

# MADISON PIKE (KY 17) INTERSECTION IMPROVEMENT STUDY

KENTON COUNTY, KENTUCKY



## **Prepared For:**

Northern Kentucky Area Planning Commission  
Kentucky Transportation Cabinet  
City of Fort Wright  
City of Covington

## **Prepared By:**

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CDS Associates, Inc.

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# ACKNOWLEDGEMENTS

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Kentucky Transportation Cabinet – District 6  
Northern Kentucky Area Planning Commission (NKAPC)  
Ohio Kentucky Indiana Regional Council of Governments (OKI)  
Transit Authority of Northern Kentucky (TANK)  
Kentucky Transportation Center – UK (KTC – UK)  
City of Covington

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### TABLE OF CONTENTS

<b>SECTION 1 – INTRODUCTION AND BACKGROUND.....</b>	<b>1</b>
1.0 Introduction .....	1
1.1 Project Purpose.....	1
1.2 History of Project Development .....	1
1.3 Project Area .....	2
<b>SECTION 2 – EXISTING CONDITIONS.....</b>	<b>3</b>
2.0 Introduction .....	3
2.1 Existing Traffic Volumes .....	3
2.2 Traffic Operations .....	3
2.3 Crash Data .....	6
2.4 Utilities .....	6
<b>SECTION 3 – FUTURE CONDITIONS.....</b>	<b>7</b>
3.0 Introduction .....	7
3.1 Future Land Use.....	7
3.2 Traffic Projections.....	7
3.3 Traffic Operations .....	8
<b>SECTION 4 – ROAD IMPROVEMENT ALTERNATIVES.....</b>	<b>10</b>
4.0 Introduction .....	10
4.0.1 Signal Options .....	10
4.0.2 Roundabout Options.....	11
4.0.3 Level of Service.....	11
4.0.4 Reserve Capacity Analysis .....	12
4.1 Comparative Analysis of Intersection Improvements .....	12
4.1.1 Holds Branch Road / Pioneer Park .....	12
4.1.2 Old Madison Pike .....	16
4.1.3 TANK Facility / Lakeview Drive.....	20
<b>SECTION 5 – RECOMMENDATIONS .....</b>	<b>26</b>
5.0 Introduction .....	26
5.1 General Recommendation.....	26
5.2 Holds Branch Road / Pioneer Park .....	26
5.3 Old Madison Pike .....	27
5.4 TANK Facility / Lakeview Drive .....	28
5.5 Other Recommendations.....	28
<b>SECTION 6 - REFERENCES.....</b>	<b>30</b>

## TABLE OF CONTENTS, *continued*

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### TABLES

Table 1:	Existing Traffic Volumes .....	3
Table 2:	Level of Service Criteria – Signalized .....	4
Table 3:	Level of Service Criteria – Unsignalized.....	4
Table 4:	Existing Level of Service .....	5
Table 5:	Future Traffic Volumes .....	8
Table 6:	Future Level of Service – No Build .....	9
Table 7:	Future Level of Service – Alternatives.....	11
Table 8:	Reserve Capacity Analysis.....	12
Table 9:	Alternatives Evaluation Matrix .....	24 - 25

### FIGURES

Figure 1:	Project Location Map
Figure 2:	Project Area / Utilities (Holds Branch Road / Pioneer Park)
Figure 3:	Project Area / Utilities (Old Madison Pike)
Figure 4:	Project Area / Utilities (TANK Facility / Lakeview Drive)
Figure 5:	Signalized Concept Drawing (Holds Branch Road / Pioneer Park)
Figure 6:	Roundabout Concept Drawing (Holds Branch Road/Pioneer Park)
Figure 7:	Signalized Concept Drawing (Old Madison Pike)
Figure 8:	North Bypass Lanes Signalized Concept Drawing (Old Madison Pike)
Figure 9:	Roundabout Concept Drawing (Old Madison Pike)
Figure 10:	Signalized Concept Drawing (TANK Facility / Lakeview Drive)
Figure 11:	Roundabout Concept Drawing (TANK Facility / Lakeview Drive)

### APPENDICES

Appendix A:	KYTC Traffic Forecast
Appendix B:	SYNCHRO Outputs for Traffic Signals
Appendix C:	Design Criteria
Appendix D:	RODEL Outputs for Modern Roundabouts
Appendix E:	Cost Estimates

# SECTION 1 – INTRODUCTION AND BACKGROUND

## 1.0 INTRODUCTION

The Madison Pike (KY 17) Intersection Improvement Study was conducted by DLZ Kentucky, Inc. and CDS Associates for the Northern Kentucky Area Planning Commission (NKAPC) in conjunction with the Kentucky Transportation Cabinet (KYTC) to assess potential improvements at the intersections of (1) Madison Pike and Holds Branch Road / Pioneer Park, (2) Madison Pike and Old Madison Pike, and (3) Madison Pike and the Transit Authority of Northern Kentucky (TANK) Facility Entrance / Lakeview Drive. Coordination with the City of Fort Wright, City of Covington, and TANK was also required for this study. Madison Pike is a north-south route with the study intersections lying in the cities of Fort Wright and Covington in Kenton County, Kentucky (Figure 1).

*Assess potential improvements at the intersections*

To increase capacity and manage congestion, the study team considered two alternatives for each intersection: installation of a traffic signal with widening and construction of a modern roundabout. The report is broken into five main sections, each of which describes an important element of the study. They are as follows:

1. Introduction and Background Information
2. Evaluation of Existing Conditions
3. Evaluation of Future Conditions
4. Comparison of Potential Intersection Improvements
5. Recommendations

## 1.1 PROJECT PURPOSE

The main purposes of the Madison Pike Intersection Improvement Study are to:

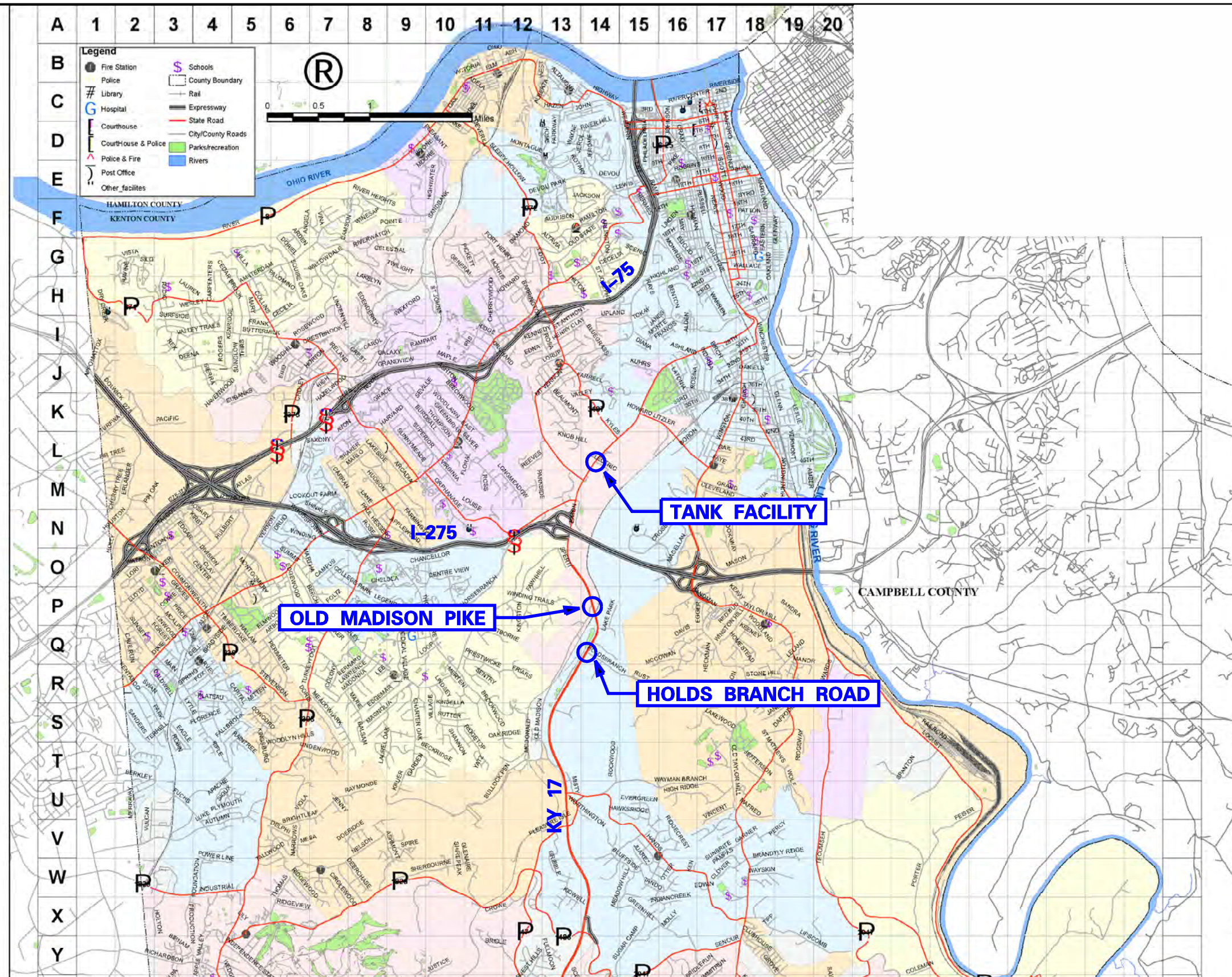
- Identify existing and potential future traffic operations and safety problems at the three study intersections.
- Identify and evaluate potential intersection improvements.
- Compare improvement options and identify a recommended course of action.

In order to meet the purposes of this project, a study was undertaken by NKAPC's consultant, DLZ Kentucky, Inc (DLZ). The following sections of the report describe the study.

## 1.2 HISTORY OF PROJECT DEVELOPMENT

The *Madison Pike Intersection Improvement Study* is a direct outcome of an earlier study – the *Madison Pike Corridor Land Use and Economic Development Plan* (NKAPC, 2005).





## MADISON PIKE (KY17) INTERSECTION IMPROVEMENT STUDY

**FIGURE 1 – PROJECT LOCATION MAP**



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This intersection improvement study addresses several specific issues discussed in Chapter 6 (Transportation) of the *Madison Pike Corridor Land Use and Economic Development Plan*.

The *Corridor Land Use and Economic Development Plan* report highlighted concerns related to adding new traffic signals on Madison Pike. This roadway is an arterial highway where high free flow speeds are desired. The concern was that additional traffic signals could impair the overall performance of the corridor.

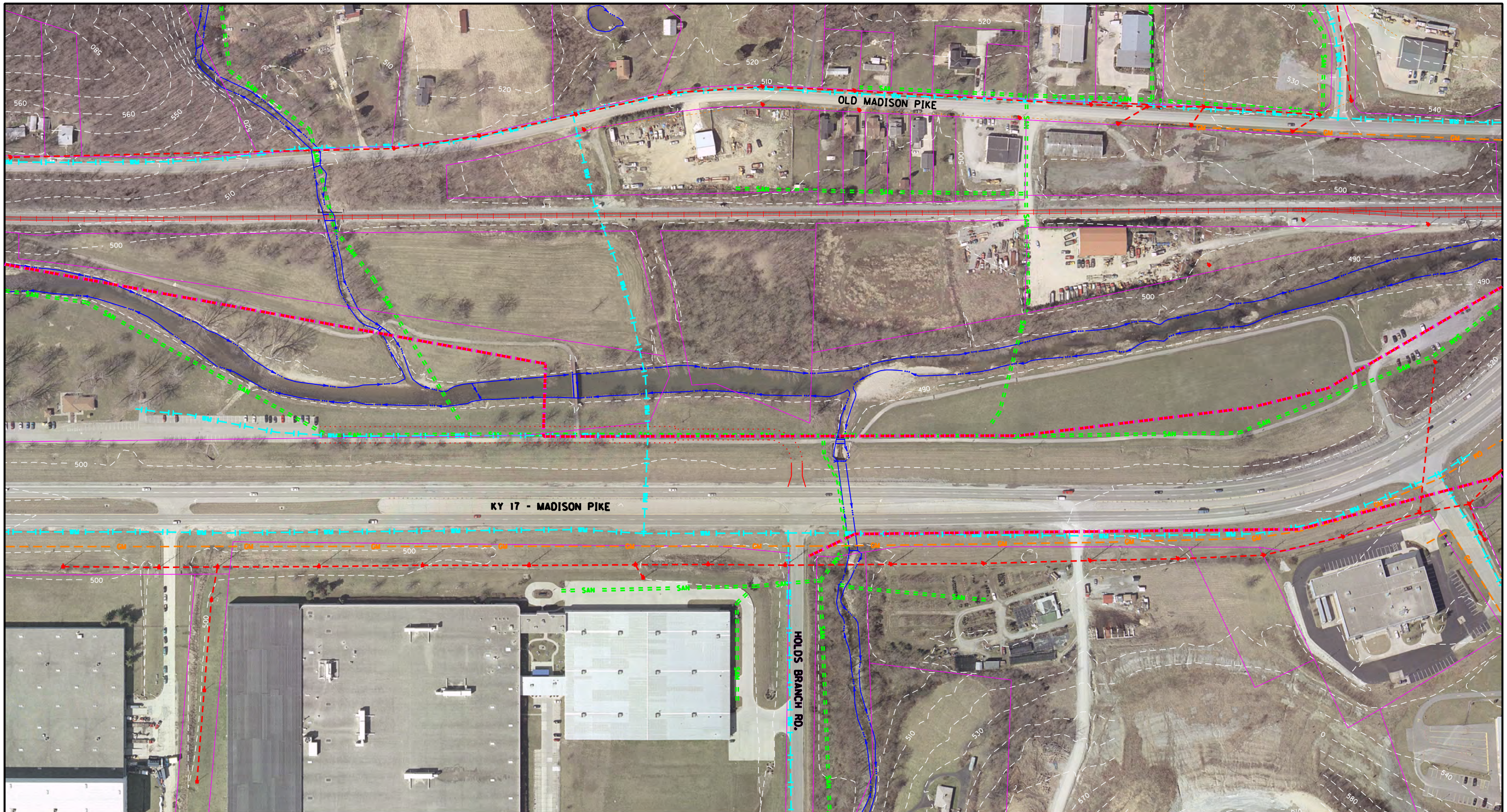
The *Madison Pike Corridor Land Use and Economic Development Plan* recommends consideration of roundabouts in lieu of traffic signals at Madison Pike and Old Madison Pike, and Madison Pike and the TANK Facility Entrance / Lakeview Drive. The *Madison Pike Intersection Improvement Study* examines this recommendation in detail.

