VALUE ENGINEERING REPORT

SR-47 Bridge Replacement Over Little River
BRST0-0076-01(036), PI No. 232310
Columbia/Lincoln Counties

August 27, 2010

OWNER AND DESIGN TEAM:

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EXECUTIVE SUMMARY

Executive Summary

VALUE ENGINEERING STUDY

BRST0-0076-01(036), P.I. No. 232310
SR 47 Bridge Replacement Over Little River
August 9-12, 2010

Introduction

This report presents the results of a value engineering (VE) study conducted on the proposed project to replace the existing SR 47 Bridge across Strom Thurmond Lake in Columbia/Lincoln Counties. The existing 720-foot steel truss bridge is structurally deficient and needs to be replaced. The original design proposed 2 alternate bridge types; 1) a five-span 740-foot PSC beam structure and 2) a four-span 740-foot steel plate girder structure. Shortly before the start of the VE study, the Army Corps of Engineers (COE) instructed GDOT to raise the profile of the new bridge to provide 29 feet of vertical clearance above the normal pool elevation. This revision will cause the current roadway profile to be raised about an additional 18 feet. This realignment will further widen the west side of the existing causeway to accommodate the roadway shift approximately 2,000 feet of the north causeway and 2,000 feet of the south causeway away from the existing roadway so the new bridge can be constructed "in the clear." The new clearance requirement will also require the new bridge to be longer (VE team estimate: 820 feet).

The new bridge and approximately 4,000 feet of realigned new causeway will be constructed within Strom Thurmond Lake. Most of the construction will be in water that is 40 feet to over 60 feet deep adding to the complexity of this project. Major contract work items include bridge construction, rock embankment, bridge removal, asphalt pavement, roadway embankment, erosion control, and guardrail installation. The estimated construction cost is $10.6 million which does not include the additional costs for the most recent alignment change and raising the roadway profile to accommodate the COE's request for additional vertical clearance. The study took place August 9-12, 2010, at the Georgia DOT Headquarters office using a four person VE team.

This report presents the Team's recommendations and all back-up information, for consideration by the decision-makers. This **Executive Summary** includes a brief description of each recommendation. The **Study Identification** section contains information about the project and the team. The **Recommendations** section presents a more detailed description and support information about each recommendation. The **Appendix** includes a complete record of the Team's activities and findings. The reader is encouraged to review all sections of the report in order to obtain a complete understanding of the VE process.

Considerations

Current project status: The project is in the preliminary design stage; however, the new COE clearance requirements will require additional design effort for the bridge and both approach roadway alignments. New right-of-way plans will also have to be developed. The Project Concept Report has been approved. The environmental process and the Section 404 Permit process needs to be completed before final design can be started.

The VE team was informed of several conditions/constraints to consider when developing their recommendations. The conditions/constraints were; the COE has stipulated additional clearance requirements for the new bridge, the originally proposed two alternate bridge designs will not meet the new clearance requirements, the new clearance requirement will require a longer bridge than currently proposed, maintain the 5% maximum roadway grade for the new elevated roadway profile, and do not impact the work associated with improving the COE parking lot.

Results Obtained

The VE team focused their efforts on the high cost items of the project. Through the use of functional analysis and "brain storming" techniques, the team generated 36 ideas with 25 being identified for additional evaluation as possible recommendations or design suggestions. The VE team developed six independent recommendations and one alternative recommendation. Implementation of the six independent recommendations has the potential to reduce the project cost by approximately $5.49 million. A detailed write-up of each recommendation is contained in the respective portion of this report. A summary of the recommendations follows.

Recommendation Highlights

Idea A-9B: Reduce the width of the shoulders on the bridge from 8 feet to 4 feet.

The most recent alignment shifts the new centerline out approximately 40 feet to the west of the original realignment so the new higher and longer (assumed to be at least 820 feet) bridge can be constructed "in the clear." The new roadway profile has been raised to provide the COE's requested 29 feet of vertical clearance under the bridge. This new alignment will require placing a large amount of new rock embankment into the lake which will require mitigation measures.

This recommendation would reduce the width of the shoulders on the new bridge from 8 feet to 4 feet thereby narrowing the overall size of the structure. The AASHTO guidelines allow for narrower shoulders on long causeways, bridges, and the associated approach roadways. This project is an excellent candidate to apply the AASHTO shoulder guideline due to the unique circumstances of constructing an elevated bridge and its causeway approach roadways in the center of a deep lake. The lake depth in the project area varies from 40 feet to over 60 feet in depth adding to the difficulty of constructing the new bridge and new rock embankment.

The VE recommendation eliminates 8 feet of rock embankment width along the causeway approaches significantly reducing the amount of rock embankment placed into the lake. The VE concept reduces the project's impact on the lake, reduces the risk tied to constructing a project in a deep lake, reduces the amount of rock and roadway embankment, simplifies and accelerates construction operations, and reduces cost.

The total potential savings if accepted is $922,000.

Idea A-9R: Reduce the width of the shoulders on the roadway approaches to the bridge from 10 feet to 4 feet.

The current design for the causeway approaches to the new bridge includes a 10-foot paved shoulder. The causeway approaches also require guardrail to be installed throughout the entire approach roadway section. Installing guardrail will extend the paved shoulder out to 15.5 feet resulting in a 55-foot total roadway width. The higher/wider new causeway approach roadways will place significant amounts of new rock embankment into the lake.

This recommendation would reduce the width of the shoulder on the causeway approach sections from 10 feet to 4 feet. Installing guardrail will add another 3.5 feet resulting in a total shoulder width of 7.5 feet resulting in a 39-foot total roadway width. The AASHTO guidelines allow for narrower shoulders on long causeways, bridges, and the associated approach roadways. This project is an excellent candidate to apply the AASHTO shoulder guideline due to the unique circumstances of constructing an elevated bridge and its causeway approach roadways in the center of a deep lake. The lake depth in the project area varies from 40 feet to over 60 feet in depth adding to the difficulty of constructing the new bridge and new rock embankment.

The VE concept eliminates 16 feet of rock embankment width from the lake. The VE concept reduces the project's impact on the lake, reduces State risk tied to constructing a project in a deep lake, reduces the amount of rock and roadway embankment, simplifies and accelerates construction operations, and reduces cost.

The total potential savings if accepted is $1,217,000.

Idea A-10: Detour traffic away from the bridge and construct the project on the existing alignment.

The most recent design shifts the new centerline out another 40 feet to the west and maintains two-way traffic on the existing road while constructing the new bridge and roadway approaches. The new alignment will require additional rock embankment to accommodate the shift of over 4,000 feet of causeway so the new bridge can be constructed "in the clear." Raising the roadway profile to provide 29 feet of clearance under the new bridge will add additional amounts of new rock embankment into the lake.

This recommendation would construct the new bridge and causeway approaches centered on the existing alignment and detour traffic around the project. Maintaining the existing alignment would eliminate the majority of the 4,000 feet of realigned new causeway approaches. The VE concept only requires the construction of small slivers of new embankment on both sides of the existing causeway to accommodate the wider new roadway. Reducing the majority of the new rock embankment that has to be placed in water that is 40 feet to over 60 feet deep will likely reduce the construction time from two years to one year.

Constructing the project on the existing alignment will require detouring traffic around the project. The VE concept reduces the project's impact on the lake, reduces the amount of rock and roadway embankment, simplifies and accelerates construction operations, minimizes the risk in constructing this project, and reduces project cost.

The total potential savings if accepted is $2,885,000.

Idea A-13: Construct the bridge with a shallower depth 90-foot center span using Type 3 PSC beams and use steel plate girders for the remaining spans.

The original preliminary bridge design to replace the existing 720-foot steel truss bridge consisted of two alternate designs. The first was a five-span 740-foot long PSC beam structure and the second was a four-span 740-foot long continuous steel plate girder structure. Since the roadway profile is being raised to accommodate 29 feet of clearance the new bridge will have to be lengthened. The VE team assumed that a new length of 820 feet would be required.

This recommendation would construct a shallower depth 90-foot center span using Type 3 AASHTO PSC beams (or other beam type configurations) and construct the remaining sides of the bridge using longer (165-foot and 200-foot) two-span continuous steel plate girders. The VE concept provides for the required 29-foot opening through the center portion of the structure while minimizing the height of the roadway profile. The new span arrangement will reduce the

structural depth allowing lowering the roadway profile by 3 feet. Reducing the roadway profile will result in a reduction in the amount of rock and roadway embankment along the entire length of the project.

The total potential savings if accepted is $124,000.

Idea D-2: Eliminate the Type II backfill material from the top of the rock embankment bench area.

The original design includes the placement of a 12-inch layer of Type II Foundation Backfill Material on the top (bench area) of the rock embankment.

This recommendation eliminates the placement of the Type II Foundation Backfill Material on top of the rock embankment. The new rock embankment is being placed to an elevation 18 inches above the normal flood pool elevation. The new roadway fill material will be placed on plastic filter fabric placed over the rock embankment to within 5 feet of the edge of the rock embankment. Since the roadway embankment will be protected by riprap to an elevation above the 100-year flood, there is no need to place the 12-inch layer of Type II backfill material.

The total potential savings if accepted is $42,000.

Idea F-3: Use sheet piling to stabilize the inside of the new roadway embankment and shift the new elevated alignment 20 feet closer to the existing roadway.

The most recent alignment provided to the VE team shifts the new centerline out approximately 40 feet to the west of the original realignment so the new higher bridge can be constructed "in the clear." The new roadway profile will provide the COE's requested 29 feet of clearance under the bridge. The new alignment will require placing a large amount of new rock embankment in the lake.

This recommendation would construct the new roadway embankment 20 feet closer to the existing roadway by using sheet piling to hold up the inside portion of the new embankment while it is being constructed. This 20-foot shift would reduce the amount of rock and roadway embankment. Reducing the quantities for these items would make the embankments easier to construct, accelerate construction, and reduce the project cost. Reducing the revised elevated alignment shift by 20 feet (at the center of the bridge) will still provide adequate clearance to construct the new bridge in a single stage. This concept also allows existing traffic to be maintained throughout the construction of the project.

The total potential savings if accepted is $1,220,000.

Idea F-5: Construct an MSE wall along the edge of the new roadway and construct the new embankment between the MSE wall and the existing roadway.

The revised alignment shifts the new roadway alignment centerline approximately 75 feet west of the existing roadway centerline and raises the roadway profile. This realignment widens the west side of the existing causeway to accommodate shifting approximately 2,000 feet of the north causeway and 2,000 feet of the south causeway away from the existing roadway so the new bridge can be constructed "in the clear." This concept requires the placement of a large amount of rock embankment into the lake.

This recommendation would construct an MSE wall on the outside edge of the new roadway and construct the new roadway embankment between the MSE wall and the existing roadway embankment. This concept reduces the width of the new roadway/rock embankment. It would eliminate most of the rock embankment required to construct the revised alignment for the elevated bridge. The VE concept reduces the project's impact on the lake, reduces the amount of rock and roadway embankment, simplifies and accelerates construction operations, minimizes State risk in constructing this project, and reduces project cost.

The total potential savings if accepted is $1,969,000.

SR 47 Bridge Replacement Over Little River

SUMMARY OF POTENTIAL COST SAVINGS

ITEM No.	CREATIVE IDEA DESCRIPTION	ORIGINAL INITIAL COST	PROPOSED INITIAL COST	INITIAL COST SAVINGS	FUTURE SAVINGS	TOTAL LCC SAVINGS	SAVINGS POTENTIAL * (%)
	RECOMMENDATIONS						
A-9B	Reduce the width of the shoulders on the bridge from 8 feet to 4 feet.	$4,071,000	$3,149,000	$922,000	N/A	$922,000	100%
A-9R	Reduce the width of the shoulders on the roadway approaches to the bridge from 10 feet to 4 feet.	$1,217,000	$0	$1,217,000	N/A	$1,217,000	100%
A-10	Detour traffic away from the bridge and construct the project on the existing alignment.	$3,716,000	$831,000	$2,885,000	N/A	$2,885,000	100%
A-13	Construct the bridge with a shallower depth 90-foot center span using Type 3 PSC beams and steel plate girders for the remaining spans.	$4,060,000	$3,936,000	$124,000	N/A	$124,000	100%
D-2	Eliminate the Type II backfill material from the top of the rock embankment bench area.	$42,000	$0	$42,000	N/A	$42,000	100%
F-3	Use sheet piling to stabilize the inside of the new roadway embankment and shift the new elevated alignment 20 feet closer to the existing roadway.	$1,522,000	$302,000	$1,220,000	N/A	$1,220,000	100%
F-5	Construct an MSE wall along the edge of the new roadway and construct the new embankment between the MSE wall and the existing roadway.	$3,859,000	$1,890,000	$1,969,000	N/A	$1,969,000	100%
	* Note: Savings Potential represents how much of an individual item, exclusive of any overlapping dependent items, can be implemented.						

