STP-155-1(23)
Widen and Reconstruct State Route 96 From State Route 87 to U.S. Interstate Highway I-16 and Reconstruct State Route 96/ U.S. Interstate Highway I-16 Interchange

Twiggs County, Georgia

Value Engineering Study Report

P.I. No. 322407, Concept Design Stage
November 2004

Design Consultant
Georgia Department of Transportation

Value Engineering Consultant

Lewis & Zimmerman Associates, Inc.

Lewis & Zimmerman Associates, Inc.
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November 3, 2004

Ms. Lisa L. Myers
Design Review Engineer Manager
State of Georgia Department of Transportation
General Office
No. 2 Capitol Square, Room 266
Atlanta, Georgia 30334-1002

re: Project Number STP-155-1(23), Widen and Reconstruct State Route 96 from State Route 87 to U.S. Interstate Highway 16 and Reconstruct the State Route 96/ U.S. Interstate Highway 16 Interchange in Twiggs County, Georgia
Value Engineering Study Report

Dear Ms. Myers:

Lewis & Zimmerman Associates, Inc. is pleased to submit four hard copies and one electronic copy of the referenced report. The alternatives and design suggestions developed during this VE effort provide opportunities to improve the value of the project in terms of: improving safety; potentially converting to an interstate facility; upgrading the facilities to current standards; capital costs, and improving constructibility.

We wish to take this opportunity to thank you and the State of Georgia Department of Transportation participants for your efforts in working with the VE team to generate new, creative solutions for this project. We look forward to working with you on future assignments.

Sincerely,

LEWIS & ZIMMERMAN ASSOCIATES, INC.

Luis M. Venegas, PE, CVS-Life
Vice President

Attachment

TABLE OF CONTENTS

EXECUTIVE SUMMARY

INTRODUCTION

This value engineering (VE) study report summarizes the events of the VE study conducted by Lewis & Zimmerman Associates, Inc. (LZA) for the State of Georgia Department of Transportation (GDOT), Atlanta, Georgia. The subject of the study was the Widening and Reconstruction of State Route (SR) 96 from SR 87 to U.S. Interstate Highway 16 (I-16) and the Reconstruction of the SR 96/I-16 Interchange in Twiggs County, Georgia. The project is being designed by the GDOT and is at the concept design stage.

PROJECT DESCRIPTION

This project proposes to widen SR 96 from two lanes to four lanes with a 44-ft. wide depressed median. The project is located on Georgia Bike Route 40, from SR 87 to SR 358. The bike route shoulder will continue along SR 96 throughout the project length. A frontage road near the south side of the SR 96/I-16 Interchange and County Road (CR) 100 located to the north of the interchange will be relocated. A raised 24-ft. median is required and will extend from the on/off ramps the south and north of the SR 96/1-16 Interchange.

The project also proposes to widen the existing SR 96 Bridge over I-16 from two lanes to six lanes with a 12-ft. shoulder, a 4-ft. raised median, and one dedicated turn lane in each direction. The on/off ramps for I-16 will be upgraded for the widening of SR 96; each on-ramp to I-16 will have an additional 16-ft. lane. Access rights along SR 96 will be acquired north and south of the interchange.

The current probable cost of construction has been identified at $36,076,293 as noted in the SR 96 Concept Cost Estimate dated September 17, 2004. This figure is divided into two segments: (1) $27,285,417 for the widening of SR 96 including right-of-way costs, and (2) $8,790,293 for the reconstruction of the SR 96/I-16 Interchange. The estimate contains an inflation rate of 15.93% based on a rate of 3.00% per annum for five years and a 10.00% rate for E and C costs.

CONCERNS AND OBJECTIVES

The stated need and purpose of the project is to accommodate existing and predicted future traffic demands while correcting operational deficiencies that exist within the project corridor. The proposed improvements will create a safer driving environment and better travel conditions for motorists along SR 96.

Although the proposed design is straightforward, the VE team noted several areas of concern: (1) the design does not take advantage of existing roadway assets as either a travel lane or full depth shoulder; (2) a meandering new alignment; (3) creation of a difficult alignment situation with the existing dam/causeway, and (4) the actual need to widen the entire corridor for potential traffic volumes in the year 2030 and optimistic economic development along the entire 8.32 mile corridor.

It was noted during the first day of the study, that alternatives developed at this early stage of design are general in nature and highly dependent on the information available – including the preliminary cost estimate. It appears the current estimate does not take into account the added right-of-way costs associated with more land acquisition and takes, both residential and commercial.

Therefore, in order to accomplish the project's goals in an expeditious and cost-effective manner, and to assist in ameliorating the concerns noted, GDOT engaged this VE study. The objective of the effort was to identify opportunities that would enhance the value of the project in terms of: improved safety, the potential for conversion to an interstate facility, upgrading to current standards, potential capital cost reductions, and improved constructibility.

HIGHLIGHTS OF THE STUDY

The project is a relatively straightforward concept involving the widening the 8.32-mile stretch of SR 96 corridor and reconstruction of the SR 96/I-16 Interchange as noted on the conceptual drawings, Project Concept Report, and other documentation. Listed below are some of the more salient ideas developed to improve the design of the project developed by the VE team.

It appears the existing dam across the private lake between CR 103 and CR 202 has created some difficulties for the widening of SR 96. Alternative No. 7 maintains the current SR 96 alignment over the dam, widens SR 96, and flattens the curve immediately to the west of the private lake. This alternative eliminates the construction of a new dam (by the owner) and in-filling between the new and existing dam while reducing the amount of right-of-way needed to accomplish the lake crossing. This solution produces about $234,000 in initial cost savings. A related manner, Alternative No. 18, would circumvent the lake altogether with a new alignment for SR 96 to the north of the lake commencing at the historic Mount Olive Church and ending in the vicinity of the New Richland Baptist Church. This solution would add about $400,000 to the project cost due to an increase of about 2,000 ft. to SR 96.

In examining the current traffic volumes and projections, it appears that the corridor will adequately handle these traffic loads. However, some isolated safety and geometric deficiencies need correcting. To accomplish this, Alternative 2 would selectively improve the SR 96 corridor as follows: (1) improve the SR 96/SR 87 intersection for safety and operations; (2) improve the SR 96/SR 358 intersection for safety and operations; (3) improve alignment between churches to correct the geometric deficiency of the exiting curve; and (4) reduce the frontage roads at I-16. Initial cost savings of just over $31,300,000 are possible.

County Road (CR) 100 was disconnected years ago when the initial I-16 project was constructed. The current project indicates improvements on both sides of the interstate along CR 100 for access to SR 96. Alternative Nos. 12 and 13 reassess the proposed improvements resulting in initial cost reductions of about $119,000 and $230,000 respectively. Both alternatives shorten the amount of the new CR 100. Alternative 12 does so behind and to the side of the Walthall Oil Company site and Alternative 13 at the Missile Based Road.

Finally, from safety and operational view points, Alternative Nos. 5 and 6 signalized the SR 96/SR 87 and SR 96/SR 358 intersections, albeit at an increase of about $260,000 to the project cost.

The *Summary of Potential Cost Savings* worksheet following this narrative outlines all of the alternatives and design suggestions developed by the VE team. Some of the alternatives are mutually exclusive or interrelated so that addition of all project cost savings does not equal total savings for the project. A full listing of all of the ideas considered by the VE team can be found on the *Creative Idea Listing* worksheets in Section 4 of this report.

SUMMARY OF POTENTIAL COST SAVINGS

PROJECT: **STP-155-1(23), P. I. Number 322470**
Twiggs County
Concept Development

ALT. NO.	DESCRIPTION	ORIGINAL COST	ALTERNATIVE COST	PRESENT WORTH OF COST SAVINGS: INITIAL COST SAVINGS	PRESENT WORTH OF COST SAVINGS: RECURRING COST SAVINGS	PRESENT WORTH OF COST SAVINGS: TOTAL PW LCC SAVINGS
1	Use a 4:1 front slope	$1,211,440	$0	$1,211,440		$1,211,440
2	Make selective improvements to the corridor in lieu of widening the entire corridor	$36,076,256	$4,769,280	$31,306,976		$31,306,976
4	Grade separate State Route 87 from State Route 96	$263,611	$3,425,194	($3,161,583)		($3,161,583)
5/6	Signalize critical/dangerous intersections	$0	$255,040	($255,040)		($255,040)
7	Maintain existing alignment for SR 96 at lake	$1,602,720	$1,368,940	$233,780		$233,780
9	Maximize the use of existing pavement and right-of-way	DESIGN SUGGESTION				
11/14	Allow right-in/right-outs at Citgo and Walthall Service Stations	DESIGN SUGGESTION				
12	Relocate access road to County Road 100 behind Walthall Oil Company	$119,116	$0	$119,116		$119,116
13	Relocate County Road 100 connection to Missile Based Road	$229,768	$0	$229,768		$229,768
18	Bypass the lake with a new alignment for SR 96	$63,760	$462,311	($398,551)		($398,551)
21	Selectively use rigid pavement	$119,359	$206,582	($87,223)		($87,223)

STUDY RESULTS

INTRODUCTION

The results are the major feature of a value engineering (VE) study since they represent the benefits that can be realized on the project by the owner, users, and designer. The results will directly affect the project design and will require coordination between the designer, and the owner in order to determine the ultimate acceptance of each alternative.

The creative ideas are organized according to the order in which they were originally generated by the VE team during their function analysis creative sessions.

RESULTS OF THE STUDY

The VE team generated 23 ideas for change during the Function Analysis and Creative Ideas phases of the VE Job Plan. The evaluation of these ideas was based upon their potential for capital cost savings, probability of acceptance, availability of information to properly develop an idea, compliance with perceived quality, adherence to universally accepted standards and procedures, life cycle cost efficiency, safety, maintainability, constructibility, and soundness of the idea.

Of the 23 ideas generated, 13 of them were sufficiently rated to warrant further investigation. Continued research and development of these ideas yielded 11 alternatives for change with an impact on project costs and three design suggestions that will enhance the value of the project in terms of: improved safety, potential for conversion to an interstate facility, upgrading to current standards, potential capital cost savings, and improved constructibility. All of the alternatives and design suggestions are presented in detail following this narrative and the *Summary of Potential Cost Savings* worksheet.

EVALUATION OF ALTERNATIVES

When reviewing the study results, the reader should consider each part of an alternative or design suggestion on its own merit. There may be a tendency to disregard an alternative because of concern about one part of it. Each area within an alternative that is acceptable should be considered for use in the final design, even if the entire alternative is not implemented. Design variations of these alternatives are encouraged.

Cost is the primary basis of comparison for alternative designs. To ensure that costs are comparable within the alternatives proposed by the VE team, life cycle calculations, where appropriate, were included to provide a long-term perspective of the capital and operational impacts of select ideas. Whenever possible, the team used the project cost estimate for the basis of analysis. When this was not the case, nationally-based cost estimating manuals were used to price the alternatives.

Some of the alternatives are “mutually exclusive,” so acceptance of one may preclude the acceptance of another. All alternatives developed independently of each other. However, some of the alternatives are interrelated so acceptance of one or more may not yield the total of the cost savings shown for each alternative. The reader should evaluate those alternatives carefully in order to select the combination of ideas with the greatest overall beneficial impact on the project.

SUMMARY OF POTENTIAL COST SAVINGS

PROJECT: **STP-155-1(23), P. I. Number 322470**
Twiggs County
Concept Development

ALT. NO.	DESCRIPTION	ORIGINAL COST	ALTERNATIVE COST	PRESENT WORTH OF COST SAVINGS: INITIAL COST SAVINGS	PRESENT WORTH OF COST SAVINGS: RECURRING COST SAVINGS	PRESENT WORTH OF COST SAVINGS: TOTAL PW LCC SAVINGS
1	Use a 4:1 front slope	$1,211,440	$0	$1,211,440		$1,211,440
2	Make selective improvements to the corridor in lieu of widening the entire corridor	$36,076,256	$4,769,280	$31,306,976		$31,306,976
4	Grade separate State Route 87 from State Route 96	$263,611	$3,425,194	($3,161,583)		($3,161,583)
5/6	Signalize critical/dangerous intersections	$0	$255,040	($255,040)		($255,040)
7	Maintain existing alignment for SR 96 at lake	$1,602,720	$1,368,940	$233,780		$233,780
9	Maximize the use of existing pavement and right-of-way	DESIGN SUGGESTION				
11/14	Allow right-in/right-outs at Citgo and Walthall Service Stations	DESIGN SUGGESTION				
12	Relocate access road to County Road 100 behind Walthall Oil Company	$119,116	$0	$119,116		$119,116
13	Relocate County Road 100 connection to Missile Based Road	$229,768	$0	$229,768		$229,768
18	Bypass the lake with a new alignment for SR 96	$63,760	$462,311	($398,551)		($398,551)
21	Selectively use rigid pavement	$119,359	$206,582	($87,223)		($87,223)

VALUE ENGINEERING ALTERNATIVE

PROJECT:	**STP-155-1(23), P.I. Number 322470** **Twiggs County** ***Concept Development***	ALTERNATIVE NO.:	**1**
DESCRIPTION:	**USE 4:1 FRONT SLOPE**	SHEET NO.:	1 of 4

ORIGINAL DESIGN: (Sketch attached)

The current design concept calls for 6:1 front slopes.

ALTERNATIVE: (Sketch attached)

Use 4:1 front slopes.

ADVANTAGES:

- Reduces earthwork
- Reduces right-of-way requirements
- Common practice

DISADVANTAGES:

- Standard clear zone concession

DISCUSSION:

This alterative would not provide the desirable 6:1 front slope. However, it would reduce earthwork, limits of grading and associated right-of-way. The 4:1 slope is an acceptable and maintainable side slope. This concept is shown on the typical sections included in the concept report for the non-ditch side and can be conside3red for use on both sides of the roadway, especially in flat areas where fills are 2 – 3 ft. high or are not present. The 4:1 slope most likely will follow the existing ground more closely as shown on the sketch.

In addition, significant right-of-way savings can be realized by reducing the limits of construction.

COST SUMMARY	INITIAL COST	PRESENT WORTH RECURRING COSTS	PRESENT WORTH LIFE-CYCLE COST
ORIGINAL DESIGN	**$ 1,211,440**	¾	**$ 1,211,440**
ALTERNATIVE	**$ 0**	¾	**$ 0**
SAVINGS	**$ 1,211,440**	¾	**$ 1,211,440**

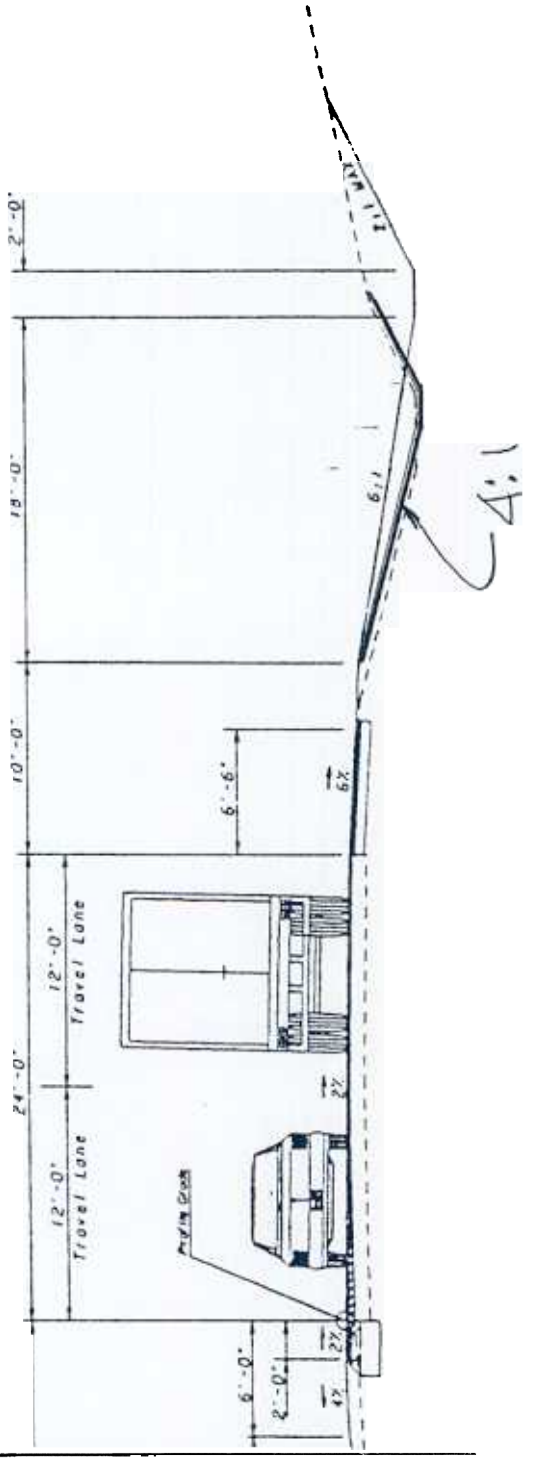
SKETCHES

PROJECT: **STP-155-1(23), P. I. Number 322470**
Twiggs County
Concept Development

☐ AS DESIGNED ☑ ALTERNATIVE

ALTERNATIVE NO.: 1

SHEET NO.: 2 of 4



CALCULATIONS

PROJECT: **STP-155-1(23), P. I. Number 322470**
Twiggs County
Concept Development

ALTERNATIVE NO.: 1

DESCRIPTION:

SHEET NO.: 3 of 4

EARTHWORK ESTIMATE

TOTAL COST $3,800,000

ELIMINATE MOST OF THE CUT & FILL ON ONE SIDE OF THE TYPICAL

ASSUME A REDUCTION OF 25%

3,800,000 (0.25) = $950,000

COST WORKSHEET

PROJECT: **STP-155-1(23), P. I. Number 322470**
Twiggs County
Concept Development

ALTERNATIVE NO: 1

DESCRIPTION

SHEET NO. 4 of 4

CONSTRUCTION ITEM		ORIGINAL ESTIMATE			PROPOSED ESTIMATE		
ITEM	UNITS	NO. OF UNITS	COST/ UNIT	TOTAL	NO. OF UNITS	COST/ UNIT	TOTAL
Earthwork	LS	1	950,000	950,000			
Sub-total				950,000			
Mark-up at 27.52%				261,440			
TOTAL				**1,211,440**			

VALUE ENGINEERING ALTERNATIVE

PROJECT:	**STP-155-1(23), P.I. Number 322470** **Twiggs County** ***Concept Development***	ALTERNATIVE NO.:	**2**
DESCRIPTION:	**MAKE SELECTIVE IMPROVEMENTS TO THE CORRIDOR IN LIEU OF WIDENING THE ENTIRE CORRIDOR**	SHEET NO.:	1 of 16

ORIGINAL DESIGN:

The original design calls for the widening of the entire corridor from two lanes to four lanes with a 44-ft. depressed median and a 24-ft. raised median at the interchange.

ALTERNATIVE: (Sketch attached)

Make selective improvements throughout the corridor to improve isolated deficiencies as follows:

1. Improve the intersection of SR 96/SR 87 for safety and operations.
2. Improve alignment between churches to correct geometric deficiency.
3. Improve the intersection of SR 96/SR 358 for safety and operations.
4. Reduce frontage roads at I-16.

ADVANTAGES:

- Saves cost
- Deficiencies in corridor
- Improves safety improves in corridor while providing adequate capacity for projected traffic

DISADVANTAGES:

- Capacity of corridor is not increased
- Full width of corridor will have to be constructed in the future

DISCUSSION:

Looking at the current traffic volumes and projections, it appears that the corridor can adequately handle the traffic. However, there are some isolated safety and geometric issues that should be addressed. Improving the intersections of SR 96/SR 87 and SR 96/SR 358 with signals will address safety and operations concerns at the intersections. Improving the alignment between the churches will correct the deficient curve. Reducing the frontage roads at I-16 will reduce cost while providing adequate access.

COST SUMMARY	INITIAL COST	PRESENT WORTH RECURRING COSTS	PRESENT WORTH LIFE-CYCLE COST
ORIGINAL DESIGN	**$ 36,076,256**	¾	**$ 36,076,256**
ALTERNATIVE	**$ 4,769,280**	¾	**$ 4,769,280**
SAVINGS	**$ 31,306,976**	¾	**$ 31,306,976**

SKETCHES

PROJECT: **STP-155-1(23), P. I. Number 322470**
Twiggs County
Concept Development

ALTERNATIVE NO.: 2

☐ AS DESIGNED ☒ ALTERNATIVE SR 96 @ SR 87 INTERSECTION

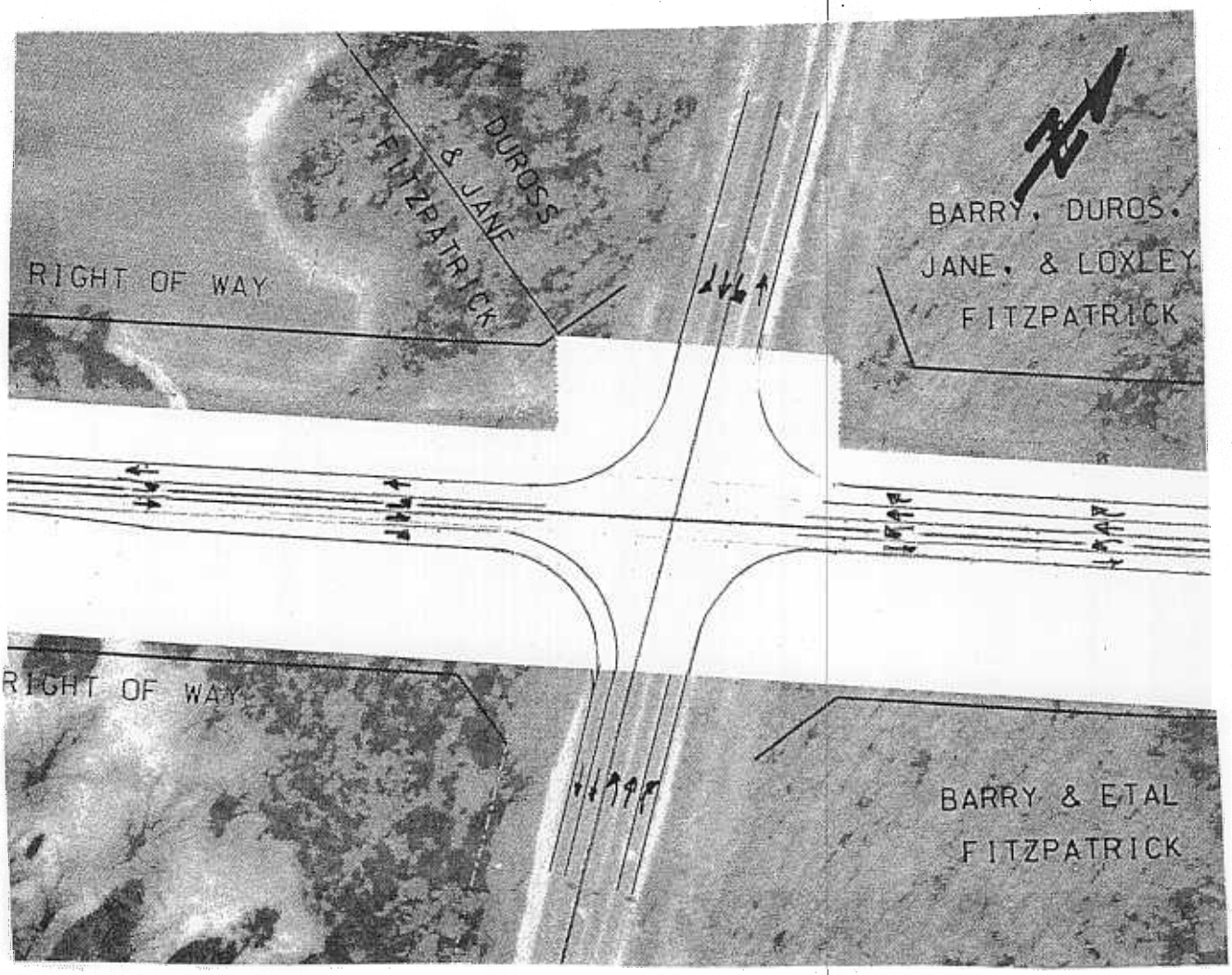
SHEET NO.: 2 of 16

SR 96 - 2-LANE SECTION. AT INTERSECTION, PROVIDE LEFT TURN AND RIGHT TURN LANES TO FACILITATE TURNING MOVEMENTS ONTO SR 87.

SR 87 - NORTH LEG - 2-LANE SECTION. AT INTERSECTION, LEFT TURN AND RIGHT TURN LANES ARE PROVIDED FOR TURNING MOVEMENTS ONTO SR 96. (EXISTING).

