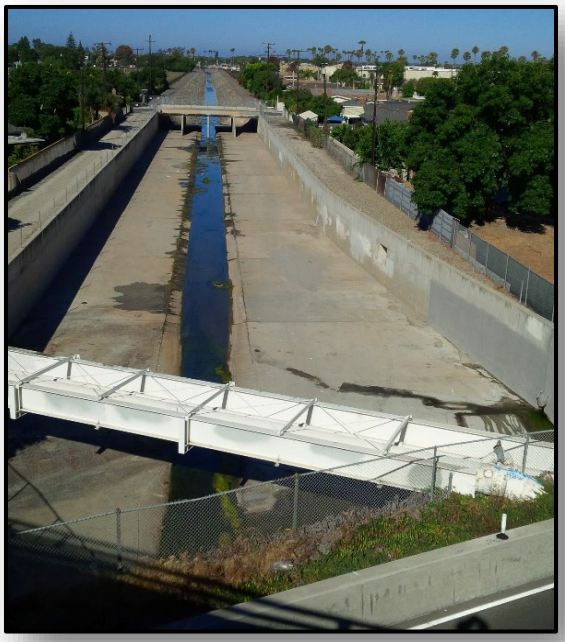
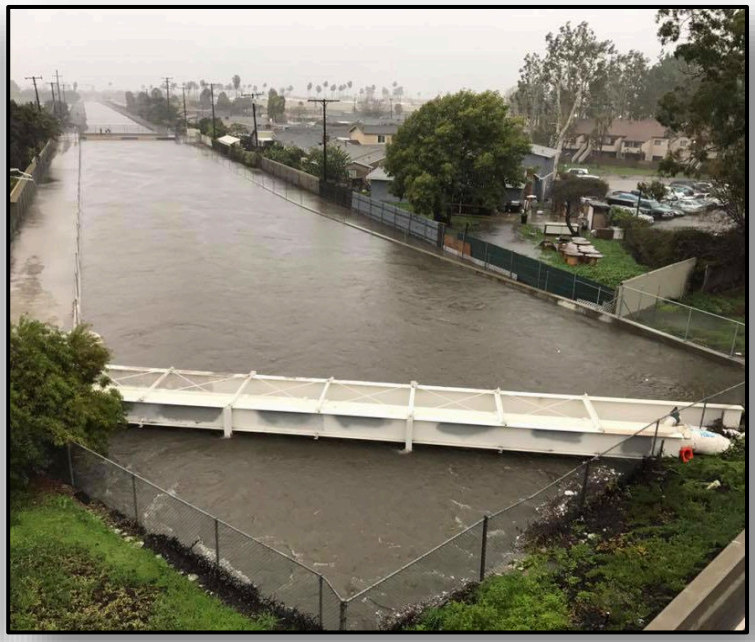
APPENDIX C - COST ENGINEERING APPENDIX
FOR
WESTMINSTER, EAST GARDEN GROVE FLOOD RISK MANAGEMENT STUDY





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1.0 Introduction

The purpose of this appendix is to summarize the assumptions and basis of the cost estimate for the proposed Nationally Economic Development plan (NED) and Locally Proffered Plan (LPP) including the major construction features for each. Cost supporting details focus on the construction costs, schedules, and corresponding risk based contingency associated with both plans.

2.0 Cost Methodology

The preparation of the cost estimate is in accordance with guidelines and policies included in: "ER 1110-1-1300 - Cost Engineering Policy and General Requirements, (26 March 1993)"; "ER 1110-2-1302 - Civil Works Cost Engineering, (30 June 2016)"; " UFC 3-730-01 Construction Cost Estimates (1 March 2011) A.K.A. EI 01D010, Construction Cost Estimates (1 Sept 1997)"; "EP 1110-1-8, Construction Equipment Ownership and Operating Expense Schedule, Region VII, (30 November 2016)"; and "EM 1110-2-1304, Civil Works Construction Cost Index System (CWCCIS), (31 March 2019)." The estimate was completed using the latest guidance from COE concerning implementation of the Civil Works Breakdown Structure (CWBS) and Chart of Accounts. Second Generation (MII) Micro-Computer Aided Cost Estimating System (MCACES) estimating software was used to compile and organize the costs for the final estimate. Independently developed cost was verified against historical data of similar scope of work and geographic proximity for validity.

A detailed Cost and Schedule Risk Analysis (CSRA) was performed to identify risks and level of certainty related to project cost and the project schedule duration. The results of the analysis produced two weighted contingency values, one for the NED features of work and a second for LPP features, and was applied to the costs and schedules developed for economic analysis and environmental planning.

Costs in this Appendix cover construction of project items including markups for Planning, Engineering, and Design (PED) as well as Construction Management (CM). These items are covered by percentages uniformly applied to the estimated construction costs. Based on historical averages on large multi-year civil works projects, 17% for PED and 8% for CM was used. These percentages are conservative estimates and more realistic dollar volumes, as applicable to a project of this magnitude, were addressed in the CSRA and considered in the overall contingency development as an opportunity for cost reduction.

All items in this cost estimate are presented in 2020 dollars, unless otherwise escalated to specific points in time, as in the Total Project Cost Summary (TPCS).

Costs for the Real Estate (WBS 01 LANDS AND DAMAGES) are provided as attachments to this appendix and further detailed in the Real Estate Appendix. Mitigation costs (WBS 06 FISH & WILDLIFE FACILITIES) are outlined in the Mitigation attachment and further detailed in the Mitigation Appendix.

Only the items and assumptions outlined in this Appendix are included in the estimate. Many of the items include assumptions (as listed) based on conversations with the Project Delivery Team (PDT) as well as the local sponsor Orange County Public Works (OCPW). Items not specifically listed below or recorded in the risk register, as included in the contingency calculations, are not included in these costs.

2.1 Basis of Design

Per ER 1110-2-1302, 13b, the level of design and technical information (approx. 5-10%) and risk contingency (approx. 20-50%) for the proposed alternatives places this estimate as a Class 3-4 Estimate. Estimates at this level, and specifically for this project, rely less on generic cost book items and use a greater reliance on quotes, historical data from comparable projects, and site and project specific details. The estimate and quantities are supported by technical information (scope, design, construction methods, etc.) which are detailed in the discipline specific appendices of the main report.

The level of design and detailed scope of work is largely conceptual with basic channel modifications typical sections and overall alignments developed by CELRC-TSD-DC Civil Design. CELRC-TSD-DT Structural Engineering developed design for Widening Warner Ave. and Removal and Replacement of the Tide Gates. The A-E (Tetra Tech) was consulted for developing design of the LPP Diversion Channel (C04 R21) as well as conceptual design for the representative crossings. As-builts from recent channel modifications, in close geographic proximity, were utilized for capturing smaller features of work and additional detail for developing the cost estimate. Hydraulic & Hydrology (H&H) channel modeling was referenced for existing and proposed channel geometries and overall alignment lengths.

Refer to the Civil Design Appendix for typical channel modification cross sections, alignment plan views, the Diversion Channel and Representative Crossings. Refer to the Structural Appendix for detailed conceptual design of Warner Ave Bridge and the Tide Gates.

2.2 Basis of Quantities

The primary channel modification quantity takeoffs (QTO) were developed and reviewed by the CELRC technical team based on preliminary design concepts and Hydraulics' HEC-RAS model channel geometry. Recent aerial drone footage was used to verify existing site conditions and channel type in various reaches. QTO stationing may not coincide with the naming convention in the latest RAS model but verification of alignment lengths was conducted to assure comparable dimensions. The QTO assumed various typical sections as formulated by planning and designed by Civil Engineering. A maximum (MAX) and minimum (MIN) channel modification were initially defined for costing measures describing a proposed rectangular concrete channel, vertical concrete walls and natural bottom, or steel sheet pile (SSP) walls and natural bottom for the MAX and trapezoidal concrete lined channel for the MIN. Conservative dimensions and reinforcing factors were used to reasonably estimate quantity assumptions where detailed design and existing channel topography where missing.

Some of the major construction features Cost Engineering specifically developed quantities for include:

- Concrete
- Sheet Pile Removal
- Riprap Removal
- Excavation
- Compacted fill/Backfill
- Concrete Removal
- Gravel Base Removal
- Reinforcing Steel
- Sheet Pile

- Bedding Stone
- Excavation Spoils

Other significant features with developed quantities by others include:

- Tide Gates Removal (USACE Structural)
- Warner Ave. (USACE Structural)
- The Diversion Channel in C04 R21 (A-E)
- Representative Channel Crossings (A-E)

Due to the preliminary stage of design, quantities may change as design progresses in the Preconstruction Engineering and Design (PED) phase. This risk is captured in the Risk Analysis and accounted for in the represented contingency values. See the attached QTO Summary tables for quantities by plan, construction feature, and respective channel reach.

2.3 Basis of Construction Cost Estimate

General Assumptions

The following assumptions were utilized in developing the cost estimates for each of the alternatives under consideration:

- This cost estimate assumes that all necessary equipment, labor, and material will be locally available for the project due to close proximity to large metropolitan areas and numerous competing distributors and suppliers.
- This cost estimate is based on the scope in this report and accounts for potential scope variations with the contingency. The contingencies account for regular construction changes that occur during design as well as potential modifications during construction. No account was made for large changes in scope due to any state or agency regulatory requirements that are not presently identified though agency/partner coordination was considered during the risk contingency development.
- This cost estimate assumes all excess materials for disposal are clean. No allowances for HTRW were made in the estimate or included in the contingency other than potential contract modifications. All demo, excavated, and rip rap spoils are assumed hauled to one of the following landfill or recycling facilities. Frank R. Bowerman, Olinda Alpha, and Prima Deschecha. Bowerman and Olinda are the two closest and most likely used. Depending on specific location in the overall project, Bowerman ranges as close as 15 miles and as far as 26 miles (and those mileages are following roads, not straight as the crow flies). Olinda ranges as close as 14 miles and as far as 29 miles. Prima is as close as 31 miles and as far as 36 miles. Recycling facilities that accept soil and concrete that are near the project are: Rainbow Environmental Services, Madison Materials, Stanton Recycling and Transfer Facility, and Tierra Verde EcoCentre. Rainbow is as close as 3 miles and as far as 12 miles. Madison is as close as 5 miles and as far as 18 miles. Stanton is as close as 7 and as far as 10 miles. Lastly, Tierra Verde is as close as 14 and as far as 26 miles.
- The cost estimates assume crews working concurrently 5 days (i.e. Monday through Friday) a week based on talks with OCPW. Overtime was also included @ 5.56% assuming an overall average of 9 hours per day and 1.5 times the regular hourly rate across all features of work whereas some features

may have 10-12 hours overtime and others none. Actual scheduling will depend on the contractor and the contracted construction schedule.

- For channel excavation, the cost estimates assume the use of conventional earth work crews and equipment. For channel demolition, the cost estimates assume the use of conventional earthwork equipment including excavators, water trucks (dust control during construction), and dozers. Equipment size selection was based conservatively on the dimensions of the channel cross section as well as type and magnitude of material handling.
- It was assumed most utilities are located within the road crossings and all earthwork, dewatering, and potential cofferdam installation for utility relocations are covered either by channel or crossing specific utility work cost.
- Storm Water Pollution Prevention Plans (SWPPPs) will need to be prepared for all alternatives per the guidance of the Los Angeles District's Corps Environmental Resources Section (Environmental Resources) and affiliated costs for plan development was assumed burdened in the field/job office overhead rates.
- Traffic control and the corresponding phasing was also considered during construction in the development of the cost engineering products including the development of risk based contingency.

Bare Costs and Markups

- MII 2016 (English) Cost Book was used for general cost data.
- Equipment rates are based on the Department of the Army EP 1110-1-8 "Construction Equipment Ownership and Expense Schedule", 2016 Region 7.
- Equipment rates were marked up from the 2016 cost book NED and LPP MII Equipment Escalation added per CWCCIS for WBS 09 CHANNELS & CANALS: Equipment 4Q16 (874.05) to 4Q19 (941.58) 7.7%
- Labor Rates were updated per latest Davis bacon Wage Rates General Decision Number: CA20190024 07/26/2019
- Material quotes were obtained for cost drivers such as steel sheet piling, soil-cement mixed columns, concrete, steel reinforcing, and aggregate fill.
- Material Escalation was added as a markup for dated material quotes per CWCCIS for WBS 09 CHANNELS & CANALS: Materials assumes 4Q18 (915.14) to 4Q19 (941.58) 2.9%
- Fuel (Gasoline and Diesel) per LA, CA and CA respectively per EIA fuel report https://www.eia.gov/petroleum/gasdiesel/
- Off-road Diesel per EIA rates less CA State & Fed tax
- Cost of Money was Updated per US Department of Treasury Prompt Pay Interest Rate
- California state tax of 7.75% was applied.
- Payroll Tax & Insurance rates were designated as follows:
    - Prime (CA, Excavation-rock/earth NOC)
    - Concrete Sub (CA, Concrete Work-NOC)
    - Demolition Sub (CA, Concrete Work-NOC)

  - Dewatering Sub (CA, Waterproofing)
  - Steel Sub (CA, Steel Erection-NOC)
  - Shoring Sub (CA, Steel Erection-NOC)
  - Fencing Sub (CA, Steel Erection-NOC)
  - Traffic Control Sub (CA, Concrete Work-NOC)
  - Utility Contractor (CA, Concrete Work-NOC)
  - Generic Sub (CA, Concrete Work-NOC)
- Job Office Overhead (JOOH) was set as a running percentage of 15% on Prime Contractors Own work as well as Sub Work.
- Subcontractor Field Office Overhead (FOOH) was set as a running percentage of 7% on the subcontractors Own work.
- Home Office Overhead (HOOH) was set as a running percentage of 10% for the Prime and 12% for subcontractors.
- Profit was developed using Profit Weighted Guidelines with 7.72% for Prime and 8.72% for subs.
- Bonding was estimated from the MII Bid Bond Table B and is set at 0.64% for the Prime and 1% (comparable to MII Bond Table value) for subcontractors in order to maintain consistency between the NED and LPP plan percentages.

