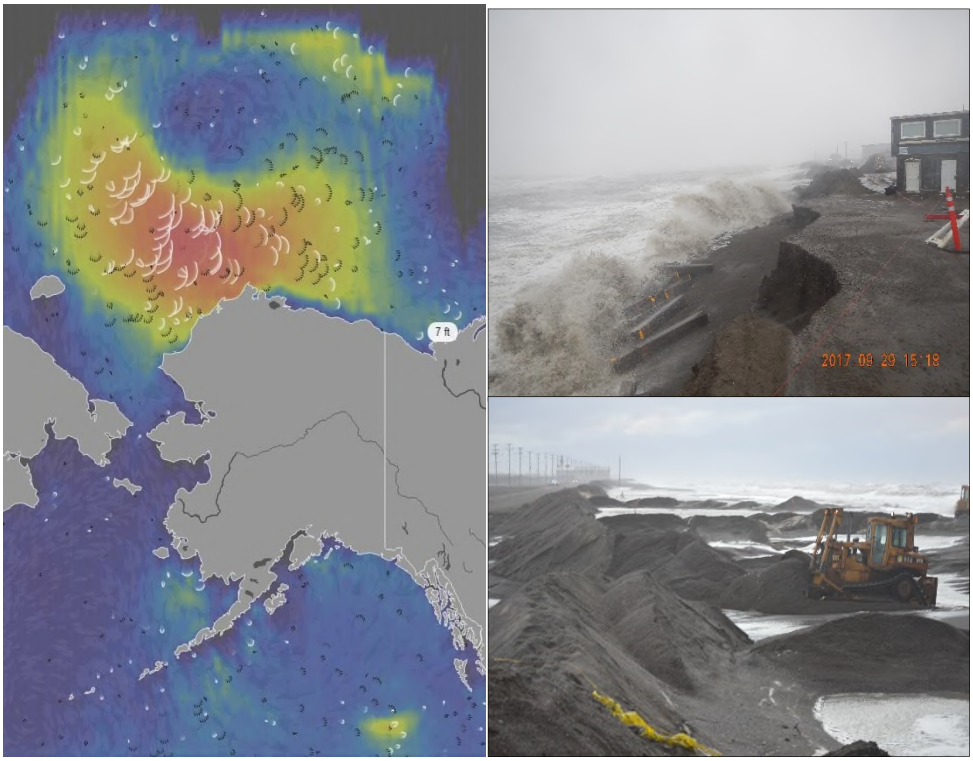
U.S. Army Corps
of Engineers
Alaska District

Barrow Alaska Coastal Erosion Feasibility Study



Cost Engineering Report

July 2019

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BARROW ALASKA
COASTAL EROSION FEASIBILITY STUDY

COST ENGINEERING REPORT

prepared for:

Alaska District

U.S. Army Corps of Engineers

prepared by:

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May 2019

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1.0 INTRODUCTION

The United States Army Corps of Engineers (Corps) has partnered with the North Slope Borough (NSB) to conduct the Barrow Alaska Coastal Erosion Feasibility Study. The study is being conducted under authority provided by Section 116 of the Energy and Water Development Appropriations Act of 2010 (PL 111-85) as amended. Section 116 provides authority for the Secretary of the Army to carry out structural and non-structural projects for storm damage prevention and reduction, coastal erosion, and ice and glacial damage in Alaska.

This feasibility study is a Corps 3x3x3 SMART Planning feasibility study being conducted in response to a request from the North Slope Borough (NSB) to resume a previous study effort by the Corps. This previous study effort, the Barrow Coastal Storm Damage Reduction Feasibility Study, culminated in a Technical Report in 2010, and is referred to as the 2010 study. Consistent with Corps SMART planning principles, the current feasibility study is utilizing existing and available information from the 2010 study combined with new data to support plan formulation and risk informed identification of a recommended plan.

This cost engineering report documents the methods and results of the cost estimates completed at various stages of the study. This estimating process is performed to support the economic analysis, and develop a total project cost, for the recommended plan studies conducted as part of the current feasibility report.

2.0 PRELIMINARY ALTERNATIVE COST ESTIMATES

This section summarizes the development of planning level cost estimates for the final array of action alternatives.

2.1 Purpose

The nine alternative estimates were developed in Q3 2018 prices. For the economic analysis, estimated construction durations and OMRR&R estimates were also developed. Interest during construction and amortized costs were calculated over the 50-year period of analysis using the FY18 Federal discount rate. The cost estimate back-up information, which includes rock pricing information, quantity calculations and abbreviated risk analysis can be found in Attachment 1. The detailed cost estimate tables can be found in Attachment 2.

2.2 Quantities

Quantities for the earthwork, rock, lagoon fill, and beach nourishment have all been calculated by the Corps Alaska District cost engineering staff. The quantities were checked for reasonableness within the provided spreadsheet and have been used in the alternative estimates with no modifications.

2.3 Unit Prices

Unit prices for the alternative estimates were taken from various sources that include vendor quotes, RS Means, previous cost estimates, available bid data, and previous study documents. All unit prices have been adjusted with local multipliers that modify the base unit price to reflect localized, labor, equipment and material prices.

1. Mobilization and Demobilization – Assumes 10% of the construction costs for each alternative.
2. Excavation – Unit cost assumes excavation to be completed with use of hydraulic excavators, and material would be stockpiled on-site prior to disposing.
3. Hauling – Unit price assumes hauling with 12-cubic yard (cy) dump trucks to a local disposal site in Barrow. No tipping fee is assumed to be required.
4. Armor Rock, B-rock, Core Rock and Gravel – Unit prices assume all rock for the berms and revetments would be delivered to Barrow from other locations in Alaska. The likely source of the

rock would be from Nome, where the material would be loaded onto barges for delivery to Barrow. Other locations are possible but may require longer shipping distances and thus higher costs. The prices used in the current estimate are based on quotes provided by several contractors familiar with the Nome quarry and with shipping of construction materials throughout Alaska. A document of discussions with these contractors, and the pricing information they provided, is provided in Attachment 1.

5. Filter Fabric – Unit price assumes placement of filter fabric at designated locations.
6. Local Material – Unit price assumes the gravel pit in Barrow has sufficient material to provide as local fill. This material would be delivered by truck to the placement location, placed and then compacted.
7. Structure Raise and/or Relocation – The exact requirements for the structure relocations are not set. Previous USACE cost estimates and documentation included approximately $150k for certain structure relocations. Given escalation factors, and potential for historic structures to require relocations, $200k per structure has been used until more details are developed.
8. Beach Nourishment Material – Unit price assumes that beach nourishment material would be purchased and excavated from a source located along the Colville River. The material would be loaded onto barges and delivered to Barrow for placement. Material could be dumped from barges in the deeper locations, or potentially could be off loaded to barges and dumped by land at the near shore locations.

2.4 Feature Accounts

The cost estimates have been separated by feature account. The features included are as follows:

01 Land and Damages – No costs are included for this account in the economic analysis as real estate costs were under development. Real estate costs for alternatives in the 2010 cost estimates ranged from 0.1 to 1.9 percent of construction costs. These values were assessed and determined to have no effect on the results of project formulation and identification of a recommended plan.

02 Relocations – Costs in this account consist of structure relocations that require relocation in order to construct the berm and/or raise Stevenson Street.

16 Bank Stabilization – Costs in this account consist of the majority of construction measures. The revetment, berm, and raising of Stevenson Street all fall under this account. All mobilization and demobilization required also is included here.

17 Beach Replenishment – Costs for this account consist of the placement of the beach nourishment materials.

18 Cultural Resources – Costs for this account consist of the need for an on-site archeologist that would likely be required for duration of construction activities.

30 Planning, Engineering and Design (PED) – Cost for this account have been assumed to be 10% of total construction costs.

31 Construction Management (CM) – Costs for this account have been assumed to be 6% of total construction costs.

2.5 Contingencies

Contingencies represent allowances to cover unknowns, uncertainties and/or unanticipated conditions that are not possible to adequately evaluate from the data on hand at the time the cost estimate is prepared but must be represented by a sufficient cost to cover the identified risks. An abbreviated risk analysis (ARA) has been prepared for the alternative cost estimates to calculate alternative specific contingencies.

2.6 OMRR&R

OMRR&R costs have been calculated for each alternative. Assumptions based on the features required in each alternative were used to estimate a quantity of rock or beach nourishment that would be required to be replaced over an assumed duration of time. The following assumptions were used to estimate OMRR&R costs for the alternative estimates:

- Annual minor maintenance and inspections - $25,000 per year (every alternative)
- Revetments rock replacement - 7.75% of armor, b-rock and core rock replaced every 5-years
- Raise Stevenson Street - 7.75% of armor, b-rock and core rock replaced every 5-years
- Berm rock replacement – 7.75% of armor, b-rock and core rock replaced every 5-years
- Beach nourishment material – 85% of nourishment material replaced every 25-years

2.7 Alternative Cost Summary

The summary of alternative costs developed for use in the CE/ICA analysis is shown in **Table 1**. **Figure 1** provides a breakout of the different features included in each alternative by reach.

Table 1 – Alternative Costs

Alternative	First Costs	Contingency	Total Costs	OMRR&R ($ PV)
2	$204,140,000	46.2%	$298,030,000	$45,643,000
5A	$82,388,000	46.8%	$121,575,000	$11,587,000
5B	$144,822,000	46.5%	$213,850,000	$26,523,000
5C	$189,164,000	46.4%	$279,566,000	$35,858,000
5D	$263,975,000	46.7%	$390,716,000	$68,517,000
6A	$323,474,000	46.6%	$478,370,000	$48,726,000
6B	$462,715,000	47.0%	$684,466,000	$35,858,000
6C	$637,064,000	47.6%	$944,066,000	$605,000
Note: Present value of OMRR&R based on 50-years of maintenance and 2.875% discount rate.				

Figure 1 – Alternative Overview by Reach

3.0 REACH AND MEASURE COSTS FOR SENSITIVITY ANALYSIS

After completing the original alternatives analysis, a more detailed comparison of costs on a reach by reach basis was performed. The filling of Tasigrook Lagoon and the beach nourishment alternatives were screened out as viable options. The estimates were also modified by analyzing alternative heights of the berms, revetments, and raising of Stevenson Street, to attempt to optimize the alternatives by reach. The Alaska District developed quantities for three different bank heights at each reach and for each construction element (see Attachment 3 for optimized scenario quantities). These updated quantities were applied to the unit costs developed for the alternative estimates discussed previously in order to estimate total costs by reach and bank height. The resulting total costs (see **Table 1Table 2**) were used in further iterations of the CE/ICA analysis.

Table 2 – Cost Summary for Sensitivity Analysis

Reach	Construction Measure	Height	First Costs	Contingency	Real Estate	Total	Annual O&M
1	Revetment	19.0	$19,588,000	$8,968,000	$1,013,000	$29,569,000	$164,000
		21.0	$20,905,750	$9,651,000	$1,013,000	$31,570,000	$178,000
		23.0	$22,329,750	$10,308,000	$1,013,000	$33,651,000	$191,000
2	Revetment	14.5	$14,832,500	$6,855,000	$608,000	$22,296,000	$134,000
		15.5	$15,716,250	$7,255,000	$608,000	$23,579,000	$142,000
		17.0	$16,884,250	$7,794,000	$608,000	$25,286,000	$152,000
3	Berm	14.5	$29,132,000	$13,462,000	$608,000	$43,202,000	$265,000
		15.5	$32,960,250	$15,215,000	$608,000	$48,783,000	$292,000
		17.0	$37,614,250	$17,364,000	$608,000	$55,586,000	$334,000
4	Raise Stevenson	14.5	$30,586,000	$14,134,000	$1,013,000	$45,733,000	$261,000
		15.5	$32,544,750	$15,024,000	$1,013,000	$48,582,000	$276,000
		17.0	$35,599,750	$16,434,000	$1,013,000	$53,047,000	$299,000
4	Berm	14.5	$43,059,750	$19,878,000	$1,013,000	$63,951,000	$378,000
		15.5	$47,276,750	$21,824,000	$1,013,000	$70,114,000	$417,000
		17.0	$53,944,750	$24,903,000	$1,013,000	$79,861,000	$478,000
5	Raise Stevenson	14.5	$62,628,000	$28,937,000	$608,000	$92,173,000	$530,000
		15.5	$66,512,250	$30,704,000	$608,000	$97,824,000	$560,000
		17.0	$75,374,250	$34,795,000	$608,000	$110,777,000	$607,000
5	Berm	14.5	$88,078,250	$40,660,000	$608,000	$129,346,000	$769,000
		15.5	$96,546,250	$44,569,000	$608,000	$141,723,000	$847,000
		17.0	$110,121,250	$50,835,000	$608,000	$161,564,000	$973,000
6	Raise Stevenson	14.5	$44,371,500	$20,501,000	$203,000	$65,076,000	$375,000
		15.5	$47,186,750	$21,783,000	$203,000	$69,173,000	$397,000
		17.0	$51,464,750	$23,758,000	$203,000	$75,426,000	$429,000
6	Berm	14.5	$62,815,750	$28,998,000	$203,000	$92,017,000	$543,000
		15.5	$69,136,750	$31,916,000	$203,000	$101,256,000	$600,000
		17.0	$78,815,750	$36,384,000	$203,000	$115,403,000	$688,000

4.0 FINAL ARRAY OF ALTERNATIVES COST ESTIMATES

The optimized costs from **Table 2** were analyzed, and it was determined that the optimum height was the lowest height for each reach and measure. Further optimization determined the preferred measure for each reach, which were formulized into the final array alternatives. **Table 3** provides the total alternative costs and **Figure 2** shows the final array alternatives locations by measure and reach. A more detailed breakdown of the final array costs is provided in Attachment 4.

Table 3 – Final Array of Alternatives Cost Summary

Alternative	Item	Value	Annual O&M
A	First Cost	$43,964,500	$399,000
	Contingency	$20,317,000	
	Real Estate	$1,216,000	
	Total Cost	$65,498,000	
B	First Cost	$63,552,500	$563,000
	Contingency	$29,285,000	
	Real Estate	$2,229,000	
	Total Cost	$95,067,000	
C	First Cost	$94,138,500	$824,000
	Contingency	$43,419,000	
	Real Estate	$3,242,000	
	Total Cost	$140,800,000	
D	First Cost	$106,592,500	$929,000
	Contingency	$49,254,000	
	Real Estate	$1,824,000	
	Total Cost	$157,671,000	
E	First Cost	$126,180,500	$1,093,000
	Contingency	$58,222,000	
	Real Estate	$2,837,000	
	Total Cost	$187,240,000	
F	First Cost	$156,766,500	$1,354,000
	Contingency	$72,356,000	
	Real Estate	$3,850,000	
	Total Cost	$232,973,000	
G	First Cost	$170,552,000	$1,468,000
	Contingency	$78,723,000	
	Real Estate	$3,040,000	
	Total Cost	$252,316,000	
H	First Cost	$201,138,000	$1,729,000
	Contingency	$92,857,000	
	Real Estate	$4,053,000	
	Total Cost	$298,049,000	

Figure 2 – Final Array Alternatives Map

SCO

5.0 RECOMMENDED PLAN COST ESTIMATE

This section documents the development of recommended plan cost estimate, which was completed using MCACES and included a Cost and Schedule Risk Analysis (CSRA) for contingency development. Alternative H from the final array of alternatives was selected as the recommended plan (see Figure 2 for construction elements by reach).

5.1 Basis of Estimate

The available design document for this project, in which the cost estimate was based on, is the *Barrow Alaska Coastal Erosion Feasibility Study* prepared by the Alaska District, USACE.

The cost estimate is based on conceptual level project quantity take-offs that have been calculated based on the assumptions and information documented in the previously referenced report. A quantity summary by reach is presented in Attachment 5. The MCACES cost estimate includes waste/loss factors for project materials as listed below:

Loose Soils	15%
Geotextiles	5%
Stone Waste/Loss	5%

5.2 Project Schedule

It is estimated that overall construction duration, from construction notice-to-proceed to completion, would take approximately 52 months to complete. However, only 24 months of the 52 total months are assumed to have construction occurring, which includes mobilization and demobilization. This is because barge delivery traffic travels to Barrow typically between the beginning of July and end of September. The schedule assumes some mobilization and demobilization efforts can be started and/or continue outside of this window. But the primary construction efforts are assumed to occur within the three-month window that the stone would be delivered in.

To fit construction within these windows, the project schedule has been separated into five phases. The first phase includes completing reaches 1 and 2. The subsequent phases assume completing one reach per construction period, which leads to a total of five phases for this project. A simplified, tentative construction schedule for this project is presented in Attachment 6.

5.3 Acquisition Plan

The estimate assumes one contract being awarded for the total project. It is assumed that the bidding process would be unrestricted. All contractor and project mark-ups have been adjusted accordingly in the cost estimate. The estimate also assumes that the Prime Contractor would be a large earthwork contractor capable of completing all the earthwork and rock placement. The estimate assumes a subcontractor for the archeological work.

5.4 Project Construction

Staging and Site Access

The cost estimate currently assumes no significant staging area would be constructed. Given the length of the project, minor staging areas where stone could be stockpiled would be constructed as the project progresses. Other equipment and materials could be stored here as well. Costs for preparing and maintaining staging and site access locations has been included in the estimate.

Borrow/Disposal Areas and Materials

Currently, all excess materials are assumed to become property of the contractor and would be required to be removed off-site. The estimate assumes excess earth would be hauled 20-miles one way for disposal.

The estimate also assumes all stone material would come from a quarry located in Nome, Alaska. Quotes for purchasing and obtaining the stone products have been obtained from the contractor currently operating the quarry. The estimate also includes the shipping of the material from Nome to Barrow. Several shipping contractors provided pricing information that was used as a basis for the price in the estimate. See Attachment 1 for a summary of discussions with these contractors.

Construction Methodology

The following is a brief discussion of assumptions made for the unit costs used in the MCACES estimates for both alternatives:

- Mobilization and Demobilization – Assumes mobilizing and demobilizing equipment to and from Anchorage for the five construction windows necessary to complete the work.
- Excavation – Unit cost assumes excavation to be completed with use of hydraulic excavators, and material would be stockpiled on-site prior to disposing.
- Hauling – Unit price assumes hauling with 12-cubic yard (cy) dump trucks to a local disposal site in Barrow. No tipping fee is assumed to be required as material would likely be able to be re-used for future projects in Barrow.
- Armor Rock, B-rock, Core Rock and Gravel – Unit prices assume all rock for the berms and revetments would be delivered to Barrow and off-loaded to shore from other locations in Alaska. The source of the rock would be from Nome, where the material would be loaded onto barges for delivery to Barrow. Other locations are possible but may require longer shipping distances and thus higher costs. The prices used in the current estimate are based on quotes provided by several contractors familiar with the Nome quarry and with shipping of construction materials throughout Alaska.
- Filter Fabric – Unit price assumes placement of filter fabric at designated locations.
- Local Material – Unit price assumes the gravel pit in Barrow has sufficient material to provide as local fill. This material would be delivered by truck to the placement location, placed and then compacted.
- Road Access (LSF) – Unit price assumes purchase of local material from the Barrow gravel pit that would be placed to create beach access over the berms or revetments. The material would be delivered by truck to the placement location, placed and compacted.
- On-Site Archaeologist – Due to the significant cultural resources that are found throughout Barrow, it is assumed that an archaeologist would be on-site for the duration of construction.

Unusual Conditions (Soil, Water, Weather, Traffic)

Possible cold temperatures, working near ocean shore, and significant materials shipped through arctic waters.

Unique Construction Techniques

None anticipated.

Equipment/Labor Availability and Distance Traveled

All equipment and labor should be available in the greater Alaska region, and is assumed to primarily come from Anchorage.

5.5 Effective Dates for Labor, Equipment and Material Pricing

The labor, equipment, and material pricing were developed using the MCACES 2016 English Unit Cost Library, 2018 Alaska Statewide Labor Library (see Attachment 7 for Davis Bacon Wage Rates), and the 2016 Equipment Library (Region IV) for the base cost estimates. The index pricing data has been prepared in January 2019 dollars.

The base cost estimates have been updated with current quoted fuel prices of $3.75/gal for off-road diesel, $3.38/gal for on-road diesel and $3.25 /gal for gasoline in the state of Alaska.

5.6 Estimated Production Rates

Much of the construction cost estimate was developed utilizing user defined crews and production rates. See Attachment 8 for the Estimated Production Rates developed for this estimate.

5.7 Project Markups

Escalation

Price levels have been escalated from effective price levels of the construction cost estimate for January 2019 (2Q19) to the mid-points of construction for the project. The appropriate escalation cost factors for each date and for each feature account have been calculated within the Total Project Cost Summary (TPCS).

Contingency

A Cost and Schedule Risk Analysis (CSRA) was completed in order to develop the contingency for the TSP MCACES cost estimate. The CSRA report, documenting the development of the risk-based contingency, is provided in Attachment 9.

Sales Tax

A 7.75% sales tax markups has been used on the purchase of materials for the construction of both alternatives. However, it should be noted that the quotes provided on the rock included sales tax, and therefore the sales tax has been removed from the MCAES for those items to avoid double counting.

Overtime

The estimate assumes that crews would be working 6-days per week and 12-hours per day in order to complete construction within the available work windows.

5.8 Functional Costs

Functional costs associated with this work were estimated as follows:

01 Account – Lands and Damages

Costs for this account have been estimated by the USACE Alaska District. The cost includes all lands as well as relocations required for this project.

02 Account – Relocations

See 01 Account discussion.

16 Account – Bank Stabilization

Costs for this account have been estimated within the MCACES construction cost estimate, and include the primary construction features of the project.

30 Account – Planning, Engineering and Design

Costs for this account were estimated at 10% of construction costs. This account covers the preparation of plans, specifications, and engineering during construction.

31 Account – Construction Management

Costs for this account were estimated to be 6% of construction costs. This account covers construction management during the construction phase.

5.9 MCACES Construction Cost Estimate

The construction cost estimate was developed using MCACES 2nd Generation (MII) estimating software in accordance with guidance contained in ER 1110-2-1302, Civil Works Cost Engineering. See Attachment 10 for the MII output report.

5.10 Total Project Cost Summary (TPCS)

The TPCS was prepared using the latest TPCS Excel spreadsheet provided by the USACE, Walla Walla District. The TPCS incorporates the construction costs developed in MCACES, the project markups and functional costs referenced previously. Per guidance from the District, the summary sheet only provides the Federal costs of the project. The local sponsor facility (LSF), which are the road access sites, are included on the third page of the TPCS for reference. See Attachment 11 for the TPCS spreadsheet.

6.0 SOURCES

Engineer Regulation 1110-1-1300, Engineering and Design Cost Engineering Policy and General Requirements; U.S. Army Corps of Engineers; Dated 26 March 1993.

Engineer Regulation 1110-2-1150, Engineering and Design for Civil Works Projects; U.S. Army Corps of Engineers; Dated 31 August 1999.

Engineer Regulation 1110-2-1302, Civil Works Cost Engineering; U.S. Army Corps of Engineers; Dated 15 September 2008.

Engineer Manual 1110-2-1304; Civil Works Construction Cost Index System (CWCCIS); U.S. Army Corps of Engineers; Dated 30 September 2008.

Engineering Technical Letter 1110-2-573, Construction Cost Estimating Guide for Civil Works; U.S. Army Corps of Engineers; Dated 31 August 1999.

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ATTACHMENT 1 – ALTERNATIVE ESTIMATE BACK-UP INFORMATION

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ALTERNATIVE QUANTITY SUMMARY BY REACH

Item Description	UOM	Revetment +19.0ft MLLW					
		Reach 1	Reach 2	Reach 3	Reach 4	Reach 5	Reach 6
Excavation	CY	51,114	-	-	-	-	-
Hauling	CY	58,781	-	-	-	-	-
B-rock Rock	CY	16,319	-	-	-	-	-
Armor Rock	CY	21,402	-	-	-	-	-
Core Rock	CY	5,423	-	-	-	-	-
Gravel	CY	5,761	-	-	-	-	-
Filter Fabric	SY	16,290	-	-	-	-	-
Local material	CY	1,148	-	-	-	-	-

Item Description	UOM	Revetment +14.5ft MLLW					
		Reach 1	Reach 2	Reach 3	Reach 4	Reach 5	Reach 6
Excavation	CY	-	33,843	-	-	-	-
Hauling	CY	-	38,919	-	-	-	-
B-rock Rock	CY	-	13,808	-	-	-	-
Armor Rock	CY	-	16,938	-	-	-	-
Core Rock	CY	-	4,667	-	-	-	-
Gravel	CY	-	4,981	-	-	-	-
Filter Fabric	SY	-	14,175	-	-	-	-
Local material	CY	-	4,127	-	-	-	-

Item Description	UOM	Berm +14.5ft MLLW					
		Reach 1	Reach 2	Reach 3	Reach 4	Reach 5	Reach 6
Excavation	CY	-	-	83,739	148,726	339,883	244,086
Hauling	CY	-	-	96,299	171,034	390,865	280,699
B-rock Rock	CY	-	-	29,289	42,603	93,173	60,265
Armor Rock	CY	-	-	31,002	45,096	99,135	64,237
Core Rock	CY	-	-	7,020	10,212	22,352	14,460
Gravel	CY	-	-	7,487	10,890	23,905	15,514
Filter Fabric	SY	-	-	22,253	32,371	71,069	46,231

Item Description	UOM	Raised Road +14.5ft MLLW					
		Reach 1	Reach 2	Reach 3	Reach 4	Reach 5	Reach 6
Excavation	CY	-	-	-	82,061	192,883	141,510
Hauling	CY	-	-	-	94,370	221,816	162,737
B-rock Rock	CY	-	-	-	27,251	59,942	38,828
Armor Rock	CY	-	-	-	30,151	66,319	42,959
Core Rock	CY	-	-	-	9,434	20,752	13,442
Gravel	CY	-	-	-	10,167	22,364	14,486
Filter Fabric	SY	-	-	-	29,082	63,969	41,490
Local material	CY	-	-	-	28,805	69,481	29,285

Item Description	UOM	Other Construction					
		Reach 1	Reach 2	Reach 3	Reach 4	Reach 5	Reach 6
Beach Nourishment	CY	238,013	284,258	374,805	357,246	689,112	232,004
Fill Tasigarook Lagoon	CY	-	-	250,000	-	-	-
Road Access - Local Material	CY	-	-	-	3,530	2,118	4,942

Material Costs

Grayed out notes indicate that information remains outstanding

- Nome Quarry | Larry Pedersen, Bering Straits Native Corporation
  - By material, in consideration of typical rock specs:
    - Armor: $113/ton base cost
    - B rock: $88/ton
    - Core: $68/ton
    - Gravel: $28/ton
  - Add $12/ton for trucking to Nome dock (do not add for loading at quarry)
  - Can apply approx. 20% savings due to job size efficiencies. With savings:
    - Armor: $90.40 /ton
    - B rock: $70.40 /ton
    - Core: $54.40 /ton
    - Gravel: $22.40 /ton

- Nome Quarry | Parry Rekers, Knik Construction (Lynden)
  - By material, all prices are cost delivered to Nome dock, and do not include any savings for job size/efficiency, and were provided without consideration of the rock spec.
    - Armor: $130 /ton
    - B rock: $115 /ton
    - Core: $75 /ton
    - Gravel: $15 /ton

- Bering Shai Rock and Gravel | Bill Shaishnikoff
  - Indicated that the quarry could provide all necessary material to Corps spec, though a job of this size would be very large compared to typical work
    - A - Rock. $41.00 per CY. Add $2.00 per CY to load onto barge
    - B - Rock. $38.00 per CY. Add 2.00 per CY to load on barge
    - Core - Rock. $34.00 per CY. Add $1.25 per CY to load on barge
    - 3 "- minus. $27.00 per CY. Add $1.00 per CY to add on barge
    - 1" - minus. $29.00 per CY. Add $1.00 to load on barge
  - The quarry has a barge ramp. The barge fee applies when a barge with a drop gate is in use. Presently the quarry cannot side load a barge as the mooring piling have not yet been installed. If they are not installed at the time this project is out to bid, then the quarry would have to truck the products to a dock that has that capability, which has been done in the past.

Material Transport Costs

Grayed out notes indicate that information remains outstanding

- UIC Marine | Don Gray
  - $60-65 per ton, given:
    - Assume barges moving to/from Nome quarry
    - Barges may originate in Puget Sound and carry up initial load of rock
    - Includes lighterage to shore at Barrow; excludes offload/trucking onshore
    - No contingencies included
    - Assumes 3 seasons

- Cook Inlet Tug & Barge (Foss) | Mike O'Shea
  - *Consistent with UIC Marine estimate with contingencies removed…*
  - $85 per ton, given:
    - Assume barges moving to/from Nome quarry
    - Barges may originate in Puget Sound and carry up initial load of rock
    - Excludes loading/offload of barges and any lighterage (assumes barges can pull up to shore for load/unload)
    - Cost includes 25% contingency and placeholder assumptions for delays
    - 3 seasons to complete

- Bowhead Transport | Billy Jarrett
  - $80 per ton including loading/offload at Nome/Barrow
    - Awaiting clarifying information about assumed contingencies

- Bryce Marine | Drew McIntyre
  - $73 – 81 per ton ROM cost, given all rock from Nome:
    - Between 3-yr and 4-yr completion timeline, multiple barges
    - $44M for 600,000 tons
    - Assumes $5/gal fuel
    - Excluded unloading
  - $110 per ton ROM cost, given all rock from Bering Shai (Dutch Harbor)
    - Between 3-yr and 4-yr completion timeline, multiple barges
    - $44M for 600,000 tons
    - Assumes $5/gal fuel
    - Excluded unloading

- Lynden via UIC Marine | Don Gray
  - _____ per ton using large 250,000 ton ship out of Vancouver BC
    - Awaiting data. Don Gray is talking with a contact at Lynden. Initial conversations with them indicated that it might be economical to use one large ship that could move all necessary material in 3 trips to Barrow in one season.

Abbreviated Risk Analysis

Project (less than $40M): **Barrow Coastal Erosion** **Alternative: N/A**

Project Development Stage/Alternative: **Feasibility (Alternatives)**

Risk Category: **Moderate Risk: Typical Project Construction Type** **Meeting Date: 5/9/2018**

Total Estimated Construction Contract Cost = **$ 9,000,000**

	CWWBS	Feature of Work	Estimated Cost		% Contingency	$ Contingency	Total
	01 LANDS AND DAMAGES	Real Estate	$ -		0.0%	$ -	$ -
1	16 BANK STABILIZATION	Mob, Demob and Site Prep.	$ 1,000,000		38.2%	$ 382,276	$ 1,382,276
2	16 BANK STABILIZATION	19 ft Revetment	$ 1,000,000		48.4%	$ 483,637	$ 1,483,637
3	16 BANK STABILIZATION	14 ft Revetment	$ 1,000,000		48.4%	$ 483,637	$ 1,483,637
4	16 BANK STABILIZATION	14 ft Berm	$ 1,000,000		48.4%	$ 483,637	$ 1,483,637
5	16 BANK STABILIZATION	14 ft Raise Stevenson Street	$ 1,000,000		48.4%	$ 483,637	$ 1,483,637
6					0.0%	$ -	$ -
7					0.0%	$ -	$ -
8	18 CULTURAL RESOURCE PRESERVATION	Cultural Resource and Historic Structures	$ 1,000,000		42.3%	$ 422,611	$ 1,422,611.29
9	02 RELOCATIONS	Building Relocations and Imrovements	$ 1,000,000		40.3%	$ 403,374	$ 1,403,374.20
10			$ -		0.0%	$ -	$ -
11			$ -		0.0%	$ -	$ -
12	All Other	Remaining Construction Items	$ 2,000,000	*28.6%*	12.0%	$ 240,000	$ 2,240,000
13	30 PLANNING, ENGINEERING, AND DESIGN	Planning, Engineering, & Design	$ 1,000,000		38.5%	$ 384,960	$ 1,384,960
14	31 CONSTRUCTION MANAGEMENT	Construction Management	$ 1,000,000		38.5%	$ 384,960	$ 1,384,960
XX	FIXED DOLLAR RISK ADD (EQUALLY DISPERSED TO ALL, MUST INCLUDE JUSTIFICATION SEE BELOW)					$ -	

Totals					
Real Estate	$ -	0.0%	$ -	$ -	
Total Construction Estimate	$ 9,000,000	37.6%	$ 3,382,811	$ 12,382,811	
Total Planning, Engineering & Design	$ 1,000,000	38.5%	$ 384,960	$ 1,384,960	
Total Construction Management	$ 1,000,000	38.5%	$ 384,960	$ 1,384,960	
Total Excluding Real Estate	**$ 11,000,000**	**37.8%**	**$ 4,152,731**	**$ 15,152,731**	
			Base	**50%**	**80%**
Confidence Level Range Estimate ($000's)			$11,000k	$13,492k	$15,153k

* 50% based on base is at 5% CL.

Fixed Dollar Risk Add: (Allows for additional risk to be added to the risk analsyis. Must include justification. Does not allocate to Real Estate.	

Barrow Coastal Erosion N/A

Feasibility (Alternatives)
Abbreviated Risk Analysis
Meeting Date: 9-May-18

Risk Level

	Negligible	Marginal	Moderate	Significant	Critical
Very Likely	2	3	4	5	5
Likely	1	2	3	4	5
Possible	0	1	2	3	4
Unlikely	0	0	1	2	3

Risk Register

Risk Element	Feature of Work	Concerns	PDT Discussions & Conclusions (Include logic & justification for choice of Likelihood & Impact)	Impact	Likelihood	Risk Level
Project Management & Scope Growth				**Maximum Project Growth**		**75%**
PS-1	Mob, Demob and Site Prep.	Alternative estimates based on conceptual level designs; Investigations and studies remain to be completed;	Alternatives are based on limited data and are conceptual alternatives for comparison. Many studies remain outstanding that could change the designs. But this is unlikely to occur, and overall cost impacts would be moderate as the current assumptions cover the primary cost drivers of any potential alternatives.	Marginal	Possible	1
PS-2	19 ft Revetment	See concerns listed above.	See discussion above.	Moderate	Unlikely	1
PS-3	14 ft Revetment	See concerns listed above.	See discussion above.	Moderate	Unlikely	1
PS-4	14 ft Berm	See concerns listed above.	See discussion above.	Moderate	Unlikely	1
PS-5	14 ft Raise Stevenson Street	See concerns listed above.	See discussion above.	Moderate	Unlikely	1
PS-6						
PS-7						
PS-8	Cultural Resource and Historic Structures	See concerns listed above.	See discussion above.	Moderate	Unlikely	1
PS-9	Building Relocations and Imrovements	See concerns listed above.	See discussion above.	Moderate	Unlikely	1
PS-10	0			Negligible	Unlikely	0
PS-11	0			Negligible	Unlikely	0
PS-12	Remaining Construction Items			Negligible	Unlikely	0
PS-13	Planning, Engineering, & Design	See concerns listed above.	See discussion above.	Marginal	Possible	1
PS-14	Construction Management	See concerns listed above.	See discussion above.	Marginal	Possible	1

Acquisition Strategy				Maximum Project Growth		30%
AS-1	Mob, Demob and Site Prep.	No contracting plan has been established; Accelerated schedules could be possibility; Harsh weather may be encountered; Could be limited bid competition given location;	Given the location of the project there could be limited contractors capable of completing work. Also the location can provide problems given the potential weather situations both in Barrow, and in the seas where the contractor would be transporting significant quantities of materials. Given the potential for these issues, it is possible that the costs of the alternatives could be impacted, and significant cost impacts would be felt if these risks occured.	Significant	Possible	3
AS-2	19 ft Revetment	See concerns listed above.	See discussion above.	Significant	Possible	3
AS-3	14 ft Revetment	See concerns listed above.	See discussion above.	Significant	Possible	3
AS-4	14 ft Berm	See concerns listed above.	See discussion above.	Significant	Possible	3
AS-5	14 ft Raise Stevenson Street	See concerns listed above.	See discussion above.	Significant	Possible	3
AS-6						
AS-7						
AS-8	Cultural Resource and Historic Structures	See concerns listed above.	See discussion above.	Significant	Possible	3
AS-9	Building Relocations and Imrovements	See concerns listed above.	See discussion above.	Significant	Possible	3
AS-10	0			Negligible	Unlikely	0
AS-11	0			Negligible	Unlikely	0
AS-12	Remaining Construction Items			Negligible	Unlikely	0
AS-13	Planning, Engineering, & Design	See concerns listed above.	See discussion above.	Significant	Possible	3
AS-14	Construction Management	See concerns listed above.	See discussion above.	Significant	Possible	3

Construction Elements				Maximum Project Growth		25%
CE-1	Mob, Demob and Site Prep.	Phased schedule and harsh weather conditions; near water construction; no dewatering or diversion included;	All work for this item considered to be constructed in the dry with no dewatering or diversion efforts required. May be small chance of dewatering efforts would be required, but would likely be limited efforts.	Moderate	Unlikely	1
CE-2	19 ft Revetment	See concerns listed above.	All work for this item considered to be constructed in the dry with no dewatering or diversion efforts required. May be small chance of dewatering efforts would be required, but would likely be limited efforts.	Moderate	Unlikely	1
CE-3	14 ft Revetment	See concerns listed above.	All work for this item considered to be constructed in the dry with no dewatering or diversion efforts required. May be small chance of dewatering efforts would be required, but would likely be limited efforts.	Moderate	Unlikely	1
CE-4	14 ft Berm	See concerns listed above.	All work for this item considered to be constructed in the dry with no dewatering or diversion efforts required. May be small chance of dewatering efforts would be required, but would likely be limited efforts.	Moderate	Unlikely	1
CE-5	14 ft Raise Stevenson Street	See concerns listed above.	All work for this item considered to be constructed in the dry with no dewatering or diversion efforts required. May be small chance of dewatering efforts would be required, but would likely be limited efforts.	Moderate	Unlikely	1
CE-6						
CE-7						
CE-8	Cultural Resource and Historic Structures	See concerns listed above.	No significant risks anticipated for this item.	Moderate	Unlikely	1
CE-9	Building Relocations and Imrovements	See concerns listed above.	No significant risks anticipated for this item.	Moderate	Unlikely	1
CE-10	0			Negligible	Unlikely	0
CE-11	0			Negligible	Unlikely	0
CE-12	Remaining Construction Items			Negligible	Unlikely	0
CE-13	Planning, Engineering, & Design	See concerns listed above.		Moderate	Unlikely	1
CE-14	Construction Management	See concerns listed above.		Moderate	Unlikely	1

Specialty Construction or Fabrication				Maximum Project Growth		65%
SC-1	Mob, Demob and Site Prep.	None anticipated.	No significant risks anticipated for this item.	Negligible	Unlikely	0
SC-2	19 ft Revetment	Purchase and transportation of rock and fill materials.	Contractor will likely have experience in obtaining and transporting materials throughout Alaska. But given the large quantities of rock/fill to be barged in, there is still a risk of delays due to availability and/or transport issues.	Moderate	Unlikely	1
SC-3	14 ft Revetment	Purchase and transportation of rock and fill materials.	Contractor will likely have experience in obtaining and transporting materials throughout Alaska. But given the large quantities of rock/fill to be barged in, there is still a risk of delays due to availability and/or transport issues.	Moderate	Unlikely	1
SC-4	14 ft Berm	Purchase and transportation of rock and fill materials.	Contractor will likely have experience in obtaining and transporting materials throughout Alaska. But given the large quantities of rock/fill to be barged in, there is still a risk of delays due to availability and/or transport issues.	Moderate	Unlikely	1
SC-5	14 ft Raise Stevenson Street	Purchase and transportation of rock and fill materials.	Contractor will likely have experience in obtaining and transporting materials throughout Alaska. But given the large quantities of rock/fill to be barged in, there is still a risk of delays due to availability and/or transport issues.	Moderate	Unlikely	1
SC-6						
SC-7						
SC-8	Cultural Resource and Historic Structures	None anticipated.	No significant risks anticipated for this item.	Negligible	Unlikely	0
SC-9	Building Relocations and Imrovements	None anticipated.	No significant risks anticipated for this item.	Negligible	Unlikely	0
SC-10	0			Negligible	Unlikely	0
SC-11	0			Negligible	Unlikely	0
SC-12	Remaining Construction Items			Negligible	Unlikely	0
SC-13	Planning, Engineering, & Design	Purchase and transportation of rock and fill materials.	PED costs could be impacted based on efforts required to find suitable materials required for the project.	Moderate	Unlikely	1
SC-14	Construction Management	Purchase and transportation of rock and fill materials.	CM costs could be impacted based on delays in obtaining and/or transporting all necessary materials to Barrow.	Moderate	Unlikely	1

Technical Design & Quantities				Maximum Project Growth		30%
T-1	Mob, Demob and Site Prep.	Low level of design; Further investigations required to provide more accurate quantities;	Potential quantity changes would not significantly impact mob/demob, and therefore this would have low impact.	Moderate	Unlikely	1
T-2	19 ft Revetment	Low level of design; Further investigations required to provide more accurate quantities;	Earthwork and rock quantities are based on conceptual level information. Typical sections were used which could potential change in future design phases. Any changes to these typical sections would likely have significant impacts to the overal quantities, and thus impact costs significantly as well.	Significant	Possible	3
T-3	14 ft Revetment	Low level of design; Further investigations required to provide more accurate quantities;	Earthwork and rock quantities are based on conceptual level information. Typical sections were used which could potential change in future design phases. Any changes to these typical sections would likely have significant impacts to the overal quantities, and thus impact costs significantly as well.	Significant	Possible	3
T-4	14 ft Berm	Low level of design; Further investigations required to provide more accurate quantities;	Earthwork and rock quantities are based on conceptual level information. Typical sections were used which could potential change in future design phases. Any changes to these typical sections would likely have significant impacts to the overal quantities, and thus impact costs significantly as well.	Significant	Possible	3
T-5	14 ft Raise Stevenson Street	Low level of design; Further investigations required to provide more accurate quantities;	Earthwork and rock quantities are based on conceptual level information. Typical sections were used which could potential change in future design phases. Any changes to these typical sections would likely have significant impacts to the overal quantities, and thus impact costs significantly as well.	Significant	Possible	3
T-6						
T-7						
T-8	Cultural Resource and Historic Structures	Number of historic structures in project area;	Further analysis is required to fully determine the exact number of historic structures that need to be relocated during construction. The current assumption may change, but overall impact is not anticipated to be significant.	Moderate	Possible	2
T-9	Building Relocations and Imrovements	Number of buildings requiring relocation;	Further analysis is required to fully determine the exact number of structures that need to be relocated during construction. The current assumption may change, but overall impact is not anticipated to be significant.	Moderate	Unlikely	1
T-10	0			Negligible	Unlikely	0
T-11	0			Negligible	Unlikely	0
T-12	Remaining Construction Items			Negligible	Unlikely	0
T-13	Planning, Engineering, & Design	Low level of design; Further investigations required to provide more accurate quantities;	Potential quantity changes would not significantly impact PED, and therefore this would have low impact.	Moderate	Unlikely	1
T-14	Construction Management	Low level of design; Further investigations required to provide more accurate quantities;	Potential quantity changes would not significantly impact CM, and therefore this would have low impact.	Moderate	Unlikely	1

Cost Estimate Assumptions				Maximum Project Growth		35%
EST-1	Mob, Demob and Site Prep.	Mob/demob assumed percentage	Mob/demob is currently assumed to be 10%. Based on scale of projects this percentage likely covers all of a contractors mob and demob needs. However there is a possibility of contractor requiring more mob/demob efforts given the location of the project, the delivery needs (rock/fill), and other issues.	Moderate	Unlikely	1
EST-2	19 ft Revetment	Price quotes for rock and borrow fill materials;	The main cost drivers of each alternative is the rock and fill materials. Depending on availability and location of the source for these materials, the potential unit cost could vary widely. A conservative approach has been incorporated to account for this, but there still could be a cost increase if different sources are used in the future. This could result in longer barge routes, increased purchase prices, etc.	Moderate	Possible	2
EST-3	14 ft Revetment	Price quotes for rock and borrow fill materials;	The main cost drivers of each alternative is the rock and fill materials. Depending on availability and location of the source for these materials, the potential unit cost could vary widely. A conservative approach has been incorporated to account for this, but there still could be a cost increase if different sources are used in the future. This could result in longer barge routes, increased purchase prices, etc.	Moderate	Possible	2
EST-4	14 ft Berm	Price quotes for rock and borrow fill materials;	The main cost drivers of each alternative is the rock and fill materials. Depending on availability and location of the source for these materials, the potential unit cost could vary widely. A conservative approach has been incorporated to account for this, but there still could be a cost increase if different sources are used in the future. This could result in longer barge routes, increased purchase prices, etc.	Moderate	Possible	2
EST-5	14 ft Raise Stevenson Street	Price quotes for rock and borrow fill materials;	The main cost drivers of each alternative is the rock and fill materials. Depending on availability and location of the source for these materials, the potential unit cost could vary widely. A conservative approach has been incorporated to account for this, but there still could be a cost increase if different sources are used in the future. This could result in longer barge routes, increased purchase prices, etc.	Moderate	Possible	2
EST-6						
EST-7						
EST-8	Cultural Resource and Historic Structures	Assumptions used for historic structure relocations	Assumptions are based on best available information, and have the possibility of increasing based on more information regarding relocation efforts.	Moderate	Possible	2

