Final Value Analysis Study Report

Mount Vernon Avenue Bridge Replacement – City of San Bernardino

Task Order No. 117

August 2011

Prepared by

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Date: August 2, 2011

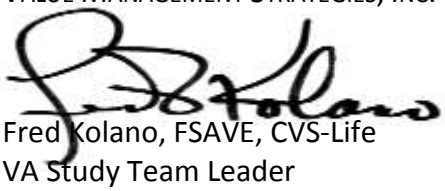
To: Mohan Char, AECOM
Mike Grubbs, City of San Bernardino

Subject: Final VA Study Report (Task Order 117)
Mount Vernon Avenue Bridge – City of San Bernardino

Value Management Strategies, Inc. is pleased to transmit the Final VA Study Report for the referenced project. This report reflects the If you have any questions or comments concerning this final report, please do not hesitate to contact me at (970) 216-1739 or email fred@vms-inc.com.

Sincerely,

VALUE MANAGEMENT STRATEGIES, INC.



Fred Kolano, FSAVE, CVS-Life
VA Study Team Leader

Copy: (PDF) Addressees
(PDF) Anthony Robinson, Caltrans DVAC
(PDF) Richel Espinoza-Noss, Caltrans HQ VA Branch

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VA STUDY SUMMARY REPORT

FINAL RESULTS

VA Study Summary Report – Final Results

Mount Vernon Avenue Bridge Replacement – City of San Bernardino

A Value Analysis (VA) study, sponsored by LAN Engineering and facilitated by Value Management Strategies, Inc., was conducted for the Mount Vernon Avenue Bridge Replacement Project in the City of San Bernardino, California. The VA study was conducted February 13-15, 2008. This *VA Study Summary Report – Final Results* provides an overview of the project, key findings, and the accepted and rejected alternatives developed by the VA team.

PROJECT DESCRIPTION

The project will replace the existing bridge on Mount Vernon Avenue that crosses the Burlington Northern Santa Fe Railroad (BNSF). The existing bridge is deteriorated and in need of replacement. The plan is to close Mount Vernon Avenue, a major arterial for the City of San Bernardino, and demolish half the bridge, longitudinally, so that the other half can be used to stage the construction of the first phase of the new bridge. Once Phase I is complete, the remaining existing bridge will be demolished and the new bridge completed using the newly completed segment to stage construction. The cost for this alternative is estimated to be $40,656,000.

PROJECT PURPOSE AND NEED

The purpose of the project is to replace the existing bridge on Mount Vernon Avenue over the BNSF yard. This is needed because the current bridge is deteriorating and requires replacing. The new bridge will be on the same alignment as the current bridge.

VA STUDY TIMING

The VA study was conducted late in the PA&ED Phase, which was to be completed in May 2008. The project is scheduled for completion in April 2014.

VA STUDY OBJECTIVES

The objective of the VA study was to identify value-improving alternatives to the original design concept that will improve value by improving performance and reducing cost, and possibly identify value alternatives that can reduce project risk.

KEY PROJECT ISSUES

The items listed below are the key drivers, constraints, or issues being addressed by the project and considered during this VA study to identify possible improvements.

- The existing bridge is in a deteriorating condition and needs replacement. Presently, the bridge is shored to provide support for cracked steel bridge members.
- It is essential that the construction of the new bridge minimizes disruption to the Burlington Northern Santa Fe Railroad (BNSF) operations, which are spanned by the existing and proposed bridges. There are 17 tracks in service in the railroad yard.
- There will be impacts to the residents of homes that are at the southwest end of the existing bridge. The retaining walls will be very close to these homes. An alleyway behind the homes is proposed to be widened to 30 feet to accommodate vehicular traffic to these homes.
- This project is proposed to be funded through the Caltrans Office of Local Assistance under the Highway Bridge Replacement Program (HBRP).

Performance Attributes
Railroad Operations
Local Operations
Construction Impacts
Environmental
Delivery Schedule
Phaseability

VA STUDY RESULTS

The main benefit of this VA study is that the accepted alternatives will save construction time, and in turn, reduce inconvenience to motorists. The implemented alternatives will cost the project approximately $1.9 million, resulting in a performance improvement of 30% and a value improvement of 24%. In addition to the construction time savings of approximately one month, there will be added benefit gained from a reduced environmental document process because of the acquisition of several residential properties and one business on the west side of the project. This will also facilitate design activities.

The accepted alternatives are discussed on the following page, along with the alternative number and title, and cost savings and performance that were validated by the Project Development Team (PDT)

after the VA study. The rejected alternatives, and their respective reasons for rejection, can be found following the descriptions of accepted alternatives.

Alternative No. and Description	Initial Cost Savings	Performance Change
1.0 Construct Columns at Least Six Feet in Diameter to Allow Elimination of Crash Protection Walls	**$535,000**	**+26%**
This VA alternative proposes to construct columns that are at least 6 feet in diameter (at least 30 square feet is the requirement) and eliminate the crash barrier.		
2.0 Use Prefabricated Bridge Components, Such as Larger Diameter Steel Shell Piles and Pre-Cast Bent Caps	**$240,000**	**+17%**
This VA alternative proposes to use prefabricated bridge components, such as a larger diameter steel shell piles and pre-cast bent caps.		
3.2 Construct Cast-in-Steel-Shell Piles with the Column Extension through the Existing Bridge Deck to Allow All Piling to be Constructed in One Phase	**($1,835,000)**	**+15%**
This VA alternative proposes to use four 72-inch diameter steel pipe piles per pier that are installed open ended by driving them into the soils. This alternative would require the full 40-foot width of half a section of the superstructure to be constructed per phase.		
4.0 Drive Piles (Cast-in-Steel-Shell Piles) in lieu of Drilling and Pouring Piles (Cast-in-Drilled-Hole)	**Cannot Quantify**	**+11%**
This VA alternative proposes to support the bridge on large diameter open-ended cast-in-steel-shell (CISS) piles at the bents with column extensions.		
5.0 Acquire Several Residential and One Business Property on the West Side of the Project to Facilitate Design and Construction	**($830,000)**	**+10%**
This VA alternative proposes to purchase several private properties and businesses to facilitate the design and construction of the project.		

Net Effect of Accepted VA Alternatives

Accepted Alternatives	Initial Cost Savings	Performance Change	Value Change
1.0, 2.0, 3.2, 4.0, 5.0	($1,890,000)	+30%	+24%

REJECTED VA ALTERNATIVES – Reason for Rejection

3.1 Use Four Pile Bents (Six Feet in Diameter) in lieu of Three Pile Bents

This alternative is rejected because the columns are already overdesigned at six feet in diameter to avoid the crash protection walls; therefore, there is no structural advantage to adding pile bents. Also, implementation would add more work in the rail yard because of installation of four pile bents.

6.0 Construct the Bridge Girders Partially of Pre-Cast Concrete and Partially of Steel

This alternative is rejected because the savings are questionable and we do not want to mix long-term maintenance requirements of steel and concrete. The different component depths would not be esthetically pleasing. Also, long-term fatigue cracking of steel is a concern.

VA TEAM

VA Study Team

Name	Organization	Title
Fred Kolano	Value Management Strategies, Inc.	VA Study Team Leader
Mike Grubbs	City of San Bernardino	Project Manager
Don Lozano	BNSF Railroad	Bridge Department
George Plaas	LAN Engineering	Bridge Engineer
Bob Price	LAN Engineering	Senior Bridge Engineer
Charlotte Sheehan	Caltrans	Environmental
John Voepel	LAN Engineering	Roadway

Key Project Contacts

Name	Organization	Title
Mike Grubbs	City of San Bernardino	Project Manager
Robert Eisenbeisz	City of San Bernardino	City Engineer
William Nascimento	LAN Engineering	Project Manager
Alicia Colburn	LAN Engineering	Environmental Manager
Anthony Robinson	Caltrans District 8	District VA Coordinator

VA ALTERNATIVES

VALUE ANALYSIS ALTERNATIVES

INTRODUCTION

The results of this study are presented as individual alternatives to the original concept. The VA alternative documents in this section are presented as written by the team during the VA Study. While they have been edited from the Preliminary VA Report to correct errors or better clarify the alternatives, they represent the VA team's findings during the VA Study.

The Implementation Action forms located behind the Summary of VA Alternatives reflects the accepted or conditionally accepted VA alternative cost and performance values. The individual VA alternatives are not edited to reflect cost and performance changes of the implementation dispositions. Added back-up information to support the validation of cost or performance changes may follow an implementation form, if available, to document the changes.

VA ALTERNATIVES

Each alternative consists of a summary of the original concept, a description of the suggested change, a listing of its advantages and disadvantages, a cost comparison, change in performance*, and a brief narrative comparing the original design with the alternative. Sketches, calculations, and performance measure ratings are also presented. The cost comparisons reflect a comparable level of detail as in the original estimate. A life cycle benefit-cost analysis for major alternatives is included where appropriate.

The alternatives in this section are as they were originally prepared by the VA team, and any changes to the cost or performance measures are documented in the Implementation Action forms.

* Please refer to the Project Analysis section of this report for an explanation of how the performance measures are calculated.

OTHER CONSIDERATIONS

The VA team generated several design suggestions for consideration by the project development team. These items represent ideas that are relatively general in nature, and are listed below.

- Install a utility duct and water line alongside the bridge.
- Incentivize the contractor for an early finish and also include liquidated damages for a late finish.
- Bring beams into the railroad yard to simplify construction.
- Construct archway on the ends of the bridge.
- Construct six-foot sidewalks in lieu of five-foot sidewalks on the bridge.
- Keep driveways near Kingman Avenue.
- Use painted murals on the walls in lieu of texturizing the walls.
- Use low-level hazardous material as embankment.

- Use the park area in the southeast end of the existing bridge as a detention pond.
- Perform a paleoarcheology study before going deeper than 15 feet.

SUMMARY OF PROPOSED VA ALTERNATIVES ***Mount Vernon Avenue Bridge Replacement – City of San Bernardino***			
Number	**Description**	**Potential Initial Savings**	**Performance**
1.0	Construct Columns at Least Six Feet in Diameter to Allow Elimination of Crash Protection Walls	$535,000	+26%
2.0	Use Prefabricated Bridge Components, Such as Larger Diameter Steel Shell Piles and Pre-Cast Bent Caps	$240,000	+17%
3.1	Use Four Pile Bents (Six Feet in Diameter) in lieu of Three Pile Bents	($1,850,000)	+7%
3.2	Construct Cast-in-Steel-Shell Piles with the Column Extension through the Existing Bridge Deck to Allow All Piling to be Constructed in One Phase	($1,835,000)	+15%
4.0	Drive Piles (Cast-in-Steel-Shell Piles) in lieu of Drilling and Pouring Piles (Cast-in-Drilled-Hole)	Cannot Quantify	+11%
5.0	Acquire Several Residential and One Business Property on the West Side of the Project to Facilitate Design and Construction	($830,000)	+10%
6.0	Construct the Bridge Girders Partially of Pre-Cast Concrete and Partially of Steel	($4,900,000)	+9%

IMPLEMENTATION ACTION — VA ALTERNATIVE 1.0

Construct Columns at Least Six Feet in Diameter to Allow Elimination of Crash Protection Walls

Responses prepared by: *Fred Kolano per Michael Grubbs* ***Date:*** July 26, 2011

Disposition:	Accept
Validated Initial Cost Savings:	$535,000
Validated LCC Savings:	$0
Project Development Support Cost Savings:	$0
Validated Schedule Savings:	~1 month
Validated Performance:	+26%

If Alternative is Rejected: *Was rejection due to VA study taking place too late in the project development process to implement the change?* **N/A**

Technical Feasibility: This alternative is technically feasible as proposed.

Validated Performance: The performance improvement of +26% is validated.

Implementable Portions: This alternative can be implemented in full.

Project Development Delivery Impacts: Less construction time needed; could save up to as much as one month.

Other Comments: None.

Acceptance of alternatives denotes intent to implement, based on current information, in the given project development phase (PID, PA&ED or PS&E). It is recognized that future conditions may change this disposition. The validation of disposition and the cost and performance changes for the alternative are required by Caltrans to ensure that the project decision makers agree with the study results. These validated results become the basis for the VA Program reportables.

IMPLEMENTATION ACTION — VA ALTERNATIVE 2.0

Use Prefabricated Bridge Components, Such as Larger Diameter Steel Shell Piles and Pre-Cast Bent Caps

Responses prepared by: *Fred Kolano per Michael Grubbs* ***Date:*** July 26, 2011

Disposition:	Accept
Validated Initial Cost Savings:	$240,000
Validated LCC Savings:	$0
Project Development Support Cost Savings:	$0
Validated Schedule Savings:	~1month
Validated Performance:	+17%

If Alternative is Rejected: *Was rejection due to VA study taking place too late in the project development process to implement the change?* **N/A**

Technical Feasibility: This alternative is technically feasible as proposed.

Validated Performance: The performance improvement of +17% is validated.

Implementable Portions: This alternative can be implemented in full.

Project Development Delivery Impacts: Less construction time needed; could save up to as much as one month.

Other Comments: None.

Acceptance of alternatives denotes intent to implement, based on current information, in the given project development phase (PID, PA&ED or PS&E). It is recognized that future conditions may change this disposition. The validation of disposition and the cost and performance changes for the alternative are required by Caltrans to ensure that the project decision makers agree with the study results. These validated results become the basis for the VA Program reportables.

IMPLEMENTATION ACTION — VA ALTERNATIVE 3.1

Use Four Pile Bents (Six Feet in Diameter) in lieu of Three Pile Bents

Responses prepared by: *Fred Kolano per Michael Grubbs* ***Date:*** July 26, 2011

Disposition:	Reject
Validated Initial Cost Savings:	N/A
Validated LCC Savings:	N/A
Project Development Support Cost Savings:	N/A
Validated Schedule Savings:	N/A
Validated Performance:	N/A

If Alternative is Rejected: *Was rejection due to VA study taking place too late in the project development process to implement the change?* **No**

Technical Feasibility:

Validated Performance:

Implementable Portions:

Project Development Delivery Impacts:

Other Comments: This alternative is rejected because the columns are already overdesigned at 6 feet in diameter to avoid the crash protection walls; therefore, there is no structural advantage to adding pile bents. Also, implementation would add more work in the rail yard because of installation of four pile bents.

Acceptance of alternatives denotes intent to implement, based on current information, in the given project development phase (PID, PA&ED or PS&E). It is recognized that future conditions may change this disposition. The validation of disposition and the cost and performance changes for the alternative are required by Caltrans to ensure that the project decision makers agree with the study results. These validated results become the basis for the VA Program reportables.

IMPLEMENTATION ACTION — VA ALTERNATIVE 3.2

Construct Cast-in-Steel-Shell Piles with the Column Extension through the Existing Bridge Deck to Allow All Piling to be Constructed in One Phase

Responses prepared by: *Fred Kolano per Michael Grubbs* ***Date:*** July 26, 2011

Disposition:	Accept
Validated Initial Cost Savings:	($1,835,000)
Validated LCC Savings:	$0
Project Development Support Cost Savings:	$0
Validated Schedule Savings:	1 months
Validated Performance:	+15%

If Alternative is Rejected: *Was rejection due to VA study taking place too late in the project development process to implement the change?* **N/A**

Technical Feasibility: This alternative is technically feasible as proposed.

Validated Performance: The performance improvement of +26% is validated.

Implementable Portions: This alternative can be implemented in full.

Project Development Delivery Impacts: Implementation of this alternative saves construction time and allows for traffic use earlier; say one month.

Other Comments: None.

Acceptance of alternatives denotes intent to implement, based on current information, in the given project development phase (PID, PA&ED or PS&E). It is recognized that future conditions may change this disposition. The validation of disposition and the cost and performance changes for the alternative are required by Caltrans to ensure that the project decision makers agree with the study results. These validated results become the basis for the VA Program reportables.

IMPLEMENTATION ACTION — VA ALTERNATIVE 4.0

Drive Piles (Cast-in-Steel-Shell Piles) in lieu of Drilling and Pouring Piles (Cast-in-Drilled-Hole)

Responses prepared by: *Fred Kolano per Michael Grubbs* ***Date:*** July 26, 2011

Disposition:	Accept
Validated Initial Cost Savings:	Cannot Quantify
Validated LCC Savings:	$0
Project Development Support Cost Savings:	$0
Validated Schedule Savings:	~1 months
Validated Performance:	+11%

If Alternative is Rejected: *Was rejection due to VA study taking place too late in the project development process to implement the change?* **N/A**

Technical Feasibility: This alternative is technically feasible as proposed.

Validated Performance: The performance improvement of +11% is validated.

Implementable Portions: This alternative can be implemented in full.

Project Development Delivery Impacts: Less construction activity; could be up to a one-month decrease.

Other Comments: Cost savings for this alternative could not be quantified at the time of the VA study because factors needed for computation were unknown or unquantifiable.

Acceptance of alternatives denotes intent to implement, based on current information, in the given project development phase (PID, PA&ED or PS&E). It is recognized that future conditions may change this disposition. The validation of disposition and the cost and performance changes for the alternative are required by Caltrans to ensure that the project decision makers agree with the study results. These validated results become the basis for the VA Program reportables.

IMPLEMENTATION ACTION — VA ALTERNATIVE 5.0

Acquire Several Residential and One Business Property on the West Side of the Project to Facilitate Design and Construction

Responses prepared by: *Fred Kolano per Michael Grubbs* ***Date:*** July 26, 2011

Disposition:	Accept
Validated Initial Cost Savings:	($830,000)
Validated LCC Savings:	$0
Project Development Support Cost Savings:	$0
Validated Schedule Savings:	~1 month
Validated Performance:	+10%

If Alternative is Rejected: *Was rejection due to VA study taking place too late in the project development process to implement the change?* **N/A**

Technical Feasibility: This alternative is technically feasible as proposed.

Validated Performance: The performance improvement of +10% is validated.

Implementable Portions: This alternative can be implemented in full.

Project Development Delivery Impacts: Less construction time and less time needed for environmental document preparation because of elimination of the acquisition of nearby properties could save up to one month.

Other Comments: None.

Acceptance of alternatives denotes intent to implement, based on current information, in the given project development phase (PID, PA&ED or PS&E). It is recognized that future conditions may change this disposition. The validation of disposition and the cost and performance changes for the alternative are required by Caltrans to ensure that the project decision makers agree with the study results. These validated results become the basis for the VA Program reportables.

IMPLEMENTATION ACTION — VA ALTERNATIVE 6.0

Construct the Bridge Girders Partially of Pre-Cast Concrete and Partially of Steel

Responses prepared by: *Fred Kolano per Michael Grubbs* ***Date:*** July 26, 2011

Disposition:	Reject
Validated Initial Cost Savings:	N/A
Validated LCC Savings:	N/A
Project Development Support Cost Savings:	N/A
Validated Schedule Savings:	N/A
Validated Performance:	N/A

If Alternative is Rejected: *Was rejection due to VA study taking place too late in the project development process to implement the change?* **No**

Technical Feasibility:

Validated Performance:

Implementable Portions:

Project Development Delivery Impacts:

Other Comments: This alternative is rejected because the savings are questionable and we do not want to mix long-term maintenance requirements of steel and concrete. The different component depths would not be esthetically pleasing. Also, long-term fatigue cracking of steel is a concern.

