Value Engineering Study

I-65 WIDENING

FROM MUNFORDVILLE TO ELIZABETHTOWN
HART-LARUE-HARDIN COUNTIES, KENTUCKY

ITEM NUMBER 4-15.00, 4-16.00, 4-17.00, 4-18.00, 4-19.00
VE STUDY NUMBER 201302

Study Date: July 22-26, 2013

Kentucky Transportation Cabinet
Frankfort, Kentucky

URS

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HART-LARUE-HARDIN COUNTIES, KENTUCKY

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VALUE ENGINEERING STUDY
for
Kentucky Transportation Cabinet
Frankfort, Kentucky

Study Date: July 22-26, 2013

Final Report

August 23, 2013

URS

EXECUTIVE SUMMARY

General

URS conducted a value engineering (VE) study of the I-65 Widening from Munfordville to Elizabethtown in Hart-Larue-Hardin Counties, Kentucky. The Item Numbers (Nos.) are 4-15.00, 4-16.00, 4-17.00, 4-18.00, and 4-19.00. The topic was the 70% design submission prepared by the Parsons Brinckerhoff 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 $239,932,000. 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, 55 creative ideas were identified; 15 of these ideas were developed into VE recommendations and 16 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 a mutually exclusive scenario to represent a range recommendations and potential cost savings. This scenario comprised a combination of individual recommendations as shown in the Summary of VE Recommendation table. The VE Team's Selected Combination represents an estimated potential cost savings of $23,126,000 in first cost and $76,000 over a 50 year life-cycle. Total cost savings realized will be based upon the final implementation status of these VE recommendations.

SUMMARY OF RECOMMENDATIONS					
DESCRIPTION		PRESENT WORTH AMOUNTS			
Rec #	Recommendation Title / Description	1st cost savings (or cost)	O & M savings (or cost)	Total LCC savings (or cost)	VE Selected Combo
VE-1	Verify traffic projections for this corridor in lieu of assuming ~75,000 ADT	Comment		Comment	X
VE-2	Assuming ~55,000 ADT (2035), use thinner asphalt pavement section with a thicker base section in lieu of current design	$11,540,000		$11,540,000	X
VE-3	Construct vertical clearances for maximum asphalt overlay, but only install the amount of asphalt needed for next 10 years and add additional overlay in the future if necessary	$2,787,000		$2,787,000	X
VE-4	Take into account the recent asphalt overlay from MP 78 to MP 91 performed in 2011 when determining new overlay thickness	$1,706,000		$1,706,000	X
VE-5	According to the geotechnical investigation of 2001, eliminate soil stabilization throughout project	$4,219,000		$4,219,000	
VE-6	Use geogrid in lieu of cement stabilization	$1,451,000		$1,451,000	X
VE-7	Use guardrail in lieu of rock cut in the clear zone where applicable (i.e. Sta. 3390+50 to Sta. 3395+00)	$510,000		$510,000	X
VE-8	Use 6 ft shoulders in lieu of 12 ft shoulders for the reconstructed US-31W overpass bridge	$483,000		$483,000	X
VE-9	At Old Sonora Road, KY 1407, and KY 1136, replace overpass bridges with bridges similar to existing width (~24 ft) in lieu of 32 ft wide bridges	$593,000		$593,000	X*
VE-10	Reconstruct KY 84 as a 3-lane corridor and bridge with shoulders in lieu of a new 5-lane corridor and bridge with shoulders	$907,000		$907,000	X
VE-11	Close Old Sonora Road in lieu of reconstructing an overpass bridge	$1,093,000	$76,000	$1,169,000	X
VE-12	Use a shorter single span structure for the Rhudes Creek Road underpass in lieu of a 3-span mainline bridge	$366,000		$366,000	X
VE-13	Increase beam spacing to reduce a beam line for the KY 728, KY 84, Rhudes Creek Road, and Nolin bridges	$245,000		$245,000	X**

SUMMARY OF RECOMMENDATIONS					
DESCRIPTION		PRESENT WORTH AMOUNTS			
Rec #	Recommendation Title / Description	1st cost savings (or cost)	O & M savings (or cost)	Total LCC savings (or cost)	VE Selected Combo
VE-14	Reuse the substructures on the Old Sonora Road, KY 1407, and KY 1136 bridges in lieu of a full replacement	$1,390,000		$1,390,000	
VE-15	Use a 2-span bridge in lieu of a 4-span bridge to eliminate outside piers where possible	$1,206,000		$1,206,000	X***
VE-16	Replace ROW fence only as needed in lieu of full fence removal and replacement	$1,223,000		$1,223,000	X
VE-17	For extremely flat sections, slope the center lane or the entire roadway toward the outside in lieu of toward the median	Comment		Comment	
VE-18	Review the cost estimate for redundancy between 10% miscellaneous cost and 15% contingency mark-up	Comment		Comment	
VE-19	Use a staggered asphalt lift joints in lieu of placing joints along wheel path	Comment		Comment	
VE-20	Use excess material to fill adjacent embankments in lieu of wasting material and installing guardrail in applicable locations	Comment		Comment	
VE-21	Close US-31W during construction in lieu of maintaining traffic during construction	Comment		Comment	
VE-22	Use a traditional temporary bridge support system during construction of the KY 224 overpass bridge in lieu of the unique single column pier	Comment		Comment	
VE-23	Use round columns in lieu of square columns for bridge piers	Comment		Comment	
VE-24	Use mechanically stabilized earth (MSE) walls in lieu of sloped embankment to shorten bridge spans and superstructure	Comment		Comment	
VE-25	Verify if the additional asphalt weight will impact the KY 2756 tunnel and/or farm lane access tunnel at Sta. 347+50	Comment		Comment	
VE-26	Allow alternate bidding of concrete versus asphalt	Comment		Comment	
VE-27	Provide concrete barrier median openings for emergency access	Comment		Comment	
VE-28	Use wet reflective pavement markings to improve driver visibility	Comment		Comment	

SUMMARY OF RECOMMENDATIONS					
DESCRIPTION		PRESENT WORTH AMOUNTS			
Rec #	Recommendation Title / Description	1st cost savings (or cost)	O & M savings (or cost)	Total LCC savings (or cost)	VE Selected Combo
VE-29	Provide truck parking areas at the old rest stops within the project to reduce driver fatigue related accidents	Comment		Comment	
VE-30	Install median footings as shallow as possible to reduce median excavation	Comment		Comment	
VE-31	Use some of the unspent funds that have been saved from implementation of VE recommendations on aesthetic and/or environmental enhancements	Comment		Comment	
	Summary of VE Team Selected Combination	**23,126,000**	**76,000**	**23,202,000**	

* If recommendation VE-11 is implemented, the cost savings associated with implementing recommendation VE-9 will be reduced to approximately $363,000.

** If recommendation VE-12 is implemented, the cost savings associated with implementing recommendation VE-13 will be reduced to approximately $155,000.

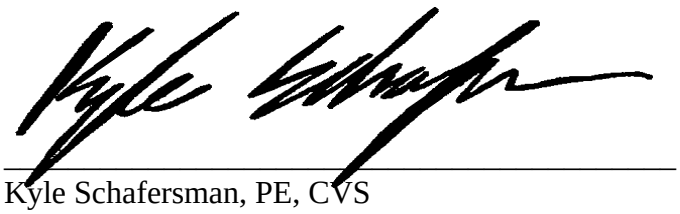
*** If recommendations VE-10 and VE-11 are implemented, the cost savings associated with implementing recommendation VE-15 will be reduced to approximately $542,000.

Acknowledgments
A thank you is given to the staff members from the Kentucky Transportation Cabinet, and the Parsons Brinckerhoff Design Team for their participation. Special thanks are also extended to Ms. Boday Borres for her assistance with this study.

Value Engineering Study Team

Name	Discipline / Role	Organization	Telephone
Stephen Curless, PE	Roadway Designer	URS	513-419-3504
Craig Klusman, PE	Structural Engineer	URS	502-217-1502
Brian Meade, PE	Transportation Engineer	URS	502-569-2301
Kyle Schafersman, PE, CVS	VE Team Leader	URS	913-344-1019
Jason Ramler, PE	Highway Engineer	URS	513-419-3493
Eileen Vaughan, PE	Lessons Learned	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 I-65 Widening from Munfordville to Elizabethtown in Hart-Larue-Hardin Counties, Kentucky. The Item Numbers (Nos.) are 4-15.00, 4-16.00, 4-17.00, 4-18.00, and 4-19.00. The study was held at the KYTC offices in Frankfort, KY on July 22-26, 2013. 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

KYTC proposes widening Interstate-65 (I-65) from Munfordville to Elizabethtown in Hart-Larue-Hardin Counties, Kentucky. The project includes the following:

I-65 Mainline (MP 64.9 to MP 91.1) – 26.2 miles:

- I-65 widened to inside with median barrier wall to provide for 6-lane facility
- Pavement overlay (~7½ in.) provided for existing I-65 pavement
- Clear zone provided for all ditches in cut slopes
- ADT (present) ~ 40,000 / ADT (2025) ~75,000 / ADTT (2025) ~40%

Interchanges:

1. I-65 and KY 728 (Bonnieville)
   - Existing flopped diamond configuration maintained
   - Minimal re-construction at ramp gore areas
   - KY 728 4-span overpass replaced on same alignment (KY 728 closed during construction)

2. I-65 and KY 224 (Upton)
   - Existing diamond configuration maintained
   - Ramps and terminals re-constructed and portion of ramps to be overlayed
   - KY 224 4-span overpass replaced with shift of alignment and phased construction

3. I-65 and KY 84 (Sonora)
   - Existing diamond configuration maintained
   - Ramps and terminals re-constructed and portion of ramps to be overlayed
   - KY 84 4-span overpass replaced on new alignment
   - KY 84 widened to 4 lanes with turn lanes and signalized terminals

4. I-65 and Western Kentucky Parkway (Elizabethtown)
   - Tie-in with minimal reconstruction at ramp gore areas

5. All Interchanges
   - Replace lighting with high mast
   - All new interchange overpasses will be 4-span with PCIBs or HN PCIBs

Other Crossroad Overpasses:

1. US 31W
   - Existing 4-span bridge replaced at same location on same alignment with phased construction to maintain at least one lane of traffic during construction

2. Old Sonora Road
   - Existing 4-span bridge replaced at same location on same alignment, and Old Sonora Road overpass closed during construction

3. KY 1407
   - Existing 4-span bridge replaced at same location on same alignment, and KY 1407 overpass closed during construction

4. KY 1136
- Existing 4-span bridge replaced at same location on same alignment, and KY 1136 overpass closed during construction

5. All New Crossroad Overpasses
- 4-span with PCIBs or HN PCIBs

I-65 Mainline Bridges:

1. Bridge Over Bacon Creek
- Existing 3-span layout maintained and existing piers reused

2. Bridge Over Nolin River
- Existing 6-span revised to 3-span of same length and existing piers reused

3. Bridge Over Rhudes Creek Road
- Existing 3-span layout maintained and existing piers reused

4. All Mainline Bridges
- All superstructure to be replaced with PCIBs or HN PCIBs
- Phased construction to maintain 2 lanes in each direction

Other Issues:

1. Southbound Weigh Station
- To be relocated in the future and minimal construction for a tie-in

2. AT&T Fiber Optic Line
- Runs along I-65 east ROW fence
- Likely impacted at KY 84, Old Sonora, KY 1407, and KY 1136

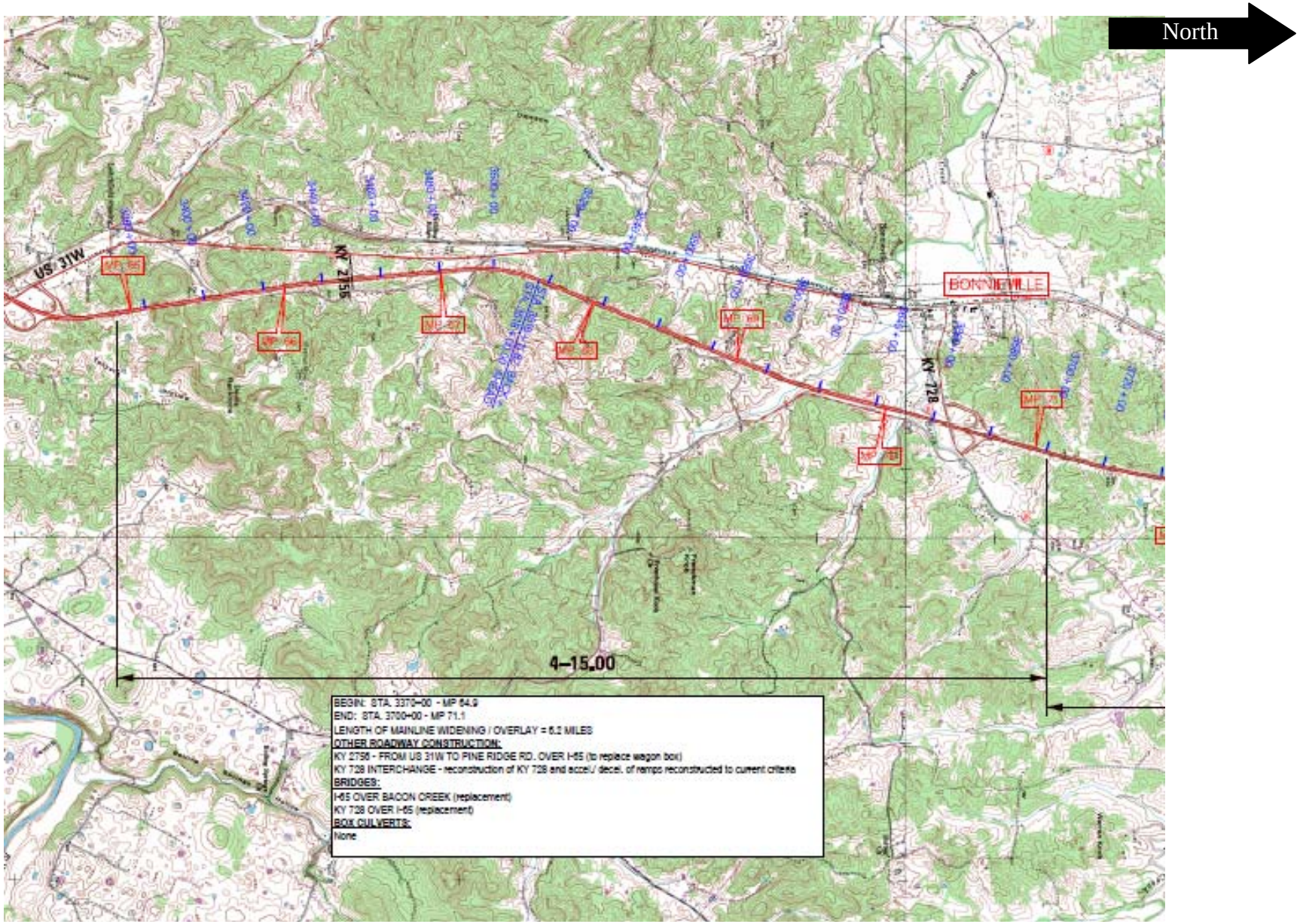
3. Karst Topography
- Over 300 sinkholes investigated and classified
- Open sinkholes receiving runoff to have permanent easements taken around them
- 10,000 gallon spill containment to be developed

Earthwork:
- Total Excavation = 806,000 CY
- Total Embankment = 334,000 CY
- Excess Excavation = 472,000 CY
- Rock excavation limited to 4-15.00, 4-16.00, and 4-17.00

ROW and Utility Relocations:
- Very minor along mainline
- Primary impacts at KY 84 and with minor impacts at other crossroads

Construction Cost Estimate:
- $240,000,000 (includes 15% contingency)
- Pavement costs based on pavement designs in 3-14.00

Manuscript Plan of Original Design (1 of 4)



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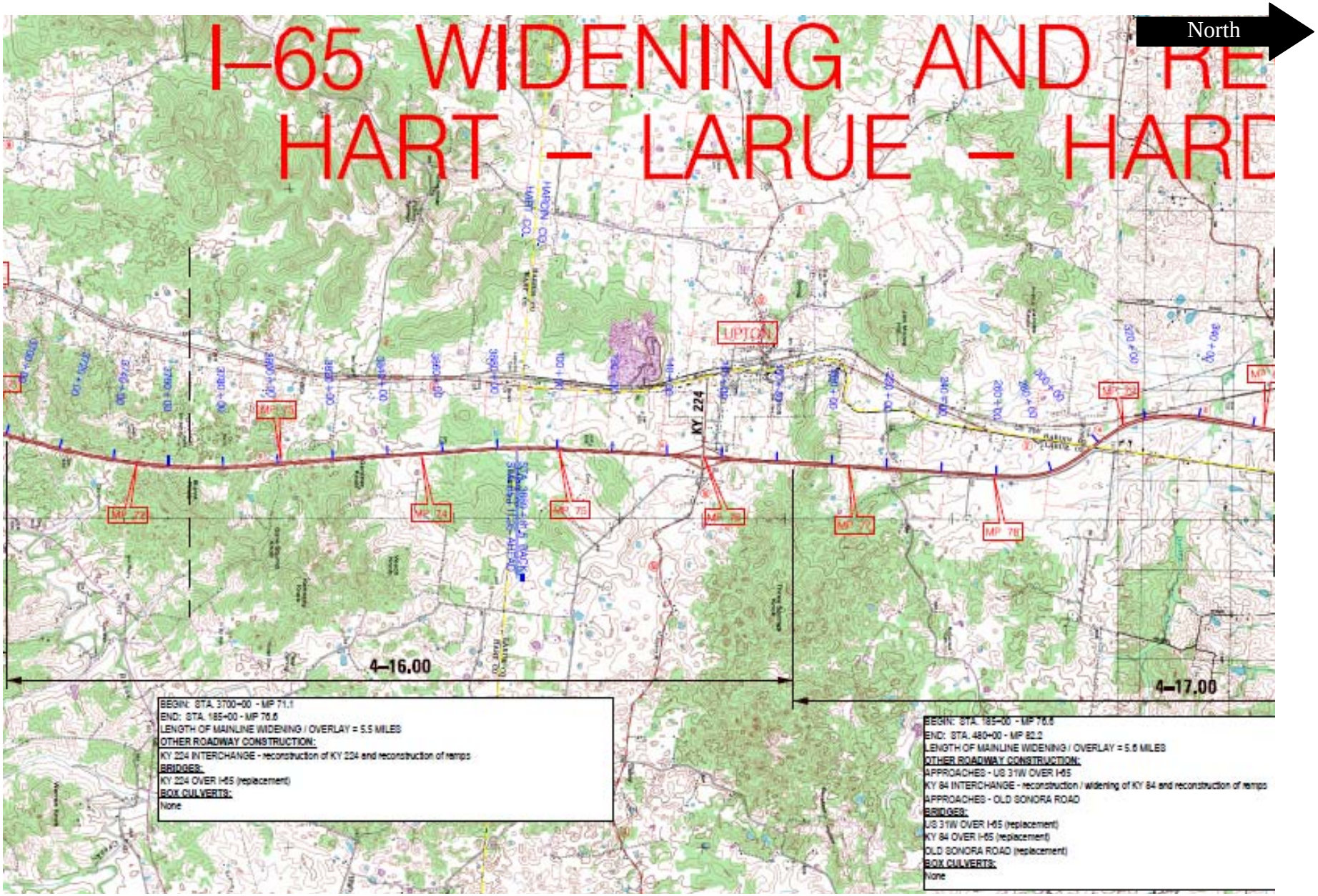

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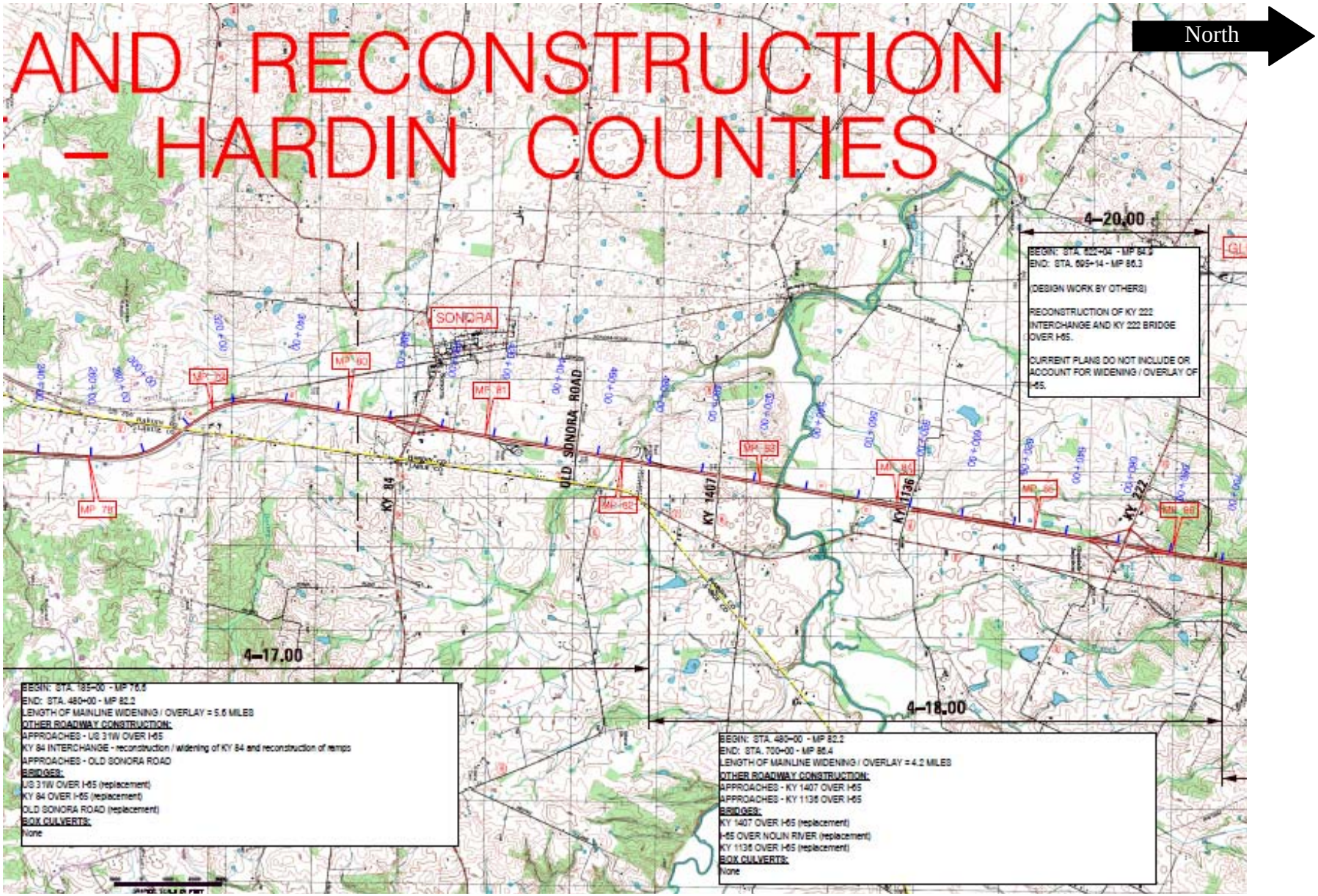