STUDY IDENTIFICATION

Study Identification

Project: SR 47 Bridge Replacement Over Little River	**Date:** August 9-12, 2010
Location: Columbia/Lincoln Counties, Georgia	

VE Team Members

Name:	Title:	Organization:	Telephone:
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Steve Bitney	Construction	StreetSmarts	770-813-0882
Aruna Sastry	Structures	Sastry and Associates	678-366-9375
Keith Borkenhagen	VE Team Facilitator	MACTEC	623-556-1875

Project Description

The proposed project will replace the existing 720-foot steel truss bridge across Strom Thurmond Lake. Shortly before the start of the VE study, the Army Corps of Engineers (COE) instructed GDOT to raise the profile of the new bridge to provide 29 feet of vertical clearance above the normal pool elevation. This revision will cause the current roadway profile to be raised about an additional 18 feet. This required a significant vertical and horizontal alignment redesign. This realignment will further widen the west side of the existing causeway to accommodate shifting approximately 4,000 feet of causeway away from the existing roadway so the new bridge can be constructed "in the clear." The new clearance requirement will also require a longer new bridge.

The new bridge and approximately 4,000 feet of realigned new causeway will be constructed within Strom Thurmond Lake. Most of the construction will be in water that is 40 feet to over 60 feet deep adding to the complexity of this project. Major contract work items include bridge construction, rock embankment, bridge removal, asphalt pavement, roadway embankment, erosion control, and guardrail installation. The estimated construction cost is $10.6 million which does not include the additional costs for the most recent alignment change and raising the roadway profile to accommodate the COE's request for additional vertical clearance.

Conditions/Constraints

The VE team was informed of several conditions/constraints to consider when developing their recommendations. The conditions/constraints were:

- the COE has stipulated additional clearance requirements for the new bridge,

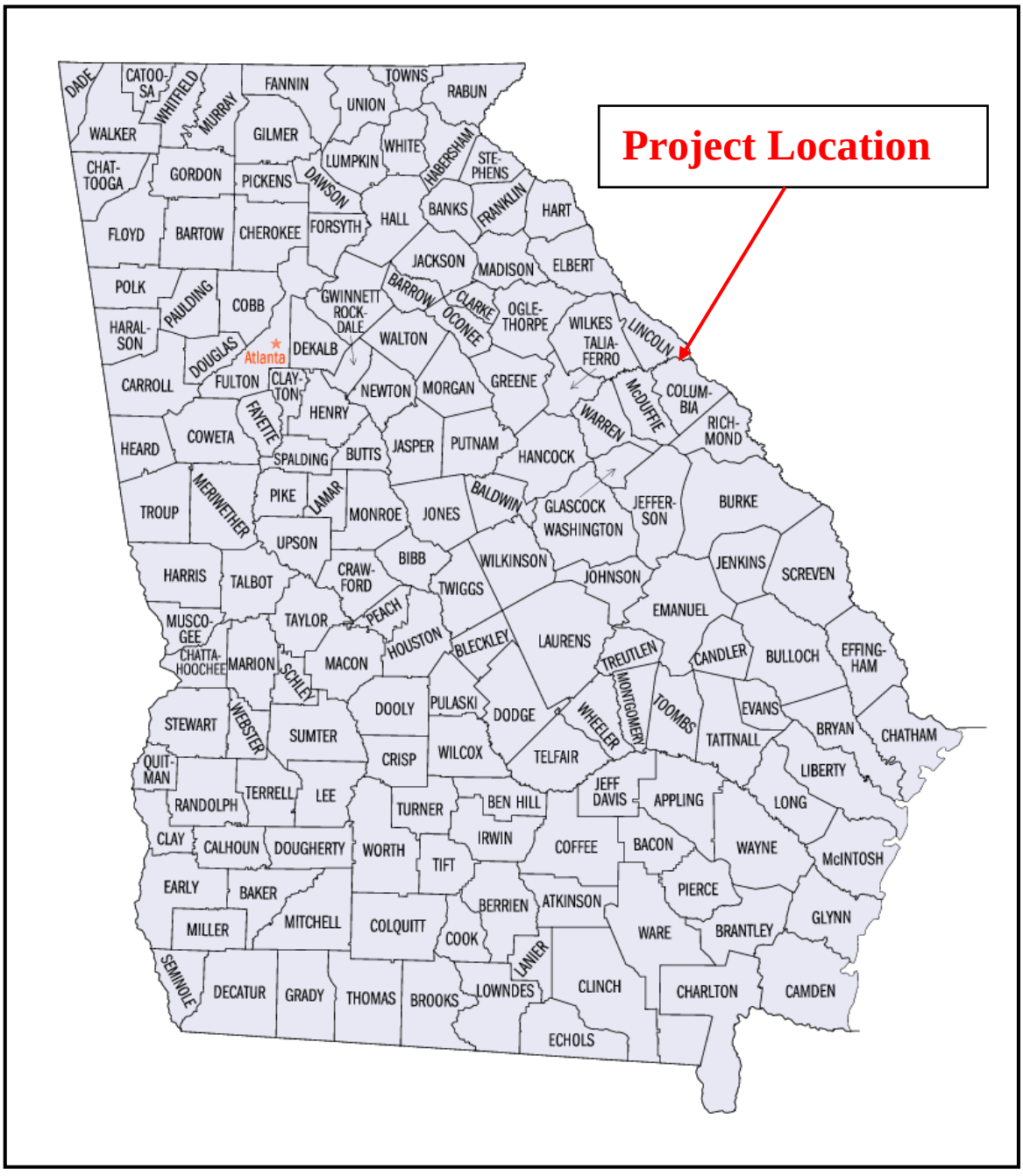
- the originally proposed two alternate bridge designs will not meet the new clearance requirements,
- maintain the 5 % maximum roadway grade for the new elevated roadway profile, and
- do not impact the work associated with improving the COE parking lot along the southern approach.

Project Briefing

An overview of the current project status was presented by Mr. Foster Grimes, GDOT Design District 2. The following items were discussed:

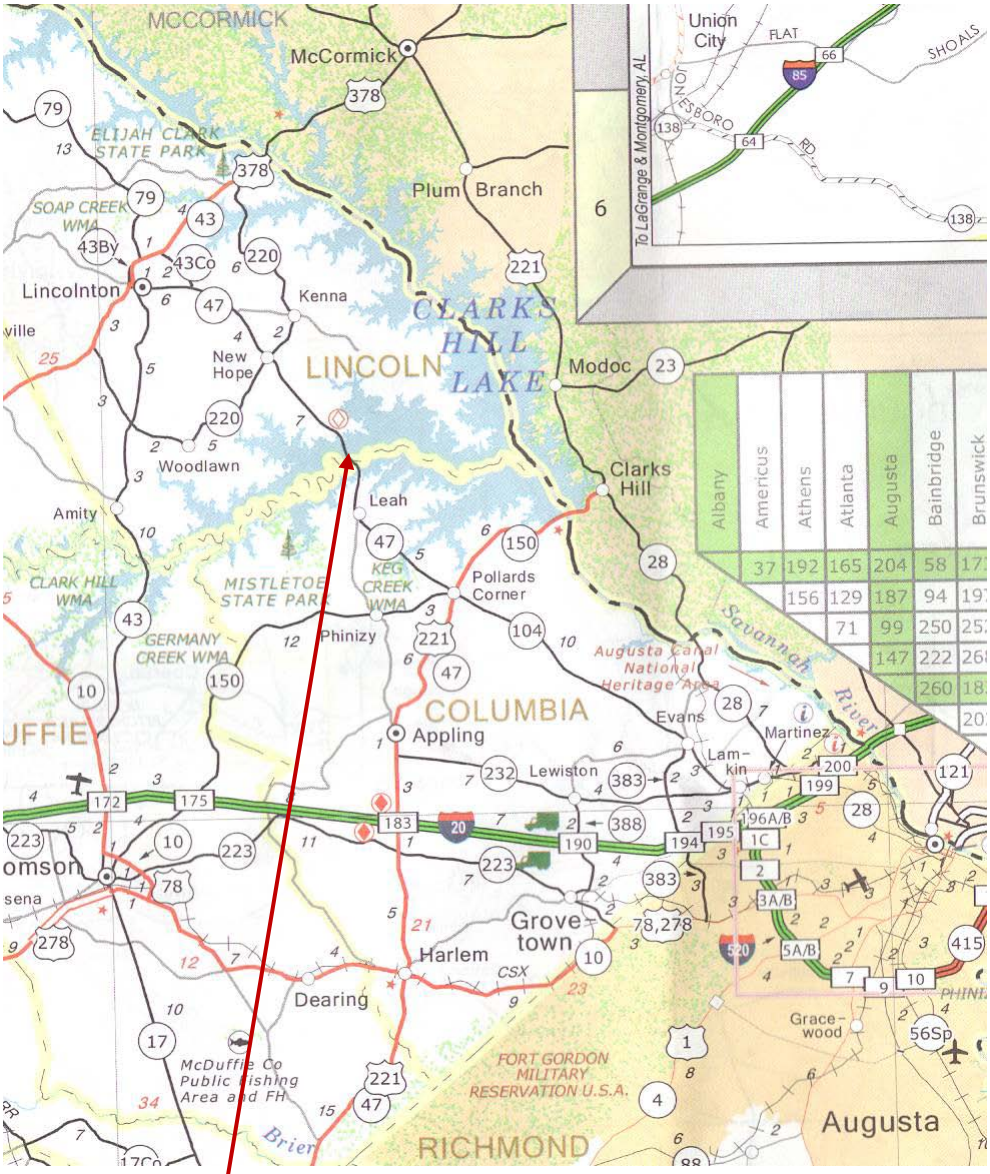
- This project will replace the SR 47 Bridge over Strom Thurmond Lake. The existing bridge has a sufficiency rating of 49.79 which constitutes a deficient structure. Since it is also a steel truss structure, which can be problematic, GDOT would like to replace it with a more conventional structure.
- The original design proposed to have 2 alternate bridge designs. The two alternates were a five span 740-foot PSC beam bridge and a four-span 740-foot steel plate girder bridge.
- The new bridge typical section will have two 12-foot traffic lanes and 8-foot shoulders on both sides. The roadway typical will provide two 12-foot traffic lanes and 10-foot paved shoulders. Placing guardrail along the approach roadways will require extending the paved shoulders out to the edge of the full shoulder (results in paving the full 15 ½ feet) to prevent erosion.
- The project will have to undergo a major change in roadway alignment and profile due to the COE requesting a taller bridge that can provide 29 feet of vertical clearance. This requirement will shift the alignment out further for constructibility purposes causing additional rock embankment to be placed into the lake. The District Office will provide the VE team with their latest roadway alignment and profile.
- The improvements being made to the COE parking lot shall be maintained.
- This proposed alignment will require open water mitigation impacts.
- The proposed alignment was shifted to the west to avoid the existing O/H utility power lines on the east side of the causeway/bridge.
- There are no weight restrictions on the existing bridge. The truss does limit vehicle heights.
- The square foot bridge cost in the estimate is assumed to include the cost of the required coffer dams to construct the piers.
- The existing bridge and foundations will be completely removed as part of the project.
- The current traffic control plan assumes that two-way traffic will be maintained through the construction site.
- The environmental process and Section 404 Process still have to be completed.

Figure 1
Project Vicinity Map



County Map of Georgia

Figure 2
Project Sketch Map



VE RECOMMENDATIONS

DEVELOPMENT AND RECOMMENDATION PHASE

Project: SR 47 Bridge Replacement Over Little River

IDEA No.: A-9B	**Sheet No.:** 1 of 4	**CREATIVE IDEA:** Reduce the width of the shoulders on the bridge from 8 feet to 4 feet

Comp By: GAO Date: 8/11/2010 Checked By: KB Date: 8/12/2010

Original Concept: The most recent design shifts the new centerline out about 40 feet west of the original realignment. This realignment widens the west side of the existing causeway to accommodate shifting the causeway away from the existing roadway so the new bridge can be constructed "in the clear." The new bridge will also be raised to provide 29 feet of clearance under the bridge. This project requires a large amount of new rock embankment to be placed in the lake. This construction will require mitigation measures for open water impacts.

Proposed Change: This recommendation would reduce the width of the shoulders on the bridge from 8 feet to 4 feet thereby narrowing the overall size of the structure.

