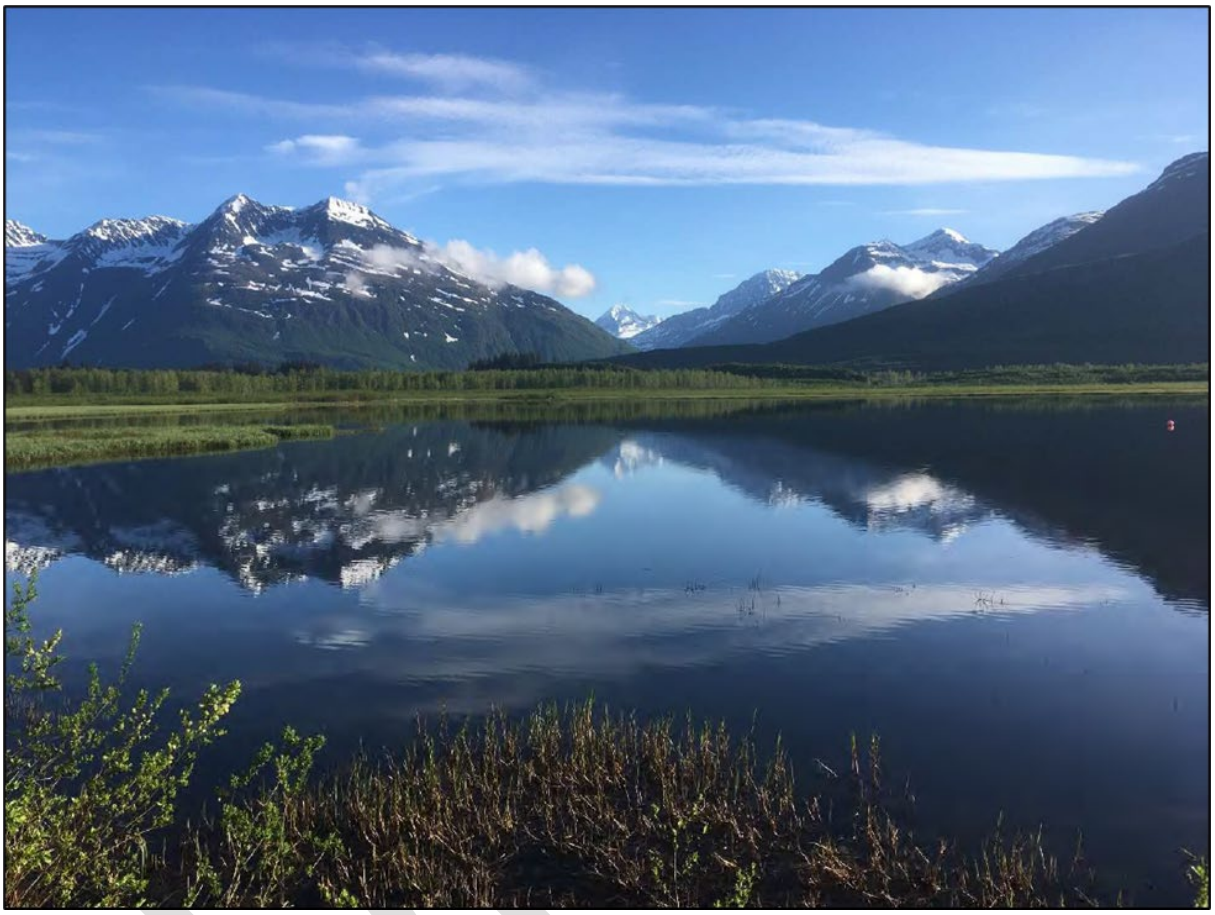
Robe Lake Ecosystem Restoration
Feasibility Study
Appendix B: Cost Engineering | DRAFT
Valdez, Alaska



U.S. Army Corps of Engineers
Alaska District

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1. APPENDIX OVERVIEW

This Cost Engineering Appendix will be consolidated into the decision document, Integrated Feasibility Report and Environmental Assessment (IFR-EA), for Robe Lake in Valdez, Alaska. The purpose of the feasibility study is to evaluate alternatives for a potential construction contract. The Cost Engineering Appendix discusses the cost assumptions, methodology, materials, labor, and equipment utilized in the contract construction cost estimates.