Acceptance of alternatives denotes intent to implement, based on current information, in the given project development phase (PID, PA&ED or PS&E). It is recognized that future conditions may change this disposition. The validation of disposition and the cost and performance changes for the alternative are required by Caltrans to ensure that the project decision makers agree with the study results. These validated results become the basis for the VA Program reportables.

VALUE ANALYSIS ALTERNATIVE

Mount Vernon Avenue Bridge Replacement – City of San Bernardino

FUNCTION:	Replace Bridge	**IDEA NO.** RB-23	**NUMBER** 1.0
TITLE:	Construct Columns at Least Six Feet in Diameter to Allow Elimination of Crash Protection Walls		**PAGE NO.** 1 of 4

ORIGINAL CONCEPT:

The original design proposes to construct crash walls for column protection from derailments or shifting railcar loads.

ALTERNATIVE CONCEPT:

This VA alternative proposes to construct columns that are at least six feet in diameter (at least 30 square feet is the requirement) and eliminate the crash barrier.

ADVANTAGES:

- Saves cost of the crash wall
- Less soil to excavate; less chance of encountering hazardous material and artifacts

DISADVANTAGES:

- None noted

COST SUMMARY	Initial Cost	Present Value Subsequent Cost	Present Value Highway User Cost	Net Present Value
Original Concept	$ 535,000	$ 0	$ 0	$ 535,000
Alternative Concept	$ 0	$ 0	$ 0	$ 0
Savings	$ 535,000	$ 0	$ 0	$ 535,000

Performance Attribute Impacts

Mainline Operations	Local Operations	Maintenance	Environmental	Construction Impacts	Delivery Schedule	Performance Change
0	**+**	**0**	**+**	**+**	**+**	**+26%**

DISCUSSION / JUSTIFICATION:

This concept will keep construction activities at minimum in the railroad yard and reduce the needed track time to perform construction activities. It also reduces the contractor's risk of injury and completion because of less interference with the railroad and possible delays to the contractors. In addition, there would be less volume of hazardous materials to be handled.

This could also reduce the bid value related to unknown contingencies because of lower risk.

TECHNICAL REVIEWER COMMENTS:

None noted.

PROJECT MANAGEMENT CONSIDERATIONS:

Minor redesign.

Get preapproval from the Burlington Northern Santa Fe Railroad (BNSF).

PERFORMANCE MEASURES *Mount Vernon Avenue Bridge Replacement – City of San Bernardino*			
TITLE: Construct Columns at Least Six Feet in Diameter to Allow Elimination of Crash Protection Walls		**NUMBER** 1.0	**PAGE NO.** 3 of 4
ATTRIBUTES and RATING RATIONALE for ALTERNATIVE	**Performance**	**Original**	**Alternative**
Railroad Operations Less disruption and excavation in the active track area.	Rating	5	7
	Weight	33	33
	Contribution	165	231
Local Operations Shortens the project schedule.	Rating	5	6
	Weight	27	27
	Contribution	135	162
Construction Impacts Less exposure to track operations.	Rating	5	6
	Weight	13	13
	Contribution	65	78
Environmental Less chance of encountering hazardous material.	Rating	5	6
	Weight	13	13
	Contribution	65	78
Delivery Schedule Less time to design and construct.	Rating	5	6
	Weight	10	10
	Contribution	50	60
Phaseability No change.	Rating	5	5
	Weight	4	4
	Contribution	20	20
	Rating		
	Weight		
	Contribution		
	Rating		
	Weight		
	Contribution		
Total Performance:		**500**	**629**
Net Change in Performance:			**+26%**

Elimination of concrete for crash barrier: $253,000 x 1.2 = $303,600, say **$305,000**

Elimination of excavation: 4 ft wide x 5 ft deep x 100 feet long = 2,000 cf / 27 = 74 cy, say 75 cy x 8 locations = 600 cy x $51/cm = approximately $40/cy = $24,000 x 1.2 markup = $28,800, say **$30,000**

Elimination of reinforcing steel: Assume $20,000 x 1.2 = **$24,000**

Elimination of backfill: Assume $20,000 x 1.2 = **$24,000**

Elimination of hazardous material handling cost: Assume a one-half reduction $300,000 / 2 = **$150,000**

Increased column cost: Assume this is a minor cost change.

Total = $533,000, say $535,000

VA TEAM ALTERNATIVE REVIEW *Mount Vernon Avenue Bridge Replacement – City of San Bernardino*		
TITLE:	Construct Columns at Least Six Feet in Diameter to Allow Elimination of Crash Protection Walls	**NUMBER** 1.0

Team Member:	ALL TEAM MEMBERS
☑ Agree as Written ☐ Disagree as Written	Comments:

VALUE ANALYSIS ALTERNATIVE

Mount Vernon Avenue Bridge Replacement – City of San Bernardino

FUNCTION:	Replace Bridge	**IDEA NO.** RB-4	**NUMBER** 2.0
TITLE:	Use Prefabricated Bridge Components, Such as Larger Diameter Steel Shell Piles and Pre-Cast Bent Caps		**PAGE NO.** 1 of 4

ORIGINAL CONCEPT:

The original design proposes to use cast-in-drilled-hole (CIDH) piles and cast-in-place pier caps.

ALTERNATIVE CONCEPT:

This VA alternative proposes to use prefabricated bridge components, such as a larger diameter steel shell piles and pre-cast bent caps

ADVANTAGES:

- Speeds up construction time
- Reduces worker exposure to train operations
- Eliminates formwork for pier cap fabrication and CIDH aboveground formwork
- Reduces risk of CIDH shaft cave in

DISADVANTAGES:

- Lifting heavy pile caps would require larger cranes

COST SUMMARY	Initial Cost	Present Value Subsequent Cost	Present Value Highway User Cost	Net Present Value
Original Concept	$ 240,000	$ 0	$ 0	$ 240,000
Alternative Concept	$ 0	$ 0	$ 0	$ 0
Savings	$ 240,000	$ 0	$ 0	$ 240,000

Performance Attribute Impacts

Mainline Operations	Local Operations	Maintenance	Environmental	Construction Impacts	Delivery Schedule	Performance Change
0	**+**	**0**	**0**	**+**	**+**	**+17%**

DISCUSSION / JUSTIFICATION:

Drilling a hole into soils has risks that the hole's sides could cave in, which results in an underground cavity that is much larger in diameter than intended. The cavity could undermine an adjacent railroad track or Travelift crane runway. It also carries the risk of using more concrete for backfill. Utilizing steel casing and driving the pile open ended eliminates the risk of caving. It also reduces the volume of soil to be removed.

Casing pipe extended all the way up to the bottom of the bent cap eliminates the need for men and materials to construct formwork between live railroad tracks. Access to the bent location can be very difficult. Materials delivery will be difficult. Form removal will be difficult.

Steel pipe pile will offer greater resistance to seismic base shear. Steel casing will be better able to withstand accidental damage due to shifting loads on railroad cars and railcar derailments.

Steel materials can be A-588 self-sealing steel; therefore, paint will not be necessary.

Pre-cast bent caps will eliminate the need for constructing formwork near and above live railroad operations.

This concept will keep construction activities at minimum in the railroad yard and reduce the needed track time to perform construction activities. It also reduces the contractor's risk of injury and completion because of less interference with the railroad and possible delays to the contractors.

This could also reduce the bid value related to unknown contingencies because of lower risk.

TECHNICAL REVIEWER COMMENTS:

Technically feasible, could be done relatively easily, maybe pier caps could not be done because of space limitations.

PROJECT MANAGEMENT CONSIDERATIONS:

Requires incorporating this concept into the design.

Caltrans Structures local assistance approval would be needed.

Verify the clearance for cast-in-place bent cap formwork.

PERFORMANCE MEASURES *Mount Vernon Avenue Bridge Replacement – City of San Bernardino*			
TITLE: Use Prefabricated Bridge Components, Such as Larger Diameter Steel Shell Piles and Pre-Cast Bent Caps	**NUMBER** 2.0	**PAGE NO.** 3 of 4	
ATTRIBUTES and RATING RATIONALE for ALTERNATIVE	**Performance**	**Original**	**Alternative**
Railroad Operations Reduces risk to railroad operations; decreases overall time to complete project	Rating	5	6
	Weight	33	33
	Contribution	165	198
Local Operations Decreases overall project construction times, allowing the bridge to reopen to traffic.	Rating	5	6
	Weight	27	27
	Contribution	135	162
Construction Impacts Decreases overall project construction times, thus allowing traffic to resume on the new bridge.	Rating	5	6
	Weight	13	13
	Contribution	65	78
Environmental No change.	Rating	5	5
	Weight	13	13
	Contribution	65	65
Delivery Schedule Decreases overall project construction times, thus allowing traffic to resume on the new bridge.	Rating	5	6
	Weight	10	10
	Contribution	50	60
Phaseability No change.	Rating	5	5
	Weight	4	4
	Contribution	20	20
	Rating		
	Weight		
	Contribution		
	Rating		
	Weight		
	Contribution		
Total Performance:		**500**	**583**
Net Change in Performance:			**+17%**

Reductions

Structural concrete (bridge): 8 bents x 80 long x 8 feet wide x 8 high = 40,960 cf / 27 cf/cy = 1,517 cy, say 1,500 x ($913 m^3 = approximately $700/cy) x $700 = $1,050,000

Reinforcing steel: Assume 1,500 cy (includes falsework) @ 250 pounds / cy = 375,000 pounds x ($3/kg / 2.2 pounds/kg = $1.36 per pound) x $1.36 = $510,000

Reductions = $1,560,000

Increases

Furnish pre-cast bent cap 2 stages per bent x 8 bents = 16 caps x assume $80,000 per cap (includes transportation and connection costs) = $1,280,000

Erection cost assume $5,000 per unit x 16 caps = $80,000

Total increases = $1,360,000

Net = $1,560,000 - $1,360,000 = $200,000 x 1.2 project markup = **$240,000**

VA TEAM ALTERNATIVE REVIEW *Mount Vernon Avenue Bridge Replacement – City of San Bernardino*		
TITLE:	Use Prefabricated Bridge Components, Such as Larger Diameter Steel Shell Piles and Pre-Cast Bent Caps	**NUMBER** 2.0

Team Member:	ALL TEAM MEMBERS
☑ Agree as Written ☐ Disagree as Written	Comments:

VALUE ANALYSIS ALTERNATIVE *Mount Vernon Avenue Bridge Replacement – City of San Bernardino*			
FUNCTION:	Replace Bridge	**IDEA NO.** RB-22	**NUMBER** 3.1
TITLE:	Use Four Pile Bents (Six Feet in Diameter) in lieu of Three Pile Bents		**PAGE NO.** 1 of 8

ORIGINAL CONCEPT:

The original design concept proposes to utilize three five-foot diameter columns (with crash walls) per bent. Approximately eight bents consisting of a total of 24 columns are proposed to be constructed.

The bridge is proposed to be phase constructed. Phase I will consist of removal of the westerly 10 feet (more or less) of the existing bridge and constructing the westerly 30 feet (more or less) of the new bridge centered on one row of columns. The new portion of the bridge would be used as a platform to remove the existing bridge and construct the remainder of the new bridge (Phase II).

ALTERNATIVE CONCEPT:

This VA alternative proposes to increase the number of columns per bent to four for a total of 32 columns. The size of the columns would be increased to a six-foot diameter. Increasing the diameter would negate the requirement for crash walls; however, the number of piles would need to be increased in kind.

Under the alternative concept, the bridge would be phase constructed in a manner similar to the original proposal; however, Phase I would utilize two columns per supporting bent instead of one. This arrangement would give a sounder supporting structure for removal of the existing bridge and construction of the remainder of the new bridge.

The team felt that Environmental, Delivery Schedule, and Phaseability would be improved; however, construction would be more complex and cost would increase somewhat.

ADVANTAGES:

- Improves flexibility to locate columns
- Better foundation construction
- Reduces collapse potential that could result from impact from a railroad derailment event or shifted rail load
- Four piles could be shallower
- Construction risk would be reduced because there would be a more stable working platform to construct Phase II

DISADVANTAGES:

- Might encounter utilities
- Makes construction more complex
- More cost to place the bents

COST SUMMARY	Initial Cost	Present Value Subsequent Cost	Present Value Highway User Cost	Net Present Value
Original Concept	$ 0	$ 0	$ 0	$ 0
Alternative Concept	$ 1,850,000	$ 0	$ 0	$ 1,850,000
Savings	$ (1,850,000)	$ 0	$ 0	$ (1,850,000)

Performance Attribute Impacts

Mainline Operations	Local Operations	Maintenance	Environmental	Construction Impacts	Delivery Schedule	Performance Change
0	**0**	**0**	**0**	+	+	**+7%**

DISCUSSION / JUSTIFICATION:

To minimize impacts on the railroad yard, the original design proposed to construct the bridge in two phases. The proposed sequencing of construction will allow most of the existing bridge to remain and be used as a platform to construct the westerly 30 feet (more or less) of the new bridge. The original design proposes to use three five-foot diameter columns with crash walls per bent.

The team has identified two weaknesses in the original design:

1. The columns, which are five feet in diameter, will require crash walls adjacent to the railroad tracks at an additional cost of approximately $385,000. The construction of the crash walls will cause disruption of work in the railroad and require additional excavation of contaminated soil.
2. Phase I of the construction will involve installation of one row of columns and placement of the deck atop the columns. The team felt that adding a second column would improve stability and safety during Phase I construction.

Increasing the number of columns may increase the cost somewhat, but the change would provide a much more stable platform for executing Phase II. Also, overall structural stability of the new bridge would be greatly improved.

A six-foot column would be better than the five-foot column because it provides more stability.

Suggestion: Consider changing the feed direction of the water line and electrical lines. They could be eliminated under the bridge.

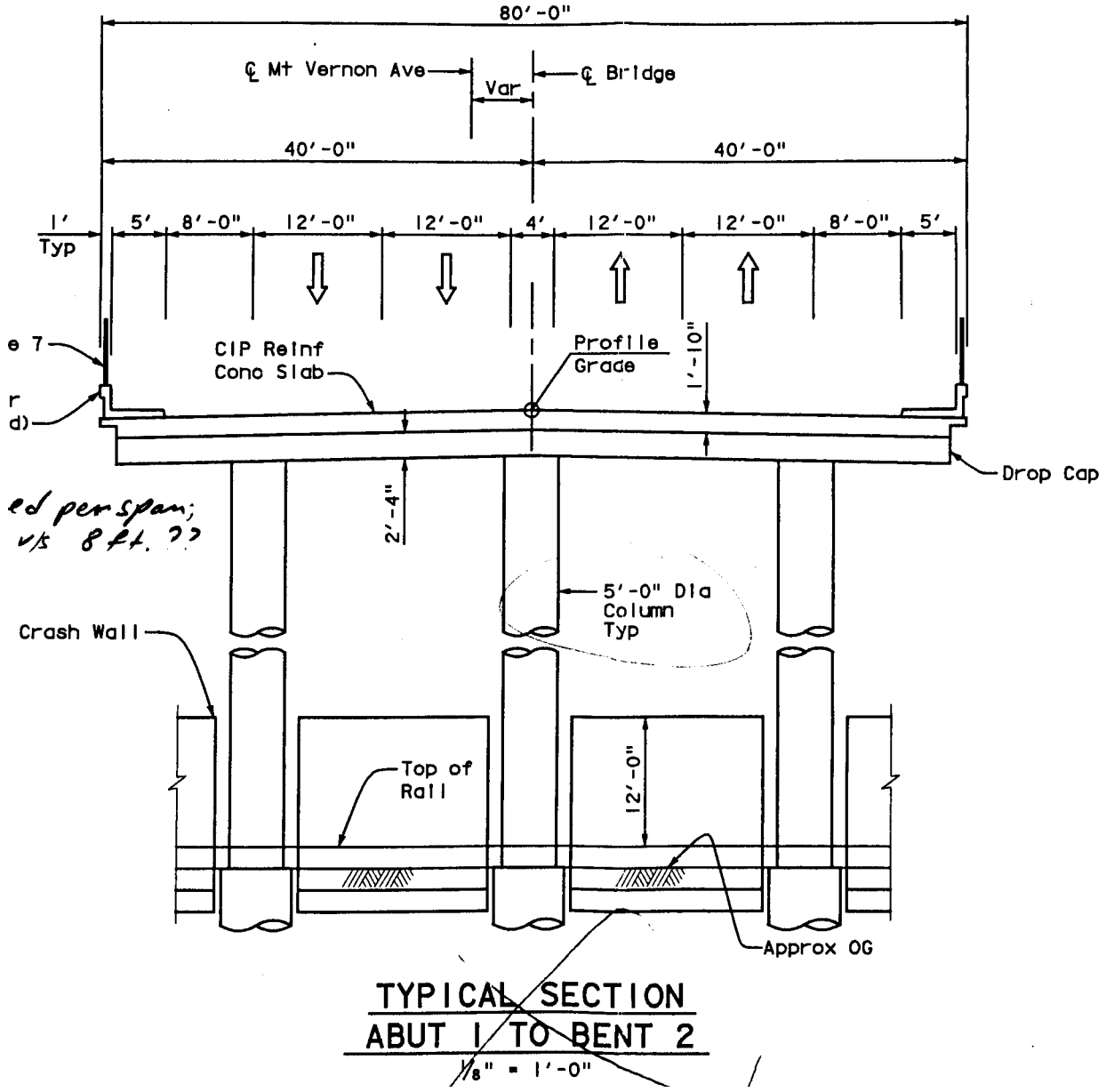
TECHNICAL REVIEWER COMMENTS:

Technically feasible.

