

# Value Engineering Study Final Report

**East Lebanon Connectivity**  
Kentucky Transportation Cabinet (KYTC)

Value Engineering Study  
Item #04-80153.00 VE202202

*Marion County, Kentucky*

**February 28 - March 4, 2022**

Prepared by:



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## Disclaimer

The information contained in this report is based on the professional opinions of the Value Engineering (VE) team members as developed during the study. These opinions are based on the information that was provided to the team at the time of the study. As the project continues to develop, recommendations and findings should be reevaluated as new information is received.

All costs displayed in the report are based on best available information at the time of the study and, unless otherwise noted, used the estimate as provided to the VE team. All drawings, graphics, maps, photos, etc., used in the report were supplied by the study sponsor or developed during the study.

The disposition of recommendations is based on the information in this report; it is independent of the resolutions generated after the study. HDR has no participation, direct or indirect, in such decisions.

For any recommendations that are accepted by the owner and design team as a result of this VE study, the responsibility for implementation into the design rests with the designer of record.

Study Statistics	Alternate		Option					
	1	2	A	A-1	B	C	D	E
Baseline Capital Cost:	<b>\$6.0</b>	<b>\$4.7</b>	<b>\$28</b>	<b>\$6.7</b>	<b>\$8.9</b>	<b>\$5.9</b>	<b>\$4.9</b>	<b>\$30.5</b>
Number of Recommendations	<b>8</b>	<b>8</b>	<b>4</b>	<b>4</b>	<b>4</b>	<b>4</b>	<b>4</b>	<b>4</b>
New Alternative / Option	<b>2A</b>		<b>F</b>					
Recommended Alternative	<b>Capital Cost</b>							
Short term: 2a	<b>\$8,200,124</b>							
Long Term 1	<b>\$11,350,956</b>							
Number of Team Members: 10								
KYTC Employees: 3								
Others: 7								
Facilitator Consultant: HDR								

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# Executive Summary

## Introduction

This report summarizes the events and results of the virtual Value Engineering (VE) study conducted by HDR Engineering, Inc. for the Kentucky Transportation Cabinet (KYTC) on the East Lebanon Connectivity project in Marion County, Kentucky. The VE study consisted of a 5-day workshop that was conducted virtually with a multidisciplinary team on February 28 - March 4, 2022 using Microsoft Teams.

## Project Overview

KYTC, in cooperation with the Federal Highway Administration (FHWA), is conducting a scoping study to improve highway connectivity around the east side of Lebanon, Kentucky in Marion County. The purpose of the East Lebanon Connectivity Study is to identify short and long-term solutions to address congestion, unreliable travel times, and safety concerns.

The City of Lebanon is home to two robust industrial parks and a host of premier attractions. With only a few narrow highways providing connections east of the city, most trips are forced into town and onto the busy US 68 (Main Street) corridor to connect. Several major freight generators are within the study area and KY 55 to US 68 is a Federal Designated Truck Route.

The proposed project typical section will consist of 11-ft lanes with a 12-ft two-lane-left-turn-lane (TWLTL) on US 68. For additional information regarding the current alignments and concepts, please see Section 2.3, Proposed Improvements.

At the time of the VE study, the total cost of the project for each Alignment and Concept was done on a parametric approach with a high degree of uncertainty and is shown in Table 1 below.

<b>Alignment or Concept</b>	<b>Construction Cost (\$M)</b>
Alternative 1	\$6.0
Alternative 2	\$4.8
Concept A	\$24.2
Concept A-1	\$8.1
Concept B	\$10.1
Concept C	\$13.2
Concept D	\$10.5
Concept E	\$25.9

## Scope of VE Study

The primary objectives of the study, through execution of the Value Methodology Job Plan (Appendix A), were to:

- Verify or improve on the various design concepts for the identified section of the East Lebanon Connectivity project.
- Conduct a thorough review and analysis of the key project functions using an independent, multidiscipline, cross-functional team.
- Make recommendations that could improve the value of the project through innovative measures aimed at improving the performance while reducing costs of the project.

## VE Recommendations and Study Results

The VE team generated 64 ideas for the project, which after an initial evaluation, 24 moved forward to development. After combining them and further evaluation they resulted in ten recommendations. Considering that there were nine different alignments, the recommended concepts could be applied in different ways, making a comparison against them as baseline impractical.

<b>#</b>	<b>Recommendation Title</b>	<b>Total Cost (\$M)</b>
1	Add traffic calming features along Main Street	\$0.6
2	Improve pedestrian accommodations	\$0.1
3	Create alternative southern bypass concept	\$15.7
4	Create vital local connections in southern Lebanon	\$13.0
5	Change the Federal Designated Truck Route to KY 2154	\$0.0
6	Convert KY 2154 to US 68 and US 68 to US 68 Business	\$2.2
7	Use a roundabout at Barber Mills Road	\$0.5
8	Create alternative northeast alignment along Corporate Drive	\$3.6
9	Use roundabouts along KY 55/N Spalding Avenue	\$1.8
10	Use roundabouts along N Spalding Avenue near downtown	\$1.0

The individual recommendations are summarized below; the detailed information about each recommendation is included in Section 7.3.

**1—Add traffic calming features along Main Street** – the purpose of this recommendation is to reduce congestion and improve travel times by discouraging truck traffic through downtown. It also enhances safety and improves pedestrian access while reducing conflicts through downtown.

**2—Improve pedestrian accommodations** – There is a need to accommodate pedestrians throughout the corridor under study, this recommendation addresses pedestrian access gaps

**3—Create an alternative southern bypass concept** – The VE team recommends the analysis of a new alternative alignment (Concept F) through the southern section of the City of Lebanon, using portions of concepts A and D, and connected diagonally from KY 49 and Fairgrounds Road.

**4—Create vital local connections in southern Lebanon**– Creating vital connections to collect traffic from the southern neighborhoods of the City will likely carry higher volumes of traffic than further out bypass options and accomplish the purpose of the project by relieving congestion from Main Street.

**5—Change the Federal Designated Truck Route to KY 2154**– The northwestern quadrant of a bypass was constructed in the past few years and the truck route still shows the Federal Designated Truck route through downtown. The purpose of this recommendation is to reroute trucks away from downtown Lebanon.

**6—Convert KY 2154 to US 68 and current US 68 (Main Street) into US 68 Bus**– The change in the western section of the project alignment and configuration will encourage trucks and bypassing traffic away from downtown and relieve congestion.

**7—Use a roundabout at Barber Mills Road**– A roundabout in this location will calm traffic approaching the City, reduce angle of conflicts at the intersection, and improve traffic operations in the area, where a number of accidents were recorded.

**8—Create alternative northeast alignment along Corporate Drive**– The VE team recommends adopting an alternative alignment by improving existing infrastructure along KY 55 and Corporate Drive.

**9—Use roundabouts along KY 55 / N Spalding Avenue at Veterans Memorial Parkway (KY 2154) and at Corporate Drive**– These intersections can operate better with roundabouts than signalized or unsignalized intersections, reducing conflicts and their severity, and by calming traffic coming along KY 55 and KY 2154.

**10—Use roundabouts along N Spalding Avenue near downtown**– Two intersections along N Spalding Avenue offer opportunities to improve operations by reducing conflicts and calming traffic approaching downtown from the north.

This Planning Level VE Study was conducted to evaluate the alternatives presented to the team, to improve on those concepts and to create new alternatives. To evaluate these concepts, the VE team used performance attributes to qualify and quantify their merits. Each alternative was scored using a rating scale shown in Table 13. Each of these scores were adjusted with the weighing factors obtained from the Performance Attribute Matrix found in Table 8, to obtain a Weighted Performance Comparison Matrix as shown in Table 14.

As each of the alternatives were evaluated and improved with additional recommendations, the VE team sought to find a combination of improvements that best

met the purpose and need of the project. The VE team’s view was to implement solutions in the short- and long-term basis, to create a northern bypass and make improvements to Main Street, which led to the creation of VE Proposal #1.

The team also considered the possibility of a southern bypass route. Although not recommended, the VE team created a summary analysis write-up with the rationale for an alignment of a southern bypass if that is the direction the project proceeds.

**VE Proposal No. 1** (Section 7.5) offers two options: short term and long-term solutions. The short-term approach combines recommendations 1, 2, 5, 6, 9 and 10, and uses an alignment along Corporate Drive (recommendation #8). The long-term approach uses the project team’s Alternative 1 (new alignment in the northwest quadrant) in combination with recommendations 1, 2, 5, 6, 7, 9 and 10. A summary of these options costs is below:

<b>Table 3. Short-Term Approach Costs</b>				
<b>#</b>	<b>Recommendation Title</b>	<b>DES/CNS</b>	<b>ROW</b>	<b>Total</b>
1	Add traffic calming features along Main Street	\$637,727		\$637,727
2	Improve pedestrian accommodations	\$101,992		\$101,992
5	Change the Federal Designated Truck Route to KY 2154			
6	Convert KY 2154 to US 68 and US 68 to US 68 Business	\$1,705,300	\$448,000	\$2,153,300
8	Create alternative northeast alignment along Corporate Drive	\$2,527,200		\$2,527,200
9	Use roundabouts along KY 55/N Spalding Avenue	\$1,759,741	\$25,500	\$1,785,241
10	Use roundabouts along N Spalding Avenue near downtown	\$989,564	\$5,100	\$994,664
			<b>Total</b>	<b>\$8,200,124</b>

<b>Table 4. Long-Term Approach Costs</b>				
<b>#</b>	<b>Recommendation Title</b>	<b>DES/CNS</b>	<b>ROW</b>	<b>Total</b>
Alt 1	Implement Alternative 1	\$4,669,000	\$1,090,909	\$6,031,909
1	Add traffic calming features along Main Street	\$637,727		\$637,727
2	Improve pedestrian accommodations	\$101,992		\$101,992
5	Change the Federal Designated Truck Route to KY 2154	\$0		\$0



<b>Table 4. Long-Term Approach Costs</b>				
<b>#</b>	<b>Recommendation Title</b>	<b>DES/CNS</b>	<b>ROW</b>	<b>Total</b>
6	Convert KY 2154 to US 68 and US 68 to US 68 Business	\$1,705,300	\$448,000	\$2,153,300
7	Use a roundabout at Barber Mills Road	\$462,548	\$6,300	\$468,848
9	Use roundabout at KY 55 and Veterans Memorial Parkway	\$953,516	\$9,000	\$962,516
10	Use roundabouts along N Spalding Avenue near downtown	\$989,564	\$5,100	\$994,664
			<b>Total</b>	<b>\$11,350,956</b>

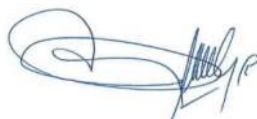
The evaluation of alternatives for a southern bypass alignment can be found on page 7-75.

A summary of the cost, of each VE Recommendation is provided in Table 1. While performance for each alternative was evaluated, the performance scores for each of them was used to compare them quantitatively; however, these scores were not used to calculate a value index for each of them as estimates are parametric with high levels of uncertainty. Therefore, the VE team leader deemed these ratios misleading at this stage of development. Please refer to Section 7.4, Performance Assessment, for more information on the value comparison of the different bypass Alignments.

## Implementation of Recommendations

To facilitate implementation, a Value Engineering Recommendation Approval Form is included as Appendix B. If the Cabinet elects to reject or modify a recommendation, please include a brief explanation of the decision.

The VE team wishes to express its appreciation to the project design managers for the excellent support they provided during the study. We hope that the recommendations and design considerations provided will assist in the management decisions necessary to move the project forward through the project delivery process.



Jose Theiler, PE, CVS®  
VE Facilitator

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# 1 Introduction

This VE report summarizes the events of the virtual VE study conducted for the Kentucky Transportation Cabinet (KYTC) and facilitated by HDR using Microsoft Teams. The subject of the study was the East Lebanon Connectivity project. The VE study was conducted February 28 - March 4, 2022 while the project was in the planning and scoping phase.

## 1.1 Scope of VE Study

Value is expressed as the relationship between functions and resources, where function is measured by the performance attributes defined by the customer, and resources are measured in materials, labor, price, and time required to accomplish that function. VE focuses on improving value by identifying the most resource-efficient way to reliably accomplish a function that meets the performance expectations of the customer.

The primary objectives of the study, through execution of the Value Methodology Job Plan (Appendix A), were to:

- Verify or improve on the various concepts for the identified section of the East Lebanon Connectivity project.
- Conduct a thorough review and analysis of the key project functions using a multidiscipline, cross-functional team.
- Make recommendations that could improve the value of the project through innovative measures aimed at improving the performance while reducing costs of the project.

With this process, the VE team identified the essential project functions and alternative ways to achieve those functions; the team then selected the optimal recommendations to develop into workable solutions for value improvements.

## 1.2 VE Team Members

The VE study was facilitated by a Certified Value Specialist (CVS) from HDR. Multiple representatives and members of the KYTC project team also participated in the VE process to provide insight into the project's background and design development, as well as their requirements for the project and expectations for the VE study. Their support of this study is greatly appreciated, and the results provided herein reflect the information they provided throughout the study.

The VE team included the following individuals. See Appendix C for details of attendees.

Adam Hedges, PE | HDR  
David Otte | KYTC  
Jonathan West, PE | HDR  
Rachel Bernhard, PE, VMA | HDR  
Amy Williams, PE | TSW

Jose Theiler, PE, CVS | HDR  
Brent Sweger, PE | KYTC  
Will Hume, PE | HDR  
Ashley Willoughby | HDR  
Justin Harrod | KYTC

Figure 1. Team Photo



## 2 Information Phase

To successfully identify alternatives, it is essential that the VE team first understand the project objectives and problems that must be solved. The VE team received the documentation and drawings from the project design team as shown in Table 5. The design team also introduced the project and its characteristics on the first day of the study. Project details and challenges as presented by the design team are summarized below.

### 2.1 Information Provided to VE Team

Table 5 lists the project documents provided to the VE team for use during the study.

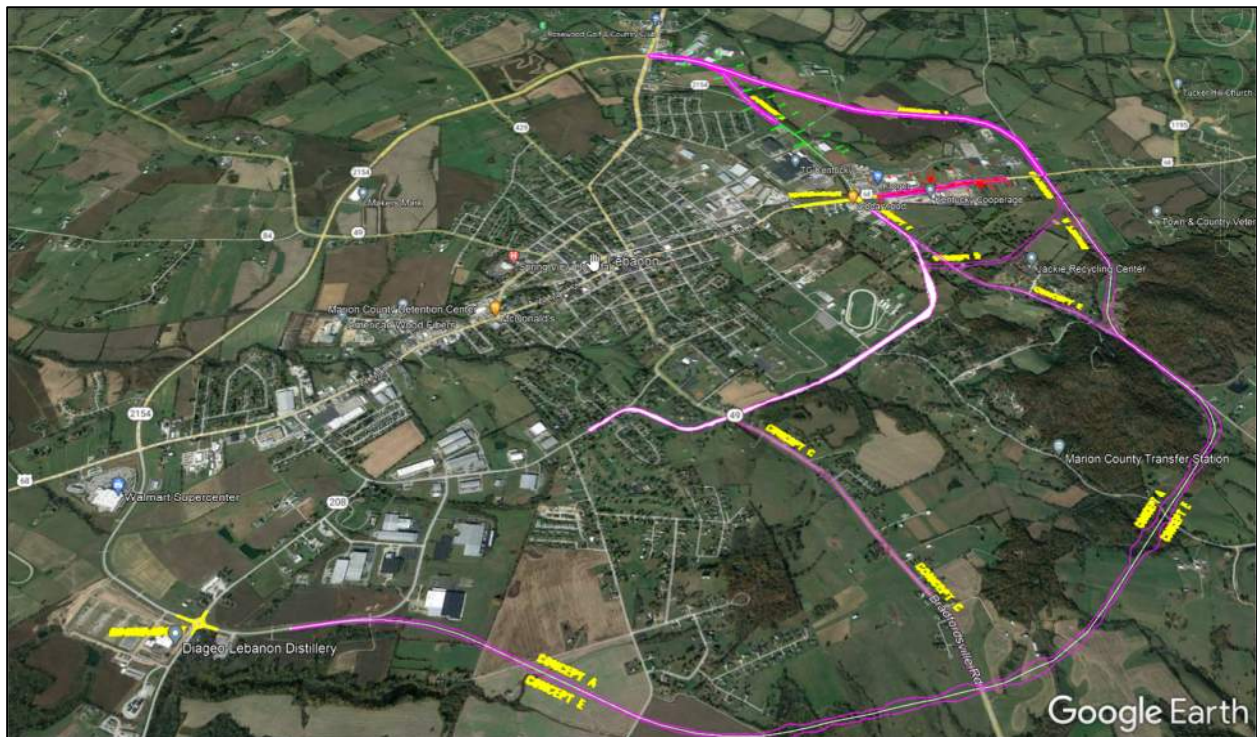
<b>Table 5. Information Provided to the VE Team</b>	
<b>Document/Drawing/Schematic</b>	<b>Document Date</b>
KYTC Traffic Counts GIS Map	February 28, 2022
East Lebanon Connectivity Study GIS Website	February 28, 2022
Crash Data and Crash Density Graphics	February 28, 2022
Traffic Information	February 28, 2022
Socioeconomic Report from the Lincoln Trail Area Development District	December 7, 2021
City of Lebanon Comprehensive Plan	September 2014
City of Lebanon Zoning Map	February 28, 2022
Kentucky Wastewater Mapping – Lebanon Sewer System	February 28, 2022
Project Team Meeting No. 1 Minutes	November 8, 2021
Public Meeting No. 1 Notebook, Minutes, LOS Summary, Public Survey Summary,	December 14, 2021
US 68 Design Files	February 28, 2022
US 68 KMZ Files	February 28, 2022
US 68 Concepts, Typical Section Meeting Handout	February 28, 2022
Northeast Bypass (US 68 to KY 55) Design Files	February 28, 2022
Northeast Bypass (US 68 to KY 55) KMZ Files	February 28, 2022
Northeast Bypass (US 68 to KY 55) Concepts, Profiles, Cross Sections	February 28, 2022
Northeast Bypass (US 68 to KY 55) Preliminary Estimate	February 28, 2022
Southeast Bypass (KY 208 to US 68) Design File	February 28, 2022
Southeast Bypass (KY 208 to US 68) KMZ File	February 28, 2022
Southeast Bypass (KY 208 to US 68) Concepts, Cross Sections, Autoturns	February 28, 2022

## 2.2 Project History and Purpose and Need

The following project history and information was extracted from the information and documentation provided by KYTC.

The City of Lebanon has experienced growth in vehicular traffic and local truck traffic which affects safety and mobility within the community. To accommodate that growth a new bypass route was constructed in recent years. In 2008, the northwestern portion of the Lebanon Bypass (KY 2154) was extended to the east from US 68 to KY 208. There continues to be growth to the east as well. A significant number of businesses, factories, and residential developments are located along the eastern portion of Lebanon. Figure 2 shows the project area along with different corridor concepts that had been studied.

Figure 2. Project Area Map



## 2.3 Proposed Improvements

KYTC is partnering with the City of Lebanon and Marion County to analyze multiple alternatives to a bypass road circumventing downtown City of Lebanon. The intent is to reduce congestion and travel times within the city of Lebanon. The two alternative alignments are primarily the northern alignment and southern alignment. All alignments show a two-lane urban undivided roadway with 12-foot lanes, with partial pedestrian and bicyclist accommodations.

There are multiple alternatives for a future bypass aligned south of the City of Lebanon:

A – a far south direct connection from KY 2154 and US 68 at the west end, extending Industrial Drive through KY 49, to US 68 across from Barbers Mill Drive

A-1 – follow the same alignment as A; however, ends at KY 49 (considered a priority section of Concept A)

B – a closer to town south connection, extending Metts Dr crossing KY 49 on a new roadway aligned behind the Marion County Fairgrounds, tying to Sulphur Springs Road and closing the bypass at US 68 across from Corporate Drive.

C – Follows alignment A-1, uses existing KY 49 to the north and then follows the alignment of Option B

D – Follows the same alignment as Option B; however, extends across Sulphur Springs Road to end at the same location as Option A completes the bypass at US 68.

E – Follows the same alignment as Option A and realigns the eastern portion to follow Sulphur Springs Road closing the bypass at US 68 across from Corporate Drive.

Similarly, two alternatives were developed for the northern bypass:

1 – Generally continues existing KY 2154 to the east across KY 55 along a new roadway that intersects Barber Mills Road just north of US 68 ending at US 68.

2 – Generally continues existing KY 21 54 to the east across KY 55 along a new roadway that heads south to intersect Corporate Dr just north of Teledyne Road and uses existing Corporate Drive to intersect US 68 just east of downtown Lebanon.

The project is in the planning stages and plans and typical sections were not yet developed.

## 2.4 Project Risks

As part of the project briefing, the VE team was given the following project constraints, controlling factors, and other issues that needed to be considered when evaluating ideas. A risk analysis was not completed as part of this VE; however, during the VE study, the team identified several risks.

- Sensitivity to local project sponsors/support/stakeholders
  - Engineering validation to support project scope
  - Property lines and terrain at southern connector
  - Managing expectations with promised scope of work
- Truck traffic on local roads and turning movements downtown
- Funding for 80152 (US 68) project
- Environmental Justice impacts
- Political support and priorities for the project
- Utilities
  - Increased impacts closer to downtown; however, lack of utilities further from downtown
- Right-of-way impacts are not quantified adequately for comparison purposes between alignments and concepts
- Public approval/feedback and property impacts
  - Communication of route concepts

## 2.5 Project Observations

The first day of the VE study included a presentation from the project design team and a virtual tour of the project using Google Earth and KMZ files. The following summarizes project issues, project drivers, and observations identified during this session:

- Project drivers = US 68 portion, bypass routes from KY 208 up to KY 55
- Unknown future economic development impacts and routing
- Traffic issues during peak hours (industrial, schools)
- Existing truck traffic goes through downtown
- Southern bypass is significant compared to city development (utility extensions)
- Desire to balance economic development with wanting to keep downtown “busy in a good way”
- Future vision for Lebanon
- Land use perspective
- What’s driving the Southern bypass – property access for development or removing traffic



- Marketing opportunities of communicating with trucking industry to move off local roads
- Increased pressure on tourism travel (bourbon industry)
  - Independent Stave tours and other bourbon
  - Diageo – no tourism aspects in Lebanon at this time
  - New Haven traffic
  - Springfield
  - Ease of travel from downtown district to distillery districts (access)
- Transportation funding/support politically
- Workforce issue in this region of Kentucky – BlueOval in Glendale will draw workforce
  - Growth projections may be outpaced by other nearby communities/economies
- Bypass solution may be overkill to this growth
  - Need to justify
  - Some basis for growth investment solutions
    - What is really needed?
    - Downtown upgrades while removing trucks from the tight streets
- Improvements downtown may be more helpful to serving this need
- Economic Development Director recently changed – bourbon/food industry connections quite significantly attracted industries effectively, providing jobs angle of industry
- Purpose and Need – Reduce Congestion and Reduce Travel Times
  - Economic Development
  - Southern bypass may not meet the purpose and need
  - Opportunity to rescope the purpose and need
    - Safety approach
    - Downtown improvements needed (in addition to diverting trucks)
- Planning study based on evaluating bypass/political pressures and funding
- Crash Data within City of Lebanon – 868 crashes; project website limits only 207 crashes
  - Need to include downtown to address these safety components
  - Density of crashes are through downtown due to congestion (rear end) and angle crashes due to access management/uncontrolled intersections
  - 6 fatalities all on segments outside study area

- Cost/benefit (northern segment)
- Federal Designated Truck Route on KY 55 directs trucks through downtown
- Enhance existing northern area to attract industry as opposed to developing southern end
  - Case study on northern segment for what is proposed on southern end
- Not a full bypass, doesn't remove avoid worst intersection (school traffic)
- Option B looks to be the most viable at first glance

## 2.6 Project Schedule

There was no schedule established for the project.

## 2.7 Project Cost Estimate

At the time of the study, the VE team was provided with the most recent planning level parametric cost estimate. There is no preferred alignment or concept selected, so any cost comparisons provided are relative to each comparable alignment or concept. The estimates lack any detail of pay items and uncertainty in quantities is very high. For the purpose of comparing, a right of way component was added using the following assumption: Project length multiplied by 150 ft footprint, using a unit price of \$30,000/acre. Below is a matrix of each alternative cost.

<b>Table 6. Summary of Construction Costs</b>	
<b>Alignment or Concept</b>	<b>Construction Cost (\$M)</b>
Alternative 1	\$6.0
Alternative 2	\$4.8
Concept A	\$24.2
Concept A-1	\$8.1
Concept B	\$10.1
Concept C	\$13.2
Concept D	\$10.5
Concept E	\$25.9

# 3 Project Analysis

## 3.1 Cost Model

The VE facilitator prepared a cost model from the cost estimate, which was provided by the project team. The model was organized to identify major construction elements, the design team’s estimated costs, and the percent of total project cost for the significant cost items (Figure 3).

The cost model allows the team to focus on project elements with the highest degree of impact and utilize their time most effectively. Figure 3 shows the cost model for Alignment 1 and Figure 4 shows the cost model for Concept A.

**Figure 3. Cost Model – Alignment 1**

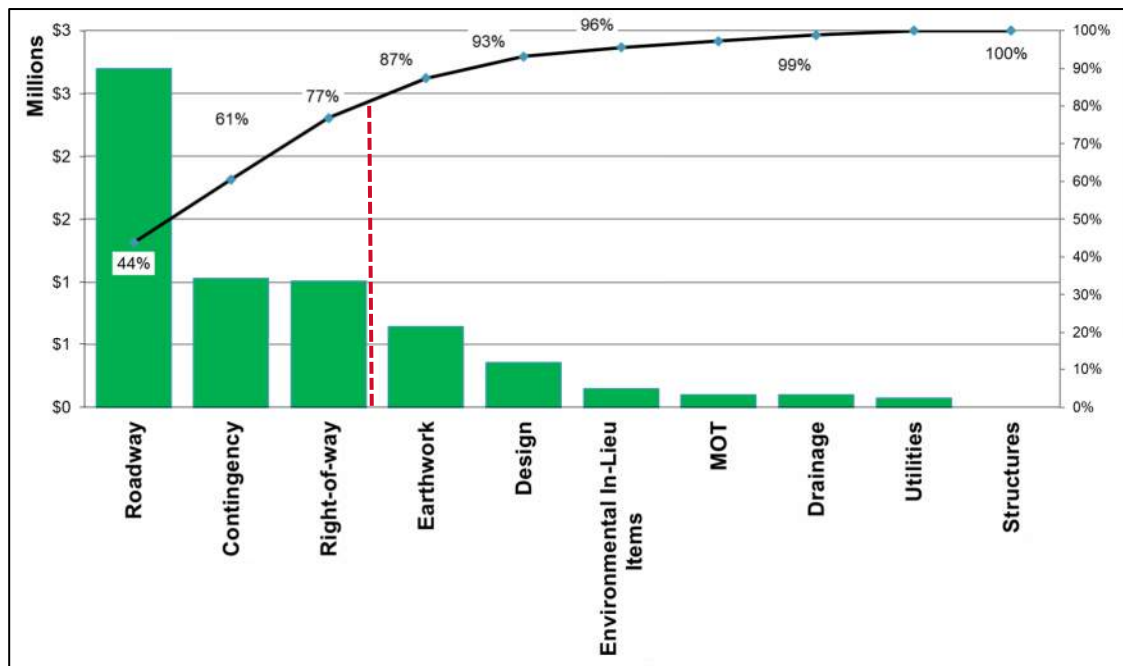
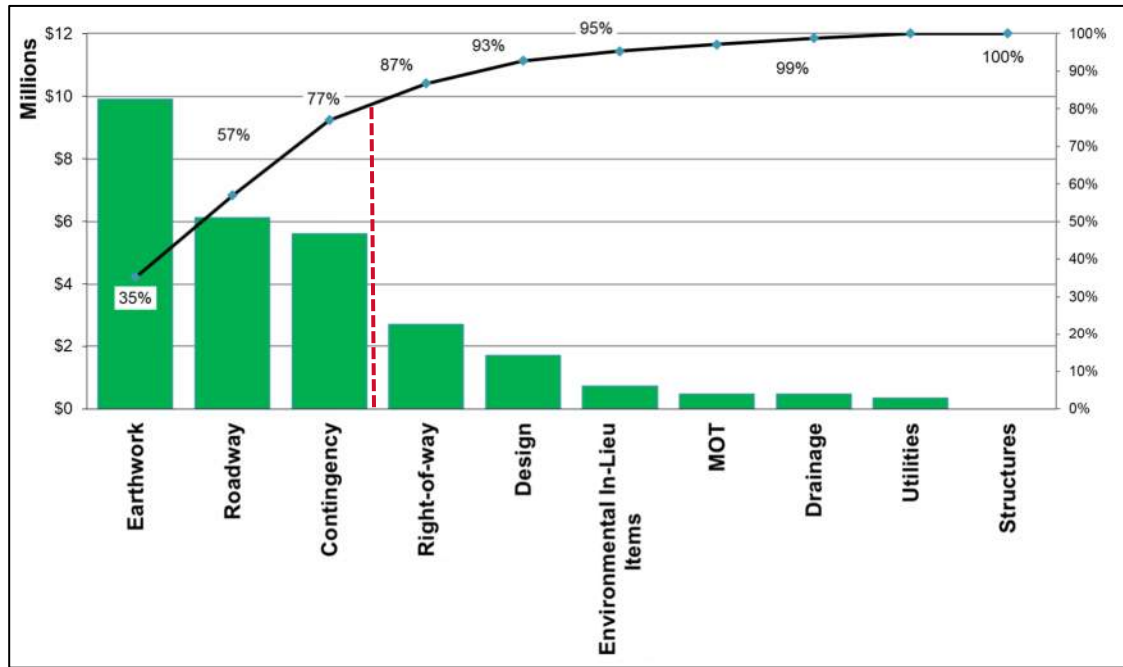


Figure 4. Cost Model – Concept A



## 3.2 Value Metrics

The value metrics process was used as an analysis tool to evaluate the baseline project and the VE recommendations. Value metrics is a system of techniques predicated on the theory that value is an expression of the relationship between the performance of a function and the cost of acquiring it. It provides a standardized means of identifying, defining, evaluating, and measuring performance. Performance is quantified in terms of how well a set of attributes contribute to the overall functional purpose of a given project.

The basic equation used for calculating value is:

$$Value = \frac{Performance}{Cost + Time}$$

In other words, value is equivalent to the relationship of the resources needed to provide a certain level of performance for a given function. Performance is defined as a set of requirements and attributes of a project's scope that are pertinent to the project's purpose and need. Participant responses are elicited for a series of paired comparisons in which the performance of alternatives are compared, with consideration of the project purpose and need, while taking into account the relative intensity of preference of one criterion over another.

The following pages describe the steps in the value metrics process.

### 3.2.1 Performance Attributes

Performance attributes are an integral part of the value analysis process. The performance of each project must be properly defined and agreed on by the project team, VE team, and representatives at the beginning of the study. These attributes represent those aspects of a project’s scope and schedule that possess a range of potential values.

Performance attributes can generally be divided between project scope components (highway operations, environmental impacts, maintainability, and system preservation) and project delivery components. It is important to make a distinction between performance *attributes* and performance *requirements*. Performance requirements are mandatory and binary in nature. All performance requirements must be met by any VE alternative concept being considered. Performance attributes possess a range of acceptable levels of performance. For example, if the project was the design and construction of a new bridge, a performance requirement might be that the bridge must meet all current seismic design criteria. In contrast, a performance attribute might be project schedule, which means that a wide range of alternatives could be acceptable that had different durations.

Typical standardized project performance attributes are shown below. The VE team, along with the project team, identified and defined the performance attributes for this project and then defined the baseline concept as it pertains to these attributes (Table 7). The following performance attributes were used throughout the study to identify, evaluate, and document ideas and recommendations.

Table 7. Performance Attributes and Description		
Performance Attribute	Description of Attribute	Baseline Concept
Main Line Operations	An assessment of traffic operations and safety on the main line within the project limits. Operational considerations include level of service relative to the 20-year traffic projections, as well as geometric considerations such as design speed, sight distance, and lane and shoulder widths.	<ul style="list-style-type: none"> <li>• US 68 (E Main Street) curb and gutter or 6-foot buffer strip or standard widening - 11-foot lanes with 12-foot TWLTL</li> <li>• NE Bypass: Two or three 12-foot lanes undivided road (rural) US 68 to KY 55 (Springfield Road) - roundabout or conventional intersection; inner 35 mph and outer 55 mph</li> <li>• SE Bypass: KY 208 to US 68 (inner/urban section: three lanes 35 mph; outer two lanes 55 mph)</li> </ul>

**Table 7. Performance Attributes and Description**

Performance Attribute	Description of Attribute	Baseline Concept
Local Operations	<p>An assessment of traffic operations and safety on the local roadway infrastructure. Local Operations include frontage roads as well as crossroads.</p> <p>Operational considerations include level of service relative to the 20-year traffic projections; geometric considerations such as design speed, sight distance, lane and shoulder widths; bicycle and pedestrian operations and access.</p>	<ul style="list-style-type: none"> <li>• KY 2154 (Corporate Dr) - 35-55 mph (3 lanes)</li> <li>• Spalding Avenue - 12-foot lanes, curb and gutter</li> <li>• Truck traffic removed from downtown areas</li> </ul>
Maintainability	<p>An assessment of the long-term maintainability of the facilities and equipment. Maintenance considerations include the overall durability, longevity, and maintainability of structures and systems; ease of maintenance; accessibility and safety considerations for maintenance personnel.</p>	<ul style="list-style-type: none"> <li>• Asphalt pavement on new roadways, matching existing where widening</li> </ul>
Schedule	<p>An assessment of the total project delivery from the time as measured from the time of the VE Study to completion of construction.</p>	<ul style="list-style-type: none"> <li>• Considerations for Environmental, PS&amp;E, RIGHT-OF-WAY,</li> <li>• Construction and funding availability</li> </ul>
Environmental Impacts	<p>An assessment of the permanent impacts to the environment including ecological (i.e., flora, fauna, air quality, water quality, visual, noise); socioeconomic impacts; impacts to shore edge; impacts to cultural, recreational and historic resources.</p>	<ul style="list-style-type: none"> <li>• Local residents prefer improving existing roads</li> <li>• Some stream impacts</li> <li>• Potential hazardous material sites</li> <li>• Industrial parks, school, development, historic downtown and other historic buildings, churches</li> </ul>
Traffic Operations	<p>An assessment of the effects to neighbors and visitors to the project surrounding area including road alignment and grade at the road crossing, access to businesses and parking lots, connection to driveways, and other changes to the existing condition.</p>	<ul style="list-style-type: none"> <li>• Emphasis to reduce travel times for each corridor/alignment</li> <li>• Traffic crash locations/frequency</li> </ul>

Table 7. Performance Attributes and Description		
Performance Attribute	Description of Attribute	Baseline Concept
Economic Development	An assessment of potential future economic development as measured in supporting businesses and services (origin/destination) development in the area	<ul style="list-style-type: none"> <li>• Outer concepts provide more land development connection potential, utility expansion considerations</li> <li>• Corporate Drive industrial area</li> <li>• Removing truck traffic from downtown areas</li> <li>• Independent Stave</li> <li>• Diageo</li> </ul>

### 3.2.2 Performance Attribute Matrix

The performance attribute matrix was used to determine the relative importance of the performance attributes for the project. The project and VE team evaluated the relative importance of the performance attributes that would be used to evaluate the creative ideas.

These attributes were compared in pairs (Table 8), asking the question: “Which one is more important to the purpose and need of the project?” (e.g., A or B, A or C, A or D, etc.) The letter code (e.g., “A”) was entered into the matrix for each pair. After all pairs were discussed, they were tallied (after normalizing the scores by adding a point to each attribute) and the percentages calculated. These scores were then used to calculate the value of each recommendation during the VE team’s performance evaluation scoring (Section 6).

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Table 8. Performance Attribute Matrix									
Paired Comparison							Total Points	% of Total	
Main Line Operations	A	A/B	A		A/E	F	A/G	4.5	17%
Local Operations		B	B		B/E	B/F	B	5.5	21%
<b>**Maintainability</b>								-	-
Schedule			D	E	F	D		3.0	11%
Environmental Impacts				E	F/E	E/G		5.0	18%
Traffic Operations					F	F/G		5.5	20%
Economic Development						G		3.5	13%
<b>Total</b>								<b>27.0</b>	<b>100%</b>

*\*\*During the Evaluation phase, the VE team decided to rearrange these attributes and their relative importance by agreeing that all alternatives would have equivalent Maintainability and Construction Impacts, then believed that Schedule had relative importance equal to both combined.*

## 4 Function Analysis Phase

### 4.1 Overview

Function analysis results in a unique view of the project. It transforms project elements into functions, which help guide the VE team in considering the functional concepts of the project— independent of the current design. Functions are defined in verb-noun statements to reduce the needs of the project to their most elemental level (Table 9). Identifying the functions of the major design elements of the project allows a broader consideration of alternative ways to accomplish the functions.

**Table 9. Random Function Identification**

Project Element	Functions
Project Purpose/Need	Improve Connectivity Enhance Safety Improve (Travel) Time Divert Trucks Divert Traffic Increase Capacity Promote (Economic) Development Repurpose (Roadway) Space Improve (Signal) Timing Maintain (City) Charm/Character Enhance Tourism Relieve Congestion Reduce Demand Accommodate (Truck) Traffic Separate (Truck) Traffic Accommodate Pedestrians/Bicycles Reduce Conflicts Modify Access Bypass Downtown Control Traffic Disincentivize Truck Traffic
Pavement	Support Loads Protect Base Increase Friction Add Lanes Remove Water Improve Geometry Improve (Sight) Distance Increase Capacity
Earthwork	Create Profile Clear Space Move Soil
Right-of-way	Create Space Control Access
Traffic Control	Separate Traffic Control Access Inform Drivers Protect Workers Divert Traffic Improve Signage Control Movements
Drainage	Collect Water Convey Water Control Water Discharge Water
Utilities	Remove (Utility) Conflicts

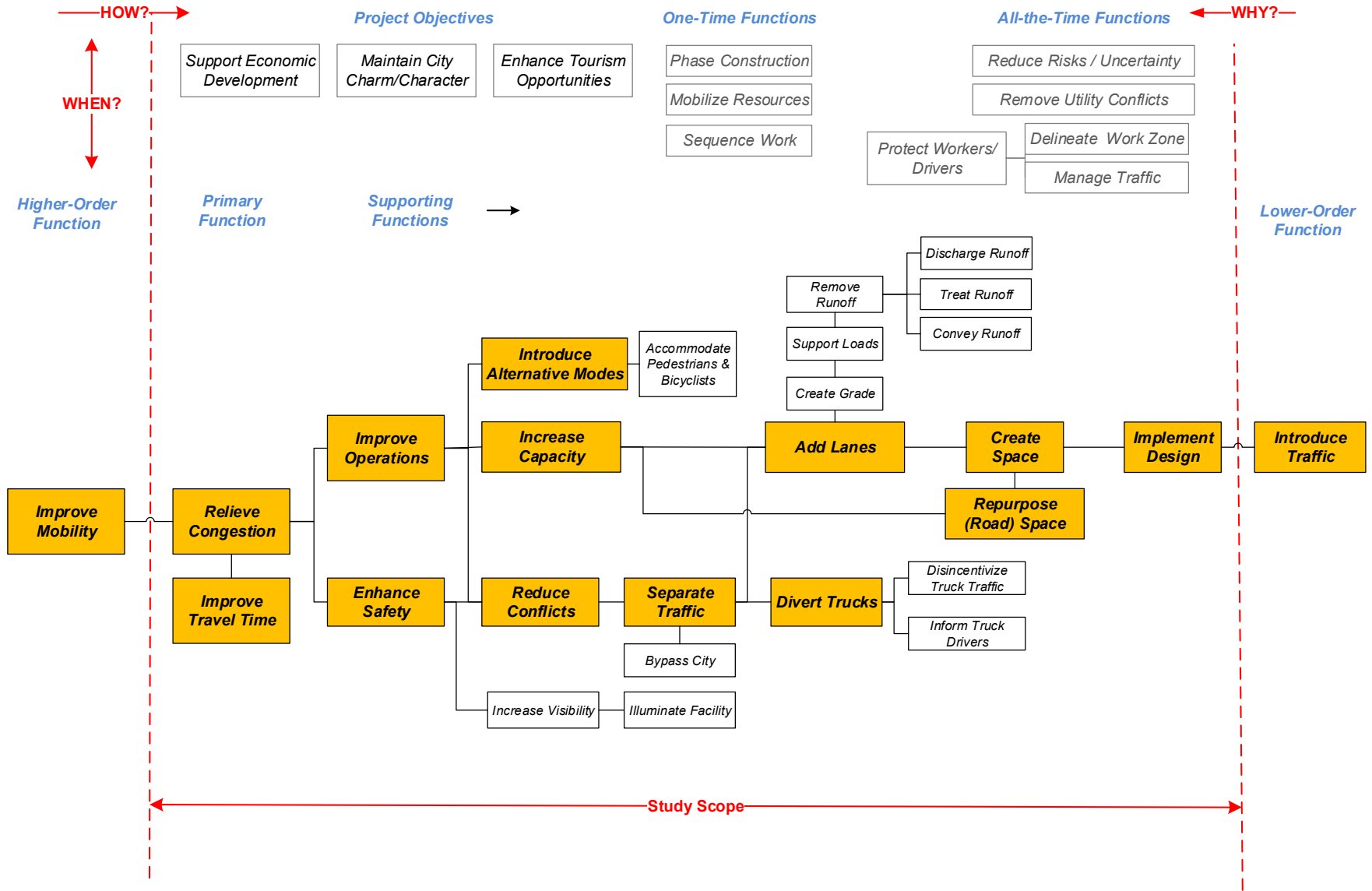
**Table 9. Random Function Identification**

Project Element	Functions
Other	Manage Risks / Uncertainty Stage Construction Deploy Resources Sequence Activities Create (Work) Zone Illuminate Facility Prepare Site Control Erosion Introduce Technology

## 4.2 Function Analysis System Technique Diagram

The Function Analysis System Technique or “FAST” diagram arranges the functions in logical order so that when read from left to right, the functions answer the question “How?” If the diagram is read from right to left, the functions answer the question “Why?” Functions connected with a vertical line are those that happen at the same time as, or are caused by, the function at the top of the column. The FAST diagram (Figure 5) provided the VE team with an understanding of which functions offer the best opportunity for cost or performance improvement.

