VALUE ENGINEERING STUDY

US Army Corps of Engineers

Los Angeles District

Preliminary Report

RIO SALADO, SALT RIVER, ARIZONA (ENVIRONMENTAL RESTORATION PROJECT)

Phoenix/Tempe, AZ

FY 2000

Workshop Dates: **September 14-18, 1998**

Report Date: **September 1998**

rsr "the value solutions team"

Robinson, Stafford & Rude, Inc.

Preliminary

Value Engineering Study Report

for

Rio Salado, Salt River, Arizona
(Environmental Restoration Project)

Phoenix/Tempe, AZ

September 1998

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SUMMARY OF RECOMMENDATIONS

VALUE ENGINEERING TEAM STUDY

PROJECT TITLE: *Rio Salado, Salt River, Arizona (Environmental Restoration Project)*

PROJECT LOCATION: *Phoenix/Tempe, AZ*

SUMMARY OF VE RECOMMENDATIONS

IDEA NO.	IDEA DESCRIPTION	FIRST COST SAVINGS	LIFE CYCLE COST SAVINGS	DECI-SION
M-02	Pave low flow channel		Reviewed & Rejected	
M-26	Construct grade control structures full-width with notches for low-flow channel	$3,861,000	$7,162,000	
M-34	Replace drop structures and use pool and riffle sequence	$834,000	$834,000	
M-58	Use less cement and use geogrids for channel stabilization		Reviewed & Rejected	
M-66	Limit the meander of LFC with cut-off walls COP N/A	$9,749,000	$13,050,000	
M-67	Locate rock (natural) in channel and use as grade control		Reviewed & Rejected	
M-89	Construct drop structures out of boulders		Reviewed & Rejected	
M-105	Raise LFC to flood terrace more frequently to lower retardance	$12,296,000	$13,016,000	
C-02	Increase base flow in LFC to provide moving water habitat and encourage herbaceous vegetation from local sources		Reviewed & Rejected	
C-03	Plant project in phases using previous areas as nursery stock	$2,644,000	$2,471,000	
C-04	Replace large boxes of plants with cuttings/whips/bare root stock from local sources such as Tres Rios	$3,761,000	$3,761,000	

A-Accepted *A/M-Accepted with Modifications* *F-Further Study Required* *O-Open or Undecided* *R-Rejected*

VALUE ENGINEERING TEAM STUDY

PROJECT TITLE: *Rio Salado, Salt River, Arizona (Environmental Restoration Project)*

PROJECT LOCATION: *Phoenix/Tempe, AZ*

IDEA NO.	IDEA DESCRIPTION	FIRST COST SAVINGS	LIFE CYCLE COST SAVINGS	DECI-SION
C-18	Use renewable energy such as methane from landfill or solar energy for pump	$(100,000)	$1,681,000	
C-54	Plant at appropriate time of year	$0	$463,000	
C-59	Post flood, recover vegetation and replant	$24,000	$350,000	
C-63	Plant the perennial stream bank with indigenous species with low "n-value" and high habitat value	$6,862,000	$6,862,000	
C-68	Design shape of planting to be hydraulically stable	$0	$1,848,000	
P-03	Protect terraces only at stress points	$3,573,000	$3,573,000	
P-10	Provide an energy dissipator at storm water outlets		Reviewed & Rejected	
P-15	Line low flow channel only a short distance downstream of grade control structures	$5,108,000	$5,108,000	
P-23	Provide provisions to protect habitat from the receding side of the flood	$(459,000)	$2,367,000	
P-31	Develop "adopt a river" or streams team programs	$0	$450,000	
P-59	Develop fire breaks in landscape plan	$331,000	$1,483,000	
R-28	Provide gateway visitor/interpretative center	Not Completed	Not Completed	

A-Accepted *A/M-Accepted with Modifications* *F-Further Study Required* *O-Open or Undecided* *R-Rejected*

RECOMMENDATIONS

VALUE ENGINEERING RECOMMENDATION

PROJECT TITLE: *Rio Salado, Salt River, Arizona (Environmental Restoration Project)*

PROJECT LOCATION: *Phoenix/Tempe, AZ*

PROPOSAL NO.: C-3

PAGE NO.: 1 of

DESCRIPTION: Plant project in phases using previous areas as nursery stock.

CRITERIA CHALLENGE: Yes/No CRITERIA NO.:

ORIGINAL CONCEPT:

Plant entire project at one time using container-grown nursery-supplied plant material.

PROPOSED CONCEPT:

Plant portions of the project as phases, staggered over several years and use plant material gathered from previous planting phases.

SUMMARY OF COST SAVINGS

	FIRST COST	PRESENT WORTH OF O&M COSTS	LIFE CYCLE COSTS
ORIGINAL CONCEPT	4,472,000	0	4,472,000
PROPOSED CONCEPT	1,828,000	173,000	2,001,000
SAVINGS	2,644,000	173,000	2,471,000

VALUE ENGINEERING RECOMMENDATION

PROPOSAL NO.: C-3

PAGE NO.: of

ADVANTAGES & DISADVANTAGES

ADVANTAGES:

- Improved success rates for future planting phases.
- Increased success of locally-adapted plants.
- Reduced costs for collection and propagation.
- Reduced risk of catastrophic loss of entire project.
-
-

DISADVANTAGES:

- Greater efforts expended for coordination and design.
-
-
-
-
-

JUSTIFICATION:

Phased planting would allow adjustments to planting ~~plan~~ designs for future phases based on analysis of observed successes and failures. ~~leading~~ Using this adaptive design approach would improve the success of future planting phases. Phased planting would reduce the risk ~~potential~~ of catastrophic loss of the entire project from a major flood event by spreading planting implementation over several years. Locally-collected plant material would probably exhibit higher survival rates and be less expensive to collect and propagate.

VALUE ENGINEERING RECOMMENDATION

PROPOSAL NO.: C-3

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DISCUSSION

Planting in phases would provide opportunities for ~~observing~~ monitoring success and failure of plantings. This information could be used to adjust planting design of future phases to improve success rates by avoiding repeating mistakes and emulating successful techniques. Using ~~locally-a~~ plant material from locally-adapted plants would increase success rates of future planting. Increased survival rates would provide cost savings by reducing replacement costs. Planting in phases would reduce the risk and potential replacement costs in the event of a catastrophic flood event. Spreading the planting out over several years would reduce losses. Larger, more established plants planted in previous phases would be more likely to withstand higher velocities and longer inundation periods. Collecting plants locally may also reduce later ~~costs~~, transportation, and storage costs associated with using nursery-grown stock. Locally-collected stock would be better adapted to local hydrologic, soil, and climate conditions. Local collection would also provide opportunities to use community volunteers for collection and planting for future replacement planting which would reduce costs ~~and~~, build community support, and contribute to environmental education goals.

VALUE ENGINEERING RECOMMENDATION

PROPOSAL NO.: C-3

PAGE NO.: of

ORIGINAL CONCEPT — CALCULATIONS

One-phase Habitat Planting:	Acres	Total No.	Total Cost
Tempe R.			
mesquite	30	~~1500~~ 3000	~~127,500~~
cot/wil	20	~~1000~~ 2000	~~85,000~~
Pho. R.			
Mesq.	130	~~6500~~ 13,000	~~552,500~~
Cott/wil	99	~~4950~~ 9900	~~420,750~~

VALUE ENGINEERING RECOMMENDATION

PROPOSAL NO.: C-3

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PROPOSED CONCEPT — CALCULATIONS

Multi-phase Habitat Planting:

	Acres	Total No.	Cost each
Tempe Reach - phase 1			
Mesq.	15	1500	$85
Cot/Will	10	1000	$85
Tempe R - phase 2 (assume smaller size, locally-collected)			
Mesq	15	1500	$45
Cot/Will	10	1000	$45
Phoenix R - phase 1			
Mesq.	50	5000	$85
Cott-Will	39	3900	$85
Pho. R. - phase 2			
Mesq.	40	4000	$14
Cot/Wil	30	3000	$14
Pho R. - phase 3			
Mesq	40	4000	$14
Cott/Will	30	3000	$14

Phase 2 planting assumes taking and rooting cuttings from local (phase 1) material and installation at tree-pot size = $14.00/plant installed

Phase 3 planting assumes same cost/plant as for phase 1 = $14/plant installed

VALUE ENGINEERING RECOMMENDATION

PROPOSAL NO.: C-3

PAGE NO.: of

PROPOSED CONCEPT — CALCULATIONS

PHASE 2 (TEMPE)					
MESQUITE BOSQUE (ACRE)	1400			15	21,000
COTTONWOOD/WILLOW (ACRE)	1400			10	14,000

PHASE 2 (PHOENIX)					
MESQUITE BOSQUE (ACRE)	1400			40	56,000
COTTONWOOD/WILLOW (ACRE)	1400			30	42,000

COST IN 3 YEARS = $133,000

PHASE 3					
MESQUITE BOSQUE (ACRE)	1400			40	56,000
COTTONWOOD WILLOW (ACRE)	1400			30	42,000

COST IN 6 YEARS = $98,000

VALUE ENGINEERING RECOMMENDATION

PROPOSAL NO.: C-3

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COST SAVINGS ESTIMATE

		Original Concept		Proposed Concept	
Item	Unit Cost	Quantity	Total	Quantity	Total
TEMPE REACH TOTAL			798,000		399,000
PHOENIX REACH TOTAL			3,674,000		1,429,000
TOTALS			4,472,000		1,828,000
NET SAVINGS					2,644,000

All costs from project MCACES Report and MCACES Database except if noted below:

1.

2.

VALUE ENGINEERING RECOMMENDATION

PROPOSAL NO.: C-3
PAGE NO.: of

COST SAVINGS ESTIMATE

		Original Concept		Proposed Concept	
Item	Unit Cost	Quantity	Total	Quantity	Total
TEMPE REACH					
SINGLE PHASE PLANTING					
MESQUITE BOSQUE (ACRE)	8500	30	255,000		
COTTONWOOD/WILLOW (ACRE)	9900	20	198,000		
MULTI PHASE PLANTING					
PHASE 1					
MESQUITE BOSQUE (ACRE)	8500			15	127,500
COTTONWOOD/WILLOW (ACRE)	9900			10	99,000
SUB-TOTAL W/OUT MARKUPS			453,000		226,500
MARKUP @ 76.19%			345,100		172,570
TOTALS			798,000		399,000
NET SAVINGS					399,000

All costs from project MCACES Report and MCACES Database except if noted below:

1.

2.

VALUE ENGINEERING RECOMMENDATION

PROPOSAL NO.: C-3

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COST SAVINGS ESTIMATE

		Original Concept		Proposed Concept	
Item	Unit Cost	Quantity	Total	Quantity	Total
PHOENIX REACH (SINGLE PHASE)					
MESQUITE BOSQUE (ACRE)	8500	130	1,105,000		
COTTONWOOD/WILLOW (ACRE)	9900	99	980,100		
MULTI PHASE PLANTING					
PHASE 1					
MEQUITE BOSQUE (ACRE)	8500			50	425,000
COTTONWOOD/WILLOW (ACRE)	9900			39	386,100
SUB-TOTAL W/OUT MARKUPS			2,085,100		811,100
MARKUP @ 76.19%			1,588,638		618,000
TOTALS			3,674,000		1,429,000
NET SAVINGS					2,245,000

All costs from project MCACES Report and MCACES Database except if noted below:

1.

2.

VALUE ENGINEERING RECOMMENDATION

PROPOSAL NO.: C-3
PAGE NO.: of

LIFE CYCLE COST ANALYSIS

LIFE CYCLE PERIOD 50 YEARS

ANNUAL PERCENTAGE RATE = 7 1/8 %

INITIAL COSTS	PRESENT DESIGN (PRESENT WORTH)	PROPOSED DESIGN (PRESENT WORTH)
Base Cost		
SUB-TOTAL		

SINGLE EXPENDITURE	YEAR	PRESENT WORTH FACTOR	PRESENT DESIGN		PROPOSED DESIGN	
			ESTI-MATE	PRESENT WORTH	ESTI-MATE	PRESENT WORTH
Phase 2	3	0.8134			133,000	108,182
Phase 3	6	0.6617			98,000	64,847
Salvage						
		SUB-TOTAL		0		173,029

ANNUAL EXPENDITURE	YEARS	PRESENT WORTH FACTOR	PRESENT DESIGN		PROPOSED DESIGN	
			ESTI-MATE	PRESENT WORTH	ESTI-MATE	PRESENT WORTH
O&M						
Energy						
		SUB-TOTAL				

TOTAL PRESENT WORTH	0	173,029
LIFE CYCLE SAVINGS		(173,029)

VALUE ENGINEERING RECOMMENDATION

PROJECT TITLE: *Rio Salado, Salt River, Arizona (Environmental Restoration Project)*

PROJECT LOCATION: *Phoenix/Tempe, AZ*

PROPOSAL NO.: C-4

PAGE NO.: 1 of

DESCRIPTION: Replace large boxes of plants with cuttings/whips/bare root stock from local sources such as Tres Rios.

CRITERIA CHALLENGE: Yes/No CRITERIA NO.:

ORIGINAL CONCEPT:

For planting habitat areas, planting materials will be planted in 5-gallon container sizes for cottonwoods, willows, and mesquites. For recreation areas, plants will be planted in sizes ranging from 5-gallon containers to 36-inch box sizes for willows and mesquites.

PROPOSED CONCEPT:

For habitat areas and recreation areas, plants should be planted in smaller sizes appropriate for the type of plant used. Smaller sizes would be dee-pot and tree-pot sizes for habitat areas and tree-pot to 15-gallon sizes for recreation areas, ~~or~~ and some plants could be planted from cuttings, whips, or bare root stock.

SUMMARY OF COST SAVINGS

	FIRST COST	PRESENT WORTH OF O&M COSTS	LIFE CYCLE COSTS
ORIGINAL CONCEPT	4,408,000	N/A	4,408,000
PROPOSED CONCEPT	647,000	N/A	647,000
SAVINGS	3,761,000	N/A	3,761,000

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VALUE ENGINEERING RECOMMENDATION

PROPOSAL NO.: C-4

PAGE NO.: of

ADVANTAGES & DISADVANTAGES

ADVANTAGES:

- Cost savings for initial cost of purchasing plants.
- Cost savings for labor for installation.
- Cost savings for replacement planting throughout life of project.
- Plants available more readily in shorter time period, requiring less coordination.
- Greater flexibility in obtaining plants throughout life of project.

DISADVANTAGES:

- Smaller size plants visible to public during first year for habitat areas
- Smaller size plants visible to public during first 2 to 3 years for recreation areas.
-
-

JUSTIFICATION:

For riparian species, plants initially planted at smaller sizes ~~initially~~ will catch up in size and vigor to plants planted from larger container sizes within one growing season and generally have lower mortality rates. Planting from smaller sizes would reduce costs and increase flexibility and adaptive management capability throughout the life of the project.

VALUE ENGINEERING RECOMMENDATION

PROPOSAL NO.: C-4
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DISCUSSION

If properly planted and given adequate water, riparian plants will grow extremely fast in the Sonoran Desert climate. Cottonwoods and willows planted from dee-pot size containers will catch up in size with the same species planted ~~planted~~ from 5-gallon containers generally within one growing season. Riparian plants that are initially planted in small container sizes have often been shown to adapt better and grow with more vigor than larger container stock because of their ability to adapt to local conditions at a younger age. Smaller stock generally has exhibited lower mortality rates within one year of planting than larger stock because of the smaller plants capability to adjust quickly to local conditions of soil and hydrology. Growing plants to larger sizes ~~in~~ in a nursery requires more time and materials and is substantially more costly. ~~Storing~~ Storage, delivery, ~~and~~ handling, and planting requires substantially more labor time and costs than planting smaller-sized plants. Roots of riparian plants do not develop naturally as well in 5-gallon containers as they do in dee- and tree-pots which are designed to accomodate the natural root structure of the plants. Smaller size containers allows greater flexibility for growing and delivery; this will provide great benefits ~~of~~ in reduced costs

DISCUSSION

given the high ~~anticipated~~ frequency of replacement planting anticipated for this project. Planting smaller stock sizes requires substantially less time and labor costs for planting will be substantially reduced.

For recreation areas, the size of plants is quite large and expensive to obtain and plant. Larger sizes are being used apparently to create more of an "instant landscape" effect. The same effect would be achieved within two to three years by using plants one to two sizes smaller for initial planting.

VALUE ENGINEERING RECOMMENDATION

PROPOSAL NO.: C-4

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ORIGINAL CONCEPT — CALCULATIONS

Habitat Planting:	Acres	Size	Density	Total No.	Cost each mat'l	Cost each lab	Total Cost
Tempe Reach							
Mesquite	30	5g.	100/ac	3,000	$15	$70	255,000
Cott/willow	20	5g.	100/ac	2,000	$20	$70	180,000
Phoenix Reach							
Mesquite	130	5g.	100/ac	13,000	$15	$70	1,105,000
Cott/Wil	99	5g.	100/ac	9900	$20	$70	891,000

Recreation Planting:	Size	Total No.	Cost each	Total Cost
Willow	36" box	50	621.00	31,050.00
	24" box	110	155.25	17,077.50
	15 g.	250	54.35	13,587.50
	5 g.	400	23.30	9,320.00
Mesquite	36" box	50	621.00	31,050.00
	24" box	110	155.25	17,077.5
	15 g.	250	54.35	13,587.5
	5 g.	400	23.30	9,320.0

VALUE ENGINEERING RECOMMENDATION

PROPOSAL NO.: C-4

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PROPOSED CONCEPT — CALCULATIONS

Habitat Planting *	Total No.	Cost each * ~~w/ tub~~ installed	Total Cost
Tampe R.			42,000
Mesquite	3,000	$14	~~21,000~~
Cot/Wil	2,000	$10	20,000
Pho. R.			182,000
Mesquite	13,000	$14	~~91,000~~
Cot/Wil	9,900	$10	99,000

Rec. Plnty	Size	Total No.	Cost ea.	Total cost
Willow	24" box	50	155.25	7,762.50
	15 g.	110	54.35	5,978.50
	5 g.	250	23.30	5,825.00
	1 g.	400	12.00	4,800.00
Mesquite	24" box	50	155.25	7,762.50
	15 g	110	54.35	5,978.50
	5 g	250	23.30	5,825.00
	1 g	400	12.00	4,800.00

* For habitat planting, assume: mesquite in three-pot size installed @ $14.00.
cottonwood & willow in dee-pot size installed @ $10.00.

VALUE ENGINEERING RECOMMENDATION

PROPOSAL NO.: C-4
PAGE NO.: of

COST SAVINGS ESTIMATE

		Original Concept		Proposed Concept	
Item	Unit Cost	Quantity	Total	Quantity	Total
HABITAT PLANTING (5-GAL)					
MESQUITE (EA)	85	16,000	1,360,000		
COTTONWOOD/WILLOW (EA)	90	11,900	1,071,000		
RECREATION PLANTING					
36-INCH BOX (EA)	621.00	50	31,050		
24-INCH BOX (EA)	155.25	110	17,078	50	7763
15-GALLON (EA)	54.35	250	13,588	110	5979
5-GALLON (EA)	23.30	400	9320	250	5825
1-GALLON (EA)	12.00			400	4800
HABITAT PLANTING (TREE/DEE POT)					
MESQUITE (EA)	14.00			16,000	224,000
COTTONWOOD/WILLOW (EA)	10.00			11,900	119,000
SUB-TOTAL W/OUT MARKUP			2,502,036		367,366
MARKUP @ 76.19%			1,906,301		279,896
TOTALS			4,408,000		647,000
NET SAVINGS					3,761,000

All costs from project MCACES Report and MCACES Database except if noted below:

1.

2.

VALUE ENGINEERING RECOMMENDATION

PROJECT TITLE: *Rio Salado, Salt River, Arizona (Environmental Restoration Project)*

PROJECT LOCATION: *Phoenix/Tempe, AZ*

PROPOSAL NO.: C-18

PAGE NO.: 1 of

DESCRIPTION: Use renewable energy, such as methane from landfill or solar, for pump energy

CRITERIA CHALLENGE: Yes/No CRITERIA NO.:

ORIGINAL CONCEPT:

The energy source for the extraction wells given in the Feasibility Study (FS) is electrical. For this alternative, electrical power must be installed at the well sites.

PROPOSED CONCEPT:

Our proposed concept uses alternative energy sources to power the extraction wells. The alternative energy source used for this analysis is solar power stations. An alternative source could be methane available at the City of Phoenix 19th Avenue Landfill. For the proposed alternative, capital costs and operation and maintenance (O&M) costs for installation of electrical power is eliminated.

SUMMARY OF COST SAVINGS

	FIRST COST	PRESENT WORTH OF O&M COSTS	LIFE CYCLE COSTS
ORIGINAL CONCEPT	0	1,834,000	1,834,000
PROPOSED CONCEPT	100,000	53,000	153,000
SAVINGS	(100,000)	1,781,000	1,681,000

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VALUE ENGINEERING RECOMMENDATION

PROPOSAL NO.: C-18

PAGE NO.: of

ADVANTAGES & DISADVANTAGES

ADVANTAGES:

1) capital and O&M costs for installation of electrical power is eliminated;

2) scheduling constraints due to installation of electrical power lines and equipment are eliminated;

3) trenching for power lines is eliminated;

4) capital costs for solar power stations is assumed to be less than capital costs for electrical power; and

5) O&M costs for solar power stations is small.

DISADVANTAGES:

1) reliability of solar power is inferior to that for electrical power;

2) power available during periods of cloud cover may be less than required by the extraction wells; and

3) no alternative power source would be available.

JUSTIFICATION:

Based on the assumptions used for this analysis, using solar energy would reduce life cycle costs with little loss in system flexibility. An additional benefit for the project would be that use of solar power is consistent with the concept of environmental restoration.

DGH

DISCUSSION

The Rio Salado Project is located in an area that has abundant solar radiation. For this analysis, we assumed that a solar power station would be located at each well site. Location of the stations at each site will eliminate the need to install electrical power lines from the nearest available power source to each well site.

Costs for solar power generating stations were not available for use in this analysis. Therefore, we have assumed that the stations could be installed at the seven wells for a total of $100,000.

VALUE ENGINEERING RECOMMENDATION

PROPOSAL NO.: C-18

PAGE NO.: of

ORIGINAL CONCEPT — CALCULATIONS

Assumptions:	Altitude (ft, msl)	Depth to Water (ft, bls)	Drawdown (ft)	Lift (ft)
Top of reservoir	1120			
Bottom of reservoir	1100			
Wells at 24th Street	1080	65	35	140
Wells at 16th Street	1060	60	9	129
Wells at 7th Street	1050	55	5	130
Average		60	16	133

Water horsepower = (lift x flow rate)/3960:

(133 feet) x (700 gpm) / (3960)= 24 horespower

18 kilowatts

Operating horsepower = water horsepower / pump efficiency:

(24 HP) / (0.8) = 29 horespower
22 kilowatts

Assume 10 cents per kilowatt-hour:

(24 hours) x (365 hr/year) =	8,760 hours per year
(22 KW) x (hours) =	192,720 KWH per year (one well)
(times 10 cents per KWH) =	19,272 annual power cost per well
times 7 wells	134,904 annual power costs for 7
operation costs for 50 years	1,832,806 present worth power costs

DGH

VALUE ENGINEERING RECOMMENDATION

PROPOSAL NO.: C-18

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PROPOSED CONCEPT — CALCULATIONS

Assumptions:

Cost for 7 solar power stations	100,000	
Replace stations at year 15	35,620	
Replace stations at year 30	12,680	
Replace stations at year 45	4,520	
Total life cycle cost	152,820	present worth

Cost savings: 1,679,986

DGH

VALUE ENGINEERING RECOMMENDATION

PROJECT TITLE: *Rio Salado, Salt River, Arizona (Environmental Restoration Project)*

PROJECT LOCATION: *Phoenix/Tempe, AZ*

PROPOSAL NO.: C-54

PAGE NO.: 1 of

DESCRIPTION: Plant at Appropriate Time of Year

CRITERIA CHALLENGE: No CRITERIA NO.:

ORIGINAL CONCEPT:

Planting may not be limited to optimal planting seasons throughout the year.

PROPOSED CONCEPT:

Identify and restrict project planting to optimal planting windows throughout the year to increase predicted first year survival rates beyond those identified in the Feasibility Report.

SUMMARY OF COST SAVINGS

	FIRST COST	PRESENT WORTH OF O&M COSTS	LIFE CYCLE COSTS
ORIGINAL CONCEPT	N/A	1,116,000	1,116,000
PROPOSED CONCEPT	N/A	653,000	653,000
SAVINGS	N/A	463,000	463,000

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ADVANTAGES & DISADVANTAGES

ADVANTAGES:

- Reduces mortality associated with first year planting.

DISADVANTAGES:

- Requires more detailed scheduling to fit within the even month planting window.

JUSTIFICATION:

This method is both a technically and financially prudent method of performing the envisioned planting. Restricting planting to the most optimal planting periods during the year is a common practice around the country. Saving money on planting will enable the project team to utilize the saved money for other items such as additional plantings and other project features.

DISCUSSION

Comparing the Feasibility Report (FR) to the MCACES Cost Estimate (CE) identified an inconsistency between the two documents. Page VI-13 of the FR, Habitat Monitoring, identifies expected first year survival rates as 80%. Reviewing Detail pages 9 and 37 of the CE identify 9% and 8% respectively, for the Tempe and Phoenix reaches. The study team believes actual survival rates will be closer to the 80% than the 9% and 8% utilized in the CE. Accordingly, the VE team first corrected this inconsistency to bring the estimate to a more accurate level.

Following the above correction, an analysis was performed to determine what was the basis of the FR and CE. It was decided, based on the information available, that the anticipated survival rates made no allowance or adjustment for restricting planting to specific time periods during the year that are most conducive for maximizing habitat survival rates. In the case of this project, this would mean restricting planting to those periods of the year when temperatures are lowest.

Analysis determined the most advantageous period for planting would be from mid-October through mid-May, a period of seven months. From this analysis calculations were performed to determine the mortality (inverse of survival) rates for the hot period months and non-hot period months.

Identifying the non-hot period mortality rates allowed us to calculate a cost for replacing dead plants after the first year. This cost was compared to the CE (revised for inconsistency) to identify the cost savings for restricting planting to optimal time periods of the year.

Although a savings was realized by restricting the planting season, it was overshadowed by the cost increase associated with correcting the original CE that utilized the lower mortality rates.

(3) adjustments for unforseen circumstances are needed; and (4) changes to structures or their operation or management techniques are required.

The Monitoring and Adaptive Management Plan provides a description of: the habitats to be restored, the density and composition of the plantings, the performance criteria and monitoring protocol to evaluate success, maintenance activities that may be performed to ensure a successful restoration effort, and reporting requirements. The monitoring program allows the Corps to perform minor modifications to the restoration project over the duration of the monitoring program based upon performance criteria described below. Adaptive Management actions are those that result from monitoring and occur after the project is turned over to the non-Federal sponsors. The complete Monitoring and Adaptive Management Plan is presented as Appendix G of the Draft Environmental Impact Statement.

Monitoring Frequency and Maintenance Protocol

Mesquite Upland

For the first six months after planting the site, it shall be monitored monthly; thereafter, the site shall be monitored every other month for a year. The site will remain free of all non-native shrubs throughout this 18 month period. Should the survival rate of plantings indicate that the species composition is less than prescribed, replanting will be undertaken to ensure that the species composition is maintained.

All plantings shall have a minimum of 80% survival the first year and 100% survival the second and third years and/or attain 40% cover after 5 years. Ninety percent cover is expected of Mesquite Upland in the overbanks after 10 years. There will be zero tolerance of exotic shrubs the first 5 years. If the survival and cover requirements are not met during the initial 5 years, the Corps is responsible for replacement planting to achieve these requirements. (Note that the replacement planting cost would be a cost-shared project cost for the first 5 years.)

After 5 years, the non-Federal sponsors (City of Tempe and City of Phoenix, as appropriate) will be responsible for maintaining the restoration sites for the remaining life of the project. The species composition shall be maintained throughout the life of the project. Site monitoring shall be performed yearly throughout the life of the project.

The Mesquite Upland habitat on the overbank is outside of the 100-year flood event and not expected to be impacted by flood flows; Mesquite habitat on the banks is only expected to be affected by the larger flood events. (i.e., 20- and 50-year events). After the larger events, the Mesquite Upland sites will be evaluated to determine the extent of the damage to the site and a determination would be made on the extent of the re-vegetation effort. (Note that under natural conditions, velvet mesquite woodlands depend on large floods to disperse seeds in the upper terraces, and late summer rains to inundate germination sites [cf. Stromberg et al. 1991]).

VALUE ENGINEERING RECOMMENDATION

PROPOSAL NO.: C-54

PAGE NO.: of

ORIGINAL CONCEPT — CALCULATIONS

TEMPE REACH

Fri 13 Mar 1998
Eff. Date 03/13/98
DETAILED ESTIMATE

U.S. Army Corps of Engineers
PROJECT RIOREC: Rio Salado Feasibility Study
Current Working Estimate of Feasibility Study
02. Tempe Reach (Recommended Plan)

TIME 13:58:39
DETAIL.PAGE 9

02.06. Annual OMRR&R	QUANTY	UOM	CREW ID	OUTPUT	MANHRS	LABOR	EQUIPMNT	MATERIAL	UNITCOST	TOTAL COST	UNIT COST
02.06. Annual OMRR&R											
Until the end of full establishment period, the annual maintenance activities will include irrigation,replacement of dead plants, removal of invasive exotic plants, and perhaps, some prunings of the plantings.											
Assume 9% dead plant replacement for the first year (see Table 2: Average Annual Vegetation Damage, CESPL-ED-MN)											
Mesquite Bosque : 0.09 * $170,000 = $15,300											
Cottonwood/willow : 0.09 * $198,000 = $17,820											
Wetland Marsh: 0.09 * $176,000 = $15,840											
TOTAL $48,960											
TOTAL Annual OMRR&R	1.00	EA			0	0	0	0	48,960	48,960	48960.00

LABOR ID: AZHN94 EQUIP ID: NAT93A

Currency in DOLLARS

CREW ID: RO793A UPB ID: RO793A

VALUE ENGINEERING RECOMMENDATION

PROPOSAL NO.: C-54

PAGE NO.: of

ORIGINAL CONCEPT — CALCULATIONS

PHOENIX REACH

Fri 13 Mar 1998
Eff. Date 03/13/98
DETAILED ESTIMATE

U.S. Army Corps of Engineers
PROJECT RIOREC: Rio Salado Feasibility Study
Current Working Estimate of Feasibility Study
09. Phoenix Reach (Recommended Plan)

TIME 13:58:39
DETAIL PAGE 37

09.06. Annual OMRR&R (Riparian Habitat)	QUANTY	UOM	CREW ID	OUTPUT	MANHRS	LABOR	EQUIPMNT	MATERIAL	UNITCOST	TOTAL COST	UNIT COST
09.06. Annual OMRR&R (Riparian Habitat)											
Assume 8% for dead plant replacement:											
mesquite: 0.08 * $1,105,000 = $ 88,400											
cottonwood/willow: 0.08 * $980,100 = $ 78,408											
wetland marsh: 0.08 * $538,230 = $ 43,058											
Total = $209,866.00(say $209,900)											
TOTAL Annual OMRR&R (Riparian Habitat)	1.00	EA			0	0	0	0	209,900	209,900	209900.00

LABOR ID: AZMN94 EQUIP ID: MAT93A Currency in DOLLARS CREW ID: R0793A UPB ID: R0793A

VALUE ENGINEERING RECOMMENDATION

PROPOSAL NO.: C-54

PAGE NO.: of

PROPOSED CONCEPT — CALCULATIONS

MOFFATT & NICHOL ENGINEERS	CLIENT COE - LA DISTRICT	JOB NO.	
	PROJECT RIO SALADO	SHEET 1 OF 2	
	DESIGN FOR ALT. C-54	DESIGNER	DATE 9-16-98
		CHECKER	DATE

PHOENIX REACH

TOTAL SEASON = JANUARY → DECEMBER = 12 MONTHS

NOT MONTHS = MID-MAY → MID-OCTOBER

= 5 MONTHS

ALLOWABLE PLANTING SEASON = TOTAL SEASON − NOT MONTHS

= 12 MONTHS − 5 MONTHS = 7 MONTHS

ASSUMED MORTALITY RATE ON ANNUAL BASIS = 20%

ASSUMED MORTALITY RATE DURING NON-NOT MONTHS (y) = $x = \left(\frac{5}{12}\right)\left(\frac{7}{12}\right)y = .7143y + y = .20$

$y = .20/1.7143 = .1167 = \underline{11.7\%}$

ASSUMED MORTALITY RATE DURING NOT MONTHS (x) = $\left(\frac{5}{12}\right)x + \left(\frac{7}{12}\right)y = .4167x + (.5833)(.117) = .20$

$x = .316 = \underline{31.6\%}$

ASSUME MORTALITY ON INITIAL PLANTING = 20% (W/YEAR-ROUND PLANTING)

1st YEAR COST FOR MORTALITY = $524,666 (REVISED FOR INCONSISTENCY)

REVISED 1st YEAR COST FOR MORTALITY = (11.7%/20%)($524,666) = $306,930

COST SAVINGS = $524,666 − $306,930 = $217,736

VALUE ENGINEERING RECOMMENDATION

PROPOSAL NO.: C-54

PAGE NO.: of

PROPOSED CONCEPT — CALCULATIONS

MOFFATT & NICHOL ENGINEERS	CLIENT COE - LA DISTRICT	JOB NO.	
	PROJECT RIO SALADO	SHEET 2 OF 2	
	DESIGN FOR ALT. C-54	DESIGNER	DATE 9-16-97
		CHECKER	DATE

TEMPE REACH

SAME SEASON BREAKDOWN AS PHOENIX REACH

ASSUMED MORTALITY RATE
ON ANNUAL BASIS (FROM MCACES) = 20%

ASSUMED MORTALITY RATE = $x + (\frac{5}{12})(\frac{7}{12})y = .7143y + y = .20$
DURING NON-HOT MONTHS (y) = $y = .20/1.7143 = .1167 = 11.7\%$

ASSUMED MORTALITY RATE = $(\frac{5}{12})x + (\frac{7}{12})y = .4167x + (.5833)(.117) = .20$
DURING HOT MONTHS (x) = $x = .3162 = 31.6\%$

ASSUME MORTALITY ON INITIAL PLANTING = 20% (W/YEAR-ROUND PLANTING)

1st YEAR COST FOR MORTALITY = $108,800 (REVISED FOR INCONSISTENCY)

REVISED 1st YEAR COST FOR MORTALITY = (11.7%/20%)($108,800) = $63,648

COST SAVINGS = $108,800 - $63,648 = $45,152

PROJECT TOTAL

PHOENIX REACH COST SAVINGS = $217,736

TEMPE REACH COST SAVINGS = $45,152

$262,888

VALUE ENGINEERING RECOMMENDATION

PROPOSAL NO.: C-54

PAGE NO.: of

O&M COST SAVINGS ESTIMATE

		Original Concept		Proposed Concept	
Item	Unit Cost	Quantity	Total	Quantity	Total
Tempe Reach Annual OMRR&R (Rev)					
Mesquite/Bosque	20.00%	$170,000	$34,000		
Cottonwood/Willow	20.00%	$198,000	$39,600		
Wetland Marsh	20.00%	$176,000	$35,200		
Phoenix Reach Annual OMRR&R (Rev)					
Mesquite/Bosque	20.00%	$1,105,000	$221,000		
Cottonwood/Willow	20.00%	$980,100	$196,020		
Wetland Marsh	20.00%	$538,230	$107,646		
Tempe Reach Annual OMRR&R (11.7%)					
Mesquite/Bosque	11.70%			$170,000	$19,890
Cottonwood/Willow	11.70%			$198,000	$23,166
Wetland Marsh	11.70%			$176,000	$20,592
Phoenix Reach Annual OMRR&R (11.7%)					
Mesquite/Bosque	11.70%			$1,105,000	$129,285
Cottonwood/Willow	11.70%			$980,100	$114,672
Wetland Marsh	11.70%			$538,230	$62,973
Sub-Total w/out Markups			$633,466		$370,578
Markups (Note 1)	76.19%		$482,638		$282,343
TOTALS			$1,116,000		$653,000

VALUE ENGINEERING RECOMMENDATION

NET SAVINGS	$463,000

All costs from project MCACES Report and MCACES Database except if noted below:

1. Includes Markups for Field Office Overhead (8%), Home Office Overhead (6%), Profit (6.89%), Bonds (0.70%), AZ Tax (4.55%), Contingency (20%), PE&D (7%), S&A (6.5%).