2. PROJECT TYPE, FEATURES, AND ALTERNATIVES

Four main alternatives (Alternatives A, B, C, and D), and four sub-alternatives (Alternatives A-1, A-3, B-1, and B-3), were evaluated for this report. All the alternatives included are intended to divert water from Corbin Creek into Old Corbin Creek or Brownie Creek, which are tributaries of Robe Lake. Each alternative incudes a diversion structure and dredging at the intersection of Corbin Creek and the tributary route.

3. PRELIMINARY ALTERANTIVE COST ESTIMATE BASIS

This section summarizes the development of planning level cost estimates for the final array of action alternatives. The estimates were developed in Q1 2022 prices.

3.1. Purpose

There were a variety of alternatives for which costs were developed during the planning and alternative decision stages. Based on the design development, these estimates would be considered Class 4 for accuracy.

3.2. Quantities and Assumptions

This estimate is based on quantities and design sketches provided by the U.S. Army Corps of Engineers (USACE) Alaska District hydraulic and hydrology engineers. These data are included at the end of this Cost Engineering Appendix in Exhibit 2.

3.3. Unit Prices

The unit prices used in Class 4 alternative estimates were, for the most part, determined using historical bid data, cost models used in similar types of project estimates, and current pricing for large cost items such as rock. These unit costs were adjusted to factor freight and local area mark-ups. The following assumptions were made during the formation of this estimate:

- Mobilization/Demobilization (feature of all alternatives): Construction is assumed to be completed in a single working season, so only one mobilization and demobilization is included. Mobilization/Demobilization is assumed to take place out of Valdez, though not all equipment is expected to be readily available at the time of construction.

- Clearing and Grubbing of Temporary Road Path (feature of all alternatives): It was assumed that 10 ft. of tree clearing and overburden removal would be necessary to provide clearance for the access road, and that only 2' of clearing and grubbing would be necessary to widen the existing ALPETCO trail. For Alternative A and Alternative C, the temporary access road will diverge from ALPETCO trail after 7,067 ft. and will continue through forest for 1,000 ft. before reaching the intended diversion structure location. Alternative B will diverge from ALPETCO after approximately 5,429 ft. and clearing will then continue along the Old Corbin Creek channel for approximately 2,560 ft. as this channel will be dredged as a feature of the alternative. The temporary access road for Alternative D will follow ALPETCO trail for approximately 9,848 ft. before reaching the Brownie Creek diversion location. All alternatives will require 10 ft. of clearing and grubbing for the dewatering dike (1,000 ft.) and for any dredging that occurs on the channel of Old Corbin Creek or Brownie Creek (Figures 1, 2, and 3). Overburden and felled trees are assumed to enhance nature-based features (i.e., woody debris), or be chipped and disposed of onsite; and no hauling will be necessary.

- Temporary Road Construction to Diversion Structure Location (feature of all alternatives): The temporary access road connecting the Levee Road to the river diversion structure is assumed to be composed of 2 ft. deep gravel with 70% of the gravel collected from an onsite borrow pit/overburden soil, and the remaining 30% being hauled onsite from Harrison Sand and Gravel (HSG). The 30% imported gravel is intended to account for road improvements prior to the establishment of a borrow pit, and to account for the possibility that gravel is not available in the immediate vicinity of the access road. A skid steer will be necessary for grading. It was assumed that the access road will be 10 ft. wide to provide clearance for any haul truck or equipment that needs to be transported on site, and that only 2 ft of widening/repair would be necessary on the existing ALPETCO trail. For Alternative A and Alternative C, the access road will diverge from ALPETCO trail after approximately 7,067 ft. and will continue through the forest for approximately 1,000 ft. before reaching the intended diversion structure location. Alternative B will diverge from ALPETCO after approximately 5,429 ft. and road work will then continue along the Old Corbin Creek channel for approximately 2,560 ft. as this channel will be dredged as a feature of the alternative. The access road for Alternative D will follow ALPETCO trail for approximately 9,848 ft. before reaching the Brownie Creek diversion location (Figures 1, 2, and 3).

- Diversion Training Dike (feature of Alternatives A, B, and D): A temporary dewatering structure, consisting of an 18” corrugated pipe and earthwork, will need to be constructed prior to construction of the training dike. The corrugated pipe and earthwork will also need to be removed prior to demobilization. The dewatering structure is assumed to have an inlet 500 ft. upstream of the construction site and outlet 500 ft. downstream of the construction site, resulting in a 1,000 ft. total dewatering pipe length. The core material of the training dike is presumedly collected from native soil and dredged unclassified gravel that will be hauled from onsite stockpiles. The armor rock is specified as Class III rip rap, which is available through HSG at a quoted estimate of $50.00 per cubic yard (CY). No earthwork or transition structures to tie into the existing channel have been estimated.