EST-9	Building Relocations and Imrovements	Assumptions used for building relocations	Assumptions are based on best available information, and have the possibility of increasing based on more information regarding relocation efforts.	Moderate	Possible	2
EST-10	0			Negligible	Unlikely	0
EST-11	0			Negligible	Unlikely	0
EST-12	Remaining Construction Items			Negligible	Unlikely	0
EST-13	Planning, Engineering, & Design	PED percentage	Based on scale of projects, current PED percentage likely covers the PED costs needed for this project. Therefore no risk of cost increase.	Marginal	Unlikely	0
EST-14	Construction Management	CM percentage	Based on scale of projects, current CM percentage likely covers the CM costs needed for this project. Therefore no risk of cost increase.	Marginal	Unlikely	0

External Project Risks				Maximum Project Growth		40%
EX-1	Mob, Demob and Site Prep.	Potential harsh weather events; Lack of political support; unanticipated inflations in key borrow materials (rock/fill);	There are limited windows to complete construction due to the climate in Barrow. Therefore any significant weather events could impact the schedule and increase costs. The alternatives may have difficulty being implemented due to the overall scale and total costs. Also, any unanticipated inflations in rock and fill materials could significantly impact costs of a potential project.	Significant	Unlikely	2
EX-2	19 ft Revetment	See concerns listed above.	See discussion above.	Significant	Unlikely	2
EX-3	14 ft Revetment	See concerns listed above.	See discussion above.	Significant	Unlikely	2
EX-4	14 ft Berm	See concerns listed above.	See discussion above.	Significant	Unlikely	2
EX-5	14 ft Raise Stevenson Street	See concerns listed above.	See discussion above.	Significant	Unlikely	2
EX-6						
EX-7						
EX-8	Cultural Resource and Historic Structures	See concerns listed above.	See discussion above.	Significant	Unlikely	2
EX-9	Building Relocations and Imrovements	See concerns listed above.	See discussion above.	Significant	Unlikely	2
EX-10	0			Negligible	Unlikely	0
EX-11	0			Negligible	Unlikely	0
EX-12	Remaining Construction Items			Negligible	Unlikely	0
EX-13	Planning, Engineering, & Design	See concerns listed above.	See discussion above.	Moderate	Possible	2
EX-14	Construction Management	See concerns listed above.	See discussion above.	Moderate	Possible	2

Barrow Coastal Erosion N/A
Feasibility (Alternatives)
Abbreviated Risk Analysis

Risk Evaluation

WBS	Potential Risk Areas	Project Management & Scope Growth	Acquisition Strategy	Construction Elements	Specialty Construction or Fabrication	Technical Design & Quantities	Cost Estimate Assumptions	External Project Risks	Cost in Thousands
01 LANDS AND DAMAGES	**Real Estate**								$0
16 BANK STABILIZATION	**Mob, Demob and Site Prep.**	**1**	**3**	**1**	**0**	**1**	**1**	**2**	$1,000
16 BANK STABILIZATION	19 ft Revetment	**1**	**3**	**1**	**1**	**3**	**2**	**2**	$1,000
16 BANK STABILIZATION	14 ft Revetment	**1**	**3**	**1**	**1**	**3**	**2**	**2**	$1,000
16 BANK STABILIZATION	14 ft Berm	**1**	**3**	**1**	**1**	**3**	**2**	**2**	$1,000
16 BANK STABILIZATION	14 ft Raise Stevenson Street	**1**	**3**	**1**	**1**	**3**	**2**	**2**	$1,000
0	0	**0**	**0**	**0**	**0**	**0**	**0**	**0**	$0
0	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	$0
18 CULTURAL RESOURCE PRESERVATION	**Cultural Resource and Historic Structures**	**1**	**3**	**1**	**0**	**2**	**2**	**2**	$1,000
02 RELOCATIONS	**Building Relocations and Imrovements**	**1**	**3**	**1**	**0**	**1**	**2**	**2**	$1,000
0	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	$0
0	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	$0
All Other	Remaining Construction Items	**0**	**0**	**0**	**0**	**0**	**0**	**0**	$2,000
30 PLANNING, ENGINEERING, AND DESIGN	Planning, Engineering, & Design	**1**	**3**	**1**	**1**	**1**	**0**	**2**	$1,000
31 CONSTRUCTION MANAGEMENT	Construction Management	**1**	**3**	**1**	**1**	**1**	**0**	**2**	$1,000
									$11,000
Risk		$ 213	$ 1,771	$ 941	$ 138	$ 426	$ 269	$ 394	**$4,153**
Fixed Dollar Risk Allocation		$ -	$ -	$ -	$ -	$ -	$ -	$ -	**$0**
	Risk	$ 213	$ 1,771	$ 941	$ 138	$ 426	$ 269	$ 394	**$4,153**
								Total	**$15,153**

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ATTACHMENT 2 – ALTERNATIVE COST ESTIMATE TABLES

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BARROW COASTAL EROSION COST ESTIMATE

ALTERNATIVE SUMMARY

Alternative	Quantity	UOM	First Cost	Contingency	Total Cost
Alternative 2	1	LS	$ 204,140,000	46.2%	$ 298,030,000
Alternative 5A	1	LS	$ 82,388,000	46.8%	$ 121,575,000
Alternative 5B	1	LS	$ 144,822,000	46.5%	$ 213,850,000
Alternative 5C	1	LS	$ 189,164,000	46.4%	$ 279,566,000
Alternative 5D	1	LS	$ 263,975,000	46.7%	$ 390,716,000
Alternative 6A	1	LS	$ 323,474,000	46.6%	$ 478,370,000
Alternative 6B	1	LS	$ 462,715,000	47.0%	$ 684,466,000
Alternative 6C	1	LS	$ 637,064,000	47.6%	$ 944,066,000

Alternative	Quantity	UOM	PV O&M	Annual O&M
Alternative 2	1	YR	$ 45,643,000	$ 1,732,000
Alternative 5A	1	YR	$ 11,587,000	$ 440,000
Alternative 5B	1	YR	$ 26,523,000	$ 1,006,000
Alternative 5C	1	YR	$ 35,858,000	$ 1,361,000
Alternative 5D	1	YR	$ 68,517,000	$ 2,600,000
Alternative 6A	1	YR	$ 48,726,000	$ 1,849,000
Alternative 6B	1	YR	$ 35,858,000	$ 1,361,000
Alternative 6C	1	YR	$ 605,000	$ 22,000

BARROW COASTAL EROSION COST ESTIMATE

CONTINGENCY CALCULATIONS

Alternative 2A

Item Description	Contingency		Alternative 2A	
			Costs	Contingency
Mob, Demob and Site Prep.	38.23%		$ 15,627,000	$ 5,975,000
19 ft Revetment	48.36%		$ 14,232,000	$ 6,883,000
14 ft Revetment	48.36%		$ 11,603,000	$ 5,612,000
14 ft Berm	48.36%		$ 22,790,000	$ 11,022,000
14 ft Raise Stevenson Street	48.36%		$ 107,640,000	$ 52,055,000
Fill Lagoon	50.08%		$ -	$ -
Beach Nourishment	50.08%		$ -	$ -
Cultural Resource and Historic Structures	42.26%		$ 300,000	$ 127,000
Relocations	40.34%		$ 1,200,000	$ 485,000
Planning, Engineering, & Design	38.50%		$ 17,339,000	$ 6,676,000
Construction Management	38.50%		$ 10,404,000	$ 4,006,000
Totals:			$ 201,135,000	$ 92,841,000
Total Alternative Contingency:			46.2%	

Alternative 2B

Item Description	Contingency		Alternative 2B	
			Costs	Contingency
Mob, Demob and Site Prep.	38.23%		$ 15,609,000	$ 5,968,000
19 ft Revetment	48.36%		$ 14,235,000	$ 6,885,000
14 ft Revetment	48.36%		$ 11,605,000	$ 5,613,000
14 ft Berm	48.36%		$ -	$ -
14 ft Raise Stevenson Street	48.36%		$ 130,111,000	$ 62,922,000
Fill Lagoon	50.08%		$ -	$ -
Beach Nourishment	50.08%		$ -	$ -
Cultural Resource and Historic Structures	42.26%		$ 135,000	$ 58,000
Relocations	40.34%		$ 1,200,000	$ 485,000
Planning, Engineering, & Design	38.50%		$ 17,290,000	$ 6,657,000
Construction Management	38.50%		$ 10,374,000	$ 3,994,000
Totals:			$ 200,559,000	$ 92,582,000
Total Alternative Contingency:			46.2%	

Alternative 5A

Item Description	Contingency		Alternative 5A	
			Costs	Contingency
Mob, Demob and Site Prep.	38.23%		$ 6,457,000	$ 2,469,000
19 ft Revetment	48.36%		$ -	$ -
14 ft Revetment	48.36%		$ 11,651,000	$ 5,635,000
14 ft Berm	48.36%		$ 22,795,000	$ 11,024,000
14 ft Raise Stevenson Street	48.36%		$ -	$ -
Fill Lagoon	50.08%		$ 30,000,000	$ 15,024,000
Beach Nourishment	50.08%		$ -	$ -
Cultural Resource and Historic Structures	42.26%		$ 120,000	$ 51,000
Relocations	40.34%		$ -	$ -
Planning, Engineering, & Design	38.50%		$ 7,103,000	$ 2,735,000
Construction Management	38.50%		$ 4,262,000	$ 1,641,000
Totals:			$ 82,388,000	$ 38,579,000
Total Alternative Contingency:			46.8%	

BARROW COASTAL EROSION COST ESTIMATE

CONTINGENCY CALCULATIONS

Alternative 5B

Item Description	Contingency		Alternative 5B	
			Costs	Contingency
Mob, Demob and Site Prep.	38.23%		$ 11,241,000	$ 4,298,000
19 ft Revetment	48.36%		$ 14,235,000	$ 6,885,000
14 ft Revetment	48.36%		$ 11,605,000	$ 5,613,000
14 ft Berm	48.36%		$ 56,355,000	$ 27,254,000
14 ft Raise Stevenson Street	48.36%		$ -	$ -
Fill Lagoon	50.08%		$ 30,000,000	$ 15,024,000
Beach Nourishment	50.08%		$ -	$ -
Cultural Resource and Historic Structures	42.26%		$ 210,000	$ 89,000
Relocations	40.34%		$ 1,200,000	$ 485,000
Planning, Engineering, & Design	38.50%		$ 12,485,000	$ 4,807,000
Construction Management	38.50%		$ 7,491,000	$ 2,885,000
Totals:			$ 144,822,000	$ 67,340,000
Total Alternative Contingency:			46.5%	

Alternative 5C

Item Description	Contingency		Alternative 5C	
			Costs	Contingency
Mob, Demob and Site Prep.	38.23%		$ 14,691,000	$ 5,617,000
19 ft Revetment	48.36%		$ 14,235,000	$ 6,885,000
14 ft Revetment	48.36%		$ 11,605,000	$ 5,613,000
14 ft Berm	48.36%		$ 56,355,000	$ 27,254,000
14 ft Raise Stevenson Street	48.36%		$ 34,591,000	$ 16,729,000
Fill Lagoon	50.08%		$ 30,000,000	$ 15,024,000
Beach Nourishment	50.08%		$ -	$ -
Cultural Resource and Historic Structures	42.26%		$ 270,000	$ 115,000
Relocations	40.34%		$ 1,200,000	$ 485,000
Planning, Engineering, & Design	38.50%		$ 16,308,000	$ 6,279,000
Construction Management	38.50%		$ 9,785,000	$ 3,768,000
Totals:			$ 189,040,000	$ 87,769,000
Total Alternative Contingency:			46.4%	

Alternative 5D

Item Description	Contingency		Alternative 5D	
			Costs	Contingency
Mob, Demob and Site Prep.	38.23%		$ 20,579,000	$ 7,868,000
19 ft Revetment	48.36%		$ 14,235,000	$ 6,885,000
14 ft Revetment	48.36%		$ 11,605,000	$ 5,613,000
14 ft Berm	48.36%		$ 56,355,000	$ 27,254,000
14 ft Raise Stevenson Street	48.36%		$ 34,591,000	$ 16,729,000
Fill Lagoon	50.08%		$ 30,000,000	$ 15,024,000
Beach Nourishment	50.08%		$ 58,575,000	$ 29,335,000
Cultural Resource and Historic Structures	42.26%		$ 300,000	$ 127,000
Relocations	40.34%		$ 1,200,000	$ 485,000
Planning, Engineering, & Design	38.50%		$ 22,757,000	$ 8,762,000
Construction Management	38.50%		$ 13,654,000	$ 5,257,000
Totals:			$ 263,851,000	$ 123,339,000
Total Alternative Contingency:			46.7%	

BARROW COASTAL EROSION COST ESTIMATE

CONTINGENCY CALCULATIONS

Alternative 6A

Item Description	Contingency		Alternative 6A	
			Costs	Contingency
Mob, Demob and Site Prep.	38.23%		$ 25,242,000	$ 9,651,000
19 ft Revetment	48.36%		$ 14,235,000	$ 6,885,000
14 ft Revetment	48.36%		$ 11,605,000	$ 5,613,000
14 ft Berm	48.36%		$ 56,510,000	$ 27,329,000
14 ft Raise Stevenson Street	48.36%		$ 83,715,000	$ 40,485,000
Fill Lagoon	50.08%		$ -	$ -
Beach Nourishment	50.08%		$ 86,019,000	$ 43,079,000
Cultural Resource and Historic Structures	42.26%		$ 330,000	$ 140,000
Relocations	40.34%		$ 1,200,000	$ 485,000
Planning, Engineering, & Design	38.50%		$ 27,886,000	$ 10,737,000
Construction Management	38.50%		$ 16,732,000	$ 6,442,000
Totals:			$ 323,474,000	$ 150,846,000
Total Alternative Contingency:			46.6%	

Alternative 6B

Item Description	Contingency		Alternative 6B	
			Costs	Contingency
Mob, Demob and Site Prep.	38.23%		$ 36,154,000	$ 13,822,000
19 ft Revetment	48.36%		$ 14,235,000	$ 6,885,000
14 ft Revetment	48.36%		$ 11,605,000	$ 5,613,000
14 ft Berm	48.36%		$ 56,355,000	$ 27,254,000
14 ft Raise Stevenson Street	48.36%		$ 34,591,000	$ 16,729,000
Fill Lagoon	50.08%		$ -	$ -
Beach Nourishment	50.08%		$ 244,172,000	$ 122,282,000
Cultural Resource and Historic Structures	42.26%		$ 135,000	$ 58,000
Relocations	40.34%		$ 1,200,000	$ 485,000
Planning, Engineering, & Design	38.50%		$ 39,890,000	$ 15,358,000
Construction Management	38.50%		$ 23,934,000	$ 9,215,000
Totals:			$ 462,271,000	$ 217,701,000
Total Alternative Contingency:			47.1%	

Alternative 6C

Item Description	Contingency		Alternative 6C	
			Costs	Contingency
Mob, Demob and Site Prep.	38.23%		$ 49,927,000	$ 19,088,000
19 ft Revetment	48.36%		$ -	$ -
14 ft Revetment	48.36%		$ -	$ -
14 ft Berm	48.36%		$ -	$ -
14 ft Raise Stevenson Street	48.36%		$ -	$ -
Fill Lagoon	50.08%		$ -	$ -
Beach Nourishment	50.08%		$ 499,265,000	$ 250,032,000
Cultural Resource and Historic Structures	42.26%		$ -	$ -
Relocations	40.34%		$ -	$ -
Planning, Engineering, & Design	38.50%		$ 54,920,000	$ 21,145,000
Construction Management	38.50%		$ 32,952,000	$ 12,687,000
Totals:			$ 637,064,000	$ 302,952,000
Total Alternative Contingency:			47.6%	

BARROW COASTAL EROSION COST ESTIMATE

ALTERNATIVE 2A

Date: 2-Jan-19

WBS No.	FEATURE ACCOUNT / ITEM DESCRIPTION	UOM	QUANTITY	UNIT COST	TOTAL COST
02	**Relocations**				
02.1	Structure Raise and/or Relocation	EA	6	$ 200,000.00	$ 1,200,000
16	**Bank Stabilization**				
16.1	Mob, Demob. and Site Prepation	LS	1	$ 15,627,000	$ 15,627,000
	Revetment +19.0ft MLLW				
16.2	Excavation	CY	51,114	$ 6.00	$ 307,000
16.3	Hauling	CY	58,781	$ 12.00	$ 705,000
16.4	B-rock Rock	CY	16,319	$ 260.00	$ 4,243,000
16.5	Armor Rock	CY	21,402	$ 330.00	$ 7,063,000
16.6	Core Rock	CY	5,423	$ 205.00	$ 1,112,000
16.7	Gravel	CY	5,761	$ 120.00	$ 691,000
16.8	Filter Fabric	YD^2	16,290	$ 4.00	$ 65,000
16.9	Local material	CY	1,148	$ 40.00	$ 46,000
	Revetment +14.5ft MLLW				
16.11	Excavation	CY	31,765	$ 6.00	$ 191,000
16.12	Hauling	CY	36,529	$ 12.00	$ 438,000
16.13	B-rock Rock	CY	13,807	$ 260.00	$ 3,590,000
16.14	Armor Rock	CY	16,937	$ 330.00	$ 5,589,000
16.15	Core Rock	CY	4,666	$ 205.00	$ 957,000
16.16	Gravel	CY	4,981	$ 120.00	$ 598,000
16.17	Filter Fabric	YD^2	14,174	$ 4.00	$ 57,000
16.18	Local material	CY	4,570	$ 40.00	$ 183,000
	Berm +14.5ft MLLW				
16.19	Excavation	CY	71,530	$ 6.00	$ 429,000
16.20	Hauling	CY	82,259	$ 12.00	$ 987,000
16.21	B-rock Rock	CY	30,887	$ 260.00	$ 8,031,000
16.22	Armor Rock	CY	32,694	$ 330.00	$ 10,789,000
16.23	Core Rock	CY	7,404	$ 205.00	$ 1,518,000
16.24	Gravel	CY	7,895	$ 120.00	$ 947,000
16.25	Filter Fabric	YD^2	22,253	$ 4.00	$ 89,000
	Raised Road +14.5ft MLLW				
16.27	Excavation	CY	398,864	$ 6.00	$ 2,393,000
16.28	Hauling	CY	458,694	$ 12.00	$ 5,504,000
16.29	B-rock Rock	CY	126,971	$ 260.00	$ 33,012,000
16.30	Armor Rock	CY	140,262	$ 330.00	$ 46,286,000
16.31	Core Rock	CY	43,963	$ 205.00	$ 9,012,000
16.32	Gravel	CY	47,396	$ 120.00	$ 5,688,000
16.33	Filter Fabric	YD^2	135,635	$ 4.00	$ 543,000
16.34	Local material	CY	120,943	$ 40.00	$ 4,838,000
16.35	Road Access - Local Material	CY	9,091	$ 40.00	$ 364,000
17	**Beach Replenishment**				
18.17	Not Applicable in this Alternative				
18	**Cultural Resources**				
18.1	On-Site Archaeologist	MO	20	$ 15,000.00	$ 300,000
				Sub-Total (1):	*$ 173,392,000*

30	Planning, Engineering and Design - 10.0% of Sub-Total (2)	$ 17,339,000
31	Construction Management - 6.0% of Sub-Total (2)	$ 10,404,000
	Sub-Total (2):	*$ 201,135,000*

	Contingency - 46.2% of Sub-Total (2)	$ 92,841,000
	Sub-Total (3):	*$ 293,976,000*

	Real Estate Costs	ACR	-	$ -	$ 3,000,000
	Real Estate Contingency - 35.0% of Real Estate Costs				$ 1,050,000
				Total Real Estate Costs:	*$ 4,050,000*

	Total Alternative Costs	**$ 298,026,000**

OPTION 2A - ANNUAL O&M COSTS

ITEM NO.	DESCRIPTION	UOM	QUANTITY	VALUE
1.	Annual Maintenance and Inspections	LS	1	$ 25,000
2.	Revetment +19.0ft MLLW (every 5-years)	LS	1	$ 984,000
3.	Revetment +14.5ft MLLW (every 5-years)	LS	1	$ 806,000
4.	Berm +14.5ft MLLW (every 5-years)	LS	1	$ 1,597,000
5.	Raised Road +14.5ft MLLW (every 5-years)	LS	1	$ 7,050,000

Alternative:	2A
Work Windows:	3.8
Construction Cost:	$ 173,392,000
Contingency:	46.2%
Total Construction:	$ 253,427,000
Discount Rate:	2.875%

Present Value Construction:	$ 230,117,000
Net Present Value O&M:	$ 45,643,000
Average Annual O&M:	$ 1,732,000

Count	Year	O&M Yr.	Construction	O&M	PV Factor	PV Construction	PV O&M
0	2018	-	$ -	$ -	1.000	$ -	$ -
1	2019	-	$ -	$ -	0.972	$ -	$ -
2	2020	-	$ 66,691,000	$ -	0.945	$ 63,016,000	$ -
3	2021	-	$ 66,691,000	$ -	0.918	$ 61,254,000	$ -
4	2022	-	$ 66,691,000	$ -	0.893	$ 59,543,000	$ -
5	2023	-	$ 53,354,000	$ -	0.868	$ 46,304,000	$ -
6	2023	1	$ -	$ 25,000	0.844	$ -	$ 21,100
7	2024	2	$ -	$ 25,000	0.820	$ -	$ 20,500
8	2025	3	$ -	$ 25,000	0.797	$ -	$ 19,900
9	2026	4	$ -	$ 25,000	0.775	$ -	$ 19,400
10	2027	5	$ -	$ 10,462,000	0.753	$ -	$ 7,879,800
11	2028	6	$ -	$ 25,000	0.732	$ -	$ 18,300
12	2029	7	$ -	$ 25,000	0.712	$ -	$ 17,800
13	2030	8	$ -	$ 25,000	0.692	$ -	$ 17,300
14	2031	9	$ -	$ 25,000	0.672	$ -	$ 16,800
15	2032	10	$ -	$ 10,462,000	0.654	$ -	$ 6,838,600
16	2033	11	$ -	$ 25,000	0.635	$ -	$ 15,900
17	2034	12	$ -	$ 25,000	0.618	$ -	$ 15,400
18	2035	13	$ -	$ 25,000	0.600	$ -	$ 15,000
19	2036	14	$ -	$ 25,000	0.584	$ -	$ 14,600
20	2037	15	$ -	$ 10,462,000	0.567	$ -	$ 5,935,000
21	2038	16	$ -	$ 25,000	0.551	$ -	$ 13,800
22	2039	17	$ -	$ 25,000	0.536	$ -	$ 13,400
23	2040	18	$ -	$ 25,000	0.521	$ -	$ 13,000
24	2041	19	$ -	$ 25,000	0.506	$ -	$ 12,700
25	2042	20	$ -	$ 10,462,000	0.492	$ -	$ 5,150,700
26	2043	21	$ -	$ 25,000	0.479	$ -	$ 12,000
27	2044	22	$ -	$ 25,000	0.465	$ -	$ 11,600
28	2045	23	$ -	$ 25,000	0.452	$ -	$ 11,300
29	2046	24	$ -	$ 25,000	0.440	$ -	$ 11,000
30	2047	25	$ -	$ 10,462,000	0.427	$ -	$ 4,470,100
31	2048	26	$ -	$ 25,000	0.415	$ -	$ 10,400
32	2049	27	$ -	$ 25,000	0.404	$ -	$ 10,100
33	2050	28	$ -	$ 25,000	0.392	$ -	$ 9,800
34	2051	29	$ -	$ 25,000	0.381	$ -	$ 9,500
35	2052	30	$ -	$ 10,462,000	0.371	$ -	$ 3,879,400
36	2053	31	$ -	$ 25,000	0.360	$ -	$ 9,000
37	2054	32	$ -	$ 25,000	0.350	$ -	$ 8,800
38	2055	33	$ -	$ 25,000	0.341	$ -	$ 8,500
39	2056	34	$ -	$ 25,000	0.331	$ -	$ 8,300
40	2057	35	$ -	$ 10,462,000	0.322	$ -	$ 3,366,800
41	2058	36	$ -	$ 25,000	0.313	$ -	$ 7,800
42	2059	37	$ -	$ 25,000	0.304	$ -	$ 7,600
43	2060	38	$ -	$ 25,000	0.296	$ -	$ 7,400
44	2061	39	$ -	$ 25,000	0.287	$ -	$ 7,200
45	2062	40	$ -	$ 10,462,000	0.279	$ -	$ 2,921,900
46	2063	41	$ -	$ 25,000	0.271	$ -	$ 6,800
47	2064	42	$ -	$ 25,000	0.264	$ -	$ 6,600
48	2065	43	$ -	$ 25,000	0.257	$ -	$ 6,400
49	2066	44	$ -	$ 25,000	0.249	$ -	$ 6,200
50	2067	45	$ -	$ 10,462,000	0.242	$ -	$ 2,535,800
51	2068	46	$ -	$ 25,000	0.236	$ -	$ 5,900
52	2069	47	$ -	$ 25,000	0.229	$ -	$ 5,700
53	2070	48	$ -	$ 25,000	0.223	$ -	$ 5,600
54	2071	49	$ -	$ 25,000	0.216	$ -	$ 5,400
55	2072	50	$ -	$ 10,462,000	0.210	$ -	$ 2,200,800

BARROW COASTAL EROSION COST ESTIMATE

ALTERNATIVE 5A

Date: 2-Jan-19

WBS No.	DESCRIPTION	UOM	QUANTITY	UNIT COST	TOTAL COST
02	**Relocation**				
02.1	Structure Raise and/or Relocation	EA	-	$ 200,000.00	$ -
16	**Bank Stabilization**				
16.1	Mob, Demob. and Site Prepation	LS	1.0	$ 6,457,000	$ 6,457,000
	Revetment +14.5ft MLLW				
16.2	Excavation	CY	31,765	$ 6.00	$ 191,000
16.3	Hauling	CY	36,529	$ 12.00	$ 439,000
16.4	B-rock Rock	CY	13,807	$ 260.00	$ 3,590,000
16.5	Armor Rock	CY	16,937	$ 330.00	$ 5,590,000
16.6	Core Rock	CY	4,666	$ 205.00	$ 957,000
16.7	Gravel	CY	4,981	$ 120.00	$ 598,000
16.8	Filter Fabric	YD^2	14,174	$ 4.00	$ 57,000
16.9	Local material	CY	4,570	$ 50.00	$ 229,000
	Berm +14.5ft MLLW				
16.10	Excavation	CY	71,530	$ 6.00	$ 430,000
16.11	Hauling	CY	82,259	$ 12.00	$ 988,000
16.12	B-rock Rock	CY	30,887	$ 260.00	$ 8,031,000
16.13	Armor Rock	CY	32,694	$ 330.00	$ 10,790,000
16.14	Core Rock	CY	7,404	$ 205.00	$ 1,518,000
16.15	Gravel	CY	7,895	$ 120.00	$ 948,000
16.16	Filter Fabric	YD^2	22,253	$ 4.00	$ 90,000
	Fill Lagoon				
16.17	Local Material	CY	250,000	$ 120.00	$ 30,000,000
17	**Beach Replenishment**				
17.1	Not Applicable in this Alternative				
18	**Cultural Resources**				
18.1	On-Site Archaeologist	MO	8	$ 15,000.00	$ 120,000
				Sub-Total (1):	*$ 71,023,000*

30	Planning, Engineering and Design - 10.0% of Sub-Total (2)	$ 7,103,000
31	Construction Management - 6.0% of Sub-Total (2)	$ 4,262,000
	Sub-Total (3):	*$ 82,388,000*

	Estimating and Construction Contingency - 46.8% of Sub-Total (3)	$ 38,579,000
	Sub-Total (4):	*$ 120,967,000*

	Real Estate Costs	ACR	-	$ -	$ 450,000
	Real Estate Contingency - 35.0% of Real Estate Costs				$ 158,000
				Total Real Estate Costs:	*$ 608,000*

	Total Alternative Costs	**$ 121,575,000**

OPTION 5A - ANNUAL O&M COSTS

ITEM NO.	DESCRIPTION	UOM	QUANTITY	VALUE
1.	Annual Maintenance and Inspections	LS	1	$ 25,000
2.	Revetment +19.0ft MLLW (every 5-years)	LS	1	$ -
3.	Revetment +14.5ft MLLW (every 5-years)	LS	1	$ 806,000
4.	Berm +14.5ft MLLW (every 5-years)	LS	1	$ 1,597,000
5.	Raised Road +14.5ft MLLW (every 5-years)	LS	1	$ -

Alternative:	5A
Work Windows:	1.5
Construction Cost:	$ 71,023,000
Contingency:	47%
Total Construction:	$ 104,280,000
Discount Rate:	2.875%

Present Value Construction:	$ 97,615,000
Net Present Value O&M:	$ 11,587,000
Average Annual O&M:	$ 440,000

Count	Year	O&M Yr.	Construction	O&M	PV Factor	PV Construction	PV O&M
0	2018	-	$ -	$ -	1.000	$ -	$ -
1	2019	-	$ -	$ -	0.972	$ -	$ -
2	2020	-	$ 69,520,000	$ -	0.945	$ 65,689,000	$ -
3	2021	-	$ 34,760,000	$ -	0.918	$ 31,926,000	$ -
4	2022	1	$ -	$ 25,000	0.893	$ -	$ 22,300
5	2023	2	$ -	$ 25,000	0.868	$ -	$ 21,700
6	2024	3	$ -	$ 25,000	0.844	$ -	$ 21,100
7	2025	4	$ -	$ 25,000	0.820	$ -	$ 20,500
8	2026	5	$ -	$ 2,428,000	0.797	$ -	$ 1,935,400
9	2027	6	$ -	$ 25,000	0.775	$ -	$ 19,400
10	2028	7	$ -	$ 25,000	0.753	$ -	$ 18,800
11	2029	8	$ -	$ 25,000	0.732	$ -	$ 18,300
12	2030	9	$ -	$ 25,000	0.712	$ -	$ 17,800
13	2031	10	$ -	$ 2,428,000	0.692	$ -	$ 1,679,700
14	2032	11	$ -	$ 25,000	0.672	$ -	$ 16,800
15	2033	12	$ -	$ 25,000	0.654	$ -	$ 16,300
16	2034	13	$ -	$ 25,000	0.635	$ -	$ 15,900
17	2035	14	$ -	$ 25,000	0.618	$ -	$ 15,400
18	2036	15	$ -	$ 2,428,000	0.600	$ -	$ 1,457,700
19	2037	16	$ -	$ 25,000	0.584	$ -	$ 14,600
20	2038	17	$ -	$ 25,000	0.567	$ -	$ 14,200
21	2039	18	$ -	$ 25,000	0.551	$ -	$ 13,800
22	2040	19	$ -	$ 25,000	0.536	$ -	$ 13,400
23	2041	20	$ -	$ 2,428,000	0.521	$ -	$ 1,265,100
24	2042	21	$ -	$ 25,000	0.506	$ -	$ 12,700
25	2043	22	$ -	$ 25,000	0.492	$ -	$ 12,300
26	2044	23	$ -	$ 25,000	0.479	$ -	$ 12,000
27	2045	24	$ -	$ 25,000	0.465	$ -	$ 11,600
28	2046	25	$ -	$ 2,428,000	0.452	$ -	$ 1,097,900
29	2047	26	$ -	$ 25,000	0.440	$ -	$ 11,000
30	2048	27	$ -	$ 25,000	0.427	$ -	$ 10,700
31	2049	28	$ -	$ 25,000	0.415	$ -	$ 10,400
32	2050	29	$ -	$ 25,000	0.404	$ -	$ 10,100
33	2051	30	$ -	$ 2,428,000	0.392	$ -	$ 952,800
34	2052	31	$ -	$ 25,000	0.381	$ -	$ 9,500
35	2053	32	$ -	$ 25,000	0.371	$ -	$ 9,300
36	2054	33	$ -	$ 25,000	0.360	$ -	$ 9,000
37	2055	34	$ -	$ 25,000	0.350	$ -	$ 8,800
38	2056	35	$ -	$ 2,428,000	0.341	$ -	$ 826,900
39	2057	36	$ -	$ 25,000	0.331	$ -	$ 8,300
40	2058	37	$ -	$ 25,000	0.322	$ -	$ 8,000
41	2059	38	$ -	$ 25,000	0.313	$ -	$ 7,800
42	2060	39	$ -	$ 25,000	0.304	$ -	$ 7,600
43	2061	40	$ -	$ 2,428,000	0.296	$ -	$ 717,700
44	2062	41	$ -	$ 25,000	0.287	$ -	$ 7,200
45	2063	42	$ -	$ 25,000	0.279	$ -	$ 7,000
46	2064	43	$ -	$ 25,000	0.271	$ -	$ 6,800
47	2065	44	$ -	$ 25,000	0.264	$ -	$ 6,600
48	2066	45	$ -	$ 2,428,000	0.257	$ -	$ 622,800
49	2067	46	$ -	$ 25,000	0.249	$ -	$ 6,200
50	2068	47	$ -	$ 25,000	0.242	$ -	$ 6,100
51	2069	48	$ -	$ 25,000	0.236	$ -	$ 5,900
52	2070	49	$ -	$ 25,000	0.229	$ -	$ 5,700
53	2071	50	$ -	$ 2,428,000	0.223	$ -	$ 540,500

BARROW COASTAL EROSION COST ESTIMATE

ALTERNATIVE 5B

Date: 2-Jan-19

ITEM NO.	DESCRIPTION	UOM	QUANTITY	UNIT COST	TOTAL COST
02	**Relocations**				
02.1	Structure Raise and/or Relocation	EA	6	$ 200,000.00	$ 1,200,000
16	**Bank Stabilization**				
16.1	Mob, Demob. and Site Prepation	LS	1.0	$ 11,241,000	$ 11,241,000
	Revetment +19.0ft MLLW				
16.2	Excavation	CY	51,114	$ 6.00	$ 307,000
16.3	Hauling	CY	58,781	$ 12.00	$ 706,000
16.4	B-rock Rock	CY	16,319	$ 260.00	$ 4,243,000
16.5	Armor Rock	CY	21,402	$ 330.00	$ 7,063,000
16.6	Core Rock	CY	5,423	$ 205.00	$ 1,112,000
16.7	Gravel	CY	5,761	$ 120.00	$ 692,000
16.8	Filter Fabric	YD^2	16,290	$ 4.00	$ 66,000
16.9	Local material	CY	1,148	$ 40.00	$ 46,000
	Revetment +14.5ft MLLW				
16.10	Excavation	CY	31,765	$ 6.00	$ 191,000
16.11	Hauling	CY	36,529	$ 12.00	$ 439,000
16.12	B-rock Rock	CY	13,807	$ 260.00	$ 3,590,000
16.13	Armor Rock	CY	16,937	$ 330.00	$ 5,590,000
16.14	Core Rock	CY	4,666	$ 205.00	$ 957,000
16.15	Gravel	CY	4,981	$ 120.00	$ 598,000
16.16	Filter Fabric	YD^2	14,174	$ 4.00	$ 57,000
16.17	Local material	CY	4,570	$ 40.00	$ 183,000
	Berm +14.5ft MLLW				
16.18	Excavation	CY	221,394	$ 6.00	$ 1,329,000
16.19	Hauling	CY	254,603	$ 12.00	$ 3,056,000
16.20	B-rock Rock	CY	75,087	$ 260.00	$ 19,523,000
16.21	Armor Rock	CY	79,480	$ 330.00	$ 26,229,000
16.22	Core Rock	CY	17,998	$ 205.00	$ 3,690,000
16.23	Gravel	CY	19,193	$ 120.00	$ 2,304,000
16.24	Filter Fabric	YD^2	55,836	$ 4.00	$ 224,000
	Fill Lagoon				
16.25	Local Material	CY	250,000	$ 120.00	$ 30,000,000
17	**Beach Replenishment**				
17.1	Not Applicable in this Alternative				
18	**Cultural Resources**				
18.1	On-Site Archaeologist	MO	14	$ 15,000.00	$ 210,000
				Sub-Total (1):	*$ 124,846,000*

30	Planning, Engineering and Design - 10.0% of Sub-Total (2)	$ 12,485,000
31	Construction Management - 6.0% of Sub-Total (2)	$ 7,491,000
	Sub-Total (3):	*$ 144,822,000*

	Estimating and Construction Contingency - 46.5% of Sub-Total (3)	$ 67,340,000
	Sub-Total (4):	*$ 212,162,000*

	Real Estate Costs	ACR	-	$ -	$ 1,350,000
	Real Estate Contingency - 25.0% of Real Estate Costs				$ 338,000
				Total Real Estate Costs:	*$ 1,688,000*

	Total Alternative Costs	**$ 213,850,000**

OPTION 5B - ANNUAL O&M COSTS

ITEM NO.	DESCRIPTION	UOM	QUANTITY	VALUE	YEARLY COST
1.	Annual Maintenance and Inspections	LS	1		$ 25,000
2.	Revetment +19.0ft MLLW (every 5-years)	LS	1		$ 984,000
3.	Revetment +14.5ft MLLW (every 5-years)	LS	1		$ 806,000
4.	Berm +14.5ft MLLW (every 5-years)	LS	1		$ 3,881,000
5.	Raised Road +14.5ft MLLW (every 5-years)	LS	1		$ -

Alternative:	5B
Work Windows:	2
Construction Cost:	$ 71,023,000
Contingency:	47%
Total Construction:	$ 104,280,000
Discount Rate:	2.875%

Present Value Construction:	$ 97,156,000
Net Present Value O&M:	$ 26,523,000
Average Annual O&M:	$ 1,006,000

Count	Year	O&M Yr.	Construction	O&M	PV Factor	PV Construction	PV O&M
0	2018	-	$ -	$ -	1.000	$ -	$ -
1	2019	-	$ -	$ -	0.972	$ -	$ -
2	2020	-	$ 52,140,000	$ -	0.945	$ 49,266,000	$ -
3	2021	-	$ 52,140,000	$ -	0.918	$ 47,890,000	$ -
4	2022	1	$ -	$ 25,000	0.893	$ -	$ 22,300
5	2023	2	$ -	$ 25,000	0.868	$ -	$ 21,700
6	2024	3	$ -	$ 25,000	0.844	$ -	$ 21,100
7	2025	4	$ -	$ 25,000	0.820	$ -	$ 20,500
8	2026	5	$ -	$ 5,696,000	0.797	$ -	$ 4,540,400
9	2027	6	$ -	$ 25,000	0.775	$ -	$ 19,400
10	2028	7	$ -	$ 25,000	0.753	$ -	$ 18,800
11	2029	8	$ -	$ 25,000	0.732	$ -	$ 18,300
12	2030	9	$ -	$ 25,000	0.712	$ -	$ 17,800
13	2031	10	$ -	$ 5,696,000	0.692	$ -	$ 3,940,400
14	2032	11	$ -	$ 25,000	0.672	$ -	$ 16,800
15	2033	12	$ -	$ 25,000	0.654	$ -	$ 16,300
16	2034	13	$ -	$ 25,000	0.635	$ -	$ 15,900
17	2035	14	$ -	$ 25,000	0.618	$ -	$ 15,400
18	2036	15	$ -	$ 5,696,000	0.600	$ -	$ 3,419,700
19	2037	16	$ -	$ 25,000	0.584	$ -	$ 14,600
20	2038	17	$ -	$ 25,000	0.567	$ -	$ 14,200
21	2039	18	$ -	$ 25,000	0.551	$ -	$ 13,800
22	2040	19	$ -	$ 25,000	0.536	$ -	$ 13,400
23	2041	20	$ -	$ 5,696,000	0.521	$ -	$ 2,967,900
24	2042	21	$ -	$ 25,000	0.506	$ -	$ 12,700
25	2043	22	$ -	$ 25,000	0.492	$ -	$ 12,300
26	2044	23	$ -	$ 25,000	0.479	$ -	$ 12,000
27	2045	24	$ -	$ 25,000	0.465	$ -	$ 11,600
28	2046	25	$ -	$ 5,696,000	0.452	$ -	$ 2,575,700
29	2047	26	$ -	$ 25,000	0.440	$ -	$ 11,000
30	2048	27	$ -	$ 25,000	0.427	$ -	$ 10,700
31	2049	28	$ -	$ 25,000	0.415	$ -	$ 10,400
32	2050	29	$ -	$ 25,000	0.404	$ -	$ 10,100
33	2051	30	$ -	$ 5,696,000	0.392	$ -	$ 2,235,300
34	2052	31	$ -	$ 25,000	0.381	$ -	$ 9,500
35	2053	32	$ -	$ 25,000	0.371	$ -	$ 9,300
36	2054	33	$ -	$ 25,000	0.360	$ -	$ 9,000
37	2055	34	$ -	$ 25,000	0.350	$ -	$ 8,800
38	2056	35	$ -	$ 5,696,000	0.341	$ -	$ 1,940,000
39	2057	36	$ -	$ 25,000	0.331	$ -	$ 8,300
40	2058	37	$ -	$ 25,000	0.322	$ -	$ 8,000
41	2059	38	$ -	$ 25,000	0.313	$ -	$ 7,800
42	2060	39	$ -	$ 25,000	0.304	$ -	$ 7,600
43	2061	40	$ -	$ 5,696,000	0.296	$ -	$ 1,683,600
44	2062	41	$ -	$ 25,000	0.287	$ -	$ 7,200
45	2063	42	$ -	$ 25,000	0.279	$ -	$ 7,000
46	2064	43	$ -	$ 25,000	0.271	$ -	$ 6,800
47	2065	44	$ -	$ 25,000	0.264	$ -	$ 6,600
48	2066	45	$ -	$ 5,696,000	0.257	$ -	$ 1,461,200
49	2067	46	$ -	$ 25,000	0.249	$ -	$ 6,200
50	2068	47	$ -	$ 25,000	0.242	$ -	$ 6,100
51	2069	48	$ -	$ 25,000	0.236	$ -	$ 5,900
52	2070	49	$ -	$ 25,000	0.229	$ -	$ 5,700
53	2071	50	$ -	$ 5,696,000	0.223	$ -	$ 1,268,100

BARROW COASTAL EROSION COST ESTIMATE

ALTERNATIVE 5C

Date: 2-Jan-19

ITEM NO.	DESCRIPTION	UOM	QUANTITY	UNIT COST	TOTAL COST
02	**Relocations**				
02.1	Structure Raise and/or Relocation	EA	6	$ 200,000.00	$ 1,200,000
16	**Bank Stabilization**				
16.1	Mob, Demob. and Site Prepation	LS	1.0	$ 14,691,000	$ 14,691,000
	Revetment +19.0ft MLLW				
16.2	Excavation	CY	51,114	$ 6.00	$ 307,000
16.3	Hauling	CY	58,781	$ 12.00	$ 706,000
16.4	B-rock Rock	CY	16,319	$ 260.00	$ 4,243,000
16.5	Armor Rock	CY	21,402	$ 330.00	$ 7,063,000
16.6	Core Rock	CY	5,423	$ 205.00	$ 1,112,000
16.7	Gravel	CY	5,761	$ 120.00	$ 692,000
16.8	Filter Fabric	YD^2	16,290	$ 4.00	$ 66,000
16.9	Local material	CY	1,148	$ 40.00	$ 46,000
	Revetment +14.5ft MLLW				
16.10	Excavation	CY	31,765	$ 6.00	$ 191,000
16.11	Hauling	CY	36,529	$ 12.00	$ 439,000
16.12	B-rock Rock	CY	13,807	$ 260.00	$ 3,590,000
16.13	Armor Rock	CY	16,937	$ 330.00	$ 5,590,000
16.14	Core Rock	CY	4,666	$ 205.00	$ 957,000
16.15	Gravel	CY	4,981	$ 120.00	$ 598,000
16.16	Filter Fabric	YD^2	14,174	$ 4.00	$ 57,000
16.17	Local material	CY	4,570	$ 40.00	$ 183,000
	Berm +14.5ft MLLW				
16.18	Excavation	CY	221,394	$ 6.00	$ 1,329,000
16.19	Hauling	CY	254,603	$ 12.00	$ 3,056,000
16.20	B-rock Rock	CY	75,087	$ 260.00	$ 19,523,000
16.21	Armor Rock	CY	79,480	$ 330.00	$ 26,229,000
16.22	Core Rock	CY	17,998	$ 205.00	$ 3,690,000
16.23	Gravel	CY	19,193	$ 120.00	$ 2,304,000
16.24	Filter Fabric	YD^2	55,836	$ 4.00	$ 224,000
	Raised Road +14.5ft MLLW				
16.25	Excavation	CY	148,073	$ 6.00	$ 889,000
16.26	Hauling	CY	170,284	$ 12.00	$ 2,044,000
16.27	B-rock Rock	CY	40,860	$ 260.00	$ 10,624,000
16.28	Armor Rock	CY	45,072	$ 330.00	$ 14,874,000
16.29	Core Rock	CY	14,148	$ 205.00	$ 2,901,000
16.30	Gravel	CY	15,247	$ 120.00	$ 1,830,000
16.31	Filter Fabric	YD^2	43,671	$ 4.00	$ 175,000
16.32	Local Material	CY	31,338	$ 40.00	$ 1,254,000
16.33	Road Access - Local Material	CY	3,100	$ 40.00	$ 124,000
	Fill Lagoon				
16.34	Local Material	CY	250,000	$ 120.00	$ 30,000,000
17	**Beach Replenishment**				
17.1	Not applicable in this Alternative				
18	**Cultural Resources**				
18.1	On-Site Archaeologist	MO	18	$ 15,000.00	$ 270,000
				Sub-Total (1):	*$ 163,071,000*