2.

VALUE ENGINEERING RECOMMENDATION

PROJECT TITLE: *Rio Salado, Salt River, Arizona (Environmental Restoration Project)*

PROJECT LOCATION: *Phoenix/Tempe, AZ*

PROPOSAL NO.: C-59

PAGE NO.: 1 of

DESCRIPTION: Post-flood, recover vegetation and replant.

CRITERIA CHALLENGE: Yes/No CRITERIA NO.:

ORIGINAL CONCEPT:

Following floods, vegetation lost would be replanted using nursery-grown plant material.

PROPOSED CONCEPT:

Following floods, lost and damaged riparian vegetation would be recovered from down-stream deposition areas and replanted

SUMMARY OF COST SAVINGS

	FIRST COST	PRESENT WORTH OF O&M COSTS	LIFE CYCLE COSTS
ORIGINAL CONCEPT	96,000	1,304,000	1,400,000
PROPOSED CONCEPT	72,000	978,000	1,050,000
SAVINGS	24,000	326,000	350,000

rsr

VD

VALUE ENGINEERING RECOMMENDATION

PROPOSAL NO.: C-59

PAGE NO.: of

ADVANTAGES & DISADVANTAGES

ADVANTAGES:

- Improved efficiency of ~~det~~ post-flood debris clearing.
- Reduced costs of replanting.
- Reduced costs of debris-clearing from channel.
-
-
-

DISADVANTAGES:

- Replanting of some large material may require large equipment
- (e.g., backhoe, large flat-bed truck).
-
-
-
-

JUSTIFICATION:

Following floods, some debris (uprooted plants) will need to be recovered from downstream deposition areas. Recovering a portion of the uprooted plants washed downstream and reusing them for planting the project area ~~#~~ would reduce costs of replanting and provide a location for deposit of some debris. Many riparian plants, particularly cottonwoods and willows will reroot and respraut and cuttings can be taken from ~~larger trees.~~

VALUE ENGINEERING RECOMMENDATION

PROPOSAL NO.: C-59
PAGE NO.: of

DISCUSSION

During flood events, some riparian trees and other plants will be sheared off ~~and~~ or uprooted and deposited in downstream locations. Some of this debris will need to be cleared from the channel. Riparian vegetation is adapted to flood damage and will often resprout and reroot. ~~Large~~ Riparian trees that have been uprooted and remain fairly intact could be cleared from the channel and replanted in the project area with reasonable success. Smaller material could be used as a source of cuttings or bundled to create willow ~~wands~~ wattles that could be replaced in the project area. This "debris" ~~material~~ would provide a cheap and available source of planting material, much of which would need to be cleared from the channel to maintain flood conveyance. Using the plant material in this way would reduce costs of replanting and improve efficiency and reduce costs for debris-clearing operations.

VALUE ENGINEERING RECOMMENDATION

PROPOSAL NO.: C-59

PAGE NO.: of

ORIGINAL CONCEPT — CALCULATIONS

O&M for dead plant replacement:

(Assume 8% for dead plant replacement):

Phoenix Reach:

~~mesquite = (.08) ($1,105,000) $88,400~~

cottonwood/willow = (.08) (980,000) = $78,408

Tempe Reach: (assume 9% for dead plant replacement)

cottonwood/willow = (.09) (198,000) = $17,820

VALUE ENGINEERING RECOMMENDATION

PROPOSAL NO.: C-59

PAGE NO.: of

PROPOSED CONCEPT — CALCULATIONS

Assume 25 % of replacement planting can be achieved using plant material recovered as "debris" from necessary channel-clearing maintenance operations following flood events.

∴ assume replacement planting cost savings of :

Phoenix Reach: (.25)(.08) = .02

Tempe Reach: (.25) (.09) = .0225

(Assume only for cottonwood and willow because of resprouting characteristics and higher probability of damage due to lower elevation position in channel.)

Savings (average annual O&M):

Phoenix Reach : (.25) (78,408) = $ 19,602

Tempe Reach : (.25) (17,820) = $ 4,455

VALUE ENGINEERING RECOMMENDATION

PROPOSAL NO.: C-59

PAGE NO.: of

O&M COST SAVINGS ESTIMATE

		Original Concept		Proposed Concept	
Item	Unit Cost	Quantity	Total	Quantity	Total
annual O&M-dead plant replacement*:			~~78,408~~		
Phoenix Reach	78,408/yr		78,408	~~58,806~~	58,806
Tempe Reach	17,820/yr		17,820	~~13,365~~	13,365
* cottonwood-willow replacement only.					
TOTALS			96,000		72,000
NET SAVINGS					24,000

All costs from project MCACES Report and MCACES Database except if noted below:

1.

2.

VALUE ENGINEERING RECOMMENDATION

PROPOSAL NO.: C-59

PAGE NO.: of

LIFE CYCLE COST ANALYSIS

LIFE CYCLE PERIOD 50 YEARS

ANNUAL PERCENTAGE RATE = 7⅛ %

INITIAL COSTS	PRESENT DESIGN (PRESENT WORTH)	PROPOSED DESIGN (PRESENT WORTH)
Base Cost		
SUB-TOTAL		

SINGLE EXPENDITURE	YEAR	PRESENT WORTH FACTOR	PRESENT DESIGN		PROPOSED DESIGN	
			ESTI-MATE	PRESENT WORTH	ESTI-MATE	PRESENT WORTH
Salvage						
		SUB-TOTAL				

ANNUAL EXPENDITURE	YEARS	PRESENT WORTH FACTOR	PRESENT DESIGN		PROPOSED DESIGN	
			ESTI-MATE	PRESENT WORTH	ESTI-MATE	PRESENT WORTH
O&M	50	13.586	96,000	1,304,000	72,000	978,000
Energy						
		SUB-TOTAL		1,304,000		978,000
TOTAL PRESENT WORTH						
LIFE CYCLE SAVINGS						326,000

VALUE ENGINEERING RECOMMENDATION

PROJECT TITLE: *Rio Salado, Salt River, Arizona (Environmental Restoration Project)*

PROJECT LOCATION: *Phoenix/Tempe, AZ*

PROPOSAL NO.: C-63

PAGE NO.: 1 of

DESCRIPTION: PLANT PERENNIAL CHANNEL & INDIGENOUS PLANTS OF LOW "n" VALUE & HIGH HABITAT VALUE

CRITERIA CHALLENGE: Yes/No CRITERIA NO.:

ORIGINAL CONCEPT: ARMOR LOW FLOW CHANNEL ENTIRE LENGTH WITH A SOIL CEMENT WALL 8' THICK. THE PURPOSE OF THE WALL IS TO MAINTAIN THE LOCATION OF THE LOW FLOW CHANNEL WHILE PROTECTING THE TERRACES FROM FLOOD SCOUR UP TO THE LEVEL OF A 12,200 cfs FLOW

PROPOSED CONCEPT: ELIMINATE SOIL CEMENT ARMOR. REPLACE WITH NATURAL CHANNEL ARMORED AT TOE AND TOP WITH MATERIAL SUCH AS GEOWEB OR HARD FILLET (AT TOE) FURTHER BANK PROTECTION IS PROVIDED BY FLATTENING THE SLOPE TO AN AVERAGE OF 3:1 AND PLANTING SUITABLE VEGETATION

SUMMARY OF COST SAVINGS

	FIRST COST	PRESENT WORTH OF O&M COSTS	LIFE CYCLE COSTS
ORIGINAL CONCEPT	24,560,000	N/A	24,560,000
PROPOSED CONCEPT	17,698,000	N/A	17,698,000
SAVINGS	6,862,000	N/A	6,862,000

rsr

NMcP

VALUE ENGINEERING RECOMMENDATION

PROPOSAL NO.: C63

PAGE NO.: of

ADVANTAGES & DISADVANTAGES

ADVANTAGES:

- ~.5.7 ACRES ADDITIONAL HABITAT
- ELIMINATION OF UNSIGHTLY PAVED WALL
- MORE FLEXIBLE, NATURAL STREAMBANK
- VISUAL CONNECTION TO TERRACE
- PROVIDES HARD PROTECTION AT POINTS OF HIGH STRESS
- PROVIDES SOME SOFT PROTECTION FROM SCOUR BY USING VEGETATION

DISADVANTAGES:

- MORE COMPLEX SHAPE
- SEVERE STORMS WILL SCOUR
-
-
-
-

JUSTIFICATION: THE RECOMMENDATION SUPPLIES PROTECTION FOR THE TERRACE HABITATS AND MAINTENANCE OF THE LOW FLOW CHANNEL THROUGH A MORE NATURAL, AESTHETICALLY PLEASING APPROACH. BY HARDENING ONLY THE HIGH STRESS EDGES OF THE LOW FLOW CHANNEL, THE PRIMARY PURPOSE OF THE SOIL CEMENT WALL IS ACHIEVED WHILE SUBSTANTIALLY INCREASING THE HABITAT

Discussion

The citizens of Phoenix have made a conscious decision to restore their river to the most natural condition feasible. A paved channel, whatever the desired protective function, remains a starkly artificial feature of the project. The purpose of this recommendation is to provide protection for the terraces while adding over 5 acers of additional habitat, eliminating a serious safety hazard and easing the passage of wildlife up the slope.

The protection for the terraces is afforded by three techniques. The toe of the low flow channel is protected by a small fillet composed of cement treated base. The top of the bench is protected by a double layer of Geoweb. The Geoweb is an open celluar reinforcement system that provides scour resistance while accomodating growth of small plants. Some scour protection is provided by sedges along the lower edge of the bench and a limited number of sandbar willow clumps along the slope. Both types of plants are exceptionally tolerant of flood damage and rebound quickly after storms.

The conveyance requirement of the project is substantially met by lowering the slope and limiting the vegetation. The original concept condition is a Manning's "n" of 0.03 and a 2:1 slope. The proposed concept condition is a Manning's "n" of 0.035 and a 3:1 slope. The 12,200 cfs flow flood elevation changes from 9.5 feet to 10.2 feet.

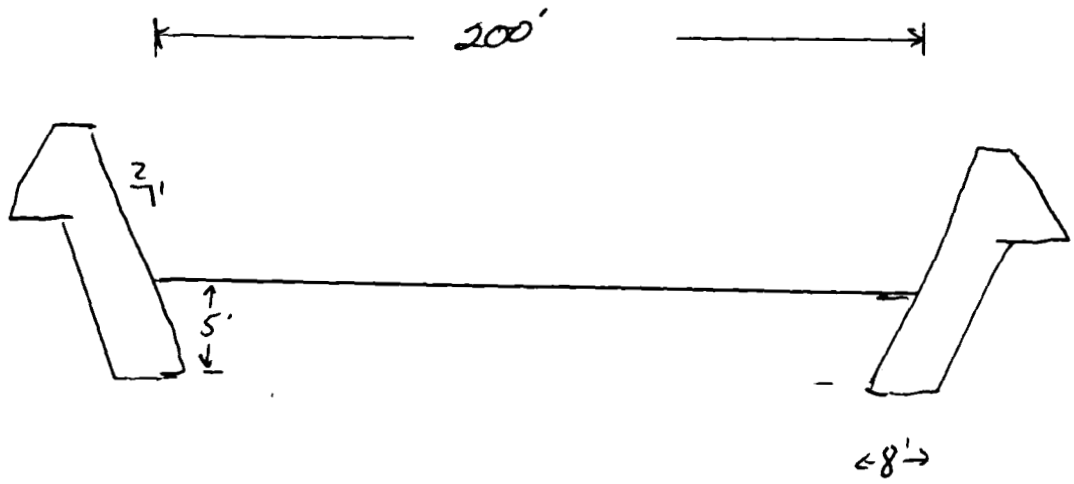
In addition to eliminating an unsightly paved channel, this recommendation visually connects the perennial stream with the terraces above. Perhaps most importantly, humans will be able to ascend a 3:1 slope of natural material far more easily than a 2:1 paved slope. This could have life saving implications in the event that a child is in the low flow area during a significant flow release.

VALUE ENGINEERING RECOMMENDATION

PROPOSAL NO.: C-63

PAGE NO.: of

ORIGINAL CONCEPT — SKETCH

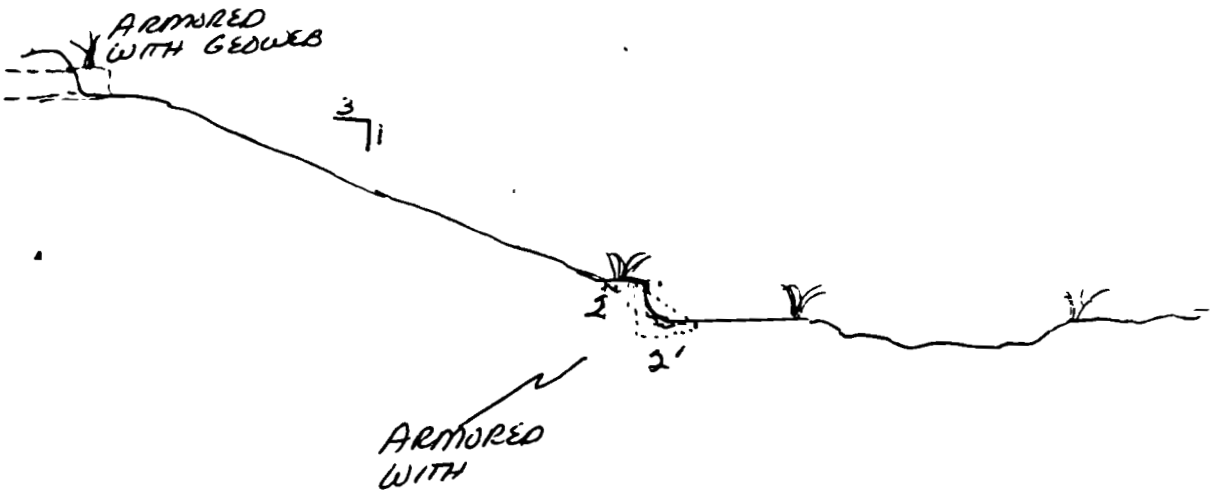


VALUE ENGINEERING RECOMMENDATION

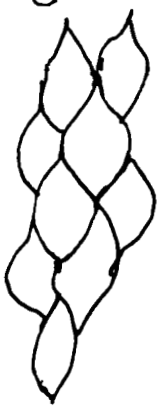
PROPOSAL NO.: ~~P-59~~ C-63

PAGE NO.: of

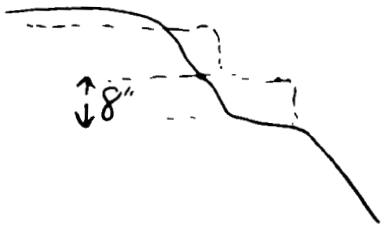
PROPOSED CONCEPT — SKETCH



GEOWEB - 8" CELLS



PLAN



SECTION AT TOP OF BENCH

DGH

VALUE ENGINEERING RECOMMENDATION

PROPOSAL NO.:

PAGE NO.: of

PROPOSED CONCEPT — CALCULATIONS

EXCAVATION VOLUME

$(2400\,ft^2 + 432\,ft^2) \times 4.6\,mi \times 5280\,ft/mi = 68{,}783{,}616\,ft^3$

$= \underline{2{,}547{,}541\,yd^3}$

BACKFILL VOLUME

$8\,ft^2/\text{running ft} = 388{,}608\,ft^3$

$= 14{,}393\,yd^3$

GEOWEB QUANTITIES

8" CELLS @ \$1.8/ft² MATERIAL + \$2.25/ft² INSTALLATION

= \$4.05/ft² INSTALLED

$\left(\frac{4.05}{ft^2}\right) \times 2\,ft$ DEEP BENCH $\times$ 48,576 ft channel

= \$393,465 GEOWEB/ROW

for 2 ROWS

\$786,931

VALUE ENGINEERING RECOMMENDATION

PROPOSAL NO.: C-63

PAGE NO.: of

COST SAVINGS ESTIMATE

		Original Concept		Proposed Concept	
Item	Unit Cost	Quantity	Total	Quantity	Total
EXCAVATION YD³	3.37	3010471	10,145,287	2547541	8,585,233
BACKFILL YD³	1.31	61600	80,696	14393	18,855
GEDWEB 8" CELLS, 2 ROWS ft²	4.05			194304	786,931
SOIL CEMENT	15.25	208,700	3,182,675		
fillet (C.T.B.)	31.00			3,600	111,600
SEDGES	$2.50	0		360	900
WILLOWS	$7.50	0		300	2,250
HAULING + DISPOSAL	1.43	2,948,871	4,216,886	2,996,078	4,284,392
CREDIT ON MINERAL VALUE	(-1.25)	2,948,871	(-3,686,089)	2,996,078	(-3,745,098)
SUB-TOTAL W/OUT MARKUPS			13,939,455		10,045,043
MARKUP @ 76.19%			10,620,471		7,653,318
TOTALS			24,560,000		17,698,000
NET SAVINGS					6,862,000

All costs from project MCACES Report and MCACES Database except if noted below:

1.

2.

VALUE ENGINEERING RECOMMENDATION

PROJECT TITLE: *Rio Salado, Salt River, Arizona (Environmental Restoration Project)*

PROJECT LOCATION: *Phoenix/Tempe, AZ*

PROPOSAL NO.: C-68

PAGE NO.: 1 of

DESCRIPTION: Design shape of plantings to be hydraulically stable.

CRITERIA CHALLENGE: Yes/No CRITERIA NO.:

ORIGINAL CONCEPT:

The feasibility report does not discuss the layout of plantings. The effect of flows on the plants is not discussed.

PROPOSED CONCEPT:

The proposed concept is to layout the plantings to be hydraulically stable. The growth pattern, distribution and type of vegetation in natural channels self-select to form hydraulically stable shapes.

SUMMARY OF COST SAVINGS

	FIRST COST	PRESENT WORTH OF O&M COSTS	LIFE CYCLE COSTS
ORIGINAL CONCEPT	-	3,695,000	3,695,000
PROPOSED CONCEPT	-	1,848,000	1,848,000
SAVINGS	-	1,848,000	1,848,000

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RP

VALUE ENGINEERING RECOMMENDATION

PROPOSAL NO.: C-68

PAGE NO.: of

ADVANTAGES & DISADVANTAGES

ADVANTAGES:

- Decreases maintenance
- Decreases damage
- Improves flow conveyance
- Creates more natrual habitat
-
-

DISADVANTAGES:

- Limits layout for other considerations other than hydraulic stability
-
-
-
-
-

JUSTIFICATION:

By designing hydraulically stable copses, flow damage to vegetation and habitat is reduced and flow is more efficient.

DISCUSSION

The effects on hydraulics of the shape, distribution and type of vegetation in restoration projects is often not considered. One of the factors controlling the length of natural islands is the width. The relationship of the width to length of copses can result in significant reduction in damage. If the ratio of width to length is too long the end of the copse will be eroded. Plants will be outside of the hydraulic shadow formed by the copse. Velocity increases at the end of the copse and flow is more turbulent.

Hydraulically efficient shapes can be used to straighten and direct flow and increase conveyance. The three dimensional shape of the copse can be used as a flow guide.

VALUE ENGINEERING RECOMMENDATION

PROPOSAL NO.: C-68

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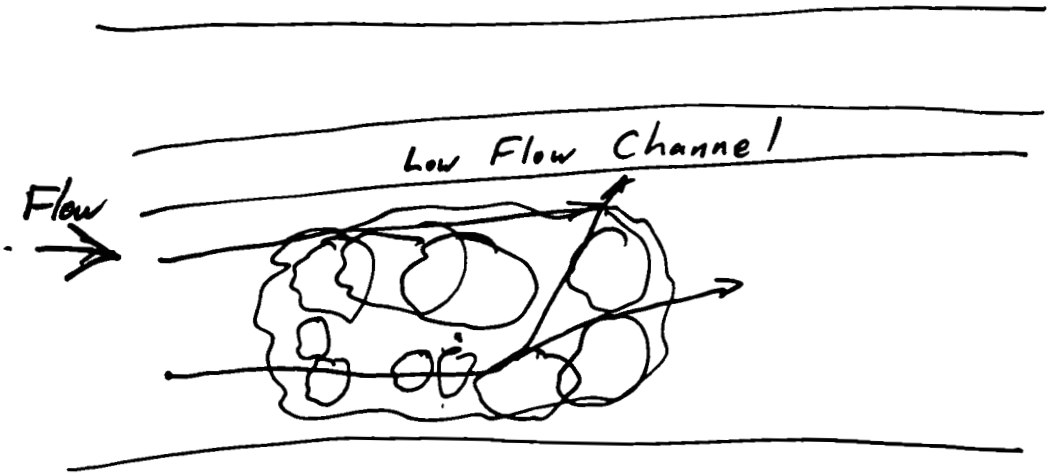
ORIGINAL CONCEPT — SKETCH



Plan

Section

VALUE ENGINEERING RECOMMENDATION

PROPOSAL NO.: C-68

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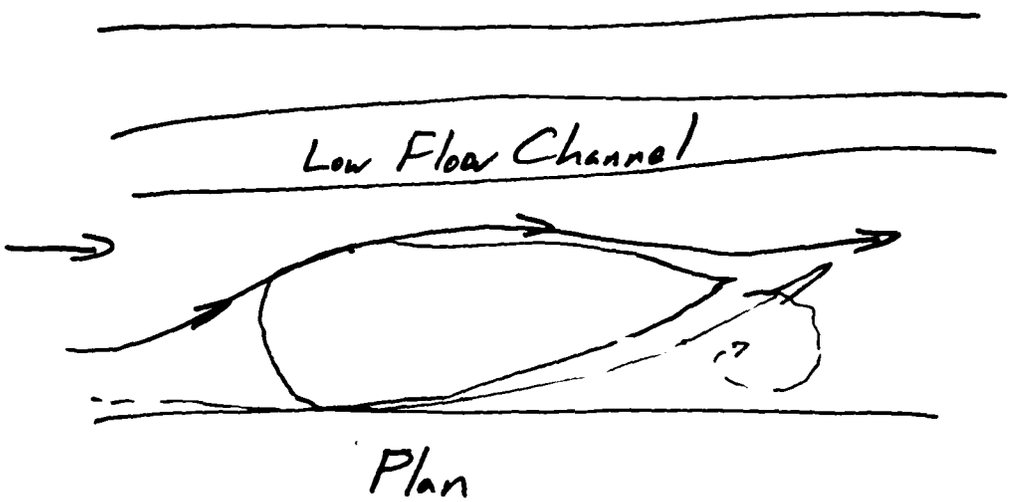
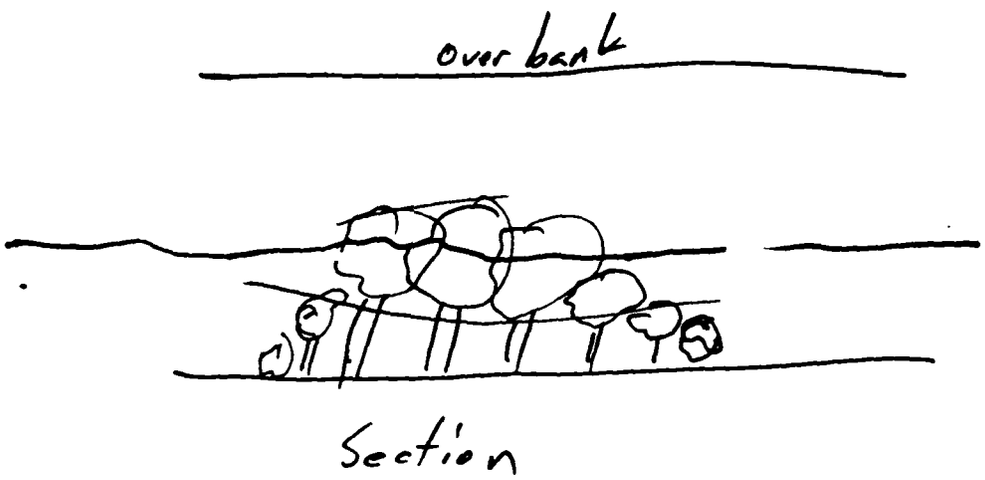
PROPOSED CONCEPT — SKETCH





VALUE ENGINEERING RECOMMENDATION

PROPOSAL NO.: C-68

PAGE NO.: of

ORIGINAL CONCEPT — CALCULATIONS

For life-cycle cost purposes based on the Feasibility Report estimate for the Phoenix reach 8% of the planting would be replaced annually

$ 3.4 M × 0.08 = $ 272,000

PROPOSED CONCEPT — CALCULATIONS

For Life cycle cost purposes we assume most loses per year would be from inundation in the Phoenix reach. If we assume a 50% reduction in plant replacement

$3.4M x 0.04 = $136,000

VALUE ENGINEERING RECOMMENDATION

PROPOSAL NO.: C-68

PAGE NO.: of

LIFE CYCLE COST ANALYSIS

LIFE CYCLE PERIOD 50 YEARS

ANNUAL PERCENTAGE RATE = 7⅛ %

INITIAL COSTS	PRESENT DESIGN (PRESENT WORTH)	PROPOSED DESIGN (PRESENT WORTH)
Base Cost		
SUB-TOTAL		

SINGLE EXPENDITURE	YEAR	PRESENT WORTH FACTOR	PRESENT DESIGN		PROPOSED DESIGN	
			ESTI-MATE	PRESENT WORTH	ESTI-MATE	PRESENT WORTH
Salvage						
SUB-TOTAL						

ANNUAL EXPENDITURE	YEARS	PRESENT WORTH FACTOR	PRESENT DESIGN		PROPOSED DESIGN	
			ESTI-MATE	PRESENT WORTH	ESTI-MATE	PRESENT WORTH
O&M	50	13.586	272,000	3,695,000	136,000	1,848,000
Energy						
SUB-TOTAL				3,695,000		1,848,000
TOTAL PRESENT WORTH						
LIFE CYCLE SAVINGS						1,848,000

VALUE ENGINEERING RECOMMENDATION

PROJECT TITLE: *Rio Salado, Salt River, Arizona (Environmental Restoration Project)*

PROJECT LOCATION: *Phoenix/Tempe, AZ*

PROPOSAL NO.: M-26

PAGE NO.: 1 of

DESCRIPTION: CONSTRUCT GRADE CONTROL STRUCTURES FULL-WIDTH WITH NOTCHES FOR LOW-FLOW CHANNEL.

CRITERIA CHALLENGE: Yes/No CRITERIA NO.:

ORIGINAL CONCEPT

Convey flows less than 12,200 cfs within a excavated low flow trapezoidal channel. The low flow channel is about 200 feet wide with 2:1 slopes reinforced with soil cement. Channel depth is sized to convey about 10 feet of flow. Roller compacted concrete (RCC) grade control structures span the low flow channel at four locations.

PROPOSED CONCEPT

Construct full channel width RCC grade control structures with V-notch at six locations. A 'training' channel is excavated that will convey a depth of flow of seven feet. The channel is unlined. A pier or bendway structure is installed upstream of the Central Avenue Bridge to control the channel thalweg.

SUMMARY OF COST SAVINGS

	FIRST COST	PRESENT WORTH OF O&M COSTS	LIFE CYCLE COSTS
ORIGINAL CONCEPT	25,552,000	3,532,000	29,084,000
PROPOSED CONCEPT	21,691,000	231,000	21,922,000
SAVINGS	3,861,000	3,301,000	7,162,000

rsr

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VALUE ENGINEERING RECOMMENDATION

PROPOSAL NO.: M-26

PAGE NO.: of

ADVANTAGES & DISADVANTAGES

ADVANTAGES:

- Because the low flow channel has the ability to adjust its location to a stable configuration and cross section, O&M costs to clean sediment from a lined channel are eliminated.
- Maintenance of the scour behind the soil cement liner is eliminated.
- The unlined channel presents are more natural appearance and allows the growth of herbacious and shrubby species.
- Creates more frequent low-volume flooding of the terraces. Localized scour will remove turf grasses, debris and weak or sick flora.

DISADVANTAGES:

- During larger storm events, portions of planted terrace may be eroded as the low flow channel migrates to a stable configuration.

JUSTIFICATION:

There is an inherit risk in trying to predetermine the low flow channel. The recent historical record shows larger storm events scouring a thalweg outside the proposed low flow channel. A safer approach is to guide the channel at critical points using grade control structures with V-notches. Between the grade control structures, the 'training' low flow channel is allowed to find its own natural alignment. This eliminates the maintenance costs associated with maintaining the conveyance of the low flow channel. Flood flows will scour a deeper channel as needed. While overbank flows will occur more frequently, significant scour or depths of inundation will not occur.

DISCUSSION

Grade control structures will be located at strategic points along the channel. The structures will perform two purposes:

1. Control the direction of flow and
2. Protect upstream bridges from scour.

Figure 1 shows conceptual locations for the grade control structures. V-notches would be included at the critical point on the grade control structure. The grade control structure West of 7th Street would be rotated slightly clockwise to direct flow northwesterly.

Special provisions are proposed at two locations.

A. Measures would be installed downstream of the existing grade control structure west of I-10 to turn the thalweg toward the north bank. An island will be constructed of boulders as a directional vane. South of the vane, cobbles would be installed to raise the channel roughness coefficient. No modification is proposed to the grade control structure.

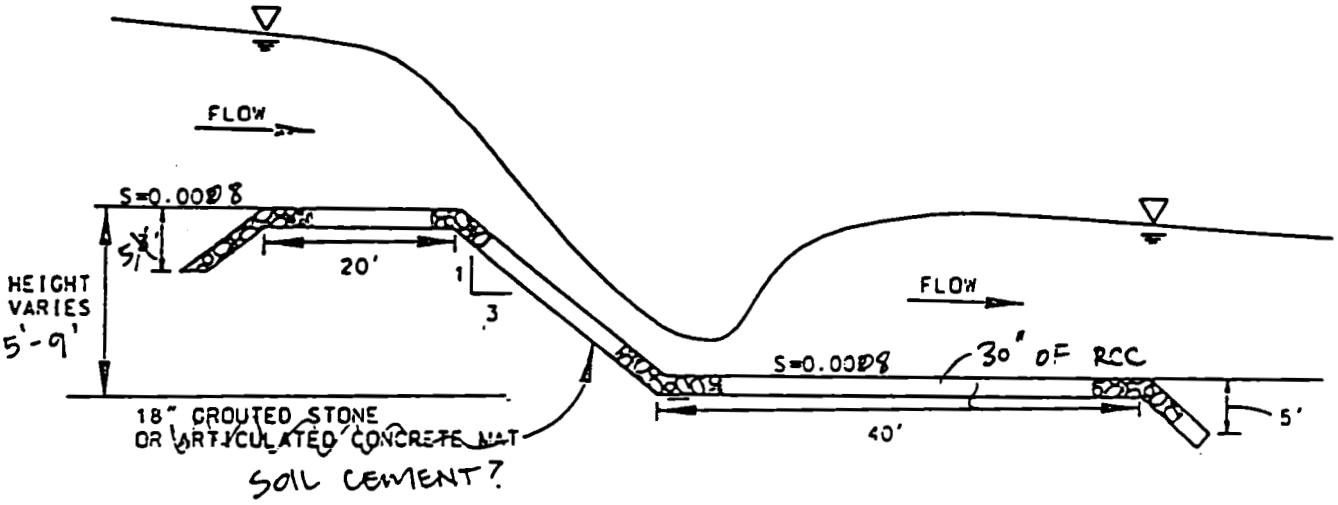
B. A pier or bendway would be installed just upstream of the Central Avenue. Bridge to encourage a migration of the thalweg toward the north bank.

