TACOMA HARBOR, WA
FEASIBILITY STUDY
PIERCE COUNTY, WASHINGTON

APPENDIX F – COST ENGINEERING

April 2022

US Army Corps of Engineers®
Seattle District

Port of Tacoma

Cost Appendix

This appendix provides supplemental and background information on the development of the project cost estimates for the Tacoma Harbor Navigation Improvement Project.

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1 Introduction

The Cost Engineering Section at the USACE Seattle District has prepared this cost estimate to determine the probable construction costs for alternatives to improve the efficiency of the navigation system in Tacoma Harbor, Washington. The point of contact for this estimate is Ian Pumo, Chief of Cost Engineering, 206-764-6763.

2 Summary of Project Features

This project includes deepening of three channels at Tacoma Harbor: Husky, WUT, and the Turning Basin. Deepening will require slope setbacks or stabilization at four locations, as well as real estate acquisition. Some landside facility improvements will also be required. There is the potential for "beneficial reuse" of dredged material by disposing of the material at the Saltchuk site instead of the Commencement Bay disposal site.

3 Recommended Plan Cost

The Recommended Plan is the NED Plan: dredging to a depth of -57 (+2 overdepth) with disposal at Saltchuk (beneficial reuse site) and Commencement Bay (open water disposal). The cost of the Recommended Plan is summarized below and detailed in the attached TPCS.

Table 1 – TSP Cost Estimate ($K)

Feature	First Cost (FY22)	Fully Funded (FY Varies)
01 – Lands & Damages	307	332
02 – Relocations	-	-
12 – Navigation	269,541	326,491
30 – PED	10,530	11,361
31 – Construction Mgmt.	14,950	17,444
Total	**295,328**	**355,628**

4 Cost Estimate Development

The estimates were prepared in accordance with ER 1110-2-1150 E&D Civil Works Projects and ER 1110-2-1302 E&D Civil Works Cost Engineering.

The basis for the cost estimates was conceptual design drawings and quantities prepared by the Project Delivery Team (PDT). The cost engineer verified the provided quantities were reasonable and calculated additional supporting quantities as necessary (e.g. turbidity fencing, sheet pile supports). Additional information provided by the PDT via e-mails, phone calls, and in-person discussions was incorporated into the estimate.

The cost estimates were prepared using the Corps of Engineers Dredge Estimating Program (CEDEP) and Micro-Computer Aided Cost Estimating System II (MII). The estimates were developed at a Class 4 level in order to support selection of the TSP and optimization of the NED Plan. Per ER 1110-2-1302, a Class 4 estimate is supported by a discussion of scope and uncertainties, with particular attention paid to large cost items. Uncertainties were documented in the Cost and Schedule Risk Analysis (CSRA) risk register, and a risk-based contingency was developed using a Monte Carlo simulation done with Crystal Ball.

4.1 Price Level

The estimated cost is communicated at three price levels: “Estimated Cost,” “Project First Cost,” and “Total Project Cost.” The Estimated Cost is the construction cost calculated in MII based on the actual price level on the preparation date. The Project First Cost includes escalation from the estimate date to the anticipated date of Authorization, and the Total Project Cost includes escalation to the anticipated midpoint of construction.

The estimate price level is October 2021 (FY22). The project first cost is presented at the October 2021 price level (FY22) for programming. The midpoints of construction vary by feature.

4.2 Estimate Structure and Feature Cost Development

The estimate is organized at a high level by feature to match the Civil Works Work Breakdown Structure (WBS) accounts. This ensures the MII estimate is consistent with the risk analysis and the TPCS. The pertinent WBS accounts and their usage are summarized below.

01 Real Estate

Real estate costs include both Lands and Damages – acquisition of project lands, easements, and rights-of-way – and Administrative Costs associated with such acquisition. These costs were provided at various intervals by Doris Cope, Omar Vega, and Nic Laponte (NWS Real Estate). The midpoint is assumed to be the same as the midpoint of design.

02 Relocations

This project has no relocations costs. Although two outfalls adjacent to the channel were identified for relocation, they are the responsibility of a third party (not the non-federal sponsor) so any associated costs are excluded from the project cost.

09 Dredging

Dredging volumes were provided by the PDT (coordinated between DMMO and Coastal Engineering), and dredging costs were developed using CEDEP Version 2.0 for Mechanical Dredging. Multiple mobilizations were included as necessary to support removing the required volumes within the work windows. To develop mobilization costs, it was assumed the work would be done by a dredging contractor from the West Coast.

Custom crews, costbook tasks, and contractor quotes were used in MII to develop the costs of driving sheet piles, handling unsuitable material, placing turbidity curtains, and constructing shallow benches and islands at the Saltchuk Beneficial Use site. Escalation was figured based on Engineering News Record’s Building Construction Index system and applied at rates of 33% for the 2016 Costbook and 13% for quotes from April 2021.

30 Planning, Engineering, and Design

The Planning, Engineering and Design (PED) costs are the design costs from authorization until project completion. This work includes detailed surveys, soil investigations, preparation of the plans and specifications to guide the contractor to construct the project, and designer support during construction. The PDT agreed to estimate the PED costs as 2.5% of the estimated

construction cost. After further discussion with the PM, we added $2,450k to this value to cover the following itemized PED requirements. These are described in the TPCS.

- ESA Consultation
- Phase II Assessment
- Sediment Sampling
- Ship Simulation
- Geotechnical Investigations
- Life Cycle Cost Updates
- Contracting

31 Construction Management

Construction Management (CM) – sometimes called Supervision and Administration, or S&A – includes the cost of project managers, project engineers, and other field staff supervising the project construction. The PDT agreed to estimate the CM costs as 6% of the estimated construction cost (~approximately $10m).

4.3 Optimization and Iterations

To support economic analysis, we produced cost estimates for (5) alternatives and (4) beneficial use sub-alternatives.