35.	Planning, Engineering and Design - 10.0% of Sub-Total (2)	$ 16,308,000
36.	Construction Management - 6.0% of Sub-Total (2)	$ 9,785,000
	Sub-Total (3):	*$ 189,164,000*

37.	Estimating and Construction Contingency - 46.4% of Sub-Total (3)	$ 87,769,000
	Sub-Total (4):	*$ 276,933,000*

38.	Real Estate Costs	ACR	-	$ -	$ 1,950,000
39.	Real Estate Contingency - 35.0% of Real Estate Costs				$ 683,000
				Total Real Estate Costs:	*$ 2,633,000*

Total Alternative Costs	**$ 279,566,000**

OPTION 5C - ANNUAL O&M COSTS

ITEM NO.	DESCRIPTION	UOM	QUANTITY	VALUE	YEARLY COST
1.	Annual Maintenance and Inspections	LS	1	$	25,000
2.	Revetment +19.0ft MLLW (every 5-years)	LS	1	$	984,000
3.	Revetment +14.5ft MLLW (every 5-years)	LS	1	$	806,000
4.	Berm +14.5ft MLLW (every 5-years)	LS	1	$	3,881,000
5.	Raised Road +14.5ft MLLW (every 5-years)	LS	1	$	2,268,000

Alternative:	5C
Work Windows:	2.5
Construction Cost:	$ 163,071,000
Contingency:	46%
Total Construction:	$ 238,733,000
Discount Rate:	2.875%

Present Value Construction:	$ 220,568,000
Net Present Value O&M:	$ 35,858,000
Average Annual O&M:	$ 1,361,000

Count	Year	O&M Yr.	Construction	O&M	PV Factor	PV Construction	PV O&M
0	2018	-	$ -	$ -	1.000	$ -	$ -
1	2019	-	$ -	$ -	0.972	$ -	$ -
2	2020	-	$ 95,493,000	$ -	0.945	$ 90,230,000	$ -
3	2021	-	$ 95,493,000	$ -	0.918	$ 87,709,000	$ -
4	2022	-	$ 47,747,000	$ -	0.893	$ 42,629,000	$ -
5	2023	1	$ -	$ 25,000	0.868	$ -	$ 21,700
6	2024	2	$ -	$ 25,000	0.844	$ -	$ 21,100
7	2025	3	$ -	$ 25,000	0.820	$ -	$ 20,500
8	2026	4	$ -	$ 25,000	0.797	$ -	$ 19,900
9	2027	5	$ -	$ 7,964,000	0.775	$ -	$ 6,170,800
10	2028	6	$ -	$ 25,000	0.753	$ -	$ 18,800
11	2029	7	$ -	$ 25,000	0.732	$ -	$ 18,300
12	2030	8	$ -	$ 25,000	0.712	$ -	$ 17,800
13	2031	9	$ -	$ 25,000	0.692	$ -	$ 17,300
14	2032	10	$ -	$ 7,964,000	0.672	$ -	$ 5,355,400
15	2033	11	$ -	$ 25,000	0.654	$ -	$ 16,300
16	2034	12	$ -	$ 25,000	0.635	$ -	$ 15,900
17	2035	13	$ -	$ 25,000	0.618	$ -	$ 15,400
18	2036	14	$ -	$ 25,000	0.600	$ -	$ 15,000
19	2037	15	$ -	$ 7,964,000	0.584	$ -	$ 4,647,800
20	2038	16	$ -	$ 25,000	0.567	$ -	$ 14,200
21	2039	17	$ -	$ 25,000	0.551	$ -	$ 13,800
22	2040	18	$ -	$ 25,000	0.536	$ -	$ 13,400
23	2041	19	$ -	$ 25,000	0.521	$ -	$ 13,000
24	2042	20	$ -	$ 7,964,000	0.506	$ -	$ 4,033,600
25	2043	21	$ -	$ 25,000	0.492	$ -	$ 12,300
26	2044	22	$ -	$ 25,000	0.479	$ -	$ 12,000
27	2045	23	$ -	$ 25,000	0.465	$ -	$ 11,600
28	2046	24	$ -	$ 25,000	0.452	$ -	$ 11,300
29	2047	25	$ -	$ 7,964,000	0.440	$ -	$ 3,500,600
30	2048	26	$ -	$ 25,000	0.427	$ -	$ 10,700
31	2049	27	$ -	$ 25,000	0.415	$ -	$ 10,400
32	2050	28	$ -	$ 25,000	0.404	$ -	$ 10,100
33	2051	29	$ -	$ 25,000	0.392	$ -	$ 9,800
34	2052	30	$ -	$ 7,964,000	0.381	$ -	$ 3,038,100
35	2053	31	$ -	$ 25,000	0.371	$ -	$ 9,300
36	2054	32	$ -	$ 25,000	0.360	$ -	$ 9,000
37	2055	33	$ -	$ 25,000	0.350	$ -	$ 8,800
38	2056	34	$ -	$ 25,000	0.341	$ -	$ 8,500
39	2057	35	$ -	$ 7,964,000	0.331	$ -	$ 2,636,600
40	2058	36	$ -	$ 25,000	0.322	$ -	$ 8,000
41	2059	37	$ -	$ 25,000	0.313	$ -	$ 7,800
42	2060	38	$ -	$ 25,000	0.304	$ -	$ 7,600
43	2061	39	$ -	$ 25,000	0.296	$ -	$ 7,400
44	2062	40	$ -	$ 7,964,000	0.287	$ -	$ 2,288,200
45	2063	41	$ -	$ 25,000	0.279	$ -	$ 7,000
46	2064	42	$ -	$ 25,000	0.271	$ -	$ 6,800
47	2065	43	$ -	$ 25,000	0.264	$ -	$ 6,600
48	2066	44	$ -	$ 25,000	0.257	$ -	$ 6,400
49	2067	45	$ -	$ 7,964,000	0.249	$ -	$ 1,985,900
50	2068	46	$ -	$ 25,000	0.242	$ -	$ 6,100
51	2069	47	$ -	$ 25,000	0.236	$ -	$ 5,900
52	2070	48	$ -	$ 25,000	0.229	$ -	$ 5,700
53	2071	49	$ -	$ 25,000	0.223	$ -	$ 5,600
54	2072	50	$ -	$ 7,964,000	0.216	$ -	$ 1,723,500

BARROW COASTAL EROSION COST ESTIMATE

ALTERNATIVE 5D

Date: 2-Jan-19

ITEM NO.	DESCRIPTION	UOM	QUANTITY	UNIT COST	TOTAL COST
02	**Relocations**				
02.1	Structure Raise and/or Relocation	EA	6	$ 200,000.00	$ 1,200,000
16	**Bank Stabilization**				
16.1	Mob, Demob. and Site Prepation	LS	1.0	$ 20,579,000	$ 20,579,000
	Revetment +19.0ft MLLW				
16.2	Excavation	CY	51,114	$ 6.00	$ 307,000
16.3	Hauling	CY	58,781	$ 12.00	$ 706,000
16.4	B-rock Rock	CY	16,319	$ 260.00	$ 4,243,000
16.5	Armor Rock	CY	21,402	$ 330.00	$ 7,063,000
16.6	Core Rock	CY	5,423	$ 205.00	$ 1,112,000
16.7	Gravel	CY	5,761	$ 120.00	$ 692,000
16.8	Filter Fabric	YD^2	16,290	$ 4.00	$ 66,000
16.9	Local material	CY	1,148	$ 40.00	$ 46,000
	Revetment +14.5ft MLLW				
16.10	Excavation	CY	31,765	$ 6.00	$ 191,000
16.11	Hauling	CY	36,529	$ 12.00	$ 439,000
16.12	B-rock Rock	CY	13,807	$ 260.00	$ 3,590,000
16.13	Armor Rock	CY	16,937	$ 330.00	$ 5,590,000
16.14	Core Rock	CY	4,666	$ 205.00	$ 957,000
16.15	Gravel	CY	4,981	$ 120.00	$ 598,000
16.16	Filter Fabric	YD^2	14,174	$ 4.00	$ 57,000
16.17	Local material	CY	4,570	$ 40.00	$ 183,000
	Berm +14.5ft MLLW				
16.18	Excavation	CY	221,394	$ 6.00	$ 1,329,000
16.19	Hauling	CY	254,603	$ 12.00	$ 3,056,000
16.20	B-rock Rock	CY	75,087	$ 260.00	$ 19,523,000
16.21	Armor Rock	CY	79,480	$ 330.00	$ 26,229,000
16.22	Core Rock	CY	17,998	$ 205.00	$ 3,690,000
16.23	Gravel	CY	19,193	$ 120.00	$ 2,304,000
16.24	Filter Fabric	YD^2	55,836	$ 4.00	$ 224,000
	Raised Road +14.5ft MLLW				
16.25	Excavation	CY	148,073	$ 6.00	$ 889,000
16.26	Hauling	CY	170,284	$ 12.00	$ 2,044,000
16.27	B-rock Rock	CY	40,860	$ 260.00	$ 10,624,000
16.28	Armor Rock	CY	45,072	$ 330.00	$ 14,874,000
16.29	Core Rock	CY	14,148	$ 205.00	$ 2,901,000
16.30	Gravel	CY	15,247	$ 120.00	$ 1,830,000
16.31	Filter Fabric	YD^2	43,671	$ 4.00	$ 175,000
16.32	Local Material	CY	31,338	$ 40.00	$ 1,254,000
16.33	Road Access - Local Material	CY	3,100	$ 40.00	$ 124,000
	Fill Lagoon				
16.34	Local Material	CY	250,000	$ 120.00	$ 30,000,000
17	**Beach Replenishment**				
17.1	Beach Nourishment Material	CY	689,112	$ 85.00	$ 58,575,000
18	**Cultural Resources**				
18.1	On-Site Archaeologist	MO	20	$ 15,000.00	$ 300,000
				Sub-Total (1):	*$ 227,564,000*

30	Planning, Engineering and Design - 10.0% of Sub-Total (2)	$ 22,757,000
31	Construction Management - 6.0% of Sub-Total (2)	$ 13,654,000
	Sub-Total (3):	*$ 263,975,000*

	Estimating and Construction Contingency - 46.7% of Sub-Total (3)	$ 123,339,000
	Sub-Total (4):	*$ 387,314,000*

	Real Estate Costs	ACR	-	$ -	$ 2,520,000
	Real Estate Contingency - 35.0% of Real Estate Costs				$ 882,000
				Total Real Estate Costs:	*$ 3,402,000*

	Total Alternative Costs	**$ 390,716,000**

OPTION 5D - ANNUAL O&M COSTS

ITEM NO.	DESCRIPTION	UOM	QUANTITY	VALUE	YEARLY COST
1.	Annual Maintenance and Inspections	LS	1	$	25,000
2.	Revetment +19.0ft MLLW (every 5-years)	LS	1	$	984,000
3.	Revetment +14.5ft MLLW (every 5-years)	LS	1	$	806,000
4.	Berm +14.5ft MLLW (every 5-years)	LS	1	$	3,881,000
5.	Raised Road +14.5ft MLLW (every 5-years)	LS	1	$	2,268,000
6.	Beach Replenishment (every 25 years)	LS	1	$	49,789,000

Alternative:	5D
Work Windows:	3
Construction Cost:	$ 227,564,000
Contingency:	47%
Total Construction:	$ 333,890,000
Discount Rate:	2.875%

Present Value Construction:	$ 306,754,000
Net Present Value O&M:	$ 68,517,000
Average Annual O&M:	$ 2,600,000

Count	Year	O&M Yr.	Construction	O&M	PV Factor	PV Construction	PV O&M
0	2018	-	$ -	$ -	1.000	$ -	$ -
1	2019	-	$ -	$ -	0.972	$ -	$ -
2	2020	-	$ 111,297,000	$ -	0.945	$ 105,163,000	
3	2021	-	$ 111,297,000	$ -	0.918	$ 102,224,000	$ -
4	2022	-	$ 111,296,000	$ -	0.893	$ 99,367,000	$ -
5	2023	1	$ -	$ 25,000	0.868	$ -	$ 21,700
6	2024	2	$ -	$ 25,000	0.844	$ -	$ 21,100
7	2025	3	$ -	$ 25,000	0.820	$ -	$ 20,500
8	2026	4	$ -	$ 25,000	0.797	$ -	$ 19,900
9	2027	5	$ -	$ 7,964,000	0.775	$ -	$ 6,170,800
10	2028	6	$ -	$ 25,000	0.753	$ -	$ 18,800
11	2029	7	$ -	$ 25,000	0.732	$ -	$ 18,300
12	2030	8	$ -	$ 25,000	0.712	$ -	$ 17,800
13	2031	9	$ -	$ 25,000	0.692	$ -	$ 17,300
14	2032	10	$ -	$ 7,964,000	0.672	$ -	$ 5,355,400
15	2033	11	$ -	$ 25,000	0.654	$ -	$ 16,300
16	2034	12	$ -	$ 25,000	0.635	$ -	$ 15,900
17	2035	13	$ -	$ 25,000	0.618	$ -	$ 15,400
18	2036	14	$ -	$ 25,000	0.600	$ -	$ 15,000
19	2037	15	$ -	$ 7,964,000	0.584	$ -	$ 4,647,800
20	2038	16	$ -	$ 25,000	0.567	$ -	$ 14,200
21	2039	17	$ -	$ 25,000	0.551	$ -	$ 13,800
22	2040	18	$ -	$ 25,000	0.536	$ -	$ 13,400
23	2041	19	$ -	$ 25,000	0.521	$ -	$ 13,000
24	2042	20	$ -	$ 7,964,000	0.506	$ -	$ 4,033,600
25	2043	21	$ -	$ 25,000	0.492	$ -	$ 12,300
26	2044	22	$ -	$ 25,000	0.479	$ -	$ 12,000
27	2045	23	$ -	$ 25,000	0.465	$ -	$ 11,600
28	2046	24	$ -	$ 25,000	0.452	$ -	$ 11,300
29	2047	25	$ -	$ 57,753,000	0.440	$ -	$ 25,385,700
30	2048	26	$ -	$ 25,000	0.427	$ -	$ 10,700
31	2049	27	$ -	$ 25,000	0.415	$ -	$ 10,400
32	2050	28	$ -	$ 25,000	0.404	$ -	$ 10,100
33	2051	29	$ -	$ 25,000	0.392	$ -	$ 9,800
34	2052	30	$ -	$ 7,964,000	0.381	$ -	$ 3,038,100
35	2053	31	$ -	$ 25,000	0.371	$ -	$ 9,300
36	2054	32	$ -	$ 25,000	0.360	$ -	$ 9,000
37	2055	33	$ -	$ 25,000	0.350	$ -	$ 8,800
38	2056	34	$ -	$ 25,000	0.341	$ -	$ 8,500
39	2057	35	$ -	$ 7,964,000	0.331	$ -	$ 2,636,600
40	2058	36	$ -	$ 25,000	0.322	$ -	$ 8,000
41	2059	37	$ -	$ 25,000	0.313	$ -	$ 7,800
42	2060	38	$ -	$ 25,000	0.304	$ -	$ 7,600
43	2061	39	$ -	$ 25,000	0.296	$ -	$ 7,400
44	2062	40	$ -	$ 7,964,000	0.287	$ -	$ 2,288,200
45	2063	41	$ -	$ 25,000	0.279	$ -	$ 7,000
46	2064	42	$ -	$ 25,000	0.271	$ -	$ 6,800
47	2065	43	$ -	$ 25,000	0.264	$ -	$ 6,600
48	2066	44	$ -	$ 25,000	0.257	$ -	$ 6,400
49	2067	45	$ -	$ 7,964,000	0.249	$ -	$ 1,985,900
50	2068	46	$ -	$ 25,000	0.242	$ -	$ 6,100
51	2069	47	$ -	$ 25,000	0.236	$ -	$ 5,900
52	2070	48	$ -	$ 25,000	0.229	$ -	$ 5,700
53	2071	49	$ -	$ 25,000	0.223	$ -	$ 5,600
54	2072	50	$ -	$ 57,753,000	0.216	$ -	$ 12,498,100

BARROW COASTAL EROSION COST ESTIMATE

ALTERNATIVE 6A

Date: 2-Jan-19

ITEM NO.	DESCRIPTION	UOM	QUANTITY	UNIT COST	TOTAL COST
02	**Relocations**				
02.1	Structure Raise and/or Relocation	EA	6	$ 200,000.00	$ 1,200,000
16	**Bank Stabilization**				
16.1	Mob, Demob. and Site Prepation	LS	1.0	$ 25,242,000	$ 25,242,000
	Revetment +19.0ft MLLW				
16.2	Excavation	CY	51,114	$ 6.00	$ 307,000
16.3	Hauling	CY	58,781	$ 12.00	$ 706,000
16.4	B-rock Rock	CY	16,319	$ 260.00	$ 4,243,000
16.5	Armor Rock	CY	21,402	$ 330.00	$ 7,063,000
16.6	Core Rock	CY	5,423	$ 205.00	$ 1,112,000
16.7	Gravel	CY	5,761	$ 120.00	$ 692,000
16.8	Filter Fabric	YD^2	16,290	$ 4.00	$ 66,000
16.9	Local material	CY	1,148	$ 40.00	$ 46,000
	Revetment +14.5ft MLLW				
16.10	Excavation	CY	31,765	$ 6.00	$ 191,000
16.11	Hauling	CY	36,529	$ 12.00	$ 439,000
16.12	B-rock Rock	CY	13,807	$ 260.00	$ 3,590,000
16.13	Armor Rock	CY	16,937	$ 330.00	$ 5,590,000
16.14	Core Rock	CY	4,666	$ 205.00	$ 957,000
16.15	Gravel	CY	4,981	$ 120.00	$ 598,000
16.16	Filter Fabric	YD^2	14,174	$ 4.00	$ 57,000
16.17	Local material	CY	4,570	$ 40.00	$ 183,000
	Berm +14.5ft MLLW				
16.18	Excavation	CY	221,394	$ 6.00	$ 1,329,000
16.19	Hauling	CY	254,603	$ 12.00	$ 3,056,000
16.20	B-rock Rock	CY	75,087	$ 260.00	$ 19,523,000
16.21	Armor Rock	CY	79,480	$ 330.00	$ 26,229,000
16.22	Core Rock	CY	17,998	$ 205.00	$ 3,690,000
16.23	Gravel	CY	19,193	$ 120.00	$ 2,304,000
16.24	Filter Fabric	YD^2	55,836	$ 4.00	$ 224,000
16.25	Road Access - Local Material	CY	3,873	$ 40.00	$ 155,000
	Raised Road +14.5ft MLLW				
16.25	Excavation	CY	320,104	$ 6.00	$ 1,921,000
16.26	Hauling	CY	368,120	$ 12.00	$ 4,418,000
16.27	B-rock Rock	CY	98,700	$ 260.00	$ 25,662,000
16.28	Armor Rock	CY	108,983	$ 330.00	$ 35,965,000
16.29	Core Rock	CY	34,176	$ 205.00	$ 7,007,000
16.30	Gravel	CY	36,849	$ 120.00	$ 4,422,000
16.31	Filter Fabric	YD^2	105,465	$ 4.00	$ 422,000
16.32	Local Material	CY	92,211	$ 40.00	$ 3,689,000
16.33	Road Access - Local Material	CY	5,218	$ 40.00	$ 209,000
17	**Beach Replenishment**				
17.1	Beach Nourishment Material	CY	374,805	$ 85.00	$ 31,859,000
17.2	Beach Nourishment Maintenance (at O&M year 25)	CY	318,585	$ 85.00	$ 27,080,000
17.3	Beach Nourishment Maintenance (at O&M year 50)	CY	318,585	$ 85.00	$ 27,080,000
18	**Cultural Resources**				
18.1	On-Site Archaeologist	MO	22	$ 15,000.00	$ 330,000
				Sub-Total (1):	*$ 278,856,000*

30	Planning, Engineering and Design - 10.0% of Sub-Total (2)	$ 27,886,000
31	Construction Management - 6.0% of Sub-Total (2)	$ 16,732,000
	Sub-Total (3):	*$ 323,474,000*

	Estimating and Construction Contingency - 46.6% of Sub-Total (3)	$ 150,846,000
	Sub-Total (4):	*$ 474,320,000*

	Real Estate Costs	ACR	-	$ -	$ 3,000,000
	Real Estate Contingency - 35.0% of Real Estate Costs				$ 1,050,000
				Total Real Estate Costs:	*$ 4,050,000*

	Total Alternative Costs	**$ 478,370,000**

OPTION 6A - ANNUAL O&M COSTS

ITEM NO.	DESCRIPTION	UOM	QUANTITY	VALUE	YEARLY COST
1.	Annual Maintenance and Inspections	LS	1	$	25,000
2.	Revetment +19.0ft MLLW (every 5-years)	LS	1	$	984,000
3.	Revetment +14.5ft MLLW (every 5-years)	LS	1	$	806,000
4.	Berm +14.5ft MLLW (every 5-years)	LS	1	$	3,881,000
5.	Raised Road +14.5ft MLLW (every 5-years)	LS	1	$	5,480,000

Alternative:	6A
Work Windows:	3.2
Construction Cost:	$ 278,856,000
Contingency:	47%
Total Construction:	$ 408,895,000
Discount Rate:	2.875%

Present Value Construction:	$ 374,364,000
Net Present Value O&M:	$ 48,726,000
Average Annual O&M:	$ 1,849,000

Count	Year	O&M Yr.	Construction	O&M	PV Factor	PV Construction	PV O&M
0	2018	-	$ -	$ -	1.000	$ -	$ -
1	2019	-	$ -	$ -	0.972	$ -	$ -
2	2020	-	$ 127,780,000	$ -	0.945	$ 120,738,000	
3	2021	-	$ 127,780,000	$ -	0.918	$ 117,364,000	$ -
4	2022	-	$ 127,780,000	$ -	0.893	$ 114,084,000	$ -
5	2023	0	$ 25,555,000	$ -	0.868	$ 22,178,000	$ -
6	2024	1	$ -	$ 25,000	0.844	$ -	$ 21,100
7	2025	2	$ -	$ 25,000	0.820	$ -	$ 20,500
8	2026	3	$ -	$ 25,000	0.797	$ -	$ 19,900
9	2027	4	$ -	$ 25,000	0.775	$ -	$ 19,400
10	2028	5	$ -	$ 11,176,000	0.753	$ -	$ 8,417,600
11	2029	6	$ -	$ 25,000	0.732	$ -	$ 18,300
12	2030	7	$ -	$ 25,000	0.712	$ -	$ 17,800
13	2031	8	$ -	$ 25,000	0.692	$ -	$ 17,300
14	2032	9	$ -	$ 25,000	0.672	$ -	$ 16,800
15	2033	10	$ -	$ 11,176,000	0.654	$ -	$ 7,305,300
16	2034	11	$ -	$ 25,000	0.635	$ -	$ 15,900
17	2035	12	$ -	$ 25,000	0.618	$ -	$ 15,400
18	2036	13	$ -	$ 25,000	0.600	$ -	$ 15,000
19	2037	14	$ -	$ 25,000	0.584	$ -	$ 14,600
20	2038	15	$ -	$ 11,176,000	0.567	$ -	$ 6,340,000
21	2039	16	$ -	$ 25,000	0.551	$ -	$ 13,800
22	2040	17	$ -	$ 25,000	0.536	$ -	$ 13,400
23	2041	18	$ -	$ 25,000	0.521	$ -	$ 13,000
24	2042	19	$ -	$ 25,000	0.506	$ -	$ 12,700
25	2043	20	$ -	$ 11,176,000	0.492	$ -	$ 5,502,200
26	2044	21	$ -	$ 25,000	0.479	$ -	$ 12,000
27	2045	22	$ -	$ 25,000	0.465	$ -	$ 11,600
28	2046	23	$ -	$ 25,000	0.452	$ -	$ 11,300
29	2047	24	$ -	$ 25,000	0.440	$ -	$ 11,000
30	2048	25	$ -	$ 11,176,000	0.427	$ -	$ 4,775,200
31	2049	26	$ -	$ 25,000	0.415	$ -	$ 10,400
32	2050	27	$ -	$ 25,000	0.404	$ -	$ 10,100
33	2051	28	$ -	$ 25,000	0.392	$ -	$ 9,800
34	2052	29	$ -	$ 25,000	0.381	$ -	$ 9,500
35	2053	30	$ -	$ 11,176,000	0.371	$ -	$ 4,144,200
36	2054	31	$ -	$ 25,000	0.360	$ -	$ 9,000
37	2055	32	$ -	$ 25,000	0.350	$ -	$ 8,800
38	2056	33	$ -	$ 25,000	0.341	$ -	$ 8,500
39	2057	34	$ -	$ 25,000	0.331	$ -	$ 8,300
40	2058	35	$ -	$ 11,176,000	0.322	$ -	$ 3,596,600
41	2059	36	$ -	$ 25,000	0.313	$ -	$ 7,800
42	2060	37	$ -	$ 25,000	0.304	$ -	$ 7,600
43	2061	38	$ -	$ 25,000	0.296	$ -	$ 7,400
44	2062	39	$ -	$ 25,000	0.287	$ -	$ 7,200
45	2063	40	$ -	$ 11,176,000	0.279	$ -	$ 3,121,400
46	2064	41	$ -	$ 25,000	0.271	$ -	$ 6,800
47	2065	42	$ -	$ 25,000	0.264	$ -	$ 6,600
48	2066	43	$ -	$ 25,000	0.257	$ -	$ 6,400
49	2067	44	$ -	$ 25,000	0.249	$ -	$ 6,200
50	2068	45	$ -	$ 11,176,000	0.242	$ -	$ 2,708,900
51	2069	46	$ -	$ 25,000	0.236	$ -	$ 5,900
52	2070	47	$ -	$ 25,000	0.229	$ -	$ 5,700
53	2071	48	$ -	$ 25,000	0.223	$ -	$ 5,600
54	2072	49	$ -	$ 25,000	0.216	$ -	$ 5,400
55	2073	50	$ -	$ 11,176,000	0.210	$ -	$ 2,351,000

BARROW COASTAL EROSION COST ESTIMATE

ALTERNATIVE 6B

Date: 2-Jan-19

ITEM NO.	DESCRIPTION	UOM	QUANTITY	UNIT COST	TOTAL COST
02	**Relocations**				
02.1	Structure Raise and/or Relocation	EA	6	$ 200,000.00	$ 1,200,000
16	**Bank Stabilization**				
16.1	Mob, Demob. and Site Prepation	LS	1.0	$ 36,154,000	$ 36,154,000
	Revetment +19.0ft MLLW				
16.2	Excavation	CY	51,114	$ 6.00	$ 307,000
16.3	Hauling	CY	58,781	$ 12.00	$ 706,000
16.4	B-rock Rock	CY	16,319	$ 260.00	$ 4,243,000
16.5	Armor Rock	CY	21,402	$ 330.00	$ 7,063,000
16.6	Core Rock	CY	5,423	$ 205.00	$ 1,112,000
16.7	Gravel	CY	5,761	$ 120.00	$ 692,000
16.8	Filter Fabric	YD^2	16,290	$ 4.00	$ 66,000
16.9	Local material	CY	1,148	$ 40.00	$ 46,000
	Revetment +14.5ft MLLW				
16.10	Excavation	CY	31,765	$ 6.00	$ 191,000
16.11	Hauling	CY	36,529	$ 12.00	$ 439,000
16.12	B-rock Rock	CY	13,807	$ 260.00	$ 3,590,000
16.13	Armor Rock	CY	16,937	$ 330.00	$ 5,590,000
16.14	Core Rock	CY	4,666	$ 205.00	$ 957,000
16.15	Gravel	CY	4,981	$ 120.00	$ 598,000
16.16	Filter Fabric	YD^2	14,174	$ 4.00	$ 57,000
16.17	Local material	CY	4,570	$ 40.00	$ 183,000
	Berm +14.5ft MLLW				
16.18	Excavation	CY	221,394	$ 6.00	$ 1,329,000
16.19	Hauling	CY	254,603	$ 12.00	$ 3,056,000
16.20	B-rock Rock	CY	75,087	$ 260.00	$ 19,523,000
16.21	Armor Rock	CY	79,480	$ 330.00	$ 26,229,000
16.22	Core Rock	CY	17,998	$ 205.00	$ 3,690,000
16.23	Gravel	CY	19,193	$ 120.00	$ 2,304,000
16.24	Filter Fabric	YD^2	55,836	$ 4.00	$ 224,000
16.25	Road Access - Local Material	CY	3,873	$ 40.00	$ 155,000
	Raised Road +14.5ft MLLW				
16.25	Excavation	CY	148,073	$ 6.00	$ 889,000
16.26	Hauling	CY	170,284	$ 12.00	$ 2,044,000
16.27	B-rock Rock	CY	40,860	$ 260.00	$ 10,624,000
16.28	Armor Rock	CY	45,072	$ 330.00	$ 14,874,000
16.29	Core Rock	CY	14,148	$ 205.00	$ 2,901,000
16.30	Gravel	CY	15,247	$ 120.00	$ 1,830,000
16.31	Filter Fabric	YD^2	43,671	$ 4.00	$ 175,000
16.32	Local Material	CY	31,338	$ 40.00	$ 1,254,000
16.33	Road Access - Local Material	CY	3,100	$ 40.00	$ 124,000
17	**Beach Replenishment**				
17.1	Beach Nourishment Material	CY	1,063,918	$ 85.00	$ 90,434,000
17.2	Beach Nourishment Maintenance (at O&M year 25)	CY	904,330	$ 85.00	$ 76,869,000
17.3	Beach Nourishment Maintenance (at O&M year 50)	CY	904,330	$ 85.00	$ 76,869,000
18	**Cultural Resources**				
18.1	On-Site Archaeologist	MO	20	$ 15,000.00	$ 300,000
				Sub-Total (1):	*$ 398,891,000*

30	Planning, Engineering and Design - 10.0% of Sub-Total (2)	$ 39,890,000
31	Construction Management - 6.0% of Sub-Total (2)	$ 23,934,000
	Sub-Total (3):	*$ 462,715,000*

	Estimating and Construction Contingency - 47.0% of Sub-Total (3)	$ 217,701,000
	Sub-Total (4):	*$ 680,416,000*

	Real Estate Costs	ACR	-	$ -	$ 3,000,000
	Real Estate Contingency - 35.0% of Real Estate Costs				$ 1,050,000
				Total Real Estate Costs:	*$ 4,050,000*

	Total Alternative Costs	**$ 684,466,000**

OPTION 6B - ANNUAL O&M COSTS

ITEM NO.	DESCRIPTION	UOM	QUANTITY	VALUE	YEARLY COST
1.	Annual Maintenance and Inspections	LS	1	$	25,000
2.	Revetment +19.0ft MLLW (every 5-years)	LS	1	$	984,000
3.	Revetment +14.5ft MLLW (every 5-years)	LS	1	$	806,000
4.	Berm +14.5ft MLLW (every 5-years)	LS	1	$	3,881,000
5.	Raised Road +14.5ft MLLW (every 5-years)	LS	1	$	2,268,000

Alternative:	6B
Work Windows:	2.8
Construction Cost:	$ 398,891,000
Contingency:	47%
Total Construction:	$ 586,564,000
Discount Rate:	2.875%

Present Value Construction:	$ 539,979,000
Net Present Value O&M:	$ 35,858,000
Average Annual O&M:	$ 1,361,000

Count	Year	O&M Yr.	Construction	O&M	PV Factor	PV Construction	PV O&M
0	2018	-	$ -	$ -	1.000	$ -	$ -
1	2019	-	$ -	$ -	0.972	$ -	$ -
2	2020	-	$ 209,487,000	$ -	0.945	$ 197,942,000	$ -
3	2021	-	$ 209,487,000	$ -	0.918	$ 192,410,000	$ -
4	2022	-	$ 167,590,000	$ -	0.893	$ 149,627,000	$ -
5	2023	1	$ -	$ 25,000	0.868	$ -	$ 21,700
6	2024	2	$ -	$ 25,000	0.844	$ -	$ 21,100
7	2025	3	$ -	$ 25,000	0.820	$ -	$ 20,500
8	2026	4	$ -	$ 25,000	0.797	$ -	$ 19,900
9	2027	5	$ -	$ 7,964,000	0.775	$ -	$ 6,170,800
10	2028	6	$ -	$ 25,000	0.753	$ -	$ 18,800
11	2029	7	$ -	$ 25,000	0.732	$ -	$ 18,300
12	2030	8	$ -	$ 25,000	0.712	$ -	$ 17,800
13	2031	9	$ -	$ 25,000	0.692	$ -	$ 17,300
14	2032	10	$ -	$ 7,964,000	0.672	$ -	$ 5,355,400
15	2033	11	$ -	$ 25,000	0.654	$ -	$ 16,300
16	2034	12	$ -	$ 25,000	0.635	$ -	$ 15,900
17	2035	13	$ -	$ 25,000	0.618	$ -	$ 15,400
18	2036	14	$ -	$ 25,000	0.600	$ -	$ 15,000
19	2037	15	$ -	$ 7,964,000	0.584	$ -	$ 4,647,800
20	2038	16	$ -	$ 25,000	0.567	$ -	$ 14,200
21	2039	17	$ -	$ 25,000	0.551	$ -	$ 13,800
22	2040	18	$ -	$ 25,000	0.536	$ -	$ 13,400
23	2041	19	$ -	$ 25,000	0.521	$ -	$ 13,000
24	2042	20	$ -	$ 7,964,000	0.506	$ -	$ 4,033,600
25	2043	21	$ -	$ 25,000	0.492	$ -	$ 12,300
26	2044	22	$ -	$ 25,000	0.479	$ -	$ 12,000
27	2045	23	$ -	$ 25,000	0.465	$ -	$ 11,600
28	2046	24	$ -	$ 25,000	0.452	$ -	$ 11,300
29	2047	25	$ -	$ 7,964,000	0.440	$ -	$ 3,500,600
30	2048	26	$ -	$ 25,000	0.427	$ -	$ 10,700
31	2049	27	$ -	$ 25,000	0.415	$ -	$ 10,400
32	2050	28	$ -	$ 25,000	0.404	$ -	$ 10,100
33	2051	29	$ -	$ 25,000	0.392	$ -	$ 9,800
34	2052	30	$ -	$ 7,964,000	0.381	$ -	$ 3,038,100
35	2053	31	$ -	$ 25,000	0.371	$ -	$ 9,300
36	2054	32	$ -	$ 25,000	0.360	$ -	$ 9,000
37	2055	33	$ -	$ 25,000	0.350	$ -	$ 8,800
38	2056	34	$ -	$ 25,000	0.341	$ -	$ 8,500
39	2057	35	$ -	$ 7,964,000	0.331	$ -	$ 2,636,600
40	2058	36	$ -	$ 25,000	0.322	$ -	$ 8,000
41	2059	37	$ -	$ 25,000	0.313	$ -	$ 7,800
42	2060	38	$ -	$ 25,000	0.304	$ -	$ 7,600
43	2061	39	$ -	$ 25,000	0.296	$ -	$ 7,400
44	2062	40	$ -	$ 7,964,000	0.287	$ -	$ 2,288,200
45	2063	41	$ -	$ 25,000	0.279	$ -	$ 7,000
46	2064	42	$ -	$ 25,000	0.271	$ -	$ 6,800
47	2065	43	$ -	$ 25,000	0.264	$ -	$ 6,600
48	2066	44	$ -	$ 25,000	0.257	$ -	$ 6,400
49	2067	45	$ -	$ 7,964,000	0.249	$ -	$ 1,985,900
50	2068	46	$ -	$ 25,000	0.242	$ -	$ 6,100
51	2069	47	$ -	$ 25,000	0.236	$ -	$ 5,900
52	2070	48	$ -	$ 25,000	0.229	$ -	$ 5,700
53	2071	49	$ -	$ 25,000	0.223	$ -	$ 5,600
54	2072	50	$ -	$ 7,964,000	0.216	$ -	$ 1,723,500

BARROW COASTAL EROSION COST ESTIMATE

ALTERNATIVE 6C

Date: 2-Jan-19

ITEM NO.	DESCRIPTION	UOM	QUANTITY	UNIT COST	TOTAL COST
02	**Relocations**				
02.1	Not Applicable in this Alternative				
16	**Bank Stabilization**				
16.1	Not Applicable in this Alternative				
17	**Beach Replenishment**				
17.1	Mob, Demob. and Site Prepation	LS	1.0	$ 49,927,000	$ 49,927,000
17.2	Beach Nourishment Material	CY	2,175,439	$ 85.00	$ 184,913,000
17.3	Beach Nourishment Maintenance (at O&M year 25)	CY	1,849,123	$ 85.00	$ 157,176,000
17.4	Beach Nourishment Maintenance (at O&M year 50)	CY	1,849,123	$ 85.00	$ 157,176,000
18	**Cultural Resources**				
18.1	Not Applicable in this Alternative				
				Sub-Total (1):	*$ 549,192,000*

30	Planning, Engineering and Design - 10.0% of Sub-Total (2)	$ 54,920,000
31	Construction Management - 6.0% of Sub-Total (2)	$ 32,952,000
	Sub-Total (3):	*$ 637,064,000*

	Estimating and Construction Contingency - 47.6% of Sub-Total (3)	$ 302,952,000
	Sub-Total (4):	*$ 940,016,000*

	Real Estate Costs	ACR	-	$ -	$ 3,000,000
	Real Estate Contingency - 35.0% of Real Estate Costs				$ 1,050,000
				Total Real Estate Costs:	*$ 4,050,000*

	Total Alternative Costs	**$ 944,066,000**

OPTION 6C - ANNUAL O&M COSTS

ITEM NO.	DESCRIPTION	UOM	QUANTITY	VALUE	YEARLY COST
1.	Annual Maintenance and Inspections		LS	1	$ 25,000

Alternative:	5C
Work Windows:	2.3
Construction Cost:	$ 549,192,000
Contingency:	48%
Total Construction:	$ 810,357,000
Discount Rate:	2.75%

Present Value Construction:	$ 753,342,000
Net Present Value O&M:	$ 605,000
Average Annual O&M:	$ 22,000

Count	Year	O&M Yr.	Construction	O&M	PV Factor	PV Construction	PV O&M
0	2018	-	$ -	$ -	1.000	$ -	$ -
1	2019	-	$ -	$ -	0.973	$ -	$ -
2	2020	-	$ 352,329,000	$ -	0.947	$ 333,722,000	$ -
3	2021	-	$ 352,329,000	$ -	0.922	$ 324,790,000	$ -
4	2022	0	$ 105,699,000	$ -	0.897	$ 94,830,000	$ -
5	2023	1	$ -	$ 25,000	0.873	$ -	$ 21,800
6	2024	2	$ -	$ 25,000	0.850	$ -	$ 21,200
7	2025	3	$ -	$ 25,000	0.827	$ -	$ 20,700
8	2026	4	$ -	$ 25,000	0.805	$ -	$ 20,100
9	2027	5	$ -	$ 25,000	0.783	$ -	$ 19,600
10	2028	6	$ -	$ 25,000	0.762	$ -	$ 19,100
11	2029	7	$ -	$ 25,000	0.742	$ -	$ 18,500
12	2030	8	$ -	$ 25,000	0.722	$ -	$ 18,100
13	2031	9	$ -	$ 25,000	0.703	$ -	$ 17,600
14	2032	10	$ -	$ 25,000	0.684	$ -	$ 17,100
15	2033	11	$ -	$ 25,000	0.666	$ -	$ 16,600
16	2034	12	$ -	$ 25,000	0.648	$ -	$ 16,200
17	2035	13	$ -	$ 25,000	0.631	$ -	$ 15,800
18	2036	14	$ -	$ 25,000	0.614	$ -	$ 15,300
19	2037	15	$ -	$ 25,000	0.597	$ -	$ 14,900
20	2038	16	$ -	$ 25,000	0.581	$ -	$ 14,500
21	2039	17	$ -	$ 25,000	0.566	$ -	$ 14,100
22	2040	18	$ -	$ 25,000	0.551	$ -	$ 13,800
23	2041	19	$ -	$ 25,000	0.536	$ -	$ 13,400
24	2042	20	$ -	$ 25,000	0.521	$ -	$ 13,000
25	2043	21	$ -	$ 25,000	0.508	$ -	$ 12,700
26	2044	22	$ -	$ 25,000	0.494	$ -	$ 12,300
27	2045	23	$ -	$ 25,000	0.481	$ -	$ 12,000
28	2046	24	$ -	$ 25,000	0.468	$ -	$ 11,700
29	2047	25	$ -	$ 25,000	0.455	$ -	$ 11,400
30	2048	26	$ -	$ 25,000	0.443	$ -	$ 11,100
31	2049	27	$ -	$ 25,000	0.431	$ -	$ 10,800
32	2050	28	$ -	$ 25,000	0.420	$ -	$ 10,500
33	2051	29	$ -	$ 25,000	0.409	$ -	$ 10,200
34	2052	30	$ -	$ 25,000	0.398	$ -	$ 9,900
35	2053	31	$ -	$ 25,000	0.387	$ -	$ 9,700
36	2054	32	$ -	$ 25,000	0.377	$ -	$ 9,400
37	2055	33	$ -	$ 25,000	0.366	$ -	$ 9,200
38	2056	34	$ -	$ 25,000	0.357	$ -	$ 8,900
39	2057	35	$ -	$ 25,000	0.347	$ -	$ 8,700
40	2058	36	$ -	$ 25,000	0.338	$ -	$ 8,400
41	2059	37	$ -	$ 25,000	0.329	$ -	$ 8,200
42	2060	38	$ -	$ 25,000	0.320	$ -	$ 8,000
43	2061	39	$ -	$ 25,000	0.311	$ -	$ 7,800
44	2062	40	$ -	$ 25,000	0.303	$ -	$ 7,600
45	2063	41	$ -	$ 25,000	0.295	$ -	$ 7,400
46	2064	42	$ -	$ 25,000	0.287	$ -	$ 7,200
47	2065	43	$ -	$ 25,000	0.279	$ -	$ 7,000
48	2066	44	$ -	$ 25,000	0.272	$ -	$ 6,800
49	2067	45	$ -	$ 25,000	0.265	$ -	$ 6,600
50	2068	46	$ -	$ 25,000	0.258	$ -	$ 6,400
51	2069	47	$ -	$ 25,000	0.251	$ -	$ 6,300
52	2070	48	$ -	$ 25,000	0.244	$ -	$ 6,100
53	2071	49	$ -	$ 25,000	0.237	$ -	$ 5,900
54	2072	50	$ -	$ 25,000	0.231	$ -	$ 5,800

ATTACHMENT 3 – OPTIMIZED SCENARIOS QUANTITY SUMMARY

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REACH 1 BLUFF - 11+04 - 29+50 (1846 FT)

Revetment +19.0ft MLLW		Revetment +21.0ft MLLW		Revetment +23.0ft MLLW		Nourishment	
Material	Volume (cy)	Material	Volume (cy)	Material	Volume (cy)		Volume (cy)
Armor	21,402	Armor	23,542	Armor	25,682	Beach Nour	238,013
B	16,319	B	17,389	B	18,459		
Core	5,423	Core	5,729	Core	6,034		
Gravel	5,761	Gravel	6,067	Gravel	6,373		
Fill	1,148	Fill	3,257	Fill	6,753		
Excavation	51,114	Excavation	44,059	Excavation	38,377		
Filter Fabric (yd^2)	16,290	Filter Fabric (yd^2)	17,110	Filter Fabric (yd^2)	17,930		

REACH 2 BARROW - 31+00 - 48+50 (1750 FT)

Revetment +14.5ft MLLW

Material	Volume (cy)
Armor	16,937
B	13,807
Core	4,666
Gravel	4,981
Fill	4,570
Excavation	31,765
Filter Fabric (yd^2)	14,174

Revetment +15.5ft MLLW

Material	Volume (cy)
Armor	18,221
B	14,450
Core	4,850
Gravel	5,165
Fill	6,041
Excavation	30,961
Filter Fabric (yd^2)	14,668