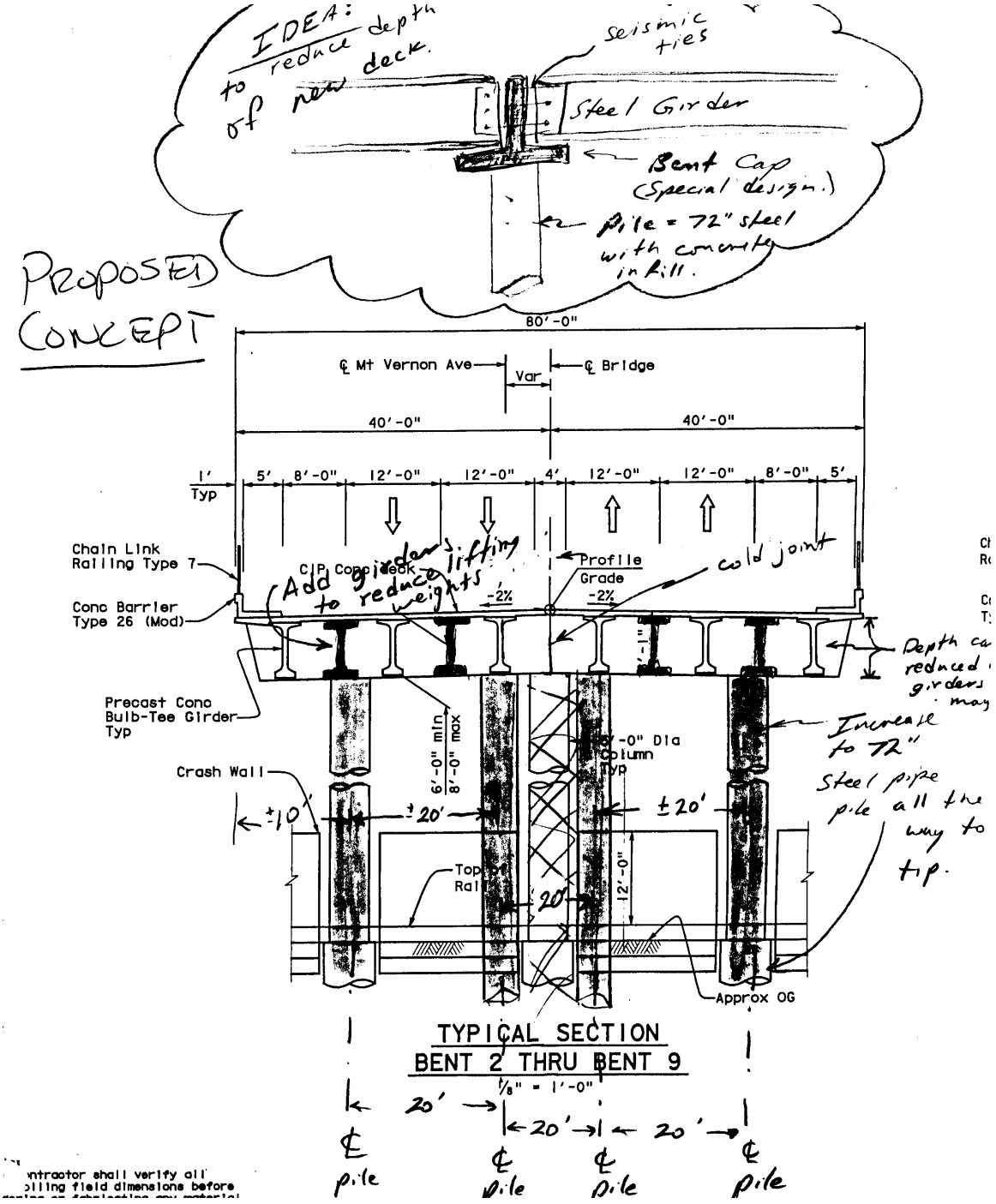
PROJECT MANAGEMENT CONSIDERATIONS:

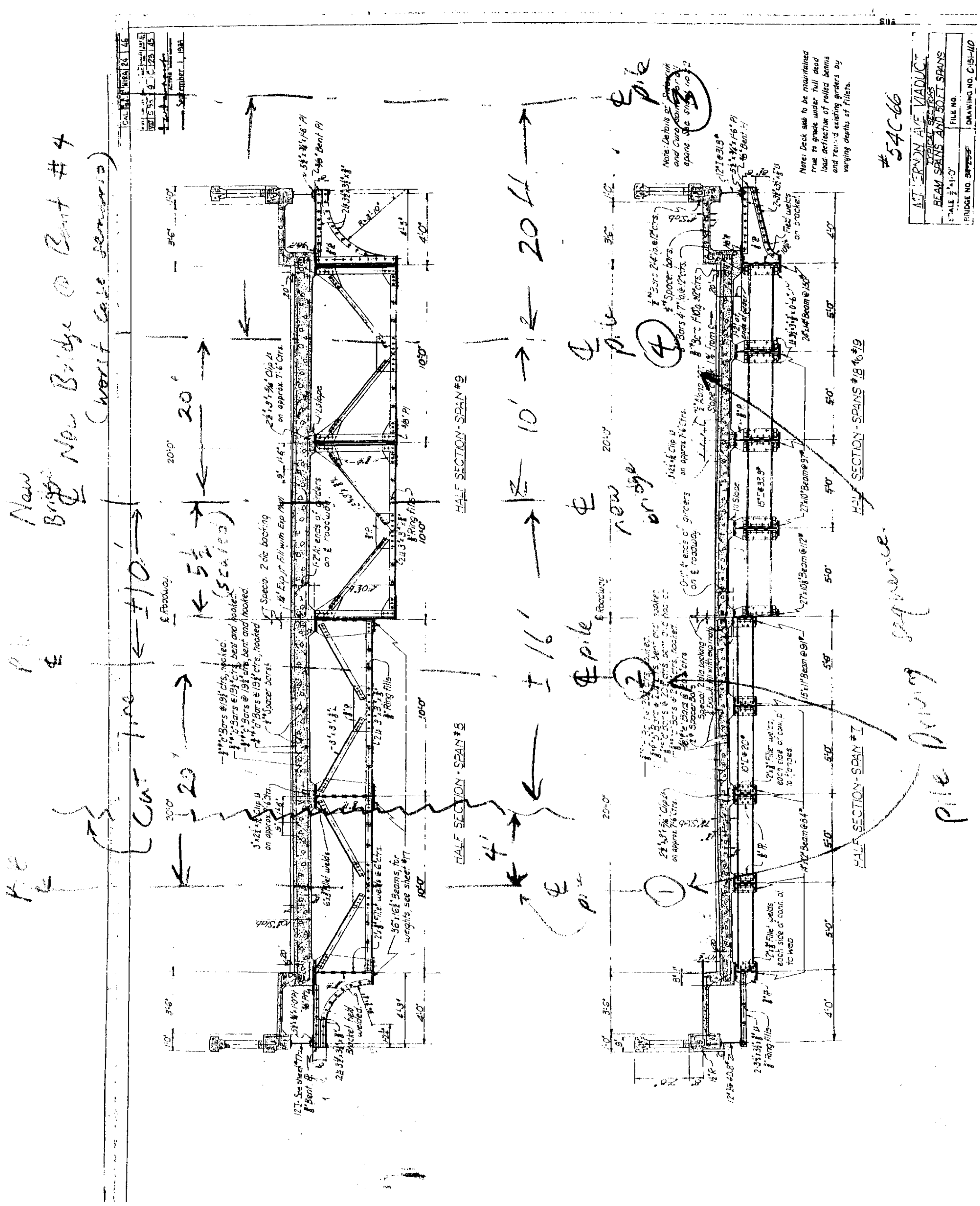
1. The City would have to program additional matching funds. Currently, the City is responsible for 11.5% of the cost of the project. It may be necessary to run the change past the FHWA representative.
2. Utilities would have to be carefully investigated and potholed to insure that none will conflict with the placement of large diameter piles.

ORIGINAL CONCEPT



TYPICAL SECTION
ABUT 1 TO BENT 2
1/8" = 1'-0"


IDEA: reduce depth of new deck.
Seismic ties
Steel Girder
Bent Cap (Special design.)
Pile = 72" steel with concrete in fill.
PROPOSED CONCEPT
80'-0"
℄ Mt Vernon Ave
Var
℄ Bridge
40'-0"
40'-0"
1' Typ
5'
8'-0"
12'-0"
12'-0"
4'
12'-0"
12'-0"
8'-0"
5'
Chain Link Railing Type 7
Conc Barrier Type 26 (Mod)
C/P Concrete Deck
(Add girders, lifting to reduce weights
Profile Grade
-2%
-2%
cold joint
Precast Conc Bulb-Tee Girder Typ
Crash Wall
6'-0" min
8'-0" max
8'-0" Dia Column Typ
Increase to 72"
Steel pipe pile all the way to tip.
±10'
±20'
±20'
±20'
Top of Rail
12'-0"
Approx OG
TYPICAL SECTION
BENT 2 THRU BENT 9
1/8" = 1'-0"
20'
20'
20'
℄ pile
℄ pile
℄ pile
℄ pile



PERFORMANCE MEASURES *Mount Vernon Avenue Bridge Replacement – City of San Bernardino*			
TITLE: Use Four Pile Bents (Six Feet in Diameter) in lieu of Three Pile Bents	**NUMBER** 3.1		**PAGE NO.** 6 of 8
ATTRIBUTES and RATING RATIONALE for ALTERNATIVE	**Performance**	**Original**	**Alternative**
Railroad Operations No change.	Rating	5	5
	Weight	33	33
	Contribution	165	165
Local Operations No change.	Rating	5	5
	Weight	27	27
	Contribution	135	135
Construction Impacts Additional piles have to be installed that would provide a more stable construction platform. This would help construction and reduce construction impacts.	Rating	5	7
	Weight	13	13
	Contribution	65	91
Environmental No change.	Rating	5	5
	Weight	13	13
	Contribution	65	65
Delivery Schedule More stable working platform is provided by the new bridge; therefore, reduced risk for Phase II construction.	Rating	5	6
	Weight	10	10
	Contribution	50	60
Phaseability No change.	Rating	5	5
	Weight	4	4
	Contribution	20	20
	Rating		
	Weight		
	Contribution		
	Rating		
	Weight		
	Contribution		
Total Performance:		**500**	**536**
Net Change in Performance:			**+7%**

This alternative is highly dependent on being able to find locations for the pilings that are clear of utility conflicts, railroad conflicts, and conflicts with the existing bridge foundation.

This alternative assumes that three columns, five feet in diameter, may not be structurally adequate due to the construction stresses to be imposed on the new structure during stage construction. If that is not true, then this alternative will have no merit.

If implemented, a separate alternative to retain three columns per bent, but increase the column size to six feet in diameter, may negate much of the value of this alternative.

Assume 32 – 24 = 8 new large diameter piles.

Assume $1,632,000 for all piles / 24 piles = $68,000 per pile x 8 piles = $544,000.

Assume $25,000 for additional rebar per pile x 8 piles = $200,000.

Assume $100,000 for each column x 8 columns = $800,000.

Total $1,544,000 x 1.2 markup = $1,852,800, say $1,850,000.

Procedure

1. Remove westerly portion of the old bridge from the walkway to the center girder under the southbound lane (equals a ±12-foot wide slice).
2. Drive or drive/drill the most westerly pile of the new bridge (assuming 4 pile bents).
3. Cut a hole in the deck of the old southbound lane and drill/drive a second pile of new westerly bridge. Note: Might have to cut out an entire slice of the superstructure if the old bent caps interfere with the new pile.
4. Set the new westerly bridge bent caps and the new girders and cast the new deck.
5. Drill/drive the most easterly pile for the new northbound bridge (outside of the deck and old bridge).
6. Demolish the old bridge. Then install the last pile.

Notes

1. Re-space the new bridge bents per the sketch to avoid interference with the old bents.
2. Skew the new Bent #4 for the new bridge per the sketch. May have to skew other new bents to avoid old bent piles.
3. Look at the possibility of increasing the number of girders per span to get the girders to weigh less, such that smaller cranes can be used to place the girders. Smaller cranes may be necessary to avoid overloading the old bridge deck.
4. For the long 180-foot span, we will probably need to use steel girders rather than concrete.
5. If the old bridge deck does not calculate to support construction cranes, may be able to strengthen with a temporary timber falsework bent.

VA TEAM ALTERNATIVE REVIEW *Mount Vernon Avenue Bridge Replacement – City of San Bernardino*		
TITLE:	Use Four Pile Bents (Six Feet in Diameter) in lieu of Three Pile Bents	**NUMBER** 3.1

Team Member:	ALL TEAM MEMBERS
☑ Agree as Written ☐ Disagree as Written	Comments:

VALUE ANALYSIS ALTERNATIVE *Mount Vernon Avenue Bridge Replacement – City of San Bernardino*			
FUNCTION:	Replace Bridge	**IDEA NO.** RB-13	**NUMBER** 3.2
TITLE:	Construct Cast-in-Steel-Shell Piles with the Column Extension through the Existing Bridge Deck to Allow All Piling to be Constructed in One Phase		**PAGE NO.** 1 of 4

ORIGINAL CONCEPT:

The original design concept proposes to use three cast-in-drilled-hole (CIDH) piles and cast-in-place pier caps. The project would be phased by constructing a 25-foot width of the westerly new bridge supported by one CIDH pile, then using the newly constructed 25-foot width of the new bridge as a working platform for building the remainder of the new bridge (80 - 25 = 55 feet) width.

ALTERNATIVE CONCEPT:

This VA alternative proposes to use four 72-inch diameter steel pipe piles per pier that are installed open ended by driving them into the soils. This alternative would require the full 40-foot width of half a section of the superstructure to be constructed per phase. In order to achieve necessary depth, a small pilot hole may need to be drilled, or the interior of the steel pipe might need to be augured to remove interior soils as the pile is progressed downward to target depth.

Underground utility lines may or may not need to be relocated with both of these alternative pile types.

ADVANTAGES:

- Minimal impact to railroad operations
- Reduces worker exposure to train operations
- One mobilization of pile contractor in lieu of two

DISADVANTAGES:

- More difficult to demolish the existing bridge
- Restricts the location of the pile; must account for the existing bridge geometry

COST SUMMARY	Initial Cost	Present Value Subsequent Cost	Present Value Highway User Cost	Net Present Value
Original Concept	$ 0	$ 0	$ 0	$ 0
Alternative Concept	$ 1,835,000	$ 0	$ 0	$ 1,835,000
Savings	$ (1,835,000)	$ 0	$ 0	$ (1,835,000)

Performance Attribute Impacts						
Mainline Operations	**Local Operations**	**Maintenance**	**Environmental**	**Construction Impacts**	**Delivery Schedule**	**Performance Change**
0	**+**	**0**	**+**	**+**	**+**	**+15%**

VALUE ANALYSIS ALTERNATIVE *Mount Vernon Avenue Bridge Replacement – City of San Bernardino*			
TITLE:	Construct Cast-in-Steel-Shell Piles with the Column Extension through the Existing Bridge Deck to Allow All Piling to be Constructed in One Phase	**NUMBER** 3.2	**PAGE NO.** 2 of 4

DISCUSSION / JUSTIFICATION:

Drilling a hole into soils has risks of the hole's sides caving in, which results in an underground cavity that is much larger in diameter than intended. The cavity could undermine an adjacent railroad track or Travelift crane runway. It also carries the risk of using more concrete for backfill. Utilizing steel casing and driving the pile open ended eliminates the risk of caving. It also reduces the volume of soil to be removed.

Casing pipe extended all the way up to the bottom of the bent cap eliminates the need for men and materials to construct formwork between live railroad tracks. Access to the bent location can be very difficult. Material delivery will be difficult. Form removal will be difficult.

Steel pipe pile will offer greater resistance to seismic base shear. Steel casing will be better able to withstand accidental damage due to shifted loads on railroad cars and derailments.

Steel materials can be A-588 self-sealing steel such that paint will not be necessary.

Because the new bridge will be phased by constructing the westerly half first, then utilizing the new westerly half as a construction platform for the easterly half of the new structure, the westerly 40-foot width will be much more stable on two piles and offer greater work platform width for supporting cranes and pile drivers than the proposed 25-foot width of the original proposal.

This alternative will require surgical removal of a slice of the old bridge deck to allow clearance to install some of the new bent piles. Also, the new bridge deck will overhang the old bridge deck at some locations, which might make demolition more difficult.

Increasing the number of girders in the new bridge superstructure may be necessary to allow only the 30-foot width to be initially constructed if there are insurmountable clearance issues at certain locations.

TECHNICAL REVIEWER COMMENTS:

Technically feasible.

PROJECT MANAGEMENT CONSIDERATIONS:

Study the column and pile locations with respect to the existing bridge geometry to validate this concept.

PERFORMANCE MEASURES *Mount Vernon Avenue Bridge Replacement – City of San Bernardino*			
TITLE: Construct Cast-in-Steel-Shell Piles with the Column Extension through the Existing Bridge Deck to Allow All Piling to be Constructed in One Phase	**NUMBER** 3.2	**PAGE NO.** 3 of 4	
ATTRIBUTES and RATING RATIONALE for ALTERNATIVE	**Performance**	**Original**	**Alternative**
Railroad Operations No change.	Rating	5	5
	Weight	33	33
	Contribution	165	165
Local Operations Decreases overall project construction times, allowing the bridge to reopen to traffic.	Rating	5	6
	Weight	27	27
	Contribution	135	162
Construction Impacts Decreases overall project construction times, thus allowing traffic to resume on the new bridge.	Rating	5	6
	Weight	13	13
	Contribution	65	78
Environmental Decreases overall project construction times, thus allowing traffic to resume on the new bridge.	Rating	5	6
	Weight	13	13
	Contribution	65	78
Delivery Schedule Decreases overall project construction times, thus allowing traffic to resume on the new bridge.	Rating	5	7
	Weight	10	10
	Contribution	50	70
Phaseability No change.	Rating	5	5
	Weight	4	4
	Contribution	20	20
	Rating		
	Weight		
	Contribution		
	Rating		
	Weight		
	Contribution		
Total Performance:		**500**	**573**
Net Change in Performance:			**+15%**

Increases

Assume 32 – 24 = 8 new large diameter piles.

Assume $1,632,000 for all piles / 24 piles = $68,000 per pile x 8 piles = $544,000.

Assume $25,000 for additional rebar per pile x 8 piles = $200,000.

Assume $100,000 for each column x 8 columns = $800,000.

Reductions

One less pile driver mobilization = assume $15,000.

Total = $1,529,000 x 1.2 markup = $1,834,800, say $1,835,000.

VA TEAM ALTERNATIVE REVIEW *Mount Vernon Avenue Bridge Replacement – City of San Bernardino*		
TITLE:	Construct Cast-in-Steel-Shell Piles with the Column Extension through the Existing Bridge Deck to Allow All Piling to be Constructed in One Phase	**NUMBER** 3.2

Team Member:	ALL TEAM MEMBERS
☑ Agree as Written ☐ Disagree as Written	Comments:

VALUE ANALYSIS ALTERNATIVE *Mount Vernon Avenue Bridge Replacement – City of San Bernardino*			
FUNCTION:	Replace Bridge	**IDEA NO.** RB-16	**NUMBER** 4.0
TITLE:	Drive Piles (Cast-in-Steel-Shell Piles) in lieu of Drilling and Pouring Piles (Cast-in-Drilled-Hole)		**PAGE NO.** 1 of 3

ORIGINAL CONCEPT:

The original design concept proposes to support the bridge on large diameter cast-in-drilled-hole (CIDH) concrete piles at the bents.

ALTERNATIVE CONCEPT:

This VA alternative proposes to support the bridge on large diameter open-ended CISS piles at the bents with column extensions.

ADVANTAGES:

- Speeds up construction
- Eliminates the potential for caving; therefore, the quality of pile construction improves and there is less risk
- Less excavation
- Improves seismic performance

DISADVANTAGES:

- More maintenance for a steel shell
- More noise to drive piles

COST SUMMARY	Initial Cost	Present Value Subsequent Cost	Present Value Highway User Cost	Net Present Value
Original Concept	$ 0	$	$	$ 0
Alternative Concept	$ 2,786,000	$	$	$ 2,786,000
Savings	$ (2,786,000)	$	$	$ (2,786,000)

Performance Attribute Impacts

Mainline Operations	Local Operations	Maintenance	Environmental	Construction Impacts	Delivery Schedule	Performance Change
0	**+**	**0**	**0**	**-**	**+**	**+11%**

VALUE ANALYSIS ALTERNATIVE *Mount Vernon Avenue Bridge Replacement – City of San Bernardino*			
TITLE:	Drive Piles (Cast-in-Steel-Shell Piles) in lieu of Drilling and Pouring Piles (Cast-in-Drilled-Hole)	**NUMBER** 4.0	**PAGE NO.** 2 of 3

DISCUSSION / JUSTIFICATION:

Assume that the CISS would be approximately $500,000 in total x 1.2 markup = $600,000.

