilities along US 41 and KY 115 include sanitary sewer services and public drinking water in incorporated areas of Hopkinsville and Pembroke, which are served by Hopkinsville Water Environment Authority. Electric service is provided by Pennyriple Rural Electric Cooperative. From KY 115 west along the north side of US 41 is a three-phase overhead electrical line. From just east of KY 115 and east through the study area, the electrical line is along the south side of US 41. Through Pembroke, overhead utilities are on the west side of and adjacent to KY 115. Between Pembroke and I-24, they switch from the east and west sides at various locations.

3.9 Crash History

Kentucky State Police traffic collision data were collected and analyzed for the five-year period between April 1, 2011 and March 31, 2016 (**Appendix B**). During the review period, 37 crashes were reported on US 41 between MP 2.5 and MP 5.8, and 142 crashes on KY 115 between MP 2.6 and MP 10.7. **Table 5** compares collected crash data with statewide averages⁶. Where comparisons could be made between the two roadways and the statewide average, the percent

⁶ http://transportation.ky.gov/Highway-Safety/Documents/2014_KY_Traffic_Collision_Facts.pdf

of crashes reported on either/both US 41 and KY 115 was higher than the statewide average in all but two categories—rear end and property damage only.

Table 5: US 41 and KY 115 Crashes

Percent of Crashes:	US 41 MP 2.5-5.8	KY 115 MP 2.6-10.7	Statewide Average
Single Vehicle	46.0%	51.4%	39.6%
Angle	40.5%	12.0%	17.4%
Sideswipe	2.7%	18.3%	11.3%
Rear End	8.1%	11.3%	22.8%
Opposing Left Turn	0.0%	3.5%	Not Shown
Backing Up	2.7%	2.8%	2.5%
Fatality	2.7%	1.4%	0.5%
Injury, Not Including Fatality	24.3%	28.0%	18.0%
Property Damage Only	73.0%	70.6%	81.5%
Involving Semi-Truck	10.8%	17.5%	4.1%
Occurring On Horizontal Curve	2.7%	24.5%	20.1%
Occurring In Darkness	37.8%	43.4%	29.4%
Occurring On Wet Roads	32.4%	24.5%	25.5%

3.9.1 Crash History by Crash Type

The location of crashes by type—fatality, injury, and property damage only (PDO) are shown on **Figure 28**. The percentages of fatal and injury crashes along US 41 and KY 115 were higher than the statewide averages. During the five-year period, three single-vehicle fatal crashes were reported: one on US 41 and two on KY 115. The following describes each fatal crash.

- 1) **US 41, MP 3.089:** A single vehicle, traveling south in a curve under dry conditions, veered from the southwest side of US 41, struck a mailbox, and overturned. Falling asleep, overcorrecting, and drug use were cited as contributing human factors.
- 2) **KY 115, MP 5.595:** A single vehicle, traveling north along a straight section of KY 115 under dry conditions, dropped off the right pavement edge, struck a driveway culvert,

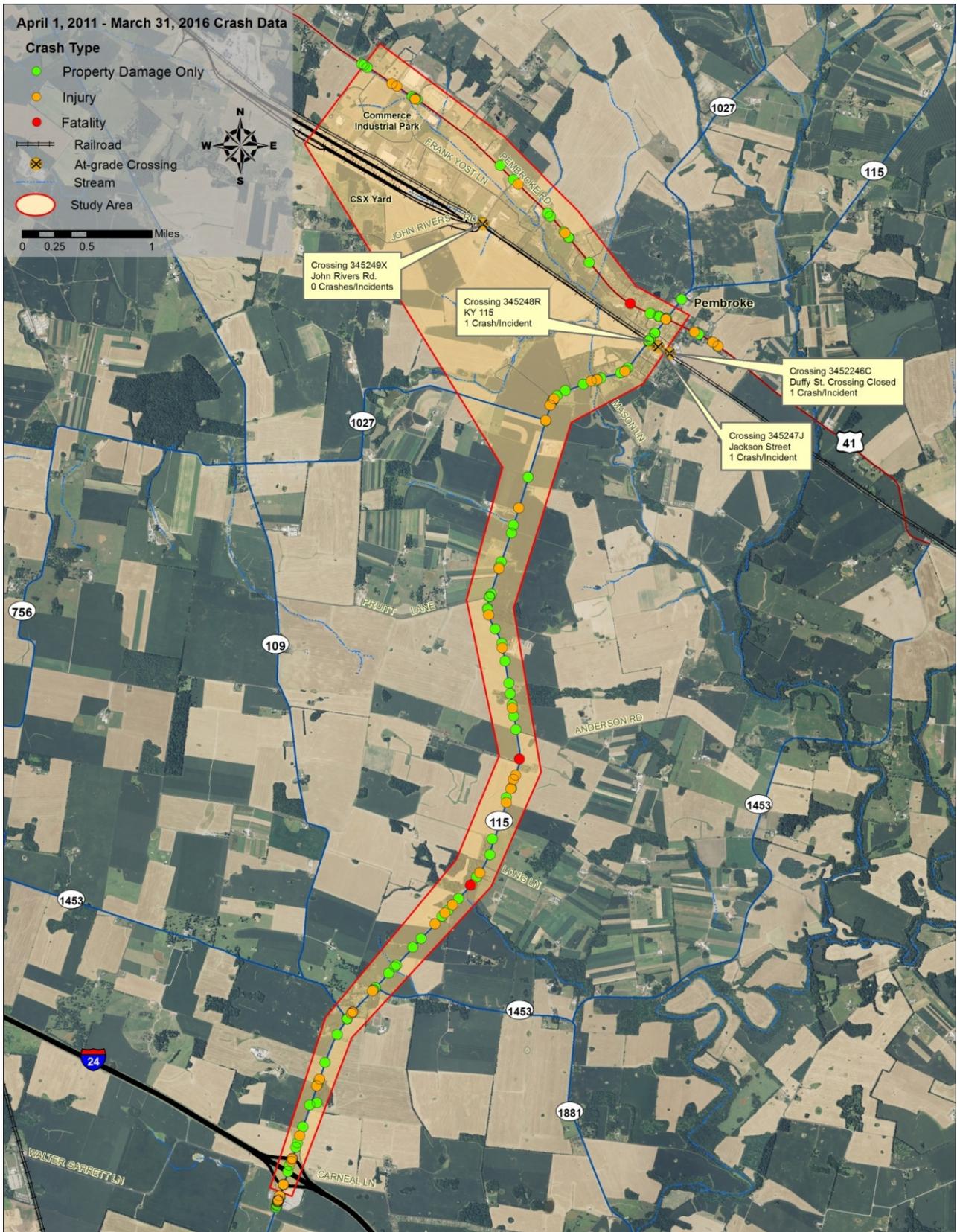


Figure 28: Crash History by Crash Type

overturned, and struck a tree. Excessive speed and inattention were cited as contributing human factors.

- 3) **KY 115, MP 6.648:** A single vehicle, traveling north in a left-hand curve in wet conditions, dropped off the right pavement edge. The operator overcorrected and slid from the roadway and overturned. Excessive speed, overcorrecting, and alcohol were cited as contributing human factors.

During the review period, nine injury crashes were recorded on US 41 with 40 on KY 115.

3.9.2 Crash History by Manner of Collision

Crashes by the manner of collision are shown on **Figure 29**. The predominant manner of collision reported was single vehicle crashes—17 (46%) on US 41 and 73 (51%) on KY 115. Forty-one single-vehicle crashes on KY 115 and six single-vehicle crashes on US 41 were reported as “vehicle ran off roadway.”

The percentage of angle crashes on US 41 (40.5%) was more than double the statewide average (17.4%). On KY 115, the percentages of sideswipe (18.3%) and horizontal curve collisions (24.5%) were higher than the statewide averages (11.3% and 20.1%), respectively.

Crashes occurring at night were commonly reported on both US 41 and KY 115.

3.9.3 Crash History of Semi-Tractor Trailers

US 41 crashes involving semi-tractor trailers (10.8%) were more than twice the statewide average (4.1%). Four of these crashes were reported on US 41: three were angle and one involved a single vehicle. On KY 115, semi-tractor trailer crashes occurred more than four times the state average (17.5%). Twenty-five of these crashes were located on KY 115 including 10 sideswipe, seven single vehicle, four angle, and four backing. Of semi-tractor trailer crashes on KY 115, nine happened south of I-24 near the Pilot Travel Center adjacent to the southern limits of the study area. Two semi-tractor trailer crashes each were at the US 41/KY 115 intersection and US 41 near entrances to the Commerce Park.

3.9.4 Crash History at Railroad Crossings

Crash histories were reviewed during the five-year study period at four at-grade railroad crossings shown in **Figure 28**:

- **John Rivers Road crossing:** No crashes were reported.
- **KY 115 crossing (MP 10.443):** One PDO crash was reported in 2012 when a freight train traveling north at 15 mph carrying hazardous material, struck a stopped semi-tractor trailer.
- **Jackson Street crossing, east of KY 115:** One PDO crash was reported in 2015 when a freight train traveling 37 mph struck the trailer portion of a semi-tractor trailer.

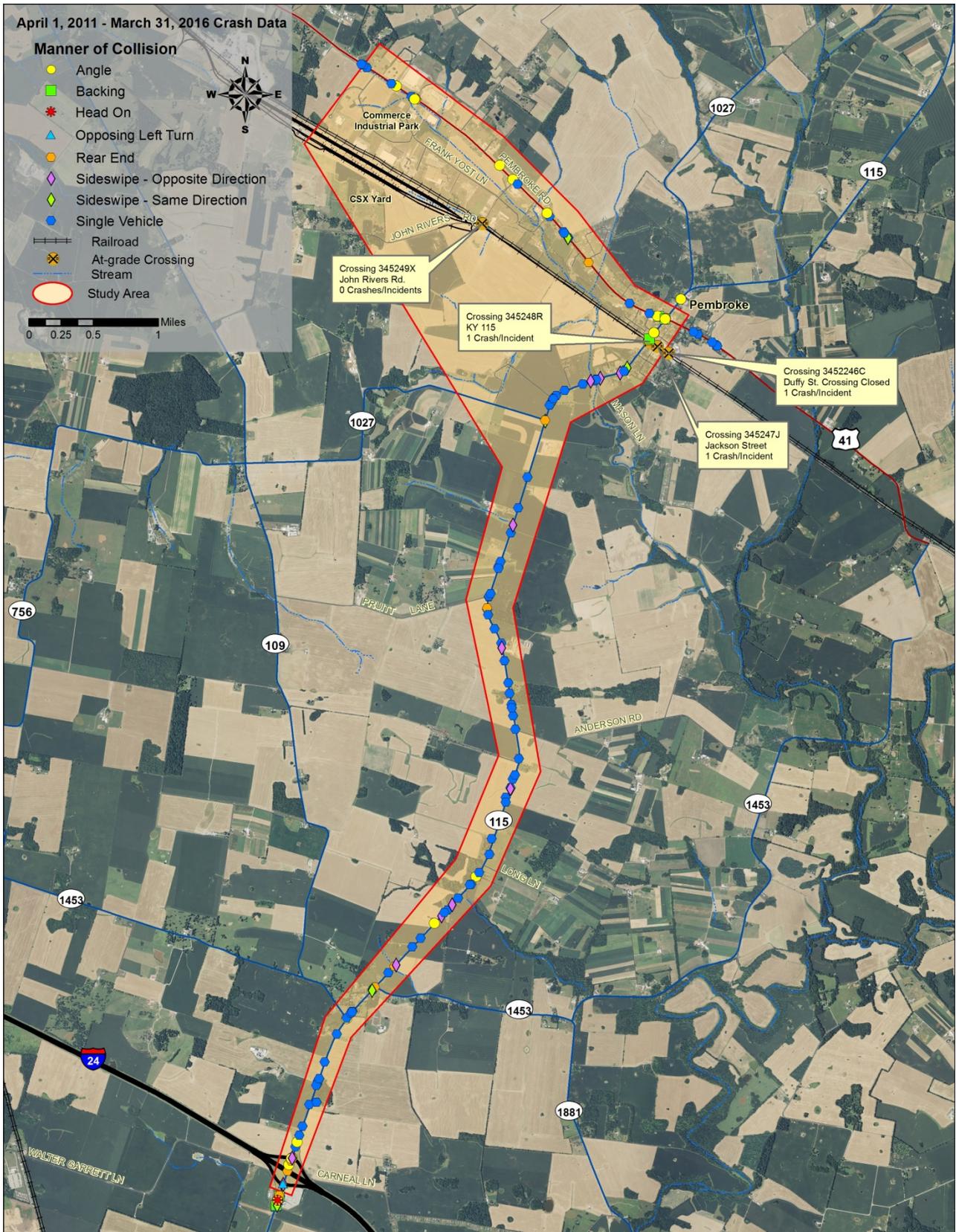


Figure 29: Crash History by Manner of Collision

- Duffy Street crossing, east of KY 115:** One injury crash was reported in 2014 when a freight train travelling 49 mph struck a stopped car. The crossing was closed with barricades following this incident. Instrumental in the closing of the crossing were crashes recorded prior to the review period. These included a crash in 2010 resulting in three fatalities and one injury, and five crashes over the previous 20-year period.

3.9.5 High-Crash Spots

Using the Kentucky Transportation Center’s methodology⁷, seven high-crash 0.1-mile spots (**Table 6**) were identified with a CCRF greater than 1.0⁸ during the five-year study period.

Table 6: High-Crash 0.1 Mile Spots

Route	Milepoints	Average ADT	Number of Lanes	Rural / Urban	Functional Class Rate	Crashes				Million Vehicles (MV)	Rates per MV				Critical Rate	CCRF
						Fatal	Injury	PDO	Total		Fatal Rate	Injury Rate	PDO Rate	Total Rate		
US 41	2.7-2.8	2,200	2	Rural	0.24	0	1	6	7	4.0150	0.00	0.25	1.49	1.74	1.00	1.74
KY 115	2.6-2.7	6,209	2	Rural	0.24	0	6	26	32	11.3314	0.00	0.53	2.29	2.82	0.66	4.25
	6.4-6.5	1,510	2	Rural	0.24	0	2	2	4	2.7558	0.00	0.73	0.73	1.45	1.19	1.22
	9.5-9.6	2,030	2	Rural	0.24	0	2	5	7	3.7048	0.00	0.54	1.35	1.89	1.04	1.82
	9.9-10.0	2,030	2	Rural	0.24	0	1	3	4	3.7048	0.00	0.27	0.81	1.08	1.04	1.04
	10.1-10.2	2,030	2	Rural	0.24	0	1	3	4	3.7048	0.00	0.27	0.81	1.08	1.04	1.04
	10.6-10.7	2,030	2	Rural	0.24	0	0	5	5	3.7048	0.00	0.00	1.35	1.35	1.04	1.30

High-crash spots are shown on **Figures 30 and 31** and are described below:

- US 41 MP 2.700–MP 2.800:** Seven crashes—one injury, six PDO—were reported at intersection with KY 115 and resulted in a CCRF of 1.74. Six were angle crashes with KY 115 motorists failing to yield right-of-way to a vehicle on US 41.
- KY 115 MP 2.600–MP 2.700:** This high-crash spot (**Figure 31**) is adjacent to the southern limits of the study area. Thirty-two crashes—six injury, twenty-six PDO—resulted in a CCRF of 4.25. According to crash reports, seven crashes, all PDO, occurred in a truck stop parking lot. Excluding the seven crashes, the CCRF lowered to 3.32. This location averages almost five crashes per year. Eight sideswipe, seven rear-end, five angle, and four opposing left turn crashes constituted the most frequent manners of collision. Ten crashes occurred in wet, snowy, or icy conditions. Of the six injury crashes, three were angle, with one each single vehicle, head on, and rear-end. The crash analysis verified existence of safety issues. KYTC addressed this spot with PIF No. 02 024 D0115 6.00 proposing a two-way-left-turn lane through this area. Therefore, no additional improvement concepts were developed for this study.

⁷ Analysis of Traffic Crash Data in Kentucky (2011-2015).

⁸ A CCRF greater than 1.0 is a calculated statistic (developed by the Kentucky Transportation Center) indicating crashes may not be occurring randomly.



Figure 30: KY 115 High-Crash Spot No. 2

- 3) **KY 115 MP 6.400–MP 6.500:** Four crashes—two injury, two PDO—resulted in a CCRF of 1.22. Crashes reflected driver error and narrow lanes.
- 4) **KY 115 MP 9.500–MP 9.600:** Seven crashes—two injury, five PDO—resulted in a CCRF of 1.82. One injury crash resulted in six injuries. Five crashes involved vehicle encroachment into the opposite lane. Three crashes occurred at night. Road conditions included narrow lanes and steeply sloped shoulders. A horizontal curve with a 960-foot radius meets minimum design standards, per the HIS.
- 5) **KY 115 MP 9.900–MP 10.000:** Four crashes—one injury, three PDO—resulted in a CCRF of 1.04. Apparent crash factors included a narrow bridge and driver error. A crash at MP 10.113 appears to have been initiated by a vehicle sideswiping bridge railing at MP 9.910.
- 6) **KY 115 MP 10.100–MP 10.200:** Four crashes—one injury, three PDO—resulted in a CCRF of 1.04. Driver error appears to have caused the crashes.
- 7) **KY 115 MP 10.600–MP 10.700:** Five crashes at intersection with US 41 resulted in a CCRF of 1.30. Driver error appears to be primary cause of crashes at this location. Recently, the stop bar on northbound KY 115 was moved closer to US 41; however, the stop sign has not been similarly relocated. Combining crashes at this location with those reported on US 41 between MP 2.600 and MP 2.700 results in a CCRF of 2.86 at the US 41/KY 115 intersection.



Figure 31: High-Crash 0.1 Mile Spots (CCRF>1)

4.0 TRAFFIC ANALYSIS – EXISTING (2016) AND FUTURE (2040)

Qk4 collected traffic data including volumes, vehicle classifications, and speeds, provided forecasts, and utilized the Christian County Travel Demand Model (CCTDM) to analyze existing and future traffic operations. The *Traffic Forecast Report* is in **Appendix C**.

4.1 2016 Traffic Counts

The KYTC provided historical traffic volume counts for six stations, two with classification counts. The most recent counts were made between 2011 and 2015. In September 2016, the following updated traffic counts and detailed classification counts were collected (**Figure 32**):

- Peak-period turning movement counts (TMCs) between 7:00 - 9:00 AM and 3:00 - 6:00 PM using Miovision technology at five unsignalized intersections.
- A 48-hour turning movement count at the US 41/Frank Yost Lane intersection to collect industrial traffic data.
- Six 48-hour volume/classification tube counts at KYTC traffic count stations.
- A 48-hour video at the KY 115/CSX railroad crossing to observe the number and length of train crossings.



Figure 32: 2016 Traffic Count Locations

Based on 2016 counts, AADT volumes along US 41 were 6,150 vpd in Pembroke and 9,050 vpd near Commerce Park. Truck percentages near Pembroke and Commerce Park were 11.6% (720 trucks) and 13.2% (1,200 trucks), respectively. AADT volumes along KY 115 from I-24 to US 41 were between 2,390 vpd and 3,580 vpd, with truck percentages between 7.8% and 11.2%, or 290 to 310 trucks per day on average. Near I-24 the 2013 AADT on KY 115 was 6,200 vpd with 8.4% and 520 trucks.

4.2 Travel Times

Field Measurements and the CCTDM were used to evaluate travel times to/from the Commerce Park and I-24 Exit 89 (at KY 115), and the Kentucky Statewide Travel Demand Model (KYSTM) was used to assess nine travel time scenarios from Commerce Park and either I-24 Exit 65 in Kentucky or I-24 Exit 4 in Tennessee (**Appendix D**). All Kentucky routes selected for the travel-time scenarios are on the Kentucky Highway Freight Network.

The travel time and total length of each scenario are compared in **Table 7**, and the paths comprising each scenario’s route are shown in **Figure 33**.

Table 7: Travel Time Comparison

Method	From	To	VIA	Length (Miles)	Travel Time (Minutes)	Path
KYTC Kentucky Statewide Travel Demand Model (KYSTM)	1. Commerce Park	I-24 Exit 65	US 41NW, Breathitt Pkwy, US 68	24.39	35.6	ADEB
	2. Commerce Park	I-24 Exit 65	US 41NW, Hopkinsville Bypass (US 68B), US 68	26.08	31.1	ADGFEB
	3. Commerce Park	I-24 Exit 65	US 41NW, Hopkinsville Bypass, Breathitt Pkwy, I-24	29.93	30.3	ADGFHB
	4. Commerce Park	I-24 Exit 65	US 41SE, KY 115S, I-24	31.92	33.0	ALKJHB
	5. Commerce Park	I-24 Exit 4	US 41SE to Trenton, KY 848, KY 181S, Guthrie Hwy (TN 79)	20.77	26.7	ALMNOC
	6. Commerce Park	I-24 Exit 4	US 41SE, KY 181S, Guthrie Hwy (TN 79)	19.22	25.6	ALMOC
	7. Commerce Park	I-24 Exit 4	US 41NW, Hopkinsville Bypass, Breathitt Pkwy, I-24	30.58	31.4	ADGFIJCK
	8. Commerce Park	I-24 Exit 4	US 41NW, Hopkinsville Bypass, US 41A, I-24	28.55	31.6	ADGJJK
	9. Commerce Park	I-24 Exit 4	US 41SE, KY 115S, I-24	17.42	20.4	ALKC
Field Measured / CCTDM	Commerce Park (at John Rivers Rd)	I-24 Exit 89 (at KY 115)	US 41SE, KY 115S	8.3	12.7 / 11.9*	ALK
	I-24 Exit 89 (at KY 115)	Commerce Park (at John Rivers Rd)	KY 115N, US 41NW	8.3	12.8 / 11.9*	KLA

Note: **Bold text** indicates the most efficient routes per destination.

* Field Measured / CCTDM

Scenarios 1 – 4 were examined for travel efficiency from Commerce Park northwest to I-24 Exit 65 in Kentucky. **Scenario 3** was the most efficient of the four scenarios, with a travel time of 30.3 minutes per vehicle over a total distance of 29.93 miles. **Scenario 4** (study area corridor) had the longest total distance (31.92 miles) and second longest total travel time (33.0 minutes) to Exit 65; however, to the Exit 89 *northbound* ramp on KY 115 is 8.2 miles—the shortest distance to I-24 from Commerce Park. The remaining distance to Exit 65 (23.72 miles, 74.3% of the route’s total length) is traveled on I-24.

