ATTACHMENT 4
VALUE ENGINEERING REPORT

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CESWG-PM-J 28 February 2017

MEMORANDUM FOR THE RECORD

SUBJECT: Implementation Decisions on Value Engineering Proposals for the Freeport Harbor Channel Improvement General Reevaluation Report, Freeport, Brazoria County, Texas.

1. The objective of the study – identify the least cost, environmentally acceptable plan consistent with sound engineering practices to provide a safe and efficient transit of Panamax vessels through a constructed section of the Freeport Harbor Channel referred to as the waist of the DOW Thumb to Velasco Terminal.

2. The Value Engineering (VE) study was conducted on the Freeport GRR at point in the study (between the Alternative Milestone and the Tentatively Selected Plan Milestone) to validate the baseline concept and determine alternatives which would improve ship navigation efficiency and safety. A principle objective of the study was to develop alternatives that would save cost while preserving the project's objectives and requirements.

3. A 3-day VE workshop was conducted with a multidisciplinary team in Galveston, Texas. The teams was composed of personnel from USACE Galveston District, the Local Sponsor Representative, Independent technical experts, and the VE facilitator. The project was studied using standard VE methodology, consisting of six phases: Information Phase, Function Phase, Creative Phase, Evaluation Phase, Development phase, and Presentation Phase.

4. The VE Team generated 57 ideas during the Creative Phase and in the Evaluation Phase dismissed 28 of them from development. Seven became proposals and the remaining 20 were designated as design comments. The VE team recommends that Proposal 1.1 and 3.0 be implemented with a total estimated first cost of $4,505,000 and life-cycle cost savings of up to $42,459,000.

   VEP 1.1 -Increase channel widening from 400 feet to 600 feet at DOW Thumb (total estimated first cost savings of $3,242,000 and life cycle cost savings of $42,459,000)
   VEP 3.0 - Use a combination of mechanical excavation and hydraulic dredging in lieu of only hydraulic dredging (Total estimated first cost savings of $1,263,000 and the life cycle savings of $0)

5. The PDT evaluated VE Proposal (VEP) number 1.1 and will consider it its implementation pending further evaluation and accepted the recommendation of VEP 3.0.

   VEP 1.1 recommends channel widening from 400 feet to 600 feet at the DOW Thumb. The PDT is considering this recommendation pending further evaluation. This is due to multitude of reasons including 1) DOW owns the thumb land and based upon previous conversations, DOW was not willing to sell the property, 2) information has been circulating about potential HTRW concerns on the thumb, 3) concerns with the authority to move the thumb under a 216 Navigation study and 4) the likely need to receive Congressional authorization to change a feature of another Federal project (Freeport Hurricane Flood Protection Project).

The PDT is not willing to consider the 600-foot alternative if the land is not available for purchase and is not willing to pursue with condemning under eminent domain due to the duration to complete the process (greater than 3-years). Additionally, substantial risk is involved with condemnation of a property with potential HTRW issues. If the property is condemned the Port and/or Government would be responsible for any HTRW cleanup which could result in significant cost and time delays.

VEP 3.0 recommends the use a combination of mechanical excavation and hydraulic dredging in lieu of only hydraulic dredging. The PDT is accepting this recommendation and has provided the TSP level cost estimate (Contract B) to reflect this incorporation. Note that the PDT is not considering defining the means and methods; therefore, allowing the contractor to determine the least cost method.

6. The PDT's justifications for rejecting the VE proposals appear to be valid and complete. The complete write up of the rationale supporting the PDTs recommendation is provided in Appendix A. Since there are no outstanding VE matters that need to be addressed, the VE study process is considered to have been completed.

_____
Engineering Lead

_____
Value Engineering Officer

_____
Project Manager

201602-C

Preliminary Value Engineering Study Report

Freeport Harbor Channel Improvement Project GRR

U.S. Army Corps of Engineers, Galveston District

Project Location: Galveston, Texas
P2 #: 402197
Design Firm: HDR Engineering, Inc.
Study Dates: 9-11 August 2016
Report Date: 18 August 2016

Prepared by

Value Management Strategies, Inc.
on Behalf of HDR Engineering, Inc.

VMS
Value Management Strategies, Inc.

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Date: 18 August, 2016

To: **Nicholas Laskowski, Project Manager**
USACE Galveston District Office
2000 Fort Point Road, Galveston, TX 77550

Neil McLellan, Sr. Professional Associate
HDR Engineering, Inc.
4828 Loop Central Drive, Ste 800, Houston, TX 77081

Subject: Preliminary VE Study Report
Freeport Harbor Channel Improvement Project GRR

Dear Nicholas and Neil,

Value Management Strategies, Inc. is pleased to transmit this Preliminary Value Engineering (VE) Study Report for the referenced project. This report summarizes the events of the study conducted 9-11 August 2016 at the USACE offices in Galveston, Texas.

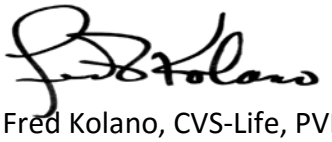
Next is a review of the proposed Value Engineering alternatives by project management and the project development individuals. Reviewers should indicate whether to accept or reject each proposed VE alternative. When the implementation recommendations have been compiled and provided to us, we will integrate the results into the Final VE Study Report.

During the VE study Outbrief, it was noted that review time would be from 19-25 August 2016. The final report will be distributed by or before 01 September 2016. Please provide your implementation recommendations to Jon Plymale, the USACE Galveston Value Engineering Officer. His email is jon.e.plymale@usace.army.mil. He will forward the information to us.

If you have any questions or comments concerning this report, please contact me at 970-216-1739 or email fred@vms-inc.com.

Sincerely,

VALUE MANAGEMENT STRATEGIES, INC.



Fred Kolano, CVS-Life, PVM, FSAVE
Value Engineering Study Team Leader

Copy: (PDF) Jon Plymale, Galveston District Value Engineering Officer

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EXECUTIVE SUMMARY

PRELIMINARY

A Value Engineering (VE) study, sponsored by USACE Galveston District and facilitated by Value Management Strategies, Inc., was conducted for Freeport Harbor Channel Improvement Project GRR in Galveston, TX. The study was conducted August 9 – 11, 2016 at the Galveston, TX USACE offices. This *Executive Summary* provides an overview of the project, key findings, and the alternatives developed by the VE team.

PROJECT SUMMARY

Freeport Harbor provides deep water access from the Gulf of Mexico to Port Freeport. The waterway extends from deep water in the Gulf through a 0.83-mile jettied channel to the Lower Turning Basin, then westerly approximately 1.5 miles to and including the Brazosport Turning Basin, and westerly again approximately 2.2 miles through the Upper Turning Basin to and including a turning basin at Brazos Harbor.

The Freeport Harbor Channel was established in the 1800s from a natural river meander, the exit to which was diverted in the 1920s. As a result, the channel flows are based upon tidal fluctuations. The configuration of the channel poses a significant challenge to ship navigation, especially as larger vessels require access to Velasco Terminal at the northern end of the channel.

A Final Environmental Impact Statement for the project was prepared by USACE in 1978. That year, Seaway Pipeline, Inc., under a Department of Army permit, was authorized to widen the Entrance (Outer Bar) Channel to 400 feet and the Jetty Channel to 230 feet. The current Freeport Harbor Project is authorized under Section 7002 of the WRDA 2014 and a feasibility study.

Total project costs for all elements of the project are currently estimated at $47,900,000.

PROJECT PURPOSE AND NEED

The purpose and need of this project is to improve channel navigation in order to accommodate Panamax vessels, thereby improving commerce in the region.

VALUE ENGINEERING STUDY TIMING

The VE study was conducted during the General Re-Evaluation Report (GRR) process. The Tentative Selection Plan is to be completed in November 2016 and the GRR is to be completed in April 2017.

VE STUDY OBJECTIVES

The objectives of the VE study was to validate the baseline concept and determine alternatives which would improve ship navigation efficiency and safety. A principal objective of the study was to develop alternatives that would save cost while preserving the project's objectives and requirements.

KEY PROJECT ISSUES

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

Construction:

- Soil conditions inhibit driving of pipe or sheet pile and slows dredging.
- Construction staging must be scheduled in increments that do not jeopardize integrity of existing levee.
- Marine traffic management during construction.
- Port of Freeport must provide laydown areas for Contractor, which may incur additional costs.

Design: Allowable setback for safe navigation of vessel adjacent to LPG loading dock is currently unknown.

Environmental: Dredging operations could negatively affect water quality.

Funding: Exceeding the 902 limit would require additional Congressional authorization.

Operations: LNG safety zone radius can extend up to 200-300 meters during loading and unloading, which takes approximately 2-3 days.

Site: Physical geometry and geometrics are narrow which limits ability to widen the channel.

Stakeholders: Coordination of several stakeholders with multiple goals and objectives is difficult.

EVALUATION OF BASELINE CONCEPT

During the course of the VE study, a number of analytical tools and techniques were applied to develop a better understanding of the baseline concept. A major component of this analysis was Value Metrics which seeks to assess the elements of cost, performance, time, and risk as they relate to project value. These elements required a deeper level of analysis, the results of which are detailed in the *Project Analysis* section of this report. The key performance attributes identified for the project are listed in the table, "Performance Attributes."

Performance Attributes
Channel Operations
Sustainability
Maintainability
Construction Impacts
Environmental Impacts

Below is a summary of the major observations and conclusions identified during the evaluation of the baseline concept which led the VE team to develop the alternatives and recommendations presented in this report.

The VE team studied the existing channel by using Google Maps. This helped the team to understand the relationships between key aspects of the proposed project. A Pareto cost analysis showed the largest cost items of the project and through function analysis the VE team was able to understand how these cost drivers worked and offered opportunity for improvement. Key performance attributes

noted above were used to help the team determine which ideas would be best to improve value. The tight turning curve radius was a key area of concern. A test of channel negotiation by seasoned marine pilots indicated that the tight curve of 400 feet was a concern. The need for turning areas was also determined to be a key factor in helping pilots negotiate the channel.

VE ALTERNATIVES

The VE team developed 7 alternatives for improvement of the project. The following are the alternatives identified, along with their associated potential initial cost and life-cycle cost (LCC) savings, potential change in schedule, performance change, and a brief discussion of each.

Alternative No. and Description	Initial Cost Savings	LCC Savings	Change in Schedule	Change in Performance
1.1 Increase channel widening from 400 feet to 600 feet at DOW Thumb	**$3,242,000**	**$42,459,000**	**+24 months**	**+40 %**
This VE alternative proposes increasing the width of the narrowest point of the channel at the DOW Thumb waist from 400 feet to 600 feet in order to better accommodate current and future vessel navigation and maneuverability. The primary advantage of this alternative is that a wider channel will better accommodate current and future vessel navigation and maneuverability in the channel.				
1.2 Consult with HFPP to authorize design waiver to remove existing underwater berm without mitigation	**$11,746,000**	**$0**	**+36 months**	**-18 %**
This VE alternative proposes to consult with the HFPP to obtain a design waiver that will allow for removal of the existing submerged berm without the need to strengthen the existing levee foundation, thus lowering the existing factor of safety. This approach would eliminate 4,300 feet of sheet piling, resulting in substantial cost savings.				
2.0 Reduce bend easing footprint by 20 percent and reconfigure optimally	**$3,591,000**	**$0**	**-2 months**	**-3 %**
The baseline concept proposes 1,500,000 CY of excavation to construct a bend easing area at the south end of the project site in order to provide a safety runoff zone, improve ship maneuverability and provide a hydrodynamic buffer. This VE alternative proposes to reduce the bend easing area footprint by 20 percent by reconfiguring the area, resulting in an excavation reduction of 300,000 CY.				
3.0 Use a combination of mechanical excavation and hydraulic dredging in lieu of only hydraulic dredging	**$1,263,000**	**$0**	**No change**	**No change**
This VE alternative proposes to use a combination of dry-land mechanical excavation and hydraulic dredging in lieu of only hydraulic dredging in the bend easing area. The alternative allows concurrent excavation work, reduces excavation costs, and results in better quality of excavated materials, increasing options for its reuse.				

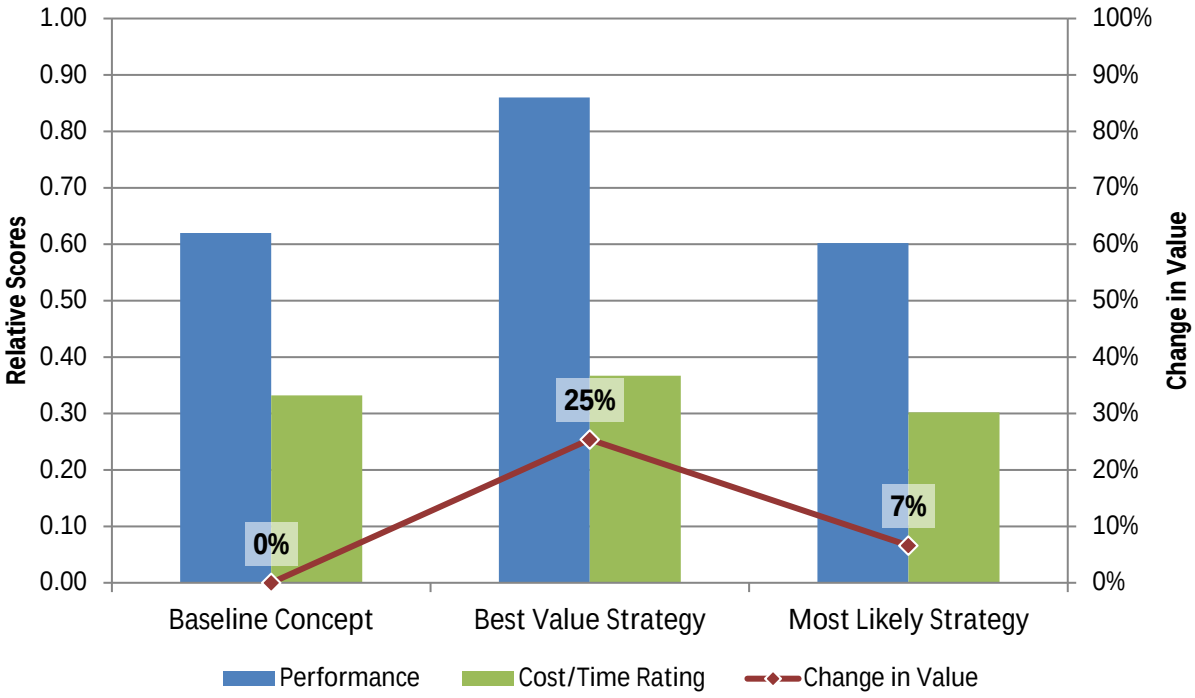
Alternative No. and Description	Initial Cost Savings	LCC Savings	Change in Schedule	Change in Performance
4.0 Sell above-ground excavated material to local developers or back to Port Freeport	**$300,000**	**$0**	**No change**	**No change**
This VE alternative proposes selling above-ground excavated material to local developers or back to Port Freeport for use in levee filling or other general applications. The feasibility of this idea would be significantly increased by use of mechanical excavation rather than hydraulic dredging to keep material dry.				
5.0 Reduce advanced maintenance dredging from 2 feet to 1 foot across the footprint of the dredging	**$1,771,000**	**$7,867,000**	**No change**	**-6 %**
The baseline concept proposes excavating an additional 2 feet of depth across the project footprint for advanced maintenance and 1 foot for overdredge. This is intended to reduce future maintenance of the channel and is a common dredging practice. This VE alternative would reduce advanced maintenance dredging from 2 feet to 1 foot, and would maintain the 1 foot of overdredge.				
6.0 Pre-purchase steel sheet piling through USACE to reduce timing and save sales tax costs	**$393,000**	**$0**	**No change**	**No change**
This VE alternative proposes that USACE Galveston District pre-purchase steel sheet piling for use in the DOW Thumb waist levee foundation strengthening, therefore exempting the material from sales tax. Although this is not common practice in the Galveston District, earlier acquisition of materials reduces lead time concerns, and there is precedent of other government agencies successfully using this approach.				

VE STUDY RESULTS

The proposed VE alternatives will improve project value by providing both construction and life cycle cost savings. Reducing the Bend Easing component of the project by 20% will produce cost and time savings. If adequate space can be obtained, aligning the channel through the DOW Thumb will widen the channel by an additional 200 feet and provide much better navigation abilities.

A summary of the VE strategies (combinations of VE alternatives) is provided in the following chart and table. This chart illustrates the relative trade-offs between performance (shown by the blue columns) versus cost and schedule (shown by the green columns). The red value line indicates the net % change in total value relative to the baseline concept. Please refer to the *Project Analysis* section of this report for additional details on this analysis.

Comparison of Value – Baseline Concept and VE Strategies



Summary of VE Strategies

Strategy Description	Initial Cost Savings	LCC Savings	Change in Schedule	Performance Change	Value Change
Best Value Strategy 1.1, 2.0, 3.0, 4.0, 5.0, 6.0	$10,294,000	$43,867,000	+22 months	+39 %	+25 %
Most Likely Strategy 2.0, 3.0, 4.0, 5.0, 6.0	$5,882,000	$7,867,000	-2 months	-3 %	+7 %

Note: The combinations of VE alternatives summarized above may result in "double-counting" of some costs and time. The VE study team discussed this concern and made adjustments to the VE strategy cost savings calculations to eliminate any "double counting" that would be contained in the strategies. Details of these adjustments for each strategy are listed below.

Best Value Strategy

- Assumes baseline bend easing is approximately 75% of overall dredging cost. 20% of that 75% is advanced maintenance dredging.
- Reduction of bend easing footprint reduces the advanced maintenance dredging savings by approximately 15%
- VE Alt 5.0 $1,771,000 X .15 = approx. $266,00 reduction in advanced maintenance savings.
- $10,560,000 strategy savings - $266,000 = **$10,294,000.**

Most Likely Strategy

- Reduction of bend easing footprint reduces the advanced maintenance dredging savings by approximately 15%.
- VE Alt 5.0 $1,771,000 X .15 = approx. $266,000 reduction in advanced maintenance savings.
- Assumes bend easing reduction of 20%, resulting in mechanical excavation reduction of 75% due to less encroachment on land and therefore reduced opportunity to use land-based excavator.
- $1.26 million savings from Alt 3.0 reduced by 75% = $315,000 savings
- Assumes selling or reuse of excavated materials reduced by 75%.
- $300,000 savings from Alt 4.0 is reduced by 75% = $75,000 savings.
- $7,318,000 strategy savings - $266,000 - $945,000 - $225,000 = **$5,882,000.**

VE TEAM

VE Study Team

Name	Organization	Title
John Bolles	CBJB Consulting	Construction
Ray Devlin	Moffat & Nichol	Dredging
Scott Marr	HDR	Geotechnical
John Plymale	USACE	VE Officer
Jake Walsdorf	USACE	VE Officer
Sarah Xie DeSoto	USACE	Geotechnical
Carlos Tate	USACE	Civil
Fred Kolano	VMS	VE Team Leader
Allegra Keith	VMS	Assistant VE Team Leader

Key Project Contacts

Name	Organization	Title
Nicholas Laskowski	USACE	Project Manager

VALUE ENGINEERING ALTERNATIVES

The results of this study are presented as individual alternatives to the baseline concept. Each alternative consists of a summary of the baseline concept, a description of the suggested change, a listing of its advantages and disadvantages, a cost comparison, change in performance and value, discussion of schedule and risk impacts (if applicable), and a brief narrative comparing the baseline design with the alternative. (Please refer to the *Project Analysis* section of this report for an explanation of how the performance attributes and value are calculated.) Sketches, calculations, and performance attribute ratings are also presented where applicable.

The cost comparisons reflect a comparable level of detail as in the baseline estimate. A life-cycle benefit-cost analysis for major alternatives is included where appropriate.

VE STRATEGIES

VE studies result in the development of a number of alternatives. While it is possible for all alternatives to be implemented, typically there are combinations of some alternatives that may provide the best solution for the project. This is due to the fact that some alternatives may be competing ideas or different ways to address the same issue. Some alternatives are developed to answer a question raised by a decision maker or to resolve an open issue and found not to be beneficial to the ultimate project.

As a result of these factors, the VE team developed two VE strategies that represent their opinion of the best combinations of alternatives for the project to assist the decision makers in their evaluation of the VE alternatives. The VE strategies are based on factors that include improved performance, likelihood of implementation, least community impact, cost savings, or any combination of the project's performance attributes. This information is a guide and is not intended to reject the other alternatives from project stakeholder consideration.

VE ALTERNATIVE SUMMARY TABLES

Summary of VE Alternatives

Alternative No. & Description	Initial Cost Savings	LCC Savings	Change in Schedule	Performance Change	Value Change
1.1 Increase channel widening from 400 feet to 600 feet at DOW Thumb	$3,242,000	$42,459,000	+24 months	+40 %	+16 %
1.2 Consult with HFPP to authorize design waiver to remove existing underwater berm without mitigation	$11,746,000	$0	+36 months	-18 %	-31 %

Alternative No. & Description	Initial Cost Savings	LCC Savings	Change in Schedule	Performance Change	Value Change
2.0 Reduce bend easing footprint by 20 percent and reconfigure optimally	$3,591,000	$0	-2 months	-3 %	+4 %
3.0 Use a combination of mechanical excavation and hydraulic dredging in lieu of only hydraulic dredging	$1,263,000	$0	No change	No change	+2 %
4.0 Sell above-ground excavated material to local developers or back to Port Freeport	$300,000	$0	No change	No change	No change
5.0 Reduce advanced maintenance dredging from 2 feet to 1 foot across the footprint of the dredging	$1,771,000	$7,867,000	No change	-6 %	-4 %
6.0 Pre-purchase steel sheet piling through USACE to reduce timing and save sales tax costs	$393,000	$0	No change	No change	No change

Summary of VE Strategies

Strategy Description	Initial Cost Savings	LCC Savings	Change in Schedule	Performance Change	Value Change
Best Value Strategy 1.1, 2.0, 3.0, 4.0, 5.0, 6.0	$10,294,000	$50,326,000	+22 months	+39 %	+25 %
Most Likely Strategy 2.0, 3.0, 4.0, 5.0, 6.0	$5,882,000	$7,867,000	-2 months	-3 %	+7 %

As noted previously, the combinations of various VE alternatives into a the VE Strategies summarized above may result in “double-counting” of some costs and time. The VE study team discussed this concern and made adjustments to the total costs to eliminate any “double counting” that would be contained in the strategies. Details of these adjustments for each strategy are described in the *Executive Summary*.

OTHER CONSIDERATIONS

The VE team identified the following observations and design suggestions, relatively general in nature, for consideration by the project team. These items are qualitative in nature and for this reason, no cost or time impacts were calculated during the VE study.

Idea Code	Idea Description
DP-1	Outsource project design to AE firm
DP-2	Consider Design-Build In lieu of Design-Bid-Build
DP-4	Use A+B bid to incentivize early project completion
DP-7	Separate dredging and structural work into A and B contracts
ML-3	Use soil mixing to strengthen the levee foundation in lieu of steel sheet piling
ML-5	Use cast-in-place auger piles in lieu of steel sheet piling
ML-6	Use H-pile with lagging and shoring in lieu of steel sheet piling
ML-7	Use combination of different sheet pile sizes tapered at ends in lieu of current PZ sheet pile design
ML-8	Use open-cell sheet pile construction in lieu of steel sheet pile
ML-11	Optimize location or placement of sheet piling based on stability analysis
ML-12	Refine design assumptions and criteria for levee
ML-13	Use timber in lieu of steel sheet piling
ML-16	Use press-in pile system such as Giken in lieu of conventional pile driving methods
ML-17	Use alternatives to rip rap such as high-performance turf reinforcement mat, ACBs, articulating mats, or geosynthetics
MS-7	Identify beneficial use projects within the region for placement for dredged soil such as marsh restoration or placement area of levees
MS-14	Lease land from DOW Corporation to provide multiple alternative channel alignments
RU-1	Relocate the existing power lines along bend easing
RU-2	Perform an investigation and analysis to determine existing pipeline presence within project limits
RU-4	Optimize schedule for early utility relocation and include in proposed early order of work sequencing
RU-6	Relocate the existing pipelines along bend easing

VE ALTERNATIVE 1.1

Increase channel widening from 400 feet to 600 feet at DOW Thumb

Initial Cost Savings:	$3,242,000
LCC Savings:	$42,459,000
Change in Schedule:	+24 months
Performance Change:	+40 %
Value Change:	+16 %

Description of Baseline Concept: The baseline concept proposes to remove 4,300 feet of the existing submerged berm (from Sta. 140+00 to 185+00) at the DOW Thumb waist area in order to allow for widening of the channel to achieve a 400-foot minimum width.

Description of Alternative Concept: This VE alternative proposes increasing the width of the narrowest point of the channel at the DOW Thumb waist from 400 feet to 600 feet in order to better accommodate current and future vessel navigation and maneuverability.

Advantages:

- Significantly widens channel to accommodate future channel expansion and improvements
- Allows for natural angle of repose for levee foundation reinforcement in lieu of sheet pile wall

Disadvantages:

- Potential for real estate costs associated with acquiring or leasing part of DOW Thumb
- Unknown environmental impacts due to encountering possible contaminants
- This idea would increase dredging of the waist, potentially offset by decreased dredging of bend easing and turning notch

Discussion: The primary advantage of this alternative is that a wider channel will better accommodate current and future vessel navigation and maneuverability in the channel. The currently proposed 400-foot width is considered dangerous for ship navigation and will require acquisition of a third tug boat in order to maneuver ships. Implementation of this alternative may eliminate the need for the third tug boat, allowing Port Freeport to use existing equipment. In addition, standoff distances required for LPG loading would be accommodated by an expanded channel. As currently designed, the 400-foot channel does not accommodate the standoff and would still preclude Panamax vessel passage through the channel when an LPG vessel is being loaded at dock 2. A wavier would be required to impact the HFPP, and the levee would need to be rebuilt completely for DOW Thumb, to the current factor of safety of 1.5.

The concerns for the feasibility of this alternative are similar to VE Alternative 1.2. It should be noted that the advantages of this alternative in terms of pilot and ship safety, and ongoing operations to improve commerce, are significant. This alternative provides the potential to allay concerns expressed by the pilots during simulation activities.

Savings would be realized from the elimination of steel sheet pile wall and the elimination of the bend-easing feature. A life cycle cost analysis was also performed based on the reduction of three tugs to two tugs that would be needed to guide vessels through each trip through the channel.

Technical Review Comments: None noted.

