

**APPENDIX D**  
**VALUE ENGINEERING STUDY**

**FINAL REPORT**  
**VALUE ENGINEERING STUDY**

**CDOT – Region 5**  
**US 550 Environmental Assessment**

**December 2003**

**Prepared for**  
**URS Corporation**

**BY SOLUTIONS ENGINEERING & FACILITATING, INC.**

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## **SECTION 1 – SUMMARY**

## SUMMARY

This Value Engineering (VE) Study generated eleven proposals and twenty-two supplemental recommendations.

### Caveats:

- Cost estimates made by the VE Team are intended to reflect relative values between alternatives. The estimated savings identified within each proposal are based upon comparison of the proposal to the EA conceptual design. For purposes of comparison only, Alternative B for Bondad Hill was selected. Therefore, as is true with all cost estimates, the savings indicated are only approximate.
- Only potential savings are shown. As the proposals are implemented, additional costs or savings may result from redesign or modification.
- Where applicable proposed savings were calculated on a life cycle cost savings basis, not just initial (capital) savings. Future operations, maintenance, and periodic replacement costs are all calculated into the potential life cycle cost savings listed.
- Where applicable future estimated potential life cycle savings are presented on a present worth basis calculated as a 8 percent interest rate over a 20-year expected equipment life span for asphalt paving, 30 years for concrete paving and 50 years for bridges ( $I = 8\%$  and  $N = 20, 30, \text{ or } 50$  years). The actual life cycle costs will vary as a function of equipment life span and the interest rate charged for capital financing.
- Some VE Proposals are mutually exclusive. Therefore, the potential savings are not the simple sum of all the VE Proposals presented.

VE PROPOSAL SUMMARY TABLE

PROPOSAL NO.	VE PROPOSAL DESCRIPTION	REVIEW BOARD COMMENTS	PAGE NO.
P01-011	<p>Use a "Super Two" concept throughout the project  <i>Initial Est. Savings: \$12,800,000</i>  <i>Future Est. Savings: \$0,000</i>  <i>Total Est. Savings: \$12,800,000</i></p>	<p><b>DECLINE</b>                      Use a "Super Two" concept throughout the project</p> <ul style="list-style-type: none"> <li>• Need to narrow the capacity range so it is specific to this corridor. Could be acceptable or it could fail. There would be some through away cost when you construct the ultimate 4-lanes. URS will perform a detailed traffic analysis to see If this concept will work for future traffic projections.</li> </ul> <p>Note: The original Board decision was to table for further study and information gathering. That was done. Based on the findings CDOT decided to decline this proposal</p>	3-1
P01-006	<p>Use a three lane cross section alternating the center lane as a passing lane.  <i>Initial Est. Savings: \$18,000,000</i>  <i>Future Est. Savings: \$0,000</i>  <i>Total Est. Savings: \$18,000,000</i></p>	<p><b>TABLE</b></p> <ul style="list-style-type: none"> <li>• This would be the ultimate (i.e. no 4-lane section). Need to determine if it meets LOS C. Look at using cable barrier to restrict left turning movements for the passing lane.</li> <li>• Signalizing the county road intersections was discussed to break up the vehicle platoons; CDOT does not want to introduce signals along this corridor. Assume no access consolidation to frontage roads.</li> <li>• The connecting links, both north and south, would be 4-lane sections. ROW savings and barrier costs were not included in the cost estimate.</li> </ul> <p>URS will perform a detailed traffic analysis to see If this concept will work for future traffic projections</p>	3-14

PROPOSAL NO.	VE PROPOSAL DESCRIPTION	REVIEW BOARD COMMENTS	PAGE NO.
P01-012	Reduce/eliminate median and examine barrier types <i>Initial Est. Savings: \$180,000 to \$430,000</i> <i>Future Est. Savings: \$0,000</i> <i>Total Est. Savings: \$180,000 to \$430,000</i>	<ul style="list-style-type: none"> <li>• A. <b>DECLINE</b> 30 ft median</li> <li>• B. <b>DECLINE</b> 14 ft median with a type 7 barrier</li> <li>• C. <b>DECLINE</b> 24 ft median with a cable barrier</li> <li>• A. U-turn movements are more difficult. Does not meet 35ft clear zone. Drainage in the median does work.</li> <li>• B. ROW cost savings is offset by the cost of the barrier and attenuators. It gives the corridor an urban look. Does not reduce roadway width enough to eliminate impacts through Sunnyside. Introduces a hazard.</li> <li>• C. A cost saving does not include cost of barrier. Maintenance could be a problem. Introduces a hazard.</li> </ul> <p><b>NOTE:</b> Following the Review Board meeting, CDOT held an internal meeting to discuss the median width in more detail. In the meeting, the decision was made to use a 46' median width.</p>	3-21
P01-049	Use County Road Standards on adjacent roadways which require modification in lieu of CDOT Standards. <i>Initial Est. Savings: \$1,180,000</i> <i>Future Est. Savings: \$0,000</i> <i>Total Est. Savings: \$1,180,000</i>	<p><b>ACCEPT</b></p> <p>The width would be reduced. La Plata County does have design standards. CDOT wants to get FHWA to ok these standards.</p>	3-25
P06-011	Steepen fill slopes from 3:1 to 2:1 with the clear zone requirements satisfied at the top of the fill slope. <i>Initial Est. Savings: \$409,000</i> <i>Future Est. Savings: \$0,000</i> <i>Total Est. Savings: \$409,000</i>	<p><b>ACCEPT</b></p> <p>These fill slopes would be predominately at Bondad Hill and in high fill areas. The cost savings are in the earthwork. Need to verify that the 2:1 can be compacted, re-vegetated, and maintained.</p>	3-30
P01-032	Relocate the weigh station in the median of the four-lane facility <i>Initial Est. Savings: \$150,000</i> <i>Future Est. Savings: \$0,000</i> <i>Total Est. Savings: \$150,000</i>	<p><b>DECLINE</b></p> <p>Trucks exiting from the passing/left lane are not safe. Trucks merging into the passing/left lane are not safe. It violates driver expectancy. Would potentially need to add the cost of barrier and attenuators to the cost.</p>	3-34

PROPOSAL NO.	VE PROPOSAL DESCRIPTION	REVIEW BOARD COMMENTS	PAGE NO.
P01-008	Use alternative alignment at Bondad Hill <i>Initial Est. Savings: \$6,470,000 vs. Alt2A</i> <i>\$8,450,000 vs. Alt2B</i> <i>Future Est. Savings: \$0,000</i> <i>Total Est. Savings: \$6,470,000</i>	<b>ACCEPT</b> <ul style="list-style-type: none"> <li>Two typical sections were run (one with retaining walls and one without). The earthwork balanced with the one without retaining walls and translated into the cost savings.</li> <li>Constructability issues have been looked at and it was concluded to be constructable. With the retaining wall option, much of the savings go away.</li> </ul> This alternative needs to be shown to the SUIT. This alternative is a 70-mph design and has a 5% grade.	3-36
P03-006	Use the existing roadway alignment as the ultimate southbound alignment in Sections 3 and 4, north of Sunnyside. <i>Initial Est. Savings: \$2,000,000</i> <i>Future Est. Savings: \$0,000</i> <i>Total Est. Savings: \$2,000,000</i>	<b>ACCEPT</b> <ul style="list-style-type: none"> <li>This is an interim condition and the ultimate would still be to reconstruct the existing lanes. The existing lanes would be a variance for the interim. Because the pavement is in poor condition, we would probably need to do something to the existing lanes to help them last longer.</li> </ul> This idea needs to be included in the EA as apart of the implementation plan. This idea would be better than P01-011 from the perspective of having to maintain accesses, because P01-011 would require accesses to extend across CDOT ROW to connect to the new 2-lane.	3-58
P01-021	Refine the alignments to make the project more constructible <i>Initial Est. Savings: \$4,300,000</i> <i>Future Est. Savings: \$0,000</i> <i>Total Est. Savings: \$4,300,000</i>	<b>DECLINE</b> Refining the alignment probably will not have significant cost savings. The as proposed alignments could be easily phased into plan packages and should be constructable.	3-63
P02-014	Rather than importing substantial amounts of subbase material, recycle the existing asphalt and subbase. <i>Initial Est. Savings: \$6,600,000</i> <i>Future Est. Savings: \$0,000</i> <i>Total Est. Savings: \$6,600,000</i>	<b>TABLE</b> Can not make a decision until we know what is out there. Contractor can use this material if it meets the R-value, but we do not want to designate that to the contractor. This would be included in the final geotechnical report. Table this proposal for CDOT geotech to do during final design.	3-66
P01-043	Match phasing of first Section 4 US 550 project with Farmington Hill US 160 project to balance earthwork. <i>Initial Est. Savings: \$420,000</i> <i>Future Est. Savings: \$0,000</i> <i>Total Est. Savings: \$420,000</i>	<b>ACCEPT</b> The material from the Farmington Hill cut could be utilized for US 550. Could also stockpile the material to be used later. At a minimum the ROW at Farmington Hill should be purchased so that the earthwork could be utilized. Accept this proposal provided the funding is available to do concurrently.	3-70

The potential savings for accepted savings are:

**Total Cost Savings of Proposals Accepted = \$10,700,000**

**Total For Additional Cost Savings For Tabled Proposals = \$24,600,000**

The conceptual estimate at the time of VE Study was:

**US 550 Mainline**

**Section 2B Bondad 60mph, 5% Grade, 14' Median**

Sta. 261+00 to Sta. 448+00 18700 lf

roadway width 78 ft  
Cut 817,219 CY  
Fill 861,397 CY  
HBP depth 8 inches  
ABC depth 18 inches

Description	Units	Quantity	Unit Price	Price
Unclassified Excavation (CIP)	CY	1,613,213.00	\$ 6.50	\$ 10,485,900.00
Topsoil (assume 30 ft, 1 side)	CY	43,998.00	\$ 6.50	\$ 286,000.00
Erosion Control	MILE	15.00	\$ 30,000.00	\$ 450,000.00
Seeding ,Tackifier, Mulching	MILE	15.00	\$ 15,750.00	\$ 236,300.00
Aggregate Base Course (Class 6)	TON	558,981.00	\$ 15.00	\$ 8,384,700.00
Hot Bituminous Pavement	TON	269,905.00	\$ 45.00	\$ 12,145,700.00
Pavement Marking Paint	GAL	719.00	\$ 50.00	\$ 36,000.00
*Bridges	SF	41,856.00	\$ 80.00	\$ 3,348,500.00
Retaining Walls	Sq. Ft.	61,550.00	\$ 70.00	\$ 4,308,500.00
Drainage	LF	79,200.00	\$ 27.00	\$ 2,138,400.00
<i>subtotal =</i>				<i>\$ 41,820,000.00</i>
Contingencies			45%	\$ 18,819,000.00
<i>subtotal</i>				<i>\$ 60,639,000.00</i>
mobilization			10%	\$ 6,063,900.00
traffic control			5%	\$ 3,031,950.00
construction survey			2%	\$ 1,212,780.00
construction engineering			17%	\$ 10,308,630.00
<b>total</b>				<b>\$ 81,256,260.00</b>
pe			10%	\$ 6,063,900.00
<b>Grand Total =</b>				<b>\$ 87,320,160.00</b>
Original Est. (assume 2B)				\$ 87,320,160.00

## **SECTION 2 – INTRODUCTION**

## INTRODUCTION

Value Engineering (VE) analysis identifies the high cost areas of a project during the early design stages. The VE Study then determines less expensive alternative designs that can still be incorporated into the final design drawings and specifications without incurring large costs for redesign or major project delay. These VE proposals are substantiated with technical and economic analyses.

A subsequent *Final Report* will include:

- A list of the Review Board members.
- A summary of cost savings as a result of the VE study.
- A summary of accepted proposals.
- The documentation of the Review Board's reasoning.
- A summary of the rejected VE proposals will also be included in the Final VE Report and will include the reason(s) for their rejection. The reasons may include cost-effectiveness, reliability concerns, unusual operation and maintenance problems, or project delays.
- The contents of the *Preliminary Report*.

## PROJECT DESCRIPTION

### Description

Conceptual design for an upgrade of the current two-lane highway to a four-lane facility

### Project Limits

This project begins at the Colorado/New Mexico State Line (milepost 0) and ends at County Road 220 (milepost 15.5), which is located approximately 1 mile south of the US 160/550 intersection.

### Project Scope

Required conceptual design needed to support the preparation of an EA for US 550. The scope of work includes developing viable design alternatives for the US 550 corridor that will be used in the US 550 EA. This task order also includes developing corridor guidelines that are intended to establish aesthetic themes for the corridor.

Related task orders are T.O. 61 (URS Project 67-00042513) - US 550 Alternate Corridor Screening, T.O. 62 (URS Project 67-00042514) - US 550 Interim Safety Improvements, and T.O. No. 45 (URS Project 68-00044628) – US 550 Environmental Field Investigations.

### Project Progress

Task Order No. 63 was approved April 9, 2001. The following work has been or is in the process of being completed.

- Developed design criteria and typical sections for CDOT approval
- Developed digital terrain models for use in conceptual design using aerial mapping furnished by CDOT
- Preliminary hydrology/hydraulics investigations
- Developed alignment alternatives for US 550
- Prepared planning-level construction cost estimates for a 4-lane and 2-lane scenario.

### Project Issues

The Southern Ute Tribe (SUIT) owns land along the US 550 Corridor in four locations. Alignment alternatives are being developed to minimize impacts to Tribal lands. In order to minimize impacts at Bondad Hill, three alternatives are being evaluated. One of the alternatives will require a design variance to keep the vertical grade at 6%.

This project is being performed concurrently with T.O. No. 45 – US 550 Field Investigations. Based on preliminary information from the field investigations, several historic and archaeological sites have been identified. Currently, alternatives are being developed to attempt to minimize impacts to these properties. At this time, it is unknown whether impacts to these properties can be completely avoided.

The Sunnyside area along US 550 includes the Old Homestead Mobile Home Park, Sunnyside Elementary School, a Fire Station, and one potentially eligible historic home; all located close to the existing right of way. This area presents one of the greatest design challenges to minimize impacts.

Surveys for the southwestern willow flycatcher are being conducted under a separate task order. Once the results of the survey are known, alignment alternatives might need to be developed to avoid the habitat if birds are found by this survey.

## ORGANIZATION

### VE STUDY TEAM

The following individuals were members of the VE Team:

VE TEAM MEMBER	FIRM	TELEPHONE/E-MAIL
Bill Beams	Felsburg Holt & Ullevig Greenwood Corporate Plaza 7951 E. Maplewood Ave. Suite 200 Greenwood Village, CO 80111	(t) 303-721-1440 (e) bill.beams@fhueng.com
Chris Beller	CDOT Region 5 3803 N. Main Avenue, Suite 108 Durango, CO 81301	(t) 970-385-3622 (e) chris.beller@dot.state.co.us
Jane Board	David Evans and Assoc. 1331 17th St. Suite 900 Denver, CO 80202	(t) 720-946-0969 (e) jebo@deainc.com
Steven Cross	URS Corporation Rock Point Dr. Suite D Durango, CO 81301	(t) 970-259-9212 (e) steven_cross@urscorp.com
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Mark Schofield	Wilson & Company 999 18th Street, Suite 2600 Denver, CO 80202	(t) 303-297-2976 (e) mark.schofield@co.wilsonco.com

FACILITATOR	FIRM	TELEPHONE/E-MAIL
C. Bernerd Dull, PE, CVS	Solutions Engineering & Facilitating, Inc.	(t) 303-670-5620 (f) 303-282-3817 (e) bdull@solutions-engineering.com

## THE REVIEW BOARD

The Review Board is comprised of the following representatives.

REVIEW BOARD MEMBER	FIRM	TELEPHONE/E-MAIL
Chris Beller	CDOT Region 5 3803 N. Main Avenue, Suite 108 Durango, CO 81301	(t) 970-385-3622 (e) chris.beller@dot.state.co.us
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Pete Hinckley	URS New Mexico 6501 Americas Parkway NE Suite 900 Albuquerque, NM 87110	(t) 505-855-7409 (e) peter_hinckley@urscorp.com
Mitch Kumar	CDOT Region 5 3803 N. Main Avenue, Suite 108 Durango, CO 81301	(t) 970-385-1444 (e) mithilesh.kumar@dot.state.co.us
Kerrie Neet	CDOT Region 5 3803 N. Main Avenue, Suite 108 Durango, CO 81303	(t) 970-385-1430 (e) kerrie.neet@dot.state.co.us
Richard Reynolds	CDOT Region 5 3803 N. Main Avenue, Suite 108 Durango, CO 81303	(t) 970-385-1402 (e) richard.reynolds@dot.state.co.us (e) karen.gomez@dot.state.co.us

The reviewers decide upon the status of the VE proposals in one of four ways:

1. Accept the proposed alternative as it stands. This will require the design team to implement the accepted proposed alternative. Those individuals comprising the Review Board are expected to have this authority for their respective organization.
2. Accept the proposed alternative with modifications. This disposition is similar to item 1 but with some changes imposed by the Review Board.
3. Decline the proposed alternative altogether. This disposition is obvious, but proper reasoning must be given for the *Final Report*.
4. Table the proposed alternative for further study or information gathering. If a proposed alternative is tabled, it is wise to assign responsibilities to resolve the issue(s), assign a schedule for resolution, and design a decision tree.

## METHOD OF THE VE STUDY

### VE ANALYTICAL PROCESS

<u>STEP</u>	<u>PROCEDURE INVOLVED</u>
Information	The VE Team reviewed the existing design to identify basic functions where effectiveness could be improved or potential cost savings could be significant. These basic functions were organized into a Function Analysis Systems Technique (FAST) diagram. FAST diagrams serve as tools to help the VE Team visualize the functions that different portions of a project must perform. The FAST diagrams set priorities for analysis and for assessing the compatibility of alternatives with the total project design package.
Creative	The VE Team selected the basic functions for further analysis on the basis of cost and potential for improvement. Formal brainstorming sessions generated as many alternative methods as possible for achieving the selected basic functions.
Analysis	Analysis was performed by first passing or failing the brainstormed ideas, then combining or grouping similar ideas. The VE Team as a whole then discussed and recorded the relative advantages and disadvantages of each idea. The ideas surviving these discussions were selected as candidates for further development by individual team members.
Development	A detailed technical examination followed, including specific quantities, costs, and calculations for ideas shown to have potential for significant savings. An economic analysis of technically feasible alternatives was made. Ideas that passed the technical and economical analyses and, in the opinion of the VE Team should be incorporated into the design, were prepared as formal proposals.
Presentation & Report	All ideas, calculations, and cost analyses were recorded during the VE process and were compiled to provide support to this document.

## **SECTION 3 – VE PROPOSALS**

## VALUE ENGINEERING PROPOSAL NO. 01-011

### SUMMARY PROPOSAL DESCRIPTION:

Develop a "Super-Two" alternative to increase mobility while minimizing Capital costs.

Estimated potential savings:

Initial:	\$ 12,800,000
Future:	\$ 0,000
Total:	\$ 12,800,000

### **Discussion:**

Develop a "Super-Two" alternative to increase mobility while minimizing Capital costs. Assume an ultimate four lane "Build Out".

### **Related Ideas:**

- SR05-001 - Develop a Phasing Implementation Plan
- SR01-045 - Reduce the speed limit through Sunnyside and use traffic calming measures to reinforce driver recognition of lower speed limits
- Brainstorm Idea 01-047 - Centerline rumble strips (See Section 7)

<b>EVALUATION</b>
<p>Idea Number: 01-011 Idea Description: Develop a "Super-Two" alternative to increase mobility while minimizing Capital costs.</p>
<p>Advantages of alternative concept:</p> <ol style="list-style-type: none"> <li>1. Significant cost savings</li> <li>2. Can be expanded in the future to a 4-lane divided or undivided section with minimal "Throw Away"</li> <li>3. Can develop project inertia</li> <li>4. Provides a safer roadway while minimizing capitol cost</li> </ol>
<p>Advantages of original concept:</p> <ol style="list-style-type: none"> <li>1. Provides acceptable/optimum Level of Service (LOS)</li> <li>2. Safe</li> <li>3. No "Throw Away"</li> </ol>
<p>Risks:</p> <ol style="list-style-type: none"> <li>1. Travel Demand could exceed expectations leaving the highway temporarily operationally deficient.</li> </ol>
<p>Conclusion:</p> <p><input checked="" type="checkbox"/> Propose this idea</p> <p><input type="checkbox"/> Propose this idea as a Supplemental Recommendation</p> <p><input type="checkbox"/> Do not propose this idea because</p>

**Calculations and/or Discussion:**

The Super Two concept is becoming popular to meet the growing demands of rural two lane highways to minimize capital costs and impacts. The concept basically improves the highway to meet current standards for a two lane facility. In addition, passing lanes are introduced at strategic locations to clear the queues of slower moving vehicles. By better platooning of the vehicles the highway capacity is increased and is safer to travel by providing for less speed differential and more consistent flow.

The Super Two concept is ideal in locations which experience extreme seasonal factors over short periods of time, such as the US 550 corridor. The concept compromise the operations of the two lane infrastructure during peak seasons. This may include sacrificing Level of Service (LOS) during a relative short time. During the majority of the year LOS increases to more optimum levels.

The passing lanes are usually placed adjacent to communities or other locations where traffic is typically slowed, including signalized intersections, speed zones within rural communities and towns, at locations were grades become steep, or in locations were topographic and/or environmental constraints require reduced geometric standards such as the tightening of horizontal curves. The passing lanes are typically .75-1.25 miles in length depending on spacing and specific site requirements.

The design of passing lane spacing depends on the traffic volumes. On segments of highway where the volumes are low, chances of developing long platoons are also low; thus driver anxiety is not a problem. In such cases, the spacing of 10 to 15 miles between the passing lane segments may be totally adequate. On the other hand, where the volumes are heavy, 700 vph or more in one direction, the spacing of the passing lane segments may need to be 3 to 5 miles or even more frequent to properly handle the platooning problem. The operational benefits of the passing lane carry-over are generally dependent on the traffic volume. It usually is 3 to 6 miles downstream from the beginning of the passing lane. When the Super Two highway passes through a series of closely spaced cities, it is preferred that 3-lane passing sections be placed 2 to 3 miles outside the limits of each of the cities in the direction of the traffic flow. This will help to break up the platoons which might have formed at the slower speeds while traveling through the towns.

In the case of the US 550 project corridor, it may be desirable to clear the queues at the intersection which introduce the highest volumes to mainline. This may include CR213 or 318, CR 215 or 218 along with CR 302, and CR 220.

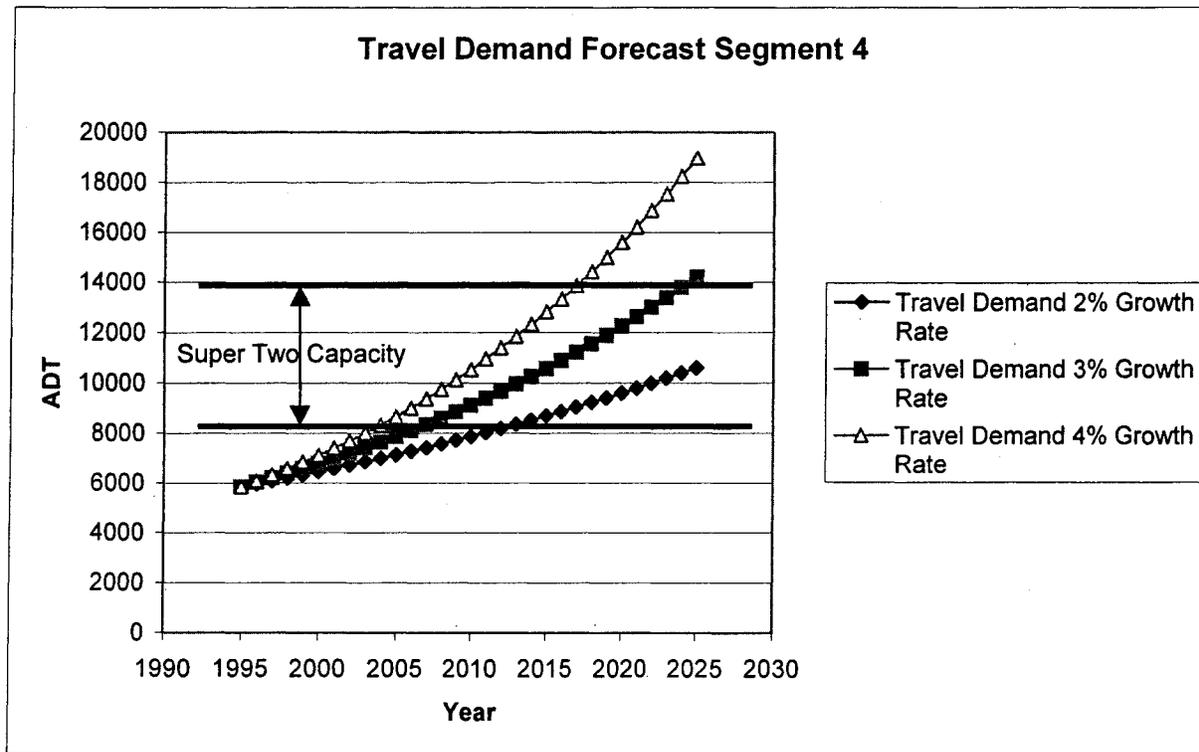
A study published in Transportation Research Record (TRR) 1303, "Warrants for Passing Lanes", shows that Passing Lanes on rural two-lane highways have a favorable benefit/cost ratio at AADTs of 6500 and greater. Based on the above, a principal arterial two-lane rural highway or selected high volume minor arterial routes could qualify to be considered for a Super Two design once it is scheduled for major upgrading or reconstruction, and the projected volume is 6000 ADT in the year after the segment is open to traffic. Construction of Super Twos, or selective use of some features of the Super Twos, may also be necessitated by high seasonal peaks, heavy commercial vehicle volumes and other unique traffic and terrain situations. Currently the volumes along US 550 are at or near these thresholds; 5850 ADT in 1995 and 6995 ADT in 2001.

The projected 2025 forecasted volumes for this corridor range from 12,960 ADT (south) to 18,100 ADT (north). These volumes are peak seasonal and apparently only occur two months of the year. A Super Two can typically handle between 12,000 – 15,000 ADT. Volumes above that will compromise the capacity and LOS. In addition, the Super Two concept is typically implemented on highways with a 70 mph design speed, and a corresponding 60 mph posted speed. The 550 corridor is currently classified and planned to provide for a 70 mph design speed with 60 to 70 mph posting.

Operational considerations must also be given to the effects of the LOS on side road intersections. Optimizing the through traffic on the mainline may limit the available gaps required for through crossing traffic or turning vehicles. Costs savings may quickly diminish if signals or grade separated structures are required to access the highway.

The projected volumes are extremely sensitive to; educated, calculated assumptions which may either drive an overly conservative long term solution, or may cause the improvements to become obsolete before the anticipated design life. The travel

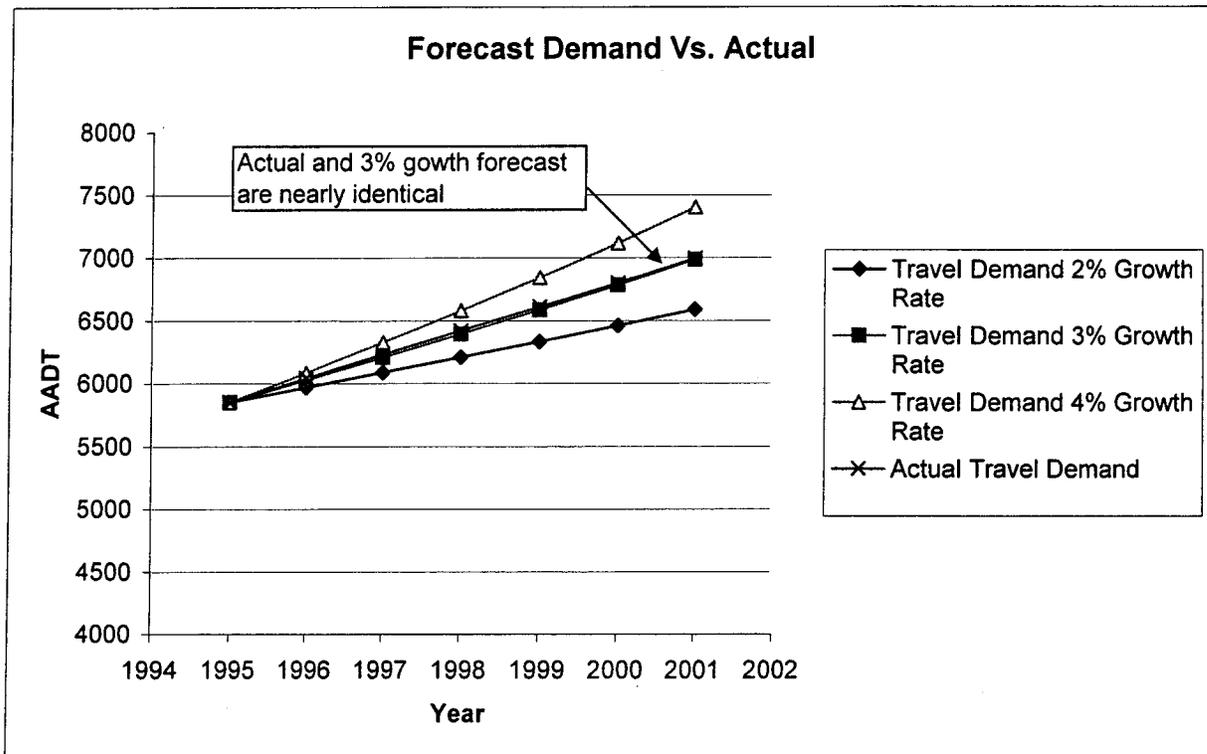
demand forecasts presented in the February 1999 URS "US 550 & 160 Feasibility Study" project adjacent land use and through vehicles at what appears to be an average annual growth rate of around 3%. The graph below represents a sensitivity analysis of an annual 3% growth rate projected to the 2025 design year.



As illustrated in this graph, the 2025 projections differ significantly based on the travel demand growth rate assumption.

The Super Two concept may be applicable for this corridor assuming a 2-3% growth rate, and may be applicable assuming a 4% growth rate though about 2018. At this time (2018) the Super Two highway may be expanded to a four lane divided section with minimal "Throwaway".

Current trends in the travel demand are illustrated below:



The Actual travel demands were based on counts in 1995 and 2001. The graph illustrates the current growth rates are increasing at about 3% annually. This rate should consider the relative poor economy over much of this period combined with lower than normal tourist traffic attracted to the area.

The Technical Memorandum below was issued by the Minnesota Department of Transportation in May of 1998 to document guidelines and criteria to be utilized in the implementation of the Super Two Concept.

MINNESOTA DEPARTMENT OF TRANSPORTATION  
Engineering Services Division  
Technical Memorandum No. 98-08-ES-01  
May 18, 1998

TO: Distribution 57, 612, 618, and 650  
FROM: David S. Ekern  
Director/Assistant Chief Engineer  
Engineering Services  
SUBJECT: Design Guidelines for Super Two Highways

## EXPIRATION

This Technical Memorandum shall remain in effect until May 5, 2002, unless superseded prior to that date or its contents become adopted in the Road Design Manual.

### *Philosophy*

Good design practice includes consideration of the basic problem or problems which need to be addressed and a range of potential solutions. Project managers and project teams need to consider such factors as social, environmental, aesthetic, economic, and community perspectives in creating a well-integrated design. Early and continuous public and agency involvement is also critical. The Super Two approach described below is one potential design tool available for certain major two-lane facilities and may be an appropriate alternative for a four-lane facility.

## SCOPE

Super Two is a special design type of highway; its design is to be used when upgrading principal arterial routes, or selected minor arterial routes. To fully appreciate the value of the concept it is desirable to apply it to segments of at least 30 kilometers (19 miles) in length. The Super Two is a combination of design features which can provide relatively high peak flows a good level of service by providing, as much as practical, an unimpeded traffic flow. It should improve safety by providing passing opportunities.

These Design Guidelines are not to be interpreted as a new standard for a two-lane rural highway. It is a consolidation of the best roadway features available applied consistently over a given length of a unique two-lane roadway.

## DESIGN GUIDELINES

### Controls:

#### *Application*

Application of the Super Two concept shall be based on the development of a long range corridor plan which considers the goals for a corridor. Factors considered should include transportation needs, community goals, environmental effect, functional classification, current and projected traffic volumes and mix, seasonal traffic peaks, heavy commercial vehicle volumes and other unique situations.

#### *Design Speed*

The Design Speed for a Super Two rural design should range from 80 to 110 km/h (50 to 70 mph) when an existing two-lane highway is upgraded to a Super Two. In all new Super Two construction and reconstruction, the Design Speed of 100 to 110 km/h (62 to 70mph) should be used throughout. In all cases, when upgrading the existing roadway,

the designer should apply the design speed which is greater than or at least equal to the posted speed.

### *Volume*

At study published in Transportation Research Record (TRR) 1303, "Warrants for Passing Lanes", shows that Passing Lanes on rural two-lane highways have a favorable benefit/cost ratio at AADTs of 6500 and greater. Also, according to input from Minnesota DOT Districts, there is visibly a problem when the volume on a two-lane rural highway surpasses 7000 ADT. Based on the above, a principal arterial two-lane rural highway or selected high volume minor arterial routes could qualify to be considered for a Super Two design once it is scheduled for major upgrading or reconstruction, and the projected volume is 6000 ADT in the year after the segment is open to traffic. Construction of Super Twos, or selective use of some features of the Super Twos, may also be necessitated by high seasonal peaks, heavy commercial vehicle volumes and other unique traffic and terrain situations.

