



2011

## US-421 DNA Pre-Design SCOPING STUDY



Franklin County:

US-421 Updated Area Review

Prepared by:

Kentucky Transportation Cabinet

District 5 and Division of Planning

3/15/2011

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## I. INTRODUCTION

### A. Study Purpose

The purpose of the Data Needs Analysis (DNA) Scoping Study is to address the nine elements of Purpose and Need as defined by the National Environmental Policy Act (NEPA) in order to develop a draft Purpose and Need Statement for the project. This study will also provide a more defined project scope, possible alternatives and a planning-level cost estimate for each of these alternatives. The study area will also review possible environmental impacts and any other information that may be beneficial in the Project Development phase of this project.

### B. Location

This project is located in Franklin County just outside the city limits of Frankfort and north of the intersection between US-127 and US-421. The project area begins at mile point 5.390 and continues north to the intersection of US-421 and Harvieland Road at mile point 7.309. The project area is shown with aerial photography in **Figure I-1** and in **Exhibit 1** in **Appendix A**. The projects termini are also shown topographically in **Figure I-2** and as **Exhibit 2** in **Appendix A**. Photos were also taken along this portion of the US-421 Corridor and are provided in **Appendix B**.

## II. PRELIMINARY PROJECT INFORMATION

### A. Existing Conditions/Roadway Data

Data describing the existing conditions of this section of US 421 was taken from the Division of Planning's Highway Information System (HIS) database. Data came from the online version of the database and data was extracted in June 2010. This portion of the US 421 corridor from mile point 5.390 to mile point 7.309 is functionally classified as a Rural Minor Arterial.

For maintenance purposes, it is classified as a State Primary Route. US 421 in the study segment has a Truck Weight Class of "AAA" (80,000 pounds gross load limit), but is not part of the Coal Haul or the Extended Weight Systems.

This study segment of US 421 is completely located in rolling terrain. Passing sight distance along the route in question was found to be zero percent. Guardrails line the majority of this portion of roadway on one side or the other due to significant topographic variations. There were a total of 28 horizontal curves and 11 vertical curves along this portion of the corridor. Among these, there were 15 horizontal curves with a degree of curve greater than 4.276. This is the greatest degree of curvature allowed with a 60 mile per hour design speed that is assumed for this road, under the Geometric Design Guide for Rural Arterial Roads, used by the Kentucky Transportation Cabinet (KYTC) Division of Highway Design (Exhibit 700-03). This is also assuming a maximum super-elevation of 6%. **Table II-1** shows the curves that are not designed to current design specifications.

