Appendix M

Value Engineering Study

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US Army Corps of Engineers ®
Kansas City District

MISSOURI RIVER BED DEGRADATION

VALUE ENGINEERING STUDY

P2# 400367

A value engineering (VE) study was completed for the Missouri River Bed Degradation Feasibility Study at the Kansas City District Office on 1 – 4 April 2014. Findings of the VE study were provided in the Value Engineering Study Summary Report for Missouri River Bed Degradation Alternative Evaluation and Analysis. This report included 10 proposals for consideration by the Missouri River Bed Degradation PDT. These proposals were evaluated by the Project Delivery Team. Of the 10 proposals, 7 are being incorporated as recommended or with modifications into alternatives being evaluated in the Draft Integrated Feasibility Report and Environmental Impact Statement. Based on these results, the VE study was successful.

SPONSOR: ______________________________
Christina Ostrander, PMP
U.S. Army Corps of Engineers
Kansas City District

NWK VEO: ___________________________
Michael Coates, R.A.
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US Army Corps of Engineers ®
Kansas City District

MISSOURI RIVER
BED DEGRADATION

VALUE ENGINEERING
EVALUATION REPORT

P2# 400367

Date of VE Study: April 2014

August 2014

INTRODUCTION

A value engineering (VE) study was completed for the Missouri River Bed Degradation Feasibility Study at the Kansas City District Office on 1 – 4 April 2014. The VE study team was led by Rick Lambert, PE, CVS, USACE RAO. Findings of the VE study were provided in the Value Engineering Study Summary Report for Missouri River Bed Degradation Alternative Evaluation and Analysis. This report included 10 proposals for consideration by the Missouri River Bed Degradation PDT. These proposals were evaluated by the PDT and the results are discussed herein. Of the 10 proposals, 7 are being incorporated as recommended or with modifications into alternatives being evaluated in the Draft Integrated Feasibility Report and Environmental Impact Statement.

PROJECT DELIVERY TEAM

Missouri River Bed Degradation PDT members involved in the evaluation of the proposals in the VE study are provided in Table 1.

Table 1: PDT members who evaluated proposals from the VE study.

PDT Member	Discipline
Christy Ostrander	Project Manager/Plan Formulation
John Shelley	Hydraulic Engineer
Clint Mason	Structural Engineer
Jesse Granet	Environmental Resources Specialist
Pendo Duku	Geotechnical Engineer
Cassidy Garden	Civil Engineer
Chris McGarry	GIS Specialist
Jennifer Henggeler	Economist
Jerry Diamantides	Economist

EVALUATION OF VE PROPOSALS

A summary of the proposals presented by the VE study team is included in Table 2. For more detailed descriptions of these proposals, see the Value Engineering Study Summary Report for Missouri River Bed Degradation Alternative Evaluation and Analysis.

Table 2: Description of proposals provided by VE study team.

Proposal Number	Description
1	Minor Modifications to BSNP Structures
2	Significantly modify the BSNP Structures and "Update the Design Criteria"
3	Build Grade Control Structures
4	Increase River Flow Length and Sinuosity through Restoration of River Channel Cutoffs
5	Construct Small Secondary Side Channels
6	Create a Wider floodway within the flood plain
7	Widen the River Within the Entire Study Reach
8	Roughen the bed of the river to dissipate energy and reduce velocities
9	Place a moratorium on sand and gravel extraction or reduce amount of sand and gravel extraction
10	Curtail Kansas River Sand Dredging

A summary of the evaluation for each of the 10 proposals by the PDT follows:

Proposal 1 – Minor Modifications to BSNP Structures: Proposal 1 was accepted by the PDT for further evaluation in the Draft Integrated Feasibility Report and Environmental Impact Statement. This proposal recommends re-using the excavated rock from measures that would lower dikes and sills to construct other measures, specifically grade control structures. The PDT accepted this proposal and is incorporating an alternative into the feasibility report that includes constructing grade control structures in combination with lowering BSNP structures as recommended. This alternative is being evaluated in the intermediate array of alternatives in the plan formulation process.

Proposal 2 – Significantly Modify the BSNP Structures and "Update the Design Criteria": Proposal 2 was accepted with modifications for further evaluation in the feasibility report. The proposal recommended conducting an analysis of the design and maintenance criteria to see if changes could be made to slow or halt bed degradation. The current design and maintenance criteria are over 40 years old. Some changes recommended for consideration included lowering the elevations of the dikes, shorting lengths of the sills, abandoning of every other dike, and shorting the crossing control structures. It was noted that these modifications would need to be at least partially funded through O&M.

After reviewing the VE Study Summary Report, the PDT developed new measures that would lower the dikes and sills to a greater degree, and over fewer river miles, than initially considered. These changes are more extensive compared to the minor changes identified in Proposal 1. Implementation of this measure would also result in updated design and maintenance criteria in locations where changes to the dikes and sills would occur. These measures are being evaluated as part of the intermediate array of alternatives presented in the

Alternative Formulation Section of the Draft Integrated Feasibility Report and Environmental Impact Statement.

However, based on the VE study team out briefing on 4 April 2014, it was assumed that the geographic scope of the proposal encompassed the entire length of the BSNP in both Omaha and Kansas City Districts. Please note that the PDT used an approach that focused on addressing bed degradation in the locations where it had the potential for greatest economic impacts. This was incorporated as part of the SMART Planning paradigm. Early in the study process, the geographic scope of the study was refined to focus on addressing bed degradation of the Missouri River in the Kansas City metropolitan area, river miles 352 to 411. The Mobile Bed Model was developed specifically to evaluate the effectiveness of alternatives between river miles 458 to 293. This extends beyond the Kansas City metropolitan area in order to evaluate any upstream or downstream affects of potential alternatives. Application of any measures or alternatives recommended in the study to locations outside of the refined geographic scope would require a separate analysis.

Proposal 3 – Build Grade Control Structures: Proposal 3 was accepted by the PDT for further evaluation in the feasibility report. This proposal recommends construction of a series of grade control structures, similar to those presented by the PDT to the VE study team. However, the VE study team recommended giving further consideration to the size, number, configurations, material, timing of implementation, and source of material to constructed grade control structures. Based on these recommendations, the size, location, number, and source of materials are being incorporated into the intermediate array of alternatives presented in the Alternative Formulation Section of the Draft Integrated Feasibility Report and Environmental Impact Statement.

Proposal 4 – Increase River Flow Length and Sinuosity through Restoration of River Channel Cutoffs: This proposal was not incorporated by the PDT for more detailed analysis in the feasibility report. This proposal identified river bends that were cut off from the river during construction of the BSNP. These river bends could be reconnected to the navigation channel to increase the flow length and sinuosity of the river. The PDT evaluated this proposal by examining specific locations in response to the VE Study and found significant costs would be associated with land acquisition, bridge replacement/widening, and BSNP construction. The VE study indicated a total cost benefit of approximately $126,000,000. However, upon further evaluation by the PDT, land acquisition and bridge construction was not included in the evaluation by the VE study. These would most likely consume any cost benefits based on the following assumptions:

- Assumed 30 miles of side channel at 500 foot wide equates to 1818 acres.
- Assumed an average of $6500 per acre equates to approximately $12 million.
- Based on an average historic cost to build a bridge across the Missouri River, assumed $50 million per bridge. There are approximately 4 existing bridges that would be have to be replaced and approximately 4 new bridges would have to be constructed to provide access to the cut off property. This equates to a total of $400 million in bridge construction.

For these reasons, this proposal was not evaluated further.

Proposal 5 – Construct Small Secondary Side Channels: This proposal was not incorporated by the PDT for more detailed analysis. This proposal recommended constructing side channels where practicable rather than just excavating at the bank. The VE Study recommended constructing the side channels to the same specifications required for shallow water habitat under the Biological Opinion. The PDT has determined it is more efficient to widen the river rather than construct small side channels in terms of degradation.

Proposal 6 – Create a wider floodway within the flood plain: This proposal was not incorporated by the PDT for more detailed analysis. This proposal recommended relocating levees and floodwalls landward in order to expand the floodway and reduce flow velocities during floods. The primary means of water conveyance and the highest velocities occur in the channel. In order to change the flow velocity, a change in flow depth for a flood event would be required. A significant amount of floodway would need to be opened for either additional conveyance or floodplain storage in order to change the flood depth. Such a change would require significant floodway modifications and the levees identified for relocation would provide little storage and no flow conveyance because immediately downstream is the Kansas City's Levee System which would constrict flow back to the channel.

However, the PDT has evaluated each of the three levees that were recommended for relocations. The first levee was a non-Federal levee unit that is upstream of Parkville, Missouri. Relocation of this levee unit is technically viable and the PDT concurs with the rough order of magnitude cost estimate provided by the VE study team. However, this would most likely be socially unacceptable. The VE study team also recommended relocating the "Power Plant Levee". However, the PDT has no information that a levee unit exists in this area. The recommendation was to relocate a portion of Fairfax Levee Unit in Kansas City, Kansas. A levee setback at this location would require moving large pump stations, and would impinge on a General Motors assembly plant shipping yards. The shipping yards include product and railroad staging areas, overhead electric track switches, and other pieces of the assembly plants infrastructure. It was assumed that it would be socially unacceptable to relocate major components of one of the region's major manufacturing sites. Based on professional experience, the PDT estimated that it would cost a minimum of $100 million to just relocate pump stations and rail lines. For these reason's this proposal for not evaluated any further.

Proposal 7 – Widen the River within the Entire Study Reach: Proposal 7 was accepted with modifications for further evaluation in feasibility report. It recommended widening the river to the maximum extent practicable within the study reach given the constraints of adjacent infrastructure and potential impacts to the Missouri River Authorized Purposes. The PDT is incorporating measures that would widen the river channel on the inside of bends. The report will document where it is expected that shallow water habitat may develop and contribute to the requirements of the Biological Opinion.

Proposal 8 – Roughen the Bed of the River to Dissipate Energy and Reduce Velocities: Proposal 8 was not carried forward by the PDT for more detailed analysis, but will be revisited if grade control is included in the proposed alternative. This proposal recommended removal of L-heads to increase turbulence, removal of every other dike to increase expansion/contraction losses, shorten dikes on the smooth outside bends, and installation of jacks or concrete boxes on the river bed. Jacks or concrete boxes are typically used to dissipate energy around bridge piers, culvert outfalls, or other isolated, high-energy environments. They are scour prevention measures, not general degradation prevention measures. For jacks or concrete boxes to be successful at slowing general degradation, they would have to cover a very long stretch of river, essentially armoring the river bed in concrete. Both cost and environmental considerations suggest this approach not be applied for overall degradation. However, if grade control structures are included in the tentatively selected plan, concrete jacks or boxes will be considered for toe scour protection.

The average cross-sectional spacing of the mobile bed model (0.5 miles) does not allow modeling modification of individual dike structures (such as every other dike). It does allow modeling of lowering of groups of dike structures. The District does not have a tool to evaluate this alternative, but the more aggressive lowering of all the structures will be evaluated.

Proposal 9 – Place a Moratorium on Sand and Gravel Extraction or Reduce the Amount of Sand and Gravel Extraction: Proposal 9 is being incorporated for further evaluation in the feasibility report. Based on the results of a sensitivity analysis conducted on the preliminary array of alternatives, modifications to commercial sand and gravel dredging are being incorporated as individual measures in the plan formulation process. However, implementing any changes to the permitted levels of sand and gravel mining is outside of the study authority. Incorporating this measure into the plan formulation process is consistent with Regulations for Implementing The Procedural Provisions of the National Environmental Policy Act, Alternatives Including the Proposed Action (40 CFR Section 1501.14), and Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies (42 U.S.C. 1962a-2 and d-1)

Proposal 10 – Curtail Kansas River Sand Dredging: The evaluation of Proposal 10 by the PDT is pending. This proposal recommends either further reduce the annual extraction limits or place a moratorium on sand extraction on the Kansas River. A causal link between the commercial dredging of the Kansas River and the amount of sediment entering the Missouri River from the Kansas River would require significant analysis and modeling of the Kansas River, which is not able to be performed under the time and budget constraints of the current study. Accordingly, the PDT will evaluate this proposal by increasing the contributing sand load from the Kansas River to the Missouri River to include the full dredged quantity. This will indicate the sensitivity of Missouri River bed elevations to Kansas River sediment input and provide an upper bound to the effect of Kansas River dredging.

SUMMARY OF VE PROPOSAL EVALUATIONS

A summary of actions taken by the Missouri River Bed Degradation PDT on each of the VE study team proposals is included in Table 3.

Table 3: PDT actions resulting from proposals presented by the VE study.