Acquisition Strategy

Though contracting acquisition strategy has not been fully determined, CSRA discussions between the PDT as well as the local sponsor (Orange County Public Works members), agreed the project would be divided into multiple contracts up to approximately $100 million. Contracts of this magnitude are typically assumed fully competitive and open to larger businesses. The potential for smaller contracts and less competitive contract acquisition or delivery vehicles was captured in the CSRA.

Significant Cost Feature Assumptions

WBS 02 RELOCATIONS (WBS 02 03 CEMETREIES, UTILITIES, AND STRUCTURES)

BRIDGES & CROSSING UTILITIES:

- Warner Ave utility cost is based on detailed removal and replacement of water supply & distribution, sanitary sewer, natural gas, electrical, communications and their respective conduit, utility poles, and appurtenances at Warner Ave. RS Mean's crews and production rates were largely used with adjustments to rates for scale and site conditions unique to Warner Ave. As a % of the total construction cost, the rate is comparable to Historical OCPW Utility Costs.
- Tide Gate utilities assumed a scaled down version (1/2) of a TYP 40 crossing utilities. See TYP 40 Crossing for detailed assumptions.
- TYP 10 Crossing utilities were based on Bolsa Ave road crossing on the C04 channel utilities including the removal and replacement of 21 IN, 48 IN, and 60 IN RCP storm drain pipe and

manhole. Disposal fees included similar to channel work. New piping and structural fill assumed. Water lines, sewer pipe, underground media/comm lines, 3 IN gas lines, overhead power lines, utility poles, and utility boxes assumed along with temporary power. Typical RS Mean's crews were selected per feature of work and productivity adjusted to meet site specific conditions. Alternate crossings assumed the same scaling methodology as WBS 08 ROADS, RAILROADS, AND BRIDGES.

- TYP 20 Crossing utilities were based on Beach Blvd road crossing in the C06 channel and include the removal and replacement of 24 IN and 36 IN RCP storm drain, 10 IN sewer siphon, 8 IN water main, and 3 IN gas line. Disposal fees included similar to channel work. New piping and structural fill included. Typical RS Mean's crews were selected per feature of work and productivity adjusted to meet site specific conditions. Alternate crossings assumed the same scaling methodology as WBS 08 ROADS, RAILROADS, AND BRIDGES.
- TYP 30 Crossing utilities were based on Beach Blvd/Heil Ave road crossing in the C05 channel and included 24 IN and 36 IN RCP storm drain, 2 – 2 FT x 4 FT RCB culvert storm drains, 8 IN water line, 3 IN gas line, 6 miscellaneous utility pipes/conduit, traffic signal, and utility box removal and replacement. Disposal fees included similar to channel work. New piping and structural fill included. Typical RS Mean's crews were selected per feature of work and productivity adjusted to meet site specific conditions. Alternate crossings assumed the same scaling methodology as WBS 08 ROADS, RAILROADS, AND BRIDGES.
- TYP 40 Crossing utilities were based on Edward Street road crossing in the C05 channel to include 84 IN RCP storm drain, 68 IN x 106 IN RCP storm drain, and 12 IN water line. Disposal fees included similar to channel work. New piping and structural fill included. Typical RS Mean's crews were selected per feature of work and productivity adjusted to meet site specific conditions. Alternate crossings assumed the same scaling methodology as WBS 08 ROADS, RAILROADS, AND BRIDGES.
- TYP 50 Crossing utilities were based on Blake St road crossing in the C04 channel utilities including 8 IN sewer siphon, 6 IN water line, utility poles, and street signs. Disposal fees included similar to channel work. New piping and structural fill included. Typical RS Mean's crews were selected per feature of work and productivity adjusted to meet site specific conditions. Alternate crossings assumed the same scaling methodology as WBS 08 ROADS, RAILROADS, AND BRIDGES.
- TYP 60 Crossing utilities were based on Pedestrian Bridge in Reach 03 of channel C05 STA 201+66.90 and assumes 0.75% of construction cost for pedestrian bridge.

CHANNEL UTILITIES:

Channel utility costs were applied per reach as a percentage markup to the total construction cost (based on Historical OCPW Utility Cost per 3 averaged channel modification projects as a % of Contract Bid, Channel Crossing utilities not included in % and in SSP Wall Reach Sections as a % of Contract Bid, 1.4% - 5.4% for 3 contracts ranging $3.6 - 1.2M, approx. $60-40K).

WBS 08 ROADS, RAILROADS, AND BRIDGES

WARNER AVE BRIDGE:

As currently laid out, the Bolsa Chica Channel is constricted under the Warner Ave. bridge impeding high flows. The proposed channel modification includes a widened cross section and in order to do that the bridge will have to be expanded. Three additional pile bents will be added to increase the length of the bridge from approximately 91 feet long to 182 feet essentially doubling the span. The plan is to leave as much of the existing bridge as possible while widening the channel and increasing the bridge span. Also a new bike lane and sidewalk will be added to the south side of the bridge. It will be separated from the road by the existing reinforced bridge rail and a new extension of that bridge rail. The new sections of the bridge will match the existing bridge construction using precast piles topped with cast-in-place pile caps. 15 inch deep precast/pre-stressed concrete "voided slabs" will be placed on top of the pile caps that span the 30 foot spacing of the pile bents. The voided slabs will be topped with a 3 inch wearing surface of asphalt. The new bike lane and sidewalk will implement the same underlying bridge construction features. This will allow for future lane expansion if the road is widened without having to do another major re-build.

- Mobilization/Demobilization assumes 5% of construction, comparable to historical cost.
- Traffic control is based on RS Mean's labor, equipment, and material for temporary traffic control. Crew types include signage, barricades, construction barriers, flagmen, lighting, and temporary traffic markings. Traffic control is approx. 6.5% of the overall estimated construction cost which is reasonable for a multi-phase bridge project of this magnitude and comparable to historical data.
- Storm water pollution and prevention assumes 1% of the construction cost considering Best Management Practices (BMP). The plan development itself was considered as part of JOOH.
- Demolition includes crews for removal and disposal of bridge sections as well as site features such as paving. The bridge demo crew includes 2 heavy equipment operators, 2 laborers and 1 equipment oiler/grade checker. Equipment includes 2 – 40,000 LB excavators rated for severe conditions and 1 concrete pulverizer. Bridge demolition assumes heavily reinforced concrete at 6.25 CY/HR. Loading/Hauling/Disposal crews include 5 truck drivers, 4 - 50,000 LB dump trucks, 1 water tanker, 2 laborers and a pickup truck. Cycle hauling assumes 12 CY/HR per dump truck driver. Disposal cost based on quotes from Information Processing Tech representing 3 Orange County landfill facilities (Frank R. Bowerman, Olinda, Prima Deshecha; POC: Randy @ 714.834.4000). $57.50/TON general waste and $62.50/TON for special handling construction debris longer than 6 FT or WWF/Rebar reinforced. Price typically increases on the first of July for each new year...assumed similar increase of 1% from previous year. USED>> $60/TON.
- HMA Paving demolition assumes 7 operators, 4 laborers, 1 cement mason, 1 asphalt miller, 1 loader, concrete saw, and pickup truck. Cutting teeth added as a wear item. Removal rate of 5,350 SF/HR. Loading/Hauling/Disposal crews similar to bridge demo with cycle hauling assumed @ 10 CY/HR per dump truck driver.
- Additional demo crew included for misc. pile cap and bent preparation. Crew includes 5 laborers and 2 operators, a 100 ton crane and 2 sets of acetylene torches for steel cutting.
- Channel excavation includes crews for installing tidal rock berm and cofferdam, channel excavation, slope protection, and diversion of water. The rock berm is assumed 10' tall x 30' wide at base approximately 500' long - approximately 3,700 CY or 7,400 tons. 2 laborers, 1 operator, lattice crane and clamshell bucket assumed for placing rip-rap and rock lining @ 7.75 CY/HR and 40 ton/HR

removal and placement as slope protection around finished structure. Channel excavation crew includes 4 operators, 2 laborers, 12 truck drivers, 1 – 310 HP dozer, 1 water truck, 1 165,000 LB excavator, 1 – 7.5 CY bucket articulated loader, 11 – 50,000 LB dump trucks, and 1 - ¾ ton pickup. Excavation and haul out assumes 172 LCY/HR. Geotextile fabric assumed for bank stabilization with crew makeup of 3 laborers and a flatbed truck installing @ 150 SY/HR. Dewatering cost based on assumptions provided by a dewatering contractor and account for approximately 8% of the overall construction cost. 4" diameter point educator wells around the perimeter of the excavations (spaces every 10-ft) with a multiple spot wells/sumps with the excavation. Total number of wells = 250 (160 around the perimeter + 90 within the excavation area). Each well would be 55 ft in depth for a total of 13,750 LF of drilling and well installation. The well system would be set up with jet-educator dewatering system with a minimum pressure of ~65psi. *For a lower reservoir condition (~2570-ft) each well would be pumped at ~1gpm (normal construction pool). For a gross pool conditions (~2605.5-ft) assume a 10x increase in the pump rate ~10gpm (flood load/or wet year). Therefore, the containment and collection system would need to be designed for at least a capacity of 250 wells x 10gpm = 2,500 gpm (or 5.5 cfs). This is likely an upper bound.* Cost items are based on recommendations from Griffin Dewatering Corporation 909-986-4498

- The new bridge structure assumes construction features such as localized dewatering, abutment construction, pile and bent construction, bridge decking, and the pedestrian pathway and parapet wall. Dewatering crew assumes localized cofferdam with temporary pile & lagging including 8 pile drivers, 3 equipment operators, 3 laborers, lattice crane, pile hammer, leads, air compressor, and chainsaw rates @ 68.1250 SF/HR. 6 IN centrifugal pump assumed for 90 days with 8 HR labor attendance and 4 HR operator attendance for relocating and repositioning. Abutment construction assumes RS Means CIP concrete preparation excavation, forming, chamfering, reinforcing, placing, finishing, and post finish treatment crews. Material pricing for steel reinforcement and concrete based on recent vendor quotes and production rates typical with reduced steel reinforcing rates due to expected increased reinforcing detail. Pile and Bent construction crews including forming, reinforcing steel, placing/finishing CIP concrete, and pre-stressed concrete piles are largely RS Mean's crews and production rates with material cost verified with recent quotes. The bridge decking crews include typical RS Means precast concrete box beam crews with updated material cost based on recent vendor quotes for concrete and reinforcing steel and adjusted for partial depth of box beam per the Structural design specifications. The pedestrian path assumes 6 FT wide path with concrete wall protection from traffic. Typical RS Mean's crews and production rates were utilized including forming, reinforcing steel, placing/finishing CIP concrete and material pricing verified.
- Roadway and parking area raise features included additional approach paving demolition, structural and paving fill placement, new paving and sidewalk, pavement stripping, and guardrail. Approach paving demolition similar to HMA paving demolition described above. Fill material import hauling assumes 2 HR/load @ 15 LCY loads per 50,000 LB truck and driver. Truck spreading and compacting sub-base fill includes operator, drum roller, and laborer for ½ the operator's time. Base material assumes imported ¾ IN clean aggregate based on a user created item with vendor material pricing. Placement crew includes 4 operators, 2 laborers, loader, articulated grader, water truck, drum roller, flatbed truck and pickup with production rate set to 288 ton/HR. HMA paving includes tack coat crews, HMA material/hauling crew, paving, and street sweep crews largely based on RS Mean's crews. Production rates set at 1,000 SY/HR for surface treatment and 183.3 TON/HR asphalt placement. HMA installation crew includes 6 operators, 3 laborers, asphalt paver, static tire compactor, 2 smooth drum rollers, loader, and pickup truck for the duration of operations. RS Mean's pavement marking crew utilized for stripping @ 300 LF/HR and RS Mean's vehicle guide rail crew and production rates for guardrail installation.

- Huntington Harbor wall armoring assumes armoring of approximately 800 LF of existing harbor wall toe assuming 25 TON of A-2 (11-17 TON/EA) stone per LF. The installation crew assumes marine plant excavator, crane, and marine crew for placement of the large stone @ approx. 100 TON/HR. Marine mobilization and demobilization included and stone pricing based on vendor quote.