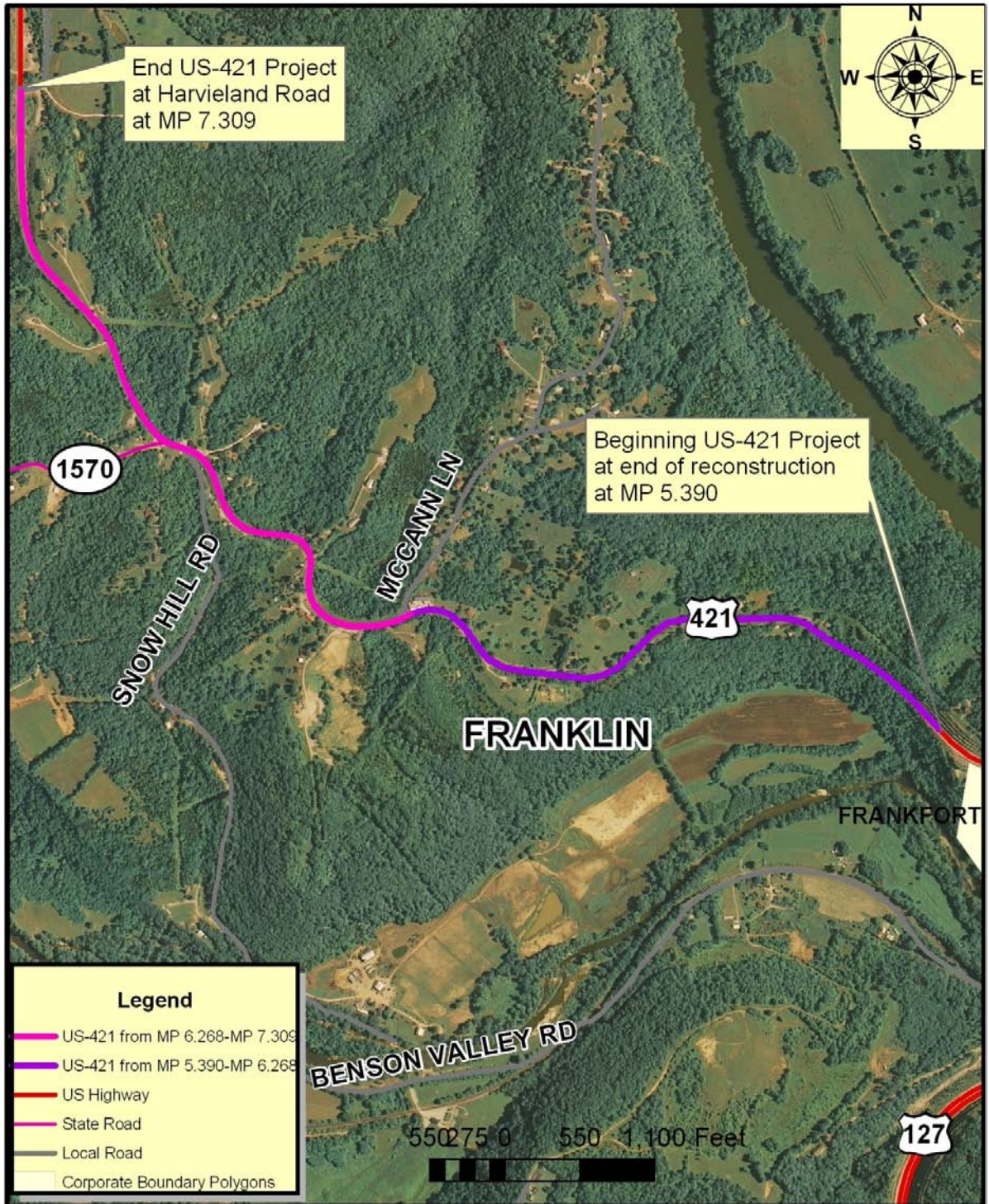


Figure I-1: Project Area Map

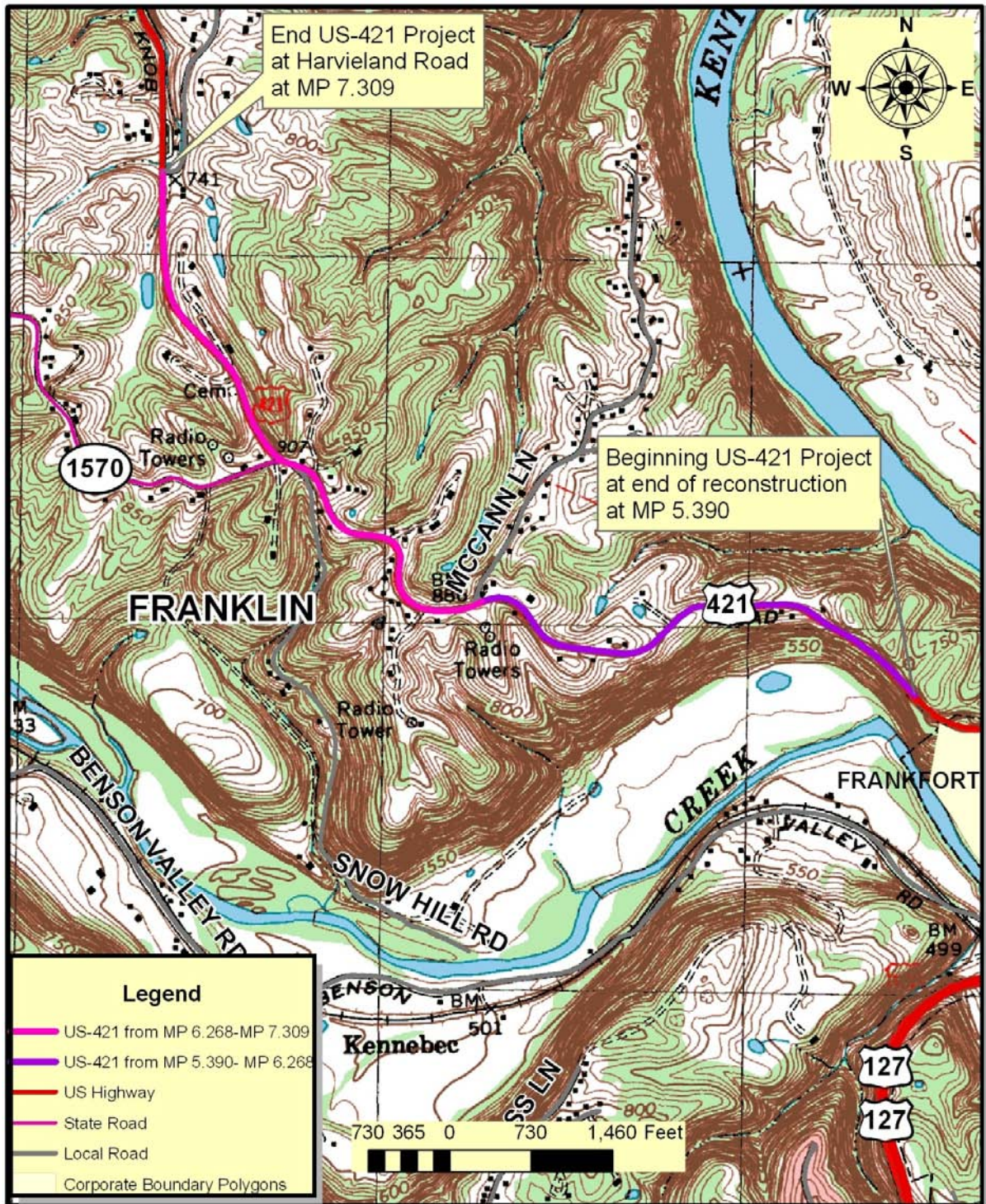


Figure I-2: Project Topographic Map

County Name	Route	Begin MP	End MP	Degree of Curve	Length (miles)	Radius (feet)
Franklin	US 421	5.243	5.407	4.5	0.164	1273.240
Franklin	US 421	5.570	5.635	14.5	0.065	395.143
Franklin	US 421	5.755	5.806	17.3	0.051	331.189
Franklin	US 421	5.878	5.925	13.6	0.047	421.292
Franklin	US 421	6.016	6.084	14.5	0.068	395.143
Franklin	US 421	6.124	6.206	18.7	0.082	306.395
Franklin	US 421	6.206	6.336	8.8	0.130	651.088
Franklin	US 421	6.336	6.393	19.6	0.057	292.325
Franklin	US 421	6.414	6.477	28.7	0.063	199.637
Franklin	US 421	6.503	6.586	16.6	0.083	345.155
Franklin	US 421	6.622	6.666	18.9	0.044	303.152
Franklin	US 421	6.701	6.773	8.4	0.072	682.093
Franklin	US 421	6.773	6.808	4.5	0.035	1273.240
Franklin	US 421	6.862	6.913	8.0	0.051	716.197
Franklin	US 421	6.978	7.125	6.8	0.147	842.585

Source: Highway Information System (HIS) Database KYTC

**Table II-1: Horizontal Curves with Degree of Curve > 4.276**

According to the same guide, the maximum grade for a rural arterial in rolling terrain with a design speed of 60 miles per hour is 4%. There were eight vertical curves with a percent grade greater than 4.5 and five additional curves that fell within the initial range that could not be verified exactly if they were above or below 4% in grade. The data describing these curves is shown in **Table II-2**.

County Name	Route	Begin MP	End MP	Length (miles)	Percent Grade (Range)
Franklin	US 421	6.039	6.339	0.300	2.5 - 4.4 Percent
Franklin	US 421	6.339	6.449	0.110	2.5 - 4.4 Percent
Franklin	US 421	5.609	5.719	0.110	4.5 - 6.4 Percent
Franklin	US 421	6.449	6.549	0.100	4.5 - 6.4 Percent
Franklin	US 421	6.549	6.734	0.185	4.5 - 6.4 Percent
Franklin	US 421	6.734	6.898	0.164	4.5 - 6.4 Percent
Franklin	US 421	7.098	7.344	0.246	4.5 - 6.4 Percent
Franklin	US 421	5.449	5.609	0.160	6.5 - 8.4 Percent
Franklin	US 421	5.779	6.039	0.260	6.5 - 8.4 Percent
Franklin	US 421	6.898	7.098	0.200	6.5 - 8.4 Percent

Source: Highway Information System (HIS) Database KYTC

Note: Grades > 4% Exceed Design Standards for 60 MPH.

**Table II-2: Vertical Curves with Grades from 2.5% to 8.4%**

The entire length of the corridor is an undivided two-lane highway with a constant lane width of 10 feet. The shoulders vary along the length of the corridor in question at a width between one to three feet. Some areas inspected were found to have almost non-existent shoulders. The driving surface is an entirely high flexible asphalt pavement that was last resurfaced between mile point 5.390 and mile point 7.309 in 2005.

The only major crossroad identified along this portion of US-421 was with KY-1570 at mile point 6.750. The last actual Average Daily Traffic (ADT) count for KY-1570 was identified in 2007 to be 397 vehicles per day. There were also three minor side roads listed in the HIS route log. The route log for minor crossroads and other important interconnections along this section of US-421 is shown in **Table II-3**.

County	Route	Mile point	Description
Franklin	US 421	5.390	End of Previous Reconstruction
Franklin	US 421	6.268	MCCANN LANE
Franklin	US 421	6.730	SNOW HILL ROAD
Franklin	US 421	6.750	KY 1570
Franklin	US 421	7.288	Plum Creek Culvert
Franklin	US 421	7.309	HARVIELAND ROAD

Source: Highway Information System (HIS) Database KYTC

**Table II-3: Route Log**

B. Utilities

The following are names of utilities in the area and contact for those utilities. The actual location of these utilities will need to be verified in future project phases.

Electric: Blue Grass Energy  
Chris Brewer  
Vice President of Engineering  
1201 Lexington Road  
Nicholasville, KY 40356  
(859) 885-4191  
(859) 885-2854  
[chrisb@bgenergy.com](mailto:chrisb@bgenergy.com)



Frankfort Plant Board  
Jim Carter, PE  
Electrical Engineer  
305 Hickory Drive  
P.O. Box 308  
Frankfort, KY 40602  
(502) 352-4401  
(502) 227-9654  
[jcarter@fewpb.com](mailto:jcarter@fewpb.com)

Cable: Frankfort Plant Board  
Mike Harrod  
Engineering Tech I  
317 West 2<sup>nd</sup> Street  
Frankfort, Kentucky 40601  
(502) 352-4443  
(502) 223-4449  
[mikeharrod@FEWPB.com](mailto:mikeharrod@FEWPB.com)

Telecommunications: Frankfort Plant Board  
Mike Harrod  
Engineering Tech I  
317 West 2<sup>nd</sup> Street  
Frankfort, Kentucky 40601  
(502) 352-4443  
(502) 223-4449  
[mikeharrod@FEWPB.com](mailto:mikeharrod@FEWPB.com)

Gas: None in Area per Columbia Gas

Water: North Shelby Water District  
4596 Bagdad Road  
P.O. Box 97  
Bagdad, Kentucky 40003  
(502) 747-8942  
(800) 870-4148

Sewer: None in Area per Frankfort Sewer

It is important to note there are septic tank systems with leach fields utilized by residences and small businesses along US 421 as a form of sewage treatment. **Figure II-1** and **Exhibit 3** in **Appendix A** shows a current map of utilities found throughout this project area. There are overhead electric, cable, and telephone lines as well as water lines along this route. Further attention will be needed on locating any gas lines as no detailed information was available through our utilities GIS database.

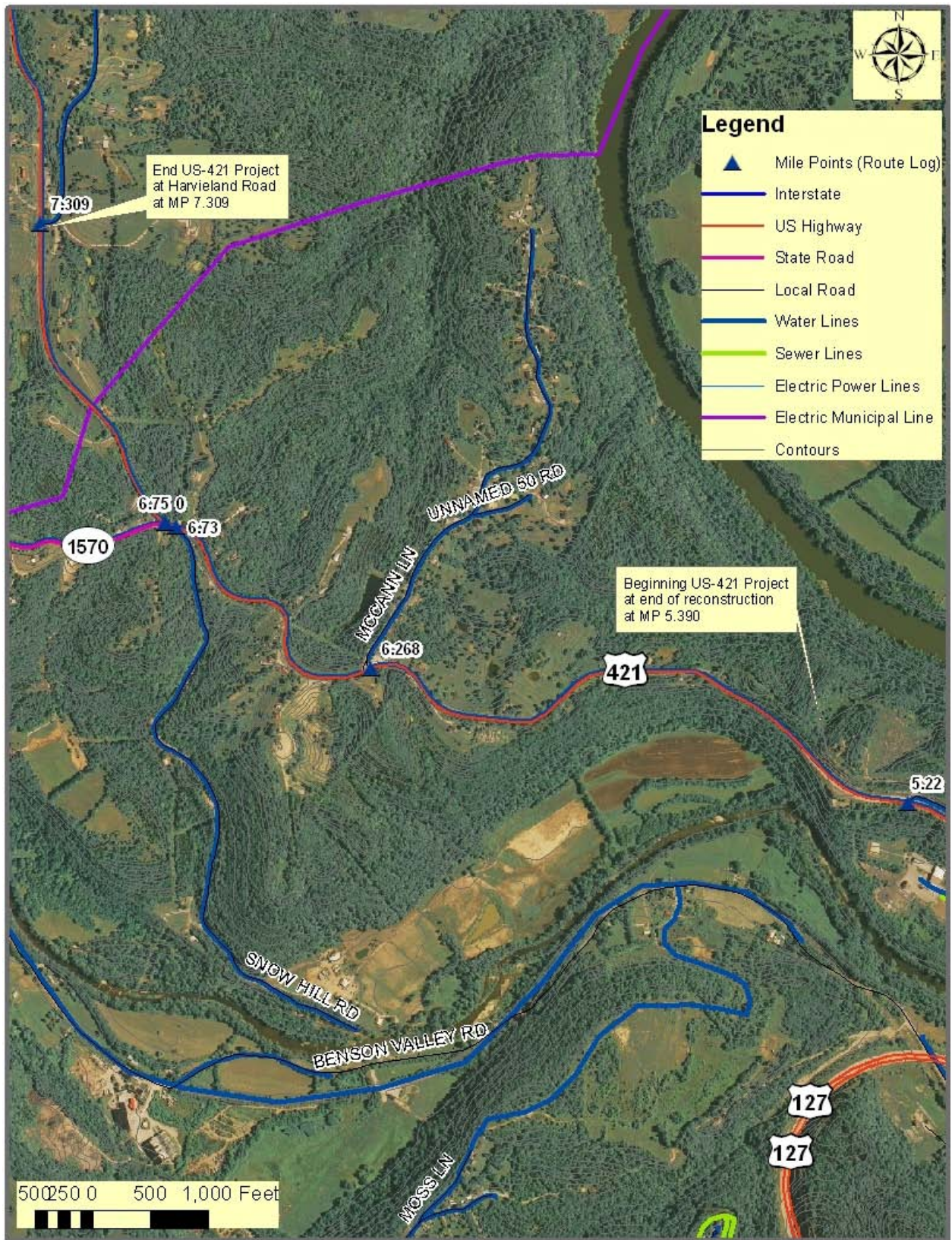


FIGURE II-1: Project Area Utilities Map

### C. Agency Coordination

The project team met on July 30, 2010 to review and discuss this project, develop a purpose and need statement as well as identify possible alternatives. This study will discuss each of these areas in greater detail as presented in this meeting. A description of each alternative and associated budgetary cost estimate from District 5 will also be provided. See **Exhibit 1** in **Appendix C** for the 1<sup>st</sup> Project Team Meeting Minutes.