SOUTH LEG - 4-LANE SECTION. AT INTERSECTION, LEFT TURN AND RIGHT TURN LANES ARE PROVIDED FOR TURNING MOVEMENTS ONTO SR 96. ONE NORTHBOUND LANE BECOMES THE RIGHT TURN LANE AT THE INTERSECTION (EXISTING).

ASSUME SIGNALIZED INTERSECTION REQUIRED



SKETCHES

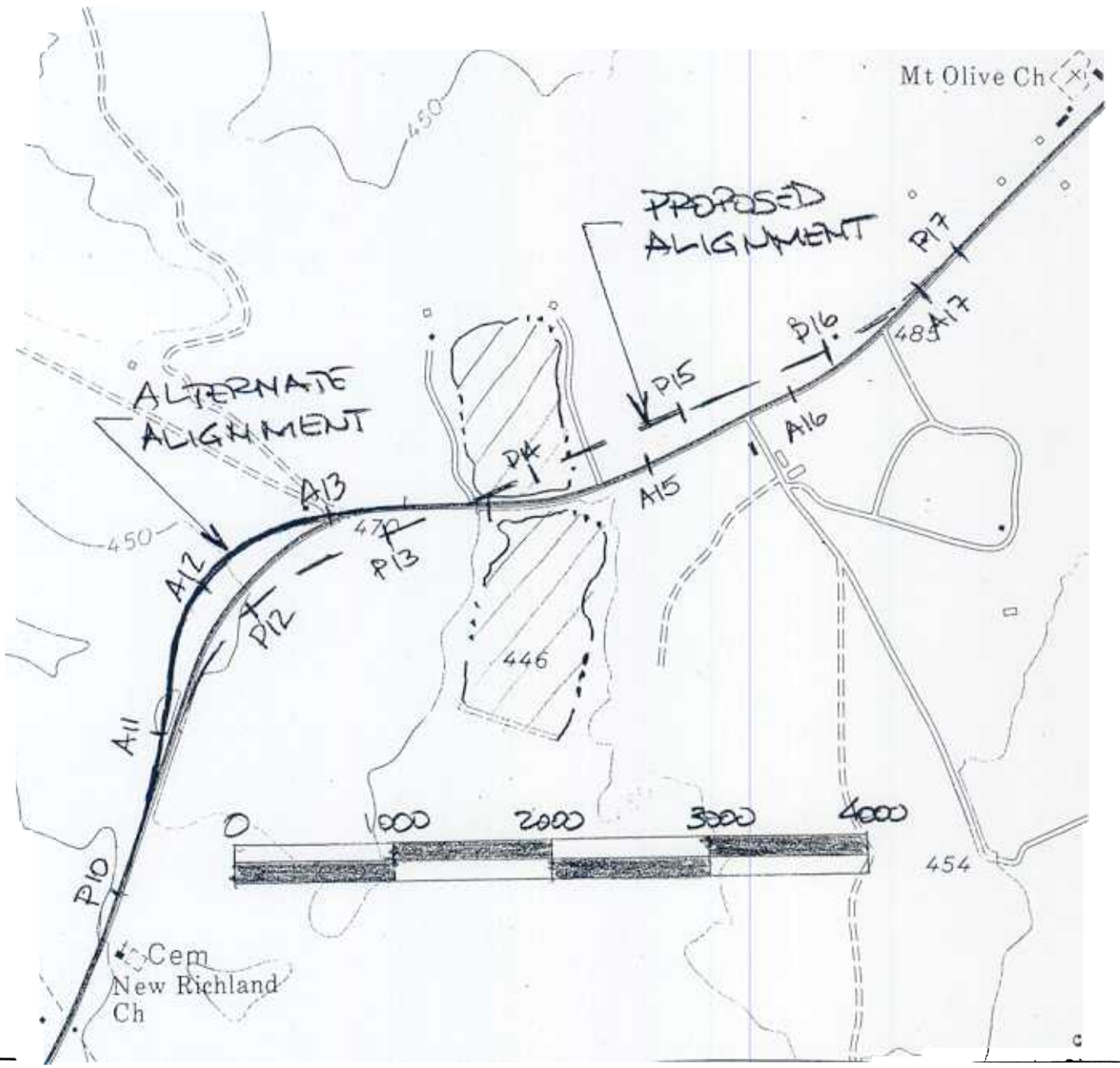
PROJECT: **STP-155-1(23), P. I. Number 322470**
Twiggs County
Concept Development

ALTERNATIVE NO.: 2

☐ AS DESIGNED ☑ ALTERNATIVE ALIGNMENT BETWEEN CHURCHES SHEET NO.: 3 of 16

REALIGN EXISTING ALIGNMENT BETWEEN CHURCHES TO CORRECT DEFICIENT CURVE

- REALIGNMENT BEGINS NEAR NEW RICHLAND BAPTIST CHURCH AND ENDS NEAR DAM AT LAKE.
- CONSTRUCT 3-LANE SECTION THROUGH REALIGNMENT.



SKETCHES

PROJECT: **STP-155-1(23), P. I. Number 322470**
Twiggs County
Concept Development

ALTERNATIVE NO.: 2

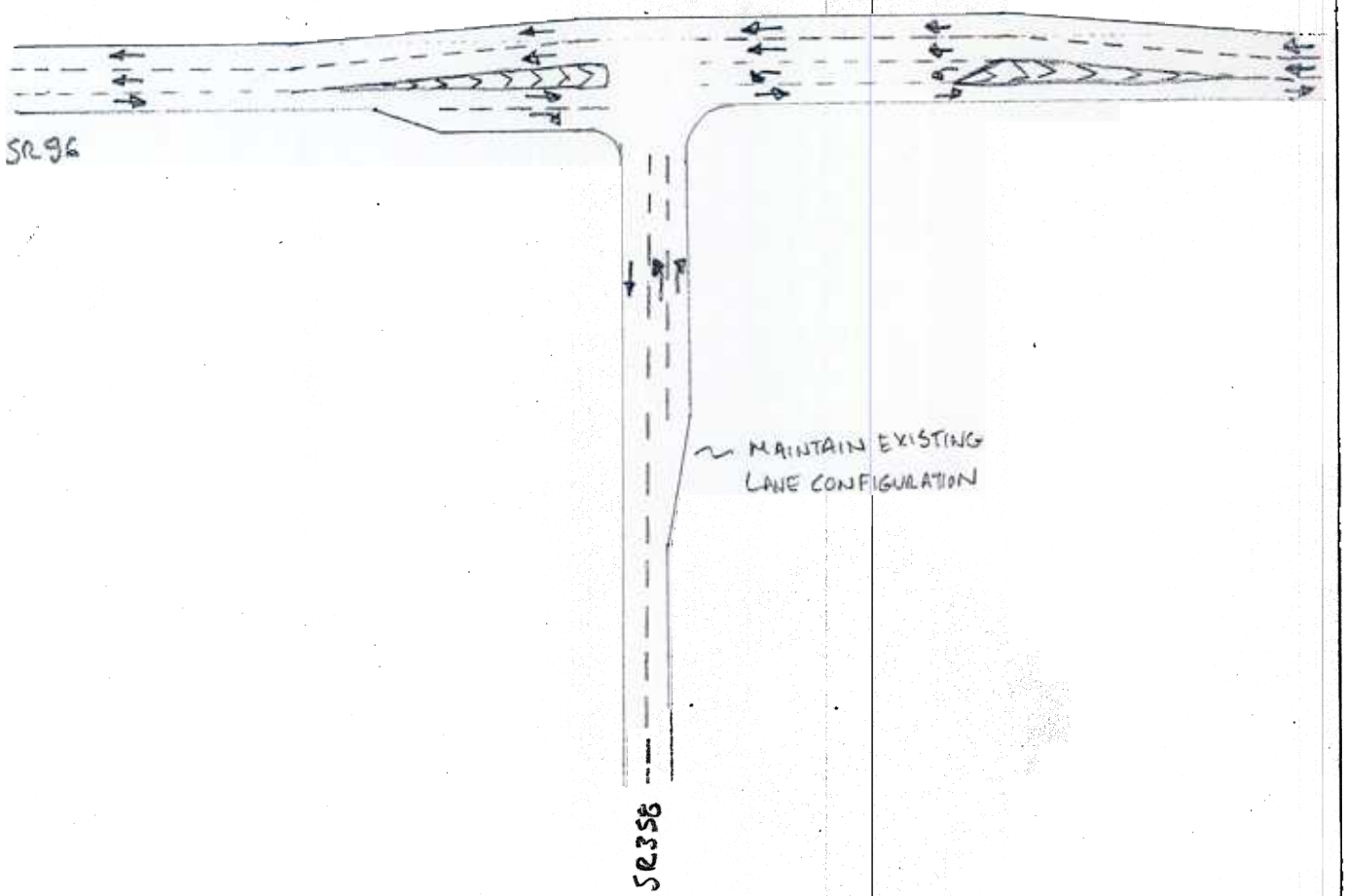
☐ AS DESIGNED ☒ ALTERNATIVE SR 96 @ SR 358 INTERSECTION

SHEET NO.: 4 of 16

INTERSECTION IMPROVEMENTS AT SR 96 @ SR 358 INTERSECTION FOR SAFETY

- ADD LEFT TURN LANE TO SR 96 WIDENING ALL TO THE NORTH
- KEEP SR 358 AS IS - ALREADY HAS DEDICATED LEFT AND RIGHT TURN LANE
- SIGNALIZE INTERSECTION

780' TAPER TO EXISTING 3-LANE SECTION | 550' 4-LANE SECTION FOR LEFT TURN LANE | 780' TAPER TO WIDEN OUT TO 4-LANE SECTION



SKETCHES

PROJECT: **STP-155-1(23), P. I. Number 322470**
Twiggs County
Concept Development

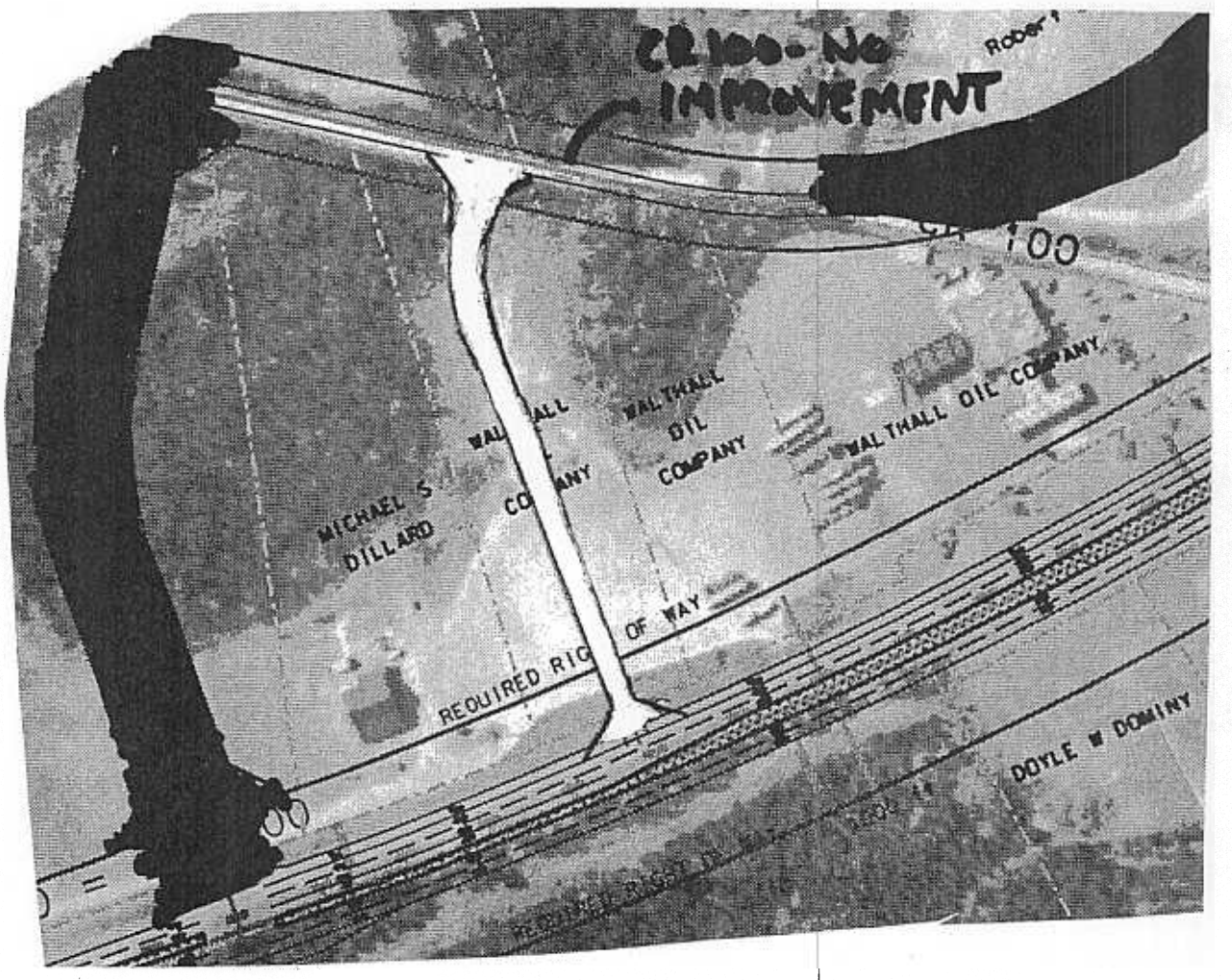
ALTERNATIVE NO.: 2

☐ AS DESIGNED ☑ ALTERNATIVE REDUCE FRONTAGE ROAD

SHEET NO.: 5 of 16

SOUTH FRONTAGE ROAD

- MOVE FRONTAGE ROAD APPROXIMATELY 1200' FROM RAMP
- TIE INTO CR 100
- NO IMPROVEMENTS TO CR 100



SKETCHES

PROJECT: **STP-155-1(23), P. I. Number 322470**
Twiggs County
Concept Development

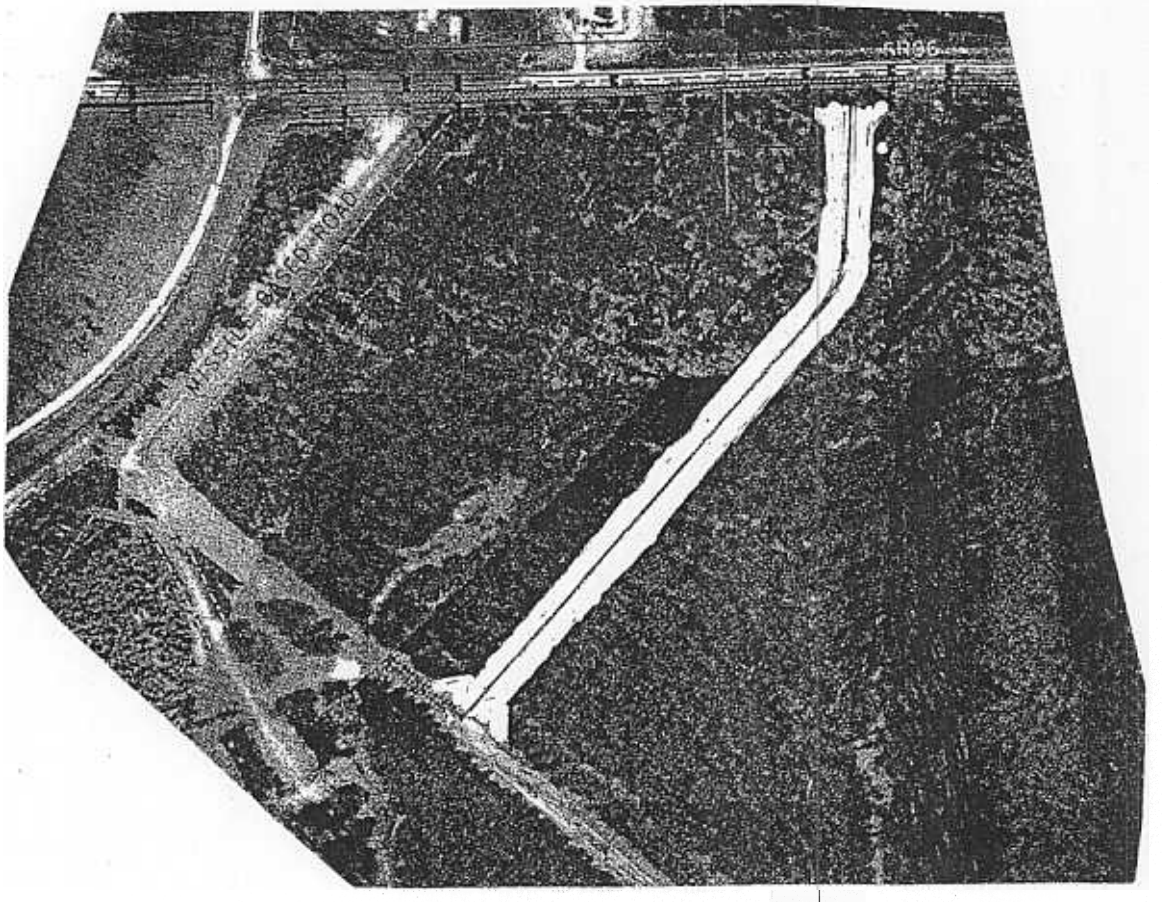
ALTERNATIVE NO.: 2

☐ AS DESIGNED ☒ ALTERNATIVE REDUCE FRONTAGE ROADS

SHEET NO.: 6 of 16

REDUCE FRONTAGE ROADS AT I-16

- NORTH FRONTAGE ROAD
  - MOVE FRONTAGE ROAD TO APPROX 1000' FROM I-16 RAMPS
  - TIE INTO CR 100 WITH A "T" INTERSECTION
  - NO IMPROVEMENTS TO CR 100



CALCULATIONS

PROJECT: **STP-155-1(23), P. I. Number 322470**
Twiggs County
Concept Development

ALTERNATIVE NO.: 2

DESCRIPTION: BASIS FOR PROJECT COST ESTIMATES

SHEET NO.: 7 of 16

TO DETERMINE PROJECT COSTS FOR SELECTED IMPROVEMENTS, FIND THE ADDITIONAL PAVEMENT REQUIRED FOR THE IMPROVEMENT, THEN USING THE GDOT PROJECT ESTIMATES, DETERMINE THE PERCENTAGE OF THE BASE & PAVEMENT COSTS FOR THE ENTIRE PROJECT THEN, APPLY THIS FACTOR TO THE SELECTED IMPROVEMENT TO FIND THE PROJECT COST. OTHER IMPROVEMENTS, SUCH AS SIGNALS ARE THEN ADDED TO THE SELECTED IMPROVEMENT PROJECT TOTAL COST.

ENTIRE PROJECT COST (CONSTRUCTION ONLY) = 17406164 + 6893715 = 24301879

BASE & PAVEMENT COST = 4258271 + 2512544 + 1761857 + 529350

= 9065022

PERCENTAGE OF PROJECT COSTS = 9065022 / 24301879 = 0.373 = 37.3%

CALCULATIONS

PROJECT: **STP-155-1(23), P. I. Number 322470**
Twiggs County
Concept Development

ALTERNATIVE NO.: 2

DESCRIPTION: SR 96 @ SR 87 INTERSECTION ALTERNATIVE

SHEET NO.: 8 of 16

SR 87 & SR 96 INTERSECTION IMPROVEMENT

BASE & PAVEMENT - AREA FOR LT TURN LANE:

FULL WIDTH = (450 x 2) x 12 = 10800 SF = 1200 SY
TRANSITION = ((6x65) x 2) x 6 = 4680 SF = 520 SY

AREA FOR RT TURN LANE =

FULL WIDTH = (300 x 2) x 12 = 7200 SF = 800 SY
TRANSITION = (180 x 2) x 6 = 2160 SF = 240 SY

TOTAL ADDITIONAL PAVEMENT = 2760 SY

12.5mm mix @ 165 #/SY (1.5") = 2760 x 165 #/SY / 2000 = 230 TON x $40/TON
19mm mix @ 440 #/SY (4") = 2760 x 440 #/SY / 2000 = 610 TONS x $40/TON
25mm mix @ 550 #/SY (5") = 2760 x 550 #/SY / 2000 = 760 TONS x $40/TON
GAB @ 12" = 2760 x (12"/12/3) x 2 TON/CY = 1840 TONS x $20/TON

PAVED SHOULDERS - LENGTH = 450 x 2 + (6 x 65) x 2 = 1680
AREA = 1680 x 6.5 = 10920 SF = 1220 SY

12.5 mm mix = 1220 x 165 / 2000 = 100 TON
19 mm mix = 1220 x 440 / 2000 = 270 TON
25 mm mix = 1220 x 550 / 2000 = 335 TON
GAB = 1220 x (12/12/3) x 2 TON/CY = 820 TON

OVERLAY EXISTING PAVEMENT ON SR 96 TURN IMPROVEMENTS

LENGTH = 1680 AREA = 1680 x 24 = 40320 SF = 4480 SY
12.5 mm mix = 4480 x 165 / 2000 = 370 TON

CALCULATIONS

PROJECT: **STP-155-1(23), P. I. Number 322470**
Twiggs County
Concept Development

ALTERNATIVE NO.: 2

DESCRIPTION: SR96 & SR87 INTERSECTION ALTERNATE

SHEET NO.: 9 of 16

SR87 & SR96 INTERSECTION IMPROVEMENT

TOTAL PAVEMENT : 12.5mm : 230 + 100 + 370 = 700 TON
19MM : 610 + 270 = 880 TON
25MM : 760 + 335 = 1095 TON
GAB : 1840 + 820 = 2660 TON

TOTAL BASE & PAVEMENT COST

12.5mm = 700 TON X $48.87/TON = 34209
19mm = 880 TON X $38.08/TON = 33511
25mm = 1095 TON X $42.99/TON = 47075
GAB = 2660 TON X $16.10/TON = 42826
157621

TOTAL PROJECT COST = 157621/0.373

TOTAL PROJECT COST = 422577

CALCULATIONS

PROJECT: **STP-155-1(23), P. I. Number 322470**
Twiggs County
Concept Development

ALTERNATIVE NO.: 2

DESCRIPTION: ALIGNMENT IMPROVEMENT ALTERNATIVE

SHEET NO.: 10 of 16

IMPROVE ALIGNMENT BETWEEN CHURCHES - BUILD THREE LANE SECTION (2 NB, 1 SB LANE) TO CORRECT DEFICIENT CURVE NORTH OF NEW RICHLAND BAPTIST CHURCH AND TIE IN NEAR DAM AT LAKE

APPROXIMATE LENGTH OF IMPROVEMENTS = 4000 LF.

AREA OF PAVEMENT: 4000 x 36 = 144000 SF = 16000 SY

12.5 mm MIX = 165 #/SY (1.5") = 16000 x 165 / 2000 = 1320 TON

19 mm MIX = 440 #/SY (4") = 16000 x 440 / 2000 = 3520 TON

25 mm MIX = 550 #/SY (5") = 16000 x 550 / 2000 = 4400 TON

GAB 12" = = 16000 x (12/12/3) x 2 TON/CY = 10670 TON

PAVED SHOULDERS: 4000 x 6.5 x 2 = 52000 SF = 5780 SY

12.5 mm MIX = 165 #/SY (1.5") = 5780 x 165 / 2000 = 480 TON

19 mm MIX = 440 #/SY (4") = 5780 x 440 / 2000 = 1275 TON

25 mm MIX = 550 #/SY (5") = 5780 x 550 / 2000 = 1590 TON

GAB 12" = = 5780 x (12/12/3) x 2 TON/CY = 3855 TON

TOTAL PAVEMENT

12.5 mm	= 1320 + 480 = 1800	x $48.87/TON	= 87966
19 mm	= 3520 + 1275 = 4795	x $38.08/TON	= 182594
25 mm	= 4400 + 1590 = 5990	x $42.99/TON	= 257511
GAB	= 10670 + 3855 = 14525	x $16.10/TON	= 233853
			761924

TOTAL BASE & PAVEMENT COST.