Scenarios 5 – 9 were examined for travel efficiency from Commerce Park southeast to I-24 Exit 4 in Tennessee. **Scenario 9** (study area corridor) was the shortest and most efficient travel route (17.42 miles and 20.4 minutes) to Exit 4. This scenario includes 8.4 miles to the Exit 89 *southbound* ramp on KY 115, which is the shortest route to I-24 from Commerce Park. Although, KY 115 (AADTT 500 to 4,000) is a Tier 3 facility of Statewide Regional Significance on the Kentucky Highway Freight Network it is a narrow, two-lane road with minimal shoulders, a railroad crossing, a narrow bridge, and has a weight restriction of 44,000 pounds. Despite

KY 115 being a critical freight corridor, the weight restriction legally requires heavier trucks to use an alternate route, as offered by Scenarios 5 – 8. During off-peak times with no train disruptions, the average field-measured travel time for the most direct connection from Commerce Park to I-24 (Exit 89 at KY 115) is 12.7 minutes. The Christian County Travel Demand Model study corridor travel time is similar at 11.9 minutes. However, day-to-day predictability of travel time in the study corridor is inconsistent due to large farm equipment, semi-tractor trailers carrying agriculture products, school buses, slow moving Amish buggies, and limited passing opportunities resulting in lower travel speeds and platooning.

Scenario 6, at 25.6 minutes per vehicle, was the second most efficient southeast travel route. However, it is primarily on narrow, two-lane roads with minimal shoulders; travels 1.9 miles through the town of Trenton at slow speeds; and is non-interstate for all 19.2 miles of the route. Although meeting the 80,000-pound maximum weight limit for heavy trucks, KY 181 and US 41 southeast of KY 115 in Pembroke are designated Tier 4 facilities of Local Access Significance on the Kentucky Highway Freight Network with an AADTT fewer than 500.



Figure 33: Travel Time Paths

4.3 2016 Traffic Operations

To evaluate congestion, 2016 traffic volumes (“v”) were compared to area roadways’ theoretical capacity (“c”). A v/c ratio greater than 0.9 in rural areas and 1.0 in urban areas indicates additional lanes may be justified. The v/c ratios developed for US 41 and KY 115 show no segments with a v/c ratio greater than 0.30 (**Table 8**).

Level of Service (LOS) is a qualitative performance measure used to evaluate a roadway or intersection congestion (**Figure 34**). Levels of service are described according to a letter rating system ranging from LOS “A” (free flow, minimal or no delays—best conditions) to LOS “F” (severe congestion, long delays — worst conditions). LOS C or better is desirable in rural areas while LOS D or better is desirable in urban areas.

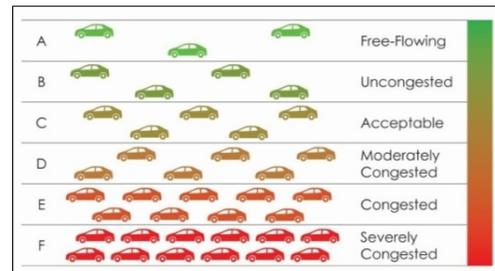


Figure 34: LOS Definition

Using 2010 Highway Capacity Manual (HCM) classifications and methodology, KY 115’s rural two-lane, 55 mph sections were analyzed as Class I highways, and US 41 and KY 115 lower speed, two-lane sections in Pembroke were evaluated as Class III highways.

Class I highways function as primary connectors of major traffic generators where motorists expect to travel at high speeds and serve as daily commuter routes. LOS criteria for Class I two-lane highways are measured by Average Travel Speed (ATS) and Percent Time Spent Following (PTSF). Class III two-lane highways serve moderately developed areas and often have reduced speed limits reflecting higher activity level. PTSF is used to determine LOS for Class III two-lane highways. The US 41 four-lane section near Commerce Park was evaluated as a multi-lane highway.

The 2016 segment traffic analysis indicates US 41 and KY 115 currently operate under capacity and at acceptable LOS C or better through most of the study area. Moderate congestion occurs near I-24 eastbound and westbound ramps (LOS D) with congested traffic south of I-24 (LOS E).

In 2016, the Frank Yost Lane approach to US 41 operated at LOS F in the PM peak hour due to left turns toward Hopkinsville. The remaining four intersections have approaches operating at LOS C or better.

The 2016 traffic operations analysis is summarized in **Tables 8 and 9** and **Figure 35**.

Table 8: 2016 Segment Traffic Analysis

Route	Beginning Milepoint	Beginning Feature	Ending Milepoint	Ending Feature	2016 Existing					
					AADT	AADT Truck %	LOS	% Time Spent Following	Average Travel Speed	v/c Ratio
US 41	2.786	KY 115	4.396	John Rivers Rd.	6,150	11.6	C	67.6	35.4	0.27
	4.396	John Rivers Rd.	5.397	Frank Yost Ln.	9,050	13.2	A / A	2.9 / 2.4	55.0	0.08 / 0.06
	5.397	Frank Yost Ln.	9.212	US 68B			A / A	3.3 / 6.1	55.0	0.09 / 0.17
KY 115	2.663	Walter Garrett Ln.	2.800	I-24 EB Ramps	6,200 (2013)	8.4	E	70.4	37.0	0.30
	2.800	I-24 EB Ramps	3.000	I-24 WB Ramps			D	66.9	41.3	0.30
	3.000	I-24 WB Ramps	3.110	Speed Limit Change	3,580	7.8	D	50.8	44.3	0.15
	3.110	Speed Limit Change	3.220	Flat Terrain Ends			B	48.1	51.5	0.16
	3.220	Rolling Terrain Begins	4.173	KY 109			C	56.1	48.0	0.16
	4.173	KY 109	9.375	KY 1027	2,390	10.7	C	52.1	47.8	0.15
	9.375	KY 1027	9.929	Mason Ln.	2,730	11.2	C	55.1	36.9	0.14
	9.929	Mason Ln.	10.523	East Cherry Street /West Cherry St.			C	48.0	26.6	0.11
	10.523	East Cherry Street /West Cherry St.	10.662	US 41			C	48.0	26.4	0.11
	10.662	US 41	10.955	KY 1027			1,940	5.8	B	50.7

Table 9: 2016 Intersection Traffic Analysis

Intersection Number	Intersections	LOS		Worst Movement
		2016 Existing		
		AM	PM	
3	US 41/KY 115	B/B	B/C	KY 115 NB and SB
2	US 41/Johns Rivers Rd.	A/B	A/B	John Rivers Rd. NB
1	US 41/Frank Yost Ln.	A/B	A/F	Frank Yost Ln. NB
5	KY 115/I-24 EB Ramp	A/B	A/B	I-24 EB Ramp
4	KY 115/I-24 WB Ramp	A/C	A/C	I-24 WB Ramp

Note: The intersections are stop controlled and the LOS reflects the worst movement for each approach.

A signal warrant analysis was performed to determine whether installation of a traffic signal is justified at the US 41/Frank Yost Lane intersection. The analysis showed the necessary hourly traffic volumes over an eight-hour period. Per Warrant 1⁹, traffic volumes were not sufficiently high to justify a signal. The intersection’s traffic met the peak-hour minimum one-hour volume per Warrant 3¹⁰; however, KYTC usually requests an intersection to also meet Warrant 1 requirements.

4.4 Year 2040 Traffic Forecasts

The Christian County Travel Demand Model (CCTDM) was provided by KYTC for modeling 2040 traffic, travel times, vehicle miles traveled (VMT) and vehicle hours traveled (VHT).

4.4.1 Growth Rates for Design Year 2040

The CCTDM was used to develop a study area traffic growth rate. A proposed overall average annual growth rate of 1.03% was found by comparing assignments between the 2016 and 2040 CCTDM. The area defining the growth rate is shown in **Figure 36**. If cars and trucks are separated, the proposed average annual car growth rate is 1.06% and the truck growth rate is 0.81%. The *Traffic Forecast Report* in **Appendix C** includes analysis details.

⁹ Applies to a high-volume intersection’s major and minor streets.

¹⁰ Applies where heavy volume on the major street causes delay on the minor street

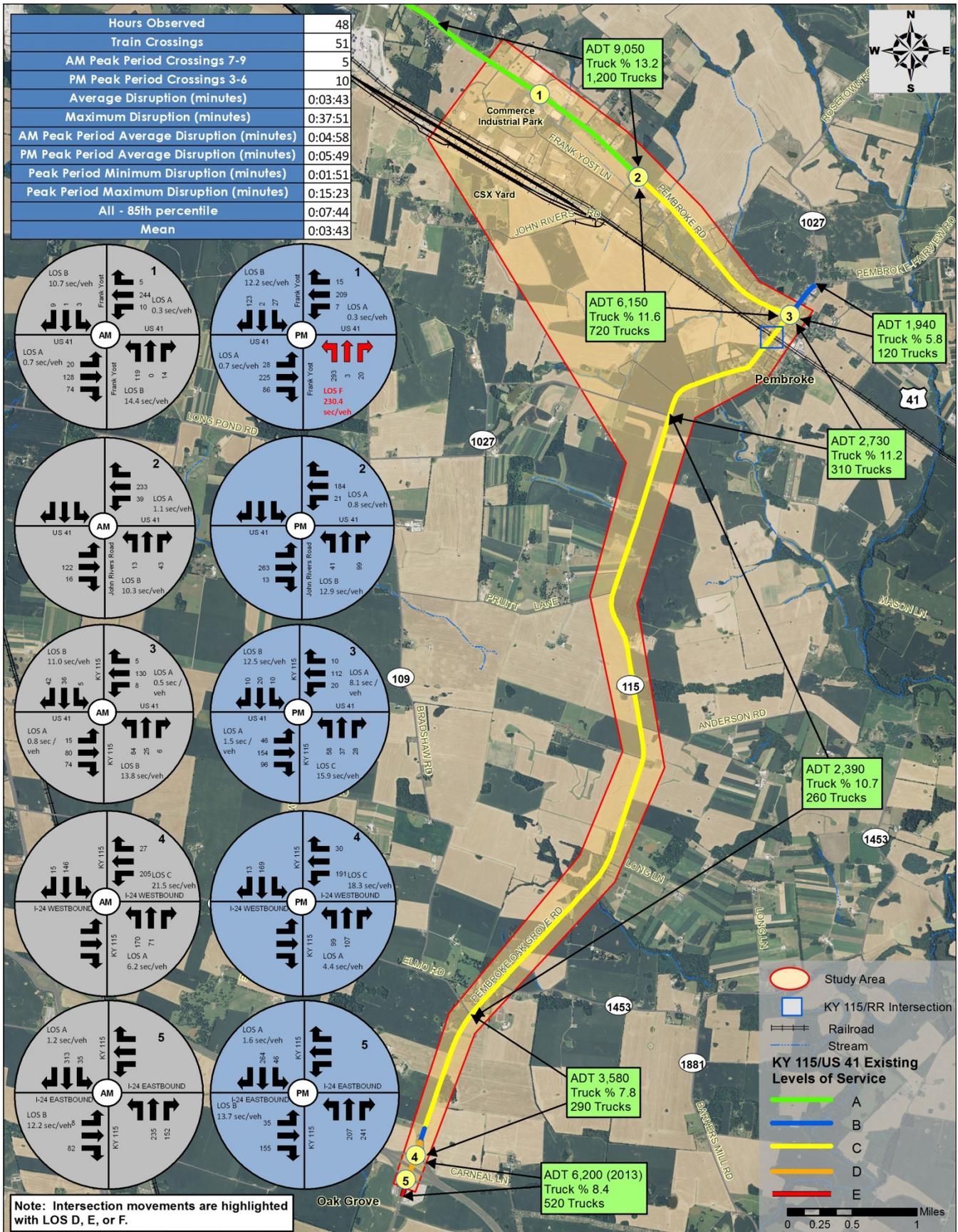


Figure 35: 2016 ADT, AM/PM Peak Hour Intersection Movements, Delay, and LOS

4.4.2 No Build Year 2040 ADT and LOS

The projected 2040 No Build traffic volumes and operations analysis compared to the existing traffic operations are summarized in **Tables 10 and 11** and **Figure 37**.

Table 10: 2040 No Build Intersection Traffic Analysis

Intersection Number	Intersections	LOS				Worst Movement
		2016 Existing		2040 No Build LOS		
		AM	PM	AM	PM	
3	US 41/KY 115	B/B	B/C	A/F	A/F	KY 115 NB and SB
2	US 41/Johns Rivers Road	A/B	A/B	A/B	A/C	John Rivers Rd. NB
1	US 41/Frank Yost Lane	A/B	A/F	A/D	B/F	Frank Yost Ln. NB
5	KY 115/I-24 EB Ramp	A/B	A/B	A/C	B/E	I-24 EB Ramp
4	KY 115/I-24 WB Ramp	A/C	A/C	A/F	A/F	I-24 WB Ramp

Note: The intersections are stop controlled and the LOS reflects the worst movement for each approach.

Table 11: 2040 No Build Segment Traffic Analysis

Route	Beginning Milepoint	Beginning Feature	Ending Milepoint	Ending Feature	2016 Existing						2040 No Build					
					AADT	AADT Truck %	LOS	% Time Spent Following	Average Travel Speed	v/c Ratio	AADT	2040 AADT Truck %	LOS	% Time Spent Following	Average Travel Speed	v/c Ratio
US 41	2.786	KY 115	4.396	John Rivers Rd.	6,150	11.6	C	67.6	35.4	0.27	7,500	11.6	C	70.6	34.6	0.33
	4.396	John Rivers Rd.	5.397	Frank Yost Ln.	9,050	13.2	A / A	2.9 / 2.4	55.0	0.08 / 0.06	11,600	13.2	A / A	3.7 / 3.1	55.0	0.10 / 0.08
	5.397	Frank Yost Ln.	9.212	US 68B			A / A	3.3 / 6.1	55.0	0.09 / 0.17			A / A	4.2 / 7.8	55.0	0.12 / 0.22
KY 115	2.663	Walter Garrett Ln.	2.800	I-24 EB Ramps	6,200 (2013)	8.4	E	70.4	37.0	0.30	8,400	8.4	E	83.2	32.4	0.52
	2.800	I-24 EB Ramps	3.000	I-24 WB Ramps			D	66.9	41.3	0.30			E	73.3	39.7	0.37
	3.000	I-24 WB Ramps	3.110	Speed Limit Change	3,580	7.8	D	50.8	44.3	0.15	4,600	7.8	D	59.4	42.2	0.22
	3.110	Speed Limit Change	3.220	Flat Terrain Ends			B	48.1	51.5	0.16			C	52.6	50.8	0.19
	3.220	Rolling Terrain Begins	4.173	KY 109			C	56.1	48.0	0.16			C	59.5	47.5	0.19
	4.173	KY 109	9.375	KY 1027	2,390	10.7	C	52.1	47.8	0.15	3,500	10.7	C	56.0	47.3	0.19
	9.375	KY 1027	9.929	Mason Ln.			C	55.1	36.9	0.14			C	59.7	36.5	0.17
	9.929	Mason Ln.	10.523	East Cherry Street /West Cherry St.	2,730	11.2	C	48.0	26.6	0.11	4,000	11.2	C	53.6	25.6	0.14
	10.523	East Cherry Street /West Cherry St.	10.662	US 41			C	48.0	26.4	0.11			C	53.6	25.4	0.14
	10.662	US 41	10.955	KY 1027	1,940	5.8	B	50.7	29.3	0.12	2,400	5.8	B	54.3	28.3	0.15

Using the 1.03% growth rate, 2040 design year AADT on US 41 is expected to reach 11,600 vpd near the Commerce Park. Design year AADT south of US 41 is projected to be between 3,500 vpd and 8,400 vpd. The truck percentage for each roadway segment is anticipated to remain the same as traffic grows.

The 2040 No Build v/c ratios developed for US 41 and KY 115 show no segments with a ratio greater than 0.52. Again, a v/c ratio greater than 0.9 in rural areas and 1.0 in urban areas indicates additional lanes may be justified.

In 2040, unimproved US 41 and KY 115 are anticipated to function similarly to 2016 performance. US 41 and most of KY 115 from north of Pembroke to near I-24 will operate at LOS C or better, near I-24 at LOS D and LOS E south of the interstate.

Left unimproved, four intersections will have approaches projected to operate at LOS D, E, or F in the 2040 AM and/or PM peak hour. These intersections should be monitored and considered for improvement.

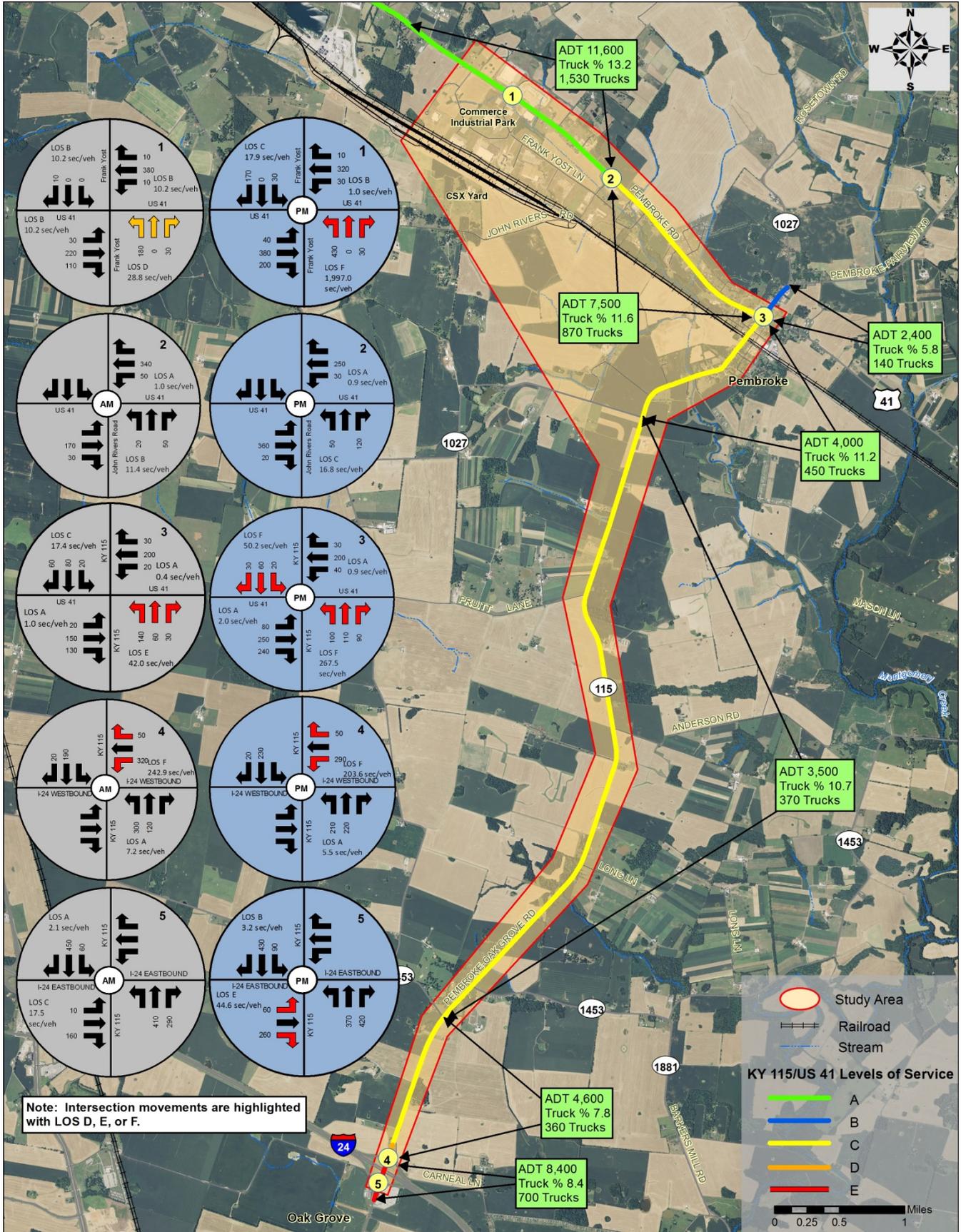


Figure 37: 2040 No Build AADT, AM/PM Peak Hour Intersection Movements, Delay, and LOS

5.0 ENVIRONMENTAL OVERVIEW

An environmental overview was conducted to identify human and natural environmental resources in the study area. These resources were identified through literature searches, field reviews, and resource agency coordination. If projects advanced from this study receive federal funds, National Environmental Policy Act (NEPA) documentation will be required to address resources, impacts, and mitigation commitments, as described in Section 8.4.

The overview study area encompasses an approximately 4,000-acre, “dog-leg” corridor containing US 41 and KY 115. The US 41 section extends from east of downtown Pembroke to Commerce Park, and then along KY 115 from I-24 north to US 41. The corridor includes several small streams, CSX railroad tracks, and two known cemeteries. The western portion of the study area near US 41 is heavy industrial, and trends to more commercial and residential uses east toward Pembroke. Land use outside the city limits of Pembroke, along KY 115, is predominantly agricultural. Ecological, historic and archaeological overviews are in **Appendix E**.

5.1 Natural Environment

Streams, wetlands, ponds, floodplains, geological features, and threatened and endangered species comprise the natural resources summarized in the following sections.

5.1.1 Ecological Resources

A review of available mapping identified ecological resources potentially in the study area. Those resources are illustrated on **Figure 38** and listed in **Table 12**. According to the Kentucky Geologic Survey (KGS), three large spring sheds in the study area may be water supply sources.