## III. PROJECT PURPOSE AND NEED

### A. Legislation

The following is a description of the project as it is listed in the 2010-2012 General Assembly's Enacted Roadway Plan.

- **Item #05-0374.00, Franklin County**

<u>Phase</u>	<u>Fund</u>	<u>Year</u>	<u>Estimate</u>
D:	SP	2010	\$680,000
R:	SP	2011	\$2,810,000
U:	SP	2011	\$1,240,000
C:			\$0

DESCRIPTION:

FRANKFORT-NEWCASTLE: RECONSTRUCT US-421 FROM TOP OF BALD KNOB HILL AT END OF RECONSTRUCTED SECTION TO HARVIELAND ROAD.

A Project Identification Form (PIF) was found as control number 05 037 B0421 16.10 and was last updated August 15, 2008. This PIF listed the construction cost from mile point 5.390 to mile point 11.132 to be \$30,000,000, which includes this project area from mile point 5.390 to mile point 7.309. See **Exhibit 2** in **Appendix C** for a copy of this PIF that includes the portion of KY-421 discussed as part of Item # 05-0374.00.

### B. Project Status

A separate US-421 Programming Study that includes this portion of US-421 was originally identified under Item # 05-8109.00 in the 2002 Kentucky Six-Year Highway Plan (FY 2003-2008). A KYTC Project Identification Form (PIF) was originally developed for Item # 05-8109.00 in the fall of 2004. This study proceeded forward in 2005 with a 1<sup>st</sup> Project Team meeting and a Local Officials Meeting. The PIF was updated in the fall of 2008. See **Exhibit 2** in **Appendix C** for a copy of the PIF on Item # 05-8109.00.

Some maintenance issues were raised and brought to the attention of the District in May 2010 along this route. The District has continued working to address these issues.

The Division of Planning provided additional information and developed recommendations for this draft study report. These findings were then presented at a 2<sup>nd</sup> Project Team Meeting

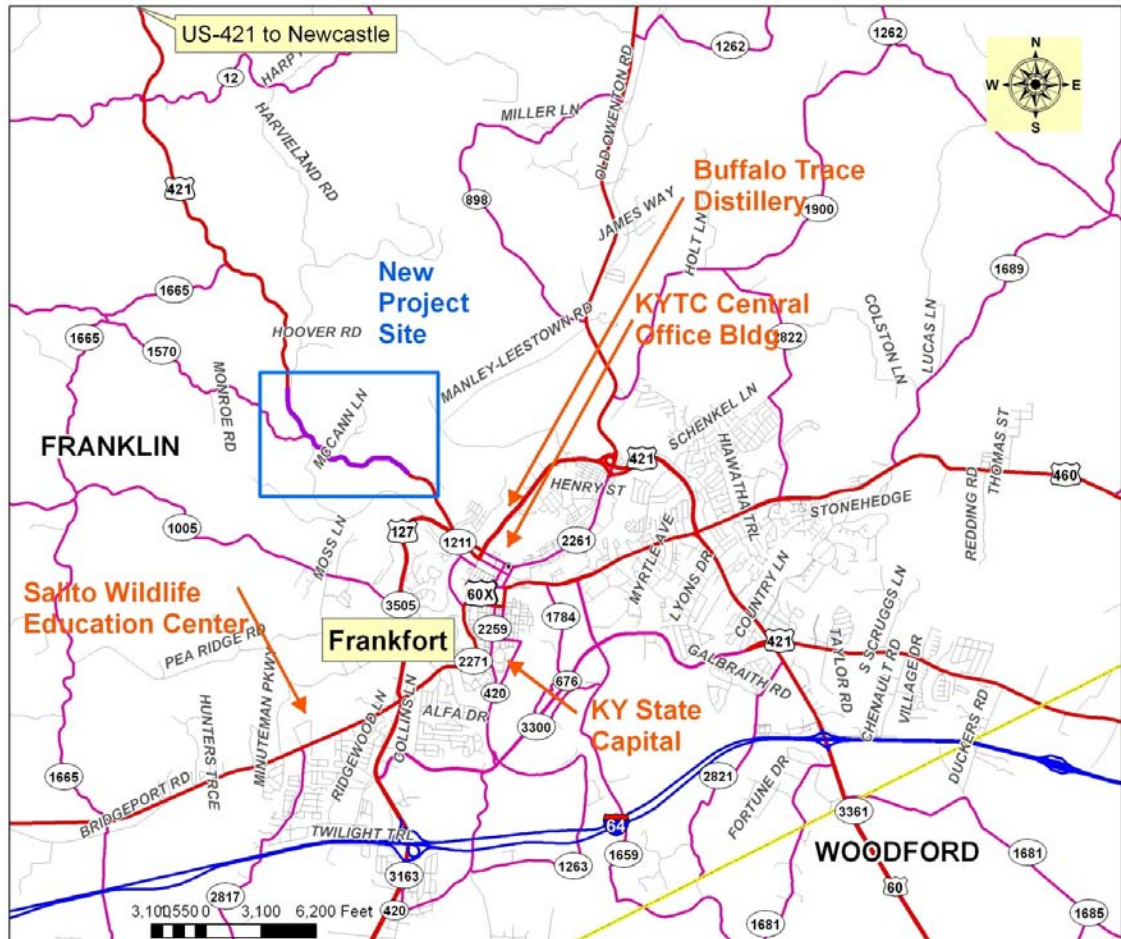
in June 2010. The results of the 2<sup>nd</sup> Project Team Meeting for Item # 05-8109.00 concluded the following:

- The draft study report shall be utilized “As Is” with references to any further data collected and/or analyzed.
- A “1<sup>st</sup> Look/DNA Pre-design Scoping” Study should be performed for Item # 05-0374.00

Design funds are not yet authorized for Item # 05-0374.00 with a Highway Plan design year of 2010. The 1<sup>st</sup> Project Team Meeting on this project was held on July 30<sup>th</sup>. The meeting minutes can be reviewed in **Exhibit 1** of **Appendix C**.

### C. System Linkage

This portion of US-421 connects Newcastle in Henry County to Frankfort, Kentucky. It is also a part of the US-421 direct link to Interstate 71 from Frankfort as well as to the Milton-Madison Bridge, which connects Kentucky to Indiana. See **Figure III-1** and **Exhibit 4** in **Appendix A** for more local system linkage information.



**Figure III-1: System Linkage**

The current road classification for this portion of US-421 will help to better understand the system linkage. The following is a listing of such classification for US-421 between MP 5.390 to MP 7.309.

- **Functional Classification** – Rural Minor Arterial
- **State System**-State Primary (Other)
- Scenic Byways-Not Designated
- Coal Haul System- Not Applicable
- **Truck Weight Classification**-AAA
- **Truck Percentage**- 10.4%
- Bike Route-Not Designated.

#### D. Modal Interrelationships

There are no intermodal issues on this route. A few public transit companies operate in Franklin County and are listed as follows: Bluegrass Community Action Partnership, Inc. /Bluegrass Ultra-Transit Service (BUS), City of Frankfort/Frankfort Transit and Federated Transportation Services of the Bluegrass, Inc. There is also a private Human Services Transportation Delivery (HSTD) Broker known as the Bluegrass Community Action Agency (BGCAA) that provides on-call transportation services.

The only rail line that is located near this area is owned and operated by CSX (formerly C&O) Transportation. This rail line runs east and west, somewhat paralleling Interstate 64 through Franklin County including downtown Frankfort. No impact is anticipated from this rail line as it runs south of the US-421 Project Area.

