Value Engineering Study

US 27 RECONSTRUCTION
FROM US 150 BYPASS IN STANFORD TO KY 34
LINCOLN AND GARRARD COUNTIES, KENTUCKY

ITEM NUMBER 7-196.00
VE STUDY NUMBER 201204

Study Date: May 7-11, 2012

Kentucky Transportation Cabinet
Frankfort, Kentucky

URS

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VALUE ENGINEERING STUDY
for
Kentucky Transportation Cabinet
Frankfort, Kentucky

Study Date: May 7 - 11, 2012

Final Report

July 17, 2012

URS

EXECUTIVE SUMMARY

General

URS conducted a value engineering (VE) study of the US 27 Reconstruction from US 150 Bypass in Stanford to KY 34 in Lincoln and Garrard Counties, Kentucky. The Item Number (No.) is 7-196.00. The topic was the 25% design submission prepared by the Stantec and WMB Design Team (Design Team) for the Kentucky Transportation Cabinet (KYTC).

The VE Team undertook the task assignment using the value engineering work plan and approach. The ideas generated from this process and chosen for full development as VE Team Recommendations are presented in Section 3 of this report. These recommendations are presented to all project stakeholders for judgment as to whether they should be implemented.

Estimate of Construction Costs and Budget

The preliminary construction cost estimate provided to the VE Team with the project documents indicates a total construction cost of $138,302,000 including right-of-way (ROW) and utility relocations. This project is scheduled to be developed as a traditional design/bid/build project, thus the cost of construction will be determined on a contractor bid.

Summary of VE Study Results

During the speculation phase of this VE study, 51 creative ideas were identified; 19 of these ideas were developed into VE recommendations and 9 were developed into design comments with cost implications where applicable. Many of the ideas represent changes in design approach, reconsideration of criteria, and in some cases, modification of the project scope. In general, the idea evaluation took into account the economic impact, other benefits obtained, and the effect on the overall project objectives.

The following table presents a summary of the ideas developed into recommendations and design comments with cost implications where applicable. Since cost is an important issue for comparison of VE proposals, the costs presented in this report are based upon original design quantities with unit rates obtained from the estimate as prepared by the Design Team and included in their submission, published cost databases, and VE Team member experience.

The table also identifies the recommendations and alternatives that, in the opinion of the VE Team, are the best combination of all the VE recommendations. This selection takes into account that the cost savings of these recommendations can be added together (summarily additive), and it also considers whether the cost savings or project improvement potential are worth the change to the project design.

For this project, the VE Team selected two mutually exclusive scenarios to represent a range recommendations and potential cost savings. These scenarios are comprised of a combination of individual recommendations as shown in the Summary of VE Recommendation table. Scenario #1 - VE Team's Selected Combination represents an estimated potential cost savings of $42,789,000 over a 50-year life-cycle. Scenario #2 – Minor Conceptual Changes results in an estimated potential cost savings of $8,888,000 over a 50-year life-cycle. Total cost savings realized will be based upon the final implementation status of these VE recommendations.

SUMMARY OF VE RECOMMENDATIONS					
Rec #	Recommendation Title / Description	1st cost savings (or cost)	O & M savings (or cost)	Total LCC savings (or cost)	VE Scenarios
VE-1	Utilize up to date traffic forecasts in lieu of old forecasts used in previous reports	Comment		Comment	
VE-2	Develop an access management plan and memorandum of understand (MOU) for the corridor. Remove unnecessary and redundant connections to US 27, make all private driveway right-in/right-out access, and create strategic U-turn locations along the corridor	Comment		Comment	
VE-3	Utilize a superstreet intersection in lieu of a standard intersection at US 27 and KY 52	($5,000)		($5,000)	
VE-4	Utilize a complete street urban section in lieu of the typical section from approximately Sta. 1190+00 to 1265+00	($795,000)		($795,000)	1
VE-5	Install a shared use path from US 150 Bypass to KY 52	($536,000)		($536,000)	1
VE-6	Install a wagon box to connect both sides of the park in lieu of severing park	($336,000)		($336,000)	2
VE-7	Utilize cap and column piers in lieu of a hammerhead piers	$613,000		$613,000	2
VE-8	Reduce span length of the new Dix River crossing by eliminating access to Rankin Road	$485,000		$485,000	2
VE-9	Shift the Dix River crossing to the east of existing alignment to provide a shorter, 90-degree structure in lieu of a skewed structure	$2,320,000		$2,320,000	
VE-10	Stay on existing US 27 alignment and utilize a widened Dix River structure in lieu of a new structure on new alignment from Sta. 1300+00 to 1450+00	$30,284,000	($164,000)	$30,120,000	1
VE-11	Utilize a 5-lane urban section on the existing alignment from the US 150 Bypass through Dix River structure and tie-in to the baseline alternative at Sta. 1300+00 in lieu of a 4-lane grass median section	$4,838,000	($164,000)	$4,674,000	
VE-12	Adjust the grade and profiles to reduce the amount of earthwork required	$2,093,000		$2,093,000	2
VE-13	Utilize existing road alignment from Sta. 1700+00 to 1760+00 in lieu of new alignment	$1,400,000		$1,400,000	2
VE-14	Utilize a 12-foot in lieu of a 14-foot center turn lane in the urban section at the southern end of the corridor	$137,000		$137,000	2

SUMMARY OF VE RECOMMENDATIONS					
Rec #	Recommendation Title / Description	1st cost savings (or cost)	O & M savings (or cost)	Total LCC savings (or cost)	VE Scenarios
VE-15	Utilize 11-foot lanes in lieu of 12-foot lanes for the urban section	$206,000		$206,000	2
VE-16	Reduce all paved shoulder widths by 2 feet throughout the corridor	$3,392,000		$3,392,000	2
VE-17	Utilize a 20-foot depressed median in lieu of a 40-foot depressed grass median	$898,000		$898,000	2
VE-18	Utilize a road diet (3 lanes in lieu of 4 lanes) on existing US 27 through downtown Lancaster	Comment		Comment	
VE-19	Utilize new construction from US 150 Bypass to Sta. 1250+00, the Lancaster bypass from Sta. 1440+00 to Sta. 1640+00, and defer constructing the remainder of the project	$67,557,000		$67,557,000	
VE-20	Utilize a 2-lane initial and 4-lane ultimate typical section for the portion north of the Lancaster Bypass	$5,546,000		$5,546,000	1
VE-21	Utilize a 2-lane typical section for the Lancaster Bypass in lieu of a 4-lane typical section	$8,454,000		$8,454,000	1
VE-22	Utilize a 2+1 lane initial with ROW for a 4-lane ultimate section from Sta. 1250+00 to the KY 34 intersection	$10,971,000		$10,971,000	
VE-23	Reduce the shoulder pavement thickness in lieu of the current design depth	Comment		Comment	
VE-24	Prioritize the Lancaster bypass to be the first section of roadway constructed	Comment		Comment	
VE-25	Review construction phasing priorities and establish segment termini	Comment		Comment	
VE-26	Demolish or deed the old Dix River structure to the county to reduce future KYTC maintenance	Comment		Comment	
VE-27	Bridge over buried utility lines in lieu of relocating utilities	Comment		Comment	
VE-28	Convert the KY 34 and US 27 intersection to a superstreet design	Comment		Comment	
	Scenario #1 - VE Team's Selected Combination:	**$42,953,000**	**($164,000)**	**$42,789,000**	
	Scenario # 2 - Minor Conceptual Changes:	**$8,888,000**	**$0**	**$8,888,000**	

Acknowledgments
A thank you is given to the staff members from the Kentucky Transportation Cabinet, Stantec, and WMB for their participation. Special thanks are also extended to Mr. Brent Sweger for his assistance with this study.

Value Engineering Study Team

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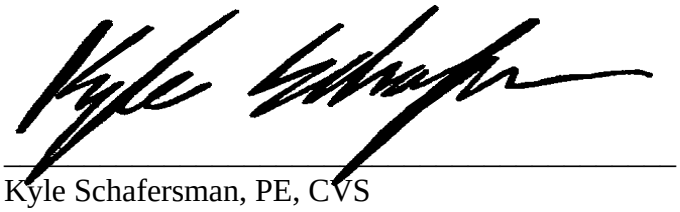
Kyle Schafersman, PE, CVS	VE Team Leader	URS	913-344-1019
Brent Sweger, PE, AVS	VE Coordinator	KYTC	502-564-3280

Certification
This is to verify that the Value Engineering study was conducted in accordance with standard value engineering principles and practices.



Kyle Schafersman, PE, CVS
Value Engineering Program Manager

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Appendices

SECTION 1 - INTRODUCTION

This report documents the results of a value engineering study on the US 27 Reconstruction from US 150 Bypass in Stanford to KY 34 in Lincoln and Garrard Counties, Kentucky. The Item Number (No.) is 7-196.00. The study was held at the KYTC offices in Frankfort, KY on May 7-11, 2012. The study team was from URS and KYTC. Kyle Schafersman, a Certified Value Specialist (CVS), Professional Engineer (PE), and team leader from URS, facilitated the study. The names and telephone numbers of all participants in the study are listed in Appendix A.

The Job Plan

This study followed the value engineering methodology as endorsed by SAVE International, the professional organization of value engineering. This report does not include any detailed explanations of the value engineering / value analysis processes used during the workshop in development of the results presented herein. This would greatly expand the size of the report. The sole purpose of this report is to document the results of the study. Additional information regarding the processes used during the study can be obtained by contacting the Certified Value Specialist team leader that facilitated the study.

Ideas, Recommendations, and Design Comments

Part of the value engineering methodology is to generate as many ideas as is practical, evaluate each idea, and then select as candidates for further development only those ideas that offer added value to the project. If an idea thus selected, turns out to work in the manner expected, that idea is put forth as a formal value engineering recommendation. Recommendations represent only those ideas that are proven to the VE Team's satisfaction. Some ideas that did not make the selection for development as recommendations, were, nevertheless judged worthy of further consideration. These ideas have been written up as Design Comments and are included in Section 3 with the recommendations.

Level of Development

Value analysis studies are working sessions for the purpose of developing and recommending alternative approaches to a given project. As such, the results and recommendations presented are of a conceptual nature, and are not intended as a final design. Detailed feasibility assessment and final design development of any of the recommendations presented herein, should they be accepted, remain the responsibility of the owner. VE Team members have not and will not sign or seal any recommendations and comments contained in this report as certifiable engineering or architectural design. These value analysis alternatives have been developed by individual VE Team members and may not reflect the entire VE Team's opinion.

Organization of the Report

The report is organized in the following outline.

A. Introductory Information
    Section 1- Introduction
    Section 2- Project Description
B. Primary Body of Results
    Section 3- Recommendations and Design Comments
C. Supporting Documentation
    Appendices

SECTION 2 – PROJECT DESCRIPTION

Project Location
The proposed project is the widening and/or relocation of a 13.1-mile section of US 27 in Lincoln and Garrard Counties, Kentucky. The project corridor extends from the US 150 intersection in Stanford (Lincoln County) north through Lancaster (Garrard County) to approximately 1,500 feet south of the KY 34 intersection in Garrard County. This project is one of several planned improvements of US 27 from the Tennessee state line to the Kentucky River at Camp Nelson. The map of the project location shows the project corridor and its proximity to nearby towns and roadways and also shows the location of the proposed project in relation to the two counties.

Existing Facility
In Kentucky, US 27 extends from Covington to the Tennessee state line in a north-to-south orientation and passes thorough Paris, Lexington, Somerset and the Lake Cumberland district, as well as many smaller Kentucky communities. Along most of its route through Kentucky, US 27 parallels Interstate 75 (I-75), which is located approximately 20 miles east and serves as the primary relief route for this interstate. US 27 is the main north/south travel route for not only Garrard and Lincoln counties, but other communities located along the highway as well. As such, the route is crucial for local and regional travel, intermodal transportation and truck travel, recreational travel, and interstate transportation.

The existing roadway is classified as Rural Principal Arterial with two lanes in the rural portions of the counties and four undivided lanes in the urbanized areas of Lancaster and Stanford. Posted speed limits range from 45 to 55 miles per hour (mph) outside corporate city limits to 25 to 35 mph in town. Existing lane widths range from 11 feet for the northernmost 6.5 miles to 12 feet for the remainder of the highway. Because US 27 is a commuter as well as a commercial route, congestion in downtown Lancaster during morning and evening commuting hours is common. Outside the commuting hours, through traffic cannot maintain free-flow speeds along US 27 because the reduced speed limits in Lancaster foster congestion and delays. In addition, horizontal and vertical design deficiencies (sharp curves and hills) impede sight distance, contribute to accidents, and inhibit free-flow travel along the roadway.

US 27 crosses the Dix River at mile point 20.875. This bridge (B00047) is 245 feet long, 33.3 feet wide, and contains a horizontal clearance of 28 feet. The bridge has a sufficiency rating of 76.3, indicating that it is neither structurally deficient nor functionally obsolete (designations for bridges rating below 50.0), and its sub- and superstructures are in good condition. The proposed project anticipates replacing this bridge with a new 4-lane bridge.

Purpose and Need
A preliminary planning document, Intermediate Planning Study, US 27 Reconstruction and Relocation From KY 34 to the US 150 Bypass at Stanford (2002a) (IPS), was prepared in 2002. As part of the process for that study, a Citizen's Advisory Group (CAG) was established. This group, along with local government agencies, interest groups, and KYTC, established project goals, which served as the basis for the development of the purpose and need statement. The goals as presented in the IPS were:

- *Create a more direct north-south transportation corridor through the project area.* As a major transportation corridor in the state, US 27 carries up to 15,000 vehicles per day along portions of the route in the study area. Varying speed limits between 25 and 55 miles per hour (mph) do not

provide for consistent travel speeds for this large volume of traffic. Frequent driveways, intersections, and traffic signals in some areas also create operational and accident problems.

- *Allow better access for commuters, industry, emergency vehicles, recreational travelers and tourists.* Improvement of the existing highway would provide a better route for those traveling the highway on a daily basis. Additionally, commercial trucks could more efficiently travel within the area, thus reducing operating costs. Emergency vehicles transporting patients to more advanced medical facilities in Lexington could potentially reduce their travel times. Lastly, those traveling the route for leisure activities will also benefit from reduced travel times.

- *Provide for better coordination between land use and transportation planning.* Local officials in Lancaster and Stanford noted the need to use local planning and zoning regulations to manage growth and expansion within the areas designated for use by any future alignments.

- *Allow the population to continue to grow while maintaining adequate transportation access.* While many roadways within the study area currently operate at satisfactory levels of service, future traffic estimates anticipate more congestion on study area routes. To maintain a satisfactory transportation network, plans for capacity expansion were developed.

The purpose of the project is to create a direct north-south transportation route through the project area from the US 150 Bypass in Stanford to KY 34 and to relieve traffic congestion on existing US 27 and through Lancaster.

The project is needed because the current infrastructure is not adequate to support existing or projected traffic. The existing facility is two lanes with many access points, narrow to non-existent shoulders, and horizontal and vertical design deficiencies. Current design guidelines provide adequate sight distances as well as lane widths and shoulders that accommodate traffic volumes. US 27 in the corridor predates these guidelines, and as such, many of these features are not present in the highway. The deficient geometry coupled with the local and regional transportation demands on the roadway justify the need for the project.

Projected growth and development trends in Garrard and Lincoln counties intensify this need in the future. Garrard and Lincoln Counties are among the fastest growing counties in Kentucky. Out of the 120 counties in Kentucky, Garrard County is the 13th fastest growing in terms of population change. From 1990 to 2000, Kentucky's population increased 9.7 percent, while Garrard County grew 27.7 percent. Lincoln County's population increased 16.5 percent during the same time period, making it the 26th fastest growing county in Kentucky from 1990 to 2000.

As the counties continue to grow, traffic volumes, delays, and commuting times will increase as well. Because of the predicted population growth, traffic volumes in the corridor are expected to more than double.

Baseline Concept

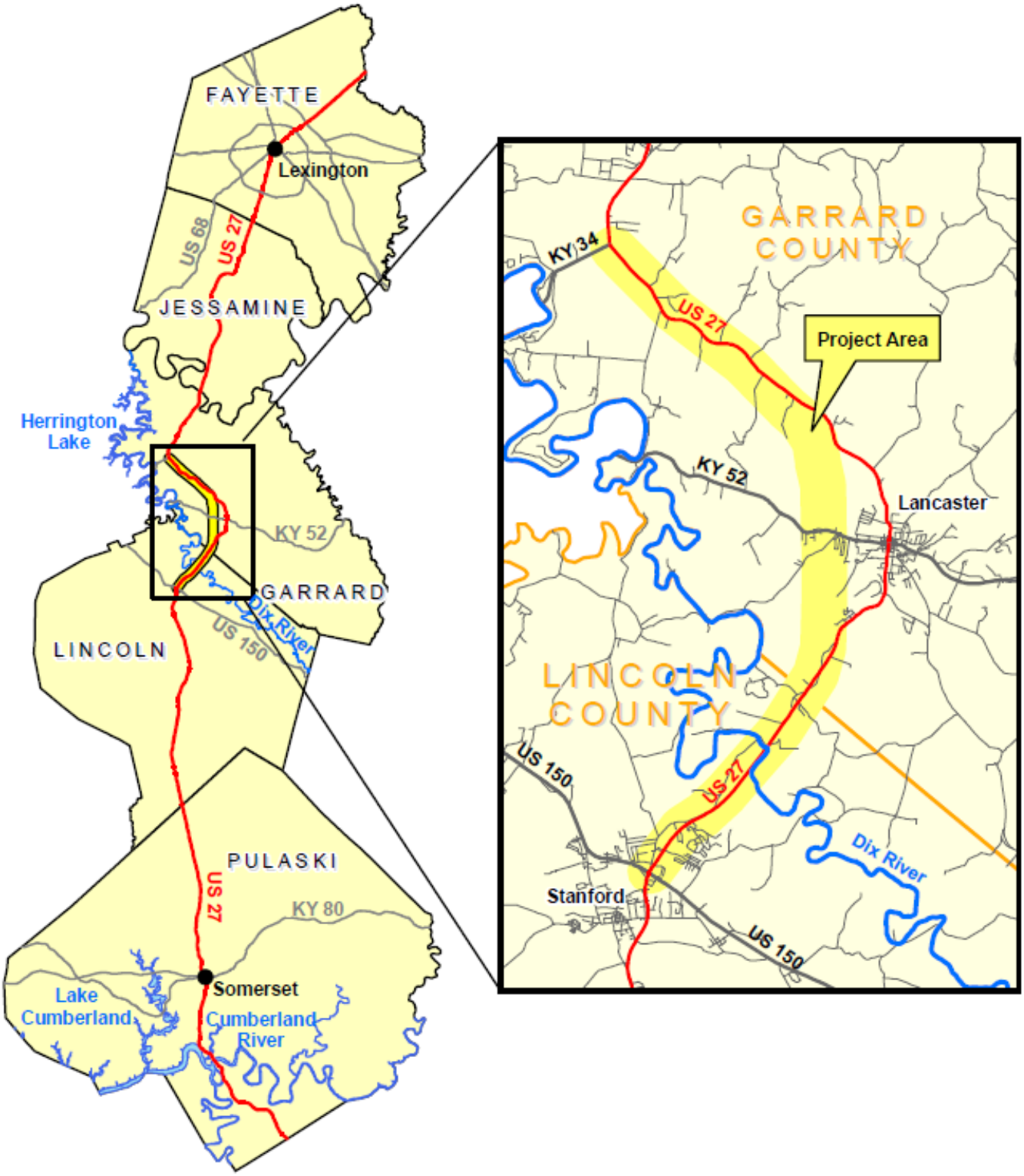
The proposed road will be a 4-lane divided highway with a 40-foot depressed grass median and a posted/design speed of 55 mph outside city limits. At the southern terminus from the US 150 Bypass to Wal-Mart, the road will be 5 lanes (4 lanes with a center turn lane). US 27 through downtown Lancaster has already exceeded its roadway capacity as evidenced by its current LOS E. Because constructing a 4-lane divided, access-controlled road through the heart of Lancaster would create significant adverse community impacts, a western bypass has been proposed to allow through traffic to maintain speed around the city.

Lane widths will be 12 feet, with 10-foot paved outside shoulders and 4-foot paved inside shoulders. As US 27 traverses rolling terrain, maximum grade will be 5%. Access to the new roadway will be controlled and limited to 1,200-foot spacing. This 1,200-foot access spacing will result in the use of frontage roads, shared driveways, and other techniques to access properties. The existing roadway will be retained as a frontage road only where necessary for accessibility of adjoining properties and where the partially controlled access spacing cannot be achieved.

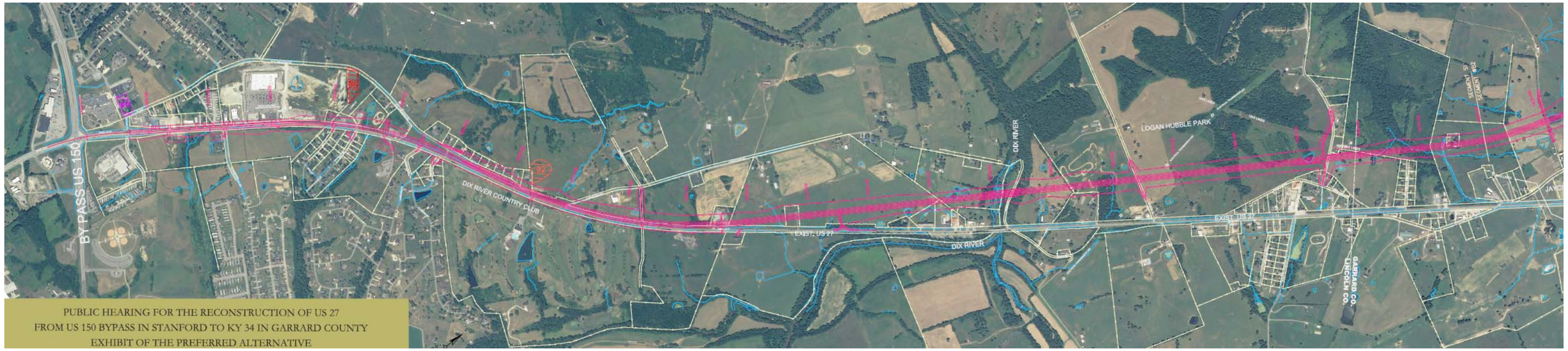
At this time, bicycle lanes and pedestrian facilities have been considered but not developed. No public comments received to date indicate an interest in such facilities along the project roadway. The wide, smooth shoulders along the reconstructed roadway may encourage residents to walk or choose bicycles as an alternative form of transportation for short trips, and the improved visibility as a result of improved horizontal and vertical alignments will make walking and bicycling safer in the area. However, the distance to commercial areas from many homes in the project corridor, combined with the large traffic numbers expected to use the road, may discourage bicycle and pedestrian use.

Funding has only been allocated for design ($1,439,839). No ROW, utility relocation, or constructions funds have been allocated at the present time.

Map of Project Location



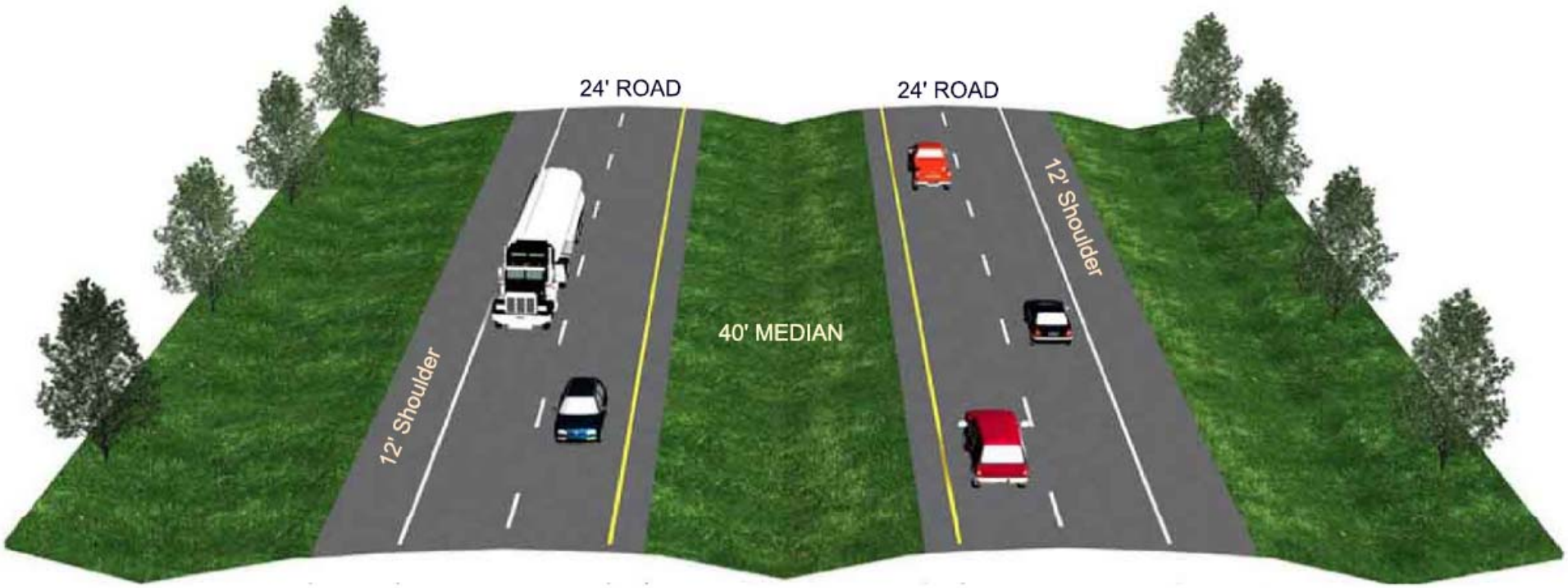
Manuscript Plan of Southern Section of Reconstructed US 27



Manuscript Plan of Central Section of Reconstructed US 27 (Lancaster Bypass)

Manuscript Plan of Northern Section of Reconstructed US 27

Typical Roadway Section of Reconstructed US 27



TYPICAL ROADWAY APPEARANCE OF RECONSTRUCTED US 27

SECTION 3 - VE RECOMMENDATIONS & DESIGN COMMENTS

Organization of Recommendations
This section contains the complete documentation of all recommendations that have resulted from this study. Each recommendation has been marked by a unique identification number.

The parent idea, or ideas from which the recommendation began, can be determined from the Creative Idea List and Evaluation located in Appendix D of this report.

Each recommendation is documented by a separate write-up that includes:
- a description of both the original design and recommended change,
- a list of advantages and disadvantages,
- sketches where appropriate,
- calculations,
- estimate of initial or first cost,
- the economic impact of the recommendation on the first cost (i.e., amount of dollars saved or added),
- and where applicable, the life cycle (LC) cost.

The economic impact is shown in terms of savings or added cost.

Acceptance of VE Recommendations
The Summary of VE Recommendations table presented in the Executive Summary of this report identifies the recommendations that, in the opinion of the VE Team, are the best combination of all the VE recommendations. This selection takes into account not only that the recommendations, and likewise their cost savings, are summarily additive (can be added together), but also the likelihood and ease of implementing the recommendations.

However, this report also includes other recommendations that could enhance the value of this project. These recommendations are either mutually exclusive of the recommendations selected by the VE Team (i.e., implementing one immediately precludes the implementation of another) or they require additional design and/or evaluation prior to implementation. These recommendations should be evaluated individually to determine whether they are worthy of implementation or not. Consideration should be given to the areas within a recommendation that are acceptable and implement those parts only. Any recommendation can be accepted in whole or in part as the owner and Design Team see fit.

Design Comments
Design Comments are ideas that in the opinion of the VE Team were good ideas, but for any number of reasons were not selected for development as VE recommendations. Design Comments can be notes to the owner or designer, a documentation of various thoughts that come up during the course of the study, a reference to possible problems, suggested items that might need further study, or questions that the owner and designer might want to explore. These comments may have implications on project cost, but due to time constraints, the VE Team did not develop cost savings estimates for Design Comments. Some comments might relate to things of which the owner or designer is already aware. Because the study is done on a design in progress and as an independent team, the VE Team may not be aware of everything intended by the owner and designer. The following comments are presented with the intent that they may aid the Design Team in some way.

VALUE ENGINEERING DESIGN COMMENT # VE-1

DESCRIPTIVE TITLE OF DESIGN COMMENT:
Utilize up to date traffic forecasts in lieu of old forecasts used in previous reports.

COMMENTARY:

Utilize the latest count data to formulate future traffic growth rates. Traffic growth has slowed significantly in the last 10 years. Newer growth rates based from more recent actual count data will give more realistic future traffic volumes. The opening of the Wal-Mart on the south end of the project in July of 2005, that caused a onetime spike in the traffic counts, also needs to be taken into consideration when determining future growth rates. Below are counts from some of the stations along the route, what the traffic forecast projected for 2030, and a rough estimate of what the VE Team believes the 2030 forecast should be.