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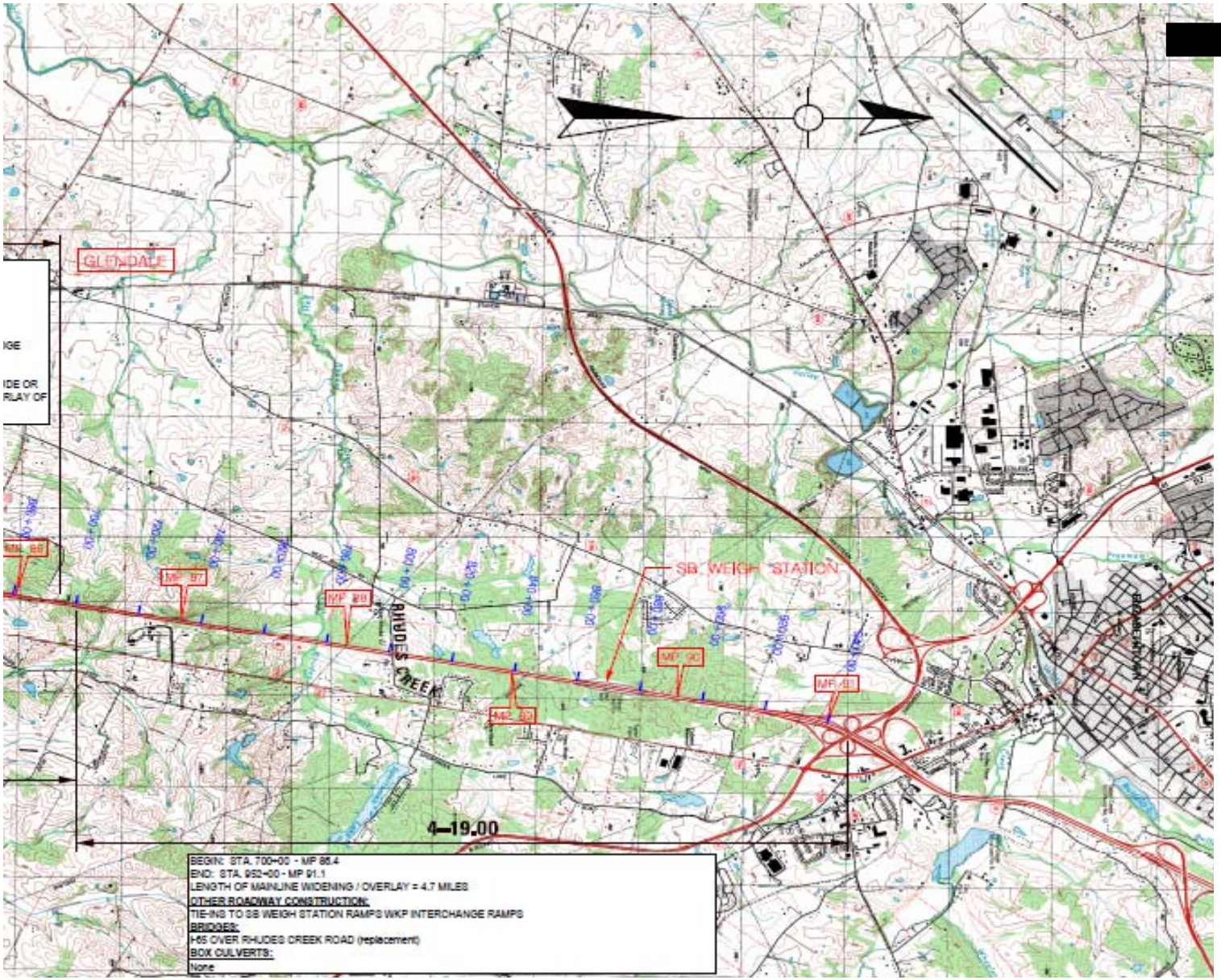
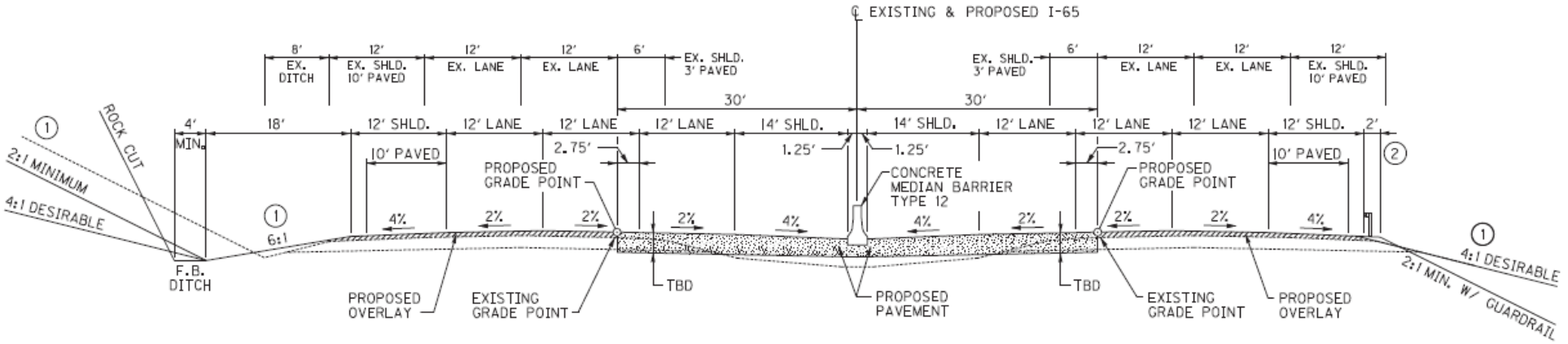
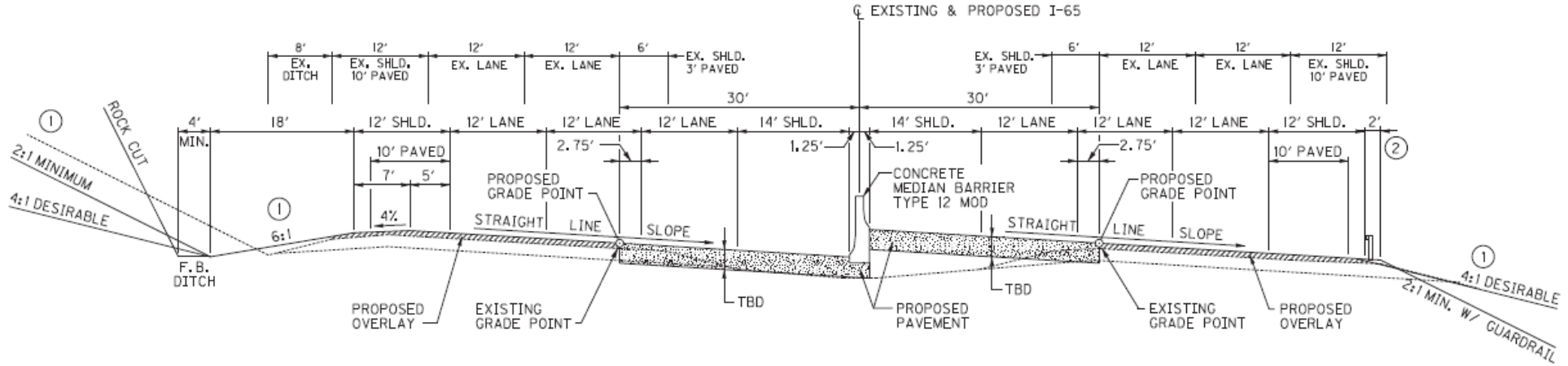


Typical Sections of Original Design



NORMAL CUT/FILL SECTION



SUPERELEVATED CUT/FILL SECTION

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 performed 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.

✓ VE Selected Scenario

VALUE ENGINEERING DESIGN COMMENT # VE-1

DESCRIPTIVE TITLE OF DESIGN COMMENT:
Verify traffic projections for this corridor in lieu of assuming ~75,000 ADT.

COMMENTARY:

The VE Team felt that the 75,000 ADT traffic projections may be unrealistic for 2025 based on the current traffic of approximately 38,000 ADT. The VE Team consulted with Daniel Hulker from the KYTC Planning Department. Daniel recently completed an update of the traffic projections for a large portion of this corridor. The draft report anticipates a growth rate of approximately 1% which results in a design year ADT (2035) in the range of 50,000 to 55,000 ADT. Existing truck percentage is 40% and is anticipated to remain approximately the same in the design year. The ESAL for this new forecast is approximately 63,000,000.

✓ VE Selected Scenario

VALUE ENGINEERING RECOMMENDATION # VE-2

DESCRIPTIVE TITLE OF RECOMMENDATION:
Assuming ~55,000 ADT (2035), use thinner asphalt pavement section with a thicker base section in lieu of current design.

ORIGINAL DESIGN:
The Design Team has not yet officially designed a pavement buildup for this project. However, pavement design has been estimated based on the construction project immediately south of this project corridor (Item 3-14.00) because the design ADT was expected to be the same (approximately 75,000).

The pavement buildup over the existing lanes is estimated to be 7.5 in. of asphalt overlay on the existing pavement of 11 in. asphalt and 12 in.-15 in. DGA (according to Design Team). Total average depth is 32 in. The structural number is approximately 7.8. The pavement buildup for the widened pavement in the median is estimated to be 16 in. asphalt, 10 in. drainage blanket, 6 in. DGA and 8 in. cement stabilized roadbed. Total depth is also 32 in. The structural number for the widened pavement is approximately 10.3. The proposed pavement depth matches the existing pavement depth to facilitate subgrade drainage.

RECOMMENDED CHANGE:
The VE Team recommends that the pavement buildup be evaluated for the current traffic projections of 55,000 ADT and approximately $63x10^6$ ESALs (see Design Comment VE-1) in lieu of the original 75,000 ADT. Required structural number would likely be between 7.83 (CBR 4) and 8.13 (CBR 3) with these projections according to preliminary calculations by Paul Looney of KYTC. Based on this, the VE Team recommends that the structural number of the widened pavement be reduced by changing the thicknesses of the layers as follows: 7.5 in. of asphalt, 12 in. Asphalt Drainage Blanket and 12.5 in. DGA. This would revise the structural number of this section to 8.2 while maintaining the same overall depth. The estimated asphalt overlay on the existing pavement may remain as estimated since the structural number of 7.8 is approximately equal to the required SN of 7.85 (for CBR 4) but may need to be increased if the CBR is 3.

ADVANTAGES:
- Reduces the amount of asphalt base

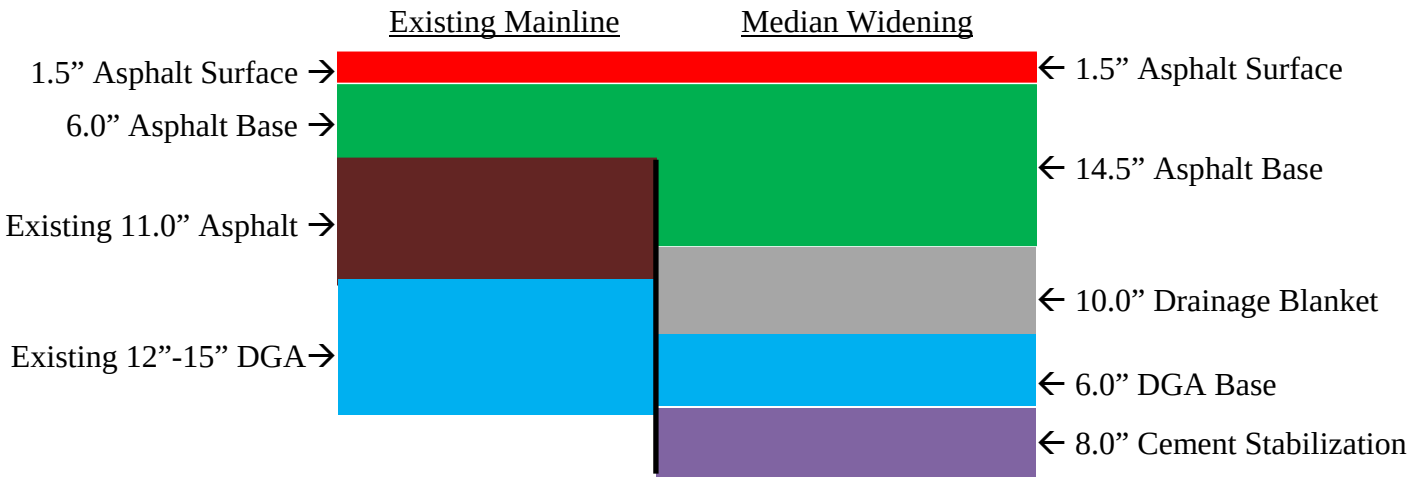
DISADVANTAGES:
- Reduces strength of widened pavement

JUSTIFICATION:
The widened pavement is overdesigned in comparison to the existing pavement with overlay. The original pavement buildup contains more asphalt base than aggregate base which provides unnecessary strength. Asphalt base costs twice as much as aggregate base. If the sole intent of the added thickness is to match the existing pavement thickness thereby facilitating drainage of the existing subbase, then the added thickness could be accomplished in less expensive layers without reducing the strength of the widened pavement below that provided by the existing (with overlay).

SUMMARY OF COST ANALYSIS			
	First Cost	O & M Costs (Present Worth)	Total LC Cost (Present Worth)
ORIGINAL DESIGN	$68,443,000	$0	$68,443,000
RECOMMENDED DESIGN	$56,903,000	$0	$56,903,000
ESTIMATED SAVINGS OR (COST)	$11,540,000	$0	$11,540,000

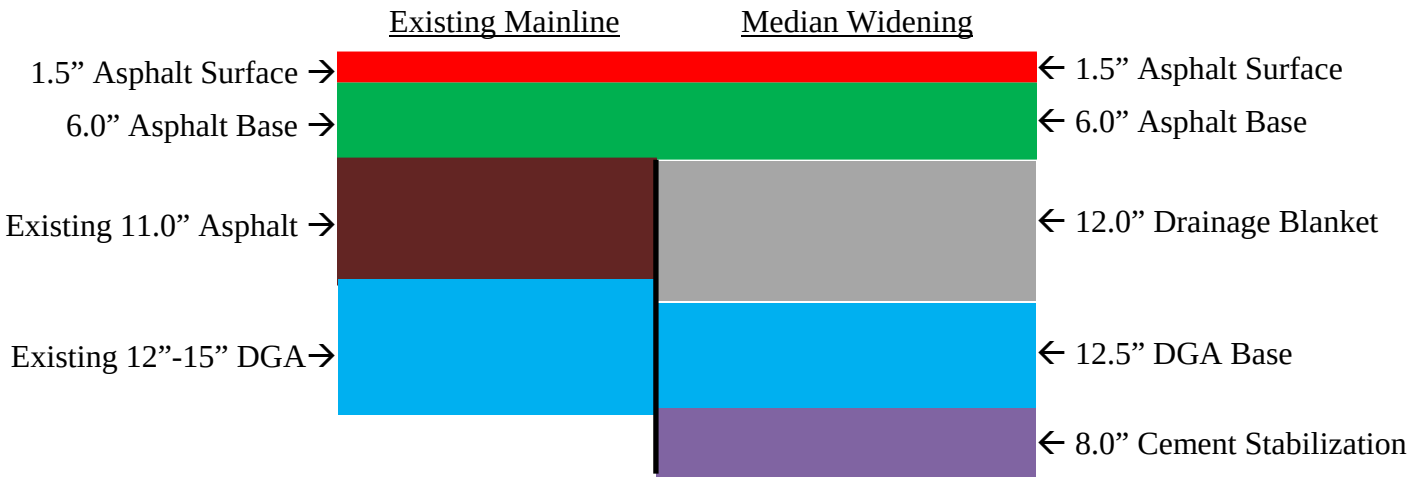
VALUE ENGINEERING RECOMMENDATION # VE-2

SKETCH OF ORIGINAL DESIGN



VALUE ENGINEERING RECOMMENDATION # VE-2

SKETCH OF RECOMMENDED DESIGN



VALUE ENGINEERING RECOMMENDATION # VE-2

CALCULATIONS

Structural Number (SN) Calculations:

Original Design:

Widened Pavement

Layer	Thickness	Coefficient	SN
Asphalt Surface	1.5	0.44	0.66
Asphalt Base	14.5	0.4	5.8
Drainage Blanket	10	0.21	2.1
DGA	6	0.14	0.84
Cement Subgrade	8	0.11	0.88
Total SN			10.28

Existing Pavement with Overlay

Layer	Thickness	Coefficient	SN
Asphalt Surface	1.5	0.44	0.66
Asphalt Base	6	0.4	2.4
Existing Asphalt	11	0.3	3.3
Existing DGA	13.5	0.11	1.485
Total SN			7.85

Recommended Design:

Widened Pavement

Layer	Thickness	Coefficient	SN
Asphalt Surface	1.5	0.44	0.66
Asphalt Base	6	0.4	2.4
Drainage Blanket	12	0.21	2.52
DGA	12.5	0.14	1.75
Cement Subgrade	8	0.11	0.88
Total SN			8.21

VALUE ENGINEERING RECOMMENDATION # VE-2

CALCULATIONS

Pavement Calculations:

Original Design:

Asphalt Base
26 mi x 5280 ft/mi x (60 ft – 2.5 ft) x 1SY/9SF x 110 lb/SY/in x 14.5 in. x 1 ton/2000 lbs.
= 700,000 Tons

Drainage Blanket
26 mi x 5280 ft/mi x (60 ft) x 1SY/9SF x 100 lb/SY/in x 10 in. x 1 ton/2000 lbs.
= 458,000 Tons

DGA
26 mi x 5280 ft/mi x (60 ft) x 1SY/9SF x 115 lb/SY/in x 6 in. x 1 ton/2000 lbs.
= 316,000 Tons

Recommended Design:

Asphalt Base
26 mi x 5280 ft/mi x (60 ft – 2.5 ft) x 1SY/9SF x 110 lb/SY/in x 6 in. x 1 ton/2000 lbs.
= 289,000 Tons

Drainage Blanket
26 mi x 5280 ft/mi x (60 ft) x 1SY/9SF x 100 lb/SY/in x 12 in. x 1 ton/2000 lbs.
= 549,000 Tons

DGA
26 mi x 5280 ft/mi x (60 ft) x 1SY/9SF x 115 lb/SY/in x 12.5 in. x 1 ton/2000 lbs.
= 658,000 Tons

VALUE ENGINEERING RECOMMENDATION # VE-2

COST ESTIMATE - FIRST COST

Cost Item	Units	$/Unit	Source Code	Original Design		Recommended Design	
				Num of Units	Total $	Num of Units	Total $
CL4 Asphalt Base 1.0D	Ton	$49.46	2	700,000	$34,622,000	289,000	$14,293,940
Drainage Blanket Ty. 11 Asphalt	Ton	$41.14	2	458,000	$18,842,120	549,000	$22,585,860
DGA Base	Ton	$19.15	2	316,000	$6,051,400	658,000	$12,600,700
Subtotal					$59,515,520		$49,480,500
Contingency	@	15%			$8,927,328		$7,422,075
Total					$68,442,848		$56,902,575

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

VALUE ENGINEERING RECOMMENDATION # VE-3

DESCRIPTIVE TITLE OF RECOMMENDATION:
Construct vertical clearances for maximum asphalt overlay, but only install the amount of asphalt needed for next 10 years and add additional overlay in the future if necessary.

ORIGINAL DESIGN:
The Design Team has not yet officially designed a pavement buildup for this project. However, it is anticipated that the proposed pavement buildup will be based on the 20 year design traffic and will be similar to the pavement design used in the adjacent project to the south (Item 3-14.00). The pavement buildup over the existing lanes is estimated to be 7.5 in. of asphalt overlay on the existing pavement of 11 in. asphalt and 12 in.-15 in. DGA (according to Design Team). The structural number is approximately 7.8. The pavement buildup for the widened pavement in the median is estimated to be 16 in. asphalt, 10 in. drainage blanket, 6 in. DGA and 8 in. cement stabilized roadbed. The structural number for the widened pavement is approximately 10.3.

RECOMMENDED CHANGE:
The VE Team recommends that the asphalt base pavement layer be reduced by 1 in. which will reduce the Structural Number of the pavement by approximately 0.4. The existing pavement with overlay will have a structural number of approximately 7.4 and the widened pavement will have a structural number of approximately 9.9. After 10 years, traffic can be reevaluated and, if necessary, the additional inch of thickness can be constructed to increase the pavement strength for traffic projections in the next 10 year period. The VE Team recommends that the vertical clearance under bridge structures be designed assuming the additional 1 in. of asphalt will be constructed in the future.

ADVANTAGES:
- Reduces the quantity of asphalt base

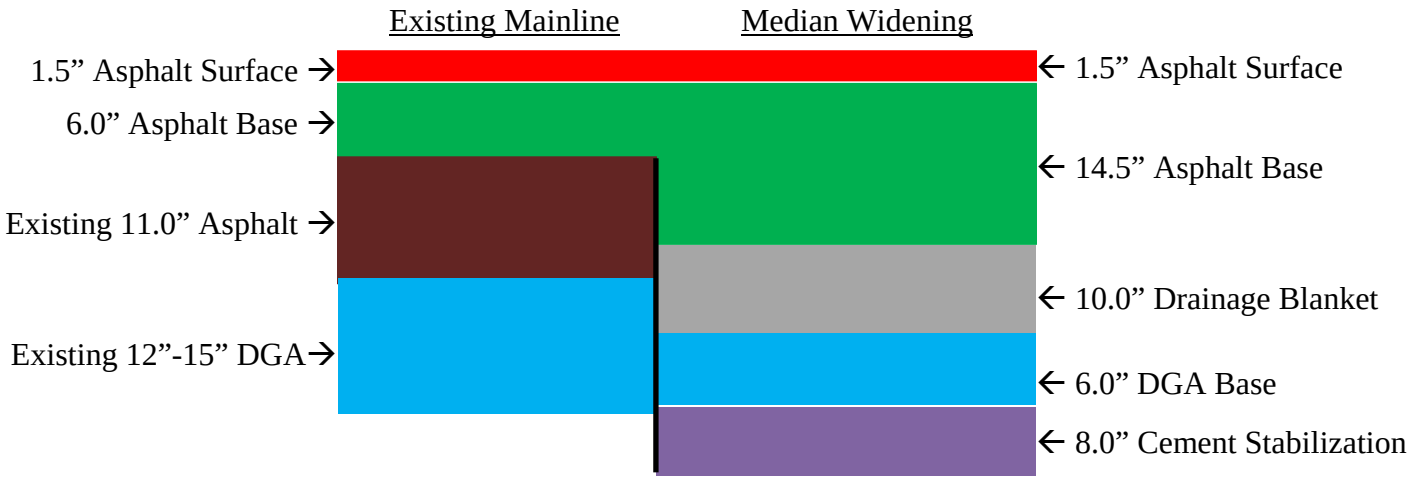
DISADVANTAGES:
- Temporarily reduces the pavement strength
- More pavement may be required in future
- The cost of constructing additional pavement 10 years in the future will likely be higher than constructing it now

JUSTIFICATION:
Traffic projections in this corridor have been lower than originally expected. The pavement can be strengthened easily in the future by constructing additional depth when the roadway is resurfaced. The estimated structural number required for the 10 year traffic would be approximately 7.4 according to a preliminary calculation provided to the VE Team by Paul Looney of KYTC. The 1 in. reduction in asphalt base thickness would likely provide the required SN to accommodate the anticipated 10 year traffic. A reevaluation of traffic can be performed after 10 years to verify the need for additional strength.

SUMMARY OF COST ANALYSIS			
	First Cost	O & M Costs (Present Worth)	Total LC Cost (Present Worth)
ORIGINAL DESIGN	$39,815,000	$0	$39,815,000
RECOMMENDED DESIGN	$37,028,000	$0	$37,028,000
ESTIMATED SAVINGS OR (COST)	$2,787,000	$0	$2,787,000

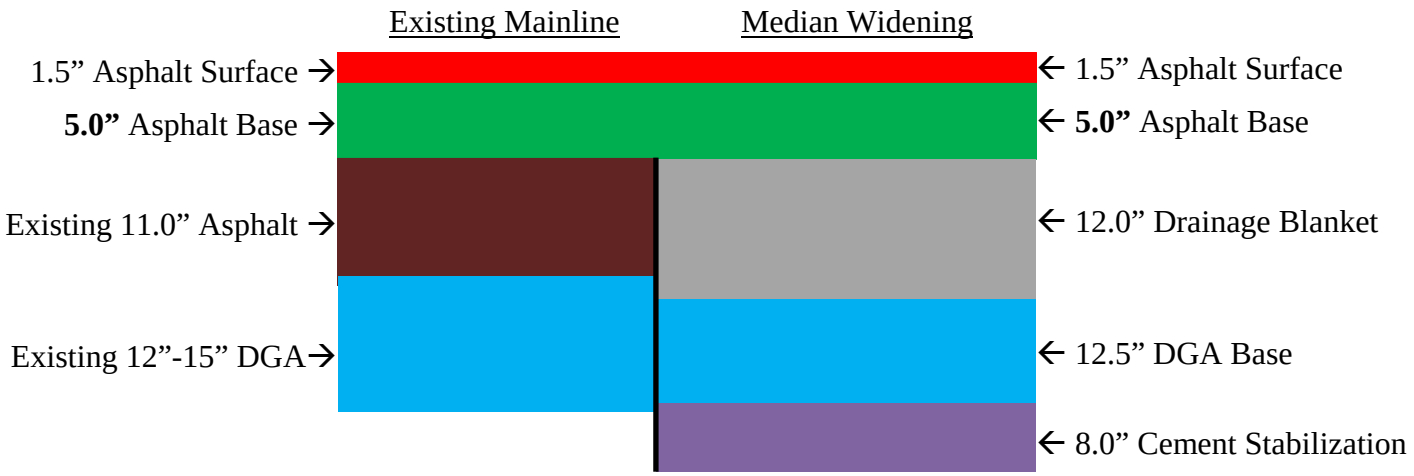
VALUE ENGINEERING RECOMMENDATION # VE-3

SKETCH OF ORIGINAL DESIGN



VALUE ENGINEERING RECOMMENDATION # VE-3

SKETCH OF RECOMMENDED DESIGN



VALUE ENGINEERING RECOMMENDATION # VE-3

CALCULATIONS

Structural Number (SN) Calculations:

Original Design:

Widened Pavement

Layer	Thickness	Coefficient	SN
Asphalt Surface	1.5	0.44	0.66
Asphalt Base	14.5	0.4	5.8
Drainage Blanket	10	0.21	2.1
DGA	6	0.14	0.84
Cement Subgrade	8	0.11	0.88
Total SN			10.28

Existing Pavement with Overlay

Layer	Thickness	Coefficient	SN
Asphalt Surface	1.5	0.44	0.66
Asphalt Base	6	0.4	2.4
Existing Asphalt	11	0.3	3.3
Existing DGA	13.5	0.11	1.485
Total SN			7.85

Recommended Design:

Widened Pavement

Layer	Thickness	Coefficient	SN
Asphalt Surface	1.5	0.44	0.66
Asphalt Base	13.5	0.4	5.4
Drainage Blanket	10	0.21	2.1
DGA	6	0.14	0.84
Cement Subgrade	8	0.11	0.88
Total SN			9.88

Existing Pavement with Overlay

Layer	Thickness	Coefficient	SN
Asphalt Surface	1.5	0.44	0.66
Asphalt Base	5	0.4	2.0
Ex. Asphalt	11	0.3	3.3
Ex. DGA	13.5	0.11	1.485
Total SN			7.45

VALUE ENGINEERING RECOMMENDATION # VE-3

CALCULATIONS

Pavement Calculations:

Original Design:

Asphalt Base
26 mi x 5280 ft/mi x (60 ft – 2.5 ft) x 1SY/9SF x 110 lb/SY/in x 14.5 in. x 1 ton/2000 lbs = 700,000 Tons

Recommended Design:

Asphalt Base
26 mi x 5280 ft/mi x (60 ft – 2.5 ft) x 1SY/9SF x 110 lb/SY/in x 13.5 in. x 1 ton/2000 lbs = 651,000 Tons

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 $
CL4 Asphalt Base 1.0D	Ton	$49.46	2	700,000	$34,622,000	651,000	$32,198,460
Subtotal					$34,622,000		$32,198,460
Contingency	@	15%			$5,193,300		$4,829,769
Total					$39,815,300		$37,028,229

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

VALUE ENGINEERING RECOMMENDATION # VE-4

DESCRIPTIVE TITLE OF RECOMMENDATION:
Take into account the recent asphalt overlay from MP 78 to MP 91 performed in 2011 when determining new overlay thickness.