A third intersection, Madison Pike and Hold Branch Road, was added to the *Madison Pike Intersection Improvement Study* through a cooperative agreement among several parties. This agreement made available funds for study of the third intersection. The Kentucky Transportation Cabinet obtained traffic counts for the three study intersections. OKI provided the traffic forecasting model used by KYTC to develop future traffic flows. The existing and future traffic flows were provided to the project team.

### **1.3 PROJECT AREA**

Figure 1 is a location map showing the three study intersections. Each intersection is shown in more detail with a project area map. The project area includes the intersections of Madison Pike and Holds Branch Road / Pioneer Park (Figure 2), Madison Pike and Old Madison Pike (Figure 3), and Madison Pike and the TANK Facility Entrance / Lakeview Drive (Figure 4). The overall Madison Pike Corridor and road segments between the three study intersections were not evaluated as part of this study.

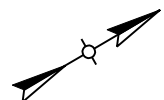




**FIGURE 2**  
**PROJECT AREA AND UTILITIES**  
**KY 17 – MADISON PIKE**  
**@ HOLDS BRANCH ROAD**

**LEGEND**

- GM EX. GAS MAIN
- SAN EX. SANITARY SEWER
- WM EX. WATER MAIN
- EX. STREAMLINE
- EX. ELECTRIC
- EX. RAILROAD
- PROPOSED ACCESS ROAD
- PROPOSED BIKE PATH
- EX. CONTOUR
- PROPERTY LINE

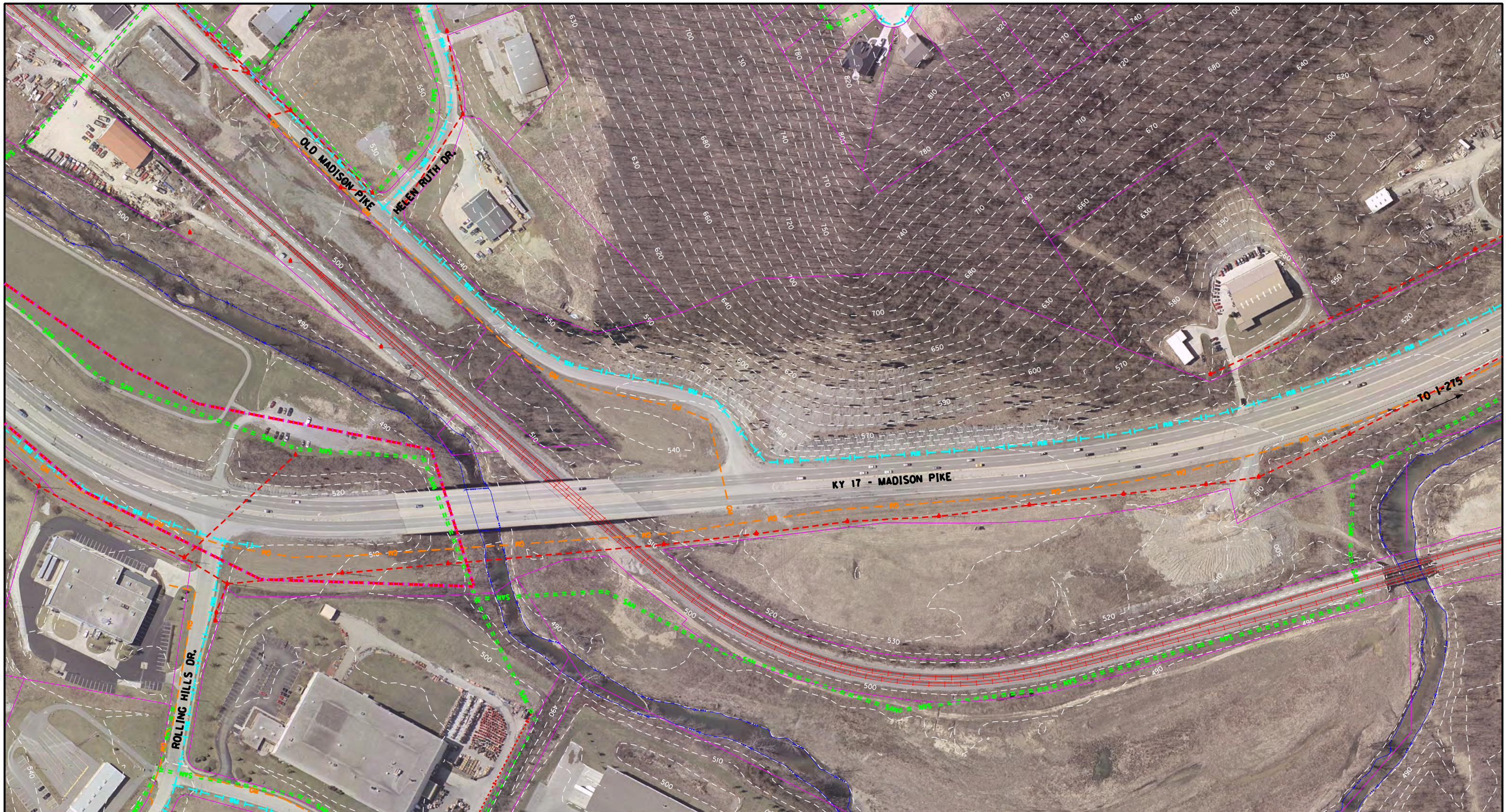


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 SCALE 1" = 100'  
 CONTOUR INTERVAL = 10 FT.



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# LEGEND

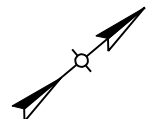
- EX. GAS MAIN
- EX. SANITARY SEWER
- EX. WATER MAIN
- EX. STREAMLINE
- EX. ELECTRIC
- EX. RAILROAD
- PROPOSED ACCESS ROAD
- PROPOSED BIKE PATH
- EX. CONTOUR
- PROPERTY LINE

**FIGURE 3**  
**PROJECT AREA AND UTILITIES**  
**KY 17 – MADISON PIKE**  
**@ OLD MADISON PIKE**



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GRAPHIC SCALE  
0 100' 200'  
SCALE 1" = 100'  
CONTOUR INTERVAL = 10 FT.

#### LEGEND

- CM --- EX. GAS MAIN
- SAN --- EX. SANITARY SEWER
- WM --- EX. WATER MAIN
- SL --- EX. STREAMLINE
- E --- EX. ELECTRIC
- RR --- EX. RAILROAD
- AR --- PROPOSED ACCESS ROAD
- BP --- PROPOSED BIKE PATH
- C --- EX. CONTOUR
- PL --- PROPERTY LINE

## FIGURE 4 PROJECT AREA AND UTILITIES KY 17 – MADISON PIKE @ TANK ENTRANCE



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## SECTION 2 – EXISTING CONDITIONS

### 2.0 INTRODUCTION

The assessment of existing peak hour traffic conditions at the study intersections is an important step in the study process. In order to perform this evaluation, existing traffic counts (including turning movements) for the three intersections were obtained by KYTC and provided to the project team. In addition to traffic operations, crash data was also requested from KYTC and examined to determine if safety problems exist at these intersections. This section of the report describes the methods used for evaluation and the results of the existing conditions analysis. It should be noted that off-peak traffic operations were not analyzed as part of this study. Only peak hour analysis was performed for each intersection since traffic volumes during the peak hour are higher than any off-peak hour. Therefore, if road improvements accommodate peak hour traffic at an acceptable level, off peak traffic operations will also be acceptable.

### 2.1 EXISTING TRAFFIC VOLUMES

The Kentucky Transportation Cabinet obtained existing traffic volumes for the three study intersections in January 2006. These counts were evaluated, and a peak traffic hour volume for both the morning and evening was determined. This process is explained in more detail in Appendix A. These peak hour traffic counts were then supplied to DLZ for analysis. Table 1 shows the results of the peak hour traffic counts as represented by a total number of vehicles entering each intersection within the peak hours.

**Table 1: Existing (2006) Intersection Traffic Volumes**

Intersection	AM Peak Hour Total Entering Volume	AM Directional Split % (SB/NB)	PM Peak Hour Total Entering Volume	PM Directional Split % (SB/NB)
Madison Pike - Holds Branch Road / Pioneer Park	3690	20 / 80	3495	69 / 31
Madison Pike - Old Madison Pike	4420	23 / 77	4200	66 / 34
Madison Pike - TANK Facility / Lakeview Drive	2270	33 / 67	2350	53 / 47

### 2.2 TRAFFIC OPERATIONS

Using the peak hour turning movement counts (diagrams shown in Appendix A), a computer traffic model was developed for each study intersection using the SYNCHRO program. This program develops a peak hour model that accounts for interaction of movements and can reflect the impacts of minor changes in intersection geometry, traffic signal timing changes, and traffic operations strategies. Each intersection was analyzed for the existing year (2006) information provided by KYTC to determine the effectiveness of the current intersection control. The most common measure of intersection performance is Level Of Service (LOS). A brief description of LOS for signalized intersections is given in Table 2. The LOS criteria



for unsignalized intersections can be found in Table 3 and are similar to that of signalized intersections.

**Table 2: Level of Service Criteria - Signalized Intersections**

LOS	Seconds Delay/Vehicle	Description
A	$\leq 10$	Most vehicles do not stop at all.
B	$> 10$ and $\leq 20$	More vehicles stop than for LOS A.
C	$> 20$ and $\leq 35$	The number of vehicles stopping is significant, although many pass through without stopping.
D	$> 35$ and $\leq 55$	Many vehicles stop. Individual cycle failures are noticeable.
E	$> 55$ and $\leq 80$	Considered being the limit of acceptable delay. Individual cycle failures are frequent.
F	$> 80$	Unacceptable delay.

Source: Transportation Research Board, Highway Capacity Manual, 2000

**Table 3: Level of Service Criteria - Unsignalized Intersections**

LOS	Seconds Delay/Vehicle	Description
A	$\leq 10$	Little or no delay, very low main street traffic.
B	$> 10$ and $\leq 15$	Short traffic delays, many acceptable gaps.
C	$> 15$ and $\leq 25$	Average traffic delays, frequent gaps still occur
D	$> 25$ and $\leq 35$	Long traffic delays, limited number of acceptable gaps.
E	$> 35$ and $\leq 50$	Very long traffic delays, very small number of acceptable gaps.
F	$> 50$	Extreme traffic delays, virtually no acceptable gaps in traffic.

Source: Transportation Research Board, Highway Capacity Manual, 2000

The Holds Branch Road / Pioneer Park and Madison Pike intersection (Figure 2) recently became a signalized intersection to accommodate improvements at Pioneer Park and a planned development on Holds Branch Road containing over 1000 dwelling units and commercial development. This development helped drive the decision to incorporate this intersection into the study. Northbound and southbound Madison Pike has two lanes each for through movement. The southbound leg has a left turn lane to turn onto Holds Branch Road. The roadway segment south of the intersection has a center median; with no left turn lane since the Pioneer Park leg is an exit only. Holds Branch is currently a two-lane road. The site plan approved for the development on Holds Branch Road includes the addition of a right turn lane from northbound Madison Pike into Holds Branch Road and an acceleration lane for vehicles turning right (north) from Holds Branch Road onto Madison Pike. These lanes were not used in the analysis as they have not yet been constructed.

The intersection of Madison Pike and Old Madison Pike (Figure 3) is currently a stop-controlled intersection. The stop-control only occurs for eastbound traffic (Old Madison Pike). Currently, northbound and southbound have two through lanes with a northbound left turn lane for access to Old Madison Pike. There is no designated right turn access to Old

Madison Pike from the southbound direction. Old Madison Pike is a two-lane road and there is currently no access to the property east of the intersection.

The intersection of Madison Pike and the TANK Facility Entrance (Figure 4) is currently a stop-controlled intersection. The stop-control only occurs for westbound traffic (TANK Entrance). Currently, northbound and southbound have two through lanes with a 14-foot continuous left turn lane. There is no designated right turn lane for the northbound direction. Lakeview Drive access is currently situated approximately 200 feet from the TANK Entrance. The TANK Entrance shares its access with Brooks Drive, which is a small (one lane) access road used by Duke Energy. There is currently no access to the property west of the intersection.

Each intersection was analyzed using a base model. This base model incorporated such factors as current lane configurations, signal timings, posted travel speeds, intersection controls, and other characteristics specific to that intersection. The existing peak hour traffic volumes for each intersection were then input into the corresponding SYNCHRO base file and evaluated for the existing condition. Each SYNCHRO model was then used to generate an output report, which can be found in Appendix B. Table 4 summarizes the results of the analysis of the existing signalized intersections.