### Access Management:

To maximize the capacity of the Super Two roadway, it is critical to manage the number and location of points of access. The preferred spacing between the points of access in rural areas is 400 meters or more. If the land use requires more entrances, combining the entrances of the adjoining land owners, relocation of entrances to the cross roads, and construction of frontage roads should be considered. Planning of the Super Two facility should include an area concept plan for future land development. Such items as future frontage roads and streets should be shown on the preliminary layout in dashed lines. The acquisition of access control should be considered in the initial stage of development of the Super Two project.

### Geometrics:

#### *Typical Cross-Section*

1. The basic lane width is 3.6 m (for other width possibilities see section, Experimental Treatment at the Centerline, at the end of this memorandum).
2. The basic shoulder width is 3 m; shoulder width along the passing lanes is 2.4 m desirable and 1.8 m minimum.
3. The inslopes are 1:4. The fill and cut slopes are to conform to the Clear Zone requirements on high speed sections.
4. Continuous Two Way Left-Turn Lanes (CTWLTL) should be 3.6 m to 4.5 m wide, with 4.0 m being the norm. In rural and in urban areas the through lanes adjacent to the CTWLTL and the outside shoulders are 3.6 m and 3.0 m respectively.
5. The width of Passing Lanes, regardless of whether a three or four lane section is used, should be 3.6 m.
6. Right-turn lanes should be developed per details and warrants given in the Road Design Manual. The widths of the right-turn lanes are 3.6 m for rural design and 4.2 m for urban design.

7. Exclusive left-turn lanes should be developed 4 m wide for both urban and rural sections.
8. Frontage roads should meet and/or match the local street requirements. In new construction, the basic pavement width should be 8.4 m. The median distance between the frontage road and the highway should be wide enough to develop a ditch section in rural design, and in urban design it should have a minimum width of 6 m face of curb to face of curb to reduce the headlight glare.
9. Rumble strips placed on shoulders

Some of the above features may not be applicable to all projects.

### *Passing Lanes*

Passing lanes are added in order to improve the passing opportunity; they may be added in one or both directions of travel. This definition includes lanes added in level or rolling terrain, climbing lanes on grade, and short four lane sections. The passing lanes may be designed as side by side short four-lane sections, alternating three-lane sections, three-lane pairs which are separated some distance apart, etc.

### *Length of Passing Lanes*

The length of a passing lane is dependent on the volume of vehicles per design hour (vph) for the project in one direction of travel. General guidelines for development of design length are as follows:

<u>Vph one way length of passing lane</u>	
400	1.2 to 1.6 km
700	1.6 to 2.0 km

Longer passing lanes lose their effectiveness and have a reduction of benefit/cost ratio per unit length. These lengths are exclusively for the passing lane sections; they do not include lane addition and lane drop tapers. Normally the passing lane length between 1.2 and 2.0 km (.75 and 1.25 miles) will be adequate for most situations, but in some extreme cases the length may be as much as 3.2 km. These longer sections are more difficult to construct because of a greater chance of conflict with cross-roads. Also, the longer sections of two-lanes in the same direction tend to have some slower drivers increase their speed, thus making the breakup of platoons more difficult.

### *Spacing of the Passing Lane Segments*

The design of passing lane spacing depends on the traffic volumes. On segments of highway where the volumes are low, chances of developing long platoons are also low; thus driver anxiety is not a problem. In such cases, the spacing of 16 to 24 km between the passing lane segments may be totally adequate. On the other hand, where the volumes are heavy, 700 vph or more in one direction, the spacing of the passing lane segments may need to be 5 to 8 km or even more frequent to properly handle the platooning problem. The operational benefits of the passing lane carry-over is generally dependent on the traffic volume. It usually is 5 to 10 km downstream from the beginning of the passing lane. When the Super Two highway passes through a series

of closely spaced cities, it is preferred that 3-lane passing sections be placed 3 to 5 km outside the limits of each of the cities in the direction of the traffic flow. This will help to break up the platoons which might have formed at the slower speeds while traveling through the towns.

#### *Location of the Passing Lanes*

The passing lane segments should be located in areas free of entrances and cross-roads as much as practical. The general guidelines for selecting appropriate locations for placement of the passing lane segments are given below:

1. Passing lanes should be constructed in segments of highway which have a minimal number of entrances and preferably no cross-roads.
2. If the comparative cost for construction of the passing lanes in rolling and flat terrain is nearly the same, it may be desirable to construct them in the rolling terrain at locations where passing sight distance is unavailable, leaving flat sections for normal passing during the off peak periods.
3. Cross roads with ADT near 400 and over should be avoided when selecting a site for a passing lane facility.
4. A widened segment of roadway, with left turn lanes, may be constructed in a passing lane section to provide for the left turning traffic when left turn volumes are significant.

#### Turn-Lanes and Entrances:

##### *Right-Turn Lanes*

Right-turn lanes are to be placed in accordance with the policy outlined in Mn/DOT Road Design Manual, which states that on two-lane high speed highway, right-turn lanes are to be considered:

- a. At all public road access points.
- b. At industrial, commercial, or where substantial trip generating land use facility is served
- c. If an access serves more than ten residential units

The need for the right-turn lanes should be based on consideration of the number of right turns.

### *Left-Turn Lanes*

The use of the left-turn lanes in the design of a Super Two roadway system requires an in-depth review and study to make it truly an efficient system. The presence of left-turn lanes or lack of them has a profound effect on the number of accidents, time delays, level of service, capacity, and most of all the aggravation of the driver. Super Two roadways should be designed to reduce the number of interferences in traffic flow. To help with the accommodation of the left turning vehicles, the following steps are recommended:

- a. Provide a CTWLTL through towns where appropriate to accommodate the left-turning vehicle within the local community to enhance the through traffic flow
- b. Provide a CTWLTL in urban and in rural areas if multiple entrances are present and they can not be consolidated or provided with a frontage road
- c. Cross roads which are at or near 400 (or even less) ADT should be given consideration for developing exclusive left-turn lanes to enhance the movement of the through traffic.

Since one of the main objectives of the Super Two system is to provide the through traffic with an efficient roadway operation, consider constructing left-turn lanes where the left turn volume is high but left-turn lane warrants are not fully met.

### *Entrances*

Development of a safe and efficient roadway facility requires that there be a maximum reduction of access points. To achieve this, it is recommended that in the very early stages of project development, arrangements and agreement be initiated to:

- a. Consolidate adjoining entrances into single points of access.
- b. Develop frontage roads to reduce the number of access points, preferably connecting the frontage road terminals to existing cross roads.
- c. Develop a plan that is in agreement with local area planning organizations for future frontage roads to be constructed by developers. This plan for future development is to be shown on the project layout in dashed lines and identified as future construction to be done by others.

### Aesthetic Treatment Features

The need for corridor aesthetics treatment on Super Two roadways should be a part of the design process. Special consideration should be given to community entrances and streetscape designs within urban areas as well as landscape designs at points of interest throughout the corridor.

## EXPERIMENTAL TREATMENT AT THE CENTERLINE

The design of the Super Two roadway calls for numerous improvements such as flattening the slopes, wide shoulders, adequate clear zone, etc. All these enhancements are on the drivers' right. The left side, where the interface between the opposing streams of traffic may have speed differential as high as 200 km/h, has been generally left unimproved. The development of the Super Two guidelines gives us an ideal opportunity to try several experimental centerline treatments and to do research on how to best improve this situation.

When preparing roadway plans for a Super Two, the designer is encouraged to request that a section on the project, preferably between two towns, be considered for experimental centerline treatment. Until there is a generally accepted Super Two centerline treatment, it is recommended that several experimental designs be constructed and studied. After these have been compared, a determination should be made as to which design could contribute most to the safety and comfort of the driver. There are many possible centerline treatment alternatives which may be developed, the following are suggested as examples only:

1. Two 4.0 meter roadway lanes with centerline striping
2. Two 4.2 meter roadway lanes with centerline striping
3. Two 4.0 meter roadway lanes which include a 0.6 meter rumble strip placed at the center (all centerline striping is painted over the rumble strip)
4. Two 4.2 meter roadway lanes which include 0.4 m left smooth in the center for striping and 0.4 meter rumble strips placed on each side of the smooth center section

Options are being programmed into a driving simulator by the Human Factors Research Lab at the University of Minnesota to evaluate driver behavior. Completion of these studies may provide some additional centerline treatments.

All experimental centerline treatments must be approved by the State Design Engineer and the State Traffic Engineer.

Any questions relative to this memorandum should be addressed to the Geometrics Unit at 651-296-3049.

## Cost Calculations

The following calculations assume that the Super Two will be constructed as an initial phase of a four-lane divided ultimate section, including all the earthwork, drainage, walls and right of way required to accommodate the ultimate section. Therefore, the cost savings will be limited to the Asphalt and Aggregate Base Course.

### US 550 Mainline

#### Super Two Concept - Corridor Costs

Assumes Alignment 2B at Bondad 60mph, 5% Grade, 14' Median

Description	Units	Quantity	Unit Price	Price
Unclassified Excavation (CIP)	CY	1,613,213.00	\$ 6.50	\$ 10,485,900.00
Topsoil (assume 30 ft, 1 side)	CY	43,998.00	\$ 6.50	\$ 286,000.00
Erosion Control	MILE	14.50	\$ 30,000.00	\$ 435,000.00
Seeding ,Tackifier, Mulching	MILE	14.50	\$ 15,750.00	\$ 228,400.00
Aggregate Base Course (Class 6)	TON	<u>391,287.00</u>	\$ 15.00	\$ 5,869,300.00
Hot Bituminous Pavement	TON	<u>189,469.00</u>	\$ 45.00	\$ 8,526,100.00
Pavement Marking Paint	GAL	719.00	\$ 50.00	\$ 36,000.00
Bridges	SF	41,856.00	\$ 80.00	\$ 3,348,500.00
Retaining Walls	Sq. Ft.	61,550.00	\$ 70.00	\$ 4,308,500.00
Drainage	LF	79,200.00	\$ 27.00	\$ 2,138,400.00
<i>subtotal =</i>				<i>\$ 35,662,100.00</i>
Contingencies			45%	\$ 16,047,945.00
<i>subtotal</i>				<i>\$ 51,710,045.00</i>
mobilization			10%	\$ 5,171,004.50
traffic control			5%	\$ 2,585,502.25
construction survey			2%	\$ 1,034,200.90
construction engineering			17%	\$ 8,790,707.65
<b>total</b>			<b>\$</b>	<b>69,291,460.30</b>
pe			10%	\$ 5,171,004.50
<b>Grand Total =</b>			<b>\$</b>	<b>74,462,464.80</b>
Original Est. (assume 2B)			\$	87,320,160.00
Total Savings			\$	(12,857,695.20)

## Quantity Calcs

**Savings of Asphalt & ABC for Super Two concept**  
assume 4 - one mile long passing lanes in each direction

**ABC 18"**

Costs from URS 9/13/03 estimate

Assume that 70% ABC will be required  
(originally estimated) this will include and assumed 4 miles of passing lanes  
in each direction

Total ABC		558981		
	*	0.70		
		391287		

**Asphalt Pavement**

14.5 miles of alignment

		15		
	x	5280		
		76,560		

2- 12foot lanes + 2-10 foot shoulders

		44		
	x	44		
		3368640		

(A)

+ 8 miles of passing lanes (4mile each direction)

		8		
	x	5280		
		42,240		

		12		
	x	12		
		506880		

(B)

Total sf

		3875520		
	(A)+(B)	3875520		
	divide by	9		
		430613		

Total Tons @ 8 Inch depth		189469		
		189469		

## VALUE ENGINEERING PROPOSAL NO. 01-006

### SUMMARY PROPOSAL DESCRIPTION:

Use a three-lane cross section, alternating the center lane as a passing lane.

Estimated potential savings:

Initial:	\$ 18,600,000
Future:	\$ 0,000
Total:	\$ 18,600,000

### **Discussion:**

Use a three-lane cross section, alternating the center lane as a passing lane. This alternative assumes no future expansion of the corridor to four lanes or more.

### **Related Ideas:**

P01-011 - Use a Super Two concept throughout the project

<b>EVALUATION</b>	
Idea Number: 01-006	
Idea Description: Use a three-lane cross section, alternating the center lane as a passing lane. This alternative assumes no future expansion of the corridor to four lanes or more.	
Advantages of alternative concept:	
1. Minimizes Right of Way	
2. Reduces cost	
3. Minimizes property impacts	
4. Minimizes environmental impacts	
5. Provides a shorter distance for wildlife to cross	
Advantages of original concept:	
1. Separates traffic and reduces severe head on accidents	
2. Consistent with the 4-lane section at the New Mexico border	
Risks:	
1. Difficult to expand and phase into a four lane divided section	
Conclusion:	
<input checked="" type="checkbox"/> Propose this idea	
<input type="checkbox"/> Propose this idea as a Supplemental Recommendation	
<input type="checkbox"/> Do not propose this idea because	

**Calculations and/or Discussion:**

This alternative is similar to proposal P01-011 "Use a Super Two concept throughout the project". The basic concept to organize platoons to optimize traffic operations is the primary goal of both the proposals. The alternate passing three-lane section, however, will add approximately 50% more opportunity to pass (over the Super Two alternative) and is, therefore, more likely to meet the goal.

The three-lane concept basically improves the highway to meet current standard for a two-lane facility. In addition, passing lanes are introduced alternating between north and southbound lanes to clear the queues of slower moving vehicles. By better platooning the vehicles, the highway capacity is increased and is safer to travel thereby providing for less speed differential and more consistent flow.

A three-lane section offers a reasonable solution in locations which experience extreme seasonal factors over short periods of time, much like the US 550 corridor. The concept may meet the travel demand during peak seasons along this corridor. This may include sacrificing Level of Service (LOS) during a relatively short period of time. During the majority of the year LOS increases to more optimum levels.

In order to optimize operations along the length of the corridor, passing lanes should be between 1 to 3 miles in length and alternate to make best use of left turn locations and avoid conflict with access points. It is not recommended to have traffic slowing down to

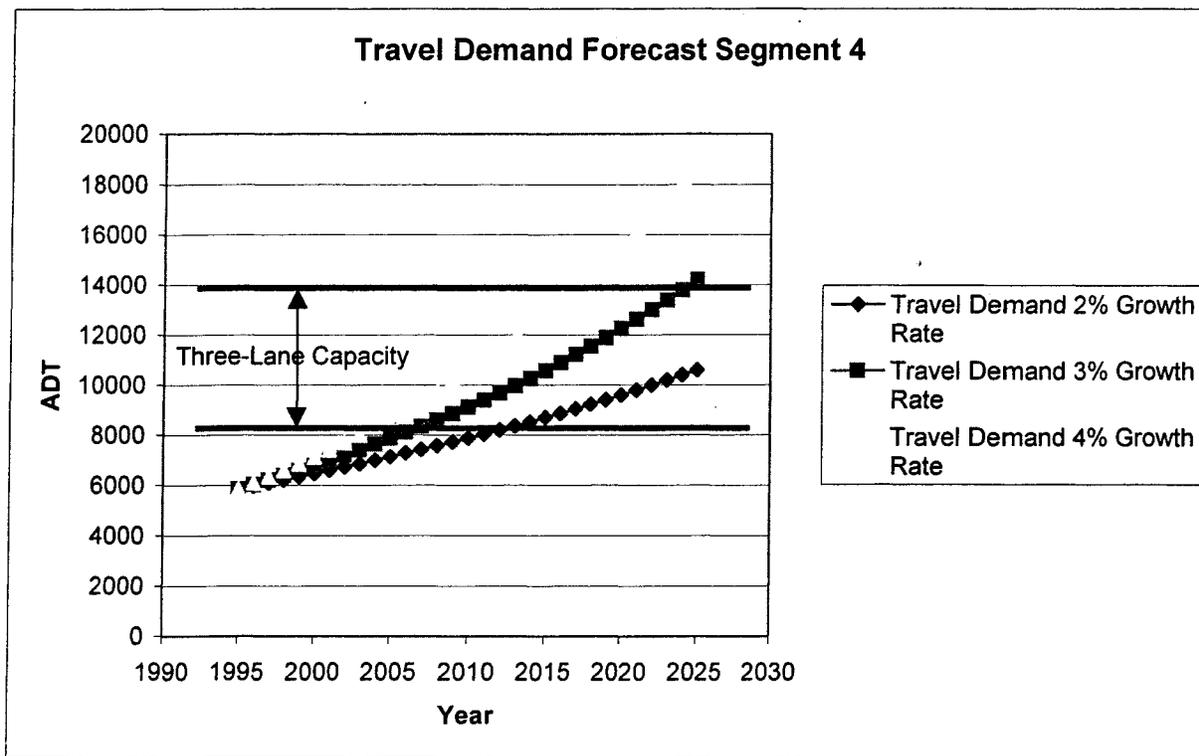
turn left from the passing lane; therefore, passing lanes should not be located where this condition exists.

The three-lane section is not easily expanded to a four-lane divided because a significant amount of “Throwaway” pavement and aggregate base course would be required.

The projected 2025 forecasted volumes for this corridor range from 12,960 ADT (south) to 18,100 ADT (north). These volumes are peak seasonal and apparently only occur two months of the year. A three-lane can typically handle between 12,000–15,000 ADT; volumes above that will compromise the capacity and LOS.

Operational considerations must also be given to the effects of the LOS on side road intersections. Optimizing the through traffic on the mainline may limit the available gaps required for through crossing traffic or turning vehicles. Costs savings may quickly diminish if signals or grade separated structures are required to access the highway.

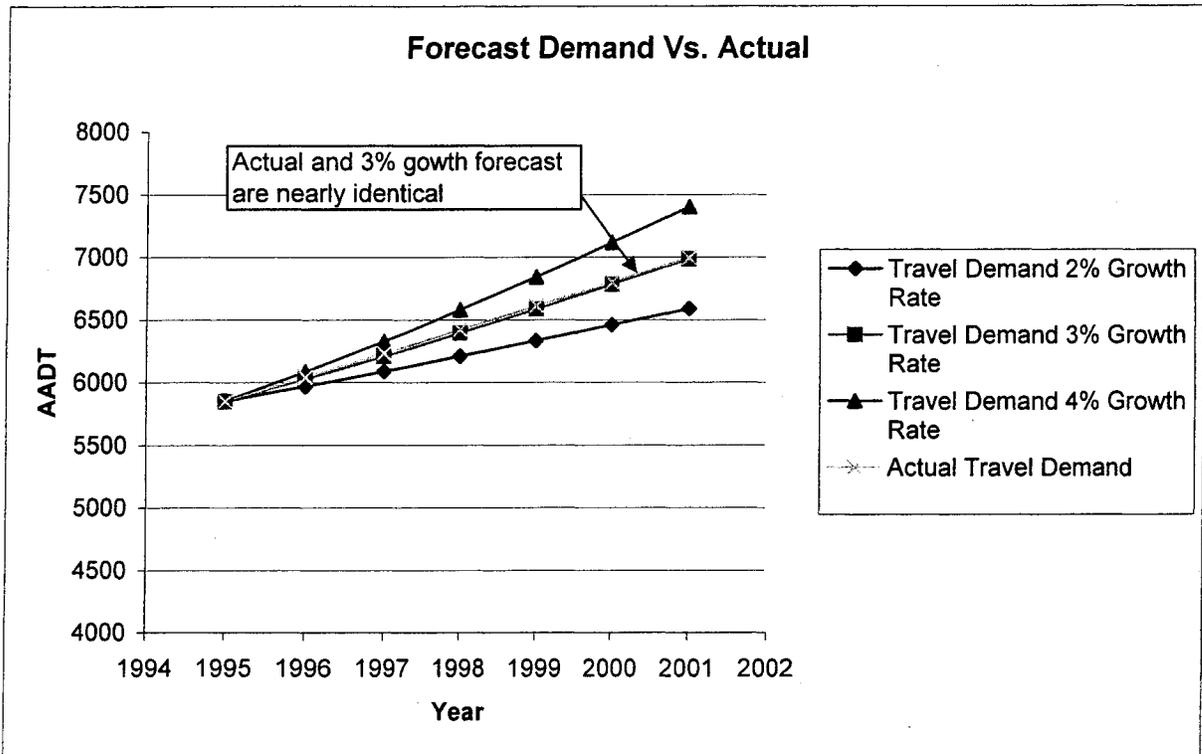
The projected volumes are extremely sensitive to educated, calculated assumptions which may either drive an overly conservative long term solution, or may cause the improvements to become obsolete before their anticipated design life. The Travel demand forecasts presented in the February 1999 URS “US 550 & 160 Feasibility Study” project adjacent land use and through vehicles at what appears to be an average annual growth rate of around 3%. The graph below represents a sensitivity analysis of 3% growth rate projected to the 2025 design year.



As illustrated in this graph, the 2025 projections differ significantly based on the growth rate assumption.

The three-lane concept may be applicable for this corridor assuming a 2-3% annual growth rate, and may only be applicable assuming a 4% growth rate though about 2018.

Current trends in the travel demand are illustrated below:



The Actual travel demands were based on counts in 1995 and 2001. The graph illustrates the current growth rates are increasing at about 3% annually. This rate should consider the relative poor economy over much of this period combined with lower than normal tourist attracted to the area.

## Cost Calculations

The following calculations assume that the three-lane will be constructed as the final improvement to the corridor and not as an initial phase of a four lane divided ultimate section. This will reduce the earthwork, drainage, walls and right of way anticipated for the As Designed scenario.

### **US 550 Mainline**

#### **3-lane Section**

**Assumes Alignment 2B at Bondad 60mph, 5% Grade, 14' Median**

Description	Units	Quantity	Unit Price	Price
Unclassified Excavation (CIP)	CY	<u>967,928.00</u>	\$ 6.50	\$ 6,291,500.00
Topsoil (assume 30 ft, 1 side)	CY	43,998.00	\$ 6.50	\$ 286,000.00
Erosion Control	MILE	14.50	\$ 30,000.00	\$ 435,000.00
Seeding ,Tackifier, Mulching	MILE	14.50	\$ 15,750.00	\$ 228,400.00
Aggregate Base Course (Class 6)	TON	<u>427,664.00</u>	\$ 15.00	\$ 6,415,000.00
Hot Bituminous Pavement	TON	<u>209,864.00</u>	\$ 45.00	\$ 9,443,900.00
Pavement Marking Paint	GAL	719.00	\$ 50.00	\$ 36,000.00
Bridges	SF	41,856.00	\$ 80.00	\$ 3,348,500.00
Retaining Walls	Sq. Ft.	61,550.00	\$ 70.00	\$ 4,308,500.00
Drainage	LF	79,200.00	\$ 27.00	\$ 2,138,400.00
		<i>subtotal</i>	=	\$ 32,931,200.00
		Contingencies	45%	\$ 14,819,040.00
		<i>subtotal</i>		\$ 47,750,240.00
		mobilization	10%	\$ 4,775,024.00
		traffic control	5%	\$ 2,387,512.00
		construction survey	2%	\$ 955,004.80
		construction engineering	17%	\$ 8,117,540.80
		<b>total</b>		<b>\$ 63,985,321.60</b>
		pe	10%	\$ 4,775,024.00
		<b>Grand Total</b>	=	<b>\$ 68,760,345.60</b>
		Original Est. (assume 2B)		\$ 87,320,160.00
		Total Savings		\$ (18,559,814.40)



## VALUE ENGINEERING PROPOSAL NO. 01-012

### SUMMARY PROPOSAL DESCRIPTION:

Reduce/eliminate median and examine barrier types.

Estimated potential savings:

Initial:	\$ 180,000 to \$430,000
Future:	\$ 0,000
Total:	\$ 180,000 to \$430,000

### **Discussion:**

Modify current median design by:

- A. Reducing median width to 30 ft.
- B. Reducing median width by using Type 7 barrier
- C. Reducing median width by using cable barrier

### **Related Ideas:**

Brainstorm Idea 10-003 - Use 15-ft. lanes

Brainstorm Idea 10-004 - Use wider lanes with narrower median

Brainstorm Idea 01-047 - Add centerline rumble strips in lieu of median barrier

### EVALUATION

Idea Number: 01-012

Idea Description: Reduce/eliminate median and examine barrier types.

Advantages of alternative concept:

1. A: ROW savings of footprint (narrowest of alternative concepts)
2. A: Facilitates U-turn movements (for small vehicles), access placement
3. A: Availability of snow storage
4. A: Reduced environmental impacts of footprint (narrowest of alt. concepts)
5. B: ROW savings of narrower footprint
6. B: Reduced environmental impacts of narrower footprint
7. B: Minimal repair time if hit
8. B: Minimal deflection if hit
9. B: Eliminates head-on collisions
10. C: ROW savings of narrower footprint
11. C: Reduced environmental impacts of narrower footprint
12. C: Cable rail does not restrict horizontal sight distance

Advantages of original concept:

1. A: Avoids drainage issues of 6:1 median slope
2. A: Better accommodations of U-turns due to extra width
3. A: Full Clear Zone requirements
4. A: Full Stopping sight distance
5. B: Barrier introduces crash hazard
6. B: Barrier reduces Stopping Sight Distance
7. B: Barrier reduces available Clear Zone
8. B: Barrier introduces shading, icing, and drainage issues
9. B: Barrier introduces snow removal issues
10. B: Barrier requires attenuation measures at barrier ends (all openings)
11. B: Attenuators require Maintenance inventory of repair parts
12. C: Cable rail median template has incrementally smaller footprint than 30-ft. median due to deflection zone of cable
13. C: Cable rail requires closure of long lengths of roadway for repair
14. C: Cable rail requires Maintenance inventory of cables, parts
15. C: Significant legal case history against median cable rail

Risks:

1. A: Assumes that all drainage issues of 6:1 slope can be accommodated in final design
2. B: Barrier increases single vehicle crashes
3. C: Cable rail has legal case history

Conclusion:

- Propose this idea  
 Propose this idea as a Supplemental Recommendation  
 Do not propose this idea because

**Calculations and/or Discussion:**

**Consider 10 mile section CR 220 to top of Bondad Hill:**

*Relative to 46 ft. median*

**A. 30 ft. median saves:**

$$10 (5,280) 2 (46-30)/2 = 844,800 \text{ sf}^*$$

Assume turnouts, 46' width, 2 per mile:

$$\text{@ } 60:1 \text{ taper, } (46-30)/2 = 8'. 8(60) = 480 \quad \text{Say } 500'$$

$$\text{Total length for upstream, downstream tapers} = 2(500) + 100 = 1,100$$

Assume rectangular prism, taper reduces ROW savings by:

$$1,100(8) = 8,800 \text{ sf} \quad \text{Say } 9,000$$

ROW Assumption: 2 miles Sunnyside (\$1.50/sf)

8 miles Agricultural (\$3,000/AC = \$ 0.07/sf)

$$\text{Aggregate ROW} \sim [2(1.5) + 8(.07)]/10 = \$ 0.36/\text{sf}$$

Therefore, Raw ROW savings for 30-ft Median is:

$$850,000^* - 10 \text{ mi}(2 \text{ turn/mile})(2 \text{ sides})(9,000 \text{ sf}) = 490,000 \text{ sf}$$

$$\text{@ } \$0.36/\text{sf} \text{ for ROW, Savings is } .36(490,000) = \mathbf{\$176,400}$$

**B. 14 ft. median (Type 7 concrete barrier) saves:**

$$10 (5,280) 2 (46-14)/2 = 1,689,600 \text{ sf}^*$$

ROW Assumption: 2 miles Sunnyside (\$1.50/sf)

8 miles Agricultural (\$3,000/AC = \$0.07/sf)

$$\text{Aggregate ROW} \sim [2(1.5) + 8(.07)]/10 = \$ 0.36/\text{sf}$$

Therefore Raw ROW savings for 14-ft Median is:

@ \$0.36/sf for ROW, ROW Savings is .36(1,700,00*) =	\$612,000
Savings reduction for 10*2*2 = 40 Attenuators @ \$4,500 =	(180,000)
Net Savings =	\$ 432,000

\*Note: Net savings do not include cost of truck turnarounds required at intersections for this option

**C. 24-ft. median (Required by cable barrier deflection criteria) saves:**

$$10 (5,280) 2 (46-24)/2 = 1,161,200 \text{ SF}^*$$

ROW Assumption: 2 miles Sunnyside (\$1.50/sf)  
8 miles Agricultural (\$3,000/AC = \$ 0.07/sf)

$$\text{Aggregate ROW} \sim [2(1.5) + 8(.07)]/10 = \$ 0.36/\text{sf}$$

Therefore, Raw ROW savings for 14-ft Median is:

$$\text{@ } \$0.36/\text{sf} \text{ for ROW, ROW Savings is } .36(1,200,000^*) = \$432,000$$

\*Note: Net savings do not include cost of truck turnarounds required at intersections for this option

**Related Ideas:**

Brainstorm Idea 10-003 – 15-ft. Lanes:

- Extra expense of addition of 12 ft. width to cross-section
- No substantial mitigation of head-on crash number or severity
- No clear zone advantage over full shoulder

Brainstorm Idea 10-004 – 15-ft. Lanes and Narrower Median:

- No substantial mitigation of head-on crash number or severity
- No clear zone advantage over full shoulder

For the above reasons, 10-003 and 10-004 are Failed.

Brainstorm Idea 01-047 - Rumble Strips

- History of reducing number of head-on and side-swipe accidents
- Advance as Supplemental Recommendation (SR) to median with barrier, and
- Advance as SR to Item P01-011 "Super 2"
- Failed as "stand alone" (not to be used in lieu of median)

## VALUE ENGINEERING PROPOSAL NO. 01-049

### SUMMARY PROPOSAL DESCRIPTION:

Use County Road Standards on adjacent roadways which require modification in lieu of CDOT Standards.

Estimated potential savings:

Initial:	\$ 1,180,000
Future:	\$ 0,000
Total:	\$ 1,180,000

### **Discussion:**

Use County Road Standards on adjacent roadways which require modification in lieu of CDOT standards, e.g., narrower and/or grass shoulders.

### **Related Ideas:**

SR01-013 - Use design exceptions to avoid or minimize impacts to environmentally sensitive areas

EVALUATION	
Idea Number: 01-049	
Idea Description: Use County Road Standards on adjacent roadways which require modification in lieu of CDOT Standards.	
Advantages of alternative concept:	
1. Saves money	
Advantages of original concept:	
1. Safer design	
Risks:	
1. None noted.	
Conclusion:	
<input checked="" type="checkbox"/> Propose this idea	
<input type="checkbox"/> Propose this idea as a Supplemental Recommendation	
<input type="checkbox"/> Do not propose this idea because	

**Calculations and/or Discussion:**

The As Designed scenario calls for full CDOT roadway standards to be utilized for any modifications to the adjacent cross roads which intersect US 550.

It is recommended that CDOT criteria still be utilized with respect to the horizontal alignment and vertical profile adjustments required at each intersection. However, the As Designed typical section utilizes full 10-foot shoulders, which may be considered overkill. Typically county standards for county roads require 28-30 feet of paved surface – two 12-foot lanes and two 2-foot shoulders.

**US 550 Mainline**  
**Assumes Alignment 2B at Bondad 60mph, 5% Grade, 14' Median**

Description	Units	Quantity	Unit Price	Price
Unclassified Excavation (CIP)	CY	1,613,213.00	\$ 6.50	\$ 10,485,900.00
Topsoil (assume 30 ft, 1 side)	CY	43,998.00	\$ 6.50	\$ 286,000.00
Erosion Control	MILE	15.00	\$ 30,000.00	\$ 450,000.00
Seeding ,Tackifier, Mulching	MILE	15.00	\$ 15,750.00	\$ 236,300.00
Aggregate Base Course (Class 6)	TON	558,981.00	\$ 15.00	\$ 8,384,700.00
Hot Bituminous Pavement	TON	269,905.00	\$ 45.00	\$ 12,145,700.00
Pavement Marking Paint	GAL	719.00	\$ 50.00	\$ 36,000.00
*Bridges	SF	41,856.00	\$ 80.00	\$ 3,348,500.00
Retaining Walls	Sq. Ft.	61,550.00	\$ 70.00	\$ 4,308,500.00
Drainage	LF	79,200.00	\$ 27.00	\$ 2,138,400.00
 Hot Bituminous Pavement Reduction	 TON	 12,554.00	 \$ 45.00	 \$ (564,900.00)
			<i>subtotal</i>	= \$ 41,255,100.00
			Contingencies	45% \$ 18,564,795.00
			<i>subtotal</i>	\$ 59,819,895.00
			mobilization	10% \$ 5,981,989.50
			traffic control	5% \$ 2,990,994.75
			construction survey	2% \$ 1,196,397.90
			construction engineering	17% \$ 10,169,382.15
			<b>total</b>	<b>\$ 80,158,659.30</b>
			pe	10% \$ 5,981,989.50
			<b>Grand Total</b>	<b>= \$ 86,140,648.80</b>
			Original Est. (assume 2B)	\$ 87,320,160.00
			Total Savings	\$ (1,179,511.20)

# Quantity Calcs

## Save Shoulder HBP

### HBP - remove 8 feet of the 10 foot shoulders on local access and CR approaches

Access/Intersection Location	Approx Length (FT)	* 8 feet wide (SF)	*2 Sides of the roadway	Total SF
sta 159	50	400	2	800
sta 170	50	400	2	800
sta 183	50	400	2	800
sta 200	400	3200	2	6400
CR 213 West	600	4800	2	9600
CR 213 East	200	1600	2	3200
sta 310	100	800	2	1600
CR 318 East	1200	9600	2	19200
sta 336	250	2000	2	4000
sta 350	200	1600	2	3200
sta 384	100	800	2	1600
sta 385	50	400	2	800
sta 396	50	400	2	800
sta 408 rt	100	800	2	1600
sta 408 lt	500	4000	2	8000
sta 415	400	3200	2	6400
sta 423	200	1600	2	3200
sta 425	400	3200	2	6400
sta 434	200	1600	2	3200
sta 435	50	400	2	800
sta 445	50	400	2	800
sta 465	50	400	2	800
sta 491	50	400	2	800
cr 215 West	2200	17600	2	35200
cr 215 East	500	4000	2	8000
sta 546	50	400	2	800
cr 218 West	1300	10400	2	20800
cr 218 East	500	4000	2	8000
sta 572	50	400	2	800
sta 585	50	400	2	800
sta 605	500	4000	2	8000
sta 615 rt	50	400	2	800
sta 615 lt	50	400	2	800
sta 623	50	400	2	800
sta 630	50	400	2	800
sta 645 rt	50	400	2	800
sta 645 lt	50	400	2	800
cr 214 lt	50	400	2	800
cr 214 rt	1000	8000	2	16000
sta 695	50	400	2	800
sta 700	50	400	2	800
sta 692	400	3200	2	6400
sta 709	50	400	2	800
sta 710	50	400	2	800
sta 722	50	400	2	800
cr 302 West	50	400	2	800
cr 302 East	400	3200	2	6400
sta 753	50	400	2	800
sta 754	50	400	2	800
sta 766	50	400	2	800
sta 763	100	800	2	1600
sta 770	900	7200	2	14400
cr 219	500	4000	2	8000

cr 219	500	4000	2	8000
sta 800	50	400	2	800
sta 809	50	400	2	800
cr 210	800	6400	2	12800
sta 821	50	400	2	800
sta 847 lt	50	400	2	800
sta 847 rt	300	2400	2	4800
sta 865	50	400	2	800
sta 889	100	800	2	1600
sta 906	50	400	2	800
		Total SF		256,800
		divide		<u>9</u>
		Total sq yd		28,533
		Tons @ 8 inches deep		12,554

## VALUE ENGINEERING PROPOSAL NO. 06-011

### SUMMARY PROPOSAL DESCRIPTION:

Steepen fill slopes from 3:1 to 2:1 with the clear zone requirements satisfied at the top of the fill slope.

