FINAL REPORT
VALUE ANALYSIS STUDY

PIMA ASSOCIATION OF GOVERNMENTS
RTA Silverbell Road
Value Analysis Project

November 2011

For PAG/RTA

BY SOLUTIONS ENGINEERING & FACILITATING, INC.

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SECTION 1 – SUMMARY

This report contains the results of the Value Analysis Study of the Pima Association of Governments (PAG) RTA Silverbell Road Value Analysis Project. The report is organized in a drill down format, that is, all items are presented first in summary format with increasing levels of detail as one delves (drills down) further into the report. This will allow the reader to easily obtain only the information he or she desires.

The first section of the report contains an executive summary of all the value analysis proposals, their estimated savings, and their ultimate disposition. The second section of the report contains a brief project background, the VA Study Team Members, a listing of the Review Board Members, and a brief description of the methodology used. The third section of the report contains detailed information about each VA Proposal. These individual proposal analyses are also organized in a drill down manner. Section Four of the report contains supplemental recommendations, i.e., ideas that the Team thought would add value to the project but do not necessarily reduce life-cycle costs. Section Five of the report contains ideas analyzed by the Team but either failed because they were thought to not be technically viable and/or did not save life-cycle costs. Section Six of the report contains functions analyzed by the VA Team. Section Seven of the report contains all of the ideas ideated by the Team both prior to and during the workshop. Section Eight of the report documents the ultimate disposition of the Team's Proposals and Supplemental Recommendations as made by the decision making board.

SUMMARY

This Value Analysis (VA) Study generated forty-one (41) proposals and fifteen (15) supplemental recommendations.

Caveats:

- The cost savings shown for each proposal are measured against the raw cost estimates from the consulting firms at the current stage of design which varies from nearly 100% complete to a conceptual estimate. Therefore for consistency's sake the VA Team did not add the normal multipliers such as contingency (which varies per design stage), escalation (which varies per bid date), services during construction and overhead and profit for the contractor.

- All savings have been rounded to reflect the level of accuracy of the VA Proposals.

- Cost estimates made by the VA 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 preliminary design basis. Therefore, as is true with all cost estimates, the savings indicated are only an opinion of probable construction cost.

- Only potential savings are shown. As the proposals are implemented, additional costs or savings may result from redesign or modification.

- Some VA Proposals are mutually exclusive; a few are synergistic and could result in greater cost savings if implemented together. Therefore, the potential savings are not the simple sum of all the VA Proposals presented.

VA PROPOSAL SUMMARY TABLE

PROPOSAL NO.	VE PROPOSAL DESCRIPTION	REVIEW BOARD COMMENTS	PAGE NO.
Drainage and Flood Control			
P01-003	Lower the road profile by removing extra freeboard in the road profile above the Santa Cruz River 100-year floodplain. *Initial Est. Savings: $2,100,000* *Future Est. Savings: $0,000* *Total Est. Savings: $2,100,000*	**Accept with Modifications.** No flooding of pavement should occur during a 100 year event on the Santa Cruz, but freeboard is not needed.	3-1
P01-055	Use site-specific hydrologic methodology to refine design discharge estimates. *Initial Est. Savings: $4,900,000* *Future Est. Savings: $0,000* *Total Est. Savings: $4,900,000*	**Accept with Modifications.** Look at watersheds on a case-by-case basis.	3-4
P03-001	Modify cross drainage design protocols to allow site-specific designs. *Initial Est. Savings: $1,320,000 to $2,300,000* *Future Est. Savings: $0,000* *Total Est. Savings: $1,320,000 to $2,300,000*	**Accept with Modifications.** Evaluate on a case-by-case basis. Ponding into the pavement area is accepted to maximize headwater depth efficiency, but overtopping is not.	3-8
P01-109	Lower the cross culvert inverts and grade outlet channels to the river. *Initial Est. Savings: $1,250,000* *Future Est. Savings: $0,000* *Total Est. Savings: $1,250,000*	**Accept with Modifications.** Consider on a case-by-case basis - should not be allowed to bring about greater permit requirements.	3-13
P01-078	Eliminate unnecessary culverts. *Initial Est. Savings: $770,000* *Future Est. Savings: $0,000* *Total Est. Savings: $770,000*	**Accept.** Need to ensure ponding time does not exceed time allowed for retention basins.	3-16
P01-019	Shorten lengths of box culverts and add guardrail. *Initial Est. Savings: $684,000* *Future Est. Savings: $43,000* *Total Est. Savings: $641,000*	**Accept.** Provided alternate modes are accommodated.	3-19
P01-047	Replace four-span, 160-foot span bridge at Station 409+00 with a multi-cell box culvert. *Initial Est. Savings: $720,000* *Future Est. Savings: $0,000* *Total Est. Savings: $720,000*	**Accept.**	3-23
P01-007	Replace the 120-foot span bridge at Station 123+00 with a multi-cell box culvert. *Initial Est. Savings: $840,000* *Future Est. Savings: $0,000* *Total Est. Savings: $840,000*	**Accept.**	3-26

PROPOSAL NO.	VE PROPOSAL DESCRIPTION	REVIEW BOARD COMMENTS	PAGE NO.
P01-116	Eliminate the bridge deck in the median by constructing two bridges with an open median at Station 123+00 with sidewalk on one side only. *Initial Est. Savings: $310,000* *Future Est. Savings: $0,000* *Total Est. Savings: $310,000*	**Accept.**	3-29
P01-013	Use high density polyethylene (HDPE) pipe alternative for cross culverts. *Initial Est. Savings: $222,923* *Future Est. Savings: $0,000* *Total Est. Savings: $222,923*	**Decline.** Concerns about potential for deflection, long-term UV deterioration, and deliberate caused fire damage prevent consideration of this proposal.	3-31
P01-011	Use arch culverts in-lieu of concrete box culverts. *Initial Est. Savings: $730,000* *Future Est. Savings: $0,000* *Total Est. Savings: $730,000*	**Accept with Modifications.** Prefer concrete arches to metal ones.	3-33
Roadway and Lighting			
P01-042	Use a raised median south of Goret Road and at signalized intersections; construct a 5-lane section elsewhere. *Initial Est. Savings: $2,200,000* *Future Est. Savings: $0,000* *Total Est. Savings: $2,200,000*	**Decline.**	3-35
P01-045	Narrow the 20' median by reducing the U-turn design vehicle and providing U-turn loons. *Initial Est. Savings: $300,000* *Future Est. Savings: $0,000* *Total Est. Savings: $300,000*	**Decline.**	3-39
P01-030	Eliminate median curb throughout the corridor. *Initial Est. Savings: $261,000* *Future Est. Savings: ($43,000)* *Total Est. Savings: $218,000*	**Decline.**	3-45
P01-099	Eliminate curb on west side of roadway. *Initial Est. Savings: $436,000* *Future Est. Savings: ($43,000)* *Total Est. Savings: $393,000*	**Decline.**	3-48
P01-010	Combine the northbound (NB) multi-use lane and the continuous turn lane in the vicinity of Casas Arroyo (Sta 124+00-143+00). *Initial Est. Savings: $45,000* *Future Est. Savings: $0,000* *Total Est. Savings: $45,000*	**Decline.**	3-51

PROPOSAL NO.	VE PROPOSAL DESCRIPTION	REVIEW BOARD COMMENTS	PAGE NO.
P01-009	Eliminate the street lighting from Grant Road to Goret Road. *Initial Est. Savings: $300,000* *Future Est. Savings: $150,000* *Total Est. Savings: $450,000*	**Accept with Modifications.** Look at lighting of intersections for safety.	3-54
P01-004	Eliminate fiber optic conduit unless user is identified and commits to providing the necessary funding. *Initial Est. Savings: $630,000* *Future Est. Savings: $0,000* *Total Est. Savings: $630,000*	**Accept.**	3-57
Multi-Use Path and Sidewalk			
P01-012	Secure an alternative funding source for the multi-use path. *Initial Est. Savings: $1,000,000* *Future Est. Savings: $0,000* *Total Est. Savings: $1,000,000*	**Decline.**	3-59
P01-023	Replace the 10' multi-use path to a 6' asphalt sidewalk. *Initial Est. Savings: $830,000* *Future Est. Savings: $0,000* *Total Est. Savings: $830,000*	**Decline.**	3-62
P01-041	Reduce asphalt multi-use path pavement section to 2" from 3". *Initial Est. Savings: $85,000* *Future Est. Savings: $0,000* *Total Est. Savings: $85,000*	**Accept.**	3-64
P05-004	Change the 6' wide concrete sidewalk on the west side of Silverbell between Goret and Grant to a 6' wide asphalt sidewalk. *Initial Est. Savings: $60,000* *Future Est. Savings: $0,000* *Total Est. Savings: $60,000*	**Decline.**	3-66
P05-003	Reduce the sidewalk on the west side of Silverbell between Goret and Grant from a 6' width down to a 5' width. *Initial Est. Savings: $14,000* *Future Est. Savings: $0,000* *Total Est. Savings: $14,000*	**Decline.**	3-68
P01-008	Reduce bike lane width from 6 feet to 5 feet. *Initial Est. Savings: $330,000* *Future Est. Savings: $0,000* *Total Est. Savings: $330,000*	**Decline.**	3-71
Materials and Paving			
P01-034	Purchase existing sand and gravel properties from Cal-Portland Corporation with Regional Flood Control District funds. *Initial Est. Savings: $2,500,000* *Future Est. Savings: $0,000* *Total Est. Savings: $2,500,000*	**Accept.**	3-73

PROPOSAL NO.	VE PROPOSAL DESCRIPTION	REVIEW BOARD COMMENTS	PAGE NO.
P01-026	Obtain borrow/source(s) prior to construction. *Initial Est. Savings: $2,300,000* *Future Est. Savings: $0,000* *Total Est. Savings: $2,300,000*	**Table.** Consider opportunities as they emerge, on a case-by-case basis.	3-75
P01-027	Eliminate overexcavation and recompaction beneath existing paved areas and piedmont areas. *Initial Est. Savings: $700,000* *Future Est. Savings: $0,000* *Total Est. Savings: $700,000*	**Accept with Modifications.** Confirm by testing.	3-77
P01-081	Optimize the pavement section by testing R values and (potentially) revising the traffic projections. *Initial Est. Savings: $800,000 to $1,100,000* *Future Est. Savings: $0,000* *Total Est. Savings: $800,000 to $1,100,000*	**Accept with Modifications.** Study further to determine feasibility.	3-89
P01-025	Replace asphaltic rubberized concrete (ARAC) with asphaltic concrete (AC). *Initial Est. Savings: $450,000* *Future Est. Savings: $0,000* *Total Est. Savings: $450,000*	**Accept with Modifications.** Study further to determine feasibility.	3-94
P01-001	Make the transition pavement section at the north end of the first phase less robust. *Initial Est. Savings: $116,000* *Future Est. Savings: $0,000* *Total Est. Savings: $116,000*	**Decline.**	3-97
Environmental			
P01-056	Institute a Programatic Agreement (PA) with the Army Corps of Engineers rather than a Memorandum of Agreement (MOA). *Initial Est. Savings: $150,000* *Future Est. Savings: $0,000* *Total Est. Savings: $150,000*	**Accept.**	3-99
P01-058	Use the project landscape plans as the Clean Water Act Section 404 (404) mitigation proposal. *Initial Est. Savings: $81,000* *Future Est. Savings: $0,000* *Total Est. Savings: $81,000*	**Decline.**	3-101

PROPOSAL NO.	VE PROPOSAL DESCRIPTION	REVIEW BOARD COMMENTS	PAGE NO.
Construction and Constructability			
P01-082	Perform a combination value engineering/partnering session after the construction contractor's notice of award but prior to the construction contractor's notice to proceed. *Initial Est. Savings: $2,300,000 to $4,600,000* *Future Est. Savings: $0,000* *Total Est. Savings: $2,300,000 to $4,600,000*	**Accept.**	3-103
P01-080	Perform a constructabiltiy review at approximately 60% design. *Initial Est. Savings: $70,000 to $210,000* *Future Est. Savings: $0,000* *Total Est. Savings: $70,000 to $210,000*	**Accept.**	3-106
P01-016	Reduce the landscape budget to 2% of construction budget and focus design on the medians. *Initial Est. Savings: $1,800,000* *Future Est. Savings: $0,000* *Total Est. Savings: $1,800,000*	**Accept.**	3-109
P01-018	Replace retaining walls with slopes where feasible. *Initial Est. Savings: $1,000,000 to $2,000,000* *Future Est. Savings: $0,000* *Total Est. Savings: $1,000,000 to $2,000,000*	**Accept with Modifications.** Consider on a case-by-case basis; need to weigh cost of right of way against cost of walls.	3-111
P01-096	Contract/bid the entire south half of the corridor as one project. *Initial Est. Savings: $240,000* *Future Est. Savings: $0,000* *Total Est. Savings: $240,000*	**Accept with Modifications.** Consider cash flow and permit timing ramifications.	3-120
P01-029	Construct major intersections early and on an accelerated schedule. *Initial Est. Savings: $47,250* *Future Est. Savings: $0,000* *Total Est. Savings: $47,250*	**Accept with Modifications.** Up to jurisdiction preference.	3-122
P01-014	Design construction phasing to provide for two-phase construction (east side phase one) with adequate detours to insure this phasing. *Initial Est. Savings: Not Quantified* *Future Est. Savings: Not Quantified* *Total Est. Savings: Not Quantified*	**Accept with Modifications.** Consider further.	3-124

PROPOSAL NO.	VE PROPOSAL DESCRIPTION	REVIEW BOARD COMMENTS	PAGE NO.
P01-040	Close Silverbell Road at Idle Hour Wash to construct 5-12x10 and 2-12x8 boxes in one phase. *Initial Est. Savings: $125,000* *Future Est. Savings: $0,000* *Total Est. Savings: $125,000*	**Accept.**	3-126
P01-091	Utilize a v-ditch with berm rather than silt fence or waddles for stormwater controls. *Initial Est. Savings: $110,000* *Future Est. Savings: $0,000* *Total Est. Savings: $110,000*	**Accept with Modifications.** Consider on a case-by-case basis.	3-129

The estimated construction cost in raw dollars (no markups, no escalation, etc.) at the time of the VA Study was $93,192,000 for the PAG RTA Silverbell Road Value Analysis Project.

The Review Board's estimate of savings from the **Accepted VA Proposals** is $13,256,000 **Accepted with Modifications VA Proposals** is $17,157,250 (with some overlapping savings) with an additional $2,300,000 in pending (Tabled) savings.

Silverbell Road Consolidated Budget and Funding Gap Review

Total Construction Cost (TCC) from plan estimate:		**$46,196,950**	
Silverbell South (30% Plans)		$23,313,568	
Silverbell North (15% Plans, 4 lane divided)		$22,883,382	
Construction Survey	2.5% of TCC	$1,154,924	Adjusted due to RTA Policy
Mobilization	8.0% of TCC	$3,695,756	
Erosion / Dust Control	4.0% of TCC	$1,847,878	
Traffic Control	5.0% of TCC	$2,309,848	
Contingency	20% of TCC	$9,239,390	
CA/QC	13% of TCC	$6,005,604	Adjusted due to RTA Policy
Design/CM	10% of TCC	$4,619,695	
Planning Expenditures to-date		$2,271,491	
Right of Way		$3,850,000	
Archeology		$12,000,000	
Current Comprehensive Cost Estimate		**$93,191,535**	
Committed Funding:		**$66,553,000**	
RTA		$42,653,000	
Jurisdictional Commitments per ballot		$14,400,000	
Additional Jurisdictional funds for 4 lane upgrade		$6,500,000	
Additional 12.6% for Archeology		$3,000,000	
Funding Shortfall/Desirable Savings		**$26,638,535**	

SECTION 2 – INTRODUCTION

INTRODUCTION

Value Analysis (VA) analysis identifies the high cost areas of a project during the early design stages. The VA 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 VA 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 study.
- A summary of accepted proposals.
- The documentation of the Review Board's reasoning.
- A summary of the rejected proposals will also be included in the Final 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

Improvements to Silverbell Road, from Grant Road to Ina Road are included in the voter approved Regional Transportation Authority (RTA) Transportation Improvement Plan. The improvements will increase roadway and intersection capacity, improve the roadway alignment and profile to enhance safety, provide dedicated facilities for bicycles and pedestrians, install drainage improvements to eliminate flooding and road closures, and provide necessary access control.

The voter-approved RTA Plan calls for construction of the first phase of Silverbell Road to commence in implementation Period 2 (2012 to 2016) of the RTA program. The following phases of work are included in Period 4 (2022 to 2026). The RTA Administrative Code describes the project scope of work as:

Widen Silverbell Road from Ina Road to Grant Road to a 4-lane, desert parkway with 3-lane segment, with 4 and 3 travel lanes; raised, landscaped median; bike lanes in each direction; and curbs and ADA-accessible sidewalks.

Right and left-turn lanes and intersection improvements at Grant Road, Sweetwater Drive, El Camino del Cerro, Sunset Road, Orange Grove Road, and Ina Road.

Planning, preliminary engineering, and environmental studies for the 7.6 miles of Silverbell Road were conducted through a multiagency effort by the City of Tucson, Pima County, and Town of Marana. Substantial public outreach was carried out in this phase of project implementation and included frequent consultation with a Citizen's Task Force, three rounds of public meetings, and discussions with individual property owners.

This comprehensive project development effort has produced the following recommended corridor improvements:

- Implement a 4-lane curbed roadway, with a raised landscaped median and 6-ft wide asphalt bike lanes, excluding gutter.
- Reconstruct the signalized intersections at Grant Road, Goret Road, Sweetwater Drive, and El Camino del Cerro, as well as the unsignalized intersection at Sunset Road to provide exclusive turn lanes and appropriate storage capacity.
- Pedestrian facilities will include a 10-ft wide asphalt multi-use path or concrete sidewalk on the east side of the roadway the entire length of the project. Sidewalk or compacted decomposed granite will

be provided on the west side of the roadway to provide connectivity to signalized intersections for pedestrians and equestrians.

- Median openings will be provided primarily at commercial driveways and residential side streets and not at individual residential driveways. Between El Camino del Cerro and Ina Road, median openings will be spaced to provide for convenient U-turn opportunity.
- The roadway will be realigned at several locations to eliminate substandard roadway geometry.
- The roadway profile will be raised, as necessary, to accommodate the installation of drainage culverts and to bring a large portion of the roadway out of the Santa Cruz River floodplain. The roadway will need to be raised an average of 5 feet on the section north of El Camino del Cerro and 2 feet between El Camino del Cerro and Goret Road.
- Install pipe or box culverts at 71 of the 73 existing drainage crossings. Short span bridges are recommended at two large wash crossings. The recommended culvert sizes will accommodate the 100-year storm. To mitigate the impact of the wider roadway on wildlife, some culverts located within five priority crossing corridors are recommended to be slightly upsized.w2w
- Bus pullouts will be constructed at existing transit stops at the Grant Road intersection. Right-of-way will be reserved at existing signalized intersections to accommodate future bus stops.
- Roadway lighting is recommended on the section from Goret Road to Grant Road. Intersection lighting will be provided at the signalized intersections and is recommended at several unsignalized intersections.
- The recommended landscape concept for the corridor is intended to support a De Anza Trail theme and includes the use of native and drought tolerant vegetation, water harvesting techniques, native materials that blend with the surrounding area, and the placement of interpretive nodes and seating areas along the multi-use path located between Silverbell Road and the Santa Cruz River. It is anticipated that the public art component of the roadway improvements will support the proposed theme.

Silverbell Road is designated as an environmentally sensitive corridor in the Sonoran Desert Conservation Plan. The corridor is dominated by archeological sites that cannot be avoided. In order to minimize impacts to archeological sites, minimum lane and median widths and maximum fill and cut slopes allowable by the City of Tucson, Pima County, and Town of Marana are used to reduce the roadway footprint. In addition, sloped inlets will be used at a majority of the drainage culverts to reduce the amount the roadway needs to be raised. Even with these measures, a substantial amount of field recovery will be required prior to utility relocation or roadway construction work. The corridor has been designated as an Archeological District in order to simplify the clearance process through the State Historic Preservation Office. The field recovery work will begin at the south end of the project and proceed north, allowing construction activities to closely follow.

Of the 73 drainage crossings, 58 are proposed to be jurisdictional waters of the U.S. Considering that the impact on several crossings will likely exceed ½ acre, coupled with the archeological clearance process which will be led by the U.S. Army Corps of Engineers, it is expected that an individual Section 404 permit will be required for several construction segments. It is recommended that the individual permit application process, which will require an alternatives assessment be initiated immediately upon approval of the jurisdictional delineation by the Corps.

The recommended roadway alignment is intended to minimize right-of-way impacts to private property, however, a substantial amount of public and private right-of-way acquisition will still be required, particularly on the section from Ina Road to El Camino del Cerro. The vast majority of private right-of-way required on this section is from one property owner – California Portland Cement. Acquisitions will include roadway right-of-way, slope easements, and drainage easements. Right-of-way and easement requirements will be fine tuned in final design.

Existing overhead and underground utilities will be impacted, potentially significantly. Widening of the roadway and shifting of the alignment in some areas will require that power poles be relocated. Placing overhead lines (power and communications) underground is not a requirement of the roadway widening nor is it planned by TEP or the communications providers. Water, gas, and communications lines will be

impacted by the drainage culverts that will be installed. The depth of the 42" water main and 24" reclaimed water main are being verified by Tucson Water to determine the impacts of the proposed roadway improvements and the need to lower or replace these lines.

Funding currently committed for the widening of Silverbell Road includes $42.7 million of RTA funds and $14.4 million from the City of Tucson and Pima County, for a total of $57.1 million. Additional local and/or regional funding will be required to complete the project.

Improvements to Silverbell Road, from Grant Road to Ina Road (7.6 miles) are included in the voter approved Regional Transportation Authority (RTA) Transportation Improvement Plan. The improvements specified in the RTA plan include:

- Widen the section from Grant Road to Sunset Road (4.7 miles) to provide 4 travel lanes, bike lanes in both directions, curb, a raised landscaped median, and ADA-accessible sidewalks.
- Widen the section from Sunset Road to Ina Road (2.9 miles) to provide two travel lanes, bike lanes in both directions, a two-way center turn lane, and ADA-accessible sidewalks.
- Install drainage culverts to eliminate flooding and road closures at dip crossings.
- Add exclusive right and left-turn lanes and intersection improvements at Grant Road, Goret Road, Sweetwater Drive, El Camino del Cerro, Sunset Road, Orange Grove Road, and Ina Road.

These improvements are to be constructed in Periods 2 and 4 of the RTA plan implementation schedule. The section from Grant Road to El Camino del Cerro will be constructed between 2012 and 2016, while the section from El Camino del Cerro to Ina Road will be constructed between 2022 and 2026.

A separate project in the RTA plan will extend Sunset Road from Silverbell Road across the Santa Cruz River to I-10. The Sunset Road extension project is scheduled for RTA Implementation Period 3 (2017-2021).

The planning and preliminary engineering phase of the Silverbell Road improvement project began in April 2009. This Design Concept Report (DCR) documents the results of this project phase. The intent of this project is to improve roadway safety and capacity, eliminate roadway closures associated with flooding, and provide facilities to encourage and support multi-modal (bike, pedestrian, and transit) travel in a cost effective manner. A primary project goal is to avoid environmental impacts where possible and minimize and/or mitigate unavoidable impacts.

Development of the design concept was based on the following engineering analyses and environmental investigations, as well as public input and comment that were provided through a Citizen's Task Force, public open houses, and meetings with individual property owners and other stakeholders.

- Traffic Engineering Study
- Drainage Studies: Existing Hydrologic and Hydraulic Conditions; Proposed Cross Drainage Improvements, and Pavement Drainage
- Geotechnical Investigation
- Environmental Studies: Biological Evaluation, Cultural Resource Survey, Wildlife Linkage Assessment, Visual Resource Analysis, Noise Study, Jurisdictional Delineation of the Waters of the U.S., Hazardous Materials Review

ORGANIZATION

VA STUDY TEAM

The following individuals were members of the VA Team:

TEAM MEMBER	FIRM	TELEPHONE/E-MAIL
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THE REVIEW BOARD

The Review Board is comprised of the following representatives.

A. REVIEW BOARD

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The reviewers decide upon the status of the VA 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 (defer) 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 VA STUDY

ANALYTICAL PROCESS

1. Information Phase

Each VA Team Member was given the plans, specifications, and cost estimate information for the project prior to the workshop. They were given instructions to familiarize themselves with the project prior to an oral briefing to be given by the owner and the designer. The facilitator asked that the design team start with a very broad overview of the project (the exact phrase used was "satellite view") of the project with concentration on purpose and need for the project. The facilitator then asked the design team to start to gradually cover the project in increasing detail (the phrase used was "airplane view" down to "feet on the ground" view). Emphasis was made as to how the project fit into scheme of things and especially the interface points at the project ends. The facilitator encouraged the other VA Team members to ask very open ended questions.

2. Function Analysis Phase

The next activity done by the VA Team was to review previous Function Analysis Technique (FAST) Diagrams. This tool forces an analytical team to look at a project with a fresh outlook. For example, if a technical group was given the assignment to improve a heating/ventilating/air conditioning system (HVAC) system for an office building they could ideate the numerous common systems, e.g., dual duct, variable air volume, multi-zone, etc. However, the phraseology of the problem has already limited the group's thinking to a mechanical system.

By using function analysis to analyze the HVAC system the VA Team would brainstorm the function "control temperature". This forces the team to broaden the number of possible solutions thus increasing the odds of achieving an improved solution. For example, by brainstorming the function "control temperature" the study team can look at insulation levels, fenestration schemes, thermal storage, reflective roofing, building axis orientation, landscaping, etc. By using the FAST Diagram the study team has been forced to abandon the paradigm of solely using a mechanical system to control temperature.

This VA Team then selected six functions that it felt covered 80% of the project cost. These functions are listed in Sections 6 & 7 of this report.

3. Creative Phase

The VA Team selected the functions for brainstorming per Pareto's Law, i.e., the 20% of the functions that drive 80% of the project. The formal brainstorming session generated as many alternative methods as possible for achieving the selected functions. These were then segregated by three categories, Constructability Review Comments (default case), Value Analysis Proposals (ideas that have the potential to save life-cycle costs), and Supplemental Recommendations (ideas that would improve the project, but don't easily fit into either of the previous two categories).

4. Analysis Phase

A rough analysis was performed by first passing or failing the brainstormed ideas, then combining or grouping similar ideas. The VA Team as a whole then discussed and recorded the relative advantages of the original concept versus the advantages of the alternative plus the risks of implementing the alternative concept. The ideas surviving these discussions were selected as candidates for further development by individual team members.

5. Development Phase

A cursory technical examination followed the analysis phase. The purpose of this examination was to see it the alternative was indeed technically viable and to better explain the alternative to the design team. An order of magnitude economic analysis of technically feasible alternatives was also made. The economic analysis was done on a life-cycle basis where appropriate. The VA Team tried to use the same base cost data as that used by the design team so that proper comparison could be made with the original concepts(s). Ideas that passed these technical and economical analyses and, in the opinion of the VA Team should be incorporated into the design, were prepared as formal proposals.

The VA Team also prepared Supplemental Recommendations. These recommendations are ideas that the VA Team thought would add worth to the project but would not necessarily save capital or future costs. The Supplemental Recommendations were not necessarily priced.

6. Presentation & Report

All proposals, supplemental recommendations, and ideas analyzed but not proposed were recorded during the VA Study and were compiled to in a *Preliminary Report* to be presented to the Review Board for their consideration. Once the Review Board has decided on the proposals' and supplemental recommendations' dispositions the *Final Report* will be prepared.

SECTION 3 – PROPOSALS

VALUE ANALYSIS PROPOSAL NO. 01-003

SUMMARY PROPOSAL DESCRIPTION:

Lower the road profile by removing extra freeboard in the road profile above the Santa Cruz River 100-year floodplain.

Estimated potential savings:

Initial:	$ 2,100,000
Future:	$ 0,000
Total:	$ 2,100,000

Additional Description:

Lowering the profile to match the Santa Cruz flood elevation saves $1,542,800. The estimate above is for lowering the profile one foot below flood elevation.

Related Value Analysis Proposals and/or Supplemental Recommendations:

P01-001 – Make the transition pavement section at the north end of the first phase less robust

P01-055 – Use site-specific hydrologic methodology to refine design discharge estimates.

EVALUATION
Idea Number: 01-003 Idea Description: Lower the road profile by removing extra freeboard in the road profile above the Santa Cruz River 100-year floodplain.
Advantages of alternative concept: 1. Reduces volume of fill required 2. Reduces amount of required earthwork 3. Meets current all-weather access standard (1 foot over roadway) 4. Lowers road profile, simplifying connections to cross streets, driveways, etc.
Advantages of original concept: 1. Provides higher level of all-weather access
Risks of implementing alternative concept: 1. Approximately two miles of roadway would be inundated during the peak of the 100-year flood on the Santa Cruz River 2. Road maintenance and/or repair may be needed to inundated portions of the road after a 100-year flood on the Santa Cruz

Calculations and/or Discussion:

All-weather access is defined in local floodplain regulations as less than one foot of flow over the top of the roadway surface. If that definition is applied to the Silverbell Road project, the profile could be dropped by up to 3.7 feet. If the road profile is lowered, the volume of fill required will be reduced. The current design elevates the roadway so that the top of the subgrade is 1.5 above the 100-year (Q100) water surface elevation (WSEL) of the Santa Cruz River. That design factor, plus the 1.2-foot thick pavement section, provides 2.7 feet of freeboard above the Q100 WSEL.

To estimate the potential cost savings of lowering the road profile, it was assumed that road profile would be lowered 2.7 or 3.7 feet (at the Q100 WSEL, and one foot below the Q100 WSEL) at every point where the Santa Cruz River 100-year floodplain touches the right-of-way, as shown on the DCR plans. In fact, the lowered profile would extend some distance beyond the point of impact by the floodplain, making the estimate slightly low. Similarly, the volume of fill associated with driveways and intersecting side roads was not counted. Also, the prism of the lowered profile was assumed to be a rectangle, rather than a trapezoid with 3:1 side slopes. Conversely, vertical profile design issues that might lessen the effect of lowering the floodplain threshold were not addressed in this analysis.

The volume calculations are shown in the following table.

				Fill removed (yd3)	
	Road		Fill	=Q100	1 ft < Q100
	Station	Distance	Width	2.7	3.7
Begin	15500		105		
end	18000	2500	105	26250	35972
Begin	21700		105		
end	28350	6650	102	67830	92952
Begin	37300		104		
end	38850	1550	104	16120	22090
			Total Vol	110200	151015
			Cost ($14)	$ 1,542,800	$ 2,114,207

Some members of the VE panel felt that there would be increased public liability if long portions of the road surface were inundated by up to one foot during the 100-year flood on the Santa Cruz River. However, if current guidelines allow one foot of inundation, there should be no increase in liability. If current guidelines do not allow such inundation, then either the regional policy should be changed or this portion of the proposal should be failed and only the option of lowering the roadway to match the roadway should be advanced.