Table 12: Ecological Resources

Resource	Quantity	Unit
Potential wetlands	414	acres
Potential streams	62,437	linear feet of perennial, intermittent, and ephemeral streams
Federal Emergency Management Agency (FEMA) floodplain	200	acres
Indiana bat (<i>Myotis sodalis</i>) and northern long-eared bat (NLEB) (<i>Myotis septentrionalis</i>) Summer	325	acres
Gray bat (<i>Myotis grisescens</i>) foraging habitat	51,689	linear feet of perennial and intermittent streams
Potential Indiana bat, NLEB, gray bat winter/roost habitat	68	sinkholes

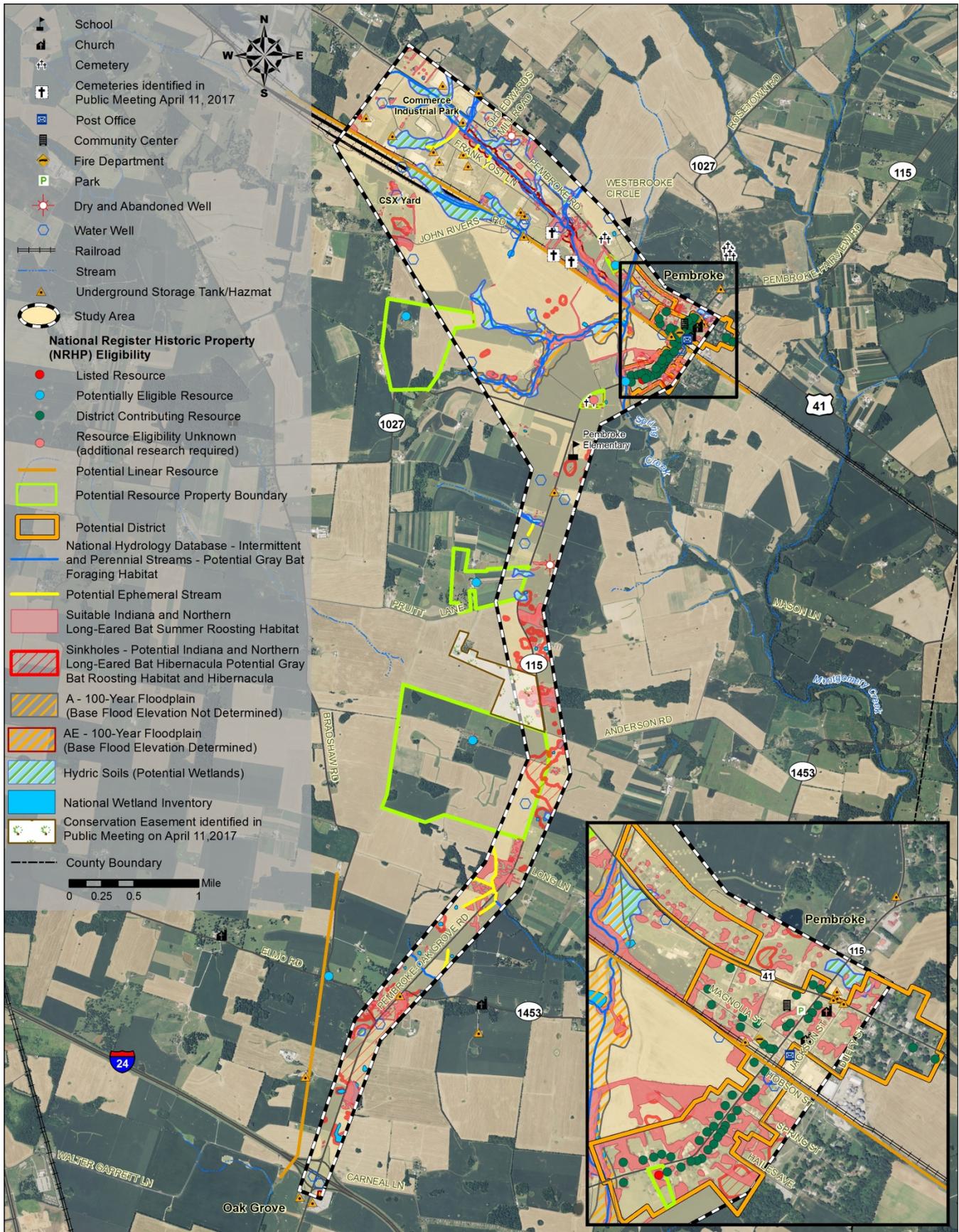


Figure 38: Environmental Overview

5.1.2 Threatened and Endangered Species

Identifying caves/karst features in the study area federally listed species occurrence databases maintained by the U.S. Fish and Wildlife Service (USFWS), the Kentucky Department of Fish and Wildlife Resources (KDFWR), and the Kentucky State Nature Preserves Commission (KSNPC) were reviewed, and data requests were submitted to the KSNPC and the KDFWR. USFWS’s Information for Planning and Conservation (IPaC) website was used to obtain an official list of species.

Federally listed species of primary concern for this project are the Indiana, northern long-eared, and gray bats because potential roosts and foraging habitat for the three species are present in the study area (**Table 13**). Several protected mussel species are also known to occur in Christian County; however, suitable habitat is not present in the project area.

Wooded areas potentially providing suitable summer habitat for Indiana and northern long-eared bats were documented through review of the National Land Cover Database and aerial photographs of the study area. The National Hydrography Dataset was accessed to identify the presence of wooded, intermittent and perennial streams, the preferred foraging habitat of gray bats. Indiana and northern long-eared bats overwinter in caves, mines, rockshelters, and sinkholes, which also provide year-long roost habitat for gray bats. Mapping from the U.S. Geological Survey (USGS), the Kentucky Department for Natural Resources (KDNR), and the KGS, and contact with the Kentucky Speleological Society (KSS) helped identify the presence of caves or karst features in the vicinity of the study corridor. The USFWS IPaC listed no critical habitats in the study area.

Table 13: Federally Listed Species Potentially Occurring in Christian County

Species	Common Name	Status	Habitat Present	Listing Agency
Mammals				
<i>Myotis sodalis</i>	Indiana bat	E	Yes	USFWS
<i>Myotis grisescens</i>	gray bat	E	Yes	USFWS, KDFWR, KSNPC
<i>Myotis septentrionalis</i>	northern long-eared bat	T*	Yes	USFWS, KDFWR

* Threatened, with 4(d) rule, which allows USFWS to focus on protections necessary/advisable to conserve species listed as “threatened.”

5.1.3 Prime Farmland

According to the U.S. Department of Agriculture-Natural Resources Conservation Service (USDA-NRCS) web soil survey, most of the study area (**Figure 39**) is considered prime farmland. Most land designated as farmland of statewide importance is in Commerce Park and south of the CSX railroad. Pockets of statewide important farmland are adjacent to KY 115 north and south of Pruitt Lane.

5.1.4 Geotechnical Overview

The *Geotechnical Overview* in **Appendix F** contains results of site and mapping reconnaissance in the project area. The report describes site conditions and near-surface geology, and also details potential design recommendations.

The study area is in Kentucky's western Pennyrile physiographic region. Topographic mapping shows relief ranging from 650 feet in the west to approximately 527 feet near the I-24/KY 115 interchange. The landscape is characterized by red clay soils, numerous sinkholes and depressions, gently rolling hills, and small streams. Ste. Genevieve Limestone underlies most of the area. Dolomite and shale may also be encountered. Residual soils weathered from Ste. Genevieve Limestone are typically reddish colored clays and exhibit moderate plasticity. The limestone bedrock is highly soluble and prone to developing sinkholes, caves, springs, and other karst features.

Geologic mapping shows faulting near the study area. One minor, unnamed, east-west trending fault is east of KY 115 just north of Anderson Road. More significant faulting is documented north of US 68 but is not expected to impact construction in the study area.

5.1.5 Karst Potential

KGS karst-potential mapping indicates very high karst potential in areas underlain by Ste. Genevieve Limestone, and high karst potential in areas underlain by Renault Limestone. Both formations underlie most of the study area. Numerous sinkholes appeared on karst-potential mapping and were observed during site reconnaissance, particularly south of US 41 and south of Pembroke.

Construction disturbance or release of pollutants could cause contamination of groundwater due to the area's karstic features. Caves are often associated with sensitive ecosystems and may provide habitat for a number of rare or endangered species. Cave organisms are heavily dependent on water quality, and introducing contaminants into the groundwater system may adversely affect sensitive cave ecosystems. Coordination with resource agencies and KGS identified 15 caves in Montgomery Creek. Although these caves are approximately three miles east of the study area, several sinkholes identified on KGS mapping (**Figure 38 as sinkholes**) may drain into aquifers that discharge into the stream. Correspondence from the KGS (Appendix E) noted at least seven large caves east of Barker Mill Road and Dickerson Road in a two-mile buffer around the study area. The caves are potentially large enough to pose a major subsidence risk. KGS data and correspondence revealed a cluster of documented cover-collapse near the northwest part of the study area and also stated any widening will be underlain with karstic limestone and vulnerable to cover and possible bedrock collapse. Measures to prevent damage to water supplies and pavement subgrade will be necessary. Cover collapse is the sudden collapse of soil or other cover over karstic bedrock.

On July 26, 2005 the KYTC adopted a BMP policy to be used in karst areas. Open sinkholes within the construction limits not used for drainage purposes should be filled and/or capped. Sinkholes used for drainage should minimize water infiltration into the subgrade and erosion control measures implemented to minimize siltation. Best Management Practices (BMPs) during and after construction may include grassy swales to retain stormwater, rerouted drainage to avoid the sinkholes, and berms that would slow and manage the introduction of runoff and spills into the natural drainage system.

5.2 Human Environment

The human environment is often defined as the “built” environment or can be described as what we live in and around and what we have built. Built-environment resources may affect or be affected by projects recommended in this corridor study are discussed in the following sections.

5.2.1 Land Use

Commerce Park and commercial and residential developments are located along US 41 northwest of Pembroke. Along KY 115 (South Main Street) and US 41 (Nashville Street within city limits) are primarily residential and commercial development and institutional uses. South of US 41 is new industrial development and small areas of agricultural land. The southern two thirds of the study area, along KY 115, is rural and consists of farmland and farmsteads, Amish farms (**Figure 40**), rural residences, Pembroke Elementary School, Rosedale Cemetery, and a small commercial use in the unincorporated community of St. Elmo. Land uses at the southern terminus of the project area are consistent with the I-24 interchange, including two large gas stations/truck stops.

Pembroke Elementary School, on KY 115 south of Pembroke, has a student population of 789. Most students live in/near Pembroke; however, many students travel from nearby Oak Grove and Fort Campbell military base to attend classes.

The HCCCP calls for more industrial land use west of Pembroke, along the CSX railroad corridor, and near the I-24 interchange (Section 2.1).

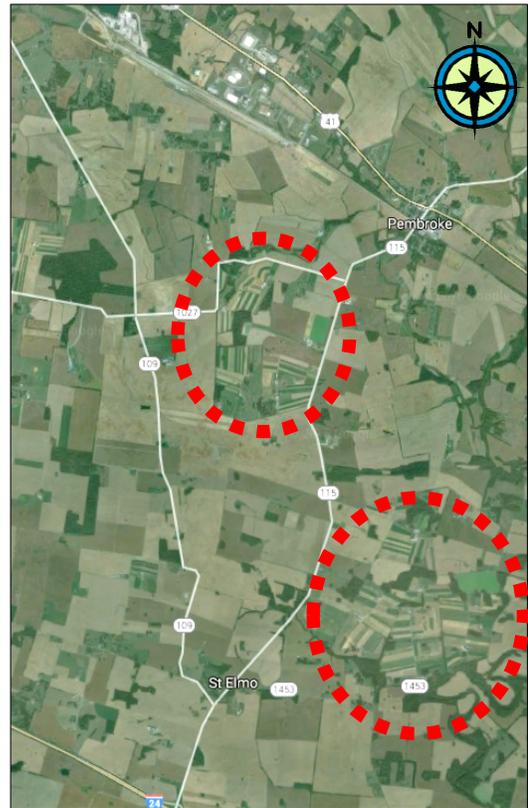


Figure 40: Amish Buggies on KY 115 (left), and Amish Farms (right)

5.2.2 Socioeconomic Review

The *Pembroke Socioeconomic and Environmental Justice (E.J.) Report (Appendix G)* was prepared by the Pennyriple Area Development District (PADD). The report relies on the U.S. Census Bureau’s 2010–2014 American Community Survey (ACS) for demographic data about the study area’s Census Tract 201301, Block Groups (BG) 1 and 2. The report includes documentation of potential environmental justice populations—racial minorities and persons below poverty level.

Statistics are provided for Hispanic or Latino, minority, elderly, poverty status, disabled, and limited English proficiency (LEP) populations. The data is intended to identify populations that may have specific concerns/needs that may require additional analysis if projects are advanced to future phases.

- Hispanic or Latino** minorities in the United States make up 16.9% of the population, but in Kentucky it drops significantly to just 3.2% (**Figure 41**). Christian County has a higher percentage of Hispanic or Latino minorities than Kentucky, with 6.9% reported by the 2010–2014 ACS. The Hispanic or Latino population is 2.1% of the BG 1 population, which is below Christian County and Kentucky percentages. BG 2 has no Hispanic or Latino population.

Block Groups identified in the PADD report are shown on **Figure 42**.

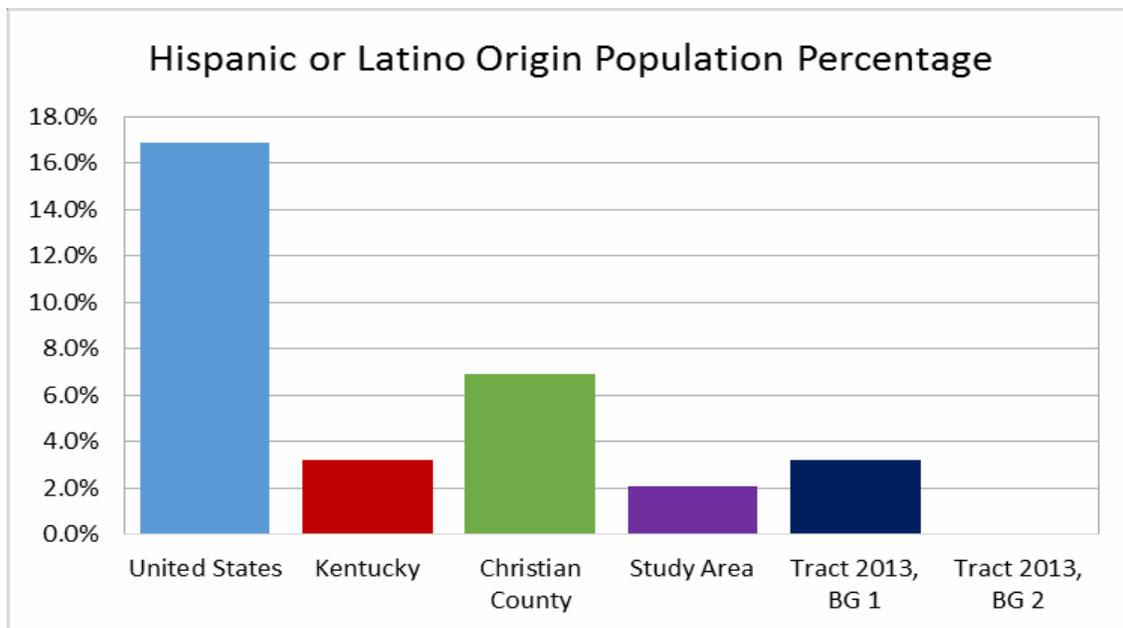


Figure 41: Hispanic or Latino Origin Population Percentage

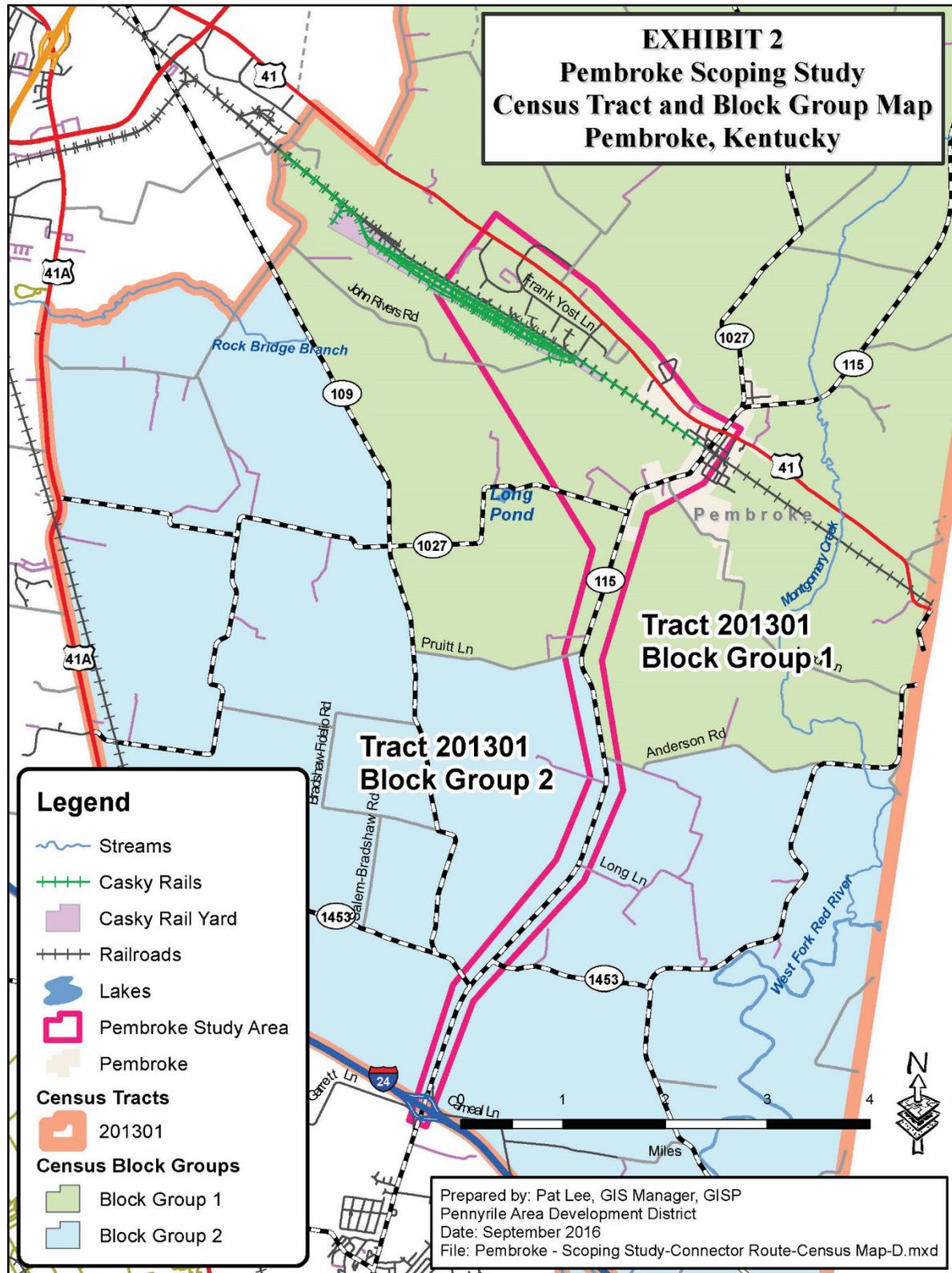


Figure 42: Study Area Census Block Group Boundaries

- BG 1 has a **racial minority population** (Figure 43) accounting for 18.3% of the Block Group’s population, which is below the Christian County percentage but slightly higher than Kentucky’s.

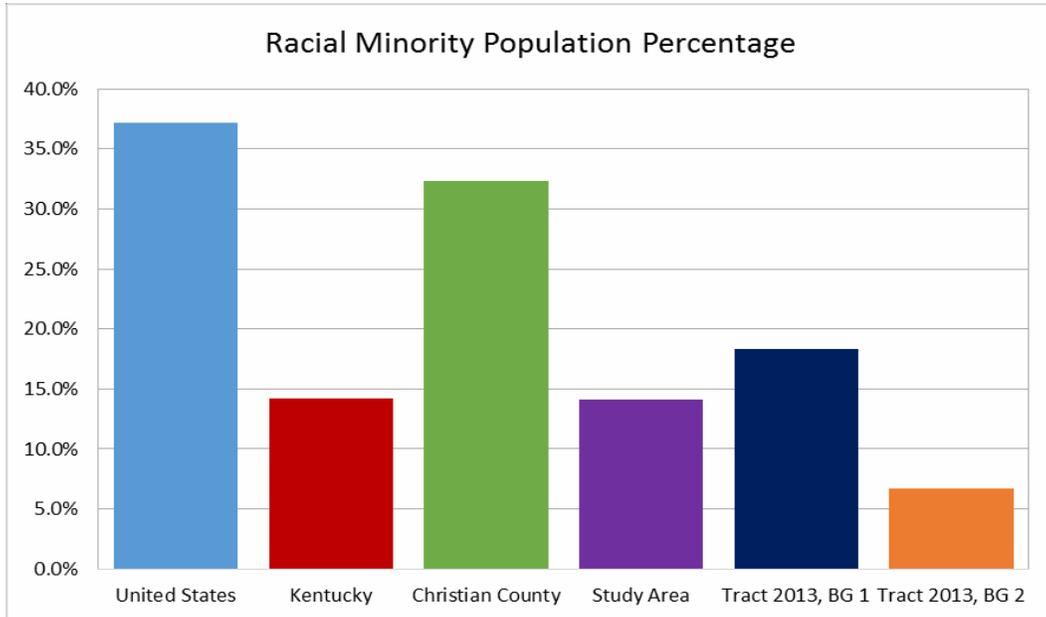


Figure 43: Racial Minority Population Percentage

- The **65 years and over population** of BG 1 is 15.4%, which is above the Christian County and Kentucky percentages (Figure 44).

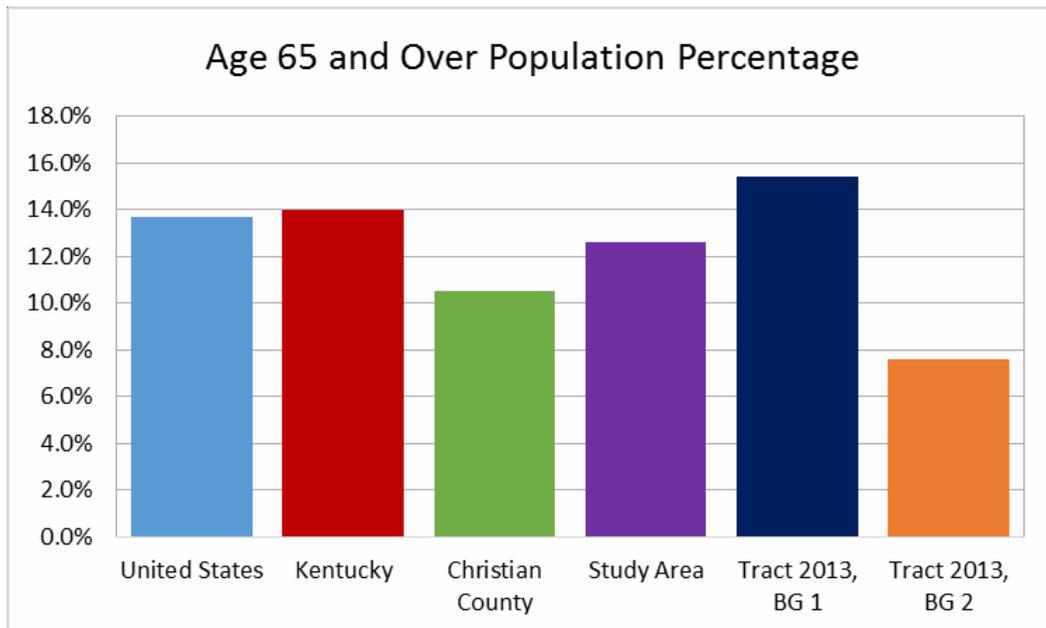


Figure 44: Age 65 and over Population Percentage

- Persons **below poverty level** are below the percentages for the county and state (**Figure 45**).

