Valley Creek Feasibility Study, Bessemer and Birmingham, Alabama

Final Integrated Feasibility Report and Environmental Assessment

Appendix D – Cost Engineering

June 2021

US Army Corps of Engineers ®

VALLEY CREEK FEASIBILITY PROJECT
JEFFERSON COUNTY
BIRMINGHAM / BESSEMER, AL

SECTION 209 OF FLOOD CONTROL ACT OF 1962
(PUBLIC LAW 87-874)

APPENDIX D1

COSTS

(PN# 476284)

(Rev 19 May 2021)

THIS DOCUMENT IS BASED ON THE INFORMATION AVAILABLE AT THE TIME OF PUBLICATION (May 19, 2021). The Corps of Engineers planning process is dynamic and responsive to public and stakeholder input; it is possible that the content herein may change as a result of review comments received. This document does not necessarily represent the perspective of higher review levels within the agencies involved or the Executive Branch of the federal government.

VALLEY CREEK FEASIBILITY PROJECT
JEFFERSON COUNTY
BIRMINGHAM / BESSEMER, AL

APPENDIX D

COSTS

1. PROJECT DESCRIPTION D-1

2. BASIS OF ESTIMATE AND QUANTITY D-3

3. ESTIMATED DESIGN AND CONSTRUCTION SCHEDULE D-3

4. ACQUISITION PLAN D-4
   - 4.1. Estimate .....
   - 4.2. Sub-Contracting .....

5. PROJECT CONSTRUCTION D-4
   - 5.1. Mobilization, Demobilization and Preparatory Work .....
   - 5.2. Surveys .....
   - 5.3. Disposal .....
   - 5.4. Features and Discussion .....
   - 5.5. Site Specific Utility Discussions .....

6. COST ESTIMATE ASSUMPTIONS D-6
   - 6.1. Effective Price Level D-6
   - 6.2. Construction Cost Estimate D-6
   - 6.3. Labor Rates D-6
   - 6.4. Labor and Equipment Productivity D-6
   - 6.5. Equipment Rates D-6
   - 6.6. Material Rates D-6
   - 6.7. Escalation D-6
   - 6.8. Functional Costs D-6
   - 6.9. Estimate Assumptions D-8
   - 6.10. Contingencies by Feature or Sub-Feature D-9
   - 6.11. Total Project Cost Summary D-10

TABLES

D-1 Measures D-1
D-2 Estimated Project Schedule D-3
D-3 Estimated Construction Duration D-3
D-4 Current Interim Plan Total Project Cost D-10

ATTACHMENTS

Recommended Plan (TSP) Total Project Cost Summary Sheet D-12

Cost & Schedule Risk Analysis Risk Register D-19

VALLEY CREEK FEASIBILITY PROJECT
JEFFERSON COUNTY
BIRMINGHAM / BESSEMER, AL

APPENDIX D

COSTS

1. PROJECT DESCRIPTION

The project consists of various measures to manage flood risk in the Birmingham and Bessemer, AL. The measures included in the current plan are indicated in Table D-1. Table D-1 describes the measures included in the current plan.

Table D-1. Measures

Summary of the Current Plan

Flood Risk Management Measure	Description
Detention Basins (2)	Earthen berms, armored with articulated concrete block and rip rap; downstream banks will contain discharge pipes allowing a controlled release of retained water.

2. BASIS OF ESTIMATE AND QUANTITY

The basis of the estimate is the "Valley Creek Measure Design Summaries" document. This document contains quantities for each tentative measure and was provided to NWK-EDC from SAM-EDH in August of 2019. Quantities for the existing utilities and the plans for replacements were derived by NWK. All costs associated with lands and damages come from SAM Real Estate. All earthwork spoil from each measure will be hauled to the nearer of the two identified disposal sites: Vulcan Materials and Birmingham Northern Landfill. There are three identified sizes of rock to be utilized among the study's measures. Due to quarry restraints, each size of rock is produced at a unique quarry. DOT #57 rock is produced at Bessemer Quarry, Class V riprap is produced at Calera Quarry, and the Class II riprap is produced at Dolcito Quarry. It is assumed that detention basins will be armored with the three rock types listed above along with articulated concrete block mats on both the channel and ponding sides with additional armoring at the toe of the spillway for each site. The top of the basins will be armored with a layer of geotextile and aggregate surfacing (DOT #57). Following Engineering Regulation (ER) 1110-2-1302, *Engineering and Design Civil Works Cost Estimating*, cost estimates were prepared at the following level:

- **Class 3** Technical information (including designs) are approaching a 10-60% quality of project definition. There is greater confidence in project planning and scope, construction elements and quantity development. The estimates rely less on generic cost book items, greater reliance on quotes, recent historical and site-specific crew based details. Class 3 estimates are a reflection of improved technical documents. The estimates must be supported by a technical information (scope, design, acquisition and construction methods, etc.) discussion within the estimate and the uncertainties associated with each major cost item in the estimate. Special attention must be given to large construction elements and items that are sensitive to technical information change. Typical Contingency Range could be 20% to 50%.