= 761924

TOTAL PROJECT COST = 761924 / 0.373 = 2042692

CALCULATIONS

PROJECT: **STP-155-1(23), P. I. Number 322470**
Twiggs County
Concept Development

ALTERNATIVE NO.: 2

DESCRIPTION: SR96 @ SR338 INTERSECTION ALTERNATIVE

SHEET NO.: 11 of 16

IMPROVEMENTS TO THE SR 96 & SR 338 INTERSECTION

BASE & PAVEMENT - AREA FOR LT TURN LANE . (ON SR96 NORTH LEG)

FULL WIDTH - (550 x 12) = 6605F = 735 SY

TRANSITION - ((12x65)x2) x6 = 9360 = 1040 SY

TOTAL ADDITIONAL PAVEMENT = 1775 ST

12.5mm mix @ 165#/SY (1.5") = 1775 SY x 165#/SY / 2000 = 150 TON

19mm mix @ 440#/SY (4") = 1775 x 440#/SY / 2000 = 395 ON

25mm mix @ 550#/SY (5") = 1775 x 550#/ST / 2000 = 490 TON

GAB @ 12" = 1775 x (12"/12/3) x 2 TON/CY = 1190 TON

PAVED SHOULDERS - LENGTH = 550 + (12x65)x2 = 2110

AREA = 2110 x 6.5 = 13715 SF = 1525 SY

12.5mm Mix @ 165#/SY = 1525 x 165/2000 = 125 TON

19 mm mix @ 440#/SY = 1525 x 440/2000 = 340 TON

25mm mix @ 550#/SY = 1525 x 550/2000 = 420 TON

GAB @ 12" = 1525 x (12/12/3) x 2 TON/CY = 1020 TON

OVERLAY EXISTING PAVEMENT ON SR96 THRU IMPROVEMENTS

LENGTH = 2110' AREA = 2110 x 36' = 75960SF = 8440 SY

12.5 mm mix = 8440 x 165 / 2000 = 700 TON

CALCULATIONS

PROJECT: **STP-155-1(23), P. I. Number 322470**
Twiggs County
Concept Development

ALTERNATIVE NO.: 2

DESCRIPTION: SR 96 @ SR 358 INTERSECTION ALTERNATIVE

SR 96 @ SR 358 INTERSECTION IMPROVEMENTS

TOTAL PAVEMENT: 12.5mm : 150 + 125 + 700 = 975
19mm : 395 + 340 = 735
25mm : 490 + 420 = 910
GAB : 1190 + 1020 = 2210

TOTAL BASE & PAVEMENT COST:

12.5mm : 975 TON x $48.87/TON = 47649
19mm = 735 TON x $38.06/TON = 27989
25mm = 910 TON x $42.99/TON = 39121
GAB = 2210 TON x $16.10/TON = 35581

150340

TOTAL PROJECT COST = 150340 / 0.373

TOTAL PROJECT COST: $403057

CALCULATIONS

PROJECT: **STP-155-1(23), P. I. Number 322470**
Twiggs County
Concept Development

ALTERNATIVE NO.: 2

DESCRIPTION: FRONTAGE ROAD ALTERNATIVE

SHEET NO.: 13 of 16

REDUCE LENGTH OF FRONTAGE ROADS.

SOUTH SIDE: PLACE FRONTAGE ROAD APPROX 1200' FROM RAMP & TIE IN TO CR 100. NO IMPROVEMENTS TO CR 100.

NORTH SIDE: PLACE FRONTAGE ROAD APPROX 1000' FROM RAMP & TIE IN TO CR 100 AT T-INTERSECTION.

SOUTH SIDE FRONTAGE ROAD LENGTH = 670'

AREA OF PAVEMENT = 670 x 24' = 16080 SF = 1790 SY

12.5mm mix : 165 #/SY (1.5") = 1790 x 165 #/SY / 2000 = 150 TON

19 mm mix = 440 #/SY (4") = 1790 x 440 #/SY / 2000 = 395 TON

25 mm mix = 550 #/SY (5") = 1790 x 550 #/SY / 2000 = 495 TON

GAB (12") = 1790 (12/12/3) x 2 TON/CY = 1195 TON

NORTH SIDE FRONTAGE ROAD LENGTH = 1500'

AREA OF PAVEMENT = 1500 x 24' = 36000 SF = 4000 SY

12.5 mm mix = 165 #/SY (1.5") = 4000 x 165 / 2000 = 330 TON x $48.87/TON

19 mm mix = 440 #/SY (4") = 4000 x 440 / 2000 = 880 TON x $38.06/TON

25 mm mix = 550 #/SY (5") = 4000 x 550 / 2000 = 1100 TON x $42.99/TON

GAB (12") = 4000 (12/12/3) x 2 TON/CY = 2670 TON x $16.10/TON

CALCULATIONS

PROJECT: **STP-155-1(23), P. I. Number 322470**
Twiggs County
Concept Development

ALTERNATIVE NO.: 2

DESCRIPTION: FRONTAGE ROAD ALTERNATIVE

TOTAL PAVEMENT : 12.5mm = 150 + 330 = 480
19 mm = 395 + 880 = 1275
25 mm = 495 + 1100 = 1595
GAB = 1195 + 2670 = 3865

TOTAL BASE & PAVEMENT COST
12.5mm : 480 x $48.87 /TON = 23458
19 mm : 1275 x $38.05 /TON = 48552
25 mm : 1595 x $42.99 /TON = 68570
GAB = 3865 x $16.10 /TON = 62227

202807

TOTAL COST = 202807 / 0.373

TOTAL PROJECT COST = 543719

CALCULATIONS

PROJECT: **STP-155-1(23), P. I. Number 322470**
Twiggs County
Concept Development

ALTERNATIVE NO.: 2

DESCRIPTION: RIGHT OF WAY ESTIMATE

SHEET NO.: 15 of 16

RIGHT OF WAY ESTIMATE

SR 96 @ SR 87 INTERSECTION IMPROVEMENTS

REQUIRED R/W ON SR 96 - 120'
EXISTING R/W ON SR 96 - 100'
REQD R/W AREA THRU IMPROVEMENTS - (1680-100) x (120-100)
= 1580 x 20 = 31600 / 43560 SF = 0.73 AC.

R/W COST = 0.73 AC x $5000/AC = $3650

IMPROVE ALIGNMENT BETWEEN CHURCHES

REQD R/W ON SR 96 - 120'
REQD R/W AREA THRU IMPROVEMENTS = 4000 x 120 = 480000/43560 = 11.02 AC

R/W COST = 11.02 AC x $5000/AC = $55100

SR 96 @ SR 338 INTERSECTION IMPROVEMENTS

REQD R/W ON SR 96 - 120'
EXIST R/W ON SR 96 - 100'
REQD R/W AREA THRU IMPROVEMENTS = 2110 x (120-100)
= 2110 x 20 = 42200/43560 = 0.97 AC

R/W COST = 0.97 AC x $5000/AC = $4850

REDUCE FRONTAGE ROAD

REQD R/W ON FRONTAGE ROADS - 100'
LENGTH OF SOUTH FRONTAGE ROAD - 670'
LENGTH OF NORTH FRONTAGE ROAD - 1500'
REQD R/W AREA = (1500+670) x 100 = 217000/43560 = 4.98 AC

R/W COST = 4.98 x $ 20000 = $99600

TOTAL R/W COST = 3650 + 55100 + 4850 + 99600 = $163200

COST WORKSHEET

PROJECT: **STP-155-1(23), P. I. Number 322470**
Twiggs County
Concept Development

ALTERNATIVE NO: 2

DESCRIPTION

CONSTRUCTION ITEM		ORIGINAL ESTIMATE			PROPOSED ESTIMATE		
ITEM	UNITS	NO. OF UNITS	COST/ UNIT	TOTAL	NO. OF UNITS	COST/ UNIT	TOTAL
Full Project (See attached):							
Widening (construction subtotal)				17,408,164			
Interchange (construction subtotal)				6,893,715			
SR 96 @ SR 87 Interchange Improvements (See attached)							422,577
Traffic Signal	LS				1	100,000	100,000
Alignment improvements between Churches (See attached)							2,042,692
SR 96 @ SR 358 Interchange Improvements (See attached)							403,057
Traffic Signal	LS				1	100,000	100,000
Reduce improvements at frontage road (See attached)							543,719
Subtotal				24,301,879			3,612,045
Mark-Up @ 27.52%				6,687,877			994,035
Construction Subtotal				**30,989,756**			**4,606,080**
Right-of-Way	AC			**5,086,500**			**163,200**
	Sub-total			36,076,256			4,769,280
Mark-up at	**27.52%**			Included			Included
	TOTAL			**36,076,256**			**4,769,280**

VALUE ENGINEERING ALTERNATIVE

PROJECT:	**STP-155-1(23), P.I. Number 322470** **Twiggs County** ***Concept Development***	ALTERNATIVE NO.:	**4**
DESCRIPTION:	**GRADE SEPARATE STATE ROUTE 87 FROM STATE ROUTE 96**	SHEET NO.:	1 of 12

ORIGINAL DESIGN: (Sketch attached)

The original design calls for a signal at the State Road SR 87/SR 96 intersection though no signal is listed in the cost estimate.

ALTERNATIVE: (Sketch attached)

Grade separate SR 87 over SR 96.

ADVANTAGES:

- Improves operations
- Improves safety
- Prepares for conversion to an interstate highway

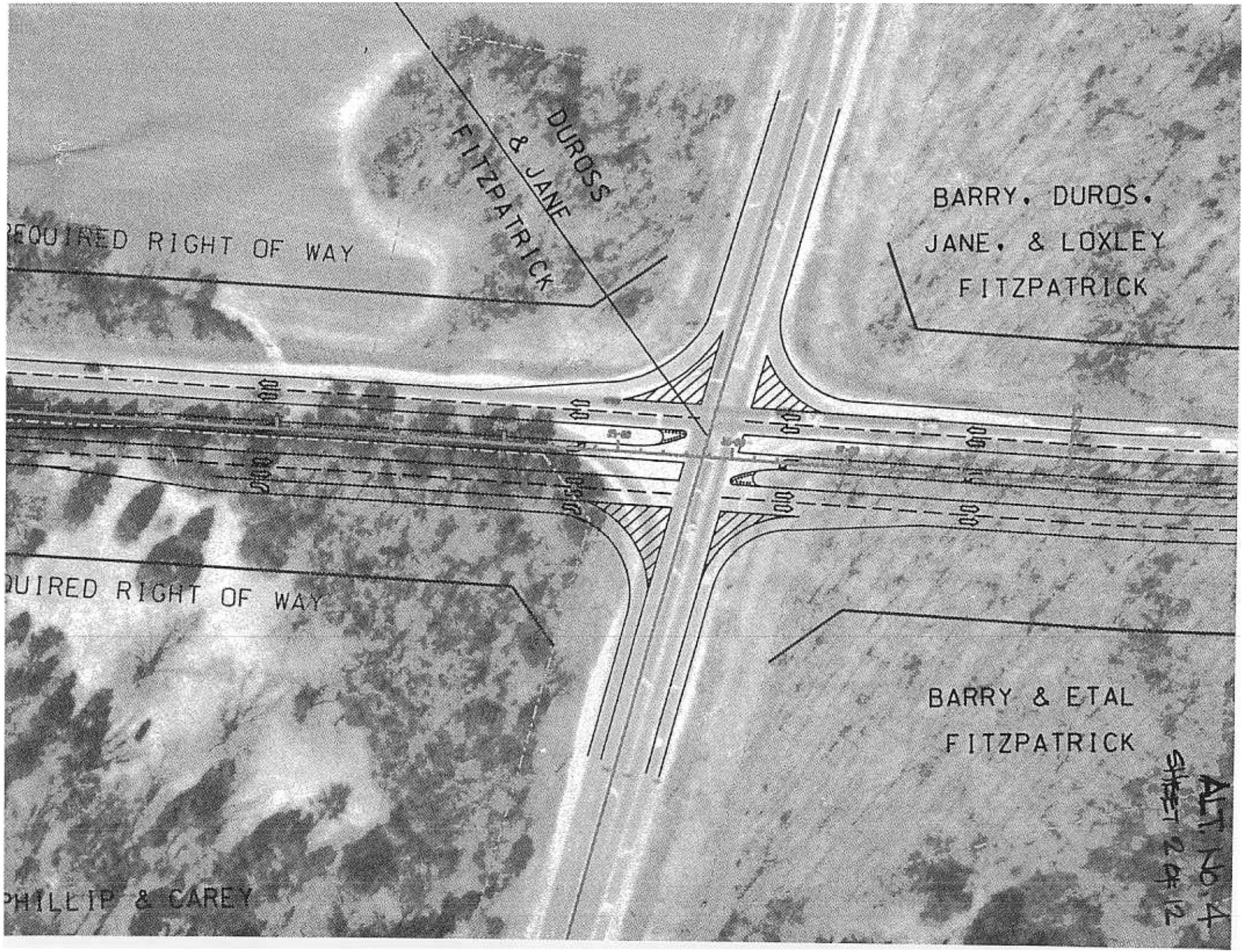
DISADVANTAGES:

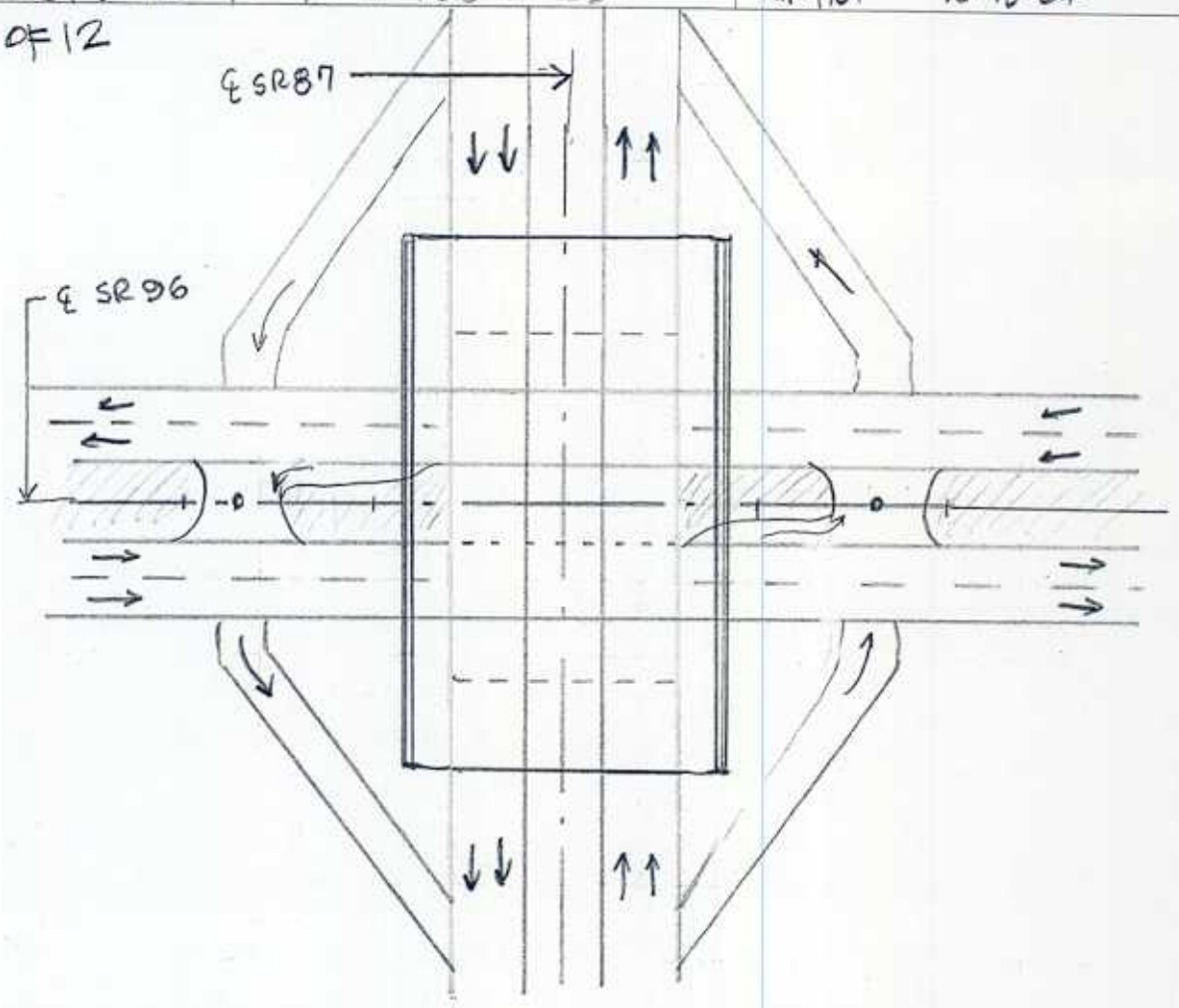
- Increases initial cost
- Could lengthen construction duration

DISCUSSION:

SR 87 carries 44% more through traffic than SR 96. There are large left turn movements from SR 87 north to SR 96 west and SR 96 east to SR 87 south. The accident rate at the intersection is higher than the state average. Adding the grade separation resolves these deficiencies.

COST SUMMARY	INITIAL COST	PRESENT WORTH RECURRING COSTS	PRESENT WORTH LIFE-CYCLE COST
ORIGINAL DESIGN	**$ 263,611**	¾	**$ 263,611**
ALTERNATIVE	**$ 3,425,194**	¾	**$ 3,425,194**
SAVINGS	**$ (3,161,583)**	¾	**$ (3,161,583)**


DUROSS & JANE FITZPATRICK
REQUIRED RIGHT OF WAY
BARRY. DUROS. JANE. & LOXLEY FITZPATRICK
QUIRED RIGHT OF WAY
BARRY & ETAL FITZPATRICK
PHILLIP & CAREY
ALT. 16-4 SHEET 2 OF 12



SCHEMATIC LAYOUT OF DIAMOND INTERCHANGE

VE STUDY : ALT 4 STP-155-1(23) GRANT 10/13/04

4 OF 12

ITEMS TO COST

✓ 1. - BRIDGE

✓ 2. - FILL / EMBANKMENT

✓ 3. - PAVEMENT ON SR87 MAINLINE & SUBGRADE

✓ 4. - RAMP PAVEMENT & SUBGRADE (4 RAMPS)

✓ 5. - MEDIAN PAVEMENT & SUBGRADE FOR SR 96

✓ 6. - SIGNALS (2)

✓ 7. - STRIPING / DRAINAGE / INCIDENTALS

8. - RIGHT OF WAY

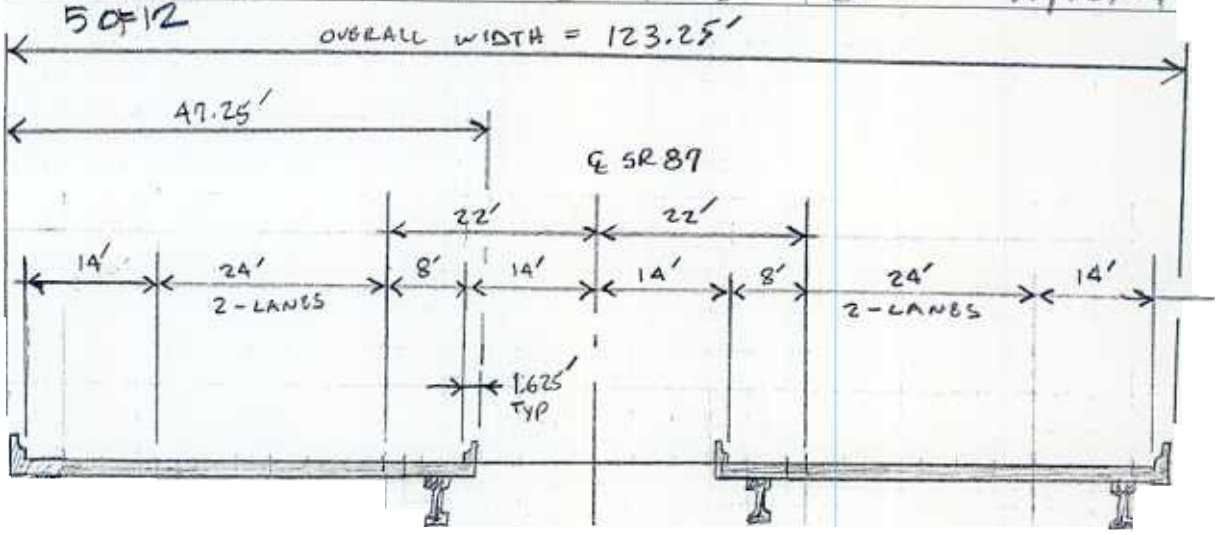
1. BRIDGE COSTS

A. DEFINE BRIDGE WIDTH (SEE ATTACHED SKETCH)

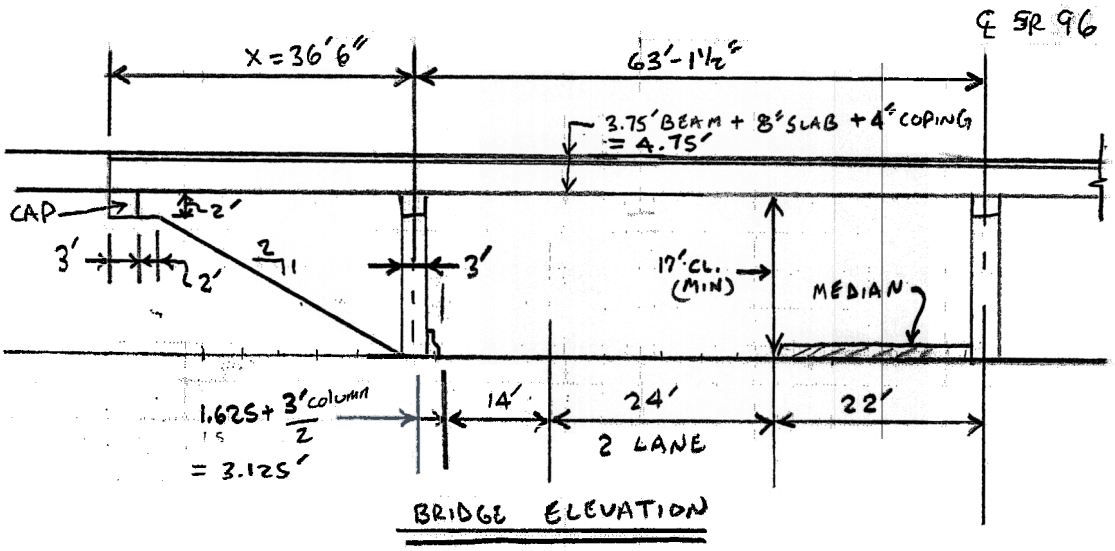
B. DEFINE BRIDGE LENGTH (SEE ATTACHED SKETCH OF BR. ELEVATION

BRIDGE COST = 2 (TWIN BRIDGES) × 47.25′ (WIDTH) × 199.25′ (LENGTH) × $65/FT² (EST. COST PSC BEAMS / GRADE SEP)

BRIDGE COST = $1,223,893



BRIDGE SECTION - TWIN BRIDGES



BRIDGE ELEVATION

$X = (17'_{CL} - 2'_{CAP}) \times 2 + \frac{3'_{column}}{2} + 3'_{WIDE\ CAP} + 2'_{BERM}$

$= 30' + 1.5' + 5'$

$= 36.5'$

TOTAL BRIDGE LENGTH $= 2(36.5' + 63.125')$

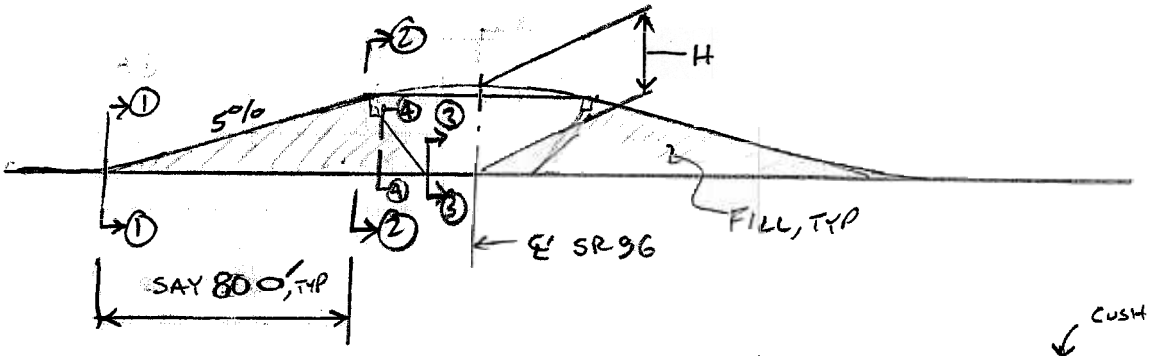
$= 2(99.625')$

$= 99.25'$

2. FILL COSTS (EMBANKMENT)

ASSUMPTIONS:

1. FIGURE FLAT GROUND.
2. RAISE GRADE OF SR 87 OVER SR 96 @ 5%, CLEAR SR 96 CROSS SECTION AND LOWER GRADE OF SR 87 BACK TO EXISTING GRADE



H = 17' CL + 4.75 STRUCTURE DEPTH + 0.5' SE ALLOWANCE + 1.75' CUSHION

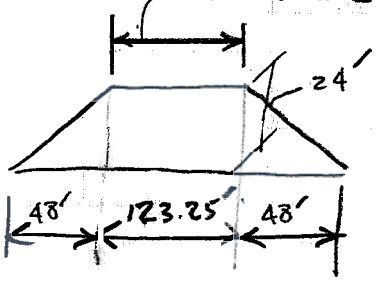
H = 24'

CALCULATE LENGTH OF GRADE BETWEEN ① & ②

RISE 24' @ 5% = 480'
+ 100' ← ½ of 200' VC @ ①
+ 150' ← ½ of 300' VC @ ②
730'

SAY 800'

@ ②



AREA = 4110 Ft²

@ ①

AREA = 0

VE STUDY : ALT 7 OF 12

155-1(23) GRANT 10/13/04

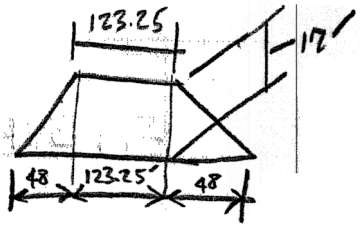
FILL FOR SIDE w/o 2:1 SLOPE UNDER BR

$$VOL_1 = \frac{4110^{Ft^2} + 0}{2} \times 800' = 1{,}644{,}000\ Ft^3$$

$$VOL_1 = 60{,}889\ yd^3$$

AREA UNDER BRIDGE

@ ④ ④ AREA =



2911 Ft^2.

@ ③ ③ AREA = 0

$$VOLUME_2 = \frac{2911 + 0}{2} \times 35' = 50942.5\ Ft^3$$

$$VOLUME_2 = 1887\ yd^3$$

$$\text{TOTAL VOLUME} = 2 \times (VOL_1 + VOLU\ )$$

$$= 2(62776\ yd^3)$$

$$= 125{,}552\ yd^3$$

← INPLACE EMBANKMENT

$$COST_{FILL} = 125{,}552\ yd^3 \times \$4.81/yd^3$$

$$\boxed{COST_{FILL} = \$603{,}905}$$

3. PAVEMENT & SUBGRADE ON SR 87

(SEE #18 COST SHEET)

COST / FT = $150/LFT ← THIS IMPLIES THAT SR87 & SR 96 costs are equal.