Figure 5. FAST Diagram



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## 5 Creativity Phase

During the Creativity Phase, the VE team generated ideas on how to perform the various functions. The idea list was grouped by function or major project element. All of the ideas generated are recorded in Table 10. The final disposition of each idea is included at the end of Section 6.

<b>Table 10. Creative Idea List</b>	
<b>Idea No.</b>	<b>Description</b>
<b><i>Function: Accommodate Pedestrians/Bicycles</i></b>	
26	Add shared use path on north side of US 68 to connect downtown to schools (complete connection), upgrade pedestrian crossings
27	Extend sidewalk accommodations west of downtown to the end of the project and in EJ areas
28	Accommodate bicycles through US 68 corridor
<b><i>Function: Bypass Downtown</i></b>	
2	Evaluate/validate portion of SE bypass
4	Utilize/reconfigure Corporate Drive as NE bypass route (Alternative 2a)
6	Realign/sign US 68 to incentivize traffic to utilize KY 2154 (convert KY 2154 to US 68, convert US 68 to US 68 Business)
11	No build
13	Alignment 1
14	Alignment 2
15	Concept A
16	Concept B
17	Concept C
18	Concept D
19	Concept E
22	Create bypass to KY 55 as main route (straighten KY 2154)
37	Greenfield US 68 to cross Calvary and tie into Concept A/E to provide southern bypass
39	Create alternative route from KY 49 (Concept A/E) to Concept B near Fairgrounds (Justin/Kevin)
55	Do not build SE bypass
57	Work with local government to develop a comprehensive plan including land use and transportation network
58	Engage Marion County in comprehensive plan in addition to the City of Lebanon

<b>Table 10. Creative Idea List</b>	
<b>Idea No.</b>	<b>Description</b>
59	Defer Concept B/D, preserve right-of-way for future construction, coordinate with the City of Lebanon as land development permits are issued
62	Complete a comprehensive Origin-Destination study (Wejo and StreetLight)
<b>Function: Control Traffic</b>	
64	Force minor movements right (2-phase signal) at Depot Street and W Main Street
<b>Function: Disincentivize Truck Traffic</b>	
7	Add traffic calming features downtown (mid-block speed tables, smaller diameter roundabouts)
10	Convert signals to stop signs in downtown
21	Utilize calming strategies along N Spalding Avenue
23	Put roundabouts at Veterans Memorial Highway/KY 55 and at N Spalding Avenue/Corporate Drive to disincentivize trucks using N Spalding Avenue
35	Reduce lane widths along Main Street and/or N Spalding Avenue to discourage trucks
<b>Function: Divert Traffic</b>	
38	Scale down full southern bypass and only make vital local connections
<b>Function: Divert Trucks</b>	
40	Improve lane section/speed limit of KY 2154 from KY 49 to KY 429 and intersections
<b>Function: Enhance Safety</b>	
34	Reduce posted speed to 25 mph throughout Main Street
<b>Function: Increase Capacity</b>	
12	Couplet (E MLK Avenue and Main Street) from N Depot Street to S Woodlawn Avenue
44	Make Corporate Drive a consistent 3 lane section to accommodate turning traffic
<b>Function: Inform Drivers</b>	
53	Use oversized signs to push trucks to use existing bypass (both ends of town)
<b>Function: Maintain City Charm/Character</b>	
32	Use complete street strategy along Main Street
33	Close two blocks of main street for pedestrians only
<b>Function: Modify Access</b>	
1	Build a road and/or access on the northern portion to alleviate school congestion

<b>Table 10. Creative Idea List</b>	
<b>Idea No.</b>	<b>Description</b>
3	Manage access for new roadways
5	Provide alternate access from Sulpher Springs Road for Independent Stave
25	Provide dedicated school access alternative
47	Relocate school access to Alignment 1
48	Extend Alignment 1 south and connect Kentucky Cooperage freight logistics to main operation
49	Downsize Kentucky Cooperage tunnel to pedestrian/material only instead of truck tunnel
52	Improve Alignment 2 by making Corporate Drive local only by closing Corporate Drive/KY 2154
61	Restripe W Walnut Street at southbound approach to W Main Street for right and through movements
63	Establish a comprehensive circulation plan for school traffic to manage queues
<b>Function: Promote Economic Development</b>	
56	Leverage developer to fund bypass sections
<b>Function: Reduce Conflicts</b>	
8	Convert signals to roundabouts on Main Street
30	Install two roundabouts on N Spalding Avenue at KY 429/St Rose Road and W Walnut Street
36	Prevent left turns along Main Street/downtown
41	Unsignalized RCUTs at KY 49 and KY 429 along KY 2154
42	Improve intersections for truck traffic at KY 49 and KY 429 along KY 2154
43	Install green-T at N Spalding Avenue and Corporate Drive
45	Use a Continuous green-T at US 68 and Barbers Mill Road
60	Use roundabout at Barbers Mill Road and US 68
<b>Function: Reduce Demand</b>	
20	Relocate Cooperage/Independent Stave to NW KY 2154 corridor
31	Introduce all way stop signs downtown to improve pedestrian accommodations
46	Relocate schools to KY 2154 bypass
<b>Function: Relieve Congestion</b>	
24	Upgrade existing Corporate Drive and intersection at KY 2154, include backage road for school access to connect Corporate Drive to Barbers Mill Road
51	Sync up entire corridor with adaptive signaling



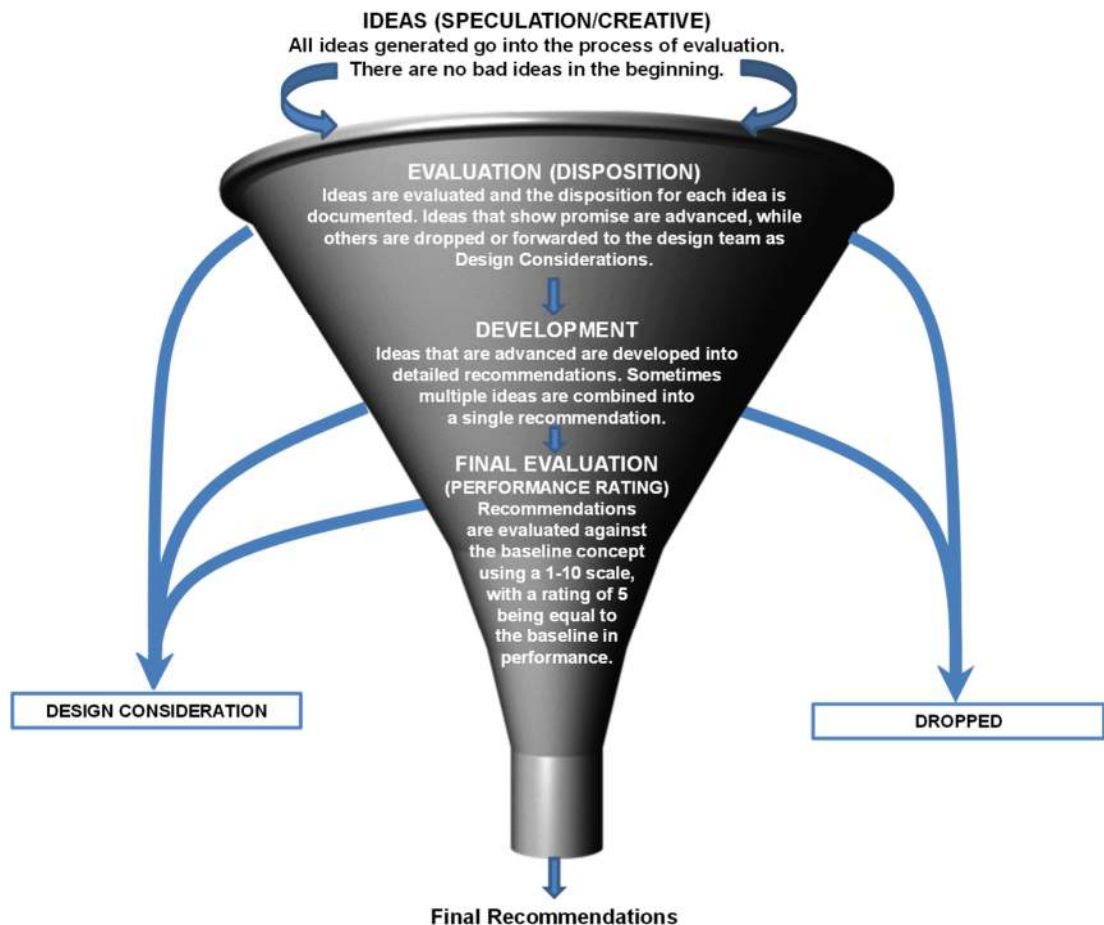
<b>Table 10. Creative Idea List</b>	
<b>Idea No.</b>	<b>Description</b>
<b><i>Function: Repurpose Roadway Space</i></b>	
9	Eliminate on-street parking to improve truck accommodations downtown and facilitate turning movements
<b><i>Function: Separate Truck Traffic</i></b>	
29	Change truck route designation out of downtown
<b><i>Function: Support Loads</i></b>	
54	Use a 2+1 (alternating passing lanes) typical section for the southern bypass

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## 6 Evaluation Phase

Although each project is different, the evaluation process for each VE effort can be thought of in its simplest form as a way of combining, evaluating, and narrowing ideas until the VE team agrees on the recommendations to be forwarded. Figure 6 depicts the typical information flow for this part of the Value Methodology Job Plan.

Figure 6. VE Process Information Flow



### 6.1 Evaluation Process

The evaluation process begins by going through the ideas brainstormed during the Creativity Phase. Considering the information provided to the VE team at the time of the study and the constraints and controlling decisions that were also given to them, the team discussed the ideas and documented their advantages and disadvantages based on their relationship to the baseline concept.

The VE team also compared each idea with its baseline concept to determine whether the performance of the attribute (as introduced in Section 3.2) was better than, equal to, or worse than the baseline concept.

Each idea was then carefully evaluated, with the VE team reaching consensus on the overall ranking of the idea (ranking values 0 through 3, as defined below).

3 = Advance for further development

2 = Design consideration; include as a comment or consideration for design team

1 = Poor Opportunity/dropped from further development

0 = Unacceptable impact/fatal flaw

This ranking resulted in the initial disposition of the idea. Those ideas ranked as a 3 were developed further; low-ranking ideas (those ranked 0 or 1) were dropped from further consideration; and those that were ranked 2 were brought forward as ideas the design team should pursue.

## 6.2 Evaluation Summary

All of the ideas that were generated during the Creativity Phase using brainstorming techniques are detailed in Table 11.

Table 11. Idea Evaluation Summary Table

Idea #	Description	Advantages	Disadvantages	Rating	Comments
<b>Function: Accommodate Pedestrians/Bicycles</b>					
26	Add shared use path on north side of US 68 to connect downtown to schools (complete connection), upgrade pedestrian crossings	<ul style="list-style-type: none"> <li>• Improves pedestrian/bicycle accommodations</li> <li>• Reduces conflicts</li> <li>• Removes pedestrians from shoulders</li> <li>• Encourages other modes of transportation</li> <li>• May reduce traffic demand</li> </ul>	<ul style="list-style-type: none"> <li>• Increases right-of-way impacts</li> <li>• May impact some businesses</li> <li>• Increases cost</li> <li>• Driver expectancy of directional bicycle traffic</li> <li>• Increases maintenance</li> <li>• Increases impervious surface</li> </ul>	3	<i>Combine 26,27 Moved forward as VE Recommendation.</i>
27	Extend sidewalk accommodations west of downtown to the end of the project and in EJ areas	<ul style="list-style-type: none"> <li>• Improves pedestrian accommodations</li> <li>• Reduces conflicts</li> <li>• Removes pedestrians from shoulders</li> <li>• Encourages other modes of transportation</li> <li>• May reduce traffic demand</li> </ul>	<ul style="list-style-type: none"> <li>• Increases right-of-way impacts</li> <li>• May impact some businesses</li> <li>• Increases cost</li> <li>• Increases maintenance</li> <li>• Increases impervious surface</li> </ul>	3	<i>Combine 26,27 Include information about existing project on SUP along Corporate Drive. Moved forward as VE Recommendation.</i>
28	Accommodate bicycles through US 68 corridor	<ul style="list-style-type: none"> <li>• Improves bicycle accommodation</li> <li>• Reduces intermodal conflicts</li> </ul>	<ul style="list-style-type: none"> <li>• May reduce parking capacity downtown</li> <li>• May not be utilized largely</li> <li>• Business/public opposition</li> </ul>	1	

Table 11. Idea Evaluation Summary Table

Idea #	Description	Advantages	Disadvantages	Rating	Comments
<b>Function: Bypass Downtown</b>					
2	Evaluate/validate portion of SE bypass	<ul style="list-style-type: none"> <li>• Better informs design/priorities</li> <li>• Allows development of cost-benefit of bypass</li> <li>• Allows analysis of downtown traffic and benefits of project</li> <li>• Identifies critical nodes</li> <li>• Prioritizes project improvements</li> <li>• Ensures infrastructure funds are best utilized</li> <li>• Identifies spot improvement potential areas</li> <li>• Identifies diversion</li> </ul>	<ul style="list-style-type: none"> <li>• Data penetration challenges such as: Wejo does not include older vehicles</li> </ul>	2	<i>Discussed with Idea 62</i>
4	Utilize/reconfigure Corporate Drive as NE bypass route (Alternative 2a)	<ul style="list-style-type: none"> <li>• Reduces cost</li> <li>• Reduces right-of-way requirement</li> <li>• Reduces implementation time</li> <li>• Does not preclude any future bypass options</li> <li>• Utilizes existing infrastructure</li> <li>• Reduces maintenance (pavement)</li> </ul>	<ul style="list-style-type: none"> <li>• Reduces access redundancy</li> <li>• May increase maintenance (if signals used)</li> </ul>	3	<i>Moved forward as VE Recommendation.</i>

**Table 11. Idea Evaluation Summary Table**

Idea #	Description	Advantages	Disadvantages	Rating	Comments
6	Realign/sign US 68 to incentivize traffic to utilize KY 2154 (convert KY 2154 to US 68, convert US 68 to US 68 Business)	<ul style="list-style-type: none"> <li>• Increases truck diversion</li> <li>• Higher speed continuity/continuous flow for trucks and through traffic</li> <li>• Reduces traffic downtown</li> <li>• May eliminate traffic signal</li> <li>• Slows speeds on Main Street</li> <li>• Encourages bypass usage</li> <li>• Incentivizes bypass for economic development</li> </ul>	<ul style="list-style-type: none"> <li>• May reduce traffic downtown to businesses</li> <li>• Requires additional right-of-way</li> <li>• Requires geometric reconfiguration for intersections</li> <li>• Zoning control considerations</li> <li>• May preclude full circle bypass in future</li> </ul>	3	<i>Moved forward as VE Recommendation.</i>
11	No build	<ul style="list-style-type: none"> <li>• Reduces cost</li> </ul>	<ul style="list-style-type: none"> <li>• Does not facilitate regional traffic bypass</li> <li>• Limits opportunities for economic development</li> </ul>	0	<i>Does not meet purpose and need of the project.</i>
13	Alignment 1	•	•	3	<i>Discussed in Alignment &amp; Concept Evaluation</i>
14	Alignment 2	•	•	3	<i>Discussed in Alignment &amp; Concept Evaluation</i>
15	Concept A	•	•	3	<i>Discussed in Alignment &amp; Concept Evaluation</i>
16	Concept B	•	•	3	<i>Discussed in Alignment &amp; Concept Evaluation</i>
17	Concept C	•	•	3	<i>Discussed in Alignment &amp; Concept Evaluation</i>
18	Concept D	•	•	3	<i>Discussed in Alignment &amp; Concept Evaluation</i>

**Table 11. Idea Evaluation Summary Table**

Idea #	Description	Advantages	Disadvantages	Rating	Comments
19	Concept E	<ul style="list-style-type: none"> <li>•</li> </ul>	<ul style="list-style-type: none"> <li>•</li> </ul>	3	<i>Discussed in Alignment &amp; Concept Evaluation</i>
22	Create bypass to KY 55 as main route (straighten KY 2154)	<ul style="list-style-type: none"> <li>• Increases truck diversion</li> <li>• Higher speed continuity/continuous flow for trucks and through traffic</li> <li>• Reduces traffic downtown</li> <li>• May eliminate traffic signal</li> <li>• Slows speeds on N Spalding Avenue</li> <li>• Encourages bypass usage</li> <li>• Incentivizes bypass for economic development</li> </ul>	<ul style="list-style-type: none"> <li>• May reduce traffic downtown to businesses</li> <li>• Requires additional right-of-way</li> <li>• Requires geometric reconfiguration for intersections</li> <li>• Zoning control considerations</li> <li>• Complicates future NE bypass tie-in/intersection</li> </ul>	3	<i>Part of a strategy for NW bypass. Moved forward into further development but then later dropped.</i>
37	Greenfield US 68 to cross Calvary and tie into Concept A/E to provide southern bypass	<ul style="list-style-type: none"> <li>• Straightens US 68 alignment</li> </ul>	<ul style="list-style-type: none"> <li>• Increases cost</li> <li>• Increases right-of-way impacts</li> </ul>	1	
39	Create alternative route from KY 49 (Concept A/E) to Concept B near Fairgrounds (Justin/Kevin)	<ul style="list-style-type: none"> <li>• May reduce cost compared to Concept A</li> <li>• Reduces right-of-way requirement</li> <li>• Shortens bypass</li> <li>• Facilitates local traffic</li> <li>• Improves direct access to Fairgrounds</li> </ul>	<ul style="list-style-type: none"> <li>• May increase cost</li> <li>• May impact more houses</li> <li>• May increase environmental impacts</li> </ul>	3	<i>EJ impacts need to be evaluated (access vs impacts) Environmental impacts need to be evaluated VE team to contact PM before moving forward. Moved forward as VE Recommendation.</i>
50	Extend Alignment 1 to connect to Concept B/Concept D	<ul style="list-style-type: none"> <li>•</li> </ul>	<ul style="list-style-type: none"> <li>•</li> </ul>	3	<i>Discussed in Alignment &amp; Concept Evaluation</i>
55	Do not build SE bypass	<ul style="list-style-type: none"> <li>•</li> </ul>	<ul style="list-style-type: none"> <li>•</li> </ul>	0	<i>Does not meet purpose and need of the project.</i>



**Table 11. Idea Evaluation Summary Table**

Idea #	Description	Advantages	Disadvantages	Rating	Comments
57	Work with local government to develop a comprehensive plan including land use and transportation network	<ul style="list-style-type: none"> <li>• Improves coordination</li> <li>• Improves planning for infrastructure investment</li> <li>• Updates zoning/subdivision specifications</li> <li>•</li> </ul>	<ul style="list-style-type: none"> <li>• Increases time for coordination</li> </ul>	2	<i>May delay justification for project Design team to pursue coordination of this planning/land use study</i>
58	Engage Marion County in comprehensive plan in addition to the City of Lebanon	<ul style="list-style-type: none"> <li>• Improves coordination</li> <li>• Improves planning for infrastructure investment</li> <li>• Updates zoning/subdivision specifications</li> <li>•</li> </ul>	<ul style="list-style-type: none"> <li>• Increases time for coordination</li> </ul>	2	<i>Combine 57,58</i>
59	Defer Concept B/D, preserve right-of-way for future construction, coordinate with the City of Lebanon as land development permits are issued	<ul style="list-style-type: none"> <li>• Defers capital investment</li> <li>• May allow developer to fund some sections</li> <li>• May reduce right-of-way costs/improve process</li> <li>• Promotes City/County involvement and commitment</li> <li>• May limit future developments from building for where bypass is planned</li> </ul>	<ul style="list-style-type: none"> <li>• May increase future cost</li> <li>• Increases project timeline</li> <li>• May not take advantage of current local/political support and funding</li> <li>• City/State opposition</li> </ul>	2	<i>Aligns development plans with planning/land use study</i>

**Table 11. Idea Evaluation Summary Table**

Idea #	Description	Advantages	Disadvantages	Rating	Comments
62	Complete a comprehensive Origin-Destination study (Wejo and StreetLight)	<ul style="list-style-type: none"> <li>• Better informs design/priorities</li> <li>• Allows development of cost-benefit of bypass</li> <li>• Allows analysis of downtown traffic and benefits of project</li> <li>• Identifies critical nodes</li> <li>• Prioritizes project improvements</li> <li>• Ensures infrastructure funds are best utilized</li> <li>• Identifies spot improvement potential areas</li> <li>• Identifies diversion</li> </ul>	<ul style="list-style-type: none"> <li>• Data penetration challenges such as: Wejo does not include older vehicles</li> </ul>	2	<i>Quick update to provide to design team</i>
<b>Function: Control Traffic</b>					
64	Force minor movements right (2-phase signal) at Depot Street and W Main Street	<ul style="list-style-type: none"> <li>• Reduces signal phasing at Depot</li> <li>• Increases throughput on Main Street</li> </ul>	<ul style="list-style-type: none"> <li>• Public opposition</li> <li>• Business opposition</li> <li>• Out of direction travel</li> <li>• May require additional signal</li> </ul>	1	<i>Evaluate this option if Depot Street is the main issue on Main Street</i>
<b>Function: Disincentivize Truck Traffic</b>					
7	Add traffic calming features downtown (mid-block speed tables, smaller diameter roundabouts)	<ul style="list-style-type: none"> <li>• Reduces speeds downtown</li> <li>• Discourages truck/through traffic downtown</li> <li>• Increases walkability of downtown</li> <li>• Reduces severity of conflicts</li> </ul>	<ul style="list-style-type: none"> <li>• Discourages through traffic downtown</li> <li>• May increase cost</li> <li>• Maintenance/emergency services preferences</li> </ul>	3	<i>Combine 7,8,10,21,34,35</i>

**Table 11. Idea Evaluation Summary Table**

Idea #	Description	Advantages	Disadvantages	Rating	Comments
10	Convert signals to stop signs in downtown	<ul style="list-style-type: none"> <li>• Reduces maintenance</li> </ul>	<ul style="list-style-type: none"> <li>• None noted</li> </ul>	3	<i>Combine 7,8,10,21,34,35</i>
21	Utilize calming strategies along N Spalding Avenue	<ul style="list-style-type: none"> <li>• Reduces speeds downtown</li> <li>• Discourages truck/through traffic downtown</li> <li>• Increases walkability of downtown</li> <li>• Reduces severity of conflicts</li> </ul>	<ul style="list-style-type: none"> <li>• May increase cost</li> <li>• Maintenance/emergency services preferences</li> </ul>	3	<i>Combine 7,8,10,21,34,35</i>
23	Put roundabouts at Veterans Memorial Highway/KY 55 and at N Spalding Avenue/Corporate Drive to disincentivize trucks using N Spalding Avenue	<ul style="list-style-type: none"> <li>• Reduces intersection delays</li> <li>• Reduces conflicts</li> <li>• Reduces maintenance</li> <li>• Diverts trucks to use existing bypass</li> </ul>	<ul style="list-style-type: none"> <li>• May require additional right-of-way</li> </ul>	3	<i>May work with 4 (Alignment 2a). Moved forward as VE Recommendation.</i>
35	Reduce lane widths along Main Street and/or N Spalding Avenue to discourage trucks	<ul style="list-style-type: none"> <li>• Discourages trucks</li> </ul>	<ul style="list-style-type: none"> <li>• Driver expectancy</li> <li>• Reduces driver comfort/buffer distance</li> </ul>	3	<i>Combine 7,8,10,21,34,35</i>
<b>Function: Divert Traffic</b>					
38	Scale down full southern bypass and only make vital local connections	<ul style="list-style-type: none"> <li>• Reduces cost</li> <li>• Reduces maintenance</li> <li>• Reduces right-of-way requirements</li> <li>• Does not preclude future southern bypass</li> <li>• Addresses local connectivity needs</li> </ul>	<ul style="list-style-type: none"> <li>• Does not facilitate regional traffic bypass</li> <li>• Limits opportunities for economic development</li> </ul>	3	<i>Moved forward as VE Recommendation.</i>

Table 11. Idea Evaluation Summary Table

Idea #	Description	Advantages	Disadvantages	Rating	Comments
<b>Function: Divert Trucks</b>					
40	Improve lane section/speed limit of KY 2154 from KY 49 to KY 429 and intersections	<ul style="list-style-type: none"> <li>• Makes KY 2154 more attractive to users</li> <li>• Increases capacity</li> <li>• Improves operations</li> <li>• Improves throughput</li> <li>• May reduce conflicts</li> <li>• Increases distance between opposing traffic</li> </ul>	<ul style="list-style-type: none"> <li>• May increase severity of conflicts</li> <li>• Geometry may not support higher design speeds</li> <li>•</li> </ul>	2	<i>Passing lane consideration</i>
<b>Function: Enhance Safety</b>					
34	Reduce posted speed to 25 mph throughout Main Street	<ul style="list-style-type: none"> <li>• Improves pedestrian accommodations</li> </ul>	<ul style="list-style-type: none"> <li>• None noted</li> </ul>	3	<i>Combine 7,8,10,21,34,35</i>
<b>Function: Increase Capacity</b>					
12	Couplet (E MLK Avenue and Main Street) from N Depot Street to S Woodlawn Avenue	<ul style="list-style-type: none"> <li>• Improves traffic flow through downtown</li> <li>• Discourages trucks through downtown</li> <li>• Increases capacity/throughput and/or downtown operations</li> <li>• Increases visibility/routing to MLK businesses</li> <li>• Reduces conflicts</li> <li>• May increase walkability of downtown</li> </ul>	<ul style="list-style-type: none"> <li>• Relies on local roads</li> <li>• Less visibility to local businesses/routing</li> <li>• May increase side street traffic</li> <li>• Opposite to National trends</li> <li>• May require additional right-of-way</li> <li>• Driver expectancy/navigation difficulties</li> </ul>	1	<i>Does not fully address traffic congestion along Main Street</i>
44	Make Corporate Drive a consistent 3 lane section to accommodate turning traffic	<ul style="list-style-type: none"> <li>• Reduces conflicts</li> <li>• Accommodates potential development</li> </ul>	<ul style="list-style-type: none"> <li>• Existing demand for turn lanes north of Fuel Total Systems may not be warranted</li> </ul>	2	

**Table 11. Idea Evaluation Summary Table**

Idea #	Description	Advantages	Disadvantages	Rating	Comments
<b>Function: Inform Drivers</b>					
53	Use oversized signs to push trucks to use existing bypass (both ends of town)	<ul style="list-style-type: none"> <li>• Encourages trucks to use bypass</li> <li>• Low cost solution</li> <li>• Low impact</li> <li>• Reduces implementation time/can be implemented immediately</li> </ul>	<ul style="list-style-type: none"> <li>• Increases cost</li> <li>• Trucks may not change behavior/follow signs or GPS may still guide trucks through downtown</li> </ul>	2	<i>District to pursue an immediate independent/safety project in the short-term</i>
<b>Function: Maintain City Charm/Character</b>					
32	Use complete street strategy along Main Street	<ul style="list-style-type: none"> <li>• Improves aesthetics</li> <li>• May attract users downtown</li> <li>• May increase pedestrian traffic/outdoor dining/shopping/business opportunities</li> </ul>	<ul style="list-style-type: none"> <li>• May reduce Main Street footprint</li> </ul>	2	
33	Close two blocks of main street for pedestrians only	<ul style="list-style-type: none"> <li>• Improves aesthetics</li> <li>• May attract users downtown</li> <li>• May increase pedestrian traffic/outdoor dining/shopping/business opportunities</li> </ul>	<ul style="list-style-type: none"> <li>• Unlikely implementation</li> <li>• Driver expectancy</li> <li>• Business district outcry</li> </ul>	0	

**Table 11. Idea Evaluation Summary Table**

Idea #	Description	Advantages	Disadvantages	Rating	Comments
<b>Function: Modify Access</b>					
1	Build a road and/or access on the northern portion to alleviate school congestion	<ul style="list-style-type: none"> <li>• Improves school access</li> <li>• Reduces school congestion</li> <li>• Improves northbound access without forcing US 68 usage</li> <li>• Improves operations</li> <li>• May reduce school schedule queues</li> </ul>	<ul style="list-style-type: none"> <li>• Increases cost</li> <li>• Increases right-of-way impacts</li> <li>• Requires coordination with schools</li> <li>• Requires coordination with City of Lebanon and Marion County</li> </ul>	3	<i>Same idea as 1,24,25,63 Moved forward into further development but then later dropped down to design consideration.</i>
3	Manage access for new roadways	<ul style="list-style-type: none"> <li>• Reduces conflict points</li> <li>• May improve traffic flow</li> <li>• Improves operations</li> </ul>	<ul style="list-style-type: none"> <li>• Public opposition</li> <li>• Business opposition</li> <li>• May increase infrastructure (median)</li> </ul>	2	
5	Provide alternate access from Sulpher Springs Road for Independent Stave	<ul style="list-style-type: none"> <li>• May reduce turning conflicts on US 68</li> <li>• May eliminate need for tunnel</li> </ul>	<ul style="list-style-type: none"> <li>• Right-of-way impacts</li> <li>• Pushes traffic through US 68/Sulpher Springs Road intersection</li> <li>• Potential user conflicts</li> </ul>	1	
25	Provide dedicated school access alternative	<ul style="list-style-type: none"> <li>• Improves school access</li> <li>• Reduces school congestion</li> <li>• Improves northbound access without forcing US 68 usage</li> <li>• Improves operations</li> <li>• May reduce school schedule queues</li> </ul>	<ul style="list-style-type: none"> <li>• Increases cost</li> <li>• Increases right-of-way impacts</li> <li>• Requires coordination with schools</li> <li>• Requires coordination with City of Lebanon and Marion County</li> </ul>	3	<i>Same idea as 1,24,25,63 Moved forward into further development but then later dropped down to design consideration.</i>
47	Relocate school access to Alignment 1	<ul style="list-style-type: none"> <li>• None noted</li> </ul>	<ul style="list-style-type: none"> <li>• None noted</li> </ul>	1	<i>Assumed Alignment 1 baseline</i>

**Table 11. Idea Evaluation Summary Table**

Idea #	Description	Advantages	Disadvantages	Rating	Comments
48	Extend Alignment 1 south and connect Kentucky Cooperage freight logistics to main operation	<ul style="list-style-type: none"> <li>• Reduces conflicts on US 68</li> <li>• Improves access/operations for Kentucky Cooperage</li> <li>• Reduces traffic at US 68/Kentucky Cooperage access</li> </ul>	<ul style="list-style-type: none"> <li>• Increases right-of-way impacts</li> <li>• Increases cost</li> </ul>	1	<i>Could be used with Concept A or Concept D also Outside the scope of this project but should be considered by other project team</i>
49	Downsize Kentucky Cooperage tunnel to pedestrian/material only instead of truck tunnel	<ul style="list-style-type: none"> <li>• Reduces required profile</li> <li>• Reduces cost</li> </ul>	<ul style="list-style-type: none"> <li>• None noted</li> </ul>	1	<i>Outside the scope of this project</i>
52	Improve Alignment 2 by making Corporate Drive local only by closing Corporate Drive/KY 2154	<ul style="list-style-type: none"> <li>• Discourages trucks from using local roads</li> <li>• Reduces conflicts on N Spalding Avenue</li> </ul>	<ul style="list-style-type: none"> <li>• Requires access to move to N Spalding Avenue</li> </ul>	2	
61	Restripe W Walnut Street at southbound approach to W Main Street for right and through movements	<ul style="list-style-type: none"> <li>• May reduce conflicts</li> <li>• Addresses specific crash type</li> <li>• Improves southbound lane continuity</li> <li>• Low cost solution</li> <li>•</li> </ul>	<ul style="list-style-type: none"> <li>• Driver familiarity</li> <li>• Minor cost increase</li> <li>• Reduces right on red potential</li> <li>• Requires traffic analysis</li> </ul>	2	<i>Reanalyze intersection striping with new truck traffic counts, if moved from this Route</i>
63	Establish a comprehensive circulation plan for school traffic to manage queues	<ul style="list-style-type: none"> <li>• Improves school access</li> <li>• Reduces school congestion</li> <li>• Improves northbound access without forcing US 68 usage</li> <li>• Improves operations</li> <li>• May reduce school schedule queues</li> </ul>	<ul style="list-style-type: none"> <li>• Increases cost</li> <li>• Increases right-of-way impacts</li> <li>• Requires coordination with schools</li> <li>• Requires coordination with City of Lebanon and Marion County</li> </ul>	3	<i>Same idea as 1,24,25,63 Moved forward into further development but then later dropped down to design consideration.</i>

Table 11. Idea Evaluation Summary Table

Idea #	Description	Advantages	Disadvantages	Rating	Comments
<b>Function: Promote Economic Development</b>					
56	Leverage developer to fund bypass sections	<ul style="list-style-type: none"> <li>• Reduces public funds necessary</li> </ul>	<ul style="list-style-type: none"> <li>• Requires extensive coordination</li> <li>• County may not have zoning/subdivision</li> <li>• May discourage development</li> <li>• May defer development</li> </ul>	1	
<b>Function: Reduce Conflicts</b>					
8	Convert signals to roundabouts on Main Street	<ul style="list-style-type: none"> <li>• Provides traffic calming</li> </ul>	<ul style="list-style-type: none"> <li>• Potential right-of-way impacts</li> </ul>	3	<i>Combine 7,8,10,21,34,35</i>
30	Install two roundabouts on N Spalding Avenue at KY 429/St Rose Road and W Walnut Street	<ul style="list-style-type: none"> <li>• Discourages trucks downtown</li> <li>• Improves operations</li> <li>• Improves pedestrian crossing(s)</li> <li>• Eliminates traffic signal(s)</li> <li>• Reduces maintenance</li> <li>• Upgrades approach/intersection</li> </ul>	<ul style="list-style-type: none"> <li>• May increase right-of-way impacts</li> <li>• Access impacts to residents</li> </ul>	3	<i>Moved forward as VE Recommendation.</i>
36	Prevent left turns along Main Street/downtown	<ul style="list-style-type: none"> <li>• Reduces signal phasing</li> <li>• May reduce conflicts</li> </ul>	<ul style="list-style-type: none"> <li>• Out of direction travel</li> <li>• Driver expectancy</li> <li>• Business impacts</li> </ul>	1	



**Table 11. Idea Evaluation Summary Table**

Idea #	Description	Advantages	Disadvantages	Rating	Comments
41	Unsignalized RCUTs at KY 49 and KY 429 along KY 2154	<ul style="list-style-type: none"> <li>• Reduces severity of conflicts</li> <li>• Reduces delay from minor approaches</li> <li>• Reduces maintenance</li> <li>• Eliminates signal</li> </ul>	<ul style="list-style-type: none"> <li>• Increases out of direction travel</li> <li>• Driver unfamiliarity</li> <li>• Median may be required to divide traffic (curb, fixed object)</li> <li>• Requires bulbouts and acceleration lanes</li> </ul>	3	<p><i>Combine 22,41 Consider as an improvement to overall NW bypass section. Moved forward into further development but then later dropped down to design consideration.</i></p>
42	Improve intersections for truck traffic at KY 49 and KY 429 along KY 2154	<ul style="list-style-type: none"> <li>• Improves freeflow to incentivize use of bypass</li> </ul>	<ul style="list-style-type: none"> <li>• Increases cost</li> </ul>	3	<p><i>Same as 41 Moved forward into further development but then later dropped down to design consideration.</i></p>
43	Install green-T at N Spalding Avenue and Corporate Drive	<ul style="list-style-type: none"> <li>• Southbound movement does not have to stop</li> <li>• Improves operations</li> <li>• Reduces conflicts</li> </ul>	<ul style="list-style-type: none"> <li>• Driveway impacts</li> <li>• May require signal</li> <li>• Increases right-of-way impacts</li> <li>• May encourage trucks to stay on N Spalding Avenue</li> <li>• Driver familiarity</li> </ul>	1	
45	Use a Continuous green-T at US 68 and Barbers Mill Road	<ul style="list-style-type: none"> <li>• Reduces conflicts</li> <li>• Improves operations</li> </ul>	<ul style="list-style-type: none"> <li>• Driveway access impacts to residents on south side of US 68</li> <li>• Requires widening</li> <li>• Increases right-of-way impacts</li> <li>•</li> </ul>	1	

**Table 11. Idea Evaluation Summary Table**

Idea #	Description	Advantages	Disadvantages	Rating	Comments
60	Use roundabout at Barbers Mill Road and US 68	<ul style="list-style-type: none"> <li>• Improves traffic control</li> <li>• Reduces conflict</li> <li>• May improve school traffic flow</li> <li>• Calms traffic/reduces speeds near school</li> </ul>	<ul style="list-style-type: none"> <li>• Increases impervious</li> <li>• Increases utility impacts</li> <li>• Increases right-of-way impacts</li> </ul>	3	<i>Moved forward as VE Recommendation.</i>
<b>Function: Reduce Demand</b>					
20	Relocate Cooperage/Independent Stave to NW KY 2154 corridor	<ul style="list-style-type: none"> <li>• Utilizes existing bypass area</li> <li>• Reduces traffic on US 68/in the area</li> <li>• Redevelopment opportunity</li> <li>• Eliminates need for tunnel</li> </ul>	<ul style="list-style-type: none"> <li>• Requires extensive coordination with industry</li> <li>• Increases cost</li> <li>• Timing may not work with their planned expansion</li> <li>• May reduce bourbon/school conflict</li> </ul>	1	<i>Outside the scope of this project but should be considered by other project team</i>
31	Introduce all way stop signs downtown to improve pedestrian accommodations	<ul style="list-style-type: none"> <li>• Improves pedestrian accommodations</li> </ul>	<ul style="list-style-type: none"> <li>• None noted</li> </ul>	3	<i>Combine 7,8,10,21,34,35</i>
46	Relocate schools to KY 2154 bypass	<ul style="list-style-type: none"> <li>• May be an access management solution</li> <li>• May reduce traffic demand in the area</li> </ul>	<ul style="list-style-type: none"> <li>• Increases cost significantly</li> </ul>	1	

**Table 11. Idea Evaluation Summary Table**

Idea #	Description	Advantages	Disadvantages	Rating	Comments
<b>Function: Relieve Congestion</b>					
24	Upgrade existing Corporate Drive and intersection at KY 2154, include backage road for school access to connect Corporate Drive to Barbers Mill Road	<ul style="list-style-type: none"> <li>• Improves school access</li> <li>• Reduces school congestion</li> <li>• Improves northbound access without forcing US 68 usage</li> <li>• Improves operations</li> <li>• May reduce school schedule queues</li> </ul>	<ul style="list-style-type: none"> <li>• Increases cost</li> <li>• Increases right-of-way impacts</li> <li>• Requires coordination with schools</li> <li>• Requires coordination with City of Lebanon and Marion County</li> </ul>	3	<i>Same idea as 1,24,25,63 Moved forward into further development but then later dropped down to design consideration.</i>
51	Sync up entire corridor with adaptive signaling	<ul style="list-style-type: none"> <li>• May improve operations</li> <li>• Improves throughput</li> <li>• Reduces congestion</li> <li>• Reduces maintenance</li> </ul>	<ul style="list-style-type: none"> <li>• May increase cost (new controllers)</li> <li>• May require additional management</li> <li>• Requires additional equipment (fiber, detectors, cameras)</li> <li>• Cost benefit may not apply to this project</li> </ul>	1	
<b>Function: Repurpose Roadway Space</b>					
9	Eliminate on-street parking to improve truck accommodations downtown and facilitate turning movements	<ul style="list-style-type: none"> <li>• Facilitates truck turning movements</li> </ul>	<ul style="list-style-type: none"> <li>• Business owner outcry</li> <li>• Public outcry</li> <li>• Does not discourage trucks from downtown</li> </ul>	1	
<b>Function: Separate Truck Traffic</b>					
29	Change truck route designation out of downtown	<ul style="list-style-type: none"> <li>• Encourages trucks to use different route</li> <li>• Relatively low cost solution</li> </ul>	<ul style="list-style-type: none"> <li>• Requires coordination with other KYTC planning/systems</li> </ul>	3	<i>Moved forward as VE Recommendation.</i>
<b>Function: Support Loads</b>					

**Table 11. Idea Evaluation Summary Table**

Idea #	Description	Advantages	Disadvantages	Rating	Comments
54	Use a 2+1 (alternating passing lanes) typical section for the southern bypass	<ul style="list-style-type: none"> <li>• Improves LOS</li> <li>• Increases passing opportunity</li> <li>• Public perception</li> <li>• Improves truck operations for future development</li> <li>• Reduces access</li> <li>• May better serve roadway as bypass</li> </ul>	<ul style="list-style-type: none"> <li>• Reduces access</li> <li>• Increases right-of-way impacts</li> <li>• Increases cost</li> <li>• Cost may not be warranted at this time</li> </ul>	2	<i>May apply to entire bypass</i>

# 7 Development Phase

This phase of the Value Methodology Job Plan takes the ideas that ranked the highest in the Evaluation Phase and further develops them into full VE recommendations. In many cases, it is possible that one or more ideas were combined to form an overall recommendation, which was then evaluated further by the VE team.