Sta. 772+00 (north of proposed bypass)	
Year	Volume
2002	8,770
2004	8,810
2005	9,000
2008	8,470
2011	8,450
2030 (forecast)	19,400
2030 (VE Team suggestion)	11,500

Sta. A10+00 (US 27 in Lancaster)	
Year	Volume
2000	12,800
2003	12,100
2006	12,600
2009	12,400
2030 (forecast) downtown/bypass	19,000/10,600
2030 (VE Team suggestion) downtown/bypass	10,000/10,000

Sta. 023+00 (north of suburban development, south of proposed bypass	
Year	Volume
2000	7,880
2003	7,170
2006	8,620
2009	8,920
2030 (forecast)	21,000
2030 (VE Team suggestion)	12,000

Sta. 032+00 (within suburban development, south of Walmart)	
Year	Volume
2002	10,200
2005	13,400
2006	14,300
2007	13,900
2010	14,900
2030 (forecast)	22,600
2030 (VE Team suggestion)	19,400

VALUE ENGINEERING DESIGN COMMENT # VE-2

DESCRIPTIVE TITLE OF DESIGN COMMENT:
Develop an access management plan and memorandum of understand (MOU) for the corridor. Remove unnecessary and redundant connections to US 27, make all private driveway right-in/right-out access, and create strategic U-turn locations along the corridor.

COMMENTARY:
The purpose and need statement states:

- Create a more direct north-south transportation corridor through the project area.
- Provide for consistent travel speeds for this large volume of traffic.
- Provide for better coordination between land use and transportation planning.

In addition the citizen's advisory group outlined the following goal:

- The purpose of the project is to create a direct north-south transportation route through the project area from the US 150 Bypass in Stanford to KY 34 to relieve traffic congestion on existing US 27 and through Lancaster.

The original design targets using partial control access for most of the corridor, most of which is designed with 1,200 feet or greater access spacing. Median opening locations and design are unknown at this time. The design of this project and future decisions regarding access are vital to sustaining long-term operations and safety. This is critical also since KYTC plans to invest $138 million public money provide a high-functioning road with the primary purpose of safe, long distance travel. Therefore, the VE Team recommends that a more vigorous approach to designing and protecting access as part of the project.

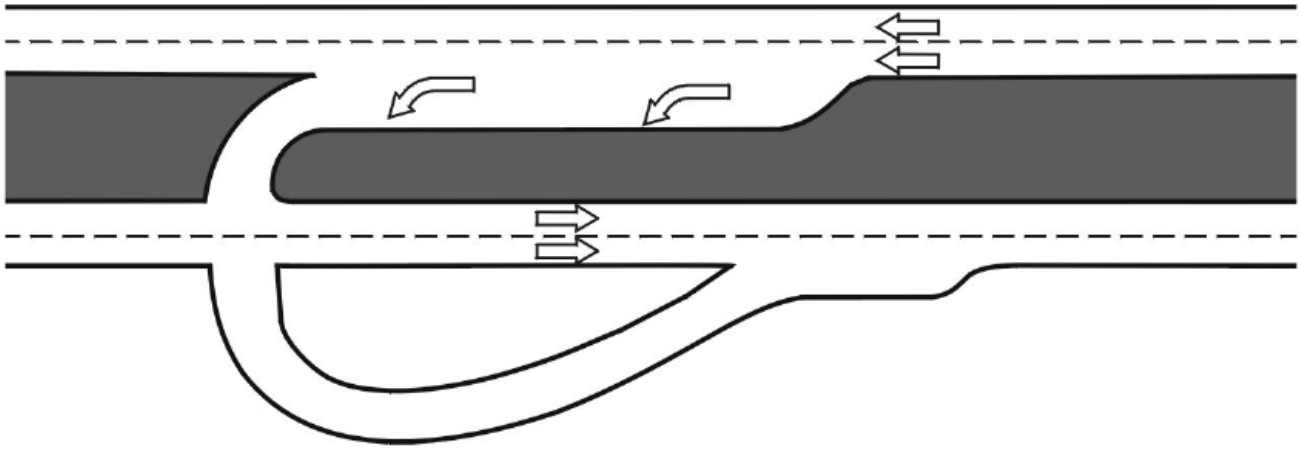
First, it is recommended that an access management plan be created for the entire corridor. This plan would locate current and potential future access points, access design, intersection designs and signal locations, median openings and median opening design. To help ensure that the plan is carried out, KYTC should enter into a MOU with the counties' and cities' governments that adopts the plan and outlines the procedure to agree on future modifications to the plan.

The following strategies are recommended to refine the current design:

1. To protect this corridor for the travelling public long term, it is recommended that all redundant and unnecessary access be removed. In locations where access is provided on each side to serve a parcel that was severed, the design team should consider installing a culvert so the conflict points and potential pressure for signals are eliminated.
2. There are several access roads (i.e. Boone Creek Road, Crimson Court) provided on the west side of the project where properties can be accessed from the old US 27. The design team should consider closing all of them.
3. Full median openings (or alternative designs such as superstreet) should only be located at high volume intersections such KY 52 and old US 27. All other access locations should be right-in/right-out with median control or have a directional median opening design that allows left turns into but no through or lefts from the access.
4. Signalization of full openings should be avoided to ensure consistent, high-speed traffic flow throughout the entire corridor. There appears to be valid alternatives to traditional signalized intersections.

VALUE ENGINEERING DESIGN COMMENT # VE-2

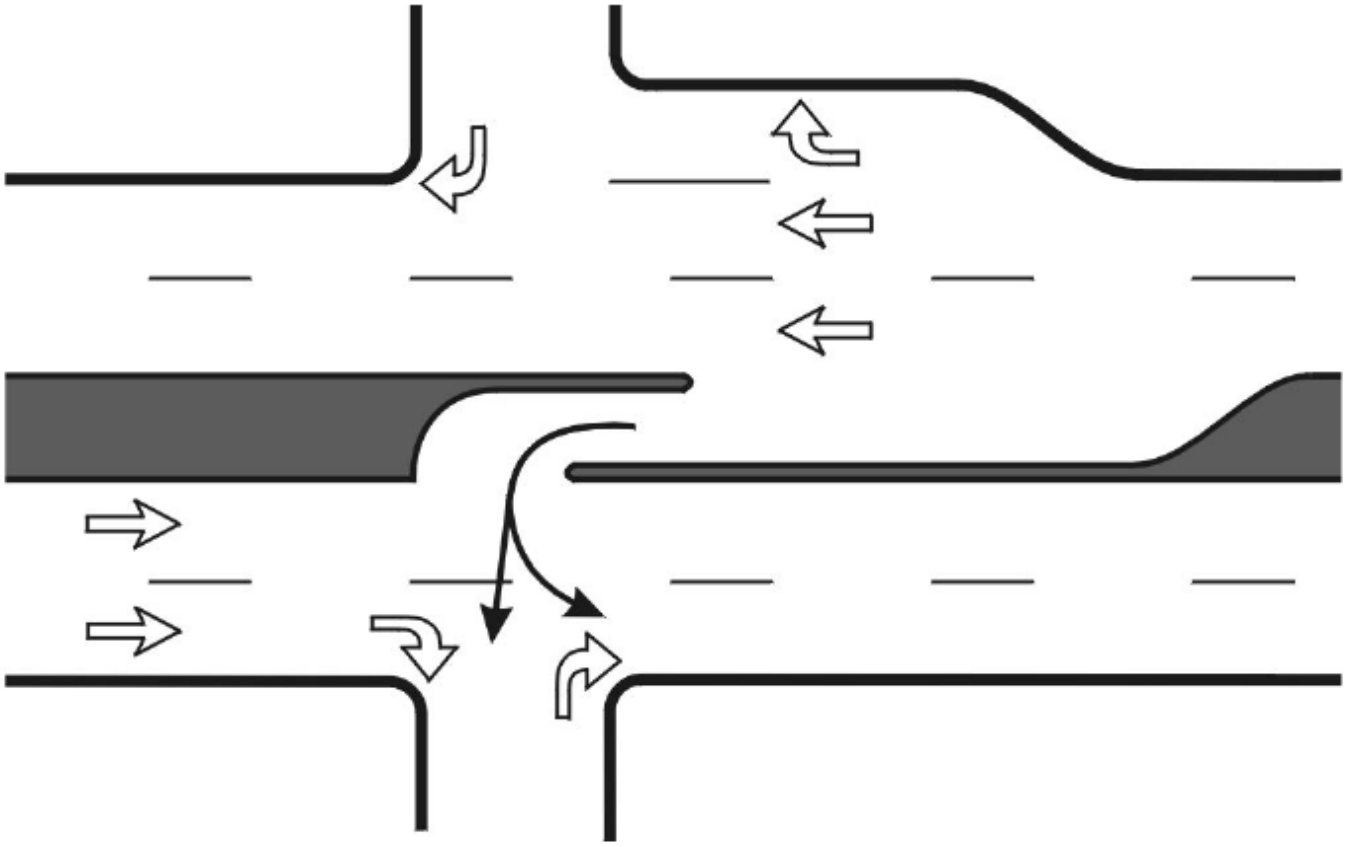
SKETCH OF RECOMMENDED DESIGN



Loon Design for U-turns

VALUE ENGINEERING DESIGN COMMENT # VE-2

SKETCH OF RECOMMENDED DESIGN



Directional Left-turn Median Design

VALUE ENGINEERING RECOMMENDATION # VE-3

DESCRIPTIVE TITLE OF RECOMMENDATION:
Utilize a superstreet intersection in lieu of a standard intersection at US 27 and KY 52.

ORIGINAL DESIGN:
The original design specifies a standard, signalized intersection, with the assumption that a traffic signal will be warranted.

RECOMMENDED CHANGE:
The VE Team recommends re-evaluating the intersection design and constructing a superstreet design.

ADVANTAGES:

- Better traffic operations for mainline US 27
- Potentially better travel times and smaller delays for all movements

DISADVANTAGES:

- New concept for drivers to learn

JUSTIFICATION:
The purpose of the project is to create a more direct north-south transportation corridor and to provide for consistent travel speeds. This can only be done if traffic signals are not installed or minimized. Where they are absolutely necessary, the number of signal phases should be minimized and priority should be given to the mainline. A variation of the superstreet design helps support this function better than a conventional intersection with traffic signal.

There are two alternatives to the superstreet design that should be considered. The first is where all movements from KY 52 and left turns from US 27 are achieved indirectly through accessing a median u-turn past the intersection. The second is where movements from KY 52 are achieved indirectly through accessing a median u-turn past the intersection; left turns are permitted at the intersection. The first would be preferred due to its simplicity and better operation on mainline US 27.

Preliminary analysis using the KTC Intersection Analysis Tool and Synchro shows that a superstreet will work well with a single lane u-turn movement and could even work if the bypass was built with a single lane in each direction. A signal would not need to be implemented at the u-turn location until future volumes warrant it. There is minimal cost changes compared to the original design.

SUMMARY OF COST ANALYSIS			
	First Cost	O & M Costs (Present Worth)	Total LC Cost (Present Worth)
ORIGINAL DESIGN	$0	$0	$0
RECOMMENDED DESIGN	$5,000	$0	$5,000
ESTIMATED SAVINGS OR (COST)	($5,000)	$0	($5,000)

VALUE ENGINEERING RECOMMENDATION # VE-3

SKETCH OF RECOMMENDED DESIGN

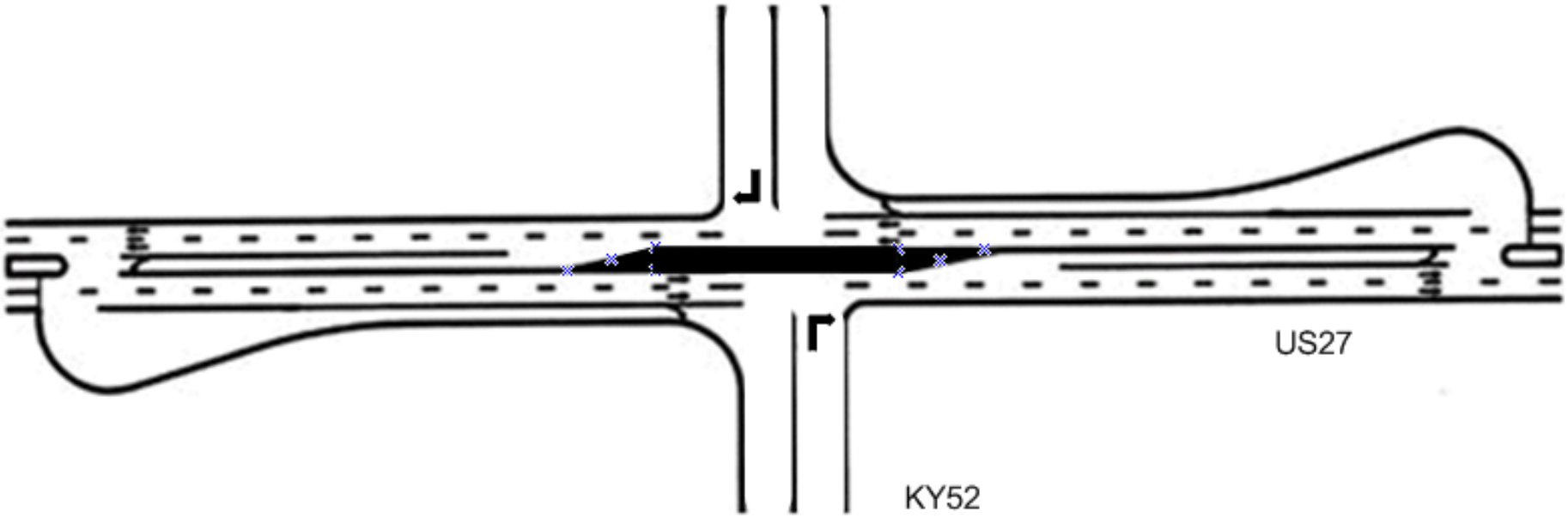


Diagram of Superstreet Concept (Alternative 1)

VALUE ENGINEERING RECOMMENDATION # VE-3

SKETCH OF RECOMMENDED DESIGN

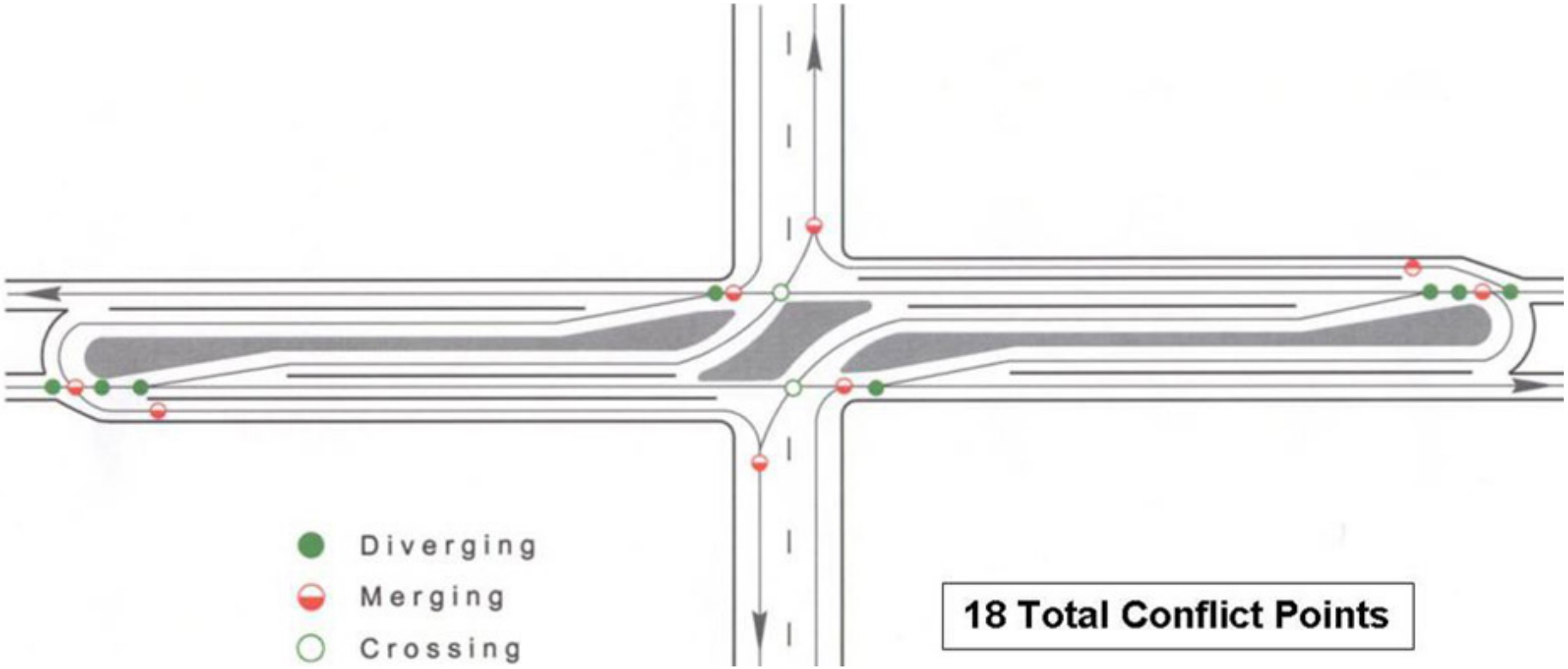


Diagram of Superstreet Concept (Alternative 2)

VALUE ENGINEERING RECOMMENDATION # VE-3

ADDITIONAL INFORMATION

			Leg 1			
		RT	Th	LT		
		155	300	135	KY348	
Leg 4	LT	155			135	RT	Leg 2
	Th	285			285	Th	
	RT	65			140	LT	
Side Street		65	300	140		
		LT	Th	RT		
			Leg 3			

Ped Leg 1	75
Ped Leg 3	75
Ped Leg 2	75
Ped Leg 4	75

INTERSECTION ALTERNATIVE	OPERATION EVALUATION	MINIMUM LANE CONFIGURATION					
		L3	L1	L4	L2	L4 U	L2 U
2-Way Stop Control*	Not Feasible						
4-Way Stop Control	Not Feasible						
Signalized Intersection (1 lanes)	Feasible						
Signalized Intersection (2 lanes)	Not Recommended						
Signalized Intersection (3 lanes)	Not Recommended						
Jughandle A EB (1 Lanes)	Feasible						
Jughandle A EB (2 Lanes)	Not Recommended						
Jughandle A EB (3 Lanes)	Not Recommended						
Jughandle A WB (1 Lanes)	Feasible						
Jughandle A WB (2 Lanes)	Not Recommended						
Jughandle A WB (3 Lanes)	Not Recommended						
Jughandle A EB-WB (1 Lanes)	Feasible						
Jughandle A EB-WB (2 Lanes)	Not Recommended						
Jughandle A EB-WB (3 Lanes)	Not Recommended						
Roundabout	Feasible						
Median U-Turn (Signalized) (1 Lanes)	Feasible						
Median U-Turn (Signalized) (2 Lanes)	Not Recommended						
Median U-Turn (Signalized) (3 Lanes)	Not Recommended						
Median U-Turn (Unsignalized)*	Not Feasible						
Superstreet (Signalized)	Feasible						

Snapshot of KTC Intersection Analysis Tool Results

HCM Signalized Intersection Capacity Analysis
8: 5/9/2012

Movement	EBT	EBR	WBU	WBL	WBT	NBL	NBR
Lane Configurations							
Volume (vph)	590	0	490	0	590	0	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0		4.0		4.0		
Lane Util. Factor	1.00		1.00		1.00		
Frt	1.00		1.00		1.00		
Flt Protected	1.00		0.95		1.00		
Satd. Flow (prot)	1863		1770		1863		
Flt Permitted	1.00		0.95		1.00		
Satd. Flow (perm)	1863		1770		1863		
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	641	0	533	0	641	0	0
RTOR Reduction (vph)	0	0	0	0	0	0	0
Lane Group Flow (vph)	641	0	533	0	641	0	0
Turn Type	NA		Prot		NA		
Protected Phases	4		3		8		
Permitted Phases							
Actuated Green, G (s)	30.4		21.6		60.0		
Effective Green, g (s)	30.4		21.6		60.0		
Actuated g/C Ratio	0.51		0.36		1.00		
Clearance Time (s)	4.0		4.0		4.0		
Vehicle Extension (s)	3.0		3.0		3.0		
Lane Grp Cap (vph)	944		637		1863		
v/s Ratio Prot	c0.34		c0.30		0.34		
v/s Ratio Perm							
v/c Ratio	0.68		0.84		0.34		
Uniform Delay, d1	11.1		17.6		0.0		
Progression Factor	1.00		1.00		1.00		
Incremental Delay, d2	2.0		9.4		0.1		
Delay (s)	13.1		26.9		0.1		
Level of Service	B		C		A		
Approach Delay (s)	13.1				12.3	0.0	
Approach LOS	B				B	A	

Intersection Summary			
HCM Average Control Delay	12.6	HCM Level of Service	B
HCM Volume to Capacity ratio	0.74		
Actuated Cycle Length (s)	60.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	64.9%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

Output from Synchro Analysis of Superstreet Signal (North Side of KY 52)

VALUE ENGINEERING RECOMMENDATION # VE-3

COST ESTIMATE - FIRST COST

Cost Item	Units	$/Unit	Source Code	Original Design		Recommended Design	
				Num of Units	Total $	Num of Units	Total $
Pavement (U-turns)	SY	$45.00	1			100	$4,500
Total					$0		$4,500

SOURCE CODE:
1 Project Cost Estimate
2 KYTC Average Bid
3 CACES Data Base
4 Means Estimating Manual
5 National Construction Estimator
6 Vendor Lit or Quote (list name / details)
7 Professional Experience (List job if applicable)
8 Other Sources (specify)

✓ VE Selected
Scenario #1

VALUE ENGINEERING RECOMMENDATION # VE-4

DESCRIPTIVE TITLE OF RECOMMENDATION:
Utilize a complete street urban section in lieu of the typical section from approximately Sta. 1190+00 to 1265+00.

ORIGINAL DESIGN:
The original design specifies a five lane cross section with wide shoulders.

RECOMMENDED CHANGE:
The VE Team recommends modifying the cross section to accommodate pedestrians and cyclists in addition to the cars and trucks. This would entail changing to an urban cross section including curb and gutter, sidewalks on both sides, bicycle lanes and a raised median. The design can be accommodated, for the most part, within the current, proposed ROW.

ADVANTAGES:
- Better supports the urban context
- Supports non-motorized travel
- Helps control access (vehicular and pedestrian safety) by limiting turning movements and minimizing conflict points
- Fits approximately within planned ROW limits

DISADVANTAGES:
- Higher construction costs for drainage

JUSTIFICATION:
This area of Stanford has grown due to Walmart and other suburban-type of development such as restaurants, shops, and offices. With this growth, more people that cannot drive or choose not to drive will need to travel to get to shopping and employment. This is the type of area where pedestrian and bicycle facilities are warranted and will be needed even more as the area continues to grow. This proposed design will benefit all users including vehicular drivers since there will be far fewer conflict points.

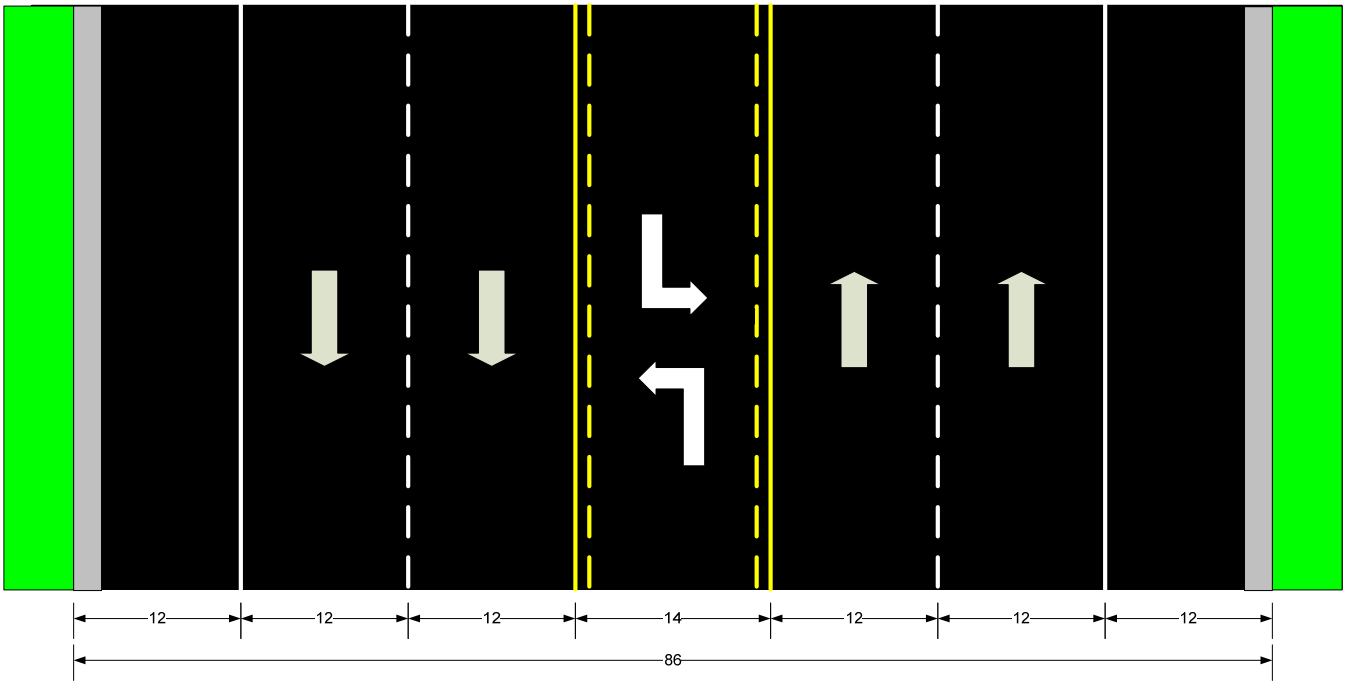
The design team will need to review this section to determine the access requirements that will drive the need for u-turn locations. Because of the narrow corridor width, a loon design or roundabout may be needed to accommodate those u-turns. There are many locations through this area where these could be established.

One other thing for the design team to consider is the construction of sidewalk connections from the mainline sidewalks toward each of the businesses. This will make safer and more attractive walking conditions because pedestrians do not have to cut across grass or walk along the driveways to reach their destinations. The cost estimate of the alternative does not include these sidewalk connections.

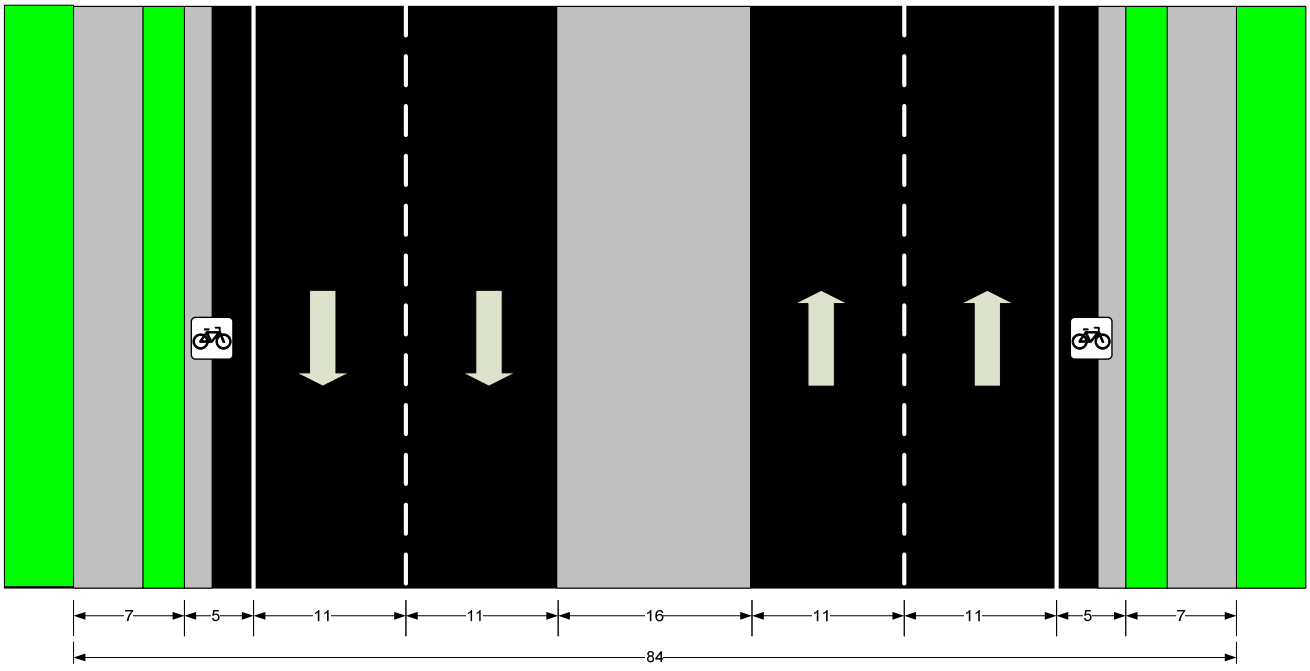
SUMMARY OF COST ANALYSIS			
	First Cost	O & M Costs (Present Worth)	Total LC Cost (Present Worth)
ORIGINAL DESIGN	$1,283,000	$0	$1,283,000
RECOMMENDED DESIGN	$2,078,000	$0	$2,078,000
ESTIMATED SAVINGS OR (COST)	($795,000)	$0	($795,000)

VALUE ENGINEERING RECOMMENDATION # VE-4

SKETCH OF ORIGINAL AND RECOMMENDED DESIGN



Original Design: Two-way Left Turn-lane (TWLTL) with Shoulders



Recommended Design: Complete Street with Raised Median, Bicycle Lanes, and Sidewalks

VALUE ENGINEERING RECOMMENDATION # VE-4

SKETCH OF RECOMMENDED DESIGN

VALUE ENGINEERING RECOMMENDATION # VE-4

COST ESTIMATE - FIRST COST

Cost Item	Units	$/Unit	Source Code	Original Design		Recommended Design	
				Num of Units	Total $	Num of Units	Total $
Sidewalk	LF	$35.00	1			15,000	$525,000
Pavement Mainline	SY	$60.00	1	17,222	$1,033,320	13,889	$833,340
Pavement Shoulders	LF	$45.00	1	5,556	$250,020		
Curb & Gutter	LF	$21.00	1			30,000	$630,000
Curb Box Inlet	EA	$3,000	2			30	$90,000
Total					$1,283,340		$2,078,340

SOURCE CODE:
1 Project Cost Estimate
2 KYTC Average Bid
3 CACES Data Base
4 Means Estimating Manual
5 National Construction Estimator
6 Vendor Lit or Quote (list name / details)
7 Professional Experience (List job if applicable)
8 Other Sources (specify)

✓ VE Selected
Scenario #1

VALUE ENGINEERING RECOMMENDATION # VE-5

DESCRIPTIVE TITLE OF RECOMMENDATION:
Install a shared use path from US 150 Bypass to KY 52.