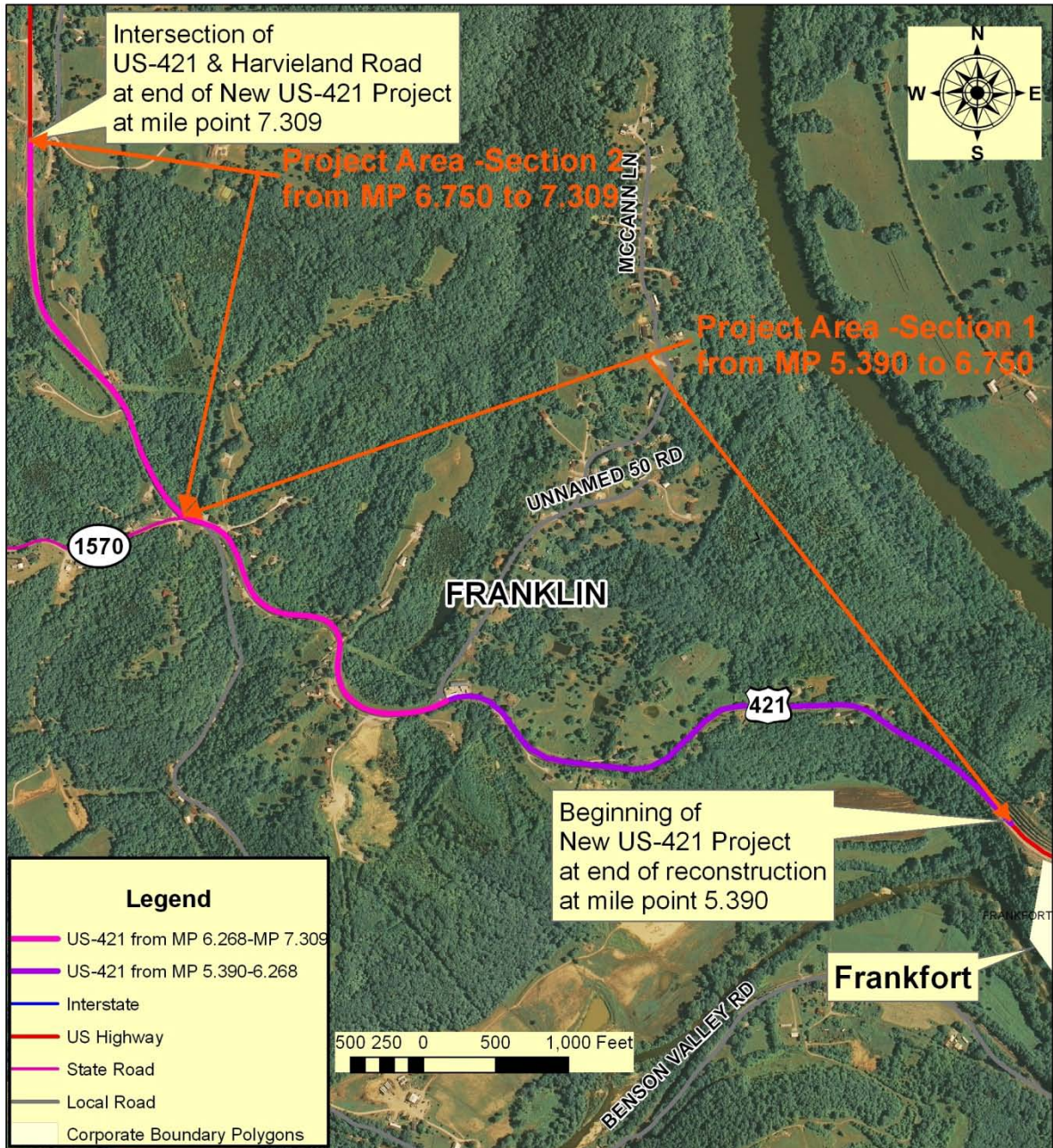
#### E. Social Demands and Economic Development

There were several social demands identified in the near vicinity to this US-421 project area in Frankfort. This roadway is likely used as a route to access tourism in Frankfort from Trimble, Henry and Carroll Counties. The Kentucky State Capital is a primary location for tourism and continued governing efforts by the General Assembly and Governor's office. There are also several historical museums in Frankfort as well. Kentucky State University and Frankfort Convention Center both bring in commuters from outside Franklin County.

The development potential along this portion of US-421 itself is very limited due to significant topographic variations.

#### F. Transportation Demand

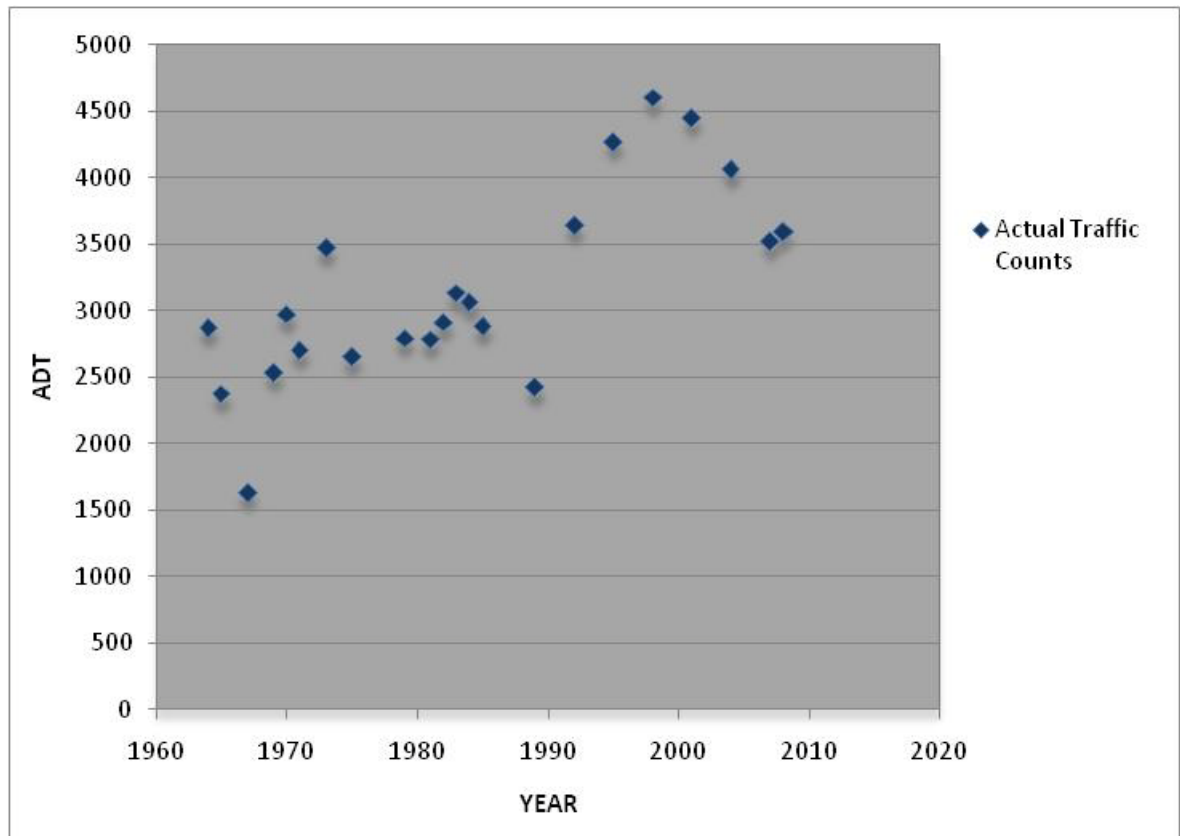
Traffic counts were broken up into two separate sections due to a change in traffic volume at the intersection with KY-1570 at MP 6.750. **Figure III-2** shows the breakout of sections along US-421.



**Figure III-2: Project Area Sections**

The first section begins at MP 5.390 and proceeds to the intersection with KY-1570 at MP 6.750. The most recent actual traffic count was completed in 2008 with a count of 3,590 vehicles per day. Computer estimation had raised this number to 3,880 vehicles per day for 2010.

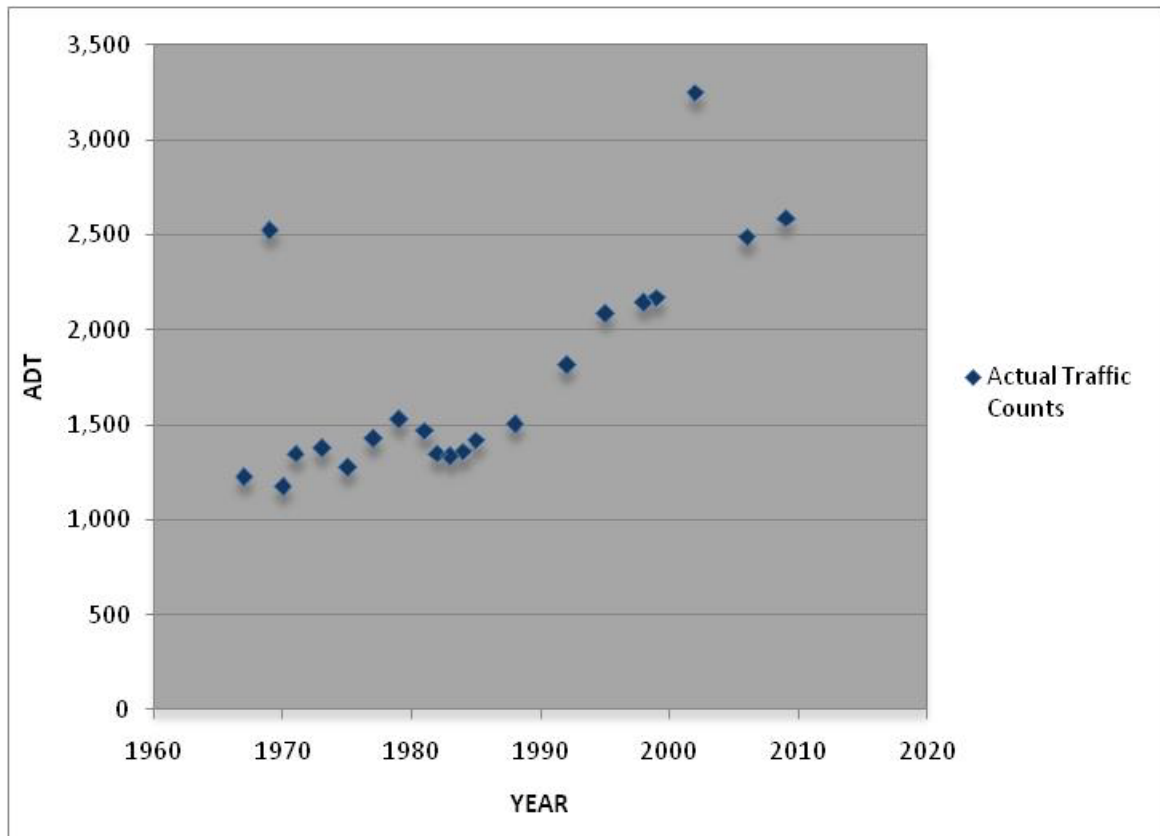
Based upon actual traffic counts collected for this section from 1964 to 2008, a historical growth rate factor of 1.2% was identified with a significant increase sometime between 1995 and 2001. See the displayed trend line below in **Figure III-3** as well as the associated traffic counts.