In the case of this project, of the 64 ideas that were generated during the Creativity Phase, 24 of those ideas were evaluated high enough to be developed further and combined. Some of the ideas were deemed more appropriate as a design consideration for the project team, rather than developed into a VE recommendation (Section 7.5). For the Development Phase, narratives, drawings, calculations, and cost estimates were prepared for each recommendation.

The VE recommendation documents in this section are presented as written by the team during the VE study. While they have been edited from the draft VE report to correct errors or better clarify the recommendation, they represent the VE team’s findings during the VE study.

Each recommendation consists of a summary of the baseline concept, a description of the suggested change, a listing of its advantages and disadvantages, discussion of schedule and risk impacts (if applicable), a cost comparison, change in performance, and a narrative comparing the baseline design with the recommendation. Sketches, calculations, and performance measure ratings are also presented. The cost comparisons reflect a comparable level of detail as in the baseline estimate.

## 7.1 Summary of Recommendations

Table 12 is a summary of all recommendations generated and their cost impact to the project.

The recommendations identified all consider multiple aspects of total value, including assessing the impacts to performance, cost, time, and risk in comparison to the baseline concept. However, since there are multiple possible baseline options, comparison with any or all of them is impractical.

The VE team combined several of these recommendations into a VE Proposal which is described in Section 7.5.

#	Recommendation Title	Total Cost (\$M)
1	Add traffic calming features along Main Street	\$0.6
2	Improve pedestrian accommodations	\$0.1
3	Create alternative southern bypass concept	\$15.7
4	Create vital local connections in southern Lebanon	\$13.0

#	Recommendation Title	Total Cost (\$M)
5	Change the Federal Designated Truck Route to KY 2154	\$0.0
6	Convert KY 2154 to US 68 and US 68 to US 68 Business	\$2.2
7	Use a roundabout at Barber Mills Road	\$0.5
8	Create alternative northeast alignment along Corporate Drive	\$3.6
9	Use roundabouts along KY 55/N Spalding Avenue	\$1.8
10	Use roundabouts along N Spalding Avenue near downtown	\$1.0

### 7.1.1 FHWA Functional Benefit Criteria

Each year, state departments of transportation are required to report on VE recommendations to the Federal Highway Administration (FHWA). In addition to cost implications, FHWA requires state departments of transportation to evaluate each approved recommendation in terms of the project features that recommendation benefits. If a specific recommendation can be shown to provide benefit to more than one feature described below, count the recommendation in each category that is applicable. These same criteria can be found on each of the individual recommendations that follow.

- **Safety:** Recommendations that mitigate or reduce hazards on the facility.
- **Operations:** Recommendations that improve real-time service and/or local, corridor, or regional levels of service of the facility.
- **Environment:** Recommendations that successfully avoid or mitigate impacts to natural and or cultural resources.
- **Construction:** Recommendations that improve work zone conditions or expedite the project delivery.
- **Right-of-way:** Recommendations that lower the impacts or costs of right-of-way.

## 7.2 Value Engineering Recommendation Approval

The resolution or disposition of recommendations is based on the information in this report and is independent of the proceeding of the VE study. HDR has no participation, direct or indirect, in such decisions. The VE Recommendation Approval form shown in Appendix B is intended to aid the project manager in tracking and informing the state Value Engineer in annual reporting of VE activities to FHWA. Resolution and disposition of recommendations contained in Appendix B are pending.

## 7.3 Individual Recommendations

Based on the evaluation process, individual recommendations were developed. Each recommendation consists of a summary of the baseline concept, a description of the

recommendation, a listing of its advantages and disadvantages, and a brief narrative that includes justification, sketches, photos, assumptions, and calculations as developed by the VE team. Final recommendations can be found beginning on page 7-4.

<b>VE RECOMMENDATION NO. 1: ADD TRAFFIC CALMING FEATURES ALONG MAIN STREET</b>		<b>Idea Nos. 7, 8, 10, 21, 34, 26</b>		
<b>Baseline Concept</b>				
The baseline concept does not include operational improvements along Main Street (US 68).				
<b>Recommendation Concept</b>				
The VE team recommends the following concepts to be included on Main Street (US 68) between Ryder Cemetery and Walnut Street in order to reduce truck traffic, reduce speeds, and increase pedestrian safety:				
<ol style="list-style-type: none"> <li>1. Connect Areas with Missing Sidewalks &amp; Define the Driveway Access Points</li> <li>2. Remove Passing Opportunities</li> <li>3. Restripe 10.5-foot to 11-foot lanes between A) Woodlawn Avenue and Harrison Street and B) Depot Street and Walnut Street</li> <li>4. Install Curb Extensions/Enhanced Pedestrian Crossings at Harrison Street and Depot Street</li> <li>5. Install Stop Signs (4-way) at Harrison Street</li> <li>6. Install Mini-Roundabouts at Woodlawn Avenue and Walnut Street</li> <li>7. Restrict Turns at Depot Street and Remove Traffic Signal</li> <li>8. Provide Opportunities for Outdoor Dining</li> </ol>				
<b>Advantages</b>		<b>Disadvantages</b>		
<ul style="list-style-type: none"> <li>• Provides traffic calming</li> <li>• Reduces speeds downtown</li> <li>• Discourages truck/through traffic downtown</li> <li>• Increases walkability of downtown</li> <li>• Reduces severity of conflicts</li> <li>• Increases pedestrian safety</li> <li>• Increases livability and pedestrian experience of downtown</li> </ul>		<ul style="list-style-type: none"> <li>• Some concepts have higher costs to implement long-term (such as reconstructing curb for sidewalks)</li> <li>• Maintenance/emergency services may have preferences with roundabouts</li> <li>• Drives may not be familiar with concepts such as roundabouts</li> <li>• Narrow lanes and additional pedestrian facilities reduces driver comfort/buffer distance</li> <li>• Discourages through traffic downtown (for businesses)</li> </ul>		
<b>Cost Summary</b>		<b>Construction</b>		<b>Right-of-way</b>
Baseline Concept		\$0		\$0
Recommendation Concept		\$637,727		Not Quantified
Cost Avoidance/(Added Value)		(\$637,727)		(\$637,727)
<b>FHWA Function Benefit</b>				
<b>Safety</b>	<b>Operations</b>	<b>Environment</b>	<b>Construction</b>	<b>Right-of-way</b>
✓	✓	✓		



**VE RECOMMENDATION NO. 1:  
ADD TRAFFIC CALMING FEATURES ALONG MAIN  
STREET**

**Idea Nos.  
7, 8, 10, 21, 34, 26**

**Discussion/Sketches/Photos/Calculations**

**Technical Discussion/Sketches**

Main Street (US 68) within downtown has five distinct character zones within what this study is considering downtown. Each zone has a different experience as a driver and pedestrian based on the roadway cross section, pedestrian facilities, and scale of adjacent development. These areas between Ryder Cemetery and Walnut Street have elements within both the right-of-way and adjacent private parcels that are reflective of a downtown with smaller setbacks, taller buildings, on-street parking, and increased pedestrian activities. A summary of the existing conditions of each zone is outlined below.

1. Zone 1: Ryder Cemetery to Taylor Avenue – This section of Main Street is characterized by a two-lane rural section with 11-foot lane widths, uncontrolled/undefined driveway access and a speed limit of 35 mph. An intermittent, five-foot integral curb and sidewalk, or striped pedestrian area (adjacent to the travel lane), is located on the north side of the road. Overhead utilities exist on both sides of the road. The land uses, excluding the cemetery, are commercial in nature.
2. Zone 2: Taylor Avenue to Harrison Street – The road transitions to an urban section at Taylor Avenue with two travel lanes (13-to-17-foot width), a five-foot integral curb and sidewalk generally on both sides of the road, and a speed limit of 35 mph. Overhead utilities are present on both sides of the road and frequently located in the middle of the sidewalk (when present). Large driveways/access points with uncontrolled access/undefined entrances also exist in this zone. Turn lanes are present at Woodlawn Avenue in both directions with a traffic signal and pedestrian crosswalks. Land uses begin to transition from commercial to residential in this area with decreasing setbacks from the road.
3. Zone 3: Harrison Street to Spalding Avenue – While only one block long, this zone has the largest visual transition into the core of downtown. The curb line is better defined and consistent (minimal driveways), providing a visual element separating motorized from non-motorized areas, and lane widths narrow to about 11 or 12 feet with a speed limit of 35 mph. On-street parking begins at Harrison Street, and decorative street lights (with banners, flags, and/or hanging baskets), a brick banding on the sidewalk edge, and larger/older trees are present. Buildings are closer to the road with some structures having no setback from the right-of-way. Most land uses are residential in nature but the structures have an urban character.
4. Zone 4: Spalding Avenue to Depot Street – This two-block zone is still a two-lane roadway with 11-to-12-foot widths and a speed limit of 25 mph. On-street parking is located on both sides of the road with turning lanes replacing this at intersections. The sidewalk expands in this area to eight to ten feet (integral curb and sidewalk) with consistent decorative street lighting and brick banding on the sidewalk edge. The land uses are predominantly commercial with one to three story structures that are built to the right-of-way (zero lot line setback). Awnings, storefront windows, and other architectural details provide a pedestrian scale. The intersections at Spalding Avenue and Proctor Knott Avenue are signalized and include multiple turning movements with left turn lanes in each direction. Pedestrian crosswalks are marked at these intersections. A signalized intersection

**VE RECOMMENDATION NO. 1:  
ADD TRAFFIC CALMING FEATURES ALONG MAIN  
STREET**

**Idea Nos.  
7, 8, 10, 21, 34, 26**

with marked pedestrian crosswalks is also located at North and South Depot Streets with only one turning lane.

5. Zone 5: Depot Street to Walnut Street – This section transitions from the core of downtown to the further suburban development located past Walnut Street. This is a two-lane urban road (curb and gutter) with 17+-foot lane widths. A five-foot sidewalk that is separated from the road by a 1-to 2-foot grass area, and a speed limit of 35 mph. Wide driveways/access points with uncontrolled access/undefined entrances also exist in this zone. Land uses begin to transition from commercial to residential in this area with increasing setbacks from the road.

Recommended concept:

Traffic calming can create a more livable and vibrant downtown by increasing road safety and providing enhanced mobility for pedestrians. The goal of the concepts included in this recommendation strive to slow traffic to a safe and appropriate speed, increase awareness of pedestrians, discourage truck/through traffic that is not compatible with downtown and pedestrians, and reduce crash frequency and severity.

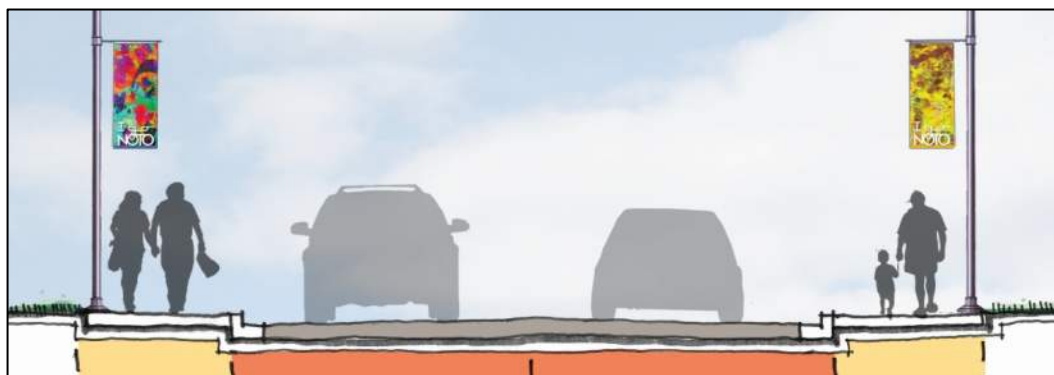
This recommendation tries to balance the ability to make significant changes to a downtown area with the recognition of changes that can be reasonably implemented based on the resources likely available to a smaller city. The following concepts should be considered on Main Street (US 68) between Ryder Cemetery and Walnut Street to reduce through traffic (specifically trucks), reduce speeds, and increase pedestrian safety.

**6. Connect Areas with Missing Sidewalks & Define the Driveway Access**

**Points:** The gaps in the sidewalk network along Main Street should be completed, including upgrading the striped area between Ryder Cemetery to Taylor Avenue. Priority should be given to sections that do not have any facilities, and new sidewalks should be installed where they are missing with a minimum width of five feet and ADA compliant. Sidewalks should remain clear of utility poles and other obstacles. Eventually all sections of Main Street should be upgraded to be ADA compliant and provide a five-foot with that is clear of obstacles. If the road is reconstructed in the future, the curb could be moved to accommodate additional sidewalk width.

Many commercial driveways/access points along the corridor are undefined and uncontrolled. These should be limited and delineated with some separation between the travel lane and parking areas (more than just striping).

*Example Integral Sidewalk:*

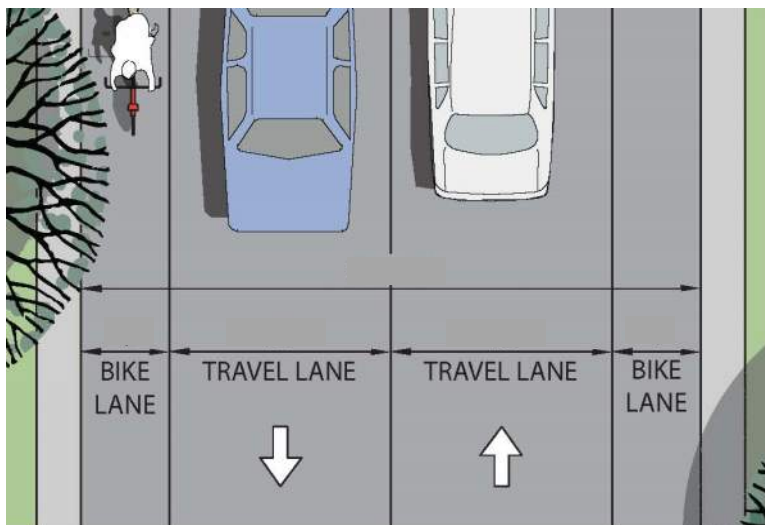


**VE RECOMMENDATION NO. 1:  
ADD TRAFFIC CALMING FEATURES ALONG MAIN  
STREET**

**Idea Nos.  
7, 8, 10, 21, 34, 26**

7. **Remove Passing Opportunities:** Some sections of Main Street allow for passing in both directions. This should be prohibited and the center line should be re-stripped as a double, solid line from Ryder Cemetery to Walnut Street.
8. **Restripe 10.5-foot to 11-foot lanes between A) Woodlawn Avenue and Harrison Street and B) Depot Street and Walnut Street:** The current lane width in these sections are 13 to 17 feet in width. The lanes can be reduced to 10.5 or 11 feet in width with the remaining space (average of 4 to 5 feet) can be striped as a bike lane or shoulder. This solution balances the need to narrow the roadway with the costs related with reconstructing the curb and gutter. If Main Street is reconstructed in the long-term, the lane width should be reduced and the curb/gutter should be reconstructed accordingly.

*Example Bike Lane/Shoulder Striping:*



**VE RECOMMENDATION NO. 1:  
ADD TRAFFIC CALMING FEATURES ALONG MAIN  
STREET**

**Idea Nos.  
7, 8, 10, 21, 34, 26**



9. **Install Curb Extensions/Enhanced Pedestrian Crossings at Harrison Street and Depot Street:** Curb extensions should be installed at intersections along Main Street where there is on-street parking and where the road cross section allows. Harrison Street and Depot Street currently have configurations that would allow for this. Harrison Street should have curb extensions at all four corners of the intersection while Depot Street should have curb extensions installed on the eastern crosswalk (see also “Restrict Turns at Depot Street and Remove Traffic Signal”). These should bring the curb to the edge of the parking and should enhanced paving and/or incorporate appropriate landscaping/street furniture.

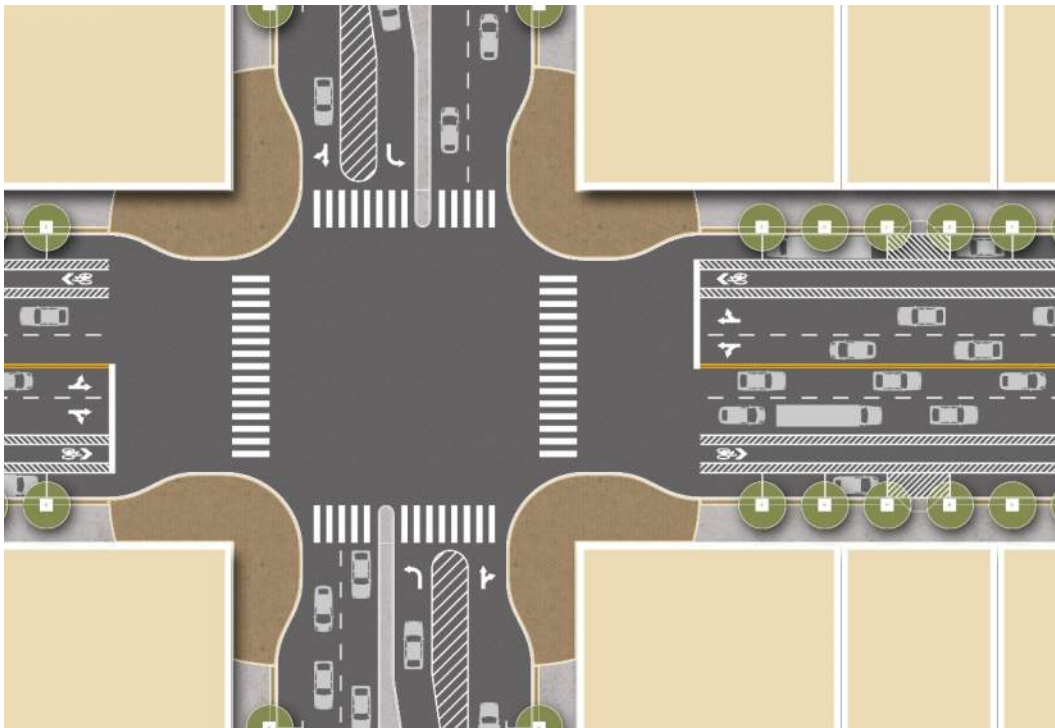
The crosswalks at these intersections should also be upgraded from the standard MUTCD markings. Upgrades could include varying materials (pavers, stamped asphalt, graphic thermoplastic markings, etc.), improved lighting, and/or warning signage. All enhancements should reflect the aesthetic character of downtown.

**VE RECOMMENDATION NO. 1:  
ADD TRAFFIC CALMING FEATURES ALONG MAIN  
STREET**

**Idea Nos.  
7, 8, 10, 21, 34, 26**



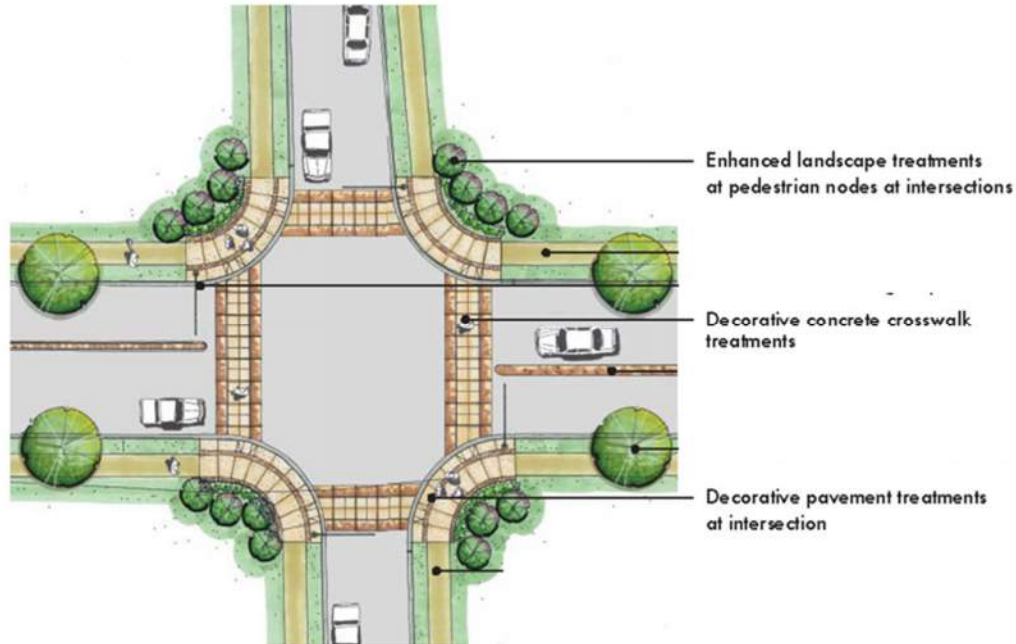
*Example Curb Extension:*



*Example Pedestrian Crosswalk Enhancements:*

**VE RECOMMENDATION NO. 1:  
ADD TRAFFIC CALMING FEATURES ALONG MAIN  
STREET**

**Idea Nos.  
7, 8, 10, 21, 34, 26**



**10. Install Stop Signs (4-way) at Harrison Street:** A four-way stop should be installed at Harrison Street and Main Street to slow traffic speeds and provide safer access from Harrison. The pedestrian crosswalks should also be upgraded with varying materials and lighting.



*Example of Enhanced Crosswalk Materials:*

**11. Install Mini-Roundabouts at Woodlawn Avenue and Walnut Street:** The current signals at Woodlawn Avenue and Walnut Street should be removed and replaced with mini-roundabouts. This would show traffic as it moves through the intersection. While a goal is to discourage trucks from using the route, both roundabouts should provide accommodations for trucks. Enhanced pedestrian crossings should also be incorporated into the roundabouts with upgraded

**VE RECOMMENDATION NO. 1:  
ADD TRAFFIC CALMING FEATURES ALONG MAIN  
STREET**

**Idea Nos.  
7, 8, 10, 21, 34, 26**

crosswalk materials, plantings, and aesthetic improvements that reinforce the character of downtown.



*Examples of Mini-Roundabout:*



*Example Enhanced Pedestrian Crossings at Roundabout:*

- 12. Restrict Turns at Depot Street and Remove Traffic Signal:** Turning movements from South Depot Street and North Depot Street onto Main Street should be limited to right in/right out movements only. This would limit the conflict points at this skewed intersection. Additionally, the traffic signal at this intersection should

**VE RECOMMENDATION NO. 1:  
ADD TRAFFIC CALMING FEATURES ALONG MAIN  
STREET**

**Idea Nos.  
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then be removed (see also “Install Curb Extensions/Enhanced Pedestrian Crossings”).



- 13. Provide Opportunities for Outdoor Dining:** Options to allow for outdoor dining should be considered not just within the existing sidewalk; however, through temporary conversions of on-street parking to dining space. An issue with many existing downtown sidewalks is that the width required to maintain ADA compliance is hard to achieve with outdoor dining on the sidewalk itself. Many communities have found creative ways to temporarily shift one or more on-street parking spaces to outdoor dining areas on roads with low travel speeds. For this to occur, a barrier or separation from the travel lane is need. This is an attractive enhancement for tourism, and local economic development.



**VE RECOMMENDATION NO. 1:  
ADD TRAFFIC CALMING FEATURES ALONG MAIN  
STREET**

**Idea Nos.  
7, 8, 10, 21, 34, 26**



*Example Flex Parking/Dining:*

**Assumptions/Calculations**

- 1. Connect Areas with Missing Sidewalks & Define the Driveway Access Points:**
  - Existing sidewalks would not be replaced unless Main Street is ever reconstructed
  - Would occur within existing right-of-way
  - 2,000 linear feet: Missing gaps would be constructed with 5 width, 4.5" depth
  - For purposes of this analysis, assumes no utilities are relocated; however, this could likely be required

<p style="text-align: center;"><b>VE RECOMMENDATION NO. 1: ADD TRAFFIC CALMING FEATURES ALONG MAIN STREET</b></p>	<p style="text-align: center;"><b>Idea Nos. 7, 8, 10, 21, 34, 26</b></p>
<ul style="list-style-type: none"> <li>• Intersection/ADA upgrades would be done as separate project as KYTC or city completes resurfacing or other projects</li> </ul> <p><b>2. Remove Passing Opportunities:</b></p> <ul style="list-style-type: none"> <li>• No construction would occur; only restriping with thermoplastic.</li> <li>• Would occur within existing right-of-way</li> <li>• 1200 linear feet</li> </ul> <p><b>3. Restripe 10.5-foot to 11-foot lanes between A) Woodlawn Avenue and Harrison Street and B) Depot Street and Walnut Street:</b></p> <ul style="list-style-type: none"> <li>• No construction would occur; only restriping with thermoplastic.</li> <li>• Would occur within existing right-of-way</li> <li>• If Main Street is ever reconstructed, curb would be moved in to allow for larger sidewalk or separation between sidewalk/travel lane.</li> <li>• New thermoplastic striping required at edge of bike lane/shoulder and travel lane in each direction</li> <li>• Woodlawn to Harrison = 1450 linear feet</li> <li>• Depot to Walnut = 2100 linear feet</li> </ul> <p><b>4. Install Curb Extensions/Enhanced Pedestrian Crossings at Harrison Street and Depot Street:</b></p> <ul style="list-style-type: none"> <li>• 4 curb extensions at Harrison Street and 2 extensions at Depot Street</li> <li>• Would occur within existing right-of-way</li> <li>• Basic improvement could include just curbing/concrete and markings. Enhanced option could include enhanced paving, landscaping, benches, lighting. Cost estimate includes only basic improvements.</li> <li>• 160 sq ft, 32 LF curb per bump out with 24 linear feet thermoplastic crosswalk</li> </ul> <p><b>5. Install Stop Signs (4-way) at Harrison Street:</b></p> <ul style="list-style-type: none"> <li>• Includes stop signs and pedestrian crossings.</li> <li>• Would occur within existing right-of-way</li> <li>• Basic improvement could include just curbing/concrete and markings. Enhanced option could include enhanced paving, landscaping, benches, lighting.</li> <li>• Cost estimate includes only basic improvements</li> </ul> <p><b>6. Install Mini-Roundabouts at Woodlawn Avenue and Walnut Street:</b></p> <ul style="list-style-type: none"> <li>• No right of way required for mini</li> <li>• Resurfacing required in some areas for both roundabouts</li> <li>• For purposes of this analysis, assumes no utilities are relocated; however, this could likely be required</li> <li>• Lump sum cost assumed for each mini-roundabout based on recent bids for KYTC</li> </ul> <p><b>7. Restrict Turns at Depot Street and Remove Traffic Signal:</b></p> <ul style="list-style-type: none"> <li>• Would occur within existing right-of-way</li> <li>• Minor construction on North and South Depot Street to restrict left turn movements and to remove signal.</li> <li>• 30 LF curb, 50 sq ft per intersection of curb</li> </ul> <p><b>8. Provide Opportunities for Outdoor Dining:</b></p> <ul style="list-style-type: none"> <li>• Would occur within existing right-of-way</li> </ul>	

**VE RECOMMENDATION NO. 1:  
ADD TRAFFIC CALMING FEATURES ALONG MAIN  
STREET**

**Idea Nos.  
7, 8, 10, 21, 34, 26**

- Demonstration project could use temporary materials. If successful, more permanent construction techniques could be used that could include removable fencing, bollards, etc.
- If Main Street is ever reconstructed, a curbless cross section could be considered that would allow for a more seamless flex area between the sidewalk and parking areas.
- Assumes costs are incurred by each individual restaurant



**VE Study Life-Cycle Costs Calculations**

East Lebanon By-Pass Planning Level Study

Component	Baseline Concept				VE Recommended Concept		
	Unit	Quantity	Cost/Unit	Total	Quantity	Cost/Unit	Total
1. Missing Sidewalks (Concrete)	CY	0	\$ 100.00	\$ -	153	\$ 100.00	\$ 15,278
1. Install curb & gutter	FT	0	\$ 26.52		2100	\$ 26.52	\$ 55,692
2. Restrict Passing (Striping)	FT	0	\$ 1.10	\$ -	2400	\$ 1.10	\$ 2,640
3. Restripe 10.5-foot to 11-foot lanes	FT	0	\$ 1.10	\$ -	14200	\$ 1.10	\$ 15,620
4. Enhanced Ped Crossings	FT	0	\$ 26.52	\$ -	192	\$ 26.52	\$ 5,092
4. Pavement	CY	0	\$ 100.00	\$ -	960	\$ 100.00	\$ 96,000
4. Crosswalk	LF	0	\$ 5.78	\$ -	288	\$ 5.78	\$ 1,665
5. Stop Signs (4-way)	SF	0	\$ 31.00	\$ -	16	\$ 31.00	\$ 496
5. Crosswalk	SQFT	0	\$ 5.78	\$ -	192	\$ 5.78	\$ 1,110
6. Mini Roundabouts	LS	0	\$ 150,000.00		2	\$ 150,000.00	\$ 300,000
7. Concrete Islands and Remove Traffic Signal	CY	0	\$ 100.00	\$ -	1	\$ 100.00	\$ 139
7. Curb & gutter	FT	0	\$ 26.52	\$ -	60	\$ 26.52	\$ 1,591
		0		\$ -		\$ -	\$ -
<b>Subtotal Construction</b>				\$ -			\$ 495,322
Mark-Up (Mark-Up MOT, Drainage, 25% cc 29%)				\$ -			\$ 142,405
<b>Total Construction</b>				\$ -			\$ 637,727
Right of Way Costs				\$ -			\$ -
<b>TOTAL CAPITAL COST</b>				\$ -			\$ 637,727
<b>COST CAPITAL SAVINGS / (VALUE ADDED)</b>							\$ (637,727)

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<b>VE RECOMMENDATION NO. 2: IMPROVE PEDESTRIAN ACCOMMODATIONS</b>		<b>Idea Nos. 26, 27</b>		
<b>Baseline Concept</b>				
<p>The baseline concept does not include operational improvements along Main Street (US 68) or any connecting streets.</p> <p>A ten-foot shared use path is currently being designed on the north side of US 68 in front of the school campus as part of a separate project.</p>				
<b>Recommendation Concept</b>				
<p>The VE team recommends the following concepts to be included on Main Street (US 68) and key intersecting roads between Barbers Mill Road and Cemetery Road in order to reduce truck traffic, reduce speeds, and increase pedestrian safety:</p> <ol style="list-style-type: none"> <li>1. Extend sidewalk accommodations west of downtown along Main Street (US 68) from Taylor Avenue to Barbers Mill Road to provide connectivity between destinations.</li> <li>2. Extend sidewalk accommodations along key connecting streets to Main Street to provide connectivity between housing areas and destinations.</li> <li>3. Upgrade pedestrian crossings along Main Street from Barbers Mill Road to Cemetery Road.</li> </ol>				
<b>Advantages</b>		<b>Disadvantages</b>		
<ul style="list-style-type: none"> <li>• Improves pedestrian accommodations</li> <li>• Reduces conflicts</li> <li>• Removes pedestrians from shoulders</li> <li>• Encourages other modes of transportation</li> <li>• May reduce traffic demand</li> </ul>		<ul style="list-style-type: none"> <li>• Increases right-of-way impacts if additional right-of-way is needed</li> <li>• May impact some businesses by adding curb/not allowing uncontrolled access to parking lots</li> <li>• Increases cost</li> <li>• Increases maintenance</li> <li>• Increases impervious surface</li> <li>• Driver expectancy of pedestrians at access points</li> </ul>		
<b>Cost Summary</b>		<b>Construction</b>		<b>Right-of-way</b>
		<b>Total</b>		
Baseline Concept		\$0		\$0
Recommendation Concept		\$101,992		Not Quantified
Cost Avoidance/(Added Value)		(\$101,992)		(\$101,992)
<b>FHWA Function Benefit</b>				
<b>Safety</b>	<b>Operations</b>	<b>Environment</b>	<b>Construction</b>	<b>Right-of-way</b>
✓	✓	✓		

**VE RECOMMENDATION NO. 2:  
IMPROVE PEDESTRIAN ACCOMMODATIONS**

**Idea Nos.  
26, 27**

Discussion/Sketches/Photos/Calculations

**Technical Discussion/Sketches**

A sidewalk generally is present along both sides of Main Street (US 68) between Walnut Street and Taylor Avenue (width varies from five feet to ten feet). Portions of sidewalks also exist between Taylor Avenue and Corporate Drive on the north side. Sidewalks are present on both sides of Main Street from Walnut Street to Cemetery Road (five-foot width with one- or two-foot grass separation from roadway); however, wider commercial driveways and uncontrolled access points exist along this portion. No marked crosswalks exist west of Walnut Street.

Multiple streets feed into Main Street and could provide pedestrian connectivity. Sidewalks do not currently exist along Sulphur Springs Roads, Corporate Drive, and Taylor Avenue.

A five-foot integral curb and sidewalk is currently located along Woodlawn from Spalding Avenue to the fairgrounds (located on the east side from Spalding to just north of Main Street where it crosses without a marked crosswalk to the west side of the street to the fairgrounds). A five-to-ten-foot sidewalk exists along both sides of Spalding Avenue from just south of Corporate Drive to Chandler Street; however, functionally ends south of Chandler. Sidewalks also currently exist along portions of Forest Street, Harrison Street, Proctor Knott Avenue, Depot Street, College Street, Rowntree Court, and Walnut Street that vary in condition. Improvements likely need to be completed along all portions of sidewalks to be ADA compliant.

A ten-foot shared use path is currently being designed on the north side of US 68 in front of the school campus.

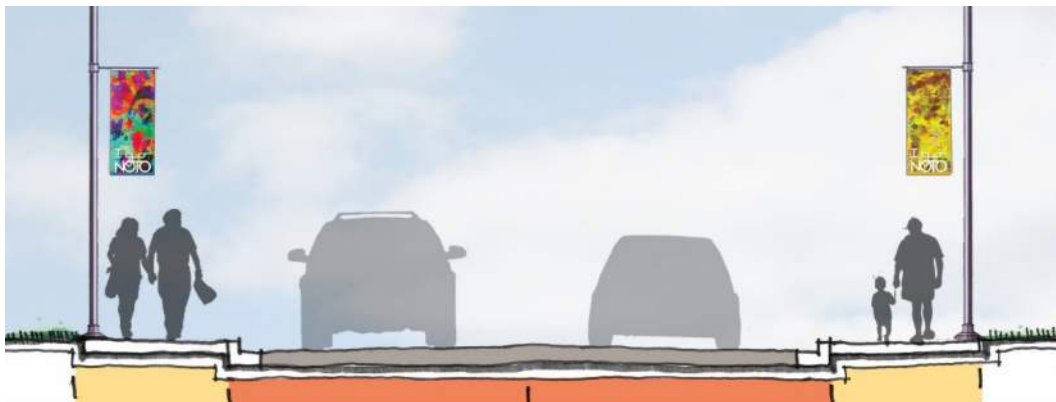
Long-term improvements should be made to the existing sidewalks to ensure ADA compliance, including sidewalk widths/clear passing widths, crosswalks, ramps/truncated domes, etc. It is assumed this would occur outside of this study.

Recommended concept:

**1. Extend sidewalk accommodations west of downtown along Main Street (US 68) from Taylor Avenue to Barbers Mill Road.**

Sidewalks (minimum five-foot width) should be provided from Taylor Avenue to Barbers Mill Road generally on both sides of the street. A ten-foot shared use path is currently being designed on the north side of US 68 in front of the school campus. A sidewalk in front of the cemetery could pose issues due to limited right-of-way and topography.

\*Note that sidewalks along Main Street from Taylor Avenue to the cemetery is included in Recommendation 1 and therefore not included here.



**VE RECOMMENDATION NO. 2:  
IMPROVE PEDESTRIAN ACCOMMODATIONS**

**Idea Nos.  
26, 27**

**2. Extend sidewalk accommodations along key connecting streets to Main Street.**

Sidewalks (minimum five-foot width) should be provided along at least one side of the street along Sulphur Springs Road from Main Street to about 0.5 to 0.75 miles south to connect the residential areas to Main Street.

A shared use path should be continued along Corporate Drive that connects to the future path along US 68 in front of the school campus.

\*Note that a shared use path along Corporate Drive is included in Recommendation 10 and therefore not included here.

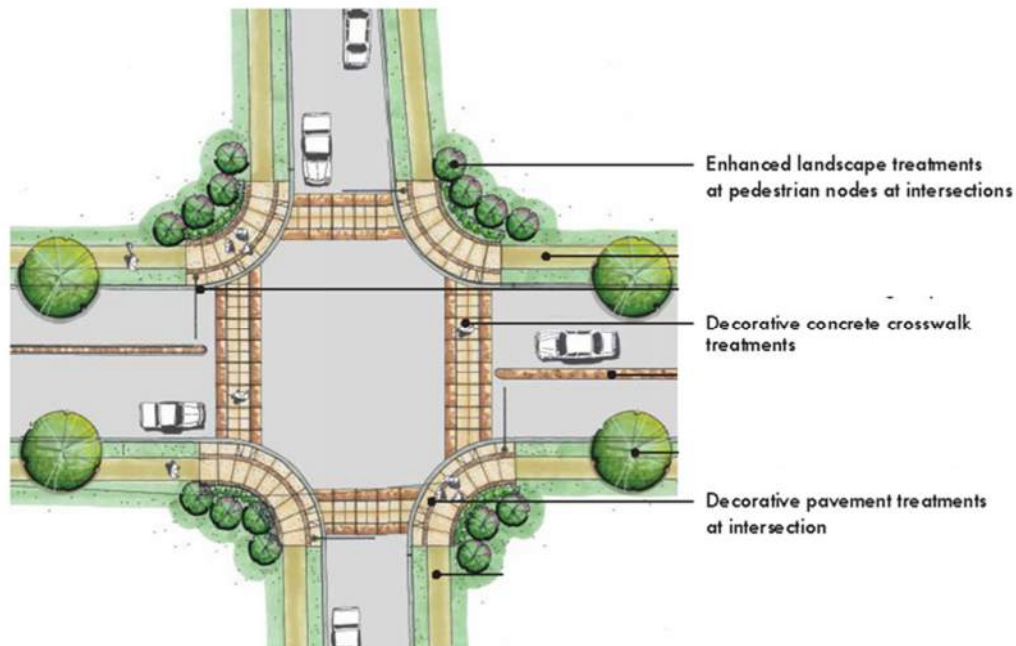
**3. Upgrade pedestrian crossings along Main Street from Barbers Mill Road to Cemetery Road.**

Very few pedestrian crossings are marked throughout the study area. Enhanced pedestrian crossings at controlled intersections are proposed in Recommendation 1 and therefore not included here.