Revetment +17.0ft MLLW

Material	Volume (cy)
Armor	19,884
B	15,247
Core	5,124
Gravel	5,403
Fill	8,832
Excavation	29,053
Filter Fabric (yd^2)	15,307

Nourishment

Material	Volume (cy)
Beach Nour	289,744

REACH 3 LAGOON - 48+50 - 76+00 = 2750 FT

Berm +14.5ft MLLW

Material	Volume (cy)
Armor	32,694
B	30,887
Core	7,404
Gravel	7,895
Excavation	71,530
Filter Fabric (yd^2)	22,253

Berm +15.5ft MLLW

Material	Volume (cy)
Armor	35,731
B	34,994
Core	7,780
Gravel	8,271
Excavation	75,496
Filter Fabric (yd^2)	23,323

Berm +17.0ft MLLW

Material	Volume (cy)
Armor	40,286
B	41,858
Core	8,344
Gravel	8,835
Excavation	81,546
Filter Fabric (yd^2)	24,927

Fill Tasigarook Lagoon

Material	Volume (cy)
Fill	250,000

Nourishment

Material	Volume (cy)
Beach Nour	431,497

REACH 4 BROWER - 76+00 - 116+00 = 4000 FT

Raised Road +14.5ft MLLW

Material	Volume (cy)
Armor	31,279
B	28,271
Core	9,787
Gravel	10,547
Road - Share	17,218
Road - LSF	11,515
Excavation	78,760
Filter Fabric (yd^2)	30,170

Raised Road +15.5ft MLLW

Material	Volume (cy)
Armor	33,685
B	29,474
Core	10,131
Gravel	10,891
Road - Share	22,565
Road - LSF	13,798
Excavation	77,764
Filter Fabric (yd^2)	31,092

Raised Road +17.0ft MLLW

Material	Volume (cy)
Armor	37,295
B	31,279
Core	10,647
Gravel	11,407
Road - Share	32,263
Road - LSF	17,247
Excavation	76,442
Filter Fabric (yd^2)	32,476

Nourishment

Material	Volume (cy)
Beach Nour	376,037

Road Access +14.5ft MLLW - LSF

Road	Volume (cy)
Brower St.	908
Tahak St.	388
Okakok St.	362
Ahkovak St.	594
C Ave	655
Ahmoagak Ave	966
Total	**3,873**
	646

Road Access +15.5ft MLLW - LSF

Road	Volume (cy)
Brower St.	1,121
Tahak St.	475
Okakok St.	479
Ahkovak St.	773
C Ave	816
Ahmoagak Ave	1,147
Total	**4,811**
	802

Road Access +15.5ft MLLW - LSF

Road	Volume (cy)
Brower St.	1,455
Tahak St.	616
Okakok St.	671
Ahkovak St.	1,069
C Ave	1,079
Ahmoagak Ave	1,440
Total	**6,330**
	1,055

Berm +14.5ft MLLW

Material	Volume (cy)
Armor	46,786
B	44,200
Core	10,594
Gravel	11,298
Excavation	149,864
Filter Fabric (yd^2)	33,583

Berm +15.5ft MLLW

Material	Volume (cy)
Armor	51,131
B	50,076
Core	11,132
Gravel	11,836
Excavation	156,195
Filter Fabric (yd^2)	35,197

Berm +17.0ft MLLW

Material	Volume (cy)
Armor	57,650
B	59,898
Core	11,939
Gravel	12,643
Excavation	165,652
Filter Fabric (yd^2)	37,618

REACH 5 SALT - 116+00 - 204+00 = 8800 FT

Raised Road +14.5ft MLLW

Material	Volume (cy)
Armor	63,911
B	57,840
Core	20,028
Gravel	21,602
Road - Share	37,898
Road - LSF	22,975
Excavation	172,031
Filter Fabric (yd^2)	61,794

Raised Road +15.5ft MLLW

Material	Volume (cy)
Armor	68,843
B	60,276
Core	20,733
Gravel	22,290
Road - Share	49,175
Road - LSF	27,602
Excavation	169,764
Filter Fabric (yd^2)	63,683

Raised Road +17.0ft MLLW

Material	Volume (cy)
Armor	76,378
B	63,952
Core	21,774
Gravel	23,361
Road - Share	68,507
Road - LSF	34,682
Excavation	166,075
Filter Fabric (yd^2)	598,642

Nourishment

Material	Volume (cy)
Beach Nour	742,248

Road Access +14.5ft MLLW - LSF

Road	Volume (cy)
Not Named 1	706
Cakeeatter Rd 1	706
Cakeeatter Rd 2	706
Total	**2,118**

Road Access +15.5ft MLLW - LSF

Road	Volume (cy)
Not Named 1	868
Cakeeatter Rd 1	868
Cakeeatter Rd 2	868
Total	**2,604**

Road Access +15.5ft MLLW - LSF

Road	Volume (cy)
Not Named 1	1,176
Cakeeatter Rd 1	1,176
Cakeeatter Rd 2	1,176
Total	**3,528**

Berm +14.5ft MLLW

Material	Volume (cy)
Armor	95,676
B	90,527
Core	21,699
Gravel	23,140
Excavation	318,868
Filter Fabric (yd^2)	68,787

Berm +15.5ft MLLW

Material	Volume (cy)
Armor	104,623
B	102,223
Core	22,741
Gravel	24,242
Excavation	332,168
Filter Fabric (yd^2)	72,093

Berm +17.0ft MLLW

Material	Volume (cy)
Armor	118,075
B	122,294
Core	24,389
Gravel	25,894
Excavation	351,847
Filter Fabric (yd^2)	77,051

REACH 6 NARL - 204+00 - 261+00 = 5700 FT

Raised Road +14.5ft MLLW

Material	Volume (cy)
Armor	45,072
B	40,860
Core	14,148
Gravel	15,247
Road - Share	18,770
Road - LSF	12,568
Excavation	148,073
Filter Fabric (yd^2)	43,671

Raised Road +15.5ft MLLW

Material	Volume (cy)
Armor	48,698
B	42,609
Core	14,641
Gravel	15,741
Road - Share	25,875
Road - LSF	15,901
Excavation	147,514
Filter Fabric (yd^2)	45,005

Raised Road +17.0ft MLLW

Material	Volume (cy)
Armor	53,842
B	45,181
Core	15,369
Gravel	16,490
Road - Share	38,171
Road - LSF	20,900
Excavation	146,622
Filter Fabric (yd^2)	47,005

Nourishment

Material	Volume (cy)
Beach Nour	248,411

Road Access +14.5ft MLLW - LSF

Road	Volume (cy)
Not Named 2	606
Fire Ln	418
Not Named 3	486
Not Named 4	382
Not Named 5	500
Not Names 6	327
Off Raised	381
Total	**3,100**

Road Access +15.5ft MLLW - LSF

Road	Volume (cy)
Not Named 2	752
Fire Ln	567
Not Named 3	644
Not Named 4	536
Not Named 5	651
Not Named 6	415
Off Raised	505
Total	**4,070**

Road Access +15.5ft MLLW - LSF

Road	Volume (cy)
Not Named 2	990
Fire Ln	816
Not Named 3	901
Not Named 4	790
Not Named 5	899
Not Named 6	558
Off Raised	709
Total	**5,663**

Berm +14.5ft MLLW

Material	Volume (cy)
Armor	67,472
B	63,441
Core	15,224
Gravel	16,330
Excavation	255,596
Filter Fabric (yd^2)	48,659

Berm +15.5ft MLLW

Material	Volume (cy)
Armor	73,923
B	72,396
Core	15,988
Gravel	16,963
Excavation	266,581
Filter Fabric (yd^2)	50,695

Berm +17.0ft MLLW

Material	Volume (cy)
Armor	83,273
B	86,560
Core	17,238
Gravel	18,277
Excavation	283,018
Filter Fabric (yd^2)	54,502

ATTACHMENT 4 – FINAL ARRAY COST ESTIMATE SUMMARY

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Alternative A

Reach	Construction Measure	Construction	PED	CM	Contingency	Real Estate	Total	Annual O&M
2	Revetment	$12,786,500	$1,279,000	$767,000	$6,855,000	$608,000	$22,296,000	$134,000
3	Berm (revetted)	$25,114,000	$2,511,000	$1,507,000	$13,462,000	$608,000	$43,202,000	$265,000
	Totals	**$37,900,500**	**$3,790,000**	**$2,274,000**	**$20,317,000**	**$1,216,000**	**$65,498,000**	**$399,000**

Alternative B

Reach	Construction Measure	Construction	PED	CM	Contingency	Real Estate	Total	Annual O&M
1	Revetment	$16,886,000	$1,689,000	$1,013,000	$8,968,000	$1,013,000	$29,569,000	$164,000
2	Revetment	$12,786,500	$1,279,000	$767,000	$6,855,000	$608,000	$22,296,000	$134,000
3	Berm (revetted)	$25,114,000	$2,511,000	$1,507,000	$13,462,000	$608,000	$43,202,000	$265,000
	Totals	**$54,786,500**	**$5,479,000**	**$3,287,000**	**$29,285,000**	**$2,229,000**	**$95,067,000**	**$563,000**

Alternative C

Reach	Construction Measure	Construction	PED	CM	Contingency	Real Estate	Total	Annual O&M
1	Revetment	$16,886,000	$1,689,000	$1,013,000	$8,968,000	$1,013,000	$29,569,000	$164,000
2	Revetment	$12,786,500	$1,279,000	$767,000	$6,855,000	$608,000	$22,296,000	$134,000
3	Berm (revetted)	$25,114,000	$2,511,000	$1,507,000	$13,462,000	$608,000	$43,202,000	$265,000
4	Raise Stevenson St.	$26,367,000	$2,637,000	$1,582,000	$14,134,000	$1,013,000	$45,733,000	$261,000
	Totals	**$81,153,500**	**$8,116,000**	**$4,869,000**	**$43,419,000**	**$3,242,000**	**$140,800,000**	**$824,000**

Alternative D

Reach	Construction Measure	Construction	PED	CM	Contingency	Real Estate	Total	Annual O&M
2	Revetment	$12,786,500	$1,279,000	$767,000	$6,855,000	$608,000	$22,296,000	$134,000
3	Berm (revetted)	$25,114,000	$2,511,000	$1,507,000	$13,462,000	$608,000	$43,202,000	$265,000
5	Raise Stevenson St.	$53,990,000	$5,399,000	$3,239,000	$28,937,000	$608,000	$92,173,000	$530,000
	Totals	**$91,890,500**	**$9,189,000**	**$5,513,000**	**$49,254,000**	**$1,824,000**	**$157,671,000**	**$929,000**

Alternative E

Reach	Construction Measure	Construction	PED	CM	Contingency	Real Estate	Total	Annual O&M
1	Revetment	$16,886,000	$1,689,000	$1,013,000	$8,968,000	$1,013,000	$29,569,000	$164,000
2	Revetment	$12,786,500	$1,279,000	$767,000	$6,855,000	$608,000	$22,296,000	$134,000
3	Berm (revetted)	$25,114,000	$2,511,000	$1,507,000	$13,462,000	$608,000	$43,202,000	$265,000
5	Raise Stevenson St.	$53,990,000	$5,399,000	$3,239,000	$28,937,000	$608,000	$92,173,000	$530,000
	Totals	**$108,776,500**	**$10,878,000**	**$6,526,000**	**$58,222,000**	**$2,837,000**	**$187,240,000**	**$1,093,000**

Alternative F

Reach	Construction Measure	Construction	PED	CM	Contingency	Real Estate	Total	Annual O&M
1	Revetment	$16,886,000	$1,689,000	$1,013,000	$8,968,000	$1,013,000	$29,569,000	$164,000
2	Revetment	$12,786,500	$1,279,000	$767,000	$6,855,000	$608,000	$22,296,000	$134,000
3	Berm (revetted)	$25,114,000	$2,511,000	$1,507,000	$13,462,000	$608,000	$43,202,000	$265,000
4	Raise Stevenson St.	$26,367,000	$2,637,000	$1,582,000	$14,134,000	$1,013,000	$45,733,000	$261,000
5	Raise Stevenson St.	$53,990,000	$5,399,000	$3,239,000	$28,937,000	$608,000	$92,173,000	$530,000
	Totals	**$135,143,500**	**$13,515,000**	**$8,108,000**	**$72,356,000**	**$3,850,000**	**$232,973,000**	**$1,354,000**

Alternative G

Reach	Construction Measure	Construction	PED	CM	Contingency	Real Estate	Total	Annual O&M
1	Revetment	$16,886,000	$1,689,000	$1,013,000	$8,968,000	$1,013,000	$29,569,000	$164,000
2	Revetment	$12,786,500	$1,279,000	$767,000	$6,855,000	$608,000	$22,296,000	$134,000
3	Berm (revetted)	$25,114,000	$2,511,000	$1,507,000	$13,462,000	$608,000	$43,202,000	$265,000
5	Raise Stevenson St.	$53,990,000	$5,399,000	$3,239,000	$28,937,000	$608,000	$92,173,000	$530,000
6	Raise Stevenson St.	$38,251,500	$3,825,000	$2,295,000	$20,501,000	$203,000	$65,076,000	$375,000
	Totals	**$147,028,000**	**$14,703,000**	**$8,821,000**	**$78,723,000**	**$3,040,000**	**$252,316,000**	**$1,468,000**

Alternative H

Reach	Construction Measure	Construction	PED	CM	Contingency	Real Estate	Total	Annual O&M
1	Revetment	$16,886,000	$1,689,000	$1,013,000	$8,968,000	$1,013,000	$29,569,000	$164,000
2	Revetment	$12,786,500	$1,279,000	$767,000	$6,855,000	$608,000	$22,296,000	$134,000
3	Berm (revetted)	$25,114,000	$2,511,000	$1,507,000	$13,462,000	$608,000	$43,202,000	$265,000
4	Raise Stevenson St.	$26,367,000	$2,637,000	$1,582,000	$14,134,000	$1,013,000	$45,733,000	$261,000
5	Raise Stevenson St.	$53,990,000	$5,399,000	$3,239,000	$28,937,000	$608,000	$92,173,000	$530,000
6	Raise Stevenson St.	$38,251,500	$3,825,000	$2,295,000	$20,501,000	$203,000	$65,076,000	$375,000
	Totals	**$173,395,000**	**$17,340,000**	**$10,403,000**	**$92,857,000**	**$4,053,000**	**$298,049,000**	**$1,729,000**

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ATTACHMENT 5 – MCACES QUANTITY SUMMARY

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BARROW COASTAL EROSION - MCACES QUANTITIES

WBS	Item Description	UOM	Waste/Loss	Quantity
16	**BANK STABILIZATION**	**LS**	**-**	**1**
16 R1	**Reach 1 - Bluffs**	**LS**	**-**	**1**
16 R1 01	**Mobilization and Demobilization**	**LS**	**-**	**1**
16 R1 02	**Revetment +19.0ft MLLW**	**LF**	**-**	**2,572**
16 R1 02 01	**Excavation**	**CY**	**-**	**51,114**
16 R1 02 01 01	**Excavation**	**CY**	**-**	**51,114**
	Embankment Excavation [2.5-cy Hydraul. Excavator]	ECY	-	51,114
	Push Excavated Material to Local Stockpile [Dozer]	LCY	15%	58,781
16 R1 02 01 02	**Hauling**	**CY**	**15%**	**58,781**
	Excavated material Hauling [12-cy Truck, 4-mile Haul]	LCY	15%	58,781
16 R1 02 02	**Local Material**	**CY**	**-**	**1,148**
	Local Fill Material, Purchased	LCY	15%	1,321
	Local Fill Material Loading and Hauling [12-cy Truck, 4-mile Haul]	LCY	15%	1,321
	Fill and Compact Material from Stockpile [FE Loader, Vibratory Roller, Water Truck]	LCY	15%	1,321
16 R1 02 03	**Filter Fabric**	**SY**	**-**	**16,290**
	Geosynthetic Soil Stabilization, Geotextile Fabric	SY	5%	17,104
16 R1 02 04	**Rock Placement**	**CY**	**-**	**48,905**
16 R1 02 04 01	**Gravel**	**CY**	**-**	**5,761**
	Gravel Material, Purchased	TON	5%	9,074
	Gravel, Placement [Hydraul. Excavator]	LCY	5%	6,049
16 R1 02 04 02	**Core Rock**	**CY**	**-**	**5,423**
	Core Rock Material, Purchased	TON	5%	8,541
	Core Rock, Placement [Hydraul. Excavator]	LCY	5%	5,694
16 R1 02 04 03	**B-rock**	**CY**	**-**	**16,319**
	B-rock Material, Purchased	TON	5%	30,843
	B-rock, Placement [Hydraul. Excavator]	LCY	5%	17,135
16 R1 02 04 04	**Armor Rock**	**CY**	**-**	**21,402**
	Armor Rock Material, Purchased	TON	5%	40,450
	Armor Rock, Placement [Hydraul. Excavator]	LCY	5%	22,472
16 R2	**Reach 2 - Barrow**	**LS**	**-**	**1**
16 R2 01	**Mobilization and Demobilization**	**LS**	**-**	**1**
16 R2 02	**Revetment +14.5ft MLLW**	**LF**	**-**	**2,139**
16 R2 02 01	**Excavation**	**CY**	**-**	**31,765**
16 R2 02 01 01	**Excavation**	**CY**	**-**	**31,765**
	Embankment Excavation [2.5-cy Hydraul. Excavator]	ECY	-	31,765
	Push Excavated Material to Local Stockpile [Dozer]	LCY	15%	36,529
16 R2 02 01 02	**Hauling**	**CY**	**15%**	**36,529**
	Excavated material Hauling [12-cy Truck, 4-mile Haul]	LCY	15%	36,529
16 R2 02 02	**Local Material**	**CY**	**-**	**4,570**
	Local Fill Material, Purchased	LCY	15%	5,255
	Local Fill Material Loading and Hauling [12-cy Truck, 4-mile Haul]	LCY	15%	5,255
	Fill and Compact Material from Stockpile [FE Loader, Vibratory Roller, Water Truck]	LCY	15%	5,255
16 R2 02 03	**Filter Fabric**	**SY**	**-**	**14,174**
	Geosynthetic Soil Stabilization, Geotextile Fabric	SY	5%	14,883
16 R2 02 04	**Rock Placement**	**CY**	**-**	**40,391**
16 R2 02 04 01	**Gravel**	**CY**	**-**	**4,981**
	Gravel Material, Purchased	TON	5%	7,845
	Gravel, Placement [Hydraul. Excavator]	LCY	5%	5,230
16 R2 02 04 02	**Core Rock**	**CY**	**-**	**4,666**
	Core Rock Material, Purchased	TON	5%	7,349
	Core Rock, Placement [Hydraul. Excavator]	LCY	5%	4,900
16 R2 02 04 03	**B-rock**	**CY**	**-**	**13,807**
	B-rock Material, Purchased	TON	5%	26,095
	B-rock, Placement [Hydraul. Excavator]	LCY	5%	14,497
16 R2 02 04 04	**Armor Rock**	**CY**	**-**	**16,937**
	Armor Rock Material, Purchased	TON	5%	32,011
	Armor Rock, Placement [Hydraul. Excavator]	LCY	5%	17,784
16 R3	**Reach 3 - Lagoon**	**LS**	**-**	**1**
16 R3 01	**Mobilization and Demobilization**	**LS**	**-**	**1**
16 R3 02	**Berm +14.5ft MLLW**	**LF**	**-**	**1,974**
16 R3 02 01	**Excavation**	**CY**	**-**	**71,530**
16 R3 02 01 01	**Excavation**	**CY**	**-**	**71,530**
	Embankment Excavation [2.5-cy Hydraul. Excavator]	ECY	-	71,530
	Push Excavated Material to Local Stockpile [Dozer]	LCY	15%	82,259
16 R3 02 01 02	**Hauling**	**CY**	**15%**	**82,259**
	Excavated material Hauling [12-cy Truck, 4-mile Haul]	LCY	15%	82,259
16 R3 02 02	**Filter Fabric**	**SY**	**-**	**22,253**
	Geosynthetic Soil Stabilization, Geotextile Fabric	SY	5%	23,366

BARROW COASTAL EROSION - MCACES QUANTITIES

WBS	Item Description	UOM	Waste/Loss	Quantity
16 R3 02 03	**Rock Placement**	**CY**	**-**	**78,880**
16 R3 02 03 01	**Gravel**	**CY**	**-**	**7,895**
	Gravel Material, Purchased	TON	5%	12,435
	Gravel, Placement [Hydraul. Excavator]	LCY	5%	8,290
16 R3 02 03 02	**Core Rock**	**CY**	**-**	**7,404**
	Core Rock Material, Purchased	TON	5%	11,661
	Core Rock, Placement [Hydraul. Excavator]	LCY	5%	7,774
16 R3 02 03 03	**B-rock**	**CY**	**-**	**30,887**
	B-rock Material, Purchased	TON	5%	58,377
	B-rock, Placement [Hydraul. Excavator]	LCY	5%	32,432
16 R3 02 03 04	**Armor Rock**	**CY**	**-**	**32,694**
	Armor Rock Material, Purchased	TON	5%	61,792
	Armor Rock, Placement [Hydraul. Excavator]	LCY	5%	34,329
16 R4	**Reach 4 - Browerville**	**LS**	**-**	**1**
16 R4 01	**Mobilization and Demobilization**	**LS**	**-**	**1**
16 R4 02	**14-ft Raise Stevenson Street**	**LF**	**-**	**5,979**
16 R4 02 01	**Excavation**	**CY**	**-**	**78,760**
16 R4 02 01 01	**Excavation**	**CY**	**-**	**78,760**
	Embankment Excavation [2.5-cy Hydraul. Excavator]	ECY	-	78,760
	Push Excavated Material to Local Stockpile [Dozer]	LCY	15%	90,575
16 R4 02 01 02	**Hauling**	**CY**	**15%**	**90,575**
	Excavated material Hauling [12-cy Truck, 4-mile Haul]	LCY	15%	90,575
16 R4 02 02	**Local Material**	**CY**	**-**	**28,732**
	Local Fill Material, Purchased	LCY	15%	33,042
	Local Fill Material Loading and Hauling [12-cy Truck, 4-mile Haul]	LCY	15%	33,042
	Fill and Compact Material from Stockpile [FE Loader, Vibratory Roller, Water Truck]	LCY	15%	33,042
16 R4 02 03	**Filter Fabric**	**SY**	**-**	**30,170**
	Geosynthetic Soil Stabilization, Geotextile Fabric	SY	5%	31,678
16 R4 02 04	**Rock Placement**	**CY**	**-**	**79,884**
16 R4 02 04 01	**Gravel**	**CY**	**-**	**10,547**
	Gravel Material, Purchased	TON	5%	16,612
	Gravel, Placement [Hydraul. Excavator]	LCY	5%	11,075
16 R4 02 04 02	**Core Rock**	**CY**	**-**	**9,787**
	Core Rock Material, Purchased	TON	5%	15,415
	Core Rock, Placement [Hydraul. Excavator]	LCY	5%	10,277
16 R4 02 04 03	**B-rock**	**CY**	**-**	**28,271**
	B-rock Material, Purchased	TON	5%	53,432
	B-rock, Placement [Hydraul. Excavator]	LCY	5%	29,684
16 R4 02 04 04	**Armor Rock**	**CY**	**-**	**31,279**
	Armor Rock Material, Purchased	TON	5%	59,117
	Armor Rock, Placement [Hydraul. Excavator]	LCY	5%	32,843
16 R4 02 05	**Road Access**	**CY**	**-**	**3,873**
	Local Fill Material, Purchased	LCY	15%	4,454
	Local Fill Material Loading and Hauling [12-cy Truck, 4-mile Haul]	LCY	15%	4,454
	Fill and Compact Material from Stockpile [FE Loader, Vibratory Roller, Water Truck]	LCY	15%	4,454
16 R5	**Reach 5 - South and Middle Salt**	**LS**	**-**	**1**
16 R5 01	**Mobilization and Demobilization**	**LS**	**-**	**1**
16 R5 02	**14-ft Raise Stevenson Street**	**LF**	**-**	**10,063**
16 R5 02 01	**Excavation**	**CY**	**-**	**172,031**
16 R5 02 01 01	**Excavation**	**CY**	**-**	**172,031**
	Embankment Excavation [2.5-cy Hydraul. Excavator]	ECY	-	172,031
	Push Excavated Material to Local Stockpile [Dozer]	LCY	15%	197,835
16 R5 02 01 02	**Hauling**	**CY**	**15%**	**197,835**
	Excavated material Hauling [12-cy Truck, 4-mile Haul]	LCY	15%	197,835
16 R5 02 02	**Local Material**	**CY**	**-**	**60,873**
	Local Fill Material, Purchased	LCY	15%	70,004
	Local Fill Material Loading and Hauling [12-cy Truck, 4-mile Haul]	LCY	15%	70,004
	Fill and Compact Material from Stockpile [FE Loader, Vibratory Roller, Water Truck]	LCY	15%	70,004
16 R5 02 03	**Filter Fabric**	**SY**	**-**	**61,794**
	Geosynthetic Soil Stabilization, Geotextile Fabric	SY	5%	64,883
16 R5 02 04	**Rock Placement**	**CY**	**-**	**163,381**
16 R5 02 04 01	**Gravel**	**CY**	**-**	**21,602**
	Gravel Material, Purchased	TON	5%	34,022
	Gravel, Placement [Hydraul. Excavator]	LCY	5%	22,682
16 R5 02 04 02	**Core Rock**	**CY**	**-**	**20,028**
	Core Rock Material, Purchased	TON	5%	31,544
	Core Rock, Placement [Hydraul. Excavator]	LCY	5%	21,029

BARROW COASTAL EROSION - MCACES QUANTITIES

WBS	Item Description	UOM	Waste/Loss	Quantity
16 R5 02 04 03	**B-rock**	**CY**	**-**	**21,602**
	B-rock Material, Purchased	TON	5%	40,827
	B-rock, Placement [Hydraul. Excavator]	LCY	5%	22,682
16 R5 02 04 04	**Armor Rock**	**CY**	**-**	**63,911**
	Armor Rock Material, Purchased	TON	5%	120,792
	Armor Rock, Placement [Hydraul. Excavator]	LCY	5%	67,107
16 R5 02 05	**Road Access**	**CY**	**-**	**2,118**
	Local Fill Material, Purchased	LCY	15%	2,436
	Local Fill Material Loading and Hauling [12-cy Truck, 4-mile Haul]	LCY	15%	2,436
	Fill and Compact Material from Stockpile [FE Loader, Vibratory Roller, Water Truck]	LCY	15%	2,436
16 R6	**Reach 6 - NARL**	**LS**	**-**	**1**
16 R6 01	**Mobilization and Demobilization**	**LS**	**-**	**1**
16 R6 02	**14-ft Raise Stevenson Street**	**LF**	**-**	**5,621**
16 R6 02 01	**Excavation**	**CY**	**-**	**148,073**
16 R6 02 01 01	**Excavation**	**CY**	**-**	**148,073**
	Embankment Excavation [2.5-cy Hydraul. Excavator]	ECY	-	148,073
	Push Excavated Material to Local Stockpile [Dozer]	LCY	15%	170,284
16 R6 02 01 02	**Hauling**	**CY**	**15%**	**170,284**
	Excavated material Hauling [12-cy Truck, 4-mile Haul]	LCY	15%	170,284
16 R6 02 02	**Local Material**	**CY**	**-**	**31,338**
	Local Fill Material, Purchased	LCY	15%	36,039
	Local Fill Material Loading and Hauling [12-cy Truck, 4-mile Haul]	LCY	15%	36,039
	Fill and Compact Material from Stockpile [FE Loader, Vibratory Roller, Water Truck]	LCY	15%	36,039
16 R6 02 03	**Filter Fabric**	**SY**	**-**	**43,671**
	Geosynthetic Soil Stabilization, Geotextile Fabric	SY	5%	45,855
16 R6 02 04	**Rock Placement**	**CY**	**-**	**115,327**
16 R6 02 04 01	**Gravel**	**CY**	**-**	**15,247**
	Gravel Material, Purchased	TON	5%	24,015
	Gravel, Placement [Hydraul. Excavator]	LCY	5%	16,010
16 R6 02 04 02	**Core Rock**	**CY**	**-**	**14,148**
	Core Rock Material, Purchased	TON	5%	22,284
	Core Rock, Placement [Hydraul. Excavator]	LCY	5%	14,856
16 R6 02 04 03	**B-rock**	**CY**	**-**	**40,860**
	B-rock Material, Purchased	TON	5%	77,225
	B-rock, Placement [Hydraul. Excavator]	LCY	5%	42,903
16 R6 02 04 04	**Armor Rock**	**CY**	**-**	**45,072**
	Armor Rock Material, Purchased	TON	5%	85,186
	Armor Rock, Placement [Hydraul. Excavator]	LCY	5%	47,326
16 R6 02 05	**Road Access**	**CY**	**-**	**3,100**
	Local Fill Material, Purchased	LCY	15%	3,565
	Local Fill Material Loading and Hauling [12-cy Truck, 4-mile Haul]	LCY	15%	3,565
	Fill and Compact Material from Stockpile [FE Loader, Vibratory Roller, Water Truck]	LCY	15%	3,565
18	**CULTURAL RESOURCES**	**LS**	**-**	**1**
18 01	**On-Site Archaeologist**	**MO**	**-**	**15**
	Archaeologist	MO	-	15

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ATTACHMENT 6 – TENTATIVE PROJECT SCHEDULE

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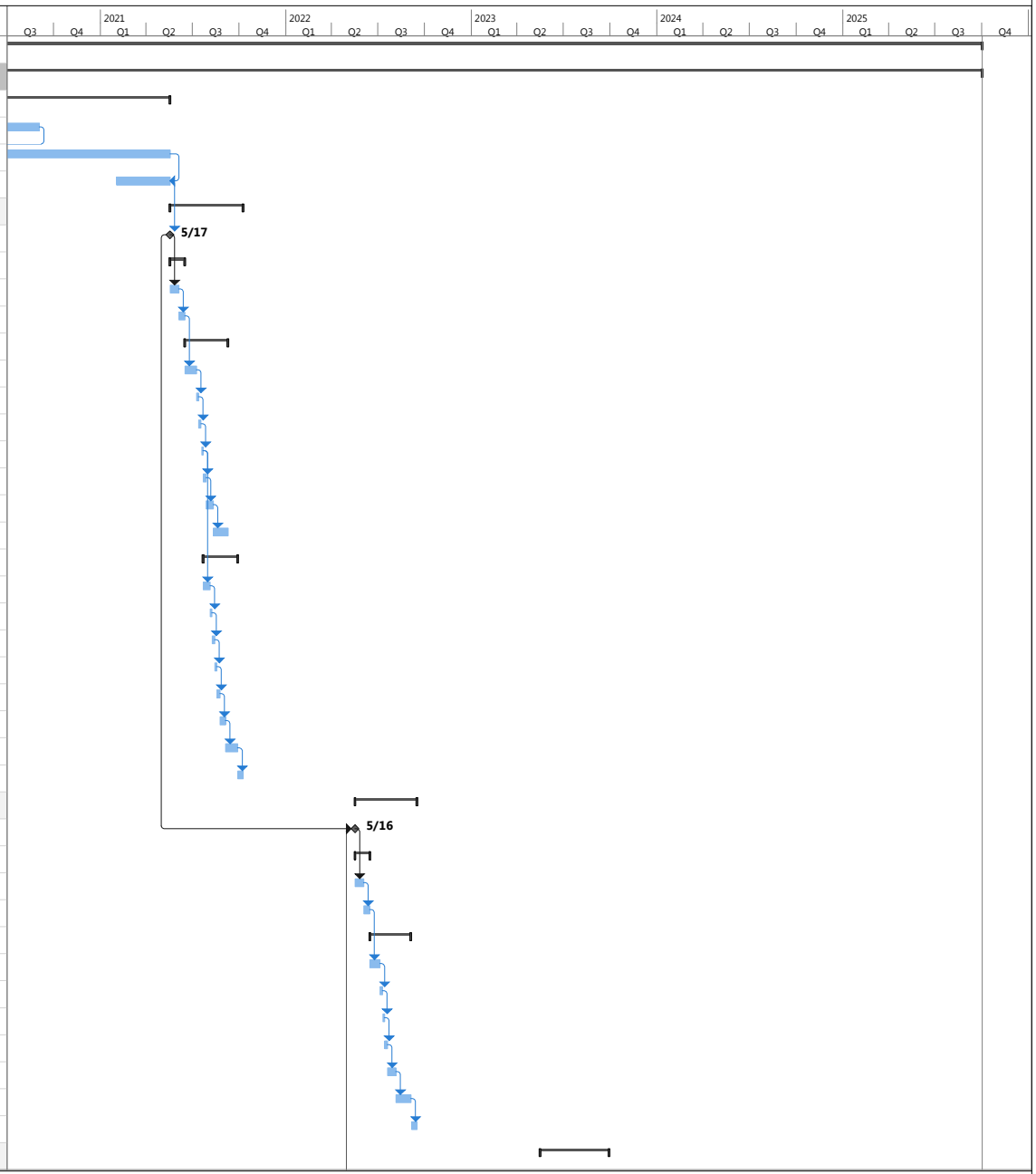
Barrow Coastal Erosion Feasibility Study
Tentative Construction Schedule

ID	Task Name	Duration	Start	Finish
1	**BARROW COASTAL EROSION PROTECTION**	**2090 days**	**Tue 1/29/19**	**Wed 10/1/25**
2	**TENTATIVELY SELECTED PLAN (TSP)**	**2090 days**	**Tue 1/29/19**	**Wed 10/1/25**
3	**Pre-Construction Award**	**720 days**	**Tue 1/29/19**	**Mon 5/17/21**
4	Planning, Engineering and Design	500 days	Tue 1/29/19	Wed 9/2/20
5	Real Estate Acquisition	500 days	Sat 10/12/19	Mon 5/17/21
6	Contract Bid and Award	90 days	Tue 2/2/21	Mon 5/17/21
7	**Construction - Phase 1 [Reach 1 and 2]**	**124 days**	**Mon 5/17/21**	**Fri 10/8/21**
8	Notice to Proceed	0 days	Mon 5/17/21	Mon 5/17/21
9	**Mobilization and Preparatory Work**	**25 days**	**Tue 5/18/21**	**Tue 6/15/21**
10	Mobilization	15 days	Tue 5/18/21	Thu 6/3/21
11	Site Access and Staging	10 days	Fri 6/4/21	Tue 6/15/21
12	**Reach 1 - 19 Ft Revetment**	**73 days**	**Wed 6/16/21**	**Wed 9/8/21**
13	Excavation	20 days	Wed 6/16/21	Thu 7/8/21
14	Local Material Fill	3 days	Fri 7/9/21	Mon 7/12/21
15	Filter Fabric	5 days	Tue 7/13/21	Sat 7/17/21
16	Gravel	3 days	Mon 7/19/21	Wed 7/21/21
17	Core Rock	5 days	Thu 7/22/21	Tue 7/27/21
18	B-rock	12 days	Wed 7/28/21	Tue 8/10/21
19	Armor Rock	25 days	Wed 8/11/21	Wed 9/8/21
20	**Reach 2 - 14.5 Ft Revetment**	**58 days**	**Thu 7/22/21**	**Mon 9/27/21**
21	Excavation	12 days	Thu 7/22/21	Wed 8/4/21
22	Local Material Fill	3 days	Thu 8/5/21	Sat 8/7/21
23	Filter Fabric	5 days	Mon 8/9/21	Fri 8/13/21
24	Gravel	3 days	Sat 8/14/21	Tue 8/17/21
25	Core Rock	5 days	Wed 8/18/21	Mon 8/23/21
26	B-rock	10 days	Tue 8/24/21	Fri 9/3/21
27	Armor Rock	20 days	Sat 9/4/21	Mon 9/27/21
28	Demobilization	10 days	Tue 9/28/21	Fri 10/8/21
29	**Construction - Phase 2 [Reach 3]**	**105 days**	**Mon 5/16/22**	**Thu 9/15/22**
30	Notice to Proceed	0 days	Mon 5/16/22	Mon 5/16/22
31	**Mobilization and Preparatory Work**	**25 days**	**Tue 5/17/22**	**Tue 6/14/22**
32	Mobilization	15 days	Tue 5/17/22	Thu 6/2/22
33	Site Access and Staging	10 days	Fri 6/3/22	Tue 6/14/22
34	**Reach 3 - 14.5 FT Berm**	**70 days**	**Wed 6/15/22**	**Sat 9/3/22**
35	Excavation	17 days	Wed 6/15/22	Mon 7/4/22
36	Filter Fabric	5 days	Tue 7/5/22	Sat 7/9/22
37	Gravel	3 days	Mon 7/11/22	Wed 7/13/22
38	Core Rock	5 days	Thu 7/14/22	Tue 7/19/22
39	B-rock	14 days	Wed 7/20/22	Thu 8/4/22
40	Armor Rock	26 days	Fri 8/5/22	Sat 9/3/22
41	Demobilization	10 days	Mon 9/5/22	Thu 9/15/22
42	**Construction - Phase 3 [Reach 4]**	**117 days**	**Mon 5/15/23**	**Thu 9/28/23**

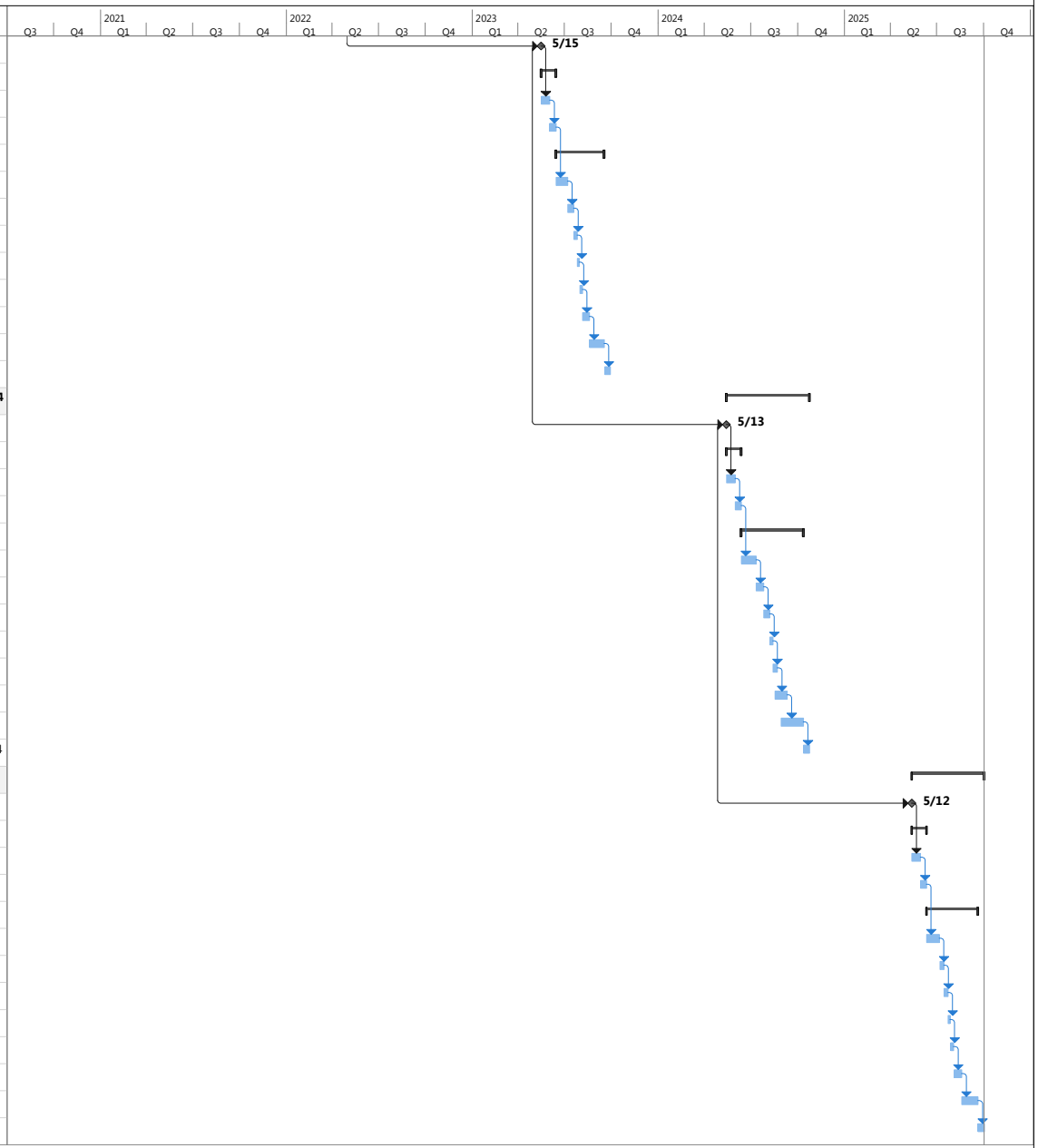


Project: Barrow_Schedule_WOR
Date: Fri 4/12/19

Task
Split
Milestone
Summary
Project Summary
Inactive Task
Inactive Milestone
Inactive Summary
Manual Task
Duration-only
Manual Summary Rollup
Manual Summary
Start-only
Finish-only
External Tasks
External Milestone
Deadline
Progress
Manual Progress

Barrow Coastal Erosion Feasibility Study
Tentative Construction Schedule

ID	Task Name	Duration	Start	Finish
43	Notice to Proceed	0 days	Mon 5/15/23	Mon 5/15/23
44	**Mobilization and Preparatory Work**	**25 days**	**Tue 5/16/23**	**Tue 6/13/23**
45	Mobilization	15 days	Tue 5/16/23	Thu 6/1/23
46	Site Access and Staging	10 days	Fri 6/2/23	Tue 6/13/23
47	**Reach 4 - 14 FT Raise Stevenson Street**	**82 days**	**Wed 6/14/23**	**Sat 9/16/23**
48	Excavation	20 days	Wed 6/14/23	Thu 7/6/23
49	Local Material Fill	10 days	Fri 7/7/23	Tue 7/18/23
50	Filter Fabric	6 days	Wed 7/19/23	Tue 7/25/23
51	Gravel	4 days	Wed 7/26/23	Sat 7/29/23
52	Core Rock	5 days	Mon 7/31/23	Fri 8/4/23
53	B-rock	12 days	Sat 8/5/23	Fri 8/18/23
54	Armor Rock	25 days	Sat 8/19/23	Sat 9/16/23
55	Demobilization	10 days	Mon 9/18/23	Thu 9/28/23
56	**Construction - Phase 4 [Reach 5]**	**140 days**	**Mon 5/13/24**	**Wed 10/23/24**
57	Notice to Proceed	0 days	Mon 5/13/24	Mon 5/13/24
58	**Mobilization and Preparatory Work**	**25 days**	**Tue 5/14/24**	**Tue 6/11/24**
59	Mobilization	15 days	Tue 5/14/24	Thu 5/30/24
60	Site Access and Staging	10 days	Fri 5/31/24	Tue 6/11/24
61	**Reach 5 - 14 Ft Raise Stevenson Street**	**105 days**	**Wed 6/12/24**	**Fri 10/11/24**
62	Excavation	25 days	Wed 6/12/24	Wed 7/10/24
63	Local Material Fill	13 days	Thu 7/11/24	Thu 7/25/24
64	Filter Fabric	10 days	Fri 7/26/24	Tue 8/6/24
65	Gravel	5 days	Wed 8/7/24	Mon 8/12/24
66	Core Rock	8 days	Tue 8/13/24	Wed 8/21/24
67	B-rock	20 days	Sat 8/17/24	Mon 9/9/24
68	Armor Rock	38 days	Thu 8/29/24	Fri 10/11/24
69	Demobilization	10 days	Sat 10/12/24	Wed 10/23/24
70	**Construction - Phase 5 [Reach 6]**	**122 days**	**Mon 5/12/25**	**Wed 10/1/25**
71	Notice to Proceed	0 days	Mon 5/12/25	Mon 5/12/25
72	**Mobilization and Preparatory Work**	**25 days**	**Tue 5/13/25**	**Tue 6/10/25**
73	Mobilization	15 days	Tue 5/13/25	Thu 5/29/25
74	Site Access and Staging	10 days	Fri 5/30/25	Tue 6/10/25
75	**Reach 5 - 14 Ft Raise Stevenson Street**	**87 days**	**Wed 6/11/25**	**Fri 9/19/25**
76	Excavation	22 days	Wed 6/11/25	Sat 7/5/25
77	Local Material Fill	7 days	Mon 7/7/25	Mon 7/14/25
78	Filter Fabric	7 days	Tue 7/15/25	Tue 7/22/25
79	Gravel	4 days	Wed 7/23/25	Sat 7/26/25
80	Core Rock	6 days	Mon 7/28/25	Sat 8/2/25
81	B-rock	13 days	Mon 8/4/25	Mon 8/18/25
82	Armor Rock	28 days	Tue 8/19/25	Fri 9/19/25
83	Demobilization	10 days	Sat 9/20/25	Wed 10/1/25



Project: Barrow_Schedule_WOR
Date: Fri 4/12/19

Task | Split | Milestone | Summary | Project Summary | Inactive Task | Inactive Milestone | Inactive Summary | Manual Task | Duration-only | Manual Summary Rollup | Manual Summary | Start-only | Finish-only | External Tasks | External Milestone | Deadline | Progress | Manual Progress

ATTACHMENT 7 – DAVIS-BACON LABOR RATES

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General Decision Number: AK180001 08/24/2018 AK1

Superseded General Decision Number: AK20170001

State: Alaska

Construction Types: Building and Heavy

Counties: Alaska Statewide.