VALUE ENGINEERING RECOMMENDATION

PROPOSAL NO.: M-26

PAGE NO.: of

ORIGINAL & PROPOSED CONCEPT — SKETCH



DROP STRUCTURE DETAIL
not to scale

STRUCTURE LENGTH

ORIGINAL: 200 FEET

PROPOSED: 900 FEET

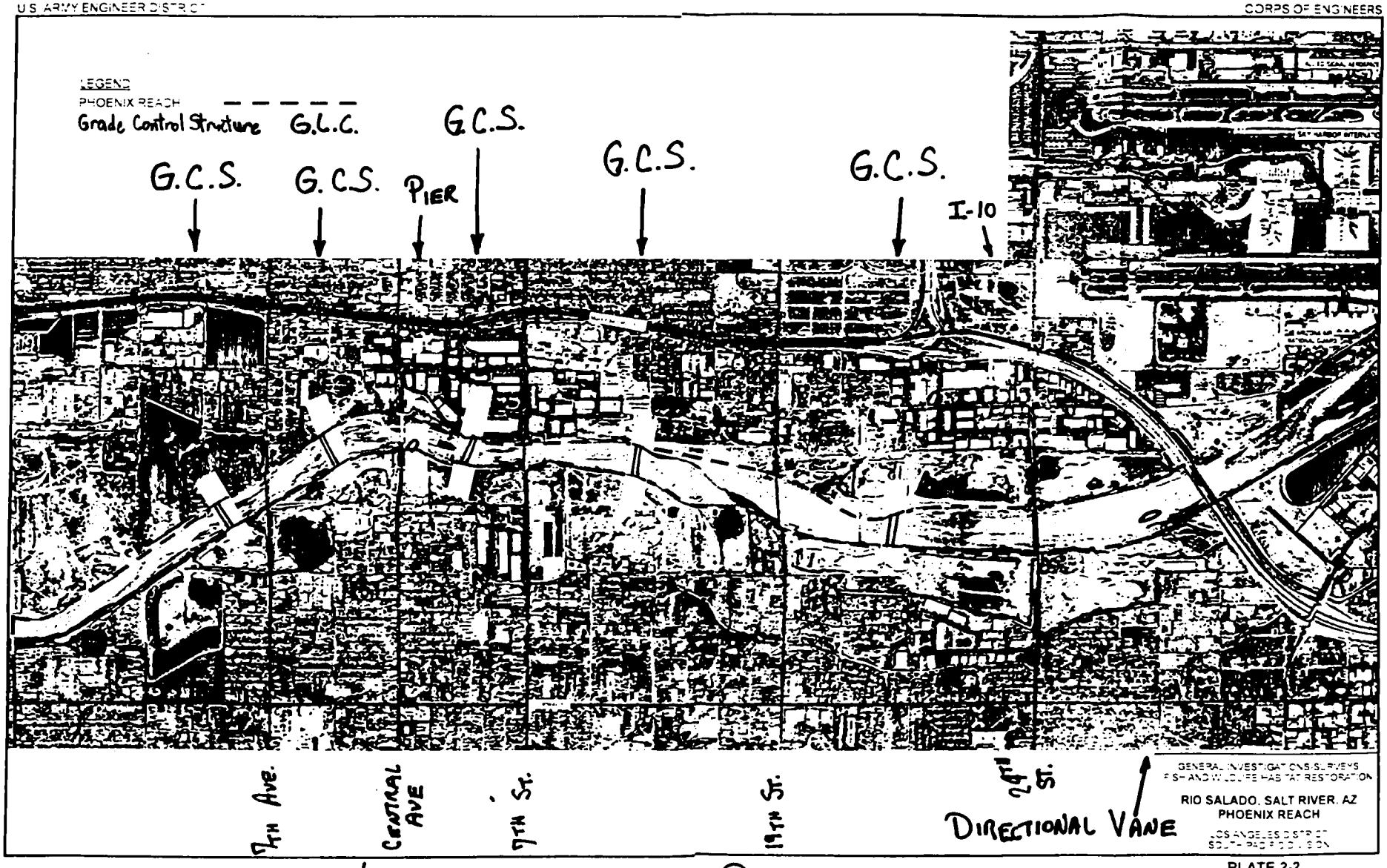


PLATE 2-2

FIG. 1: LOCATIONS OF STRUCTURES

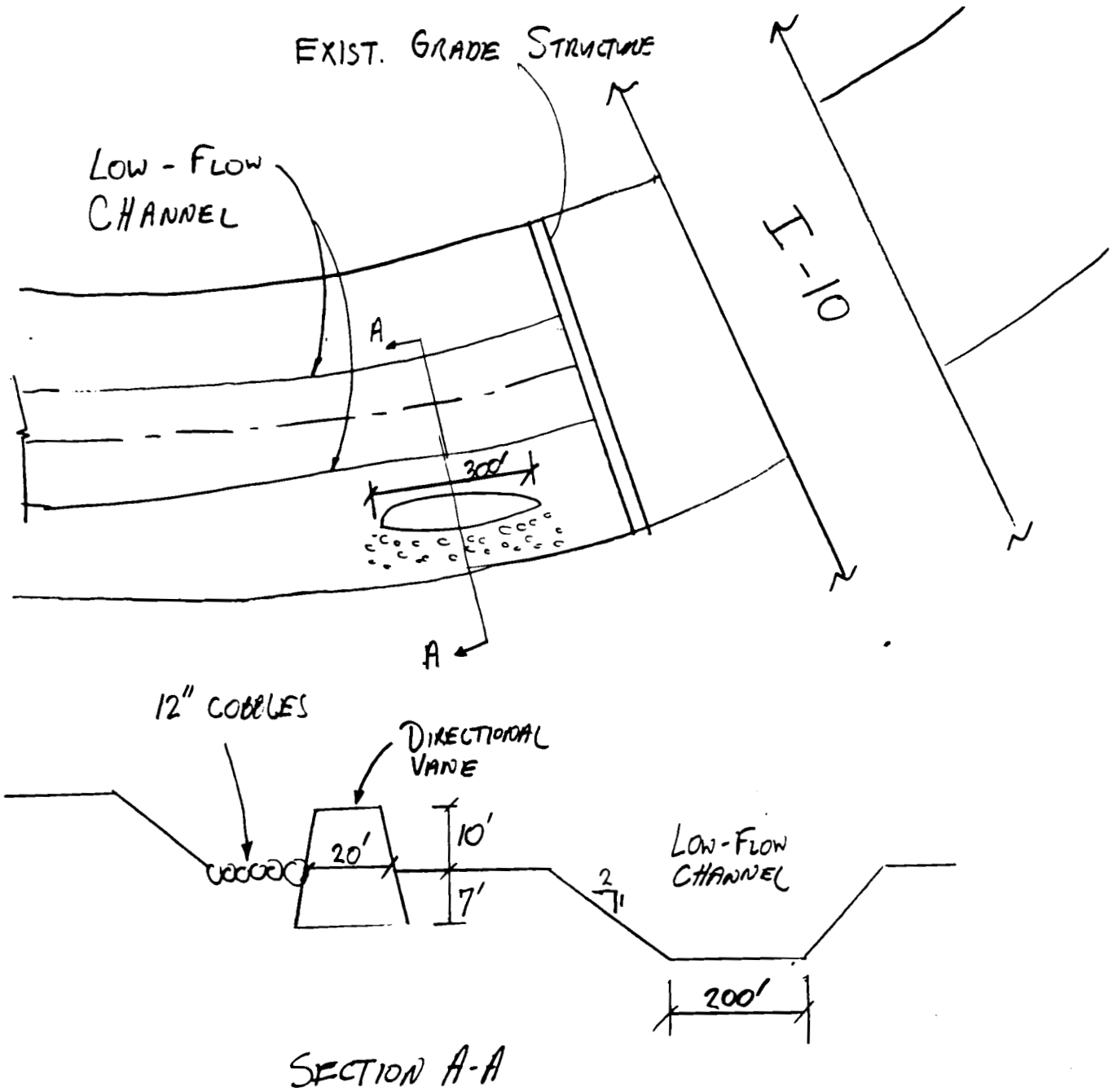
VALUE ENGINEERING RECOMMENDATION

PROPOSAL NO.: M-26

PAGE NO.: of

PROPOSED CONCEPT — SKETCH

DIRECTIONAL VANE



VALUE ENGINEERING RECOMMENDATION

PROPOSAL NO.: M-26
PAGE NO.: of

ORIGINAL CONCEPT — CALCULATIONS

FOR LCC PURPOSES IT IS ASSUMED BASED ON INFORMATION PROVIDED BY ROB DAVINROY AT ST. LOUIS DISTRICT, CORPS OF ENGINEERS THAT THE LOW FLOW CHANNEL REQUIRE THE EQUIVALENT OF 100% EXCAVATION FOR SEDIMENT REMOVAL OVER THE LIFE OF THE PROJECT.

MR. DAVINROY IS IN THE HYDRAULIC/HYDROLOGIC SECTION AND HAS DEVELOPED MICRO-MODELING TECHNIQUES TO STUDY SEDIMENT TRANSPORT.

ASSUME 100% CHANNEL EXCAVATION AT $13,000,000
ANNUALIZED = $260,000/YR

VALUE ENGINEERING RECOMMENDATION

PROPOSAL NO.: M-26
PAGE NO.: of

PROPOSED CONCEPT — CALCULATIONS

FOR LCC PURPOSES ASSUME THAT CHANNEL MIGRATION WILL REQUIRE 25% OF THE HABITAT WILL HAVE TO BE REPLANTED DUE TO LOSS OF TERRACE AREA.

= $3,400,000 x 0.25 = $850,000 OVER 50 YEARS
ANNUALIZED = $17,000

VALUE ENGINEERING RECOMMENDATION

PROPOSAL NO.: M-26
PAGE NO.: of

COST SAVINGS ESTIMATE

		Original Concept		Proposed Concept	
Item	Unit Cost	Quantity	Total	Quantity	Total
RCC	70.77	8500	601,545	44,000	3,113,880
EXCAVATION	3.37	3,000,000	10,110,000	2,500,000	8,425,000
HAULING & DISPOSAL	1.43	2,940,000	4,204,200	2,470,000	3,532,100
CREDIT ON MINERAL VALUE	(-1.25)	2,940,000	(-3,675,000)	2,470,000	(-3,087,500)
SOIL CEMENT	15.25	208,700	3,182,675		
BACKFILL	1.32	60,000	79,200	30,000	39,600
ROCK DIRECTIONAL VEIN (D,50=3')	50.00			4,000	200,000
12-INCH COBBLES	44.00			2,000	88,000
SUB-TOTAL W/OUT MARKUPS			14,502,620		12,311,080
MARKUP @ 76.19%			11,049,546		9,379,812
TOTALS			25,552,000		21,691,000
NET SAVINGS					3,861,000

All costs from project MCACES Report and MCACES Database except if noted below:

1.

2.

VALUE ENGINEERING RECOMMENDATION

PROPOSAL NO.: M-26

PAGE NO.: of

LIFE CYCLE COST ANALYSIS

LIFE CYCLE PERIOD 50 YEARS

ANNUAL PERCENTAGE RATE = 7 1/8 %

INITIAL COSTS	PRESENT DESIGN (PRESENT WORTH)	PROPOSED DESIGN (PRESENT WORTH)
Base Cost		
SUB-TOTAL		

SINGLE EXPENDITURE	YEAR	PRESENT WORTH FACTOR	PRESENT DESIGN		PROPOSED DESIGN	
			ESTI-MATE	PRESENT WORTH	ESTI-MATE	PRESENT WORTH
Salvage						
SUB-TOTAL						

ANNUAL EXPENDITURE	YEARS	PRESENT WORTH FACTOR	PRESENT DESIGN		PROPOSED DESIGN	
			ESTI-MATE	PRESENT WORTH	ESTI-MATE	PRESENT WORTH
O&M	50	13,586	260,000	3,532,000	17,000	231,000
Energy						
SUB-TOTAL				3,532,000		231,000
TOTAL PRESENT WORTH						
LIFE CYCLE SAVINGS						3,301,000

VALUE ENGINEERING RECOMMENDATION

PROJECT TITLE: *Rio Salado, Salt River, Arizona (Environmental Restoration Project)*

PROJECT LOCATION: *Phoenix/Tempe, AZ*

PROPOSAL NO.: M-34

PAGE NO.: 1 of

DESCRIPTION: REPLACE DROP STRUCTURES AND USE POOL AND RIFFLE SEQUENCE.

CRITERIA CHALLENGE: Yes/No CRITERIA NO.:

ORIGINAL CONCEPT

To restrict velocities to below 6 feet per second (fps) within the low flow channel, four grade control structures are incorporated into the design of the low flow channel at approximate Stations 212.5, 215.0, 215.5, and 216.0. The four grade control structures are constructed of roller compacted concrete (RCC). The height of the structures varies from 5 to 9 feet.

PROPOSED CONCEPT

Replace the RCC grade control structures with rip-rap (riffle) structures. Construct top of rip-rap structure slightly above low flow channel grade to pool water.

SUMMARY OF COST SAVINGS

	FIRST COST	PRESENT WORTH OF O&M COSTS	LIFE CYCLE COSTS
ORIGINAL CONCEPT	1,366,000	N/A	1,366,000
PROPOSED CONCEPT	532,000	N/A	532,000
SAVINGS	834,000	N/A	834,000

rsr JSP

RS

VALUE ENGINEERING RECOMMENDATION

PROPOSAL NO.: M-34

PAGE NO.: of

ADVANTAGES & DISADVANTAGES

ADVANTAGES:

- Creates a structure with a appearance more appropriate for the river habitat
- Creates a shallow pool just upstream of the grade control structure
- Creates aquatic habitat within the voids and scour areas of the rock structure for macro-invertebrates
- Promotes aquatic strand vegetation
- Creates better oxygenation for the perennial stream

DISADVANTAGES:

- Potential for higher maintenance
- Dislodged woody material could create higher scour if a debris dam is formed

JUSTIFICATION:

A rip-rap grade control structure accomplishes the goal of maintaining an upstream gradient of 0.0008 to restrict low flow velocities to 6 fps. The rock structure uses on-site materials to provide a more natural grade transition. The structure provides for channeling flow along the preferred flow path. Aquatic habitat is induced just upstream of the grade control structure and, as the channel mature, within the rock structure itself.

VALUE ENGINEERING RECOMMENDATION

PROPOSAL NO.: M-34

PAGE NO.: of

DISCUSSION

The pond and riffle concept attempts to mimic how a river naturally manages grade changes. Grade control and energy dissipation occurs in the steeper portions of the channel lined with rock. The structure is flexible and allows for limited scour to achieve a natural equilibrium condition.

The proposed rip-rap structure is sloped at 15:1 with a horizontal apron at the toe of the structure to control the length of the hydraulic jump. For flows of 12,200 cfs, the length of the hydraulic jump is approximately 55 feet.

The median rock size is a function of average velocity down the drop structure and average flow depth in the main channel. The average velocity on the drop structure is expected to be somewhat less than normal depth velocity of 23.4 fps. For an average velocity of 20 fps, the median rock size is 2.5 feet and a maximum rock size of 4 feet.

As the channel matures, scour in induced in the rip-rap armor. Water ponding in the rock mass provides cover for macro-invertebrates, fish and small amphibians. These in turn provide a food source for birds, amphibians, fish and macro-invertebrates.

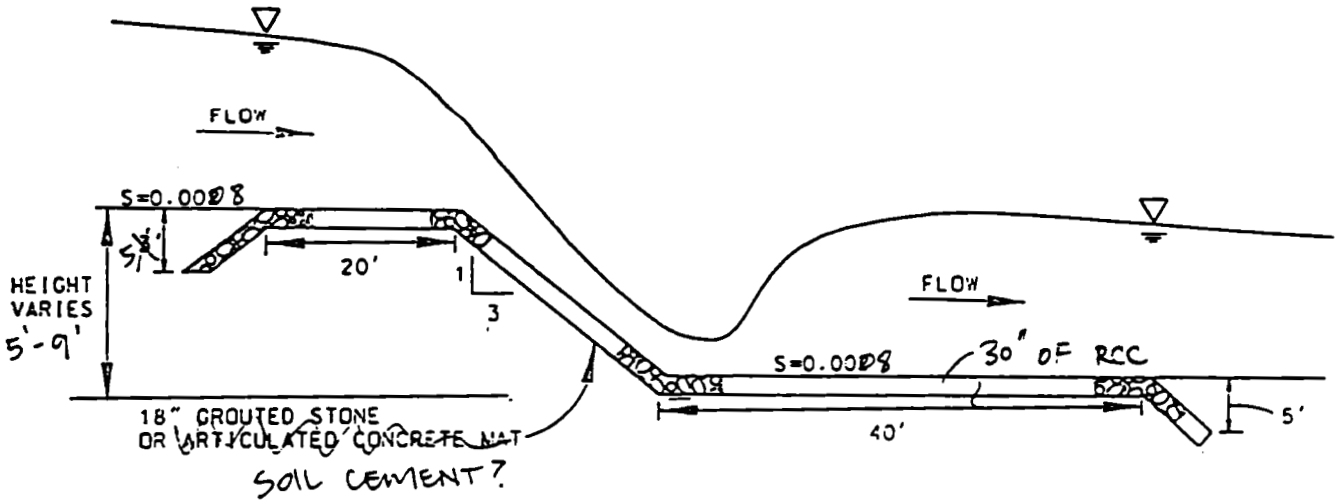
FURTHER ANALYSIS IS REQUIRED TO DETERMINE THE AVERAGE VELOCITY ON THE DROP STRUCTURE. IF THE AVERAGE VELOCITY IS 17.5 fps, D_{50} IS APPROXIMATELY 1.7 FEET. AN AVERAGE VELOCITY OF 15 fps YIELDS AN D_{50} OF 1.1 FEET.

VALUE ENGINEERING RECOMMENDATION

PROPOSAL NO.: M-34

PAGE NO.: of

ORIGINAL CONCEPT — SKETCH



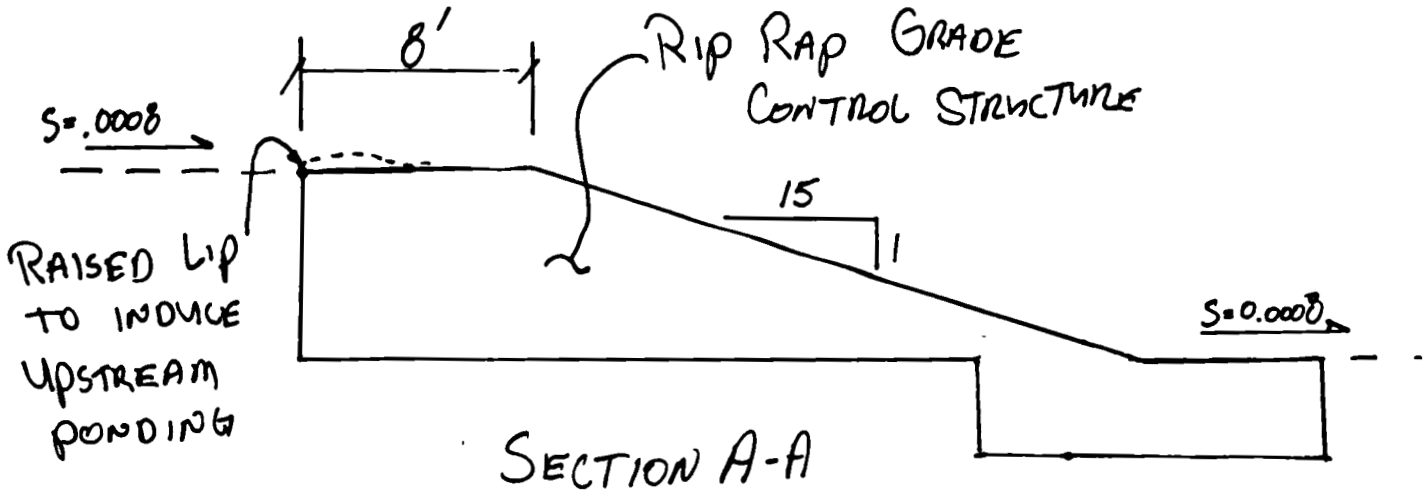
DROP STRUCTURE DETAIL
not to scale

VALUE ENGINEERING RECOMMENDATION

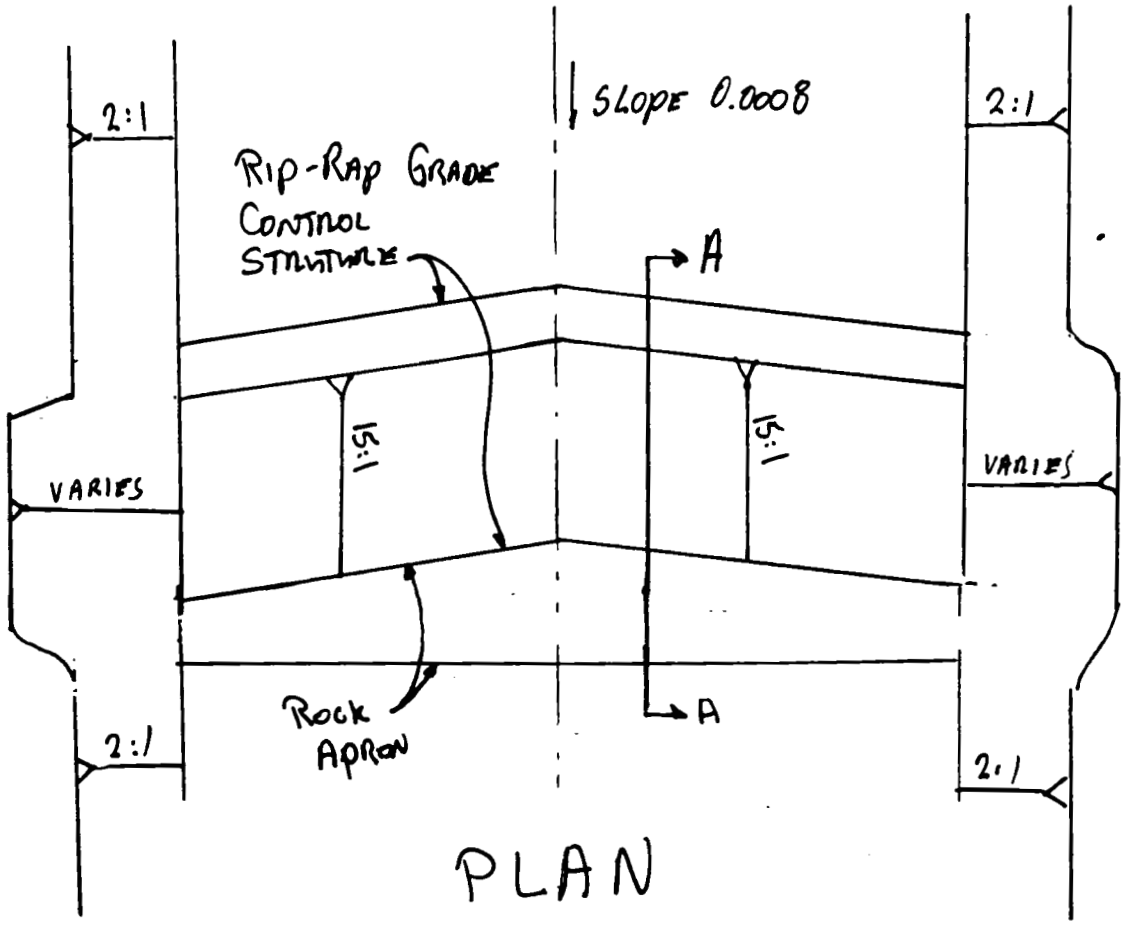
PROPOSAL NO.: M-34

PAGE NO.: of

PROPOSED CONCEPT — SKETCH



SECTION A-A



PLAN

RS

VALUE ENGINEERING RECOMMENDATION

PROPOSAL NO.: M-34
PAGE NO.: of

PROPOSED CONCEPT — CALCULATIONS

Rip-rap Volumes

Station	Grade Differerential [ft]	Cross-Sectional Area [ft**2]	Channel Width [ft]	Volume [ft**3]	Volume [cy]	Weight [ton]
212.5	5	157.5	200	31500		
215	9	219.5	200	43900		
215.5	5	157.5	200	31500		
216	7	188.5	200	37700		
			Total	144600	5356	9100

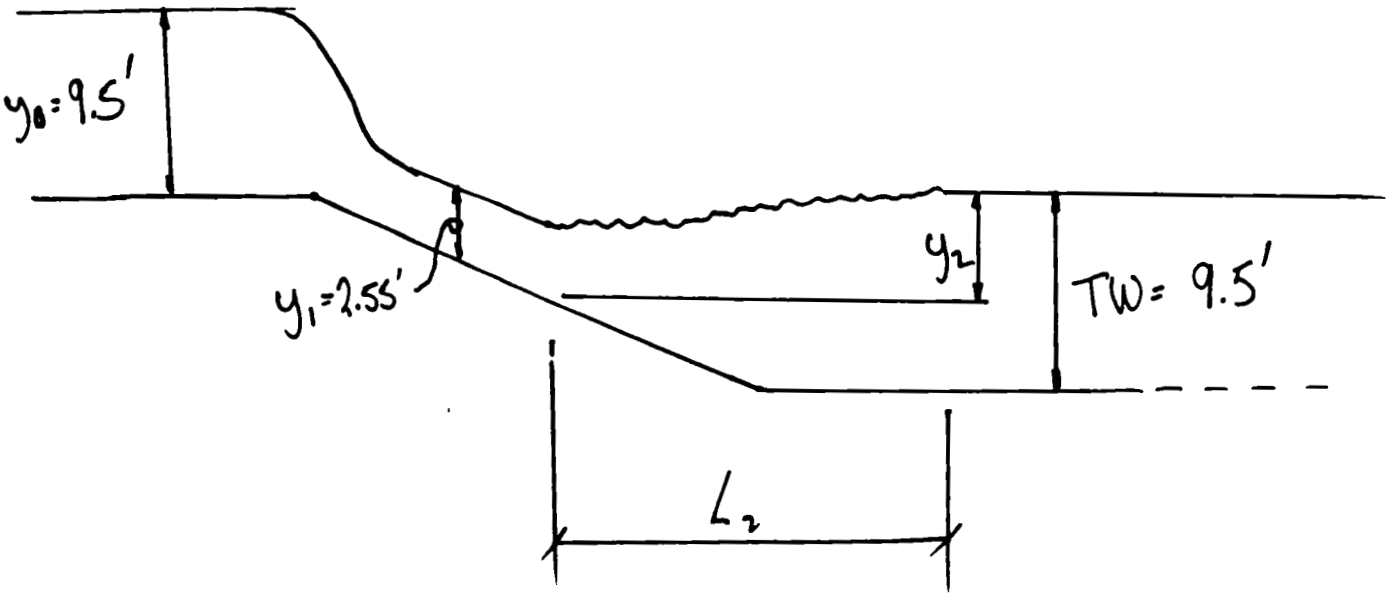
PER MANNING'S EQ., VELOCITY ON RIP-RAP STRUCTURE

$$V_n = \frac{1.49}{n} R^{2/3} S^{1/2} = 23.9 \text{ fps}$$

FOR $n = 0.03$
$S = 0.0667$ (15:1)
$Q = 12,200$ cfs
BOTTOM WIDTH: 200'
SIDE SLOPES: 2:1

$D_n = 2.55'$

PROPOSED CONCEPT — CALCULATIONS



FROM HENDERSON, OPEN CHANNEL FLOW, pp 218-219:

$$\frac{TW}{y_2} = 1 + 11.2\, S_0^{3/2}$$

$$\underline{\underline{y_2 = 8.0\ FT}}, \quad S_0 = 0.0667$$

$$\frac{L_2}{y_2} = 0.82\, S_0^{-0.78}$$

$$\underline{\underline{L_2 = 55\ FT.}}$$

VALUE ENGINEERING RECOMMENDATION

PROPOSAL NO.: M-34
PAGE NO.: of

COST SAVINGS ESTIMATE

	(1)	Original Concept		Proposed Concept	
Item	Unit Cost	Quantity	Total	Quantity	Total
ROLLER COMPACTED CONCRETE (CY)	160.65	8,500	1,365,525		
RIPRAP STRUCTURE					
D_{50} = 2.5-FT 1 CY = 1.70 TON					
PURCHASE ROCK (TN)	31.71			9,100	288,561
FREIGHT TO SITE (TN)	9.16			9,100	83,356
INSTALLATION (TN)	17.62			9,100	160,342
TOTALS			1,365,525		532,259
NET SAVINGS					833,266

All costs from project MCACES Report and MCACES Database except if noted below:

1. ALL UNIT COSTS INCLUDE OVERHEAD (8%), HOME OFFICE (6%), PROFIT (6.9%), BOND (0.7%), AZ TAX (4.55%), CONTINGENCY (20%), PE&D (7%), S&A (6.5%)
2.

VALUE ENGINEERING RECOMMENDATION

PROJECT TITLE: *Rio Salado, Salt River, Arizona (Environmental Restoration Project)*

PROJECT LOCATION: *Phoenix/Tempe, AZ*

PROPOSAL NO.: M-6b

PAGE NO.: 1 of

DESCRIPTION: Limit the meander of the LFC with cut-off walls

CRITERIA CHALLENGE: Yes/No CRITERIA NO.:

ORIGINAL CONCEPT:

Excavate low flow channel with 2:1 side slope Armor sideslope with 8' wide soil cement with a minimum 5' embedment and top turndown. Construct 4 RCC drop structure. Low flow channel is armored to protect planted terrace

PROPOSED CONCEPT:

Locate vertical cement-slurry walls to protect terrace and build grade controls. Allow the low flow channel to self-form between the cement-slurry walls. Bed elevation is controlled by grade controls.

SUMMARY OF COST SAVINGS

	FIRST COST	PRESENT WORTH OF O&M COSTS	LIFE CYCLE COSTS
ORIGINAL CONCEPT	24,434,000	N/A	24,434,000
PROPOSED CONCEPT	14,685,000	N/A	14,685,000
SAVINGS	9,749,000	N/A	9,749,000

rsr

RDP

VALUE ENGINEERING RECOMMENDATION

PROPOSAL NO.: M-66

PAGE NO.: of

ADVANTAGES & DISADVANTAGES

ADVANTAGES:

- Allows more natural appearance.
- Allows channel to self-form and meander in limits while protecting terrace planting.
- Allows vegetation to grow on slopes.
- Drop structures limit incision
- Although terraces may be narrower, habitat will develop on slopes wherre water is available.

DISADVANTAGES:

- Channel has to self-form. At times, channel will have to scour to gain capacity. If scouring is slower than increase in capacity channel could overflow.
- Channel may scour and hold more than 12,200 cfs, therefore not inundating terrace every 5-7 years.
- Channel may scour exposing cement-slurry wall at some locations.
- Channel could scour to expose cement-slurry wall for entire length
- It wll be more difficult to deliver flow for 5 cfs stream.
- [redacted]

JUS Terraces may be narrower. in some locations

Justification

This is a restoration project. The more natural the appearance and behavior the more we have accomplished our goal. The channel will self-form in response to discharges to a meta-stable form. Vegetation should volunteer along the slopes and contribute to the stability.

DISCUSSION

The purpose of the project is to restore riparian habitat along the river. By establishing planform limits with the cement slurry walls and vertical limits with the drop structures we allow a natural channel to form in response to frequent discharges. The natural channel is prevented from meandering into the planted terrace. Natural vegetation can grow on the slopes. The vegetation will help stabilize the slopes and the plan-form. The channel side slopes will be flatter. The channel will approach a more triangular cross-section.

There are risks associated with the design. Until the low-flow channel stabilizes, there will not be capacity for the 12,200 cfs discharges. There will be flow on the terraces. The flow could scour behind the cement slurry wall. This could also occur behind the soil cement facing.

There is a risk that the cement slurry wall could be exposed fora length inside of the channel as a meander approaches. The surface of the12-foot high vertical wall would contain exposed rock as part of the cement slurry. The appearance should be similar to erosion faces observed in the area.

If the stream forming flow is not the 12,200 cfs, the entire channel may-be scoured out to expose the cement slurry walls. The exposed face would have th arrearance discribed above.

Because the channel is self-forming, there will be a response to intervene more frequently. Maintenance cost could become unreasonable. More maintenance may be required to control opportunistic exotics.

VALUE ENGINEERING RECOMMENDATION

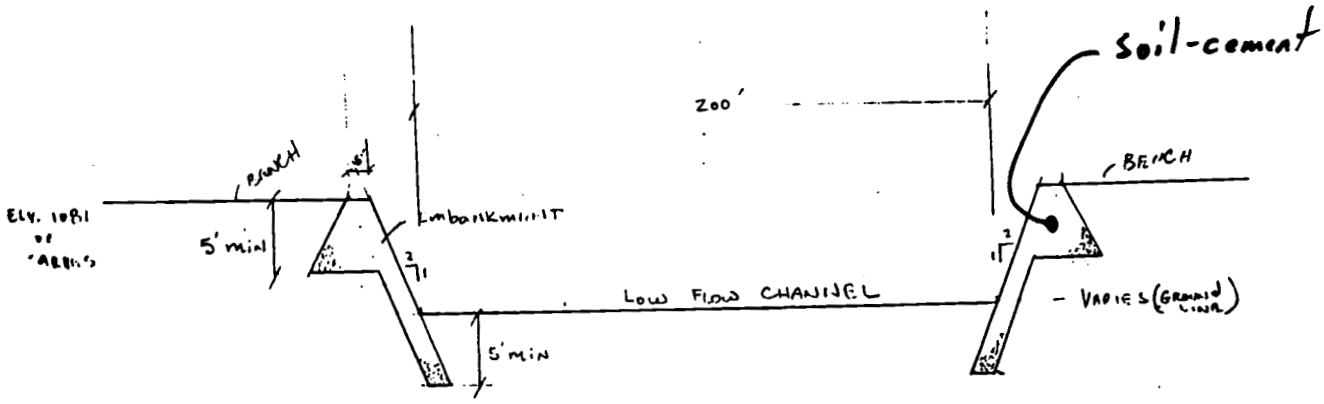
PROPOSAL NO.: M-66

PAGE NO.: of

ORIGINAL CONCEPT — SKETCH

TYPICAL LOW FLOW CHANNEL CROSS-SECTION

FIGURE 1-1



VALUE ENGINEERING RECOMMENDATION

PROPOSAL NO.: M-66

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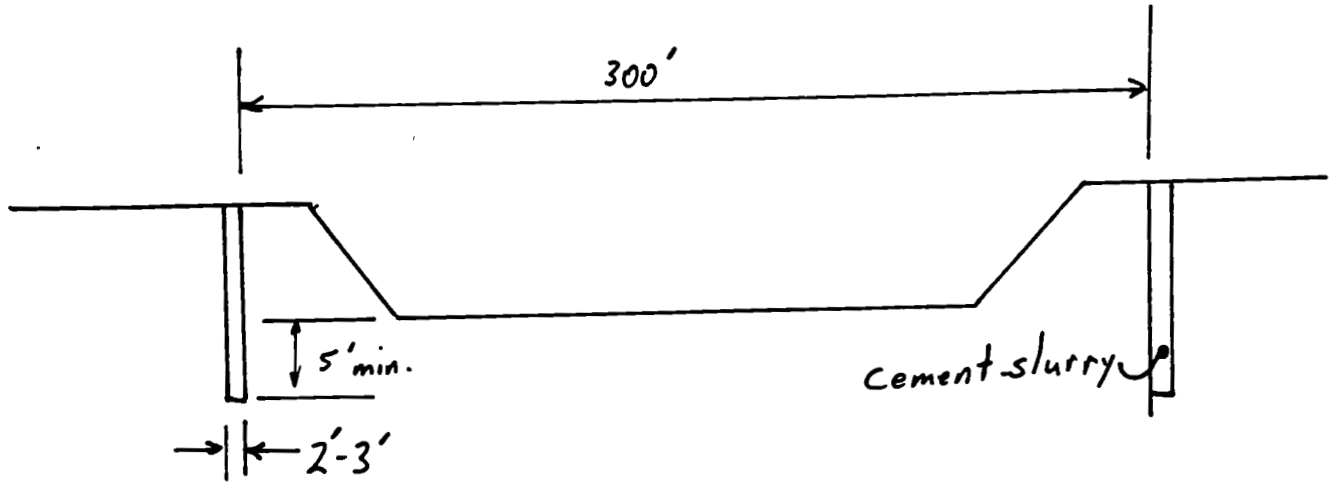
PROPOSED CONCEPT — SKETCH



VALUE ENGINEERING RECOMMENDATION

PROPOSAL NO.: M-66

PAGE NO.: of

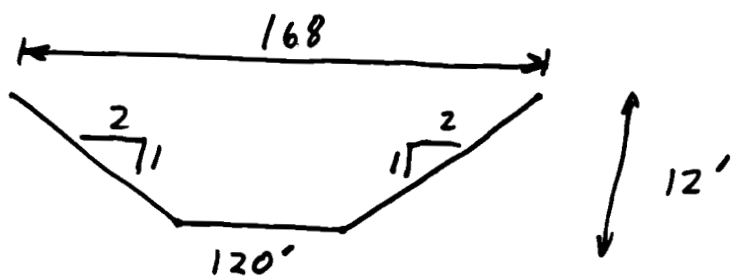
PROPOSED CONCEPT — CALCULATIONS

Assume 12' depth + 5' embedment say 17' deep

Say ~~8~~ 4.6 miles both sides ~~10~~ 9.2 miles = ~~52,800~~ 48,576'

~~897,600~~ 825,792 sq ft

+



1728 sq ft.