Estimated potential savings:

Initial:	\$ 409,000
Future:	\$ 0,000
Total:	\$ 409,000

### **Discussion:**

The conceptual designs for the project use 3:1 fill slopes. In areas of high fill, and in particular at the location of Bondad Hill, the slopes could be steepened to 2:1 to reduce embankment and right of way requirements. Because 2:1 slopes are non-transversible by a vehicle, it is necessary to increase the 6:1 "z distance" by 13' to obtain a 35' clear zone in advance of the slope.

In addition to the earthwork and right of way cost savings, this design may also provide safety advantages, as a result of the added clear zone at the top of the fill. Though the 3:1 side slopes of the original design are considered to traversable by a vehicle, they actually present a safety hazard due to overturning potential for high gravity centered vehicles such a SUV's.

2:1 slopes will be more difficult to vegetate, but previous CDOT projects have demonstrated that it can be accomplished.

### **Related Ideas:**

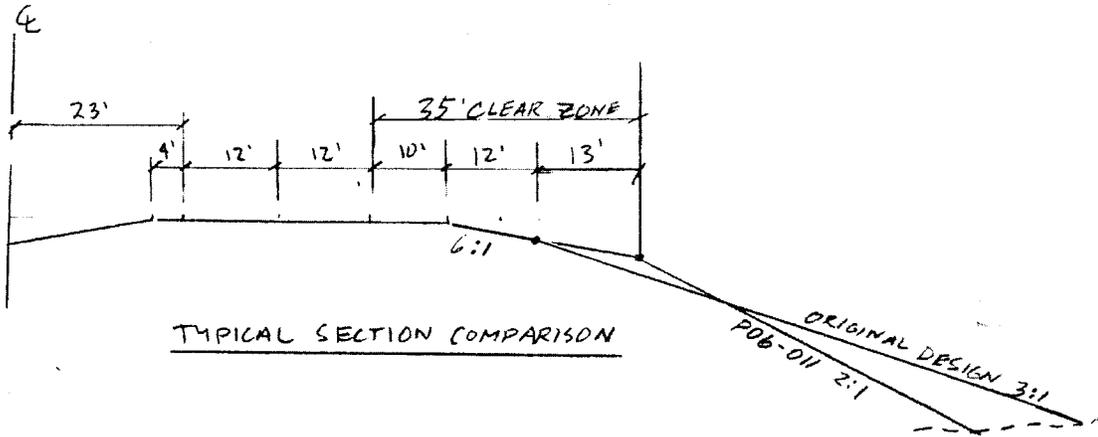
SR01-013 - Use design exceptions to avoid or minimize impacts to environmentally sensitive areas

EVALUATION	
Idea Number: 06-011	
Idea Description: Steepen fill slopes from 3:1 to 2:1, with clear zone requirements satisfied at the top of the fill slope.	
Advantages of alternative concept:	
1. Improved safety through use of increased clear zone at the top of the fill slope.	
2. Reduced right of way requirements.	
3. Reduced embankment and associated cost savings.	
Advantages of original concept:	
1. Easier to establish vegetation on less steep slopes.	
2. Easier to maintain less steep slopes.	
3. Less potential for slope erosion on flatter slopes.	
Risks:	
1. Without proper design and construction specifications, slope maintenance could be a problem.	
Conclusion:	
<input checked="" type="checkbox"/> Propose this idea	
<input type="checkbox"/> Propose this idea as a Supplemental Recommendation	
<input type="checkbox"/> Do not propose this idea because	

**Calculations and/or Discussion:**

See attached calculations

06-011



**Earthwork Comparison with Alternative 2B (at Bondad Hill)**

References

Station	Reduced Fill Area sf	Average Area sf	Volume cy
345	0	275	5093
350	550	750	13889
355	950	1075	19907
360	1200	600	4444
362	0		
TOTALS			43,333

**Estimated Cost Savings Due to Reduced Earthwork**

Unit Price of Earthwork	\$6.50	per cy
Volume of Embankment Reduction	<u>43,333</u>	cy
Estimated Cost Savings	\$282,000	
Add Contingencies (Per URS est 9/13/03)	<u>\$126,900</u>	45%
<b>Total Estimated Savings</b>	<b>\$409,000</b>	

URS Cost Est 9/13/03

## **VALUE ENGINEERING PROPOSAL NO. 01-032**

### **SUMMARY PROPOSAL DESCRIPTION:**

Relocate the weigh station in the median of the four-lane facility.

Estimated potential savings:

Initial:	\$ 150,000
Future:	\$ 0,000
Total:	\$ 150,000

### **Discussion:**

A weigh station in the median could be designed to accommodate highway patrol inspections and their portable scales and minimize the need for additional ROW.

### **Related Ideas:**

SR01-033 - Additional ROW for Junior Bonds property

<b>EVALUATION</b>
Idea Number: 01-032 Idea Description: Relocate the weigh station in the median of the four-lane facility.
Advantages of alternative concept: <ol style="list-style-type: none"> <li>1. ROW for the weigh station could be minimized</li> <li>2. Since CDOT cannot condemn for weigh station ROW, may be able to eliminate the need to purchase additional ROW.</li> </ol>
Advantages of original concept: <ol style="list-style-type: none"> <li>1. Drivers expect slow moving traffic to merge into the through lanes from the right</li> <li>2. Right exits are more common</li> <li>3. Traffic normally stops to the right of the travel lanes</li> </ol>
Risks: <ol style="list-style-type: none"> <li>1. None noted.</li> </ol>
Conclusion: <input checked="" type="checkbox"/> Propose this idea <input type="checkbox"/> Propose this idea as a Supplemental Recommendation <input type="checkbox"/> Do not propose this idea because

**Calculations and/or Discussion:**

Existing Location:

If the weigh station is not placed in the median and it is left as is, then it will be necessary to purchase ROW from Junior Bonds. This additional ROW may be purchased from Junior Bonds, without condemnation, if CDOT agrees to install a stronger (deer) fence along his property. The cost difference between deer fence and barbed wire fence is described below.

Deer Fence 6,000' x \$13/ft. =	\$78,000
Barbed Wire Fence 6,000' x \$2/ft =	<u>\$12,000</u>
Cost Difference =	\$66,000

Additional ROW = 39,750 sq. ft. x \$2/sq. ft. = \$79,500

Note: The length of fence was calculated along conceptual ROW only and not along his entire property.

## VALUE ENGINEERING PROPOSAL NO. 01-008

### SUMMARY PROPOSAL DESCRIPTION:

Use alternative alignment at Bondad Hill.

Estimated potential savings:

Initial:	\$ 6,470,000 vs Alt2A
	\$ 8,450,000 vs Alt2B
Future:	\$ 0,000
Total:	\$ 6,470,000

### **Discussion:**

An alternative alignment was developed for the Bondad Hill area in Section 2. The alignment was designed for a 70 mph design speed, making use of the sight distance analysis described in Proposal 01-050 (for sight distances across median barriers). A maximum grade of 5 % was used).

The horizontal alignment is similar to Alternative 2A of the original design, but with slightly flatter horizontal curvature (R=2050', versus 1910'), and lateral shifts of the control line location of up to 100', to provide a better balance of earthwork. The vertical alignment is an improvement relative to Alternative 2A (5% grade versus 6% grade), and equivalent to the vertical alignment of Alternative 2B.

The alignment provide a good balance of earthwork for Section 2, by cutting into Bondad Hill on the west side of the roadway, rather than using an uphill retaining wall.

This alternative may impact eligible archeological resources SLP6463 (also impacted by Alt. 2B), and SLP3105 (also potentially impacted by Alt 2A and Alt 2B).

Because the alternative relies on sight lines across the median barrier, glare screen is not an acceptable barrier treatment.

The alternative will present constructability difficulties, relative to Alternative 2B and 2D. Construction traffic control costs are not included in the relative cost estimate. The cost savings may be reduced subsequent to a more detailed analysis of constructibility.

The alternative alignment includes an optional uphill retaining wall in lieu of extensive cuts into Bondad Hill. The wall may be required to avoid archeological sites, or if geotechnical investigations reveal that excavation in Bondad Hill is too

difficult. The alternative was costed assuming the uphill wall will not be required. If the wall is necessary the cost savings relative to Alt 2 may be eliminated.

**Related Ideas:**

SR01-050 - Perform a 3D graphical Analysis of sight distances to increase design speeds at Bondad Hill, using current AASHTO standards

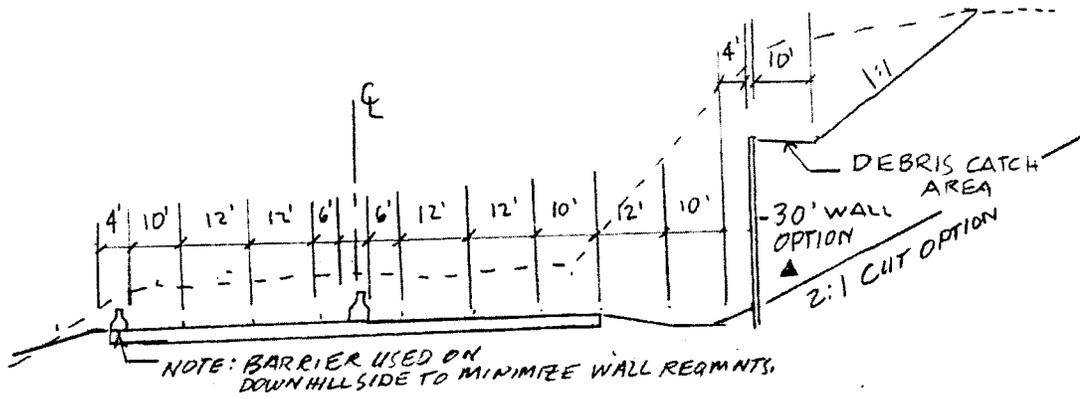
SR01-013 - Design exceptions in environmentally sensitive areas

<b>EVALUATION</b>	
Idea Number: 01-008 Idea Description: Use alternative alignment at Bondad Hill.	
Advantages of alternative concept: 1. Improved horizontal alignment relative to Alternative 2A 2. 70 mph design speed 3. Improved vertical grades relative to Alternative 2A, equal to grades of Alternative 2B 4. Significant cost savings	
Advantages of original concept: 1. Alternative 2B provides flatter horizontal curvature 2. Alternative 2B provides 70 mph sight distances to small objects (less than 2.0 ft) 3. Alternative 2B has better constructibility.	
Risks: 1. There is a minimal increased risk for accidents due to limited sight distance to small objects. Updated AASHTO standards (2001) state that there is no documented evidence supporting an increased risk of accidents by use of the new standards (refer to SR). 2. There is potential for impact to archeological sites.	
Conclusion: <input checked="" type="checkbox"/> Propose this idea <input type="checkbox"/> Propose this idea as a Supplemental Recommendation <input type="checkbox"/> Do not propose this idea because	

**Calculations and/or Discussion:**

See attached calculations and drawings.

01-008



SECTION @ 370+00

▲ DETERMINATION OF WALL OPTION VERSUS CUT OPTION IS DEPENDENT UPON GEOTECHNICAL EVALUATION

US 550 Environmental Assessment  
Value Engineering Study

9/24/03  
mms

Computations: Idea Number 01-008

Use alternative alignment at Bondad Hill

<p>Design Speed: 70mph</p> <p>Maximum Superelevation: e=.06'</p> <p>Minimum Curvature for Superelevation 2050'</p> <p>Horizontal Sight Distance Requirements:</p> <p>For inside sight distances across barriers assume barrier does not obstruct line of sight (see idea 01-050), but recognize that vertical curves must not be placed in conjunction with horizontal curvature.</p> <p>For sight distances across uphill roadside a m distance of approximately 35 ft is required (approx graphical solution). Therefore:</p> <p>unobstructed roadside = (35 -6-12-10) = 7' beyond pavement</p> <p>Superelevation runoff and runout:</p> <p>Use direct rotation of superelevation through reversing curves with approx 1/2 of superelevation in the curve. Therefore the tangent section between curves is equal to runoff length.</p> <p>Tangent length between curves: 250' min use 300' tangent</p> <p>Minimum Crest Vertical Curve: k=247 for 70mph Minimum Sag Vertical Curve: k=181 for 70mph</p> <p>Crest Vertical Curve at 387</p> <p>Use very long vertical curve, say 2000', to facilitate horiz site distance across inside barriers.</p> <p>note: a detailed graphical analysis of horiz site distances will be required at this location.</p> <p>Grade in: 5.00% Grade out: 1.30% Length: 2,000' K: 540 m: 9.25' 2000(3.7)/800</p>	<p><u>references</u></p> <p>project design standard</p> <p>project design standard</p> <p>AASHTO2001Ex3-22</p> <p>AASHTO2001Ex3-22</p> <p>AASHTO2001Ex3-76 AASHTO2001Ex3-79</p>
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US 550 Environmental Assessment  
Value Engineering Study

9/24/03  
mms

Computations: Proposal Number 01-008

Use alternative alignment at Bondad Hill

Earthwork Comparison with Alternative 2A (Option with Uphill Wall)

Station	add cut area sf	average area sf	volume cy	add fill area sf	average area sf	volume cy
335	0	0	0	0	1150	21296
340	0	0	0	2300	1930	35741
345	0	0	0	1560	780	14444
350	0	0	0	0	-710	-13148
355	0	0	0	-1420	-3710	-68704
360	0	150	2778	-6000	-7500	-138889
365	300	1450	26852	-9000	-4675	-86574
370	2600	1950	36111	-350	-175	-3241
375	1300	1280	23704	0	0	0
380	1260	930	17222	0	0	0
385	600	300	5556	0	0	0
390	0			0		
TOTALS			112,222			-239,074

Retaining Wall Requirements (Option with Uphill Wall)

Station	Uphill Wall Ht lf	Average Wall Ht lf	Wall Area sf	Downhill Wall Ht lf	Average Wall Ht Ht	Wall Area sf
360	0	15	7500	0	0	0
365	30	30	15000	0	0	0
370	30	30	15000	0	0	0
375	30	15	7500	0	6	3000
380	0	0	0	12	16	8000
385	0	0	0	20	10	5000
390	0			0		
TOTALS			45,000			16,000

US 550 Environmental Assessment  
Value Engineering Study

9/24/03  
mms

Computations: Idea Number 01-008

Use alternative alignment at Bondad Hill

Earthwork Comparison with Alternative 2A (Option without Uphill Wall)

Station	add cut area sf	average area sf	volume cy	add fill area sf	average area sf	volume cy
335	0	0	0	0	1150	21296
340	0	0	0	2300	1930	35741
345	0	0	0	1560	780	14444
350	0	0	0	0	-710	-13148
355	0	0	0	-1420	-3710	-68704
360	0	3380	62593	-6000	-7500	-138889
365	6760	6480	120000	-9000	-4675	-86574
370	6200	4700	87037	-350	-175	-3241
375	3200	2230	41296	0	0	0
380	1260	930	17222	0	0	0
385	600	300	5556	0	0	0
390	0			0		
TOTALS			333,704			-239,074

Retaining Wall Requirements (Option without Uphill Wall)

Station	Uphill Wall Ht lf	Average Wall Ht lf	Wall Area sf	Downhill Wall Ht lf	Average Wall Ht Ht	Wall Area sf
360	0	0	0	0	0	0
365	0	0	0	0	0	0
370	0	0	0	0	0	0
375	0	0	0	0	6	3000
380	0	0	0	12	16	8000
385	0	0	0	20	10	5000
390	0	0	0	0		
TOTALS			0			16,000

US 550 Environmental Assessment  
Value Engineering Study

Computations: Idea Number 01-008  
Use alternative alignment at Bondad Hill

**Estimate of Costs For Section 2, Using Alternative Alignment, without Uphill wall Option**

Sta. 261+00 to Sta. 449+86 18,886 lf

roadway width 82 ft  
Cut 637,378 CY  
Fill 609,406 CY  
HBP depth 8 inches  
ABC depth 18 inches

Description	Units	Quantity	Unit Price	Price
Unclassified Excavationn (CIP)	CY	637,378.00	\$ 6.50	\$ 4,143,000.00
Topsoil (assume 30 ft, 1 side)	CY	10,492.22	\$ 6.50	\$ 68,200.00
Erosion Control	MILE	3.58	\$ 30,000.00	\$ 107,300.00
Seeding ,Tackifier, Mulching	MILE	3.58	\$ 15,750.00	\$ 56,300.00
Aggregate Base Course (Class 6)	TON	156,801.02	\$ 15.00	\$ 2,352,000.00
Hot Bituminous Pavement	TON	75,711.88	\$ 45.00	\$ 3,407,000.00
Pavement Marking Paint	GAL	171.69	\$ 50.00	\$ 8,600.00
Bridges	SF	31,992.00	\$ 80.00	\$ 2,559,400.00
Retaining Walls	Sq. Ft.	16,000.00	\$ 70.00	\$ 1,120,000.00
Drainage	LF	18,886.00	\$ 27.00	\$ 509,900.00
<i>subtotal</i> =				\$ 14,331,700.00
			Contingencies 45%	\$ 6,449,265.00
<i>subtotal</i>				\$ 20,780,965.00
			mobilization 10%	\$ 2,078,096.50
			traffic control 5%	\$ 1,039,048.25
			construction survey 2%	\$ 415,619.30
			construction engineering 17%	\$ 3,532,764.05
			subtract additional row costs*	\$ (66,000.00)
<b>total</b>				<b>\$ 27,780,493.10</b>
			pe 10%	\$ 2,078,096.50

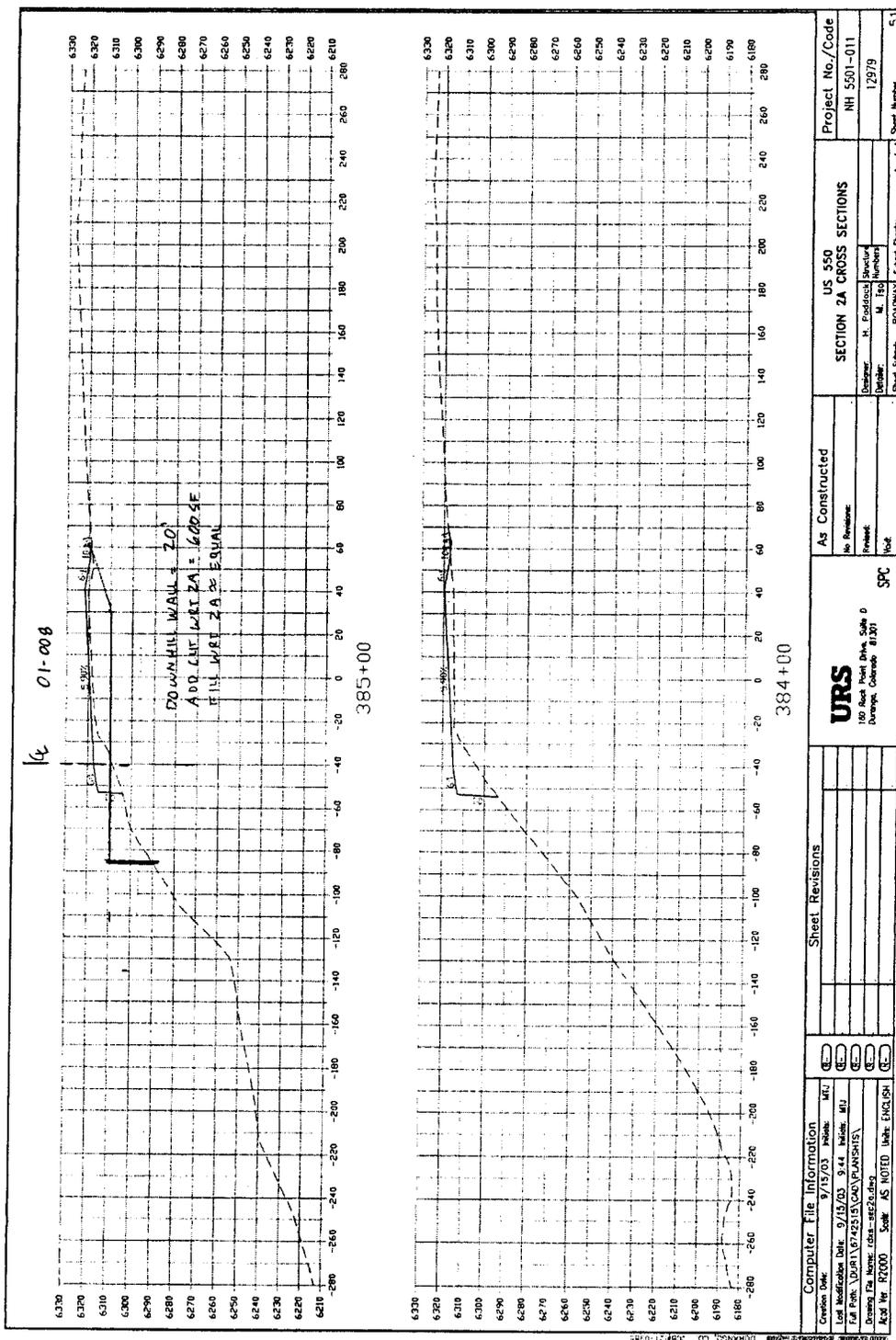
\* Estimate 120' width x 2000' length = 5.5 acres  
Estimate \$12,000/acre x 5.5 acres = \$66,000

**Grand Total = \$ 29,858,589.60**  
Original URS Estimate \$ 36,329,738.40  
Alt 2A (9/13/03)

<b>Savings of Alternative Alignment Relative to Alt 2A</b>	<b>\$6,470,000</b>
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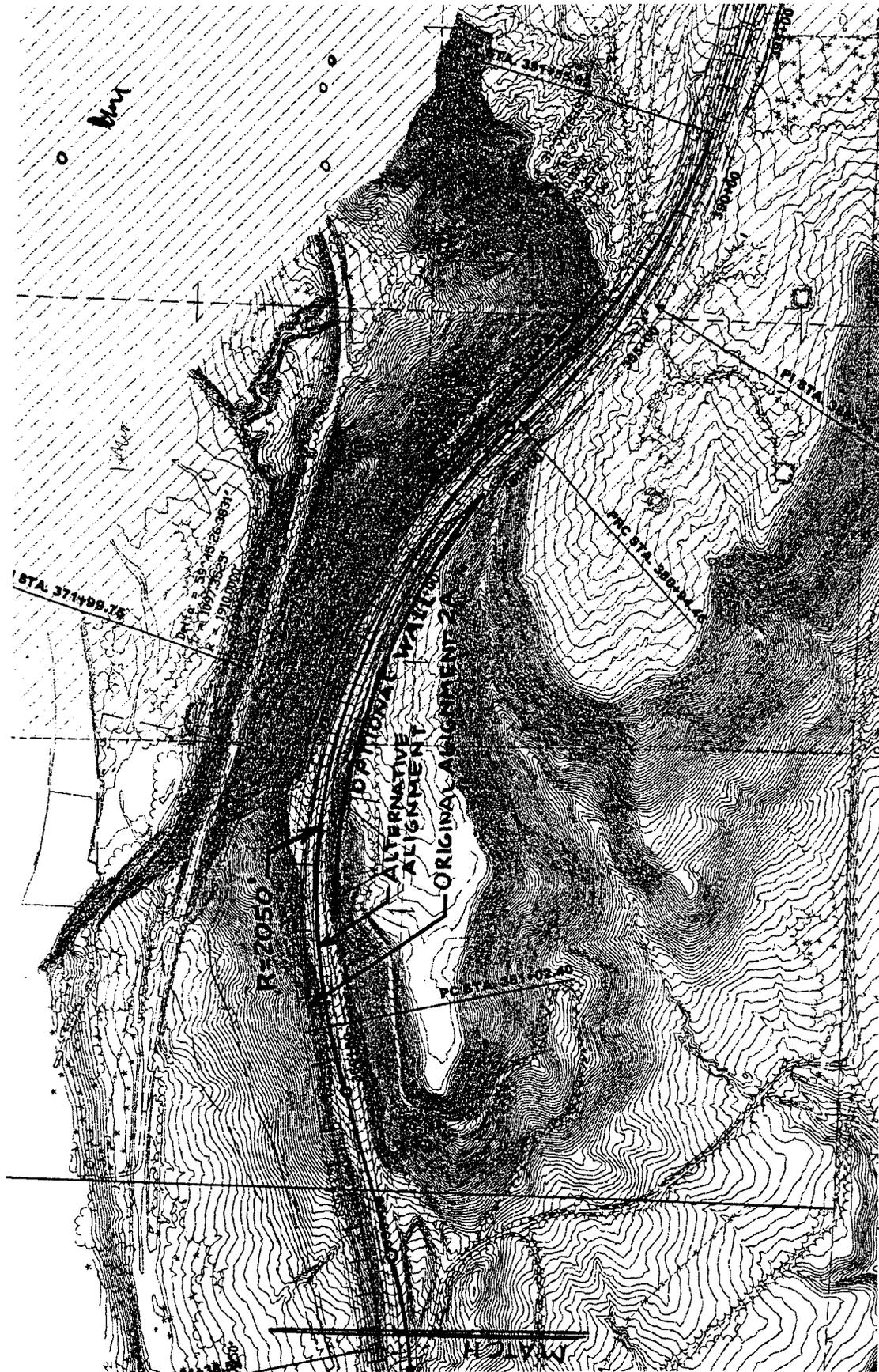
Original URS Estimate \$ 38,308,327.20  
Alt 2A (9/13/03)

<b>Savings of Alternative Alignment Relative to Alt 2B</b>	<b>\$8,450,000</b>
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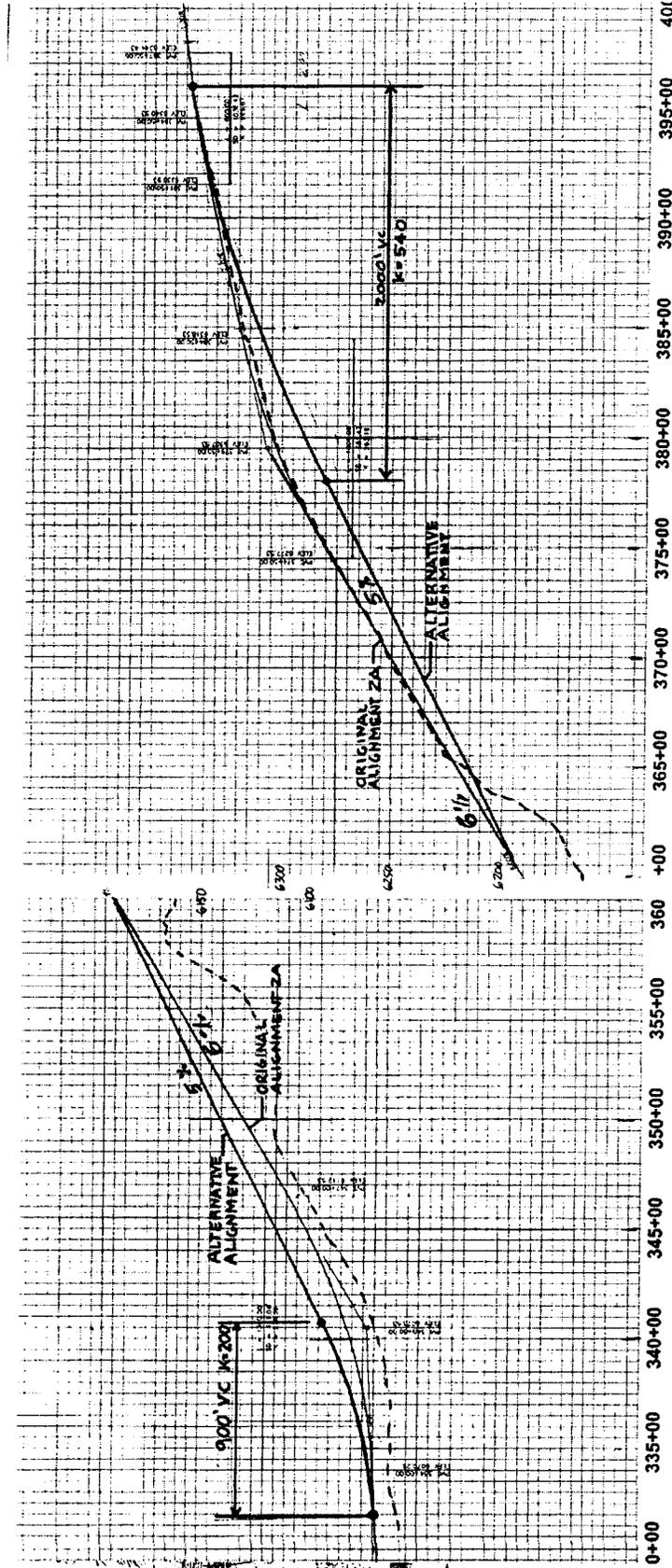


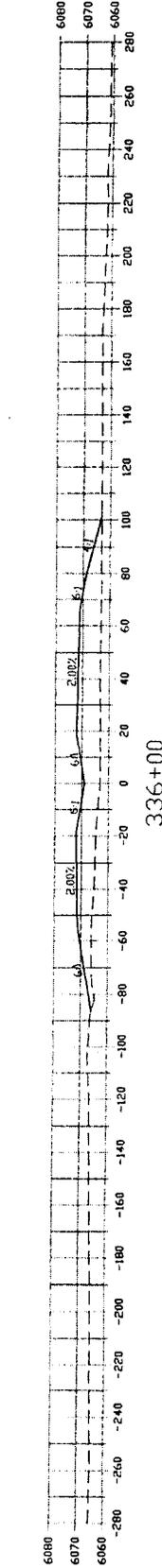
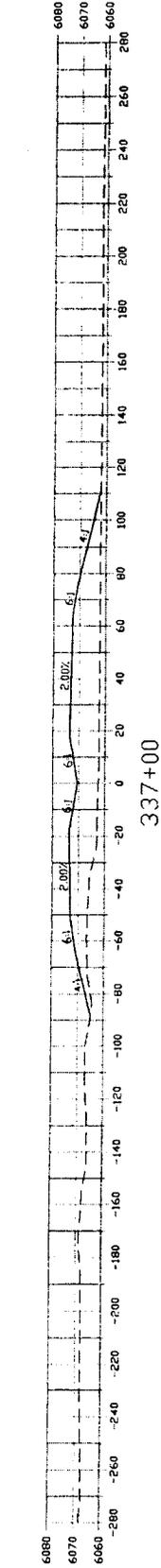
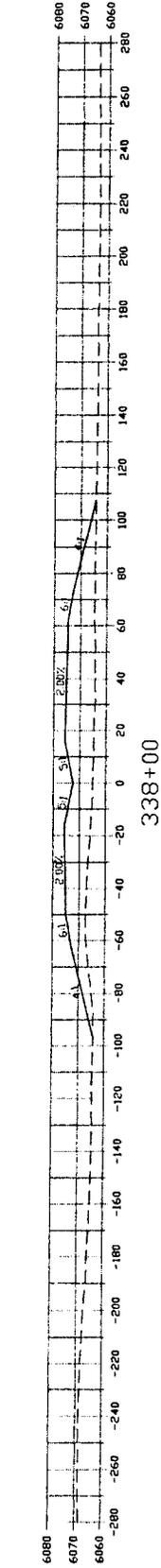
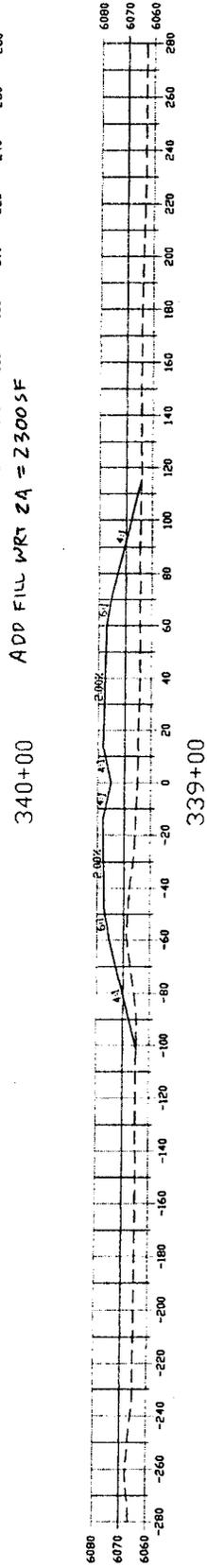
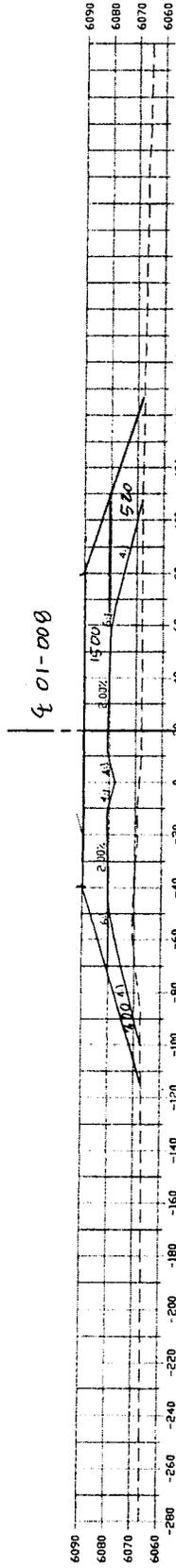
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<b>URS</b> 100 Rock Point Drive, Suite D Memphis, Tennessee 38151				SPC		Sheet Number: 51		1 of 1	