VALUE ANALYSIS PROPOSAL NO. 01-055

SUMMARY PROPOSAL DESCRIPTION:

Use site-specific hydrologic methodology to refine design discharge estimates.

Estimated potential savings:

Initial:	$ 4,900,000
Future:	$ 0,000
Total:	$ 4,900,000

Additional Description:

Related Value Analysis Proposals and/or Supplemental Recommendations:

P03-001 - Modify cross drainage design protocols to allow site-specific designs.
P01-078 - Eliminate unnecessary culverts.
P01-047 - Replace four-span, 160-foot span bridge at Station 409+00 with a multi-cell box culvert.
P01-007 - Replace the 120-foot span bridge at Station 123+00 with a multi-cell box culvert.
P01-011 - Use arch culverts in-lieu of concrete box culverts.
P01-109 - Lower the cross culvert inverts and grade outlet channels to the river.
SR01-100 - Eliminate upsizing of culverts to accommodate wildlife.

EVALUATION
Idea Number: 01-055 Idea Description: Use site-specific hydrologic methodology to refine design discharge estimates.
Advantages of alternative concept: 1. More accurate discharge estimates 2. More appropriately-sized cross drainage facilities 3. Eliminate unintentional over-design of cross drainage facilities
Advantages of original concept: 1. Standard of practice, locally
Risks of implementing alternative concept: 1. Resistance by local agency regulatory personnel 2. Will require a design exception 3. Potential precedent set for use of alternative methodologies by others

Calculations and/or Discussion:

The methodologies (COT Hydrology and PCFCD Method) are perceived by some hydrologists to be very conservative. The discharges used in the Silverbell Road design average 36% higher than discharges estimated using the USGS Regression equations based on stream gauge data from southern Arizona. To estimate the potential impact of using alternative, site-specific methodologies on cost, we assumed that a 36% reduction in discharge results in a 36% reduction in culvert size, except for culverts that are already at the minimum size (24”). The size and/or number of culverts was reduced to approximate a 36% reduction. Headwalls and wingwalls were not accounted for in the cost estimates because both the proposed and the reduced size culverts would have essentially the same end treatments. A table of adjusted culvert sizes is shown below. The estimated cost savings from reducing the culvert size due to reduced discharges is $4,900,000. Potential additional savings in earthwork and borrow were not quantified, which would require more detailed evaluation.

A site-specific hydrology analysis could include use of regional gauge data (USGS, ALERT) to calibrate peak discharge estimates, use of a locally-derived rainfall distribution, use of the NOAA14 standard rainfall depths (vs. 90% confidence interval depths), derivation of a local time of concentration equation, and application of more physically based loss rate parameters.

DA (ac)	Study Q100 (cfs)	USGS Q100 (cfs)	Q100 Reduction %
1330	2900	2011	31%
176	440	495	-12%
8	39	27	32%
7.1	35	23	34%
910	1458	1585	-9%
4.3	25	13	49%
28.9	145	102	29%
1.7	11	4	65%
95.1	312	301	4%
0.5	3	1	79%
2.3	14	6	58%
1	6	2	69%
3646	6471	3598	44%
2.6	15	7	54%
2.6	15	7	54%
42.5	182	148	19%
179.6	507	503	1%
1.4	8	3	63%
6.3	36	20	44%
	294		
22.7	112	81	28%
3.5	20	10	50%
82.7	280	267	5%
2.2	12	5	54%
1809	2546	2419	5%
4.6	85	14	84%
38.9	168	136	19%
111	396	342	14%
3438	5563	3484	37%
5.3	32	17	48%
44.1	247	153	38%
24.2	85	86	-1%
	191		
3072	2099	3275	-56%
24.2	1867	86	95%
4	25	12	53%
4	50	12	76%
795	1182	1453	-23%
3.9	23	11	50%
71.1	298	234	21%
1.6	10	4	64%
79.5	311	258	17%
15.9	86	56	35%
45.5	202	157	22%
290	735	723	2%
2.3	13	6	55%
6.7	38	22	43%
2.7	15	7	52%
29.8	169	106	38%
233	549	614	-12%
1.9	11	5	59%
17.1	83	61	27%
3.1	18	9	52%
48.9	237	168	29%
259	700	665	5%
70.7	314	233	26%
8.4	64	28	56%
1.1	8	2	74%
4177	5680	3871	32%
21.8	117	78	34%
3.3	19	9	51%
8.3	49	28	43%
3	17	8	52%
4.6	27	14	48%
54.7	251	186	26%
16.6	102	59	42%
288	832	719	14%
64	283	214	24%
2	12	5	60%
44	235	152	35%
12.2	82	42	48%
2	12	5	60%
0.7	4	1	73%
686	1594	1318	17%
4.4	25	13	47%
2.2	13	5	58%
2.5	14	6	54%
513	1229	1084	12%
12.9	67	45	33%
154	452	446	1%
			36%

STATION	PROPOSED STRUCTURE	Q100 (CFS)	36% Reduction	New Culvert	Cost Savings
465+58	5 – 12' x 8' RCBC (Extension)	2900	1856	n.c - existing box	0
456+52	1 – 10' x 4' RCBC & 1 - 10' x 6' RCBC	440	282	1-10x6	202500
455+51	3 - 36" RCPs	160	102	2-36"	20400
449+92	2 – 30" RCPs (Existing)	39	25	n.c - existing box	0
449+40	3 – 30" RCPs	72	46	2-30"	9750
440+50	48" RCP (Extension)	35	22	n.c - existing box	0
437+35	6 – 10' x 6' RCBC (Extension)	1458	933	n.c - existing box	0
428+80	24" RCP	25	16	smallest pipe, n.c.	0
424+41	3 – 36" RCPs	145	93	2-36"	12750
421+22	24" RCP	11	7	smallest pipe, n.c.	0
416+93	6 - 36" RCPs	312	200	4-36"	23800
415+80	24" RCP	3	2	smallest pipe, n.c.	0
413+47	24" RCP	14	9	smallest pipe, n.c.	0
411+48	24" RCP	6	4	smallest pipe, n.c.	0
409+36	4 Span x 110' Bridge	6471	4141	Bridge - no change	0
406+77	3-10'x 5' RCBC		0	2-10x5	130000
396+80	24" RCP	15	10	smallest pipe, n.c.	0
395+48	24" RCP	15	10	smallest pipe, n.c.	0
393+52	7 – 24" RCPs	182	116	4-24"	28050
385+51	2 – 8' x 4' RCBC	507	324	1-8x4	200000
384+29	24" RCP	8	5	smallest pipe, n.c.	0
381+42	30" RCP	36	23	1-24"	6000
379+81	2 - 10'x 4' RCBC	294	188	1-10x4	153000
378+83	3 - 36" RCPs	112	72	2-36"	14450
373+71	30" RCP	20	13	1-24"	5400
372+29	5 – 48" RCPs	280	179	3-48"	40800
370+56	24" RCP	12	8	smallest pipe, n.c.	0
365+10	4 – 12' x 8' RCBC	2546	1629	3-12x8	195000
359+90	5-30" RCP	85	54	3-30"	19500
348+36	3 - 10'x 4' RCBC	168	108	2-10x4	180000
344+79	2 – 10' x 4' RCBC	396	253	1-10x4	126000
337+50	2-24" RCP	32	20	1-24"	8250
332+61	6 – 12' x 8' RCBC	5563	3560	4-12x8	420000
334+70	1-10'x 6' RCBC		0		140000
327+51	30" RCP	32	20	1-24"	1900
321+60	2 – 10' x 4' RCBC	247	158	1-10x4	117000
319+78	2 - 36" RCPs	85	54	1-36"	10200
315+71	1-10'x 4' RCBC	191	122	2-36"	131400
314+11	6 – 10' x 5' RCBC	2099	1343	4-10x5)	300000
305+06	5 – 10' x 5' RCBC	1867	1195	3-10x5	280000
300+00	2 - 24" RCP	25	16	1-24"	9350
294+75	2 - 24" RCPs	50	32	1-24"	7150
285+42	4 – 10' x 4' RCBC	1182	756	3-10x4	135000
279+63	2 - 24" RCP	23	15	1-24"	9900
274+60	10' x 4' RCBC	298	191	no change	0
271+08	24" RCP	10	6	n.c - existing box	0
267+75	10' x 5' RCBC	311	199	1-10x4	17000
261+25	5 - 24" RCPs	86	55	3-24"	14300
255+52	4 - 36" RCPs	202	129	3-36"	16150
251+29	2 - 10' x 5' RCBC	735	470	1-10x5	140000
249+03	24" RCP	13	8	smallest pipe, n.c.	0
245+61	42" RCP	38	24	1-24"	6300
242+89	30" RCP	15	10	1-24"	1400
237+29	2 - 42" RCP	169	108	1-42"	17000
232+34	2 - 8' x 5' RCBC	549	351	1-8x5	165000
230+30	24" RCP	11	7	smallest pipe, n.c.	0
224+52	48" RCP	83	53	1-36"	4550
221+89	24" RCP	18	12	smallest pipe, n.c.	0
216+31	2 - 54" RCPs	237	152	2-36"	32200
212+69	10' x 6' RCBC	700	448	1-10x4	15000
207+73	2 - 10' x 4' RCBC	314	201	1-10x6	104000
203+61	2 - 36" RCP	64	41	1-36"	15300
198+00	24" RCP	8	5	smallest pipe, n.c.	0
194+39	1-30" RCP		0	delete	9750
192+25	5 - 12' x 10' RCBC	5680	3635	3-12x10	640000
189+85	2 - 12'x 8' RCBC		0	1-12x8	240000
181+79	2 - 36" RCPs	117	75	2-24"	9000
179+09	24" RCP	19	12	smallest pipe, n.c.	0
175+80	36" RCP	49	31	1-24"	6000
174+40	24" RCP	17	11	smallest pipe, n.c.	0
168+36	36" RCP	27	17	1-24"	5400
163+00	4 – 36" RCPs	251	161	3-36"	11900
159+39	5 - 30" RCPs	102	65	3-30"	9100
155+04	12' x 8' RCBC	832	532	2-10x6	0
147+82	3 - 10' x 4' RCBC	283	181	2-10x4	126000
142+83	24" RCP	12	8	smallest pipe, n.c.	0
140+53	4 - 48" RCPs	235	150	3-48"	18000
134+89	48" RCP	82	52	1-36"	6300
131+94	24" RCP	12	8	smallest pipe, n.c.	0
128+05	24" RCP	4	3	smallest pipe, n.c.	0
122+92	1-120' Span Bridge	1594	1020	Bridge - no change	0
118+76	24" RCP	25	16	smallest pipe, n.c.	0
116+54	24" RCP	13	8	smallest pipe, n.c.	0
115+07	24" RCP	14	9	smallest pipe, n.c.	0
107+40	3 - 10' x 5' RCBC	1229	787	2-10x5	160000
100+61	2 - 30" RCP	67	43	1-36"	6300
97+86	2 - 8' x 4' RCBC	452	289	1-10x4	132000
					4865500

VALUE ANALYSIS PROPOSAL NO. 03-001

SUMMARY PROPOSAL DESCRIPTION:

Modify cross drainage design protocols to allow site-specific designs.

Estimated potential savings:

Initial:	$ 1,320,000 to $2,300,000
Future:	$ 0,000
Total:	$ 1,320,000 to $2,300,000

Additional Description:

Low flow crossing:

- Q50 under road: $1,320,000
- Q25 under road: $2,200,000

Headwater ponding increase:

- 1 ft. rise: $1,510,000
- 2 ft. rise: $2,270,000

Related Value Analysis Proposals and/or Supplemental Recommendations:

P01-011 - Use arch culverts in lieu of concrete box culverts.
P01-078 - Eliminate unnecessary culverts
P01-047 - Replace four-span, 160-foot span bridge at Station 409+00 with a multi-cell box culvert.
P01-055 - Use site-specific hydrologic methodology to refine design discharge estimates.
P01-007 - Replace the 120-foot span bridge at Station 123+00 with a multi-cell box culvert.
P01-013 - Use high density polyethylene (HDPE) pipe alternative for cross culverts.
SR01-100 - Eliminate upsizing of culverts to accommodate wildlife.
P01-109 - Lower the cross culvert inverts and grade outlet channels to the river.

EVALUATION
Idea Number: 03-001 Idea Description: Modify cross drainage design protocols to allow site-specific designs.
Advantages of alternative concept: 1. Higher headwater pooling can reduce culvert size 2. Allowing roadway overtopping reduces culvert size (or eliminates culverts) 3. Reduced volume of fill and earthwork required 4. Replace RCBC or RCP with alternative materials/shapes 5. Lower freeboard?? 6. Site-specific risk analysis
Advantages of original concept: 1. No increased Q100 water surface on upstream lands 2. Less frequent interruption of traffic/access 3. No need for maintenance/repair after overtopping event
Risks of implementing alternative concept: 1. Potential damage to roadway during and after overtopping event 2. Interruption of travel during and after overtopping event

Calculations and/or Discussion:

The following design protocols for cross drainage structures have significant cost implications for the Silverbell Road project:

1. No overtopping. The current design dictates that the entire 100-year peak discharge (Q100) be conveyed under the roadway. The consequence of this design protocol is to increase size and number of culverts, raise road profile, and increase the volume of fill needed. The recommended alternative to no overtopping is to convey the most frequent floods under the roadway and allow the Q100 over the road surface at a depth less than one foot.
2. No upstream increase in water surface elevations. The current design dictates that no increase in water surface elevations occur upstream of the road. The consequence of this design protocol is to increase the size and number of culverts required to pass the Q100 under the roadway. The recommended alternative to no increase in upstream water surface elevation is to allow increased headwater ponding which improves the inlet efficiency of culverts.
3. Use of only RCBC and RCP materials. This protocol was addressed in P01-011 and P01-013.
4. Placement of culverts at every concentration point. This protocol was addressed in P01-078. Some culverts can be combined with nearby culvert crossings, or ponded at the right-of-way (small Q100).

Overtopping: Current City and County design standards do not require that the full Q100 be passed under the road surface, just that the Q100 be less than one foot deep at the crossing. If the one-foot deep standard is applied instead of the Q100 under the road standard used in the current design, many of the culverts could be down-sized or entirely deleted. Note that overtopping could not be accomplished where the crossing exists at crest points of the roadway vertical curve unless the road profile were adjusted.

To accomplish overflows over the Silverbell Road, the following modifications of the road section would be required:

- Removal of curbing in the median and on the downstream side of the road section.
- Removal of dense vegetation and raised fill in the median.
- Placement of guard rails that would minimize the capture of flotsam and debris.
- Placement of erosion protection on the downstream face of the roadway embankment.

The following items were included and not included in the value engineering estimate:

- Included:
    - Reduction of culvert sizes.
        - Q50 Under Road. In Southern Arizona, the Q50 peak is approximately 70% of the Q100. Similarly, the culvert size was assumed to 70% of the originally culvert design size, and that half of the culvert down-sizing could be achieved as a savings in construction cost. That is, 15% of the total cost of the culverts would be saved. (15% of $8,800,000 = $1,320,000)
        - Q25 Under Road. In Southern Arizona, the Q25 peak is approximately 50% of the Q100. Similarly, the culvert size was assumed to 50% of the originally culvert design size, and that half of the culvert down-sizing could be achieved as a savings in construction cost. That is, 25% of the total cost of the culverts would be saved. (25% of $8,800,000 = $2,200,000)
- Not Included:
    - Headwall/Wingwalls – assumed to be equivalent regardless of pipe size
    - Fill – savings in lowered road profile assumed to be offset by erosion protection on downstream face of roadway embankment.
    - Erosion Protection – cost of erosion protection assumed to be offset by savings in required fill.
    - Maintenance and repair after overflow events – assumed to occur very rarely given Q50 or Q25 under road design standard.

Note that the chances of experiencing a flow greater than a Q25 and Q50 event during a 25-year design life period are 65% and 40%, respectively. The Q100 has a 22% chance of occurring during a 25-year period. In addition, during the rare events that exceed the peak of a Q25 or Q50, the duration of flow at the overtopping rate typically has a duration of a less than a few hours, limiting both the interruption time and potential for damage.

No Upstream Increase in 100-Year Water Surface Elevation: The current design precludes any increases in the Q100 water surface due to headwater pooling at the culvert inlets. In order to achieve the zero rise criteria, the culverts need to be wide, have drop inlets, and/or need to include relief structures in wide floodplains. In most cases, there are no existing habitable structures that would be adversely impacted by rises in the water surface elevations. Furthermore, given the steep terrain upslope from the roadway, increases in water surface would be unlikely to carry any significant distances upstream. Finally, because of the steep gully walls upstream of the road, the affected lands have very low potential for future development without significant grading. Therefore, it is likely that any affected private landowners would be amenable to selling small drainage easements.

The following items were included and not included in the value engineering estimate:

- Included:
    - Reduction of culvert sizes.
        - 1-foot rise in WSEL. A one-foot rise in headwater elevation generally increases the culvert capacity by 40%. Therefore, if a one-foot rise is allowed, the culvert size was assumed to be reduced by about 28.6%, and that 60% of the culvert down-sizing could be achieved as a savings in construction cost. That is, 17% of the total cost of the culverts would be saved. (17% of $8,800,000 = $1,510,000)
        - 2-foot rise in WSEL. A two-foot rise in headwater elevation generally increases the culvert capacity by 75%. Therefore, if a one-foot rise is allowed, the culvert size was assumed to be reduced by about 43%, and that 60% of the culvert down-sizing could be achieved as a savings in construction cost. That is, 26% of the total cost of the culverts would be saved. (26% of $8,800,000 = $2,270,000)
        - Increased headwater pooling continues to increase culvert efficiency, resulting in potential increased savings with depth.

  - Drainage Easements – Drainage easements would only be required for areas not currently in the floodplain. Most of the floodplains up-gradient from the roadway are bounded by small canyons with steep side slopes. Therefore, the land areas affected by increased flow depths are likely to be relatively small. Assuming the canyons have 2:1 side slopes, a 1% tributary channel slope, and 60 individual tributary crossings that extend outside the right-of-way, the total increased ponding areas for a 1-ft, 2-ft, or 3-ft rise would be 0.3, 1.1, and 2.5 acre. The costs of obtaining that size of drainage easements would be within the margin of error of the culvert cost savings.

- Not Included:

  - Headwall/Wingwalls – assumed to be equivalent regardless of pipe size
  - Fill – no changes in fill or road profile were assumed for this alternative.
  - Drainage Easements
  - Erosion protection – cost of erosion protection assumed to be offset by savings in required fill.

It is likely that there are combinations of overtopping, culvert sizing, material types, and other factors that could be assessed for individual crossings to optimize the risk vs. cost in a manner that could save additional costs.

VALUE ANALYSIS PROPOSAL NO. 01-109

SUMMARY PROPOSAL DESCRIPTION:

Lower the cross culvert inverts and grade outlet channels to the river.

Estimated potential savings:

Initial:	$ 1,250,000
Future:	$ 0,000
Total:	$ 1,250,000

Additional Description:

Related Value Analysis Proposals and/or Supplemental Recommendations:

P03-001 - Modify cross drainage design protocols to allow site-specific designs.

EVALUATION
Idea Number: 01-109 Idea Description: Lower the cross culvert inverts and grade outlet channels to the river.
Advantages of alternative concept: 1. Lowering the cross culverts will allow the roadway profile to be lowered in several areas in order to reduce fill requirements 2. Lowering the cross culvert inverts will require the outlet channels to be graded to the east creating material to be used as fill. 3. Channelizing outlet channels can reduce erosion concerns.
Advantages of original concept: 1. Reduces the impacts on Waters of the US.
Risks of implementing alternative concept: 1. The Corp of Engineers (COE) may not accept the increased impacts to jurisdictional washes as the required alternative analysis will identify other options to reduce these impacts. 2. Lowering culverts may be infeasible due to upstream water surface level requirements. 3. Lowering cross culverts may result in increased impacts to the existing water lines. 4. Flatter outlet channel grades may result in siltation issues.

Calculations and/or Discussion:

For the purpose of estimating a cost savings, several assumptions based on project knowledge were made:

- 30 cross culverts can be lowered 2 feet (most of the boxes)
- Downstream channel grading will be at a 0.5% longitudinal grade, resulting in a 400’ length for a 2’ culvert lowering (assume existing channel is flat for this analysis)
- Average channel width will be 30’ wide
- By lowering the culvert 2’, the roadway profile can lower 1.5’ for a length of 400’
- Typical cross section is 110’ wide.
- $3.00 per CY to excavate the downstream channels
- The $14 per CY cost for this fill is not required.

Total savings would be $1.25 M, mostly resulting from a reduction in fill requirement by lowering the roadway profile.

Lowering the roadway profile may cause problems with the cross culvert design and upstream water surface elevations overtopping the roadway. This will need to be further investigated and may make lowering the culverts infeasible.

As part of the individual permit application, the COE will require an alternatives analysis for each drainage crossing to identify the option with least impact to jurisdictional

waters. Lowering the culverts and grading the outlet downstream will have greater impacts on jurisdictional washes than raising the roadway will have. Therefore, it is unlikely that the COE will accept this option. Lowering the roadway will reduce the roadway footprint, but the benefit of the footprint reduction will be less than the channel grading impacts.

Fill reduction from lowering the road profile 2'						
crossings	length	width	depth	CF of Fill	CY of Fill	Cost of Fill Saved ($14/CY)
30	400	110	1.5	1980000	73333.33	$ 1,026,666.67
Fill reduction from channel grading						
crossings	length	width	depth	CF of Fill	CY of Fill	Cost of Borrow Saved
30	400	30	1.5	540000	20000	$ 280,000.00
Cost of grading channel and placing as embankment near channel						
Assume $3 per CY for earthwork, $14/CY for borrow						
Cost	unit cost	CY Fill	Cost			
	$ 3.00	20000	$60,000.00			
total Savings:						
Savings from lowering profile				$ 1,026,666.67		
Savings from channel excavation				$ 280,000.00		
Cost of Channel Excavation				$ (60,000.00)		
	Total Savings			$ 1,246,666.67		

VALUE ANALYSIS PROPOSAL NO. 01-078

SUMMARY PROPOSAL DESCRIPTION:

Eliminate unnecessary culverts.

Estimated potential savings:

Initial:	$ 770,000
Future:	$ 0,000
Total:	$ 770,000

Additional Description:

Related Value Analysis Proposals and/or Supplemental Recommendations:

P01-055 - Use site-specific hydrologic methodology to refine design discharge estimates.
P03-001 - Modify cross drainage design protocols to allow site-specific designs.

EVALUATION
Idea Number: 01-078 Idea Description: Eliminate unnecessary culverts.
Advantages of alternative concept: 1. Reduced cost 2. Provides opportunities for rainwater harvesting 3. Provides pockets of increased vegetative growth/habitat
Advantages of original concept: 1. Reflect original design parameters
Risks of implementing alternative concept: 1. Temporary ponding of stormwater along road alignment (possible embankment issues) 2. May require drainage easements on private upstream properties 3. May increase 404 impacts at isolated locations.

Calculations and/or Discussion:

Parameters established for and by the design team necessitated placing culverts where not necessarily needed in order to achieve the desired function of the roadway. These parameters included assuming small flows could not be diverted along the right-of-way, that small flows could not pond against the road embankment, and that wide braided channels required multiple crossings. "Unnecessary" culverts were identified by inspection of the 15% design plans, and included the following types of situations:

1. Very small discharges that could be ponded in or near the right-of-way, typically Q100 < 10 cfs.
2. Culverts that could be eliminated by diverting small discharges along the right-of-way to a nearby culvert.
3. Multiple culverts that could be centralized and combined.

In some cases it may be necessary to negotiate drainage easements from adjacent property owners. However, given the steepness of the terrain on the uphill side of the road, the ponding areas for these small discharges are likely to be correspondingly small. Furthermore, the steep terrain makes most of the areas unbuildable and more likely to be favorably regarded for inclusion as drainage easements.

Twenty-five (25) culvert crossings were identified for potential elimination, at a total initial cost savings of $1,006,525. The potential cost savings are based solely culvert and headwall construction costs. The initial cost savings estimate was reduced by 5% to account for construction of ditches, grading and possible 404 impacts. The cost of obtaining easements was estimated at $10,000 per culvert, assuming that 75% of the crossings would require easements ($187,500) and that the remainder affected only the existing right-of-way.

A list of the identified culverts is provided in the following table.

STATION	PROPOSED STRUCTURE	Q100 (CFS)	VE Evaluation	Cost
456+52	1 – 10' x 4' RCBC & 1 - 10' x 6' RCBC	440	Combine, delete 10x4	
455+51	3 - 36" RCPs	160	Delete, divert to ^^	74750
428+80	24" RCP	25	Delete, ditch to 424+41	22000
421+22	24" RCP	11	Delete, ditch to 424+41	22000
415+80	24" RCP	3	Delete, pond	19250
413+47	24" RCP	14	Delete, pond	18700
411+48	24" RCP	6	Delete, pond	18150
406+77	3-10'x 5' RCBC		Consider alternatives to RCBC	
396+80	24" RCP	15	Delete, ditch to 392+98	23650
384+29	24" RCP	8	Delete, ditch to 385 or pond	19800
379+81	2 - 10'x 4' RCBC	294	Delete, negotiate alternative access	102000
370+56	24" RCP	12	Delete, ditch to 372	19800
348+36	3 - 10'x 4' RCBC	168	Appears to be oversized	
337+50	2-24" RCP	32	Delete, use other Roger Wash culverts	27500
334+70	1-10'x 6' RCBC		Delete, evaluate need to 10x6 (404, WSEL rise)	160000
319+78	2 - 36" RCPs	85*	Possibly delete, divert to 321	33100
315+71	1-10'x 4' RCBC	191	Delete, combine with 314	192000
271+08	24" RCP	10	Delete, no concentration point	19800
249+03	24" RCP	13	Delete, ditch to 242	18700
245+61	42" RCP	38	Delete, ditch to 242	25000
237+29	2 - 42" RCP	169*	Delete, in SCR floodplain (breakout from north)	45000
230+30	24" RCP	11	Delete, pond	19250
198+00	24" RCP	8	Delete, pond	20350
194+39	1-30" RCP		Delete, combine 192	21400
168+36	36" RCP	27	Delete, pond	26300
142+83	24" RCP	12	Delete, pond	17875
128+05	24" RCP	4	Replaces existing	
116+54	24" RCP	13	Delete, pond	19250
115+07	24" RCP	14	Delete, ditch to 117	20900
				1006525

VALUE ANALYSIS PROPOSAL NO. 01-019

SUMMARY PROPOSAL DESCRIPTION:

Shorten lengths of box culverts and add guardrail.

Estimated potential savings:

Initial:	$ 684,000
Future:	$ 43,000
Total:	$ 641,000

Additional Description:

Reduce the lengths of each box culvert to within the clear zone. On the east side, the multi-use path will stay on top of the box. The average length reduction is 38 feet. Install guardrail.

Related Value Analysis Proposals and/or Supplemental Recommendations:

EVALUATION
Idea Number: 01-019 Idea Description: Shorten lengths of box culverts and add guardrail.
Advantages of alternative concept: 1. Reduces box lengths and capital cost
Advantages of original concept: 1. Culverts extend beyond the clear zone, eliminating the need for guardrail
Risks of implementing alternative concept: 1. Guardrail creates increased hazard to the motorist. 2. Guardrail adds maintenance costs.

Calculations and/or Discussion:

See chart on following page.

Reduced Length - 38 ft total for each box
Savings = 50% of LF cost

Box Size				
Cells	Width	HT	LF Cost	Savings
2	8	4	1000	$19,000
2	8	4	1000	$19,000
3	10	5	2000	$38,000
3	10	5	2000	$38,000
3	10	4	1800	$34,200
2	10	5	1200	$22,800
2	10	5	1200	$22,800
2	12	8	1500	$28,500
5	12	10	4000	$76,000
2	10	4	1100	$20,900
2	10	4	1100	$20,900
2	10	4	1100	$20,900
1	10	6	1000	$19,000
1	10	6	1000	$19,000
2	8	5	1100	$20,900
1	10	5	1000	$19,000
1	10	4	900	$17,100
1	10	4	900	$17,100
1	10	4	900	$17,100
4	10	4	2500	$47,500
5	10	5	3200	$60,800
6	10	5	5000	$95,000
6	10	6	5100	$96,900
4	12	8	3000	$57,000
				$847,400

Assume 100 ft of guardrail per box with terminal sections on each approach.
Does not include increased wingwall costs when box is shortened.

Savings

Item	Unit	Quantity	Unit Price	Total Amount
RBC's				$847,400
Guard Rail	LF	2400	$18.00	($43,200)
Terminal Section	Each	48	$2,500.00	($120,000)
			Total Savings	$684,200

LIFE CYCLE COST ANALYSIS

PROJECT LIFE (IN YEARS):	20	INTEREST:	6.00%	
	ORIGINAL COSTS	**ALTERNATIVE "A" COSTS**	**ALTERNATIVE "B" COSTS**	**ALTERNATIVE "C" COSTS**
INITIAL COSTS:				
BASE COST:				
OTHER INITIAL COSTS:				
SUBTOTAL INITIAL COSTS:				
SINGLE EVENT FUTURE COSTS				
YEAR (from base year):				
COST:				
YEAR:				
COST:				
YEAR:				
COST:				
YEAR:				
COST:				
SALVAGE VALUE:				
PRESENT WORTH OF REPLACEMENT COSTS:				
ANNUAL COSTS				
MAINTENANCE COSTS: $500/mi		$3,750.00		
OPERATIONS COSTS:				
ENERGY COSTS:				
OTHER ANNUAL COSTS:				
SUBTOTAL ANNUAL COSTS:		$3,750.00		
PRESENT WORTH OF ANNUAL COSTS:		$43,012.20		
NET PRESENT VALUE		$43,012		
CAPITAL SAVINGS		$0		
FUTURE SAVINGS		($43,012)		
TOTAL SAVINGS (original - alternative)		($43,012)		
NOTE: Items in italics are calculated				

VALUE ANALYSIS PROPOSAL NO. 01-047

SUMMARY PROPOSAL DESCRIPTION:

Replace four-span, 160-foot span bridge at Station 409+00 with a multi-cell box culvert.

Estimated potential savings:

Initial:	$ 720,000
Future:	$ 0,000
Total:	$ 720,000

Additional Description:

Related Value Analysis Proposals and/or Supplemental Recommendations:

P01-007 - Replace the 120-foot span bridge at Station 123+00 with a multi-cell box culvert.

EVALUATION
Idea Number: 01-047 Idea Description: Replace four-span, 160-foot span bridge at Station 409+00 with a multi-cell box culvert.
Advantages of alternative concept: 1. Saves money on initial construction 2. Box culvert would likely require less long term maintenance than the bridge 3. Opening is still large enough to accomodate wildlife crossing
Advantages of original concept: 1. Provides more open crossing for wildlife
Risks of implementing alternative concept: 1. The increased foot print may impact additional environmental resources including 404 and archeology

Calculations and/or Discussion:

The preliminary design calls for a new bridge to be constructed over the Camino De Oeste wash at station 409+00, just south of Neosha Street. Hydraulic analysis completed in the design concept study shows that the design flow can be accommodated in a reinforced concrete box culvert with eight 12' openings. For costing this proposal, it was assumed that the boxes would be 8' in depth. This proposal would construct a multi-cell reinforced concrete box culvert in lieu of the 160' span bridge. Construction of the box would require approximately 5' to 8' of fill to be placed through the existing channel. The box culvert would need to be approximately 105' in length.