Table 2 – Alternatives Considered for NED Analysis

Alternative	Name	Reaches	Depth
1	No Action	n/a	n/a
2	Max Expansion	Husky, WUT, TB	Varies from -51 (+2) to -58 (+2)
3	Husky	Husky	Varies from -51 (+2) to -58 (+2)
4	NED Plan	Husky, WUT, TB	-57 (+2)
5	NED Plan Light	Husky	-57 (+2)

Table 3 – Opportunities for Beneficial Use

Beneficial Use Sub-Alternative	Description	Quantity (CY)	Total Quantity (CY)
1	Bench 1	850,000	850,000
2	Bench 2	161,000	1,011,000
3	Bench 3	50,000	1,061,000
4	Islands	789,000	1,850,000

Table 4 – Combinations of Alternatives Considered for Beneficial Use

Alt #	Description
2	Dredge all reaches, (-58) + 2, All material disposed of at Commencement Bay
2.1	… and Fill Saltchuk Bench 1 from Husky and WUT, remaining material sent to CB.
2.2	… and Fill Saltchuk Benches 1 and 2 from Husky and WUT, remaining material sent to CB.
2.3	… and Fill Saltchuk Benches 1, 2, and 3 from Husky and WUT, remaining material sent to CB.
2.4	… and Fill Saltchuk Benches 1, 2, and 3 from Husky and WUT; all islands (789 kCY) from Husky, WUT, TB); remaining material sent to CB.
4	Dredge all reaches, (-57) + 2, All material disposed of at Commencement Bay
4.1	… and Fill Saltchuk Bench 1 from Husky and WUT, remaining material sent to CB.

4.2	… and Fill Saltchuk Benches 1 and 2 from Husky and WUT, remaining material sent to CB.
4.3	… and Fill Saltchuk Benches 1, 2, and 3 from Husky and WUT, remaining material sent to CB.
4.4	… and Fill Saltchuk Benches 1, 2, and 3 from Husky and WUT; all islands (789 kCY) from Husky, WUT, TB); remaining material sent to CB.
5	Dredge Husky, (-57) + 2, All material disposed of at Commencement Bay
5.1	… send all material to Saltchuk Bench 1 instead of CB, approx 675k CY.

4.4 O&M Costs

O&M costs are limited to dredging on 25-year intervals. Quantities for maintenance dredging were provided by Coastal Engineering. The O&M cost includes mobilization and removal of both suitable and unsuitable material; it excludes lands & damages, PED, CM, contingency, and any other allowances. O&M cost is approximately $4,755k (price level FY22) to mobilize and dredge 30,000 CY from the Husky Channel.

4.5 Beneficial Reuse Costs

Our group estimated the cost of the recommended plan with and without beneficial reuse of material at Saltchuk. The table below shows the construction cost (from MII) and the total first cost (from TPCS, includes PED, CM, Real Estate, and contingency) with and without beneficial reuse. The total incremental cost difference is approximately $9.5m at the FY22 price level.

Feature	Estimated Cost ($K, FY22)	Project First Cost ($K, FY22)
With beneficial reuse at Saltchuk	207,339	355,628
Without beneficial reuse	201,568	346,086
Incremental difference	**5,771**	**9,542**

4.6 Key Assumptions

Several key assumptions were made to estimate the construction costs:

- The work window is 6 months each year, limited to 150 working days per season.
- Dredging of suitable material will be done with a large clamshell bucket, and dredging of unsuitable material will be done with a small environmental bucket.
- Landfills within 20 miles of Tacoma can support disposal of the unsuitable material (assumption confirmed by special waste management at LRI).
- For beneficial reuse sites, the contractor will supply sufficient barges to match maximum excavation rates.
- The estimate includes an open water disposal fee of $0.95/CY for all disposal at Commencement Bay based on the latest guidance from DNR. (The current fee is $0.45/CY but will increase to $0.75/CY on 1 July 2022 and to $0.95/CY on 1 July 2025.)

5 Risk-Based Contingency Development

A Construction Schedule Risk Analysis (CSRA) was conducted with the PDT in order to identify, assess, and mitigate all potential risks to the project. The risks identified are documented in the CSRA document included as an attachment. Analysis of these risks contributed to the determination of how much contingency should be added to the total cost of the project. The

CSRA has been updated to reflect the base case estimate and risks inherent in the Recommended Plan. Key risks identified include:

- Limited bid competition
- Uncertainty around the slope stabilization
- Potential for additional unforeseen unsuitable material or unanticipated HTRW
- Delays in project funding
- Debris in dredged material
- ~~Regulatory impacts due to delayed ESA consultation~~ (removed in Feb 2022 because ESA consultation was completed)

6 Construction and Implementation Schedules

Dredging work is restricted to a 6-month work window between August and February. Due to this restriction, the construction duration varies by depth and extent of dredging from one to four years. The tentatively selected plan will require three seasons to complete. The team has assumed that non-dredging work can be done concurrently, and that dredging durations will drive the schedule.

The implementation schedule is summarized in the table below:

Table 5 – Implementation Schedule of the TSP

Event	Duration (mo)	Start	Finish	Midpoint	Notes
Feasibility	48	Sep 2018	Jul 2022	Aug 2020	Chief's report in Aug 2022
PED	30	Apr 2022	Oct 2025	Jun 2024	Start when appropriations received
Construction	39	Aug 2026	Oct 2029	Mar 2028	Four seasons, reference excel for more info
Season 1	6	Aug 2026	Feb 2027	n/a	150 workdays
Season 2	6	Aug 2027	Feb 2028	n/a	150 workdays
Season 3	6	Aug 2028	Feb 2029	n/a	150 workdays
Season 4	6	Aug 2029	Oct 2029	n/a	80 workdays

7 Enclosures

The following attachments supplement this appendix.