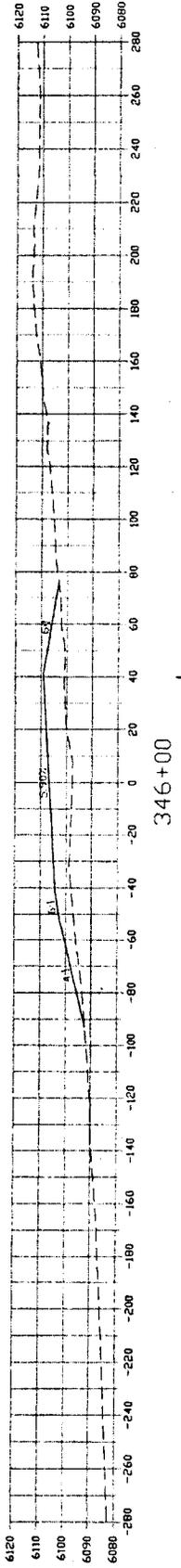
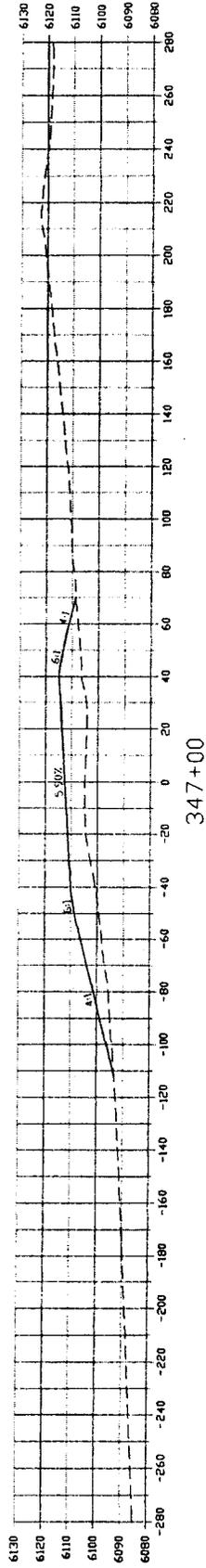




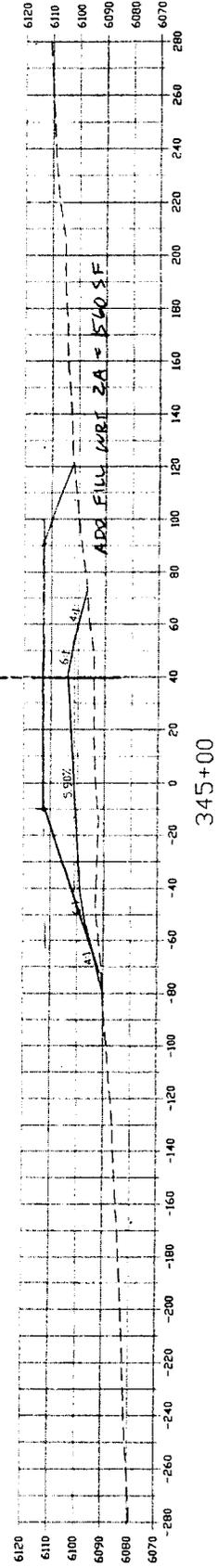


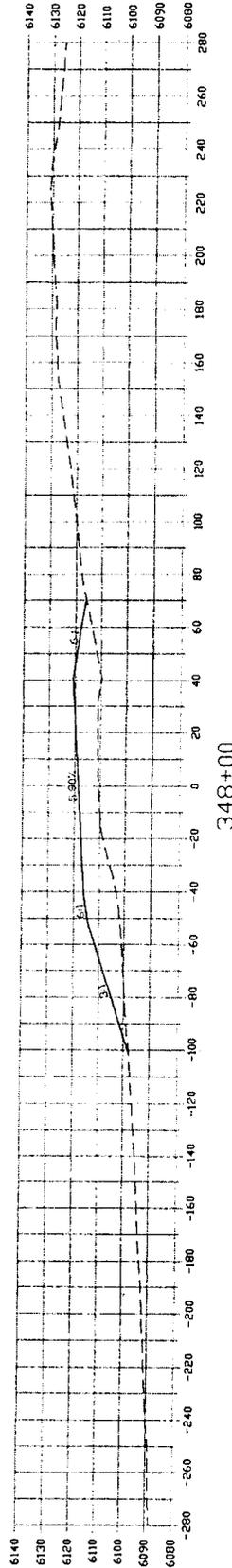
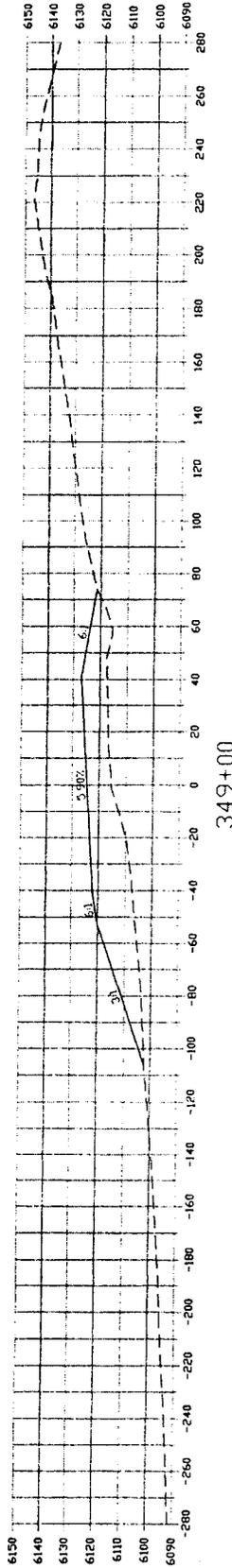
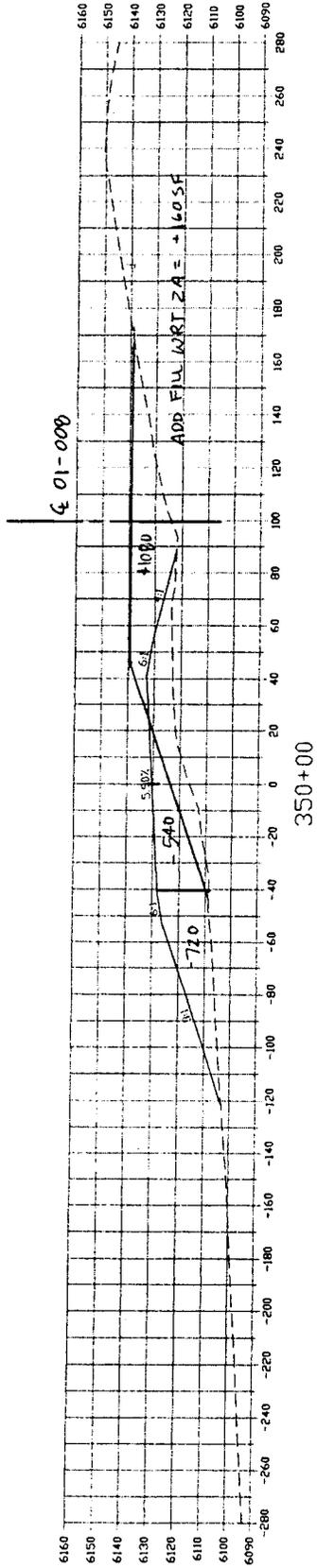


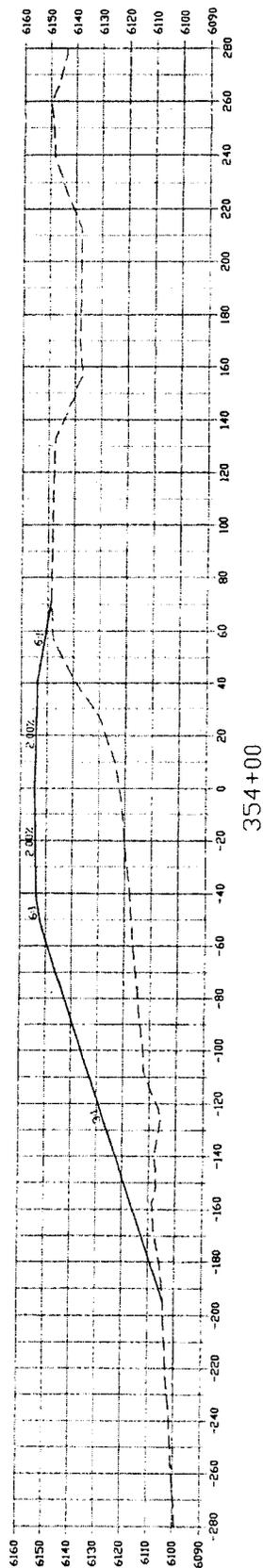
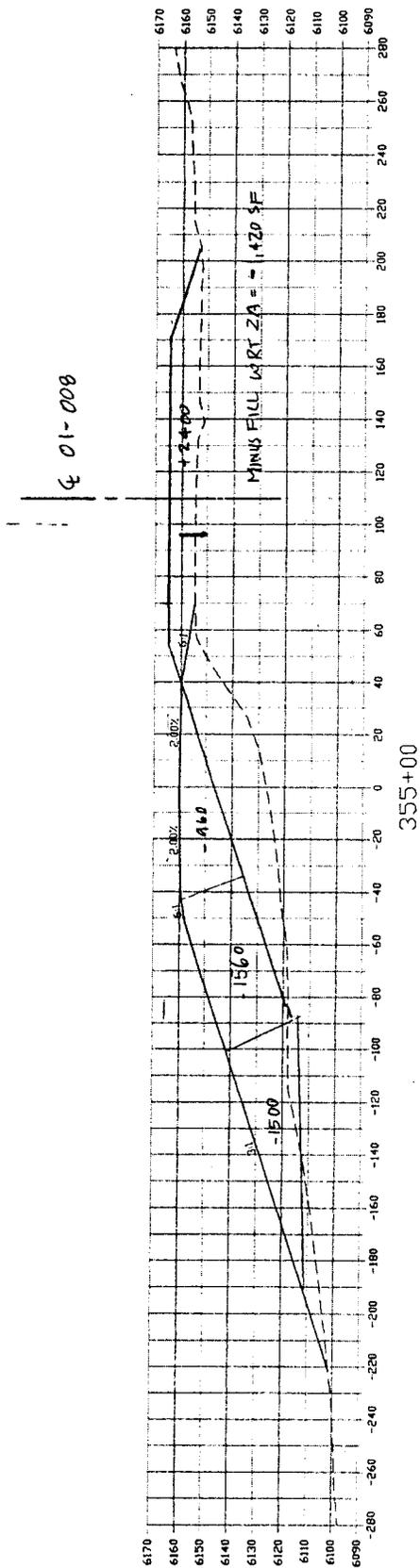
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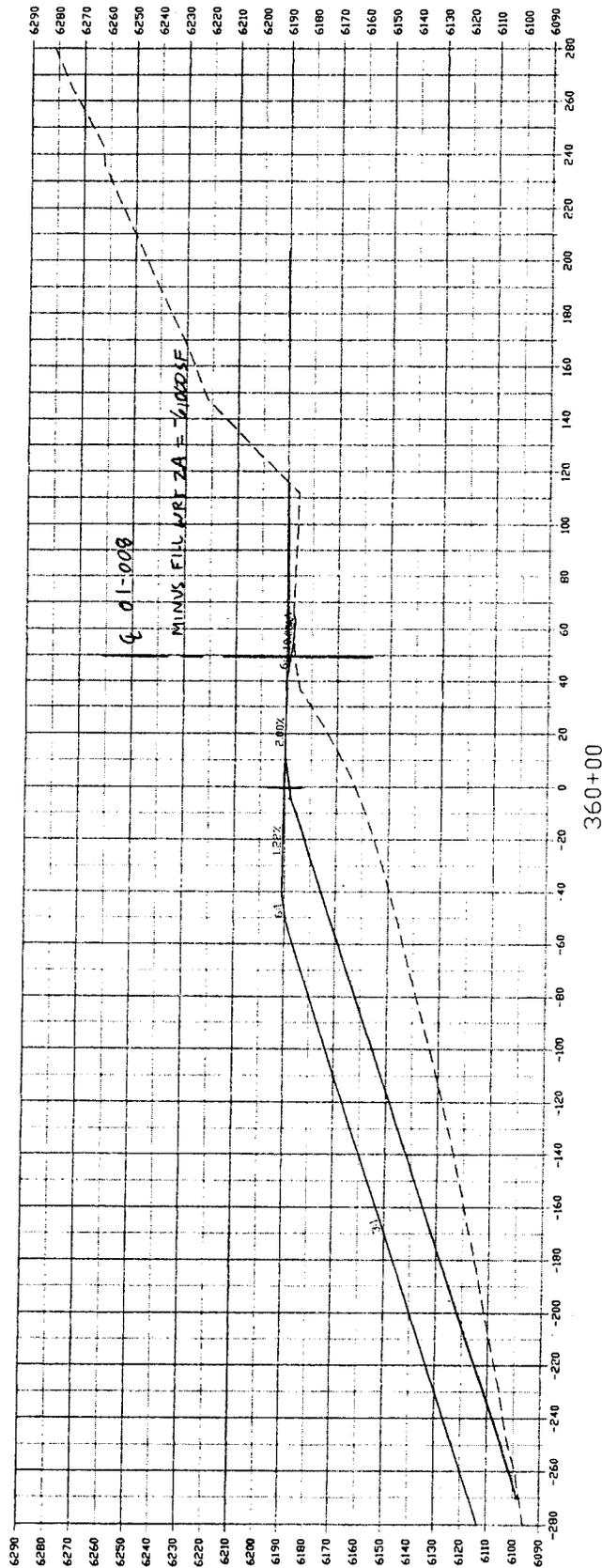


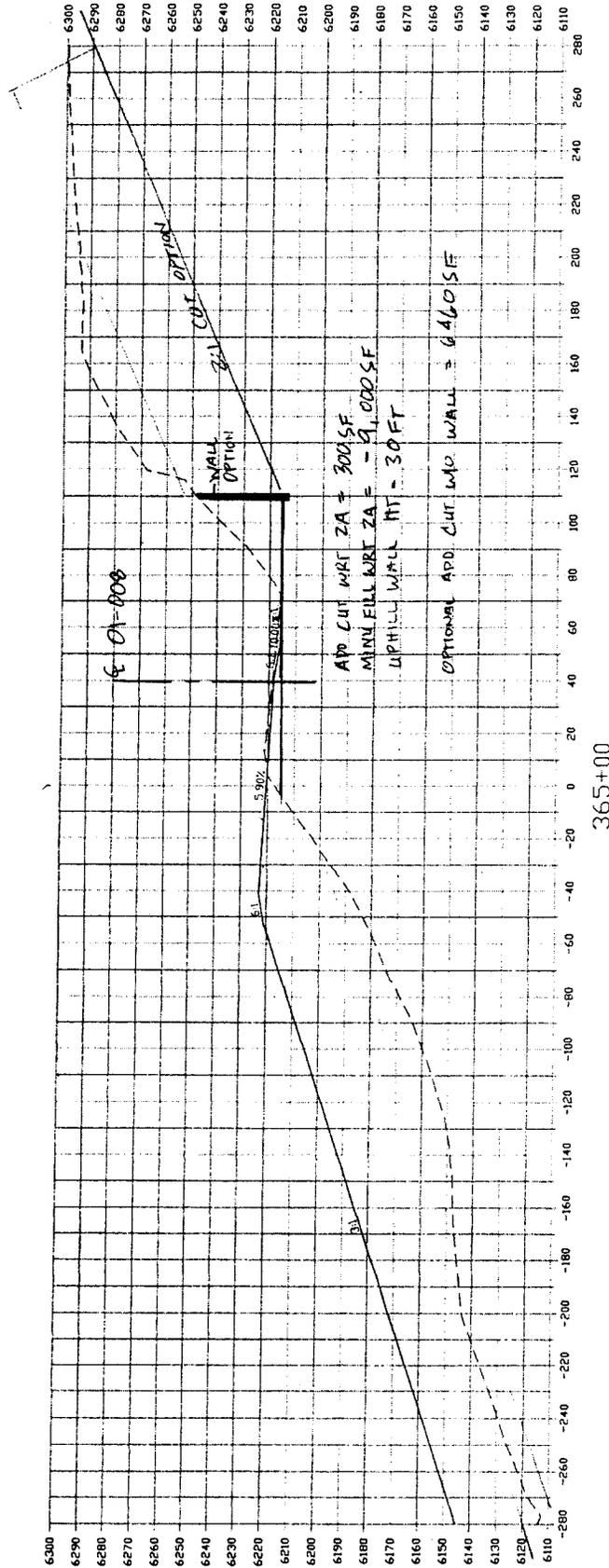
4 01-008

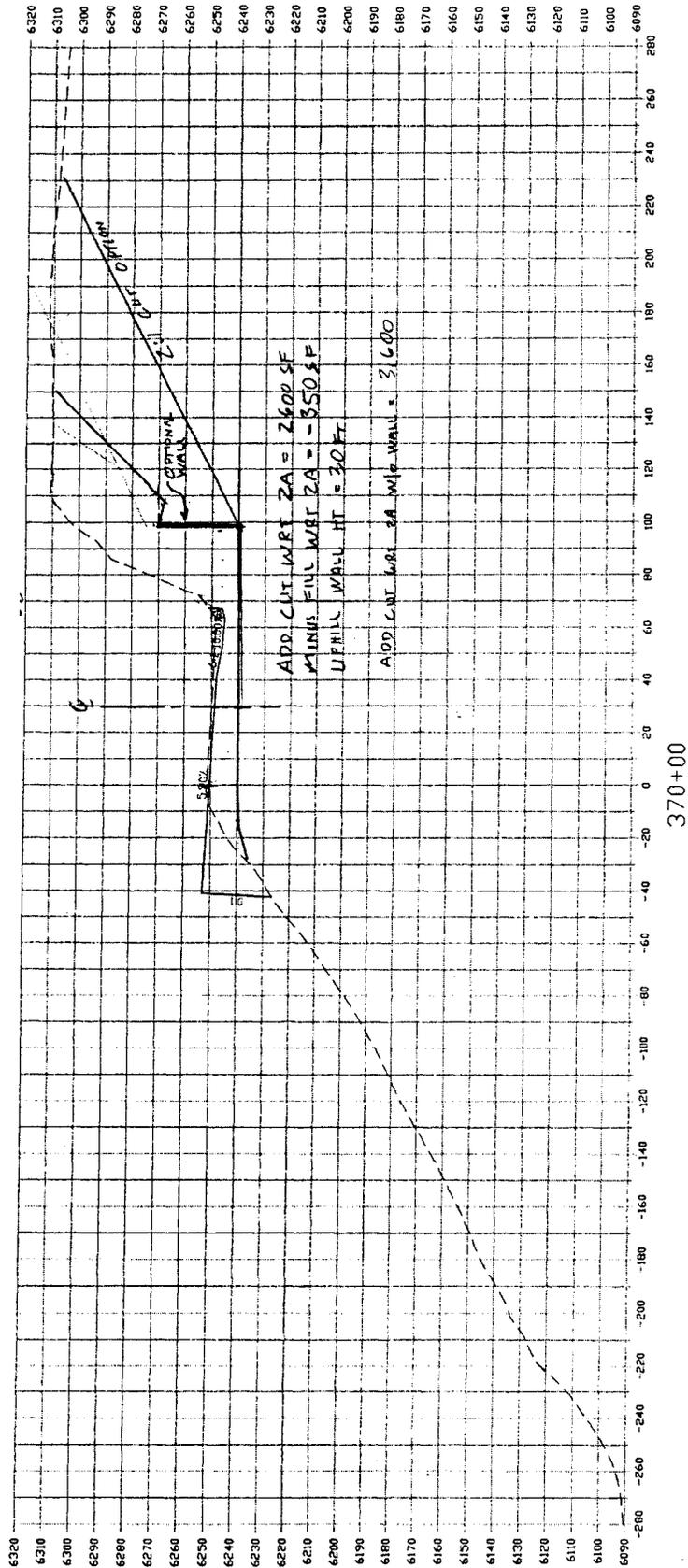


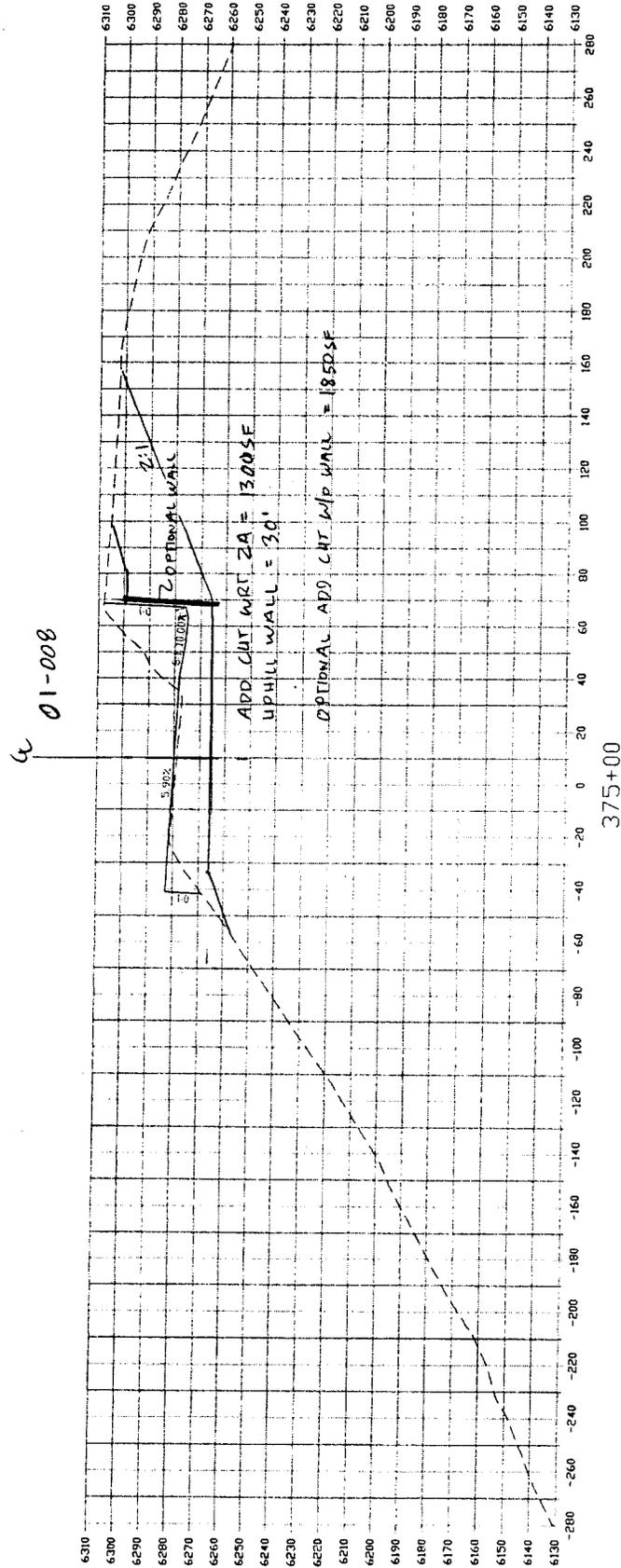




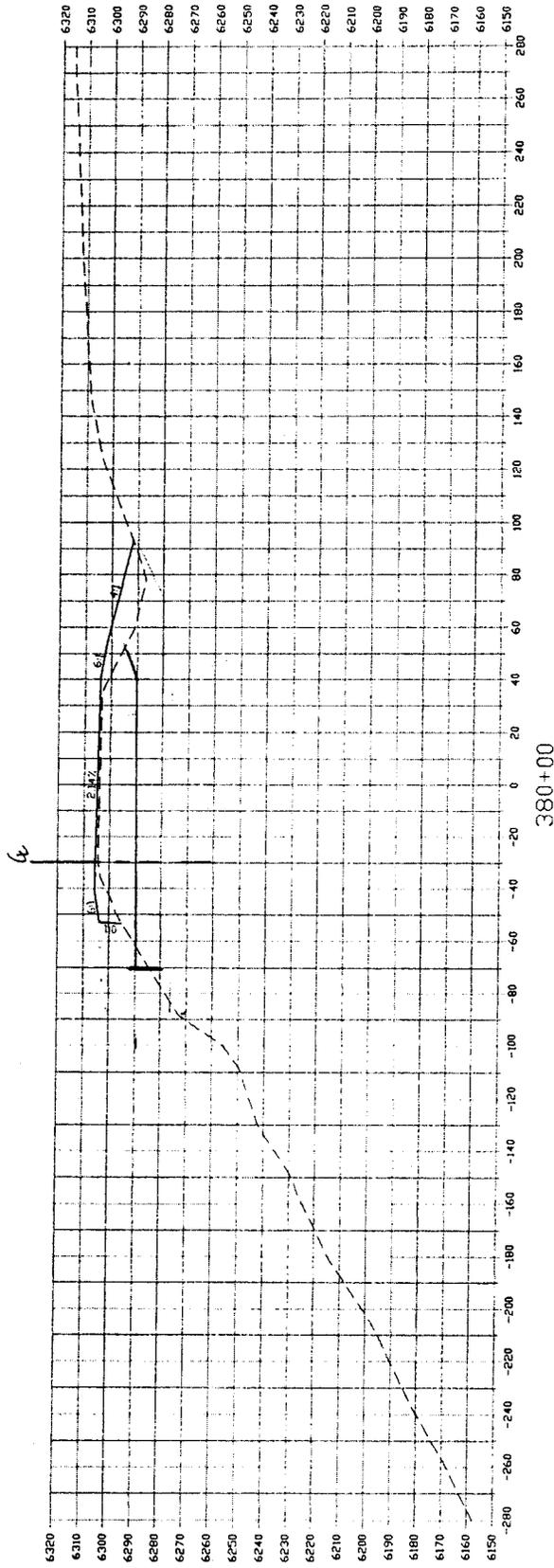








01-008  
ADD CUT WRT ZA = 1260 SF  
DOWNHILL WALL = 12'



## VALUE ENGINEERING PROPOSAL NO. 03-006

### SUMMARY PROPOSAL DESCRIPTION:

Use the existing roadway alignment as the ultimate southbound alignment in Sections 3 and 4, north of Sunnyside.

Estimated potential savings:

Initial:	\$ 2,000,000
Future:	\$ 0,000
Total:	\$ 2,000,000

### **Discussion:**

The current design north of Sunnyside follows an alignment that is generally east of the existing roadway, to allow for maintenance of traffic during construction and limiting the right of way impacts on the east side. The roadway alignment closely follows that of the existing roadway, both vertically and horizontally, although there are some minor variations necessary to conform with design standards. Given these conditions it is recommended that consideration be given to refining the alignment design to conform to a typical section template that closely aligns the proposed southbound roadway with the existing roadway.

Aligning the existing roadway with the proposed southbound roadway will reduce project costs by making use of the existing road platform, and facilitating pavement construction techniques such as hot or cold recycling of the existing bituminous mat and subgrade.

Another potential benefit of the of this approach is to incorporate the existing roadway in a phased implementation of the ultimate roadway. An initial project could construct the ultimate northbound lanes of the project and use the existing roadway as temporary southbound lanes to provide an interim four lane facility. Such an initial project could provide inertia for the corridor, by demonstrating the value of the four lane section to the public, the stakeholders and governmental authorities. The estimated cost of an initial project for this 4.5 mile segment of roadway is estimated to be \$10,100,000.

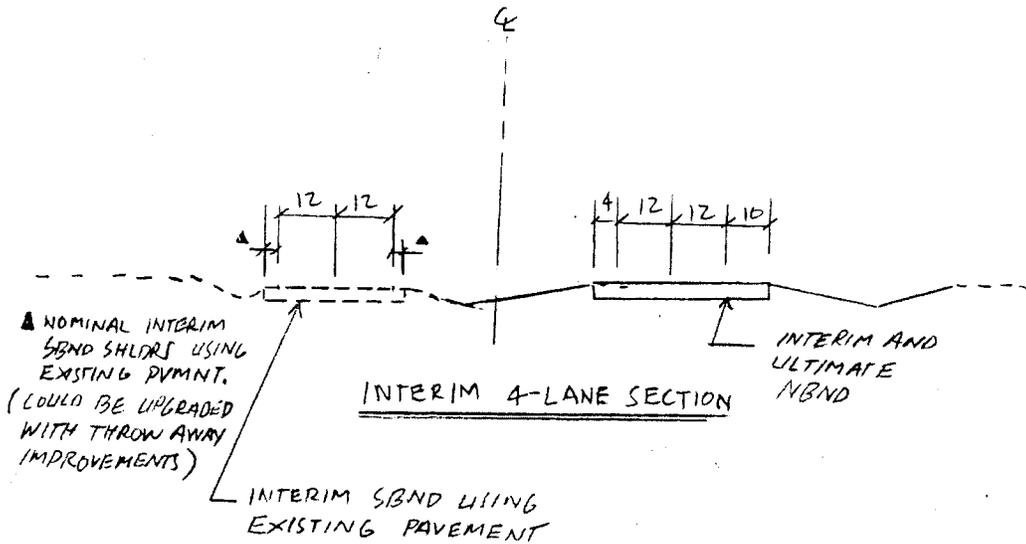
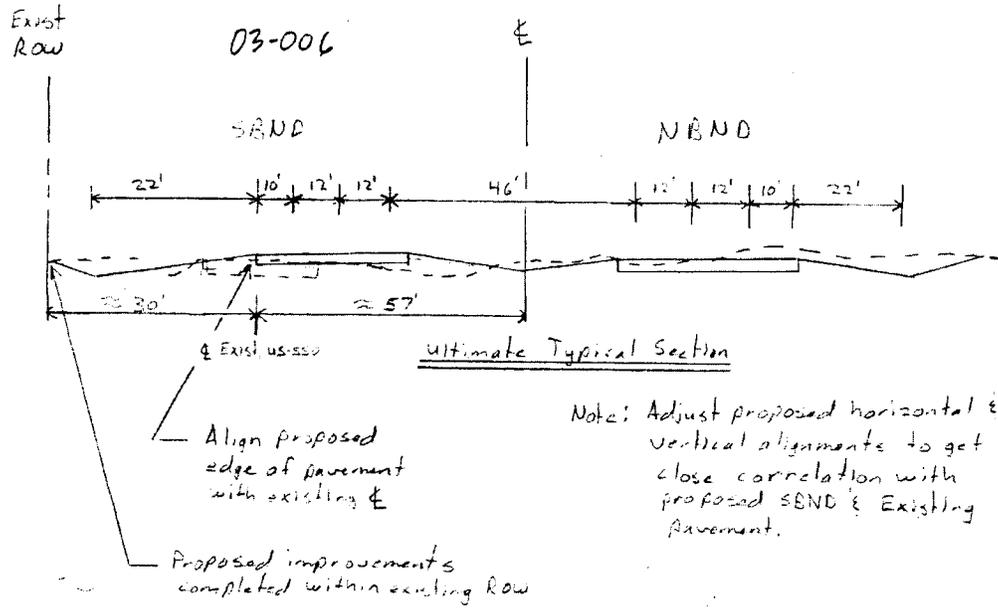
### **Related Ideas:**

P02-014 - Do a recycled asphalt project

<b>EVALUATION</b>	
Idea Number: 03-006	
Idea Description: Use the existing roadway alignment as the ultimate southbound alignment, in Sections 3 and 4, north of Sunnyside.	
Advantages of alternative concept:	
1. Reduced construction costs for southbound lanes and associated roadside designs.	
2. Interim use of the existing roadway as southbound lanes for a four lane facility.	
Advantages of original concept:	
1. None noted.	
Risks:	
1. Reduced safety on the interim southbound lanes of the four lane facility, if temporary (throw away) improvements are not constructed on the interim southbound facility.	
Conclusion:	
<input checked="" type="checkbox"/> Propose this idea	
<input type="checkbox"/> Propose this idea as a Supplemental Recommendation	
<input type="checkbox"/> Do not propose this idea because	

**Calculations and/or Discussion:**

See attached sketch and calculations.





US 550 Environmental Assessment  
Value Engineering Study

Computations:

Idea Number 03-006

Use existing roadway alignment as the ultimate southbound alignment in Sections 3 and 4, north of Sunnyside.