BUILDING AND HEAVY CONSTRUCTION PROJECTS (does not include residential construction consisting of single family homes and apartments up to and including 4 stories)

Note: Under Executive Order (EO) 13658, an hourly minimum wage of $10.35 for calendar year 2018 applies to all contracts subject to the Davis-Bacon Act for which the contract is awarded (and any solicitation was issued) on or after January 1, 2015. If this contract is covered by the EO, the contractor must pay all workers in any classification listed on this wage determination at least $10.35 per hour (or the applicable wage rate listed on this wage determination, if it is higher) for all hours spent performing on the contract in calendar year 2018. The EO minimum wage rate will be adjusted annually. Please note that this EO applies to the above-mentioned types of contracts entered into by the federal government that are subject to the Davis-Bacon Act itself, but it does not apply to contracts subject only to the Davis-Bacon Related Acts, including those set forth at 29 CFR 5.1(a)(2)-(60). Additional information on contractor requirements and worker protections under the EO is available at www.dol.gov/whd/govcontracts.

Modification Number	Publication Date
0	01/05/2018
1	01/12/2018
2	02/09/2018
3	03/30/2018
4	04/06/2018
5	04/20/2018
6	04/27/2018
7	06/01/2018
8	08/03/2018
9	08/17/2018
10	08/24/2018

ASBE0097-001 01/01/2018

	Rates	Fringes
Asbestos Workers/Insulator (includes application of all insulating materials protective coverings, coatings and finishings to all types of mechanical systems)	$ 38.68	21.57
HAZARDOUS MATERIAL HANDLER (includes preparation, wetting, stripping, removal scrapping, vacuming, bagging, and disposing of all insulation materials, whether they contain asbestos or not,		

from mechanical systems).....$ 37.38 19.55

BOIL0502-002 08/01/2016

	Rates	Fringes
BOILERMAKER	$ 44.26	28.41

BRAK0001-002 07/01/2017

	Rates	Fringes
Bricklayer, Blocklayer, Stonemason, Marble Mason, Tile Setter, Terrazzo Worker	$ 40.81	19.19
Tile & Terrazzo Finisher	$ 34.79	19.19

CARP1501-001 09/01/2016

	Rates	Fringes
MILLWRIGHT	$ 36.74	22.99

CARP2520-003 09/01/2017

	Rates	Fringes
Diver		
Stand-by	$ 42.65	25.16
Tender	$ 41.65	25.16
Working	$ 82.45	25.16
Piledriver		
Piledriver; Skiff Operator and Rigger	$ 38.34	25.16
Sheet Stabber	$ 38.34	25.16
Welder	$ 43.90	25.16

DEPTH PAY PREMIUM FOR DIVERS BELOW WATER SURFACE:
50-100 feet $1.00 per foot
101 feet and deeper $2.00 per foot

ENCLOSURE PAY PREMIUM WITH NO VERTICAL ASCENT:
5-50 FEET $1.00 PER FOOT/DAY
51-100 FEET $2.00 PER FOOT/DAY
101 FEET AND ABOVE $3.00 PER FOOT/DAY

SATURATION DIVING:
The standby rate applies until saturation starts. The saturation diving rate applies when divers are under pressure continuously until work task and decompression are complete. the diver rate shall be paid for all saturation hours.

WORK IN COMBINATION OF CLASSIFICATIONS:
Employees working in any combination of classifications within the diving crew (except dive supervisor) in a shift are paid in the classification with the highest rate for that shift.

CARP4059-001 09/01/2016

	Rates	Fringes
CARPENTER		

```
     Including Lather and
     Drywall Hanging.....$ 38.34            25.04
------------------------------------------------------------
 ELEC1547-004 04/01/2018

                                  Rates          Fringes

CABLE SPLICER.....................$ 39.82        3%+$26.44
ELECTRICIAN.......................$ 39.49        3%+$26.69
------------------------------------------------------------
 ELEC1547-005 04/01/2018

Line Construction

                                  Rates          Fringes

CABLE SPLICER.....................$ 52.57         3%+30.81
Linemen (Including Equipment
Operators, Technician)............$ 50.52         3%+30.81
Powderman.........................$ 48.52         3%+30.81
TREE TRIMMER......................$ 36.21         3%+24.19
------------------------------------------------------------
 ELEV0019-002 01/01/2018

                                  Rates          Fringes

ELEVATOR MECHANIC.................$ 55.45       32.645+a+b

FOOTNOTE: a.  Employer contributes 8% of the basic hourly rate
    for over 5 year's service and 6% of the basic
    hourly rate for 6 months to 5 years' of service
    as vacation paid credit.   b. Eight paid holidays:
    New Year's Day; Memorial Day; Independence Day;
    Labor Day; Veteran's Day; Thanksgiving Day; Friday after
    Thanksgiving, and Christmas Day

------------------------------------------------------------
 ENGI0302-002 04/01/2018

                                  Rates          Fringes

POWER EQUIPMENT OPERATOR
     GROUP 1.....................$ 40.28            23.05
     GROUP 1A....................$ 42.04            23.05
     GROUP 2.....................$ 39.51            23.05
     GROUP 3.....................$ 38.79            23.05
     GROUP 4.....................$ 32.58            23.05
     TUNNEL WORK
      GROUP 1....................$ 44.31            23.05
      GROUP 1A...................$ 46.24            23.05
      GROUP 2....................$ 43.46            23.05
      GROUP 3....................$ 42.67            23.05
      GROUP 4....................$ 35.84            23.05

POWER EQUIPMENT OPERATOR CLASSIFICATIONS

  GROUP 1:  Asphalt Roller: Breakdown, Intermediate, and
  Finish; Back Filler; Barrier Machine (Zipper); Beltcrete
  with power pack and similar conveyors; Bending Machine;
  Boat Coxwains; Bulldozers; Cableways, Highlines and
  Cablecars; Cleaning Machine; Coating Machine; Concrete
  Hydro Blaster; Cranes-45 tons and under or 150 foot boom
  and under (including jib and attachments): (a) Hydralifts
  or Transporters, all track or truck type,(b) Derricks;
  Crushers; Deck Winches-Double Drum; Ditching or Trenching
```

Machine (16 inch or over); Drilling Machines, core, cable, rotary and exploration; Finishing Machine Operator, Concrete Paving, Laser Screed, Sidewalk, Curb and Gutter Machine; Helicopters; Hover Craft, Flex Craft, Loadmaster, Air Cushion, All Terrain Vehicle, Rollagon, Bargecable, Nodwell, and Snow Cat; Hydro Ax: Feller Buncher and similar; Loaders (2 1/2 yards through 5 yards, including all attachments): Forklifts with telescopic boom and swing attachment, Overhead and front end, 2 1/2 yards through 5 yards, Loaders with forks or pipe clamps; Loaders, elevating belt type, Euclid and similar types; Mechanics, Bodyman; Micro Tunneling Machine; Mixers: Mobile type w/hoist combination; Motor Patrol Grader; Mucking Machines: Mole, Tunnel Drill, Horizontal/Directional Drill Operator, and/or Shield; Operator on Dredges; Piledriver Engineers, L. B. Foster, Puller or similar Paving Breaker; Power Plant, Turbine Operator, 200 k.w. and over (power plants or combination of power units over 300 k.w.); Scrapers-through 40 yards; Service Oiler/Service Engineer; Sidebooms-under 45 tons; Shot Blast Machine; Shovels, Backhoes, Excavators with all attachments, and Gradealls (3 yards and under), Spreaders, Blaw Knox, Cedarapids, Barber Greene, Slurry Machine; Sub-grader (Gurries, Reclaimer, and similar types); Tack tractor; Truck mounted Concrete Pumps, Conveyor, Creter; Water Kote Machine; Unlicensed off road hauler

GROUP 1A: Camera/Tool/Video Operator (Slipline), Cranes-over 45 tons or 150 foot (including jib and attachments): (a) Clamshells and Draglines (over 3 yards), (b) Tower cranes; Licensed Water/Waste Water Treatment Operator; Loaders over 5 yds.; Certified Welder, Electrical Mechanic, Camp Maintenance Engineer, Mechanic (over 10,000 hours); Motor Patrol Grader, Dozer, Grade Tractor, Roto-mill/Profiler (finish: when finishing to final grade and/or to hubs, or for asphalt); Power Plants: 1000 k.w. and over; Quad; Screed; Shovels, Backhoes, Excavators with all attachments (over 3 yards), Sidebooms over 45 tons; Slip Form Paver, C.M.I. and similar types; Scrapers over 40 yards;

GROUP 2: Boiler-fireman; Cement Hog and Concrete Pump Operator; Conveyors (except as listed in group 1); Hoist on steel erection; Towermobiles and Air Tuggers; Horizontal/Directional Drill Locator;Licensed Grade Technician; Loaders, (i.e., Elevating Grader and Material Transfer Vehicle); Locomotives: rod and geared engines; Mixers; Screening, Washing Plant; Sideboom (cradling rock drill regardless of size); Skidder; Trencing Machine under 16 inches; Waste/ Waste Water Treatment Operator.

GROUP 3: "A" Frame Trucks, Deck Winches: single power drum; Bombardier (tack or tow rig); Boring Machine; Brooms-power; Bump Cutter; Compressor; Farm tractor; Forklift, industrial type; Gin Truck or Winch Truck with poles when used for hoisting; Grade Checker and Stake Hopper; Hoist, Air Tuggers, Elevators; Loaders: (a) Elevating-Athey, Barber Green and similar types (b) Forklifts or Lumber Carrier (on construction job site) (c) Forklifts with Tower (d) Overhead and Front-end, under 2 1/2 yds. Locomotives:Dinkey (air, steam, gas and electric) Speeders; Mechanics (light duty); Oil, Blower Distribution; Post Hole Diggers, mechanical; Pot Fireman (power agitated); Power Plant, Turbine Operator, under 200 k.w.; Pumps-water; Roller-other than Plantmix; Saws, concrete; Skid Steer with all

attachments; Straightening Machine; Tow Tractor

GROUP 4: Rig Oiler/Crane Assistant Engineer;Parts and Equipment Coordinator; Swamper (on trenching machines or shovel type equipment); Spotter; Steam Cleaner; Drill Helper.

FOOTNOTE: Groups 1-4 receive 10% premium while performing tunnel or underground work. Rig Oiler/Crane Assistant Engineer shall be required on cranes over 85 tons or over 100 feet of boom.

IRON0751-003 07/01/2017

	Rates	Fringes
Ironworkers:		
BRIDGE, STRUCTURAL, ORNAMENTAL, REINFORCING MACHINERY MOVER, RIGGER, SHEETER, STAGE RIGGER, BENDER OPERATOR	$ 37.25	30.43
FENCE, BARRIER INSTALLER	$ 33.75	30.08
GUARDRAIL INSTALLERS	$ 34.75	30.08
GUARDRAIL LAYOUT MAN	$ 34.49	30.08
HELICOPTER, TOWER	$ 38.25	30.43

LABO0341-005 04/01/2018

	Rates	Fringes
Laborers: South of the 63rd Parallel & West of Longitude 138 Degrees		
GROUP 1	$ 30.26	27.01
GROUP 2	$ 31.26	27.01
GROUP 3	$ 32.16	27.01
GROUP 3A	$ 35.44	27.01
GROUP 3B	$ 39.98	24.30
GROUP 4	$ 19.83	27.01
TUNNELS, SHAFTS, AND RAISES		
GROUP 1	$ 33.29	27.01
GROUP 2	$ 34.39	27.01
GROUP 3	$ 35.38	27.01
GROUP 3A	$ 38.98	27.01
GROUP 3B	$ 42.88	24.30

LABORERS CLASSIFICATIONS

GROUP 1: Asphalt Workers (shovelman, plant crew); Brush Cutters; Camp Maintenance Laborer; Carpenter Tenders; Choke Setters, Hook Tender, Rigger, Signalman; Concrete Laborer(curb and gutter, chute handler, grouting, curing, screeding); Crusher Plant Laborer; Demolition Laborer; Ditch Diggers; Dump Man; Environmental Laborer (asbestos (limited to nonmechanical systems), hazardous and toxic waste, oil spill); Fence Installer; Fire Watch Laborer; Flagman; Form Strippers; General Laborer; Guardrail Laborer, Bridge Rail Installers; Hydro-Seeder Nozzleman; Laborers (building); Landscape or Planter; Laying of Decorative Block (retaining walls, flowered decorative block 4 feet and below); Material Handlers; Pneumatic or Power Tools; Portable or Chemical Toilet Serviceman; Pump Man or Mixer Man; Railroad Track Laborer; Sandblast, Pot

Tender; Saw Tenders; Scaffold Building and Erecting; Slurry Work; Stake Hopper; Steam Point or Water Jet Operator; Steam Cleaner Operator; Tank Cleaning; Utiliwalk, Utilidor Laborer and Conduit Installer; Watchman (construction projects); Window Cleaner

GROUP 2: Burning and Cutting Torch; Cement or Lime Dumper or Handler (sack or bulk); Choker Splicer; Chucktender (wagon, airtrack and hydraulic drills); Concrete Laborers (power buggy, concrete saws, pumpcrete nozzleman, vibratorman); Culvert Pipe Laborer; Cured in place Pipelayer; Environmental Laborer (marine work, oil spill skimmer operator, small boat operator); Foam Gun or Foam Machine Operator; Green Cutter (dam work); Gunnite Operator; Hod Carriers; Jackhammer or Pavement Breakers (more than 45 pounds);Laying of Decorative Block (retaining walls, flowered decorative block above 4 feet); Mason Tender and Mud Mixer (sewer work); Pilot Car; Plasterer, Bricklayer and Cement Finisher Tenders; Power Saw Operator; Railroad Switch Layout Laborer; Sandblaster; Sewer Caulkers; Sewer Plant Maintenance Man; Thermal Plastic Applicator; Timber Faller, chain saw operator, filer; Timberman

GROUP 3: Alarm Installer; Bit Grinder; Guardrail Machine Operator; High Rigger and tree topper; High Scaler; Multiplate; Slurry Seal Squeegee Man

GROUP 3A: Asphalt Raker, Asphalt Belly dump lay down; Drill Doctor (in the field); Drillers (including, but not limited to, wagon drills, air track drills; hydraulic drills); Powderman; Pioneer Drilling and Drilling Off Tugger (all type drills); Pipelayers

GROUP 3B: Grade checker (setting or transfering of grade marks, line and grade)

GROUP 4: Final Building Cleanup

TUNNELS, SHAFTS, AND RAISES CLASSIFICATIONS

GROUP 1: Brakeman; Muckers; Nippers; Topman and Bull Gang; Tunnel Track Laborer

GROUP 2: Burning and Cutting Torch; Concrete Laborers; Jackhammers; Nozzleman, Pumpcrete or Shotcrete.

GROUP 3: Miner; Retimberman

GROUP 3A: Asphalt Raker, Asphalt Belly dump lay down; Drill Doctor (in the field); Drillers (including, but not limited to, wagon drills, air track drills; hydraulic drills); Powderman; Pioneer Drilling and Drilling Off Tugger (all type drills); Pipelayers.

GROUP 3B: Grade checker (setting or transfering of grade marks, line and grade)

Tunnel shaft and raise rates only apply to workers regularly employed inside a tunnel portal or shaft collar.

LABO0942-001 04/01/2018

	Rates	Fringes

Laborers: North of the 63rd
Parallel & East of Longitude
138 Degrees

GROUP 1	$ 30.26	27.21
GROUP 2	$ 31.26	27.21
GROUP 3	$ 32.16	27.21
GROUP 3A	$ 35.44	27.21
GROUP 3B	$ 38.98	24.50
GROUP 4	$ 19.83	27.21
TUNNELS, SHAFTS, AND RAISES		
GROUP 1	$ 33.29	27.21
GROUP 2	$ 34.39	27.21
GROUP 3	$ 35.38	27.21
GROUP 3A	$ 38.98	27.21
GROUP 3B	$ 42.88	24.50

LABORERS CLASSIFICATIONS

GROUP 1: Asphalt Workers (shovelman, plant crew); Brush Cutters; Camp Maintenance Laborer; Carpenter Tenders; Choke Setters, Hook Tender, Rigger, Signalman; Concrete Laborer(curb and gutter, chute handler, grouting, curing, screeding); Crusher Plant Laborer; Demolition Laborer; Ditch Diggers; Dump Man; Environmental Laborer (asbestos (limited to nonmechanical systems), hazardous and toxic waste, oil spill); Fence Installer; Fire Watch Laborer; Flagman; Form Strippers; General Laborer; Guardrail Laborer, Bridge Rail Installers; Hydro-Seeder Nozzleman; Laborers (building); Landscape or Planter; Laying of Decorative Block (retaining walls, flowered decorative block 4 feet and below); Material Handlers; Pneumatic or Power Tools; Portable or Chemical Toilet Serviceman; Pump Man or Mixer Man; Railroad Track Laborer; Sandblast, Pot Tender; Saw Tenders; Scaffold Building and Erecting; Slurry Work; Stake Hopper; Steam Point or Water Jet Operator; Steam Cleaner Operator; Tank Cleaning; Utiliwalk, Utilidor Laborer and Conduit Installer; Watchman (construction projects); Window Cleaner

GROUP 2: Burning and Cutting Torch; Cement or Lime Dumper or Handler (sack or bulk); Choker Splicer; Chucktender (wagon, airtrack and hydraulic drills); Concrete Laborers (power buggy, concrete saws, pumpcrete nozzleman, vibratorman); Culvert Pipe Laborer; Cured in place Pipelayer; Environmental Laborer (marine work, oil spill skimmer operator, small boat operator); Foam Gun or Foam Machine Operator; Green Cutter (dam work); Gunnite Operator; Hod Carriers; Jackhammer or Pavement Breakers (more than 45 pounds);Laying of Decorative Block (retaining walls, flowered decorative block above 4 feet); Mason Tender and Mud Mixer (sewer work); Pilot Car; Plasterer, Bricklayer and Cement Finisher Tenders; Power Saw Operator; Railroad Switch Layout Laborer; Sandblaster; Sewer Caulkers; Sewer Plant Maintenance Man; Thermal Plastic Applicator; Timber Faller, chain saw operator, filer; Timberman

GROUP 3: Alarm Installer; Bit Grinder; Guardrail Machine Operator; High Rigger and tree topper; High Scaler; Multiplate; Slurry Seal Squeegee Man

GROUP 3A: Asphalt Raker, Asphalt Belly dump lay down; Drill Doctor (in the field); Drillers (including, but not limited to, wagon drills, air track drills; hydraulic drills); Powderman; Pioneer Drilling and Drilling Off Tugger (all type drills); Pipelayers

GROUP 3B: Grade checker (setting or transfering of grade marks, line and grade)

GROUP 4: Final Building Cleanup

TUNNELS, SHAFTS, AND RAISES CLASSIFICATIONS

GROUP 1: Brakeman; Muckers; Nippers; Topman and Bull Gang; Tunnel Track Laborer

GROUP 2: Burning and Cutting Torch; Concrete Laborers; Jackhammers; Nozzleman, Pumpcrete or Shotcrete.

GROUP 3: Miner; Retimberman

GROUP 3A: Asphalt Raker, Asphalt Belly dump lay down; Drill Doctor (in the field); Drillers (including, but not limited to, wagon drills, air track drills; hydraulic drills); Powderman; Pioneer Drilling and Drilling Off Tugger (all type drills); Pipelayers.

GROUP 3B: Grade checker (setting or transfering of grade marks, line and grade)

Tunnel shaft and raise rates only apply to workers regularly employed inside a tunnel portal or shaft collar.

PAIN1959-001 07/01/2018

NORTH OF THE 63RD PARALLEL

	Rates	Fringes
PAINTER		
BRUSH/ROLLER PAINT OR WALL COVERER	$ 32.09	21.09
TAPING, TEXTURING, STRUCTURAL PAINTING, SANDBLASTING, POT TENDER, FINISH METAL, SPRAY, BUFFER OPERATOR, RADON MITIGATION, LEAD BASED PAINT ABATEMENT, HAZARDOUS MATERIAL HANDLER	$ 32.61	21.09

PAIN1959-002 07/01/2018

SOUTH OF THE 63RD PARALLEL

	Rates	Fringes
PAINTER		
Brush, Roller, Sign, Paper and Vinyl, Swing Stage, Hand Taper/Drywall, Structural Steel, and Commercial Spray	$ 32.09	21.09
Machine Taper/Drywall	$ 32.61	21.09
Spray-Sand/Blast, Epoxy and Tar Applicator	$ 32.61	20.09

PAIN1959-003 07/01/2018

NORTH OF THE 63RD PARALLEL

	Rates	Fringes
GLAZIER	$ 39.28	23.49

PAIN1959-004 07/01/2018

	Rates	Fringes
FLOOR LAYER: Carpet	$ 29.13	14.06

PAIN1959-006 07/01/2018

SOUTH OF THE 63RD PARALLEL

	Rates	Fringes
GLAZIER	$ 39.28	23.49

PLAS0867-001 02/01/2016

	Rates	Fringes
PLASTERER		
North of the 63rd parallel	$ 37.25	20.41
South of the 63rd parallel	$ 37.00	20.41

PLAS0867-004 02/01/2016

	Rates	Fringes
CEMENT MASON/CONCRETE FINISHER		
North of the 63rd parallel	$ 37.25	20.41
South of the 63rd parallel	$ 37.00	20.41

PLUM0262-002 01/01/2017

East of the 141st Meridian

	Rates	Fringes
Plumber; Steamfitter	$ 38.02	26.72

PLUM0367-002 07/01/2017

South of the 63rd Parallel

	Rates	Fringes
Plumber; Steamfitter	$ 39.00	23.80

PLUM0375-002 07/01/2018

North of the 63rd Parallel

	Rates	Fringes
Plumber; Steamfitter	$ 41.16	26.55

PLUM0669-002 04/01/2017

	Rates	Fringes
SPRINKLER FITTER	$ 46.00	23.29

ROOF0189-006 04/01/2018

	Rates	Fringes
ROOFER	$ 44.62	15.50

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* SHEE0023-003 07/01/2018

South of the 63rd Parallel

	Rates	Fringes
SHEET METAL WORKER	$ 42.70	26.40

SHEE0023-004 07/01/2017

North of the 63rd Parallel

	Rates	Fringes
SHEET METAL WORKER	$ 47.74	23.48

TEAM0959-003 03/01/2018

	Rates	Fringes
TRUCK DRIVER		
GROUP 1	$ 39.59	23.62
GROUP 1A	$ 40.86	23.62
GROUP 2	$ 38.33	23.62
GROUP 3	$ 37.51	23.62
GROUP 4	$ 36.93	23.62
GROUP 5	$ 36.17	23.62

GROUP 1: Semi with Double Box Mixer; Dump Trucks (including rockbuggy and trucks with pups) over 40 yards up to and including 60 yards; Deltas, Commanders, Rollogans and similar equipment when pulling sleds, trailers or similar equipment; Boat Coxswain; Lowboys including attached trailers and jeeps, up to and including 12 axles; Ready-mix over 12 yards up to and including 15 yards); Water Wagon (250 Bbls and above); Tireman, Heavy Duty/Fueler

GROUP 1A: Dump Trucks (including Rockbuggy and Trucks with pups) over 60 yards up to and including 100 yards; Jeeps (driver under load)

GROUP 2: Turn-O-Wagon or DW-10 not self-loading; All Deltas, Commanders, Rollogans, and similar equipment; Mechanics; Dump Trucks (including Rockbuggy and Trucks with pups) over 20 yards up to and including 40 yards; Lowboys including attached trailers and jeeps up to and including 8 axles; Super vac truck/cacasco truck/heat stress truck; Ready-mix over 7 yards up to and including 12 yards; Partsman; Stringing Truck

GROUP 3: Dump Trucks (including Rockbuggy and Trucks with pups) over 10 yards up to and including 20 yards; batch trucks 8 yards and up; Oil distributor drivers; Oil Distributor Drivers; Trucks/Jeeps (push or pull); Traffic Control Technician

GROUP 4: Buggymobile; Semi or Truck and trailer; Dumpster; Tireman (light duty); Dump Trucks (including Rockbuggy and

Truck with pups) up to and including 10 yards; Track Truck Equipment; Grease Truck; Flat Beds, dual rear axle; Hyster Operators (handling bulk aggregate); Lumber Carrier; Water Wagon, semi; Water Truck, dual axle; Gin Pole Truck, Winch Truck, Wrecker, Truck Mounted "A" Frame manufactured rating over 5 tons; Bull Lifts and Fork Lifts with Power Boom and Swing attachments, over 5 tons; Front End Loader with Forks; Bus Operator over 30 passengers; All Terrain Vehicles; Boom Truck/Knuckle Truck over 5 tons; Foam Distributor Truck/dual axle; Hydro-seeders, dual axle; Vacuum Trucks, Truck Vacuum Sweepers; Loadmaster (air and water); Air Cushion or similar type vehicle; Fire Truck/Ambulance Driver; Combination Truck-fuel and grease; Compactor (when pulled by rubber tired equipment); Rigger (air/water/oilfield); Ready Mix, up to and including 7 yards;

GROUP 5: Gravel Spreader Box Operator on Truck; Flat Beds, single rear axle; Boom Truck/Knuckle Truck up to and including 5 tons; Pickups (Pilot Cars and all light duty vehicles); Water Wagon (Below 250 Bbls); Gin Pole Truck, Winch Truck, Wrecker, Truck Mounted "A" Frame, manufactured rating 5 tons and under; Bull Lifts and Fork Lifts (fork lifts with power broom and swing attachments up to and including 5 tons); Buffer Truck; Tack Truck; Farm type Rubber Tired Tractor (when material handling or pulling wagons on a construction project); Foam Distributor, single axle; Hydro-Seeders, single axle; Team Drivers (horses, mules and similar equipment); Fuel Handler (station/bulk attendant); Batch Truck, up to and including 7 yards; Gear/Supply Truck; Bus Operator, Up to 30 Passengers; Rigger/Swamper

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WELDERS - Receive rate prescribed for craft performing operation to which welding is incidental.

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Note: Executive Order (EO) 13706, Establishing Paid Sick Leave for Federal Contractors applies to all contracts subject to the Davis-Bacon Act for which the contract is awarded (and any solicitation was issued) on or after January 1, 2017. If this contract is covered by the EO, the contractor must provide employees with 1 hour of paid sick leave for every 30 hours they work, up to 56 hours of paid sick leave each year. Employees must be permitted to use paid sick leave for their own illness, injury or other health-related needs, including preventive care; to assist a family member (or person who is like family to the employee) who is ill, injured, or has other health-related needs, including preventive care; or for reasons resulting from, or to assist a family member (or person who is like family to the employee) who is a victim of, domestic violence, sexual assault, or stalking. Additional information on contractor requirements and worker protections under the EO is available at www.dol.gov/whd/govcontracts.

Unlisted classifications needed for work not included within the scope of the classifications listed may be added after award only as provided in the labor standards contract clauses (29CFR 5.5 (a) (1) (ii)).

The body of each wage determination lists the classification and wage rates that have been found to be prevailing for the cited type(s) of construction in the area covered by the wage determination. The classifications are listed in alphabetical order of "identifiers" that indicate whether the particular rate is a union rate (current union negotiated rate for local), a survey rate (weighted average rate) or a union average rate (weighted union average rate).

Union Rate Identifiers

A four letter classification abbreviation identifier enclosed in dotted lines beginning with characters other than "SU" or "UAVG" denotes that the union classification and rate were prevailing for that classification in the survey. Example: PLUM0198-005 07/01/2014. PLUM is an abbreviation identifier of the union which prevailed in the survey for this classification, which in this example would be Plumbers. 0198 indicates the local union number or district council number where applicable, i.e., Plumbers Local 0198. The next number, 005 in the example, is an internal number used in processing the wage determination. 07/01/2014 is the effective date of the most current negotiated rate, which in this example is July 1, 2014.

Union prevailing wage rates are updated to reflect all rate changes in the collective bargaining agreement (CBA) governing this classification and rate.

Survey Rate Identifiers

Classifications listed under the "SU" identifier indicate that no one rate prevailed for this classification in the survey and the published rate is derived by computing a weighted average rate based on all the rates reported in the survey for that classification. As this weighted average rate includes all rates reported in the survey, it may include both union and non-union rates. Example: SULA2012-007 5/13/2014. SU indicates the rates are survey rates based on a weighted average calculation of rates and are not majority rates. LA indicates the State of Louisiana. 2012 is the year of survey on which these classifications and rates are based. The next number, 007 in the example, is an internal number used in producing the wage determination. 5/13/2014 indicates the survey completion date for the classifications and rates under that identifier.

Survey wage rates are not updated and remain in effect until a new survey is conducted.

Union Average Rate Identifiers

Classification(s) listed under the UAVG identifier indicate that no single majority rate prevailed for those classifications; however, 100% of the data reported for the classifications was union data. EXAMPLE: UAVG-OH-0010 08/29/2014. UAVG indicates that the rate is a weighted union average rate. OH indicates the state. The next number, 0010 in the example, is an internal number used in producing the wage determination. 08/29/2014 indicates the survey completion date for the classifications and rates under that identifier.

A UAVG rate will be updated once a year, usually in January of each year, to reflect a weighted average of the current

negotiated/CBA rate of the union locals from which the rate is based.

WAGE DETERMINATION APPEALS PROCESS

1.) Has there been an initial decision in the matter? This can be:

* an existing published wage determination
* a survey underlying a wage determination
* a Wage and Hour Division letter setting forth a position on a wage determination matter
* a conformance (additional classification and rate) ruling

On survey related matters, initial contact, including requests for summaries of surveys, should be with the Wage and Hour Regional Office for the area in which the survey was conducted because those Regional Offices have responsibility for the Davis-Bacon survey program. If the response from this initial contact is not satisfactory, then the process described in 2.) and 3.) should be followed.

With regard to any other matter not yet ripe for the formal process described here, initial contact should be with the Branch of Construction Wage Determinations. Write to:

Branch of Construction Wage Determinations
Wage and Hour Division
U.S. Department of Labor
200 Constitution Avenue, N.W.
Washington, DC 20210

2.) If the answer to the question in 1.) is yes, then an interested party (those affected by the action) can request review and reconsideration from the Wage and Hour Administrator (See 29 CFR Part 1.8 and 29 CFR Part 7). Write to:

Wage and Hour Administrator
U.S. Department of Labor
200 Constitution Avenue, N.W.
Washington, DC 20210

The request should be accompanied by a full statement of the interested party's position and by any information (wage payment data, project description, area practice material, etc.) that the requestor considers relevant to the issue.

3.) If the decision of the Administrator is not favorable, an interested party may appeal directly to the Administrative Review Board (formerly the Wage Appeals Board). Write to:

Administrative Review Board
U.S. Department of Labor
200 Constitution Avenue, N.W.
Washington, DC 20210

4.) All decisions by the Administrative Review Board are final.

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END OF GENERAL DECISION

ATTACHMENT 8 – ESTIMATED PRODUCTION RATES

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TITLE:	Barrow Alaska Coastal Erosion Feasibility Study		
SUBJECT:	Output Rates for Excavation		
MADE BY:	SKV	JOB NO.:	
CHECKED BY:	IP	DATE:	8/24/2018

CSI TASK:

EMBANKMENT EXCAVATION

CREW: *Hydraul. Excavation Crew* — 2 crew members

1 Equip. Oper. Heavy
1 Oiler
1 Hydraul. Excavator, 2-cy Bucket

PRODUCTION

2.5	cy bucket
0.85	% fill
55	min/hr
1.00	cycle/min

117 cy/crew hr

PUSH EXCAVATED MATERIAL TO STOCKPILE

CREW: *Push to/from Stockpile Crew* — 1 crew members

1 Equip. Oper. Medium
1 Dozer

PRODUCTION

5.0	cy bucket
0.85	% fill
55	min/hr
0.50	cycle/min

117 cy/crew hr

TITLE:	Barrow Alaska Coastal Erosion Feasibility Study		
SUBJECT:	Output Rates for Loading and Hauling Material to Disposal		
MADE BY:	SKV	JOB NO.:	
CHECKED BY:	IP	DATE:	8/24/2018

Sheet No. 1 of 1

CSI TASK:

HAUL TO DISPOSAL SITE

SUB-CREW: Load and Haul Crew — 2 crew members

- 1 Truck Driver, Heavy
- 1 Equip. Oper. Medium
- 1 12-cy Dump Truck
- 1 Front End Loader

PRODUCTION

12	cy truck
0.95	% fill
5.0	min. for loading
4	mi. to disposal location
20	mph haul speed
2.5	min. dump time
60	min/hr

QUANTITY PER TRUCK 11.4 cy/truck

DURATION OF HAULING 0.53 hr

21.7 cy/hr →

TITLE:	Barrow Alaska Coastal Erosion Feasibility Study		
SUBJECT:	Output Rates for Fill and Compact From Stockpile		
MADE BY:	SKV	JOB NO.:	
CHECKED BY:	IP	DATE:	8/24/2018

CSI TASK:

FILL AND COMPACT FROM STOCKPILE
[300-ft Haul , 3-cy Bucket, Vibro Compacted, with 3,000-gal Water Truck]

CREW NAME: *Fill and Compact from Stockpile Crew* — 5 crew members

3	Eq. Oper. Med.
1	Laborers
1	Truck Driver, Heavy
1	Dozer
1	Front End Loader 3-cy Bucket
1	Vibratory Roller
1	Dozer
1	Water Truck, 3000-gal

OVERALL PRODUCTION RATE → **98 cy/crew hr**

FILL FROM STOCKPILE

SUB-CREW: Fill From Stockpile Crew — 3 crew members

2	Eq. Oper. Med.
0.5	Laborer
1	Dozer
1	Front End Loader, 3-cy Bucket

PRODUCTION

3	cy bucket (avg.)
0.85	% fill
55	min/hr
0.70	cycle/min

→ 98 cy/crew hr

COMPACT FILL

SUB-CREW: Compaction Crew — 1.5 crew members

0.5	laborer
1	Equip. Oper. Medium
1	Vibratory Roller

PRODUCTION

0.24	min/cy	→ 250 cy/hr
0.39	crews/equipment members to match overall production rate	
1.00	total number of crews needed	

TITLE:	Barrow Alaska Coastal Erosion Feasibility Study		
SUBJECT:	Output Rates for Fill and Compact From Stockpile		
MADE BY:	SKV	JOB NO.:	
CHECKED BY:	IP	DATE:	8/24/2018

WATER TRUCK

SUB-CREW: Water Truck Crew — 1 crew members

1 Truck Driver, Heavy
1 Water Truck, 3000-gal

PRODUCTION 0.48 min/cy → 125 cy/hr

0.79 crews/equipment members to match overall production rate

1.00 total number of crews needed

TITLE:	Barrow Alaska Coastal Erosion Feasibility Study		
SUBJECT:	Output Rates for Stone Placement		
MADE BY:	SKV	JOB NO.:	
CHECKED BY:	IP	DATE:	8/24/2018

CSI TASK:

ARMOR ROCK, PLACEMENT

CREW: *Rock Placement Crew* — 5 crew members

- 2 Laborers
- 1 Truck Driver
- 1 Oiler
- 1 Equip. Oper. Heavy
- 1 Hydraulic Excavator
- 1 12 cy Dump Truck

2.5	cy bucket
0.65	% fill
55	min/hr
0.40	cycle/min

OVERALL PRODUCTION RATE → **36 cy/hr**

B-ROCK PLACEMENT

CREW: *Rock Placement Crew* — 5 crew members

- 2 Laborers
- 1 Truck Driver
- 1 Oiler
- 1 Equip. Oper. Heavy
- 1 Hydraulic Excavator
- 1 12 cy Dump Truck

2.5	cy bucket
0.75	% fill
55	min/hr
0.55	cycle/min

OVERALL PRODUCTION RATE → **57 cy/hr**

B-ROCK PLACEMENT

CREW: *Rock Placement Crew* — 5 crew members

- 2 Laborers
- 1 Truck Driver
- 1 Oiler
- 1 Equip. Oper. Heavy
- 1 Hydraulic Excavator
- 1 12 cy Dump Truck

2.5	cy bucket
0.80	% fill
55	min/hr
0.60	cycle/min

OVERALL PRODUCTION RATE → **66 cy/hr**

TITLE:	Barrow Alaska Coastal Erosion Feasibility Study		
SUBJECT:	Output Rates for Stone Placement		
MADE BY:	SKV	JOB NO.:	
CHECKED BY:	IP	DATE:	8/24/2018

CSI TASK:

GRAVEL PLACEMENT

CREW: *Rock Placement Crew* — 5 crew members

2	Laborers
1	Truck Driver
1	Oiler
1	Equip. Oper. Heavy
1	Hydraulic Excavator
1	12 cy Dump Truck

2.5	cy bucket
0.90	% fill
55	min/hr
0.85	cycle/min

OVERALL PRODUCTION RATE → **105 cy/hr**

TITLE:	Barrow Alaska Coastal Erosion Feasibility Study		
SUBJECT:	Output Rates for Loading and Hauling Material to Disposal		
MADE BY:	SKV	JOB NO.:	
CHECKED BY:		DATE:	8/24/2018

CSI TASK:

BARGE MOB/DEMOB

Barge Mob/Demob Crek

PRODUCTION

2200	Distance (mi.)
5	mph speed
40.0	Prep time (hrs.)

DURATION OF SHIPPING 480.00 hrs/trip

0.0021 trip/hr →

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ATTACHMENT 9 – COST AND SCHEDULE RISK ANALYSIS REPORT

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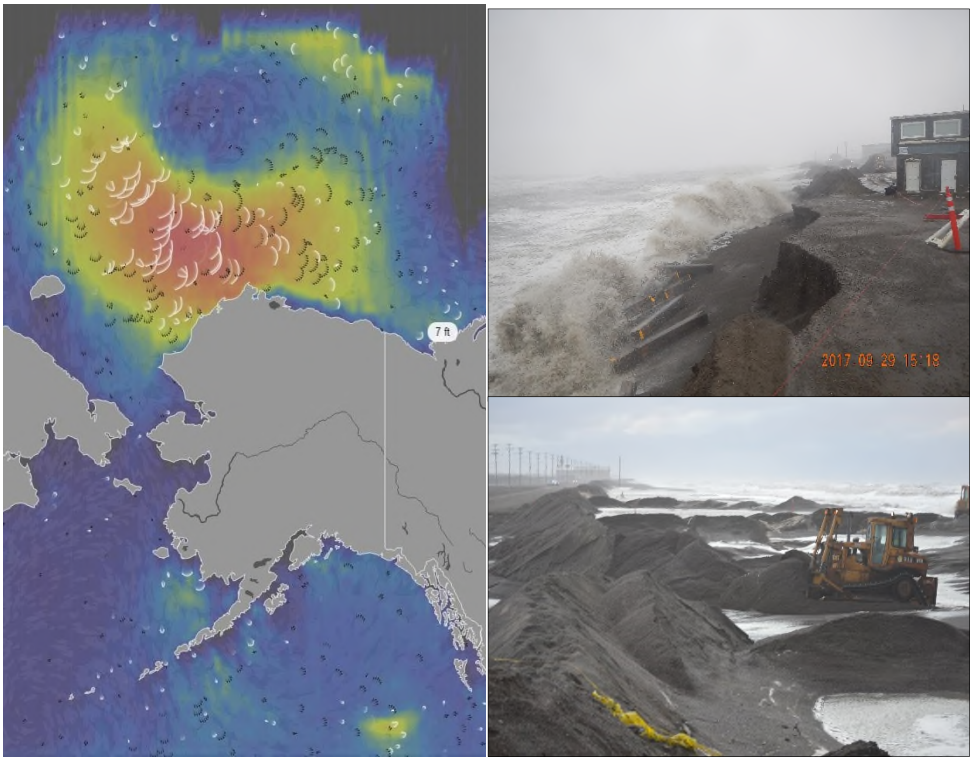
U.S. Army Corps
of Engineers
Alaska District

Barrow Alaska Coastal Erosion Feasibility Study



Cost and Schedule Risk Analysis (CSRA) Report

May 2019

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BARROW ALASKA
COASTAL EROSION FEASIBILITY STUDY

COST AND SCHEDULE RISK ANALYSIS (CSRA) REPORT

prepared for:

Alaska District

U.S. Army Corps of Engineers

prepared by:

Tetra Tech Inc.

1420 5th Ave Suite 650

Seattle, Washington

May 2019

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EXECUTIVE SUMMARY

This report presents a recommendation for the total construction cost and schedule contingency for the *Barrow Coastal Erosion Project, Feasibility Report.* A formal risk analysis study was conducted to develop a reliable and defensible contingency factor for the total construction cost associated with the MCACES construction cost estimate. The cost and schedule risk analysis involved the development of project contingencies by identifying and evaluating the impacts of project uncertainties on the construction cost and schedule and a subsequent calculation of the estimated total construction cost.

The Project Delivery Team (PDT) conducted a brainstorming session on November 11th, 2018, to identify the risks associated with the project. Additional coordination of the PDT for review and input occurred thereafter. Key project and risk assumptions reflected in the analysis were identified. The risk analysis was performed using Oracle Crystal Ball software to estimate a contingency with the use of Monte Carlo simulations in correlation with the proposed risks and uncertainties.

The contingency is based on an 80 percent (P80) confidence level, per accepted U.S. Army Corps of Engineers guidance. For the Barrow Coastal Erosion Project, the most likely baseline construction cost is estimated at $208.6 million (Table ES-1). The risk analysis resulted in a contingency value of $85.5 million which equates to approximately 41 percent of construction costs.

Table ES1 – Contingency Summary

Contingency on Base Estimate	80% Confidence Project Cost	
Base Construction Estimate	**$206,396,620**	
Baseline Estimate Cost Contingency Amount ->	$84,622,614	**41%**
Baseline Estimate Construction Cost (80% Confidence) ->	**$291,019,234**	

Contingency on Schedule	80% Confidence Project Schedule	
Project Base Schedule Duration ->	**52.6 Months**	
Schedule Contingency Duration ->	24.7 Months	**47%**
Project Schedule Duration (80% Confidence) ->	**77.3 Months**	

Key Findings, Observations and Recommendations

An analysis of the relative impact of the key drivers on the cost and schedule contingency indicates that the following risks result in the most impact on the overall contingency levels:

Cost Risks:

- CO6: material availability and delivery – This project is reliant on large quantities of rock to be available to construct the proposed berms and revetments. There is potential risk of cost increases and schedule delays due to the availability and delivery of the stone from the currently assumed source.
- TD1: design at preliminary level – The project is currently at a conceptual design level. The current assumptions used to develop the design and quantities could change as the project progresses, which could impact the costs in a positive or negative way.
- PM1: project scope definition is incomplete – There is a risk of the tentatively selected plan changing based on updates and revisions to the CE/ICA analysis. Based on further analysis

reaches could be removed from the plan, which would decrease costs. Alternatively, additional elements or increased berm heights could be added which could increase costs.

- ES4: fuel prices – The delivery cost of the rock materials will be completed by barge. Barge delivery is heavily dependent on fuel prices at time of delivery. Therefore, the cost of the delivered rock could vary from current assumptions depending on the market fluctuations of fuel at time of delivery.
- CA3: contract modifications – There is a potential risk of contract modifications occurring at some point during construction. These modifications could increase cost and push out the schedule depending on the scale of the modification.

Schedule Risks:

- CO6: material availability and delivery – This project is reliant on large quantities of rock to be available to construct the proposed berms and revetments. There is potential risk of cost increases and schedule delays due to the availability and delivery of the stone from the currently assumed source.
- EX1: extreme events – There is a potential for an extreme storm event to occur, which could impact construction or change site conditions. Large changes to the site conditions or significant rework post event could push the construction schedule out.
- CO2: weather/seasonal impacts – There is potential for weather delays slowing the contractor beyond current productivity assumptions. This could in turn create the need for more construction periods, which would push out the overall project schedule.

The key recommendations discussed in this document are the implementation of the calculated cost and schedule contingencies, along with continued study of key risk components as the project progresses to final design. This will enable the PDT to efficiently manage and maintain possible risks that could impact either costs or schedule durations.

1.0 PURPOSE

A cost and schedule risk analysis (CSRA) was conducted to develop a reliable and defensible contingency factor for the construction cost estimate developed for the Barrow Coastal Erosion Project Feasibility Report. The cost estimate was prepared using Micro-Computer Aided Estimating System (MII) software. The contingency factors for both cost and schedule was calculated at the 80 percent confidence level as recommended by U.S. Army Corps of Engineers (USACE) guidance (2009). The contingency was calculated in terms of dollars for the cost analysis and in terms of months for the schedule analysis.