LENGTH = 2 (800' APPROACH + 200' BRIDGE)

= 1800' LONG

$$\text{COST}_{\text{PAVEMENT \& SUBGRADE}} = 1800' \times \$150/\text{LF}$$

$$\boxed{\text{COST}_{\text{PAVEMENT \& SUBGRADE}} = \$270{,}000}$$

4. RAMP PAVEMENT & SUBGRADE (4 RAMPS)

A. FIND A RATIO OF WIDTHS TO CREATE A $/LF OF RAMP FROM $/LF OF SR87

RAMP WIDTH = 16' WIDE

SR87 = WIDTH OF SR96 = $2\left[\underbrace{24'}_{\text{2 lanes}} + \underbrace{2'+6}_{\text{SHOULDERS}}\right] = 64'$

$$\text{RATIO} = \frac{16}{64} = 0.25$$

USE $/LF = $0.25 \times \$150/\text{LF} = \$37.5$

4. CONTINUED

B. LENGTH OF RAMPS

4 RAMPS x 1000' LONG = 4000'

$COST_{RAMPS}$ = 4000' x $37.5/LFT

$COST_{RAMPS}$ = $150,000

5. MEDIAN PAVEMENT & SUBGRADE FOR SR 96

{ THIS COST IS FOR MEDIAN CROSS OVERS @ LEFT TURN LANES FOR THE 44' MEDIAN UNDER THE BRIDGE }

CALCULATE RATIO OF COST TO USE BASED ON $/LF OF PAVING FOR SR 89

$150/FT x 44' (MEDIAN WIDTH) / 64' (SR 89 PAVING LIMITS) = $103.13/LF

LENGTH = 550' ← EQUALS 500' + 50' BETWEEN RAMP INTERSEC

$COST_{MEDIAN\ PAVEMENT}$ = 550 x $103.13

$COST_{MEDIAN\ PAVEMENT}$ = $56,719

TRAFFIC

6. SIGNALS @ RAMP INTERSECTIONS

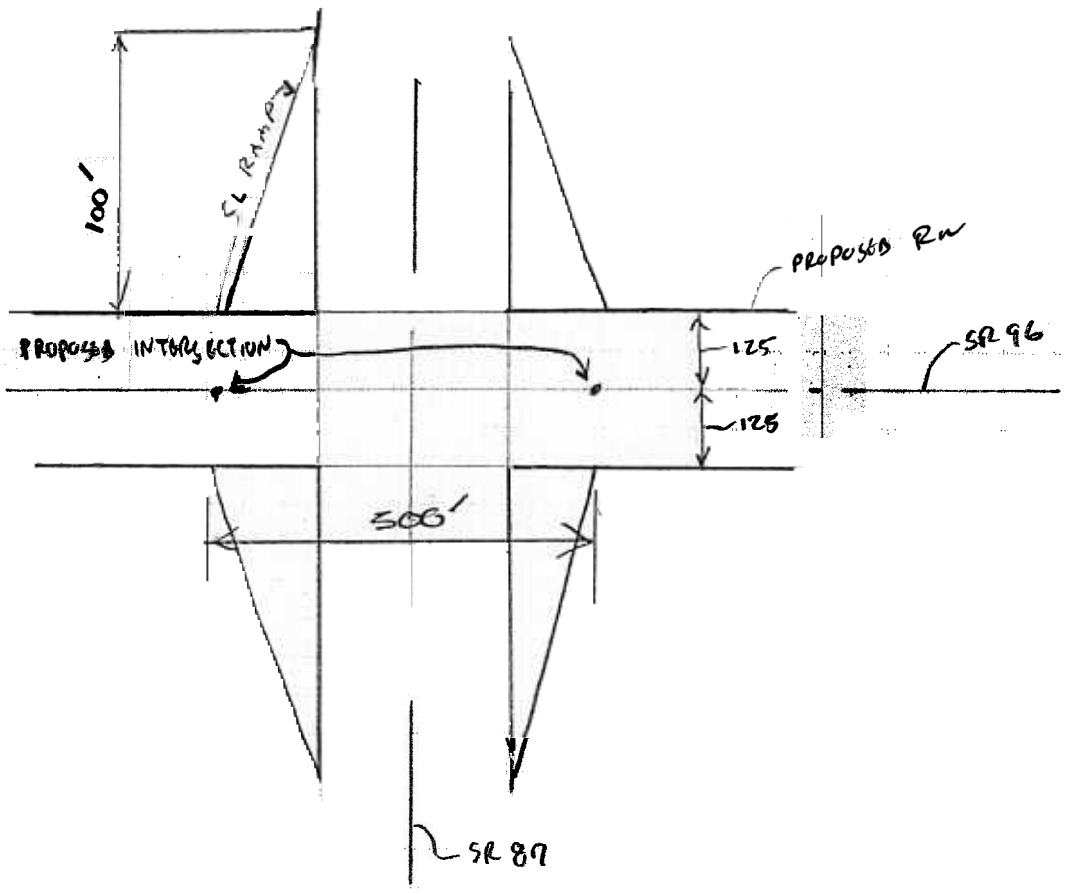
$$\text{COST}_{\text{SIGNALS}} = 2 \text{ INTERSECTIONS} \times \$100{,}000/\text{SIGNAL}$$

$$\text{COST}_{\text{INTERSECTIONS}} = \$200{,}000$$

7. STRIPING / DRAINAGE / INCIDENTALS

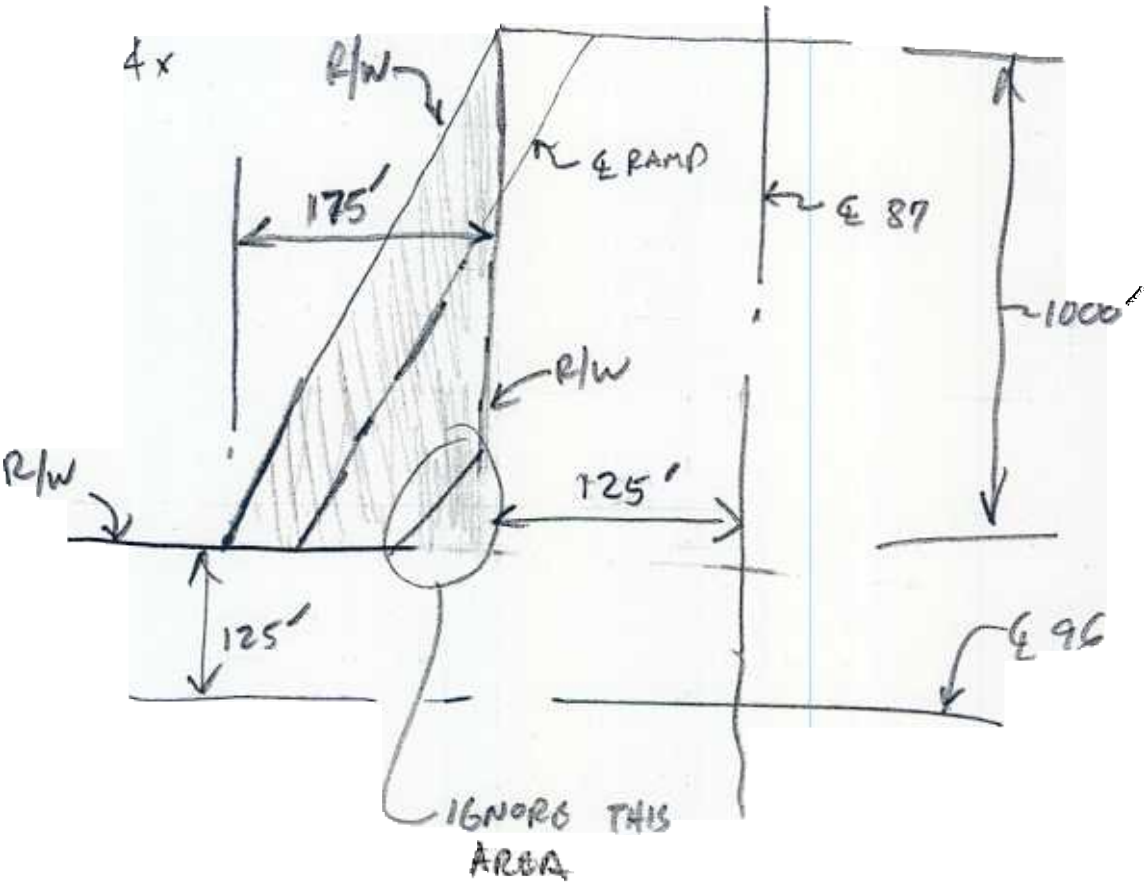
$$\text{COST}_{\text{SDI}} = \$150{,}000$$

8. RIGHT OF WAY



STUDY ALT 4 OF ADAL 1/23

ESTIMATE R/W REQUIRED FOR INTERCHANGE AS



$$\text{AREA}_{\text{SHADED}} \quad \frac{175' \times 1000}{2} = 87500 \text{ FT}^2$$

TOTAL AREA + $\text{AREA}_{\text{SHADED}}$

TOTAL AREA $350{,}000 \text{ FT}^2 = 8.03$ ACRES

COST WORKSHEET

PROJECT: **STP-155-1(23), P. I. Number 322470**
Twiggs County
Concept Development

ALTERNATIVE NO: 4

DESCRIPTION

SHEET NO. 12 of 12

CONSTRUCTION ITEM		ORIGINAL ESTIMATE			PROPOSED ESTIMATE		
ITEM	UNITS	NO. OF UNITS	COST/ UNIT	TOTAL	NO. OF UNITS	COST/ UNIT	TOTAL
Bridge Cost	CF				18,829.13	65.00	1,223,893
Embankment / Fill	CY				125,552	4.81	603,905
Pavement / Subgrade (mainline)	LF				1,800	150.00	270,000
Pavement / Subbase (ramps)	LF				4,000	37.50	150,000
Median Pavement / Subbase	LF	550	103.13	56,722	550	103.13	56,722
Traffic Signals	EA	1	100,000	100,000	2	100,000	200,000
Striping / Drainage / Incidentals	LS	1	50,000	50,000	3	50,000	150,000
Subtotal				206,722			2,654,520
Mark-Up @ 27.52%				56,890			730,524
Construction Subtotal				**263,611**			**3,385,044**
Right-of-Way (Rural)	AC				8.03	5,000	**40,150**

	Sub-total	263,611		3,425,194
Mark-up at	**27.52%**	Included		Included
	TOTAL	**263,611**		**3,425,194**

VALUE ENGINEERING ALTERNATIVE

PROJECT:	**STP-155-1(23), P.I. Number 322470** **Twiggs County** ***Concept Development***	ALTERNATIVE NO.:	**5/6**
DESCRIPTION:	**SIGNALIZE CRITICAL/DANGEROUS INTERSECTIONS**	SHEET NO.:	1 of 2

ORIGINAL DESIGN:

No significant traffic control is indicated on the current concept design but it appears the SR 87/SR 96 intersection is intended to be controlled.

ALTERNATIVE:

Signalize the two critical intersections SR 96/SR 87 and SR 96/SR 358.

ADVANTAGES:

- Improves safety
- Controls movements
- Improves operations

DISADVANTAGES:

- Increases cost

DISCUSSION:

The need for this alternative might become more apparent during the progression of the design and associated traffic study. This possibility was discussed during the information gathering phase. Due to the amount of accidents and expressed dangerous nature/alignment of these two intersections, signalization could improve safety conditions. The amount of traffic turning volumes, significant truck traffic, and excessive accident rates are all contributing factors for considering signalization. The additional costs will be relatively minor compared to the overall project cost and the value of the resulting safety improvements.

COST SUMMARY	INITIAL COST	PRESENT WORTH RECURRING COSTS	PRESENT WORTH LIFE-CYCLE COST
ORIGINAL DESIGN	**$ 0**	¾	**$ 0**
ALTERNATIVE	**$ 255,040**	¾	**$ 255,040**
SAVINGS	**$ (255,040)**	¾	**$ (255,040)**

COST WORKSHEET

PROJECT: **STP-155-1(23), P. I. Number 322470**
Twiggs County
Concept Development

ALTERNATIVE NO: 5 and 6

DESCRIPTION

SHEET NO. 2 of 2

CONSTRUCTION ITEM		ORIGINAL ESTIMATE			PROPOSED ESTIMATE		
ITEM	UNITS	NO. OF UNITS	COST/ UNIT	TOTAL	NO. OF UNITS	COST/ UNIT	TOTAL
Traffic Signals (assumed cost)	EA				2	100,000	200,000
	Sub-total						200,000
Mark-up at	**27.52%**						55,040
	TOTAL						**255,040**

VALUE ENGINEERING ALTERNATIVE

PROJECT: **STP-155-1(23), P.I. Number 322470** ALTERNATIVE NO.: **7**
Twiggs County
Concept Development

DESCRIPTION: **MAINTAIN EXISTING ALIGNMENT FOR SR 96 AT LAKE** SHEET NO.: 1 of 4

ORIGINAL DESIGN: (Sketch attached)

The current concept proposes a skewed new roadway alignment for SR 96 at the private lake.

ALTERNATIVE: (Sketch attached)

Maintain existing alignment and realign curve to improve alignment.

ADVANTAGES:

- Eliminates new alignment construction through lake
- Eases/facilities constructibility and staging within lake area
- Maintains more of the existing alignment further north

DISADVANTAGES:

- Pushes curved alignment further out (west)

DISCUSSION:

This alternative would maintain the existing alignment within the lake, widening the road only to the west side and extending the alignment further south and west to improve the current tight curve problem. The significant benefit of this alternative is that new alignment within the lake is avoided which could be costly and time consuming to construct. It would also use more of the existing alignment and roadway pavement north of the lake, further reducing costs.

The proposed alignment, as currently shown, is a skewed alignment, crossing the existing alignment through the lake area. This is not desirable for constructibility and staging purposes.

COST SUMMARY	INITIAL COST	PRESENT WORTH RECURRING COSTS	PRESENT WORTH LIFE-CYCLE COST
ORIGINAL DESIGN	**$ 1,602,720**	¾	**$ 1,602,720**
ALTERNATIVE	**$ 1,368,940**	¾	**$ 1,368,940**
SAVINGS	**$ 233,780**	¾	**$ 233,780**

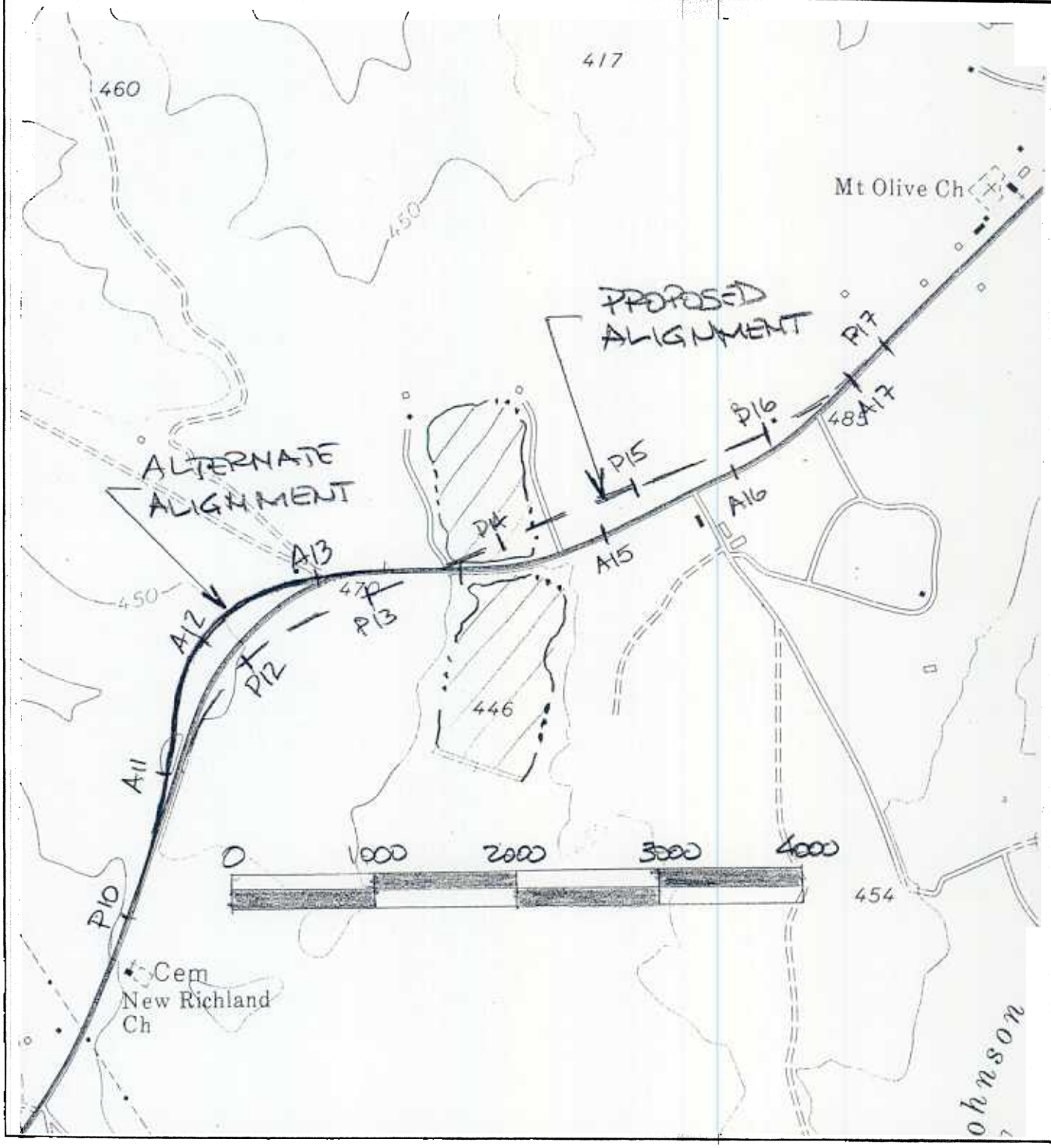
SKETCHES

PROJECT: **STP-155-1(23), P. I. Number 322470**
Twiggs County
Concept Development

ALTERNATIVE NO.: 7

☑ AS DESIGNED ☑ ALTERNATIVE

SHEET NO.: 2 of 4



CALCULATIONS

PROJECT: **STP-155-1(23), P. I. Number 322470**
Twiggs County
Concept Development

ALTERNATIVE NO.: 7

DESCRIPTION:

SHEET NO.: 3 of 4

CURRENT PROPOSED ALIGNMENT (P) — 7,000 LN. FT
ALL NEW, FULL WIDTH PAVEMENT

PROPOSED ALTERNATE ALIGNMENT (A) — 7,500 LN FT
3,500 FULL WIDTH NEW
4,000 USE EXISTING / WIDEN TO ONE SIDE

UNIT COSTS –
FULL WIDTH, NEW ROADWAY ASPHALT & BASE COST. USE 150 $/LF
(REF. ALT NO 18)

USE EXISTING ALIGNMENT, RESURFACE & WIDEN TO ONE SIDE USE 100 $/LF

R/W COSTS / AREA ASSUMPTIONS

(P) 7,000 (250) = 1,750,000 ft² = 40 ACRES

(A) 3,500(250) + 4000(125) =
875,000 + 500,000 = 1,375,000 ft² = 31.5 AC

COST WORKSHEET

PROJECT: **STP-155-1(23), P. I. Number 322470**
Twiggs County
Concept Development

ALTERNATIVE NO: 7

DESCRIPTION

SHEET NO. 4 of 4

CONSTRUCTION ITEM		ORIGINAL ESTIMATE			PROPOSED ESTIMATE		
ITEM	UNITS	NO. OF UNITS	COST/ UNIT	TOTAL	NO. OF UNITS	COST/ UNIT	TOTAL
Roadway / Asphalt (full width	LF	7,000	150.00	1,050,000	3,500.00	150.00	525,000
widening)							
Roadway / Asphalt (widening to	LF				4,000	100.00	400,000
one side)							
Lake Construction (full width	LS	1	50,000	50,000			
widening)							
Lake Construction (widening to	LS				1	25,000	25,000
one side)							
Subtotal				1,100,000			950,000
Mark-Up @ 27.52%				302,720			261,440
Construction Subtotal				**1,402,720**			**1,211,440**
Right-of-Way (Rural)	AC	40	5,000	**200,000**	31.50	5,000	**157,500**
	Sub-total			1,602,720			1,368,940
Mark-up at	**27.52%**			Included			Included
	TOTAL			**1,602,720**			**1,368,940**

VALUE ENGINEERING ALTERNATIVE

PROJECT:	**STP-155-1(23), P.I. Number 322470** **Twiggs County** ***Concept Development***	ALTERNATIVE NO.:	**9**
DESCRIPTION:	**MAXIMIZE USE OF EXISTING PAVEMENT AND RIGHT-OF-WAY**	SHEET NO.:	1 of 2

ORIGINAL DESIGN: (Sketch attached)

The current concept provides for widening SR 96 from two to four lanes. The new alignment creates a meandering centerline, therefore necessitating additional right-of-way.

ALTERNATIVE: (Sketch attached)

Use the existing pavement in more areas and reduce right-of-way requirements.

ADVANTAGES:

- Reduces initial costs
- Eases construction

DISADVANTAGES:

- Non-symmetric alignment throughout corridor

DISCUSSION:

Reuse of the existing pavement has been somewhat incorporated into the design. However, there are some areas where this can be further implemented. Most of these areas occur around design constraints such as historic properties and existing residences, but some areas could be further investigated for reuse.

Additionally, the proposed right-of-way offset at 125 ft. seems excessive. While it is desirable to acquire this corridor width, some cost savings can be realized by a reduced width, while maintaining the required typical section.