Additional mid-block crossings should be considered between Walnut Street and Cemetery Road. A basic crossing with markings and a median refuge should be installed every quarter to half mile. Depending upon traffic volumes, a pedestrian activated signal could be needed.

A pedestrian crossing should also be installed at Sulphur Springs Road/Main Street. The crosswalks at these locations should also be upgraded from the standard MUTCD markings.

Upgrades could also include varying materials (pavers, stamped asphalt, graphic thermoplastic markings, etc.), improved lighting, and/or warning signage.



*Example of Pedestrian Crosswalk Enhancements:*

**VE RECOMMENDATION NO. 2:  
IMPROVE PEDESTRIAN ACCOMMODATIONS**

**Idea Nos.  
26, 27**



*Example of Enhanced Crosswalk Materials:*

**Assumptions/Calculations**

**1. Extend sidewalk accommodations west of downtown along Main Street (US 68) from Taylor Avenue to Barbers Mill Road.**

- The sidewalks along Main Street from Taylor Avenue to the cemetery are included in Recommendation 1 and therefore not included here. A shared use path is included in Recommendation 10 and therefore not included here.
- Existing sidewalks would not be replaced unless Main Street is ever reconstructed
- Assumes sidewalks occur within existing right-of-way
- 6,500 linear feet: Missing gaps would be constructed with 5 width, 4.5" depth and separated from road (no curb)
- For purposes of this analysis, assumes no utilities are relocated; however, this could likely be required
- Intersection/ADA upgrades would be done as separate project as KYTC or city completes resurfacing or other projects

**2. Extend sidewalk accommodations along key connecting streets to Main Street.**

- Assumes sidewalks occur within existing right-of-way
- 4,000 linear feet along Sulphur Springs would be constructed with 5 width, 4.5" depth and separated from road (no curb)
- For purposes of this analysis, assumes no utilities are relocated; however, this could be required
- Intersection/ADA upgrades would be done as separate project as KYTC or city completes resurfacing or other projects

**3. Upgrade pedestrian crossings along Main Street from Barbers Mill Road to Cemetery Road.**

- Includes crossing included at Sulphur Springs and 3 mid-block crossings east of Walnut
- Mid-block crossings would include 10'x20' median with curb with 6-foot walk through median.
- 200 sq ft concrete and 60 LF curbing per mid-block crossing.
- Basic improvement could include just curbing/concrete and markings. Enhanced option could include enhanced paving, landscaping, benches, lighting. Cost estimate includes only basic improvements.
- Assumes no pedestrian activated signals.



**VE RECOMMENDATION NO. 2:  
IMPROVE PEDESTRIAN ACCOMMODATIONS**

**Idea Nos.  
26, 27**

- Assumes no repaving required

Component	Unit	Baseline Concept			VE Recommended Concept		
		Quantity	Cost/Unit	Total	Quantity	Cost/Unit	Total
1. Extend sidewalks along Main Street	CY	0	\$ 100.00	\$ -	451	\$ 100.00	\$ 45,138.89
2. Extend sidewalks along Sulphur Springs	CY	0	\$ 100.00	\$ -	278	\$ 100.00	\$ 27,777.78
3. Crosswalk (markings)	LF	0	\$ 5.78	\$ -	120	\$ 5.78	\$ 693.60
Concrete	CY	0	\$ 100.00	\$ -	8	\$ 100.00	\$ 833.33
curbs	FT	0	\$ 26.52	\$ -	180	\$ 26.52	\$ 4,773.60
<b>Subtotal Construction</b>				\$ -			\$ 79,217.20
Mark-Up (Mark-Up MOT, Drainage, 25% cont 29%)				\$ -			\$ 22,774.95
<b>Total Construction</b>				\$ -			\$ 101,992.15
Monetized Time Savings							\$ -
Right of Way Costs				\$ -			\$ -
<b>TOTAL CAPITAL COST</b>				\$ -			\$ 101,992.15
<b>COST CAPITAL SAVINGS / (VALUE ADDED)</b>							\$ (101,992.15)

<b>VE RECOMMENDATION NO. 3: CREATE ALTERNATIVE SOUTHERN BYPASS CONCEPT</b>		<b>Idea No. 39</b>		
<b>Baseline Concept</b>				
Scoping Study is looking at Concepts A-E for creating a Southeast Bypass around Lebanon, KY.				
<b>Recommendation Concept</b>				
Create alternative route to serve as Concept F, which would begin at the same point as Concept A/E and ties into Concept B/D near the Fairgrounds.				
<b>Advantages</b>		<b>Disadvantages</b>		
<ul style="list-style-type: none"> <li>• May reduce cost compared to A</li> <li>• Reduces right-of-way requirement</li> <li>• Shortens bypass</li> <li>• Facilitates local traffic</li> <li>• Improves direct access to Fairgrounds</li> <li>• Provides connections to existing development</li> </ul>		<ul style="list-style-type: none"> <li>• May increase cost</li> <li>• May impact more houses</li> <li>• May increase environmental impacts</li> </ul>		
<b>Cost Summary</b>		<b>Capital Cost</b>		
Baseline Concept		Depends on Option to compare		
Recommendation Concept		\$15,750,000		
Cost Avoidance/(Added Value)		Depends on Option to compare		
<b>FHWA Function Benefit</b>				
<b>Safety</b>	<b>Operations</b>	<b>Environment</b>	<b>Construction</b>	<b>Right-of-way</b>
✓	✓	✓		

**VE RECOMMENDATION NO. 3:  
CREATE ALTERNATIVE SOUTHERN BYPASS CONCEPT**

**Idea No.  
39**

**Discussion/Sketches/Photos/Calculations**

**Technical Discussion/Sketches**

Baseline:

The Kentucky Transportation Cabinet is conducting a scoping study to improve highway connectivity around the East side of Lebanon, KY in Marion County. This study is intended to explore options to improve connectivity east of the city. With only a few narrow highways providing connections east of the city, most trips are forced into town and onto the US 68 (Main Street) corridor to connect. This study is looking at the possible costs and benefits to make the east side of town more accessible. This includes a Southeast Bypass where Concepts A-E are proposed.

Concept A – Outer from KY 2154 to US 68 (4.96 miles long)

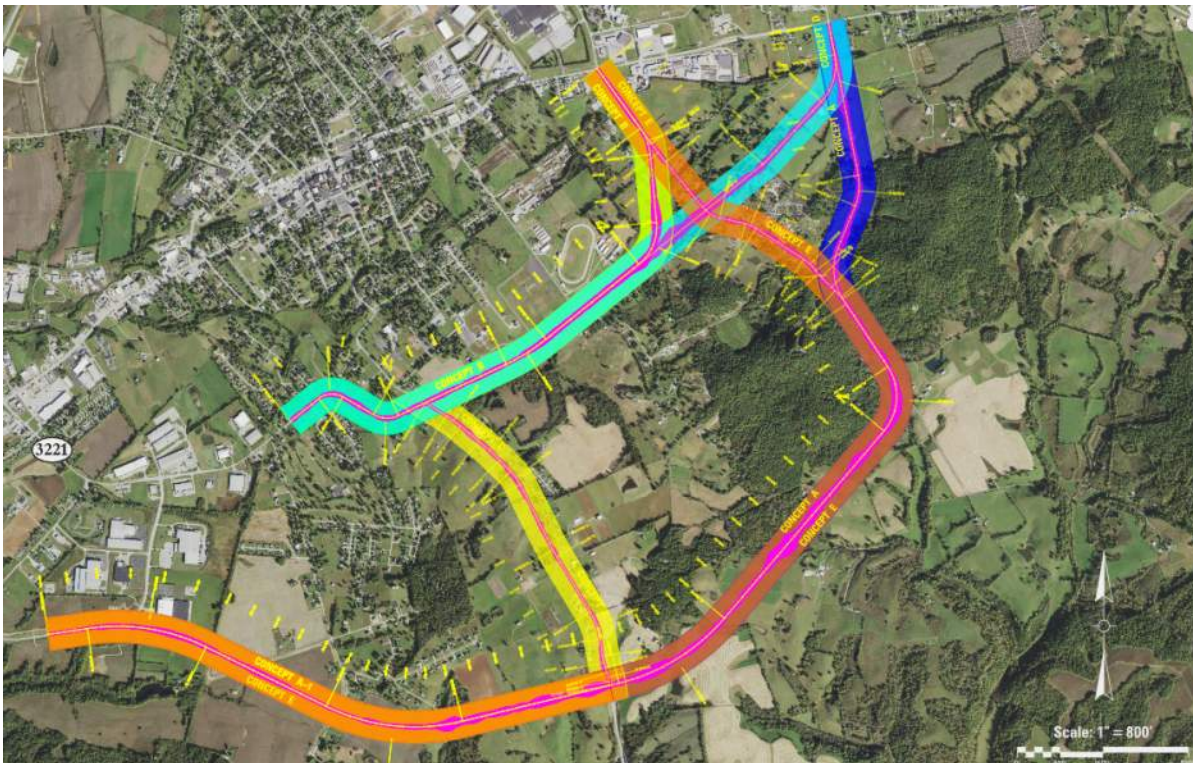
Concept A-1 – Outer from KY 2154 to KY 49 (2.07 miles long)

Concept B – Inner from KY 2154 to US 68 (2.21 miles long)

Concept C – Connector along KY 49 from A-B (2.07 miles long)

Concept D – Connector from B-A (1.45 miles long)

Concept E –Connector along Sulphur Springs from A-B (5.17 miles long)



VE Recommendation:

The VE Team is recommending an alternate route to serve as Concept F, which would begin at the same point as Concept A/E and would tie-in to Concept B/D near the Fairgrounds. This concept appears to have more value since it utilizes the advantages of A on the west by connecting to the industrial area and southern bypass and aligns with funded segment A-1, maintains the connections with KY 49 and Sulfer Springs, and ties with Concept B or D on the

**VE RECOMMENDATION NO. 3:  
CREATE ALTERNATIVE SOUTHERN BYPASS CONCEPT**

**Idea No.  
39**

East at Fairgrounds Road. This facilitates access to the South Lebanon downtown communities, acting as a collector to bypass critical sections of downtown and putting traffic by Barber Mills Road and the school entrances.

The travel demand model shows the volume along Concepts A through E carrying between 1,000 and 1,900 vehicles per day. The utilization, or higher traffic demand, corresponds to the proximity to US 68 and downtown Lebanon, with demand dropping off the further out the alignment is. Concept F provides the benefit of a higher speed continuous alignment, similar to Concept A and E, while providing the higher projected demand seen with Concept B. The shorter alignment length reduces the right-of-way and environmental impacts. Concept F better balances the purpose and need with the traffic demand and environmental impacts.



*Concept F – Outer KY 2154 to inner US 68 (3.75 miles long)*

**Assumptions/Calculations**

The baseline cost for each of the concepts (with 25percent contingency) are below:

Concept A – \$24,243,455

Concept A-1 – \$8,145,091

Concept B – \$10,101,455

Concept C – \$13,239,182

Concept D – \$10,498,364

Concept E – \$25,939,000

Concept F – \$15,750,000 (calculated as a weighted average of cost for options A and D, assumed at \$4,200,000 per mile x 3.75 miles)

<b>VE RECOMMENDATION NO. 4: CREATE VITAL LOCAL CONNECTIONS IN SOUTHERN LEBANON</b>			<b>Idea Nos. 38</b>	
<b>Baseline Concept</b>				
The baseline concept proposes several alignment concepts to facilitate a southern bypass of US 68. The concept alignments vary from higher design speed outer loop alignments, lower speed inner loop alignments, and varying speed circuitous alignments. The length of alignments vary from approximately 2.5 miles to 5 miles.				
<b>Recommendation Concept</b>				
Scale down full southern bypass and only make vital local connections				
<b>Advantages</b>			<b>Disadvantages</b>	
<ul style="list-style-type: none"> <li>• Reduces cost</li> <li>• Reduces maintenance</li> <li>• Reduces right-of-way requirements</li> <li>• Does not preclude future southern bypass</li> <li>• Addresses local connectivity needs</li> <li>• Supports contiguous development</li> </ul>			<ul style="list-style-type: none"> <li>• Does not facilitate regional traffic bypass</li> <li>• Limits opportunities for economic development</li> </ul>	
<b>Cost Summary</b>				
	<b>Construction</b>	<b>Right-of-way</b>	<b>Total</b>	
Baseline Concept	\$21,369,925	\$333,200	\$21,703,125	
Recommendation Concept	\$12,736,475	\$271,300	\$13,007,775	
Cost Avoidance/(Added Value)	\$8,633,450	\$61,900	\$8,695,350	
<b>FHWA Function Benefit</b>				
<b>Safety</b>	<b>Operations</b>	<b>Environment</b>	<b>Construction</b>	<b>Right-of-way</b>
	✓	✓		

**VE RECOMMENDATION NO. 4:  
CREATE VITAL LOCAL CONNECTIONS IN SOUTHERN  
LEBANON**

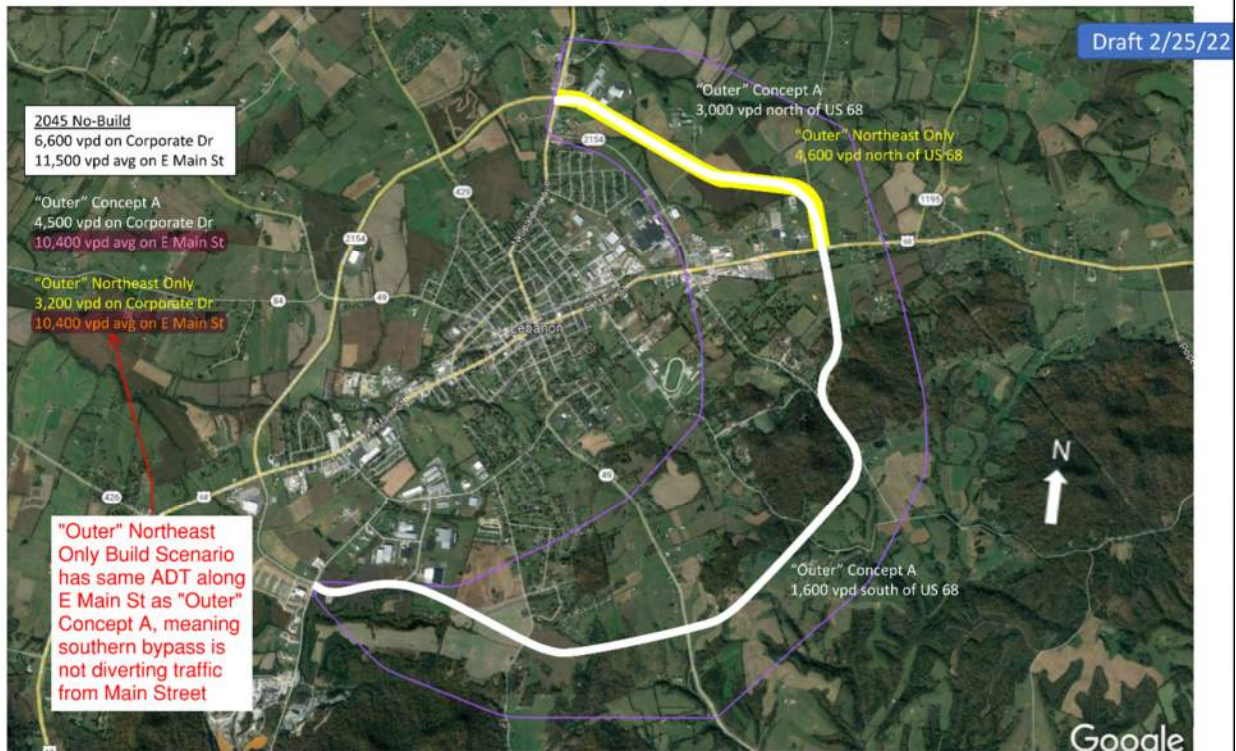
**Idea Nos.  
38**

**Discussion/Sketches/Photos/Calculations**

**Technical Discussion/Sketches**

The intent of the southern bypass concept alignments is to alleviate congestion and reduce delay along Main Street (US 68) by diverting east-west pass-through traffic from US 68 and downtown Lebanon. Based on preliminary travel demand models of various build scenarios, the proposed southern bypass concepts will carry between 1,000 and 1,900 vehicles per day, with 600-800 vehicles diverted from Main Street (US 68).

The preliminary travel demand models for the southern bypass Outer Concept A does not show any diversion of traffic away from Main Street (US 68). The sub scenario where only the Outer Northeast Bypass is constructed shows the same projected ADT on Main Street (US 68) as the full build of Outer Concept A, see graphic below.



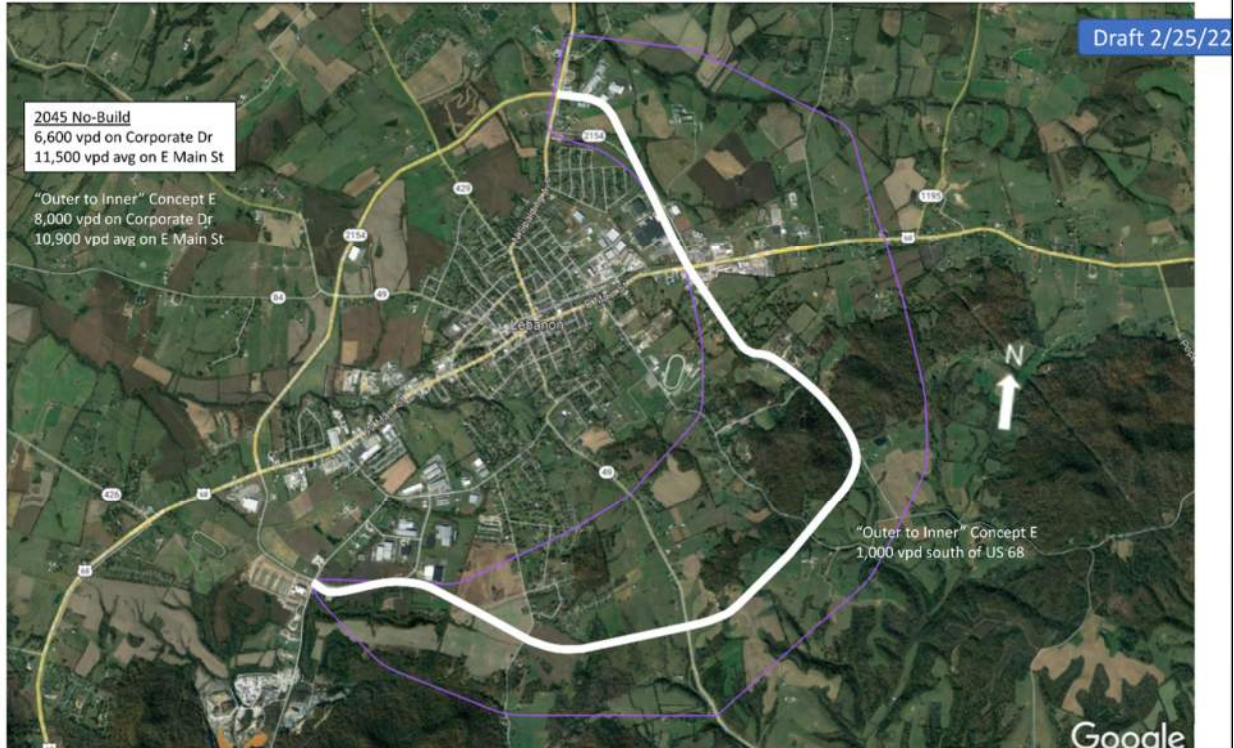
**Figure 1: Travel Demand Output for Outer Concept A**

The preliminary travel demand model for the Inner Concept B alternative projects a total of 800 vehicles per day diverted from Main Street (US 68). The preliminary travel demand model for the Outer to Inner Concept E projects a total of 600 vehicles per day diverted from Main Street (US 68). See graphics below.

**Figure 2: Travel Demand Output for Inner Concept B**

**VE RECOMMENDATION NO. 4:  
CREATE VITAL LOCAL CONNECTIONS IN SOUTHERN  
LEBANON**

**Idea Nos.  
38**



**Figure 3: Travel Demand Output for Inner to Outer Concept E**

Based on the travel demand output for Concept B and Concept E, it is not conclusive as to how much of the total diverted traffic from Main Street (US 68) is utilizing the southern bypass versus how much is using Alternative 2 of the completed northern bypass. However, since the travel demand model for Concept B and Concept E both utilize the same northern bypass alternative, one can glean that Concept B will divert 200 more vehicles per day than Concept E. This is likely due to the improved local connectivity Concept B provides for local traffic to complete their trips without utilizing Main Street (US 68). Furthermore, since Concept A did not show any vehicles diverting from Main Street (US 68), one can conclude that the bypass is not serving regional pass-through traffic; however, rather providing alternate routes for local traffic to utilize.

Based on these conclusions, this recommendation is to improve local road connectivity south of Main Street (US 68) to reduce congestion and travel time along Main Street (US 68) rather than constructing a full southern bypass.

Two main components of the existing traffic congestion and delays along Main Street (US 68) have been identified: truck traffic and heavy school traffic throughout the day. Completion of the northern bypass will alleviate the high truck volume that is currently using Main Street (US 68). Improving the local connectivity to the south of Main Street (US 68) will reduce the congestion and travel time during peak school pick up and drop-off times.

The graphic below shows recommended alignment for critical links to improve local connectivity. The alignment modifies Concept B while utilizing Concept D, which ties into Barbers Mill Road better serving traffic bound for the schools.

**VE RECOMMENDATION NO. 4:  
CREATE VITAL LOCAL CONNECTIONS IN SOUTHERN  
LEBANON**

**Idea Nos.  
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**Figure 4: Recommended Local Connection Alignment**

In conjunction with constructing the southern local connector, intersection improvements at Barbers Mill Road should be considered to improve intersection control. Intersection improvements could be a roundabout to better facilitate minor approach traffic to and from the school or a signal if it meets warrants.

Eliminating the Country Club Drive to Bradfordsville connection and realigning the tie in point to Sulphur Springs Road reduces right-of-way impacts, eliminating impacts to residential homes. This will reduce costs and also improve community support for the new roadway.

**Assumptions/Calculations**

It is assumed the difference in traffic diverted from Main Street (US 68) in the travel demand models Inner Concept B and Inner to Outer Concept E is local traffic only utilizing the southern bypass for local trips. It is assumed this recommendation will divert the same volume of traffic per day as Inner Concept B.

The assumed typical section of the southern local connector is the same as the southern bypass concepts typical section.

Total length of the recommended alignment is 2.18 miles, measured from Google Earth.

Since the recommended alignment modifies and combines Concept B and Concept D, total length of the recommended alignment and the total length of Concept B and D was used to determine a ratio, as shown below:

Total Length of Concept B = 2.21 miles

Total Length of Concept D = 1.45 miles

Total Length of southern local connector = 2.18 miles

Cost ratio  $2.18 / (2.21+1.45) = 0.596$

This cost ratio was applied to the combined total cost of Concept B and Concept D to determine cost of the southern local connector.

**Area of right-of-way Impacts (Measured polygon of catch point from Google Earth)**

Concept B = Total of 21.41 acres

- 4.26 acres between Country Club Drive and Bradfordsville Road
- 17.15 acres between Bradfordsville Road and Sulphur Springs Road

Concept D = Total of 11.91 acres

- 11.91 acres between Sulphur Springs Road and US 68

Total Concept B and D = 33.32 acres

Southern Local Connector = 27.13 acres

- 16.01 acres between Bradfordsville Road and Sulphur Springs Road



**VE RECOMMENDATION NO. 4:  
CREATE VITAL LOCAL CONNECTIONS IN SOUTHERN  
LEBANON**


**Idea Nos.  
38**

- 11.12 acres between Sulphur Springs Road and US 68

Assumed cost per acre for right-of-way = \$10,000.

Total right-of-way cost for Concept B & D = \$333,200

Total right-of-way cost for Southern Local Connector = 271,300

		<b>VE Study Life-Cycle Costs Calculations</b>						
		East Lebanon By-Pass Planning Level Study						
Baseline Concept					VE Recommended Concept			
Component	Unit	Quantity	Cost/Unit	Total	Quantity	Cost/Unit	Total	
Concept B	LS	1	\$ 8,595,000	\$ 8,595,000	0	\$ 8,595,000	\$ -	
Concept D	LS	1	\$ 8,003,000	\$ 8,003,000	0	\$ 8,003,000	\$ -	
Local Southern Connector	LS	0	\$ 9,892,408	\$ -	1	\$ 9,892,408	\$ 9,892,408	
				\$ -		\$ -	\$ -	
<b>Subtotal Construction</b>				\$ 16,598,000			\$ 9,892,408	
Mark-Up (MOT, Mob., PE, 29%)				\$ 4,771,925			\$ 2,844,067	
<b>Total Construction</b>				\$ 21,369,925			\$ 12,736,475	
Monetized Time Savings							\$ -	
Right of Way Costs	Acre	\$ 33.32	\$ 10,000	\$ 333,200	27.13	\$ 10,000	\$ 271,300	
<b>TOTAL CAPITAL COST</b>				\$ 21,703,125			\$ 13,007,775	
<b>COST CAPITAL SAVINGS / (VALUE ADDED)</b>							\$ 8,695,350	

<b>VE RECOMMENDATION NO. 5: CHANGE THE FEDERAL DESIGNATED TRUCK ROUTE TO KY 2154</b>		<b>Idea No. 29</b>			
<b>Baseline Concept</b>					
Currently US 68 is designated as the truck route taking trucks through downtown Lebanon leading to congestion.					
<b>Recommendation Concept</b>					
Change truck route designation out of downtown to KY 2154					
<b>Advantages</b>		<b>Disadvantages</b>			
<ul style="list-style-type: none"> <li>• Encourages trucks to use different route</li> <li>• Relatively low cost solution</li> <li>• Can be implemented quickly</li> </ul>		<ul style="list-style-type: none"> <li>• Requires coordination with KYTC &amp; federal agencies</li> </ul>			
<b>Cost Summary</b>		<b>Construction</b>	<b>Right-of-way</b>	<b>Total</b>	
Baseline Concept					
Recommendation Concept		\$0	\$0	\$0	
Cost Avoidance/(Added Value)		\$0	\$0	\$0	
<b>FHWA Function Benefit</b>					
<b>Safety</b>	<b>Operations</b>	<b>Environment</b>	<b>Construction</b>	<b>Right-of-way</b>	
✓	✓	✓			

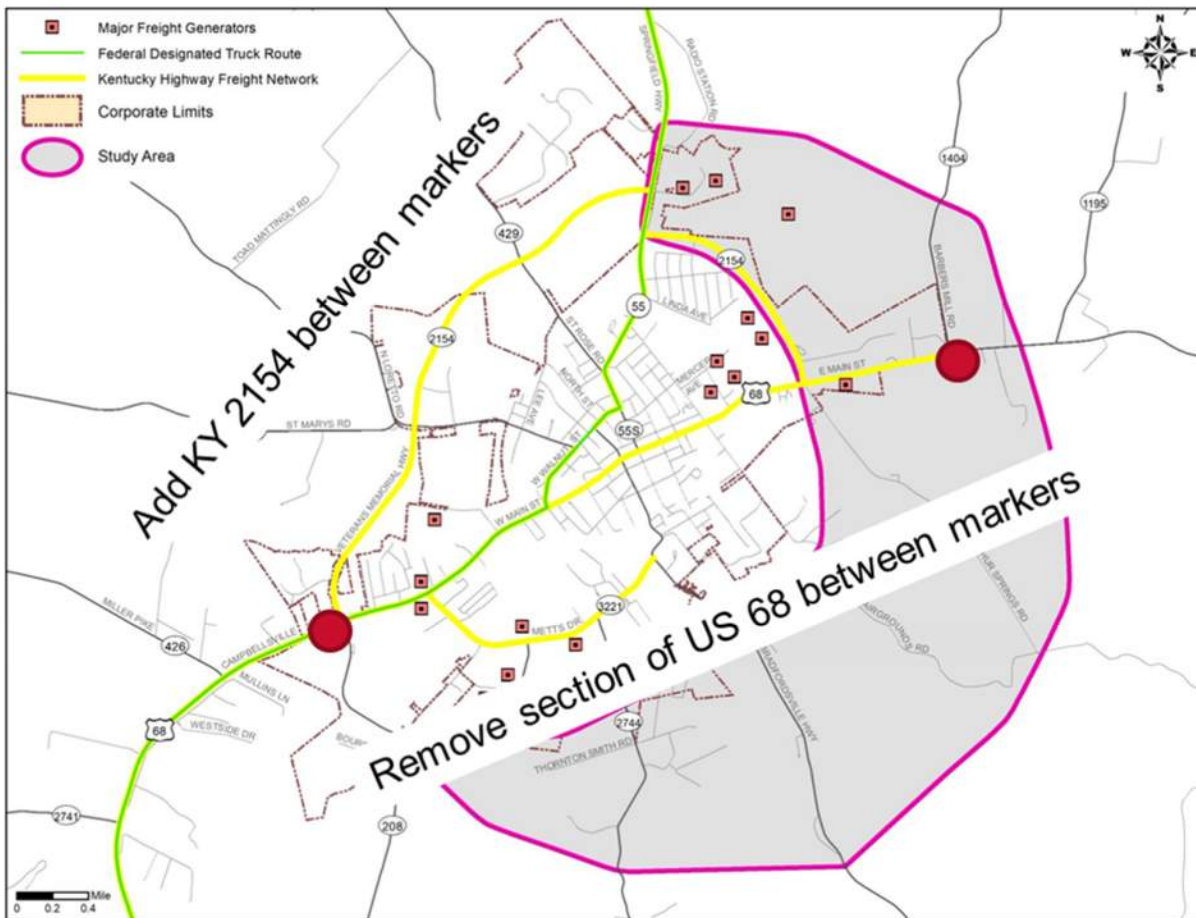
**VE RECOMMENDATION NO. 5:  
CHANGE THE FEDERAL DESIGNATED TRUCK ROUTE TO  
KY 2154**

**Idea No.  
29**

**Discussion/Sketches/Photos/Calculations**

**Technical Discussion/Sketches**

The current Federal Designated Truck Route (in Green) is US 68 to KY 55 through the city of Lebanon. The VE Team recommends changing the route to divert trucks through KY 2154 (northern bypass), which was constructed with the purpose of bypassing the City of Lebanon (downtown).



KYTC Division of Planning Systems Branch from Central Office & FHWA would approve or deny the standards listed in Assumptions. Coordination would also need to be done with the Modal Branch since that is where the Freight Office is within KYTC. Then write an Official Order to add KY 2154 to the National Truck Network.

**VE RECOMMENDATION NO. 5:  
CHANGE THE FEDERAL DESIGNATED TRUCK ROUTE TO  
KY 2154**

**Idea No.  
29**

**DESIGNATED NATIONAL TRUCK NETWORK**

**Assumptions/Calculations**

**REASONABLE ACCESS REVIEW  
ENGINEERING and SAFETY CRITERIA**

Criteria Feature	603 KAR 5:250 Criteria	
Any one (1) of the following design deficiencies shall disqualify a route		
Weight Classification	80,000 lbs	
Lane Width	10 feet	
Bridge Allowance	80,000 lbs	
Underpass Vertical Clearance	13'-6" min	
Bridge Width Min.	22'-0" curb-to-curb	
Sight Passing Distance	> 50% of any segment restricted to < 1500 ft	
Insufficient turning radii	In urban areas	
Accidents	High incidence - unsafe	
No combination of any two (2) or more of the following		
High Horizontal Curvature or *	2 or lower - better 3 or higher - worse	
High Vertical Curvature *	2 or lower - better 3 or higher - worse	
Roadway Shoulder	< 4 feet	
Narrow Bridge	< roadway width	

> greater than      < less than

\* Rating numbers 1 to 4 - lower number indicates lower degree of curvature  
3 indicates impaired sight distance, safety and speed of trucks affected

<b>VE RECOMMENDATION NO. 6: CONVERT KY 2154 TO US 68 AND US 68 TO US 68 BUSINESS</b>		<b>Idea No. 6</b>			
<b>Baseline Concept</b>					
The intersection of KY 2154 and US 68 (west side of town) was not addressed in the planning study.					
<b>Recommendation Concept</b>					
Realign so US 68 to the west where it connects to KY 2154 as the main line movement. Realign Main Street (US 68) to tee into the main line and create a roundabout south of the intersection to manage traffic on access roads and other connections.					
<b>Advantages</b>		<b>Disadvantages</b>			
<ul style="list-style-type: none"> <li>• Encourages bypass usage</li> <li>• Increases truck diversion</li> <li>• Higher speed continuity/continuous flow for trucks and through traffic</li> <li>• Reduces through traffic downtown</li> <li>• Improves livability along the corridor</li> <li>• May eliminate traffic signal</li> <li>• Slows speeds entering Main Street commercial area</li> </ul>		<ul style="list-style-type: none"> <li>• May reduce traffic downtown to businesses</li> <li>• Requires additional right-of-way</li> <li>• Requires geometric reconfiguration for intersections</li> </ul>			
<b>Cost Summary</b>		<b>Construction</b>	<b>Right-of-way</b>	<b>Total</b>	
Baseline Concept		\$0	\$0	\$0	
Recommendation Concept		\$1,705,300	\$448,000	\$2,153,300	
Cost Avoidance/(Added Value)		(\$1,705,300)	(\$448,000)	\$(2,153,300)	
<b>FHWA Function Benefit</b>					
<i>Safety</i>	<i>Operations</i>	<i>Environment</i>	<i>Construction</i>	<i>Right-of-way</i>	
✓	✓				

**VE RECOMMENDATION NO. 6:  
CONVERT KY 2154 TO US 68 AND US 68 TO US 68  
BUSINESS**

**Idea No.  
6**

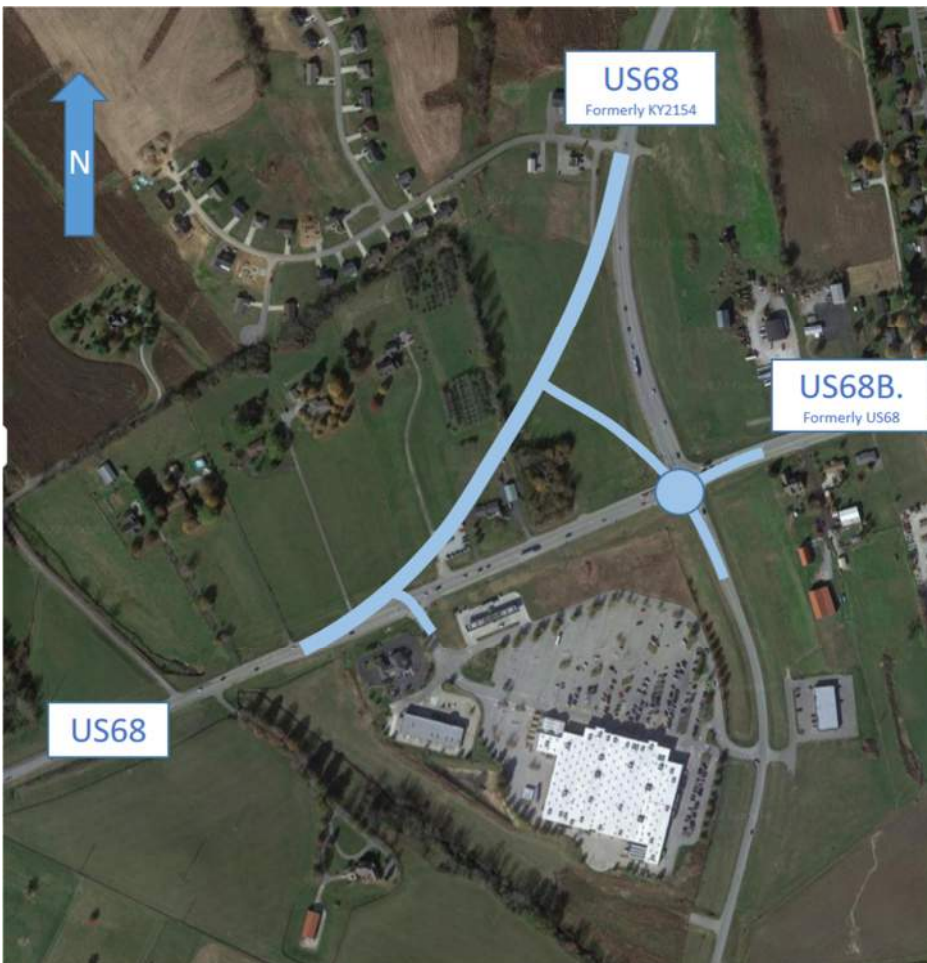
**Discussion/Sketches/Photos/Calculations**

**Technical Discussion/Sketches**

One of the concerns raised was the amount of traffic as well as the number of trucks traversing Main Street. Unnecessary vehicles in the urban area increase traffic issues, especially in peak travel times. They also lead to additional noise, air pollution, and increased difficulty for pedestrians to cross the street.

Reconfiguration of this intersection will be one tool to encourage the use of the bypass to traverse from one end of the city to the other, rather than travelling through Main Street. This will also improve flow for traffic coming from and going to KY 55. With this change, vehicles will be able to travel unimpeded; they will no longer have to stop at the signal or slow down to make a turn. This configuration should all be paired with other improvements to the existing bypass and modifications to calm traffic on Main Street.

Should US 68 be widened in the future, it is recommended that an unsignalized R-CUT be implemented to safely facilitate vehicles turning from Main Street to US 68 westbound.



**VE RECOMMENDATION NO. 6:  
CONVERT KY 2154 TO US 68 AND US 68 TO US 68  
BUSINESS**


**Idea No.  
6**

**Assumptions/Calculations**

Additional roadway construction:

- 2000-foot main line US 68/KY 2154
- 400-foot KY 2154 south
- 900-foot Main Street
- 100-foot Walmart entrance
- Roundabout splitters, central island, lighting

Basis of estimate: the VE team used Estimate for Alternate 1, exclude environmental in-lieu fees, and maintain percentages for drainage, MOT and design. Right of way estimate is assumed at \$10,000/acre plus administrative costs, negotiation allowance, condemnation allowance and other ancillary costs, assume \$30,000/acre plus improvements (\$200,000). Assume 150 FT width. Pavement removal and roundabout concrete apron, including splitters and lighting (25 luminaires).