**Table 4: Existing (2006) LOS (Average Delay in Seconds)**

Intersection	AM Peak Hour LOS	PM Peak Hour LOS
Madison Pike and Holds Branch Road / Pioneer Park	D (38.2)	A (6.9)
Madison Pike and Old Madison Pike	F (111.0)	F (>max) <sup>1</sup>
Madison Pike and TANK Facility / Lakeview Drive	D (34.9)	E (39.9)

<sup>1</sup> In the PM Peak Hour Analysis for Old Madison Pike, an error was given by the SYNCHRO analysis for the delay to the approach road. An error occurs when the delay exceeds a specified value – in this case, 9999 seconds. Essentially, the analysis indicates that there are no acceptable gaps during the PM peak to allow traffic from Old Madison Pike to turn on to Madison Pike. Therefore the “>max” is used to show the delay.

At the intersection of Madison Pike and Holds Branch Road, the current configuration seems to perform at a reasonable level since the current signal is actuated. The PM peak analysis shows that the intersection is estimated to operate at LOS A with a 6.9 second average delay. However, there is still considerable delay in the AM peak for the northbound through movement (46.5 sec, LOS D) as well as to the traffic on Holds Branch Road (54.6 sec, LOS D). The discrepancy between the AM and PM LOS can be attributed to the AM peak northbound traffic volume of 2,880 vehicles per hour, compared to 1,050 vehicles per hour in the northbound direction during the PM peak hour. The heavy northbound through movement in the AM peak hour adversely impacts signal timing for other turn movements in the intersection, thus operating at a lower Level of Service.

***Heavy northbound movement adversely impacts other turn movements***

The evaluation of the intersection of Madison Pike and Old Madison Pike, on the other hand, revealed considerable delays to traffic on Old Madison Pike in both the AM and PM peak. The LOS shown in Table 4 reflects delay to the leg that is stop-controlled (in this case, Old



Madison Pike). Madison Pike northbound and southbound movements are free flow with no delays.

The intersection of Madison Pike and the TANK Facility also experiences delay for the stop-controlled leg (TANK Entrance). Again, Madison Pike northbound and southbound movements are free flow. These delays are also noted in Table 4.

## **2.3 CRASH DATA**

In addition to the existing traffic data, crash data was requested from KYTC and evaluated to determine if crash countermeasures would be appropriate. The data provided by KYTC included accident reports for the Madison Pike Corridor from 0.5 miles south of Holds Branch Road to 0.5 miles north of the TANK facility for the years 2003, 2004, and 2005. The data provided contained approximately 330 accidents.

While there were several accident reports for the Madison Pike Corridor, there were minimal reports located within 500 feet in either direction of the study intersections. Of the 330 reports, there were no accidents reported in the vicinity of Holds Branch Road, four (4) accidents reported near Old Madison Pike, and only three (3) reported at the TANK Facility Entrance. There were no fatalities in the 7 accidents reported near the study intersections, and only one injury accident. The existing statistical information at these intersections does not appear to indicate a safety problem with one accident per 3.5 million vehicles entering the Madison Pike and TANK Facility entrance intersection and one accident per 10 million vehicles entering the Madison Pike and Old Madison Pike intersection. However, with the increasing traffic and congestion at these intersections, the potential exists for an increased accident rate.

Another area of potential concern is the TANK exit located just south of the TANK Facility Entrance. This requires buses turning south from TANK to either wait for an adequate gap in both directions or turn into the continuous left turn (center) lane until there is an adequate southbound gap.

## **2.4 UTILITIES**

Several utility companies have facilities near the locations of the study intersections. These utilities include Duke Energy (gas and electric) and Cincinnati Bell (telephone). These utility companies were contacted by DLZ to determine the location of any facilities they may have in the area in order to assess potential impacts due to improvement alternatives. All contacts responded and provided maps indicating approximate locations of facilities. These locations, in relation to each intersection, are shown on Figures 2, 3, and 4.

## **SECTION 3 – FUTURE CONDITIONS**

### **3.0 INTRODUCTION**

As a result of ongoing and planned development, the future traffic demands on the study intersections were assessed using a revised SYNCHRO model. The revised SYNCHRO model used the existing condition model as a base but added projected future traffic volumes. The objective was to define peak hour traffic operations issues that could occur in the year 2030 without any road improvements (i.e. “No Build” scenario).

This evaluation highlights potential future traffic issues that should be addressed with intersection improvements such as a traffic signal or roundabout. As with the existing conditions evaluation, off-peak traffic operations were not analyzed. Only peak hour analysis was performed for each intersection since traffic volumes during the peak hour are higher than any off-peak hour. Therefore, if road improvements accommodate peak hour traffic at an acceptable level, off peak traffic operations will also be acceptable.

### **3.1 FUTURE LAND USE**

Through discussions with NKAPC and the Cities of Fort Wright and Covington, future land development was anticipated throughout the corridor. In coordination with NKAPC and the City of Fort Wright, each parcel in the corridor was analyzed for future and projected development based on local land use plans. Traffic volumes were then estimated for these developments (estimates obtained using the ITE Trip Generation Manual). This information was incorporated into OKI’s traffic network model to develop future (year 2030) Annual Daily Traffic (ADT) and AM and PM peak hour trips. The future land use table and map are included in Appendix A.

### **3.2 TRAFFIC PROJECTIONS**

Based on the future land uses in the corridor and surrounding areas, KYTC used OKI’s network traffic model for the region to project traffic volumes for each intersection (Diagrams and volumes are in Appendix A) and supplied this information to DLZ for analysis.

The theoretical capacity of a roadway link typically ranges from 1500 to 1900 vehicles per lane per hour (vplph) and depends on site specific factors such as travel speed, density of driveways, driver behavior, median type, etc. Exercising collective professional judgment, the project team assumed a maximum road link capacity of 1700 vplph for planning purposes, with the understanding that KTYC has no plans to add lanes on KY-17. Therefore, the peak hour projected traffic flow was adjusted to allow a maximum of 1700 vplph for all traffic flows except for southbound traffic at Old Madison Pike and Holds Branch Road. The southbound traffic approaching Old Madison Pike and Hold Branch in the PM was further constrained to 1450 vplph due to congestion at the intersection of Madison Pike and Dudley Road which is located approximately 3300 feet north of the Madison Pike / Old Madison



Pike intersection. The Dudley Road intersection would likely prevent traffic flow from reaching 1700 vplph due to the capacity of this intersection.

KYTC indicated that the Dudley Road intersection at Madison Pike may be improved before any of the three intersections in this study, although there are no plans at this time to do so. Because the analysis in this report assumes no improvement to the Madison Pike / Dudley Road intersection (resulting in a maximum southbound flow of 1450 vplph), if this intersection were upgraded (resulting in a southbound flow greater than 1450 vplph), the LOS for nearby intersections would be worse than presented in this report. As a result, it may not be possible to achieve LOS C or even D at the Old Madison Pike and Holds Branch intersections.

The adjusted projected traffic volumes (year 2030) for each intersection are shown in Table 5. Additional information regarding future traffic volumes and turning movement diagrams can be found in Appendix A.

**Table 5: Future (year 2030) Projected Traffic Volumes**

Intersection	AM Peak Hour Total Entering Volume	AM Directional Split % (SB/NB)	PM Peak Hour Total Entering Volume	PM Directional Split % (SB/NB)
Madison Pike - Holds Branch Road / Pioneer Park	5110	31 / 69	5665	60 / 40
Madison Pike - Old Madison Pike	5400	35 / 65	5745	54 / 46
Madison Pike - TANK Facility / Lakeview Drive	3750	35 / 65	4190	52 / 48

The peak hour factor (PHF) also had to be considered in the analysis of each intersection. The PHF specifies how the peak hour traffic is spread throughout the hour. Due to the existing capacity of the roadway and the constraints placed on the traffic projections, DLZ in collaboration with the project team assumed that the traffic would essentially be balanced throughout the peak hour. From this, the default PHF used was 0.95 with a maximum of 1.00 (equally balanced throughout the hour). Each movement was checked to ensure that the movement combined with the peak hour factor would not exceed the constrained volumes described above. If traffic flow did exceed the allowable limit, the peak hour factor was adjusted to comply with the constraint.

### 3.3 TRAFFIC OPERATIONS

The “No Build” scenario for the year 2030 was evaluated in order to assess the need for intersection improvements. This “No Build” scenario is the situation that assumes projected population growth and development along and near the corridor and that no road improvements would be performed with the exception of planned access roads. Using the existing conditions SYNCHRO model as a baseline, a traffic model was run using the year 2030 traffic volumes. The future conditions model included the same road network as the existing condition and was first analyzed using the same intersection control that currently exists.

For the Old Madison Pike intersection, an access road was added to the east and analyzed using a stop control for the approaches. These approaches are projected to operate at LOS F with a “>max” delay for both the AM and PM peak hours. An access road was also added to the west of the TANK Facility Entrance and then evaluated for a stop control on the approaches. These approaches were also projected to operate at LOS F with a “>max” delay for both the AM and PM peak hours.

The future conditions model was then analyzed for the “No Build” scenario with a traffic signal using a cycle time of 125 seconds to match existing signals within the corridor. The results of the signalized analysis can be seen in Table 6. The outputs generated from the SYNCHRO program are included in Appendix B.

**Table 6: Future (year 2030) No Build Level of Service (average delay in seconds)**

Intersection	AM Peak Hour LOS			PM Peak Hour LOS		
	Overall	SB	NB	Overall	SB	NB
Madison Pike - Holds Branch Road	F (206.5)	E (68.6)	F (256.3)	F (177.9)	F (84.3)	E (56.8)
Madison Pike - Old Madison Pike (with signal)	F (120.6)	B (15.3)	F (184.8)	F (93.8)	F (116.0)	E (58.9)
Madison Pike - TANK Facility (with signal)	D (42.9)	C (20.4)	D (44.1)	E (64.8)	D (46.7)	E (74.2)

All intersections examined do not meet the desired LOS C for the year 2030 in the “No Build” scenario during the peak hours. The off-peak operations of these intersections may provide an acceptable level of service, however, the analysis for this study was limited to peak hour traffic operations only.

Additional signal timings were also analyzed to determine the best overall traffic operation under these conditions. Each intersection was evaluated for a 115 second cycle time, a 135 second cycle time and an optimized cycle time for the “No Build” scenario. The optimized cycle time is a feature in SYNCHRO that selects the signal timing for optimal performance. In all situations, the LOS for the intersection was the same. For Holds Branch Road / Pioneer Park, the optimized cycle times were 150 seconds and 75 seconds for the AM and PM peak hours respectively. At Old Madison Pike, the optimized cycle times were 150 seconds for both the AM and PM peak. For the TANK Facility Entrance / Lakeview Dr., the optimized cycle times were 140 seconds for the AM peak and 120 seconds for the PM peak. Any modification to cycle times at one intersection would require modifications to the other signals within the corridor to maintain vehicle platoon movement. All results shown and documented from the SYNCHRO analysis within this report are based on a 125 second cycle time to match existing traffic signals.



## SECTION 4 – ROAD IMPROVEMENT ALTERNATIVES

### 4.0 INTRODUCTION

The development and evaluation of potential road improvements is presented in this section of the report. These road improvements address the peak hour problems identified in the preceding sections of the report. A comparison of road improvement alternatives for future peak hour traffic volumes is also included. The design criteria used to develop improvement alternatives can be found in Appendix C.

The project team discussed the operational goals for the study intersections early in the process. It was decided that each improvement option should achieve LOS C or better if practical. However, the team also agreed that this might not be possible at some locations, and LOS D or even E might have to be accepted. It also became apparent as the study was conducted that reaching LOS C or better at the three study intersections could create unintended traffic congestion at other locations outside the immediate study area. Specifically, allowing more traffic to get through the three project area intersections could result in already-congested downstream intersections and road links becoming overloaded.

For this reason, the project team considered the possibility of managing overall congestion by accepting a lower level of service (i.e., LOS E or F) at the three study intersections. This approach could limit increases in traffic volumes and congestion at other intersections within the KY-17 corridor and on Interstate 275 (traffic would be “bottled up” at selected locations to prevent potentially more serious problems elsewhere). It could also minimize negative impacts and construction costs. Last, it could affect land use and transit patterns in the project area, as noted in the *Madison Pike Corridor Land Use and Economic Development Plan*. However, due to the limited scope of this study, the effects of such an approach upon other intersections could not be evaluated. Also, the interaction between intersections was not evaluated. As described in more detail in the Recommendations section of this report, these issues would be best addressed as part of an overall corridor study.

#### 4.0.1 SIGNAL OPTIONS

Each intersection was initially modified from the “No Build” scenario by adding turn lanes and additional through lanes to Madison Pike and the intersecting streets to operate at LOS C or better. Each option was then analyzed until an overall satisfactory intersection improvement was determined. At two of the intersections (Holds Branch and Old Madison Pike), the standard techniques of adding turn lanes would not obtain a desirable LOS. It became apparent that adding a lane through the intersection would be required to obtain a desirable LOS. A lane widening is increasing the approach of the intersection from two through lanes to three through lanes to enable more vehicles to pass through the intersection during the allotted green time. Upon passing through the intersection the roadway typically decreases from three through lanes back to two through lanes. KYTC recommends the use of approximately 600 feet of storage

*Adding through lanes would be required to obtain a desirable LOS*

past the intersection (full width lane) and an additional taper length dependent upon the design speed in the area.