ORIGINAL DESIGN:
The original design specifies a uniform overlay thickness for the entire 26 mile project. The anticipated overlay thickness is 7.5 in. based on the project immediately to the south (Item 3-14.00). In 2011 KYTC recently overlaid the section of the project from MP 78 to MP 91 (13 miles). It is assumed that the overlay thickness was 1.25 in. and the existing pavement was not milled.

RECOMMENDED CHANGE:
The VE Team recommends that the Design Team reduce the pavement overlay thickness from MP 78 to MP 91 by 1.25 in. The recommended overlay buildup is 1.5 in. Asphalt Surface Course and 4.75 in. Asphalt Base.

ADVANTAGES:
- Reduces the amount of asphalt base course

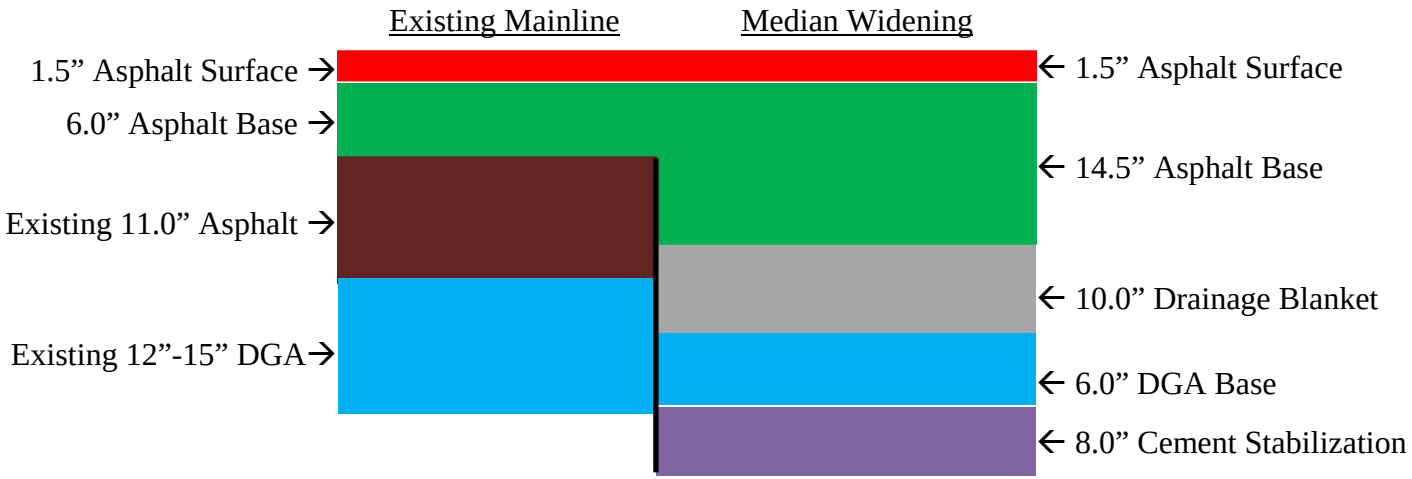
DISADVANTAGES:
- Reduces additional strength of pavement

JUSTIFICATION:
The recent overlay thickness provides is still in good condition and can contribute to the required pavement strength. The cost of the asphalt base can be reduced by accounting for the strength already in this section. Note that the thickness of the 2011 overlay and whether or not the existing surface was milled needs to be verified. If existing surface was milled, then no change in the overlay thickness is recommended.

SUMMARY OF COST ANALYSIS			
	First Cost	O & M Costs (Present Worth)	Total LC Cost (Present Worth)
ORIGINAL DESIGN	$8,247,000	$0	$8,247,000
RECOMMENDED DESIGN	$6,541,000	$0	$6,541,000
ESTIMATED SAVINGS OR (COST)	$1,706,000	$0	$1,706,000

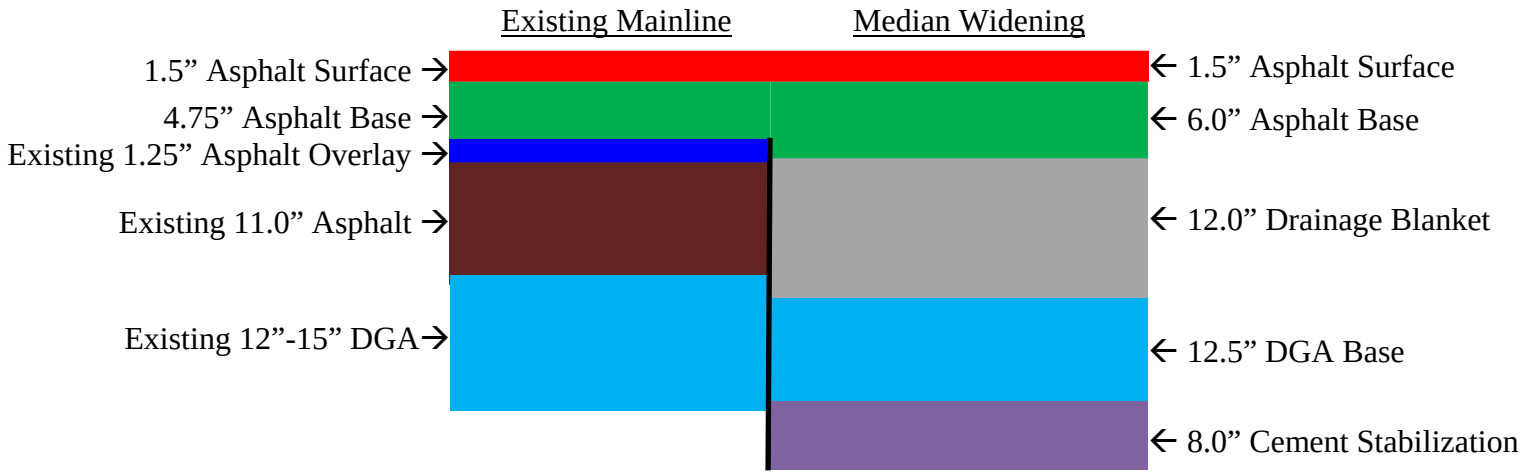
VALUE ENGINEERING RECOMMENDATION # VE-4

SKETCH OF ORIGINAL DESIGN



VALUE ENGINEERING RECOMMENDATION # VE-4

SKETCH OF RECOMMENDED DESIGN



VALUE ENGINEERING RECOMMENDATION # VE-4

CALCULATIONS

Pavement Calculations:

Asphalt Base (Original Design thickness = 6 in.)

13 mi x 5280 ft/mi x (60 ft – 2.5 ft) x 1SY/9SF x 110 lb/SY/in x 6 in. x 1 ton/2000 lbs. = 145,000 Tons

Asphalt Base (Recommended Design thickness = 4.75 in.)

13 mi x 5280 ft/mi x (60 ft – 2.5 ft) x 1SY/9SF x 110 lb/SY/in x 4.75 in. x 1 ton/2000 lbs. = 115,000 Tons

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 $
CL4 Asphalt Base 1.0D	Ton	$49.46	2	145,000	$7,171,700	115,000	$5,687,900
Subtotal					$7,171,700		$5,687,900
Contingency	@	15%			$1,075,755		$853,185
Total					$8,247,455		$6,541,085

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-5

DESCRIPTIVE TITLE OF RECOMMENDATION:
According to the geotechnical investigation of 2001, eliminate soil stabilization throughout project.

ORIGINAL DESIGN:
The original design specifies cement soil stabilization for the widened pavement. According to KYTC staff, the stabilization specified for this project is based on experiences with other widening projects on I-65. On those projects, the cement stabilization was not necessarily needed to improve the strength of the subgrade. Rather it was used to provide a stable working platform during construction, especially in cases where the soil subgrade may become saturated during winter or spring. This softens the subgrade, makes the subgrade susceptible to rutting and may affect the long term strength of the subgrade.

RECOMMENDED CHANGE:
The VE Team recommends the Design Team consider eliminating soil stabilization for the widened pavement as recommended in the original geotechnical report from 2001. In doing so, the contract should require that the subgrade work be completed outside of the winter or spring months.

ADVANTAGES:

- Eliminates cement stabilization from the contract

DISADVANTAGES:

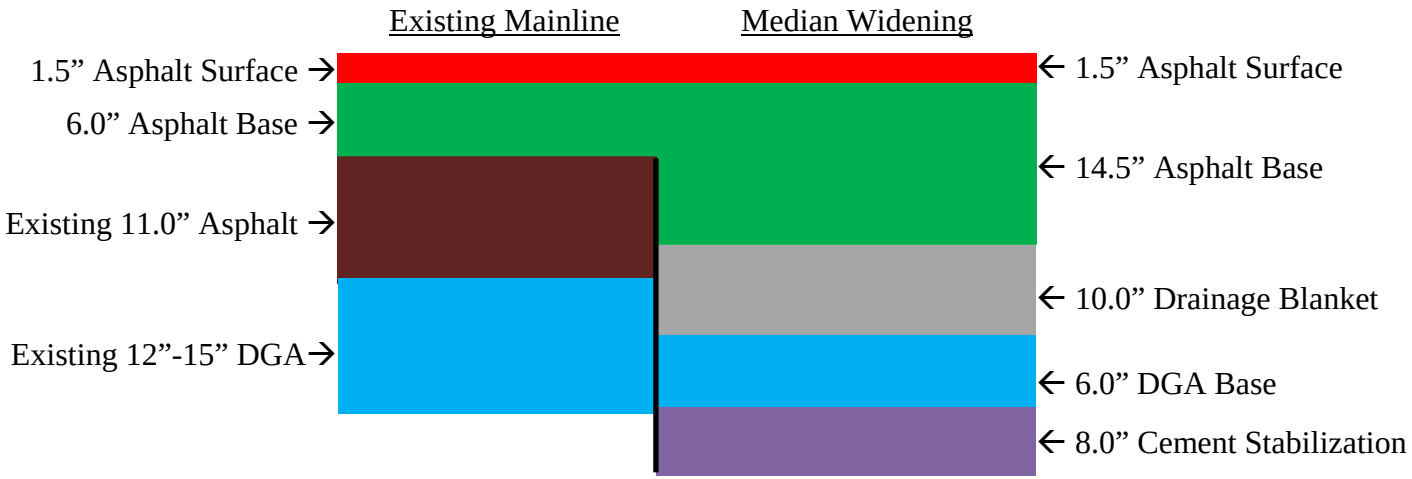
- Possible problems with a working platform on the subgrade during construction (based on experience from projects elsewhere)

JUSTIFICATION:
The original geotechnical report recommended no cement stabilization for the project. The report states: because this is a widening project, and the maintenance of traffic issues associated with such, chemical treatment for soil stabilization is not recommended. The cost of the cement stabilization is significant. If the contract could limit the time of year when the subgrade work is performed, the stabilization may not be needed.

SUMMARY OF COST ANALYSIS			
	First Cost	O & M Costs (Present Worth)	Total LC Cost (Present Worth)
ORIGINAL DESIGN	$4,219,000	$0	$4,219,000
RECOMMENDED DESIGN	$0	$0	$0
ESTIMATED SAVINGS OR (COST)	$4,219,000	$0	$4,219,000

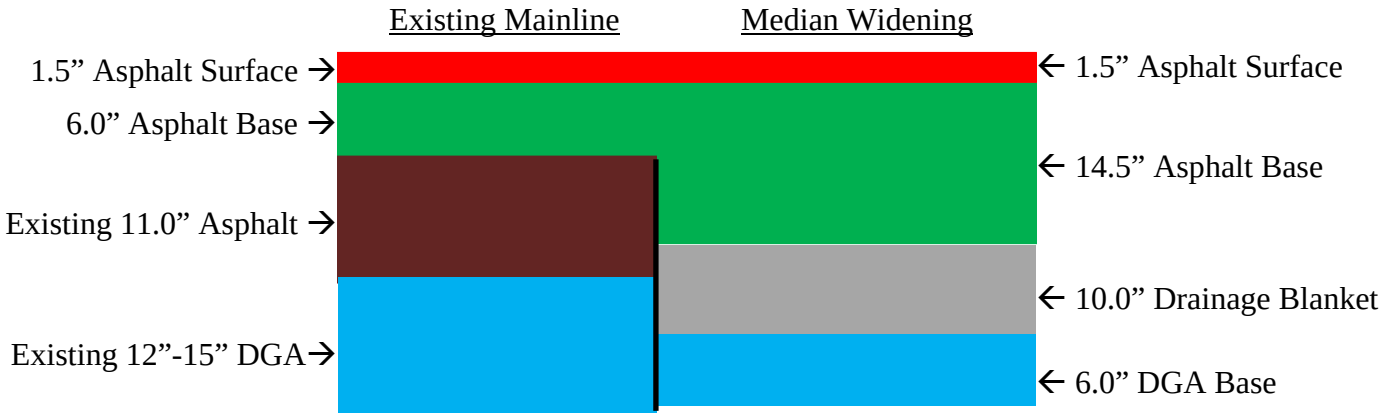
VALUE ENGINEERING RECOMMENDATION # VE-5

SKETCH OF ORIGINAL DESIGN



VALUE ENGINEERING RECOMMENDATION # VE-5

SKETCH OF RECOMMENDED DESIGN



VALUE ENGINEERING RECOMMENDATION # VE-5

CALCULATIONS

Cement Stabilization Calculations:

Original Design:

Cement Stabilized Roadbed
26 mi x 5280 ft/mi x (60 ft) x 1SY/9SF = 915,000 SY

Cement (estimated at 38 lb/SY for 8 in. stab. depth based on quantities from Item 3-14.00)
915,000 SY x 38 lb/SY x 1 Ton/2000 lbs = 17,000 Tons

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 $
Cement Stabilized Roadbed	SY	$2.04	2	915,000	$1,866,600		
Cement	Ton	$106.03	2	17,000	$1,802,510		
Subtotal					$3,669,110		$0
Contingency	@	15%			$550,367		$0
Total					$4,219,477		$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

VALUE ENGINEERING RECOMMENDATION # VE-6

DESCRIPTIVE TITLE OF RECOMMENDATION:
Use geogrid in lieu of cement stabilization.

ORIGINAL DESIGN:
The original design specifies using cement stabilization for the widened section of the roadway. According to KYTC staff, this stabilization is to provide a working platform during construction in case the subgrade soils become saturated.

RECOMMENDED CHANGE:
The VE Team recommends using Geogrid in lieu of cement stabilization. The geogrid should be accompanied by a minimum of 7 in. DGA according to the KYTC Pavement Design Manual.

ADVANTAGES:
- Eliminates quantity of cement and cement stabilized roadbed
- Geogrid is a more economical compared to cement stabilization

DISADVANTAGES:
- Additional quantity of DGA
- Possible improper installation without appropriate oversight by supplier

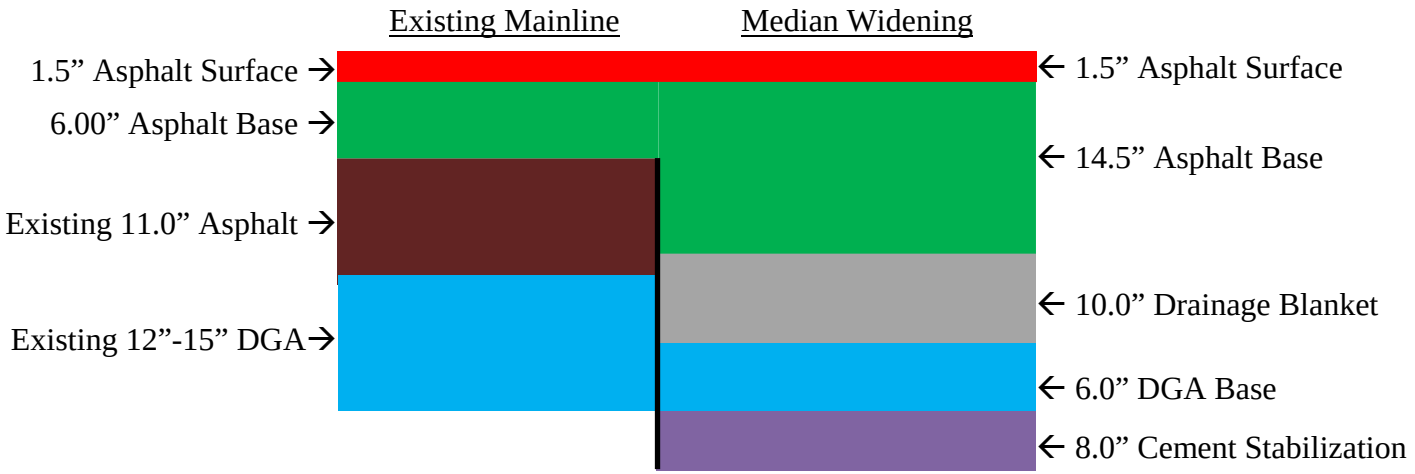
JUSTIFICATION:
The use of geogrid is gaining widespread acceptance as a means to stabilize subgrades, increase subgrade strength and reduce pavement buildups. This is accomplished by taking advantage of the geogrid's unilateral strength which acts as a mechanically stabilized layer. Because the patent on Tensar has recently expired, costs for geogrid have become much more competitive in comparison to cement stabilization. According to Paul Looney from KYTC, recent projects using geogrid have been bid at $1.50/SY which is approximately half the cost of cement stabilization. Installation of geogrid is fairly new to KYTC and will require close supervision. Therefore, use of geogrid by a contractor that is unfamiliar could cause problems unless the appropriate oversight is provided by the supplier.

The cost analysis includes an additional 1 in. thickness of DGA to the original design DGA thickness of 6 in. to provide a minimum depth of 7 in. DGA according to the KYTC Pavement Design Manual. If the alternative pavement design in Recommendation 2 is utilized (DGA thickness = 12.5 in.), the cost of this recommendation could be reduced by an additional $1.2 million because no additional DGA thickness would be required to meet the 7 in. minimum thickness.

SUMMARY OF COST ANALYSIS			
	First Cost	O & M Costs (Present Worth)	Total LC Cost (Present Worth)
ORIGINAL DESIGN	$4,219,000	$0	$4,219,000
RECOMMENDED DESIGN	$2,768,000	$0	$2,768,000
ESTIMATED SAVINGS OR (COST)	$1,451,000	$0	$1,451,000

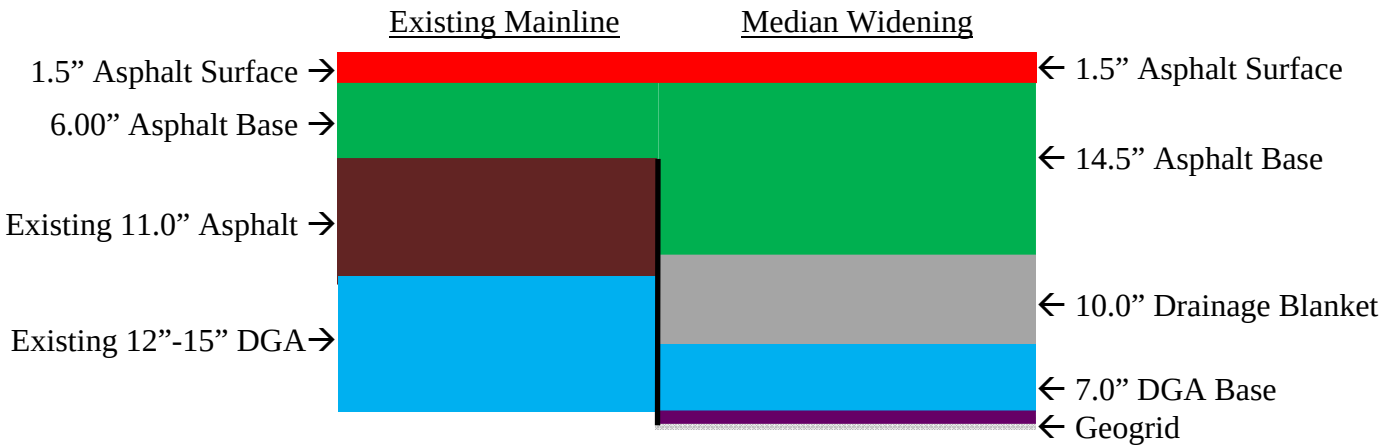
VALUE ENGINEERING RECOMMENDATION # VE-6

SKETCH OF ORIGINAL DESIGN



VALUE ENGINEERING RECOMMENDATION # VE-6

SKETCH OF RECOMMENDED DESIGN



VALUE ENGINEERING RECOMMENDATION # VE-6

SKETCH OF RECOMMENDED DESIGN

VALUE ENGINEERING RECOMMENDATION # VE-6

CALCULATIONS

Pavement Calculations:

Original Design:

Cement Stabilized Roadbed
26 mi x 5280 ft/mi x 60 ft x 1SY/9SF = 915,000 SY

Cement (estimated at 38 lb/SY for 8 in. stab. depth based on quantities from Item 3-14.00)
915,000 SY x 38 lb/SY x 1 Ton/2000 lbs = 17,000 Tons

Recommended Design:

Geogrid
26 mi x 5280 ft/mi x 60 ft x 1 SY/9SF = 915,000 SY

DGA (additional 1 in. for minimum 7 in. depth)
26 mi x 5280 ft/mi x 60 ft x 1SY/9SF x 115 lb/SY/in x 1 in. x 1 ton/2000 lbs
= 53,000 Tons

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 $
Geogrid Reinforcement for Subgrade	SY	$1.50	8			915,000	$1,372,500
Additional 1 in. DGA	Ton	$19.51	2			53,000	$1,034,030
Cement Stabilized Roadbed	SY	$2.04	2	915,000	$1,866,600		
Cement	Ton	$106.03	2	17,000	$1,802,510		
Subtotal					$3,669,110		$2,406,530
Contingency	@	15%			$550,367		$360,980
Total					$4,219,477		$2,767,510

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

VALUE ENGINEERING RECOMMENDATION # VE-7

DESCRIPTIVE TITLE OF RECOMMENDATION:
Use guardrail in lieu of rock cut in the clear zone where applicable (Sta. 3390+50 to Sta. 3395+00).

ORIGINAL DESIGN:
The original design provides a 30 ft clear zone on the right side between stations 3390+50 and 3395+00 on the right side by the removal of existing rock. The maximum height of rock cut is approximately 90 ft and the amount of rock to be removed is 45,200 cubic yards. Two adjacent properties (P-103 and P-105) will be affected. The alignment is tangent and the profile is a crest vertical curve.

RECOMMENDED CHANGE:
The VE Team recommends that within this area the rock be left in place and use guardrail at the standard offset for protection.