As Designed 160' Span Bridge

ITEM	UNIT	TOTAL	COST PER UNIT $	TOTAL COST $
Bridge	SF	13200	$125.00	###########
				$0.00
Subtotal				###########
TOTAL				###########

8 Cell 10'x10' Box Culvert Proposal

ITEM	UNIT	TOTAL	COST PER UNIT $	TOTAL COST $
8'x12' Box Culvert (8 cell)	LF	105	########	$840,000.00
Borrow	CUYD	4563	$14.00	$63,882.00
Aggregate Base	CUYD	200	$25.00	$5,000.00
Asphalt	TON	308	$60.00	$18,480.00
Curb and Gutter	LF	640	$9.00	$5,760.00
				$0.00
				$0.00
Subtotal				$933,122.00
TOTAL				$933,122.00

Proposal Savings **$716,878**

VALUE ANALYSIS PROPOSAL NO. 01-007

SUMMARY PROPOSAL DESCRIPTION:

Replace the 120-foot span bridge at Station 123+00 with a multi-cell box culvert.

Estimated potential savings:

Initial:	$ 840,000
Future:	$ 0,000
Total:	$ 840,000

Additional Description:

Related Value Analysis Proposals and/or Supplemental Recommendations:

P01-047 - Replace four-span, 160-foot span bridge at Station 409+00 with a multi-cell box culvert.

EVALUATION
Idea Number: 01-007 Idea Description: Replace the 120-foot span bridge at Station 123+00 with a multi-cell box culvert.
Advantages of alternative concept: 1. Saves money on initial construction 2. Box culvert would likely require less long-term maintenance than the bridge 3. May be able to lower the roadway an further reduce borrow costs 4. Opening is still large enough to accomodate wildlife crossing
Advantages of original concept: 1. Spans potentially historic arch culvert 2. Provides more open crossing for wildlife
Risks of implementing alternative concept: 1. The increased foot print may impact additional environmental reources including jurisdictional wetlandsand archeology 2. Sedimentation may also be an issue to consider in design 3. Design should also consider scour

Calculations and/or Discussion:

The preliminary design calls for a new 120’ span bridge (106’ wide bridge typical section) to be constructed over the unnamed wash at station 123+00, just north of Abington Road. The flow is currently accommodated by an existing arch plate culvert that was constructed in the 1930’s. Hydraulic analysis completed in the design concept study shows that the design flow can be accommodated in a reinforced concrete box culvert with two 10’x10’ openings. This proposal would construct a multi cell reinforced concrete box culvert in lieu of the 120’ span bridge. Construction of the box would require approximately 25’ of fill to be placed through the existing channel. The box culvert would need to be approximately 190’ in length. Scour has been an issue in this channel, box culverts would need to be designed with cut off walls or other design elements to protect against scour. Sedimentation may also be an issue to consider in design.

As Designed 120' Span Bridge

ITEM	UNIT	TOTAL	COST PER UNIT $	TOTAL COST $
Bridge	SF	12720	$125.00	############
				$0.00
Subtotal				############
TOTAL				############

2 Cell 10'x10' Box Culvert Proposal

ITEM	UNIT	TOTAL	COST PER UNIT $	TOTAL COST $
10'x10' Box Culvert (2 cell)	LF	190	$2,500.00	$475,000.00
Borrow	CUYD	17800	$14.00	$249,200.00
Aggregate Base	CUYD	150	$25.00	$3,750.00
Asphalt	TON	231	$60.00	$13,860.00
Curb and Gutter	LF	480	$9.00	$4,320.00
				$0.00
				$0.00
Subtotal				$746,130.00
TOTAL				$746,130.00

Proposal Savings **$843,870**

VALUE ANALYSIS PROPOSAL NO. 01-116

SUMMARY PROPOSAL DESCRIPTION:

Eliminate the bridge deck in the median by constructing two bridges with an open median at Station 123+00 with sidewalk on one side only.

Estimated potential savings:

Initial:	$ 310,000
Future:	$ 0,000
Total:	$ 310,000

Additional Description:

Related Value Analysis Proposals and/or Supplemental Recommendations:

EVALUATION
Idea Number: 01-116 Idea Description: Eliminate the bridge deck in the median by constructing two bridges with an open median at Station 123+00 with sidewalk on one side only.
Advantages of alternative concept: 1. Lower cost by reducing bridge deck area.
Advantages of original concept: 1. Allows for future additional lanes across the bridges 2. Availabilty of additional bridge width for lane shifts during construction
Risks of implementing alternative concept: 1. None noted.

Calculations and/or Discussion:

This proposal would eliminate the bridge deck in the median by constructing two bridges with an open median over the unnamed wash at station 123+00 with sidewalk on one side only. This option would require construction of a two foot shoulder and median bridge parapet in lieu of 20' of bridge deck. This proposal would also eliminate a 6' sidewalk on one side of the road. Including the elimination of the sidewalk, we estimate a total reduction in bridge deck width of approximately 22'. This proposal could limit the ability to shift traffic across bridge during construction.

Reduced Bridge Area	SF	2640	$125.00	$330,000.00
Bridge Median Parapet (additional cost)	LF	240	$100.00	($24,000.00)
Subtotal				$306,000.00
TOTAL SAVINGS				$306,000.00

VALUE ANALYSIS PROPOSAL NO. 01-013

SUMMARY PROPOSAL DESCRIPTION:

Use high density polyethylene (HDPE) pipe alternative for cross culverts.

Estimated potential savings:

Initial:	$ 222,923
Future:	$ 0,000
Total:	$ 222,923

Additional Description:

HDPE pipe comes in 20-foot lengths versus 8-foot lengths for RCP as well as being much lighter weight, making it much easier to handle.

Related Value Analysis Proposals and/or Supplemental Recommendations:

EVALUATION
Idea Number: 01-013 Idea Description: Use high density polyethylene (HDPE) pipe alternative for cross culverts.
Advantages of alternative concept: 1. Ease of installation 2. Lower cost per lineal foot 3. Resistant to chemical attack 4. Unaffected by soils with a PH range of 1.5 to 14.
Advantages of original concept: 1. None noted.
Risks of implementing alternative concept: 1. Possibly flamable

Calculations and/or Discussion:

Buy Pipe					
Pipe	Length	RCP Cl 4	HDPE	Diff	Savings
24"	6658	$ 20.00	$ 16.00	$ 4.00	$ 26,632.00
30"	2620	$ 37.00	$ 23.00	$ 14.00	$ 36,680.00
36"	5211	$ 45.00	$ 29.00	$ 16.00	$ 83,376.00
42"	475	$ 55.00	$ 40.00	$ 15.00	$ 7,125.00
48"	1763	$ 67.00	$ 49.00	$ 18.00	$ 31,734.00
54"	308	$ 79.00	$ 60.00	$ 19.00	$ 5,852.00
					$ 191,399.00
Installation (20' lengths in lieu of 8" lengths)					
Pipe	Length	Approx. Cost Diff			Savings
24"	6658	$ 2.00			$ 13,316.00
30"	2620	$ 2.00			$ 5,240.00
36"	5211	$ 2.00			$ 10,422.00
42"	475	$ 1.00			$ 475.00
48"	1763	$ 1.00			$ 1,763.00
54"	308	$ 1.00			$ 308.00
					$ 31,524.00
Total Potential Savings					$ 222,923.00

VALUE ANALYSIS PROPOSAL NO. 01-011

SUMMARY PROPOSAL DESCRIPTION:

Use arch culverts in-lieu of concrete box culverts.

Estimated potential savings:

Initial:	$ 730,000
Future:	$ 0,000
Total:	$ 730,000

Additional Description:

Related Value Analysis Proposals and/or Supplemental Recommendations:

EVALUATION
Idea Number: 01-011 Idea Description: Use arch culverts in-lieu of concrete box culverts.
Advantages of alternative concept: 1. Cost savings
Advantages of original concept: 1. Familiarty of product
Risks of implementing alternative concept: 1. Corrosion 2. Redesign

Calculations and/or Discussion:

Alternative material analysis for the five major wash crossings was done using precast concrete arch and steel plate arch in lieu of concrete box culverts.

No material dollar cost savings was found using precast concrete. The use of precast does provide a substantial time savings in time of construction.

The steel plate results in a material savings of 40% versus concrete box culverts.

Wash Name	Structure	Cost	Savings
Trails End	4-12 x 8	$250K	$87K
Roger	6-12 x 8	$573K	$200K
Sweetwater	6-10 x 5	$438K	$153K
Del Cerro	4-10 x 4	$241K	$84K
Idle Hour	2-12 x 8	$157K	$54K
	5-12 x 10	$434K	$152K
Total			$732K
			Round to $730K

VALUE ANALYSIS PROPOSAL NO. 01-042

SUMMARY PROPOSAL DESCRIPTION:

Use a raised median south of Goret Road and at signalized intersections; construct a 5-lane section elsewhere.

Estimated potential savings:

Initial:	$ 2,200,000
Future:	$ 0,000
Total:	$ 2,200,000

Additional Description:

Related Value Analysis Proposals and/or Supplemental Recommendations:

P01-030 - Eliminate median curb throughout the corridor.
P01-045 - Narrow the 20' median by reducing the U-turn design vehicle and providing U-turn loons.
SR01-068 - Provide median landscaping that does not require irrigation.

EVALUATION
Idea Number: 01-042 Idea Description: Use a raised median south of Goret Road and at signalized intersections; construct a 5-lane section elsewhere.
Advantages of alternative concept: 1. Improved access to property abutting the road, eliminates U-turn concerns for horse trailers 2. Likely to receive public support 3. Significant cost savings in areas such as cross drainage, curbing, landscaping and embankment by reducing typical section width.
Advantages of original concept: 1. Increased capacity/access control 2. Better aesthetics
Risks of implementing alternative concept: 1. May need to amend RTA administrative code to revise the language regarding the landscaped median 2. Expectation of a divided road by the public may need to be dealt with. May get pushback on the aesthetics of a 5 lane

Calculations and/or Discussion:

The current concept includes a raised landscaped median throughout the project limits. This is justified in the more urban area between Grant Road and Goret Road because the land uses are more intense (with significant commercial use), and the crash records indicate the frequent occurrence of angle and left turn crashes (they represent 50% of all crashes in that segment). Those types of crashes can be corrected by controlling access and limiting the conflict points. Medians are also desirable at major signalized intersections to preserve the storage of the turning movements and avoid conflicts with nearby driveways.

However, based on the following considerations, it is believed that a 5-lane roadway section (with a center left turn lane) could be implemented throughout the rest of the project without any loss in functionality:

1. Crash History: "*The crash rate for each roadway segment, with the exception of segment between Goret Road and Grant Road, is below the average crash rate of 1.31 for roadway segments within Pima County*" – page 11 of the Traffic Engineering Report. Further evaluation of the data also shows that most of the crashes in those segments are rear-end collisions or single vehicles crashes (not susceptible to correction with a median). Correctable angle and left turn crashes represent only 10% of the crashes.
2. Low Density Uses: As a result of the low density uses prevailing in these areas (residential, park, open space, resource extraction, etc), the volumes at most access points are very low, which creates limited safety exposure.

3. Improved Access: The public has expressed concerns about u-turns for horse trailers and other vehicles. Having a two-way left turn lane would alleviate this concern and reduce vehicle miles of travel (VMT).
4. Traffic Volumes: The projected volumes for the year 2040 are less than 30,000 veh/day. This is a number that can be easily handled by a 5-lane roadway with adequate intersection turn lanes and mid-block right turn lanes. Therefore, further reductions in access points are not necessary.
5. Comparable Roadways: Silverbell Road from Ina to Cortaro and River Road from Campbell to Alvernon are two comparable 5-lane arterials that residents and agencies can relate to. They both serve similar suburban areas and have the same posted speeds (40 and 45 mph). No safety deficiencies or capacity problems have been identified on those roadways (even though River Road serves well over 20,000 veh/day already).

The estimated savings from this proposal are calculated based on the following assumptions:

Cost Reductions

- The length of raised median will be from Grant to Goret (5,200 ft) and 500 feet on the north/south approaches to the signalized intersections. As a result, 80% of the project length will be a 5-lane section.
- The 5-lane section will be 10 feet narrower than the raised median section because the current 20-ft median and 1 foot shy distance on each side (22 feet total) will be replaced with a 12-ft lane.
- The roadway prism is approximately 100 feet wide (60-ft road, 20-ft median, 20-ft bike/pedestrian area). Therefore, saving 10 feet in width represents a 10% reduction in road prism.
- The following elements are reduced 8% in proportion to the narrower prism (10% reduction on 80% of the length): box culverts, cross drainage pipes, drainage excavation, drainage easements, borrow, and roadway excavation.
- The two bridges (which are assumed to be 106 feet wide in the DCR) are reduced by 10 feet, resulting in 10% savings.
- The landscape and irrigation costs are reduced by 25% because a significant portion of the landscaping is typically located in the median.
- Curbing is reduced by 40%, because 50% or the curb (inside curb, not edge of pavement) is eliminated through 80% of the project.
- Other elements such as clearing and grubbing, removal of obstructions, seeding and SWPPP will be reduced but are more difficult to quantify. A 4% reduction was assumed for those. Other elements such as mobilization and utility conflicts were not estimated, but could also be reduced.

Cost Increases

- The width of AC, ARAC, and AB will increase from 58 feet to 68 feet through 80% of the project. This equates to a 14% increase in AC, ARAC, and AB.
- Some of the catch basins and pipes for the storm drain will need to be upsized as a result of the increased impermeable area. However, not all the pipes or catch basins will need to be upsized; therefore, a 5% increase was assumed.

Project length (ft)	40,000
Curbed Segments	
Grant - Goret	5200
Signalized intersections (5@500 ft each)	2500
Total Curbed	**7700**
Total 5 lanes	32,300
% 5 lanes	**81%**

		Original Cost Ina-Del Cerro	Original Cost Del Cerro-Grant	Total Original	Savings
Drainage Easement	-8%	87200	40,700	$ 127,900	$ (10,232)
Box Culverts	-8%	2,814,800	4,491,700	$ 7,306,500	$ (584,520)
Drainage Pipes	-8%	704,580	690,490	$ 1,395,070	$ (111,606)
Drainage Excavation	-8%	41,040	76,308	$ 117,348	$ (9,388)
Bridge	-10%	1,590,000	1,320,000	$ 2,910,000	$ (291,000)
Borrow	-8%	5,880,000	2,114,000	$ 7,994,000	$ (639,520)
Road Excavation	-8%	259,000	343,000	$ 602,000	$ (48,160)
Landscaping and Irrig	-25%	1,600,000	1,900,000	$ 3,500,000	$ (875,000)
Storm Drain	5%	591,000	536,070	$ 1,127,070	$ 56,354
Curb	-40%	984,087	715,887	$ 1,699,974	$ (679,990)
AC, ARAC	14%	2,812,120	3,173,775	$ 5,985,895	$ 838,025
AB	14%	786,975	1,015,075	$ 1,802,050	$ 252,287
Other elements (clearing grubbing, removals, seeding, SWPPP)	-4%	1,254,169	1,259,051	$ 2,513,220	$ (100,529)
				TOTAL	**$ (2,203,278)**

VALUE ANALYSIS PROPOSAL NO. 01-045

SUMMARY PROPOSAL DESCRIPTION:

Narrow the 20' median by reducing the U-turn design vehicle and providing U-turn loons.

Estimated potential savings:

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

Additional Description:

Related Value Analysis Proposals and/or Supplemental Recommendations:

P01-042 - Use a raised median south of Goret Road and at signalized intersections; construct a 5-lane section elsewhere.

EVALUATION
Idea Number: 01-045 Idea Description: Narrow the 20' median by reducing the U-turn design vehicle and providing U-turn loons.
Advantages of alternative concept: 1. Reduces the fill limits and borrow needs 2. Reduces the length of culverts and drainage excavation.
Advantages of original concept: 1. Provides a standard 20' median that allows for design vehicle u-turns without additional accomodations or roadway hour-glassing geometry.
Risks of implementing alternative concept: 1. Inconsistent median width may create geometric irregularities. 2. Driver uncertainty/confusion in negotiating u-turns. 3. Reduces ability to place larger vegetation in medians.

Calculations and/or Discussion:

The passenger car with trailer was used as the design vehicle for u-turns. As shown in the attached Exhibits 1 and 1B, the passenger car turn template is very similar to the car with trailer so reducing the U-turn design vehicle to a passenger car will not allow for a cross section reduction. (Note: the purpose of Exhibit 1B illustrates a truck and trailer ability to U-turn in the existing cross section with a minor steering adjustment).

The current median width is 20’ wide. The median width can be reduced by 4’ and still allow a left turn lane (10’) with a raised median nose (6’) and not require the roadway geometry to hour-glass between median openings. Additional loon pavement will be required in this condition to allow for u-turns at median openings.

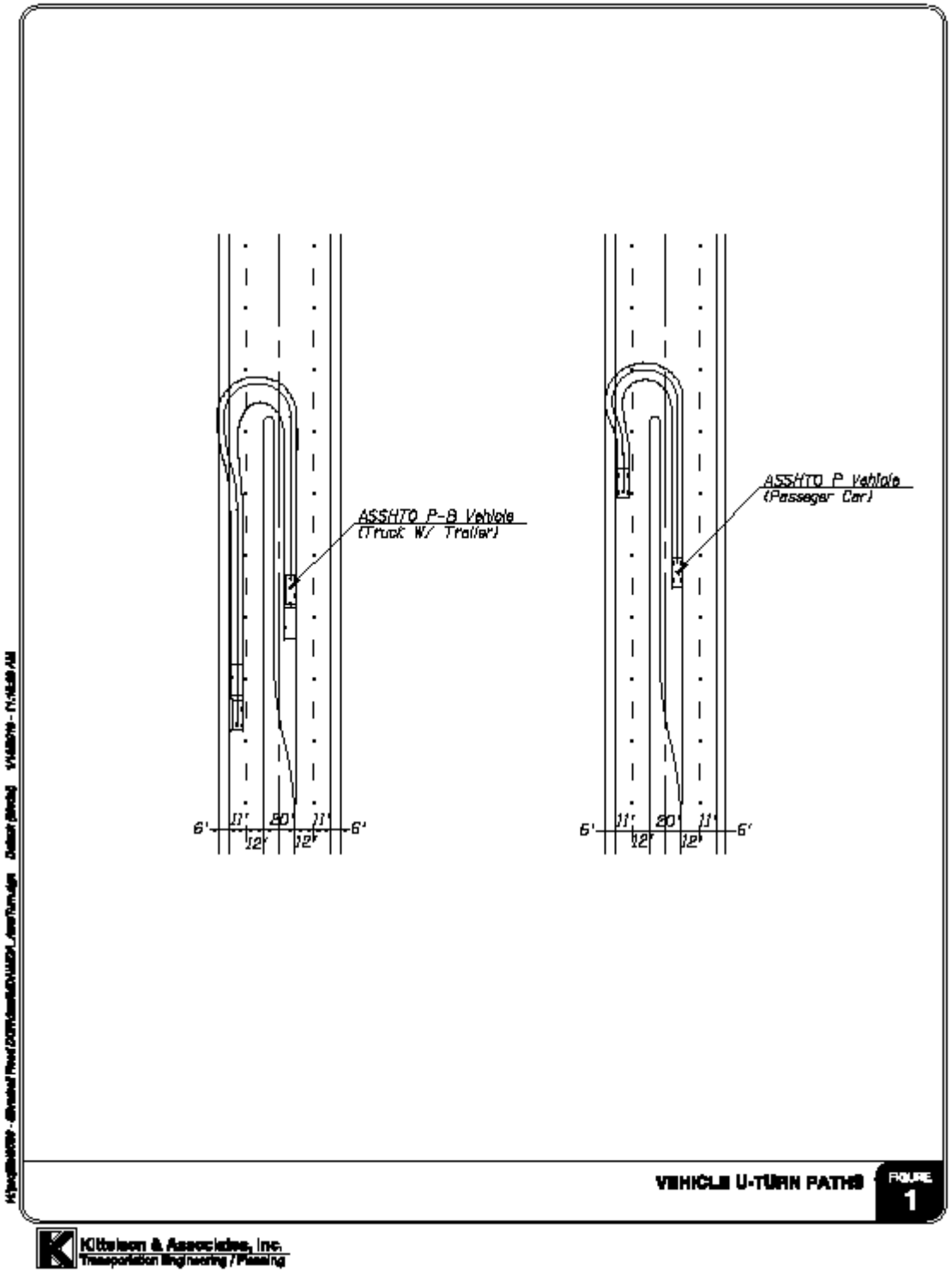
The savings from reducing the median will come from reducing the amount of fill in areas where the roadway is being raised. The attached diagram illustrates the length of the roadways where this savings can be applied.

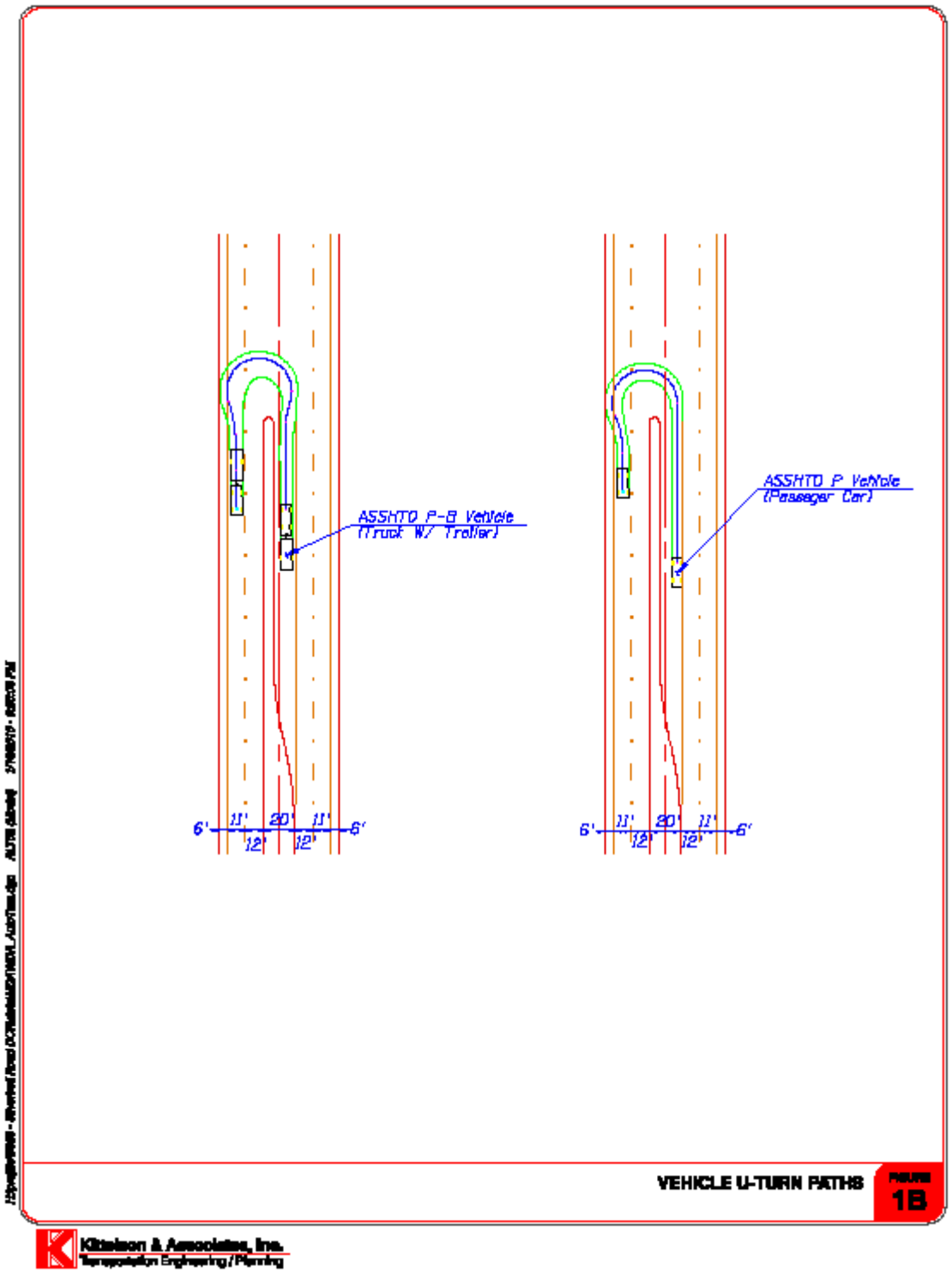
South - Neosha to Del Cerro - 10,500 ft long, 4' high fill
North 1 - Del Cerro to Sunset - 5,900 ft long, 7' high fill
North 2 - Sunset to Belmont - 10,000 ft long, 4' high fill

Road Section	Length of Narrow Median	Average Height of Fill	Width of Median Reduction	CF of Fill Saved	CY of Fill Savings	Cost of Fill Saving ($14/CY)
South	10,500	4	4	168000	6222	$ 87,111
North 1	5,900	7	4	165200	6119	$ 85,659
North 2	10,000	4	4	160000	5926	$ 82,963
					Total Savings	$ 255,733

There will be a savings from the reduction in box lengths expected to be approximately $40,000 for a total savings of $300,000.

Box	Unit cost	reduction in length	Possible savings	Assume 50% of per foot savings
4 - 12x8	$3,000.00	4	$12,000.00	$ 6,000.00
6 - 12x8	$6,000.00	4	$24,000.00	$12,000.00
6 - 10x5	$5,000.00	4	$20,000.00	$10,000.00
4 - 10x4	$1,100.00	4	$ 4,400.00	$ 2,200.00
5 - 12x10	$4,000.00	4	$16,000.00	$ 8,000.00
			Total savings	$38,200.00


AASHTO P-8 Vehicle
(Truck W/ Trailer)
AASHTO P Vehicle
(Passenger Car)
6'
11'
40'
11'
6'
12'
12'
VEHICLE U-TURN PATHS
FIGURE
1
Kittelson & Associates, Inc.
Transportation Engineering / Planning


AASHTO P-B Vehicle
(Truck W/ Trailer)
AASHTO P Vehicle
(Passenger Car)
6'
11'
20'
11'
6'
12'
12'
VEHICLE U-TURN PATHS
FIGURE
1B
Kittelson & Associates, Inc.
Transportation Engineering / Planning

With a narrow median, a U-turn loon will need to be added to allow the U-turn movements. The total cost of each loon is $250.

	length	width	depth	CF of material	Tons of Material	Cost per ton	Cost per Loon
AC	25	4	0.3	30	2.2	$ 50.00	$ 108.75
ARC	25	4	0.17	17	1.2	$ 70.00	$ 86.28
Loon	length	width	depth	CF of material	CY of Material	Cost per CY	
AB	25	4	0.58	58	2.1	$ 25.00	$ 53.70
						Total Cost per Loon	$ 248.73
		Number of Loons			cost/loon	Total cost	
			South	20	$ 250.00	$ 5,000.00	
			North	20	$ 250.00	$ 5,000.00	
					total	$ 10,000.00	

Narrowing the median to 16' wide in areas where the roadway is being raised significantly will result in approximately $300,000 savings.

Total Savings with reduced median width					
		Savings from Reduced Fill			$ 293,733
			Additional cost of Loons		$ 10,000
				Total Savings	$ 283,733

A further reduction in median width does not appear to be feasible do to the frequency and location of median openings. This would require undesirable geometry as the travel lanes would have to transition side to side (hour-glass configuration) between each of the median openings. The median openings have been spaced to provide appropriate access for various stakeholders including homeowners, business owners and emergency vehicle requirements.

VALUE ANALYSIS PROPOSAL NO. 01-030

SUMMARY PROPOSAL DESCRIPTION:

Eliminate median curb throughout the corridor.

Estimated potential savings:

Initial:	$ 261,000
Future:	$ (43,000)
Total:	$ 218,000

Additional Description:

Related Value Analysis Proposals and/or Supplemental Recommendations:

EVALUATION
Idea Number: 01-030 Idea Description: Eliminate median curb throughout the corridor.
Advantages of alternative concept: 1. Reduces cost
Advantages of original concept: 1. Curbed medians provide greater access control, reduces the chance of errant vehicles crossing the median into on-coming traffic, improves median delineation particularly on curves, reduces trash accumulation in the median, protects median landscape, and reduces unwanted vegetation (weeds) in the median..
Risks of implementing alternative concept: 1. No definative documentation on impacts to traffic safety or operations; 2. Will likely increase maintenance costs

Calculations and/or Discussion:

Eliminate median curb except at left-turn lanes and median openings. Include header curb in super-elevated sections. Maintain median landscape.

Assumptions:

- The proposed medians are depressed to accommodate water harvesting. This will remain with an uncurbed median.
- The current design includes median catch basins in super-elevated roadway sections. These would still be required with an uncurbed median. Instead of curb inlets, install grated area inlets. As such, no cost savings assumed.
- Header curb will be required in super-elevated sections. In crowned sections no header curb assumed. Should cross drainage be allowed to overtop the roadway, header curb will be required in all dip sections, although not assumed in this proposal.
- Raised curb will be provided at all left-turn lanes, median openings, and in medians shorter than 300 feet.
- Median landscape will continue to be provided, however rip rap to discourage traffic from cutting across medians is not assumed.
- Increased maintenance cost - $500/mile/yr

		Quantity			Total
Item	Unit	North	South	Unit Price	Amount
Curb	LF	24200	10000	$9.00	$307,800
Header Curb	LF	7200	600	$6.00	($46,800)
				Total Savings	$261,000

LIFE CYCLE COST ANALYSIS

PROJECT LIFE (IN YEARS):	20	INTEREST:	6.00%	
	ORIGINAL COSTS	**ALTERNATIVE "A" COSTS**	**ALTERNATIVE "B" COSTS**	**ALTERNATIVE "C" COSTS**
INITIAL COSTS:				
BASE COST:				
OTHER INITIAL COSTS:				
SUBTOTAL INITIAL COSTS:				
SINGLE EVENT FUTURE COSTS				
YEAR (from base year):				
COST:				
YEAR:				
COST:				
YEAR:				
COST:				
YEAR:				
COST:				
SALVAGE VALUE:				
PRESENT WORTH OF REPLACEMENT COSTS:				
ANNUAL COSTS				
MAINTENANCE COSTS:		$3,750.00		
OPERATIONS COSTS:				
ENERGY COSTS:				
OTHER ANNUAL COSTS:				
SUBTOTAL ANNUAL COSTS:		$3,750.00		
PRESENT WORTH OF ANNUAL COSTS:		$43,012.20		
NET PRESENT VALUE		$43,012		
CAPITAL SAVINGS		$0		
FUTURE SAVINGS		($43,012)		
TOTAL SAVINGS (original - alternative)		($43,012)		
NOTE: Items in italics are calculated				

VALUE ANALYSIS PROPOSAL NO. 01-099

SUMMARY PROPOSAL DESCRIPTION:

Eliminate curb on west side of roadway.