ORIGINAL DESIGN:
The original design specifies no pedestrian and bicycle facilities.

RECOMMENDED CHANGE:
The VE Team recommends connecting the cities of Lancaster and Stanford to the Logan Hubble Park with a shared use path. The path would follow the west side of the highway, beginning at US 150 to the park. Should the original cross section in the suburban area change to add bike lanes and sidewalks, the shared use path would begin at the north end of that section. The path would follow the east side of the highway alignment north of the Park and end at KY 52, where there may be a signal to allow for residents on the west side to cross US 27. The north section could access the park directly from existing US 27 and then cross under the highway using a wagon box culvert (not included in estimate).

ADVANTAGES:
- Recreational facility
- Transportation facility for peds and cyclists
- Connects residents of each city to the park

DISADVANTAGES:
- Adds additional construction
- May require additional ROW

JUSTIFICATION:
It was made clear by the project team that the Logan Hubble Park is an important resource for the citizens of Lincoln and Garrard Counties. Building a shared use path will allow for a safe, non-motorized access to the park and also provide for the option of transportation for people travelling along the corridor to various land uses along the corridor.

SUMMARY OF COST ANALYSIS			
	First Cost	O & M Costs (Present Worth)	Total LC Cost (Present Worth)
ORIGINAL DESIGN	$0	$0	$0
RECOMMENDED DESIGN	$536,000	$0	$536,000
ESTIMATED SAVINGS OR (COST)	($536,000)	$0	($536,000)

VALUE ENGINEERING RECOMMENDATION # VE-5

PHOTOGRAPH OF RECOMMENDED DESIGN (EXAMPLE)

VALUE ENGINEERING RECOMMENDATION # VE-5

COST ESTIMATE - FIRST COST

Cost Item	Units	$/Unit	Source Code	Original Design		Recommended Design	
				Num of Units	Total $	Num of Units	Total $
Shared use path (10-foot bituminous surface)	Mi	$80,000	8			7	$536,000
Total					$0		$536,000

SOURCE CODE:
1 Project Cost Estimate
2 KYTC Average Bid
3 CACES Data Base
4 Means Estimating Manual
5 National Construction Estimator
6 Vendor Lit or Quote (list name / details)
7 Professional Experience (List job if applicable)
8 Other Sources (specify)

✓ VE Selected
Scenario #2

VALUE ENGINEERING RECOMMENDATION # VE-6

DESCRIPTIVE TITLE OF RECOMMENDATION:
Install a wagon box to connect both sides of the park in lieu of severing park.

ORIGINAL DESIGN:
The original design specifies an alignment and grade for US 27 that will sever an eastern portion of the Logan Hubble Park. The entire Logan Hubble Park, including the proposed eastern portion of land is designated for park use and cannot easily be utilized for other purposes.

RECOMMENDED CHANGE:
The VE Team recommends installing a box culvert structure to carry pedestrian and equestrian traffic to connect the east and west park land. The box culvert could be sized in such a way to make horse passage inviting, and also allow usage by pedestrians. A 14-foot wide opening with an 11-foot rise box culvert section was assumed to provide maximum head clearance for equestrian use as well as to provide an open atmosphere for pedestrian usage. The length of the structure will require lighting.

ADVANTAGES:
- Maintains connectivity to park areas
- Installed during original construction
- Allows for equestrian access as well as future use for other recreational activities
- Adds value to community by providing increased recreational opportunities
- Encourages usage in conjunction with possible share use paths

DISADVANTAGES:
- Requires additional structure
- Additional maintenance
- Tunnel effect

JUSTIFICATION:
The design team expressed that severing this portion of the park was acceptable to the park board. The park land is deeded specifically for park use and therefore will not be used for other purposes. The park is currently utilized mainly for equestrian activity, but also for general recreation and pedestrian use. The VE Team recommends maintaining access to the eastern portion of the park. Installing a structure now as opposed to mobilizing in the future will save money and preserve as much of the park as possible for use by the adjacent residents. Possible future shared use paths leading the Logan Hubble Park would invite increase usage of this valuable community resource. The VE Team feels that to allow for current and future park use, investment in this structure adds value to the community within the project limits. Ownership of the wagon box should be transferred to the owners of the park.

SUMMARY OF COST ANALYSIS			
	First Cost	O & M Costs (Present Worth)	Total LC Cost (Present Worth)
ORIGINAL DESIGN	$0	$0	$0
RECOMMENDED DESIGN	$336,000	$0	$336,000
ESTIMATED SAVINGS OR (COST)	($336,000)	$0	($336,000)

VALUE ENGINEERING RECOMMENDATION # VE-6

PHOTOGRAPHS OF RECOMMENDED DESIGN (EXAMPLES)

VALUE ENGINEERING RECOMMENDATION # VE-6

COST ESTIMATE - FIRST COST

Cost Item	Units	$/Unit	Source Code	Original Design		Recommended Design	
				Num of Units	Total $	Num of Units	Total $
3 Sided Box Culvert	SF	$120.00	7			2,800	$336,000
Total					$0		$336,000

SOURCE CODE:
1 Project Cost Estimate
2 KYTC Average Bid
3 CACES Data Base
4 Means Estimating Manual
5 National Construction Estimator
6 Vendor Lit or Quote (list name / details)
7 Professional Experience (List job if applicable)
8 Other Sources (specify)

✓ VE Selected
Scenario #2

VALUE ENGINEERING RECOMMENDATION # VE-7

DESCRIPTIVE TITLE OF RECOMMENDATION:
Utilize cap and column piers in lieu of hammerhead piers.

ORIGINAL DESIGN:
The original design specifies the use of hammerhead piers. The height of the piers are 46-foot-6-inch with a thickness of 5-foot-0-inch, a stem width of 25-foot-0-inch, and a hammerhead shape cap with a height of 10-foot-0-inch. Due to the skew of the structure the overall pier cap width is shown as 50-foot-0-inch. The original piers are shown founded on spread footers due to the assumed shallow rock depth.

RECOMMENDED CHANGE:
The VE Team recommends use of cap and column pier shape in lieu of the hammerhead pier. The cap and column configuration would consist of 3 columns on individual spread footings. The assumed cap and column configuration would utilize 4-foot diameter columns, a 50-foot-0-inch wide cap with 5-foot-0-inch height, and assumed spread footings of 12-foot x 12-foot x 5-foot dimensions.

ADVANTAGES:
- Minimize concrete quantity
- Minimize reinforcement
- Placement of reinforcement is simplified
- Formwork for columns is simplified

DISADVANTAGES:
- More flexible
- Individual footers
- More susceptible to debris build up during a flood event

JUSTIFICATION:
Utilizing a substructure of this type will save on material costs and will be easier to form than a hammerhead pier. The piers are not located within the river normal flow line, therefore debris collection on this pier type should not be a concern. Also, as the piers are located outside of the normal flow, spread footings on rock are acceptable as scour should not be a concern. The recommended change will have equal function and utility as the original design. Hammerhead piers of similar height have been valued engineered to cap and columns by the contractor during construction.

SUMMARY OF COST ANALYSIS			
	First Cost	O & M Costs (Present Worth)	Total LC Cost (Present Worth)
ORIGINAL DESIGN	$1,237,000	$0	$1,237,000
RECOMMENDED DESIGN	$624,000	$0	$624,000
ESTIMATED SAVINGS OR (COST)	$613,000	$0	$613,000

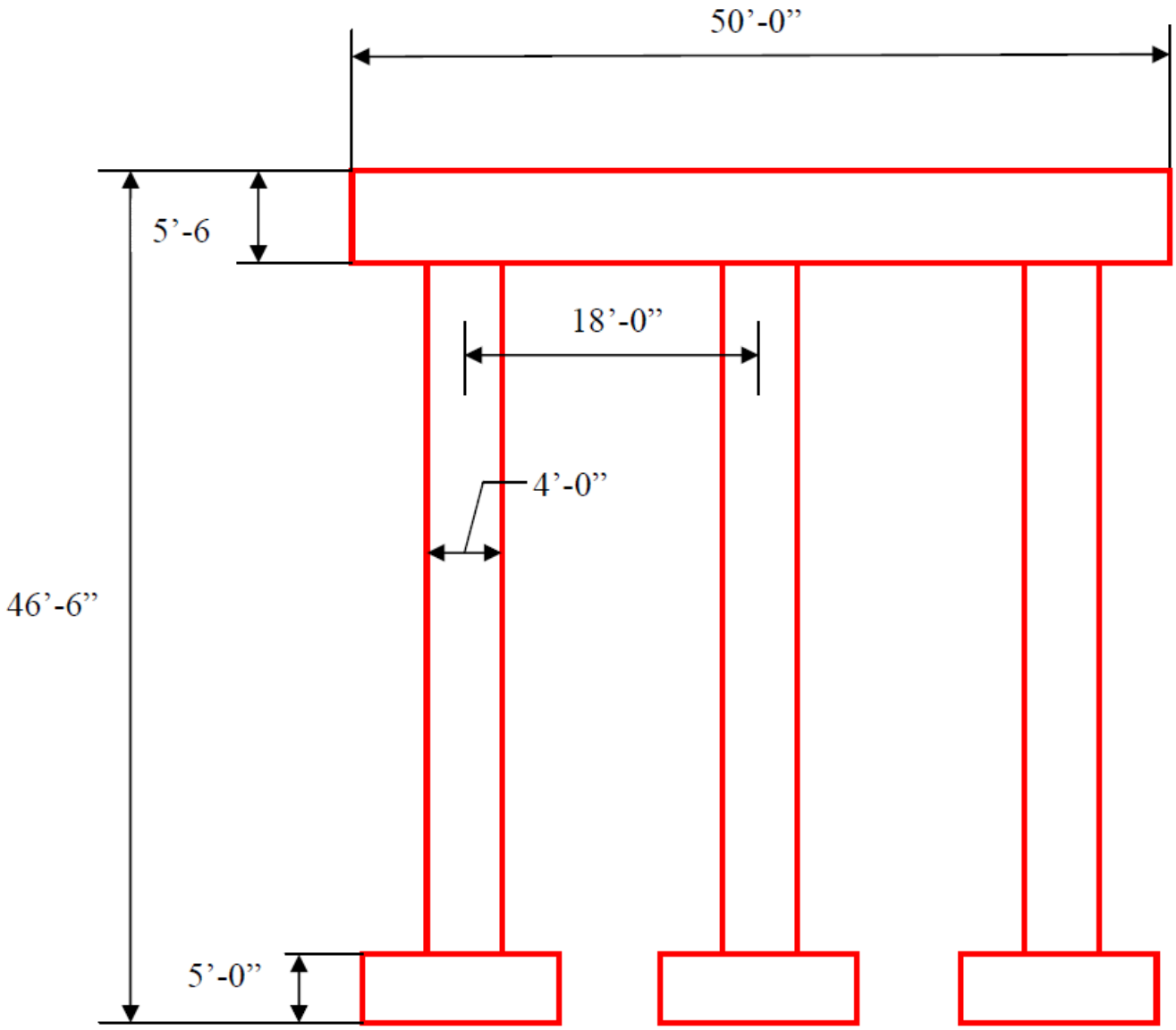
VALUE ENGINEERING RECOMMENDATION # VE-7

PHOTOGRAPH OF ORIGINAL DESIGN (EXAMPLE)

Photograph of Hammerhead Bridge Piers

VALUE ENGINEERING RECOMMENDATION # VE-7

SKETCH OF RECOMMENDED DESIGN



Cap and Column Pier

VALUE ENGINEERING RECOMMENDATION # VE-7

PHOTOGRAPH OF RECOMMENDED DESIGN (EXAMPLE)

Photograph of Conventional Cap and Column Bridge Piers

VALUE ENGINEERING RECOMMENDATION # VE-7

COST ESTIMATE - FIRST COST

Cost Item	Units	$/Unit	Source Code	Original Design		Recommended Design	
				Num of Units	Total $	Num of Units	Total $
Concrete Class A	CY	$414	2	2,112	$874,368	1,066	$441,324
Reinforcement	LBS	$0.98	2	369,600	$362,208	186,550	$182,819
Total					$1,236,576		$624,143

SOURCE CODE: 1 Project Cost Estimate
2 KYTC Average Bid
3 CACES Data Base
4 Means Estimating Manual
5 National Construction Estimator
6 Vendor Lit or Quote (list name / details)
7 Professional Experience (List job if applicable)
8 Other Sources (specify)

✓ VE Selected
Scenario #2

VALUE ENGINEERING RECOMMENDATION # VE-8

DESCRIPTIVE TITLE OF RECOMMENDATION:
Reduce span length of the new Dix River crossing by eliminating access to Rankin Road.

ORIGINAL DESIGN:
The original design utilizes a crossing at the Dix River that requires spanning Rankin Road. This is in contrast to the existing crossing to the east that only requires spanning the Dix River. The existing span is approximately 200 feet. Rankin Road is a rural route with limited/few access points and residents. The original design total span length is approximately 705 feet.

RECOMMENDED CHANGE:
The VE Team recommends eliminating the span over Rankin Road. Eliminating this span would split Rankin Road into a west and an east section. The fill area under the bridge would have little direct effect to the properties in the area. Access to US 27 is maintained by an existing connection to the West. The recommended change would result in a total span length of approximately 560 feet.

ADVANTAGES:
- Reduce total span length
- Reduce number of piers
- Eliminates pier placement in steep existing slopes
- Reduce bridge deck to maintain

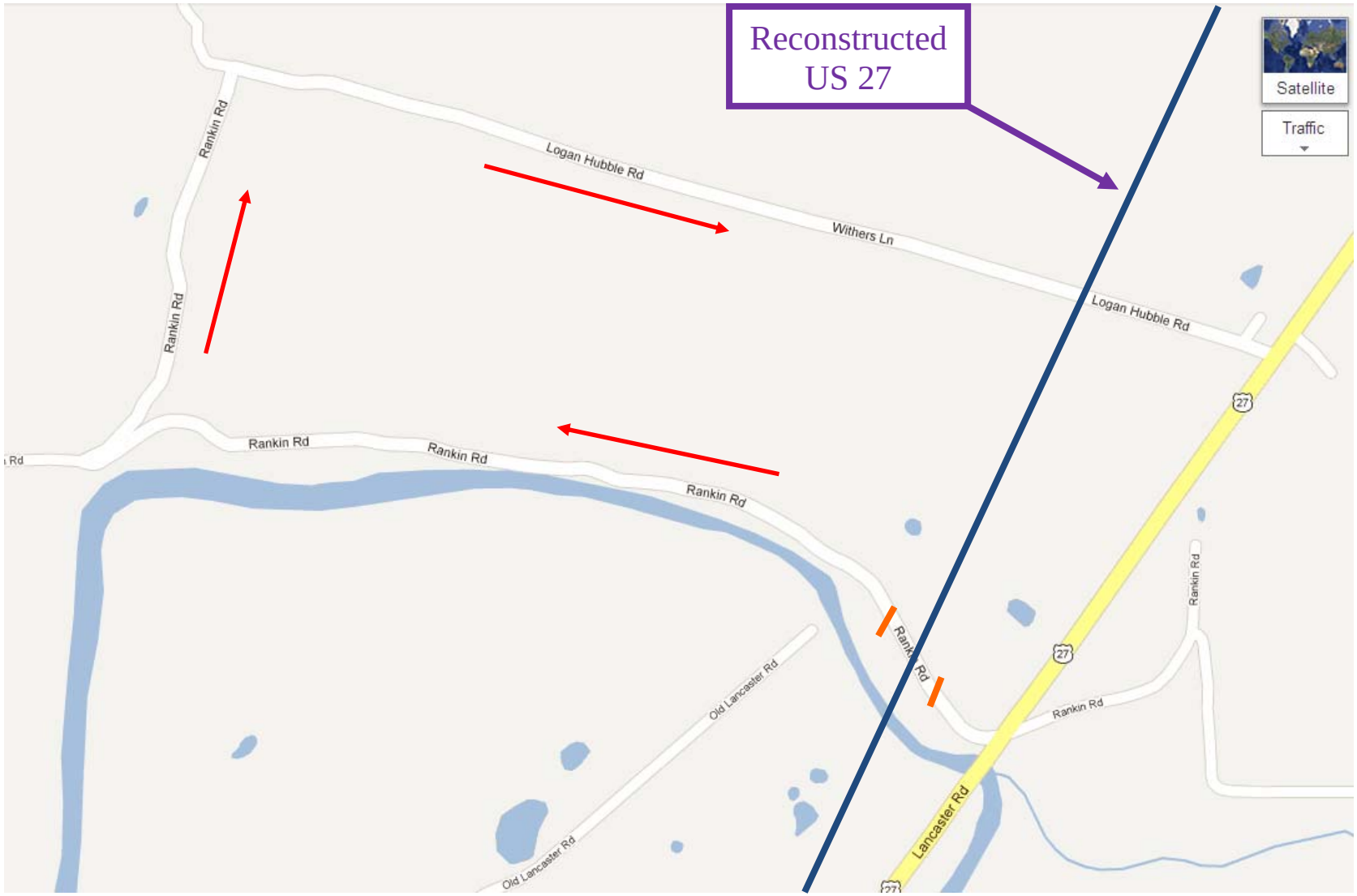
DISADVANTAGES:
- Cuts off Rankin Road direct access
- Forward abutment on fill, requires piles
- Possible impacts on hydraulics

JUSTIFICATION:
Rankin Road is a relatively undeveloped road with a low need for through movements. Applying this recommendation would reduce the total structure length by 16%. The pier construction in the steep slope could be replaced by a mechanically stabilized earth (MSE) or cast in place retaining walls. This may have some impact on the hydraulics depending on the stream flow and floodplain in the Dix River. Access to properties to the West of the proposed US 27 alignment is maintained due to the Rankin Road connection to Wilbers Lane/Logan Hubble Road.

SUMMARY OF COST ANALYSIS			
	First Cost	O & M Costs (Present Worth)	Total LC Cost (Present Worth)
ORIGINAL DESIGN	$5,300,000	$0	$5,300,000
RECOMMENDED DESIGN	$4,815,000	$0	$4,815,000
ESTIMATED SAVINGS OR (COST)	$485,000	$0	$485,000

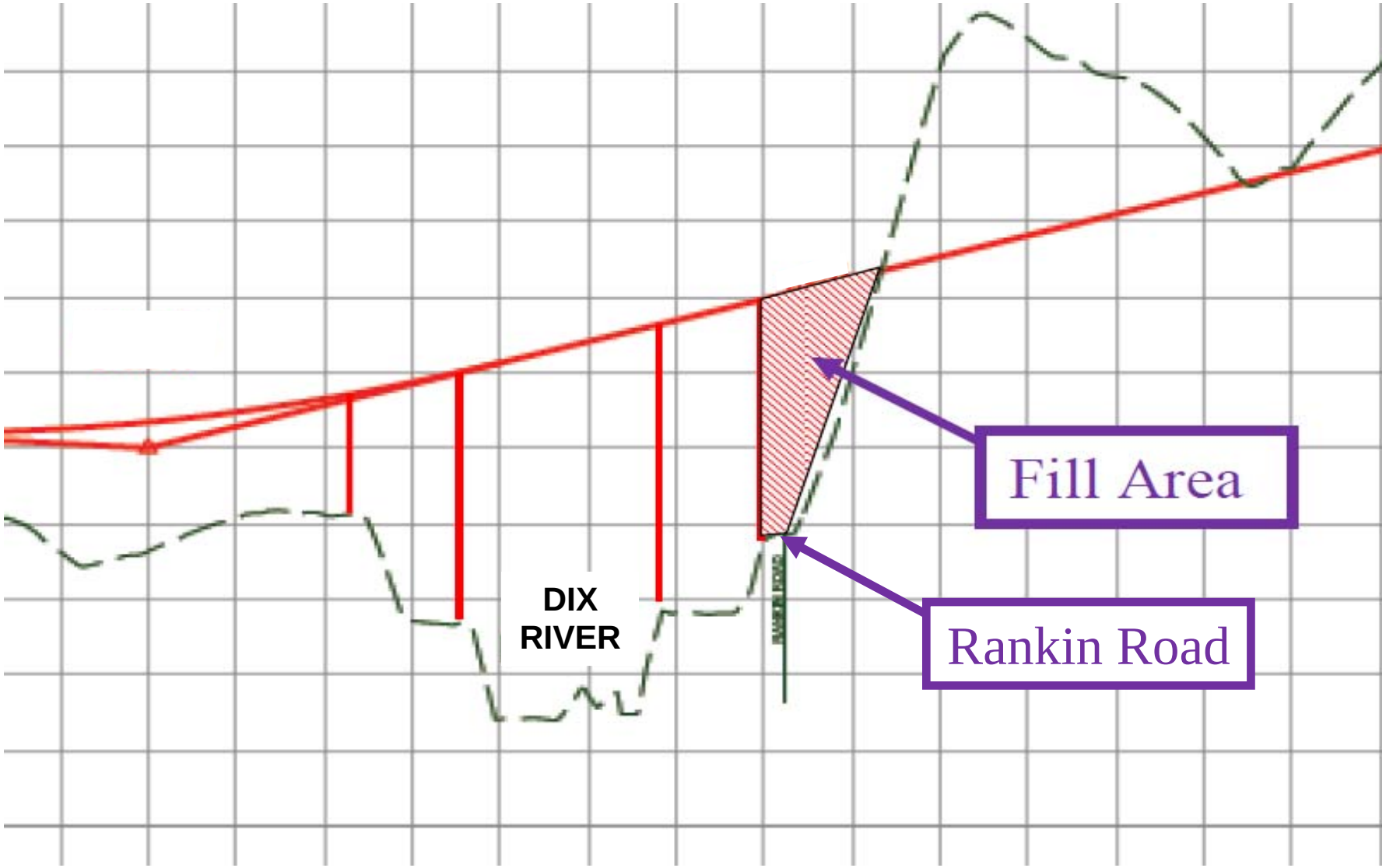
VALUE ENGINEERING RECOMMENDATION # VE-8

SKETCH OF RECOMMENDED DESIGN



VALUE ENGINEERING RECOMMENDATION # VE-8

SKETCH OF RECOMMENDED DESIGN



VALUE ENGINEERING RECOMMENDATION # VE-8

COST ESTIMATE - FIRST COST

Cost Item	Units	$/Unit	Source Code	Original Design		Recommended Design	
				Num of Units	Total $	Num of Units	Total $
Bridge	SF	$91.68	1	57,810	$5,300,021	45,920	$4,209,946
MSE Wall	SF	$55.00	7			11,000	$605,000
Total					$5,300,021		$4,814,946

SOURCE CODE:
1 Project Cost Estimate
2 KYTC Average Bid
3 CACES Data Base
4 Means Estimating Manual
5 National Construction Estimator
6 Vendor Lit or Quote (list name / details)
7 Professional Experience (List job if applicable)
8 Other Sources (specify)

VALUE ENGINEERING RECOMMENDATION # VE-9

DESCRIPTIVE TITLE OF RECOMMENDATION:
Shift the Dix River crossing to the east of existing alignment to provide a shorter, 90-degree structure in lieu of a skewed structure.

ORIGINAL DESIGN:
The original design specifies a skewed bridge crossing the Dix River. The skew, combined with the wide river width and Rankin Road crossing, necessitates a long structure.

RECOMMENDED CHANGE:
The VE Team recommends crossing the Dix River to the east, at 90 degrees with the river centerline. Also, there is not a road that needs to be crossed at this location.

ADVANTAGES:
- Shorten construction duration
- Fewer spans
- Reduce bridge materials

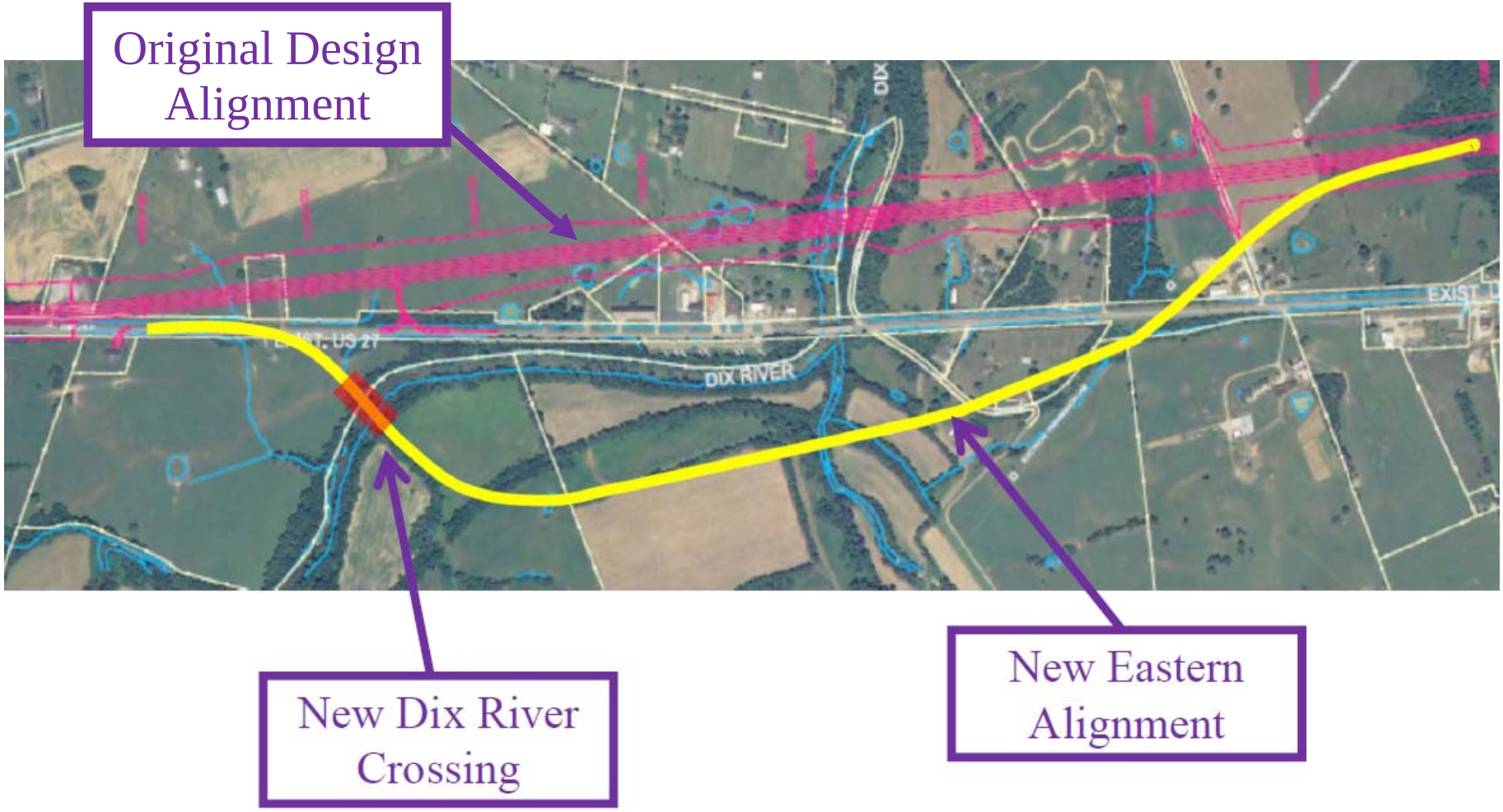
DISADVANTAGES:
- Potential increase to ROW
- At least two relocations
- Another box culvert

JUSTIFICATION:
The VE Team recommended bridge is approximately 38% of the cost of the original design. The necessity to cross Rankin Road makes the current proposed bridge 4 spans; while the VE Team river crossing location only needs a 3 span bridge.

SUMMARY OF COST ANALYSIS			
	First Cost	O & M Costs (Present Worth)	Total LC Cost (Present Worth)
ORIGINAL DESIGN	$19,340,000	$0	$19,340,000
RECOMMENDED DESIGN	$17,020,000	$0	$17,020,000
ESTIMATED SAVINGS OR (COST)	$2,320,000	$0	$2,320,000

VALUE ENGINEERING RECOMMENDATION # VE-9

SKETCH OF RECOMMENDED DESIGN



VALUE ENGINEERING RECOMMENDATION # VE-9

COST ESTIMATE - FIRST COST

Cost Item	Units	$/Unit	Source Code	Original Design		Recommended Design	
				Num of Units	Total $	Num of Units	Total $
Roadway Construction	Mi	$7,800,000	1	1.8	$14,040,000	1.9	$14,820,000
Dix River crossing	EA	$5,300,000	1	1	$5,300,000		
Shorter Dix River crossing	EA	$2,000,000	1			1	$2,000,000
Culvert on new alignment	EA	$200,000	1			1	$200,000
Total					$19,340,000		$17,020,000

SOURCE CODE: 1 Project Cost Estimate
2 KYTC Average Bid
3 CACES Data Base
4 Means Estimating Manual
5 National Construction Estimator
6 Vendor Lit or Quote (list name / details)
7 Professional Experience (List job if applicable)
8 Other Sources (specify)

✓ VE Selected
Scenario #1

VALUE ENGINEERING RECOMMENDATION # VE-10

DESCRIPTIVE TITLE OF RECOMMENDATION:
Stay on existing US 27 alignment and utilize a widened Dix River structure in lieu of a new structure on new alignment from Sta. 1300+00 to 1450+00.