CHANNEL CROSSINGS (NOT INCLUDING WARNER AVE):

The crossing locations are existing vehicular roads and pedestrian bridges that cross over the C05/C06 and C02/C04 channel systems. These road crossings include clear span bridges, multi span bridges with piers, multi celled culverts, underground conduits, smaller maintenance bridges, and pedestrian bridges. In lieu of developing a unique estimate for each impacted structure, a select number of cost estimates were created based on typical or representative road crossing designs. The developed cost estimates for these representative road crossing were then used to develop an approximate cost for reconstructing each individual road crossing throughout the entire system. The typical crossing designs were developed by first grouping all the road crossings into six separate categories based on characteristics of the existing road crossings and then selecting a representative road crossing for each category. The representative crossing was scaled appropriately per individual crossings within the representative crossings group, characteristics such as number of lanes, span length, and low chord height. The overall pricing on the various types of crossings were then compared to historical bid abstracts for similar crossings that have recently been constructed by OCPW and the overall scaling model calibrated accordingly.

Types of Crossing Groups and Classification:

- Type 10: Cost estimate based on Bolsa Ave road crossing in Reach 20 of channel C04. 3 existing 12 x 9 FT culverts will be replaced by 3 new 12 x 9 culverts and an additional 16 x 9 FT RCB culvert. The TYP 10 is essentially a culvert or multi-cell culvert with a single roadway overtopping.
- Type 20: Cost estimate based on Beach Blvd road crossing in Reach 13 of channel C06. 2 existing 9 x 10 FT culverts will be replaced by 2 new 12 x 12 FT RCB culverts. The TYP 20 is essentially a culvert or multi-cell culvert with 1.5 roadways overtopping (i.e. adjacent parallel roadway near overtopping roadway.
- Type 30: Cost estimate based on Beach Blvd and Heil Ave road crossing in Reach 03 of channel C05. 3 existing 10 x 10 FT culverts will be replaced by 3 new 20 x 10 FT RCB culverts. The TYP 30 is essentially a culvert or multi-cell culvert with an intersecting pair of roadways overtopping the skewed structure.
- Type 40: Cost estimate based on Edward Street road crossing in Reach 01 of channel C05. Existing 118 FT multi-spanning bridge will be replaced by a 166 FT structure. The TYP 40 is essentially a multi-spanning bridge with 1-2 roadways overtopping.
- Type 50: Cost estimate based on Blake Street road crossing in Reach 22 of channel C04. 1 existing 9.5 x 7 FT opening will be replaced by 1 new 9.5 x 7 FT and 1 new 8 x 7 FT RCB culvert. The TYP 50 is essentially a relatively small clear spanning structure or culvert with a single roadway overtopping and immediately adjacent intersecting roadway parallel the channel.
- Type 60: Cost estimate to replace existing pedestrian bridges based on Pedestrian Bridge in Reach 03 of channel C05. The existing structure is approximately 59 FT span over trapezoidal channel and

the new structure 60 FT span with modified end loading support for rectangular channel crossing. The TYP 60 is essentially a pedestrian bridge or elevated pedestrian path.

Typical Construction features for each representative crossing type include the following:

Mobilization, Demobilization, and Site Preparation:

TYP 60 crossings assume all MOB/DEMOB costs as part of channel work. Types 10-50 have essentially the same assumptions for the representative crossings with the exception of TYP 30 which has increased MOB/DEMOB labor and equipment hours. General Mobilization assumes 6 pieces (8 pieces for TYP 30) of miscellaneous equipment hauled on 20-ton trailers. A separate crew for MOB/DEMOB of pile driving equipment assumes 2 mobilizations and 2 demobilizations (4/4 MOB/DEMOB for TYP 30) of 5 pile driver crew members, 3 operators, lattice crane, pile hammer, and pile accessories. Labor and equipment for mobilizing construction equipment and initial site prep is assumed for 10 days (15 days for TYP 30). General Demobilization and Pile Driving Demobilization assumes similar crews and durations for hauling out equipment and site restoration.

Traffic Control:

Traffic control is accounted for by assuming single or multi-phase construction of the various typical structures. TYP 10 assumes 3-phase, TYP 20 assumes 2-phase with additional median traffic control, TYP 30 assumes 4-phase with additional median traffic control, TYP 40 assumes 2-phase, and TYP 50 single-phase construction for the relatively smaller crossings with alternate neighborhood traffic routing options. Each phase of temporary traffic control crews include RS Mean's barricades, traffic cones, concrete vehicle barriers, signage, User defined flaggers, and respective labor and equipment for installation, maintenance, and operations. Traffic control at the crossings is in addition to the Traffic Control assigned to channel modifications and is assumed localized to the crossing.

Diversion and Control of Water:

Diversion and control of water at crossings is assumed localized to the crossing and separate from channel modification dewatering or diversion of water. Crossing types 10, 20, 30, and 50, where new culverts are proposed, assume independent water diversion from channel modification work. Temporary coffer damming walls including concrete barriers, sandbags, HDPE membrane, 24 IN diversion piping for gravity fed controlled bypass and labor and equipment for installation, maintenance, and removal. Dewatering crew includes 1 operator and ½ time laborer, 4 IN centrifugal pump and hoses pumping 8 hours, attended 2 hours per day for various durations (2, 4, 5, and 7 months for TYP 50, 20, 10, and 30 crossings respectively).

Temporary Shoring:

Pile and lagging shoring assumed for crossing types 10, 20, 30, and 50, where new culverts are proposed. Temporary shoring is assumed single or multi-phase corresponding with the overall construction plan. TYP 10 assumes 3-phase, TYP 20 assumes 2-phase with additional median traffic control, TYP 30 assumes 4-phase, and TYP 50 single-phase construction. Each phase of temporary shoring pile driving crew assumes 5 Pile Driver + 2 Equip Oper Heavy + 1 crane, crawler, 50 ton + 1 pile hammer, 18,100 FT-LBS w Lead @ 73.75 VLF/HR. Lagging crew assumes 3" thick wood between piles 8' O.C. and includes 3 Pile Driver + 3 Laborer + 1 chain saw, 36" long with crew output @ 31.25 SF/HR. Sheet piling, wales, connections and struts assumed at 2/3 salvage with crew makup of 4 Carpenter + 2 Operators and 1 crane, hyd, trk mtd, 65 ton with crew output set at 0.15 TON/HR.

Demolition:

Demolition is assumed for all representative crossing types though various crew makeups were assumed for culverts and bridges. Culvert demolition crews include culvert demo, concrete channel transition demo, bedding removal, roadway demo, sidewalk demo, median demo, fence, and/or block wall demo. Bridge demolition crews assume roadway demo, sidewalk, fence, bridge, and pile demolition. Reinforced Concrete Demolition crew includes 2 laborers, 2 operators, 30,000 LB excavator and attachments to remove concrete @ 4 CY/HR. Loading and hauling material to off-site disposal assumes 1 operator, 1 truck driver, 35,000 LB dump truck (12-cy dump truck, 25-mile haul, 35-mph avg) and ½ time loader. Landfill Tipping Fee based on current landfill costs in Orange Co. (www.oclandfills.com) 6/22/2018 Quote from Information Processing Tech representing 3 Orange County landfill facilities (Frank R. Bowerman, Olinda, Prima Desshecha; POC: Randy @ 714.834.4000). $57.50/TON general waste and $62.50/TON for special handling construction debris longer than 6 FT or WWF/Rebar reinforced. Pricing generally increases the first of July each year. Assuming a similar increase of 1% from previous year, $60/TON was used. Bedding removal assumes 1 laborer, 1 operator, and 24,000 LB excavator @ 10 CY/HR. Roadway demolition includes 2 Equip Oper Medium + 5 Laborer + 1 loader, F/E, crawler, 2.60 CY + 2 paving breaker, 66 lb + 1 air comp, 100 CFM + 1 hose @ 300 SF/HR. Sidewalk removal assumes 5 Laborer + 1 Equip Oper Light + 1 air comp, 250 CFM + 2 paving breaker, 66 lb + 2 Hose @ 96.625 SF/HR. Median demolition (remove pavement & curb, remove concrete curbs) includes 2 Laborer + 1 Equip Oper Light + 1 loader, BH, wheel, 0.80 CY FE bkt @ 45 LF/HR and 1 labor to remove paving bricks @ 11.25 SF/HR. Fence demo includes 2 Laborer + 1 Equip Oper Light + 1 loader, BH, wheel, 0.80 CY FE bkt @ 111.25 LF/HR and 2 Laborer + 1 Equip Oper Light + 1 loader, BH, wheel, 0.80 CY FE bkt for removing gates @ 1.25 EA/HR. Block wall demolition assumes masonry, concrete block walls, reinforced alternate courses, 12" thick with laborer and equipment to dismantle @ 55.625 SF/HR. Loading, hauling, and disposal similar for each demolition construction feature. Pedestrian bridge demo assumes 5 Laborer + 2 Operators, 1 crane, lattice boom, 100 ton + 2 torch w tanks & hoses removing @ 62.50 SF/HR.

Earthwork:

Earthwork includes excavation, backfill and excess material disposal crews. Structural excavation crew includes labor, operator, and 24,000 LB hydraulic excavator with output of 10 CY/HR. Loading and hauling material to/from stockpile assumes 1 operator, 1 truck driver, 35,000 LB dump truck (12-cy dump truck, 10-mile haul, 25-mph avg) @ 12 CY/HR. Compacted fill crew includes same hauling crew and productivity to return material as backfill. Structural backfill includes labor, operator, and 24,000 LB excavator @ 30 CY/HR. Hand compaction assumed next to structure with laborer and plate compactor @ 7.5 ECY/HR and roller compaction includes 1 laborer, 1 operator, and 12 TON vibratory drum roller @ 160 ECY/HR. Excess material assumes loading and hauling material to off-site stockpile with 1 operator, 1 truck driver, 35,000 LB dump truck (12-cy dump truck, 25-mile haul, 35-mph avg) and ½ time loader.

Bridge Work, Culvert, or Pedestrian Bridge Replacement:

Type 60 pedestrian bridge replacement assume foundations, erection, etc. approximate double the cost of a prefab bridge. $283,400 (bridge) + $283,400 (installation & foundations) = $566,800 (Quote from Contech). Bridge work assumes concrete filled pipe piles with 5 Pile Drivers + 2 Equip Oper Heavy + 1oiler/grade checker + 1 crane, crawler, 50 ton + 1 pile hammer, 18,100 FT-LBS w Lead with production rates of 38.75 VLF/HR. Pile cap is assumed with C.I.P. concrete forms, pile cap, square or rectangular, plywood, 4 use, includes erecting, bracing, stripping and cleaning crew labor includes 3 Carpenter + 1 Laborer and crew output 47.875 SFC/HR). Structural concrete, ready mix, verified @ $119/CY 5,000 psi

concrete & Fees per AVG 3 vendor quotes (A&A Redimix, National Cement, and Robertson's Ready Mix in Southern Cal, mid-2018). Structural concrete, placing, pile caps, pumped, over 10 CY, includes leveling (strike off) & consolidation crew includes 6 Laborers + 1 Cement Finisher + 1 Equip Oper Medium + 1 conc pump, 117 cy/hr, truck mtd + 2 conc vib, 2.5" dia w 7.5 HP generator with crew output of 30 CY/HR. Reinforcing steel, in place, footings, #4 to #7, A615, grade 60, incl labor for accessories, excl material for accessories assumes 1 ironworker @ 0.0656 TON/HR. Precast concrete box beam, 36" wide x 33" deep includes 7 Structural Steel Workers + 1 Equip Oper Heavy + 1 oiler/grade checker + 1 crane, mech, trk mtd, 150 ton with rates of 270 SF/HR. Culvert construction crew includes bedding stone, RCB culvert, concrete transition, and debris wall (TYP 30 & 20 crossings). Bedding stone fill by borrow and utility bedding, for pipe and conduit, crushed or screened bank run gravel using 2 Laborer + 1 Equip Oper Light + 1 loader, BH, wheel, 0.80 CY FE bkt @ 18.75 LCY/HR. RS Means Stone pricing comparable to recent vendor quotes. Compaction assumes 6" to 8" lifts with 5 laborers and hand held compaction equipment @ 31.25 ECY/HR. RCB culvert includes similar wall, invert slab, and structural roof crews a various crew outputs. C.I.P. concrete forms, wall, job built, plywood, to 8' high, 4 use, includes erecting, bracing, stripping and cleaning including 5 Carpenter + 1 Laborer @ approx. 63/54/70 SFC/HR for walls/slab/roof respectively, Structural concrete, ready mix, heavyweight, 5000 psi per vendor quotes, Structural concrete, placing, walls, pumped, 12" thick, includes leveling (strike off) & consolidation with 6 Laborer + 1 Cement Finisher + 1 Equip Oper Medium + 1 conc pump, 117 cy/hr, truck mtd + 2 conc vib, 2.5" dia w 7.5 HP generator @ approx. 13.75/23.13/22.50 CY/HR, and Reinforcing steel, in place, walls, #3 to #7, A615, grade 60, incl labor for accessories, excl material for accessories assuming 1 ironworker @ 0.0938/0.0719/0.0906 TON/HR crew output. The concrete transition crew assumes structural concrete, in place, free-standing wall (3000 psi), 8" thick x 14' high, includes forms (4 uses), Grade 60 rebar, concrete (Portland cement Type I), placing and finishing includes 19 Carpenter + 2 Rodmen + 2 Laborer + 1 Cement Finisher + 1 Equip Oper Medium + 1 conc pump, 117 cy/hr, truck mtd + 1 conc vib, 2.5" dia w 7.5 HP generator with crew output of 3.4075 CY/HR. Debris wall crew assumes the same crew makeup and productivity as the concrete transition walls.