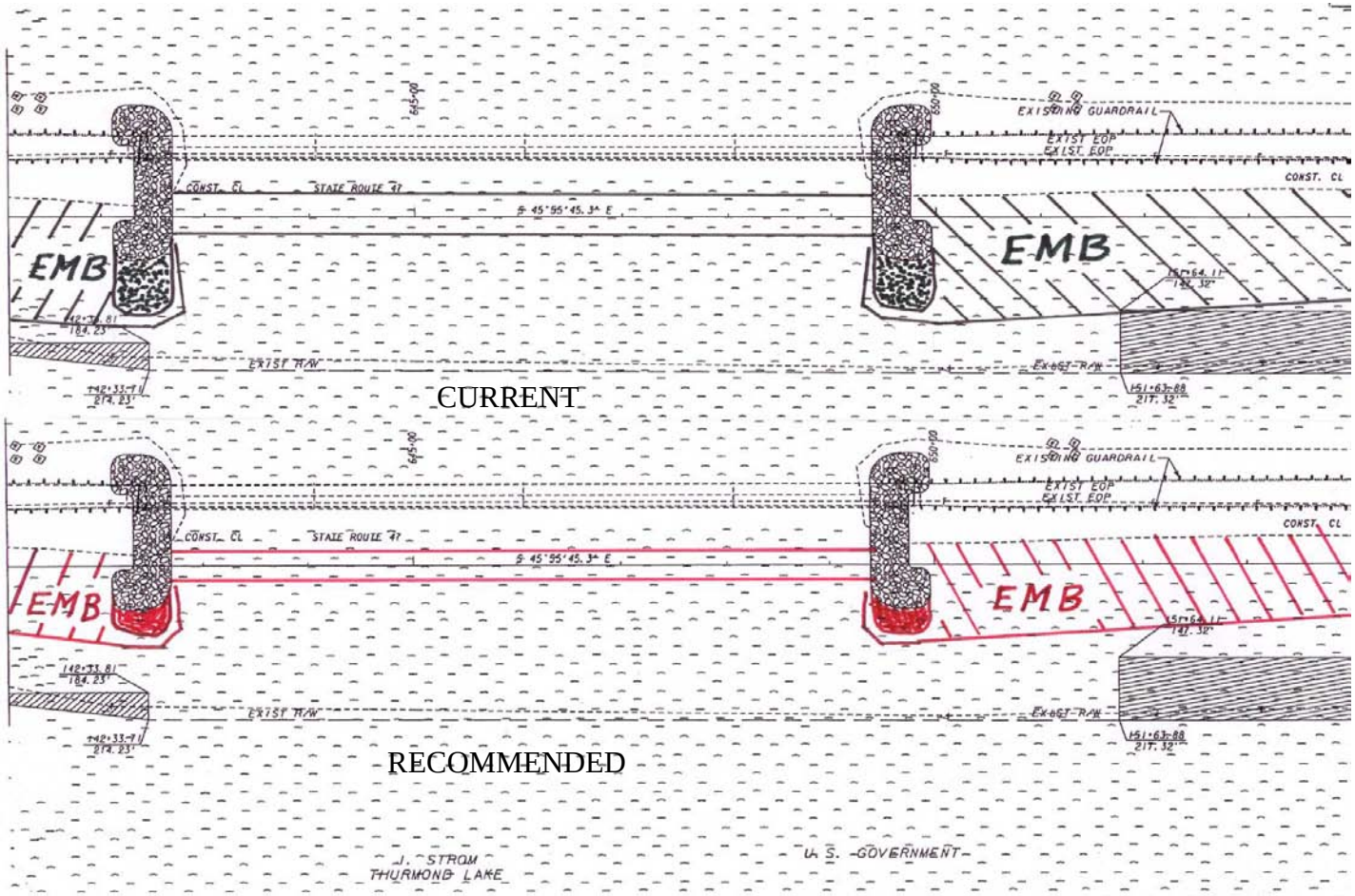
Justification: The AASHTO guidelines allow for narrower shoulders on long causeways, bridges, and the associated approach roadways. This project is an excellent candidate to apply the AASHTO narrow shoulder guideline due to the unique circumstances of constructing an elevated bridge and its causeway approach roadways within a deep lake. The lake in which the new roadway approaches and bridge will be constructed varies between 40 feet and 60 feet in depth adding to the difficulty of constructing the bridge and the rock embankment.

The VE narrower bridge design would eliminate 8 feet of bridge deck width (at the highest elevation point) along the causeway approaches significantly reducing the amount of rock embankment to be placed in the lake. The VE concept reduces the project's impact on the lake, reduces State construction risk tied to constructing a project in a deep lake, reduces the amount of rock and roadway embankment, simplifies and accelerates construction operations, and reduces cost. The VE team assumed the 8-foot reduction in rock embankment would occur only for the length (500 ft on either side) of the new elevated roadway section.

COST SUMMARY	INITIAL COST	FUTURE COST	TOTAL L. C. COST SAVINGS
Original	$4,071,000		
Proposed	$3,149,000		
Savings	$922,000		$922,000
FUTURE COST: – Savings		N/A	N/A
TOTAL PRESENT WORTH SAVINGS			**$922,000**

Idea No.: A-9B Sheet 2 of 4

Current 40-foot wide bridge & wider embankment on new alignment to accommodate higher profile



VE 32-foot wide bridge & narrower embankment on new alignment to accommodate higher profile

COST WORKSHEET

Project: SR 47 Bridge Replacement Over Little River					Idea No.: A-9B Client: GDOT Sheet 3 of 4		
CONSTRUCTION ELEMENT		**ORIGINAL ESTIMATE**			**NEW ESTIMATE**		
Item	**Unit**	**No. Units**	**Cost/Unit**	**Total Cost**	**No. Units**	**Cost/Unit**	**Total Cost**
Original Bridge Design:							
Assumes a new 820-ft length to meet the new bridge height.	SF	32,800	$120.00	$3,936,000	0		$0
Reduced Rock Embankment	CY	7,407	$18.20	$134,807	0		$0
VE proposed bridge:							
820 ft. long x 32 ft. wide	SF	0		$0	26,240	$120.00	$3,148,800
SUBTOTAL				$4,070,807			$3,148,800
TOTAL ROUNDED				**$4,071,000**			**$3,149,000**

CALCULATIONS

Project: SR 47 Bridge Replacement Over Little River	Idea No.: A-9B Client: GDOT Sheet 4 of 4

Bridge Design Considerations:
Original Steel Truss Bridge: 720 ft x 29.5 ft
Current Steel or Concrete Bridge: 740 ft x 40 ft
Lengthen Bridge to accommodate new COR height requirements:
Assumed New Bridge Length: 820 ft x 40 ft

820 ft x 40 ft wide = 32,800 SF x $120.00/SF = $3,936,000

Reduction in rock embankment: (4-ft @ 2:1 slope = 8 ft)
Assume reduction would take place in the new elevated roadway section.
Station 137 to Station 142 = 500 ft & Station 150 to Station 155 = 500 ft
End Area at Sta. 137 & 155 = 1 SF & End area at Sta. 142 & 150 = 8 ft x 50 ft – 400 SF
Volume = (500 ft + 500 ft) x (1 SF + 400 SF)/2 = 200,000/27 = 7,407 CY

VE proposed bridge:

820 ft x 32 ft wide = 26,240 SF X $ 120/SF = $3,148,800

DEVELOPMENT AND RECOMMENDATION PHASE

Project: SR 47 Bridge Replacement Over Little River

IDEA No.: A-9R	**Sheet No.:** 1 of 5	**CREATIVE IDEA:** Reduce the width of the shoulders on the roadway approaches to the bridge from 10 feet to 4 feet.

Comp By: GAO Date: 8/11/2010 Checked By: KB Date: 8/12/2010

Original Concept: The current design for the causeway approaches to the new bridge includes a 10-foot paved shoulder. The causeway approaches will require guardrail throughout the entire approach section. Installing guardrail will extend the paved shoulder out to 15.5 feet resulting in a 55-foot total roadway width. The higher/wider new roadway section will require adding significant amounts of new rock embankment into the lake. This project will require mitigation measures for open water impacts.

Proposed Change: This recommendation would reduce the shoulder width on the causeway approach sections from 10 feet to 4 feet. Adding guardrail to this section would add another 3.5 feet resulting in a total shoulder width of 7.5 feet resulting in a 39-foot total roadway width.

Justification: The purpose of this project is to replace an old truss bridge with a sufficiency rating of 49.79. The existing causeway approach sections are 36 feet wide. The current design for the roadway section consists of 24 feet of pavement with 15.5 feet of paved shoulder/guardrail area resulting in a total width of 55 feet. The VE concept would reduce the total roadway width from 55 feet to 39 feet. This concept would eliminate a 16-foot width of new rock embankment from being placed into the lake. Based on the current alignment and costs, the rock embankment construction is about 70% of the overall roadway construction. This figure will be even higher with the new elevated profile. Reducing the rock embankment will provide the most savings.

The lake in which the new causeway approaches and bridge will be constructed varies from 40 feet to over 60 feet in depth adding to the difficulty of constructing the rock embankment. The AASHTO guidelines allow for narrower shoulders on long causeways, bridges, and the associated approach roadways. This project is an excellent candidate to apply the AASHTO narrow shoulder guideline due to its unique circumstances of constructing an elevated bridge and its causeway approach roadways within a deep lake.

COST SUMMARY	**INITIAL COST**	**FUTURE COST**	**TOTAL L. C. COST SAVINGS**
Original	$1,217,000		
Proposed	$0		
Savings	$1,217,000		$1,217,000
FUTURE COST: – Savings		N/A	N/A
TOTAL PRESENT WORTH SAVINGS			**$1,217,000**

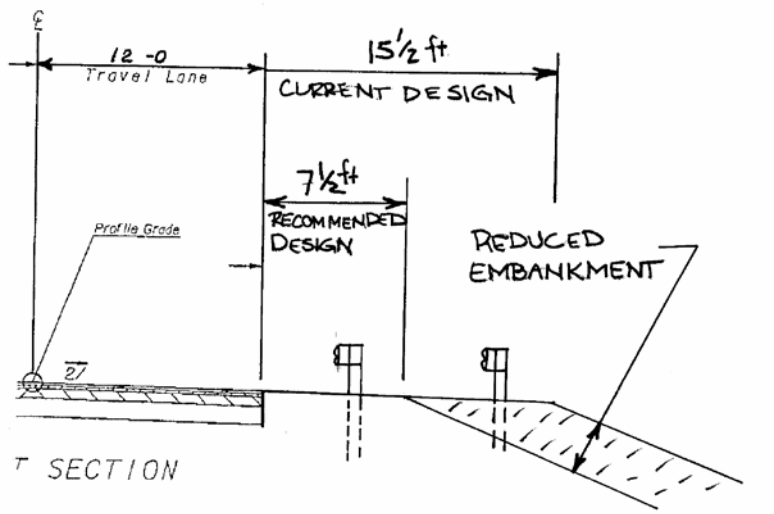
CONTINUATION SHEET	
Project: SR 47 Bridge Replacement Over Little River	Idea No.: A-9R Client: GDOT Sheet 2 of 5

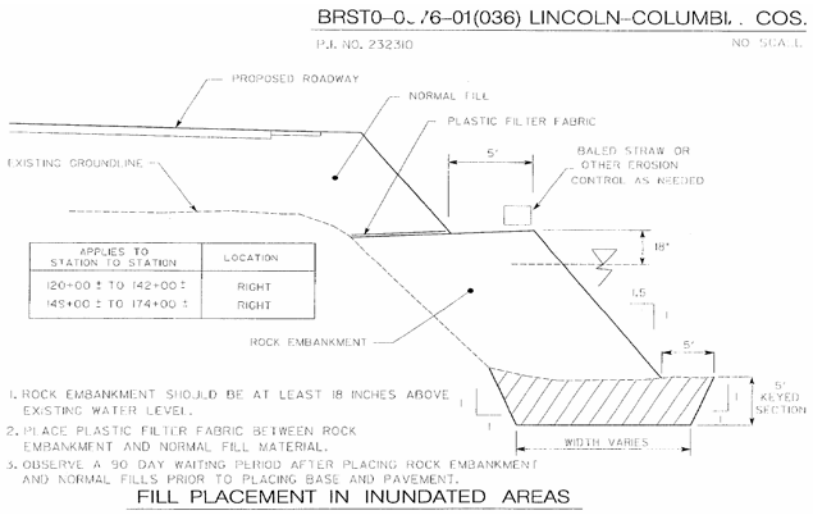
The VE concept would reduce the project's impact on the lake, reduce the risk with constructing in a deep lake, reduce the amount of rock and roadway embankment, simplify and accelerate construction operations, and reduce cost.

In addition, no accident or incident data was provided that specifically listed problems with broken down vehicles on the existing narrow roadway/bridge that has been in place for nearly 60 years. The recommended 4-foot-wide shoulder would provide more space than is currently available.