Proposal Number	Description	PDT Action
1	Minor Modifications to BSNP Structures	Incorporated into feasibility report for further evaluation
2	Significantly modify the BSNP Structures and "Update the Design Criteria"	Incorporated with modifications into feasibility report for further evaluation
3	Build Grade Control Structures	Incorporated into feasibility report for further evaluation
4	Increase River Flow Length and Sinuosity through Restoration of River Channel Cutoffs	Not evaluated further
5	Construct Small Secondary Side Channels	Not evaluated further
6	Create a Wider floodway within the flood plain	Not evaluated further
7	Widen the River Within the Entire Study Reach	Incorporated into feasibility report for further evaluation
8	Roughen the bed of the river to dissipate energy and reduce velocities	Incorporated with modifications into feasibility report for further evaluation. Not evaluated further as a degradation measure, but incorporated as a scour prevention measure to accompany grade control structures.
9	Place a moratorium on sand and gravel extraction or reduce amount of sand and gravel extraction	Incorporated into feasibility report for further evaluation
10	Curtail Kansas River Sand Dredging	Incorporated into feasibility report for further evaluation

US Army Corps of Engineers

VALUE ENGINEERING STUDY SUMMARY REPORT

MISSOURI RIVER
BED DEGRADATION

ALTERNATIVE EVALUATION AND ANALYSIS

MISSOURI RIVER, MISSOURI

P2# 400367

Sponsored By:

U.S. Army Corps of Engineers, Kansas City District

DRAFT

April 2014

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DOD SERVICE: USACE ACTING VALUE ENGINEERING OFFICER: MICHAEL COATES

Value Engineering Study Summary Report for

MISSOURI RIVER
BED DEGRADATION

ALTERNATIVE EVALUATION AND ANALYSIS

MISSOURI RIVER, MISSOURI

P2# 400367

APRIL 2014

SPONSOR: Christina Ostrander
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FACILITATOR: Rick Lambert, PE, CVS, USACE RAO

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VALUE ENGINEERING TEAM STUDY

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VALUE ENGINEERING TEAM STUDY

PROJECT DESCRIPTION AND BACKGROUND

PROJECT TITLE:	Missouri River Bed Degradation – Alternative Evaluation and Analysis
PROJECT LOCATION:	Missouri River, Missouri

The Missouri River Bed Degradation Feasibility Study is authorized by Section 216 of the Flood Control Act of 1970 (Public Law 91-611). The study area is located on the lower Missouri River, from River Mile (RM) 498 at Rulo, Nebraska, to the mouth, located north of St. Louis, Missouri (See Project Area Map, page 6). Major cities affected in Missouri are St. Joseph, Kansas City, and Jefferson City. In Kansas, Kansas City and smaller communities adjacent to the Missouri River are affected. The study area also includes tributary rivers and streams where direct influence or effects between the tributary and the Missouri River are evident. Federal projects within the study area include the Missouri River Bank Stabilization and Navigation Project (BSNP) and the associated Missouri River Recovery Program including Endangered Species Act compliance and fish and wildlife mitigation for the BSNP. In addition, there are significant federal flood risk management infrastructure located throughout the study area including the Kansas City Levee System (Flood Control Act of 1936) and the Missouri River Levee System (Flood Control Act of 1944).

Portions of the lower Missouri River in the Kansas City reach have experienced significant lowering (bed degradation), starting around 1990. Previous studies have indicated that the predominant causes of channel bed degradation are commercial dredging of the river bed and erosional scour brought about by BSNP structures (USACE, 2009; Williams & Wolman, 1984; Schmidt & Wilcock, 2008). The increased rate of degradation of the Missouri River bed and the associated lowering of water levels have resulted in increased costs due to impacts to the operation and performance of federal and non-federal infrastructure within and abutting the river. In addition, mainstem degradation has initiated erosional headcuts and bed degradation along tributaries to the Missouri River, resulting in significant expenditures in infrastructure repair and replacement. The purpose of this study is to propose actions to reduce the rate of Missouri River bed degradation in an effort to reduce and/or avoid future economic damages.

The Project Delivery Team (PDT) evaluated fifteen preliminary alternatives for effectiveness under various alternative commercial dredging scenarios. These evaluations provided valuable insight into the varying effectiveness of measures in different combinations and locations. The six most effective alternatives and the No-Action alternative have been advanced into the viable array of alternatives, and were presented to the Value Engineering Team. The viable array of alternatives includes alternatives consisting of standalone measures and combinations of measures (Tables 2 and 3). Rough order of magnitude construction costs were estimated for the full extent of each of the six actionable alternatives (Table 4). Construction costs include rock removal, rock placement, excavation, and real estate costs.

PROJECT TITLE:	Missouri River Bed Degradation – Alternative Evaluation and Analysis
PROJECT LOCATION:	Missouri River, Missouri

Project benefits include potentially avoided capital and O&M costs of adapting to further bed degradation. These costs would be incurred by local utilities and USACE under without-project conditions. Capital cost estimates of adapting to further bed degradation range from $350 million to $450 million and annual O&M costs may increase by as much as $13 million. The rough order of magnitude costs indicate that each of the six alternatives may be economically viable when compared to potential project benefit.

PROJECT AREA MAP

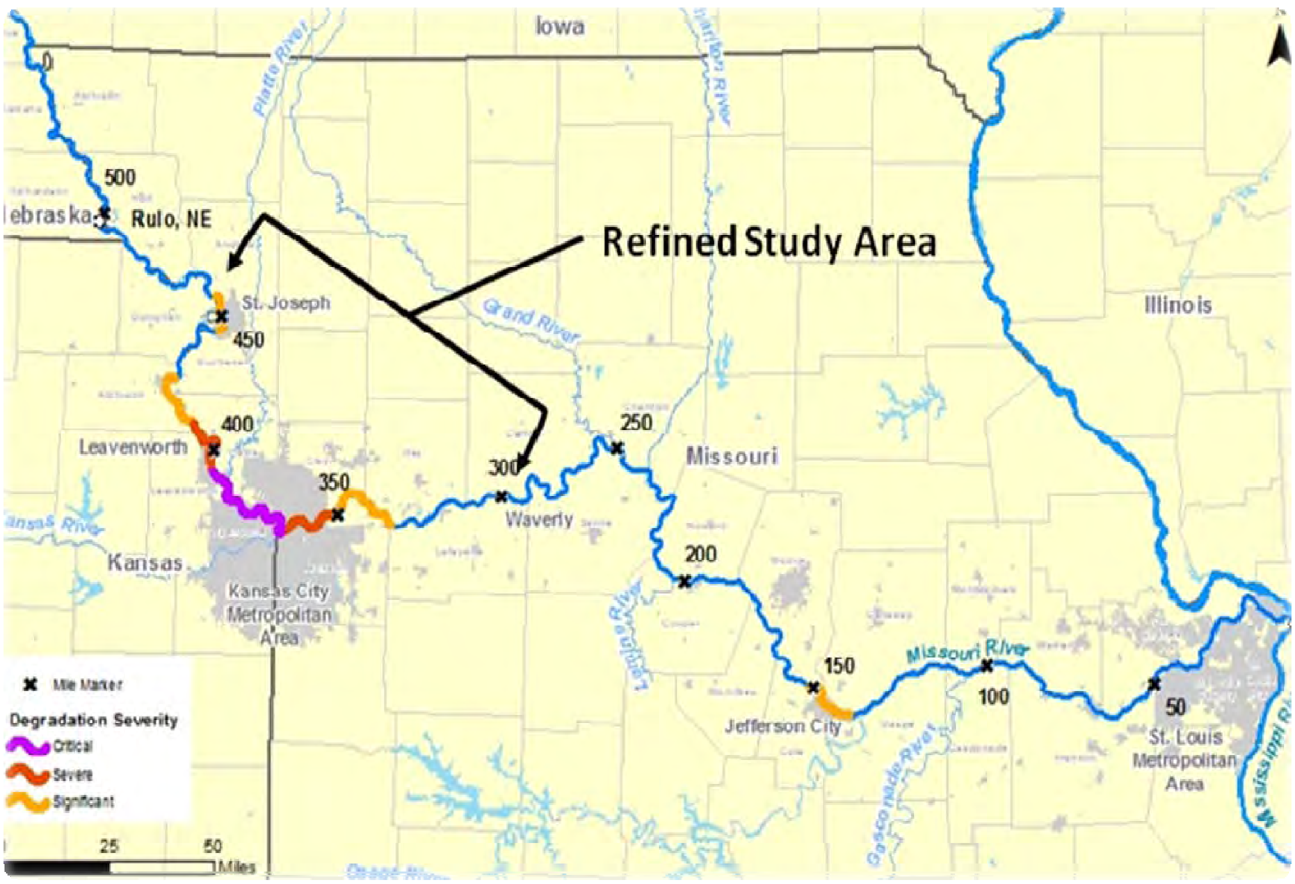

Table 2: Viable Array of Alternatives

	Measures Included In Alternative		
	Structure Lowering	**Channel Widening**	**Grade Control**
Alternative 1 (No Action)	---	---	---
Alternative 2	+2 CRP (Dikes), -2 CRP (Sills)	---	---
Alternative 3	-2 CRP (Dikes and Sills)	---	---
Alternative 4	-2 CRP (Dikes and Sills)	66 ft top width widening (200 ft from RCL)	---
Alternative 5	---	---	-14 CRP
Alternative 6	+2 CRP (Dikes), -2 CRP (Sills)	---	-14 CRP
Alternative 7	-2 CRP (Dikes and Sills)	66 ft top width widening (200 ft from RCL)	-14 CRP

Table 3: Largest Geographic Extent and Scale of Alternatives

Alternative Number	Alternative Description
1	No Action – Future Without Project Condition
2	Lower all sill and dikes to 2010 design criteria (+2 CRP Dikes, -2 CRP Sills) from river mile 294 to river mile 458 without excavation into accreted land
3	Lower sills to design criteria (-2 CRP) and dikes to the sill level (-2 CRP) from river mile 294 to river mile 458 without excavation into accreted land
4	Alternative 3 AND 66 ft of top width widening (200 feet of lowering from the rectified channel line down to -2 CRP) from river mile 350 to river mile 410
5	Grade control (-14 CRP) in the Kansas City reach (RM 347 to RM 388)
6	Grade control (-14 CRP) in the Kansas City reach (RM 347 to RM 388) AND Alternative 2
7	Grade control (-14 CRP) in the Kansas City reach (RM 347 to RM 388) AND Lower sills to design criteria (-2 CRP) and dikes to the sill level (-2 CRP) from river mile 294 to river mile 347 AND 66 ft top width widening (200 feet of lowering from the rectified channel line down to -2 CRP) from river mile 294 to river mile 347

Table 4: Order of Magnitude Costs

Alternative	Cost
Alternative #1 (No Action)	---
Alternative #2	$10,000,000
Alternative #3	$20,000,000
Alternative #4	$100,000,000
Alternative #5	$100,000,000
Alternative #6	$120,000,000
Alternative #7	$150,000,000

The Value Engineering Study was conducted at the USACE Kansas City District office on 1 - 4 April 2014. The VE team was comprised of members of the Kansas City, Omaha, St Paul, and Pittsburgh Districts and a CVS facilitator provided by USACE Reemployed Annuitant Office. (See Appendix A).

Value Engineering (VE) is an organized study of functions to satisfy the users' needs with a quality product at the lowest life cycle cost. VE identifies critical project functions and evaluates how those functions are proposed to be met. Alternative ways are considered to achieve the equivalent function while increasing the value and the benefit ratio of the project. In the end, it is hoped that the project will realize a reduction in cost, but increased value is the focus of the process, rather than simply reducing cost. The project was studied using the Corps of Engineers standard Value Engineering (VE) methodology, consisting of six phases:

Information Phase: The Project Manager furnished the Array of Alternatives report for the In-Progress-Review, the Feasibility Study Report Synopsis, and Decision Management Plan documents prior to the study. On the first day of the VE study, the project manager and other members of the Project Delivery Team briefed the VE team on the project. A short field trip was conducted to a high bluff overlooking a large bend in the river. Cost information was presented by the Cost Engineer (see Appendix B).

Function Analysis Phase: The Team identified functions, expressed in noun-verb pairs and these were assembled in logical sequence using the Function Analysis System Technique. (See the FAST diagram in Appendix C)

Creative (Speculation) Phase: The Team speculated by conducting a brainstorming session to generate ideas for alternative designs. All team members contributed ideas and critical analysis of the ideas was discouraged (see Appendix D).

Evaluation (Analysis) Phase: Evaluation, testing and critical analysis of all ideas generated during speculation was performed to determine potential for savings and possibilities for risk. Ideas were ranked by priority for development. Ideas that did not survive critical analysis were deleted.

Development Phase: The priority ideas were developed into written proposals by VE team members. Proposal descriptions, along with sketches, technical support documentation, and cost estimates were prepared to support implementation of ideas. Additional VE Team Comments were included for items of interest that were not developed as proposals, and these comments follow the study proposals.

Presentation Phase: An informal outbriefing was conducted on the last day at the Sacramento District office to present the results of the VE study. This VE Study Report will be distributed for review by the project delivery team.