- Weir (feature of Alternative C): A temporary dewatering structure, consisting of an 18 in. corrugated pipe and earthwork, will need to be constructed prior to construction of the weir. The corrugated pipe and earthwork will also need to be removed prior to demobilization. The dewatering structure is assumed to have an inlet 500 ft. upstream of the construction site and outlet 500 ft. downstream of the construction site, resulting in a 1,000 ft. total dewatering pipe length. A price estimate has been made for both a concrete and sheet pile type weir, with the assumption that all materials, equipment, and labor can be sourced from Valdez, and that all construction can be done using typical cast-in-place or piledriving methods. No features have been included for tying into the existing riverbanks. The concrete weir is specified as having a height of 2.7 ft., length of 65 ft., and 1 ft. thickness. It was assumed that the wall would have a 5 ft. deep foundation in addition to the 2.7 ft. height above surface, which would require excavation. The weir and foundation are presumably poured monolithically. It was also assumed that the concrete would be composed of Type I cement and grade 60 rebar. The sheet pile weir is estimated using 10 ft. long, 27.5 in. wide sheet pile sections, which would require 18 sections to span the width of the design weir. A crane crew is included in the estimate and it is assumed that a sufficient crane could be brought on site without adjustment to the temporary access road.

- Dredging Channel from Corbin Creek to the existing channel (feature of all alternatives): A channel will need to be dredged to connect Corbin Creek to the Original Corbin Creek, or to Brownie Creek in the case of Alternative D. It is assumed all dredged material can be disposed of on site or can be used for fill material/site improvement. Seeding is included as a site improvement measure for material disposed of onsite, assuming an 8 in. depth of fill.

- Dredging 1.5 Miles of channel of Old Corbin Creek (feature of Alternative B): Alternative B includes dredging the channel of Old Corbin Creek for approximately 8,237 ft. from the constructed dike. The 3 ft. by 12 ft. dredging cross section was based on the preliminary alternative description and assumes uniformity along the channel. No dewatering is included as the headwater will be

diverted during construction of the training dike. 10 ft. of clearing and grubbing is included for the path south of ALPETCO trail to facilitate transport through this region. Chipping has been included for disposing of brush material. It is assumed that dredged material will be kept on site as fill material or will be dispersed and seeded.

- Remove and Replace Culverts Under Richardson Highway with Bridge (feature of Alternative B-1): The two existing 12 ft. culverts under Richardson Highway are to be replaced with a 50 ft. DOT designed and constructed bridge. The bridge has the assumed dimensions of 100 ft. long and 50 ft. wide based on the alternative description and the length of the existing culverts. The cost of the bridge was based on the 2011 *Western Alaska Planning Study Appendix B Bridge Unit Cost*. This estimate assumes 2% markup for each year since 2011, and an additional $2.50 per square foot (SF) for traffic control, resulting in total cost of $460.00 per square foot. This figure was increased by 10% to account for study and design costs within the DOT. No part of the existing Robe River crossing is estimated for re-use in the new bridge. A dewatering dike was also added. No measures have been added for construction in winter.

- Remove and Replace Culverts Under Richardson Highway with New Culverts (Feature of Alternatives A-3 and B-3): The two existing 12 ft. culverts under Richardson Highway at the Robe River crossing are to be removed and replaced with three 14 ft. diameter culverts to prevent flood occurrences during 1% and 0.2% annual exceedance probability flood event.

- Schedule: The construction is assumed to require one season to construct.