VE ALTERNATIVE 1.1

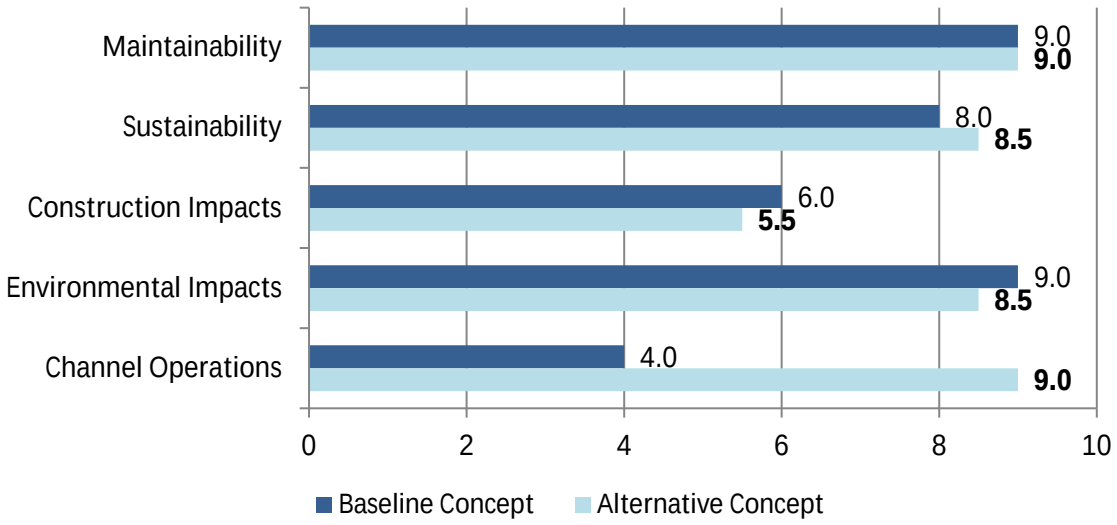
Increase channel widening from 400 feet to 600 feet at DOW Thumb

Project Management Considerations: Requires GRR Project Manager and team to coordinate with HFPP project team. Obtaining permits and waivers would require additional studies and coordination with Risk Management Center.

Discussion of Schedule Impacts: Negotiations with DOW Corporation and obtaining waivers will increase the project schedule. Additional simulations would require time to complete. In addition, construction time is lengthened by increased dredging and reconstruction of the levee, but not significantly. For the purposes of this VE study it is assumed that this alternative would increase overall schedule by 24 months.

Discussion of Risk Impacts: There is a risk that real estate cannot be acquired. If this VE alternative were implemented, there may be risk of encountering contaminated soil, requiring mitigation.

Comparison of Performance



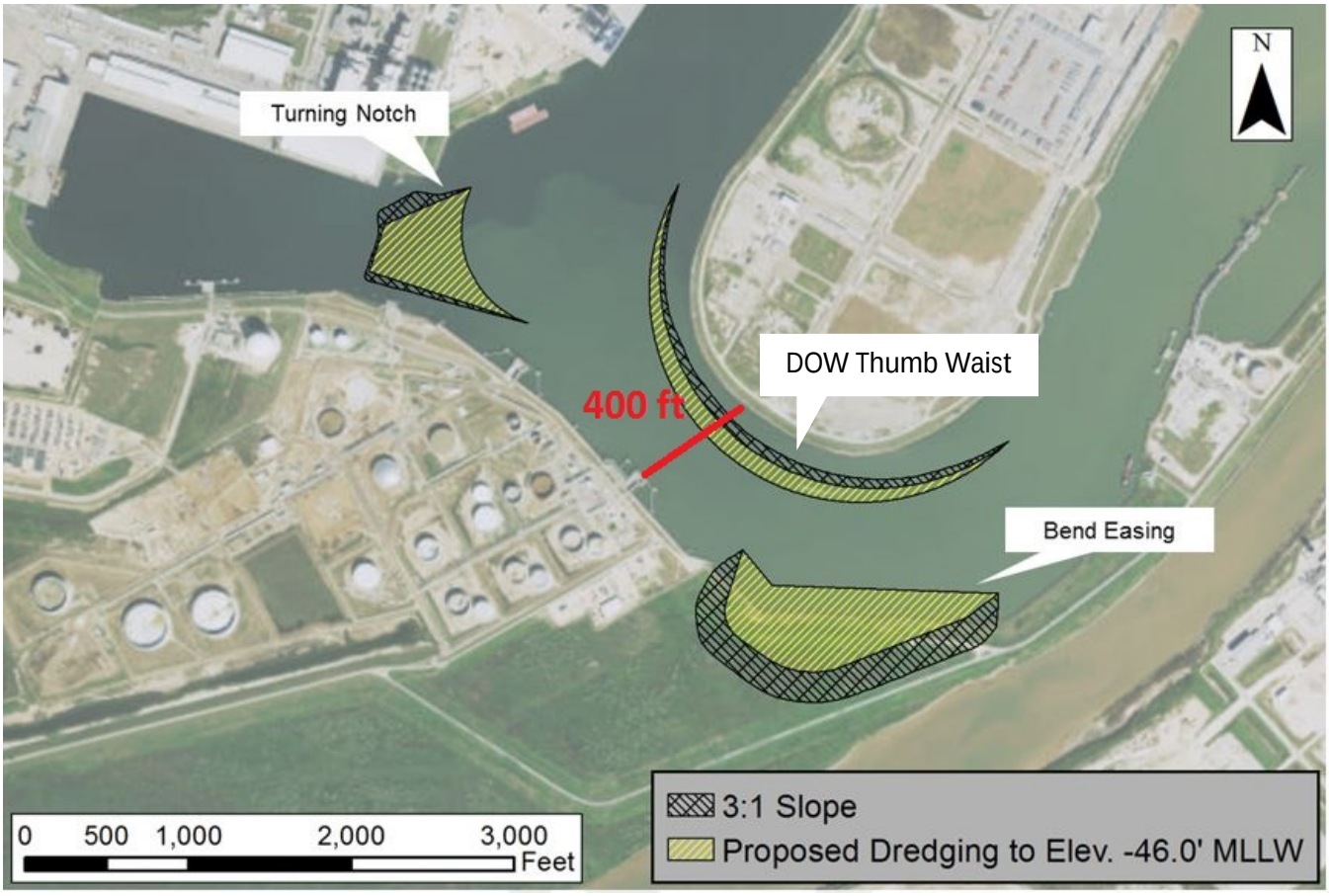
Performance Assessment

Performance Attribute	Rationale for Change in Performance
Channel Operations	Improved channel operations is the primary benefit of this alternative, and is substantially improved.
Sustainability	Allows for future flexibility to potentially accommodate larger vessels in the future, and may allow for two-way traffic.
Maintainability	No change.
Construction Impacts	Dredges will be in the channel longer, which will hinder channel operations; however, impacts will progressively reduce as the dredging moves into DOW Thumb, away from active channel operations.
Environmental Impacts	Additional dredging increases the impact to water quality.

VE ALTERNATIVE 1.1

Increase channel widening from 400 feet to 600 feet at DOW Thumb

Baseline Concept Sketch

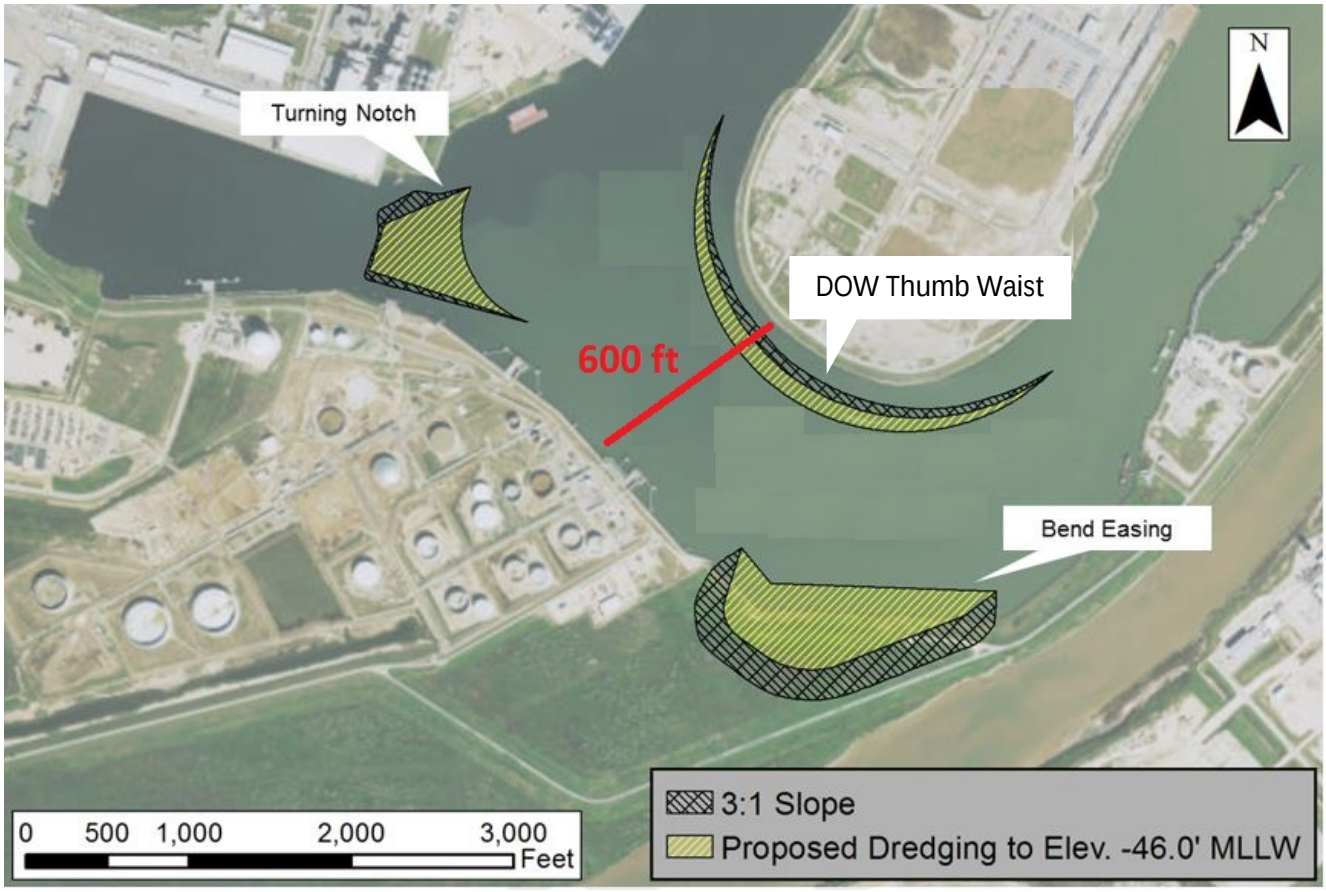


The baseline concept proposes widening the section of the channel at DOW Thumb to 400 feet.

VE ALTERNATIVE 1.1

Increase channel widening from 400 feet to 600 feet at DOW Thumb

VE Alternative Concept Sketch



The alternative would widen the section of the channel at DOW Thumb to 600 feet, roughly shown above.

Assumptions and Calculations: Assumes widening channel to 600 feet could eliminate need for bend easing, therefore the amount of dredging and excavation would not incur additional costs. Potential for contaminated material may exist, however this was unknown at the time of the VE study and could not be quantified. Encountering contaminated material would incur additional costs.

A life cycle cost analysis was performed based on the reduction of three tugs to two tugs that would be needed to guide vessels through each trip through the channel. This was used as a basis for the life cycle cost analysis.

Levee Relocation Assumes:

- 12-foot levee crest with 3:1 slope
- 1500 lineal feet x 25 CY/lineal ft = 37,500 CY x $65/ CY = $3.2 million (including mark-ups)
- Real Estate Acquisition cannot be quantified at the time of the VE study

VE ALTERNATIVE 1.1

Increase channel widening from 400 feet to 600 feet at DOW Thumb

Initial Cost Estimate

CONSTRUCTION ELEMENT		*BASELINE CONCEPT*			*ALTERNATIVE CONCEPT*		
Description	**Unit**	**Qty**	**Cost/Unit**	**Total**	**Qty**	**Cost/Unit**	**Total**
Levee Relocation	cy	37,500	$ 65	$2,437,500			
(assume 12 crown and 20cf/lf)							
1,300 lf with a 3:1 slope							
Real Estate Cost is unknown and TBD							
SUB-TOTAL				$2,437,500			$0
PROJECT MARK-UPS	33%			$804,375			$0
TOTAL (Rounded)				$3,242,000			$0
						SAVINGS	**$3,242,000**

Life-Cycle Cost Estimate

Life-Cycle Period	50	Years	Real Discount Rate	2.00%	**BASELINE**	**ALTERNATIVE**
A. INITIAL COST					$3,242,000	$0
Service Life - Baseline	50	Years	**INITIAL COST SAVINGS:**			**$3,242,000**
Service Life - Alternative	50	Years				
B. SUBSEQUENT ANNUAL COSTS						
Eliminate one of three tugs to assist navagation					$ 3,744,000	$ 2,496,000
Basecase: assume three tugs @ three times a week and one is a rental						
Alternative: assume two Freeport Tugs, eliminate one rental						
Say 156 time per year x 3 tugs @ $2,000 per hour @ 4 hrs / tug						
Total Subsequent Annual Costs:					$ 3,744,000	$ 2,496,000
Present Value Factor (P/A):					31.424	31.424
PRESENT VALUE OF SUBSEQUENT ANNUAL COSTS (Rounded):					**$ 117,650,000**	**$ 78,433,000**
C. SUBSEQUENT SINGLE COSTS	**Year**	**Amount**	**PV Factor (P/F)**		**Present Value**	**Present Value**
			1.00000		$ -	
			1.00000			$ -
PRESENT VALUE OF SUBSEQUENT SINGLE COSTS (Rounded):					**$ -**	**$ -**
D. TOTAL SUBSEQUENT ANNUAL AND SINGLE COSTS (B+C)					**$ 117,650,000**	**$ 78,433,000**
E. TOTAL SUBSEQUENT COSTS SAVINGS:						**$ 39,217,000**
F. TOTAL PRESENT VALUE COST (A+D)					**$ 120,892,000**	**$ 78,433,000**
TOTAL LIFE-CYCLE SAVINGS:						**$ 42,459,000**

VE ALTERNATIVE 1.2

Consult with HFPP to authorize design waiver to remove existing underwater berm without mitigation

Initial Cost Savings:	$11,746,000
Subsequent LCC Savings:	$0
Change in Schedule:	+36 months
Performance Change:	-18 %
Value Change:	-31 %

Description of Baseline Concept: The baseline concept proposes removing 4,300 feet of the existing submerged berm (from Sta. 140+00 to 185+00) at the DOW Thumb waist area in order to allow for widening of the channel to achieve the 400-foot minimum width, and using steel sheet piling to mitigate for the resulting loss of levee foundation strength, raising the factor of safety to 1.5.

Description of Alternative Concept: This VE alternative proposes to consult with the HFPP to obtain a design waiver that will allow for removal of the existing submerged berm without the need to strengthen the existing levee foundation, thus lowering the existing factor of safety.

Advantages:

- Eliminates 4,300 feet of sheet piling resulting in substantial cost savings

Disadvantages:

- Reduces stability of the existing levee
- Increases risk of future flooding
- Potential future sloughing of existing levee into newly widened channel creating increased maintenance concerns
- Impacts HFPP

Discussion: Removal of the berm requires additional strengthening of the existing levee foundation in order to meet the current factor of safety of 1.5 (note that the existing factor of safety is 1.1). This VE alternative proposes to consult with the HFPP to obtain a design waiver that will allow for removal of the existing submerged berm without the need to strengthen the existing levee foundation. The primary benefit of this alternative is the elimination of the cost associated with installing sheet piling. However, there is concern that the time required for permitting and waivers would push the project schedule to an unacceptable time frame. In addition, it was discussed during the VE study that this alternative may not be acceptable due to hurricane protection requirements in the area.

Technical Review Comments: None noted.

Project Management Considerations: Requires GRR Project Manager and team to coordinate with HFPP project team. Obtaining permits and waivers would require additional studies and coordination with Risk Management Center.

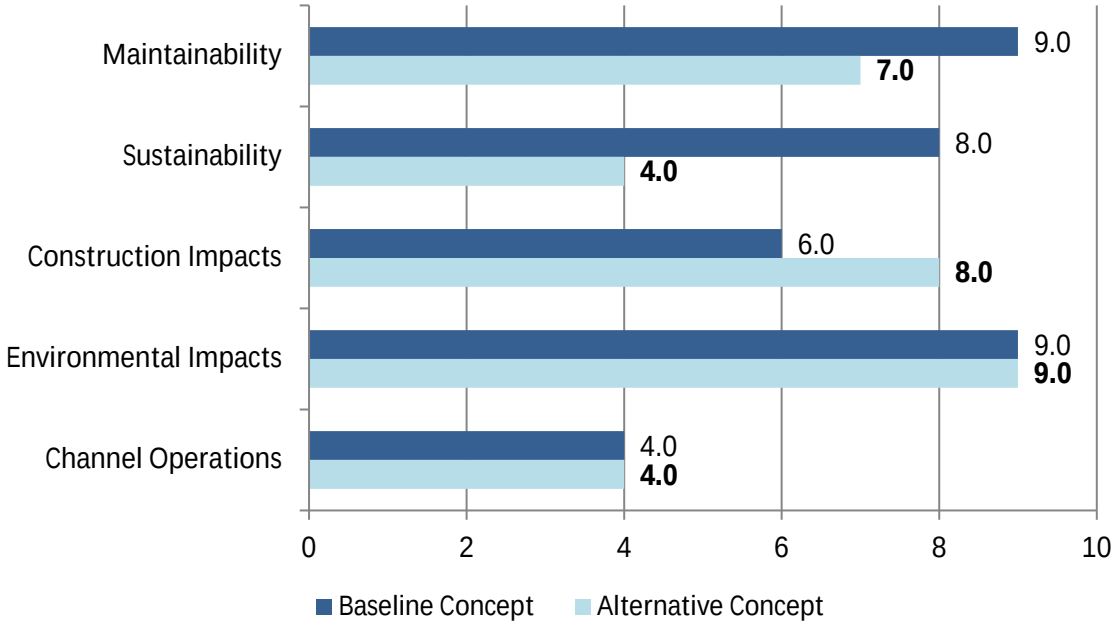
Discussion of Schedule Impacts: The need to obtain permits and waivers to implement this VE alternative may extend the schedule significantly, resulting in inability to accomplish the project. However, if this alternative was able to be implemented, construction time would be saved. The VE team estimated 18 months to obtain permits and waivers, plus the 18 months to conduct the required Quantitative Risk Assessment, resulting in a schedule increase of 36 months.

VE ALTERNATIVE 1.2

Consult with HFPP to authorize design waiver to remove existing underwater berm without mitigation

Discussion of Risk Impacts: Increases risk of levee failing and sliding into the newly dredged template. It was noted during the VE study that a requirement of this project is to not interfere with the structural integrity of the HFPP levees or lower the factor of safety. The existing submerged berm or an equally strong alternative is considered integral for the current success, and future raising, of the levee.

Comparison of Performance



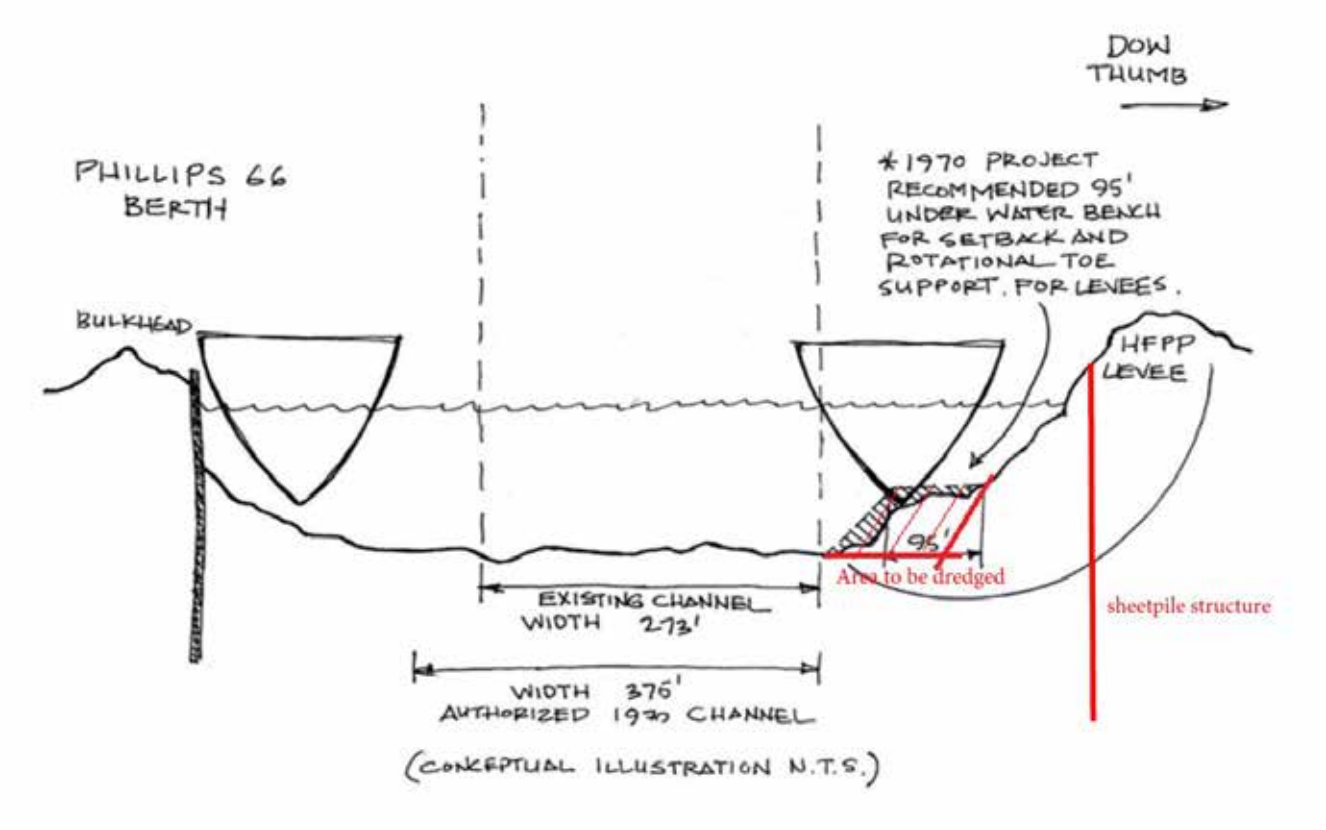
Performance Assessment

Performance Attribute	Rationale for Change in Performance
Channel Operations	No significant change.
Sustainability	If the levee foundation is not reinforced, the risk of slough and of catastrophic levee failure due to a hurricane event is significantly increased, limiting the ability of the project to meet a 50-year design life by impacting the channel.
Maintainability	Requires continued monitoring for potential levee failure and removal of sloughed material.
Construction Impacts	Reduced impacts due to elimination of steel sheet pile driving.
Environmental Impacts	No change.

VE ALTERNATIVE 1.2

Consult with HFPP to authorize design waiver to remove existing underwater berm without mitigation

Baseline Concept Sketch

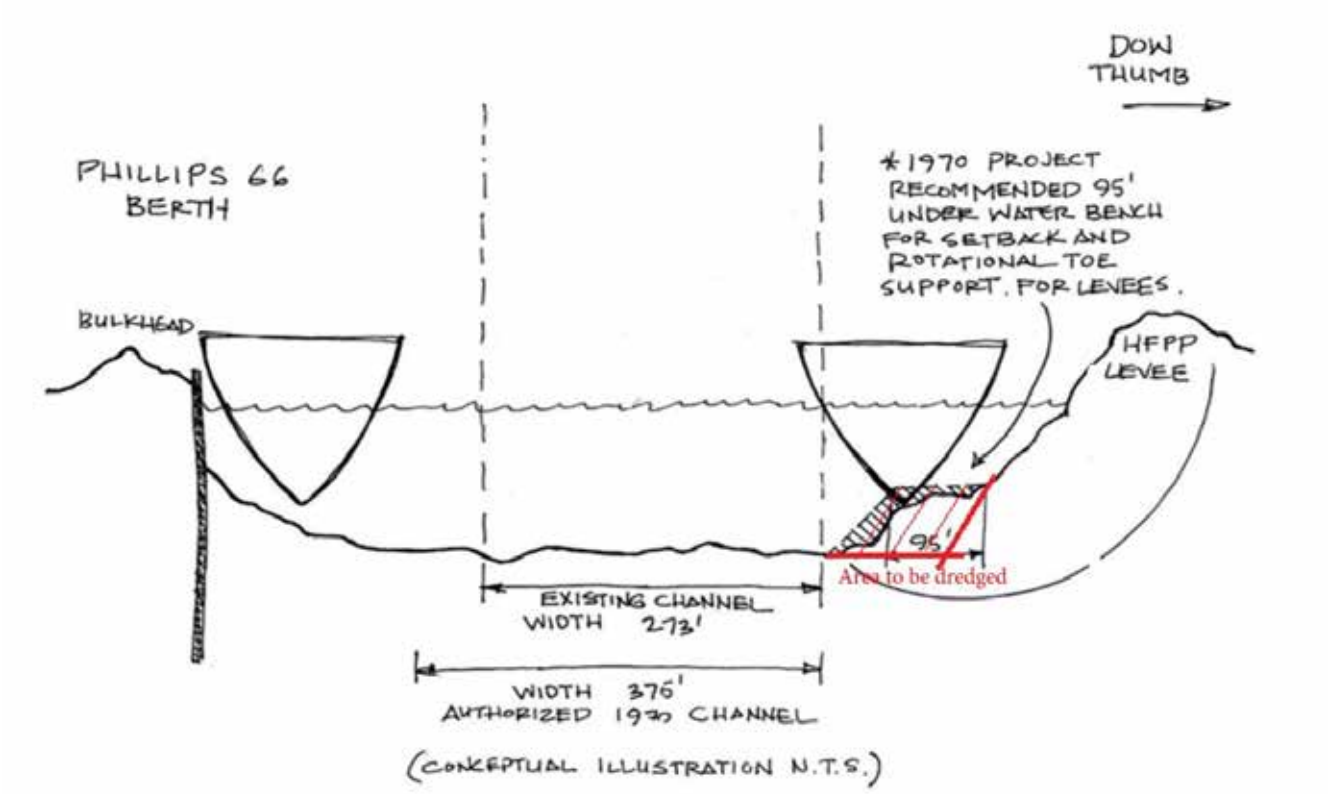


The baseline concept includes installation of a sheet pile structure in order to mitigate for the effects of removing the existing underwater berm, indicated in the above sketch as "area to be dredged."

VE ALTERNATIVE 1.2

Consult with HFPP to authorize design waiver to remove existing underwater berm without mitigation

VE Alternative Concept Sketch



The alternative proposes removing the underwater berm ("area to be dredged" above), but not installing a sheet pile structure.

Assumptions and Calculations: Assumes that project management and review time would incur $250,000 additional cost. Assumes Quantitative Risk Assessment is required and will cost $1.8 million.