SKETCH

Project: SR 47 Bridge Replacement Over Little River	Idea No.: A-9R Client: GDOT Sheet 3 of 5





COST WORKSHEET

Project: SR 47 Bridge Replacement Over Little River					Idea No.: A-9R Client: GDOT Sheet 4 of 5		
CONSTRUCTION ELEMENT		**ORIGINAL ESTIMATE**			**NEW ESTIMATE**		
Item	**Unit**	**No. Units**	**Cost/Unit**	**Total Cost**	**No. Units**	**Cost/Unit**	**Total Cost**
Current Shoulder Concept:							
Asphalt Pavement	SY	7,591	$18.00	$136,638	0		$0
Roadway Embankment	CY	15,815	$4.61	$72,907	0		$0
Rock Embankment	CY	55,352	$18.20	$1,007,406	0		$0
SUBTOTAL				$1,216,951			$0
TOTAL ROUNDED				**$1,217,000**			**$0**

CALCULATIONS

Project: SR 47 Bridge Replacement Over Little River	Idea No.: A-9R Client: GDOT Sheet 5 of 5

North approach: station 122+00 to 142+20 = 2,020 ft
South approach: station 149+50 to 172+00 = 2,250 ft

Average height of embankment = 10 ft
Average height of rock embankment = 35 ft

Reduction in embankment:
10 ft x 10 ft (2,020 ft + 2250 ft) = 427,000 CF/27 = 15,815 CY

Reduction in rock embankment:
10 ft x 35 ft (2,020 ft + 2250 ft) = 1,494,500 CF/27 = 55,352 CY

Reduction in shoulder pavement: (10 ft shoulder + 5 ½ ft for guardrail)
31 ft – 15 ft = 16 ft
16 ft x (2,020 ft + 2,250 ft) = 68,320 SF/9 = 7,591 SY

<u>Asphalt shoulder pavement; SR 47 3.5 in asphalt on 6 inch GAB</u>

(3.5/12 ft) (150 #/CF) (1 ton/2000#) = 0.021875 ton/SF
(6/12 ft) (135 #/CF) (1 ton/2000#) = 0.03375 ton/SF
Cost per SY
(0.021875 ton/SF x 9 SF/SY @ $60/ton) + (0.03375 ton/SF x 9 SF/SY @ $18/ton) =
$11.81 + $5.47 = $17.28/SY USE: $18 per SY

DEVELOPMENT AND RECOMMENDATION PHASE

Project: SR 47 Bridge Replacement Over Little River

IDEA No.:	**Sheet No.:**	**CREATIVE IDEA:**
A-10	1 of 5	Detour traffic away from the bridge and construct the project on the existing alignment.

Comp By: GAO Date: 8/11/2010 Checked By: KB Date: 8/12/2010

Original Concept: The most recent design shifts the new centerline out approximately 40 feet west of the original realignment and maintains 2-way traffic on the existing road while constructing the new bridge and roadway approaches. This realignment widens the west side of the existing causeway to accommodate shifting approximately 2,000 feet of the north causeway and 2,000 feet of the south causeway away from the existing roadway so the new bridge can be constructed "in the clear."

This bridge replacement project will also accommodate the COE's recent request to raise the road profile to provide 29 feet of clearance under the new bridge. This project will require a large amount of new rock embankment to be placed in the lake.

Proposed Change: This recommendation would construct the new bridge and causeway approaches centered on the existing alignment and detour traffic around the project.

Justification: This project will replace the 740-foot truss bridge and causeway approaches in the center of Strom Thurmond Lake. The new bridge and 4,000 feet of realigned new causeway will be constructed within the lake. This construction will be in water that is 40 feet to over 60 feet deep adding to the complexity of the project and increasing the project's negative impact on the lake. The new rock embankment near the bridge abutments will be larger than originally designed because the profile has been raised an additional 18 feet.

The VE concept of reconstructing on the existing roadway alignment will significantly reduce the amount of new rock embankment that has to be placed in the lake. Instead of having to construct a wide new embankment for the realigned roadway, the VE concept would only require the construction of small amounts of new embankment on both sides of the existing causeway to accommodate the wider new roadway.

COST SUMMARY	**INITIAL COST**	**FUTURE COST**	**TOTAL L. C. COST SAVINGS**
Original	$3,716,000		
Proposed	$831,000		
Savings	$2,885,000		$2,885,000
FUTURE COST: – Savings		N/A	N/A
TOTAL PRESENT WORTH SAVINGS			**$2,885,000**

CONTINUATION SHEET

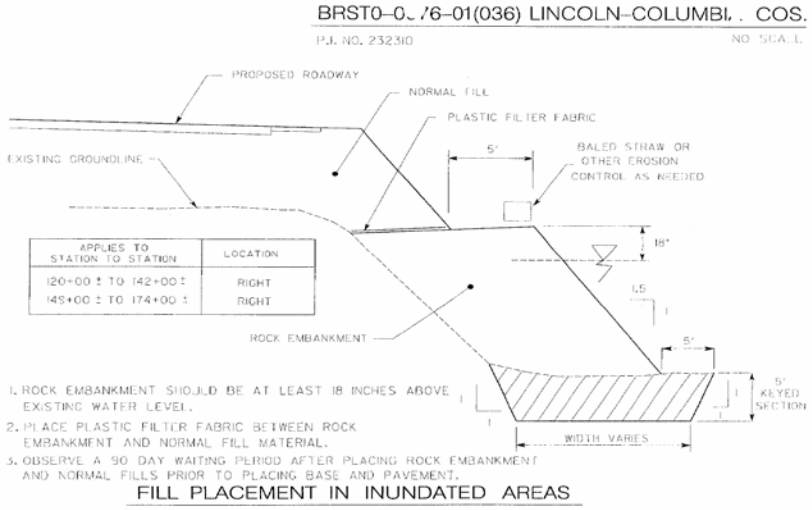
Project: SR 47 Bridge Replacement Over Little River	Idea No.: A-10 Client: GDOT Sheet 2 of 5

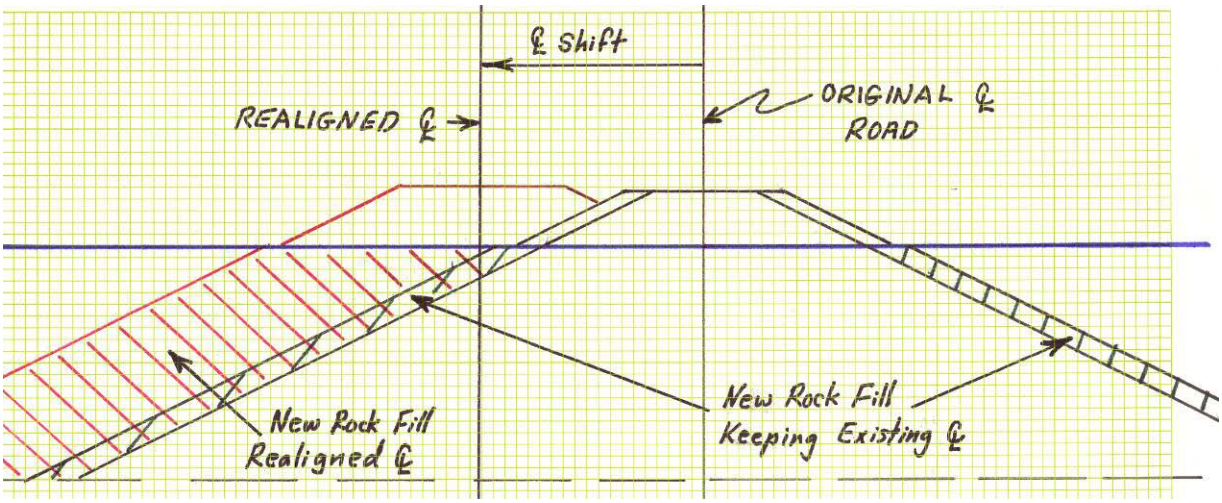
Constructing the project on the existing alignment will require detouring traffic around the project. Current year (2010) AADT is 4,772 and local traffic is assumed to be light since there are very few identified residential areas on either side of the lake. The detour would use SR 150 to I-20 to SR 43 to SR 220 to SR 47, a distance of approximately 25 miles. However, the VE team assumed the lake was the destination for most of the trips indicating traffic was coming from outside the area and could more easily use other routes to get to their specific destination, thereby, significantly reducing their detour distance. For example, traffic traveling north from the Augusta/Martinez area could go west on I-20 and north on SR 43 or go north on SR 28 (US 221 in SC) and travel south on US 378 which would not add many miles to their trip. Additionally, the duration of the detour can be shortened by including contractor incentives in the contract language.

Allowing the contractor full access to the project site will shorten the overall construction duration. This concept could potentially reduce construction time from two years to one-year. The VE concept reduces the project's impact on the lake, reduces the amount of rock and roadway embankment, simplifies and accelerates construction operations, minimizes the risk in constructing this project, and reduces project cost. The estimated cost savings reflects the original profile, not the elevated one. All the benefits of this idea become even more critical when analyzed for the new elevated profile. Should the adjacent overhead utility lines/towers conflict with widening to both sides, the utility lines could be relocated by attaching conduits to the new bridge or incorporating minor adjustments in the alignment shift.

SKETCH

Project: SR 47 Bridge Replacement Over Little River	Idea No.: A-10 Client: GDOT Sheet 3 of 5





COST WORKSHEET

Project: SR 47 Bridge Replacement Over Little River					Idea No.: A-10 Client: GDOT Sheet 4 of 5		
CONSTRUCTION ELEMENT		**ORIGINAL ESTIMATE**			**NEW ESTIMATE**		
Item	**Unit**	**No. Units**	**Cost/Unit**	**Total Cost**	**No. Units**	**Cost/Unit**	**Total Cost**
Original Design:							
Additional Rock Emb.	CY	185,185	$18.20	$3,370,367	0		$0
Additional Roadway Emb.	CY	74,074	$4.61	$346,091	0		$0
VE Design:							
Additional Rock Emb.	CY	0		$0	44,444	$18.20	$808,881
Additional Roadway Emb.	CY	0		$0	4,815	$4.61	$22,197
SUBTOTAL				$3,716,458			$831,078
TOTAL ROUNDED				**$3,716,000**			**$831,000**

CALCULATIONS

Project: SR 47 Bridge Replacement Over Little River	Idea No.: A-10 Client: GDOT Sheet 5 of 5

Additional material to revise alignment to raise the grade for new clearance requirement.
Assume: Shift alignment between Station 122 to Station 142 and Station 150 to Station 170.

Additional Rock Embankment:
End area at Sta. 122 & 170 = 1 SF & End area at Sta. 142 & 150 = 50 ft x 50 ft = 2,500 SF
Volume = (2,000 ft + 2,000 ft) x (1 SF + 2,500 SF)/2 = 5,000,000/27 = 185,185 CY
185,185 CY @ $18.20 = $3,370,367

Additional Roadway Embankment:
End area at Sta. 122 & 170 = 1 SF End area at Sta. 142 & 170 = 25 ft x 40 ft = 1,000 SF
Volume = (2,000 ft + 2,000 ft) x (1 SF + 1,000SF)/2 = 2,000,000/27 =74,074 CY
75,074 CY @ $4.61 = $346,091
Total Cost Increase = $3,370,367 + $346,091 = $3,716,458

VE Concept:

Rock embankment:
Station 122 to Station 142 = 2,000 ft & Station 150 to Station 170 = 2,000 ft
End Area at Sta. 122 & 170 = 1 SF & End area at Sta. 142 & 150 = 12 ft x 50 ft – 600 SF
Volume = (2,000 ft + 2,000 ft) x (1 SF + 600 SF)/2 = 1,200,000/27 = 44,444 CY

Roadway Embankment:
Station 122 to Station 142 = 2,000 ft & Station 150 to Station 170 = 2,000 ft
End area at Sta. 122 & 170 = 1 SF & End area at Sta. 142 & 150 = (5 ft x 40 ft) = 200 SF
Volume = (2,000 ft + 2,000 ft) x (1 SF + 200 SF)/2 = 400,000/27 = 4,815 CY

DEVELOPMENT AND RECOMMENDATION PHASE

Project: SR 47 Bridge Replacement Over Little River

IDEA No.: A-13	**Sheet No.:** 1 of 5	**CREATIVE IDEA:** Construct the bridge with a shallower depth 90-foot center span using Type 3 PSC beams and use steel plate girders for the remaining structure.

Comp By: Aruna Sastry Date: 8/12/2010 Checked By: KB Date: 8/11/2010

Original Concept: The preliminary bridge design consists of two alternate designs:

- First alternate is a five-span 740-foot long PSC beam structure having 3 spans of 150 feet and two spans of 145 feet.
- The second alternate is a four-span 740-foot long continuous steel plate girder structure having concrete intermediate bents165'-205'-205'-165'.