This concept will keep construction impacts to the railroad yard from potential caving, and subsidence would be virtually eliminated. It also reduces the contractor's risk of injury and completion because of less interference with the railroad and possible delays to the contractors.

Also, this could reduce the bid value related to unknown contingencies because of lower risk.

TECHNICAL REVIEWER COMMENTS:

Technically feasible.

PROJECT MANAGEMENT CONSIDERATIONS:

Analysis to validate the concept. This would be part of the foundation report and seismic analysis.

PERFORMANCE MEASURES *Mount Vernon Avenue Bridge Replacement – City of San Bernardino*			
TITLE: Drive Piles (Cast-in-Steel-Shell Piles) in lieu of Drilling and Pouring Piles (Cast-in-Drilled-Hole)	**NUMBER** 4.0	**PAGE NO.** 3 of 3	
ATTRIBUTES and RATING RATIONALE for ALTERNATIVE	**Performance**	**Original**	**Alternative**
Railroad Operations Less impact to railroad operations related to soil subsidence.	Rating	5	6
	Weight	33	33
	Contribution	165	198
Local Operations Shorter construction duration, thus traffic will be back to normal quicker.	Rating	5	6
	Weight	27	27
	Contribution	135	162
Construction Impacts More noise from driving piles.	Rating	5	4
	Weight	13	13
	Contribution	65	52
Environmental No change.	Rating	5	5
	Weight	13	13
	Contribution	65	65
Delivery Schedule Less time to construct, simplifies construction.	Rating	5	6
	Weight	10	10
	Contribution	50	60
Phaseability No change.	Rating	5	5
	Weight	4	4
	Contribution	20	20
	Rating		
	Weight		
	Contribution		
	Rating		
	Weight		
	Contribution		
Total Performance:		**500**	**557**
Net Change in Performance:			**+11%**

VA TEAM ALTERNATIVE REVIEW *Mount Vernon Avenue Bridge Replacement – City of San Bernardino*		
TITLE:	Drive Piles (Cast-in-Steel-Shell Piles) in lieu of Drilling and Pouring Piles (Cast-in-Drilled-Hole)	**NUMBER** 4.0

Team Member:	ALL TEAM MEMBERS
☑ Agree as Written ☐ Disagree as Written	Comments:

VALUE ANALYSIS ALTERNATIVE

Mount Vernon Avenue Bridge Replacement – City of San Bernardino

FUNCTION:	Construct Project	**IDEA NO.** CP-6	**NUMBER** 5.0
TITLE:	Acquire Several Residential and One Business Property on the West Side of the Project to Facilitate Design and Construction		**PAGE NO.** 1 of 4

ORIGINAL CONCEPT:

The original design proposes that no properties are to be acquired on the west side of the project.

ALTERNATIVE CONCEPT:

This VA alternative proposes to purchase several private properties and businesses to facilitate the design and construction of the project.

ADVANTAGES:

- Removes individuals from a poor spot
- Easier right-of-way certification
- Would provide an adjacent staging area
- Would not have to reconstruct the alley near residences
- Could provide room for 2:1 slopes
- Simplifies the environmental document
- The original concept design does not have provisions to acquire the properties; doing this acquisition now would reduce the project risk

DISADVANTAGES:

- More initial cost to acquire right-of-way

COST SUMMARY	Initial Cost	Present Value Subsequent Cost	Present Value Highway User Cost	Net Present Value
Original Concept	$ 0	$ 0	$ 0	$ 0
Alternative Concept	$ 830,000	$ 0	$ 0	$ 830,000
Savings	$ (830,000)	$ 0	$ 0	$ (830,000)

Performance Attribute Impacts						
Mainline Operations	**Local Operations**	**Maintenance**	**Environmental**	**Construction Impacts**	**Delivery Schedule**	**Performance Change**
0	**0**	**0**	**+**	**+**	**+**	**+10%**

DISCUSSION / JUSTIFICATION:

Due to the close proximity of the bridge retaining walls to the existing residences on the west side of the project, and if the owners agree the properties on the west side could be purchased, these properties could be purchased under a contract separate from this project with a simplified environmental document that would cover this activity.

The environmental studies were conducted four years prior to the time of this VA Study (February 2004). When the environmental studies were conducted, it is alleged that the homeowners whose properties will be affected by the close proximity to the proposed bridge retaining walls voiced no objections. Today (February 2008) only one residence is occupied in the southwest area of the project. Another residence is for sale and another is under construction. This issue should be confirmed.

In the meantime activities have not moved forward and home ownership may or could change. An artist's rendering could be provided to help owners visualize the impact of the project.

TECHNICAL REVIEWER COMMENTS:

None noted.

PROJECT MANAGEMENT CONSIDERATIONS:

The City of San Bernardino would have to establish a new project with a simplified environmental document to acquire the properties and obtain the necessary funding.

PERFORMANCE MEASURES

Mount Vernon Avenue Bridge Replacement – City of San Bernardino

TITLE:	Acquire Several Residential and One Business Property on the West Side of the Project to Facilitate Design and Construction	**NUMBER** 5.0	**PAGE NO.** 3 of 4

ATTRIBUTES and RATING RATIONALE for ALTERNATIVE	**Performance**	**Original**	**Alternative**
Railroad Operations No change.	Rating	5	5
	Weight	33	33
	Contribution	165	165
Local Operations No change.	Rating	5	5
	Weight	27	27
	Contribution	135	135
Construction Impacts More room if the properties are acquired. Contractors can use this area for construction.	Rating	5	6
	Weight	13	13
	Contribution	65	78
Environmental The noise and air quality issues related to residents would be out of the project and would simplify the environmental document. The alley would not have to be widened and there would be no retaining wall.	Rating	5	7
	Weight	13	13
	Contribution	65	91
Delivery Schedule Easier construction and simplification of environmental documents would accelerate the schedule.	Rating	5	6
	Weight	10	10
	Contribution	50	60
Phaseability No change.	Rating	5	5
	Weight	4	4
	Contribution	20	20
	Rating		
	Weight		
	Contribution		
	Rating		
	Weight		
	Contribution		
Total Performance:		**500**	**549**
Net Change in Performance:			**+10%**

The asking price for the house under construction is $330,000.

The asking price for the house under renovation is $249,000.

The vacant business property in the north end west side is estimated at $520,000.

One vacant lot is $120,000.

Occupied residence on the corner of 3rd Street and the Mount Vernon Avenue frontage road (raised foundation) is $300,000.

Increase embankment material for slope (400 feet long x 20 feet x 40 feet wide) / 2 to average = 160,000 ft^3 / 27 ft^3/yd^3 = 5,925, say 6,000 cy x $10 per cy = $60,000 x 1.2 markup = $72,000, say $70,000 x 2 ends of the bridge = $140,000.

Landscaping = assume $50,000.

Total is $1,709,000 additional cost, say $1,700,000.

Less:

Reduced retaining wall: Assume $600,000 (about ½ MSE wall) x 20% markup = $720,000.

Elimination of alley: Assume $100,000 x 20% markup = $120,000.

Less design cost for one less retaining wall: 2 weeks x 40 hours x $120 per hour = $9,600, say $10,000.

Less environmental document work: 4 weeks x 40 hours x $130 = $20,800, say $20,000.

Total cost reduction = $870,000.

Net cost impact = $1,700,000 - $870,000 = $830,000.

VA TEAM ALTERNATIVE REVIEW *Mount Vernon Avenue Bridge Replacement – City of San Bernardino*		
TITLE:	Acquire Several Residential and One Business Property on the West Side of the Project to Facilitate Design and Construction	**NUMBER** 5.0

Team Member:	ALL TEAM MEMBERS
☑ Agree as Written ☐ Disagree as Written	Comments:

VALUE ANALYSIS ALTERNATIVE *Mount Vernon Avenue Bridge Replacement – City of San Bernardino*			
FUNCTION:	Replace Bridge	**IDEA NO.** RB-18	**NUMBER** 6.0
TITLE:	Construct the Bridge Girders Partially of Pre-Cast Concrete and Partially of Steel		**PAGE NO.** 1 of 5

ORIGINAL CONCEPT:

The original design concept proposes to construct a pre-cast concrete girder bridge with cast-in-drilled-hole (CIDH) pilings. The new bridge will follow the existing bridge alignment and profile with some alterations. The profile will be raised to accommodate the required vertical clearance guidelines set forth by the California PUC and Burlington Northern Santa Fe Railroad (BNSF). The alignment will be slightly shifted to allow Mount Vernon Avenue to travel north and south across the rail yard with no change in alignment. (The current alignment contains a small curve at the intersection of Mount Vernon Avenue and 2nd Street, which creates sight distance and aesthetic issues.)

ALTERNATIVE CONCEPT:

This VA alternative proposes to construct a pre-cast bulb-tee girder bridge with a steel girder bridge on CIDH pilings. The concrete bridge would incorporate 80% of the spans (7) and the steel bridge would account for the remaining 20% (2). The new bridge will follow the existing bridge alignment and profile with some alterations. The profile will be raised to accommodate the required vertical clearance guidelines set forth by the California PUC and BNSF. The alignment will be slightly shifted to allow Mount Vernon Avenue to travel north and south across the rail yard with no change in alignment. (The current alignment contains a small curve at the intersection of Mount Vernon Avenue and 2nd Street, which creates sight distance and aesthetic issues.)

ADVANTAGES:

- Easier to construct
- Steel is easier to splice than concrete
- Easier to place steel than concrete
- Less risk of damage to steel beams during transport and erection

DISADVANTAGES:

- More maintenance; more deck joints to maintain
- Fatigue cracking is a concern
- More time to splice steel
- Different structure depths; therefore, aesthetically unpleasing

COST SUMMARY	Initial Cost	Present Value Subsequent Cost	Present Value Highway User Cost	Net Present Value
Original Concept	$ 0	$ 0	$ 0	$ 0
Alternative Concept	$ 4,900,000	$ 0	$ 0	$ 4,900,000
Savings	$ (4,900,000)	$ 0	$ 0	$ (4,900,000)

Performance Attribute Impacts						
Mainline Operations	**Local Operations**	**Maintenance**	**Environmental**	**Construction Impacts**	**Delivery Schedule**	**Performance Change**
0	**0**	**0**	**0**	**0**	**+**	**+9%**

DISCUSSION / JUSTIFICATION:

The justification for the steel girder bridge alternative was based on various criteria. The two main arguments were for aesthetics and for ease of construction.

Considering that the existing bridge is a steel girder bridge, it was discussed that the new bridge should follow the same theme in efforts to preserve some of the aesthetic characteristics of the bridge. With the demolition of the old bridge there would be no correlation to the new project if it was to be constructed entirely out of concrete. Additionally, steel would give the bridge a definitive image that would also match the characteristics of the rail yard.

The largest opponent to steel construction would be the cost. In general, a steel bridge would be twice as costly as a comparative concrete bridge. However, the advantages to working with steel are as follows: easier to transport, easier to splice, easier to lift and assemble, and it is also more forgiving as a construction material, allowing it to be bumped with no damage to the member. Since each member is smaller, steel can be moved much faster and set much faster than concrete, but it will require more members to replicate the same structural characteristics. These performance characteristics were discussed and it was concluded that the overall construction time would most likely be the same, although because each steel member can be moved faster there are potentially time saving attributes that would eliminate dead track time for the railroad.

TECHNICAL REVIEWER COMMENTS:

Technically feasible; however, the additional cost of steel (twice that of pre-cast concrete) would be difficult to substantiate; in turn, it would be difficult to receive Federal or State funding.

PROJECT MANAGEMENT CONSIDERATIONS:

Funding justification for steel versus concrete represents the largest obstacle. The most probable approach to justify the additional cost could be if the steel bridge was requested as the preferred build alternative by the community/public. This could be done by creating a small public awareness campaign which would inform the public of the historical significance of the bridge and characterize the steel bridge as a historical memorial. This could in turn receive additional Federal funds as subject to a memorial structure.

Same profile and alignment as the proposed bridge; however, the aesthetic characteristics would be different.

PERFORMANCE MEASURES *Mount Vernon Avenue Bridge Replacement – City of San Bernardino*			
TITLE: Construct the Bridge Girders Partially of Pre-Cast Concrete and Partially of Steel	**NUMBER** 6.0	**PAGE NO.** 4 of 5	
ATTRIBUTES and RATING RATIONALE for ALTERNATIVE	**Performance**	**Original**	**Alternative**
Railroad Operations Less time for construction would mean less impact to railroad operations.	Rating	5	6
	Weight	33	33
	Contribution	165	198
Local Operations No change.	Rating	5	5
	Weight	27	27
	Contribution	135	135
Construction Impacts No change.	Rating	5	5
	Weight	13	13
	Contribution	65	65
Environmental No change.	Rating	5	5
	Weight	13	13
	Contribution	65	65
Delivery Schedule Easier to place steel components; therefore, less time to construct the project.	Rating	5	6
	Weight	10	10
	Contribution	50	60
Phaseability No change.	Rating	5	5
	Weight	4	4
	Contribution	20	20
	Rating		
	Weight		
	Contribution		
	Rating		
	Weight		
	Contribution		
Total Performance:		**500**	**543**
Net Change in Performance:			**+9%**

Original Bridge Cost

#35 512235 pre-cast concrete bulb-tee girder = $3,955,270, say $4,000,000

#36 52500 erect girders = $112,853, say $120,000

Total = $4,100,000

Alternative Concrete/Steel Bridge Cost

Assume that there are 9, spans of which 2 are steel, or 20%.

Concrete/Steel bridge assuming steel is 2 times pre-cast = 2 x $4,000,000 x 0.2 + $4,000,000 x 0.8 = $1,600,000 +$3,200,000 = $4,800,000.

Erect steel/pre-cast bridge, assume similar to pre-cast = $100,000.

Total = $4,900,000

Cost difference = $800,000

VA TEAM ALTERNATIVE REVIEW *Mount Vernon Avenue Bridge – City of San Bernardino*		
TITLE:	Construct the Bridge Girders Partially of Pre-Cast Concrete and Partially of Steel	**NUMBER** 6.0

Team Member:	ALL TEAM MEMBERS
☑ Agree as Written ☐ Disagree as Written	Comments:

PROJECT ANALYSIS

PROJECT ANALYSIS

SUMMARY OF ANALYSIS

The following analysis tools were used to study the project:

- Key Project Factors
  - Project Issues
  - Site Visit Observations
  - Project Drivers
- Cost Model
- Function Analysis / FAST Diagram
- Value Metrics
  - Performance Attributes
    - Definitions
    - Matrix
    - Rating Scale
  - Value Matrix
    - Rationale for Performance Ratings
      - Original Concept
      - Strategy 1 – VA Team Recommended
    - Performance Rating Matrix – Original Concept and VA Strategy
    - Rationale for Performance Ratings – Accepted Alternatives
    - Performance Rating Matrix – Accepted Alternatives

KEY PROJECT FACTORS

The first day of the study included meetings with the project stakeholders and a site visit. The following summarizes key project issues, site visit observations, and project drivers identified during these sessions.

PROJECT ISSUES

The following are some of the issues and concerns associated with the project:

- The existing bridge is in a deteriorating condition and needs replacement. Presently, the bridge is shored to provide support for cracked steel bridge members.
- It is essential that the construction of the new bridge minimizes disruption to the Burlington Northern Santa Fe Railroad (BNSF) operations, which are spanned by the existing and proposed bridges. There are 17 tracks in service in the railroad yard.
- There will be impacts to the residents of homes that are at the southwest end of the existing bridge. The retaining walls will be very close to these homes. An alleyway behind the homes is proposed to be widened to 30 feet to accommodate vehicular traffic to these homes.
- This project is proposed to be funded through the Caltrans Office of Local Assistance under the Highway Bridge Replacement Program (HBRP).

SITE VISIT OBSERVATIONS

The following issues and concerns were listed by the VA team following the site visit:

- There is shoring in place to support the existing bridge structure.
- The BNSF railroad yard operations are very busy and complex. There are 17 tracks and several areas where sea containers that are placed on trucks are transferred to rail cars and vice versa.
- The residences and businesses are approximately 100 feet from the existing Mount Vernon Avenue Bridge.
- There are power lines in the project area.

PROJECT DRIVERS

The VA team identified the following list of project aspects that are determining the size, shape, extent, and nature of respective and specific project features throughout the project. The VA team used this list as a precursor to function analysis to identify the controlling factors that led the design team and project stakeholders to the various project specifics indicated in the project documents. The main items listed below are the drivers, constraints, or issues being addressed by the project, and the sub-items are the features influenced by these aspects.

1. City of San Bernardino
    a. Get the project moving as soon as reasonably possible
    b. Ensure that the new bridge reflects historical aesthetic treatments
    c. Ensure that pedestrians, bicyclists, and ADA requirements are accommodated in the new structure
    d. Appropriate landscaping is installed
2. Caltrans Standards
    a. Lane widths
    b. Sidewalks
    c. Alignment of bypass

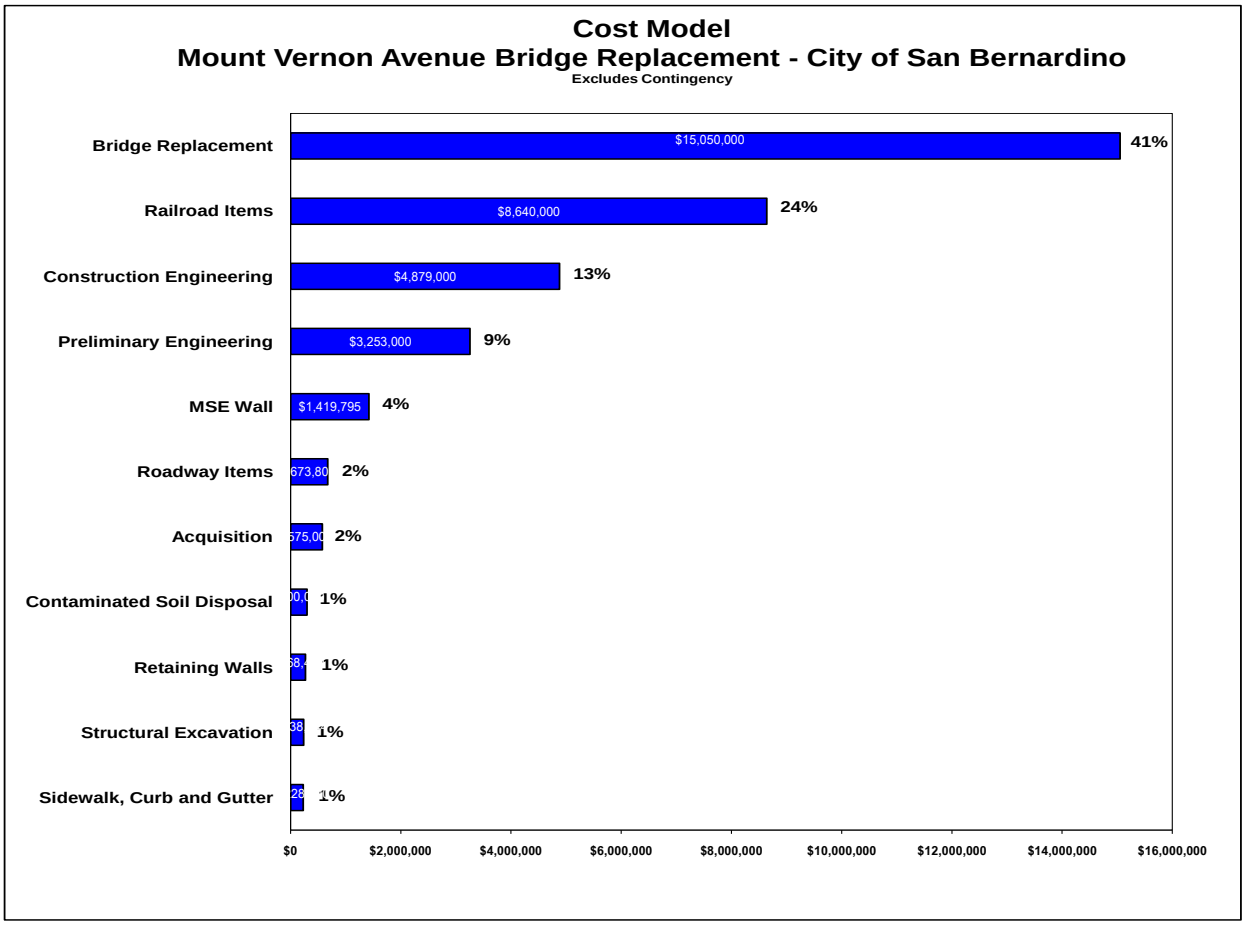
COST MODEL

The VA Team Leader prepared a cost model from the cost estimate of the original design concept. The cost model is used to identify major construction elements or trade categories, the originally estimated costs, and the percent of total project cost for the significant cost items.