EXECUTIVE SUMMARY

This VE Study brought together a team of experienced professionals from across USACE with the goal of identifying additional creative alternatives and solutions that improve the Feasibility Study within the framework of the SMART planning process requirements.

The objectives of this Value Engineering Study were to develop cost reduction measures for the existing list of alternatives and to develop some new alternatives that could be used to improve the MO River Bed Degradation project. The VE team was tasked with identifying creative alternatives that would improve the following aspects of the project:

- Reduce future damages, repair, and replacement costs for in-water and stream bank Federal infrastructure
- Reducing future Federal operations and maintenance costs for in-water and stream bank infrastructure, flood plain habitats, and shall water habitats
- Reduce negative environmental impacts of bed degradation in the main stem MO River and tributaries
- Improve infrastructure reliability and reduces risk of failure
- Minimize uncertainty and variance of future water surface and bed elevations as they affect infrastructure

This VE study report documents the results of the VE study. The following VE proposals identify many cost saving and / or quality enhancing alternatives. VE proposals typically document ideas that have quantifiable results either in savings or additional cost. VE comments document ideas that were considered to add value to the project but the cost impacts are not defined. Some of the concepts presented as proposals or comments will require additional investigation by the PDT and coordination with the project sponsor to determine suitability for incorporation into the project plan.

VALUE ENGINEERING TEAM STUDY

SUMMARY OF RECOMMENDATIONS

The value engineering study identified 54 value improvement ideas during the creative phase of the study. After these ideas were evaluated, 5 of these ideas became cost saving proposals that could reduce project cost by as much as $ 45.1 Million, 5 ideas became quality improvements that add cost to the project but result in improved quality, and 11 ideas became design comments.

PROPOSAL NUMBER	DESCRIPTION	POTENTIAL SAVINGS	RECOMMENED ACTION
1	Minor Modifications to BSNP Structures	$ 8.6 Million	______
2	Significantly modify the BSNP structures And Update the Design Criteria	$ 5.6 Million *	______
3	Build Grade Control Structures	$34 Million	______
4	Increase River Flow Length and Sinuosity through Restoration of River Channel Cutoffs	(-) $126 Million	______
5	Construct Small Secondary Side Channels	(-) $ 480 Million	______
6	Create a wider floodway within the flood plain	(-) $ 43.9 Million	______
7	Widen the River Within the Entire Study Reach	(-) $ 480 Million	______
8	Roughen the bed of the river to Dissipate energy and reduce velocities	(-) $ 32 Million	______
9	Place moratorium on sand and gravel extraction or reduce amount of sand & gravel extraction	$ 2.4 Million	______
10	Curtail Kansas River Sand Dredging	$ 143,000	______

CUMULATIVE SAVINGS:

Implementation of Proposals #1,3, 9 & 10 could save as much as **$45.1 Million**

Proposals #4 thru #8 improve quality but result in significant additional cost

DESCRIPTION: Minor Modifications to BSNP Structures

ORIGINAL DESIGN:

The original Alternatives 2 and 3 are minor modifications to BSNP Structures.

Alternative 2: Lower all sills and dikes to 2010 design criteria (+2 CRP dikes, -2 CRP sills) from river mile 294 to river mile 458 without excavation into accreted land.

Alternative 3: Lower sills to design criteria (-2 CRP) and dikes to the sill level (-2 CRP) from river mile 294 to river mile 458 without excavation into accreted land. This requires removal of approximately 150,000 CY of rock from the dikes and 25,000 CY from the sills; excavated rock would be moved across the river and placed on existing revetments. Construction cost is estimated at $6.9 million (without planning, engineering, design, or construction supervision and administration costs).

PROPOSED DESIGN:

Use excavated rock to build other structures, such as grade control structures (in a combined alternative). *(See slides 47-48 from the 1-Apr-14 presentation.)*

ADVANTAGES:

1. Low cost.
2. Little impact to existing accreted land.
3. Rock material is already paid for and close to location of new uses.

DISADVANTAGES:

1. Produces only minor beneficial effects on bed degradation.

JUSTIFICATION:

Making minor modifications to the existing BSNP structures could be part of a larger plan with more hydraulically effective measures. Borrowing rock from the existing dikes and sills could reduce the overall cost of a plan and increase the hydraulic benefits slightly. Cost savings could be as much as $8.67 Million.

COST ESTIMATE WORKSHEET				
Proposal # 1A Minor Mods to BSNP Structures: Assuming combined project				
DELETIONS				
ITEM	UNITS	QUANTITY	UNIT COST	TOTAL
Buy Rock for Grade Control Structures	TN	289,000	$30.00	$8,670,000
				$0
				$0
		Total Deletions		$8,670,000
ADDITIONS				
ITEM	UNITS	QUANTITY	UNIT COST	TOTAL
Re-use Rock from existing structures	TN	289,000	$0.00	$0
				$0
		Total Additions		$0
		Net Cost Decrease		$8,670,000
		Mark-ups	0.00%	$0
		Total Cost Decrease		$8,670,000

COST ESTIMATE WORKSHEET				
Proposal # 1B Minor Mods to BSNP Structures: Assuming mods made just to obtain rock				
(This assumes the minor mods serve no independent purpose other than to supply rock.)				
DELETIONS				
ITEM	UNITS	QUANTITY	UNIT COST	TOTAL
Buy Rock for Grade Control Structures	TN	289,000	$30.00	$8,670,000
				$0
				$0
		Total Deletions		$8,670,000
ADDITIONS				
ITEM	UNITS	QUANTITY	UNIT COST	TOTAL
Obtain Rock from existing structures	TN	289,000	$23.88	$6,901,320
				$0
		Total Additions		$6,901,320
		Net Cost Decrease		$1,768,680
		Mark-ups	0.00%	$0
		Total Cost Decrease		$1,768,680

PROPOSAL NO:	2 (Speculation List Item No. 7 & 27)	PAGE NO: 1 OF 2
DESCRIPTION:	Significantly modify the BSNP structures and Update the Design Criteria.	

ORIGINAL DESIGN:

The original design and maintenance criteria of the BSNP was essentially finalized in the early 1970's which was at the end of the time period of high sediment loads on the Missouri River. Since the BSNP was designed to be self scouring, the design and maintenance criteria was promulgated with the expectation of future high sediment loads. Upstream dams and the BSNP itself have greatly reduced the sediment loads which may make the design and maintenance criteria obsolete and in need of update.

PROPOSED DESIGN:

This proposal is to conduct an analysis of the design and current maintenance criteria to see if changes could be made that will help either slow or halt the degradation problem. This study could potentially utilize the hydraulic model that was developed for the Degradation Study to better understand what changes could be made and still meet authorized purposes. This study would likely need to be at least partially funded with O&M dollars. Some likely changes include lower elevations of the dikes, shorter lengths of the sills, abandonment of every other dike, shorter crossing control structures.

ADVANTAGES:

1. The design and maintenance criteria have not been updated in over 40 years although flow and sediment conditions on the river have changed. This proposal is timely as a matter of ongoing management of the BSNP.
2. This proposal could result in lower O&M costs of the BSNP if the study results in lower dike elevations, shorter sills, or abandonment of structures. This could be an important advantage in an time of declining budgets.
3. This proposal could result in less degradation at virtually no costs to basin stakeholders.
4. If the study resulted in lower structure heights or abandonment of structures, there could be an associated increase in aquatic habitat which would help the Corps meet its obligations under the BiOp.

DISADVANTAGES:

1. Minor bank erosion of private property could result if structure elevations are lowered or sills shortened. This erosion would likely be minor but could endanger important infrastructure if it is located next to the river bank.
2. There could be negative public perception if the design or criteria is changed. Some basin stakeholders are very sensitive to this issue and currently perceive that the Corps has already changed maintenance practices and that change has resulted in reduced channel reliability or increased bank erosion.

JUSTIFICATION:

It is unknown if the design and current maintenance criteria are adversely impacting degradation. As part of the Corps management of the river, it is incumbent that the Corps periodically re-examine the design and maintenance practices of the BSNP to ensure there are no unnecessary negative effects. This proposal could also result in lower O&M costs of the BSNP which is an important consideration when a low use waterway is competing for O&M funds.

COST ESTIMATE WORKSHEET				
Proposal # 2				
	DELETIONS			
ITEM	UNITS	QUANTITY	UNIT COST	TOTAL
Reduced maintenance costs as criteria is lower	tons	15,000	$32.00	$480,000
				$0
				$0
				$0
				$0
				$0
				$0
				$0
				$0
	Cost	# Years	Interest=0.03	
Present worth of annual cost	480000	50		$12,350,287
Present worth of future single cost				$0
		Total Deletions		$12,830,287
	ADDITIONS			
ITEM	UNITS	QUANTITY	UNIT COST	TOTAL
Restudy of Design Criteria	LS	1	$500,000.00	$500,000
Lowering of selected dikes over 140 miles	cubic yard	320,000	$21.00	$6,720,000
				$0
				$0
				$0
				$0
				$0
				$0
				$0
	Cost	# Years	Interest=0.03	
Present worth of annual cost				$0
Present worth of future single cost				$0
		Total Additions		$7,220,000
		Net Cost Decrease		$5,610,287
		Mark-ups	0.00%	$0
		Total Cost Decrease		$5,610,287

ORIGINAL DESIGN:

The PDT's original Alternative 5 is to build 14 grade control structures through the Kansas City reach of the river (RM 347 to 388). One grade control structure would be located at each crossover in this reach of the river. The typical cross section would have a 100-foot top width with 20% slope upstream and 5% slope downstream. Grade control structures would have a 450-foot crest at an elevation 14 feet below the 1973 CRP. The design size and profile, as understood from discussion with PDT, is not based on any specific modeling efforts at this point in time.

It is initially estimated that three million tons of rock would be required to build the 14 structures at a total cost of $124 million.

PROPOSED DESIGN:

The PDT is continuing to model the effects of different numbers of grade control structures to optimize their systemic cost-effectiveness. It may be that fewer or potentially smaller structures) or a staged approach would accomplish most of the beneficial effects and be more cost-effective overall.

An adaptive management strategy should be included in the construction of these structures which would assess the effectiveness of the structures and possibly realize the necessary benefits with the full extent of proposed construction.

- Gradually phase-in grade control structures and include sheet-pile in the structures – 2-pronged approach

The original proposal to build 14 grade control structures calls for 3 million tons of large rock. This rock may not be readily available within a reasonable period of time, which may unacceptably extend the project schedule. The size of the proposed grade control structures (400 ft total length, 100-ft across top), the number of structures considered necessary, their construction across the entire river channel, the 3 million tons of large rock anticipated to be needed, and the depth such structures are expected to sink into the river bed, led to the realization that the availability of locally-available, appropriately-sized rock may be a controlling factor, potentially extending project completion, which would exacerbate already challenged, sponsor short-term water needs.

It may be beneficial to start building partial structures in strategic locations downstream of specific infrastructure to provide local benefits sooner than the whole system can be built, i.e. using a two-pronged approach.

PROPOSED DESIGN (Continued):

Additional discussion regarding the generally acknowledged effectiveness of starting grade control structure construction at the lower part of a project area (given the expected rapid bed erosion down-river caused by the insertion of any such structures and that water level benefits accrue up-river), incorporating consideration of the potentially extended construction time due to insufficient materials (addressed above), and the location of major water intakes closer to Kansas City (of particular importance to major sponsors), led to speculation regarding a phased, two-pronged approach in the construction of grade control structures. Such an approach could meet sponsors' short-term, water-level needs nearer the mid-project area with partially-constructed structures that yield at least some immediate water-level benefits, while simultaneously starting full construction of structures at the downstream end of the project area, eventually working up-river, completing the partial structures, before moving on up-river toward project completion.

Regarding the partial structures near the major water intakes: it's envisioned these would consist of sheet-pile with a rock ramp on the downstream side. The sheet-pile would be started near a shore (or both shores) with rock dumped immediately downstream of the sheet-pile, immediately after driving sheet-pile to its full depth and actually laying up against the sheet-pile and extending some distance (~100-200 ft) down-river, continuously as sheet-pile is extended across the river; this would provide structural rigidity and armor the most vulnerable portion of the river bed from accelerated degradation. This concept would require far less rock than the full structure that would eventually be completed, but it could be constructed more quickly and would provide benefits at specific locations earlier.

The rock would be placed to form a ramp downstream of the sheet-pile to maintain fish passage for fish swimming upstream along the river bed. The extended length down-river is necessary to ameliorate obstruction to native fish passage up-river. When the larger grade control structures are completed down-river, construction at the partial structures will consist of placing more rock both above and below the previously inserted sheet-pile to build the grade control structures' full cross-section with 100-foot top width, 20% upstream slope and 5% downstream slope.

The temporary nature of these partial structures cannot be over-emphasized. Without the full upstream and downstream rock ramps, they would present a much greater potential latitudinal obstruction to many native fish species that move along river bottom and shallows, both up- and down-river, often year-round. (The majority of fish movement for almost all species is associated with spring flows, but recent research has shown that many large-river fish, including listed species, move great distances during other times of the year, too.) In summary, concerted effort must be made to complete construction of partial structures as soon as possible after their construction, certainly within 1-3 annual budget cycles.