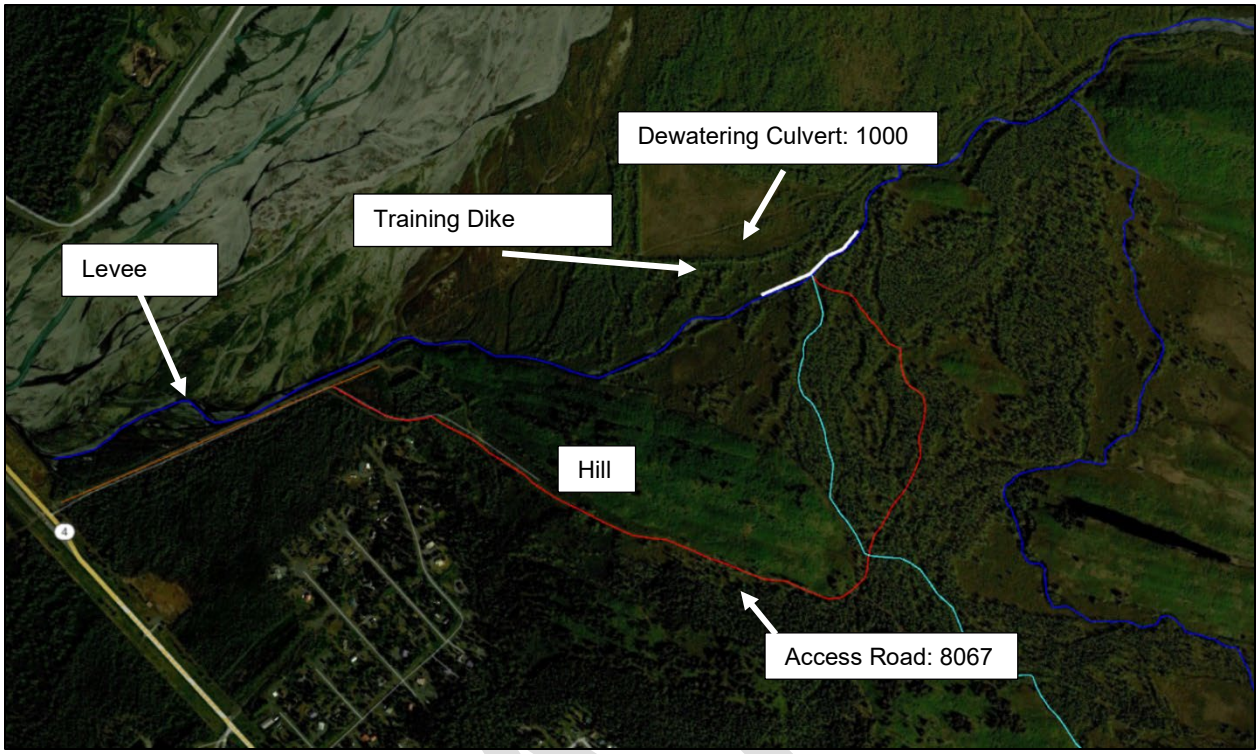

Figure 1. Clearing and grubbing to project site for Alternative A and Alternative C.