1. TPCS
2. CSRA Risk Register and Outputs

WALLA WALLA COST ENGINEERING MANDATORY CENTER OF EXPERTISE

COST AGENCY TECHNICAL REVIEW

CERTIFICATION STATEMENT

For Project No. 465354

NWS – Tacoma Harbor Navigation Improvement Study

The Tacoma Harbor Navigation Improvement Study, as presented by Seattle District, has undergone a successful Cost Agency Technical Review (Cost ATR), performed by the Walla Walla District Cost Engineering Mandatory Center of Expertise (Cost MCX) team. The Cost ATR included study of the project scope, report, cost estimates, schedules, escalation, and risk-based contingencies. This certification signifies the products meet the quality standards as prescribed in ER 1110-2-1150 Engineering and Design for Civil Works Projects and ER 1110-2-1302 Civil Works Cost Engineering.

As of February 22, 2022, the Cost MCX certifies the estimated total project cost:

FY 22 Project First Cost: $295,328,000
Fully Funded Amount: $355,628,000

Cost Certification assumes Efficient Implementation (Funding). It remains the responsibility of the District to correctly reflect these cost values within the Final Report and to implement effective project management controls and implementation procedures including risk management through the period of Federal Participation.

FOR: **Michael P. Jacobs, PE, CCE**
Chief, Cost Engineering MCX
Walla Walla District

****** TOTAL PROJECT COST SUMMARY ******

PROJECT: **Tacoma Harbor Deepening**
PROJECT NO: P2 465354
LOCATION: Tacoma, WA

DISTRICT: **Seattle District** **PREPARED:** **2/18/2022**
POC: **CHIEF, COST ENGINEERING, Ian Pumo**

This Estimate reflects the scope and schedule in report; Final Feasibility Report / EA

Civil Works Work Breakdown Structure		ESTIMATED COST				PROJECT FIRST COST (Constant Dollar Basis)						TOTAL PROJECT COST (FULLY FUNDED)			
						Program Year (Budget EC): 2022									
						Effective Price Level Date: 1 OCT 21									
WBS NUMBER	Civil Works Feature & Sub-Feature Description	COST ($K)	CNTG ($K)	CNTG (%)	TOTAL ($K)	ESC (%)	COST ($K)	CNTG ($K)	**TOTAL ($K)**	Spent Thru: **1-Oct-21** ($K)	**TOTAL FIRST COST** ($K)	INFLATED (%)	COST ($K)	CNTG ($K)	FULL ($K)
A	*B*	*C*	*D*	*E*	*F*	*G*	*H*	*I*	*J*		*K*	*L*	*M*	*N*	*O*
12	NAVIGATION PORTS & HARBORS	$207,339	$62,202	30.0%	$269,541	0.0%	$207,339	$62,202	$269,541	$0	$269,541	21.1%	$251,147	$75,344	$326,491
	CONSTRUCTION ESTIMATE TOTALS:	$207,339	$62,202		$269,541	0.0%	$207,339	$62,202	$269,541	$0	$269,541	21.1%	$251,147	$75,344	$326,491
01	LANDS AND DAMAGES	$250	$57	22.8%	$307	0.0%	$250	$57	$307	$0	$307	8.0%	$270	$62	$332
30	PLANNING, ENGINEERING & DESIGN	$8,100	$2,430	30.0%	$10,530	0.0%	$8,100	$2,430	$10,530	$0	$10,530	7.9%	$8,740	$2,622	$11,361
31	CONSTRUCTION MANAGEMENT	$11,500	$3,450	30.0%	$14,950	0.0%	$11,500	$3,450	$14,950	$0	$14,950	16.7%	$13,418	$4,025	$17,444
	PROJECT COST TOTALS:	$227,189	$68,139	30.0%	$295,328		$227,189	$68,139	**$295,328**	$0	**$295,328**	20.4%	$273,575	$82,053	$355,628

ESTIMATED TOTAL PROJECT COST: **$355,628**

_____ **CHIEF, COST ENGINEERING, Ian Pumo**

_____ **PROJECT MANAGER, Kristine Ceragioli**

_____ **CHIEF, REAL ESTATE, Tom Seymou**

_____ **CHIEF, PLANNING, Laura Boerner**

_____ **CHIEF, ENGINEERING, JoAnn Walls**

_____ **CHIEF, OPERATIONS, Amy Reese**

_____ **CHIEF, CONSTRUCTION, Mark Slominski**

_____ **CHIEF, CONTRACTING, Dave Wiliams**

_____ **CHIEF, PM-PB, xxxx**

_____ **CHIEF, DPM, Ginny Dierich**

****** TOTAL PROJECT COST SUMMARY ******

****** CONTRACT COST SUMMARY ******

PROJECT: Tacoma Harbor Deepening
LOCATION: Tacoma, WA
This Estimate reflects the scope and schedule in report; Final Feasibility Report / EA

DISTRICT: Seattle District
POC: CHIEF, COST ENGINEERING, Ian Pumo
PREPARED: 2/18/2022