Say 300 ft between walls = 1728 x 300 ÷

19,200 cuyds of excavation

VALUE ENGINEERING RECOMMENDATION

PROPOSAL NO.: M-66

PAGE NO.: of

COST SAVINGS ESTIMATE

		(1)	Original Concept		Proposed Concept	
	Item	Unit Cost	Quantity	Total	Quantity	Total
	EXCAVATION (CY)	5.94	3,010,500	17,882,370		
	SOIL CEMENT (CY)	26.87	208,700	5,607,769		
	HAULING + DISPOSAL (CY)	2.52	2,948,900	7,431,228		
	CREDIT ON MAT'L VALUE (CY)	(-2.20)	2,948,900	(-6,487,580)		
(2)	SLURRY WALL (SF)	17.87			825,800	14,757,046
	EXCAVATION FOR DROP STRUC. (CY)	5.94			19,200	114,048
	HAULING + DISPOSAL (CY)	2.52			19,200	48,384
	CREDIT ON MAT'L VALUE (CY)	(-2.20)			19,200	(-234,240)
	TOTALS			24,434,000		14,685,000
	NET SAVINGS					9,749,000

All costs from project MCACES Report and MCACES Database except if noted below:

1. ALL UNIT COSTS INCLUDE OVERHEAD (8%), HOME OFFICE (6%), PROFIT (6.9%), BOND (0.7%), AZ. TAX (4.55%), CONTINGENCY (20%), PE+D (7.8%), S+A (6.5%)
2. COSTS INCLUDE ALL APPLICABLE MARKUPS IN NOTE (1) ABOVE

VALUE ENGINEERING RECOMMENDATION

PROJECT TITLE: *Rio Salado, Salt River, Arizona (Environmental Restoration Project)*

PROJECT LOCATION: *Phoenix/Tempe, AZ*

PROPOSAL NO.: M 105

PAGE NO.: 1 of

DESCRIPTION: Raise LFC to flood terrace more frequently to lower resistance

CRITERIA CHALLENGE: Yes/No CRITERIA NO.:

ORIGINAL CONCEPT:

The original concept is to excavate a low flow channel to maintain conveyance for the 100-year event and contain peak flow for a 5-year flow or discharge for a 50-year storm, 30 day duration. The channel side slopes are lined with soil cement.

PROPOSED CONCEPT:

Excavate a shallower channel and fill in areas for plants that are inundation intolerant. Limit fill not to impede conveyance of the 100-year event. Inundation of other areas will be more frequent and will flush wetlands and suppress growth thus lowering Manning's n.

SUMMARY OF COST SAVINGS

	FIRST COST	PRESENT WORTH OF O&M COSTS	LIFE CYCLE COSTS
ORIGINAL CONCEPT	24,561,000	1,454,000	26,015,000
PROPOSED CONCEPT	12,265,000	734,000	12,999,000
SAVINGS	12,296,000	720,000	13,016,000

rsr

RDT

VALUE ENGINEERING RECOMMENDATION

PROPOSAL NO.: M105

PAGE NO.: of

ADVANTAGES & DISADVANTAGES

ADVANTAGES:

- Decreases depth of channel. A shallower channel with 2:1 slide slopes is safer and permit easier viewing of the perennial stream.
- Inundation of part of the terrace will be more frequent and will flush wetlands
- Inundation of part of the terrace will be more frequent and suppress growth of turf grasses and scrub shrubs thus lowering Manning's n and decreasing maintenance.
- A more natural land-form and habitat is created.
- Reduces maintenance associated with scrub removal

DISADVANTAGES:

- Trails may flood more frequently.
- Areas may not be available during periods of inundation.
-
-
-
-

JUSTIFICATION:

This recommendation creates a more natural landform and varied habitat. The more frequent inundation will limit growth of grasses and flush woody debris maintaining conveyance (lower Manning's n)

VALUE ENGINEERING RECOMMENDATION

PROPOSAL NO.: M 105

PAGE NO.: of

DISCUSSION

Rivers and streams normally establish a bankfull shelf at the depth of the 1.7-year flow and not the 5-year flow. By allowing more frequent flooding of part of the terrace a more natural habitat is established. Flows greater than the 12,200 cfs will still flood the terrace which is desired.

Decreasing the capacity of the channel will result in more frequent flooding that could inundate and threaten some of the plants. To protect those plants, berms and hummocks will be constructed. The average height of the fill will be limited not to decrease conveyance-cross-sectional area. The mesquite and other plants that cannot endure long durations of inundation would be planted on the hummocks that would be constructed.

The channel will be 6.8 feet deep with 2:1 side slopes. It will be easier to observe the perrenial-flow stream in the shallower channel. The shallower channel is safer if a small child were to fall and need to be recovered.

VALUE ENGINEERING RECOMMENDATION

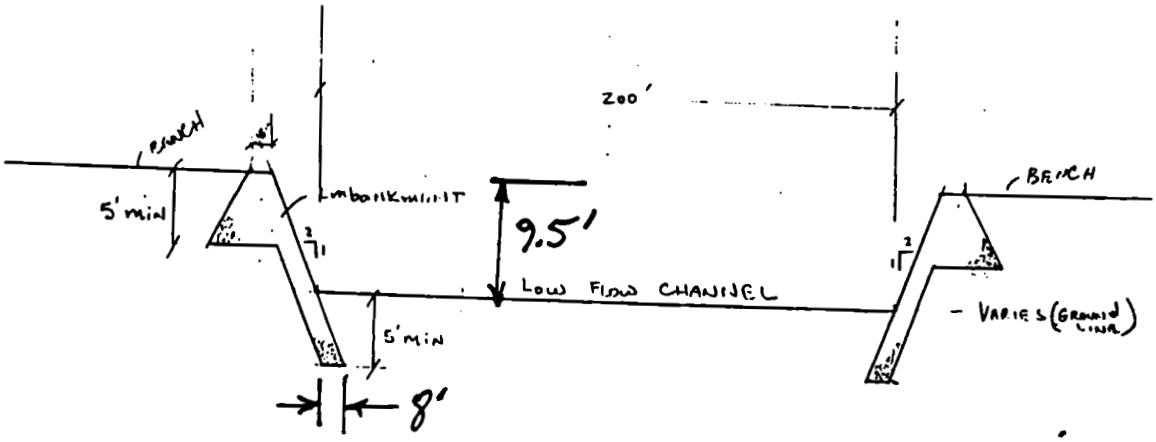
PROPOSAL NO.: M105

PAGE NO.: of

ORIGINAL CONCEPT — SKETCH

TYPICAL LOW FLOW CHANNEL CROSS-SECTION

FIGURE 1-1



VALUE ENGINEERING RECOMMENDATION

PROPOSAL NO.: M105

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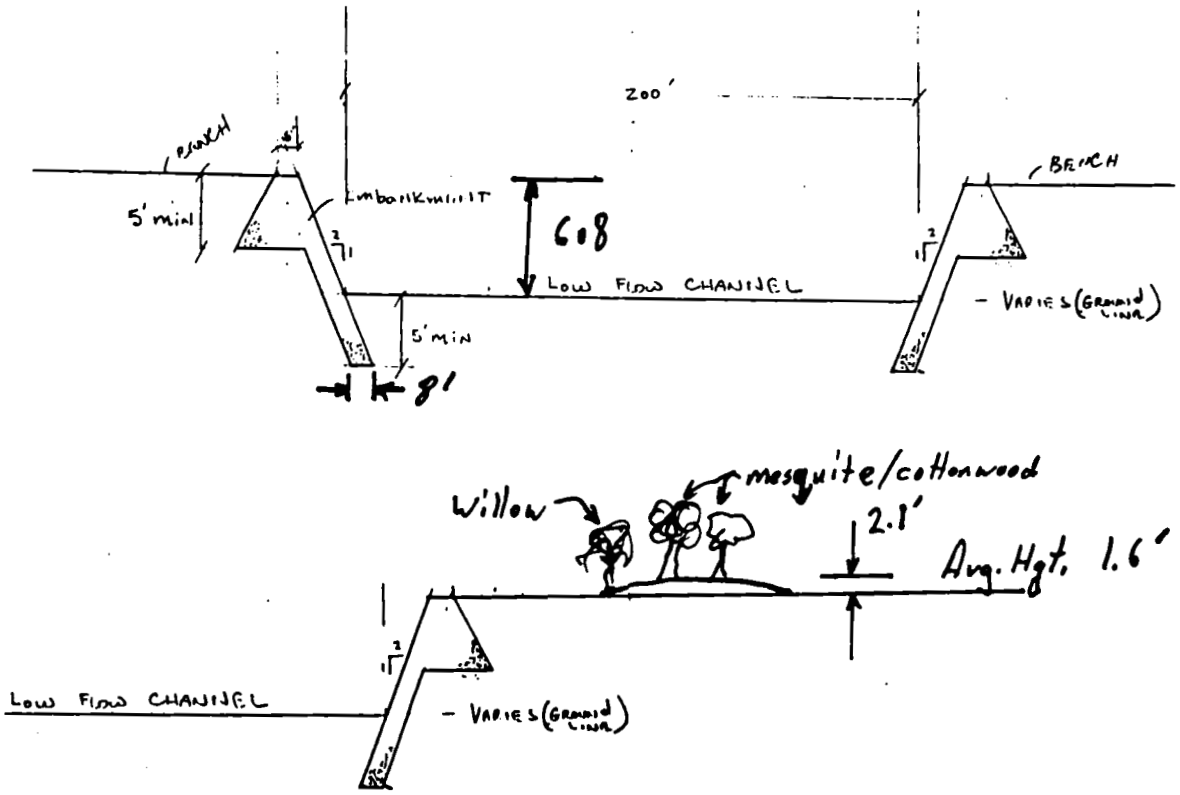
PROPOSED CONCEPT — SKETCH

TYPICAL LOW FLOW CHANNEL CROSS-SECTION

FIGURE 1-1



VALUE ENGINEERING RECOMMENDATION

PROPOSAL NO.: M-105

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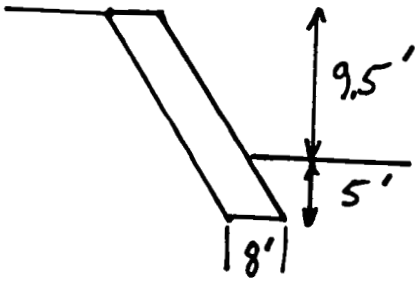
ORIGINAL CONCEPT — CALCULATIONS

Volume of soil cement



$(9.5' + 5') \times 8' \times 2 \text{ sides} \times 4.6 \text{ miles} \times 5280'/\text{mile} / 27 \text{ cf/cy}$

208,700 cuyds

VALUE ENGINEERING RECOMMENDATION

PROPOSAL NO.: M 105

PAGE NO.: of

PROPOSED CONCEPT — CALCULATIONS

From computer program.

$Q_{Low\ Flow}$ cfs	$Depth_{Low\ Flow}$ ft	$Q_{Terrace}$ cfs	$Depth_{Terrace}$ ft	Velocity fps
7,000	6.8'	5,200	2.14	3

n = 0.03

Excavation

$6.8' \times 200' \times 4.6 \text{ miles} \times 5280 \text{ ft/mile} / 27 \frac{cf}{cy} = 1,223,400$

Soil cement

$(6.8' + 5) \times 8' \times 2 \text{ sides} \times 4.6 \text{ miles} \times 5280'/\text{mile} / 27 \text{ cf/cy} =$

169,000 cu yds

VALUE ENGINEERING RECOMMENDATION

PROPOSAL NO.: M-105
PAGE NO.: of

PROPOSED CONCEPT — CALCULATIONS

FOR LCC PURPOSES ASSUME THAT 10% OF THE ANNUAL O&M PERSONNEL COST IS ASSOCIATED WITH SCRUB & DEBRIS REMOVAL, BASED ON THE CURRENT PLAN

ORIGINAL

SCRUB & DEBRIS REMOVAL = $1,069,000 x 0.1 = $107,000/YR

FOR THE PROPOSED, ASSUME THE ORIGINAL O&M COST IS REDUCED BY 50% DUE TO MORE FREQUENT FLUSHING.

$107,000 x 0.5 = $54,000

VALUE ENGINEERING RECOMMENDATION

PROPOSAL NO.: M 105

PAGE NO.: of

COST SAVINGS ESTIMATE

		Original Concept		Proposed Concept	
Item	Unit Cost	Quantity	Total	Quantity	Total
Excavation	3.37	3010471	10,145,287	1,223,900	4,122,858
Soil cement	15.25	208,700	3,182,675	169,800	2,589,450
HAULING + DISPOSAL	1.43	2,948,871	4,216,886	1,198,367	1,713,665
CREDIT ON MINERAL VALUE	(-1.25)	2,948,871	(-3,686,089)	1,198,367	(-1,497,959)
BACKFILL	1.32	61,600	81,312	25,033	33,044
SUB-TOTAL W/OUT MARKUPS			13,940,071		6,961,058
MARKUP @ 76.19%			10,620,940		5,303,630
TOTALS			24,561,000		12,265,000
NET SAVINGS					12,296,000

All costs from project MCACES Report and MCACES Database except if noted below:

1.

2.

VALUE ENGINEERING RECOMMENDATION

PROPOSAL NO.: M-105
PAGE NO.: of

LIFE CYCLE COST ANALYSIS

LIFE CYCLE PERIOD 50 YEARS

ANNUAL PERCENTAGE RATE = 7⅛ %

INITIAL COSTS	PRESENT DESIGN (PRESENT WORTH)	PROPOSED DESIGN (PRESENT WORTH)
Base Cost		
SUB-TOTAL		

SINGLE EXPENDITURE	YEAR	PRESENT WORTH FACTOR	PRESENT DESIGN		PROPOSED DESIGN	
			ESTI-MATE	PRESENT WORTH	ESTI-MATE	PRESENT WORTH
Salvage						
SUB-TOTAL						

ANNUAL EXPENDITURE	YEARS	PRESENT WORTH FACTOR	PRESENT DESIGN		PROPOSED DESIGN	
			ESTI-MATE	PRESENT WORTH	ESTI-MATE	PRESENT WORTH
O&M	50	13.586	107,000	1,454,000	54,000	734,000
Energy						
SUB-TOTAL				1,454,000		734,000
TOTAL PRESENT WORTH						
LIFE CYCLE SAVINGS						720,000

VALUE ENGINEERING RECOMMENDATION

PROJECT TITLE: *Rio Salado, Salt River, Arizona (Environmental Restoration Project)*

PROJECT LOCATION: *Phoenix/Tempe, AZ*

PROPOSAL NO.: P-3.

PAGE NO.: 1 of

DESCRIPTION: PROTECT TERRACES ONLY AT STRESS POINTS.

CRITERIA CHALLENGE: Yes/No CRITERIA NO.: —

ORIGINAL CONCEPT: LINED LOW FLOW CHANNEL WITH 8' THICK SOIL CEMENT SECTIONS ALONG THE ENTIRE REACH OF THE RIVER.

PROPOSED CONCEPT: LINE THE LOW FLOW CHANNEL WITH 8' THICK SOIL CEMENT ONLY IN THE PORTIONS OF THE CHANNEL WITH THE HIGHEST STRESS.

SUMMARY OF COST SAVINGS

	FIRST COST	PRESENT WORTH OF O&M COSTS	LIFE CYCLE COSTS
ORIGINAL CONCEPT	5,608,000	N/A	5,608,000
PROPOSED CONCEPT	2,035,000	N/A	2,035,000
SAVINGS	3,573,000	N/A	3,573,000

rsr

VALUE ENGINEERING RECOMMENDATION

PROPOSAL NO.: P-3.
PAGE NO.: of

ADVANTAGES & DISADVANTAGES

ADVANTAGES:

- KEEPS SOIL CEMENT SECTIONS IN THE CURVES WHICH HAVE THE MOST STRESS DURING FLOWS.
- ELIMINATES 18,200 LF OF UNNECESSARY SOIL CEMENT.
-
-
-
-

DISADVANTAGES:

- MAY RESULT IN THE LOSS OF SOME OF THE TERRACE AREA NEAR LOW FLOW CHANNEL DURING HIGH FLOWS. 12K CFS + ?
- SOME INCREASE IN O+M COST MAY RESULT DUE TO MORE FREQUENT EROSION OF THE TERRACE AREA NEAR LOW FLOW CHANNEL
-
-
-
-

JUSTIFICATION:

THE CHANNEL FLOW VELOCITIES DURING FLOWS FROM 0 CFS TO 12,000 CFS RANGE FROM 0 TO 6 FT/S.

THE EXCAVATED LOW FLOW CHANNEL WILL HOLD VERY WELL DURING MOST FLOWS < 12,000 CFS. DURING 100 YR FLOW THE RIVER WILL BASICALLY BE ERODED AS PLANNE

ORIGINAL CONCEPT — CALCULATIONS

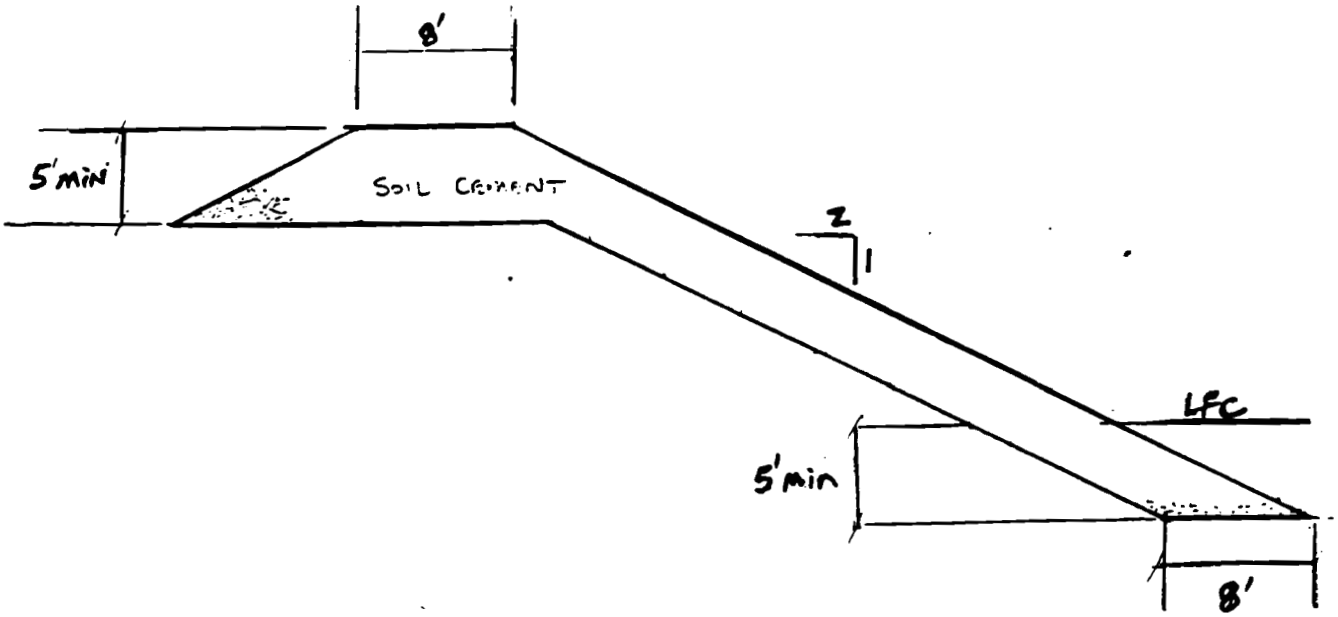
SOIL CEMENT AS PRESENTY

DESIGNED 208,700 CY.

TOTAL LENTH SOIL CEMENT APPROX. 48,200 L.F.

TYPICAL CHANNEL EMBANKMENT CROSS-SECTION

FIGURE 4-2



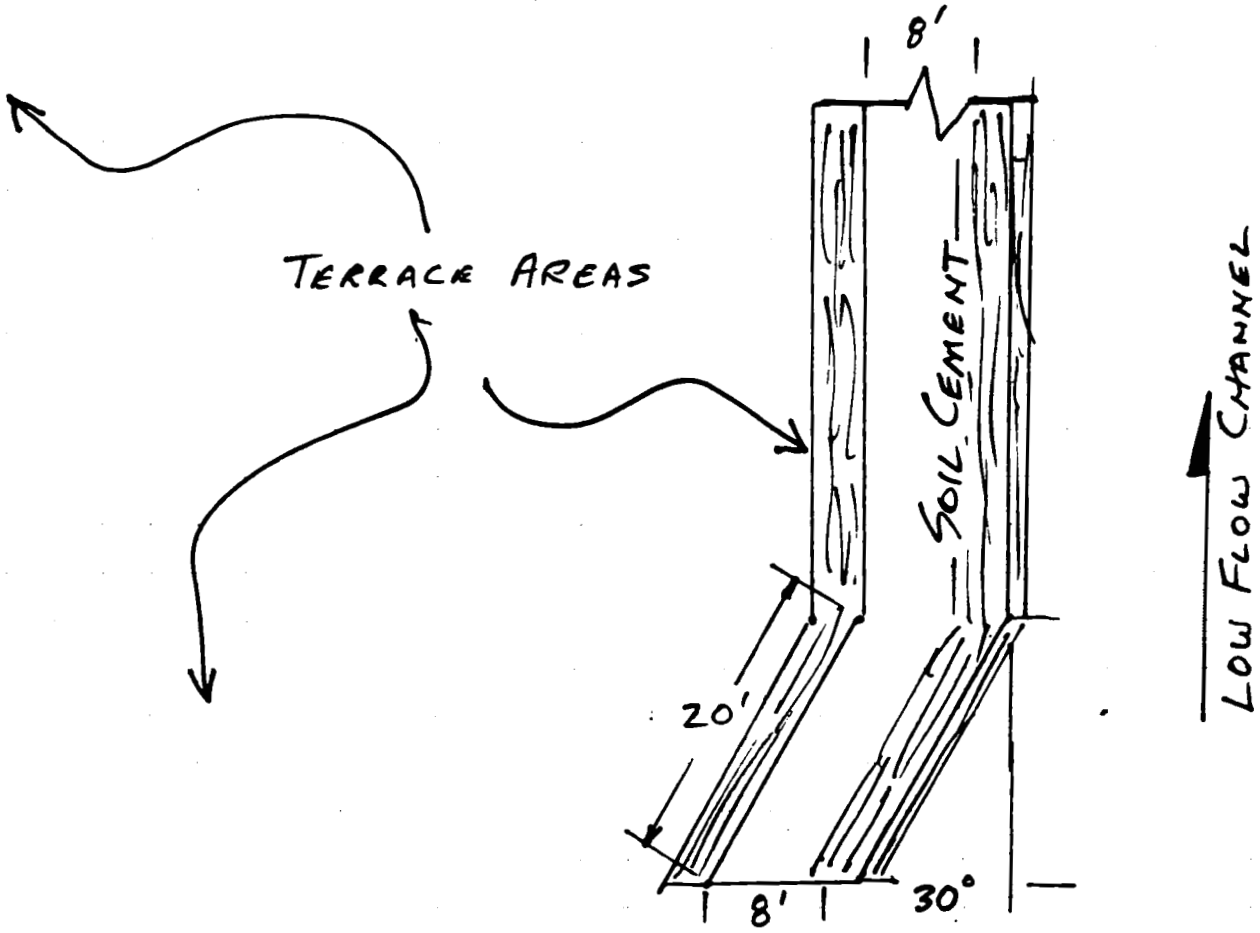
SCALE: 1" = 10'

VALUE ENGINEERING RECOMMENDATION

PROPOSAL NO.: P-3.

PAGE NO.: of

PROPOSED CONCEPT — SKETCH



PLAN VIEW

TYPICAL SKETCH SECTION FOR TRANSITION INTO + OUT OF (FLIPPED) SOIL CEMENT REACHES

NTS

VALUE ENGINEERING RECOMMENDATION

PROPOSAL NO.: P-3
PAGE NO.: of

ORIGINAL CONCEPT — CALCULATIONS

LEFT + RIGHT LOOKING D/S

1. DROP STRUCTURE #2 TO #3.
ELIMINATE SOIL CEMENT LEFT SIDE 2500 LF.

2. DROP STRUCTURE #3 (600' D/S) TO #4
ELIMINATE SOIL CEMENT RIGHT SIDE 2300 LF.

3. D/S OF DROP STRUCTURE #4 FOR 1000 LF
ELIMINATE SOIL CEMENT RIGHT SIDE.

4. D/S OF 16th ST. BRIDGE FOR 1000' LF
ELIMINATE 3000 LF OF SOIL CEMENT ON LEFT SIDE.

5. 1000 LF U/S OF 7th ST BRIDGE TO 1800 LF D/S OF 7th ST BRIDGE ELIMINATE SOIL CEMENT ON RIGHT SIDE.

6. 400 LF U/S OF 7th AVE BRIDGE TO 1000 LF D/S OF 7th AVE BRIDGE ELIMINATE SOIL CEMENT ON RIGHT SIDE.

VALUE ENGINEERING RECOMMENDATION

PROPOSAL NO.: P-3

PAGE NO.: of

ORIGINAL CONCEPT — CALCULATIONS

(7.) 600 LF U/S OF 7th AVE BRIDGE TO 2400 LF D/S OF 7th AVE BRIDGE ELIMINATE SOIL CEMENT ON LEFT SIDE.

(8.) 2800 LF D/S OF 7th AVE BRIDGE TO 19th AVE BRIDGE ELIMINATE 2200 LF OF SOIL CEMENT ON RIGHT SIDE

1. 2500 LF
2. 2300 LF
3. 1000 LF
4. 3000 LF
5. 2800 LF
6. 1400 LF
7. 3000 LF
8. 2200 LF

18,200 LF OF ELIMINATED SOIL CEMENT.

VALUE ENGINEERING RECOMMENDATION

PROPOSAL NO.: P-3.
PAGE NO.: of

PROPOSED CONCEPT — CALCULATIONS

ELIMINATE SOIL CEMENT AT THE LOW STRESS SECTIONS OF THE LOW FLOW CHANNEL (LFC) - LEFT + RIGHT BANKS.

APPROXIMATELY: 18200 L.F.

48,200 IS THE APPROX. TOTAL L.F AS DESIGNED:

18,200/48,200 = .37
REDUCTION OF SOIL CEMENT
37%

VALUE ENGINEERING RECOMMENDATION

PROPOSAL NO.: P-3.

PAGE NO.: of

COST SAVINGS ESTIMATE

		Original Concept		Proposed Concept	
Item	Unit Cost	Quantity	Total	Quantity	Total
SOIL CEMENT (LFC)	$15.25	208,700	3,182,675	75,721	$1,154,745
MARKUPS @ 76.19%			2,424,880		879,800
TOTALS			5,608,000		2,035,000
NET SAVINGS					3,573,000

All costs from project MCACES Report and MCACES Database except if noted below:

1.

2.

VALUE ENGINEERING RECOMMENDATION

PROJECT TITLE: *Rio Salado, Salt River, Arizona (Environmental Restoration Project)*

PROJECT LOCATION: *Phoenix/Tempe, AZ*

PROPOSAL NO.: P-15

PAGE NO.: 1 of

DESCRIPTION: LINE THE LOW FLOW CHANNEL ONLY A SHORT DISTANCE DOWNSTREAM OF THE GRADE CONTROL STRUCTURES

CRITERIA CHALLENGE: Yes/No CRITERIA NO.:

ORIGINAL CONCEPT:

Original Concept: Line the low flow channel throughout the project reach with a soil cement wall eight feet thick. The wall is intended to restrict the migration of the channel and to protect the terraces from flood scour and extended innundation up to a 12,200 cfs flood event. The original concept provides no habitat on the slope and does not accomodate natural migration of the channel.

PROPOSED CONCEPT:

Proposed Concept: Armor the banks of the low flow channel only to the degree necessary to dissipate energy downstream of grade controls and other critical points such as outside bends and bridges. To prevent the flow from wandering far outside of the desired path, the concept includes interceptor walls upstream of the armored drop structures. This approach provides protection in critical areas while allowing the stream to seek a stable configuration.

SUMMARY OF COST SAVINGS

	FIRST COST	PRESENT WORTH OF O&M COSTS	LIFE CYCLE COSTS
ORIGINAL CONCEPT	24,561,000	N/A	24,561,000
PROPOSED CONCEPT	19,453,000	N/A	19,453,000
SAVINGS	5,108,000	N/A	5,108,000

rsr

MeP

VALUE ENGINEERING RECOMMENDATION

PROPOSAL NO.:

PAGE NO.: of

ADVANTAGES & DISADVANTAGES

ADVANTAGES:

- Allows the stream to establish a stable alignment reducing the inherent risk of channel confinement
- Excessive wandering is controlled by embedded interceptor walls upstream of the grade cpntrols
- Eliminates most of an unsightly, unnatural paved surface
- Eliminates the safety hazard of a steep, smooth slope along the entire reach
- Provides substantial additional habitat
-
-

DISADVANTAGES:

- Provides additional risk of terrace scour during moderate flow events
-
-
-
-
-

JUSTIFICATION:

The proposed concept provides most of the protection afforded by the fully lined channel while adding additional benefits of aesthetic values and habitat.

DISCUSSION

The most critical areas for scour damage are downstream of the drop structures, around the bridges and at the outside of bends along the excavated low flow channel. The proposed approach provides hard protection at those critical points only. The recommended distance for bank armoring is analagous to the length of the apron for the drop structure. B y considering the area of disturbed flow, most of the energy is dissipated within 100 feet.

At each drop structure, there are interceptor walls that extend half the width of the terrace. This feature guides the flow to the drop structures and maintains the integrity of the terrace design.

The use of intermittent hard structures poses an important design challenge. It is crucial to gradually transition between the two types of bank. A sudden transition from hard to soft bank material invariably results in serious scour. This is a detail best managed by the designers but it is an important factor.

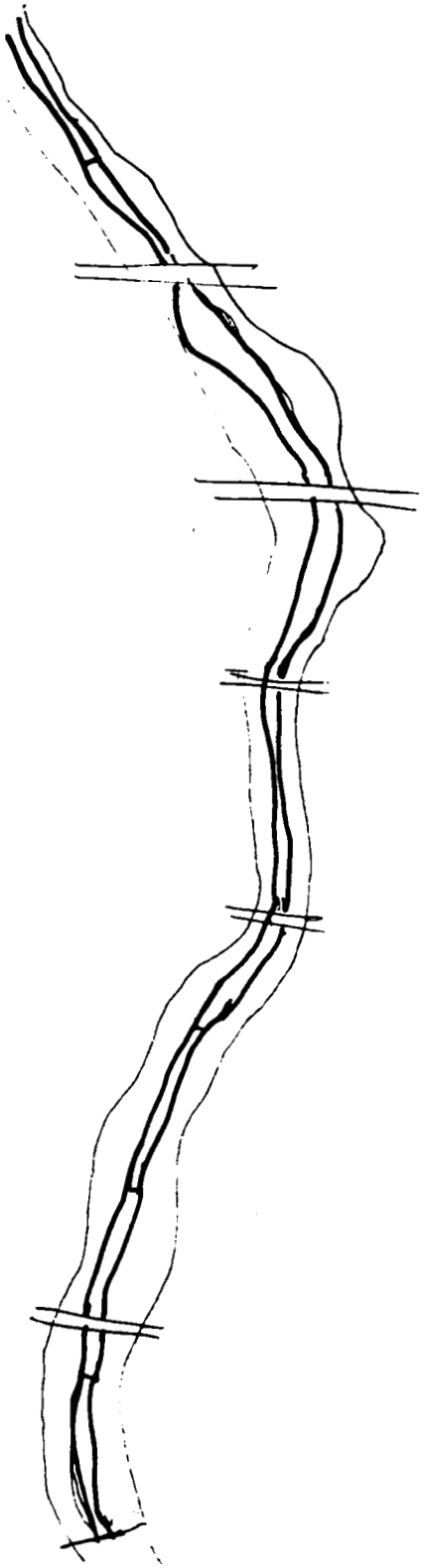
By eliminating the majority of the soil cement, the project gains about 4 acres of additional habitat.