3. ESTIMATED DESIGN AND CONSTRUCTION SCHEDULE

The estimated schedule is shown in Table D-2.

Table D-2. Estimated Project Schedule

Phase	Estimated Start	Estimated End	Estimated Midpoint
Sign Design Agreement	Jul 2022	Jul 2022	N/A
Sign PPA	Jul 2022	Jul 2022	N/A
Real Estate Acquisition	Feb 2023	Feb 2024	Aug 2023
Preconstruction, Engrg & Design	Aug 2022	Feb 2024	May 2023
Solicit/Award	Mar 2024	Apr 2024	N/A

The Recommended Plan construction schedule is presented in this Appendix. The estimated construction time is based on:

- **Typical Construction Crew:** (1 shift) working 8 hours per day and 5 days per week.

Table D-3. Estimated Construction Duration

	Recommended Plan
Construction Start	Jan 2024
Construction End	Dec 2027
Midpoint	April 2026

- **Construction Windows:** None
- **Overtime:** This estimate contains no overtime to complete the project.

4. ACQUISITION PLAN

4.1. Estimate: The estimate is based on one contract being awarded to the Prime Contractor with multiple sub-contractors. The acquisition strategy is assumed as Full and

Open Invitation for Bid. The prime contractor will be responsible for oversight of the contract overseeing the work performed by subcontractors.

4.2. Sub-Contracting: For the Recommended Plan estimate, the subcontractors are broken out as:

- Demolition Subcontractor
- Pipework Subcontractor
- Landscaping Subcontractor

It is assumed that the prime contractor will subcontract all work except demolition, pipe work, and, site seeding/restoration.

5. PROJECT CONSTRUCTION

5.1. Mobilization, Demobilization and Preparatory Work

Mobilization/Demobilization: The estimate for this study assumes the Contractors will be from the Birmingham area. This does not exclude any work effort to contractors from other locations during the bidding process.

5.2. Disposal

- **Excess Material:** All excess material that cannot be balanced on site, will be hauled to the closer of the two disposal sites identified: Vulcan Materials and Birmingham Northern Landfill.

5.3. Features and Discussion

- **Site Access:** The sites are located in urban Birmingham and Bessemer, AL. All construction features will be located near to paved roads, minimizing extensive access road construction.
- **Construction Methodology:** The construction methodology will be industry standard.
- **Unusual Conditions (Soil, Water, and Weather):** Locations that will encounter groundwater during excavation include labor to dry the wetted material out for use in construction. It is assumed that dewatering efforts will not be required as it appears any groundwater aquifers encountered will be perched aquifers. This type of aquifer along with the natural downstream grade of the site will negate any dewatering requirements. The project schedule includes anticipated weather delays.
- **Bedrock Excavation:** With updated geotechnical borings, bedrock will likely be encountered on site. The estimate includes an assumed 5% of the total excavation quantity will be bedrock excavation. Methods discussed among the PDT for

excavation concluded that while the bedrock is competent, how the bedrock lies in the soil allows for removal with a hammer attachment on an excavator. The Cost and Schedule Risk Analysis (CSRA) includes a risk of an additional 5% of the total excavation quantity to be bedrock excavation.

5.4. Basis of Estimate: The basis of the estimate is the "Valley Creek Measure Design Summaries" document. This document contains quantities for each tentative measure and was provided to NWK-EDC from SAM-EDH in August of 2019. Quantities for the existing utilities and the plans for replacements were derived by NWK. All costs associated with lands and damages come from SAM Real Estate. All earthwork spoil from each measure will be hauled to the nearer of the two identified disposal sites: Vulcan Materials and Birmingham Northern Landfill. There are three identified sizes of rock to be utilized among the study's measures. Due to quarry restraints, each size of rock is produced at a unique quarry. DOT #57 rock is produced at Bessemer Quarry, Class V riprap is produced at Calera Quarry, and the Class II riprap is produced at Dolcito Quarry. It is assumed that detention basins will be armored with the three rock types listed above along with articulated concrete block mats on both the channel and ponding sides with additional armoring at the toe of the spillway for each site. The top of the basins will be armored with a layer of geotextile and aggregate surfacing (DOT #57).

5.5. Site Specific Utility Discussions: Following is a summary of quantities for demolition or relocation of utilities associated with VD1 and VD2.

- **VD1:** 2319 linear feet of an 8" diameter vitrified clay pipe with nine associated manholes will be demolished. 675 linear feet of 27" diameter reinforced concrete pipe with four associated manholes and 240 linear feet of 15" diameter reinforced concrete pipe with one associated manhole will be demolished and replaced with 630 linear feet of 27" diameter reinforced concrete pipe and five associated manholes at an assumed depth of 12 feet. The replacement of the reinforced concrete pipe lines requires the demolition and replacement of 1184 square yards of asphalt cement concrete including concrete curb and gutter. 9662 square yards of asphalt cement concrete will be demolished. One small house, assumed to have a slab on grade foundation, will be demolished.