Estimated potential savings:

Initial:	$ 436,000
Future:	$ (43,000)
Total:	$ 393,000

Additional Description:

Related Value Analysis Proposals and/or Supplemental Recommendations:

EVALUATION
Idea Number: 01-099 Idea Description: Eliminate curb on west side of roadway.
Advantages of alternative concept: 1. Reduces cost of curb
Advantages of original concept: 1. Curbed section provides greater access control, reduces chance for errant vehicles to run off the road, reduces shoulder erosion, reduces trash buildup and shoulder maintenance, protects landscape, provides more comfortable pedestrian walking area.
Risks of implementing alternative concept: 1. Increased chance of errant vehicles leaving the roadway, 2. Increased chance of pedestrians walking within the bike lane

Calculations and/or Discussion:

Remove curb on the west side of Silverbell and provide V-ditch instead of storm drain. Bike lane would be 6 feet wide. Curb on east side would remain to allow multi-use path to be located close to the roadway.

Assumptions:

- Curb required on east side of Silverbell to allow multi-use path to be placed closer to roadway to reduce cross section width and fill.
- Uncurbed section on the west side will extend from Ina to Goret. Returns at signalized intersections will be curbed.
- V-ditches and driveway culverts will be required in lieu of curb and storm drain. Placing the V-ditches will require additional shoulder grading (cut or fill) within the clear zone to allow for a pedestrian/equestrian area to be provided. Little rip-rap or concrete ditches are required due to the flat grades on Silverbell.
- Assume additional maintenance costs of $500/mile/yr

Curb	LF	0	19500	$9.00	$175,500	
Curb and Gutter	LF	15200	0	$15.00	$228,000	
Catch basins	Ea	30	20	$5,000.00	$250,000	3
Driveway Culverts	LF	1080	630	$55.00	($94,050)	
Grading	LF	19000	22000	$3.00	($123,000)	
				Total Savings	$436,450	

LIFE CYCLE COST ANALYSIS

PROJECT LIFE (IN YEARS):	20	INTEREST:	6.00%	
	ORIGINAL COSTS	**ALTERNATIVE "A" COSTS**	**ALTERNATIVE "B" COSTS**	**ALTERNATIVE "C" COSTS**
INITIAL COSTS:				
BASE COST:				
OTHER INITIAL COSTS:				
SUBTOTAL INITIAL COSTS:				
SINGLE EVENT FUTURE COSTS				
YEAR (from base year):				
COST:				
YEAR:				
COST:				
YEAR:				
COST:				
YEAR:				
COST:				
SALVAGE VALUE:				
PRESENT WORTH OF REPLACEMENT COSTS:				
ANNUAL COSTS				
MAINTENANCE COSTS:		$3,750.00		
OPERATIONS COSTS:				
ENERGY COSTS:				
OTHER ANNUAL COSTS:				
SUBTOTAL ANNUAL COSTS:		$3,750.00		
PRESENT WORTH OF ANNUAL COSTS:		$43,012.20		
NET PRESENT VALUE		$43,012		
CAPITAL SAVINGS		$0		
FUTURE SAVINGS		($43,012)		
TOTAL SAVINGS (original - alternative)		($43,012)		
NOTE: Items in italics are calculated				

VALUE ANALYSIS PROPOSAL NO. 01-010

SUMMARY PROPOSAL DESCRIPTION:

Combine the northbound (NB) multi-use lane and the continuous turn lane in the vicinity of Casas Arroyo (Sta 124+00-143+00).

Estimated potential savings:

Initial:	$ 45,000
Future:	$ 0,000
Total:	$ 45,000

Additional Description:

Related Value Analysis Proposals and/or Supplemental Recommendations:

P01-008 - Reduce bike lane width from 6 feet to 5 feet.

EVALUATION
Idea Number: 01-010 Idea Description: Combine the northbound (NB) multi-use lane and the continuous turn lane in the vicinity of Casas Arroyo (Sta 124+00-143+00).
Advantages of alternative concept: 1. Reduced cost 2. Reduces/eliminates the need for a temporary construction easement 3. Reduces length of 4 pipe culverts 4. Bikes and vehicles would be more aware of each other instead of having vehicles cross the path of bikes at multiple locations 5. Vehicular volume is very low.
Advantages of original concept: 1. Separates bikes from vehicles
Risks of implementing alternative concept: 1. Some bicyclists and residents may be upset because they prefer the current design

Calculations and/or Discussion:

The current plans include a 1,700-foot continuous auxiliary lane south of Ina Road in the northbound direction to serve 20 lots in the Casas Arroyo subdivision.

The volume expected to be served by that lane (assuming 50% of the vehicles enter/exit the area using it) is:

Daily = 9.5 veh/house x 20 houses x 50% = 95 veh/day
Peak hour = 10% x daily volume = 10 veh/hr

Given that the volume is so low, very few (if any) bike/vehicle conflicts are anticipated. In fact, having a shared lane may make drivers and cyclists more aware of each other, instead of having vehicles cross over the bike lane at multiple locations.

The bike lane and the auxiliary lane could be combined into a single 11-foot lane (10 feet of asphalt, 1foot of gutter), saving 7 feet of asphalt. In addition, it would also reduce or eliminate the need for a TCE currently shown on the 15% plans. Finally, it would shorten 4 cross culverts by about 10 feet each (7-ft narrowing with most culverts at 45d skew = 10 ft)

Pavement

Area (sf)	11900
Depth (in)	5.5
Density (lb/ft3)	145
Quant (Tons)	395
Unit Price	60
Pavement Savings	**$23,725.63**

AB

AB Thickness (in)	7
Volume (CY)	257.1
Unit Price	25
AB Savings	**$ 6,427.47**

TCE

Area	11900
Unit Price ($/SF)	0.5
TCE Savings	**$ 5,950.00**

Pipes

Pipe	Cost/LF	Savings (Shorten 10 ft)
1-24" RCP	55	550
1-24" RCP	55	550
1-48" RCP	120	1200
4-48"RCP	480	4800
		$ 7,100

TOTAL SAVINGS $ 43,203

VALUE ANALYSIS PROPOSAL NO. 01-009

SUMMARY PROPOSAL DESCRIPTION:

Eliminate the street lighting from Grant Road to Goret Road.

Estimated potential savings:

Initial:	$ 300,000
Future:	$ 150,000
Total:	$ 450,000

Additional Description:

Related Value Analysis Proposals and/or Supplemental Recommendations:

EVALUATION
Idea Number: 01-009 Idea Description: Eliminate the street lighting from Grant Road to Goret Road.
Advantages of alternative concept: 1. Reduced capital costs 2. Reduced maintenance costs 3. Satisfies dark skies concerns of groups of amateur astronomers in the area
Advantages of original concept: 1. Consistent with Comprehensive Tucson Roadway Illumination Study (2003) 2. Added night-time visibility in a built up area
Risks of implementing alternative concept: 1. Slight risk of increased liability

Calculations and/or Discussion:

Installation of street lighting would require power drops, avoidance of conflicts with underground and overhead utilities, maintenance and replacement of luminaire, and illumination costs.

According to the Traffic Report, the Comprehensive Roadway Illumination Study recommended street lighting for Silverbell primarily because of roadway alignment deficiencies. This project will remove those deficiencies, eliminating the need for street lighting. In addition, raised pavement markers (RPM) and reflective striping will provide night-time roadway delineation.

The distance from Goret to Grant is approximately 1 mile. Recent bids for street lighting have been for approximately $300,000 per mile. Therefore, capital savings are estimated as $300,000.

Poles would be spaced approximately 170 ft on each side of the road. Therefore, the number of luminaires would be = 2 sides x 5,280 ft/170 ft = 62 luminaires.

Based on this, the annual operating cost for electricity would be:

> Annual reduced energy cost for the 400W luminaires can be calculated as:
>
> (365nights)(11 hrs/night)(0.4 kWh/lum)(62 lum)($0.1/kWh): $10,000/year = $124,000 present value

Assuming luminaires are replaced every 10 years, 6 luminaires per year would be replaced at a cost of $300 each. Present value is $23,000

LIFE CYCLE COST ANALYSIS

PROJECT LIFE (IN YEARS):	20	INTEREST:	5.00%	
	ORIGINAL COSTS	**ALTERNATIVE "A" COSTS**	**ALTERNATIVE "B" COSTS**	**ALTERNATIVE "C" COSTS**
INITIAL COSTS:				
BASE COST:				
OTHER INITIAL COSTS:				
SUBTOTAL INITIAL COSTS:				
SINGLE EVENT FUTURE COSTS				
YEAR (from base year):				
COST:				
YEAR:				
COST:				
YEAR:				
COST:				
YEAR:				
COST:				
SALVAGE VALUE:				
PRESENT WORTH OF REPLACEMENT COSTS:				
ANNUAL COSTS				
MAINTENANCE COSTS:	$1,800.00			
OPERATIONS COSTS:				
ENERGY COSTS:	$10,000.00			
OTHER ANNUAL COSTS:				
SUBTOTAL ANNUAL COSTS:	$11,800			
PRESENT WORTH OF ANNUAL COSTS:	$147,054			
NET PRESENT VALUE	$147,054			
CAPITAL SAVINGS				
FUTURE SAVINGS				
TOTAL SAVINGS (original - alternative)				
NOTE: Items in italics are calculated				

VALUE ANALYSIS PROPOSAL NO. 01-004

SUMMARY PROPOSAL DESCRIPTION:

Eliminate fiber optic conduit unless user is identified and commits to providing the necessary funding.

Estimated potential savings:

Initial:	$ 630,000
Future:	$ 0,000
Total:	$ 630,000

Additional Description:

Related Value Analysis Proposals and/or Supplemental Recommendations:

EVALUATION
Idea Number: 01-004 Idea Description: Eliminate fiber optic conduit unless user is identified and commits to providing the necessary funding.
Advantages of alternative concept: 1. Save $630,000 2. One less "utility" to try to contend with during design and construction.
Advantages of original concept: 1. Would allow for future expansion of City IT network. 2. Traffic signals could be tied in to RTDN.
Risks of implementing alternative concept: 1. Limits City's ability to expand IT network. 2. Traffic signals would not be tied in to Regional Transportation Data Network (RTDN) using conventional/existing City technology.

Calculations and/or Discussion:

On TDOT projects, TDOT has been directed to absorb the cost of fiber optic conduit, pull-boxes, and often the fiber. Given this is an RTA project, it is appropriate to have the end-users be responsible for the added cost of all fiber related materials and installation.

VALUE ANALYSIS PROPOSAL NO. 01-012

SUMMARY PROPOSAL DESCRIPTION:

Secure an alternative funding source for the multi-use path.

Estimated potential savings:

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

Additional Description:

Related Value Analysis Proposals and/or Supplemental Recommendations:

P01-041 – Reduce asphalt multi-use path pavement section to 2” from 3”.
P01-023 - Replace the 10' multi-use path to a 6' asphalt sidewalk.

EVALUATION
Idea Number: 01-012 Idea Description: Secure an alternative funding source for the multi-use path.
Advantages of alternative concept: 1. Multi-use path could depart from the roadway and follow Santa Cruz River or be better integrated into the Cristopher Columbus park 2. Better budget adherence.
Advantages of original concept: 1. Construction of multi-use path improvements at the time of road construction 2. Dedicated path funding would be available for other multi-use path projects
Risks of implementing alternative concept: 1. Additional costs due to delayed/separate construction 2. Multi-use path construction may be delayed 3. ADA accessible path may still be required

Calculations and/or Discussion:

The RTA Ballot materials did not cite the construction of a multi-use path as a project element. The RTA Administrative Code, adopted after the RTA vote, does identify a "ADA accessible sidewalk" as a project element; however, the RTA Board has the ability to amend this requirement. It should be noted that there are no existing sidewalks or improved paths connecting to Silverbell Road, north of Goret Road, so elimination of the multi-use path north of Goret Road would not isolate existing infrastructure or perpetuate a discontinuity.

This said, the development of multi-use path improvements is still desirable, and alternative funding sources should be pursued to fund these improvements. Potential sources of funding for the multi-use path include:

- Federal Transportation Enhancement Funds
- Pima County Bond Funding
- RTA Greenway, Bikeway, Pathway and Sidewalk funding (RTA #41)

If the multi-use path is decoupled from the Silverbell Road project, the path could also be moved to better serve the potential users by connecting to destinations along the Santa Cruz River and Christopher Columbus Park more directly.

The multi-use path north of Goret Road is ten feet wide and approximately 34,000 feet in length. Earthwork would not be reduced through the elimination of the multi-use path, as the roadway prism is defined by clear zone requirements. The project cost savings would be associated with avoided paving expenses. It is assumed that any handicap ramps associated with the multi-use path would still be installed to accommodate potential future improvements.

Cost Savings Potential:

(34,000 ft)(10 ft)($3.00/sf) = $1,020,000

Use $1,000,000

VALUE ANALYSIS PROPOSAL NO. 01-023

SUMMARY PROPOSAL DESCRIPTION:

Replace the 10' multi-use path to a 6' asphalt sidewalk.

Estimated potential savings:

Initial:	$ 830,000
Future:	$ 0,000
Total:	$ 830,000

Additional Description:

Related Value Analysis Proposals and/or Supplemental Recommendations:

P05-004 - Change the 6' wide concrete sidewalk on the west side of Silverbell between Goret and Grant to a 6' wide asphalt sidewalk.

P05-003 - Reduce the sidewalk on the west side of Silverbell between Goret and Grant from a 6' width down to a 5' width.

EVALUATION
Idea Number: 01-023 Idea Description: Replace the 10' multi-use path to a 6' asphalt sidewalk.
Advantages of alternative concept: 1. Reduced quantities of asphalt, embankment and culverts 2. Pedestrians are still accommodated on a path
Advantages of original concept: 1. Provides a separated multi use path
Risks of implementing alternative concept: 1. Path would be a "sidewalk instead of a "multi-use path"

Calculations and/or Discussion:

This proposal replaces the 10' asphalt multi-use path with a 6' asphalt sidewalk. The pathway would remain in the same location, 3’ off the back of curb and the width would be reduced by 4’. This proposal would reduce the overall width of the typical section from 101’ to 97’, a 4% reduction in width. In addtion to the savings in asphalt, this proposal would also result in reduced quantities for the embankment and shortened culvert lengths. No cost reductions were factored into this proposal for reduced right-of-way (ROW) or easements. This proposal would require that the path be reclassified as a “Sidewalk” instead of a “Multi Use Path”. This proposal would meet all design standards for a sidewalk; however, accomodating two-way recreational bicycle traffic would be difficult with this proposal. It should be noted that the roadway typical has 6’ bicycle lanes on each side of Silverbell, so bicycle safety should not be compromised.

Savings for 4' reduction in asphalt path and typical section

ITEM	UNIT	TOTAL	COST PER UNIT $	TOTAL COST $
Asphalt (4'reduction in path width, 7.5 mile	TON	2871	$50.00	$143,550.00
Borrow (assume a 4% reduction in quantit	CUYD	23000	$14.00	$322,000.00
*Reinforced Concrete Box (4% reduction)	$			$292,000.00
**Reinforced Concrete Pipe (4% Reductio	$			$70,000.00
				$0.00
Subtotal				$827,550.00
TOTAL SAVINGS				$827,550.00

* Total was calculated using current estimates for RC box culvert items in both projects (approx. $7,306,000)
** Total was calculated using current estimates for RCP items in both projects (approx. $1,759,000)

VALUE ANALYSIS PROPOSAL NO. 01-041

SUMMARY PROPOSAL DESCRIPTION:

Reduce asphalt multi-use path pavement section to 2" from 3".

Estimated potential savings:

Initial:	$ 85,000
Future:	$ 0,000
Total:	$ 85,000

Additional Description:

Related Value Analysis Proposals and/or Supplemental Recommendations:

EVALUATION
Idea Number: 01-041 Idea Description: Reduce asphalt multi-use path pavement section to 2" from 3".
Advantages of alternative concept: 1. Reduce cost.
Advantages of original concept: 1. While 2" is adequate for this path, the service-life may be reduced by 2-5 years due to aging and the elements.
Risks of implementing alternative concept: 1. See advantages of original concept above.

Calculations and/or Discussion:

Savings per 1,000 square feet are shown as quantity of asphalt multi-use path may vary due to other proposals.

Item	Quantity (sq.ft.)	Tons of AC	AC Cost (Ton)
Multi-use @ 3" Ph 1	165,175	2,931.86	
Multi-use @ 3" Ph 2	194,044	3,444.28	
Total tons for 3"		6,376.14	$40.00
AC Cost for 3"		$255,045.49	
Multi-use @ 2" Ph 1	165,175	1,954.57	
Multi-use @ 2" Ph 2	194,044	2,296.19	
Total tons for 2"		4,250.76	$40.00
AC Cost for 2"		$170,030.33	
Tonnage Reduction		2,125.38	$40.00
Total Savings		$85,015.16	
Savings per 1,000 Sq.ft.		$236.62	

VALUE ANALYSIS PROPOSAL NO. 05-004

SUMMARY PROPOSAL DESCRIPTION:

Change the 6' wide concrete sidewalk on the west side of Silverbell between Goret and Grant to a 6' wide asphalt sidewalk.

Estimated potential savings:

Initial:	$ 60,000
Future:	$ 0,000
Total:	$ 60,000

Additional Description:

Related Value Analysis Proposals and/or Supplemental Recommendations:

P05-003 - Reduce the sidewalk on the west side of Silverbell between Goret and Grant from a 6' width down to a 5' width.
P01-023 - Replace the 10' multi-use path to a 6' asphalt sidewalk.

EVALUATION
Idea Number: 05-004 Idea Description: Change the 6' wide concrete sidewalk on the west side of Silverbell between Goret and Grant to a 6' wide asphalt sidewalk.
Advantages of alternative concept: 1. Reduced initial construction cost
Advantages of original concept: 1. Concrete sidewalks tend to last longer and require less maintenance than asphalt
Risks of implementing alternative concept: 1. Asphalt sidewalk will likely require more maintenace over the life of the sidewalk

Calculations and/or Discussion:

This proposal would change the 6' concrete sidewalk on the west side of Silverbell between Goret and Grant to 6' asphalt sidewalk. The current design has approximately 4,800 linear feet of 6’ concrete sidewalk on the west side of the roadway between the above mentioned stations. The location and width of the sidewalk would not change, just the pavement type.

As Designed 6' Sidewalk (4800')

ITEM	UNIT	TOTAL	COST PER UNIT $	TOTAL COST $
6' Concrete Sidewalk	SF	28800	$3.00	$86,400.00
Subtotal				$86,400.00
TOTAL				$86,400.00

Proposed 6' Asphalt Sidewalk Proposal (4800')

ITEM	UNIT	TOTAL	COST PER UNIT $	TOTAL COST $
Asphalt (6' sidewalk)	TON	522	$50.00	$26,100.00
Subtotal				$26,100.00
TOTAL				$26,100.00

Proposal Savings **$60,300**

VALUE ANALYSIS PROPOSAL NO. 05-003

SUMMARY PROPOSAL DESCRIPTION:

Reduce the sidewalk on the west side of Silverbell between Goret and Grant from a 6' width down to a 5' width.

Estimated potential savings:

Initial:	$ 14,000
Future:	$ 0,000
Total:	$ 14,000

Additional Description:

Related Value Analysis Proposals and/or Supplemental Recommendations:

P05-004 - Change the 6' wide concrete sidewalk on the west side of Silverbell between Goret and Grant to a 6' wide asphalt sidewalk.
P01-023 - Replace the 10' multi-use path to a 6' asphalt sidewalk.

EVALUATION
Idea Number: 05-003 Idea Description: Reduce the sidewalk on the west side of Silverbell between Goret and Grant from a 6' width down to a 5' width.
Advantages of alternative concept: 1. Reduced cost 2. Meets AASHTO Standards
Advantages of original concept: 1. Meets City of Tucson Standard for a 6' sidewalk when adjacent to curb and gutter 2. Provides greater separation for pedestrians and vehicular traffic
Risks of implementing alternative concept: 1. Would require a variance to the City standard for a 6' sidewalk

Calculations and/or Discussion:

This proposal would reduce the sidewalk on the west side of Silverbell between Goret and Grant from a 6' width down to 5'. The current design has approximately 4,800 linear feet of 6’ sidewalk on the west side of to roadway between the above-mentioned stations. The City of Tucson currently requires a 6’ sidewalk when adjacent to the curb and gutter. AASHTO will allow a 5’ sidewalk adjacent to the curb. The current Silverbell typical section has a 6’ bycicle lane on the shoulder which provides a buffer between the sidewalk and the travel way. This buffer helps to alleviate concerns with safety on the slightly narrower sidewalk. In addition, Silverbell is planned to not allow parking on the shoulder, which would eliminate any potential conflicts with car doors and pedestrians. This proposal would require a variance to the City of Tucson’s standard.

As Designed 6' Sidewalk (4800')

ITEM	UNIT	TOTAL	COST PER UNIT $	TOTAL COST $
6' Concrete Sidewalk	SF	28800	$3.00	$86,400.00
Subtotal				$86,400.00
TOTAL				$86,400.00

5' Sidewalk Proposal (4800')

ITEM	UNIT	TOTAL	COST PER UNIT $	TOTAL COST $
5' Concrete Sidewalk	SF	24000	$3.00	$72,000.00
Subtotal				$72,000.00
TOTAL				$72,000.00

Proposal Savings **$14,400**

VALUE ANALYSIS PROPOSAL NO. 01-008

SUMMARY PROPOSAL DESCRIPTION:

Reduce bike lane width from 6 feet to 5 feet.

Estimated potential savings:

Initial:	$ 330,000
Future:	$ 0,000
Total:	$ 330,000

Additional Description:

Five-foot wide bike lanes meet the standards of City of Tucson, Pima County, and Town of Marana. Wider bike lanes are desired by the Silverbell Road Citizen's Task Force and the Pima County BAC.

Related Value Analysis Proposals and/or Supplemental Recommendations:

EVALUATION
Idea Number: 01-008 Idea Description: Reduce bike lane width from 6 feet to 5 feet.
Advantages of alternative concept: 1. Reduces pavement cost while maintaining standard bike lane width
Advantages of original concept: 1. Wider bike lanes are desired by the Silverbell Road Citizen's Task Force and the Pima County BAC.
Risks of implementing alternative concept: 1. None noted.

Calculations and/or Discussion:

The proposed roadway cross section includes 6-ft wide bike lanes the length of the project. This change would provide 5-ft bike lanes plus 1-ft gutter from Ina to Sunset and 5-ft bike lanes with vertical curb between Sunset and Grant.

Based on pavement section of 2" ARAC, 3.5" AC, 7.5" ABC, cost savings are:

Item	Unit	Quantity	Unit Price	Amount
Borrow	CY	10,000	14.00	$140,000
AB	CY	1,829	25.00	$45,725
AC (1/2" Mix)	Ton	1,647	50.00	$82,350
ARAC	Ton	902	70.00	$63,140
Tack Coat		Assume negligible		
			Total Savings	$331,215

VALUE ANALYSIS PROPOSAL NO. 01-034

SUMMARY PROPOSAL DESCRIPTION:

Purchase existing sand and gravel properties from Cal-Portland Corporation with Regional Flood Control District funds.

Estimated potential savings:

Initial:	$ 2,500,000
Future:	$ 0,000
Total:	$ 2,500,000

Additional Description:

Related Value Analysis Proposals and/or Supplemental Recommendations:

EVALUATION
Idea Number: 01-034 Idea Description: Purchase existing sand and gravel properties from Cal-Portland Corporation with Regional Flood Control District funds.
Advantages of alternative concept: 1. Proximity to project 2. Cost reduction
Advantages of original concept: 1. Contractor may have cheaper source
Risks of implementing alternative concept: 1. Poor soils

Calculations and/or Discussion:

The Pima County Regional Flood Control District is proposing to purchase 600 acres of existing sand and gravel operation operated by the Cal-Portland Corporation. The purchase would include the proposed 15.2 acres required for Phase 2 at right-of-way at an estimated cost of $1.9 million.

In addition, significant overburden has already been stockpiled as part of the ongoing mining operation. This material would be available for Phase 1 of the Silverbell project.

The 111,000 cubic yards would cost $8.00/yd versus $14.00/yd at a savings of $650,000.

VALUE ANALYSIS PROPOSAL NO. 01-026

SUMMARY PROPOSAL DESCRIPTION:

Obtain borrow/source(s) prior to construction.

Estimated potential savings:

Initial:	$ 2,300,000
Future:	$ 0,000
Total:	$ 2,300,000

Additional Description:

Related Value Analysis Proposals and/or Supplemental Recommendations:

P01-034 - Purchase existing sand and gravel properties from Cal-Portland Corporation with Regional Flood Control District funds.

EVALUATION
Idea Number: 01-026 Idea Description: Obtain borrow/source(s) prior to construction.
Advantages of alternative concept: 1. Reduce borrow cost. 2. Pre-determine borrow measurement prior to construction. 3. Potentially pre-determine quality of borrow prior to construction. 4. Utilize 'waste' material from other projects. 5. May speed -up construction.
Advantages of original concept: 1. Does not require location(s) to stockpile prior to construction and Stormwater Best Mangement Practices. 2. Contractor may have a less expensive alternate source(s).
Risks of implementing alternative concept: 1. Storage locations may not be available. 2. Stockpiled borrow may need to be stabilzed/revegetated.

Calculations and/or Discussion:

Currently, borrow is estimated at $14 per cubic yard; if borrow can be obtained and designated for use, it is reasonable to anticipate significant savings. Public properties adjacent to the project are available to stockpile borrow prior to construction if necessary.

Due to the possibilities of various borrow sources, it is difficult to quantify the savings. The following are possible borrow sources:

- Material from the purchase of CalPortland property
- Excess material from near-by projects that could be purchased and stockpiled on public property
- Suitable excess material from material suppliers in the area

It is reasonable to anticipate a savings of up-to $4 per cubic yard due to this effort, resulting in potential savings of $2,284,000. Recommend obtaining borrow and/or borrow sources be assigned as a specific task to design team.

VALUE ANALYSIS PROPOSAL NO. 01-027

SUMMARY PROPOSAL DESCRIPTION:

Eliminate overexcavation and recompaction beneath existing paved areas and piedmont areas.

Estimated potential savings:

Initial:	$ 700,000
Future:	$ 0,000
Total:	$ 700,000

Additional Description:

Related Value Analysis Proposals and/or Supplemental Recommendations:

EVALUATION
Idea Number: 01-027 Idea Description: Eliminate overexcavation and recompaction beneath existing paved areas and piedmont areas.
Advantages of alternative concept: 1. Decreases construction time and cost by reducing footprint area of overexcavation 2. Takes advantage of observational approach showing limited evidence of realized collapse potential
Advantages of original concept: 1. Completely removes soil with collapse potential within footprint of both existing and new lanes
Risks of implementing alternative concept: 1. None noted

Calculations and/or Discussion:

According to the design team, the existing roadway has been in use since the 1930's. It has been paved and overlayed since at least that time. Accordingly, the subgrade beneath the existing paved area has a demonstrated long history of supported traffic loads. Since existing drainage crosses dip sections, it may be assumed that traffic loads have also been supported during conditions when the subgrade has been saturated. Based on these considerations, the likelihood that collapsible subgrade remains beneath existing paved areas is negligible and these areas may be deducted from the overexcavation and recompaction quantity.

The current roadway excavation and borrow associated with the subgrade treatment has not yet been calculated by the design team. A rough estimate of cost savings has been developed through evaluation of the cross sections. Only those areas where the new pavement subgrade overlaps the existing roadway were considered for elimination of overexcavation and recompaction. Consideration was also given to embankment areas where a reduced overexcavation depth is required since the new roadway will be constructed in the embankment above existing grade.

The cross sections also show areas where the new roadway excavation will extend into the Pleistocene terraces of the Tucson Mountain piedmont. These units, which are not collapsible, are described in Pearthree, P.A. and Biggs, T.H. 1999. Surficial Geology and Geologic Hazards of the Tucson Mountains, Pima County, Arizona: Avra, Brown Mountain, Cat Mountain, and Jaynes Quadrangles. Open-File Report No. 99-22. Arizona Geological Survey, Tucson. In this report, the collapsible units are also identified as Holocene floodplain and terrace deposits and Middle Pleistocene river and terrace deposits. Subgrade areas that are outside of the limits of these mapped soil units should not be included in the final limits recommended for overexcavation and recompaction.