For comparison purposes, the VE team increased the length of original structure from 740 feet to 820 feet to accommodate the 18-foot increase in bridge height required by the COE. The unit price was kept at $120/square foot resulting in a bridge cost of $3,936,000.

Proposed Change:

This recommendation would construct a 90-foot center span using Type 3 AASHTO PSC beams and construct the remaining sides of the bridge using longer two-span continuous steel plate girders (165'-200'). This results in a total structure length of 820 feet. The recreational watercrafts can pass through 90 feet center span with minimum available vertical clearance of 29 feet.

Justification:

The VE concept provides for the required 29-foot vertical opening through the center portion of the structure while minimizing the height of the roadway profile. The new span arrangement will allow for lowering the profile of the roadway by 3 feet. This concept results in a reduction in the amount of rock and roadway embankment along the entire length of the project.

COST SUMMARY	INITIAL COST	FUTURE COST	TOTAL L. C. COST SAVINGS
Original	$4,060,000		
Proposed	$3,936,000		
Savings	$124,000		$124,000
FUTURE COST: – Savings		N/A	N/A
TOTAL PRESENT WORTH SAVINGS			**$124,000**

DEVELOPMENT AND RECOMMENDATION PHASE

Project: SR 47 Bridge Replacement Over Little River

IDEA No.:	**Sheet No.:**	**CREATIVE IDEA:** Construct the bridge with a shallower depth 90-foot center span using Type 3 PSC beams and use steel plate girders for the remaining structure.
A-13	2 of 5	

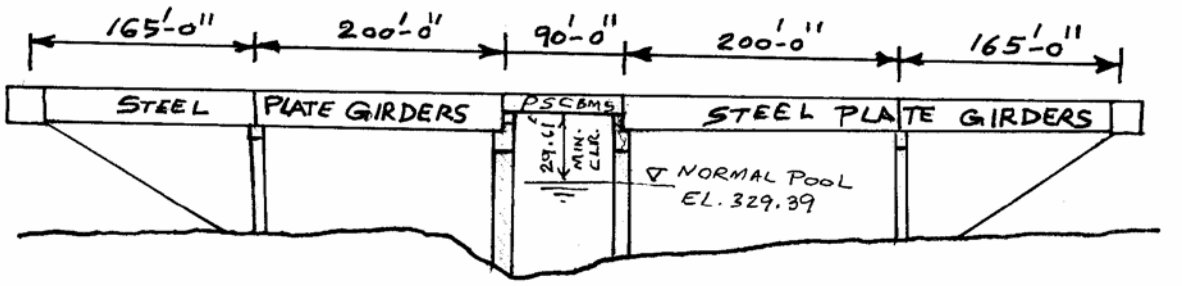
Comp By: Aruna Sastry Date: 8/12/2010 Checked By: KB Date: 8/11/2010

The 90-foot span was chosen as the adequate span for a Type III beam and a reasonable width for boats to pass underneath. A slightly narrower span should also suffice. Establishing the minimum width for the opening is a key design element. This should be coordinated with COE and/or the local navigational codes.

It is also important, in developing the new bridge span arrangements and openings to establish and follow the appropriate design criteria and use realistic unit costs. This bridge was originally constructed prior to the lake being impounded. The hydraulic considerations are not the same as they were when the bridge was originally designed. This is now a dam controlled lake. The hydraulic design criteria and required openings are much different and replacement "in-kind" is not the most appropriate or the efficient method of bridge replacement. Also, the unit costs to consider in evaluating the bridge / rock embankment layout should be realistic. The construction methods, for both deep water bridge piers and rock embankment placement are quite different for this project than conventional methods and using standard pay item data is not a realistic approach. These factors will be a significant element in the construction of the new bridge and should be strongly considered in developing the new layouts.

SKETCH

Project: SR 47 Bridge Replacement Over Little River	Idea No.: A-13 Client: GDOT Sheet 3 of 5



COST WORKSHEET

Project: SR 47 Bridge Replacement Over Little River					Idea No.: A-13 Client: GDPT Sheet 4 of 5		
CONSTRUCTION ELEMENT		**ORIGINAL ESTIMATE**			**NEW ESTIMATE**		
Item	**Unit**	**No. Units**	**Cost/Unit**	**Total Cost**	**No. Units**	**Cost/Unit**	**Total Cost**
Proposed bridge:							
Assumes a new 820-ft length to meet the new bridge height.	SF	32,800	$120.00	$3,936,000			
Reduction in Rock Emb.	CY	6,520	$18.20	$118,664			
Reduction in Roadway Emb.	CY	1,185	$4.61	$5,463			
VE proposed bridge:							
820 ft. long x 40 ft. wide	SF				32,800	$120.00	$3,936,000
SUBTOTAL				$4,060,127			$3,936,000
TOTAL ROUNDED				**$4,060,000**			**$3,936,000**

CALCULATIONS

Project: SR 47 Bridge Replacement Over Little River	Idea No.: A-13 Client: GDOT Sheet 5 of 5

Bridge Design Considerations:
Original Steel Truss Bridge: 720 ft x 29.5 ft
Current Steel or Concrete Bridge: 740 ft x 40 ft
Lengthen Bridge to accommodate new COE height requirements:
Assumed New Bridge Length: 820 ft x 40 ft

820 ft x 40 ft wide = 32,800 SF x $120.00/SF = $ 3,936,000

Rock Embankment Reduction:
(2 ft x 110 ft x 400 ft) x 2 = 176,000 CF/27 = 6,518.5 CY Use 6,520 CY

Roadway Embankment reduction:
(2 ft x 40 ft x 400 ft) x 2 = 32,000 CF/27 =1,185 CY

VE proposed bridge:

820 ft x 40 ft wide = 32800 SF X $ 120/SF = $ 3,936,000

Assumes Bridge Length of 820 feet to accommodate additional 18-foot clearance.

DEVELOPMENT AND RECOMMENDATION PHASE

Project: SR 47 Bridge Replacement Over Little River

IDEA No.: D-2	**Sheet No.:** 1 of 4	**CREATIVE IDEA:** Eliminate the Foundation Backfill Material on the top of the Rock Embankment.

Comp By: KB Date: 8/11/2010 Checked By: GAO Date: 8/11/2010

Original Concept:

The original design includes the placement of a 12-inch layer of Type II Foundation Backfill Material on the top (bench area) of the rock embankment.

Proposed Change:

This recommendation eliminates the placement of the Type II Foundation Backfill Material on top of the rock embankment.

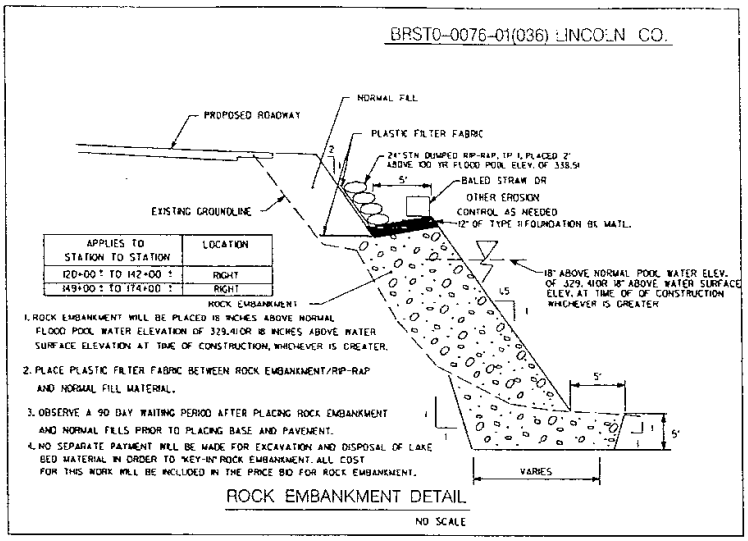
Justification:

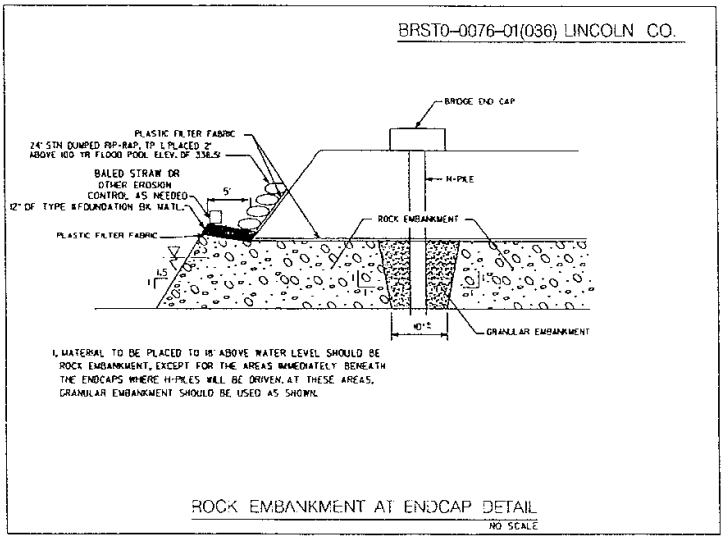
The rock embankment is being placed to an elevation that is 18 inches above the normal flood pool elevation. The roadway fill material will be placed on top of plastic filter fabric over the rock embankment to within 5 feet of the edge of the rock embankment. Since the roadway embankment will be protected by riprap to an elevation above the 100-year flood, there is no need to place the 12-inch layer of Type II backfill material.

COST SUMMARY	**INITIAL COST**	**FUTURE COST**	**TOTAL L. C. COST SAVINGS**
Original	$42,000		
Proposed	$0		
Savings	$42,000		$42,000
FUTURE COST: – Savings		N/A	N/A
TOTAL PRESENT WORTH SAVINGS			**$42,000**

SKETCH

Project: SR 47 Bridge Replacement Over Little River	Idea No.: D-2 Client: GDOT Sheet 2 of 4





COST WORKSHEET

Project: SR 47 Bridge Replacement Over Little River					Idea No.: D-2 Client: GDOT Sheet 3 of 4		
CONSTRUCTION ELEMENT		**ORIGINAL ESTIMATE**			**NEW ESTIMATE**		
Item	**Unit**	**No. Units**	**Cost/Unit**	**Total Cost**	**No. Units**	**Cost/Unit**	**Total Cost**
Original Design							
Rock Bench Area	CY	1,111	$37.37	$41,518	0		$0
SUBTOTAL				$41,518			$0
TOTAL ROUNDED				**$42,000**			**$0**

CALCULATIONS

Project: SR 47 Bridge Replacement Over Little River	Idea No.: D-2 Client: GDOT Sheet 4 of 4

Type II Backfill Material:

Rock Bench Area:
5 ft x 1 ft x 6,000 ft = 30,000 CF/27 = 1,111 CY

Excess in Cost Estimate:
23,400 CY – 1,111 CY = 22,289 CY

DEVELOPMENT AND RECOMMENDATION PHASE

Project: SR 47 Bridge Replacement Over Little River

IDEA No.: F-3	**Sheet No.:** 1 of 6	**CREATIVE IDEA:** Use Sheet Piling to Stabilize the inside of the new embankment and shift the new alignment 20 feet closer to the existing roadway.

Comp By: SB Date: 8/11/2010 Checked By: KB Date: 8/11/2010

Original Concept:

The new alignment to accommodate the additional vertical clearance (18 feet, 29 feet total) required by the COE shifted the centerline approximately 40 feet out from the original alignment. This 40-foot outward shift will require significant additional rock and roadway embankment.

Proposed Change:

This recommendation would construct the new roadway embankment 20 feet closer to the existing roadway by using sheet piling to hold up the inside portion of the new embankment while it is being constructed.