Initial Cost Estimate

CONSTRUCTION ELEMENT		*BASELINE CONCEPT*			*ALTERNATIVE CONCEPT*		
Description	**Unit**	**Qty**	**Cost/Unit**	**Total**	**Qty**	**Cost/Unit**	**Total**
Sheet Pile Wall	ea	1	$ 10,342,000	$ 10,342,000			
Engineering	ea	1	$ 840,000	$ 840,000			
Coodination & Review	ea				1	$ 250,000	$ 250,000
Borings	ea				1	$ 300,000	$ 300,000
Quantative Risk Assessment	ea				1	$ 1,800,000	$ 1,800,000
SUB-TOTAL				$11,182,000			$2,350,000
PROJECT MARK-UPS	33%			$3,690,060			$775,500
TOTAL (Rounded)				$14,872,000			$3,126,000
						SAVINGS	**$11,746,000**

VE ALTERNATIVE 2.0

Reduce bend easing footprint by 20 percent and reconfigure optimally

Initial Cost Savings:	$3,591,000
LCC Savings:	$0
Change in Schedule:	-2 months
Performance Change:	-3 %
Value Change:	+4 %

Description of Baseline Concept: The baseline concept proposes 1,500,000 CY of excavation to construct a bend easing area at the south end of the project site in order to provide a safety runoff zone, improve ship maneuverability and provide a hydrodynamic buffer.

Description of Alternative Concept: This VE alternative proposes to reduce the bend easing area footprint by 20 percent by reconfiguring the area, resulting in an excavation reduction of 300,000 CY.

Advantages:

- Saves significant cost and time associated with excavation
- Saves significant cost associated with disposal of excavated materials

Disadvantages:

- Potentially reduces bend easing area shown in feasibility study, resulting in increased maneuverability concerns for pilots

Discussion: The proposed excavation reduction of 300,000 CY would be achieved by reconfiguring the area, therefore possibly maintaining the safety runoff zone, hydrodynamic buffer and aid to ship maneuverability. It is acknowledged that there has not been a full hydrodynamic analysis of the configuration proposed in the baseline concept, so this alternative may potentially present a viable and desirable option. In addition, the profile of the bend easing could be modified to be gradually sloped in lieu of full depth with a steep slope.

Technical Review Comments: None noted.

Project Management Considerations: Continued refinement of the bend easing area is considered to be an ongoing design activity that is already expected. Additional simulations may be required to determine optimal configuration and footprint of the bend easing area.

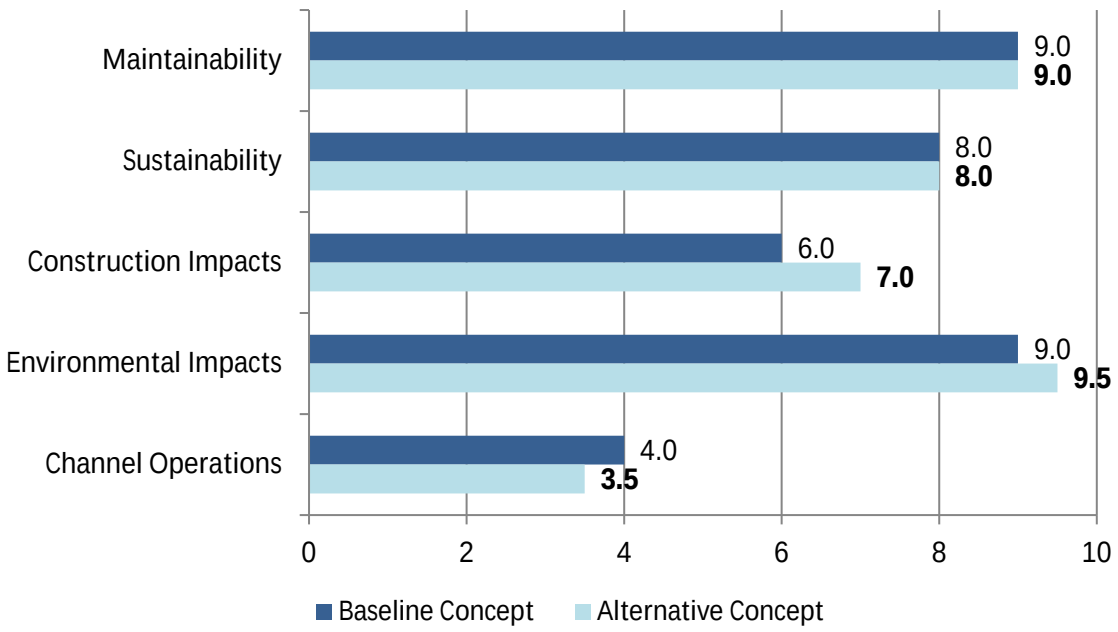
Discussion of Schedule Impacts: The VE team estimated a potential schedule reduction of 2 months off of the critical path related to excavation.

Discussion of Risk Impacts: Reconfiguration must be acceptable to pilots and verified through ship simulations.

VE ALTERNATIVE 2.0

Reduce bend easing footprint by 20 percent and reconfigure optimally

Comparison of Performance



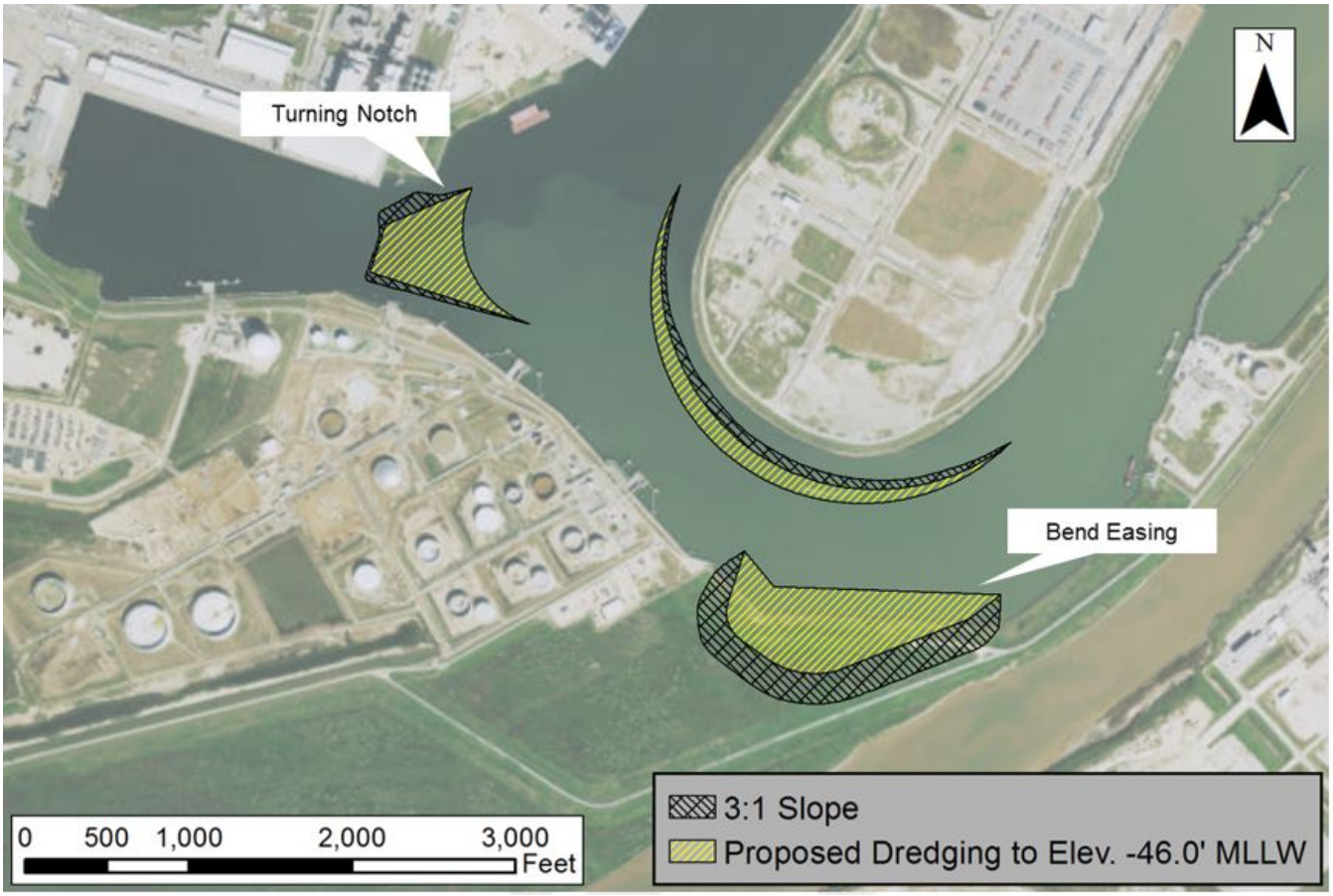
Performance Assessment

Performance Attribute	Rationale for Change in Performance
Channel Operations	Potentially restricts ship maneuverability (the full impact will need to be verified via additional ship simulations).
Sustainability	No change.
Maintainability	No change.
Construction Impacts	Reduced construction time.
Environmental Impacts	Reduced impact due to reduced dredging or excavation.

VE ALTERNATIVE 2.0

Reduce bend easing footprint by 20 percent and reconfigure optimally

Baseline Concept Sketch

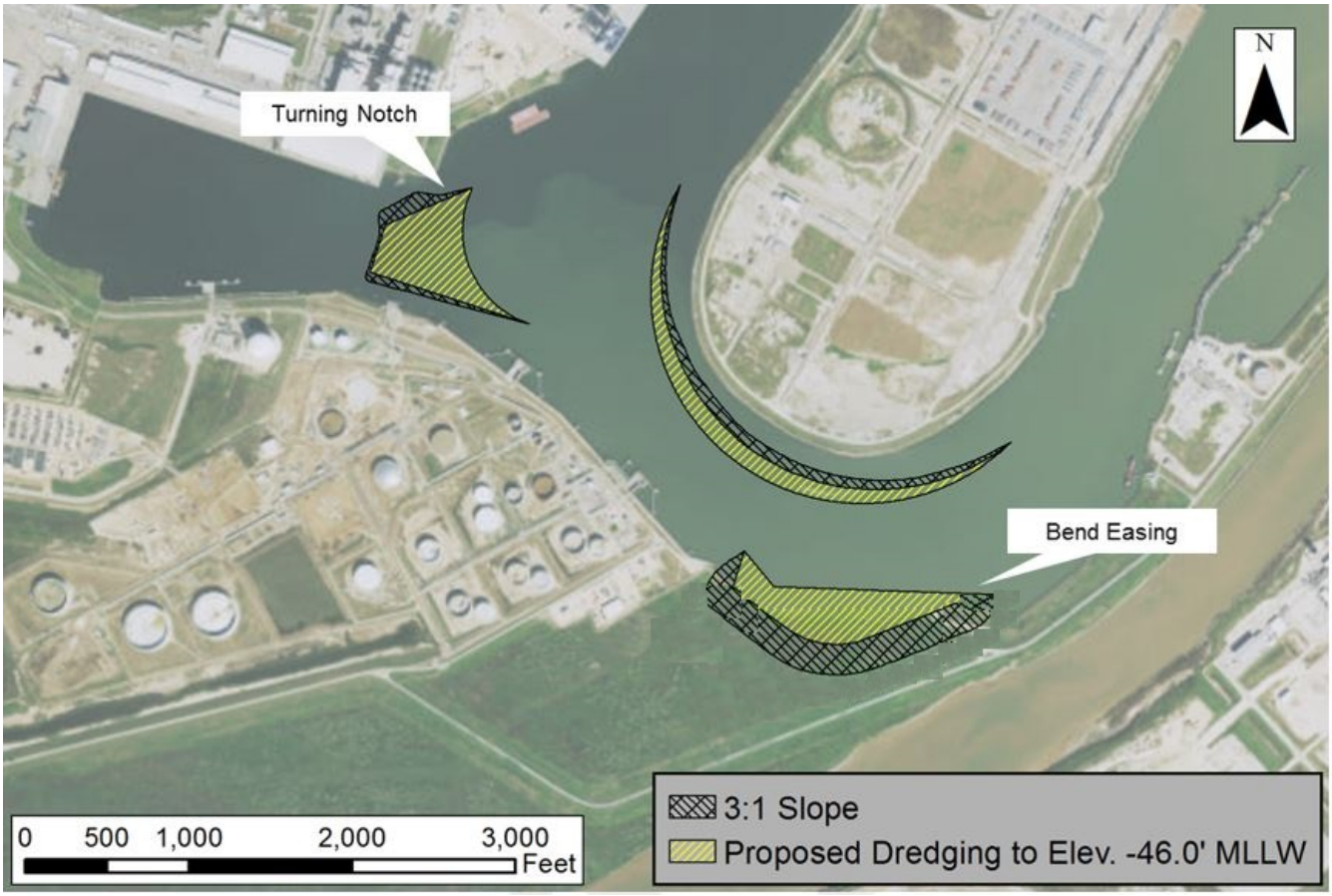


The sketch above shows the area of the bend easing footprint as proposed in the baseline concept.

VE ALTERNATIVE 2.0

Reduce bend easing footprint by 20 percent and reconfigure optimally

VE Alternative Concept Sketch



The alternative would reduce the bend easing area by 20 percent, roughly shown in the sketch above. This assumes a reconfiguration of the bend easing area in order to provide optimal functionality despite the reduced footprint (not shown).

Initial Cost Estimate

CONSTRUCTION ELEMENT		*BASELINE CONCEPT*			*ALTERNATIVE CONCEPT*		
Description	**Unit**	**Qty**	**Cost/Unit**	**Total**	**Qty**	**Cost/Unit**	**Total**
Hydraulic Dredging	cy	1,500,000	$ 9	$ 13,500,000	1,200,000	$ 9	$ 10,800,000
Assume a 20% reduction of the							
Bend Easing area							
SUB-TOTAL				$13,500,000			$10,800,000
PROJECT MARK-UPS	33%			$4,455,000			$3,564,000
TOTAL (Rounded)				$17,955,000			$14,364,000
						SAVINGS	**$3,591,000**

VE ALTERNATIVE 3.0

Use a combination of mechanical excavation and hydraulic dredging in lieu of only hydraulic dredging.

Initial Cost Savings:	$1,263,000
Subsequent LCC Savings:	$0
Change in Schedule:	No change
Performance Change:	No change
Value Change:	+2 %

Description of Baseline Concept: The baseline estimate assumes using only hydraulic dredging to widen the channel at the bend easing area.

Description of Alternative Concept: This VE alternative proposes to use a combination of dry-land mechanical excavation and hydraulic dredging in lieu of only hydraulic dredging in the bend easing area.

Advantages:

- Allows for concurrent excavation work
- Reduces excavation costs
- Results in better quality of excavated materials, increasing options for its reuse

Disadvantages:

- Mechanical excavation is slower than hydraulic dredging

Discussion: The baseline concept proposes using only hydraulic dredging to widen the channel. This VE alternative proposes to use a combination of dry-land mechanical excavation and hydraulic dredging in lieu of only hydraulic dredging. It was determined during the VE study that approximately 500,000 CY of the 1,500,000 CY of dredging in the bend easing area could be performed using land-based techniques, resulting in cost savings associated with reduced hydraulic dredging. Excavating some material in the dry improves options for reuse of the material in other areas, as compared to dredged material.

Technical Review Comments: None noted.

Project Management Considerations: In order to implement this alternative, the bid documents could specify a quantity of excavated materials to remain dry in order to be available for other uses.

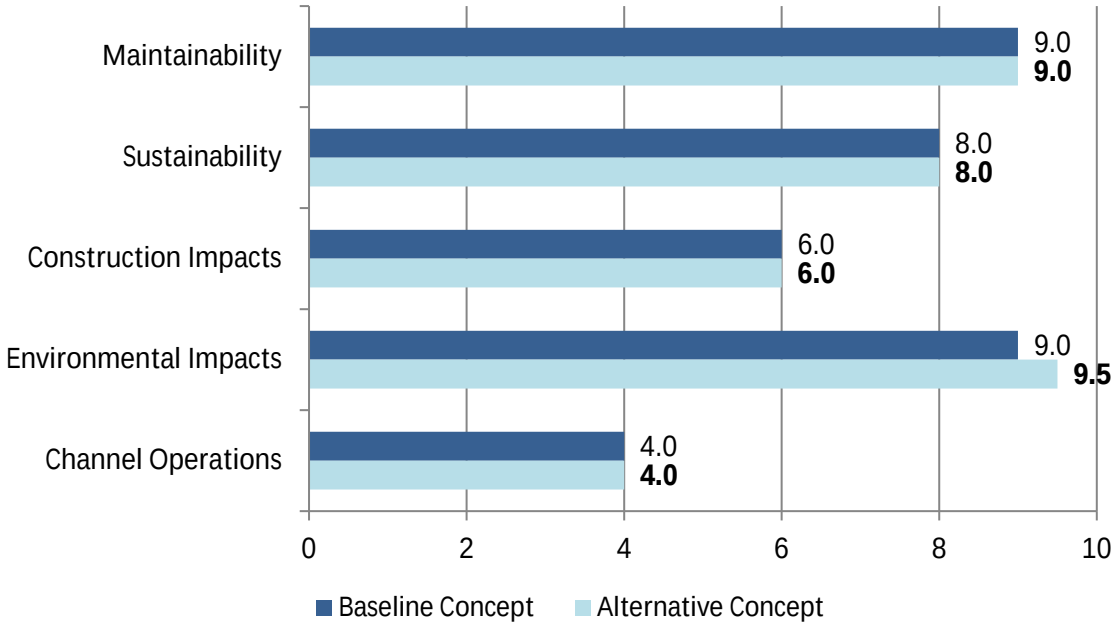
Discussion of Schedule Impacts: No significant impact.

Discussion of Risk Impacts: No significant impact.

VE ALTERNATIVE 3.0

Use a combination of mechanical excavation and hydraulic dredging in lieu of only hydraulic dredging.

Comparison of Performance



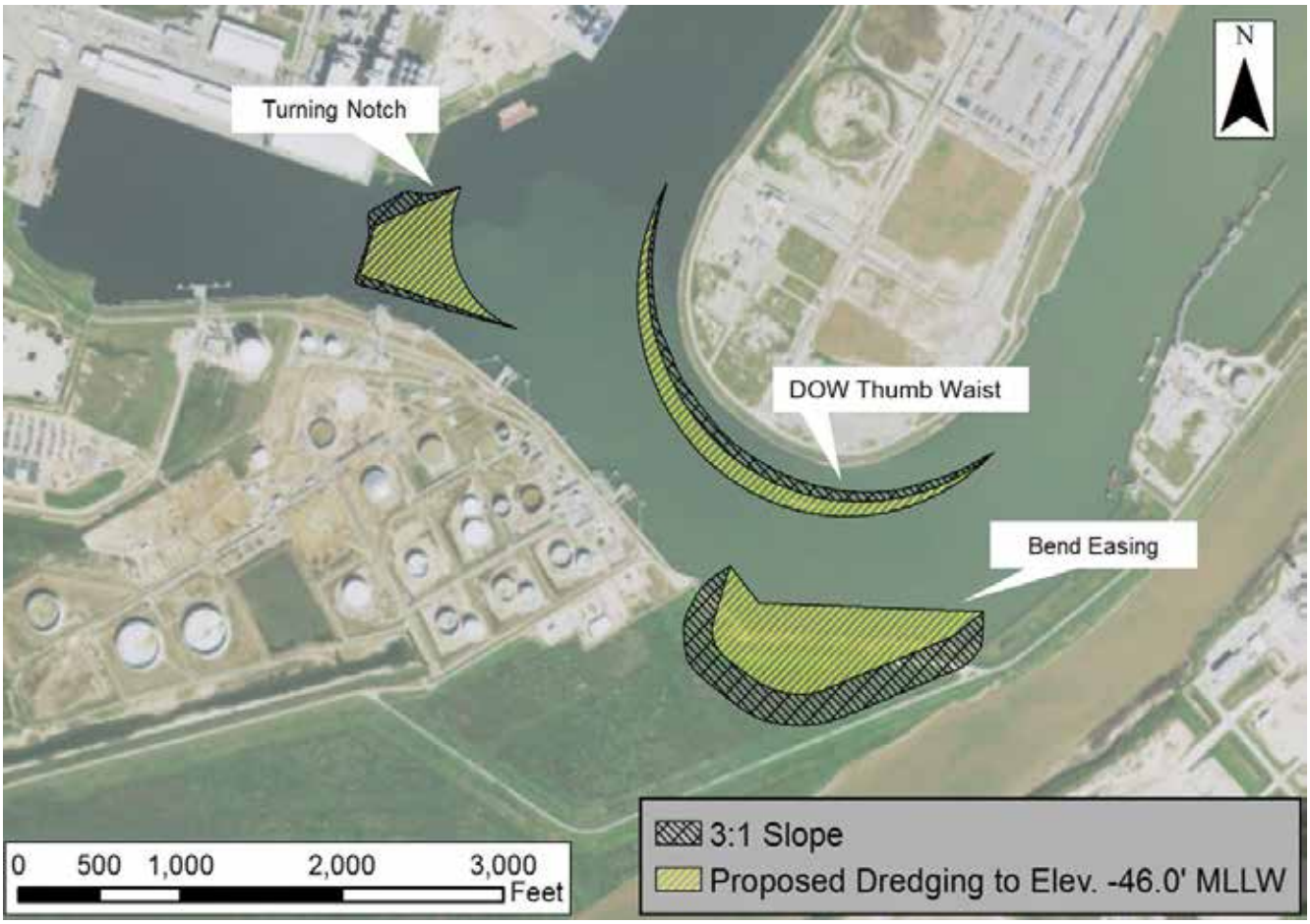
Performance Assessment

Performance Attribute	Rationale for Change in Performance
Channel Operations	No change.
Sustainability	No change.
Maintainability	No change.
Construction Impacts	Moderate positive impact due to reduced use of hydraulic dredger (less time in the channel).
Environmental Impacts	Decreased impact to water quality due to decreased use of hydraulic dredge.

VE ALTERNATIVE 3.0

Use a combination of mechanical excavation and hydraulic dredging in lieu of only hydraulic dredging.

Baseline Concept Sketch

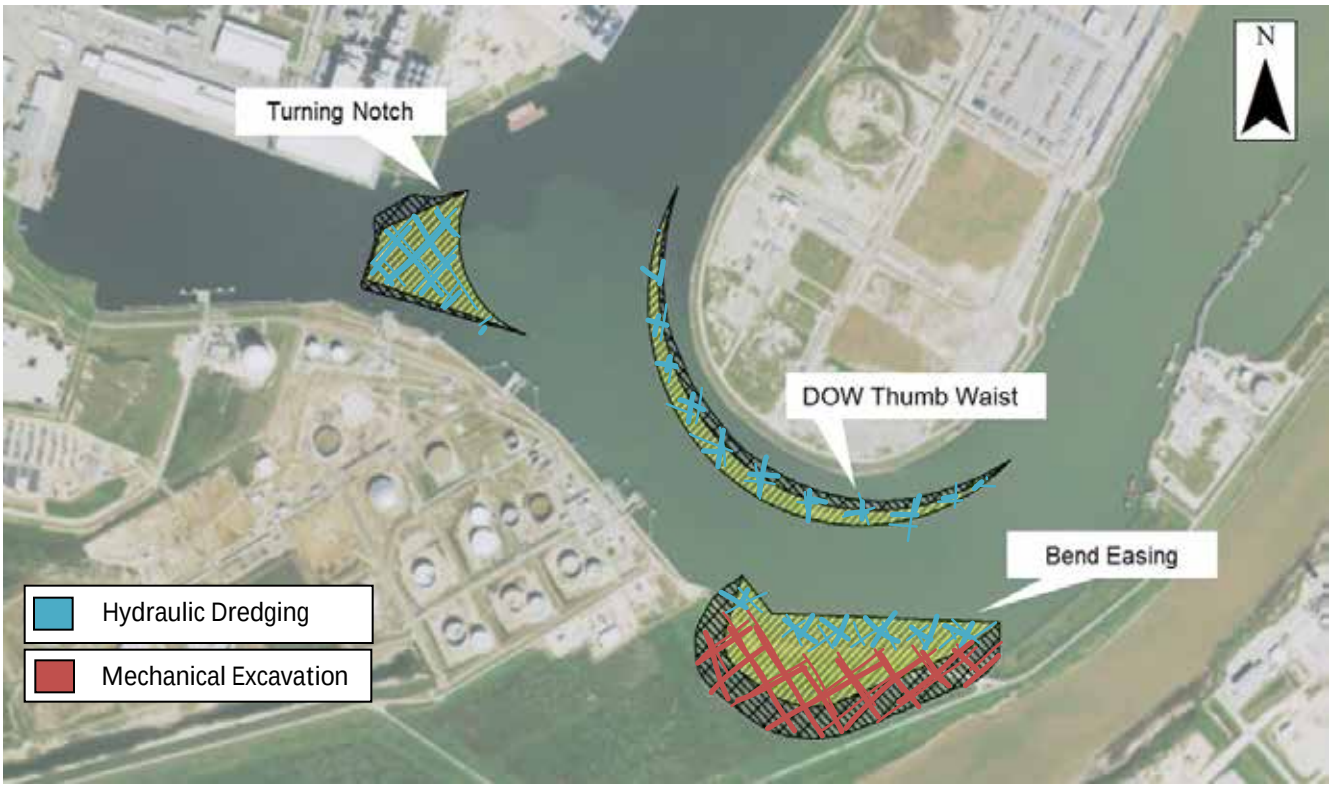


The baseline concept assumes hydraulic dredging for the Turning Notch, DOW Thumb Waist and Bend Easing areas, shown above.

VE ALTERNATIVE 3.0

Use a combination of mechanical excavation and hydraulic dredging in lieu of only hydraulic dredging.

VE Alternative Concept Sketches



The alternative proposes using mechanical excavation for the majority of the bend easing area.

Mechanically excavated materials from the bend easing area would be transported by truck to the disposal site using the route shown in yellow above.

VE ALTERNATIVE 3.0

Use a combination of mechanical excavation and hydraulic dredging in lieu of only hydraulic dredging.

Assumptions and Calculations: Assumes 500,000 CY of the 1,500,000 CY of dredging in the bend area could be performed using land-based techniques. Assumes contractor removes excavated materials to PA-1 as presented in the baseline concept.