		<b>VE Study Life-Cycle Costs Calculations</b>						
		East Lebanon By-Pass Planning Level Study						
		Baseline Concept			VE Recommended Concept			
Component	Unit	QTY	Cost/Unit	Total	Quantity	Cost/Unit	Total	
Mainline new construction US 68/KY 2154 (2000FT)	FT	0	\$ 450	\$ -	2,000	\$ 450	\$ 900,000	
KY 2154 new construction (400 FT)	FT	0	\$ 450	\$ -	400	\$ 450	\$ 180,000	
Main Street (900 FT)	FT	0	\$ 450	\$ -	900	\$ 450	\$ 405,000	
Walmart entrance 100 FT	FT	0	\$ 450	\$ -	100	\$ 450	\$ 45,000	
Roundabout splitters, central island	CY	0		\$ -	100	\$ 78	\$ 7,800	
Pavement removal	SY	0	\$ 4	\$ -	20,000	\$ 4	\$ 80,000	
Lighting	EA	0	\$ 2,500	\$ -	25	\$ 2,500	\$ 87,500	
				\$ -		\$ -	\$ -	
<b>Subtotal Construction</b>				\$ -			\$ 1,705,300	
Mark-Up (Mark-Up MOT, Drainage, 25% contingency)		0%		\$ -			\$ -	
<b>Total Construction</b>				\$ -			\$ 1,705,300	
Monetized Time Savings							\$ -	
Right of Way Costs	ac	0	\$ 30,000	\$ -	8.3	\$ 30,000	\$ 448,000	
<b>TOTAL CAPITAL COST</b>				\$ -			\$ 2,153,300	
<b>COST CAPITAL SAVINGS / (VALUE ADDED)</b>							\$ (2,153,300)	

<b>VE RECOMMENDATION NO. 7: USE A ROUNDABOUT AT BARBER MILLS ROAD</b>		<b>Idea No. 60</b>		
<b>Baseline Concept</b>				
The baseline does not show any intersection improvements at Barber Mills Road and US 68, the east terminus of the project.				
<b>Recommendation Concept</b>				
Use roundabout at Barbers Mill Road and US 68				
<b>Advantages</b>		<b>Disadvantages</b>		
<ul style="list-style-type: none"> <li>• Improves traffic control</li> <li>• Reduces conflict</li> <li>• May improve school traffic flow</li> <li>• Calms traffic/reduces speeds near school</li> <li>• Provides a east Gateway into Lebanon</li> </ul>		<ul style="list-style-type: none"> <li>• Increases impervious</li> <li>• Increases utility impacts</li> <li>• Increases right-of-way impacts</li> <li>• May require additional illumination which may be unfavorable to nearby residences</li> </ul>		
<b>Cost Summary</b>				
	<b>Capital</b>	<b>Right-of-way</b>	<b>Total</b>	
Baseline Concept	\$0	\$0	\$0	
Recommendation Concept	\$462,548	\$6,300	\$468,848	
Cost Avoidance/(Added Value)	(\$462,548)	(\$6,300)	(\$468,848)	
<b>FHWA Function Benefit</b>				
<b>Safety</b>	<b>Operations</b>	<b>Environment</b>	<b>Construction</b>	<b>Right-of-way</b>
✓	✓			



**VE RECOMMENDATION NO. 7:  
USE A ROUNDABOUT AT BARBERS MILLS ROAD**

**Idea No.  
60**

**Discussion/Sketches/Photos/Calculations**

**Technical Discussion/Sketches**

One of the purposes of the project is to address the high number of crashes along US 68. Although a reduction in crashes is likely to be realized by diverting traffic onto the bypass roads, additional improvements can be considered to further enhance safety along US 68. This recommendation is to provide a single lane roundabout at Barbers Mill Road/US 68.

Today, the Barbers Mill/US 68 is an uncontrolled intersection with a 45 mph posted speed to the west and 55 mph posted speed to the east of the intersection. Further west, the posted speed limit is reduced to 35 mph and then to 25 mph within downtown Lebanon.

Although there have only been 7 crashes located at the Barbers Mill Road/US 68 intersection between 2015 and 2020, approximately 56 crashes have occurred along the 0.83 mile segment of US 68 between Barbers Mill Road and Corporate Drive, accounting for 6.5 percent of all crashes within the area. Approximately 63 percent of the crashes were angle or rear end crashes, which can be attributed to high approach speeds.

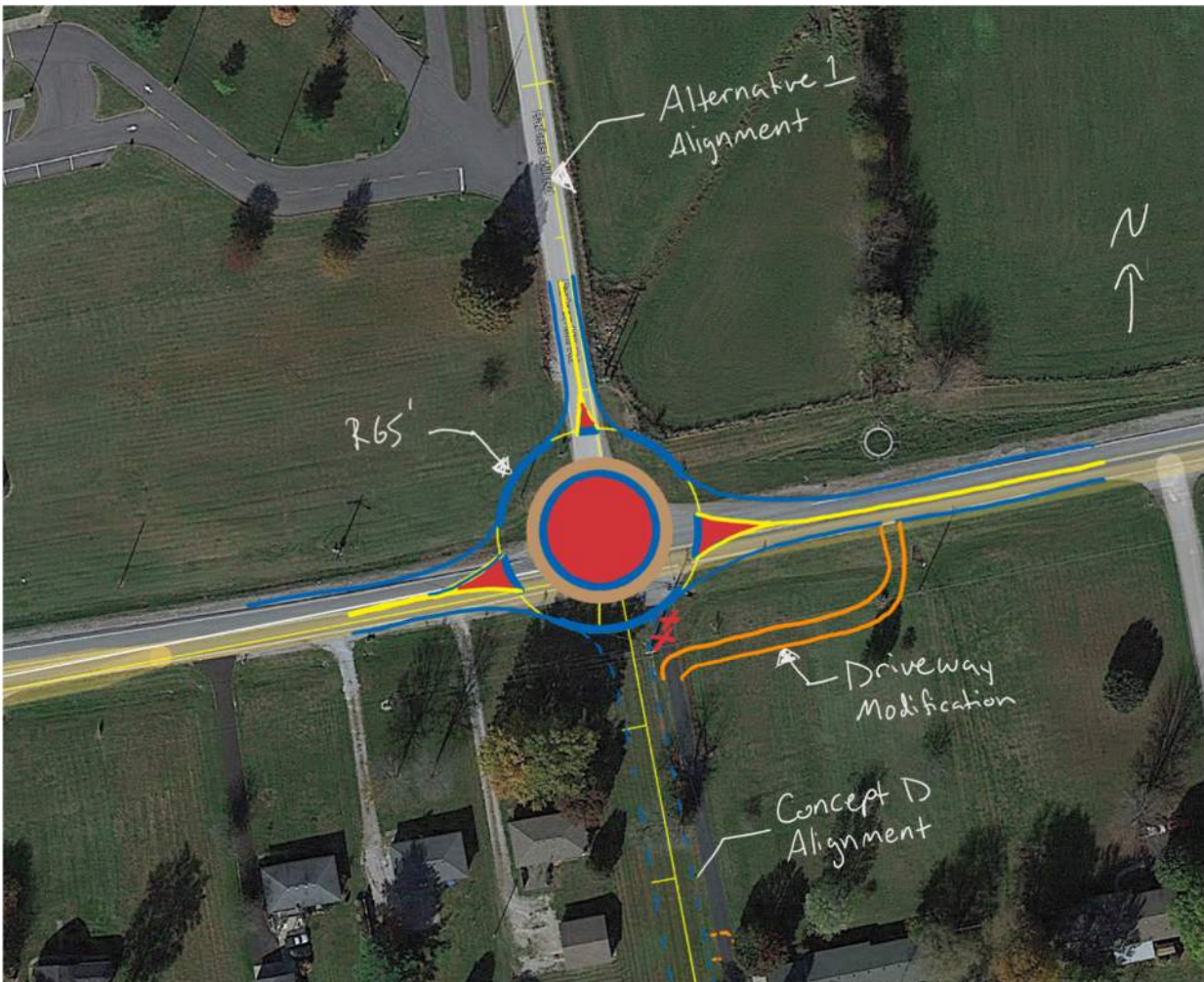


**Figure 1: Crash History along US 68 Between Corporate Drive and Barbers Mill Road**

Constructing a roundabout at Barbers Mill Road will calm westbound US 68 traffic approaching Lebanon, effectively reducing speeds prior to approaching downtown congestion. A roundabout will also facilitate improved traffic flow to and from Glasscock Elementary School. Figure 2 below shows a proposed sketch of the single lane roundabout.

**VE RECOMMENDATION NO. 7:  
USE A ROUNDABOUT AT BARBER MILLS ROAD**

**Idea No.  
60**



**Figure 2: Single Lane Roundabout at Barbers Mill Road and US 68**

The proposed roundabout is compatible with Alternative 1 for the northern bypass and Concept D for the southern bypass. However, a roundabout at this location can be implemented with any of the bypass alternatives and concepts currently proposed.

The proposed roundabout is anticipated to have some impacts, including:

- ROW
- Utility (overhead power)
- Driveway

Due to the current posted speed limit and average operating speeds along the westbound approach along US 68, additional advance signing will be required to inform drivers of the roundabout intersection control.

**VE RECOMMENDATION NO. 7:  
USE A ROUNDABOUT AT BARBER MILLS ROAD**

**Idea No.  
60**

**Assumptions/Calculations**

Roadway Dimensions:

- 12-foot lane width and 2-foot paved right shoulders on approaches
- 14-foot lane width and 4-foot right shoulders within circulatory lanes
- 10-foot-wide concrete wide truck apron
- Reconstruction of 100 feet of roadway approaches outside of roundabout

Roadway Quantities:

Pavement

- Approaches: 26' x 100' x 3 approaches = 7,800 SF
- Circulatory Lanes: Outer Diameter = 130'; Outer Diameter of truck apron = 94'  
 $Pi \cdot 65^2 = 13,273$   $Pi \cdot 47^2 = 6,940$   
Total Circulatory Lane Pavement = 13,273 – 6,940 = 6,333 SF

Concrete Truck Apron and Curb

- Truck Apron: Outer Diameter = 94'; Inner Diameter = 74'  
 $Pi \cdot 47^2 = 6,940$   $Pi \cdot 37^2 = 4,301$   
Total Truck Apron Area = 6,940 – 4,301 = 2,639 SF
- Concrete islands at roundabout approaches are assumed to be 200 SF each for a total of 600 SF

Driveway Modifications

- 200 feet, measured from Google Earth. Assumed 10-foot width to match existing. Total AC driveway is 2,000 SF. Assumed depth of 6" AC on 6" base  
Total AC = 2,000 x 0.5 / 27 = 37 CY  
Total Base = 2,000 x 0.5 / 27 = 37 CY

Illumination

- Assumed total of 3 new light poles including wiring

Based on existing topography, earthwork is assumed to be minimal and covered by contingency

Signing, striping, landscape is assumed to be included in contingency

**VE RECOMMENDATION NO. 7:  
USE A ROUNDABOUT AT BARBER MILLS ROAD**

**Idea No.  
60**


**ROW**

Polygons of proposed roadway outside assumed public right-of-way measured from Google Earth total 0.21 acres

**Utilities**

Relocation of 1 utility pole

**Cost Estimate**

	<b>VE Study Life-Cycle Costs Calculations</b>							
	East Lebanon By-Pass Planning Level Study							
	Baseline Concept				VE Recommended Concept			
<b>Component</b>	<b>Unit</b>	<b>QTY</b>	<b>Cost/Unit</b>	<b>Total</b>	<b>Quantity</b>	<b>Cost/Unit</b>	<b>Total</b>	
US 68/Barbers Mill Approach Construction	SF	0	\$ 20	\$ -	7,800	\$ 20	\$ 156,000	
US 68/Barbers Mill Circulation	SF	0	\$ 20	\$ -	6,333	\$ 20	\$ 126,660	
US 68/Barbers Mill Truck Apron	SF	0	\$ 16	\$ -	2,639	\$ 16	\$ 42,224	
US 68/Barbers Mill Splitter Islands	SF	0	\$ 13	\$ -	600	\$ 13	\$ 7,680	
Lighting	EA	0	\$ 5,000	\$ -	3	\$ 5,000	\$ 15,000	
Utility Pole Relocation	EA	0	\$ 5,000	\$ -	1	\$ 5,000	\$ 5,000	
Driveway Reconstruction	SF	0	\$ 3	\$ -	2,000	\$ 3	\$ 6,000	
				\$ -		\$ -	\$ -	
<b>Subtotal Construction</b>				\$ -			\$ 358,564	
Mark-Up (Mark-Up MOT, Drainage, 25% <b>29%</b> )				\$ -			\$ 103,984	
<b>Total Construction</b>				\$ -			\$ 462,548	
Monetized Time Savings							\$ -	
Right of Way Costs	ac	\$ -	\$ 30,000	\$ -	0.2	\$ 30,000	\$ 6,300	
<b>TOTAL CAPITAL COST</b>				\$ -			\$ 468,848	
<b>COST CAPITAL SAVINGS / (VALUE ADDED)</b>							\$ (468,848)	

<b>VE RECOMMENDATION NO. 8: CREATE ALTERNATIVE NORTHEAST ALIGNMENT ALONG CORPORATE DRIVE</b>		<b>Idea No. 4</b>			
<b>Baseline Concept</b>					
Corporate Drive in effect operates as the northeast “bypass” of downtown from KY 55 to US 68. The existing typical section is a rural two 12-foot lane roadway with minimal shoulders. The project team studied Alignment 2 which provides for an improved tie-in across from KY 2154 along KY 55.					
<b>Recommendation Concept</b>					
Utilize/reconfigure Corporate Drive as northeast bypass route (Alignment 2a)					
<b>Advantages</b>		<b>Disadvantages</b>			
<ul style="list-style-type: none"> <li>• Reduces cost</li> <li>• Reduces right-of-way requirement</li> <li>• Reduces implementation time</li> <li>• Does not preclude any future bypass options</li> <li>• Utilizes existing infrastructure</li> <li>• Reduces maintenance (pavement)</li> </ul>		<ul style="list-style-type: none"> <li>• Reduces access redundancy</li> <li>• May increase maintenance (if signals used)</li> </ul>			
<b>Cost Summary</b>		<b>Construction</b>	<b>Right-of-way</b>	<b>Total</b>	
Baseline Concept		\$4,209,000	\$545,455	\$4,754,455	
Recommendation Concept		\$3,627,200	\$0	\$3,627,200	
Cost Avoidance/(Added Value)		\$581,800	\$545,455	\$1,127,255	
<b>FHWA Function Benefit</b>					
<i>Safety</i>	<i>Operations</i>	<i>Environment</i>	<i>Construction</i>	<i>Right-of-way</i>	
✓	✓	✓	✓	✓	

**VE RECOMMENDATION NO. 8:  
CREATE ALTERNATIVE NORTHEAST ALIGNMENT  
ALONG CORPORATE DRIVE**

**Idea No.  
4**

**Discussion/Sketches/Photos/Calculations**

**Technical Discussion/Sketches**

In effect, Corporate Drive currently operates as the northeast “bypass” of downtown from KY 55 to US 68. The existing typical section is a rural two 12-foot lane roadway with minimal shoulders.

The project team proposed Alignment 2, which provides for an improved tie-in across from KY 2154 along KY 55 and partial three-lane configuration from Teledyne Dr to US 68.

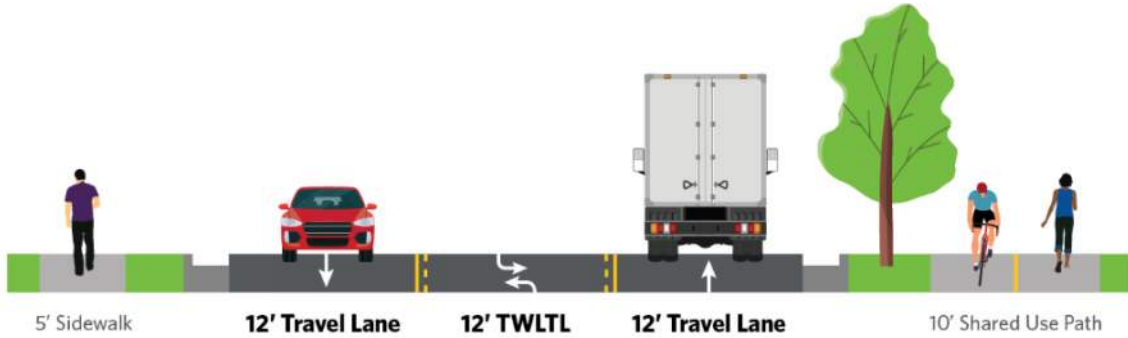
The recommended alternative, referred hereinafter as Alternative 2A, offers an improvement along Corporate Drive by widening the typical section to a three-lane with a TWLTL along the existing alignment. The intersection with Spalding (KY 55) will be upgraded to a roundabout to promote free flow, to reduce conflicts, and to better facilitate truck travel to freight destinations along US 68 to the east and Corporate Drive.



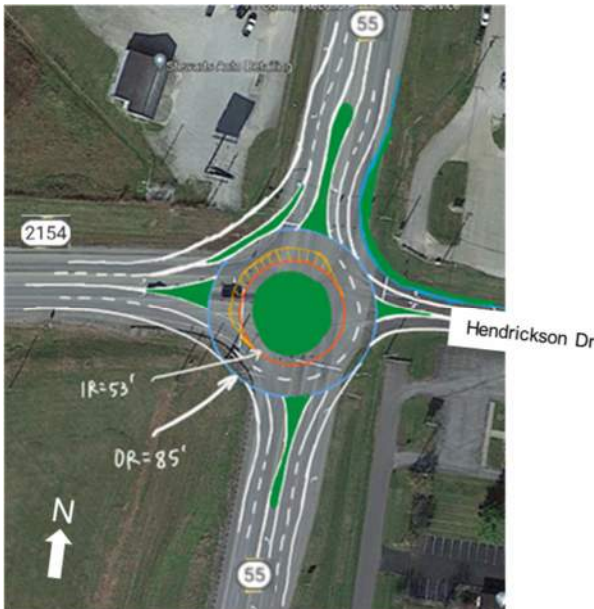
The recommendation includes upgrading Corporate Dr. from a two-lane rural typical section to a three-lane urban typical section with curb & gutter, and bike / pedestrian accommodations. Since there is a planned bike/pedestrian improvement along US 68 and due to the community and school connections in the area, a 5-foot sidewalk will be proposed on one side and a 10-foot shared use path on the opposite as illustrated below.

**VE RECOMMENDATION NO. 8:  
CREATE ALTERNATIVE NORTHEAST ALIGNMENT  
ALONG CORPORATE DRIVE**

**Idea No.  
4**



*Recommended roundabouts at KY 2154 and Corporate Dr along KY 55*



*Detail of Roundabout at KY 2154*



*Detail of Roundabout at Corporate Dr*

**VE RECOMMENDATION NO. 8:  
CREATE ALTERNATIVE NORTHEAST ALIGNMENT  
ALONG CORPORATE DRIVE**

**Idea No.  
4**

The addition of left turn lanes will reduce the potential for rear-end collisions and may reduce conflicts with opposing traffic as vehicles are removed from the primary travel lane. The roundabouts on each end should improve traffic flow during peak times as long queues are common with the current control device at the intersection at US 68. Corporate Drive has experienced a high comparative number of rear-end collisions in the past five years, with high traffic access points for Marion County Schools, a major industry, and a primary commercial center within 1,000 ft. of the intersection with US 68.

The school area and commercial properties on the southern end have the potential for high pedestrian connectivity to residential areas on the northern end. The addition of pedestrian facilities will enhance livability and safety for local populations.

Roundabouts will be three leg two-lane for Spalding Avenue and Corporate Drive Intersection, and four leg multi-lane for US 68 and Corporate Drive Intersection.

Impacts will include increased right of way acquisition and associated costs, although as noted in the Detail sketch (above-right), impacts to the historic property are avoided while taking advantage of a currently available parcel. While disruptions to the traveling public and Maintenance of Traffic during construction are typical, the overall improvements will increase operational efficiency and connections with existing roadways and encourage usage of the existing Veterans Memorial Parkway (KY 2154), avoiding further overloading of downtown pathways.

**Assumptions/Calculations**

Cost Estimate including markups

\$1,100,000 (2 roundabouts at \$550,000 each)

\$2,527,200 (1.35 miles at \$1,872,000 per mile- from Estimate Alt 2)

\$3,627,200 Total

**Roadway Dimensions**

- 12-foot lane width (two travel lanes and shared central turn-lane)
- 2-foot Curb and gutter
- 5-foot pedestrian sidewalk on west side
- 10-foot shared use path (non-motorized)



<b>VE RECOMMENDATION NO. 9: USE ROUNDABOUTS ALONG KY 55/N SPALDING AVE</b>			<b>Idea No. 23</b>	
<b>Baseline Concept</b>				
Along KY 55/ N Spalding Avenue are currently two conventional intersections – KY 55 and Veterans Memorial Parkway is a signalized, 4-legged intersection and N Spalding Avenue and Corporate Drive is a two-way-stop-control, 3-legged intersection.				
<b>Recommendation Concept</b>				
Put roundabouts at Veterans Memorial Parkway/KY 55 and at N Spalding Avenue/Corporate Drive to disincentivize trucks using N Spalding Avenue and improve traffic flow.				
<b>Advantages</b>			<b>Disadvantages</b>	
<ul style="list-style-type: none"> <li>• Reduces intersection delays</li> <li>• Reduces conflicts</li> <li>• Reduces maintenance</li> <li>• Diverts trucks to use existing bypass</li> <li>• Introduces traffic calming approaching Lebanon</li> </ul>			<ul style="list-style-type: none"> <li>• May require additional right-of-way</li> </ul>	
<b>Cost Summary</b>				
	<b>Construction</b>	<b>Right-of-way</b>	<b>Total</b>	
Baseline Concept	\$0	\$0	\$0	
Recommendation Concept	\$1,759,741	\$25,500	\$1,785,241	
Cost Avoidance/(Added Value)	(\$1,759,741)	(\$25,500)	\$(1,785,241)	
<b>FHWA Function Benefit</b>				
<b>Safety</b>	<b>Operations</b>	<b>Environment</b>	<b>Construction</b>	<b>Right-of-way</b>
✓	✓	✓		

**VE RECOMMENDATION NO. 9:  
USE ROUNDABOUTS ALONG KY 55/N SPALDING AVE**

**Idea No.  
23**

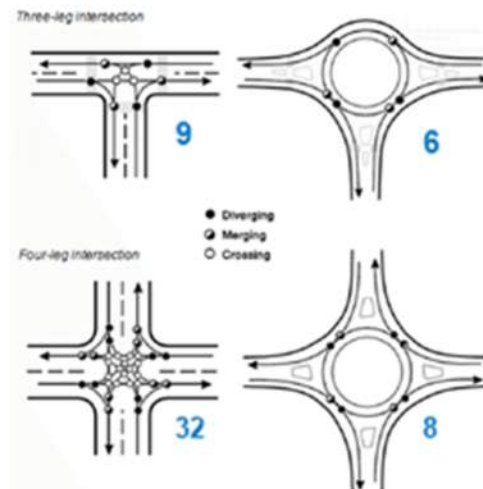
**Discussion/Sketches/Photos/Calculations**

**Technical Discussion/Sketches**

Roundabouts at both intersections will improve traffic operations, traffic safety, introduce traffic calming, and influence truck movements onto the existing northern bypass (Veterans Memorial Parkway).

Traffic operations would be improved at both intersections as it would provide priority to the primary non-through movements for the intersections. KY 55 and Veterans Memorial Parkway this would be the southbound right movement onto the bypass and the eastbound left movement from the bypass. For the intersection N Spalding Avenue and Corporate Drive, these movements would be the southbound left and westbound right.

The safety operations would be improved at both intersections as well. Either one-lane or two-lane roundabouts will reduce the number and types of conflicts at the intersections. (See basic conflict diagram comparison below).



As these intersections serve as an entry/exit point to Lebanon – the roundabout design would serve as a traffic calming feature for vehicles entering along KY 55 from the North. Additionally, it will incentivize drivers and heavy vehicles to use the bypass for trips not destined for downtown as they will be able to make a southbound right at the first intersection as opposed to going through two roundabouts.

The roundabouts can be designed to accommodate the existing roadway network or modified to accommodate the addition of either of the proposed northeast bypass options connecting at KY 55/ Veterans Memorial Parkway as the westbound approach.

**KY 55 and Veterans Memorial Parkway:**

The current intersection is signalized with 4-legs. This intersection provides a connection to the existing Northern Bypass (Veterans Memorial Parkway) with KY 55 to the North and N Spalding Avenue. to the South. This recommendation is to convert the existing intersection into a roundabout.

This roundabout would help facilitate traffic movements to-from the existing bypass and encourage traffic to utilize the bypass instead of continuing south along KY 55/N Spalding Avenue into Lebanon. To accommodate the predominant movements for the intersection and utilize the existing geometry, the roundabout could be configured to allow for a southbound right bypass lane

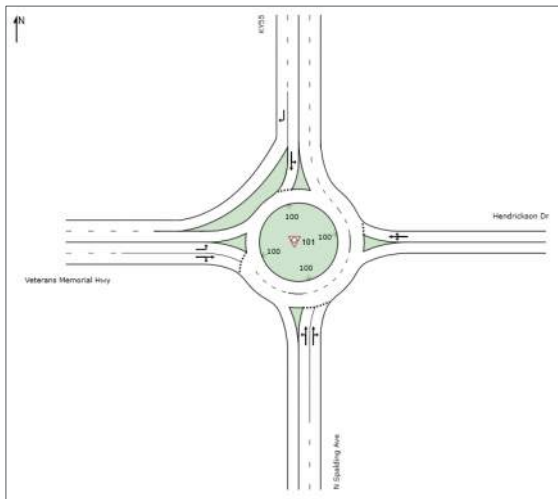
**VE RECOMMENDATION NO. 9:  
USE ROUNDABOUTS ALONG KY 55/N SPALDING AVE**

**Idea No.  
23**

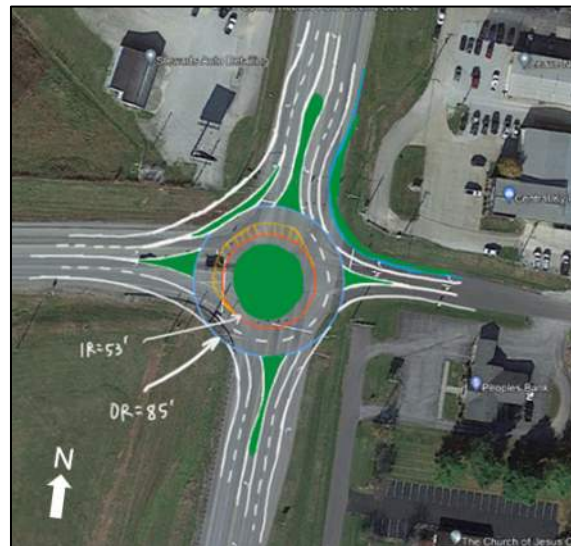
to access the existing bypass and then dual approach and circulating lanes on the eastbound and northbound approaches. This would better accommodate the eastbound left movement and utilize the current 5-lane typical along KY 55/N Spalding Avenue. Based on some traffic volume assumptions it is anticipated that this configuration would work with existing traffic volumes and considerable traffic growth (discussed further in the assumptions/calculations section).

The following shows a conceptual analysis sketch of the configuration and a sketch over an aerial in the location:

Conceptual Configuration



Sketch in location



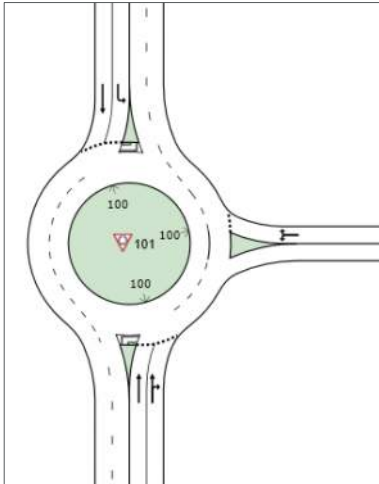
**N Spalding Avenue and Corporate Drive:**

This intersection is currently unsignalized (two-way-stop-control) and has 3-legs. Currently, this intersection experiences delay and queuing due to the amount of southbound left traffic. Converting this intersection into a roundabout would accommodate the major southbound left movement as it would provide them priority over the approaching northbound volume. This would allow for improved traffic operations without the need for a traffic signal. As discussed in the analysis section, the current and projected volumes would operate adequately with a single lane roundabout; however, to better accommodate the existing geometry and provide additional truck accommodations for the southbound left movement, a modern two-lane roundabout could be implemented with two northbound-southbound lanes and approaches.

**VE RECOMMENDATION NO. 9:  
USE ROUNDABOUTS ALONG KY 55/N SPALDING AVE**

**Idea No.  
23**

Conceptual Configuration



Sketch in location



This intersection is adjacent to a historic property on the west side of Spalding Avenue – it is anticipated that the roundabout could be shifted to more to the east to avoid right-of-way takings from the historic property.

**Assumptions/Calculations**

KY 55 and Veterans Memorial Parkway:

There were no traffic counts included for this intersection; however, using the current roadway AADTs and the traffic counts at Corporate Drive (just south of this intersection) assumptions were made to generate peak turning movement counts at this intersection. The table below shows the assumed peak turning movement volumes for this intersection.

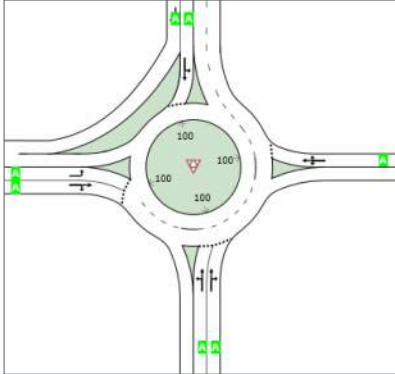
	KY 55			Hendrickson Dr			Spalding Ave			Veterans Memorial Parkway/ KY 2154		
	Southbound			Westbound			Northbound			Eastbound		
	Right	Thru	Left	Right	Thru	Left	Right	Thru	Left	Right	Thru	Left
AM	242	258	20	40	10	10	20	240	150	258	20	329
PM	329	171	20	40	20	20	20	300	180	171	10	242

These volumes were analyzed with the proposed roundabout configuration (shown above) using software SIDRA 8 for both peak periods. It is anticipated that a roundabout with the current volumes would operate with LOS A. Additionally, an assumed future condition with 2 percent traffic growth for 20-years will continue to function with LOS A or B. This indicates that the roundabout can handle the capacity of the current roadway configurations and has additional capacity should the northwest Bypass alternatives be developed further to tie-in. The LOS operational graphics are shown below.

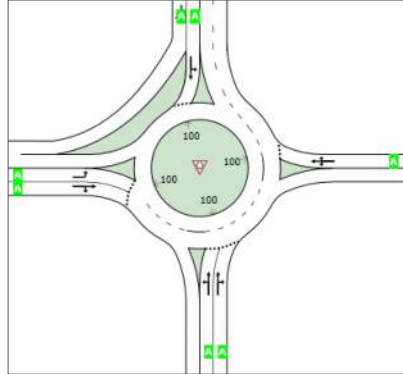
**VE RECOMMENDATION NO. 9:  
USE ROUNDABOUTS ALONG KY 55/N SPALDING AVE**

**Idea No.  
23**

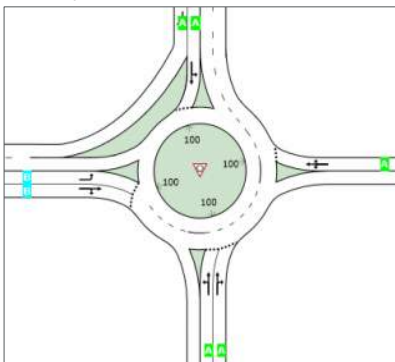
Existing AM LOS



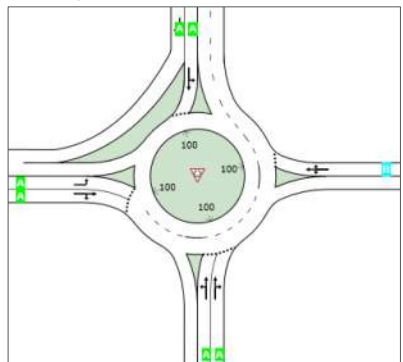
Existing PM LOS



+20year AM LOS



+20year PM LOS



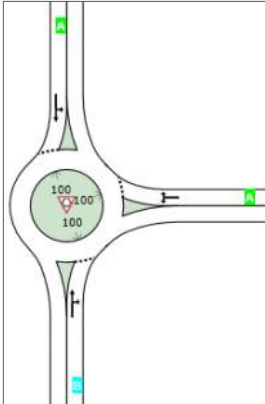
N Spalding Avenue and Corporate Drive:

The project files include traffic count data at this intersection from 09/15/2021 for AM and PM peak periods. That data was used to conduct a high-level roundabout analysis in SIDRA 8. Based on the existing volumes and assuming a 2 percent traffic growth for a 20-year period a single lane roundabout will function with adequate LOS during both peak periods.

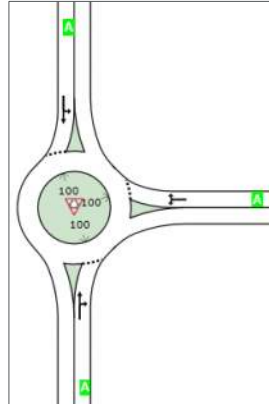
**VE RECOMMENDATION NO. 9:  
USE ROUNDABOUTS ALONG KY 55/N SPALDING AVE**

**Idea No.  
23**

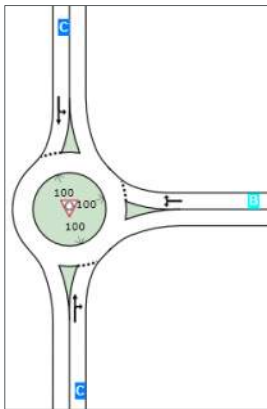
Existing AM LOS



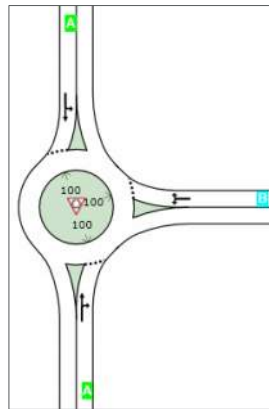
Existing PM LOS



+20year AM LOS



+20year PM LOS



This is a capacity level analysis. Currently, N Spalding Avenue is a five-lane roadway with two travel lanes in each direction and a TWLTL. This provides the option to either reduce the number of lanes approaching/ departing the intersection or configure a roundabout alternative that would work with the existing lane configuration – since the capacity will not be a constraint point based on the analysis, multiple options could be considered. Based on the current roadway configuration and to better accommodate the southbound left movement, a two-lane roundabout is recommended, and costs estimated accordingly.

The traffic volumes are consistent with the traffic volume projections provided by the project team and provide a more conservative analysis for future traffic than what is anticipated through the area.

**Cost Estimate:**

**Roadway Dimensions – both roundabouts**

- 12-foot lane width and 2-foot paved right shoulders on approaches
- 14-foot lane width and 4-foot right shoulders within circulatory lanes
- 10-foot-wide concrete wide truck apron

**VE RECOMMENDATION NO. 9:  
USE ROUNDABOUTS ALONG KY 55/N SPALDING AVE**

**Idea No.  
23**

- Reconstruction of 100 feet of roadway approaches outside of roundabout

**Roadway Quantities**


	KY 55 and Veterans Memorial Parkway	N Spalding Avenue and Corporate Dr
<b>Pavement</b>		
Approaches	N: $(4*12+2+2)*100 = 5,200\text{SF}$ S: $(4*12+2+2)*100 = 5,200\text{SF}$ E: $(2*12+2+2)*100 = 2,600\text{SF}$ W: $(4*12+2+2)*100 = 5,200\text{SF}$ Total: 18,200SF	N: $(4*12+2+2)*100 = 5,200\text{SF}$ S: $(4*12+2+2)*100 = 5,200\text{SF}$ E: $(2*12+2+2)*100 = 2,600\text{SF}$ Total: 13,000SF
Circulatory Lanes	Outer: $\pi*85^2 = 22,700\text{SF}$ Inner: $\pi*53^2 = 8,850\text{SF}$ Total Circulatory = 13,850SF	Outer: $\pi*85^2 = 22,700\text{SF}$ Inner: $\pi*53^2 = 8,850\text{SF}$ Total Circulatory = 13,850SF
Truck Apron	Outer: $\pi*53^2 = 8,850\text{SF}$ Inner: $\pi*37^2 = 4,300\text{SF}$ Total: 4,550SF	Outer: $\pi*53^2 = 8,850\text{SF}$ Inner: $\pi*37^2 = 4,300\text{SF}$ Total: 4,550SF
Concrete Islands	1200SF <i>(assumed increase for bypass lane)</i>	600SF
ROW	0.3 Ac	0.55 Ac

\*Assumed that earthwork and restriping are included within the contingency estimate as this will be minimal in comparison to overall project cost.

**VE RECOMMENDATION NO. 9:  
USE ROUNDABOUTS ALONG KY 55/N SPALDING AVE**

**Idea No.  
23**

KY 55 @ Veterans Memorial Parkway:


	<b>VE Study Life-Cycle Costs Calculations</b> East Lebanon By-Pass Planning Level Study							
	Baseline Concept				VE Recommended Concept			
Component	Unit	QTY	Cost/Unit	Total	Quantity	Cost/Unit	Total	
KY 55/Veterans Approach Construction	SF	0	\$ 20	\$ -	18,200	\$ 20	\$ 364,000	
KY 55/Veterans Circulation	SF	0	\$ 20	\$ -	13,850	\$ 20	\$ 277,000	
KY 55/Veterans Truck Apron	SF	0	\$ 16	\$ -	4,550	\$ 16	\$ 72,800	
KY 55/Veterans Splitter Islands	SF	0	\$ 13	\$ -	1,200	\$ 13	\$ 15,360	
Lighting	EA	0	\$ 2,500	\$ -	4	\$ 2,500	\$ 10,000	
				\$ -		\$ -	\$ -	
<b>Subtotal Construction</b>				\$ -			\$ 739,160	
Mark-Up (Mark-Up MOT, Drainage, 25% <b>29%</b> )				\$ -			\$ 214,356	
<b>Total Construction</b>				\$ -			\$ 953,516	
Monetized Time Savings							\$ -	
Right of Way Costs	ac	\$ -	\$ 30,000	\$ -	0.3	\$ 30,000	\$ 9,000	
<b>TOTAL CAPITAL COST</b>				\$ -			\$ 962,516	
<b>COST CAPITAL SAVINGS / (VALUE ADDED)</b>							\$ (962,516)	



**VE RECOMMENDATION NO. 9:  
USE ROUNDABOUTS ALONG KY 55/N SPALDING AVE**

**Idea No.  
23**

N Spalding Avenue @ Corporate Drive:

	<b>VE Study Life-Cycle Costs Calculations</b>							
	East Lebanon By-Pass Planning Level Study							
	Baseline Concept				VE Recommended Concept			
<b>Component</b>	<b>Unit</b>	<b>QTY</b>	<b>Cost/Unit</b>	<b>Total</b>	<b>Quantity</b>	<b>Cost/Unit</b>	<b>Total</b>	
KY 55/Veterans Approach Construction	SF	0	\$ 20	\$ -	13,000	\$ 20	\$ 260,000	
KY 55/Veterans Circulation	SF	0	\$ 20	\$ -	13,850	\$ 20	\$ 277,000	
KY 55/Veterans Truck Apron	SF	0	\$ 16	\$ -	4,550	\$ 16	\$ 72,800	
KY 55/Veterans Splitter Islands	SF	0	\$ 13	\$ -	600	\$ 13	\$ 7,680	
Lighting	EA	0	\$ 2,500	\$ -	3	\$ 2,500	\$ 7,500	
				\$ -		\$ -	\$ -	
<b>Subtotal Construction</b>				\$ -			\$ 624,980	
Mark-Up (Mark-Up MOT, Drainage, 25%)				\$ -			\$ 181,244	
<b>Total Construction</b>				\$ -			\$ 806,224	
Monetized Time Savings							\$ -	
Right of Way Costs	ac	\$ -	\$ 30,000	\$ -	0.6	\$ 30,000	\$ 16,500	
<b>TOTAL CAPITAL COST</b>				\$ -			\$ 822,724	
<b>COST CAPITAL SAVINGS / (VALUE ADDED)</b>							\$ (822,724)	

<b>VE RECOMMENDATION NO. 10: USE ROUNDABOUTS ALONG N SPALDING AVENUE NEAR DOWNTOWN</b>		<b>Idea No. 30</b>		
<b>Baseline Concept</b>				
The baseline concept does not include any traffic calming improvements along N Spalding Avenue to discourage truck pass-through traffic from using US 68 through downtown Lebanon.				
<b>Recommendation Concept</b>				
Install two roundabouts on N Spalding Avenue at KY 429/St Rose Road and W Walnut Street.				
<b>Advantages</b>		<b>Disadvantages</b>		
<ul style="list-style-type: none"> <li>• Discourages through trucks downtown</li> <li>• Improves operations</li> <li>• Improves pedestrian crossing(s)</li> <li>• Eliminates traffic signal(s)</li> <li>• Reduces maintenance</li> <li>• Upgrades approach/intersection</li> <li>• Provides opportunities for a gateway into downtown</li> </ul>		<ul style="list-style-type: none"> <li>• May increase right-of-way impacts</li> <li>• Access impacts to residents</li> <li>• Utility impacts</li> </ul>		
<b>Cost Summary</b>				
	<b>Construction</b>	<b>Right-of-way</b>	<b>Total</b>	
Baseline Concept	\$0	\$0	\$0	
Recommendation Concept	\$989,564	\$5,100	\$994,664	
Cost Avoidance/(Added Value)	(\$989,564)	(\$5,100)	(\$994,664)	
<b>FHWA Function Benefit</b>				
<b>Safety</b>	<b>Operations</b>	<b>Environment</b>	<b>Construction</b>	<b>Right-of-way</b>
✓	✓			

**VE RECOMMENDATION NO. 10:  
USE ROUNDABOUTS ALONG N SPALDING AVENUE  
NEAR DOWNTOWN**

**Idea No.  
30**

**Discussion/Sketches/Photos/Calculations**

**Technical Discussion/Sketches**

Based on public comments and considering that the purpose and need of this project is to improve congestion, the VE team believes that reducing the truck traffic through downtown is one of the desired outcomes of the proposed improvements. Although Veterans Memorial Parkway (KY 2154) serves as a north bypass, a significant proportion of truck traffic utilizes N Spalding Avenue (KY 55), which sends trucks through the west side of Lebanon.