Roadway and Site Work:

Roadway and site work includes crews for bridge concrete barrier & sidewalk (TYP 40), tube fencing (TYP 40), asphalt road, sidewalk, curb & gutter, street median (TYP 20 & 30), fencing/gates, block wall (TYP 10 & 50), gutter drain on headwall (TYP 10). Bridge concrete barrier & sidewalk crew includes sidewalks, driveways, and patios, sidewalk, concrete, cast-in-place with 6 x 6 - W1.4 x W1.4 mesh, broomed finish, 3000 psi, 6" thick, excludes base with 1 Cement Finisher + 1 Carpenter + 1 Laborer @ 63.75 SF/HR and vehicle guide rails, median barrier, precast concrete, single face, 3'-6" high, 2' wide, 10 ' long using 5 Laborer + 2 operator + 1 hyd excavator, wheel, .625 CY @ 47.5 LF/HR. Tube fencing assumes vehicle guide rails, guide/guard rail, steel box beam, corrugated beam RS Mean's crew with 3 Laborer + 1 truck, hwy + 1 flatbed, 8' x12' @ 50 LF/HR. The Asphalt crew assumes 2-layers and placement of plant-mix asphalt paving, for highways and large paved areas, binder course, 2" thick with 8 Laborer + 3 Equip Oper Medium + 1 asphalt paver, 10' + 1 roller static, S/P, 14 Ton + 1 roller, vib, S/P, dd, 10.4 Ton @ 222.3333 SY/HR. Base course drainage layers, aggregate base course for roadways and large paved areas, crushed stone base, compacted, crushed 1-1/2" stone base, to 8" deep with crew makeup of 3 Laborer + 4 Equip Oper Medium + 1 Truck Driver Heavy + 1 water tank, 5000 gal + 1 loader, FE, 1.5 CY + 1 dozer, 300 HP + 1 grader, 135 HP + 1 roller, vib, S/P, sd, 22 ton and crew output of 562.5 SY/HR. Concrete sidewalk, curb, and gutter crew includes RS Mean's crews for cast-in place concrete curbs & gutters, concrete, wood forms, radius, 6" x 18", includes concrete with 4 Carpenter + 1 Cement Finisher + 1 Laborer @ 25 LF/HR and sidewalks, driveways, and patios, sidewalk, concrete, cast-in-place with 6 x 6 - W1.4 x W1.4 mesh, broomed finish, 3000 psi, 6" thick with 1 Cement Finisher + 1 Carpenter + 1 Laborer @ 63.75 SF/HR. Street median crew assumes brick paving, brick on thick sand

bed, laid flat, (4.5 brick/SF), 1" thick sand bed with 1 Bricklayer + 1 Helper @ 12.5 SF/HR and concrete radius curbing, 6" x 18" with 5 Laborer + 2 operators + 1 hyd excavator, wheel, .625 CY @ 20 LF/HR. Fencing and gates installation assumes fence, chain link industrial, no barbed wire, galvanized steel, 2" line post, 10' O.C., 1-5/8" top rail, 5' - 0" high, includes excavation, in concrete crew makeup of 2 Laborer + 1 Truck Driver Light + 1 post hole drill, up to 8" + 1 truck, hwy w flatbed @ 37.5 LF/HR. Fence, chain link industrial, double swing gates, 5' high, 20' opening, includes excavation, posts & hardware in concrete with 2 Laborer + 1 Truck Driver Light + 1 post hole drill, up to 8" + 1 truck, hwy w flatbed @ 0.35 EA/HR. Block wall construction includes cavity walls, brick and concrete masonry unit (CMU) cavity wall, 4" brick and 8" concrete masonry unit (CMU), includes mortar, ties and horizontal joint reinforcing every other course, excludes scaffolding, vertical reinforcing and grout by 3 Bricklayer + 2 Helper @ 15.6250 SF/HR. Gutter Drain on Headwall assumes utility area drain, catch basins or manholes curb inlet frame, grate, and curb box, small, medium duty, 10" x 21" with 1 Cement Finisher + 1 Carpenter + 1 Laborer @ 0.25 EA/HR.

A complete list of individual crossings as included in each plan formulation can be referenced in the Report body or in the Economics Appendix.

WBS 09 CHANNELS & CANALS

PARAMETRIC CHANNEL MODIFICATION FEATURES:

Mobilization/Demobilization:

Mobilization and Demobilization cost was based on a percentage of total cost per channel reach. For rectangular channel modifications, Historical Data indicates 4.5-6% (approximately $500K - $2M) of total contract costs between $10-50M. (Based on 2010 Westminster Channel, 2012 East Garden Grove-Wintersburg Channel, and 2014 Newland Storm Channel Improvements). Assumed higher contract cost reduces MOB %. For concrete trapezoidal lining channel modifications, 3% of total project cost for MOB/DEMOB was assumed. Historical Data indicates 5-10% ($100 - $125K) of total contract costs between $2.5-1M. (Based on 2013 Rossmoor Storm Channel and 2011 Lewis Storm Channel Improvements bid Abstracts). Assumed the higher estimated contract costs reduces MOB %.

SWPPP:

The Storm Water Pollution and Prevention & Planning cost is based largely on historical data per length of channel reach. Rectangular channel modifications assumes a Civil/Environmental Engineers time working on this activity for 2 weeks. Based on SWPPP Historical Data (average of 3 similar OCPW channel projects and escalated to today's dollars approx. $17/LF of channel). Concrete trapezoidal lining channel modifications were based on SWPPP Historical Data [average of 3 similar OCPW channel projects (2013 Rossmoor Storm Channel, 2011 Lewis Storm Channel, and 2018 Ocean View Channel) and escalated to today's dollars approx. $5.56/LF of channel].

Traffic Control:

Traffic Control cost was based on historical data per length of channel reach. Rectangular channel modifications assumed parametric data provided by local sponsor and compared with escalated Historical channel construction cost (Averaging lower half of the contractor's bids, dividing by the channel length,

and escalating to a present value of $69.56/LF). Concrete trapezoidal lining channel modifications were based on 2018 parametric data from Ocean View Channel Rehabilitation Project Bid Abstract (Averaging the lower half of the contractor's bids, dividing by the channel length, and escalating to the present value of $28.46/LF)

Dust Control:

Dust Control was based on historical data per length of channel reach. Rectangular channel modifications assumed primarily during excavation and/or rip rap removal activity. The cost per LF is comparable to Historical Channel Construction Pricing ($33/LF for 3 Contract Avg., escalated). Dust control for concrete trapezoidal lining channel modifications were assumed mainly needed during excavation and/or rip rap removal activities. The cost per LF is comparable to Historical Channel Construction Pricing (2013 Rossmoor Storm Channel averaged lower half bids divided by the channel length and escalated approx. $3.03/LF).

Chain Link Fence:

Chain link fencing unit pricing was based largely on OCPW Historical Data assuming subcontracted and average 4 FT tall fence for each side of channel per modified reach length. Reference project: Newland Storm Channel (Facility No. C05S01) Bids Opened: 3/5/2014 W.O. No. EF07404 Limits: Fr. East Garden Grove-Wintersburg Channel (Fac. #C05) Confluence to Whitley Ave. Sta. 00+34.11 to Sta. 61+40.00. The unit pricing is also comparable to escalated and averaged 4 Historical Bid Abstract Unit Prices related to OCPW Channel Improvements.

CREW DEVELOPMENT FOR CHANNEL MODIFICATION FEATURES:

Dewatering:

- Dewatering includes cofferdam and pumping downstream of construction activities. Comparable to historical pricing @ approx. $60-110/LF ($600-150K) for projects ranging from $50-4M (2012 East Garden Grove-Wintersburg Channel Improvements Bid Abstract Item #8, 2010 Westminster Channel Improvements Bid Abstract Item #6, and 2018 Ocean View Channel Rehabilitation Bid Abstract Item#2).
- The cofferdam crew includes 3 journeyman and 1 foreman pile driver, 2 journeyman equipment operators and 1 journeyman equipment operator/oiler. 2 pile hammer drivers, 2 pile hammer leads, 2 lattice cranes, and 2 generator sets. Crew output set at 60 SF/HR.
- Assumes Cofferdam placement every 3,000 LF. Assumes 150 FT width of channel and 20 FT SSP. Approx. 2 SSP sections or 1 pairs driven per half hour and half hour to remove.
- Assumes 2 pumps setup for 24 hour operation by float activated switches during construction. Approx. 1/2 day per 10 LF of channel per pump.
- For earthen bottom (soft-bottom) channel sections, dewatering methods are not expected to hinder the channel bottom's naturally wetted conditions by impeding storm water flow or tidal influence during construction.

Clear Site and Remove Obstructions:

- The Rectangular channel modification areas are comparable to Historical Pricing (2010 Westminster Channel Item #2 LS of $20K approx. $7/LF, 2010 Edinger Storm Channel Imp Item #10 LS approx. $30K or $10.50/LF, 2012 East Garden Grove-Wintersburg Channel Improvements approx. $100K for approx. 9,600 LF approx. $10.50/LF, and 2014 Newland Storm Channel Item #2 approx. $25K or $4/LF).
- Trapezoidal channel lining areas are also comparable to Historical Pricing (2013 Rossmoor Storm Channel and 2011 Lewis Storm Channel averaged bids and escalated to present approx. $2.38/LF).
- The Rectangular and Trapezoidal channel modification clearing crew includes 2 truck drivers and 1 equipment operator. 2 - 75,000 LB dump trucks and 1 - 55,000 LB hydraulic excavator assumed. Trapezoidal lining channels also included cutting, brush piling, and chipping equipment/labor and associated disposal fees.
- Productivity was adjusted to 50-60 LF of channel per hour for rectangular channels and 320 LF of channel per hour and assumed 23% of total area requires clearing, primarily the channel bed, for trapezoidal lined channels.
- Areas computed from channel widths represented in the quantity takeoffs and applied to the overall reach alignment length.

Concrete Removal:

- The concrete removal crew assumes a modified RS Mean's crew. The Concrete Demo crew production rates were reduced to 15 CY/HR for rectangular channel as well as 15 CY/HR for trapezoidal channel based on Cost Book production rates and crew makeup for Selective demolition, retaining walls, concrete retaining wall, 10' high, includes reinforcing (approx. 6-7 CY/HR with varying wall thickness) and Building footings and foundations demolition, floors, concrete slab on grade, concrete, rod reinforced, 6" thick (approx. 8.3 CY/HR). NED/LPP Crews include 3 additional laborers than the cost book crew, additional 2 - 90lb hammers and 1 - cutting torch than the cost book for cutting entangled reinforced concrete sections and for retaining wall removal additional (compared to cost book crew) hydraulic excavator breaker attachment as well as grapple for handling and loading trucks directly without loaders. The NED/LPP breaker is 2,000 FT-LBS compared to the cost books 1,300 and the Hydraulic Excavators significantly larger than the cost book crew equipment at 140,000 LB vs 30,000 LB. Considering the additional and larger equipment as well as crew labor, the NED/LPP concrete demo rates are reasonable greater.
- Hauling and disposal rates assumed 50% Bulking Factor for LCY hauling and 4050 lbs/cy = 2.025 tons/cy for disposal. Tipping fee Quotes obtained from Information Processing Tech representing 3 Orange County landfill facilities (Frank R. Bowerman, Olinda, Prima Deshecha; POC: Randy @ 714.834.4000).
- Direct Cost Reasonable compared to Historical Data for reinforced concrete removal.

Sheet Pile Removal:

- Unit Pricing comparable to 2012 East Garden Grove-Wintersburg Channel Improvement Project (Limits: From Tide Gates to Upstream of Warner Ave). Averaged 5 low bidders EA unit pricing and compared with 180 SF (Approx. $550/EA, $550/180SF, or $3.06/SF escalated to today's dollars)
- SSP removal crew is the same as the sheet pile driving described above with the addition of operator foreman and standard pickup as supervisor during operations. Assumes 3-4 (315 SF) pilings removed per hour.
- Disposal and scrapping of SSP assumes sheet pile material recyclable (i.e. no tipping fees). And hauled at approx. 25,000 lbs per hour with 2 drivers and 2 – 25,000 LB flatbed trucks.

Excavation:

- Excavation Unit Pricing Comparable to Unclassified Excavation Historical Unit Pricing (4 Bid Abstract AVG escalated to $24/CY)
- Excavation crew includes 2 operators and 2 - 140,000 LB hydraulic excavators with 3.5 CY buckets. 1 equipment operator foreman and 1 equipment operator as oiler and grade checker and pickup truck. Assumes approx. 260 CY excavated and loaded per hour
- Hauling crew includes 2 – 22 ton trucks and drivers cycle hauling (wait, load, travel, unload or dump & return) time per cycle, excavated or borrow, loose cubic yards, 20 min load/wait/unload, 16.5 C.Y. truck, cycle 20 miles, 35 MPH
- Assumes 800 CY access ramps and partial access roads constructed as part of excavation
- Disposal cost based on quotes from Information Processing Tech representing 3 Orange County landfill facilities (Frank R. Bowerman, Olinda, Prima Deshecha; POC: Randy @ 714.834.4000). $57.50/TON general waste and $62.50/TON for special handling construction debris longer than 6 FT or WWF/Rebar reinforced. Price increases July 1st of each year...assumed similar increase of 1% from previous year. USED >> $60/TON.
- Street sweeping is assumed for half the duration of excavation and includes an 8 FT street sweeper and operator.