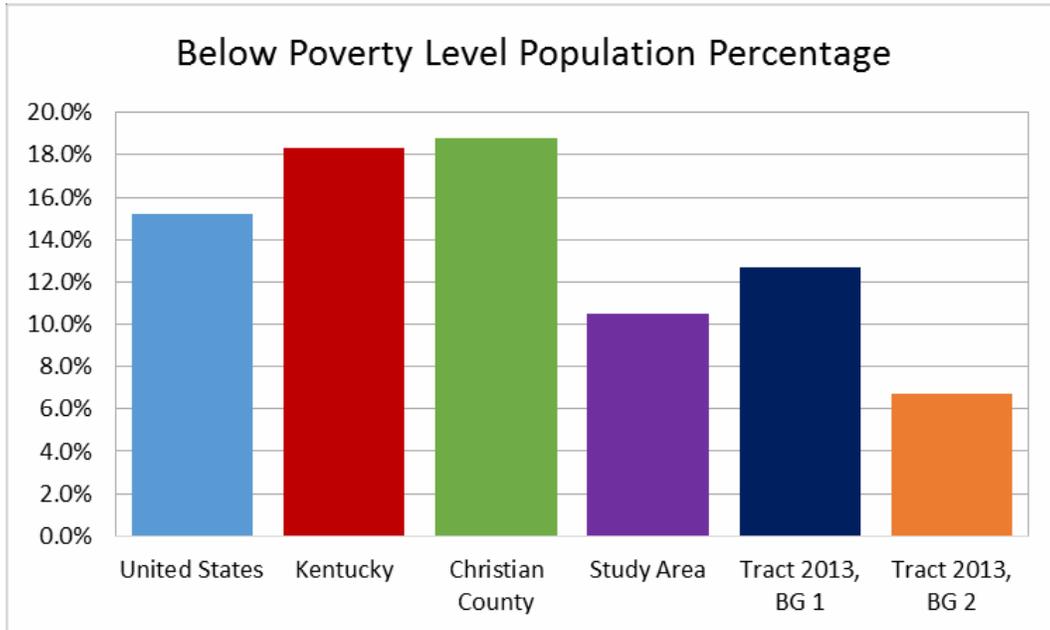


Figure 45: Below Poverty Level Population Percentage

- BG 1's **disabled population** is 15.8%, and that of BG 2 is 16.9%, both above the county and slightly above the state percentages (**Figure 46**).

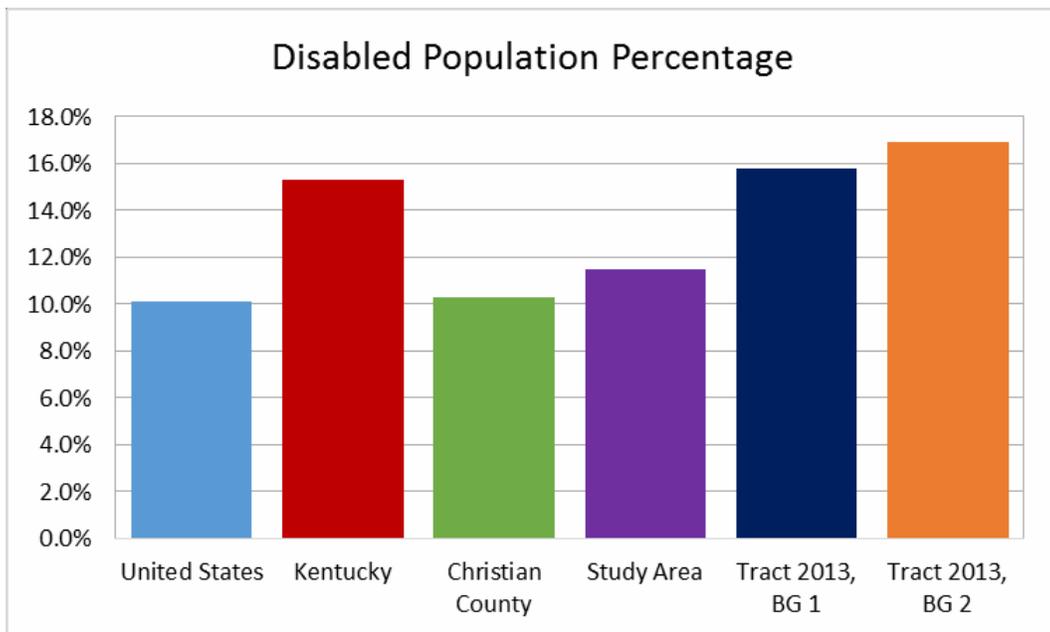


Figure 46: Disabled Population Percentage

- Persons with **LEP** comprise 5.2% of BG 1's population, which is higher than Christian County's percentage. Persons in the LEP category comprise 10.3% of BG 2's population, which is above the county, state, and BG 1 percentages primarily due to a mix of Hispanic and Amish populations in BG 2 (**Figure 47**).

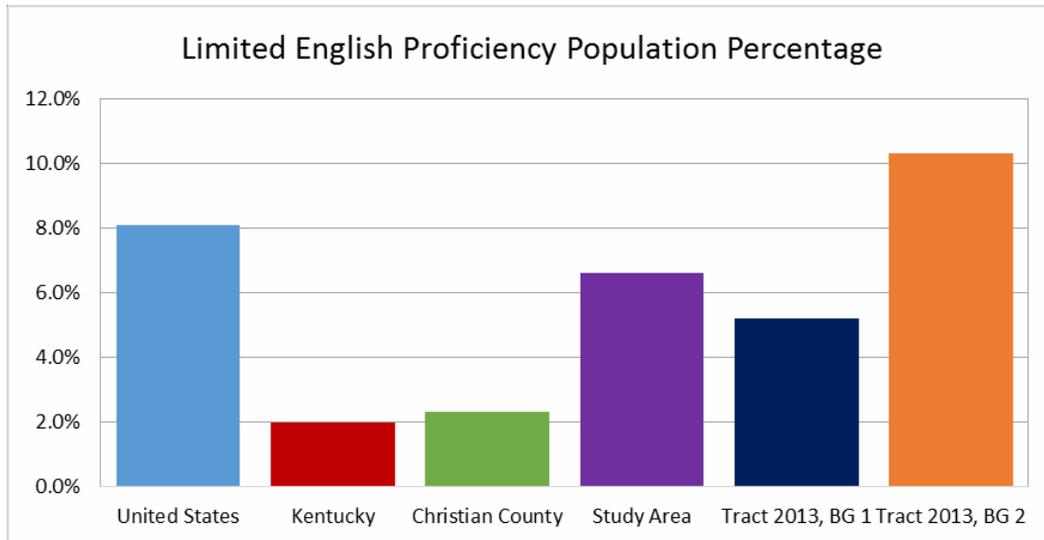


Figure 47: Limited English Proficiency Population Percentage

During future phases of project development a more detailed analysis may be required for NEPA documentation, per Environmental Justice Executive Order 12898, to assess potential for adverse and disproportionate impacts to low-income and minority (i.e., environmental justice) populations.

5.2.3 Noise

Several clusters of single-family residential dwellings, approximately one church/place of worship, a potential historic district, Town Hall, and Pembroke Elementary School are adjacent to the corridor (**Figure 38**). A noise sensitive area, or NSA, is generally defined as a geographical area covering multiple properties with similar land uses and noise environments that may benefit from a single noise abatement measure, such as a noise barrier wall. Noise sensitive sites typically represent property (owner occupied, rented, or leased) where frequent human outdoor activity would benefit from a lowered noise level. An NSA can represent a single isolated property or an entire neighborhood.

If a project is advanced from this study and receives federal funds, additional noise impact analysis may be required. However, given existing and projected future traffic volumes, anticipated noise levels are not expected to approach or exceed FHWA Noise Abatement Criteria (NAC).

5.2.4 Air Quality

Christian County is in attainment for all National Ambient Air Quality Standards (NAAQS) for six major air quality pollutants: carbon monoxide (CO), nitrogen dioxide (NO₂), ozone (O₃), sulfur dioxide (SO₂), lead (Pb), and particulate matter (PM_{2.5}) and (PM₁₀). Based on Kentucky CO

Screening Criteria, projects resulting from this study will not require a CO project-level analysis and will not produce a projected violation of the CO standard.

Regarding mobile source air toxics (MSATs), the scenarios presented in this study are considered as a project with “Low Potential MSAT Effects”; therefore; only a qualitative assessment of emissions projections will be required.

5.2.5 Hazardous Materials

Review of potential hazardous materials sites is based on the Environmental Data Resources, Inc. (EDR) DataMap Area Overview map and a limited field reconnaissance to identify additional potential sites of concern. An electronic review of applicable environmental database searches of 57 federal records, nine state and local records, and one EDR proprietary record was conducted. The database search reported by EDR identified 29 potential hazardous waste sites in the study area. **Table 14** lists these sites. The EDR map and report are in **Appendix H**.

Table 14: Potential UST/Hazmat Sites

Site	Address	Map ID Number
PTC Hopkinsville Sealin	500 Frank Yost Lane	(Map ID #2)
Vertner Smith West	US 41A /South Pembroke Road	(Map ID #3)
Gary Marsh Development	US 41	(Map ID #4)
Riken Elastomers Corp.	340 Riken Court	(Map ID #5)
Martinrea Hopkinsville	1500 Frank Yost Lane	(Map ID #6)
Siemer Milling Co	315 Quintin Court	(Map ID #6)
Denso Manufacturing	1405 Frank Yost Lane	(Map ID #6)
Continental Mills	100 Krustez Way	(Map ID #6)
Alliance Tubular Hol	500 Plant Yost Lane	(Map ID #6)
T-rad North America	750 Frank Yost Lane	(Map ID #6)
FP International - H	1 Graham Way	(Map ID #7)
Sun Chemical Corp GP	100 Sun Chemical Court	(Map ID #8)
Excess Soil Disposal	7097 John Rivers Road	(Map ID #9)
Casky Inspection Yard	Various	(Map ID #10)
CSX Transportation	6512 John Rivers Road	(Map ID #10)
Amfine Chemical Corp.	6805 John Rivers Road	(Map ID #10)
Unknown	South Nashville Road	(Map ID #12)
Moe’s Service Center	112 Nashville Road	(Map ID #13)
Minit Mart #92	125 West Nashville Road	(Map ID #13)
Minit Mart 90	150 West Nashville Road	(Map ID #13)
Recycling Center Inc.	Broad Street	(Map ID #14)
Pembroke Elementary	1600 Pembroke Oak Grove	(Map ID #17)
Gates Grocery	6310 Pembroke Oak Grove	(Map ID #19)
I-24 Disposal Site	7125 Pembroke Oak Grove	(Map ID #20)
Pilot Travel Center	8190 Pembroke Oak Grove	(Map ID #21)
Barker Family Trust	SR 1453	(Map ID #22)
City of Oak Grove	8505 Pembroke Oak Grove	(Map ID #23)
Sudden Service #50	2905 Walter Garret Lane	(Map ID #25)

5.2.6 Historic Architectural Resources (Section 106)

A review of Kentucky Heritage Council (KHC) files identified 63 previously recorded historic architectural resources in the study area and 11 previously unrecorded resources within a one-half mile buffer. Of the 63 recorded resources, 51 are in a newly identified historic district. Numerous houses, a general store, a bridge, and a cemetery are among the previously recorded sites. Resource CH-72, the Richardson House, was listed in the National Register of Historic Places (NRHP) in 1979.

Archival research and windshield reconnaissance were conducted to identify other architectural resources listed or potentially eligible for listing in the NRHP. A field survey identified the following five resources at least 50 years of age appear potentially eligible:

- Rosedale Cemetery—Unknown Eligibility: additional research required.
- Pembroke Historic District—Recommended Eligible: contains 51 previously recorded properties considered contributing elements to the district.
- Circa 1960 ranch house—Recommended Potentially Eligible.
- West Pembroke Ranch House Historic District—Recommended Potentially Eligible.
- Louisville and Nashville Railroad corridor—Recommended Potentially Eligible.

NRHP eligibility assessments are based on a reconnaissance-level effort to ascertain integrity; therefore, preliminary pending a formal, more intensive survey under Section 106 of the National Historic Preservation Act. The survey will help refine potential historic district boundaries, contributing/non-contributing district resources, and NRHP boundaries for individual properties.

The overview report documenting research and reconnaissance conducted for this corridor study is in **Appendix E**.

5.2.7 Archaeological Resources

An archaeological overview was completed to identify sites listed in or eligible for listing in the NRHP. No fieldwork was undertaken; however, background research was conducted utilizing historic maps, LiDAR data, USDA soil data, and Office of State Archaeology (OSA) GIS data/site files. A summary of previously recorded archaeological sites and survey data, a review of historic mapping and LiDAR derived mapping, and analysis of the probability of archaeological sites being in the study area based on existing data.

Archaeological data obtained from the OSA identifies five previously recorded archaeological sites in the study area. Approximately 11% of the approximately 4,000 acres comprising the study area have been subjected to previous archaeological surveys, nine of which were conducted partially or wholly in the study area.

Methods employed during surveys by Schock and Wyss (1970), and Schock (1987, 1994, 1997a, and 1997b) may not have conformed to current survey guidelines set forth by the KHC (Sanders 2006). Archaeological investigations associated with projects resulting from this corridor study may need to cover these previously surveyed areas.

Due to sensitive information, the archaeological overview has been submitted to the KYTC under separate cover and is not included in this document.

5.2.8 Land and Water Conservation Fund (LWCF)—Section 6(f)

Based on current LWCF records, two grants were sponsored by the City of Pembroke:

- ID 11457 1987 \$25,164.53 Christian Pembroke Municipal Park
- ID 11451 1981 \$5,732.85 City of Pembroke

Parks using LWCF grants are afforded certain protections. If proposed roadway projects affect recreational land/facilities benefitted by LWCF grants, Section 6(f) issues may arise. Information about the two grants and other LWCF grants in Christian County is in **Appendix E**.

5.2.9 Public Parks

No public parks are in the Pembroke Corridor study area.

5.2.10 Agricultural Districts

The Kentucky Division of Conservation administers the Agricultural District Program, the goals of which are to protect Kentucky's best agricultural land for food and fiber production, and to prevent its conversion to nonagricultural usage. Four agricultural districts are along KY 115 and US 41 in the study area (**Figure 48**). Land enrolled in the program cannot be annexed or condemned without mitigation, is taxed at the agricultural rate, and is eligible for deferred assessment costs when water lines are extended.

5.2.11 Conservation Easements

Kentucky's Farmland Preservation Program authorizes the purchase of agricultural conservation easements through the Purchase of Agricultural Conservation Easements (PACE) program to ensure lands currently in agricultural use will remain available for agriculture and not be converted to other uses. The Kentucky Department of Agriculture data shows no PACE Program properties are in or near the study area. However, a Pembroke official reported a recent conservation easement has been established west of the KY 115/Anderson Road intersection.

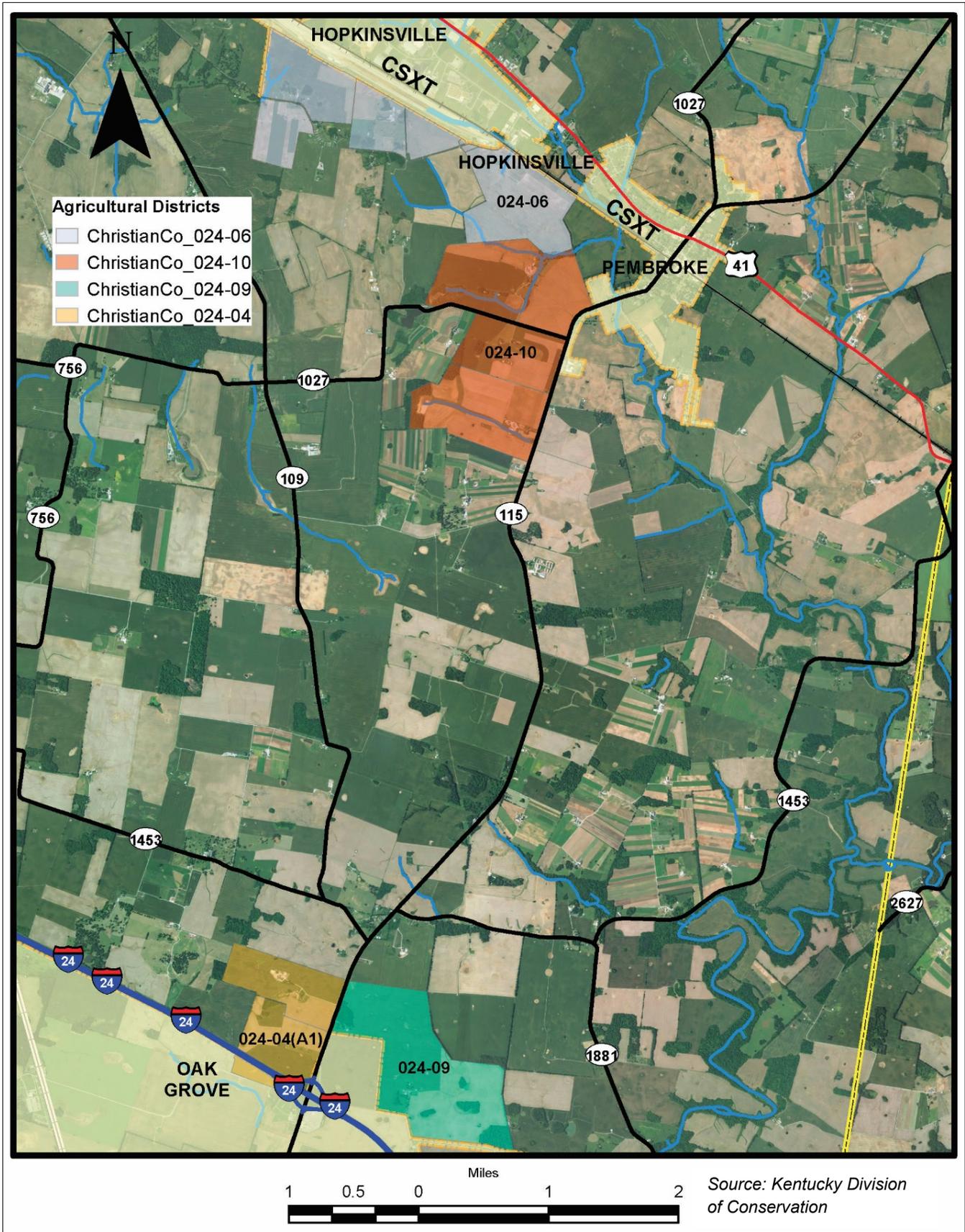


Figure 48: Agricultural Districts

6.0 INITIAL MEETINGS

Three project team meetings were held during the course of this study. The team also met twice with local officials and stakeholders and once with the public. Project team members include the KYTC Central Office Division of Planning, District 2 Planning and Design staffs, a PADD representative, and the consultant Qk4.

6.1 First Project Team Meeting

The first project team meeting was held the morning of November 10, 2016 at Pembroke Baptist Church. The meeting objective was to discuss existing roadway, traffic, and environmental conditions, and gather input prior to concept development. All project team meeting summaries are in **Appendix I**. Key discussion items are summarized below.

- Widening concepts must meet horizontal and vertical curve radius requirements cited in the Green Book.
- A reduction in truck percentages was noted on KY 115—from a 2011 count of 420 trucks per day (28.3%) at Station 325 to the 2016 study count of 260 (10.7%), a difference of 160 trucks per day.
- Limited English proficiency population percentage is more than three times higher than the statewide percentage. This may be attributable to German being the first language of many in the Amish community.
- Passing lanes on KY 115 are not desired because of potential conflicts between accelerating vehicles and large trucks frequently entering/exiting farm driveways along the route.
- The Pembroke community wants road shoulders to safely accommodate Amish horse and buggy travel. A shoulder design similar to US 41A south of Hopkinsville, i.e., 10-foot paved shoulder with a one-foot rumble strip between the traveled way and shoulder, was recommended with US 41 and KY 115 widening concepts.
- A new Pembroke Connector should have partial controlled access.
- Any proposed bridge over the railroad must be 23 feet from top of rail to the bottom of the bridge beam. Historically, railroad companies have required the KYTC to span the entire right-of-way at this same height.
- Various options will be considered for connecting the southern terminus of a Pembroke Connector to KY 115.

6.2 First Local Officials/Stakeholders Meeting

The first Local Officials/Stakeholders (LO/S) meeting was held the afternoon of November 10, 2016, at Pembroke Baptist Church. The project team met with city officials, including the

Pembroke Mayor, and representatives from the Pembroke police and fire departments, Hopkinsville and Christian County Community Development Services, and Pennyryle Transportation Committee. The meeting objective was to discuss existing roadway, traffic, and environmental conditions, and gather input prior to concept development. All local official/stakeholder meeting summaries are in **Appendix J**. Key items of discussion included the following:

- Reinstating the former truck ban on KY 115 may eliminate the need to improve this corridor. Note: This ban could not be confirmed by the KYTC or local officials.
- Widen/reconstruct KY 115 before constructing a Pembroke Connector.
- KY 115 bridge at MP 9.910 is very narrow, which impairs the ability of opposing vehicles, e.g., a tractor trailer and a car, to cross the bridge simultaneously.
- Traffic on KY 115 has worsened due to Pembroke Elementary School's expansion.
- Tying the Pembroke Connector to KY 115 south of the school will affect more prime farmland and be less appealing to landowners.
- District 9 State Representative Myron Dossett submitted a letter identifying widening KY 115 as his most important priority.
- Mayor of Pembroke Judy Peterson requested a bicycle/pedestrian facility with proposed connector concepts. The Mayor's first preference was a shared-use path separated from traffic and having connection to the bridge over the railroad. The second choice was for bicycles and pedestrians to have a place on the shoulder of the road.
- Oak Grove residents travel KY 115 to Pembroke Elementary School and/or the Commerce Park on US 41, and Pembroke residents who work at Fort Campbell also rely on KY 115 for their commutes.
- Local officials cautioned the project team to expect resistance to a Pembroke Connector from landowners and community members concerned about loss of business downtown.
- Follow property lines as much as possible when determining right-of-way.

Asked to identify future growth areas and existing conditions or environmental resources not mentioned during the presentation, attendees noted the following:

- Google has acquired a 1,215-acre industrial site in Montgomery County, Tennessee, to build a data center, which could lead to growth in the project area.
- Montgomery County has emergency management services (EMS) and a hospital that serve the study area.

7.0 PURPOSE AND NEED STATEMENT

The **purpose** of projects resulting from this study is to improve roadway geometrics and mobility of traffic, especially freight traffic, to and from I-24 and Commerce Park.

In recent years Christian County and Hopkinsville have been successful in recruiting new industries to the Hopkinsville Industrial Park and the newly expanded Commerce Park, both on US 41 (Pembroke Road), northwest of Pembroke. According to 2016 data from the Kentucky Cabinet for Economic Development, larger industries in the Commerce Park include Martinrea, T. RAD North America, Continental Mills Inc., and PTC Seamless Tube Corporation, totaling over 1,500 employees. Currently, Commerce Park has 10 or more active industrial facilities and 766 acres available for industrial expansion. The HCCCP *Draft Land Use Element* identifies the Pembroke industrial area as “accounting for a large percentage of (Hopkinsville’s) industrial land,” and calls for expanded industrial growth in the Pembroke area.

The **need** for projects is based on the following existing conditions and future plans:

- 1) Commerce Park is expanding. **Figure 49** shows 2003 and 2015 aerial site views, by which time substantial development had occurred. **Figure 50** illustrates the park’s existing occupants, utilities, etc., and **Figure 51** locates the area planned for the park’s expansion south of the CSX railroad tracks.