The intersection of N Spalding Avenue and Main Street (US 68) was identified as a hot spot for crashes, with a high density of crashes. The predominant crash type at this location is angle crashes.

This recommendation is to construct two roundabouts along N Spalding Avenue at W Walnut Street and at St Rose Road. Roundabouts at these locations will provide the following benefits along Spalding Avenue:

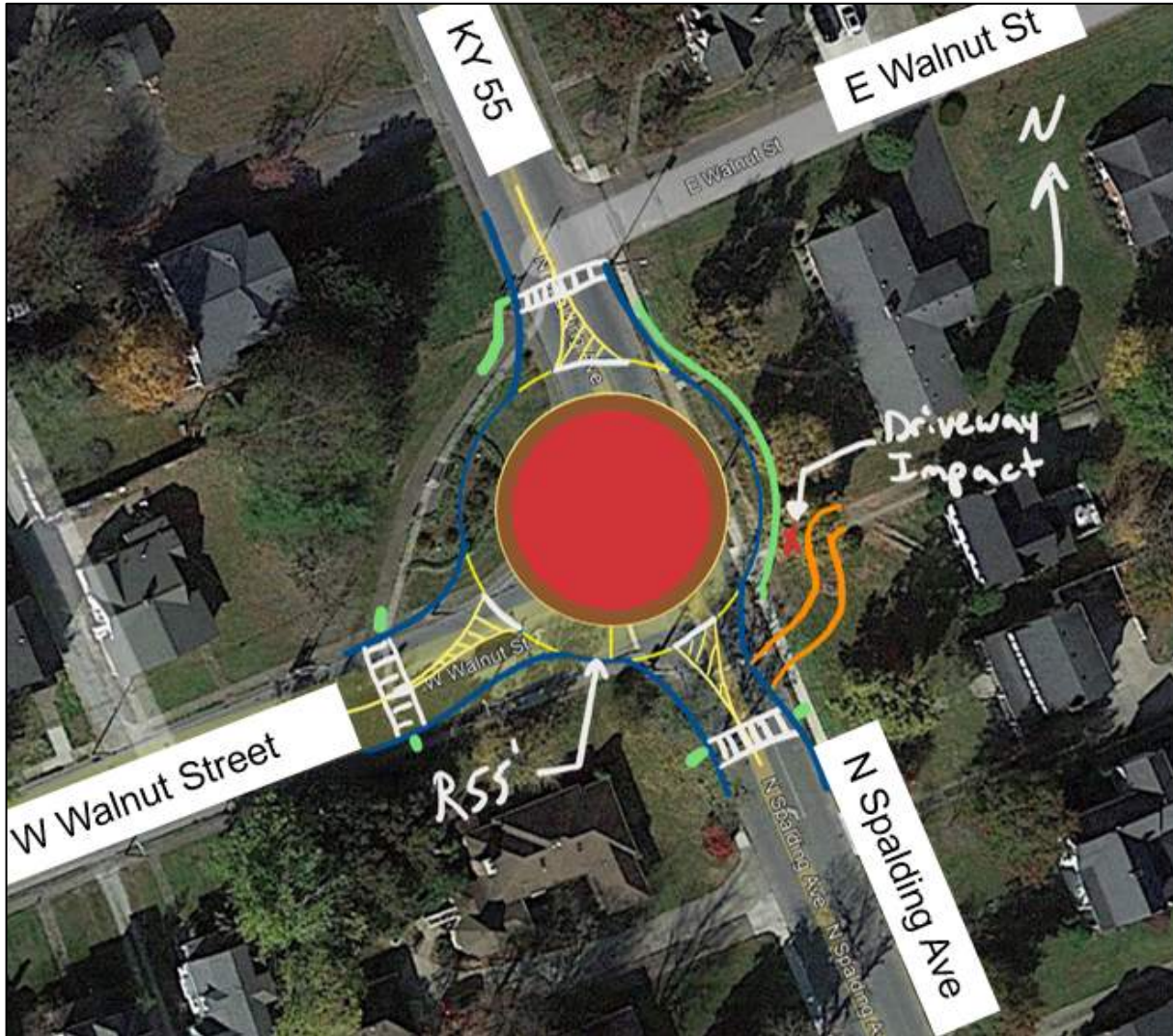
- Discourage truck traffic which will also improve signal operations at Main Street/N Spalding Avenue
- Calm traffic
- Improve pedestrian access across . Spalding Avenue
- Reduce crash rate
- Establish the character of downtown (placemaking)

The proposed roundabout at W Walnut Street, shown in Figure 1 below, has an outer diameter of 110'. It was located to minimize impacts to private property and public space in the northwest quadrant. Due to the size of the outer diameter and the needs for pedestrian access, spitter islands are not provided, and striping provides positive guidance on approach of the roundabout.

The roundabout will require relocation of three utility poles.

**VE RECOMMENDATION NO. 10:  
USE ROUNDABOUTS ALONG N SPALDING AVENUE  
NEAR DOWNTOWN**

Idea No.  
30



**Figure 1: Single Lane Roundabout at N Spalding Avenue and W Walnut Street**

The proposed roundabout will have right-of-way impacts and impact one private driveway. Realignment of the driveway is possible, however the driveway location with respect to the northbound entrance approach of the roundabout is not optimal. The distance between the roundabout and W Walnut Street, located north of the proposed roundabout, is also less than optimal.

A mini roundabout can be considered to mitigate the above-mentioned concerns while providing similar benefits described above.

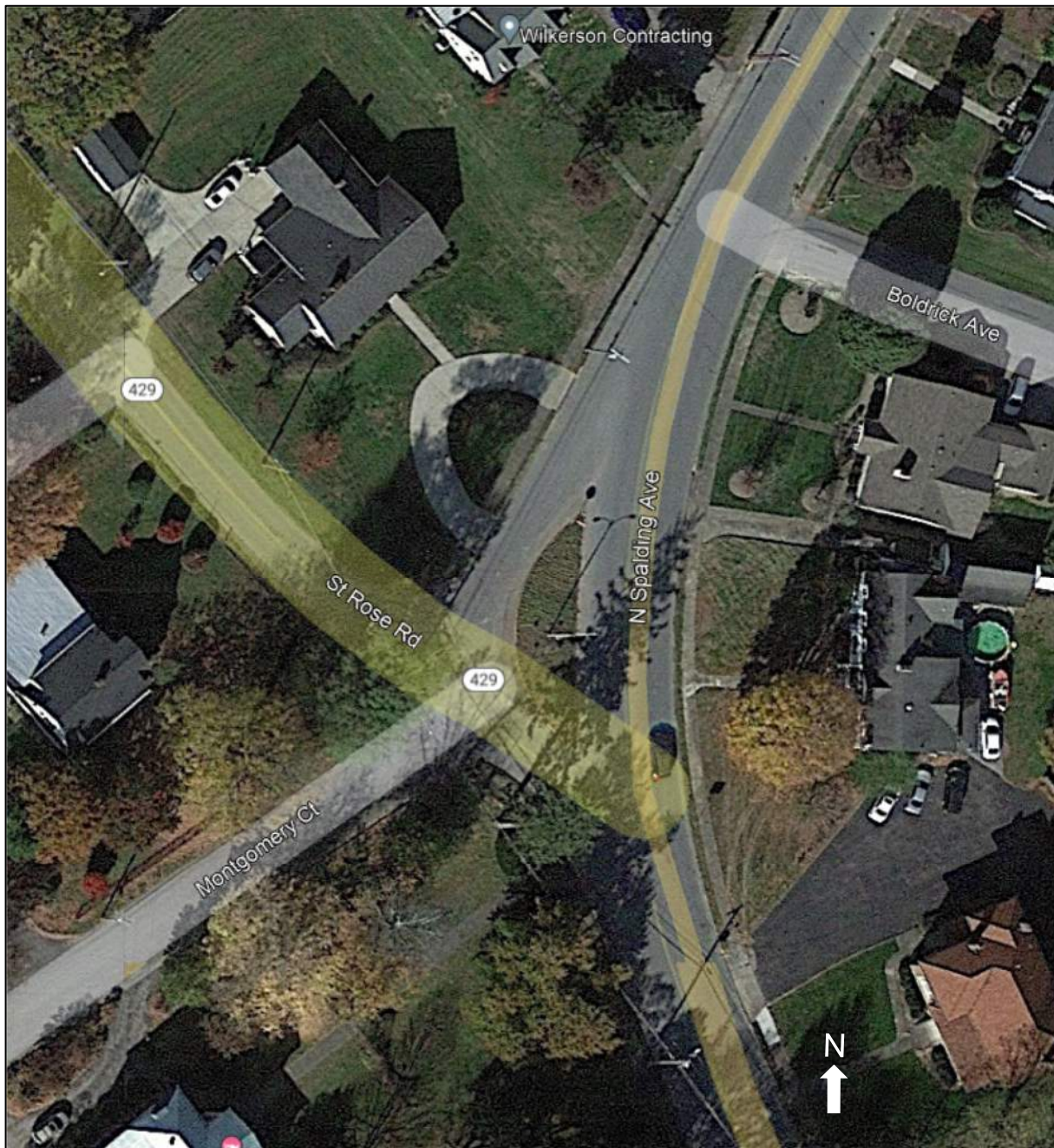
Converting the signalized intersection into a roundabout has a crash modification factor of 0.65 ([http://www.cmfclearinghouse.org/study\\_detail.cfm?stid=46](http://www.cmfclearinghouse.org/study_detail.cfm?stid=46)). In addition to reducing crashes, converting this intersection to a roundabout will reduce long term maintenance associated with the signal.

The existing roadway geometry is atypical, with a large, vegetated median located at the apex of the horizontal curve along N Spalding Avenue, see Figure 2 below. A roundabout at this location

**VE RECOMMENDATION NO. 10:  
USE ROUNDABOUTS ALONG N SPALDING AVENUE  
NEAR DOWNTOWN**

**Idea No.  
30**

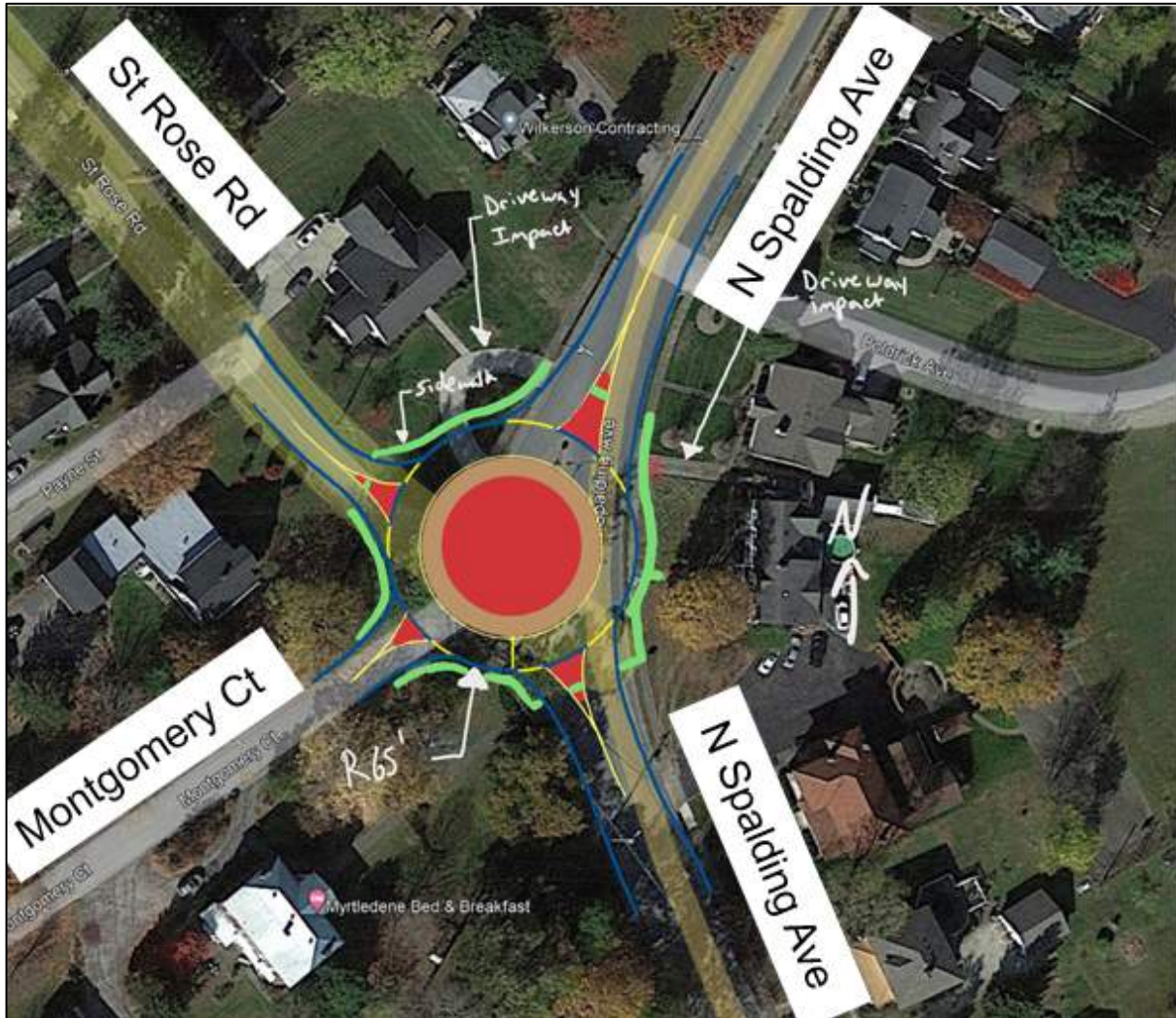
will calm traffic and improve the overall roadway geometry of this intersection. The proposed roundabout at St Rose Road, shown in Figure 3 below, has an outer diameter of 130'. Converting a minor approach stop controlled intersection to a roundabout has a crash modification factor of 0.75 (<http://www.cmfclearinghouse.org/detail.cfm?facid=9285#commentanchor>)



**Figure 2: Existing Intersection Geometry N Spalding Avenue and St Rose Road**

**VE RECOMMENDATION NO. 10:  
USE ROUNDABOUTS ALONG N SPALDING AVENUE  
NEAR DOWNTOWN**

Idea No.  
30



**Figure 3: Proposed Single Lane Roundabout at N Spalding Avenue and St Rose Road**

The proposed roundabout does have some right-of-way impacts including two driveways. The driveway impacts in the northeast and northwest quadrants likely require removal of those driveways with no opportunity to realign or replace in-kind.

The roundabout will require relocation of three utility poles.

**Assumptions/Calculations**

**Roadway Dimensions**

- 12-foot lane width and 2-foot paved right shoulders on approaches
- 14-foot lane width and 4-foot right shoulders within circulatory lanes
- 10-foot-wide concrete wide truck apron
- Reconstruction of 100-foot of roadway approaches outside of roundabout

**Roadway Quantities –N Spalding Avenue and W Walnut Street**

**VE RECOMMENDATION NO. 10:  
USE ROUNDABOUTS ALONG N SPALDING AVENUE  
NEAR DOWNTOWN**

**Idea No.  
30**

**Pavement**

- Approaches: 26' x 100' x 3 approaches = 7,800 SF
- Circulatory Lanes: Outer Diameter = 110'; Outer Diameter of truck apron = 74'  
 $\text{Pi} \cdot 55^2 = 9,503$   $\text{Pi} \cdot 37^2 = 4,301$   
 Total Circulatory Lane Pavement = 9,503 – 4,301 = 5,202 SF

**Concrete Truck Apron, Curbed Islands, Sidewalk**

- Truck Apron: Outer Diameter = 74'; Inner Diameter = 54'  
 $\text{Pi} \cdot 37^2 = 4,301$   $\text{Pi} \cdot 27^2 = 2,290$   
 Total Truck Apron Area = 4,301 – 2,290 = 2,011 SF  
 6" depth = 37.24 CY
- No concrete splitter island due to limited space and crosswalk locations
- New sidewalk approximated from Google Earth = 130-foot long, 6-foot wide, 4" depth = 9.63 CY

**Driveway Modifications**

- 70 feet, measured from Google Earth. Assumed 10-foot width to match existing. Total AC driveway is 700 SF. Assumed depth of 6" AC on 6" base  
 Total AC =  $700 \times 0.5 / 27 = 13$  CY  
 Total Base =  $700 \times 0.5 / 27 = 13$  CY

**Illumination**

- Assumed total of 3 new light poles including wiring

Based on existing topography, earthwork is assumed to be minimal and covered by contingency

Signing, striping, landscape is assumed to be included in contingency

**ROW**

Polygons of proposed roadway outside assumed public right-of-way measured from Google Earth total 0.10 acres

**Utilities**

Relocation of 3 utility poles

**Roadway Quantities –N Spalding Avenue and St Rose Road**

**Pavement**

- Approaches: 26' x 100' x 4 approaches = 10,400 SF
- Circulatory Lanes: Outer Diameter = 130'; Outer Diameter of truck apron = 94'  
 $\text{Pi} \cdot 65^2 = 13,273$   $\text{Pi} \cdot 47^2 = 6,940$   
 Total Circulatory Lane Pavement = 13,273 – 6,940 = 6,333 SF

**Concrete Truck Apron, Curbed Islands, Sidewalk**

**VE RECOMMENDATION NO. 10:  
USE ROUNDABOUTS ALONG N SPALDING AVENUE  
NEAR DOWNTOWN**

**Idea No.  
30**

- Truck Apron: Outer Diameter = 94'; Inner Diameter = 74'  
 $\text{Pi} \times 47^2 = 6,940$   $\text{Pi} \times 37^2 = 4,301$   
Total Truck Apron Area = 6,940 – 4,301 = 2,639 SF  
6" depth = 48.87 CY
- Concrete islands at roundabout approaches are assumed to be 200 SF each for a total of 800 SF  
6" depth = 14.82 CY
- New sidewalk approximated from Google Earth = 140-foot long, 6-foot wide, 4" depth = 10.37 CY

**Illumination**

- Assumed total of 4 new light poles including wiring

Based on existing topography, earthwork is assumed to be minimal and covered by contingency

Signing, striping, landscape is assumed to be included in contingency

**ROW**

Polygons of proposed roadway outside assumed public right-of-way measured from Google Earth total 0.07 acres

**Utilities**


Relocation of 3 utility poles



**VE RECOMMENDATION NO. 10:  
USE ROUNDABOUTS ALONG N SPALDING AVENUE  
NEAR DOWNTOWN**

**Idea No.  
30**


N Spalding Avenue/W Walnut Street Estimate

		<b>VE Study Life-Cycle Costs Calculations</b>						
		East Lebanon By-Pass Planning Level Study						
		Baseline Concept			VE Recommended Concept			
Component	Unit	QTY	Cost/Unit	Total	Quantity	Cost/Unit	Total	
Spalding/Walnut Approach Construction	SF	0	\$ 20.00	\$ -	7,800	\$ 20	\$ 156,000	
Spalding/Walnut Circulation	SF	0	\$ 20.00	\$ -	5,202	\$ 20	\$ 104,040	
Spalding/WalnutTruck Apron	SF	0	\$ 16.00	\$ -	2,290	\$ 16	\$ 36,640	
Lighting	EA	0	\$ 5,000.00	\$ -	3	\$ 5,000	\$ 15,000	
Utility Pole Relocation	EA	0	\$ 5,000.00	\$ -	3	\$ 5,000	\$ 15,000	
Sidewalk	SF	0	\$ 10.00	\$ -	780	\$ 10	\$ 7,800	
Driveway Reconstruction	EA	0	\$ 3.00	\$ -	700	\$ 3	\$ 2,100	
<b>Subtotal Construction</b>				\$ -			\$ 336,580	
Mark-Up (Mark-Up MOT, Drainage, 25% cor				29%			\$ 97,608	
<b>Total Construction</b>				\$ -			\$ 434,188	
Right of Way Costs	ac	\$ -	\$ 30,000.00	\$ -	0.1	\$ 30,000	\$ 3,000	
<b>TOTAL CAPITAL COST</b>				\$ -			\$ 437,188	
<b>COST CAPITAL SAVINGS / (VALUE ADDED)</b>							\$ (437,188)	

**VE RECOMMENDATION NO. 10:  
USE ROUNDABOUTS ALONG N SPALDING AVENUE  
NEAR DOWNTOWN**

**Idea No.  
30**

N Spalding Avenue/St Rose Street Estimate

		<b>VE Study Life-Cycle Costs Calculations</b>						
		East Lebanon By-Pass Planning Level Study						
		Baseline Concept			VE Recommended Concept			
Component	Unit	QTY	Cost/Unit	Total	Quantity	Cost/Unit	Total	
Spalding/St. Rose Approach Construction	SF	0	\$ 20.00	\$ -	10,400	\$ 20	\$ 208,000	
Spalding/St. Rose Circulation	SF	0	\$ 20.00	\$ -	6,333	\$ 20	\$ 126,660	
Spalding/St. Rose Truck Apron	SF	0	\$ 16.00	\$ -	2,639	\$ 16	\$ 42,224	
Spalding/St. Rose Splitter Islands	SF	0	\$ 12.80	\$ -	800	\$ 13	\$ 10,240	
Lighting	EA	0	\$ 5,000.00	\$ -	4	\$ 5,000	\$ 20,000	
Utility Pole Relocation	EA	0	\$ 5,000.00	\$ -	3	\$ 5,000	\$ 15,000	
Sidewalk	SF	0	\$ 10.00	\$ -	840	\$ 10	\$ 8,400	
<b>Subtotal Construction</b>				\$ -			\$ 430,524	
<b>Mark-Up (Mark-Up MOT, Drainage, 25% co</b>				29%			\$ 124,852	
<b>Total Construction</b>				\$ -			\$ 555,376	
<b>Right of Way Costs</b>		ac	\$ -	\$ 30,000.00	0.1	\$ 30,000	\$ 2,100	
<b>TOTAL CAPITAL COST</b>				\$ -			\$ 557,476	
<b>COST CAPITAL SAVINGS / (VALUE ADDED)</b>							\$ (557,476)	

## 7.4 Performance Assessment

This Planning Level VE Study was conducted to evaluate the alternatives presented to the team, to improve on those concepts and to create new alternatives. To evaluate these concepts, the VE team used performance attributes to qualify and quantify their merits. Each alternative was scored using a rating scale shown in Table 13. Each of these scores were adjusted with the weighing factors obtained from the Performance Attribute Matrix found in Table 8, to obtain a Weighted Performance Comparison Matrix as shown in Table 14.

<b>Table 13. Performance Attribute Rating Scale</b>	
<b>Rating</b>	<b>Performance Attribute Scales</b>
10	Concept meets purpose and need extremely better
9	Concept meets purpose and need very strongly better
8	Concept meets purpose and need strongly better
7	Concept meets purpose and need moderately better
6	Concept meets purpose and need slightly better
5	Concept just meets purpose and need
4	Concept meets purpose and need slightly less
3	Concept meets purpose and need moderately less
2	Concept meets purpose and need strongly less
1	Concept meets purpose and need very strongly less
0	Concept meets purpose and need extremely less

The Weighted Performance Comparison Matrix (Table 14) shows how each Alternative or Option presented to the VE team stacks against each other according to the VE team's views and opinion.

<b>Table 14. Weighted Performance Comparison Matrix</b>											
<b>Attribute</b>	<b>Attribute Weight</b>	<b>Alternative</b>			<b>Concept</b>						
		<b>1</b>	<b>2</b>	<b>2a</b>	<b>A</b>	<b>A1</b>	<b>B</b>	<b>C</b>	<b>D</b>	<b>E</b>	<b>F</b>
Main Line Operations	17	8	3.5	3	6.5	1	2	1.5	3.5	6	7
Local Operations	21	6.5	4.5	4.5	2.5	1.5	5	3	2.5	2	4
Environmental Impacts	18	5	7	8	3	3.5	4	4	4	3.5	4.75
Traffic Operations	20	6	5	4.5	3	1	4.75	3.5	5.5	2	5.5
Economic Development	13	7	5	5	2.5	3	4	5.5	5.5	2	6
Schedule	11	5	6	8	2	5	4.5	4.75	5	2	5
<b>Totals</b>		<b>628.5</b>	<b>511</b>	<b>532.5</b>	<b>331.5</b>	<b>225.5</b>	<b>407.5</b>	<b>354.25</b>	<b>420.5</b>	<b>295</b>	<b>531.5</b>

## 7.5 VE Proposals

As each of the alternatives were evaluated and improved with additional recommendations, the VE team sought to find a combination of improvements that best met the purpose and need of the project. The VE team's view was to implement solutions in the short- and long-term basis, to create a northern bypass and make improvements to Main Street, which led to the creation of VE Proposal #1.

The team also considered the possibility of a southern bypass route. Although not recommended, the VE team created a summary analysis write-up with the rationale for an alignment of a southern bypass if that is the direction the project proceeds.

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<b>VE PROPOSAL NO. 1 ADOPT NORTHERN BYPASS ALTERNATIVE</b>	<b>Alignment 1, Alignment 2A and Rec. #s 1,2,5,6,7,8,9,10</b>
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**Baseline Concept**

There are two alternatives to complete the northern bypass:

Alignment 1: Generally, follows an easterly then ESE alignment east of Corporate Drive and north of the schools' campus, from KY 55/N Spalding Avenue along Hendrickson Dr to Barbers Mill Dr.

Alignment 2: Follows Alignment 1 alignment for about 1,700 feet then turns southward towards Corporate Dr and continues on Corporate Drive to end at US 68.

There are no operational improvements to improve downtown congestion.

**Proposed Concept**

The VE Team proposes two solutions to completing the bypass:

Short term solution:

- Implement Alternative 2A (Recommendation #8) - improve the intersection along N Spalding Avenue at Corporate Drive with a roundabout and widening Corporate Drive to a 3-lane roadway throughout to US 68. Realign US 68 to the west and KY 2154 (existing bypass) as the main line movement. Realign Main Street to tee into the mainline. (Recommendation #6). Implement traffic calming strategies along Main Street (Recommendation #1) and pedestrian accommodations improvements (Recommendation #2). Change the Federal Designated Truck Route using KY 2154 northern loop (Recommendation #5)

Long term solution:

- Implement "Alignment 1" with operational improvements at KY 55 (Recommendation #9) on the northern end and US 68 at the eastern end (Recommendation #7), Realign US 68 to the west and KY 2154 (existing bypass) as the main line movement, realign Main Street to tee into the mainline. (Recommendation #6), implement traffic calming strategies along Main Street (Recommendation #1), pedestrian accommodations improvements (Recommendation #2), and change the Federal Designated Truck Route using KY 2154 northern loop (Recommendation #5)

<b>Cost Summary</b>	<b>Design/Construction</b>	<b>Right-of-way</b>	<b>Total</b>
Baseline Alternate 2	\$3,921,000	\$896,000	\$4,817,000
Short Term Solution	\$7,721,524	\$478,600	\$8,200,124
Added Value	\$(3,800,524)	\$417,400	\$(3,383,124)
Baseline Alternate 1	\$4,669,000	\$1,115,702	\$5,784,702
Long Term Solution	\$9,519,647	\$1,559,309	\$11,078,956
Added Value	\$(4,850,647)	\$(443,607)	\$(5,294,254)

<b>VE PROPOSAL NO. 1 ADOPT NORTHERN BYPASS ALTERNATIVE</b>	<b>Alignment 1, Alignment 2A and Rec. #s 1,2,5,6,7,8,9,10</b>
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**Discussion/Sketches/Photos/Calculations**

**Technical Discussion/Sketches**

Main Line Operations

For the purpose of this study, KY 2154 which serves as the US 68 bypass, is considered the main line operations. For short-term improvements, KY 2154 and Corporate Drive are considered main line operations.

The short-term improvements will not complete the northern bypass alignment and therefore not provide significant improvements to main line operations. The travel demand model outputs however do show improvements along Corporate Drive will increase the volume of traffic diverted from US 68. Providing a roundabout at N Spalding Avenue and Corporate Drive will facilitate better mobility to/from KY 2154 and Corporate Drive while reducing traffic demand at US 68/Corporate Drive and along US 68. The proposed roundabouts at N Spalding Avenue/Corporate Drive and US 68/Corporate Drive will serve the projected 20-year traffic projections at a high level of service, reducing congestion and vehicular delay at each intersection.

The long-term improvements complete the northern bypass, allowing a complete east-west connection to US 68 without using E/W Main Street through downtown Lebanon. The travel demand shows a total of 1,100 vehicles per day diverted from downtown once the northern bypass is complete. Once Alignment 1 is completed for the northern bypass, Corporate Drive will see a reduction of 3,100 vehicles per day, based on the travel demand model outputs. Alignment 1 diverts between 300 and 500 more vehicles from US 68 than Alignment 2, better meeting the purpose and need of the project.

Depending on funding availability and projected horizon year for Alignment 1 completing the northern bypass, the typical section of Corporate Drive can be modified to better align capital investment with the demand and anticipated years of service demand. If the completion of Alignment 1 is projected to be within 5 to 10 years, consider constructing a 3-lane section along Corporate Drive for 2,000-3,000 feet at the southern terminus to facilitate industrial and school traffic. This will provide a greater cost-benefit for the short-term improvement.

Local Operations

The short-term improvements will have minor impacts on local operations throughout the study area. The Corporate drive improvements will improve side street operations by providing the opportunity for two-stage gap acceptance for turning vehicles. Improving the intersection at N Spalding Avenue and Corporate drive will improve operations along N Spalding south of the intersection and the associated connecting roadways into downtown as it should improve diversion from this route and improve traffic flow and relieve some congestion. The realignment of the KY 2154 and US 68 area should have similar local operational improvements as it will further incentivize traffic to use the KY 2154 and avoid the downtown core areas. The inclusion of roundabouts on US 68/ US 68 business at Corporate Drive and the connection to the existing Southern Bypass will provide general operational and safety improvements as vehicles enter a slower speed area while providing an opportunity for further diversion. The downtown traffic calming, and pedestrian strategies should show safety benefits - lower traffic exposure operating at generally lower speeds through intersections with fewer conflicts should reduce the number, lessen the severity, and change the types of crashes through the downtown sections.

The long-term improvements of the construction of Alignment 1 will have larger impacts to the local operations. At this stage Corporate Drive will become a local roadway as it will not be part of the bypass. The short-term improvements to this roadway and intersections will continue to have benefit to the local traffic access the school facilities and businesses with much of the through traffic removed. The introduction of Alignment 1 will further help divert traffic from using US 68



<p style="text-align: center;"><b>VE PROPOSAL NO. 1</b></p> <p style="text-align: center;"><b>ADOPT NORTHERN BYPASS ALTERNATIVE</b></p>	<p style="text-align: center;"><b>Alignment 1, Alignment 2A and Rec. #s 1,2,5,6,7,8,9,10</b></p>
<p>through downtown further emphasizing the operational and safety benefits from the short-term improvements – less congestion due to less traffic exposure and similarly fewer crashes of lesser severity.</p> <p><u>Maintainability</u>  Short term: There will be little difference between the recommended improvements and the current conditions. There will be some additional pavement from the turning lane on Corporate Drive. Signal maintenance will be eliminated at the bypass/KY 55 and the bypass/US 68.</p> <p>Long Term:  The construction of "Alignment 1" will add more lane miles of pavement to the system that will need to be resurfaced periodically.</p> <p><u>Construction</u>  Short Term: There will be construction impacts to existing roadways at several locations. Three of them will be at the location where the realignments tie in at the southwest end (Recommendation #8). This may somewhat impact the flow of freight and traffic accessing the commercial district. There will also be traffic impacts during the reconstruction of the two intersections. Maintenance of traffic and access will be a challenge during the reconstruction of Corporate Drive since it is heavily used by school and industry traffic. There will be noise impacts to some of the residents on both ends of the project. There will be some construction impacts for the improvements along Main Street, however it is anticipated that they take place in short segments and will be minor and short in duration.</p> <p>Long Term: Considering that "Alternate 1" uses a cross country alignment, there should be little construction impact to for traffic operations or to property owners.</p> <p><u>Environmental</u>  An assessment of the permanent impacts to the environment including ecological (i.e., flora, fauna, air quality, water quality, visual, noise); socioeconomic impacts; impacts to shore edge; impacts to cultural, recreational and historic resources.</p> <p>Potential impacts for short-term solution 2a (including recommendation #10 for Corporate Drive) offer relatively low impacts as it improves and widens an existing route. It will require additional right of way on previously disturbed ground and will create additional impervious surface for runoff; however, with expected curb and gutter, some of those impacts can be mitigated. It is not expected to impact any streams, habitats, or toxic locations. There is an historic property at the northern end of Corporate Dr. across the intersection with KY 55 that will need review. It will enhance the livability of the local area for residents by providing safe pedestrian access to local educational and commercial facilities. Potential impacts for recommendation #8 (Realignment of KY 2154 as the main route at the intersection of it and US 68 on the west side of the existing bypass, poses some risk for impact to an existing historical property on the north -west side of the intersection. Realignment will need to examine spacing on that corner. Other impacts would be very minimal to any natural or socio categories. Impacts for Traffic Calming recommendations would be minimal as well. There are several historic structures along the downtown route; however, it is believed that all of the strategies could be implemented within the existing right of way, minimizing any disturbance and improving the character of the downtown area as high-density, walkable commercial and institutional.</p> <p>Potential long term Solution impacts for the new proposed route of Alignment 1 include substantial right of way acquisitions. It does not appear that any significant historical or agricultural will be affected; however, long term development along the route may increase the potential to affect those categories. The route will cross of two minor ephemeral streams (small tributaries to Cartwright Creek) and removal of some minor tree stands. Sensitivity to Indiana / Grey bat</p>	

<b>VE PROPOSAL NO. 1 ADOPT NORTHERN BYPASS ALTERNATIVE</b>	<b>Alignment 1, Alignment 2A and Rec. #s 1,2,5,6,7,8,9,10</b>
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populations will be needed. Other species impacts would be minimal. The area is interspersed with Karst terrain so some geotechnical review will be warranted. Substantial new impervious surfaces will be created.

Traffic Operations

An assessment of the effects to neighbors and visitors to the project surrounding area including road alignment and grade at the road crossing, access to businesses and parking lots, connection to driveways, and other changes to the existing condition.

In the short-term scenario the traffic operations will be improved throughout the US 68 downtown section and along N Spalding Avenue due to lower traffic volumes. Through downtown the conversion of signalized intersections to roundabouts (traditional and mini) should improve traffic operations by eliminating as much stop-go delay as associated with signalized intersections. The geometric changes on connection of US 68 with KY 2154 and the adjacent roundabout to connect with the southern bypass and US 68 business will improve operations at this intersection from the current signalized condition as it will have significantly less traffic flowing through the intersection. The roundabout at N Spalding Avenue and Corporate will improve the current congestion present due to the southbound left queuing as this movement will essentially have priority access at the intersection as there will be a dedicated southbound lane and less opposing traffic volume.

In the long-term condition the traffic operations throughout the network should be further improved as more traffic is anticipated to divert to Alignment 1, thus moving more traffic from the downtown core section. The intersection improvements made from the short-term solutions will still be impactful as the volumes will either be unchanged or lowered due to diversion.

Economic Development

An assessment of potential future economic development as measured in supporting businesses and services (origin/destination) development in the area

Short term solutions of development of 2a will likely have few major new economic development impacts other than small commercial along the north eastern side. The eastern side of Corporate Drive is already developed with residential in the north and industrial in the south. There is a small parcel available for further residential development adjacent to an existing subdivision. The addition of a turning lane may offer higher commercial use; however, not significant and should enhance existing industrial facility usage.

The Realignment on the west end of the existing KY 2154 at the intersection of US 68 does not substantially change the character of the routes; however, the designation of KY 2154 as the Main Street / US 68 Route and the designation of downtown US 68 as the Business Route may alter the types of business traffic that each experience. The new Business Route designation may improve some business-related trips through downtown to existing businesses and could enhance the destination trips downtown by relieving downtown of excess truck and through traffic.

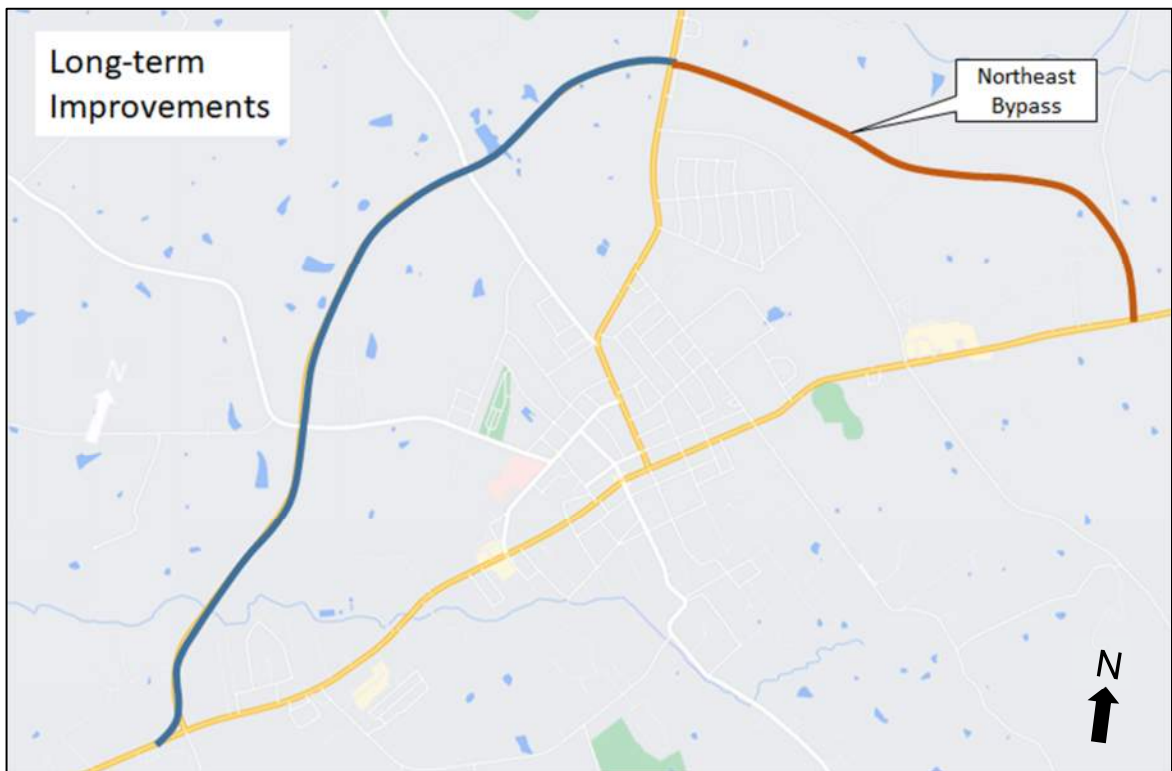
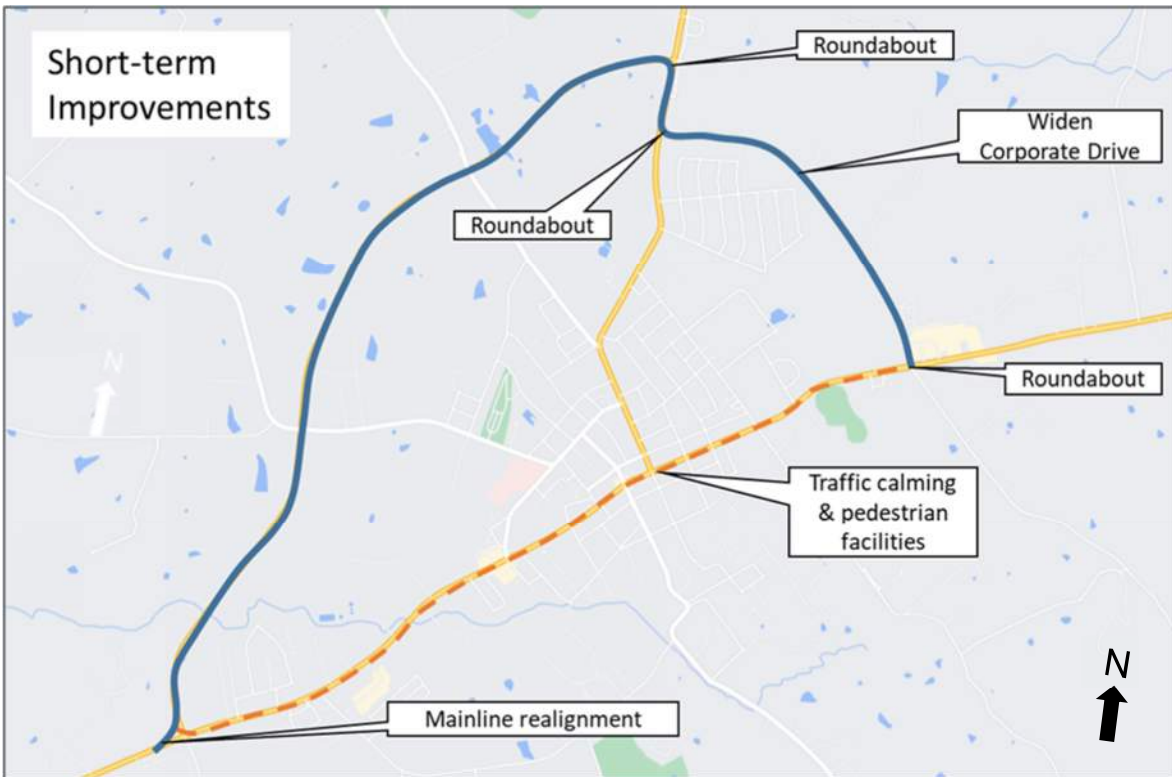
The implementation of Traffic Calming strategies through the downtown may reduce through traffic, which may affect unplanned business stops; however, should enhance walkability and destination visits, which would be potentially important for visitors seeking local experiences.