Temporary Shoring:

- Shoring will be required to construct channel modifications due to the limited space available within the existing channel right-of-way. Temporary Shoring material cost assumes material will be reused or salvaged upon removal and Crew Output assumes temporary soldier piles and steel plates. This is in line with what OCPW has seen in construction of similar channels. GIKEN push pile equipment is expected to be used with higher drive rates.
- Temporary Shoring Soldier Beam and Lagging estimated cost compared with OCPW historical cost for verification. Comparable to OCPW Historical Cost (2010 Westminster Channel D/S of Hoover to D/S Beach Blvd, approx. 2,900 LF of channel, Bid Abstract Item #18 approx. $1M or $350/LF channel, 2010 Edinger Storm Channel Improvement Bid Abstract Item #26 approx. $350 per LF of Channel (approx. 3,000 LF of channel), and approx. $500/lf channel compared to 2014 Newland Storm Channel Bid Abstract Item # 27 for approx. $3M for 6,100 LF of channel)

- Assumes mostly re-usable beams/lagging system. R1 and R2 already contain single SSP wall that may be used as shoring while R1 downstream has newly proposed shoring. R1-3 is approx. 5,000 LF of proposed rectangular channel with concrete walls and earthen bottom. This segment of the channel will likely require temporary shoring during construction.
- The typical crew includes 8 pile drivers (2 foreman & 6 journeyman), 3 operators, and 3 laborers. 1 pile hammer, 1 pile hammer lead, 1 50 ton crane, air hoses, air compressor, and chain saw. Assumes 125 SF/HR crew output.

Subsurface Drain:

- Subsurface "French Drains" assumed in dual SSP areas for drainage and dewatering throughout construction. Through the "French' drain the flow can be collected and drained downstream. After the ditch is dug and graded, geotextile material is placed and a 6" bed of gravel is laid down over the bottom. Then a perforated 12" diameter pipe is placed. After the pipe has been placed, the trench is filled with gravel to a depth 6" above the top of the pipe. The remainder of the ditch is backfilled with native soil. The pipe provides passage for the water and the gravel provides additional infiltration of ground water. The drain will be left permanently in place. It will provid permanent lowering of the ground-water table. Diversion and control of water will redirect surface water from the excavation areas toward the drain. Two (2) "French" drain lines are assumed along the channel.
- Equipment operator and hydraulic excavator assumed for trenching @ 75 CY/HR. Lining of trench with geotextile includes labor and material to place at 156.25 SY/HR. Aggregate material based on 2 local Southern California vendor quotes. Assumes delivery to Westminster and 26 TON loads. West Coast Sand and Gravel Buena Park, CA (800) 522-0282 $28/TON before tax. POC Robert Halma Quote #30174 (2/19/2019). Placement of the aggregate involves operator and excavator @ 20 ton/HR. Installing perforated pipe includes 5 laborers, 1 operator, and 1 backhoe @ 33.75 LF/HR. The trench is assumed backfilled with the same crew as excavation @ 75 CY/HR.

Aggregate Base Layer:

- The aggregate base layer crew includes dozer and operator, loader/backhoe and operator, and 2 laborers for the placement of aggregate material. Aggregate material pricing based on 2 local Southern California vendor quotes. Assumes delivery to Westminster and 26 TON loads. West Coast Sand and Gravel Buena Park, CA (800) 522-0282 $28/TON before tax. POC Robert Halma Quote #30174 (2/19/2019). Backfill and spreading aggregate rates are assumed 60 CY/HR for rectangular channel modifications and 200 CY/HR for trapezoidal channel lining where it is assumed the stone can be dumped directly from trucks and spread.
- Geotextile placement includes RS Means costbook crew @ 156.25 SY/HR. Material pricing adjusted to $1.50/SY per vendor quotes.

Sheet Pile & Soil-Cement Mixing Columns:

- RS Mean's (Costbook) crew were utilized for installing the dual SSP wall and soil-cement mixed columns. Material pricing was updated per vendor quotes and production rates adjusted resulting in comparable cost to historical data and recent contractor quotes.
- Steel Sheet Pile Pricing was updated per contractor quotes for Southern California in May 2018 to include pricing for miscellaneous cap, connection bolts, and splice material. $28/SF assumed to account for SSP. SSP base on average of 2 Southern California vendor quotes (A690 PZ35 Skyline Steel 5/10/2018 and A690 PZC26 LB Foster 5/7/2018) mill rail and delivered approx. $27.25/SF. Doubles the SPL Design QTO (602,802 SF) for dual seismic wall TYP Section. Assumes 1.25 SSP pairs pressed per hour per crews
- For SSP driving, the Cost book crew labor and equipment were doubled and the production rate set at 1.25 SSP pairs pressed per hour to a depth of 60 FT. The A690 PZ35 width is 22.6 IN or 3.77 FT wide per pair. MII assumes 4.71 FT wide by 60 FT drive depth per hour. The GIKEN F401-1400 Silent Piler has a MIN press-in speed of 4.2 ft/MIN for 45.27-55.76 IN dual sheet pile width therefore approx. 226 SF/15 MIN or 904 SF per HR. The GIKEN was used on previous channel work for OCPW.
- SSP and SCM Column channel modification (and appurtenances like grouting, whales, and struts) production rates based on historical rates from OCPW. Crew Labor, equipment, and material added for approx. equipment type and hours for environmental and individual production rates based on engineering judgment and reasonableness to historical rates and cost overall. Pricing for soil cement mixing was estimated by the contractor that performed the work for the previous contract. The cost was broken out based on price per column and the resulting price per cubic yard equates similarly to what was developed in MII ($100-$110/CY). Based on OCPW Historical Cost from East Garden Grove - Wintersburg Channel Improvements Bid Abstract 8/22/2012, to include inspection/testing and escalation from 2012, the contractor's rates were comparable.
- SCM column production rates assume 4.5 augered columns per 4.75 LF of dual SSP wall @ 40 FT depth ~ 38 VFT/LF of dual SSP wall. Assumes 55 VFT of soil column auger mixed per hour per crew. Assumes 5% cement ratio to soil volume. Cement material assume 80% of the Binder Content @ $5/CF ($113/Metric Ton per 2017 Pricing Index and 94lb/CF) additional lime and bentonite assumed as 20% of binder volume. USED >> $4.50 per CF of binder material. Assumes 777 CF total volume auger mixed per hour or 55 VFT column per crew @ 5% approx. 42.4 CF/HR
- Soil-cement mixing column costs verified with OCPW Historical Cost from East Garden Grove - Wintersburg Channel Improvements Bid Abstract 8/22/2012 approx. $105/CY to include inspection/testing and escalation from 2012. Approx. 10 CY/LF of Dual SSP Wall per bid abstract (70,000 CY and 6,967 LF of SSP Wall). TYP SSP depth 60 FT per SPL Design QTO. Includes 10% additional material markup as part of SSP markup QTY. Estimated Contract Cost comparable to Historical Data. Includes mounted auger, binder material, and water feed while agitating soil-cement column mix
- Assumes 4 times the channel segment length for proposed SSP. Comparable to escalated historical cost from 2012 East-Garden Grove-Wintersburg Channel Improvement for Furnish and Installing SSP ($1,737/LF for 45 FT adjusted to $2,500/LF in 2018 dollars for 60 Ft). Includes furnishing material and installing with temp cantilevered support landside after driving. Channel embankment slope to be removed after soil-cement mixing and backfilled.

- Assumes 22.9 IN x 14 IN tall cap per As-Built C05-101-12 Tide gates to Warner Concrete Pile Cap Sheet 23. Unit pricing comparable to East Garden Grove-Wintersburg Channel Improvement 2012 Bid Abstract. Compared to mid ranged bids approx. 0.08 CY/LF or $41/LF for concrete (item #25 structural concrete approx. $500/CY) + approx. $100/LF (item #23 A615 reinforcing bar) 5 lb/SF for A955 stainless reinforcing steel (@ 2.23 SF/LF ~ 11.13 lb/LF ~ $55.66/LLF) = $141 escalated to present time approx. $150
- Assumed avg. 10.45 IN x 6.6 FT tall cladding per As-Built C05-101-12 Tide gates to Warner Concrete Pile Cap Sheet 23. Unit pricing comparable to East Garden Grove-Wintersburg Channel Improvement 2012 Bid Abstract. Approx. 0.21 CY/LF or $106/LF for concrete (item #25 structural concrete approx. $500/CY) + approx. 5 lb/SF for A955 stainless reinforcing steel (@ 5.75 SF/LF ~ 28.75 lb/LF x $5/lb ~ $143.75/LF) = $249.75 escalated to present time approx. $264.75/LF

Reinforced Steel:

- Rebar pricing per contractor quotes for Southern California in May 2018.
- Rectangular channel modification Unit Pricing of $1.02/lb comparable to escalated Historical Data ($0.99/lb, 3 Bid Abstract AVG)
- Trapezoidal concrete lined channels Unit Pricing comparable to escalated Historical Data (Rossmoor Storm Channel $2,4853/TON AVG for approx. 120 TON)
- Materials assume Steel Benchmark Pricing Steel Rebar cost of $0.48/lb which translates to approximately $960/ton (includes basic bend/cut fabrication)
- Installation crew includes 4 rodmen installing bar at 1 HR/TON and 14 ton crane and operator assumed for swinging bar into place 10% of rodmen's hours.

Concrete Volume:

- Concrete forming and placement crew based on RS Mean's (Costbook) crew with adjusted production rates. Although the Concrete Formwork crew is the same for the NED and LPP (3 carpenters and 1 laborer) the production rates vary for the trapezoidal and vertical walled channels. Trapezoidal sections assume 4 times the length of channel for overbank limits and inflection points at the channel toe. Additional formwork included laterally for construction joints (expansion joints, transition bulkheads) and for intermediate screed board placement. Assumes 32 SF/HR to cut, stake to elevation, kick to alignment, strip, clean, restack and relocate on site. The vertical walls assumes variable wall height with form work interior/exterior and both sides of channel for length of channel (4 times the channel length). Reduced production rate due to height of channel, gang forming, additional bracing, and working from wall scaffold 50 SF/HR.
- Concrete placement assumes concrete pumps, labor, and concrete finishers @ 15 MIN/8 CY and 45 MIN/8 CY for the rectangular channels and trapezoidal respectively.
- Material pricing based on $110/CY 4000 psi concrete per AVG 3 vendor quotes (A&A Redi-mix, National Cement, and Robertson's Ready Mix in Southern Cal, mid-2018). Material pricing was escalated to present value at time of report.

- Miscellaneous Concrete items not specifically included such as water stops, curing compound, chamfer strips, expansion material, joint filler/sealer, cement bonding slurry, drainage features, compaction, cement finishers, saw cuts were captured with a user item set @ $20/CY.
- Vertical wall FORMWORK and CONCRETE VOLUME combined into 1 CY unit price is comparable to Historical Data (Present Value of $323-$359/CY for 6,106 - 2,892 LF of channel respectively). Combining Trapezoidal FORMWORK and CONCRETE VOLUME into 1 CY unit price is comparable to Historical Data (2013 Rossmoor and 2011 Lewis Storm Channel Present Value of $440-483/CY for 2,543 - 1,135 LF of channel and 2,148 - 669 CY respectively). Operator and crane added to Reinforced Steel Installation @ 10% of the Rodmen crew duration.

Compacted Fill:

- Rectangular channel modification compacted fill comparable to Historical Bid Abstract pricing for unclassified fill. Escalated 3 abstract average unit price to approx. $42/CY. Assumes re-use of excavated channel material. Trapezoidal concrete lined channel modification compacted fill comparable to Historical Bid Abstract pricing for unclassified fill. Escalated 3 abstract average unit price to approx. $30/CY from approx. 400 - 3,200 CY. Assumes re-use of excavated channel material.
- Assumes Re-use of suitable excavation material for backfill. Use existing channel excavation material to build access road. There is initial access for track equipment through an old access road. Assumed compacted fill material already stockpiled in channel near areas where compaction needed. Backfill, structural, sand and gravel, 200 H.P. dozer, 150' haul, from existing stockpile. Compaction included as separate crew.
- Backfill crew includes loader, operator and laborer. Spreading and grading crew includes loader and operator, 2 laborers, and 250-300 HP dozer and operator. Compaction crew includes tandem drum roller and operator, water truck and driver, and additional laborer.
- Backfilling, grading, and compacting assumed @ 44 CY/HR. Cycle hauling (wait, load, travel, unload or dump & return) time per cycle, excavated or borrow, loose cubic yards, 10 min wait/load/unload, 8 C.Y. truck, cycle 6 miles, 30 MPH.

Diversion Channel at Westminster Mall:

Costs for the Diversion Channel were utilized from the A-E's construction cost estimate in 'Alternative 3 Design (C02/04 Channel) for Westminster East Garden Grove Flood Risk Management for the USACE Feasibility Study' Report prepared by Tetra Tech for Orange County Public Works dated July 2018. The report included a breakout of assumed quantities and construction costs for all of the proposed construction elements. The contingency applied in the report was removed, and the estimated construction costs were included in the LPP plan formulation costs associated with C04 R21 channel modifications with related contingencies from the CSRA. The A-E developed cost for the diversion and the cost of specific construction features were reviewed, updated with similar USACE parametric feature costs and channel modification crews, and verified with historical cost for consistency with the remaining channel modifications.