The cost model clearly showed the cost drivers for the project and was used to guide the VA team during the VA Study.

The following conclusions were noted by the VA team regarding the project costs:

- The bridge structure is approximately 41% of the project cost.
- The railroad items account for approximately 24% of the project cost.
- Engineering will be approximately 21% (Construction Engineering is 13% and Preliminary Engineering is 9%).
- The roadway on either end of the proposed bridge will be approximately 9% for MSE walls, roadway items, retaining walls, structural excavation, sidewalks, and curbs and gutters.



Cost Model

Mount Vernon Avenue Bridge Replacement - City of San Bernardino

Item	Quantity	Unit	Unit Price	Cost	% of Estimated Items
Earthwork					
Roadway Excavation		CY		$0	0.0%
Finishing Slope		LS		$0	0.0%
Clearing and Grubbing		LS		$0	0.0%
Grout Backfill		CY		$0	0.0%
Total Earthwork				**$0**	0.0%
Structural Section					
Roadway	16,845	m2	$40	$673,800	1.6%
Structural Excavation	3,508	m3	$68	$238,544	0.6%
Structural Backfill	281	m3	$99	$27,819	0.1%
Clearing and Grubbing	1	ls	$25,000	$25,000	0.1%
Hot Mix AC		Tonnes		$0	0.0%
Aggregate Base		CY		$0	0.0%
Sawcut AC Pavement		LF		$0	0.0%
AC Dike Place and Remove		LF			0.0%
Total Structural Section				**$965,163**	2.4%
Drainage					
Drainage	1	ls	$120,000	$120,000	0.3%
Total Drainage				**$120,000**	0.3%
Specialty Items					0.0%
Remove Retaining Walls	502	m2	$230	$115,460	0.3%
Retaining Walls	310	m3	$866	$268,460	0.7%
Sidewalk, Curb & Gutter	1	LS	$228,800	$228,800	0.6%
MSE Wall	1,755	m2	$809	$1,419,795	3.5%
Fencing	1	LS	$35,000	$35,000	0.1%
Water Pollution Control	1	LS	$21,000	$21,000	0.1%
Contaminated Soil Disposal	1	LS	$300,000	$300,000	0.7%
Landscaping	1	LS	$65,000	$65,000	0.2%
Total Specialty Items				**$2,453,515**	6.0%
Traffic Items					
Traffic Control Systems	1	LS	$102,000	$102,000	0.2%
Signs and Signals	1	LS	$155,000	$155,000	0.4%
					0.0%
				$0	0.0%
				$0	0.0%
Total Specialty Items				**$257,000**	**0.6%**
Subtotal				**$3,795,678**	
Contingency	20%			$800,000	2.0%
Total Roadway Items	**20%**			**$4,595,678**	**11.2%**
Railroad Items	1	LS	$8,640,000	**$8,640,000**	**21.1%**
STRUCTURES ITEMS					
Bridge Replacement	1	LS	$15,050,000	$15,050,000	**36.8%**
Total Structures				**$15,050,000**	**36.8%**
Right-of-Way					
Acquisition	1	LS	$575,000	$575,000	1.4%
Utility Relocation	1	LS	$150,000	$150,000	0.4%
Title and Escrow		LS		$0	0.0%
Right-of-Way				**$725,000**	**1.8%**
Preliminary Engineering	1	LS	$3,253,000	**$3,253,000**	
Construction Engineering	1	LS	$4,879,000	**$4,879,000**	
Subtotal Construction Cost				**$40,938,356**	
				$0	
TOTAL COST (NIC Support)				**$40,938,356**	

FUNCTION ANALYSIS / FAST DIAGRAM

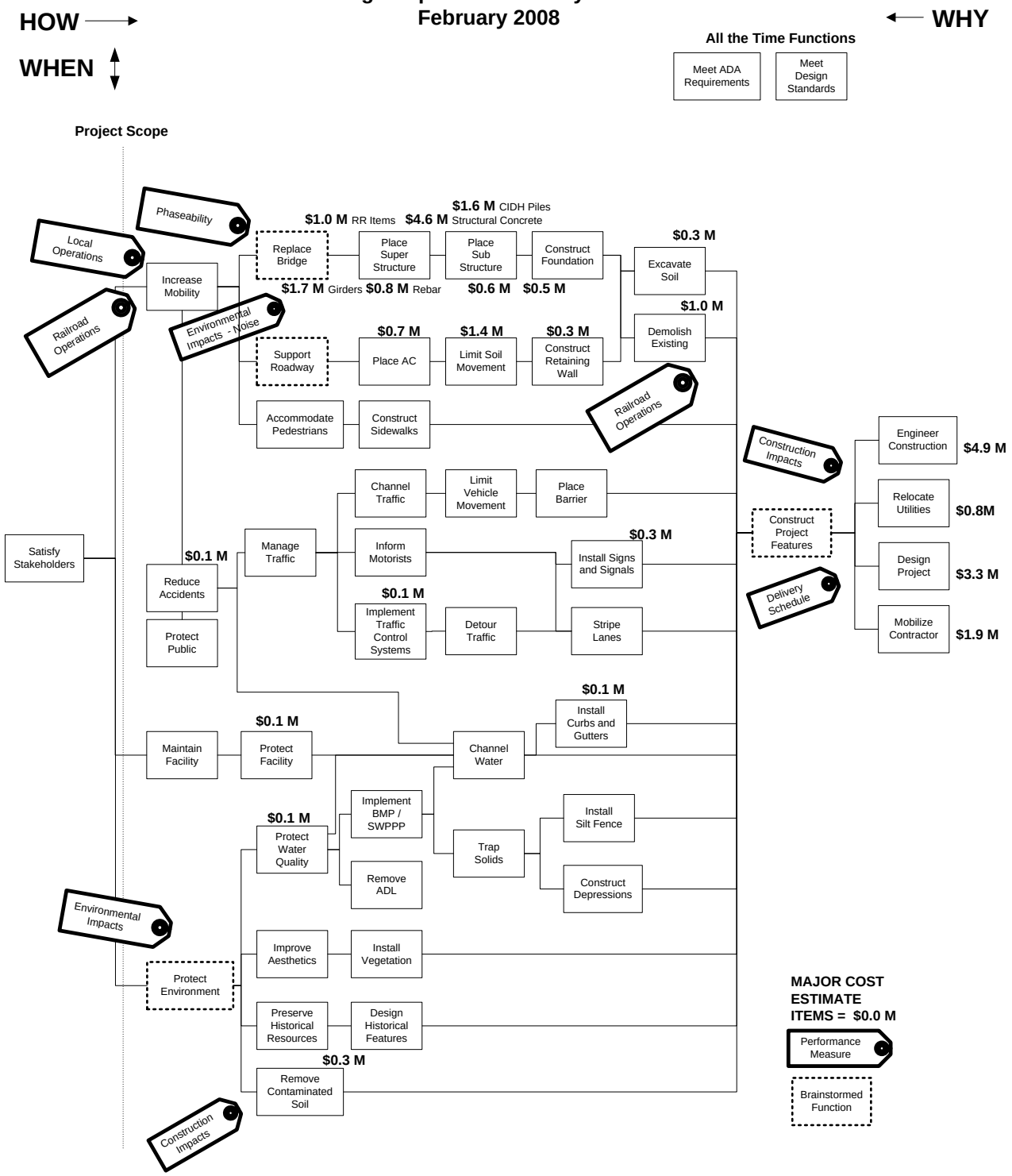
Function analysis was performed and a Function Analysis System Technique (FAST) Diagram was produced, which revealed the key functional relationships for the project. This analysis provided a greater understanding of the total project and how the issues, project cost, and function requirements are related.

The FAST diagram arranges the functions in logical order so that when read from left to right, the functions answer the question "How?" If the diagram is read from right to left, the functions answer the question "Why?" Functions connected with a vertical line are those that happen at the same time as, or are caused by, the function at the top of the column (a "When?" relationship).

The FAST Diagram for this project shows *Improve Mobility* as the basic function and *Satisfy Stakeholders* as the Higher Order Function. Key secondary functions include *Increase Mobility, Replace Bridge, Protect Environment, Protect Property,* and *Manage Traffic*. This provided the VA team with an understanding of the project's design rationale and which functions offer the best opportunity for Cost or Performance improvement.

FUNCTION ANALYSIS SYSTEM TECHNIQUE

Mt. Vernon Bridge Replacement – City of San Bernardino
February 2008



VALUE METRICS

The Value Metrics process is an integral part of the Caltrans Value Analysis Process. This process provides the cornerstone of the VA process by providing a systematic and structured means of considering the relationship of a project's performance and cost as they relate to value. Project performance must be properly defined and agreed upon by the stakeholders at the beginning of the VA Study. The performance attributes and requirements developed are then used throughout the study to identify, evaluate, and document alternatives.

In conjunction with the VA team, the Project Stakeholders identified and defined the performance attributes and requirements, and then developed a rating scale to measure performance. Performance requirements represent essential, non-discretionary aspects of project performance. Performance attributes represent those aspects of a project's scope and schedule that may possess a range of potential values.

The original (baseline) design concept is first evaluated relative to each of the performance attributes based upon a 0 to 10 rating scale. A "0" represents performance that is unacceptable while a "10" represents the highest desired level of performance. Typically, a standard comparative scale is used that measures all VA alternatives against the baseline design concept. In this case, the baseline concept is rated in the middle of the scale as a "5". Once the attributes have been rated by the Project Development Team (PDT), the relative importance of each attribute in meeting the project's purpose and need is determined using the paired comparison method. This process yields relative weightings which are used as modifiers in rating the relative performance of the original design concept.

As the VA team develops alternatives, the performance of each is rated against the original design concept. Changes in performance are always based upon the overall impact to the total project. Once performance and cost data have been developed by the VA team, the net change in value of the VA alternatives can be compared to the original design concept. The resulting Value Matrix provides a summary of these changes and allows a way for the PDT to assess the potential impact of the VA alternatives on total project value.

The PDT is asked to validate the performance measures and rationale at the Implementation Meeting. The rationale for the numerical rating change for each alternative in each strategy is developed. The Value Matrix shows the numerical change for each performance measure and alternative strategy. The Total Performance is calculated by multiplying the attribute weight by the performance rating for each performance measure of either the original concept or VA Strategy.

The following pages summarize the results of the Value Metrics process for this VA Study:

- Performance Attribute Definitions
- Performance Attribute Scales
- Performance Attribute Matrix
- Value Matrix
- Rationale for Change in Performance

PERFORMANCE ATTRIBUTES

Prior to beginning the VA Study, the VA Team Leader met with project stakeholders to discuss project performance. The following performance attributes were identified as being of critical importance in meeting the project's need and purpose.

Performance Attributes for Caltrans Transportation Projects	
Performance Attribute	**Definition**
Railroad Operations	An assessment of the ability to minimize impacts to railroad operations during construction.
Local Operations	An assessment of traffic operations and safety on the local streets, including off-ramps and collector-distributor roads. Operational considerations include geometric considerations such as design speed, sight distance, lane widths, and shoulder widths.
Construction Impacts	An assessment of the temporary impacts to the public during construction related to traffic disruptions, detours, and delays; impacts to businesses and residents relative to access, visual, noise, vibration, dust, and construction traffic; environmental impacts related to water quality, air quality, soil erosion, and local flora and fauna.
Environmental	An assessment of the permanent impacts to the environment including ecological (i.e., flora, fauna, air quality, water quality, visual, noise); socioeconomic impacts (i.e., environmental justice); impacts to cultural, recreational, and historic resources.
Delivery Schedule	An assessment of the total project delivery from the time of the VA Study to completion of construction in April 2014.
Phaseability	An assessment of how easily a transportation facility can be improved or expanded upon at some future date. This attribute considers the degree of "throwaway work" involved, as well as future traffic and public impacts when the planned future improvements are made.

Performance Attribute Matrix

The performance attribute matrix was used to determine the relative importance of the performance attributes for the project. The project owner, design team, and stakeholders evaluated the relative importance of the performance attributes that would be used to evaluate the creative ideas. These attributes were compared in pairs, asking the question: "An improvement to which attribute will provide the greatest benefit to the project relative to need and purpose?" The letter code (e.g., "a") was entered into the matrix for each pair. After all pairs were discussed they were tallied (after normalizing the scores by adding a point to each attribute) and the percentages calculated.

The Performance Attribute Matrix is shown below. The definitions and measurement scales for each criterion are included on the following pages.

PERFORMANCE ATTRIBUTE MATRIX ***Mount Vernon Avenue Bridge Replacement – City of San Bernardino***	**VMS, Inc.**

Which attribute will provide the greater improvement to the project relative to Need and Purpose?

							TOTAL	**%**
Railroad Operations	**A**	a	a	a	a	a	5.0	33%
Environmental	**B**	c	d	b	b		2.0	13%
Delivery Schedule	**C**	d	e	c/f			1.5	10%
Local Operations	**D**	d	d				4.0	27%
Construction Impacts	**E**	e					2.0	13%
Phaseability	**F**						0.5	4%
							15.0	100%

Performance Attribute Rating Scale

The following scales were used to evaluate the performance of the alternative concepts relative to the baseline concept.

Performance Attribute & Requirement Definitions ***Mount Vernon Avenue Bridge Replacement – City of San Bernardino***						**Caltrans**
Performance Attribute Scales						
Rating	**Railroad Operations**	**Local Operations**	**Construction Impacts**	**Environmental**	**Delivery Schedule**	**Phaseability**
10	Alternative Concept is extremely preferred.					
9	Alternative Concept is very strongly preferred.					
8	Alternative Concept is strongly preferred.					
7	Alternative Concept is moderately preferred.					
6	Alternative Concept is slightly preferred.					
5	***Concepts are equally preferred.***					
4	Baseline Concept is slightly preferred.					
3	Baseline Concept is moderately preferred					
2	Baseline Concept is strongly preferred.					
1	Baseline Concept is very strongly preferred.					
0	Baseline Concept is extremely preferred.					

VALUE MATRIX

Value Matrix permits the comparison of competing strategies of value alternatives by organizing the data developed for the performance attributes into a matrix format in order to yield value indices. Value alternatives are compared to the baseline project for the all attributes in order to compare and contrast the potential for value improvement. The matrix is essential for understanding the relationship of cost, performance, and value of the project baseline and VA concepts. Comparing the performance and cost suggests which alternatives are potentially as good as, or better than, the project baseline concept in terms of overall value. Comparison at the value index level suggests which alternatives have the best functionality per unit cost, or provides the project with the "best value." However, in this case, the cost varies so widely and needs to be refined, the team focused on the meeting the performance requirements and satisfying the need and purpose for the project.

The following discusses how the design alternatives meet the performance requirements of the project, and the matrix at the end of this section shows the rating given for each performance alternative. The total performance score is shown at the bottom of that matrix. Each alternative developed as part of the VA Study was rated to compare against the appropriate Design Alternative and the percent change in performance is relative to that alternative, but the total score can be used as a comparison of all alternatives, those developed by both the Design Team and VA team.

Rating Rationale: **Original Concept**

Design Alternative: **Replace the Existing Mount Vernon Avenue Bridge with a Pre-Cast Post-Tensioned Concrete Bulb-Tee Girder Bridge**

Performance Attribute	Rationale for Rating
Railroad Operations	BNSF operations will be minimally disrupted. Construction windows will be provided.
Local Operations	Traffic will be detoured around the project limits.
Construction Impacts	There will be the typical noise, dust, and delays to traffic normally encountered during construction.
Environmental	There will be minimal impacts to the environment. Some contaminated soil will be encountered during excavation.
Delivery Schedule	The project is expected to be complete in April 2014.
Phaseability	Presently, the project should be constructed as one project.

Rating Rationale: **VA Strategy 1**

VA Recommended Strategy: **(Alternatives 1.0, 2.0, 3.2, 4.0, 5.0)**

Performance Attribute	Rationale for Rating
Railroad Operations	Elimination of crash wall construction results in less impact to railroad operations; the pre-cast cap reduces the need for track time for installation.
Local Operations	A shorter construction period should result in less impact to local traffic flows.
Construction Impacts	Because of less construction time that would be realized from implementation of the proposed alternatives, there could be less noise and dust generated.
Environmental	There will be less chance of encountering contaminated soil; however, there will be eight more locations in which to encounter contaminated soil. This is offset because the amount of soil that would not be disturbed because of elimination of the construction of crash walls. Therefore, this performance attribute is slightly improved.
Delivery Schedule	Constructing cast-in-steel-shell (CISS) piles, using pre-cast bent caps, acquiring property early, and reducing potential delays to the contractor would increase bid competition, lower contingency, and reduce the construction period.
Phaseability	No change.

VALUE MATRIX - Preliminary *Mount Vernon Avenue Bridge Replacement – City of San Bernardino*	**VMS, Inc.**

Attribute	Attribute Weight	Concept	Performance Rating 1	2	3	4	5	6	7	8	9	10	Total Performance
Railroad Operations	33	Original Concept					5						165
		VA Strategy 1							7				231
Traffic Operations	27	Original Concept					5						135
		VA Strategy 1						6					162
		VA Strategy 2											0
Construction Impacts	13	Original Concept					5						65
		VA Strategy 1						6					78
Environmental	13	Original Concept					5						65
		VA Strategy 1						6					78
Delivery Schedule	10	Original Concept					5						50
		VA Strategy 1								8			80
Phaseability	4	Original Concept					5						20
		VA Strategy 1					5						20

OVERALL PERFORMANCE	Total Performance	% Perf. Improve.	Total Cost	Value Index (Performance / Cost)	% Value Improvement
Original Concept	500		40.6	12.3	
VA Strategy 1	649	30%	43.1	15.1	22%

Rating Rationale: **Accepted Alternatives**

(Alternatives 1.0, 2.0, 3.2, 4.0, 5.0)

Performance Attribute	Rationale for Rating
Railroad Operations	Reduces risk to railroad operations; decreases overall time to complete project.
Local Operations	Decreases overall project construction times, allowing the bridge to reopen to traffic.
Construction Impacts	Decreases overall project construction times, thus allowing traffic to resume on the new bridge. Also, additional piles would have to be installed, providing a more stable construction platform. This would help construction and reduce construction impacts.
Environmental	The noise and air quality issues related to residents would be out of the project and would simplify the environmental document. The alley would not have to be widened and there would be no retaining wall.
Delivery Schedule	Decreases overall project construction times, thus allowing traffic to resume on the new bridge.
Phaseability	No change.

