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1.0 INTRODUCTION

The Kentucky Transportation Cabinet (KYTC) initiated the KY 251 Scoping Study to seek improvement strategies for current and anticipated future transportation deficiencies within a portion of Hardin County. The project study area, shown in **Figure 1**, is north of the city of Elizabethtown and includes the section of KY 251 from Ring Road (KY 3005) to the Joe Prather Highway (KY 313). KY 251 is a north-south route paralleling US 31W to the west and I-65 to the east. The purpose of the KY 251 Scoping Study was to determine the extent of and justification for needed improvements necessary along KY 251 as the roadway has experienced additional traffic due to growth at Fort Knox.

1.1 Draft Purpose and Need Statement

The Purpose and Need Statement for the study, and for project recommendations which may result from the study, is as follows:

The purpose of the KY 251 Improvement Project is to provide a safer, more efficient corridor between KY 3005 (Ring Road) and KY 313 (Joe Prather Highway), connecting Elizabethtown to Fort Knox and areas north. Ultimately, the project will serve a number of existing needs.

The U.S. Department of Defense 2005 Base Realignment and Closure (BRAC) plan included a number of changes that will affect the Fort Knox Military Reservation and surrounding region. Fort Knox has three controlled access points to enter post. Because each of these gates relies on access from US 31W, an already congested corridor, travel alternatives that minimize the need to utilize US 31W have been sought. KY 251 currently provides an eastern north-south travel alternative that indirectly connects Elizabethtown to Fort Knox. Should a new southern access point to Fort Knox be provided in the future, travel demand on KY 251 is likely to increase significantly.

The existing alignment for KY 251 is on rolling terrain with some segments on grades of up to seven percent that limit sight distance. While the horizontal alignment is relatively good, of the 45 vertical curves in the study section, 37 do not have adequate sight distance for a 55-mile per hour (mph) design speed. The nine-foot travel lanes with little to no shoulder are not adequate to accommodate the current truck traffic (10 percent) and anticipated future travel demand. Although KY 251 does not currently have a high crash rate, there is a disproportionately high percentage of single vehicle crashes. Nearly 38 percent of all crashes that occurred between 2006 and 2010 involved a single vehicle, and in 60 percent of those cases, vehicles ran off the roadway. A project is under design to improve KY 251 south of Ring Road (KYTC Item 4-7030), and these improvements will extend north of Ring Road to just north of Bluegrass Road providing needed congestion relief at the Ring Road intersection by providing additional lanes and shoulder. The KY 251 Improvement Project will extend these currently proposed improvements north to KY 313.

Hardin County and the surrounding region have experienced increased population growth in the recent past, in large part due to the BRAC plan. It is estimated that the BRAC plan has resulted in as many as 13,700 persons relocating to the region and over 10,000 new vehicle trips entering post each day. Transportation improvements have been recommended to assist the area after this period of growth, including enhancements to a section of KY 251. Several studies related to BRAC recommended opening a southern access point onto KY 313, partly due to the newly constructed Human Resource Command which to date has added about 3,000 staff with the potential to add another 2,000-2,500. The Human Resource Command is located in the southern part of Fort Knox and the North Wilson Road gate is the closest access control point. With a potential new connection between KY 313 and the south side of the post, traffic along KY 251 and the surrounding routes is expected to increase. The three existing gates are accessed directly from US 31W along the west side of post, as shown in **Figure 2**.

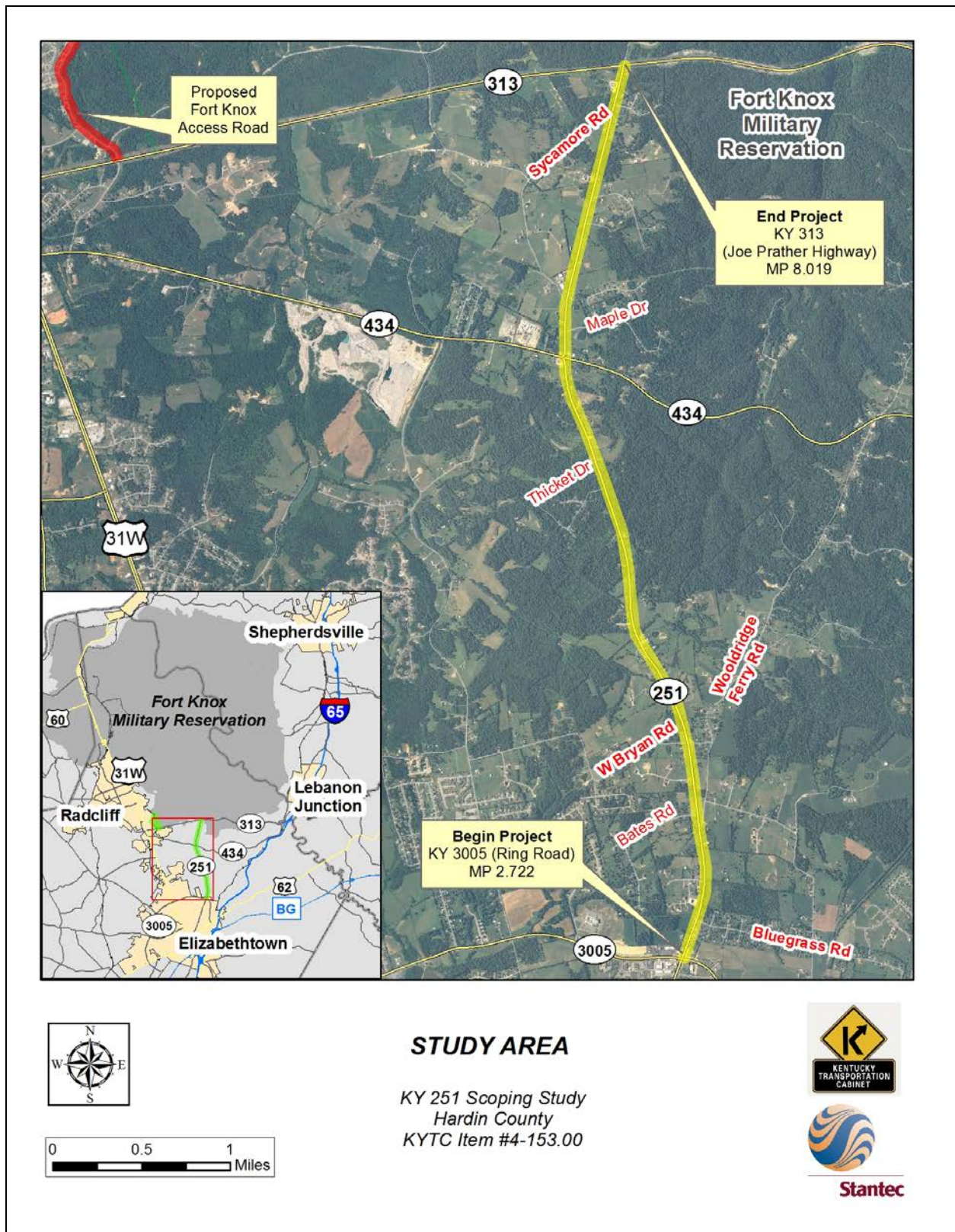


Figure 1: Study Area for the KY 251 Scoping Study

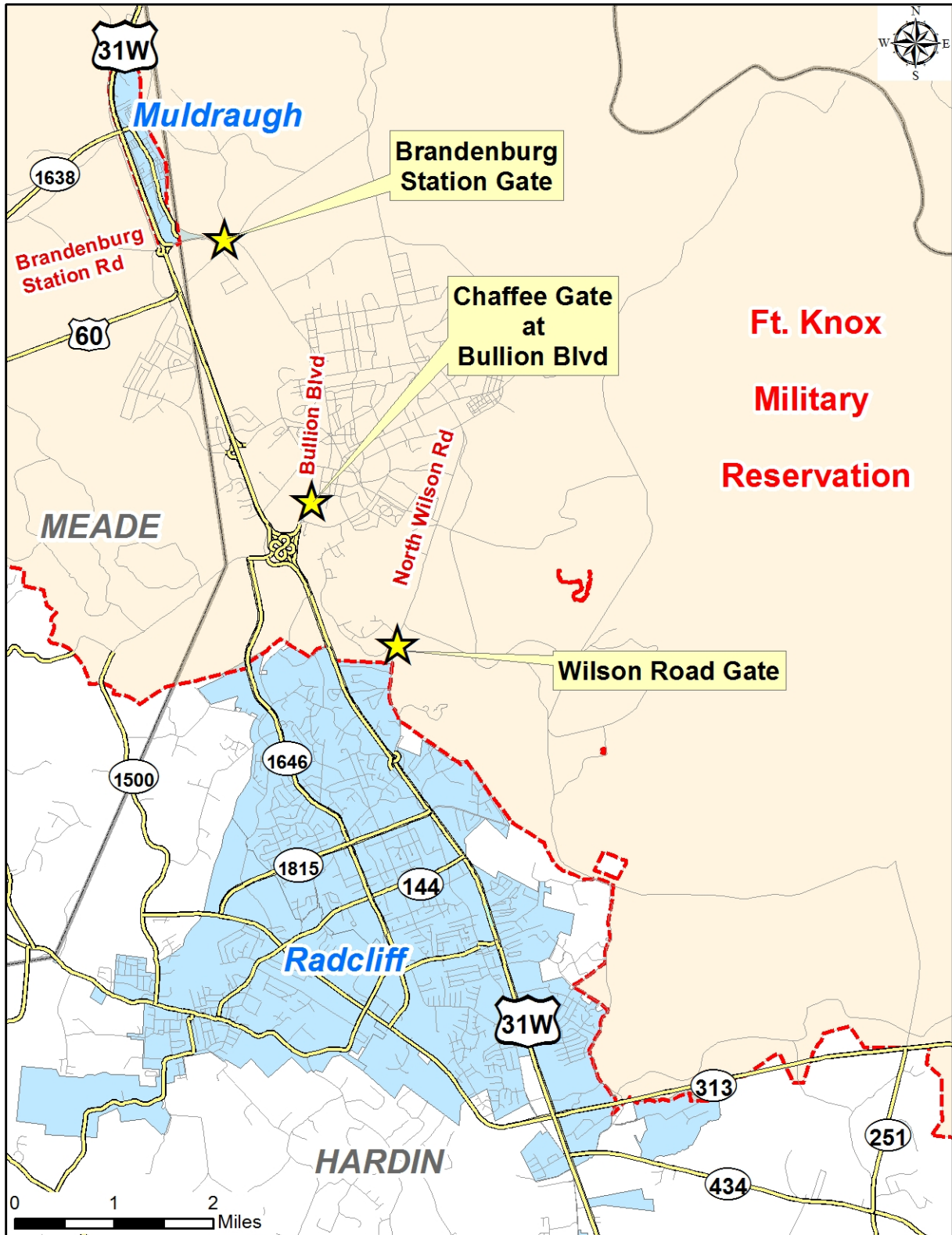


Figure 2: Access to Fort Knox from US 31W

Items involved with the study include the following:

- Discuss the project needs with public officials, resource agencies, the general public and other groups which have an interest in the project
- Define project goals, needs, and issues
- Identify any known environmental issues
- Identify and evaluate long term improvement alternatives, including access management, spot improvements, alternate corridors and design criteria

Project Issues

Major issues and concerns initially identified within the study area that will be addressed include:

- Mobility and Connectivity
 - Lack of adequate routes that access the Fort Knox Military Reservation
 - A need to improve connectivity between Radcliff and Elizabethtown
 - Traffic congestion and safety along US 31W
- Determination of Community Desire and Expectations
 - Project Costs and Schedule
 - Project phasing
 - Right-of-Way
- Environmental Issues
 - Community and Residential Impacts
 - Environmental Justice
 - Historical Properties
 - Natural Environment

1.2 Study Evolution

There have been several recent studies recommending improvements to KY 251. The 2005 Radcliff-Elizabethtown Urbanized Area Transportation Plan recommended the reconstruction of KY 251 from KY 3005 to KY 313 to Rural Major Collector standards. The 2008 BRAC Task Force Priority Transportation projects had the reconstruction of KY 251 from KY 3005 to KY 434 as #6 on the ranking list and the reconstruction from KY 434 to KY 313 as #6a. It has since been moved up to #2a and #2b by the Task Force. The 2009 Fort Knox Regional Highway Capacity Study recommended reconstruction of KY 251, with the prioritization of such a reconstruction depending on whether new southern access was to be provided from KY 313 to Fort Knox. Assuming new access was to be provided, the project would be a high priority. If new access was not provided, it was a medium priority. The 2010 First Look Scoping Study prepared by KYTC District 4 identified four alternatives: No-Build, spot improvements, minor widening and a major widening with four lanes proposed.

Kentucky's FY 2012 – FY 2018 Recommended Highway Plan (Six Year Plan) includes two separate projects for KY 251, with the first between Ring Road and KY 434 (KYTC Item No. 4-153.05) and the second between KY 434 and KY 313 (KYTC Item No. 4-153.01). The plan includes a combined \$2.86 million for design (fiscal year 2012), \$4.0 million for right-of-way (2014-2015), and \$2.5 million for utility relocations (2015-2016) for improvements to KY 251. The funding source is listed as "State Project" (SP). The recently enacted Biennial Highway Construction Plan includes SP funding of \$2.86 million for Phase I (preliminary) design in fiscal year 2012 and \$2.5 million for right-of-way acquisition in the southern section in 2014.

The Kickoff Meeting for the KY 251 Scoping Study was held on February 11, 2011. Copies of all Study Team meetings are included in **Appendix A**. Initially, the study was to be an investigation of improving only the existing alignment for KY 251. There was some discussion at the kickoff meeting concerning the northern end

of the study corridor, between KY 434 and KY 313. The team decided to look at a new western connector between KY 434 and KY 313 to the west of KY 251. Improvements to KY 251 from north of KY 434 to KY 313 were still to be investigated. The team ultimately decided to also explore improvements along KY 434 near the KY 251 intersection and west to US 31W. Any recommended improvements to KY 251 will begin at the north end of KYTC Project, Item # 4-7030.00 near Bluegrass Road.

The preliminary design criteria consisted of a two-lane or four-lane roadway section using 11-foot lane widths, an eight-foot shoulder with four feet paved, and a 10-foot ditch. It was decided one option would be to follow the existing horizontal alignment while making corrections to the vertical curves in order to meet current design standards for a 55-mph design speed, if possible.