ADVANTAGES:
- Reduce rock cut and excavation
- Reduces ROW
- Close a gap between embankment guardrail

DISADVANTAGES:
- Less available clear zone

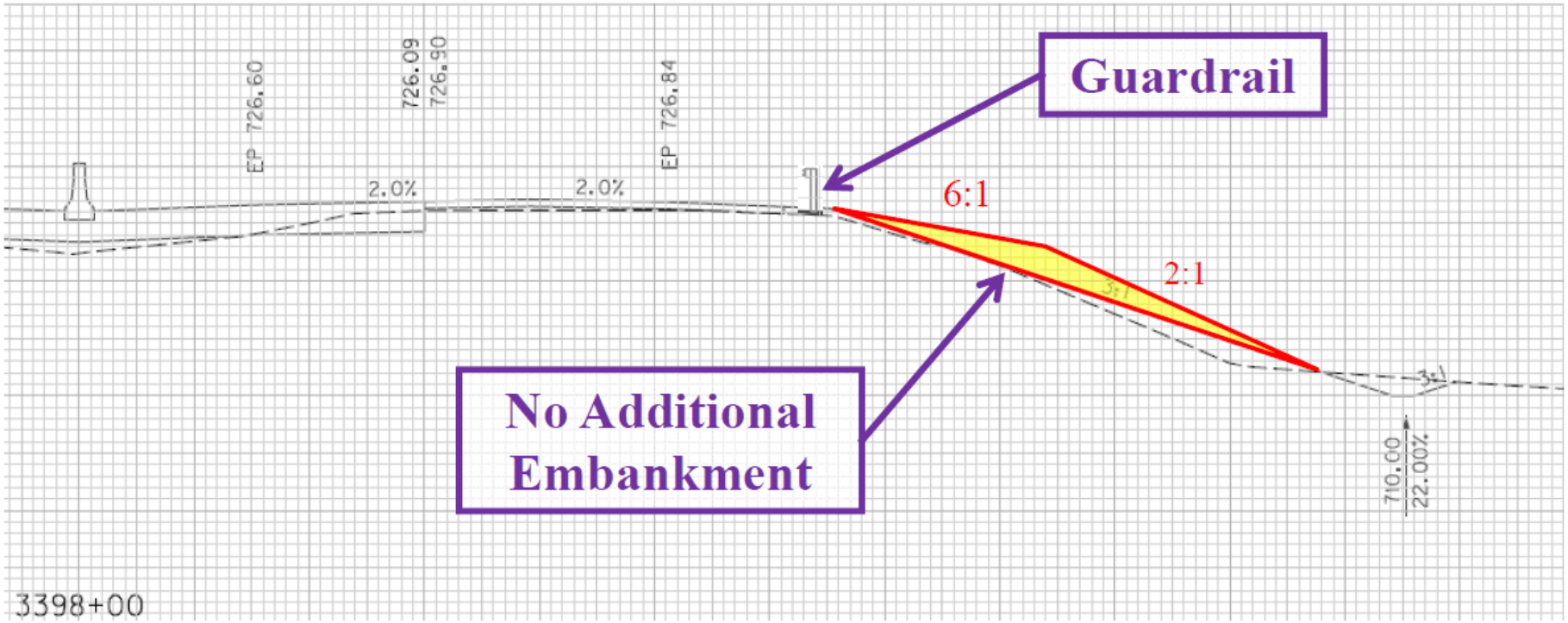
JUSTIFICATION:
The VE Team recognizes the importance of providing a consistent clear zone and agrees that clear zone should be provided in the vast majority of the project. However, due to the height of cut in this 600 ft segment, this rock removal costs approximately $452,000, which averages approximately $750 per ft. If it is acceptable to provide guardrail at a 12-ft offset in high fill segments, then the VE Team believes that it might be acceptable to provide guardrail in deep cut segments. It is acknowledged that the savings would be reduced by the cost of guardrail at $15 per ft.

SUMMARY OF COST ANALYSIS			
	First Cost	O & M Costs (Present Worth)	Total LC Cost (Present Worth)
ORIGINAL DESIGN	$520,000	$0	$520,000
RECOMMENDED DESIGN	$10,000	$0	$10,000
ESTIMATED SAVINGS OR (COST)	$510,000	$0	$510,000

VALUE ENGINEERING RECOMMENDATION # VE-7

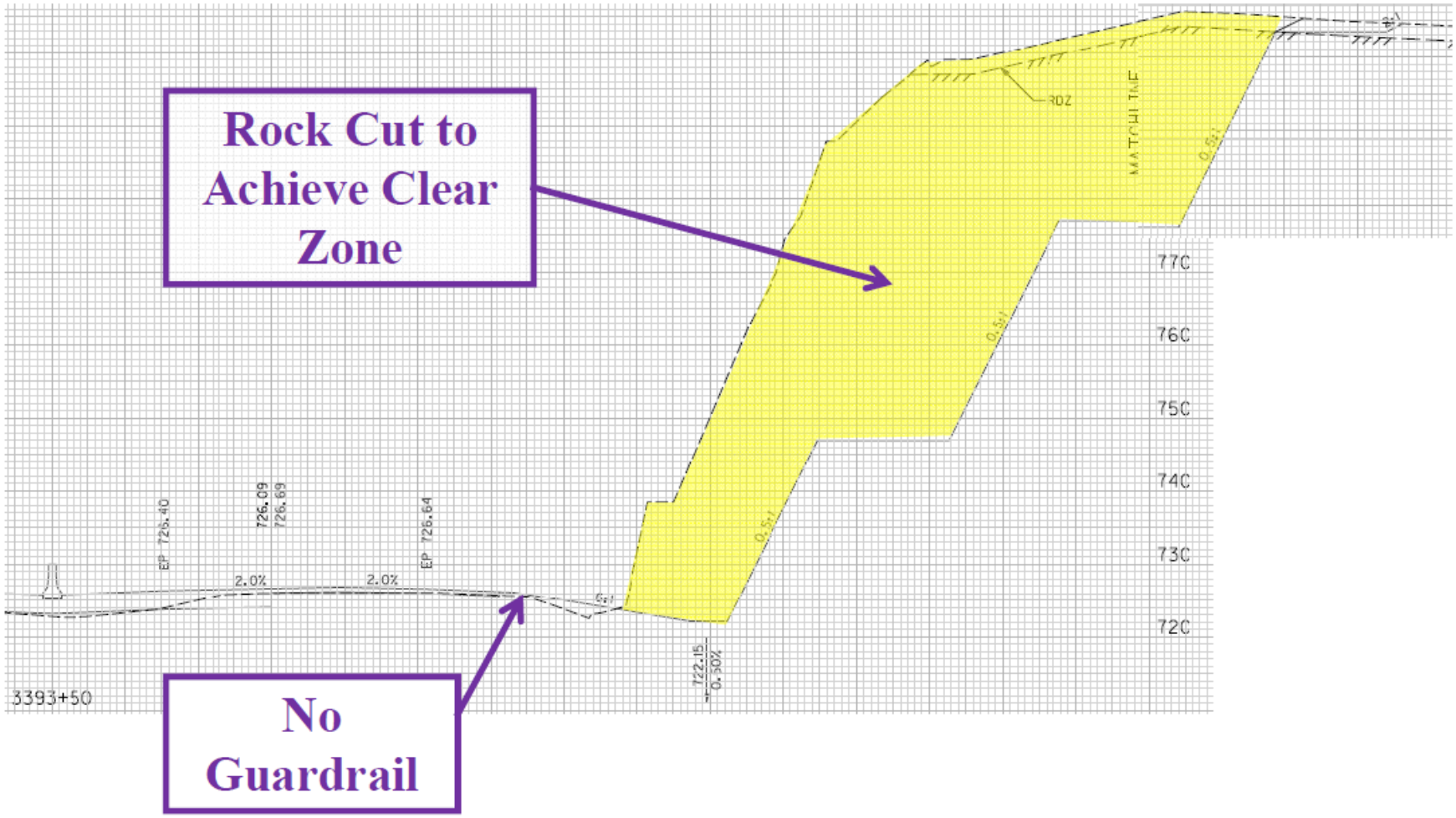
SKETCH OF ORIGINAL DESIGN

Typical Original Design in Fill Areas



SKETCH OF ORIGINAL DESIGN

Typical Original Design in Rock Cut Areas



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 $
Rock Excavation	CY	$10.00	1	45,200	$452,000		
Guardrail	LF	$15.00	1			600	$9,000
Subtotal					$452,000		$9,000
Contingency	@	15%			$67,800		$1,350
Total					$519,800		$10,350

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

VALUE ENGINEERING RECOMMENDATION # VE-8

DESCRIPTIVE TITLE OF RECOMMENDATION:
Use 6 ft shoulders in lieu of 12 ft shoulders for the reconstructed US-31W overpass bridge.

ORIGINAL DESIGN:
The original design specifies that the proposed US-31W bridge have a deck width based on two 12 ft lanes with 12 ft shoulders (51 ft fascia-fascia). Roadway shoulders are tapered to match.

RECOMMENDED CHANGE:
The VE Team recommends that the proposed bridge have a deck width based on two 12 ft lanes with 6 ft shoulders (39 ft fascia-fascia) with similar modifications to the shoulders.

ADVANTAGES:
- Reduces bridge deck and shoulder area
- Eliminates one beam line
- Reduces earthwork

DISADVANTAGES:
- Expensive to widen in the future

JUSTIFICATION:
The current land use and roadways do not show evidence of impending improvements nor a need for widening in the near future. In the absence of a significant traffic increase, then the bridge shoulders do not need to be wider than the approach shoulders. A 36 ft barrier-barrier width should be able to accommodate present and future needs.

SUMMARY OF COST ANALYSIS			
	First Cost	O & M Costs (Present Worth)	Total LC Cost (Present Worth)
ORIGINAL DESIGN	$2,415,000	$0	$2,415,000
RECOMMENDED DESIGN	$1,932,000	$0	$1,932,000
ESTIMATED SAVINGS OR (COST)	$483,000	$0	$483,000

VALUE ENGINEERING RECOMMENDATION # VE-8

PHOTOGRAPH OF EXISTING CONDITIONS

Photograph of US-31W (looking north) crossing over I-65 at approximately Sta. 295+00 (MP 78.6)

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 $
US-31W Bridge	LS	$2,100,000	1	1	$2,100,000	0.8	$1,680,000
Subtotal					$2,100,000		$1,680,000
Contingency	@	15%			$315,000		$252,000
Total					$2,415,000		$1,932,000

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

VALUE ENGINEERING RECOMMENDATION # VE-9

DESCRIPTIVE TITLE OF RECOMMENDATION:
At Old Sonora Road, KY 1407, and KY 1136, replace overpass bridges with bridges similar to existing width (~24 ft) in lieu of 32 ft wide bridges.

ORIGINAL DESIGN:
The original design specifies that the proposed bridges (Old Sonora Road, KY 1407, and KY 1136) each have a deck width based on two 12 ft lanes with 4 ft shoulders (35 ft fascia-fascia). Roadway pavement is similar.

RECOMMENDED CHANGE:
The VE Team recommends that the proposed bridges each have a deck width based on two 9 ft lanes with 4 ft shoulders (29 ft fascia-fascia) with similar pavement modifications.

ADVANTAGES:
- Reduces bridge deck and pavement area
- Eliminates one beam line
- Reduces earthwork

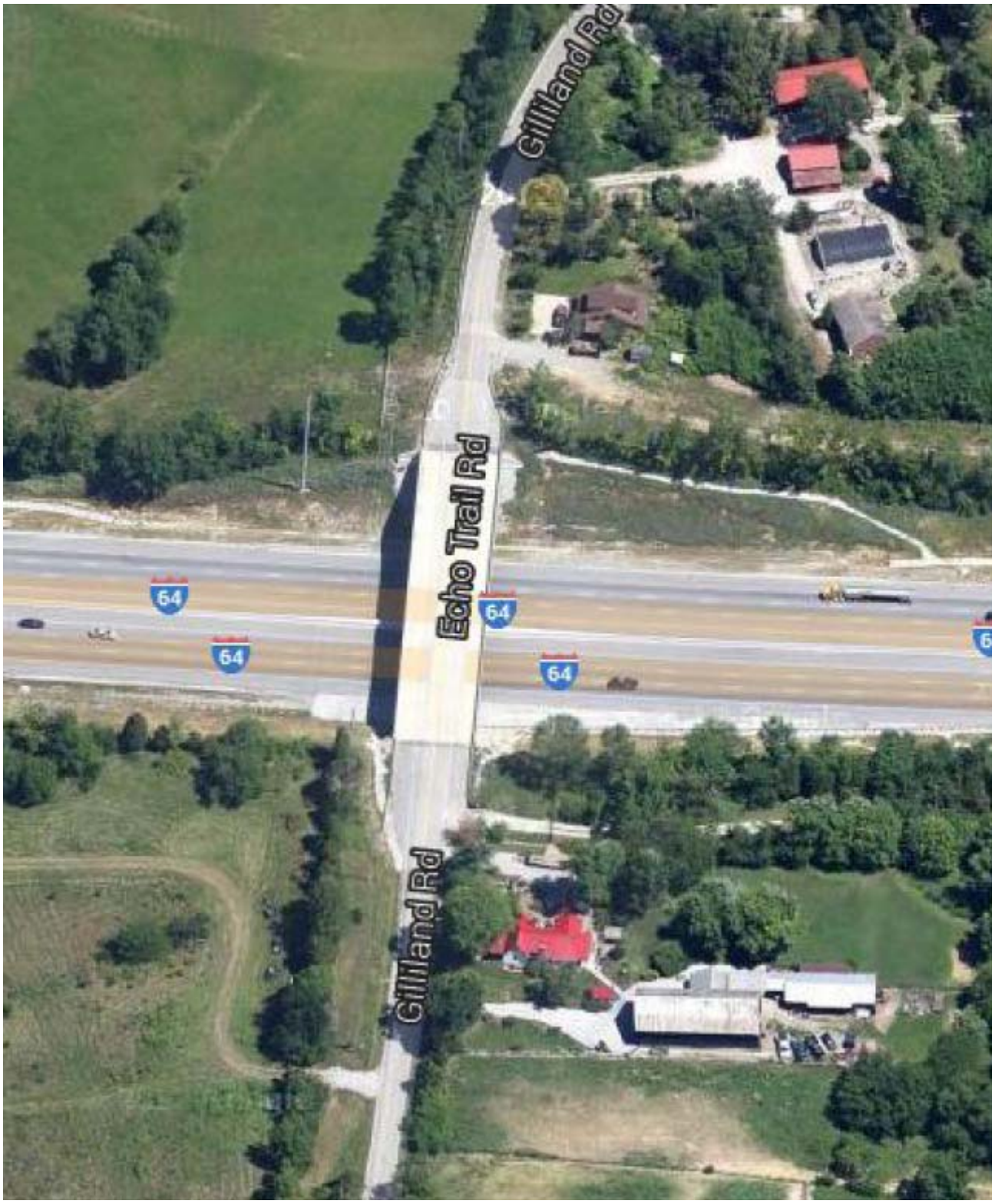
DISADVANTAGES:
- Expensive to widen in the future

JUSTIFICATION:
The current land use and roadways do not show evidence of impending improvements nor a need for widening in the near future. In the absence of a significant traffic increase, then the bridges do not need to be wider than the approach roadways. A 26 ft width should allow passing of a stalled vehicle or allow the occasional use of extra wide farm equipment if given adequate stopping sight distance.

SUMMARY OF COST ANALYSIS			
	First Cost	O & M Costs (Present Worth)	Total LC Cost (Present Worth)
ORIGINAL DESIGN	$3,895,000	$0	$3,895,000
RECOMMENDED DESIGN	$3,302,000	$0	$3,302,000
ESTIMATED SAVINGS OR (COST)	$593,000	$0	$593,000

VALUE ENGINEERING RECOMMENDATION # VE-9

PHOTOGRAPH OF EXAMPLE SIMILAR TO ORIGINAL 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 $
Old Sonora Road Bridge	LS	$1,250,000	1	1	$1,250,000	0.85	$1,062,500
Full-Depth Crossroad Pavement	SY	$44.00	1	1,800	$79,200	1,500	$66,000
KY 1407 Bridge	LS	$900,000	1	1	$900,000	0.85	$765,000
Full-Depth Crossroad Pavement	SY	$44.00	1	3,500	$154,000	2,900	$127,600
KY 1136 Bridge	LS	$850,000	1	1	$850,000	0.85	$722,500
Full-Depth Crossroad Pavement	SY	$44.00	1	3,500	$154,000	2,900	$127,600
Subtotal					$3,387,200		$2,871,200
Contingency	@	15%			$508,080		$430,680
Total					$3,895,280		$3,301,880

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

VALUE ENGINEERING RECOMMENDATION # VE-10

DESCRIPTIVE TITLE OF RECOMMENDATION:
Reconstruct KY 84 as a 3-lane corridor and bridge with shoulders in lieu of a new 5-lane corridor and bridge with shoulders.

ORIGINAL DESIGN:
The original design specifies a 5-lane typical section with on KY 84 across I-65 based on forecasted traffic. Included in the forecasted traffic was based on a potential auto plant to the north of this interchange. The forecast determined that a 5-lane typical section (2 lanes per direction and a left-hand turn lane) was warranted in the 2025 design year.

RECOMMENDED CHANGE:
The VE Team recommends that the existing design of a 5-lane structure with shoulders be resized to a 3-lane structure with shoulders. The recommendation is based on new traffic volume forecasting information. The proposed 3-lane typical section will accommodate the existing and proposed traffic volumes with an acceptable LOS.

ADVANTAGES:
- Reduce bridge width
- Reduce approach work
- Reduce interstate ramp tie in work
- Reduce impacts to utilities
- Reduce ROW impacts

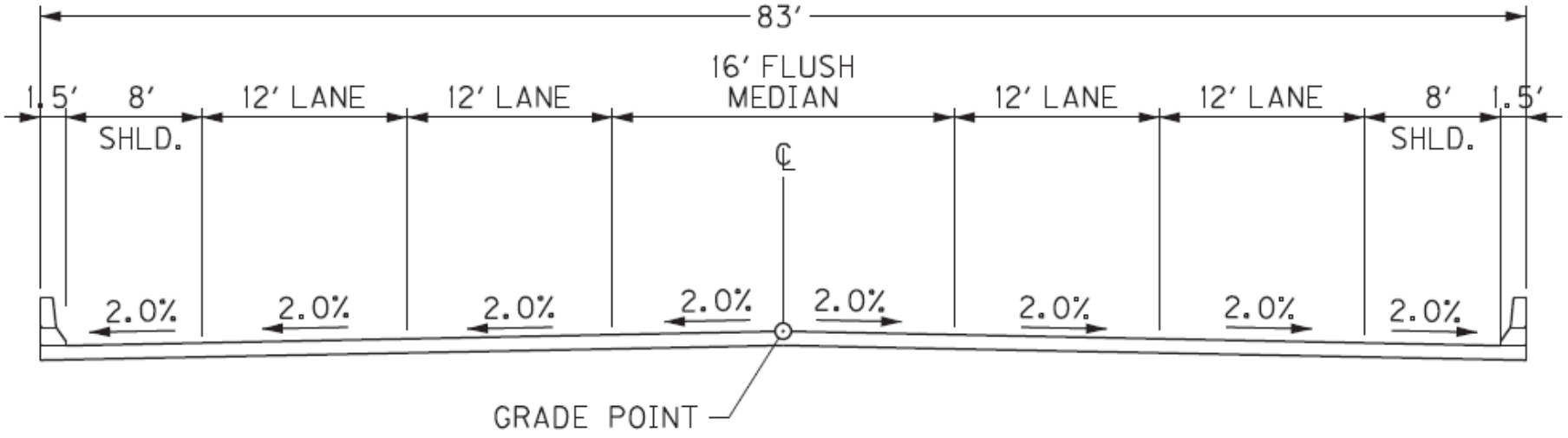
DISADVANTAGES:
- More complex MOT
- Reduce capacity

JUSTIFICATION:
The VE Team's recommendation is based on new traffic volume data. The original forecast was based on 1999 existing traffic volumes and forecasted at a growth rate that is no longer applicable. Discussion with the Division of Planning provided guidance on obtaining a more realistic anticipated volume in the design year. The average growth rate on KY 84 has ranged from 0.1% on the west side to 0.4% on the east side of I-65. Using the updated forecast and guidance from the Division of Planning an acceptable LOS can be obtained while reducing the structure width and the approaches.

SUMMARY OF COST ANALYSIS			
	First Cost	O & M Costs (Present Worth)	Total LC Cost (Present Worth)
ORIGINAL DESIGN	$2,971,000	$0	$2,971,000
RECOMMENDED DESIGN	$2,064,000	$0	$2,064,000
ESTIMATED SAVINGS OR (COST)	$907,000	$0	$907,000

VALUE ENGINEERING RECOMMENDATION # VE-10

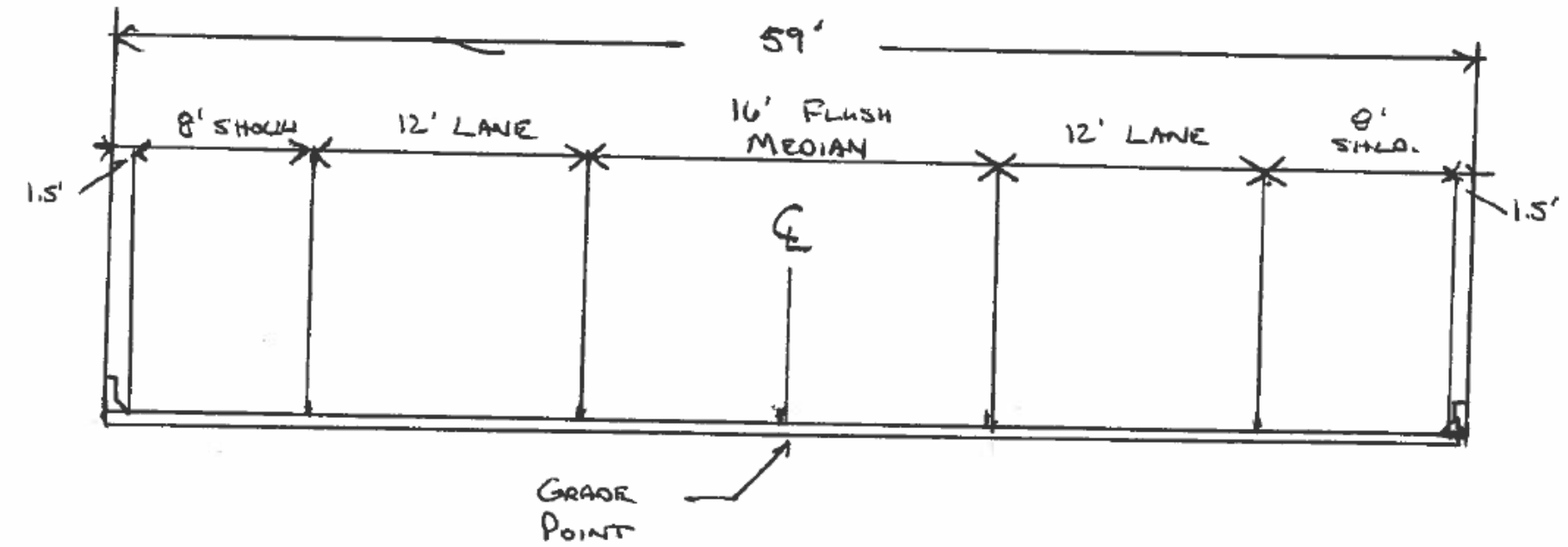
SKETCH OF ORIGINAL DESIGN



KY 84 BRIDGE OVER I–65

VALUE ENGINEERING RECOMMENDATION # VE-10

SKETCH OF RECOMMENDED DESIGN



KY 84 BRIDGE OVER I–65

VALUE ENGINEERING RECOMMENDATION # VE-10

CALCULATIONS

Original Forecast from 1999

KY 84 west of I-65	KY 84 east of I-65
1999 4,000 ADT	1999 10,000 ADT
2025 8,600 ADT	2025 21,600 ADT

July 2013 Revised Forecast Projection
(ADT taken from KYTC's CTS Database and Projected forward)

KY 84 west of I-65	KY 84 east of I-65
1999 4,000 ADT	1999 4,070 ADT
2011 4,030 ADT	2011 4,260 ADT
2025 4,064 ADT	2025 4,475 ADT
2035 4,088 ADT	2035 4,648 ADT

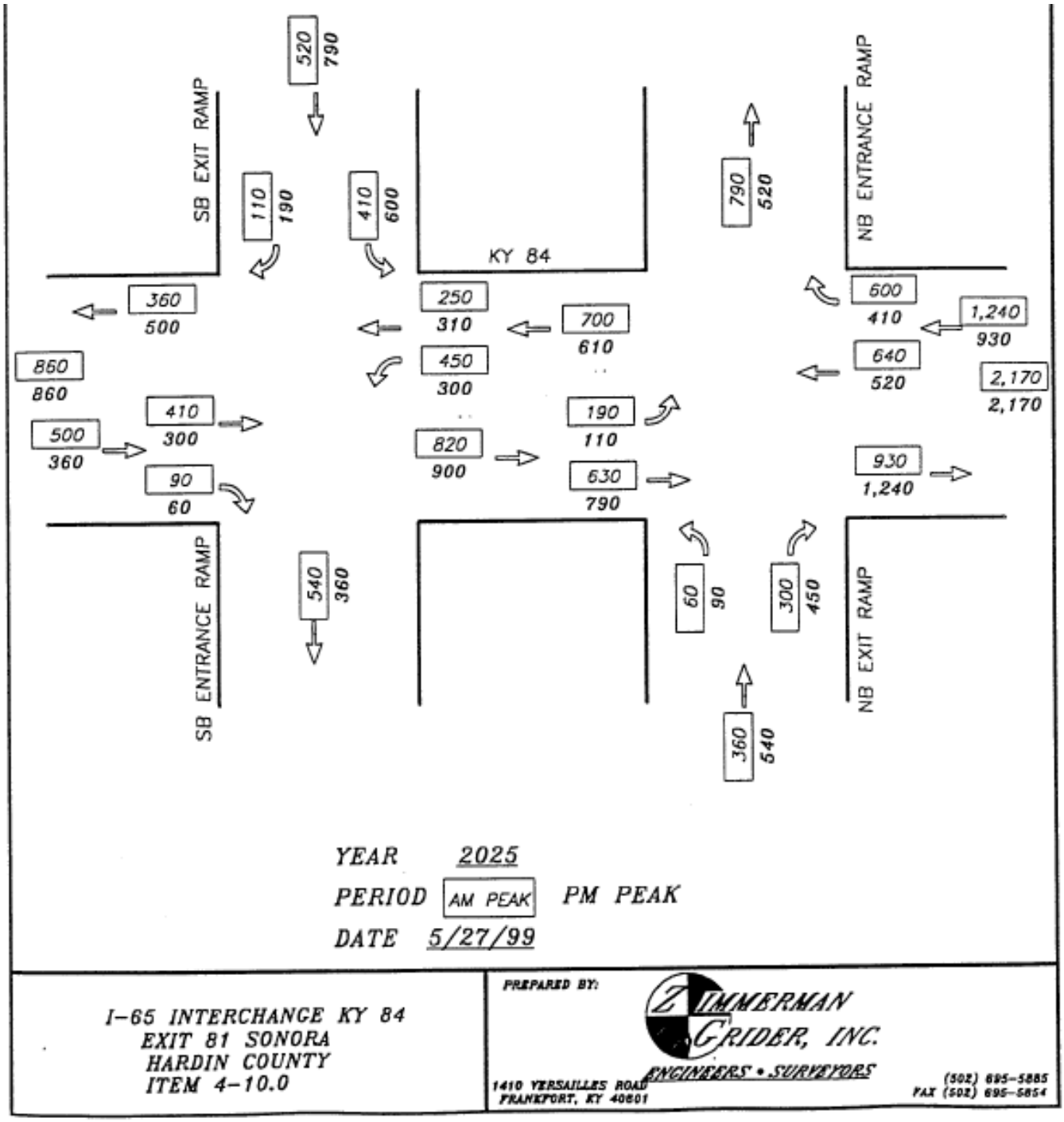
Existing Bridge for KY 84 over I-65 is 255 ft and 83 ft wide (21,165 SF)

Proposed Bridge for KY 84 over I-65 is 255 ft and 59 ft wide (15,045 SF)

This recommendation results is a 29% reduction in cost.