Initial Cost Estimate

CONSTRUCTION ELEMENT		*BASELINE CONCEPT*			*ALTERNATIVE CONCEPT*		
Description	**Unit**	**Qty**	**Cost/Unit**	**Total**	**Qty**	**Cost/Unit**	**Total**
Bend Area Hydraulic Dredging	cy	1,500,000	$ 9	$ 13,500,000	1,000,000	$ 9	$ 9,000,000
Bend Area Mechanical Excavation	cy				500,000	$ 7	$ 3,500,000
Establish Haul Roadway	ea				1	$ 50,000	$ 50,000
Note: $7 per cy includes haulage cost							
SUB-TOTAL				$13,500,000			$12,550,000
PROJECT MARK-UPS	33%			$4,455,000			$4,141,500
TOTAL (Rounded)				$17,955,000			$16,692,000
						SAVINGS	**$1,263,000**

VE ALTERNATIVE 4.0

Sell above-ground excavated material to local developers or back to Port Freeport.

Initial Cost Savings:	$300,000
Subsequent LCC Savings:	$0
Change in Schedule:	No change
Performance Change:	No change
Value Change:	No change

Description of Baseline Concept: The baseline concept assumes that the contractor will dispose of excavated materials in the most cost effective manner.

Description of Alternative Concept: This VE alternative proposes selling above-ground excavated material to local developers or back to Port Freeport for use in levee filling or other general applications. The feasibility of this idea would be significantly increased by use of mechanical excavation rather than hydraulic dredging to keep material dry.

Advantages:

- Some unit cost reduction of dredging may be realized if the material is sold
- Potentially reduced transportation costs
- Reduces amount of disposal area used

Disadvantages:

- Administration of selling the material requires time
- Material may require storage prior to sale

Discussion: The baseline concept assumes that the contractor will dispose of excavated materials in the most cost effective manner. This VE alternative proposes selling above-ground excavated material to local developers or back to Port Freeport. The feasibility of this idea would be significantly increased by use of mechanical rather than hydraulic dredging to keep material dry. Selling excavated material may take a long time, which does not increase project schedule, but would require storage of the material. Port Freeport may decide to spread material onsite to improve property.

Technical Review Comments: None noted.

Project Management Considerations: None noted.

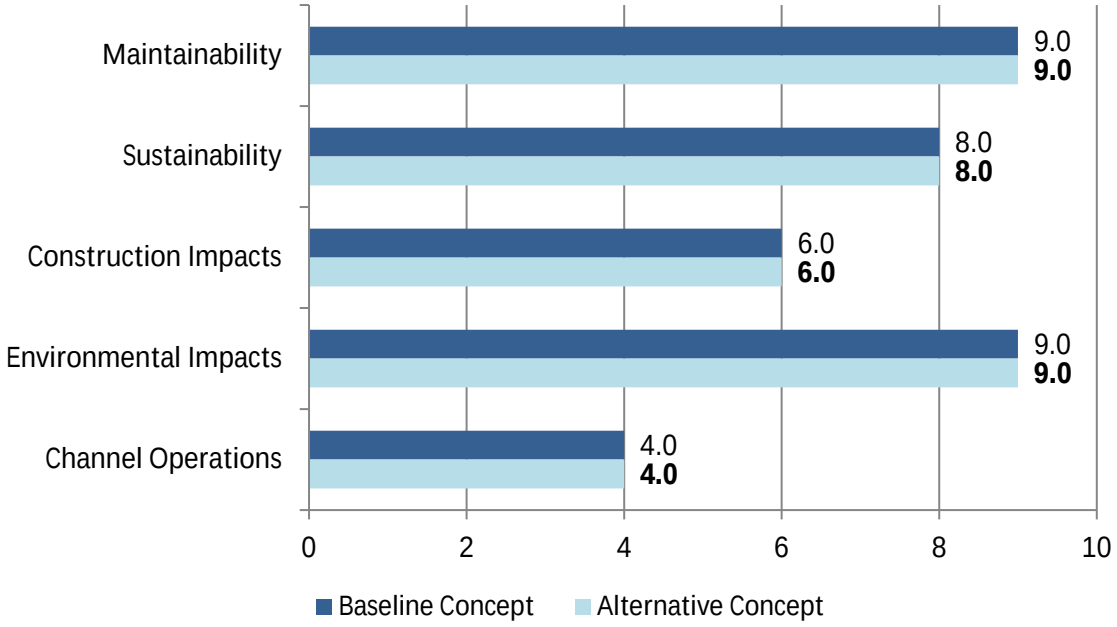
Discussion of Schedule Impacts: No significant impact.

Discussion of Risk Impacts: No significant impact.

VE ALTERNATIVE 4.0

Sell above-ground excavated material to local developers or back to Port Freeport.

Comparison of Performance



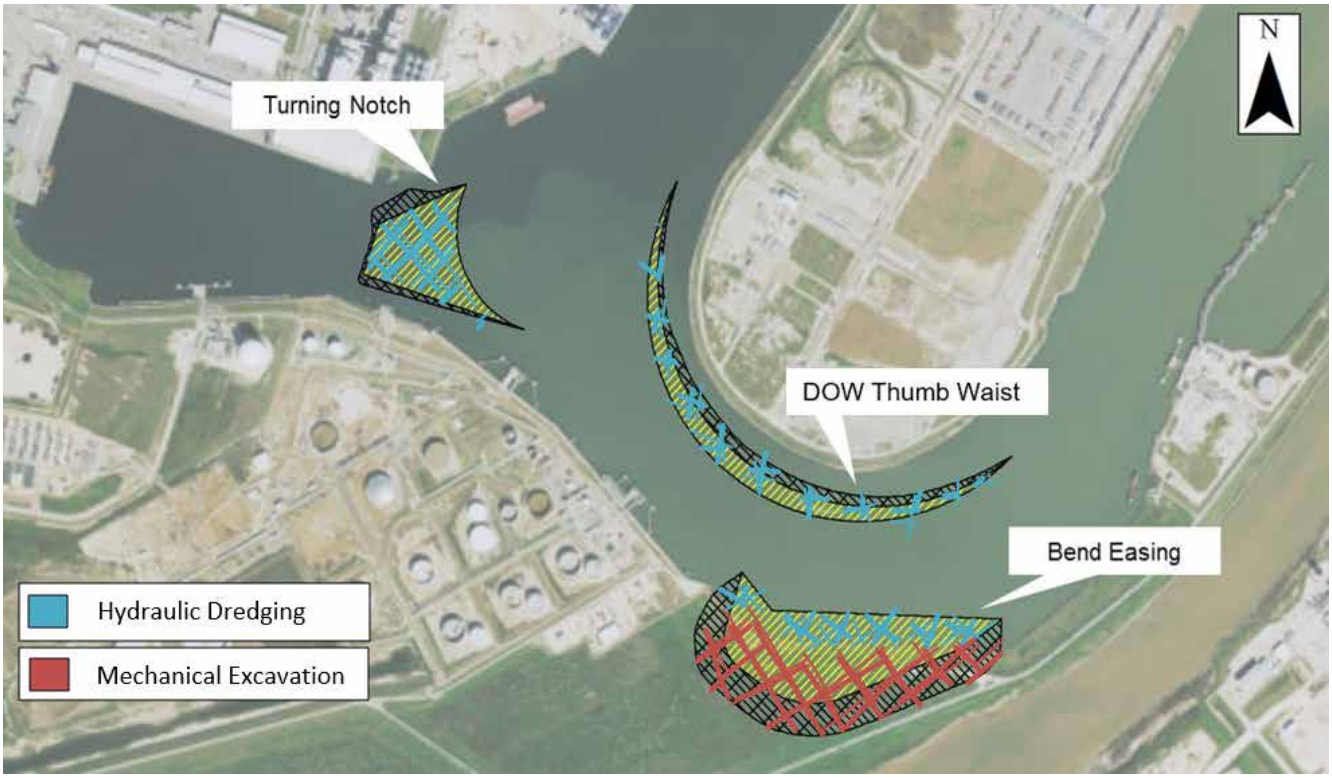
Performance Assessment

Performance Attribute	Rationale for Change in Performance
Channel Operations	No change.
Sustainability	No change.
Maintainability	No change.
Construction Impacts	No change.
Environmental Impacts	No change.

VE ALTERNATIVE 4.0

Sell above-ground excavated material to local developers or back to Port Freeport.

VE Alternative Concept Sketches



This alternative assumes that Alternative 3.0, suggesting use of mechanical excavation in addition to hydraulic dredging, has been implemented.

Mechanically excavated materials from the bend easing area could be sold.

VE ALTERNATIVE 4.0

Sell above-ground excavated material to local developers or back to Port Freeport.

Assumptions and Calculations:

- Assume 500,000 CY mechanical excavation
- Assume 150,000 CY is usable as general fill
- Assume $2/CY value of excavated material
- 150,000 CY x $2/CY = **$300,000 potential savings**

VE ALTERNATIVE 5.0

Reduce advanced maintenance dredging from 2 feet to 1 foot across the footprint of the dredging.

Initial Cost Savings:	$1,771,000
LCC Savings:	$7,867,000
Change in Schedule:	No change
Performance Change:	-6 %
Value Change:	-4 %

Description of Baseline Concept: The baseline concept proposes excavating an additional 2 feet of depth across the project footprint for advanced maintenance and 1 foot for overdredge. This is intended to reduce future maintenance of the channel and is a common dredging practice.

Description of Alternative Concept: This VE alternative would reduce advanced maintenance dredging from 2 feet to 1 foot, and would maintain the 1 foot of overdredge.

Advantages:

- Saves significant costs associated with dredging
- Reduces environmental impact by reducing dredging

Disadvantages:

- Potentially more frequent maintenance dredging in the future

Discussion: This VE alternative would reduce advanced maintenance dredging from 2 feet to 1 foot, and maintain the 1 foot of overdredge. It was discussed during the VE study that the full 2 feet of advanced maintenance dredging may not be necessary for this region, especially considering the low sedimentation accumulation rates in the DOW Thumb area. An exception would be if specific areas experience shoaling; however, this could be managed with minimal cost and effort over the life of the project.

Technical Review Comments: None noted.

Project Management Considerations: None noted.

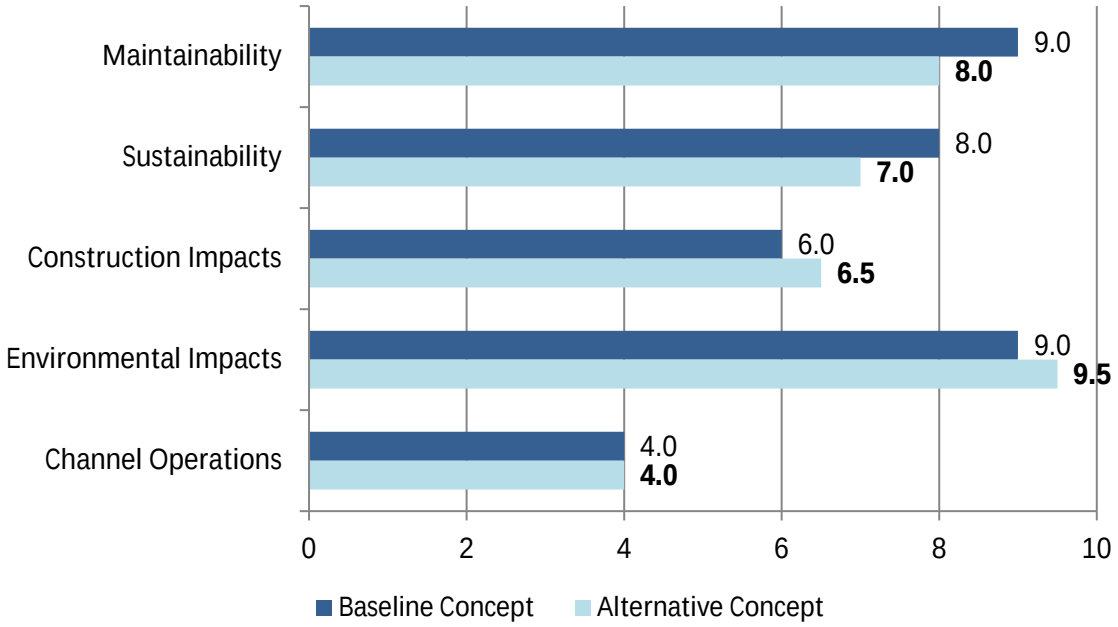
Discussion of Schedule Impacts: No significant impact.

Discussion of Risk Impacts: No significant impact.

VE ALTERNATIVE 5.0

Reduce advanced maintenance dredging from 2 feet to 1 foot across the footprint of the dredging.

Comparison of Performance



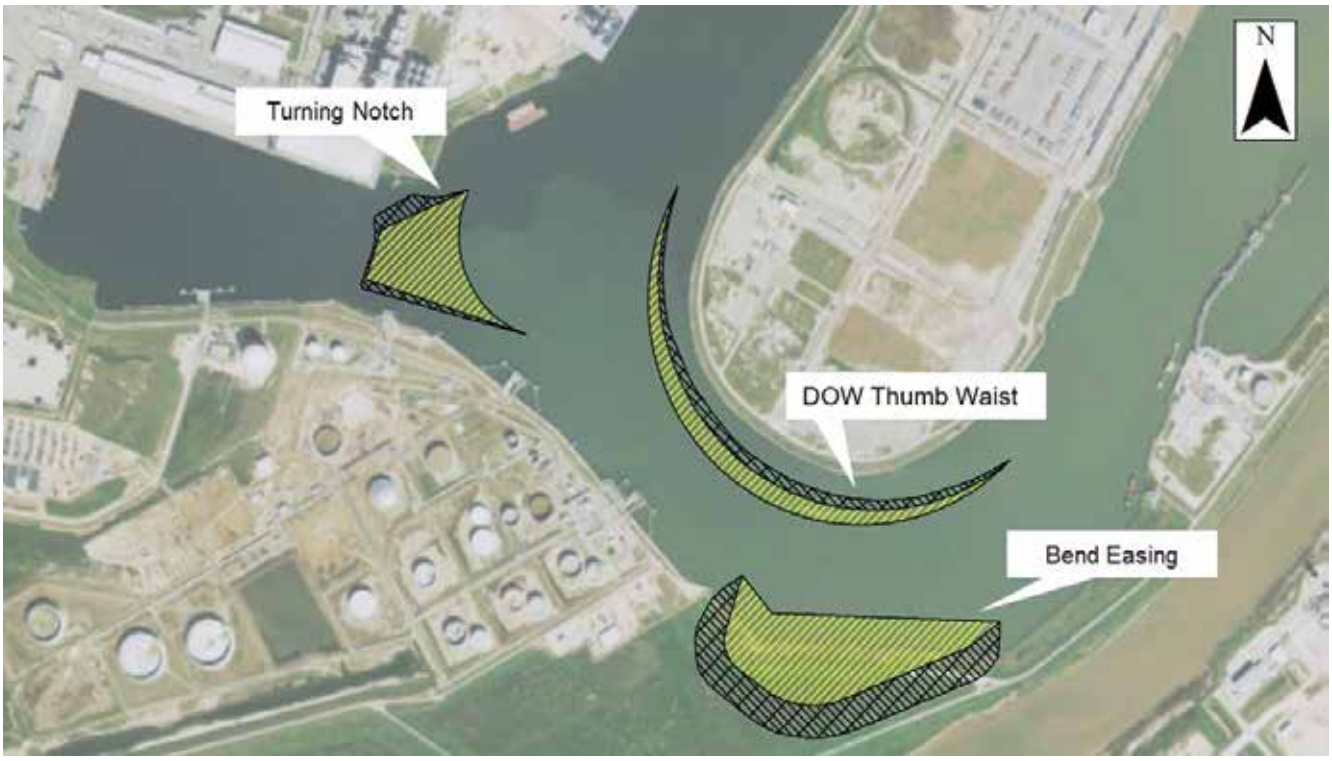
Performance Assessment

Performance Attribute	Rationale for Change in Performance
Channel Operations	Slight potential decrease due to future maintenance interruption of channel operations; however, not enough to change this attribute rating.
Sustainability	Slightly reduced.
Maintainability	Minor decrease due to potential need for future maintenance.
Construction Impacts	Some improvement due to minor schedule decrease.
Environmental Impacts	Less chance of siltation impacting water quality.

VE ALTERNATIVE 5.0

Reduce advanced maintenance dredging from 2 feet to 1 foot across the footprint of the dredging.

Baseline Concept Sketch

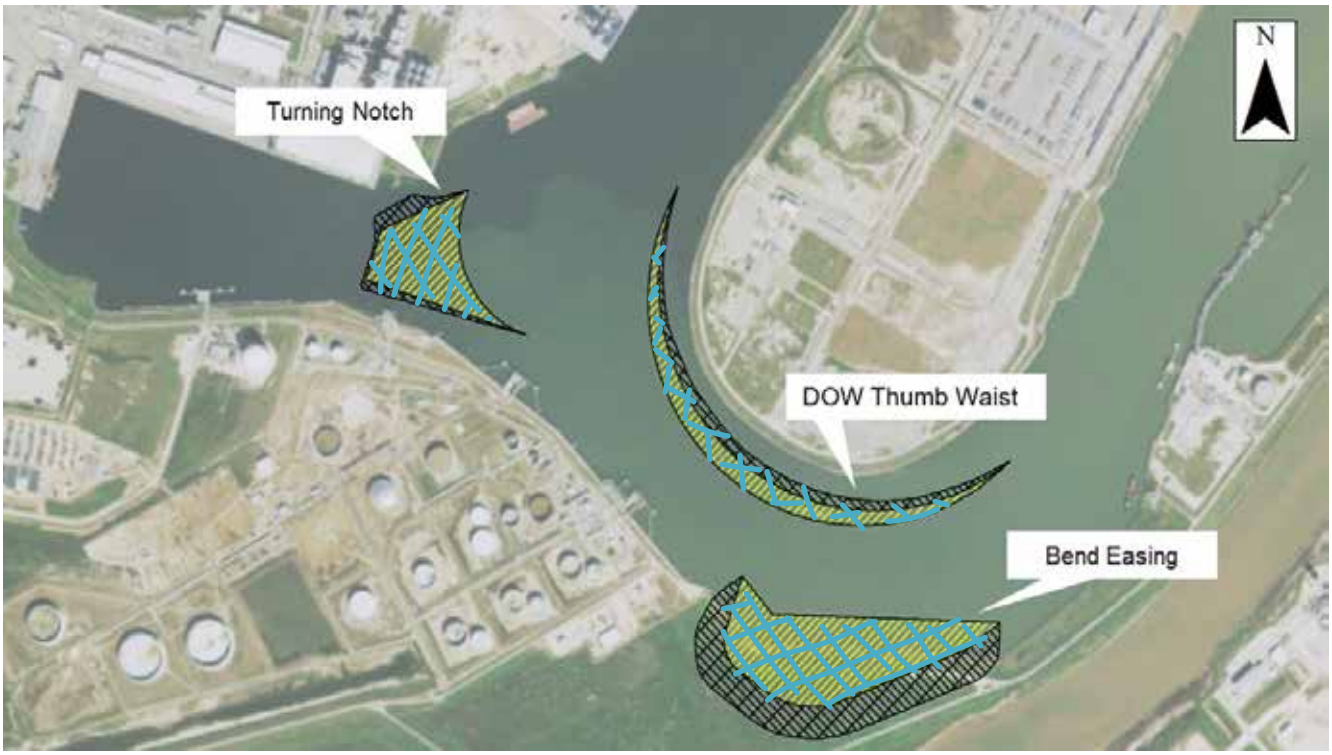


The baseline includes 2 feet of advanced maintenance dredging in all areas shown in yellow above.

VE ALTERNATIVE 5.0

Reduce advanced maintenance dredging from 2 feet to 1 foot across the footprint of the dredging.

VE Alternative Concept Sketch



The alternative proposes only 1 foot of advanced maintenance dredging in the areas hatched in blue.

Assumptions and Calculations:

- Assumes natural rate of sediment accumulation in the area is relatively insignificant. Historical data demonstrates that maintenance dredging has been performed in this area every 7 to 10 years.
- Note that this is hot spot dredging, not full dredging.
- Current channel activities use a hopper to excavate hot spot areas as needed.
- Assumes baseline for advanced maintenance volume, based upon a 2-foot depth = 296,000 CY

VE ALTERNATIVE 5.0

Reduce advanced maintenance dredging from 2 feet to 1 foot across the footprint of the dredging.

Initial Cost Estimate

CONSTRUCTION ELEMENT		*BASELINE CONCEPT*			*ALTERNATIVE CONCEPT*		
Description	**Unit**	**Qty**	**Cost/Unit**	**Total**	**Qty**	**Cost/Unit**	**Total**
Advance Maintence Dredging	cy	296,000	$ 9	$ 2,664,000	148,000	$ 9	$ 1,332,000
Assume a 50% reduction from							
2 feet to 1 foot							
SUB-TOTAL				$2,664,000			$1,332,000
PROJECT MARK-UPS	33%			$879,120			$439,560
TOTAL (Rounded)				$3,543,000			$1,772,000
						SAVINGS	**$1,771,000**

Life-Cycle Cost Estimate

Life-Cycle Period	50	Years	Real Discount Rate	2.00%	**BASELINE**	**ALTERNATIVE**
A. INITIAL COST					$3,543,000	$1,772,000
Service Life - Baseline	50	Years	**INITIAL COST SAVINGS:**			**$1,771,000**
Service Life - Alternative	50	Years				
B. SUBSEQUENT ANNUAL COSTS						
1. Maintenance Dredging					$ 420,000	$ 226,000
Based on maint of 296,000 cy x 50% for every 7 years @ $9 / yd						
Baseline is capital dredging and Alternative is maintenance dredging						
Total Subsequent Annual Costs:					$ 420,000	$ 226,000
Present Value Factor (P/A):					31.424	31.424
PRESENT VALUE OF SUBSEQUENT ANNUAL COSTS (Rounded):					**$ 13,198,000**	**$ 7,102,000**
C. SUBSEQUENT SINGLE COSTS		**Year**	**Amount**	**PV Factor (P/F)**	**Present Value**	**Present Value**
				1.00000	$ -	
				1.00000		$ -
PRESENT VALUE OF SUBSEQUENT SINGLE COSTS (Rounded):					**$ -**	**$ -**
D. TOTAL SUBSEQUENT ANNUAL AND SINGLE COSTS (B+C)					**$ 13,198,000**	**$ 7,102,000**
E. TOTAL SUBSEQUENT COSTS SAVINGS:						**$ 6,096,000**
F. TOTAL PRESENT VALUE COST (A+D)					**$ 16,741,000**	**$ 8,874,000**
TOTAL LIFE-CYCLE SAVINGS:						**$ 7,867,000**

VE ALTERNATIVE 6.0

Pre-purchase steel sheet piling through USACE to reduce timing and save sales tax costs

Initial Cost Savings:	$393,000
Subsequent LCC Savings:	$0
Change in Schedule:	No change
Performance Change:	No change
Value Change:	No change

Description of Baseline Concept: The baseline concept assumes that the contractor will acquire steel sheet piling and pay sales tax on the cost of the material.

Description of Alternative Concept: This VE alternative proposes that USACE Galveston District pre-purchase steel sheet piling for use in the DOW Thumb waist levee foundation strengthening, therefore exempting the material from sales tax.

Advantages:

- Reduces cost by eliminating sales tax on materials
- Earlier acquisition of materials reduces lead time concerns

Disadvantages:

- This is not common practice in the USACE Galveston District
- Increases USACE liability associated with acquisition of materials
- Potentially requires storage of materials purchased in advance

Discussion: The baseline concept assumes that the contractor will acquire steel sheet piling and pay sales tax on the cost of the material. This VE alternative proposes that USACE Galveston District pre-purchase steel sheet piling for use in the DOW Thumb waist levee foundation strengthening, therefore exempting the material from sales tax. The primary benefit of this alternative is significant cost savings due to the elimination of sales tax on the purchase of steel sheet piling. It is assumed that the government will be able to purchase steel sheet piling at the same price as the contractor would be able to, less the 8% sales tax. It was noted during the VE study that this is not common practice in the USACE Galveston District; however, other government agencies have successfully used this practice.

Technical Review Comments: None noted.

Project Management Considerations: Requires consultation with procurement contracting office to establish parameter around pre-purchase of materials.

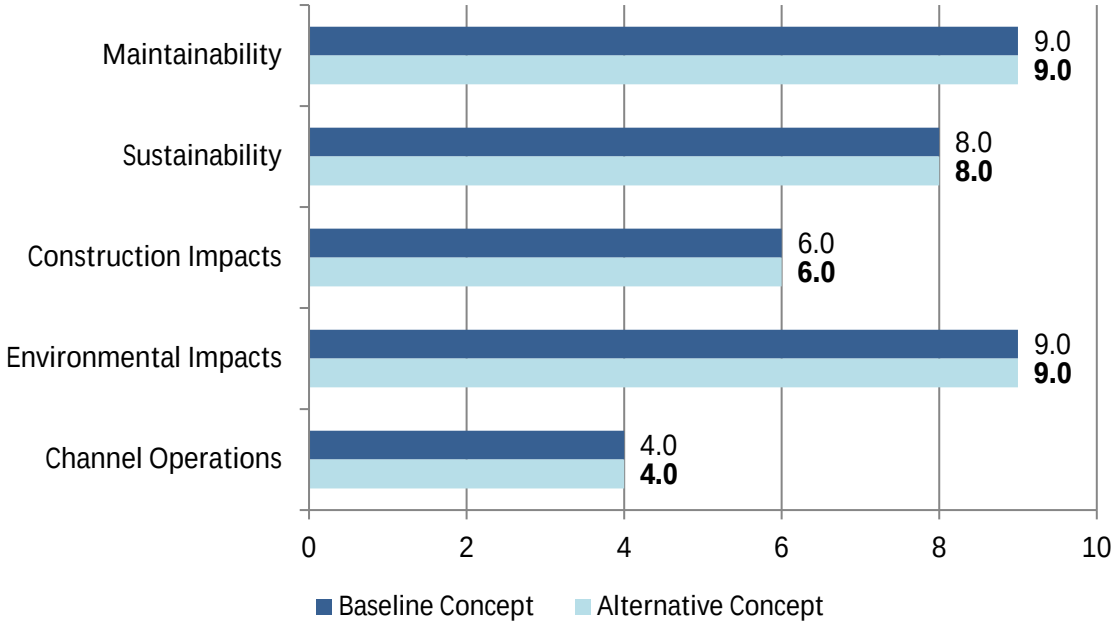
Discussion of Schedule Impacts: Reduces concerns of long lead time associated with materials acquisition, however there is no significant impact to the critical path.

Discussion of Risk Impacts: Increases USACE liability associated with acquisition of materials.