**Cost Estimate for Total Project Assuming Use of Recycled Asphalt for Southbound Lanes Sta 585+00 to 810+00**

Description	Units	Quantity	Unit Price	Price
Unclassified Excavation (CIP)	CY	1,613,213.00	\$ 6.50	\$ 10,485,900.00
Topsoil (assume 30 ft, 1 side)	CY	43,998.00	\$ 6.50	\$ 286,000.00
Erosion Control	MILE	15.00	\$ 30,000.00	\$ 450,000.00
Seeding ,Tackifier, Mulching	MILE	15.00	\$ 15,750.00	\$ 236,300.00
Aggregate Base Course (Class 6)	TON	490,131.00	\$ 15.00	\$ 7,352,000.00
Hot Bituminous Pavement	TON	269,905.00	\$ 45.00	\$ 12,145,700.00
Pavement Marking Paint	GAL	719.00	\$ 50.00	\$ 36,000.00
Bridges	SF	41,856.00	\$ 80.00	\$ 3,348,500.00
Retaining Walls	Sq. Ft.	61,550.00	\$ 70.00	\$ 4,308,500.00
Drainage	LF	79,200.00	\$ 27.00	\$ 2,138,400.00
Recycle Asphalt Mat	Sq. Yd.	75,000.00	\$ 3.25	\$ 243,800.00
Remove Asphalt Mat	Sq. Yd.	75,000.00	\$ 2.60	\$ (195,000.00)
<i>subtotal</i> =				\$ 40,836,100.00
Contingencies 45%				\$ 18,376,245.00
<i>subtotal</i>				\$ 59,212,345.00
mobilization 10%				\$ 5,921,234.50
traffic control 5%				\$ 2,960,617.25
construction survey 2%				\$ 1,184,246.90
construction engineering 17%				\$ 10,066,098.65
<b>total</b>				<b>\$ 79,344,542.30</b>
pe 10%				\$ 5,921,234.50
<b>Grand Total</b> =				<b>\$ 85,265,776.80</b>
Original URS Est. - 9/13/2003 (assume 2B)				\$ 87,320,159.00
Total Savings				\$ (2,054,000.00)

## Quantity Calcs

Recycled asphalt in lieu of sub base import for southbound lanes from Station 585+00 to 810+00

Remove asphalt mat will not be required for the project reflecting a cost savings

Remove asp. Mat will not be required for recycled process

810+00 - 585+00 = 22,500 lf

$$\begin{array}{r}
 22,500 \text{ lf} \\
 \times \quad \underline{\quad 30 \text{ ft wide}} \\
 \hline
 675,000 \text{ sq ft} \\
 \text{divide by} \quad \underline{\quad 9 \text{ sq ft/sq yd}} \\
 \hline
 75,000 \text{ sq yd}
 \end{array}$$

ABC 18" - will be reduced by the area of the recycled mat

$$\begin{array}{r}
 675,000 \text{ sq ft} \\
 \times \quad \underline{\quad 1.5 \text{ ft depth}} \\
 \hline
 1,012,500 \text{ cu ft} \\
 \times \quad \underline{\quad 0.068 \text{ ton/cu ft}} \\
 \hline
 68,850 \text{ tons}
 \end{array}$$

Reduced amount of ABC

68,850 tons

Recycled Asph. This is in addition to the base costs

\$ 75,000 sq yd

## VALUE ENGINEERING PROPOSAL NO. 01-021

### SUMMARY PROPOSAL DESCRIPTION:

Refine the alignments to make the project more constructable.

Estimated potential savings:

Initial:	\$ 4,300,000
Future:	\$ 0,000
Total:	\$ 4,300,000

### **Discussion:**

Refine the alignments to make the project more constructable and to allow for projects to be implemented in segments as funding is identified.

### **Related Ideas:**

P03-006 - Make use of existing lanes as ultimate southbound lanes  
P05-001 - Develop an implementation plan

<b>EVALUATION</b>	
Idea Number: 01-021	
Idea Description: Refine the alignments to make the project more constructable.	
Advantages of alternative concept:	
<ol style="list-style-type: none"> <li>1. Projects can be bid in smaller packages as funding becomes available</li> <li>2. Detouring costs are reduced</li> <li>3. The highway is safer to drive during construction</li> </ol>	
Advantages of original concept:	
<ol style="list-style-type: none"> <li>1. Design minimizes impacts to the environment</li> <li>2. Design minimizes impact to adjacent properties</li> </ol>	
Risks:	
<ol style="list-style-type: none"> <li>1. None noted.</li> </ol>	
Conclusion:	
<input checked="" type="checkbox"/> Propose this idea <input type="checkbox"/> Propose this idea as a Supplemental Recommendation <input type="checkbox"/> Do not propose this idea because	

**Calculations and/or Discussion:**

The US 550 corridor presents many alignment challenges to avoid property and environmental impacts. Logical termini should be considered with respect to potential segments which could be independently funded in \$5 million to \$10 million packages. This range is a reasonable package which may be anticipated in future funding scenarios for the corridor.

In order to meet FHWA guidelines and requirements, the design team should consider the following:

- Provide for construction packages with independent utility. These packages should be able to stand alone without substantial other project requirements and provide benefit to the stakeholders and the traveling public.
- Provide logical termini that will minimize “throwaway” work and provide a safe transition to previously constructed segments and/or into the existing corridor.
- Prioritize improvements based on the most critical and immediate needs. This may include mobility improvements on the north end of the project which has more demand, both near and long term. The capacity requirements may need to be balanced with safety goals of the project at locations such as Bondad Hill which has a high accident and severity rate.
- Provide “tie ins” which require minimal construction of detours and bypasses both during construction and after segment construction is completed.
- Provide “tie-ins” that can safely transition back to portions of the unimproved corridor.

- “Shelf” an adequate number of plan packages which can be “mixed and matched” as funding becomes available or as funding changes. This could include both reductions and increases in funding.
- Develop construction packages well in advance of anticipated funding. These “shelved” projects will allow the region to obtain any surplus funds quickly and be prioritized higher than projects throughout the state that have not been completely designed.

The costs savings recognized by this proposal could be expected to be in the range of 5-10 percent. Due to the tight corridor constraints flexibility in alignment and profile adjustments are limited, therefore 5% will be assumed as the cost savings.

\$87,120,360 was the estimated construction cost of project (URS 09/13/2001) assuming alignment 2B in segment 2. 5% of this number translates to a project savings of approximately \$4,300,000.

## VALUE ENGINEERING PROPOSAL NO. 02-014

### SUMMARY PROPOSAL DESCRIPTION:

Rather than importing substantial amounts of subbase material, recycle the existing asphalt and subbase.

Estimated potential savings:

Initial:	\$ 7,000,000
Future:	\$ 0,000
Total:	\$ 7,000,000

### **Discussion:**

Recycling existing pavement has become a popular alternative to importing subbase material. The process includes milling and mixing the existing pavement material with the existing subbase. This recycled material is then recompacted and topped with the appropriate asphalt section. The process best lends itself to projects which require a rehabilitation of the pavement due to subgrade structural failures, rather than adding additional overlays on top of a failed subbase, and reaching the point of diminishing returns with respect to calculated strength of the existing section, the recycled options saves money while providing a strong foundation for the roadway. The process also minimizes the construction impacts of traditional deep overlays such as sharp pavement drop-offs at the shoulder edge, or the need to provide significant volumes of shouldering fill material to avoid such drop-offs. This condition often steepens "Z-Slopes" and can compromise clear zone requirements.

In the case of the US 550 project, significant shifts in alignment and profile are anticipated. This is problematic in the sense that material will need to be wind-rowed or stockpiled. The other problem that this process presents to this specific project is the need to remove the old roadway in order to construct the new roadway, leaving no paved roadway surface during construction of individual segments, unless a temporary surface is constructed. Leaving a compacted unpaved surface is acceptable however speed through the construction area will need to be substantially reduced.

### **Related Ideas:**

<b>EVALUATION</b>	
Idea Number: 02-014	
Idea Description: Rather than importing substantial amounts of subbase material, recycle the existing asphalt and subbase.	
Advantages of alternative concept:	
1. Cost reduced	
2. Environmental "sustainable" solution	
3. Avoids excessive import of subbase material	
Advantages of original concept:	
1. Requires less time to construct	
2. Allows for some portions of the existing alignment to be utilized during construction.	
3. Construction is more easily phased	
Risks:	
1. None noted.	
Conclusion:	
<input checked="" type="checkbox"/> Propose this idea	
<input type="checkbox"/> Propose this idea as a Supplemental Recommendation	
<input type="checkbox"/> Do not propose this idea because	

**Calculations and/or Discussion:**

**US 550 Mainline**  
**Assumes Alignment 2B at Bondad 60mph, 5% Grade, 14' Median**

Description	Units	Quantity	Unit Price	Price
Unclassified Excavation (CIP)	CY	1,613,213.00	\$ 6.50	\$ 10,485,900.00
Topsoil (assume 30 ft, 1 side)	CY	43,998.00	\$ 6.50	\$ 286,000.00
Erosion Control	MILE	15.00	\$ 30,000.00	\$ 450,000.00
Seeding ,Tackifier, Mulching	MILE	15.00	\$ 15,750.00	\$ 236,300.00
Aggregate Base Course (Class 6)	TON	335,389.00	\$ 15.00	\$ 5,030,800.00
Hot Bituminous Pavement	TON	269,905.00	\$ 45.00	\$ 12,145,700.00
Pavement Marking Paint	GAL	719.00	\$ 50.00	\$ 36,000.00
Bridges	SF	41,856.00	\$ 80.00	\$ 3,348,500.00
Retaining Walls	Sq. Ft.	61,550.00	\$ 70.00	\$ 4,308,500.00
Drainage	LF	79,200.00	\$ 27.00	\$ 2,138,400.00
Recycle Asphalt Mat	Sq. Yd.	264,000.00	\$ 3.25	\$ 858,000.00
Remove Asphalt Mat	Sq. Yd.	264,000.00	\$ 2.60	\$ (686,400.00)
<i>subtotal =</i>				\$ 38,637,700.00
Contingencies 45%				\$ 17,386,965.00
<i>subtotal</i>				\$ 56,024,665.00
mobilization 10%				\$ 5,602,466.50
traffic control 5%				\$ 2,801,233.25
construction survey 2%				\$ 1,120,493.30
construction engineering 17%				\$ 9,524,193.05
<b>total</b>				<b>\$ 75,073,051.10</b>
pe 10%				\$ 5,602,466.50
<b>Grand Total =</b>				<b>\$ 80,675,517.60</b>
Original URS Est. dated 9/13/2003(assume 2B)				\$ 87,320,159.00
Total Savings				\$ (6,644,641.40)

## Quantity Calcs

### Recycled asphalt in lieu of sub base import

Remove asphalt mat will not be required for the project reflecting a cost savings  
Remove asp. Mat will not be required for recycled process  
15 miles of alignment

$$\begin{array}{r}
 15 \text{ miles} \\
 \times \quad 5280 \text{ ft/mile} \\
 \hline
 79,200 \text{ ft} \\
 \times \quad 30 \text{ ft wide} \\
 \hline
 2376000 \text{ sq ft} \\
 \text{divide by } 9 \text{ sq ft/sq yd} \\
 \hline
 264000 \text{ sq yd}
 \end{array}$$

ABC 18" - will be reduced by 40% for the project  
Costs from URS 9/13/03 estimate

Assume that 60% ABC will be required  
(originally estimated)

$$\begin{array}{r}
 \text{Total ABC} \quad 558981 \text{ tons} \\
 \times \quad 0.60 \text{ factor} \\
 \hline
 335389 \text{ tons}
 \end{array}$$

Recycled Asph. This is in addition to the base costs  
15 miles of alignment

2.70 \$/sq M WCP-w Bid costs  
(2.7/1.2 sq yd sq M=3.24\$/sq yd)

$$\begin{array}{r}
 15 \text{ miles} \\
 \times \quad 5280 \text{ ft/mile} \\
 \hline
 79,200 \text{ ft} \\
 \times \quad 30 \text{ ft wide} \\
 \hline
 2376000 \text{ sq ft} \\
 \text{divide by } 9 \text{ sq ft/sq yd} \\
 \hline
 264000 \text{ sq yd} \\
 \times \quad 3.25 \text{ \$/sq yd} \\
 \hline
 \$858,000
 \end{array}$$

## VALUE ENGINEERING PROPOSAL NO. 01-043

### SUMMARY PROPOSAL DESCRIPTION:

Match phasing of first Section 4 US 550 project with Farmington Hill US 160 project to balance earthwork.

Estimated potential savings:

Initial:	\$ 420,000
Future:	\$ 0,000
Total:	\$ 420,000

### **Discussion:**

Construct the Section 4 US 550 project(s) simultaneously with US 550 Section "5" (CR 220 to SH 160 in Grandview). Use the embankment mined from the US 160 project, as it descends the hill at the mesa edge to Grandview, to construct embankment for US 550 on Section 4.

### **Related Ideas:**

Note: This proposal assumes that environmental clearances and permits have been obtained separately for each project, and that subsequent construction schedules coincide.

<b>EVALUATION</b>
Idea Number: 01-043 Idea Description: Match phasing of first Section 4 550 project with Farmington Hill US 160 project to balance earthwork.
Advantages of alternative concept: <ol style="list-style-type: none"> <li>1. Significant cost savings by minimizing dirt haul from mesa edge to 550 Section 4 embankment</li> <li>2. Synergistic effect of dealing with the largest bid item on projects in 2 corridors at once by balancing the embankment quantity</li> <li>3. Eliminates significant amount of contract furnished material and/or waste</li> </ol>
Advantages of original concept: <ol style="list-style-type: none"> <li>1. All project funded costs go to construction of roadway, rather than ROW (See proposal 05-006)</li> <li>2. The 2 corridors remain financially independent. Smaller amounts of funding can be spent in one corridor or the other, rather than "splitting the baby"</li> </ol>
Risks: <ol style="list-style-type: none"> <li>1. Savings can only be realized if there is enough funding for projects in 2 corridors, or if enough funding for additional ROW purchase on US 550 job</li> <li>2. ROW purchase cost will partially offset savings produced by cheaper embankment (See proposal 05-006)</li> </ol>
Conclusion: <input checked="" type="checkbox"/> Propose this idea <input type="checkbox"/> Propose this idea as a Supplemental Recommendation <input type="checkbox"/> Do not propose this idea because

**Calculations and/or Discussion:**

For calculation purposes, assume following:

1,400,000 cy excavation for Section "5" US 550 @ US 160 Grandview  
825,000 required for US 160 embankment  
 575,000 cy available for US 550 embankment; Say 500,000 cy

Section 4 US 550 requires  $(286-166)*1000 = 120,000$  cy fill  
 120 < 500 Material amount OK

Assume CIP cost of \$6.50/cy for material hauled from "off site"  
 Assume CIP cost of \$3/cy for material hauled from 550 Mesa

@  $$(6.50 - 3.00) = 3.50$ /cy savings:

120,000 cy \*  $$(3.50) = \$420,000$  SAVINGS

## **SECTION 4 – SUPPLEMENTAL RECOMMENDATIONS**

The following ideas were generated by the VE Team and thought to have considerable merit. These ideas are thought to offer improvements, but either the economics were not calculable or the idea could not be developed because of insufficient information.

The VE Team suggests that these recommendations be carefully reviewed and given as much thought and effort as the formal VE Proposals.

**SUPPLEMENTAL RECOMMENDATION SUMMARY TABLE**

<b>PROPOSAL NO.</b>	<b>VE PROPOSAL DESCRIPTION</b>	<b>REVIEW BOARD COMMENTS</b>	<b>PAGE NO.</b>
SR01-001	Evaluate full range of alternatives in the EA including phasing descriptions.	<b>DECLINE</b> Need to look at alternatives where we have impacts. EA does not require us to look at a full range of alternatives.	4-4
SR01-005	Use the existing alignment as bikeway.	<b>DECLINE</b> Conflicts with the acceptance of P03-006	4-6
SR01-010	Widen southbound US 550 inside shoulder at Bondad Hill to provide improved sight distances (applies to original Alt 2A and 2B).	<b>ACCEPT WITH MODIFICATIONS</b> This is one of the tools that can be used and we will review areas where it is appropriate.	4-8
SR01-013	Use design exceptions to avoid or minimize impacts to environmentally sensitive areas.	<b>ACCEPT</b> This is something that has to be done.	4-11
SR01-015	Install school bus turnouts	<b>DECLINE</b> Kids are picked up and dropped off at their driveways. These points constantly vary and there would be several. Legally vehicles are required to stop, so these should not be needed.	4-14
SR01-017	Utilize joint environmental mitigation, e.g. combine mitigation sites with those of other projects such as US 160.	<b>ACCEPT</b> Will look at this where it is feasible. It also would require that other agencies accept this concept.	4-16
SR01-023	Challenge the Environmental Justice perception of the Sunnyside Mobile Home Park.	<b>DECLINE</b> The current design concept has minimal impacts to the trailer park. There are fewer property owner impacts by missing the trailer park.	4-18
SR01-030	Grandfather existing accesses and assess impact fees for future accesses.	<b>DECLINE</b> This is not consistent with State policies.	4-20
SR01-033	Use deer fencing at selected locations where justified to mitigate right-of-way issues where landowner has livestock fencing issues.	<b>DECLINE</b> CDOT will utilize deer fence where feasible.	4-22

PROPOSAL NO.	VE PROPOSAL DESCRIPTION	REVIEW BOARD COMMENTS	PAGE NO.
SR01-035	Make US 550 a Scenic Byway and request enhancement funds.	<b>DECLINE</b> CDOT has no control with the signing and billboards on the SUIT property. With the SUIT property at various locations along the corridor and knowing the restrictions for a Scenic Byway, it would be difficult to get this corridor approved as a Scenic Byway	4-24
SR01-036	Perform an early geotechnical feasibility study at Bondad Hill.	<b>DECLINE</b> At this time, CDOT does not want a formal geotechnical feasibility study at Bondad Hill. However if existing data from site investigations or possibly oil and gas wells is available it will be utilized.	4-26
SR01-039	Use a retaining wall along the mobile home park at Sunnyside.	<b>ACCEPT</b> This would minimize ROW and possibly avoid need to do any relocations at Sunnyside.	4-28
SR01-040	Provide grade separated game crossings in Design Sections 3 & 4	<b>ACCEPT</b> This will be evaluated where appropriate. Other wildlife mitigation measures will also be evaluated.	4-30
SR01-045	Reduce the speed limit through Sunnyside and use traffic calming measures to reinforce driver recognition of lower speed limits.	<b>DECLINE</b> Could use vegetation, flashing beacons, different pavement or texture. Goal for the corridor is not to have to reduce the speed limit.	4-33
SR01-046	Provide a grade separated pedestrian structure near the Sunnyside Elementary School for access across US 550.	<b>DECLINE</b> Could look at enhancement funds. Kids are currently being bused	4-35
SR01-048	Upsize or add culverts for microfauna (small critters) road crossing	<b>ACCEPT</b> It is a part of the environmental process.	4-37
SR01-050	Perform 3-D graphical analysis of sight distance to increase design speeds at Bondad Hill using current AASHTO standards	<b>ACCEPT</b> This will be evaluated during final design.	4-39
SR04-011	Add overhead lighting to US 550 corridor.	<b>DECLINE</b> Overhead lighting is an urban look. The residences along the corridor are not in favor of lighting.	4-44
SR05-001	Develop a Phasing Implementation Plan	<b>ACCEPT</b> The phasing plan is a part of the environmental process.	4-46
SR06-005	Accommodate U-Turns at median breaks for WB62 Vehicles.	<b>DECLINE</b> A 71' median would be needed. The highway would be transitioning in and out almost constantly.	4-48
SR09-001	Provide rockfall arresting features/devices at Bondad Hill	<b>ACCEPT</b> This will be done as part of the final design process.	4-50

PROPOSAL NO.	VE PROPOSAL DESCRIPTION	REVIEW BOARD COMMENTS	PAGE NO.
SR10-001	Split horizontal and vertical alignments	<b>ACCEPT</b> In some sections this has already been implemented. This will be evaluated as part of the final design process.	4-52

## **SUPPLEMENTAL RECOMMENDATION NO. 01-001**

### **SUMMARY RECOMMENDATION DESCRIPTION:**

Evaluate full range of alternatives in the Environmental Assessment (EA) including phasing descriptions.

### **Description:**

Document the need for a four-lane facility by the year 2025 as part of the Purpose and Need discussion in the EA. Also, describe an ultimate two-lane configuration as the No Action alternative. Include a phasing description (from two to four lanes) for each alternative to document that each phase provides independent utility (functions adequately on its own without requiring substantial other improvements).

### **Related Ideas:**

- P01-006 - Use a three-lane cross section with alternate passing lanes
- P01-011 - Use a "Super Two" concept throughout the project
- P01-041 - Use existing US 550 as interim southbound lanes during construction

<b>EVALUATION</b>	
Idea Number: 01-001	
Idea Description: Evaluate full range of alternatives in the EA including phasing descriptions	
Advantages of alternative concept:	
1. Ensure legal sufficiency of the EA	
2. Provide for comparison of the action alternatives to the No Action	
3. Ensures that segmentation issues are avoided	
Advantages of original concept:	
1. N/A	
Risks:	
1. None noted.	
Conclusion:	
<input type="checkbox"/> Propose this idea	
<input checked="" type="checkbox"/> Propose this idea as a Supplemental Recommendation	
<input type="checkbox"/> Do not propose this idea because	

**DISCUSSION AND/OR CALCULATIONS:**

## **SUPPLEMENTAL RECOMMENDATION NO. 01-005**

### **SUMMARY RECOMMENDATION DESCRIPTION:**

Use the existing alignment as bikeway.

### **Description:**

Once construction of the new northbound (NB) lanes is complete and bench is used for 2-way traffic, set aside existing alignment as a bikeway.

### **Related Ideas:**

<b>EVALUATION</b>	
Idea Number: 01-005	
Idea Description: Use the existing alignment as a bikeway	
Advantages: <ol style="list-style-type: none"><li>1. Increased quality of life</li><li>2. Reserves existing alignment for just-in-time use for capacity increase project</li><li>3. Insulates CDOT from rising ROW prices</li><li>4. Safety of bike/pedestrian public</li><li>5. Increased sight distance for accesses on West side</li><li>6. Facilitates access consolidation on West side</li><li>7. Minimal cost to put into service</li><li>8. Encourages alternative modal use of the corridor</li></ol>	
Disadvantages: <ol style="list-style-type: none"><li>1. Very difficult to take back as 4-lane</li><li>2. Access conflicts with bikes/pedestrians</li></ol>	
Risks: <ol style="list-style-type: none"><li>1. None noted.</li></ol>	
Conclusion: <input type="checkbox"/> Propose this idea <input checked="" type="checkbox"/> Propose this idea as a Supplemental Recommendation <input type="checkbox"/> Do not propose this idea because	

**DISCUSSION AND/OR CALCULATIONS:**

Forward as Supplemental Recommendation with no cost savings.

## **SUPPLEMENTAL RECOMMENDATION NO. 01-010**

### **SUMMARY RECOMMENDATION DESCRIPTION:**

Widen southbound US 550 inside shoulder at Bondad Hill to provide improved sight distances (applies to original Alt 2A and 2B).

### **Description:**

The as-designed southbound inside shoulder at Bondad Hill has a 6-ft width at locations where median barrier is use in the original Alt 2A and 2B. Sight distances that are obstructed by the median barrier can be improved by increased inside shoulder widths for the southbound traffic.

### **Related Ideas:**

P01-008 - Use alternative alignment at Bondad Hill

SR01-050 - Perform a 3D graphical analysis of sight distances to increase design speeds at Bondad Hill using current AASHTO standards

<b>EVALUATION</b>
Idea Number: 01-010 Idea Description: Widen southbound US 550 inside shoulder at Bondad Hill to provide improved sight distances (applies to original Alt 2A and 2B).
Advantages of alternative concept: 1. Increase available driver reaction time for small objects in travel lane, ie rocks 2. Increase design speed with respect to stopping sight distance
Advantages of original concept: 1. Lower construction cost
Risks: 1. None noted
Conclusion: <input type="checkbox"/> Propose this idea <input checked="" type="checkbox"/> Propose this idea as a Supplemental Recommendation <input type="checkbox"/> Do not propose this idea because

**DISCUSSION AND/OR CALCULATIONS:**

2001 updated AASHTO standards do not require the designer to provide stopping sight distance for objects less than 2 feet high. Therefore, in many cases a 3D graphical solution can be used to demonstrate that the median barrier does not constrain design sight distances (refer to SR 01-005). Nonetheless, the safety of the roadway can be improved by providing better sight distances to smaller objects. As a result there may be value in increasing inside shoulder widths for improved sight distances to small objects in areas of concern. At Bondad Hill increases in the inside shoulder width can provide design sight distances to objects less than 2 feet, as shown in the following calculation.

The CDOT 1995 Design Guide, Figure 3-1, was used to evaluate the available sight distance for various shoulder widths.

$$S = (R/28.65) \times \cos^{-1}[(R-M)/R]$$

Exhibit 3-2 in 1991 AASHTO for Stopping Sight Distances on Grade was used to interpolate the effective design speed using the available sight distance. US 550 Section 2A geometrics were assumed.

- For a 6-foot shoulder: M = 6'(1/2 lane width) + 6'(shoulder) = 12'; R = 1910'(HCL curve radius) + 6'(1/2 lane width) + 6'(shoulder) + 1' (1/2 median barrier width) = 1923'; S = 430' (from equation in Figure 3-1). Interpolating Exhibit 3-2 for 5% downhill grade, the effective design speed is approximately 48 mph.

- For a 12-foot shoulder:  $M = 6'(1/2 \text{ lane width}) + 12'(\text{shoulder}) = 18'$ ;  $R = 1910'$ (HCL curve radius) +  $6'(1/2 \text{ lane width}) + 12'(\text{shoulder}) + 1'$  (1/2 median barrier width) = 1929';  $S = 527'$  (from equation in Figure 3-1). Interpolating Exhibit 3-2 for 5% downhill grade, the effective design speed is approximately 54 mph.
- For an 18-foot shoulder:  $M = 6'(1/2 \text{ lane width}) + 18'(\text{shoulder}) = 24'$ ;  $R = 1910'$ (HCL curve radius) +  $6'(1/2 \text{ lane width}) + 18'(\text{shoulder}) + 1'$  (1/2 median barrier width) = 1935';  $S = 610'$  (from equation in Figure 3-1). Interpolating Exhibit 3-2 for 5% downhill grade, the effective design speed is approximately 59 mph.

### Cost for Improved Sight Distance

Each of these shoulder width increase come at an increase to the project construction cost. The length of curve in question at Bondad Hill is 1992 ft. The increased cost is due to added embankment, pavement and retaining wall height, with the retaining wall at \$70/sq. ft. being the primary cost.

- For a 12' shoulder (6 ft wider), the added cost at Station 374+00 is approximately \$460/linear foot (without contingencies) or  $\$460 \times 1992/2$  (reduction for averaging) = \$460,000.
- For an 18' shoulder (12 ft wider), the added cost at Station 374+00 is approximately \$930/linear foot (without contingencies) or  $\$930 \times 1992/2$  (reduction for averaging) = \$930,000.

## **SUPPLEMENTAL RECOMMENDATION NO. 01-013**

### **SUMMARY RECOMMENDATION DESCRIPTION:**

Use design exceptions to avoid or minimize impacts to environmentally sensitive areas.

### **Description:**

Apply reduced design standards in environmentally sensitive locations such as wildlife crossing areas or adjacent to cultural resources sites to avoid or minimize impacts. Design standard reductions could include reduced median width, narrower shoulders, sharper curves, reduced ditch width, etc.

These reductions may come in the form of utilizing minimum rather than desirable criteria, or a design exception/variance.

### **Related Ideas:**

- P01-006 - 3-lane typical
- P01-011 - Super 2 concept
- P01-012 - Reduce median width

EVALUATION	
Idea Number: 01-013	Idea Description: Use design exceptions to avoid or minimize impacts to environmentally sensitive areas.
Advantages of alternative concept:	<ol style="list-style-type: none"><li>1. Reduce impacts to key resources</li><li>2. Lower cost by reducing template</li><li>3. Helps to achieve Context Sensitive Solution goals</li></ol>
Advantages of original concept:	<ol style="list-style-type: none"><li>1. More consistent design speed, driver expectancy and application of current design standards.</li></ol>
Risks:	<ol style="list-style-type: none"><li>1. Induces changes in design speed that may affect driver expectations</li></ol>
Conclusion:	<input type="checkbox"/> Propose this idea <input checked="" type="checkbox"/> Propose this idea as a Supplemental Recommendation <input type="checkbox"/> Do not propose this idea because

**DISCUSSION AND/OR CALCULATIONS:**

Environmentally sensitive areas within the US 550 corridor may include wildlife concentration/crossing areas, cultural resources sites, and the potential environmental justice (EJ) population at the Sunnyside mobile home park. The EJ issues are discussed in SR 01-023. Wildlife and cultural resources issues are discussed below.

**Wildlife:** Existing high-use big game areas were identified from big game-vehicle collision data for the period from January 2000 to December 2001. These include:

- MP 5 to MP 7 (Bondad Hill) with 15 of 55 (27%) of animal/vehicle collisions, is considered a high mule deer movement corridor.
- MP 8 to MP 11 (north of Sunnyside in an area of predominately agricultural fields and pastures) with 15 of 55 (27%) of animal/vehicle collisions is considered to be a major wildlife movement corridor.
- MP 12 to MP 17 (outside of the project area) is predominately pinion-juniper vegetation and experienced 21 of 55 (38%) of animal/vehicle collisions and is considered a major wildlife movement corridor.

Design exceptions such as reduced median width, narrower shoulders, sharper curves, reduced ditch width, use of lesser county standards, etc. could be applied within these areas to minimize the roadway template and allow easier wildlife crossing.

**Archaeological Resources:** Sites within the study corridor that are eligible to the NHR or classified as “needs data” include:

- 5LP 6665: near Farmington Hill. Potentially significant impact due to high quality of site. Evaluate avoidance by a narrower median, reduced shoulders, or reduced ditch width.
- 5LP6463: appears to be on Southern Ute Indian Tribal lands, is impacted by 2Alt. B (Bondad Hill). Evaluate avoidance or impact reduction by use of a retaining wall.
- 5LP3104/4226: not impacted
- 5LP6461: not impacted
- 5LP3129: not impacted
- 5LP3105: impacted by Alt. 2A, 2B at Bondad Hill. Evaluate avoidance through use of a retaining wall or minor alignment shift.
- 5LP5949: may be impacted by Alt. 2D at Bondad Hill. Evaluate avoidance or impact reduction through a minor alignment shift.
- 5LP3107: may be impacted by Alt. 2A or 2D at Bondad Hill. Evaluate avoidance or impact reduction through a minor alignment shift or retaining wall.

Design exceptions may also be used to achieve Context Sensitive Design objectives by allowing the roadway to better “lay with the land” and create less visual impact.

## **SUPPLEMENTAL RECOMMENDATION NO. 01-015**

### **SUMMARY RECOMMENDATION DESCRIPTION:**

Install school bus turnouts.

### **Description:**

Provide school bus turnouts on US 550 at locations to be determined with the La Plata County school district. Where possible, construct at key intersections (CR 318, 301, 218) and include use of the right turn lane as part of the turnout and for acceleration. Depending on county or school district requirements, turnouts may need to be 28-40' deep and include a barrier median adjacent to the shoulder for protection from through traffic. The actual loading area should be 10-12 feet wide and at least 50' long to accommodate one school bus. The existing shoulder can be used for part of the acceleration lane and the total acceleration lane constructed at not sharper than 3:1.

At locations where demand warrant a bus stop but right turn lanes are not available, include adequate acceleration/deceleration shoulder extensions. Install at key school bus drop-off locations as determined with the school district.

### **Related Ideas:**

<b>EVALUATION</b>	
Idea Number: 01-015 Idea Description: Install school bus turnouts.	
Advantages of alternative concept: 1. Improve safety during school year by 1) minimizing the frequency and number of vehicles stopped behind buses and creating stationary obstacles and 2) providing additional space for children entering/exiting the bus and for parents to park vehicles off of the main travelway, as feasible. 2. Improve mobility by reducing traffic queues on US 550 formed behind buses 3. Avoid possible rear end accidents involving buses	
Advantages of original concept: 1. No additional shoulder required 2. No acceleration into traffic stream by school bus drivers 3. Narrower shoulder may reduce driver perception that another travel lane is available	
Risks: 1. None noted.	
Conclusion: <input type="checkbox"/> Propose this idea <input checked="" type="checkbox"/> Propose this idea as a Supplemental Recommendation <input type="checkbox"/> Do not propose this idea because	

**DISCUSSION AND/OR CALCULATIONS:**

Bus pullout locations and need should be discussed with the school district. If warranted, specific design guidelines should be developed. Design elements to be discussed include the need for a barrier to separate the bus pullout from adjacent traffic and the length and width of the actual pullout.

## **SUPPLEMENTAL RECOMMENDATION NO. 01-017**

### **SUMMARY RECOMMENDATION DESCRIPTION:**

Utilize joint environmental mitigation, e.g. combine mitigation sites with those of other projects such as US 160.

### **Description:**

Look for opportunities to conduct mitigation for vegetation, wetlands, wildlife habitat, and farmland impacts in combination with other CDOT or agency projects.

### **Related Ideas:**

Wetland mitigation banking

<b>EVALUATION</b>	
Idea Number: 01-017	
Idea Description: Utilize joint environmental mitigation, e.g. combine mitigation sites with those of other projects such as US 160.	
Advantages of alternative concept:	
1. May allow use of higher-quality mitigation sites	
2. Efficiency of mitigation site construction (one time/location rather than multiple locations over time)	
Advantages of original concept:	
1. On-site mitigation may be less expensive if within CDOT ROW	
Risks:	
1. None noted.	
Conclusion:	
<input type="checkbox"/> Propose this idea	
<input checked="" type="checkbox"/> Propose this idea as a Supplemental Recommendation	
<input type="checkbox"/> Do not propose this idea because	

**DISCUSSION AND/OR CALCULATIONS:**

## **SUPPLEMENTAL RECOMMENDATION NO. 01-023**

### **SUMMARY RECOMMENDATION DESCRIPTION:**

Challenge the Environmental Justice (EJ) perception of the Sunnyside Mobile Home Park.