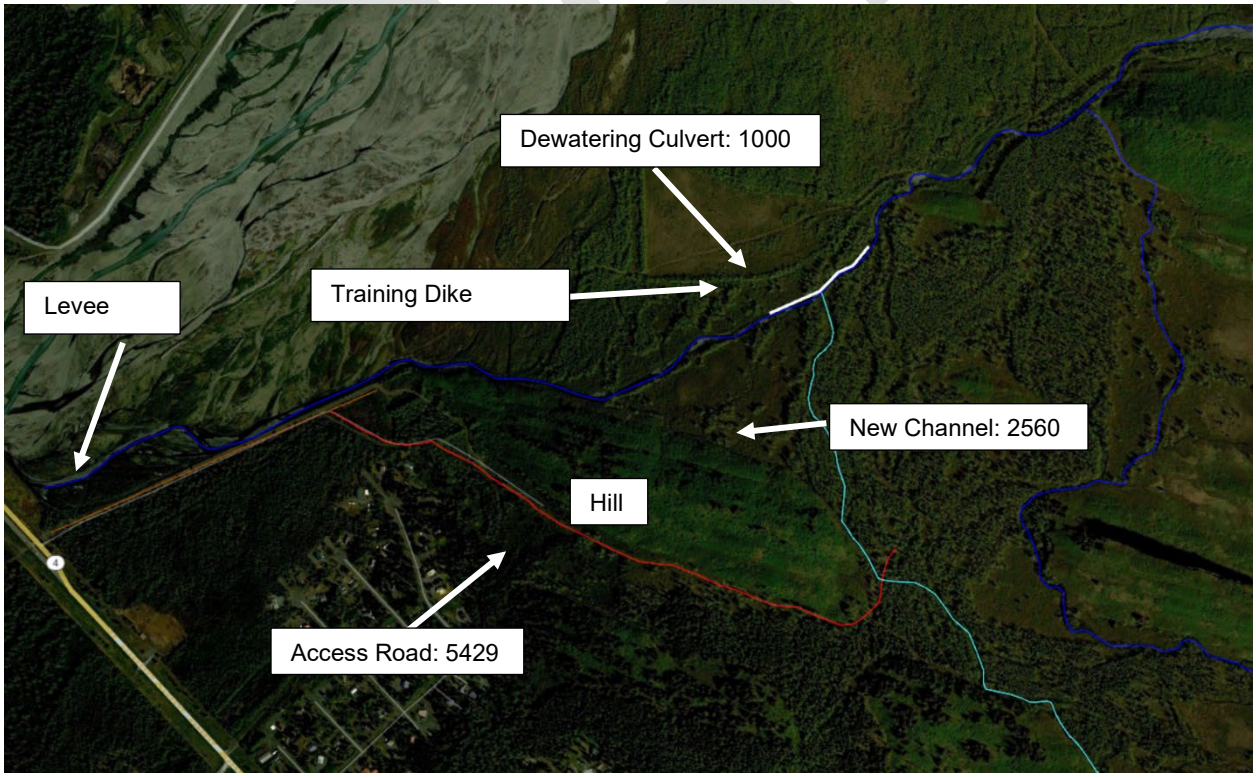

Figure 2. Clearing and grubbing to project site for Alternative B.

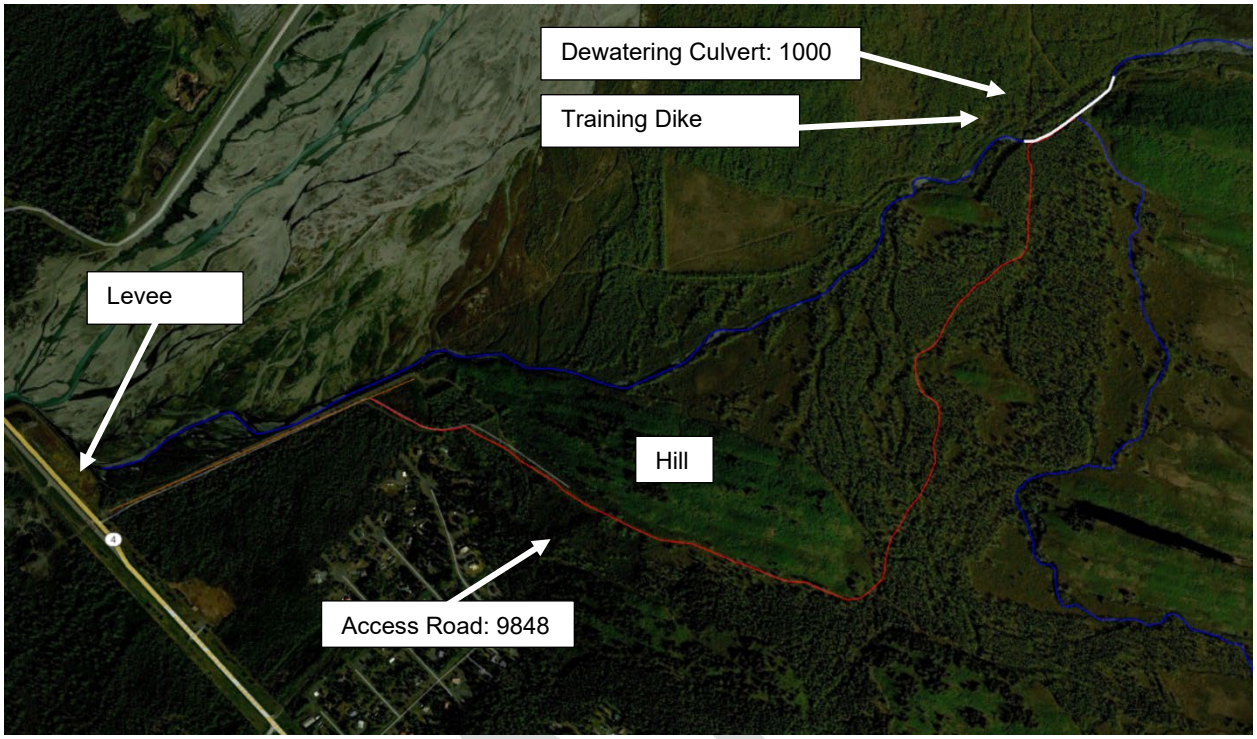

Figure 3. Clearing and grubbing to project site for Alternative D.