VE ALTERNATIVE 6.0

Pre-purchase steel sheet piling through USACE to reduce timing and save sales tax costs

Comparison of Performance



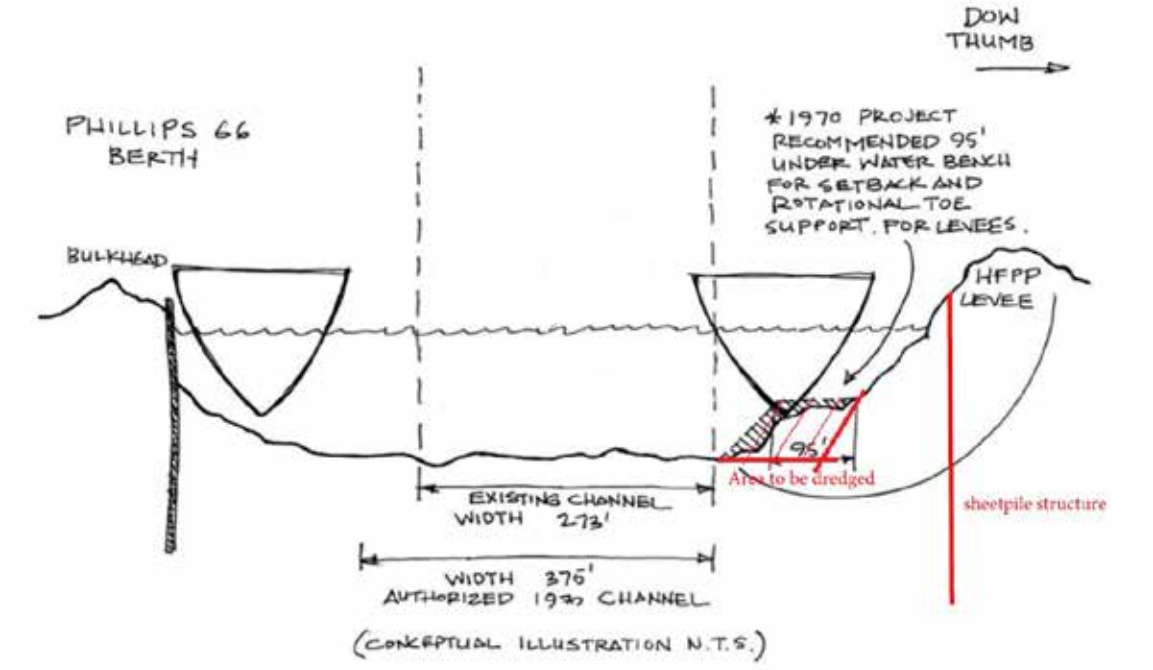
Performance Assessment

Performance Attribute	Rationale for Change in Performance
Channel Operations	No change.
Sustainability	No change.
Maintainability	No change.
Construction Impacts	No change.
Environmental Impacts	No change.

VE ALTERNATIVE 6.0

Pre-purchase steel sheet piling through USACE to reduce timing and save sales tax costs

Baseline Concept Sketch



The baseline concept assumes that the contractor will procure the sheet piling to be installed at the DOW Thumb Waist (indicated as "sheet pile structure" above).

VE Alternative Concept Sketch

The alternative proposes pre-purchasing sheet piling through USACE Galveston District.

VE ALTERNATIVE 6.0

Pre-purchase steel sheet piling through USACE to reduce timing and save sales tax costs

Assumptions and Calculations: Assume material cost for baseline steel sheet piling (furnish and installation) = $9,245,000 x 40% (for materials only) = $3,698,000 x .08 (sales tax) = $295,120 x 1.33 = $393,000 savings

Initial Cost Estimate

CONSTRUCTION ELEMENT		*BASELINE CONCEPT*			*ALTERNATIVE CONCEPT*		
Description	**Unit**	**Qty**	**Cost/Unit**	**Total**	**Qty**	**Cost/Unit**	**Total**
Material Cost of Sheet Pile Steel	$	3,689,000	$ 0.08	$295,120			
40% of $9,245,000 = $3,698,000	cy						
Assume 40% of cost is for steel piling							
SUB-TOTAL				$295,120			$0
PROJECT MARK-UPS	33%			$97,390			$0
TOTAL (Rounded)				$393,000			$0
						SAVINGS	**$393,000**

PROJECT INFORMATION

PROJECT INFORMATION

BACKGROUND

Freeport Harbor provides deep water access from the Gulf of Mexico to Port Freeport. The waterway extends from deep water in the Gulf through a 0.83-mile jettied channel to the Lower Turning Basin, then westerly approximately 1.5 miles to and including the Brazosport Turning Basin, then westerly approximately 2.2 miles through the Upper Turning Basin to and including a turning basin at Brazos Harbor. The Freeport Harbor Channel was established in the 1800s from a natural river meander, the exit to which was diverted in the 1920s. As a result, the channel flows are based upon tidal fluctuations. The configuration of the channel poses a significant challenge to ship navigation, especially as larger vessels require access to Velasco Terminal at the northern end of the channel.

The original project for Federal channel improvement at Freeport was authorized by the River and Harbor Act (RHA) in 1880. This included construction of jetties for controlling and improving the channel at the mouth of the Brazos River. A second Freeport Harbor Project was authorized by the RHAs of May 1950 and July 1958. The acts provided for an Outer Bar Channel 38 feet deep and 300 feet wide from the Gulf of Mexico to a point inside the jetties, with inside channels 36 feet deep and 200 feet wide to and including the Upper Turning Basin. Greater depth and width were authorized by Congress in 1970 and by the President in 1974. These authorizations were for the Jetty Channel to be relocated and deepened to 45 feet, widened to 400 feet, and the North Jetty relocated northward. The relocated Entrance Channel (Outer Bar) was authorized to a 400-foot width, to a 47-foot depth, and to extend approximately 4.6 miles into the Gulf of Mexico. A Final Environmental Impact Statement for the project was prepared by the U.S. Army Corps of Engineers (USACE) in 1978. In 1978, Seaway Pipeline, Inc., under a Department of Army permit, was authorized to widen the Entrance (Outer Bar) Channel to 400 feet and the Jetty Channel to 230 feet.

The current Freeport Harbor Project is authorized under Section 7002 of the WRDA 2014 and a feasibility study.

PROJECT DESCRIPTION

It has been determined that the project authorized under WRDA 2014 contains engineering deficiencies that would prevent the safe navigation of large vessels. The feasibility study identified and simulated these deficiencies in collaboration with the Brazos Harbor Pilots, STAR, the Velasco Drainage District, Port Freeport and other Freeport Harbor channel users and stakeholders. It was determined that the following features are necessary to enable a Panamax vessel to safely navigate the channel as previously authorized:

- Channel Widening upstream of Brazosport Turning Basin (Station 115+00 to 132+66).
- Bend Easing – Elliptical bend easing feature would allow the stern end of ships to be maneuvered such that the vessel direction would be aligned properly to transit directly to the upper reaches of the channel.

- Channel Widening Around the Dow Thumb (Station 132+66 to 173+75) – The P66 Berth 2 will be relocated at P66 cost to take advantage of land to be made available by Port Freeport that would allow for relocation of the P66 Berth along a newly constructed access channel by P66. With the relocation of the P66 Berth, the channel can be widened to almost 600 feet without excavation of the DOW property.
- Reconstruction of HFPP Levee – This feature addresses potential levee stability problems with channel widening by relocating/reconstructing 1,000 feet of levee around the tip of the DOW thumb.
- Widening of Upper Turning Basin – This feature widens the basin to allow for turning of the design vessel.
- Deepening Emergency Stopping Area in the Inner Harbor – This feature provides an escape area for the turn into the Velasco Terminal.

The additional features listed above still do not adequately allow for safe navigation of the design vessel to the Velasco Terminal and the benefits claimed for the Lower Stauffer Channel are not fully realized. Since design vessel transit can only be accomplished with restrictions of one-way, tug-assisted, daylight hours-only operations, the result is that the channel is functioning at approximately 65% utilization. Along with not fully achieving the RHA 1970 authorized project benefits, the result of the constructed project was a channel with pilot constraints on operations of the design vessel in order to safely navigate. Port Freeport conducted ship simulations of 5 channel alignment options in January 2014 for Panamax vessels. The STAR Center simulations illustrated the inability of large vessels to navigate safely around the DOW thumb in the current channel width when a tanker is moored at P66 Berth 2. However, no change was proposed to the channel width at this location in the 2012 FHCIP Feasibility Study.

A GRR has been developed with an integrated Environmental Assessment (EA) to ensure the modifications are in compliance with USACE policies, the National Environmental Policy Act (NEPA) and other environmental laws. A GRR is a reanalysis of a previously completed study, using current planning criteria and policies, which is required due to changed conditions and/or assumptions in the study area. The purpose of the GRR is to evaluate the previously authorized project and recommend modifications to that plan based on changed economic and physical conditions. The ultimate goal of Port Freeport is to identify modifications to the authorized plan, related to channel widths and bend-easing that allow for the projected fleet of Panamax vessels. This would require a change in the feasibility design prepared in 2012 feasibility report and NEPA compliance to ensure the changes are in the Federal interest.

The current project estimate at the time of the VE study is $47,900,000 with a schedule of 42 months.

INFORMATION PROVIDED TO THE VE TEAM

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

- Design Memorandum No. 8 Old River South Levee and Wave Barrier - June 1967
- Drawing X-Section
- SWG Greeport White Paper - 19 September 2015

- Freeport Map Detail Mitigation Feature
- Final FHCIP Final Environmental Impact Statement Vol 1 - August 2012
- Freeport Map Overview Mitigation Feature
- PSI Freeport PA 1 Geotech Report - 1 June 1996
- Final Report Freeport TX Containership Evaluation 2016 DWW-STAR 13 July 2016
- Final FHCIP FEIS Appendices D-M - August 2012
- Freeport Levee Wave Barrier Location Map
- Final FHCIP FEIS Vol II Appendices B-C - August 2012
- Final FHCIP FEIS Vol II Appendix A - August 2012
- FHCIP Final Feasibility Report Vol I - August 2012
- FHCIP DMMP Preliminary - 20 July 2016
- FHCIP Final Feasibility Report Vol II Appendices - August 2012
- OPCC FHCIP Waist Levee Foundation Relief Draft - 16 June 2016
- OPCC FHCIP New Work Dredging Draft - 16 June 2016
- Memo HH Task 4 Overtopping Analysis Draft - 25 May 2016
- Memo HH Task 3 Wave Analysis Report Draft - 09 May 2016
- Memo HH Task 3 Wave Analysis Draft Appendix - 09 May 2016
- Memo HH Task 5 Hydrodynamic Analysis Draft - 09 May 2016
- Memo HH Task 2 Sea Level Rise Analysis Draft - 09 May 2016
- Memo HH Task 1 Sedimentation Analysis Draft - 09 May 2016
- Project Management Plan Freeport Harbor Channel Improvement GRR - 02 February 2016

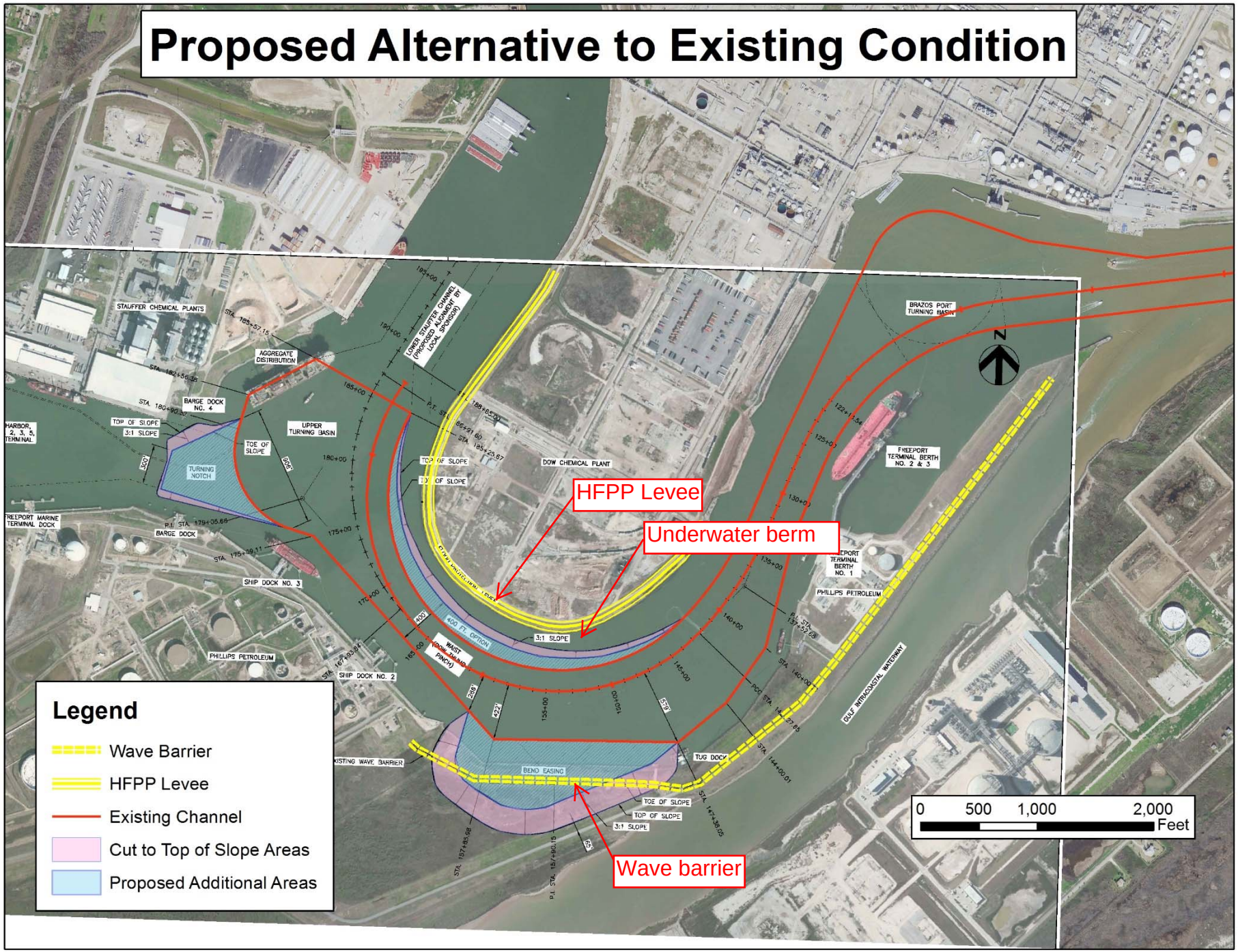
Note: The information presented in this section of the report may have been excerpted either in part or in full from the documents/information provided to the VE team listed above.

PROJECT DRAWINGS

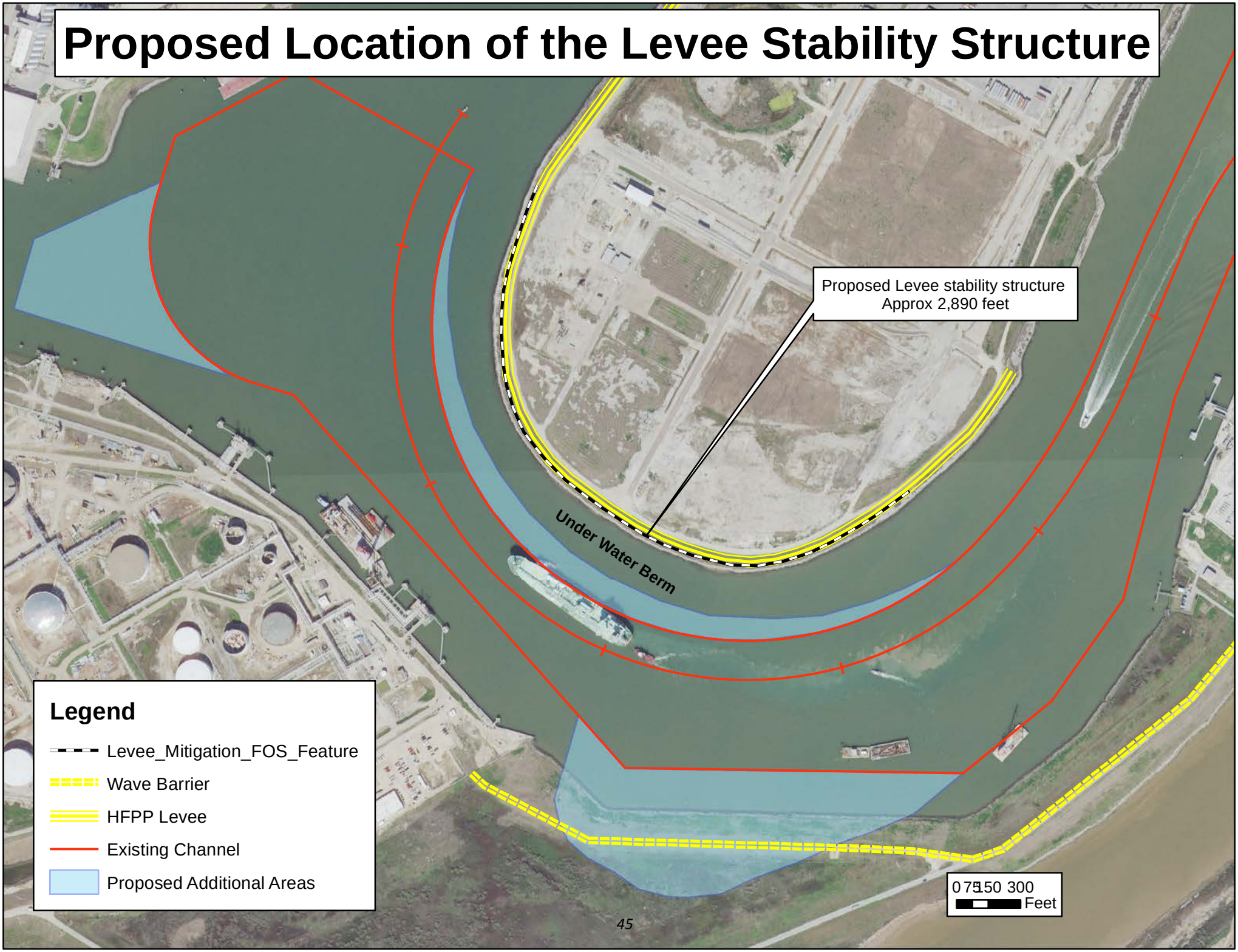
Selected sheets from the project drawings are included on the following pages.

PROJECT COST ESTIMATE

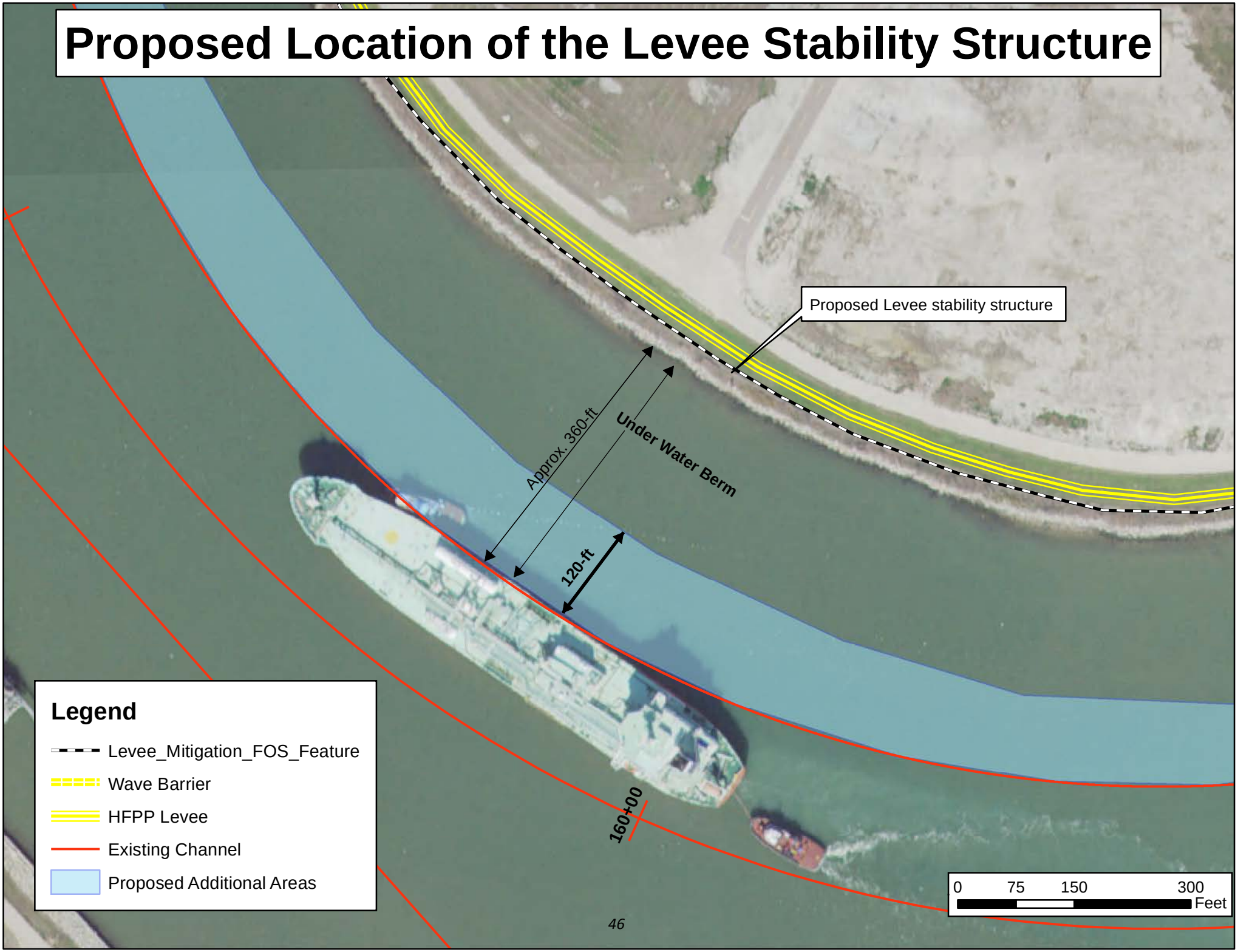
The project cost estimate that was used as the baseline for the VE study is included at the end of this section.

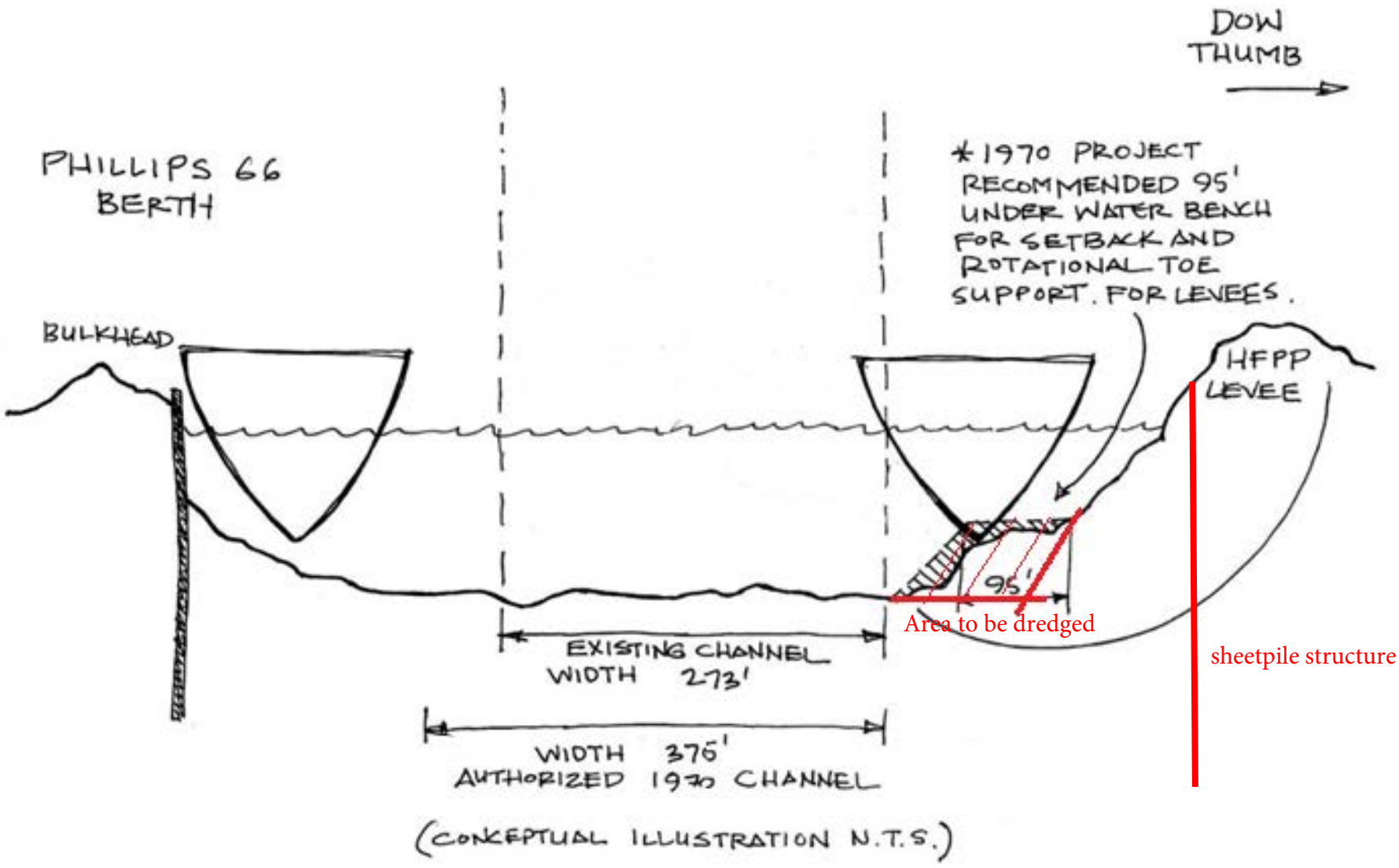

Proposed Alternative to Existing Condition
HFPP Levee
Underwater berm
Wave barrier
Legend
Wave Barrier
HFPP Levee
Existing Channel
Cut to Top of Slope Areas
Proposed Additional Areas
0 500 1,000 2,000
Feet
STAUFFER CHEMICAL PLANTS
AGGREGATE DISTRIBUTION
BARGE DOCK NO. 4
UPPER TURNING BASIN
TURNING NOTCH
DOW CHEMICAL PLANT
BRAZOS PORT TURNING BASIN
FREEPORT TERMINAL BERTH NO. 2 & 3
FREEPORT TERMINAL BERTH NO. 1
PHILLIPS PETROLEUM
SHIP DOCK NO. 3
SHIP DOCK NO. 2
400 FT. OPTION
BEND EASING
TUG DOCK
GULF INTRACOASTAL WATERWAY
N

Proposed Location of the Levee Stability Structure



Proposed Location of the Levee Stability Structure




DOW THUMB
PHILLIPS 66 BERTH
*1970 PROJECT RECOMMENDED 95' UNDER WATER BENCH FOR SETBACK AND ROTATIONAL TOE SUPPORT. FOR LEVEES.
BULKHEAD
HFPP LEVEE
95'
Area to be dredged
sheetpile structure
EXISTING CHANNEL WIDTH 273'
WIDTH 375' AUTHORIZED 1970 CHANNEL
(CONCEPTUAL ILLUSTRATION N.T.S.)