There has been recent interest from Fort Knox to investigate the feasibility of new southern access from KY 313 to the access control gate on North Wilson Road. This potential new connector would be located east of the existing South Boundary Road. With forecasts suggesting traffic would travel more heavily in a westward direction and the possibility of a new connector road from Fort Knox, new route alternatives west of KY 251 should be considered in the study. A final effort to reduce right of way impact and projected costs yielded another considered design option. An alternative utilizing a minor roadway widening to a two-lane section, a four-foot wide shoulder, and a ditch slope width of six feet was used. This alternative also considered only making spot improvements to the vertical curves that would meet current design standards for a 45-mph design speed. A separate new western connector road between KY 434 and KY 313 was also included in the study to address the anticipated heavier westward traffic flow.

2.0 EXISTING CONDITIONS

Conditions of the study area's existing transportation network are examined in the following section. The information compiled includes roadway facilities and geometrics, crash history, and traffic volumes within the study area. Data for this section was collected from the KYTC's Highway Information System (HIS) database, aerial photography, as-built plans, and field review.

2.1 Roadway Characteristics

The portion of KY 251 in the study area was originally constructed in the 1930's. There have been no major upgrades to the roadway since its construction. **Figure 3** shows the typical section from the as-built plans. The resulting construction did not provide adequate shoulder or recovery area beyond the traveled way. **Figure 4** and **Figure 5** are representative photographs taken along the roadway.

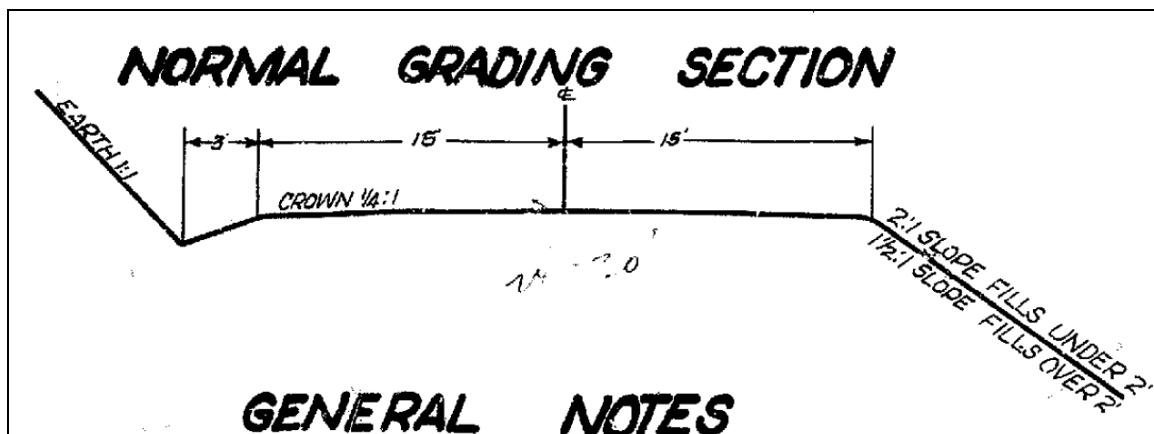


Figure 3: Typical Section from the As-Built Plans



Figure 4: KY 251 North of KY 434 (looking south)



Figure 5: KY 251 at Bates Road (looking north)

Figure 6 shows the functional classification of all roadways within the study area. Functional classification is the grouping of roads, streets and highways into integrated systems ranked by the level of mobility for through movements and access to adjoining land. This grouping acknowledges that roads serve multiple functions and it provides a basis for comparing roads fairly. Functional classification can be used for, but is not limited to, the following purposes:

- Provide a framework for highways serving mobility and connecting regions and cities within a state.
- Provide a basis for assigning jurisdictional responsibility according to the roadway's importance.
- Provide a basis for development of minimum design standards according to function.
- Provide a basis for evaluating present and future needs.
- Provide a basis for allocation of limited financial resources

All of KY 251 within the study area is classified as a collector roadway. KY 434 is also classified as a collector. At the north and south ends of the study area, KY 3005 (Ring Road) and KY 313 (Joe Prather Highway) are both arterials.

Figure 7 shows the existing lane widths for all roadways within the study area. KY 251 is a two-lane roadway with nine to 9.5-foot wide driving lanes and little or no shoulder for most of its length. Current KYTC design guidelines call for a minimum of 11-foot wide lanes on arterials and collector roadways. KY 434 consists of two 10-foot wide lanes. As shown in **Figure 8**, shoulder widths along KY 251 typically vary from no shoulder to about one foot. The shoulder along KY 434 is primarily earth and widths are between four and 10 feet.

The existing horizontal alignment meets current sight distance requirements for a 55-mph design speed, as suggested in **Figure 9**. **Figure 10** presents a summary of the HIS data concerning the vertical curve adequacy. The HIS data suggest the majority of KY 251 north of Bluegrass Road meets current design guidelines for rolling terrain. However, a more in-depth analysis of the existing alignment based on the as-built plans suggests the vertical alignment does not satisfy current guidelines for a 55-mph design speed. There are 45 vertical curves along KY 251, and many of them are quite short. A majority of these vertical curves (37 of the 45) do not meet current sight distance requirements, as shown in **Figure 11**. Improving the corridor on its existing alignment will be difficult because correcting the vertical deficiencies will require significant changes to existing grades, as many of the existing vertical curves are back to back. This will also make it particularly difficult to maintain traffic flow during construction.