PROPOSED DESIGN (Continued):

Additional grade control structures could be built at locations between the partial structures as funding and rock supplies allow, in order to complete the entire system needed for long-term effectiveness throughout the Kansas City reach.

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- Install multiple and smaller grade control structures (Speculation # 42).

The size of the initially proposed grade control structures (400 ft total length) and the need for large rock with potentially limited availability generated speculation that perhaps smaller grade control structures could meet water-level needs, thereby reducing material needs, even if more than 14 (smaller) structures were constructed. From an environmental perspective, smaller potential barriers to fish passage on a river are always a better idea; however, from a functional perspective, efficiency in scale would almost certainly decline with the reduction in structure size, and larger structures may last longer in strong current than smaller structures, that might disappear in time, as individual rocks are scattered or subsumed into the bed. One possible design consideration could be using sheet pile for the upstream face of the structure and rock on the downstream slope to prevent channel erosion and allow for fish passage in the upstream direction.

PROPOSED DESIGN (Continued):

If modeling is unable to provide reliable estimates of optimal size for the range of flow velocities anticipated, a size-range of grade control structures could be constructed in such manner that smaller structures could be relatively easily amended, following the adaptive management paradigm, bringing them up to optimal functionality (probably much more cheaply than over-engineering such structures and then attempting to reduce them in size for their optimal function). Based on this premise, it may be better to start smaller and increase in size, as needed. The 2-pronged approach suggested earlier could be considered an integral step in this direction. Some form of success metric(s) would have to be established to adaptively manage/optimize such structures, but given the need for at least some O&M monitoring, this shouldn't represent undue cost. Additionally, if adaptively managing such structures, any increase in flooding frequency or magnitude could be met in a responsive fashion.

ADVANTAGES:

1. Permanently stabilizes both the bed and water surface through the Kansas City reach.
2. Little impact to existing accreted land.
3. Raises non-navigation season low water elevations significantly, which should benefit water intakes.
4. Provides excellent benthic substrate for smaller fish species (e.g., darters) and a multitude of other aquatic organisms, both animal and plant, as shelter/refugia.
5. May provide concentrated, local sources of river sand & gravel, also critically important to numerous aquatic organisms for spawning/breeding/reproduction.
6. Staged construction may significantly reduce the time required to obtain at least partial benefits.

DISADVANTAGES:

1. Induces additional bed degradation downstream of the last structure (below RM 347). The level of this impact would be directly tied to the size of the structures.
2. Would eventually hinder low-powered navigation with an abrupt water surface drop at the downstream grade control structure. Additional grade control structures may be needed downstream in the future to address this problem.
3. May somewhat impede longitudinal connectivity of weak swimming river fishes (more downstream, than upstream, given the current design cross-section), especially when considering temporary sheet-pile structures.

JUSTIFICATION:

This appears to be the single most effective measure to solve bed degradation and water surface lowering problems in the Kansas City reach. It may require additional measures to mitigate for the additional degradation induced downstream. The construction method employed and the adaptive management of the structures could significantly reduce the cost of the structures.

Cost = $124 million (per PDT presentation on 2-Apr-14).

--Assuming 14 structures using 3 million tons of rock.

Generally, the PDT proposes to build 14 grade control structures through the Kansas City reach of the river (RM 347 to 388). One grade control structure would be located at each crossover in this reach of the river. The typical cross section would have a 100 foot top width with 20% slope upstream and 5% slope downstream. Grade control structures would have a 450 foot crest at an elevation 14 feet below the 1973 CRP.

Three million tons of rock would be required to build the 14 structures at a total cost of $124 million; however, this estimate doesn't address possible cost-savings if rock from removed dikes is beneficially re-used to supplement needed rock on control structures.

COST ESTIMATE WORKSHEET				
Proposal # 3				
DELETIONS				
ITEM	UNITS	QUANTITY	UNIT COST	TOTAL
Alternative #5 -	LS	1	$124,000,000.00	$124,000,000
New proposal would attempt to meet				
all the goals of Alt #7, passive grade				
control, widening, and SWH benefits				
		Total Deletions		$124,000,000
ADDITIONS				
ITEM	UNITS	QUANTITY	UNIT COST	TOTAL
Phased Construction				
sheet pile for 14 struct (700' x 50'/sht)	SqFt	490,000	$30.00	$14,700,000
downstrm struct rock (50K Ton / struct)	Tons	700,000	$40.00	$28,000,000
remainder of rock for original design	Tons	2,300,000	$40.00	$92,000,000
Phased Construction Cost =				$134,700,000
Smaller or more frequent structures				
14 structures at 75% rock volume (min)	Tons	2,250,000	$40.00	$90,000,000
21 structures at 75% rock volume (max)	Tons	3,375,000	$40.00	$135,000,000
		Net Cost Decrease (max) =		$34,000,000
	(Or possible Net Cost Increase =			-$11,000,000)
Costs will vary widely depending on the final installed design; however, no cost benefit				
has been assigned to the ability to realize benefits sooner or reduce supply costs using				
staged construction.				

PROPOSAL NO:	4 (Speculation List Item No. 10 & 12)	PAGE NO: 1 OF 4
DESCRIPTION:	Increase River Flow Length and Sinuosity through Restoration of River Channel Cutoffs.	

ORIGINAL DESIGN:

The original alternatives do not address the reduction of degradation by increasing the flow length of the river.

PROPOSED DESIGN:

The current Missouri River BSNP channel slopes at between 0.8-1.0 ft/mile. This slope is matched with the flow and channel width to maintain a self-scouring channel. Since this original design was completed, sediment inflow has been reduced along with an increase in sediment removed from the system. This unbalancing of the BSNP has resulted in additional degradation.

The proposed design is to indentify bends that were cut off from the river channel during construction of the BSNP and reconnect them as part of the navigation channel of the river. This process would increase the flow length and sinuosity of the river. Since it will all be new construction, development of SWH along the banks should be considered as part of the design.

ADVANTAGES:

1. With reduced sediment supply, a reduced slope of the river channel would slow the degradation process by reducing the river velocity and subsequently the sediment transport capacity.
2. Creation of SWH
3. Increased opportunities for recreation access

DISADVANTAGES:

1. Reduced velocity and increased flow length could result in increased flood stages, which may require increased levee height
2. High Cost
3. Possibility of induced aggradation that could negatively impact the BSNP navigation channel.

JUSTIFICATION:

Lengthening the river will reduce the river slope resulting in a reduction in degradation, more opportunities for SWH, reduced future O&M costs, and increased recreation opportunities compared to in-channel structures or modification of existing BSNP structures.

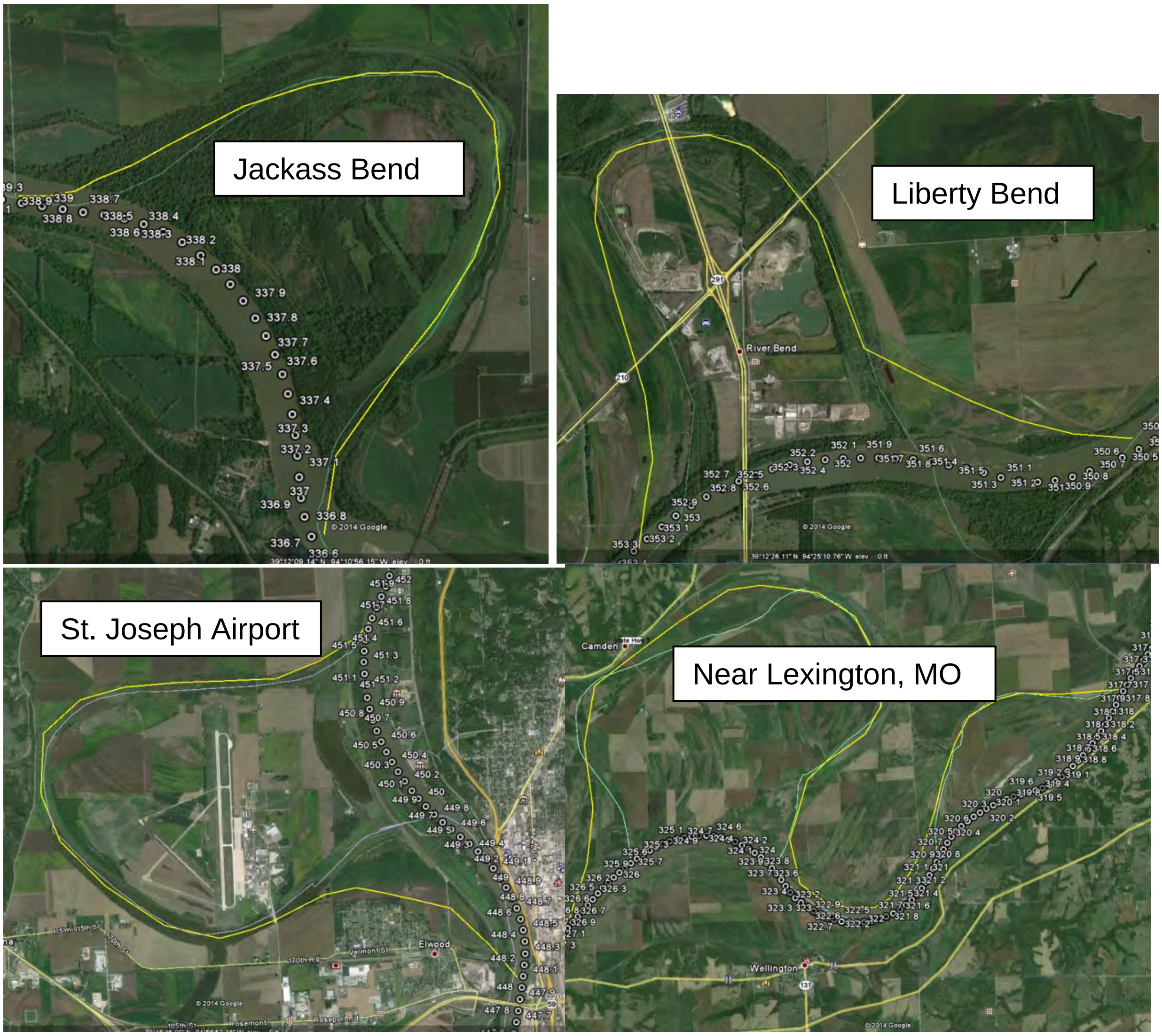

Figure 1: Example Cutoffs for Reconnection to Navigation Channel

The intent of this proposal is to use the increased channel length to reduce or eliminate the degradation in the river, hence eliminating the need to construction the grade control structures. In addition, the creation of shallow water habitat should be designed into the project. Future costs compared to the grade control could be lessened. If the cutoff re-connections are spaced appropriately, there should be a consistent reduction of river channel velocity, possibly preventing the need to address future degradation below the grade control reach.

COST ESTIMATE WORKSHEET				
Spec Item #10, 12				
DELETIONS				
ITEM	UNITS	QUANTITY	UNIT COST	TOTAL
Alternative 7	LS	1	$138,000,000.00	$138,000,000
New proposal would attempt to meet all				$0
the goals of Alt #7, passive grade control,				$0
widening, and SWH benefits				$0
				$0
				$0
				$0
				$0
				$0
	Cost	# Years	Interest=0.03	
Present worth of annual cost				$0
Present worth of future single cost				$0
		Total Deletions		$138,000,000
ADDITIONS				
ITEM	UNITS	QUANTITY	UNIT COST	TOTAL
Channel connection dredging	river mile	30	$6,160,000.00	$184,800,000
700' wide channel, 15' deep, $3/CY				$0
				$0
Bank stabilization rock	river mile	30	$2,640,000.00	$79,200,000
15' bank x 5' deep with 5' toe trench				$0
180 sf / lin ft for both banks				$0
=35K CY = 52.8 K ton @ $50/ton placed				$0
				$0
				$0
	Cost	# Years	Interest=0.03	
Present worth of annual cost				$0
Present worth of future single cost				$0
		Total Additions		$264,000,000
		Net Cost Decrease		-$126,000,000
		Mark-ups	0.00%	$0
		Total Cost Decrease		-$126,000,000

ORIGINAL DESIGN:

The original design included widening the river 200 feet from the rectified channel line. This would create a 65 foot increase in top width of the river, and would have a minor, long-term benefit to degradation in the reach. In addition there would be minor temporary benefits from the potential sediment reintroduction.

PROPOSED DESIGN:

Construct secondary side channels where practicable rather than just excavating at the bank. The secondary side channels could be constructed to the same specifications required for Shallow Water Habitat under the Biological Opinion. This would require the side channels to be less than 5 feet deep with velocities less than 2 feet per second.