**Figure III-3: Transportation Demand for MP 5.390-MP 6.750**

The second section of this project area starts at the intersection of US-421 and KY-1570 at MP 6.750 and ends at the intersection with Harvieland Road at mile point 7.309. This section of the project area had the most recent actual traffic count performed in 2009 with an ADT of 2,590 vehicles per day. Actual traffic counts were performed along this section of roadway beginning in 1967 with an initial ADT of 1,230 vehicles per day. The historic traffic count data showed a 2.0% growth rate. The associated trend line is shown in **Figure III-4** with a significant increase in growth rate occurring from 1999 to 2002.

In phase 1 Design, a current traffic forecast should be requested, since future funding and implementation of this project is not clearly defined at this time.



**Figure III-4: Transportation Demand for MP 6.750-MP 7.309**

#### G. Capacity

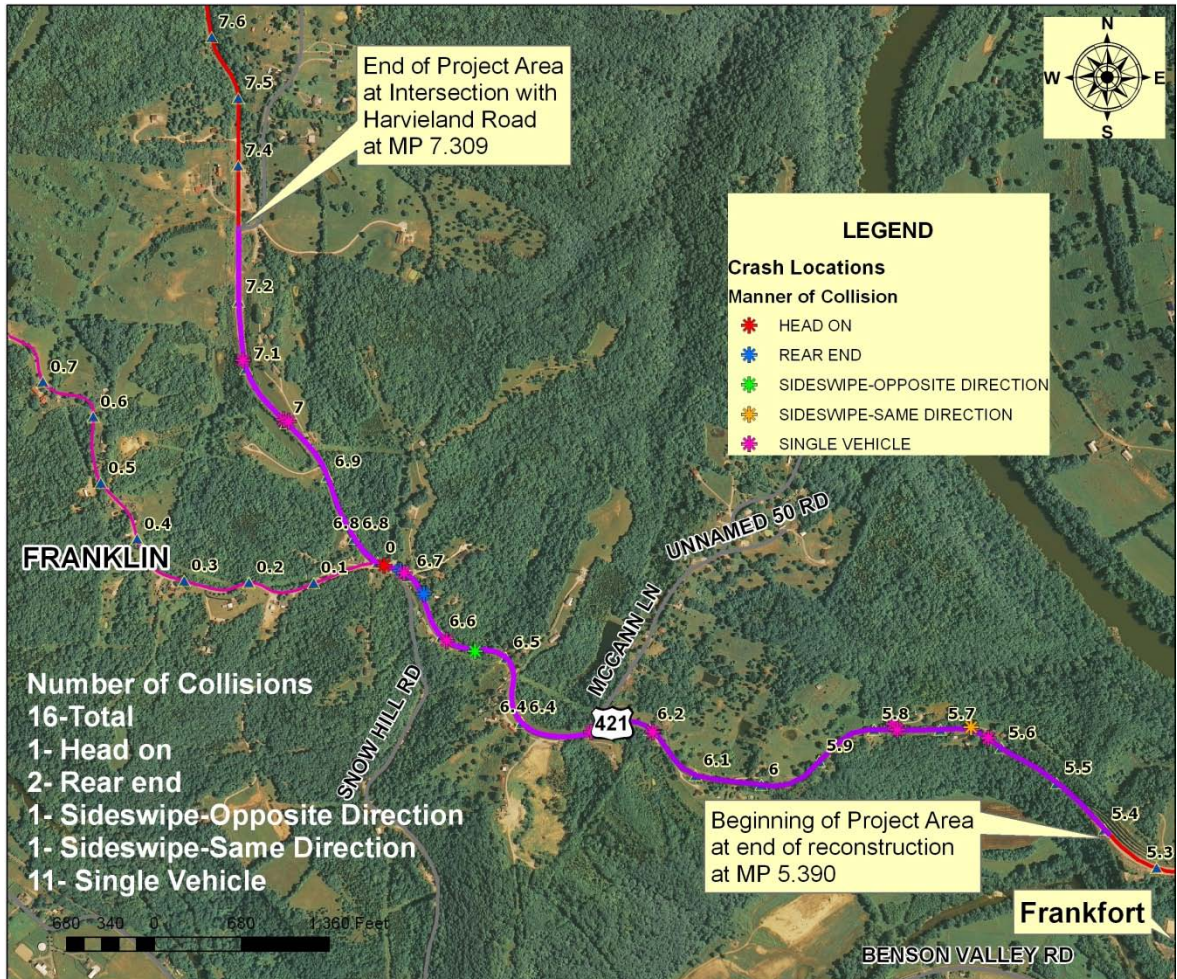
This roadway was reviewed through the volume to service flow ratio (VSF), International Roughness Index (IRI), Adequacy Rating (based on capacity, roughness and crashes) and Future ADTs. The following is a summation of findings along this portion of roadway.

1. US-421 (from mile point 5.390 to mile point 7.309)
  - Two-lane highway
  - VSF = 0.25
  - IRI = 109.0
  - Adequacy Rating = 10.04%
  - Current ADT (2010) = 3,880 vehicles per day (from MP 5.390 –MP 6.750) & 2,680 vehicles per day (from MP 6.750 –MP 7.309)



H. Safety

The Kentucky Collision Analysis for the Public Database maintained by the Kentucky State Police was utilized for the collection of collision data over a three year period from January 1, 2007 through December 31, 2009. Along US-421 between MP 5.309 to MP 7.309, there were a total of 16 collisions and of those, there were five different manners of collisions with no fatalities. There were five reported injury crashes and eleven Property Damage Only (PDO) crashes. **Figure III-5** shows the locations of these collisions as well as the manner in which they occurred. As noted in **Figure III-5**, eleven out of sixteen collisions were single vehicle with most of these collisions occurring during daylight under wet weather conditions.



**Figure III-5: Collision Locations**

Crash Data was also used to calculate Critical Rate Factors (CRF) in accordance with the procedure described in *Analysis of Traffic Crash Data (2005-2009)* in Kentucky, published by the Kentucky Transportation Center. The only location within this project area to have a CRF greater than 1.0 is between MP 5.670 to MP 5.770. Another location closely approaching that threshold was between MP 6.646 to MP 6.746, which includes the intersections with Snow Hill Road and KY-1570. A more detailed analysis of the collision data can be seen in **Appendix D**.

I. Roadway Deficiencies

**Section II, Item A. Existing Conditions/Roadway Data** of this report discusses the HIS database for this portion of roadway. **Table III-1** shows the breakdown in existing conditions for both identified sections of roadway. This roadway has a posted speed limit of 55 MPH. According to the Common Geometric Practices for Rural Arterial Roads (Other Than Freeways) as stated in the Kentucky Highway Design Guidance Manual, the pavement width is defined to be 24 feet (12 feet per lane) with an 8 foot shoulder at all design speeds for roadways with 2,000 ADT or greater. The design speed for this type of rural roadway under current design standards would be 60 mph. There are horizontal and vertical curves requiring a reduced speed due to not meeting the current design standards. These curves were also previously discussed in **Section II** of this report in greater detail to include **Table II-1** and **Table II-2**. A copy of the current geometric design standards is provided in **Exhibit 3** in **Appendix C**.

Existing Conditions	Geometric Practices
<b>Section 1- US-421 (MP 5.309 to MP 6.750) – Posted speed limit of 55 mph</b>	
1. 12 ft lanes (from MP 5.390-5.4210)	1. 12 ft lanes (Over 2000 A.D.T.)
2. 10 ft lanes (from MP 5.4210-6.750)*	2. 12 ft lanes (Over 2000 A.D.T.)
3. 10 ft Shoulders (from MP 5.390-5.4210)	3. 8 ft shoulders (Minimum Graded Shoulder Width) + 3 ft for Guardrail
4. 1-3 ft Shoulders (from MP 5.4210-6.750)*	4. 8 ft shoulders (Minimum Graded Shoulder Width) + 3 ft for Guardrail
5. < 965 ft Horizontal Radius for 11 out of 12 curves*	5. 965 ft @ eMAX. 8% for Min. Radius
6. 2.5-4.4% Vertical Grade for 2 out of 7 curves*	6. 5% Maximum grade for Rolling Terrain
<b>Section 2- US-421 (MP 6.750 to MP 7.309) – Posted speed limit of 55 mph</b>	
1. 10 ft lanes	1. 12 ft lanes (Over 2000 A.D.T.)
2. 1-3 ft Shoulders	2. 8 ft shoulders (Minimum Graded Shoulder Width) + 3 ft for Guardrail
3. < 965 ft Horizontal Radius for 18 out of 22 curves*	3. 965 ft @ eMAX. 8% for Min. Radius
4. 2.5-4.4% Vertical Grade for 3 out of 7 curves*	4. 5% Max. grade for Rolling Terrain

❖ Note: Asterisk and red indicates deficiency with current design standards.