Existing Roadway Areas							
North Project				South Project			
Station	Depth (ft)	Volume (CF)		Sta.	Depth (ft)	Volume (CF)	
96	3	9,000		139	3	9,000	
97	3	9,000		140	3	9,000	
98	2.5	7,500		141	3	9,000	
99	3	9,000		142	3	9,000	
100	3	9,000		143	3	9,000	
101	3	9,000		144	3	9,000	
102	3	9,000		145	3	9,000	
103	3	9,000		146	3	9,000	
104	3	9,000		147	3	9,000	
105	3	9,000		148	2	6,000	
106	2	6,000		149	2	6,000	
107	0	-		150	2	6,000	
108	0	-		297	2	6,000	
109	0	-		298	2	6,000	
110	0	-		299	3	9,000	
111	3	9,000		300	3	9,000	
112	3	9,000		301	3	9,000	
113	3	9,000		302	3	9,000	
114	3	9,000		303	3	9,000	
115	3	9,000		304	3	9,000	
116	1	3,000		305	3	9,000	
117	0	-		306	3	9,000	
118	1	3,000		307	3	9,000	
119	2	6,000		308	3	9,000	
120	2	6,000		309	3	9,000	
121	0.5	1,500		310	3	9,000	
122	0	-		311	3	9,000	
123	0	-		312	3	9,000	
124	0	-		313	3	9,000	
125	2.5	7,500		314	0	-	
126	3	9,000		315	3	9,000	
	Subtotal:	175,500	CF			255,000	CF

Existing Roadway Areas							
North Project				South Project			
Station	Depth (ft)	Volume (CF)		Sta.	Depth (ft)	Volume (CF)	
127	3	9000		316	3	9000	
128	3	9000		317	3	9000	
129	3	9000		318	0	0	
130	3	9000		319	0	0	
131	3	9000		320	0	0	
132	3	9000		321	0	0	
133	3	9000		322	0	0	
134	3	9000		323	0	0	
135	3	9000		324	3	9000	
136	3	9000		325	3	9000	
137	3	9000		326	3	9000	
138	3	9000		327	3	9000	
139	3	9000		328	3	9000	
140	0.5	1500		329	3	9000	
141	2	6000		330	2	6000	
142	3	9000		331	1	3000	
143	3	9000		332	0	0	
144	3	9000		333	0	0	
145	3	9000		334	0	0	
146	3	9000		335	0	0	
147	0	0		336	0	0	
148	0	0		337	0	0	
149	0	0		338	3	9000	
150	0	0		339	3	9000	
151	1	3000		340	3	9000	
152	2	6000		341	3	9000	
153	3	9000		342	3	9000	
154	3	9000		343	0	0	
155	0	0		344	0	0	
156	0	0		345	0	0	
157	0	0		346	0	0	
	Subtotal:	196,500	CF			126,000	CF

Existing Roadway Areas							
North Project				South Project			
Station	Depth (ft)	Volume (CF)		Sta.	Depth (ft)	Volume (CF)	
158	2	6,000		347	2	6,000	
159	0	-		348	0	-	
160	0	-		349	0	-	
161	0	-		350	0	-	
162	0	-		351	3	9,000	
163	0	-		352	3	9,000	
164	0	-		353	3	9,000	
165	3	9,000		354	3	9,000	
166	2	6,000		355	3	9,000	
167	0	-		356	3	9,000	
168	0	-		357	3	9,000	
169	0	-		358	3	9,000	
170	0	-		359	3	9,000	
171	0	-		360	3	9,000	
172	0	-		361	3	9,000	
173	0	-		362	3	9,000	
174	0	-		363	3	9,000	
175	0	-		364	1	3,000	
176	0	-		365	0	-	
177	0	-		366	0	-	
178	0	-		367	3	9,000	
179	0	-		368	3	9,000	
180	0	-		369	2	6,000	
181	0	-		370	1	3,000	
182	2	6,000		371	0.5	1,500	
183	3	9,000		372	0	-	
184	0	-		373	0	-	
185	0	-		374	0	-	
186	0	-		375	1	3,000	
187	0	-		376	1	3,000	
188	0	-		377	1	3,000	
	Subtotal:	36,000	CF			163,500	CF

Existing Roadway Areas							
North Project				South Project			
Station	Depth (ft)	Volume (CF)		Sta.	Depth (ft)	Volume (CF)	
189	0	0		378	0.5	1500	
190	0	0		379	0.5	1500	
191	0	0		380	0.5	1500	
192	0	0		381	0	0	
193	0	0		382	0	0	
194	0	0		383	0.5	1500	
195	0	0		384	2.5	7500	
196	0	0		385	3	9000	
197	1	3000		386	1	3000	
198	3	9000		387	2	6000	
199	3	9000		388	3	9000	
200	3	9000		389	3	9000	
201	3	9000		390	3	9000	
202	3	9000		391	3	9000	
203	3	9000		392	3	9000	
204	3	9000		393	3	9000	
205	3	9000		394	3	9000	
206	3	9000		395	0.5	1500	
207	0	0		396	0.5	1500	
208	0	0		397	0.5	1500	
209	0	0		398	0.5	1500	
210	0	0		399	0.5	1500	
211	0	0		400	2.5	7500	
212	0	0		401	2.5	7500	
213	0	0		402	3	9000	
214	0	0		403	3	9000	
215	0	0		404	3	9000	
216	0	0		405	3	9000	
217	0	0		406	2	6000	
218	0	0		407	2	6000	
219	0	0		408	1	3000	
	Subtotal:	84,000	CF			168,000	CF

Existing Roadway Areas							
North Project				South Project			
Station	Depth (ft)	Volume (CF)		Sta.	Depth (ft)	Volume (CF)	
220	0	0		409	0	0	
221	0	0		410	0	0	
222	0	0		411	2	6000	
223	0	0		412	2	6000	
224	0	0		413	0.5	1500	
225	0	0		414	0.5	1500	
226	0	0		415	0.5	1500	
227	0	0		416	2	6000	
228	0	0		417	2	6000	
229	0	0		418	3	9000	
230	0	0		419	3	9000	
231	0	0		420	3	9000	
232	0	0		421	3	9000	
233	1	3000		422	3	9000	
234	3	9000		423	3	9000	
235	3	9000		424	3	9000	
236	2	6000		425	3	9000	
237	0	0		426	3	9000	
238	0	0		427	3	9000	
239	0	0		428	2	6000	
240	0	0		429	2	6000	
241	0	0		430	2.5	7500	
242	0	0		431	3	9000	
243	0	0		432	3	9000	
244	0	0		433	3	9000	
245	0	0		434	3	9000	
246	0	0		435	3	9000	
247	0	0		436	3	9000	
248	0	0		437	3	9000	
249	0	0		438	3	9000	
250	0	0		439	2.5	7500	
	Subtotal:	27,000	CF			217,500	CF

Existing Roadway Areas							
North Project				South Project			
Station	Depth (ft)	Volume (CF)		Sta.	Depth (ft)	Volume (CF)	
251	0	0		440	1	3000	
252	0	0		441	0	0	
253	0	0		442	0	0	
254	0	0		443	2	6000	
255	0	0		444	2.5	7500	
256	0	0		445	3	9000	
257	0	0		446	3	9000	
258	0	0		447	3	9000	
259	0	0		448	3	9000	
260	0	0		449	3	9000	
261	0	0		450	3	9000	
262	0	0		451	3	9000	
263	0	0		452	3	9000	
264	0	0		453	3	9000	
265	0	0		454	3	9000	
266	0	0		455	3	9000	
267	0	0		456	3	9000	
268	0	0		457	3	9000	
269	0	0		458	3	9000	
270	0	0		459	3	9000	
271	0	0		460	3	9000	
272	0	0		461	3	9000	
273	0	0		462	3	9000	
274	0	0		463	3	9000	
275	0	0		464	3	9000	
276	0	0		465	3	9000	
277	0	0		466	3	9000	
278	0	0		467	2	6000	
279	0	0		468	2	6000	
280	0	0		469	3	9000	
281	0	0		470	3	9000	
282	0	0		471	3	9000	
283	0	0		472	3	9000	
	Subtotal:	-	CF			262,500	CF

Existing Roadway Areas							
North Project				South Project			
Station	Depth (ft)	Volume (CF)		Sta.	Depth (ft)	Volume (CF)	
284	0	0		473	3	9000	
285	0	0		474	3	9000	
286	0	0		475	3	9000	
287	0	0		476	3	9000	
288	2	6000		477	3	9000	
289	3	9000		478	3	9000	
290	3	9000		479	3	9000	
291	3	9000		480	3	9000	
292	3	9000		481	3	9000	
293	3	9000		482	3	9000	
294	3	9000		483	3	9000	
295	3	9000		484	3	9000	
296	3	9000					
297	3	9000					
298	3	9000					
	Subtotal:	96,000	CF			108,000	CF

Piedmont Areas					
North Project					
Sta.	Length	Width	Depth	Volume	
	(ft)	(ft)	(ft)	CF	
115	100	18	3	5400	
118	100	13	3	3900	
120	100	23	3	6900	
121	100	30	3	9000	
135	100	15	3	4500	
136	100	13	3	3900	
200	100	8	3	2400	
201	100	23	3	6900	
202	100	23	3	6900	
220	100	13	3	3900	
221	100	10	3	3000	
228	100	13	3	3900	
229	100	13	3	3900	
231	100	8	3	2400	
		Subtotal:		66900	CF

Piedmont Areas						
South Project						
Sta.	Length	Width	Depth	Volume		
	(ft)	(ft)	(ft)	CF		
381	100	30	3	9000		
383	100	40	3	12000		
384	100	40	3	12000		
385	100	33	3	9900		
390	100	20	3	6000		
404	100	14	3	4200		
412	100	13	3	3900		
413	100	13	3	3900		
419	100	23	3	6900		
420	100	23	3	6900		
421	100	23	3	6900		
422	100	23	3	6900		
426	100	23	3	6900		
427	100	23	3	6900		
428	100	20	3	6000		
431	100	13	3	3900		
432	100	3	3	900		
433	100	3	3	900		
460	100	36	3	10800		
461	100	36	3	10800		
462	100	36	3	10800		
471	100	23	3	6900		
472	100	23	3	6900		
473	100	13	3	3900		
475	100	13	3	3900		
		Subtotal:		168000	CF	
Total from piedmont areas:				234,900	CF	
				8,700	CY	
Total all areas:				79,644	CY	

Revised Cost:					
2030300	Roadway Excavation (existing pavement)	C.Y.	-70,944	$ 7.00	(496,608)
2030300	Roadway Excavation (Piedmont)	C.Y.	-8,700	$ 7.00	(60,900)
2030901	Borrow (existing pavement)	C.Y.	-17,736	$ 7.00	(124,152)
2030901	Borrow (Piedmont)	C.Y.	-2,175	$ 7.00	(15,225)
					$ (696,885)
			Savings:		$ (696,885)

VALUE ANALYSIS PROPOSAL NO. 01-081

SUMMARY PROPOSAL DESCRIPTION:

Optimize the pavement section by testing R values and (potentially) revising the traffic projections.

Estimated potential savings:

Initial:	$ 800,000 to $1,100,000
Future:	$ 0
Total:	$ 800,000 to $1,100,000

Additional Description:

Related Value Analysis Proposals and/or Supplemental Recommendations:

EVALUATION
Idea Number: 01-081 Idea Description: Optimize the pavement section by testing R values and (potentially) revising the traffic projections.
Advantages of alternative concept: 1. Reduced initial costs 2. Sufficient service life
Advantages of original concept: 1. Longer service life
Risks of implementing alternative concept: 1. If traffic grows beyond projections or if actual soils are worse than those tested, the service life of the pavement may be shortened

Calculations and/or Discussion:

Alternative 1 - Test Actual R Values to Revise Design R Value

The borings performed for pavement design developed an average correlated R value of 51.7. However, because the actual R values were not tested, the report reduces the actual R values for design to 30. This seems like an overly conservative assumption that could be easily corrected by testing the samples. Pima County's experience is that Actual R values are lower than correlated values by up to 15. Even if the worst case scenario assumption is made (R value reduced by 15), the R value for design should be 37. It should be noted that savings could be greater if actual testing is performed. Making that revision to the R value would reduce the calculated SN and paving costs as follows:

Silverbell North	Original	Revised			
ESALS		2,180,000			
Calced Struct Number	3.31	3.01	Delta (%)	Original Cost	Revised Cost
ARAC (in)	2	2	0%	$ 1,232,420	$ 1,232,420
AC (in)	3.5	3	-14%	$ 1,540,550	$ 1,320,471
AB (in)	7	5.5	-21%	$ 786,975	$ 618,338
			TOTAL	$ 3,559,945	$ 3,171,229
			Savings		$ 388,716

Silverbell South	Original	Revised			
ESALS		3,000,000			
Calced Struct Number	3.50	3.19	Delta (%)	Original Cost	Revised Cost
ARAC (in)	2	2	0%	$ 1,390,900	$ 1,390,900
AC (in)	3.5	3	-14%	$ 1,738,650	$ 1,490,271
AB (in)	8	7	-13%	$ 1,015,075	$ 888,191
			TOTAL	$ 4,144,625	$ 3,769,362
			Savings		$ 375,263

TOTAL SAVINGS **$ 763,979**

Alternative 2 - Revise Traffic Projections and Test Actual R Values

The anticipated traffic growth for this project is anticipated to be limited because most of the area in the Tucson Mountains is built out and because the additional connection to I-10 at Sunset will reduce the pressure on Silverbell Road.

Still, the Regional Traffic Model has exponential growth rates between 2-3%/yr. A conversation with the PAG Modeling staff brought up that the primary reason for that high growth rate is traffic that would prefer to use I-10, but would not because of capacity constraints on the freeway. Assuming interchange and other capacity improvements are made to I-10, the modeling staff believes the projected volumes on Silverbell Rd would be reduced 25%. The revised calculated ESALs and pavement sections resulting from this change would be as follows:

Silverbell North

% of TRAFFIC		70.6%	24.3%	4.1%	0.3%	0.6%	0.1%	YEARLY ESALs						Total ESALs
								0.0008	0.0100	0.4000	0.2500	2.4825	2.3289	
Year	ADT	Auto	LT	MT	Bus	TS	TT	Auto	LT	MT	Bus	TS	TT	
2010	10,100													
2021	12,271	8,663	2,982	503	37	74	12	2,530	10,883	73,452	3,359	66,711	10,430	167,365
2022	12,490	8,818	3,035	512	37	75	12	2,575	11,078	74,763	3,419	67,902	10,617	170,354
2023	12,713	8,975	3,089	521	38	76	13	2,621	11,276	76,098	3,480	69,114	10,806	173,395
2024	12,940	9,135	3,144	531	39	78	13	2,668	11,477	77,457	3,542	70,348	10,999	176,491
2025	13,171	9,299	3,200	540	40	79	13	2,715	11,682	78,840	3,605	71,605	11,196	179,642
2026	13,406	9,465	3,258	550	40	80	13	2,764	11,890	80,248	3,670	72,883	11,395	182,850
2027	13,645	9,634	3,316	559	41	82	14	2,813	12,103	81,680	3,735	74,184	11,599	186,115
2028	13,889	9,806	3,375	569	42	83	14	2,863	12,319	83,139	3,802	75,509	11,806	189,438
2029	14,137	9,981	3,435	580	42	85	14	2,914	12,539	84,623	3,870	76,857	12,017	192,820
2030	14,389	10,159	3,497	590	43	86	14	2,966	12,763	86,134	3,939	78,229	12,231	196,263
2031	14,646	10,340	3,559	600	44	88	15	3,019	12,990	87,672	4,009	79,626	12,450	199,767
2032	14,908	10,525	3,623	611	45	89	15	3,073	13,222	89,237	4,081	81,048	12,672	203,334
2033	15,174	10,713	3,687	622	46	91	15	3,128	13,458	90,831	4,154	82,495	12,898	206,964
2034	15,445	10,904	3,753	633	46	93	15	3,184	13,699	92,452	4,228	83,968	13,129	210,660
2035	15,721	11,099	3,820	645	47	94	16	3,241	13,943	94,103	4,303	85,467	13,363	214,421
2036	16,001	11,297	3,888	656	48	96	16	3,299	14,192	95,783	4,380	86,993	13,602	218,249
2037	16,287	11,499	3,958	668	49	98	16	3,358	14,446	97,494	4,459	88,546	13,845	222,146
2038	16,578	11,704	4,028	680	50	99	17	3,418	14,704	99,234	4,538	90,127	14,092	226,113
2039	16,874	11,913	4,100	692	51	101	17	3,479	14,966	101,006	4,619	91,737	14,343	230,150
2040	17,175	12,126	4,174	704	52	103	17	3,541	15,233	102,810	4,702	93,375	14,599	234,259
											Total ESALs			3,980,796
2040	17,175										% Veh in Design Lane			45%
25% Reduction in vol											Design ESALs			1,791,358

Silverbell South

% of TRAFFIC		70.6%	24.3%	4.1%	0.3%	0.6%	0.1%	YEARLY ESALs						Total ESALs
								0.0008	0.0100	0.4000	0.2500	2.4825	2.3289	
Year	ADT	Auto	LT	MT	Bus	TS	TT	Auto	LT	MT	Bus	TS	TT	
2010	15,600													
2015	16,536	11,674	4,018	678	50	99	17	3,409	14,666	98,982	4,527	89,898	14,056	225,537
2016	16,729	11,811	4,065	686	50	100	17	3,449	14,838	100,141	4,580	90,951	14,220	228,179
2017	16,925	11,949	4,113	694	51	102	17	3,489	15,012	101,315	4,633	92,017	14,387	230,853
2018	17,124	12,089	4,161	702	51	103	17	3,530	15,188	102,502	4,688	93,095	14,556	233,557
2019	17,324	12,231	4,210	710	52	104	17	3,571	15,366	103,702	4,742	94,185	14,726	236,294
2020	17,527	12,374	4,259	719	53	105	18	3,613	15,546	104,917	4,798	95,289	14,899	239,062
2021	17,732	12,519	4,309	727	53	106	18	3,656	15,728	106,147	4,854	96,405	15,073	241,863
2022	17,940	12,666	4,359	736	54	108	18	3,698	15,912	107,390	4,911	97,535	15,250	244,697
2023	18,150	12,814	4,411	744	54	109	18	3,742	16,099	108,648	4,969	98,678	15,429	247,563
2024	18,363	12,964	4,462	753	55	110	18	3,786	16,287	109,921	5,027	99,834	15,609	250,464
2025	18,578	13,116	4,515	762	56	111	19	3,830	16,478	111,209	5,086	101,003	15,792	253,398
2026	18,796	13,270	4,567	771	56	113	19	3,875	16,671	112,512	5,145	102,187	15,977	256,367
2027	19,016	13,425	4,621	780	57	114	19	3,920	16,866	113,830	5,206	103,384	16,164	259,371
2028	19,239	13,583	4,675	789	58	115	19	3,966	17,064	115,164	5,267	104,595	16,354	262,410
2029	19,464	13,742	4,730	798	58	117	19	4,013	17,264	116,513	5,328	105,821	16,545	265,484
2030	19,692	13,903	4,785	807	59	118	20	4,060	17,466	117,878	5,391	107,060	16,739	268,594
2031	19,923	14,066	4,841	817	60	120	20	4,107	17,671	119,259	5,454	108,315	16,935	271,741
2032	20,156	14,230	4,898	826	60	121	20	4,155	17,878	120,657	5,518	109,584	17,134	274,925
2033	20,393	14,397	4,955	836	61	122	20	4,204	18,087	122,070	5,582	110,868	17,334	278,146
2034	20,632	14,566	5,013	846	62	124	21	4,253	18,299	123,500	5,648	112,166	17,538	281,405
											Total ESALs			5,049,909
2040	22,125										**% Veh in Design Lane**			45%
											Design ESALs			2,272,459

25% Reduction in vol

Silverbell North	Original	Revised			
ESALS	2,180,000	1,791,358			
Calced Struct Number	3.31	2.91	Delta (%)	Original Cost	Revised Cost
ARAC (in)	2	2	0%	$ 1,232,420	$ 1,232,420
AC (in)	3.5	2.5	-29%	$ 1,540,550	$ 1,100,393
AB (in)	7	6.5	-7%	$ 786,975	$ 730,763
			TOTAL	$ 3,559,945	$ 3,063,575
			Savings		$ 496,370

Silverbell South	Original	Revised			
ESALS	3,000,000	2,272,459			
Calced Struct Number	3.50	3.04	Delta (%)	Original Cost	Revised Cost
ARAC (in)	2	2	0%	$ 1,390,900	$ 1,390,900
AC (in)	3.5	3	-14%	$ 1,738,650	$ 1,490,271
AB (in)	8	5.5	-31%	$ 1,015,075	$ 697,864
			TOTAL	$ 4,144,625	$ 3,579,035
			Savings		$ 565,590
			TOTAL SAVINGS		**$ 1,061,959**

VALUE ANALYSIS PROPOSAL NO. 01-025

SUMMARY PROPOSAL DESCRIPTION:

Replace asphaltic rubberized concrete (ARAC) with asphaltic concrete (AC).

Estimated potential savings:

Initial:	$ 450,000
Future:	$ 0,000
Total:	$ 450,000

Additional Description:

Related Value Analysis Proposals and/or Supplemental Recommendations:

EVALUATION
Idea Number: 01-025 Idea Description: Replace asphaltic rubberized concrete (ARAC) with asphaltic concrete (AC).
Advantages of alternative concept: 1. Less expensive. 2. Better product control during production. 3. Increased workability and ease of placement. 4. Increased opportunity to achieve compaction. 5. Terminal blend asphalt can be substituted as needed in designated noise reduction areas. 6. Increased durability in areas of turning and stop/starting
Advantages of original concept: 1. Use of 'green' technology. 2. May be quieter particularly during initial service life.
Risks of implementing alternative concept: 1. Terminal blend asphalt may be required in some areas.

Calculations and/or Discussion:

This proposal shows replacing all ARAC, but a section as addressed in the noise report indicates a need for the 3 dBA credit for a small portion of the roadway. For this section an AC with terminal blend asphalt could be utilized to achieve this. The cost for the terminal blend mix could be considered the same as ARAC; therefore, a reduction of $28/ton of terminal blend asphalt used would have to be subtracted from the savings.

In regard to life-cycle costs, at this time there is not sufficient data on cost of ARAC long-term maintenance. However, since its initial use several years ago, noticeable raveling has occurred in turning and stop/start areas requiring early patching.

A conservative replacement of 2" ARAC with 2.5" of AC is reflected in the estimate; it could be argued that an exact replacement is sufficient. Plus check with pavement calculations for any rounding up that may have been made. Based on a like for like replacement, savings would be $1,000,000.

Item	Quantity (tons)	Unit cost **	Amount	
ARAC Ph 1	19,870	$93.00	$1,847,910.00	
ARAC Ph 2	17,606	$93.00	$1,637,358.00	
Total ARAC	37,476		$3,485,268.00	
AC Ph 1 *	24,838	$65.00	$1,614,470.00	
AC Ph 2 *	22,008	$65.00	$1,430,520.00	
Total AC	46,846		$3,044,990.00	
Savings			$440,278.00	
*Includes additional 0.5" to match ARAC structural number				
**Unit price differs than estimate and was based on current prices				

VALUE ANALYSIS PROPOSAL NO. 01-001

SUMMARY PROPOSAL DESCRIPTION:

Make the transition pavement section at the north end of the first phase less robust.

Estimated potential savings:

Initial:	$ 116,000
Future:	$ 0,000
Total:	$ 116,000

Additional Description:

Related Value Analysis Proposals and/or Supplemental Recommendations:

EVALUATION
Idea Number: 01-001 Idea Description: Make the transition pavement section at the north end of the first phase less robust.
Advantages of alternative concept: 1. Thinner pavement will reduce costs
Advantages of original concept: 1. The pavement will not wear out during 20 year design life in the transition area.
Risks of implementing alternative concept: 1. The pavement will need to be replaced with the originally designed pavement structural section 1 if the north half does not get built soon enough.

Calculations and/or Discussion:

	station	width (ft)		
beginning point	138 + 34.96	40		
ending point	150 + 36.98	84		
	sq ft			
Area of pavement	74525.24			
	tons of ARAC	tons of AC	cu yd ABC	
weight of pavement	850.83	675.38	920.06	
cost per unit ($)	70	50	25	total saved
cost saved ($)	$59,558.09	$33,769.25	$23,001.62	$116,328.95

The total amount saved by reducing the pavement section from 2” ARAC on 3.5” AC on 8” ABC to 2” AC on 4” ABC is about $116,000.

This proposal is to change the design to reduce the pavement structural section 1 to a 2" AC on 4" ABC between sections 150 + 36.98 to 138 + 34.96 where the north half of the project will tie into the south half during the 4 RTA period.

VALUE ANALYSIS PROPOSAL NO. 01-056

SUMMARY PROPOSAL DESCRIPTION:

Institute a Programatic Agreement (PA) with the Army Corps of Engineers rather than a Memorandum of Agreement (MOA).

Estimated potential savings:

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

Additional Description:

Related Value Analysis Proposals and/or Supplemental Recommendations:

EVALUATION
Idea Number: 01-056 Idea Description: Institute a Programatic Agreement (PA) with the Army Corps of Engineers rather than a Memorandum of Agreement (MOA).
Advantages of alternative concept: 1. A PA will last for the life of the project needs where as the MOA will expire 2. The specific needs of the project will be addressed 3. Will provide for consistency and predictibility of the consultation process 4. Proposal will save time and potentially money 5. PA will establish agreed upon protocol and eliminate duplicated effort
Advantages of original concept: 1. Addresses consultation requirements
Risks of implementing alternative concept: 1. Initial coordination to develop agreement

Calculations and/or Discussion:

The PA will build flexibility into the project by addressing the specific needs of Silverbell Road as far as meeting federal requirements, constructability, and schedule needs. The actual value of this savings is difficult to estimate. The savings will come from reduced duplication of efforts. The project can complete one master treatment plan rather than multiple treatment plans along the way. The PA will allow the project to be constructed in phases and have the archaeology completed in phases as well. For example, there will be cost savings in producing one plan instead of four, so there is a potential cost savings of $30,000-$50,000 per report. So this could represent a potential savings of $150,000.

The PA can specify that there will be one lead one local agency and that the local lead will consult on behalf of the Corps. This will save time, potentially months. In addition the PA can specify that the shift from Phase I and Phase II fieldwork will occur as a result of a field consultation between the agencies which will result in months saved.

VALUE ANALYSIS PROPOSAL NO. 01-058

SUMMARY PROPOSAL DESCRIPTION:

Use the project landscape plans as the Clean Water Act Section 404 (404) mitigation proposal.

Estimated potential savings:

Initial:	$ 81,000
Future:	$ 0,000
Total:	$ 81,000

Additional Description:

Related Value Analysis Proposals and/or Supplemental Recommendations:

P01-016 - Reduce the landscape budget to 2% of construction budget and focus design on the medians.

EVALUATION
Idea Number: 01-058 Idea Description: Use the project landscape plans as the Clean Water Act Section 404 (404) mitigation proposal.
Advantages of alternative concept: 1. No additional mitigation needed 2. No additional costs to pay for off-site in-lieu fee
Advantages of original concept: 1. Landscaping must be installed with the project 2. Landscape must be maintained
Risks of implementing alternative concept: 1. Corps of Engineers may no longer be accepting on-site mitigation as they are trying to go to an in-lieu mitigation method

Calculations and/or Discussion:

The cost of the in-lieu is estimated at $15,000/acre of disturbance to Waters of the US. The disturbance to waters is unknown at this time, so the savings is unknown. We are also not sure if the Corps of Engineers will still allow on-site mitigation at the time the project goes to construction. The Corps of Engineers is working on a policy to not allow on-site mitigation due to the lack of preservation of the mitigation sites.

As currently designed, 5.4 acres are being disturbed which would result in approximately $81,000 in-lieu fees owed.

VALUE ANALYSIS PROPOSAL NO. 01-082

SUMMARY PROPOSAL DESCRIPTION:

Perform a combination value engineering/partnering session after the construction contractor's notice of award but prior to the construction contractor's notice to proceed.

Estimated potential savings:

Initial:	$ 2,300,000 to $4,600,000
Future:	$ 0,000
Total:	$ 2,300,000 to $4,600,000

Additional Description:

Related Value Analysis Proposals and/or Supplemental Recommendations:

EVALUATION
Idea Number: 01-082 Idea Description: Perform a combination value engineering/partnering session after the construction contractor's notice of award but prior to the construction contractor's notice to proceed.
Advantages of alternative concept: 1. Could save considerable capital expenditures 2. Establishes a rapport between the owner, designer, and contractor 3. Larger percentage of the savings goes to the owner than would through a value engineering proposal (VECP) 4. The savings will be proposed in time to be implemented for maximum savings
Advantages of original concept: 1. Simpler contract administration 2. Does not have the cost of an additional study
Risks of implementing alternative concept: 1. Possible bid protest if the contract is not structured properly

Calculations and/or Discussion:

This idea is to perform a combination value engineering/partnering session (session) with the owner, designer, and contractor in the short time period between the construction contractor's notice of award and notice to proceed. This allows the owner and contractor to negotiate contract, design, and material changes with a contract cost baseline established. This added negotiation process step will require special provisions in the construction and bid documents to implement.

The purpose of the session is to identify cost savings ideas the contractor has identified during his bid preparation, vette them with the owner and designer, and arrive at a mutually agreed-upon cost savings to be shared between the owner and contractor while keeping the designer's chain of liability intact. The cost savings will then be deducted from the contractor's bid price.

The session will also allow the contractor to offer changes to the design that could result in savings and share them with the owner if the designer agrees the changes will not detract from the design. If the designer disagrees with contractor's proposed changes it provides a non-adversarial forum to help the contractor understand why they won't work in the design.

Finally, the session provides a safe forum for all parties to discuss the upcoming challenges of the project and reach a common path forward like most partnering sessions.

This proposal has been previously made on prior Value Analysis efforts of the RTA, and should be considered for inclusion in the Standard Specifications for the region.

Critical elements include the following:

1. The special conditions of the construction contract have to require the contractor's participation in the session. The contractor should be required to supply at a minimum the following individuals for the session:
    a. A principal of the firm with the authority to change the bid price.
    b. The actual estimator that prepared the contractor's bid
    c. The project superintendent that will be assigned to the project
    d. The project engineer assigned to the project (if there is one).
    e. One key foreman – usually the person in charge of the most critical project element
2. The designer's contract should be modified to include their participation in the session. The designer can treat the contractor's proposals as requests for information to meet their formal documentation requirements. The designer should include at a minimum the following individuals:
    a. A principal of the firm
    b. The engineer(s) that stamped the plans (to keep the chain of liability intact)
    c. Key lead designers
3. The owner needs to supply the following individuals at a minimum:
    a. The individual authorized to sign the construction contract (usually someone from the jurisdiction's Attorney's office)
    b. The jurisdiction's project manager and their assistant
    c. Lead inspector(s) from the jurisdiction

On projects of this size (>$10,000,000), the sessions will last approximately five days. Cost for the contractor's time will be included in his or her bid. The jurisdiction's cost is that usually allocated for a partnering session. The designer's extra cost for participating should be around $50,000.

Past savings have varied greatly but could conservatively be expected in the 5 to 10 percent range. Therefore, savings on this project's construction cost of $46,000,000 could be expected to range between $2,300,000 and $4,600,000. (The designer's cost is assumed to be negligible as a percentage of the savings.)

VALUE ANALYSIS PROPOSAL NO. 01-080

SUMMARY PROPOSAL DESCRIPTION:

Perform a constructabiltiy review at approximately 60% design.

Estimated potential savings:

Initial:	$ 70,000 to $210,000
Future:	$ 0,000
Total:	$ 70,000 to $210,000

Additional Description:

Related Value Analysis Proposals and/or Supplemental Recommendations:

EVALUATION
Idea Number: 01-080 Idea Description: Perform a constructabiltiy review at approximately 60% design.
Advantages of alternative concept: 1. Obtain input from an experienced contractor 2. Could reduce contract cost as much as 1.25% of estimated cost 3. Early identification of risk 4. Eliminate guess work when bidding project
Advantages of original concept: 1. None noted
Risks of implementing alternative concept: 1. Additional cost to project 2. Contractor performing reviews will be precluded from bidding job to avoid conflict of interest 3. May have additional design costs associated with the constructability reviews

Calculations and/or Discussion:

Contractors learn over time more efficient ways to construct various project elements. An experienced contractor (maybe retired) can provide insight into more efficient, less costly construction methods.

At 60% design completion, a constructability review can be held on the project site. This effort could be combined with a Value Analysis study. This entails walking the site with the plans. A shorter review could be held at 90% completion. A reasonably detailed review can be conducted for 0.5% of the estimated project cost. These reviews typically save 0.75% to 1.25% in change orders and improve construction efficiency and reduce risk to the owner. (Note: These numbers are based on past experience in Arizona).

Each of the following components represents a significant potential cost or time factor in a project that should be addressed before the beginning of construction. As RTA contemplates their next project it will be beneficial to consider each of the planning and development tasks listed below and determine who on the team is responsible for accomplishing them.

- Review Property Title Report Documents
- Review environmental clearance documents for mitigation items to be incorporated into the project Special Provisions
- Review 404 Permit
- Review Final Design Concept Report
- Review Storm Water Pollution Preventative Plan
- Review Soils Report and Recommendations
- Review Off-Site Utilities and Accessibility
- Review Drainage analysis and design
- Review of traffic control plan
- Review the Owner's Plan Check Comments

VALUE ANALYSIS PROPOSAL NO. 01-016

SUMMARY PROPOSAL DESCRIPTION:

Reduce the landscape budget to 2% of construction budget and focus design on the medians.