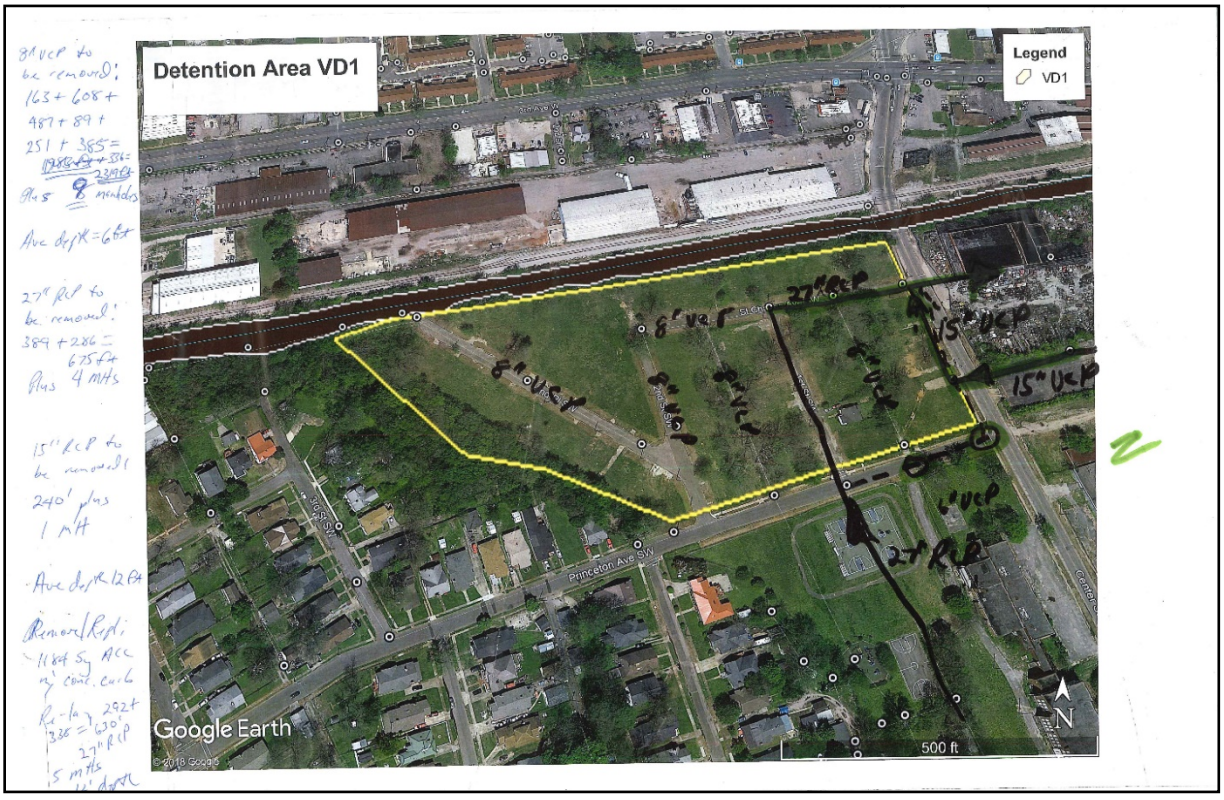

Figure 5.5.A Aerial view of detention basin VD1

- **VD2:** 2603 linear feet of an 8” diameter vitrified clay pipe with 17 associated manholes will be demolished. 1808 linear feet of 24” diameter ductile iron pipe with seven associated manholes will be demolished and replaced with 2267 linear feet of 27” diameter reinforced concrete pipe and 11 associated manholes at an assumed depth of six feet. The replacement of the reinforced concrete pipe lines requires the demolition and replacement of 527 square yards of asphalt cement concrete including concrete curb and gutter. 9101 square yards of asphalt cement concrete will be demolished. Three small houses, assumed to have a slab on grade foundations, will be demolished.

Figure 5.5.B Aerial view of detention basin VD2

6. COST ESTIMATE ASSUMPTIONS

6.1. Effective Price Level: Project costs are presented in October 2020 (1Q2021) dollars.

6.2. Construction Cost Estimate. The construction cost estimate was developed using MCACES 2nd Generation estimating software in accordance with ER 1110-2-1302, *Civil Works Cost Engineering*, 15 Sep 2008; UFC 3-740-05, Handbook: *Construction Cost Estimating*, 8 November 2010, Change 1, June 2011. The construction cost estimate was prepared using MII Version 4.4.2, and the latest 2016 English Cost Book, quotes on major material items, and 2018 Equipment Library (Region 03).

6.3. Labor Rates. This estimate uses a prevailing wage labor rates for Jefferson County, AL. The Davis Bacon Wages from decision AL20200107 dated 7 January 2020 were used for preparing the estimate. An escalation factor has been applied to all wages to update them to current pricing.

6.4. Labor and Equipment Productivity: No overtime hours or productivity adjustments have been included in the MCACES estimate.

6.5. Equipment Rates - This estimate is based on the latest available/supported MCACES MII equipment rate database (EP18R03), which has been updated for the estimate to represent current prices more accurately.