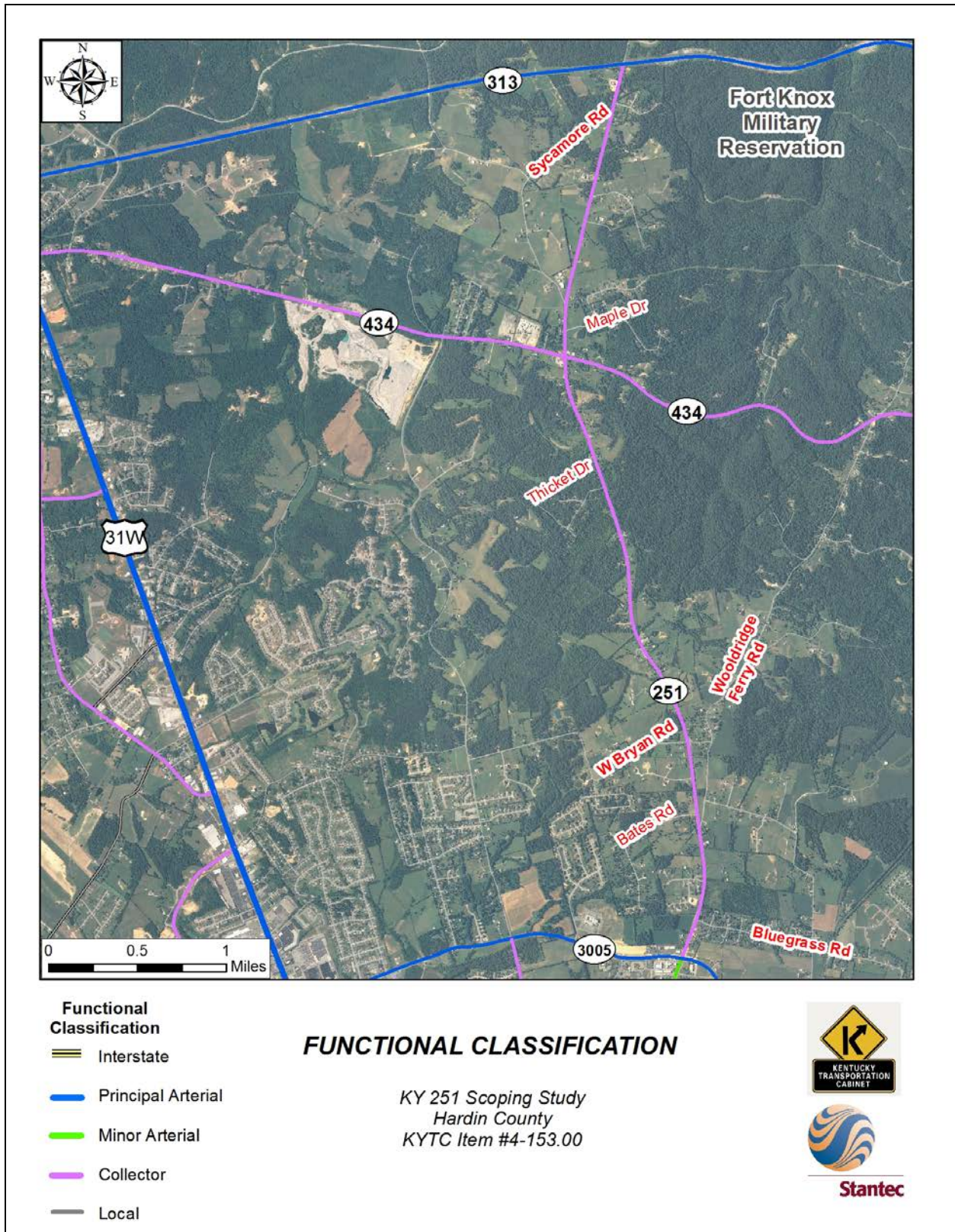


Figure 6: Functional Classification for Study Area Roadways

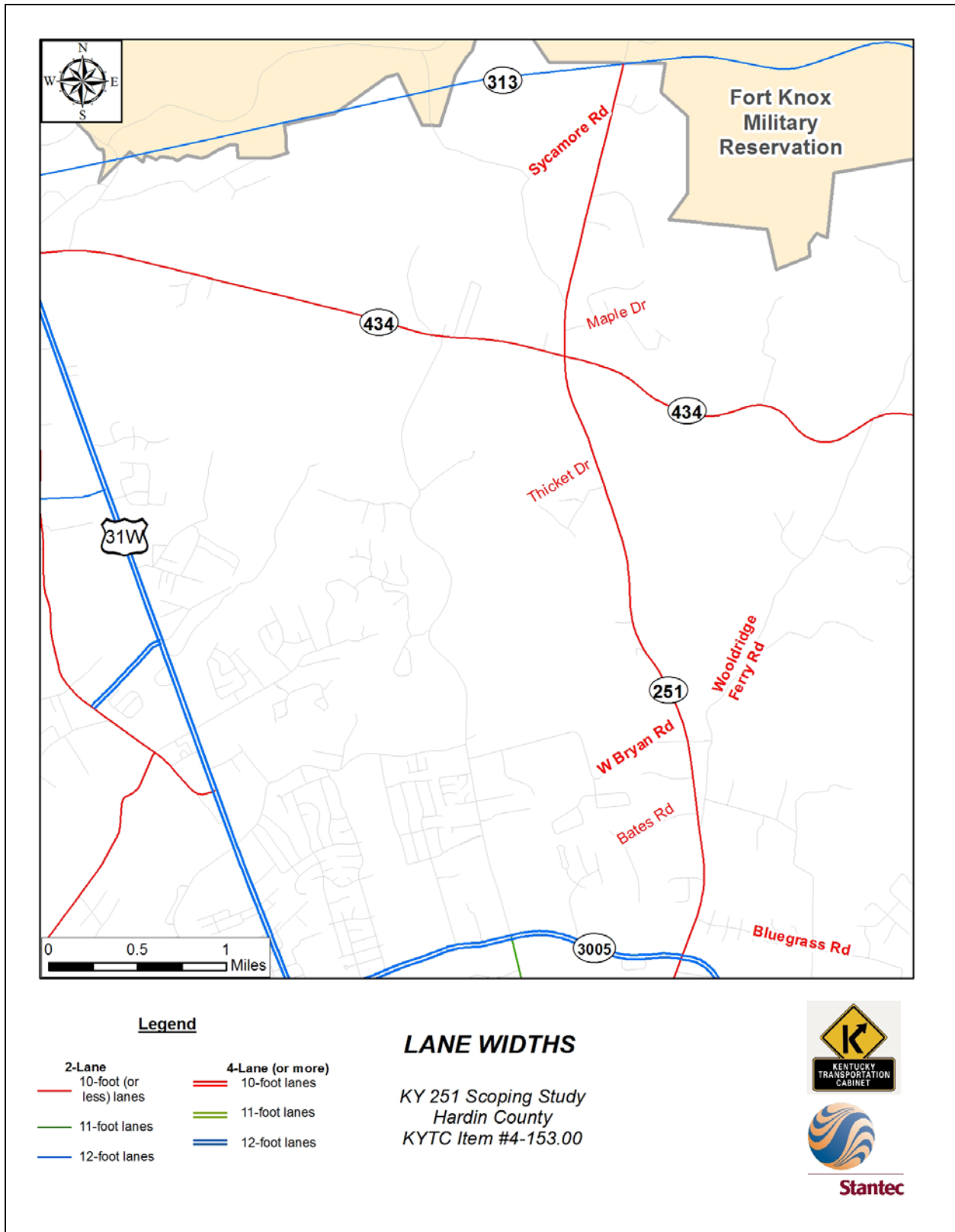


Figure 7: Lane Widths

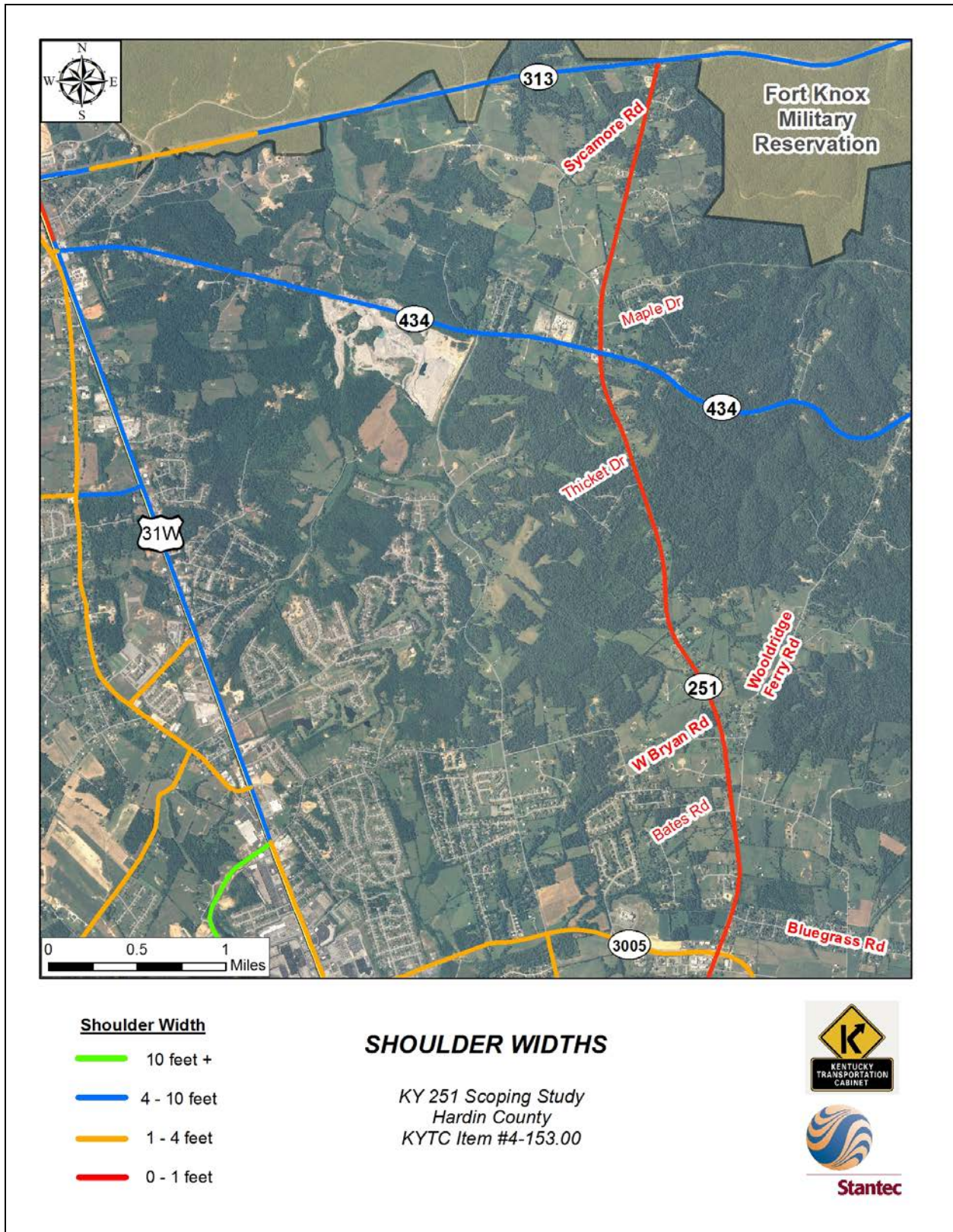


Figure 8: Shoulder Widths

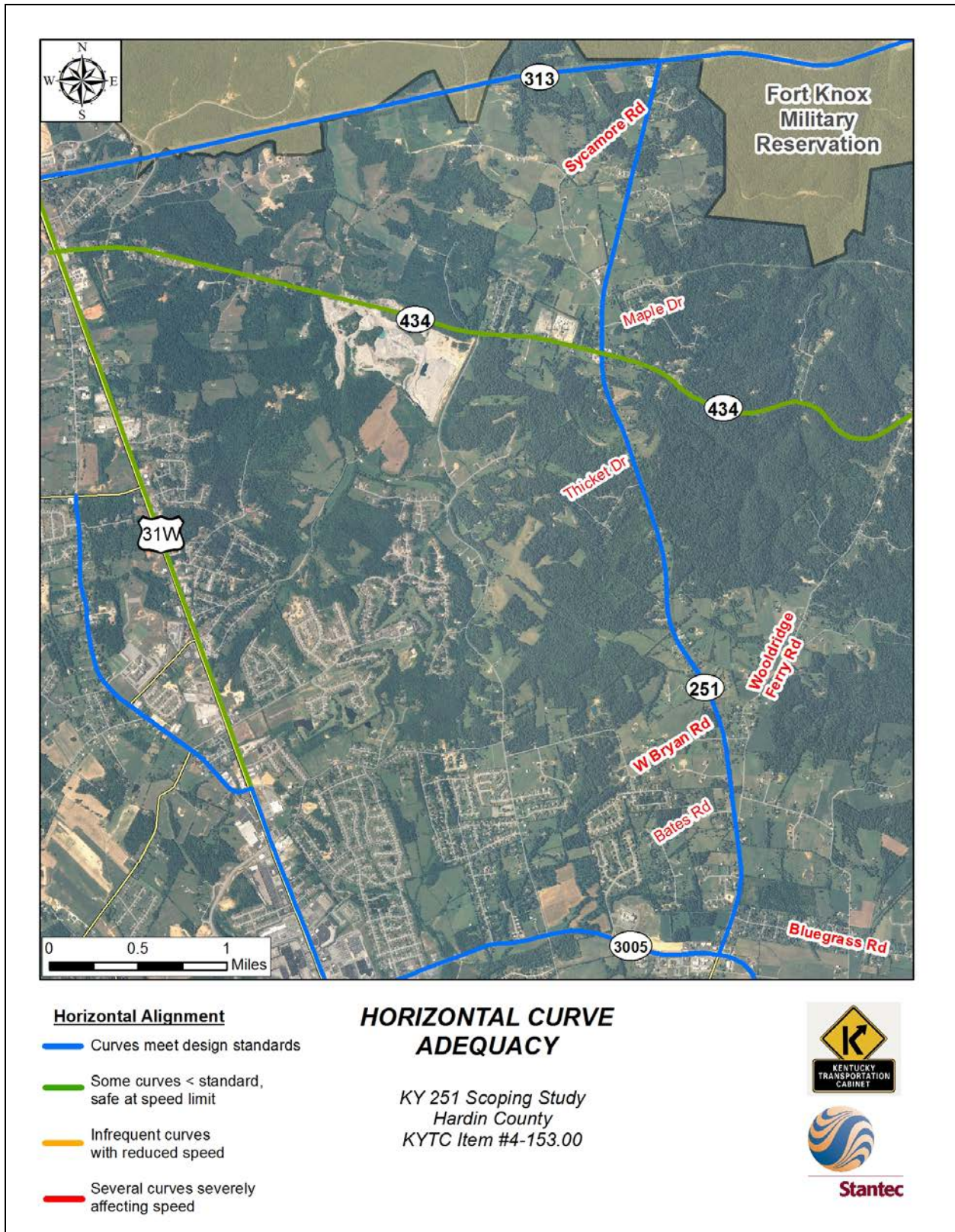


Figure 9: Adequacy of Horizontal Curvature

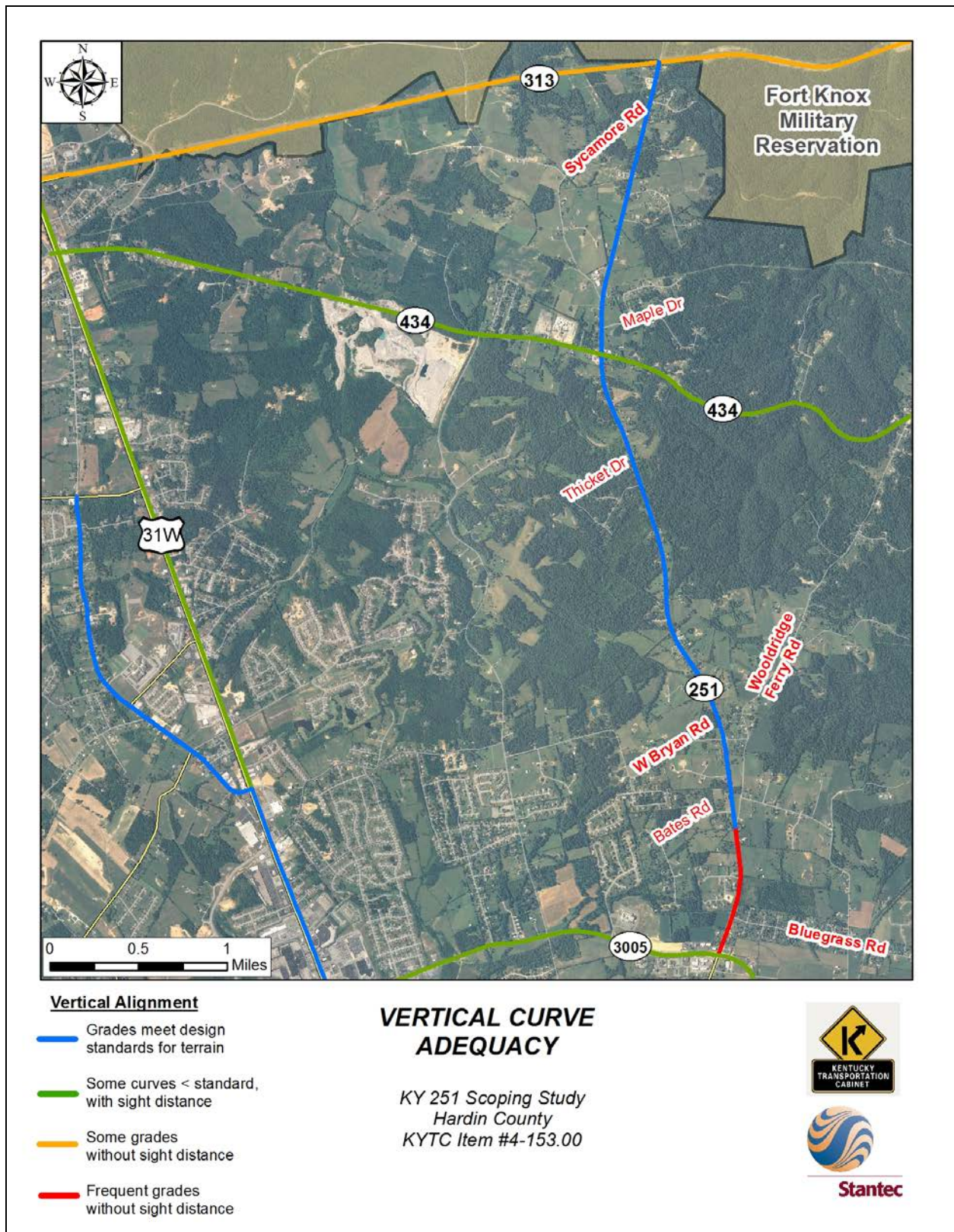


Figure 10: Adequacy of Vertical Curvature

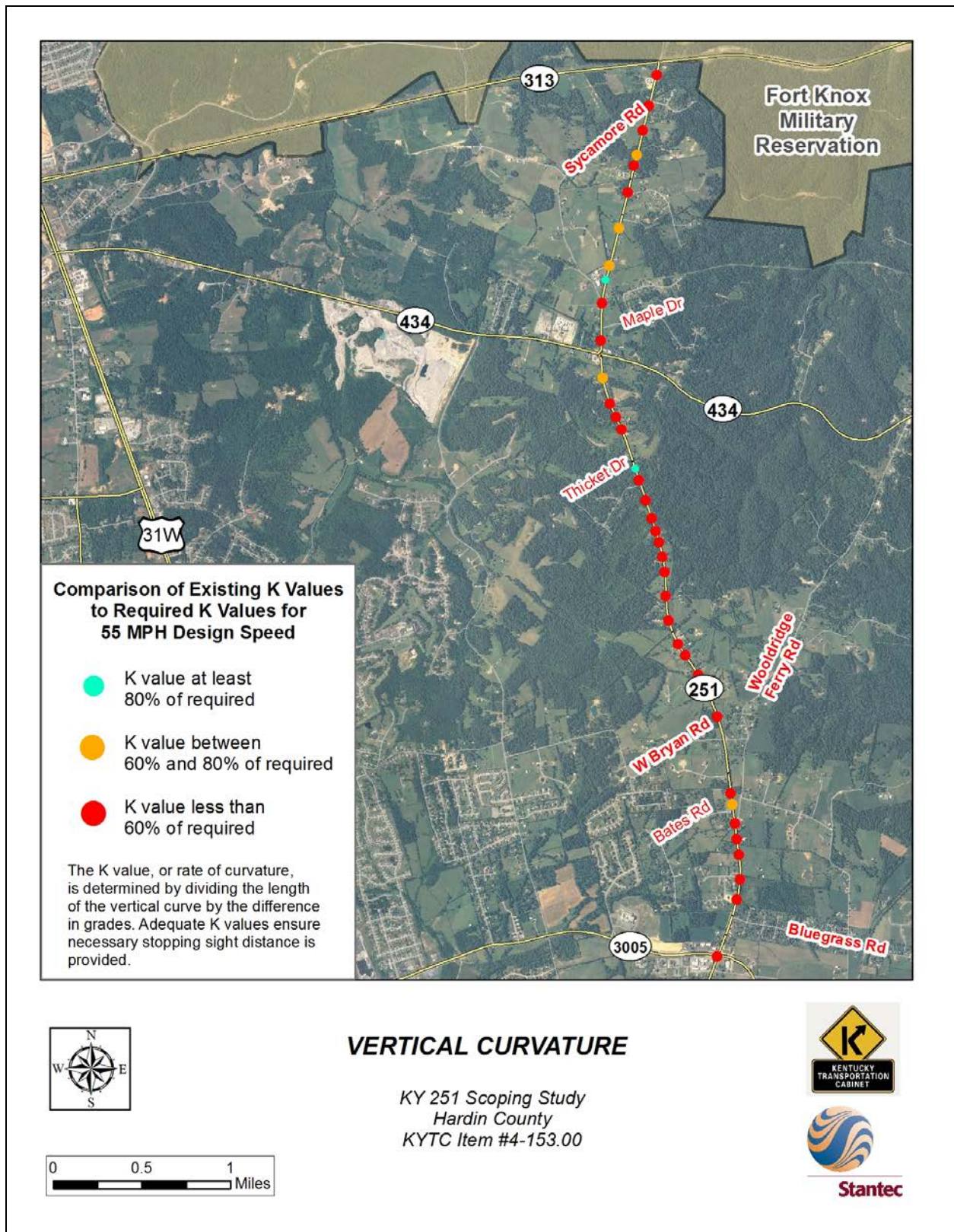


Figure 11: Vertical Curves along KY 251

2.2 Existing Traffic Volumes

Existing average daily traffic (ADT) volumes were obtained for roadway segments within the study area using the KYTC HIS database. **Figure 12** shows the current ADTs as provided in the KYTC HIS database along each of the state-maintained roadways within the study area. Traffic volumes along KY 251 range from a low of about 1,600 vehicles per day at the north end to 5,400 vehicles per day north of KY 3005. Single unit trucks comprise 2.7 percent of the daily traffic and combination trucks comprise 1.2 percent.

The volume-to-service flow (VSF) ratio is a basic measure of congestion, comparing the traffic demand to the roadway's capability. The VSF is calculated by dividing the peak hour traffic flow by the calculated or theoretical capacity of the roadway segment. Areas of concern are where the VSF values approach or exceed 1.0, in which limited capacity leads to congestion. As illustrated on **Figure 12**, all roadways are performing adequately, with VSF value of 0.8 or below. There are no roadway segments within the study area with a VSF greater than 1.0.