**Table III-1: All Sections – Roadway Deficiencies**

Several S-curves were identified along this route with one example shown in **Figure III-6** at MP 6.150. As can be seen in this figure, most of the curves throughout the project area have multiple private access points. Both county and state roads often intersect US-421 at some point within a curve where sight distance is limited. Significant topographic variations have limited possible intersecting locations with other roadways. **Figure III-7** provides an example of such an intersection. **Appendix B** provides photographs throughout the US-421 project area. Current roadway plans are also provided in **Appendix E**.



**Figure III-6: US-421 at MP 6.150 in S-Curve, Northbound**



**Figure III-7: US-421 near Snow Hill Road at MP 6.700, Northbound**

Flooding is also known to occur in several side roads connecting to US-421 but actual water pooling on US-421 has not been reported. The majority of the single vehicle accidents, however, has occurred under wet weather conditions and may have been impacted by runoff. Flood Insurance Rate Maps (FIRMs) of the project area are provided in **Appendix F**.

#### IV. PRELIMINARY ENVIRONMENTAL AND SOCIOECONOMIC OVERVIEW

*A Cultural Historic Overview for Improvements to US-421 in Franklin County, Kentucky* was completed for Item No. 05-8109.00 in May 2005 by the Kentucky Transportation Cabinet. This was completed for District 5 with Rebecca Horn Turner being the Principal Investigator from the Division of Environmental Analysis. This study includes the area defined for this US-421 DNA Pre-design Scoping Study. This same US-421 Programming Study identified under Item No. 05-8109.00, also had a brief environmental analysis conducted to locate places of significant historical or cultural value as well as places of potential hazards.

An Environmental Overview by District 5 is pending completion during the early phase of engineering. The following is a list of items that would be addressed as part of the Environmental Overview, with some items having limited data already provided:

- Air Quality - Per the KYTC, Division of Planning, Modal Programs website, Franklin County is in attainment for all monitored pollutants.
- Archaeological Overview
- Aquatic Ecosystems
- Culturally Sensitive Locations
- UST/Hazardous Materials -One service station is located adjacent to the project area on the east side of US-421 between the intersections of Snow Hill Road and KY-1570. Right of way may be needed to perform some spot improvements that would eliminate a few geometrically deficient curves.
- Historic Resources –Section 4(f), 106 and 6(f)-The 2005 cultural overview study identified three properties within the current study area in question as having the potential to meet National Register Criterion C and include: Site 45, Site 51 & Site 80. The report also noted that a more in-depth cultural historic report would be warranted to evaluate the sites under Criteria A and B. This included the location of a single headstone cemetery at Site 47. See **Appendix G** for a detailed map of these locations from the 2005 report.
- Noise
- Permitting
- Socioeconomic
- Threatened and Endangered Species

#### V. PROJECT DRAFT PURPOSE AND NEED STATEMENT

Existing conditions along US-421 need improvement to address geometric deficiencies and safety concerns for the purpose of reducing crashes along this corridor. These improvements should also enhance interregional mobility and economic development with US-421 being a direct connection from the Milton-Madison Bridge and Interstate 71 to the City of Frankfort.

## VI. POSSIBLE ALTERNATIVES

### A. Alternative #1

This option would be the No-Build alternative. This approach would be to wait and see what happens under current conditions into the near future before proceeding with any further significant financial investment in this portion of US-421. This alternative would be the least expensive in terms of up-front costs and would have the least community and environmental impacts. Still, this approach would not adequately address the Purpose and Need of this project, which is to improve safety and address geometric concerns.

### B. Alternative #2

This short term alternative is to primarily address concerns along the curves and intersections of US-421 through a low cost, quick improvement approach. The improvements in this alternative would include the addition of chevrons on curves where the advised speed is more than 10 miles per hour lower than the 55 miles per hour posted speed limit. This alternative would also include the addition of reflector tabs in the “W” of existing guardrail throughout the entire length of the US-421 project area from MP 5.390 to MP 7.309.

**Figure VI-1** and **Exhibit 1** in **Appendix H** also identified select areas to be addressed with one or more of the following items: clearing trees and vegetation, laying back slopes, providing a high friction surface and adding chevrons and reflectors. The application of the high friction surface material was further reviewed along this route by the District. This has resulted in a contract being developed to implement this improvement between mile point 5.68 and mile point 6.25 and mile point 6.27 to mile point 6.75. However, poor pavement conditions relative to this application existing around mile point 6.4, and as such, this section may need to be repaved and repaired prior to applying the high friction surface material. Drainage ditches along this route where the roadway comes next to a hillside, should also be inspected as well and in some instances cleaned out or possibly even enlarged to meet runoff demands.

There are a few disadvantages to this approach. This option may require the purchasing of some additional right-of-way to allow for proper layback of shoulder at select locations and to remove enough trees and vegetation to improve sight distance. This will also require the temporary relocation of some utilities. Also, geographic deficiencies throughout the route will not be addressed.

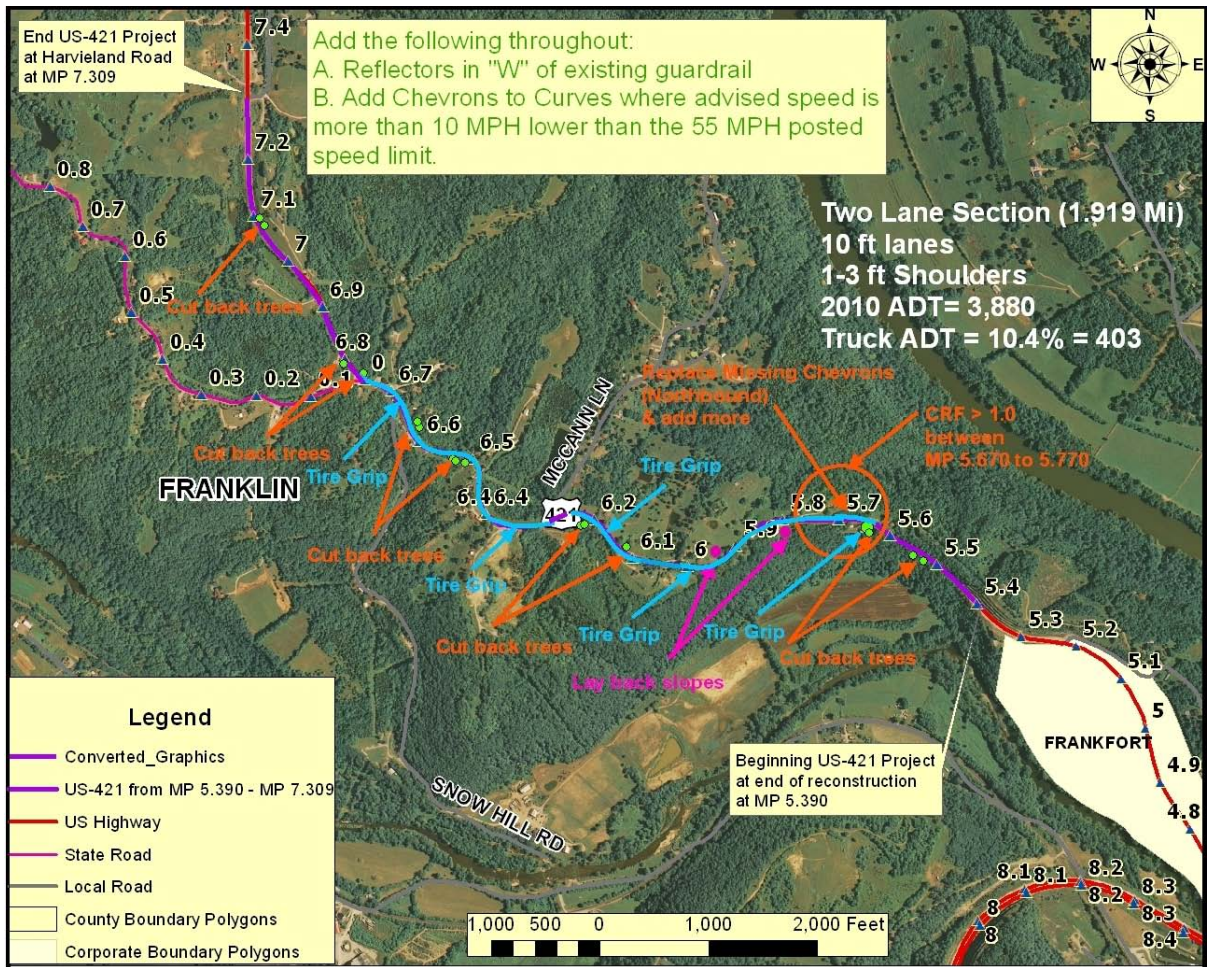


Figure VI-1: Alternative #2

There were several advantages identified for this alternative as well. The primary advantage is the relatively quick implementation of this alternative in the short term due in part to a much lower cost than other alternatives. This approach will improve safety through increased sight distance and enhanced traction around curves while bringing added awareness to these curves with reflectors and chevrons. These improvements should be implemented without having to close the roadway or to displace anyone from their homes to minimize community impacts. Environmental impacts would also be kept to a minimum.