6.6. Material Rates – Minor Material costs were derived from CB16EN – MII English Cost Book 2016. The price level date for this Cost Book is assumed to be Jan 2016. A 20.28% adjustment factor was included in the MCACES estimate to normalize the costs to 1st Quarter 2020. Quotes were received for major material cost items and were overridden within the MCACES estimate.

6.7. Escalation: Escalation has been calculated within the estimate. Once labor, equipment, and material prices were normalized, an escalation factor was included at the owner level to escalate the overall estimate to a price level date of Oct 2020. The price level of the MCACES estimate is Oct 2020. Price levels within the Total Project Cost Summary have been escalated from price levels of the construction cost estimate to the midpoint of construction indicated in Table D-3.

6.8. Functional Costs: Functional costs using the Civil Works Breakdown Structure (CWBS) associated with this work were developed from quantity take-offs using hand sketches and excel spreadsheets, historical costs and input from PDT members as follows:

> **01 – Lands and Damages:** This account covers Real Estate costs for Construction. The initial estimate for real estate costs were derived from the tax map key for full replacement. Market cost will be determined by an appraiser in a later stage of design.

02 – Relocations: This account covers all relocation costs in the project. Structures to be demolished and replaced have been placed in the 02 Account for Relocations, whereas all other structures to be demolished have been placed in the Construction Account. In general, relocations were assumed to be within existing utility corridors. The most common and costly relocation are gravity sanitary sewers. When these utilities are within proposed detention basins identified as former "buy out" locations, they are quite often small service lines that serviced single family homes, which have since been demolished. In some cases, larger lines crossed through proposed detention basins and need to remain in service. Relocation of these lines entailed routing them around the proposed detention basins within existing utility corridors, and in some cases, up-sizing existing lines to accommodate longer runs and increased flows.

The PDT does not have enough information to do a detailed assessment of water, gas and electric, but the PDT input has given the team a general idea of what to expect based on how each area is laid out. For "other utilities", the following allowances have been used in the estimate:

VD1:
Water: $50,000 for removal of any neighborhood mains and services, including capping the line at the main line, particularly at Princeton Ave.
Gas: $20,000 for abandoning service lines and capping at the main lines.
Electric: $5,000 for pole/wire removal - It is uncertain how thorough the demolition work for the previous houses were; it is assumed that some removal will be required.

VD2: Similar layout as VD1
Water: $50,000
Gas: $20,000
Electric: $5,000

It is recommended to request detailed water & gas mapping for each of these areas. Areas that "appear" to be vacant of any utilities may have large water or gas mains traversing the site. It is most likely unnecessary to ask for further electric data as all electrical utilities appears to be overhead which can be seen via Google Earth.

06 – Fish and Wildlife Facilities: Costs include mitigation bank credits plus a small amount for seeding, mulching, native grasses and forbs at VD1.

14 – Recreation Facilities: This account covers the costs associated with constructing hiking trails and appurtenances.

15 – Floodway Control and Diversion Structures: This account covers the bulk of the project, including all work associated with constructing the detention basins.

30 – Planning, Engineering and Design (PED): This account covers all costs associated with Planning, Engineering, and Design. The costs are based on 20 percent of the construction cost. The 20% includes 1% Project Management, 1% for Planning &

Environmental Compliance, 10% Engineering & Design, 1% Engineering Tech Reviews, 1% Life Cycle Updates, 1% Contracting and Reprographics, 2% EDC, 1% Planning during construction, 1% for Adaptive Management and Monitoring, and 1% Project Operations for a total of 20% of the construction cost features. These percentages were supplied by Project Manage.

31 Construction Management (CM): This account covers supervision and administration costs during construction. The costs are based on 12 percent of the construction cost. The 12% includes 10% Construction Management (including QC), 1% Project Operations, and 1% Project Management for a total of 12% of the construction cost features. These percentages were supplied by Project Manager.

6.9. Estimate Assumptions: Key assumptions used for estimating the construction cost of the proposed alternative are as follows:

1) Detailed water or gas maps were not available, but from larger scale maps that were provided it appeared that the main lines were located along major roads, with smaller service lines extending to the former homes within the proposed basins. Again, no relocations in the sense of removing and replacing lines, but rather demolition and removal of the service lines within the proposed basins. NWK-Planning provided NWK-EDC allowances for this work.

6.10. Contingencies by Feature: Current Headquarters USACE guidance requires a formal risk analysis on all projects where the projected cost exceeds $40 million. In accordance with ER 1110-2-1302 and ECB 2007-17, 10 Sep 2007, Cost Risk Analysis was used to identify and measure the cost impact of project uncertainties within the estimated total project cost.

Oracle Crystal Ball analysis was used to develop contingencies for the original Recommended Plan. Contingencies are added to the cost estimate based on results of risk analysis. Table D-4 summarizes the contingency amounts. NOTE: A Cost and Schedule Risk Analysis workshop was held on 29 March 2021 to develop the contingency for this revision. Notable additions to risk are the bedrock excavation and truck availability during construction.