FREEPORT HARBOR CHANNEL IMPROVEMENT PROJECT
375 FT WIDENING ALTERNATIVE
FREEPORT HARBOR, TEXAS

CONCEPTUAL-LEVEL OPINION OF PROBABLE CONSTRUCTION COST -- CHANNEL DREDGING

ITEM	QUANTITY	UNIT	UNIT PRICE	EXTENSION	EXTENDED TOTAL
1. Mobilization/Demobilization	1	LS	$ 1,000,000	$ 1,000,000	
Dredging Pipeline & Booster Pump	1	LS	$ 1,110,000	$ 1,110,000	
					$ 2,110,000
2. Pipeline Dredging					
Bend Easing (Sta 147+00 to 159+85)	1,556,000	CY	$ 9.00	$ 14,004,000	
Turning Notch (Sta 175+77 to 181+41)	132,000	CY	$ 9.00	$ 1,188,000	
Channel Widening -- Reach 1 (Sta 142+28 to 154+00)	75,000	CY	$ 9.00	$ 675,000	
Channel Widening -- Reach 2 (Sta 154+00 to 166+15)	72,000	CY	$ 9.00	$ 648,000	
Channel Widening -- Reach 3 (Sta 166+15 to 185+26)	57,000	CY	$ 9.00	$ 513,000	
					$ 17,028,000
3. Allowances for Subsidiary Work					
Submerged Pipeline Crossing	1	LS	$ 50,000	$ 50,000	
Shoreline Protection at Bend Easing	2,000	LF	$ 750	$ 1,500,000	
Raise PA 1 Levees from +25' to +28' NAVD	110,000	CY	$ 7.00	$ 770,000	
Decant Structure Upgrades	1	LS	$ 50,000	$ 50,000	
Misc. Minor Ancillary	1	LS	$ 50,000	$ 50,000	
					$ 2,420,000
4. Surveying and Acceptance					
Pre-Dredge Hazard (Magnetometer) Survey	1	LS	$ 50,000	$ 50,000	
Hydrographic and Topographic Surveys	1	LS	$ 300,000	$ 300,000	
					$ 350,000
				SUBTOTAL:	$ 21,908,000
				3.2% Cost Escalation:	$ 702,000
				Contingency (30%)	$ 6,783,000
				SUBTOTAL (CONSTRUCTION COST):	**$ 29,393,000**
5. Engineering & Environmental					
Engineering Analysis and Design					$ 750,000
Regulatory / Permitting					$ 440,000
Construction Administration and Observation					$ 500,000
				TOTAL (CONSTRUCTION + ENGR & ENVIRO):	**$ 31,083,000**

Notes:

1. All dredging assumed to be performed using 30", 1800 hp cutter and 8,000 hp pumps with average production of approximately 29,200 cy/day. Approximate distance for dredge mobilization assumed to be 490 nmi. Actual cost for pipeline dredging may be lower if local dredging contractor used. Dredged material placement area assumed to be PA 1. Average pumping distance = 4 miles.
2. Allowance for dredging pipeline crossing includes additional dredging and other work for submerging dredging pipeline across bottom of existing channel.
3. Detailed requirements (limits and cross section) for shoreline protection at Bend Easing have not yet been determined.
4. Allowance for minor ancillary work includes crew and work boats, meetings, signs, miscellaneous equipment and personnel, etc.
5. Cost escalation based on approximate mid-point of construction of January 2018 and determined in accordance with EM 1110-2-1304.
6. Estimate includes approximately 296,000 CY for advance maintenance and 92,000 CY for allowable overdepth.

FREEPORT HARBOR CHANNEL IMPROVEMENT PROJECT
400 FT WIDENING ALTERNATIVE
FREEPORT HARBOR, TEXAS

CONCEPTUAL-LEVEL OPINION OF PROBABLE CONSTRUCTION COST -- CHANNEL DREDGING

ITEM	QUANTITY	UNIT	UNIT PRICE	EXTENSION	EXTENDED TOTAL
1. Mobilization/Demobilization	1	LS	$ 1,000,000	$ 1,000,000	
Dredging Pipeline & Booster Pump	1	LS	$ 1,110,000	$ 1,110,000	
					$ 2,110,000
2. Pipeline Dredging					
Bend Easing (Sta 147+00 to 159+85)	1,556,000	CY	$ 9.00	$ 14,004,000	
Turning Notch (Sta 175+77 to 181+41)	132,000	CY	$ 9.00	$ 1,188,000	
Channel Widening -- Reach 1 (Sta 142+28 to 154+00)	87,000	CY	$ 9.00	$ 783,000	
Channel Widening -- Reach 2 (Sta 154+00 to 166+15)	98,000	CY	$ 9.00	$ 882,000	
Channel Widening -- Reach 3 (Sta 166+15 to 185+26)	77,000	CY	$ 9.00	$ 693,000	
					$ 17,550,000
3. Allowances for Subsidiary Work					
Submerged Pipeline Crossing	1	LS	$ 50,000	$ 50,000	
Shoreline Protection at Bend Easing	2,000	LF	$ 750	$ 1,500,000	
Raise PA 1 Levees from +25' to +28' NAVD	110,000	CY	$ 7.00	$ 770,000	
Decant Structure Upgrades	1	LS	$ 50,000	$ 50,000	
Misc. Minor Ancillary	1	LS	$ 50,000	$ 50,000	
					$ 2,420,000
4. Surveying and Acceptance					
Pre-Dredge Hazard (Magnetometer) Survey	1	LS	$ 50,000	$ 50,000	
Hydrographic and Topographic Surveys	1	LS	$ 300,000	$ 300,000	
					$ 350,000
				SUBTOTAL:	$ 22,430,000
				3.2% Cost Escalation:	$ 718,000
				Contingency (30%)	$ 6,944,000
				SUBTOTAL (CONSTRUCTION COST):	**$ 30,092,000**
5. Engineering & Environmental					
Engineering Analysis and Design					$ 750,000
Regulatory / Permitting					$ 440,000
Construction Administration and Observation					$ 500,000
				TOTAL (CONSTRUCTION + ENGR & ENVIRO):	**$ 31,782,000**

Notes:

1. All dredging assumed to be performed using 30", 1800 hp cutter and 8,000 hp pumps with average production of approximately 29,200 cy/day. Approximate distance for dredge mobilization assumed to be 490 nmi. Actual cost for pipeline dredging may be lower if local dredging contractor used. Dredged material placement area assumed to be PA 1. Average pumping distance = 4 miles.
2. Allowance for dredging pipeline crossing includes additional dredging and other work for submerging dredging pipeline across bottom of existing channel.
3. Detailed requirements (limits and cross section) for shoreline protection at Bend Easing have not yet been determined.
4. Allowance for minor ancillary work includes crew and work boats, meetings, signs, miscellaneous equipment and personnel, etc.
5. Cost escalation based on approximate mid-point of construction of January 2018 and determined in accordance with EM 1110-2-1304.
6. Estimate includes approximately 313,000 CY for advance maintenance and 94,000 CY for allowable overdepth.

FREEPORT HARBOR CHANNEL IMPROVEMENT PROJECT
PAZ24 / AZ19 - 700 Wall Option
FREEPORT HARBOR, TEXAS

CONCEPTUAL-LEVEL OPINION OF PROBABLE CONSTRUCTION COST

ITEM	QUANTITY	UNIT	UNIT PRICE	EXTENSION	EXTENDED TOTAL
1. Mobilization	1	LS	$ 200,000	$ 200,000	
Demobilization	1	LS	$ 100,000	$ 100,000	
					$ 300,000
2. Sheet Pile Combi-wall					
PAZ24 / AZ19 - 700 Sheet Piling	4,300	LF	$ 2150.00	$ 9,245,000	
20' Coating length on both sides	4,300	LF	$ 140.00	$ 602,000	
Storage Barge	2	EA	$ 72800.00	$ 145,600	
					$ 9,992,600
3. Surveying and Acceptance					
Hydrographic and Topographic Surveys	1	LS	$ 50,000	$ 50,000	
					$ 50,000
				SUBTOTAL:	$ 10,342,600
				3.2% Cost Escalation:	$ 331,000
				Contingency (30%)	$ 3,202,000
				SUBTOTAL (CONSTRUCTION COST):	**$ 13,876,000**
4. Engineering & Environmental					$ 840,000
				TOTAL (CONSTRUCTION + ENGR & ENVIRO):	**$ 14,716,000**

Notes:
1. Cost escalation based on approximate mid-point of construction of January 2018 and determined in accordance with EM 1110-2-1304.
2. Labor cost assumes the wall to be constructed from barge

FREEPORT HARBOR CHANNEL IMPROVEMENT PROJECT
PAZ24 / NZ19 Wall Option
FREEPORT HARBOR, TEXAS

CONCEPTUAL-LEVEL OPINION OF PROBABLE CONSTRUCTION COST

ITEM	QUANTITY	UNIT	UNIT PRICE	EXTENSION	EXTENDED TOTAL
1. Mobilization	1	LS	$ 200,000	$ 200,000	
Demobilization	1	LS	$ 100,000	$ 100,000	
					$ 300,000
2. Sheet Pile Combi-wall					
PAZ24 / NZ19 Sheet Piling	4,300	LF	$ 2180.00	$ 9,374,000	
20' Coating length on both sides	4,300	LF	$ 140.00	$ 602,000	
Storage Barge	2	EA	$ 72800.00	$ 145,600	
					$ 10,121,600
3. Surveying and Acceptance					
Hydrographic and Topographic Surveys	1	LS	$ 50,000	$ 50,000	
					$ 50,000
				SUBTOTAL:	$ 10,471,600
				3.2% Cost Escalation:	$ 336,000
				Contingency (30%)	$ 3,242,000
				SUBTOTAL (CONSTRUCTION COST):	**$ 14,050,000**
4. Engineering & Environmental					$ 850,000
				TOTAL (CONSTRUCTION + ENGR & ENVIRO):	**$ 14,900,000**

Notes:
1. Cost escalation based on approximate mid-point of construction of January 2018 and determined in accordance with EM 1110-2-1304.
2. Labor cost assumes the wall to be constructed from barge

FREEPORT HARBOR CHANNEL IMPROVEMENT PROJECT
PAZ30 / NZ19 Wall Option
FREEPORT HARBOR, TEXAS

CONCEPTUAL-LEVEL OPINION OF PROBABLE CONSTRUCTION COST

ITEM	QUANTITY	UNIT	UNIT PRICE	EXTENSION	EXTENDED TOTAL
1. Mobilization	1	LS	$ 200,000	$ 200,000	
Demobilization	1	LS	$ 100,000	$ 100,000	
					$ 300,000
2. Sheet Pile Combi-wall					
PAZ30 / NZ19 Sheet Piling	4,300	LF	$ 2230.00	$ 9,589,000	
20' Coating length on both sides	4,300	LF	$ 140.00	$ 602,000	
Storage Barge	2	EA	$ 72800.00	$ 145,600	
					$ 10,336,600
3. Surveying and Acceptance					
Hydrographic and Topographic Surveys	1	LS	$ 50,000	$ 50,000	
					$ 50,000
				SUBTOTAL:	$ 10,686,600
				3.2% Cost Escalation:	$ 342,000
				Contingency (30%)	$ 3,309,000
				SUBTOTAL (CONSTRUCTION COST):	**$ 14,338,000**
4. Engineering & Environmental					$ 870,000
				TOTAL (CONSTRUCTION + ENGR & ENVIRO):	**$ 15,208,000**

Notes:
1. Cost escalation based on approximate mid-point of construction of January 2018 and determined in accordance with EM 1110-2-1304.
2. Labor cost assumes the wall to be constructed from barge

FREEPORT HARBOR CHANNEL IMPROVEMENT PROJECT
Soil Mixing Wall Option -- Soilcrete Columns
FREEPORT HARBOR, TEXAS

CONCEPTUAL-LEVEL OPINION OF PROBABLE CONSTRUCTION COST

ITEM	QUANTITY	UNIT	UNIT PRICE	EXTENSION	EXTENDED TOTAL
1. Mobilization	1	LS	$ 200,000	$ 200,000	
Demobilization	1	LS	$ 100,000	$ 100,000	
					$ 300,000
2. Soil Mixing					
Soil Mixing Sta 142+27 to 185+25	4,300	LF	$ 1,600	$ 6,880,000	
					$ 6,880,000
3. Surveying and Acceptance					
Hydrographic and Topographic Surveys	1	LS	$ 50,000	$ 50,000	
					$ 50,000
				SUBTOTAL:	$ 7,230,000
				3.2% Cost Escalation:	$ 232,000
				Contingency (30%)	$ 2,239,000
				SUBTOTAL (CONSTRUCTION COST):	**$ 9,701,000**
4. Engineering & Environmental					$ 590,000
				TOTAL (CONSTRUCTION + ENGR & ENVIRO):	**$ 10,291,000**

Notes:
1. Cost escalation based on approximate mid-point of construction of January 2018 and determined in accordance with EM 1110-2-1304.
2. Cost assumes the soil mixing to be performed from barge.
3. No downtime for vessel traffic, weather, or other port activities.
4. Assume 4-ft dia wet soil mix columns overlapping 6-in. from El. 0 to -55
5. No steel reinforcement.
6. Design not checked for stability. Recommend perpedicular panel design to provide stability per Filz and Templeton USACE Manual.
7. 100 psi achievable, 500 psi may not be achievable
8. Zero discharge could add additional costs

FREEPORT HARBOR CHANNEL IMPROVEMENT PROJECT
Soil Mixing Wall Option -- Soilcrete Shear Panel
FREEPORT HARBOR, TEXAS

CONCEPTUAL-LEVEL OPINION OF PROBABLE CONSTRUCTION COST

ITEM	QUANTITY	UNIT	UNIT PRICE	EXTENSION	EXTENDED TOTAL
1. Mobilization	1	LS	$ 200,000	$ 200,000	
Demobilization	1	LS	$ 100,000	$ 100,000	
					$ 300,000
2. Soil Mixing					
Soil Mixing Sta 142+27 to 185+25	18,120	LF	$ 1,100	$ 19,932,000	
					$ 19,932,000
3. Surveying and Acceptance					
Hydrographic and Topographic Surveys	1	LS	$ 50,000	$ 50,000	
					$ 50,000
				SUBTOTAL:	$ 20,282,000
				3.2% Cost Escalation:	$ 650,000
				Contingency (30%)	$ 6,280,000
				SUBTOTAL (CONSTRUCTION COST):	**$ 27,212,000**
4. Engineering & Environmental					$ 1,640,000
				TOTAL (CONSTRUCTION + ENGR & ENVIRO):	**$ 28,852,000**

Notes:
1. Cost escalation based on approximate mid-point of construction of January 2018 and determined in accordance with EM 1110-2-1304.
2. Cost assumes the soil mixing to be performed from barge.
3. No downtime for vessel traffic, weather, or other port activities.
4. Assume 4-ft dia wet soil mix columns overlapping 6-in. from El. 0 to -55, 453 perpindicular pannels that are 40 ft long spaced at 9.5 ft center-to-
5. No steel reinforcement.
6. Preliminary design only checked for stability.
7. Zero discharge could add additional costs

PROJECT ANALYSIS

PROJECT ANALYSIS

SUMMARY OF ANALYSIS

The following analysis tools were used to study the project:

- Key Project Factors
- Cost Model
- Function Analysis
- Value Metrics
- Risk Analysis

KEY PROJECT FACTORS

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

Project Issues

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

Construction:

- Soil conditions inhibit driving of pipe or sheet pile and slows dredging.
- Construction staging must be scheduled in increments that do not jeopardize the integrity of the existing levee.
- Marine traffic management during construction will be complex.
- Port of Freeport must provide laydown areas for Contractor, which may incur additional costs.

Design:

- Allowable setback for safe navigation of vessel adjacent to LPG loading dock is currently unknown.

Environmental:

- Dredging operations could negatively affect water quality.

Funding:

- Exceeding the 902 limit would require additional Congressional authorization.

Operations:

- LNG safety zone radius can extend up to 200-300-meters during loading and unloading, which takes approximately 2-3 days.

Site:

- Physical geometry and geometrics are narrow which limits ability to widen the channel.

Stakeholders:

- Coordination of several stakeholders with multiple goals and objectives is difficult.

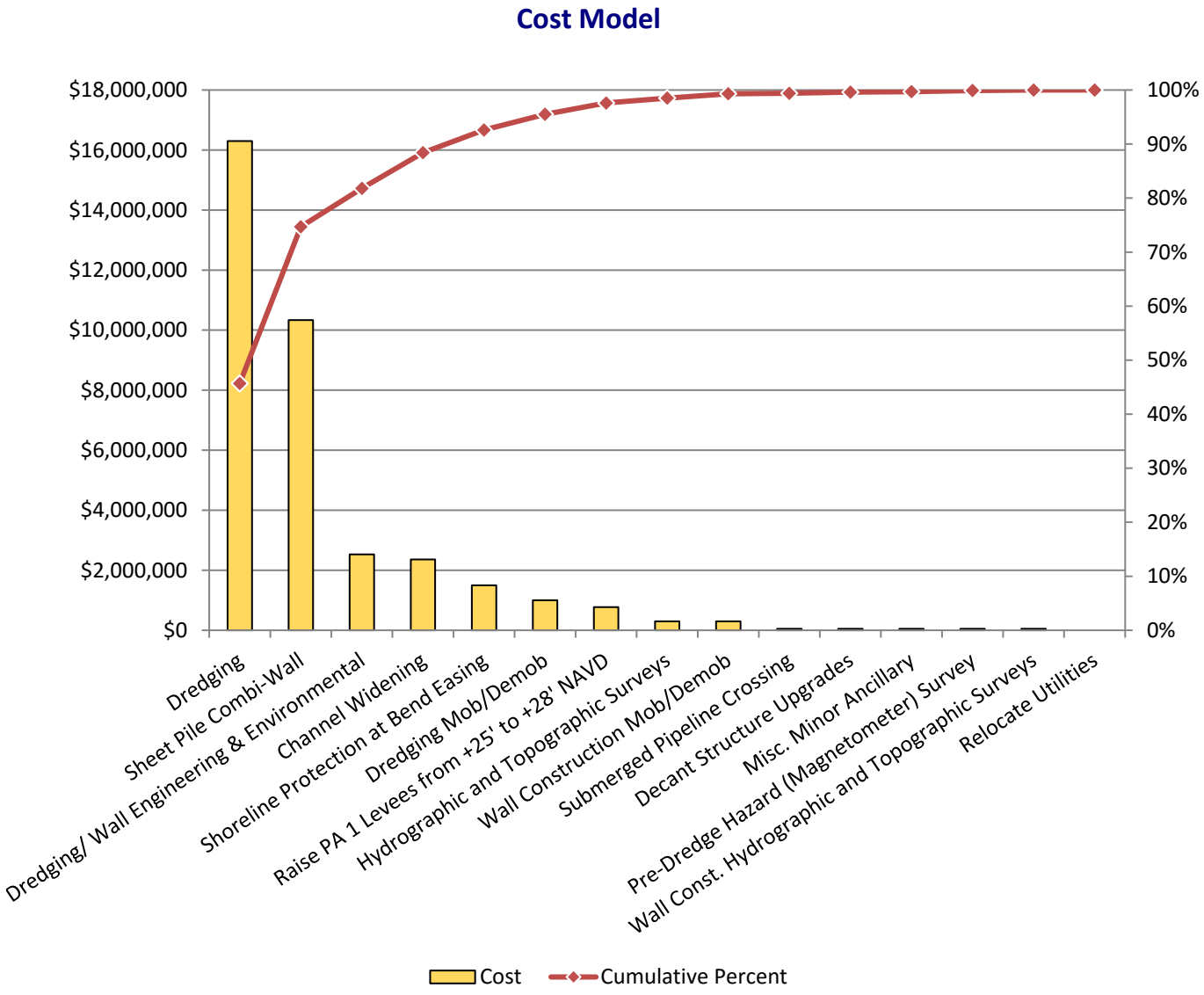
Site Visit Observations

A virtual site visit was conducted in order to visually assess the project site conditions. The following observations were made by the VE team.

- Silt buildup is not considered a primary project issue.
- Mooring dolphins present near entrance to project site in Brazos Harbor.
- Aid to Navigation (ATON) and power lines are present at wave barrier area, which will require relocation if wave barrier is removed.
- Combination of hydraulic and mechanical dredging is assumed for bend easing and turning notch.
- There are non-graded rocks present on the underwater berm which will require Contractor to clear a setting line without jeopardizing the integrity of the levee.
- Phillips 66 Company 30-inch crude transmission pipeline runs across south side of channel, though this may have been relocated.
- Abandoned Anglier Pipeline Highly Volatile Liquids pipeline is present within existing wave barrier area.
- Existing buoys may need to be relocated.

COST MODEL

The VE team leader prepared a cost model from the cost estimate presented in the *Project Information* section of this report. The model is organized to identify major construction elements or trade categories, the original estimated costs, and the percent of total project cost for the significant cost items. The cost model clearly showed the cost drivers for the project and was used to guide the VE team during the VE study.



FUNCTION ANALYSIS

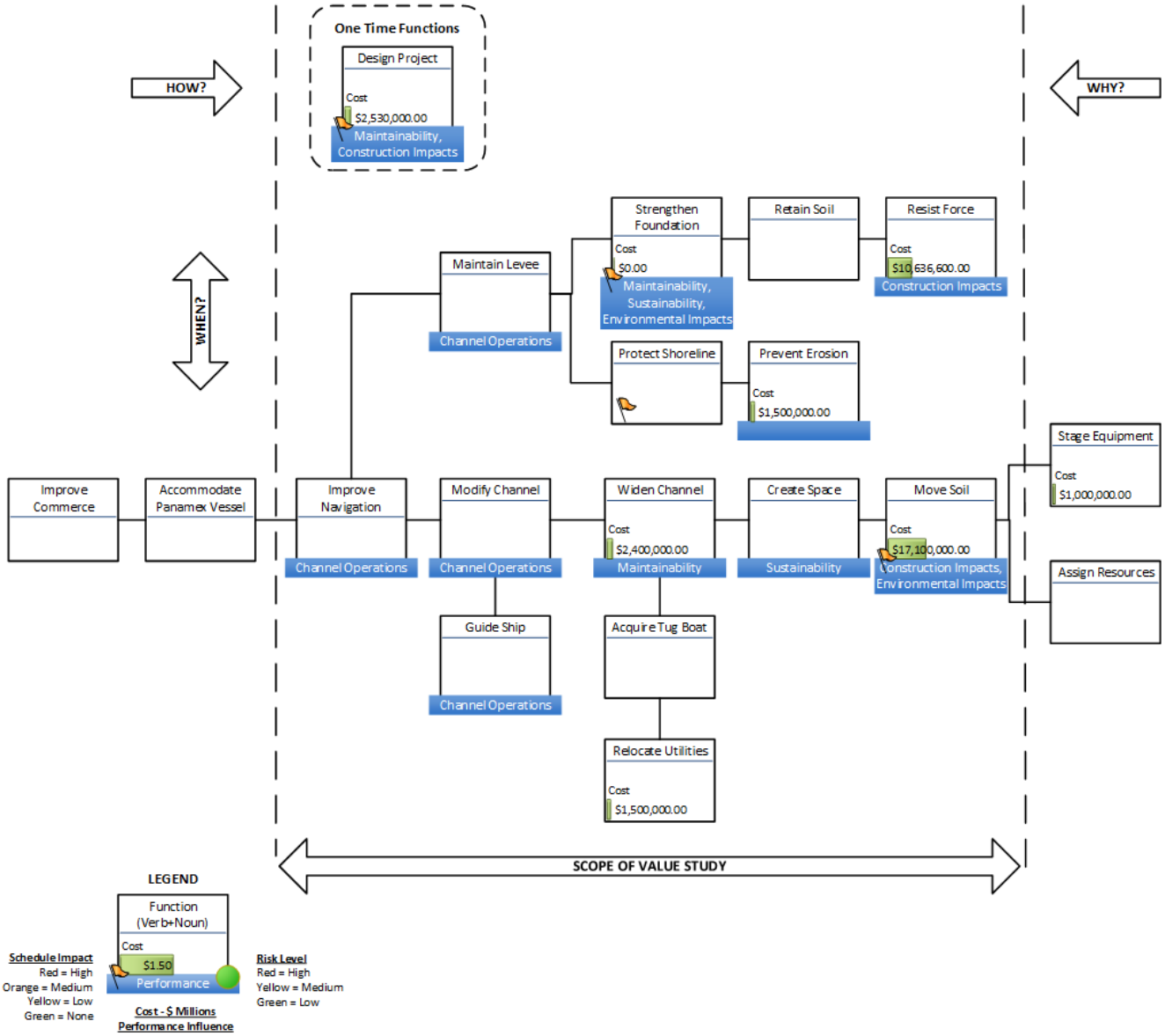
Function analysis was performed and a Function Analysis System Technique (FAST) Diagram was produced, which revealed the key functional relationships for the project. This analysis provided a greater understanding of the total project and how the project's performance, cost, time, and risk characteristics are related to the various functions identified.

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

Random Function Determination

Project Element	Function
Need	Accommodate Panamax
Purpose	Improve Navigation
Hydraulic Dredging & Raise PA 1 Levees	Move Soil
Sheet Pile Combi-Wall	Maintain Levee
Sheet Pile Combi-Wall	Resist Force
Sheet Pile Combi-Wall	Retain Soil
Tug Boats	Acquire Tug Boat
Tug Boats	Guide Ship
	Improve Commerce
Design	Design Project
Channel Widening	Modify Channel
Channel Widening	Widen Channel
Channel Widening	Create Space
Shoreline Protection at Bend Easing	Prevent Erosion
Shoreline Protection at Bend Easing	Protect Shoreline
Shoreline Protection at Bend Easing	Strengthen Foundation
Dredging Mob/Demob	Assign Resources
Dredging Mob/Demob	Stage Equipment
Relocate Utilities	Relocate Utilities

Freeport Harbor Channel Improvement Project GRR – FAST Diagram



VALUE METRICS

Value Methodology (VM) has traditionally been perceived as an effective means for reducing project costs. This paradigm only addresses one part of the value equation, oftentimes at the expense of the role that VM can play with regard to improving project performance. Project costs are fairly easy to quantify and compare; performance is not.

Project performance must be properly defined and agreed to by the stakeholders at the beginning of the VE study. The performance requirements and attributes developed are then used throughout the study to identify, evaluate, and document alternatives. This process, Value Metrics, emphasizes the interrelationship between the elements of performance, cost, and time and can be quantified and compared in terms of how they contribute to overall value. The basic equation for value is:

$$Value = \frac{Performance}{Cost + Time}$$

Value Metrics provides a standardized means of identifying, defining, evaluating, and measuring performance. Once this has been achieved and costs for all VE alternatives have been developed, measuring value is very straightforward.