Armor rock pricing is based on quotes from Harris Sand and Gravel dated December 2022:

- A-Rock: $50/Ton

As this is a Class 4 estimate, the following assumptions were made:

- Includes contingency based off the Abbreviated Risk Analysis
- Design Costs and Supervision, Inspection, and Overhead (SIOH) are allowances
- The estimated index (date of development) is May 2023.

3.4. Contingencies

Project risks include flooding or storm delay during construction, wetlands restrictions, fish windows, effort of removing a portion of the existing gravel berm, equipment access in marsh, machine work vs. hand work, material hauled off site vs. spreading and leaving, and length of project if option to replace Richardson Highway culverts with DOT constructed bridge is chosen. Contingencies represent allowances to cover unknowns, uncertainties, and/or unanticipated conditions that cannot adequately evaluate the data on hand when the cost estimate is prepared. Still, it must be represented by a sufficient cost to cover the identified risks.

3.5. Summary

The alternatives evaluated were estimated to range in costs from approximately $3.8 million to $21.7 million as seen in Table 1.

Table 1. Alternatives and total costs.

	Robe Lake Feasibility Study - Summary of Alternatives - ROM														
Item	Alt A-1 OCC Dike	Alt A-3	Alt B-1 OCC Dike w/ Bridge.	Alt B-3	Alt C - Conc. Concrete Weir	Alt C - Steel Sheetpile Weir	Alt D Brownie Dike	Abbreviated Risk Analysis Contingency (percentage)	Alt A-1 OCC Dike Rounded	Alt A-3 Rounded	Alt B-1 OCC Dike w/ Bridge Rounded	Alt B-3 Rounded	Alt C - Concrete Weir Rounded	Alt C - Steel Sheetpile Weir Rounded	Alt D Brownie Dike Rounded
	Estimated Construction Cost (ECC) from MII Files								Estimated Construction Cost + ARA Contingency						
Clearing and Grubbing	$137,517	$137,517	$137,517	$137,517	$137,517	$137,517	$137,517	46%	$200,800	$200,800	$200,800	$200,800	$200,800	$200,800	$200,800
Temporary Access Road	$182,142	$182,142	$223,313	$223,313	$182,142	$182,142	$200,575	57%	$286,000	$286,000	$350,600	$350,600	$286,000	$286,000	$314,900
Training Dike	$1,342,427	$1,342,427	$1,342,427	$1,342,427	-	-	$1,901,715	34%	$1,798,900	$1,798,900	$1,798,900	$1,798,900	-	-	$2,548,300
Weir	-	-	-	-	$443,667	$585,684	-	48%	-	-	-	-	$656,600	$866,800	-
Dredge Old Corbin Creek to Corbin Creek	$185,565	$185,565	$185,565	$185,565	$185,565	$185,565	-	54%	$285,800	$285,800	$285,800	$285,800	$285,800	$285,800	-
Dredging 1.5 mi of Old Corbin Creek	-	-	$3,036,872	$3,036,872	-	-	-	54%	-	-	$4,676,800	$4,676,800	-	-	-
Replace Rich. Hwy. Culverts with DOT Bridge	-	-	$6,205,833	-	-	-	-	47%	-	-	$9,122,600	-	-	-	-
Remove Rich. Hwy Culverts	-	-	$105,398	-	-	-	-	25%	-	-	$131,700	-	-	-	-
Remove 24" Trail Culverts and Replace with trail bridge	$85,131	$85,131	$85,131	$85,131	$85,131	$85,131	-	25%	$106,400	$106,400	$106,400	$106,400	$106,400	$106,400	-
Berm	$184,124	$184,124	$184,124	$184,124	$184,124	$184,124	-	24%	$228,300	$228,300	$228,300	$228,300	$228,300	$228,300	-
Remove/Replace Rich. Hwy Culverts w. 3 (14' diameter) Culverts	-	$1,695,629	-	$1,695,629	-	-	-	25%	-	$2,119,500	-	$2,119,500	-	-	-
Dredge Corbin Creek to Brownie Creek	-	-	-	-	-	-	$1,542,760	62%	-	-	-	-	-	-	$2,499,300
Real Estate	$46,570	$46,570	$56,170	$56,170	$46,570	$46,570	$50,000		$46,600	$46,600	$56,200	$56,200	$46,600	$46,600	$50,000
Mobilization and Demobilization => use 10%	$211,691	$381,254	$1,150,618	$689,058	$121,815	$136,016	$378,257		$290,600	$502,600	$1,690,200	$976,700	$176,400	$197,400	$556,300
Design Costs (ROM) => escalated to Midpoint of	$1,680,000	$1,680,000	$1,680,000	$1,680,000	$1,680,000	$1,680,000	$1,680,000		$1,680,000	$1,680,000	$1,680,000	$1,680,000	$1,680,000	$1,680,000	$1,680,000
Construction Management => used 8% of ECC	$169,352	$305,003	$920,494	$551,246	$97,452	$108,813	$302,605		$232,500	$402,100	$1,352,200	$781,400	$141,100	$157,900	$445,100
Project Cost	$4,224,519	$6,225,361	$15,313,462	$9,867,052	$3,163,982	$3,331,562	$6,193,429		$5,155,900	$7,657,000	$21,680,500	$13,261,400	$3,808,000	$4,056,000	$8,294,700