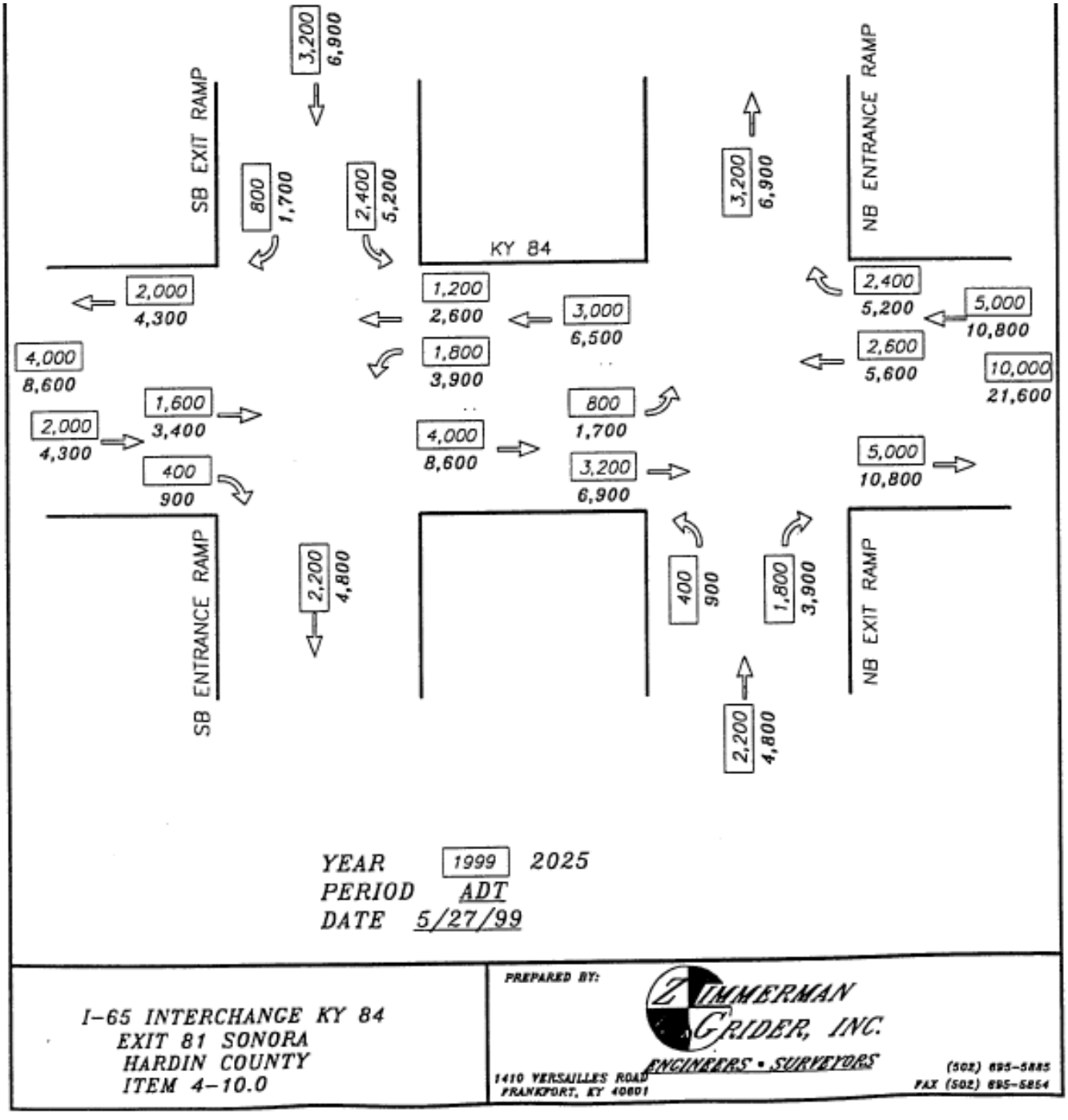
VALUE ENGINEERING RECOMMENDATION # VE-10

ADDITIONAL INFORMATION



VALUE ENGINEERING RECOMMENDATION # VE-10

ADDITIONAL INFORMATION



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 $
Bridge Structure	SF	$99.00	1	21,165	$2,095,335	15,045	$1,489,455
Crossroad Full-Depth Pavement	SY	$44.00	1	11,092	$488,048	6,932	$305,008
Subtotal					$2,583,383		$1,794,463
Contingency	@	15%			$387,507		$269,169
Total					$2,970,890		$2,063,632

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

VALUE ENGINEERING RECOMMENDATION # VE-11

DESCRIPTIVE TITLE OF RECOMMENDATION:
Close Old Sonora Road in lieu of reconstructing an overpass bridge.

ORIGINAL DESIGN:
The original design specifies that the existing structure for Old Sonora Road be reconstructed with a 4-span bridge on this project. A small amount of ROW is required to reconstruct this structure.

RECOMMENDED CHANGE:
The VE Team recommends the structure be removed and Old Sonora Road be terminated at I-65 control access on each approach.

ADVANTAGES:
- No reconstruction of Structure
- No acquisition of ROW
- Less disruption to I-65 during construction
- No future maintenance of structure

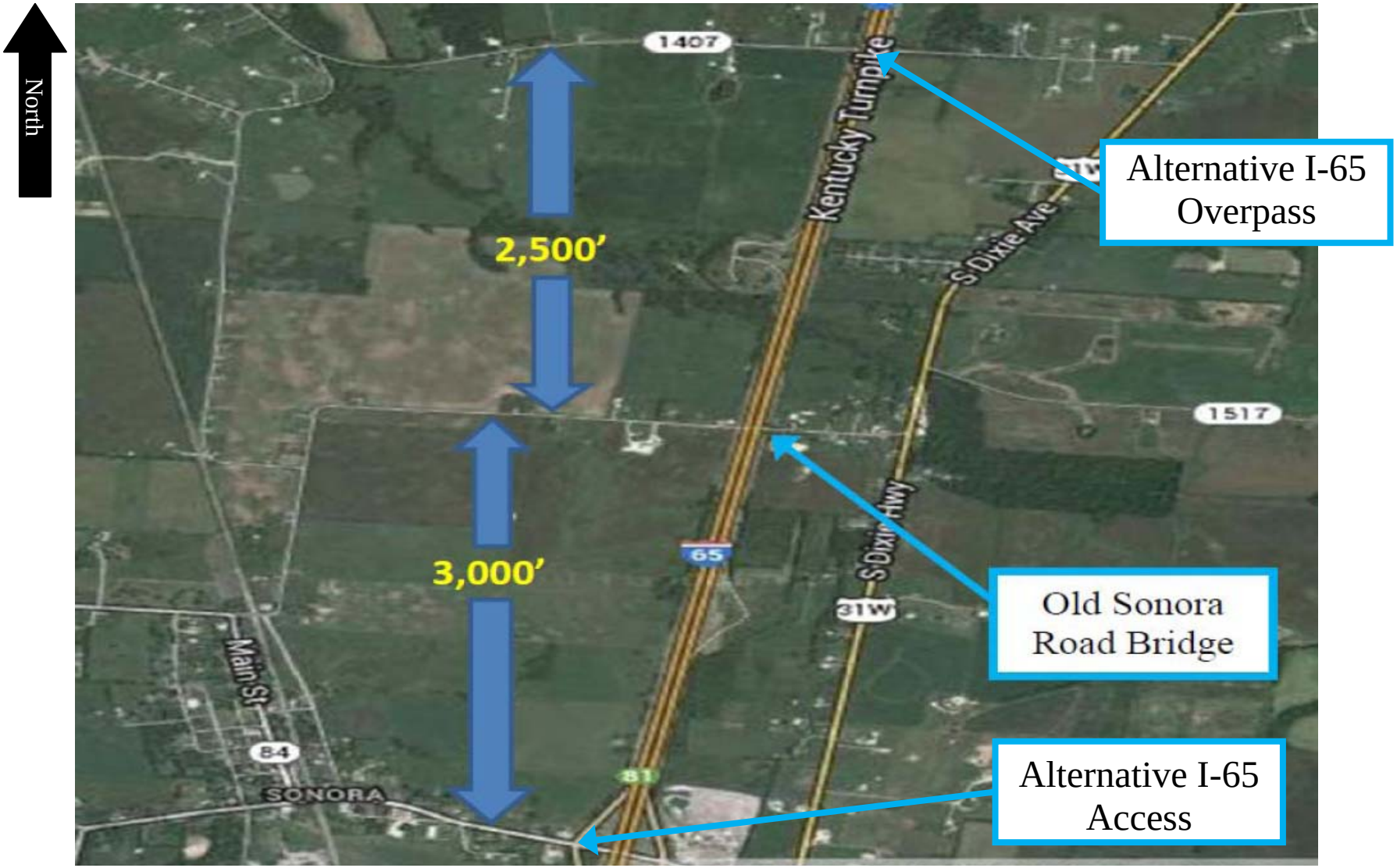
DISADVANTAGES:
- Possible opposition from property owners
- Delay for emergency responders

JUSTIFICATION:
This recommendation is based on the initial cost savings by not replacing the structure and the future savings that are incurred by eliminating the maintenance of this structure. It appears that the removal could occur within existing ROW and the ROW required for the structure replacement will not be needed.

SUMMARY OF COST ANALYSIS			
	First Cost	O & M Costs (Present Worth)	Total LC Cost (Present Worth)
ORIGINAL DESIGN	$1,093,000	$76,000	$1,169,000
RECOMMENDED DESIGN	$0	$0	$0
ESTIMATED SAVINGS OR (COST)	$1,093,000	$76,000	$1,169,000

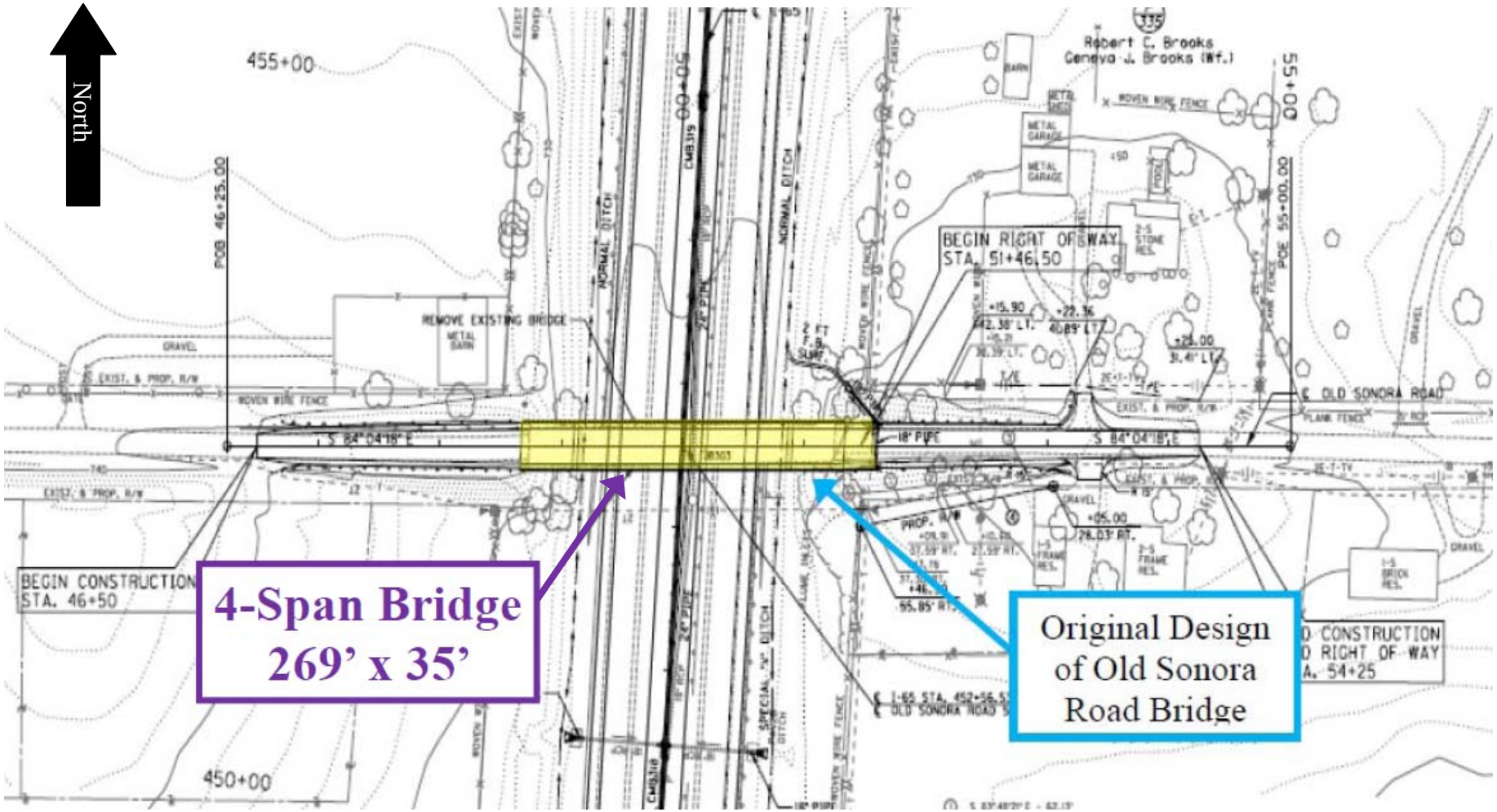
VALUE ENGINEERING RECOMMENDATION # VE-11

SKETCH OF ORIGINAL DESIGN



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 $
Old Sonora Road Bridge Over I-65	LS	$950,000	1	1	$950,000		
Subtotal					$950,000		$0
Contingency	@	15%			$142,500		$0
Total					$1,092,500		$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 PROPOSAL # VE-11

COST ESTIMATE - O & M (LIFE CYCLE) COST

PRESENT WORTH METHOD
LIFE CYCLE PERIOD (YEARS) = 50
ANNUAL PERCENTAGE RATE = 4%

O&M Costs. Single Expenditure	In the Yr	PW Factor	Original Design		Proposed Design	
			Est $	PW $	Est $	PW $
Joint Repair	15	0.5553	$30,000	$16,658		
Deck Overlay	30	0.3083	$100,000	$30,832		
Slab Replacement	50	0.1407	$200,000	$28,143		
Subtotal Single Life Cycle O&M Costs				$75,632		$0
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				$76,000		$0

✓ VE Selected Scenario

VALUE ENGINEERING RECOMMENDATION # VE-12

DESCRIPTIVE TITLE OF RECOMMENDATION:
Use a shorter single span structure for the Rhudes Creek Road underpass in lieu of a 3-span mainline bridge.

ORIGINAL DESIGN:
The original design specifies a 3-span bridge for the I-65 Bridge over Rhudes Creek Road. The proposed beams are Prestressed Concrete I-beams Type 2 with a depth of 36 inches. The original design proposes to set the new end bents behind the existing abutments.

RECOMMENDED CHANGE:
The VE Team recommends utilizing a one-span bridge and minimizing the length of the I-65 Bridge over Rhudes Creek Road. The recommended design places the abutments in front of the existing abutments, at the top of the slope.

ADVANTAGES:
- Eliminates two piers
- Increases clear zone for Rhudes Creek Road
- Decreases the total bridge deck area

DISADVANTAGES:
- Beam type may be more expensive due to vertical clearance limitations

JUSTIFICATION:
The proposed 3-span bridge can be substantially shortened to accommodate a single span. Composite spread box beams or W36 rolled beams can be utilized to span the approximate 100 ft simple span at a similar structure depth to the original design. The VE Team also recommends analyzing the lump sum cost shown in the original cost estimate, which is about $84 per square ft. It is expected that the bridge construction cost should be approximately $100 per square ft.

SUMMARY OF COST ANALYSIS			
	First Cost	O & M Costs (Present Worth)	Total LC Cost (Present Worth)
ORIGINAL DESIGN	$1,632,000	$0	$1,632,000
RECOMMENDED DESIGN	$1,266,000	$0	$1,266,000
ESTIMATED SAVINGS OR (COST)	$366,000	$0	$366,000

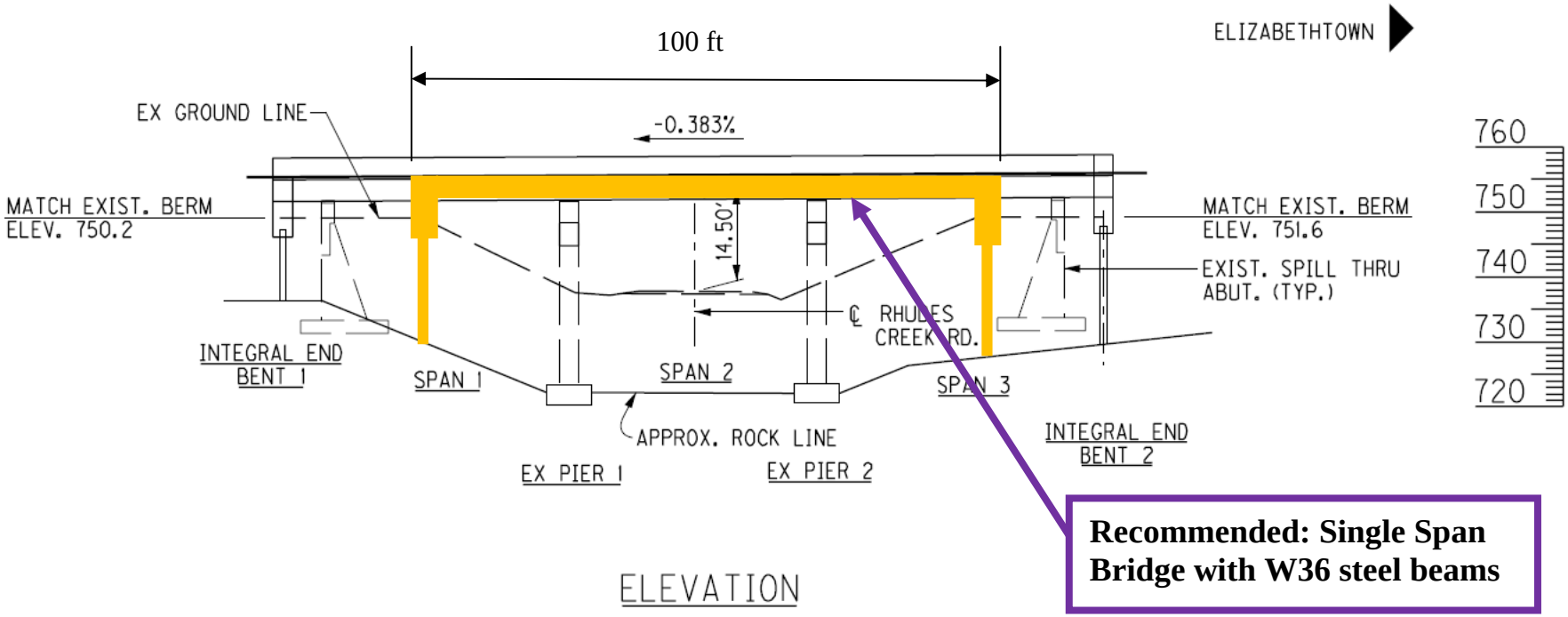
VALUE ENGINEERING RECOMMENDATION # VE-12

PHOTOGRAPH OF EXISTING CONDITION

Existing Rhudes Creek Road Bridge

VALUE ENGINEERING RECOMMENDATION # VE-12

SKETCH OF RECOMMENDED DESIGN



ELEVATION

44'-0", 38'-0", 44'-0" - TYPE 2 PCIB CONTINUOUS FOR LIVE LOAD
126'-6" ROADWAY - 126'-6" SHOULDER WIDTH AT BRIDGE- HL-93X1.25
2:1 (NORMAL) SLOPES - 13°08'00" SKEW LT.

VALUE ENGINEERING RECOMMENDATION # VE-12

CALCULATIONS

Span Length:

Rhudes Creek Road Width:	20 ft
Shoulder and Ditches:	2 @ 6 ft = 12 ft
2:1 Slopes:	2 @ 12.5 ft x 2 = 50 ft
Berm:	2 @ 3 ft = 6 ft
Total	**98 ft**

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 $
Rhudes Creek Road Bridge	SF	$85.00	1	16,700	$1,419,500	12,950	$1,100,750
Subtotal					$1,419,500		$1,100,750
Contingency	@	15%			$212,925		$165,113
Total					$1,632,425		$1,265,863

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

VALUE ENGINEERING RECOMMENDATION # VE-13

DESCRIPTIVE TITLE OF RECOMMENDATION:
Increase beam spacing to reduce a beam line for the KY 728, KY 84, Rhudes Creek Road, and Nolin bridges.

ORIGINAL DESIGN:
The original design specifies the following:
KY 728 over I-65: 5 beam lines @ 9 ft-0 in. spacing
KY 84 over I-65: 9 beam lines @ 9 ft-6 in. spacing
I-65 over the Nolin River: 14 beam lines @ 9 ft-4 in.
I-65 over Rhudes Creek Road: 14 beam lines @ 9 ft-5 in.

RECOMMENDED CHANGE:
The VE Team recommends increasing the beam spacing thereby eliminating one beam line on each structure. The table on the following page lists the proposed beam spacing and number of beams in both the original design and the VE recommended design.

ADVANTAGES:
- Reduces the number of beams
- Reduce construction duration

DISADVANTAGES:
- Requires additional steel reinforcement in the deck or deck thickness
- May require a change in beam shape and/or additional capacity of the beam

JUSTIFICATION:
The cost of precast concrete beams is a substantial cost in the construction of bridges. The savings realized from eliminating a beam line is usually not offset by the increased costs of accommodating the increased beam spacing (see disadvantages above for a list of these potential impacts). The recommended typical section of the Nolin River and Rhudes Creek Bridge matches the original design shown in the preliminary plans of the I-65 bridge over Bacon Creek. These three mainline bridges are the same width (129 ft-6 in.) and have the same maintenance of traffic scheme.