ORIGINAL DESIGN:
The original design specifies a new bridge and new four-lane roadway alignment with depressed grass median between the referenced stations.

RECOMMENDED CHANGE:
The VE Team recommends the existing alignment be used to widen the existing roadway and bridge to a three lane rural typical section between the referenced stations. Only two areas would need access by permit: Logantown and the Gilbert's Creek Road vicinity. Access management techniques could be used to achieve 600 feet entrance spacing in most of the other areas; a few frontage roads may have to be built. This would allow partial control of access. In most places, widening could be done on the west side with little impact. The bridge would be totally re-decked, with three additional beams added to the width.

ADVANTAGES:
- Less environmental impact
- Less mileage to maintain
- Use existing bridge substructure
- Use existing roadway and existing ROW

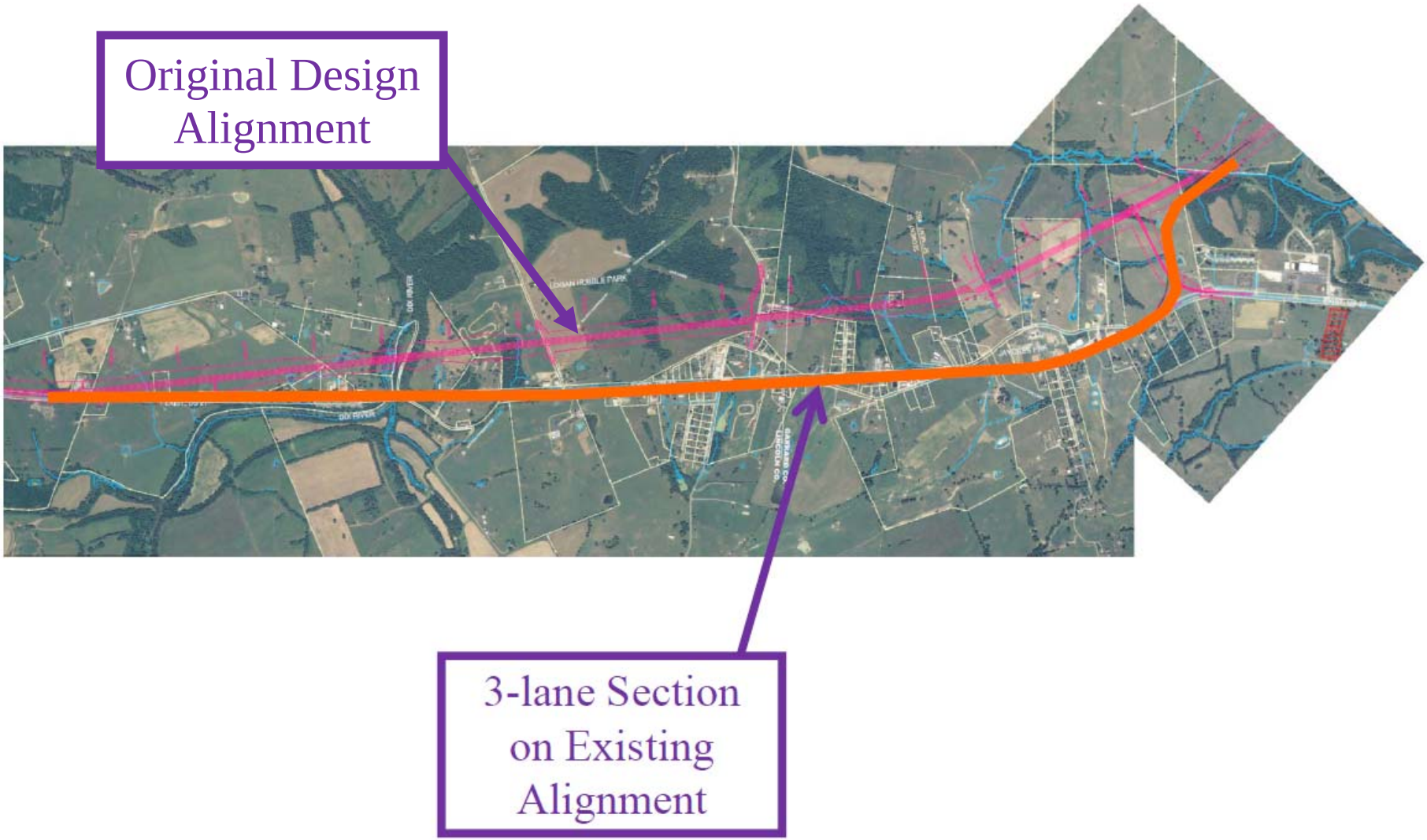
DISADVANTAGES:
- Access by permit in some places – more entrances
- Greater impact to existing property owners
- Potential Utility costs – in construction time and money

JUSTIFICATION:
The proposed design takes several acres of ROW, requires a new Dix River crossing, and miles of new roadway. The VE Team recommends using the existing roadway, ROW, and bridge substructure. This will result in substantial cost savings. We assume the cost of utilities to be comparable between the alternatives. Utilities on existing US 27 could possibly be moved for the $5,000,000 that is included in the original design estimate.

SUMMARY OF COST ANALYSIS			
	First Cost	O & M Costs (Present Worth)	Total LC Cost (Present Worth)
ORIGINAL DESIGN	$37,700,000	$563,000	$38,263,000
RECOMMENDED DESIGN	$7,416,000	$727,000	$8,143,000
ESTIMATED SAVINGS OR (COST)	$30,284,000	($164,000)	$30,120,000

VALUE ENGINEERING RECOMMENDATION # VE-10

SKETCH OF RECOMMENDED DESIGN



VALUE ENGINEERING RECOMMENDATION # VE-10

CALCULATIONS

Calculations to widen US 27 to 3 lanes:

4.5 miles long, 14-foot wide lane width: 4.5 miles = 24,000 feet

24,000 x 14 = 336,000 SF = 37,000 SY

Assume 4-foot shoulders, use one half of engineer's estimate for pavement approaches and shoulders: 40,000 SY.

Assume pavement overlay cost of $15.00/SY

VALUE ENGINEERING RECOMMENDATION # VE-10

COST ESTIMATE - FIRST COST

Cost Item	Units	$/Unit	Source Code	Original Design		Recommended Design	
				Num of Units	Total $	Num of Units	Total $
New Dix River crossing	LS	$5,300,000	1	1	$5,300,000		
ROW	LS	$17,000,000	1	1	$17,000,000		
Excavation	CY	$3.75	1	1,070,000	$4,012,500	100,000	$375,000
Mainline Paving	SY	$60.00	1	129,480	$7,768,800	37,000	$2,220,000
Shoulder Paving	SY	$45.00	1	80,415	$3,618,675	40,000	$1,800,000
Asphalt Surface for Pavement Overlay	TON	$67.71	7			7,000	$473,970
Additional Access Management	LS	$1,000,000	7			1	$1,000,000
Concrete - Class AA	CY	$508.00	2			341	$173,228
Steel Reinforcement - Epoxy Coated	LB	$1.00	2			93,775	$93,775
Structural Steel	LB	$2.50	7			367,500	$918,750
Concrete - Class A	CY	$414.53	2			211	$87,466
Steel Reinforcement	LB	$0.98	2			36,906	$36,168
Piles - Steel HP12x53	LF	$46.88	2			320	$15,002
Cyclopean Rip Rap	TON	$27.81	2			300	$8,343
Bridge Barrier	LF	$30.00	2,7			490	$14,700
Contingency of 15%	LS	$200,000	7			1	$200,000
Total					$37,699,975		$7,416,402

SOURCE CODE: 1 Project Cost Estimate
2 KYTC Average Bid
3 CACES Data Base
4 Means Estimating Manual
5 National Construction Estimator
6 Vendor Lit or Quote (list name / details)
7 Professional Experience (List job if applicable)
8 Other Sources (specify)

VALUE ENGINEERING RECOMMENDATION # VE-10

COST ESTIMATE - O & M (LIFE CYCLE) COST

PRESENT WORTH METHOD
LIFE CYCLE PERIOD (YEARS) = 50
ANNUAL PERCENTAGE RATE = 4.0%

O&M Costs. Single Expenditure	In the Yr	PW Factor	Original Design		Proposed Design	
			Est $	PW $	Est $	PW $
Paint Bridge	25	0.3751			$1,000,000	$375,117
Re-deck both, Paint old	50	0.1407	$4,000,000	$562,850	$2,500,000	$351,782
Subtotal Single Life Cycle O&M Costs				$562,850		$726,899
O&M Costs. Annual Continuous Costs	For How Many Yrs	PW Factor	Original Design		Proposed Design	
			Est $	PW $	Est $	PW $
Subtotal Annual Life Cycle Costs				$0		$0
Total Life Cycle O&M Costs				$563,000		$727,000

VALUE ENGINEERING RECOMMENDATION # VE-11

DESCRIPTIVE TITLE OF RECOMMENDATION:
Utilize a 5-lane urban section on the existing alignment from the US 150 Bypass through Dix River structure and tie-in to the baseline alternative at Sta. 1300+00 in lieu of a 4-lane grass median section.

ORIGINAL DESIGN:
The original design specifies a four lane depressed grass median on new alignment, using new ROW.

RECOMMENDED CHANGE:
The VE Team recommends the existing alignment be used to widen the existing roadway and bridge to a five lane urban typical section between the referenced locations. Only the Logantown area would need access by permit. Access management techniques could be used to achieve 600-foot spacing in most of the other areas; a few frontage roads may have to be built. This would allow partial control of access. In most places, widening could be done on the west side with little impact.

ADVANTAGES:
- Less environmental impact
- Less mileage to maintain
- Use existing bridge substructure
- Use existing roadway and existing ROW

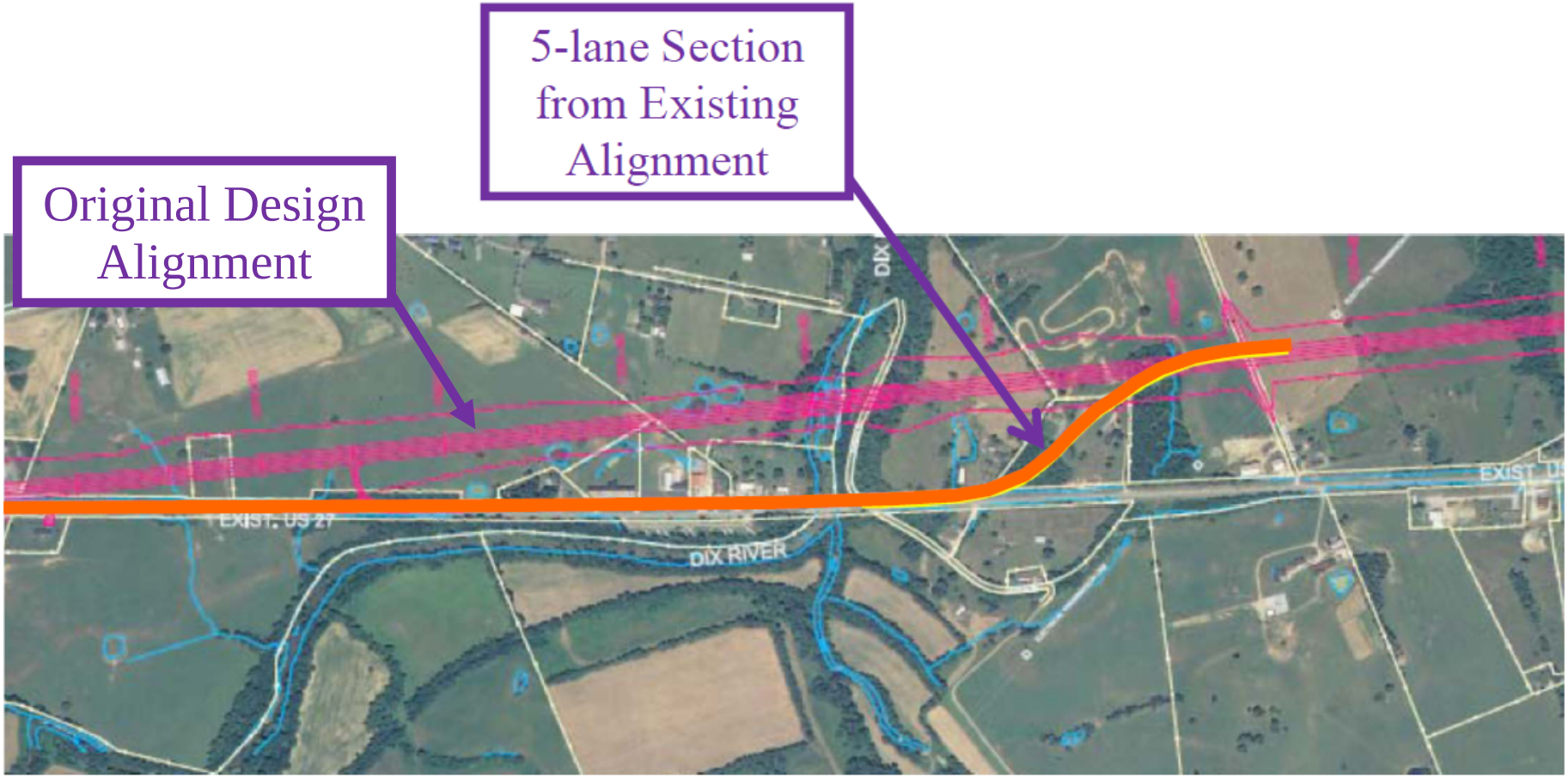
DISADVANTAGES:
- Access by permit in Logantown – more entrances
- Greater impact to existing property owners
- Potential Utility costs – in construction time and money

JUSTIFICATION:
The proposed design takes several acres of ROW, requires a new Dix River crossing, and thousands of feet of new roadway. The VE Team recommends using the existing roadway, ROW, and bridge substructure. This will result in substantial cost savings. We assume the cost of utilities to be comparable between the two alternates. The VE Team also assumes the paving quantities between the two alternates are comparable.

SUMMARY OF COST ANALYSIS			
	First Cost	O & M Costs (Present Worth)	Total LC Cost (Present Worth)
ORIGINAL DESIGN	$26,313,000	$563,000	$26,876,000
RECOMMENDED DESIGN	$21,475,000	$727,000	$22,202,000
ESTIMATED SAVINGS OR (COST)	$4,838,000	($164,000)	$4,674,000

VALUE ENGINEERING RECOMMENDATION # VE-11

SKETCH OF RECOMMENDED DESIGN



VALUE ENGINEERING RECOMMENDATION # VE-11

COST ESTIMATE - FIRST COST

Cost Item	Units	$/Unit	Source Code	Original Design		Recommended Design	
				Num of Units	Total $	Num of Units	Total $
New Dix River crossing	LS	$5,300,000	1	1	$5,300,000		
ROW	LS	$17,000,000	1	1	$17,000,000	0.8	$13,600,000
Excavation	CY	$3.75	1	1,070,000	$4,012,500	800,000	$3,000,000
Additional Access Management	LS	$1,000,000	7			1	$1,000,000
Curb and Gutter	LF	$21.00	1			32,000	$672,000
Storm Sewer with inlets	Mi	$315,000	1			3.2	$1,008,000
Concrete - Class AA	CY	$508.00	2			457	$232,156
Steel Reinforcement - Epoxy Coated	LB	$1.00	2			125,675	$125,675
Structural Steel	LB	$2.50	7			490,000	$1,225,000
Concrete - Class A	CY	$414.53	2			338	$140,111
Steel Reinforcement	LB	$0.98	2			59,150	$57,967
Piles - Steel HP12x53	LF	$46.88	2			480	$22,502
Cyclopean Rip Rap	TON	$27.81	2			400	$11,124
Bridge Barrier	LF	$30.00	2,7			490	$14,700
Contingency of 20%	LS	$365,850	7			1	$365,850
Total					$26,312,500		$21,475,085

SOURCE CODE:
1 Project Cost Estimate
2 KYTC Average Bid
3 CACES Data Base
4 Means Estimating Manual
5 National Construction Estimator
6 Vendor Lit or Quote (list name / details)
7 Professional Experience (List job if applicable)
8 Other Sources (specify)

VALUE ENGINEERING RECOMMENDATION # VE-11

COST ESTIMATE - O & M (LIFE CYCLE) COST

PRESENT WORTH METHOD
LIFE CYCLE PERIOD (YEARS) = 50
ANNUAL PERCENTAGE RATE = 4.0%

O&M Costs. Single Expenditure	In the Yr	PW Factor	Original Design		Proposed Design	
			Est $	PW $	Est $	PW $
Paint Bridge	25	0.3751			$1,000,000	$375,117
Re-deck both, Paint old	50	0.1407	$4,000,000	$562,850	$2,500,000	$351,782
Subtotal Single Life Cycle O&M Costs				$562,850		$726,899
O&M Costs. Annual Continuous Costs	For How Many Yrs	PW Factor	Original Design		Proposed Design	
			Est $	PW $	Est $	PW $
Subtotal Annual Life Cycle Costs				$0		$0
Total Life Cycle O&M Costs				$563,000		$727,000

✓ VE Selected
Scenario #2

VALUE ENGINEERING RECOMMENDATION # VE-12

DESCRIPTIVE TITLE OF RECOMMENDATION:
Adjust the grades and profiles to reduce the earthwork required.

ORIGINAL DESIGN:
The original design specifies a few long vertical curves.

RECOMMENDED CHANGE:
The VE Team recommends more vertical curves that more closely follow the topography. The VE Team wants to reduce both the amount of excavation and the amount of embankment in place.

ADVANTAGES:

- Reduces removing/installing of material
- Less impact to the environment because less material is being moved around

DISADVANTAGES:

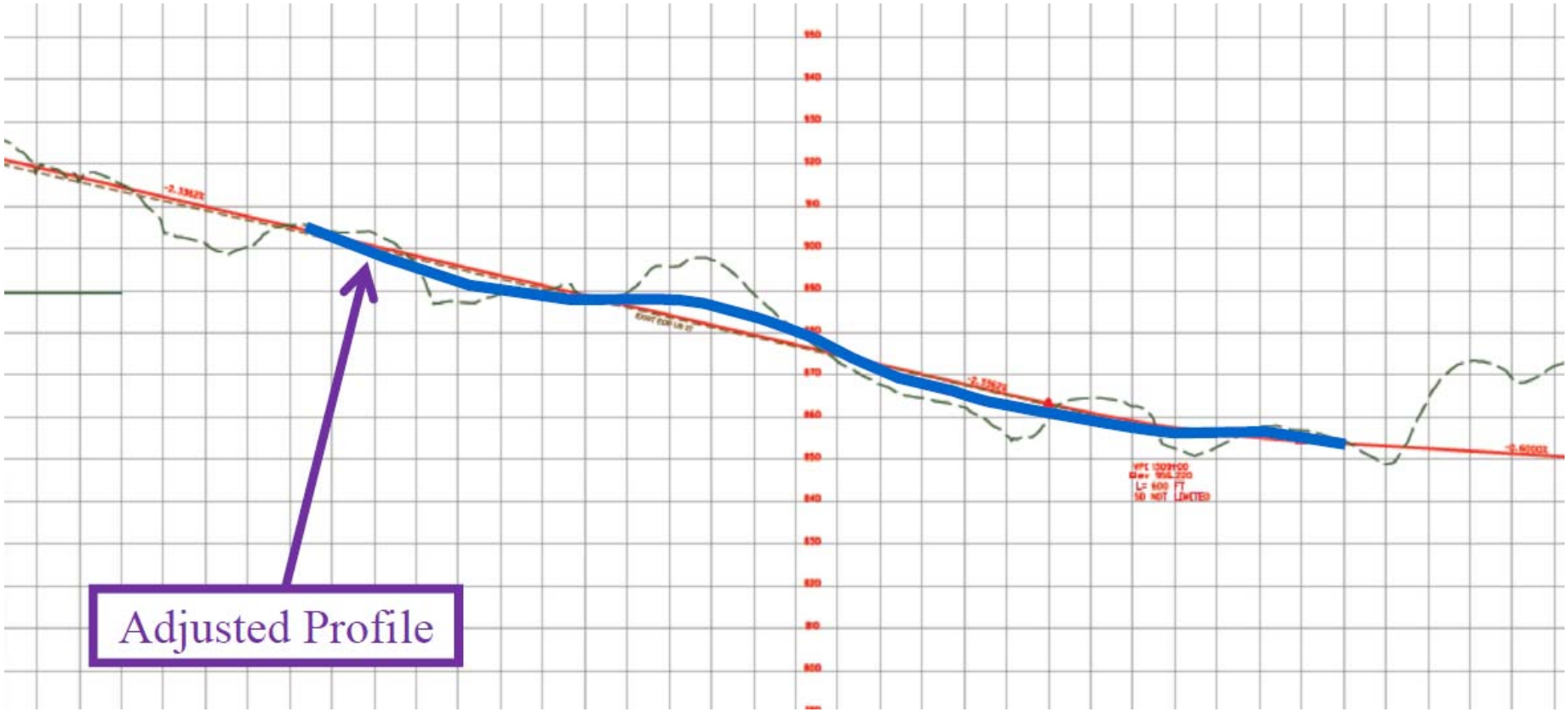
- More vertical curves will add a very minimal amount of length to the project

JUSTIFICATION:
The opportunity for the installation of additional vertical curves could possibly reduce both excavation and embankment in place, thereby reducing costs. The cost estimate was developed assuming a maximum grade of 5%.

SUMMARY OF COST ANALYSIS			
	First Cost	O & M Costs (Present Worth)	Total LC Cost (Present Worth)
ORIGINAL DESIGN	$22,013,000	$0	$22,013,000
RECOMMENDED DESIGN	$19,920,000	$0	$19,920,000
ESTIMATED SAVINGS OR (COST)	$2,093,000	$0	$2,093,000

VALUE ENGINEERING RECOMMENDATION # VE-12

SKETCH OF RECOMMENDED DESIGN



VALUE ENGINEERING RECOMMENDATION # VE-12

CALCULATIONS

There are about 95 vertical topography points on the project. The recommended alternate has about 34 vertical curves. This suggests that an opportunity may exist for additional vertical curves. The VE Team assumes 9 vertical curves can be added to the project. The VE Team also assumes that 36,000 CY of excavation can be saved per additional curve, and 14,000 CY of embankment can be saved per vertical curve. Therefore:

9 curves * 36,000 CY/curve = 324,000 CY excavation

9 curves * 14,000 CY/curve = 126,000 CY embankment-in-place

VALUE ENGINEERING RECOMMENDATION # VE-12

COST ESTIMATE - FIRST COST

Cost Item	Units	$/Unit	Source Code	Original Design		Recommended Design	
				Num of Units	Total $	Num of Units	Total $
Embankment-In-Place	CY	$5.00	1	3,600,000	$18,000,000	3,276,000	$16,380,000
Excavation	CY	$3.75	1	1,070,000	$4,012,500	944,000	$3,540,000
Total					$22,012,500		$19,920,000

SOURCE CODE:
1 Project Cost Estimate
2 KYTC Average Bid
3 CACES Data Base
4 Means Estimating Manual
5 National Construction Estimator
6 Vendor Lit or Quote (list name / details)
7 Professional Experience (List job if applicable)
8 Other Sources (specify)

✓ VE Selected
Scenario #2

VALUE ENGINEERING RECOMMENDATION # VE-13

DESCRIPTIVE TITLE OF RECOMMENDATION:
Utilize existing road alignment from Sta. 1700+00 to Sta. 1760+00 in lieu of new alignment.

ORIGINAL DESIGN:
The original US 27 design applies a rural 4-lane typical section with a 40-foot depressed grass median. The rural section between Sta. 1700+00 and Sta. 1760+00 is aligned several hundred feet parallel to the current US 27 alignment.

RECOMMENDED CHANGE:
The VE Team recommends remaining on existing US 27 alignment from Sta. 1700+00 to Sta. 1760+00. The new 4-lane rural section has less impact utilizing a portion of the existing corridor.

ADVANTAGES:
- Reduce ROW
- Reduce amount of pavement

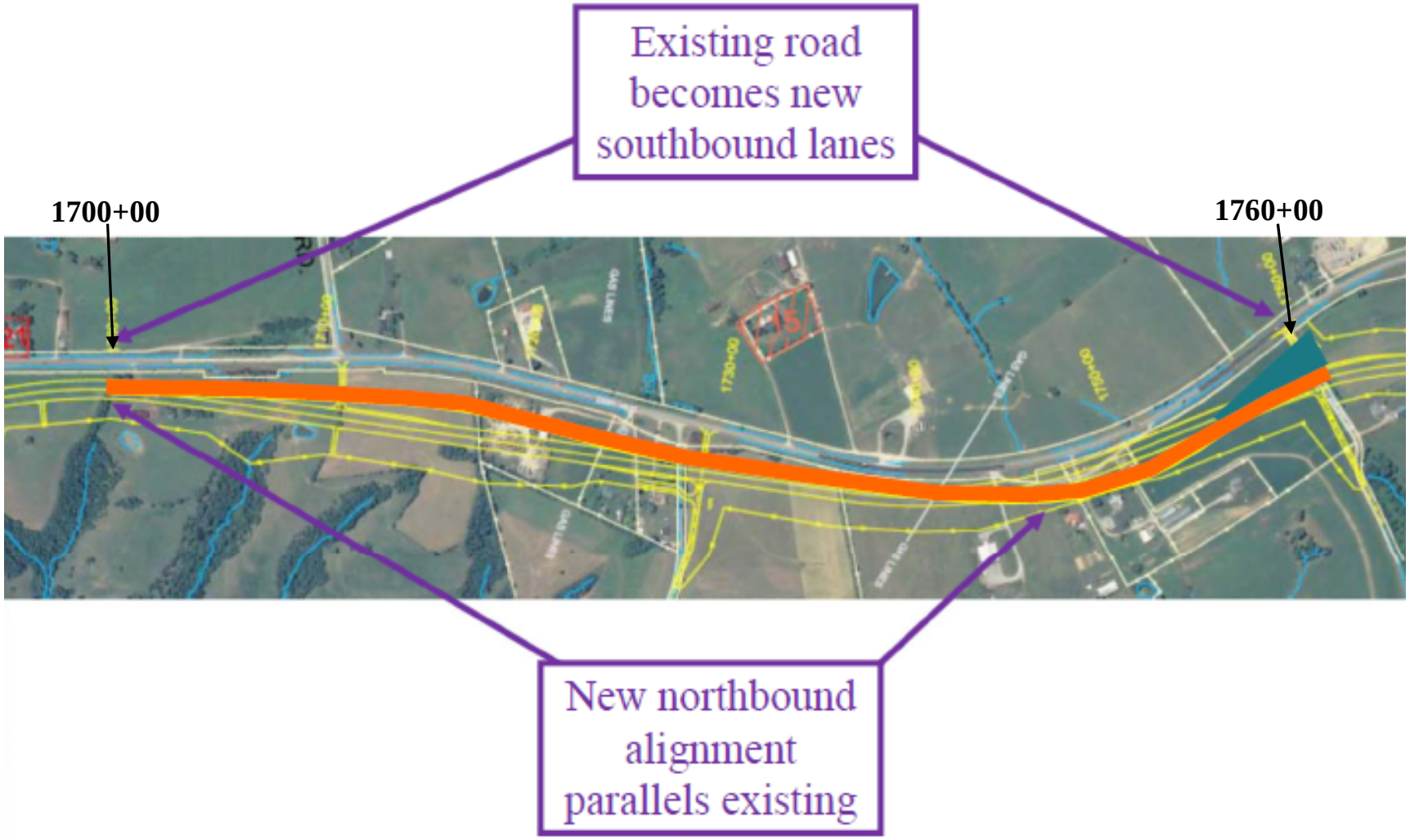
DISADVANTAGES:
- Additional work west of US 27

JUSTIFICATION:
The utilization of existing US 27 will reduce ROW costs and pavement quantities along this portion of the project. ROW and pavement are major costs on this project, and any steps taken to reduce the two should be studied.

SUMMARY OF COST ANALYSIS			
	First Cost	O & M Costs (Present Worth)	Total LC Cost (Present Worth)
ORIGINAL DESIGN	$16,687,000	$0	$16,687,000
RECOMMENDED DESIGN	$15,287,000	$0	$15,287,000
ESTIMATED SAVINGS OR (COST)	$1,400,000	$0	$1,400,000

VALUE ENGINEERING RECOMMENDATION # VE-13

SKETCH OF RECOMMENDED DESIGN



VALUE ENGINEERING RECOMMENDATION # VE-13

CALCULATIONS

The VE Team assumes the reduction of ROW and pavement needed by utilizing the existing pavement from Sta. 1700+00 to Sta. 1760+00. Average disturbed width along the corridor is 300 feet. A 25% reduction of disturbed area may be achieved. The following describes the breakdown of the cost savings for Segment 3:

Total length of Segment 3 – 4.67 miles
Sta. 1700+00 to Sta. 1760+00 – 1.14 miles

ROW:
Segment total – $8.8 Million
Sta. 1700+00 to Sta. 1760+00 by % - $2.2 Million
$2.2 Million x .75 - $ 1.65 Million

Pavement Reduction:
Sta. 1700+00 to Sta. 1760+00
Full depth pavement
6,000 feet x 24-feet – 144,000 SF
144,000/9 – 16,000 SY

Pavement required for existing US 27:
Sta. 1700+00 to Sta. 1760+00
Shoulders
6,000 feet x 14 feet – 84,000 SF
84,000/9 – 9,300 SY

Mill and Overlay:
6,000 feet x 24 feet - 144,000 SF
144,000 x 0.125 feet – 18,000 CF
18,000/27 – 660 Cubic yards

This 25% ROW reduction and use of existing US 27 will reduce two of this projects large budget items.