Unknowns that could affect the project costs and design assumptions prior to the detailed PED phase include:

- Variation in estimated quantities
- Changes in Acquisition strategy
- Changes in bid schedule
- Unexpected contaminated soils
- Unexpected geotechnical or ground water issues
- Unanticipated underground utilities
- Further refinement of designs based on refinement of hydraulic models
- Delays in real estate acquisition or funding
- Responsibility of O&M between City and State Government
- Traffic delays during construction of the features

- Unseasonal weather delays (hurricanes, tornados, flooding) during construction
- Single or multiple contracts over multiple years.

Real Estate Contingency was based on judgment by the Real Estate Project Delivery Team for the recommended plan.

6.11. Total Project Cost Summary: The Total Project Cost Summary (TPCS) Sheet includes the construction costs from the MCACES estimate, project markups, as well as costs for Lands and Damages, Planning, Engineering & Design, and Construction Management.

Cost Appendix Attachments

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

PROJECT: **Valley Creek GI**
PROJECT NO: P2 476284
LOCATION: Birmingham/Bessemer, AL

DISTRICT: SAM **PREPARED: 10/12/2021**
POC: CHIEF, COST ENGINEERING, John Dillon

This Estimate reflects the scope and schedule in report; Valley_Creek_Measures_Design_Summaries August 2019

Civil Works Work Breakdown Structure		ESTIMATED COST				PROJECT FIRST COST (Constant Dollar Basis)						TOTAL PROJECT COST (FULLY FUNDED)			
						Program Year (Budget EC): 2022									
						Effective Price Level Date: 1 OCT 21									
WBS NUMBER	Civil Works Feature & Sub-Feature Description	COST ($K)	CNTG ($K)	CNTG (%)	TOTAL ($K)	ESC (%)	COST ($K)	CNTG ($K)	**TOTAL ($K)**	Spent Thru: **1-Oct-20** ($K)	**TOTAL FIRST COST** ($K)	INFLATED (%)	COST ($K)	CNTG ($K)	FULL ($K)
A	*B*	*C*	*D*	*E*	*F*	*G*	*H*	*I*	*J*		*K*	*L*	*M*	*N*	*O*
	ALTERNATIVE 4														
02	RELOCATIONS	$1,112	$423	38.0%	$1,534	7.1%	$1,191	$452	$1,643	$0	$1,643	14.8%	$1,367	$520	$1,887
06	FISH & WILDLIFE FACILITIES	$231	$88	38.0%	$319	8.6%	$251	$95	$347	$0	$347	14.8%	$288	$110	$398
14	RECREATION FACILITIES	$116	$44	38.0%	$160	13.3%	$131	$50	$181	$0	$181	14.8%	$151	$57	$208
15	FLOODWAY CONTROL & DIVERSION STRU	$11,272	$4,283	38.0%	$15,556	8.6%	$12,246	$4,654	$16,900	$0	$16,900	14.8%	$14,063	$5,344	$19,408
	#N/A	$0	$0	-	$0	-	$0	$0	$0	$0	$0	-	$0	$0	$0
	#N/A	$0	$0	-	$0	-	$0	$0	$0	$0	$0	-	$0	$0	$0
	#N/A	$0	$0	-	$0	-	$0	$0	$0	$0	$0	-	$0	$0	$0
	#N/A	$0	$0	-	$0	-	$0	$0	$0	$0	$0	-	$0	$0	$0
	CONSTRUCTION ESTIMATE TOTALS:	$12,731	$4,838		$17,569	8.5%	$13,819	$5,251	$19,071	$0	$19,071	14.8%	$15,870	$6,031	$21,901
01	LANDS AND DAMAGES	$1,986	$306	15.4%	$2,292	8.4%	$2,153	$332	$2,484	$0	$2,484	5.6%	$2,273	$350	$2,624
30	PLANNING, ENGINEERING & DESIGN	$2,546	$968	38.0%	$3,514	2.4%	$2,607	$991	$3,597	$0	$3,597	5.0%	$2,736	$1,040	$3,776
31	CONSTRUCTION MANAGEMENT	$1,528	$581	38.0%	$2,108	2.4%	$1,564	$594	$2,158	$0	$2,158	11.8%	$1,748	$664	$2,412
	PROJECT COST TOTALS:	$18,791	$6,692	35.6%	$25,484		$20,143	$7,168	**$27,311**	$0	**$27,311**	12.5%	$22,627	$8,085	$30,713

_____ **CHIEF, COST ENGINEERING, John Dillon**

_____ **PROJECT MANAGER, Ron Jansen**

_____ **CHIEF, REAL ESTATE, Karen Kennedy**

ESTIMATED TOTAL PROJECT COST: $30,713

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

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

PROJECT: Valley Creek GI
LOCATION: Birmingham/Bessemer, AL
This Estimate reflects the scope and schedule in report; Valley_Creek_Measures_Design_Summaries August 2019