VALUE ENGINEERING RECOMMENDATION

PROPOSAL NO.: P-15

PAGE NO.: of

ORIGINAL CONCEPT — SKETCH



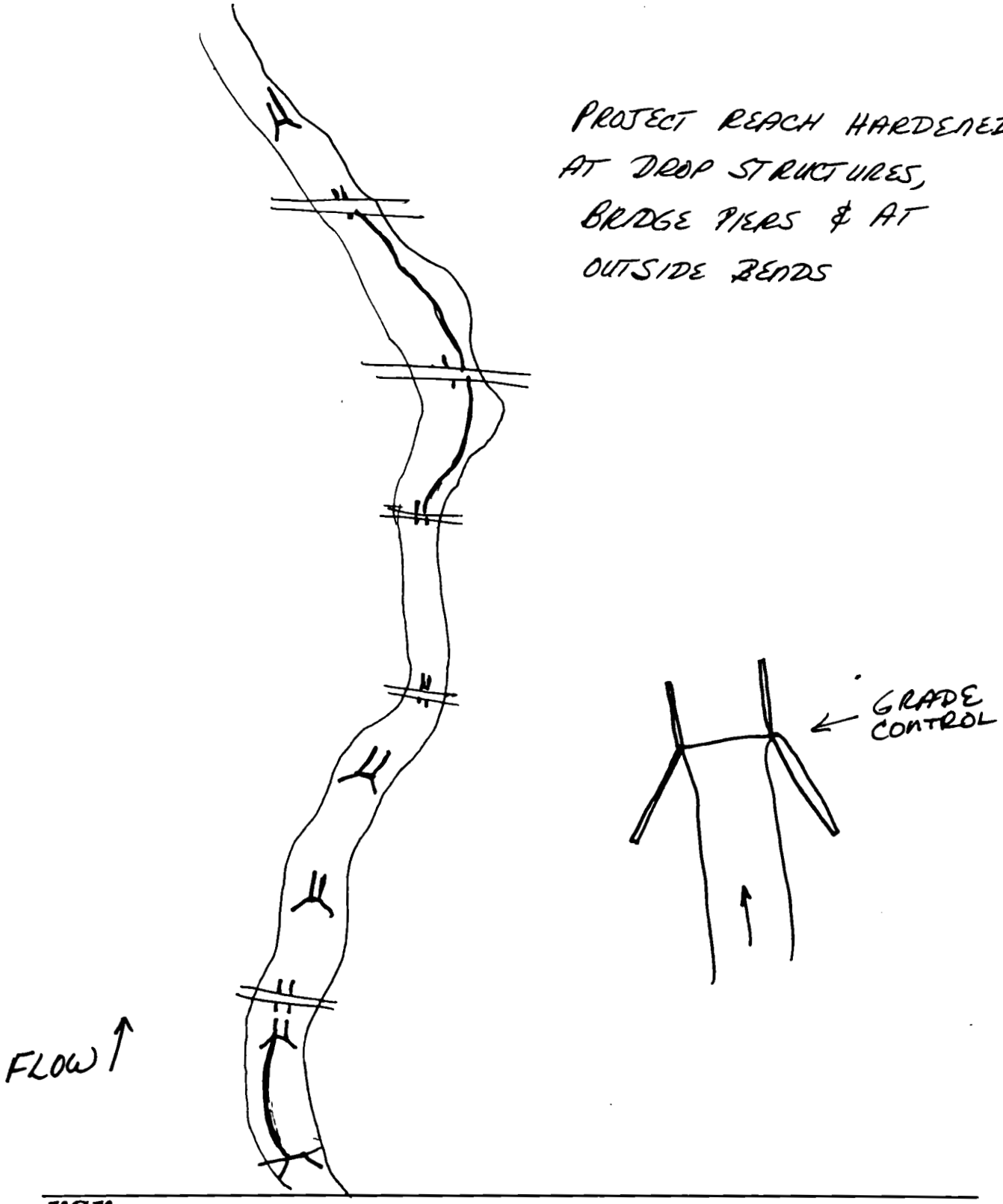
FULLY HARDENED CHANNEL

VALUE ENGINEERING RECOMMENDATION

PROPOSAL NO.: P-15

PAGE NO.: of

PROPOSED CONCEPT — SKETCH



VALUE ENGINEERING RECOMMENDATION

PROPOSAL NO.:

PAGE NO.: of

ORIGINAL CONCEPT — CALCULATIONS

48,576 linear feet OF SOIL CEMENT LINED CHANNEL

287,700 yd^3

VALUE ENGINEERING RECOMMENDATION

PROPOSAL NO.:

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PROPOSED CONCEPT — CALCULATIONS

LIMIT ARMORING TO

1) 100 LINEAR FEET BELOW ~~BELT~~ GRADE CONTROLS

5 GRADE CONTROLS - ARMOR BOTH SIDES

1000 LINEAR FEET

2) 7th STREET TO 7th AVENUE - CONTINUOUS ON OUTSIDE BEND 7200 ft

INSIDE BEND 150 ft. AROUND BRIDGES - 450 ft

3) 100 LINEAR FEET BELOW BRIDGES & 50 LINEAR FEET UPSTREAM OF BRIDGES EXCLUDING 3 BETWEEN 7th & 14th.

600 LINEAR FT.

4) OUTSIDE BEND

I-10 ~~to~~ DROP STRUCTURE TO 2nd DROP STRUCTURE ~800 ft.

10,050 linear feet

59,523 yd^3 soil cement

VALUE ENGINEERING RECOMMENDATION

PROPOSAL NO.: P-15

PAGE NO.: of

COST SAVINGS ESTIMATE

		Original Concept		Proposed Concept	
Item	Unit Cost	Quantity	Total	Quantity	Total
SOIL CEMENT YD³	15.25	208,700	3,182,675	59,523	907,726
EXCAVATION	3.37	3010471	10,145,287	2,767,686	9,327,102
BACKFILL	1.32	61,600	81,312	56,632	74,754
HAULING + DISPOSAL	1.43	2,948,871	4,216,886	2,711,054	3,876,807
CREDIT FOR MINERAL VALUE	(-1.25)	2,948,871	(-3,686,089)	2,711,054	(-3,388,818)
SLURRY WALL (12'x200'x2.5)	10.14			24,000	243,360
SUB-TOTAL W/OUT MARKUPS			13,940,071		11,040,931
MARKUPS @ 76.19%			10,620,940		8,412,085
TOTALS			24,561,000		19,453,000
NET SAVINGS					5,108,000

All costs from project MCACES Report and MCACES Database except if noted below:

1.

2.

VALUE ENGINEERING RECOMMENDATION

PROJECT TITLE: *Rio Salado, Salt River, Arizona (Environmental Restoration Project)*

PROJECT LOCATION: *Phoenix/Tempe, AZ*

PROPOSAL NO.: P-23

PAGE NO.: 1 of

DESCRIPTION: PROVIDE PROVISIONS TO PROTECT HABITAT FROM THE RECEDING SIDE OF THE FLOOD.

CRITERIA CHALLENGE: Yes/No CRITERIA NO.:

ORIGINAL CONCEPT

Flood control measures are proposed to manage the peak flow for the 5-year storm event (12,200 cfs). These concepts assume flow longitudinal to the channel. No protection measures have been proposed to protect habitat from the receding side of the flood, which involve transverse flows.

PROPOSED CONCEPT

Provide flood control measures to handle the transverse flows including:

1. A vegetated berm at the top of low flow channel slope. Convey flow into the low-flow channel using PCC down drains.
2. Plant trees in clusters.
3. Contour long berms in the terrace area longitudinal to the channel and plant with erosion resistant shrubs.
4. Use roadways and trails to break flows transverse to the channel.

SUMMARY OF COST SAVINGS

	FIRST COST	PRESENT WORTH OF O&M COSTS	LIFE CYCLE COSTS
ORIGINAL CONCEPT	5,608,000	2,826,000	8,434,000
PROPOSED CONCEPT	6,067,000	0	6,067,000
SAVINGS	(459,000)	2,826,000	2,367,000

RS

ADVANTAGES & DISADVANTAGES

ADVANTAGES:

Interrupting transverse flow will:

- Minimize the transport of sediment into the low flow channel and reduce channel maintenance costs.
- Reduce destruction of flora.
- Reduce destruction of hardscape improvements including trails and irrigation facilities.
- Reduce erosion along the line of the soil cement at the top of the low flow channel.

DISADVANTAGES:

- Additional design and site improvements are required.

JUSTIFICATION:

Site improvements to protect the reach habitat will reduce annual maintenance.

Jl

VALUE ENGINEERING RECOMMENDATION

PROPOSAL NO.: P-23

PAGE NO.: of

DISCUSSION

STUDIES SHOW THAT DAMAGE THAT OCCURS AS THE FLOOD STAGE RECEDES CAN EXCEED THAT WHICH OCCURS DURING THE RISING LIMB OF THE HYDROGRAPH. AS THE FLOOD TAPERS OFF, RUNOFF WILL FLOW TOWARD THE LOW FLOW CHANNEL CARRYING SIGNIFICANT AMOUNTS OF SEDIMENT. WE HAVE (CONSERVATIVELY) ASSUMED THAT OVER THE LIFE OF THE PROJECT, THE AMOUNT OF SEDIMENT REMOVED FROM THE LOW-FLOW CHANNEL WILL BE EQUAL TO THE ORIGINAL EXCAVATION VOLUME. EROSION CONTROL MEASURES ARE HIGHLY RECOMMENDED

ORIGINAL CONCEPT — CALCULATIONS

For LCC purposes, Assume the following additional O&M costs over the 50 year life

Additional sedimentation excavation

3,000,000 cy x $3.37/cy = $10,110,000

Additional habitat repair

$3,400,000 x 5% = $170,000

Repair top of low flow channel

48,000 LF x 10 ft wide x $0.25/SF = $120,000

Total = $10,400,000

Annualized = $208,000

VALUE ENGINEERING RECOMMENDATION

PROPOSAL NO.: P-23

PAGE NO.: of

COST SAVINGS ESTIMATE

		Original Concept		Proposed Concept	
Item	Unit Cost	Quantity	Total	Quantity	Total
VEGETATED BERM	3.37			15,000	50,550
TERRACE GRADING	3.37			15,000	50,550
PCC DOWN DRAINS	300.00			300	90,000
SOIL CEMENT	15.25	208,700	3,182,675	208,400	3,178,100
TRAIL/ROAD UPGRADES	1,488,000			5%	74,400
			3,182,675		3,443,600
			2,424,880		2,623,679
TOTALS			5,608,000		6,067,000
NET SAVINGS					(-459,000)

All costs from project MCACES Report and MCACES Database except if noted below:

1.

2.

VALUE ENGINEERING RECOMMENDATION

PROPOSAL NO.: P-23

PAGE NO.: of

LIFE CYCLE COST ANALYSIS

LIFE CYCLE PERIOD 50 YEARS

ANNUAL PERCENTAGE RATE = 7 1/8 %

INITIAL COSTS	PRESENT DESIGN (PRESENT WORTH)	PROPOSED DESIGN (PRESENT WORTH)
Base Cost		
SUB-TOTAL		

SINGLE EXPENDITURE	YEAR	PRESENT WORTH FACTOR	PRESENT DESIGN		PROPOSED DESIGN	
			ESTI-MATE	PRESENT WORTH	ESTI-MATE	PRESENT WORTH
Salvage						
SUB-TOTAL						

ANNUAL EXPENDITURE	YEARS	PRESENT WORTH FACTOR	PRESENT DESIGN		PROPOSED DESIGN	
			ESTI-MATE	PRESENT WORTH	ESTI-MATE	PRESENT WORTH
O&M	50	13.586	208,000	2,826,000		0
Energy						
SUB-TOTAL				2,826,000		0
TOTAL PRESENT WORTH						
LIFE CYCLE SAVINGS						2,826,000

VALUE ENGINEERING RECOMMENDATION

PROJECT TITLE: *Rio Salado, Salt River, Arizona (Environmental Restoration Project)*

PROJECT LOCATION: *Phoenix/Tempe, AZ*

PROPOSAL NO.: P-31

PAGE NO.: 1 of

Description: Develop "Adopt-A-River" or StreamTeam program
Criteria Challenge: No

CRITERIA CHALLENGE: [redacted]No CRITERIA NO.:

ORIGINAL CONCEPT:

Original Concept:
Not described

Proposed Concept:

Promote and coordinate volunteer water quality and habitat monitoring activities by citizen and student groups. Monitoring usually includes parameters such as nitrate, phosphate, chloride, TDS, conductivity, dissolved oxygen and turbidity using inexpensive field kits. These groups also conduct stream-side plantings, habitat evaluations, litter removal and storm-drain stenciling ("No dumping - drains to our river"). Schools, neighborhoods, clubs or business groups form teams.

SUMMARY OF COST SAVINGS

	FIRST COST	PRESENT WORTH OF O&M COSTS	LIFE CYCLE COSTS
ORIGINAL CONCEPT	N/A	14,661,000	14,661,000
PROPOSED CONCEPT	N/A	14,211,000	14,211,000
SAVINGS	N/A	450,000	450,000

rsr

mmp

VALUE ENGINEERING RECOMMENDATION

PROPOSAL NO.: P - 31

PAGE NO.: of

ADVANTAGES & DISADVANTAGES

Advantages:

* Provides frequent, regular monitoring of water quality throughout project
* Involves citizens in the care of the project - enhances local support
* Tends to lower maintenance costs by reducing vandalism and littering
* By forming a sister monitoring team in Indian Bend Wash, can provide an early warning to the project in case of pollutants entering the system
* Provides biology, chemistry and physics learning opportunities for K-12 students
* Involves neighboring businesses in the project - encourages them to support the project and manage their businesses in a project-friendly way
* Promotes better environmental behavior (not dumping oil into storm drains) from a non-governmental group.
* POSITIVE MEDIA ATTENTION GENERATED BY OTHERS

DISADVANTAGES:

Disadvantages

* May involve allowing citizens or students into sensitive areas
* Requires training or coordination with a training program
* Involves some staff time to coordinate volunteers

JUSTIFICATION:

Justification:

This recommendation meets critical functions of the project including educating citizens, creating support for the project, attracting people to the site and promoting a positive image for the community. The Adopt-A-Stream activities are closely tied to habitat protection by providing regular frequent assessment of biological and chemical indicators of water quality.

DISCUSSION

Discussion

The recommendation provides for meaningful citizen and student participation in the care of the project. The concept is widely applied to water resource protection throughout the nation. In some cases, StreamTeams are sponsored byand report their results to the state Department of Natural Resource. Groups such as StreamTeam, Adopt-A-Stream and Stream Doctors are easily adapted models. All provide model training programs in water chemistry, macroinvertibrate monitoring, student experiments and teacher's guides. Through these programs, water quality and habitat values will be evaluated frequently and provide a useful adjunct to professional monitoring. In addition, the participation of citizens and local businesses in the maintenance of the project may lead to support for expansion of the project to other reaches. Further, widespead citizen participation strengthens political support.

VALUE ENGINEERING RECOMMENDATION

PROPOSAL NO.: P-21

PAGE NO.: of

ORIGINAL CONCEPT — CALCULATIONS

1) WATER QUALITY MONITORING - STAFF PERSON
- 16 MONITORING SITES, MONITORED QUARTERLY
- ASSUME 3hr/SITE INCLUDING REPORTING

COST: 192 hr/yr @ $40/hr = $7680/YR.

2) PUBLIC EDUCATION/Professional Presentations

ASSUME 12 EVENTS/YR, 2 OF WHICH ARE MAJOR REGIONAL/NATIONAL CONFERENCES

16 hr for major conf.
40 hr for smaller events
56 hr @ $40/hr = $2,240.00/YR.

3) SITE MAINTENANCE INCLUDING LITTER & INVASIVE SPECIES REMOVAL

26,725 man-hr @ $40/hr $1,069,000/YR.

VALUE ENGINEERING RECOMMENDATION

PROPOSAL NO.: P-31

PAGE NO.: of

PROPOSED CONCEPT — CALCULATIONS

Calculations:

Annual cost of materials

Water chemistry kits (dissolved O2, nitrate, phosphate, turbidity, chloride)

$150/set; each set contains 50 tests, assume 10 sets/year for K-12 or citizen groups +$1500/yr

Kick or D nets and assorted macroinvertibrate monitoring equipment
$30/set assume 10 sets, each set lasts approximately 5 years
+$300

Labor costs:
assume one park staff person one day per month, 96 hours/year, .05 FTE
$18/hr. +$1568

Labor reductions: assume 20% reduction in annual litter removal costs attributable to semiannual stream cleaning events

~40 man-hr @ $35/hr
– $1400.00

NOTE: MATERIALS MAY BE DONATED BY AZ DEQ

VALUE ENGINEERING RECOMMENDATION

PROPOSAL NO.: P-31

PAGE NO.: of

PROPOSED CONCEPT — CALCULATIONS

1) ASSUME 16 MONITORING SITES (STREAM, WETLAND, LAKES)

ASSUME QUARTERLY MONITORING

ASSUME 3hr/SITE INCLUDING REPORTING

192 hr/yr @ $40/hr - $7680/yr

~~$760,000~~ 1,069,000

2) ASSUME 2 TRASH/TAMARISK EVENTS/YR

2 DAYS/EVENT - 50 PEOPLE/EVENT

800 MAN-HOURS @ $40/hr $32,000/yr

3) ASSUME 5 PUBLIC SPEAKING EVENTS/yr; ONE OF WHICH IS A MAJOR REGIONAL/NATIONAL CONF.

prep + presentation ≅ 20hr @ $40/hr

$800

26,725 man-hr

VALUE ENGINEERING RECOMMENDATION

PROPOSAL NO.: P-31

PAGE NO.: of

PROPOSED CONCEPT — CALCULATIONS

1) WATER QUALITY MONITORING

- SUPPORT/COORDINATION OF TEAMS
  8 hr/mo - 96 hr/yr
- QC RESULTS OF TEAMS
  ASSUME VERIFY RESULTS 25% OF SITES
  12hr/quarter
  48 hr/yr

COST: 144 hr/yr @ $40/hr = $5760/yr

VALUE ENGINEERING RECOMMENDATION

PROPOSAL NO.: P-31

PAGE NO.: of

O&M COST SAVINGS ESTIMATE

		Original Concept		Proposed Concept	
Item	Unit Cost	Quantity	Total	Quantity	Total
WATER QUALITY MON.	40	192	7680	144	5760
MAINTENANCE	40	26725	1,069,000	25,925	1037,000
SPEAKING/PUBLIC ED.	40	56	2240	36	1440
WATER QUALITY MATERIALS	180	1	180	10	1800
TOTALS			1079100		1046000
NET SAVINGS					33,100

All costs from project MCACES Report and MCACES Database except if noted below:

1.

2.

VALUE ENGINEERING RECOMMENDATION

PROPOSAL NO.: P-31

PAGE NO.: of

LIFE CYCLE COST ANALYSIS

LIFE CYCLE PERIOD 50 YEARS

ANNUAL PERCENTAGE RATE = ____ %

INITIAL COSTS	PRESENT DESIGN (PRESENT WORTH)	PROPOSED DESIGN (PRESENT WORTH)
Base Cost		
SUB-TOTAL	1079100	1046000

SINGLE EXPENDITURE	YEAR	PRESENT WORTH FACTOR	PRESENT DESIGN		PROPOSED DESIGN	
			ESTI-MATE	PRESENT WORTH	ESTI-MATE	PRESENT WORTH
Salvage						
SUB-TOTAL						

ANNUAL EXPENDITURE	YEARS	PRESENT WORTH FACTOR	PRESENT DESIGN		PROPOSED DESIGN	
			ESTI-MATE	PRESENT WORTH	ESTI-MATE	PRESENT WORTH
O&M	50	13.586		1466063		1921096
Energy						
SUB-TOTAL						
TOTAL PRESENT WORTH						
LIFE CYCLE SAVINGS					$ 449,697	

VALUE ENGINEERING RECOMMENDATION

PROJECT TITLE: *Rio Salado, Salt River, Arizona (Environmental Restoration Project)*

PROJECT LOCATION: *Phoenix/Tempe, AZ*

PROPOSAL NO.: P-59

PAGE NO.: 1 of

DESCRIPTION: Develop fire breaks in landscape plan - Phoenix Reach

CRITERIA CHALLENGE: Yes/No CRITERIA NO.:

ORIGINAL CONCEPT:

Original Concept: The landscape / habitat plan given in the Feasibility Study (FS) includes several sections of continuous and contiguous vegetation comprising one or more habitats. Length for contiguous habitats of Cottonwood, Willow, or Mesquite zones range from about 1,000 feet to more than 1 mile for individual habitats and more for multiple contiguous habitats. The original concept considers functional relations between habitats.

PROPOSED CONCEPT:

Proposed Concept: Our proposed concept incorporates the same functional relations between habitats, but incorporates fire breaks into habitat design to prevent catastrophic loss of a substantial fraction of the created habitats due to a single fire event. The design of the fire breaks should include the following parameters: type of vegetation; height of vegetation; width of break required; distance between breaks, access points to the river bed and to the low flow channel; and hydrodynamic stability of the habitat stands between fire breaks. This proposed concept is appropriate solely for the Phoenix Reach of the Rio Salado Project.

SUMMARY OF COST SAVINGS

	FIRST COST	PRESENT WORTH OF O&M COSTS	LIFE CYCLE COSTS
ORIGINAL CONCEPT	4,472,000	1,200,000	5,672,000
PROPOSED CONCEPT	4,141,000	48,000	4,189,000
SAVINGS	331,000	1,152,000	1,483,000

rsr

DGH

VALUE ENGINEERING RECOMMENDATION

PROPOSAL NO.: P-59

PAGE NO.: of

ADVANTAGES & DISADVANTAGES

ADVANTAGES:

1) reduces potential for catastrophic loss of a substantial fraction of the created habitat during a single fire event;

2) reduces capital costs and maintenance costs required for habitat that would otherwise be created inside the areas recommended for use as fire breaks; and

3) provides additional open areas that could be used for other purposes.

•

DISADVANTAGES:

1) reduces the total area of habitat created by the project;

2) introduces artificial separations in the habitats that were designed to be continuous and contiguous; and

3) costs for will be incurred to maintain the fire breaks as vegetation-free areas.

•

•

JUSTIFICATION:

Incorporating fire breaks into design of habitats will provide protection for vegetation and wildlife that is not provided by the original concept presented in the FS. In addition, life cycle costs for project are reduced.

DISCUSSION

To prevent catastrophic loss of a substantial fraction of the habitat that will be created by the Rio Salado Project as a result of a single fire event, the Value Engineering Team recommends that fire breaks be incorporated into the habitat design. Fire breaks should be designed with consideration of the following parameters: type of vegetation; height of vegetation; width of break required; distance between breaks, access points to the river bed and to the low flow channel; and hydrodynamic stability of the habitat stands between fire breaks.

Fire breaks should be located in a manner that will provide appropriate protection for each area of single-zone or multiple-zone habitat. Width of the fire breaks and distance between fire breaks will be controlled by the height and density of the vegetation in each habitat cluster. The following table provides the assumptions used for the preliminary design of the fire breaks given in this recommendation:

Habitat	Density	Height	Break Width	Distance Between Fire Breaks
Cottonwood	50/acre	50 feet	75 feet	1,000 feet
Willow	50/acre	40 feet	60 feet	1,000 feet
Mesquite	100/acre	25 feet	38 feet	1,500 feet
Desert Broom	not given	12 feet	18 feet	not applicable
Wetland Marsh	not given	5 feet	8 feet	not applicable

Width of the fire breaks given in the above table and used in this analysis are 1.5 times the height of the controlling habitat. Based on proposed habitat densities and the linear geometry of the habitats along the river, excessive heat may not be a substantial concern and the risk of blowing embers may be low.

To provide full protection, the fire breaks should extend across the entire river channel. The breaks should cut across multiple-zone habitats. The fire breaks could be placed at all bridges. For aesthetic purposes, the fire breaks could be curved rather than linear. However, the minimum separation of the plants should be as given above; curved firebreaks will have an apparent width larger than the values given above. For this analysis, we have assumed that the distance between the fire breaks will be the same for each cluster of habitat; however, this could be varied to reduce monotony.

VALUE ENGINEERING RECOMMENDATION

PROPOSAL NO.: P-59

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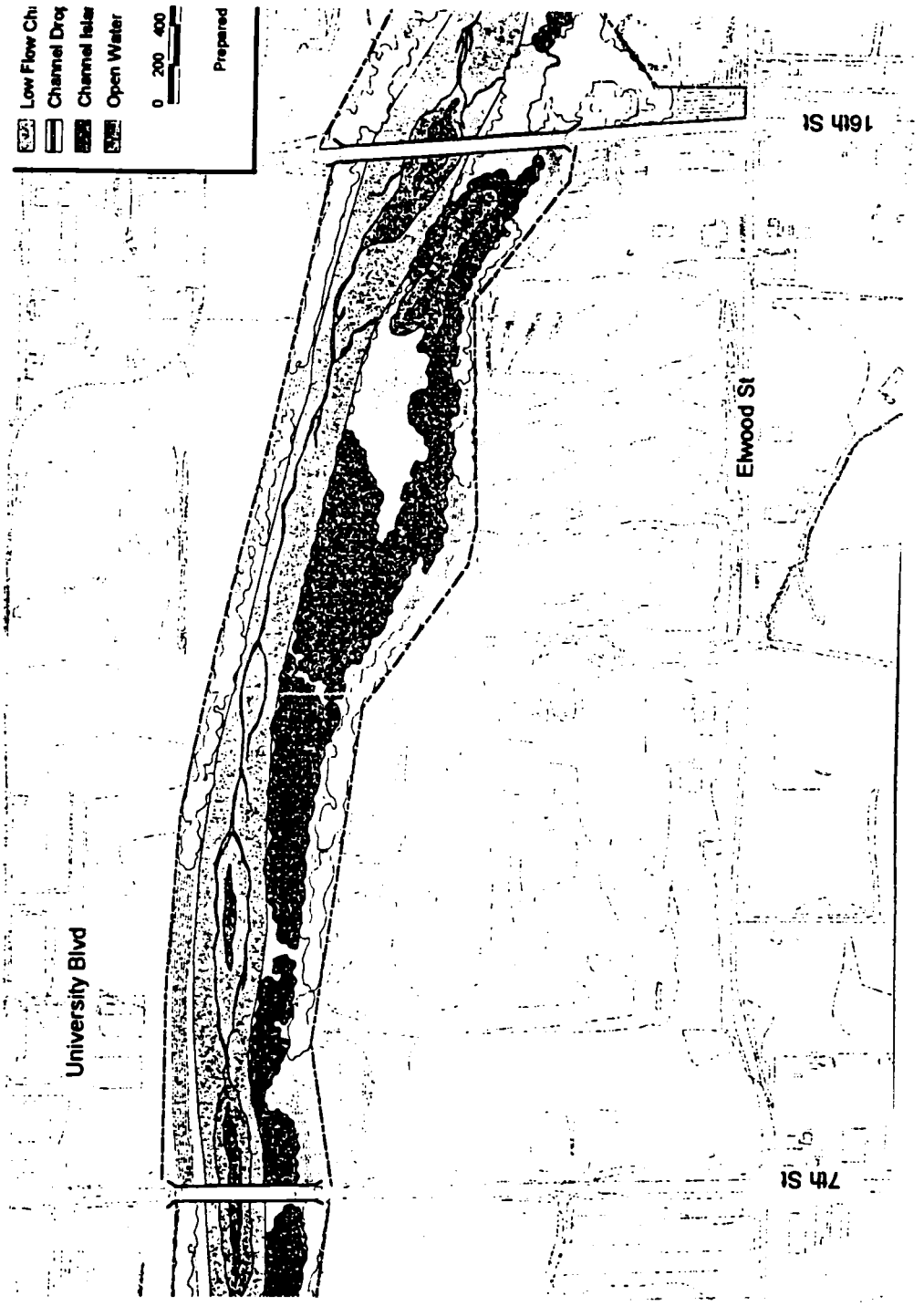
ORIGINAL CONCEPT — SKETCH



Source: Figure 6-5 of Feasibility Study

No fine breaks included

DGH

VALUE ENGINEERING RECOMMENDATION

PROPOSAL NO.: P-59

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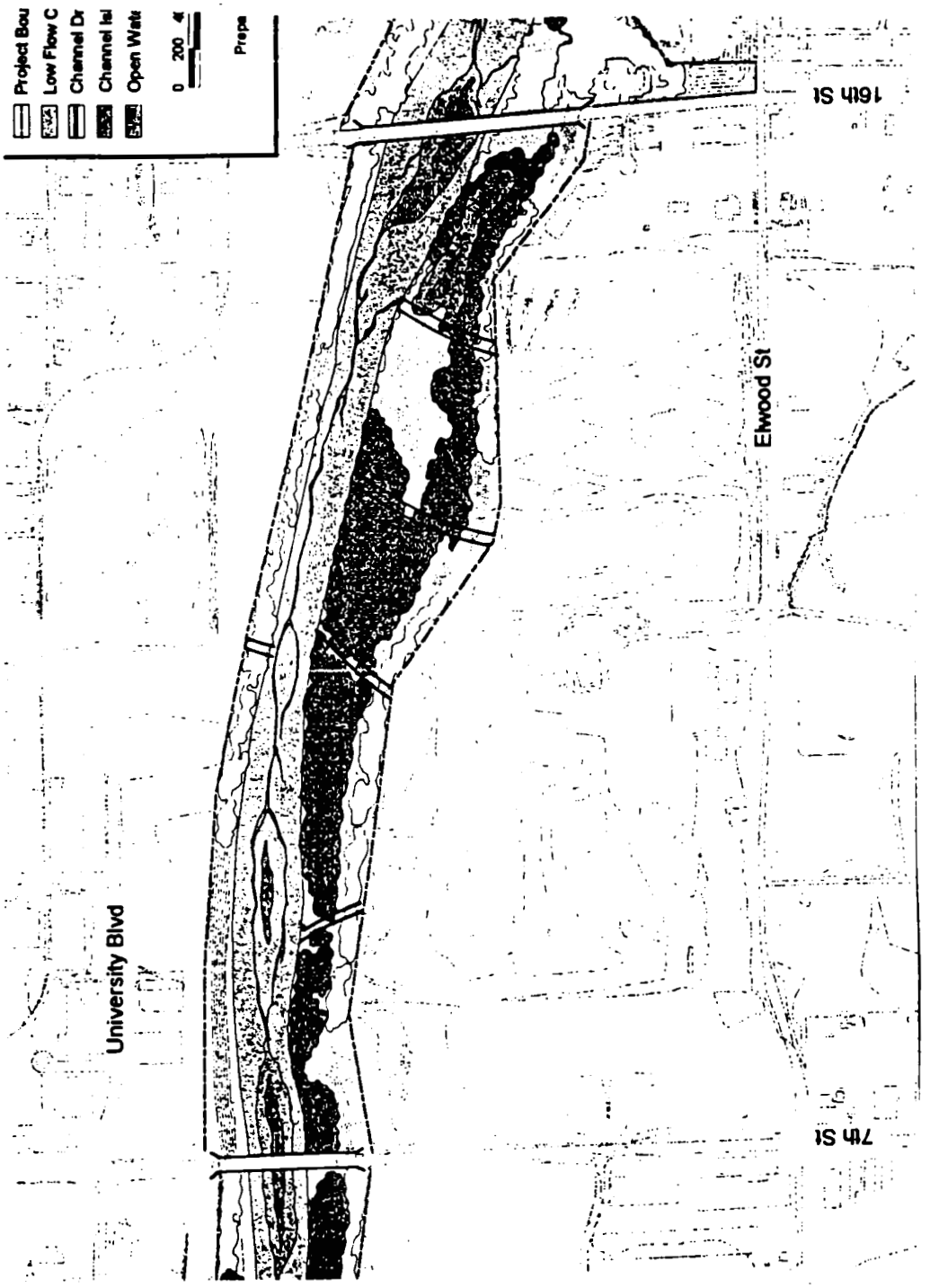
PROPOSED CONCEPT — SKETCH



Fine break (locations approximate)

Source: Figure 6-5 of Feasibility Study

DGH

VALUE ENGINEERING RECOMMENDATION

PROPOSAL NO.: P-59

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ORIGINAL CONCEPT — CALCULATIONS

Based on the generalized schematic diagram of the proposed habitats given in Figures 6-4, 6-5, 6-6, and 6-7 of the FS, we have calculated the following reductions of habitat acreage:

Habitat	Density	FS Acreage	Reduction in Acreage
Cottonwood / Willow	50/acre 50/acre	99	7.3
Mesquite	100/acre	130	9.6
Desert Broom	not given	NA	NA
Wetland Marsh	not given	NA	NA

For this analysis, we have assumed that the entire 229 acres of proposed habitat along the 5 mile length of river would be installed uniformly along the river.

Total area of habitat:

(229 acres) x (43,560 sq.ft/acre) = 9,975,000 sq. ft

Length of Phoenix Reach:

(5 miles) x (5,280 ft/mile) = 26,400 feet

Average width of habitat:

(9,975,000 sq. ft) / (26,400 ft) = 378 feet

Number of fire breaks along length of river:

(26,400 ft) / (1,000 ft between breaks) = 26 fire breaks

Area of fire breaks:

(26 breaks) x (378 ft length) x (75 feet width) = 737,000 sq. ft
= 16.9 acres

Fraction of total habitat:

(16.9 acres breaks) / (229 acres proposed) = 7.4 percent

DGH

VALUE ENGINEERING RECOMMENDATION

PROPOSAL NO.: P-59

PAGE NO.: of

PROPOSED CONCEPT — CALCULATIONS

Capital cost reduction:

Cotton / Willow: ~~$1,105,000~~ 1,178,000 (from analysis for Proposal C-4)

Mesquite: $~~842,000~~ 1,360,000 (from analysis for Proposal C-4)

Total proposed habitat capital cost: ~~$1,947,000~~ 2,538,000

Projected capital cost savings:

(~~$1,947,000~~ 2,538,000) x (7.4 percent) = ~~$144,000~~ 187,812.

If a catastrpohic fire would run the entire length of the the river, the channel island would likely prevent the fire from destroying the habitat on both sides of the island. Therefore, 50 percent of the habitat could be lost. Fifty percent of the capital cost for the habitat is:

(~~$1,947,000~~ 2,538,000) x (0.5) = ~~$974,000~~ 1,269,000 (O&M savings)

This analysis does not include reductions in non-habitat-related capital and O&M costs that would result from the reduction of the habitat area. Non-habitat-related costs would include providing a water source for the habitat.

This concept could also be incorporated into the development plan with no cost savings by planting the same acreage of habitat in a slightly larger area to include the fire breaks.