VALUE ENGINEERING RECOMMENDATION # VE-13

COST ESTIMATE - FIRST COST

Cost Item	Units	$/Unit	Source Code	Original Design		Recommended Design	
				Num of Units	Total $	Num of Units	Total $
ROW (Segment 3)	LS	$6,600,000	1	1	$6,600,000	1	$6,600,000
ROW (Segment 3)	LS	$2,200,000	1	1	$2,200,000	0.75	$1,650,000
Pavement, Mainline	SY	$60.00	1	131,451	$7,887,060	115,451	$6,927,060
Asphalt Pave Milling and Texturing	TON	$15.69	2			1,320	$20,711
Surface Course	TON	$67.71	2			1,320	$89,377
Total					$16,687,060		$15,287,148

SOURCE CODE:
1 Project Cost Estimate
2 KYTC Average Bid
3 CACES Data Base
4 Means Estimating Manual
5 National Construction Estimator
6 Vendor Lit or Quote (list name / details)
7 Professional Experience (List job if applicable)
8 Other Sources (specify)

✓ VE Selected
Scenario #2

VALUE ENGINEERING RECOMMENDATION # VE-14

DESCRIPTIVE TITLE OF RECOMMENDATION:
Utilize a 12-foot in lieu of a 14-foot center turn lane in the urban section at the southern end of the corridor.

ORIGINAL DESIGN:
The original US 27 design applies a rural 5-lane typical section with shoulders. The 5-lane section consists of four 12-foot travel lanes and a 14-foot two-way left turn lane (TWLTL). This section begins at US 150 and continues to approximately at Sta. 1250+00 where the 4-lane depressed median rural section begins.

RECOMMENDED CHANGE:
The VE Team recommends using a similar 5-lane section that consists of 4 12-foot travel lanes and a 12-foot TWLTL. This section will also begin at US 150 and continue to approximately at Sta. 1250+00 where the 4-lane depressed median rural section begins.

ADVANTAGES:
- Reduce ROW
- Reduce amount of pavement

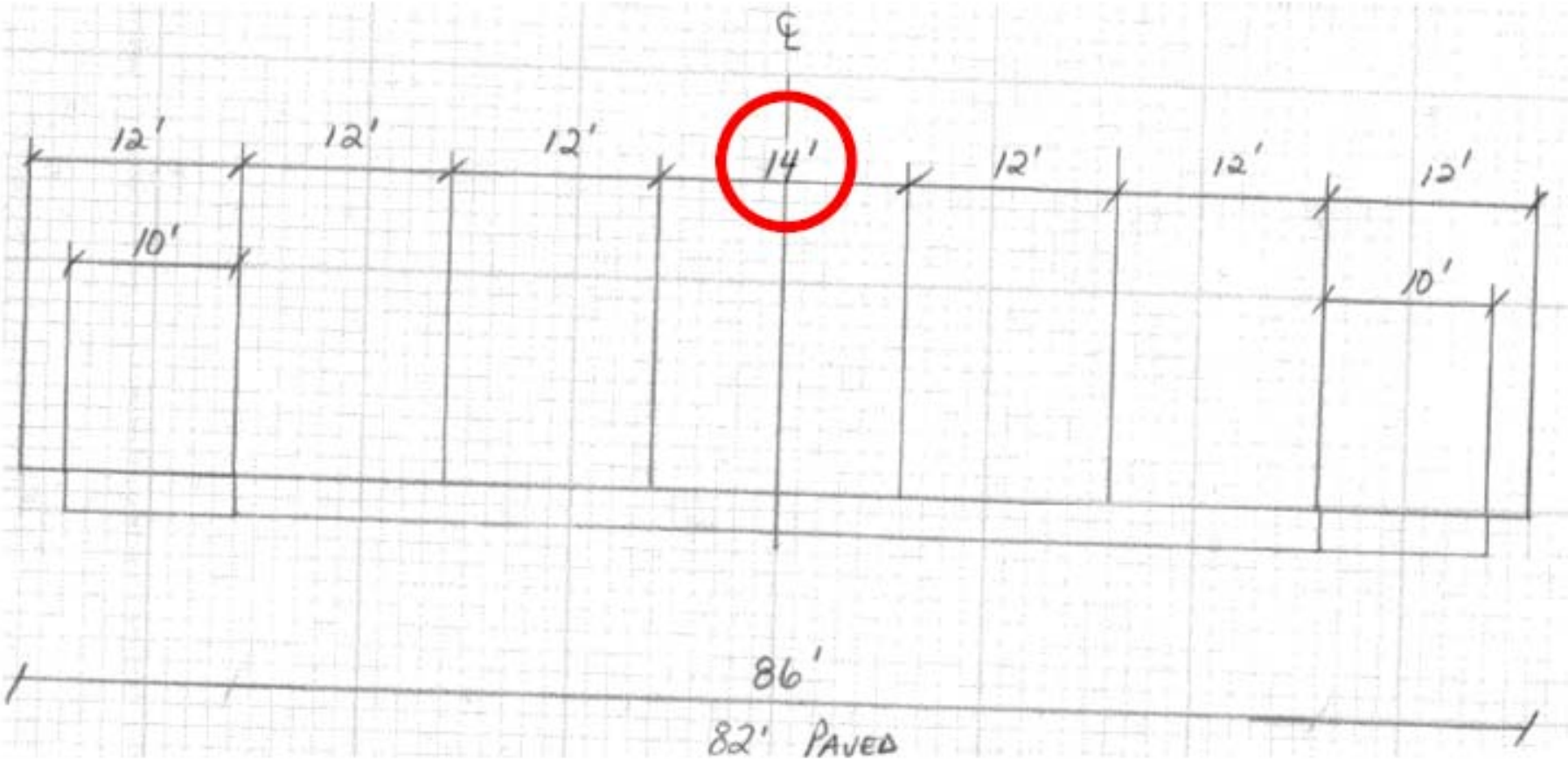
DISADVANTAGES:
- Turn conflicts in shared turn lane

JUSTIFICATION:
This reduction of the typical section will help minimize the overall cost of the ROW and pavement. ROW and pavement are major costs on this project, and any steps taken to reduce ROW impact and constructed pavement should be considered. This change will not substantially impact the safety or operation of the TWLTL.

SUMMARY OF COST ANALYSIS			
	First Cost	O & M Costs (Present Worth)	Total LC Cost (Present Worth)
ORIGINAL DESIGN	$19,739,000	$0	$19,739,000
RECOMMENDED DESIGN	$19,602,000	$0	$19,602,000
ESTIMATED SAVINGS OR (COST)	$137,000	$0	$137,000

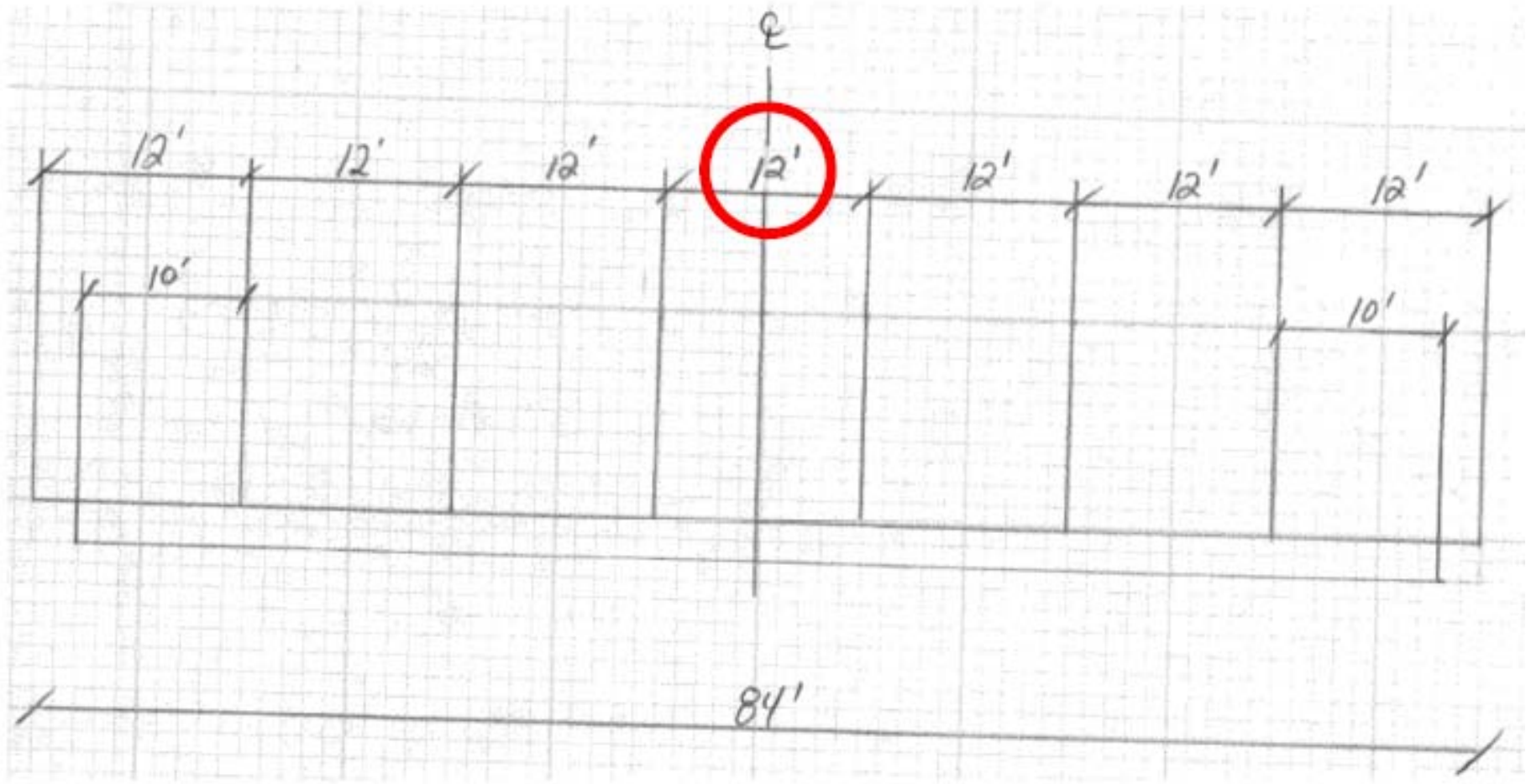
VALUE ENGINEERING RECOMMENDATION # VE-14

SKETCH OF ORIGINAL DESIGN



VALUE ENGINEERING RECOMMENDATION # VE-14

SKETCH OF RECOMMENDED DESIGN



VALUE ENGINEERING RECOMMENDATION # VE-14

CALCULATIONS

The VE Team assumes by reducing the two-way left-turn lane width by 2 feet, the new typical section width of 84-feet will decrease potential ROW impacts and pavement needed for construction. The average disturbed width along the 5-lane corridor is 225-feet. A 1% reduction of disturbed ROW is anticipated. The improvements above only apply to Segment 1.

ROW:
Begin Project thru Proposed 5-lane Section – approximately $6.7 Million
5-lane Section - $6.7 Million x 0.99 = approximately $6.63 Million
Rural Section - $10.05 Million unchanged

This 1% ROW reduction along 5-lane portion of the project will reduce one of this projects large budget items.

Pavement:
Sta. 1198+00 to Sta. 1250+00 = 5200 feet
5200 feet x 2-feet = 10,400 SF
10,400/9 = 1,160 SY

The 2-foot two-way left turn lane reduction eliminates 1,160 SY of pavement.

VALUE ENGINEERING RECOMMENDATION # VE-14

COST ESTIMATE - FIRST COST

Cost Item	Units	$/Unit	Source Code	Original Design		Recommended Design	
				Num of Units	Total $	Num of Units	Total $
ROW (Segment1)	LS	$6,700,000	1	1	$6,700,000	0.99	$6,633,000
ROW (Segment1)	LS	$10,057,000	1	1	$10,057,000	1	$10,057,000
Pavement, Mainline	SY	$60.00	1	49,700	$2,982,000	48,540	$2,912,400
Total					$19,739,000		$19,602,400

SOURCE CODE:
1 Project Cost Estimate
2 KYTC Average Bid
3 CACES Data Base
4 Means Estimating Manual
5 National Construction Estimator
6 Vendor Lit or Quote (list name / details)
7 Professional Experience (List job if applicable)
8 Other Sources (specify)

✓ VE Selected
Scenario #2

VALUE ENGINEERING RECOMMENDATION # VE-15

DESCRIPTIVE TITLE OF RECOMMENDATION:
Utilize 11-foot lanes in lieu of 12-foot lanes for the urban section.

ORIGINAL DESIGN:
The original US 27 design applies a rural 5-lane typical section. The 5-lane section consists of four 12-foot travel lanes and a 14-foot two-way left turn lane. This section begins at US 150 and continues to approximately at Sta. 1250+00 where the 4-lane depressed median rural section begins.

RECOMMENDED CHANGE:
The VE Team recommends using a similar 5-lane section that consists of four 11-foot travel lanes and a 14-foot two-way left turn lane. This section will also begin at US 150 and continue to approximately at Sta. 1250+00 where the 4-lane depressed median rural section begins.

ADVANTAGES:
- Reduce ROW
- Reduce quantity of pavement
- May calm traffic

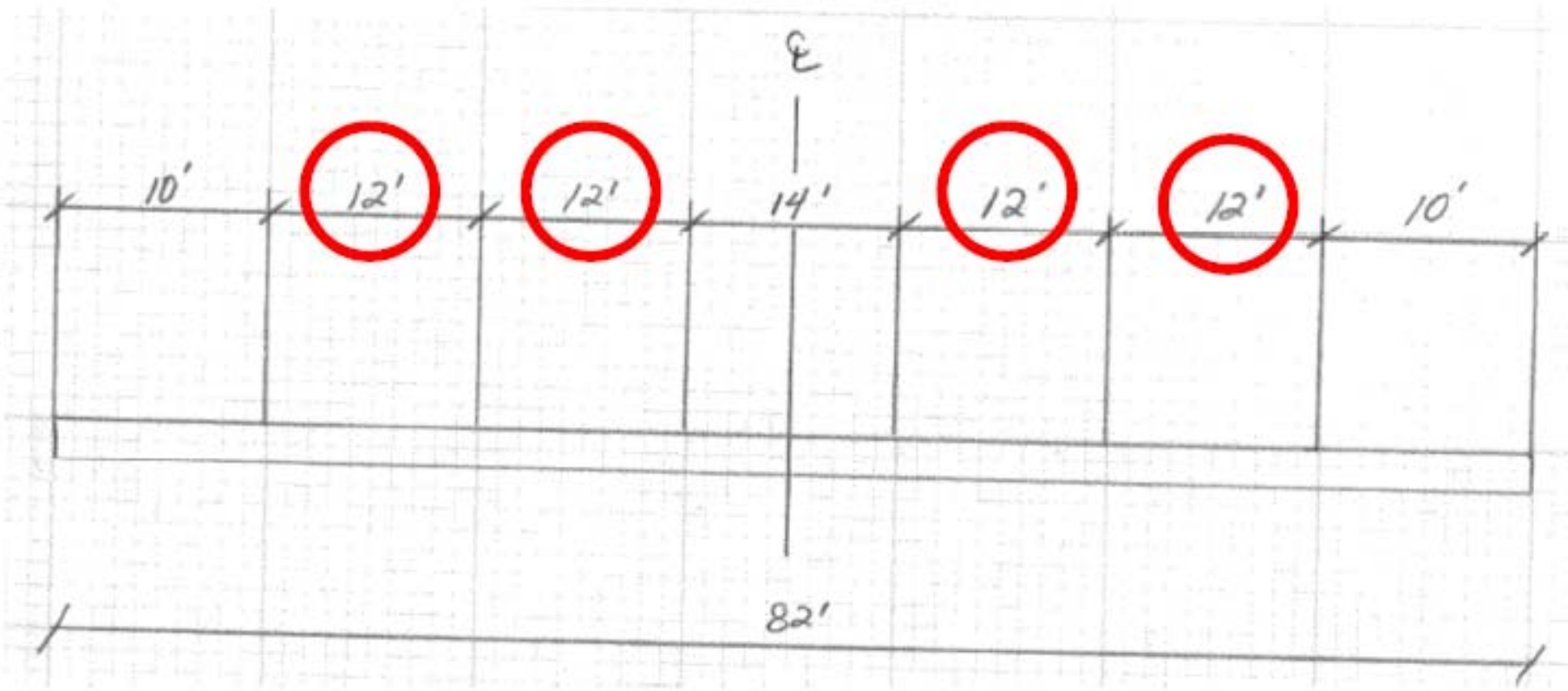
DISADVANTAGES:
- Reduces travel lane width

JUSTIFICATION:
This reduction of the typical section will help minimize the overall cost of the ROW and pavement. ROW and pavement are major costs on this project, and any steps taken to reduce ROW impact and constructed pavement should be considered. This change will not substantially impact the safety or operations of the roadway.

SUMMARY OF COST ANALYSIS			
	First Cost	O & M Costs (Present Worth)	Total LC Cost (Present Worth)
ORIGINAL DESIGN	$14,469,000	$0	$14,469,000
RECOMMENDED DESIGN	$14,263,000	$0	$14,263,000
ESTIMATED SAVINGS OR (COST)	$206,000	$0	$206,000

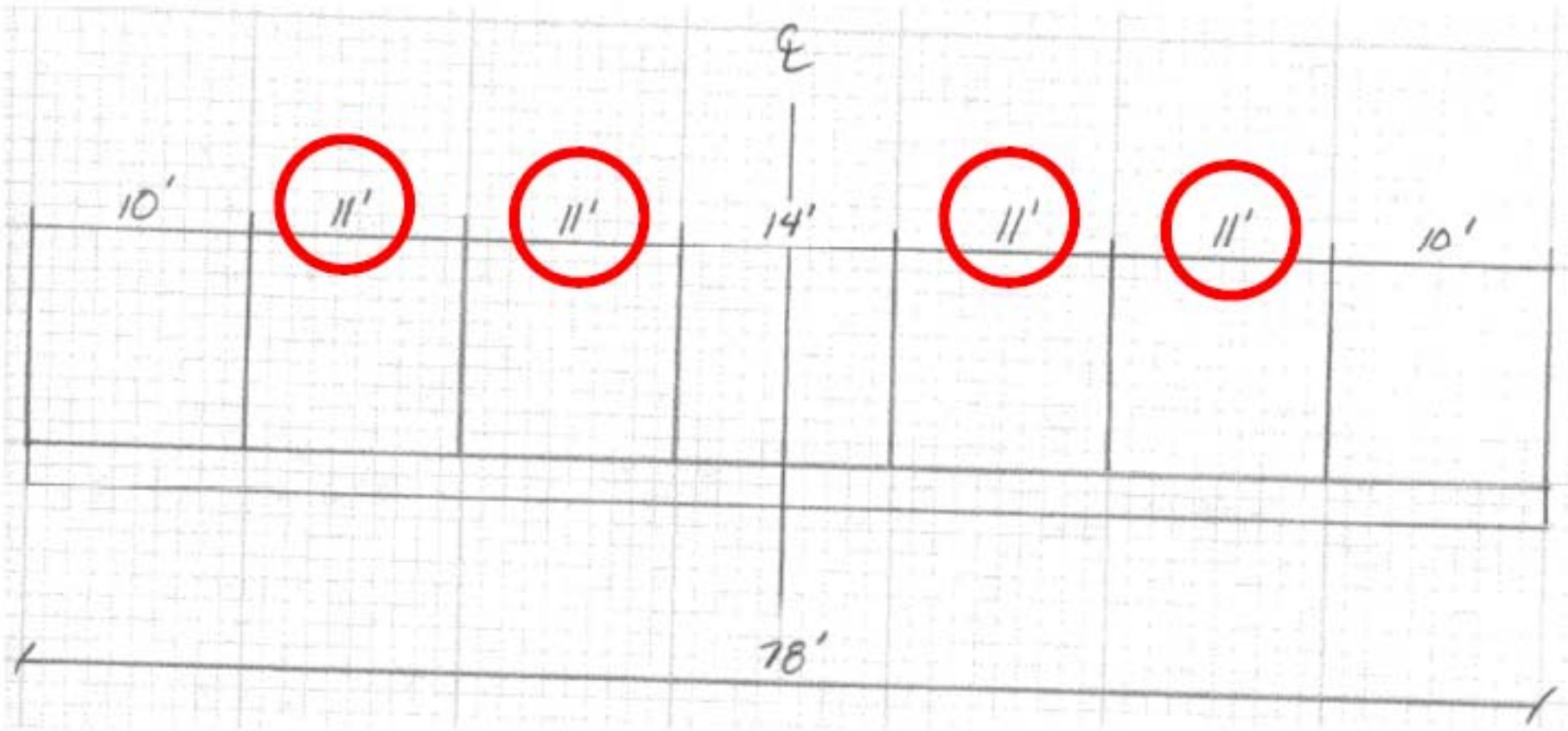
VALUE ENGINEERING RECOMMENDATION # VE-15

SKETCH OF ORIGINAL DESIGN



VALUE ENGINEERING RECOMMENDATION # VE-15

SKETCH OF RECOMMENDED DESIGN



VALUE ENGINEERING RECOMMENDATION # VE-15

CALCULATIONS

The VE Team assumes by reducing each 12-foot travel lane to 11 feet, the new paved typical section width of 78-feet will decrease potential ROW impacts and pavement needed for construction. The average disturbed width along the 5-lane corridor is 225-feet. A 2% reduction of disturbed ROW is anticipated. The improvements above only apply to Segment 1.

ROW:
Begin Project thru Proposed 5-lane Section – approximately $6.7 Million
5-lane Section - $6.7 Million x 0.98 = approximately $6.56 Million
Rural Section - $10.05 Million unchanged

This 2% ROW reduction along 5-lane portion of the project will reduce one of this projects large budget items.

Pavement:
Sta. 1198+00 to Sta. 1250+00 = 5,200 feet
5,200 feet x 4-feet = 20,800 SF
20,800/9 = 2,320 SY

The 1-foot travel lane reduction eliminates 2320 SY of pavement.

VALUE ENGINEERING RECOMMENDATION # VE-15

COST ESTIMATE - FIRST COST

Cost Item	Units	$/Unit	Source Code	Original Design		Recommended Design	
				Num of Units	Total $	Num of Units	Total $
ROW (Urban Section)	LS	$6,700,000	1	1	$6,700,000	0.99	$6,633,000
Pavement, Mainline (Segment 1)	SY	$60.00	1	129,480	$7,768,800	127,160	$7,629,600
Total					$14,468,800		$14,262,600

SOURCE CODE:
1 Project Cost Estimate
2 KYTC Average Bid
3 CACES Data Base
4 Means Estimating Manual
5 National Construction Estimator
6 Vendor Lit or Quote (list name / details)
7 Professional Experience (List job if applicable)
8 Other Sources (specify)

✓ VE Selected
Scenario #2

VALUE ENGINEERING RECOMMENDATION # VE-16

DESCRIPTIVE TITLE OF RECOMMENDATION:
Reduce all paved shoulder widths by 2 feet throughout the corridor.

ORIGINAL DESIGN:
The original US 27 design applies a rural 5-lane typical section with 10-foot paved shoulders, and a 4-lane rural depressed median section with 4-foot paved inside shoulders and 10-foot paved outside shoulders. The 2 sections above run the entire length of the corridor.

RECOMMENDED CHANGE:
The VE Team recommends reducing all paved shoulders by 2 feet for the entire length of project.

ADVANTAGES:
- Reduce ROW
- Reduce quantity of pavement

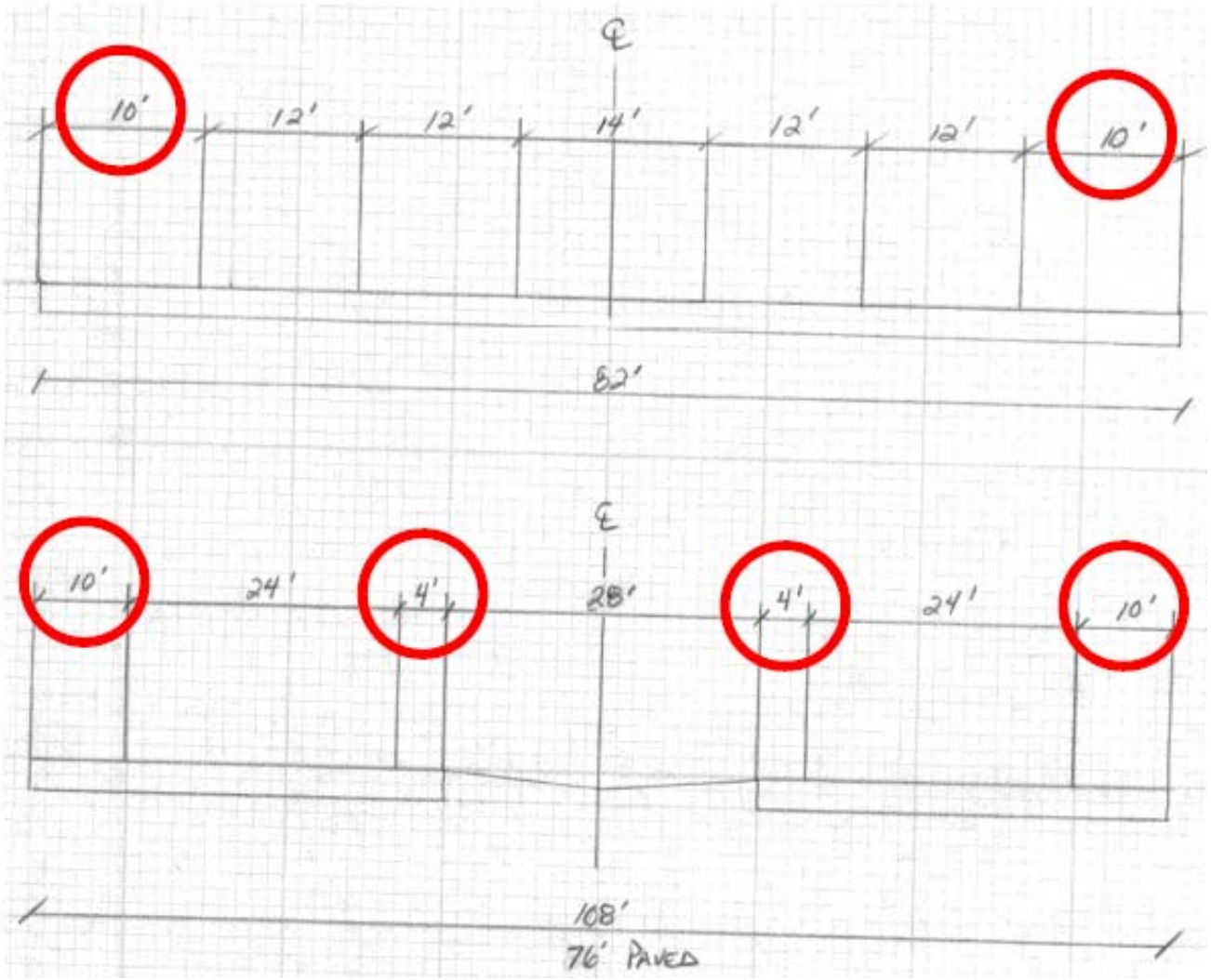
DISADVANTAGES:
- None

JUSTIFICATION:
This 2-foot shoulder reduction of the typical section will help minimize the overall cost of the ROW and pavement. ROW and pavement are major costs on this project, and any steps taken to reduce ROW impact and constructed pavement should be considered. This change will not substantially impact the function of the shoulders or median.