2.3 Crash Analysis

Crash data were collected along existing roadways within the study area for a five-year period between January 1, 2006 and December 31, 2010. During that period, there were 78 reported crashes on KY 251 with 18 (23 percent) injury crashes. The locations of these crashes and the crash types are shown on **Figure 13**. The predominant crash type has been single vehicle crashes (29 crashes, 37 percent) followed by rear end crashes (24 crashes, 31 percent).

Critical Rate Factors (CRFs) were also determined as part of this analysis. The CRF value is calculated by dividing the actual crash rate along a particular roadway segment by the critical rate, which is the maximum accident rate for which it can be said that crashes are occurring randomly based on roadway characteristics and traffic. A CRF less than 1.0 indicates that crashes occur at random, and greater than 1.0 suggests that conditions or causative factors may exist that contribute to non-random occurrences.

Both roadway segments (in this case, stretch between significant intersections) and spots (0.2 mile segments centered on intersections) were analyzed. **Table 1** summarizes the segments on both KY 251 and KY 434 and **Table 2** summarizes the spots along both roadways.

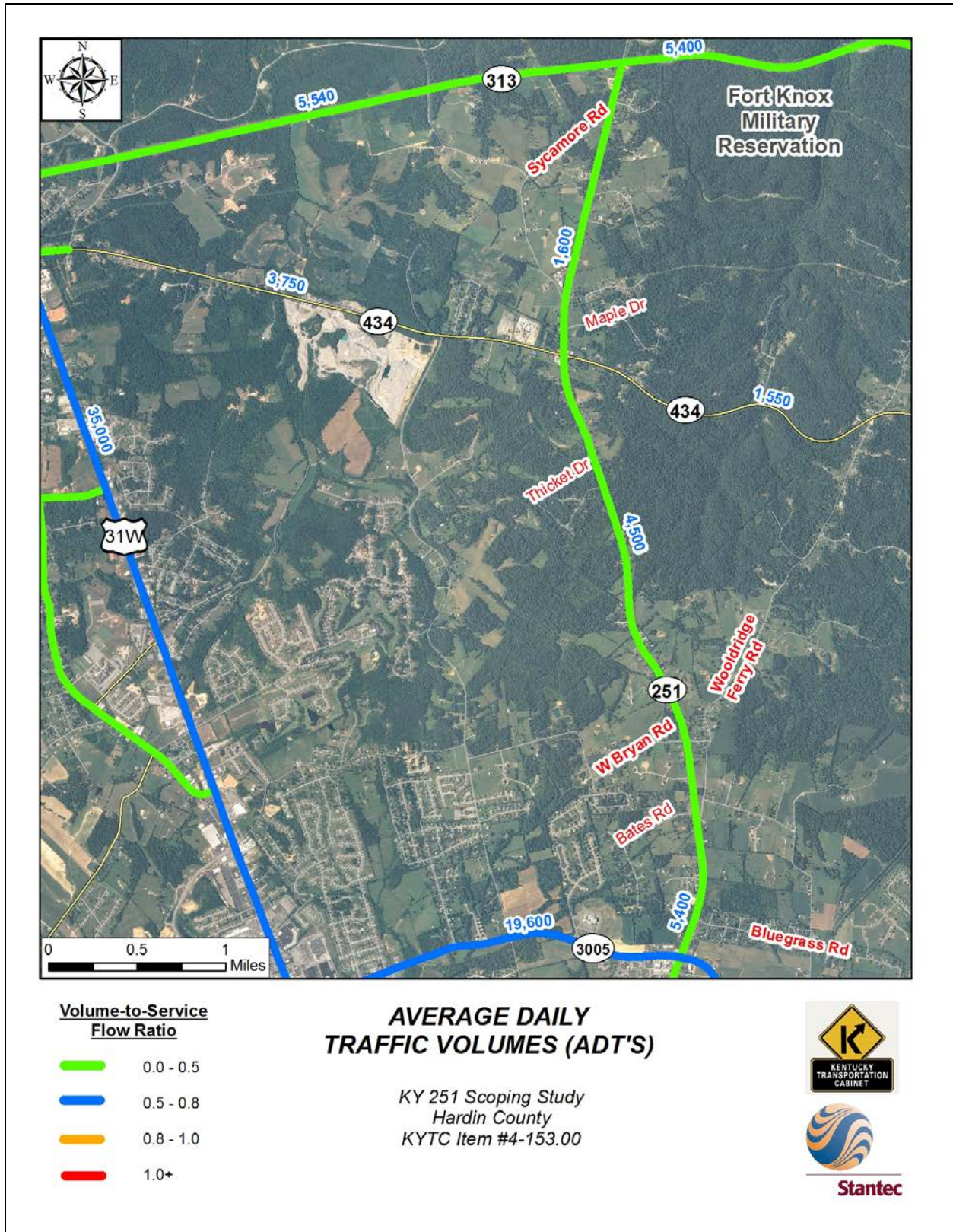


Figure 12: Average Daily Traffic (ADT) Volumes

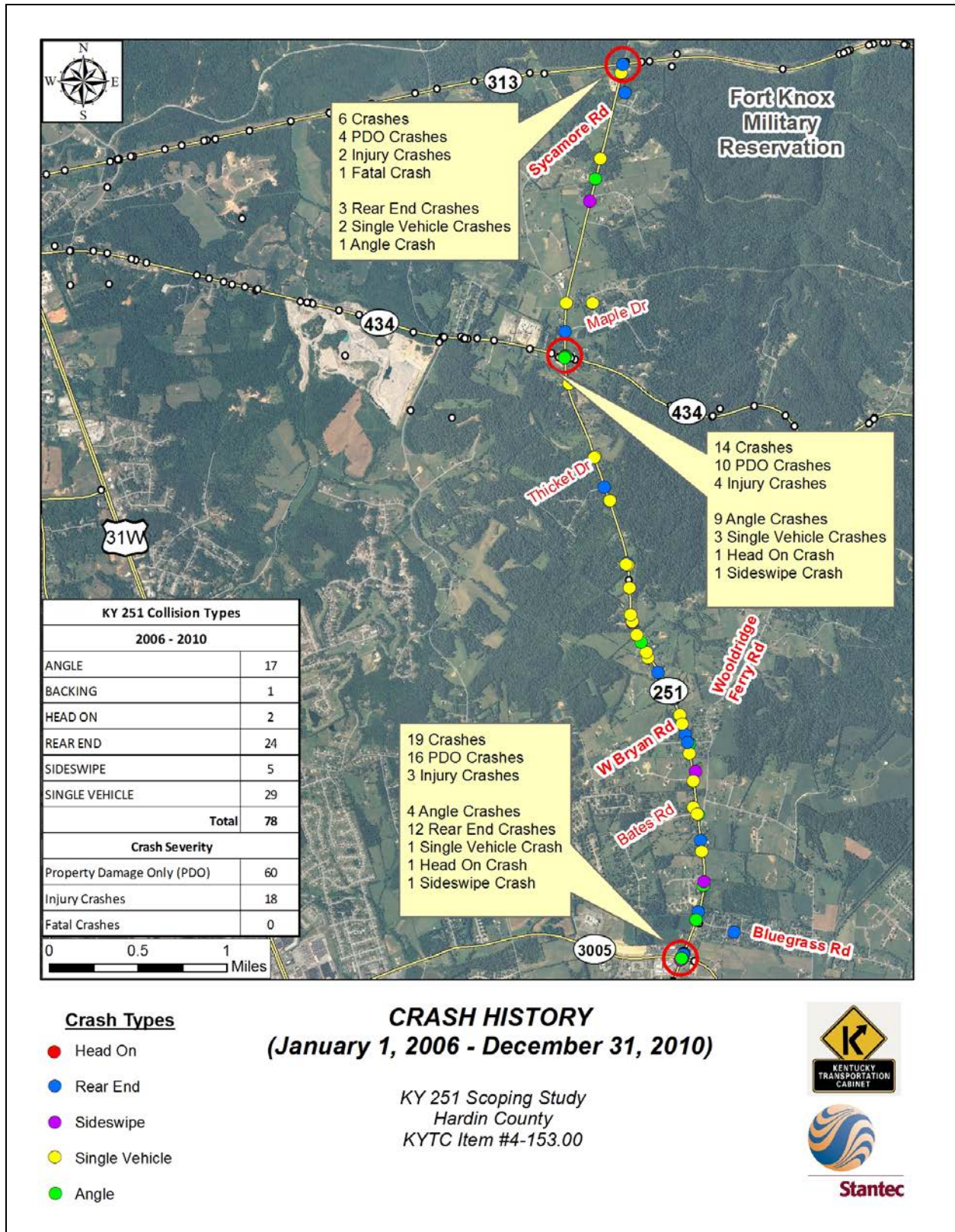


Figure 13: Crash History

Table 1: Segment Crash Analysis Results

Route	Begin Segment	Begin Milepoint	End Segment	End Milepoint	Avg. ADT	Number of Crashes	Actual Crash Rate	Road Type	Average Crash Rate	Calculated Critical Crash Rate	CRF
KY 251	KY 3005	2.722	Wooldridge Ferry Rd.	3.473	5,800	19	398.4	Urban 2-lane	287.0	497.3	0.80
KY 251	Wooldridge Ferry Rd.	3.473	E/W Bryan Rd.	3.967	5,300	6	209.3	Rural 2-lane	209.2	446.7	0.47
KY 251	E/W Bryan Rd.	3.967	KY 434	6.326	4,500	22	189.3	Rural 2-lane	209.2	322.8	0.59
KY 251	KY 434	6.326	KY 313	8.019	3,300	4	65.4	Rural 2-lane	209.2	368.1	0.18
KY 434	US 31W	0.025	Bewley Hollow Rd.	2.455	7,040	29	154.8	Rural 2-lane	209.2	298.0	0.52
KY 434	Bewley Hollow Rd.	2.455	KY 251	3.158	5,310	11	269.1	Rural 2-lane	209.2	405.8	0.66

Table 2: Spot Crash Analysis Results

Route	Intersection	Begin Milepoint	End Milepoint	Avg. ADT	Number of Crashes	Actual Crash Rate	Road Type	Average Crash Rate	Calculated Critical Crash Rate	CRF
KY 251	KY 3005	2.622	2.822	5,800	15	2.4	Urban 2-lane	0.6	1.4	1.65
KY 251	Wooldridge Ferry Rd.	3.373	3.573	5,300	2	0.3	Rural 2-lane	0.4	1.2	0.29
KY 251	E/W Bryan Rd.	3.867	4.067	5,300	4	0.7	Rural 2-lane	0.4	1.2	0.57
KY 251	KY 434	6.226	6.426	3,050	3	0.9	Rural 2-lane	0.4	1.5	0.61
KY 251	KY 313	7.819	8.019	1,600	1	0.6	Rural 2-lane	0.4	2.0	0.29
KY 434	Bewley Hollow Rd.	2.355	2.555	2,065	3	1.3	Rural 2-lane	0.4	1.8	0.76
KY 434	KY 251	3.058	3.258	2,565	8	2.8	Rural 2-lane	0.4	1.6	1.79

There are no roadway segments with a CRF greater than 1.0, suggesting that crashes occur randomly. The KY 251 intersection with KY 3005 and the KY 434 intersection with KY 251 both have CRF's greater than 1.0. The KY 3005 intersection will be improved with the KYTC Item #4-7030.00 project. Improvements to the KY 434 intersection with KY 251 are discussed later in this report.

3.0 ENVIRONMENTAL OVERVIEW

The environmental overview provides a general summary of the social, economic, and environmental composition of the project area. These findings were used to evaluate the impact that improvement options might have on the environmental resources in the study area. The environmental review area is generally 300 feet each side of the existing centerline of KY 251 (600 feet total width), beginning at the intersection of KY 3005 (Ring Road) and extending northward to KY 313 (Joe Prather Highway), for a distance of approximately 5.3 miles. A detailed Environmental Overview Report dated March 2011, which includes resource agency letters and contacts, has been prepared and submitted to the KYTC under separate cover. A copy, which includes a detailed Environmental Footprint map, is included in **Appendix B**. Due to changes to the limits of the original study area for alternative development, the environmental overview is limited to the KY 251 corridor.

3.1 Socioeconomics and Environmental Justice

Information regarding socioeconomic data and the presence or absence of environmental justice populations is included in the Environmental Justice Overview in **Appendix C**. During on-site reconnaissance of the study area, one small mobile home neighborhood (consisting of about five mobile homes) was identified along KY 251 southbound, south of Five Oaks Drive.

3.2 Air Quality

Review of available U.S. Environmental Protection Agency (USEPA) Envirofacts data for Hardin and adjoining counties (USEPA, 2010a) did not indicate any air quality issues for the reporting year through September 2010. Review of available USEPA Green Book data (USEPA, 2010b) indicates adjoining Bullitt and Jefferson Counties (Louisville, KY-IN area) are in “non-attainment” status for particulate matter PM-2.5 1997 pollutant criteria, while Hardin County is not listed for any criteria pollutants. The KYTC Division of Planning’s Air Quality Modal Program does not list Hardin County as an Air Quality Non-Attainment Area (8-Hour Ozone or PM2.5) as of July 2007 (KYTC, 2010b).

3.3 Noise

Noise-sensitive receptors observed within or adjacent to the study area included the following:

- Low density residential neighborhood developments (e.g. maximum of five dwelling units per acre) such as Bluegrass Road, Amber Wood and Grand Hill Villas in the south of the study area, a small mobile home park, Five Oaks Drive and The Woods between West Bryan Road and Battle Training Road.
- Camp Nikao, youth and adult camp and retreat facility in the north of the study area.
- Two churches, one in the south and one in the center of the study area.

Aside from the specified residential areas, the majority of the study area exhibited very low density (i.e. two or fewer dwelling units per acre) rural residential and agricultural development patterns with widely separated single family residential structures along KY 251. A project-specific traffic noise impact study may be needed to identify and mitigate noise impacts as this project further develops.

3.4 Aquatic and Terrestrial Ecology

No high quality stream corridors or 100-year floodplains are located in the study area. There are some small ponds in the area which serve mostly local agricultural and recreational purposes. A number of minor streams exist within the project area. Most of the streams are ephemeral with two potentially recognized as USGS features. Initial reconnaissance identified some areas that show characteristics of wetlands. Further evaluation would be required to determine if these areas would be subject to any permitting and mitigation requirements. There are several wells located within the study area. These are primarily domestic, single home use sources. The southern portion of the study area falls within a Source Water Assessment and Protection area for a public water supply. Additional coordination with local watershed management programs and protection measures during construction may need to be taken.