WBS 15 FLOODWAY CONTROL AND DIVERSION STRUCTURES

TIDE GATES REMOVAL:

Existing Tide Gates Removal and Replacement Structure estimate is based largely on the construction As-Builts (C05-101-1A_Tidelands to Beach) for existing conditions and the H&H RAS Model cross section for culvert properties as well as quantities.

Removal of structure is outlined in the Structural Appendix. The estimate is developed in the LPP & NED MII files under WBS 15 FLOODWAY CONTROL AND DIVERSION STRUCTURE sub folder TIDE GATE REMOVAL. The new structure is outlined in the C05 R01 CROSSINGS folder under WBS 08 ROADS, RAILROADS, AND BRIDGES. The same methodology was used as the other crossing structures. Folder Notes: Tide Gate Replacement Crossing 006+25.87 Major quantities from June 2019 Structural Appendix Figure 9. Estimated Quantities – Channel Outlet Structure Bridge Replacement 146 LF x 24.7 FT Three intermediate bridge pile bents are provided which consist of cast in place or driven precast/pre-stressed concrete piles supporting a cast-in-place bridge bent. The pile design is based on similar pile requirements at the oil field bridge just upstream of the bridge. Approximately 60 foot long piles are required for the pile bents. Scaled replacement crossing per TYP 40 C05 Edwards St Model. DEMO included as part of Tide Gate Removal 15 FLOODWAY CONTROL AND DIVERSION

Tide gate removal major construction feature costs include:

- Mobilization and demobilization cost methodology similar to the WBS 09. Assumes 5% of total project cost for MOB/DEMOB. Historical Data indicates 4.5-6% ($2M-$500K) of total contract costs between $10-50M. (Based on 2010 Westminster Channel, 2012 East Garden Grove-Wintersburg Channel, and 2014 Newland Storm Channel Improvements).
- Erosion Control assumes silt fencing and straw bale check dams installed with RS Means (Costbook) crews including 2 laborers and 1 operator with skid-steer and maintained by laborer ½ HR per duration of demo.
- A turbidity curtain was included in the estimate to isolate silt and sediment during marine construction. 450 FT of curtain wall. User crews were developed for installation, inspection, testing turbidity, and removal of the curtains. Crew makeup assumed a 19 FT utility boat, boatmen, tender, and 2 divers for installation. Material pricing based on Type III $2,260.06 per 100 FT 65 lb Anchor System $595.49 per 50 FT Triton Univ. Bulk Floating Tow Bridle $103.55 EA Reefing Line $6.10 per FT (5 x $2,260.06) + (10 x $595.46) + $103.55 + (500 x $6.10) = $20,408.45 or $40.82 per FT >> Assume $45/FT for additional seem and end point fasteners per Kirk Wands at GEI Works PH: 772-646-0597 FX: 772-589-3343 EM: Kwands@geiworks.com GEI Works Oct-02-2017 Sebastian, FL, 32958 Estimate #510538
- Dewatering included during excavation near the water line otherwise assumed cut/fill in the dry. RS Mean's crews and production rates were utilized for cofferdam construction and pumping during operations. Duration of demolition assumes 300 HR/8 HR/DAY = 25 DAYS for 2 pumps. SSP cofferdam assumes 200 piles @ 40 FT installed by 4 laborers, 1 carpenter and pile driving equipment @ 165 LF/HR. Operator and labor with 25 TON crane and 1.1 CY general purpose clamshell bucket included for clearing driveline.
- Survey crew included for pre/post construction grading. Crew includes chief surveyor, assistant surveyor and labor along with surveying equipment for approx. 20 hours

- Demolition and Removal Crews includes operator, laborer, 33,700 LB excavator and ½ ton pickup truck. Production rate of 8 CY/HR assumed for removal. Removal of structure assumes 2 dump trucks and drivers cycle hauling and disposing as follows: assume 2.5 HR/cycle load/haul/dispose/return, 10 LOADS @ 8 BCY/LOAD = 2.5HR/8 BCY or 0.3125 HR/BCY two trucks and drivers are included to increase production to 0.15625 HR/CY or 6.4 BCY/HR. 3 disposal facilities identified within 45 MIN drive each. 1-4 Ton/CY (concrete, steel, sheet metal, fencing, pvc) use 2 TON/CY. 6/22/2018 Quote from Information Processing Tech representing 3 Orange County landfill facilities (Frank R. Bowerman, Olinda, Prima Deshecha; POC: Randy @ 714.834.4000). $57.50/TON general waste and $62.50/TON for special handling construction debris longer than 6 FT or WWF/Rebar reinforced. Price increases July first of each year...assumed similar increase of 1% from previous year. USED >>$62.67/TON
- Earthwork and regrading included as part of restoration of embankment areas and shoreline. Imported sand assumed at fill @ $5.25/TON Sand FOB Aggregate Ind. $16.50 Haul, USED>> $22/TON. 2 Laborers, 1 operator, and front end loader assumed for placing initial fill @ 18.75 CY/HR. 1 operator, and ½ laborer along with 140 HP dozer assumed for rough grading 220 CY/HR. 1 operator, 1 laborer, and 1 215 HP articulated grader assumed for fine grading @ 437.5 SY/HR. Jute mesh fabric assumed for bank stabilization with crew makeup of 3 laborers and a flatbed truck installing @ 300 SY/HR.

O&M COSTS:

Annual O&M costs are based on the historical O&M average annual cost that was provided by Orange County Public Works for various channel types. Historical expenditures were compiled from a 10 year span (fiscal year 2008 through 2018). The cost data was used to determine the average cost per square foot of the proposed channel type and differentiated with the existing condition. The unit cost is based on cost per square foot for concrete, riprap, and earthen lined channel. The unit costs used are $0.0045, $0.035, and $0.0821/SF respectively. Channel surface areas were developed from the QTO and formulation alignments. A 35% contingency was applied to these costs to account for any other potential issues that come up in later design phases.

Refer to the attached O&M costs, provided by OCPW, for more detail.

3.0 Cost & Schedule Risk Analysis (Basis of Contingency)

This section of the appendix presents a preliminary risk analysis of the construction measures of the project. Cost risk analysis is the process of identifying and measuring the cost impact of project uncertainties. The calculated contingencies for each of the plans is applied to the estimated construction costs to determine a probable construction cost for further economic analysis.

The matrix approach utilized by USACE identifies seven major risk categories, each related to unique risks from design-contract solicitation-construction. These categories are more generic in nature and have been established over time through detailed study of the Monte Carlo style risk analyses performed throughout USACE on many and varied large projects. The following were considered for each of the measures:

- Project Scope Maturity and Potential Growth
- Acquisition Strategy
- Quantities of Current Scope
- Construction Elements
- Specialty Fabrication and Equipment
- Cost Estimate Assumptions
- External Project Risks

Refer to the attached Risk Register for risk specific details captured during the CSRA Workshop and presentation of the Risk Matrix.

4.0 Construction Schedule

Detailed project schedules were developed for the NED and LPP plans utilizing standard software and applying data from previously constructed reaches provided by OCPW as well as input from the project team for reasonableness.

The construction schedules reflects overall construction duration for various channel modifications based on historical production rate ranges provided by the local sponsor (OCPW). The estimated durations are based on modification type (concrete lined trapezoidal 57 LF/WK, rectangular concrete 75 LF/WK, and SSP 150 LF/WK) and applied to the overall channel reach lengths. The historical rates are assumed to include material lead times, assumed construction element specific productivities, work window limitations, etc. The historical production rates were applied to entire reaches or reach segments between crossings assumed as separable contract areas. Reach and reach segment alignment lengths were estimated from the QTO and verified in Google Earth with representative .kmz line files. The historical rates were tied to construction durations alone. Preliminary Engineering and Design, PED, and Advertising/Award were estimated separately and scheduled to follow a consistent methodology of 6 weeks, 40 weeks, and 26 weeks respectively per assumed contracted segment. Preliminary design was assumed to start 64 weeks before the finish date of the adjacent downstream section construction duration period. Construction phasing is assumed from the downstream most reaches working toward the upstream and concurrent activities between separate channel systems occur at the beginning for C05 lower Reach 1 and C02 lower Reach 23. C06 Reach 13 is assumed to start at the completion of C05 Reach 2 and at the same time as C05 Reach 3. C04 activities will follow the completion of C02 in the upstream direction. The Critical path for the LPP is along C05 between Reach 1 and upstream of Reach 9 the NED follows the same Critical path from Reach 1 to upstream of Reach 5.

The current estimated start and end dates (including preliminary design, PED, and Advertising/Award), at the *80% confidence level based on the CSRA, follow:

- LPP: January 2020 – March 2034 *February 2039
- NED: January 2020 – July 2031 *November 2033

The schedules were developed using standard industry-recognized scheduling software MS Project, depicting major milestones, concurrent and sequential activities, predecessors, successors, and durations within a developed calendar and a critical path identified. The NTP date is assumed as the construction start date. Overall the construction schedules for the NED and LPP reflect the construction estimates and timeframes used in the escalation/inflation calculations for the TPCS. The Construction schedules are attached for reference.

5.0 Attachments

5.1 LERRDS

From: Rohde, Michael B CIV USARMY CELRE (USA)
To: Gadbois, Jeremiah D CIV USARMY CELRC (USA)
Cc: Mishra, Rana S CIV USARMY CELRC (USA)
Subject: RE: Westminster LPP Real Estate Costs (UNCLASSIFIED)
Date: Thursday, October 31, 2019 4:36:17 PM

Jeremiah,
The costs below for NED and LPP are good to use.

Revised NED without C02 and C04 the staging area # is reduced to $1,102,000. So

NED-
Mitigation (Fee Simple) = $583,000
Staging Areas (Temporary Work Area Easements 2yrs) = $1,102,000
Channel Right of Way (Channel Improvement Easements) = -$0-
Warner Ave. Bridge Widening (Fee Simple) = $40,000
Total Lands and Easements: $1,725,000
Administrative Costs: $150,000
Contingency 10%: $187,500

Total NED LERRDs without C02 and C04 (01 Lands and Damages): $2,062,500

Mike Rohde

-----Original Message-----
From: Gadbois, Jeremiah D CIV USARMY CELRC (USA)
Sent: Wednesday, October 30, 2019 1:37 PM
To: Rohde, Michael B CIV USARMY CELRE (USA) <Michael.B.Rohde@usace.army.mil>
Cc: Mishra, Rana S CIV USARMY CELRC (USA) <Rana.S.Mishra@usace.army.mil>
Subject: RE: Westminster LPP Real Estate Costs (UNCLASSIFIED)

Hey Mike,

I'm hoping to re-cert on Monday the 4th, can you provide the NED (without C02/C04) and verify the previous NED (with C02/C04) and LPP LERRDs below?

Thanks,
Jeremiah

-----Original Message-----
From: Rohde, Michael B CIV USARMY CELRE (USA)
Sent: Friday, October 25, 2019 11:14 AM
To: Gadbois, Jeremiah D CIV USARMY CELRC (USA) <Jeremiah.D.Gadbois@usace.army.mil>
Subject: FW: Westminster LPP Real Estate Costs (UNCLASSIFIED)

Is this the latest you want me to respond to?

-----Original Message-----
From: Gadbois, Jeremiah D CIV USARMY CELRC (USA)
Sent: Friday, October 4, 2019 9:54 AM
To: Hoxsie, Alex R CIV USARMY CELRC (USA) <Alex.R.Hoxsie@usace.army.mil>; Rohde, Michael B CIV USARMY CELRE (USA) <Michael.B.Rohde@usace.army.mil>; Mishra, Rana S CIV USARMY CELRC (USA) <Rana.S.Mishra@usace.army.mil>
Cc: Padilla, Michael C CIV CELRC CELRD (USA) <Michael.C.Padilla@usace.army.mil>; Hallisy, Michael J CIV

USARMY CESPL (US) <Michael.J.Hallisy@usace.army.mil>; Davis, Susanne J CIV USARMY CELRC (USA) <Susanne.J.Davis@usace.army.mil>
Subject: RE: Westminster LPP Real Estate Costs (UNCLASSIFIED)

Mike,

These are the LERRDs I'm tracking for the LPP and NED (with C02/C04). Can you provide the NED (without C02/C04)?

LPP-
Mitigation (Fee Simple) = $583,000
Staging Areas (Temporary Work Area Easements 2yrs) = $1,595,000 Diversion Channel (Fee Simple) = $1,502,000 Channel Right of Way (Channel Improvement Easements) = -$0- Warner Ave. Bridge Widening (Fee Simple) = $40,000 Total Lands and Easements: $3,720,000 Administrative Costs: $150,000 Contingency 10%: $387,000

Total LPP LERRDs (01 Lands and Damages): $4,257,000

NED-
Mitigation (Fee Simple) = $583,000
Staging Areas (Temporary Work Area Easements 2yrs) = $1,595,000 Channel Right of Way (Channel Improvement Easements) = -$0- Warner Ave. Bridge Widening (Fee Simple) = $40,000 Total Lands and Easements: $2,218,000 Administrative Costs: $150,000 Contingency 10%: $237,000

Total NED LERRDs (01 Lands and Damages): $2,605,000

Thanks,
Jeremiah

-----Original Message-----
From: Hoxsie, Alex R CIV USARMY CELRC (USA)
Sent: Monday, September 30, 2019 8:05 AM
To: Gadbois, Jeremiah D CIV USARMY CELRC (USA) <Jeremiah.D.Gadbois@usace.army.mil>; Rohde, Michael B CIV USARMY CELRE (USA) <Michael.B.Rohde@usace.army.mil>; Mishra, Rana S CIV USARMY CELRC (USA) <Rana.S.Mishra@usace.army.mil>
Cc: Padilla, Michael C CIV CELRC CELRD (USA) <Michael.C.Padilla@usace.army.mil>; Hallisy, Michael J CIV USARMY CESPL (US) <Michael.J.Hallisy@usace.army.mil>; Davis, Susanne J CIV USARMY CELRC (USA) <Susanne.J.Davis@usace.army.mil>
Subject: RE: Westminster LPP Real Estate Costs (UNCLASSIFIED)

Minus ~$1,502,000 because the NED doesn't include the diversion channel even if C02/C04 are included.