SUMMARY OF COST ANALYSIS			
	First Cost	O & M Costs (Present Worth)	Total LC Cost (Present Worth)
ORIGINAL DESIGN	$47,291,000	$0	$47,291,000
RECOMMENDED DESIGN	$43,899,000	$0	$43,899,000
ESTIMATED SAVINGS OR (COST)	$3,392,000	$0	$3,392,000

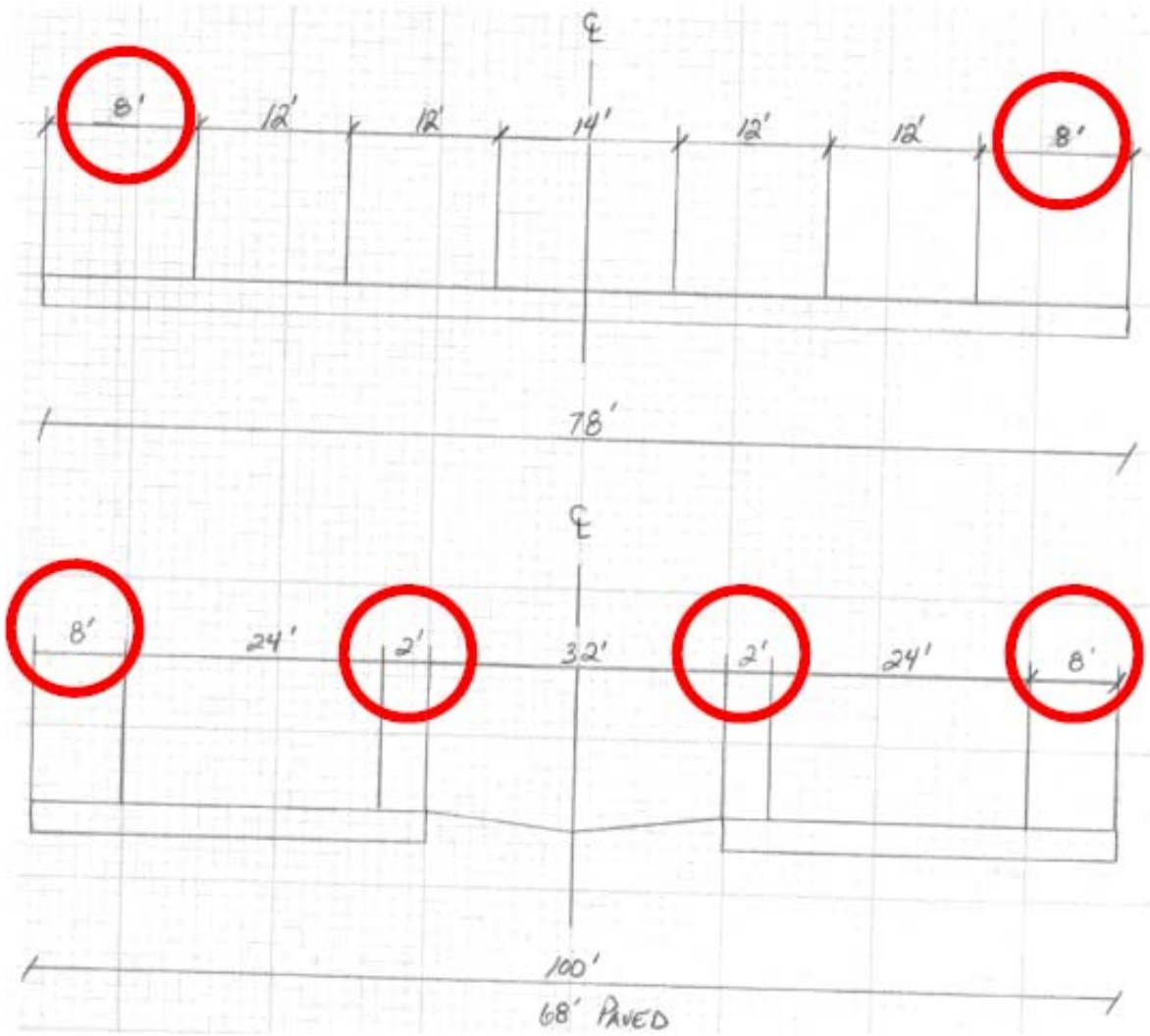
VALUE ENGINEERING RECOMMENDATION # VE-16

SKETCH OF ORIGINAL DESIGN



VALUE ENGINEERING RECOMMENDATION # VE-16

SKETCH OF RECOMMENDED DESIGN



VALUE ENGINEERING RECOMMENDATION # VE-16

CALCULATIONS

The VE Team assumes by reducing all paved shoulder width by 2 feet, the typical section width will decrease by 4 feet along the 5-lane section and 8 feet along the 4-lane section. Reducing the shoulder widths help minimize potential ROW impacts and pavement needed for construction. The average disturbed width along the corridor is 400-feet. A 2% reduction of disturbed area is anticipated.

ROW:
Proposed project ROW cost – $36,621,000
ROW cost reduced 2% - $35,888,580

This 2% ROW reduction will reduce one of this projects large budget items.

Shoulder Pavement:
5-lane section, Sta. 1198+00 to Sta. 1250+00 = 5,200 feet
5200 feet x 4 feet = 20,800 SF
28,800/9 = 3,100 SY

4-lane section, Sta. 1250+00 to End of project = 63,000 feet
63,000 feet x 8 feet = 504,000 SF
504,000/9 = 56,000 SY

The 2-foot paved shoulder reduction eliminates 59,100 SY of pavement.

VALUE ENGINEERING RECOMMENDATION # VE-16

COST ESTIMATE - FIRST COST

Cost Item	Units	$/Unit	Source Code	Original Design		Recommended Design	
				Num of Units	Total $	Num of Units	Total $
ROW	LS	$36,621,000	1	1	$36,621,000	0.98	$35,888,580
Other Pavement	SY	$45.00	1	237,100	$10,669,500	178,000	$8,010,000
Total					$47,290,500		$43,898,580

SOURCE CODE:
1 Project Cost Estimate
2 KYTC Average Bid
3 CACES Data Base
4 Means Estimating Manual
5 National Construction Estimator
6 Vendor Lit or Quote (list name / details)
7 Professional Experience (List job if applicable)
8 Other Sources (specify)

✓ VE Selected
Scenario #2

VALUE ENGINEERING RECOMMENDATION # VE-17

DESCRIPTIVE TITLE OF RECOMMENDATION:
Utilize a 20-foot depressed median in lieu of a 40-foot depressed grass median.

ORIGINAL DESIGN:
The original US 27 design applies a rural 4-lane typical section with a 40-foot depressed grass median. The rural section begins approximately at Sta. 1250+00 and continues throughout the remainder of the corridor.

RECOMMENDED CHANGE:
The VE Team recommends using a 4-lane typical section with a 20-foot depressed median to replace the 40-foot depressed median. This typical section shall begin at approximately Sta. 1250+00 and continue throughout the remainder of the corridor.

ADVANTAGES:
- Reduce ROW
- Allow future left turn lanes

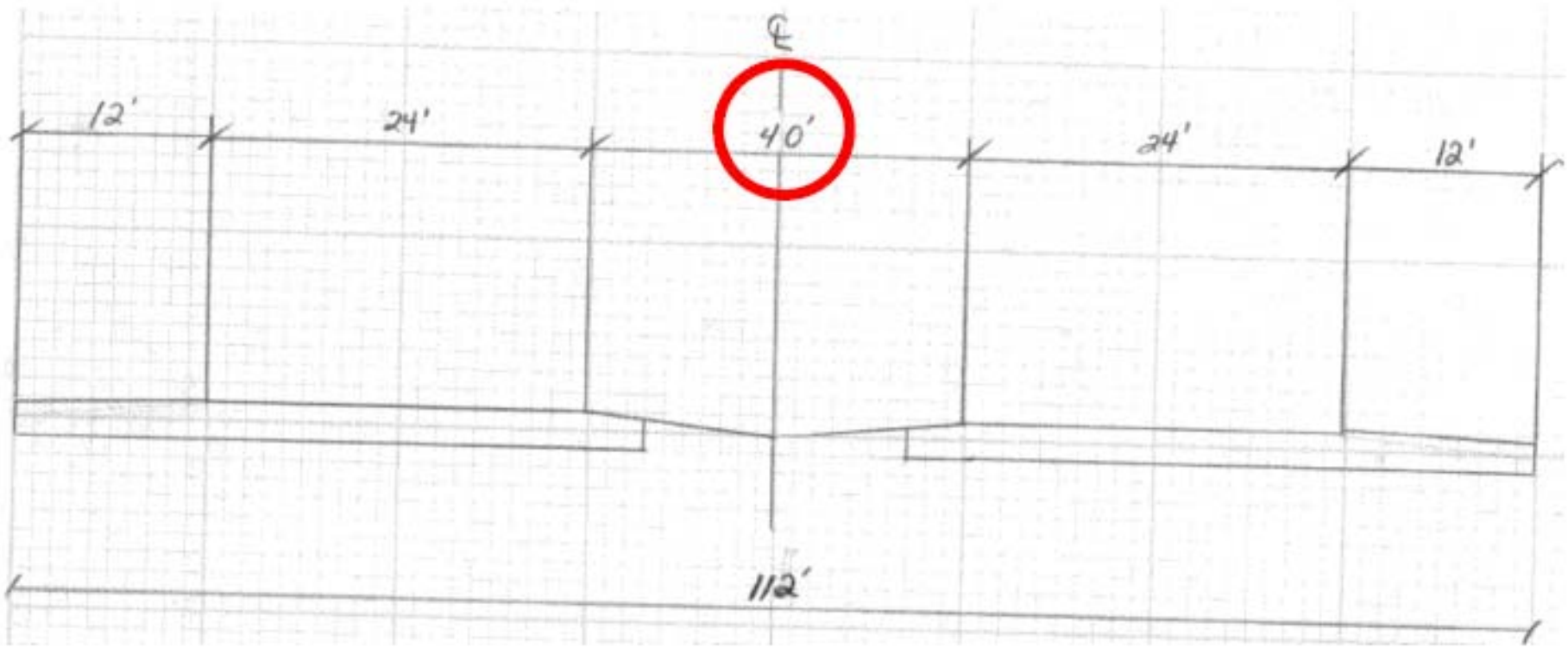
DISADVANTAGES:
- Does not meet clear zone guideline

JUSTIFICATION:
This reduction of the typical section will help minimize the overall cost of the ROW. ROW is a major cost on this project, and any steps taken to reduce ROW impact should be studied. Although this reduces the clear zone width within the median, this design still allows for offset left turn lanes or standard left turn lanes that allow U-turns for passenger vehicles. This recommendation may be modified to a median width of 25 or 30 feet to allow for a larger clear zone.

SUMMARY OF COST ANALYSIS			
	First Cost	O & M Costs (Present Worth)	Total LC Cost (Present Worth)
ORIGINAL DESIGN	$898,000	$0	$898,000
RECOMMENDED DESIGN	$0	$0	$0
ESTIMATED SAVINGS OR (COST)	$898,000	$0	$898,000

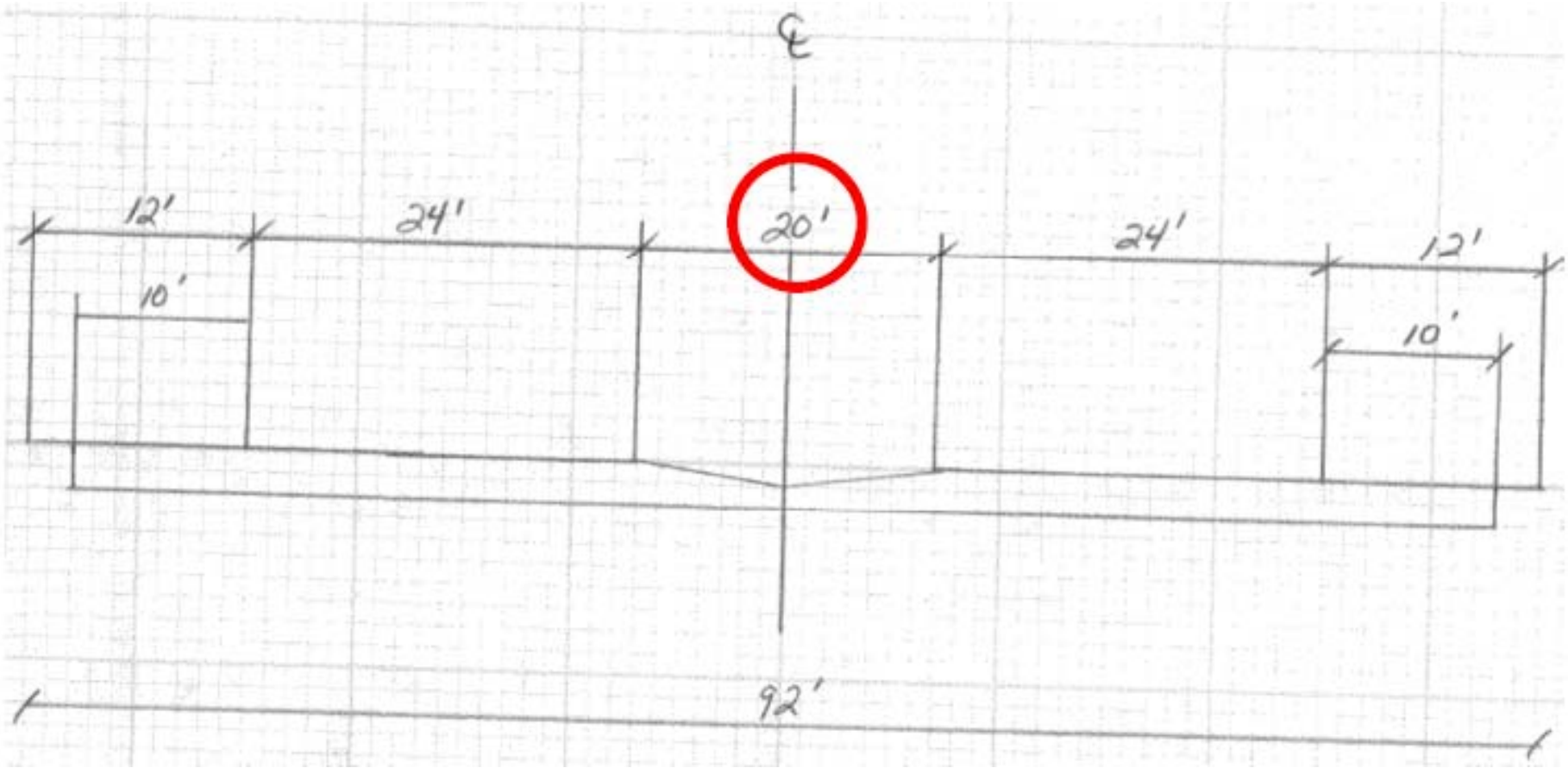
VALUE ENGINEERING RECOMMENDATION # VE-17

SKETCH OF ORIGINAL DESIGN



VALUE ENGINEERING RECOMMENDATION # VE-17

SKETCH OF RECOMMENDED DESIGN



VALUE ENGINEERING RECOMMENDATION # VE-17

CALCULATIONS

The VE Team assumes the reduction of ROW by reducing the typical section to 92-feet from the proposed 112-feet. Average disturbed width along the corridor was 400. A 3% reduction of disturbed area can be achieved. The following describes the breakdown of the cost savings by segment:

Segment 1:
Begin Project thru Proposed 5-lane Section (unchanged) – $6.7 Million
Rural Section - $10.05 Million x 0.97 = approximately $9.74 Million

Segment 2:
Rural Section - $11.06 Million x 0.97 = approximately $10.72 Million

Segment 3:
Rural Section - $8.8 Million x 0.97 = approximately $8.54 Million

New ROW total = approximately $35.70 Million

This 3% ROW reduction along the rural portion of the project will reduce one of this projects large budget items.

VALUE ENGINEERING RECOMMENDATION # VE-17

COST ESTIMATE - FIRST COST

Cost Item	Units	$/Unit	Source Code	Original Design		Recommended Design	
				Num of Units	Total $	Num of Units	Total $
ROW (Rural Section)	LS	$898,000	1	1	$898,000		
Total					$898,000		$0

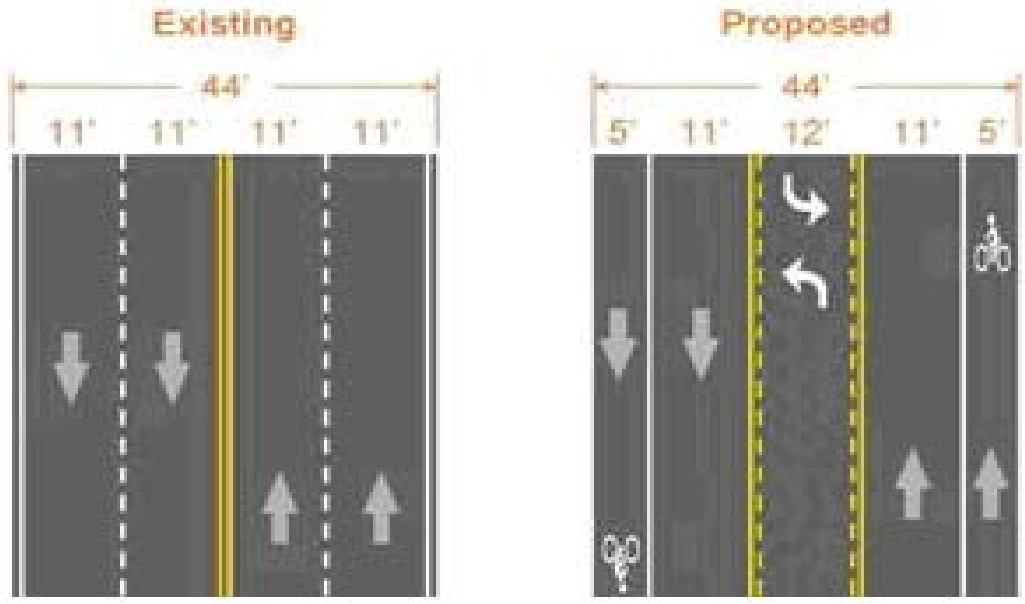
SOURCE CODE: 1 Project Cost Estimate
2 KYTC Average Bid
3 CACES Data Base
4 Means Estimating Manual
5 National Construction Estimator
6 Vendor Lit or Quote (list name / details)
7 Professional Experience (List job if applicable)
8 Other Sources (specify)

VALUE ENGINEERING DESIGN COMMENT # VE-18

DESCRIPTIVE TITLE OF DESIGN COMMENT:
Utilize a road diet (3 lanes in lieu of 4 lanes) on existing US 27 through downtown Lancaster.

COMMENTARY:
Utilize a road diet in downtown Lancaster. The bypass will remove some traffic from downtown, freeing up capacity. The existing 4 lanes will not be needed. One northbound through lane, one southbound through lane, and one two-way left-turn lane can be striped, allowing for bike lanes in both directions on US 27 through town. The downtown section of US 27 south of KY 52 is a designated bike route, part of the Midland bike route. If the multi-use path is built to Logan Hubble Park, these bike lanes could possibly be extended to connect to the multi-use path in the future.

Photograph of the Downtown Section of Existing US 27 through Lancaster



Example of Current Roadway Configuration and the Recommeded Roadway Diet Configuration

VALUE ENGINEERING RECOMMENDATION # VE-19

DESCRIPTIVE TITLE OF RECOMMENDATION:
Utilize new construction from US 150 Bypass to Sta. 1250+00, the Lancaster bypass from Sta.1440+00 to Sta. 1640+00, and defer constructing the remainder of the project.

ORIGINAL DESIGN:
The original design specifies that, from approximate Sta. 1250+00 northward, the typical section have four 12-foot lanes with shoulders (4-foot median paved, 10-foot outside paved) and a depressed median.

RECOMMENDED CHANGE:
The VE Team recommends that the portion of the project from the urban section (approximate Sta. 1250+00) to the Lancaster Bypass and the portion of the project north of the Lancaster Bypass be deferred until such time as warrants and finances permit.

ADVANTAGES:
- Reduces quantity of ROW
- Reduces utility relocations
- Reduces construction labor and materials

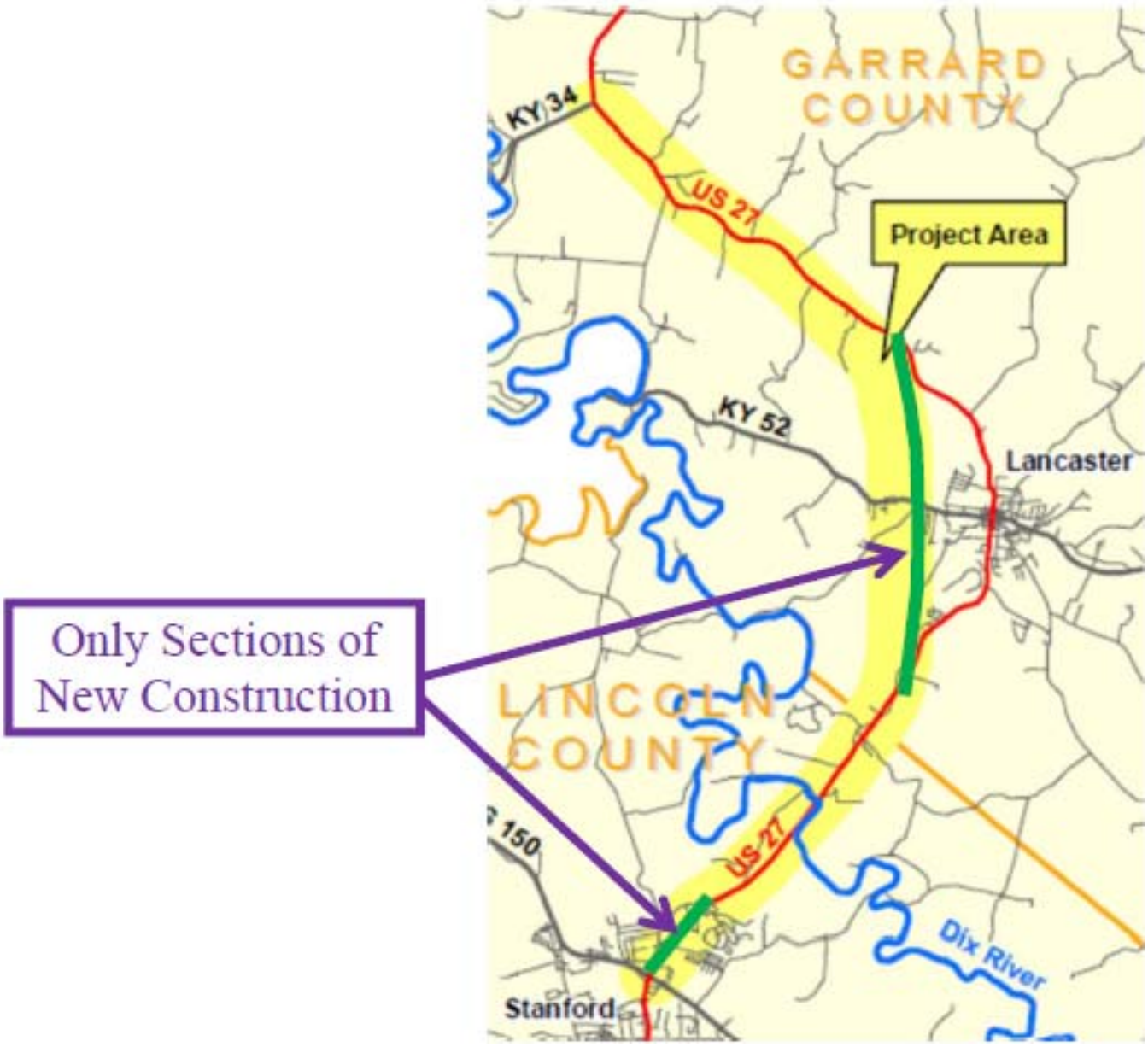
DISADVANTAGES:
- Fewer opportunities to pass slower vehicles

JUSTIFICATION:
The traffic study indicates that, in the design year, the projected corridor ADT is likely to be less than 12,000 vehicles on the unimproved sections which would accommodate an acceptable level of service. The southern section and the area through Lancaster show the most need in terms of congestion and therefore would benefit the most from a reprioritization of construction sections.

SUMMARY OF COST ANALYSIS			
	First Cost	O & M Costs (Present Worth)	Total LC Cost (Present Worth)
ORIGINAL DESIGN	$67,557,000	$0	$67,557,000
RECOMMENDED DESIGN	$0	$0	$0
ESTIMATED SAVINGS OR (COST)	$67,557,000	$0	$67,557,000

VALUE ENGINEERING RECOMMENDATION # VE-19

SKETCH OF RECOMMENDED DESIGN



VALUE ENGINEERING RECOMMENDATION # VE-19

COST ESTIMATE - FIRST COST

Cost Item	Units	$/Unit	Source Code	Original Design		Recommended Design	
				Num of Units	Total $	Num of Units	Total $
Excavation	CY	$3.75	1	647,500	$2,428,125		
Embankment-in-place	CY	$5.00	1	1,325,000	$6,625,000		
Pipe drainage, etc.	LS	$1,341,100	1	1	$1,341,100		
Bridge over Dix River	LS	$5,300,000	1	1	$5,300,000		
Pavement striping, Signs, etc.	LS	$245,150	1	1	$245,150		
Guardrail and end treatments	LS	$796,450	1	1	$796,450		
Pavement- mainline	SY	$60.00	1	222,250	$13,335,000		
Pavement- other	SY	$45.00	1	154,350	$6,945,750		
Miscellaneous construction pavement	LS	$2,510,374	1	1	$2,510,374		
ROW	LS	$20,529,900	1	1	$20,529,900		
Utility relocation	LS	$7,500,000	1	1	$7,500,000		
Unit Costs shown herein were derived from the Estimate of Approximate Construction Costs, generally by averaging the values for Alternatives 1 and 2. Considered 50% Segment 1 plus all of Segments 2 and 3.							
Total					$67,556,849		$0

SOURCE CODE: 1 Project Cost Estimate
2 KYTC Average Bid
3 CACES Data Base
4 Means Estimating Manual
5 National Construction Estimator
6 Vendor Lit or Quote (list name / details)
7 Professional Experience (List job if applicable)
8 Other Sources (specify)

✓ VE Selected
Scenario #1

VALUE ENGINEERING RECOMMENDATION # VE-20

DESCRIPTIVE TITLE OF RECOMMENDATION:
Utilize a 2-lane initial and 4-lane ultimate typical section for the portion north of the Lancaster Bypass.

ORIGINAL DESIGN:
The original design specifies that the portion of the project north of the Lancaster Bypass be constructed with a typical section having four 12-foot lanes with shoulders (4-foot median paved, 10-foot outside paved) and a depressed median.

RECOMMENDED CHANGE:
The VE Team recommends that the portion of the project north of the Lancaster Bypass be constructed initially with a typical section having two 12-foot lanes and 10-foot paved shoulders plus an added left turn lane to selected side/cross roads. The 2 lanes could be constructed offset from the centerline to become the future southbound lanes. Initial ROW would be purchased for the ultimate; however, northbound pavement, shoulder, and some of the grading would be deferred until such time as warrants and finances permit, which could allow more traversable side slopes on the east side with less guardrail.

ADVANTAGES:
- Less initial construction labor and materials
- Partial delayed construction expenses
- Less initial need for guardrail
- Likely earlier funding

DISADVANTAGES:
- Fewer opportunities to pass slower vehicles
- Greater ultimate total construction cost

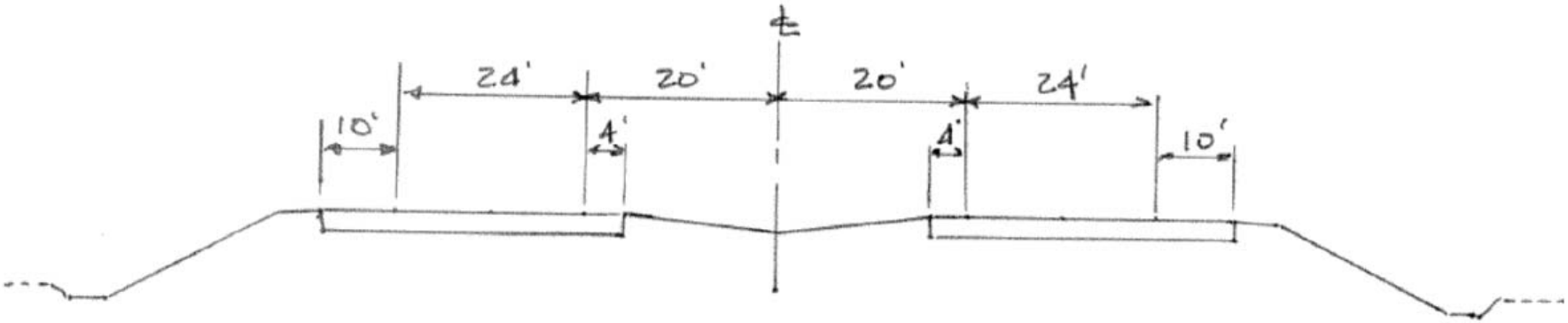
JUSTIFICATION:
The traffic study indicates that, in the design year, the projected ADT in this segment is likely to be less than 12,000 vehicles and could be accommodated by a two-lane roadway with an acceptable level of service. The future northbound pavement could be added at a later date with minimal disruption.