Although there are no known records of any federal-listed endangered species within the project area, there have been instances of some occurring or have the potential to occur within Hardin County. There are a few species of mussel that have the potential to occur in Hardin County, however no suitable habitats were observed in the area. Potential summer habitats for the Indiana bat and the gray bat were observed during

initial inspections. Review of information provided in the Indiana Bat Mitigation Guidance for the Commonwealth of Kentucky indicates portions of Indiana Bat Recovery and Mitigation Focus Areas (RMFA's) are located within a couple of miles of the study area. Due to the approximation of the study area to these RMFA's, additional habitat assessment and coordination with resource agencies may be required as the project progresses. No known caves are located along the KY 251 corridor for this study which would serve as a potential habitat for the bats.

No known records of any state-listed species exist within the project area. There are about 46 species that are known or have the potential to occur in Hardin County. Of these, the rough rattlesnake-root, a state-endangered plant species, has been recorded near, yet outside, of the study area. Due to the occurrence of potential habitats for state-listed species, assessment and coordination with resource agencies may be required as the project progresses.

3.5 Cultural Historic Resources Evaluation

Review of information from the Kentucky Heritage Council indicated no previously recorded historic resources occur in or adjacent to the study area. An initial project review indicated the possibility of structures 50 years of age or older present within the study area, and recommended further study. A KYTC pre-qualified consultant will be required to determine the presence (and National Register of Historic Places (NRHP) eligibility) or absence of cultural historic resources in the study area as there appears to be several residences and associated structures which may be over 50 years of age. One cemetery is indicated on USGS mapping (Colesburg Quad) within the project study area, namely the McMillen Cemetery located southeast of the south intersection of KY 251 and Sycamore Road, approximately 250 feet east of KY 251 centerline. This site is possibly a private family cemetery as it is mapped within the same property parcel as the residential home. The presence of this cemetery will need to be verified and further evaluated for NRHP eligibility.

3.6 Archaeological Resources Evaluation

Review of information from the Kentucky Office of State Archaeology indicates one prior archaeological survey has been performed which partially overlaps a small portion of the project study area at the north project terminus (KOSA, 2011; Attachments A3 and B15). The prior archaeological survey identified one previously recorded archaeological site (National Register eligibility undetermined). Specific information regarding the location, context and content of this site was not provided.

Since most of the project area has not been previously surveyed, a Phase I archaeological site investigation will be required to determine the presence or absence of archaeological resources.

3.7 UST/Hazmat Considerations

An initial review of the area identified potential UST/Hazmat considerations. One site with confirmed UST and AST present is a gas station located at the southwest corner of KY 251 and KY 434 intersection. A vacant site located on KY 251 and East Bryan Road exhibits characteristics of a former service/gas station. Further survey work would be required to determine the presence of any UST or other environmental concerns. A few other businesses in the area may contain materials that would warrant consideration of a Phase I survey for hazardous materials.

4.0 GEOTECHNICAL OVERVIEW

Bedrock in the study area is underlain by plane bedded sedimentary rocks of the Mississippian and Devonian Periods, overlain by shale and limestone of the Borden Formation, and capped by additional layers of Salem, St. Louis and St. Genevieve Limestones (Arms, et. al., 1979; Kepferle, 1966 and 1967).

The majority of Hardin County, including all of the study area, is considered to be in an intense karst and very high karst potential area (KGS, 2001b and 2010a). Intense and very high karst indicates an area “underlain by bedrock with high potential for karst development...thick-bedded, typically fine-grained and pure limestone units with little or no insoluble content. May [Will] exhibit mature karst, including caves, sinkholes and springs where they crop out” (KGS, 2010b). Several sinkholes are mapped within the study area (KGS, 2003), and were observed during on-site reconnaissance activities. The Kentucky Speleological Society reported there are no known caves listed along or near the project study area (KSS, 2011).

The presence of mines or quarries in the study area was investigated through review of information from the Kentucky Department for Natural Resources (Division of Mine Permits, Division of Mine Reclamation and Enforcement, and Division of Abandoned Mine Lands; KDNR, 2010), Kentucky Mine Mapping Information (2010), and on-site reconnaissance. Review of secondary source information indicated several active mines and/or quarries occur in Hardin County. The Fort Knox Quarry, a limestone quarry operated by Vulcan Construction Materials, is the nearest operating mine or quarry and is located along KY 434 approximately 0.75 mile west of the KY 251 and KY 434 intersection. There are no mined out areas mapped within the county, and the county is not covered by any of the Division of Abandoned Mine Lands’ three field offices.

5.0 TRAFFIC FORECASTS

In order to determine the need for and purpose of potential transportation improvement projects, it is necessary to estimate future conditions within the study area. A starting point in this effort was to first consider historical travel trends along KY 251. **Figure 14** shows KYTC’s average daily traffic counts along KY 251 between 1994 and 2011. The southernmost section, north of KY 3005, has historically carried the highest volume of traffic which exceeded 6,000 vehicles per day in 2007. The volume on that section has since decreased to about 5,400 vehicles per day. The section north of KY 434 carries the lowest volume of traffic and has not exceeded 2,000 vehicles per day.

The KYTC provided a copy of the Elizabethtown-Radcliff Travel Demand Model to incorporate the proposed alternatives into future year forecasts. The model would demonstrate how the individual alternatives would affect the distribution and volume of traffic on KY 251 and surrounding highways.

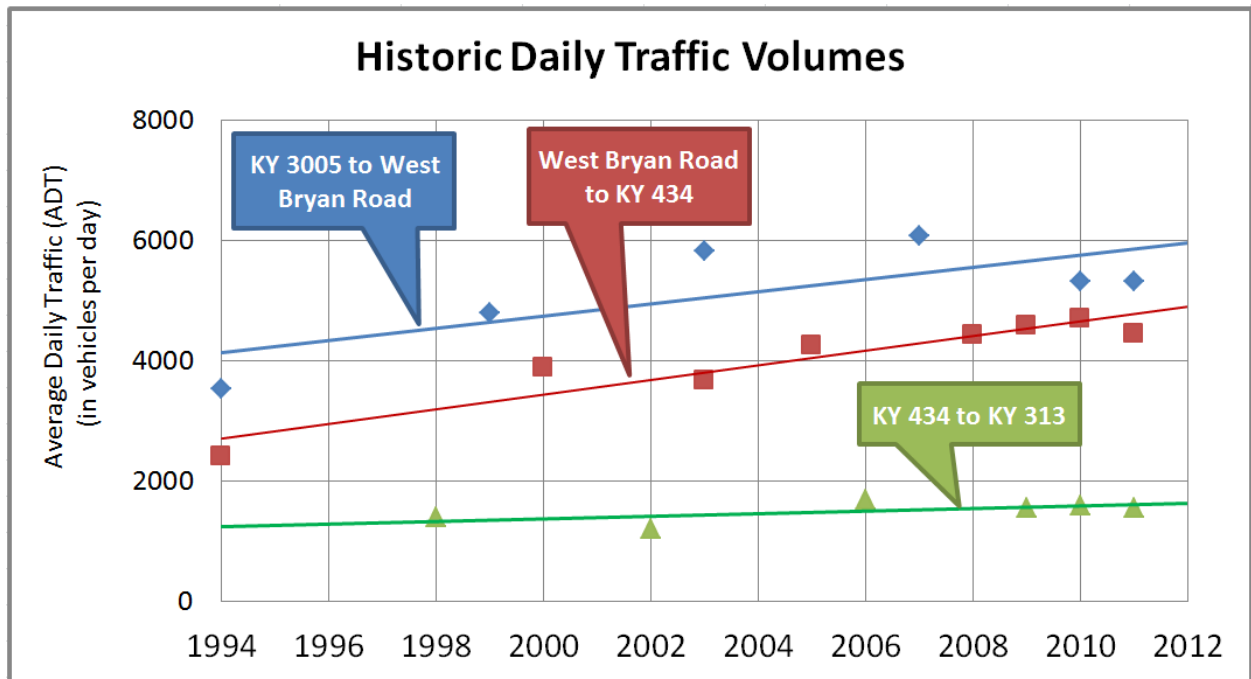


Figure 14: Historic Traffic Counts along KY 251

The Elizabethtown model had been developed for the Cabinet in 2009 with a 2008 base year and 2035 horizon year. Minor code and operational adjustments were made to make the model compatible with the current version of Caliper’s TransCAD operating software. Model network and zonal data files were then revised to reconcile base year network and zonal files with future year files. New Traffic Analysis Zones (TAZs) were created in the base year to reflect future committed projects that would distinctly affect traffic distribution. These projects, shown in **Figure 15** (Hardin County), **Figure 16** (Elizabethtown), and **Figure 17** (Meade County), included the KY 313 extension from Vine Grove to US 60 in Meade County (KYTC Item No. 4-297) and the Elizabethtown to Radcliff connector (KYTC Item No. 4-8103) which roughly parallels US 31W to the west. The adjustments resulted in the addition of nine TAZs, although no new TAZs were added directly to the study area.

The new connector from Veteran’s Parkway to KY 313 (KYTC Item No. 4-8103.50) and proposed Fort Knox Access Road running parallel east of US 31W were also included in the future network. The new connector is included in all future year scenarios. The Fort Knox Access Road is not a committed project, but is a conceptual proposal intended to redirect post-related traffic arriving from KY 313 on the east away from US 31W. It was included in some alternative model runs, but is not presumed to be part of the analytical purview of this study.

The base year model was updated and re-validated to 2010 using new traffic counts collected by KYTC as well as the most recently available counts at Fort Knox’s three active entry gates. While the model generally conforms to KYTC’s standard protocols for file structure and user interface, it is unique in its use of special generators to balance and match traffic at the entry gates. Given the general capacity and fluidity of on-post traffic generating activities, this approach allows the model to set traffic volumes entering and exiting the post to counts either observed or estimated at each gate. Observational travel speeds and travel times along KY 251 and KY 434 were provided by KYTC staff and included in the validation process.