COST SUMMARY	INITIAL COST	PRESENT WORTH RECURRING COSTS	PRESENT WORTH LIFE-CYCLE COST
ORIGINAL DESIGN			
ALTERNATIVE	**DESIGN SUGGESTION**		
SAVINGS			

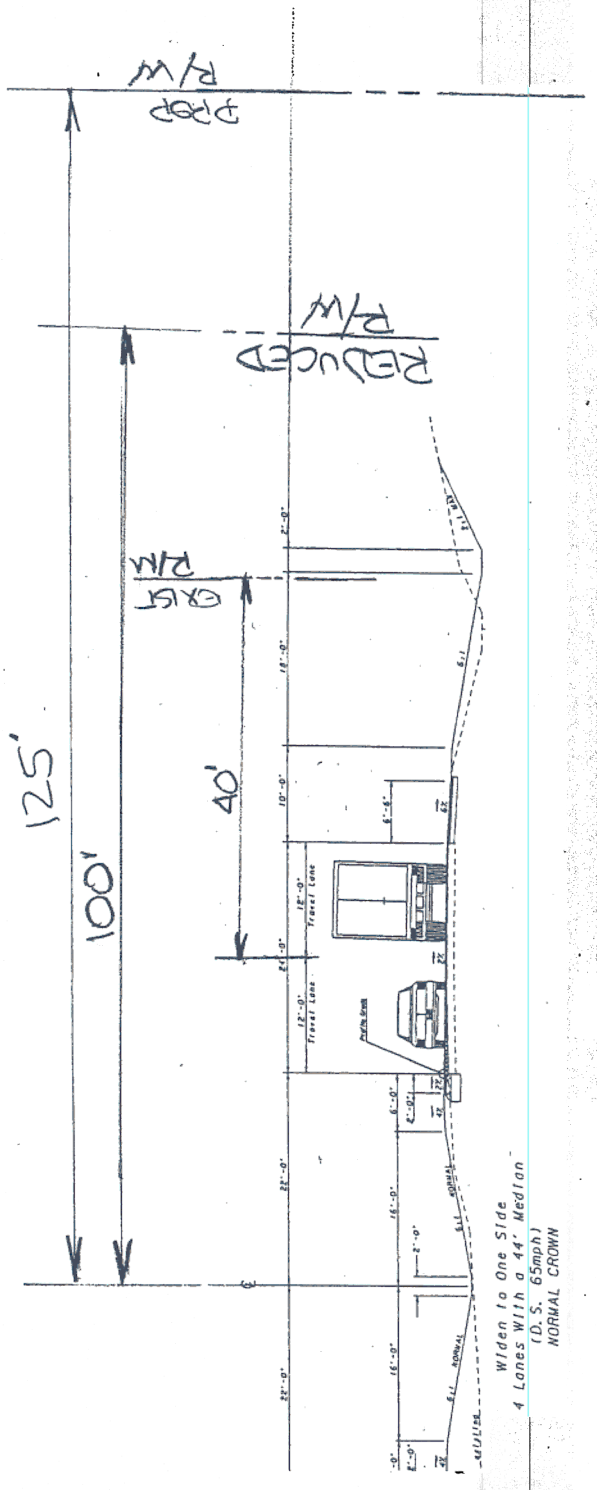
SKETCHES

PROJECT: **STP-155-1(23), P. I. Number 322470**
Twiggs County
Concept Development

ALTERNATIVE NO.: 9

☑ AS DESIGNED ☐ ALTERNATIVE

SHEET NO.: 2 of 2



VALUE ENGINEERING ALTERNATIVE

PROJECT:	**STP-155-1(23), P.I. Number 322470** **Twiggs County** ***Concept Development***	ALTERNATIVE NO.:	**11/14**
DESCRIPTION:	**USE RIGHT-IN/RIGHT-OUTS AT CITGO AND WALTHALL SERVICE STATIONS**	SHEET NO.:	1 of 2

ORIGINAL DESIGN: (Sketch attached)

The current practice eliminates access to the Citgo and Walthall gas stations.

ALTERNATIVE:

It is suggested to allow right-in/right-out access to these two businesses along SR 96 in the vicinity of the I-16/ SR 96 Interchange.

ADVANTAGES:

- Reduces impact to property owners
- Provides convenient access to businesses for travelers

DISADVANTAGES:

- Reduces traffic operations
- Increases potential for accidents

DISCUSSION:

This would be a help in the right-of-way negotiations with these two property owners since the raised median will eliminate left turns into these businesses. This is the only possible access for the Citgo site.

COST SUMMARY	INITIAL COST	PRESENT WORTH RECURRING COSTS	PRESENT WORTH LIFE-CYCLE COST
ORIGINAL DESIGN			
ALTERNATIVE	**DESIGN SUGGESTION**		
SAVINGS			

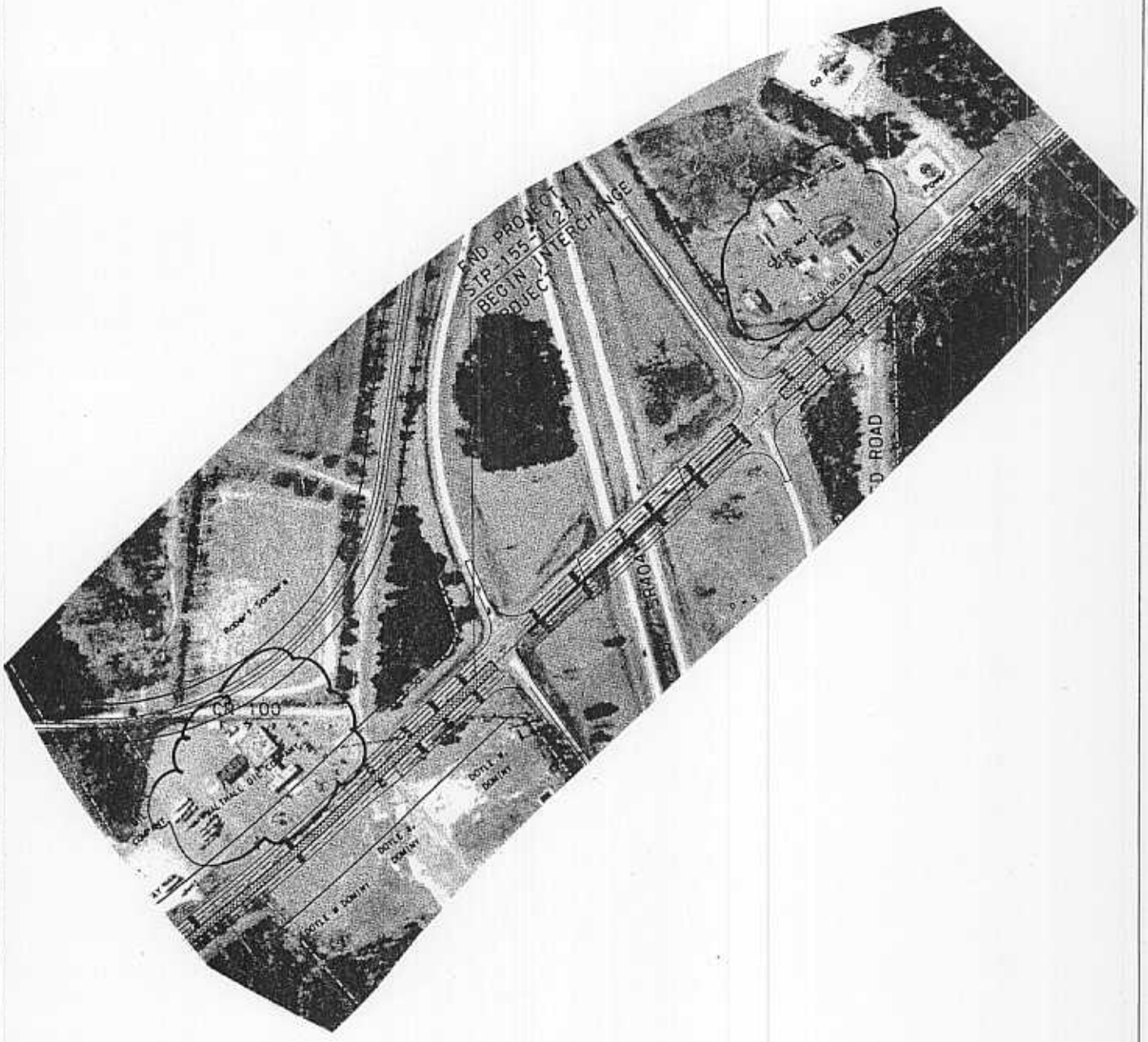
SKETCHES

PROJECT: **STP-155-1(23), P. I. Number 322470**
Twiggs County
Concept Development

ALTERNATIVE NO.: 11 & 14

■ AS DESIGNED ☐ ALTERNATIVE

SHEET NO.: 2 of 2



VALUE ENGINEERING ALTERNATIVE

PROJECT: **STP-155-1(23), P.I. Number 322470**
Twiggs County
Concept Development

ALTERNATIVE NO.: **12**

DESCRIPTION: **RELOCATE ACCESS ROAD TO COUNTY ROAD 100 BEHIND WALTHALL OIL COMPANY**

SHEET NO.: 1 of 7

ORIGINAL DESIGN: (Sketch attached)

The original design calls for improvement of CR 100 and CR 173 behind the Walthall Oil Company on the west side of SR 96. The current intersection of CR 173 with SR 96 will be severed because of the interchange improvement project. Access to SR 96 will be provided by connecting CR 173 to CR 100 with a horizontal curve and adding an access road on CR 100 to connect to SR 96.

ALTERNATIVE: (Sketch attached)

Provide access for CR 100 and CR 173 to SR 96 by moving the road closer to the SR 96 interchange though still outside the 1,000-ft. separation zone for the I-16 ramp termini. Provide the same radius curve as the original design.

ADVANTAGES:

- Reduces initial cost
- Provides more access to the Walthall property which may lower right-of-way costs/impact

DISADVANTAGES:

- Access road will be closer to the interchange (still beyond 1,000-ft. limit)

DISCUSSION:

The alternative design lowers costs and length of roadway improvements while providing the same function as the original design without compromising safety.

COST SUMMARY	INITIAL COST	PRESENT WORTH RECURRING COSTS	PRESENT WORTH LIFE-CYCLE COST
ORIGINAL DESIGN	**$ 119,116**	¾	**$ 119,116**
ALTERNATIVE	**$ 0**	¾	**$ 0**
SAVINGS	**$ 119,116**	¾	**$ 119,116**

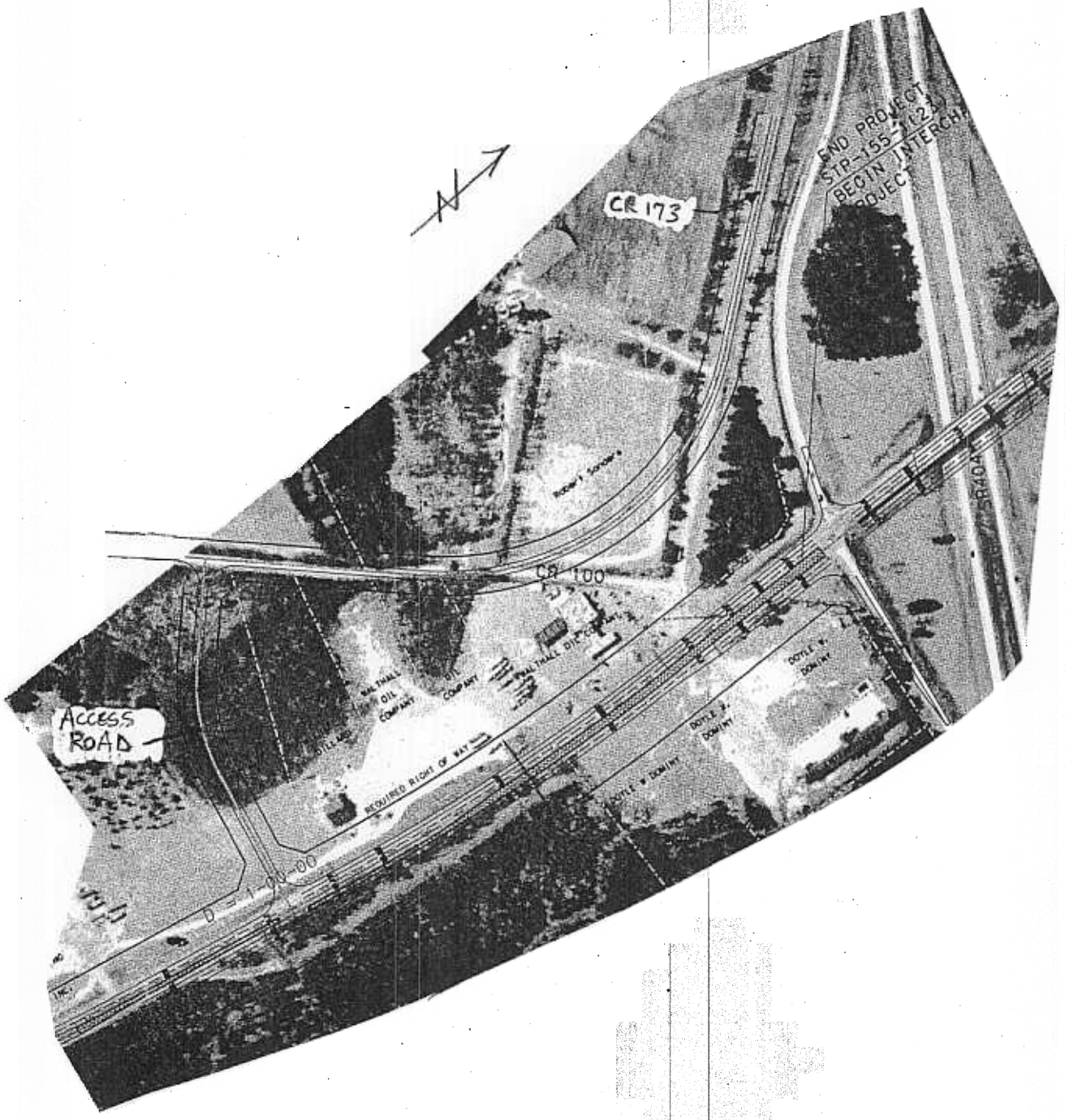
SKETCHES

PROJECT: **STP-155-1(23), P. I. Number 322470**
Twiggs County
Concept Development

ALTERNATIVE NO.: 12

■ AS DESIGNED ☐ ALTERNATIVE

SHEET NO.: 2 of 7



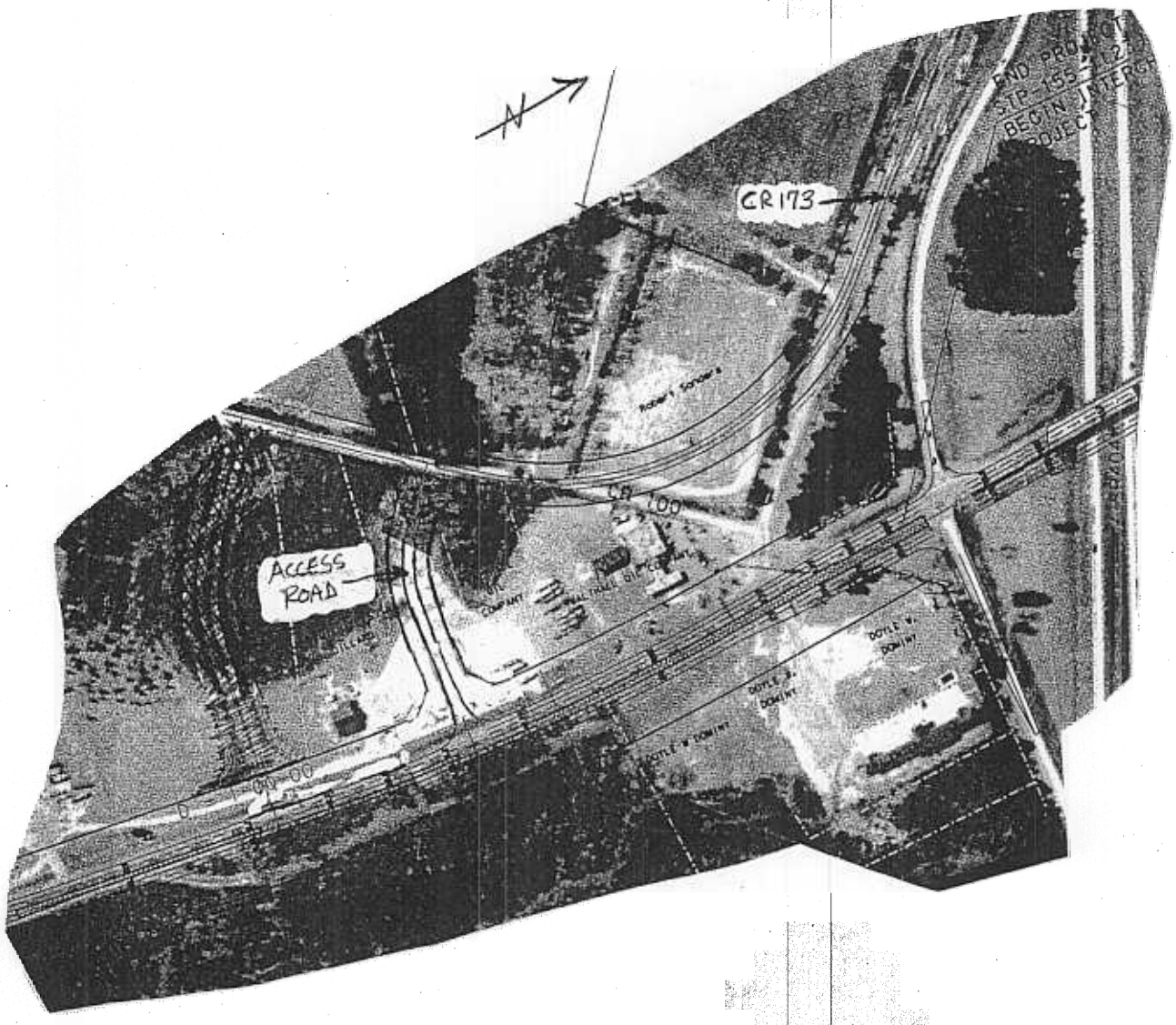
SKETCHES

PROJECT: **STP-155-1(23), P. I. Number 322470**
Twiggs County
Concept Development

ALTERNATIVE NO.: 12

☐ AS DESIGNED ■ ALTERNATIVE

SHEET NO.: 3 of 7



COST TO QUANTIFY (DIFFERENTIAL COSTS)

1. ROADWAY COSTS
2. R/W COSTS (100' WIDTH)
3. EARTHWORK

NOTE: THE COST ESTIMATE DOES NOT INCLUDE A COST FOR A SIGNAL AT THE ACCESS ROAD/SR96 INTERSECTION. THIS ALTERNATE ASSUMES THAT THE SAME TRAFFIC CONTROL DEVICES WILL BE USED AT THE TWO ENDS OF THE ACCESS ROAD AS THE ORIGINAL DESIGN USES.

LENGTH OF ROADWAY TO REPLACE

ALONG THE NEW CR100/CR173 ALIGNMENT

ORIGINAL DESIGN 2500'
ALTERNATE DESIGN: 1800'
} - DIFFERENCE = 700'

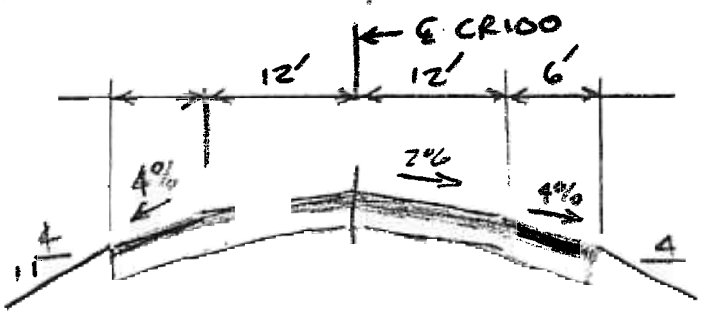
ALONG THE NEW ACCESS ROAD

ORIGINAL DESIGN: 850
ALTERNATE DESIGN: 600'
} - DIFFERENCE = 150'

TOTAL DIFFERENCE = 850'

WIDTH OF ROADWAY

DETERMINE COST / LFT.



TYPICAL SECTION

WIDTH OF PAVEMENT = 36'

PAVEMENT & GAB $/LF = $150/LF FOR MAINLINE (SEE ALT 4)
← FOR 64' PAVEMENT

PAVEMENT & GAB for CR100 = $150/LF × 36'/64' = $84.38/LF

COST RDWY PAVEMENT & GAB = 850' × $84.38/LF

COST RDWY PAVEMENT & GAB = $71,723

R/W COSTS

- ASSUME NO R/W REQ'D ALONG EXISTING TANGENTS
- ASSUME THAT IMPACT TO ROBERT SANDERS PARCEL IS IDENTICAL FOR BOTH DESIGNS
- IGNORE COST OF R/W FILLETS @ TIE-INS
- THE DIFFERENCE IN R/W COSTS IS:

$$\Delta R/W = \frac{\text{DIFFERENCE IN LENGTH OF ACCESS RD} \times 100' \text{ R/W} \times \frac{\text{R/W COST}}{\text{ACRE}}}{43{,}560 \text{ FT}^2/\text{ACRE}}$$

$$\Delta R/W = \frac{150' \times 100' \text{ R/W}}{43560 \text{ FT}^2/\text{ACRE}} \times \frac{\$20{,}000}{\text{ACRE}}$$

($20,000 ← COMMERCIAL COST/ACRE)

0.34 ACRES

$$\boxed{\Delta R/W = \$6887}$$

EARTHWORK

- BALANCE EARTHWORK AS MUCH AS PRACTICAL
- AREA IN QUESTION IS VERY FLAT

SAY, PLACE 3' OF EARTH ACROSS THE PAVEMENT SECTION TO CREATE A COST #

$$\frac{3' \text{ HIGH} \times 36' \text{ WIDE} \times (700' + 150')}{27} = 3400 \text{ yd}^3$$

(700' ← DIFF. CR100/CR173; 150' ← DIFF. ACCESS RD)

$$\boxed{\text{COST}_{\text{EARTHWORK}} = 3400 \text{ yd}^3 \times \$4.81/\text{yd}^3 = \$16{,}354}$$

COST WORKSHEET

PROJECT: **STP-155-1(23), P. I. Number 322470**
Twiggs County
Concept Development

ALTERNATIVE NO: 12

DESCRIPTION

SHEET NO. 7 of 7

CONSTRUCTION ITEM		ORIGINAL ESTIMATE			PROPOSED ESTIMATE		
ITEM	UNITS	NO. OF UNITS	COST/ UNIT	TOTAL	NO. OF UNITS	COST/ UNIT	TOTAL
Pavement and GAB	LF	850	84.38	71,723			
Earthwork	CY	3,400	4.81	16,354			
Subtotal				88,077			
Mark-Up @ 27.52%				24,239			
Construction Subtotal				**112,316**			
Right-of-Way (Commercial)	AC	0.34	20,000	**6,800**			

	Sub-total		119,116	
Mark-up at	**27.52%**		Included	
	TOTAL		**119,116**	

VALUE ENGINEERING ALTERNATIVE

PROJECT: **STP-155-1(23), P.I. Number 322470**
Twiggs County
Concept Development

ALTERNATIVE NO.: **13**

DESCRIPTION: **RELOCATE COUNTY ROAD 100 CONNECTION TO MISSILE BASED ROAD**

SHEET NO.: 1 of 6

ORIGINAL DESIGN: (Sketch attached)

The original design calls for construction of 3,100-ft. of CR 100 along a new alignment parallel to an existing electrical transmission line to connect to SR 96. 600 ft. of existing CR 100 is realigned to tie-in with the new alignment and to provide access for Missile Based Road, which is cut off from SR 96.

ALTERNATIVE: (Sketch attached)

Construct CR 100 from SR 96 on the new alignment south of the electrical transmission line, proceed approximately 300 ft. to a horizontal curve, and then run 1,200 ft. to intersect with the existing CR 100 which connects to Missile Based Road.

ADVANTAGES:

- Reduces initial cost

DISADVANTAGES:

- Forces a 90° intersection for new CR 100 with the existing CR 100

DISCUSSION:

The alternative design provides access to the existing CR 100 from SR 96 because Missile Based Road is closed by the interchange project. The alterative ties more quickly to the existing CR 100 and avoids a tie-in beneath the transmission line.