Civil Works Work Breakdown Structure		ESTIMATED COST				PROJECT FIRST COST (Constant Dollar Basis)				TOTAL PROJECT COST (FULLY FUNDED)				
		Estimate Prepared: 18-Feb-22 Effective Price Level: 1-Oct-21				Program Year (Budget EC): 2022 Effective Price Level Date: 1 OCT 21								
WBS NUMBER	Civil Works Feature & Sub-Feature Description	COST ($K)	CNTG ($K)	RISK BASED CNTG (%)	TOTAL ($K)	ESC (%)	COST ($K)	CNTG ($K)	TOTAL ($K)	Mid-Point Date	INFLATED (%)	COST ($K)	CNTG ($K)	FULL ($K)
A	*B*	*C*	*D*	*E*	*F*	*G*	*H*	*I*	*J*	*P*	*L*	*M*	*N*	*O*
	Dredge Tacoma Harbor -57 (+2)													
12	NAVIGATION PORTS & HARBORS	$207,339	$62,202	30.0%	$269,541	0.0%	$207,339	$62,202	$269,541	2028Q2	21.1%	$251,147	$75,344	$326,491
	CONSTRUCTION ESTIMATE TOTALS:	$207,339	$62,202	30.0%	**$269,541**		$207,339	$62,202	$269,541			$251,147	$75,344	$326,491
01	LANDS AND DAMAGES	$250	$57	22.8%	$307	0.0%	$250	$57	$307	2024Q3	8.0%	$270	$62	$332
30	PLANNING, ENGINEERING & DESIGN													
0.5%	Project Management	$1,100	$330	30.0%	$1,430	0.0%	$1,100	$330	$1,430	2024Q3	6.4%	$1,170	$351	$1,521
0.7%	Planning & Environmental Compliance	$1,500	$450	30.0%	$1,950	0.0%	$1,500	$450	$1,950	2024Q3	6.4%	$1,596	$479	$2,074
1.4%	Engineering & Design	$3,000	$900	30.0%	$3,900	0.0%	$3,000	$900	$3,900	2024Q3	6.4%	$3,191	$957	$4,148
0.5%	Reviews, ATRs, IEPRs, VE	$1,100	$330	30.0%	$1,430	0.0%	$1,100	$330	$1,430	2024Q3	6.4%	$1,170	$351	$1,521
0.0%	Life Cycle Updates (cost, schedule, risks)	$100	$30	30.0%	$130	0.0%	$100	$30	$130	2024Q3	6.4%	$106	$32	$138
0.0%	Contracting & Reprographics	$100	$30	30.0%	$130	0.0%	$100	$30	$130	2024Q3	6.4%	$106	$32	$138
0.3%	Engineering During Construction	$600	$180	30.0%	$780	0.0%	$600	$180	$780	2028Q2	16.7%	$700	$210	$910
0.3%	Planning During Construction	$600	$180	30.0%	$780	0.0%	$600	$180	$780	2028Q2	16.7%	$700	$210	$910
0.0%	Adaptive Management & Monitoring	$0	$0	30.0%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
0.0%	Project Operations	$0	$0	30.0%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
31	CONSTRUCTION MANAGEMENT													
5.0%	Construction Management	$10,400	$3,120	30.0%	$13,520	0.0%	$10,400	$3,120	$13,520	2028Q2	16.7%	$12,135	$3,640	$15,775
0.0%	Project Operation:	$0	$0	30.0%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
0.5%	Project Management	$1,100	$330	30.0%	$1,430	0.0%	$1,100	$330	$1,430	2028Q2	16.7%	$1,283	$385	$1,669
	CONTRACT COST TOTALS:	$227,189	$68,139		$295,328		$227,189	$68,139	**$295,328**			$273,575	$82,053	**$355,628**

****** TOTAL PROJECT COST SUMMARY ******

****** CONTRACT COST SUMMARY ******

PROJECT: Tacoma Harbor Deepening
LOCATION: Tacoma, WA
This Estimate reflects the scope and schedule in report; Final Feasibility Report / EA

DISTRICT: Seattle District
POC: CHIEF, COST ENGINEERING, Ian Pumo

PREPARED: 2/18/2022

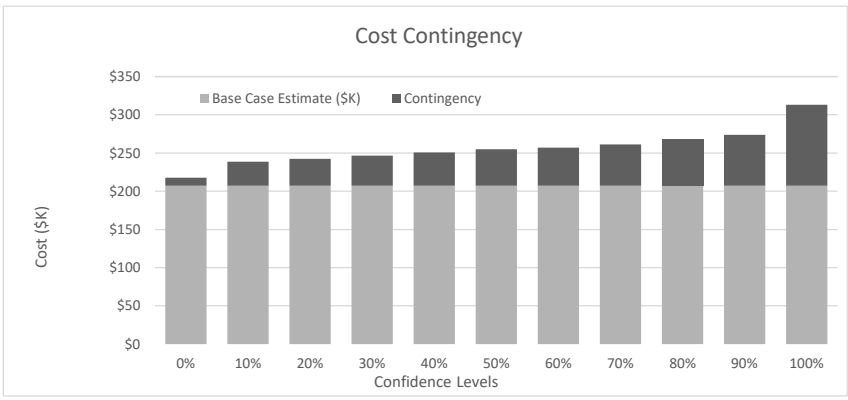
Civil Works Work Breakdown Structure		ESTIMATED COST				PROJECT FIRST COST (Constant Dollar Basis)				TOTAL PROJECT COST (FULLY FUNDED)				
		Estimate Prepared: / Effective Price Level:			18-Feb-22 / 1-Oct-21	Program Year (Budget EC): / Effective Price Level Date:			2022 / 1 OCT 21					
WBS NUMBER	Civil Works Feature & Sub-Feature Description	COST ($K)	CNTG ($K)	CNTG (%)	TOTAL ($K)	ESC (%)	COST ($K)	CNTG ($K)	TOTAL ($K)	Mid-Point Date	INFLATED (%)	COST ($K)	CNTG ($K)	FULL ($K)
A	*B*	*C*	*D*	*E*	*F*	*G*	*H*	*I*	*J*	*P*	*L*	*M*	*N*	*O*
	Typical O&M Contract (not incl in TPCS)													
12	NAVIGATION PORTS & HARBORS	$0	$0	0.0%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
	CONSTRUCTION ESTIMATE TOTALS:	$0	$0	0.0%	**$0**		$0	$0	$0			$0	$0	$0
01	LANDS AND DAMAGES	$0	$0	0.0%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
30	PLANNING, ENGINEERING & DESIGN													
0.5%	Project Management		$0	10.0%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
0.5%	Planning & Environmental Compliance		$0	10.0%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
0.5%	Engineering & Design		$0	10.0%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
0.5%	Reviews, ATRs, IEPRs, VE		$0	10.0%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
0.0%	Life Cycle Updates (cost, schedule, risks)		$0	10.0%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
0.0%	Contracting & Reprographics		$0	10.0%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
0.3%	Engineering During Construction		$0	10.0%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
0.3%	Planning During Construction		$0	10.0%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
0.0%	Adaptive Management & Monitoring		$0	10.0%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
0.0%	Project Operations		$0	10.0%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
31	CONSTRUCTION MANAGEMENT													
5.0%	Construction Management		$0	10.0%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
0.0%	Project Operation:		$0	10.0%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
0.5%	Project Management		$0	10.0%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
	CONTRACT COST TOTALS:	$0	$0		$0		$0	$0	**$0**			$0	$0	**$0**