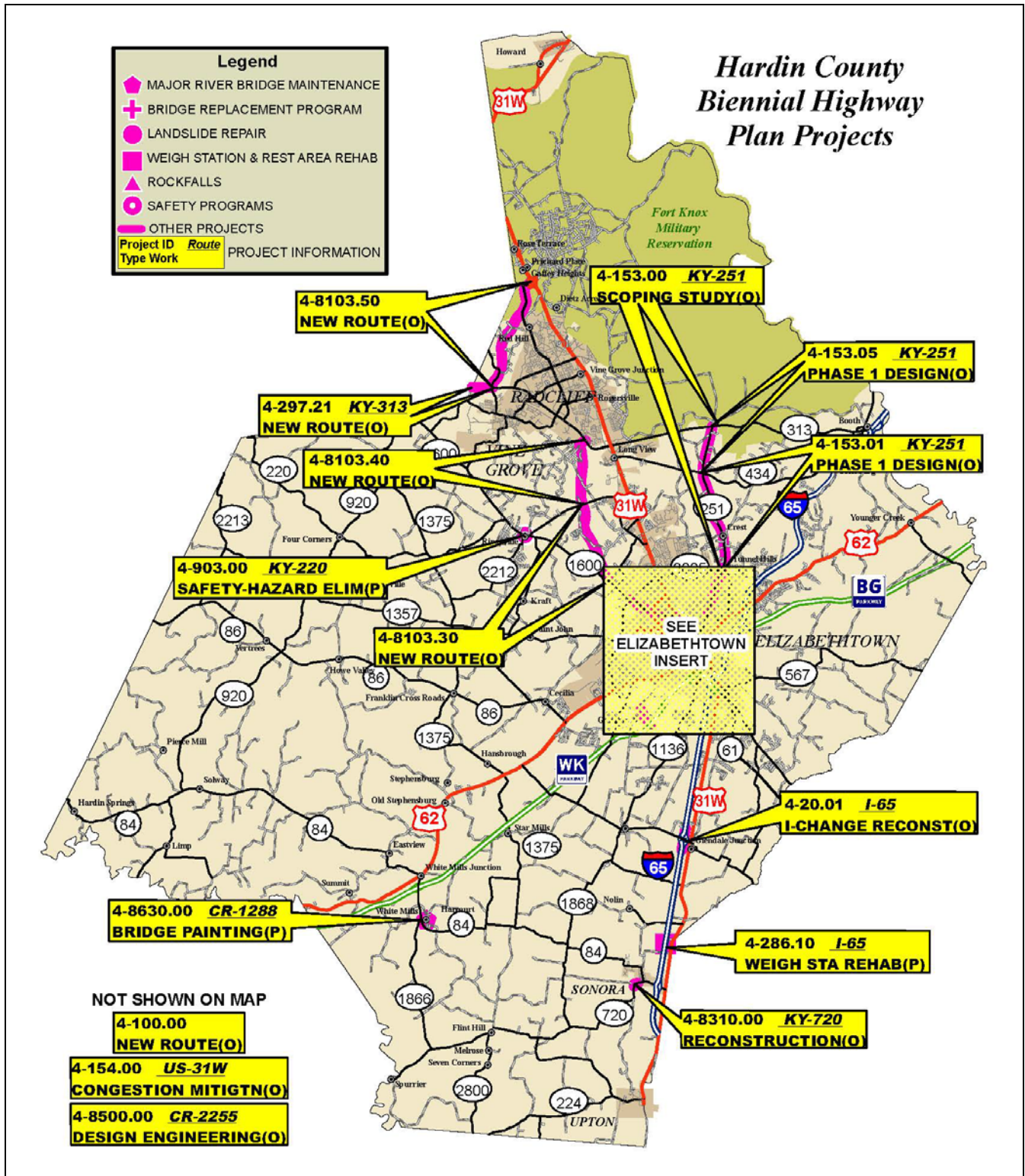


Figure 15: Committed Projects in Hardin County

Source: Kentucky's FY 2010-FY 2012 Enacted Biennial Highway Plan

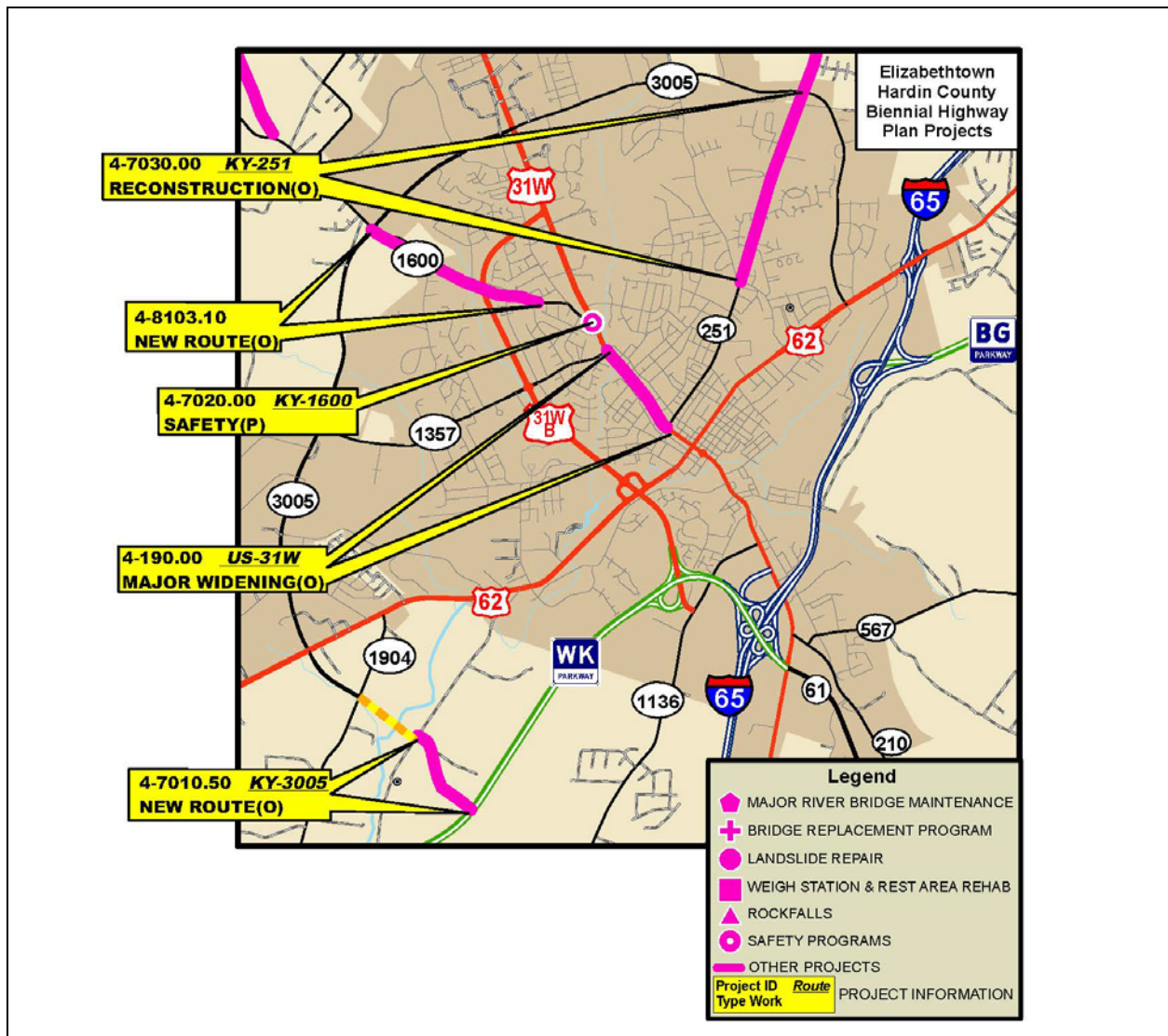


Figure 16: Committed Projects in Elizabethtown

Source: Kentucky's FY 2010-FY 2012 Enacted Biennial Highway Plan

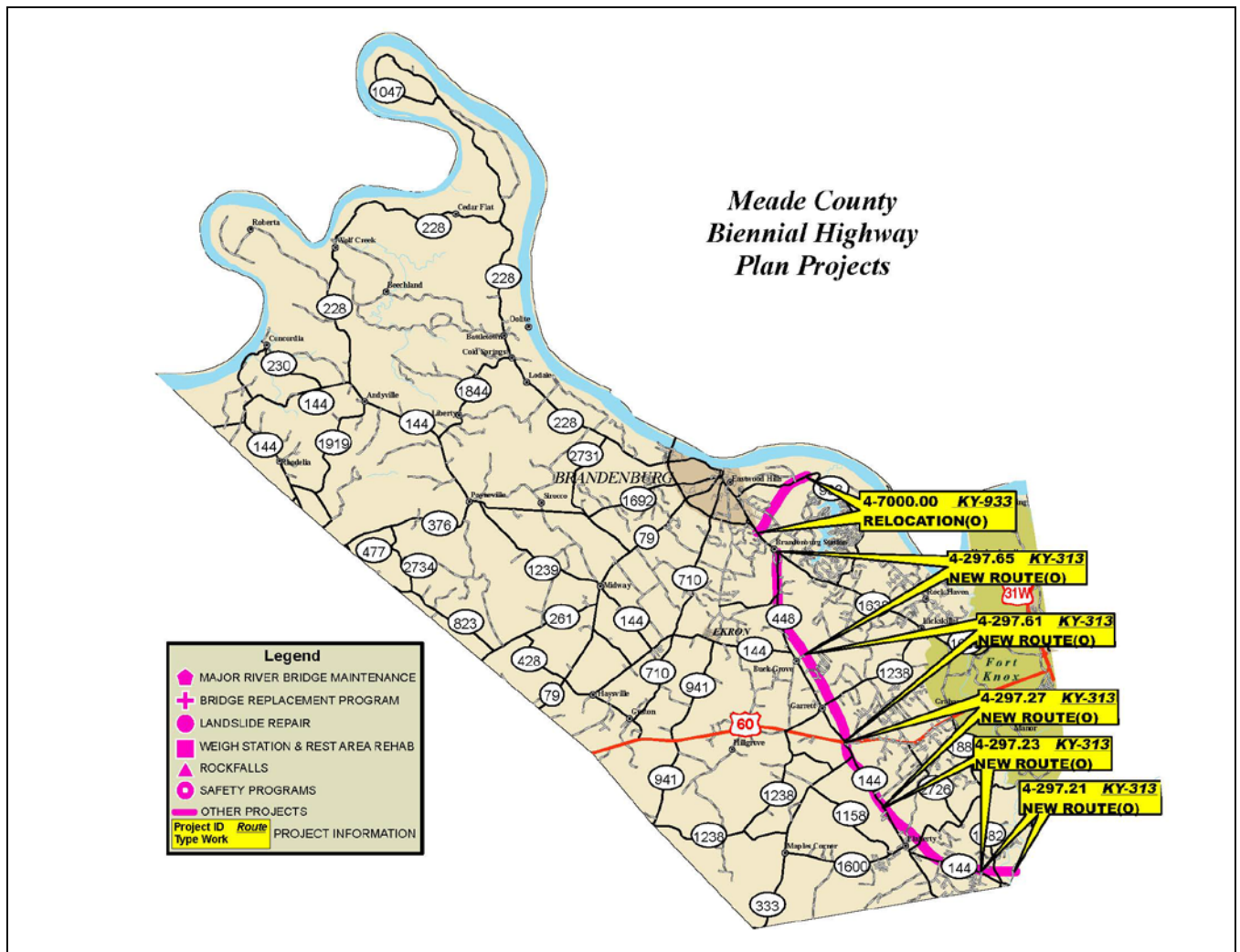


Figure 17: Committed Projects in Meade County

Source: Kentucky's FY 2010-FY 2012 Enacted Biennial Highway Plan

Final validation statistics for the 2010 base year model include the percent Root Mean Square Error (%RMSE) and assigned-to-observed ratio of Vehicle Miles Traveled (VMT). The %RMSE is the standard statistic used to indicate how well a model assigns traffic to the network as compared to observed counts. The %RMSE for the 2010 base model is 33.1%, which falls below the acceptable 35% threshold for models incorporating a higher percentage of low-volume roads as typically found in rural and small urban areas. The overall ratio of assigned-to-observed VMT was 1.0002, indicating a very good overall fit, although the model's VMT ratio for collector roads was high at 1.20.

There were only eleven count stations within the study area, but for those counts, the %RMSE was 23.7% and the VMT ratio was 1.09. **Figure 18** shows the location of these count stations.

The resulting traffic forecasts for the No-Build Scenario as well as the base year 2010 ADT volumes are included on **Figure 19**. Compared to the 2010 traffic counts, future volumes are expected to increase along KY 251. The highest volume is south of Bluegrass Road where the forecast is 15,000 vehicles per day and annual growth is about 4.6 percent per year. The remainder of KY 251 is not expected to exceed 9,000 vehicles per day with growth rates ranging from 2.3 to 3.5 percent per year through 2030.

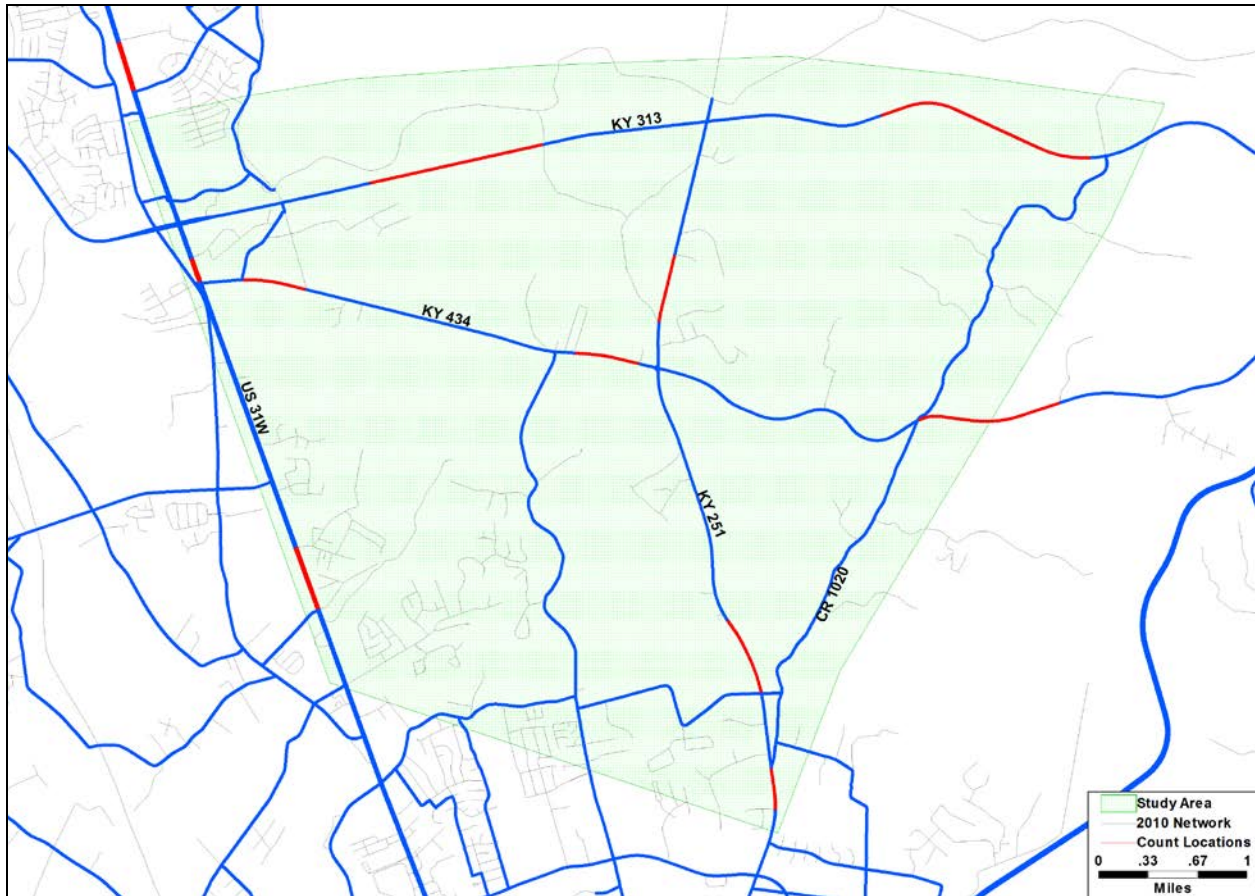


Figure 18: KYTC Count Stations in Proximity to the Study Area

Source: Radcliff-Elizabethtown Regional Travel Demand Model
(Segments with count stations shown in red)

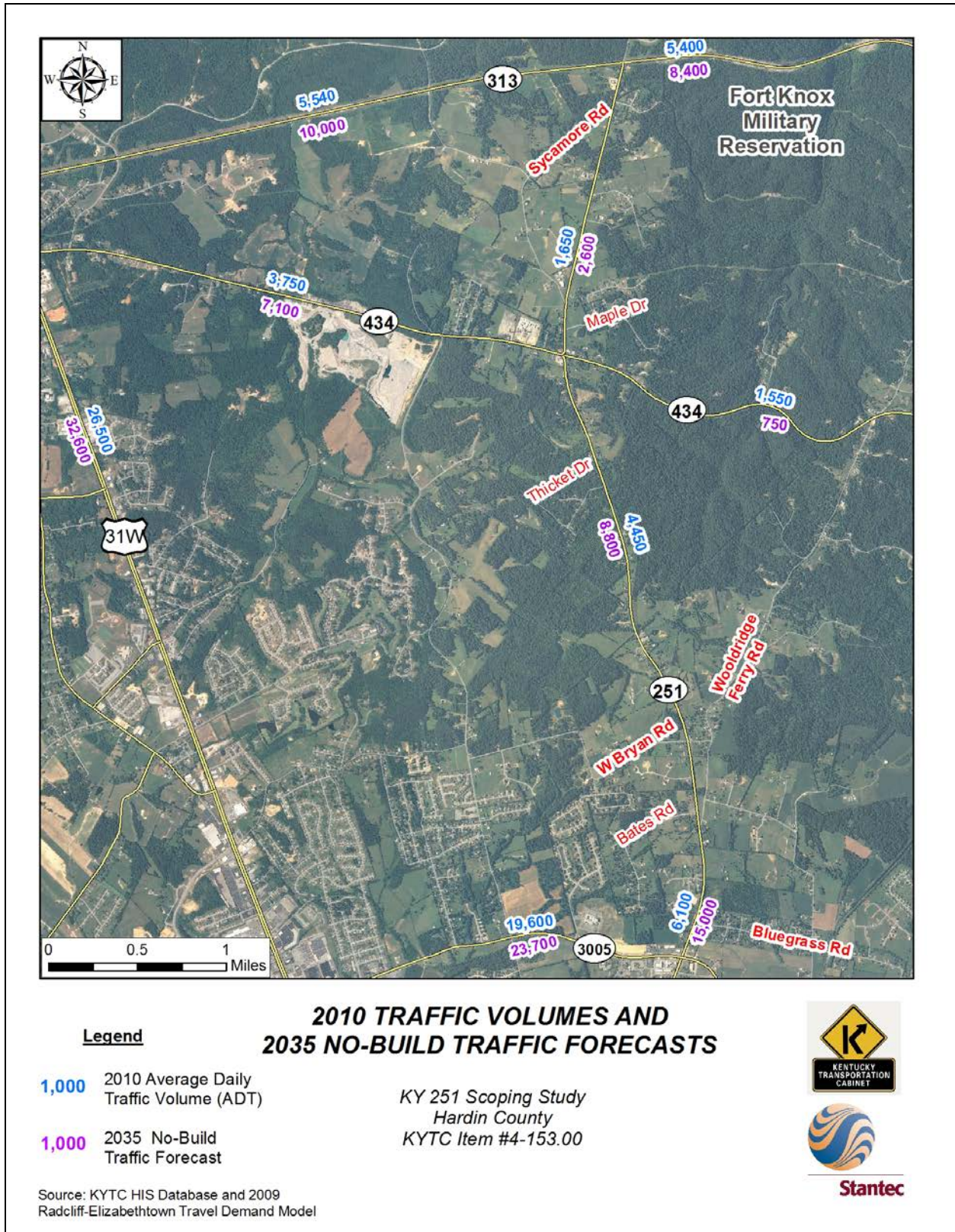


Figure 19: 2010 Traffic Counts and 2035 No-Build Traffic Forecasts

6.0 DEVELOPMENT OF ALTERNATIVES

A number of transportation alternatives were developed and evaluated in the KY 251 Scoping Study. This includes both short-term projects that could potentially be implemented in the near term with minimal cost and long-range corridor alternatives that would require more significant resources. This chapter discusses these conceptual improvement alternatives.