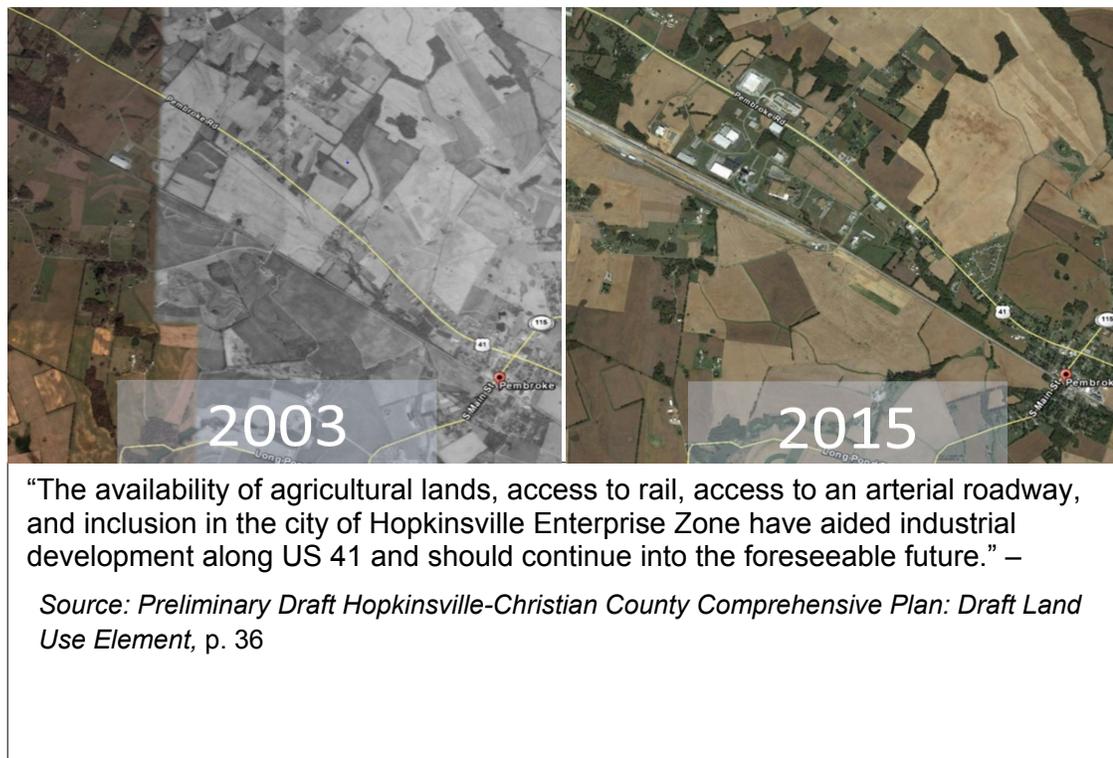


Figure 49: Recent Commerce Industrial Park Growth

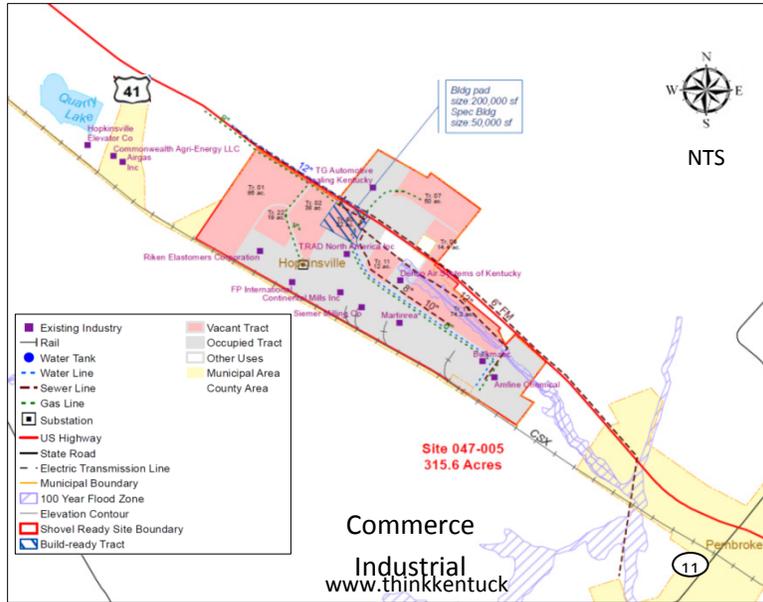


Figure 50: Existing Commerce Industrial Park

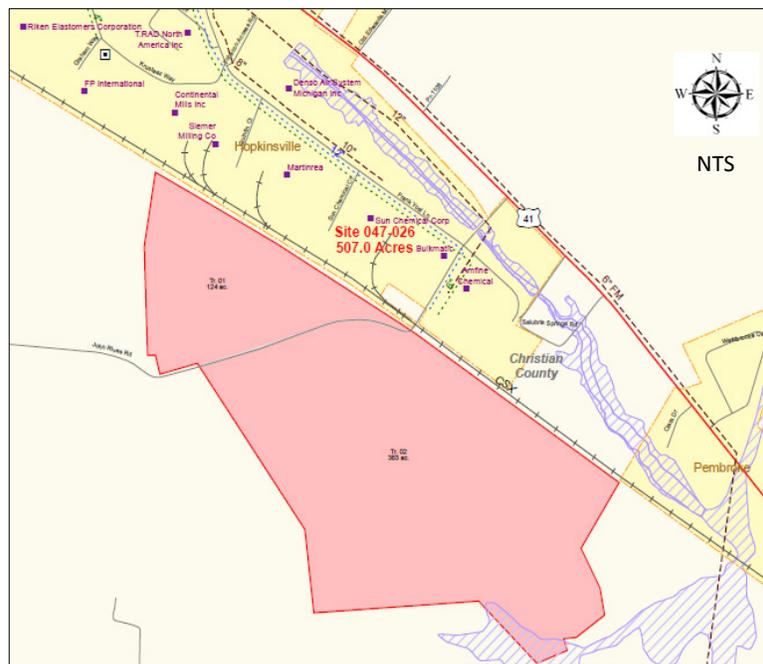


Figure 51: Commerce Industrial Park Expansion

- 2) KY 115 is a narrow, two-lane road assigned truck weight classification “A,” 44,000 pounds maximum allowable gross weight, on the Kentucky Highway Freight Network. KY 115 connects US 41 and I-24 as the shortest corridor to and from I-24, both of which are classified “AAA,” 80,000 pounds maximum. Consequently, due to its proximity between I-24 and US 41, KY 115 experiences a high volume of heavy truck traffic it is not designed to accommodate.

- 3) The US 41/KY 115 intersection in Pembroke is skewed with substandard turning radii, especially for large vehicles, as seen in **Figure 52**.



Figure 52: US 41/KY 115 Intersection Looking North

- 4) During off-peak times with no train disruptions, the average field-measured travel time for the most direct connection from Commerce Park to I-24 (Exit 89 at KY 115) is 12.7 minutes. The CCTDM travel time for the study corridor is similar at 11.9 minutes. However, day-to-day predictability of travel time in the study corridor is inconsistent due to large farm equipment, semi-tractor trailers carrying agriculture products, school buses, slow moving Amish buggies, and limited passing opportunities result in lower travel speeds and platooning.
- 5) CSX operated a railyard south of the Commerce Park until it was abruptly closed in May 2017. Prior to closure, the at-grade railroad crossing on KY 115 posed geometric challenges and travel time delays. In an observed 48-hour period, 51 trains crossed KY 115, blocking traffic between 1.51 and 15.23 minutes in peak hours. Average disruption was 3:43 minutes per train, with maximum disruption lasting nearly 38 minutes (off peak hours).
- 6) KY 115 bridge over Montgomery Branch (MP 9.910) is narrow, functionally obsolete, and a high-crash spot.

Needs along the corridor can be further defined by the following factors:

Roadway Geometrics

- Narrow lanes (10 feet on US 41 and nine feet on KY 115).
- Narrow, paved shoulders (zero to two feet on US 41 and KY 115).
- Three vertical sight distance issues on US 41 and eight on KY 115.
- One narrow, functionally obsolete bridge on KY 115, with a curb-to-curb width of 20 feet.

Study goals are twofold: (1) where feasible improve traveling safety, to include Amish horse and buggy and large farm equipment; and (2) advance relevant HCCCP transportation elements that support continued growth for the area.

Community Concerns

- Seven high-crash spots have a Critical Crash Rate Factor (CCRF) > 1.0.
- Pembroke is a recommended Eligible Historic District with 51 resources.
- Traffic flow is impeded by large farm equipment and Amish horse and buggies.
- Pembroke Elementary School traffic mixes with large truck traffic on KY 115.

8.0 CONCEPT DEVELOPMENT

Initial improvement concepts show two corridors that meet the study's purpose and need: (1) existing US 41 from Commerce Park through Pembroke, then south along KY 115 to I-24, and (2) a new connector southwest of Pembroke from US 41 to KY 115, then south along KY 115 to I-24. Concepts initially developed within the corridors follow:

- Concept A widens US 41 to KY 115.
- Concept A-1 improves the US 41/KY 115 intersection.
- Concept B constructs a new US 41/KY 115 connector southwest of Pembroke.
- Concept C rebuilds KY 115 from near I-24 to north of the KY 115 bridge over Montgomery Branch in Pembroke, and is compatible with either Concept A or B.

The improvement concepts were developed based on the existing conditions analysis, field reviews, traffic forecasts, and input received from the project team and LO/S. All concepts are preliminary and subject to change in future project phases. Both short- and long-term improvements were considered. Concepts were developed considering residential, business, environmental impacts, and minimizing impacts to farming operations.

8.1 Typical Sections

The project team, with LO/S input, considered various typical sections for US 41 and KY 115 widening concepts (A and C). Key considerations were the large farming and Amish populations, and community leaders' desire to safely accommodate slower moving horse and buggy, bicycle, and large farm equipment by providing wider shoulders on these roads. The project team agreed to use 11-foot lanes and 10-foot paved shoulders, as shown in **Figure 53**.

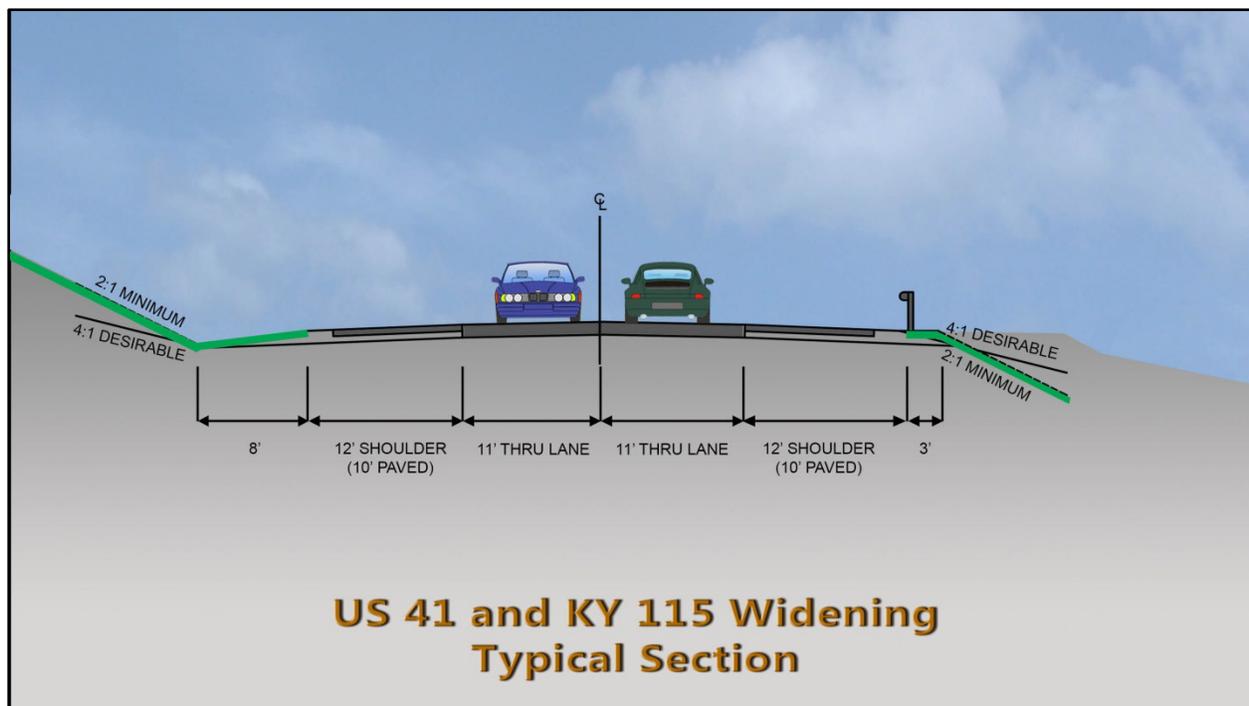


Figure 53: US 41 and KY 115 Widening Concepts A and C—Typical Section

For the new route connecting US 41 northwest of Pembroke to KY 115 south of Pembroke (Concept B), the project team elected to advance it as a partial controlled access road with 11-foot lanes and eight-foot paved shoulders with an optional 10-wide shared-use path, as shown in **Figure 54**.

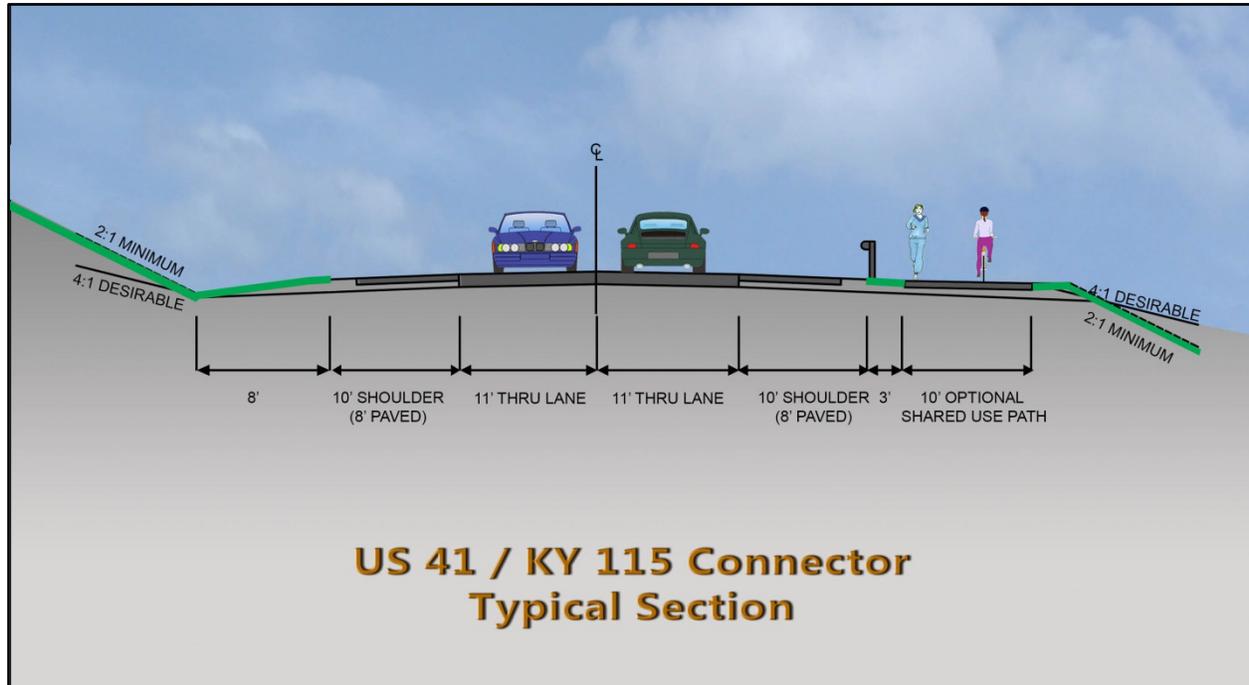


Figure 54: Pembroke Connector/US 41/KY 115 Connector (Concept B) Typical Section

8.2 Second Project Team Meeting

Staff from the KYTC Central Office, KYTC District 2 Office, PADD, and Qk4 met February 13, 2017, at the KYTC District 2 office in Madisonville. The purpose was to review and analyze LO/S input, and to present improvement concepts for discussion. The concepts, which build upon those identified in the previous meeting, are described below and shown in **Figure 55**.

8.2.1 No Build/Do Nothing

The No Build/Do Nothing concept serves as a baseline for comparison of other concepts. This concept indicates existing conditions remain without new construction improvements and only future maintenance would take place.

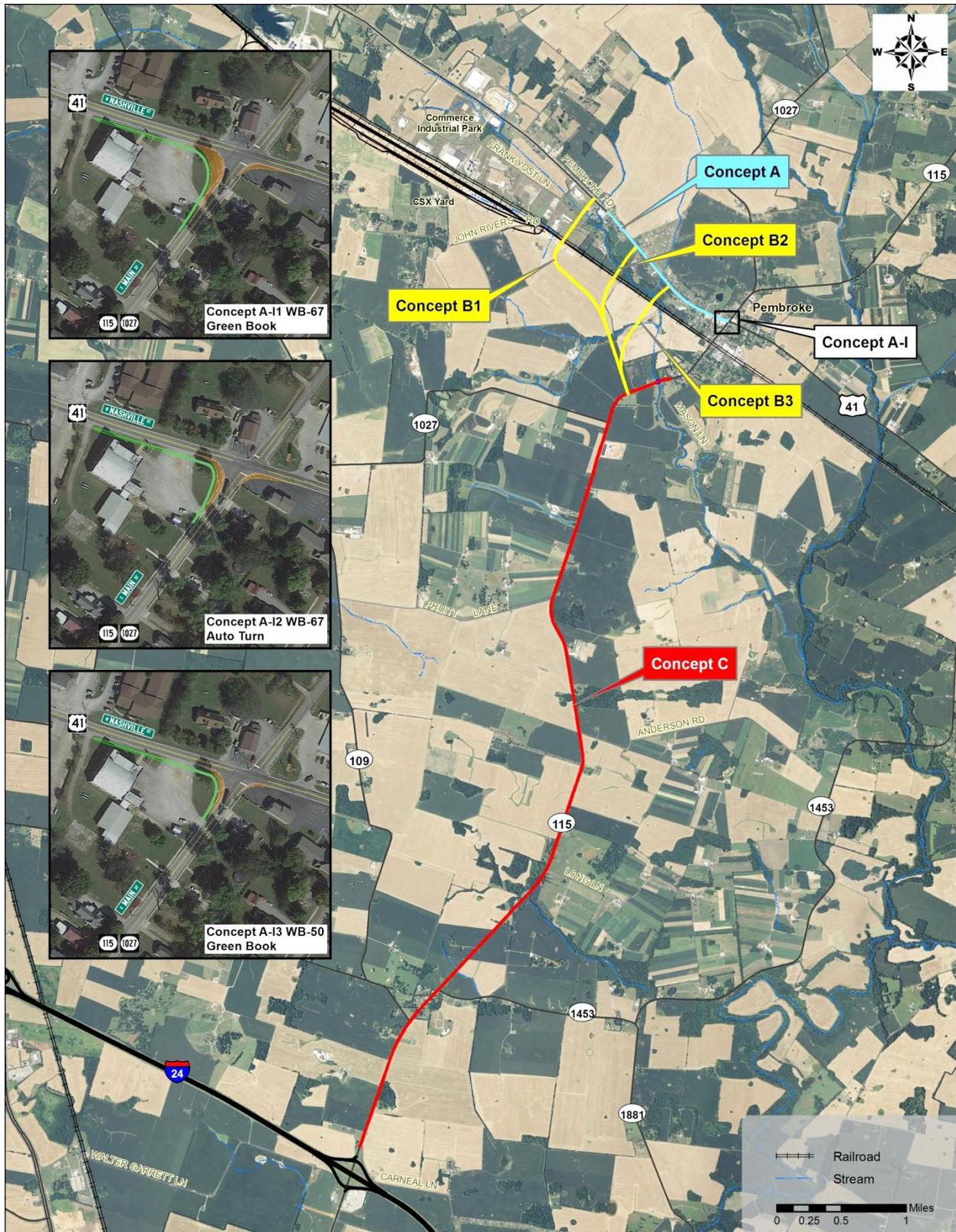


Figure 55: Initial Improvement Concepts Considered and Presented to LO/S

8.2.2 Concept A—Improve/Widen US 41 (Long-Term)

Widen the 1.214-mile, two-lane section of US 41, and make the following improvements:

- Widen equally the 10-foot lanes to 11 feet and two-foot paved shoulders to eight feet paved, from MP 2.786 intersecting with KY 115 to the widened two-lane section at MP 4.000 northwest of Salubria Springs Road, where US 41 transitions to 12 foot lanes and ten foot paved shoulders with a middle, continuous left-turn lane.
- Widen the two-span culvert at MP 3.422 (Bridge ID 024B00025N) to accommodate the widening of US 41.
- Reconstruct sidewalk from MP 2.790 near KY 115 to MP 3.037 west of Walnut Street.

Concept A improves connectivity for motorists from the Commerce Park to downtown Pembroke.

8.2.3 Concept B—Pembroke Connector (Long-Term)

Construct a new route connecting US 41 and KY 115 northwest and south of Pembroke with a grade separated crossing over the CSX railroad.

The proposed Pembroke Connector is a partially controlled access route, which limits access to 1,200-foot intervals; with a design speed of 45 mph. A crossing over the CSX railroad will have a minimum vertical clearance of 23 feet from top of rail to bottom of bridge and a minimum horizontal clearance of 25 feet from centerline of railroad track. Concept B was initially developed with a “T” intersection at US 41 and KY 115, and an alternative tie-in to KY 115. The concept makes the connector the through movement with KY 115 as a “T” intersection (**Figure 56**).

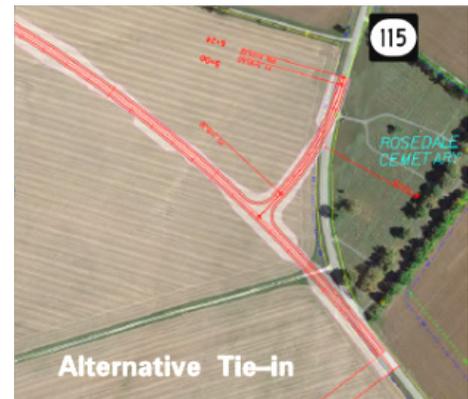


Figure 56: KY 115 Alternative Tie-In

Connector concepts would remove large semi-tractor trailers from the reduced speed limit sections of US 41 and KY 115 in downtown Pembroke and provide an alternative to the KY 115 railroad crossing and narrow bridge that contribute to travel time delays and an inconsistent and unreliable route, especially for emergency vehicles. These concepts will add additional mileage to maintain.

Three connector concepts were examined and are described in the following sections.