Side channel chutes are constructed to -5 CRP and are designed to an ultimate width of 200’ wide at the base. This is significantly larger top width widening than the proposed Alternative 4.

ADVANTAGES:

1. Win-win scenario with other Corps mission areas.
2. Sources of funding for widening could potentially come from the Missouri River Recovery Program which would lessen the burden to stakeholders.

DISADVANTAGES:

1. Constraints of adjacent infrastructure (scour and underseepage near levees, bridges, utilities, impacts to private property, etc).
2. Potential impacts to Missouri River Authorized Purposes (e.g. Navigation).
3. Large real estate tracts are typically required for this proposal.

JUSTIFICATION:

This proposal would benefit more than one Corps mission area, result in win-win scenarios with Endangered Species Act compliance, and could share costs, while designs could be coordinated and shared between the programs.

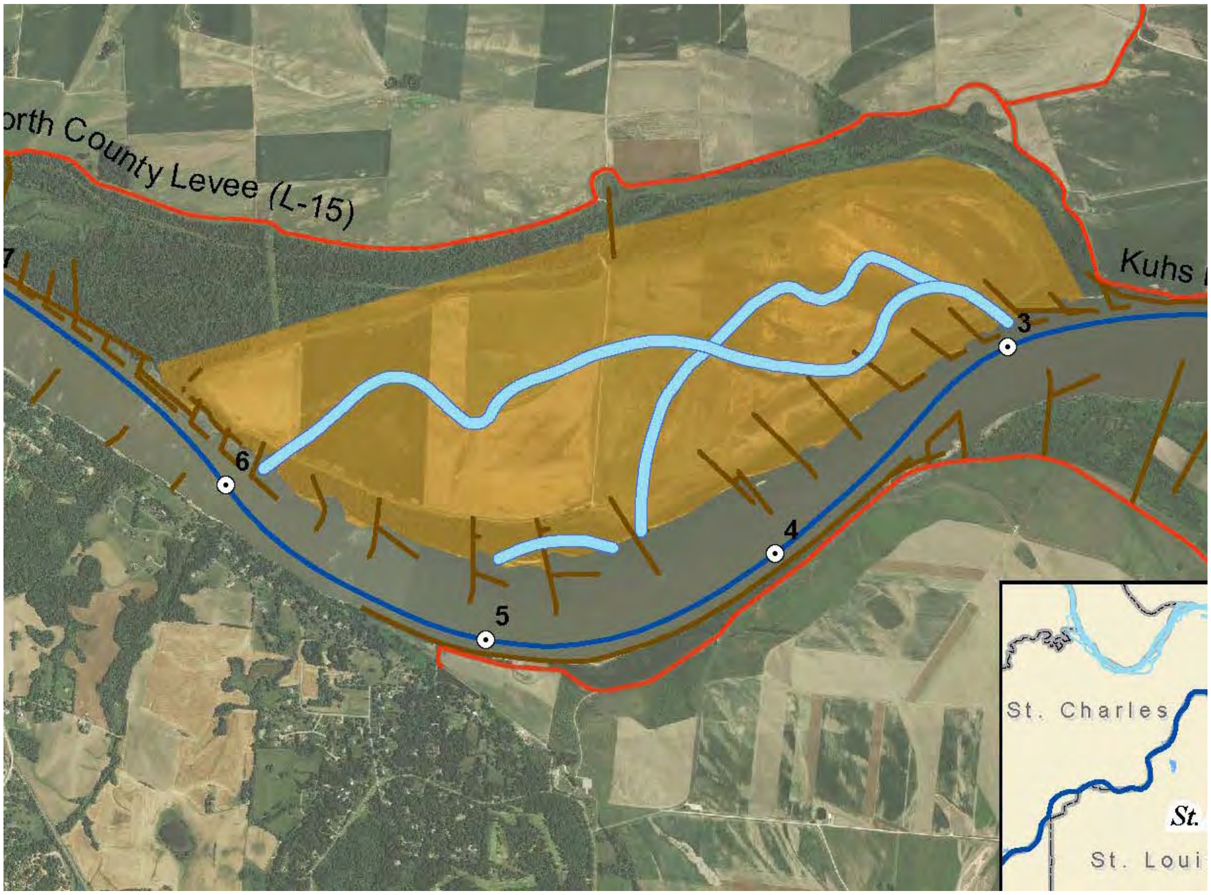

Figure 1: Typical side channel chute project.

Cost Estimate

River Miles	160	160
Acres per River Mile	20	30
Cost per Acre	$100,000	$100,000
Cost of Widening	$320,000,000	$480,000,000

This is a rough estimate based on past cost per SWH acre.
Real estate is also not factored in to this cost.

PROPOSAL NO:	6 (Speculation List Item No. 1, 15, 51)	PAGE NO: 1 OF 4
DESCRIPTION:	Create a wider floodway within the flood plain	

ORIGINAL DESIGN:

All of the original designs preserve the existing levees and floodwalls that constrict the river, especially through the Kansas City reach but also in rural areas.

PROPOSED DESIGN:

Relocate levees and floodwalls landward in order to expand the floodway and reduce flow velocities during floods. Additional conveyance could be provided by excavating a channel through the accreted areas riverward of the new levee if modeling shows it to be effective.

There are two industrial intakes at river mile 378 to 379 (Water One and a power plant). Approximately 4 miles of existing agricultural levee across the river from these intakes could be set back 1,500 to 3,000 feet to provide additional floodway.

Approximately 2 miles of agricultural levee along the inside bend from river mile 374 to 378 could be set back and/or a conveyance channel excavated to provide more floodway.

Approximately 2 miles of the levee between river mile 369 and 372 in the Fairfax industrial area could be moved landward. A General Motors assembly plant now occupies some of the former airport site, but a significant floodway could be reestablished on the inside bend at this location. The Kansas City Water Works intake and Highway 169 levee are located on the outside of the bend in this reach of the river and could be benefitted by reduced flow velocities.

There may be opportunities from river mile 355 to 359 to move ag levees landward without affecting other structures.

ADVANTAGES:

1. Provides additional conveyance for flood flows, which may reduce bed degradation.
2. Could provide more floodplain and/or wetland habitat riverward of new levees.
3. Establishes a buffer against future development that would make levee setbacks more difficult in the future.

DISADVANTAGES:

1. Relatively expensive.
2. Likely to be opposed by affected landowners.

JUSTIFICATION:

This proposal should be modeled in the mobile bed model to determine how effective it is in stabilizing the bed and water surface. If it is effective, one or more levee setbacks could be combined with other measures to make a complete solution.

Figure 1: Levee relocation near Water One intake and power plant.

Figure 2: Levee relocation at Fairfax Industrial Area.

Assume $20 per CY for finished levee in place, per Omaha District estimator.
Railroad cost $1M per mile per research on Internet (Evans 4-3-14).

COST ESTIMATE WORKSHEET				
Proposal # 1-15-51				
WATER ONE LEVEE				
Assume levee is 4 miles long, 12 feet high.				
ITEM	UNITS	QUANTITY	UNIT COST	TOTAL
Real Estate	Acre	870	$6,000.00	$5,220,000
Levee Construction (Complete in place)	CY	550,000	$20.00	$11,000,000
				$0
				$0
		Total Deletions		$16,220,000
POWER PLANT LEVEE				
Assume levee is 2 miles long, 12 feet high.				
ITEM	UNITS	QUANTITY	UNIT COST	TOTAL
Real Estate	Acre	620	$6,000.00	$3,720,000
Levee Construction (Complete in place)	CY	275,000	$20.00	$5,500,000
				$0
				$0
		Total Deletions		$9,220,000
FAIRFAX LEVEE				
Assume levee is 2 miles long, 12 feet high, and 5 parallel RR tracks must be relocated.				
ITEM	UNITS	QUANTITY	UNIT COST	TOTAL
Real Estate	Acre	200	$15,000.00	$3,000,000
Levee Construction (Complete in place)	CY	275,000	$20.00	$5,500,000
Railroad Relocation	Miles	10	$1,000,000.00	$10,000,000
				$0
		Total Deletions		$18,500,000

PROPOSAL NO:	7 (Speculation List Item No. 52)	
DESCRIPTION:	Widen the River Within the Entire Study Reach	

ORIGINAL DESIGN:

The original design included widening the river 200 feet from the rectified channel line. This would create a 65 foot increase in top width of the river, and would have a minor, long-term benefit to degradation in the reach. In addition there would be minor temporary benefits from the potential sediment reintroduction.

PROPOSED DESIGN:

Widen the river to the maximum extent practicable within the Study Reach, given the constraints of adjacent infrastructure (levees, bridges, utilities, private property, etc), and the potential impacts to the Missouri River Authorized Purposes (e.g. Navigation). In addition, consider win-win scenarios with other Corps missions. Specifically Endangered Species Act compliance with respect to Shallow Water Habitat should be considered, and the widening designed to fulfill the metrics outlined in the Biological Opinion.

Shallow Water Habitat is defined in the Biological Opinion as areas less than 5 feet deep with velocities less than 2 feet per second. It further called for 20 to 30 acres of Shallow Water Habitat per river mile. To meet this metric, 165 to 250 feet of top width widening would be required.

Top width widening could be considered beyond the metrics of the SWH, to the maximum extent practicable given the constraints and potential impacts to authorized purposes.

ADVANTAGES:

1. Win-win scenario with other Corps mission areas.
2. Sources of funding for widening could potentially come from the Missouri River Recovery Program which would lessen the burden to stakeholders.
3. Could also lower long-term O&M of the BSNP structures with reduced velocities.

DISADVANTAGES:

1. Constraints of adjacent infrastructure (scour and underseepage near levees, bridges, utilities, impacts to private property, etc).
2. Potential impacts to Missouri River Authorized Purposes (e.g. Navigation).
3. Could make BSNP structures more difficult to maintain.

JUSTIFICATION:

This proposal would benefit more than one Corps mission area, and costs and designs could be coordinated and shared between the programs.

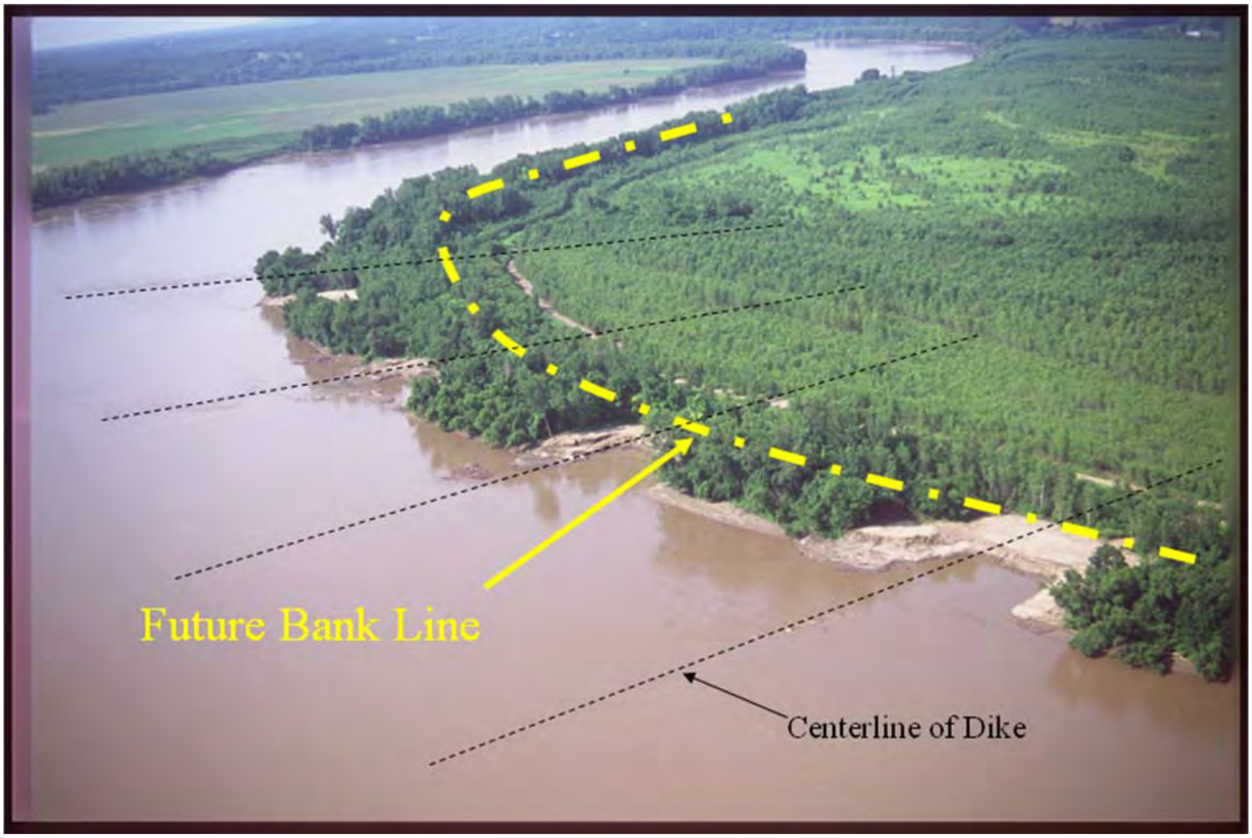

Figure 1: Typical top width widening.