The following **Table VI-1** shows a preliminary cost estimate for Alternative #2 provided by District 5 in 2011 dollars. This cost was developed on a cost per mile basis relative to similar projects in the area. The majority of items could be requested through Highway Safety Improvement Program (HSIP) funds but the District showed interest in pursuing this approach with State Funds.

Alternative #2	Length (miles)	Phased Cost (\$)				Total Cost (\$)
		Design	Right-of-Way	Utilities	Construction	
Shoulder Layback		\$75,000	\$150,000	\$75,000	\$400,000	\$700,000
Tyre Grip	1.05				\$162,000	\$162,000
Cut Back Trees						\$12,000
Reflectors on Guardrail*					\$1,400	\$1,400
Chevrons*					\$6,400	\$6,400
<b>TOTAL (rounded)</b>	—	—	—	—	—	\$890,000

\*Assumes labor cost for state forces.

**Table VI-1: Alternative # 2 Preliminary Cost Estimate**

C. Alternative #3

This option would be to completely rebuild the roadway to current design standards. This would include addressing curve deficiencies, and widening to 12 foot lanes and 8 foot shoulders. Due to topographic limitations, a considerable amount of cut and fill material would be anticipated. The construction cost for this project would be considerable and as such require this project be divided up into sections. See **Figure VI-2** and in **Exhibit 2** in **Appendix H** for two preliminarily proposed line and grade routes.

In reviewing this alternative, some drawbacks were noted. The most significant aspect of this option would be the cost associated with completing a project of this type, especially given the relatively low ADT counts. The second most significant impact would be the construction time due to the massive amounts of cut and fill anticipated. Another concern would be the potential environmental impacts. Also, the community would be impacted by road closures where ever the existing roadway footprint matches or crosses with the proposed roadway. Considerable right-of-way would need to be purchased and a large number of homes would be removed relative to the total number of homes existing along this route. Significant utility relocation would need to occur and all these factors would tie into the extended construction time to complete the project.

There were also several benefits identified for this option. This approach would address geometric deficiencies along this route, drainage issues and sight distance limitations by bringing the roadway to current design standards and thus eliminating current safety concerns.



Figure VI-2: Alternative #3

The following **Table VI-2** shows the preliminary cost estimate for Alternative #3 provided by District 5 in 2011 dollars. This cost was developed on a cost per mile basis relative to similar projects in the area. The right of way cost for this alternative includes an estimated cost to relocate four possible houses for Preliminary Alternative Route No. 1 or five possible houses for Preliminary Alternative Route No.2. Further design may provide a way to avoid or reduce this cost.

Alternative #3	Length (miles)	Phased Cost (\$)				Total Cost (\$)
		Design	Right-of-Way	Utilities	Construction	
	1.919	\$2,000,000	\$3,000,000	\$3,000,000	\$10,000,000	\$18,000,000

Table VI-2: Alternative # 3 Preliminary Cost Estimate



#### D. Alternative #4

This option consists of intersection and spot improvements that may require phasing. Two different approaches to this alternative were suggested. The following discusses these approaches.

One approach known as Alternative #4A would be to perform these improvements by starting sequentially from the end of the previous reconstruction at MP 5.390 until all allocated dollars were utilized. **Figure VI-3** and in **Exhibit 3** in **Appendix H** graphically present this option. Alternative #4A would utilize 11 ft lanes and 4 ft shoulders in a more cost effective approach as opposed to meeting full design standards as listed in Alternative #3. The project team considered this approach as a continued improvement along the corridor from the previous reconstruction forward. The possible concern raised by the project team was by improving a specific area the same problem would then be perpetuated further along the corridor at another geometrically deficient location where funds were not available to address the deficiency.

There are several advantages to Alternative #4A. One is that this approach would address concerns along the designated portion of the route until the balance of allocated dollars was utilized. The environmental impacts would also be minimal as the existing right-of-way would be utilized as much as possible with no blue line streams apparently being crossed.

The disadvantages to this approach would be that other areas of greater concern would not be addressed because they are not located sequentially following the previous mile marker improvements. This approach would also require the purchase of right-of-way, relocation of utilities, considerable cut and some fill as well as the reconstruction of six driveways and two field entrances. Two homes would also be directly impacted by this approach in order to provide the anticipated radius of curvature necessary for the roadway design speed.

**Figure VI-4** is a photo showing an approaching area of concern with a high CRF located between MP 5.670 to MP 5.770. This portion of roadway with S-curves is designated for 30 mph and would be redesigned through this approach.

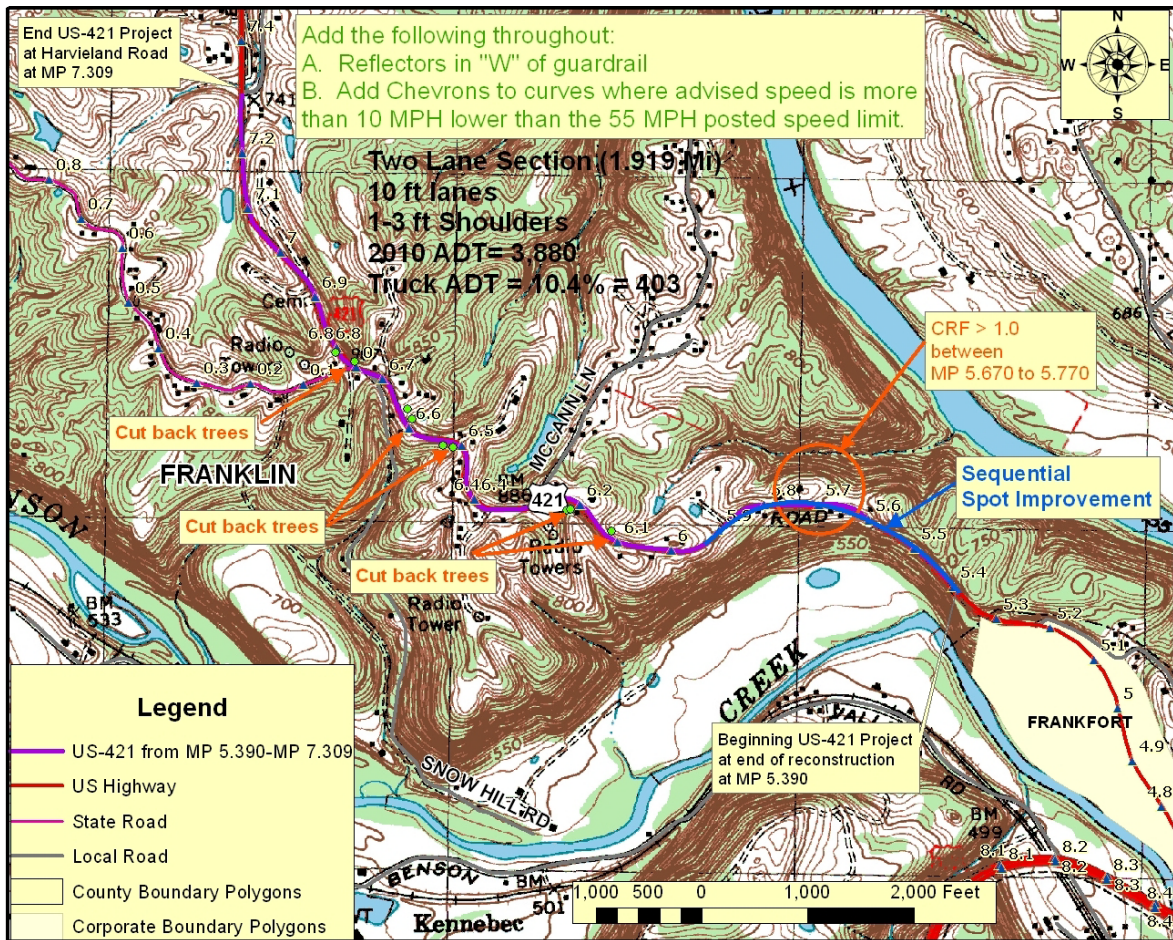


Figure VI-3: Alternative #4A

The following **Table VI-3** shows the preliminary cost estimate for Alternative #4A provided by District 5 in current year dollars. This cost was developed on a cost per mile basis relative to similar projects in the area. The right of way cost for this alternative includes an estimated cost to relocate two houses, neither of which was deemed eligible for the National Register of Historic Places per the 2005, *A Cultural Historic Overview for Improvements to US-421 in Franklin, County* as previously discussed. Further design may provide a way to avoid or reduce this cost.

Alternative #4A	Length (miles)	Phased Cost (\$)				Total Cost (\$)
		Design	Right-of-Way	Utilities	Construction	
Seq. Spot Improvement	1.150	\$1,100,000	\$1,900,000	\$900,000	\$6,900,000	\$10,800,000
Cut Back Trees					\$12,000	\$12,000
Reflectors on Guardrail*					\$1,400	\$1,400
TOTAL (rounded)	—	—	—	—	—	\$10,850,000

\*Assumes labor cost for state forces.