SUMMARY OF COST ANALYSIS			
	First Cost	O & M Costs (Present Worth)	Total LC Cost (Present Worth)
ORIGINAL DESIGN	$21,163,000	$0	$21,163,000
RECOMMENDED DESIGN	$15,617,000	$0	$15,617,000
ESTIMATED SAVINGS OR (COST)	$5,546,000	$0	$5,546,000

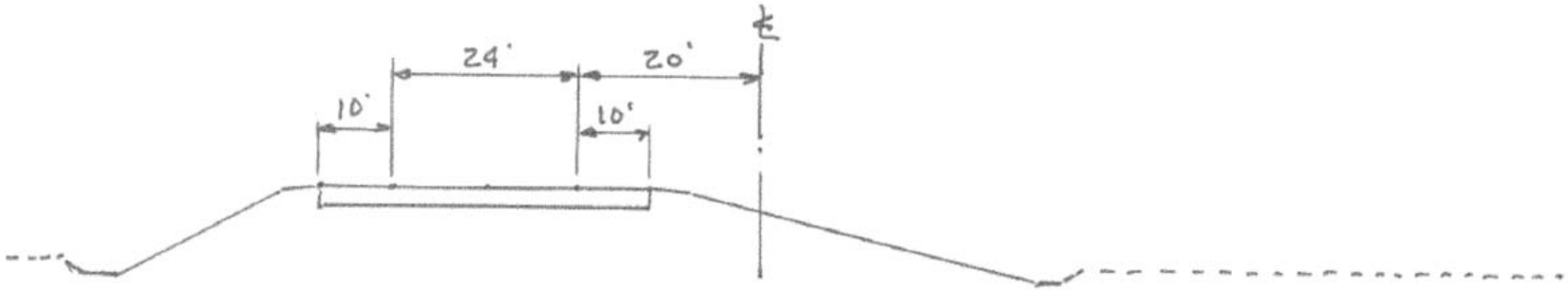
VALUE ENGINEERING RECOMMENDATION # VE-20

SKETCH OF ORIGINAL AND RECOMMENDED DESIGN

Original Design



Recommended Design



VALUE ENGINEERING RECOMMENDATION # VE-20

COST ESTIMATE - FIRST COST

Cost Item	Units	$/Unit	Source Code	Original Design		Recommended Design	
				Num of Units	Total $	Num of Units	Total $
Embankment-in-place (70%)	CY	$5.00	1	1,325,000	$6,625,000	927,500	$4,637,500
Pipe drainage, etc.	LS	$807,000	1	1	$807,000	0.7	$564,900
Pavement striping, signs, etc.	LS	$148,000	1	1	$148,000	0.7	$103,600
Guardrail and end treatments	LS	$479,000	1	1	$479,000	0.6	$287,400
Pavement - mainline (60%)	SY	$60.00	1	130,000	$7,800,000	78,000	$4,680,000
Pavement - other (90%)	SY	$45.00	1	91,000	$4,095,000	100,100	$4,504,500
Miscellaneous construction pavement	LS		1	1	$1,208,850	1	$839,010
Unit Costs shown herein were derived from the Estimate of Approximate Construction Costs, generally by averaging the values for Alternatives 1 and 2.							
Total					$21,162,850		$15,616,910

SOURCE CODE: 1 Project Cost Estimate
2 KYTC Average Bid
3 CACES Data Base
4 Means Estimating Manual
5 National Construction Estimator
6 Vendor Lit or Quote (list name / details)
7 Professional Experience (List job if applicable)
8 Other Sources (specify)

✓ VE Selected
Scenario #1

VALUE ENGINEERING RECOMMENDATION # VE-21

DESCRIPTIVE TITLE OF RECOMMENDATION:
Utilize a 2-lane typical section for the Lancaster Bypass in lieu of a 4-lane typical section.

ORIGINAL DESIGN:
The original design specifies that, from approximate Sta. 1250+00 northward, the typical section have four 12-foot lanes with shoulders (4-foot median paved, 10-foot outside paved) and a depressed median.

RECOMMENDED CHANGE:
The VE Team recommends that, in the Lancaster Bypass portion of the project, the typical section be constructed with two 12-foot lanes and 10-foot paved shoulders plus an added left turn lane to selected side/cross roads.

ADVANTAGES:
- Reduces the quantity of ROW
- Less construction materials
- Less future maintenance
- Likely earlier funding

DISADVANTAGES:
- Fewer opportunities to pass slower vehicles

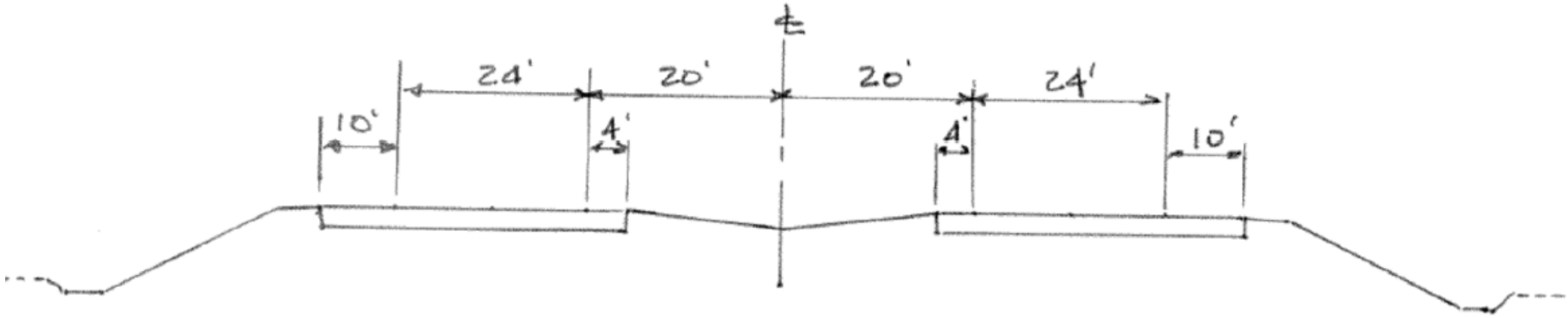
JUSTIFICATION:
The traffic study indicates that, in the design year, approximately half the traffic from the US 27 corridor would use existing US 27 through downtown and approximately half would use the Bypass. The projected Bypass ADT is likely to be roughly 10,000 vehicles and could be accommodated by an access-controlled, two-lane roadway with an acceptable level of service. In addition, there will be redundancy and additional north-south capacity on the existing US 27 through Lancaster.

SUMMARY OF COST ANALYSIS			
	First Cost	O & M Costs (Present Worth)	Total LC Cost (Present Worth)
ORIGINAL DESIGN	$31,605,000	$0	$31,605,000
RECOMMENDED DESIGN	$23,151,000	$0	$23,151,000
ESTIMATED SAVINGS OR (COST)	$8,454,000	$0	$8,454,000

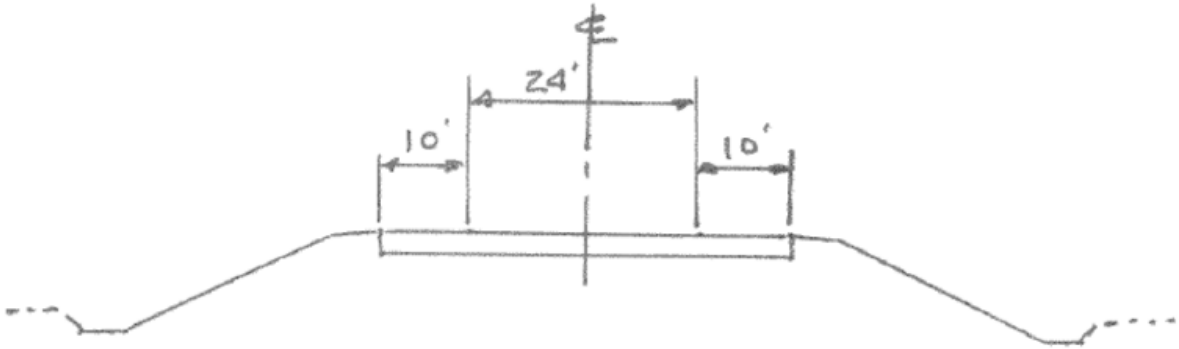
VALUE ENGINEERING RECOMMENDATION # VE-21

SKETCH OF ORIGINAL AND RECOMMENDED DESIGN

Original Design



Recommended Design



VALUE ENGINEERING RECOMMENDATION # VE-21

COST ESTIMATE - FIRST COST

Cost Item	Units	$/Unit	Source Code	Original Design		Recommended Design	
				Num of Units	Total $	Num of Units	Total $
Clear and grub	LS	$148,000	1	1	$148,000	0.7	$103,600
Embankment-in-place (70%)	CY	$5.00	1	1,450,000	$7,250,000	1,015,000	$5,075,000
Box culverts	LS	$1,100,000	1	1	$1,100,000	0.7	$770,000
Pipe drainage, etc.	LS	$700,000	1	1	$700,000	0.7	$490,000
Pavement, striping, signs, etc.	LS	$128,000	1	1	$128,000	0.6	$76,800
Pavement - mainline (60%)	SY	$60.00	1	113,000	$6,780,000	67,800	$4,068,000
Pavement - other (90%)	SY	$45.00	1	68,900	$3,100,500	62,010	$2,790,450
Miscellaneous construction pavement	LS		1	1	$1,398,900	1	$977,310
ROW (80%)	LS	$11,000,000	1	1	$11,000,000	0.8	$8,800,000
Unit Costs shown herein were derived from the Estimate of Approximate Construction Costs, generally by averaging the values for Alternatives 1 and 2.							
Total					$31,605,400		$23,151,160

SOURCE CODE: 1 Project Cost Estimate
2 KYTC Average Bid
3 CACES Data Base
4 Means Estimating Manual
5 National Construction Estimator
6 Vendor Lit or Quote (list name / details)
7 Professional Experience (List job if applicable)
8 Other Sources (specify)

VALUE ENGINEERING RECOMMENDATION # VE-22

DESCRIPTIVE TITLE OF RECOMMENDATION:
Utilize a 2+1 lane initial with ROW for a 4-lane ultimate section from Sta. 1250+00 to the KY 34 intersection.

ORIGINAL DESIGN:
The original design specifies that, from approximate Sta. 1250+00 northward, the typical section have four 12-foot lanes with shoulders (4-foot median paved, 10-foot outside paved) and a depressed median.

RECOMMENDED CHANGE:
The VE Team recommends that the portion of the project north of urban section (approximate Sta. 1250+00) be constructed initially with a typical section having three 12-foot lanes and 10-foot paved shoulders. The middle lane would be used for intermittent passing zones in alternating directions and for left turn lanes to selected side/cross roads. The initial lanes could be constructed offset from the centerline to become the future southbound lanes. Initial ROW would be purchased for the ultimate. Northbound pavement, shoulder, and some of grading could be deferred until such time as warrants and finances permit, which could allow more traversable side slopes on the east side with less guardrail. When completing the ultimate typical section, some of the initial pavement would be removed.

ADVANTAGES:
- Less initial construction labor and materials
- Partial delayed construction cost
- Less initial need for guardrail
- Likely earlier funding

DISADVANTAGES:
- Fewer opportunities to pass slower vehicles
- Greater ultimate total construction cost

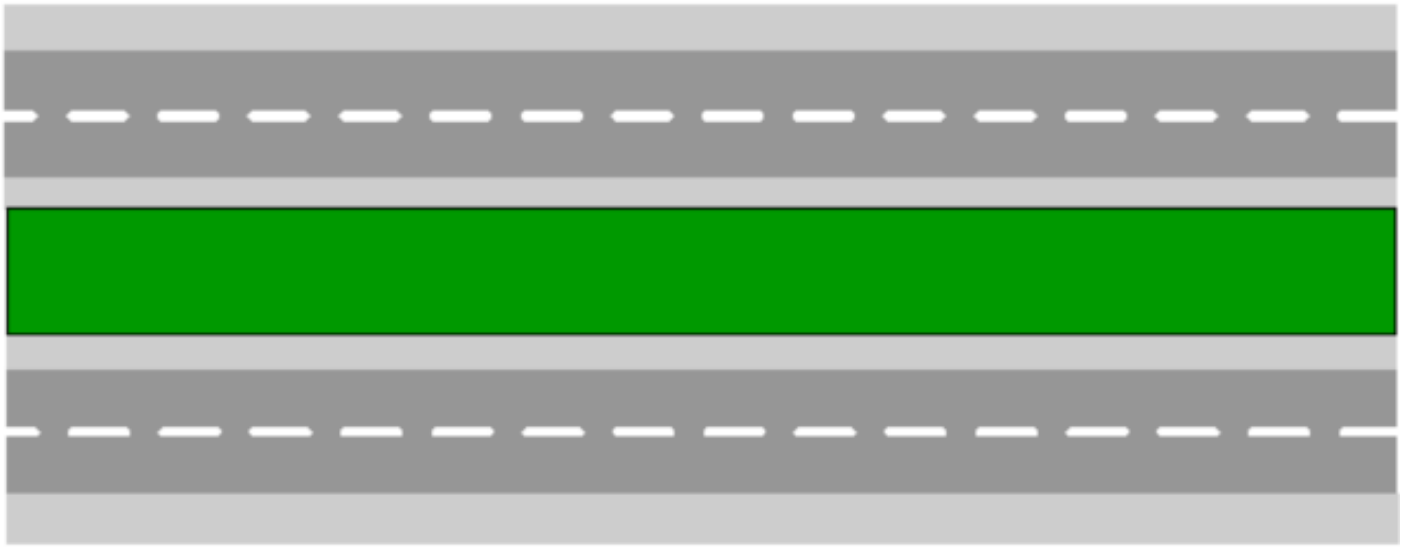
JUSTIFICATION:
The traffic study indicates that, in the design year, the projected corridor ADT is likely to be less than 12,000 vehicles and could be accommodated by a 2 plus 1 configuration with a high level of service. Should additional capacity be needed, future northbound pavement could be added at a later date with minimal disruption.

SUMMARY OF COST ANALYSIS			
	First Cost	O & M Costs (Present Worth)	Total LC Cost (Present Worth)
ORIGINAL DESIGN	$59,183,000	$0	$59,183,000
RECOMMENDED DESIGN	$48,212,000	$0	$48,212,000
ESTIMATED SAVINGS OR (COST)	$10,971,000	$0	$10,971,000

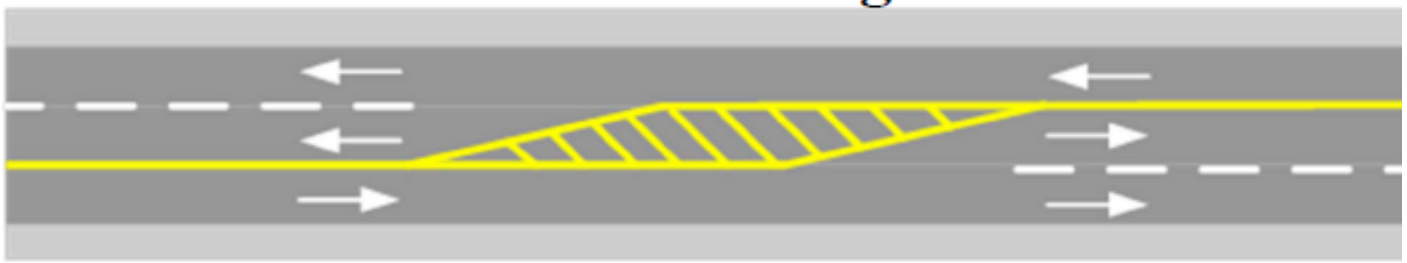
VALUE ENGINEERING RECOMMENDATION # VE-22

SKETCH OF ORIGINAL AND RECOMMENDED DESIGN

Original Design – 4 lanes w/ depressed median



Recommended Design – 2 + 1



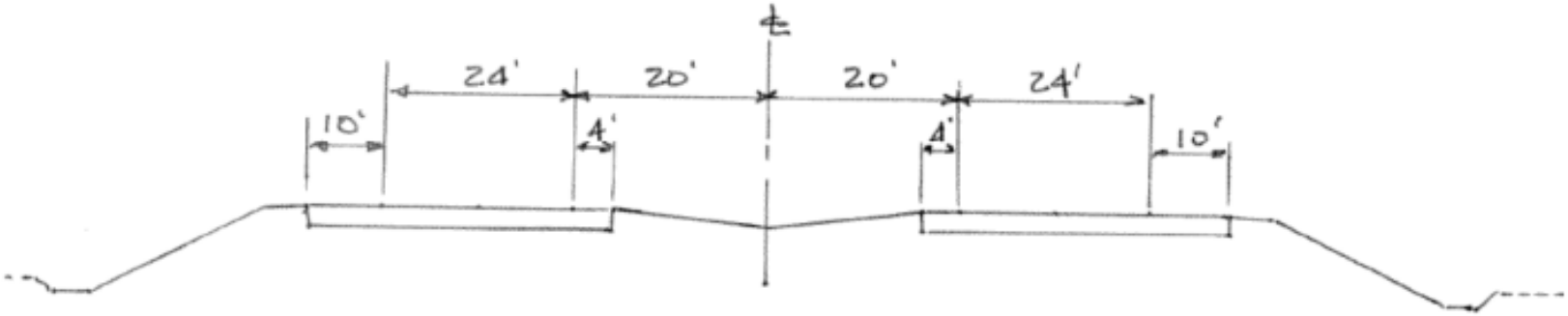
VALUE ENGINEERING RECOMMENDATION # VE-22

SKETCH OF RECOMMENDED DESIGN (EXAMPLE)

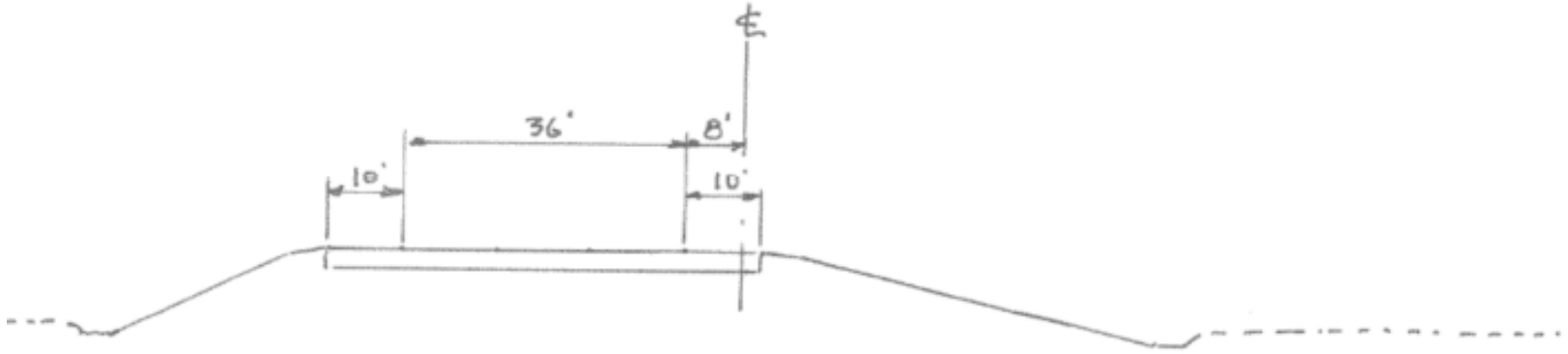
VALUE ENGINEERING RECOMMENDATION # VE-22

SKETCH OF ORIGINAL AND RECOMMENDED DESIGN

Original Design



Recommended Design



VALUE ENGINEERING RECOMMENDATION # VE-22

COST ESTIMATE - FIRST COST

Cost Item	Units	$/Unit	Source Code	Original Design		Recommended Design	
				Num of Units	Total $	Num of Units	Total $
Excavation (80%)	CY	$3.75	1	647,500	$2,428,125	518,000	$1,942,500
Embankment-in-place (80%)	CY	$5.00	1	2,775,000	$13,875,000	2,220,000	$11,100,000
Pipe drainage, etc.	LS	$2,042,600	1	1	$2,042,600	0.8	$1,634,080
Bridge over Dix River	LS	$5,300,000	1	1	$5,300,000	0.8	$4,240,000
Pavement striping, signs, etc.	LS	$373,150	1	1	$373,150	0.8	$298,520
Guardrail and end treatments	LS	$1,213,450	1	1	$1,213,450	0.7	$849,415
Pavement - mainline (80%)	SY	$60.00	1	335,250	$20,115,000	268,200	$16,092,000
Pavement - other (90%)	SY	$45.00	1	223,350	$10,050,750	201,015	$9,045,675
Miscellaneous construction pavement	LS		1	1	$3,784,849	1	$3,009,677
Unit Costs shown herein were derived from the Estimate of Approximate Construction Costs, generally by averaging the values for Alternatives 1 and 2. Considered 50% Segment 1 plus all of Segments 2 and 3.							
Total					$59,182,924		$48,211,867

SOURCE CODE: 1 Project Cost Estimate
2 KYTC Average Bid
3 CACES Data Base
4 Means Estimating Manual
5 National Construction Estimator
6 Vendor Lit or Quote (list name / details)
7 Professional Experience (List job if applicable)
8 Other Sources (specify)

VALUE ENGINEERING DESIGN COMMENT # VE-23

DESCRIPTIVE TITLE OF DESIGN COMMENT:
Reduce the shoulder pavement thickness in lieu of current design depth.

COMMENTARY:
Utilize the less than mainline pavement thickness on the shoulders. The typical section provided shows the shoulder pavement thickness the same as the mainline pavement thickness. This could save substantial cost in construction.

VALUE ENGINEERING DESIGN COMMENT # VE-24

DESCRIPTIVE TITLE OF DESIGN COMMENT:
Prioritize the Lancaster Bypass to be the first section of roadway constructed.

COMMENTARY:
Given that funding for the entire project might not be currently available, it may be beneficial prioritize the Lancaster Bypass to be the first section of roadway constructed. This will help alleviate the bottleneck and slow speeds for long-distance travel in the City of Lancaster. Other parts could be constructed later as need and funds become available.

VALUE ENGINEERING DESIGN COMMENT # VE-25

DESCRIPTIVE TITLE OF DESIGN COMMENT:
Review construction phasing priorities and establish segment termini.

COMMENTARY:
Given that a need for transportation improvements currently exists but funding for the entire project might not be currently available, it might be beneficial to construct a portion of the project now and other parts later as funds become available. If subsequent segments of the project are years away, then it may be good to review construction phasing priorities and establish segment termini that are logical for long term use.

VALUE ENGINEERING DESIGN COMMENT # VE-26

DESCRIPTIVE TITLE OF DESIGN COMMENT:
Demolish or deed the old Dix River structure to the county to reduce future KYTC maintenance.

COMMENTARY:
If the county wants the bridge to remain open to traffic, they should maintain it. If not, the time to demolish it is with the construction project. This will add only about 1 mile of adverse travel for people on the north side of the Dix River to access Stanford, and vice versa.

VALUE ENGINEERING DESIGN COMMENT # VE-27

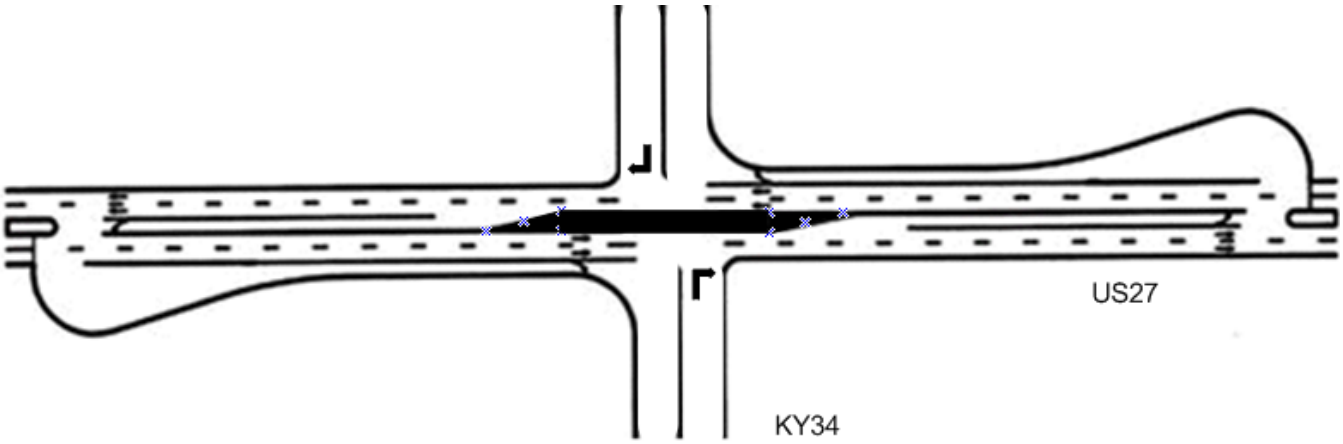
DESCRIPTIVE TITLE OF DESIGN COMMENT:
Bridge over buried utility lines in lieu of relocating utilities.

COMMENTARY:
The preferred alternative for the reconstruction of US27 crosses gas transmission lines multiple times throughout the project length. Although these facilities are buried, the large volume of proposed fill along with general construction impacts requires possible utility relocation and/or casing of the pipes. This contributes to a high utility cost for the length of this project. The project is early in the design process causing uncertainty and therefore contributing to conservative utility cost estimates. The design team expressed that the utilities prefer to avoid being spanned by structure, but given the high cost of relocation the VE Team believes this option should be fully vetted during the design process. The drawback of this approach is a lack of access for the utility as well as additional structure maintenance costs. Structures available to span the utilities include three-sided box culverts or small precast concrete beam structures.

VALUE ENGINEERING DESIGN COMMENT # VE-28

DESCRIPTIVE TITLE OF DESIGN COMMENT:
Convert the KY 34 and US 27 intersection to a superstreet design.

COMMENTARY:
Although this intersection lies on an adjacent project and is outside the scope of this project, the VE Team feels that it would be worthwhile to revisit the design of this important intersection. The purpose of the project is to create a more direct north-south transportation corridor and to provide for consistent travel speeds. This can only be done if traffic signals are not installed or minimized along the length of the corridor. Where they are absolutely necessary, the number of signal phases should be minimized and priority should be given to the mainline. A variation of the superstreet design helps support this function better in the long term than a conventional intersection with traffic signal.



APPENDICES

The appendices in this report contain backup information supporting the body of the report, and the mechanics of the workshop. The following appendices are included.

CONTENTS

APPENDIX A
Study Participants

APPENDIX A – Study Participants

Workshop Attendance

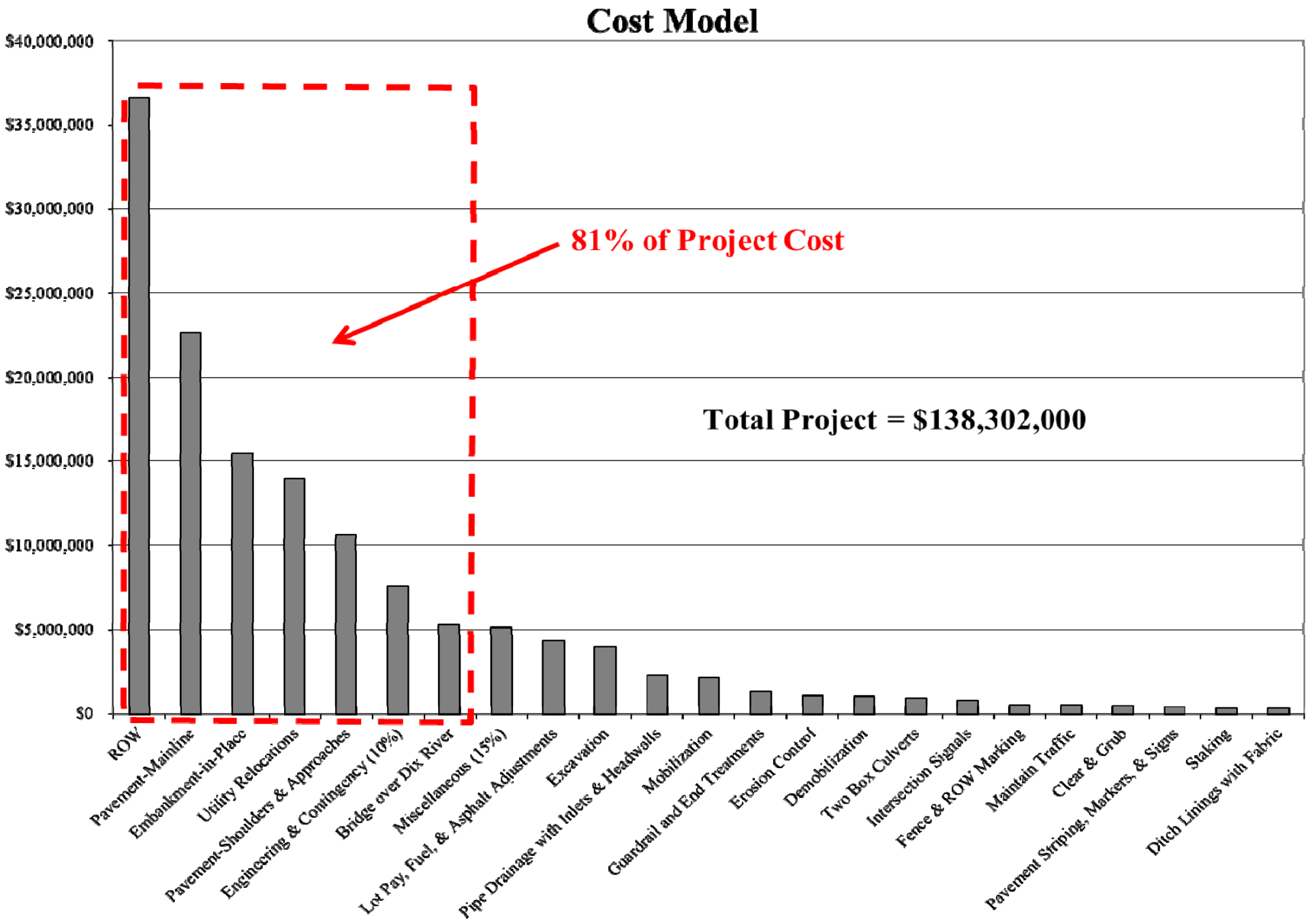
Name	Organization and Address (Organization first, with complete address underneath)	Tel # and Email (Tel first with Email underneath)	Role in Workshop	Participation						
				Meetings		Study Sessions				
				Intro	Out Brief	Day 1	Day 2	Day 3	Day 4	Day 5
Dwayne Beshear	Stantec	859-233-2100 Dwayne.beshear@stantec.com	Design Team	X	X					
Ananias Calvin, III	KYTC, District 7	859-246-2355	KYTC Project Manager	X	X					
Keith Caudill	KYTC 200 Mero Street Frankfort, KY 40602	502-564-3280	KYTC Central Office Location Engineer	X						
Stephen Curless	URS Corporation 36 East Seventh Street Cincinnati, OH 45202	513-419-3504 Steve.Curless@urs.com	VE Roadway Designer	X	X	X	X	X	X	X
Adam Dykes	URS Corporation 36 East Seventh Street Cincinnati, OH 45202	513-419-3486 Adam.Dykes@urs.com	VE Roadway Designer	X	X	X	X	X	X	X
Glenn Hardin	Stantec	859-233-2100 Glenn.hardin@stantec.com	Design Team	X	X					
Phil Logsdon	KYTC 200 Mero Street Frankfort, KY 40602	502-564-7250 Phil.logsdon@ky.gov	KYTC Environmental		X					
Brandon Lowe	WMB, Inc. 1950 Haggard Court Lexington, KY 40505	859-299-5226 Brandon@wmbinc.com	Design Team	X	X					
Bill Madden	URS Corporation 36 East Seventh Street Cincinnati, OH 45202	513-419-3513 William.f.madden@urs.com	VE Maintenance & Operations	X	X	X	X	X	X	X
Bob Nunley	KYTC, District 7	859-246-2355	KYTC Project Development Branch Manager	X	X					
Brian Rhodes	URS Corporation 36 East Seventh Street Cincinnati, OH 45202	513-419-3500 Brian.Rhodes@urs.com	VE Structural Engineer	X	X	X	X	X	X	X