The Alignment 1 recommendation would include long term economic development impacts. It would potentially open a small amount of new undeveloped land for further industrial prospects, especially on the northern end where it will intersect with Hendricks Drive. The land is rolling with a substantial creek to the west. Overall, there is not new significant industrial or commercial land with higher potential than what is currently available on the existing KY 2154 Bypass.

Below are high level sketches of Short- and Long-Term improvements:

**VE PROPOSAL NO. 1  
ADOPT NORTHERN BYPASS ALTERNATIVE**

**Alignment 1, Alignment  
2A and Rec. #s  
1,2,5,6,7,8,9,10**



### Assumptions/Calculations

Depending on funding availability, these improvements can be made as safety and operational improvements in the area as one project or multiple separate projects. Recommendation 8 has a desirable footprint; however, could be minimized and lower the scope of improvements along Corporate Drive.

Short-Term:

#	Description	Des/Const	ROW	Total
1	Add traffic calming features along Main Street	\$637,727		\$637,727
2	Improve pedestrian accommodations	\$101,992		\$101,992
5	Change the Federal Designated Truck Route to KY 2154	\$0		\$0
6	Convert KY 2154 to US 68 and US 68 to US 68 Business	\$1,705,300	\$448,000	\$2,153,300
8	Create alternative northeast alignment along Corporate Dr	\$2,527,200		\$2,527,200
9	Use roundabouts along KY 55/N Spalding Avenue	\$1,759,741	\$25,500	\$1,785,241
10	Use roundabouts along N Spalding Avenue near downtown	\$989,564	\$5,100	\$994,664
			<b>Total</b>	<b>\$8,200,124</b>

If a decision and funding is available in the short term for implementation of Alternative 1, the VE team recommends implementing the operation improvements shown above, except for recommendation 8, along with Alternative 1 and other improvement costs as detailed below.

Long-Term estimate:

#	Description	Des/Const	ROW	Total
<b>Alt 1</b>	Implement Alternative 1	\$4,669,000	\$1,090,909	\$6,031,909
1	Add traffic calming features along Main Street	\$637,727		\$637,727
2	Improve pedestrian accommodations	\$101,992		\$101,992
5	Change the Federal Designated Truck Route to KY 2154	\$0		\$0
6	Convert KY 2154 to US 68 and US 68 to US 68 Business	\$1,705,300	\$448,000	\$2,153,300
7	Use a roundabout at Barber Mills Road	\$462,548	\$6,300	\$468,848
9	Use roundabout at KY 55 and Veterans Memorial Parkway	\$953,516	\$9,000	\$962,516
10	Use roundabouts along N Spalding Avenue near downtown	\$989,564	\$5,100	\$994,664
			<b>Total</b>	<b>\$11,350,956</b>

In summary, the northern bypass alignment with either the short- or long-term solution, offers the best value for the region because it takes advantage of existing infrastructure, takes less to complete a bypass and minimizes impacts to the environment, while improving traffic congestion and shortening traveling times for local and long-distance users. These improvements also benefit

**VE PROPOSAL NO. 1  
ADOPT NORTHERN BYPASS ALTERNATIVE**

**Alignment 1, Alignment  
2A and Rec. #s  
1,2,5,6,7,8,9,10**

the local community by offering similar economic opportunities and enhance business opportunities for the downtown area.

A summary of performance evaluation is below, showing Alternative 1 performance being higher than all the others presented by the project team. In the short term, Alternative 2a offers a high score as well and should be considered further.

Attribute	Attribute Weight	Alternative		
		1	2	2a
Main Line Operations	17	8	3.5	3
Local Operations	21	6.5	4.5	4.5
Environmental Impacts	18	5	7	8
Traffic Operations	20	6	5	4.5
Economic Development	13	7	5	5
Schedule	11	5	6	8
<b>Totals</b>		<b>623.5</b>	<b>505</b>	<b>524.5</b>

From the Value Index perspective, which is expressed as a ratio of performance divided by cost, the VE team leader takes exemption to using it since the costs of all alternatives are parametric in nature and don't have the level of detail necessary to arrive to a reliable outcome. The VE team recommends to further develop these concepts and their cost estimates to perform the value index analysis in the future.

However, in comparing short- and long-term solutions as they stand today with this information, the value index for short term is  $V=524.5/\$8.2M= 63.9$  while the long term is  $V=623.5/\$11.35=54.9$ , which shows the short term solution having higher value than the long term.

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## VE Concept Analysis for Southern Bypass

### Baseline Concept

There are multiple alternatives for a future bypass aligned south of the City of Lebanon:

A – a far south direct connection from KY 2154 and US 68 at the west end, extending Industrial Drive through KY 49, to US 68 across from Barbers Mill Drive

A-1 – follow the same alignment as A; however, ends at KY 49 (considered a priority section of Concept A)

B – a closer to town south connection, extending Metts Dr crossing KY 49 on a new roadway aligned behind the Marion County Fairgrounds, tying to Sulphur Springs Road and closing the bypass at US 68 across from Corporate Drive.

C – Follows alignment A-1, uses existing KY 49 to the north and then follows the alignment of Option B

D – Follows the same alignment as Option B; however, extends across Sulphur Springs Road to end at the same location as Option A completes the bypass at US 68.

E – Follows the same alignment as Option A and realigns the eastern portion to follow Sulphur Springs Road closing the bypass at US 68 across from Corporate Drive.

### Recommendation Concept

If a southern bypass is constructed or considered, the VE Team recommends adopting a new hybrid Concept F that combines Concepts A and D, connected with a new diagonal alignment crossing KY 49.

#### Advantages

- May reduce overall costs compared to A
- Reduces right-of-way requirement
- Shortens bypass
- Facilitates local traffic
- Improves direct access to Fairgrounds
- More likely to facilitate freight vehicles away from downtown

#### Disadvantages

- May directly impact more residences
- May increase environmental impacts
- May not accomplish economic development goals and objectives

#### Cost Summary

#### Construction

#### Right-of-way

#### Total

Cost Summary	Construction	Right-of-way	Total
Baseline Concept			
Recommendation Concept			
Cost Avoidance/(Added Value)			

## VE Concept Analysis for Southern Bypass

### Discussion/Sketches/Photos/Calculations

#### Technical Discussion/Sketches

##### Baseline:

The Kentucky Transportation Cabinet is conducting a scoping study to improve highway connectivity around the East side of Lebanon, KY in Marion County. This study is intended to explore options to improve connectivity east of the city. With only a few narrow highways providing connections east of the city, most trips are forced into town and onto the US 68 (Main Street) corridor to connect. This study is looking at the possible costs and benefits to make the east side of town more accessible. This includes a Southeast Bypass where Concepts A-E are proposed.



#### **Concept A – Outer from KY 2154 to US 68 (4.96 miles long)**

Concept A is one of two concepts which creates an outer bypass around Lebanon and connects back in at Barbers Mill Road. There is potential for this Concept to provide future economic development. This concept would have minimal conflict points since KY 49 would be the only intersecting point along the new route. However, due to its length, Concept A would not create much of a connectivity to the northern routes or pull much traffic off the downtown (US 68) route. Driver expectation could rationalize that it would take roughly the same amount of time to go through downtown as it would to go around downtown using this bypass. There is concern that given Concept A has so much land on either side and requires the most right-of-way, a leapfrog approach to economic development could occur. Getting utilities out that far could be costly, and the Concept also fall outside of current zoning. This could create a very disorganized development over the years and lead to property value issues.



## VE Concept Analysis for Southern Bypass

CONCEPT A			
Attribute	Advantages	Disadvantages	Rating (0-10)
Main Line Operations	<ul style="list-style-type: none"> <li>- Creates a new bypass and diverts traffic out of downtown</li> <li>- Diverts X amount</li> <li>- Minimal conflict points</li> <li>- Limited access</li> <li>- Diverts traffic from 49</li> </ul>	<ul style="list-style-type: none"> <li>- Out of direction travel</li> <li>- May not reduce travel times significantly (1 min)</li> <li>- Lacks connectivity to northern routes</li> </ul>	6.5
Local Operations	<ul style="list-style-type: none"> <li>- Diverts traffic from Corporate/68</li> </ul>	<ul style="list-style-type: none"> <li>- Does not serve local traffic</li> <li>- No pedestrian accommodations</li> </ul>	2.5
Environmental Impacts		<ul style="list-style-type: none"> <li>- Some stream impacts</li> <li>- May be some historical site impacts</li> <li>- Requires the most right-of-way</li> <li>- Most impervious surface</li> <li>- Some Karst Prone area impacts</li> <li>- Some forest impacts (Indiana bat potential)</li> </ul>	3
Traffic Operations	<ul style="list-style-type: none"> <li>- Improves school access</li> <li>- Separates traffic movements from main congestion at Corporate Drive and 68</li> </ul>	<ul style="list-style-type: none"> <li>- New roadway, new alignment, no connections</li> </ul>	3
Economic Development	<ul style="list-style-type: none"> <li>- Provides space/connection for development</li> </ul>	<ul style="list-style-type: none"> <li>- Too much land potential</li> <li>- Too far away</li> <li>- Zoning issues (lack of zoning)</li> <li>- Utility concerns to reach area</li> </ul>	2.5
Schedule	<ul style="list-style-type: none"> <li>- Minor MOT since new roadway</li> </ul>	<ul style="list-style-type: none"> <li>- Longest to construct, longest route, most pavement</li> <li>- Requires 2-phases</li> </ul>	2
<b>WEIGHTED SCORE</b>			<b>251.8</b>

### Concept A-1 – Outer from KY 2154 to KY 49 (2.07 miles long)

Concept A-1 currently has potential funding tied to it already, however, seems like it would not divert traffic from downtown which is one of the main purposes of the Scoping Study. Since A-1 stops at KY 49, this would also not allow for much economic development. Concept A-1 overall seems to have no logical termini along its route.

## VE Concept Analysis for Southern Bypass

CONCEPT A1			
Attribute	Advantages	Disadvantages	Rating (0-10)
Main Line Operations		<ul style="list-style-type: none"> <li>- Incomplete bypass</li> <li>- Does not divert traffic from downtown</li> <li>- Does not meet all purpose and need</li> <li>- No logical termini</li> </ul>	1
Local Operations	- Makes local connection	<ul style="list-style-type: none"> <li>- Serves fewer existing local roads</li> <li>- No pedestrian accommodations</li> </ul>	1.5
Environmental Impacts	- Avoids streams	<ul style="list-style-type: none"> <li>- May impact historic area</li> <li>- May impact agricultural area</li> <li>- Some right-of-way impacts</li> <li>- No logical termini (environmental process)</li> </ul>	3.5
Traffic Operations	- Connects to 49 and some existing roadways	<ul style="list-style-type: none"> <li>- Does not separate traffic movements from main congestion at Corporate Drive and 68</li> <li>- New roadway</li> </ul>	1
Economic Development	- Provides some space/connection for development	<ul style="list-style-type: none"> <li>- Too far away</li> <li>- Zoning issues</li> <li>- Utility concerns to reach area</li> </ul>	3
Schedule	- Funding support		5
		<b>WEIGHTED SCORE</b>	<b>113.0</b>

### Concept B – Inner from KY 2154 to US 68 (2.21 miles long)

Concept B provides the tightest southern option giving better access to existing utilities and the fairgrounds. It would join with Corporate Drive to the north and would pair well with alignment 2. This would increase congestion at a problem intersection near the school complex and industry along Corporate Drive. This concept would have lower design speeds and could have more residential and recreational impacts than the wider options.

## VE Concept Analysis for Southern Bypass

CONCEPT B			
Attribute	Advantages	Disadvantages	Rating (0-10)
Main Line Operations	<ul style="list-style-type: none"> <li>- Completes the loop</li> <li>- Provides southern connectivity</li> <li>- Existing utilities</li> <li>- Diverts traffic from 49</li> </ul>	<ul style="list-style-type: none"> <li>- Does not remove traffic from busiest Corporate/68 intersection</li> <li>- Unclear bypass/already in town before drivers get on bypass</li> <li>- Increases conflicts</li> <li>- Increased utility conflicts</li> <li>- Lower design speed than 55mph</li> </ul>	2
Local Operations	<ul style="list-style-type: none"> <li>- Provides local bypass</li> <li>- Serves many existing local roads</li> <li>- Opportunity to install pedestrian</li> </ul>	<ul style="list-style-type: none"> <li>- Does not remove traffic from busiest Corporate/68 intersection</li> </ul>	5
Environmental Impacts	<ul style="list-style-type: none"> <li>- Less stream impacts</li> </ul>	<ul style="list-style-type: none"> <li>- Historic site impacts</li> <li>- Right-of-way impacts to recreational areas and diverting traffic to community</li> </ul>	4
Traffic Operations	<ul style="list-style-type: none"> <li>- Improves access to Fairgrounds</li> <li>- Connects with local roads/communities</li> </ul>	<ul style="list-style-type: none"> <li>- Does not separate traffic movements from main congestion at Corporate Drive and 68</li> <li>- New roadway</li> <li>- Similar school access as existing</li> </ul>	4.75
Economic Development	<ul style="list-style-type: none"> <li>- Closer to utility connections</li> <li>- Contiguous to existing development</li> </ul>	<ul style="list-style-type: none"> <li>- Does not connect to oversized southern development area</li> <li>- Some minor development opportunity area</li> </ul>	4
Schedule	<ul style="list-style-type: none"> <li>- Shorter alignment/construction</li> </ul>	<ul style="list-style-type: none"> <li>- MOT impacts</li> <li>- More difficult to construct</li> <li>- May have longer right-of-way process</li> <li>- Reduces constructability</li> </ul>	4.5
		<b>WEIGHTED SCORE</b>	<b>287.1</b>

### Concept C – Connector along KY 49 from A-B (2.07 miles long)

Concept C strives to combine Concept A and Concept B to capture the advantages of both concepts. These advantages include completing the bypass on the southwestern portion of the city and providing connections to current and future industrial areas in that area. It also uses existing the infrastructure by upgrading a portion of KY 49 and provides an “inner” connection south of the fairgrounds and other existing development. It also provides access to some new areas for future economic development opportunities. This concept also resulted in some disadvantages including creating more conflicts than some other concepts, a lower design speed due to sharp curves (KY 49), potential minor impacts to adjacent houses, and increased MOT. However, the largest disadvantage is that this concept does not remove or divert traffic from the Corporate Drive/US 68 intersection, which is one of the most congested areas. Overall, this concept was only viewed as more viable than Concept A and Concept B.

## VE Concept Analysis for Southern Bypass

CONCEPT C			
Attribute	Advantages	Disadvantages	Rating (0-10)
Main Line Operations	<ul style="list-style-type: none"> <li>- Utilizes existing roadway (49)</li> <li>- Avoids industry at southern connection</li> <li>- Less conflicts than B</li> <li>- Diverts traffic from 49</li> </ul>	<ul style="list-style-type: none"> <li>- More conflicts than A</li> <li>- May not serve as full bypass</li> <li>- Design speed lower</li> <li>- Sharp curves</li> </ul>	1.5
Local Operations	<ul style="list-style-type: none"> <li>- Serves local roads along 49</li> <li>- Partial opportunity to install pedestrian</li> </ul>	<ul style="list-style-type: none"> <li>- Does not remove traffic from busiest Corporate/68 intersection</li> </ul>	3
Environmental Impacts	<ul style="list-style-type: none"> <li>- Uses a portion of existing roadway</li> </ul>	<ul style="list-style-type: none"> <li>- May impact historic area</li> <li>- May impact agricultural area</li> <li>- Some right-of-way impacts</li> </ul>	4
Traffic Operations	<ul style="list-style-type: none"> <li>- Improves access to Fairgrounds</li> <li>- Uses existing roadway</li> <li>- Connects to existing roads/communities</li> </ul>	<ul style="list-style-type: none"> <li>- Does not separate traffic movements from main congestion at Corporate Drive and 68</li> <li>- New roadway</li> <li>- Similar school access as existing</li> </ul>	3.5
Economic Development	<ul style="list-style-type: none"> <li>- Closer to utility connections</li> <li>- Contiguous to existing development</li> <li>- More prone for residential development</li> <li>- Some development opportunity area</li> </ul>		5.5
Schedule	<ul style="list-style-type: none"> <li>- Partial funding support</li> </ul>	<ul style="list-style-type: none"> <li>- Significant impacts to 49 (MOT)</li> </ul>	4.75
<b>WEIGHTED SCORE</b>			<b>239.4</b>

### Concept D – Connector from B-A (1.45 miles long)

Concept D builds off of B's advantages by staying closest to the city; however, would meet the northern bypass at KY 1404. This would naturally pair with alignment 1. It has the advantage of taking traffic outside of the schools and Corporate Drive meeting a core need to reduce congestion. In additions to concept B's negatives, it also could see additional right-of-way delays with stream and historic site impacts.

## VE Concept Analysis for Southern Bypass

CONCEPT D			
Attribute	Advantages	Disadvantages	Rating (0-10)
Main Line Operations	- Relieves traffic from Corporate Drive congestion	- May not divert as much traffic as A or 1 - Still may require lower design speed - Still significant conflicts	3.5
Local Operations	- May connect to Sulpher Springs to carry local traffic - Diverts traffic from Corporate Drive/68 - Opportunity to install pedestrian	- Does not upgrade Sulpher Springs/depends on existing infrastructure that may need upgrading	2.5
Environmental Impacts		- Historic site impacts - Right-of-way impacts to recreational areas and diverting traffic to community - Some stream impacts	4
Traffic Operations	- Improves access to Fairgrounds - Connects with local roads/communities - Improves school access - Connectivity to Sulphur Spring - Separates traffic from Corporate Drive/68 congestion		5.5
Economic Development	- Closer to utility connections - Contiguous to existing development - Potential commercial development opportunity	- Does not connect to oversized southern development area - Some minor development opportunity area	5.5
Schedule	- Shorter alignment/construction	- MOT impacts - More difficult to construct - May have longer right-of-way process - Reduces constructability	5
<b>WEIGHTED SCORE</b>			<b>300.8</b>

### Concept E –Connector along Sulphur Springs from A-B (5.17 miles long)

Concept E follows the route of Concept A except it connects with US 68 at Corporate Drive rather than Barbers Mill Road. This concept has the same advantages and disadvantages of Concept A; however, provides less connectivity because it joins US 68 at Corporate Drive. Like similar concepts that provide a connection at this intersection, it does not reduce traffic congestion from this high-traffic area. It also does not easily facilitate travelers going west on US 68. This concept provides economic development opportunities; however, the distance to extend utilities and would likely cause leapfrog development because the vast amount of undeveloped land likely does not match development demand. This concept only scored higher than Concept A1.

## VE Concept Analysis for Southern Bypass

<b>CONCEPT E</b>			
Attribute	Advantages	Disadvantages	Rating (0-10)
Main Line Operations	<ul style="list-style-type: none"> <li>- Further from downtown</li> <li>- May be less effective diverting traffic than A</li> <li>- Completes the loop</li> <li>- Less conflicts than B</li> </ul>	<ul style="list-style-type: none"> <li>- Does not remove traffic from Corporate Drive/68 congested intersection</li> <li>- Out of direction traffic</li> <li>- More conflicts than A</li> </ul>	6
Local Operations	<ul style="list-style-type: none"> <li>- Serves Sulphur Springs</li> </ul>	<ul style="list-style-type: none"> <li>- Does not remove traffic from busiest Corporate/68 intersection</li> </ul>	2
Environmental Impacts		<ul style="list-style-type: none"> <li>- Some stream impacts</li> <li>- May be some historical site impacts</li> <li>- Requires the second most right-of-way</li> <li>- Second most impervious surface</li> <li>- Some Karst Prone area impacts</li> <li>- Some forest impacts (Indiana bat potential)</li> </ul>	3.5
Traffic Operations		<ul style="list-style-type: none"> <li>- New roadway, new alignment</li> <li>- Does not separate traffic movements from main congestion at Corporate Drive and 68</li> <li>- Similar school access as existing</li> </ul>	2
Economic Development	<ul style="list-style-type: none"> <li>- Provides some space/connection for development</li> </ul>	<ul style="list-style-type: none"> <li>- Too much land potential</li> <li>- Too far away</li> <li>- Zoning issues (lack of zoning)</li> <li>- Utility concerns to reach area</li> <li>- Reduces development potential compared to A</li> </ul>	2
Schedule	<ul style="list-style-type: none"> <li>- Minor MOT since new roadway but connects to Corporate Drive</li> </ul>	<ul style="list-style-type: none"> <li>- Longest to construct, longest route, most pavement</li> <li>- Requires 2-phases</li> </ul>	2
<b>WEIGHTED SCORE</b>			<b>206.4</b>

**VE Recommendation:**

The VE Team is recommending an alternate route to serve as Concept F, which would begin at the same point as Concept A/E and would tie-in to Concept B/D near the Fairgrounds.

**Concept F – Outer KY 2154 to inner US 68 (3.75 miles long).**

Concept F would be a compromise between all the concepts that are currently being proposed for the Southeast Bypass. Concept F could impact a stream as it starts to curve up towards KY 49. Concept F would create the best connectivity option as it is shorter than Concepts A and E,; however, allows for higher design speed than Concepts B and D. Concept F would also tie-in right around the Fairgrounds, which could provide congestion relief during the times of year that the city/county or any organization holds an event at that location.

## VE Concept Analysis for Southern Bypass

<b>CONCEPT F</b>			
<b>Attribute</b>	<b>Advantages</b>	<b>Disadvantages</b>	<b>Rating (0-10)</b>
Main Line Operations	<ul style="list-style-type: none"> <li>- Shorter trip than A and E but still gets benefits from them</li> <li>- Completes loop</li> <li>- Bypasses downtown</li> <li>- Higher design speed than inner options</li> </ul>	<ul style="list-style-type: none"> <li>- Similar number of conflicts to C</li> </ul>	7
Local Operations	<ul style="list-style-type: none"> <li>- Closer to town</li> <li>- Hits more local roads</li> <li>- Provides access to Fairgrounds</li> </ul>	<ul style="list-style-type: none"> <li>- Diverts traffic from Corporate/68</li> </ul>	4
Environmental Impacts		<ul style="list-style-type: none"> <li>- Some historic impacts</li> <li>Some stream impacts</li> <li>May impact forested areas</li> <li>Some right-of-way impacts</li> </ul>	4.75
Traffic Operations	<ul style="list-style-type: none"> <li>- Improves access to Fairgrounds</li> <li>- Connects with local roads/communities</li> <li>- Improves school access</li> <li>- Connectivity to Sulphur Spring</li> <li>- Separates traffic from Corporate Drive/68 congestion</li> </ul>	<ul style="list-style-type: none"> <li>- New roadway</li> </ul>	5.5
Economic Development	<ul style="list-style-type: none"> <li>- Closer to utility connections</li> <li>- Contiguous to existing development</li> <li>- Commercial, industrial, residential potential</li> </ul>	<ul style="list-style-type: none"> <li>- Part may still be too far from current development</li> <li>- Part may still be oversized</li> </ul>	6
Schedule	<ul style="list-style-type: none"> <li>- Partial funding support</li> </ul>		5
		<b>WEIGHTED SCORE</b>	<b>394.2</b>

## VE Concept Analysis for Southern Bypass



### Assumptions/Calculations

#### Cost:

The baseline cost for each of the concepts (with 25 percent contingency) are below:

Concept A – \$24,243,455

Concept A-1 – \$8,145,091

Concept B – \$10,101,455

Concept C – \$13,239,182

Concept D – \$10,498,364

Concept E – \$25,939,000

Concept F – \$15,750,000 (calculated as a weighted average of cost for options A and D, assumed at \$4,200,000 per mile x 3.75 miles)

### Summary and conclusion

A summary of performance evaluation is below, showing Alternative F performance being significantly higher than all the others presented by the project team. From the Value Index perspective, which is expressed as a ratio of performance divided by cost, the VE team leader takes exemption to using it since the costs of all alternatives are parametric in nature and don't have the level of detail necessary to arrive to a reliable outcome.

The VE team recommends to further develop these concepts and their cost estimates to perform the value index analysis in the future.



### VE Concept Analysis for Southern Bypass

Attribute	Attribute Weight	Concept						
		A	A1	B	C	D	E	F
Main Line Operations	17	6.5	1	2	1.5	3.5	6	7
Local Operations	21	2.5	1.5	5	3	2.5	2	4
Environmental Impacts	18	3	3.5	4	4	4	3.5	4.75
Traffic Operations	20	3	1	4.75	3.5	5.5	2	5.5
Economic Development	13	2.5	3	4	5.5	5.5	2	6
Schedule	11	2	5	4.5	4.75	5	2	5
<b>Totals</b>		<b>329.5</b>	<b>220.5</b>	<b>403</b>	<b>349.5</b>	<b>415.5</b>	<b>293</b>	<b>526.5</b>

## 7.6 Design Considerations

The VE team generated the following design suggestions for the project design team's consideration. These items represent ideas that are general in nature and are listed below in Table 15. Additional details can be found in the evaluation form in Section 6.2. The write-ups for three design considerations the VE team wanted to describe further can be found on the following pages.

<b>Idea No.</b>	<b>Description</b>
1	Build a road and/or access on the northern portion to alleviate school congestion
2	Evaluate/validate portion of SE bypass
3	Manage access for new roadways
24	Upgrade existing Corporate Drive and intersection at KY 2154, include back access road for school to connect Corporate Drive to Barbers Mill Road
25	Provide dedicated school access alternative
32	Use complete street strategy along Main Street
40	Improve lane section/speed limit of KY 2154 from KY 49 to KY 429 and intersections
41	Unsignalized RCUTs at KY 49 and KY 429 along KY 2154
42	Improve intersections for truck traffic at KY 49 and KY 429 along KY 2154
44	Make Corporate Drive a consistent 3 lane section to accommodate turning traffic
52	Improve Alignment 2 by making Corporate Drive local only by closing Corporate Drive/KY 2154
53	Use oversized signs to push trucks to use existing bypass (both ends of town)
54	Use a 2+1 (alternating passing lanes) typical section for the southern bypass
57	Work with local government to develop a comprehensive plan including land use and transportation network
58	Engage Marion County in comprehensive plan in addition to the City of Lebanon
59	Defer Concept B/D, preserve right-of-way for future construction, coordinate with the City of Lebanon as land development permits are issued
61	Restripe W Walnut Street at SB approach to W Main Street for right and through movements
62	Complete a comprehensive Origin-Destination study (Wejo and StreetLight)
63	Establish a comprehensive circulation plan for school traffic to manage queues

<b>DESIGN CONSIDERATION NO. 1: DEVELOP A COMPREHENSIVE LAND USE AND TRANSPORTATION NETWORK PLAN</b>		<b>Idea Nos. 57, 58</b>
<b>Baseline Concept</b>		
No land use planning or long-range comprehensive planning efforts are included in the current project.		
<b>Suggested Concept</b>		
The City of Lebanon should develop and adopt an updated comprehensive plan including, at a minimum, strategies for land use and transportation network.		
The City of Lebanon should engage Marion County to create a more comprehensive approach to future development.		
<b>Advantages</b>		<b>Disadvantages</b>
<ul style="list-style-type: none"> <li>• Creates consensus from residents, businesses, and visitors in identifying a direction for the community's future</li> <li>• Identifies the big issues facing the city currently as well as big ideas for the city's future; Creates an action plan for strategies to solve these issues and achieve the big ideas</li> <li>• Improves coordination</li> <li>• Improves planning for infrastructure investment</li> <li>• Coordinates future development types and locations with transportation and utility infrastructure (current and future)</li> <li>• Defines efforts that can define the city's character and increase the sense of place</li> <li>• Provides direction for future economic development efforts</li> <li>• Provides direction for future updates to zoning/subdivision regulations</li> </ul>	<ul style="list-style-type: none"> <li>• Increases time for coordination</li> <li>• Requires local political support</li> <li>• Requires funding from local government or entity</li> </ul>	
<b>Discussion</b>		
<p>A comprehensive plan is a unique document and process. It's the one plan that compiles various planning efforts, such as land use, transportation, utilities, economic development, placemaking, and more. Comprehensive planning should be a pro-active, not reactive, process that builds public and private consensus on a community's future to increase the quality of life for residents, workers, and visitors. By creatively merging public and private interests through an effective public participation program, a community can create consensus and local champions that are needed to ensure their vision is realized.</p> <p>This plan should coordinate major elements that impact development and the community's viability, such as land use, transportation, and utilities. It is based on an understating of how the ever-changing systems of a community interact and affect one another. All of these elements must work together for a city to be successful – if planned independently, it typically will lead to disjointed public investments that do not produce the intended results.</p> <p>While critical, this process cannot be rushed or cut short. A comprehensive plan typically takes about 9-12 months from starting the plan through adoption. If the city places the current bypass project on hold to create a comprehensive plan, it could delay the bypass project.</p>		

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# Appendix A. Value Methodology Process

Value Methodology is a systematic process using a multidisciplinary team to improve the value of a project through the analysis of its functions. This process incorporates, to the extent possible, the values of design, construction, maintenance, contractor, state, local, and federal approval agencies, other stakeholders, and the public.

The primary objective of a Value Engineering (VE) study is value improvement. Value improvements might relate to scope definition, functional design, constructability, coordination (both internal and external), or the schedule for project development. Other possible value improvements are reduced environmental impacts, reduced public (traffic) inconvenience, or reduced project cost.

## **Pre-VE Study**

Prior to the start of a VE study, the Project Manager, and the VE facilitator carry out the following activities:

Initiate study – Identify study project and define study goals

Organize study – Conduct pre-VE study meeting and select team members

Prepare data – Collect and distribute data and prepare cost models.

All of the information gathered prior to the VE study is given to the team members for their use.

## **Value Methodology**

The VE team employed the eight-step Value Methodology in analyzing the project. This process is recommended by SAVE International® and is composed of the following phases:

**Pre-workshop** – The Team Leader facilitates a pre-workshop meeting with the project team to establish VE Team, logistics and parameters to analyze the project.

**Information** – The team reviews and defines the current conditions of the project and identifies the goals of the study.

**Function Analysis** – The team defines the project functions using a two-word active verb/ measurable noun context. The team reviews and analyzes these functions to determine which need improvement, elimination, or creation to meet the project's goals.

**Creativity** – The team employs creative techniques to identify other ways to perform the project's function(s).

**Evaluation** – The team follows a structured evaluation process to select those ideas that offer the potential for value improvement while delivering the project's function(s) and considering performance requirements and resource limits.

**Development** – The team develops the selected ideas into alternatives (or proposals) with a sufficient level of documentation to allow decision makers to determine if the alternative should be implemented.

**Presentation** – The team facilitator develops a report and/or presentation that documents and conveys the adequacy of the alternative(s) developed by the team and the associated value improvement opportunity.

**Implementation** – The project team is then charged with reviewing the report and hold a Disposition Meeting with management and other stakeholders, to determine which recommendations will be implemented in the design. The project team then tracks their implementation into the plans.

The following is a general discussion and overview of the Performance-Based VE process. Ideas that have been introduced and warrant further consideration, will be documented with their advantages and disadvantages; each idea will then be carefully evaluated against project-specific attributes.

### **Performance-Based Value Engineering**

Performance measures an integral part of the VE process. It provides the cornerstone of the VE process by giving a systematic and structured way of considering the relationship of a project's performance and cost as they relate to value. Project performance must be properly defined and agreed on by the stakeholders at the beginning of the VE study. The performance attributes and requirements that are developed are then used throughout the study to identify, evaluate, and document alternatives.

#### Introduction

Value engineering has traditionally been perceived as an effective means for reducing project costs. This paradigm only addresses one part of the value equation, oftentimes at the expense of overlooking the role that VE can play with regard to improving project performance. Project costs are fairly easy to quantify and compare through traditional estimating techniques. Performance is not so easily quantifiable.

The VE facilitator will lead the team and external stakeholders through the methodology, using the power of the process to distill subjective thought into an objective language that everyone can relate to and understand. The dialogue that develops forms the basis for the VE teams understanding of the performance requirements of the project and to what degree the current design concept is meeting those requirements. From this baseline, the VE team can focus on developing alternative concepts that will quantify both performance and cost and contribute to overall project value.

Performance-based VE yields the following benefits:

Builds consensus among project stakeholders (especially those holding conflicting views)

Develops a better understanding of a project's goals and objectives

Develops a baseline understanding of how the project is meeting performance goals and objectives

Identifies areas where project performance can be improved through the VE process

Develops a better understanding of a VE alternative's effect on project performance

Develops an understanding of the relationship between performance and cost in determining value

Uses value as the true measurement for the basis of selecting the right project or design concept

Provides decision-makers with a means of comparing costs and performance (i.e., costs vs. benefits) in a way that can assist them in making better decisions.

### Methodology

The application of Performance-based VE consists of the following steps:

1. Identify key project (scope and delivery) performance attributes and requirements for the project.
1. Establish the hierarchy and impact of these attributes on the project.
2. Establish the baseline of the current project performance by evaluating and rating the effectiveness of the current design concepts.
3. Identify the change in performance of alternative project concepts generated by the study.
4. Measure the aggregate effect of alternative concepts relative to the baseline project's performance as a measure of overall value improvement.

The primary goal of value engineering is to improve the value of the project. A simple way to think of value in terms of an equation is as follows:

$$Value = \frac{Performance}{Cost}$$

### Assumptions

Before embarking on the details of this methodology, some assumptions need to be identified. The methodology described in the following steps assumes the project functions are well established. Project functions are defined as what the project delivers to its users and stakeholders; a good reference for the project functions can be found in the environmental document's purpose and need statement. Project functions are generally well defined prior to the start of the VE study. In the event that project functions have been substantially modified, the methodology must begin anew (Step 1).

#### *Step 1 – Determine the Major Performance Attributes*

Performance attributes can generally be divided between project scope components (highway operations, environmental impacts, and system preservation) and project delivery components. It is important to make a distinction between performance *attributes* and performance *requirements*. Performance requirements are mandatory and binary in nature. All performance requirements MUST be met by any VE alternative concept being considered. Performance attributes possess a range of acceptable levels of performance. For example, if the project was the design and construction of a new bridge, a performance requirement might be that the bridge meets all current seismic design criteria. In contrast, a performance attribute might be project schedule, which means that a wide range of alternatives could be acceptable that had different durations.

The VE facilitator will initially request representatives from project team and external stakeholders identify performance attributes that they feel are essential to meeting the

overall need and purpose of the project. Usually four to seven attributes are selected. It is important that all potential attributes be thoroughly discussed. The information that comes out of this discussion will be valuable to both the VE team and the project owner. It is important that each attribute be discretely defined and be quantifiable in some form. The vast majority of performance attributes that typically appear in transportation VE studies have been standardized. This standardized list can be used “as is” or adopted with minor adjustments as required.

Typical standardized project performance attributes are shown below. Specific definitions of each attribute can be found below.

Main Line Operations

Local Operations

Maintainability

Construction Impacts

Environmental Impacts

<b>PERFORMANCE ATTRIBUTE AND DEFINITIONS</b>	
<b>Performance Attribute</b>	<b>Description of Attribute</b>
Main Line Operations	An assessment of traffic operations and safety on the main line. Operational considerations include level of service relative to the 20-year traffic projections as well as geometric considerations such as design speed, sight distance, and lane and shoulder widths.
Local Operations	An assessment of traffic operations and safety on the local roadway infrastructure. Operational considerations include level of service relative to the 20-year traffic projections; geometric considerations such as design speed, sight distance, lane widths; bicycle and pedestrian operations and access, including shared use path.
Maintainability	An assessment of the long-term maintainability of the transportation facility(s). Maintenance considerations include the overall durability, longevity, and maintainability of pavements, structures, and systems; ease of maintenance; accessibility and safety considerations for maintenance personnel.
Construction Impacts	An assessment of the temporary impacts to the public during construction related to traffic disruptions, detours and delays; impacts to businesses and residents relative to access, visual, noise, vibration, dust, and construction traffic. Temporary environmental impacts related to water quality, air quality, soil erosion, and local flora and fauna.
Environmental Impacts	An assessment of the permanent impacts to the environment, including ecological (i.e., flora, fauna, air quality, water quality, visual, noise); socioeconomic impacts (i.e., environmental justice, business, residents); impacts to cultural, recreational and historic resources.

**Step 2 – Determine the Relative Importance of the Attributes**

Once the group has agreed on the project’s performance attributes, the next step is to determine their relative importance in relation to each other. This is accomplished through the use of an evaluative tool termed in this report as the “Performance Attribute Matrix.” This matrix compares the performance attributes in pairs, asking the question: “An improvement in which attribute will provide the greatest benefit to the project relative to purpose and need?”



A letter code (e.g., “A”) is entered into the matrix for each pair, identifying which of the two is more important. If a pair of attributes is considered to be of essentially equal importance, both letters (e.g., “A/B”) are entered into the appropriate box. This, however, should be discouraged, as it was found that in practice a tie usually indicates the pairs have not been adequately discussed. When all pairs have been discussed, the number of “votes” for each is tallied and percentages (which will be used as weighted multipliers later in the process) are calculated. It is not uncommon for one attribute to not receive any “votes.” If this occurs, the attribute is given a token “vote,” as it made the list in the first place and should be given some degree of importance.

An example of this exercise is shown below.

PERFORMANCE ATTRIBUTE MATRIX								
[Project Name]								
Which attribute is more important to the project?							TOTAL	%
Main Line Operations	A	B	A	A	A		5.0	23.8%
Local Operations		B		B	B	B/F	5.5	26.2%
Maintainability				C	E	F	2.0	9.5%
Construction Impacts				D	E	D/F	1.5	7.1%
Environmental Impacts					E	E	4.0	19.0%
Project Schedule						F	3.0	14.3%
						<b>Total</b>	21.0	100%
<b>Without emphasis on preference</b>								
A = A is of greater importance								
A/B = A and B are of equal importance								

For the example project above, the project owner, design team, and stakeholders determined that main line operations, followed by environmental, gave the greatest improvement relative to the projects purpose and need, while construction impacts and project schedule gave the least improvement.