The traffic signal improvements options considered many factors related to traffic operations and safety. To maintain a platoon of vehicles traveling from one intersection to another, a traffic signal cycle length of 125 seconds was maintained through this analysis, matching current traffic signals within the corridor. The traffic analysis also utilized different timings for the AM and PM peak hour conditions to increase the efficiency of the traffic signal. The signals were designed in accordance with the *Highway Capacity Manual 2000* (Transportation Research Board).

As part of the traffic signal option analysis, SYNCHRO software was utilized to determine the traffic signal operations and LOS for each intersection. The level of service criteria used is the same as the existing conditions analysis and can be found in Table 2.

#### **4.0.2 ROUNDABOUT OPTIONS**

Modern roundabout geometry is influenced by a variety of factors related to traffic operations and safety considerations. After detailed analysis and conceptual design work, the modern roundabouts proposed for the study intersections along KY-17 were developed. Like the signal option, the roundabouts were designed to accommodate year 2030 traffic projections. Additionally, the roundabouts are designed to accommodate AM and PM peak hour volumes. All of the roundabouts were designed in accordance with the Federal Highway Administration's *Roundabouts: An Informational Guide* (FHWA, 2000) and Ourston's *Roundabout Design Guidelines* (Ourston, 2001).

As part of the analysis conducted for the roundabout options, RODEL software was used to analyze the future traffic operations and determine the LOS for each intersection. The output generated by RODEL can be found in Appendix D. LOS criteria are summarized in Table 3 for unsignalized intersections.

#### **4.0.3 LEVEL OF SERVICE**

Each intersection was evaluated to determine the level of service for the AM and PM peak hours for each alternative (Signalized, Roundabout). This evaluation is used as one criterion in the comparison of alternatives. Table 7 (shown below) will be referenced in subsequent sections of this report.

**Table 7: Alternatives Level of Service (average delay in seconds)**

Intersection	Signalized		Roundabout	
	AM	PM	AM	PM
Madison Pike and Holds Branch Road / Pioneer Park	C (28.6)	C (30.1)	C (16.8)	B (12.6)
Madison Pike and Old Madison Pike	C (21.4)	C (20.3)	A (2.7)	B (13.7)
Madison Pike and TANK Facility / Lakeview Drive	C (30.2)	C (32.8)	A (5.2)	A (5.8)

Based on future (year 2030) traffic volumes



#### **4.0.4 RESERVE CAPACITY ANALYSIS**

The reserve capacity analysis is used to indicate the amount of additional traffic that would be required before an intersection would reach LOS E. Reserve capacities are expressed as the percentage increase in total entering traffic (beyond the 2030 projection) during the controlling peak hour. The controlling peak hour is the peak hour (AM or PM) that provides the least percentage increase in total entering traffic. For this analysis, increases were assumed to occur equally on all legs of the intersection. Table 8 indicates the percentage increase for the controlling peak hour for both alternatives before reaching LOS E and will be referenced in subsequent sections as an evaluation criterion.

**Table 8: Reserve Capacity Analysis for Alternatives**

Intersection	Signalized	Roundabout
Madison Pike and Holds Branch Road / Pioneer Park	15% (PM)	4% (AM)
Madison Pike and Old Madison Pike	17% (PM)	6% (PM)
Madison Pike and TANK Facility / Lakeview Drive	14% (PM)	23% (AM & PM)

Typically, motorist delay at a roundabout is relatively low until traffic volumes approach capacity. However, once volumes get closer to capacity, delays can increase rapidly, leading to poor LOS. For this reason, it is possible to have a very good LOS (such as A or B) with a low reserve capacity. In this situation, relatively small increases in traffic volumes can result in the intersection having an unacceptable LOS. This is the case at the Madison Pike and Old Madison Pike intersection as well as the Madison Pike and Holds Branch Road intersection.

*Delay at a roundabout is relatively low until volumes approach capacity*

### **4.1 COMPARATIVE ANALYSIS OF ROAD IMPROVEMENTS**

Table 9, located on pages 24 and 25, is a comparative matrix, which shows the major criteria used in comparing alternatives. All information contained in this section of the report can be found in summary form in Table 9. This matrix was used to provide a recommendation based on the evaluation criteria.

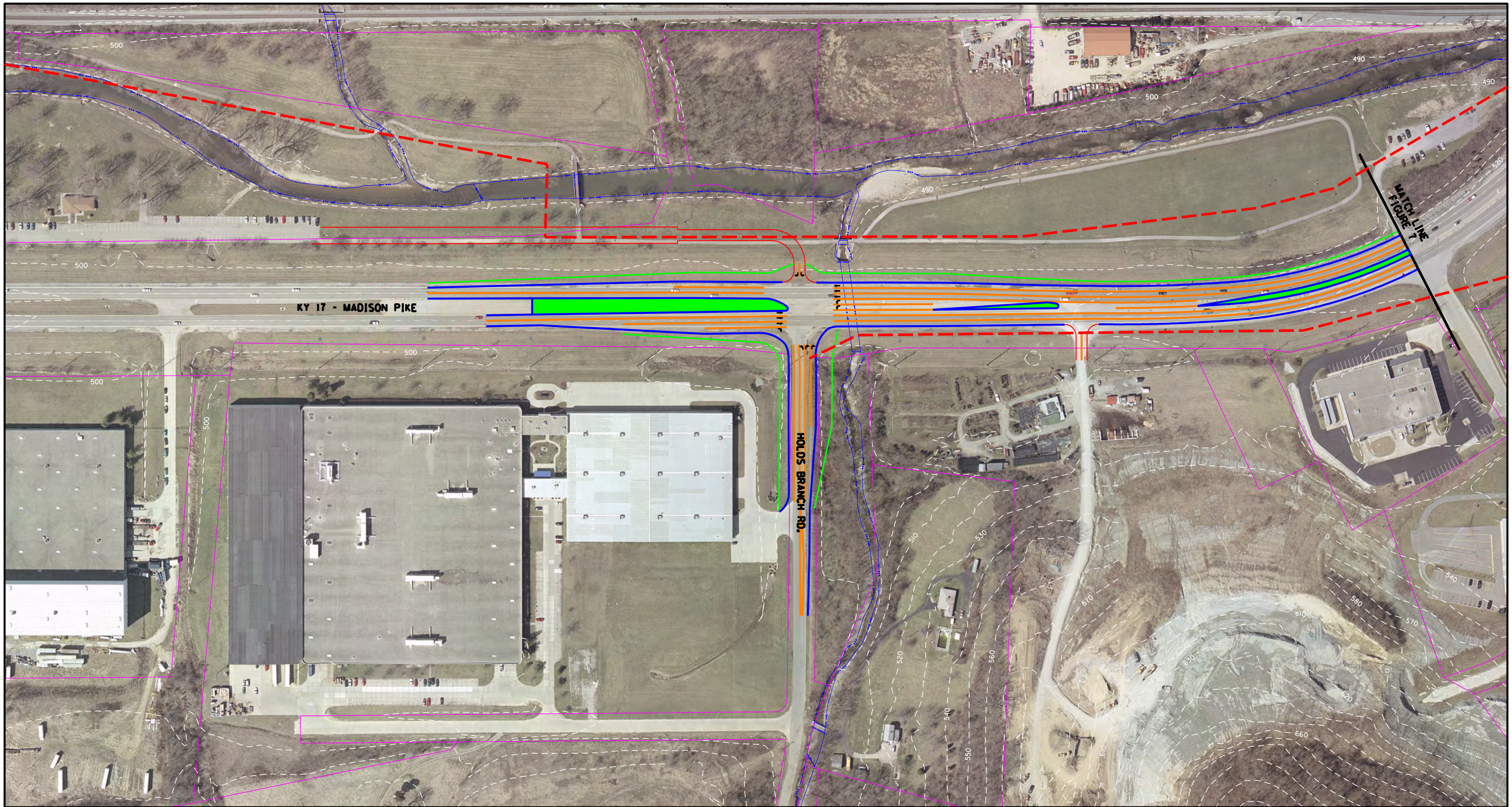
#### **4.1.1 HOLDS BRANCH ROAD / PIONEER PARK**

##### **SIGNAL ALTERNATIVE**

##### **Geometry**

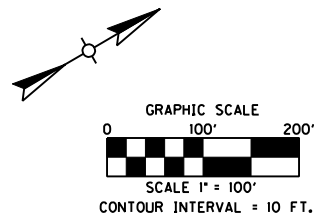
The proposed signalized intersection improvement has three through lanes for northbound and southbound Madison Pike. A dual left turn lane is proposed for Southbound Madison Pike onto Holds Branch Road. Holds Branch Road would be widened to have one left turn lane and two right turn lanes (Figure 5). Since three through lanes in each direction are also





# **LEGEND**

- PROPOSED LANE MARKINGS
- PROPOSED EDGE OF PVT / CURBING
- PROPOSED EDGE OF DISTURBANCE
- PROPOSED RETAINING WALL
- PROPOSED STRUCTURE
- - - PROPOSED BIKE PATH
- - - EX. CONTOUR
- PROPERTY LINE



## **FIGURE 5 – SIGNAL CONCEPT**

### **KY 17 – MADISON PIKE @ HOLDS BRANCH ROAD**





required at the intersection with Old Madison Pike, this cross section widening would be extended from the Holds Branch intersection to Old KY 17 to maintain continuity.

### Traffic Operations

The improved signalized intersection is projected to operate at LOS C in the year 2030 with an average delay of 28.6 seconds in the AM Peak Hour. During the PM peak hour the improved signalized intersection is estimated to operate at LOS C with an average delay of 30.1 seconds (Table 7). The majority of the delay from the AM and PM peaks can be attributed to the westbound approach (Holds Branch Road), which is estimated to operate at LOS E (64.5 seconds of delay) and LOS E (55.3 seconds of delay) respectively. During the AM and PM peaks, northbound and southbound traffic show considerable volumes, therefore, the signal was timed to allow north and south traffic to flow as freely as possible. The signal alternative would have a reserve capacity of 15 percent (Table 8) during the controlling peak hour (PM).

### Safety

This intersection does not currently have a high crash frequency. The installation of modified signal layout at this location with the additional traffic volumes projected would create a similar situation to other signalized intersections within the corridor. The addition of pedestrian crosswalks and a signal phase that is pedestrian actuated (push button) could be incorporated into the signal option. The extended green time required for pedestrian crossing would likely impact the operation of the intersection, however, the effects would likely be temporary with normal operations/delays returning after three or four signal cycles.

### Right-of-Way

This alternative would require an additional 0.6 acres of right-of-way. No relocations would be required as a result of the signal alternative. No parking will be impacted by the signal alternative. Because this is a planning level cost estimate with many details still unknown, a right-of-way cost estimate was not prepared.

### Cost

Planning level cost estimates are in year 2006 dollars and include construction (with water line relocation) and engineering costs. Utility company facilities that are located within the state right of way are the responsibility of the utility company to relocate and have therefore not been estimated. An additional 15% was included for miscellaneous construction items in order to cover any smaller construction items that have not yet been quantified. Contingency was also added (20%) for material cost fluctuations and unforeseen items. Planning level cost estimates can be found in Appendix E. Planning level costs will total \$2,500,000 for this alternative and are as follows:

- Construction – \$2,100,000
- Engineering – \$400,000

Operational costs will be minimal and will include periodic maintenance.

### Driveways / Access

There is currently an existing access with planned improvements approximately 600 feet north of the intersection on the east side of Madison Pike. A traffic impact analysis should



be conducted to determine the most desirable type of access for this intersection. The visibility of and the driveway to the business located on Holds Branch Road will remain the same.

#### Impacts

The signal alternative would have minor impacts to existing utilities in the area, including water mains and electric. This option should have no impact on the sanitary sewer or gas mains. Most of these impacts occur near the intersection. The tributary to Banklick Creek may require a channel change depending on the direction of widening for Holds Branch Road. A retaining wall is also an option to avoid significant impacts to this tributary. Construction will cause notable delays and congestion, and access to businesses would be impacted.

#### Aesthetics

The signal alternative would result in minimal negative impact on the adjacent area. The additional pavement required for the intersection will reduce existing green space in the adjacent area.

### *ROUNDABOUT ALTERNATIVE*

#### Geometry

The Madison Pike and Holds Branch Road roundabout would be a four-leg roundabout with the eastbound leg containing an approach to the roundabout with no exit from the roundabout to access Pioneer Park. The roundabout would require three lane entries on the northbound, eastbound, and southbound approaches. The westbound leg would require two right turn semi-bypass lanes and one entry lane for left turn movements (Figure 6). The roundabout would have a diameter of 260 feet.

#### Traffic Operations

The roundabout intersection is projected to operate at a LOS C for the AM peak hour with an average delay of 16.8 seconds. The roundabout intersection for the PM peak hour is estimated to operate at LOS B with an average delay of 12.6 seconds (Table 7). Reserve capacity was also analyzed for each alternative. The roundabout alternative would have a reserve capacity of 4 percent (Table 8) during the controlling peak hour (AM). With roundabouts, once volumes get closer to capacity, delays can increase rapidly, leading to poor LOS. For this reason, it is possible to have a very good LOS (such as A or B) with a low reserve capacity. In this situation, relatively small increases in traffic volumes can result in the intersection having an unacceptable LOS.

#### Safety

As a general rule, modern roundabouts are very safe for automobiles, pedestrians, and bicyclists. Modern roundabouts, when designed properly, are significantly safer for automobiles than signalized intersections as the injury crash rate is about half that of signalized options. Although the total crash frequency for this three-lane roundabout could be near what would be seen with a signal, the injury crash frequency would be notably lower.