2.0 BACKGROUND

The United States Army Corps of Engineers (Corps) has partnered with the North Slope Borough (NSB) to conduct the Barrow Alaska Coastal Erosion Feasibility Study. The study is being conducted under authority provided by Section 116 of the Energy and Water Development Appropriations Act of 2010 (PL 111-85) as amended. Section 116 provides authority for the Secretary of the Army to carry out structural and non-structural projects for storm damage prevention and reduction, coastal erosion, and ice and glacial damage in Alaska.

This feasibility study is a Corps 3x3x3 SMART Planning feasibility study being conducted in response to a request from the North Slope Borough (NSB) to resume a previous study effort by the Corps. This previous study effort, the Barrow Coastal Storm Damage Reduction Feasibility Study, culminated in a Technical Report in 2010. Consistent with Corps SMART planning principles, the current feasibility study is utilizing existing and available information from the 2010 study combined with new data to support plan formulation and risk informed identification of a tentatively selected plan (TSP).

3.0 REPORT SCOPE

The scope of this CSRA report is the calculation and presentation of cost and schedule contingencies at the 80 percent confidence level using the risk analysis processes mandated by USACE Engineer Regulation (ER) 1110-2-1150, ER 1110-2-1302, and Engineer Technical Letter 1110-2-573 (USACE 1999, 2008a, 2008b). The report presents the contingency results for cost risks for all project features. The study excluded a consideration of operation and maintenance and life cycle costs.

3.1 Project Scope

The formal process included extensive involvement of the PDT for risk identification and the development of the risk register. The analysis process evaluated the Micro Computer Aided Cost Estimating System (MCACES) cost estimate, project schedule, and funding profiles using Crystal Ball software to conduct a Monte Carlo simulation and statistical sensitivity analysis, per the guidance in Engineer Technical Letter (ETL 1110-2-573) Construction Cost Estimating Guide for Civil Works, dated September 30, 2008.

The construction estimate and schedule for the project has been prepared by Tetra Tech and serves as the basis for the risk analysis for the construction cost estimate. The construction cost estimate has been developed from the current design documents and information provided in the Barrow Coastal Erosion Project Feasibility Report.

3.2 USACE Risk Analysis Process

The risk analysis process used in this study follows the USACE Headquarters requirements as well as guidance from the Cost Engineering Directory of Expertise for Civil Works. It uses probabilistic CSRA methods within the framework of the Oracle Crystal Ball software. The results of a risk analysis are intended to serve several functions, one being the establishment of reasonable contingencies reflective of an 80

percent confidence level to successfully accomplish the project work within that established contingency amount. The scope of the report includes the identification of important steps, rationale, key assumptions, limitations, and decisions to help ensure that risk analysis results can be appropriately interpreted.

The risk analysis results discussed in this report are intended to provide project leadership with contingency information for scheduling, budgeting, and project control purposes, as well as tools to support decision making and risk management as the project progresses through planning and implementation. To fully recognize its benefits, a CSRA should be considered an ongoing process that is conducted concurrently and iteratively with other important project processes such as scope and execution plan development, resource planning, procurement planning, cost estimating, budgeting, and scheduling.

In addition to satisfying broadly defined risk analysis standards and recommended practices, this risk analysis was performed in accordance with the requirements and recommendations of the following documents and sources:

- Cost and Schedule Risk Analysis Guidance USACE (2009)
- Memorandum from Major General Don T. Riley, U.S. Army Director of Civil Works (USACE 2007a)
- Engineering and Construction Bulletin 2007-17 (USACE 2007b)
- Engineer Regulation 1110-2-1150 (USACE 1999)
- Engineer Regulation 1110-2-1302 (USACE 2008a)
- Engineer Technical Letter 1110-2-573 (USACE 2008b)

4.0 METHODOLOGY/PROCESS

The risk analysis team received cost support from the cost engineer as well as coordination support from project management and other PDT members. Tetra Tech facilitated the identification and documentation of potential risks, as well as performed the risk-based modeling for the contingency development.

The risk analysis process for this study is intended to determine the probability of various cost outcomes and quantify the required contingency needed in the cost estimate to achieve the desired level of confidence related to project cost.

Contingency is defined as an amount added to an estimate to allow for items, conditions, or events for which the occurrence or impact is uncertain and that experience suggests will likely result in additional costs or additional time. The amount of contingency included in project control plans depends, at least in part, on the project leadership's willingness to accept the risk of project overruns. The less risk that project leadership is willing to accept, the more contingency should be applied in the project control plans. The risk of overrun is expressed, in a probabilistic context, using confidence levels.

The Cost Engineering District guidance for CSRA generally focuses on the 80 percent level of confidence (P80) for cost contingency calculation. The use of P80 as a decision criterion is a risk-averse approach (whereas the use of P50 is considered a risk-neutral approach, and the use of levels less than 50 percent is considered a risk-seeking approach). Thus, the use of a P80 confidence level results in a greater contingency relative to that resulting from a P50 confidence level. The selection of contingency at a selected confidence level is ultimately the decision and responsibility of the project's district and/or division management.

The risk analysis process uses Monte Carlo techniques to determine probabilities and contingency. The Monte Carlo techniques are facilitated computationally by a commercially available risk analysis software package (Oracle Crystal Ball), which is an add-in to Microsoft Excel. Cost estimates are packaged into an Excel format and used directly for cost risk analysis purposes. The level of detail recreated in the Excel-

format schedule is enough for risk analysis purposes that reflect the established risk register, but generally less than that of the native format.

In functional terms, the primary steps of the risk analysis process are described in the following subsections. The results of the risk analysis are provided in Section 6.

4.1 Identification and Assessment of Risk Factors

Identification of the risk factors by the PDT is considered a qualitative process that results in the establishment of a risk register, which is used to document the results of the quantitative study of risks. Risk factors are events and conditions that may influence or drive uncertainty associated with project performance. They may be inherent characteristics or conditions of the project or external influences, events, or conditions such as weather or economic conditions. Risk factors may have either favorable or unfavorable impacts on project cost and schedule.

Checklists or historical databases of common risk factors are sometimes used to facilitate the identification of risk factors. However, the key risk factors are often unique to a project and cannot be readily derived from historical information. Therefore, input is obtained from the entire PDT be means of creative processes such as brainstorming or other facilitated risk assessment meetings. In practice, a combination of professional judgment from the PDT and empirical data from similar projects is desirable.

A formal PDT meeting is held for the purposes of identifying and assessing risk factors. The meeting should include capable and qualified representatives from multiple project team disciplines and functions, for example:

- Project/program managers
- Contracting/acquisitions
- Facility design
- Civil design
- Cost and schedule engineers
- Construction
- Key sponsors

The initial formal meeting should focus primarily on risk factor identification using brainstorming techniques but also include some facilitated discussions based on risk factors common to projects of similar scope and geographic location. Subsequent discussions should focus primarily on risk factor assessment and quantification. The members of the risk analysis team are indicated in Table 1.

Conference calls and informal meetings could also occur throughout the risk analysis process on an as-needed basis to further facilitate risk factor identification, market analysis, and risk assessment. The risk register document developed for this project can be seen in Attachment A.

Table 1 – PDT Member Positions and Organizations

Name	Position	Organization
Jenipher Cate	Project Manager	USACE POA
Karl Harvey	Cost Engineering	USACE POA
Joey Sparaga	Archaeologist	USACE POA
Amber Metallo	Biologist/Planner	USACE POA
Doug Bliss	Supervisory Civil Engineer, Geotechnical	USACE POA
Rebecca Kloster	Hydrology & Hydraulics	USACE POA
Cindy Upah	Chief of Planning, Civil Works	USACE POA
Brandee Ketchum	Office of Council	USACE POA
Ron Green	Real Estate	USACE POA
Bob Shears	Local Sponsor Representative	North Slope Borough
Ridge Robinson	Project Manager	Tetra Tech
James Carney	Economics	Tetra Tech
Scott Vose	Cost Estimating/Risk Analyst	Tetra Tech

4.2 Quantification of Risk Factor Impacts

The quantitative impacts of risk factors on project plans are analyzed using a combination of professional judgment, empirical data, and analytical techniques. Risk factor impacts are quantified using probability distributions (density functions) as required for use in the Crystal Ball software.

Like the identification and assessment process, risk factor quantification involves multiple project team disciplines and functions. However, the quantification process relies more extensively on collaboration between cost engineering and risk analysis team members with lesser input from the other functions and disciplines. The quantification process uses an iterative approach to estimate the following elements of each risk factor:

- Maximum possible value for the risk factor
- Minimum possible value for the risk factor
- Most likely value (the statistical mode), if applicable
- Nature of the probability density function used to approximate risk factor uncertainty
- Mathematical correlations between risk factors
- Affected cost estimate and schedule elements

The resulting product from the PDT discussions is captured within a risk register for both cost and schedule risk concerns. The risk register documents the PDT's risk concerns, discussions related to those concerns, and potential impacts on the current cost and schedule estimates. The concerns and discussions are meant to support the team's decisions related to event likelihood, impact, and the resulting risk levels for each risk event. The risk register has been updated since the initial PDT meeting to incorporate risks at the current point of the project.

4.3 Analysis of Cost Estimate and Schedule Contingency

Contingency is analyzed using the Crystal Ball software, an add-in to the Microsoft Excel format of the cost estimate and schedule. Monte Carlo simulations are performed by applying the risk factors (quantified as probability density functions) to the appropriate estimated cost and schedule elements identified by the PDT and the market research. Contingencies are calculated by applying only the moderate- and high-level risks

identified for each option (i.e., low-level risks are typically not considered but remain within the risk register to serve historical purposes as well as support follow-on risk studies as the project and risks evolve).

For the cost estimate in this study, the contingency was calculated as the difference between the P80 cost forecast and the base cost estimate. Standard deviation was used as the feature-specific measure of risk for contingency allocation purposes. This approach resulted in a relatively larger portion of all the project feature cost contingency being allocated to features with relatively higher estimated cost uncertainty.

Schedule contingency was analyzed only on the total duration of construction from the current proposed schedule. Based on the guidance, only critical path and near critical path tasks are considered uncertain for the purposes of contingency analysis (USACE 2009).

5.0 KEY ASSUMPTIONS

The CSRA for this project is based on the following key assumptions:

- The project is currently at the Draft Feasibility submittal for the design documents.
- Design is at the preliminary level, with conceptual cross sections used for the basis of quantities.
- Contingencies have been developed only on construction costs and schedule. The resulting contingency is used for PED and CM costs.
- Neither life cycle nor operation and maintenance costs are included in the risk study. This study is based solely on the initial construction of the project.
- Major features of this project include construction of rock revetments and berms along six reaches protecting Barrow.
- The current working estimate costs by feature account and reach:

Table 2 – Current MCACES Construction Costs

Item	Total Cost*
16 – Bank Stabilization	
Reach 1	$19,583,659
Reach 2	$15,202,610
Reach 3	$30,448,541
Reach 4	$31,817,661
Reach 5	$63,512,313
Reach 6	$45,385,230
18 – Cultural Resources	$446,605
30 – PED	$20,639,662
31 – CM	$12,383,797
Total Cost	*$239,428,954*
* Costs shown are pre-contingency.	

- The cost estimate is based on local labor, material, and fuel costs. The construction schedule is based on estimated productivities of the construction activities estimated within the cost estimate.
- The recommended contingency is based on an 80 percent confidence level, per accepted USACE Civil Works guidance.
- Only the high and moderate risk levels as determined by the PDT in the risk register are included in the risk analysis. The low risk levels are excluded based on the assumption that they would have a negligible impact in determining the contingency.

6.0 RISK ANALYSIS RESULTS

The CSRA results are provided in the following subsections. In addition to the contingency calculations, the results of sensitivity analyses are presented to provide decision makers with an understanding of variability and the key contributors to the variability.

6.1 Risk Register

A risk register is a tool commonly used in project planning and risk analysis. The risk register developed for this project is provided in Attachment A. The complete risk register includes low-level risks, as well as additional information regarding the nature and impacts of each risk.

A risk register can be an effective tool for managing identified risks throughout the project life cycle. As such, it is generally recommended that risk registers be updated as the designs, cost estimates, and schedule are further refined, especially on large projects with extended schedules. Recommended uses of the risk register going forward include the following:

- Documenting risk mitigation strategies being pursued in response to the identified risks and their assessment in terms of probability and impact
- Providing project sponsors, stakeholders, and leadership/management with a documented framework from which risk status can be reported in the context of project controls
- Communicating risk management issues
- Providing a mechanism for eliciting feedback and project control input
- Identifying risk transfer, elimination, or mitigation actions required for implementation of risk management plans

6.2 Cost Contingency Sensitivity Analysis

The result of risk or uncertainty analysis is quantification of the cumulative impact of all analyzed risks or uncertainties as compared to probability of occurrence. These results, as applied to the analysis herein, depict the overall project cost at intervals of confidence (probability).

Table 2 provides the construction cost contingency calculated for the P80 confidence level and rounded to the nearest thousand. The construction cost contingencies for the P10, P50, and P95 confidence levels are also provided for illustrative purposes only.

Table 3 – Construction Cost Contingency Summary

Confidence Level	Baseline Total Project Cost	Contingency	Total Project Cost with Contingency	Contingency
10%	$206,396,620	$39,215,358	$245,611,978	19%
50%	$206,396,620	$66,046,918	$272,443,538	32%
80%	**$206,396,620**	**$84,622,614**	**$291,019,234**	**41%**
90%	$206,396,620	$94,942,445	$301,339,065	46%

Cost Risks Sensitivity Analysis Results

A sensitivity analysis generally ranks the relative impact of each risk/opportunity as a percentage of total cost uncertainty. From this analysis, the key cost drivers can be identified and used to support the development of a risk management plan that will facilitate control of risk factors and their potential impacts throughout the project life cycle.

The cost sensitivity analysis for this project shows the rank of the risks from the highest impact on the cost contingency to the lowest (Figure 1). Approximately 74.7 percent of the construction contingency is generated from five risk items.

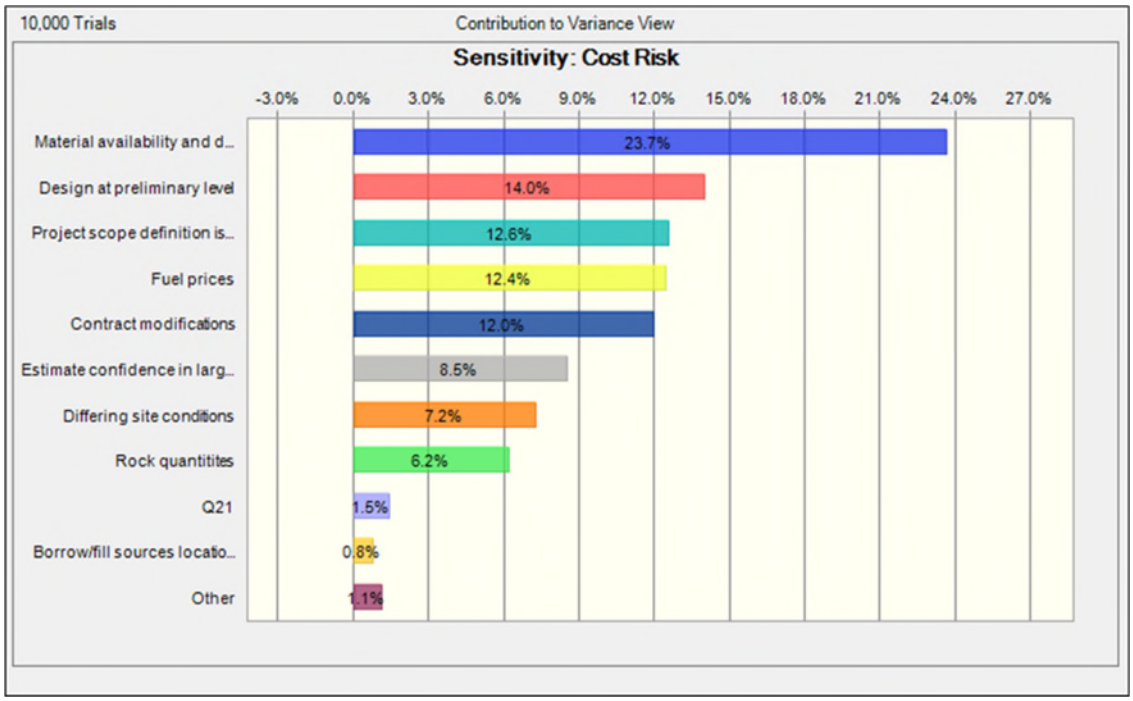

Figure 1 – Sensitivity Analysis (Cost)

6.3 Schedule Contingency Sensitivity Analysis

In the same methodology as the cost contingency, the estimated schedule duration contingency was estimated at the P80 level. Table 3 shows the resulting schedule contingency at the P80 level and includes the P10, P50, and P95 confidence levels for illustrative purposes.

Table 4 – Construction Schedule Contingency Summary

Confidence Level	Baseline Schedule Duration	Contingency	Total Schedule Duration	Contingency
10%	52.6 Months	.5 Months	53.1 Months	1%
50%	52.6 Months	13.1 Months	65.7 Months	25%
80%	**52.6 Months**	**24.7 Months**	**77.3 Months**	**47%**
90%	52.6 Months	36.3 Months	88.8 Months	69%

Schedule Risks Sensitivity Analysis Results

The cost sensitivity analysis for this project shows the rank of the risks from the highest impact on the cost contingency to the lowest (Figure 2). Approximately 41.9 percent of the schedule contingency is generated from three of the top risk items.

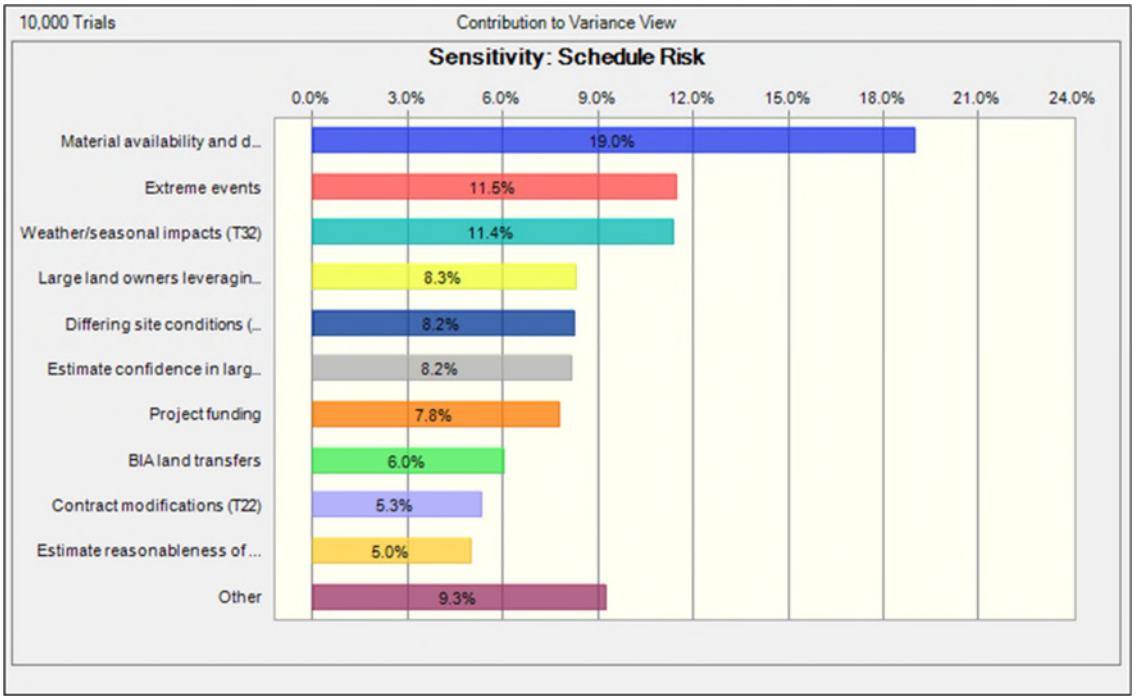

Figure 2 – Sensitivity Analysis (Schedule)

7.0 MAJOR FINDINGS, OBSERVATIONS AND RECOMMENDATIONS

This section provides a summary of significant risk analysis results that are identified in the preceding sections of the report. Risk analysis results are intended to provide project leadership with contingency information for scheduling, budgeting, and project control purposes, as well as to provide tools to support decision making and risk management as projects progress through planning and implementation. Because of the potential for use of risk analysis results for such diverse purposes, this section also reiterates and highlights important steps, logic, key assumptions, limitations, and decisions to help ensure that the risk analysis results are appropriately interpreted.

The following sections discuss the risk items that are the most impactful to the contingency development for both cost and schedule. All risk items that generate over ten (9.0) percent of the contingency, as shown in the sensitivity analysis, for both cost and schedule are discussed here. Further information on all risk items and their corresponding PDT discussions can be found in Attachment A, and full cost and schedule contingency probability range summaries can be found in Tables 5 and 6.

7.1 Cost Risks

- CO6: material availability and delivery – This project is reliant on large quantities of rock to be available to construct the proposed berms and revetments. There is potential risk of cost increases and schedule delays due to the availability and delivery of the stone from the currently assumed source.
- TD1: design at preliminary level – The project is currently at a conceptual design level. The current assumptions used to develop the design and quantities could change as the project progresses, which could impact the costs in a positive or negative way.
- PM1: project scope definition is incomplete – There is a risk of the tentatively selected plan changing based on updates and revisions to the CE/ICA analysis. Based on further analysis reaches could be removed from the plan, which would decrease costs. Alternatively, additional elements or increased berm heights could be added which could increase costs.

- ES4: fuel prices – The delivery cost of the rock materials will be completed by barge. Barge delivery is heavily dependent on fuel prices at time of delivery. Therefore, the cost of the delivered rock could vary from current assumptions depending on the market fluctuations of fuel at time of delivery.
- CA3: contract modifications – There is a potential risk of contract modifications occurring at some point during construction. These modifications could increase cost and push out the schedule depending on the scale of the modification.

Table 5 – Project Cost Contingency Summary

Confidence Level	Baseline Total Project Cost	Contingency	Total Project Cost with Contingency	Contingency
0%	$206,396,620	$2,063,966	$208,460,586	1%
10%	$206,396,620	$39,215,358	$245,611,978	19%
20%	$206,396,620	$49,535,189	$255,931,809	24%
30%	$206,396,620	$55,727,087	$262,123,707	27%
40%	$206,396,620	$61,918,986	$268,315,606	30%
50%	$206,396,620	$66,046,918	$272,443,538	32%
60%	$206,396,620	$72,238,817	$278,635,437	35%
70%	$206,396,620	$78,430,716	$284,827,336	38%
80%	**$206,396,620**	**$84,622,614**	**$291,019,234**	**41%**
90%	$206,396,620	$94,942,445	$301,339,065	46%
100%	$206,396,620	$152,733,499	$359,130,119	74%

7.2 Schedule Risks

- CO6: material availability and delivery – This project is reliant on large quantities of rock to be available to construct the proposed berms and revetments. There is potential risk of cost increases and schedule delays due to the availability and delivery of the stone from the currently assumed source.
- EX1: extreme events – There is a potential for an extreme storm event to occur, which could impact construction or change site conditions. Large changes to the site conditions or significant rework post event could push the construction schedule out.
- CO2: weather/seasonal impacts – There is potential for weather delays slowing the contractor beyond current productivity assumptions. This could in turn create the need for more construction periods, which would push out the overall project schedule.

Table 6 – Project Schedule Duration Contingency Summary

Confidence Level	Baseline Schedule Duration	Contingency (Duration)	Baseline Schedule Duration with Contingency	Contingency
0%	52.6 Months	.5 Months	53.1 Months	1%
10%	52.6 Months	.5 Months	53.1 Months	1%
20%	52.6 Months	1.6 Months	54.1 Months	3%
30%	52.6 Months	12.6 Months	65.2 Months	24%
40%	52.6 Months	12.6 Months	65.2 Months	24%
50%	52.6 Months	13.1 Months	65.7 Months	25%
60%	52.6 Months	13.7 Months	66.2 Months	26%
70%	52.6 Months	24.2 Months	76.7 Months	46%
80%	**52.6 Months**	**24.7 Months**	**77.3 Months**	**47%**
90%	52.6 Months	36.3 Months	88.8 Months	69%
100%	52.6 Months	72.5 Months	125.1 Months	138%

7.3 Mitigation Recommendations

Risk management is an all-encompassing, iterative, life cycle process of project management. According to A Guide to the Project Management Body of Knowledge (PMBOK® Guide), "project risk management includes the processes concerned with conducting risk management planning, identification, analysis, responses, and monitoring and control on a project" (PMI 2008). Risk identification and risk analysis are processes within the knowledge area of risk management. Their output pertinent to this effort includes the risk register, risk quantification (risk analysis model), the contingency report, and the sensitivity analysis.

The intended use of these outputs is implementation by the project leadership with respect to risk responses (such as mitigation) and risk monitoring and control. In short, the effectiveness of the project risk management effort requires that the proactive management of risks not conclude with the study completed in this report.

The Cost and Schedule Risk Analysis (CSRA) produced by the PDT provides a list of recommendations for continued management of the risks identified and analyzed in this study. Note that this list is not all inclusive and should not be a substitute for a formal risk management and response plan.

The CSRA study serves as a "road map" towards project improvements and reduced risks over time. The PDT should include the recommended cost and schedule contingencies and incorporate risk monitoring and mitigation on those identified risks. Further iterative study and updates of the risk analysis throughout the design stages is important in ensuring all cost and schedule estimates remain within approved budgets and timelines.

Risk Management

Project leadership should use the outputs created during the risk analysis effort as tools in future risk management processes. The risk register should be updated at each major project milestone. The results of the sensitivity analysis may also be used for response planning strategy and development. These tools should be used in conjunction with regular risk review meetings.

Risk Analysis Updates

Project leadership should review risk items identified in the original risk register and add others, as required, throughout the project life-cycle. Risks should be reviewed for status and reevaluation (using qualitative measure, at a minimum) and placed on risk management watch lists if any risk's likelihood or impact significantly increases. Project leadership should also be mindful of the potential for secondary (new risks created specifically by the response to an original risk) and residual risks (risks that remain and have unintended impact following response).

Specific Risks

Further iterative project and risk study is important throughout the project life-cycle to efficiently manage and maintain a reasonable cost and schedule. The results of the CSRA sensitivity analysis indicate that the following risk factors have the most significant impact on the cost and schedule contingencies and thus mitigation recommendations are discussed for these items:

- CO6: material availability and delivery (cost and schedule)
- TD1: design at preliminary level (cost)
- PM1: project scope definition is incomplete (cost)
- ES4: fuel prices (cost)
- CA3: contract modifications (cost)
- EX1: extreme events (schedule)
- CO2: weather/seasonal impacts (schedule)

However, many of the key risk drivers are not necessarily risks that the PDT has a significant sphere of influence over. The material availability and delivery risk is solely dependent on the operating capabilities of the rock supplier and reliability of the contractor to transport large quantities on time. Fuel prices are simply based on changes in the market for fuel, which could impact the cost to deliver the significant quantities of rock required. Then the two weather related risks are well beyond the PDTs control, and therefore some built in work delays should be determined.

Other risks are likely to be mitigated through the typical design process and ensuring of accurate drawings, specifications and other assumptions. As the project progresses, and design is finalized, the risk of significant cost impacts due to preliminary level of design should be mitigated. Secondly, a final selected plan should be determined in the near future. This would all but negate the scope definition risk since a final CE/ICA result will define the tentatively selected plan's scope. These two risks are likely to be mitigated through the basic design progression. But they should be noted at this time, such that project management and the PDT are aware that potential changes could occur and be impactful at this time.

Lastly, the PDT should stress to identify and resolve any other risks or concerns that may have cost or schedule implications. Further analysis could lead to new risks that have not been previously analyzed, and therefore should be brought to the PDT's attention.

8.0 SOURCES

PMI (Project Management Institute). 2008. A Guide to the Project Management Body of Knowledge (PMBOK® Guide). 4th edition.

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ATTACHMENT 1 – PROJECT DELIVERY TEAM RISK REGISTER

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				Project Cost			Project Schedule			Other Information				COST			Schedule Model			Cost From Schedule			TOTAL Cost		TOTAL Schedule			
CREF	Risk/Opportunity Event	Risk Event Description	PDT Discussions on Impact and Likelihood	Likelihood ©	Impact ©	Risk Level ©	Likelihood (S)	Impact (S)	Risk Level (S)	Cost Variance Distribution	Schedule Variance Distribution	Responsibility/ POC	Affected Project Component	Low Variance (Min)	Likely (C)	High Variance (80%H)	Low Variance (S) (Min)	Likely (S)	High Variance (S) (80%H)	Low Variance (CS) (Min)	Likely Added Cost (CS)	High Variance (CS) (80%H)	Event Prob (PC)	Simulated Cost (C) + (CS)	Event Prob (PS)	Simulated Sched (S)	Risk Quantification Discussions	Risk Mitigation Measures
Project & Program Management (PM)																												
PM1	Project scope definition is unclear/incomplete	Potential for TSP to change based on updated results of CE/CA	Linear and above ground work is assumed accurate; geotechnical analysis is still remaining to be completed, which could alter design and quantities; if alternatives change, they would change by reach or distance, as opposed to wholesale changes in design elements; there is potential for costs to decrease if reaches are not cost effective; PDT thinks this would be medium risk to the cost estimate, but low risk to schedule.	Possible	Moderate	Medium	Possible	Negligible	Low	Triangular	N/A -Not Modeled	Project Management	Contract Cost	-$12,260,358		$24,520,715							100%	$0	100%	0 Mo	The TSP is not anticipated to change, but there still may be changes to design and assumptions as project progresses. Assumes a total project cost potential range of -5% to +10% could be possible.	
PM2	Project funding	Risk of not receiving Federal or local funding	Project is currently in good position to obtain supplemental funding; there would still be time and capability to fight for congressional funding if needed; current estimates support a raising BCR; could have staggered implementation by reaches over multiple years, which would likely be more palatable to funding sources; local sponsor will have to sell new bonds, and will have to go before the voters of North Slope; low probability that bond funding will not become immediately available; other capital improvement projects are needed in the North Slope for critical facilities though, which could limit funding availability;	Unlikely	Negligible	Low	Possible	Moderate	Medium	N/A	Triangular	Project Management	Project Schedule				0 Months	Likely	12 Months				100%	$0	100%	0 Mo	Schedule could be pushed out one construction period (12 months) if funding is not received. It is assumed that there is a 10% chance this occurs.	
PM3	Unplanned work that must be accomodated	Currently experiencing unplanned work for model review/CE/CA	There is on-going work that was unplanned, but the work has already been accounted for in current project schedule; the project has excess funding to account for this effort, and therefore the PDT lists this as a low risk for both cost and schedule.	Possible	Negligible	Low	Possible	Marginal	Low	N/A -Not Modeled	N/A -Not Modeled	Project Management	N/A -Not Modeled										100%	$0	100%	0 Mo	N/A - not modeled	
PM4	Delayed funding impacting field investigations	Delayed funding could delay critical PED investigations.	If project funding is received at inopportune times, then field investigations could be pushed back to subsequent year because of weather windows; current schedule assumes 2-years already for PED phase which should lessen the potential risk; PDT thinks this risk is overall low to both cost and schedule.	Unlikely	Negligible	Low	Possible	Marginal	Low	N/A -Not Modeled	N/A -Not Modeled	Project Management	N/A -Not Modeled										100%	$0	100%	0 Mo	N/A - not modeled	
PM5	Project competing with other projects, funding and resources	Potential for other large project to kick-off	District has technical staff able to complete work, but many projects moving simultaneously could cause some difficulties in this regard; similar projects with similar timeframes and due dates could cause funding/resource issues; District does have it in their plan to hire more staff in the future; new staff may need to be caught up, but overall PDT thinks this is an overall low risk to both cost and schedule;	Unlikely	Negligible	Low	Possible	Moderate	Medium	N/A -Not Modeled	Custom	Project Management	Project Schedule				0 Months	Likely	12 Months				100%	$0	5%	0 Mo	Schedule could be pushed out one construction period (12 months) if significant project funding and resources are diverted. It is assumed that there is a 10% chance this occurs.	
PM6	Losing critical staff at crucial points of project	Potential for delays or cost increases due to staff turnover	PMs have changed already, and key staff could retire/move-on; new staff would have to be trained, but this is typical on any project and PDT thinks would be overall low risk to both cost and schedule.	Unlikely	Negligible	Low	Unlikely	Marginal	Low	N/A -Not Modeled	N/A -Not Modeled	Project Management	N/A -Not Modeled										100%	$0	100%	0 Mo	N/A - not modeled	
PM7	Ability to identify NFIP compliance or alternatives	Delays in determining NFIP compliance	The city of Barrow is looking to become NFIP compliant or comparable; PDT is currently looking into what the comparable measures are for NFIP; Barrow is not currently an NFIP participant; if project is not compliant with NFIP, funding will not be obtained; project would likely not move forward if NFIP compliance is not obtained; PDT thinks there could be significant delays in the project schedule if NFIP compliance does not go according to current plans.	Unlikely	Marginal	Low	Possible	Significant	Medium	N/A	Custom	Project Management	Project Schedule				0 Months	Likely	12 Months				100%	$0	5%	0 Mo	Schedule could be pushed out one construction period (12 months) if NFIP compliance requirements are not determined on schedule. It is assumed that there is a 10% chance this risk event occurs.	
Contract Acquisition (CA)																												
CA1	Undefined acquisition strategy	Acquisition strategy assumptions differ from actual	The acquisition strategy would likely be full and open bid; incremental funding and phasing of the project would likely be more of a risk to the project; it is anticipated that a select group of large contractors, with adequate subcontractors, would be bidding; still potential for limited bid competition if several of these contractors do not bid; potential for local acquisition of work-in-kind services which could impact schedule; overall the PDT thinks the acquisition strategy is a medium risk for both cost and schedule.	Possible	Significant	Medium	Possible	Significant	Medium	Triangular	Triangular	Contracting	Project Cost & Schedule	$0		$20,879,927	0 Months	Likely	12 Months				10%	$0	10%	0 Mo	Potential for the construction cost to increase based on bidding conditions over life of project, and number of projects let out. Assumes potential for 10% increase to total construction costs. Schedule could be impacted as well, and assumes one additional construction period (12 months) occuring. Assumes 10% chance of schedule risk event occuring.	
CA2	Potential for several contracts	Multiple contracts or phases could result in changes to current cost/schedule	Project is able to be separated by reaches, which in turn could be separated into phases/contracts as needed; currently not estimating in phased contracts; phasing strategy will be developed in PED phase and incorporated into cost estimate and construction schedule accordingly; Due to construction work windows, schedule is already "phased", but costs could still be a medium risk to project costs if numerous contracts are required to be let out.	Likely	Moderate	Medium	Possible	Marginal	Low	Triangular	N/A -Not Modeled	Contracting	Project Cost	$0		$12,260,358							100%	$0	100%	0 Mo	Current estimate assumes phasing of construction, with appliable mob/demob costs. Therefore model assumes potential 5% increase to total project cost if more contracts are required.	
CA3		Contract modifications during construction	There is always a risk to have modifications from the contractor during construction; PDT does not currently anticipate these to be a significant impact to cost or schedule, but mods are likely to occur;	Likely	Marginal	Medium	Likely	Marginal	Medium	Triangular	Custom	Project Management	Project Cost & Schedule	$0		$31,319,891	0 Months	Likely	12 Months				100%	$0	10%	0 Mo	Contract modifications are a significant risk to any project. Given the scale of this project, it is anticipated that significant mods could add 15% to costs. Mods could also delay construction, and significant delays could add another construction window (12 months).	
Technical Design (TD) / Project Scope Growth																												
TD1	Design at preliminary level	Design still has outstanding information to be developed, and does not incorporate sea level change or resiliency guidance currently	Not incorporating sea level change or resiliency could lead to changes in rock type, embankment heights, quantity of rock, footprints, etc; there is a possibility that sheet piles would be required based on results of geotech investigations; still need to look into beach access/parking locations, permafrost stabilizers, and other items that could change costs; a sensitivity analysis is being completed for crest heights and rock sizing (this could be a potential opportunity); these are all known tasks, and not anticipated to impact schedule significantly; PDT thinks there is a likely chance of these risks impacting the cost estimate, and the changes could be significant.	Likely	Significant	High	Unlikely	Marginal	Low	Triangular	N/A -Not Modeled	Project Management	Project Cost	-$12,260,358		$24,520,715							100%	$0	100%	0 Mo	Quantities have recently been revised based on new topo and cross sections. Still possible to change, since design is limited, and estimated to be a range between -5% and +10% cost impact.	

				Project Cost			Project Schedule			Other Information				COST			Schedule Model			Cost From Schedule			TOTAL Cost		TOTAL Schedule			
CREF	Risk/Opportunity Event	Risk Event Description	PDT Discussions on Impact and Likelihood	Likelihood ©	Impact ©	Risk Level ©	Likelihood (S)	Impact (S)	Risk Level (S)	Cost Variance Distribution	Schedule Variance Distribution	Responsibility/ POC	Affected Project Component	Low Variance (Min)	Likely (C)	High Variance (80%H)	Low Variance (S) (Min)	Likely (S)	High Variance (S) (80%H)	Low Variance (CS) (Min)	Likely Added Cost (CS)	High Variance (CS) (80%H)	Event Prob (PC)	Simulated Cost (C) + (CS)	Event Prob (PS)	Simulated Sched (S)	Risk Quantification Discussions	Risk Mitigation Measures
TD2	Remaining studies and investigations to be completed	Geotech, H&H, sea level change, cultural have yet to be finalized	Cultural and H&H studies have already begun; geotech and relative sea level change have baselines developed; all these studies have been included in PED for both the costs and schedule, therefore PDT thinks this is a low risk to both cost and schedule.	Unlikely	Negligible	Low	Unlikely	Negligible	Low	N/A -Not Modeled	N/A -Not Modeled	Project Management	N/A -Not Modeled										100%	$0	100%	0 Mo	N/A - not modeled	
TD3	Rock quantitites	Potential for change to rock quantities	Revised quantities are currently being developed; quantities may be impacted by changes to existing land conditions (storms/erosion); sea level change results could change rock quantities; results of finalized CE/ICA could also impact overall quantities of rock (potential opportunity for decreased quantities); due to the volume of rock required, changes in quantities would have at least a moderate impact to costs.	Possible	Moderate	Medium	Unlikely	Negligible	Low	Triangular	N/A -Not Modeled	Geotechnical/ Civil Design	Contract Cost	-$8,782,672	[redacted]	$17,565,343							100%	$0	100%	0 Mo	Estimated that total cost impact of just the rock purchase, delivery and placement could range from -5% to +10% with additional changes to rock assumptions and calculations.	
TD4	Borrow/fill sources locations and quality	Currently assume rock and gravel sources, but general fill suitability is still to be defined	There is a concern of local fill material not being suitable for use in this project, and/or there is a concernt that there are not sufficient quantities available locally; there may be a potential to use local material with some innovative designs to ensure proper compaction, but that is not a current assumption; the overall quantity of fill required could use up all remaining local fill supplies; fill not supplied locally would have to come from elsewhere, and there is risk/opportunity of using other suppliers; contract will not be able to force contractor to use local material; PDT does not think this would impact the overall schedule, but could have a medium impact to the cost estimate;	Likely	Moderate	Medium	Unlikely	Negligible	Low	Triangular	N/A -Not Modeled	Geotechnical/ Civil Design	Contract Cost	$0	[redacted]	$5,832,690							100%	$0	100%	0 Mo	Due to current limitations at local borrow site, costs could be much higher for the purchase of local material Barrow. Assumes potential of 100% increase to borrow costs for this project.	
TD5	Hazardous waste concerns	Encountering hazardous waste in the project footprint	There are two locations that could encounter hazardous materials during excavation; high potential for encountering materials close to NARL; the city of Barrow currently has a method for disposal of hydrocarbon materials; encountering other materials could cause increases to costs; this risk is likely to occur due to the scale of the project length, and PDT anticipates it could be a moderate impact to costs, but a low risk to the overall schedule.	Likely	Moderate	Medium	Unlikely	Negligible	Low	Triangular	N/A -Not Modeled	Geotechnical/ Civil Design	Contract Cost	$0	[redacted]	$5,623,611							100%	$0	100%	0 Mo	Hazardous waste risks are assumed to apply to earthwork costs only. Potential for 50% increase to total earthwork costs if significant HTRWs are encountered.	
TD6	Drainage issues	Project does not currently account for potential drainage issues during break-up, or at the sewage outfall	Project currently lacks surveys for existing culvert data; obtaining this information would better help with drainage details and assumptions; drainage is not part of the feasibility design, but anticipated to be included in O&M manual to be completed for final design; therefore no current drainage items included in cost estimate, and PDT does anticipates this being a low risk to cost and schedule.	Likely	Negligible	Low	Possible	Marginal	Low	N/A -Not Modeled	N/A -Not Modeled	Geotechnical/ Civil Design	N/A -Not Modeled										100%	$0	100%	0 Mo	N/A - not modeled	
Construction (CO)																												
CO1	Labor availability	Risk of contractor not having adequate labor for rock placement	Skillset required for rock placement is very specific, and likely a small pool of local laborers for that aspect; there is a known shortage of local equipment operators; project will likely attract the required labor to be brought up to Barrow; labor costs for non-local labor should already be accounted for in estimate already, and therefore this is considered a low risk overall.	Unlikely	Marginal	Low	Unlikely	Negligible	Low	N/A -Not Modeled	N/A -Not Modeled	Cost Engineering	N/A -Not Modeled										100%	$0	100%	0 Mo	N/A - not modeled	
CO2	Weather/seasonal impacts	Weather issues cause delays to the contractor creating new for more construction periods	Rock delivery via barge has been delayed due to storm conditions at quarries in past projects; offloading of materials in Barrow could be impacted from storms; long enough delays could extend the number of construction periods required; additional seasons would add additional mob/demob costs; contractor may store equipment in Barrow, and incur storage costs, if pushed into other construction seasons; due to the number of assumed construction periods, and overall quantity of material to be barged to Barrow, it is likely that some impacts occur which impact the cost and schedule moderately.	Likely	Moderate	Medium	Likely	Moderate	Medium	Triangular	Custom	Construction	Contract Cost	$0	[redacted]	$3,713,153	0 Months	[redacted]	12 Months				100%	$0	100%	0 Mo		
CO3	Unknown cultural or historic preservation	Encountering human remains where not currently anticipated	There are human remains present, and currently being found at the bluff; a full project stop would be required if remains are encountered; PDT is attempting to incorporate a "minimum project stop" clause into contract to help mitigate delays from this risk; excavation will encounter numerous types of bones, and staff is assumed to be available be on-site with the experience to identify animal and human remains; based on the minimum project stop clause likely to be included, the PDT thinks there is low risk to schedule, but could still be medium risk to costs.	Likely	Marginal	Medium	Possible	Marginal	Low	Triangular	N/A -Not Modeled	Environmental Compliance	Contract Cost	$0	[redacted]	$2,000,000							100%	$0	100%	0 Mo	If significant culturally valuable items are found within the site, a lump sum of $2,000,000 has been assumed. This would account for additional archeologists, and other specialists to be mobilized and working on site during construction.	
CO4	Identified staging areas	Potential for staging area assumptions to change	Two off-loading areas have been identified with local concurrence from Barrow personnel; two to three other areas would be viable for staging, but need to be finalized; costs are planned to include these staging area assumptions, and therefore overall risk is low for both cost and schedule.	Unlikely	Negligible	Low	Unlikely	Negligible	Low	N/A -Not Modeled	N/A -Not Modeled	Construction	N/A -Not Modeled										100%	$0	100%	0 Mo	N/A - not modeled	
CO5	Control and diversion of water	Increased water control activities are needed	The work near the gabion baskets may require some dewatering/diversion efforts, but majority of project is not anticipated to require significant water control efforts; if contaminated materials are located near the gabions, then contaminated water may be encountered, which could increase costs; this risk is deemed unlikely to occur by the PDT, and would not lead to any substantial impacts to costs or schedule if it occurs.	Unlikely	Negligible	Low	Unlikely	Negligible	Low	N/A -Not Modeled	N/A -Not Modeled	Technical Lead	N/A -Not Modeled										100%	$0	100%	0 Mo	N/A - not modeled	