DISTRICT: SAM
POC: CHIEF, COST ENGINEERING, John Dillon

PREPARED: 10/12/2021

Civil Works Work Breakdown Structure		ESTIMATED COST				PROJECT FIRST COST (Constant Dollar Basis)				TOTAL PROJECT COST (FULLY FUNDED)				
		Estimate Prepared: 7-Apr-21 Effective Price Level: 1-Oct-20				Program Year (Budget EC): 2022 Effective Price Level Date: 1 OCT 21								
WBS NUMBER	Civil Works Feature & Sub-Feature Description	COST ($K)	CNTG ($K)	RISK BASED CNTG (%)	TOTAL ($K)	ESC (%)	COST ($K)	CNTG ($K)	TOTAL ($K)	Mid-Point Date	INFLATED (%)	COST ($K)	CNTG ($K)	FULL ($K)
A	*B*	*C*	*D*	*E*	*F*	*G*	*H*	*I*	*J*	*P*	*L*	*M*	*N*	*O*
	ALTERNATIVE 4													
02	RELOCATIONS	$1,112	$423	38.0%	$1,534	7.1%	$1,191	$452	$1,643	2026Q3	14.8%	$1,367	$520	$1,887
06	FISH & WILDLIFE FACILITIES	$231	$88	38.0%	$319	8.6%	$251	$95	$347	2026Q3	14.8%	$288	$110	$398
14	RECREATION FACILITIES	$116	$44	38.0%	$160	13.3%	$131	$50	$181	2026Q3	14.8%	$151	$57	$208
15	FLOODWAY CONTROL & DIVERSION STRU	$11,272	$4,283	38.0%	$15,556	8.6%	$12,246	$4,654	$16,900	2026Q3	14.8%	$14,063	$5,344	$19,408
	#N/A	$0	$0	0.0%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
	#N/A	$0	$0	0.0%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
	#N/A	$0	$0	0.0%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
	#N/A	$0	$0	0.0%	$0	0.0%	$0	$0	$0	0	0.0%	$0	$0	$0
	CONSTRUCTION ESTIMATE TOTALS:	$12,731	$4,838	38.0%	**$17,569**		$13,819	$5,251	$19,071			$15,870	$6,031	$21,901
01	LANDS AND DAMAGES	$1,986	$306	15.4%	$2,292	8.4%	$2,153	$332	$2,484	2023Q4	5.6%	$2,273	$350	$2,624
30	PLANNING, ENGINEERING & DESIGN													
1.0%	Project Management	$127	$48	38.0%	$176	2.4%	$130	$50	$180	2023Q3	3.8%	$135	$51	$187
1.0%	Planning & Environmental Compliance	$127	$48	38.0%	$176	2.4%	$130	$50	$180	2023Q3	3.8%	$135	$51	$187
10.0%	Engineering & Design	$1,273	$484	38.0%	$1,757	2.4%	$1,303	$495	$1,799	2023Q3	3.8%	$1,353	$514	$1,867
1.0%	Reviews, ATRs, IEPRs, VE	$127	$48	38.0%	$176	2.4%	$130	$50	$180	2023Q3	3.8%	$135	$51	$187
1.0%	Life Cycle Updates (cost, schedule, risks)	$127	$48	38.0%	$176	2.4%	$130	$50	$180	2023Q3	3.8%	$135	$51	$187
1.0%	Contracting & Reprographics	$127	$48	38.0%	$176	2.4%	$130	$50	$180	2023Q3	3.8%	$135	$51	$187
2.0%	Engineering During Construction	$255	$97	38.0%	$351	2.4%	$261	$99	$360	2026Q3	11.8%	$291	$111	$402
1.0%	Planning During Construction	$127	$48	38.0%	$176	2.4%	$130	$50	$180	2026Q3	11.8%	$146	$55	$201
1.0%	Adaptive Management & Monitoring	$127	$48	38.0%	$176	2.4%	$130	$50	$180	2023Q3	3.8%	$135	$51	$187
1.0%	Project Operations	$127	$48	38.0%	$176	2.4%	$130	$50	$180	2023Q3	3.8%	$135	$51	$187
31	CONSTRUCTION MANAGEMENT													
10.0%	Construction Management	$1,273	$484	38.0%	$1,757	2.4%	$1,303	$495	$1,799	2026Q3	11.8%	$1,457	$553	$2,010
1.0%	Project Operation:	$127	$48	38.0%	$176	2.4%	$130	$50	$180	2026Q3	11.8%	$146	$55	$201
1.0%	Project Management	$127	$48	38.0%	$176	2.4%	$130	$50	$180	2026Q3	11.8%	$146	$55	$201
	CONTRACT COST TOTALS:	$18,791	$6,692		$25,483.532		$20,143	$7,168	**$27,311**			$22,627	$8,085	**$30,713**

CSRA Totals

Risk Event Exceeds (CHECK ASSUMPTIONS and COST &SCHED SUMMARY SHEETS FOR VALUES

Information

Negligible	-	1
Marginal	84,630	3
Moderate	338,520	5
Significant	507,780	8
Critical	846,290	10