The following pages describe the steps in the Value Metrics process.

Define Performance Requirements

Performance requirements represent essential, non-discretionary aspects of project performance. Any concept that fails to meet the project's performance requirements, regardless of whether it was developed during the project's design process or during the course of the VE study, cannot be considered as a viable solution. Concepts that do not meet a performance requirement cannot be considered further unless such shortcomings are addressed through the VE study process in the form of VE alternatives. It should be noted that in some cases, a performance requirement may also represent the minimum acceptable level of a performance attribute. The following performance requirements were selected for this project.

Performance Requirement	Definition
Maintain Water Quality	Project must maintain existing water quality.
Meet 50-Year Service Life	Project must maintain a 50-year service life.
Meet Design Standards	Levee and physical structures must meet current design standards without impacting adjacent industrial facilities.
Meet Levee Life Safety Standards	Must maintain or increase the safety factor of the existing levee system (existing 1.2, current standard 1.5).
Accommodate Panamax Vessel	Channel must safely accommodate Panamax vessel (considered to be 400-ft based on simulations).

Performance Requirement	Definition
Do Not Impact Other Federal Projects	Project must not impact the adjacent Hurricane Flood Protection Project.
Meet Setback Distances	Navigation of vessels through channel must accommodate setback distance world guidelines from loading of flammable materials.

Define Performance Attributes and Scales

Performance attributes represent those aspects of a project's scope that may possess a range of potential values. For example, an attribute called "Environmental Impacts" may have a range of acceptable values for a project ranging from 1 acre to 20 acres of wetlands mitigation. It is clear that a concept that offered 15 acres of mitigation would perform at a higher level than one that offered 5 acres, but both would meet the project's need and purpose, and their values (i.e., the relationship between performance and cost) could be rationally compared. The following performance attributes were selected for this project.

Channel Operations

An assessment of the ability of the channel to accommodate the Panamax vessel and facilitate channel operations. This includes vessel safety and accommodation of LPG standoff requirements.

Rating	Label	Description
0.0	Unacceptable	Very poor channel configurations make operations very hazardous.
2.0	Poor	Very complicated channel configurations make operations very difficult.
4.0	Fair	Complicated channel configurations make operations difficult.
6.0	Good	Simple channel configurations make operations somewhat easy.
8.0	Very Good	Very good channel configurations make operations easy.
10.0	Excellent	Excellent channel configurations make operations very easy.

Sustainability

An assessment of how well design and construction will work to achieve a 50-year design life. This also includes consideration of the project to accommodate future changes.

Rating	Label	Description
0.0	Unacceptable	The project does not meet the 50-year design life requirement.
2.0	Poor	The project will be designed and constructed in a manner that will provide improvements to the channel that will last the expected 50 years of life, but with considerable amount of extra maintenance and upgrading.

Rating	Label	Description
4.0	Fair	The project will be designed and constructed in a manner that will provide improvements to the channel that will last the expected 50 years of life; but with a medium amount of extra maintenance and upgrading.
6.0	Good	The project will be designed and constructed in a manner that will provide improvements to the channel that will last the expected 50 years of life; but with a moderate amount of extra maintenance and upgrading.
8.0	Very Good	The project will be designed and constructed in a manner that will provide improvements to the channel that will last the expected 50 years of life; but with a minimal amount of extra maintenance and upgrading.
10.0	Excellent	The project will be designed and constructed in a manner that will provide improvements to the channel that will easily last the expected 50 years of life.

Maintainability

An assessment of the ability of the design and construction of the project to minimize future maintenance activities (severity, duration and frequency). Includes safety of maintenance personnel.

Rating	Label	Description
0.0	Unacceptable	The channel becomes inaccessible.
2.0	Poor	The channel requires maintenance dredging in 5 years.
4.0	Fair	The channel requires maintenance dredging in 8 years
6.0	Good	The channel requires maintenance dredging in 10 years.
8.0	Very Good	The channel requires maintenance dredging in 12 years.
10.0	Excellent	The channel requires no maintenance to keep the channel open over the 50-year design life of the project.

Construction Impacts

An assessment of the temporary impacts of the project to channel operations, adjacent industrial facilities, and turbidity during construction.

Rating	Label	Description
0.0	Unacceptable	Severe impacts to channel operations due to construction activities.
2.0	Poor	Considerable impacts to channel operations due to construction activities.
4.0	Fair	Many impacts to channel operations due to construction activities.
6.0	Good	Moderate impacts to channel operations due to construction activities.

Rating	Label	Description
8.0	Very Good	Minor impacts to channel operations due to construction activities.
10.0	Excellent	Minimal impact to channel operations due to construction activities.

Environmental Impacts

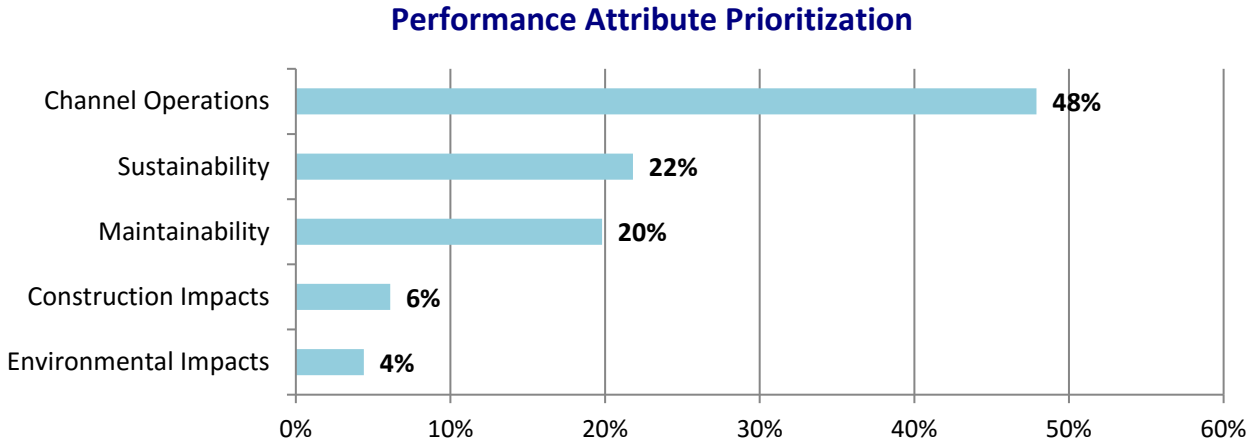
Impacts to habitat, water quality and aquatic life.

Rating	Label	Description
0.0	Unacceptable	Severe impacts that would be very difficult and expensive to mitigate.
2.0	Poor	Considerable degradation to water quality is likely.
4.0	Fair	Some degradation to water quality is likely.
6.0	Good	Minor degradation to water quality might be expected.
8.0	Very Good	Project will have minimal environmental conditions at the project location.
10.0	Excellent	Project improves the environmental conditions at the project location.

Prioritize Performance Attributes

The performance attributes of a project are seldom of equal importance. Therefore, a systematic approach must be utilized in order to determine their relative importance in meeting the project's need and purpose.

Once the performance attributes were defined and their scales developed, the Project Team and stakeholders prioritized them based on their relative importance to the project. The Analytic Hierarchy Process (AHP) was utilized in the prioritization process. The performance attributes were systematically compared in pairs, asking the question: "An improvement to which attribute will provide the greatest benefit relative to the project's need and purpose?" Participants were then asked to indicate their priorities and the relative intensities of their preferences. The chart below provides the results of this analysis.



Measure Performance of Baseline Concept

The project team and stakeholders evaluated the performance of the Baseline Concept relative to the scales previously identified. The information below reflects the performance ratings and associated rationale for each attribute.

Channel Operations
Rating: **4.0**

Rationale: Does not accommodate two-way traffic and results in limited movement. Three tug boats are required to navigate safely. Requires rotation of vessel 180 degrees. Based on the baseline simulation, pilots are nervous about the ability to successfully navigate the channel even with the 400-ft width. In addition, LNG and LPG setback radius requirements will continue to limit vessel navigation even after channel widening.

Sustainability
Rating: **8.0**

Rationale: Threats to the system are not considered significant enough to impact the ability of the project to meet a 50-year design life.

Maintainability
Rating: **9.0**

Rationale: Sedimentation build-up and future maintenance dredging is not a significant concern. Sheet piling will be fully encased, limiting need for future inspection and maintenance.

Construction Impacts
Rating: **6.0**

Rationale: Dredging will primarily occur outside of the active channel. Construction impacts will be limited to channel operations. The Combi-wall will have greater impact due to driving panels. Noise and light pollution will have a minor impact adjacent facilities and marine life.

Environmental Impacts
Rating: **9.0**

Rationale: The primary impact will result from turbidity caused by dredging.

Measure Performance of VE Alternatives

The VE team prepared performance assessments for each alternatives during the Development Phase of the study. To do so, the team rated performance of each alternative using the previously defined scale for each performance attribute. The rationale for any change in performance as compared to the Baseline Concept was recorded. Please refer to the individual performance assessments for each VE alternative as presented in the *VE Alternatives* section of this report.

Define VE Strategies

VE strategies reflect different combinations of complimentary VE alternatives. The VE team identified two VE strategies for consideration, which are summarized in the table below.

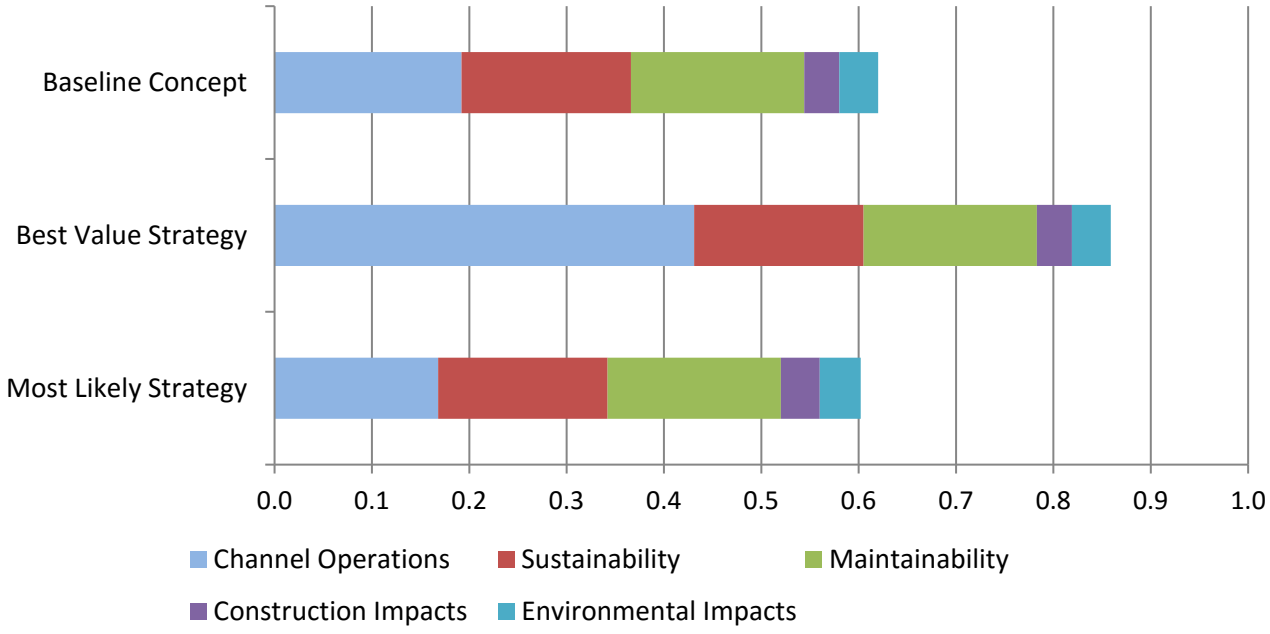
Summary of VE Strategies

Strategy Description	Initial Cost Savings	LCC Savings	Change in Schedule	Performance Change	Value Change
Best Value Strategy 1.1, 2.0, 3.0, 4.0, 5.0, 6.0	$10,294,000	$43,867,000	+22 months	+39 %	+25 %
Most Likely Strategy 2.0, 3.0, 4.0, 5.0, 6.0	$5,882,000	$7,867,000	-2 months	-3 %	+7 %

Compare Performance – Baseline Concept and VE Strategies

The VE team considered the combined effect of all VE alternatives for each VE strategy. The total performance scores reflect the performance rating for each attribute multiplied by its overall priority (weight) expressed using a ratio scale. A total performance score of "1" would indicate the highest level of desired performance (i.e., "ideal" performance). The chart below compares the total performance scores for the Baseline Concept and the VE strategies.

Comparison of Performance



Rating Rationale for VE Strategies

The rating rationale for the performance of the Baseline Concept was presented previously in this section. The rating rationale for the VE strategies that were developed by the VE team is provided below.

VE Strategy 1 – Best Value Strategy

Channel Operations
Rating: **9.0**

Rationale: Providing a 600-foot channel will significantly improve channel operations by providing more maneuver room for ships.

Sustainability
Rating: **8.0**

Rationale: No change.

Maintainability
Rating: **9.0**

Rationale: No change.

Construction Impacts
Rating: **6.0**

Rationale: No change.

Environmental Impacts
Rating: **9.0**

Rationale: No change.

VE Strategy 2 – Most Likely Strategy

Channel Operations
Rating: **3.5**

Rationale: Reduction of the bend easing footprint may restrict ship maneuverability.

Sustainability
Rating: **8.0**

Rationale: No change.

Maintainability
Rating: **9.0**

Rationale: No change.

Construction Impacts
Rating: **6.5**

Rationale: Slight improvement because of less construction time.

Environmental Impacts
Rating: **9.5**

Rationale: Slight improvement because of less time in the water with a reduced construction schedule.

Compare Value

The cost and time (i.e., schedule) elements were compared and normalized for the Baseline Concept and the VE strategies using the following tables. These tables illustrate how cost and time (schedule) scores were derived. In this comparison, a lower score is desirable as the project will benefit from lower costs and a shorter schedule.

Strategies		Cost	Score
Baseline Concept		$47,900,000	0.376
Best Value Strategy		$37,606,000	0.295
Most Likely Strategy		$42,018,000	0.329
	TOTAL	**$127,524,000**	**1.000**

Strategies		Time	Score
Baseline Concept		42 months	0.288
Best Value Strategy		64 months	0.438
Most Likely Strategy		40 months	0.274
	TOTAL	**146 months**	**1.000**

Project Management indicated the following preferences in considering trade-offs between cost and time:

Relative Importance	
COST	50.00 %
TIME	50.00 %

Once relative scores for performance, cost and time have been derived, the next step is to synthesize a value index for the baseline concept and each VE strategy. This is achieved by applying the following algorithm for value:

- V = Value
- f = Function
- P = Performance
- C = Cost
- t = Time
- α = Risk

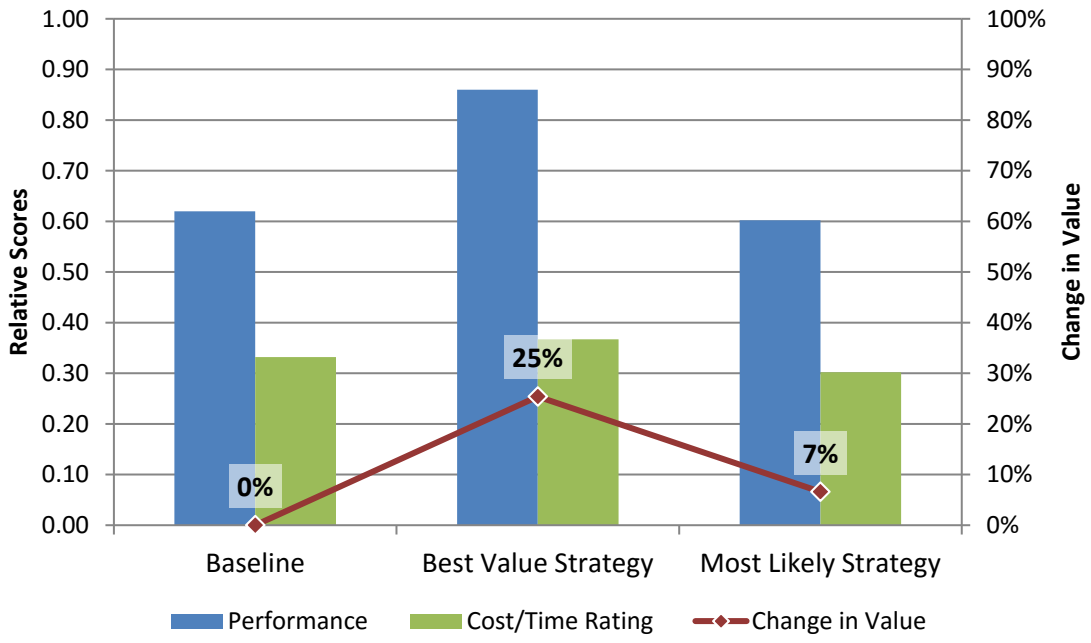
$$V_f(P,C,t)_{total} = \frac{\sum_{n=1}^{\infty} P_n \cdot \alpha}{\sum_{n=1}^{\infty}[(C_n \cdot \alpha) + (t_n \cdot \alpha)]}$$

A Value Matrix was prepared which facilitated the comparison of competing strategies by organizing and summarizing this data into a tabular format. The performance scores for each strategy were divided by the total cost/time scores for each strategy to derive a value index. The value indices for the VE strategies are then compared against the value index of the baseline concept and the difference is expressed as a percent (±%) deviation.

Value Matrix
Baseline Concept and VE Strategies

Strategies	Performance Score	Change in Performance	Cost/Time Score	Net Change	Value Index	Change in Value
Baseline	0.620	---	0.332	---	1.870	---
Best Value Strategy	0.860	+39 %	0.367	+11 %	2.346	+25 %
Most Likely Strategy	0.602	-3 %	0.302	-9 %	1.994	+7 %

Comparison of Value – Baseline Concept and VE Strategies



RISK ANALYSIS

A qualitative risk analysis was performed to summarize the risks related to the project performance, cost, and time (schedule). The VE team, in conjunction with the project team, generated a list of the potential risks. Eight risks were identified and placed into a Design or Construction risk category.

The focus was to identify risks that are specific to the project. Then the team qualitatively evaluated the likelihood of each risk occurring and its potential impact to cost, schedule, and/or performance. The risks identified were qualified using a calculated indexing scheme that took into account the range of probability and impact in terms of the qualitative ratings (very low to very high). All risks were identified as threats; no opportunity threats were identified during this exercise.

ID	Category	Name	Description	Probability	Impact
1	Construction	Weather Events	Weather events disrupt typical production activities.	High	Medium
2	Construction	Sheet Piling Installation	Wind conditions require specialized construction and installation of sheet piling.	High	Medium
3	Construction	Construction Staging	Construction staging jeopardizes integrity of existing levee.	High	High
4	Design	Exceed 902 Authorization Limit	Project costs exceed the 902 limit and require additional Congressional authorization.	Medium	Very High
5	Design	Material Cost Increase	Material costs (fuel, steel) increase significantly, causing dredging operation costs to increase, requiring additional authorization.	Medium	Very High
6	Design	Channel Operation Disruption	Operation of the channel is significantly impeded during construction due to dredging equipment placement.	Low	Medium
7	Design	Incident Disrupts Schedule	Incident occurs which disrupts construction schedule.	Low	High
8	Construction	Utilities Relocation	Existing utilities require relocation (not accounted for in current cost estimate).	High	Very High

IDEA EVALUATION

IDEA EVALUATION

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

PERFORMANCE ATTRIBUTES

The following are key performance attributes identified for this project and used to assist the VE team in evaluating the ideas:

- Channel Operations
- Sustainability
- Maintainability
- Construction Impacts
- Environmental Impacts

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

EVALUATION PROCESS

The VE team generated and evaluated ideas on how to perform the various project functions using other approaches. The idea list was grouped by function or major project element. Each idea was evaluated with respect to the functional requirements of the project. Performance, cost, time, and risk may also have been considered during this evaluation.

Once each idea was fully evaluated, it was given a rating, is based on a scale of 1 to 7, as indicated by the rating index described in the *VE Process* section of this report. Ideas rated 4 to 7 were developed further and those that were found to have the greatest potential for value improvement are documented in the *VE Alternatives* section of this report. The rationale for why ideas that were rated highly but were not developed as alternatives is documented later in this section.

IDEA SUMMARY

All of the ideas that were generated during the Speculation Phase using brainstorming techniques were recorded on the following pages. Ideas received an idea code based on the function statement under which it was brainstormed. The following table indicates the functions related to each idea code.

Idea Code	Related Function
DP	Design Project
GS	Guide Ship
ML	Maintain Levee

Idea Code	Related Function
MS	Move Soil
RU	Relocate Utilities
SE	Stage Equipment

A detailed idea evaluation summary is also included. This summary includes additional information related to how each idea improves or degrades the elements of performance, cost, time (schedule), and risk. Only those elements where the idea differs from the baseline concept are included in this summary.

IDEA SUMMARY LIST

Idea Code and Description	Rating
DP-1: Outsource project design to AE firm	DS
DP-2: Consider Design-Build In lieu of Design-Bid-Build	DS
DP-3: Use incentives for earlier project completion	DIS
DP-4: Use A+B bid to incentivize early project completion	DS
DP-5: Increase end user funding participation to reduce tax payer portion of project cost	DIS
DP-6: Consult with HFPP to authorize design waiver to remove existing shelf without mitigation	7
DP-7: Separate dredging and structural work into A and B contracts	DS
DP-8: Continue existing processes for lightening ships prior to entering channel in lieu of designing for fully loaded vessels	DIS
GS-1: Adjust channel operations to accommodate less frequent Panamax ship entrances, reducing tug boat requirements	DIS
ML-1: Use alternate slope stability methods in lieu of steel sheet pile cutoff wall	DIS
ML-2: Relocate levee 200 feet into DOW Thumb	6
ML-3: Use soil mixing to strengthen the levee foundation in lieu of steel sheet piling	DS
ML-4: Use slurry wall in lieu of steel sheet piling	DIS
ML-5: Use cast-in-place auger piles in lieu of steel sheet piling	DS
ML-6: Use H-pile with lagging and shoring in lieu of steel sheet piling	DS
ML-7: Use combination of different sheet pile sizes tapered at ends in lieu of current PZ sheet pile design	DS
ML-8: Use open-cell sheet pile construction in lieu of steel sheet pile	DS
ML-9: Reuse excavated rip rap and broken concrete for project construction	DIS
ML-10: Sell excavated rip rap and broken concrete	DIS
ML-11: Optimize location or placement of sheet piling based on stability analysis	DS
ML-12: Refine design assumptions and criteria for levee	DS
ML-13: Use timber in lieu of steel sheet piling	DS

Idea Code and Description	Rating
ML-14: Use geotubes in lieu of steel sheet piling	DIS
ML-15: Use Slope Reinforcing Technology (SRT) system in lieu of steel sheet piling	DIS
ML-16: Use press-in pile system such as Giken in lieu of conventional pile driving methods	DS
ML-17: Use alternatives to rip rap such as high-performance turf reinforcement mat, ACBs, articulating mats, or geosynthetics	DS
MS-1: Use mechanical excavation in lieu of hydraulic dredging	6
MS-2: Reuse dredged soil beneficially within the project limits	DIS
MS-3: Sell above-ground excavated material to local developers or back to Port	5
MS-4: Identify uncommon beneficial uses for dredged and excavated material	DIS
MS-5: Relocate channel to the east, through DOW Thumb, to create straight alignment for ship channel	4
MS-6: Reduce footprint of the bend easing by 20 percent	6
MS-7: Identify beneficial use projects within the region for placement for dredged soil such as marsh restoration or placement area of levees	DS
MS-8: Add structure to reduce the amount of soil dredged at bend easing	DIS
MS-9: Add structure to reduce the amount of soil dredged at waist	DIS
MS-10: Use hopper dredge to dispose of dredged fill at an offshore location in lieu of hydraulic dredging	DIS
MS-11: Use trailing suction dredge to dispose of dredged fill in lieu of hydraulic dredging	DIS
MS-12: Use road transport to dispose of dry excavated material	DIS
MS-13: Purchase part of DOW Thumb and realign channel and eliminate wall	DIS
MS-14: Lease land from DOW Corporation to provide multiple alternative channel alignments	DS
MS-15: Use multiple dredges in lieu of a single dredge	DIS
MS-16: Reconfirm unit costs of dredging (cubic yard)	DIS
MS-17: Use offshore disposal site for dredged materials to reduce need for upland placement areas	DIS
MS-18: Use two large dredges to reduce construction time and impact to navigation	DIS
MS-19: Use long pipeline to pump dredged materials offshore	DIS
MS-20: Use flocculants to consolidate sediments and facilitate excavation	DIS
MS-21: Use open sheet pile cells filled with dredged material in lieu of sheet pile wall at waist	DIS

Idea Code and Description	Rating
MS-22: Modify the profile of the bend easing by gradually sloping in lieu of full depth with a steep slope	DIS
MS-23: Reduce advanced maintenance dredging from 2 feet to 1 foot across the footprint of the dredging	6
RU-1: Relocate the existing power lines along bend easing	DS
RU-2: Perform an investigation and analysis to determine existing pipeline presence within project limits	DS
RU-3: Transfer responsibility of utility relocation cost to end user or utility provider	DIS
RU-4: Optimize schedule for early utility relocation and include in proposed early order of work sequencing	DS
RU-5: Abandon any existing pipelines in place	DIS
RU-6: Relocate the existing pipelines along bend easing	DS
SE-1: Optimize project delivery timing to take advantage of nearby dredge equipment, reducing mobilization distances and costs	DIS
SE-2: Pre-purchase steel for wall through USACE to reduce timing and save sales tax costs	6

DEV: Develop (as a VE Alternative)

DS: Design Suggestion

ABD: Already Being Done (in the Baseline Concept)

DIS: Dismissed

DETAILED IDEA EVALUATION SUMMARY

DP-1: **Outsource project design to AE firm** — Overall Rating: **DS**

General comments: This idea could be considered further if time constraints become an issue in project development.

DP-2: **Consider Design-Build In lieu of Design-Bid-Build** — Overall Rating: **DS**

General comments: This idea could be considered further if time, budget or liability constraints become an issue in project development. At the time of the VE study there were too many unknown factors to fully assess this idea. It should be noted that this idea has the potential to increase bid competition. This project is fairly simple in terms of tasks but complicated due to many constraints.

DP-3: **Use incentives for earlier project completion**

Overall Rating: **DIS**

General comments: Using incentives may be incompatible with government contracting requirements. On a firm fixed price contract, USACE does not use incentive clauses. Use of incentives would require special permissions and is not a common practice in Galveston District.

DP-5: **Increase end user funding participation to reduce tax payer portion of project cost**

Overall Rating: **DIS**

General comments: It is considered common practice for end users to contribute to funding via cost sharing. It was confirmed during the VE study that while Port Freeport could bring in additional cost sharing entities to reduce their 25% contribution, the federal contribution would remain 75%, and the project cost would be unchanged.