PERFORMANCE ATTRIBUTE MATRIX - Accepted Alternatives

Mount Vernon Avenue Bridge Replacement – City of San Bernardino

VMS, Inc.

Attribute	Attribute Weight	Concept	Performance Rating										Total Performance
			1	2	3	4	5	6	7	8	9	10	
Railroad Operations	33	Original Concept					5						165
		Accepted Alts							7				231
Environmental	27	Original Concept					5						135
		Accepted Alts						6					162
Delivery Schedule	13	Original Concept					5						65
		Accepted Alts						6					78
Local Operations	13	Original Concept					5						65
		Accepted Alts						6					78
Construction Impacts	10	Original Concept					5						50
		Accepted Alts								8			80
Phaseability	4	Original Concept					5						20
		Accepted Alts					5						20

OVERALL PERFORMANCE	Total Performance	% Perf. Improve.	Total Cost	Value Index (Performance / Cost)	% Value Improvement
Original Design Concept	500		40.6	12.3	
Accepted Alts	649	30%	42.5	15.3	24%

PROJECT DESCRIPTION

PROJECT DESCRIPTION

INTRODUCTION

This Highway Bridge Replacement Project (HBRP) is proposed to replace the existing Mount Vernon Avenue Bridge located in the City of San Bernardino. The project is originally initiated by the mandated statewide Local Bridge Seismic Safety Retrofit Program. In 1996, Caltrans conducted a seismic analysis and retrofit study for the existing bridge. The final report concluded that the bridge falls under Category 1, a category for bridges that may collapse in a seismic event and potentially threaten public safety.

PROJECT DESCRIPTION

The purpose of the project is to replace the existing Mount Vernon Avenue Bridge with a new bridge. The vertical clearance over the Burlington Northern Santa Fe Railroad (BNSF) will be 24 feet over all tracks. The bridge will be 1,040 feet long, with nine spans and five-foot sidewalks on both sides.

This bridge will reduce the existing kink near 2nd Street by changing the horizontal alignment of the bridge. A southbound left-turn pocket is proposed at 2nd Street. At the Mount Vernon Avenue/2nd Street Intersection, the free right turn from westbound 2nd Street to northbound Mount Vernon Avenue would be replaced by a right-turn pocket.

The bridge girders are proposed to be pre-cast concrete bulb-tee girders. The bridge foundation will be large diameter drilled shafts commonly referred to as cast-in-drilled-hole (CIDH) piles. This would avoid the need for a large area that would be required if pile group type foundations were used. Columns would be supported on the CIDH piles where required and/or feasible crash walls will be constructed for protection from railroad derailments or shifting railcar loads.

Construction methods would be employed that would minimize impacts to railroad operations. Removal of the existing bridge would be performed prior to construction using overhead techniques when and where possible. The original design concept would be to remove a portion of the west side of the existing bridge deck and use the remaining bridge deck as a platform from which to construct one-half of the new structure. When the new structure was complete, the construction activities would shift to the new structure to enable demolition of the remainder of the existing Mount Vernon Avenue Bridge and construction of the remaining east side of the new structure.

As part of this project, a service frontage road that is located along the east side of several homes located in the area of the southwest end of the existing bridge would have to be closed to allow construction of the new bridge. As a consequence of the closure of the frontage service roadway, an alleyway located on the west side of the homes would be widened from 12 to 14 feet to 30 feet. This widening would provide vehicular access to the homes.

The cost estimate for the original design concept used for this VA Study was $40,656,000.

The proposed project schedule is as follows:

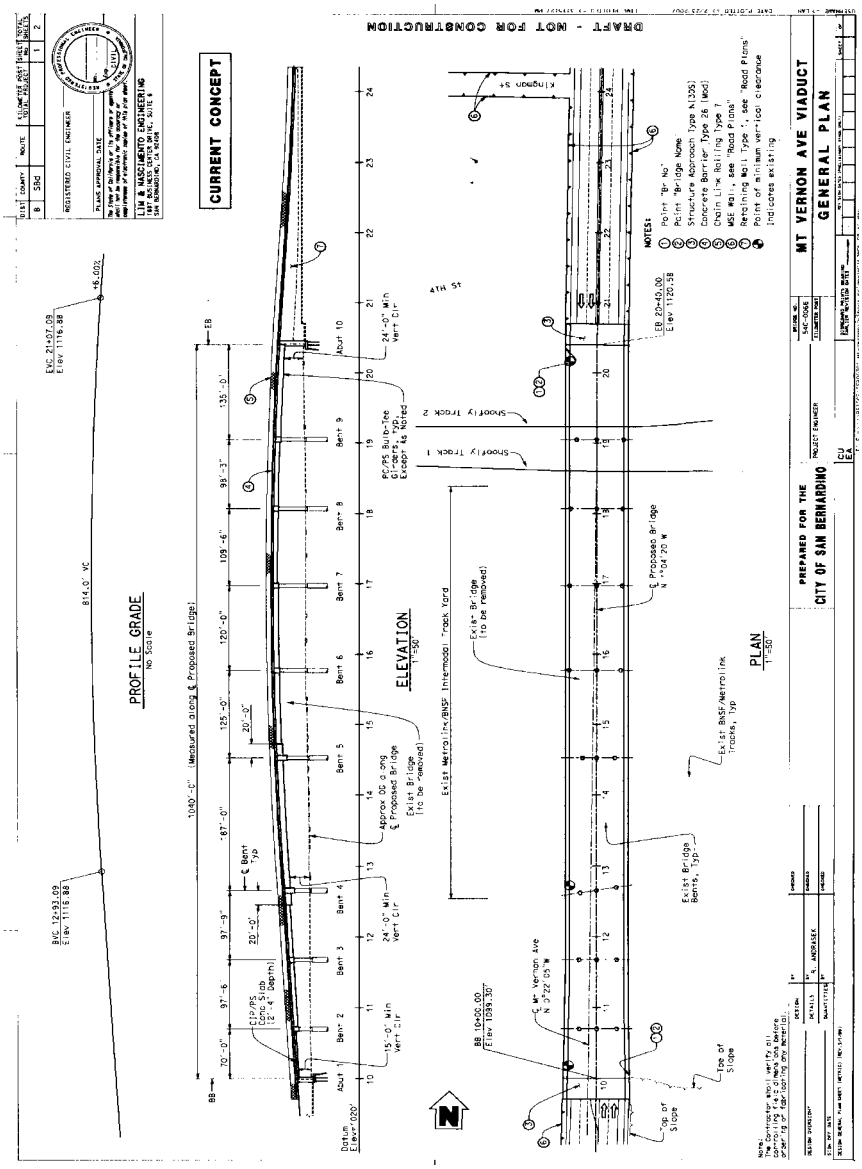
- Environmental Clearance.....October 2009
- Design.....June 2008 – June 2010
- Construction.....June 2010 – April 2012

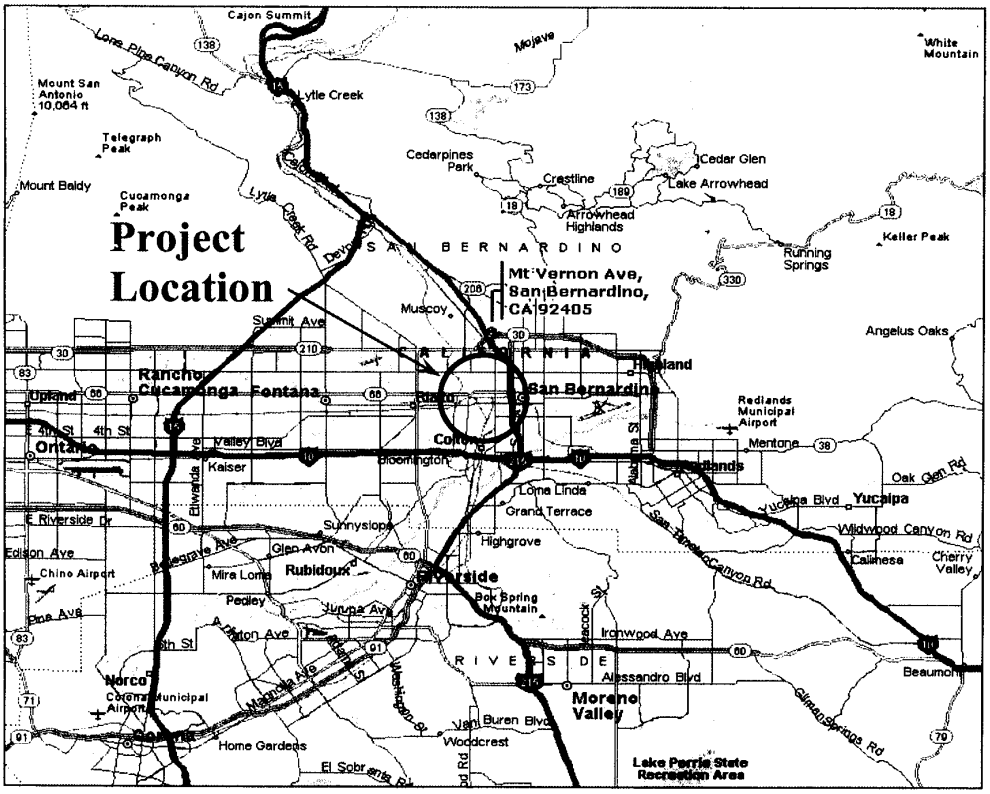
INFORMATION PROVIDED TO THE VA TEAM

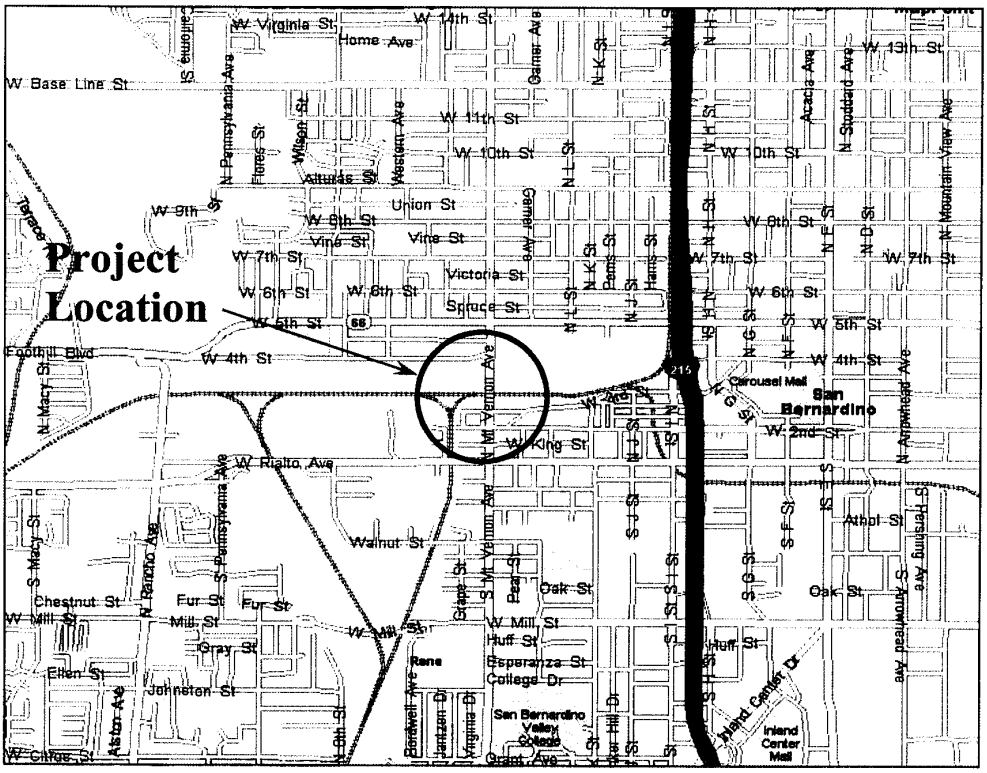
The following project documents were provided to the VE team for their use during the study:

- Application fro HBRRP funds to replace the Mt. Vernon Avenue Bridge over the BNSF Railroad; State Bridge No. 54C-0066, August 3, 2004.
- Cost Estimate, August 3, 2006

PROJECT DRAWINGS




Project Location
Mt Vernon Ave, San Bernardino, CA 92405
Cajon Summit
Lytle Creek
Cedarpines Park
Crestline
Cedar Glen
Lake Arrowhead
Arrowhead Highlands
Running Springs
Keller Peak
Mount San Antonio 10,064 ft
Telegraph Peak
Mount Baldy
Cucamonga Peak
Muscoy
Angelus Oaks
Rancho Cucamonga
Fontana
San Bernardino
Redlands Municipal Airport
Mentone
Upland
Ontario
Colton
Loma Linda
Grand Terrace
Yucaipa
Highgrove
Riverside
Rubidoux
Mira Loma
Pedley
Norco
Corona Municipal Airport
Home Gardens
Woodcrest
Morena Valley
Lake Perris State Recreation Area
Alessandro Blvd
Ironwood Ave
Beaumont
Cherry Valley
Calimesa
Oak Glen Rd
Wildwood Canyon Rd
Chino Airport
Edison Ave
E Riverside Dr
Valley Blvd
Kaiser
Bloomington
Sunnyslope
Glen Avon
Jurupa Ave
Magnolia Ave
Van Buren Blvd
Limonite Ave
Cajalco Rd
Glen Helen Parkway
San Timoteo Canyon Rd
Yucaipa Blvd
Mountain View Ave
Redlands
Bob Spring Mountain


Project Location
W Virginia St
W 14th St
Home Ave
W Base Line St
W 11th St
W 10th St
W 9th St
Union St
W 8th St
Vine St
W 7th St
Victoria St
W 6th St
Spruce St
W 5th St
Foothill Blvd
W 4th St
W Rialto Ave
Walnut St
Chestnut St
Fur St
Mill St
Gray St
Ellen St
Johnston St
Cirrus St
Oak St
Huff St
Esperanza St
College Dr
Rane
San Bernardino Valley College
Carousel Mall
San Bernardino
W 2nd St
Athol St
Inland Center Dr
Inland Center Mall
N Arrowhead Ave
N Mountain View Ave
N Sierra Way
N Waterman Ave
N Pennsylvania Ave
N Macy St
N Rancho Ave
Flores St
Wilson St
Western Ave
Alturas St
Garner Ave
Pepper St
Harris St
Acacia Ave
N Standard Ave
Terrace
Bordwell Ave
Janizan Dr
Virginia Dr
Grant Ave
Star Hill Dr
Mt Vernon Ave
Waterman Ave
215

PROJECT COST ESTIMATE

The project cost estimate is shown below.

PRELIMINARY PROJECT COST ESTIMATE
MT. VERNON BRIDGE PROJECT
August 3, 2006 - Revision No. 7

District-County-Route: 08-SBd-LOC
EA:

PROJECT DESCRIPTION:

The existing Mount Vernon Avenue Overhead, spanning the BNSF rail yard in San Bernardino, CA: to be replaced with a single span of CIP/PS Slab and 8 spans of PC/PS Bulb-Tee Girders, Post-Tensioned for full continuity under both dead and live loads.

Limits: Between 2nd St. (South) and 5th St. (North) on Mount Vernon Avenue

Proposed Improvement (Scope):

The existing overhead structure has been determined to be both structurally deficient and functionally obsolete. The bridge is to be replaced with a new bridge, designed to meet all applicable standards.

SUMMARY OF PROJECT COST ESTIMATE

			Estimated	Rounded Off	
TOTAL ROADWAY ITEMS			$3,988,861.46	**$4,000,000**	
	Contingency	20%	$797,772.29	**$800,000**	
TOTAL BRIDGE ITEMS			$15,039,519.72	**$15,050,000**	
	Contingency	20%	$3,007,903.94	**$3,010,000**	
TOTAL RAILROAD ITEMS *			$7,200,000.00	**$7,200,000**	
	Contingency	20%	$1,440,000.00	**$1,440,000**	
TOTAL POTENTIAL DISPOSAL OF CONTAMINATED SOIL *			$300,000.00	**$300,000**	
TOTAL CONSTRUCTION			$31,774,057.41	**$31,800,000**	
TOTAL RIGHT OF WAY COSTS *			$500,000.00	**$500,000**	
TOTAL UTILITY COSTS *			$150,000.00	**$150,000**	
TOTAL RIGHT OF WAY ENG/ACQUISITION			$75,000.00	**$75,000**	
TOTAL R/W & UTILITY			$725,000.00	**$725,000**	
TOTAL CONST + R/W & UTILITY			$32,499,057.41	**$32,525,000**	
PRELIMINARY ENGINEERING					
CALTRANS	* 0.00%		$0.00		
CITY	* 2.00%		$635,481.15	$650,500	
CONSULTANT	* 8.00%		$2,541,924.59	$2,602,000	
	10.00%			**$3,252,500**	<-PE
CONSTRUCTION ENGINEERING	* 15.00%		$4,766,108.61	**$4,878,750**	<-CE
TOTAL COSTS			$40,442,571.77	**$40,656,250**	<-Total

Note:
* Indicates placeholder estimate values to be updated as more detailed information becomes available.

Mt. Vernon - Engineers Estimate of Probable Cost (Check)

Bob Fish
08-01-06.