COST SUMMARY	INITIAL COST	PRESENT WORTH RECURRING COSTS	PRESENT WORTH LIFE-CYCLE COST
ORIGINAL DESIGN	**$ 229,768**	¾	**$ 229,768**
ALTERNATIVE	**$ 0**	¾	**$ 0**
SAVINGS	**$ 229,768**	¾	**$ 229,768**

SKETCHES

PROJECT: **STP-155-1(23), P. I. Number 322470**
Twiggs County
Concept Development

ALTERNATIVE NO.: 13

☑ AS DESIGNED ☐ ALTERNATIVE

SHEET NO.: 2 of 6

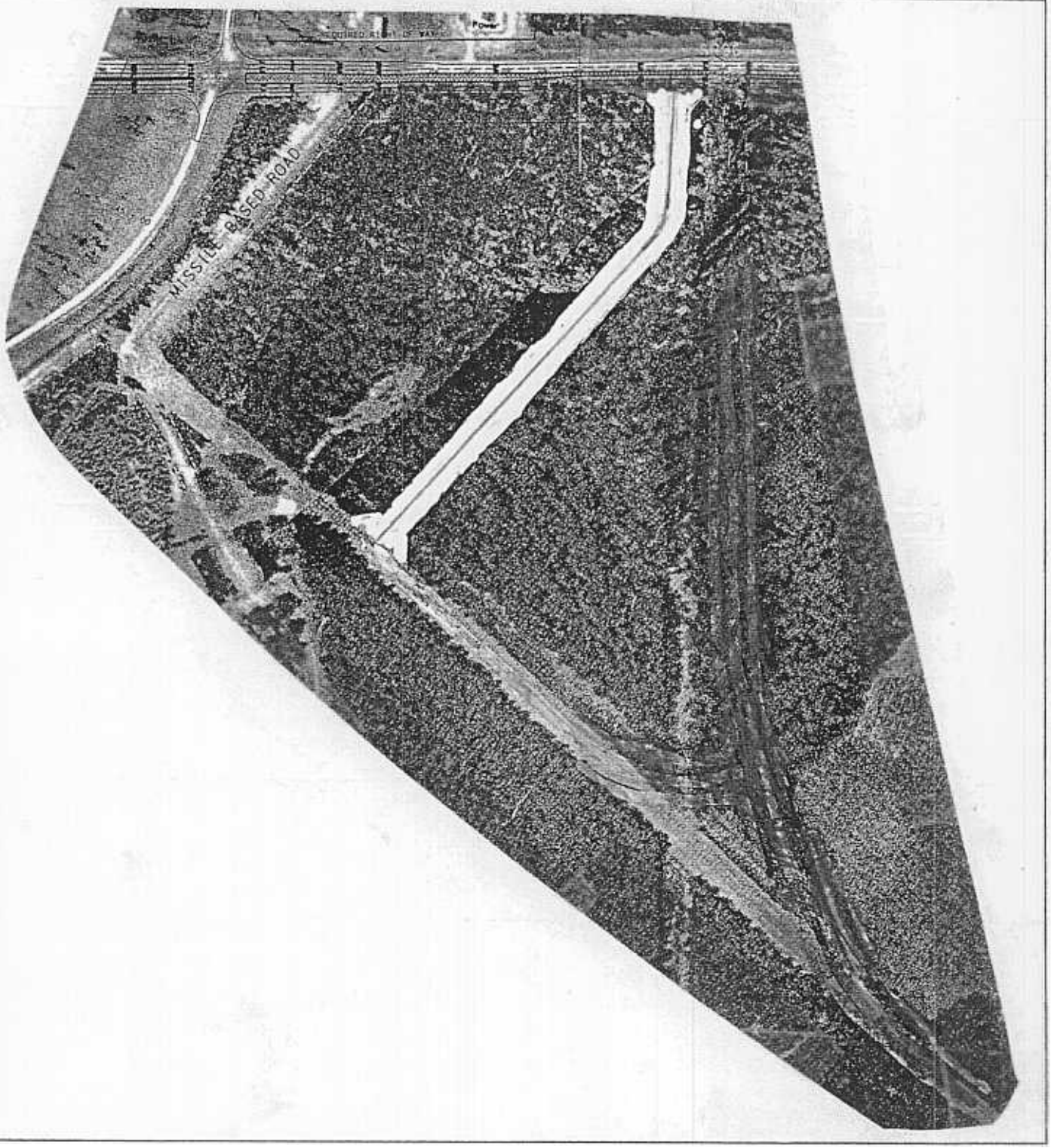
SKETCHES

PROJECT: **STP-155-1(23), P. I. Number 322470**
Twiggs County
Concept Development

ALTERNATIVE NO.: 13

☐ AS DESIGNED ☑ ALTERNATIVE

SHEET NO.: 3 of 6



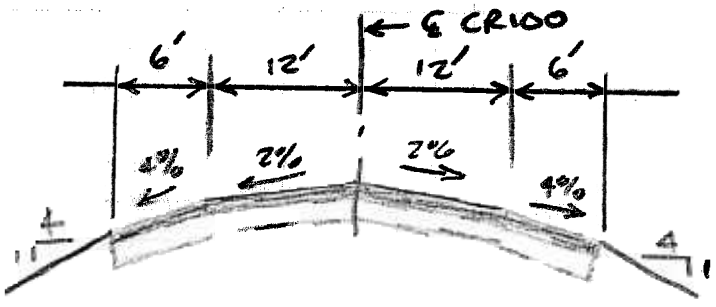
COST DIFFERENTIAL BETWEEN IMPROVEMENTS TO CR100 (ORIGINAL DESIGN VS. ALTERNATIVE)

LENGTH OF ORIGINAL DESIGN = 3100'

LENGTH OF ALTERNATIVE = 1500'

SAVINGS IN LENGTH = 3100 - 1500 = 600'

DETERMINE COST / LFT.



TYPICAL SECTION

WIDTH OF PAVEMENT = 36'

ITEMS TO COST

1. PAVEMENT & GAB ✓
2. EARTHWORK ✓
3. RIGHT OF WAY ✓

PAVEMENT & GAB $/LF = $150/LF FOR MAINLINE (SEE ALT 4)
↑ FOR 64' PAVEMENT

PAVEMENT & GAB FOR CR100 = $150/LF × 36'/64' = $84.38/LF

COST PAVEMENT & GAB = 1600' × $84.38 = $135,000

EARTH WORK

- BALANCE EARTHWORK AS MUCH AS PRACTICAL.
- ADDITIONAL WORK WOULD BE ELIMINATED BY REDUCTION IN LENGTH

SAY, PLACE 3' OF EARTH ACROSS THE PAVEMENT SECTION. SECTIONS WILL BE IN CUT AND OTHER SECTIONS WILL BE IN FILL.

$$\frac{3' \text{ HIGH} \times 36' \text{ WIDE} \times 1600' \text{ LONG}}{27} = 6400 \text{ yd}^3$$

$$\text{COST}_{\text{EARTH WORK}} = \$4.81 \times 6400 = \$30,784$$

RIGHT OF WAY

RIGHT OF WAY SET @ 100'

$$\frac{1600' \times 100' \text{ WIDE}}{43560 \text{ ft}^2/\text{acre}} = 3.67 \text{ acres}$$

$$\text{COST}_{RW} = 3.67 \text{ acres} \times \$5000/\text{acre} = \$18,350$$

COST WORKSHEET

PROJECT: **STP-155-1(23), P. I. Number 322470**
Twiggs County
Concept Development

ALTERNATIVE NO: 13

DESCRIPTION

SHEET NO. 6 of 6

CONSTRUCTION ITEM		ORIGINAL ESTIMATE			PROPOSED ESTIMATE		
ITEM	UNITS	NO. OF UNITS	COST/ UNIT	TOTAL	NO. OF UNITS	COST/ UNIT	TOTAL
Pavement and GAB	LF	1,600	84.38	135,008			
Earthwork	CY	6,400	4.81	30,784			
Subtotal				165,792			
Mark-Up @ 27.52%				45,626			
Construction Subtotal				**211,418**			
Right-of-Way (Rural)	AC	3.67	5,000	**18,350**			

	Sub-total		229,768	
Mark-up at	**27.52%**		Included	
	TOTAL		**229,768**	

VALUE ENGINEERING ALTERNATIVE

PROJECT: **STP-155-1(23), P.I. Number 322470**
Twiggs County
Concept Development

ALTERNATIVE NO.: **18**

DESCRIPTION: **BYPASS LAKE WITH A NEW ALIGNMENT FOR SR 96**

SHEET NO.: 1 of 4

ORIGINAL DESIGN: (Sketch attached)

The original design alignment of the concept design requires embankment construction within the existing lake.

ALTERNATIVE: (Sketch attached)

Realign mainline further to the east around the lake and avoid the private lake in its entirety.

ADVANTAGES:

- Eliminates road through existing lake
- No new construction within the lake
- Could possibly ease/facilitate right-of-way acquisition from a significant land owner
- Can restore/combine lakes into one large lake
- Avoids historic properties
- Eliminates staging difficulties in crossing traffic between existing and proposed alignment especially at the lake

DISADVANTAGES:

- Longer/more circuitous alignment

DISCUSSION:

This alternate alignment circumvents the lake and eliminates any construction within the lakes. Although it increases the overall project costs. The main benefit is to eliminate the construction within the lake which can be costly, time-consuming, and somewhat questionable. This will also eliminate a future maintenance issue for GDOT since any new road through the lake will be an earthen dam that becomes a maintenance and access problem. A secondary benefit is to the local property owner who should be receptive to restoring the lake to one larger lake. This alternative also avoids the historic properties.

COST SUMMARY	INITIAL COST	PRESENT WORTH RECURRING COSTS	PRESENT WORTH LIFE-CYCLE COST
ORIGINAL DESIGN	**$ 63,760**	¾	**$ 63,760**
ALTERNATIVE	**$ 462,311**	¾	**$ 462,311**
SAVINGS	**$ (398,551)**	¾	**$ (398,551)**

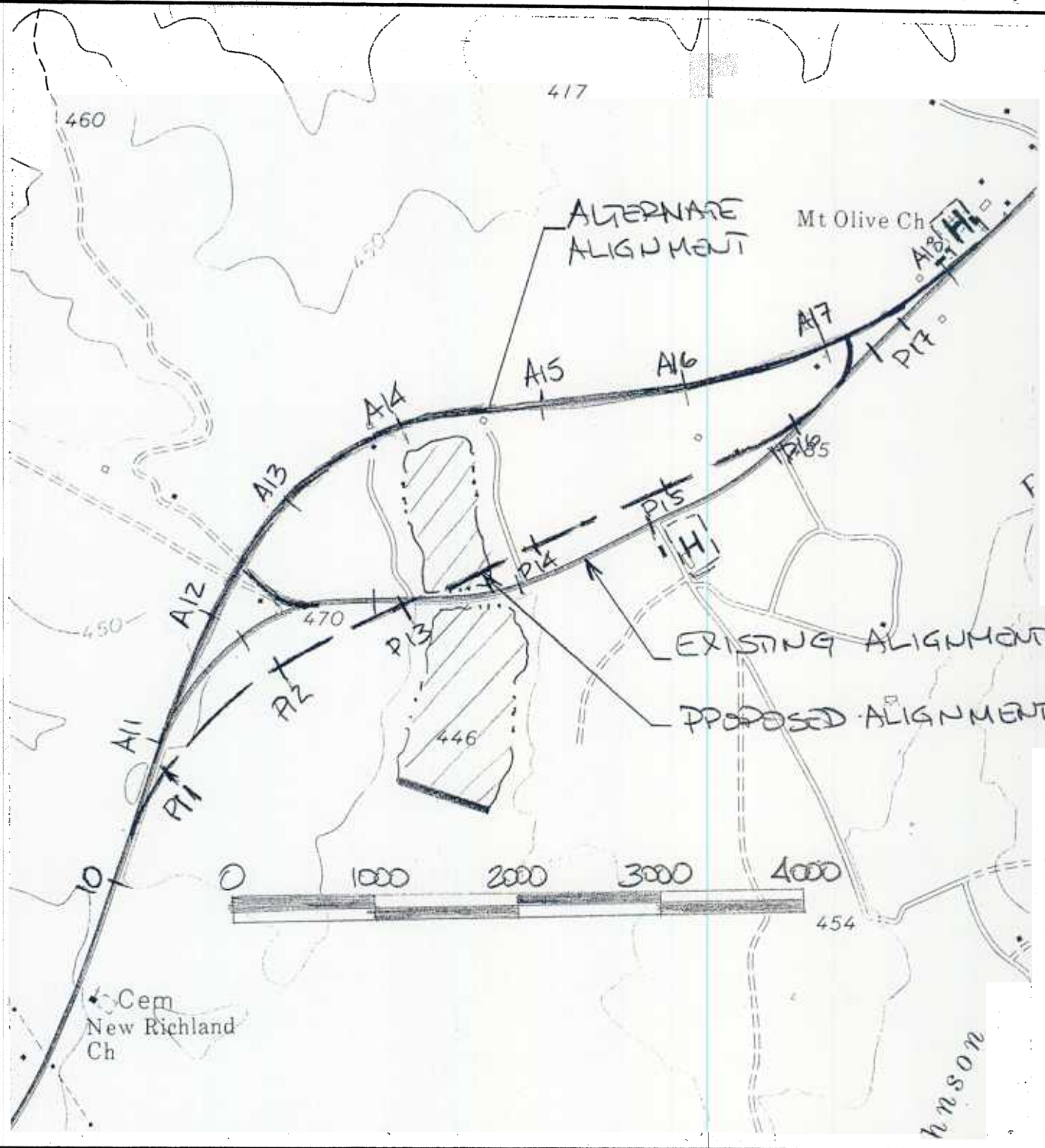
SKETCHES

PROJECT: **STP-155-1(23), P. I. Number 322470**
Twiggs County
Concept Development

ALTERNATIVE NO.: 18

☒ AS DESIGNED ☒ ALTERNATIVE

SHEET NO.: 2 of 4



CALCULATIONS

PROJECT: **STP-155-1(23), P. I. Number 322470**
Twiggs County
Concept Development

ALTERNATIVE NO.: 18

DESCRIPTION:

SHEET NO.: 3 of 4

PROPOSED ALIGNMENT - 6,500 FT

ALTERNATE ALIGNMENT - 8,500 FT

2,000 FT

2,000 LN FT OF ADDITIONAL FULL WIDTH ROADWAY WITH ALTERNATE ALIGNMENT

	L(ft)	W(ft)	D(ft)	#/ft³	TONS
GAB	2000	48	1	135	6480
12MM	2000	65		165 #/yd²	1192
19MM	2000	41		440 #/yd²	2004
25MM	2000	28		550 #/yd²	1711

R/W

2,000 LF (250 ft) = 500,000 ft² = 11.5 ACRES

ROADWAY COST PER FOOT

$$\frac{(104,328 + 58,253 + 76312 + 73,556)\$}{2,000 \text{ ft}} = 158 \$/\text{FT}$$

COST WORKSHEET

PROJECT: **STP-155-1(23), P. I. Number 322470**
Twiggs County
Concept Development

ALTERNATIVE NO: 18

DESCRIPTION

SHEET NO. 4 of 4

CONSTRUCTION ITEM		ORIGINAL ESTIMATE			PROPOSED ESTIMATE		
ITEM	UNITS	NO. OF UNITS	COST/ UNIT	TOTAL	NO. OF UNITS	COST/ UNIT	TOTAL
Pavement:							
GAB	TN				6,480	16.10	104,328
12mm	TN				1,192	48.87	58,253
19mm	TN				2,004	38.08	76,312
25mm	TN				1,711	42.99	73,556
Misc. Striping	LS				1	5,000	5,000
Lake Construction (full width	LS	1	50,000	50,000			
widening)							
Subtotal				50,000			317,449
Mark-Up @ 27.52%				13,760			87,362
Construction Subtotal				**63,760**			**404,811**
Right-of-Way (Rural)	AC				11.50	5,000	**57,500**
	Sub-total			63,760			462,311
Mark-up at	**27.52%**			Included			Included
	TOTAL			**63,760**			**462,311**

VALUE ENGINEERING ALTERNATIVE

PROJECT:	**STP-155-1(23), P.I. Number 322470** **Twiggs County** ***Concept Development***	ALTERNATIVE NO.:	**21**
DESCRIPTION:	**SELECTIVELY USE RIGID PAVEMENT**	SHEET NO.:	1 of 4

ORIGINAL DESIGN:

The current concept drawings and cost estimates indicate the use of asphalt pavement for the preponderance of the roadway.

ALTERNATIVE: (Sketch attached)

Selectively incorporate rigid pavement at certain locations that could be prone to excessive stress fatigue from truck traffic, and turning maneuvers.

ADVANTAGES:

- Prolongs pavement life
- Improves operations
- Improves maintenance/replacement costs
- Improves safety

DISADVANTAGES:

- Increases initial cost

DISCUSSION:

During the course of design for the project, the pavement study will identify the recommended pavement composition. It is recommended that rigid pavement be used at some of the busier intersections, especially the SR 87/SR 96 and SR 358/SR 96 intersections where significant truck volumes and turning maneuvers will quickly deteriorate asphalt pavement.

A detailed pavement life cycle analysis will yield more beneficial information with respect to the increased up-front costs.

COST SUMMARY	INITIAL COST	PRESENT WORTH RECURRING COSTS	PRESENT WORTH LIFE-CYCLE COST
ORIGINAL DESIGN	**$ 119,359**	¾	**$ 119,359**
ALTERNATIVE	**$ 206,582**	¾	**$ 206,582**
SAVINGS	**$ (87,223)**	¾	**$ (87,223)**

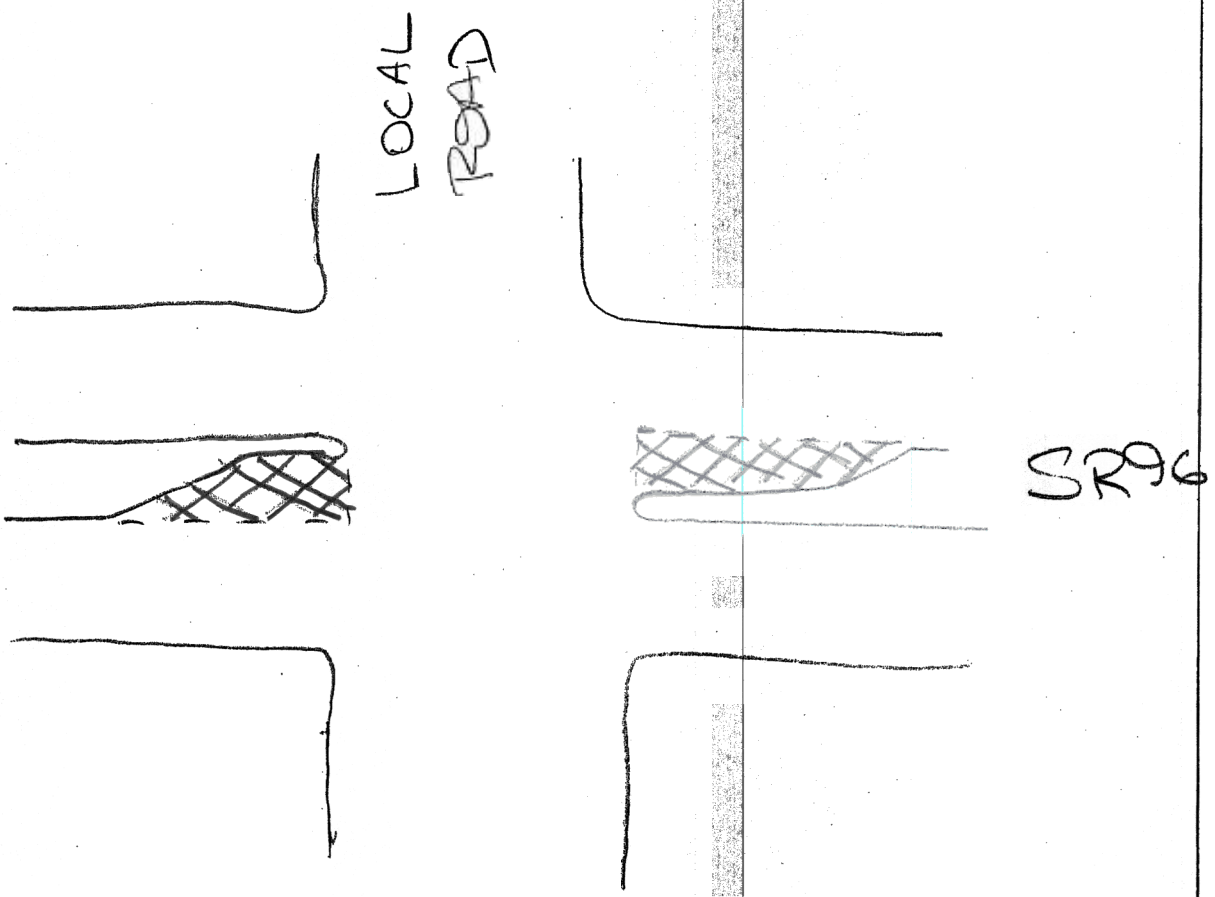
SKETCHES

PROJECT: **STP-155-1(23), P. I. Number 322470**
Twiggs County
Concept Development

☐ AS DESIGNED ☑ ALTERNATIVE

ALTERNATIVE NO.: 21

SHEET NO.: 2 of 4



AREAS FOR RIGID PAVEMENT CONSIDERATION

ASSUME $500 ft (16 ft)(2) \frac{1 yd^2}{9 ft^2} = 1778 yd^2$

@ 2 INTERSECTIONS $= 3556 yd^2$

CALCULATIONS

PROJECT: **STP-155-1(23), P. I. Number 322470**
Twiggs County
Concept Development

DESCRIPTION:

ALTERNATIVE NO.: 21

SHEET NO.: 3 of 4

COSTS

ASPHALT

$(165 + 440 + 550)\ \#/yd^2 \quad \frac{1\ TON}{2000\#} \left(45\$/TON\right) = \#25.99/SY$

CONCRETE PAVEMENT - USE $45\$/SY$

COST WORKSHEET

PROJECT: **STP-155-1(23), P. I. Number 322470**
Twiggs County
Concept Development

ALTERNATIVE NO: 21

DESCRIPTION

CONSTRUCTION ITEM		ORIGINAL ESTIMATE			PROPOSED ESTIMATE		
ITEM	UNITS	NO. OF UNITS	COST/ UNIT	TOTAL	NO. OF UNITS	COST/ UNIT	TOTAL
Pavement	SY	3,600	26.00	93,600	3,600	45	162,000
	Sub-total			93,600			162,000
Mark-up at	**27.52%**			25,759			44,582
	TOTAL			**119,359**			**206,582**

PROJECT DESCRIPTION

BACKGROUND

State Route (SR) 96, is classified as a rural minor arterial from SR 87 to SR 358 and from SR 358 to U.S. Interstate highway 16 (I-16) as a rural major collector. SR 96 is a primary east-west corridor in central Georgia which connects to I-75 on the west and I-16 to the east. The proposed project involves the widening and reconstruction of SR-96 from SR-87 to I-16 for a total of 8.32 miles. SR 96 is one of three state routes, two federal routes, and one interstate principal arterial which traverse through Twiggs County. SR 96 is a school bus route. A portion of SR 96 is included on the Georgia Bike Route 40 corridor from SR 87 to SR 358. From this point, the bike route continues on SR 358 as part of the TransGeorgia route from Columbus to Savannah. The proposed construction will provide four 12-ft. lanes divided by a 44-ft. median for the entire project length. Project STP-155-1(23) will increase the capacity and Level-of-Service (LOS) on SR-96.

EXISTING, DESIGN YEAR, AND FUTURE TRAFFIC

The 2002 Average Annual Daily Traffic (AADT) on SR-96 is 4,175 vehicles per day; for the design year of 2010, traffic ranges from 5,900 to 10,500 vehicles per day and the projected year 2030 traffic volumes range from 9,700 to 17,300 AADT, providing for a LOS in the "E" to "F" range. Growth in this area is likely to continue, possibly at an even quicker rate than in the past. The increasing traffic volumes, the large percentage of trucks at 15%, and the lack of passing opportunities will eventually cause the roadway to reach unacceptable levels of service.

SR 96 AADT			
Year	**LOS A-B**	**LOS C-D**	**LOS E-F**
2002	4,175		
2010		5,900	10,500
2030			9,700 — 17,300

ACCIDENT, FATALITY, AND SAFETY

Although the project corridor has two passing lanes, one in each direction, the accident rates in the corridor are higher than the statewide averages for similar facilities and the injury rate far exceeds the statewide averages. The improvements to the existing facility should help reduce the accidents along the project corridor by correcting substandard vertical and horizontal alignments to current state route standards. The accidents along the project corridor consist of rear-end, sideswipes, and angle intersecting collisions which are caused by turning movements to and from SR 96. The following table summarizes the corridor's accident statistics:

	2000		**2001**		**2002**	
	SR96 from SR 87 to I-16	**State[1]**	**SR96 from SR 87 to I-16**	**State[1]**	**SR96 from SR 87 to I-16**	**State[1]**
Total accidents	17		15		15	

	2000		2001		2002	
	SR96 from SR 87 to I-16	**State[1]**	**SR96 from SR 87 to I-16**	**State[1]**	**SR96 from SR 87 to I-16**	**State[1]**
Accident rate[2]	217	182	170	186	137	188
Injuries	14		14		14	
Injury Rate	179	58	159	60	128	62
Fatalities	2		0		0	
Fatality Rate	25.51	2.06	0.00	2.09	0.00	2.09

1. *Statewide rates for similar facilities (Rural Minor Arterial)*
2. *Accident rates per 100 million vehicle miles*

NEED AND PURPOSE

The need and purpose of the proposed project is to accommodate the existing and future traffic demands and to correct the operational deficiencies which currently exist within the project corridor. Additional benefits will include a safer driving environment and better travel conditions for motorists along SR 96.