Project Name:	**Tacoma Harbor GI**
CSRA Date:	**Feb 2022**
Project Manager:	Kristine Ceragioli
Technical Lead:	??
CSRA Prepared by:	Bridget Bentley (updates by Pumo)
CSRA Reviewed by:	Ian Pumo
POC Phone:	206-764-6763

Project Cost - 80% Confidence Interval	
Base Construction Estimate ->	$207,339
Cost Contingency, 80% C.I. ->	$60,128
Total Construction Estimate, Incl Contingency ->	$267,467
Project Schedule - 80% Confidence Interval	
Base Schedule Duration ->	93 Months
Schedule Contingency, 80% C.I. ->	18 Months
Total Schedule Duration, Incl Contingency ->	111 Months

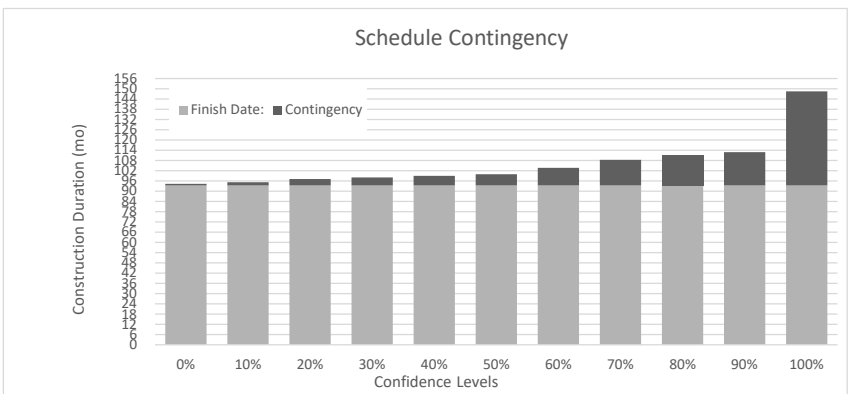
- PROJECT CONTINGENCY DEVELOPMENT -

Base Case Estimate ($K)	**$207,339**	
Confidence Level	**Contingency Value ($K, %)**	
0%	10,367	6%
10%	31,101	16%
20%	35,248	18%
30%	39,394	20%
40%	43,541	22%
50%	47,688	24%
60%	49,761	25%
70%	53,908	27%
80%	**60,128**	**30%**
90%	66,348	33%
100%	105,743	52%

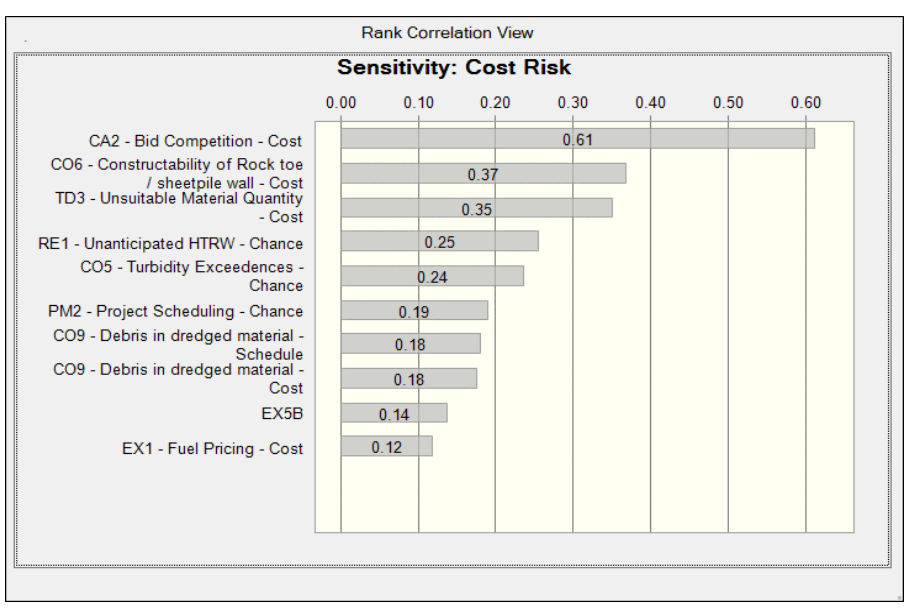


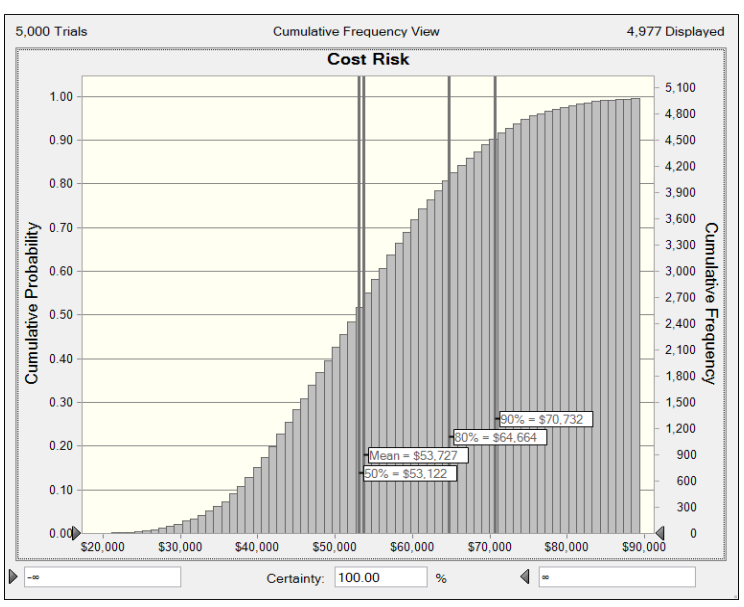
- SCHEDULE CONTINGENCY (DURATION) DEVELOPMENT -