				Project Cost			Project Schedul			Other Informatio				Cost Model: COST			Schedule Model: Schedule Model			Cost due to Schedule Risk: Cost From Scheudule			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)
CSRA Totals														-$3,198,000	$0	$7,652,000	-7 Months	0 Months	25 Months	-$413,000	$0	$1,475,000		$0		0 Mo
Organizational and Project Management Risks (PM)																										
PM1	Scope Variance	Risk for scope to change	Current scope is well defined, 2D hydraulic modeling performed extensively. No chance for floodwalls to enter scope converstations. Confidence in having captured all scope for detention basins is high.	Unlikely	Marginal	Low	Unlikely	Negligible	Low	N/A -Not Modeled	N/A -Not Modeled	Technical Lead	Project Cost & Schedule	$0	$0	$0	0 Months	0 Months	0 Months	$0	$0	$0	100%	$0	100%	0 Mo
Contract Acquisition Risks (CA)																										
CA1	Bidding Climate	Construction market may be saturated with work, producing more expensive bids due to excess of work.	Unlikely to occur, appear to be plenty of capable contractors	Unlikely	Negligible	Low	Unlikely	Negligible	Low	N/A -Not Modeled	N/A -Not Modeled	Contracting	Project Cost	$0	$0	$0	0 Months	0 Months	0 Months	$0	$0	$0	100%	$0	100%	0 Mo
CA2	Bidding Pool	Small business, IFB, MATOC, etc. Costs may increase due to bidding out to small business or another contracing method.	Unlikely to occur do to magnitude of project	Unlikely	Negligible	Low	Unlikely	Negligible	Low	N/A -Not Modeled	N/A -Not Modeled	Contracting	Project Cost	$0	$0	$0	0 Months	0 Months	0 Months	$0	$0	$0	100%	$0	100%	0 Mo
General Technical Risks (TR)																										
TR1	Bedrock Conditions	If bedrock is encountered, the unit cost on cut will significantly increase due to the use of blasting/hammering and additional considerations.	Bedrock was echountered at depths of between 6 and 9 feet accross most of the project, originally assumed to be at around 15 feet. Drilling and blasting/hammering will be required for excavation. Bedrock quantities run by Marshall. Approximately 6% bedrock encountered, in terms of planned excavation at VD1, 4% at VD2. Bedrock appears to be fairly compentent, but not too strong for an excavator attachment	Very Likely	Critical	High	Very Likely	Moderate	High	Triangular	Triangular	Hydrology/Hydraulic Design	Project Cost & Schedule	-$1,300,000	$0	$1,300,000	-7 Months	0 Months	7 Months	-$413,000	$0	$413,000	100%	$0	100%	0 Mo
TR2	Fill Conditions	Possibility that excavated material may be unsuitable for re-use.	Due to a geotechnical investigation, the soil onsite appears suitable for re-use, and if there is any soil unsuitable, it will be a negligable quantity.	Unlikely	Negligible	Low	Unlikely	Marginal	Low	N/A -Not Modeled	N/A -Not Modeled	Geotechnical/Civil Design	N/A -Not Modeled	$0	$0	$0	0 Months	0 Months	0 Months	$0	$0	$0	100%	$0	100%	0 Mo
TR3	Petroleum Contaminated Soil Disposal	There may be some residual petroleum in the soil in site VD1, which will have to be disposed of properly at an appropriate disposal site. Marginal/unlikely	If petroleum contaminated soil is encountered, it will be hauled to a dump. Some excess material for the projecct is already hauled to the dump in the estimate. It is most likely that the potential contaminated material is already hauled off. Assume $50/CY for petroleum remediation, assume 5,000 CY for $250,000 *1.2 PED*1.12 CM = $336,000	Unlikely	Moderate	Low	Unlikely	Marginal	Low	N/A -Not Modeled	N/A -Not Modeled	Geotechnical/Civil Design	N/A -Not Modeled	$0	$0	$0	0 Months	0 Months	0 Months	$0	$0	$0	100%	$0	100%	0 Mo
TR4	Unknown Utilities	Possibility for some data to be missing for old utilities.	Very limited information on water lines and other utilities, plans for relocating utilties may not be acceptable. Water line relocations had significant assumptions. Per PDT input, this risk has the potential to increase cost up to 1.5 mil. And very likely to occur. Assume schedule impact of an increase of 6 months.	Very Likely	Critical	High	Likely	Marginal	Medium	Triangular	Triangular	Geotechnical/Civil Design	Project Cost & Schedule	$0	$0	$1,500,000	0 Months	0 Months	6 Months	$0	$0	$354,000	100%	$0	100%	0 Mo
TR5	Truck Availability	Risk for the number of required trucks to allow for maximum efficiency of excavation may not be available since the haul distance is so long. Risk for hauling location to change closer of further.	Current assumed disposal sites are roughly 25 miles round trip. There may be closer disposal sites. More or less haul distance, number of trucks on the road, number of trucks available. Currently require 26 trucks to excavate at 150 BCY/hr, if only 13 trucks were available, production would be at 75 bcy/hr and a schedule increase of 12 months would be found and a project cost increase of $900,000. Likely to not	Possible	Critical	High	Possible	Critical	High	Triangular	Triangular	Geotechnical/Civil Design	Project Cost & Schedule	$0	$0	$900,000	0 Months	0 Months	12 Months	$0	$0	$708,000	100%	$0	100%	0 Mo