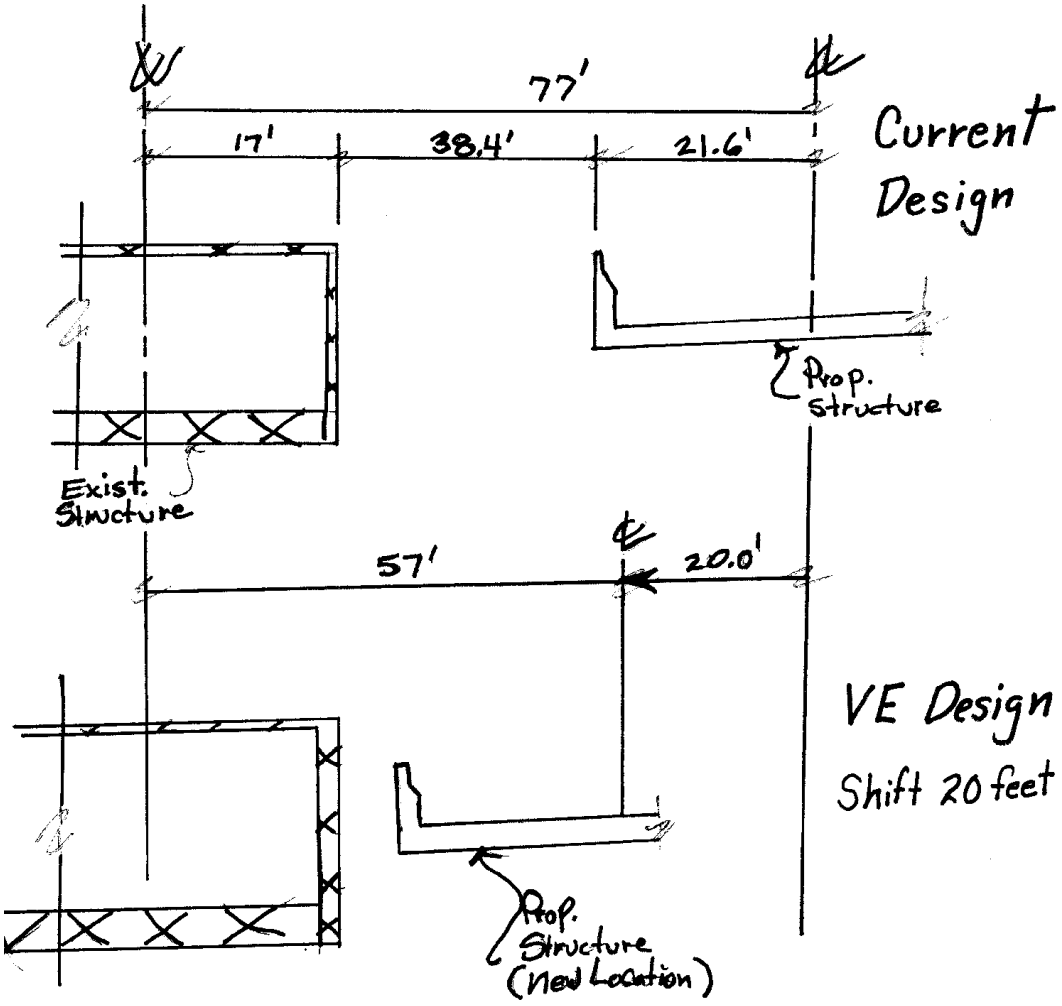
Justification:

This 20-foot shift would reduce the amount of rock and roadway embankment. Reducing the quantities for these items would make the embankments easier to construct, accelerate construction, and reduce the project cost. Reducing the revised elevated alignment shift by 20 feet (at the center of the bridge) will still provide adequate clearance to construct the new bridge in a single stage. This concept also allows existing traffic to be maintained throughout the construction of the project.

COST SUMMARY	INITIAL COST	FUTURE COST	TOTAL L. C. COST SAVINGS
Original	$1,522,000		
Proposed	$302,000		
Savings	$1,220,000		$1,220,000
FUTURE COST: – Savings		N/A	N/A
TOTAL PRESENT WORTH SAVINGS			**$1,220,000**

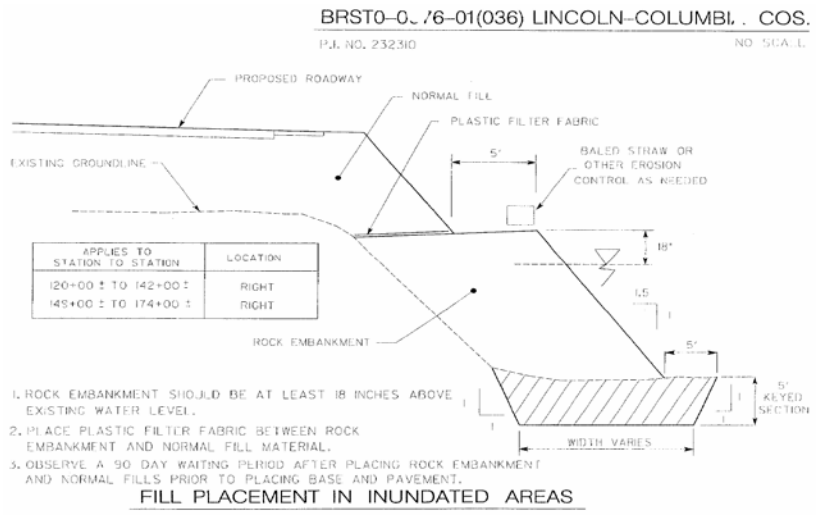
SKETCH

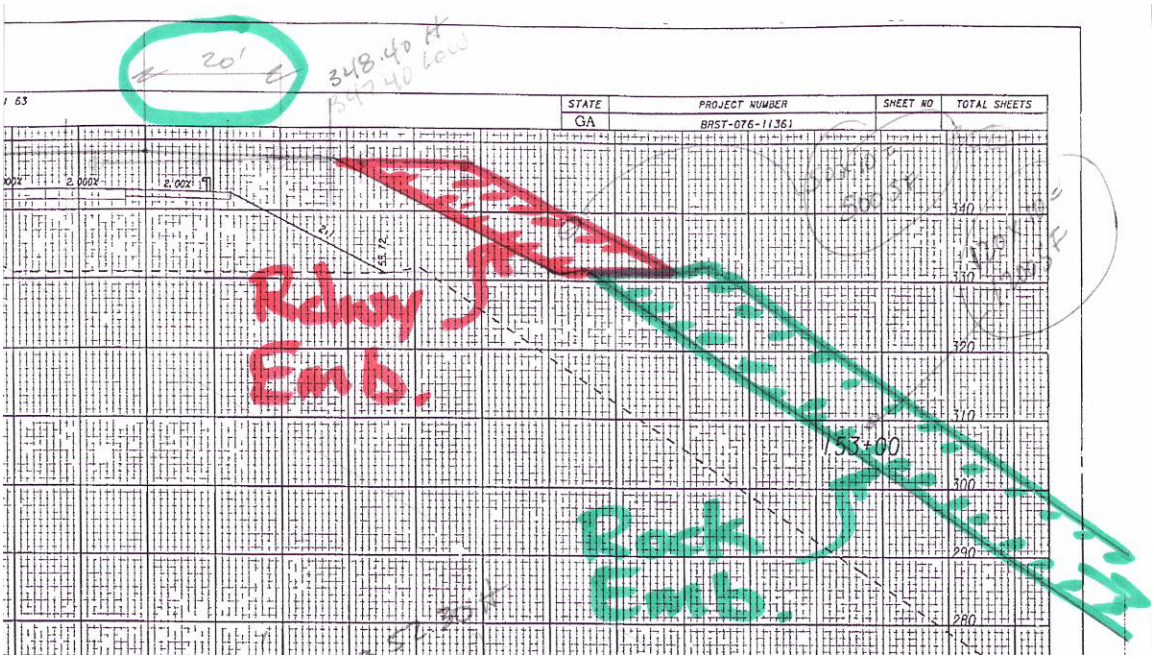
Project: SR 47 Bridge Replacement Over Little River	Idea No.: F-3 Client: GDOT Sheet 2 of 6



SKETCH

Project: SR 47 Bridge Replacement Over Little River	Idea No.: F-3 Client: GDOT Sheet 3 of 6





COST WORKSHEET

Project: SR 47 Bridge Replacement Over Little River					Idea No.: F-3 Client: GDOT Sheet 4 of 6		
CONSTRUCTION ELEMENT		**ORIGINAL ESTIMATE**			**NEW ESTIMATE**		
Item	**Unit**	**No. Units**	**Cost/Unit**	**Total Cost**	**No. Units**	**Cost/Unit**	**Total Cost**
Original Design: Latest alignment for the 18-foot elevated bridge.							
Rock Embankment	CY	75,260	$18.20	$1,365,000			
Roadway Embankment	CY	34,126	$4.61	$157,321			
VE Design: Reduce alignment shift and use sheet piling.							
Steel Sheet Piling	SF				20,151	$15.00	$302,265
SUBTOTAL				$1,522,321			$302,265
TOTAL ROUNDED				**$1,522,000**			**$302,000**

CALCULATIONS

Project: SR 47 Bridge Replacement Over Little River	Idea No.: F-3 Client: GDOT Sheet 5 of 6

The proposed new elevated alignment is 40 feet outside the original alignment.

<u>Rock Embankment:</u>
North Side
Sta. 125 = 0 SF, Sta. 135 = 900 SF, Sta. 136 = 950 SF, Sta. 137 = 1,000 SF,
Sta. 138 = 1,000 SF, Sta. 139 = 800 SF, Sta. 140 = 900 SF, Sta. 141 = 1,000 SF,
Sta. 142 = 1,200 SF, Sta. 142+23 = 1,200 SF

End area vol. = (0 + 900)/2 x 1,000 ft + ((900 + 950)/2 x 100 + (950 + 1,000)/2 x 100 +
(1,000 + 1,000)/2 x 100 + (1,000 + 800)/2 = 100 + (800 + 900)/2 x 100 +
(900 + 1,000)/2 x 100 +(1,000 + 1,200)/2 x 100 + (1,200 +1,200)/2 x 23

450,000 + 92,500+ 97,500 +100,000 + 90,000 + 85,0000 + 95,000 + 110,000 + 27,600 =
1,147,600 SF/27 = 42,503.7 CY

South Side
Sta. 149+63 = 1,200 SF, Sta. 150 =1,200 SF, Sta.151 = 1,200 SF, Sta. 152 = 1,200 +
Sta. 153 = 1,200 SF, Sta. 154 = 1,200 SF, Sta. 160 = 0

End area vol. = (1,200 + 1,200)/2 x 37 + (1,200 + 1,200)/2 x 100 + (1,200 +1,200)/2 x 100 +
(1,200 +1,200)/2 x 100 + (1,200 +1,200)/2 x 100 + (1,200 +0)/2 x 600 =
44,400 + 120,000 + 120,000 + 120,000 +120,000 + 360,000 = 884,400 CF/27 = 32,756 CY
Total Volume: 42,504 + 32,756 = 75,260 CY

CALCULATIONS

Project: SR 47 Bridge Replacement Over Little River	Idea No.: F-3 Client: GDOT Sheet 6 of 6

The proposed new elevated alignment is 40 feet outside the original alignment.

Roadway Embankment:
Sta. 125 = 0 SF, Sta. 135 = 400 SF, Sta. 136 = 400 SF, Sta. 137 = 450 SF, Sta. 138 = 500 SF, Sta. 139 = 480 SF, Sta. 140 = 530 SF, Sta. 141 = 600 SF, Sta. 142 = 700 SF, Sta. 142+23 = 700 SF

Sta. 149+63 = 680 SF, Sta. 150 =6800 SF, Sta.151 = 700 SF, Sta. 152 = 580 SF, Sta. 153 = 500 SF,
Sta. 154 = 480 SF, Sta. 160 = 0

End areas =
(0 + 400)/2 x 1,000 ft + (400 + 400)/2 x 100 + (400 + 450)/2 x 100 + (450 + 500)/2 x 100 + (500 + 480)/2 = 100 + (480 + 530)/2 x 100 + (530 + 600)/2 x 100 +(600 + 700)/2 x 100 + (700 +700)/2 x 23
200,000 + 40,000+ 42,500 +47,500 + 49,000 + 50,500 + 56,500 + 65,000 + 16,100 = 567,100 SF
567,100 SF/27 = 21,004 CY

(680 + 680)/2 x 37 + (680 + 700)/2 x 100 + (700 +580)/2 x 100 +(580 +500)/2 x 100
(500 +480)/2 x 100 + (480 +0)/2 x 600
25,160 + 69,000 + 64,000 + 54,000 +49,000 + 144,000 = 405,160 CF/27 = 15,006 CY
Total Volume: 13,122 + 21,004 = 34,126 CY

VE Proposal:

Sheet Piling Size:
Assumes piling is driven to twice as deep as its clear height.
North side clear height is 2 ft to 16 ft
South side clear height is 2 ft to 14 ft

Total piling size
Sta. 138+50 to 142+23 (6 ft + 48 ft)/2 x 373 ft = 10,071 SF
Sta. 149+80 to 154 +00 (6 ft + 42 ft)/2 x 420 ft = 10,080 SF
Total: = 20,151 SF

DEVELOPMENT AND RECOMMENDATION PHASE

Project: SR 47 Bridge Replacement Over Little River

IDEA No.: F-5	**Sheet No.:** 1 of 4	**CREATIVE IDEA:** Construct an MSE wall along the edge of the existing/new rock embankment to hold the new roadway embankment.