8.2.3.1 Concept B1

Concept B1 is a 1.909-mile connector from MP 9.450 of KY 115 near Rosedale Cemetery to MP 4.230 of US 41, southeast of John Rivers Road, with an estimated 285-foot-long, steel girder, three-span bridge over 172-foot-wide CSX railroad right-of-way. Conceptual profile grades are less than 2% and -4% on either side of the bridge. Concept B1 divides a large tract of farmland south of the CSX railroad, crosses two streams requiring estimated 12x11 and 22x11-foot culverts, and ties to the existing three-lane, 12-foot wide driving lanes, 10-foot paved shoulder

section of US 41. The following enhancements are presented for consideration but are not included in the cost estimate or concept length:

- Create a right-turn-lane at Concept B1 by widening US 41 approximately 0.270 miles west to MP 4.495 west of John Rivers Road.
- The grade for Concept B1 can accommodate an at-grade intersection with Frank Yost Lane, if desired.
- Reconstruct John Rivers Road south of the CSX railroad to tie into Concept B1 and eliminate the existing high-speed at-grade rail crossing.

8.2.3.2 Concept B2

Concept B2 is a 1.365-mile connector from MP 9.450 of KY 115 near Rosedale Cemetery to MP 3.730 of US 41 with an estimated 240-foot-long, pre-stressed concrete I-Beam (PCIB), three-span bridge over 120-foot-wide CSX railroad right-of-way. Conceptual profile grades are less than 4% and -6% on either side of bridge. Concept B2 grades could be flattened, if advanced to the design phase; however, embankment quantities would increase. Conceptual alignment closely follows property lines and crosses two streams with estimated 12x11 and 22x11-foot culverts. This concept ties to the section of existing US 41 having two 10-foot lanes and two-foot paved shoulder, and may require relocation of a small commercial business near US 41. The following enhancements should be considered but are not included in cost estimate or concept length:

- Widen US 41 approximately 0.270 mile from the northern terminus of the connector (MP 3.730) northwest to the improved (12-foot lanes and 10-foot paved shoulders) section near Salubria Springs Road. *Note: This improvement was later added as Concept A-to-B2; see Section 11.0.*

8.2.3.3 Concept B3

Concept B3 is a 0.970 mile connector from MP 9.450 of KY 115 near Rosedale Cemetery to MP 3.330 of US 41 with an estimated 240-foot-long, pre-stressed concrete I-Beam (PCIB), three-span bridge over 120-foot-wide CSX railroad right-of-way. Conceptual profile grades are less than 6% and -8% on either side of bridge. Concept B3 grades could be flattened, if advanced to design phase; however, embankment quantities would increase. Conceptual alignment crosses two streams with estimated 24x12 and 22x11-foot culverts. Concept B3 ties into US 41 approximately 0.7 mile east of the improved section. US 41 widening improvements are not included in cost estimate or concept length.

8.2.4 Concept C – Improve/Widen KY 115 (Long-Term)

Concept C widens KY 115 travel lanes and improves shoulders for 6.863 miles from MP 3.137 at Carneal Lane located), just north of I-24, to MP 10.000 north of Mason Lane in Pembroke. Concept C includes replacing the functionally obsolete bridge at MP 9.910. This would improve three high-crash spots, the route to AAA truck rating, and the Kentucky Freight Network.

Four widening options were reviewed along the existing horizontal alignment to assess impacts: widen equally along the existing centerline, widen left, widen right, and a best fit alignment. If a project results from Concept C, the following should be considered to minimize costs and impacts:

- Urban template, where applicable, with narrower shoulders and/or curb and gutter.
- Avoid the historic Rosedale Cemetery.
- Minimize large sinkholes adjacent to the roadway.

Concept C improves safety and provides AAA route for potential freight traffic.

8.2.5 Concept A_I—Improve US 41/KY 115 Intersection (Short-Term)

Widen KY 115 (MP 10.662) and US 41 (MP 2.786), in the southeast and southwest intersection quadrants, to enable large trucks to make right turns from US 41 eastbound to KY 115 southbound and KY 115 northbound to US 41 eastbound without encroaching on the opposite lanes.

Concept A_I improves two high-crash spots (one each on US 41 and KY 115), corrects substandard turning radii, and relocates and reconstructs the broken sidewalk and water main in the southwest quadrant. Three different intersection improvement concepts were initially developed:

- Concept A_I1 provides for the AASHTO Green Book WB 67 (73.5-foot) semi-tractor trailer common in the area to negotiate the intersection without encroaching in the opposite lane.
- Concept A_I2 requires a lesser footprint than the AASHTO method noted above by using software to simulate the same WB 67 wheel path while making the required right turn.
- Concept A_I3 assumes a lesser size semi-tractor trailer to allow large trucks to continue to use opposing lanes when making right turns at the US 41/KY 115 intersection but lessen the amount of space needed.

Only one of these concepts would be implemented.

Concept A_I, whether it is A_I1, A_I2, or A_I3, is a standalone, lower cost improvement project that can be implemented to address safety, geometric, and pedestrian issues.

8.2.6 Concept D—Replace KY 115 Bridge (Short-Term)

Concept D is 0.100 mile long and replaces the functionally obsolete KY 115 bridge (MP 9.910) over Montgomery Branch. This bridge is located in a high-crash spot, has a 20-foot traveled way from curb to curb, and is potentially a contributing element to the recommended NRHP-eligible Pembroke Historic District. Concept D can be implemented as a standalone, lower cost project to address safety on and near the bridge by allowing north and southbound large vehicles to pass safely.

8.3 Concept Evaluation

The project team's evaluation of preliminary concepts resulted in the following decisions:

- Eliminate Concept A_I3 because it does not fully address maneuverability requirements of WB-67 (73.5-foot) semi-tractor trailers common in the area. Large trucks would continue to use opposing lanes when making right turns at the US 41/KY 115 intersection.
- Advance Concept A_I1 in lieu of Concept A_I2. Concept A_I1 requires the largest pavement widening footprint and has the most impacts but meets the needs of larger vehicles and is a conservative preliminary design.
- Eliminate Concept B3, which is the shortest connector concept and closest to downtown Pembroke, but requires the lengthiest US 41 improvements, the most embankment fill, and has the steepest grades for a bridge over the CSX railroad.
- If a connector concept advances from this study, it is possible to reduce the shoulder width on Concept B1 or B2 to lower project costs and discourage horse and buggy traffic, since 40% of the projected traffic will be heavy trucks. With a connector, KY 115 and US 41 through Pembroke would have fewer large trucks and less vehicles therefore providing less vehicular conflicts.
- Regarding Concept C, while four widening options were considered, the best fit alignment is used for purposes of cost estimating and assessing impacts.
- For US 41 (Concept A), if connector Concept B2 is advanced, widen US 41 only from the northern terminus of the connector west to MP 4.000 near Salubria Springs Road, approximately 0.270 miles. This shortened version of Concept A is identified as Concept A to B2.
- For KY 115 (Concept C), if the Pembroke Connector (Concept B1 or B2) is advanced, do not extend the improvements north from the connector into Pembroke. This shortened version of Concept C; identified as Concept C-to-B, does not include the bridge replacement at MP 9.910 (Concept D), and is 6.313 miles long.

All remaining concepts are shown in **Figure 57**.

8.4 National Environmental Policy Act (NEPA) Documentation Requirements

If future stages of a project resulting from this planning study receive federal funding, a NEPA document will be required for that project. Per FHWA policy, each individual project must have independent utility and logical termini. In 2015, the KYTC and FHWA implemented a Categorical Exclusion (CE) Agreement to guide the NEPA document scoping process. Per the Agreement, the level of NEPA documentation likely required for each concept advanced is as follows:

- ➡ **Concept A and A-to-B2**—CE Level 1 or 2, if widening US 41 has minimal environmental impacts.

- ➔ **Concept B1 or B2**—Environmental Assessment/Finding Of No Significant Impact (EA/FONSI), because either connector concept involves construction of a new road on new alignment more than one mile in length.
- ➔ **Concept C and C-to-B**—CE Level-3 because the concept reconstructs KY 115 along its current alignment and requires more than 25 acres of new right-of-way.
- ➔ **Concept D—CE Level-1**—If the bridge is a contributing element of the Historic District, “State Level-1 documentation” will be required to comply with Section 106 of the National Historic Preservation Act, and a Programmatic 4(f) document for the use of historic bridges will be required to comply with Section 4(f) of the US DOT Act (23 CFR 774).

Before the NEPA process begins, the KYTC Division of Environmental Analysis will have a Scope Verification Meeting with the FHWA to determine the appropriate level of NEPA documentation for each project. Initiating Section 106 consultation and intensifying public engagement with the Amish Community are recommended early-on whatever the level of NEPA documentation.

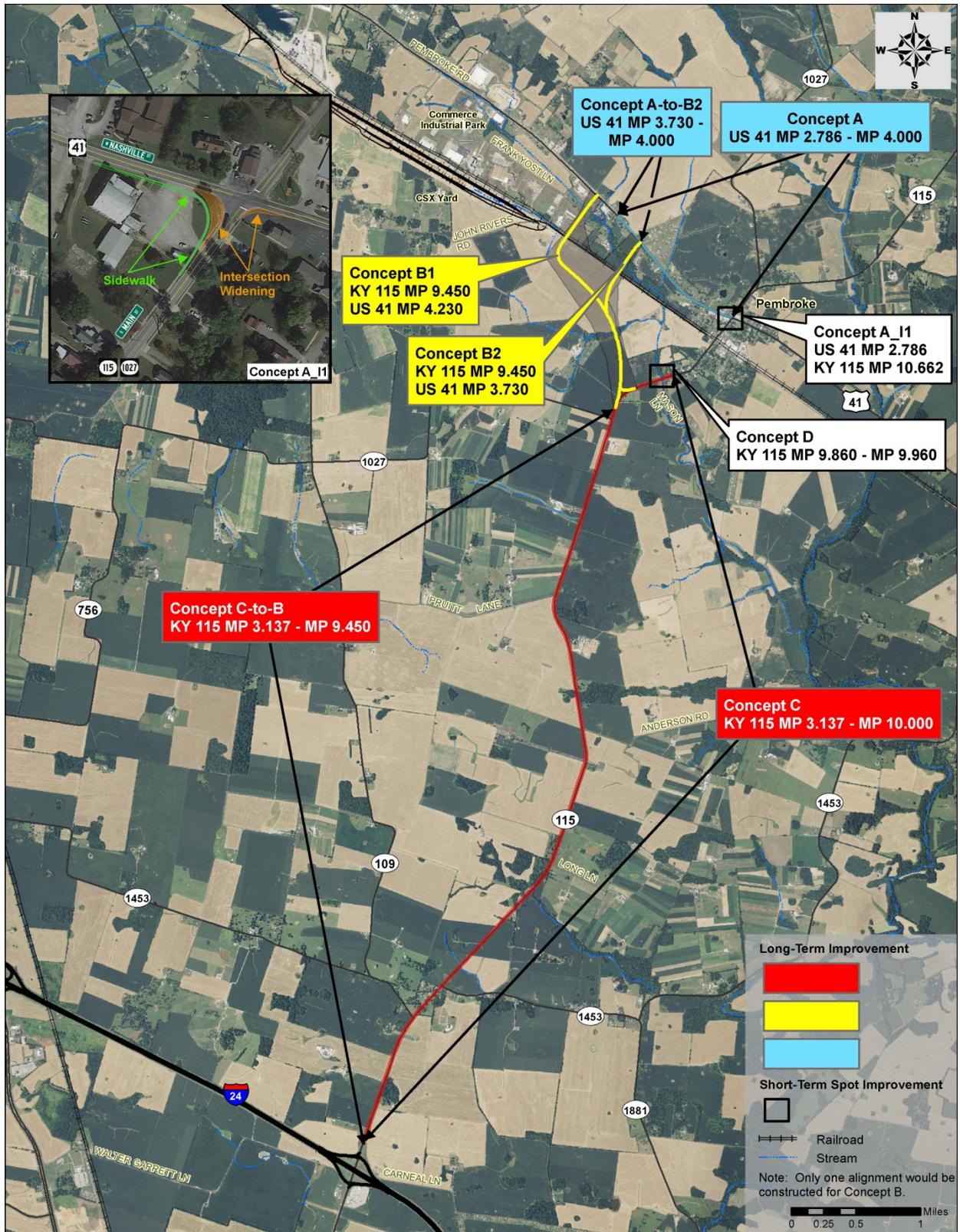


Figure 57: Concepts Advanced for Detailed Evaluation

9.0 2040 TRAFFIC ANALYSIS OF BUILD CONCEPTS

The projected 2040 future year Build traffic volumes and operations analysis are summarized in **Tables 15 and 16** and **Figure 58**.

Utilizing the CCTDM discussed in Section 5.3, a Build scenario for Concept B2 was modeled to determine traffic diversion to a new connector. Model results project the following:

- A new connector attracts 2,200 vpd in 2040, including 880 trucks.
- US 41 2040 ADT from the connector east to KY 115 decreases by 2,400 vpd, including 360 trucks per day.
- KY 115 2040 ADT north of the connector through Pembroke decreases by 500 vpd, including 310 trucks.
- South of the connector, KY 115 traffic increases by 1,600 vpd, including 550 trucks.

Widening existing lanes and shoulders of a narrow, two-lane road may improve safety but, per the traffic model, does not increase capacity. Likewise the model does not take into account traffic changes from improving KY 115 from “A” to “AAA” freight weight class. Consequently, modeling US 41 and KY 115 widening concepts without including a new connector, the CCTDM assigned the same traffic volume and percent truck traffic as those assigned to the No Build scenario. An assumption can be made that more trucks would use the KY 115 corridor if widened; however, the CCTDM does not account for this.

Utilizing the same subarea shown in Section 4.4.1, **Figure 36** with a connector from US 41 to KY 115 west of Pembroke, the CCTDM models the 2040 Build versus No Build daily savings in vehicle hours traveled (VHT) and vehicle miles traveled (VMT) to be 37 VHT and 891 VMT, respectively.

Although building a connector will reduce traffic in downtown Pembroke and increase traffic on US 41 between the Commerce Park and the connector and on KY 115 between the connector and I-24, the design year LOS will remain the same as the No Build LOS for all segments of US 41 and KY 115.

The Build v/c ratio changes from 0.33 to 0.24 on US 41 and from 0.14 to 0.12 on KY 115 between the Pembroke Connector and the US 41/KY 115 intersection in Pembroke.

The US 41/KY 115 intersection displays improved LOS C in the Build connector scenario, compared to LOS D and LOS F with the No Build scenario.

The John Rivers Road and Frank Yost Lane intersection approaches to US 41 are projected to operate at LOS F in 2040 in the PM peak hours and the I-24 westbound ramp terminal delay worsens slightly. These intersections may require improvement if a Pembroke Connector is built.

Table 15: 2040 Build Segment Traffic Analysis

Route	Beginning Milepoint	Beginning Feature	Ending Milepoint	Ending Feature	2040 No Build						2040 Build					
					AADT	2040 AADT Truck %	LOS	% Time Spent Following	Average Travel Speed	v/c Ratio	AADT	2040 AADT Truck %	LOS	% Time Spent Following	Average Travel Speed	v/c Ratio
US 41	2.786	KY 115	4.396	John Rivers Rd.	7,500	11.6	C	70.6	34.6	0.33	5,100	10.0	C	64.9	35.9	0.24
	4.396	John Rivers Rd.	5.397	Frank Yost Ln.	11,600	13.2	A/A	3.7 / 3.1	55.0	0.10 / 0.08	11,200	10.0	A/A	3.7 / 3.1	55.0	0.10 / 0.08
	5.397	Frank Yost Ln.	9.212	US 68B			A/A	4.2 / 7.8	55.0	0.12 / 0.22			A/A	4.2 / 7.8	55.0	0.12 / 0.22
KY 115	2.663	Walter Garrett Ln.	2.800	I-24 EB Ramps	8,400	8.4	E	83.2	32.4	0.52	8,400	8.4	E	83.2	32.4	0.52
	2.800	I-24 EB Ramps	3.000	I-24 WB Ramps			E	73.3	39.7	0.37			E	73.8	39.6	0.38
	3.000	I-24 WB Ramps	3.110	Speed Limit Change	4,600	7.8	D	59.4	42.2	0.22	5,100	18.0	D	60.3	42.6	0.19
	3.110	Speed Limit Change	3.220	Flat Terrain Ends			C	52.6	50.8	0.19			C	54.1	50.7	0.19
	3.220	Rolling Terrain Begins	4.173	KY 109			C	59.5	47.5	0.19			C	64.4	49.6	0.25
	4.173	KY 109	9.375	KY 1027			C	56.0	47.3	0.19			C	58.7	49.9	0.22
	9.375	KY 1027	9.929	Mason Ln.	4,000	11.2	C	59.7	36.5	0.17	4,000	4.0	C	62.6	36.0	0.20
	9.929	Mason Ln.	10.523	East Cherry Street /West Cherry St.			C	53.6	25.6	0.14			C	53.6	25.6	0.12
	10.523	East Cherry Street /West Cherry St.	10.662	US 41			C	53.6	25.4	0.14			C	53.6	25.4	0.12
	10.662	US 41	10.955	KY 1027	2,400	5.8	B	54.3	28.3	0.15	2,400		B	54.3	28.3	0.15

Table 16: 2040 Build Intersection Traffic Analysis

Intersection Number	Intersections	LOS						Worst Movement
		2016 Existing		2040 No Build LOS		2040 Build		
		AM	PM	AM	PM	AM	PM	
3	US 41/KY 115	B/B	B/C	A/D	A/F	A/B	A/C	KY 115 NB and SB
2	US 41/Johns Rivers Road	A/B	A/B	A/B	A/C	A/C	A/F	John Rivers Rd. NB
1	US 41/Frank Yost Lane	A/B	A/F	A/D	B/F	A/C	B/F	Frank Yost Ln. NB
5	KY 115/I-24 EB Ramp	A/B	A/B	A/C	B/E	A/C	B/E	I-24 EB Ramp
4	KY 115/I-24 WB Ramp	A/C	A/C	A/F	A/F	A/F	A/F	I-24 WB Ramp

Note: The intersections are stop controlled and the LOS reflects the worst movement for each approach.

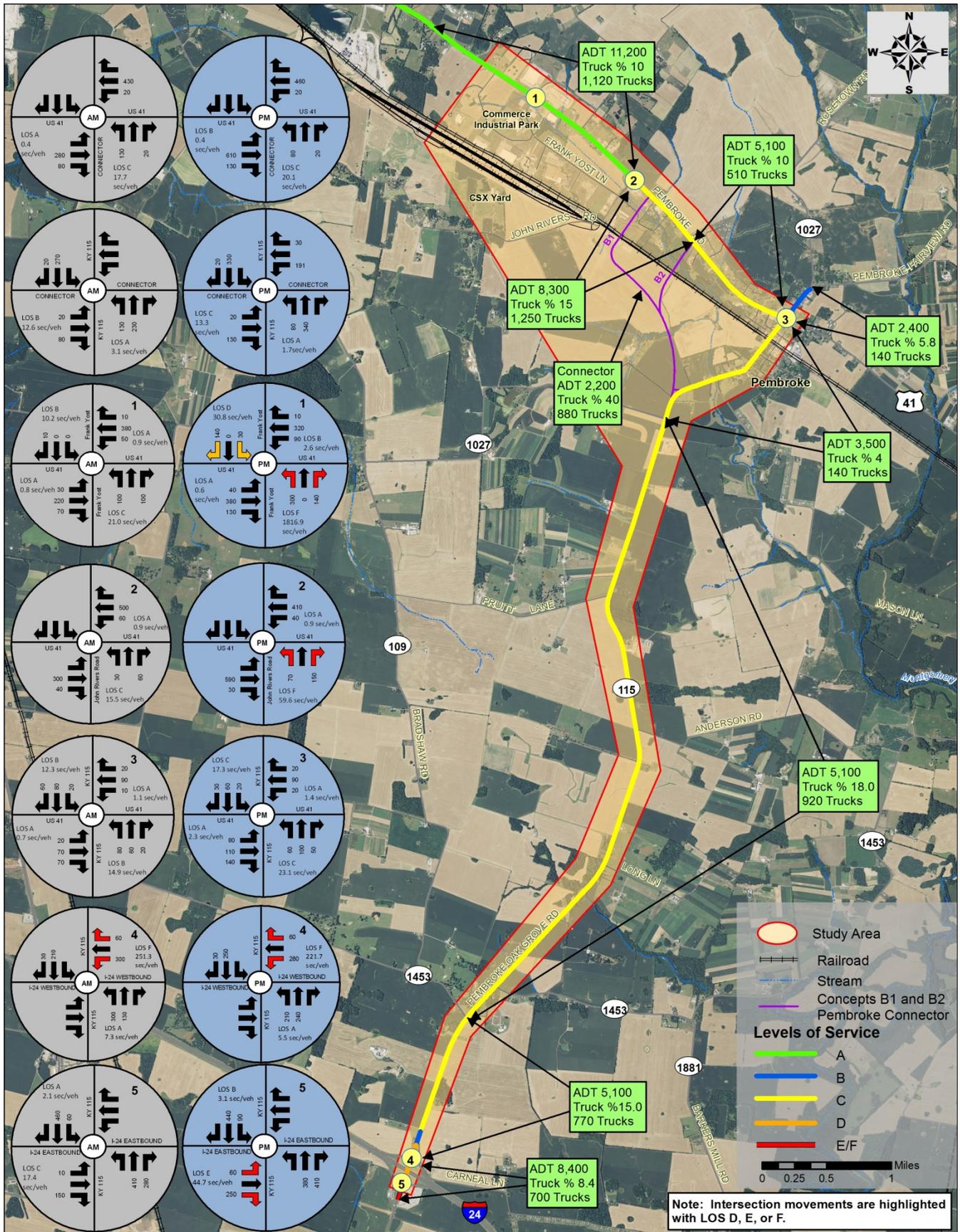


Figure 58: 2040 Build AADT, AM/PM Peak Hour Intersection Movements, Delay, and LOS

10.0 RESOURCE AGENCY COORDINATION AND FINAL MEETINGS

10.1 Resource Agency Coordination

Resource agency coordination was conducted to help identify potential environmental resources, development plans, or other potential issues. The KYTC Division of Planning mailed applicable resource agencies a packet of project-related information including purpose and need, existing conditions, an environmental overview, crash data, initial improvement concepts, and No Build and Build traffic data and maps. Responses received from 23 agencies are summarized in **Table 17**, and provided in full in **Appendix L**.