DGH

VALUE ENGINEERING RECOMMENDATION

PROPOSAL NO.: P-59
PAGE NO.: of

ORIGINAL CONCEPT — CALCULATIONS

IF A FIRE WERE TO BREAKOUT in the current plan, POTENTIALLY 50% OF THE HABITAT COULD BE LOST

$2,538,000 x 0.5 = 1,269,000

IF A FIRE WERE TO BREAKOUT in THE PROPOSED PLAN POTENTIALLY 2% OF THE HABITAT COULD BE LOST

$2,538,000 x 0.02 = $50,760

FOR LIFE Cycle Cost purposes assume a fire breaks out every 10 years

Year	PWF	Original Estimate	Original PW	Proposed Estimate	Proposed PW
10	0.5024	$ 1,269,000	$ 637,546	$ 50,800	$ 25,522
20	0.2525	$ 1,269,000	$ 320,423	$ 50,800	$ 12,827
30	0.1268	$ 1,269,000	$ 160,909	$ 50,800	$ 6,441
40	0.0637	$ 1,269,000	$ 80,835	$ 50,800	$ 3,236
			$ 1,199,713		$ 48,026

DGH

VALUE ENGINEERING RECOMMENDATION

PROPOSAL NO.: P-59
PAGE NO.: of

COST SAVINGS ESTIMATE

		Original Concept		Proposed Concept	
Item	Unit Cost	Quantity	Total	Quantity	Total
MESQUITE PLANTING (LS)	1,360,000	1.000	1,360,000	0.926	1,259,360
COTTONWOOD/WILLOW PLANTING (LS)	1,178,000	1.000	1,178,000	0.926	1,090,828
SUB-TOTAL W/OUT MARKUP			2,538,000		2,350,188
MARKUP @ 76.19%			1,933,702		1,790,608
TOTALS			4,472,000		4,141,000
NET SAVINGS					331,000

All costs from project MCACES Report and MCACES Database except if noted below:

1.

2.

DGH

VALUE ENGINEERING RECOMMENDATION

PROJECT TITLE: *Rio Salado, Salt River, Arizona (Environmental Restoration Project)*

PROJECT LOCATION: *Phoenix/Tempe, AZ*

PROPOSAL NO.: R-28

PAGE NO.: 1 of

DESCRIPTION: Provide gateway visitor/interpretive center.

CRITERIA CHALLENGE: Yes/No CRITERIA NO.:

ORIGINAL CONCEPT:

A visitor center/interpretive center is planned as a 5,000 s.f. facility to include the following:

			Cost-shared amount:
Visitor Center / Interpretive Center	Square Feet		
Restrooms/Mech. Room	1,500	$220,000[1]	$220,000
Computer Room	1,000	$192,500[2]	
Interpretive Displays	1,000	$55,000[3]	
Entrance Area	500	$27,500[3]	
Admin Office	1,000	$55,000[3]	

PROPOSED CONCEPT:

The visitor center/interpretive center is planned as an important, centrally-located, gateway interpretive facility for the project.

SUMMARY OF COST SAVINGS

	FIRST COST	PRESENT WORTH OF O&M COSTS	LIFE CYCLE COSTS
ORIGINAL CONCEPT	969,000	N/A	969,000
PROPOSED CONCEPT	1,441,000	N/A	1,441,000
SAVINGS	(472,000)	N/A	(472,000)

rsr

VALUE ENGINEERING RECOMMENDATION

PROPOSAL NO.: R-28

PAGE NO.: of

ADVANTAGES & DISADVANTAGES

ADVANTAGES:

- Provide powerful image and icon for the project.
- Create community support
- Improve visibility and understanding of the project
- Attract out-of-town and community residents
- Enhance visual quality of downtown environment
- Improve economic opportunities in downtown area
- ~~Provide community~~ Create focal point ~~and~~ that helps link north and south Phoenix districts.
- Improve public environmental education opportunities
- Help protect habitat and project investments
- Create focal point for community activities in support of project

DISADVANTAGES:

- ~~High~~ Increased Cost of initial construction
- ~~High on-going~~ Increased costs for maintenance and operations.

JUSTIFICATION:

A gateway visitor/interpretive center would ~~create~~ be a strong community asset, benefiting the community and the project in both tangible and intangible ways. It would support the environmental restoration purpose of the project and help protect habitat and project investments. Also, it would create a focal point for community awareness and volunteer activities that ~~would~~ may reduce project O&M costs for the life of the project.

VD

VALUE ENGINEERING RECOMMENDATION

PROPOSAL NO.: R-28
PAGE NO.: of

DISCUSSION

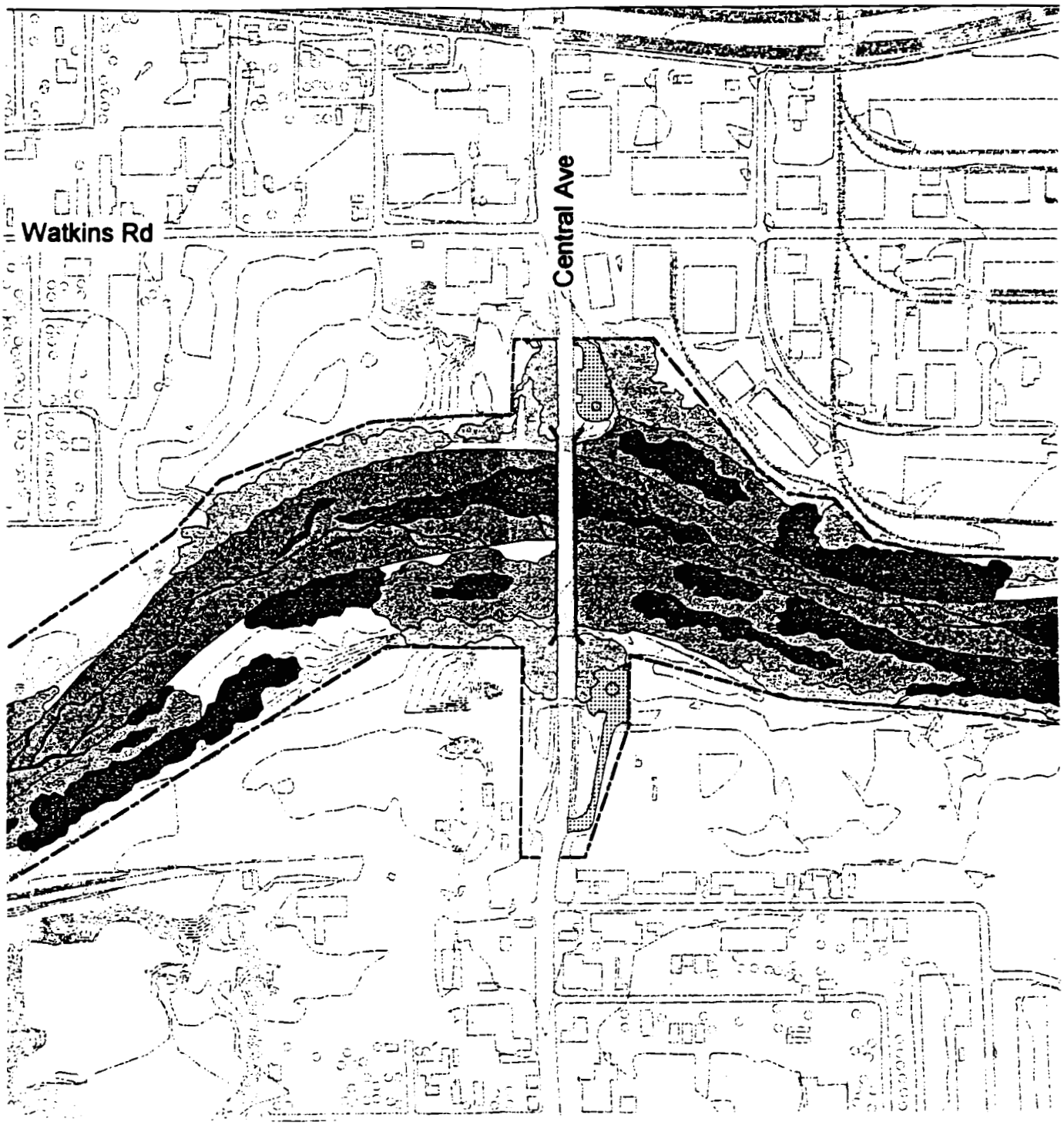
The gateway visitor/interpretive center would be located central to the project at one of the existing areas identified for public access. It would include both indoor and outdoor facilities and have a strong physical and visual linkage to the river corridor and diverse habitats. An important component of the project would be one or more outdoor interpretive plazas with interpretive exhibits, seating, shade, and a gathering area (e.g., small amphitheatre). By serving as a gateway to the project, access could be concentrated and controlled, helping to protect habitats and improve awareness of the project and the river environment. A high quality, centrally-located, visitor/interpretive facility ~~located in a~~ would support the overall intent of the project for environmental restoration in both tangible and intangible ways and it would directly support purposes of serving as a community asset, attracting people, educating the public, creating support, and improving the image of the project stakeholders, sponsors, and community.

VALUE ENGINEERING RECOMMENDATION

PROPOSAL NO.: R-28

PAGE NO.: of

ORIGINAL CONCEPT — SKETCH



VALUE ENGINEERING RECOMMENDATION

PROPOSAL NO.:

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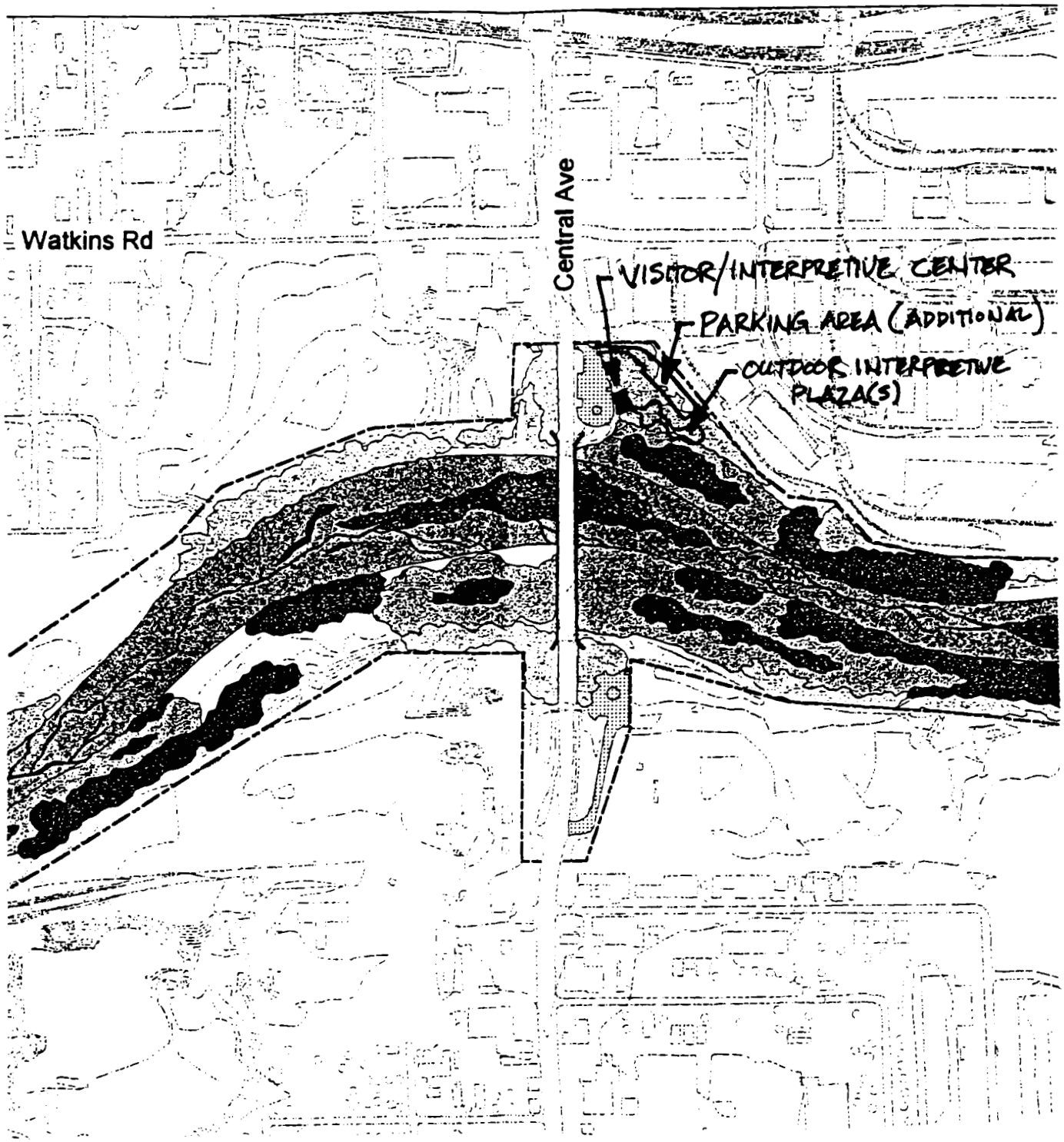
PROPOSED CONCEPT — SKETCH



VALUE ENGINEERING RECOMMENDATION

PROPOSAL NO.: R-28

PAGE NO.: of

ORIGINAL CONCEPT — CALCULATIONS

Table 6.8. City of Phoenix Proposed Recreation Plan - Phoenix Reach

Description	Quantity	Unit Cost	Total
Parking Lots:			
A	130 spaces	$1000/space	$130,000
B	60 spaces	$1000/space	$60,000
C	60 spaces	$1000/space	$60,000
Information Kiosk:			
Large	3	$15,000/each	$45,000
Medium	5	$7,500/each	$37,500
Small	9	$3,000/each	$27,000
Visitor Center / Interpretive Center	5,000 sf.	$110/sf	$550,000
Overlooks with railing:			
Large (1225 sf.)	2	$40,000/each	$80,000
Medium (625 sf.)	5	$20,000/each	$100,000
Small (225 sf.)	9	$10,000/each	$90,000
Shade Structures:			
Large	3	$60,000/each	$180,000
Medium	5	$30,000/each	$150,000
Small	9	$10,000/each	$90,000
Bridges:			
Large (50' span)	2	$50,000/each	$100,000
Medium (30' span)	2	$30,000/each	$60,000
Small (15' span)	5	$15,000/each	$75,000
Restroom Facility	2	$150,000/each	$300,000
Trails:			
Paved Interpretive	84,480 sf	$3.00/sf	$253,440
Stabilized D.G.	126,730 sf	$0.90/sf	$114,050
Graded Earth	464,640 sf	$0.10/sf	$46,500
Ramps	35,000 sf	$2.50/sf	$87,500
Retaining Walls:			
C.I.P	2,000 lf	$150/lf	$300,000
Gabions	2,000 lf	$80/lf	$160,000
Boulders	4,000 lf	$50/lf	$200,000
Demonstration Gardens	4	$125,000/each	$500,000
Outdoor Classrooms:			
Large Formal (30-70 people)	1	$75,000/each	$75,000
Medium Formal (20-40 people)	1	$40,000/each	$40,000
Small Informal (5-15 people)	2	$20,000/each	$40,000
Interpretive Signage / Displays	250	$300/each	$75,000

TD

VALUE ENGINEERING RECOMMENDATION

PROPOSAL NO.: R-28

PAGE NO.: of

ORIGINAL CONCEPT — CALCULATIONS

Table 6.9 Cost-Shared Recreation Plan - Phoenix Reach

Description	Quantity	Unit Cost	Total
Parking Lots:			
A	130 spaces	$1000/space	$130,000
B	60 spaces	$1000/space	$60,000
C	60 spaces	$1000/space	$60,000
Information Kiosk:			
Large	3	$15,000/each	$45,000
Visitor Center / Interpretive Center	Square Feet		
Restrooms/Mech. Room	1,500	$220,000[1]	$220,000
Computer Room	1,000	$192,500[2]	
Interpretive Displays	1,000	$55,000[3]	
Entrance Area	500	$27,500[3]	
Admin Office	1,000	$55,000[3]	
Overlooks with railing:			
Large (1225 sf.)	2	$20,000/each	$40,000
Medium (625 sf.)	5	$10,000/each	$50,000
Small (225 sf.)	9	$5,000/each	$45,000
Shade Structures:			
Large	3	$60,000/each	$180,000
Medium	5	$30,000/each	$150,000
Small	9	$10,000/each	$90,000
Bridges:			
Large (50' span)	2	$50,000/each	$100,000
Medium (30' span)	2	$30,000/each	$60,000
Small (15' span)	5	$15,000/each	$75,000
Restroom Facility	2	$150,000/each	$300,000
Trails:			
Paved Interpretive	84,480 sf	$3.00/sf	$253,440
Stabilized D.G.	126,730 sf	$0.90/sf	$114,050
Graded Earth	464,640 sf	$0.10/sf	$46,500
Ramps	35,000 sf	$2.50/sf	$87,500

[1] Cost Shared Recreation Feature

[2] Primary Restoration Project Purpose & Cost Feature

[3] 100% Non-Federal Cost

JD

VALUE ENGINEERING RECOMMENDATION

PROPOSAL NO.: R-28

PAGE NO.: of

PROPOSED CONCEPT — CALCULATIONS

	Quantity	Unit Cost	Total
Visitor/Interpretive Center:	5,000 s.f.	$110/s.f.	$550,000
Outdoor interpretive plaza(s)	5,000 sf.	$ 16	80,000
Outdoor amphitheatre	1,600 sf	$ 25	40,000
Interpretive exhibits	16	$3,000	48,000
Shade structures - small	4	$10,000	40,000
Additional parking	60 spaces	$1,000	60,000

VALUE ENGINEERING RECOMMENDATION

PROPOSAL NO.:

PAGE NO.: of

COST SAVINGS ESTIMATE

		Original Concept		Proposed Concept	
Item	Unit Cost	Quantity	Total	Quantity	Total
VISITOR INTERPRETIVE CENTER	110	5000	550,000	5000	550,000
OUTDOOR INTERPRETIVE PLAZA(S)	16			5000	80,000
OUTDOOR AMPHITHEATRE	25			1600	40,000
INTERPRETIVE EXHIBITS	3000			16	48,000
SHADE STRUCTURES - SMALL	10,000			4	40,000
ADDITIONAL PARKING	1000			60	60,000
SUB-TOTAL W/OUT MARKUPS			550,000		818,000
MARKUP @ 76.19%			419,045		623234
TOTALS			969,000		1,441,000
NET SAVINGS					(472,000)

All costs from project MCACES Report and MCACES Database except if noted below:

1.

2.

VALUE ENGINEERING RECOMMENDATION

PROPOSAL NO.:

PAGE NO.: of

LIFE CYCLE COST ANALYSIS

LIFE CYCLE PERIOD ____ YEARS ANNUAL PERCENTAGE RATE = ____ %

INITIAL COSTS	PRESENT DESIGN (PRESENT WORTH)	PROPOSED DESIGN (PRESENT WORTH)
Base Cost		
SUB-TOTAL		

SINGLE EXPENDITURE	YEAR	PRESENT WORTH FACTOR	PRESENT DESIGN		PROPOSED DESIGN	
			ESTI-MATE	PRESENT WORTH	ESTI-MATE	PRESENT WORTH
Salvage						
SUB-TOTAL						

ANNUAL EXPENDITURE	YEARS	PRESENT WORTH FACTOR	PRESENT DESIGN		PROPOSED DESIGN	
			ESTI-MATE	PRESENT WORTH	ESTI-MATE	PRESENT WORTH
O&M						
Energy						
SUB-TOTAL						
TOTAL PRESENT WORTH						
LIFE CYCLE SAVINGS						

DESIGN SUGGESTIONS

DESIGN SUGGESTION

PROPOSAL NO.: C-32

PAGE NO.: of

DESCRIPTION: Incorporate flowing water features on the terraces to distribute the water

The vegetation on the terraces will be watered using an irrigation system. Most of the public use will be on the terraces. By adapting landform, such as, small raised areas and by using cross-terrace flows, small flowing water features can be incorporated in the trail and interpretive system to introduce the flowing water habitat.

DESIGN SUGGESTION

PROPOSAL NO.: I-20
PAGE NO.: of

DESCRIPTION: MANAGE VECTORS USING NATURAL PREDATORS

THE INCLUSION OF PREDATORS INTO A COMPREHENSIVE VECTOR CONTROL PROGRAM OFFERS SEVERAL ADVANTAGES. SMALL MAMMALS AND RABBITS SUCH AS MEADOW VOLES, MICE, & RATS ARE ATTRACTIVE PREY FOR RAPTORS.

SIMILARLY, INSECT EATERS SUCH AS SWALLOWS, ARE A USEFUL AND HIGHLY ATTRACTIVE ADJUNCT TO Bti OR OTHER MOSQUITO CONTROL MEASURES.

THE PRACTICE CAN BE INCLUDED INTO PUBLIC EDUCATION PROGRAMS TO ILLUSTRATE THE IMPORTANCE OF PREDATOR-PREY RELATIONSHIPS.

DESIGN SUGGESTION

PROPOSAL NO.: M-33

PAGE NO.: of

DESCRIPTION: Use applied geomorphic analysis to define channel configurations

Although the study of how moving water shapes the land is ancient, fluvial geomorphology has been defined as a discipline in recent decades. Historically, geomorphologists documented the behavoir of a river system. They used documented behaviors of river systems to develop quantitative relationships. More recently the relationships discovered by the science are being applied to predict the behavior of river systems over time.

Applied geomorphology is an outgrowth of traditional river engineering. Applied geomorphology, however, works with the natural forces rather than attempting to overcome them. Geomorphology can be used to determine the most stable alignment for the low flow channel as well as the appropriate depth and cross-sectional configuration. Other critical features that should be sited by geomorphic principles include pools and riffles, islands and the size, shape and location of terrace features including trails and access roads.

By using the predictive ability of geomorphic principles to determine geometry, the project can reduce losses to both plants and landforms thereby substantially lowering O&M costs as well as avoiding disturbance of the aesthetic quality of the project.

Restoration projects can benefit from understanding similar natural systems. Since the Salt no longer functions as a perennial river in the Southwest, different models may be necessary. As an example, rather than attempting to model the Salt River as a western river with regulated flows, it may be more appropriate to use an alpine river in a temperate climate as the model. If the quantity of flow and geometry and materials of the channel are similar, the discharges may best be modeled as the flow of rapid spring melts.

The selection and application of the appropriate geomorphic model will materially enhance the value and stability of this project.

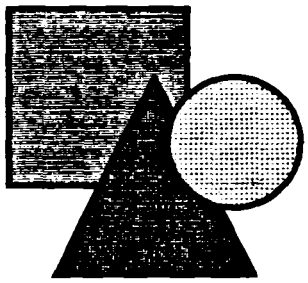
DESIGN SUGGESTION

PROPOSAL NO.: M-96

PAGE NO.: of

DESCRIPTION: Use micro-modelling to predict sediment transport and effects on Low Flow Channel.

Micromodeling for sediment transport is becoming a powerful tool. The team is concerned that the low flow channel may fill with sediment as a result of falling floodwaters. The team contacted Rob Davinroy of the St. Louis District of the Corps and briefly discussed our concerns. Mr. Davinroy roughly estimated a cost of $70,000 to predict sediment transport, predict rate of infill and to model preventive measures to control sedimentation of the channel.



MICRO MODELING **is physical sediment modelling on an extremely small (Micro) scale. The simulated hydrographic/sediment response of any alluvial system, including detailed engineering analysis, is conducted in a table top flume.**

MICRO MODELING IS QUICK. **Because of the micro scale, the time increment required for the simulation of the hydrographic/sediment response of the prototype can be accomplished in just a few short minutes. As a result, a complete, calibrated micro model study incorporating a variety of design plans can be achieved quickly.**

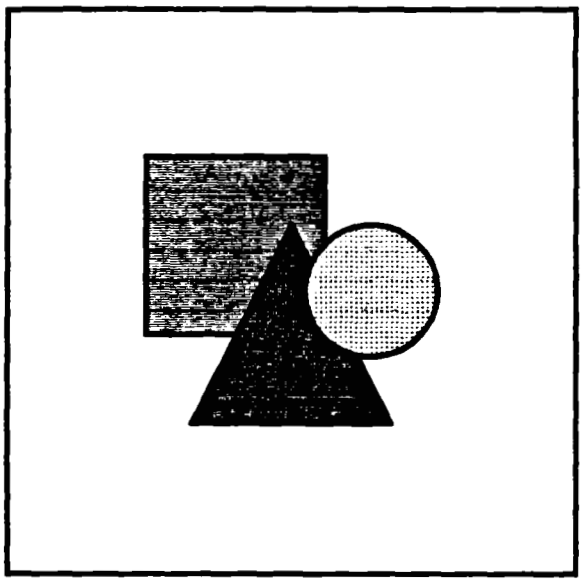
MICRO MODELING IS QUALITATIVE. **The micro model can qualitatively predict the average expected sediment response of the prototype. Future trends may then be examined. Engineers may also gage the effectiveness of various structural design alternatives placed in the prototype.**

MICRO MODELING IS INEXPENSIVE. **A complete micro model study, including detailed bathymetric surveys, flow visualization, etc., usually costs no more than $50,000 to $60,000. This could be the controlling factor for extending confidence to the engineer in the pursuit of the most cost effective design implementation.**

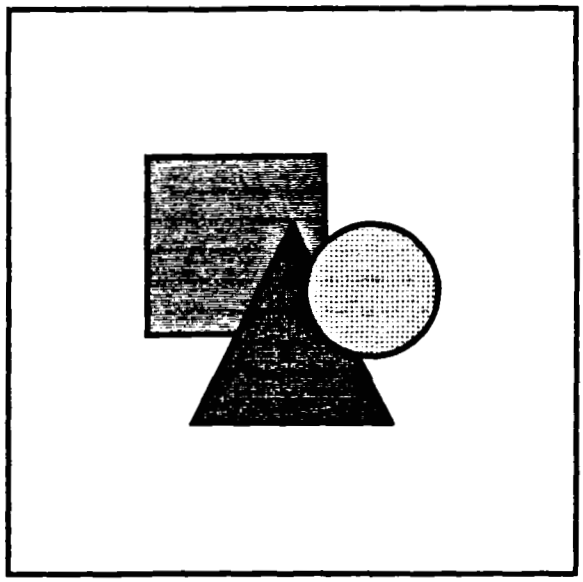
MICRO MODELING IS VISUAL. **The engineer may use the micro model as a visual communication tool, explaining the complex phenomena of sediment transport to others, including both professionals and non professionals!**

Applications:

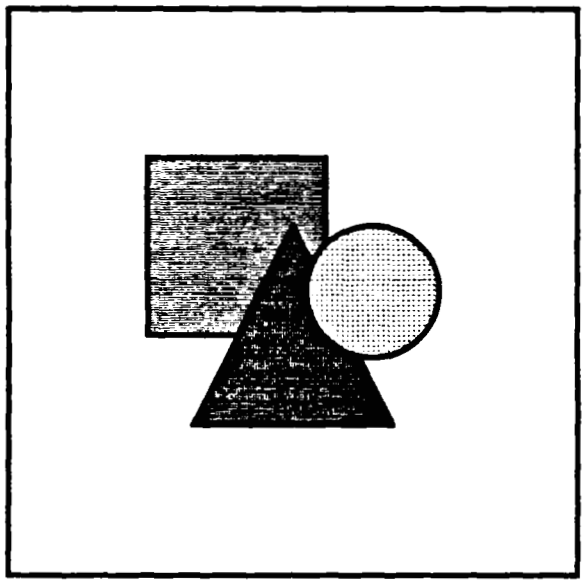
- Major River Navigation Design Including Dikes and Revetments
- Dredging Studies: Dredging Rate, Trends, Disposal Impacts
- Small River Design, Stabilization, Bridge Scour Studies
- Geomorphic Studies: Meandering, Aggradation and Degradation
- Flow Visualization
- Educational Studies



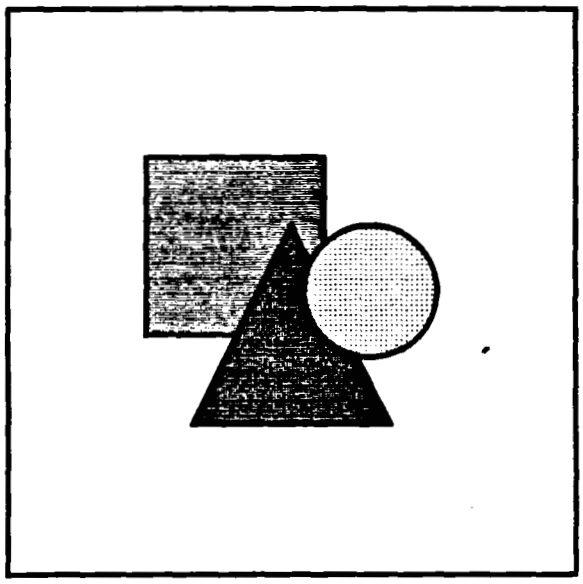
Close-up of Model Insert and Sedimentation in Divided Flow. Mississippi River, New Madrid, Missouri



Flow Visualization Technique on Environmental Design Alternatiive. Sante Fe Chute Micro

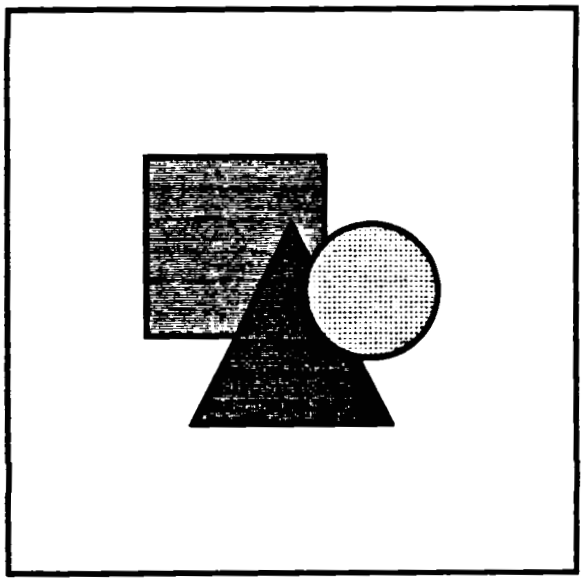


Bathymetric Survey of Sante Fe Chute Micro Model. Mississippi River

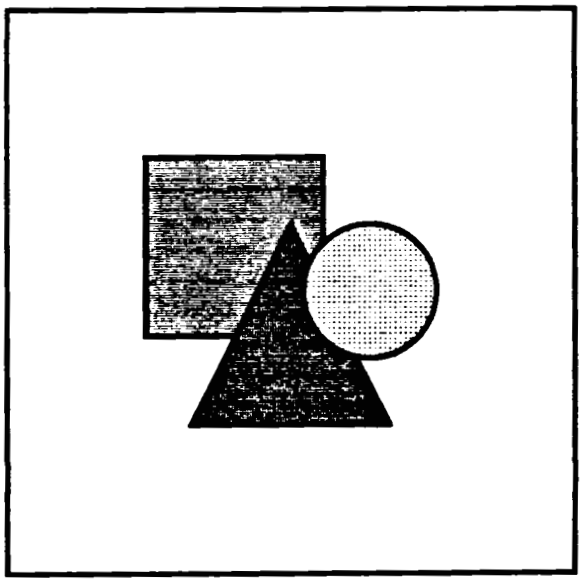


Micro Model Calibration. Comparison with the Prototype. Big Creek . Lincoln County Mo.

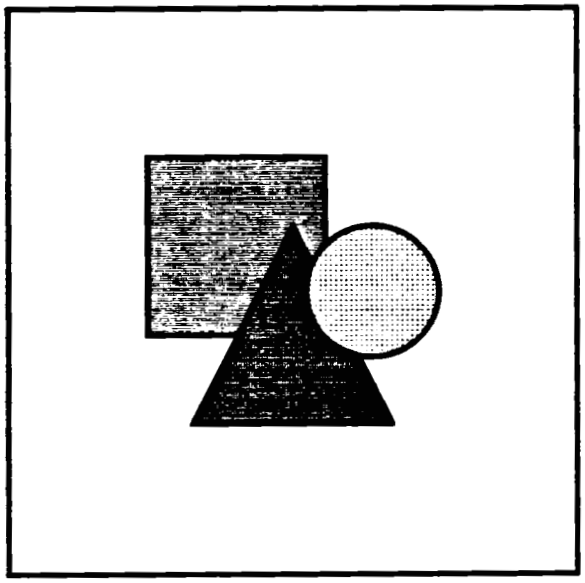
Some Past Micro Model Studies:



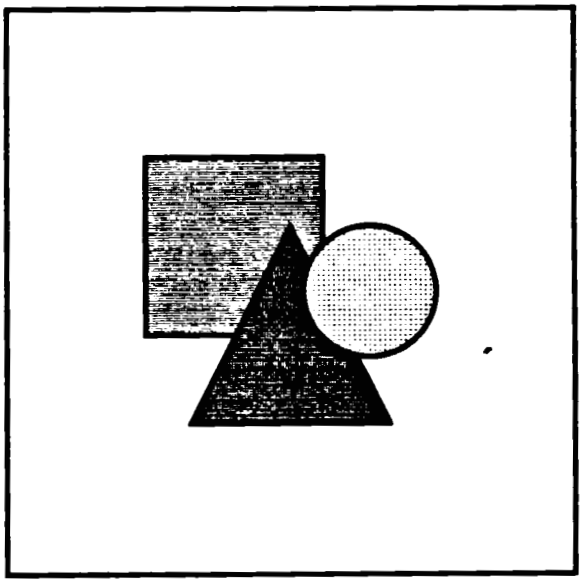
Mississippi River. Sante Fe Chute. Environmental Study of Side Channels. 1996



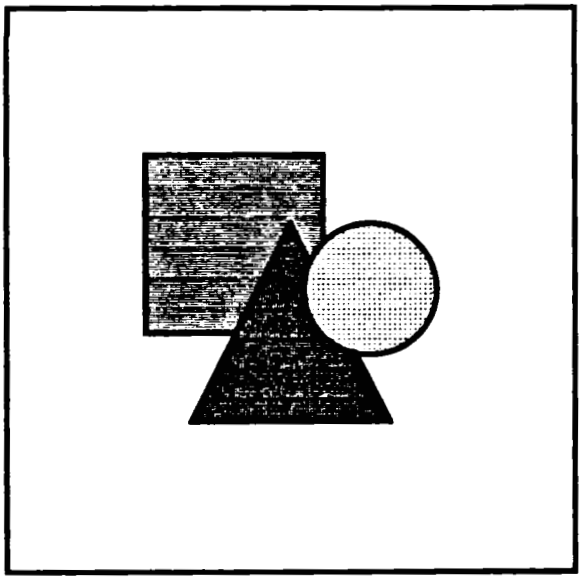
Mississippi River. Schenimann Chute. Environmental Study of Side Channels, 1996



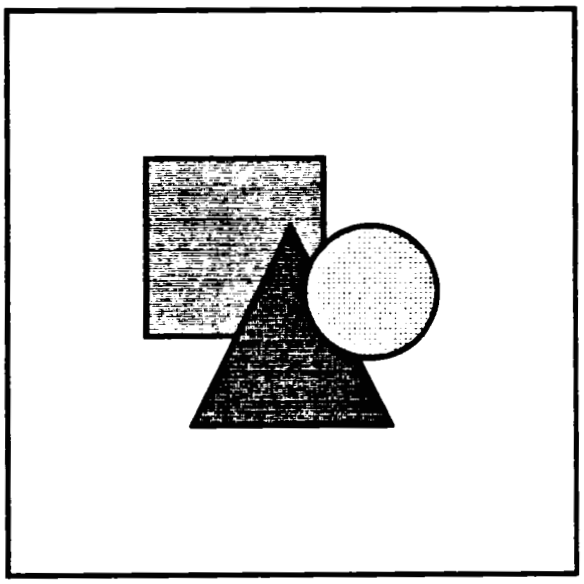
Big Creek Lateral and Channel Erosion Study at Highway Bridge 729 Lincoln County. Mo. . 1996



Mississippi River. New Madrid Bend Navigation Study of Main Channel. 1985



If you have any comments or questions regarding this homepage, please contact
hetrick@smtp.mvs.usace.army.mil

This page has been accessed  times.