Roundabouts as a general class have many safety benefits for pedestrians (a reduction in the number of vehicle/pedestrian conflict points, slower vehicle speeds, and a splitter island refuge that separates the directions of traffic and shortens the distance a pedestrian must cross). Studies (mostly involving single and two lane roundabouts) have shown a substantial reduction in both the severity and number of pedestrian crashes when modern roundabouts are installed in place of other intersection controls (Lalani, 1975). However, there is not specific data available which evaluates the safety performance of three lane roundabouts such as the one at this intersection.

It is generally believed that three lane roundabouts are not as pedestrian-friendly as two and single lane roundabouts and may not provide the same degree of benefit as single and two lane roundabouts. However, the situations that require the use of three lane roundabouts (i.e., heavy traffic flows) would typically result in signalized intersections that are not pedestrian friendly either. In the situation at hand, the benefits of a roundabout over a traffic signal may not be substantial. At some roundabouts with heavy traffic flows and significant numbers of pedestrians, pedestrian-actuated signals are installed. Such an option could be investigated here if the roundabout option were advanced for further study. Use of such a signal close to the roundabout would need to be evaluated carefully to assure that traffic operations are not seriously impacted as a result.

Although modern roundabouts may not improve safety for bicyclists, it is generally believed that, if the proper facilities are installed, roundabouts are at least as safe as signalized intersections for bicyclists.

#### Right-of-Way

This alternative would require an additional 1.1 acres of right-of-way with additional land from Pioneer Park (the property used for Pioneer Park is already state-owned right-of-way, and Kenton County holds a lease to use the land). No relocations would be required as a result of the roundabout alternative. No parking will be impacted by the roundabout alternative. Because this is a planning level cost estimate with many details still unknown, a right-of-way cost estimate was not prepared.

#### Cost

Planning level cost estimates are in year 2006 dollars and include construction (with water line relocation) and engineering costs. Utility company facilities that are located within the state right of way are the responsibility of the utility company to relocate and have therefore not been estimated. An additional 15% was included for miscellaneous construction items in order to cover any smaller construction items that have not yet been quantified. Contingency was also added (20%) for material cost fluctuations and unforeseen items. Planning level cost estimates can be found in Appendix E. Planning level costs will total \$4,100,000 for this alternative and are as follows:

- Construction – \$3,400,000
- Engineering – \$700,000

Operational costs will be minimal and will include periodic maintenance.



### Driveways / Access

The existing driveway to the north of the intersection (on the east side) could be treated in the same way as the signalized option (full access). Another option could be to allow  $\frac{3}{4}$  access (i.e., right-in / right-out / left-in) with left-outs handled as u-turns through the median to the north. If this option was selected, the median width would need to be evaluated and could possibly require widening to safely accommodate u-turns. The business located along Holds Branch Road will maintain the same visibility and driveway access on Holds Branch Road.

### Impacts

The roundabout alternative would have significant impacts to existing utilities in the area, including water mains and sanitary sewers. Most of these impacts occur near the intersection. The tributary to Banklick Creek would require a culvert extension and a possible channel change. A retaining wall is also an option to avoid significant impacts to this tributary. Construction will cause notable delays and congestion.

### Aesthetics

The modern roundabout alternative would provide opportunities for aesthetic enhancement. These opportunities would come from the green space in the splitter islands and the central island. Roundabouts are often used as “gateway” improvements for communities. In these instances, the central island of the roundabout can contain a variety of features to contribute to the aesthetic setting.

## **4.1.2 OLD MADISON PIKE**

### SIGNAL ALTERNATIVE

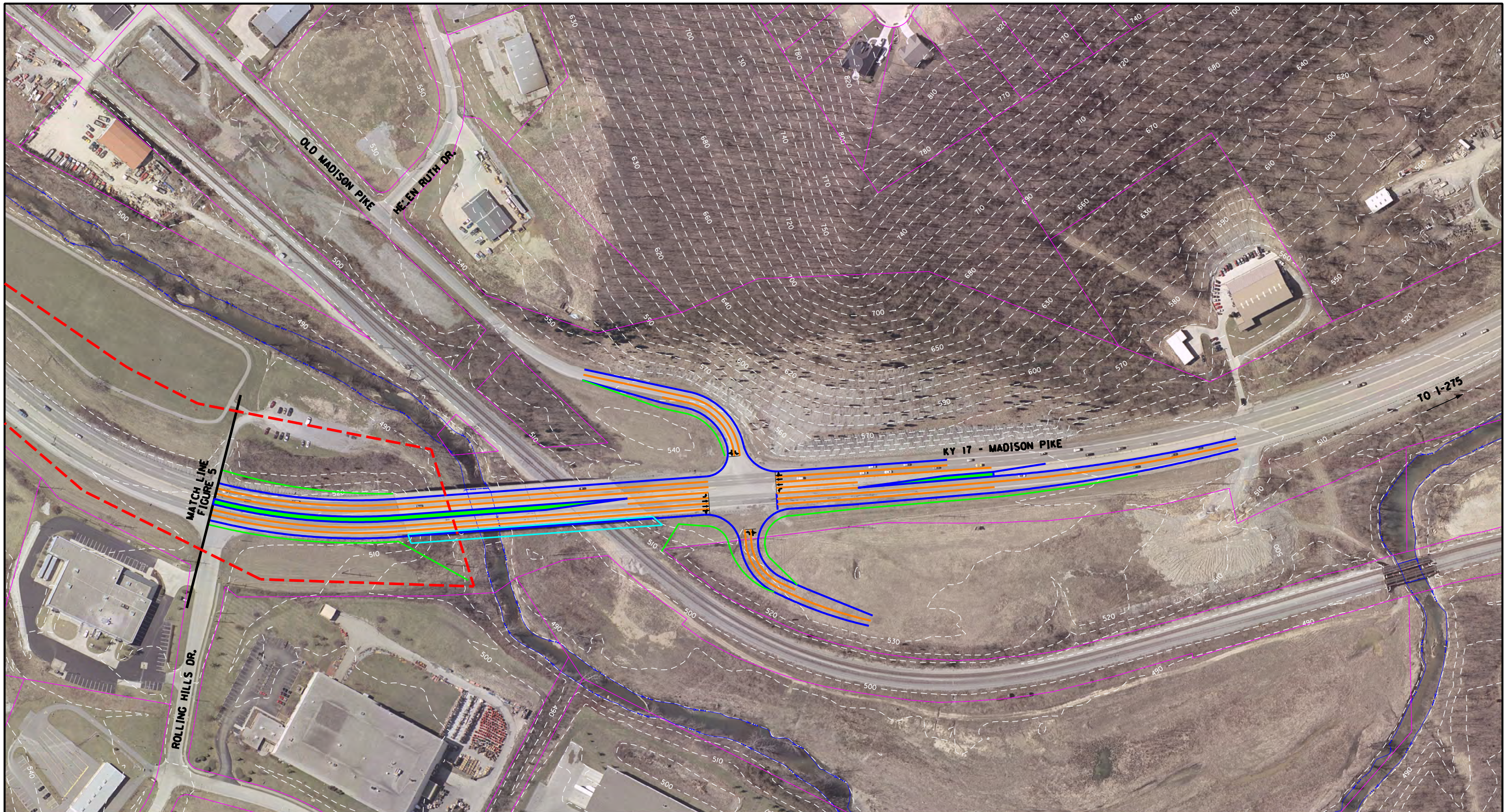
#### Geometry

The proposed intersection improvement utilizing additional lanes with a traffic signal is shown in Figure 7. An additional through-right turn lane was added to the southbound direction, an additional through-right turn lane was added to the northbound, and two lanes were used for the eastbound (Old Madison Pike) and westbound approaches. The westbound approach is a potential new access to the property located east of the intersection in anticipation of future development. The widening for the south leg of the intersection extends to the Holds Branch Road intersection. The lane widening proposed with this configuration will require widening of the bridge located south of the intersection. All evaluations contained within section 4.2.1 are related to this signalized configuration.

#### Traffic Operations

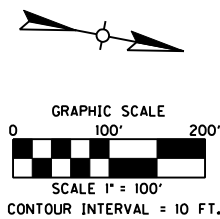
The improved signalized intersection is projected to operate at LOS C in the year 2030 with an average delay of 21.4 seconds in the AM Peak Hour. During the PM peak hour the improved signalized intersection is estimated to operate at LOS C with an average delay of 20.3 seconds (Table 7). The majority of the delay from the AM and PM peaks can be attributed to the eastbound approach (Old Madison Pike), which is estimated to operate at LOS E (66.6 seconds of delay) and LOS E (64.3 seconds of delay) respectively and the westbound approach (future access), which is projected to operate at LOS E (63.0 seconds of delay) and LOS E (65.9 seconds of delay) respectively. The signal was timed to





#### LEGEND

- PROPOSED LANE MARKINGS
- PROPOSED EDGE OF PVMT / CURBING
- PROPOSED EDGE OF DISTURBANCE
- PROPOSED RETAINING WALL
- PROPOSED STRUCTURE
- - - PROPOSED BIKE PATH
- - - EX. CONTOUR
- PROPERTY LINE



### FIGURE 7 – SIGNAL CONCEPT

## KY 17 – MADISON PIKE @ OLD MADISON PIKE





accommodate northbound and southbound traffic. The signal alternative would have a reserve capacity of 17 percent (Table 8) during the controlling peak hour (PM).

#### Safety

This intersection does not currently have a high crash frequency. The installation of modified signal layout at this location with the additional traffic volumes projected would create a similar situation to other signalized intersections within the corridor. Pedestrian and bicycle traffic may be handled in a similar fashion to that discussed for the Holds Branch Road intersection.

#### Right-of-Way

This alternative would require an additional 1.7 acres of right-of-way. The right-of-way required for this alternative would be taken to construct the access to the property located east of the intersection. No relocations would be required as a result of the signal alternative. No parking will be impacted by the signal alternative. Because this is a planning level cost estimate with many details still unknown, a right-of-way cost estimate was not prepared.

#### Cost

Planning level cost estimates are in year 2006 dollars and include construction (with bridge widening and water line relocation), and engineering costs. Utility company facilities that are located within the state right of way are the responsibility of the utility company to relocate and have therefore not been estimated. Planning level cost estimates can be found in Appendix E. An additional 15% was included for miscellaneous construction items in order to cover any smaller construction items that have not yet been quantified. Contingency was also added (20%) for material cost fluctuations and unforeseen items. Planning level costs will total \$5,800,000 for this alternative and are as follows:

- Construction – \$4,800,000
- Engineering – \$1,000,000

Operational costs will be minimal and will include periodic maintenance.

#### Driveways / Access

The signalized alternative would provide access to the property east of the intersection to allow development (currently there is no access). Any new access points between this intersection and Dudley Road could be handled in a variety of ways. The use of  $\frac{3}{4}$  intersections (no left turn out) or right in / right out control could be incorporated. However, these options may require median widening to accommodate U-turns and may affect the efficiency of other intersections.

A full access may also be provided to accommodate left turn out traffic. While this option would decrease the need for median widening, it may also create an increased safety concern for motorists wanting to turn left. A full access, depending on the amount of traffic, may also require a traffic signal during peak times, however, traffic operations of this access may be acceptable during off-peak times without a signal. Access for proposed developments near the Dudley Road intersection could also be accommodated by a frontage road with access to Dudley Road rather than Madison Pike.

Any additional access locations between Old Madison Pike and Dudley Road and what type of access to provide will depend on such factors as proximity to adjacent intersections, traffic volumes, land use, etc. Additional access locations have not been analyzed and would be better addressed as part of a separate corridor study. Current business access and visibility will largely remain the same.

#### Impacts

The signal alternative would have significant impacts to the gas line as well as minor impacts to water and electric facilities. Most of these impacts would occur near the intersection. The bridge to the south of the intersection would also need to be widened to accommodate the additional traffic lanes extending to Holds Branch Road. With the seven required lanes, the bridge would have to be widened by approximately 20 feet and could be widened to one side (east). This widening could be performed by construction of the 20-foot wide section along the entire length of the existing bridge without replacing the existing structure. There are no significant impacts to the hillside located northwest of the intersection with the signal option.

#### Aesthetics

The signal alternative would result in minimal negative impact on the adjacent area. The additional pavement required for the intersection will reduce existing green space in the adjacent area.