6.1 Spot Improvements

Two short-term improvements (also referred to as “spot improvements”) were developed based on investigation of crash data and site reconnaissance. Descriptions of each of these two projects follow.

Wooldridge Ferry Road intersects KY 251 at a skew, resulting in a very wide approach, as shown in **Figure 20**. It also has less than desirable sight distance to the south, demonstrated in **Figure 21**. Although only two crashes have occurred at the Wooldridge Ferry intersection over the past five years, a realignment of Wooldridge Ferry to connect directly across from Bates Road would eliminate the skewed intersection and sight distance issue.



Figure 20: KY 251 at Wooldridge Ferry (looking north)



Figure 21: Looking South along KY 251 from Wooldridge Ferry

The second intersection discussed was KY 434 at KY 251, shown in **Figure 22**. There were 14 crashes reported at this two-way stop-controlled intersection over the past five years. The predominant turning movements at the intersection are from northbound KY 251 to westbound KY 434, and from eastbound KY 434 to southbound KY 251. The KY 251 approaches are stop-controlled, and travel speeds on KY 434 tend to be relatively high as the speed limit is 55 mph. Thus, there is the potential for serious crashes to occur. A high crash rate spot exists on KY 434 through the intersection. The study team discussed options to better facilitate traffic flow between the west and south approaches. A preliminary layout showing a single lane roundabout was presented as an alternative to accommodate turning traffic and to slow traffic through the intersection. The team agreed this option should be pursued further.



Figure 22: KY 251 at KY 434 (looking south)

6.2 Long-Term Improvements

The conceptual long-range corridor alternatives for the KY 251 Scoping Study were developed based on a comprehensive investigation of existing conditions. These alternatives, shown on **Figure 23**, involve both improvements to existing sections of KY 251 as well as new routes. The new routes are all west of existing KY 251 in an effort to provide a more efficient and more direct connection to the potential new connector road into Fort Knox east of South Boundary Road. The following concepts were presented and discussed at a public meeting in November 2011.

Do Nothing/ No-Build Alternative

A Do Nothing/ No-Build alternative was briefly discussed in the preliminary stages of the study. This alternative would not satisfy the Purpose and Need for the study.

Alternative #1A

Alternative #1A involves the improvement of KY 251 from KY 3005 to KY 313 utilizing a 55-mph design speed and an improved rural two-lane cross section, including 11-foot driving lanes and eight-foot shoulders with four feet being paved. This typical roadway section, shown in **Figure 24**, is being referred to as a minor widening. The existing roadway will be widened and improved along its current horizontal alignment. Utilizing a 55-mph design speed will require improvements in the vertical curves which will result in areas with large earthwork quantities and land disturbance. A number of relocations are anticipated in order to construct the roadway to meet current design standards. The constructed roadway should increase safety and maintain an acceptable level of service.

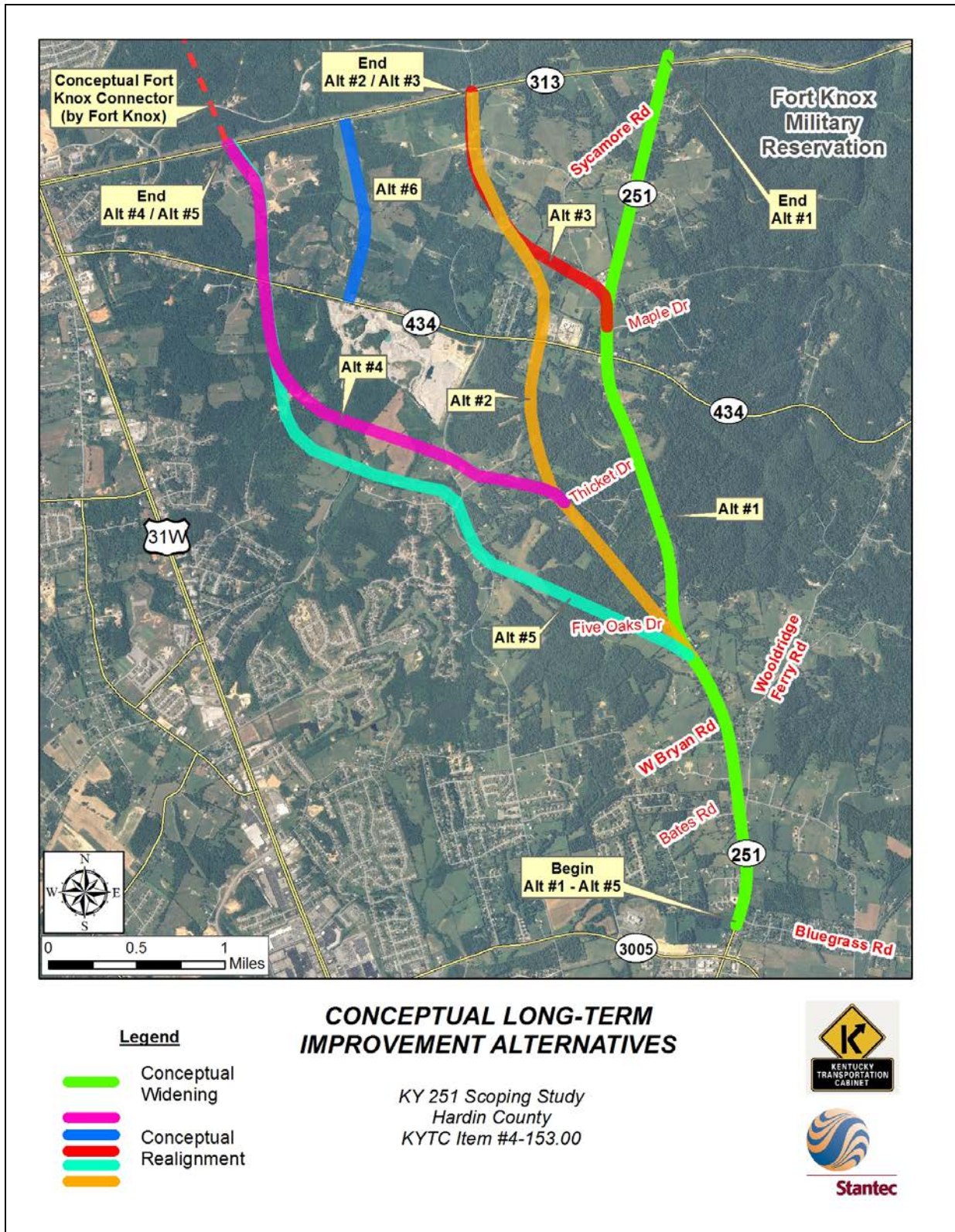


Figure 23: Conceptual Long-Term Improvement Alternatives

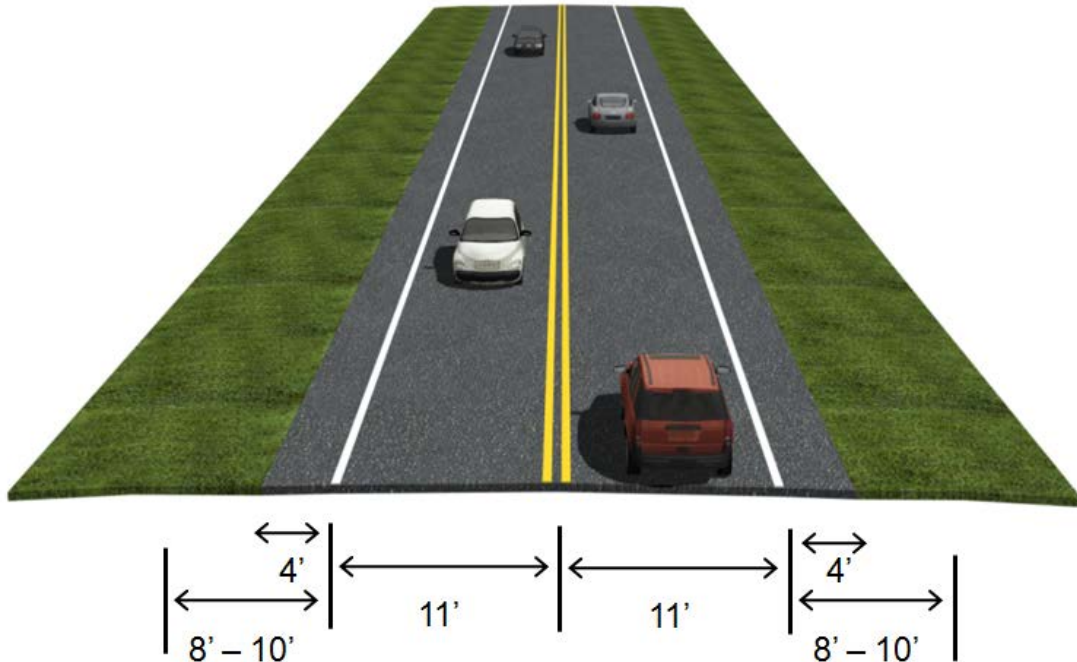


Figure 24: Assumed Typical Section for Minor Widening

Alternative #1B

Alternative #1B involves the reconstruction of KY 251 from KY 3005 to KY 313 utilizing a typical section with a four-lane roadway with paved shoulders, being referred to as a major widening and shown in **Figure 25**. The roadway would be reconstructed following the existing horizontal alignment while improving the vertical alignment to meet current design standards for a 55-mph roadway. The existing narrow lanes and minimal shoulders would be replaced with 11-foot travel lanes with eight-foot shoulders (four feet paved). This alternative would require a great deal of right of way to be purchased to accommodate the increase in roadway width. In addition, making the required vertical improvements would also result in large earthwork quantities and increased need for right of way. This will also result in increased impact to residences and business, leading to a larger number of relocations. Although the improved roadway would provide a safer and more functional route, with the increased capacity of a four-lane roadway with the projected traffic volumes, this alternative would function below the ideal volume to capacity ratio and would function far below efficiency.

Alternative #1C

Alternative #1C involves widening the existing KY 251 roadway to two 11-foot driving lanes while providing a smaller four-foot wide shoulder and narrower ditches. Spot improvements to the vertical curves would be made at identified locations to meet 45-mph design speed standards. This alternative reduces the impact of the roadway construction while making improvements to help alleviate some of the deficiencies of the current roadway. The purpose of this alternative is to provide a low cost alternative that, while not meeting 55-mph design standards as the other alternatives, still will improve the safety and functionality of the roadway without adversely impacting properties along the current route.

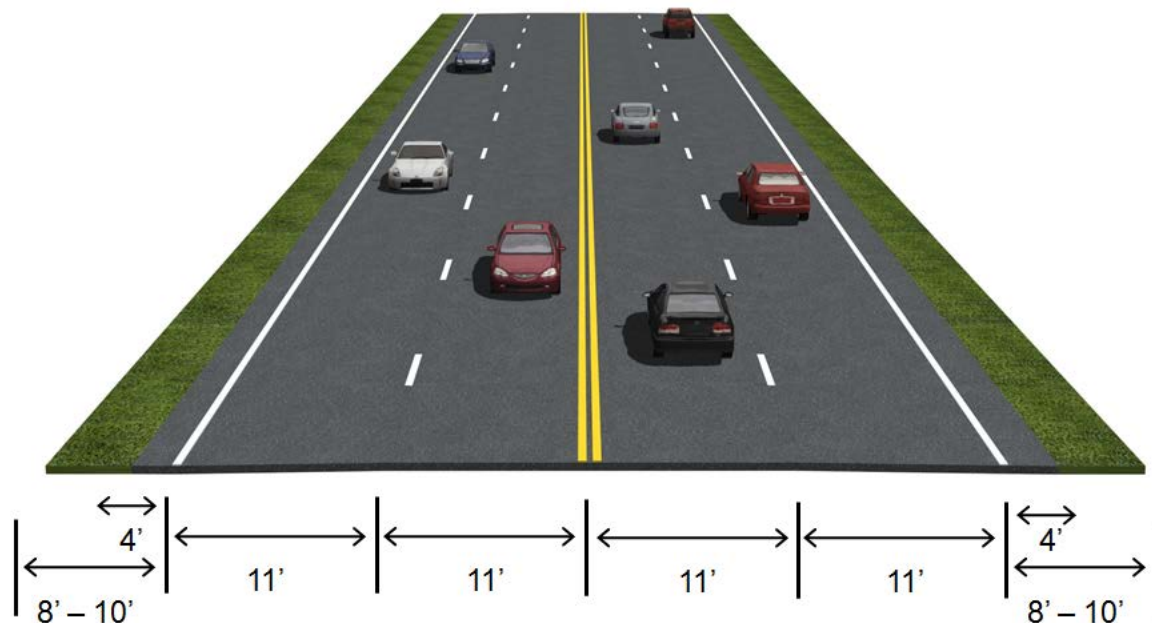


Figure 25: Assumed Typical Section for Major Widening

Alternative #2

Alternative #2 utilizes the minor widening roadway section and meets 55-mph design standards. This alternative starts along the existing KY 251 alignment until reaching a point near its intersection with Five Oaks Drive. In this area, the roadway will turn and follow a new horizontal alignment to the west of existing KY 251 and proceed northward to KY 313 near its current intersection with Master Lane. This alternative provides the ability to design the roadway for a 55-mph design speed while reducing the impact to property owners along the existing KY 251 roadway. Construction time would be reduced as the realignment portion would not require maintaining traffic. A new western route would remove a large amount of traffic from a portion of the existing KY 251 roadway in this area resulting in an increase of safety for local traffic along KY 251. The new portion would be safer since it would meet higher design standards and have a reduction in access points along the roadway.