Cost Estimate

River Miles	160	160
Acres per River Mile	20	30
Cost per Acre	$100,000	$100,000
Cost of Widening	$320,000,000	$480,000,000

This is a rough estimate based on past cost per SWH acre for a side channel chute. Likely some savings in cost near the bank. Could also excavate the top few feet and allow to degrade to -5 CRP. Structures would have to be removed to -5 CRP. Estimate is likely high as grade control structures are a significant portion of SWH construction costs. Real estate is also not factored in to this cost. Project could be completed without excavating the entire bank but instead allowing to erode over time as shown in the picture.

VALUE ENGINEERING PROPOSAL

PROPOSAL NO: 8 (Speculation List Item No. 46 thru 50) PAGE NO: 1 OF 2

DESCRIPTION: Roughen the bed of the river to dissipate energy and reduce velocities.

ORIGINAL DESIGN:

The original design of the BSNP focused on creating a smooth river bed with easy bend transitions and minimal eddies off of most dikes. The theory during the design and construction phase was that all the flow energy was needed to move the heavy sediment load and create a self scouring channel. Hence, the design strived to minimize energy loses as the water flows downhill. Features incorporated to this end include, smooth outside bends, L-heads on the ends of dikes to reduce turbulence, closely spaced structures to minimize contraction and expansion losses.

PROPOSED DESIGN:

This proposal is to change the design of the BSNP to increase energy loss as the river flows downhill. Some features that could be incorporated include removal of L-heads to increase turbulence, removal of every other dike to increase expansion/contraction losses, short dikes on the smooth outside bends to increase turbulence, installation of Ajax or concrete boxes on the river bed to increase roughness and turbulence.

ADVANTAGES:

1. The design and maintenance criteria have not been updated in over 40 years although flow and sediment conditions on the river have changed. This proposal is timely as a matter of ongoing management of the BSNP.
2. This proposal could be constructed within the existing alignment of the river.
3. This proposal could result in less degradation at virtually no costs to basin stakeholders.
4. If this proposal resulted in lower structure heights or abandonment of structures, there could be an associated increase in aquatic habitat which would help the Corps meet its obligations under the BiOp.

DISADVANTAGES:

1. Minor bank erosion of private property could result if structure elevations are lowered or sills shortened. This erosion would likely be minor but could endanger important infrastructure if it is located next to the river bank. Some form of compensation to these landowners may be needed.
2. There could be negative public perception if the design or criteria is changed. Some basin stakeholders are very sensitive to this issue and currently perceive that the Corps has already changed maintenance practices and that change has resulted in reduced channel reliability or increased bank erosion.

DISADVANTAGES (Continued):

3. Small dikes off the revetted bank could pose a navigation hazard as navigators are not used to dikes at those locations. This would apply to both commercial and recreational navigation. This disadvantage could be mitigated by education of navigators and/or making the structures visible by keeping their elevation above normal water level.

JUSTIFICATION:

It is unknown if the design and current maintenance criteria are adversely impacting degradation. As part of the Corps management of the river, it is incumbent that the Corps periodically re-examine the design and maintenance practices of the BSNP to ensure there are no unnecessary negative effects. This proposal could also result in lower O&M costs of the BSNP which is an important consideration when a low use waterway is competing for O&M funds.

COST ESTIMATE WORKSHEET				
Proposal # 8				
DELETIONS				
ITEM	UNITS	QUANTITY	UNIT COST	TOTAL
Reduced maintenance costs	tons	15,000	$31.00	$465,000
				$0
				$0
				$0
				$0
				$0
				$0
				$0
				$0
	Cost	# Years	Interest=0.03	
Present worth of annual cost	465000	50		$11,964,340
Present worth of future single cost				$0
		Total Deletions		$12,429,340
ADDITIONS				
ITEM	UNITS	QUANTITY	UNIT COST	TOTAL
Lower selected dikes	cubic yard	500,000	$21.00	$10,500,000
Placement of salvaged stone	ton	300,000	$10.00	$3,000,000
Stone fill for energy dissipation structures	ton	1,000,000	$31.00	$31,000,000
				$0
				$0
				$0
				$0
				$0
				$0
	Cost	# Years	Interest=0.03	
Present worth of annual cost				$0
Present worth of future single cost				$0
		Total Additions		$44,500,000
		Net Cost Decrease		-$32,070,660
		Mark-ups	0.00%	$0
		Total Cost Decrease		-$32,070,660

VALUE ENGINEERING PROPOSAL

PROPOSAL NO:	9 (Speculation List Item No. 4 & 5)	PAGE NO: 1 OF 2
DESCRIPTION:	Place moratorium on sand and gravel extraction or reduce amount of sand & gravel extraction.	

ORIGINAL DESIGN:

Commercial sand and gravel extraction is occurring in the study reach. The Corps has Regulatory authority over the activity of sand and gravel extraction on the river and as such can set restrictions on annual extraction tonnage, limit the location of extraction, or eliminate extraction altogether. Results of the hydraulic model indicate a clear connection between the rate of sand and gravel extraction and the rate of degradation. Over the past few years, new tonnage limits have been placed on the extraction companies which has greatly reduced the annual tonnage in the central part of the study reach but new tonnage limits actually increased the allowable tonnage at the upstream and downstream limits of the study reach.

PROPOSED DESIGN:

This proposal is to either further reduce the annual extraction limits throughout the whole study reach or place an outright moratorium on sand and gravel extraction within the study reach. Alternative sources of sand are currently available in floodplain pit mines currently located along both the Missouri and Kansas rivers. However, additional new pit mines may need to be opened to meet demand if all river extraction is prohibited. This may require a phase in period of extraction limits or a moratorium to allow the industry to move to pit mines and meet demand. This action would need to be taken sooner than later as delaying the action will push the benefits to degradation into the future which will reduce the economic benefits of the proposal.

ADVANTAGES:

1. The Corps already has the Regulatory authority to implement this proposal. All that is needed to implement this proposal is to finalize the model results and go through the Regulatory steps to implement this proposal.
2. Low to no cost to most basin stakeholders or the tax payer. This proposal will have a temporary negative effect on the extraction companies as they switch from river extraction to floodplain pit mines. This could result in temporary sand and gravel shortages and an increase in sand and gravel costs during the transition period. However, almost all other basin stakeholders will see a no cost benefit in the form of reduced degradation.

DISADVANTAGES:

1. Temporary increase in sand and gravel costs as discussed above.
2. Regulatory will need to go through a process to implement this proposal in a fair and equitable manner. Some additional modeling may be needed for a phase in period.

JUSTIFICATION:

Most basin stakeholders do not view the Corps Regulatory process as separate from the Degradation Study. When the model results are made public, stakeholders will wonder why the Corps is permitting an activity that has been shown to make the degradation problem worse and will therefore increase the costs of either a degradation fix or the direct costs to the stakeholders such as tributary instability or lowering of water intakes. Both the Missouri River and Kansas River floodplains have massive sand deposits in the floodplain that can be utilized to meet the basin's sand and gravel needs. These deposits make this proposal feasible.

COST ESTIMATE WORKSHEET				
Proposal # 9				
DELETIONS				
ITEM	UNITS	QUANTITY	UNIT COST	TOTAL
Reduced maintenance costs	tons	15,000	$31.00	$465,000
				$0
				$0
				$0
				$0
				$0
				$0
				$0
				$0
	Cost	# Years	Interest=0.03	
Present worth of annual cost	465000	50		$11,964,340
Present worth of future single cost				$0
		Total Deletions		$12,429,340
ADDITIONS				
ITEM	UNITS	QUANTITY	UNIT COST	TOTAL
Costs to dredgers to move off river	LS	1		$10,000,000
				$0
				$0
				$0
				$0
				$0
				$0
				$0
				$0
	Cost	# Years	Interest=0.03	
Present worth of annual cost				$0
Present worth of future single cost				$0
		Total Additions		$10,000,000
		Net Cost Decrease		$2,429,340
		Mark-ups	0.00%	$0
		Total Cost Decrease		$2,429,340

PROPOSAL NO:	10 (Speculation List Item No. 16)	PAGE NO: 1 OF 2
DESCRIPTION:	Curtail Kansas River Sand Dredging.	

ORIGINAL DESIGN:

Commercial sand and gravel extraction is occurring on the Kansas River which is upstream of part of the study reach. This extraction is very likely limiting the amount of sand the Kansas River delivers to the Missouri River which reduces the sediment load of the Missouri which can lead to degradation. The Corps has Regulatory authority over the activity of sand and gravel extraction on the Kansas River and as such can set restrictions on annual extraction tonnage, limit the location of extraction, or eliminate extraction altogether. Over the past few years annual sand extraction on the Kansas River has been trending downward but the activity still occurs.

PROPOSED DESIGN:

This proposal is to either further reduce the annual extraction limits or place an outright moratorium on sand extraction on the Kansas River. Alternative sources of sand are currently available in floodplain pit mines currently located along both the Missouri and Kansas rivers. However, new pit mines may need to be opened to meet demand if all river extraction is prohibited. This may require a phase in period of extraction limits or a moratorium to allow the industry to move to pit mines and meet demand. This action would need to be taken sooner than later as delaying the action will push the benefits to degradation into the future which will reduce the economic benefits of the proposal. The Degradation Study team will need to model this proposal to better quantify the benefits so stakeholders can understand why the action needs to be taken.

ADVANTAGES:

1. The Corps already has the Regulatory authority to implement this proposal. All that is needed to implement this proposal is to model the proposal and go through the Regulatory steps to implement this proposal.
2. Low to no cost to most basin stakeholders or the tax payer. This proposal will have a temporary negative effect on the extraction companies as they switch from river extraction to floodplain pit mines. This could result in temporary sand and gravel shortages and an increase in sand and gravel costs during the transition period. However, almost all other basin stakeholders will see a no cost benefit in the form of reduced degradation.

DISADVANTAGES:

1. Temporary increase in sand and gravel costs as discussed above.
2. The Degradation Study team will need to model this proposal so the benefits can be quantified. Regulatory will then need to go through a process to implement this proposal in a fair and equitable manner.

JUSTIFICATION:

Both the Missouri River and Kansas River floodplains have massive sand deposits in the floodplain that can be utilized to meet the basin's sand and gravel needs. These deposits make this proposal feasible. The Corps needs to take a regional sediment management approach to commercial sand extraction on all rivers within the District, especially those rivers that are upstream of a degrading reach of river.

COST ESTIMATE WORKSHEET				
Proposal # 10				
DELETIONS				
ITEM	UNITS	QUANTITY	UNIT COST	TOTAL
Reduced maintenace costs	tons	5,000	$31.00	$155,000
				$0
				$0
				$0
				$0
				$0
				$0
				$0
				$0
	Cost	# Years	Interest=0.03	
Present worth of annual cost	155000	50		$3,988,113
Present worth of future single cost				$0
		Total Deletions		$4,143,113
ADDITIONS				
ITEM	UNITS	QUANTITY	UNIT COST	TOTAL
Costs to dredgers to move off river	LS	1	$0.00	$4,000,000
				$0
				$0
				$0
				$0
				$0
				$0
				$0
				$0
	Cost	# Years	Interest=0.03	
Present worth of annual cost				$0
Present worth of future single cost				$0
		Total Additions		$4,000,000
		Net Cost Decrease		$143,113
		Mark-ups	0.00%	$0
		Total Cost Decrease		$143,113

1. ***Utilize Spoil from River Widening for Sand Source (Spec List Item No 2)***.

To the maximum extent practicable, material from river widening projects – including the proposals and alternatives from this study and other Missouri River projects – should be integrated into the Missouri River bedload subject to applicable laws and regulations including the Clean Water Act, State specific water quality criteria, etc.

This comment is not to say that ALL material from these projects is required to be integrated into the river. There are many other beneficial reuses for sediment, and some may be more applicable than the Missouri River Bed Degradation study. These projects should be studied on a case-by-case basis, and the best solution should be found for that particular project.

The soil should also be tested for pollutants and high nutrient contents prior to placement or reintroduction into the river in accordance with State and Federal Laws.

2. ***Restore Sediment Delivery from Tributaries (Spec List Item No 13, 32)***.

Restore Sediment Delivery from Tributaries (13) – In the reservoir reach of the Missouri River, tributary sediments are deposited in the reservoirs. In the BSNP, sediment is delivered directly to the Missouri River channel except where prevented from doing so by grade control structures, headwalls, and dams. An assessment should be made of the available sediment behind the tributary structures and what effect reintroduction of that sediment would have to BSNP channel degradation.