Estimated potential savings:

Initial:	$ 1,800,000
Future:	$ 0,000
Total:	$ 1,800,000

Additional Description:

Related Value Analysis Proposals and/or Supplemental Recommendations:

SR01-068 - Provide median landscaping that does not require irrigation.
P01-058 - Use the project landscape plans as the Clean Water Act Section 404 (404) mitigation proposal.

EVALUATION
Idea Number: 01-016 Idea Description: Reduce the landscape budget to 2% of construction budget and focus design on the medians.
Advantages of alternative concept: 1. Reduces capital cost and maintenance costs 2. Allows roadsides to revegetate naturally
Advantages of original concept: 1. Reduces the timeline to revegetate impacted areas 2. Provides mitigation for visual and construction impacts
Risks of implementing alternative concept: 1. Extended time period to mitigate impacted areas, some areas may not revegetate to original conditions 2. Possible erosion problems may develop on slopes 3. Community backlash for not mitigating the impacted area. The community has expressed very strong opinions about the use of native plants to landscape the corridor in order to mitigate the roadway impacts. 4. Must still meet stormwater regulations.

Calculations and/or Discussion:

Original landscape budget was created based on a per mile cost of recently bid projects of a similar character, worked out to be about 6% of construction cost. The RTA maximum for landscape is 4% per Board policy.

	Original Landscape Budget	Constrcution Cost	Original %	2% Budget	Savings
South	$ 1,500,000	$ 23,313,568	6.4%	$ 466,271	$1,033,729
North	$ 1,200,000	$ 22,883,832	5.2%	$ 457,677	$ 742,323
Total	$ 2,700,000	$ 46,197,400	5.8%	$ 923,948	$1,776,052

Because of limited development along the roadway, roadside landscaping is recommended to be reduced to the minimum amount needed to stabilize the disturbed areas. Irrigation of roadside areas could be eliminated and median landscaping could be reduced and implemented with indigenous plant materials, at densities matching that in the area.

VALUE ANALYSIS PROPOSAL NO. 01-018

SUMMARY PROPOSAL DESCRIPTION:

Replace retaining walls with slopes where feasible.

Estimated potential savings:

Initial:	$ 1,000,000 to $2,000,000
Future:	$ 0,000
Total:	$ 1,000,000 to $2,000,000

Additional Description:

Related Value Analysis Proposals and/or Supplemental Recommendations:

SR06-001 - Use a performance specification to complete different retaining wall systems against each other during bidding.

EVALUATION
Idea Number: 01-018 Idea Description: Replace retaining walls with slopes where feasible.
Advantages of alternative concept: 1. Constructing a 4:1 landscaped cut slope is more cost effective than constructing retaining walls (soil nail) 2. Constructing 4:1 cut slopes will generate more material for fill, thus reducing borrow needs. 3. Once revegetated, a cut slope will appear more natural and fit the existing surrounding topography.
Advantages of original concept: 1. Retaining walls (soil nail) will reduce right of way takes of private property, unless the proposed alternative is limited to areas where public right of way is available.
Risks of implementing alternative concept: 1. Revegetation of cut slopes will take time to mature and successful revegetation may be risky, particularly if the slopes are not irrigated for establishment 2. Cut slopes can encroach into private property and may impact existing housing structures at some locations.

Calculations and/or Discussion:

See attached analysis memo on following pages.

Replacing all retaining walls with 3:1 or flatter landscaped cut slopes may result in up to $2 M in savings, including cost to purchase new right of way from private property owners.

Replacing all retaining walls with 3:1 or flatter landscaped cut slopes only where public property is impacted will result in up to $1 M in savings. No private right-of-way would be needed for slopes in this alternative.

MEMO

Introduction

The impacts of utilizing cut slope retaining walls versus recoverable cut slopes were evaluated as part of the alternatives assessment for the Silverbell Road Design Concept Study. The purpose of the evaluation was to look objectively and quantifiably at the two options from an environmental, fiscal, and social perspective in order to provide a recommendation that best serves the interests of the various project stakeholders, including the public.

Methodology

Background

As horizontal and vertical alignment alternatives were evaluated, cut slope and wall locations were identified through the use of InRoads 3-D roadway modeling software. The general roadway modeling template used for Silverbell Road utilized a 4:1 cut slope within the clear zone, to provide a recoverable slope expected to be successfully revegetated. Outside the clear zone, a 3:1 cut slope was modeled to reduce the horizontal distance required to tie in to existing ground. A representative typical section is included for reference as Attachment A.

Potential retaining wall locations were also identified through the initial roadway modeling. The assumption made in determining locations of retaining walls was that a retaining wall would be required at any location where the 3:1 cut slope cannot tie in to existing ground within 6 feet horizontally of the clear zone. This translates into a total horizontal distance of 20 feet from the roadway edge before a retaining wall is required. These assumptions were meant to balance the right-of-way and excavation needs of the project with the costs and visual impacts associated with building retaining walls. Retaining walls were assumed (and modeled accordingly) to be located outside the clear zone, with a 2% sloped buffer area extending to the toe of wall, in order to eliminate the need for guardrail at wall locations.

The initial modeling effort outlined above was the starting point for the alternative evaluation contained in this memorandum.

Alternatives

After potential retaining wall locations were identified through the initial roadway modeling effort, an inventory was taken of each retaining wall location, including:

Location;

Length;

Maximum height of wall;

Surface area of wall face;

Adjacent land use (public or private); and

Net earthwork quantities of the roadway through the length of the wall section when modeled as a retaining wall.

Additional roadway modeling was then undertaken to determine the relative impacts associated with 4:1 cut slopes at each of the retaining wall locations. A cut slope of 4:1 was used because it is the maximum slope which can be successfully replanted and landscaped without significant irrigation, which would help to reduce the visual impacts of the project in these larger cut areas. Once modeled, an inventory was taken of the locations, including:

Additional right-of-way area required (if any) with 4:1 cut compared to retaining wall; and

Net earthwork quantities of the roadway through the length of the section when modeled as a 4:1 cut slope.

The information outlined above was summarized in a spreadsheet (Attachment A), with the comparison of impacts provided below.

Comparison of Impacts

Table 1 below summarizes the results of the roadway modeling for the alternatives evaluation of retaining walls versus cut slopes for each location identified for a potential retaining wall.

Retaining Wall and 4:1 Cut Slope Impacts

Wall Number	Begin Sta.	End Sta.	Offset	Wall Length (ft)	Max. Wall Height (ft)	Wall Face Area (sq. ft.)	Adjacent ROW Private/Public	4:1 Cut Additional ROW Required (sq. ft.)	4:1 Cut Additional Earthwork (Cut) (cu. yd.)
1	474+10.00	475+20.00	RIGHT	110	13.6	9748	PRIVATE	1602	746
2	470+40.00	474+00.00	RIGHT	360	12.8	2569	PRIVATE	7235	1295
3	459+60.00	462+80.00	RIGHT	320	19.2	4084	PRIVATE	14986	3831
4	431+60.00	433+20.00	RIGHT	160	7.2	870	PUBLIC - COT	615	1050
5	430+70.00	431+60.00	RIGHT	90	7.8	606	PUBLIC - COT	0	215
6	426+00.00	428+30.00	RIGHT	230	13.6	2392	PUBLIC - COT	7964	3032
7	380+20.00	381+70.00	RIGHT	150	15.7	1577	PUBLIC - COT	6905	1739
8	420+90.00	423+10.00	RIGHT	220	10.6	1507	PUBLIC - COT	15509	5123
9	418+50.00	420+30.00	RIGHT	180	14.3	1849	PUBLIC - COT	10677	4412
11	411+70.00	413+20.00	RIGHT	150	12.0	1128	PRIVATE	3567	1191
13	403+50.00	404+40.00	RIGHT	90	11.0	689	PUBLIC - COT	1705	531
14	389+40.00	390+70.00	RIGHT	130	14.4	1262	PUBLIC - COT	5083	1572
15	384+80.00	385+80.00	RIGHT	100	15.0	1020	PUBLIC - COT	2744	626
16	382+90.00	384+10.00	RIGHT	120	16.4	1267	PUBLIC - COT	4884	943
17	230+60.00	231+80.00	RIGHT	120	9.2	678	PRIVATE	2589	394.3
18	227+00.00	229+30.00	RIGHT	230	6.4	1077	PRIVATE	7844	544.0
19	219+00.00	221+50.00	RIGHT	250	5.7	1023	PRIVATE	75555	2426.9
20	199+30.00	202+50.00	RIGHT	320	12.0	2557	PRIVATE	4852	1897.5
21	134+40.00	137+40.00	RIGHT	300	10.2	2043	PRIVATE	134645	9773.3
22	129+70.00	131+10.00	RIGHT	140	4.4	530	PRIVATE	1397`	68.9
23	119+70.00	121+60.00	RIGHT	190	5.6	821	PRIVATE	4551	334.6
24	117+90.00	118+40.00	RIGHT	50	4.0	156	PRIVATE	183	23.4
25	114+80.00	115+80.00	RIGHT	100	6.3	492	PRIVATE	981	204.5
					Total	**39,945**		**316,075**	**41,973**

Right-of-Way

Table 1 above shows that utilizing 4:1 cut slopes instead of retaining walls will result in approximately 316,000 square feet of additional right-of-way need for the project. Utilizing slopes instead of retaining walls would result in the need for full property acquisitions in

two locations. Table 2 below summarizes the additional property impacts of using a 4:1 cut slope at each potential wall location, including the associated cost.

Right-of-Way Costs – 4:1 Slope vs. Retaining Wall

Wall Number	Begin Sta.	End Sta.	Adjacent ROW Private/Public	Property Type	4:1 Cut Additional ROW Required (sq. ft.)	Unit Cost[1] ($/sq. ft.)	4:1 Cut Additional ROW Cost
1	474+10.00	475+20.00	Private	Residential	1602	$3.00	$4,806.00
2	470+40.00	474+00.00	Private	Residential	7235	$3.00	$21,705.00
3	459+60.00	462+80.00	Private	Residential	14986	$3.00	$44,958.00
4	431+60.00	433+20.00	Public - COT	Open Space	615	$0.00	$0.00
5	430+70.00	431+60.00	Public - COT	Open Space	0	$0.00	$0.00
6	426+00.00	428+30.00	Public - COT	Open Space	7964	$0.00	$0.00
7	380+20.00	381+70.00	Public - COT	Open Space	6905	$0.00	$0.00
8	420+90.00	423+10.00	Public - COT	Open Space	15509	$0.00	$0.00
9	418+50.00	420+30.00	Public - COT	Open Space	10677	$0.00	$0.00
11	411+70.00	413+20.00	Private	Residential	3567	$3.00	$10,701.00
13	403+50.00	404+40.00	Public - COT	Open Space	1705	$0.00	$0.00
14	389+40.00	390+70.00	Public - COT	Open Space	5083	$0.00	$0.00
15	384+80.00	385+80.00	Public - COT	Open Space	2744	$0.00	$0.00
16	382+90.00	384+10.00	Public - COT	Open Space	4884	$0.00	$0.00
17	230+60.00	231+80.00	Private	Residential	2589	$3.00	$7,767.00
18	227+00.00	229+30.00	Private	Residential	7844	$3.00	$23,532.00
19	219+00.00	221+50.00	Private	Residential-Full Take	75555	$3.00	$226,665.00
20	199+30.00	202+50.00	Private	Residential	4852	$3.00	$14,556.00
21	134+40.00	137+40.00	Private	Residential-Full take	134645	$3.00	$403,935.00
22	129+70.00	131+10.00	Private	Residential	1397	$3.00	$4,191.00
23	119+70.00	121+60.00	Private	Residential	4551	$3.00	$13,653.00
24	117+90.00	118+40.00	Private	Residential	183	$3.00	$549.00
25	114+80.00	115+80.00	Private	Residential	981	$3.00	$2,943.00
				Total	**316,075 Sq. Ft.**		**$779,961.00**

1. Assumed same ROW costs as 30% project cost estimate. Assumed all right-of-way purchase, no slope easements.

Of the total 316,000 square feet of additional right-of-way needs for 4:1 cut slopes compared to retaining walls, approximately 260,000 square feet are private property, and approximately 56,100 square feet are public property. Many of the affected parcels in the south portion of the project (El Camino Del Cerro to Grant Road) are owned by the City of Tucson, in which case the utilization of 4:1 cut slopes would likely be more cost effective

with no right-of-way costs combined with the higher cost of constructing a retaining wall. In areas where the 4:1 slopes would encroach on privately owned property, such as the north portion of the project from Ina Road to El Camino Del Cerro, the additional right-of-way would need to be purchased in the form of an outright right-of-way acquisition, or a slope easement. Table 2 assumes that the right-of-way would be acquired from the property owners (as opposed to easements) since the areas are relatively large.

Cost

The costs associated with the two alternatives being evaluated have been summarized relative to each other in Table 3 below. Units and unit prices are consistent with the 30% cost estimate for the Silverbell Road project.

Alternative Cost Comparison – 4:1 Slope vs. Retaining Wall

Item	Unit	Quantity	Unit Price	Total Cost	
				4:1 Slope	Retaining Wall
Roadway Excavation	Cu. Yd.	41,973	$7.00	$293,811.00	
Borrow	Cu. Yd.	-37776 [1]	$14.00	-$528,860.00	
Soil Nailing (Cut Walls)	Sq. Ft.	39,945	$45.00		$1,797,525.00
Soil Nailing, Architectural Face	Sq. Ft	39,945	$30.00		$1,198,350.00
Soil Nailing, Drainage Swale	L. Ft.	4,110	$15.00		$61,650.00
Landscaping	Sq. Ft.	188,671	$0.20	$37,734.00	
Irrigation	Acre	4.33	$90,000.00 [2]	$389,816.00	
Right-of-Way (Private)	Sq. Ft.	259,987	$3.00	$779,961.00	
Right-of-Way (Public)	Sq. Ft.	56,086	$0.00	$0.00	
Net Costs				**$972,462.00**	**$3,057,525.00**
Delta Cost (Retaining Walls)					**$2,085,062.00**

1. Additional excavation amount assumed to be used as fill on the project. Assumed 10% shrink from roadway excavation quantity for borrow quantity.
2. Irrigation cost assumed to be $2,500/mo/acre. Irrigation needed for average of 3 years. Total = $90,000/acre

Table 3 shows that retaining walls have an overall higher project construction cost relative to utilizing 4:1 cut slopes at the same locations, with a cost differential of approximately $2.5 million through the length of the project.

Because there will be no right-of-way cost associated with encroaching on most City-owned properties, utilizing cut slopes instead of retaining walls in the locations where

walls have been identified adjacent to public property will be more economically feasible in almost all cases. Table 4 below compares the use of 4:1 cut slopes versus retaining walls at locations adjacent to City-owned property.

Alternative Cost Comparison – 4:1 Slope vs. Retaining Wall at Public Properties

Item	Unit	Quantity	Unit Price	Total Cost	
				4:1 Slope	Retaining Wall
Roadway Excavation	Cu. Yd.	19,243	$7.00	$134,699.00	
Borrow	Cu. Yd.	-17,318 [1]	$14.00	-$242,458.00	
Soil Nailing (Cut Walls)	Sq. Ft.	39,945	$45.00		$586,755.00
Soil Nailing, Architectural Face	Sq. Ft	39,945	$30.00		$391,170.00
Soil Nailing, Drainage Swale	L. Ft.	4,110	$15.00		$22,050.00
Landscaping	Sq. Ft.	84,905	$0.20	$16,981.00	
Irrigation	Acre	1.95	$90,000.00 [2]	$175,426.00	
Right-of-Way (Public)	Sq. Ft.	56,086	$0.00	$0.00	
			Net Costs	**$84,648.00**	**$999,975.00**
			Delta Cost (Retaining Walls)		**$915,327.00**

1. Additional excavation amount assumed to be used as fill on the project. Assumed 10% shrink from roadway excavation quantity for borrow quantity.

2. Irrigation cost assumed to be $2,500/mo/acre. Irrigation needed for average of 3 years. Total = $90,000/acre

Visual Impacts

Feedback was solicited from the Silverbell Road Task Force (SRTF) regarding the use of recoverable cut slopes versus retaining walls. The general consensus of the SRTF was to limit retaining walls to areas where they are required in order to limit right-of-way purchases, or excessively large cut slope areas. To this end, it was preferred that retaining walls be used in any location identified above that would require right-of-way purchase from a private property. Thus, the preference is that 4:1 cut slopes only be used at locations adjacent to publicly owned land.

Another concern of the SRTF was to limit the impact area of cut slopes in order to reduce the impacts to native landscape, topography, vegetation, and the scenic nature of the corridor. Any cut slope would require landscaping and irrigation to re-establish vegetation over a period of time after construction. In order to reduce the sizes of cut slope areas, the SRTF recommended option of limiting the horizontal length of cut (perpendicular to

roadway centerline) to 50 feet outside the roadway, and utilizing a shorter retaining wall adjacent to the roadway to recover the remaining vertical distance required.

Conclusions

Through the alternatives evaluation process outlined above, and through input by the City of Tucson, Pima County, Town of Marana, SRTF and other stakeholders, the following conclusions were made with regard to utilizing cut slopes versus retaining walls for the Silverbell Road project:

- No single option fits all cases along the corridor. Both cut slopes and retaining walls will be needed on a case-by-case basis.
- In general, cut slopes are more cost-effective than retaining walls and should be used where impacts to right-of-way, native vegetation, and aesthetics are minimized. This goal results in the following:
    - Utilize retaining walls in locations where right-of-way impacts would be significant with the use of cut slopes.
    - Consider cut slopes in locations where the right-of-way encroachment would be on publicly owned land.
- Where the horizontal length (perpendicular to the roadway) of the cut slope is significant, limit the length of cut to 50 feet horizontally (perpendicular to roadway), and provide a short retaining wall at the clear zone to account for the remaining vertical cut.

VALUE ANALYSIS PROPOSAL NO. 01-096

SUMMARY PROPOSAL DESCRIPTION:

Contract/bid the entire south half of the corridor as one project.

Estimated potential savings:

Initial:	$ 240,000
Future:	$ 0,000
Total:	$ 240,000

Additional Description:

Related Value Analysis Proposals and/or Supplemental Recommendations:

EVALUATION
Idea Number: 01-096 Idea Description: Contract/bid the entire south half of the corridor as one project.
Advantages of alternative concept: 1. May be able to take advantage of lower prices due to current economic conditions. 2. Reduced mobilization costs. 3. Economies of scale for material purchases. 4. Better production rates in the field. 5. Utility relocations would be more efficient. 6. More opportunities for staging, stockpiling and material balancing. 7. Duration of construction and overall inconvenience to the travelling public would be reduced. 8. May be opportunities for closer coordination and sequencing of roadway work, utility relocation work and archeology work. 9. Less rework/throw-away work at interfaces between project segments.
Advantages of original concept: 1. Work might be able to be spread around to 3 contractors.
Risks of implementing alternative concept: 1. Project may attract and be awarded to an out of town contractor.

Calculations and/or Discussion:

By consolidating what is anticipated to be 3 - 1+ mile projects into 1 - 3.5 mile project, you could potentially achieve cost savings related to the above listed advantages.

However, with the exception of the elimination of the two transitions (valued at a potential savings of $120,000 each – see P01-001 calculations), it is difficult to quantify the savings associated with the other above-mentioned advantageous alternate items.

VALUE ANALYSIS PROPOSAL NO. 01-029

SUMMARY PROPOSAL DESCRIPTION:

Construct major intersections early and on an accelerated schedule.

Estimated potential savings:

Initial:	$ 47,250
Future:	$ 0,000
Total:	$ 47,250

Additional Description:

Related Value Analysis Proposals and/or Supplemental Recommendations:

EVALUATION
Idea Number: 01-029 Idea Description: Construct major intersections early and on an accelerated schedule.
Advantages of alternative concept: 1. Minimizes inconvenience(time) to the traveling public. 2. Maximizes contractor's operation in a shorter period of time. 3. Reduces contractor's overhead 4. Reduces traffic control costs
Advantages of original concept: 1. None noted.
Risks of implementing alternative concept: 1. None noted.

Calculations and/or Discussion:

Grant and Goret intersections will have to be sequenced with the actual construction of the roadway. This will require more time. Camino del Cerro should be constructed along with Silverbell Road to the north to Station 138+34.96 and both legs of Camino del Cerro east and west.

The contractor will find benefit in an accelerated schedule which would be reflected in their bid, which would include mobilization, overheads, and traffic control. This is hard to quantify without actually pricing the project.

Intersections		Camino Del Cerro	Sweetwater	Goret	Grant
Original Days		90	60	120	120
Accelerated Days		45	30	90	90
Days Reduced		45	30	30	30
Traffic Control		Qty	Cost/Day		Total
Barricades		200	$ 1.00		$ 200.00
Message Bds		2	$ 10.00		$ 20.00
Arrow Bds		4	$ 5.00		$ 20.00
Labor		2	$ 55.00		$ 110.00
					$ 350.00
Total		135	$ 350.00		$47,250.00

VALUE ANALYSIS PROPOSAL NO. 01-014

SUMMARY PROPOSAL DESCRIPTION:

Design construction phasing to provide for two-phase construction (east side phase one) with adequate detours to insure this phasing.

Estimated potential savings:

Initial:	$ Not Quantified
Future:	$ Not Quantified
Total:	$ Not Quantified

Additional Description:

This is a constructability issue with potentially large cost savings.

Related Value Analysis Proposals and/or Supplemental Recommendations:

EVALUATION
Idea Number: 01-014 Idea Description: Design construction phasing to provide for two-phase construction (east side phase one) with adequate detours to insure this phasing.
Advantages of alternative concept: 1. Allows more efficient construction of drainage, embankment, curb & gutter and paving. 2. More than two phases reduces efficiency thus driving costs up along with time of construction. 3. Easier for vehicular traffic with reduced traffic control costs.
Advantages of original concept: 1. None noted.
Risks of implementing alternative concept: 1. None noted.

Calculations and/or Discussion:

It is imperative that existing traffic be accommodated while the NB lanes of Silverbell are being constructed. The first phase of construction should allow for the NB median curb to be constructed along with the AC paving prior to a traffic switch.

In areas where this is not feasible, detours or temporary A,C. widenings should be addressed. Three phase construction will increase costs for all items of work in the affected areas, along with time driven costs as the schedule will be extended.

Short of fully pricing two-phase construction and three-phase construction, it is very difficult to place a dollar value on the savings; however, it is expected that the amount would be substantial not to mention it would reduce, if not eliminate, the potential for disputes and claims.

Three-phase related work items could be expected to result in a 30% increase in costs.

VALUE ANALYSIS PROPOSAL NO. 01-040

SUMMARY PROPOSAL DESCRIPTION:

Close Silverbell Road at Idle Hour Wash to construct 5-12x10 and 2-12x8 boxes in one phase.

Estimated potential savings:

Initial:	$ 125,000
Future:	$ 0,000
Total:	$ 125,000

Additional Description:

Related Value Analysis Proposals and/or Supplemental Recommendations:

P01-014 – Design construction phasing to provide for two-phase consturction (east side Phase 1) with adequate detours to insure this phasing.

EVALUATION
Idea Number: 01-040 Idea Description: Close Silverbell Road at Idle Hour Wash to construct 5-12x10 and 2-12x8 boxes in one phase.
Advantages of alternative concept: 1. Schedule is shortened 2. Improved safety for workers 3. Reduced traffic control costs
Advantages of original concept: 1. Maintains roadway open during construction
Risks of implementing alternative concept: 1. Complaints from residents and emergency service providers

Calculations and/or Discussion:

The project plans show two very large culverts at Idle Hour wash, a 5-cell 12'x10' box, and a 2-cell 12'x8' box. Normally those structures would be constructed in two or more phases to keep the roadway open to traffic. However, that strategy increases labor and traffic control costs, and lengthens the schedule.

This large wash (Q100=5500 cfs) is located approximately 1 mile north of Sunset Road and 2 miles south of Ina Road. If the proposed Sunset interchange is constructed prior to construction of this segment of Silverbell Road (as is currently anticipated), residents on the north and south of the wash would have convenient access to I-10. (See map on next page.)

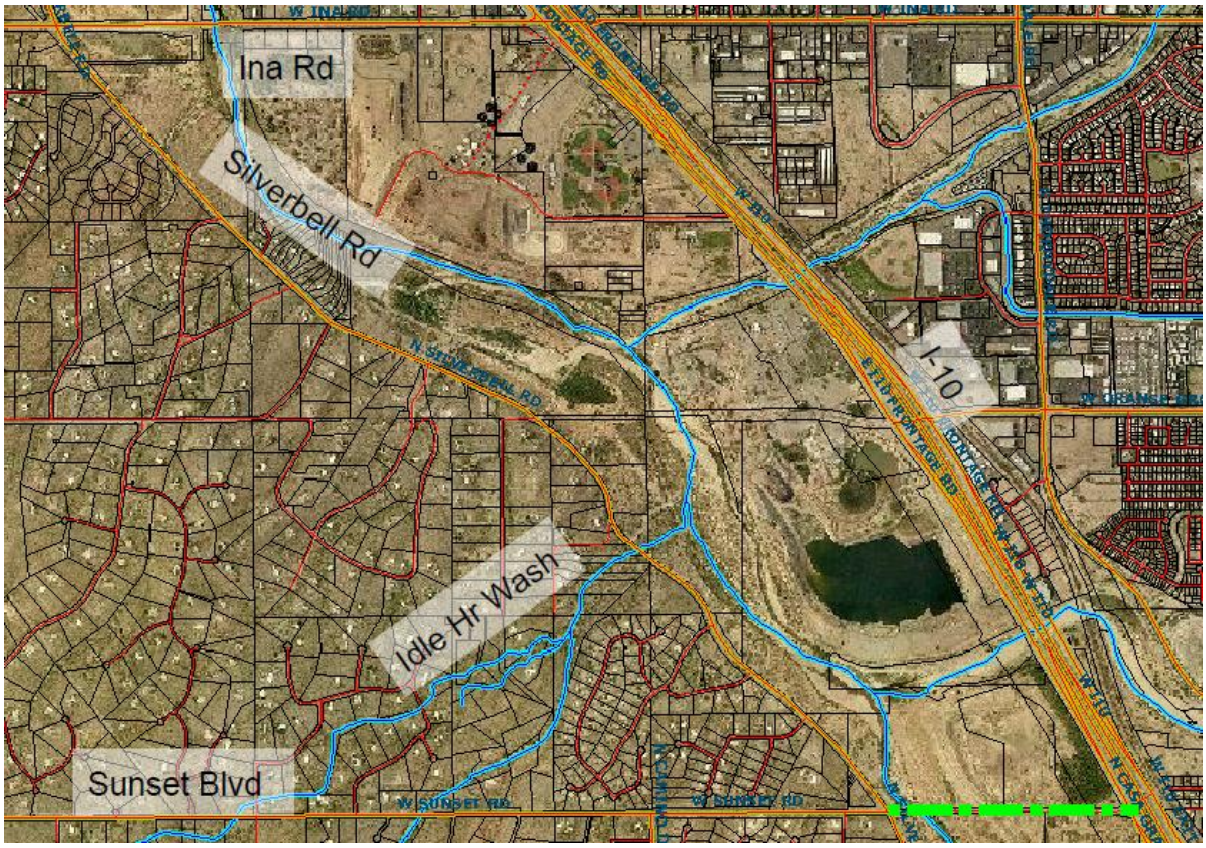
Anticipated savings from this proposal are as follows:

Structure	Cost	Total Labor (50%)	Savings in Labor (25%)
5-12x10	$ 668,000	334,000	$ 83,500.00
2-12x8	$ 241,500	120,750	$ 30,187.50

Traffic Control Savings (Est)	$ 10,000.0
TOTAL SAVINGS	**$ 123,687.50**

Another alternative would be to provide a paved detour around the construction of the culvert, which would still provide the labor savings. The cost of the detour (width = 24') would be approximately $17/lf x 500 ft = $8,500. Resulting savings would still exceed $100,000.

Area Map



VALUE ANALYSIS PROPOSAL NO. 01-091

SUMMARY PROPOSAL DESCRIPTION:

Utilize a v-ditch with berm rather than silt fence or waddles for stormwater controls.

Estimated potential savings:

Initial:	$ 110,000
Future:	$ 0,000
Total:	$ 110,000

Additional Description:

Related Value Analysis Proposals and/or Supplemental Recommendations:

EVALUATION
Idea Number: 01-091 Idea Description: Utilize a v-ditch with berm rather than silt fence or waddles for stormwater controls.
Advantages of alternative concept: 1. Cost savings 2. Faster implementation
Advantages of original concept: 1. V-ditch can not be used in all locations so other stormwarer controls will still be necessary
Risks of implementing alternative concept: 1. None noted

Calculations and/or Discussion:

The below estimate assumes that the v-ditch will run the length of the entire project. The estimate also assumes that the plans would call for silt fence as the stormwater control.

Type of Stormwater Control	Linear feet of Project	Estimated cost per linear foot	Total Cost for Project
Silt Fence	40128	$4.50	$180,576.00
9" waddles	40128	$3.50	$140,448.00
v-ditch with berm	40128	$1.75	$70,224.00

$180,576 - $70,224 = $110,352 cost savings from silt fence to v-ditch with berm.

SECTION 4 - SUPPLEMENTAL RECOMMENDATIONS

The following ideas were generated by the VA 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 VA Team suggests that these recommendations be carefully reviewed and given as much thought and effort as the formal VA Proposals.

SUPPLEMENTAL RECOMMENDATIONS SUMMARY TABLE

PROPOSAL NO.	VE PROPOSAL DESCRIPTION	REVIEW BOARD COMMENTS	PAGE NO.
Funding			
SR01-022	Seek opportunities to utilize Water Resources Development Act (WRDA) funding.	**Accept.**	4-3
SR01-053	Pursue alternative funding sources from adjacent future projects.	**Accept.**	4-5
SR01-112	Pursue alternative funding sources for various project elements such as bike facilities, multi-use path, trails, and wildlife enhancements.	**Accept with Modifications.** For trails and wildlife crossings.	4-7
Archaeology			
SR01-070	Develop a special provision for compaction after archaeological excavations during construction.	**Accept.**	4-9
SR01-057	Select one local lead agency to facilitate cultural resources consultation with the Corps of Engineers and the State Historic Preservation Office (SHPO).	**Accept.**	4-11
SR01-073	Include provision for the contractor to do any required archaeological scraping during construction.	**Accept.**	4-13
Wildlife			
SR01-061	Priortize the implementation of wildlife crossing structures based on adjacent features.	**Accept.**	4-15
SR01-100	Eliminate upsizing of culverts to accommodate wildlife.	**Decline.**	4-18
Flood Control			
SR01-049	Provide erosion protection to prevent impending erosion of Silverbell Road near Sunset Road from Santa Cruz River migration.	**Accept.**	4-20
SR01-005	Lower the 100-year water surface elevation of Santa Cruz River.	**Accept with Modifications.** Work with RFCD on mutually-beneficial opportunities.	4-23
Construction/Miscellaneous			
SR01-075	Use a joint trench for utilities.	**Accept with Modifications.** Explore.	4-25
SR01-068	Provide median landscaping that does not require irrigation.	**Accept.**	4-27
SR01-054	Identify potential water sources for the project in the Special Provisions.	**Accept.**	4-29
SR01-077	Have Pima County perform materials testing.	**Decline.**	4-31

PROPOSAL NO.	VE PROPOSAL DESCRIPTION	REVIEW BOARD COMMENTS	PAGE NO.
SR06-001	Use a performance specification to compete different retaining wall systems against each other during bidding.	**Accept with Modifications.** Explore.	4-33

SUPPLEMENTAL RECOMMENDATION NO. 01-022

SUMMARY RECOMMENDATION DESCRIPTION:

Seek opportunities to utilize Water Resources Development Act (WRDA) funding.