DESCRIPTION OF THE PROPOSED PROJECT

This project consists of the widening and reconstruction of SR 96, beginning at SR 87, Mile Marker 5.7, and ending at approximately 0.82 miles north of the SR 96/1-16 Interchange. An exception is to be made to this project with programmed Project and PI Numbers, which will be the SR 96/I-16 Interchange reconstruction. The overall length of this project is 8.32 miles and is located entirely in Twiggs County.

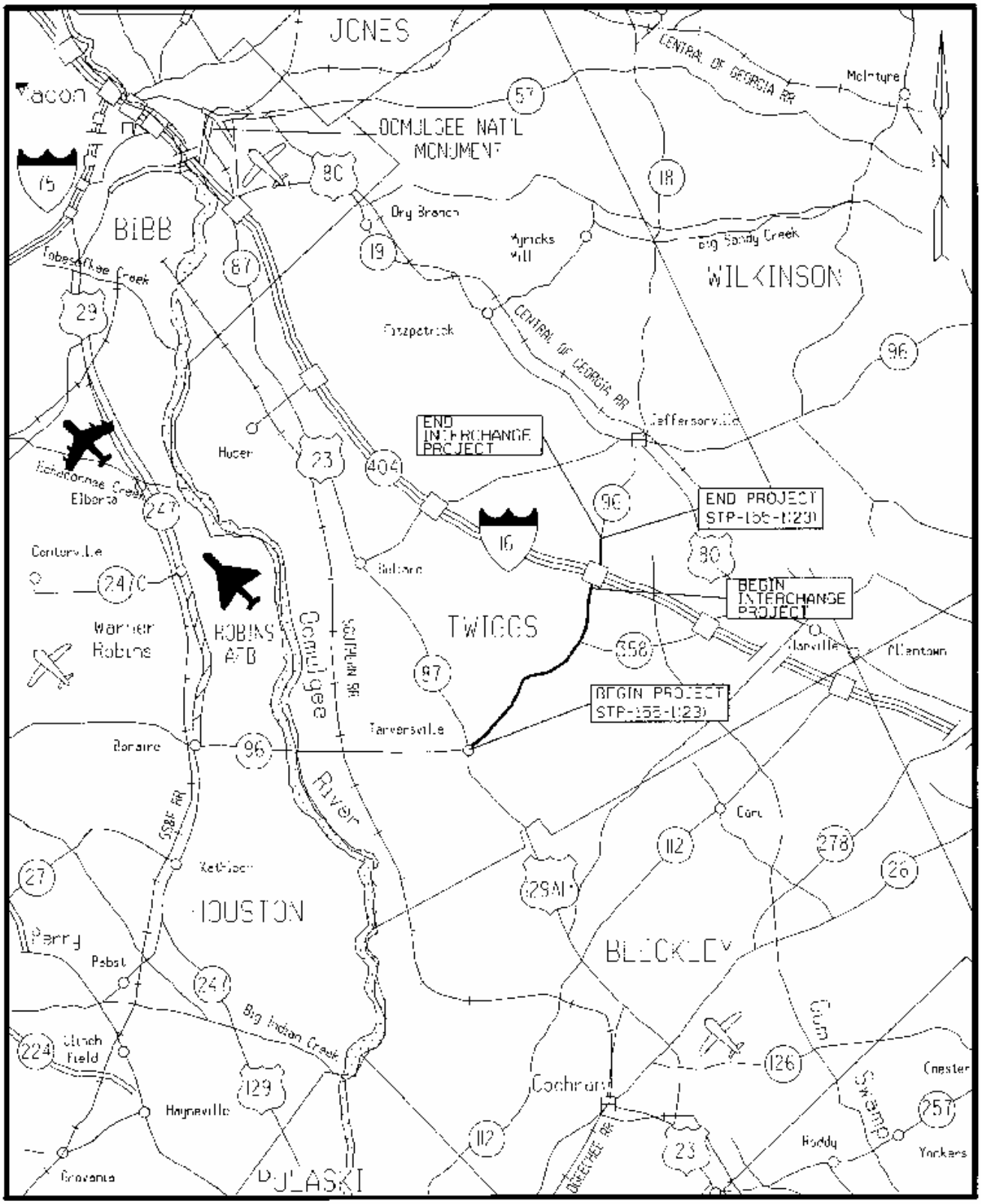
Project STP-155-1(23), PI Number 322470, is the widening of the existing two-lane road, SR 96, to four lanes with a 44-ft. wide depressed median. There are two existing passing lane sites on this project beginning at Mile Marker 7.94 and ending at Mile Marker 9.53, on the eastbound side and on the westbound side beginning at Mile Marker 10.57 and ending at Mile Marker 11.92. SR 96 is classified as a Rural Minor Arterial from SR 87 to SR 358, and is classified as a Rural Major Collector from SR 358 to I-16. This project is located on Georgia Bike Route 40, from SR 87 to SR 358, but the bike route shoulder will continue along SR 96 through the project. A frontage road near the south side of SR 96/I-16 Interchange and County Road (CR) 100 located to the north of the interchange will be relocated. A raised 24-ft. median is required and will extend from the on/off ramp termini to approximately 2,240 ft. towards the south of the SR 96/1-16 Interchange and approximately 1,960 ft. towards the north of the interchange.

The exception for this project is the widening of the existing SR 96 Bridge from two lanes to six lanes with a 12-ft. shoulder, a 4-ft. raised median, and one dedicated turn lane in each direction. The on/off ramps for I-16 will be upgraded for the widening of SR 96; each on-ramp to I-16 will have an additional 16-ft. lane. Access rights along SR 96 will be acquired north and south of the interchange and will extend for 1,000 ft. in each direction.

COST DATA

The current probable cost of construction has been identified at $36,076,293 as noted on the SR 96 Concept Cost Estimate dated September 17, 2004. This figure is divided into two segments; (1) $27,285,417 for the widening of SR 96 including right-of-way costs, and (2) $8,790,293 for the reconstruction of the SR 96/I-16 Interchange. The estimate contains an inflation rate of 15.93% based on a rate of 3.00% per annum for five years and a 10.00% rate for E and C costs.

STP-155-1(23), PI# 322470



LOCATION MAP

VALUE ANALYSIS AND CONCLUSIONS

GENERAL

This section describes the value analysis procedure used during the value engineering (VE) study. It is followed by separate narratives and conclusions concerning:

- Value Engineering Workshop Participants
- Economic Data
- Cost Estimate Summary and Cost Histograms
- Function Analysis
- Creative Idea Listing and Judgment of Ideas

A systematic approach was used in the VE study and the key procedures involved were organized into three distinct parts: 1) preparation; 2) VE workshop; and 3) post-study. A Task Flow Diagram that outlines each of the procedures included in the VE study is attached for reference.

PREPARATION EFFORT

Pre-study preparation for the VE effort consisted of scheduling study participants and tasks; gathering necessary background information on the facility; and compiling project data into a graphic cost histogram. Information relating to the design, construction, and operation of the facility is important as it forms the basis of comparison for the study effort. Information relating to funding, project planning, operating needs, systems evaluations, basis of cost, soil conditions, and construction of the facility was also a part of the analysis.

VALUE ENGINEERING WORKSHOP EFFORT

The VE workshop was a three-day effort (see attached agenda). During the workshop, the VE job plan was followed. The job plan guided the search for high cost areas in the project and included procedures for developing alternative solutions for consideration. It includes the following six phases:

- Information Phase
- Function Identification and Analysis Phase
- Creative Phase
- Evaluation Phase
- Development Phase
- Presentation Phase *(Not conducted)*

Value Engineering Study Task Flow Diagram

Preparation Effort

Coordinate Project

- Verify Schedule
- Suggest Format for Designer Presentation
- Outline Project Responsibilities
- Outline Needed Background Data
- Establish Performance and Acceptance Requirements
- Conduct Coordination Meeting
- Identify Project Constraints

→

Prepare for Workshop

- Collect Project Data
- Distribute Data to Team Members
- Team Members Become Familiar with Project
- Visit Project Site

→

Construct Cost, LCC, Energy Models

- Construct Models
- Identify High Cost and Consumption Areas

Workshop Effort

Information Phase

- VETL Opens Workshop
- Designer Gives Project Description/Presentation
- Discuss Owner Requirements
- Review Project Data
- Visit Project Site (Alt.)
- Finalize Cost, LCC, Energy Models

→

Function Identification and Analysis Phase

- Perform Function Analysis
- Calculate Cost/Worth Ratios

List Ideas Generated During Function Analysis

→

Creative Phase

- VETL Introduces Creative Thinking
- Prepare Creative Idea Listing. Seek:
  - Quantity of Ideas
  - Association of Ideas
- Brainstorm
- Do Creative Thinking
  - Group Thinking
  - Individual Thinking

→

Evaluation Phase

- Eliminate Impractical Alternatives
- Rank Ideas with Advantages/Disadvantages
- Evaluate Alternatives (Include Non-Economic considerations: Safety, Reliability, Environment, Aesthetics, O & M, etc.)
- Select Best Ideas for Implementation

→

Development Phase

- Develop Proposed Alternatives
- Prepare Alternative Sketches
- Estimate Costs
- Perform Life Cycle Comparison
  - Initial Cost
  - Redesign Cost
  - O & M Cost
  - LCC Cost

→

Presentation Phase

- Summarize Findings
- Present VE Ideas to Owner/User/Designer
- Prepare VE Report

Post-Workshop Effort

Implementation Phase

- Develop Implementation Plan
- Designer Prepares Responses to VE Report
- Participate in Implementation Meeting with Owner/User/ Designer/VE Team, as needed
- Owner Evaluates and Selects Preferred Alternatives

→

Final Acceptance

- Redesign by Designer

Information Phase

At the beginning of the study, the conditions and decisions that have influenced the development of the project must be reviewed and understood. For this reason, the development manager presented information about the project to the VE team on the first day of the session. Following the presentation, the VE team discussed the project using the following documents:

- *100 Scale Aerial Photograph Drawing* entitled Conceptual Layout, SR 96 Widening, STP-155-1(23), P.I. No. 322470, Twiggs County, prepared by the Department of Transportation, State of Georgia, dated September 8, 2004;
- *200 Scale Aerial Photograph Drawing* entitled Twiggs County, SR 96 and I-16 Interchange Project, prepared by the Department of Transportation, State of Georgia, dated September 10, 2004;
- *Project Concept Report* for Project Number STP-155-1(23); County: Twiggs; P. I. No. 322470; prepared by the Department of Transportation, State of Georgia, Office of Road and Airport Design; Federal Route Number: None; State Route Number: 96; draft dated September 17, 2004;
- *Initial Concept Team Meeting Minutes* for STP-144-1(23) Twiggs County; P.I. No. 322407; prepared by Georgia Department of Transportation Office of Road Design; dated November 25, 2003;
- *Concept Team Meeting Minutes* for STP-144-1(23) Twiggs County; P.I. No. 322407; prepared by Georgia Department of Transportation Office of Road Design; dated July 29, 2004;
- *Bridge Data* for Bridge Structure ID 289-0019-0 on SR 96 over I-16; prepared by the Georgia Department of Transportation; information printed September 16, 2004; and
- *Information Gathering for Project Concept*; for STP-144-1(23) Twiggs County; P.I. No. 322407; Widening & Reconstruction of SR 96 from SR 87 to I-16; prepared by Georgia Department of Transportation Office of Road Design to State Environmental / Location Engineer; dated August 12, 2004, and handwritten notes.

Function Identification and Analysis Phase

Based on historical and background data, a cost model and graphic function analysis were developed for this project by major construction elements. They were used to distribute costs by project element; serve as a basis for alternative functional categorization; and to assign worth to the categories, where worth is the least cost to provide the required function, as determined by the VE team. The VE team identified the functions of the various project elements and subsystems by using random function generation techniques resulting in the attached Random Function Analysis worksheet and / or Function Analysis Systems Technique (F.A.S.T.) diagram.

Creative Phase

This VE study phase involved the creation and listing of ideas. Creative idea worksheets were organized by project element. During this phase, the VE team developed as many ideas as possible to provide the necessary functions within the project at a lower cost to the owner, or to improve the quality of the project. Judgment of the ideas was restricted at this point. The VE team was looking for a large quantity of ideas and free association of ideas.

The Georgia Department of Transportation (GDOT) and U.S. DOT Federal Highway Administration (FHWA) representatives may wish to review the creative list since it may contain ideas that can be further evaluated for potential use in the design.

Evaluation Phase

During this phase of the workshop, the VE team judged the ideas generated during the creative phase. Advantages and disadvantages of each idea were discussed to find the best ideas for development. Ideas found to be irrelevant or not worthy of additional study were discarded. Those that represented the greatest potential for cost savings or improvement to the project were then developed further.

The VE team would like to develop all ideas, but time constraints usually limit the number that can be developed. Therefore, each idea was compared with the present schematic design concepts in terms of how well it met the design intent. Advantages and disadvantages were discussed, and each team member rated the ideas on a scale of zero to five, with the best ideas rated five. Total scores were summed for each idea and only highly-rated ideas were developed into alternatives. In cases where there was little cost impact, but an improvement to the project was anticipated, the design suggestion, designation (DS), was used. The design team should review this listing for possible incorporation of ideas into the project.

The creative listing was re-evaluated frequently during the process of alternatives development. As the relationship between creative ideas became more clearly defined, their importance and ratings may have changed, or they may have been combined into a single alternative. For these reasons, some of the originally highly-rated items may not have been developed into alternatives.

Development Phase

During the development phase, each highly-rated idea was expanded into a workable solution. The development consisted of a description of the alternative, life cycle cost comparisons, where applicable, and a descriptive evaluation of the advantages and disadvantages of the proposed alternatives. Each alternative was written with a brief narrative to compare the original design to the proposed change. Sketches and design calculations, where appropriate, were also prepared in this part of the study. The VE alternatives are included in the *Study Results* section.

Presentation Phase

The last phase of a VE study would typically involve a presentation of the findings of the study; however, GDOT now conducts the presentation internally upon receipt of the report. The VE alternatives were screened by the VE team before draft copies of the *Summary of Potential Cost Savings* worksheets were provided to GDOT representatives. The VE alternatives were arranged in the same order as the creative idea listing sheets to facilitate cross-referencing.

POST-WORKSHOP EFFORT

The post-study portion of the VE study includes the preparation of this VE Study Report. Personnel from GDOT will analyze each alternative and prepare a short response, recommending incorporating

the alternative into the project, offering modifications before implementation, or presenting reasons for rejection. Lewis & Zimmerman Associates, Inc. is available at your convenience as you review the alternatives. Please do not hesitate to call on us for clarification or further information as you consider an implementation approach.

VALUE ENGINEERING STUDY AGENDA

Lewis & Zimmerman Associates, Inc. (LZA) will conduct a 24-hour VE Study on the **Widening of State Route 96 (SR 96) and Reconstruction of the SR 96 / U. S. Interstate Highway 16 (I-16) Interchange** located in Twiggs County, Georgia. It is expected the owner, the Georgia Department of Transportation (GDOT) will be available to make a formal presentation concerning the project at the beginning of the workshop and be available to answer questions during the VE study effort.

VE Study Agenda

The VE study will follow the outline described below and be conducted October 12 - 14, 2004. The study will be conducted in Room 274 in GDOT's General Office located at No. 2 Capitol Square Street, Atlanta, Georgia 30334. The point-of-contact is Ms. Lisa L. Myers, Design Review Engineer Manager, who can be reached at 404-651-7468.

Tuesday, October 12th

9:00 am - 9:15 am **General Introduction of all Parties and review of the VE Process**

9:15 am - 11:15 am **Owner's / Designer's Presentation**

GDOT is to present information concerning the project including, but not necessarily limited to: rationale for design; criteria for specific areas of study, project constraints and the reasons for design decisions.

11:15 am - 12:00 noon **Commence Function Analysis Phase**

The VE team will continue their familiarization with the cost models and project data for each area of study. The cost model(s) will be refined, as necessary; define the function of each project element or system in the cost model, select the primary or basic functions, and determine the worth, or least cost, to provide the function. Cost / worth or value index ratios will be calculated, and high cost / low worth areas for study identified. In addition, the VE team will continue defining the function of each element / system to gain a thorough understanding of the project's needs and requirements.

12:00 noon - 1:00 pm **Lunch**

1:00 pm - 5:00 pm **Conclude the Function Analysis Phase and Commence the Creative Phase**

The VE team will conduct a brainstorming session and list as many ideas as possible for consideration. The aim is to obtain a large quantity of ideas through free association, by eliminating roadblocks to creativity and deferring judgment.

Wednesday, October 13th

8:30 am - 10:00 am **Conclude Creative Phase and Complete Evaluation / Analytical Phase**

The VE team will analyze the ideas listed in the creative phase and select the best ideas for further development.

10:00 am - 12:00 noon **Development Phase**

VE team will develop creative ideas into alternate design solutions. Initial and life cycle cost estimates comparing original and proposed alternatives will be prepared. Selected alternatives for change will be developed and supported with sketches, calculations and written substantiation.

12:00 noon - 1:00 pm **Lunch**

1:00 pm - 5:00 pm **Continue Development Phase**

Thursday, October 14th

8:30 am - 12:00 am **Continue Development Phase**

12:00 noon - 1:00 pm **Lunch**

1:00 pm - 4:00 pm **Conclude Development Phase and Commence Summary Worksheets**

Upon completion of the Development Phase, the VE facilitator will commence preparation of the summary worksheets based on the alternatives developed by the VE team. The summary work sheets form the basis of the informal oral presentation.

4:00 – 5:00 pm **Finalize Summary Worksheets**

The VE team will provide draft copies of the *Summary of Potential Cost Savings* worksheets to GDOT representatives and be available to clarify any points.

Please note: As with any Initial Concept Value Engineering Study, there may be a possibility the study could conclude at the end of the second day; however, plan your calendar for the potential of a full three-day effort.

VALUE ENGINEERING WORKSHOP PARTICIPANTS

The VE team was organized to provide specific expertise on the unique project elements involved. Team members consisted of a multidisciplinary group with professional design experience and a working knowledge of VE procedures. The VE team included the following professionals:

George A. Obaranec, PE	Civil/Roadway Engineer	Delon Hampton & Associates, Chartered
Gregory C. Grant, PE	Director, Structural Engineering, Bridge Engineer	HNTB
Edward F. Culican, Jr., PE	Senior Project Manager, Transportation/Roadway Engineer	HNTB
Luis M. Venegas, PE, CVS, LEED™ AP	VE Facilitator	Lewis & Zimmerman Associates, Inc.

OWNER'S/DESIGNER'S PRESENTATION

Representatives from the State of Georgia Department of Transportation (GDOT) administration and the U.S. Department of Transportation, Federal Highway Administration (FHWA) presented an overview of the project on Tuesday, October 12, 2004. The purpose of this meeting, in addition to being an integral part of the Information Gathering Phase of the VE Study, was to bring the VE team "up-to-speed" regarding the overall project. Additionally, the meeting afforded the design team the opportunity to highlight in greater detail any areas of the project requiring additional or special attention.

VALUE ENGINEERING TEAM'S FINAL PRESENTATION

The VE team did not conduct a final, oral presentation to GDOT on Thursday, October, 14, 2004. However, copies of the draft *Summary of Potential Cost Savings* worksheets were provided for interim use by GDOT and FHWA personnel.

A copy of the meeting participants is attached for reference.

VALUE ENGINEERING ATTENDEES

MEETING PARTICIPANTS

PROJECT: **STP-155-1(23), P. I. Number 322470** **Twiggs County** ***Concept Development***		Date: **October 12 - 14, 2004**
NAME & E-MAIL (PLEASE PRINT)	**ORGANIZATION/TITLE**	**PHONE/FAX**
John Baxter, PE em: john.baxter@dot.state.ga.us	Georgia Department of Transportation (GDOT), Office of Road & Airport Design Design Engineer	ph: 404-657-9706 fx: 404-657-0653
Lyn Clements, PE em: lyn.clements@dot.state.ga.us	GDOT, Office of Bridge Design Assistant Group Bridge Design Engineer	ph: 404-656-5289 fx: 404-651-7076
Tajsha LaShore em: tajsha.lashore@dot.state.ga.us	GDOT, Office of Environmental/Location (OEL) Environmental Planner	ph: 404-699-4411 fx: 404-699-4440
Richard C. Marshall em: richard.marshall@dot.state.ga.us	GDOT, Office of Construction Construction Liaison Engineer	ph: 404-656-5306 fx: 404-657-0783
Gerald A. Milligan em: jerry.milligan@dot.state.ga.us	GDOT, Right-of-Way Estimator Supervisor Appraisal	ph: 770-986-1541 fx: 770-986-1542
Lisa L. Myers em: lisa.myers@dot.state.ga.us	GDOT, Office Engineering Services Design Review Engineer Manager	ph: 404-651-7468 fx: 404-463-6131
Lamar M. Pruitt, Jr. em: lamar.pruitt@dot.state.ga.us	GDOT, District 3, Office of Construction District Construction Engineer	ph: 706-646-6579 fx: 706-646-6584
Nasser Rad em: nasser.rad@dot.state.ga.us	GDOT, Office of Road & Airport Design Assistant Design Engineer, Group Manager	ph: 404-657-9706 fx: 404-657-0653
Klint Rommel em: klint.rommel@dot.state.ga.us	GDOT, OEL Transportation Planner Associate	Ph: 404-699-4415 fx: 404-699-4440
Brink Stokes em: brink.stokes@dot.state.ga.us	GDOT, District 3, Office of Construction Area Engineer	ph: 478-757-2601 fx: 706-646-6584
David Painter, PE em: david.painter@fhwa.dot.gov	U.S. Department of Transportation (US DOT), Federal Highway Administration (FHWA) Transportation Engineer	ph: 404-562-3658 fx: 404-562-3703

VALUE ENGINEERING ATTENDEES

MEETING PARTICIPANTS

PROJECT: **STP-155-1(23), P. I. Number 322470** **Twiggs County** ***Concept Development***		Date: **October 12 - 14, 2004**
NAME & E-MAIL (PLEASE PRINT)	**ORGANIZATION/TITLE**	**PHONE/FAX**
George A. Obaranec, PE em: gobaranec@delonhampton.com	Delon Hampton & Associates, Chartered Project Manager	ph: 404-524-8030 fx: 404-524-2575
Gregory C. Grant, PE em: ggrant@hntb.com	HNTB Director, Structural Engineering, Bridge Engineer	ph: 770-956-5770 fx: 770-956-5779
Edward F. Culican, Jr., PE em: eculican@hntb.com	HNTB Senior Project Manager	ph: 770-923-7775 fx: 770-279-9297
Luis M. Venegas, PE, CVS-Life, LEED™ AP em: lmvenegas@aol.com	Lewis & Zimmerman Associates, Inc. VE Facilitator	ph: 770-992-3032 fx: 770-992-0228
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ECONOMIC DATA

The VE team developed economic criteria used for evaluation with information gathered from the State of Georgia Department of Transportation. To express costs in a meaningful manner, the VE team alternatives are presented on the basis of discounted present worth. Criteria for planning project period interest rates are based on the following parameters:

Year of Analysis:	2004
Construction Start-Up:	May 2009
Construction Duration:	±30 Months
Economic Planning Life: Economic Planning Life:	35 years 50 years
Discount Rate/Interest:	3.70% (Latest United States Office of Management and Budget Circular A-94)
Inflation/Escalation Rate:	3.00% (GDOT)
Uniform Present Worth (UPW) Factor:	19.4439 for 35 years 22.6330 for 50 years
Operation and Maintenance Costs *(Industry Norms)*:	
Structural	1.00%-2.00% (or less) of Capital Cost
Overall Composite Mark-Up for Bricks and Mortar: *(Composed of: Inflation at 3.00% for 5 Years (15.93%) and E and C Costs at 10.00%)*	27.52% (1.2752)

COST ESTIMATE SUMMARY AND COST HISTOGRAMS

The VE team prepared several cost models for the project that are included in the following pages. The cost models are arranged in the Pareto Charting/Cost Histogram format to aid in identifying high cost areas and are based on the *SR 96 Concept Cost Estimate* dated *September 17, 2003* prepared by the Georgia Department of Transportation (GDOT), Office of Road and Airport Design. As can be expected, judgments at this stage of the study are based on experience and intuition rather than facts, which are not uncovered until well along in the analysis of function. As a result of these qualified hypotheses, there appears to be a potential for initial savings in the following areas:

SR 96 WIDENING	RECONSTRUCTION OF THE SR 96/I-16 INTERCHANGE
Asphalt Pavement	Asphalt Pavement
Excavated Unclassified Soil	Concrete Pavement
Graded Aggregate Base Course	Widen Existing Bridge
Clearing and Grubbing	
Erosion Control	
Detours	