				Project Cost			Project Schedule			Other Information				COST			Schedule Model			Cost From Schedule			TOTAL Cost		TOTAL Schedule			
CREF	Risk/Opportunity Event	Risk Event Description	PDT Discussions on Impact and Likelihood	Likelihood ©	Impact ©	Risk Level ©	Likelihood (S)	Impact (S)	Risk Level (S)	Cost Variance Distribution	Schedule Variance Distribution	Responsibility/ POC	Affected Project Component	Low Variance (Min)	Likely (C)	High Variance (80%H)	Low Variance (S) (Min)	Likely (S)	High Variance (S) (80%H)	Low Variance (CS) (Min)	Likely Added Cost (CS)	High Variance (CS) (80%H)	Event Prob (PC)	Simulated Cost (C) + (CS)	Event Prob (PS)	Simulated Sched (S)	Risk Quantification Discussions	Risk Mitigation Measures
CO6	Material availability and delivery	Rock availability changes causing delays and/or cost increases.	There is a schedule risk due to not receiving the rock to the project site on time; there is some risk of the quarry not being able to keep up with production to meet current schedule; barges typically start arriving in July and continue for approximately 9 weeks; quarry may have competing projects which could impact material availability; rock availability that meet required specifications has been issue in previous projects; PDT sees this as a high risk that could impact both costs and schedule.	Likely	Significant	High	Likely	Significant	High	Triangular	Custom	Construction	Contract Cost	$0	[redacted]	$43,913,359	0 Months	[redacted]	12 Months				100%	$0	100%	0 Mo	Cost changes to the rock material and delivery could see significant impacts to the estimate. Assumes potential 25% increase in total rock placement costs, and potential for one additional construction window to be needed (12 months).	
CO7	Differing site conditions	The site changes seasonally and could cause changes to design	Contract will have to build in how to change design after the pre-construction survey; there will likely be modifications because conditions will be different at time of construction due to current weather patterns; the project schedule should account for pre-construction survey and design changes already, but there still is a risk of more significant changes being required; PDT thinks this is an overall medium risk to both cost and schedule.	Likely	Moderate	Medium	Likely	Marginal	Medium	Triangular	Custom	Construction	Contract Cost	$0	[redacted]	$24,520,715	0 Months	[redacted]	12 Months				100%	$0	100%	0 Mo	Differing site conditions may impact many areas of the project. It is assumed that a potential 10% increase to total project costs could be incurred.	
Cost and Schedule (ES)																												
ES1	Rock prices	Potential for changes to quoted price for rock material purchase and delivery.	Current estimate has obtained rock prices for material and delivery from the anticipated rock supplier; due to scale of rock required, changes to rock price can have significant impacts to the overall costs; the rock prices from the quarry could change drastically due to market conditions, and rock availability at time of construction; delivery costs could fluctuate widely based on various market conditions like labor/barge availability, fuel rates, etc.; This is a high risk to the cost estimate.	Possible	Critical	High	Unlikely	Negligible	Low	N/A -Not Modeled	N/A -Not Modeled	Cost Engineering	N/A -Not Modeled											100%	$0	100%	0 Mo	The price for the rock is primarily going to be driven by the availability and delivery which is discussed in C06. Therefore no costs have been included for this item, to avoid double counting.	
ES2	Estimate confidence in large and critical quantities	Current quantities could change as design detail increases	Current design is limited, and quantities are calculated based on this information; project is currently re-analyzing the design assumptions and quantity calculations will be changing based on more detailed information; as project progresses, quantity accuracy should improve, but currently, based on scale of quantities, changes could see large moderate swings in both cost and schedule (benefits possible as well);	Possible	Moderate	Medium	Possible	Moderate	Medium	Triangular	Custom	Cost Engineering	Contract Cost	-$10,439,964	[redacted]	$20,879,927	0 Months	[redacted]	12 Months				100%	$0	100%	0 Mo	Changes in quantities as project progresses could be a benefit or increase to the project. It is assumed that potential -5% decrease in construction costs, to +10% increase. Also, increased quantities could result in additional construction period (12 months) being required.	
ES3	Estimate reasonableness of crews and productivities	Assumed crews and productivities differ from those of the construction contractor	Current MCACES estimate has developed user defined crews for key construction elements such as rock placement, excavation and fill; crew sizing and productivity assumptions have been based on previous projects and cost estimates, but are still being refined and verified for accuracy; potential for these assumptions to change as project progresses; since the material costs are more of the driver of the estimate, this is anticipated to be a marginal impact to cost; due to limited construction period durations, changes to productivities could impact schedule some;	Possible	Marginal	Low	Possible	Moderate	Medium	N/A -Not Modeled	Custom	Cost Engineering	Contract Cost				0 Months	[redacted]	12 Months				100%	$0	100%	0 Mo	Productivity and delivery of stone could take longer than currently assumed. This could potentially push construction our one window (12 months) if it occurs.	
ES4	Fuel prices	Differing fuel prices at time of construction would impact barge delivery rates	Fuel prices are expected to have a significant influence over the barge delivery of rock materials; barge shipping costs are heavily dependent on fuel prices, and current estimate is based on recent fuel prices; as fuel prices fluctuate, the estimate for rock delivery will as well (could decrease costs too); this is anticipated to be a moderate risk overall to the cost estimate, and negligible risk to the schedule.	Possible	Moderate	Medium	Possible	Negligible	Low	Triangular	Custom	Cost Engineering	Contract Cost	-$8,782,672	[redacted]	$26,348,015							100%	$0	100%	0 Mo	Changes in fuel prices could significantly impact the delivery of the rock materials. It is assumed that the total rock cost could vary between -5% and +15% depending on fuel prices at time of construction.	
Regulatory & Environmental (RE)																												
RE1	HTRW scope grows	Discussed in previous risk items.	This risk has been discussed previously in risk item TD5;	Unlikely	Negligible	Low	Unlikely	Negligible	Low	N/A -Not Modeled	N/A -Not Modeled	Environmental Compliance	N/A -Not Modeled										100%	$0	100%	0 Mo	N/A - not modeled	
RE2	Project in area of high sensitivity to paleontology/cultural artifacts	Discussed in previous risk items.	This risk has been discussed previously in risk item CO3;	Unlikely	Negligible	Low	Unlikely	Negligible	Low	N/A -Not Modeled	N/A -Not Modeled	Environmental Compliance	N/A -Not Modeled										100%	$0	100%	0 Mo	N/A - not modeled	
RE3	Permits or agency actions delayed or take longer than expected	Delays due to interaction between agencies	No significant impacts from this risk are anticipated by the PDT; potential for various interaction plans to be developed between various agencies;	Unlikely	Negligible	Low	Unlikely	Negligible	Low	N/A -Not Modeled	N/A -Not Modeled	Environmental Compliance	N/A -Not Modeled										100%	$0	100%	0 Mo	N/A - not modeled	
Lands and Damages (LD)																												
LD1	Real estate plan defined	Potential for changes to current real estate assumptions as plan becomes better defined	Real estate plan will be defined for the feasibility study; there is a potential for cost increases as plan becomes better defined; the market value of land is well known in Barrow, but project could impact value for real estate due to market supply/demand changes; the continual erosion of the bluffs could also change real estate plan and assumptions; if more properties/utilities are included in future plans, then schedule could be impacted as well as costs; PDT thinks this risk is likely to occur in some fashion, but would cause marginal impacts to cost and schedule;	Likely	Marginal	Medium	Likely	Marginal	Medium	Triangular	Custom	Project Management	Contract Cost	-$450,000	[redacted]	$1,500,000	0 Months	[redacted]	12 Months				100%	$0	100%	0 Mo	Real estate costs are based on rough assumptions currently, and areas required and relocations may differ. Assumes -15% to +50% range to real estate costs only. Obtaining real estate may be more difficult which could push the project out one construction window (12 months).	
LD2	Known and unknown utility impacts	Encountering unknown utilities late in PED, or during construction.	There is a known electrical distribution section in the existing berm that will need to be dealt with; also a burried gas line is located near gas station, and runs parallel all the way to NARL; items will be included in TSP estimate, but there is potential for other utilities being found; PDT thinks handling unknown utilities can fit in current schedule, but could be a moderate impact to the cost estimate;	Likely	Moderate	Medium	Unlikely	Negligible	Low	Triangular	N/A -Not Modeled	Project Management	Contract Cost	$0	[redacted]	$750,000							100%	$0	100%	0 Mo	Utilities are expected to be limited, and assumed as project progresses a maximum of 25% additional real estate costs could be incurred.	

				Project Cost			Project Schedule			Other Information				COST			Schedule Model			Cost From Schedule			TOTAL Cost		TOTAL Schedule			
CREF	Risk/Opportunity Event	Risk Event Description	PDT Discussions on Impact and Likelihood	Likelihood ©	Impact ©	Risk Level ©	Likelihood (S)	Impact (S)	Risk Level (S)	Cost Variance Distribution	Schedule Variance Distribution	Responsibility/ POC	Affected Project Component	Low Variance (Min)	Likely (C)	High Variance (80%H)	Low Variance (S) (Min)	Likely (S)	High Variance (S) (80%H)	Low Variance (CS) (Min)	Likely Added Cost (CS)	High Variance (CS) (80%H)	Event Prob (PC)	Simulated Cost (C) + (CS)	Event Prob (PS)	Simulated Sched (S)	Risk Quantification Discussions	Risk Mitigation Measures
LD3	BIA land transfers	Potential for delays in obtaining easements with BIA approval	Getting easements on the bluffs will require moving some property owners off the bluff; obtaining these easements would thus require dealing with BIA in obtaining land; process of this is an identifiable cost, but has potential to delay the schedule; PDT agrees that this is a medium risk to the overall schedule;	Unlikely	Negligible	Low	Likely	Moderate	Medium	N/A -Not Modeled	Custom	Project Management	Contract Cost				0 Months	6 Months	12 Months				100%	$0	100%	0 Mo	Obtaining BIA lands could push out one of the construction windows (12 months).	
LD4	Land ownership determination	Difficulty in obtaining property from properties with multiple heirs.	There is potential to have many heirs living on one property; may require negotiating with every heir in order to obtain the property; encountering these situations could have cost and schedule impacts;	Likely	Moderate	Medium	Likely	Moderate	Medium	Triangular	Custom	Project Management	Contract Cost	$0	$0	$990,000	0 Months	3 Months	12 Months				100%	$0	100%	0 Mo	Obtaining all land in time for construction could be difficult, and therefore an additional construction could be required (12 months).	
External																												
EX1	Extreme events	Extreme storm event occuring during construction activities	Severe storm events are possible, especially given the trends of extreme long term weather patterns; weather patterns could potentially provide an opportunity if longer open water season for barge traffic become normal; unfortunate community event could shut down work for some period; PDT does not see this as being a risk to costs, but could potentially push out the number of consruction periods required.	Unlikely	Negligible	Low	Likely	Moderate	Medium	N/A -Not Modeled	Custom	Construction	Contract Cost				0 Months	6 Months	12 Months				100%	$0	100%	0 Mo	Potential with extreme events impacting the delivery of material and/or construction activities. A major event would likely close one working window and push the schedule out an additional window (12 months).	
EX2	Vandalism	Locals could damage equipment and/or construction materials	Potential for contractor coming back to sponsors due to equipment damages; contract language should mitigate this issue by requiring contractor to protect equipment adequately; small risk of loss of rock from locals taking the material for personal use; this is considered a low risk overall to cost and schedule though.	Unlikely	Negligible	Low	Possible	Marginal	Low	N/A -Not Modeled	N/A -Not Modeled	Construction	N/A -Not Modeled										100%	$0	100%	0 Mo	N/A - not modeled	
EX3	Large land owners leveraging land rights	Risk of encountering difficulties in obtaining/using land from large land owning companies in the area	A private contractor is a large local land holder, that owns a significant portion of the lands on this project; the contractor is currently willing to make properties available, and use existing resources on the project; however, there is risk in dealing with corporate lawyers, and the lawyers making late requests/changes; there is also a potential for private entities to leverage land acquisition for other requests; if this is an issue, the project could attempt to re-define project limits up to the land owners property and not into it; these risks have arisen in past, and PDT thinks they should be medium risks to both costs and schedule.	Likely	Moderate	Medium	Likely	Moderate	Medium	Triangular	Custom	Project Management	Contract Cost	$0	$0	$3,000,000	0 Months	3 Months	12 Months				100%	$0	100%	0 Mo	Large land owners may impact the purchase price of land. It is estimated an additional $3 million may be incurred as a maximum. These owners may also delay construction, pushing the project out one window (12 months).	
EX4	Labor strikes or shutdowns	Delays to project caused by labor disputes	Potential labor strike or shutdown could delay schedule; if potential quarry changes ownership, there could be impacts to agreed upon purchasing agreements or estimates; PDT lists this as unlikely to occur, but could have moderate impacts to both costs and schedule.	Unlikely	Moderate	Low	Unlikely	Moderate	Low	N/A -Not Modeled	N/A -Not Modeled	Construction	N/A -Not Modeled										100%	$0	100%	0 Mo	N/A - not modeled	
EX5	Threat of lawsuits	Lawsuits arise during the project	Potential for lawsuits would likely come from dealing with human remains that are found; a memorandum of agreement will be developed and should cover issues relating to remains being found; PDT thinks this is a low risk overall.	Unlikely	Negligible	Low	Unlikely	Negligible	Low	N/A -Not Modeled	N/A -Not Modeled	Project Management	N/A -Not Modeled										100%	$0	100%	0 Mo	N/A - not modeled	
EX6	Congressional authorization changes	Unexpected changes to authorizations during the project	Changes to key guidance documents and/or authorizations could delay schedule; PDT does not anticipate this risk being significantly impactful to either costs or schedule.	Unlikely	Negligible	Low	Possible	Marginal	Low	N/A -Not Modeled	N/A -Not Modeled	Project Management	N/A -Not Modeled										100%	$0	100%	0 Mo	N/A - not modeled	
END																												

ATTACHMENT 2 – RISK ANALYSIS BACKUP SPREADSHEETS AND FIGURES

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Project Details

District:	**Alaska District**
Project:	**Barrow Coastal Erosion Project**
Study Phase:	**Feasibility (Alternatives) - For Milestone #1**
Document Type:	**Feasibility Report**
Date:	**Feb-19**
Project Scope:	**The United States Army Corps of Engineers (Corps) has partnered with the North Slope Borough (NSB) to conduct the Barrow Alaska Coastal Erosion Feasibility Study. The study is being conducted under authority provided by Section 116 of the Energy and Water Development Appropriations Act of 2010 (PL 111-85) as amended. Section 116 provides authority for the Secretary of the Army to carry out structural and non-structural projects for storm damage prevention and reduction, coastal erosion, and ice and glacial damage in Alaska.** **This feasibility study is a Corps 3x3x3 SMART Planning feasibility study being conducted in response to a request from the North Slope Borough (NSB) to resume a previous study effort by the Corps. This previous study effort, the Barrow Coastal Storm Damage Reduction Feasibility Study, culminated in a Technical Report in 2010. Consistent with Corps SMART planning principles, the current feasibility study is utilizing existing and available information from the 2010 study combined with new data to support plan formulation and risk informed identification of a tentatively selected plan (TSP).**
Report Title	**Barrow Coastal Erosion Project Feasibility Report**

Project Development Stage/Alternative: Feasibility (Alternatives) - For Milestone #1

Risk Category: Moderate Risk: Typical Project or Possible Life Safety **Meeting Date:** 11/28/2018

Schedule Duration May-2021 (From (Month/Year)) Oct-2025 (From (Month/Year)) **Schedule Duration:** 52.6 Months 47% (Schedule Contingency)

80% Finish Date Oct-2027

	CWWBS	Feature of Work	Contract Cost	% Contingency	$ Contingency	Total
	Risk Not included within CSRA Model					
	01 LANDS AND DAMAGES	Real Estate	$ -	0%	$ -	$ -
	Risk included within CSRA Model					
1	16 BANK STABILIZATION	**Reach 1**	$ 19,583,659	41%	$ 8,029,300	$ 27,612,959
2	16 BANK STABILIZATION	**Reach 2**	$ 15,202,610	41%	$ 6,233,070	$ 21,435,680
3	16 BANK STABILIZATION	**Reach 3**	$ 30,448,541	41%	$ 12,483,902	$ 42,932,443
4	16 BANK STABILIZATION	**Reach 4**	$ 31,817,661	41%	$ 13,045,241	$ 44,862,902
5	16 BANK STABILIZATION	**Reach 5**	$ 63,512,313	41%	$ 26,040,048	$ 89,552,361
6	16 BANK STABILIZATION	**Reach 6**	$ 45,385,230	41%	$ 18,607,944	$ 63,993,174
7	18 CULTURAL RESOURCE PRESERVATION		$ 446,605	41%	$ 183,108	$ 629,713
8			$ -	0%	$ -	$ -
9			$ -	0%	$ -	$ -
10			$ -	0%	$ -	$ -
11			$ -	0%	$ -	$ -
12			$ -	0%	$ -	$ -
13			$ -	0%	$ -	$ -
14			$ -	0%	$ -	$ -
15			$ -	0%	$ -	$ -
16			$ -	0%	$ -	$ -
17			$ -	0%	$ -	$ -
18			$ -	0%	$ -	$ -
19			$ -	0%	$ -	$ -
20			$ -	0%	$ -	$ -
21			$ -	0%	$ -	$ -
22	All Other	**Remaining Construction Items**	$ -	0%	$ -	$ -
23	30 PLANNING, ENGINEERING, AND DESIGN	**Planning, Engineering, & Design**	$ 20,639,662	41%	$ 8,462,261	$ 29,101,923
24	31 CONSTRUCTION MANAGEMENT	**Construction Management**	$ 12,383,797	41%	$ 5,077,357	$ 17,461,154
XX	FIXED DOLLAR RISK ADD (EQUALLY DISPERSED TO ALL, MUST INCLUDE JUSTIFICATION SEE BELOW)				$ -	

Totals				
Real Estate	$ -	0%	$ -	$ -
Total Construction Estimate	$ 206,396,620	41%	$ 84,622,614	$ 291,019,234
Total Planning, Engineering & Design	$ 20,639,662	41%	$ 8,462,262	$ 29,101,924
Total Construction Management	$ 12,383,797	41%	$ 5,077,357	$ 17,461,154
Fixed Dollar Risk Equally Distributed	$ -	0%	$ -	$ -
Total	**$ 239,420,079**	**41%**	**$ 98,162,233**	**$ 337,582,312**

RISK RAGE ASSUMPTION DEVELOPMENT

Risk Matrix

Likelihood of Occurrence	Impact or Consequence of Occurrence				
	Negligible	Marginal	Moderate	Significant	Critical
Certain	RELOOK AT BASIS OF ESTIMATE				
Very Likely	Low	Medium	High	High	High
Likely	Low	Medium	Medium	High	High
Possible	Low	Low	Medium	Medium	High
Unlikely	Low	Low	Low	Medium	Medium

Likelihood of Occurrence Table

Any changes to these assumptions will change the assumptions in the models.

Likelihood	Low % Occurrence	High % Occurrence
Very Likely	75%	100%
Likely	25%	75%
Possible	5%	25%
Unlikely	0%	5%
Unrated		

Percent's above are based on 10 events, and are considered approximate, judgment should be used for final grouping dependent on # of occurrences, project size, flexibility and complexity.

If event occurrence	then it's likelihood is thought to be between…
Certain	Relook at Basis of Estimate
Very Likely	75% and 100%
Likely	25% and 75%
Possible	5% and 25%
Unlikely	0% and 5%

Likelihood of Occurrence Tables.

If an event is

- Certain: implies the event has a 100% chance of occurrence. Relook at Basis of estimate.
- Very Likely: implies the event has a 75% to 100% chance of occurrence.
- Likely: implies the event has a 25% to 75% chance of occurrence.
- Possible: implies the event has a 5% to 25% chance of occurrence.
- Unlikely: implies the event has a 0% to 5% chance of occurrence.

Impact or Consequence of Occurrence

Any changes to these assumptions will change the assumptions in the models.

	% of Project Cost or Schedule Change	
	per Cost Event Exceeds	per Schedule Event Exceeds
Negligible	0.000%	2.000%
Marginal	0.500%	5.000%
Moderate	2.000%	10.000%
Significant	3.000%	15.000%
Critical	5.000%	20.000%

Percent's above are based on 10 events, and are considered approximate, judgment should be used for final grouping dependent on # of occurrences, project size, flexibility and complexity.

If event occurrence	then it's Impact to total project cost is thought to be between…
Negligible	0% and .5%
Marginal	.5% and 2%
Moderate	2% and 3.%
Significant	3.% and 5%
Critical	over 5%

Impact or Consequence of Occurrence

If an event is classified as....

- Negligible: implies the event has a 0% to .5 impact to project cost..
- Marginal: implies the event has a .5% to 2 impact to project cost.
- Moderate: implies the event has a 2.% to 3 impact to project cost.
- Significant: implies the event has a 3.% to 5 impact to project cost.
- Critical: implies the event has a greater than 5% to impact to project cost.

Cost and Schedule Risk Analysis **Barrow Coastal Erosion Project**

Risk Facilitator Scott Vose

Risk Register Meeting

Date: 11/28/2018

Attendance	Name	Office	Representing
Full	Jenipher Cate	USACE POA	Project Manager
Full	Karl Harvey	USACE POA	Cost Engineering
Full	Joey Sparaga	USACE POA	Archaeologist
Full	Amber Metallo	USACE POA	Biologist/Planner
Full	Doug Bliss	USACE POA	Supervisory Civil Eng., Geotech
Full	Rebecca Kloster	USACE POA	H&H
Full	Cindy Upah	USACE POA	Chief of Planning, Civil Works
Full	Brandee Ketchum	USACE POA	Office of Council
Full	Ron Green	USACE POA	Real Estate
Full	Bob Shears	North Slope Borough	Local Sponsor Representative
Full	Ridge Robinson	Tetra Tech	Project Manager
Full	James Carney	Tetra Tech	Economics
Full	Scott Vose	Tetra Tech	Cost Estimating/Risk Analyst

Follow-Up Discussions - Individual or group discussions

Date: **through**

Attendance	Name	Office	Representing

Follow-Up Meeting Notes

PDT members supplied additional data based on the questions from the CSRA with regards to the following:

				Project Cost			Project Schedule			Other Information				COST			Schedule Model			Cost From Schedule			TOTAL Cost		TOTAL Schedule			
CREF	Risk/Opportunity Event	Risk Event Description	PDT Discussions on Impact and Likelihood	Likelihood ©	Impact ©	Risk Level ©	Likelihood (S)	Impact (S)	Risk Level (S)	Cost Variance Distribution	Schedule Variance Distribution	Responsibility / POC	Affected Project Component	Low Variance (Min)	Likely (C)	High Variance (80%H)	Low Variance (S) (Min)	Likely (S)	High Variance (S) (80%H)	Low Variance (CS) (Min)	Likely Added Cost (CS)	High Variance (CS) (80%H)	Event Prob (PC)	Simulated Cost (C) + (CS)	Event Prob (PS)	Simulated Sched (S)	Risk Quantification Discussions	Risk Mitigation Measures
Project & Program Management (PM)																												
PM1	Project scope definition is unclear/incomplete	Potential for TSP to change based on updated results of CE/ICA	Linear and above ground work is assumed accurate; geotechnical analysis is still remaining to be completed, which could alter design and quantities; if alternatives change, they would change by reach or distance, as opposed to wholesale changes in design elements; there is potential for costs to decrease if reaches are not cost effective; PDT thinks this would be medium risk to the cost estimate, but low risk to schedule.	Possible	Moderate	**Medium**	Possible	Negligible	**Low**	Triangular	N/A -Not Modeled	Project Management	Contract Cost	-$12,260,358	$0	$24,520,715							100%	$0	100%	0 Mo	The TSP is not anticipated to change, but there still may be changes to design and assumptions as project progresses. Assumes a total project cost potential range of -5% to +10% could be possible.	
PM2	Project funding	Risk of not receiving Federal or local funding	Project is currently in good position to obtain supplemental funding; there would still be time and capability to fight for congressional funding if needed; current estimates support a raising BCR; could have staggered implementation by reaches over multiple years, which would likely be more palatable to funding sources; local sponsor will have to sell new bonds, and will have to go before the voters of North Slope; low probability that bond funding will not become immediately available; other capital improvement projects are needed in the North Slope for critical facilites though, which could limit funding availability;	Unlikely	Negligible	**Low**	Possible	Moderate	**Medium**	N/A	Triangular	Project Management	Project Schedule				0 Months	12 Months	12 Months				100%	$0	100%	0 Mo	Schedule could be pushed out one construction period (12 months) if funding is not received. It is assumed that there is a 10% chance this occurs.	
PM3	Unplanned work that must be accomodated	Currently experiencing unplanned work for model review/CEICA	There is on-going work that was unplanned, but the work has already been accounted for in current project schedule; the project has excess funding to account for this effort, and therefore the PDT lists this as a low risk for both cost and schedule.	Possible	Negligible	**Low**	Possible	Marginal	**Low**	N/A -Not Modeled	N/A -Not Modeled	Project Management	N/A -Not Modeled										100%	$0	100%	0 Mo	N/A - not modeled	
PM4	Delayed funding impacting field investigations	Delayed funding could delay critical PED investigations.	If project funding is received at inopportune times, then field investigations could be pushed back to subsequent year because of weather windows; current schedule assumes 2-years already for PED phase which should lessen the potential risk; PDT thinks this risk is overall low to both cost and schedule.	Unlikely	Negligible	**Low**	Possible	Marginal	**Low**	N/A -Not Modeled	N/A -Not Modeled	Project Management	N/A -Not Modeled										100%	$0	100%	0 Mo	N/A - not modeled	
PM5	Project competing with other projects, funding and resources	Potential for other large project to kick-off	District has technical staff able to complete work, but many projects moving simultaneously could cause some difficulties in this regard; similar projects with similar timeframes and due dates could cause funding/resource issues; District does have it in their plan to hire more staff in the future; new staff may need to be caught up, but overall PDT thinks this is an overall low risk to both cost and schedule;	Unlikely	Negligible	**Low**	Possible	Moderate	**Medium**	N/A -Not Modeled	Custom	Project Management	Project Schedule				0 Months	12 Months	12 Months				100%	$0	5%	0 Mo	Schedule could be pushed out one construction period (12 months) if significant project funding and resources are diverted. It is assumed that there is a 10% chance this occurs.	
PM6	Losing critical staff at crucial points of project	Potential for delays or cost increases due to staff turnover	PMs have changed already, and key staff could retire/move-on; new staff would have to be trained, but this is typical on any project and PDT thinks would be overall low risk to both cost and schedule.	Unlikely	Negligible	**Low**	Unlikely	Marginal	**Low**	N/A -Not Modeled	N/A -Not Modeled	Project Management	N/A -Not Modeled										100%	$0	100%	0 Mo	N/A - not modeled	
PM7	Ability to identify NFIP compliance or alternatives	Delays in determining NFIP compliance	The city of Barrow is looking to become NFIP compliant or comparable; PDT is currently looking into what the comparable measures are for NFIP; Barrow is not currently an NFIP participant; if project is not compliant with NFIP, funding will not be obtained; project would likely not move forward if NFIP compliance is not obtained; PDT thinks there could be significant delays in the project schedule if NFIP compliance does not go according to current plans.	Unlikely	Marginal	**Low**	Possible	Significant	**Medium**	N/A	Custom	Project Management	Project Schedule				0 Months	12 Months	12 Months				100%	$0	5%	0 Mo	Schedule could be pushed out one construction period (12 months) if NFIP compliance requirements are not determined on schedule. It is assumed that there is a 10% chance this risk event occurs.	
Contract Acquisition (CA)																												
CA1	Undefined acquisition strategy	Acquisition strategy assumptions differ from actual	The acquisition strategy would likely be full and open bid; incremental funding and phasing of the project would likely be more of a risk to the project; it is anticipated that a select group of large contractors, with adequate subconctractors, would be bidding; still potential for limited bid competition if several of these contractors do not bid; potential for local acquisition of work-in-kind services which could impact schedule; overall the PDT thinks the acquisition strategy is a medium risk for both cost and schedule.	Possible	Significant	**Medium**	Possible	Significant	**Medium**	Triangular	Triangular	Contracting	Project Cost & Schedule	$0	$0	$20,879,927	0 Months	12 Months	12 Months				10%	$0	10%	0 Mo	Potential for the construction cost to increase based on bidding conditions over life of project, and number of projects let out. Assumes potential for 10% increase to total construction costs. Schedule could be impacted as well, and assumes one additional construction period (12 months) occuring. Assumes 10% chance of schedule risk event occuring.	
CA2	Potential for several contracts	Multiple contracts or phases could result in changes to current cost/schedule	Project is able to be separated by reaches, which in turn could be separated into phases/contracts as needed; currently not estimating in phased contracts; phasing strategy will be developed in PED phase and incorporated into cost estimate and construction schedule accordingly; Due to construction work windows, schedule is already "phased", but costs could still be a medium risk to project costs if numerous contracts are required to be let out.	Likely	Moderate	**Medium**	Possible	Marginal	**Low**	Triangular	N/A -Not Modeled	Contracting	Project Cost	$0	$0	$12,260,358							100%	$0	100%	0 Mo	Current estimate assumes phasing of construction, with appliable mob/demob costs. Therefore model assumes potential 5% increase to total project cost if more contracts are required.	
CA3		Contract modifications during construction	There is always a risk to have modifications from the contractor during construction; PDT does not currently anticipate these to be a significant impact to cost or schedule, but mods are likely to occur;	Likely	Marginal	**Medium**	Likely	Marginal	**Medium**	Triangular	Custom	Project Management	Project Cost & Schedule	$0	$0	$31,319,891	0 Months	6 Months	12 Months				100%	$0	10%	0 Mo	Contract modifications are a significant risk to any project. Given the scale of this project, it is anticipated that significant mods could add 15% to costs. Mods could also delay construction, and significant delays could add another construction window (12 months).	
Technical Design (TD) / Project Scope Growth																												

				Project Cost			Project Schedule			Other Information				COST			Schedule Model			Cost From Schedule			TOTAL Cost		TOTAL Schedule			
CREF	Risk/Opportunity Event	Risk Event Description	PDT Discussions on Impact and Likelihood	Likelihood ©	Impact ©	Risk Level ©	Likelihood (S)	Impact (S)	Risk Level (S)	Cost Variance Distribution	Schedule Variance Distribution	Responsibility / POC	Affected Project Component	Low Variance (Min)	Likely (C)	High Variance (80%H)	Low Variance (S) (Min)	Likely (S)	High Variance (S) (80%H)	Low Variance (CS) (Min)	Likely Added Cost (CS)	High Variance (CS) (80%H)	Event Prob (PC)	Simulated Cost (C) + (CS)	Event Prob (PS)	Simulated Sched (S)	Risk Quantification Discussions	Risk Mitigation Measures
TD1	Design at preliminary level	Design still has outstanding information to be developed, and does not incorporate sea level change or resiliency guidance currently	Not incorporating sea level change or resiliency could lead to changes in rock type, embankment heights, quantity of rock, footprints, etc; there is a possibility that sheet piles would be required based on results of geotech investigations; still need to look into beach access/parking locations, permafrost stabilizers, and other items that could change costs; a sensitivity analysis is being completed for crest heights and rock sizing (this could be a potential opportunity); these are all known tasks, and not anticipated to impact schedule significantly; PDT thinks there is a likely chance of these risks impacting the cost estimate, and the changes could be significant.	Likely	Significant	High	Unlikely	Marginal	Low	Triangular	N/A -Not Modeled	Project Management	Project Cost	-$12,260,358	$0	$24,520,715							100%	$0	100%	0 Mo	Quantities have recently been revised based on new topo and cross sections. Still possible to change, since design is limited, and estimated to be a range between -5% and +10% cost impact.	
TD2	Remaining studies and investigations to be completed	Geotech, H&H, sea level change, cultural have yet to be finalized	Cultural and H&H studies have already begun; geotech and relative sea level change have baselines developed; all these studies have been included in PED for both the costs and schedule, therefore PDT thinks this is a low risk to both cost and schedule.	Unlikely	Negligible	Low	Unlikely	Negligible	Low	N/A -Not Modeled	N/A -Not Modeled	Project Management	N/A -Not Modeled										100%	$0	100%	0 Mo	N/A - not modeled	
TD3	Rock quantities	Potential for change to rock quantities	Revised quantities are currently being developed; quantities may be impacted by changes to existing land conditions (storms/erosion); sea level change results could change rock quantities; results of finalized CE/ICA could also impact overall quantities of rock (potential opportunity for decreased quantities); due to the volume of rock required, changes in quantities would have at least a moderate impact to costs.	Possible	Moderate	Medium	Unlikely	Negligible	Low	Triangular	N/A -Not Modeled	Geotechnical/Civil Design	Contract Cost	-$8,782,672	$0	$17,565,343							100%	$0	100%	0 Mo	Estimated that total cost impact of just the rock purchase, delivery and placement could range from -5% to +10% with additional changes to rock assumptions and calculations.	
TD4	Borrow/fill sources locations and quality	Currently assume rock and gravel sources, but general fill suitability is still to be defined	There is a concern of local fill material not being suitable for use in this project, and/or there is a concern that there are not sufficient quantities available locally; there may be a potential to use local material with some innovative designs to ensure proper compaction, but that is not a current assumption; the overall quantity of fill required could use up all remaining local fill supplies; fill not supplied locally would have to come from elsewhere, and there is risk/opportunity of using other suppliers; contract will not be able to force contractor to use local material; PDT does not think this would impact the overall schedule, but could have a medium impact to the cost estimate;	Likely	Moderate	Medium	Unlikely	Negligible	Low	Triangular	N/A -Not Modeled	Geotechnical/Civil Design	Contract Cost	$0	$0	$5,832,690							100%	$0	100%	0 Mo	Due to current limitations at local borrow site, costs could be much higher for the purchase of local material Barrow. Assumes potential of 100% increase to borrow costs for this project.	
TD5	Hazardous waste concerns	Encountering hazardous waste in the project footprint	There are two locations that could encounter hazardous materials during excavation; high potential for encountering materials close to NARL; the city of Barrow currently has a method for disposal of hydrocarbon materials; encountering other materials could cause increases to costs; this risk is likely to occur due to the scale of the project length, and PDT anticipates it could be a moderate impact to costs, but a low risk to the overall schedule.	Likely	Moderate	Medium	Unlikely	Negligible	Low	Triangular	N/A -Not Modeled	Geotechnical/Civil Design	Contract Cost	$0	$0	$5,623,611							100%	$0	100%	0 Mo	Hazardous waste risks are assumed to apply to earthwork costs only. Potential for 50% increase to total earthwork costs if significant HTRW's are encountered.	
TD6	Drainage issues	Project does not currently account for potential drainage issues during break-up, or at the sewage outfall	Project currently lacks surveys for existing culvert data; obtaining this information would better help with drainage details and assumptions; drainage is not part of the feasibility design, but anticipated to be included in O&M manual to be completed for final design; therefore no current drainage items included in cost estimate, and PDT does anticipates this being a low risk to cost and schedule.	Likely	Negligible	Low	Possible	Marginal	Low	N/A -Not Modeled	N/A -Not Modeled	Geotechnical/Civil Design	N/A -Not Modeled										100%	$0	100%	0 Mo	N/A - not modeled	
Construction (CO)																												
CO1	Labor availability	Risk of contractor not having adequate labor for rock placement	Skillset required for rock placement is very specific, and likely a small pool of local laborers for that aspect; there is a known shortage of local equipment operators; project will likely attract the required labor to be brought up to Barrow; labor costs for non-local labor should already be accounted for in estimate already, and therefore this is considered a low risk overall.	Unlikely	Marginal	Low	Unlikely	Negligible	Low	N/A -Not Modeled	N/A -Not Modeled	Cost Engineering	N/A -Not Modeled										100%	$0	100%	0 Mo	N/A - not modeled	
CO2	Weather/seasonal impacts	Weather issues cause delays to the contractor creating new for more construction periods	Rock delivery via barge has been delayed due to storm conditions at quarries in past projects; offloading of materials in Barrow could be impacted from storms; long enough delays could extend the number of construction periods required; additional seasons would add additional mob/demob costs; contractor may store equipment in Barrow, and incur storage costs, if pushed into other construction seasons; due to the number of assumed construction periods, and overall quantity of material to be barged to Barrow, it is likely that some impacts occur which impact the cost and schedule moderately.	Likely	Moderate	Medium	Likely	Moderate	Medium	Triangular	Custom	Construction	Contract Cost	$0	$0	$3,713,153	0 Months	0 Months	12 Months				100%	$0	100%	0 Mo		

				Project Cost			Project Schedule			Other Information				COST			Schedule Model			Cost From Schedule			TOTAL Cost		TOTAL Schedule			
CREF	Risk/Opportunity Event	Risk Event Description	PDT Discussions on Impact and Likelihood	Likelihood ©	Impact ©	Risk Level ©	Likelihood (S)	Impact (S)	Risk Level (S)	Cost Variance Distribution	Schedule Variance Distribution	Responsibility / POC	Affected Project Component	Low Variance (Min)	Likely (C)	High Variance (80%H)	Low Variance (S) (Min)	Likely (S)	High Variance (S) (80%H)	Low Variance (CS) (Min)	Likely Added Cost (CS)	High Variance (CS) (80%H)	Event Prob (PC)	Simulated Cost (C) + (CS)	Event Prob (PS)	Simulated Sched (S)	Risk Quantification Discussions	Risk Mitigation Measures
CO3	Unknown cultural or historic preservation	Encountering human remains where not currently anticipated	There are human remains present, and currently being found at the bluff; a full project stop would be required if remains are encountered; PDT is attempting to incorporate a "minimum project stop" clause into contract to help mitigate delays from this risk; excavation will encounter numerous types of bones, and staff is assumed to be available be on-site with the experience to identify animal and human remains; based on the minimum project stop clause likely to be included, the PDT thinks there is low risk to schedule, but could still be medium risk to costs.	Likely	Marginal	Medium	Possible	Marginal	Low	Triangular	N/A -Not Modeled	Environmental Compliance	Contract Cost		$0	$2,000,000							100%	$0	100%	0 Mo	If significant culturally valuable items are found within the site, a lump sum of $2,000,000 has been assumed. This would account for additional archeologists, and other specialists to be mobilized and working on site during construction.	
CO4	Identified staging areas	Potential for staging area assumptions to change	Two off-loading areas have been identified with local concurrence from Barrow personnel; two to three other areas would be viable for staging, but need to be finalized; costs are planned to include these staging area assumptions, and therefore overall risk is low for both cost and schedule.	Unlikely	Negligible	Low	Unlikely	Negligible	Low	N/A -Not Modeled	N/A -Not Modeled	Construction	N/A -Not Modeled										100%	$0	100%	0 Mo	N/A - not modeled	
CO5	Control and diversion of water	Increased water control activities are needed	The work near the gabion baskets may require some dewatering/diversion efforts, but majority of project is not anticipated to require significant water control efforts; if contaminated materials are located near the gabions, then contaminated water may be encountered, which could increase costs; this risk is deemed unlikely to occur by the PDT, and would not lead to any substantial impacts to costs or schedule if it occurs.	Unlikely	Negligible	Low	Unlikely	Negligible	Low	N/A -Not Modeled	N/A -Not Modeled	Technical Lead	N/A -Not Modeled										100%	$0	100%	0 Mo	N/A - not modeled	
CO6	Material availability and delivery	Rock availability changes causing delays and/or cost increases.	There is a schedule risk due to not receiving the rock to the project site on time; there is some risk of the quarry not being able to keep up with production to meet current schedule; barges typically start arriving in July and continue for approximately 9 weeks; quarry may have competing projects which could impact material availability; rock availability that meet required specifications has been issue in previous projects; PDT sees this as a high risk that could impact both costs and schedule.	Likely	Significant	High	Likely	Significant	High	Triangular	Custom	Construction	Contract Cost	$0	$0	$43,913,359	0 Months	0 Months	12 Months				100%	$0	100%	0 Mo	Cost changes to the rock material and delivery could see significant impacts to the estimate. Assumes potential 25% increase in total rock placement costs, and potential for one additional construction window to be needed (12 months).	
CO7	Differing site conditions	The site changes seasonally and could cause changes to design	Contract will have to build in how to change design after the pre-construction survey; there will likely be modifications because conditions will be different at time of construction due to current weather patterns; the project schedule should account for pre-construction survey and design changes already, but there still is a risk of more significant changes being required; PDT thinks this is an overall medium risk to both cost and schedule.	Likely	Moderate	Medium	Likely	Marginal	Medium	Triangular	Custom	Construction	Contract Cost	$0	$0	$24,520,715	0 Months	0 Months	12 Months				100%	$0	100%	0 Mo	Differing site conditions may impact many areas of the project. It is assumed that a potential 10% increase to total project costs could be incurred.	
Cost and Schedule (ES)																											
ES1	Rock prices	Potential for changes to quoted price for rock material purchase and delivery.	Current estimate has obtained rock prices for material and delivery from the anticipated rock supplier; due to scale of rock required, changes to rock price can have significant impacts to the overall costs; the rock prices from the quarry could change drastically due to market conditions, and rock availability at time of construction; delivery costs could fluctuate widely based on various market conditions like labor/barge availability, fuel rates, etc.; This is a high risk to the cost estimate.	Possible	Critical	High	Unlikely	Negligible	Low	N/A -Not Modeled	N/A -Not Modeled	Cost Engineering	N/A -Not Modeled										100%	$0	100%	0 Mo	The price for the rock is primarily going to be driven by the availability and delivery which is discussed in C06. Therefore no costs have been included for this item, to avoid double counting.	
ES2	Estimate confidence in large and critical quantities	Current quantities could change as design detail increases	Current design is limited, and quantities are calculated based on this information; project is currently re-analyzing the design assumptions and quantity calculations will be changing based on more detailed information; as project progresses, quantity accuracy should improve, but currently, based on scale of quantities, changes could see large moderate swings in both cost and schedule (benefits possible as well);	Possible	Moderate	Medium	Possible	Moderate	Medium	Triangular	Custom	Cost Engineering	Contract Cost	-$10,439,964	$0	$20,879,927	0 Months	0 Months	12 Months				100%	$0	100%	0 Mo	Changes in quantities as project progresses could be a benefit or increase to the project. It is assumed that potential -5% decrease in construction costs, to +10% increase. Also, increased quantities could result in additional construction period (12 months) being required.	
ES3	Estimate reasonableness of crews and productivities	Assumed crews and productivities differ from those of the construction contractor	Current MCACES estimate has developed user defined crews for key construction elements such as rock placement, excavation and fill; crew sizing and productivity assumptions have been based on previous projects and cost estimates, but are still being refined and verified for accuracy; potential for these assumptions to change as project progresses; since the material costs are more of the driver of the estimate, this is anticipated to be a marginal impact to cost; due to limited construction period durations, changes to productivities could impact schedule some;	Possible	Marginal	Low	Possible	Moderate	Medium	N/A -Not Modeled	Custom	Cost Engineering	Contract Cost				0 Months	0 Months	12 Months				100%	$0	100%	0 Mo	Productivity and delivery of stone could take longer than currently assumed. This could potentially push construction our one window (12 months) if it occurs.	
ES4	Fuel prices	Differing fuel prices at time of construction would impact barge delivery rates	Fuel prices are expected to have a significant influence over the barge delivery of rock materials; barge shipping costs are heavily dependent on fuel prices, and current estimate is based on recent fuel prices; as fuel prices fluctuate, the estimate for rock delivery will as well (could decrease costs too); this is anticipated to be a moderate risk overall to the cost estimate, and negligible risk to the schedule.	Possible	Moderate	Medium	Possible	Negligible	Low	Triangular	Custom	Cost Engineering	Contract Cost	-$8,782,672	$0	$26,348,015							100%	$0	100%	0 Mo	Changes in fuel prices could significantly impact the delivery of the rock materials. It is assuemd that the total rock cost could very between -5% and +15% depending on fuel prices at time of construction.	
Regulatory & Environmental (RE)																											