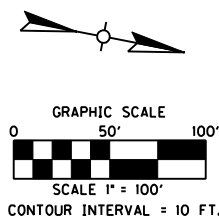
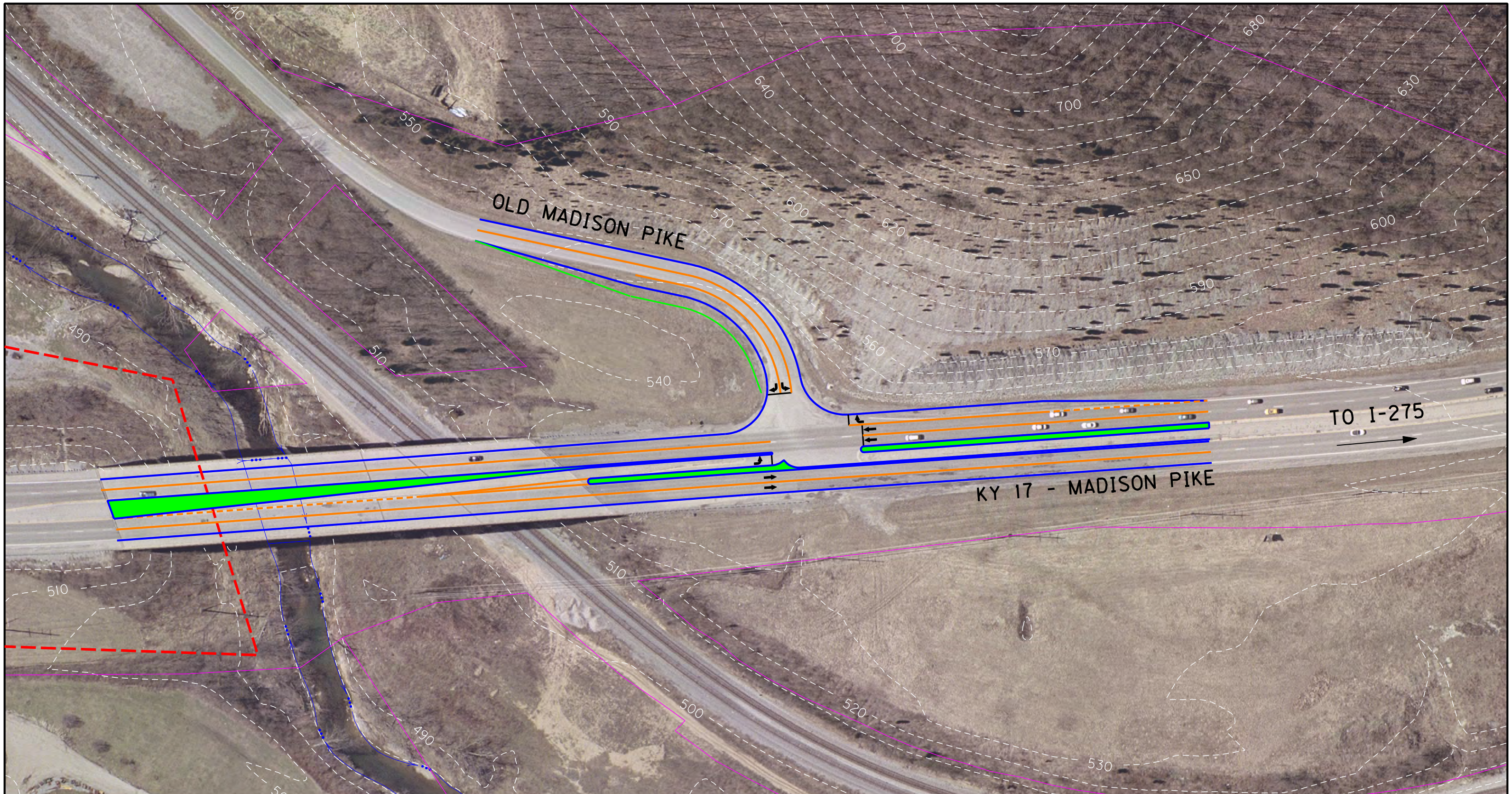
### ALTERNATIVE SIGNAL SCHEME

In the late stages of this study, the project team developed an alternative signal scheme at this location. This scheme would use a bypass concept for the northbound through movement (Figure 8). With the help of the Kentucky Transportation Center at the University of Kentucky (KYC at UK), a preliminary analysis indicated that an acceptable level of service could be obtained with this option. The SYNCHRO analysis provided by the KTC at UK estimated that this alternative would operate at LOS A (6.8 second delay) during the AM peak and LOS B (20.0 second delay) during the PM peak hour for the future year conditions. Additional evaluation will be required before implementing this option, including a signal warrant analysis.

With this alternative, the access to the east property would need to be located north of the intersection as the northbound bypass lanes would prohibit a full access at the intersection. In addition, this lane configuration would not require any modifications to the bridge located south of the intersection or to the hillside to the northeast and could be implemented within the existing pavement section.

A southbound right turn lane may be added to improve the efficiency of this option by reconstructing the existing shoulder while avoiding impact to the hillside. This may require a slight shift or decrease in width of the median. Based on preliminary evaluation, this alternative appears to be a viable concept with an estimated planning level cost of \$250,000 and no additional right of way requirements.





#### LEGEND

- PROPOSED LANE MARKINGS
- PROPOSED EDGE OF PVMT / CURBING
- PROPOSED EDGE OF DISTURBANCE
- PROPOSED RETAINING WALL
- PROPOSED STRUCTURE
- - - PROPOSED BIKE PATH
- - - EX. CONTOUR
- PROPERTY LINE

## FIGURE 8 – SIGNAL CONCEPT WITH NORTH BYPASS LANES

### KY 17 – MADISON PIKE @ OLD MADISON PIKE





## ROUNDAABOUT ALTERNATIVE

### Geometry

This three-leg roundabout would require two entry lanes on the eastbound approach and three entry lanes on the south and northbound approaches (Figure 9). The northbound approach would require two through bypass lanes. The roundabout would have a diameter of 260 feet.

### Traffic Operations

The roundabout intersection is projected to operate at a LOS A for the AM peak hour with an average delay of 2.7 seconds. The roundabout intersection is estimated to operate at LOS B with an average delay of 13.7 seconds during the PM peak hour (Table 7). The roundabout alternative would have a reserve capacity of 6 percent (Table 8) during the PM peak. With roundabouts, once volumes get closer to capacity, delays can increase rapidly, leading to poor LOS. For this reason, it is possible to have a very good LOS (such as A or B) with a low reserve capacity. In this situation, relatively small increases in traffic volumes can result in the intersection having an unacceptable LOS.

### Safety

The impacts on safety with the installation of a roundabout at this location are similar to that discussed above for the Holds Branch Road intersection alternative.

### Right-of-Way

This alternative would require an additional 1.3 acres of right-of-way. No relocations would be required as a result of the roundabout alternative. No parking will be impacted by the roundabout alternative. Because this is a planning level cost estimate with many details still unknown, a right-of-way cost estimate was not prepared.

### Cost

Planning level cost estimates are in year 2006 dollars and include construction (with water line relocation) and engineering costs. Utility company facilities that are located within the state right of way are the responsibility of the utility company to relocate and have therefore not been estimated. An additional 15% was included for miscellaneous construction items in order to cover any smaller construction items that have not yet been quantified. Contingency was also added (20%) for material cost fluctuations and unforeseen items. No bridge widening is required with this alternative. Planning level cost estimates can be found in Appendix E. Planning level costs will total \$5,000,000 for this alternative and are as follows:

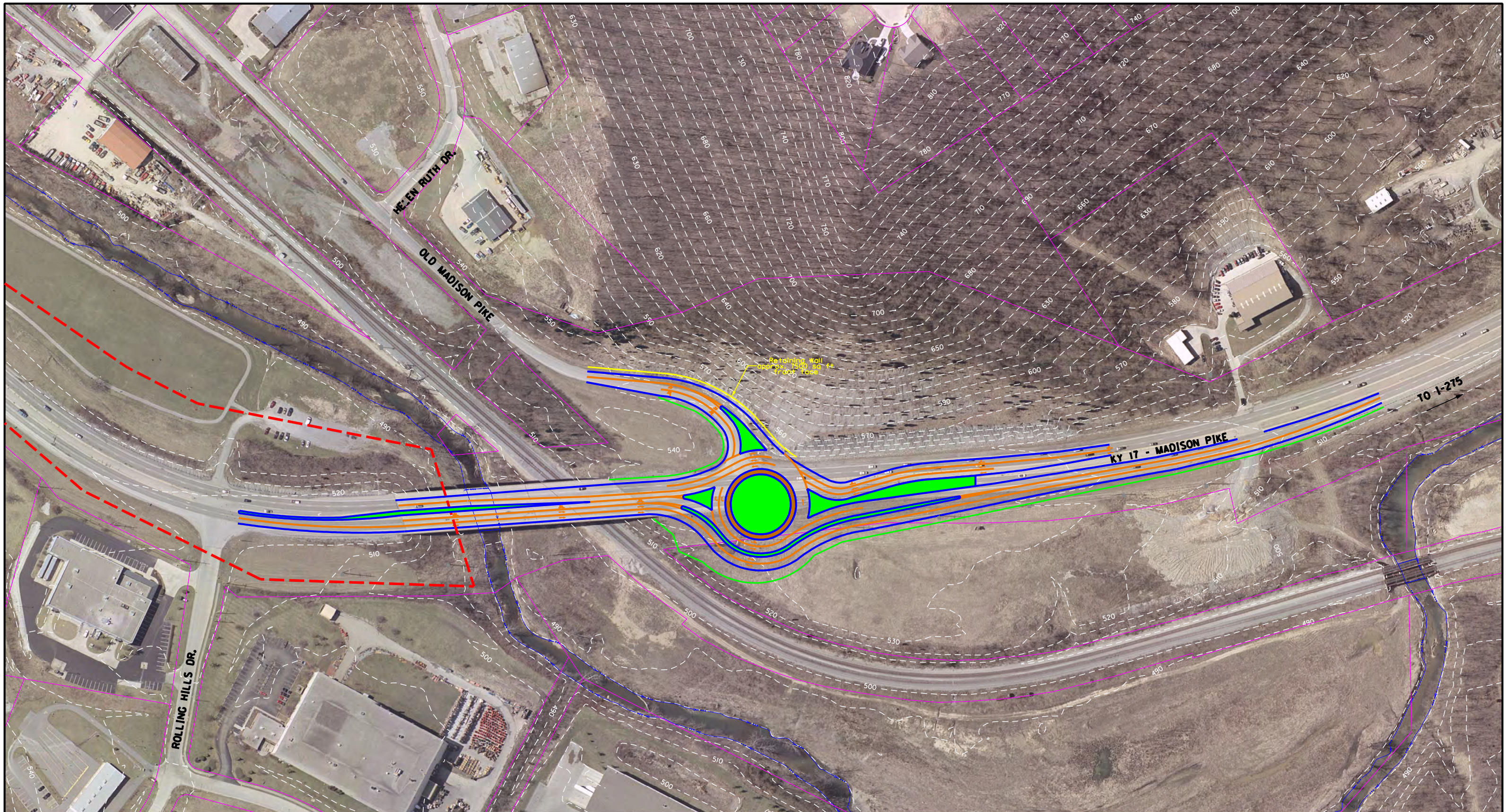
- Construction – \$4,200,000
- Engineering – \$800,000

Operational costs will be minimal and will include periodic maintenance.

### Driveways / Access

The roundabout alternative would not provide access to the property east of the intersection at the roundabout location. Access to this property would be located to the north of the intersection. This location may allow for access to the west of Madison Pike for future development near Dudley Road and may be handled in a similar fashion as mentioned with





# LEGEND

- PROPOSED LANE MARKINGS
- PROPOSED EDGE OF PVMT / CURBING
- PROPOSED EDGE OF DISTURBANCE
- PROPOSED RETAINING WALL
- PROPOSED STRUCTURE
- PROPOSED TRUCK APRON
- PROPOSED BIKE PATH
- EX. CONTOUR
- PROPERTY LINE

## FIGURE 9 – ROUNDABOUT CONCEPT

### KY 17 – MADISON PIKE @ OLD MADISON PIKE





the signal option. However, this would require an additional, more detailed study. Current business access and visibility will largely remain the same.

#### Impacts

The roundabout alternative would significantly impact existing utilities in the area, including water mains, electric facilities, and gas mains. Most of these impacts would occur along the east side of Madison Pike. The intersection will require a retaining wall (approximately 7500 sq ft – front face) to avoid significant excavation of the hillside to the northwest. This option will not require widening of the bridge located south of the intersection. Construction will cause notable delays and congestion.

#### Aesthetics

The modern roundabout alternative would provide opportunities for aesthetic enhancement. These opportunities are similar to those mentioned above for the Madison Pike and Holds Branch Road roundabout alternative.

### **4.1.3 TANK FACILITY / LAKEVIEW DRIVE**

#### *SIGNAL ALTERNATIVE*

##### Geometry

The proposed intersection improvement utilizing additional turn lanes is shown in Figure 10. An additional right turn lane was added to the northbound direction and two lanes were used for the eastbound and westbound (TANK entrance) approaches. An access road was added to the west as there is a desire to develop the properties west of the intersection. The continuous left turn (center) lane was also converted to designated left turn lanes for both the northbound and southbound directions. Widening for this option is minimal and occurs only to the east with the addition of the right turn lane.

The signal alternative includes a new approach from the west side of the intersection. Should the new approach to the intersection not be constructed (3-leg intersection), traffic movements from the west would be eliminated improving traffic operations to a level better than predicted. A signal warrant analysis should be conducted for this intersection. All information contained in this section is related to the 4-leg intersection.

##### Traffic Operations

The improved signalized intersection is projected to operate at LOS C in the year 2030 with an average delay of 30.2 second in the AM Peak Hour. During the PM peak hour the improved signalized intersection is estimated to operate at LOS C with an average delay of 32.8 seconds (Table 7). The majority of the delay from the AM and PM peaks can be attributed to the westbound (TANK entrance) and eastbound (future access) approaches. The westbound approach is estimated to operate at LOS E (58.3 seconds of delay) for the AM peak and LOS D (48.0 seconds of delay) during the PM peak while the eastbound approach is projected to operate at LOS E (60.9 seconds of delay) during the AM peak and LOS D (49.6 seconds of delay) for the PM peak. The signal was timed to accommodate northbound and southbound traffic. The signal alternative would have a reserve capacity of 14 percent (Table 8) during the controlling peak hour (PM).