Are we overlooking anything else that you can think of, Mike?

Cheers,

Alex Hoxsie
Planner/Landscape Architect
US Army Corps of Engineers, Chicago District
231 S. LaSalle Street, Suite 1500
Chicago, IL 60604-1437

Phone: (312) 846-5587
Cell: (312) 728-0719

CHICAGO USACE WEB SITE: http://www.lrc.usace.army.mil
FACEBOOK: http://www.facebook.com/usacechicago

-----Original Message-----
From: Gadbois, Jeremiah D CIV USARMY CELRC (USA)
Sent: Monday, September 30, 2019 7:59 AM
To: Hoxsie, Alex R CIV USARMY CELRC (USA) <Alex.R.Hoxsie@usace.army.mil>; Rohde, Michael B CIV USARMY CELRE (USA) <Michael.B.Rohde@usace.army.mil>; Mishra, Rana S CIV USARMY CELRC (USA) <Rana.S.Mishra@usace.army.mil>
Cc: Padilla, Michael C CIV CELRC CELRD (USA) <Michael.C.Padilla@usace.army.mil>; Hallisy, Michael J CIV USARMY CESPL (US) <Michael.J.Hallisy@usace.army.mil>; Davis, Susanne J CIV USARMY CELRC (USA) <Susanne.J.Davis@usace.army.mil>
Subject: RE: Westminster LPP Real Estate Costs (UNCLASSIFIED)

Good point, so essentially stays the same?

-----Original Message-----
From: Hoxsie, Alex R CIV USARMY CELRC (USA)
Sent: Monday, September 30, 2019 7:37 AM
To: Gadbois, Jeremiah D CIV USARMY CELRC (USA) <Jeremiah.D.Gadbois@usace.army.mil>; Rohde, Michael B CIV USARMY CELRE (USA) <Michael.B.Rohde@usace.army.mil>; Mishra, Rana S CIV USARMY CELRC (USA) <Rana.S.Mishra@usace.army.mil>
Cc: Padilla, Michael C CIV CELRC CELRD (USA) <Michael.C.Padilla@usace.army.mil>; Hallisy, Michael J CIV USARMY CESPL (US) <Michael.J.Hallisy@usace.army.mil>; Davis, Susanne J CIV USARMY CELRC (USA) <Susanne.J.Davis@usace.army.mil>
Subject: RE: Westminster LPP Real Estate Costs (UNCLASSIFIED)

I expect it would still differ due to the diversion channel in the LPP.

Cheers,

Alex Hoxsie
Planner/Landscape Architect
US Army Corps of Engineers, Chicago District
231 S. LaSalle Street, Suite 1500
Chicago, IL 60604-1437

Phone: (312) 846-5587
Cell: (312) 728-0719

CHICAGO USACE WEB SITE: http://www.lrc.usace.army.mil
FACEBOOK: http://www.facebook.com/usacechicago

-----Original Message-----
From: Gadbois, Jeremiah D CIV USARMY CELRC (USA)
Sent: Friday, September 27, 2019 12:32 PM
To: Rohde, Michael B CIV USARMY CELRE (USA) <Michael.B.Rohde@usace.army.mil>; Mishra, Rana S CIV USARMY CELRC (USA) <Rana.S.Mishra@usace.army.mil>
Cc: Hoxsie, Alex R CIV USARMY CELRC (USA) <Alex.R.Hoxsie@usace.army.mil>; Padilla, Michael C CIV CELRC CELRD (USA) <Michael.C.Padilla@usace.army.mil>; Hallisy, Michael J CIV USARMY CESPL (US) <Michael.J.Hallisy@usace.army.mil>; Davis, Susanne J CIV USARMY CELRC (USA) <Susanne.J.Davis@usace.army.mil>
Subject: RE: Westminster LPP Real Estate Costs (UNCLASSIFIED)

Mike,

Thanks for the RE cost!

One more question. If C02 & C04 are included in the NED, after re-modeling traffic, will the NED have the same cost as LPP?

NED (WITH C02/C04)-
Mitigation (Fee Simple) = $583,000
Staging Areas (Temporary Work Area Easements 2yrs) = $1,595,000 Diversion Channel (Fee Simple) = $1,502,000 Channel Right of Way (Channel Improvement Easements) = -$0- Warner Ave. Bridge Widening (Fee Simple) = $40,000 Total Lands and Easements: $3,720,000 Administrative Costs: $150,000 Contingency 10%: $387,000

Total NED (WITH C02/C04) LERRDs (01 Lands and Damages): $4,257,000

Jeremiah

-----Original Message-----
From: Rohde, Michael B CIV USARMY CELRE (USA)
Sent: Thursday, September 26, 2019 2:46 PM
To: Gadbois, Jeremiah D CIV USARMY CELRC (USA) <Jeremiah.D.Gadbois@usace.army.mil>; Mishra, Rana S CIV USARMY CELRC (USA) <Rana.S.Mishra@usace.army.mil>
Cc: Hoxsie, Alex R CIV USARMY CELRC (USA) <Alex.R.Hoxsie@usace.army.mil>; Padilla, Michael C CIV CELRC CELRD (USA) <Michael.C.Padilla@usace.army.mil>; Hallisy, Michael J CIV USARMY CESPL (US) <Michael.J.Hallisy@usace.army.mil>; Davis, Susanne J CIV USARMY CELRC (USA) <Susanne.J.Davis@usace.army.mil>
Subject: RE: Westminster LPP Real Estate Costs (UNCLASSIFIED)

Jeremiah,
1. Yes, go ahead and apply the 10% contingency to the Admin costs.
2. NED and LPP costs are summarized below:

LPP-
Mitigation (Fee Simple) = $583,000
Staging Areas (Temporary Work Area Easements 2yrs) = $1,595,000 Diversion Channel (Fee Simple) = $1,502,000 Channel Right of Way (Channel Improvement Easements) = -$0- Warner Ave. Bridge Widening (Fee Simple) = $40,000 Total Lands and Easements: $3,720,000 Administrative Costs: $150,000 Contingency 10%: $387,000

Total LPP LERRDs (01 Lands and Damages): $4,257,000

NED-
Mitigation (Fee Simple) = $583,000
Staging Areas (Temporary Work Area Easements 2yrs) = $1,595,000 Channel Right of Way (Channel Improvement Easements) = -$0- Warner Ave. Bridge Widening (Fee Simple) = $40,000 Total Lands and Easements: $2,218,000 Administrative Costs: $150,000 Contingency 10%: $237,000

Total NED LERRDs (01 Lands and Damages): $2,605,000

-----Original Message-----
From: Gadbois, Jeremiah D CIV USARMY CELRC (USA)
Sent: Thursday, September 26, 2019 8:37 AM
To: Rohde, Michael B CIV USARMY CELRE (USA) <Michael.B.Rohde@usace.army.mil>; Mishra, Rana S CIV USARMY CELRC (USA) <Rana.S.Mishra@usace.army.mil>

Cc: Hoxsie, Alex R CIV USARMY CELRC (USA) <Alex.R.Hoxsie@usace.army.mil>; Padilla, Michael C CIV CELRC CELRD (USA) <Michael.C.Padilla@usace.army.mil>; Hallisy, Michael J CIV USARMY CESPL (US) <Michael.J.Hallisy@usace.army.mil>; Davis, Susanne J CIV USARMY CELRC (USA) <Susanne.J.Davis@usace.army.mil>
Subject: RE: Westminster LPP Real Estate Costs (UNCLASSIFIED)

Mike R,

Please verify the following RE assumptions before I update the TPCS for NED & LPP and submit for Re-certification:

-NED & LPP LERRDs costs are the same totaling $4,257,000 each $3,870,000 (includes admin cost) as the estimated WBS 01 LANDS & DAMAGES input cost and 10% contingency ($387,000) for the LPP & NED plans. (or should I back into the $4,242,000 without admin cost contingency)

-I'm conservatively assuming mid-point of overall construction for escalating to the Lands & Damages Midpoint, considering staging areas throughout the entire system.

Thanks,
Jeremiah

-----Original Message-----
From: Rohde, Michael B CIV USARMY CELRE (USA)
Sent: Wednesday, September 25, 2019 5:38 PM
To: Mishra, Rana S CIV USARMY CELRC (USA) <Rana.S.Mishra@usace.army.mil>; Gadbois, Jeremiah D CIV USARMY CELRC (USA) <Jeremiah.D.Gadbois@usace.army.mil>
Cc: Hoxsie, Alex R CIV USARMY CELRC (USA) <Alex.R.Hoxsie@usace.army.mil>; Padilla, Michael C CIV CELRC CELRD (USA) <Michael.C.Padilla@usace.army.mil>; Hallisy, Michael J CIV USARMY CESPL (US) <Michael.J.Hallisy@usace.army.mil>; Davis, Susanne J CIV USARMY CELRC (USA) <Susanne.J.Davis@usace.army.mil>
Subject: RE: Westminster LPP Real Estate Costs (UNCLASSIFIED)

Tomorrow, or later tonight if I can finish it- we are moving forward on the basis that the NED mitigation acreage will be the same as the LPP, from a real estate standpoint, it seems easiest to do it that way.

-----Original Message-----
From: Mishra, Rana S CIV USARMY CELRC (USA)
Sent: Wednesday, September 25, 2019 10:50 AM
To: Rohde, Michael B CIV USARMY CELRE (USA) <Michael.B.Rohde@usace.army.mil>; Gadbois, Jeremiah D CIV USARMY CELRC (USA) <Jeremiah.D.Gadbois@usace.army.mil>
Cc: Hoxsie, Alex R CIV USARMY CELRC (USA) <Alex.R.Hoxsie@usace.army.mil>; Padilla, Michael C CIV CELRC CELRD (USA) <Michael.C.Padilla@usace.army.mil>; Hallisy, Michael J CIV USARMY CESPL (US) <Michael.J.Hallisy@usace.army.mil>; Davis, Susanne J CIV USARMY CELRC (USA) <Susanne.J.Davis@usace.army.mil>
Subject: RE: Westminster LPP Real Estate Costs (UNCLASSIFIED)

CLASSIFICATION: UNCLASSIFIED

Thanks Mike. What is timeframe to get the revised NED costs? We cannot certify without them and right now current schedule has us certifying this week (trying to).

Rana S. Mishra, P.E., CCE
Chief- Cost Engineering, Civil Design (CADD\GIS) and Specifications
---
U.S. Army Corps Engineers, Chicago District
231 S. LaSalle St, Suite 1500
Chicago, IL 60604
Phone: 312-846-5428

-----Original Message-----
From: Rohde, Michael B CIV USARMY CELRE (USA)
Sent: Monday, September 23, 2019 8:20 PM
To: Mishra, Rana S CIV USARMY CELRC (USA) <Rana.S.Mishra@usace.army.mil>; Gadbois, Jeremiah D CIV USARMY CELRC (USA) <Jeremiah.D.Gadbois@usace.army.mil>
Cc: Hoxsie, Alex R CIV USARMY CELRC (USA) <Alex.R.Hoxsie@usace.army.mil>; Padilla, Michael C CIV CELRC CELRD (USA) <Michael.C.Padilla@usace.army.mil>; Hallisy, Michael J CIV USARMY CESPL (US) <Michael.J.Hallisy@usace.army.mil>
Subject: Westminster LPP Real Estate Costs

Summary of LERRDs for Westminster LPP

Mitigation (Fee Simple) = $583,000
Staging Areas (Temporary Work Area Easements 2yrs) = $1,595,000 Diversion Channel (Fee Simple) = $1,502,000 Channel Right of Way (Channel Improvement Easements) = -$0- Warner Ave. Bridge Widening (Fee Simple) = $40,000 Total Lands and Easements: $3,720,000

Contingency 10%: $372,000
Administrative Costs: $150,000

Total LPP LERRDs (01 Lands and Damages): $4,242,000

Note: Real Estate cost estimates are prepared in accordance with RE PGL 31 and are not considered an appraisal product.