Base Case Duration (mo)	**93 Months**	
Start Date:	**Feb 2022**	
Finish Date:	**Oct 2029**	
Confidence Level	**Contingency Value (months, %)**	
0%	1 Months	1%
10%	2 Months	2%
20%	4 Months	4%
30%	5 Months	5%
40%	6 Months	6%
50%	7 Months	7%
60%	10 Months	11%
70%	15 Months	16%
80%	**18 Months**	**19%**
90%	20 Months	21%
100%	55 Months	59%

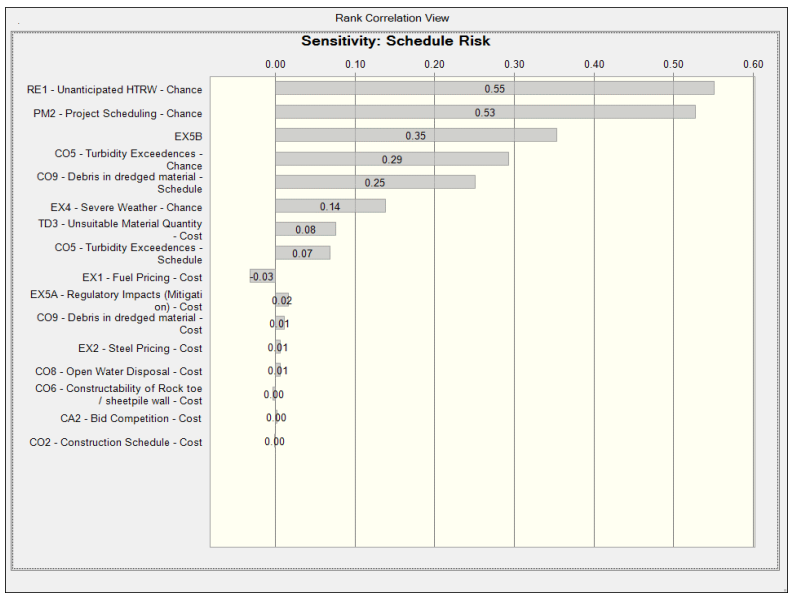


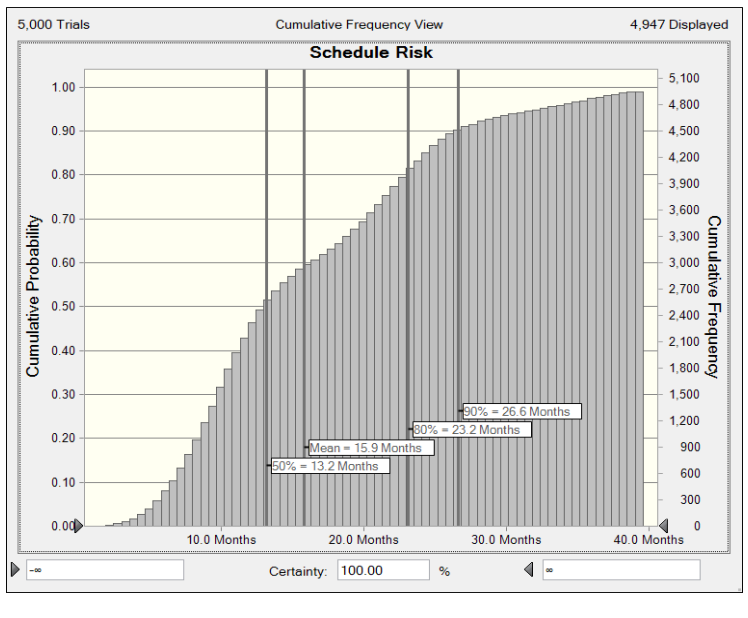
- COST OUTPUTS SENSITIVITY -





- SCHEDULE CONTINGENCY (DURATION) DEVELOPMENT -





TACOMA HARBOR - Risk Register

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Contract Acquisition (CA)																	
CA1	Contracting Plan	Could this project be an 8a or small business set-aside?	The consensus was that this project could not be completed by a small business because they do not have the equipment required to complete such a large scale project.	Unlikely	Moderate	Low		Unlikely	Moderate	Low			N/A -Not Modeled	N/A -Not Modeled			
CA2	Bid Competition	Could limited bid competition increase the cost?	This is always an issue with dredging projects. The number of bidders will likely be smaller than usual because of the magnitude of the project.	Possible	Critical	High	$ 17,000	Unlikely	Negligible	Low			Triangular	N/A -Not Modeled			Contract Cost
CA3	Contract Mods	Always a risk, but does this project have any aspects that will make them more likely.	There is not a lot that should change about this because it is mostly a dredging a project.	Unlikely	Moderate	Low		Unlikely	Moderate	Low			N/A -Not Modeled	N/A -Not Modeled			
Lands and Damages (LD)																	
LD1	Cutback Areas	How can this impact costs? Timeline? Will we need to	Real estate acqusistion fees along with additional effort on the part of the USACE Real Estate section. This was not originally going to be part of the project but the real estate costs will be included in the TPCS. Nothing to model.	Unlikely	Negligible	Low		Unlikely	Negligible	Low			N/A -Not Modeled	N/A -Not Modeled			
LD2	Any impacts to shipping industries that we could be held liable for?	Any impacts to shipping industries that we could be held liable for?	Not a concern. If anything the contractor will be slowed down because of letting the ships pass through.	Unlikely	Marginal	Low		Unlikely	Negligible	Low			N/A -Not Modeled	N/A -Not Modeled			
Construction (CO)																	
CO1	Work Windows	Can the work be completed in a single season? Does the Saltchuk area have a different work window? Will we restrict the hours worked per day?	Work window is restricted to a 6 month period (16 Aug to 15 Feb), during which severe weather is likely to happen. The number of seasons that construction will take depends on the depth of dredging, it varies from 1 to as many as 4 mobilizations. Base case estimate assumes more conservaitve 5-month work window which requires 4 mobilizations. Other risks cover possibility of exceeding work windows. Nothing to model here.	Unlikely	Negligible	Low		Unlikely	Negligible	Low			N/A -Not Modeled	N/A -Not Modeled			
CO2	Construction Schedule	Work is assumed to be completed 24/7? Is there anything that would prevent this?	24/7 Operation is a reasonable assumption. Shipping operations will continue during this time however and schedules can be unpredictable due to weather and other issues. This needs to be accounted for in productivity. It is possible there will be a few occastions when they will have to pause operations completely to allow for a ship to pass.	Possible	Significant	Medium	$ 3,000	Unlikely	Negligible	Low			Triangular	N/A -Not Modeled			Contract Cost
CO3	Production Rates	Producitivity impacts as a result of other boat traffic	This is an active harbor and as a result productivity levels will be reduced in the CEDEP. Costs associated with having to move the dredge to accommodate ships are modeled in Risk CO2.	Possible	Marginal	Low		Unlikely	Marginal	Low			N/A -Not Modeled	N/A -Not Modeled			