Table 2. OMRR&R Costs

Dredging OMRR&R (every 10 years)	**Alt A1**	**Alt A3**	**Alt B1**	**Alt B3**	**Alt C - Conc Weir**	**Alt C - Steel Weir**	**Alt D**
Dredging Total Cost	$285,800	$285,800	$4,962,600	$4,962,600	$285,800	$285,800	$2,499,300
% of total for dredging OMRR&R (yr 10)	6.5%	6.5%	6.5%	6.5%	6.5%	6.5%	6.5%
OMRR&R Cost - Dredging	$ 18,577	$ 18,577	$ 322,569	$ 322,569	$ 18,577	$ 18,577	$ 162,455
Dredging mob/demob	$ 100,000	$ 100,000	$ 100,000	$ 100,000	$ 100,000	$ 100,000	$ 100,000
Total Dredging OMRR&R Cost	**$ 118,577**	**$ 118,577**	**$ 422,569**	**$ 422,569**	**$ 118,577**	**$ 118,577**	**$ 262,455**
Training Dike OMRR&R (every 10 years)	**Alt A1**	**Alt A3**	**Alt B1**	**Alt B3**	**Alt C - Conc Weir**	**Alt C - Steel Weir**	**Alt D**
Training Dike Total Cost	$1,798,900	$1,798,900	$1,798,900	$1,798,900	-	-	$2,548,300
% of total for Training Dike OMRR&R (yr 10)	7.5%	7.5%	7.5%	7.5%	-	-	7.5%
OMRR&R Cost - Training Dike	$ 134,918	$ 134,918	$ 134,918	$ 134,918	$ -	$ -	$ 191,123
Training Dike mob/demob	$ 100,000	$ 100,000	$ 100,000	$ 100,000	$ -	$ -	$ 100,000
Total Training Dike OMRR&R Cost	**$ 234,918**	**$ 234,918**	**$ 234,918**	**$ 234,918**	**$ -**	**$ -**	**$ 291,123**

Berm OMRR&R (every 20 years)	**Alt A1**	**Alt A3**	**Alt B1**	**Alt B3**	**Alt C - Conc Weir**	**Alt C - Steel Weir**	**Alt D**
Berm Total Cost	$228,300	$228,300	$228,300	$228,300	$228,300	$228,300	-
% of total for Berm OMRR&R (yr 20)	8%	8%	8%	8%	8%	8%	-
OMRR&R Cost - Berm	$ 18,264	$ 18,264	$ 18,264	$ 18,264	$ 18,264	$ 18,264	$ -
Berm mob/demob	$ 100,000	$ 100,000	$ 100,000	$ 100,000	$ 100,000	$ 100,000	$ -
Total Berm OMRR&R Cost	**$ 118,264**	**$ 118,264**	**$ 118,264**	**$ 118,264**	**$ 118,264**	**$ 118,264**	**$ -**

Dredging OMRR&R assumes $100,000 mob/demob + 6.5% of initial dredge quantity every 5 years

Training Dike OMRR&R assumes $100,000 mob/demob + 7.5% of initial training dike to be replaced every 10 years

Berm OMRR&R assumes $100,000 mob/demob + 8% of initial cost every 20 years