Workshop Attendance

				Participation						
				Meetings		Study Sessions				
Name	**Organization and Address (Organization first, with complete address underneath)**	**Tel # and Email (Tel first with Email underneath)**	**Role in Workshop**	**Intro**	**Out Brief**	**Day 1**	**Day 2**	**Day 3**	**Day 4**	**Day 5**
Kyle Schafersman	URS Corporation 8300 College Boulevard, Suite 200 Overland Park, KS 66210	913-344-1019 Kyle.Schafersman@urs.com	VE Team Leader	X	X	X	X	X	X	X
Carl Shield	KYTC 200 Mero Street Frankfort, KY 40602	502-564-7250 Carl.shields@ky.gov	KYTC DEA		X					
Brent Sweger	KYTC 200 Mero Street Frankfort, KY 40602	502-564-3280 Brent.Sweger@ky.gov	KYTC VE Coordinator	X	X	X	X	X	X	X

APPENDIX B
Cost Information

APPENDIX B - Cost Information


Cost Model
$40,000,000
$35,000,000
$30,000,000
$25,000,000
$20,000,000
$15,000,000
$10,000,000
$5,000,000
$0
81% of Project Cost
Total Project = $138,302,000
ROW
Pavement-Mainline
Embankment-in-Place
Utility Relocations
Pavement-Shoulders & Approaches
Engineering & Contingency (10%)
Bridge over Dix River
Miscellaneous (15%)
Lot Pay, Fuel, & Asphalt Adjustments
Excavation
Pipe Drainage with Inlets & Headwalls
Mobilization
Guardrail and End Treatments
Erosion Control
Demobilization
Two Box Culverts
Intersection Signals
Fence & ROW Marking
Maintain Traffic
Clear & Grub
Pavement Striping, Markers, & Signs
Staking
Ditch Linings with Fabric

APPENDIX C
Function Analysis

APPENDIX C - Function Analysis

Function Model

Item	Cost	Function
Total Construction	$138,301,597	Relieve congestion on US 27 Improve corridor Move traffic Manage access
ROW	$36,621,000	Support corridor Accommodate construction
Pavement-Mainline	$22,685,280	Support vehicles Smooth surface Create durable wearing surface
Embankment-in-Place	$15,500,000	Raise roadbed Establish grade Smooth profile
Utility Relocations	$14,000,000	Maintain existing services Accommodate alignment
Pavement-Shoulders & Approaches	$10,667,550	Facilitate drainage Support mainline pavement Remove disabled vehicles from travel way Increase capacity Maintain connectivity
Engineering & Contingency (10%)	$7,575,545	Account for unknowns
Bridge over Dix River	$5,300,000	Span river valley
Miscellaneous (15%)	$5,105,273	Account for minor items
Lot Pay, Fuel, & Asphalt Adjustments	$4,349,595	Account for petroleum cost fluctuation
Excavation	$4,012,500	Lower roadbed Establish grade Smooth profile
Pipe Drainage with Inlets & Headwalls	$2,289,219	Convey water Drain median
Mobilization	$2,174,798	Mobilize equipment and labor
Guardrail and End Treatments	$1,360,450	Contain vehicles Prevent vehicle runoff Absorb energy
Erosion Control	$1,138,069	Mitigate impacts
Demobilization	$1,087,399	Demobilize equipment and labor
Two Box Culverts	$990,000	Convey water Maintain stream connectivity
Intersection Signals	$840,000	Assign ROW
Fence & ROW Marking	$562,494	Define ROW
Maintain Traffic	$525,000	Maintain traffic Create safe workzone
Clear & Grub	$484,006	Prepare site Dispose of vegetation
Pavement Striping, Markers, & Signs	$418,600	Direct traffic

Item	Cost	Function
Staking	$327,031	Define alignment
Ditch Linings with Fabric	$287,788	Reduce erosion

APPENDIX D
Creative Idea List and Evaluation

APPENDIX D - Creative Idea List and Evaluation

List of Creative Ideas			
ID #	**Name of Idea / Description**	**Develop Status**	**Team Member Responsible**
1	Install a wagon box to connect both sides of the park in lieu of severing park	2	B. Rhodes
2	Utilize a 5-lane urban section from the US 150 Bypass to the Dix River crossing on the existing alignment in lieu of a 4-lane grass median section	2	A. Dykes
3	Install a raised concrete median in lieu of a two-way left turn lane at the southern end (urban section) of the corridor	4	
4	Adjust the grade and profiles to reduce the amount of earthwork required	1	B. Madden
5	Utilize a 12-foot in lieu of a 14-foot center turn lane in the urban section at the southern end of the corridor	2	A. Dykes
6	Utilize an complete streets urban section in lieu of the typical section from Sta. 1190+00 to Sta. 1265+00	1	B. Sweger
7	Install a shared use path from US 150 Bypass to the Logan Hubble Park	4	
8	Install a shared use path from KY 52 to the Logan Hubble Park	4	
9	Install a shared use path from US 150 Bypass to KY 52	1	B. Sweger
10	Review the traffic forecast to improve the design criteria	DC	B. Madden
11	Remove the redundant driveways and provide access from side streets between Sta. 1190+00 and 1265+00	DC	B. Sweger
12	Utilize a 2-lane initial and 4-lane ultimate typical section for the portion north of the Lancaster Bypass	1	S. Curless
13	Utilize a 2-lane typical section for the Lancaster Bypass in lieu of a 4-lane typical section	1	S. Curless
14	Eliminate traffic signals throughout this project	3	
15	Utilize existing road alignment from Sta. 1700+00 to 1760+00 in lieu of new alignment	2	A. Dykes
16	Shift the Dix River crossing to the east of existing alignment to provide a shorter, 90-degree structure in lieu of a skewed structure	2	B. Rhodes & B. Madden
17	Utilize a 2-foot paved inside shoulder in lieu of a 4-foot paved inside shoulder	4	
18	Reduce all shoulder widths by 2-foot throughout the corridor	1	A. Dykes
19	Reduce the shoulder pavement thickness in lieu of the current design depth	DC	B. Madden
20	Utilize cap and column piers in lieu of “T” type columns	1	B. Rhodes
21	Reduce span length of the new Dix River crossing by eliminating access to Rankin Road	1	B. Rhodes
22	Adjust alignment of US 27 at Sta. 1467+00 to reduce the skew with box culvert	4	
23	Relocate stream at Sta. 1467+00 to reduce the skew with US 27	3	
24	Realign US 27 between Sta. 1580+00 to Sta. 1640+00 to more closely follow the existing alignment	3	
25	Demolish the old Dix River structure to reduce future maintenance	4	
26	Demolish or deed the old Dix River structure to the county to reduce future KYTC maintenance	DC	B. Madden

List of Creative Ideas			
ID #	**Name of Idea / Description**	**Develop Status**	**Team Member Responsible**
27	Stay on existing US 27 alignment and utilize a widened Dix River structure in lieu of a new structure on new alignment from Sta. 1300+00 to 1450+00	1	B. Rhodes & B. Madden
28	Develop an access management plan and memorandum of understanding (MOU) between KYTC and local governments	DC	B. Sweger
29	Utilize all right-in/right-out access for private driveways with strategic U-turn locations in lieu of full intersection access	DC	B. Sweger
30	Prioritize the Lancaster bypass to be the first section of roadway constructed	DC	S. Curless
31	Review construction phasing priorities and establish segment termini	DC	S. Curless
32	Utilize mechanically stabilized earth (MSE) walls at the Dix River structure in lieu of spill through slopes	3	
33	Bridge over buried utility lines in lieu of relocating utilities	DC	B. Rhodes
34	Utilize a superstreet intersection in lieu of a standard intersection at US 27 and KY 52	1	B. Sweger
35	Utilize an elevated roadway section from US 150 Bypass to just past Jaycees Park to reduce ROW and earthwork	4	
36	Utilize steeper side slopes outside of typical section in lieu of 2:1 slopes	4	
37	Utilize a 16-foot median with Jersey barrier in lieu of a 40-foot depressed grass median	1	A. Dykes
38	Utilize a 20-foot depressed median throughout project in lieu of a 40-foot depressed grass median	1	A. Dykes
39	Utilize a 16-foot depressed median throughout project in lieu of a 40-foot depressed grass median	4	
40	Utilize 11-foot lanes in lieu of 12-foot lanes for the urban section	2	A. Dykes
41	Include the KY 52 connector project within this project	4	
42	Steepen the roadway grade from Sta. 1335+00 to 1370+00 to 5% in lieu of 3%	with #4	B. Madden
43	Verify that all intersections with US 27 have adequate intersection sight distance	4	
44	Remove the US 27 access points at Boone Creek Road, Walker Road, Crimson Court, and at Sta. 1870+00	DC	B. Sweger
45	Improve KY 34 corridor in lieu of improving US 27 corridor	4	
46	Convert KY 34 to a superstreet at the intersection with US 27	DC	B. Sweger
47	Utilize a 2+1 lane ultimate configuration from Sta. 1280+00 to the KY 34 intersection	3	
48	Utilize a 2+1 lane configuration with ROW for a 4-lane ultimate section from Sta. 1280+00 to the KY 34 intersection	1	S. Curless
49	Utilize new construction from US 150 Bypass to Sta. 1250+00, the Lancaster bypass from Sta.1440+00 to Sta. 1640+00, and defer constructing the remainder of the project	1	S. Curless
50	Install a roundabout at the existing US 27 and the link to the new US 27 around approximately Sta. 1455+00	4	

List of Creative Ideas			
ID #	**Name of Idea / Description**	**Develop Status**	**Team Member Responsible**
51	Utilize a road diet (3 lanes in lieu of 4 lanes) on existing US 27 through downtown Lancaster	DC	B. Madden

Development Status Legend:

1: Idea is considered by the VE Team to be the best value enhancement possibility and is currently being developed as a VE recommendation

2: Idea is considered by the VE Team to be a good value enhancement possibility and will be developed as a VE recommendation after all the “1s” have been developed

3: Idea is considered by the VE Team to be of marginal value enhancement possibility and may be developed as a VE recommendation after all the “1s” and “2s” have been developed

4: Idea was not considered to enhance the value of the project and has been eliminated from further consideration by the VE Team

DC: Idea is being developed as a Value Engineering Design Comment to the designers with no easily quantifiable cost associated

APPENDIX E
VE Punch List

APPENDIX E – VE Punch List

VALUE ENGINEERING PUNCH LIST

ITEM NO. **7-196.00** PROJECT COUNTIES: **Lincoln, Garrard** DATE OF STUDY: **5/7/2012 to 5/11/2012** **VE # 201204**

VE Alternative Number	VE Team Top Pick	Description	Activity* (Y, N, UC-Date)	Implemented Life Cycle Cost Savings	Original Cost	Alternative Cost	Initial Cost Saving	Life Cycle Cost Savings (Total Present Worth)	FHWA Categories	Remarks
Roadway										
VE-3		Utilize a superstreet intersection in lieu of a standard intersection at US 27 and KY 52			$0	$5,000	($5,000)	NA	Saf, Ops	
VE-4	✓-1	Utilize a complete street urban section in lieu of the typical section from approximately Sta. 1190+00 to 1265+00			$1,283,000	$2,078,000	($795,000)	NA	Saf	
VE-5	✓-1	Install a shared use path from US 150 Bypass to KY 52			$0	$536,000	($536,000)	NA	Saf, Env	
VE-10	✓-1	Stay on existing US 27 alignment and utilize a widened Dix River structure in lieu of a new structure on new alignment from Sta. 1300+00 to 1450+00			$37,700,000	$7,416,000	$30,284,000	$30,120,000	Ops, Env, Con	
VE-11		Utilize a 5-lane urban section on the existing alignment from the US 150 Bypass through Dix River structure and tie-in to the baseline alternative at Sta. 1300+00 in lieu of a 4-lane grass median section			$26,313,000	$21,475,000	$4,838,000	$4,674,000	Ops, Env, Con	
VE-12	✓-2	Adjust the grade and profiles to reduce the amount of earthwork required			$22,013,000	$19,920,000	$2,093,000	NA	Env, Oth	
VE-13	✓-2	Utilize existing road alignment from Sta. 1700+00 to 1760+00 in lieu of new alignment			$16,687,000	$15,287,000	$1,400,000	NA	Env, Oth	
VE-14	✓-2	Utilize a 12-foot in lieu of a 14-foot center turn lane in the urban section at the southern end of the corridor			$19,739,000	$19,602,000	$137,000	NA	Oth, Env	
VE-15	✓-2	Utilize 11-foot lanes in lieu of 12-foot lanes for the urban section			$14,469,000	$14,263,000	$206,000	NA	Oth, Env	

VALUE ENGINEERING PUNCH LIST

ITEM NO. **7-196.00** PROJECT COUNTIES: **Lincoln, Garrard** DATE OF STUDY: **5/7/2012 to 5/11/2012** **VE # 201204**

VE Alternative Number	VE Team Top Pick	Description	Activity* (Y, N, UC-Date)	Implemented Life Cycle Cost Savings	Original Cost	Alternative Cost	Initial Cost Saving	Life Cycle Cost Savings (Total Present Worth)	FHWA Categories	Remarks
VE-16	✓-2	Reduce all paved shoulder widths by 2 feet throughout the corridor			$47,291,000	$43,899,000	$3,392,000	NA	Oth, Env	
VE-17	✓-2	Utilize a 20-foot depressed median in lieu of a 40-foot depressed grass median			$898,000	$0	$898,000	NA	Oth, Env	
VE-19		Utilize new construction from US 150 Bypass to Sta. 1250+00, the Lancaster bypass from Sta. 1440+00 to Sta. 1640+00, and defer constructing the remainder of the project			$67,557,000	$0	$67,557,000	NA	Ops, Oth	
VE-20	✓-1	Utilize a 2-lane initial and 4-lane ultimate typical section for the portion north of the Lancaster Bypass			$21,163,000	$15,617,000	$5,546,000	NA	Ops, Oth	
VE-21	✓-1	Utilize a 2-lane typical section for the Lancaster Bypass in lieu of a 4-lane typical section			$31,605,000	$23,151,000	$8,454,000	NA	Ops, Oth	
VE-22		Utilize a 2+1 lane initial with ROW for a 4-lane ultimate section from Sta. 1250+00 to the KY 34 intersection			$59,183,000	$48,212,000	$10,971,000	NA	Ops, Oth	
Structures										
VE-6	✓-2	Install a wagon box to connect both sides of the park in lieu of severing park			$0	$336,000	($336,000)	NA	Con, Env	
VE-7	✓-2	Utilize cap and column piers in lieu of a hammerhead piers			$1,237,000	$624,000	$613,000	NA	Con, Oth	
VE-8	✓-2	Reduce span length of the new Dix River crossing by eliminating access to Rankin Road			$5,300,000	$4,815,000	$485,000	NA	Con, Oth	

VALUE ENGINEERING PUNCH LIST

ITEM NO. **7-196.00** PROJECT COUNTIES: **Lincoln, Garrard** DATE OF STUDY: **5/7/2012 to 5/11/2012** **VE # 201204**

VE Alternative Number	VE Team Top Pick	Description	Activity* (Y, N, UC-Date)	Implemented Life Cycle Cost Savings	Original Cost	Alternative Cost	Initial Cost Saving	Life Cycle Cost Savings (Total Present Worth)	FHWA Categories	Remarks
VE-9		Shift the Dix River crossing to the east of existing alignment to provide a shorter, 90-degree structure in lieu of a skewed structure			$19,340,000	$17,020,000	$2,320,000	NA	Oth, Con, Env	
Other Design Comments										
VE-1		Utilize up to date traffic forecasts in lieu of old forecasts used in previous reports			NA	NA	NA	NA	Ops	
VE-2		Develop an access management plan and memorandum of understand (MOU) for the corridor. Remove unnecessary and redundant connections to US 27, make all private driveway right-in/right-out access, and create strategic U-turn locations along the corridor			NA	NA	NA	NA	Saf, Ops	
VE-18		Utilize a road diet (3 lanes in lieu of 4 lanes) on existing US 27 through downtown Lancaster			NA	NA	NA	NA	Saf, Ops	
VE-23		Reduce the shoulder pavement thickness in lieu of the current design depth			NA	NA	NA	NA	Oth	
VE-24		Prioritize the Lancaster bypass to be the first section of roadway constructed			NA	NA	NA	NA	Ops, Con	
VE-25		Review construction phasing priorities and establish segment termini			NA	NA	NA	NA	Ops, Con	
VE-26		Demolish or deed the old Dix River structure to the county to reduce future KYTC maintenance			NA	NA	NA	NA	Oth	
VE-27		Bridge over buried utility lines in lieu of relocating utilities			NA	NA	NA	NA	Con	

VALUE ENGINEERING PUNCH LIST

ITEM NO. **7-196.00** PROJECT COUNTIES: **Lincoln, Garrard** DATE OF STUDY: **5/7/2012 to 5/11/2012** **VE # 201204**

VE Alternative Number	VE Team Top Pick	Description	Activity* (Y, N, UC-Date)	Implemented Life Cycle Cost Savings	Original Cost	Alternative Cost	Initial Cost Saving	Life Cycle Cost Savings (Total Present Worth)	FHWA Categories	Remarks
VE-28		Convert the KY 34 and US 27 intersection to a superstreet design			NA	NA	NA	NA	Saf, Ops	
					Saf 6 Ops 13 Env 11 Con 9 Oth 15					

* Y=yes, N=no, UC=under construction

APPENDIX F
Rejected Recommendations

APPENDIX F – Rejected Recommendations

Rejected Recommendations

Occasionally, an idea that was originally selected for development into a recommendation is found to not achieve the desired result or potential savings expected. During the development phase some items are found to have fatal flaws or other strong reasons for rejection. Since a portion of the development has already been completed, the VE Team would like to share this information with the owner and design team. If one of these ideas is proposed in the future, the analysis in this section can be referenced as justification for rejection. These additional two comments are presented for informational purposes only. The VE Team does not recommending these ideas.

REJECTED RECOMMENDATION # 1

DESCRIPTIVE TITLE OF RECOMMENDATION:
Utilize a 16-foot median with Jersey barrier in lieu of a 40-foot depressed grass median.

ORIGINAL DESIGN:
The original US 27 design applies a rural 4-lane typical section with a 40-foot depressed grass median. The rural section begins approximately at Sta. 1250+00 and continues throughout the remainder of the corridor.

RECOMMENDED CHANGE:
The VE Team recommends using a 4-lane typical section with a 16-foot median and Jersey barrier to replace the 40-foot depressed median. This typical section shall begin approximately at Sta. 1250+00 and continue throughout the remainder of the corridor.

ADVANTAGES:
- Reduce ROW
- Control access
- Prevent crossover accidents

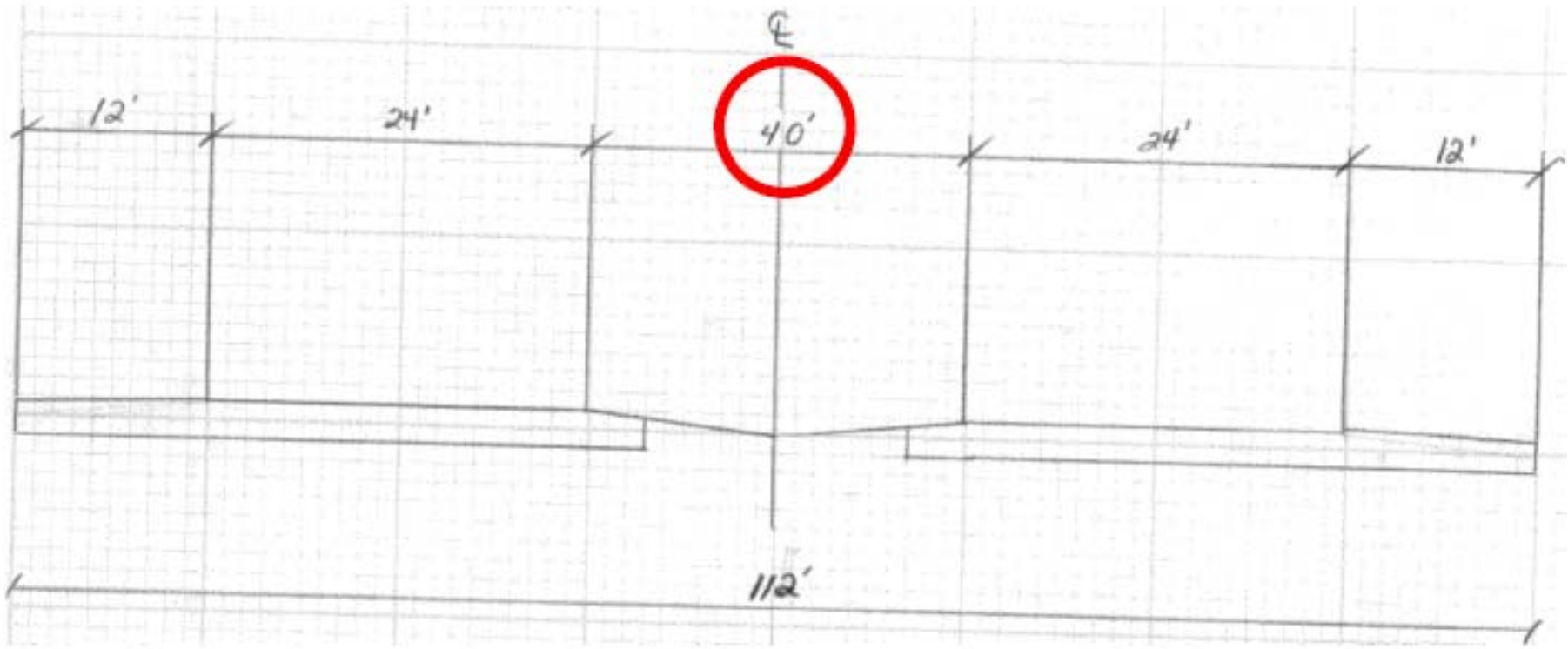
DISADVANTAGES:
- Permanent fixed object for conflict
- Additional cost for barrier

JUSTIFICATION:
After further evaluation from the VE Team, our conclusion is the cost of the barrier does not justify this recommendation. The cost of median barrier far exceeds any cost savings from reducing the typical section to minimalize ROW impacts.

SUMMARY OF COST ANALYSIS			
	First Cost	O & M Costs (Present Worth)	Total LC Cost (Present Worth)
ORIGINAL DESIGN	$36,621,000	$0	$36,621,000
RECOMMENDED DESIGN	$38,128,000	$0	$38,128,000
ESTIMATED SAVINGS OR (COST)	($1,507,000)	$0	($1,507,000)

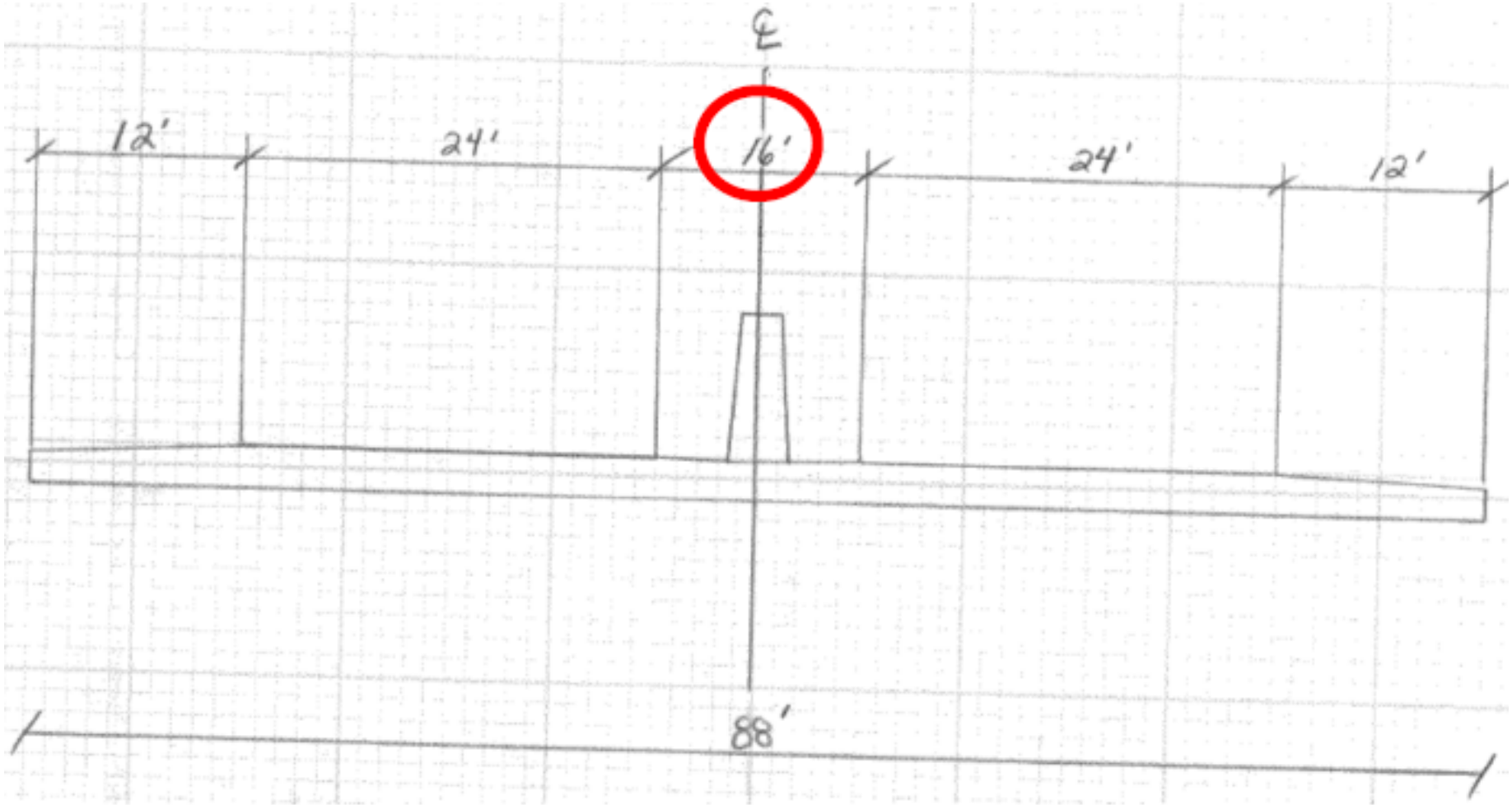
REJECTED RECOMMENDATION # 1

SKETCH OF ORIGINAL DESIGN



REJECTED RECOMMENDATION # 1

SKETCH OF RECOMMENDED DESIGN



REJECTED RECOMMENDATION # 1

CALCULATIONS

The VE Team assumes the reduction of ROW by reducing the typical section to 88 feet from the proposed 112 feet. The following describes the breakdown of the cost savings by segment:

Segment 1:
Begin Project thru Proposed 5-lane Section (unchanged) – $6.7 Million
Rural Section - $10.05 Million x 0.95 = approximately $9.55 Million

Segment 2:
Rural Section - $11.06 Million x 0.95 = approximately $10.51 Million

Segment 3:
Rural Section - $8.8 Million x 0.95 = approximately $8.36 Million

New ROW total = approximately $35.11 Million

This 5% ROW reduction along the rural portion of the project will reduce one of the large budget items. This recommendation will also add the cost to include a permanent barrier.

REJECTED RECOMMENDATION # 1

COST ESTIMATE - FIRST COST

Cost Item	Units	$/Unit	Source Code	Original Design		Recommended Design	
				Num of Units	Total $	Num of Units	Total $
ROW	LS	$36,621,000	1	1	$36,621,000	0.95	$34,789,950
Concrete barrier	LF	$55.00	2			60,700	$3,338,500
Total					$36,621,000		$38,128,450

SOURCE CODE: 1 Project Cost Estimate
2 KYTC Average Bid
3 CACES Data Base
4 Means Estimating Manual
5 National Construction Estimator
6 Vendor Lit or Quote (list name / details)
7 Professional Experience (List job if applicable)
8 Other Sources (specify)

END OF REPORT

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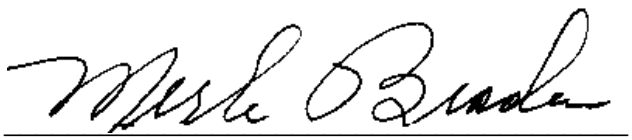

Approved by Merle Braden, PE, CVS-Life (URS)