SUMMARY OF COST ANALYSIS			
	First Cost	O & M Costs (Present Worth)	Total LC Cost (Present Worth)
ORIGINAL DESIGN	$2,998,000	$0	$2,998,000
RECOMMENDED DESIGN	$2,753,000	$0	$2,753,000
ESTIMATED SAVINGS OR (COST)	$245,000	$0	$245,000

VALUE ENGINEERING RECOMMENDATION # VE-13

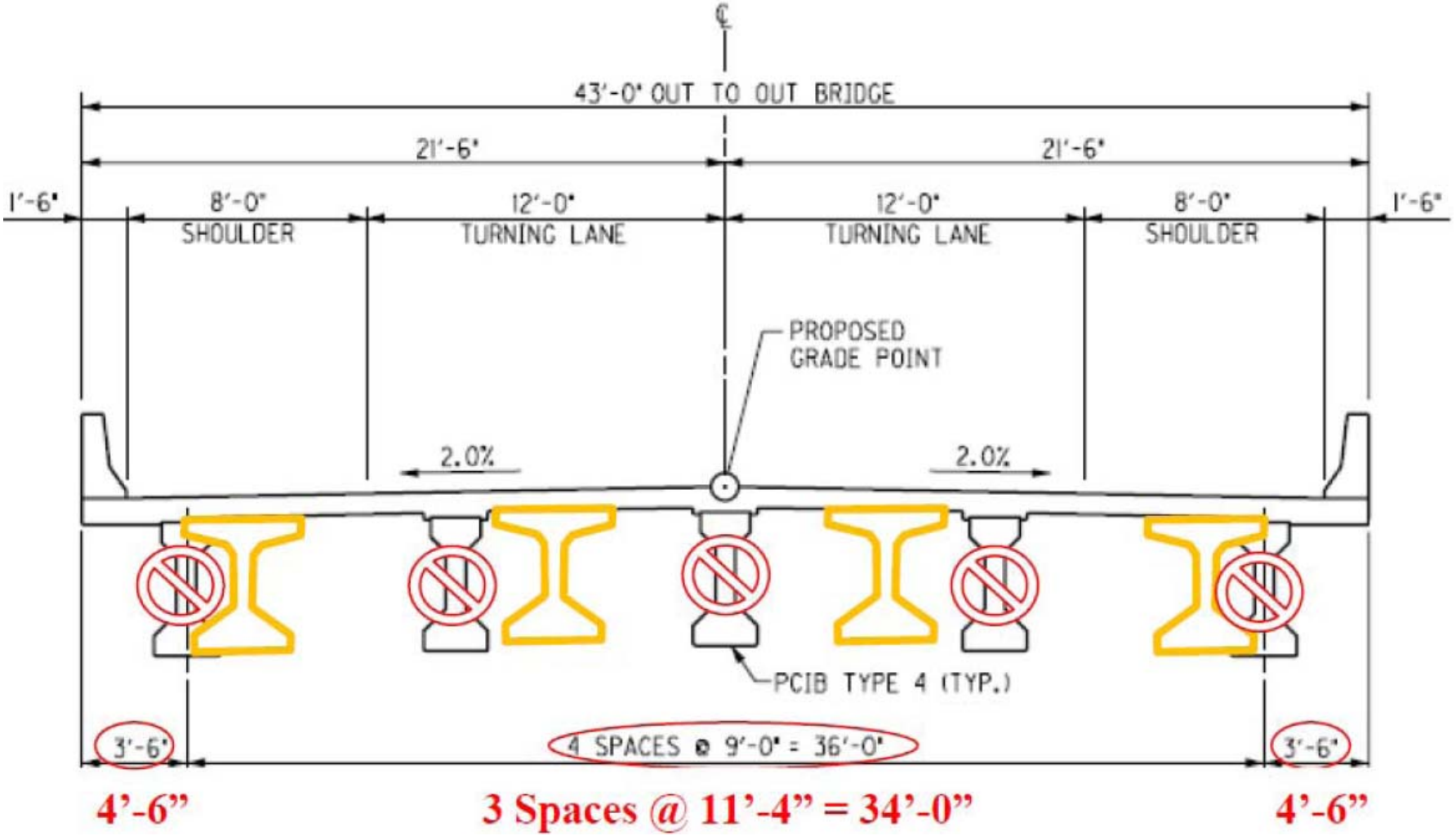
DISCUSSION CONTINUED

The following table lists the proposed beam spacing and number of beams in both the original design and the VE recommended design:

		Beam Type	Cantilever	Beam Spacing	Total Deck Width	# of Beams
KY 728	Original	PCIB Type IV	3’-6”	9’-0”	36’-0”	5
	Recommended	HN 48 49	4’-6”	11’-4”		4
KY 84	Original	HN 42 49	3’-6”	9’-6”	83’-0”	9
	Recommended	HN 42 49	4’-2”	10’-8”		8
Nolin River	Original	PCIB Type 6	4’-1”	9’-4”	129’-6”	13
	Recommended	PCIB Type 6	3’-3”	10’-3”		12
Rhudes Creek Road	Original	PCIB Type 2	3’-6.5”	9’-5”	129’-6”	13
	Recommended	Box Beam	3’-3”	10’-3”		12

VALUE ENGINEERING RECOMMENDATION # VE-13

SKETCH OF RECOMMENDED DESIGN



Recommended design for KY 728 bridge over I-65. This graphic is typical of the other structures identified in this proposal.

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 $
KY 728							
PCIB Type 4	LF	$225.00	2	1,525	$343,125		
HN 48 49	LF	$275.00	2			1,220	$335,500
Epoxy Coated Steel Reinforcement	LBS	$1.00	2			4,600	$4,600
KY 84							
HN 42 49	LF	$250.00	2	2,295	$573,750	2,040	$510,000
Epoxy Coated Steel Reinforcement	LF	$1.00	2			7,500	$7,500
Nolin River							
PCIB Type 6	LF	$270.00	2	4,634	$1,251,180	4,303	$1,161,810
Epoxy Coated Steel Reinforcement	LBS	$1.00	2			14,000	$14,000
Rhudes Creek Bridge							
PCIB Type 2	LF	$243.00	2	1,806	$438,858		
CB21-48	LF	$215.00	2			1,677	$360,555
Subtotal					$2,606,913		$2,393,965
Contingency	@	15%			$391,037		$359,095
Total					$2,997,950		$2,753,060

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-14

DESCRIPTIVE TITLE OF RECOMMENDATION:
Reuse the substructures on the Old Sonora Road, KY 1407, and KY 1136 bridges in lieu of a full replacement.

ORIGINAL DESIGN:
The original design specifies full replacement of the Old Sonora Road, KY 1407, and KY 1136 bridges.

RECOMMENDED CHANGE:
The VE Team recommends replacing the superstructures on these bridges and reusing the substructures by adding additional height to the substructures as necessary to satisfy profile grade requirements.

The VE Team assumes that the substructures have sufficient capacity to allow the deck to be widened from the existing width of 29 ft-0 in. to 33 ft-0 in. The recommended deck width can accommodate two 11 ft lanes and two 4 ft shoulders, which closely resembles the original design of two 12 ft lanes and two 4 ft shoulders.

ADVANTAGES:

- Eliminates the need to reconstruct piers and abutments

DISADVANTAGES:

- Clear zone is not provided on I-65. Guardrail must be used to protect the piers.
- Substructure is not upgraded to current standards

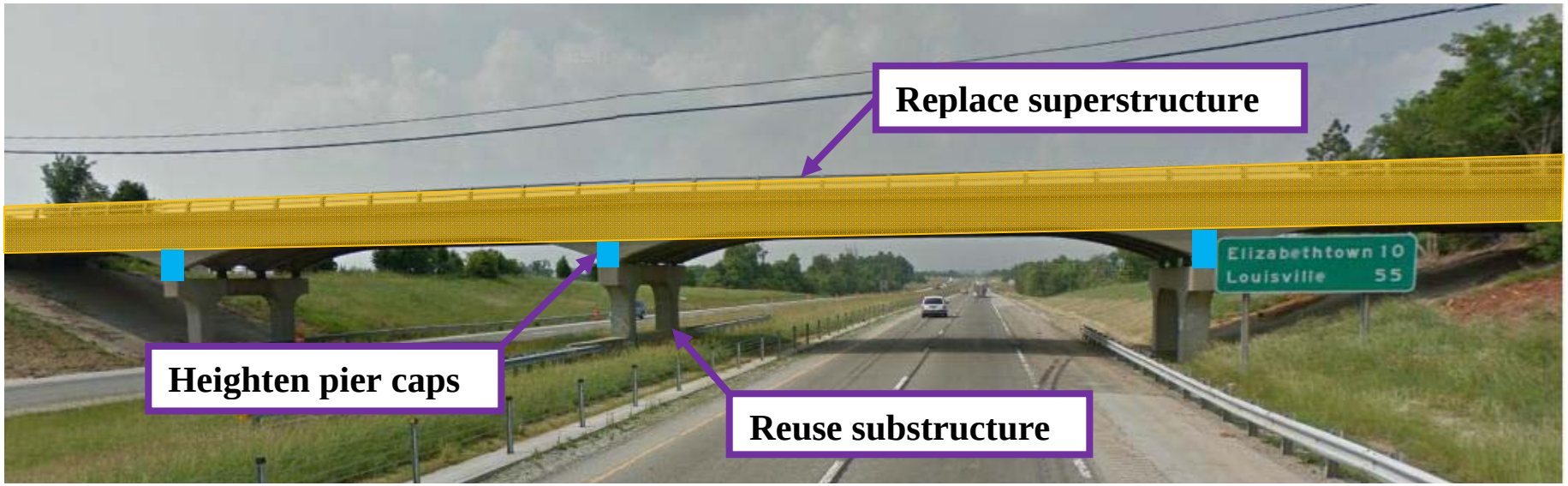
JUSTIFICATION:
The existing substructures are in good to very good condition. Reusing the substructures saves substantial dollars over a full reconstruction. These are low volume local roads that are not anticipated to have increased traffic in the future.

Note: Jacking these bridges was also considered; however, the existing bridge decks are in fair condition and therefore the VE Team removed this option from consideration.

SUMMARY OF COST ANALYSIS			
	First Cost	O & M Costs (Present Worth)	Total LC Cost (Present Worth)
ORIGINAL DESIGN	$3,414,000	$0	$3,414,000
RECOMMENDED DESIGN	$2,024,000	$0	$2,024,000
ESTIMATED SAVINGS OR (COST)	$1,390,000	$0	$1,390,000

VALUE ENGINEERING RECOMMENDATION # VE-14

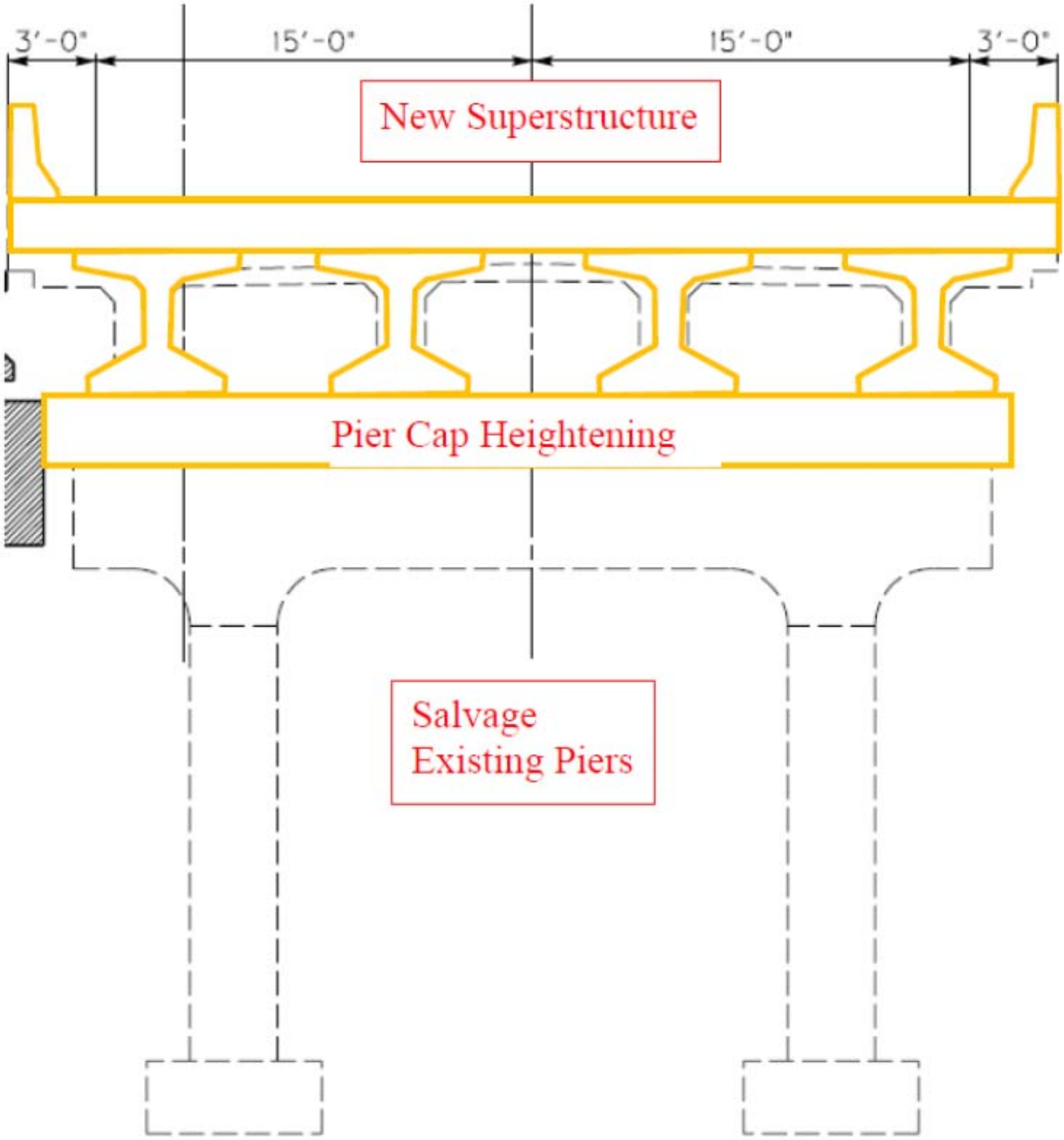
SKETCH OF RECOMMENDED DESIGN



Graphic showing recommended changes to Old Sonora Bridge over I-65 (typical of other structures in this recommendation)

VALUE ENGINEERING RECOMMENDATION # VE-14

SKETCH OF RECOMMENDED DESIGN



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 $
Old Sonora Road Bridge							
Substructure Construction	LS	$570,000	1	1	$570,000		
Pier/Abut Cap Retrofit	EA	$6,000	7			5	$30,000
Superstructure Replacement	SF	$71.69	1	9,415	$674,961	8,877	$636,392
Guardrail & End Treatment	LS	$15,000	7			1	$15,000
KY 1407 Bridge							
Substructure Construction	LS	$360,000	1	1	$360,000		
Pier/Abut Cap Retrofit	EA	$6,000	7			5	$30,000
Superstructure Replacement	SF	$54.78	1	9,415	$515,754	8,877	$486,282
Guardrail & End Treatment	LS	$15,000	7			1	$15,000
KY 1136 Bridge							
Substructure Construction	LS	$276,000	1	1	$276,000		
Pier/Abut Cap Retrofit	EA	$6,000	7			5	$30,000
Superstructure Replacement	SF	$56.75	1	10,072	$571,586	8,850	$502,238
Guardrail & End Treatment	LS	$15,000	7			1	$15,000
Subtotal					$2,968,301		$1,759,912
Contingency	@	15%			$445,245		$263,987
Total					$3,413,546		$2,023,898

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

VALUE ENGINEERING RECOMMENDATION # VE-15

DESCRIPTIVE TITLE OF RECOMMENDATION:
Use a 2-span bridge in lieu of a 4-span bridge to eliminate outside piers where possible.

ORIGINAL DESIGN:
The original design specifies using 4-span bridges on the following overpass structures:

- KY 728
- KY 224
- US31W
- KY 84
- Old Sonora Road
- KY 1407
- KY 1136

RECOMMENDED CHANGE:
The VE Team recommends using shorter 2-span bridges on the following structures:

- KY 224
- KY 84
- Old Sonora Road
- KY 1407
- KY 1136

The VE Team does not believe it is reasonable to use a 2-span bridge on the KY 728 and US31W bridges due to the skew which increases the span length. The resultant span length requires an increased structure depth beyond what would be economically feasible. The VE Team recommends that the profile of the approach roadway be raised to accommodate the existing structure depth so that we do not negatively impact the stopping sight distance. The overall bridge length can be minimized on these structures with the removal of the outside piers. A 3:1 slope can be utilized within the clear zone. The flat bottom ditch running parallel to I-65 on some of these structures can be piped under the embankment slope in an effort to shorten the bridge spans.

VALUE ENGINEERING RECOMMENDATION # 15

DISCUSSION CONTINUED

ADVANTAGES:

- Eliminates construction of two piers
- Could increase clear zone
- Provides opportunity for additional future widening
- Reduces bridge deck area
- Aesthetically pleasing

DISADVANTAGES:

- Increases beam depth necessitates increasing the profile on side roads
- Increased profile will require additional embankment
- Increased profile could have ROW impacts

JUSTIFICATION:

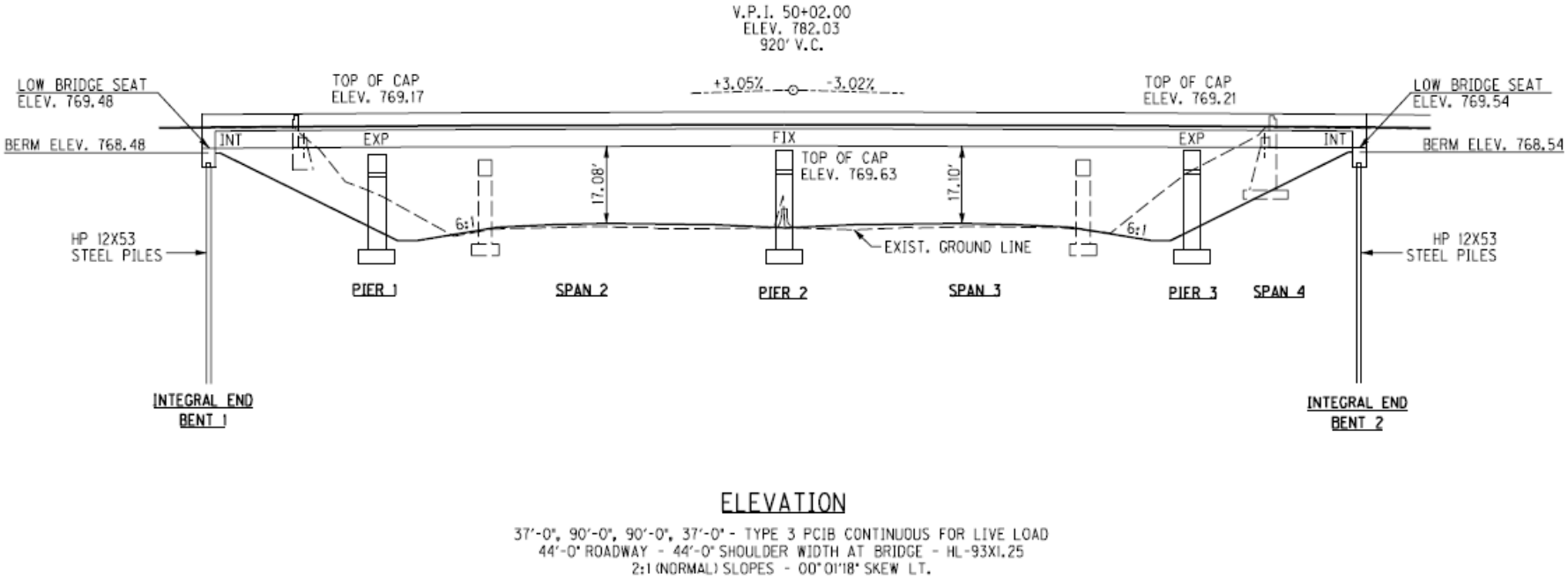
2-span bridges offer significant cost savings over 4-span bridges since they eliminate the use of two piers, which are a significant portion of the construction cost. 2-span structures were used exclusively on the widening of I-64 in Shelby County.

The VE Team assumes that the span length for bridge with 0 degree skew will be about 117 ft. Skewed bridges will require longer spans. It is assumed that a prestressed concrete beam with a depth of 66 in., such as the HN 66 49 shape, will have sufficient structural capacity for this span length. This will require an increase in profile over the original design, ranging from 12 in. to 24 in. on these five structures. The increase in profile will need to be accommodated in the approach roadways with additional embankment.

SUMMARY OF COST ANALYSIS			
	First Cost	O & M Costs (Present Worth)	Total LC Cost (Present Worth)
ORIGINAL DESIGN	$4,521,000	$0	$4,521,000
RECOMMENDED DESIGN	$3,315,000	$0	$3,315,000
ESTIMATED SAVINGS OR (COST)	$1,206,000	$0	$1,206,000

VALUE ENGINEERING RECOMMENDATION # VE-15

SKETCH OF ORIGINAL DESIGN



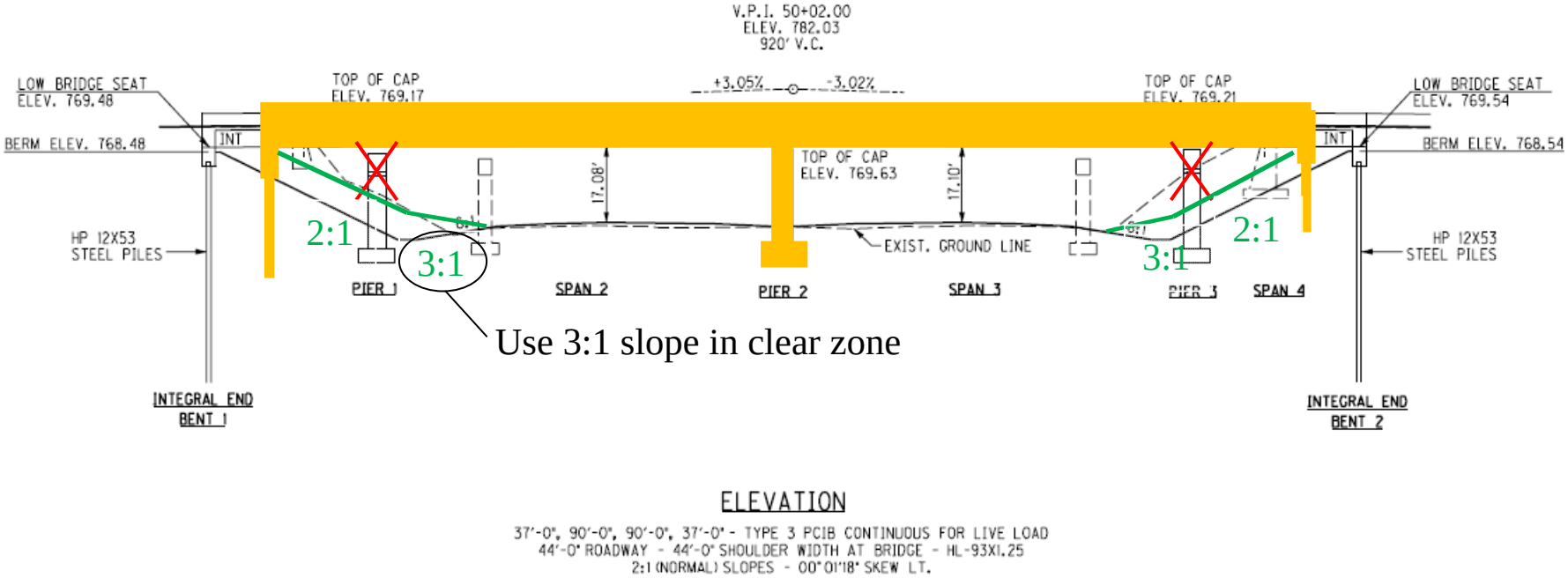
ELEVATION

37'-0", 90'-0", 90'-0", 37'-0" - TYPE 3 PCIB CONTINUOUS FOR LIVE LOAD
44'-0" ROADWAY - 44'-0" SHOULDER WIDTH AT BRIDGE - HL-93XI.25
2:1 (NORMAL) SLOPES - 00°01'18" SKEW LT.

Example of original 4-span bridge (KY 224 shown)

VALUE ENGINEERING RECOMMENDATION # 15

SKETCH OF RECOMMENDED DESIGN



ELEVATION

37'-0", 90'-0", 90'-0", 37'-0" - TYPE 3 PCIB CONTINUOUS FOR LIVE LOAD
44'-0" ROADWAY - 44'-0" SHOULDER WIDTH AT BRIDGE - HL-93XI.25
2:1 (NORMAL) SLOPES - 00°01'18" SKEW LT.

Example of recommended 2-span bridge shown in orange (KY 224 shown)

VALUE ENGINEERING RECOMMENDATION # 15

PHOTOGRAPH OF RECOMMENDED DESIGN

VALUE ENGINEERING RECOMMENDATION # 15

CALCULATIONS

The proposed length of a single span on a 2-span bridge on a 0 degree skew is as follows. This will be an incidental cost.