Sediment Bypass on Kansas River Reservoir System (32) – Four large reservoirs on tributaries of the Kansas River collect sediment before it reaches the mainstem and can be delivered to the Missouri River. The sediment collected in these reservoirs may be fine enough to warrant consideration of sediment bypass during high flow events, or drawdown flushing during low water times.

3. ***Upstream Sediment Reintroduction (Spec List Item No 21, 30, 31, 22)***.

The Missouri River mainstem system consists of six large reservoirs. In addition, dozens of tributaries have smaller reservoirs that cumulatively reduce sediment delivery to the lower river. As long as the vast majority of the pre-dam sediment transport on the river is trapped by these reservoirs, degradation in the KC reach will be a concern.

Build Sediment Flushing Tunnels on Existing Dams (21) – None of the mainstem reservoirs were constructed with low level outlets to facilitate drawdown flushing of sediment. If such tunnels were installed in the dams, starting at Gavins Point Dam and working upstream, sediment transport to the lower river could be increased. Significant modeling would be necessary to determine the magnitude of the benefit to bed degradation.

Remove Gavins Point Dam (30) – Removal of Gavins Point Dam would instantly reintroduce sediment discharge from an additional 90 miles of the Missouri River and the Niobrara River, as well as the sediment stored in Lewis and Clark Lake over the past 55 years. This would result in a moderate, short-term increase in sediment as the reservoir delta erodes, and a smaller, long-term increase due sediment delivery from the Niobrara. The majority of sediment discharged by the Niobrara river is fine sand.

Bypass Niobrara River (31) – a Section 905(b) reconnaissance study in 2001 determined that relocating the mouth of the Niobrara River to below Gavins Point Dam would require approximately 11B CY of excavation to maintain a channel and flood plain. This project would reduce the aggradation rate in the lower Niobrara River and Lewis and Clark Lake by approximately 60-70%.

Dredge Behind Dam of Existing Reservoirs and Send Sediment Downstream (22) – Mechanical dredging of deposited sediments behind dam could be discharged into the Missouri River and it’s tributaries. The reintroduction of this sediment would aid in slowing degradation in the KC reach of the Missouri River. Suggested areas include reservoirs on the Kansas River and Gavins Point Dam on the Missouri. A rough estimate of the annual cost to dredge Gavins Point dam is $40-50M.

It should be identified in the study that reintroduction of sediment to the river would be the most effective way to reduce degradation in the BSNP reach of the Missouri River. However, with environmental, social, economic, and political issues, significant changes in sediment management in the reservoir system are not expected in the near future.

4. ***Intensify Shallow Water Habitat Upstream to Reintroduce Sediment (Spec List Item No 29)***.

Sediment from upstream Shallow Water Habitat sites can be used to temporarily augment the loss of the bedload through the study reach. This can be done during construction by means of hydraulic dredging directly to the bedload, or by placement of material into the widening zone of pilot side channel chutes. Side channel chutes are typically built as pilot projects which are designed to widen over time and dependent upon river stages.

Currently, the Missouri River Recovery Program does not include Missouri River Bed Degradation into their considerations for selection of sites. Sites within or upstream of the study reach could be prioritized to provide temporary benefits to the bed degradation within the study reach.

5. ***Relocate the infrastructure (water intakes, roads, bridges, etc.) (Spec List Item No 36***.

The PDT's proposed future without project condition assumes that affected utilities will choose to relocate or modify their facilities prior to the bed degradation reaching a critical elevation for each facility. The water supply, power, flood risk reduction and transportation functions provided by the existing facilities are critically important, so this assumption is appropriate for the economic analysis. The "do nothing" alternative is essentially a choice to relocate or modify the existing infrastructure to preserve its functionality rather than stabilizing the river bed and water surface.

6. ***Plan beyond the short-term; identify inevitable expenses (Spec List Item No 37)***.

The PDT should determine a realistic "base year" for the analysis and document the assumptions that support the determination. The economic analysis should be based on reasonable expectations for the timing of federal actions and any benefits of a federal project. Some of the utilities will likely be at their critical bed or water surface elevation before any federal action is effective, and modifications will be needed to guarantee continued reliability. Any costs that will have to be expended before the federal project is actually effective cannot be counted in the project benefits.

7. ***Survey a sample of structures on tributaries to estimate potential tributary benefits (Spec List Item No 38)***.

The VE team understands that this is a SMART Planning study, so time and resources are limited. The PDT intends to qualitatively discuss potential benefits on the tributaries. The VE team believes that an inexpensive sampling effort using GIS tools could add significant quantitative support to the qualitative discussion of potential benefits. A random sampling of the tributary reaches combined with limited assessment of structures in the sampled reaches would provide a statistically valid basis for estimating the number and types of structures that are potentially impacted on the tributaries. While it would probably be more difficult to estimate the timing of future impacts on the tributaries, knowing the number and types of structures involved would at least provide a potential ultimate magnitude of damages to compare with similar data on the main river channel. These benefits may be important to capture, especially if the project costs appear to exceed main channel benefits.

8. ***Identify temporary measures to implement for short-term benefits (Spec List Item No 39)***.

The PDT should identify temporary actions that could be implemented quickly to stabilize the bed and water surface near critical infrastructure. One action discussed was to use sheet pile weirs for grade control at key locations. Placing a temporary moratorium on dredging operations could delay degradation.

9. ***Incentivize sand and gravel suppliers to obtain material from other sources (Spec List Item No 40)***.

The VE team discussed the connection between Missouri River dredging and ongoing bed degradation. It appears that dredging operations contribute significantly to the problem, but dredging has historically been permitted. Dredgers provide lower-cost sand and gravel, but it must be recognized that the lower price is “subsidized” because the external costs of bed degradation are not accounted for.

The Corps and other regulators should account for these external costs in their analyses of future permit actions. Reducing permitted dredging volumes would force suppliers to use other sources.

The Corps and other stakeholders may be able to work with dredgers to excavate material from strategic places in the floodplain to provide more diverse habitat or achieve other goals.

10. ***Install in-river structures to induce sand deposition (Speculation # 44).***

BLUF: Originally considered a *Proposal*, investigation of potential in-river structures to induce sand deposition—other than commonly-used structures, such as chevrons (which are assumed to have already been considered and discounted by the District PDT)—revealed no known existing structure that would induce in-river sand deposition as its primary purpose within the refined study area. Sufficiently-sized grade control structures, however, may induce some localized sand deposition.

Justification: It's important to differentiate between in-river and flood-plain/over-bank deposition. This *Comment* only addresses in-river deposition, where sand has great value in both reducing bed degradation and for numerous environmental reasons. While a lack of sand input from headwaters and its substantial commercial removal currently define the Missouri River system, flood events of sufficient duration with tributary contributions from plains runoff, can and have provided appreciable amounts of sand.[1] As such, it was considered prudent to take the time to consider other, less recognized in-river structures to trap sand in-river when periodically made available.

Discussion: Dikes and associated structures, used primarily to create and maintain a self-scouring navigation channel, have allowed entrained sediment to accrete enough that former river habitat has become terrestrial habitat. While the latter habitat is of great value to agriculture and wildlife, high quality sediment (i.e., sand & gravel) is locked-up in fields and lowland forest. More critically, however, up-river dams greatly reducing sediment input and substantial commercial in-river sand & gravel extraction have led to rapid river bed degradation. Original river control structures (providing navigable river & reduce flooding) did not consider in-river sand deposition important; a consideration only widely acknowledged in about the last decade.

Recent observations along the Missouri River[1] indicated that sand stayed in-river when less constrained sections of the channel were more incised or aggraded (thus, wider). Any potential structure capable of inducing sand disposition must reduce flow, which may be accomplished multiple ways (e.g., widening/introducing channels, reducing river gradient). Common structures used to "train" rivers (e.g., chevrons, revetments, dikes) modify both hydraulic flow and sediment response; however, such structures are either not considered appropriate for the section of river being studied (e.g., chevrons), or having been used (e.g., dikes), eventually contributed to the bed degradation problem. On-line search and expert solicitation revealed no known structures that would induce in-river sand deposition, other than sufficiently-sized grade control structures, that in simultaneously reducing both local river gradient and flow energy (forcing water up, against gravity), may induce some localized sand deposition as an ancillary function.

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[1] Alexander, J.S., R.B. Jacobson and D.L. Rus. 2013. Sediment transport and deposition in the lower Missouri River during the 2011 flood: U.S. Geological Survey Professional Paper 1798–F, 27 p., http://dx.doi.org/10.3133/pp1798f.

11. ***Remove Alternating dikes for channel widening and grade control material supply (Spec List Item No 54)***.

The density of dikes in the BSNP was designed to 1) induce accretion of land between the dikes, and 2) narrow and maintain the river flow in a single channel. It should be considered that the current density of dikes is no longer needed in the current planform. Analysis should be completed to determine if some dikes could be removed well into the existing river bank and still maintain the navigation channel.

If it were possible to remove some dikes at least 300-500 feet into the bank, the material that would erode between the remaining dikes would create a wider top-width of the river, and provide a significant supply of recycled rock that could be used for grade control structures.