Additional Description:

Related Value Analysis Proposals and/or Supplemental Recommendations:

SR01-053 - Pursue alternative funding sources from adjacent future projects.

EVALUATION
Idea Number: 01-022 Idea Description: Seek opportunities to utilize Water Resources Development Act (WRDA) funding.
Advantages of alternative concept: 1. Utilized potential federal funding for elements of the project that may be consistent with the Tres Rios del Norte Feasibility Study
Advantages of original concept: 1. None noted.
Risks of implementing alternative concept: 1. Funding may not be available as WRDA is a federal allocation

DISCUSSION AND/OR CALCULATIONS:

There is an adjacent project to this project called the Tres Rios del Norte Project. There may be certain elements of this project that the Silverbell Road project may benefit from. The funding is federal, but the project is already federalized due to the impacts to Waters of the United States.

The Tres Rios del Norte project includes scrub shrub and mesquite vegetative cover over lands east of the roadway. Silverbell Road is the western limit of the project, but there may be some opportunities for landscaping in the form of restoration along the roadway. This funding could not be used if the landscaping was used as the Clean Water Act Section 404 permit mitigation for impacts to waters of the United States. Since the Tres Rios del Norte project funding is federal, then it could not be used to pay for the required mitigation for the federal Section 404 permit. In other words, federal funding cannot pay for federal requirements.

SUPPLEMENTAL RECOMMENDATION NO. 01-053

SUMMARY RECOMMENDATION DESCRIPTION:

Pursue alternative funding sources from adjacent future projects.

Additional Description:

Related Value Analysis Proposals and/or Supplemental Recommendations:

SR01-022 - Seek opportunities to utilize Water Resources Development Act (WRDA) funding.

EVALUATION
Idea Number: 01-053 Idea Description: Pursue alternative funding sources from adjacent future projects.
Advantages of alternative concept: 1. May apply to Phase 2 2. Cost savings 3. Bank stabilzation may protect road project 4. Change in floodplain limits may reduce profile requirements
Advantages of original concept: 1. Stand alone project easier to schedule and construct
Risks of implementing alternative concept: 1. None noted.

DISCUSSION AND/OR CALCULATIONS:

A significant Santa Cruz River project is being proposed for the next County Bond election. The El Corazon de Tres Rios del Norte project will consist of bank stabilization north of the Rillito River confluence and recreation amenities between Sweetwater Drive and Ina Road. This project will be completed over a twenty to thirty year time frame using several funding sources. The Water Resource Development Act (WRDA) funds will be applied for from the Corps of Engineers. Additional local funding is anticipated from the bond election as well as the Regional Flood Control District CIP program.

Recreational facilities such as multi-use paths and linear parks, as well as river restoration, may utilize such improvements for Phase Two of the Silverbell RTA project. 404 permit mitigation should be proposed within the El Corazon project limits to reduce Silverbell Road costs.

SUPPLEMENTAL RECOMMENDATION NO. 01-112

SUMMARY RECOMMENDATION DESCRIPTION:

Pursue alternative funding sources for various project elements such as bike facilities, multi-use path, trails, and wildlife enhancements.

Additional Description:

Related Value Analysis Proposals and/or Supplemental Recommendations:

EVALUATION
Idea Number: 01-112 Idea Description: Pursue alternative funding sources for various project elements such as bike facilities, multi-use path, trails, and wildlife enhancements.
Advantages of alternative concept: 1. May be able to offset/augment costs of non-essential roadway elements such as bike facilities, multi-use path, trails and wildlife enhancements.
Advantages of original concept: 1. All desired elements were captured/included in the original design.
Risks of implementing alternative concept: 1. Funding availability is uncertain due to many competing interests.

DISCUSSION AND/OR CALCULATIONS:

Regional funding sources could be pursued to cover/augment the cost of non-essential project elements, namely, RTA dollars for Safety (intersection safety and elderly and pedestrian safety) and Environmental and Economic Vitality (greenway, pathways, bikeways and sidewalks, and wildlife linkages).

Additional, other regional funds such as Transportation Enhancement funds from Federal Highways (for items like the multi-use path) could be pursued through the PAG process.

SUPPLEMENTAL RECOMMENDATION NO. 01-070

SUMMARY RECOMMENDATION DESCRIPTION:

Develop a special provision for compaction after archaeological excavations during construction.

Additional Description:

Related Value Analysis Proposals and/or Supplemental Recommendations:

SR01-073 - Include provision for the contractor to do any required archaeological scraping during construction.

EVALUATION
Idea Number: 01-070 Idea Description: Develop a special provision for compaction after archaeological excavations during construction.
Advantages of alternative concept: 1. This will reduce the quantity of overexcavation and recompaction needed to mitigation collapsible soil
Advantages of original concept: 1. None noted.
Risks of implementing alternative concept: 1. Archaeological work will be completed outside existing roadway ahead of construction in trenches that may reduce the applicable areas. 2. Benefit may be limited to scraping excavations during new construction outside of existing roadway limits.

DISCUSSION AND/OR CALCULATIONS:

Excavations to evaluate cultural resources are not typically backfilled to an engineering specification. Since the recovery area coincides with the future paved areas, this may lead to future pavement distress where loose backfill settles beneath the pavement. The as-designed project includes overexcavation and recompaction of loose surface soil to prevent this type of distress in native subgrade areas.

Including a special provision in the project to address soil placement and compaction within archaeological excavations that are made during construction will eliminate the need to overexcavate and recompact native soil in these areas once roadway construction begins, resulting in a cost savings to the project.

In addition to the special provision addressing backfilling and compaction in recovery areas, the provision addressing the overexcavation and recompaction should note that areas shown in the plans developed during cultural resource recovery that overlap the subgrade treatment areas (since the recovery areas are not known in advance) are to be deducted from the subgrade treatment area.

SUPPLEMENTAL RECOMMENDATION NO. 01-057

SUMMARY RECOMMENDATION DESCRIPTION:

Select one local lead agency to facilitate cultural resources consultation with the Corps of Engineers and the State Historic Preservation Office (SHPO).

Additional Description:

Related Value Analysis Proposals and/or Supplemental Recommendations:

EVALUATION
Idea Number: 01-057 Idea Description: Select one local lead agency to facilitate cultural resources consultation with the Corps of Engineers and the State Historic Preservation Office (SHPO).
Advantages of alternative concept: 1. There is a simplified archaeology consultation 2. It will remove or reduce the duplication of efforts by other entities
Advantages of original concept: 1. None noted.
Risks of implementing alternative concept: 1. One entity has all consultation responsibility

DISCUSSION AND/OR CALCULATIONS:

By selecting one local lead agency to consult on behalf of the Corps of Engineers it will save time. This allows the local agency to assist with time savings as they have a stake in a quick consultation where the Corps of Engineers has no federal time mandate to initiate consultation with the consulting parties. Such actions may include sending out consultation letters and documents for review.

SUPPLEMENTAL RECOMMENDATION NO. 01-073

SUMMARY RECOMMENDATION DESCRIPTION:

Include provision for the contractor to do any required archaeological scraping during construction.

Additional Description:

Related Value Analysis Proposals and/or Supplemental Recommendations:

SR01-070 - Develop a special provision for compaction after archaeological excavations during construction.

EVALUATION
Idea Number: 01-073 Idea Description: Include provision for the contractor to do any required archaeological scraping during construction.
Advantages of alternative concept: 1. Saves mobilization of equipment that is already on the job
Advantages of original concept: 1. Need the person to be trained or already qualified to do such work
Risks of implementing alternative concept: 1. Corps of Engineers and the State Historic Preservation Office (SHPO) and Corps would need to agree

DISCUSSION AND/OR CALCULATIONS:

The construction contract shall include a provision to provide scraping and equipment during the construction of the new road to the archaeologist working on the existing road. This work will also include areas on the new road where excavation was not complete or burials were found to be present. This will provide savings by using equipment already on site.

The cost savings is estimated at $800/day for use of the construction equipment already available on site. The mobilization cost savings is estimated at $300 per use.

SUPPLEMENTAL RECOMMENDATION NO. 01-061

SUMMARY RECOMMENDATION DESCRIPTION:

Priortize the implementation of wildlife crossing structures based on adjacent features.

Additional Description:

Related Value Analysis Proposals and/or Supplemental Recommendations:

P01-019 - Shorten lengths of box culverts and add guardrail.

EVALUATION
Idea Number: 01-061 Idea Description: Priortize the implementation of wildlife crossing structures based on adjacent features.
Advantages of alternative concept: 1. This will provide an opportunity to evaluate the need for the crossing structure 2. Upsizing of some structures may be found unnecessary due to adjacent projects, lighting, future development, etc. There may be a cost savings in fill and culvert upsizing.
Advantages of original concept: 1. Crossings upsized to meet wildlife recommendations
Risks of implementing alternative concept: 1. May not have development for some time in the future, so upsizing a culvert may have wildlife benefits until such a time that the development moves forward.

DISCUSSION AND/OR CALCULATIONS:

Property may have a zoning that will allow future development on the property. If this is adjacent to the wildlife crossing, then the wildlife is not likely to use it. There may also be signals too close to a crossing that would make it unusable. A drop structure situation may also prohibit the culvert from being used.

The upsizing of culverts and placement of additional culverts will be from a separate funding category at the RTA. The proposal will be submitted to the RTA Wildlife Linkages Subcommittee to request for supplemental funding. The savings for evaluating crossings will be to the separate funding source and will not have a savings to this project.

The pipes discussed in the following table are pipes that are only included in the project to accommodate wildlife crossing. They are not necessary to address drainage conveyance.

Wildlife Crossing Station	Structure Size (for Wildlife)	Connectivity through adjacent land	Existing and Future Traffic Signals	Conservation Land System
97+86	2-8'x5' culverts	Private Property on west, PC on east	None	Yes
119+00 (115 may be better) to 107+50	3-18" pipes	Private Property on west, PC on east	None	Yes
185+00 to 195+00	3-18" pipes	Private Property on west, Cal Port on east	None	Yes
245+61	8'x 5' culverts	Private Property	None	Yes
246+50	1-18" pipes	Yes	None	Yes
344+79	2-10'x5' box	Private Property on west and COT on north. No connectivity.	None	Yes
348+36	2-10'x5' box	Private Property on west and COT on north. No connectivity.	None	Yes
378+84	8'x5' box	By recharge basins	None	No
365+00 to 370+50	2-18" pipes	COT property	None	No

SUPPLEMENTAL RECOMMENDATION NO. 01-100

SUMMARY RECOMMENDATION DESCRIPTION:

Eliminate upsizing of culverts to accommodate wildlife.

Additional Description:

Should RTA Wildlife Linkages Funding not be available, the proposed upsizing of the boxes and addition of pipes for small wildlife species could be eliminated from the project, likely with limited impact on providing structures that benefit wildlife crossing.

Related Value Analysis Proposals and/or Supplemental Recommendations:

SR01-061 - Priortize the implementation of wildlife crossing structures based on adjacent features.

EVALUATION
Idea Number: 01-100 Idea Description: Eliminate upsizing of culverts to accommodate wildlife.
Advantages of alternative concept: 1. Reduces overall corridor improvement costs
Advantages of original concept: 1. Provides slightly larger drainage structures intended to improve wildife crossing function.
Risks of implementing alternative concept: 1. Seems limited, however could result in higher road kill and possibly compromise connectivity for some species

DISCUSSION AND/OR CALCULATIONS:

The wildlife crossing assessments prepared for the Silverbell corridor identified 13 drainage culverts within 5 priority wildlife corridors that are considered prime locations where wildlife are likely to cross and recommended improvements to enhance the wildlife crossing function. At 8 locations, the proposed culvert sizes based on drainage requirements meet or exceed the sizes recommended in the wildlife study. At 4 locations, the wildlife study recommended that the box heights be increased by 1 foot to a 5-foot minimum. At one location, an 8'x5' box is recommended in lieu of 3-36"RCPs. The wildlife study also recommended 18" RCPs be installed at 13 locations for small species.

A proposal to provide additional funds from the RTA Wildlife Linkage program has been submitted. The total requested funds is $820,000 of which $562,000 is for increased culverts and added RCP's.

SUPPLEMENTAL RECOMMENDATION NO. 01-049

SUMMARY RECOMMENDATION DESCRIPTION:

Provide erosion protection to prevent impending erosion of Silverbell Road near Sunset Road from Santa Cruz River migration.

Additional Description:

Related Value Analysis Proposals and/or Supplemental Recommendations:

SR01-053 - Pursue alternative funding sources from adjacent future projects.

EVALUATION
Idea Number: 01-049 Idea Description: Provide erosion protection to prevent impending erosion of Silverbell Road near Sunset Road from Santa Cruz River migration.
Advantages of alternative concept: 1. Prevents destruction of roadway and right-of-way from lateral erosion
Advantages of original concept: 1. None noted.
Risks of implementing alternative concept: 1. None noted.

DISCUSSION AND/OR CALCULATIONS:

The primary bank of the Santa Cruz River low-flow channel is located within 100 feet of the proposed Silverbell Road right-of-way just north of the Sunset Road alignment (Figure 1). At this point, Silverbell Road is located at the outside of a river bend. The Santa Cruz River has been subject to long-term incision due to a variety of human-caused impacts. Lateral erosion of more than several hundred feet has been documented during past floods on the Santa Cruz River. Given the history of lateral erosion, the location at the outside of the river bend, the proximity of the low flow channel, it is likely that a portion of Silverbell Road could be destroyed by erosion during a future flood. Such erosion could totally remove not only the improved roadway, but would also remove up to 1,000 linear feet the land under the right-of-way, significantly complicating its repair.

Figure 1

The proposed bank stabilization is assumed to be located adjacent to or within the Sliverbell Road right-of-way, rather than along the main channel bank, to avoid 404 permitting concerns. The bank stabilization will extend 1,000 feet and will be located in the vicinity of Sunset Road.

Costs:

1. Bank protection (1,000 lf; $2M/mile): $380,000

Benefits:

1. Protect 1,000 ft roadway ($2M/lane mile-4 lanes): $1,500,000
2. Reduced risk of long-term interruption of travel: (not quantified)
3. B/C Ratio: 3.9

Funding Source:

1. PCRFCD (100%)

Summary: Erosion protection is recommended to prevent long-term damage to the roadway.

SUPPLEMENTAL RECOMMENDATION NO. 01-005

SUMMARY RECOMMENDATION DESCRIPTION:

Lower the 100-year water surface elevation of Santa Cruz River.

Additional Description:

Related Value Analysis Proposals and/or Supplemental Recommendations:

EVALUATION
Idea Number: 01-005 Idea Description: Lower the 100-year water surface elevation of Santa Cruz River.
Advantages of alternative concept: 1. Lower flood potential to Silverbell project 2. May reduce project fill requirements
Advantages of original concept: 1. No additional studies required 2. Corps of Engineer involvement may hinder proposal
Risks of implementing alternative concept: 1. No funding for Flood Control project

DISCUSSION AND/OR CALCULATIONS:

The regulatory 100-year water surface elevation of the Santa Cruz River is a constraint to the minimum profile elevation for the Phase 2 portion of the Silverbell Road Project. Proposed future river projects such as El Corazon may include river overbank contouring which may lower the future regulatory water surface elevations.

In order to quantify this proposal, an iterative process of proposed grading and river hydraulic modeling is required. This step would be taken in the future as the river projects proceed. At that time the Regional Flood Control District will coordinate with the design team to review the results and incorporate where possible in the Phase 2 plans. Additional conveyance can be provided in the existing overbanks without impacting the existing primary channel.

SUPPLEMENTAL RECOMMENDATION NO. 01-075

SUMMARY RECOMMENDATION DESCRIPTION:

Use a joint trench for utilities.

Additional Description:

Related Value Analysis Proposals and/or Supplemental Recommendations:

EVALUATION
Idea Number: 01-075 Idea Description: Use a joint trench for utilities.
Advantages of alternative concept: 1. Shared costs will reduce cost of fiber optic line to government entities and utility companies. The Utility companies will not need as much archeologically cleared area. Utilities can be relocated more quickly and time will be saved. Utilities can be shifted to the outside of the right-of-way and relocation for future widening can be avoided.
Advantages of original concept: 1. Utilities all relocate with no cost to government entity
Risks of implementing alternative concept: 1. The design costs may not be collectable if a utility company pulls out between design and the completion of a joint trench contract. Some utilities have been known to want their own trench. Qwest is now owned by Century Link and may not support the joint trench concept as Qwest did. SW Gas and Comcast may not see sufficient cost savings without Qwest, TEP and/or Municipal Fiber Optic participation in joint trench.

DISCUSSION AND/OR CALCULATIONS:

Cost savings achieved by the utilities and likely upgrading of infrastructure when using a joint trench provides more reliable utility service to existing customers and potential industries not yet located in Pima County.

SUPPLEMENTAL RECOMMENDATION NO. 01-068

SUMMARY RECOMMENDATION DESCRIPTION:

Provide median landscaping that does not require irrigation.

Additional Description:

Related Value Analysis Proposals and/or Supplemental Recommendations:

EVALUATION
Idea Number: 01-068 Idea Description: Provide median landscaping that does not require irrigation.
Advantages of alternative concept: 1. Saves capital costs on irrigation lines and water costs 2. Maintains the natural desert landscape 3. Preserves water 4. Limits the use of high maintenance plants
Advantages of original concept: 1. Allows the use of plant species not otherwise feasible without irrigation 2. Better survival rate during establishment period
Risks of implementing alternative concept: 1. Plant survival rate may be less than desirable especially during the establishment period 2. More cactus species may be used which tend to collect more roadway debris

DISCUSSION AND/OR CALCULATIONS:

The project is currently designed to use plants native to the Tucson basin in order to conserve water and provide a sustainable plant environment. Using plants in the median that do not require watering such as cactus species, Palo Verde trees, or Mesquite trees, would maintain the designed aesthetics and would also eliminate the need for irrigation lines to isolated groupings in the median.

A drawback to using cacti is increased road debris and litter tend to get captured in the median which increases maintenance costs, so other low maintenance species may need to be identified that will preserve the desired aesthetics and that will not require watering such as Palo Verde trees or Mesquite trees.

Succulent plants can still be planted where Dri-water gel packs are installed. This would eliminate the need for irrigation lines while maintaining the survival rate during the establishment period.

SUPPLEMENTAL RECOMMENDATION NO. 01-054

SUMMARY RECOMMENDATION DESCRIPTION:

Identify potential water sources for the project in the Special Provisions.

Additional Description:

Related Value Analysis Proposals and/or Supplemental Recommendations:

EVALUATION
Idea Number: 01-054 Idea Description: Identify potential water sources for the project in the Special Provisions.
Advantages of alternative concept: 1. Saves time up front for the contractor in searching for water sources.
Advantages of original concept: 1. None noted.
Risks of implementing alternative concept: 1. Special Provisions needs to be clear that they are potential and not necessarily available.

DISCUSSION AND/OR CALCULATIONS:

Identifiy locations of potential water sources, such as the Ina Road Treatment Plant, the Roger Road Treatment Plant, any well sites in the area, and Silverbell Lake.

SUPPLEMENTAL RECOMMENDATION NO. 01-077

SUMMARY RECOMMENDATION DESCRIPTION:

Have Pima County perform materials testing.

Additional Description:

Related Value Analysis Proposals and/or Supplemental Recommendations:

EVALUATION
Idea Number: 01-077 Idea Description: Have Pima County perform materials testing.
Advantages of alternative concept: 1. Lower cost verses letting out to consultants. 2. Being in-house provides increased resource including, decision making, ownership and availability.
Advantages of original concept: 1. None noted.
Risks of implementing alternative concept: 1. None noted.

DISCUSSION AND/OR CALCULATIONS:

Letting a public agency provide the materials testing would result in direct cost savings.

Example: Approximate hourly rate for Pima County materials technician including overhead and vehicle is $45/hour. This is considerably lower than the cost of private technicians.

The project includes the following three jurisdictions: City of Tucson, Marana, and Pima County; of the three, Pima County has the widest available services and would be available to provide QC/QA. Other than providing the required testing, using Pima County would include review of mix designs, material submittals, and participation in material related decision making.

SUPPLEMENTAL RECOMMENDATION NO. 06-001

SUMMARY RECOMMENDATION DESCRIPTION:

Use a performance specification to compete different retaining wall systems against each other during bidding.

Additional Description:

Related Value Analysis Proposals and/or Supplemental Recommendations:

EVALUATION
Idea Number: 06-001 Idea Description: Use a performance specification to compete different retaining wall systems against each other during bidding.
Advantages of alternative concept: 1. Save money by increasing competition between wall systems and subcontractors
Advantages of original concept: 1. The wall system is defined in the plan set
Risks of implementing alternative concept: 1. Will require an extensive review of contractor shop drawing submittal to insure an acceptable solution

DISCUSSION AND/OR CALCULATIONS:

This supplemental recommends evaluating the use of a performance specification for the retaining walls on this corridor. The current Silverbell Road design has 23 separate retaining walls. MSE walls, soil nail, and other systems can offer substantial savings in fill situations, often as much as a 50% less expensive than other systems. The goal of this concept would be to allow the market to price the most cost competitive wall system for each situation. The contract plans would define line and grade of the retaining walls and the performance specifications that would define the required design parameters including acceptable wall types, design life, and aesthetic requirements. This would allow the contractors bidding the project to compete a range of wall solutions against each other to insure a best value solution. It should be noted that design parameters can often limit the range of feasible wall solutions. In these situations, the designer should perform the design. We would anticipate that most of the walls on this project would not have many design limitations.

SECTION 5 – IDEAS ANALYZED BUT NOT PROPOSED

EVALUATION
Idea Number: 01-017 Idea Description: Mitigate unsuitable subgrade with geogrid stabilization.
Advantages of alternative concept: 1. Eliminates overexcavation and recompaction 2. Lower unit cost 3. Rapid installation
Advantages of original concept: 1. Complete physical removal of unsuitable subgrade
Risks of implementing alternative concept: 1. Typical products used to strengthen clay subgrade are insufficiently stiff. 2. Structural geogrids will be as expensive as the original concept
Conclusion: Do not propose this idea because the cost advantage is diminished due to the grade of product required to provide benefit.

Calculations and/or Discussion:

A review was performed of the standard practice for mitigation of collapsible soil. The following mitigation methods are available:

1. Removal (including complete removal or removal and replacement or recompaction.
2. Avoidance of wetting
3. Chemical stabilization, including grouting
4. Prewetting or controlled wetting
5. Differential settlement resistant foundations.

Geogrid stabilization falls under Category 5, and it does have a record of successful use in reducing the differential settlement of rigid concrete footings. For flexible pavements, the flexural rigidity of the geogrid products that are commonly used to strengthen clay subgrade will not be high enough to reduce differential settlement with a single layer application. Multiple layers placed in a compacted layer of soil may be feasible, but this configuration results in negligible cost savings over the original concept and only in areas where significant shrinkage due to compaction would have been realized.

This idea was combined with treating the subgrade with cement in lieu of overexcavation. Unit costs for soil cement at 5% cement are approximate $0.65/sy-inch. Depth of treatment would probably need to be at least 8 inches to be effective. The cost at this depth essentially the same as the cost for overexcavation and replacement, except where significant shrinkage results from soil compaction. However, cement treated subgrade will likely develop frequent transverse cracking as it ages, which would develop into reflective cracking in the pavement.

EVALUATION
Idea Number: 01-031 Idea Description: Review Reinforced Concrete Box Culvert (RCBC) spans to see if a more uniform size can be used to accommodate lumber size.
Advantages of alternative concept: 1. None noted.
Advantages of original concept: 1. None noted.
Risks of implementing alternative concept: 1. None noted.
Conclusion: Do not propose this idea because there only 5 different span sizes for 28 box culverts, thus any costs saving would be very small at best.

Calculations and/or Discussion:

EVALUATION
Idea Number: 01-036 Idea Description: Do a competitive bid for archeological work.
Advantages of alternative concept: 1. Potentially lower cost
Advantages of original concept: 1. Work with better qualified firms
Risks of implementing alternative concept: 1. Low bid firm may create fines, liability and other issues for project owners
Conclusion: Do not propose this idea because of the risk of getting an unqualified firm that may end up increasing final costs of archeology

Calculations and/or Discussion:

EVALUATION
Idea Number: 01-044 Idea Description: Re-negotiate the State Historic Preservation Office (SHPO) requirements for less archaeological work under the existing roadway.
Advantages of alternative concept: 1. Less archaeological work required which would reduce cost 2. Archaeological resources preserved in place
Advantages of original concept: 1. Compliant with Section 106 of the National Historic Preservation Act (NHPA) and 36 Code of Federal Regulations (CFR) Section 800 2. No time delays to address additional consultation concerns
Risks of implementing alternative concept: 1. It is highly likey that the tribes will not agree with the proposed action during consultation. 2. The Corpsof Engineers and the SHPO will not approve since it does not meet intent of federal regulations 3. The proposal is not compliant with SHPO policy
Conclusion: Do not propose this idea because it is not compliant with federal regulations and SHPO policy.

Calculations and/or Discussion:

There is a lot of case law around this issue and the consultation is required before a project is implemented. If one party does not agree, it goes into dispute resolution with the Advisory Council. This will cause substantial time delays and negative perceptions.

EVALUATION
Idea Number: 01-046 Idea Description: Reduce lane width from 12 and 13 feet to 11 feet for right-hand turn lanes.
Advantages of alternative concept: 1. A savings of $3,600 can be achieved in reduced pavement and fill costs
Advantages of original concept: 1. Drivers are more comfortable making right turns.
Risks of implementing alternative concept: 1. Drivers may get in more accidents and if it can be shown that a wider right turn lane should have been used, a lawsuit may occur.
Conclusion: Do not propose this idea because of the low savings and high risk

Calculations and/or Discussion:

location	street name 1	street name 2	length 1	width 1	area (sq. ft)	fill height	fill volume
1	Silverbell	Sunset	73	1	73	5	365
2	Sunset	Silverbell	55	1	55	5	275
3	Silverbell	Camino Del Cerro	73	1	73	3	219
4	Camino De Cerro	Silverbell	73	1	73	3	219
5	Camino De Cerro	Silverbell	73	1	73	3	219
6	Silverbell	Cristopher Columbu	73	1	73	0	0
7	Silverbell	Sweetwater	73	1	73	1	73
8	Sweetwater	Silverbell	73	1	73	1	73
9	Silverbell	Goret	82	1	82	0.5	41
10	Silverbell	Goret	66	1	66	0.5	33
11	Silverbell	Ironwood Hills Dr	58	1	58	1	58
12	Silverbell	Grant	94	1	94	0	0
13	Silverbell	Camino Del Cerro	59	1	59	3	177
14	Silverbell	Camino Del Cerro	67	1	67	3	201
15	Silverbell	Camino Del Cerro	61	2	122	3	366
total					1114		2319
			unit cost	total saved			
	tons of ARAC	13	70	$890.27			
	tons of AC	24	50	$1,177.82			
	cu yd ABC	14	25	$343.83			
	cu yd of fill	86	14	$1,202.44			
			saved	$3,614.37			

EVALUATION
Idea Number: 01-060 Idea Description: Acquire a Clean Water Act Section 404 Individual Permit rather than multiple Nationwide Permits.
Advantages of alternative concept: 1. Individual Permits expire in five (5) years rather than two (2) years
Advantages of original concept: 1. Less time to get Section 404 Permit 2. Do not need to develop alternatives for each crossing
Risks of implementing alternative concept: 1. The project will need to be published in the federal register so there is more opportunity to comment and concern from the opportunity to comment
Conclusion: Do not propose this idea because there will be additional cost in preparing additional documents required for the individual permit.

Calculations and/or Discussion:

Ultimately this will be a Corps of Engineers decision and the project will need to comply. Based on the feedback from the Corps of Engineers, to date it is likely that individual permits will required for the south section and the north section.

EVALUATION
Idea Number: 01-102 Idea Description: Use a roundabout in lieu of signalized intersections.
Advantages of alternative concept: 1. Facilitates U-turns and other turning movements 2. Reduces median width approaching intersection 3. Reduced severity of vehicular crashes
Advantages of original concept: 1. Less ROW needed (and less associated archeology) 2. More driver familiarity 3. lower capital cost
Risks of implementing alternative concept: 1. None noted.
Conclusion: Do not propose this idea because it is unlikely to result in any savings

Calculations and/or Discussion:

The initial plans include five new/reconstructed signalized intersections:

- Goret
- Sweetwater
- Camino del Cerro
- Sunset W
- Sunset E

The projected volumes at all of those intersections for the year 2040 is less than 40,000 entering vehicles per day (total of both streets), which can be efficiently handled by two lane roundabouts. Roundabouts also generally result in safer operations with less severe crashes (due to the low speeds around the roundabout). The other benefit is that the width of the median (currently 20 feet) could be reduced approaching the roundabout. Significant median width reductions could not be achieved in other areas because turn lanes and pedestrian refuge areas need to be provided.

The primary disadvantages of roundabouts on this particular project are:

1. They would require a larger footprint. This would increase right-of-way costs, and, most importantly, increase the area of impact for archeological issues.
2. Based on recently published ADA Guidelines for Public Rights-of-Way (currently under public review), multi-lane roundabouts will require pedestrian traffic signals on the approaches. While this does not impact operations significantly due to the low pedestrian volumes, it would require the construction, operation, and maintenance of full signal systems at each roundabout. Those systems are expected to be as costly as those at typical signalized intersections, which eliminates the long-term M&O savings generally associated with roundabouts.

EVALUATION
Idea Number: 01-108 Idea Description: Use Pima County SHPO approved Monitoring Plan to complete early utility relocations.
Advantages of alternative concept: 1. The utilities will be out of the way for the project
Advantages of original concept: 1. Project is in compliance with federal regulations
Risks of implementing alternative concept: 1. Plan must be approved by Corps, SHPO, and local jurisdictions
Conclusion: Do not propose this idea because the County Plan may not be applied to federalized undertakings as specified in the plan.