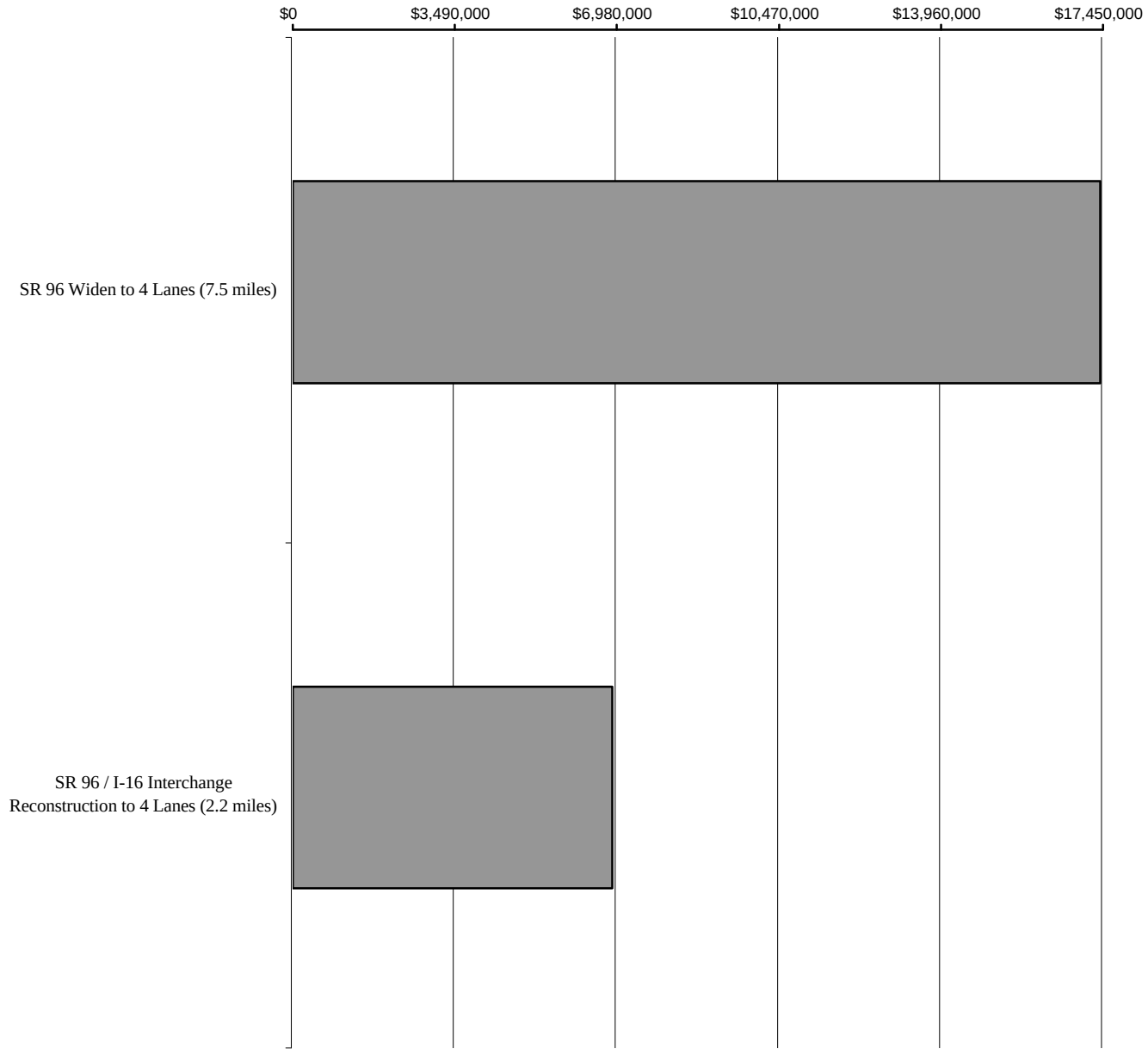
DESIGNER'S COST ESTIMATE

The cost estimate, as described above, did contain sufficiently detailed information to perform a VE evaluation but was supplemented by an excerpt from a recent GDOT Tabulation of Bids dated June 25, 2004 for Contract No. B10715-04-000-2 in Forsythe and Fulton Counties, and GDOT Item Mean Summary for 07/2003 to 06/2004 (English and Metric) for Specification Year 2001 Contracts.

COST HISTOGRAM

PROJECT: STP-155-1(23), P. I. Number 322470
Twiggs County
Concept Development

TOTAL PROJECT		COST	PERCENT	CUM. PERCENT
SR 96 Widen to 4 Lanes (7.5 miles)		17,408,165	71.63%	71.63%
SR 96 / I-16 Interchange Reconstruction to 4 Lanes (2.2 miles)		6,893,715	28.37%	100.00%
Construction Subtotal		**$ 24,301,880**	**100.00%**	
Inflation Rate, 5 years at 3.00%	15.93%	$ 3,870,659		
E and C Costs at	10.00%	$ 2,817,254		
Right-of-Way for SR 96 Widening		$ 5,086,500		
TOTAL		**$ 36,076,293**	**Comp Mark-up:**	48.45%

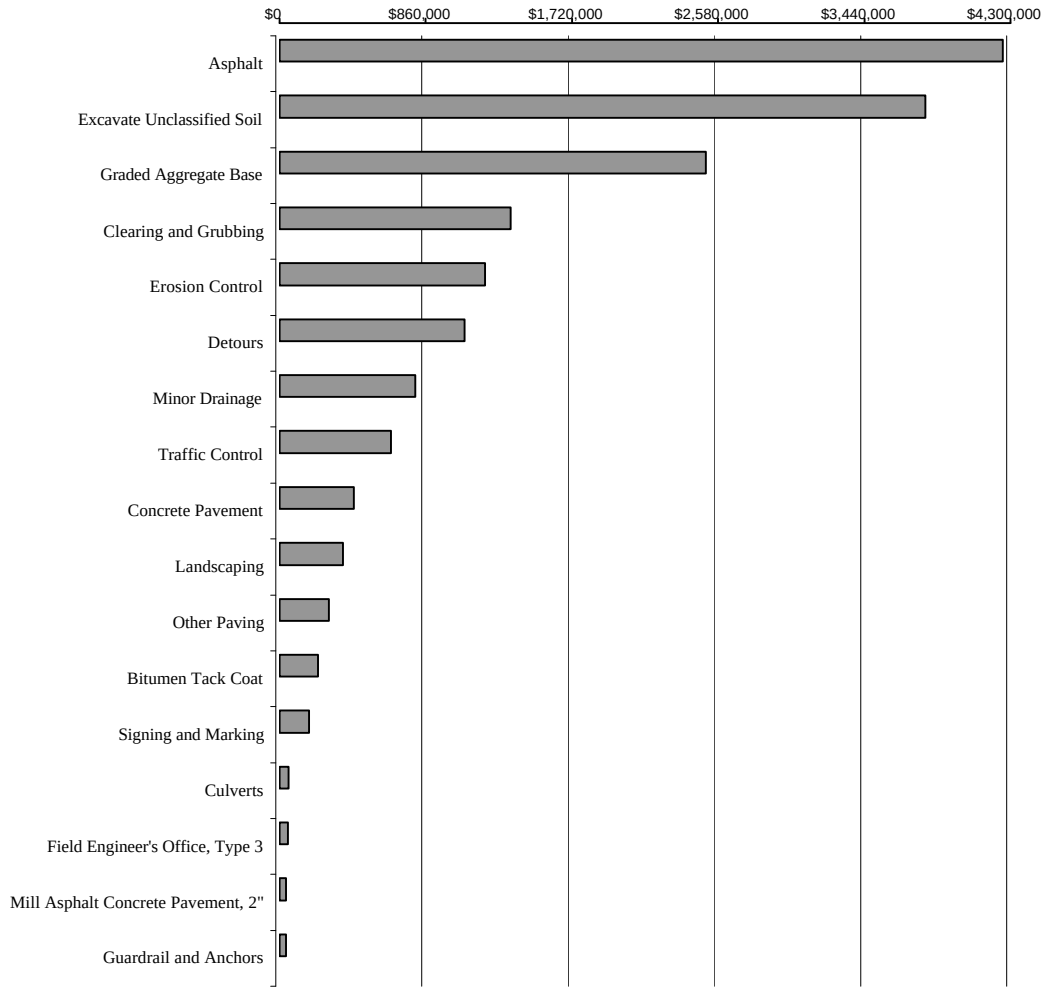


Costs in graph are not marked-up.

COST HISTOGRAM

PROJECT: **STP-155-1(23), P. I. Number 322470**
Twiggs County
Concept Development

SR 96 WIDENING	COST	PERCENT	CUM. PERCENT
Asphalt	4,258,271	24.46%	24.46%
Excavate Unclassified Soil	3,802,950	21.85%	46.31%
Graded Aggregate Base	2,512,544	14.43%	60.74%
Clearing and Grubbing	1,363,620	7.83%	68.57%
Erosion Control	1,213,883	6.97%	75.55%
Detours	1,090,701	6.27%	81.81%
Minor Drainage	800,858	4.60%	86.41%
Traffic Control	660,000	3.79%	90.20%
Concrete Pavement	441,138	2.53%	92.74%
Landscaping	375,000	2.15%	94.89%
Other Paving	292,368	1.68%	96.57%
Bitumen Tack Coat	231,403	1.33%	97.90%
Signing and Marking	175,635	1.01%	98.91%
Culverts	55,861	0.32%	99.23%
Field Engineer's Office, Type 3	53,000	0.30%	99.54%
Mill Asphalt Concrete Pavement, 2"	40,920	0.24%	99.77%
Guardrail and Anchors	40,012	0.23%	100.00%
Construction Subtotal	**$ 17,408,164**	**100.00%**	
Inflation Rate, 5 years at 3.00% 15.93%	$ 2,772,669		
E and C Costs at 10.00%	$ 2,018,083		
Right-of-Way	$ 5,086,500		
TOTAL	**$ 27,285,416**	**Comp Mark-up:**	56.74%

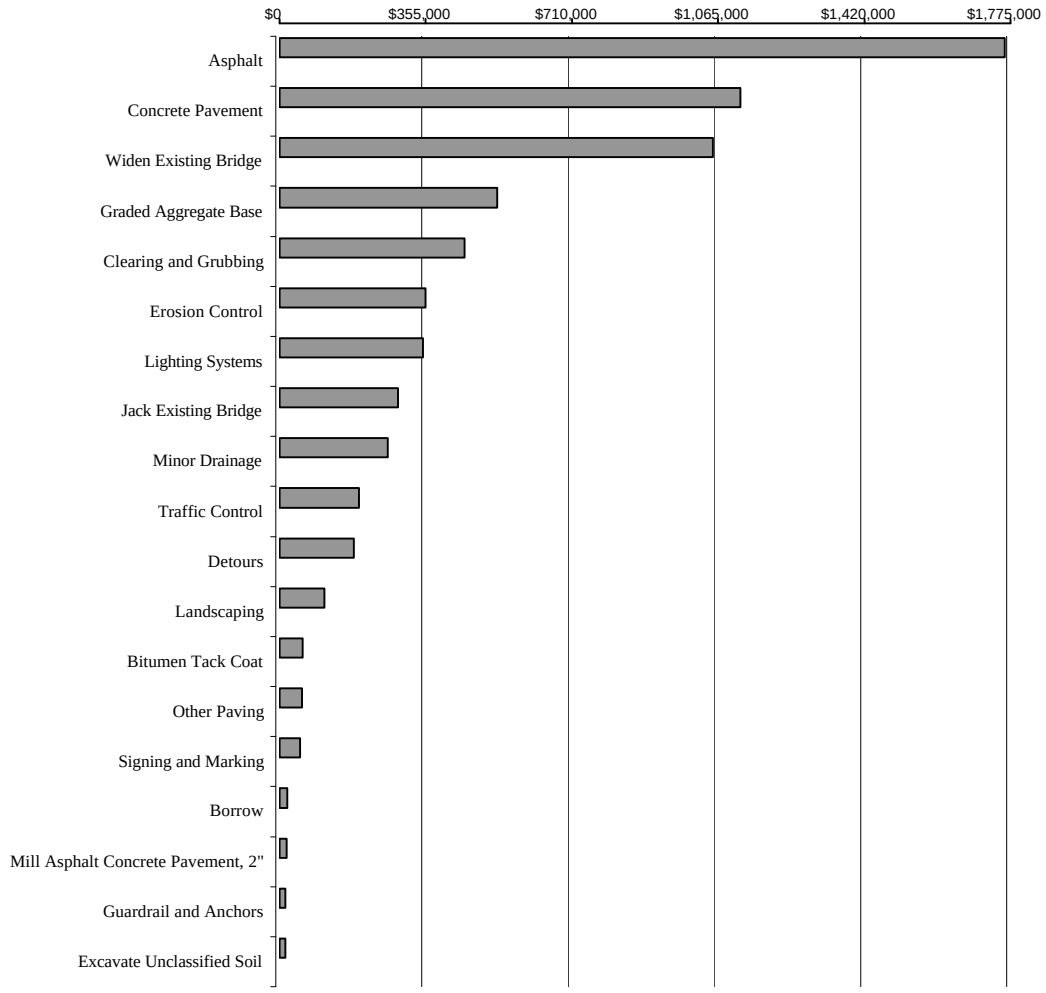


Costs in graph are not marked-up.

COST HISTOGRAM

PROJECT: **STP-155-1(23), P. I. Number 322470**
Twiggs County
Concept Development

SR 96 / I-16 RECONSTRUCTION	COST	PERCENT	CUM. PERCENT
Asphalt	1,761,857	25.56%	25.56%
Concrete Pavement	1,120,153	16.25%	41.81%
Widen Existing Bridge	1,053,489	15.28%	57.09%
Graded Aggregate Base	529,350	7.68%	64.77%
Clearing and Grubbing	450,000	6.53%	71.29%
Erosion Control	356,072	5.17%	76.46%
Lighting Systems	350,000	5.08%	81.54%
Jack Existing Bridge	289,420	4.20%	85.74%
Minor Drainage	264,000	3.83%	89.56%
Traffic Control	193,600	2.81%	92.37%
Detours	181,784	2.64%	95.01%
Landscaping	110,000	1.60%	96.61%
Bitumen Tack Coat	57,227	0.83%	97.44%
Other Paving	55,187	0.80%	98.24%
Signing and Marking	51,520	0.75%	98.98%
Borrow	19,626	0.28%	99.27%
Mill Asphalt Concrete Pavement, 2"	19,135	0.28%	99.55%
Guardrail and Anchors	15,945	0.23%	99.78%
Excavate Unclassified Soil	15,350	0.22%	100.00%
Construction Subtotal	**$ 6,893,715**	**100.00%**	
Inflation Rate, 5 years at 3.00% 15.93%	$ 1,097,990		
E and C Costs at 10.00%	$ 799,170		
TOTAL	**$ 8,790,875**	**Comp Mark-up:**	27.52%



Costs in graph are not marked-up.

FUNCTION ANALYSIS

A function analysis was performed to: (1) define the requirements for each project element, and (2) ensure a complete and thorough understanding by the VE team of the basic function(s) needed to attain a given requirement. A *Random Function Analysis* worksheet for the project is attached. This part of the function analysis stimulated the VE team members to think in terms of areas in which to channel their creative idea development.

Function Analysis is a means of evaluating a project to see if the expenditures actually perform the requirements of the project, or if there are disproportionate amounts of money spent on support functions. These elements add cost to the final product, but have a relatively low worth to the basic function.

In addition to the random function analysis, the VE Facilitator worked with members of the study team to develop a Function Analysis System Technique (F.A.S.T.) diagram. The F.A.S.T. diagram was used to show the flow of function within the project. It helps to confirm the project is addressing issues that have been voiced by the owner as important. The diagram was generated by asking the key question: "What is the most important function to be accomplished by this phase?" The answer is characterized by a verb/noun pair. In turn, another question is asked: "Why?" The answer is again listed in a verb/noun pair, and the process continues from left to right. If the result is a true F.A.S.T. diagram, the flow of functions from right to left will answer the question "Why?" No F.A.S.T. diagram is ever completed. The readers of this report may wish to challenge themselves by seeing how far they can carry the construction of the F.A.S.T. diagram.

This F.A.S.T. diagram notes the critical function path and identifies the project's basic function as: **IMPROVE/TRANSPORTATION** by **INCREASING/CAPACITY** by **REDUCING/TRAVEL TIME** and **WIDENING/HIGHWAY** and is included at the end of this section of the report.

RANDOM FUNCTION ANALYSIS

PROJECT: **STP-155-1(23), P. I. Number 322470**
Twiggs County
Concept Development

SHEET NO.: 1 of 1

DESCRIPTION	FUNCTION		
	VERB	NOUN	KIND
WIDENING OF STATE ROUTE (SR) 96 and RECONSTRUCTION OF THE U.S. INTERSTATE HIGHWAY 16 (I-16)/SR 96 INTERCHANGE	**INCREASE**	**CAPACITY**	**B**
	ENHANCE	**CORRIDOR**	**B**
	Enhance	Safety	RS
	IMPROVE	**TRANSPORTATION**	**B**
	REDUCE	**TRAVEL TIME**	**B**
	Improve	Interchange Operation	RS
	Facilitate	Development	S/G
	Increase	Property Value	S
	Modernize	Facility	RS
	Create	Jobs	S
	Continues	Bike Corridor	RS
	Alternate	Freeway Routing	G
	Improve	Access	RS
	Avoid	Historic Resources	RS
	Facilitate	Bike Use	G/O
	Accommodate	Future Projects	G/O

Function defined as: Action Verb, Measurable Noun

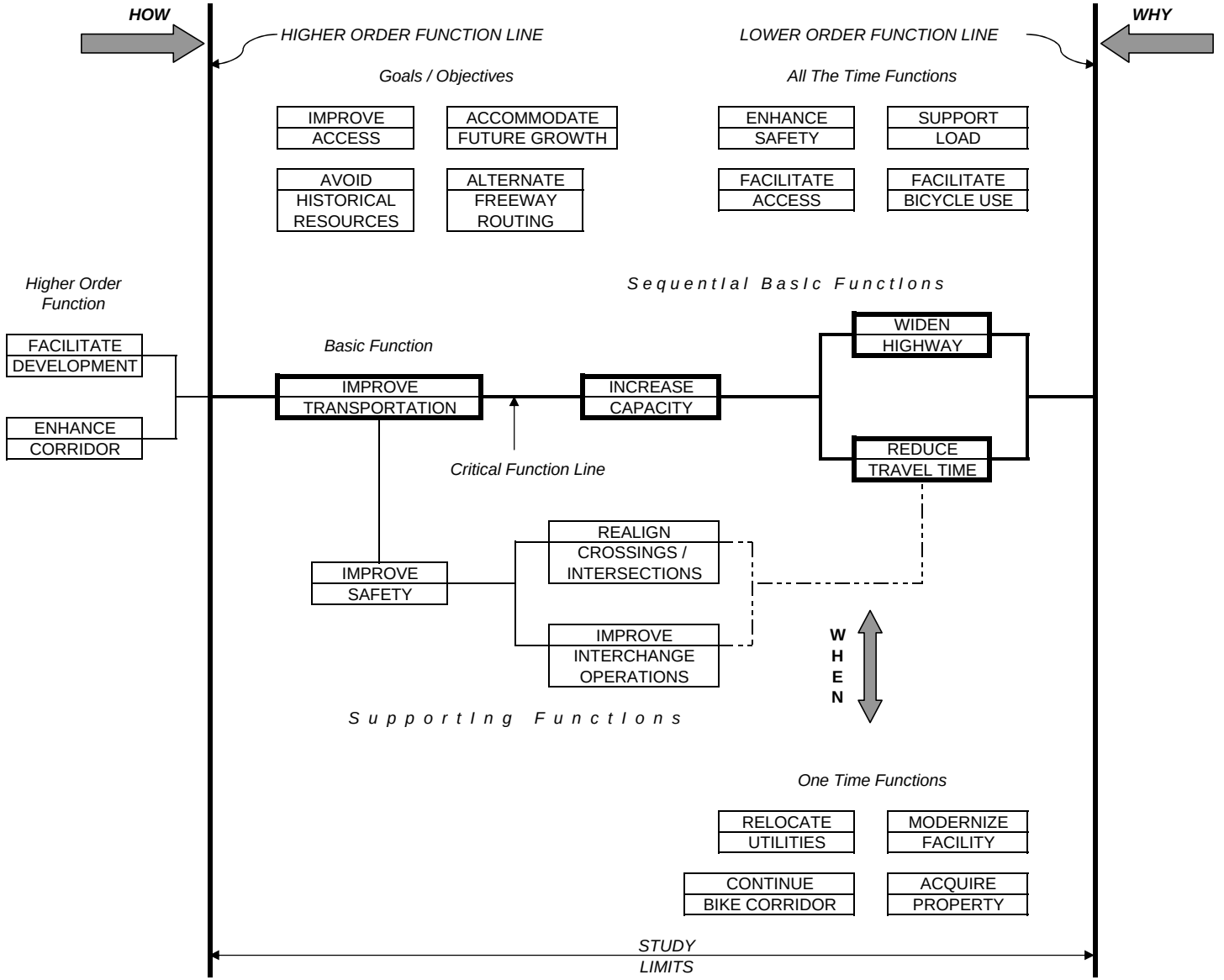
Kind: B = Basic; S = Secondary; RS = Required Secondary; HO = Higher Order; LO = Lower Order; O = Objective; G = Goal; U = Unwanted

FUNCTION ANALYSIS SYSTEMS TECHNIQUE (F. A. S. T.)

SR 96 WIDENING and RECONSTRUCTION OF SR 96/I-16 INTERCHANGE

Georgia Department of Transportation, District 3

Twiggs County, Georgia



CREATIVE IDEA LISTING AND JUDGMENT OF IDEAS

During the creative phase, numerous ideas, alternative proposals and/or recommendations were generated using conventional brainstorming techniques as recorded on the following pages.

These ideas were then discussed and the advantages/disadvantages of each listed. The VE design team compared each of the ideas with the concept solution determining whether it improved value, was equal in value, or lessened the value of the solution.

The ideas were then ranked on a scale of one to five based on how well the VE design team believed the idea met necessary criteria and program needs. The higher rated ideas were then developed into formal alternatives and included in the VE workshop. Some ideas were judged to have minimal cost impacts to the project but provided enhancements in the form of improved operations, efficiency, constructibility, or potential to save unknown or hidden costs. These were given the designation "DS" which indicates a design suggestions. This designation is also used when an idea is difficult to price but improves the functionality of the project or system, and is deemed to be of significant value to the owner, user, operator, or designer.

Typically, all ideas rated four or above are included in the Study Report. When this is not the case, an idea was combined with another related idea or discarded as a result of additional research that indicated the concept was not cost-effective or technically feasible.

The reader is encouraged to review the *Creative Idea Listing and Evaluation* worksheets since they may suggest additional ideas that can be applied to the design.

CREATIVE IDEA LISTING

PROJECT: **STP-155-1(23), P. I. Number 322470** SHEET NO.: 1 of 1
Twiggs County
Concept Development

NO.	IDEA DESCRIPTION	RATING
1	Use a 4:1 front slope on outside shoulder	4
2	Minimal effort: (1) fix intersection at SR 87/SR 96, (2) flatten curve between churches, (3) fix intersection at SR 358/SR 96, (4) shorten frontage roads to I-16	5
3	Eliminate bike lanes	3
4	Grade separate SR 87 and SR 96	4
5	Signalize SR 87/SR 96 intersection	4
6	Signalize SR 358/SR 96 intersection	4
7	Reevaluate alignment to use existing dam	4
8	Super-elevate current curve alignment at dam	2
9	Maximize use of existing pavement	4
10	Use a bridge over the lake	3
11	Allow right-in/right-out only at Walthall Oil property (combine with No. 14)	DS
12	Reevaluate CR 100 behind Walthall Oil	4
13	Reevaluate CR 100 at Missile Based Road	4
14	Allow right-in/right-out only at Citgo Station (combine with No. 11)	DS
15	Realign SR 96 at I-16 by using exiting bridge and lanes as southbound lanes	2
16	Provide a new 4-lane bridge and road east of I-16 and use existing bridge and lanes as frontage road	3
17	Selectively cul-de-sac minor accesses	1
18	Bypass lake with an alternate alignment	4
19	Tunnel under the lake	1
20	Do nothing	1
21	Selectively use rigid pavement	4
22	Provide a CR 100 extension to facilitate development of the northeast quadrant of the SR 96/I-16 interchange	3
23	Provide a CR 100 extension to facilitate development of the southwest quadrant of the SR 96/I-16 interchange	3

Rating: 1®2 = Not to be Developed; 3®4 = Varying Degrees of Development Potential; 5 = Most likely to be Developed; DS = Design Suggestion