Inside Shoulder	14 ft-0 in.
Three Lanes	3 @ 12 ft-0 in. = 36 ft-0 in.
Outside Shoulder	12 ft-0 in.
Ditch	6 ft-0 in.
3:1 slope within clear zone (4 ft rise)	12 ft-0 in.
2:1 slope (16 ft rise)	32 ft-0 in.
Berm	1 ft-0 in.
Substructure Width	2 @ 2 ft-0 in. = 4 ft-0 in.
Total Span Length	**117 ft-0 in.**

The following assumptions were made by the VE Team when developing the cost estimate for this recommendation:

- The construction cost of each pier is equivalent to approximately 25% of the total substructure cost or 10% of the total cost of each structure.
- The original design for the Old Sonora Road bridge shows that Pier 2 will require reconstruction. It is assumed that this will also be required for the KY 1407 and 1136 bridges regardless of the number of spans utilized.
- The savings in slab area is offset by the additional costs necessary to increase the capacity of the end bents and the median pier and therefore is not shown.

VALUE ENGINEERING RECOMMENDATION # 15

COST ESTIMATE - FIRST COST

Cost Item	Units	$/Unit	Source Code	Original Design		Recommended Design	
				Num of Units	Total $	Num of Units	Total $
KY 224 Bridge							
PCIB Type III	LF	$208.21	1	1,769	$368,323		
PCIB Type VI	LF	$265.00	7			1,640	$434,600
Piers	EA	$110,000	1/7	3	$330,000	1	$110,000
Embankment	LS	$40,000	7			1	$40,000
KY 84 Bridge							
HN 42 49	LF	$250.00	1	2,261	$565,250		
HN 66 49	LF	$325.00	7			2,150	$698,750
Piers	EA	$320,000	1/7	3	$960,000	1	$320,000
Embankment	LS	$60,000	7			1	$60,000
Old Sonora Road Bridge							
HN 42 49	LF	$250.00	1	1,060	$265,000		
HN 66 49	LF	$325.00	7			940	$305,500
Piers	EA	$140,000	1/7	3	$420,000	1	$140,000
Embankment	LS	$30,000	7			1	$30,000
KY 1407 Bridge							
PCIB Type IV	LF	$215.59	1	1,064	$229,388		
PCIB Type VI	LF	$265.00	7			940	$249,100
Piers	EA	$90,000	1/7	3	$270,000	1	$90,000
Embankment	LS	$30,000	7			1	$30,000
KY 1136 Bridge							
PCIB Type IV	LF	$215.59	1	1,174	$253,103		
PCIB Type VI	LF	$265.00	7			960	$254,400
Piers*	EA	$90,000	1/7	3	$270,000	1	$90,000
Embankment	LS	$30,000	7			1	$30,000
Subtotal					$3,931,064		$2,882,350
Contingency	@	15%			$589,660		$432,353
Total					$4,520,723		$3,314,703

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

VALUE ENGINEERING RECOMMENDATION # VE-16

DESCRIPTIVE TITLE OF RECOMMENDATION:
Replace ROW fence only as needed in lieu of full fence removal and replacement.

ORIGINAL DESIGN:
The original design specifies removing and replacing all of the ROW fencing. The total amount of fencing identified to be replaced is 243,862 ft.

RECOMMENDED CHANGE:
The VE Team recommends conducting a condition survey of existing fencing and replacing fencing only in areas where the fencing is damaged.

ADVANTAGES:

- Reduced construction labor and material
- Reduces construction duration
- Reuse of existing materials
- Less landscape restoration

DISADVANTAGES:

- Useful life expectancy not consistent
- Analysis needed to determine replacement areas
- Inconsistent materials
- Non-brushed sections of roadside fence

JUSTIFICATION:
In rural areas, open stretches of interstate ROW fencing often remain undisturbed aside from tree and weed growth. The fencing in these areas is frequently in good condition. Many areas of the project will not be cleared to the ROW line. Replacing fencing in good condition is unnecessary in areas that are not being disturbed. It is assumed that as much as 40% of the fencing is in good condition and still viable.

SUMMARY OF COST ANALYSIS			
	First Cost	O & M Costs (Present Worth)	Total LC Cost (Present Worth)
ORIGINAL DESIGN	$3,085,000	$0	$3,085,000
RECOMMENDED DESIGN	$1,862,000	$0	$1,862,000
ESTIMATED SAVINGS OR (COST)	$1,223,000	$0	$1,223,000

VALUE ENGINEERING RECOMMENDATION # VE-16

PHOTOGRAPHS OF EXISTING CONDITIONS

Photographs of existing ROW fencing in good condition along I-65 near the KY 224 interchange

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 $
Remove and Replace ROW Fence	LF	$11.00	1	243,862	$2,682,482	146,317	$1,609,489
Additional Condition Survey	LS	$10,000	7			1	$10,000
Subtotal					$2,682,482		$1,619,489
Contingency	@	15%			$402,372		$242,923
Total					$3,084,854		$1,862,413

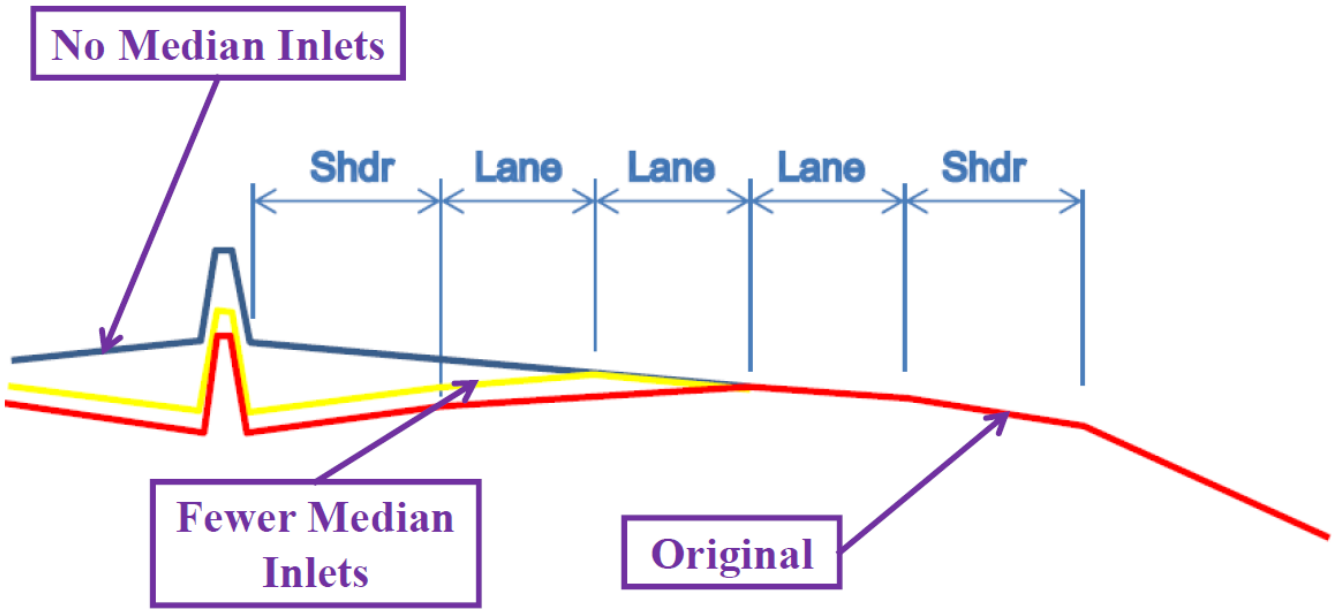
SOURCE CODE: 1 Project Cost Estimate
2 KYTC Average Bid
3 CACES Data Base
4 Means Estimating Manual
5 National Construction Estimator
6 Vendor Lit or Quote (list name / details)
7 Professional Experience (List job if applicable)
8 Other Sources (specify)

VALUE ENGINEERING DESIGN COMMENT # VE-17

DESCRIPTIVE TITLE OF DESIGN COMMENT:
For extremely flat sections, slope the center lane or the entire roadway toward the outside in lieu of toward the median.

COMMENTARY:
Between Station 537+00 and Station 560+00, the profile grade is +0.00183%. The pavement crown in each direction is proposed to be 39.25 ft from the freeway centerline. Water in this area will flow readily toward the median barrier but likely will spread significantly before flowing into a median inlet.

If all of the pavement and shoulder in this segment were to be sloped outward (e.g. 2%) similar to that of a superelevated section, then the contributing area would be zero and no median drain would be needed. If only the center lane in this segment were to be sloped outward, then the contributing area would be reduced by 30% but some of the inlets would still be needed. It is acknowledged that either of these options would require a cross slope transition at each end of the segment and would require additional asphalt in the affected overlay portions. It is also acknowledged that sloping the median shoulder toward the mainline pavement has some risks during snow/ice melt.



VALUE ENGINEERING DESIGN COMMENT # VE-18

DESCRIPTIVE TITLE OF DESIGN COMMENT:
Review the cost estimate for redundancy between 10% miscellaneous cost and 15% contingency mark-up.

COMMENTARY:
The project cost estimate contains a 10% miscellaneous line item that accounts for $18,150,179 of the total project cost. The cost estimate also includes a 15% contingency that amounts to $31,295,445. It is understood that the miscellaneous line item is intended to capture any small or minor cost item that was not specifically called out as one of the 48 line items on the cost estimate. The VE team recommends verifying the accuracy of this miscellaneous line item to prevent any redundancy with the contingency mark-up. Improving the accuracy of the cost estimate will improve the decision making ability of KYTC.

VALUE ENGINEERING DESIGN COMMENT # VE-19

DESCRIPTIVE TITLE OF DESIGN COMMENT:
Use staggered asphalt lift joints in lieu of placing joints along wheel path.

COMMENTARY:
Where placing new full-depth pavement adjacent to existing and where placing full-width layers, locate the longitudinal joint of each asphalt layer such that it is offset from the longitudinal joint of the preceding layer to improve bonding. Stepped removal of layers of the existing pavement edge might be necessary. Any joint in the surface course should be along a lane line and not in a wheel path.

VALUE ENGINEERING DESIGN COMMENT # VE-20

DESCRIPTIVE TITLE OF DESIGN COMMENT:
Use excess material to fill adjacent embankments in lieu of wasting material and installing guardrail in applicable locations.

COMMENTARY:
Where excess material is available from excavated areas, place that material on the side slopes of nearby roadway embankments to create flatter slopes within the clear zone. The benefits would be to reduce the length of guardrail and improve safety.

VALUE ENGINEERING DESIGN COMMENT # VE-21

DESCRIPTIVE TITLE OF DESIGN COMMENT:
Close US-31W during construction in lieu of maintaining traffic during construction.

COMMENTARY:
The VE Team requests that the Design Team consider closing US 31W during the construction of the overpass of I-65. Current ADT of US 31W at this location is 3240 ADT. The overpass over I-65 is approximately 2 miles from the KY 84/I-65 interchange and approximately 3 miles from the KY 224/I-65 interchange. Detoured traffic could possibly encounter a 5 mile detour depending on origin and destination. By allowing the closure of US 31W to construct this overpass, KYTC will get a better product, possible cost savings due to the contractor being able to work outside of traffic and minimizing the time that work will need to occur over I-65.

VALUE ENGINEERING DESIGN COMMENT # VE-22

DESCRIPTIVE TITLE OF DESIGN COMMENT:
Use a traditional temporary bridge support system during construction of the KY 224 overpass bridge in lieu of the unique single column pier.

COMMENTARY:
The preliminary bridge plans for the construction phasing shows a single column pier in Phase 1 of construction. Though this may be the most economical phasing, it will be necessary to account for all loading cases in the temporary condition, which may require an increased pier column size and/or steel reinforcement.

VALUE ENGINEERING DESIGN COMMENT # VE-23

DESCRIPTIVE TITLE OF DESIGN COMMENT:
Use round columns in lieu of square columns for bridge piers.

COMMENTARY:
The VE Team recommends that consideration be given to using round columns in lieu of square columns for bridge piers, unless existing piers are widened. Round columns are likely easier to form and construct than square columns. Additionally the spirals for round columns may be easier to construct and place than the ties used on square columns.

VALUE ENGINEERING DESIGN COMMENT # VE-24

DESCRIPTIVE TITLE OF DESIGN COMMENT:
Use mechanically stabilized earth (MSE) walls in lieu of sloped embankment to shorten bridge spans and superstructure.

COMMENTARY:
The original design specifies multi-span bridges that include end spans with stub abutments and sloped embankments. The sloped embankment reduces the abutment height and eliminates the need for a retaining wall in front of the abutment.

The VE Team recommends utilizing mechanical stabilized earth (MSE) or modular block walls in lieu of sloped embankments in order to shorten bridge lengths where possible. The full height MSE retaining walls should be in front of integral or semi-integral abutments.

ADVANTAGES:

- Reduced overall bridge length and possibly the number of spans
- Elimination of bents in some cases which includes elimination of piles
- Reduction in future bridge area to maintain
- Enhanced safety, particularly during winter driving conditions, due to decreased bridge deck area
- Easier to remove snow
- Enhanced bridge aesthetics

DISADVANTAGES:

- Potential future maintenance issues if MSE walls are not properly installed
- Additional construction coordination/ sequencing may be required to ensure MSE straps are not damaged
- Based on prior KYTC experience, revised specifications and/or the need for additional construction monitoring/testing would be advisable to ensure quality construction of MSE walls

The unit cost of bridge structure is typically much higher than the cost of retained earth. This recommendation eliminates bridge length and replaces it with less expensive engineered fill and retaining wall. This recommendation has no impact on safety or ride ability. The operations and maintenance (O&M) cost are assumed to be comparable to the original design for this recommendation as bridges are just being reduced opposed to being completely eliminated. The cost of MSE walls is usually between $55-$60/SF.

The elimination of end spans with sloped grading significantly reduces the cost of the bridges. Although additional costs will be incurred for the MSE walls, the MSE wall costs are much less than the bridge spans that are eliminated. In addition to the initial construction cost reduction, future bridge maintenance costs will be reduced. The quantity of salt required during winters will also be reduced, and safety is anticipated to be enhanced due to the substantial decrease in bridge deck area. Although the VE Team is aware that KYTC has had some past issues with MSE wall construction, the VE Team believes that if the construction specifications/criteria require the contractor to sequence his construction appropriately, and possibly provide independent monitoring/testing as a condition of acceptance, that quality construction of MSE walls is achievable. Use of MSE walls also offers an opportunity for enhanced bridge aesthetics.

VALUE ENGINEERING DESIGN COMMENT # VE-24

PHOTOGRAPH OF ORIGINAL DESIGN

VALUE ENGINEERING DESIGN COMMENT # VE-24

PHOTOGRAPH OF RECOMMENDED DESIGN

VALUE ENGINEERING DESIGN COMMENT # VE-25

DESCRIPTIVE TITLE OF DESIGN COMMENT:
Verify if the additional asphalt weight will impact the KY 2756 tunnel and/or farm lane access tunnel at Sta. 3494+50

COMMENTARY:
With the depressed divided median being converted to travel lanes, median and barrier wall the VE Team recommends that the Design Team verify that the additional load can be handled by the existing structure for KY 2756 under I-65.

VALUE ENGINEERING DESIGN COMMENT # VE-26

DESCRIPTIVE TITLE OF DESIGN COMMENT:
Allow alternate bidding of concrete versus asphalt.

COMMENTARY:
The VE Team suggests considering alternate pavement type selection as defined in the March 30, 2009 KYTC Policy:

1.3.1 Interstates
This policy applies to projects on the Interstates that are new construction, reconstruction, major widening, or include pavement rehabilitation. Major widening includes projects that add additional traffic lanes to the current system. Pavement rehabilitation projects are defined as projects greater than one (1) mile in centerline length that include more than 1 ½ in. of grade change or greater than 2 in. of pavement milling.

The allowance of Alternate Pavement encourages greater competion and which leads to lower bid prices.

VALUE ENGINEERING DESIGN COMMENT # VE-27

DESCRIPTIVE TITLE OF DESIGN COMMENT:
Provide concrete barrier median openings for emergency access.

COMMENTARY:
The VE Team recommends that the Design Team consider barrier wall openings for emergency access vehicles. By improving access for emergency responders you can improve incident management response. An opening in the barrier wall for Emergency Responders was installed on a recently completed portion of I-64 in Jefferson County. The possible location could be identified by reviewing historical crash data and conversing with the emergency responders. The existing interchanges within the project limits are spaced roughly 5 miles apart. Presently emergency responders have the ability to use the divided median to cross from one side of I-65 to the other.

VALUE ENGINEERING DESIGN COMMENT # VE-28

DESCRIPTIVE TITLE OF DESIGN COMMENT:
Use wet reflective pavement markings to improve driver visibility.

COMMENTARY:
Frequent accidents within the project area were attributed to driver fatigue. These accidents occurred often at night. The use of high reflectivity pavement markings improves wet-night visibility and other-low visibility (fog) conditions. Using these products would improve pavement marking visibility in areas prone to fatigue crashes while improving traffic operations and safety. The VE Team recommends investigating and considering these products for inclusion into the project.

VALUE ENGINEERING DESIGN COMMENT # VE-29

DESCRIPTIVE TITLE OF DESIGN COMMENT:
Provide truck parking areas at the old rest stops within the project to reduce driver fatigue related accidents.

COMMENTARY:
Reduce truck driver fatigue by constructing additional roadside truck parking. Evaluate repurposing abandoned rest areas to limited facility parking areas to provide opportunities for drivers to rest and reduce the possibility for driver fatigue related accidents. The VE Team recommends providing parking/rest areas along this corridor. KYTC still owns the ROW of the old, abandoned rest stops which could be reused for new resting areas. The old, abandoned northbound rest stop was located between KY 84 and Old Sonora Road (approximately Sta. 430+00). The old, abandoned southbound rest stop was located between Old Sonora and KY 1407 (approximately Sta. 480+00). Providing rest areas has the potential to reduce the number of fatigue related crashes.

VALUE ENGINEERING DESIGN COMMENT # VE-30

DESCRIPTIVE TITLE OF DESIGN COMMENT:
Install median footings as shallow as possible to reduce median excavation.

COMMENTARY:
The VE Team recommends installing the foundations for the median piers as shallow as possible to minimize the excavation required. Increased excavation may have negative impacts to the construction phasing and increase the overall construction time of the project.

VALUE ENGINEERING DESIGN COMMENT # VE-31

DESCRIPTIVE TITLE OF DESIGN COMMENT:
Use some of the unspent funds that have been saved from implementation of VE recommendations on aesthetic and/or environmental enhancements.

COMMENTARY:
The VE Team acknowledges that most of the recommendations and design comments have focused more on cost savings and less on increased benefit. It is suggested that some of the savings, if any, be used for enhancements in the form of local recognition or other environmental work (e.g.: the Lincoln name, caves, tree plantings, remediation, etc.).

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

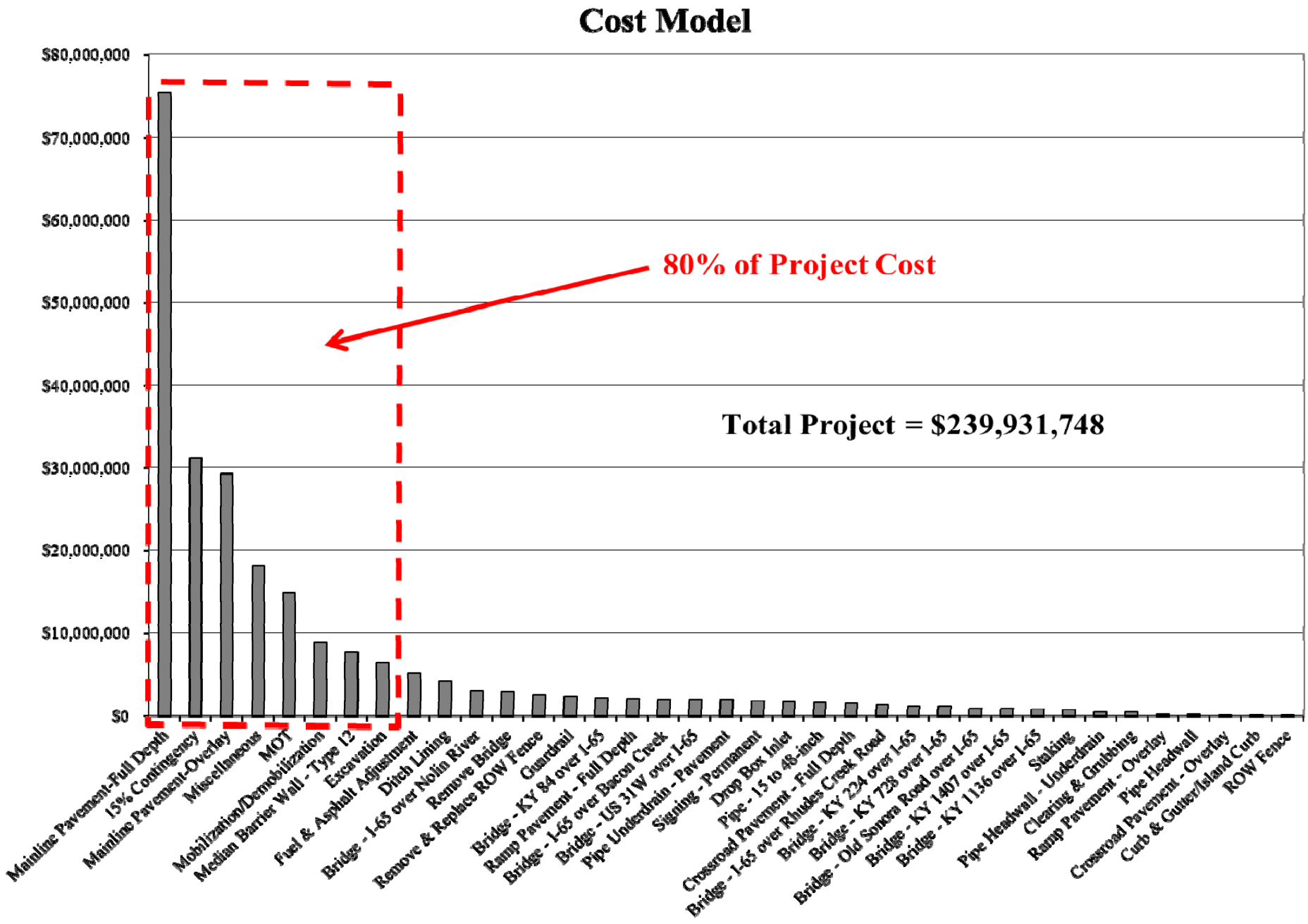
Attendees				Participation						
				Meetings		Study Sessions				
Name	Organization and Address	Telephone # and Email	Role in Workshop	Intro	Out Brief	Day 1	Day 2	Day 3	Day 4	Day 5
Boday Borres	KYTC 200 Mero Street Frankfort, KY 40602	502-564-3280 Boday.Borres@ky.gov	KYTC VE Coordinator	X	X	X				
Travis Carrico	KYTC 200 Mero Street Frankfort, KY 40602	502-564-3280 Travis.Carrico@ky.gov	KYTC Observer	X	X	X	½			X
James Codell	URS Corporation 325 W. Main Street, Suite 1200 Louisville, KY 40206	859-537-2901 James.Codell@urs.com	Observer		X					
Stephen Curless	URS Corporation 525 Vine Street, Suite 1800 Cincinnati, OH 45202	513-419-3504 Steve.Curless@urs.com	VE Roadway Designer	X	X	X	X	X	X	X
Aaron Detjen	Parsons Brinckerhoff 1792 Alysheba Way, Suite 230 Lexington, KY 40509	859-245-3866 detjen@pbworld.com	Design Team Member	X						
Dan Hite	KYTC 200 Mero Street Frankfort, KY 40602	502-564-3280 Dan.Hite@ky.gov	KYTC Representative	X	X					
Andre Johannes	KYTC 200 Mero Street Frankfort, KY 40602	502-564-3280 Andre.Johannes@ky.gov	KYTC Representative	X	X					
Craig Klusman	URS Corporation 325 W. Main Street, Suite 1200 Louisville, KY 40206	502-217-1502 Craig.Klusman@urs.com	VE Structural Engineer	X	X	X	X	X	X	X
Paul Looney	KYTC 200 Mero Street Frankfort, KY 40602	502-564-3280 Paul.Looney@ky.gov	KYTC Pavement Design Engineer	X	X					
Brian Meade	URS Corporation 325 W. Main Street, Suite 1200 Louisville, KY 40206	502-569-2301 Brian.Meade@urs.com	VE Transportation Engineer	X	X	X	X	X	X	X