				Project Cost			Project Schedule			Other Information				COST			Schedule Model			Cost From Schedule			TOTAL Cost		TOTAL Schedule			
CREF	Risk/Opportunity Event	Risk Event Description	PDT Discussions on Impact and Likelihood	Likelihood ©	Impact ©	Risk Level ©	Likelihood (S)	Impact (S)	Risk Level (S)	Cost Variance Distribution	Schedule Variance Distribution	Responsibility / POC	Affected Project Component	Low Variance (Min)	Likely (C)	High Variance (80%H)	Low Variance (S) (Min)	Likely (S)	High Variance (S) (80%H)	Low Variance (CS) (Min)	Likely Added Cost (CS)	High Variance (CS) (80%H)	Event Prob (PC)	Simulated Cost (C) + (CS)	Event Prob (PS)	Simulated Sched (S)	Risk Quantification Discussions	Risk Mitigation Measures
RE1	HTRW scope grows	Discussed in previous risk items.	This risk has been discussed previously in risk item TD5;	Unlikely	Negligible	Low	Unlikely	Negligible	Low	N/A -Not Modeled	N/A -Not Modeled	Environmental Compliance	N/A -Not Modeled										100%	$0	100%	0 Mo	N/A - not modeled	
RE2	Project in area of high sensitivity to paleontology/cultural artifacts	Discussed in previous risk items.	This risk has been discussed previously in risk item CO3;	Unlikely	Negligible	Low	Unlikely	Negligible	Low	N/A -Not Modeled	N/A -Not Modeled	Environmental Compliance	N/A -Not Modeled										100%	$0	100%	0 Mo	N/A - not modeled	
RE3	Permits or agency actions delayed or take longer than expected	Delays due to interaction between agencies	No significant impacts from this risk are anticipated by the PDT; potential for various interaction plans to be developed between various agencies;	Unlikely	Negligible	Low	Unlikely	Negligible	Low	N/A -Not Modeled	N/A -Not Modeled	Environmental Compliance	N/A -Not Modeled										100%	$0	100%	0 Mo	N/A - not modeled	
Lands and Damages (LD)																												
LD1	Real estate plan defined	Potential for changes to current real estate assumptions as plan becomes better defined	Real estate plan will be defined for the feasibility study; there is a potential for cost increases as plan becomes better defined; the market value of land is well known in Barrow, but project could impact value for real estate due to market supply/demand changes; the continual erosion of the bluffs could also change real estate plan and assumptions; if more properties/utilities are included in future plans, then schedule could be impacted as well as costs; PDT thinks this risk is likely to occur in some fashion, but would cause marginal impacts to cost and schedule;	Likely	Marginal	Medium	Likely	Marginal	Medium	Triangular	Custom	Project Management	Contract Cost	-$450,000	$0	$1,500,000	0 Months	0 Months*	12 Months				100%	$0	100%	0 Mo	Real estate costs are based on rough assumptions currently, and areas required and relocations may differ. Assumes -15% to +50% range to real estate costs only. Obtaining real estate may be more difficult which could push the project out one construction window (12 months).	
LD2	Known and unknown utility impacts	Encountering unknown utilities late in PED, or during construction.	There is a known electrical distribution section in the existing berm that will need to be dealt with; also a burried gas line is located near gas station, and runs parallel all the way to NARL; items will be included in TSP estimate, but there is potential for other utilities being found; PDT thinks handling unknown utilities can fit in current schedule, but could be a moderate impact to the cost estimate;	Likely	Moderate	Medium	Unlikely	Negligible	Low	Triangular	N/A -Not Modeled	Project Management	Contract Cost	$0	$0	$750,000							100%	$0	100%	0 Mo	Utilities are expected to be limited, and assumed as project progresses a maximum of 25% additional real estate costs could be incurred.	
LD3	BIA land transfers	Potential for delays in obtaining easements with BIA approval	Getting easements on the bluffs will require moving some property owners off the bluff; obtaining these easements would thus require dealing with BIA in obtaining land; process of this is an identifiable cost, but has potential to delay the schedule; PDT agrees that this is a medium risk to the overall schedule;	Unlikely	Negligible	Low	Likely	Moderate	Medium	N/A -Not Modeled	Custom	Project Management	Contract Cost				0 Months	0 Months*	12 Months				100%	$0	100%	0 Mo	Obtaining BIA lands could push out one of the construction windows (12 months).	
LD4	Land ownership determination	Difficulty in obtaining property from properties with multiple heirs.	There is potential to have many heirs living on one property; may require negotiating with every heir in order to obtain the property; encountering these situations could have cost and schedule impacts;	Likely	Moderate	Medium	Likely	Moderate	Medium	Triangular	Custom	Project Management	Contract Cost	$0	$0	$990,000	0 Months	0 Months*	12 Months				100%	$0	100%	0 Mo	Obtaining all land in time for construction could be difficult, and therefore an additional construction could be required (12 months).	
External																												
EX1	Extreme events	Extreme storm event occuring during construction activities	Severe storm events are possible, especially given the trends of extreme long term weather patterns; weather patterns could potentially provide an opportunity if longer open water season for barge traffic become normal; unfortunate community event could shut down work for some period; PDT does not see this as being a risk to costs, but could potentially push out the number of construction periods required.	Unlikely	Negligible	Low	Likely	Moderate	Medium	N/A -Not Modeled	Custom	Construction	Contract Cost				0 Months	0 Months*	12 Months				100%	$0	100%	0 Mo	Potential with extreme events impacting the delivery of material and/or construction activities. A major event would likely close one working window and push the schedule out an additional window (12 months).	
EX2	Vandalism	Locals could damage equipment and/or construction materials	Potential for contractor coming back to sponsors due to equipment damages; contract language should mitigate this issue by requiring contractor to protect equipment adequately; small risk of loss of rock from locals taking the material for personal use; this is considered a low risk overall to cost and schedule though.	Unlikely	Negligible	Low	Possible	Marginal	Low	N/A -Not Modeled	N/A -Not Modeled	Construction	N/A -Not Modeled										100%	$0	100%	0 Mo	N/A - not modeled	
EX3	Large land owners leveraging land rights	Risk of encountering difficulties in obtaining/using land from large land owning companies in the area	A private contractor is a large local land holder, that owns a significant portion of the lands on this project; the contractor is currently willing to make properties available, and use existing resources on the project; however, there is risk in dealing with corporate lawyers, and the lawyers making late requests/changes; there is also a potential for private entities to leverage land acquisition for other requests; if this is an issue, the project could attempt to re-define project limits up to the land owners property and not into it; these risks have arisen in past, and PDT thinks they should be medium risks to both costs and schedule.	Likely	Moderate	Medium	Likely	Moderate	Medium	Triangular	Custom	Project Management	Contract Cost	$0	$0	$3,000,000	0 Months	0 Months*	12 Months				100%	$0	100%	0 Mo	Large land owners may impact the purchase price of land. It is estimated an additional $3 million may be incurred as a maximum. These owners may also delay construction, pushing the project out one window (12 months).	
EX4	Labor strikes or shutdowns	Delays to project caused by labor disputes	Potential labor strike or shutdown could delay schedule; if potential quarry changes ownership, there could be impacts to agreed upon purchasing agreements or estimates; PDT lists this as unlikely to occur, but could have moderate impacts to both costs and schedule.	Unlikely	Moderate	Low	Unlikely	Moderate	Low	N/A -Not Modeled	N/A -Not Modeled	Construction	N/A -Not Modeled										100%	$0	100%	0 Mo	N/A - not modeled	
EX5	Threat of lawsuits	Lawsuits arise during the project	Potential for lawsuits would likely come from dealing with human remains that are found; a memorandum of agreement will be developed and should cover issues relating to remains being found; PDT thinks this is a low risk overall.	Unlikely	Negligible	Low	Unlikely	Negligible	Low	N/A -Not Modeled	N/A -Not Modeled	Project Management	N/A -Not Modeled										100%	$0	100%	0 Mo	N/A - not modeled	

				Project Cost			Project Schedule			Other Information				COST			Schedule Model			Cost From Schedule			TOTAL Cost		TOTAL Schedule			
CREF	Risk/Opportunity Event	Risk Event Description	PDT Discussions on Impact and Likelihood	Likelihood (C)	Impact (C)	Risk Level (C)	Likelihood (S)	Impact (S)	Risk Level (S)	Cost Variance Distribution	Schedule Variance Distribution	Responsibility / POC	Affected Project Component	Low Variance (Min)	Likely (C)	High Variance (80%H)	Low Variance (S) (Min)	Likely (S)	High Variance (S) (80%H)	Low Variance (CS) (Min)	Likely Added Cost (CS)	High Variance (CS) (80%H)	Event Prob (PC)	Simulated Cost (C) + (CS)	Event Prob (PS)	Simulated Sched (S)	Risk Quantification Discussions	Risk Mitigation Measures
EX6	Congressional authorization changes	Unexpected changes to authorizations during the project	Changes to key guidance documents and/or authorizations could delay schedule; PDT does not anticipate this risk being significantly impactful to either costs or schedule.	Unlikely	Negligible	Low	Possible	Marginal	Low	N/A -Not Modeled	N/A -Not Modeled	Project Management	N/A -Not Modeled										100%	$0	100%	0 Mo	N/A - not modeled	
END																												

		COST VARIANCES					SCHEDULE VARIANCES				
CREF		- Change	Low	Element Cost	High	+ Change	- Change	Low	Likely	High	+ Change
Project & Program Management (PM)											
PM1	Project scope definition is unclear/incomplete	-5%	-$11,971,448	$239,428,954	$23,942,895	10%					
PM2	Project funding						months	53 months	53 months	65 months	12 months
PM3	Unplanned work that must be accomodated										
PM4	Delayed funding impacting field investigations										
PM5	Project competing with other projects, funding and resources						months	53 months	53 months	65 months	12 months
PM6	Losing critical staff at crucial points of project										
PM7	Ability to identify NFIP compliance or alternatives						months	53 months	53 months	65 months	12 months
Contract Acquisition (CA)											
CA1	Undefined acquisition strategy	0%	$0	$206,396,620	$20,639,662	10%	months	53 months	53 months	65 months	12 months
CA2	Potential for several contracts	0%	$0	$239,428,954	$11,971,448	5%					
CA3	Contract modifications	0%	$0	$206,396,620	$30,959,493	15%	months	53 months	53 months	65 months	12 months
Technical Design (TD) / Project Scope Growth											
TD1	Design at preliminary level	-5%	-$11,971,448	$239,428,954	$23,942,895	10%					
TD2	Remaining studies and investigations to be completed										
TD3	Rock quantitites	-5%	-$8,921,086	$178,421,724	$17,842,172	10%					
TD4	Borrow/fill sources locations and quality	0%	$0	$6,138,222	$6,138,222	100%					
TD5	Hazardous waste concerns	0%	$0	$12,209,434	$6,104,717	50%					
TD6	Drainage issues										
Construction (CO)											
CO1	Labor availability										
CO2	Weather/seasonal impacts	0%	$0	$7,697,073	$1,924,268	25%	months	53 months	53 months	65 months	12 months
CO3	Unknown cultural or historic preservation		$0	$446,605	$2,000,000						
CO4	Identified staging areas										
CO5	Control and diversion of water										
CO6	Material availability and delivery	0%	$0	$178,421,724	$44,605,431	25%	months	53 months	53 months	65 months	12 months
CO7	Differing site conditions	0%	$0	$239,428,954	$23,942,895	10%	months	53 months	53 months	65 months	12 months
Cost and Schedule (ES)											
ES1	Rock prices										
ES2	Estimate confidence in large and critical quantities	-5%	-$10,319,831	$206,396,620	$20,639,662	10%	months	53 months	53 months	65 months	12 months
ES3	Estimate reasonableness of crews and productivities						months	53 months	53 months	65 months	12 months
ES4	Fuel prices	-5%	-$8,921,086	$178,421,724	$26,763,259	15%					
Regulatory & Environmental (RE)											
RE1	HTRW scope grows										
RE2	Project in area of high sensitivity to paleontology/cultural artifacts										
RE3	Permits or agency actions delayed or take longer than expected										
Lands and Damages (LD)											
LD1	Real estate plan defined	-15%	-$1,331	$8,875	$4,438	50%	months	53 months	53 months	65 months	12 months
LD2	Known and unknown utility impacts	0%	$0	$8,875	$2,219	25%					
LD3	BIA land transfers						months	53 months	53 months	65 months	12 months
LD4	Land ownership determination	0%	$0	$8,875	$2,929	33%	months	53 months	53 months	65 months	12 months
External											
EX1	Extreme events						months	53 months	53 months	65 months	12 months
EX2	Vandalism										
EX3	Large land owners leveraging land rights	0%	$0	$8,875	$8,875	100%	months	53 months	53 months	65 months	12 months
EX4	Labor strikes or shutdowns										
EX5	Threat of lawsuits										
EX6	Congressional authorization changes										

Contingency on Base Estimate	80% Confidence Project Cost	
Base Construction Estimate	$206,396,620	
Baseline Estimate Cost Contingency Amount ->	$84,622,614	41%
Baseline Estimate Construction Cost (80% Confidence) ->	$291,019,234	

Contingency on Schedule	80% Confidence Project Schedule	
Project Base Schedule Duration ->	52.6 Months	
Schedule Contingency Duration ->	24.7 Months	47%
Project Schedule Duration (80% Confidence) ->	77.3 Months	

Barrow Coastal Erosion Project
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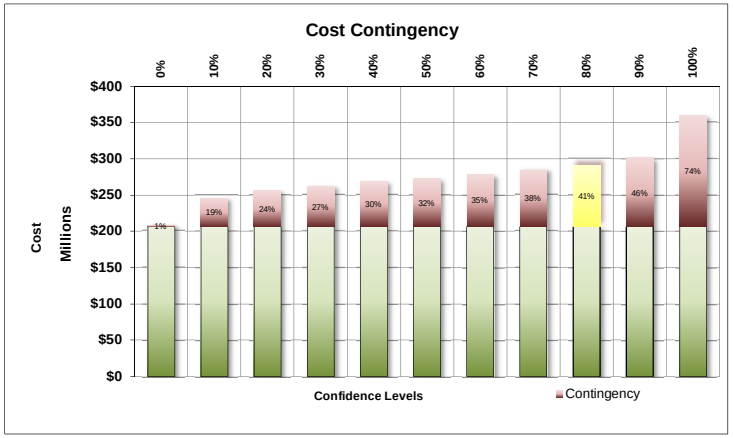
- PROJECT CONTINGENCY DEVELOPMENT -

INITIAL CONSTRUCTION
Contingency Analysis

Base Case Estimate (Excluding 01)	$206,396,620	
Confidence Level	**Contingency Value**	**Contingency**
0%	2,063,966	1%
10%	39,215,358	19%
20%	49,535,189	24%
30%	55,727,087	27%
40%	61,918,986	30%
50%	66,046,918	32%
60%	72,238,817	35%
70%	78,430,716	38%
80%	**84,622,614**	**41%**
90%	94,942,445	46%
100%	152,733,499	74%



Barrow Coastal Erosion Project
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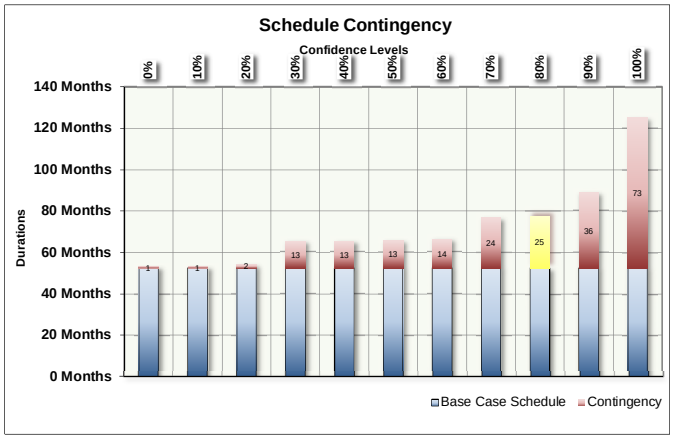
- SCHEDULE CONTINGENCY (DURATION) DEVELOPMENT -

Contingency Analysis

Base Case Schedule	52.6 Months	
Confidence Level	**Contingency Value**	**Contingency**
0%	1 Months	1%
10%	1 Months	1%
20%	2 Months	3%
30%	13 Months	24%
40%	13 Months	24%
50%	13 Months	25%
60%	14 Months	26%
70%	24 Months	46%
80%	**25 Months**	**47%**
90%	36 Months	69%
100%	73 Months	138%

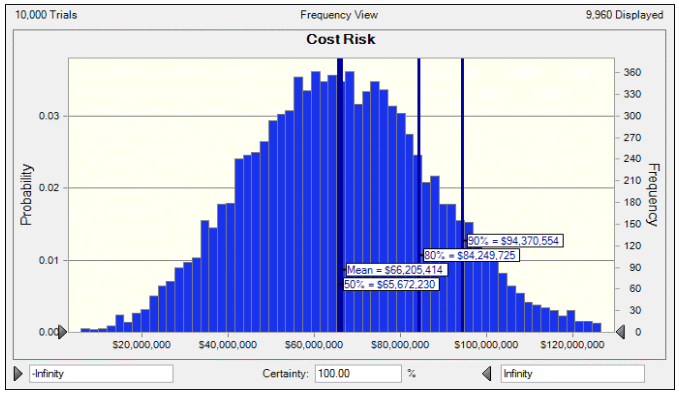


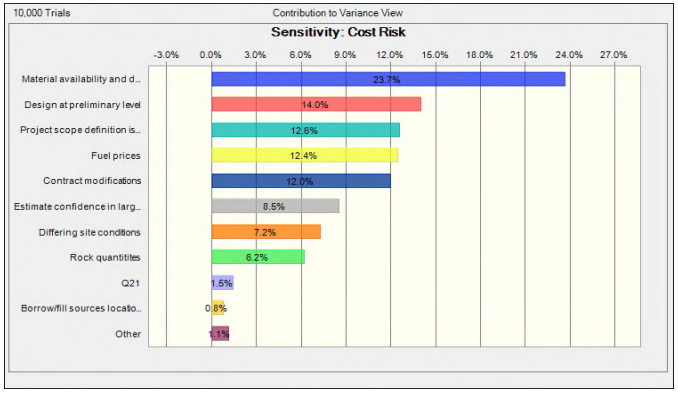
Contingency on Base Estimate		
Base Construction Estimate	**$206,396,620**	
Baseline Estimate Cost Contingency Amount ->	$84,622,614	**41%**
Baseline Estimate Construction Cost (80% Confidence) ->	**$291,019,234**	

Contingency on Schedule		
Project Base Schedule Duration ->	**52.6 Months**	
Schedule Contingency Duration ->	24.7 Months	47%
Project Schedule Duration (80% Confidence) ->	**77.3 Months**	

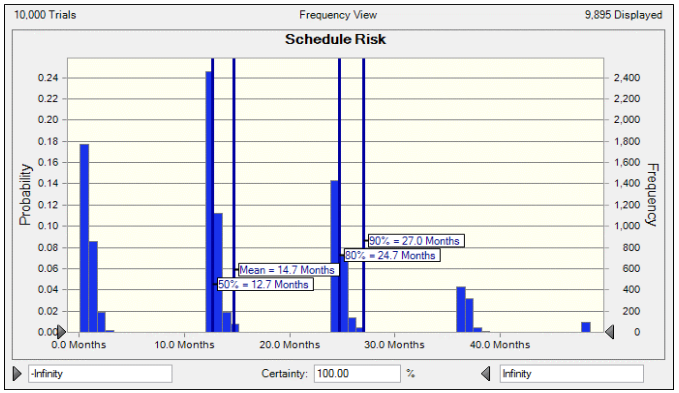
Barrow Coastal Erosion Project
12-Feb-19

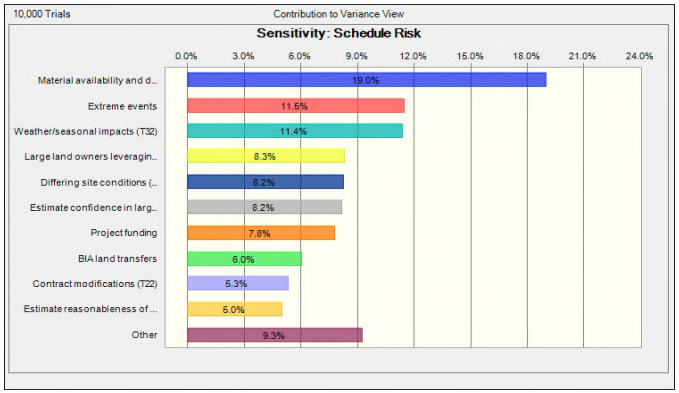
- Cost Outputs Distribution and Sensitivity -





- Schedule Outputs Distribution and Sensitivity -





ATTACHMENT 10 – MCACES COST ESTIMATE SUMMARY

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Estimated by Tetra Tech, Inc.
Designed by USACE POA
Prepared by Tetra Tech, Inc
Preparation Date 5/20/2019
Effective Date of Pricing 5/20/2019
Estimated Construction Time 1,600 Days

Description	Quantity	UOM	ContractCost	ProjectCost	CostOverride
Project Cost Summary Report			**206,396,620**	**206,396,620**	
Barrow Coastal Erosion Cost Estimate - Alternative Selection	**1.00**	**LS**	**206,396,620**	**206,396,620**	
16 16 - Bank Stabilization	**1.00**	**LS**	**205,513,819**	**205,513,819**	
16 01 Phase 1	**1.00**	**LS**	**34,786,269**	**34,786,269**	
16 R1 Reach 1 - Bluffs	**1.00**	**LS**	**19,583,659**	**19,583,659**	
16 R1 01 Mobilization and Demobilization	**1.00**	**LS**	**1,539,415**	**1,539,415**	
16 R1 01 01 Mobilization	**1.00**	**LS**	**534,341**	**534,341**	
16 R1 01 02 Demobilization	**1.00**	**LS**	**534,341**	**534,341**	
16 R1 01 03 Site Preparation	**1.00**	**LS**	**470,733**	**470,733**	
			7,015.65	*7,015.65*	
16 R1 02 Revetment +19.0ft MLLW	**2,572.00**	**LF**	**18,044,245**	**18,044,245**	
			22.07	*22.07*	
16 R1 02 01 Excavation	**51,114.00**	**CY**	**1,127,965**	**1,127,965**	
			4.94	*4.94*	
16 R1 02 01 01 Excavation	**51,114.00**	**CY**	**252,479**	**252,479**	
			14.89	*14.89*	
16 R1 02 01 02 Hauling	**58,781.10**	**CY**	**875,486**	**875,486**	
			48.45	*48.45*	
16 R1 02 02 Local Material	**1,148.00**	**CY**	**55,625**	**55,625**	
			3.04	*3.04*	
16 R1 02 03 Filter Fabric	**16,290.00**	**SY**	**49,550**	**49,550**	
			343.75	*343.75*	
16 R1 02 04 Rock Placement	**48,905.00**	**CY**	**16,811,104**	**16,811,104**	
			182.58	*182.58*	
16 R1 02 04 01 Gravel	**5,761.00**	**CY**	**1,051,851**	**1,051,851**	
			245.16	*245.16*	
16 R1 02 04 02 Core Rock	**5,423.00**	**CY**	**1,329,514**	**1,329,514**	
			328.92	*328.92*	
16 R1 02 04 03 B-rock	**16,319.00**	**CY**	**5,367,591**	**5,367,591**	
			423.43	*423.43*	
16 R1 02 04 04 Armor Rock	**21,402.00**	**CY**	**9,062,148**	**9,062,148**	
16 R2 Reach 2 - Barrow	**1.00**	**LS**	**15,202,610**	**15,202,610**	

Labor ID: LNS2018 EQ ID: EP16R09 Currency in US dollars TRACES MII Version 4.3

Description	Quantity	UOM	ContractCost	ProjectCost	CostOverride
16 R2 01 Site Preparation	**1.00**	**LS**	**470,733**	**470,733**	
			6,887.27	*6,887.27*	
16 R2 02 Revetment +14.5ft MLLW	**2,139.00**	**LF**	**14,731,877**	**14,731,877**	
			22.07	*22.07*	
16 R2 02 01 Excavation	**31,765.00**	**CY**	**700,979**	**700,979**	
			4.94	*4.94*	
16 R2 02 01 01 Excavation	**31,765.00**	**CY**	**156,905**	**156,905**	
			14.89	*14.89*	
16 R2 02 01 02 Hauling	**36,529.75**	**CY**	**544,074**	**544,074**	
			48.47	*48.47*	
16 R2 02 02 Local Material	**4,570.00**	**CY**	**221,490**	**221,490**	
			3.04	*3.04*	
16 R2 02 03 Filter Fabric	**14,174.00**	**SY**	**43,116**	**43,116**	
			340.83	*340.83*	
16 R2 02 04 Rock Placement	**40,391.00**	**CY**	**13,766,292**	**13,766,292**	
			182.57	*182.57*	
16 R2 02 04 01 Gravel	**4,981.00**	**CY**	**909,388**	**909,388**	
			245.17	*245.17*	
16 R2 02 04 02 Core Rock	**4,666.00**	**CY**	**1,143,961**	**1,143,961**	
			328.91	*328.91*	
16 R2 02 04 03 B-rock	**13,807.00**	**CY**	**4,541,297**	**4,541,297**	
			423.43	*423.43*	
16 R2 02 04 04 Armor Rock	**16,937.00**	**CY**	**7,171,646**	**7,171,646**	
16 02 Phase 2	**1.00**	**LS**	**30,448,541**	**30,448,541**	
16 R3 Reach 3 - Lagoon	**1.00**	**LS**	**30,448,541**	**30,448,541**	
16 R3 01 Mobilization and Demobilization	**1.00**	**LS**	**1,539,415**	**1,539,415**	
16 R3 01 01 Mobilization	**1.00**	**LS**	**534,341**	**534,341**	
16 R3 01 02 Demobilization	**1.00**	**LS**	**534,341**	**534,341**	
16 R3 01 03 Site Preparation	**1.00**	**LS**	**470,733**	**470,733**	
			14,644.95	*14,644.95*	
16 R3 02 Berm +14.5ft MLLW	**1,974.00**	**LF**	**28,909,127**	**28,909,127**	
			22.07	*22.07*	

Labor ID: LNS2018 EQ ID: EP16R09 Currency in US dollars TRACES MII Version 4.3

Description	Quantity	UOM	ContractCost	ProjectCost	CostOverride
16 R3 02 01 Excavation	**71,530.00**	**CY**	**1,578,500**	**1,578,500**	
			4.94	*4.94*	
16 R3 02 01 01 Excavation	**71,530.00**	**CY**	**353,326**	**353,326**	
			14.89	*14.89*	
16 R3 02 01 02 Hauling	**82,259.50**	**CY**	**1,225,173**	**1,225,173**	
			3.04	*3.04*	
16 R3 02 02 Filter Fabric	**23,469.00**	**SY**	**71,387**	**71,387**	
			345.58	*345.58*	
16 R3 02 03 Rock Placement	**78,880.00**	**CY**	**27,259,240**	**27,259,240**	
			182.58	*182.58*	
16 R3 02 03 01 Gravel	**7,895.00**	**CY**	**1,441,458**	**1,441,458**	
			245.16	*245.16*	
16 R3 02 03 02 Core Rock	**7,404.00**	**CY**	**1,815,181**	**1,815,181**	
			328.91	*328.91*	
16 R3 02 03 03 B-rock	**30,887.00**	**CY**	**10,159,144**	**10,159,144**	
			423.42	*423.42*	
16 R3 02 03 04 Armor Rock	**32,694.00**	**CY**	**13,843,457**	**13,843,457**	
16 03 Phase 3	**1.00**	**LS**	**31,629,968**	**31,629,968**	
16 R4 Reach 4 - Browerville	**1.00**	**LS**	**31,629,968**	**31,629,968**	
16 R4 01 Mobilization and Demobilization	**1.00**	**LS**	**1,539,415**	**1,539,415**	
16 R4 01 01 Mobilization	**1.00**	**LS**	**534,341**	**534,341**	
16 R4 01 02 Demobilization	**1.00**	**LS**	**534,341**	**534,341**	
16 R4 01 03 Site Preparation	**1.00**	**LS**	**470,733**	**470,733**	
			5,032.71	*5,032.71*	
16 R4 02 14-ft Raise Stevenson Street	**5,979.00**	**LF**	**30,090,553**	**30,090,553**	
			22.07	*22.07*	
16 R4 02 01 Excavation	**78,760.00**	**CY**	**1,738,048**	**1,738,048**	
			4.94	*4.94*	
16 R4 02 01 01 Excavation	**78,760.00**	**CY**	**389,038**	**389,038**	
			14.89	*14.89*	
16 R4 02 01 02 Hauling	**90,574.00**	**CY**	**1,349,010**	**1,349,010**	
			48.46	*48.46*	

Labor ID: LNS2018 EQ ID: EP16R09 Currency in US dollars TRACES MII Version 4.3

Description	Quantity	UOM	ContractCost	ProjectCost	CostOverride
16 R4 02 02 Local Material	**28,732.00**	**CY**	**1,392,405**	**1,392,405**	
			3.04	*3.04*	
16 R4 02 03 Filter Fabric	**30,170.00**	**SY**	**91,771**	**91,771**	
			336.34	*336.34*	
16 R4 02 04 Rock Placement	**79,884.00**	**CY**	**26,868,329**	**26,868,329**	
			182.58	*182.58*	
16 R4 02 04 01 Gravel	**10,547.00**	**CY**	**1,925,650**	**1,925,650**	
			245.18	*245.18*	
16 R4 02 04 02 Core Rock	**9,787.00**	**CY**	**2,399,531**	**2,399,531**	
			328.91	*328.91*	
16 R4 02 04 03 B-rock	**28,271.00**	**CY**	**9,298,750**	**9,298,750**	
			423.43	*423.43*	
16 R4 02 04 04 Armor Rock	**31,279.00**	**CY**	**13,244,399**	**13,244,399**	
16 04 Phase 4	**1.00**	**LS**	**63,414,042**	**63,414,042**	
16 R5 Reach 5 - South and Middle Salt	**1.00**	**LS**	**63,414,042**	**63,414,042**	
16 R5 01 Mobilization and Demobilization	**1.00**	**LS**	**1,539,415**	**1,539,415**	
16 R5 01 01 Mobilization	**1.00**	**LS**	**534,341**	**534,341**	
16 R5 01 02 Demobilization	**1.00**	**LS**	**534,341**	**534,341**	
16 R5 01 03 Site Preparation	**1.00**	**LS**	**470,733**	**470,733**	
			6,148.73	*6,148.73*	
16 R5 02 14-ft Raise Stevenson Street	**10,063.00**	**LF**	**61,874,627**	**61,874,627**	
			22.07	*22.07*	
16 R5 02 01 Excavation	**172,031.00**	**CY**	**3,796,320**	**3,796,320**	
			4.94	*4.94*	
16 R5 02 01 01 Excavation	**172,031.00**	**CY**	**849,755**	**849,755**	
			14.89	*14.89*	
16 R5 02 01 02 Hauling	**197,835.65**	**CY**	**2,946,565**	**2,946,565**	
			48.46	*48.46*	
16 R5 02 02 Local Material	**60,873.00**	**CY**	**2,950,001**	**2,950,001**	
			3.04	*3.04*	
16 R5 02 03 Filter Fabric	**61,794.00**	**SY**	**187,968**	**187,968**	
			336.27	*336.27*	

Labor ID: LNS2018 EQ ID: EP16R09 Currency in US dollars TRACES MII Version 4.3

Description	Quantity	UOM	ContractCost	ProjectCost	CostOverride
16 R5 02 04 Rock Placement	**163,381.00**	**CY**	**54,940,339**	**54,940,339**	
			182.57	*182.57*	
16 R5 02 04 01 Gravel	**21,602.00**	**CY**	**3,943,928**	**3,943,928**	
			245.17	*245.17*	
16 R5 02 04 02 Core Rock	**20,028.00**	**CY**	**4,910,216**	**4,910,216**	
			328.92	*328.92*	
16 R5 02 04 03 B-rock	**57,840.00**	**CY**	**19,024,552**	**19,024,552**	
			423.43	*423.43*	
16 R5 02 04 04 Armor Rock	**63,911.00**	**CY**	**27,061,643**	**27,061,643**	
16 05 Phase 5	**1.00**	**LS**	**45,234,999**	**45,234,999**	
16 R6 Reach 6 - NARL	**1.00**	**LS**	**45,234,999**	**45,234,999**	
16 R6 01 Mobilization and Demobilization	**1.00**	**LS**	**1,539,415**	**1,539,415**	
16 R6 01 01 Mobilization	**1.00**	**LS**	**534,341**	**534,341**	
16 R6 01 02 Demobilization	**1.00**	**LS**	**534,341**	**534,341**	
16 R6 01 03 Site Preparation	**1.00**	**LS**	**470,733**	**470,733**	
			7,773.63	*7,773.63*	
16 R6 02 14-ft Raise Stevenson Street	**5,621.00**	**LF**	**43,695,584**	**43,695,584**	
			22.07	*22.07*	
16 R6 02 01 Excavation	**148,073.00**	**CY**	**3,267,622**	**3,267,622**	
			4.94	*4.94*	
16 R6 02 01 01 Excavation	**148,073.00**	**CY**	**731,413**	**731,413**	
			14.89	*14.89*	
16 R6 02 01 02 Hauling	**170,283.95**	**CY**	**2,536,210**	**2,536,210**	
			48.46	*48.46*	
16 R6 02 02 Local Material	**31,338.00**	**CY**	**1,518,700**	**1,518,700**	
			3.04	*3.04*	
16 R6 02 03 Filter Fabric	**43,671.00**	**SY**	**132,841**	**132,841**	
			336.23	*336.23*	
16 R6 02 04 Rock Placement	**115,327.00**	**CY**	**38,776,420**	**38,776,420**	
			182.57	*182.57*	
16 R6 02 04 01 Gravel	**15,247.00**	**CY**	**2,783,688**	**2,783,688**	
			245.17	*245.17*	

Labor ID: LNS2018 EQ ID: EP16R09 Currency in US dollars TRACES MII Version 4.3

Description	Quantity	UOM	ContractCost	ProjectCost	CostOverride
16 R6 02 04 02 Core Rock	**14,148.00**	**CY**	**3,468,625**	**3,468,625**	
			328.91	*328.91*	
16 R6 02 04 03 B-rock	**40,860.00**	**CY**	**13,439,429**	**13,439,429**	
			423.43	*423.43*	
16 R6 02 04 04 Armor Rock	**45,072.00**	**CY**	**19,084,678**	**19,084,678**	
16a 16 - Bank Stabilization (LSF)	**1.00**	**LS**	**436,196**	**436,196**	
16a R4 Reach 4 - Browerville	**1.00**	**LS**	**187,694**	**187,694**	
			48.46	*48.46*	
16a R4 01 Road Access	**3,873.00**	**CY**	**187,694**	**187,694**	
16a R5 Reach 5 - South and Middle Salt	**1.00**	**LS**	**98,272**	**98,272**	
			48.46	*48.46*	
16a R5 01 Road Access	**2,028.00**	**CY**	**98,272**	**98,272**	
16a R6 Reach 6 - NARL	**1.00**	**LS**	**150,231**	**150,231**	
			48.46	*48.46*	
16a R6 01 Road Access	**3,100.00**	**CY**	**150,231**	**150,231**	
18 18 - Cultural Resources	**1.00**	**LS**	**446,605**	**446,605**	
			18,608.56	*18,608.56*	
18 01 On-Site Archaeologist	**24.00**	**MO**	**446,605**	**446,605**	

Labor ID: LNS2018 EQ ID: EP16R09 Currency in US dollars TRACES MII Version 4.3

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ATTACHMENT 11 – TOTAL PROJECT COST SUMMARY

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

PROJECT: **Barrow Coastal Erosion Project**
PROJECT NO: 464169
LOCATION: Barrow, AK

DISTRICT: Alaska **PREPARED: 7/29/2019**
POC: CHIEF, COST ENGINEERING, KARL HARVEY

This Estimate reflects the scope and schedule in report; Barrow Alaska Coastal Erosion Feasibility Study

Civil Works Work Breakdown Structure		ESTIMATED COST				PROJECT FIRST COST (Constant Dollar Basis)						TOTAL PROJECT COST (FULLY FUNDED)			
						Program Year (Budget EC): 2020									
						Effective Price Level Date: 1 OCT 19									
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-18** ($K)	**TOTAL FIRST COST** ($K)	INFLATED (%)	COST ($K)	CNTG ($K)	FULL ($K)
A	*B*	*C*	*D*	*E*	*F*	*G*	*H*	*I*	*J*		*K*	*L*	*M*	*N*	*O*
16	BANK STABILIZATION	$205,514	$84,261	41.0%	$289,774	2.5%	$210,734	$86,401	$297,135	$0	$297,135	11.7%	$235,426	$96,525	$331,950
18	CULTURAL RESOURCE PRESERVATION	$447	$183	41.0%	$630	2.5%	$458	$188	$646	$0	$646	11.7%	$512	$210	$721
	CONSTRUCTION ESTIMATE TOTALS:	$205,960	$84,444		$290,404	2.5%	$211,192	$86,589	$297,781	$0	$297,781	11.7%	$235,937	$96,734	$332,671
01	LANDS AND DAMAGES	$3,600	$749	20.8%	$4,349	2.5%	$3,691	$768	$4,459	$0	$4,459	5.3%	$3,887	$809	$4,696
30	PLANNING, ENGINEERING & DESIGN	$6,000	$2,460	41.0%	$8,460	3.9%	$6,232	$2,555	$8,788	$0	$8,788	6.6%	$6,641	$2,723	$9,364
31	CONSTRUCTION MANAGEMENT	$12,358	$5,067	41.0%	$17,424	3.9%	$12,836	$5,263	$18,099	$0	$18,099	14.8%	$14,742	$6,044	$20,787
	PROJECT COST TOTALS:	$227,918	$92,719	40.7%	$320,637		$233,952	$95,175	**$329,127**	$0	**$329,127**	11.7%	$261,208	$106,310	$367,518

ESTIMATED TOTAL PROJECT COST (FEDERAL SHARE): **$367,518**

ASSOCIATED COSTS: **$810**

_____ **CHIEF, COST ENGINEERING, KARL HARVEY**

_____ **PROJECT MANAGER, JENIPHER CATE**

_____ **CHIEF, REAL ESTATE, ALEX DERAV**

_____ **CHIEF, PLANNING, CINDY UPAH**

_____ **CHIEF, ENGINEERING, JIM JEFFORDS**

_____ **CHIEF, OPERATIONS, JULIE ANDERSON**

_____ **CHIEF, CONSTRUCTION, JIM JEFFORDS**

_____ **CHIEF, CONTRACTING, CHRISTOPHER TEW**

_____ **CHIEF, PM-PB,**

_____ **CHIEF, DPM, RANDALL BOWKER**

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

RECOMMENDED PLAN (FEDERAL COSTS)

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

PROJECT: Barrow Coastal Erosion Project
LOCATION: Barrow, AK
This Estimate reflects the scope and schedule in report; Barrow Alaska Coastal Erosion Feasibility Study

DISTRICT: Alaska
POC: CHIEF, COST ENGINEERING, KARL HARVEY

PREPARED: 7/29/2019

Estimate Prepared: **22-May-19**
Effective Price Level: 1-Oct-18

Program Year (Budget EC): 2020
Effective Price Level Date: 1 OCT 19

WBS NUMBER	Civil Works Feature & Sub-Feature Description	ESTIMATED COST COST ($K)	CNTG ($K)	RISK BASED CNTG (%)	TOTAL ($K)	PROJECT FIRST COST (Constant Dollar Basis) ESC (%)	COST ($K)	CNTG ($K)	TOTAL ($K)	TOTAL PROJECT COST (FULLY FUNDED) 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*
	Federal Costs													
16	BANK STABILIZATION	$205,514	$84,261	41.0%	$289,774	2.5%	$210,734	$86,401	$297,135	2023Q4	11.7%	$235,426	$96,525	$331,950
18	CULTURAL RESOURCE PRESERVATION	$447	$183	41.0%	$630	2.5%	$458	$188	$646	2023Q4	11.7%	$512	$210	$721
	CONSTRUCTION ESTIMATE TOTALS:	$205,960	$84,444	41.0%	**$290,404**		$211,192	$86,589	$297,781			$235,937	$96,734	$332,671
01	LANDS AND DAMAGES	$3,600	$749	20.8%	$4,349	2.5%	$3,691	$768	$4,459	2021Q4	5.3%	$3,887	$809	$4,696
30	PLANNING, ENGINEERING & DESIGN													
1.0%	Project Management	$500	$205	41.0%	$705	3.9%	$519	$213	$732	2021Q1	3.8%	$539	$221	$760
0.0%	Planning & Environmental Compliance	$500	$205	41.0%	$705	3.9%	$519	$213	$732	2021Q1	3.8%	$539	$221	$760
0.5%	Engineering & Design	$1,500	$615	41.0%	$2,115	3.9%	$1,558	$639	$2,197	2021Q1	3.8%	$1,617	$663	$2,280
3.0%	Reviews, ATRs, IEPRs, VE	$500	$205	41.0%	$705	3.9%	$519	$213	$732	2021Q1	3.8%	$539	$221	$760
0.5%	Life Cycle Updates (cost, schedule, risks)	$500	$205	41.0%	$705	3.9%	$519	$213	$732	2021Q1	3.8%	$539	$221	$760
0.5%	Contracting & Reprographics	$500	$205	41.0%	$705	3.9%	$519	$213	$732	2021Q1	3.8%	$539	$221	$760
0.5%	Engineering During Construction	$500	$205	41.0%	$705	3.9%	$519	$213	$732	2023Q4	14.8%	$596	$245	$841
1.5%	Planning During Construction	$500	$205	41.0%	$705	3.9%	$519	$213	$732	2023Q4	14.8%	$596	$245	$841
0.5%	Adaptive Management & Monitoring	$500	$205	41.0%	$705	3.9%	$519	$213	$732	2023Q4	14.8%	$596	$245	$841
0.5%	Project Operations	$500	$205	41.0%	$705	3.9%	$519	$213	$732	2021Q1	3.8%	$539	$221	$760
31	CONSTRUCTION MANAGEMENT													
4.0%	Construction Management	$8,238	$3,378	41.0%	$11,616	3.9%	$8,557	$3,509	$12,066	2023Q4	14.8%	$9,828	$4,030	$13,858
1.0%	Project Operation:	$2,060	$844	41.0%	$2,904	3.9%	$2,139	$877	$3,017	2023Q4	14.8%	$2,457	$1,007	$3,464
1.0%	Project Management	$2,060	$844	41.0%	$2,904	3.9%	$2,139	$877	$3,017	2023Q4	14.8%	$2,457	$1,007	$3,464
	CONTRACT COST TOTALS:	$227,918	$92,719		$320,637		$233,952	$95,175	**$329,127**			$261,208	$106,310	**$367,518**

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

RECOMMENDED PLAN (NON-FEDERAL COSTS)

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

PROJECT: Barrow Coastal Erosion Project
LOCATION: Barrow, AK
This Estimate reflects the scope and schedule in report; Barrow Alaska Coastal Erosion Feasibility Study

DISTRICT: Alaska
POC: CHIEF, COST ENGINEERING, KARL HARVEY

PREPARED: 7/29/2019

Civil Works Work Breakdown Structure		ESTIMATED COST				PROJECT FIRST COST (Constant Dollar Basis)				TOTAL PROJECT COST (FULLY FUNDED)				
		Estimate Prepared: / Effective Price Level:			22-May-19 / 1-Oct-18	Program Year (Budget EC): / Effective Price Level Date:			2020 / 1 OCT 19					
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*
	Associated Costs (LSF)													
16	BANK STABILIZATION - LSF	$436	$179	41.0%	$615	2.5%	$447	$183	$631	2023Q4	11.7%	$500	$205	$705
	CONSTRUCTION ESTIMATE TOTALS:	$436	$179	41.0%	**$615**		$447	$183	$631			$500	$205	$705
01	LANDS AND DAMAGES	$0	$0	0.0%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
30	PLANNING, ENGINEERING & DESIGN													
1.0%	Project Management	$4	$2	41.0%	$6	3.9%	$5	$2	$6	2021Q1	3.8%	$5	$2	$7
0.5%	Planning & Environmental Compliance	$2	$1	41.0%	$3	3.9%	$2	$1	$3	2021Q1	3.8%	$2	$1	$3
3.0%	Engineering & Design	$13	$5	41.0%	$18	3.9%	$14	$6	$19	2021Q1	3.8%	$14	$6	$20
0.5%	Reviews, ATRs, IEPRs, VE	$2	$1	41.0%	$3	3.9%	$2	$1	$3	2021Q1	3.8%	$2	$1	$3
0.5%	Life Cycle Updates (cost, schedule, risks)	$2	$1	41.0%	$3	3.9%	$2	$1	$3	2021Q1	3.8%	$2	$1	$3
0.5%	Contracting & Reprographics	$2	$1	41.0%	$3	3.9%	$2	$1	$3	2021Q1	3.8%	$2	$1	$3
1.5%	Engineering During Construction	$7	$3	41.0%	$9	3.9%	$7	$3	$10	2023Q4	14.8%	$8	$3	$11
0.5%	Planning During Construction	$2	$1	41.0%	$3	3.9%	$2	$1	$3	2023Q4	14.8%	$3	$1	$4
0.5%	Adaptive Management & Monitoring	$2	$1	41.0%	$3	3.9%	$2	$1	$3	2023Q4	14.8%	$3	$1	$4
0.5%	Project Operations	$2	$1	41.0%	$3	3.9%	$2	$1	$3	2021Q1	3.8%	$2	$1	$3
31	CONSTRUCTION MANAGEMENT													
4.0%	Construction Management	$17	$7	41.0%	$25	3.9%	$18	$7	$26	2023Q4	14.8%	$21	$9	$29
1.0%	Project Operation:	$4	$2	41.0%	$6	3.9%	$5	$2	$6	2023Q4	14.8%	$5	$2	$7
1.0%	Project Management	$4	$2	41.0%	$6	3.9%	$5	$2	$6	2023Q4	14.8%	$5	$2	$7
	CONTRACT COST TOTALS:	$502	$206		$707		$515	$211	**$726**			$574	$236	**$810**