#### **Description:**

Evaluate the ethnicity and income of residents at the Sunnyside MHP to determine likely status as an EJ population in relation to other such populations in the project area. If the Sunnyside MHP residents are not low-income or a minority population in percentages considered disproportionate to the project area population then this community should not be considered an EJ population. As such, the MPH would not warrant special consideration and ROW could be acquired from the MPH instead of from the residential/rental property on the east side of US 550.

Under this scenario the MHP residents would be relocated according to the Uniform Relocation Act. Because La Plata County apparently has instituted a moratorium on new mobile home parks, residents would likely be relocated to apartments or single family homes. This total relocation cost may be less than the cost associated with purchasing and relocating the mobile homes to new location(s), and less than purchasing the Short property on the east side of US 550.

#### **Related Ideas:**

Presume that the MHP does contain an EJ population and may be disproportionately impacted by the preferred alternative, but work with the residents and owner to determine other mitigation measures (retaining wall/noise wall, removal of some but not all mobile homes and recluster of others to avoid impact, landscaping, etc.) to avoid a disproportionate impact.

<b>EVALUATION</b>	
Idea Number: 01-023 Idea Description: Challenge the Environmental Justice (EJ) perception of the Sunnyside Mobile Home Park.	
Advantages of alternative concept: 1. Potential reduced ROW cost 2. Relocations may be acceptable to MHP residents 3. Allows consideration of MHP for ROW on the same criteria as the property on the east side of US 550	
Advantages of original concept: 1. Less data collection required if MHP is assumed to be an EJ population. Note that income and ethnicity data is often difficult to obtain due to privacy issues, so it is frequently easier to assume an EJ population exists. Similarly, it may be difficult to determine the presence/absence of "disproportionate" impacts without extensive data collection for the entire project area.	
Risks: 1. None noted.	
Conclusion: <input type="checkbox"/> Propose this idea <input checked="" type="checkbox"/> Propose this idea as a Supplemental Recommendation <input type="checkbox"/> Do not propose this idea because	

**DISCUSSION AND/OR CALCULATIONS:**

## **SUPPLEMENTAL RECOMMENDATION NO. 01-030**

### **SUMMARY RECOMMENDATION DESCRIPTION:**

Grandfather existing accesses and assess impact fees for future accesses.

### **Description:**

Accommodate existing accesses as designed for the preferred alternative, and then apply one of two methods:

1. Jointly determine a limited number of specific future access locations with La Plata County and implement impact fee program for those accesses based on a) distance of the property needing access; and b) trip generation rate by proposed land use type (residential, commercial, industrial)
2. Do not identify specific future access locations, but implement impact fee program for future proposed accesses based on a) distance of undeveloped properties to the requested access; and b) trip generation rate by land use type (residential, commercial, industrial).

### **Related Ideas:**

<b>EVALUATION</b>	
Idea Number: 01-030	Idea Description: Grandfather existing accesses and assess impact fees for future accesses.
Advantages of alternative concept:	<ol style="list-style-type: none"><li>1. Preserves existing access points</li><li>2. Provides revenue for roadway construction</li><li>3. Local precedent for use of impact fees (La Plata County)</li><li>4. Acquire ROW from Southern Ute Indian Tribe at no or reduced initial cost</li></ol>
Advantages of original concept:	<ol style="list-style-type: none"><li>1. N/A</li></ol>
Risks:	<ol style="list-style-type: none"><li>1. Does not seem to be currently used by CDOT. Need to investigate legal and policy issues</li></ol>
Conclusion:	<p><input type="checkbox"/> Propose this idea</p> <p><input checked="" type="checkbox"/> Propose this idea as a Supplemental Recommendation</p> <p><input type="checkbox"/> Do not propose this idea because</p>

**DISCUSSION AND/OR CALCULATIONS:**

Impact fees have been assessed in La Plata County for the La Posta Road bridge since approximately 1998. Fees are based on 1) property distance from bridge; and 2) expected trip generation from the proposed land use at a set rate per trip per day. A similar formula could be used for funding of US 550.

Use of Method 1 (identify specific access locations jointly with LaPlata County) could be used to consolidate all future accesses in pre-determined locations, thus better managing traffic ingress/egress to US 550. This method may also assist the County in determining appropriate land use patterns that avoid overburdening the county roadway network.

## **SUPPLEMENTAL RECOMMENDATION NO. 01-033**

### **SUMMARY RECOMMENDATION DESCRIPTION:**

Use deer fencing at selected locations where justified to mitigate right-of-way issues where landowner has livestock fencing issues.

### **Description:**

For right-of-way fencing CDOT expects to use the M&S standard fencing due to legal precedent. For this project location that would be M-607-1, a four-strand barbed wire fencing which is 42-inches high. This fence does not have sufficient height or number of strands to contain certain types of livestock, and the landowner(s) was not satisfied with the right-of-way settlement.

Under this proposal, a higher standard fencing type would be used and justified on the basis of expected safety improvements and reduced maintenance cost.

### **Related Ideas:**

SR01-040 - Provide grade separated game crossings in Design Sections 3 and 4

P01-032 - Locate weigh station in the median

<b>EVALUATION</b>	
Idea Number: 01-033	
Idea Description: Use a deer fencing at selected locations, where justified to mitigate right-of-way issues where landowner has livestock fencing issues.	
Advantages of alternative concept:	
1. Satisfies landowner's concerns	
2. Reduces deer/wildlife accident frequency	
Advantages of original concept:	
1. Follows CDOT standard practice and legal precedent	
Risks:	
1. Could create a precedent with landowners by obligating CDOT to provide more expensive fencing than the CDOT standard at other locations	
Conclusion:	
<input checked="" type="checkbox"/> Propose this idea	
<input checked="" type="checkbox"/> Propose this idea as a Supplemental Recommendation	
<input type="checkbox"/> Do not propose this idea because	

**DISCUSSION AND/OR CALCULATIONS:**

The present M&S Standard M-607-1 has been used as right-of-way fencing. It is recommended that that the CDOT M&S Standard M-607-4, Deer Fences and Gates, be used at locations where necessary to mitigate/satisfy the landowner's livestock fencing concerns. In addition, use of this fencing would reduce the deer and elk/vehicle accident frequency.

Livestock fencing, particularly for bulls, needs to be at a minimum 54 inches high, having at least 8 stands of barb wire and closer spaced (10-ft) steel tee posts and intermediate stays. In addition, larger intermediate line posts (2-inch pipe) at 100 feet are often used to assist in providing stability/strength to the fencing.

To use the deer fencing, a crossing(s) will need to be located for deer/elk to cross US 550.

## **SUPPLEMENTAL RECOMMENDATION NO. 01-035**

### **SUMMARY RECOMMENDATION DESCRIPTION:**

Make US 550 a Scenic Byway and request enhancement funds.

### **Description:**

Scenic Byways are nominated by local partners and approved by the Colorado Scenic and Historic Byways Commission. Designation as a Scenic Byway is made on criteria of exceptional scenic, historic, cultural, recreational or natural features value. In 2003, approximately \$600,000 of discretionary Scenic Byway Program funds were available to CDOT. These funds are available for Scenic Byway improvements such as signage, scenic pullouts including restrooms and ADA facilities, minor safety improvements, landscaping, corridor management plans and marketing materials including brochures. Explore potential with Chamber of Commerce and other potential partners.

### **Related Ideas:**

<b>EVALUATION</b>	
Idea Number: 01-035	
Idea Description: Make US 550 a Scenic Byway and request enhancement funds.	
Advantages of alternative concept:	
1. Additional funding for construction	
2. Help to build public support for the project	
3. Encourage tourism	
Advantages of original concept:	
1. None noted.	
Risks:	
1. None noted.	
Conclusion:	
<input type="checkbox"/> Propose this idea	
<input checked="" type="checkbox"/> Propose this idea as a Supplemental Recommendation	
<input type="checkbox"/> Do not propose this idea because	

**DISCUSSION AND/OR CALCULATIONS:**

Explore potential Scenic Byway classification by preparing a visual inventory of the project to identify outstanding views, particularly of the Animas river valley. Solicit local support (Chambers of Commerce, bicycling/trails groups, etc.) and submit request to the Colorado Scenic and Historic Byways Commission for evaluation.

Note: Sally Pierce at CDOT HQ is the contact person for the Scenic Byways program.

## **SUPPLEMENTAL RECOMMENDATION NO. 01-036**

### **SUMMARY RECOMMENDATION DESCRIPTION:**

Perform an early geotechnical feasibility study at Bondad Hill.

### **Description:**

A geotechnical feasibility study conducted early in the EA process that included geology at Bondad Hill, cut and fill slope recommendation, and identify springs and ground water in the area would help to better set the alignments, avoid environmental issues and better determine costs.

### **Related Ideas:**

None

<b>EVALUATION</b>	
Idea Number: 01-036	
Idea Description: Perform an early geotechnical feasibility study at Bondad Hill/	
Advantages of alternative concept:	
<ol style="list-style-type: none"><li>1. Better estimate the retaining wall types and costs</li><li>2. Better estimate the earthwork (rock excavation)</li><li>3. The early geotechnical report would be used throughout the life of the project</li></ol>	
Advantages of original concept:	
<ol style="list-style-type: none"><li>1. No initial cost of a early geotechnical feasibility study</li><li>2. Geotechnical study would be limited to the preferred alternative</li></ol>	
Risks:	
<ol style="list-style-type: none"><li>1. The geotechnical study may not be as useful for alternative 2D if it is selected as the preferred alignment.</li></ol>	
Conclusion:	
<input type="checkbox"/> Propose this idea	
<input checked="" type="checkbox"/> Propose this idea as a Supplemental Recommendation	
<input type="checkbox"/> Do not propose this idea because	

**DISCUSSION AND/OR CALCULATIONS:**

Four holes spaced approximately 500 feet apart should provide enough good information to know what types of retaining walls will work at this location and give a good estimate for cut and fill slope requirements. The cost of this investigation would be negligible compared to the benefits of better alternative definition and construction cost implementations.

At a minimum, a Geotechnical Engineer should tour the site and evaluate any existing data to give a conceptual opinion of challenges the project may face.

## **SUPPLEMENTAL RECOMMENDATION NO. 01-039**

### **SUMMARY RECOMMENDATION DESCRIPTION:**

Use a retaining wall along the mobile home park at Sunnyside.

### **Description:**

Incorporate a retaining wall into the design along the mobile home park at Sunnyside to reduce or avoid impacts to residents and the mobile home property. The retaining wall could also be extended above the travel lanes and be used as a noise wall if one is found to be required.

### **Related Ideas:**

01-023 - Challenge the environmental justice assumption for the mobile home park at Sunnyside

<b>EVALUATION</b>	
Idea Number: 01-039	
Idea Description: Use a retaining wall along the mobile home park at Sunnyside.	
Advantages of alternative concept:	
<ol style="list-style-type: none"><li>1. Reduces the ROW required from the mobile home park</li><li>2. Could serve as both a retaining wall and noise wall</li></ol>	
Advantages of original concept:	
<ol style="list-style-type: none"><li>1. Less visual impact</li><li>2. Construction cost would be less than alternative</li></ol>	
Risks:	
<ol style="list-style-type: none"><li>1. This alternative assumes that the mobile home park is an environmental justice issue and that mobile homes cannot be relocated due to a County moratorium.</li><li>2. Without a noise study, there is not enough information to determine if a noise wall is needed.</li><li>3. Residents may not want a wall due to visual impacts or other factors.</li></ol>	
Conclusion:	
<input type="checkbox"/> Propose this idea	
<input checked="" type="checkbox"/> Propose this idea as a Supplemental Recommendation	
<input type="checkbox"/> Do not propose this idea because	

**DISCUSSION AND/OR CALCULATIONS:**

## **SUPPLEMENTAL RECOMMENDATION NO. 01-040**

### **SUMMARY RECOMMENDATION DESCRIPTION:**

Provide grade-separated game crossings in Design Sections 3 and 4.

#### **Description:**

Vehicle collisions/accidents with big game account for more than 30% of the recorded accidents within Design Sections 3 and 4. As such, it is important to minimize these accidents where/if possible.

#### **Related Ideas:**

SR01-048 - Upsize or add culverts for microfauna (small critters) road crossing

EVALUATION	
Idea Number: 01-040	
Idea Description: Provide grade-separated game crossings in Design Sections 3 and 4.	
Advantages of alternative concept:	
1. Improve safety	
2. Minimize accidents / vehicle damage animal collisions	
Advantages of original concept:	
1. Less construction cost	
Risks:	
1. None noted.	
Conclusion:	
<input type="checkbox"/> Propose this idea	
<input checked="" type="checkbox"/> Propose this idea as a Supplemental Recommendation	
<input type="checkbox"/> Do not propose this idea because	

**DISCUSSION AND/OR CALCULATIONS:**

Previous construction in Design Section 1 has already included several game under-crossings at natural drainage features/draws. These include two bridges and one concrete box culvert. The construction cost for the CBC Game Crossing (20' wide x 10' high x 158' long) was approximately \$350,000. Lengthening the Animas River Bridge would enhance/accommodate game undercrossing (with a bench in the riprap similar to that used for bikepaths/trails) as well as provide additional wetland or riparian mitigation acreage.

Section 3 and 4 of US 550 is up on the mesa/plateau and as such has winter big game grazing is not concentrated into specific areas. Since the feeding areas are not contained/concentrated, and no draws exist in these sections similar to that in Section 1, the location of strategic big game crossings is problematic. In other words, how do we encourage big game to cross where we want them to cross?

There are no major drainages crossing US 550 in Section 3 and 4, so the use of bridge under-crossings is not practical. Over-crossings would be significantly more expensive than CBC type under crossings, therefore only CBC under-crossings are recommended.

These under-crossings could also have joint use crossings, such as for drainage, farm equipment/livestock and pedestrians (Sunnyside). Several locations, by reviewing the contours/features on project plans/maps appear to be possible:

- Between Sta 490+00 and 495+00
- Between Sta 615+00 and 625+00
- Between Sta 650+00 and 670+00
- Between Sta 705+00 and 715+00
- Approximately Station 795+00

Field reconnaissance and verification of these possible locations is required.

As a possible means of further mitigating big game related accidents along US 550, the following related ideas are suggested, and were combined under/as part of this recommendation. These include:

- Install deer fencing to limit crossings, and direct animals to provided crossings
- Use non-palatable plant species to direct animal traffic to provided crossings
- Revegetate reconstructed shoulders of US 550 with non-palatable plant species to discourage animal grazing on shoulder areas
- Use winter feeding program to contain/direct big game species

## **SUPPLEMENTAL RECOMMENDATION NO. 01-045**

### **SUMMARY RECOMMENDATION DESCRIPTION:**

Reduce the speed limit through Sunnyside and use traffic calming measures to reinforce driver recognition of lower speed limits.

### **Description:**

Reducing the speed limit through Sunnyside may not be sufficient to get the traveling public to slow down. Traffic calming measures such as landscaping in the median and/or on the slopes, could be utilized to alert the drivers that they need to make a speed adjustment.

### **Related Ideas:**

SR01-046 - Use grade separated pedestrian structure at Sunnyside for school access

<b>EVALUATION</b>	
Idea Number: 01-045 Idea Description: Reduce the speed limit through Sunnyside and use traffic calming measures to reinforce driver recognition of lower speed limits.	
Advantages of alternative concept: 1. Would address the school's concern about high speed traffic next to their property 2. Traffic calming measures encourage drivers to reduce their speed 3. Intersections are safer at lower speeds 4. Could also use a lower design speed, which would reduce the lengths of the acceleration and deceleration lane	
Advantages of original concept: 1. Traveling public would not have to reduce speed 2. Lack of landscaping needed for traffic calming measures would minimize maintenance	
Risks: 1. None noted.	
Conclusion: <input type="checkbox"/> Propose this idea <input checked="" type="checkbox"/> Propose this idea as a Supplemental Recommendation <input type="checkbox"/> Do not propose this idea because	

**DISCUSSION AND/OR CALCULATIONS:**

## **SUPPLEMENTAL RECOMMENDATION NO. 01-046**

### **SUMMARY RECOMMENDATION DESCRIPTION:**

Provide a grade-separated pedestrian structure near the Sunnyside Elementary School for access across US 550.

### **Description:**

At the public meetings, concern has been raised regarding safe crossing of US 550 by pedestrians to/from the Sunnyside Elementary school and adjacent recreation facilities. A grade-separated structure has been suggested. Two types of grade-separated pedestrian structures are possible: an undercrossing or an overpass structure.

### **Related Ideas:**

If it is determined that a pedestrian structure is too costly at this location, consideration should be given to reducing the speed limit in the area along with a demand actuated pedestrian crossing signal, or if warranted, a signalized intersection.

SR01-045 - Reduced speed through Sunnyside area through the application of traffic calming devices and speed limit reductions.

<b>EVALUATION</b>
Idea Number: 01-046 Idea Description: Provide a grade-separated pedestrian structure near the Sunnyside Elementary School for access across US 550.
Advantages of alternative concept: <ol style="list-style-type: none"> <li>1. Improved safety</li> <li>2. Satisfies community concern</li> </ol>
Advantages of original concept: <ol style="list-style-type: none"> <li>1. Less project cost</li> </ol>
Risks: <ol style="list-style-type: none"> <li>1. None noted.</li> </ol>
Conclusion: <input type="checkbox"/> Propose this idea <input checked="" type="checkbox"/> Propose this idea as a Supplemental Recommendation <input type="checkbox"/> Do not propose this idea because

**DISCUSSION AND/OR CALCULATIONS:**

Two types of grade separated pedestrian crossings are possible: an under crossing or an overpass structure.

Under-crossing structures typically make use of a modified concrete box culvert, with appropriate entrance features, lighting, drainage, and air circulation. An under-crossing structure in this location would be approximately 160 feet long. Similar pedestrian structures, 12' wide x 10' high with interior lighting, waterproofing, and a mid-length median air/skylight have recently bid in the Denver area. Assuming some increase (10%) in cost for Durango over Denver, the construction cost for an under-crossing would be approximately \$1,000 per linear foot, plus \$45,000 for wingwalls. Therefore, for a 160-foot long structure the total estimate of approximate construction cost for a 12' wide x 10' high underpass would be \$205,000.

Overpass structures typically are prefabricated pedestrian bridges with approach ramps on each end. Given a max grade of 6%, and a clear height of 17'-6" over US 550, the ramps would be approximately 300 feet long (each end). Given the US 550 template, with a 46-foot median, and appropriate clear zones, a bridge length of approximately 155 feet is required. Since the bridge is over traffic, chain link fencing is required.

The estimate of approximate construction cost for the overpass would be: \$500,000 for approach ramps + \$200,000 for the bridge = \$700,000 total.

These construction cost estimates do not include approach sidewalk/path leading up to the structures, landscaping, construction surveying, or mobilization costs.

Further consideration should include access/location and anticipated usage.

## **SUPPLEMENTAL RECOMMENDATION NO. 01-048**

### **SUMMARY RECOMMENDATION DESCRIPTION:**

Upsize or add culverts for microfauna (small critters) road crossing.

### **Description:**

Install upsized or new culverts to facilitate smaller animal passage (coyote, skunk, raccoon, amphibians, etc.) Install the culverts at known wildlife crossing areas and/or at drainages. Determine diameter of culverts based on consultation with CDOT and DOW wildlife staff for a four-lane facility.

### **Related Ideas:**

EVALUATION	
Idea Number: 01-048	
Idea Description: Upsize or add culverts for microfauna (small critter) road crossing.	
Advantages of alternative concept:	
1. Reduce vehicular/animal conflict (smaller animals are numerous and can cause accidents through attempted driver avoidance)	
2. Improved wildlife habitat/preservation of movement corridors	
Advantages of original concept:	
1. Less cost	
Risks:	
1. None noted.	
Conclusion:	
<input type="checkbox"/> Propose this idea	
<input checked="" type="checkbox"/> Propose this idea as a Supplemental Recommendation	
<input type="checkbox"/> Do not propose this idea because	

**DISCUSSION AND/OR CALCULATIONS:**

Examine drainages and existing culverts on US 550 (after a light snow or use ash on metal plates) to check for footprints and determine existing use patterns. If warranted, install larger culverts to promote usage through the longer culvert length that would be needed due to the wider (four-lane) typical section.

## **SUPPLEMENTAL RECOMMENDATION NO. 01-050**

### **SUMMARY RECOMMENDATION DESCRIPTION:**

Perform 3-D graphical analysis of sight distance to increase design speeds at Bondad Hill using current AASHTO standards.

#### **Description:**

Sight distance calculations are typically performed using mathematical formulas based on assumed level surfaces. In reality, the ground along the line of sight varies in elevation due to the road profile, road cross slopes, and obstructions. These conditions can sometimes be used to the advantage of the designer in demonstrating that the actual sight distance at constrained locations exceeds those derived from the mathematical formulas.

In particular, a 3D Graphical analysis can be used at Bondad hill to demonstrate that the acceptable sight distances are achieved across the inside barrier, in areas of horizontal curves. Two primary factors contribute to this analysis:

- a. Horizontal curve superelevations increase both the height of the eye and the height of the object relative to the height of the barrier
- b. New AASHTO standards increase the height of the object (obstruction) from 0.5' to 2.0'

#### **Related Ideas:**

SR 01-010 - Widen southbound US 550 inside shoulder at Bondad Hill to provide improved sight distance

P01-008 - Use alternative alignment at Bondad Hill

<b>EVALUATION</b>
<p>Idea Number: 01-050 Idea Description: Perform 3-D graphical analysis of sight distance to increase design speeds at Bondad Hill using current AASHTO standards.</p>
<p>Advantages of alternative concept:</p> <ol style="list-style-type: none"> <li>1. Increasing design speeds without modifying alignment (or with minor modifications vertical curves)</li> </ol>
<p>Advantages of original concept:</p> <ol style="list-style-type: none"> <li>1. More conservative criteria could provide for a safer design with lower risk</li> <li>2. More to see and react to small animals and rock fall</li> </ol>
<p>Risks:</p> <ol style="list-style-type: none"> <li>1. Increased potential for accidents due to less conservative design. New AASHTO standards consider this to be a minor increase in risk that does not warrant the increased cost of the more conservative design.</li> </ol>
<p>Conclusion:</p> <p><input type="checkbox"/> Propose this idea</p> <p><input checked="" type="checkbox"/> Propose this idea as a Supplemental Recommendation</p> <p><input type="checkbox"/> Do not propose this idea because</p>

**DISCUSSION AND/OR CALCULATIONS:**

Background

Sight distance calculations are typically performed using mathematical formulas based on assume level surface. In reality, the ground along the line of sight varies in elevation due to the road profile, road cross slopes and obstructions. These conditions can sometimes be used to the advantage of the designer in demonstrating that the actual sight distance at constrained locations exceeds those derived from the mathematical formulas. Two primary factors contribute to this analysis:

- a. Horizontal curve superelevations increase both the height of the eye and the height of the object relative to the height of the barrier
- b. New AASHTO standards increase the height of the object (obstruction) from 0.5' to 2.0'

In particular, a 3D Graphical analysis can be used at Bondad Hill to investigate whether design speeds can be increased from the current design speed of 45 mph, for the original design Alternative 2A. A preliminary 3D graphical analysis was performed on the Alternative 2A Bondad Hill alignment. The analysis indicated that due to the crest curve occurring in conjunction with the horizontal curve, sight distances across the median barrier most likely cannot see object heights of 2.0'. However, lengthening of the vertical crest curve and subsequent reduction the curve "K" value may yield acceptable sigh distances across the barrier, to allow for increase of the design speed from 45mph to 70 mph.

The current AASHTO standards strongly advocate the use of the new sight distance design criteria, with an object height of 2.0 ft. From AASHTO 2001 page 127>:

“It is considered that an object 2.0 ft. high is representative of an object that involves risk to drivers and can be recognized by a driver in time to stop before reaching it. Using object heights of less than 2.0 ft. for stopping sight distance calculation would result in longer crest vertical curve without documented safety benefits. Object height of less than 2.0 ft could substantially increase construction costs because additional excavation would be needed to provide the longer crest vertical curves. It is also doubtful that the driver’s ability to perceive situation involving risk of collisions would be increased because recommended stopping sight distances for high-speed design are beyond most drivers’ capabilities to detect small objects.”

US 550 Environmental Assessment Value Engineering Study

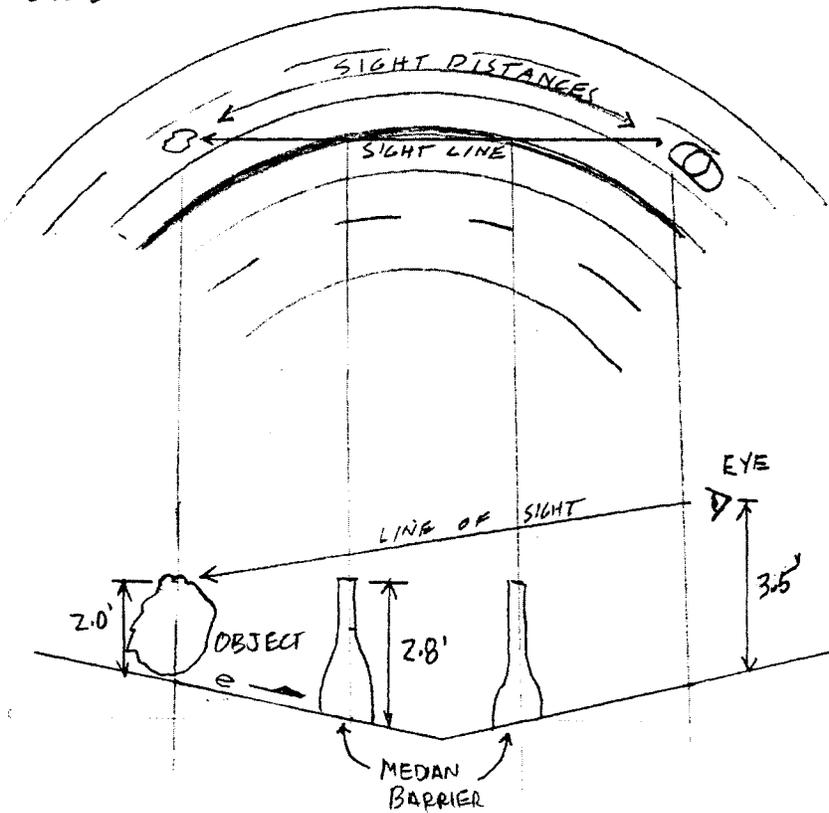
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Computations: Idea Number 01-050

Perform a 3D graphical analysis of sight distances to increase design speeds at Bondad Hill, using current AASHTO standards.

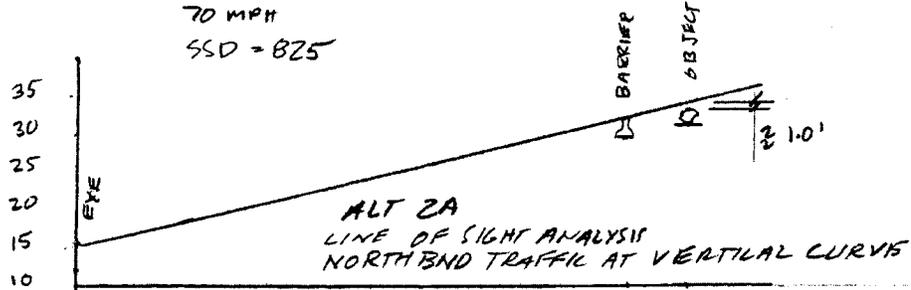
		<u>References</u>
Height of eye:	3.5'	AASHTO2001p271
Height of object:	2.0'	
Stopping Sight Distances:	70mph 825'	AASHTO2001Ex3-1
	65mph 728'	
adjusted for 6 % downgrade	60mph 638'	
	55mph 553'	
	50mph 474'	
	45mph 400'	
Barrier Ht:	34"=2.83' for CDOT guardrail type 7	CDOT Std. M-606-13

SR 0105



SIGHT DISTANCE ACROSS INSIDE MEDIAN BARRIERS  
(USING CURRENT AASHTO STANDARDS)

C 5E01-050



382  
12' RT  
6312

389+50 390+20  
E 12' RT  
6329.5 6331.4

CONCLUSION: THE LEVEL OF ANALYSIS IS VERY APPROX, BUT INDICATES THAT 70 MPH HORIZ SIGHT DISTANCE CANNOT BE ACHIEVED DUE TO VERTICAL CURVATURE, LENGTHENING OF THE CREST VERTICAL CURVE WILL BE NECESSARY TO ACHIEVE 70 MPH DESIGN SPEEDS.

## **SUPPLEMENTAL RECOMMENDATION NO. 04-011**

### **SUMMARY RECOMMENDATION DESCRIPTION:**

Add overhead lighting to US 550 corridor.

### **Description:**

Install overhead lighting on US 550 either:

1. Along entire corridor
2. At high-accident or use areas such as major curves, intersections, school, etc.

### **Related Ideas:**

<b>EVALUATION</b>	
Idea Number: 04-011	
Idea Description: Add overhead lighting to US 550 corridor.	
Advantages of alternative concept:	
1. Improve safety at dark/dusk, especially during adverse conditions	
Advantages of original concept:	
1. Absence of lighting may better match the rural roadway character	
Risks:	
1. Neighbors may object to increased lighting, especially at residences	
2. Substantial capital and O&M cost	
3. Poles can be accident hazard	
4. Some evidence that lighting disrupts bird/bat flight patterns and amphibian activity	
Conclusion:	
<input type="checkbox"/> Propose this idea	
<input type="checkbox"/> Propose this idea as a Supplemental Recommendation	
<input checked="" type="checkbox"/> Do not propose this idea because high cost.	

**DISCUSSION AND/OR CALCULATIONS:**

Estimated cost \$350-400k per mile based on 250' light pole spacing (cost is an average of the SH 119 mountainous roadway lighting at \$500k per mile (installed in 2001) and Powers Blvd (Colorado Springs) at \$250k per mile.

## **SUPPLEMENTAL RECOMMENDATION NO. 05-001**

### **SUMMARY RECOMMENDATION DESCRIPTION:**

Develop a Phasing Implementation Plan.

### **Description:**

Segment Construction Projects by various categories:

1. Break projects into stand-alone pieces that can function independently and without the need for other substantial actions. (Independent utility and logical termini)
2. Break project into phases, e.g.: ROW, Utility, etc.
3. Phased typical section (2-lane in short term) to immediately improve safety
4. Create plan packages of independent utility to match likely funding scenarios
5. Prioritize high-profile projects, e.g., high accident or traffic areas

### **Related Ideas:**

P01-021 - Refine the alignments for constructibility

P03-006 - Make use of existing lanes as ultimate Southbound alignment

<b>EVALUATION</b>	
<b>Idea Number:</b> 05-001	
<b>Idea Description:</b> Develop a Phasing Implementation Plan.	
<b>Advantages:</b> <ol style="list-style-type: none"><li>1. See discussion below for categories</li><li>2. Allows immediate safety improvement to corridor followed by longer-term capacity increases as required. (See 03-006 - Short term 2-lane, upgraded 4-lane scenario) (A, B below). Cross reference with 01-011 - Super 2 Cross-Section and 02-014 - Section Increase with Recycled asphalt</li><li>3. Insulates CDOT from quickly rising ROW costs (03-006 - Short term 2-lane, upgraded 4-lane) (A, B below)</li><li>4. "Off-the-shelf" Construction projects can be matched to funding opportunities (Item C below)</li><li>5. Political reality that shelved projects attract funding (Item D below)</li><li>6. Political reality that partially-built projects attract funds (Item D below)</li></ol>	
<b>Disadvantages:</b> <ol style="list-style-type: none"><li>1. Early phased project funds likely spent on ROW, which doesn't provide instant asphalt gratification or short term safety delivery</li><li>2. Public perception of fallow ROW corridor not being used for highest/best land use in short term (03-006 - Short term 2-lane)</li></ol>	
<b>Risks:</b> <ol style="list-style-type: none"><li>1. Plan package size may not meet smaller funding threshold</li><li>2. Public perception of no "Bang for buck" if large sums spent on items other than asphalt (e.g., ROW)</li><li>3. Unusable partially-built projects</li></ol>	
<b>Conclusion:</b> <input type="checkbox"/> Propose this idea <input checked="" type="checkbox"/> Propose this idea as a Supplemental Recommendation <input type="checkbox"/> Do not propose this idea because	

**DISCUSSION AND/OR CALCULATIONS:**

Develop a Corridor Construction Phasing Plan that optimizes projects by several means:

- A. Delivery of safety improvements
- B. Delivery of capacity improvements
- C. Take advantage of funding availability
- D. Construction cost savings

This discussion should be repeated in the EA.

## **SUPPLEMENTAL RECOMMENDATION NO. 06-005**

### **SUMMARY RECOMMENDATION DESCRIPTION:**

Accommodate U-Turns at median breaks for WB62 Vehicles.

### **Description:**

Accommodate U-Turns for WB62 Vehicles without requiring turning into or through travel lanes by widening the median nose.

### **Related Ideas:**

<b>EVALUATION</b>	
Idea Number: 06-005	
Idea Description: Accommodate U-Turns at median breaks for WB62 Vehicles.	
Advantages of alternative concept: 1. Allows for safe U-Turns of large vehicles 2. Accommodates the types of vehicles which are consistent with the surrounding agricultural land use 3. Improve safety and mobility on mainline	
Advantages of original concept: 1. Less ROW would be required along the corridor 2. Less impacts along the corridor may be encountered due to the narrower envelope	
Risks: 1. None noted.	
Conclusion: <input type="checkbox"/> Propose this idea <input checked="" type="checkbox"/> Propose this idea as a Supplemental Recommendation <input type="checkbox"/> Do not propose this idea because	

**DISCUSSION AND/OR CALCULATIONS:**

Due to the left turn restrictions provided by the proposed median, and the primary adjacent land use (agricultural) combined with the relatively high volume and running speed of US 550, accommodating U-turns by large trucks may improve safety and mobility.