Construction Project 08-
DIST-CO-RTE-PM
08-SBD-

Checkers Estimate

ITEM No.	ITEM CODE		ITEM DESCRIPTION	Unit	Quantity	UNIT PRICE Amount	COST
			ROADWAY ITEMS				
1	71301		TEMPORARY FENCING (ROADWAY)	LS	1	$10,000	$10,000
2	71301		TEMPORARY FENCING (RR YARD)	LS	1	$25,000	$25,000
3	74019		PREPARE STORM WATER POLLUTION PREVENTION PLAN	LS	1	$5,030	$5,030
4	74020		WATER POLLUTION CONTROL	LS	1	$15,998	$15,998
5	79999		TEMPORARY RR YARD ON-GRADE CROSSINGS	M2	1,273	$54	$68,500
6	120100	(S)	TRAFFIC CONTROL SYSTEM	LS	1	$102,071	$102,071
7			TRAFFIC SIGNAL (REMOVE & REPLACE)	LS	1	$140,000	$140,000
8	150829		REMOVE RETAINING WALL	M2	502	$230	$115,320
9	160101		CLEARING AND GRUBBING	LS	1	$24,598	$24,598
10	192037	(F)	STRUCTURE EXCAVATION (RETAINING WALL)	M3	3,508	$68	$238,169
11	193013	(F)	STRUCTURE BACKFILL (RETAINING WALL)	M3	281	$99	$27,847
12			DRAINAGE FACILITIES	LS	1	$120,000	$120,000
13	197031		MSE WALL	M2	1,755	$809	$1,419,382
14			LANDSCAPE AND IRRIGATION RESTORATION	LS	1	$65,000	$65,000
15			ROADWAY	M2	16,845	$40	$679,961
16	510060	(F)	STRUCTURAL CONCRETE, RETAINING WALL	M3	310	$866	$268,301
17	731504		MINOR CONCRETE (CURB AND GUTTER)	M	1,999	$55	$110,771
18	731521		MINOR CONCRETE (SIDEWALK)	M3	284	$416	$118,236
19			PIPE RAILING	M	181	$115	$20,790
20			SIGNING AND STRIPING	LS	1	$15,000	$15,000
				sub-total Roadway Items			**$3,589,975**
			BRIDGE ITEMS				
21	157561		BRIDGE REMOVAL (PORTION)	M2	4,639	$211	$980,935
22	159999		PILE REMOVAL (TYPE CREOSOTED, 25lf)	EA	42	$1,076	$45,180
23	192003	(F)	STRUCTURE EXCAVATION (BRIDGE)	M3	1,070	$51	$54,125
24	193003	(F)	STRUCTURE BACKFILL (BRIDGE)	M3	596	$108	$64,558
25	490669	(S)	2000 mm CAST-IN-DRILLED-HOLE CONCRETE PILING	M	640	$2,549	$1,631,671
26	490700		FURNISH PILING (CLASS 900)	M	1,951	$24	$47,565
27	490701		DRIVE PILING (CLASS 900)	EA	160	$3,103	$496,533
28	500020		POST TENSION CONCRETE	LS	1	$138,000	$138,000
29		Note:	(Requires Kg weight of tendons to derive accurate LS cost)	KG			
30	510051	(F)	STRUCTURAL CONCRETE, BRIDGE FOOTING	M3	473	$455	$215,100
31	510053	(F)	STRUCTURAL CONCRETE, BRIDGE	M3	4,334	$913	$3,955,277
32	510059		STRUCTURAL CONCRETE, CRASH WALL	M3	291	$866	$252,402
33		Note:	use same data as for "Retaining Wall" below				
34	510085	(F)	STRUCTURAL CONCRETE, APPROACH SLAB (TYPE N)	M3	136	$804	$109,433
35	512235		FURNISH PRECAST PRESTRESSED CONCRETE BULB-TEE GIRDERS	EA	36	$42,117	$1,516,200
36	512500		ERECT PRECAST PRESTRESSED CONCRETE GIRDERS	EA	36	$3,135	$112,852
37	519123		JOINT SEAL ASSEMBLY (MR = 2)	M	73	$312	$22,821
38	520102	(F)(P)(S	BAR REINFORCING STEEL (BRIDGE)	KG	1,038,030	$3	$2,595,076
39	750505		BRIDGE DECK DRAINAGE SYSTEM	LS	1	$60,000	$60,000
40	833032	(F)(P)(S	CHAIN LINK RAILING (TYPE 7)	M	800	$278	$222,386
41	833140	(F)	CONCRETE BARRIER (TYPE 26 MODIFIED)	M	1,088	$820	$891,953
42			RESTORATION OF PAVEMENT IN RR YARD AREA	LS	1	$50,000	$50,000
43			BRIDGE LIGHTING (ARCHITECHTURAL ELECTROLIER)	EA	21	$3,500	$73,500
				sub-total Bridge Items			**$13,535,568**
			MOBILIZATION				
44	999990		MOBILIZATION	LS	1	$1,902,838	**$1,902,838**
				SUBTOTAL CONTRACT ITEMS			$19,028,381
				CONTINGENCIES AT		20.00%	$3,805,700
				TOTAL CONTRACT ITEMS			$22,834,081

engr\estimate\project completion\100%\060803 Mt Vernon_Cost 2

IDEA EVALUATION

IDEA EVALUATION

INTRODUCTION

The ideas generated by the VA team are carefully evaluated, and project-specific attributes are applied to each idea to assure an objective evaluation.

PERFORMANCE ATTRIBUTES

The VA team used the paired comparison method to prioritize the key performance attributes for this project:

- Railroad Operations (33%)
- Local Operations (27%)
- Construction Impacts (13%)
- Environmental (13%)
- Delivery Schedule (10%)
- Phaseability (4%)

The team enlisted the assistance of the stakeholders and designers (when available) to develop these attributes so that the evaluation would reflect their specific requirements.

EVALUATION PROCESS

The VA team, as a group, generated and evaluated ideas on how to perform the various functions. The idea list was grouped by function or major project element.

The team compared each of the ideas with the original concept for each of the performance attribute to determine whether it was better than, equal to, or worse than the original concept. The team reached a consensus on the ranking of the idea. High-ranked ideas would be developed further; low-ranked ones would be dropped from further consideration.

IDEA EVALUATION FORMS

All of the ideas that were generated during the creative phase using brainstorming techniques were recorded on the following Idea Evaluation forms. These ideas were discussed and the advantages and disadvantages of each were listed.

IDEA EVALUATION

Mount Vernon Avenue Bridge Replacement – City of San Bernardino

Ideas		Performance Attributes						Advantages	Disadvantages	$	Rank
No.	Function	RO	LO	CI	EI	DS	P				
	REPLACE BRIDGE										
RB-1	Use pre-cast segmental construction with crawler crane (up to contractor)	+1	+1	+2	+1	+3	0	♦ Faster construction (deck is part of the segments) ♦ Fewer traffic disruptions ♦ Affects railroad operations less than placing girders ♦ Box girders typically perform better seismically	♦ More construction cost because of specialized equipment and offsite segment fabrication ♦ Geometric issues would be complex to allow construction ♦ Technical Reviewer Comment: Technically feasible; concern about structure depth; profile is already fixed	↑↑↑	3

Ranking Scale:
5 = Significant Value Improvement
4 = Good Value Improvement
3 =Minor Value Improvement
2 = Minor Value Degradation
1 = Significant Value Degradation or Does Not Meet Project Purpose and Need
OC = Other Consideration or Suggestion

Performance Attributes: **Significant Improvement +2, +1, 0, -1, -2 Significant Degradation**

RO = Railroad Operations **LO = Local Operations** **CI = Construction Impacts**
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IDEA EVALUATION

Mount Vernon Avenue Bridge Replacement – City of San Bernardino

Ideas		Performance Attributes						Advantages	Disadvantages	$	Rank
No.	**Function**	**RO**	**LO**	**CI**	**EI**	**DS**	**P**				
RB-2	Construct a "landmark/ gateway" cable stay bridge or arch bridge	0	-1	-1	0	-1	-1	♦ Becomes a San Bernardino visitor attraction ♦ If not done now, the window to accommodate aesthetic issues could be lost ♦ Superstructure depth would be shallower and the profile could be lower, or it could provide more vertical clearance for railroad operations	♦ Significantly more expensive ♦ Does not match the historic theme ♦ More difficult to construct ♦ Could block views	↑↑↑↑	1
RB-3	Slide in preassembled bridge panels and incorporate a clear span launch technique	-2	+2	-2	-1	-1	-1	♦ Shorter traffic disruptions	♦ Too heavy to lift into place ♦ Sliding mechanism would have to be designed ♦ More cost because a temporary bridge would be needed ♦ Would need a larger staging area	↑↑↑	2

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IDEA EVALUATION

Mount Vernon Avenue Bridge Replacement – City of San Bernardino

Ideas		Performance Attributes						Advantages	Disadvantages	$	Rank
No.	Function	RO	LO	CI	EI	DS	P				
RB-4	Use prefabricated bridge components, such as a larger diameter steel shell and pier caps	+1	+1	+1	0	+1	0	♦ Speeds up construction time ♦ Reduces worker exposure to train operations ♦ Eliminates formwork for pier caps fabrication	♦ Lifting heavy pile caps would require larger cranes ♦ Technical Reviewer Comment: Technically feasible; could be done relatively easily; maybe pier caps could not be done because of space limitations	🡻	4
RB-5	Construct from both ends to the middle; use railroad yard for staging							♦ Speeds up construction time	♦ Could increase construction costs ♦ Contractor construction choice, which would be as designed		1
RB-6	Use cast-in-place bridge with falsework	-2							♦ Significant disruption to railroad operations, fabrication, and removal of falsework; therefore, not practical		1

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IDEA EVALUATION

Mount Vernon Avenue Bridge Replacement – City of San Bernardino

Ideas		Performance Attributes						Advantages	Disadvantages	$	Rank
No.	Function	RO	LO	CI	EI	DS	P				
RB-7	Relocate the bridge approximately 1,000 feet to the west							♦ Would not close existing bridge	♦ Does not meet purpose and need ♦ No working platform; increases disruptions to railroad operations ♦ Reroutes existing traffic ♦ Affects businesses ♦ Much higher right-of-way ♦ Not practical		1
RB-8	Realign the bridge approximately 50 feet to the east to avoid nearby houses							♦ Keeps the bridge away from four property parcels	♦ Worsens the 2nd Street Intersection ♦ Geometry in the north end would be challenging; would affect existing railroad operations in this area ♦ Would have a kink in the north end of the project ♦ More right-of-way cost ♦ Not practical	↑↑	1

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IDEA EVALUATION

Mount Vernon Avenue Bridge Replacement – City of San Bernardino

Ideas		Performance Attributes						Advantages	Disadvantages	$	Rank
No.	Function	RO	LO	CI	EI	DS	P				
RB-9	Tunnel under the railroad	+3						♦ Reduces roadway noise	♦ Disposal of hazardous soils would be very expensive ♦ Excavation would be much more expensive ♦ Would require new or revised environmental document ♦ Need air and water pumps ♦ Challenging geometry ♦ More difficult construction ♦ Could encounter unexpected cultural resources ♦ Excellent for railroad operations, but very expensive	↑↑↑	1
RB-10	Construct new bridges on either side of existing, then demolish existing structure							♦ Easier construction	♦ Requires more right-of-way acquisition ♦ Previously evaluated and rejected because of major impacts to the railroad		1

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IDEA EVALUATION

Mount Vernon Avenue Bridge Replacement – City of San Bernardino

Ideas		Performance Attributes						Advantages	Disadvantages	$	Rank
No.	**Function**	**RO**	**LO**	**CI**	**EI**	**DS**	**P**				
RB-11	Demolish the bridge in total and reconstruct in one phase	-2	-1	+1	+1	-2	+1	♦ Less construction cost ♦ Reduces construction time	♦ Disrupts railroad operations; working around tracks ♦ Introduces risk to the contractor ♦ Adds complexity to construction and related phasing ♦ Almost impossible for the railroad to provide construction windows; therefore, this idea is rejected	↓↓	1
RB-12	Do not rebuild the bridge; just demolish the existing								♦ Does not meet project purpose and need		1
RB-13	Construct the cast-in-steel-shell piles with column extension through the existing bridge deck to get all piling constructed in one phase, then set the deck	0	+1	+1	+1	+1	0	♦ Minimal impact to railroad operations ♦ One mobilization of pile contractor in lieu of two	♦ More difficult demolition of the existing bridge ♦ Would have to raise the bridge profile ♦ Restricts the location of pile; must account for existing bridge geometry	↓	4/3

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IDEA EVALUATION

Mount Vernon Avenue Bridge Replacement – City of San Bernardino

Ideas		Performance Attributes						Advantages	Disadvantages	$	Rank
No.	Function	RO	LO	CI	EI	DS	P				
RB-14	Longer bridge to minimize MSE walls							♦ Better visual because of less wall	♦ This idea would increase the cost of the project ♦ Previously considered by the designer, and the original concept is the best to fit FHWA cost requirements		1
RB-15	Install a utility duct and water line along side the bridge								♦ Other consideration		OC
RB-16	Drive piles (CISS) in lieu of drilling and pouring piles (CIDH)	+1	+1	0	-1	+1	0	♦ Speeds up construction ♦ Eliminates the potential for caving; therefore, the quality of pile construction improves and there is less risk ♦ Less excavation ♦ Improves seismic performance	♦ More maintenance for a steel shell ♦ More noise to drive piles ♦ More complex construction ♦ Technical Reviewer Comment: Technically feasible	0	4

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IDEA EVALUATION

Mount Vernon Avenue Bridge Replacement – City of San Bernardino

Ideas		Performance Attributes						Advantages	Disadvantages	$	Rank
No.	Function	RO	LO	CI	EI	DS	P				
RB-17	All steel bridge girders in lieu of pre-cast concrete	+1	0	0	0	+1	0	♦ Easier to construct ♦ Faster to construct ♦ Would match the existing structure ♦ Steel is easier to splice than concrete ♦ Easier to place steel than concrete ♦ Less risk of damage to steel beams during transport and erection ♦ Less depth of structure	♦ More maintenance; more deck joints to maintain ♦ Fatigue cracking is a concern ♦ More time to splice steel	↑↑	3
RB-18	Use steel for longer spans and pre-cast concrete for remainder	+1	0	0	0	+1	0	♦ Easier to construct ♦ Steel is easier to splice than concrete ♦ Easier to place steel than concrete ♦ Less risk of damage to steel beams during transport and erection	♦ More maintenance; more deck joints to maintain ♦ Fatigue cracking is a concern ♦ More time to splice steel ♦ Different structure depths; therefore, aesthetically unpleasing	↑	3

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IDEA EVALUATION

Mount Vernon Avenue Bridge Replacement – City of San Bernardino

Ideas		Performance Attributes						Advantages	Disadvantages	$	Rank
No.	Function	RO	LO	CI	EI	DS	P				
RB-19	Increase the vertical clearance to allow travel lift operations								♦ Does not meet stated purpose and need ♦ Geometry would severely impact local businesses		1
RB-20	Use traveling form construction technique							♦ Improves seismic performance	♦ Limited number of contractors that can do this work ♦ Span lengths would be limited ♦ Reduces vertical clearance during construction ♦ Too many disadvantages to be practical		1
RB-21	Use helicopters to place girders								♦ Not practical		1

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IDEA EVALUATION

Mount Vernon Avenue Bridge Replacement – City of San Bernardino

Ideas		Performance Attributes						Advantages	Disadvantages	$	Rank
No.	Function	RO	LO	CI	EI	DS	P				
RB-22	Use four pile bents (six feet in diameter) in lieu of three pile bents	0	0	-1	+1	+1	+1	♦ Reduces construction complexity ♦ Improves flexibility to locate columns ♦ Better foundation construction ♦ Reduces collapse potential that could result from impact from railroad derailment event or shifted rail load ♦ Four piles would be shallower ♦ Construction risk would be reduced because there would be a more stable working platform to construct Phase II	♦ Might encounter utilities ♦ More cost to place the bents	0	3/2
RB-23	Use six-foot columns to eliminate crash walls	+2	+1	+1	+1	+1	+1	♦ Saves cost of the crash wall ♦ Less soil to excavate; less chance of encountering hazardous material and artifacts	♦ None noted	🡻	4

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EI = Environmental **DS = Delivery Schedule** **P = Phaseability**

IDEA EVALUATION

Mount Vernon Avenue Bridge Replacement – City of San Bernardino

Ideas		Performance Attributes						Advantages	Disadvantages	$	Rank
No.	Function	RO	LO	CI	EI	DS	P				
RB-24	Use a rectangular pier wall (approximately 3 feet x 50 feet) on a narrow pile cap	-1	0	-1	0	-1	0	♦ Uses smaller piles; therefore, easier construction; smaller cranes	♦ Shoring needed ♦ Would require form work from below ♦ More labor exposure to railroad operations	0	
RB-25	Incentivize the contractor for early finish and also include liquidated damage for late finish								♦ Other consideration		OC
RB-26	Bring beams into the railroad yard to simplify construction							♦ Safer construction ♦ Reduces size of crane, but need two cranes	♦ Other consideration		OC
RB-27	Ship steel girders by rail if they are used								♦ Other consideration		OC
RB-28	Construct archway on the ends of the bridge								♦ Other consideration		OC
RB-29	Construct observation platform as part of the bridge deck								♦ As designed		1

Ranking Scale:
5 = Significant Value Improvement
4 = Good Value Improvement
3 =Minor Value Improvement
2 = Minor Value Degradation
1 = Significant Value Degradation or Does Not Meet Project Purpose and Need
OC = Other Consideration or Suggestion

Performance Attributes: **Significant Improvement +2, +1, 0, -1, -2 Significant Degradation**

RO = Railroad Operations **LO = Local Operations** **CI = Construction Impacts**
EI = Environmental **DS = Delivery Schedule** **P = Phaseability**

IDEA EVALUATION

Mount Vernon Avenue Bridge Replacement – City of San Bernardino

Ideas		Performance Attributes						Advantages	Disadvantages	$	Rank
No.	Function	RO	LO	CI	EI	DS	P				
	CONSTRUCT PROJECT										
CP-1	Relocate the houses on the property in lieu of acquisition								♦ Adds cost ♦ Not practical because of the value of the structures		1
CP-2	Construct cast-in-place retaining walls and relocate utilities early			+1		+1	+1		♦ Requires a separate contract ♦ Other consideration		OC
CP-3	Consider replicating the stairwell in the southeast part of the project for historical preservation								♦ Opposed by the City of San Bernardino because of liability and maintenance concerns		1
CP-4	Provide ADA lifts								♦ Complicates the design ♦ Maintenance issues ♦ Opposed by the City of San Bernardino because of liability and maintenance concerns; ADA requirements will partially be met		1

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IDEA EVALUATION

Mount Vernon Avenue Bridge Replacement – City of San Bernardino

Ideas		Performance Attributes						Advantages	Disadvantages	$	Rank
No.	Function	RO	LO	CI	EI	DS	P				
CP-5	Construct 6-foot sidewalks in lieu of 5-foot sidewalks on the bridge								♦ 5-footsidewalks meet the City standard width on the bridge; therefore, no reason to implement ♦ Probably not reimbursable ♦ Other consideration		OC
CP-6	Acquire properties on the west side of the project and relocate one homeowner and one car wash as soon as reasonably possible (acquire the property under a separate contract with its own environmental document as a categorical exclusion)	0	0	+1	+2	+1	0	♦ Removes individuals from a poor spot ♦ Easier right-of-way certification ♦ Would provide an adjacent staging area ♦ Would not have to reconstruct the alley near residences ♦ Could provide room for 2:1 slopes ♦ Simplifies the environmental document ♦ The original concept design does not have provisions to acquire the properties; doing this acquisition now would reduce project risk	♦ More initial cost to acquire right-of-way	↑↑	3

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IDEA EVALUATION

Mount Vernon Avenue Bridge Replacement – City of San Bernardino

Ideas		Performance Attributes						Advantages	Disadvantages	$	Rank
No.	Function	RO	LO	CI	EI	DS	P				
CP-7	Keep driveways near Kingman Avenue								♦ Other consideration		OC
CP-8	Construct CIDH piles early								♦ Up to the contractor ♦ Would have to have a separate contract		1
CP-9	Adjust span lengths for consistency								♦ Other consideration		OC
CP-10	Keep pedestrian/bicycle access on existing bridge during construction with barriers/fences								♦ Too dangerous; conflicts between pedestrian and construction activities ♦ Need to check with community desires		OC

Ranking Scale: **5 = Significant Value Improvement** **2 = Minor Value Degradation**
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IDEA EVALUATION

Mount Vernon Avenue Bridge Replacement – City of San Bernardino

Ideas		Performance Attributes						Advantages	Disadvantages	$	Rank
No.	Function	RO	LO	CI	EI	DS	P				
	SUPPORT ROADWAY										
SR-1	Construct 2:1 slopes in lieu of retaining walls on the west side	0	0	0	+1	0	0	♦ Can provide improved aesthetics; can add low-water landscaping	♦ Have to purchase all the properties to implement ♦ More maintenance for landscaping, weed control ♦ Limited applicability in the north and south end west side only	↑	2
SR-2	Use an "L" shaped retaining wall in lieu of "inverted T" shape MSE wall								♦ Other consideration		OC
SR-3	Shotcrete on MSE wall								♦ Other consideration		OC
SR-4	PCC in lieu of AC on approach roadway	0	+1	0	0	0	0	♦ Less rutting at the 2nd and 5th Street Intersections ♦ Less future maintenance	♦ Higher initial cost	↑	OC
SR-5	Painted murals on walls in lieu of texturizing walls								♦ Other consideration		OC
SR-6	Construct "keystone" walls in lieu of MSE walls								♦ Other consideration		OC

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IDEA EVALUATION

Mount Vernon Avenue Bridge Replacement – City of San Bernardino

Ideas		Performance Attributes						Advantages	Disadvantages	$	Rank
No.	Function	RO	LO	CI	EI	DS	P				
	PROTECT ENVIRONMENT										
PE-1	Check ongoing soil cleanup activities and use this information for the design										OC
PE-2	Use low-level hazardous material as embankment										OC
PE-3	Recycle concrete from the existing bridge										OC
PE-4	Use the park area in the southeast end of the existing bridge as a detention pond										OC
PE-5	Revaluate the noise and air quality studies								♦ The studies were determined to be acceptable		1
PE-6	Perform a paelonthropology study before going deeper than 15 feet										OC

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VA PROCESS

VALUE ANALYSIS PROCESS

INTRODUCTION

The Value Analysis process involves fifteen activities needed to accomplish a VA Study, organized in three parts: Preparation, VA Study, and Report. The following Caltrans VA Study Activity Chart describes each activity; the individual tasks are summarized below.