CO4	Material Testing during dredging	Will testing during dredging have to occur?	A full characterization of the material will occur prior to the start of the project which will remove any requirement for testing of material beyond standard monitoring.	Possible	Marginal	Low		Possible	Negligible	Low			N/A -Not Modeled	N/A -Not Modeled			
CO5	Turbidity Exceedences	Are we likely to have high turbidity? What happens?	The CB Disposal site has had issues with sediment drift in the past and that would result in a closure of the site for as much as a season (worst case). Dredged material in this area is silty and therefore more likely to remain in the water. Cost of potential remob covered in risk CO10.	Possible	Marginal	Low	$ 1,250	Possible	Significant	Medium	6 Months	$ 3,000	Yes-No	Triangular			Contract Cost & Schedule
CO6	Constructability of Rock toe / sheetpile wall	Potential for mods here?	The design has not been decided on yet, but since conditions of the sideslope are still unknown there is potential for mods.	Likely	Critical	High	$ 12,000	Possible	Marginal	Low			Triangular	N/A -Not Modeled			Contract Cost
CO7	Upland Disposal	Is LRI dependable?	LRI landfill is starting to fill up and there is a chance that this material is "too clean" for them to take. Worst case the material would have to go all the way to Eastern Washington, but really it is not contaminated enough to warrant that. Estimate assumes trucking of material rather than rail. **Update, 25 April:** Spoke with LRI special waste manager and he was not concerned about taking in the quantity of unsuitable material over several seasons in the mid 2020s.	Possible	Marginal	Low		Possible	Marginal	Low			N/A -Not Modeled	N/A -Not Modeled			
CO8	Open Water Disposal	Any specific restrictions in place for the Commencement Bay Disposal site?	Tipping fees - currently $0.45/CY but could double (or more).	Likely	Marginal	Medium	$ 1,000	Likely	Negligible	Low			Triangular	N/A -Not Modeled			Contract Cost
CO9	Debris in dredged material	This area has never been dredged to these depths, therefore it is unknown if any unusual debris will be discovered.	Woody debris is known to exist in the Saltchuk	Possible	Significant	Medium	$ 6,000	Possible	Significant	Medium	2 Months	$ 5,000	Triangular	Triangular			Contract Cost & Schedule
CO10	Add'l Seasons	Cumulative schedule impacts could lead to remobilization.	Current schedule allows for 5-month work seasons. Total construction duration is 17 months. Cumulative construction delays beyond 3 months will lead to a 5th season which carries another mobilization and a 6-month delay for off-season… Create a non-crystal bill risk that add's 6 months and a mobilization if necessary.... **The risks included here are: CO5 Turbidity, CO9 Debris, TD3 Unsuitable Material, EX4 Severe Weather.**	Possible	Significant	Medium	$ 1,250	Possible	Significant	Medium	6 Months	$ 5,000	Yes-No	Yes-No			Contract Cost & Schedule
Cost and Schedule (ES)																	
ES1	Assumptions in Estimate	Estimator made assumptions when design details were not complete.	Estimator made assumption regarding dredge equipment and the means and methods for slope stability. These assumptions were conservative and based on the input or PDT members.	Likely	Negligible	Low		Possible	Negligible	Low			N/A -Not Modeled	N/A -Not Modeled			
Project & Program Management (PM)																	
PM1	PED Costs	Scope creep / addition of Saltchuk to the scope	No estimates for PED were completed prior to this point, so not a concern.	Unlikely	Negligible	Low		Unlikely	Negligible	Low			N/A -Not Modeled	N/A -Not Modeled			