#### LEGEND

- PROPOSED LANE MARKINGS
- PROPOSED EDGE OF PVT / CURBING
- PROPOSED EDGE OF DISTURBANCE
- PROPOSED RETAINING WALL
- PROPOSED STRUCTURE
- - - PROPOSED ACCESS ROAD
- - - EX. CONTOUR
- PROPERTY LINE

## FIGURE 10 – SIGNAL CONCEPT

### KY 17 – MADISON PIKE @ TANK ENTRANCE



DLZ KENTUCKY, INC.  
201 BRIGHTON PARK BLVD.  
FRANKFORT, KY 40601  
(502) 695-2300 (Fax) 695-1497



### Safety

This intersection does not currently have a high crash frequency. The installation of modified signal layout at this location with the additional traffic volumes projected would create a similar situation to other signalized intersections within the corridor. Pedestrian and bicycle traffic may be handled in a similar fashion to what was discussed at the Holds Branch Road intersection.

### Right-of-Way

This alternative would require an additional 0.1 acres of right-of-way. No relocations would be required as a result of the signal alternative. No parking will be impacted by the signal alternative. Because this is a planning level cost estimate with many details still unknown, a right-of-way cost estimate was not prepared. The right-of-way impact for this option does not account for land required to connect Lakeview Drive and the TANK Facility Entrance. It is expected that this connection will be made when the TANK expansion occurs.

### Cost

Planning level cost estimates are in year 2006 dollars and include construction (with water line relocation) and engineering costs. Utility company facilities that are located within the state right of way are the responsibility of the utility company to relocate and have therefore not been estimated. An additional 15% was included for miscellaneous construction items in order to cover any smaller construction items that have not yet been quantified. Contingency was also added (20%) for material cost fluctuations and unforeseen items. Planning level cost estimates can be found in Appendix E. Planning level costs will total \$1,300,000 for this alternative and are as follows:

- Construction – \$1,100,000
- Engineering – \$200,000

Operational costs will be minimal and will include periodic maintenance.

### Driveways / Access

The project team expressed a desire for an access road located west of the intersection. One possible horizontal location of this road with access to Madison Pike is shown in Figure 10. Business access and visibility will change with the addition of the road to the west. If the road does not provide access directly to Madison Pike (west leg of intersection), then access and visibility will remain the same. Also, the TANK Facility Entrance may be enhanced with the improvements in combining the entrance with Brooks Drive. All driveways currently within the project area would be reasonably accommodated.

### Impacts

The signal alternative would have minimal to no impacts to existing utilities in the area. Any impacts would occur near the intersection. Allowing adequate distance for an eastbound leg would require that the future access road for the properties to the west be shifted into the hillside. This will create significant impacts due to the construction of the access road.



### Aesthetics

The signal alternative would result in minimal negative impact on the adjacent area. The additional pavement required for the intersection will reduce existing green space in the adjacent area.

## ROUNDABOUT ALTERNATIVE

### Geometry

The Madison Pike and TANK intersection would be constructed as a three-leg roundabout with the possibility of constructing a fourth leg (west) for future development. The roundabout would consist of two lanes on the eastbound and westbound approaches and three entry lanes on the southbound and northbound approaches. Lakeview Drive would be converted into a cul-de-sac, and traffic would be rerouted to Electric Drive, as shown on Figure 11. The roundabout would have a diameter of 250 feet.

The evaluation below includes the impacts of creating a new approach from the west side of the intersection (4-leg intersection). Removal of the west leg would offer some very minor traffic operational benefits (i.e., avg overall delays would go down by 1-2 seconds), but that is inconsequential since it would still be LOS A and we would not be able to reduce the ICD (3 lanes would still be needed NB and SB). The main benefit would be cost since we could avoid the rock cuts, retaining wall, and road construction for that leg. As far as access, there could be a direct drive onto 17 and/or they could use the two adjacent intersections (Highland and Kyle's) if connections were made. Either way, the volumes are low enough that access concerns are probably not substantial.

### Traffic Operations

The roundabout intersection is projected to operate at a LOS A for the AM peak hour with an average delay of 5.2 seconds. The roundabout intersection for the PM peak hour is estimated to operate at LOS A with an average delay of 5.8 seconds (Table 7). The roundabout alternative would have a reserve capacity of 23 percent (Table 8) for both the AM and PM peak. With roundabouts, once volumes get closer to capacity, delays can increase rapidly, leading to poor LOS. For this reason, it is possible to have a very good LOS (such as A or B) with a low reserve capacity. As volumes approach the capacity of the roundabout, relatively small increases in traffic volumes can result in the intersection having an unacceptable LOS.

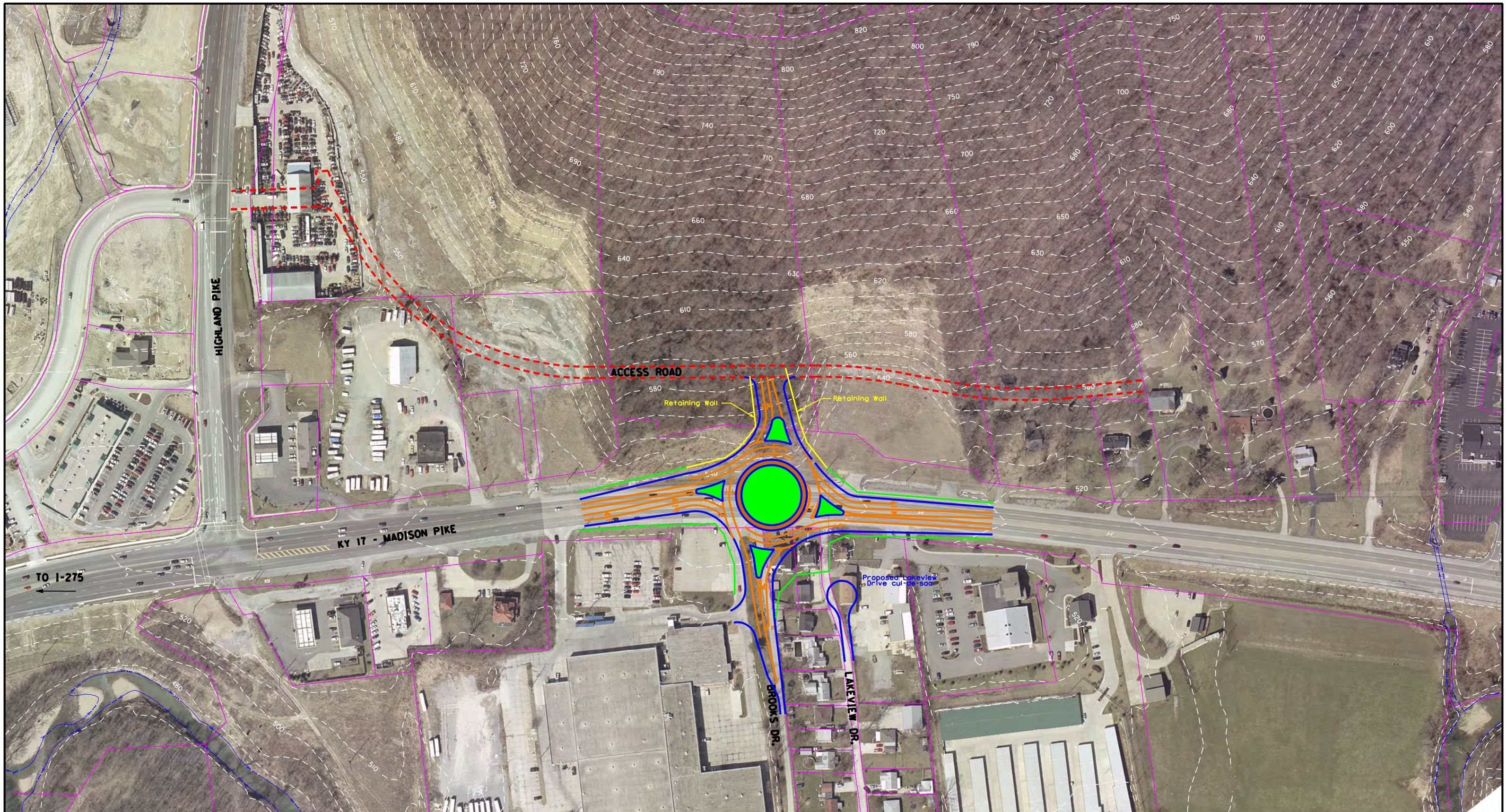
### Safety

The impacts on safety with the installation of a roundabout at this location are similar to that discussed for the Holds Branch Road intersection alternative.

### Right-of-Way

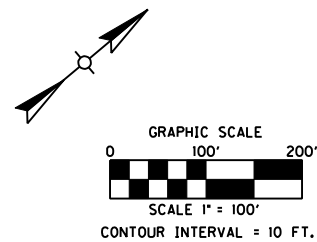
This alternative would require an additional 1.6 acres of right-of-way. Five relocations (7 buildings) would be required as a result of the roundabout alternative. Two properties situated between Brooks Dr. and Lakeview Dr along Madison Pike, one property at the corner of Lakeview Dr. and Madison Pike (north), and two properties at the end of Brooks Dr. and between Brooks Dr. and Lakeview Dr. will be total takes to accommodate the connection of Lakeview Dr. to Brooks Dr. along with the roundabout and cul-de-sac. No





# LEGEND

- PROPOSED LANE MARKINGS
- PROPOSED EDGE OF PAVT / CURBING
- PROPOSED EDGE OF DISTURBANCE
- PROPOSED RETAINING WALL
- PROPOSED STRUCTURE
- PROPOSED TRUCK APRON
- - - PROPOSED ACCESS ROAD
- EX. CONTOUR
- PROPERTY LINE



## FIGURE 11 – ROUNDABOUT CONCEPT

### KY 17 – MADISON PIKE @ TANK ENTRANCE





parking will be impacted by the roundabout alternative. Because this is a planning level cost estimate with many details still unknown, a right-of-way cost estimate was not prepared.

### Cost

Planning level cost estimates are in year 2006 dollars and include construction (with water line relocation) and engineering costs. Utility company facilities that are located within the state right of way are the responsibility of the utility company to relocate and have therefore not been estimated. An additional 15% was included for miscellaneous construction items in order to cover any smaller construction items that have not yet been quantified. Contingency was also added (20%) for material cost fluctuations and unforeseen items. Planning level cost estimates can be found in Appendix E. Planning level costs will total \$4,800,000 for this alternative and are as follows:

- Construction – \$4,000,000
- Engineering – \$800,000

Operational costs will be minimal and will include periodic maintenance.

### Driveways / Access

One possible horizontal location of the access road to the west as it relates to a roundabout is shown in Figure 10. This location assumes access to Madison Pike. Business access and visibility will change with the addition of the road to the west. If the road does not provide access directly to Madison Pike (west leg of intersection), then access and visibility will remain the same. Also, the TANK Facility Entrance may be enhanced with the improvements in combining the entrance with Brooks Drive. All driveways currently within the project area will be reasonably accommodated.

### Impacts

The roundabout alternative would have significant impacts to water mains and gas mains with minor impacts to electric facilities in the area. Most of these impacts would occur along the west side of Madison Pike. Allowing adequate distance for an eastbound leg would require that the future access road for the properties to the west be shifted into the hillside. This will create significant impacts due to the construction of the access road. Construction will cause notable delays and congestion, and access to businesses would be impacted.

### Aesthetics

The modern roundabout alternative would provide opportunities for aesthetic enhancement. These opportunities are similar to those mentioned above for the Madison Pike and Holds Branch Road roundabout alternative.



**Table 9 Practical Alternatives Matrix –Kentucky 17 Alternatives.**

Evaluation Criteria	Comments	KY-17 & Holds Branch Road		KY-17 & Old KY-17		KY-17 & TANK Entrance	
		Roundabout	Signalized Intersection	Roundabout	Signalized Intersection*	Roundabout	Signalized Intersection
<b>Future Traffic Operations</b>	Total delay (Entering volume x Average delay for each intersection) AM and PM peak hours	24 hours AM 20 hours PM	41 hours AM 48 hours PM	4 hour AM 22 hours PM	33 hours AM 33 hours PM	5 hours AM 7 hours PM	32 hours AM 39 hours PM
	Intersection Level of Service (with average delay in seconds)	AM = C (16.8) PM = B (12.6)	AM = C (28.6) PM = C (30.1)	AM = A (2.7) PM = B (13.7)	AM = C (21.4) PM = C (20.3)	AM = A (5.2) PM = A (5.8)	AM = C (30.2) PM = C (32.8)
	Number of approaches operating at LOS E or worse for AM peak hour	1 out of 4	1 out of 4	0 out of 3	2 out of 4	0 out of 4	2 out of 4
	Number of approaches operating at LOS E or worse for PM peak hour	1 out of 4	2 out of 4	0 out of 3	2 out of 4	0 out of 4	0 out of 4
<b>Safety Improvements</b>	Based on existing crash data, crash prediction model and recent U.S. studies.	Significantly safer than signal. Injury crash rate will be about half as high as signal.	Significantly higher injury crash rate than roundabout. Injury crash rate will be about twice as high as roundabout. PDO crashes similar to roundabout.	Significantly safer than signal. Injury crash rate will be about half as high as signal.	Significantly higher injury crash rate than roundabout. Injury crash rate will be about twice as high as roundabout. PDO crashes similar to roundabout.	Significantly safer than signal. Injury crash rate will be about half as high as signal.	Significantly higher injury crash rate than roundabout. Injury crash rate will be about twice as high as roundabout. PDO crashes similar to roundabout.
<b>Right-of-Way Impacts</b>	Approximate acres of new right-of-way required for each alternative as well as number of business and residential relocations for each alternative.	1.1 acres 0 relocations	0.6 acres 0 relocations	1.3 acres 0 relocations	1.7 acres 0 relocations	1.6 acres 5 relocations	0.1 acres 0 relocations
<b>Cost (2006 dollars)</b>	Cost includes Construction and Engineering (design & construction)	TOTAL COST - \$4,100,000 Construction - \$3,400,000 Engineering - \$700,000	TOTAL COST - \$2,500,000 Construction - \$2,100,000 Engineering - \$400,000	TOTAL COST - \$5,000,000 Construction - \$4,200,000 Engineering - \$800,000	TOTAL COST - \$5,800,000 Construction - \$4,800,000 Engineering - \$1,000,000	TOTAL COST - \$4,800,000 Construction - \$4,000,000 Engineering - \$800,000	TOTAL COST - \$1,300,000 Construction - \$1,100,000 Engineering - \$200,000
<b>Reserve Capacity</b>	Amount (%) that 2030 peak hour auto traffic could increase before the intersection would reach LOS E. Assumes a proportional increase of all entering volumes simultaneously.	4% (AM).	15% (PM)	6% (PM)	17% (PM)	23% (AM & PM)	14% (PM)
<b>Accommodation of Driveway Access</b>	Rating of how well the alternative will accommodate existing driveway access. Factors considered include ability to make left turn outs, queue blockage, additional traffic volumes placed along driveway, and driveway relocations.	All driveways reasonably accommodated.	All driveways reasonably accommodated but left turn conflicts will increase as volumes increase.	All driveways reasonably accommodated.	All driveways reasonably accommodated but left turn conflicts will increase as volumes increase.	All driveways reasonably accommodated.	All driveways reasonably accommodated but left turn conflicts will increase as volumes increase.
<b>Truck Access</b>	Factors considered include distance trucks must travel to utilize turnarounds and access to individual businesses.	Slightly better than the signalized alternative since conflicts are less because trucks can use the roundabouts for U-turns to access businesses.	Trucks would have direct access.	Slightly better than the signalized alternative since conflicts are less because trucks can use the roundabouts for U-turns to access businesses. .	Trucks would have direct access.	Slightly better than the signalized alternative since conflicts are less because trucks can use the roundabouts for U-turns to access businesses. .	Trucks would have direct access.