Comp By: KB Date: 8/10/2010 Checked By: GAO Date: 8/11/2010

Original Concept: The original design shifts the new roadway alignment centerline approximately 75 feet west of the existing roadway centerline. This realignment widens the west side of the existing causeway to accommodate shifting approximately 2,000 feet of the north causeway and 2,000 feet of the south causeway away from the existing roadway so the new bridge can be constructed "in the clear." This concept requires the placement of a large amount of rock/roadway embankment in order to raise the profile and construct the new approached to the new bridge.

Proposed Change: This recommendation would construct an MSE wall on the outside edge of the new roadway and construct the new roadway embankment between the MSE wall and the existing roadway embankment. This concept assumes the revised (8/9/2010) alignment for the elevated bridge.

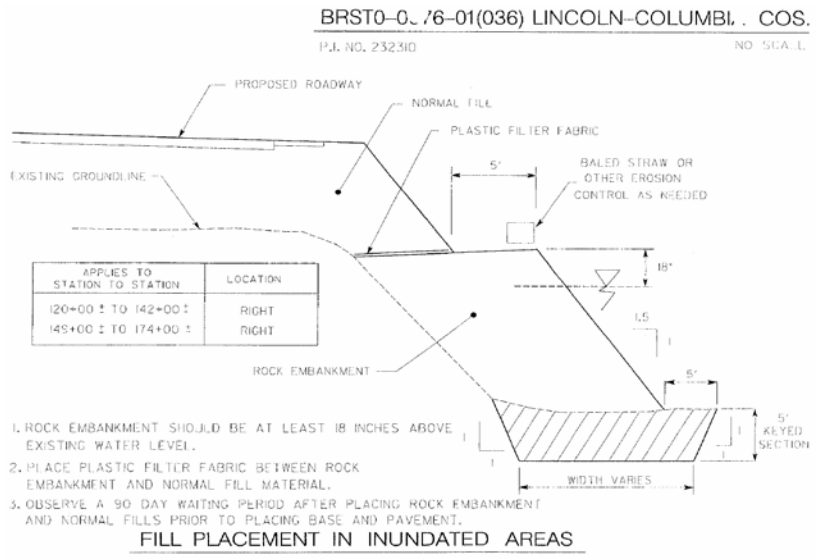
Justification: Constructing the new approach roadway between an MSE wall and the existing roadway embankment will reduce the width of the new roadway and rock embankment. This concept eliminates most of the additional rock embankment that would be required to construct the revised (shifted out) alignment for the elevated bridge.

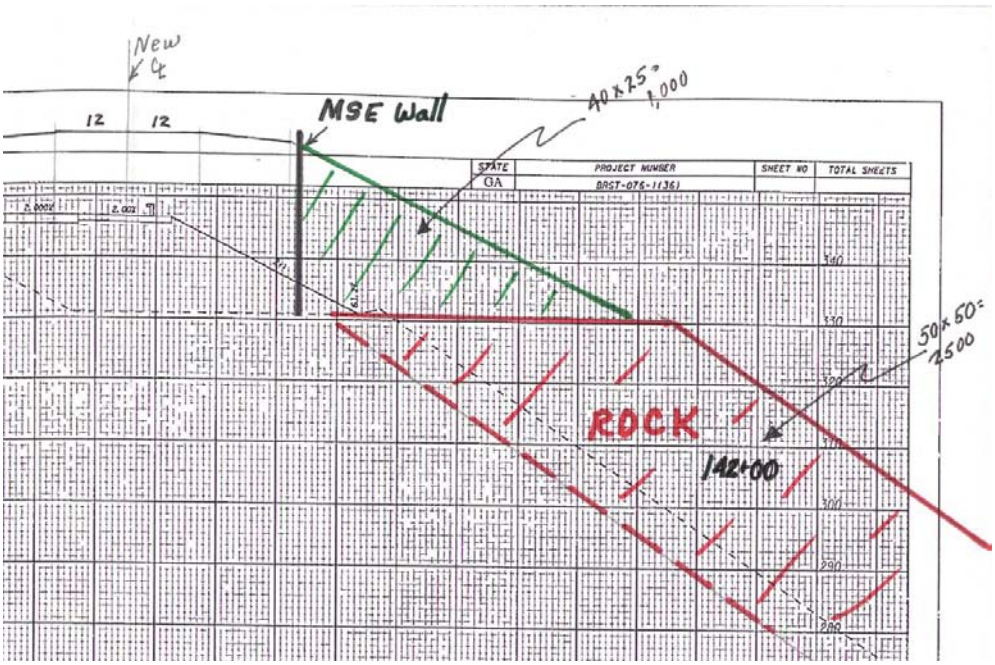
The VE concept reduces the project's impact on the lake, reduces the amount of rock and roadway embankment, simplifies and accelerates construction operations, minimizes the risk in constructing this project, and reduces project cost.

COST SUMMARY	INITIAL COST	FUTURE COST	TOTAL L. C. COST SAVINGS
Original	$3,859,000		
Proposed	$1,890,000		
Savings	$1,969,000		$1,969,000
FUTURE COST: – Savings		N/A	N/A
TOTAL PRESENT WORTH SAVINGS			**$1,969,000**

SKETCH

Project: SR 47 Bridge Replacement Over Little River	Idea No.: F-5 Client: GDOT Sheet 2 of 4





COST WORKSHEET

Project: SR 47 Bridge Replacement Over Little River					Idea No.: F-5 Client: GDOT Sheet 3 of 4		
CONSTRUCTION ELEMENT		**ORIGINAL ESTIMATE**			**NEW ESTIMATE**		
Item	**Unit**	**No. Units**	**Cost/Unit**	**Total Cost**	**No. Units**	**Cost/Unit**	**Total Cost**
Original Design:							
Additional Rock Emb.	CY	185,185	$18.20	$3,370,367	0		$0
Additional Roadway Emb.	CY	74,074	$4.61	$346,091	0		$0
Foundation Backfill	CY	741	$37.37	$27,691	0		$0
Riprap	SY	1,333	$41.78	$55,692	0		$0
Guardrail Type W	LF	4,000	$14.46	$57,840	0		$0
Guardrail Type T	LF	42	$42.46	$1,783	0		$0
VE MSE Wall Concept:							
MSE Wall	SF				36,000	$40.00	$1,440,000
Barrier Wall on MSW wall	LF				3,000	$150.00	$450,000
SUBTOTAL				$3,859,464			$1,890,000
TOTAL ROUNDED				**$3,859,000**			**$1,890,000**

CALCULATIONS

Project: SR 47 Bridge Replacement Over Little River	Idea No.: F-5 Client: GDOT Sheet 4 of 4

Additional material to revise alignment to raise the grade for new clearance requirement.
Assume: Shift alignment between Station 122 to Station 142 and Station 150 to Station 170.

Additional Rock Embankment:
End area at Sta. 122 & 170 = 1 SF & End area at Sta. 142 & 170 = 50 ft x 50 ft = 2,500 SF
Volume = (2,000 ft + 2,000 ft) x (1 SF + 2,500 SF)/2 = 5,000,000/27 = 185,185 CY
185,185 CY @ $18.20 = $3,370,367

Additional Roadway Embankment:
End area at Sta. 122 & 170 = 1 SF End area at Sta. 142 & 170 = 25 ft x 40 ft = 1,000 SF
Volume = (2,000 ft + 2,000 ft) x (1 SF + 1,000SF)/2 = 2,000,000/27 =74,074 CY
75,074 CY @ $4.61 = $346,091
Total Cost Increase = $3,370,367 + $346,091 = $3,716,458

Foundation Backfill Volume:
Assume (5 ft wide x 2,000 ft long x 1 ft thick) x 2 = 20,000 CF/27 = 740.7 CY Use 741 CY
Cost = 741 CY @ $37.37 = $27,691

Riprap Area:
Assume (Ave 3 ft tall x 2,000 ft wide) x 2 = 12,000 SF/9 = 1,333 SY
Cost = 1,333 SY @ $41.78 = $55,692

Guardrail Type T: Assume ½ cost estimate = $1,783
Guardrail Type W Assume 4,000 ft @ $14.57 = $57,840

VE Concept:
MSE wall:
Station 127 to 142 + Station 150 to 165 = 3,000 ft
Assume wall height of 4 to 28 ft = 12 ft average
Wall area = 3,000 ft x 12 ft = 36,000 SF
Total Wall Cost = 36,000 @ 40/SF =$1,440,000

Traffic Barrier H on MSE wall: Assume 3,000 ft @ $150.00 = $450,000

APPENDIX

Sources

Approving/Authorizing Persons

Name:	Position:	Telephone:
Ron Wishon	Engineering Services	404-631-1753
Foster Grimes	District 2 Project Engineer	478-552-4643

Personal Contacts

Name:	Telephone:	Notes:
Foster Grimes	478-552-4643	Project Briefing
Susan Beck	404-631-1862	Discuss Hydraulic Information relating to Q-Values for a lake.
Tom Scruggs	404-363-7548	Discuss use of Foundation Backfill material.
Foster Grimes	478-552-4643	Discuss Foundation Backfill Quantity and other Cost Estimate Quantities/Prices

Documents/Abstracts

Reference:	Reference:
Project Concept Report	Preliminary Cross Sections
Project Cost Estimate	VE Study Constraints
Revised Project Profile	Soil Survey Summary
Revised Project Alignment	Fill Placement Area Schematic
Preliminary Steel Bridge Layout	Benching Detail Schematic
Preliminary Concrete Bridge Layout	Existing Bridge Plans

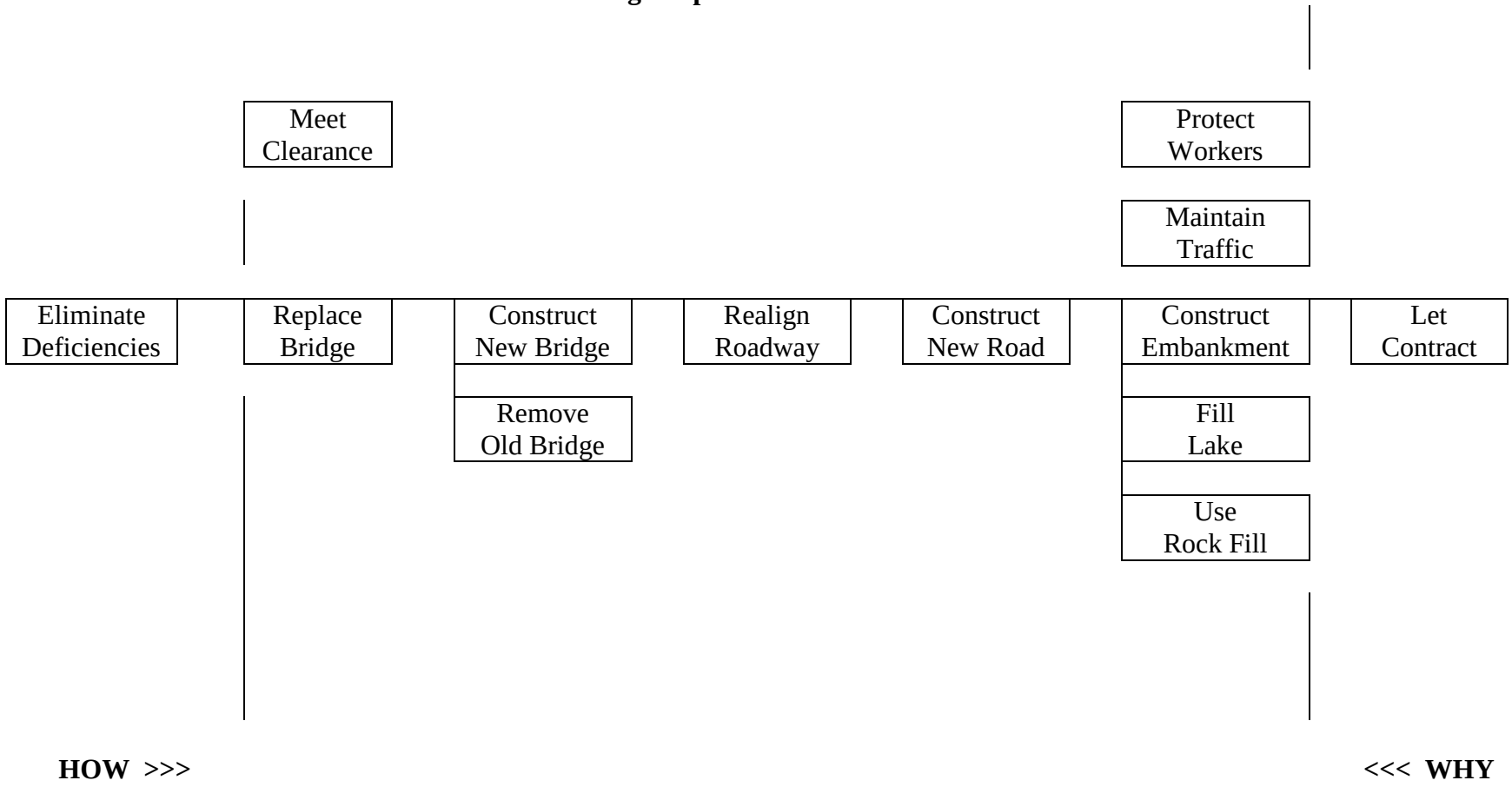
SR 47 Bridge Replacement Over Little River