Alternative #3

Alternative #3 also utilizes the minor widening roadway section and a new roadway portion to intersect KY 313 near Master Lane. This alternative differs in that the majority of the length of this option involves following the existing KY 251. The alternative would follow KY 251 past the intersection with KY 434 and then follow a new alignment from a point south of Sycamore Road. This alternative would reduce right of way impacts, although it would only slightly reduce the number of relocations potentially required along existing KY 251. Traffic impacts would remain high, and construction time would not be reduced as much as Alternative #2 due to the required level of maintenance of traffic involved while widening along the existing roadway. The end result would still be an improved and safer route.

Alternative #4

Alternative #4 utilizes the minor widening roadway section along KY 251 until close to Five Oaks Drive where a new horizontal alignment is followed similar to that of Alternative #2. However, Alternative #4 will continue on a more westward route initially before turning northward again. Alternative #4 will intersect KY 313 over two miles west of the current intersection of KY 251 and KY 313. Traffic modeling has indicated higher traffic demand for a more western route, and this alternative would connect directly to a candidate location for a new connector road onto post. This route would provide an alternative to using US 31W to reach the access

control checkpoint if Fort Knox constructs the new roadway. This alternative would have a large right of way acquisition and would have increased costs from the construction of additional length of new roadway. Impact to traffic during construction would be limited to the widening portion along existing KY 251 and at new intersections created along the route.

Alternative #5

Alternative #5 takes a similar concept approach as Alternative #4 in providing a new, more westward route for KY 251. The roadway template would utilize the two 11-foot driving lanes with eight-foot shoulder on the minor widening sections. This alternate would begin slightly south of the Alternative #4 and proceed on a route that aims to minimize commercial and residential relocations. While this would potentially reduce the right of way costs, this route is anticipated to have an increased environmental impact. This route would result in increased impact to existing drainage crossings and streams.

Alternative #6

Alternative #6 utilizes the roadway template with the two 11-foot driving lanes and eight-foot (four feet paved) shoulders on the minor widening section as described previously. Alternative #6 would provide a north-south connection between KY 434 and KY 313 near the west edge of a quarry site located on KY 434. This alternative does little to address the current deficiencies and conditions located along the KY 251 corridor. The alternative would provide an option to the forecasted western traffic demand. It can be considered a supplement to the other alternatives considered for the KY 251 corridor or an independent option.

6.3 Evaluation of Long-Term Alternatives

A comprehensive approach was utilized to provide some insight as to which alternatives perform better than others. This evaluation process was not intended to necessarily determine which corridors should be pursued for further study, but rather provide a relative comparison between all alternatives in terms of traffic relief, adverse impacts, and public sentiment. Each alternative was evaluated based on nine criteria. These criteria and how they were applied are as follows:

1. **Satisfies Purpose and Need Statement** – Based on the Purpose and Need Statement, this criterion considers how much traffic relief would be likely for existing routes or how much traffic can be diverted from existing routes and how much traffic might be carried by the proposed alternative.
2. **Traffic volume on new corridor** – Based on the highest traffic volume carried by the segment of a proposed alternative corridor just south of KY 434.
3. **Traffic diversion from US 31W** – Based on the estimated amount of traffic that could be diverted from US 31W just south of KY 434. Traffic volumes were compared to the No-Build Alternative.
4. **Environmental impacts** – Includes a number of potential impacts to the natural environment (i.e. impacts to streams, encroachment on wetlands, etc.) and the manmade environment (i.e. proximity to historic sites, parks, etc.)
5. **Community impacts** – Considers the adverse effects that a new route may introduce, such as dividing an existing community, impacting community resources (i.e. churches, schools, etc.) or requiring a significant number of residential relocations within a densely populated area. Also considers the potential benefits that could be realized by a community, such as increased mobility from additional travel alternatives.
6. **Business relocations** – Based on estimates of the total number of businesses that would be taken by each alternative.
7. **Residential relocations** - Based on estimates of the total number of residences that would be taken by each alternative.
8. **Public input** – Based on the results of the questionnaire from the public meeting, where attendees were asked if they were in favor of or opposed each alternative.
9. **Cost** – Based on the total estimated cost, including design, right-of-way, utilities, and construction.



Actual values that could be quantified or estimated for each alternative, such as construction cost or relocations, were used where possible. Where actual measures were not possible to estimate, the potential level of impacts were rated as high (significant adverse impacts), medium (some impacts), or low (little or no impact). With respect to public input, the percentage of favorable responses from the public meeting were used. A summary of the values used in this process are presented in **Table 3**.

Table 3: Summary of Long-Term Improvement Alternatives

CRITERIA	Satisfies Purpose and Need	Traffic Volume on New Corridor	Traffic Diversion from US 31W	Environmental Impacts	Community Impacts	Business Relocations	Residential Relocations	Public Input	Cost
SCALE	H, M, L	Vehicles per Day (VPD)	Vehicles per Day (VPD)	H, M, L	H, M, L	Approx. number of businesses	Approx. number of homes	Based on favorable input from Public Mtg.	Total cost (construction, right-of-way, utilities)
No Build	L	7,400	0	L	L	0	0	0	\$0
Alternative 1a	M	7,400	0	L	M	0	10	41.7%	\$16,900,000
Alternative 1b	H	8,400	1,100	L	H	2	28	54.2%	\$31,800,000
Alternative 1c	M	7,400	0	L	M	0	5	33.3%	\$11,000,000
Alternative 2	M	9,000	700	H	M	0	5	4.2%	\$16,900,000
Alternative 3	H	8,400	1,100	M	M	0	8	20.8%	\$17,500,000
Alternative 4	H	11,200	1,800	H	M	0	3	20.8%	\$19,800,000
Alternative 5	H	11,200	1,800	H	M	0	0	29.2%	\$21,400,000
Alternative 6	M	2,500	0	L	L	0	0	8.3%	\$3,000,000

Alternatives that provide a more direct connection to Fort Knox received a high rating under “Satisfies the Purpose and Need”. Traffic forecasts from the travel demand model suggest the westernmost alternatives that connect directly to the potential new Fort Knox connector road would carry the highest volume of traffic (up to 11,200 vehicles per day in 2035), but two lanes would still accommodate the future demand. There is little diversion of traffic away from US 31W because other committed projects- namely the Elizabethtown to Radcliff connector and the Veterans Memorial Parkway connector- are anticipated to divert a significant volume of traffic already. In general, the alternatives that require significant new construction result in more adverse effects in terms of environmental and community impacts and were rated high or medium in those categories.

One issue not included in this analysis is related to future maintenance. Construction of new transportation corridors results in more miles of roadway for the KYTC to maintain. Should a new alignment be pursued, the KYTC would either maintain the additional mileage (in addition to the existing KY 251) or try to work with Hardin County to take over the future maintenance of the existing route.

Cost estimates were developed based on 2011 average KYTC unit bid costs and estimated right-of way costs at \$25,000 per acre and \$150,000 per relocation.



7.0 FINAL RECOMMENDATION

The study alternatives were discussed at a final Project Team meeting held in December 2011. At the meeting, the alternatives were discussed, comments from the Public Meeting were summarized, and a recommended alternative was selected by the study team.

A hybrid alternative, shown on **Figure 25**, was chosen by the Project Team for final recommendation. A desire to limit right of way impacts, minimize costs, and provide a more western route to connect to a potential connector road into Fort Knox has led to the decision to apply a mix of components from the presented alternatives. KY 251 is proposed to be widened from KY 3005 to KY 434 using the minor widening template as proposed in Alternative #1C. The shoulders along KY 434 would be improved for the anticipated increase in traffic from the existing intersection between KY 251 and KY 434 to the west approximately 2 miles to an intersection with a new connector road. This new road would connect KY 434 to KY 313 similar to Alternative #6 but located further west to where Alternatives #4 and 5 are located to meet with the possible connector road into Fort Knox. As this recommendation is based on the assumption the conceptual connector road into Fort Knox will be pursued in the future, other alternatives may be considered by the KYTC if the connector road concept does not move forward.

This alternative will help eliminate some of the contributing factors of crashes along KY 251 by improving sight distance and providing more usable shoulder, thereby enhancing the overall safety of the roadway. It may be determined during the design process that some other intersection improvements and turn lanes may be added to further improve the quality and efficiency of the roadway for the projected increase of traffic if a new Fort Knox connector road is constructed. **Table 4** includes a cost estimate for the recommended alternative, by project phase. This cost does not include the cost to construct the new connector road north of KY 434.

Table 4: Cost Estimate for Recommended Alternative

PHASE	KY 251 / KY 434 IMPROVEMENTS COST	INTERSECTION "SPOT" IMPROVEMENTS COST
DESIGN	\$855,000	\$100,000
RIGHT-OF-WAY	\$1,145,000	\$200,000
UTILITIES	\$1,195,000	\$200,000
CONSTRUCTION	\$7,755,000	\$1,000,000
SUBTOTAL	\$10,950,000	\$1,500,000
TOTAL	\$12,450,000	

Maintenance of traffic will provide some difficulties along existing KY 251. For the vertical grade improvement locations, the full extent of the impact on the grade changes required to meet the current standards for a 45-mph design speed cannot be fully determined under the current scope and resources of this study. The ability to provide a diversion compared to requiring a road closure would need to be determined during the design phase. Due to its current lane widths and lack of existing shoulders through most of the study area, it may prove difficult to maintain adequate travel lanes along KY 251 during construction. There could be a need for restrictions on size and types of vehicles that would be allowed during construction requiring a detour route for the trucks that currently use KY 251. It is anticipated to be easier to maintain traffic along KY 434 for its improvements as no new vertical alignment changes would be made and other existing conditions appear to be more favorable. However, with the late inclusion of this option in the study, there could be some obstacles that may arise from the lack of current, more in depth information on the KY 434 corridor.

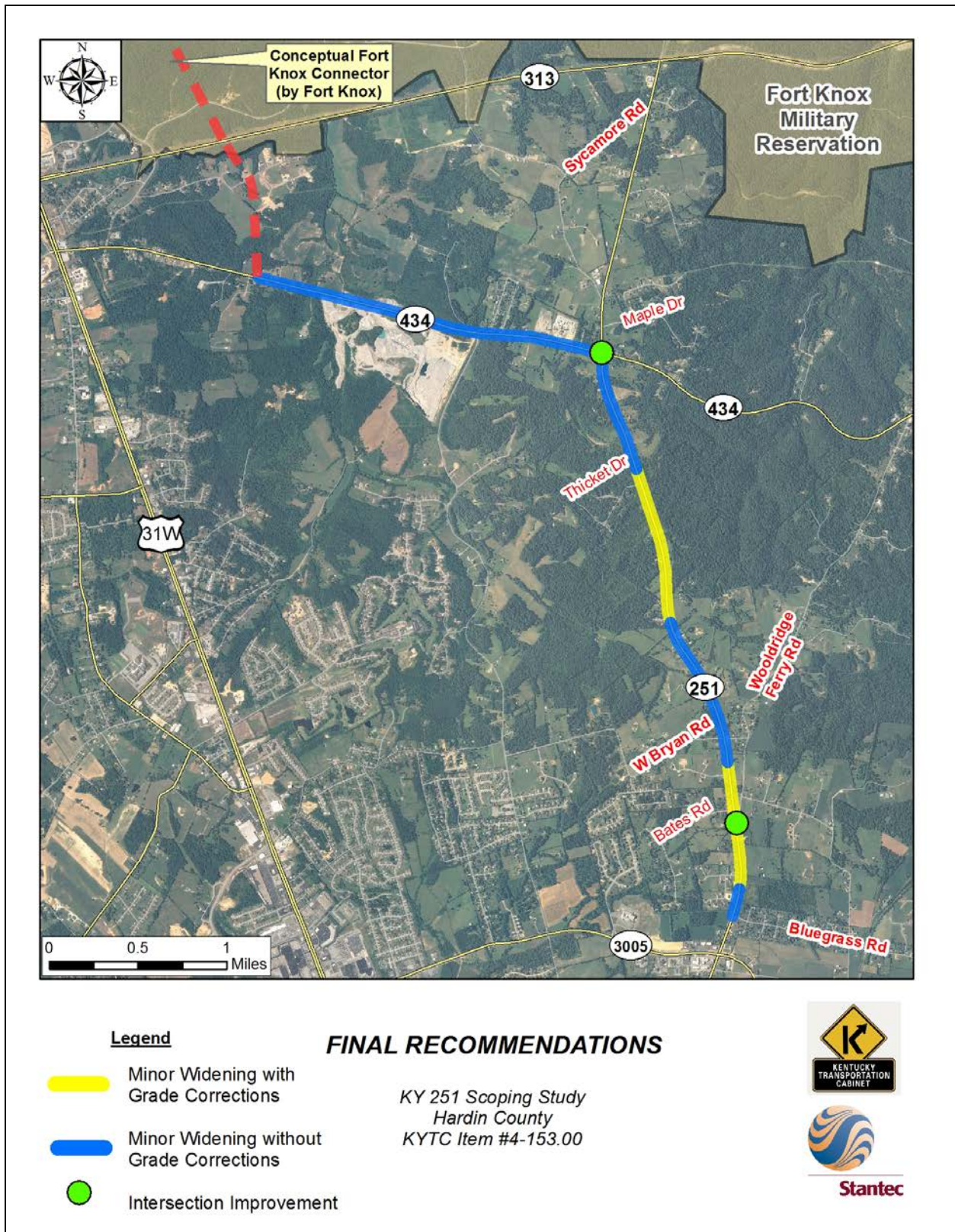


Figure 26: Study Recommendations