Table 17: Resource Agency Coordination

Representing	Summary of Comments
US Environmental Protection Agency	<ul style="list-style-type: none"> • Clarify if Concepts A and B are mutually exclusive, and provide more details on the alternatives. • The project purpose and need should be appropriately broad to ensure consideration of other reasonable alternatives. • Expand the number of reasonable alternatives considered. For example, KY 109 appears to provide a direct link from KY 115 to the Commerce Park. • Consider additional alternatives to ensure “Concept B and C” do not appear predetermined. <ul style="list-style-type: none"> ○ Discuss the proposed action in context of the other proposed projects in local comprehensive plans. ○ Alternatives need supporting information to demonstrate achievement of the purpose. • Identify and discuss potential impacts to the affected communities, the number of relocations, economic impact, minority and low income populations, children from environmental health and safety risks, schools, parks, playgrounds, healthcare, the Rosedale Cemetery, air-quality, hazardous waste, aquatic resources, and farmland. Likewise, discuss proposed mitigation.
US Coast Guard	<ul style="list-style-type: none"> • Coast Guard bridge permit is not required for this project.
USDA-NRCS	<ul style="list-style-type: none"> • If project may convert farmland to non-agricultural use and is anticipated to receive federal dollars, an AD-1006 Farmland Conversion Impact Rating must be initiated and forwarded to NRCS for completion in accordance with the Farmland Policy Protection Act.
KY Airport Zoning Commission (KAZC)	<ul style="list-style-type: none"> • Construction equipment or permanent structures greater than 200 feet above ground level require a permit from the KAZC.
KY Cabinet for Health and Family Services	<ul style="list-style-type: none"> • Does not lease or own property within the area; therefore, does not anticipate or have issues or concerns with the proposed project.
KY Cabinet for Economic Development	<ul style="list-style-type: none"> • Proposed improvements impact a multitude of industrial park sites in the immediate area, with the majority of traffic using US 41/KY 115 intersection to access I-24. • Improvements made to this corridor will have a positive effect on the economic growth of the area by decreasing traffic hazards, bottlenecks, and crashes, and attracting future industry. Adjacent sites have 10 or more active industrial facilities and 766 acres available for industrial expansion. • The Cabinet is not aware of environmental or conservation issues or concerns in the redevelopment area.
KY Energy And Environment Cabinet – Department for Environmental Protection	<ul style="list-style-type: none"> • <u>Division of Water</u>: This project will have potential impacts to an unnamed tributary (UT) to Montgomery Creek, which are expected minor and temporary. • <u>The Groundwater Section of the Watershed Management Branch</u>: Endorses the proposed work. Several domestic groundwater water well users are near the proposed work. The proposed work is also in an area with high potential for karst; groundwater is susceptible to direct contamination from surface activities. Recommends awareness of the requirements of 401 KAR 5:037 and the need to develop a Groundwater Protection Plan (GPP) for the protection of groundwater resources within the area. • <u>KY Department of Fish and Wildlife (KDFWR)</u>: ... the Piping Plover... Gray bat... and Northern Long-eared bat...are known to occur within 10 miles of the project area. No additional state-listed species, caves, mine portals or special natural areas are known to occur within one mile of the project area. Known locations of listed species do not occur within the outlined project area. • To minimize impacts to the aquatic environment, the KDFWR recommends erosion control measures be developed and implemented prior to construction to reduce siltation into waterways and/or karst features.
KY Division of Waste Management	<ul style="list-style-type: none"> • All solid waste generated by this project must be disposed at a permitted facility. If underground storage tanks, asbestos, lead paint, and/or other contaminants are encountered, they must be properly addressed. • <u>Hazardous Waste Branch</u>: ... an old city landfill is near the west side of Hailes Avenue and Dewey Street/ City Dump Road near the study area. Gates Grocery (along KY 115 near the southeast corner of KY 1453) had a 560-gallon gasoline tank removed in 1998. • <u>Superfund Branch</u>: Two superfund sites—Amfine Chemical Corp – Active; may pose concern; Barker Family Trust Farm – Drums; closed in 2005

Table 17: Resource Agency Coordination (Continued)

Representing	Summary of Comments
KY Division for Air Quality	<ul style="list-style-type: none"> • 401 KAR 63:010 – Fugitive Emissions • 401 KAR 63:005 – Open Burning • Utilize alternatively fueled equipment. • Utilize other emission controls applicable to your equipment. • Reduce idling time on equipment.
KY Division of Forestry	<ul style="list-style-type: none"> • The Division of Forestry does not have comments regarding the planning study, but agrees with using an urban template where appropriate to minimize impacts.
KY Department of Natural Resources Division of Conservation	<ul style="list-style-type: none"> • Portions of four agricultural districts are within or adjacent to the study area. State agencies must mitigate impacts their programs have on land enrolled in an agricultural district.
KY Department of Agriculture	<ul style="list-style-type: none"> • PACE (Purchase of Agricultural Conservation Easements) program has no easements in/ near the study area.
KY State Police (KSP)	<ul style="list-style-type: none"> • As part of the Data Driven Enforcement Program, KSP considers KY 115 one of the nine most dangerous roads in the county in terms of crashes, and is a targeted enforcement area. KSP also notes the roadway is very narrow for the amount of traffic it experiences. • Widening the roadway surface and improving the US 41/KY 115 intersection are wise investments towards improving the safe and efficient traffic on this route.
KY State Police Commercial Vehicle Enforcement Division	<ul style="list-style-type: none"> • After review of documents and physical review of the area, it appears...all concepts discussed should be put in place. • KY 115 is a single "A" highway (44,000 pounds) that will need upgraded to a triple "AAA" highway (80,000 pounds) due to increase in heavy truck traffic expected. At present, KY115 is not suitable to handle this traffic type as seen in numerous crashes that have occurred due to the roadway condition. • The US 41/KY115 intersection will need improvements due to the increase in traffic and to allow better traffic flow in a congested area. • Recommends "Concept B1." By using this concept it may avoid the need to widen US 41 and will eliminate some truck traffic at the original intersection of US 41 and KY 115 in the limits of Pembroke.
KY Geological Survey	<ul style="list-style-type: none"> • Entire length of widening project underlain with karstic limestone and vulnerable to cover collapse and possibly bedrock collapse. • Protection of groundwater is critical – crosses three spring sheds. • Flooding of sinkholes is a possible risk. • No known caves along project corridor however, caves nearby are large enough to cause subsidence risk. • 7 major caves in area, including Glovers Cave about two miles east of the project study area. • Need extraordinary measures to prevent damage to water supplies and the highway pavement and subgrade by cover collapse.
KY Department of Mine Reclamation and Enforcement	<ul style="list-style-type: none"> • No impacts to mining operations in the area of this project, as there currently are no mining operations in Christian County.
Christian County Chamber of Commerce	<ul style="list-style-type: none"> • KY 115 is a very narrow road with many twists and turns, some of which make visibility difficult while driving. Bad weather conditions and darkness make visibility even worse. Because of narrow road, there is little room for error or room to move over. • This road is traveled heavily by tractor trailers and Amish buggies, which create additional hazards. The bridge just before Mason Lane is so narrow a vehicle has to almost stop if a semi-tractor trailer is coming from the opposite direction at the same time. • The intersection of 115 and US 41 also has problems as... shown in the crash data provided. It is uneven causing cars to back up when a tractor trailer needs to turn and has visibility issues. • ...very supportive of efforts made to improve this area of roadway.
Southwestern KY Economic Development Council	<ul style="list-style-type: none"> • Safe and reliable access to the expanded Commerce Park is a critical asset to job creation and retention in the region. • Rail accessible industrial sites are critical to economic growth and business recruitment. • Enhanced roadways will also be a critical tool in the aforementioned efforts.
Pembroke Elementary School	<ul style="list-style-type: none"> • Favors Concept B. elevated railroad bridge allows faster access for first responders if a train is on the track.
State Representative 9 th District Myron Dossett	<ul style="list-style-type: none"> • Favors widening KY 115 (Concept C): • Placing more traffic on KY 115 may increase the potential for more crashes. • Concepts A_1 and B would have to be seen in more detail to assess impacts. • Two cemeteries are near or adjacent to the railroad right -of -way.

Color Key: Federal State Study Area

Abbreviations: KY = Kentucky USFWS = U.S. Fish and Wildlife Service USDA–NRCS = U.S. Dept. of Agriculture–Natural Resources
 Conservation Service KDNR = Kentucky Dept. for Natural Resources KSNPC = Kentucky State Nature Preserves Commission

10.2 Second Local Officials/Stakeholders Meeting

Staff from the KYTC Central Office, KYTC District 2 Office, PADD and Qk4 met with 11 local and state officials and stakeholders the afternoon of April 11, 2017, at the Pembroke Baptist Church. The meeting's purpose was to present improvement concepts with projected future traffic and impacts, and gather feedback. Attendees were distributed handouts, including an agenda, a location map with brief descriptions of improvement concepts, and a 13-question survey. LO/S attendees included 3rd District State Senator Whitney Westerfield, 9th District State Representative Myron Dossett, Pembroke Mayor Judy Peterson, and representatives from the Pembroke Zoning Board and police department, Southwest Kentucky (SWK) Economic Development Council, and Martinrea. Key items of discussion included the following:

- The State Representative supported Concept C (widening KY 115).
- SWK Economic Development Council supported enhancing roadways to serve the Commerce Park.
- Pembroke Elementary School preferred Concept B because it provides a bridge over the railroad.
- The Mayor supported improving the US 41/KY 115 intersection (Concept A_I1) if costs prohibit widening KY 115. If KY 115 is widened (Concept C), Concept A_I1 should be included to accommodate anticipated increase in truck traffic.
- Local officials agreed a new connector and a wider KY 115 attracts more trucks to the corridor. They stated several industries do not send their trucks on KY 115 today because it is too narrow. If the road is widened, those industries would direct their trucks to I-24 via KY 115.
- Old cemeteries are adjacent to the CSX railroad in or near the Concept B shaded area.
- A property owner recently entered into a conservation easement agreement along the west side of KY 115 across from Anderson Road.

The meeting summary and other meeting documents/materials comprise **Appendix J**.

10.3 Public Meeting

Following the second LO/S meeting, a public meeting was held the evening of April 11, 2017, from 4:00 PM to 7:00 PM at Pembroke Baptist Church. The meeting's purpose was to inform the public about the study; to present existing roadway, existing and future traffic, and environmental conditions; and to discuss and gather input on improvement concepts developed by the project team. No formal presentation took place. Sixty-two members of the public attended the meeting. A study handout and survey were distributed to attendees, who were then directed to view an introductory project video presentation. After the video, attendees viewed exhibits at four stations: existing conditions, improvement concepts, future traffic, and a 3D modeled visualization video of a bridge over the CSX railroad.

Five proposed concepts were presented on exhibits:

- No Build/Do Nothing
- Concept A—US 41 Widening
- Concept A_I1—US 41/KY 115 Intersection Improvement

- Concept B—New Road Connecting US 41 and KY 115 southwest of Pembroke (Pembroke Connector), with Concept Options B1 and B2 displayed
- Concept C—KY 115 Widening

A total of 42 surveys were completed and returned either at the meeting or online/by mail. Survey results are summarized in **Table 18**. A recap of the meeting is in **Appendix K**.

Table 18: Public Meeting and Local Officials Survey Results

Question	Total Responses	Responses (% of Total)		Additional Comments (# of Comments)
Q. 1—What is your primary reason for travel in the Project Corridor?	41	Live Along the Corridor	(59%)	n/a
		Work Other Personal Business /Errands Shopping	(20%) (12%) (7%) (2%)	
Q. 2—How often do you travel within the study area?	41	Several times per day	(59%)	n/a
		Twice daily Several times per week Several times per month Once daily	(17%) (15%) (7%) (2%)	
Q. 3—Do you ride a bicycle or walk/run along the corridor?	41	Neither Walk/run Both Bike	(76%) (12%) (10%) (2%)	n/a
Q. 4—Do you believe US 41 needs improvement?	40	Yes	(72%)	Widen lanes (15); Add sidewalks (5); Widen shoulders (3); Improve drainage (3); Misc. (3)
		No	(28%)	n/a
Q. 5—Do you believe KY 115 needs improvement?	40	Yes	(97%)	Widen lanes (20); Widen shoulders (12); Misc. (5); Add lanes (2)
		No	(3%)	n/a
Q. 6—Please rank your level of concern in the study area from 0-3: 0=no concern 3=high concern	41	High Concerns include:		
		Narrow Lanes Narrow Shoulders Large Trucks Congestion Safety/Number of Crashes Amish traffic	(85%) (85%) (83%) (66%) (59%) (59%)	
Q. 7—Please rank the level of concern you have in making turns or maneuvers at these locations in the study area from 0-3: 0=no concern 3 high concern	41	High Concerns include:		KY 115 bridge too narrow (3); more law enforcement (2); semi- tractor trailers (2); widen US 41/KY 115 intersection (2); left turn lane at Pembroke Elementary (1)
		US 41/KY 115 Intersection KY 115/Railroad Crossing	(63%) (63%)	
Q. 8—Please rank your level of environmental concern in the study area from 0-3: 0=no concern 3=high concern	41	High Concerns include:		
		Farmland Impacts Schools Cemeteries Residential Impacts	(59%) (54%) (51%) (46%)	

Table 18: Public Meeting and Local Officials Survey Results (Continued)

Question	Total Responses	Responses (% of Total)		Additional Comments (# of Comments)
Q. 9—Please identify your preference for improvements for this project: 0=no desire 3=highly desired.	41	Highly Desired include:		Widen KY 115 (15); Concept B1 over B2 (5); improve intersection (4); prefer Concept B2 (1)
		No Build/Do Nothing* Improve/Widen US 41 Improve US 41/KY 115 Inter. Improve/Widen KY 115 New US 41/KY 115 Connector	(26%) (33%) (61%) (93%) (49%)	
Q. 10—Would you use a new US 41/ KY 115 Connector with a grade separated railroad crossing (bridge)?	38	Yes	(71%)	Train delays (9); (4); commute to work (3); school (1)
		No	(29%)	n/a
Q. 11—If a new US 41/KY 115 Connector included bicycle/pedestrian accommodations, would you use them?	39	Yes	(29%)	Exercise/health (2); badly needed (1); very useful for whole city (1); would use occasionally (1); sidewalks broken in town (1)
		No	(71%)	Too old to ride (1); no bike (1); too dangerous (1); primarily semi- tractor trailers on connector (1); no, but know someone in wheelchair who risks his life on road every day (1)
Q. 12—List additional information KYTC should know about.	5	Would not use bicycle/pedestrian accommodations along connector knowing traffic along connector would consist primarily of semi- tractor trailers. (1) Listed priorities (1): 1. Widen KY 115 2. Widen US 41 3. Bypass Pembroke Culvert opening under US 41 is too small and floods. (1) Support Concept C and Concept B1. (1) Provided address of family residence. (1)		

10.4 Final Project Team Meeting

The project team met May 2, 2017, at the KYTC District 2 Office in Madisonville to discuss resource agency comments, survey results received from the second LO/S meeting and the public meeting, and to review alternative concepts and identify recommendations for the study. The meeting summary is in **Appendix I**. Decisions reached by the team included the following:

- Improvement concepts will not be combined into complete/single study area-long alternatives. Instead, the study report narrative will discuss connectivity between the I-24 and the Commerce Park and improvement concepts will be presented separately within two corridors—Corridor 1 using existing roads only, and Corridor 2 using a new connector and existing roads.
- A cost estimate for a shared-use path along a new Pembroke Connector will be provided.
- Replacing the functionally obsolete KY 115 bridge over Montgomery Branch (MP 9.910) will be identified as Concept D—a standalone, short-term improvement. Replacing the bridge is also part of the long-term reconstruction of KY 115 (Concept C).

- The study will include cost estimate and descriptions of:
 - Concept C, reconstructing KY 115 from I-24 north to the southern terminus of the connector (Concept B). This concept is a shortened version of Concept C, and is presented as Concept C-to-B;
 - Concept A, reconstructing US 41 from connector Concept B1 or B2 to the current improved section of US 41 west of Pembroke. This shortened segment of Concept A is Concept A to B2.
- The study will not recommend a preferred concept.

11.0 FINAL CONCEPTS, COST ESTIMATES, AND EVALUATION MATRIX

Improvement concepts were developed within two corridors that meet the study's purpose and need. **Corridor 1** begins on KY 115 at I-24, heads north to Mason Lane (MP 10.000) and the intersection of KY 115 with US 41, then continues west along US 41 to Salubria Springs Road (MP 4.000) to the Commerce Park. **Corridor 2** also starts on KY 115 at I-24, heads north to near KY 1027, before transitioning northwest on a new connector between KY 115 and US 41 southwest of Pembroke, to US 41 turning northwest to end near the Commerce Park. Two long-term and two short-term improvement concepts are in Corridor 1, and three long-term concepts are in Corridor 2. The short-term concepts were developed as standalone, low cost spot improvements to geometric deficiencies at three high-crash spots.

Two long-term and two short-term improvement concepts are in Corridor 1, and three long-term improvement concepts are in Corridor 2. The short-term concepts were developed as standalone, low cost spot improvements to correct geometric deficiencies at three high-crash spots. The locations of these concepts are illustrated on **Figure 59**. Each concept is illustrated with a conservative corridor based on the widest disturb limits for each proposed improvement.

Corridor 1 Concepts—Improve existing routes US 41 and KY 115 in the study area.

- ➡ **Concept A (Long-term):** Improve/Widen US 41 from the KY 115 intersection westward to northwest of Salubria Springs Road near the Commerce Park (**Figure 60**).
- ➡ **Concept C (Long-term):** Improve/Widen KY 115 from near I-24 to near Mason Lane (north of the KY 115 bridge) in Pembroke. This project also includes replacing the KY 115 bridge over Montgomery Branch (**Spot Concept D and Figure 61**).

Corridor 2 Concepts— Construct a new connector between KY 115 and US 41 northwest of Pembroke that bridges over the CSX railroad; and, to and from the connector improve/widen KY 115 from I-24 north and US 41 west to Salubria Springs Road near the Commerce Park.

- ➡ **Concept A-to-B2 (Long-term):** Improve/Widen US 41 as it approaches Pembroke Connector Concept B2 (**Figure 62**).
- ➡ **Concept B (B1 or B2) (Long-term):** Construct connector from KY 115 to US 41 (Pembroke Connector) on new alignment (**Figure 63**).
- ➡ **Concept C-to-B (Long-term):** Improve/Widen KY 115 from near I-24 north to Pembroke Connector (**Figure 64**).

Spot Concepts—Construct standalone, low cost improvements at high-crash spots.

- ➡ **Concept A_I1 (Short-term):** Improve US 41/KY 115 intersection (**Figure 65**).
- ➡ **Concept D (Short-term):** Replace KY 115 bridge over Montgomery Branch (**Figure 66**).

If a project is advanced and receives federal funds, NEPA documentation will address resources, impacts, and mitigation commitments. The KYTC-DEA and FHWA will jointly determine the appropriate level of documentation for each project.

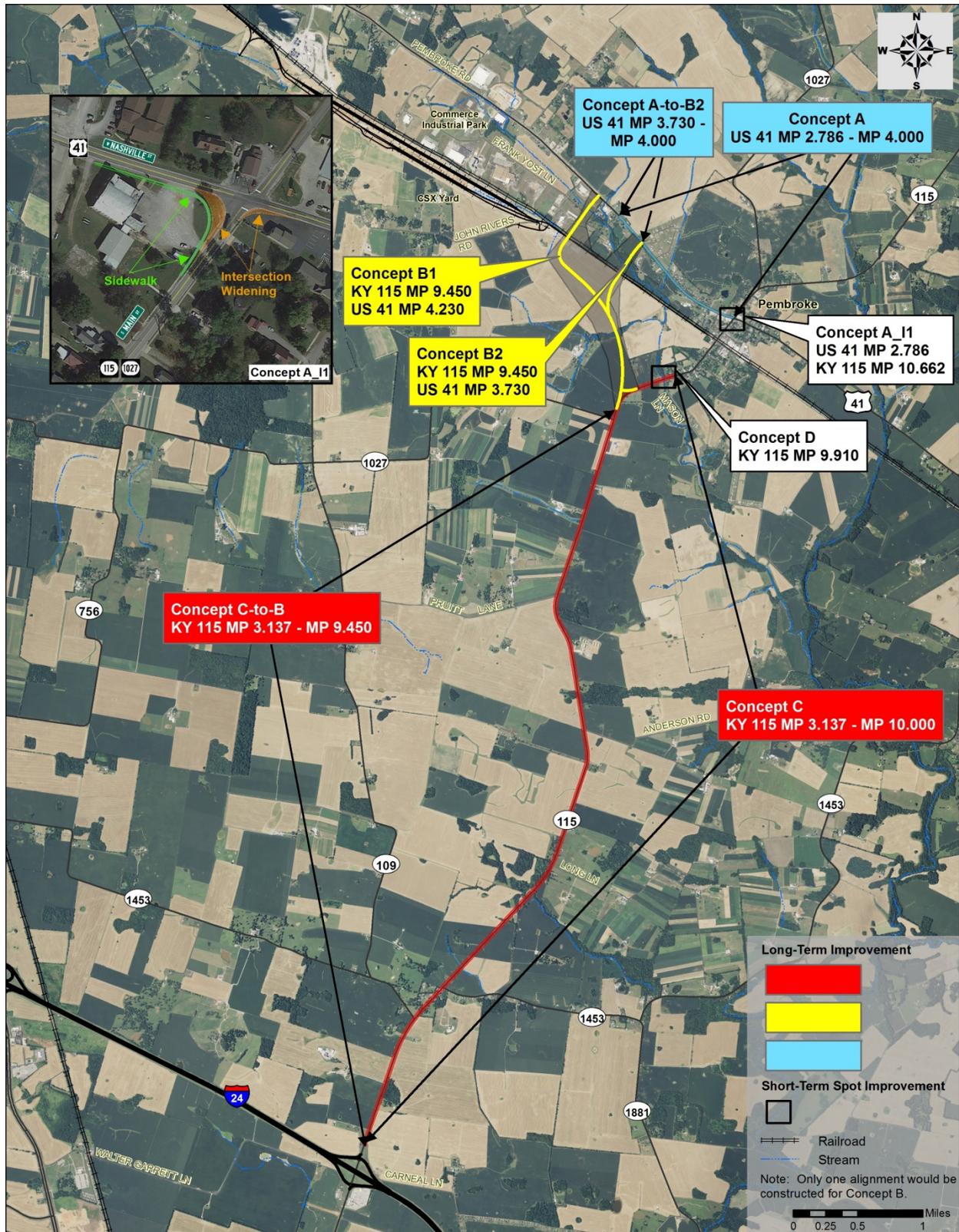


Figure 59: Final Improvement Concepts

11.1 Cost Estimates

Phased cost estimates for each improvement concept are shown in **Table 19**. Open Roads Concept Station was used to create 3D conceptual road and bridge design models of each corridor concept. A five foot digital elevation model, derived from LiDAR collected as part of Kentucky’s Aerial Photography and Elevation Data, was used as existing terrain. Conceptual design models generated quantities of high-cost construction items including earthwork, pavement, and structures. Construction costs were tabulated using the KYTC District 2 average unit bid prices. The KYTC District 2 assisted with right-of-way and utility cost estimates based on conceptual model disturb limits. Cost estimates for widening KY 115 (Concept C) are based on the best-fit alignment. Detailed estimates are located in **Appendix M**.