**Step 3 – Establish the Performance Baseline for the Original Design**

The next step in the process is to document the project-specific elements for the performance attributes developed in Step 1. This step establishes a baseline against which the VE alternative concepts can be compared. An example of project-specific elements is shown below.

Evaluation of Baseline Project		
Standard Performance Attribute	Description of Attribute	Baseline Design Rating Rational
Main Line Operations	An assessment of traffic operations and safety on the project. Operational considerations include level of service relative to the 20-year traffic projections as well as geometric considerations such as design speed, sight distance, lane widths, and shoulder widths.	Design Speed - __ MPH Bridge – __' Lanes, __' shoulders Roadway - __' Lanes, __' shoulders Bridge __ Loading
Local Operations	An assessment of traffic operations and safety on the local roadway infrastructure. Operational considerations include level of service relative to the 20-year traffic projections; geometric considerations such as design speed, sight distance, lane widths; bicycle and pedestrian operations and access.	Revisions will need to be made to the existing streets and private approaches due to vertical alignment
Maintainability	An assessment of the long-term maintainability of the transportation facility(s). Maintenance considerations include the overall durability, longevity, and maintainability of pavements, structures and systems; ease of maintenance; accessibility and safety considerations for maintenance personnel.	Baseline design assumes a replacement bridge Bridge design – low slump overlay on a 7" deck Steel welded plate girder 100' - 150' - 250' - 250' - 150' - 100' spans
Construction Impacts	An assessment of the temporary impacts to the public during construction related to traffic disruptions, detours and delays; impacts to businesses and residents relative to access, visual, noise, vibration, dust and construction traffic; environmental impacts.	Maintain traffic across river Noise permit required Short term detour to construct tie-ins to existing highways
Environmental Impacts	An assessment of the permanent impacts to the environment including ecological (i.e., flora, fauna, air quality, water quality, visual, noise); socioeconomic impacts (i.e., environmental justice, business, residents); impacts to cultural, recreational and historic resources.	In-water window Considered a navigable body of water Existing bridge is under consideration for historical significance

Once the baseline definitions for the various attributes have been established, their total performance should be calculated by multiplying the attribute's weight (which was developed in Step 2) by its rating. While one could assign a 0 to 10 rating for each attribute, using the definitions and scales developed in Step 1, a baseline rating of 5 is typically used as a mid-point so that alternatives can be evaluated – better than or worse than the baseline.

Total baseline performance is calculated by multiplying the attribute’s weight (which was developed in Step 2) by its rating (5). The baseline design’s total performance of 500 points can be calculated by adding all of the scores for the attributes. This numerical expression of the original design’s performance forms the baseline against which all alternative concepts will be compared.

*Step 4 – Evaluate the Performance of the VE Alternative Concepts*

Once the performance of the baseline was established for the original design concept, it can be used to help the VE team develop performance ratings for individual VE alternative concepts as they are developed during the study. The Performance Measures Form is used to capture this information. This form allows a side-by-side comparison of the original design and VE alternative concepts to be performed.

It is important to consider the alternative concept’s impact on the entire project (rather than on discrete components) when developing performance ratings for the alternative concept.

Proposals are evaluated against the baseline for all attributes to compare and contrast the potential for value improvement. As discussed in Step 3, the baseline is given a rating of 5. The following ratings were used to evaluate the performance of the alternative concepts relative to the baseline concept.

Rating	Performance Attribute Scale
10	Alternative concept is extremely preferred
9	Alternative concept is very strongly preferred
8	Alternative concept is strongly preferred
7	Alternative concept is moderately preferred
6	Alternative concept is slightly preferred
5	<b>Baseline</b>
4	Baseline concept is slightly preferred
3	Baseline concept is moderately preferred
2	Baseline concept is strongly preferred
1	Baseline concept is very strongly preferred
0	Baseline concept is extremely preferred

*Step 5 – Compare the Performance Ratings of Alternative Concepts to the Baseline Project*

As the VE team develops alternatives, the performance of each is rated against the original design concept (baseline). Changes in performance are always based on the overall impact to the total project. Once performance and cost data have been developed by the VE team, the net change in value of the VE alternatives can be compared to the baseline design concept. The resulting “Value Matrix” provides a summary of these changes and allows a way for the Project Team to assess the potential impact of the VE recommendations on total project value.

The VE team groups the VE alternatives into a strategy (or strategies) to provide the decision-makers a clear picture of how the alternatives fit together into possible solutions. At least one strategy is developed to present the VE team's consensus of what should be implemented. Additional strategies are developed as necessary to present other combinations to the decision-makers that should be considered. The strategy(s) of VE alternatives are rated and compared against the baseline concept. The performance ratings developed for the VE strategies are entered into the matrix, and the summary portion of the Value Matrix is completed. The summary provides details on net changes to cost, performance, and value, using the following calculations:

$$\text{Percent Performance Improvement} = \frac{\Delta \text{Performance VE Strategy}}{\text{Total Performance Original Concept}}$$

$$\text{Value Index} = \frac{\text{Total Performance}}{\text{Total Cost (in Millions)}}$$

$$\text{Percent Value Improvement} = \frac{\Delta \text{Value Index VE Strategy}}{\text{Value Index Original Concept}}$$

The following is an example of a Value Matrix worksheet.

Performance Attribute Ratings				
Attribute	Attribute Weight	Concept	Performance Rating	Total Performance
Main Line Operations	28.9	Baseline	5	144.5
		1	7	202.3
		2	7	202.3
		3	5	144.5
Local Operations	14.2	Baseline	5	71.0
		1	5	71.0
		2	5	71.0
		3	8	113.6
Maintainability	14.2	Baseline	5	71.0
		1	3	42.6
		2	6	85.2
		3	4.5	63.9
Environmental Impacts	16.6	Baseline	5	83.0
		1	7	107.3
		2	7	83.0
		3	4	74.7
Construction Impacts	14.2	Baseline	5	71.0
		1	4	56.8
		2	5	85.2
		3	5	71.0
Project Schedule	11	Baseline	5	59.5
		1	5	59.5
		2	5	59.5
		3	5	59.5

Recommendation Summary							
Recommendations	Performance	% Change Performance	Cost (C) \$ millions	Cost Change \$ millions	% Change Cost	Value Index	% Value Improvement
Baseline	500	---	\$46.1	---	---	10.85	---
1 Recommendation No. 1 - Title	540	+8.0%	\$46.6	\$0.5	+1.2%	11.58	+6.8%
2 Recommendation No. 2 - Title	586	+17.2%	\$46.5	\$0.4	+0.9%	12.60	+16.2%
3 Recommendation No. 3 - Title	527	+5.4%	\$46.1	\$0.0	+0.0%	11.43	+5.4%
<b>Total</b>				<b>\$3.9</b>			

## Appendix B. VE Recommendation Approval Form

Project: East Lebanon Connectivity  
 VE Study Date: February 28 - March 4, 2022

Recommendation		Approved Y/N	FHWA Functional Benefit					VE Team Estimated Construction Cost	Actual Estimated Construction Cost
			Safety	Operations	Environment	Construction	Right-of-Way		
1	Add traffic calming features along Main Street		1	1	1			\$0.6	
2	Improve pedestrian accommodations		1	1	1			\$0.1	
3	Create alternative southern bypass concept		1	1	1			\$15.7	
4	Create vital local connections in southern Lebanon			1	1		1	\$13.0	
5	Change the Federal Designated Truck Route to KY 2154		1	1	1			\$0.0	
6	Convert KY 2154 to US 68 and US 68 to US 68 Business		1	1				\$2.2	
7	Use a roundabout at Barber Mills Road		1	1				\$0.47	
8	Create alternative northeast alignment along Corporate Drive		1	1	1	1	1	\$3.6	
9	Use roundabouts along KY 55/N Spalding Avenue		1	1	1			\$1.8	
10	Use roundabouts along N Spalding Avenue near downtown		1	1				\$1.0	
<b>TOTALS</b>			9	10	7	1	2	Varies	

Please provide justification if the value engineering study recommendations are **not** approved or are implemented in a modified form.

KYTC is required to report Value Engineering results annually to FHWA. To facilitate this reporting requirement, the Value Engineering Recommendation Approval Form is included herein. If the Cabinet elects to reject or modify a recommendation, please include a brief explanation of why.

\_\_\_\_\_  
Signature – Project Manager    Date

\_\_\_\_\_  
Name (please print)

**FHWA Functional Benefit Criteria**

Each year, State DOTs are required to report on VE recommendations to FHWA. In addition to cost implications, FHWA requires the DOTs to evaluate each approved recommendation in terms of the project feature or features that recommendation benefits. If a specific recommendation can be shown to provide benefit to more than one feature described below, count the recommendation in *each category that is applicable*.

**Safety:** Recommendations that mitigate or reduce hazards on the facility.

**Operations:** Recommendations that improve real-time service and/or local, corridor, or regional levels of service of the facility.

**Environment:** Recommendations that successfully avoid or mitigate impacts to natural and/or cultural resources.

**Construction:** Recommendations that improve work zone conditions or expedite the project delivery.

**Right-of-Way:** Recommendations that lower the impacts or costs of right-of-way.

# Appendix C. VE Study Memo, Agenda and Attendees

## Memo

Congratulations!!! You have been chosen to participate in this Value Engineering (VE) study because of your expertise and valuable contributions to the project.

This memo is to introduce some of the expectations for the upcoming VE study. I'm looking forward to working with you on this endeavor. My hope is that this memo will provide information about the project and expectations on working together.

If you have any questions, please contact me, Jose Theiler, at 561-386-3879 (cell), or e-mail: [jose.theiler@hdrinc.com](mailto:jose.theiler@hdrinc.com).

## VE Study Dates and Location

The VE study will be held on Monday, February 28, 2022 through Friday, March 4, 2022 using Microsoft Teams with In-Person Options on Tuesday and Wednesday (Room C107) as follows:

[Click here to join the meeting](#)

### Or call in (audio only)

[+1 402-513-9026,859720978#](tel:+14025139026859720978) United States, Omaha

[\(833\) 255-2803,859720978#](tel:(833)255-2803859720978) United States (Toll-free)

Phone Conference ID: 859 720 978#

[Find a local number](#) | [Reset PIN](#)

[Learn More](#) | [Meeting options](#)

## What to Bring

Be sure to bring your normal tools of the trade (e.g., calculator, laptop computer, scale, etc.). Bring a creative and open mind. VE studies are a lot of work,; however, if you bring your creativity and sense of humor you will have a good time and a rewarding experience.

## Ground Rules

1. A VE study follows a prescribed process that was proven over many years to produce the best results. This process requires the team members be fully engaged and have an open mind to “step” outside of the box throughout the week.
2. To maintain our schedule and provide the best results to the project team, I ask that we follow some basic ground rules:
  - a. Virtual/Hybrid Virtual/Hybrid Meetings Guidelines: The meeting invitation includes a Virtual Meeting Ground Rules to help with the difficulties of virtual meetings; please follow these guidelines
  - b. We will use Microsoft Teams as a holding place for conversation, notes, documentation, etc. Follow the link [KYTC 04-80153.00](#) to make sure you have access and become familiar with the site.
  - c. Please be prepared to attend the entire duration of the workshop. You were selected to assist on this team based on your expertise. If you cannot be in

attendance for the entire time, then please notify me prior to the study. When team members leave part way through, or come and go frequently, the VE team can lose its momentum and cohesiveness. We understand that conducting business virtually is different and typical interruptions or noise background is expected at times. Please minimize disruptions by muting your phone or asking for a break.

- d. Avoid multitasking during the study. Unless it is information to assist the team, please try to wait until breaks to return phone calls, check on messages, or sort through e-mails.
- e. Dress code. I want everyone to be comfortable. Some of us will attend from our homes; please dress appropriately (business casual).
- f. A laptop is required for the workshop. We will develop recommendations using templates in Word format and will exchange and share files throughout the workshop.

**3. For those attending in-person on Tuesday and Wednesday:**

- a. Doors to the building open to the public at 8am. Once they go through security, they will report to the front desk to let them know why they are here, and they should direct each person to the conference room where the study will be (Room C107).
  - b. While in the conference room, people will be social distanced to where they do not have to wear their mask (unless they want to). Outside the conference room though, a mask is still required (i.e. to walk around, go to bathroom, or the cafeteria).
  - c. Each team member will need to have their own laptop.
    - i. Wireless Wi-Fi will be provided; however, the capability of using an ethernet cord is available if so desired.
  - d. Each team member will use their camera so you can see each person.
  - e. Each team member will need to mute the sound on their computers.
    - i. We are using an OWL system for the audio.
  - f. Each team member will need to still log in each morning through the Teams invite regardless if it is virtual or in-person that day.
4. Our success will be evaluated based on the level of contribution that we bring to the project. Remember that the goal of any VE study is to add value to the project; saving money is just a byproduct. We want to make recommendations based on solid engineering judgment that will result in an improved project.



## Value Engineering Job Plan

The VE team will employ the six-phase VE job plan in analyzing the project. This process is recommended by SAVE International® and AASHTO, and is composed of the following phases:

**Information Phase** – The objective of this phase is to obtain a thorough understanding of the project’s design criteria and objectives by reviewing the project’s documents and drawings, cost estimates, and schedules. Elements include:

- Overview of the VE process
- Understanding of study objectives
- Project Overview and Briefing by the Design team
  - Provide insight on project history, design concepts, environmental issues, etc.
  - Discuss any design concerns and new concepts involved with the project.
  - All appropriate project disciplines should be discussed.
  - Discuss/identify any risks or issues that the VE team should concentrate on.
  - Provide the VE team with any specific project constraints.
  - Q&A – Presenters answers questions from the VE team.
- Risk Elicitation: I will conduct a brief risk elicitation session to identify and quantify the top 10 risks of the project. This information may provide an opportunity for the VE team to develop response strategies in the form of recommendations.

**Function Analysis Phase** – Identifying each of the key functions of the project is the most important phase of value engineering, as it is the basis for unlocking the creativity of team members. As part of this phase, the team performs the following tasks with the assistance of the VE Facilitator:

- Defines project and risk functions and assigns them to key project components.
- Classifies functions as either “basic” or “secondary.”
- Sequence functions to understand their relationships using the Function Analysis System Technique (FAST).
- Establishes performance measures.
- Creates the project’s cost model.

**Brainstorming/Creative Phase** – During this phase the team will employ creative techniques such as team brainstorming to develop a number of alternative concepts that satisfy the project’s basic and supporting functions, and mitigate project risks.

**Evaluation Phase** – The purpose of this phase is to evaluate the alternative concepts developed by the VE team during the brainstorming sessions. To that purpose, the team discusses advantages and disadvantages, and uses a number of tools to determine the qualitative and quantitative merits of each concept.

**Mid-study Review With Management Team:** At this point, the VE team holds a meeting with the project team, management, and other stakeholders, to validate the direction of the team and that ideas moving forward to the development phase do not step outside the boundaries set forth by project constraints.

**Development Phase** – Those concepts that ranked highest in the evaluation are further developed into VE recommendations. Recommendation narratives, additional advantages and disadvantages, drawings, calculations, and life cycle cost analysis are prepared for each recommendation.

**Presentation Phase** – The VE team presents their findings during an oral presentation to the owner and the project team. Following the workshop, a written report is submitted that summarizes the study, its findings, and recommendations.

I'm looking forward to working with you on this VE study and I really appreciate each of you blocking time out of your busy schedules to participate. Please don't hesitate to call or e-mail me if you have any questions.

Sincerely,

**Jose Theiler**, PE CVS®  
 East Region Manager of  
 Project Risk Management and Value Engineering  
**HDR Engineering, Inc**  
 440 S. Church Street, Suite 1000  
 Charlotte, NC 28202-2075  
 M 561.386.3879  
[jose.theiler@hdrinc.com](mailto:jose.theiler@hdrinc.com)

## Agenda

<b>Day 1</b>		
<b>Monday, February 28, 2022</b>		
<b>Objective for the day: Learn about VE and the Project</b>		
		<b>All audiences</b>
<b>8:00</b>	<b>Connect to Microsoft Teams</b>	Project owner, PMs, designers, VE team
<b>8:15</b>	<ul style="list-style-type: none"> <li>• <b>Roll call</b></li> <li>• <b>Study kickoff</b></li> <li>• <b>Review ground rules for hybrid meetings</b></li> <li>• <b>VE Process Overview:</b> an instructional presentation on the principles of value engineering and their application to the project</li> </ul>	<b>All audiences facilitated by</b> Jose Theiler, PE, CVS
<i>Information Phase</i>		
<b>9:00</b>	<b>Project Overview</b>	<b>All audiences facilitated by</b>
<i>Information Phase</i>	<ul style="list-style-type: none"> <li>• Purpose and need of the project</li> <li>• Goals and objectives of the project</li> <li>• Constraints</li> <li>• Basis of design</li> <li>• Virtual site visit</li> <li>• Questions and answers</li> </ul>	Project team/designer
<b>10:15</b>	<b>Break</b>	
<b>10:30</b>	Roll call	<b>All audiences facilitated by</b>
<i>Information Phase</i>	<b>Risk Elicitation</b>	Jose Theiler, PE, CVS
<b>11:15</b>	Roll call	<b>All audiences facilitated by</b>
<i>Information Phase</i>	<b>Define/Review Performance Attributes</b>	Jose Theiler, PE, CVS
<b>12:00</b>	<b>Lunch</b>	

<b>1:00</b>	Roll call	<b>VE team facilitated by</b>
<i>Information Phase</i>	<b>Project Documentation Review</b> <ul style="list-style-type: none"> <li>• Site visit observations</li> <li>• Review plans/schematics, cross sections, typical sections, traffic control plans, construction constraints</li> <li>• Cost estimate, including construction, right-of-way, utilities, railroad, environmental, etc.</li> <li>• Project schedule, including construction phasing/sequencing, work windows</li> </ul>	Jose Theiler, PE, CVS
<b>3:00</b>	<b>Break</b>	<b>11:00</b>
<b>3:15</b>	<b>Function Analysis</b> <ul style="list-style-type: none"> <li>• Review project cost model</li> <li>• Define key project functions using “verb + noun” expressions</li> </ul>	<b>VE team facilitated by</b>
<i>Function Analysis Phase</i>	Build a FAST diagram	Jose Theiler, PE, CVS
<b>5:00</b>	<b>Adjourn</b>	
<b>Day 2 Tuesday, March 1, 2022</b>		
<b>Objective for the day: Function Analysis, Brainstorming Ideas, Evaluate Ideas</b>		
<b>In-Person Option: Room C107</b>		
<b>8:00</b>	<b>Connect to Microsoft Teams</b> <ul style="list-style-type: none"> <li>• Roll call</li> <li>• Day 1 Recap</li> </ul>	<b>VE team facilitated by</b>
		Jose Theiler, PE, CVS
<b>8:15</b>	<b>Creative Phase</b> <ul style="list-style-type: none"> <li>• Brainstorm alternative ways to perform key functions</li> <li>• Brainstorm ways to improve value of key functions</li> </ul>	<b>VE team facilitated by</b>
<i>Creative Phase</i>		Jose Theiler, PE, CVS
<b>10:00</b>	<b>Break</b>	
<b>10:15</b>	Roll call	
<i>Creative Phase</i>	<b>Creative Phase continues</b> <ul style="list-style-type: none"> <li>• Brainstorm alternative ways to perform key functions</li> <li>• Brainstorm ways to improve value of key functions</li> </ul>	<b>VE team facilitated by</b>
		Jose Theiler, PE, CVS
<b>12:00</b>	<b>Lunch</b>	
<b>1:00</b>	Roll call	
<i>Evaluation Phase</i>	<b>Evaluate Ideas</b> <ul style="list-style-type: none"> <li>• Discuss advantages and disadvantages for each idea</li> </ul>	<b>VE team facilitated by</b>
	Score ideas based on predetermined criteria to develop further into recommendations	Jose Theiler, PE, CVS
<b>3:00</b>	<b>Break</b>	
<b>3:15</b>	Roll call	
<i>Evaluation Phase</i>	<b>Evaluate Ideas continues</b> <ul style="list-style-type: none"> <li>• Discuss advantages and disadvantages for each idea</li> <li>• Score ideas based on predetermined criteria to develop further into recommendations</li> </ul>	<b>VE team facilitated by</b>
		Jose Theiler, PE, CVS
<b>5:00</b>	<b>Adjourn</b>	

<b>Day 3</b>		
<b>Wednesday, March 2, 2022</b>		
<b>Objective for the day: Evaluate Ideas and Begin Developing</b>		
<b>In-Person Option: Room C107</b>		
<b>8:00</b>	<b>Connect to Microsoft Teams</b> Roll call	<b>VE team facilitated by</b> Jose Theiler, PE, CVS
<b>8:05</b> <i>Evaluation Phase</i>	<b>Evaluate Ideas continues</b> <ul style="list-style-type: none"> <li>• Discuss advantages and disadvantages for each idea</li> <li>• Score ideas based on predetermined criteria to develop further into recommendations</li> </ul>	<b>VE team facilitated by</b> Jose Theiler, PE, CVS
<b>9:45</b>	<b>Break</b>	
<b>10:15</b> <i>Development Phase</i>	Roll call <b>Develop Ideas into Recommendations</b> <ul style="list-style-type: none"> <li>• Individual/team assignments</li> <li>• Development of recommendations: <ul style="list-style-type: none"> <li>○ Test design feasibility</li> <li>○ Design analysis</li> <li>○ Technical narratives</li> <li>○ Further discussion on advantages and disadvantages</li> </ul> </li> <li>• Cost analysis (life cycle cost comparison)</li> </ul>	<b>VE team facilitated by</b> Jose Theiler, PE, CVS
<b>12:00</b>	<b>Lunch</b>	
<b>1:00</b> <i>Development Phase</i>	<b>Check-in every hour</b> <ul style="list-style-type: none"> <li>• Technical write-up</li> <li>• Sketches <ul style="list-style-type: none"> <li>○ Life cycle cost estimate</li> </ul> </li> </ul>	<b>VE team facilitated by</b> Jose Theiler, PE, CVS
<b>5:00</b>	<b>Adjourn</b>	
<b>Day 4</b>		
<b>Thursday, March 3, 2022</b>		
<b>Objective for the day: Continue Development of Recommendations</b>		
<b>8:00</b>	<b>Connect to Microsoft Teams</b> Roll call	<b>VE team facilitated by</b> Jose Theiler, PE, CVS
<b>8:05</b> <i>Development Phase</i>	<b>Check-in every hour</b> <ul style="list-style-type: none"> <li>• Technical write-up</li> <li>• Sketches</li> <li>• Life cycle cost estimate</li> </ul>	<b>VE team facilitated by</b> Jose Theiler, PE, CVS
<b>12:00</b>	<b>Lunch</b>	
<b>1:00</b> <i>Development Phase</i>	<b>Finalize recommendations</b> Peer review of recommendations	<b>VE team facilitated by</b> Jose Theiler, PE, CVS
<b>3:30</b> <i>Development Phase</i>	<b>Evaluate performance attributes of recommendations</b>	<b>VE team facilitated by</b> Jose Theiler, PE, CVS
<b>5:00</b>	<b>Adjourn</b>	

<b>Day 5</b>	<b>Friday, March 4, 2022</b>	
	<b>Objective for the day: Deliver Close-out Presentation</b>	
<b>8:00</b> <i>Presentation Phase</i>	<b>Connect to Microsoft Teams</b> Roll call	<b>VE team facilitated by</b> Jose Theiler, PE, CVS
<b>8:05</b> <i>Presentation Phase</i>	<b>Finalize Close-out Presentation</b> <ul style="list-style-type: none"> <li>• Team rehearsal</li> </ul>	<b>VE team facilitated by</b> Jose Theiler, PE, CVS
<b>9:45</b>	<b>Break</b>	
<b>10:00</b> <i>Presentation Phase</i>	<b>Presentation of VE Findings</b> <ul style="list-style-type: none"> <li>• Team presents recommendations to management</li> <li>• Questions and answers</li> </ul>	<b>All audiences:</b> Project owner, management, stakeholders, designers, etc.
	<b>Adjourn</b>	

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## VE Study Attendees Kentucky Transportation Cabinet 10-269.20



F					NAME	ORGANIZATION – POSITION/DISCIPLINE	EMAIL	PHONE
28	1	2	3	4				
✓	✓	✓	✓	✓	Bernhard, Rachel	HDR, VMA – VE Team Assistant	<a href="mailto:rachel.bernhard@hdrinc.com">rachel.bernhard@hdrinc.com</a>	360.259.0787
✓				✓	Blain, Kevin	KYTC – District 4 Planning Section Supervisor/PM	<a href="mailto:kevin.blain@ky.gov">kevin.blain@ky.gov</a>	
✓				✓	Bottoms, Bradley	KYTC – District 4 Project Development Branch Manager and Interim Chief District Engineer	<a href="mailto:bradley.bottoms@ky.gov">bradley.bottoms@ky.gov</a>	
✓					De Witte, Stephen	KYTC – Corridor Planning	<a href="mailto:stephen.dewitte@ky.gov">stephen.dewitte@ky.gov</a>	
✓				✓	Ferguson, Joseph	KYTC – District 4 Environmental Coordinator	<a href="mailto:joseph.ferguson@ky.gov">joseph.ferguson@ky.gov</a>	
✓	✓	✓	✓	✓	Harrod, Justin	KYTC – VE Coordinator	<a href="mailto:justin.harrod@ky.gov">justin.harrod@ky.gov</a>	502.395.0401
✓	✓	✓	✓	✓	Hedges, Adam	HDR – Traffic/Safety Engineer	<a href="mailto:adam.hedges@hdrinc.com">adam.hedges@hdrinc.com</a>	
				✓	Heil, Dave	KYTC –	<a href="mailto:dAvenueheil@ky.gov">dAvenueheil@ky.gov</a>	
✓	✓	✓	✓		Hume, Will	HDR – Senior Transportation Engineer	<a href="mailto:will.hume@hdrinc.com">will.hume@hdrinc.com</a>	971.645.0993
✓				✓	Kelly, Taylor	Qk4 – Project Manager	<a href="mailto:tkelly@qk4.com">tkelly@qk4.com</a>	
✓				✓	Layson, Tim	KYTC – Highway Design	<a href="mailto:tim.layson@ky.gov">tim.layson@ky.gov</a>	502.782.4895
✓				✓	Niemann, Elizabeth	KYTC –	<a href="mailto:elizabeth.niemann@ky.gov">elizabeth.niemann@ky.gov</a>	
✓	✓	✓	✓	✓	Otte, David	KYTC – Safety	<a href="mailto:david.otte@ky.gov">david.otte@ky.gov</a>	502.294.6703
✓	✓	✓	✓	✓	Sweger, Brent	KYTC – Quality Assurance Manager	<a href="mailto:brent.sweger@ky.gov">brent.sweger@ky.gov</a>	502.782.4912



## VE Study Attendees Kentucky Transportation Cabinet 10-269.20



F					NAME	ORGANIZATION – POSITION/DISCIPLINE	EMAIL	PHONE
28	March 2021							
	1	2	3	4				
✓	✓	✓	✓	✓	Theiler, Jose	HDR, CVS – VE Facilitator	<a href="mailto:jose.theiler@hdrinc.com">jose.theiler@hdrinc.com</a>	561.386.3879
✓				✓	Thompson, Rebecca	Qk4 – Planning	<a href="mailto:rthompson@qk4.com">rthompson@qk4.com</a>	
✓				✓	Ulrich, Adam	KYTC – District 4 Location Engineer/Roadway Design	<a href="mailto:adam.ulrich2@ky.gov">adam.ulrich2@ky.gov</a>	502.782.4886
✓				✓	Vaughan, Eileen	FHWA – VE Coordinator	<a href="mailto:eileen.vaughan@dot.gov">eileen.vaughan@dot.gov</a>	502.223.6740
✓	✓	✓	✓	✓	West, John	HDR – Roadway/Planning/Estimating	<a href="mailto:jonathan.west@hdrinc.com">jonathan.west@hdrinc.com</a>	
✓	✓	✓	✓	✓	Williams, Amy	TSW – Land Use/Community Planner	<a href="mailto:awilliams@tswdesigngroup.com">awilliams@tswdesigngroup.com</a>	502.595.7432
✓	✓	✓	✓	✓	Willoughby, Ashley	HDR – Municipal Advisor/Funding	<a href="mailto:ashley.willoughby@hdrinc.com">ashley.willoughby@hdrinc.com</a>	



# Appendix D. Project Estimate

Northeast Bypass – US 68 to KY 55

For the purpose of comparing, a right of way component was added using the following assumption:  
Project length multiplied by 150 ft footprint, using a unit price of \$30,000/acre.

COST ESTIMATE - CONCEPT A (OUTER FROM KY 2154 TO US 68)					
				<b>CONCEPT A</b>	
<b>Mainline Length (miles)</b>				4.96	
	Unit	Unit Cost		Quantity      Cost	
<b>Design</b>		10%			
				\$1,425,000	
<b>Right of Way</b>	ac	10000	Assumed project length x 150 ft wide	90	\$2,705,455
<b>Utilities</b>		2%			\$285,000
<b>Construction</b>					\$14,252,000
MOT		3.0%			\$403,000
Drainage		3.0%			\$403,000
Earthwork					
	Cut (CY)	CY		733,132	\$7,331,000
	Fill	CY			\$0
Roadway		SY		87,363	\$6,115,000
Structures					
	Bridges	SF		0	\$0
	Culvert	CF			\$0
<b>Environmental In-Lieu Fees</b>					\$727,000
	Wetlands	Acre		0.6	\$89,000
	Wooded areas	Acre		12.0	\$38,000
	Streams	LF		1,000	\$600,000
<b>Subtotal</b>					<b>\$19,394,455</b>
Contingency 25%					\$4,849,000
<b>TOTAL</b>					<b>\$24,243,455</b>

**COST ESTIMATE - Alternate 2 (NORTHEAST FROM US 68 TO KY 2154)**

			ALTERNATE 2	
Mainline Length (miles)			1.16	
	Unit	Unit Cost	Quantity	Cost
<b>Design</b>		10%		\$190,000
<b>Right of Way</b>		10000	18	\$545,455
<b>Utilities</b>		2%		\$38,000
<b>Construction</b>				\$1,898,000
MOT		3.0%		\$54,000
Drainage		3.0%		\$54,000
Earthwork				
Cut (CY)	CY	\$10	34,000	\$170,000
Fill	CY	\$15	38,000	\$570,000
Roadway	SY	\$70	15,000	\$1,050,000
Structures				
Bridges	SF	\$300		\$0
Culvert	CF	\$25		\$0
<b>Environmental In-Lieu Fees</b>				\$60,000
Wetlands	Acre	\$147,600	0	\$0
Wooded areas	Acre	\$3,150	0.0	\$0
Streams	LF	\$600	200	\$60,000
<b>Subtotal</b>				<b>\$2,731,455</b>
Contingency 25%				\$683,000
<b>TOTAL</b>				<b>\$3,414,455</b>

**COST ESTIMATE - Widen Remaining Existing Corporate Drive  
Shoulders Only**

<b>Mainline Length (miles)</b>			<b>SHOULDER CORP DR</b>	
	Unit	Unit Cost	0.61	
			Quantity	Cost
<b>Design</b>		10%		\$35,000
<b>Right of Way</b>				\$0
<b>Utilities</b>		2%		\$7,000
<b>Construction</b>				\$345,000
MOT		3.0%		\$10,000
Drainage		3.0%		\$10,000
Earthwork				
Cut (CY)	CY	\$10		\$0
Fill	CY	\$15	10,000	\$150,000
Roadway	SY	\$70	2,500	\$175,000
Structures				
Bridges	SF	\$300		\$0
Culvert	CF	\$25		\$0
<b>Environmental In-Lieu Fees</b>				\$0
Wetlands	Acre	\$147,600	0	\$0
Wooded areas	Acre	\$3,150	0.0	\$0
Streams	LF	\$600	0	\$0
<b>Subtotal</b>				<b>\$387,000</b>
Contingency 25%				\$97,000
<b>TOTAL</b>				<b>\$484,000</b>

**COST ESTIMATE - Widen Corporate 3-Lanes Teledyne Way to US 68**

Right of Way Line Length (miles)			3-LANE CORP DR	
	Unit	Unit Cost	Quantity	Cost
			0.49	
<b>Design</b>		10%		\$61,000
<b>Right of Way</b>				
<b>Utilities</b>		2%		\$12,000
<b>Construction</b>				\$612,000
MOT		3.0%		\$17,000
Drainage		3.0%		\$17,000
Earthwork				
Cut (CY)	CY	\$10	10,000	\$50,000
Fill	CY	\$15	10,000	\$150,000
Roadway	SY	\$70	5,400	\$378,000
Structures				
Bridges	SF	\$300		\$0
Culvert	CF	\$25		\$0
<b>Environmental In-Lieu Fees</b>				\$0
Wetlands	Acre	\$147,600	0	\$0
Wooded areas	Acre	\$3,150	0.0	\$0
Streams	LF	\$600	0	\$0
<b>Subtotal</b>				\$685,000
Contingency 25%				\$171,000
<b>TOTAL</b>				\$856,000

Southeast Bypass – KY 208 to US 68

COST ESTIMATE - CONCEPT A (OUTER FROM KY 2154 TO US 68)				
			<b>CONCEPT A</b>	
<b>Mainline Length (miles)</b>			4.96	
	Unit	Unit Cost	Quantity	Cost
<b>Design</b>		10%		\$1,425,000
<b>Right of Way</b>	ac	10000	90	\$2,705,455
			Assumed project length x 150 ft wide	
<b>Utilities</b>		2%		\$285,000
<b>Construction</b>				\$14,252,000
MOT		3.0%		\$403,000
Drainage		3.0%		\$403,000
Earthwork				
	Cut (CY)	CY	733,132	\$7,331,000
	Fill	CY		\$0
Roadway		SY	87,363	\$6,115,000
Structures				
	Bridges	SF	0	\$0
	Culvert	CF		\$0
<b>Environmental In-Lieu Fees</b>				\$727,000
	Wetlands	Acre	0.6	\$89,000
	Wooded areas	Acre	12.0	\$38,000
	Streams	LF	1,000	\$600,000
<b>Subtotal</b>				<b>\$19,394,455</b>
Contingency 25%				\$4,849,000
<b>TOTAL</b>				<b>\$24,243,455</b>

**COST ESTIMATE - CONCEPT A (OUTER FROM KY 2154 TO US 68)**

CONCEPT A1					
Mainline Length (miles)				2.07	
	Unit	Unit Cost		Quantity	Cost
<b>Design</b>		10%			\$481,000
<b>Right of Way</b>	ac	10000	Assumed project length x 150 ft wide	38	\$1,129,091
<b>Utilities</b>		2%			\$96,000
<b>Construction</b>					\$4,810,000
MOT		3.0%			\$136,000
Drainage		3.0%			\$136,000
Earthwork					
Cut (CY)	CY	\$10		198,276	\$1,983,000
Fill	CY	\$15			\$0
Roadway	SY	\$70		36,500	\$2,555,000
Structures					
Bridges	SF	\$300		0	\$0
Culvert	CF	\$25			\$0
<b>Environmental In-Lieu Fees</b>					\$0
Wetlands	Acre	\$147,600		0.0	\$0
Wooded areas	Acre	\$3,150		0.0	\$0
Streams	LF	\$600		0	\$0
<b>Subtotal</b>					\$6,516,091
Contingency 25%					\$1,629,000
<b>TOTAL</b>					\$8,145,091

**COST ESTIMATE - CONCEPT B (INNER FROM KY 2154 TO US 68)**

					CONCEPT B	
Mainline Length (miles)					2.21	
	Unit	Unit Cost			Quantity	Cost
<b>Design</b>		10%				\$526,000
<b>Right of Way</b>	ac	10000	Assumed project length x 150 ft wide		40	\$1,205,455
<b>Utilities</b>		2%				\$105,000
<b>Construction</b>						\$5,255,000
MOT		3.0%				\$149,000
Drainage		3.0%				\$149,000
Earthwork						
	Cut (CY)	CY	\$10		133,025	\$1,330,000
	Fill	CY	\$15		0	\$0
Roadway		SY	\$70		38,963	\$2,727,000
Structures						
	Bridges	SF	\$300		3,000	\$900,000
	Culvert	CF	\$25			\$0
<b>Environmental In-Lieu Fees</b>						\$990,000
	Wetlands	Acre	\$147,600		0	\$0
	Wooded areas	Acre	\$3,150		9.5	\$30,000
	Streams	LF	\$600		3,200	\$960,000
<b>Subtotal</b>						\$8,081,455
Contingency 25%						\$2,020,000
<b>TOTAL</b>						\$10,101,455

COST ESTIMATE - CONCEPT C (CONNECTOR ALONG KY 49 FROM A-B)					
				CONCEPT C	
<b>Mainline Length (miles)</b>				4.14	
	Unit	Unit Cost		Quantity	Cost
<b>Design</b>		10%			\$744,000
<b>Right of Way</b>	ac	10000	Assumed project length x 150 ft wide	75	\$2,258,182
<b>Utilities</b>		2%			\$149,000
<b>Construction</b>					\$7,435,000
MOT		3.0%			\$210,000
Drainage		3.0%			\$210,000
Earthwork					
Cut (CY)	CY	\$10		356,000	\$3,560,000
Fill	CY	\$15		0	\$0
Roadway	SY	\$70		36,500	\$2,555,000
Structures					
Bridges	SF	\$300		3,000	\$900,000
Culvert	CF	\$25			\$0
<b>Environmental In-Lieu Fees</b>					\$5,000
Wetlands	Acre	\$147,600		0	\$0
Wooded areas	Acre	\$3,150		1.7	\$5,000
Streams	LF	\$600		0	\$0
<b>Subtotal</b>					<b>\$10,591,182</b>
Contingency 25%					\$2,648,000
<b>TOTAL</b>					<b>\$13,239,182</b>



**COST ESTIMATE - CONCEPT D (CONNECTOR FROM B-A)**

COST ESTIMATE - CONCEPT D (CONNECTOR FROM B-A)				
				<b>CONCEPT D</b>
<b>Mainline Length (miles)</b>				3.66
	Unit	Unit Cost		Quantity      Cost
<b>Design</b>		10%		\$568,000
<b>Right of Way</b>	ac	10000	Assumed project length x 150 ft wide	67      \$1,996,364
<b>Utilities</b>		2%		
<b>Construction</b>				\$5,678,000
MOT		3.0%		\$161,000
Drainage		3.0%		\$161,000
Earthwork				
Cut (CY)	CY	\$10		312,522      \$3,125,000
Fill	CY	\$15		0      \$0
Roadway	SY	\$70		25,437      \$1,781,000
Structures				
Bridges	SF	\$300		3,000      \$450,000
Culvert	CF	\$25		\$0
<b>Environmental In-Lieu Fees</b>				\$42,000
Wetlands	Acre	\$147,600		0.2      \$30,000
Wooded areas	Acre	\$3,150		3.9      \$12,000
Streams	LF	\$600		0      \$0
<b>Subtotal</b>				<b>\$8,398,364</b>
Contingency 25%				\$2,100,000
<b>TOTAL</b>				<b>\$10,498,364</b>

**COST ESTIMATE - CONCEPT E (CONNECTOR ALONG SULPHUR SPRINGS FROM A-B)**

					CONCEPT E	
Mainline Length (miles)					5.17	
	Unit	Unit Cost			Quantity	Cost
<b>Design</b>		10%				\$1,589,000
<b>Right of Way</b>	ac	10000	Assumed project length x 150 ft wide		94	\$2,820,000
<b>Utilities</b>		2%				\$318,000
<b>Construction</b>						\$15,894,000
MOT		3.0%				\$450,000
Drainage		3.0%				\$450,000
Earthwork						
Cut (CY)	CY	\$10				\$0
Fill	CY	\$15			574,597	\$8,618,955
Roadway	SY	\$70			91,067	\$6,375,000
Structures						
Bridges	SF	\$300				\$0
Culvert	CF	\$25				\$0
<b>Environmental In-Lieu Fees</b>						\$130,000
Wetlands	Acre	\$147,600			0.6	\$89,000
Wooded areas	Acre	\$3,150			13.0	\$41,000
Streams	LF	\$600			0	\$0
<b>Subtotal</b>						\$20,751,000
Contingency 25%						\$5,188,000
<b>TOTAL</b>						\$25,939,000