DESIGN SUGGESTION

PROPOSAL NO.: M-98
PAGE NO.: of

DESCRIPTION: USE HEC-18 ANALYSIS TO BETTER DETERMINE SCOUR AT BRIDGES.

THE PROPOSED PROJECT WILL EXCAVATE A LOW FLOW CHANNEL BENEATH THE BRIDGES. ISLANDS ARE ENVISIONED BENEATH BRIDGES WITH COLLECTOR LEVEES CONSTRUCTED UPSTREAM OF THE BRIDGES. THESE IMPROVEMENTS CREATE POTENTIAL PROBLEMS INCLUDING:

a) LOSS OF PILE LATERAL SUPPORT
b) LOSS OF PILE FRICTIONAL RESISTANCE CAPACITY.
c) LOSS OF CHANNEL CONVEYANCE WILL PUSH VELOCITIES TOWARD CRITICALITY.
d) ISLANDS PUSH FLOW TOWARD THE ABUTEMENTS.

THE HEC-6 ANALYSIS DOES NOT PROVIDE THE DETAILED INFORMATION NEEDED TO DETERMINE SCOUR POTENTIAL AT THE BRIDGE CROSSINGS. A MORE DETAILED ANALYSIS IS WARRANTED AT THIS TIME AS SOME BRIDGES DO NOT HAVE DEEPLY EMBEDDED

DESIGN SUGGESTION

PROPOSAL NO.: M-78
PAGE NO.: 2 of

DESCRIPTION:

PILES (CENTRAL AVE BRIDGE PILES HAVE LESS THAN 40 FEET OF EMBEDMENT).

THE HEC-18 STUDY WILL EVALUATE

a) WATER SURFACE ELEVATIONS
b) LONG-TERM AGGRADATION OR DEGRADATION
c) PLANFORM CHANGES
d) CONTRACTION SCOUR
e) LOCAL PIER SCOUR
f) LOCAL ABUTMENT SCOUR.

Design Suggestion

P-20 Have an emergency response plan in case of contamination

The project is an exceptionally valuable public and ecological asset. Accidental contamination of the site or other potentially catastrophic event could seriously damage both people and wildlife. A disaster response plan for this site would cover a broad range of topics and contingencies. Some of the areas worthy of consideration are listed below:

- Spill response - Several major bridges cross the project and events such as a container truck accident are a real possibility. The response to an accident or other spill for this project differs from a standard HAZMAT response in several important respects. These include strategies for containment of spilled material, evacuation of people from the area, retrieving and potentially treating injured wildlife, removal of contaminated vegetation and soils with minimal disturbance to the ecosystem, ecologically sensitive remediation strategies, revised monitoring plans, and contingency plans for limiting public access to the reach. Valuable local partners include wildlife medicine experts, hazardous material specialists and local industries with specific expertise in response planning. Neighboring industries with a potential for spills are particulary important partners in the planning process.

  Features should be built into the project design that allow rapid response and access to areas at regular intervals throughout the site for spill containment and other emergencies. Maintenance access ramps should be located and designed with these considerations. Access to the bottom of the low flow channel and the ability to cutoff or contain flows is important for containing flowing hazardous materials.

- Other emergencies - Fires, disease, infestation, human safety considerations suggest a need to identify types of emergency response materials that need to be available on site or available on short notice. Examples include staging areas containing response equipment and supplies, alternate sources of water for increasing flow or suppressing fires, a series of shutoff valves. Disease or infestations can sweep quickly through plant and animal communities. To some degree these are natural processes and the managers of the project may choose to let the disease run its course. Regardless of the degree to which the the project managers choose to be intervene, a strategy for managing the problem, criteria for intervention and a method of communicating the response to the public are indicated.

DESIGN SUGGESTION

PROPOSAL NO.: P-48

PAGE NO.: of

DESCRIPTION: Require adjacent land use to adhere to habitat protection techniques

Restoration projects are often threatened by other activities in the watershed. It is not uncommon for government to restrict activities in the watershed to protect its investment. Methods commonly employed include: enacting new laws, enforcing old laws, zoning, community development plans, landscape ordinances, etc.

For this project we recommend considering the following:

low impact lighting techniques for protecting wildlife

methods to prevent bird impact on glass or reflective surfaces

control of pets, feral cats, etc.

landscape ordinances to prevent introduction of invasive or exotic plants

noise controls

minimizing production of litter, such as take-out food containers

RP

DESIGN SUGGESTION

PROPOSAL NO.: P-55
PAGE NO.: of

DESCRIPTION: Formalize active management plan for the project area.

A comprehensive management plan should be developed for the project ~~in~~ that identifies and guides management of the natural resources and public use of the area. This will be important ~~because of the sensitive resources of the site and ensuring because the site's sensitive resources~~ because of the site's sensitive resources located in a highly urbanized area. A comprehensive management plan, developed through close coordination between ~~stakeholders and community~~ agencies and ~~the~~ community interest groups, would serve to ~~guide~~ protect the ~~site~~ project area's ~~sensiti~~ natural resources; enhance the experience of users; ~~and~~ guide development of design features; ~~and~~ protect the health, welfare, and safety of the public; and identify implementation techniques, phasing, and costs. The following elements ~~should be~~, along with other elements identified during ~~the~~ development of the management plan, should be included:

- vegetation management
  - habitat management, including sensitive plant and habitat protection

JD

DESIGN SUGGESTION

PROPOSAL NO.: P 55

PAGE NO.: of

DESCRIPTION:

- replacement planting and habitat restoration
- ~~exotic~~ control of invasive, noxious, exotic vegetation
- vegetation monitoring
- fire ~~mans~~ and fuel management

• wildlife management
- sensitive habitat protection
- control of animals that may present a public health threat
- control of feral ~~and~~, domestic, and nuisance animals (e.g., feral cats)
- wildlife monitoring
- vector control

• hydrology, water quality, and erosion management
- drainage facilities monitoring and operations
- water supply system operations
- flood management
- erosion control and management
- water quality monitoring and management

VD

DESIGN SUGGESTION

PROPOSAL NO.: P-55
PAGE NO.: of

DESCRIPTION:

- public use management
  - access control
  - maintenance and operation of recreation and interpretive facilities and programs
  - public use and safety management
  - ADA compliance
  - emergency access
  - visual quality and design development

DESIGN SUGGESTION

PROPOSAL NO.: P-69

PAGE NO.: of

DESCRIPTION: Provide seasonal closure of sensitive breeding habitat.

In order to better protect wildlife habitat and wildlife values, it may be necessary to have the capability for seasonally closing sensitive habitat areas, particularly during the breeding season. Structural methods for closure (e.g., fences and gates) would probably not be appropriate or effective given the potential storm-flow conditions. Non-structural techniques, such as signs ~~and~~, educational materials, and friendly policing by maintenance staff and rangers would be most effective for this area.

VD

DESIGN SUGGESTION

PROPOSAL NO.: R-2

PAGE NO.: of

DESCRIPTION: Provide ethnobotanical habitat ~~interpretive~~ areas.

Ethnobotanical interpretive areas should be provided in the project design as one method of improving public awareness and knowledge of local plants and people's relationships with them. ~~These~~ Ethnobotanical information could be interpreted as part of demonstration gardens or specific interpretive exhibits and areas. Areas could be planted emphasizing cultural uses of native Sonoran Desert plants. Examples include agaves for food, fiber, and beverage; mesquite for ~~medicine and~~ food; and creosote bush for medicine. Agricultural applications of native desert plants may also be emphasized (e.g., melons, jojoba, and corn). Modern as well as historical uses could be identified. Partnerships could be developed with local cultural groups, ~~could be developed~~ schools, and ~~and~~ educational and environmental organizations to develop and maintain exhibits and areas. Development of ethnobotanical interpretive areas could help build and strengthen community partnerships and increase public awareness and knowledge of people relationships with their environment. Benefits would also include improved protection of habitats within the project area.

JD

DESIGN SUGGESTION

PROPOSAL NO.: R-32
PAGE NO.: of

DESCRIPTION: Provide a Kinder Habitat Program

The Rio Salado Project has enormous potential for ~~an~~ hands-on instruction for small children regarding the intricate functions and interactions of a desert riparian habitat. The VE Team suggests that the design be conducted with consideration for alternatives for education of young children. Specific attention should be given to the following concepts:

1. allow space near the visitor / interpretive center for development of a shaded kinder habitat;
2. the kinder habitat should focus on visuals and items that the children could touch and "investigate;"
3. "play and learn" concept should be emphasized;
4. a Docent Program with emphasis toward inclusion of ~~young~~ activities / demonstrations for young children;
5. integration ~~of~~ with an ethno-botanical interpretative area, if implemented; ~~show~~
6. coordination ~~+~~ / organization of kinder festivals; and
7. providing sufficient and appropriate children's facilities, such as bathrooms; potable water.

DESIGN SUGGESTION

PROPOSAL NO.: G-1
PAGE NO.: of

DESCRIPTION: Design for Consideration of Entire 33+ Mile Area

The present Rio Salado Project plan includes solely the Tempe Reach and 5 miles of the Phoenix Reach. The entire ~~project length~~ study reach is 33 miles, and appears to have support of the Federal government. The remainder of the project would be constructed in subsequent phases.

The VE team suggests that the entire 33-mile length be included in the original engineering design. Designing the entire 33-mile length at one time will yield the following benefits:

1. overall design costs will be minimized;
2. the design in reaches that are not included in the present ~~design~~ plan will be functionally integrated with the present plan;
3. the risk of retrofitting parts of the presently-planned reaches, at locations adjacent to future-phase construction areas, will be eliminated; and
4. planning for non-project developments adjacent to the river could proceed without risk of potential losses.

APPENDIX – CONTACT LIST

VALUE ENGINEERING STUDY — SIGN-UP SHEET

RIO SALADO, SALT RIVER, ARIZONA — **SEPTEMBER 14, 1998**

Workshop Introduction Meeting

Name	Firm/Agency	Role	Phone
JOHN ROBINSON	ROBINSON, STAFFORD & RUDE	VE TEAM LEADER	816-220-1105
BILL ZEIGLER	COE	LAD VALUE ENGR.	(213) 452-3747
MUNSELL MCPHILLIPS	INTUITION & LOGIC	TEAM MEMBER BUS SYSTEMS	(314) 963-9581
Robert Prager	Intuition & Logic	Geotechnical/Water Resources	314-963-9581
Keith Lamson	COP Water Services	Water	602-495-3669
WALT KINSLER	COP PARKS DEV'L	HABITAT	602-261-8809
Dinn Stolthus	COP Envo Programs	Environmental	256-5669
Joe Donaldson	Jones & Stokes Assoc.	Environ.	916-737-3000
Rick Rhonds	Moffatt & Nichol Eng.	Construction/Estimating	925-944-5411
Dennis Hall	Errol L. Montgomery & Assoc.	Hydrogeologist	602-948-7747
BILL CHASE	CITY OF PHOENIX	WATER	602-279-6446
Peter Pfonna	City of Phoenix	Planning	602-262-4067

rsr "the value solutions team"

Robinson, Stafford & Rude, Inc.

VALUE ENGINEERING STUDY **SIGN-UP SHE**

RIO SALADO, SALT RIVER, ARIZONA **SEPTEMBER 14, 1998**

Workshop Introduction Meeting

Name	Firm/Agency	Role	Phone
Priscilla E. Perry	COE, LA District	Civil Engineer	213-452-3878
Mike Ternak	" " "	STUDY MGR	(602) 640-2003
Sarah Hall	City of Phoenix	Parks Dept Liasion	602 262-4837
CHRIS MESSER	CITY OF TEMPE	STUDY MNGR	(602)-350-8625
STEVE LOHIDE	LOGAN SIMPSON DESIGN	LANDSCAPE ARCHITECT	602.967.1343
Van Crisostomo	COE, L.A. District	Hydraulic Engineer	213-452-3558
BOB STEIN	MOFFATT & NICHOL	CIVIL ENGR	(562) 426-9551
DAVID LUKESH	COE - Geotech	Geologist	213 452-3577
Roland Wass	City of Phoenix/Tres Rios	Research Project Mngr.	(602) 495-7927
Warren Rosebraugh	Flood Control Dist	Civil Engr.	506-4720
REY FARUG	COE, LA District	Biologist	213-452-3864
[illegible]	Flood Control District Maricopa County	Civil Engineer	(602) [illegible]

rsr "the value solutions team"

Robinson, Stafford & Rude, Inc.

VALUE ENGINEERING STUDY

SIGN-UP SHEET

RIO SALADO, SALT RIVER, ARIZONA

SEPTEMBER 14, 1998

Workshop Introduction Meeting

Name	Firm/Agency	Role	Phone
TOM FERICK	FCDMC	PM/COST	506-4778
TOM RENCHLY	FCDMC	PM/REVIEWS/AUTHORIZATION	(602) 506-8610
DICK PERREAULT	FCDMC	PROJ. DEV./AUTH.	(602) 506-4774

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"the value solutions team"

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APPENDIX - AGENDA

Value Engineering Study

Workshop Agenda — September 14-18, 1998

Rio Salado – Environmental Restoration Project
Salt River, AZ

Monday

8:00 – 9:00	VE Team Orientation
9:00 – 9:15	Introduction
9:15 – 9:30	Corps of Engineers – Project Overview Presentation
9:30 – 9:45	City of Phoenix – Project Objectives, Issues, & Concerns
9:45 – 10:00	City of Tempe – Project Objectives, Issues, & Concerns
10:00 – 10:15	Maricopa County – Project Objectives, Issues, & Concerns
10:15 – 10:30	Break
10:30 – 12:00	Planning & Design Team Presentation of Project
12:00 – 1:00	Lunch Break
1:00 – 4:00	Site Visit
4:00 – 6:00	Project Analysis/Function Analysis

Tuesday

8:00 – 10:00	Function Analysis (continued)
10:00-10:15	Break
10:15 – 12:00	Function Analysis (continued)
12:00 – 1:00	Lunch Break
1:00 – 6:00	Creative Idea Generation

Wednesday

8:00 – 9:00	Creative Idea Generation (continued)
9:00 – 9:45	Evaluation of Ideas
9:45 – 10:00	Break
10:00 – 11:00	Evaluation of Ideas
11:00 – 12:00	VE Recommendation Development
12:00 – 1:00	Lunch Break
3:00 – 4:00	Mid-Point Review with COE, Cities, and County
1:00 – 6:00	VE Recommendation Development (continued)

Thursday

8:00 – 12:00	VE Recommendation Development (continued)
12:00 – 1:00	Lunch Break
1:00 – 5:00	VE Recommendation Development (continued)
5:00 – 6:00	Prepare for VE Team Presentation

Friday

8:00 – 9:00	Prepare for VE Team Presentation (continued)
9:00 – 12:00	VE Team Presentation of Workshop Results

APPENDIX - COST DATA

Detailed Cost Estimate
Tempe Reach Selected Plan

Mob/Demob & Prep Work	$300,000
Mesque Bosque/Upland	$330,000
Cottonwood/Willows	$255,100
Wetland Marsh (incl. Soil Liner)	$376,300
Water Supply (2.85 MGD)	$703,000
24"RCP Gravity Drain	$118,800
Pump & Pipe System	$660,000
36" Conveyance Pipe Line	$672,300
Water Distribution/Irrigation System	$480,700
Operation & Maintenance Roads	$379,000
Sub-Total	$4,275,000
Contingency (20%)	$855,000
Sub-Total	$5,130,000
Planning, Engineering, & Design (PE&D) (7%)	$359,000
Sub-Total	$5,489,000
Supervision & Administration (6.5%)	$357,000
Total First Cost – Construction (Rounded)	**$5,846,000**
Monitoring Plan (1%)	$58,000
Adaptive Management (1%)	$58,000
Real Estate (Including Contingency)	-0-
Total First Cost	**$5,962,000**
Interest During Construction (1 Yr Constr. Period)	$209,000
Gross Investment	**$6,171,000**
Annual Cost (50 Yrs, 7 1/8%)	**$454,000**
Associated Non-Federal Annual Costs	$154,000
Annual OMRR&R (Habitat)	$76,000
Total OMRR&R	**$230,000**
Total Annual Cost	**$684,000**

Detailed Cost Estimate
Phoenix Reach Selected Plan

Mob/Demob & Prep Work	$1,000,000
Low Flow Channel w/ 4 Drop Structures	$23,824,000
Mesque Bosque/Upland	$1,430,000
Cottonwood/Willows	$1,262,700
Wetland Marsh (WM)	$694,300
Design Development Test Habitat	$500,000
Perennial Stream in Low Flow Channel	$54,000
Liner (9 acr of Open Water assoc. w/ WM and 9 acr of Shallow Ponds assoc. w/ LFC)	$365,400
Collector Levees & Outlets	$23,000
Water Supply (5.82 MGD)	
Well Construction & Piping	$4,560,000
Monitoring Wells	$180,000
Well Control Room	$192,500
VOC (Environmental) Treatment	$8,400,000
Water Distribution/Irrigation System	$10,933,000
Operation & Maintenance Roads	$1,000,000
Sub-Total	$54,419,000
Contingency (20%)	$10,884,000
Sub-Total	$65,303,000
Planning, Engineering, & Design (PE&D) (7%)	$4,571,000
Sub-Total	$69,874,000
Supervision & Administration (6.5%)	$4,542,000
Total First Cost – Construction (Rounded)	**$74,416,000**
Monitoring Plan (1%)	$744,000
Adaptive Management (1%)	$744,000
Real Estate (Including Contingency)	$3,714,000
Total First Cost	**$79,618,000**
Interest During Construction (1 Yr Constr. Period)	$2,788,000
Gross Investment	**$82,406,000**
Annual Cost (50 Yrs, 7 1/8%)	**$6,066,000**
Associated Non-Federal Annual Cost	$1,017,000
Annual OMRR&R	$774,000
Total OMRR&R	**$1,791,000**
Total Annual Cost	**$7,857,000**

MOFFATT & NICHOL ENGINEERS

MEMORANDUM/TELEPHONE LOG

TO: ALAN DINGEN FROM: HAYWARD-BAKER JOB NO. 3787-11

PROJECT: PETALUMA FLOOD CONTROL CHANNEL DATE 5-21 1998

SUBJECT: SLURRY WALLS. TEL. NO. 805-933-1331

- DISCUSSED SLURRY WALLS
- SOIL/BENTONITE WALL IS TYPICALLY MOST IMPERVIOUS
- PERMEABILITY =
- PROVIDES NO STRENGTH
- CEMENT/BENTONITE WALL HAS STRENGTHS FROM 15-150 PSI
- LOW STRENGTH HAS PERMEABILITY OF ~ 10^{-6}
- HIGHER STRENGTH INCREASES PERMEABILITY
- PRICES: SOIL/BENTONITE 5-10 /SF
  CEMENT/BENTONITE 10-80 /SF
  CONCRETE DIAPHRAM 50-75 /SF
- RECOMMEND CEMENT/BENTONITE WALL THEN DRIVE PILES AFTER WALL

MOFFATT & NICHOL ENGINEERS

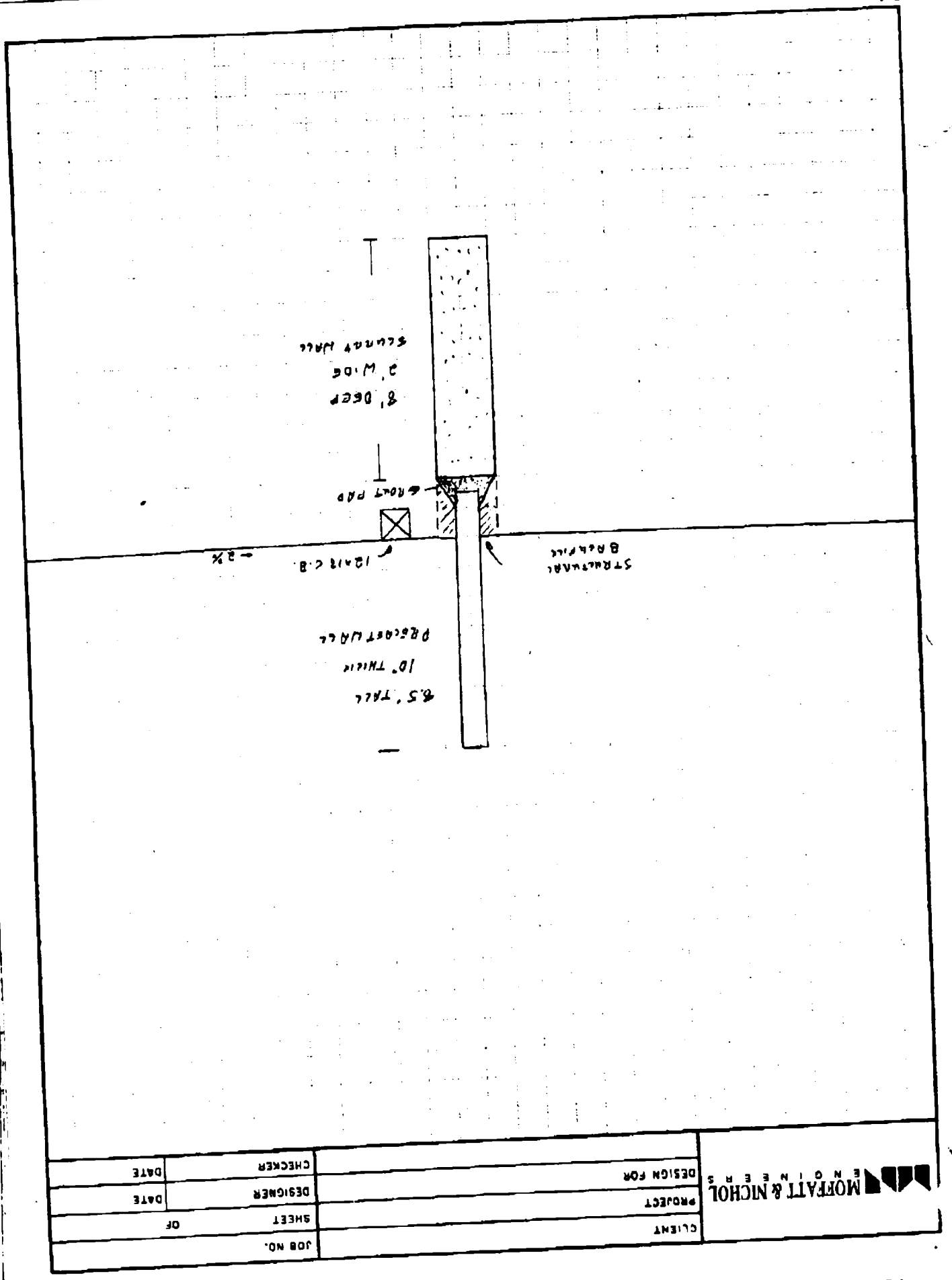
MEMORANDUM/TELEPHONE LOG

TO: OSAMU TAKI FROM: SCC TECHNOLOGY JOB NO. 3989-11

PROJECT: PETALUMA FLOOD CONTROL CHANNEL DATE 5-20 1998

SUBJECT: SLURRY WALLS TEL. NO. 650-592-3435

- DISCUSSED SLURRY WALLS
- CEMENT/SOIL WALLS
- STRENGTHS 400-1000 PSI.
- TYPICALLY 28, 24, 30, 36-IN WIDTHS
- WORKING IN REDWOOD CITY FOR CALTRAIN UNDERPASS
- SOIL MIX W/SINGLE DRILL
- WOULD DRILL SOLDIER PILES TO DEPTH + INSTALL SOLDIER PILE AS SLURRY WALL IS CONSTRUCTED
- 24-INCH WALL IS 8-10/SF FOR 10^{-6} PERMEABILITY
- USE GROUT TO SEAL WALL TO PANEL
- MOBILIZATION IS APPROX. $15K
- NO PRETRENCHING IS REQUIRED, CAN DO IF DESIRED.



MOFFATT & NICHOL ENGINEERS		
CLIENT		
PROJECT		
DESIGN FOR		
JOB NO.	SHEET OF	DESIGNER DATE
		CHECKER DATE

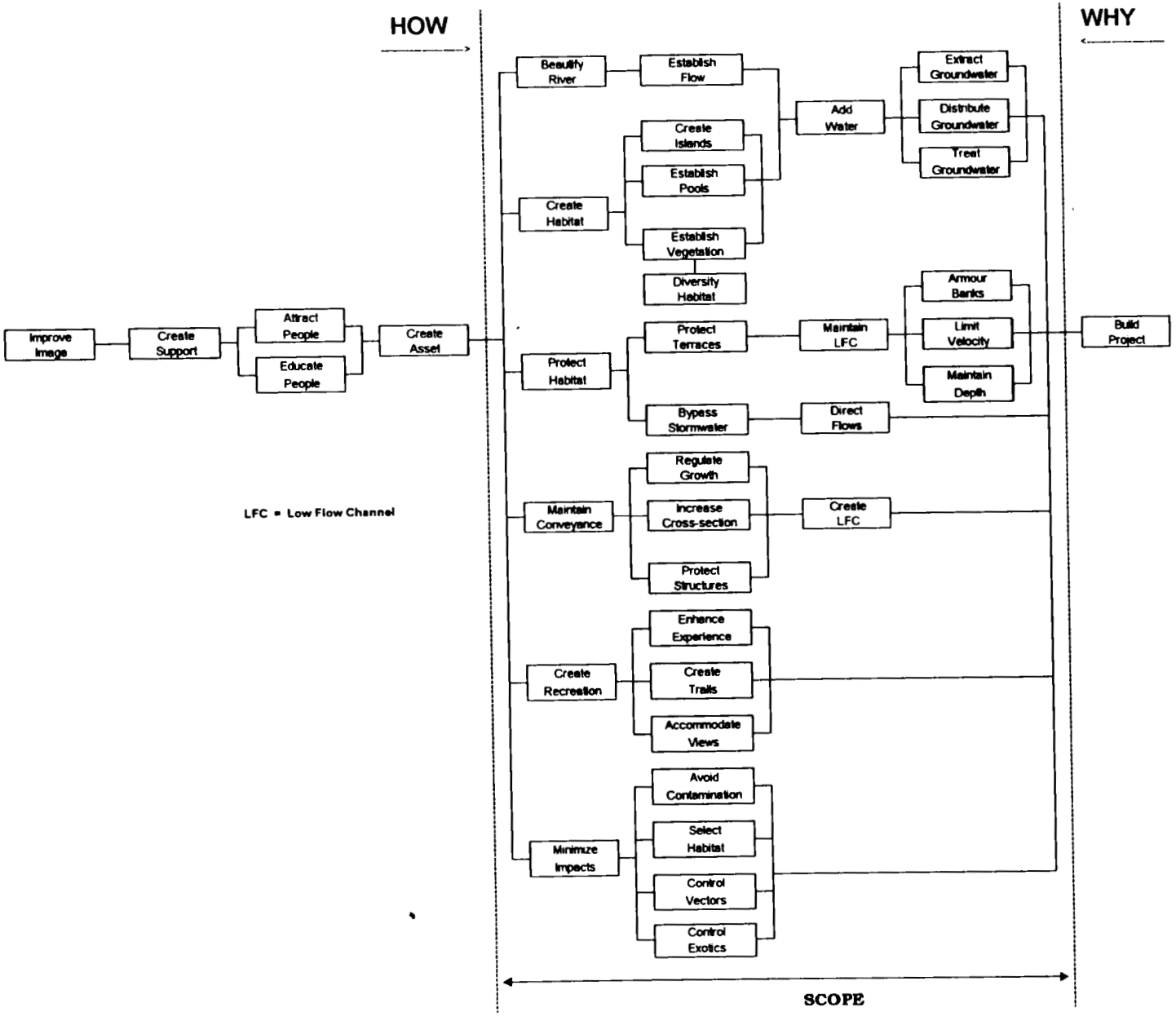
7.125% · COMPOUND INTEREST

	SINGLE PAYMENT		UNIFORM SERIES				
	Compound Amount Factor (CAF)	Present Worth Factor (PWF)	Sinking Fund Factor (SFF)	Capital Recovery Factor (CRF)	Compound Amount Factor (CAF)	Present Worth Factor (PWF)	
N	Given P to Find S	Given S to Find P	Given S to Find R	Given P to Find R	Given R to Find S	Given R to Find P	N
1	1.071	.9335	1.00000	1.07125	1.000	.933	1
2	1.148	.8714	.48280	.55405	2.071	1.805	2
3	1.229	.8134	.31067	.38192	3.219	2.618	3
4	1.317	.7593	.22481	.29606	4.448	3.378	4
5	1.411	.7088	.17346	.24471	5.765	4.087	5
6	1.511	.6617	.13936	.21061	7.176	4.748	6
7	1.619	.6177	.11511	.18636	8.687	5.366	7
8	1.734	.5766	.09703	.16828	10.306	5.942	8
9	1.858	.5382	.08305	.15430	12.040	6.481	9
10	1.990	.5024	.07195	.14320	13.898	6.983	10
11	2.132	.4690	.06294	.13419	15.889	7.452	11
12	2.284	.4378	.05549	.12674	18.021	7.890	12
13	2.447	.4087	.04925	.12050	20.305	8.299	13
14	2.621	.3815	.04395	.11520	22.751	8.680	14
15	2.808	.3562	.03941	.11066	25.372	9.036	15
16	3.008	.3325	.03549	.10674	28.180	9.369	16
17	3.222	.3104	.03206	.10331	31.188	9.679	17
18	3.452	.2897	.02906	.10031	34.410	9.969	18
19	3.698	.2704	.02641	.09766	37.862	10.239	19
20	3.961	.2525	.02406	.09531	41.559	10.492	20
21	4.243	.2357	.02197	.09322	45.521	10.728	21
22	4.546	.2200	.02009	.09134	49.764	10.948	22
23	4.870	.2054	.01841	.08966	54.310	11.153	23
24	5.217	.1917	.01690	.08815	59.179	11.345	24
25	5.588	.1789	.01553	.08678	64.396	11.524	25

7.125% COMPOUND INTEREST

	SINGLE PAYMENT		UNIFORM SERIES				
	Compound Amount Factor (CAF)	Present Worth Factor (PWF)	Sinking Fund Factor (SFF)	Capital Recovery Factor (CRF)	Compound Amount Factor (CAF)	Present Worth Factor (PWF)	
N	Given P to Find S	Given S to Find P	Given S to Find R	Given P to Find R	Given R to Find S	Given R to Find P	N
26	5.986	.1670	.01429	.08554	69.984	11.691	26
27	6.413	.1559	.01316	.08441	75.970	11.847	27
28	6.870	.1456	.01214	.08339	82.383	11.992	28
29	7.359	.1359	.01120	.08245	89.253	12.128	29
30	7.884	.1268	.01035	.08160	96.612	12.255	30
31	8.445	.1184	.00957	.08082	104.496	12.373	31
32	9.047	.1105	.00885	.08010	112.941	12.484	32
33	9.692	.1032	.00820	.07945	121.988	12.587	33
34	10.382	.0963	.00759	.07884	131.680	12.683	34
35	11.122	.0899	.00704	.07829	142.062	12.773	35
36	11.914	.0839	.00653	.07778	153.184	12.857	36
37	12.763	.0784	.00606	.07731	165.098	12.935	37
38	13.673	.0731	.00562	.07687	177.861	13.009	38
39	14.647	.0683	.00522	.07647	191.534	13.077	39
40	15.690	.0637	.00485	.07610	206.181	13.141	40
45	22.135	.0452	.00337	.07462	296.637	13.401	45
50	31.228	.0320	.00236	.07361	424.250	13.586	50
55	44.055	.0227	.00165	.07290	604.282	13.717	55
60	62.151	.0161	.00117	.07242	858.264	13.809	60
65	87.681	.0114	.00082	.07207	1216.572	13.875	65
70	123.697	.0081	.00058	.07183	1722.060	13.922	70
75	174.507	.0057	.00041	.07166	2435.185	13.955	75
80	246.188	.0041	.00029	.07154	3441.234	13.978	80
85	347.313	.0029	.00021	.07146	4860.533	13.995	85
90	489.976	.0020	.00015	.07140	6862.826	14.006	90
95	691.241	.0014	.00010	.07135	9687.589	14.015	95
100	975.177	.0010	.00007	.07132	13672.661	14.021	100