SUPPORTING DOCUMENTS

CONTACT DIRECTORY

NAME	ORGANIZATION	DISCIPLINE	PHONE	EMAIL
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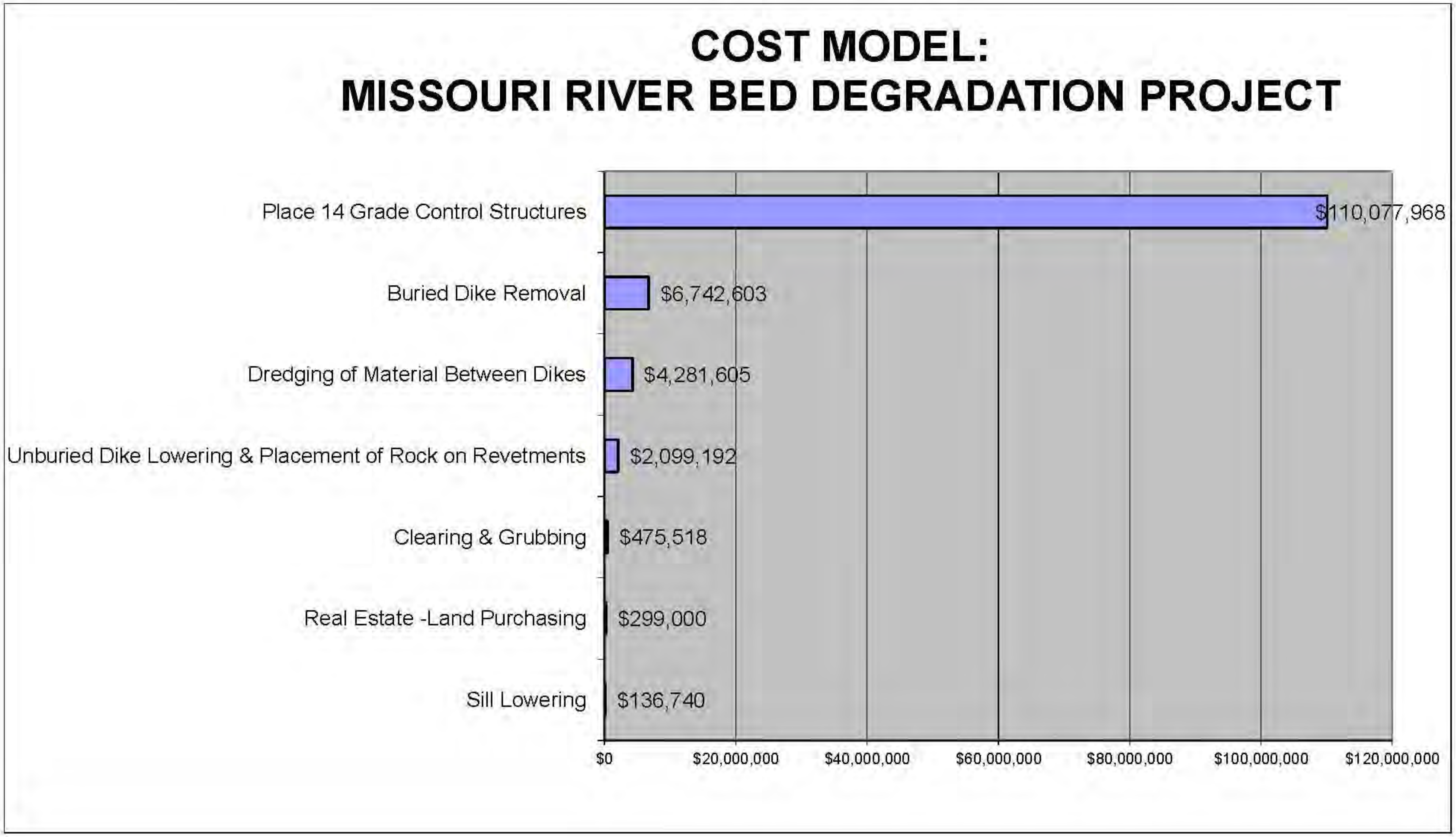
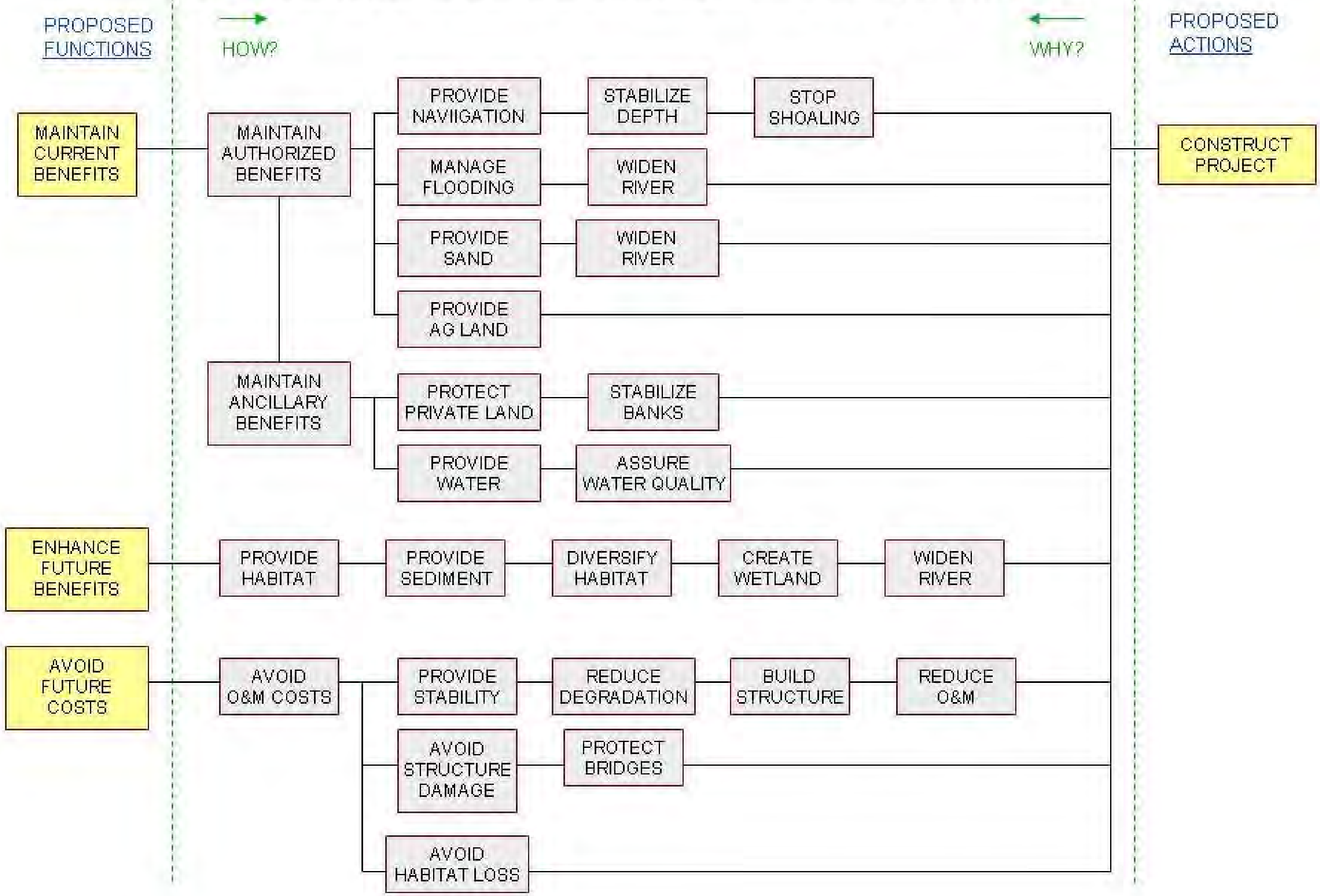
Chris McGarry Jerry Diamatious	David Miller & Assoc.	GIS Econ	779-290-0166 (o) 401-861-0084 (o)	cmcgarry@dma-us.com jerry@dma-us.com

COST MODEL


COST MODEL:
MISSOURI RIVER BED DEGRADATION PROJECT
Place 14 Grade Control Structures
$110,077,968
Buried Dike Removal
$6,742,603
Dredging of Material Between Dikes
$4,281,605
Unburied Dike Lowering & Placement of Rock on Revetments
$2,099,192
Clearing & Grubbing
$475,518
Real Estate -Land Purchasing
$299,000
Sill Lowering
$136,740
$0
$20,000,000
$40,000,000
$60,000,000
$80,000,000
$100,000,000
$120,000,000

FUNCTION ANALYSIS SYSTEM TECHNIQUE (FAST) DIAGRAM

FAST DIAGRAM FOR MISSOURI RIVER BED DEGRADATION



VE SPECULATION LIST

APPENDIX D: VE SPECULATION LIST

PR #	Spec Item #	Disposition	Description
1	53	P	Minor modification to BSNP structures
2	7	P	Significantly modify the BSNP Structures w/27
2	27	P	Update BSNP design criteria w/7
3	8	P	Build grade control structures
3	41	P	Gradually phase in grade control structures
3	42	P	Install multiple and smaller grade control structures
3	43	P	Install low weir w/ sheet pile for Grade control
4	10	P	Increase sinuosity of river channel w/12
4	12	P	Restore liberty bend cutoff w/10
5	14	P	Construct small secondary channel any where there is space
6	1	P	Widen the river within the city w/15, 23, 51
6	15	P	Create flood way within flood plane w/1, 23, 51
6	23	P	Construct Temporary Structures to widen river w/1, 15, 51
6	51	P	Set back some ag levees in lower river reaches to widen flood plane w/ 1, 15, 23
7	52	P	Widen the river within the entire study reach
8	46	P	Install energy dissipaters w/47, 48, 49, 50
8	47	P	Remove L heads from dikes
8	48	P	Install dikes on outside bank on curves to dissipate energy
8	49	P	Install precast concrete boxes on river bottom to roughen the bottom
8	50	P	Install Ajax on river bottom
9	4	P	Place moratorium on sand and gravel extraction w/5
9	5	P	Reduce amount of sand & gravel extraction w/4
10	16	P	Curtail Kansas river dredging

APPENDIX D: VE SPECULATION LIST

CMT #	Spec Item #	Disp-osition	Description
1	2	C	Utilize spoil from river widening for sand source
2	13	C	Restore sediment supply from tributaries w/32
2	32	C	Sediment bypass on the Kansas reservoir system w/13
3	21	C	Build sediment flushing tunnels on existing dams w/22
3	22	C	Dredge behind Dam of existing reservoirs and send sediment downstream w/21
3	30	C	Remove Gavins Point dam w/31
3	31	C	Bypass Niobrara river w/30
4	29	C	Intensify shallow water habitat upstream to re-introduce sediment
5	36	C	Relocate infrastructure
6	37	C	Plan Beyond Short Term Identify inevitable Expenses
7	38	C	Survey & Sampling to determine cost impacts to tributary structure
8	39	C	ID temporary measures to implement for short term
9	40	C	Incentivize sand and gravel suppliers to obtain material from delta at Lewis&Clark lake
10	44	C	Install structures in river to induce sand deposition
11	54	C	Remove alternating dikes for channel widening and grade control material supply

Spec Item #	Disp-osition	Description
1	P	Widen the river within the city w/15, 23, 51
2	C	Utilize spoil from river widening for sand source
3	X	Consider sediment augmentation
4	P	Place moratorium on sand and gravel extraction w/5
5	P	Reduce amount of sand & gravel extraction w/4
6	X	Manage flows within the master manual
7	P	Significantly modify the BSNP Structures w/27
8	P	Build grade control structures
9	X	Shift BSNP Alignment
10	P	Increase sinuosity of river channel w/12
11	X	Use Geotubes for grade control
12	P	Restore liberty bend cutoff w/10
13	C	Restore sediment supply from tributaries w/21, 22, 32
14	P	Construct small secondary channel any where there is space
15	P	Create flood way within flood plane w/1, 23, 51
16	P	Curtail Kansas river dredging
17	X	Armor the Bed w certain reaches w/18, 19
18	X	Install ACM articulated concrete mattress w/17, 19
19	X	Use recycled concrete for armoring w/17, 18
20	X	Build a lock and dam

Spec Item #	Disp-osition	Description
21	C	Build sediment flushing tunnels on existing dams w/13, 22, 32
22	C	Dredge behind Dam of existing reservoirs and send sediment downstream w/13, 21, 32
23	P	Construct Temporary Structures to widen river w/1, 15, 51
24	X	Employ more BSNP structures in channel downstream
25	X	Construct aqueducts
26	X	Permit dredgers to coincide with river widening
27	P	Update BSNP design criteria w/7
28	BD	Perform sediment study using Hec model
29	C	Intensify shallow water habitat upstream to re-introduce sediment
30	C	Remove Gavins Point dam w/31
31	C	Bypass Niobrara river w/30
32	C	Sediment bypass on the Kansas reservoir system w/13, 21, 22
33	X	Subterranean water storage
34	X	New upstream reservoir
35	X	Inflatable dams
36	C	Relocate infrastructure
37	C	Plan Beyond Short Term Identify inevitable Expenses
38	C	Survey & Sampling to determine cost impacts to tributary structure
39	C	ID temporary measures to implement for short term
40	C	Incentivize sand and gravel suppliers to obtain material from delta at Lewis&Clark lake

Spec Item #	Disp-osition	Description
41	C	Gradually phase in grade control structures
42	C	Install multiple and smaller grade control structures
43	C	Install low weir w/ sheet pile for Grade control
44	P	Install structures in river to induce sand deposition
45	X	Install Run-of-River Hydropower
46	P	Install energy dissipaters w/47, 48, 49, 50
47	P	Remove L heads from dikes
48	P	Install dikes on outside bank on curves to dissipate energy
49	P	Install precast concrete boxes on river bottom to roughen the bottom
50	P	Install Ajax on river bottom
51	P	Set back some ag levees in lower river reaches to widen flood plane w/ 1, 15, 23
52	P	Widen the river within the entire study reach
53	P	Minor modification to BSNP structures
54	C	Remove alternating dikes for channel widening and grade control material supply
	P= PROPOSAL	
	C= COMMENT	
	X= DELETE	
	BD= BEING DONE	

VE STUDY AGENDA

VALUE ENGINEERING WORKSHOP AGENDA
MISSOURI RIVER BED DEGRADATION FEASIBILITY REPORT
1-4 April 2014
KANSAS CITY DISTRICT OFFICE BUILDING

TUESDAY - 1 APR 14:

0900-0930	Introductions and Workshop Purpose – Christy Ostrander VE Process, How it will be used, and Agenda – Rick Lambert, PE, CVS
0930-1030	*Information Phase:* Presentation of Project and Current Status Project Overview Presentation – PDT • Project Description and Background • Description of Alternatives Analyses and Evaluations • Summary of Current IPR and Vertical Team Meetings/Decisions Summary of Project Constraints, Issues and Concerns – PDT
1045-1300	Site Visit and Lunch
1300-1400	*Function Analysis Phase:* - Rick Lambert
1400-1700	*Creative Phase:* Brainstorming session - Rick Lambert

WEDNESDAY – 2 APR 14:

0830-1130	*Creative Phase:* Continue brainstorming session - Rick Lambert
1130-1230	Lunch
1230-1330	*Evaluation Phase:* Analyze and critique all ideas, determine if idea will be developed as a proposal, comment, or rejected - Rick Lambert
1330-1630	*Development Phase:* - Assign tasks to team members, review sample VE study report, discuss requirements for proposal write-ups - Rick Lambert

THURSDAY – 3 APR 14:

8:30-1130	*Continue Development Phase:* - VE Team *Prepare VE study Report:* - Rick Lambert
1130-1230	Lunch
1230-1630	*Continue Development Phase:* - VE Team *Prepare VE study Report:* - Rick Lambert

VALUE ENGINEERING WORKSHOP AGENDA
MISSOURI RIVER BED DEGRADATION FEASIBILITY REPORT
1-4 April 2014
KANSAS CITY DISTRICT OFFICE BUILDING

FRIDAY – 4 APR 14:

0830-1130	*Complete Development Phase*: - VE Team *Draft Out Brief Presentation:* - Rick Lambert
1130-1230	Lunch
1230-1400	*Review Outbrief Presentation* - VE Team
1400-1500	*Out Brief Presentation*: - Rick Lambert
1500-1600	*Wrap Up and Completion:* - Rick Lambert & Christiana Ostrander
Week following study:	Review Draft VE Report – VE Team Revise and submit corrected Draft VE Report - Rick Lambert
Week following issuance of Draft VE Report:	Review Draft VE Report, make implementation decisions – PDT Revise and submit Final VE Report - Rick Lambert

CERTIFICATION

This report was commissioned by:
US Army Corps of Engineers, Kansas City District

This report was compiled by:

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END OF REPORT