DP-6: **Consult with HFPP to authorize design waiver to remove existing shelf without mitigation**

Overall Rating: **7**

Attributes	*Rating*	*Comments*
Maintainability	Degraded	Degraded due to reduced stability and lower factor of safety.
Sustainability	Degraded	Degraded due to reduced stability.
Construction Impacts	Improved	
Environmental Impacts	Degraded	Increased risk of encountering future contamination.

General comments: None.

DP-7: **Separate dredging and structural work into A and B contracts**

Overall Rating: **DS**

General comments: Potentially already being done in the base case, however this was unknown at the time of the VE study. It is assumed that some contractors may bid both contracts during the bidding process.

DP-8: **Continue existing processes for lightening ships prior to entering channel in lieu of designing for fully loaded vessels**

Overall Rating: **DIS**

General comments: This idea would address channel depth requirements, not channel width requirements. Since the baseline concept does not deepen the channel, this idea is does not offer value improvement.

GS-1: **Adjust channel operations to accommodate less frequent Panamax ship entrances, reducing tug boat requirements**

Overall Rating: **DIS**

General comments: The standoff distance requirements for LPG carrier loading may preclude entrance of Panamax ships when there is a vessel at Phillips Dock 2, even with the increased channel width proposed in the baseline. There are up to 6 Panamax vessels expected in the 2040 timeframe, making this idea irrelevant.

ML-1: **Use alternate slope stability methods in lieu of steel sheet pile cutoff wall**

Overall Rating: **DIS**

General comments: During the VE study the team analyzed this idea and determined that it was impractical due to likely high implementation costs relative to the base case, therefore this idea was dismissed.

ML-2: **Relocate levee 200 feet into DOW Thumb**

Overall Rating: **6**

Attributes	*Rating*	*Comments*
Maintainability	Improved	Significantly widens channel to accommodate future channel expansion and improvements.
Sustainability	Improved	
Environmental Impacts	Unchanged	Unknown environmental impacts due to encountering possible contaminants.
Channel Operations	Improved	Significantly improved channel operations.

General comments: This project constraint requires further evaluation to determine feasibility.

ML-3: **Use soil mixing to strengthen the levee foundation in lieu of steel sheet piling**

Overall Rating: **DS**

General comments: It should be noted that this idea requires additional design and verification of the current cost estimate, including USACE soil mixing requirements. Since there are too many unknown factors at the time of the VE study this idea cannot be quantified.

ML-4: **Use slurry wall in lieu of steel sheet piling**

Overall Rating: **DIS**

General comments: Does not achieve required strength for levee foundation and is therefore impractical.

ML-5: **Use cast-in-place auger piles in lieu of steel sheet piling.**

Overall Rating: **DS**

Attributes	*Rating*	*Comments*
Environmental Impacts	Degraded	Potential environmental impact.

General comments: It should be noted that this idea requires additional design. Since there are too many unknown factors at the time of the VE study this idea cannot be quantified.

ML-6: **Use H-pile with lagging and shoring in lieu of steel sheet piling**

Overall Rating: **DS**

General comments: Requires design analysis to determine practicality and feasibility. Too many unknown factors at the time of the VE study to quantify this idea.

ML-7: **Use combination of different sheet pile sizes tapered at ends in lieu of current PZ sheet pile design**

Overall Rating: **DS**

General comments: Requires design analysis to determine practicality and feasibility. Too many unknown factors at the time of the VE study to quantify this idea.

ML-8: **Use open-cell sheet pile construction in lieu of steel sheet pile**

Overall Rating: **DS**

General comments: Requires design analysis to determine practicality and feasibility. Too many unknown factors at the time of the VE study to quantify this idea. Combine with MS-21 "Use open sheet pile cells filled with dredged material in lieu of sheet pile wall at waist."

ML-9: **Reuse excavated rip rap and broken concrete for project construction**

Overall Rating: **DIS**

General comments: The VE team determined that this idea is not feasible because the rip rap material used, and its current level of deterioration is unknown. It is assumed that the salt water and wave action will have deteriorated the existing rip rap, making most of it unusable and therefore not presenting significant cost savings or value improvement to the project.

ML-10: **Sell excavated rip rap and broken concrete**

Overall Rating: **DIS**

General comments: Baseline assumes that the contractor will dispose of excavated materials. This idea cannot be quantified as it is assumed that the contractor will dispose of the material in the most cost effective manner.

ML-12: **Refine design assumptions and criteria for levee**

Overall Rating: **DS**

General comments: This is a normal ongoing design activity.

ML-13: **Use timber in lieu of steel sheet piling**

Overall Rating: **DS**

General comments: Further geotechnical analysis required.

ML-14: **Use geotubes in lieu of steel sheet piling**

Overall Rating: **DIS**

General comments: Dismissed due to deep excavation requirements for geotubes. In addition, there is poor historical performance in the region.

ML-15: **Use Slope Reinforcing Technology (SRT) system in lieu of steel sheet piling**

Overall Rating: **DIS**

Attributes	*Rating*	*Comments*
Maintainability	Degraded	SRT is less strong than sheet piling.

General comments: This idea is dismissed as it applies to shallower slopes than this project includes.

ML-16: **Use press-in pile system such as Giken in lieu of conventional pile driving methods**

Overall Rating: **DS**

Attributes	*Rating*	*Comments*
Construction Impacts	Improved	
Environmental Impacts	Improved	Vibration impacts of driving sheet pile is minimized.

General comments: This idea may require for piles to be pressed-in and then cut at surface to remove material left above the waterline. This idea is a means and methods consideration.

ML-17: **Use alternatives to rip rap such as high-performance turf reinforcement mat, ACBs, articulating mats, or geosynthetics**

Overall Rating: **DS**

Attributes	*Rating*	*Comments*
Sustainability	Improved	Decreases slope erosion.

General comments: None.

MS-1: **Use mechanical excavation in lieu of hydraulic dredging**

Overall Rating: **6**

General comments: In addition, with this idea, excavated fill would be dry rather than wet, making it more usable and able to be reused or sold. Combine with MS-12 "Use road transport to dispose of dry excavated material."

MS-2: **Reuse dredged soil beneficially within the project limits**

Overall Rating: **DIS**

General comments: Impractical and increased cost. Does not meet design constraints for fully submerged sheet piling.

MS-3: **Sell above-ground excavated material to local developers or back to Port**

Overall Rating: **5**

General comments: The feasibility of this idea would be increased by use of mechanical rather than hydraulic dredging to keep material dry.

MS-4: **Identify uncommon beneficial uses for dredged and excavated material**

Overall Rating: **DIS**

Attributes	*Rating*	*Comments*
Environmental Impacts	Improved	

General comments: The VE team determined that there are not many uncommon beneficial uses which could be identified for this project.

MS-5: **Relocate channel to the east, through DOW Thumb, to create straight alignment for ship channel**

Overall Rating: **4**

Attributes	*Rating*	*Comments*
Environmental Impacts	Unchanged	Potential to encounter contaminated material.

General comments: Dismissed due to high cost and complications with stakeholders.

MS-6: **Reduce footprint of the bend easing by 20 percent.**

Overall Rating: **6**

Attributes	*Rating*	*Comments*
Construction Impacts	Improved	Reduced due to decreased construction.
Environmental Impacts	Improved	Reduced due to decreased dredging.

MS-6: **Reduce footprint of the bend easing by 20 percent.** Overall Rating: **6**

Channel Operations	Unchanged	Based on the available simulation data, the VE team considers this a viable alternative that would not impact the ability of Panamax vessels to safely navigate the channel.

General comments: Based on the available vessel pilot simulations and analysis, the necessary bend easing footprint is still undetermined. It should be noted that an additional pilot simulation could determine the exact bend easing footprint required, ultimately resulting in project cost savings. The simulations were conducted with pilots who were not familiar with navigating a Panamax vessel through the channel, therefore, technique and training over time will improve navigation safety. The area was requested by pilots for the following reasons: ability to turn ship, emergency run off area, hydrodynamic cushion area for turning as existing water in channel is not sufficient for propulsion during turning. Combine with MS-22 "Modify the profile of the bend easing by gradually sloping in lieu of full depth with a steep slope."

MS-7: **Identify beneficial use projects within the region for placement for dredged soil such as marsh restoration or placement area of levees** Overall Rating: **DS**

Attributes	*Rating*	*Comments*
Environmental Impacts	Improved	Provides increased habitat.

General comments: Nearest candidate projects may be up to 9 miles away, making it difficult to quantify costs savings and offsets.

MS-8: **Add structure to reduce the amount of soil dredged at bend easing** Overall Rating: **DIS**

Attributes	*Rating*	*Comments*
Maintainability	Degraded	Significant reduction due to more structure to maintain and impact of ships.

General comments: Impractical due to increased cost, reduced hydrodynamic buffer, and increased maintenance.

MS-9: **Add structure to reduce the amount of soil dredged at waist** Overall Rating: **DIS**

General comments: Dismissed because real estate must be acquired.

MS-10: **Use hopper dredge to dispose of dredged fill at an offshore location in lieu of hydraulic dredging**

Overall Rating: **DIS**

Attributes	*Rating*	*Comments*
Construction Impacts	Improved	Maintains space in placement area 1.

General comments: It is considered impractical to use a hopper dredge for new work clay. Testing requirements and permitting for offshore disposal can take up to 1 year. Combine with MS-17 "Use offshore disposal site for dredged materials to reduce need for upland placement areas." Combine with MS-19 "Use long pipeline to pump dredged materials offshore."

MS-11: **Use trailing suction dredge to dispose of dredged fill in lieu of hydraulic dredging**

Overall Rating: **DIS**

General comments: Infeasible due to clay material to be excavated.

MS-13: **Purchase part of DOW Thumb and realign channel and eliminate wall.**

Overall Rating: **DIS**

General comments: Combine with MS-5 "Relocate channel to the east, through DOW Thumb, to create straight alignment for ship channel."

MS-14: **Lease land from DOW Corporation to provide multiple alternative channel alignments**

Overall Rating: **DS**

General comments: Too many unknown factors to quantify at the time of the VE study. Previous attempts by Port Freeport to communicate with DOW Corporation have been minimal. DOW Corporation's future plans for DOW Thumb are unknown. USACE internal real estate department is in process of coordinating subsurface rights for PZ wall installation with DOW Corporation.

MS-15: **Use multiple dredges in lieu of a single dredge**

Overall Rating: **DIS**

Attributes	*Rating*	*Comments*
Construction Impacts	Improved	Reduced schedule results in decreased construction impact duration.
Environmental Impacts	Degraded	Turbidity is increased due to higher horsepower dredges and use of multiple dredged concurrently.

General comments: The primary benefit of this idea would be to reduce schedule. This idea is a means and methods approach that directs the contractor and is therefore not desired. Production rates could be specified.

MS-16: **Reconfirm unit costs of dredging (cubic yard)**

Overall Rating: **DIS**

General comments: Discussions by the VE team related to recent history in the area indicate that the figure of $9 is realistic. However, it is suggested that the Design Team review the composition of the material to confirm realistic unit costs to be used for dredging.

MS-17: **Use offshore disposal site for dredged materials to reduce need for upland placement areas**

Overall Rating: **DIS**

General comments: Combine with MS-10 "Use hopper dredge to dispose of dredged fill at an offshore location in lieu of hydraulic dredging."

MS-18: **Use two large dredges to reduce construction time and impact to navigation**

Overall Rating: **DIS**

General comments: Combine with MS-15 "Use multiple dredges in lieu of a single dredge."

MS-19: **Use long pipeline to pump dredged materials offshore**

Overall Rating: **DIS**

General comments: Combine with MS-10 "Use hopper dredge to dispose of dredged fill at an offshore location in lieu of hydraulic dredging."

MS-20: **Use flocculants to consolidate sediments and facilitate excavation**

Overall Rating: **DIS**

General comments: Impractical and not needed as material to be excavated will be competent and does not need consolidation.

MS-21: **Use open sheet pile cells filled with dredged material in lieu of sheet pile wall at waist**

Overall Rating: **DIS**

General comments: Combine with ML-8 "Use open-cell sheet pile construction in lieu of steel sheet pile."

MS-22: **Modify the profile of the bend easing by gradually sloping in lieu of full depth with a steep slope**

Overall Rating: **DIS**

General comments: Combine with MS-6 "Reduce footprint of the bend easing by 20 percent."

MS-23: **Reduce advanced maintenance dredging from 2 feet to 1 foot across the footprint of the dredging**

Overall Rating: **6**

General comments: It is the VE team's understanding that the level of silt accumulation in the project area does not require significant maintenance.

RU-1: **Relocate the existing power lines along bend easing**

Overall Rating: **DS**

General comments: The baseline cost estimate does not account for relocation of the power lines.

RU-2: **Perform an investigation and analysis to determine existing pipeline presence within project limits**

Overall Rating: **DS**

General comments: The location of these pipeline is indicated by Texas Railroad Commission online maps, and will need to be verified. It is unknown whether these pipelines are active.

RU-3: **Transfer responsibility of utility relocation cost to end user or utility provider**

Overall Rating: **DIS**

General comments: It is unknown at the time of the VE study whether the nearby utilities at the bend easing are within the project limits. It is assumed that relocation of utilities is a non-Federal cost, but is a project cost (shared between utility provider and Port Freeport).

RU-4: **Optimize schedule for early utility relocation and include in proposed early order of work sequencing**

Overall Rating: **DS**

General comments: It is unknown at the time of the VE study whether the nearby utilities at the bend easing are within the project limits. This will need to be confirmed.

RU-5: **Abandon any existing pipelines in place**

Overall Rating: **DIS**

General comments: Removal of pipelines is required for safe dredging.

RU-6: **Relocate the existing pipelines along bend easing**

Overall Rating: **DS**

General comments: The location of these pipelines is indicated by Texas Railroad Commission online maps, and will need to be verified. It is unknown whether these pipelines are active. $50,000 is included in the baseline cost estimate for subsidiary work/submerged pipeline crossing, though this does not include pipeline relocation.

SE-1: **Optimize project delivery timing to take advantage of nearby dredge equipment, reducing mobilization distances and costs**

Overall Rating: **DIS**

General comments: It is assumed that competition between contractors will defeat the potential savings of this idea. The conditions of the dredging market at the time the project is put out to bid will have an impact. There are too many unknown factors at the time of the VE study to determine value improvement.

SE-2: **Pre-purchase steel for wall through USACE to reduce timing and save sales tax costs**

Overall Rating: **6**

General comments: This is not common practice in USACE Galveston district, however it will produce cost savings. Assumes same cost for contractor and USACE to purchase steel, but that USACE does not pay sales tax, resulting in savings.
40% of installed sheet pile cost is material = 3,700.000
3,700,000 x 8% sales tax x 1.3 = $300,000

VALUE ENGINEERING PROCESS

VE PROCESS

A systematic approach is used in the VE study. The key procedures followed were organized into three distinct parts: (1) Pre-Study Preparation, (2) VE Study, and (3) Post-Study Procedures.

PRE-STUDY PREPARATION

In preparation for the VE study, the team leader reviews critical aspects of the project and areas for improvement. In the week prior to the start of the VE study, the VE team reviews the documents provided by the designer to become better prepared for the study. In addition, performance attributes and requirements are initially identified that are relevant to the project.

VE STUDY

The Value Methodology (VM) Job Plan is followed to guide the teams in the consideration of project functionality and performance, potential schedule issues, high cost areas, and risk factors in the design. These considerations are taken into account in developing alternative solutions for the optimization of project value. The Job Plan phases are:

- Information Phase
- Function Phase
- Creative Phase
- Evaluation Phase
- Development Phase
- Presentation Phase

Information Phase

At the beginning of the VE study, the design team presents a more detailed review of the design and the various systems. This includes an overview of the project and its various requirements, which further enhances the VE team's knowledge and understanding of the project. The project team also responds to questions posed by the VE team.

The project's performance requirements and attributes are discussed, and the performance of the baseline concept is evaluated.

Function Phase

Key to the VM process is the function analysis techniques used during the Function Phase. Analyzing the functional requirements of a project is essential to assuring an owner that the project has been designed to meet the stated criteria and its need and purpose. The analysis of these functions in terms cost, performance, time and risk is a primary element in a VE study, and is used to develop alternatives. This procedure is beneficial to the VE team, as it forces the participants to think in terms

of functions and their relative value in meeting the project's need and purpose. This facilitates a deeper understanding of the project.

Creative Phase

The Creative Phase involves identifying and listing creative ideas. During this phase, the VE team participates in a brainstorming session to identify as many means as possible to provide the necessary project functions. Judgment of the ideas is not permitted in order to generate a broad range of ideas.

The idea list includes all of the ideas suggested during the study. These ideas should be reviewed further by the project team, since they may contain ideas that are worthy of further evaluation and may be used as the design develops. These ideas could also help stimulate additional ideas by others.

Evaluation Phase

The purpose of the Evaluation Phase is to systematically assess the potential impacts of ideas generated during the Creative Phase relative to their potential for value improvement. Each idea is evaluated in terms of its potential impact to performance, cost, time and risk. Once each idea is fully evaluated, it is given a total rating number. This is based on a scale of 1 to 7, as indicated by the following rating index.

7 = Major Value Improvement 6 = Moderate Value Improvement 5 = Minor Value Improvement 4 = Possible Value Improvement	These ratings represent the subjective opinion of the VE team regarding the potential benefits of the concepts in order to prioritize them for development.
3 = Minor Value Degradation	Concept results in a minor cost or performance improvement at the expense of the other.
2 = Moderate Value Degradation	Concept reduces cost but creates an unacceptable degradation to performance.
1 = Major Value Degradation	Concept is not technically feasible or does not meet project need and purpose.

Ideas rated 4 to 7 are developed further and those found to have the greatest potential for value improvement are documented in the *VE Alternatives* section of this report. The rationale for why ideas were rated highly but not developed as alternatives is documented in the *Idea Evaluation* section of the report.

Development Phase

During the Development Phase, the highly rated ideas are expanded and developed into VE alternatives. The development process considers the impact to performance, cost, time, and risk of the alternative concepts relative to the baseline concept. This analysis is prepared as appropriate for each alternative, and the information may include a performance assessment, initial cost, and life-cycle cost comparisons, schedule analysis, and an assessment of risk. Each alternative describes

the baseline concept and proposed changes and includes a technical discussion. Sketches and calculations are also prepared for each alternative as appropriate.

Presentation Phase

The VE study concludes with a preliminary presentation of the VE team's assessment of the project and VE alternatives. The presentation provides an opportunity for the owner, project team, and stakeholders to preview the alternatives and develop an understanding of the rationale behind them.

POST-STUDY PROCEDURES

A *Preliminary VE Study Report* is prepared after the completion of the workshop. This report summarizes the activities and results of the VE study. Once this report has been reviewed by the owner and project team, an implementation meeting is held in order to determine the disposition of the alternatives presented therein. An implementation plan is developed for those accepted VE alternatives, detailing actions, responsibilities, and key milestones for integrating them into the project. VE alternatives that are rejected include a summary of the reasons for their rejection. A *Final VE Study Report* is prepared once the implementation results are finalized.

VALUE ENGINEERING STUDY AGENDA

FREEPORT HARBOR CHANNEL IMPROVEMENT PROJECT GRR | August 9 – 11, 2016

Meeting Location: COE Galveston District Office, Room 185, Jadwin building
2000 Fort Point Road, Galveston, TX 77550

Tuesday, August 9		
0800	**VE Study Kick-Off Meeting**	Stakeholders, Designer, VE Team
	Introductions and Purpose of VE Study	Fred Kolano
0915	Brief Overview of VE Process	Fred Kolano
0930	Overview of Project	Designer
1030	Value Discussion: Performance, Cost and Schedule	VE Team
	End of VE Study Kick-Off Meeting	
1100	Lunch and Site Visit	Designer and VE Team
1330	Site Visit Lessons Learned Discussion	VE Team
1400	Project Discussion	VE Team
1500	Project Cost Drivers Discussion and Pareto Analysis	VE Team
1600	**Function Analysis** and FAST Diagram	VE Team
1700	Adjourn	
Wednesday, August 10		
0800	Review of Day 1 Activities	Fred Kolano
0815	**Speculation** for New Improvement Ideas	VE Team
1130	**Evaluation** of Ideas	VE Team
1230	Lunch	
1330	Evaluation of Ideas (continued)	VE Team
1500	Overview of VE Alternative Development	Fred Kolano
1530	**Development** of VE Alternatives	VE Team
1700	Adjourn	
Thursday, August 11		
0800	Development of VE Alternatives (continued)	VE Team
1230	Lunch	
1230	Preparation of Management Presentation	VE Team
1300	**Management Presentation of VE Results**	Stakeholders, Designer, VE Team
1400	Wrap-Up and Additional Development if Needed	VE Team
1600	Adjourn	

MEETING ATTENDEES

8/9	8/10	8/11	Name	Position/Role	Organization	Telephone	E-mail
X	X	X	Nicholas Laskowski	Project Manager	USACE	409-766-3168	Nicholas.a.laskowski@usace.army.mil
X	X	X	Jon Plymale	VEO	SWG	409-766-6375	Jon.e.plymale@usace.army.mil
	X	X	Jake Walsdorf	VEO	SWG	409-766-3817	Jacob.c.walsdorf@usace.army.mil
X		X	Neil McLellan		HDR/Port Freeport	713-256-6362	Neil.mclellan@hdrinc.com
X		X	Jan Stokes	Environmental	RPEC	409-766-3039	Janelle.s.stokes@usace.army.mil
X	X	X	Cheryl Jaynes	Planning Lead	RPEC	409-766-3804	Cheryl.jaynes@usace.army.mil
X	X	X	John Bolles	Construction	CBJB Consulting	813-965-1253	jlbolles@gmail.com
X	X	X	Ray Devlin	Dredging	Moffat & Nichol	713-977-7372	rdevlin@moffattnichol.com
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X	X	X	Mike Coffman		USACE		
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		X	Dave Brown	Engineering	EC-EG	X3969	David.r.brown@usace.army.mil
X	X	X	Fred Kolano	VE Team Leader	VMS, Inc.	970-216-1739	fred@vms-inc.com
X	X	X	Allegra Keith	Technical Editor	VMS, Inc.	541-280-1670	allegra@vms-inc.com

APPENDIX: AFTER ACTION REVIEW

AFTER ACTION REVIEW

PROJECT: **Freeport Channel Harbor Improvement Project GRR** **Value Engineering Study 9-11 AUG 2016**	SHEET NO.: 1 of 1

NO.	QUESTIONS
1	**What did we do at this workshop that we should continue to do?**
	You clearly stated the goals of the workshop.
	Your step by step process was right-on.
2	**What did we do at this workshop that we should not do at future workshops?**
	The presentation was rushed. More interaction was needed, especially from the none team members.
	The none team members really did have a chance to offer a 'outside view or idea' that we team members may have missed by being to close to the project.
3	**What did we not do at this workshop that we should do at future workshops?**
	With a 3-day 'rushed' format, it would be a good idea to have lunch brought in not only for timing, but to encourage informal interaction between the team members. Maybe even a dinner 1 night.

AFTER ACTION REVIEW

PROJECT: **Freeport Channel Harbor Improvement Project GRR Value Engineering Study 9-11 AUG 2016**	SHEET NO.: 1 of 1

NO.	QUESTIONS
1	**What did we do at this workshop that we should continue to do?**
	I think the implementation of working as a group using the VMS software was excellent and should continue to be the method.
2	**What did we do at this workshop that we should not do at future workshops?**
	Nothing. Everything was done as expected.
3	**What did we not do at this workshop that we should do at future workshops?**
	Nothing.

AFTER ACTION REVIEW

PROJECT: **Freeport Channel Harbor Improvement Project GRR Value Engineering Study 9-11 AUG 2016**	SHEET NO.: 1 of 1

NO.	QUESTIONS
1	**What did we do at this workshop that we should continue to do?**
	· Provided immediate editing of value study information provided by the team. This effort insured the team was kept moving through the evaluation process.
	· Facilitation was on point through the entire event. The team was kept focused and moving to document the process throughout the 3 day effort.
	· Activities that went into developing the final report were performed well and made sense.
	· Being able to view the draft report prior to presenting it out to senior leaders was helpful.
	· The VE study team continually viewed the base plan information pertaining to design, cost, and constructing timing. The team at Value Management Strategies, Inc. provided all the base plan information in a clear and useful manner at the start of the session. This was extremely useful as the information was referred to constantly.
2	**What did we do at this workshop that we should not do at future workshops?**
	· At times, efforts to come up with cost values for the alternative solutions felt a little forced.
	· I wondered why the Planning lead and Environmental lead did not stay through the entire effort of developing, evaluating and costing out alternatives.
3	**What did we not do at this workshop that we should do at future workshops?**
	· Have paper print outs each morning of what was developed the previous day.

	· Provide as many colored site plan drawings, detailed drawings and detailed verbal descriptions of the base project. As well as provide all historic studies and drawings developed for the site.
	· When costing out the alternatives and the strategies, take as much time as possible.
	· Build the report as you go. And allow the team time to review and provide input.
	· Provide a cost editor to develop costs "on the fly" so the team could evaluate an alternative more quickly and effectively.
	· Have the District provide accurate drawings of the base plan for use in the final report.

AFTER ACTION REVIEW

PROJECT: **Freeport Channel Harbor Improvement Project GRR Value Engineering Study 9-11 AUG 2016**	SHEET NO.: 1 of 1

NO.	QUESTIONS
1	**What did we do at this workshop that we should continue to do?**
	The process was, overall, very useful. Establishing the baseline and assumptions was very
	Important. The process to evaluate the avenues for value improvement was also very
	Useful.
2	**What did we do at this workshop that we should not do at future workshops?**
	One issue, which was a little concerning, was the available data used to identify the
	Baseline. Some of the supporting data seemed incomplete, or contradictory.
	The FAST diagram, while useful in its own right, took some time. Perhaps on more
	Complex projects the usefulness would be more obvious, however, the key areas
	Influencing this project where clear from the outset.
	There was a concern that we were evaluating life cycle costs on very limited data, sometimes with no data. This had the tendency to skew the performance, perhaps over or underestimating the impact.
3	**What did we not do at this workshop that we should do at future workshops?**
	It would have been better to have full participation from the design team to answer
	Basic questions about the baseline.

AFTER ACTION REVIEW

PROJECT: **Freeport Channel Harbor Improvement Project GRR** **Value Engineering Study 9-11 AUG 2016**	SHEET NO.: 1 of 1

NO.	QUESTIONS
1	**What did we do at this workshop that we should continue to do?**
	Facilitate open discussion and ideas.
2	**What did we do at this workshop that we should not do at future workshops?**
	Nothing that I can think of.
3	**What did we not do at this workshop that we should do at future workshops?**
	Nothing that I can think of.