PREPARATION

Prior to the start of a VA Study, the District VA Coordinator (DVAC) and Team Leader carry out the following three activities:

- **Initiate Study** – Identify study project; define study goals; prepare draft study charter and Task Order Initiation Document.
- **Organize Study** – Conduct preparation meeting; select team members; finalize study charter and Task Order Initiation Document
- **Prepare Data** – Collect and distribute data; prepare cost models; develop LCC model.

All of the information gathered prior to the VA Study is given to the team members for their use.

VA STUDY

There are ten activities carried out by the VA team during the performance of the study, organized in three segments:

Segment 1

- **Inform Team** – Receive designer presentation; determine performance attributes; visit project site.
- **Analyze Functions** – Identify basic functions and cost drivers; prepare FAST diagram.
- **Create Ideas** – List a large quantity of alternative ideas; use group/individual brainstorming.
- **Evaluate Ideas** – Evaluate all ideas against performance attributes; rank all ideas.

Segment 2

- **Develop Alternatives** – Develop high-ranked ideas into VA alternatives; measure performance.
- **Critique Alternatives –** Team and Technical Reviewer review of alternatives to develop and ensure team consensus and technical viability. Develop and rate recommended VA alternatives.
- **Present Alternatives** – Give interim presentation of alternatives; prepare preliminary report.

Segment 3

- **Assess Alternatives** – Review alternatives; prepare draft implementation decisions.
- **Resolve Alternatives** – Resolve dispositions; edit and revise alternatives; summarize results.
- **Present Results** – Give final presentation of accepted alternatives.

REPORT

Following the VA Study, the Team Leader assembles all study documentation into the final report:

- **Publish Results** – Prepare Final VA Study Report; distribute printed and electronic copies.
- **Close Out VA Study** – Resolve open conditionally accepted VA alternatives and update the Executive Summary and VASSR. Provide final deliverables to the HQ VA Branch.

The VA Study is complete when the report is issued as a record of the VA team's analysis and development work, as well as the project development team's implementation dispositions for the alternatives.

Performance measures are integral to the VA process and are used throughout the VA Study. The following detailed discussion of the performance measures provides better clarification of how they are used within the VA process. A VA Study Activity Chart, which outlines the fifteen VA activities in more detail, follows the performance measures. The VA Study Agenda and Meeting Attendees sheet, which document the schedule and participants in the VA Study, are at the end of this section.

VALUE METRICS

The Value Metrics process is an integral part of the Caltrans Value Analysis Process. This process provides the cornerstone of the VA process by providing a systematic and structured means of considering the relationship of a project's performance and cost as they relate to value. Project performance must be properly defined and agreed upon by the stakeholders at the beginning of the VA study. The performance attributes and requirements developed are then used throughout the study to identify, evaluate, and document alternatives.

Introduction

The methodology described herein measures project value by correlating the performance of project scope and schedule to the project costs. This process is known as Value Metrics. The objective of this methodology is to prescribe a systematic, structured approach to study and optimize a project's scope, schedule, and cost.

Value Analysis has traditionally been perceived as an effective means for reducing project costs. This paradigm only addresses one part of the value equation, oftentimes at the expense of overlooking the role that VA can play with regard to improving project performance. Project costs are fairly easy to quantify and compare through traditional estimating techniques. Performance is not so easily quantifiable.

The direct and active involvement of the project's PDT is at the core of this process. The VA Team Leader will lead Caltrans and external stakeholders through the methodology, using the power of the process to distill subjective thought into an objective language that everyone can relate to and understand. The dialog that develops forms the basis for the VA team's understanding of the performance requirements of the project and to what degree the current design concept is meeting those requirements. From this baseline, the VA team can focus on developing alternative concepts that will quantify both performance and cost and contribute to overall project value.

Value Metrics yields the following benefits:

- Builds consensus among project stakeholders (especially those holding conflicting views)
- Develops a better understanding of a project's goals and objectives
- Develops a baseline understanding of how the project is meeting performance goals and objectives
- Identifies areas where project performance can be improved through the VA process
- Develops a better understanding of a VA alternative's effect on project performance
- Develops an understanding of the relationship between performance and cost in determining value
- Uses value as the true measurement for the basis of selecting the right project or design concept
- Provides decision makers with a means of comparing costs and performance (i.e., costs vs. benefits) in a way that can assist them in making better decisions.

METHODOLOGY

The application of Value Metrics consists of the following steps:

1. Identify key project (scope and delivery) performance attributes and requirements for the project
2. Establish the hierarchy and impact of these attributes upon the project
3. Establish the baseline of the current project performance by evaluating and rating the effectiveness of the current design concepts
4. Identify the change in performance of alternative project concepts generated by the study
5. Measure the aggregate effect of alternative concepts relative to the baseline project's performance as a measure of overall value improvement

The primary goal of Value Analysis is to improve project value. A simple way to think of value in terms of an equation is as follows:

$$\textit{Value} = \frac{\textit{Project Performance (Scope \& Schedule)}}{\textit{Project Cost}}$$

Assumptions

Before embarking on the details of this methodology some assumptions need to be identified:

- An evaluation of the creative ideas (ideas generated during the brainstorming, creative sessions—not to be confused with VE alternative concepts described in Step 4) is done between Steps 3 and 4. The idea evaluation process remains true to the "value" approach of measuring performance

and costs; however, due to the time constraints, the idea evaluation is a qualitative form of evaluating ideas, as opposed to the quantitative procedures done in the other steps.

- The methodology described in the following steps assumes the project functions are well established. Project functions are "the what" the project delivers to its users and stakeholders; a good reference for the project functions can be found in the environmental document's purpose and need statement. Project functions are generally well defined prior to the start of the VE Study. In the event that project functions have been substantially modified, the methodology must begin anew from the beginning (Step 1).

Step 1 – Determine the Major Performance Attributes

Performance attributes can generally be divided between Project Scope components (Highway Operations, Environmental Impacts, and System Preservation) and Project Delivery components. It is important to make a distinction between performance attributes and performance requirements. Performance requirements are mandatory and are binary in nature. All performance requirements MUST be met by any VA alternative concept being considered. Performance attributes possess a range of acceptable levels of performance. For example, if the project was the design and construction of a new bridge, a performance requirement might be that the bridge must meet all current seismic design criteria. In contrast, a performance attribute might be Project Schedule which means that a wide range of alternatives could be acceptable that had different durations.

The VA Team Leader will initially request that representatives from Caltrans and external stakeholders identify performance attributes that they feel are essential to meeting the overall need and purpose of the project. Usually four to eight attributes are selected. It is important that all potential attributes be thoroughly discussed. The information that comes out of this discussion will be valuable to both the VA team and Caltrans. It is important that the attribute be discretely defined, and they must be quantifiable in some form. By quantifiable, it is meant that a useable scale must be delineated with values given on a scale of 0 to 10. A "0" indicates unacceptable performance, while a "10" indicates optimal or ideal performance. The vast majority of performance attributes that typically appear in transportation VA studies have been standardized. This standardized list can be used "as is" or adopted with minor adjustments as required. Every effort should be made to make the ratings as objective as possible.

Step 2 – Determine the Relative Importance of the Attributes

Once the group has agreed upon the project's performance attributes, the next step is to determine their relative importance in relation to each other. This is accomplished through the use of an evaluative tool termed in this report as the "Performance Attribute Matrix." This matrix compares the performance attributes in pairs, asking the question: "An improvement in which attribute will provide the greatest benefit to the project relative to purpose and need?" A letter code (e.g., "a") is entered into the matrix for each pair, identifying which of the two is more important. If a pair of attributes is considered to be of essentially equal importance, both letters (e.g., "a/b") are entered into the appropriate box. This, however, should be discouraged, as it has been found that in practice a tie usually indicates that the pairs have not been adequately discussed. When all pairs have been discussed, the number of "votes" for each is tallied and percentages (which will be used as weighted multipliers later in the process) are calculated. It is not uncommon for one attribute to not receive any "votes." If this occurs, the attribute is given a token "vote", as it made the list in the first place and should be given some degree of importance.

Step 3 – Establish the Performance "Baseline" for the Original Design

The next step in the process is to evaluate how well the original design is addressing the project's performance attributes. This step establishes a "baseline" against which the VA alternative concepts can be compared. The Performance Rating Matrix is used to assist the VA team in determining the performance ratings for the original design concept. Representatives from the design team and external stakeholders next begin assigning a 0 to 10 rating for each attribute, using the definitions and scales developed in Step 1.

Once the 0 to 10 ratings for the various attributes have been established, their total performance should be calculated by multiplying the attribute's weight (which was developed in Step 2) by its rating. Once the total performance for each attribute has been determined, the original design's total performance can be calculated by adding all of the scores for the attributes. The concept's total performance will be somewhere between 0 and 1,000 points. A concept scoring 1,000 would represent a hypothetically "optimal" design concept, with all performance attributes being addressed to their theoretical maximum. This numerical expression of the original design's performance forms the "baseline" against which all alternative concepts will be compared.

Step 4 – Evaluate the Performance of the VA Alternative Concepts

Once the performance baseline has been established for the original design concept, it can be used to help the VA team develop performance ratings for individual VA alternative concepts as they are developed during the course of the VA Study. The Performance Measures form is used to capture this information. This form allows a side-by-side comparison of the original design and VA alternative concepts to be performed.

It is important to consider the alternative concept's impact on the entire project, rather than on discrete components, when developing performance ratings for the alternative concept

Step 5 – Compare the Performance Ratings of Alternative Concepts to the "Baseline" Project

The last step in the process completes the Value Matrix that was initially begun to develop the performance ratings for the original design concept. The VA team groups the VA alternatives into a strategy (or strategies) to provide the decision makers a clear picture of how the alternatives fit together into possible solutions. At least one strategy is developed to present the VA team's consensus of what should be implemented. Additional strategies are developed as necessary to present other combinations to the decision makers that should be considered. The strategy(s) of VA alternatives are rated and compared against the original concept. The performance ratings developed for the VA Strategies are entered into the matrix, and the summary portion of the Value Matrix is completed. The summary provides details on net changes to cost, performance, and value, using the following calculations.

- % Performance Improvement = Δ Performance VA Strategy / Total Performance Original Concept
- Value Index = Total Performance / Total Cost (in Millions)
- % Value Improvement = ΔValue Index VA Strategy / Value Index Original Concept

The PDT is asked to validate the performance measures and rationale at the Implementation Meeting. The rationale for the numerical rating change for each alternative in each strategy is developed. The Value Matrix shows the numerical change for each performance measure and alternative strategy. The Total Performance is calculated by multiplying the attribute weight by the performance rating for each performance measure of either the original concept or VA Strategy.

Caltrans VA Study Activity Chart

PREPARATION

INITIATE STUDY — 1
- Identify study project
- Identify study roles and responsibilities
- Define study goals
- Select team leader
- Prepare draft Study Charter

ORGANIZE STUDY — 2
- Conduct Pre-Study Meeting
- Select team members
- Identify stakeholders, decision-makers, and technical reviewers
- Identify data collection
- Select study dates
- Determine study logistics
- Update VA Study Charter

PREPARE DATA — 3
- Collect and distribute data
- Develop construction cost models
- Develop highway user benefit / life cycle cost (LCC) model

VA STUDY

Segment 1

INFORM TEAM — 4
- Review study activities and confirm reviewers
- Present design concept
- Present stakeholders' interests
- Review project issues and objectives
- Identify key functions and performance attributes
- Visit project site

ANALYZE FUNCTIONS — 5
- Analyze project data
- Expand project functions
- Prepare FAST diagram
- Determine functional cost drivers

CREATE IDEAS — 6
- Focus on functions
- List all ideas
- Apply creativity and innovation techniques (group and individual)

EVALUATE IDEAS — 7
- Apply key performance attributes
- Consider cost impacts
- List advantages and disadvantages
- Rate each idea
- Rank all ideas
- Assign alternatives for development

Segment 2

DEVELOP ALTERNATIVES — 8
- Develop alternative concepts
- Prepare sketches and calculations
- Measure performance
- Estimate costs, LCC benefits/costs

CRITIQUE ALTERNATIVES — 9
- VA Alternatives Technical Review
- VA Alternatives Team Consensus Review
- Identify mutually exclusive groups of alternatives
- Identify VA strategies
- Validate performance

PRESENT ALTERNATIVES* — 10
- Present findings
- Document feedback
- Confirm pending reviews
- Prepare preliminary report

**Interim presentation of study findings*

Segment 3

ASSESS ALTERNATIVES** — 11
- Review Preliminary Report
- Assess alternatives for project acceptance
- Prepare draft implementation dispositions

***Activities performed by PDT, Technical Reviewers, and Stakeholders*

RESOLVE ALTERNATIVES — 12
- Review implementation dispositions
- Resolve implementation actions with decision-makers and stakeholders
- Edit alternatives
- Revisit rejected alternatives, if needed

PRESENT RESULTS* — 13
- Present results
- Obtain management approval on implemented alternatives
- Summarize performance, cost, and value improvements

**Final presentation of study results*

REPORT

PUBLISH RESULTS — 14
- Document process and study results
- Incorporate all comments and implementation actions
- Distribute Final VA Report
- Distribute electronic report to HQ VA Branch
- Update VA Study Summary Report (VASSR)
- Provide HQ the Final VA Report in pdf format

CLOSE OUT VA STUDY — 15
(if Conditionally Accepted Alternatives exist)
- Resolve Conditionally Accepted Alternatives
- Finalize VA Study Summary Report (VASSR)
- Finalize Performance Measures
- Finalize VA Report Executive Summary and provide electronically to HQ

Note: The dashed boxes indicate steps that ***may*** not be required in some VA Studies.

Wednesday, February 13

Kick-Off Meeting
8:00 VA Team Setup
8:15 Introductions (All) and VA Agenda Review (VA Team Leader)
8:20 Project Overview (Project Manager and Engineers)
8:45 Stakeholder Issues and Concerns
9:00 Performance Attribute Development and Analysis of Design Alternatives
Conclusion of Kick-Off Meeting
9:30 Break
9:45 Site Visit
12:15 Lunch
1:15 Recap Site Visit and Review Project Information and Cost Estimate
2:00 Function Analysis/FAST Diagram
2:30 Cost/Function and Performance/Function Analysis
3:30 Team Brainstorming

Thursday, February 14

8:00 Team Brainstorming (Continued)
10:15 Break
10:30 Technical Review
12:00 Lunch
1:00 Evaluation of Ideas, Team Assignments for Development
2:00 ***Technical Review***
2:30 Alternative Development

Friday, February 15

8:00 Alternative Development (Continued)
10:15 Break
10:30 Group Review and Ranking of VA Alternatives/Strategies; Presentation Preparation
12:00 Lunch
1:00 Finalize Alternatives and Prepare Presentation
2:00 ***Presentation of VA Alternatives Meeting***
(Presentation of VA Study Results to Management and Stakeholders)

MEETING ATTENDEES

Mount Vernon Avenue Bridge Replacement – City of San Bernardino

LAN Engineering/San Bernardino County, California

2008 February				NAME	ORGANIZATION	POSITION	PHONE	EMAIL
PS	13	14	15					
	x	x	x	Fred Kolano	VMS, Inc.	VA Study Team Leader	(970) 216-1739	fred@vms-inc.com
x				Terry Hays	VMS, Inc.	VA Study Contact	(760) 741-1155	terry@vms-inc.com
	x	x	x	Charlotte Sheehan	Caltrans - District 8	Environmental	(909) 383-6389	charlotte_sheehan@dot.ca.gov
	x			Charles Smith	Jones & Stokes	Environmental	(949) 218-7741	csmith@jsanet.com
	x	x	x	Don Lozano	BNSF Railroad	Bridge Department	(913) 551-4178	donald.lozano@bnsf.com
	x	x	x	Bob Price	LAN Engineering	Senior Bridge Engineer	(916) 605-6315	robert.price@lanengineering.com
	x	x		Mike Grubbs	City of San Bernardino	P.E. Project Manager	(909) 384-5179	grubbs_mi@sbcity.org
	x	x	x	John Voepel	LAN Engineering	Roadway	(949) 768-8888	Johnv@lancivil.com
	x	x	x	Robert Eisenbeisz	City of San Bernardino	City Engineer	(909) 384-5203	eisenbeisz_ro@sbcity.org
	x	x		Alicia Colburn	LAN Engineering	Environmental Manager	(909) 890-0477	alicia.colburn@lanengineering.com
	x	x	x	Todd Dudley	LAN Engineering	Bridge Engineer	(949) 413-1074	todd.dudley@lanengineering.com
	x	x	x	George Plaas	LAN Engineering	Bridge Engineer - Construction Reviews	(760) 243-6946	
x	x	x	x	William Nascimento	LAN Engineering	Project Manager	(909) 890-0477	Williamn@lanengineering.com
			x	Laura Weidimawn	City of San Bernardino	Engineering Assistant	(909) 384-5574	weidemawn@sbcity.org
			x	Valerie C. Ross	City of San Bernardino	Delivery Services Director	(909) 384-5357	ross_va@sbcity.org

Value Management Strategies, Inc.

Offices in Escondido and Sacramento, California; Grand Junction, Colorado; Sarasota, Florida; Marietta, Georgia; Portland, Oregon; Seattle, Washington; Kansas City, Kansas; and Great Falls, Montana

Value Management Strategies, Inc.

Final Value Analysis Study Report

MOUNT VERNON AVENUE BRIDGE REPLACEMENT – CITY OF SAN BERNARDINO

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