Table 19: Cost Estimates for Final Improvement Concepts

Type	Corridor	Improvement Concept (Description)	Length (miles)	Design	Right-of-Way	Utilities	Construction	Total	
				Dollars					
Long-Term	(1)	A (Widen US 41)	1.214	\$300,000	\$2,750,000	\$1,750,000	\$3,000,000	\$7,800,000	
		C (Widen KY 115 and Bridge Replacement)	6.863	\$1,500,000	\$2,500,000	\$4,250,000	\$14,900,000	\$23,150,000	
	(2)	A-to-B2 (Widen US 41 to Pembroke Connector B2)		0.270	\$70,000	\$600,000	\$400,000	\$630,000	\$1,700,000
		B (Pembroke Connector)	B1*	1.909	\$1,100,000	\$1,000,000	\$500,000	\$11,000,000	\$13,600,000
			B2*	1.365	\$900,000	\$500,000	\$500,000	\$8,500,000	\$10,400,000
		B1** (Shared-Use Path)		1.909	\$370,000	\$140,000	\$70,000	\$3,620,000	\$4,200,000
		B2** (Shared-Use Path)		1.365	\$260,000	\$70,000	\$70,000	\$2,600,000	\$3,000,000
		C-to-B (Widen KY 115 to Pembroke Connector)		6.313	\$1,400,000	\$2,300,000	\$3,900,000	\$13,400,000	\$21,000,000
Short-Term	Spot	A_I1 (US 41/KY 115 Intersection)	0.100	\$25,000	\$100,000	\$150,000	\$100,000	\$375,000	
		D (KY 115 Bridge Replacement)	0.100	\$100,000	\$40,000	\$70,000	\$900,000	\$1,110,000	

* Does not include cost associated with optional Shared Use Path (SUP).

** Assumes widening bridge over railroad for SUP and not reducing bridge shoulders to accommodate.

11.2 Evaluation Matrix and Benefit/Cost Analysis

An evaluation matrix (**Table 20**) is provided to assist the KYTC and future decision makers in comparing impacts, benefit/cost (B/C) ratio, and public input when assessing which concepts to carry forward for future development.

A Benefit/Cost Analysis used the Highway Safety Manual, the study five-year crash history, 2016 existing and future AADT, existing and improved lane and shoulder widths, the *2015 Kentucky Collision Facts Comprehensive Costs*, traffic and crash growth rate of 1.03%, and a 20 year horizon. A 3% discount rate was used to put all present and future costs and benefits in a common metric, their present value. Benefit cost analysis typically ignore inflation because the prediction of future prices introduces unnecessary uncertainty into the analysis. Therefore discount rates are typically applied based on interest rates for government borrowing which has little risk, with an inflation component.

Using the Highway Safety Manual, Crash Modification Factors were calculated for existing and improved lane and shoulder widths (using the five-year crash history and AADT). That $CMF_{treatment}/CMF_{existing}$ ratio was applied to the total crash costs/per year to develop an annual crash reduction. Crashes were assumed to grow at the same 1.03% as future traffic.

For connector Concepts B1 and B2, crash savings (decrease in crashes) were developed for the bypassed KY 115 and US 41 segments based on the percent change in traffic. Again, the *2015 Kentucky Collision Facts Comprehensive Costs* was used to calculate crash savings and costs. The 2040 daily travel time savings of 37 VHT from the CCTDM was included as savings for Concepts B1 and B2 connectors.

Annual maintenance costs were also estimated for Concepts B1 and B2 using KY 115 annual maintenance costs provided by KYTC and added as a “cost.”

- All concepts improve safety between the Commerce Park and I-24.
- All concepts improve roadways on the Kentucky Highway Freight Network.
- Concept B quantifiably improves mobility between the Commerce Park and I-24 by improving travel time.
- Concept B improves travel time by constructing a bridge over the railroad eliminating crossing delays.
- Concept B improves the v/c ratio on US 41 and KY 115 segments in Pembroke.
- All improvements meet purpose and need, as well as goals of improving safety for Amish and large farm equipment and advancing transportation elements of the draft HCCCP.
- 93% of public respondents highly desired improvements to KY 115.
- Short-term improvement concepts were highly desired by public respondents.
- Improving/Widening KY 115 has a benefit/cost (B/C) ratio of over 1.0 with a 3% discount.

Concept A_{I1} was not included in the B/C analysis. However from crash history, at least four crashes in five years could be attributed to left turning vehicles encroaching upon the opposing lane.

Table 20: Evaluation Matrix

	No Build	Long-Term					Short-Term		
		Corridor (1) Improve US 41 and KY 115 from Commerce Park to I-24		Corridor (2) Construct Pembroke Connector and Improve US 41 and KY 115 Segments Connecting Commerce Park to I-24			Spot		
		Concept A ¹ PIF 02 024 B0041 1.00	Concept C Item Nos. 2-8953 and 2-8954	Concept A-to-B2	Concept B Item No. 2-381 Concept B1 ² Concept B2 ²		Concept C-to-B Item Nos. 2-8953 and 2-8954	Concept A_I1 ¹	Concept D PIF 02-024 B0041 1.10
Description	Do Nothing	Widen US 41	Widen KY 115	Widen US 41 for Concept B2	New Connector Route	New Connector Route	Widen KY 115 to Pembroke Connector	US 41/KY 115 Intersection	KY 115 Bridge Replacement
MPs	N/A	2.786 – 4.000	3.137 – 10.000	3.730 – 4.000	0.000 – 1.909 ³	0.000 – 1.365 ³	3.137 – 9.450	US 41 (2.786) KY 115 (10.662)	9.860 – 9.960
Length	N/A	1.214	6.863	0.270	1.909	1.365	6.313	0.100	0.100
Project Purpose									
Improve Safety	No	Yes–Wider Lanes and Shoulders and 7% Crash Reduction	Yes–Wider Lanes and Shoulders, Improves 3 High-Crash Spots, and 25% Crash Reduction	Yes–Wider Lanes and Shoulders and 7% Crash Reduction	Yes – Reduces Traffic at 5 High-crash Spots		Yes–Wider Lanes and Shoulders, Improves 2 High-Crash Spots, and 25% Crash Reduction	Yes–Improves 2 High-Crash Spots	Yes–Improves 1 High-Crash Spot
Improve Mobility	No	No	No	No	Yes		No	No	No
Improve Freight Network	No	Yes	Yes – to AAA	Yes	Yes		Yes – to AAA	Yes	Yes
Project Goals									
Improve Safety for Amish and Large Farm Equipment	No	Yes–Wider Lanes and Shoulders	Yes–Wider Lanes and Shoulders	Yes–Wider Lanes and Shoulders	Yes–Reduces Trucks in Downtown Pembroke		Yes–Wider Lanes and Shoulders	Yes	Yes
Advance Relevant Transportation Elements of 2014 Draft HCCCP	No	Yes	Yes	Yes	Yes		Yes	Yes	Yes
Traffic Operations									
Improve 2040 v/c and Travel Time over No Build	N/A	No	No	No	v/c: Yes–in Pembroke Daily VMT: -37 Daily VHT: -891		No	No	No
Improve 2040 Intersection LOS over No Build	N/A	No	No	No	Yes–Improves approach delays		No	No	No
Improve Railroad Crossing Delay	No	No	No	No	Yes		No	No	No
Public Input									
Survey Results	26% Highly Desire, 61% No Desire	33% Highly Desire	93% Highly Desire	33% Highly Desire	49% Highly Desire		93% Highly Desire	61% Highly Desire	93% Highly Desire
Potential Environmental and Community Impacts									
Prime Farmland (Acres)	0	10	102	2	20	17	96	0	1
Agriculture District (Acres)	0	0	22	0	19	14	22	0	0
Conservation Easement (Acres)	0	0	4	0	0	0	4	0	0
Parcels/Acres	0/0	54/12	59/116	10/2	6/24	7/19	49/110	2/<1	3/1
Cemetery	0	0	1	0	1	1	0	0	0
Intermittent, Ephemeral, or Perennial Streams (Linear Feet)	0	160	600	0	450	400	400	0	200
Bat Habitat (Acres)	0	2	12	<1	1	3	11	0	<1
Sinkholes	0	0	15	0	1	0	15	0	0
Potential Involvement with NRHP / # of Sites	No/0	Yes/1	Yes/4	Yes/1	Yes/2	Yes/2	Yes/2	No/0	Yes/1
Potential Historic District	No	Yes	Yes	No	No	No	No	Yes	Yes
Cost Estimate									
Total Cost	\$0	\$7,800,000	\$23,150,000	\$1,700,000	\$13,600,000	\$10,400,000	\$21,000,000	\$375,000	\$1,110,000
B/C Ratio (3% Discount)	N/A	0.33	1.08	0.02	0.74	0.86	1.13	N/A	N/A

¹ Includes sidewalk reconstruction ² Does not include Shared Use Path ³ Milepoints do not include 0.117 miles of KY 115 reconstruction to tie into new connector

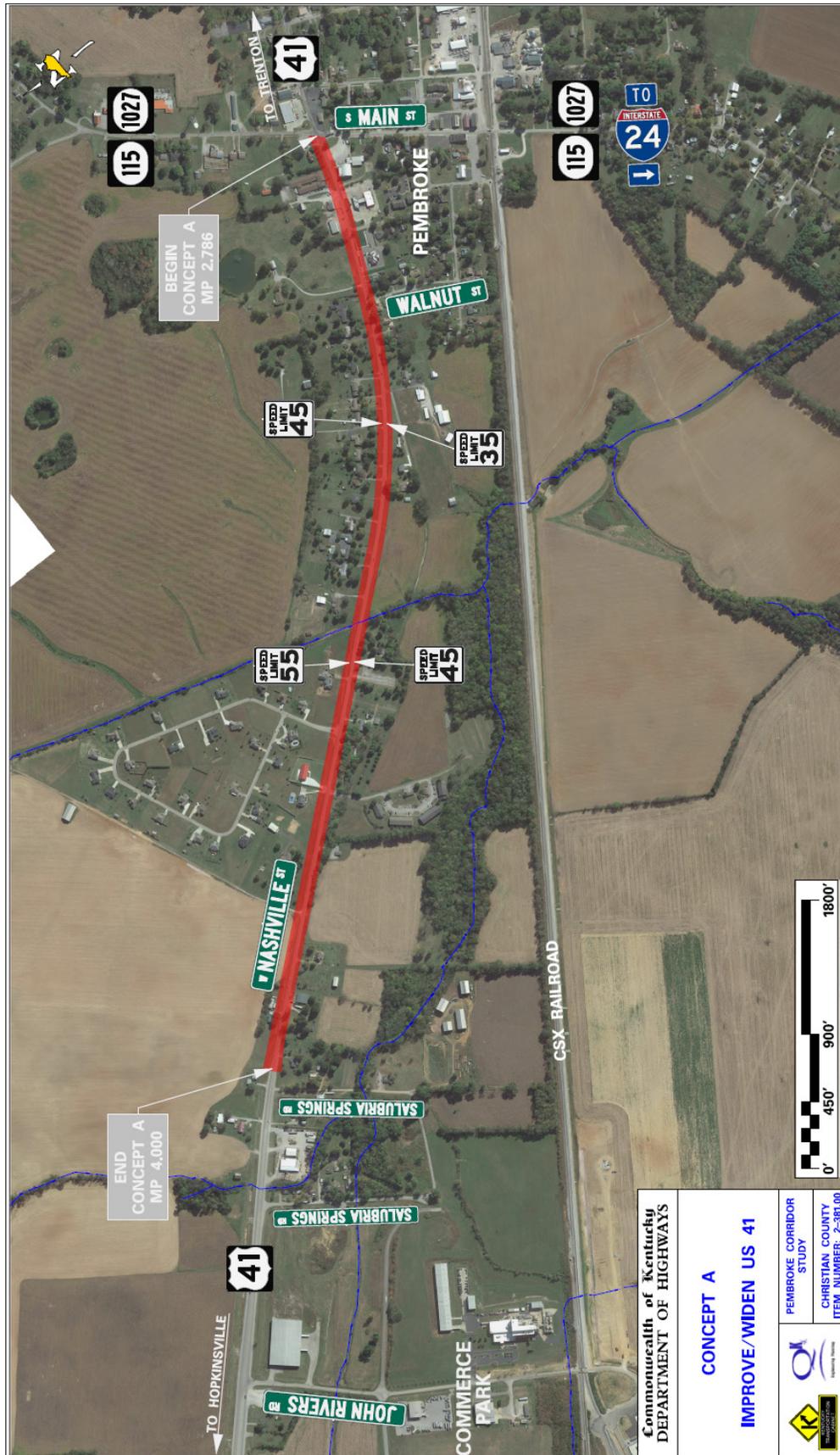


Figure 60: Concept A – Improve/Widen US 41

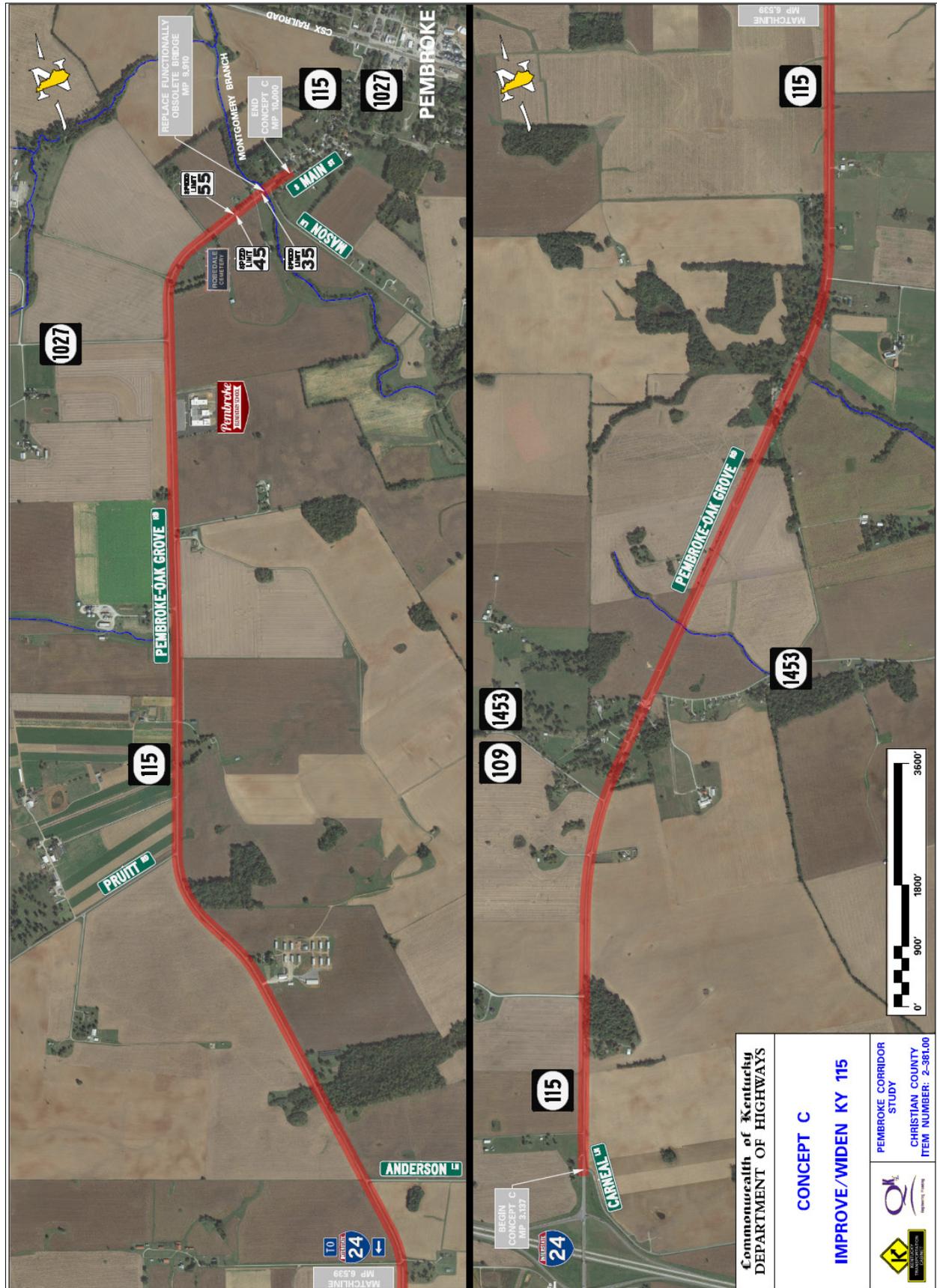


Figure 61: Concept C – Improve/Widen KY 115



Figure 62: Concept A-to-B2 – Improve/Widen US 41



Figure 63: Concept B (B1 or B2) - Pembroke Connector

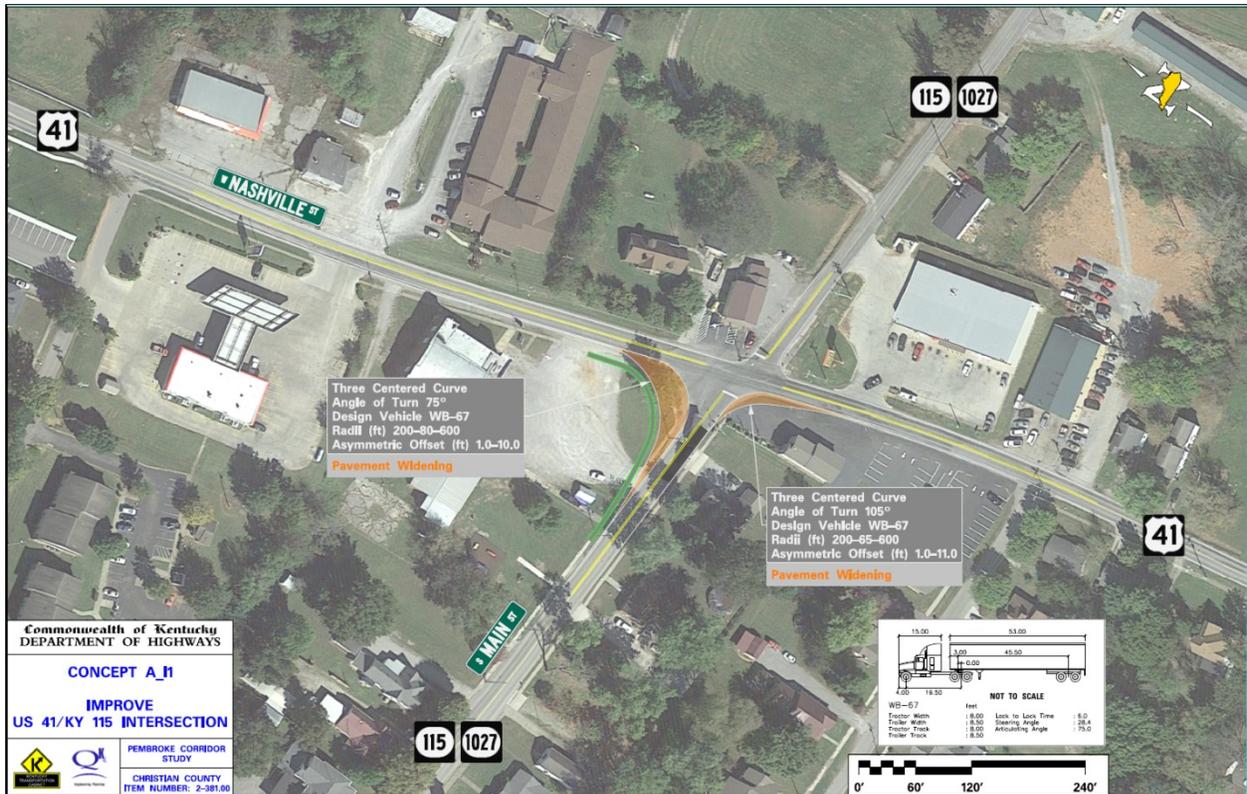


Figure 65: Concept A_I1 - Improve US 41/KY 115 Intersection

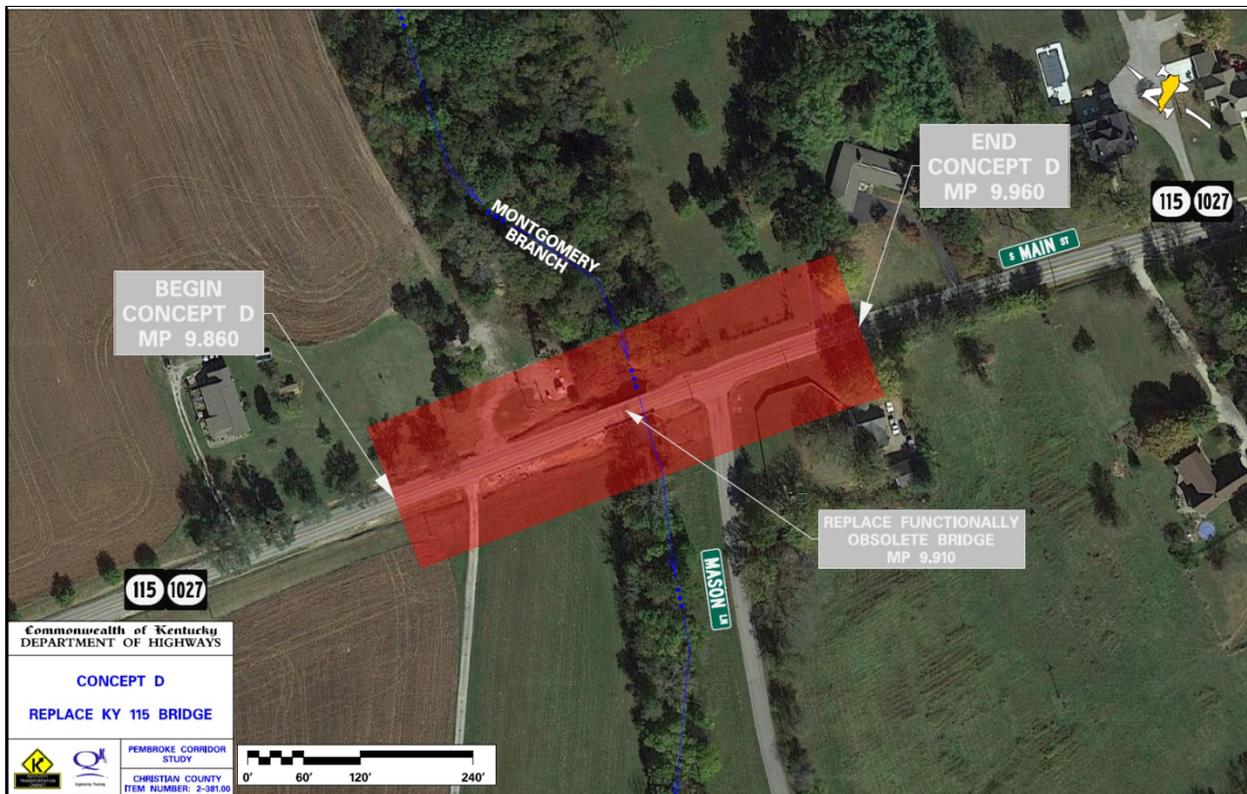


Figure 66: Concept D - Replace KY 115 Bridge

12.0 CONTACTS / ADDITIONAL INFORMATION

Written requests for additional information regarding the Pembroke Corridor Study should be sent to:

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