In order to accommodate a WB62 vehicle U-turn, a 71-foot diameter is required at the nose of the median. This 71-foot dimension can either be extended throughout the length of the corridor or can be tapered in and out of a lesser median. Under either scenario, additional right of way and impacts will be required.

## **SUPPLEMENTAL RECOMMENDATION NO. 09-001**

### **SUMMARY RECOMMENDATION DESCRIPTION:**

Provide rockfall arresting features/devices at Bondad Hill.

### **Description:**

Rockfalls onto US 550 have occurred at Bondad Hill, and will likely continue for improvements located on the present alignment (west side and below the hill). It is proposed that rockfall arresting features be included in the design to minimize these hazards.

### **Related Ideas:**

EVALUATION	
Idea Number: 09-001	
Idea Description: Provide rockfall arresting features/devices at Bondad Hill.	
Advantages of alternative concept:	
1. Minimize accidents/vehicle damage due to rockfalls	
Advantages of original concept:	
1. None noted.	
Risks:	
1. None noted.	
Conclusion:	
<input type="checkbox"/> Propose this idea	
<input checked="" type="checkbox"/> Propose this idea as a Supplemental Recommendation	
<input type="checkbox"/> Do not propose this idea because	

**DISCUSSION AND/OR CALCULATIONS:**

There are several design features and improvements that should be considered for use to arrest falling rock, depending on the size. The purpose of an arresting device is to contain falling rock, if possible, to the roadway shoulder or prevent them from falling onto the highway itself. These improvements may include:

- blankets/netting on slopes (\$2.00 to \$5.00/sf)
- rock bolting
- benching of hill/cuts above roadway
- rock scaling/cleanup
- catchments/barriers
- minimize/improve drainage
- fencing to retain falling debris/rocks (\$400.00/lf)
- wildlife fencing on top of the hill (concern that deer/sheep/goats may be the cause of some rock falls) (\$13.00/lf)

Construction of each of these items will increase the overall project cost. Use/application of these improvements needs to be evaluated for specific locations with respect to the degree of risk and benefit. Discussions with CDOT Regions 1 and 3 may prove beneficial in assessing the appropriate/application of these improvements.

## **SUPPLEMENTAL RECOMMENDATION NO. 10-001**

### **SUMMARY RECOMMENDATION DESCRIPTION:**

Split horizontal and vertical alignments.

### **Description:**

In areas where terrain is steep, or a drainage creek or river constrains the alignment, or where special landuse conditions exists, dividing through lanes on separate alignments and profiles can optimize these unique circumstances.

### **Related Ideas:**

P01-008 - Use alternative alignment(s) at Bondad Hill

<b>EVALUATION</b>
Idea Number: 10-001 Idea Description: Split horizontal and vertical alignments.
Advantages of alternative concept: 1. Some environmental impacts may be minimized 2. Impacts to the Ute Tribe may be minimized
Advantages of original concept: 1. Standard access approaches can be accommodated 2. Cost effective
Risks: 1. None noted.
Conclusion: <input type="checkbox"/> Propose this idea <input checked="" type="checkbox"/> Propose this idea as a Supplemental Recommendation <input type="checkbox"/> Do not propose this idea because

**DISCUSSION AND/OR CALCULATIONS:**

In areas where terrain is steep, or a drainage creek or river constrains the alignment, or where special land use conditions exists, dividing through lanes on separate alignments and profiles can optimize these unique circumstances. The US 550 corridor does not have these issues throughout; however due to the extreme costs of relocating/impacting gas wells and the limiting options at Bondad Hill, splitting the roadway may provide a reasonable alternative at these specific locations. Constructability, rather than cost savings, may ultimately drive the final decision. If access is required to the separated area (i.e., access to maintain a well), non-standard approaches will need to be incorporated into the left hand through travel lanes. In addition, adjacent land use and intersections must be considered with respect to providing through movement and turning opportunities.

**SECTION 5 – IDEAS ANALYZED BUT NOT PROPOSED**

EVALUATION	
Idea Number: 01-029	
Idea Description: Consider independent alignments (horizontal and vertical) at Bondad Hill to allow the use of overhanging roadway templates similar to Glenwood Canyon.	
Advantages of alternative concept:	
1. Minimizes extent of rock cuts	
Advantages of original concept:	
1. Reduced long term maintenance cost	
2. More typical/conventional construction	
Risks:	
1. None noted.	
Conclusion:	
<input type="checkbox"/> Propose this idea	
<input type="checkbox"/> Propose this idea as a Supplemental Recommendation	
<input checked="" type="checkbox"/> Do not propose this idea because there is no apparent benefit.	

**Calculations and/or Discussion:**

Two concepts were explored under this proposal:

1. Tiered Wall Scheme at Bondad Hill Sta (see attached sketch)
2. Additional downhill wall between Stations 354+00 and 366+00 just south of Bondad Hill

Scheme 1 – Tiered Walls at Bondad Hill

This scheme has proven useful on other projects where right-of-way is expensive and needs to be minimized; fill slopes extend for great distance downhill and a reduction in the typical section width is beneficial; and environmental impacts can be minimized/eliminated.

The following assumptions/design requirements were made with respect to this scheme:

- Station 374+00 was selected as the typical location to evaluate this concept.
- Required roadway width without tiered walls (as-designed) is 108 ft. The inside shoulder/clear zone of 36 feet (10' shdr+12' Z+10'ditch+4'ditch) from edge of travel way is required for sight distance to meet sight/drainage/rockfall needs.
- The vertical clearance under the overhang is 16'-6", or an assumed 18'-6" including structure/slab depth.
- Based on past experience, a six foot maximum roadway overhang was used (net 7'-6" including bridge rail width)

- The upper roadway width (face of wall to inside face of bridge rail) = 66'. The lower roadway width (face of wall to inside face bridge rail) = 51'. Note this leads to an overall roadway template width of 111' (a net increase of 3 feet due to sight distance requirements). This increases the cost.

Typical sections were sketched at Sta 374+00 to evaluate this concept (see attached). A spreadsheet was developed to evaluate the comparative construction costs, which is attached.

- As-Designed Cost: \$11,800 per linear foot
- Tiered Wall Scheme: \$14,000 per linear foot

As can be seen, there is no cost benefit to this proposal, nor is there any reduction in right-of-way width (3-ft increase).

#### Scheme 2 – Additional Downhill Wall Sta 354+00 to 366+00

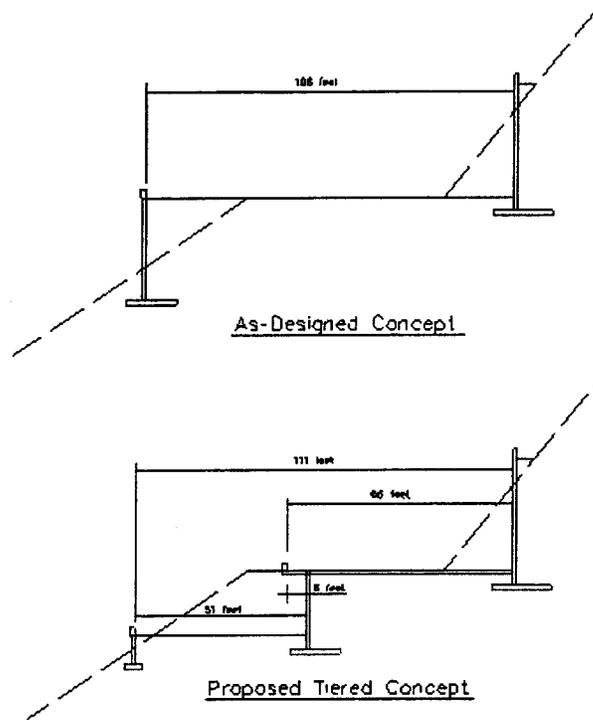
It appeared during review of the cross sections for Section 2A, that significant fills are required between the stations noted. In addition, due to the existing side slope grades, and the proposed fill slope, a long "catch up" distance was required. The side slopes in this area appear to require up to 300 feet before they catch. This may have significant environmental impacts (removal of all existing trees and vegetation in fill section), which were not evaluated as part of this proposal.

Using the cross sections, approximate fill end areas and wall heights were determined (scaled). A spreadsheet was developed to evaluate the cost (see attached).

- Embankment Cost \$ 1.20 million
- Retaining Wall Cost \$ 2.65 million (includes ROW savings)

No contingencies were included in the above values.

As can be seen, there is no cost benefit to this scheme either.



**Scheme 1 - Tiered Retaining Wall Cost Evaluation**

**Roadway / Wall Cost at Station 374+00 (per linear foot)**

Item	Description	Unit Price	Units	As-Designed (Sect. 2A)		Tiered Walls	
				Quantity	Amount	Quantity	Amount
203	Unclassified Excavation (CIP)	\$6.50	cy	6	\$39	30.00	\$195.00
203	Rock Excavation	\$12.00	cy	45	\$540	45.00	\$540.00
206	Str Excavation	\$7.50	cy	8.5	\$64	10.00	\$75.00
206	Structure Bkfl (CL 1)	\$24.00	cy	6.5	\$156	7.50	\$180.00
304	ABC (CL 6)	\$15.00	ton	3.4	\$51	3.60	\$54.00
403	HBP	\$45.00	ton	5.2	\$234	4.00	\$180.00
504	Retaining Wall	\$70.00	sq. ft.	69.5	\$4,865	69.00	\$4,830.00
515	Waterproofing (membrane)	\$1.00	sq. ft.	0	\$0	34.00	\$34.00
618	Prestressed Conc Pavement	\$30.00	sq. ft.	0	\$0	34.00	\$1,020.00
606	Bridge Rail Type 7	\$50.00	lin. ft.	1	\$50	2.00	\$100.00
606	Guardrail Type 7 (Style CA)	\$50.00	lin. ft.	1	\$50	0.00	\$0.00
	Subtotal				\$6,049		\$7,208
	Contingencies	45.00%			\$2,722		\$3,244
	Subtotal				\$8,771		\$10,452
	Mobilization	10.00%			\$877		\$1,045
	Traffic Control	5.00%			\$439		\$523
	Construction Surveying	2.00%			\$175		\$209
	Construction Engineering	17.00%			\$1,491		\$1,777
	Total Estimated Construction Cost (less PE Cost)				\$11,753		\$14,005
				Say	\$11,800.00	Say	\$14,000.00

**Scheme 2 – Retaining Wall Cost Evaluation**

**Comparison of Embankment vs Wall Cost Station 354+00 to 366+00**

Station	fill height (ft)	fill length (ft)	crosssection end area (sq ft)	average (sq ft) end area	earthwork volume (cy)	Ave. Fill Surface Area (acres)	retaining wall (sq ft)
35400	30	160	2,400				
				3,000	11,111	0.39	3,500
35500	40	180	3,600				
				3,300	12,222	0.44	3,500
35600	30	200	3,000				
				2,750	10,185	0.46	2,750
35700	25	200	2,500				
				2,750	10,185	0.51	2,500
35800	25	240	3,000				
				3,300	12,222	0.55	2,750
35900	30	240	3,600				
				4,200	15,556	0.55	3,500
36000	40	240	4,800				
				5,000	18,519	0.57	4,000
36100	40	260	5,200				
				6,100	22,593	0.62	4,500
36200	50	280	7,000				
				6,500	24,074	0.67	4,500
36300	40	300	6,000				
				5,275	19,537	0.64	3,750
36400	35	260	4,550				
				4,525	16,759	0.64	3,250
36500	30	300	4,500				
				3,375	12,500	0.69	2,250
36600	15	300	2,250				
				Total	185,463	6.73	40,750
				Unit cost	\$6.50	\$3,000.00	\$70.00
				Total Cost	\$1,205,509	\$20,179	\$2,852,500

<b>EVALUATION</b>	
Idea Number: 01-037	
Idea Description: Use alternative pavement strategies to phase the pavement depth (structure) to meet travel demand thresholds.	
Advantages of alternative concept:	
1. Less capital costs required	
2. Provides a new wearing surface in relative short term	
Advantages of original concept:	
1. Assures that the structural depth of the pavement is accounted for and there is no risk of subbas/subgrad failure dur to overloading	
Risks:	
1. Money may not be avalible in the future when the overlay is required	
Conclusion:	
<input type="checkbox"/> Propose this idea	
<input type="checkbox"/> Propose this idea as a Supplemental Recommendation	
<input checked="" type="checkbox"/> Do not propose this idea because because it is consistant with current CDOT practice with respect to the overlaying of rural highways, therefore this proposal is As Designed.	

**Calculations and/or Discussion:**

The following ideas were dismissed during the initial idea cull. They were not analyzed to the point of listing individual advantages and disadvantages.

**INITIALLY FAILED IDEAS TABLE**

<b>Idea No.</b>	<b>Idea Description</b>	<b>Reason for Failing Idea</b>
01-003	Use a frontage road in Section 4 for access consolidation	Would cost more initially and create additional long term maintenance for CDOT. Is not necessary to conform to access standards.
01-009	Split the alignments at select locations, e.g., Bondad Hill	Would cost more because it retains the problems of the existing condition plus having to purchase right of way. Would increase the environmental impact. The southbound is too deficient without major reconstruction.
01-014	Use a mass transit system to reduce the overall traffic demand	Out of scope
01-018	Use a bypass option at Sunnyside	Many impacts and CDOT maintenance concerns
01-020	Phase the project implementation	Too general
01-024	Optimize the accesses	Too general
01-027	Encourage the diversion of traffic to CR 213 by improving it as well as doing lesser improvements to US 550	Too many improvements would be required on CR 213. The sum of costs for the two roads' improvements would be greater than just improving US 550.
01-034	Make US 550 a toll road	Not consistent with the use of the roadway. Volumes may be too low for economic viability. Unfriendly to tourists.
01-042	Develop an implementation package from north to south responding to short term traffic needs and limited funding	Too general, more specifics listed under function 05 brainstorming list.
01-044	Use the existing railroad grade at Bondad Hill	Grades won't work
02-003	Do not add lanes - just improve the pavement	Doesn't meet project purpose and need
02-006	Reversible three-lane with signals	Would require a signal at each access point which would be excessive
02-007	Narrower lanes (11 foot)	Does not meet CDOT or AASHTO criteria
02-008	Add HOT lanes	Not consistent with the use of the roadway. Volumes may be too low for economic viability. Unfriendly to tourists.
02-009	Add bus/HOV lanes	Not consistent with the use of the roadway. Volumes may be too low for economic viability. Unfriendly to tourists.
02-010	Double-deck the roadway	Facetious
02-011	Viaduct the roadway	Facetious
02-012	Add four additional lanes in lieu of two lanes	Facetious
02-013	Do a hot remix job on the whole alignment	Will not work with current pavement structure deficiencies
03-002	Use modified Alternative "D" at Bondad Hill to avoid SUIT land	Really can't avoid the SUIT Land altogether

Idea No.	Idea Description	Reason for Failing Idea
03-003	Relocate Sunnyside mobile home park	There is a La Plata County moratorium on new trailer parks
04-007	Issue more hunting licenses	Facetious
04-012	Add an automatic de-icing system	Not cost effective for the need
04-013	Use underground utilities	Cost prohibitive
04-016	No access for entire length of roadway; local traffic takes alternate routes	Facetious
04-017	Grade separate access points	Traffic demand doesn't warrant it.
05-002	Break each section into its own construction package	The section breaks are arbitrary and don't necessarily make good construction packages.
09-007	Construct snow shed	Facetious
10-006	Thinner inside shoulders	Constructability makes this impractical
10-007	Use 12' shoulders	No significant advantages

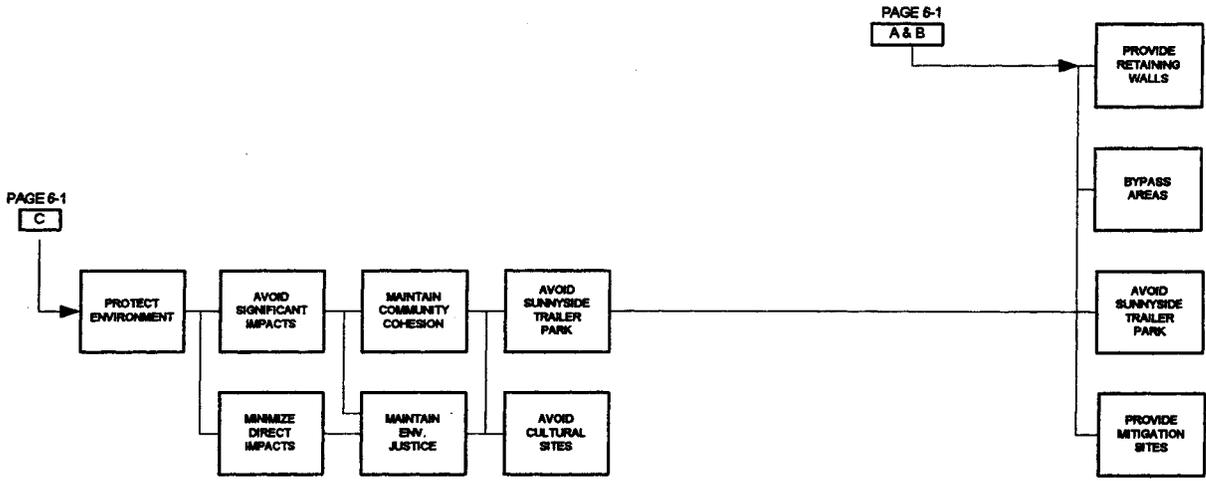
**SECTION 6 – F.A.S.T. DIAGRAM**



### US 550 EA VE Study

← WHY?

→ HOW?



## **SECTION 7 – BRAINSTORMING IDEAS**

The following table lists all of the ideas generated by the VE Team. They are arranged by the function from which they were generated. Shotgun list ideas are alternatives the VE Team members initially brought to the workshop as a result of their pre-study assignment.

Each idea can be traced to its ultimate disposition by crosschecking the disposition column of this table with Sections 3, 4, and 5 of this report.

PLEASE NOTE: One of the rules for creativity exercises in a formal VE Study requires the team members to "stretch" their imaginations by generating sometimes facetious and seeming nonsensical ideas in order to ideate a possible conceptual blockbuster. These ideas, too, are recorded in this table.

**Brainstorming List**

<b>Idea No.</b>	<b>Idea Description</b>	<b>Disposition</b>	<b>With</b>
	<b>Shotgun List</b>		
01-001	Evaluate a two-lane option in the EA	Supplemental Recommendation	-
01-002	Include evaluations of off alignment previous alternatives in the EA	Combine	01-001
01-003	Use a frontage road in Section 4 for access consolidation	Fail	-
01-004	Add animal crossings in Section 4	Combine	01-040
01-005	Use the existing alignment as a bike lane	Supplemental Recommendation	-
01-006	Use a three-lane cross section with alternate passing lanes	Pass	-
01-007	Refine Alternative "A" at Bondad Hill	Combine	01-008
01-008	Use alternative alignment(s) at Bondad Hill	Pass	-
01-009	Split the alignments at select locations, e.g., Bondad Hill	Fail	-
01-010	Shift the shoulder on Bondad Hill by changing the striping to improve the sight distance	Pass	-
01-011	Use a "super 2" concept throughout the project	Pass	-
01-012	Reduce the median width	Pass	-
01-013	Use design exceptions in environmentally sensitive areas	Pass	-
01-014	Use a mass transit system to reduce the overall traffic demand	Fail	-
01-015	Install school bus turnouts	Supplemental Recommendation	-
01-016	Add wildlife under or over passes	Combine	01-040
01-017	Look for joint mitigation opportunities	Supplemental Recommendation	-
01-018	Use a bypass option at Sunnyside	Fail	-
01-019	Reduce the median width by using a cable barrier in the center median	Combine	01-012
01-020	Phase the project implementation	Fail	-
01-021	Refine the alignments for constructability	Pass	-
01-022	Refine the profile alignment either with new or old AASHTO Standards	Pass	-
01-023	Challenge the Environmental Justice perception at Sunnyside	Pass	-

Idea No.	Idea Description	Disposition	With
01-024	Optimize the accesses	Fail	-
01-025	Eliminate the median	Combine	01-012
01-026	Shift the alignment to reduce retaining wall costs	Combine	01-021
01-027	Encourage the diversion of traffic to CR 213 by improving it as well as doing lesser improvements to US 550	Fail	-
01-028	Put intersection improvements at CR 318 and US 550	As Designed	-
01-029	Cantilever a split horizontal alignment at Bondad Hill similar to the scheme at Glenwood Canyon	Pass	-
01-030	Grandfather the existing accesses and assess impact fees for future accesses	Supplemental Recommendation	-
01-031	Trade right of way with SUIT and allow them to assess access impact fees	Combine	01-030
01-032	Locate the weigh station in alternative locations, e.g., the median	Pass	-
01-033	Use a combination wildlife/livestock fence at select locations to mitigate right of way issues	Supplemental Recommendation	-
01-034	Make US 550 a toll road	Fail	-
01-035	Make US 550 a scenic byway and request enhancement funds	Supplemental Recommendation	-
01-036	Do an early geotechnical feasibility study	Supplemental Recommendation	-
01-037	Use new pavement strategies to phase the pavement cost versus a longer period of time	Pass	-
01-038	Provide a weigh in motion system in lieu of a pullout	Combine	01-032
01-039	Use a retaining/noise wall at Sunnyside	Supplemental Recommendation	-
01-040	Provide game under/over crossings in Sections 3 & 4	Supplemental Recommendation	-
01-041	Use existing US 550 as interim southbound lanes during construction	As Designed	-
01-042	Develop an implementation package from north to south responding to short term traffic needs and limited funding	Fail	-
01-043	Match phasing of the first US 550 project with the first US 160 project to balance the earthwork	Pass	-
01-044	Use the existing railroad grade at Bondad Hill	Fail	-
01-045	Reduce the speed at Sunnyside and use traffic calming measures	Supplemental Recommendation	-
01-046	Use grade separated pedestrian structure at Sunnyside for school access	Supplemental Recommendation	-
01-047	Install center line rumble strips in lieu of median	Combine	01-012
01-048	Add small culverts for micro-fauna (small critters)	Supplemental Recommendation	-

Idea No.	Idea Description	Disposition	With
01-049	Use county road standards in lieu of CDOT standards, e.g., narrower and/or grass shoulders	Pass	-
01-050	Perform rigorous analysis of sight distances to increase speeds at Bondad Hill	Pass	-
01-051	Consider making the Bondad Hill area a design-build contract	Combine	05-001
	<b>Add Lanes</b>		
02-001	Add only auxiliary lanes and leave the rest of the highway as two-lane	Combine	01-011
02-002	Add left-turn lanes	As Designed	-
02-003	Do not add lanes - just improve the pavement	Fail	-
02-004	Add shoulders in lieu of acceleration/deceleration lanes	As Designed	-
02-005	Add shoulders as a bicycle lane	As Designed	-
02-006	Reversible three-lane with signals	Fail	01-006
02-007	Narrower lanes (11 foot)	Fail	-
02-008	Add HOT lanes	Fail	-
02-009	Add bus/HOV lanes	Fail	-
02-010	Double-deck the roadway	Fail	-
02-011	Viaduct the roadway	Fail	-
02-012	Add four additional lanes in lieu of two lanes	Fail	-
02-013	Do a hot remix job on the whole alignment	Fail	-
02-014	Do a recycled asphalt project	Pass	-
	<b>Modify Alignments</b>		
03-001	Use Alternative "D" at Bondad Hill	Combine	01-008
03-002	Use modified Alternative "D" at Bondad Hill to avoid SUIT land	Fail	-
03-003	Relocate Sunnyside mobile home park	Fail	-
03-004	Utilize minimum design criteria where necessary	As Designed	-
03-005	Use structures at Bondad Hill to swing alignment out	Combine	01-029
03-006	Make use of existing lanes as ultimate south-bound	Pass	-
	<b>Reduce Conflicts</b>		
04-001	Lengthen the Animas River bridge to enhance animal passage/reduce floodplain impacts	Combine	01-040
04-002	Viaduct portions of the roadway for animal crossings	Duplicate	02-011
04-003	Reduce the number of access points	As Designed	-
04-004	Install deer/elk fencing	Combine	01-040
04-005	Use non-palatable plant species to direct animal traffic	Combine	01-040
04-006	Revegetate roadside shoulders with non-palatable species	Combine	01-040
04-007	Issue more hunting licenses	Fail	-
04-008	Use winter feeding program to direct elk/deer	Combine	01-040
04-009	Add shoulders	As Designed	-

Idea No.	Idea Description	Disposition	With
04-010	Improve sight distances	As Designed	-
04-011	Add lighting	Supplemental Recommendation	-
04-012	Add an automatic de-icing system	Fail	-
04-013	Use underground utilities	Fail	-
04-014	Remove trees in clear zone	As Designed	-
04-015	Improve access points	As Designed	-
04-016	No access for entire length of roadway; local traffic takes alternate routes	Fail	-
04-017	Grade separate access points	Fail	-
	<b>Segment Construction Packages</b>		
05-001	Develop an implementation plan	Supplemental Recommendation	-
05-002	Break each section into its own construction package	Fail	-
05-003	Break project into stand-alone pieces of independent utility and logical termini, e.g., intersections with CR 318	Combine	05-001
05-004	Break project into ROW and/or utility packages	Combine	05-001
05-005	Pair up Section 4 and Farmington Hill (Section "5") contracts	Combine	01-043
05-006	Purchase ROW for Farmington Hill to use for fill in Section 4	Combine	01-043
05-007	Make four-lane conversion of Section 1 a separate construction package	Combine	05-001
05-008	Typical section phased implementation to immediately improve safety and to match travel demand thresholds	Combine	05-001
05-009	Create \$5-10mm plan packages to match likely funding	Combine	05-001
	<b>Improve Geometrics</b>		
06-001	Flatten side slopes	As Designed	-
06-002	Flatten horizontal and vertical curves	As Designed	-
06-003	Use minimum superelevation	As Designed	-
06-004	Improve intersection geometry	As Designed	-
06-005	Accommodate U-turns for WB62 vehicles	Supplemental Recommendation	-
06-006	Reduce earthwork by optimizing the geometric design	As Designed	-
06-007	Optimize geometrics to control running speeds	As Designed	-
06-008	Avoid using barriers	As Designed	-
06-009	Use alternative barriers types	Combine	01-012
06-010	Eliminate the center barrier or median	Combine	01-012
06-011	Steepen fill slopes from 3:1 to 2:1 outside of clear zone	Pass	-
	<b>Create Initial Project</b>		
07-001	Prioritize high-profile projects, eg. high accident rate areas	Combine	05-001
	<b>Mitigate Rockfall</b>		
09-001	Install rockfall blankets/netting	Supplemental Recommendation	-
09-002	Realign roadway to avoid rockfall areas	Combine	01-008

Idea No.	Idea Description	Disposition	With
09-003	Install rockbolts	Combine	09-001
09-004	Use benching	Combine	09-001
09-005	Install retaining walls	As Designed	-
09-006	Install rock catchments	Combine	09-001
09-007	Construct snowshed	Fail	-
09-008	Rock scaling program	Combine	09-001
09-009	Install retaining fence	Combine	09-001
09-010	Wildlife fencing on steep slopes	Combine	09-001
09-011	Improve drainage to mitigate freeze/thaw cycle	Combine	09-001
	<b>Widen Envelope</b>		
10-001	Completely separate n/b and s/b lanes on independent alignments	Pass	-
10-002	Buy ROW	As Designed	-
10-003	Use 15-foot lanes	Combine	01-012
10-004	Use wider lanes w/ narrower median	Combine	01-012
10-005	Use a composite shoulder	Combine	01-049
10-006	Thinner inside shoulders	Fail	-
10-007	Use 12' shoulders	Fail	-

## **SECTION 8 – REVIEW BOARD DECISIONS**

<b>Response to Value Engineering Proposal</b>	
<b>Project:</b>	US-550 Environmental Assessment from New Mexico/Colorado State Line north to approx. CR-220
<b>Proposal No.:</b>	SR01-039
<b>Proposal Description:</b>	Use a retaining wall along the mobile home park at Sunnyside.
<b>Recommended Action:</b>	Accept
<b>Discussion:</b>	This would minimize ROW and possibly avoid need to do any relocations at Sunnyside.
<b>Construction Cost Savings Comparison</b> VE Team Savings Estimate N/A Designer Savings Estimate Reason for Difference in Estimates	
<b>Estimated Design Cost</b>	
<b>Total Cost Savings (Designer Savings Cost Estimate - Estimated Design Cost)</b>	

<b>Response to Value Engineering Proposal</b>	
<b>Project:</b>	US-550 Environmental Assessment from New Mexico/Colorado State Line north to approx. CR-220
<b>Proposal No.:</b>	SR01-040
<b>Proposal Description:</b>	Provide grade separated game crossings in Design Sections 3 & 4.
<b>Recommended Action:</b>	Accept
<b>Discussion:</b>	This will be evaluated where appropriate. Other wildlife mitigation measures will also be evaluated.
<b>Construction Cost Savings Comparison</b> VE Team Savings Estimate N/A Designer Savings Estimate Reason for Difference in Estimates	
<b>Estimated Design Cost</b>	
<b>Total Cost Savings (Designer Savings Cost Estimate - Estimated Design Cost)</b>	

<b>Response to Value Engineering Proposal</b>	
<b>Project:</b>	US-550 Environmental Assessment from New Mexico/Colorado State Line north to approx. CR-220
<b>Proposal No.:</b>	SR01-045
<b>Proposal Description:</b>	Reduce the speed limit through Sunnyside and use traffic calming measures to reinforce driver recognition of lower speed limits.
<b>Recommended Action:</b>	Decline
<b>Discussion:</b>	Could use vegetation, flashing beacons, different pavement or texture. Goal for the corridor is not to have to reduce the speed limit.
<b>Construction Cost Savings Comparison</b> VE Team Savings Estimate N/A Designer Savings Estimate Reason for Difference in Estimates	
<b>Estimated Design Cost</b>	
<b>Total Cost Savings (Designer Savings Cost Estimate - Estimated Design Cost)</b>	

<b>Response to Value Engineering Proposal</b>	
<b>Project:</b>	US-550 Environmental Assessment from New Mexico/Colorado State Line north to approx. CR-220
<b>Proposal No.:</b>	SR01-046
<b>Proposal Description:</b>	Provide a grade separated pedestrian structure near the Sunnyside Elementary School for access across US 550.
<b>Recommended Action:</b>	Decline
<b>Discussion:</b>	Could look at enhancement funds. Kids are currently being bused
<b>Construction Cost Savings Comparison</b> VE Team Savings Estimate N/A Designer Savings Estimate Reason for Difference in Estimates	
<b>Estimated Design Cost</b>	
<b>Total Cost Savings (Designer Savings Cost Estimate - Estimated Design Cost)</b>	

<b>Response to Value Engineering Proposal</b>	
<b>Project:</b>	US-550 Environmental Assessment from New Mexico/Colorado State Line north to approx. CR-220
<b>Proposal No.:</b>	SR01-048
<b>Proposal Description:</b>	Upsize or add culverts for microfauna (small critters) road crossing.
<b>Recommended Action:</b>	Accept
<b>Discussion:</b>	It is a part of the environmental process.
<b>Construction Cost Savings Comparison</b>	
	VE Team Savings Estimate N/A
	Designer Savings Estimate
	Reason for Difference in Estimates
<b>Estimated Design Cost</b>	
<b>Total Cost Savings (Designer Savings Cost Estimate - Estimated Design Cost)</b>	

<b>Response to Value Engineering Proposal</b>	
<b>Project:</b>	US-550 Environmental Assessment from New Mexico/Colorado State Line north to approx. CR-220
<b>Proposal No.:</b>	SR01-050
<b>Proposal Description:</b>	Perform 3-D graphical analysis of sight distance to increase design speeds at Bondad Hill using current AASHTO standards
<b>Recommended Action:</b>	Accept
<b>Discussion:</b>	This will be evaluated during final design.
<b>Construction Cost Savings Comparison</b> <b>VE Team Savings Estimate N/A</b> <b>Designer Savings Estimate</b> <b>Reason for Difference in Estimates</b>	
<b>Estimated Design Cost</b>	
<b>Total Cost Savings (Designer Savings Cost Estimate - Estimated Design Cost)</b>	

<b>Response to Value Engineering Proposal</b>	
<b>Project:</b>	US-550 Environmental Assessment from New Mexico/Colorado State Line north to approx. CR-220
<b>Proposal No.:</b>	SR04-011
<b>Proposal Description:</b>	Add overhead lighting to US-550 corridor.
<b>Recommended Action:</b>	Decline
<b>Discussion:</b>	Overhead lighting is an urban look. The residences along the corridor are not in favor of lighting.
<b>Construction Cost Savings Comparison</b> <b>VE Team Savings Estimate N/A</b> <b>Designer Savings Estimate</b> <b>Reason for Difference in Estimates</b>	
<b>Estimated Design Cost</b>	
<b>Total Cost Savings (Designer Savings Cost Estimate - Estimated Design Cost)</b>	

<b>Response to Value Engineering Proposal</b>	
<b>Project:</b>	US-550 Environmental Assessment from New Mexico/Colorado State Line north to approx. CR-220
<b>Proposal No.:</b>	SR05-001
<b>Proposal Description:</b>	Develop a Phasing Implementation Plan
<b>Recommended Action:</b>	Accept
<b>Discussion:</b>	The phasing plan is a part of the environmental process.
<b>Construction Cost Savings Comparison</b> VE Team Savings Estimate N/A Designer Savings Estimate Reason for Difference in Estimates	
<b>Estimated Design Cost</b>	
<b>Total Cost Savings (Designer Savings Cost Estimate - Estimated Design Cost)</b>	

<b>Response to Value Engineering Proposal</b>	
<b>Project:</b>	US-550 Environmental Assessment from New Mexico/Colorado State Line north to approx. CR-220
<b>Proposal No.:</b>	SR06-005
<b>Proposal Description:</b>	Accommodate U-turns at median breaks for WB 62 vehicles.
<b>Recommended Action:</b>	Decline
<b>Discussion:</b>	A 71' median would be needed. The highway would be transitioning in and out almost constantly.
<b>Construction Cost Savings Comparison</b> VE Team Savings Estimate N/A Designer Savings Estimate Reason for Difference in Estimates	
<b>Estimated Design Cost</b>	
<b>Total Cost Savings (Designer Savings Cost Estimate - Estimated Design Cost)</b>	

<b>Response to Value Engineering Proposal</b>	
<b>Project:</b>	US-550 Environmental Assessment from New Mexico/Colorado State Line north to approx. CR-220
<b>Proposal No.:</b>	SR09-001
<b>Proposal Description:</b>	Provide rockfall arresting features/devices at Bondad Hill
<b>Recommended Action:</b>	Accept
<b>Discussion:</b>	This will be done as part of the final design process.
<b>Construction Cost Savings Comparison</b> VE Team Savings Estimate N/A Designer Savings Estimate Reason for Difference in Estimates	
<b>Estimated Design Cost</b>	
<b>Total Cost Savings (Designer Savings Cost Estimate - Estimated Design Cost)</b>	

<b>Response to Value Engineering Proposal</b>	
<b>Project:</b>	US-550 Environmental Assessment from New Mexico/Colorado State Line north to approx. CR-220
<b>Proposal No.:</b>	SR10-001
<b>Proposal Description:</b>	Split horizontal and vertical alignments
<b>Recommended Action:</b>	Accept
<b>Discussion:</b>	In some sections this has already been implemented. This will be evaluated as part of the final design process.
<b>Construction Cost Savings Comparison</b> VE Team Savings Estimate N/A Designer Savings Estimate Reason for Difference in Estimates	
<b>Estimated Design Cost</b>	
<b>Total Cost Savings (Designer Savings Cost Estimate - Estimated Design Cost)</b>	

## Summary of Responses to Value Engineering Proposals/Supplemental Recommendations

**Project:** US-550 Environmental Assessment from New Mexico/Colorado State Line north to approx. CR-220

### Definitions of Response Terminology

**Accept:** The VE proposal will be accepted and the original design concept will be modified accordingly.

**Partially Accept:** Portions of the VE recommendation will be accepted and/or the VE proposal will be modified somewhat.