Calculations and/or Discussion:

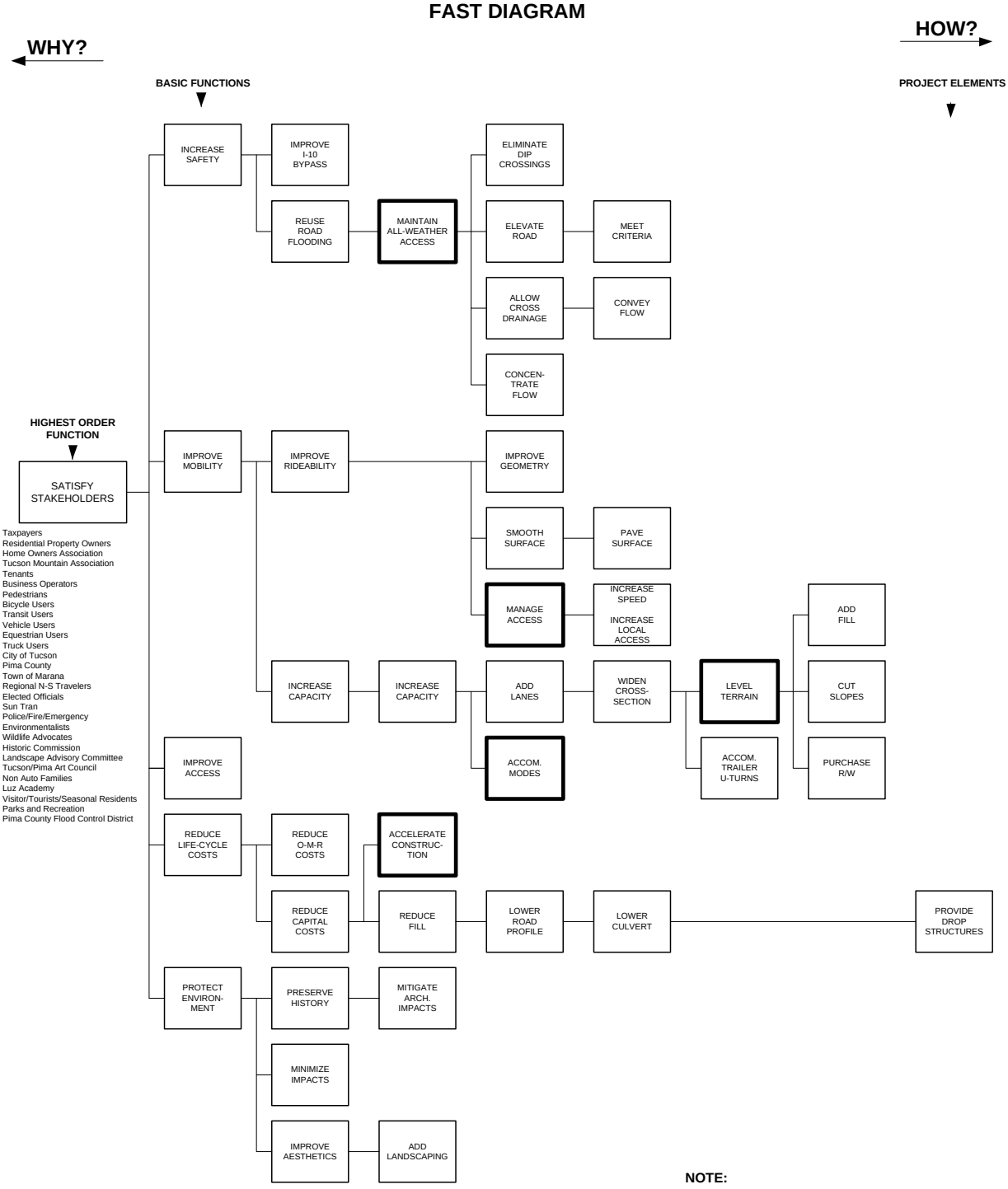
The following ideas were dismissed during the initial idea cull. They were not analyzed to the point of listing individual advantages and disadvantages.

INITIALLY FAILED IDEAS TABLE

Idea No.	Idea Description	Reason for Failing Idea
01-006	Use dip sections	This is what the design is trying to eliminate
01-020	Use three-lane section from Sunset to Ina Rd	Out of scope
01-043	Where traffic warrants, construct inside two lanes first	Remobilization cost would obviate the savings
01-051	Combine bike lane and multi-use paths	Violates the ballot language and ADA requirements
01-063	Use soil cement for erosion protection, slope protection, road base and multi-use path.	Do demonstrated need and probability of batch plant availability. Maintenance is a problem.
01-071	Reduce the skew of the culverts	404 permit issues
01-072	Increase the invert inlet elevation to reduce culvert size	No apparent savings
01-079	Use a collector or distributor channel for wildlife	No fencing hence no apparent cost savings
01-086	Lower the design speed	No apparent savings
01-087	Reduce the posted speed to 40 MPH throughout entire project	People will drive faster than that
01-088	Use squashed pipes	Design doesn't preclude its use
01-092	Pave the medians with stamped concrete	No apparent advantage
01-095	Use a design build contracting method	No apparent advantage on this project. Archeology is the critical path constraint and schedule is not a problem.
01-097	Use fill slopes on east side in lieu of soil cement	No apparent advantage
01-110	Use upstream detention / retention to reduce box culverts	No apparent economic advantage with private land purchase and topography does not work well because it is too steep in general
01-111	Use terrace walls w/ gravity blocks to steepen slopes	No apparent economic advantage
01-113	Sell some of existing publically owned land to pay for project	Out of scope
01-114	Shift alignment to the East, move the path to the west, and eliminate curbs on the east side	Previously analyzed and the horizontal alignment has been optimized
02-002	Do not investigate archeology underneath existing roadway	Prohibited by state law
02-003	Use alternative project delivery methods	No apparent advantage on this project since there are no schedule constraints
02-005	Shift alignment further to the east especially north bound	No apparent economic advantage
02-006	Designate detour routes	No viable alternative routes are available
02-009	Develop alternative detour access through Christopher Columbus Park	There are archeological issues with going through the park
04-005	Increase access to I-10 to reduce load on Silverbell	Out of scope

SECTION 6 – FUNCTION ANALYSIS SYSTEM TECHNIQUE (F.A.S.T.) DIAGRAM

SILVERBELL RD. – GRANT RD. TO INA RD.
FAST DIAGRAM



NOTE:
BOLDED BOXES INDICATE FUNCTIONS SELECTED FOR BRAINSTORMING BASED ON COST & POTENTIAL FOR IMPROVEMENT

SECTION 7 – BRAINSTORMING IDEAS

The following table lists all of the ideas generated by the VA Team. They are arranged by the function from which they were generated. Shotgun list ideas are alternatives the VA 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.

Some of the ideas whose disposition is listed as "As Designed" were also assumed to be "as will be designed."

PLEASE NOTE: One of the rules for creativity exercises in a formal VA 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

Idea No.	Idea Description	Disposition	With
	SHOTGUN LIST		
01-001	Make the transition pavement section less robust	Pass	-
01-002	Re-route the mixed-use path vertically and horizontally decouple from roadway	As Designed	-
01-003	Allow The Santa Cruz River to inundate the roadway of up to one foot	Pass	-
01-004	Eliminate fiber optic conduit unless user is identified	Pass	-
01-005	Lower The Santa Cruz River flood plain elevation	Pass	-
01-006	Use dip sections	Fail	-
01-007	Use box culverts in lieu of bridge at Abbington Rd	Pass	-
01-008	Reduce bike lanes to 5ft	Pass	-
01-009	Eliminate street lighting	Pass	-
01-010	Replace the continuous right turn lane with a combined bike lane	Pass	-
01-011	Use arches in lieu of concrete box culverts	Pass	-
01-012	Take the multi-use path out this project and put in bond project	Pass	-
01-013	Allow alternative pipe material types	Pass	-
01-014	Design to consider construction phasing	Pass	-
01-015	Build entire east half of roadway first	Combine	01-014
01-016	Eliminate the roadside landscaping and only landscape the medians	Pass	-
01-017	Use geo-grid material in over excavation areas	Pass	-
01-018	Minimize the use of retaining walls by using cut slopes	Pass	-
01-019	Shorten length of larger boxes and use guardrail	Pass	-
01-020	Use three-lane section from Sunset to Ina Rd	Fail	-
01-021	Itemize wildlife expenses and pursue additional RTA wildlife linkages funding for culverts enhancements	Combine	01-112

Idea No.	Idea Description	Disposition	With
01-022	Tap WRDA funding	Supplemental Recommendation	-
01-023	Reduce multi-use path widths	Pass	-
01-024	Stock pile retaining wall spoil for roadway fill	As Designed	-
01-025	Use asphaltic concrete in lieu of asphaltic rubberized concrete for surface course	Pass	-
01-026	Pursue and identify borrow sources early	Pass	-
01-027	Eliminate over excavation between existing roadway and median	Pass	-
01-028	Eliminate over excavation terraced areas	Combine	01-027
01-029	Construct the intersections first in early packages	Pass	-
01-030	Eliminate the median curb and build a depressed median	Pass	-
01-031	Look at the span of the box culverts and determine a standard form size	Pass	-
01-032	Mill the existing road and use for aggregate base	As Designed	-
01-033	Designate acceptable onsite material sources	As Designed	-
01-034	Use California Portland Cement site as borrow source	Pass	-
01-035	Have the Regional Flood control district purchase the California Portland Cement site	Combine	01-034
01-036	Bid cultural work as guaranteed maximum price	Pass	-
01-037	Lower the alignment at Sunset Rd.	As Designed	-
01-038	Put pedestrian facilities on only one side of roadway	As Designed	-
01-039	Treat subgrade in lieu of over excavation	Combine	01-017
01-040	Use full closures for culvert construction at Idle Hour Wash	Pass	-
01-041	Reduce multi-use path aspahaltic concrete from 3 inches to 2 inches	Pass	-
01-042	Use median only south of Goret at signalized intersections and 5-lanes elsewhere	Pass	-
01-043	Where traffic warrants, construct inside two lanes first	Fail	-
01-044	Re-negotiate the SHPO requests	Pass	-
01-045	Narrow the 20' median	Pass	-
01-046	Use 11-ft right turn lanes consistently	Pass	-
01-047	Replace bridge at station 409 with box culverts	Pass	-
01-048	Allow the use of precast box culverts	As Designed	-
01-049	Protect the fill embankment close to the river	Supplemental Recommendation	-
01-050	Optimize retaining walls versus right of way costs	Combine	01-018
01-051	Combine bike lane and multi-use paths	Fail	-
01-052	Remove material from The Santa Cruz river flood plain and use for borrow	Combine	01-005

Idea No.	Idea Description	Disposition	With
01-053	Get synergy from adjacent projects, i.e., funding for portions of project	Supplemental Recommendation	-
01-054	Use the Ina road Wastewater treatment plant effluent for roadway construction	Supplemental Recommendation	-
01-055	Use site specific hydrologic method to refine cross drainage flows	Pass	-
01-056	Institute a programmatic agreement in lieu of a memorandum of agreement with US Army Corps of Engineers	Pass	-
01-057	Pick one entity to be the lead negotiator	Supplemental Recommendation	-
01-058	Use landscaping for 404 impact mitigation	Pass	-
01-059	Set up phasing for archeological data recovery	As Designed	-
01-060	Consolidate all nationwide 404 permits into one individual permit	Supplemental Recommendation	-
01-061	Prioritize wildlife crossing requirements	Supplemental Recommendation	-
01-062	Coordinate Santa Cruz river improvements with road work	Combine	01-053
01-063	Use soil cement for erosion protection, slope protection, road base and multi-use path.	Fail	-
01-064	Accelerate construction of Sunset Road	As Designed	-
01-065	Use multi-use plate low head arches in lieu of multiple set boxes	Combine	01-011
01-066	Use gabion walls in lieu of retaining walls	Combine	06-001
01-067	Reduce the landscape budget to 2 percent	Combine	01-016
01-068	Consider median landscaping without irrigation.	Supplemental Recommendation	-
01-069	Use proprietary pre-cast wildlife crossings	Combine	01-061
01-070	Do not over excavate archeological digs and compact after the dig	Supplemental Recommendation	-
01-071	Reduce the skew of the culverts	Fail	-
01-072	Increase the invert inlet elevation to reduce culvert size	Fail	-
01-073	Negotiate with SHPO and/or corps of engineers to allow contractor to excavate in lifts	Supplemental Recommendation	-
01-074	Use construction manager at risk contract for archeological	Combine	01-036
01-075	Joint trenches for utilities	Supplemental Recommendation	-
01-076	Early relocation of utilities	As Designed	-
01-077	County to do the material testing	Supplemental Recommendation	-
01-078	Eliminate culverts for very low discharges	Pass	-
01-079	Use a collector or distributor channel for wildlife	Fail	-
01-080	Have the contractor review plan at 60% design	Pass	-
01-081	Redo traffic projections for growth and pavement design	Pass	-

Idea No.	Idea Description	Disposition	With
01-082	Do a combination value engineering study partnering session	Pass	-
01-083	Allow backwater at culvert crossings	Combine	03-001
01-084	Allow low flow crossings	Combine	03-001
01-085	Use 11-ft inside lanes	Pass	-
01-086	Lower the design speed	Fail	-
01-087	Reduce the posted speed to 40 MPH throughout entire project	Fail	-
01-088	Use squashed pipes	Fail	-
01-089	Use California Portland Cement for fill	Combine	01-034
01-090	Use concrete slope paving	Combine	01-018
01-091	Use a berm in lieu of silt fence	Pass	-
01-092	Pave the medians with stamped concrete	Fail	-
01-093	Allow the contactor to build a construction detour	Combine	01-014
01-094	Reduce the vehicle U-turn requirements	Combine	01-045
01-095	Use a design build contracting method	Fail	-
01-096	Contract entire southern portion under one contract	Pass	-
01-097	Use fill slopes on east side in lieu of soil cement	Fail	-
01-098	Lower the culverts	Combine	03-001
01-099	Eliminate the curb on the west side	Pass	-
01-100	Eliminate the wildlife upsizing on pipes	Pass	-
01-101	Use alternative retaining wall types	Combine	06-001
01-102	Use roundabouts in lieu of signalized intersections	Pass	-
01-103	Consolidate drainage crossings	Combine	03-001
01-104	Allow some drop at wildlife crossings	As Designed	-
01-105	Eliminate and/or reduce wildlife fencing	As Designed	-
01-106	Use V ditch berm system in lieu of waddles	Combine	01-091
01-107	Curb inlets for water harvesting	As Designed	-
01-108	Use existing cultural plans to do early utility relocations	Supplemental Recommendation	-
01-109	Excavate cross drainage to river on public lands	Pass	-
01-110	Use upstream detention / retention to reduce box culverts	Fail	-
01-111	Use terrace walls w/ gravity blocks to steepen slopes	Fail	-
01-112	Pursue alternative RTA funding sources for project elements	Supplemental Recommendation	-
01-113	Sell some of existing publically owned land to pay for project	Fail	-
01-114	Shift alignment to the East, move the path to the west, and eliminate curbs on the east side	Fail	-
01-115	Use bulbs for U-turns and/or bus pullouts	Combine	01-045
	ACCELERATE CONSTRUCTION		
02-001	Close the road in segments especially from Camino del Cerro to Sunset Rd	Combine	01-040
02-002	Do not investigate archeology underneath existing roadway	Fail	-

Idea No.	Idea Description	Disposition	With
02-003	Use alternative project delivery methods	Fail	-
02-004	Expand first phase from Goret to Sweetwater	Combine	01-096
02-005	Shift alignment further to the east especially north bound	Fail	-
02-006	Designate detour routes	Fail	-
02-007	Install Sunset Rd. access early	As Designed	-
02-008	Deal with all archeology first	As Designed	-
02-009	Develop alternative detour access through Christopher Columbus Park	Fail	-
	MAINTAIN ALL-WEATHER ACCESS		
03-001	Apply flexibility in cross drainage design	Pass	-
03-002	Eliminate freeboard	Combine	03-001
03-003	use site specific risk analysis	Combine	03-001
03-004		Pass	-
	MANAGE ACCESS		
04-001	Reduce the number of median openings	Combine	01-045
04-002	Consolidate access points	As Designed	-
04-003	Do not manage access rather use continuous left turn	Combine	01-042
04-004	Use flexible access depending on context	Combine	01-042
04-005	Increase access to I-10 to reduce load on Silverbell	Fail	-
	ACCOMMODATE MODES		
05-001	Do not improve the equestrian trail surface	As Designed	-
05-002	Use one 6-ft path on one side	Combine	01-023
05-003	Reduce the sidewalk to 5ft on south end	Pass	-
05-004	Use 6ft wide path in lieu of sidewalks throughout	Pass	-
	LEVEL TERRAIN		
06-001	Use a performance specification for the retaining walls	Pass	-

SECTION 8 – REVIEW BOARD DECISIONS

PROPOSAL or SR NO.	VE PROPOSAL DESCRIPTION	DISPOSITION 1 = ACCEPT 2 = ACCEPT w/ MODIFICATIONS 3 = DECLINE "BLANK" = TABLE	Comments
VA PROPOSALS			
		DRAINAGE and FLOOD CONTROL	
P01-003	Lower the road profile by removing extra freeboard in road profile above Santa Cruz 100-year floodplain. Initial Est. Savings: $2,100,000 Future Est. Savings: $0,000 Total Est. Savings: $2,100,000	2 = ACCEPT w/ MODIFICATIONS	No flooding of pavement should occur during a 100 year event on the Santa Cruz, but freeboard is not needed.
P01-055	Use site-specific hydrologic methodology to refine design discharge estimates. Initial Est. Savings: $4,900,000 Future Est. Savings: $0,000 Total Est. Savings: $4,900,000	2 = ACCEPT w/ MODIFICATIONS	Look at watersheds on a case-by-case basis.
P03-001	Modify cross drainage design protocols to allow site-specific designs. Initial Est. Savings: 1,320,000 to 3,080,000 Future Est. Savings: $0,000 Total Est. Savings: $1,320,000 to 3,080,000	2 = ACCEPT w/ MODIFICATIONS	Evaluate on a case-by-case basis. Ponding into the pavement area is accepted to maximize headwater depth efficiency, but overtopping is not.
P01-109	Lower the cross culvert inverts and grade outlet channels to the river. Initial Est. Savings: $1,250,000 Future Est. Savings: $0,000 Total Est. Savings: $1,250,000	2 = ACCEPT w/ MODIFICATIONS	Consider on a case-by-case basis - should not be allowed to bring about greater permit requirements.
P01-078	Eliminate unnecessary culverts. Initial Est. Savings: $770,000 Future Est. Savings: $0,000 Total Est. Savings: $770,000	1 = ACCEPT	Need to ensure ponding time does not exceed time allowed for retention basins
P01-019	Shorten lengths of box culverts and add guardrail Initial Est. Savings: $684,000 Future Est. Savings: $43,000 Total Est. Savings: $641,000	1 = ACCEPT	Provided alternate modes are accomodated.
P01-047	Replace four span 160 foot span bridge at station 409+00 with a multi-cell box culvert. Initial Est. Savings: $720,000 Future Est. Savings: $0,000 Total Est. Savings: $720,000	1 = ACCEPT	

PROPOSAL or SR NO.	VE PROPOSAL DESCRIPTION	DISPOSITION 1 = ACCEPT 2 = ACCEPT w/ MODIFICATIONS 3 = DECLINE "BLANK" = TABLE	Comments
P01-007	Replace the 120 foot span bridge at station 123+00 with a multi-cell box culvert. Initial Est. Savings: $840,000 Future Est. Savings: $0,000 Total Est. Savings: $840,000	1 = ACCEPT	
P01-116	Eliminate the bridge deck in the median by constructing two bridges with an open median at station 123+00 with sidewalk on one side only. Initial Est. Savings: $310,000 Future Est. Savings: $0,000 Total Est. Savings: $310,000	1 = ACCEPT	
P01-013	High Density Polyethylene (HDPE) Pipe alternative for cross culverts. Initial Est. Savings: $222,923 Future Est. Savings: $0,000 Total Est. Savings: $222,923	3 = DECLINE	Concerns about potential for deflection, long-term UV deterioration, and deliberate caused fire damage prevent consideration of this proposal.
P01-011	Use arch culverts in-lieu of concrete box culverts Initial Est. Savings: $730,000 Future Est. Savings: $0,000 Total Est. Savings: $730,000	2 = ACCEPT w/ MODIFICATIONS	Prefer concrete arches to metal ones.
		ROADWAY and LIGHTING	
P01-042	Use a raised median south of Goret and at signalized intersections; construct a 5-lane section elsewhere Initial Est. Savings: $2,200,000 Future Est. Savings: $0,000 Total Est. Savings: $2,200,000	3 = DECLINE	
P01-045	Narrow the 20' median by reducing the U-turn design vehicle and providing U-turn loons. Initial Est. Savings: $300,000 Future Est. Savings: $0,000 Total Est. Savings: $300,000	3 = DECLINE	
P01-030	Eliminate median curb throughout the corridor Initial Est. Savings: $261,000 Future Est. Savings: -$43,000 Total Est. Savings: $218,000	3 = DECLINE	

PROPOSAL or SR NO.	VE PROPOSAL DESCRIPTION	DISPOSITION 1 = ACCEPT 2 = ACCEPT w/ MODIFICATIONS 3 = DECLINE "BLANK" = TABLE	Comments
P01-099	Eliminate curb on west side of roadway Initial Est. Savings: $436,000 Future Est. Savings: -$43,000 Total Est. Savings: $393,000	3 = DECLINE	
P01-010	Combine the NB multi-use lane and the continuous turn lane in the vicinity of Casas Arroyo (Sta 124+00-143+00) Initial Est. Savings: $45,000 Future Est. Savings: $0,000 Total Est. Savings: $45,000	3 = DECLINE	
P01-009	Eliminate the street lighting from Grant to Goret Initial Est. Savings: $300,000 Future Est. Savings: $150,000	2 = ACCEPT w/ MODIFICATIONS	Look at lighting of intersections for safety.
	Total Est. Savings: $450,000		
P01-004	Eliminate fiber optic conduit unless user is identified and commits to providing the necessary funding. Initial Est. Savings: $630,000 Future Est. Savings: $0,000 Total Est. Savings: $630,000	1 = ACCEPT	
		MULTI-USE PATH and SIDEWALK	
P01-012	Secure alternative funding source for multi-use path Initial Est. Savings: $1,000,000 Future Est. Savings: $0,000 Total Est. Savings: $1,000,000	3 = DECLINE	
P01-023	Replace the 10' multi use path to a 6' asphalt sidewalk. Initial Est. Savings: $830,000 Future Est. Savings: $0,000 Total Est. Savings: $830,000	3 = DECLINE	
P01-041	Reduce pavement section for multi-use path Initial Est. Savings: $85,000 Future Est. Savings: $0,000 Total Est. Savings: $85,000	1 = ACCEPT	

PROPOSAL or SR NO.	VE PROPOSAL DESCRIPTION	DISPOSITION 1 = ACCEPT 2 = ACCEPT w/ MODIFICATIONS 3 = DECLINE "BLANK" = TABLE	Comments
P05-004	Change the 6' wide concrete sidewalk on the west side of Silverbell between Goret and Grant to 6' wide asphalt sidewalk. Initial Est. Savings: $60,000 Future Est. Savings: $0,000 Total Est. Savings: $60,000	3 = DECLINE	
P05-003	Reduce the sidewalk on the west side of Silverbell between Goret and Grant from a 6' width down to a 5'width Initial Est. Savings: $14,000 Future Est. Savings: $0,000 Total Est. Savings: $14,000	3 = DECLINE	
P01-008	Reduce bike lane width from 6 ft to 5 ft Initial Est. Savings: $330,000 Future Est. Savings: $0,000 Total Est. Savings: $0,000	3 = DECLINE	
		MATERIALS and PAVING	
P01-034	Purchase existing sand and gravel properties from Cal-Portland Corporation with Regional Flood Control District funds. Initial Est. Savings: $2,500,000 Future Est. Savings: $0,000 Total Est. Savings: $2,500,000	1 = ACCEPT	
P01-026	Obtain borrow/source(s) prior to construction Initial Est. Savings: $2,300,000 Future Est. Savings: $0,000 Total Est. Savings: $2,300,000	4 = TABLE	Consider opportunities as they emerge, on a case-by-case basis.
P01-027	Eliminate overexcavation and recompaction beneath existing paved areas and piedmont areas Initial Est. Savings: $700,000 Future Est. Savings: $0,000 Total Est. Savings: $700,000	2 = ACCEPT w/ MODIFICATIONS	Confirm by testing.
P01-081	Optimize the pavement section by testing R values and (potentially) revising the traffic projections Initial Est. Savings: 800,000 to 1,100,000 Future Est. Savings: $0,000 Total Est. Savings: 800,000 to 1,100,000	2 = ACCEPT w/ MODIFICATIONS	Study further to determine feasibility.

PROPOSAL or SR NO.	VE PROPOSAL DESCRIPTION	DISPOSITION 1 = ACCEPT 2 = ACCEPT w/ MODIFICATIONS 3 = DECLINE "BLANK" = TABLE	Comments
P01-025	Replace asphaltic rubberized concrete (ARAC) with asphaltic concrete (AC) Initial Est. Savings: $450,000 Future Est. Savings: $0,000 Total Est. Savings: $450,000	2 = ACCEPT w/ MODIFICATIONS	Study further to determine feasibility.
P01-001	Make the transition pavement section at the north end of the first phase less robust. Initial Est. Savings: $116,000	3 = DECLINE	
		ENVIRONMENTAL	
P01-056	Institute a Programmatic Agreement (PA) with the Army Corps of Engineers rather than a Memorandum of Agreement (MOA) Initial Est. Savings: $150,000 Future Est. Savings: $0,000 Total Est. Savings: $150,000	1 = ACCEPT	
P01-058	Use the project landscape plans as the 404 mitigation proposal. Initial Est. Savings: $81,000 Future Est. Savings: $0,000 Total Est. Savings: $81,000	3 = DECLINE	May introduce delays and complications that exceed the benefit derived.
		CONSTRUCTION and CONSTRUCTABILITY	
P01-082	Perform a combination value engineering/partnering session after the construction contractor's notice of award but prior to the construction contractor's notice to proceed. Initial Est. Savings: 2,300,000 to 4,600,000 Future Est. Savings: $0,000 Total Est. Savings: 2,300,000 to 4,600,000	1 = ACCEPT	
P01-080	Perform a constructability review at approximately 60% design. Initial Est. Savings: 70,000 to $210,000 Future Est. Savings: $0,000 Total Est. Savings: 70,000 to $210,000	1 = ACCEPT	

PROPOSAL or SR NO.	VE PROPOSAL DESCRIPTION	DISPOSITION 1 = ACCEPT 2 = ACCEPT w/ MODIFICATIONS 3 = DECLINE "BLANK" = TABLE	Comments
P01-016	Reduce the landscape budget to 2% of construction budget and focus design on the medians. Initial Est. Savings: $1,800,000 Future Est. Savings: $0,000 Total Est. Savings: $1,800,000	1 = ACCEPT	
P01-018	Replace retaining walls with slopes where feasible. Initial Est. Savings: 1,000,000 to 2,000,000 Future Est. Savings: $0,000 Total Est. Savings: 1,000,000 to 2,000,000	2 = ACCEPT w/ MODIFICATIONS	consider on a case-by-case basis; need to weigh cost of right of way against cost of walls.
P01-096	Contract/bid the entire south half of the corridor as one project. Initial Est. Savings: $240,000 Future Est. Savings: $0,000 Total Est. Savings: $240,000	2 = ACCEPT w/ MODIFICATIONS	Consider cashflow and permit timing ramifications.
P01-029	Construct major intersections early and on an accelerated schedule. Initial Est. Savings: $47,250 Future Est. Savings: $0,000 Total Est. Savings: $47,250	2 = ACCEPT w/ MODIFICATIONS	Up to jurisdiction preference
P01-014	Design construction phasing to provide for two phase construction (east side phase one) with adequate detours to insure this phasing. Initial Est. Savings: Not Quantified Future Est. Savings: $0,000 Total Est. Savings: Not Quantified	2 = ACCEPT w/ MODIFICATIONS	Consider further
P01-040	Close Silverbell Road at Idle Hour Wash to construct 5-12x10 and 2-12x8 boxes in one phase Initial Est. Savings: $125,000 Future Est. Savings: $0,000 Total Est. Savings: $125,000	1 = ACCEPT	
P01-091	Utilize a v-ditch with berm rather than silt fence or waddles for stormwater controls Initial Est. Savings: $110,000 Future Est. Savings: $0,000 Total Est. Savings: $110,000	2 = ACCEPT w/ MODIFICATIONS	consider on a case-by-case basis

PROPOSAL or SR NO.	VE PROPOSAL DESCRIPTION	DISPOSITION 1 = ACCEPT 2 = ACCEPT w/ MODIFICATIONS 3 = DECLINE "BLANK" = TABLE	Comments
VA SUPPLEMENTAL RECOMMENDATIONS			
		FUNDING	
SR01-022	Seek opportunities to utilize Water Resources Development Act (WRDA) funding.	1 = ACCEPT	
SR01-053	Pursue alternative funding sources from adjacent future projects.	1 = ACCEPT	
SR01-112	Pursue alternative funding sources for various project elements such as bike facilities, multi-use path, trails and wildlife enhancements. .	2 = ACCEPT w/ MODIFICATIONS	For trails and wildlife crossings
		FUNDING	
SR01-070	Develop a special provision for compaction after archaeological excavations during construction.	1 = ACCEPT	
SR01-057	Select one local lead agency to facilitate cultural resources consultation with the Corps of Engineers and the State Historic Preservation Office (SHPO).	1 = ACCEPT	
SR01-073	Include provision for the contractor to do any required archaeological scraping during construction.	1 = ACCEPT	
		WILDLIFE	
SR01-061	Prioritize the implementation of wildlife crossing structures based on adjacent features.	1 = ACCEPT	
SR01-100	Eliminate upsizing of culverts to accommodate wildlife	3 = DECLINE	
		FLOOD CONTROL	
SR01-049	Provide erosion protection to prevent impending erosion of Silverbell Road near Sunset Road from Santa Cruz River migration.	1 = ACCEPT	
SR01-005	Lower the 100-year water surface elevation of Santa Cruz River	2 = ACCEPT w/ MODIFICATIONS	Work with RFCD on mutually beneficial opportunities

PROPOSAL or SR NO.	VE PROPOSAL DESCRIPTION	DISPOSITION 1 = ACCEPT 2 = ACCEPT w/ MODIFICATIONS 3 = DECLINE "BLANK" = TABLE	Comments
		CONSTRUCTION/ MISCELLANEOUS	
SR01-075	Use joint trench for utilities	2 = ACCEPT w/ MODIFICATIONS	Explore
SR01-068	Provide median landscaping that does not require irrigation	1 = ACCEPT	
SR01-054	Identify potential water sources for the project in the Special Provisions.	1 = ACCEPT	
SR01-077	Have Pima County perform materials testing.	3 = DECLINE	
SR06-001	Use a performance specification to compete different retaining wall systems against each other during bidding.	2 = ACCEPT w/ MODIFICATIONS	Explore