				Project Cost			Project Schedul			Other Informatio				Cost Model			Schedule Model			Cost due to Schedule Risk						
														COST			Schedule Model			Cost From Scheudule			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 Distributio n	Schedule Variance Distributio n	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)
Lands and Damages (LD)																										
LD1	Additional Real Estate Costs	Risk for additioinal real estate aqcuisitions	Additional real estate costs associated with VD1, several structures on the backside may need to be acquired due to induced impacts. VD1 RE costs are rounded to an approximate $1,000,000. Assume a potential increase of 25% for $250,000.	Possible	Marginal	Low	Unlikely	Negligible	Low	N/A -Not Modeled	N/A -Not Modeled	Project Management	N/A -Not Modeled	$0	$0	$0	0 Months	0 Months	0 Months	$0	$0	$0	100%	$0	100%	0 Mo
Construction Risks (CO)																										
CO1	Large Rainfall Event	A large rainfall event may change channel conditions or in progress construciton activities	Re-work/delays assumed to be minimal due to weather, site is graded to drain	Unlikely	Negligible	Low	Unlikely	Negligible	Low	N/A -Not Modeled	N/A -Not Modeled	Project Management	N/A -Not Modeled	$0	$0	$0	0 Months	0 Months	0 Months	$0	$0	$0	100%	$0	100%	0 Mo
CO2	Endangered Species	Endagered species such as the "fresh water darter" may be encountered at certain construction sites, most likely the bridges. May impact construction staging or even construcitons zones prohibiting work.	Project measures have been reduced to two detention basins and will not affect Valley Creek species	Unlikely	Negligible	Low	Unlikely	Negligible	Low	N/A -Not Modeled	N/A -Not Modeled	Project Management	N/A -Not Modeled	$0	$0	$0	0 Months	0 Months	0 Months	$0	$0	$0	100%	$0	100%	0 Mo
CO3	Cultural Risks	Areas have not been surveyed extensively. Potential to find artifacts during construction.	Risk to delay the project up to two months if artifacts are found	Unlikely	Negligible	Low	Unlikely	Negligible	Low	N/A -Not Modeled	N/A -Not Modeled	Project Management	N/A -Not Modeled	$0	$0	$0	0 Months	0 Months	0 Months	$0	$0	$0	100%	$0	100%	0 Mo
CO4	Encountering Groundwater	Risk to encounter groundwater that will impact excavation	water table readings were variable at VD2, may be due to a perched water table, may need ot add piezometers. if fresh water table encountered, storage capacity will be affected, standing water may be encountered. Water encountered at 545' bottom design is 541'. Risk to impact excavation productivity (drying out soil). No specific location identified for drying material. Material will be double handled to and from a	Very Likely	Moderate	High	Very Likely	Marginal	Medium	N/A -Not Modeled	N/A -Not Modeled	Hydrology/Hydraulic Design	Project Cost & Schedule	$0	$0	$0	0 Months	0 Months	0 Months	$0	$0	$0	100%	$0	100%	0 Mo
Estimate and Schedule Risks (ES)																										
ES1	JOOH Variance	Risk for JOOH to vary by contractor	Current estimate uses 15% and 10% for JOOH and HOOH respectively. JOOH may vary +/-5%	Likely	Significant	High	Unlikely	Negligible	Low	Triangular	N/A -Not Modeled	Cost Engineering	Project Cost	-$400,000	$0	$400,000	0 Months	0 Months	0 Months	$0	$0	$0	100%	$0	100%	0 Mo
ES2	HOOH Variance	Risk for HOOH to vary by contractor	Current estimate uses 15% and 10% for JOOH and HOOH respectively. HOOH may vary +/-5%.	Possible	Significant	Medium	Unlikely	Negligible	Low	Triangular	N/A -Not Modeled	Cost Engineering	Project Cost	-$500,000	$0	$500,000	0 Months	0 Months	0 Months	$0	$0	$0	100%	$0	100%	0 Mo
ES3	JOOH Derivation		JOOH is 1.4M, schedule is 47 months, for a monthly cost of $35,000													$35,000							100%	$0	100%	0 Mo
ES4	HOOH Derivation		HOOH is 1.1M, schedule is 47 months, for a monthly cost of $24,000													$24,000							100%	$0	100%	0 Mo
External Risks (EX)																										
EX1	Market Conditions	Market conditions fluctuate with contractors workload	Market Conditions may vary -5% or +15%	Possible	Critical	High	Unlikely	Negligible	Low	Triangular	N/A -Not Modeled	Cost Engineering	Project Cost	-$998,000	$0	$2,993,000	0 Months	0 Months	0 Months	$0	$0	$0	100%	$0	100%	0 Mo