Workshop Attendance

Attendees				Participation						
				Meetings		Study Sessions				
Name	**Organization and Address**	**Telephone # and Email**	**Role in Workshop**	**Intro**	**Out Brief**	**Day 1**	**Day 2**	**Day 3**	**Day 4**	**Day 5**
John Moore	KYTC – District 4 634 East Dixie Highway Elizabethtown, KY 42701	270-766-5066 JohnW.Moore@ky.gov	KYTC District Representative	X	Via Video					
Mary Murray	FHWA KY Division 330 W. Broadway Street Frankfort, KY 40601	502-223-6745 Mary.Murray@dot.gov	FHWA Representative	X	X					
Jason Ramler	URS Corporation 525 Vine Street, Suite 1800 Cincinnati, OH 45202	513-419-3493 Jason.Ramler@urs.com	VE Highway Engineer	X	X	X	X	X	X	X
Arlen Sandlin	Parsons Brinckerhoff 1792 Alysheba Way, Suite 230 Lexington, KY 40509	859-245-3867 sandlin@pbworld.com	Design Team		X					
Kyle Schafersman	URS Corporation 8300 College Blvd., Suite 200 Overland Park, KS 66210	913-579-4286 Kyle.Schafersman@urs.com	VE Team Leader	X	X	X	X	X	X	X
Steve Slade	Parsons Brinckerhoff 1792 Alysheba Way, Suite 230 Lexington, KY 40509	859-245-3862 slade@pbworld.com	Design Team Project Manager	X	X					
Lynn Soporowski	KYTC 200 Mero Street Frankfort, KY 40602	502-564-7183 Lynn.Soporowski@ky.gov	Traffic Forecast Freight		X					
Eileen Vaughan	KYTC 200 Mero Street Frankfort, KY 40602	502-564-3280 Eileen.Vaughan@ky.gov	Lessons Learned Coordinator	X	X	X	X	X	X	X

APPENDIX B
Cost Information

APPENDIX B – Cost Information


Cost Model
$80,000,000
$70,000,000
$60,000,000
$50,000,000
$40,000,000
$30,000,000
$20,000,000
$10,000,000
$0
80% of Project Cost
Total Project = $239,931,748
Mainline Pavement-Full Depth
15% Contingency
Mainline Pavement-Overlay
Miscellaneous
MOT
Mobilization/Demobilization
Median Barrier Wall - Type 12
Excavation
Fuel & Asphalt Adjustment
Ditch Lining
Bridge - I-65 over Nolin River
Remove Bridge
Remove & Replace ROW Fence
Guardrail
Bridge - KY 84 over I-65
Ramp Pavement - Full Depth
Bridge - I-65 over Bacon Creek
Bridge - US 31W over I-65
Pipe Underdrain - Pavement
Signing - Permanent
Drop Box Inlet
Pipe - 15 to 48-inch
Crossroad Pavement - Full Depth
Bridge - I-65 over Rhudes Creek Road
Bridge - KY 224 over I-65
Bridge - KY 728 over I-65
Bridge - Old Sonora Road over I-65
Bridge - KY 1407 over I-65
Bridge - KY 1136 over I-65
Staking
Pipe Headwall - Underdrain
Clearing & Grubbing
Ramp Pavement - Overlay
Pipe Headwall
Crossroad Pavement - Overlay
Curb & Gutter/Island Curb
ROW Fence

APPENDIX C
Function Analysis

APPENDIX C – Function Analysis

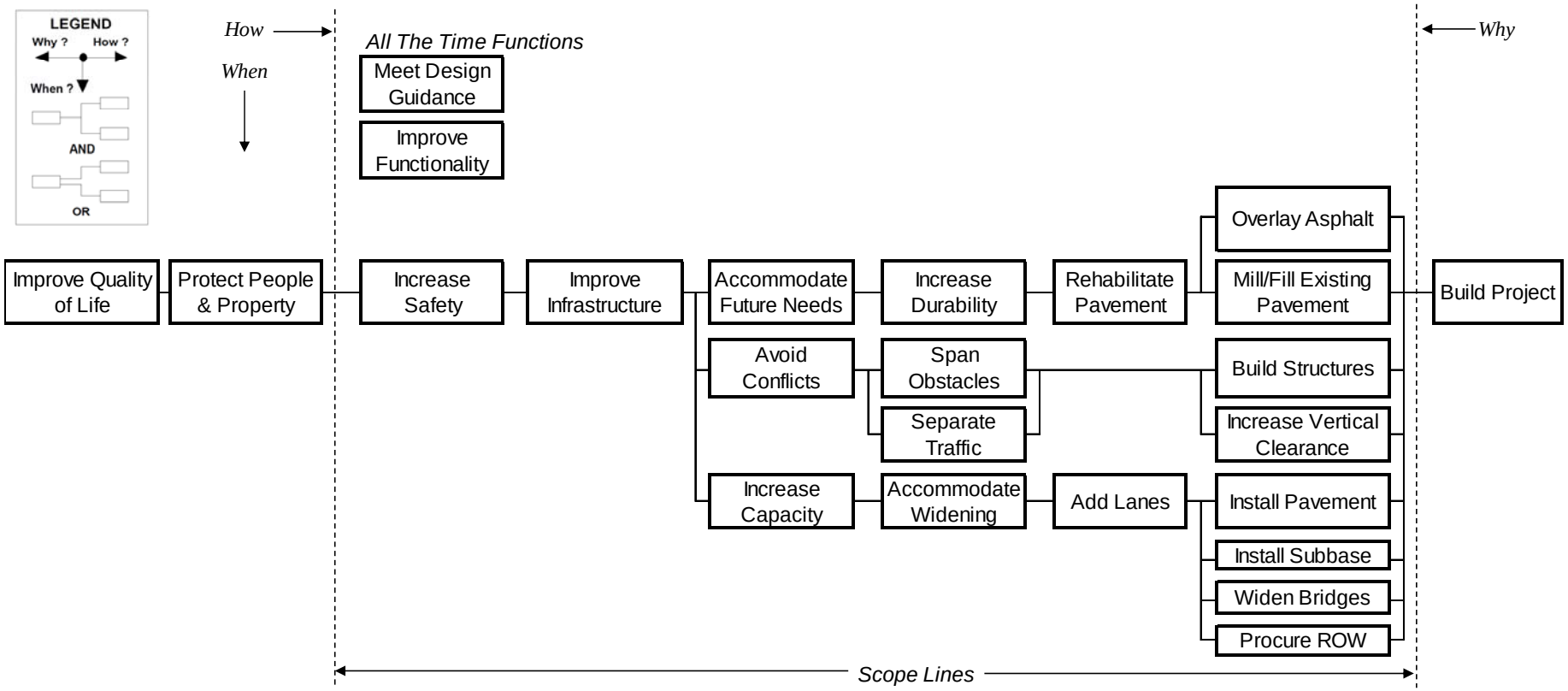
Function Model

Item	Cost	Function
Total Construction	$239,931,748	Improve lane consistency Increase capacity Improve safety Improve traffic operations Meet standards Support increased freight weight
Mainline Pavement Full-Depth	$75,657,743	Improve lane consistency Increase capacity Improve safety Improve traffic operations
15% Contingency	$31,295,445	Account for unknowns
Mainline Pavement-Overlay	$29,292,581	Support increased freight weight Strengthening pavement structure Eliminate pavement joint
Miscellaneous	$18,150,179	Account for minor items Light interchanges Improve safety Control erosion during construction Obtain permit
MOT	$15,057,804	Separate construction zone Manage traffic Maintain capacity
Mobilization/Demobilization	$8,984,338	Locate equipment/staff on site Open job office
Median Barrier Wall - Type 12	$7,862,460	Separate traffic Reduce glare Prevent vehicle crossover
Excavation	$6,448,000	Increase clear zone Prepare for widening
Fuel & Asphalt Adjustment	$5,240,000	Reduce contractor risk Account for price shifts
Ditch Lining	$4,323,424	Reduce erosion Slow conveyance
Bridge - I-65 over Nolin River	$3,100,000	Span river Allow conveyance Manage floodplain Widen interstate
Remove Bridge	$3,000,000	Maintain alignment Accommodate new widening and profile Increase vertical clearance
Remove & Replace ROW Fence	$2,682,482	Define ROW Control access Replace old fence

Item	Cost	Function
Guardrail	$2,476,350	Contains vehicles within roadway Absorb energy Separates vehicles from obstructions Improves safety Update infrastructure
Bridge - KY 84 over I-65	$2,300,000	Connect Sonora to west Support traffic growth (auto plant) Separate traffic Widen shoulders Increase capacity
Ramp Pavement Full-Depth	$2,141,017	Meet profile of side streets
Bridge - I-65 over Bacon Creek	$2,100,000	Span river Allow conveyance Manage floodplain Widen interstate
Bridge - US 31W over I-65	$2,100,000	Supply north-south connectivity Accommodate alternative to interstate Increase capacity on I-65 Widen shoulders Increase clear zone Improve level of service
Pipe Underdrain - Pavement	$2,075,210	Drain subbase Improve longevity of base
Signing - Permanent	$1,915,650	Notify travelers Facilitate way finding
Drop Box Inlet	$1,779,000	Convey drainage Drain roadway
Pipe - 15 to 48-inch	$1,729,606	Convey drainage Drain roadway
Crossroad Pavement Full-Depth	$1,565,960	Accommodate vertical clearance of I-65 Accommodate widening Improve safety
Bridge - I-65 over Rhudes Creek Road	$1,400,000	Supply north-south connectivity Increase capacity on I-65 Widen shoulders Increase clear zone Improve level of service
Bridge - KY 224 over I-65	$1,250,000	Accommodate vertical clearance of I-65 Accommodate widening of I-65 Increase clear zone of I-65 Improve level of service of KY 224
Bridge - KY 728 over I-65	$1,200,000	Accommodate vertical clearance of I-65 Accommodate widening of I-65 Increase clear zone of I-65 Improve level of service of KY 728

Item	Cost	Function
Bridge - Old Sonora Road over I-65	$950,000	Supply east-west connectivity Increase capacity on I-65 Widen shoulders Increase clear zone Improve level of service
Bridge - KY 1407 over I-65	$900,000	Supply east-west connectivity Increase capacity on I-65 Widen shoulders Increase clear zone Improve level of service
Bridge - KY 1136 over I-65	$850,000	Supply east-west connectivity Increase capacity on I-65 Widen shoulders Increase clear zone Improve level of service
Staking	$696,600	Locate roadway
Pipe Headwall - Underdrain	$462,500	Prevent pipe crushing Daylight drain pipe
Clearing & Grubbing	$439,035	Prepare site Remove organic material
Ramp Pavement - Overlay	$210,401	Improve ramp surface Maintain material consistency
Pipe Headwall	$130,000	Support pipe outlet
Crossroad Pavement - Overlay	$74,061	Improve roadway surface Maintain material consistency
Curb & Gutter/Island Curb	$63,175	Separate traffic Define travel path
ROW Fence	$28,727	Define ROW Control access

FAST Diagram



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	Verify traffic projections for this corridor in lieu of assuming ~75,000 ADT	DC	J. Ramler
2	Assuming ~55,000 ADT (2035), use thinner asphalt pavement section in lieu of current design	1	J. Ramler
3	Construct vertical clearances for maximum asphalt overlay, but only install the amount of asphalt needed for next 10 years and add additional overlay in the future if necessary	1	J. Ramler
4	Use concrete overlay (white-topping) in lieu of 7.5 in. asphalt overlay	3	
5	Take into account the recent asphalt overlay from MP 78 to MP 91 performed in 2011 when determining new overlay thickness	2	J. Ramler
6	According to the geotechnical investigation of 2001, eliminate soil stabilization throughout project	1	J. Ramler
7	Use 8 in. of chemical stabilized subbase for the median shoulder in lieu of 16 in.	BD	
8	Use geogrid to reduce the pavement design	2	J. Ramler
9	Use a staggered asphalt lift joints in lieu of placing joints along wheel path	DC	S. Curless
10	Use guardrail in lieu of rock cut in the clear zone where applicable (Sta. 3390+50 to Sta. 3395+00)	1	S. Curless
11	For clear zone conflicts, reduce interior median shoulder to allow an increase in outside shoulder width	4	
12	Use excess material to fill adjacent embankments in lieu of wasting material and installing guardrail in applicable locations	DC	S. Curless
13	Lower mainline I-65 at overpasses in lieu of raising the elevation of overpass structures	3	
14	Reduce the amount of ROW acquisition by lower the profile of the overpasses	4	
15	Use hybrid beams in lieu of traditional PCI beams to improve vertical clearance and/or eliminate beam lines where applicable	BD	
16	Reconstruct KY 84 as a 2-lane corridor and bridge with shoulders in lieu of a new 5-lane corridor bridge with shoulders	4	
17	Reconstruct KY 84 as a 3-lane corridor and bridge with shoulders in lieu of a new 5-lane corridor bridge with shoulders	1	B. Meade
18	Reconstruct KY 84 using part-width construction along the same alignment in lieu of shifting alignment to the south and acquiring new ROW	3	
19	Use roundabouts at KY 84 ramp terminals in lieu of stop conditions	4	
20	Use box culverts for the floodway section and 3 short spans for the river section in lieu of reconstructing 6-spans for the Nolin River Bridge	4	
21	Close US-31W during construction in lieu of maintaining traffic during construction	DC	B. Meade
22	Use 6 ft shoulders in lieu of 12 ft shoulders for the reconstructed US-31W overpass bridge	2	S. Curless

List of Creative Ideas			
ID #	**Name of Idea / Description**	**Develop Status**	**Team Member Responsible**
23	Close Rhudes Creek Road in lieu of reconstructing an overpass bridge	3	
24	Use a 3-sided structure for the Rhudes Creek Road underpass in lieu of replacing and widening the 3-span mainline bridge	3	
25	Use a single span structure for the Rhudes Creek Road underpass in lieu of a 3-span mainline bridge	2	C. Klusman
26	Close Old Sonora Road in lieu of reconstructing an overpass bridge	1	B. Meade
27	Increasing beam spacing thereby reducing a beam line for the KY 728, KY 84, Rhudes Creek Road, and Nolin bridges	2	C. Klusman
28	At Old Sonora Road, KY 1407, and KY 1136, replace overpass bridge with a bridge of similar width (~24 ft) in lieu of 32 ft wide bridges	1	S. Curless
29	Reuse the substructures on the Old Sonora Road, KY 1407, and KY 1136 bridges in lieu of a full replacement	1	C. Klusman
30	Close the KY 224 overpass bridge during construction in lieu of phased construction	4	
31	Eliminate skew in lieu of a 1 degree skew for the new KY 224 overpass bridge	4	
32	Use a traditional temporary bridge support system during construction of the KY 224 overpass bridge in lieu of the unique single column pier	DC	C. Klusman
33	Maintain existing outside piers in current locations protected by guardrail in lieu of shifting these piers outside of the clear zone	4	
34	Use 2-span in lieu of 4-span to eliminate the outside piers where possible	2	C. Klusman
35	Use full pier reconstruction in lieu of widening of existing piers	4	
36	Use round columns in lieu of square columns for bridge piers	DC	C. Klusman
37	Use mechanically stabilized earth (MSE) walls in lieu of sloped embankment to shorten bridge spans and superstructure	DC	K. Schafersman
38	Verify if the additional asphalt weight will impact the KY 2756 tunnel and/or farm lane access tunnel at Sta. 347+50	DC	B. Meade
39	For extremely flat sections, slope the roadway toward the outside in lieu of toward the median	DC w/ 40	S. Curless
40	For extremely flat sections, slope the center lane toward the outside in lieu of toward the median	DC w/ 39	S. Curless
41	For extremely flat sections, use an undulating profile to assist the stormwater collection at drainage structures	4	
42	Install underdrain for the existing pavement subgrade to eliminate the drainage blanket layer from the proposed pavement design	BD	
43	Restrict truck traffic to the right two lanes to reduce pavement design and improve operations in lieu of allowing truck traffic in all three lanes	4	
44	Provide and sign a truck only lane to separate trucks from cars	4	
45	Close I-65 and detour traffic on Natcher and Western Kentucky Parkway in lieu of phased construction	4	
46	Use a 2-lane mainline section with improved shoulders in lieu of a 3-lane mainline section with improved shoulders	3	

List of Creative Ideas			
ID #	**Name of Idea / Description**	**Develop Status**	**Team Member Responsible**
47	Create toll road for this section of interstate to offset future maintenance	4	
48	Allow alternate bidding of concrete versus asphalt	DC	B. Meade
49	Provide concrete barrier median openings for emergency access	DC	B. Meade
50	Review the cost estimate for redundancy between 10% Miscellaneous cost and 15% contingency mark-up	DC	K. Schafersman
51	Use wet reflective pavement markings to improve driver visibility	DC	E. Vaughan
52	Replace ROW fence only as needed in lieu of full fence replacement	2	E. Vaughan
53	Provide a truck parking area within the old rest areas within the project to reduce driver fatigue related accidents	DC	E. Vaughan
54	Install median footings as shallow as possible to reduce median excavation	DC	E. Vaughan
55	Use some of the unspent funds that have been saved from implementation of VE recommendations on aesthetic and/or environmental enhancements	DC	S. Curless

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

BD: Idea is already being done or implemented in some manner

APPENDIX E
VE Punch List

APPENDIX E – VE Punch List

VALUE ENGINEERING PUNCH LIST

ITEM NO. **4-15.00, 4-16.00, 4-17.00, 4-18.00, 4-19.00** PROJECT COUNTIES: **Hart, Larue, Hardin** DATE OF STUDY: **7/22/2013 to 7/26/2012** **VE # 201302**

VE Alternative Number	VE Team Picks	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-1	✓	Verify traffic projections for this corridor in lieu of assuming ~75,000 ADT			NA	NA	NA	NA	Oth	
VE-2	✓	Assuming ~55,000 ADT (2035), use thinner asphalt pavement section with a thicker base section in lieu of current design			$68,443,000	$56,903,000	$11,540,000	NA	Oth	
VE-3	✓	Construct vertical clearances for maximum asphalt overlay, but only install the amount of asphalt needed for next 10 years and add additional overlay in the future if necessary			$39,815,000	$37,028,000	$2,787,000	NA	Oth	
VE-4	✓	Take into account the recent asphalt overlay from MP 78 to MP 91 performed in 2011 when determining new overlay thickness			$8,247,000	$6,541,000	$1,706,000	NA	Oth	
VE-5		According to the geotechnical investigation of 2001, eliminate soil stabilization throughout project			$4,219,000	$0	$4,219,000	NA	Oth, Con	
VE-6	✓	Use geogrid in lieu of cement stabilization			$4,219,000	$2,768,000	$1,451,000	NA	Oth, Con	
VE-7	✓	Use guardrail in lieu of rock cut in the clear zone where applicable (i.e. Sta. 3390+50 to Sta. 3395+00)			$520,000	$10,000	$510,000	NA	Saf, Env, Con, Oth	
VE-16	✓	Replace ROW fence only as needed in lieu of full fence removal and replacement			$3,085,000	$1,862,000	$1,223,000	NA	Env, Con	
VE-19		Use a staggered asphalt lift joints in lieu of placing joints along wheel path			NA	NA	NA	NA	Ops, Con	

VALUE ENGINEERING PUNCH LIST

ITEM NO. **4-15.00, 4-16.00, 4-17.00, 4-18.00, 4-19.00** PROJECT COUNTIES: **Hart, Larue, Hardin** DATE OF STUDY: **7/22/2013 to 7/26/2012** **VE # 201302**

VE Alternative Number	VE Team Picks	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-20		Use excess material to fill adjacent embankments in lieu of wasting material and installing guardrail in applicable locations			NA	NA	NA	NA	Env, Con	
VE-26		Allow alternate bidding of concrete versus asphalt			NA	NA	NA	NA	Oth, Con	
VE-27		Provide concrete barrier median openings for emergency access			NA	NA	NA	NA	Saf, Ops	
VE-28		Use wet reflective pavement markings to improve driver visibility			NA	NA	NA	NA	Saf, Ops	
Structures										
VE-8	✓	Use 6 ft shoulders in lieu of 12 ft shoulders for the reconstructed US-31W overpass bridge			$2,415,000	$1,932,000	$483,000	NA	Saf, Con, Oth	
VE-9	✓	At Old Sonora Road, KY 1407, and KY 1136, replace overpass bridges with bridges similar to existing width (~24 ft) in lieu of 32 ft wide bridges			$3,895,000	$3,302,000	$593,000	NA	Saf, Con, Oth	
VE-10	✓	Reconstruct KY 84 as a 3-lane corridor and bridge with shoulders in lieu of a new 5-lane corridor and bridge with shoulders			$2,971,000	$2,064,000	$907,000	NA	Con, Env, Oth	
VE-11	✓	Close Old Sonora Road in lieu of reconstructing an overpass bridge			$1,093,000	$0	$1,093,000	$76,000	Env, Con, Ops, Oth	
VE-12	✓	Use a shorter single span structure for the Rhudes Creek Road underpass in lieu of a 3-span mainline bridge			$1,632,000	$1,266,000	$366,000	NA	Con, Oth	
VE-13	✓	Increase beam spacing to reduce a beam line for the KY 728, KY 84, Rhudes Creek Road, and Nolin bridges			$2,998,000	$2,753,000	$245,000	NA	Con, Oth	

VALUE ENGINEERING PUNCH LIST

ITEM NO. **4-15.00, 4-16.00, 4-17.00, 4-18.00, 4-19.00** PROJECT COUNTIES: **Hart, Larue, Hardin** DATE OF STUDY: **7/22/2013 to 7/26/2012** **VE # 201302**

VE Alternative Number	VE Team Picks	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-14		Reuse the substructures on the Old Sonora Road, KY 1407, and KY 1136 bridges in lieu of a full replacement			$3,414,000	$2,024,000	$1,390,000	NA	Con, Oth	
VE-15	✓	Use a 2-span bridge in lieu of a 4-span bridge to eliminate outside piers where possible			$4,521,000	$3,315,000	$1,206,000	NA	Saf, Con, Oth	
VE-21		Close US-31W during construction in lieu of maintaining traffic during construction			NA	NA	NA	NA	Con, Ops	
VE-22		Use a traditional temporary bridge support system during construction of the KY 224 overpass bridge in lieu of the unique single column pier			NA	NA	NA	NA	Con, Oth	
VE-23		Use round columns in lieu of square columns for bridge piers			NA	NA	NA	NA	Con	
VE-24		Use mechanically stabilized earth (MSE) walls in lieu of sloped embankment to shorten bridge spans and superstructure			NA	NA	NA	NA	Con, Oth	
VE-25		Verify if the additional asphalt weight will impact the KY 2756 tunnel and/or farm lane access tunnel at Sta. 347+50			NA	NA	NA	NA	Con	
VE-30		Install median footings as shallow as possible to reduce median excavation			NA	NA	NA	NA	Con, Oth	
Other Design Comments										
VE-17		For extremely flat sections, slope the center lane or the entire roadway toward the outside in lieu of toward the median			NA	NA	NA	NA	Saf, Ops, Con	

VALUE ENGINEERING PUNCH LIST

ITEM NO. **4-15.00, 4-16.00, 4-17.00, 4-18.00, 4-19.00** PROJECT COUNTIES: **Hart, Larue, Hardin** DATE OF STUDY: **7/22/2013 to 7/26/2012** **VE # 201302**

VE Alternative Number	VE Team Picks	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-18		Review the cost estimate for redundancy between 10% miscellaneous cost and 15% contingency mark-up			NA	NA	NA	NA	Oth	
VE-29		Provide truck parking areas at the old rest stops within the project to reduce driver fatigue related accidents			NA	NA	NA	NA	Saf, Ops	
VE-31		Use some of the unspent funds that have been saved from implementation of VE recommendations on aesthetic and/or environmental enhancements			NA	NA	NA	NA	Oth, Env	
					Saf 8	Ops 6	Env 6	Con 22	Oth 21	

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

APPENDIX F
List of Common Abbreviations

APPENDIX F – List of Common Abbreviations

List of Common Abbreviations

AADT	Average Annual Daily Traffic
AASHTO	American Association of State Highway and Transportation Officials
ADD	Area Development District
ADT	Average Daily Traffic
ADTT	Average Daily Truck Traffic
CRF	Critical Rate Factor
CSB	Crushed Stone Base
CY	Cubic Yard
DES	Design Executive Summary
DGA	Dense Graded Aggregate
DHV	Design Hour Volume
EA	Each
ESAL	Equivalent Single Axle Load
FHWA	Federal Highway Administration
FT	Foot or Feet
HN PCIBs	Hybrid Precast/Prestressed Concrete I-Beams (featuring wide flanges)
IJS	Interchange Justification Study
KTC	Kentucky Transportation Center
KY	Kentucky
KYTC	Kentucky Transportation Cabinet
LF	Linear Feet
LOS	Level of Service
LS	Lump Sum
MI	Mile
MOU	Memorandum of Understanding
MP	Milepoint
MPO	Metropolitan Planning Organization
MSE	Mechanically Stabilized Earth
NHS	National Highway System
PCIBs	Precast/Prestressed Concrete I-Beams
PD	Project Development
PDP	Project Delivery and Preservation
PL&G	Preliminary Line and Grade
RCBC	Reinforced Concrete Box Culvert
ROW	Right-of-Way
SF	Square Feet
SY	Square Yard
SYP	Six Year Plan
TRB	Transportation Research Board
V/C	Volume to Capacity Ratio
VE	Value Engineering
VPH	Vehicles per Hour

END OF REPORT

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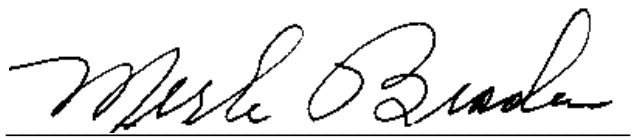

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