**Decline:** The VE proposal will not be accepted and the original design concept will be implemented

**Table for Further Study or Information Gathering:** Additional information will be gathered

VE Proposal No./ Supplementary Recommendation No.	Proposal Description	Lead Responder	Response	Total Initial Savings (\$)	Total Cost Savings (\$) <sup>1</sup>
P01-006	Use a three lane cross section alternating the center lane as a passing lane.		<p>Table for further study and information gathering.</p> <ul style="list-style-type: none"> <li>This would be the ultimate (i.e. no 4-lane section). Need to determine if it meets LOS C. Look at using cable barrier to restrict left turning movements for the passing lane.</li> <li>Signalizing the county road intersections was discussed to break up the vehicle platoons, CDOT does not want to introduce signals along this corridor. Assume no access consolidation to frontage roads.</li> <li>The connecting links, both north and south, would be 4-lane sections. ROW savings and barrier costs were not included in the cost estimate.</li> <li>URS will perform a detailed traffic analysis to see if this concept will work for future traffic projections</li> </ul>		

<p>P01-008</p>	<p>Use alternative alignment at Bondad Hill</p>	<p>Accept</p> <ul style="list-style-type: none"> <li>Two typical sections were run (one with retaining walls and one without). The earthwork balanced with the one without retaining walls and translated into the cost savings.</li> <li>Constructability issues have been looked at and it was concluded to be constructable. With the retaining wall option, much of the savings go away.</li> <li>This alternative needs to be shown to the SUIT. This alternative is a 70-mph design and has a 5% grade.</li> </ul>	<p>\$6,706,030 VS Alt 2A &amp; \$8,684,618 VS Alt 2b</p>
<p>P01-011</p>	<p>Use a "Super Two" concept throughout the project</p>	<p>Decline</p> <p>Use a "Super Two" concept throughout the project</p> <ul style="list-style-type: none"> <li>Need to narrow the capacity range so it is specific to this corridor. Could be acceptable or it could fail. There would be some through away cost when you construct the ultimate 4-lanes. URS will perform a detailed traffic analysis to see if this concept will work for future traffic projections.</li> <li>Note: The original Board decision was to table for further study and information gathering. That was done. Based on the findings CDOT decided to decline this proposal</li> </ul>	

P01-012	Reduce/eliminate median and examine barrier types	<ul style="list-style-type: none"> <li>• A. 30 ft median – Decline</li> <li>• B. 14 ft median with a type 7 barrier – Decline</li> <li>• C. 24 ft median with a cable barrier – Decline</li> <li>• A. U-turn movements are more difficult. Does not meet 35ft clear zone. Drainage in the median does work.</li> <li>• B. ROW cost savings is offset by the cost of the barrier and attenuators. It gives the corridor an urban look. Does not reduce roadway width enough to eliminate impacts through Sunnyside. Introduces a hazard.</li> <li>• C. A cost saving does not include cost of barrier. Maintenance could be a problem. Introduces a hazard.</li> <li>• Following the Review Board meeting, CDOT held an internal meeting to discuss the median width in more detail. In the meeting, the decision was made to use a 46' median width.</li> </ul>		
P01-021	Refine the alignments to make the project more constructable.	<p>Decline</p> <ul style="list-style-type: none"> <li>• Refining the alignment probably will not have significant cost savings. The as proposed alignments could be easily phased into plan packages and should be constructable.</li> </ul>		
P01-032	Relocate the weigh station in the median of the four-lane facility.	<p>Decline</p> <ul style="list-style-type: none"> <li>• Trucks exiting from the passing/left lane are not safe. Trucks merging into the passing/left lane are not safe. It violates driver expectancy. Would potentially need to add the cost of barrier and attenuators to the cost.</li> </ul>		
P01-043	Match phasing of first Section 4 US 550 project with Farmington Hill US 160 project to balance earthwork.	<p>Accept</p> <ul style="list-style-type: none"> <li>• The material from the Farmington Hill cut could be utilized for US 550. Could also stockpile the material to be used later. At a minimum the ROW at Farmington Hill should be purchased so that the earthwork could be utilized. Accept this proposal provided the funding is available to do concurrently.</li> </ul>		\$420,000

P01-049	Use County Road Standards on adjacent roadways which require modification in lieu of CDOT Standards	Accept <ul style="list-style-type: none"> <li>The width would be reduced. La Plata County does have design standards. CDOT wants to get FHWA to ok these standards.</li> </ul>	\$1,180,000
P02-014	Rather than importing substantial amounts of subbase material, recycle the existing asphalt and subbase.	Table for further study or information gathering <ul style="list-style-type: none"> <li>Can not make a decision until we know what is out there. Contractor can use this material if it meets the R-value, but we do not want to designate that to the contractor. This would be included in the final geotechnical report. Table this proposal for CDOT geotech to do during final design.</li> </ul>	
P03-006	Use the existing roadway alignment as the ultimate southbound alignment in Sections 3 and 4, north of Sunnyside.	Accept <ul style="list-style-type: none"> <li>This is an interim condition and the ultimate would still be to reconstruct the existing lanes. The existing lanes would be a variance for the interim. Because the pavement is in poor condition, we would probably need to do something to the existing lanes to help them last longer.</li> <li>This idea needs to be included in the EA as apart of the implementation plan. This idea would be better than P01-011 from the perspective of having to maintain accesses, because P01-011 would require accesses to extend across CDOT ROW to connect to the new 2-lane.</li> </ul>	\$2,000,000
P06-011	Steepen fill slopes from 3:1 to 2:1 with the clear zone requirements satisfied at the top of the fill slope.	Accept <ul style="list-style-type: none"> <li>These fill slopes would be predominately at Bondad Hill and in high fill areas. The cost savings are in the earthwork. Need to verify that the 2:1 can be compacted, re-vegetated, and maintained.</li> </ul>	\$409,000
<b>Total Cost Savings of Proposals Accepted =</b>			<b>\$10,715,030</b>
<b>Notes:</b>			
1. The Total Cost Savings is the designer's estimated cost savings minus the estimated cost for the design change.			
2. The "Total Cost Savings of Proposals" is the sum of all savings associated with "accepted" or "partially accepted" proposals.			
3. ND - Not Determined, NA - Not Applicable			

## Summary of Responses to Value Engineering Proposals/Supplemental Recommendations

**Project:** US-550 Environmental Assessment from New Mexico/Colorado State Line north to approx. CR-220

### Definitions of Response Terminology

- Accept:** The VE proposal will be accepted and the original design concept will be modified accordingly.
  - Partially Accept:** Portions of the VE recommendation will be accepted and/or the VE proposal will be modified somewhat.
  - Decline:** The VE proposal will not be accepted and the original design concept will be implemented
- Table for Further Study or Information Gathering:** Additional information will be gathered

VE Proposal No./ Supplementary Recommendation No.	Proposal Description	Lead Responder	Response	Total Initial Savings (\$)	Total Cost Savings (\$) <sup>1</sup>
SR01-001	Evaluate full range of alternatives in the EA including phasing descriptions.		Decline <ul style="list-style-type: none"> <li>• Need to look at alternatives where we have impacts. EA does not require us to look at a full range of alternatives.</li> </ul>		
SR01-005	Use the existing alignment as bikeway.		Decline <ul style="list-style-type: none"> <li>• Conflicts with the acceptance of P03-006</li> </ul>		
SR01-010	Widen southbound US 550 inside shoulder at Bondad Hill to provide improved sight distances (applies to original Alt 2A and 2B)		Accept with modifications <ul style="list-style-type: none"> <li>• This is one of the tools that can be used and we will review areas where it is appropriate.</li> </ul>		
SR01-013	Use design exceptions to avoid or minimize impacts to environmentally sensitive areas.		Accept <ul style="list-style-type: none"> <li>• This is something that has to be done.</li> </ul>		

SR01-015	Install school bus turnouts		Decline <ul style="list-style-type: none"> <li>Kids are picked up and dropped off at their driveways. These points constantly vary and there would be several. Legally vehicles are required to stop, so these should not be needed.</li> </ul>	
SR01-017	Utilize joint environmental mitigation, e.g. combine mitigation sites with those of other projects such as US 160.		Accept <ul style="list-style-type: none"> <li>Will look at this where it is feasible. It also would require that other agencies accept this concept.</li> </ul>	
SR01-023	Challenge the Environmental Justice perception of the Sunnyside Mobile Home Park.		Decline <ul style="list-style-type: none"> <li>The current design concept has minimal impacts to the trailer park. There are fewer property owner impacts by missing the trailer park.</li> </ul>	
SR01-030	Grandfather existing accesses and assess impact fees for future accesses.		Decline <ul style="list-style-type: none"> <li>This is not consistent with State policies.</li> </ul>	
SR01-033	Use deer fencing at selected locations where justified to mitigate right-of-way issues where landowner has livestock fencing issues.		Decline <ul style="list-style-type: none"> <li>CDOT will utilize deer fence where feasible.</li> </ul>	
SR01-035	Make US 550 a Scenic Byway and request enhancement funds.		Decline <ul style="list-style-type: none"> <li>CDOT has no control with the signing and billboards on the SUIT property. With the SUIT property at various locations along the corridor and knowing the restrictions for a Scenic Byway, it would be difficult to get this corridor approved as a Scenic Byway</li> </ul>	

SR01-036	Perform an early geotechnical feasibility study at Bondad Hill.		Decline <ul style="list-style-type: none"> <li>At this time, CDOT does not want a formal geotechnical feasibility study at Bondad Hill. However if existing data from site investigations or possibly oil and gas well's is available it will be utilized.</li> </ul>	
SR01-039	Use a retaining wall along the mobile home park at Sunnyside.		Accept <ul style="list-style-type: none"> <li>This would minimize ROW and possibly avoid need to do any relocations at Sunnyside.</li> </ul>	
SR01-040	Provide grade separated game crossings in Design Sections 3 & 4.		Accept <ul style="list-style-type: none"> <li>This will be evaluated where appropriate. Other wildlife mitigation measures will also be evaluated.</li> </ul>	
SR01-045	Reduce the speed limit through Sunnyside and use traffic calming measures to reinforce driver recognition of lower speed limits.		Decline <ul style="list-style-type: none"> <li>Could use vegetation, flashing beacons, different pavement or texture. Goal for the corridor is not to have to reduce the speed limit.</li> </ul>	
SR01-046	Provide a grade separated pedestrian structure near the Sunnyside Elementary School for access across US 550.		Decline <ul style="list-style-type: none"> <li>Could look at enhancement funds. Kids are currently being bused</li> </ul>	
SR01-048	Upsize or add culverts for microfauna (small critters) road crossing.		Accept <ul style="list-style-type: none"> <li>It is a part of the environmental process.</li> </ul>	
SR01-050	Perform 3-D graphical analysis of sight distance to increase design speeds at Bondad Hill using current AASHTO standards		Accept <ul style="list-style-type: none"> <li>This will be evaluated during final design.</li> </ul>	

SR04-011	Add overhead lighting to US-550 corridor.	Decline	<ul style="list-style-type: none"> <li>Overhead lighting is an urban look. The residences along the corridor are not in favor of lighting.</li> </ul>		
SR05-001	Develop a Phasing Implementation Plan	Accept	<ul style="list-style-type: none"> <li>The phasing plan is a part of the environmental process.</li> </ul>		
SR06-005	Accommodate U-turns at median breaks for WB 62 vehicles.	Decline	<ul style="list-style-type: none"> <li>A 71' median would be needed. The highway would be transitioning in and out almost constantly.</li> </ul>		
SR09-001	Provide rockfall arresting features/devices at Bondad Hill	Accept	<ul style="list-style-type: none"> <li>This will be done as part of the final design process.</li> </ul>		
SR10-001	Split horizontal and vertical alignments	Accept	<ul style="list-style-type: none"> <li>In some sections this has already been implemented. This will be evaluated as part of the final design process.</li> </ul>		
					\$0
					\$0
<p><b>Total Cost Savings of Proposals Accepted =</b></p>					
<p><b>\$0</b></p>					
<p>Notes:</p>					
<p>1. The Total Cost Savings is the designer's estimated cost savings minus the estimated cost for the design change.</p>					
<p>2. The "Total Cost Savings of Proposals" is the sum of all savings associated with "accepted" or "partially accepted" proposals.</p>					
<p>3. ND - Not Determined, NA - Not Applicable</p>					

<b>Response to Value Engineering Proposal</b>	
<b>Project:</b>	US-550 Environmental Assessment from New Mexico/Colorado State Line north to approx. CR-220
<b>Proposal No.:</b>	P01-006
<b>Proposal Description:</b>	Use a three lane cross section alternating the center lane as a passing lane.
<b>Recommended Action:</b>	Table for further study and information gathering
<b>Discussion:</b>	This would be the ultimate (i.e. no 4-lane section). Need to determine if it meets LOS C. Look at using cable barrier to restrict left turning movements for the passing lane. Signalizing the county road intersections was discussed to break up the vehicle platoons, CDOT does not want to introduce signals along this corridor. Assume no access consolidation to frontage roads. The connecting links, both north and south, would be 4-lane sections. ROW savings and barrier costs were not included in the cost estimate. URS will perform a detailed traffic analysis to see if this concept will work for future traffic projections.
<b>Construction Cost Savings Comparison</b>	
<b>VE Team Savings Estimate</b> \$18,600 <b>Designer Savings Estimate</b> Not calculated <b>Reason for Difference in Estimates</b>	
<b>Estimated Design Cost</b>	
<b>Total Cost Savings (Designer Savings Cost Estimate - Estimated Design Cost)</b>	

<b>Response to Value Engineering Proposal</b>	
<b>Project:</b>	US-550 Environmental Assessment from New Mexico/Colorado State Line north to approx. CR-220
<b>Proposal No.:</b>	P01-008
<b>Proposal Description:</b>	Use alternative alignment at Bondad Hill
<b>Recommended Action:</b>	Accept
<b>Discussion:</b>	Two typical sections were run (one with retaining walls and one without). The earthwork balanced with the one without retaining walls and translated into the cost savings. Constructability issues have been looked at and it was concluded to be constructable. With the retaining wall option, much of the savings go away. This alternative needs to be shown to the SUIT. This alternative is a 70 mph design and has a 5% grade.
<b>Construction Cost Savings Comparison</b>	
<b>VE Team Savings Estimate</b>	\$6,470,000 vs Alt 2A \$8,450,000 vs Alt 2B
<b>Designer Savings Estimate</b>	\$6,706,030 vs Alt 2A \$8,684,618 vs Alt 2B
<b>Reason for Difference in Estimates</b>	
<b>Estimated Design Cost</b>	
<b>Total Cost Savings (Designer Savings Cost Estimate - Estimated Design Cost)</b>	

<b>Response to Value Engineering Proposal</b>	
<b>Project:</b>	US-550 Environmental Assessment from New Mexico/Colorado State Line north to approx. CR-220
<b>Proposal No.:</b>	P01-011
<b>Proposal Description:</b>	Use a "Super Two" concept throughout the project
<b>Recommended Action:</b>	Decline
<b>Discussion:</b>	<p>Need to narrow the capacity range so it is specific to this corridor. Could be acceptable or it could fail. There would be some through away cost when you construct the ultimate 4-lanes. URS will perform a detailed traffic analysis to see if this concept will work for future traffic projections.</p> <p>Note: The original Board decision was to table for further study and information gathering. That was done. Based on the findings CDOT decided to decline this proposal</p>
<p><b>Construction Cost Savings Comparison</b></p> <p><b>VE Team Savings Estimate \$12,800,000</b></p> <p><b>Designer Savings Estimate Not calculated</b></p> <p><b>Reason for Difference in Estimates</b></p>	
<b>Estimated Design Cost</b>	
<b>Total Cost Savings (Designer Savings Cost Estimate - Estimated Design Cost)</b>	

<b>Response to Value Engineering Proposal</b>	
<b>Project:</b>	US-550 Environmental Assessment from New Mexico/Colorado State Line north to approx. CR-220
<b>Proposal No.:</b>	P01-012
<b>Proposal Description:</b>	Reduce/eliminate median and examine barrier types
<b>Recommended Action:</b>	A. 30 ft median – Decline B. 14 ft median with a type 7 barrier – Decline C. 24 ft median with a cable barrier – Decline
<b>Discussion:</b>	A. U-turn movements are more difficult. Does not meet 35ft clear zone. Drainage in the median does work. B. ROW cost savings is offset by the cost of the barrier and attenuaters. It gives the corridor an urban look. Does not reduce roadway width enough to eliminate impacts through Sunnyside. Introduces a hazard. C. A cost saving does not include cost of barrier. Maintenance could be a problem. Introduces a hazard. Following the Review Board meeting, CDOT held an internal meeting to discuss the median width in more detail. In the meeting, the decision was made to use a 46' median width.
<b>Construction Cost Savings Comparison</b>	
<b>VE Team Savings Estimate</b>	A. \$176,000 B. \$432,000 C. \$432,000
<b>Designer Savings Estimate</b>	Not calculated
<b>Reason for Difference in Estimates</b>	
<b>Estimated Design Cost</b>	
<b>Total Cost Savings (Designer Savings Cost Estimate - Estimated Design Cost)</b>	

<b>Response to Value Engineering Proposal</b>	
<b>Project:</b>	US-550 Environmental Assessment from New Mexico/Colorado State Line north to approx. CR-220
<b>Proposal No.:</b>	P01-021
<b>Proposal Description:</b>	Refine the alignments to make the project more constructable.
<b>Recommended Action:</b>	Decline
<b>Discussion:</b>	Refining the alignment probably will not have significant cost savings. The as proposed alignments could be easily phased into plan packages and should be constructable.
<b>Construction Cost Savings Comparison</b>	
VE Team Savings Estimate \$4,300,000	
Designer Savings Estimate	
Reason for Difference in Estimates	
<b>Estimated Design Cost</b>	
<b>Total Cost Savings (Designer Savings Cost Estimate - Estimated Design Cost)</b>	

<b>Response to Value Engineering Proposal</b>	
<b>Project:</b>	US-550 Environmental Assessment from New Mexico/Colorado State Line north to approx. CR-220
<b>Proposal No.:</b>	P01-032
<b>Proposal Description:</b>	Relocate the weigh station in the median of the four-lane facility.
<b>Recommended Action:</b>	Decline
<b>Discussion:</b>	Trucks exiting from the passing/left lane are not safe. Trucks merging into the passing/left lane are not safe. It violates driver expectancy. Would potentially need to add the cost of barrier and attenuaters to the cost.
<b>Construction Cost Savings Comparison</b> <b>VE Team Savings Estimate</b> \$150,000 <b>Designer Savings Estimate</b> Not calculated <b>Reason for Difference in Estimates</b>	
<b>Estimated Design Cost</b>	
<b>Total Cost Savings (Designer Savings Cost Estimate - Estimated Design Cost)</b>	

<b>Response to Value Engineering Proposal</b>	
<b>Project:</b>	US-550 Environmental Assessment from New Mexico/Colorado State Line north to approx. CR-220
<b>Proposal No.:</b>	P01-043
<b>Proposal Description:</b>	Match phasing of first Section 4 US 550 project with Farmington Hill US 160 project to balance earthwork.
<b>Recommended Action:</b>	Accept
<b>Discussion:</b>	The material from the Farmington Hill cut could be utilized for US 550. Could also stockpile the material to be used later. At a minimum the ROW at Farmington Hill should be purchased so that the earthwork could be utilized. Accept this proposal provided the funding is available to do concurrently.
<b>Construction Cost Savings Comparison</b>	
VE Team Savings Estimate \$420,000	
Designer Savings Estimate Not calculated	
Reason for Difference in Estimates	
<b>Estimated Design Cost</b>	
<b>Total Cost Savings (Designer Savings Cost Estimate - Estimated Design Cost)</b>	

<b>Response to Value Engineering Proposal</b>	
<b>Project:</b>	US-550 Environmental Assessment from New Mexico/Colorado State Line north to approx. CR-220
<b>Proposal No.:</b>	P01-049
<b>Proposal Description:</b>	Use County Road Standards on adjacent roadways which require modification in lieu of CDOT Standards
<b>Recommended Action:</b>	Accept
<b>Discussion:</b>	The width would be reduced. La Plata County does have design standards. CDOT wants to get FHWA to ok these standards.
<b>Construction Cost Savings Comparison</b> <b>VE Team Savings Estimate</b> \$1,180,000 <b>Designer Savings Estimate</b> Not calculated <b>Reason for Difference in Estimates</b>	
<b>Estimated Design Cost</b>	
<b>Total Cost Savings (Designer Savings Cost Estimate - Estimated Design Cost)</b>	

<b>Response to Value Engineering Proposal</b>	
<b>Project:</b>	US-550 Environmental Assessment from New Mexico/Colorado State Line north to approx. CR-220
<b>Proposal No.:</b>	P02-014
<b>Proposal Description:</b>	Rather than importing substantial amounts of subbase material, recycle the existing asphalt and subbase.
<b>Recommended Action:</b>	Table for further study or information gathering
<b>Discussion:</b>	Can not make a decision until we know what is out there. Contractor can use this material if It meets the R-value, but we do not want to designate that to the contractor. This would be included in the final geotechnical report. Table this proposal for CDOT geotech to do during final design.
<b>Construction Cost Savings Comparison</b>	
VE Team Savings Estimate \$6,600,000	
Designer Savings Estimate	
Reason for Difference in Estimates	
<b>Estimated Design Cost</b>	
<b>Total Cost Savings (Designer Savings Cost Estimate - Estimated Design Cost)</b>	

<b>Response to Value Engineering Proposal</b>	
<b>Project:</b>	US-550 Environmental Assessment from New Mexico/Colorado State Line north to approx. CR-220
<b>Proposal No.:</b>	P03-006
<b>Proposal Description:</b>	Use the existing roadway alignment as the ultimate southbound alignment in Sections 3 and 4, north of Sunnyside.
<b>Recommended Action:</b>	Accept
<b>Discussion:</b>	This is an interim condition and the ultimate would still be to reconstruct the existing lanes. The existing lanes would be a variance for the interim. Because the pavement is in poor condition, we would probably need to do something to the existing lanes to help them last longer. This idea needs to be included in the EA as apart of the implementation plan. This idea would be better than P01-011 from the perspective of having to maintain accesses, because P01-011 would require accesses to extend across CDOT ROW to connect to the new 2-lane.
<b>Construction Cost Savings Comparison</b> <b>VE Team Savings Estimate</b> \$2,000,000 <b>Designer Savings Estimate</b> Not calculated <b>Reason for Difference in Estimates</b>	
<b>Estimated Design Cost</b>	
<b>Total Cost Savings (Designer Savings Cost Estimate - Estimated Design Cost)</b>	

<b>Response to Value Engineering Proposal</b>	
<b>Project:</b>	US-550 Environmental Assessment from New Mexico/Colorado State Line north to approx. CR-220
<b>Proposal No.:</b>	P06-011
<b>Proposal Description:</b>	Steepen fill slopes from 3:1 to 2:1 with the clear zone requirements satisfied at the top of the fill slope.
<b>Recommended Action:</b>	Accept
<b>Discussion:</b>	These fill slopes would be predominately at Bondad Hill and in high fill areas. The cost savings are in the earthwork. Need to verify that the 2:1 can be compacted, re-vegetated, and maintained.
<b>Construction Cost Savings Comparison</b> <b>VE Team Savings Estimate</b> \$409,000 <b>Designer Savings Estimate</b> Not calculated <b>Reason for Difference in Estimates</b>	
<b>Estimated Design Cost</b>	
<b>Total Cost Savings (Designer Savings Cost Estimate - Estimated Design Cost)</b>	

<b>Response to Value Engineering Proposal</b>	
<b>Project:</b>	US-550 Environmental Assessment from New Mexico/Colorado State Line north to approx. CR-220
<b>Proposal No.:</b>	SR01-001
<b>Proposal Description:</b>	Evaluate full range of alternatives in the EA including phasing descriptions.
<b>Recommended Action:</b>	Decline
<b>Discussion:</b>	Need to look at alternatives where we have impacts. EA does not require us to look at a full range of alternatives.
<b>Construction Cost Savings Comparison</b> VE Team Savings Estimate N/A Designer Savings Estimate Reason for Difference in Estimates	
<b>Estimated Design Cost</b>	
<b>Total Cost Savings (Designer Savings Cost Estimate - Estimated Design Cost)</b>	

<b>Response to Value Engineering Proposal</b>	
<b>Project:</b>	US-550 Environmental Assessment from New Mexico/Colorado State Line north to approx. CR-220
<b>Proposal No.:</b>	SR01-005
<b>Proposal Description:</b>	Use the existing alignment as bikeway.
<b>Recommended Action:</b>	Decline
<b>Discussion:</b>	Conflicts with the acceptance of P03-006
<b>Construction Cost Savings Comparison</b> VE Team Savings Estimate N/A Designer Savings Estimate Reason for Difference in Estimates	
<b>Estimated Design Cost</b>	
<b>Total Cost Savings (Designer Savings Cost Estimate - Estimated Design Cost)</b>	

<b>Response to Value Engineering Proposal</b>	
<b>Project:</b>	US-550 Environmental Assessment from New Mexico/Colorado State Line north to approx. CR-220
<b>Proposal No.:</b>	SR01-010
<b>Proposal Description:</b>	Widen southbound US 550 inside shoulder at Bondad Hill to provide improved sight distances (applies to original Alt 2A and 2B)
<b>Recommended Action:</b>	Accept with modifications
<b>Discussion:</b>	This is one of the tools that can be used and we will review areas where it is appropriate.
<b>Construction Cost Savings Comparison</b> VE Team Savings Estimate N/A Designer Savings Estimate Reason for Difference in Estimates	
<b>Estimated Design Cost</b>	
<b>Total Cost Savings (Designer Savings Cost Estimate - Estimated Design Cost)</b>	

<b>Response to Value Engineering Proposal</b>	
<b>Project:</b>	US-550 Environmental Assessment from New Mexico/Colorado State Line north to approx. CR-220
<b>Proposal No.:</b>	SR01-013
<b>Proposal Description:</b>	Use design exceptions to avoid or minimize impacts to environmentally sensitive areas.
<b>Recommended Action:</b>	Accept
<b>Discussion:</b>	This is something that has to be done.
<b>Construction Cost Savings Comparison</b> VE Team Savings Estimate N/A Designer Savings Estimate Reason for Difference in Estimates	
<b>Estimated Design Cost</b>	
<b>Total Cost Savings (Designer Savings Cost Estimate - Estimated Design Cost)</b>	

<b>Response to Value Engineering Proposal</b>	
<b>Project:</b>	US-550 Environmental Assessment from New Mexico/Colorado State Line north to approx. CR-220
<b>Proposal No.:</b>	SR01-015
<b>Proposal Description:</b>	Install school bus turnouts
<b>Recommended Action:</b>	Decline
<b>Discussion:</b>	Kids are picked up and dropped off at their driveways. These points constantly vary and there would be several. Legally vehicles are required to stop, so these should not be needed.
<b>Construction Cost Savings Comparison</b> <b>VE Team Savings Estimate</b> N/A <b>Designer Savings Estimate</b> <b>Reason for Difference in Estimates</b>	
<b>Estimated Design Cost</b>	
<b>Total Cost Savings (Designer Savings Cost Estimate - Estimated Design Cost)</b>	

<b>Response to Value Engineering Proposal</b>	
<b>Project:</b>	US-550 Environmental Assessment from New Mexico/Colorado State Line north to approx. CR-220
<b>Proposal No.:</b>	SR01-017
<b>Proposal Description:</b>	Utilize joint environmental mitigation, e.g. combine mitigation sites with those of other projects such as US 160.
<b>Recommended Action:</b>	Accept
<b>Discussion:</b>	Will look at this where it is feasible. It also would require that other agencies accept this concept.
<b>Construction Cost Savings Comparison</b> VE Team Savings Estimate N/A Designer Savings Estimate Reason for Difference in Estimates	
<b>Estimated Design Cost</b>	
<b>Total Cost Savings (Designer Savings Cost Estimate - Estimated Design Cost)</b>	

<b>Response to Value Engineering Proposal</b>	
<b>Project:</b>	US-550 Environmental Assessment from New Mexico/Colorado State Line north to approx. CR-220
<b>Proposal No.:</b>	SR01-023
<b>Proposal Description:</b>	Challenge the Environmental Justice perception of the Sunnyside Mobile Home Park.
<b>Recommended Action:</b>	Decline
<b>Discussion:</b>	The current design concept has minimal impacts to the trailer park. There are fewer property owner impacts by missing the trailer park.
<b>Construction Cost Savings Comparison</b> VE Team Savings Estimate N/A Designer Savings Estimate Reason for Difference in Estimates	
<b>Estimated Design Cost</b>	
<b>Total Cost Savings (Designer Savings Cost Estimate - Estimated Design Cost)</b>	

<b>Response to Value Engineering Proposal</b>	
<b>Project:</b>	US-550 Environmental Assessment from New Mexico/Colorado State Line north to approx. CR-220
<b>Proposal No.:</b>	SR01-030
<b>Proposal Description:</b>	Grandfather existing accesses and assess impact fees for future accesses.
<b>Recommended Action:</b>	Decline
<b>Discussion:</b>	This is not consistent with State policies.
<b>Construction Cost Savings Comparison</b> VE Team Savings Estimate N/A Designer Savings Estimate Reason for Difference in Estimates	
<b>Estimated Design Cost</b>	
<b>Total Cost Savings (Designer Savings Cost Estimate - Estimated Design Cost)</b>	

<b>Response to Value Engineering Proposal</b>	
<b>Project:</b>	US-550 Environmental Assessment from New Mexico/Colorado State Line north to approx. CR-220
<b>Proposal No.:</b>	SR01-033
<b>Proposal Description:</b>	Use deer fencing at selected locations where justified to mitigate right-of-way issues where landowner has livestock fencing issues.
<b>Recommended Action:</b>	Decline
<b>Discussion:</b>	CDOT will utilize deer fence where feasible.
<b>Construction Cost Savings Comparison</b> VE Team Savings Estimate N/A Designer Savings Estimate Reason for Difference in Estimates	
<b>Estimated Design Cost</b>	
<b>Total Cost Savings (Designer Savings Cost Estimate - Estimated Design Cost)</b>	

<b>Response to Value Engineering Proposal</b>	
<b>Project:</b>	US-550 Environmental Assessment from New Mexico/Colorado State Line north to approx. CR-220
<b>Proposal No.:</b>	SR01-035
<b>Proposal Description:</b>	Make US 550 a Scenic Byway and request enhancement funds.
<b>Recommended Action:</b>	Decline
<b>Discussion:</b>	CDOT has no control with the signing and billboards on the SUIT property. With the SUIT property at various locations along the corridor and knowing the restrictions for a Scenic Byway, it would be difficult to get this corridor approved as a Scenic Byway.
<b>Construction Cost Savings Comparison</b> <b>VE Team Savings Estimate N/A</b> <b>Designer Savings Estimate</b> <b>Reason for Difference in Estimates</b>	
<b>Estimated Design Cost</b>	
<b>Total Cost Savings (Designer Savings Cost Estimate - Estimated Design Cost)</b>	

<b>Response to Value Engineering Proposal</b>	
<b>Project:</b>	US-550 Environmental Assessment from New Mexico/Colorado State Line north to approx. CR-220
<b>Proposal No.:</b>	SR01-036
<b>Proposal Description:</b>	Perform an early geotechnical feasibility study at Bondad Hill.
<b>Recommended Action:</b>	Decline
<b>Discussion:</b>	At this time, CDOT does not want a formal geotechnical feasibility study at Bondad Hill. However if existing data from site investigations or possibly oil and gas well's is available it will be utilized.
<b>Construction Cost Savings Comparison</b> VE Team Savings Estimate N/A Designer Savings Estimate Reason for Difference in Estimates	
<b>Estimated Design Cost</b>	
<b>Total Cost Savings (Designer Savings Cost Estimate - Estimated Design Cost)</b>	