Table VI-3: Alternative # 4A Preliminary Cost Estimate



**Figure VI-4: US 421 at MP 5.600, Northbound on US 421**

The other approach to in this alternative is titled Alternative #4B. This option would be to perform spot improvements at those areas with potential for the greatest safety impact. The two locations within this project area from MP 5.390 and MP 7.309 were identified with high CRFs and geographical deficiencies. The areas of greatest concern are located between MP 5.550 to MP 5.900 (0.350 mi.) and between MP 6.414 to MP 6.750 (0.336 mi.).

**Figure VI-5** and in **Exhibit 4** in **Appendix H** graphically presents this approach. Consideration for this approach would be to make sure the most significant areas of concern were addressed to positively impact the travelers more quickly verses taking a sequential approach that would likely address only the area adjacent to the previous improvements. This option would also utilize a cost effective approach with 11 ft lanes and 4 ft shoulders at spot improvement locations verses meeting the full design standards as listed in Alternative #3. This alternative would require the purchase of right-of-way, relocation of utilities, considerable cut and some fill and the reconstruction of 11 driveways, 2 field entrances and one intersection with a county roadway. At these locations, the road would be widened, straightened and flattened and Snow Hill Road would possibly be realigned to intersect US-421 at a 90 degree angle.

Other relatively short-term safety improvements would be implemented throughout the remaining project area should additional dollars become available. These improvements

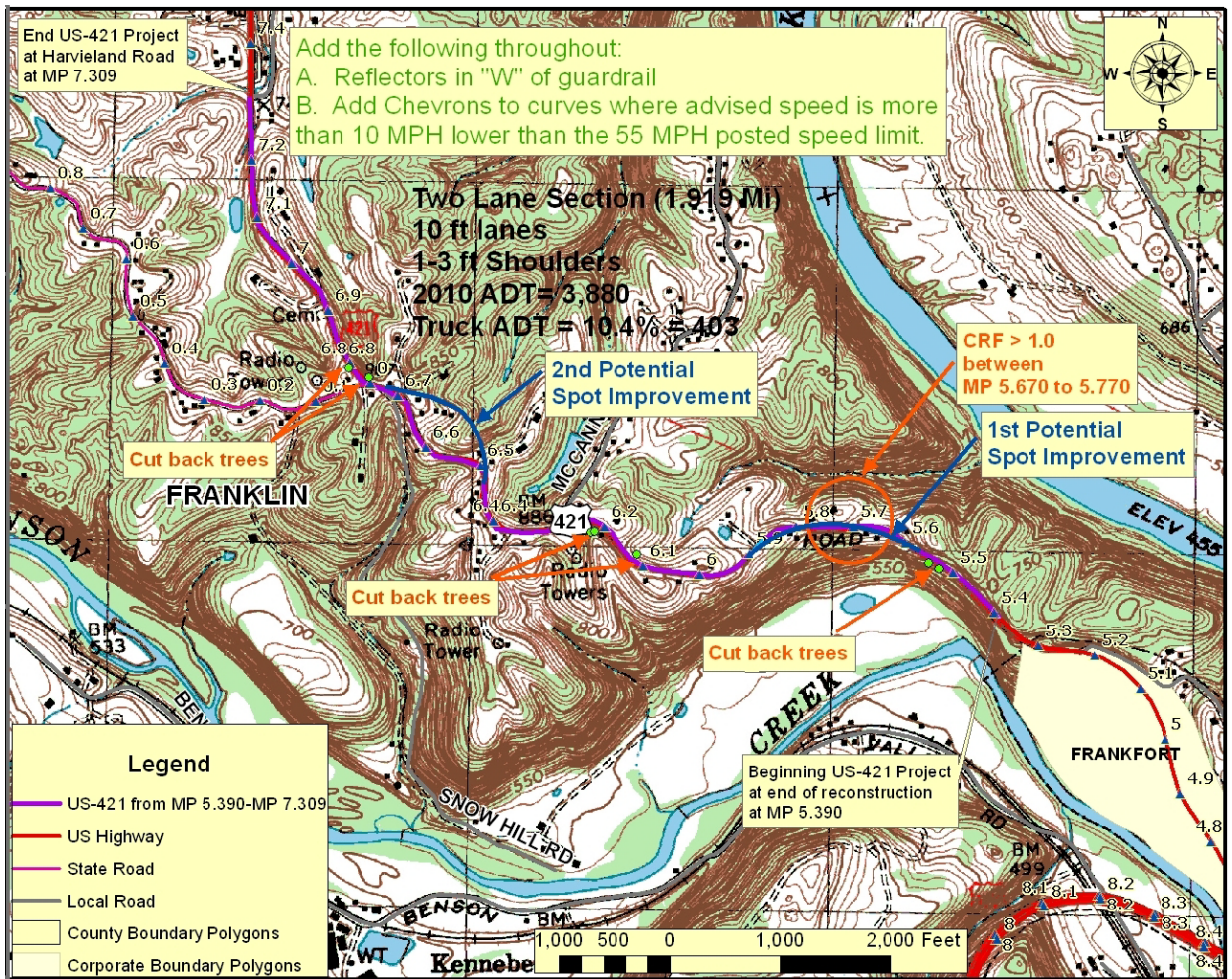


Figure VI-5: Alternative #4B

would be considered upon completion of the two previously identified spot improvements to include: Cutting back of trees and vegetation, reflector tabs on guardrail, chevrons and adding high velocity surface in curves. Should programming dollars not be available to complete the balance of these safety improvements, other potential funding sources should be considered such as HSIP funds.

The benefits to Alternative #4B would be that geometric deficiencies would be addressed at the two locations with the greatest safety concerns within the project area. Also, no blue line streams are anticipated to be crossed for both spot improvements and none of the property considered for these spot improvements were identified to be on the National Register of Historic Places per the 2005, *A Cultural Historic Overview for Improvements to US-421 in Franklin, County* as previously discussed.

**Figure VI-6** shows a photo of one area of concern within the 2<sup>nd</sup> Spot improvement. The limited site distance and skewed intersection could be addressed by moving the centerline of US-421 northeast to remove two curves and thereby allowing a portion of the existing “old” US-421 to be utilized as a landing for Snow Hill Road traffic, while providing a more perpendicular connection to the “new alignment” from the 2<sup>nd</sup> Spot Improvement on US-421.



**Figure VI-6: US-421 and Snow Hill Road Intersection, Northbound on US-421**

There are a few drawbacks to Alternative #4B to be considered. One concern would be the impact to the local community due to approximately four houses being directly in the proposed roadway realignment. Another shortcoming to this alternative would be the potential environmental impact from the removal of at least one underground storage tank (UST) located directly across from the intersection of US-421 with Snow Hill Road.

The following **Table VI-4** shows the preliminary cost estimate for Alternative #4B provided by District 5 in current year dollars. This cost was developed on a cost per mile basis relative to similar projects in the area. The right of way cost for this alternative includes an estimated cost to relocate four houses. Further design may provide a way to avoid or reduce this cost.

Alternative #4B	Length (miles)	Phased Cost (\$)				Total Cost (\$)
		Design	Right-of-Way	Utilities	Construction	
1 <sup>st</sup> Spot Imp.	0.350	\$500,000	\$1,000,000	\$500,000	\$3,000,000	\$5,000,000
2 <sup>nd</sup> Spot Imp.	0.336	\$300,000	\$400,000	\$300,000	\$3,000,000	\$4,000,000
Re-connect Snow Hill Rd	0.350	\$300,000	\$500,000	\$100,000	\$900,000	\$1,800,000
Cut Back Trees					\$12,000	\$12,000
Reflectors on Guardrail*					\$1,400	\$1,400
<b>TOTAL (rounded)</b>	—	—	—	—	—	\$10,850,000

\*Assumes labor cost for state forces.

**Table VI-4: Alternative # 4B Preliminary Cost Estimate**

## **VII. SUMMARY, CONCLUSIONS AND RECOMMENDATIONS**

This study is a Data Needs Analysis (DNA) Study for US-421 in Franklin County from mile point 5.390 to mile point 7.309. This section of US-421 is a part of the current approved highway plan under item number 05-0374.00. This existing roadway was analyzed for geometric deficiencies and safety concerns through review of geometric databases, traffic demands, crash data, site visits and discussion with the project team. The following needs were identified by the project team:

- The roadway does not meet current design standards and the roadway geometrics have significant issues.
- Collisions and high Critical Rate Factors (CRF) were reviewed along the corridor. The areas of greatest concern were identified from mile point 5.670 to mile point 5.770 and between mile point 6.646 and MP 6.746. The latter of the two locations includes the US 421/Snow Hill Road and US 421/KY-1570 intersections.

The purpose of this project is to improve the safety, the geometrics and the interregional mobility between Frankfort and many small communities with US-421 being a direct connection from the Milton-Madison Bridge and Interstate 71 to the City of Frankfort.

The No-Build Alternative #1 does not address the Purpose and Need Statement for the project previously discussed in Section V of this report. Alternative #2 would address some safety concerns in a low-cost, short-term approach to meet a portion of the Purpose and Need Statement. This alternative was considered most favorable by the project team given the limited funds available and construction dollars not yet being allocated for this project in the approved highway plan. The project team did not consider the Complete Rebuild Alternative #3 to warrant further consideration due to geographic limitations, possible environmental concerns and significant cost given the relatively low ADT. However, Alternative #4 option A & B were both considered feasible to address the Purpose and Need Statement, depending on the availability of funding. Further review in Phase 1 Design is recommended, should construction dollars become available.

## **VIII. CONTACTS**

The following persons may be contacted if additional information is needed concerning the project or the study process:

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