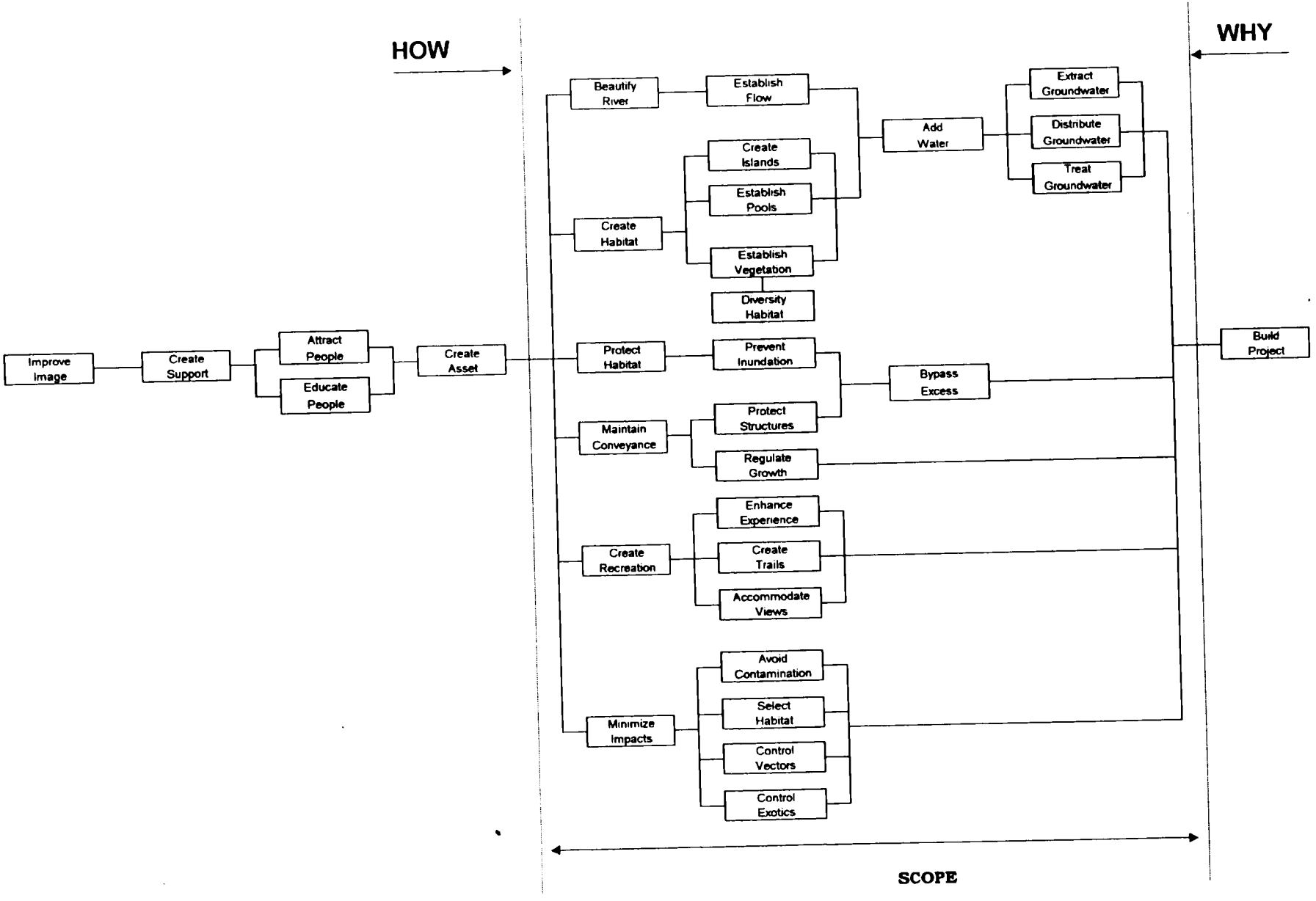
Function Analysis System Technique
DIAGRAM



LFC = Low Flow Channel

PHOENIX REACH

Function Analysis : m Technique
DIAGRAM



TEMPE REACH

APPENDIX - CREATIVE IDEA LISTING

VALUE ENGINEERING TEAM STUDY

PROJECT TITLE: *Rio Salado, Salt River, Arizona (Environmental Restoration Project)*

PROJECT LOCATION: *Phoenix/Tempe, AZ*

CREATIVE IDEA LISTING & EVALUATION

IDEA NO.	DESCRIPTION	VOTES
	MAINTAIN CONVEYANCE	
M-01	Don't plant	0
M-02	Pave low flow channel	5
M-03	Widen river	0
M-04	Deepen river	0
M-05	Cut back growth prior to storm season	3
M-06	Cut back prior to releases	0
M-07	Plant weaker species	0
M-08	Increase slope of low flow channel	0
M-09	Increase slope of main channel	0
M-10	Construct low flow walls with slurry mix and then excavate	2
M-11	Stage the planting – don't plant entire reach at once	4
M-12	Plant low "n-value" species	0
M-13	Plant fake plants and animals	0
M-14	Plant only wetlands	0
M-15	Minimize bends	0
M-16	Extend Town Lake	0
M-17	Increase ponds	1
M-18	Decrease antecedent water content	2
M-19	Construct Phoenix Lake	0
M-20	Change cross section to more hydraulically efficient	0

VALUE ENGINEERING TEAM STUDY

PROJECT TITLE: *Rio Salado, Salt River, Arizona (Environmental Restoration Project)*

PROJECT LOCATION: *Phoenix/Tempe, AZ*

IDEA NO.	DESCRIPTION	VOTES
M-21	Build high flow bypass	1
M-22	Eliminate islands	0
M-23	Widen low flow channel	0
M-24	Increase channel width in restricted areas	1
M-25	Maintain natural low flow channel	1
M-26	Construct grade control structures full-width with notches for low-flow channel	6
M-27	Change Roosevelt regulation	0
M-28	Locate islands to not increase low flow channel velocities	1
M-29	Reduce low flow channel width and line with stainless steel	0
M-30	Build new upstream reservoir for storm flows	3
M-31	Pipe low flow and store some water for later use for the plants	2
M-32	Add hydrodynamic leads/tail (pier nose extensions) on bridge piers	4
M-33	Use applied geomorphic analysis to define channel configuration	DS
M-34	Replace drop structures and use pool and riffle sequence	6
M-35	Install directional vanes instead of islands	0
M-36	Locate vegetation to use as vanes and flow directors	4
M-37	Mine upstream sand/gravel to increase storage	0
M-38	Construct low flow channel with interlocking blocks and eliminate drop structures	2
M-39	Vary cross section of the channel to maintain capacity and eliminate drop structures	0
M-40	Transfer water to another system	2
M-41	Use existing gravel pits for extra storage or improved geometry	1

VALUE ENGINEERING TEAM STUDY

PROJECT TITLE: *Rio Salado, Salt River, Arizona (Environmental Restoration Project)*

PROJECT LOCATION: *Phoenix/Tempe, AZ*

IDEA NO.	DESCRIPTION	VOTES
M-42	Build infiltration and conveyance canals	0
M-43	Reduce irrigation	0
M-44	Irrigate selectively	1
M-45	Induce flood flows to reduce vegetation	1
M-46	Use herbicides to reduce vegetation	0
M-47	Introduce animals to control growth	0
M-48	Introduce herbivores to control growth	1
M-49	Use shade to regulate growth	2
M-50	Harvest plants to control growth	2
M-51	Use removed plants to populate future phases	2
M-52	Harvest plants for nursery stock	1
M-53	Increase low flow and use as a raft ride	0
M-54	Create hydraulically favorable habitats	4
M-55	Selectively remove undesirable plants and reduce removal of desirable plants	0
M-56	Use controlled burns to reduce vegetation	0
M-57	Let public trample down growth	0
M-58	Use less cement and use geogrids for channel stabilization	6
M-59	Eliminate soil cement and build composite revetment of rock/geogrid and plants	2
M-60	Construct low flow using gabions and mats	0
M-61	Plant on slopes and use turf reinforcing	4
M-62	Build downstream removable dam for minimizing initial improvements and maintaining conveyance	0

VALUE ENGINEERING TEAM STUDY

PROJECT TITLE: *Rio Salado, Salt River, Arizona (Environmental Restoration Project)*

PROJECT LOCATION: *Phoenix/Tempe, AZ*

IDEA NO.	DESCRIPTION	VOTES
M-63	Build live levee	2
M-64	Build dead levee	1
M-65	Build removable dams up/downstream and create a lake in the low flow channel	0
M-66	Limit the meander of LFC with cut-off walls	5
M-67	Locate rock (natural) in channel and use as grade control	6
M-68	Lay back slopes in the LFC and use geo-webs with vegetation	4
M-69	Do M-68 with concrete instead of vegetation	0
M-70	Decrease roughness of existing sidewalls and increase flow	1
M-71	Create and "internal" high flow channel with parallel "habitat" low flow	1
M-72	Increase width of flood plain in specific areas by land acquisition	0
M-73	Increase water quality to allow co-mingling of water at Town Lake	4
M-74	Siphon water around Town Lake	1
M-75	Construct inlet at upstream dam on Town Lake and pipe to downstream through the lake (buried)	1
M-76	Do M-75 and don't bury pipe	1
M-77	Take actions to prevent Town Lake from scouring and depositing downstream	0
M-78	Control water build-up upstream of Town Lake by controlling extraction well	1
M-79	Don't protect upstream Town Lake Dam	0
M-80	Route water upstream of Town Lake to existing storm water conveyance pipe	3
M-81	Use existing irrigation canals not used during the winter for storm water	0
M-82	Use groundwater recharge upstream of Town Lake instead of bypass	0
M-83	Increase capacity Granite Reef underground storage and recovery project	0

VALUE ENGINEERING TEAM STUDY

PROJECT TITLE: *Rio Salado, Salt River, Arizona (Environmental Restoration Project)*

PROJECT LOCATION: *Phoenix/Tempe, AZ*

IDEA NO.	DESCRIPTION	VOTES
M-84	Maximize offsite storage of flood water	2
M-85	Limit maximum size of trees to reduce debris on bridges	1
M-86	Line entire river channel to increase velocity	0
M-87	Selectively line river channel where needed	0
M-88	Construct drop structures out of gravel and stone	1
M-89	Construct drop structures out of boulders	6
M-90	Provide seasonal mining contracts to remove material to maintain cross section	3
M-91	Increase levee heights	1
M-92	Increase level and reduce low flow channel	1
M-93	Decrease viscosity of water	0
M-94	Use upstream watershed management plan	0
M-95	Change downstream conditions to lower flooding conditions	0
M-96	Use micro-modeling to predict sediment transport and effects on low flow channel used	DS
M-97	Use 2-D modeling for M-96	2
M-98	Use HEC-18 model to better determine scour at bridges	DS
M-99	Identify reference reach and measure Manning's "n-values"	4
M-100	Research historical records to determine channel configurations	2
M-101	Restore and maintain previous hydraulic connections to the Gila System	1
M-102	Investigate long-term plan data to better project the 100-year event	2
M-103	Decrease plant density	2
M-104	Place LFC excavation in gravel pits for re-mining	0

VALUE ENGINEERING TEAM STUDY

PROJECT TITLE: *Rio Salado, Salt River, Arizona (Environmental Restoration Project)*

PROJECT LOCATION: *Phoenix/Tempe, AZ*

IDEA NO.	DESCRIPTION	VOTES
M-105	Raise LFC to flood terrace more frequently to lower retardance	5
M-106	Build a prototype and measure actual "n-value"	3
M-107	Plant in such a manner that scour areas are pre-determined	4
M-108	Do M-107 for other features such as trails	0
M-109	Build a fuse-plug grade control that fails during the 100-year flood to get conveyance capacity through scour	4
M-110	Use "n-value" for long term flow conditions rather than the flood peak	4
M-111	Support the downstream side of large trees then remove support before floods	0
M-112	Set up control sections for measuring retardance and use adaptive management to modify project design	4
M-113	Determine real control on flow resistance and design for that component	2
M-114	Build new field structures to break away during flood	0
M-115	Aggressively manage growth in the low flow channel	2
M-116	Investigate Town Lake bed as sediment source	2
M-117	Minimize soil cement wall designs	4
	CREATE HABITAT	
C-01	Construct LFC and don't plant anything – provide water on terraces and allow natural population	0
C-02	Increase base flow in LFC to provide moving water habitat and encourage herbaceous vegetation from local sources	5
C-03	Plant project in phases using previous areas as nursery stock	6
C-04	Replace large boxes of plants with cuttings/whips/bare root stock from local sources such as Tres Rios	6
C-05	Import soil	0

VALUE ENGINEERING TEAM STUDY

PROJECT TITLE: *Rio Salado, Salt River, Arizona (Environmental Restoration Project)*

PROJECT LOCATION: *Phoenix/Tempe, AZ*

IDEA NO.	DESCRIPTION	VOTES
C-06	Add water	1
C-07	Evaluate myccorhyza to determine need for soil amendment	0
C-08	Rank the relative importance of water consumptive use versus aesthetic value of plants	0
C-09	Rank the relative importance of water consumptive use versus habitat value of plants	1
C-10	Use adaptive management for planting in phases based on project success	4
C-11	Don't bury the liners	2
C-12	Use wastewater effluent for water source	0
C-13	Use geomorphology to identify locations for islands/pools/vegetation	0
C-14	Use geomorphologic analysis to site riffles for both grade control and habitat for macro-invertebrates and others	2
C-15	Use geotextile for reinforcement of terrace areas to retain plants and reduce density of plants	0
C-16	Locate treated groundwater supply within terrace area as water feature	1
C-17	Do C-16 and incorporate public education	0
C-18	Use renewable energy such as methane from landfill or solar energy for pump	5
C-19	Do C-16 on 100-year flood plain	0
C-20	Use biological system to treat for VOCs, metals, etc.	1
C-21	Create habitats at storm water outfalls and standing water	2
C-22	Plant upstream reach only and use controlled inundation to distribute seed	1
C-23	Use solar for powering pumps	4
C-24	Only armor the base of the LFC and plant the upper portion of the slope	4
C-25	Flatten slope of the low flow channel to reduce shear and plant	2

VALUE ENGINEERING TEAM STUDY

PROJECT TITLE: *Rio Salado, Salt River, Arizona (Environmental Restoration Project)*

PROJECT LOCATION: *Phoenix/Tempe, AZ*

IDEA NO.	DESCRIPTION	VOTES
C-26	Add redundancy to groundwater supply	2
C-27	Put water feature where low flow channel intercepts groundwater	1
C-28	Capture water in gravel pits for use in watering habitat	0
C-29	Slope the slopes of the pools to provide wading and vector control	2
C-30	Increase edge length and diversity	3
C-31	Incorporate the mine reclamation requirements into the habitat plan	0
C-32	Incorporate flowing water features on the terraces to distribute the water	DS
C-33	Supply water at a high elevation to eliminate pressure distribution	1
C-34	Design to minimize mosquito population	1
C-35	Attract mosquito predators	0
C-36	Take advantage of shade features to reduce evapo-transpiration	0
C-37	Provide shade over low flow channel to reduce water temperature and improve habitat value	1
C-38	(not used)	
C-39	Control exotic animals	1
C-40	Control herbivores especially in early development	1
C-41	Plant native vegetation to discourage herbivores	0
C-42	Provide varied topography within the channel	0
C-43	Use hydrophilic products to water replacement plants	DS
C-44	Using a successional approach	0
C-45	Use community volunteers to monitor and plant	2
C-46	Perform additional aquifer analysis to avoid water treatment	0

VALUE ENGINEERING TEAM STUDY

PROJECT TITLE: *Rio Salado, Salt River, Arizona (Environmental Restoration Project)*

PROJECT LOCATION: *Phoenix/Tempe, AZ*

IDEA NO.	DESCRIPTION	VOTES
C-47	Use plants that provide multi-structural canopy	1
C-48	Construct liners without excavating the channels – inject liners	2
C-49	Plant by hydro-seeing	1
C-50	Use aerial seeding in lieu of planting	1
C-51	Plant by hydro-seeding a bonded fiber matrix	0
C-52	Fertilize plants	0
C-53	Determine soil nutrient levels and amend using controlled release products	0
C-54	Plant at appropriate time of year	5
C-55	Use Goulder Paste technology to create liners incorporating seeds and nutrients	3
C-56	Use Goulder Paste technology to provide slope protection	1
C-57	Plant in bottom-less buckets to provide deep rooting	1
C-58	Select appropriate propagule	2
C-59	Post flood, recover vegetation and replant	5
C-60	Use deep injection of nutrients to promote deep rooting	2
C-61	Use local propagule sources	4
C-62	Use engineered plants for flood and draught resistance	0
C-63	Plant the perennial stream bank with indigenous species with low "n-value" and high habitat value	6
C-64	Plant endangered species plants in certain areas	1
C-65	Select plants to maximize wildlife diversity	2
C-66	Place less flood resistant plants downstream of bridges	3
C-67	Create islands with special habitats downstream of bridges	4

VALUE ENGINEERING TEAM STUDY

PROJECT TITLE: *Rio Salado, Salt River, Arizona (Environmental Restoration Project)*

PROJECT LOCATION: *Phoenix/Tempe, AZ*

IDEA NO.	DESCRIPTION	VOTES
C-68	Design shape of planting to be hydraulically stable	6
C-69	Provide open water habitat in the FAA limits and provide falcons for control	1
C-70	Provide falcon habitat	3
C-71	Improve habitat within the FAA limits	1
C-72	Provide non-open water for plant production in the FAA limit area	0
C-73	Use FAA area as a public education area to demonstrate contrast	1
C-74	In the FAA zone, provide native cactus	0
C-75	Do C-73 and C-74 in area near Superfund site	0
C-76	Attract tolerant wildlife species near viewing areas	1
C-77	Establish nesting boxes and roost structure and ensure necessary material is available	1
C-78	In FAA zone, terrace and plant cottonwood willows	0
C-79	Negotiate for Town Lake water in exchange for plantings	1
C-80	Provide link-style golf course in FAA area	1
C-81	Create shore bird habitat	1
C-82	Don't use traditional irrigation	1
C-83	Extend habitat up collection streets and available right-of-way	2
C-84	Design planting and irrigation schemes that progress toward sustainability	1
C-85	Provide endangered species habitat free of raptor predation	0
C-86	Stock pond with alligators	0
C-87	Place wells along storm water collection system then use storm water system for delivery	2
C-88	Identify wastewater sites along route, treat and deliver to river and eliminate	3

IDEA NO.	DESCRIPTION	VOTES
	wells	
C-89	Put planters in low flow channels	1
C-90	Place habitat in low flow channel at stress points to scour out	4
	PROTECT HABITAT	
P-01	Vary size and location of terraces	4
P-02	Vary dimensions of low flow channel	1
P-03	Protect terraces only at stress points	7
P-04	Manage public use to control access	1
P-05	Control the IBW pump to avoid plant inundation	1
P-06	Use vegetation to control public access to sensitive areas	0
P-07	Devise planting plan to shelter and protect weaker species	1
P-08	Monitor groundwater quality	0
P-09	Position habitat areas away from storm water outlets	1
P-10	Provide an energy dissipator at storm water outlets	5
P-11	Armor terraces rather than low flow channel	2
P-12	Use land forms to protect plants on terraces	4
P-13	Protect top of low flow channel	1
P-14	Construct slurry walls around terrace planting areas	1
P-15	Line low flow channel only a short distance downstream of grade control structures	6
P-16	Place planting areas off-line from river for refuge	1
P-17	Alternate discharge from extraction wells to minimize migration of contaminants to the low flow channel	1

VALUE ENGINEERING TEAM STUDY

PROJECT TITLE: *Rio Salado, Salt River, Arizona (Environmental Restoration Project)*

PROJECT LOCATION: *Phoenix/Tempe, AZ*

IDEA NO.	DESCRIPTION	VOTES
P-18	Provide capability to flush wetland areas and ponds	1
P-19	Bypass excess flow from IBW to storm drains	0
P-20	Have an emergency response plan in case of water contamination	DS
P-21	Have a response plan for contaminants coming off bridges (wrecks)	0
P-22	Identify alternate source of water for emergency use	1
P-23	Provide provisions to protect habitat from the receding side of the flood	5
P-24	Provide bio-treatment of storm water outlets	2
P-25	Install debris deflectors	0
P-26	Develop a management plan for identifying and removing harmful materials from the area in conjunction with an education component	0
P-27	Install debris traps at points of entry	2
P-28	Update SWPPP to condition upstream development	0
P-29	Incorporate P-26 in interpretative features	0
P-30	Include recycling collection point in all public access areas	0
P-31	Develop "adopt a river" or streams team programs	5
P-32	Establish community programs to monitor water quality and conduct habitat evaluation	0
P-33	Establish community programs to monitor water quality throughout the urban drainage areas	1
P-34	Adopt advanced farming practice to manage habitat	1
P-35	Use FAA area for active recreation area	2
P-36	Control dogs and other animals in the corridors	1
P-37	Restrict cat ownership near the river area	0

VALUE ENGINEERING TEAM STUDY

PROJECT TITLE: *Rio Salado, Salt River, Arizona (Environmental Restoration Project)*

PROJECT LOCATION: *Phoenix/Tempe, AZ*

IDEA NO.	DESCRIPTION	VOTES
P-38	Build a containment pond downstream of I-10 and maintain	4
P-39	Restrict picnic area	0
P-40	Monitor water quality in ponds	0
P-41	Actively manage habitat health using biological methods for control (beetle, wasps, etc.)	0
P-42	Education program to cover the do-nothing response to an infestation	0
P-43	Develop plan for managing the health of the wildlife	0
P-44	Eradicate invasive species	0
P-45	Develop an active public education about habitat protection	2
P-46	Identify industries that have a spill threat along the storm water collection system	0
P-47	Do P-46 and make the industries a partner in the program	0
P-48	Require adjacent land use to adhere to habitat protection techniques	DS
P-49	Use low impact techniques for protecting wildlife (lighting)	1
P-50	Check insulator length to protect raptors	0
P-51	Monitoring and removing excess salt in the soil	1
P-52	Investigate large glass areas as hazardous to birds	0
P-53	Partner with wildlife rehabilitation experts	0
P-54	Partner with experts to maintain health of system	0
P-55	Formalize active management plan for the project area	DS
P-56	Provide access control along entire reach	0
P-57	Divert a portion of the CAP through this channel	0
P-58	Use reclaimed water	0

VALUE ENGINEERING TEAM STUDY

PROJECT TITLE: *Rio Salado, Salt River, Arizona (Environmental Restoration Project)*

PROJECT LOCATION: *Phoenix/Tempe, AZ*

IDEA NO.	DESCRIPTION	VOTES
P-59	Develop fire breaks in landscape plan	5
P-60	Prioritize habitat areas for selective fire protection	0
P-61	Increase release from upstream in case of fire	0
P-62	Control vegetation as part of fire hazard plan	1
P-63	Locate sensitive habitat near bridges and allow multi-directional attack of fire	0
P-64	Provide onsite staging area for non-toxic fire suppression materials	0
P-65	Locate fire house along reach	0
P-66	Collaborate and hold drills with dire department	0
P-67	Design emergency access points	0
P-68	Provide communication stations along reach	1
P-69	Provide seasonal closure of sensitive breeding habitat	DS
P-70	Create ordinance limit of invasive plants	0
P-70	Use wetland treatment for contaminated pond water (where possible) and return water to system	2
P-71	Install fossil filters in all storm drains to prevent entry of hydrocarbons into stream	0
	MINIMIZE IMPACTS	
I-01	No bungee jumping from bridge	0
I-02	Protect bridges from fire threat	1
I-03	Mitigate bird strike on bridges	0
I-04	Lower speed limit over bridges	0
I-05	Put screens along bridges	0
I-06	Hang flacon shapes	0

VALUE ENGINEERING TEAM STUDY

PROJECT TITLE: *Rio Salado, Salt River, Arizona (Environmental Restoration Project)*

PROJECT LOCATION: *Phoenix/Tempe, AZ*

IDEA NO.	DESCRIPTION	VOTES
I-07	Shield lights	0
I-08	Extract ground water from deeper in aquifer	4
I-09	Clip wings so they can't fly	0
I-10	Selectively remove highly dangerous species	0
I-11	Eliminate access	0
I-12	Post warnings	0
I-13	Limit tree heights	0
I-14	Limit maximum sizes	0
I-15	Actively manage vectors	0
I-16	Conduct contaminant transport model	0
I-17	Place groundwater monitoring wells throughout reach	1
I-18	Decrease size of project	0
I-19	Develop contingency plan if remedial action sites are impacted	1
I-20	Manage vectors, using natural predators	DS
I-21	Provide capability for draining ponds and wetlands	2
I-22	Install slurry cut-off wall at landfill area	4
I-23	Provide soil stabilization measures to reduce erosion	1
I-24	Provide sediment traps from all outfall	2
	CREATE RECREATION	
R-01	Place gazebo on terrace areas	0
R-02	Provide ethnobotanical habitat areas	DS
R-03	Use FAA zone for recreation areas such as golf course	0

VALUE ENGINEERING TEAM STUDY

PROJECT TITLE: *Rio Salado, Salt River, Arizona (Environmental Restoration Project)*

PROJECT LOCATION: *Phoenix/Tempe, AZ*

IDEA NO.	DESCRIPTION	VOTES
R-04	Provide access and large parking area in FAA zone	0
R-05	Place Indian designs on channel walls	0
R-06	Provide an audio tape tour	0
R-07	Provide a receiver/transmitter tour	0
R-08	Provide public access TV information	0
R-09	Radio channel (like airport information channel)	0
R-10	Place view points to maximize viewing area (telescope)	0
R-11	Provide RV parking	0
R-12	Have pull-off areas by bridges	0
R-13	Use remote cameras near sensitive areas	2
R-14	Release fish to simulate spawning	0
R-15	Locate perennial stream to maximize viewing	3
R-16	Provide timber walkways through wetland areas	0
R-17	Pedestrian bridge spanning the River	1
R-18	Provide donation boxes	0
R-19	Encourage environmental recreation groups to participate	1
R-20	Encourage Indian participation	0
R-21	Include classrooms and meeting areas in exhibit area and interpretative center	0
R-22	Develop series of rotating exhibits	1
R-23	Install overhead tramway	0
R-24	Provide adaptive recreation program and accessible trails	2
R-25	Provide docent program	0

VALUE ENGINEERING TEAM STUDY

PROJECT TITLE: *Rio Salado, Salt River, Arizona (Environmental Restoration Project)*

PROJECT LOCATION: *Phoenix/Tempe, AZ*

IDEA NO.	DESCRIPTION	VOTES
R-26	Provide potable water along trails	1
R-27	Provide motorized trams through area	0
R-28	Provide gateway visitor/interpretative center	5
R-29	Add visitor center with gift shop	0
R-30	Provide ADA compliance	0
R-31	Provide culturally diverse programs	0
R-32	Provide a kinder habitat program	DS
R-33	Coordinate with City of Tempe and their Town Lake	0
R-34	Encourage eating establishments along the reach and partner to protect habitat	0
R-35	Provide public transportation to site	0
R-36	Develop an image and marketing program	0
R-37	Design trails and roads to consider geomorphic issues and to minimize losses	4
	GENERAL	
G-01	Design for consideration of entire 33+ mile area	DS
G-02	Create a loop to connect the upstream with the downstream	0
G-03	Use local place-appropriate materials and recycled materials for designed features	0

APPENDIX – LIST OF STUDY MATERIALS

GEOMORPHIC ASSESSMENT OF THE LOWER SALT RIVER, CENTRAL ARIZONA

by

William L. Graf, Patricia J. Beyer, and Thad A. Wasklewicz
Department of Geography
Arizona State University
Tempe, Arizona 85287-0104

for

U.S. Army Corps of Engineers, Los Angeles District
Arizona Area Office, Planning Section C
1636 North Central Avenue, Suite 740
Phoenix, Arizona 85012-1936

Contract DACW09-94-M-0494 Part 2

October 1994

Bob Stein

U.S. Department of Transportation

Federal Highway Administration

Publication No. FHWA-IP-90-017
November 1995

Hydraulic Engineering Circular No. 18

Evaluating Scour at Bridges

Third Edition

Office of Technology Applications, HTA-22
Federal Highway Administration
400 Seventh Street, S.W.
Washington, D.C. 20590

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U.S. Department of Transportation

Federal Highway Administration

Hydraulic Engineering Circular No. 20

Publication No. FHWA-IP-90-014
September 1990 (Draft)

STREAM STABILITY AT HIGHWAY STRUCTURES

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International Erosion Control Association

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Design Procedures for Channel Protection and Streambank Stabilization

Instructor: Carol L. Forrest, P.E.
Vice President
Woodward-Clyde Consultants

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AS ADAPTED FROM THE
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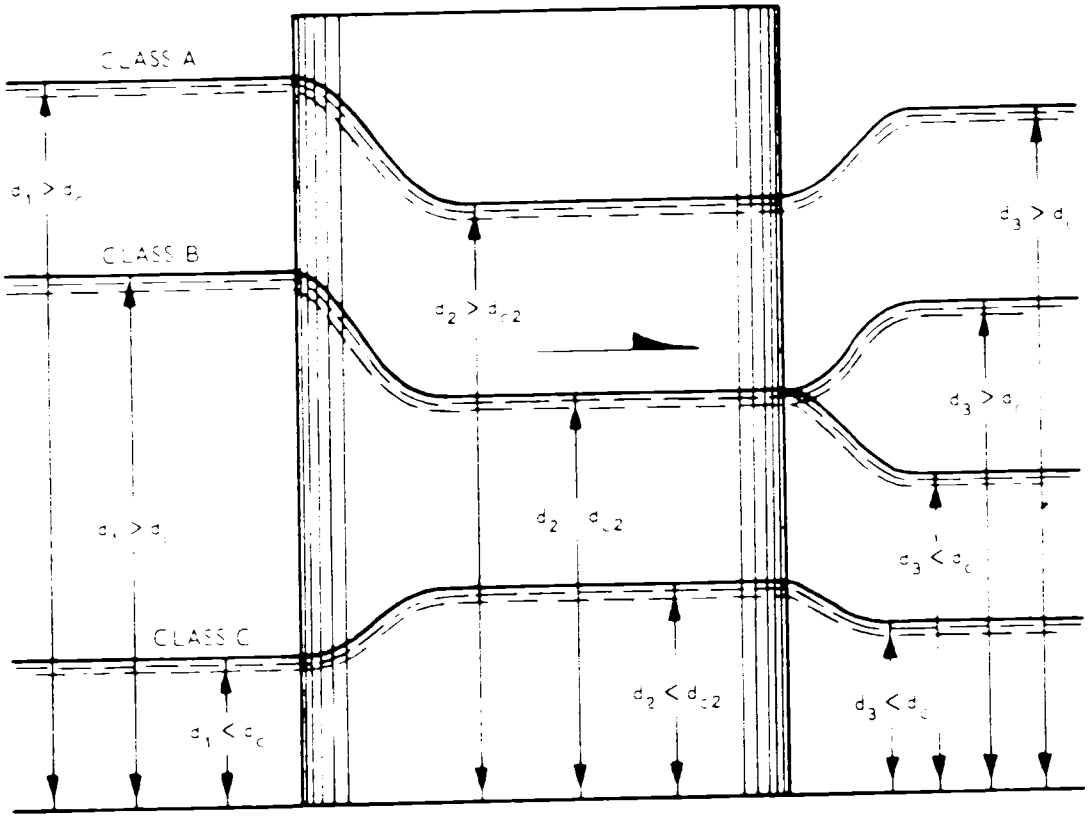

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DAVE ROSGEN
Wildland Hydrology
Pagosa Springs, Colorado

Illustrations
HILTON LEE SILVEY
Western Hydrology
Lakewood, Colorado

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GROUNDWATER QUALITY SURVEY

RIO SALADO HABITAT RESTORATION PROJECT

CITY OF PHOENIX OFFICE OF ENVIRONMENTAL PROGRAMS

D&M Job No. 05370-054-033
October 3, 1997

GROUNDWATER QUALITY SURVEY
RIO SALADO HABITAT RESTORATION PROJECT
CITY OF TEMPE RIO SALADO PROJECT

Registered Professional Engineer (Civil)
CERTIFICATE NO.
24424
JEFFREY W.
OWENS
Date Signed 4-22-98

Prepared for:

City of Tempe
Economic Development, Rio Salado
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Project No. 97-0029A.R01

Geotechnical and Environmental Consultants, Inc.

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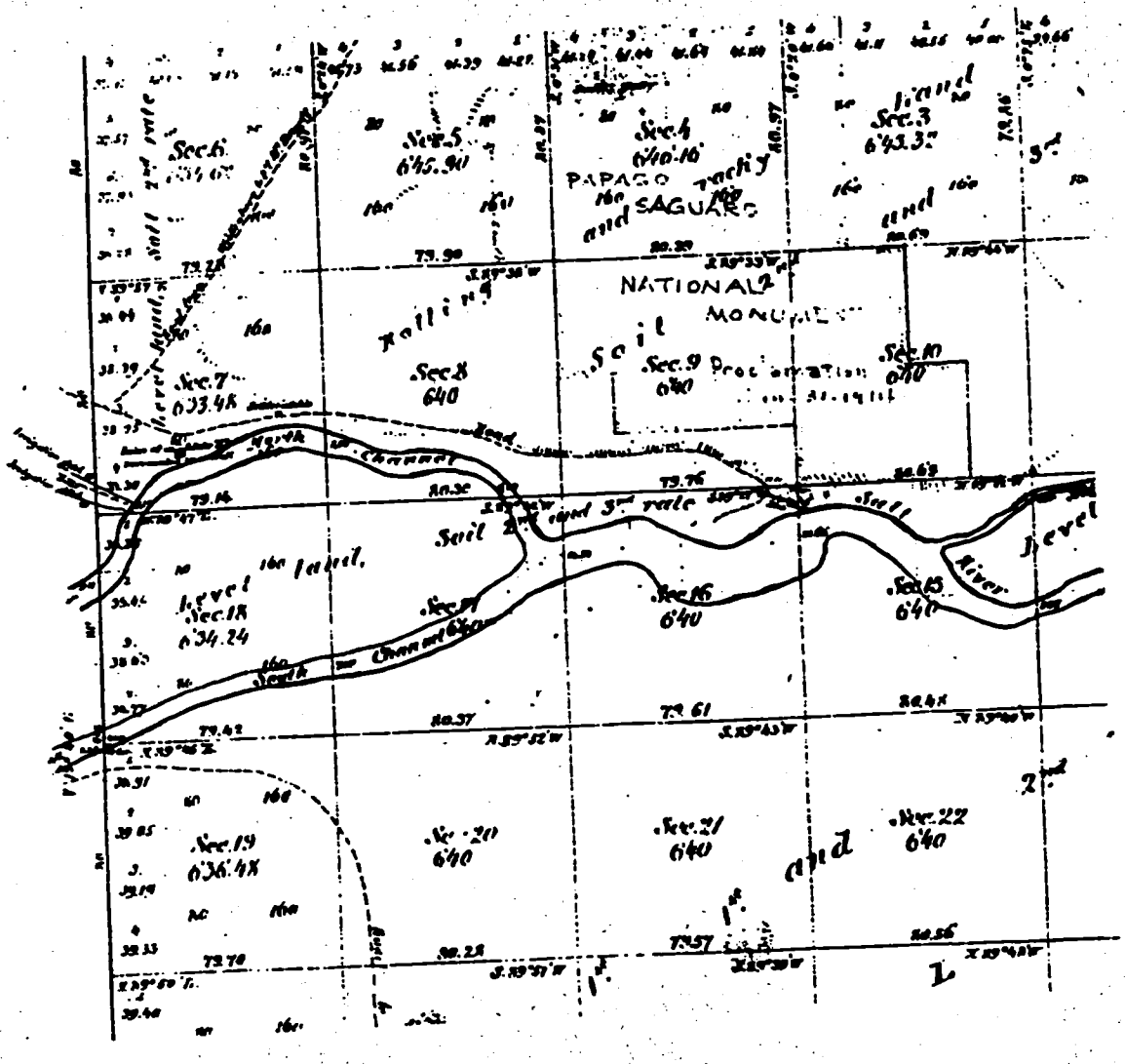

Participants in GPH/GLG 494/598,
Geographic Analysis of Environmental Information

May 1998