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PM2	Project Scheduling	Could anything cause the project to be delayed	If there are funding delays or difficulties with land acquisition the execution of the project could be delayed.	Unlikely	Moderate	Low		Possible	Critical	High	12 Months	$ 7,000	N/A -Not Modeled	Yes-No			Project Cost & Schedule
Regulatory & Environmental (RE)																	
RE1	Unanticipated HTRW	HTRW discovered that can not be disposed of at LRI	The biggest concern is the sideslopes because samples were not collected here. As discussed by the PDT, there is no official definition of HTRW, but we are concerned about the existence of any contaminents that can not be disposed of at LRI. According to Kristen Kerns this would not be our problem, it would be something the Port has to deal with so it should not be included in cost.	Unlikely	Negligible	Low		Unlikely	Critical	Medium	12 Months	$ 7,000	N/A -Not Modeled	Binomial			Project Cost & Schedule
RE2	Requirement to change scope	Will regulatory organizations require us to change anything about the design, etc?	Not believed to be an issue. We have to file permits, work in the fish window, and make sure we don't exceed turbidity, but that is all pretty standard for dredging. Nothing to model	Possible	Marginal	Low		Possible	Marginal	Low			N/A -Not Modeled	N/A -Not Modeled			
RE3	Turbidity Monitoring	Anything beyond what is typically required for dredging projects? What about at Saltchuk?	Baseline turbidity monitoring should be included in the base estimate. It is possible that additional monitoring would be required if there are exceedences detected. Exceedence impacts are documented in CO5	Possible	Negligible	Low		Possible	Marginal	Low			N/A -Not Modeled	N/A -Not Modeled			
Technical Design (TD) / Project Scope Growth																	
TD1	Scope Changes	Potential for scope growth or added features	Biggest potential scope change is the decision that needs to be made with regard to the cutback areas for this estimate that risk will be mitigated by assuming that sheetpile walls will be installed at each location. No need to model this.	Unlikely	Negligible	Low		Unlikely	Negligible	Low			N/A -Not Modeled	N/A -Not Modeled			
TD2	Dredging Quantites	Will the quantity of material needing to be dredged increase significantly between the time of the estimate and the start of construction?	It is unlikely that there will be any significant change because there is no body of water flowing into the waterway. Additionally, there has not been any requirement for maintence dredging the waterway. The quantited used in the cost estimate include 2 ft of overdepth and 10% for shoaling.	Unlikely	Marginal	Low		Unlikely	Negligible	Low			N/A -Not Modeled	N/A -Not Modeled			
TD3	Unsuitable Material Quantity	Will the assumptions made about quanitties for open water vs upland disposal vary?	Yes, to some degree. We don't have a lot sampling for the side slopes so assumptions are being made right now. By breaking up the waterway into three sections we should be increasing the accuracy of these assumption, however there are still a number of unknowns. If the quantitiy of unsuitable material increased it could have an impact on both cost and schedule. This can not be mitigated at this point, but once a full characterization has been completed.	Likely	Critical	High	$ 11,000	Likely	Negligible	Low	1 Months	$ -	Triangular	N/A -Not Modeled			Contract Cost & Schedule
TD4	Non-Native vs Native Materials	Differences in how they are remvoed and handled?	Non-native materials will need to be screened prior to open water disposal - this will be included in the estimate. Native materials will be significantly more difficult to remove because they are undisturbed and compacted, etc. Count on productivity being reduced by as much as ~1/2.	Unlikely	Marginal	Low		Unlikely	Negligible	Low			N/A -Not Modeled	N/A -Not Modeled			
TD5	Cutback Area/ Slope Stability	There are 4 areas that are of concern following the ShipSim	The team still does not have a set solution for these 4 locations. Most likely there will either be cutbacks or a sheetpile wall installed in order to stabilize the slopes and allow for deepening. The consensus among the team is that the most technically complicated and expensive would be a sheetpile wall, therefore this is the option that will be included in the estimate. No need to model any risks.	Unlikely	Negligible	Low		Unlikely	Negligible	Low			N/A -Not Modeled	N/A -Not Modeled			
External																	
EX1	Fuel Pricing	Project will take place over 2-3 seasons therefore the cost of fuel may flucuate.	Fuel price is a major drive for the costs of dredging and an increase in price would increase construction costs.	Possible	Significant	Medium	$ 4,000	Possible	Negligible	Low			Triangular	N/A -Not Modeled			Contract Cost
EX2	Steel Pricing	This is only relevant if we the sheetpile retaining wall option is used.	Steel pricing has been volatile lately. There is no way to know if that will continue to be the case, but the large quantity required means that the cost impacts could be significant.	Possible	Significant	Medium	$ 3,000	Possible	Negligible	Low			N/A -Not Modeled	N/A -Not Modeled			Contract Cost
EX3	Stakeholder Influence	Could input from stakeholders, tribes, or political influence lead to additional requirements or delays?	According to the Port of Tacoma reps the tribes have not expressed any concern about the project previously. If anything it is believed that they will find the project even more "tolerable" if the Saltchuk disposal site happens. Land acquisition may be an issue for sites 2-3, this risk is accounted for in PM2	Unlikely	Negligible	Low		Unlikely	Negligible	Low			N/A -Not Modeled	N/A -Not Modeled			
EX4	Severe Weather	The project work window is already very small. Severe weather could delay the project and force additional seasons or mobs.	Severe weather is a definite possibility based on the window of time when work will be completed. Model schedule impact here. Potentail cost of mob/remob is covered in CO10.	Unlikely	Negligible	Low	$ -	Likely	Marginal	Medium	1 Months	$ -	N/A -Not Modeled	Yes-No			Contract Cost & Schedule

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EX5A	Regulatory Impacts (Mitigation)	Dept of Ecology, EPA, etc. What impact can they have on the project? Can they force any design changes?	**Update, Feb 2022: We have received our BiOp and were not directed to do mitigation. This risk no longer exists. Reference the CSRA from June 2021 for historical info on this risk.**	Unlikely	Negligible	Low	$ -	Unlikely	Negligible	Low			N/A -Not Modeled	N/A -Not Modeled			Project Cost
EX5B	Regulatory Impacts (Coordination)	Dept of Ecology, EPA, etc. What impact can they have on the project? Can they force any design changes?	**Update, Feb 2022: ESA Consultation was completed. This risk no longer exists. Reference the CSRA from June 2021 for historical info on this risk.**	Possible	Negligible	Low		Possible	Negligible	Low	0 Months	$ -	N/A -Not Modeled	N/A -Not Modeled			Project Schedule
EX6	Existing Contracts for work in the area	Port has mentioned that there are existing contracts for other environmental clean up work, etc in the area.. Will any of these still be ongoing?	This project will be a priority, ongoing work will be complete by then.	Unlikely	Marginal	Low		Unlikely	Negligible	Low							
EX7	USCG Requirements	What restrictions might the Coast Guard put on the project, particularly if Saltchuk is pursued.	The Cost Guard may require the installation of Aids to Navigation (ATONs). Cost is negligible. Included (7) in base case estimate using pricing from Seattle Harbor. Do not model.	Likely	Negligible	Low		Possible	Negligible	Low							
END																	