Cost Model/Distribution

Item	Description	$ Amount	% of Total Project
A	New Bridge	$3,552,000	33.5%
B	Rock Embankment	$3,349,000	31.6%
C	Remove Old bridge	$1,188,000	11.2%
D	Found Backfill Material	$874,000	8.2%
E	Asphalt Pavement	$445,000	4.2%
F	In-Place Embankment	$330,000	3.1%
G	Erosion Control	$176,000	1.7%
H	Guardrail Type T & W	$150,000	1.4%
I	GR Aggregate Subbase	$142,000	1.3%
J	Miscellaneous	$104,000	1.0%
K	Clear & Grubbing	$90,000	0.8%
L	Asphalt Curb	$85,000	0.8%
M	Dumped Rip Rap	$51,000	0.5%
N	Traffic Control	$50,000	0.5%
O	Signing & Marking	$19,000	0.2%
		$10,605,000	100.0%

FAST DIAGRAM

SR 47 Bridge Replacement Over Little River



INFORMATION PHASE – FUNCTION ANALYSIS

Project: SR 47 Bridge Replacement Over Little River
Function: Replace Bridge

ITEM No.	DESCRIPTION	FUNCTION		INITIAL DOLLARS		
		Verb	Noun	Cost	% of Total	Worth/Save
A	**New Bridge**	Cross	Channel	$3,552,000	33.5%	Yes
		Accommodate	Sailboats			
		Raise	Grade			
		Add	Shoulders			
		Eliminate	Def. Bridge			
		Accommodate	ACOE Height			
B	**Rock Embankment**	Support	Roadway	$3,349,000	31.6%	Yes
		Protect	Embankment			
		Fill	Lake			
		Minimize	Scour			
C	**Remove Existing Bridge**	Remove	Bridge	$1,188,000	11.2%	Yes
		Free	Vertical Obstruction			
D	**Foundation Backfill Material**	Support	Substructure	$874,000	8.2%	Yes
		Replace	Unsuitable Mat			
		Backfill	Culverts			

INFORMATION PHASE – FUNCTION ANALYSIS

Project: SR 47 Bridge Replacement Over Little River
Function: Replace Bridge

ITEM No.	DESCRIPTION	FUNCTION		INITIAL DOLLARS		
		Verb	Noun	Cost	% of Total	Worth/Save
E	**Asphalt Pavement**	Support	Traffic	$445,000	4.2%	Yes
		Construct	Shoulders			
		Connect	Bridge			
F	**In-Place Embankment**	Support	Roadway	$330,000	3.1%	Yes
		Achieve	Grade			
G	**Erosion Control**	Eliminate	Sediment	$176,000	1.7%	No
		Protect	Lake			
H	**Guardrail Type T & W**	Protect	Motorists	$150,000	1.4%	Yes
		Steepen	Slopes			
I	**Aggregate Subbase**	Support	Roadway	$142,000	1.3%	No
		Drain	Pavement			
J	**Miscellaneous**	Construct	Project	$104,000	1.0%	No

INFORMATION PHASE – FUNCTION ANALYSIS

Project: SR 47 Bridge Replacement Over Little River
Function: Replace Bridge

ITEM No.	DESCRIPTION	FUNCTION		INITIAL DOLLARS		
		Verb	Noun	Cost	% of Total	Worth/Save
K	**Clearing & Grubbing**	Prepare	Site	$90,000	0.8%	No
L.	**Asphalt Curb**	Minimize	Erosion	$85,000	0.8%	No
		Contain	Water			
		Protect	Slopes			
		Convey	Water			
M	**Dumped Rip Rap**	Protect	Structures	$51,000	0.5%	Yes
		Prevent	Erosion			
		Prevent	Scour			
N	**Traffic Control**	Maintain	Traffic	$50,000	0.5%	Yes
		Separate	Work Zones			
		Protect	Motorists			
		Protect	Worker			
O	**Signing & Markings**	Advise	Motorists	$19,000	0.2%	No
		Improve	Safety			

CREATIVE PHASE Creative Idea Listing		JUDGMENT PHASE Idea Evaluation	
No.	**CREATIVE IDEA**	**COMMENTS**	**IDEA RATING**
A	**New Bridge**		
A-1	Revise Span Arrangement to Remove Pier form the Center of the Channel.	Lower pier height.	X
A-2	Revise Steel Bridge Option to Allow Longer Spans	Longer Spans Will Raise Profile	X
A-3	Lengthen the Bridge and Eliminate Some of the High Embankment Areas.	Less Impact on the Lake	✓
A-4	Shorten the Bridge to Allow Boating through only 1 or 2 Center Spans.	Doesn't Meet Hydraulic Opening Requirements	X
A-5	Realign the Bridge so it Crosses at a Different Location.	Eliminate Staging	✓
A-6	Add Sidewalks/Bike Lanes to Bridge.	Accommodate Pedestrians	DS
A-7	Construct a Bascule Bridge to Obtain Vertical Clearance.	Not Practical	X
A-8	Construct the Bridge using Longer Center Spans and Causeway Approaches.	See Idea A-3	X
A-9	Reduce the Width of the Shoulders since Bridge > 200 ft	Reduce the Cost of the Bridge	✓
A-10	Close the Existing Bridge, Detour Traffic, and Construct the New Bridge on the Existing Alignment.	Road Closure & Detour Traffic Impact.	✓
A-11	Reduce Center Spans Lengths to Use Smaller Depth Beams	Lower Grade and reduce Embankment	✓
✓ = Will be considered further; X = will be dropped; DS = Design suggestion –written for consideration by design team			

CREATIVE PHASE Creative Idea Listing		JUDGMENT PHASE Idea Evaluation	
No.	**CREATIVE IDEA**	**COMMENTS**	**IDEA RATING**
A-12	Use Combination Structure of Concrete & Steel (center spans) to Reduce Beam Thickness and lower Grade	See Idea A-13	X
A-13	Construct 1 Short Center Span (90 ft) using Type 3 PSC Beams to Reduce Beam Depth and Use Continuous Steel System one the End Spans to Maximize Spacing.	Lower Roadway Profile, Reduce Amount of Embankment.	✓
A-14	Revise Roadway Curve Approaches to Shift Alignment.	Eliminate Construction Staging	X
B	**Rock Embankment**		
B-1	Revise/Lower Roadway Grade to Reduce Embankment Height.	Reduce Size of the new Embankment	✓
B-2	Use Alternate Materials (broken concrete) to Build some of the Embankment.	Question Availability, Environmental Concerns	X
B-3	Use Sheet Piling During Stage Construction to Reduce the Amount of the New Roadway Offset.	See Idea F-3	X
B-4	Use Precast Concrete Units/Blocks to Hold the Edge of the New Embankment in-place.	Higher Cost, Question Availability	DS
C	**Remove the Old Bridge**		
C-1	Remove only the Center Spans of the Old Bridge.	Reduce Cost, Simplify Construction	X
✓ = Will be considered further; X = will be dropped; DS = Design suggestion –written for consideration by design team			

CREATIVE PHASE Creative Idea Listing		JUDGMENT PHASE Idea Evaluation	
No.	**CREATIVE IDEA**	**COMMENTS**	**IDEA RATING**
D	**Foundation Backfill Material**		
D-1	Lower the Roadway Grade and Reduce the Height of the Embankment Approaches.	See Idea F-1, F-2	X
D-2	Eliminate the Foundation Backfill Material from the top of the Rock Embankment.	Reduce Cost	✓
D-3	Use Alternate Material in-lieu-of Foundation Backfill	Reduce Cost	✓
E	**Asphalt Pavement**		
E-1	Check Cost Estimate to Verify that the Full-Depth Right Shoulder Quantities are Included in the Pavement Costs	Verify Cost Estimate	DS
E-2	Will Temporary Barrier be Required on Both Sides of the Temporary Lane using the Full-Depth Right Shoulder	Verify Cost Estimate	DS
F	**In-Place Embankment**		
F-1	Lower the Center Bridge Height (shorter spans & shallow beams) and Lower the Roadway Grade at Embankments	Reduce Roadway Profile and Embankment Height	✓
F-2	Lower the Roadway Grade to match the Existing Grade.	Reduce Embankment Size	✓
✓ = Will be considered further; X = will be dropped; DS = Design suggestion –written for consideration by design team			

CREATIVE PHASE Creative Idea Listing		JUDGMENT PHASE Idea Evaluation	
No.	**CREATIVE IDEA**	**COMMENTS**	**IDEA RATING**
F-3	Use Sheet Piling to Hold the New Embankment and Reduce the Distance between the New and Old Roadways	Reduce Embankment Size. Bring Old and New Roadway closer together.	✓
F-4	Increase the Roadway Grade at the Bridge to shorten the length of the high fill areas..	Reduce Embankment Area	✓
F-5	Build MSE Wall to contain new Roadway in-lieu-of Rock Embankment	Reduce Rock Embankment	✓
H	**Guardrail Type T and W**		
H-1	Use Cable Barrier in-lieu-of Type W guardrail in areas with low fills.	Possible Cost reduction	✓
H-2	Eliminate the Asphalt paving and use aggregate shoulders in flat sections at the ends of the project.	No Erosion Would Take Place in Flat Segments with Low Fills	DS
M	**Dumped Riprap**		
M-1	Add Quantity for Bridge End rolls	Verify Cost Estimate	DS
M-2	Verify Quantity	Assure all Quantities are Counted	DS
N	**Traffic Control**		
N-1	Check Cost and Quantity	Current cost Estimate Appears Low	DS
✓ = Will be considered further; X = will be dropped; DS = Design suggestion –written for consideration by design team			

CREATIVE PHASE Creative Idea Listing		JUDGMENT PHASE Idea Evaluation	
No.	**CREATIVE IDEA**	**COMMENTS**	**IDEA RATING**
N-2	Check Constructing Staging and need for Temporary Barrier	Staging will Require significant Amounts of Barrier Wall which may not be included in Cost Estimate.	DS
N-2	Address Necessary Drainage Requirements Needed for the Construction Staging.	Could be a High Cost items that may not be Included in Current Cost Estimate	DS
✓ = Will be considered further; X = will be dropped; DS = Design suggestion –written for consideration by design team			

VE STUDY SIGN-IN SHEET

Project No.: BRSTO-0076-01(036) County: Lincoln/Columbia PI No.: 232310- Date: August 9-12, 2010

Days FIRST	Days LAST	NAME	EMPLOYEE ID NO.	DOT OFFICE OR COMPANY	PHONE NUMBER	EMAIL ADDRESS
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✓		Ken Werho		Traffic Operations	404-635-8144	kwerho@dot.ga.gov
✓	✓	Ron Wishon		Engineering Services	404-631-1753	rwishon@dot.ga.gov
✓	✓	GEORGE OBAMNIC		MACTEC	770-421-3346	GASSAMANC@MACTEC.COM
✓	✓	Steve Bitney		Street Smarts	770-813-0882	Steveb@streetsmarts.us
✓	✓	ARUNA SASTRY		SASTRY AND ASS.	678-366-9375	Sast9375@bellsouth.net
✓	✓	Keith Borkenhagen		MACTEC	623-556-1875	kborkenhagen@msn.com
✓	✓	Bill DuVall		BRIDGE	404-631-1883	bduvall@dot.ga.gov
	✓	Cindy Pollard		BRIDGE	404-631-1865	cipollard@DOT.ga.gov

✓ Check all that attend

17 Attended Project Overview(Day 1)
7 VIA VIDEO (Dist. #2)

14 Attended Project Presentation (Day 4)
5 VIA VIDEO (Dist. #2)

VE STUDY SIGN-IN SHEET

Project No. BRSTO-0076-01(036) County Lincoln/Columbia PI No 232310- Date. August 9-12, 2010

Days

FIRST	LAST	NAME	EMPLOYEE ID NO	DOT OFFICE OR COMPANY	PHONE NUMBER	EMAIL ADDRESS
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✓		RUSTY MERRITT		"	552 4603	rmerritt@ dot ga gov

✓ Check all that attend 7 Attended Project Overview(Day 1) via VIDEO ____ Attended Project Presentation (Day 4)