Evaluation Criteria	Comments	KY-17 & Holds Branch Road		KY-17 & Old KY-17		KY-17 & TANK Entrance	
		Roundabout	Signalized Intersection	Roundabout	Signalized Intersection*	Roundabout	Signalized Intersection
<b>Bicyclists and Pedestrians</b>	Rating of the mobility, safety, and impacts on bicyclists and pedestrians of the proposed intersections.	Pedestrians safely accommodated; Bikes safely accommodated as long as they do not use the circulating roadway; Minor concerns related to visually impaired pedestrians.	Pedestrians and bicyclists safely accommodated	Pedestrians safely accommodated; Bikes safely accommodated as long as they do not use the circulating roadway; Minor concerns related to visually impaired pedestrians.	Pedestrians and bicyclists safely accommodated	Pedestrians safely accommodated; Bikes safely accommodated as long as they do not use the circulating roadway; Minor concerns related to visually impaired pedestrians.	Pedestrians and bicyclists safely accommodated
<b>Construction Effects on Traffic</b>	Factors considered include the comparative duration of construction, likely lane closures, and major access restrictions.	Moderate to Major	Moderate to Major	Moderate to Major	Moderate to Major	Moderate to Major	Moderate to Major
<b>Driver Familiarity</b>	Locations where drivers' expectations may not be met	Drivers may be unfamiliar with roundabouts causing some apprehension. Other locations in the U.S. have seen drivers adapt quickly.	Driver expectations met at all locations.	Drivers may be unfamiliar with roundabouts causing some apprehension. Other locations in the U.S. have seen drivers adapt quickly.	Driver expectations met at all locations.	Drivers may be unfamiliar with roundabouts causing some apprehension. Other locations in the U.S. have seen drivers adapt quickly.	Driver expectations met at all locations.
<b>Parking Impacts</b>	Approximate number of parking spaces impacted by the alternative (number and location).	No parking will be impacted.	No parking will be impacted.	No parking will be impacted.	No parking will be impacted.	No parking will be impacted.	No parking will be impacted.
<b>Aesthetics</b>	Factors considered include consistency with community aesthetic goals and the aesthetic opportunities provided by each alternative.	Several opportunities for additional landscaping on central islands and splitter islands.	Minor scenic impacts will result. Limited opportunities for aesthetic enhancements in remaining ROW and an increase in the amount of paved surface.	Several opportunities for additional landscaping on central islands and splitter islands.	Minor scenic impacts will result. Limited opportunities for aesthetic enhancements in remaining ROW and an increase in the amount of paved surface.	Several opportunities for additional landscaping on central islands and splitter islands.	Minor scenic impacts will result. Limited opportunities for aesthetic enhancements in remaining ROW and an increase in the amount of paved surface.
<b>Impacts to Utilities</b>	Type of utility and extent of impact.	Sanitary, Water – significant impact	Water, Electric – minor impacts	Gas, Electric, Water – significant impact	Gas – significant impact Water, Electric – minor impact	Gas, Water – significant impact Electric – minor impact	Minimal to no impacts
<b>Structural Impacts (Culvert / Bridge)</b>	Approximate new culvert length needed for each alternative.	50' culvert extension with 120' channel change along Tributary. Retaining Wall (4000 sq ft) required to avoid impact to Banklick Creek.	Minimal to no impacts	No impacts to bridge or stream.	Bridge widening (20') required. Approximately 11,000 sq ft of top deck.	N/A	N/A
<b>Impacts to Hillside</b>	Degree of impact to surrounding topography (steep hillsides adjacent to Madison Pike)	N/A	N/A	Retaining Wall (7500 sq ft) required to minimize impacts to hillside.	The hillside will not be impacted	Addition of Access Road will create significant impacts to the hillside. Approximate 40' cut.	Addition of Access Road will create significant impacts to the hillside. Approximate 35' cut.
<b>Operational Cost</b>	Cost of ongoing operations including electricity (lighting), signal adjustment, bulbs/other equipment, mowing, pavement markings, etc.	Low	Low-Moderate	Low	Low-Moderate	Low	Low-Moderate

\* Refer to section 4.1.2 for more information regarding a variation on the signal option.



## SECTION 5 – RECOMMENDATIONS

### 5.0 INTRODUCTION

The following technical recommendations are based on the factors and criteria discussed earlier in this report and include consideration of traffic operations, cost, ROW impacts, safety, and other factors. The Practical Alternatives matrix shown previously in Table 9 was used in preparing the recommendations.

### 5.1 GENERAL RECOMMENDATIONS

During the course of this study, it became evident to members of the study team that the three intersections which were the focus of this study are inextricably linked to the overall Madison Pike corridor from Holds Branch Road on the south to Kyle's Lane on the north. As a result, the project team expressed a clear and unanimous desire to evaluate the operation and interaction of all intersections and major access points in the corridor. Therefore, it is recommended that these issues be addressed through joint study, planning, and site plan reviews among local authorities and KYTC. An overall corridor study is recommended to identify specific road improvements and access management measures for the entire corridor, taking into account relevant interaction and connectivity. It is important that all of the intersection-specific recommendations provided in sections 5.2, 5.3, and 5.4 be revisited as part of the corridor study to assure that they make sense in the context of the overall solution that is ultimately selected.

Recommendations that could be implemented prior to the overall corridor study are included for each of the three study intersections. It is recommended that decisions be made soon regarding measures to be implemented at each intersection and that these be added to OKI's unscheduled project list so that funding can be sought.

*Decisions need to be made soon..... so that funding can be sought.*

The topic of access management is very important in the Madison Pike Corridor. This study only evaluated access points directly influencing or affected by the three study intersections. The use of  $\frac{3}{4}$  intersections (no left turn out) or right in / right out control could be utilized at most or all of these access points. However, these options may require median widening to accommodate U-turns and may affect the efficiency of other intersections. Access for proposed developments may also be accommodated using a frontage road with limited access locations to Madison Pike. In addition, common access management procedures such as combined drives, joint driveway permit reviews, etc. are recommended.

### 5.2 HOLDS BRANCH ROAD / PIONEER PARK

The existing intersection performs marginally with LOS D in the AM peak hour for 2006 traffic conditions. The future traffic conditions in 2030 are predicted to be LOS F for AM and PM peak hour conditions.



Traffic operations for both alternatives would be similar. However, the estimated cost and right of way for the signal alternative provides a more realistic long term solution. In the short term, local authorities (planning and zoning) and KYTC should add turn lanes to accommodate the additional traffic volumes if funds are not available for the recommended intersection improvement. It is possible that developers fund these improvements as part of their site plan approvals. In the short term, two turn lanes could be added: 1) westbound right turn lane on Holds Branch Road and 2) an additional left turn lane along southbound Madison Pike into Holds Branch Road. The additional left turn lane may be constructed within existing right of way, however, this lane should not be added until absolutely necessary because a protected left turn phase would be required, and this would affect off-peak delays.

***Developers fund improvements as part of site plan approvals***

### 5.3 OLD MADISON PIKE

The Madison Pike and Old Madison Pike intersection has an unacceptable LOS F for AM and PM traffic operations for 2006 and 2030. The signal alternative with additional lanes and the roundabout alternative both provide for acceptable traffic operations, however, both appear to be non-cost effective requiring significant impacts to the bridge and the hillside respectively.

The recommended alternative is the altered signal scheme that utilizes two northbound bypass lanes on Madison Pike (Figure 8). Traffic operations for this alternative perform at an acceptable level of service for future traffic volumes at this intersection. This alternative will cost an estimated \$250,000 without any impact to the bridge located south or to the hillside located northwest of the intersection. This recommendation will require that any access to the east property be located north of the intersection.

Any new access points between this intersection and Dudley Road could be handled in a variety of ways. The use of  $\frac{3}{4}$  intersections (no left turn out) or right in / right out control could be incorporated. However, these options may require median widening to accommodate U-turns and may affect the efficiency of other intersections. A full access may also be provided to accommodate left turn out traffic. While this option would decrease the need for median widening, it may also create an increased safety concern for motorists wanting to turn left. A full access, depending on the amount of traffic, may also require a traffic signal during peak times. Access for proposed developments near the Dudley Road intersection could also be accommodated by a frontage road with access to Dudley Road rather than Madison Pike. A recommendation for additional access type and location between Old Madison Pike and Dudley Road has not been provided. Off-peak traffic operations of any access (including full access) may be acceptable without a signal depending on such factors as proximity to adjacent intersections, traffic volumes, land use, and site specific factors (based on developer intentions) that are not known at this time.



## 5.4 TANK FACILITY / LAKEVIEW DRIVE

The TANK facility is currently operating at a LOS D in the AM peak and LOS E in the PM peak for 2006 traffic conditions. The No Build scenario (with installation of a traffic signal) estimates that the intersection will operate at LOS D in the AM peak and LOS E in the PM peak in the year 2030. Through project team discussions, this would be an acceptable level of service and therefore, is the recommended alternate. The No Build alternative involves installing a traffic signal with no lane widening for through or turn movements. The existing continuous left turn lane should be striped for a designated left turn lane on either side of the intersection. A Traffic Signal Warrant Analysis will need to be performed prior to the installation of a traffic signal to determine whether the intersection meets KYTC criteria for a traffic signal. We recommend creating a cul-de-sac on Lakeview Drive and improving Brooks Drive and the TANK Facility Entrance, creating one access point to Madison Pike. The connection of Lakeview Drive to the TANK Facility Entrance could occur in conjunction with TANK Facility Expansion plans.

*Installing a traffic signal with no lane widening...*

Access management will be important as the properties north of the intersection redevelop. New access for developments in this location may be handled with the use of a frontage or rear access road that connects to the TANK facility entrance. Full access points directly onto Madison Pike should be limited, however, they may be created as right in / right out access or shared access with other developments in the area. Right in / right out control will require U-turn locations at nearby intersections requiring a wider median and may lower the traffic operations at these intersections.

## 5.5 OTHER RECOMMENDATIONS

The *Madison Pike Corridor Land Use and Economic Development Plan* recommended further evaluation of a non-traversable median along the corridor. This was considered for both the signal and roundabout options. The use of non-traversable medians throughout the corridor is likely to improve or at least maintain existing operational efficiency. The non-traversable median would require right in – right out access at driveways where the non-traversable median is present. Median cuts may be incorporated at designated locations to allow left turn movements and U-turns. The location of these openings will depend on the density of businesses as well as maintaining adequate storage for anticipated queue lengths. U-turns for larger vehicles will require a wider median in order for the vehicle to complete the u-turn movement. The specifics of this median should be identified as part of the overall corridor study since this measure has implications beyond the three intersections included in the current study.

Indirect or “Michigan” left turns are another option for access management and can also provide a significant increase in intersection capacity. This type of facility typically requires the use of a median 50 to 80 feet wide in order to facilitate left and u-turns, especially if trucks are involved. This treatment is not desirable at the three study intersections due to constraints such as Banklick Creek, adjacent development, the railroad, and steep hillsides adjacent to Madison Pike. All of these conflicts would result in substantial cost increases.



Based on DLZ's recommendations, the project team decided not to evaluate this option as part of this study. However, if a larger corridor study is eventually conducted, this option should be considered since it could be cost effective relative to other corridor-level solutions.



## SECTION 6 – REFERENCES

American Association of State Highway and Transportation Officials, “A Policy of Geometric Design of Highways and Streets,” Washington D.C., 2004.

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Lalani, N., “The impact on accidents of the introduction of mini, small, and large roundabouts at major/minor priority junctions,” Traffic Engineering and Control, London, United Kingdom, 1975.