Michael B. Rohde
US Army Corps of Engineers, Chicago District Real Estate Specialist
231 S. LaSalle Street, Suite 1500
Chicago, IL 60604
PH: (312) 846-5576
Cell: (312) 259-3840
Michael.B.Rohde@usace.army.mil

CLASSIFICATION: UNCLASSIFIED

5.2 Mitigation

From:	Herleth-King, Shawna S CIV USARMY CELRC (US)
To:	Gadbois, Jeremiah D CIV USARMY CELRC (USA)
Cc:	Mishra, Rana S CIV USARMY CELRC (USA); Davis, Susanne J CIV USARMY CELRC (USA); Zylka, Jason J CIV (US)
Subject:	Westminster_FEAS_Final_Mitigation Costs.xlsx
Date:	Monday, September 23, 2019 10:48:48 AM
Attachments:	Westminster_FEAS_Final_Mitigation Costs.xlsx
Importance:	High

Hey Jeremiah,

Here are the updated costs unless Sue and Jason think we should have a discussion. The LPP would be the same as before. For the NED, I think we would just remove the eelgrass mitigation from the total cost. I realize we would have less of a mitigation requirement since we are not paving as much under the NED, but since our proposed mitigation site is the muted tidal pocket, we can't really parse anything out. It's either all or nothing when it comes to that site. Sue and Jason, let me know if you disagree.

I added a tab to the spreadsheet, though, for NED and just deleted the eelgrass row.

Thanks, Shawa

From: Herleth-King, Shawna S CIV USARMY CELRC (US)
To: Gadbois, Jeremiah D CIV USARMY CELRC (USA)
Cc: Mishra, Rana S CIV USARMY CELRC (USA); Davis, Susanne J CIV USARMY CELRC (USA); Zylka, Jason J CIV (US)
Subject: RE: Westminster_FEAS_Final_Mitigation Costs.xlsx
Date: Friday, September 27, 2019 12:28:44 PM

Yes. We'll be back to the same mitigation cost for both plans. If you need anything else just let me know.

Thanks,
Shawna

Shawna Herleth-King
LRD Regional Technical Specialist
US Army Corps of Engineers
231 South LaSalle Street, Suite 1500
Chicago, Illinois 60604
(312) 846-5407 Office
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FACEBOOK: http://www.facebook.com/usacechicago

-----Original Message-----
From: Gadbois, Jeremiah D CIV USARMY CELRC (USA)
Sent: Friday, September 27, 2019 12:26 PM
To: Herleth-King, Shawna S CIV USARMY CELRC (US) <Shawna.S.Herleth-King@usace.army.mil>
Cc: Mishra, Rana S CIV USARMY CELRC (USA) <Rana.S.Mishra@usace.army.mil>; Davis, Susanne J CIV USARMY CELRC (USA) <Susanne.J.Davis@usace.army.mil>; Zylka, Jason J CIV (US) <Jason.J.Zylka@usace.army.mil>
Subject: RE: Westminster_FEAS_Final_Mitigation Costs.xlsx

Shawna,

If C02 & C04 are back in the NED, as a result of re-modeling traffic, will the NED and LPP have the same mitigation cost?

Thanks,
Jeremiah

-----Original Message-----
From: Herleth-King, Shawna S CIV USARMY CELRC (US)
Sent: Monday, September 23, 2019 10:49 AM
To: Gadbois, Jeremiah D CIV USARMY CELRC (USA) <Jeremiah.D.Gadbois@usace.army.mil>
Cc: Mishra, Rana S CIV USARMY CELRC (USA) <Rana.S.Mishra@usace.army.mil>; Davis, Susanne J CIV USARMY CELRC (USA) <Susanne.J.Davis@usace.army.mil>; Zylka, Jason J CIV (US) <Jason.J.Zylka@usace.army.mil>
Subject: Westminster_FEAS_Final_Mitigation Costs.xlsx
Importance: High

Hey Jeremiah,

Here are the updated costs unless Sue and Jason think we should have a discussion. The LPP would be the same as before. For the NED, I think we would just remove the eelgrass mitigation from the total cost. I realize we would have less of a mitigation requirement since we are not paving as much under the NED, but since our proposed mitigation site is the muted tidal pocket, we can't really parse anything out. It's either all or nothing when it comes to that site. Sue and Jason, let me know if you disagree.

I added a tab to the spreadsheet, though, for NED and just deleted the eelgrass row.

Thanks, Shawa

Mitigation Measure	Associated Channel System	Estimated Size	Parametric Cost	Planting Costs*	Total	
Tern Islands						
Sand Addendum	Warner/C05	12,000	$42.35/CY	-	$508,200.00	
Grading		50	$26.93/CY	-	$1,346.50	
Muted Tidal Pocket						
Stop Log Structure	Warner/C05	20 LF	$65,000/LF	-	$1,300,000.00	
Large Culvert		300 LF	$2,725/LF	-	$817,500.00	
Grading & Soil Removal		20	$26.93/CY	-	$538.60	
	C02	4.08 acre	$90612.14/acre	$369,697.53	$369,697.53	
		Subtotal			**$2,997,282.63**	
		Adaptive Management (5 yrs @ $150,000/yr)			**$750,000.00**	
		Quantity Markup (20%)			**$749,456.53**	
		Monitoring and OMRR&R ($50K for 10yrs; $25K for 40 yrs)				**$1,500,000.00** NOT INLCUDED AS FIRST COST
		Total Cost			**$4,496,739.16**	

Construction Management, Planning, Engineering & Design (Combined)	25%	$1,124,184.79
Contingency	39%	$2,192,160.34
TOTAL MITIGATION COST (TODAY'S DOLLARS)		**$7,813,084.29**

.

	Channel System	Actual area plus 5 m buffer	Area with eelgrass ratio (2.4:1)	
eelgrass	C02	1.7	4.08	

5.3 QTO

WESTMINSTER FEASIBILITY QUANTITY CALCULATIONS

CHANNEL CO5-REACH 1-MINIMUM CHANNEL MODIFICATION

Number	Description	QUANTITY	Unit	QUANTITY	Unit
0001	DIVERSION OF WATER	1	LS		
0002	CLEAR SITE AND REMOVE OBSTRUCTIONS	1	LS		
0003	CONCRETE VOLUME	17,378	CY		
0004	RIPRAP REMOVAL (DISPOSAL)	0	CY	-	TN
0005	EXCAVATION	40,854	CY		
0006	COMPACTED FILL/Backfill (BASED ON STONE B	2,728	CY		
0007	REINFORCED STEEL	1,013	TON		
0010	OPERATION AND MAINTENANCE PER YEAR				
0011	STONE BEDDING	20,748	CY	31,122	TN
0012	EXCAVATION SPOILS	38,126	CY		

***DOES NOT INCLUDE MAX SSP AREA SOUTH OF WARNER**

CHANNEL CO5-REACH 2-MINIMUM CHANNEL MODIFICATION

Maintain Baseline Conditions

CHANNEL CO5-REACH 3-MINIMUM CHANNEL MODIFICATION

Item Numbe	Description	QUANTITY	Unit	QUANTITY	Unit
0001	DIVERSION OF WATER	1	LS		
0002	CLEAR SITE AND REMOVE OBSTRUCTIONS	1	LS		
0003	CONCRETE VOLUME	8,464	CY		
0004	RIPRAP REMOVAL (DISPOSAL)	20,868	CY	33,389	TN
0005	EXCAVATION	16	CY		
0006	COMPACTED FILL/Backfill (BASED ON STONE B	1,122	CY		
0007	REINFORCED STEEL	535	TON		
0010	OPERATION AND MAINTENANCE PER YEAR				
0011	STONE BEDDING	11,297	CY	16,946	TN
0012	EXCAVATION SPOILS	0	CY		

CHANNEL CO5-REACH 4-MINIMUM CHANNEL MODIFICATION

Item Number	Description	QUANTITY	Unit	QUANTITY	Unit
0001	DIVERSION OF WATER	1	LS		
0002	CLEAR SITE AND REMOVE OBSTRUCTIONS	1	LS		
0003	CONCRETE VOLUME	10,032	CY		
0004	RIPRAP REMOVAL (DISPOSAL)	24,899	CY	39,838	TN
0005	EXCAVATION	0	CY		
0006	COMPACTED FILL/Backfill (BASED ON STONE B	349	CY		

0007	REINFORCED STEEL	553	TON		
0010	OPERATION AND MAINTENANCE PER YEAR				
0011	STONE BEDDING	14,517	CY	21,776	TN
0012	EXCAVATION SPOILS	0	CY		

CHANNEL CO5-REACH 5-MINIMUM CHANNEL MODIFICATION

Item Number	Description	QUANTITY	Unit	QUANTITY	Unit
0001	DIVERSION OF WATER	1	LS		
0002	CLEAR SITE AND REMOVE OBSTRUCTIONS	1	LS		
0003	CONCRETE VOLUME	9,611	CY		
0004	RIPRAP REMOVAL (DISPOSAL)	24,148	CY	38,636	TN
0005	EXCAVATION	0	CY		
0006	COMPACTED FILL/Backfill (BASED ON STONE B	157	CY		
0007	REINFORCED STEEL	538	TON		
0010	OPERATION AND MAINTENANCE PER YEAR				
0011	STONE BEDDING	14,380	CY	21,570	TN
0012	EXCAVATION SPOILS	0	CY		

CHANNEL CO5-REACH 6 -MINIMUM CHANNEL MODIFICATION

Maintain Baseline Conditions

CHANNEL CO5-REACH 7 -MINIMUM CHANNEL MODIFICATION

Maintain Baseline Conditions

CHANNEL CO5-REACH 8 -MINIMUM CHANNEL MODIFICATION

Maintain Baseline Conditions

CHANNEL CO5-REACH 9 -MINIMUM CHANNEL MODIFICATION

Maintain Baseline Conditions

CHANNEL CO5-REACH 10-MINIMUM CHANNEL MODIFICATION

Maintain Baseline Conditions

CHANNEL CO5-REACH 11-MINIMUM CHANNEL MODIFICATION

Maintain Baseline Conditions

CHANNEL CO5-REACH 12-MINIMUM CHANNEL MODIFICATION

Maintain Baseline Conditions

WESTMINSTER FEASIBILITY QUANTITY CALCULATIONS

CHANNEL CO6-REACH 13-MINIMUM CHANNEL MODIFICATION

Maintain baseline conditions

Item Number	Description	QUANTITY	Unit
0001	DIVERSION OF WATER	1	LS
0002	CLEAR SITE AND REMOVE OBSTRUCTIONS	1	LS
0003	CONCRETE VOLUME	4,343	CY
0004	RIPRAP REMOVAL (DISPOSAL)	12,447	CY
0005	EXCAVATION	0	CY
0006	COMPACTED FILL	6,792	CY
0007	REINFORCED STEEL	278	TON
0010	OPERATION AND MAINTENANCE PER YEAR		$
0011	STONE BEDDING	1,312	CY
0012	EXCAVATION SPOILS	0	CY

CHANNEL CO6-REACH 14 -MINIMUM CHANNEL MODIFICATION

Maintain baseline conditions

CHANNEL CO6-REACH 15 -MINIMUM CHANNEL MODIFICATION

Maintain baseline conditions

CHANNEL CO6-REACH 16 -MINIMUM CHANNEL MODIFICATION

Maintain baseline conditions

CHANNEL CO6-REACH 17-MINIMUM CHANNEL MODIFICATION

Item Number	Description	QUANTITY	Unit	QUANTITY	Unit
0001	DIVERSION OF WATER	1	LS		
0002	CLEAR SITE AND REMOVE OBSTRUCTION	1	LS		
0003	CONCRETE VOLUME	2,624	CY		
0004	RIPRAP REMOVAL (DISPOSAL)	7,690	CY	12,303	TN
0005	EXCAVATION	0	CY		
0006	COMPACTED FILL/Backfill (BASED ON ST	4,055	CY		
0007	REINFORCED STEEL	161	TON		
0010	OPERATION AND MAINTENANCE PER YEAR		$		
0011	STONE BEDDING	1,010	CY	1,515	TN
0012	EXCAVATION SPOILS	0	CY		

CHANNEL CO6-REACH 18-MINIMUM CHANNEL MODIFICATION

Maintain baseline conditions

CHANNEL CO6-REACH 19-MINIMUM CHANNEL MODIFICATION

WESTMINSTER FEASIBILITY QUANTITY CALCULATIONS

CHANNEL CO4-REACH 20 -MINIMUM CHANNEL MODIFICATION

Item Number	Description	QUANTITY	Unit	QUANTITY	Unit
0001	DIVERSION OF WATER	1	LS		
0002	CLEAR SITE AND REMOVE OBSTRUCTION	1	LS		
0003	CONCRETE VOLUME	28,034	CY		
0004	RIPRAP REMOVAL (DISPOSAL)	23,428	CY	37,485	TN
0005	EXCAVATION	52,512	CY		
0006	COMPACTED FILL/Backfill (Based on Stone E	7,124	CY		
0007	REINFORCED STEEL	1,740	TON		
0010	OPERATION AND MAINTENANCE PER YEAR				
0011	STONE BEDDING	40,782	CY	61,173	TN
0012	EXCAVATION SPOILS	45,388	CY		

CHANNEL CO4-REACH 21 -MINIMUM CHANNEL MODIFICATION

Maintain Baseline Conditions

CHANNEL CO4-REACH 22 -MINIMUM CHANNEL MODIFICATION

Item Number	Description	QUANTITY	Unit	QUANTITY	Unit
0001	DIVERSION OF WATER	1	LS		
0002	CLEAR SITE AND REMOVE OBSTRUCTION	1	LS		
0003	CONCRETE VOLUME	4,531	CY		
0004	RIPRAP REMOVAL (DISPOSAL)	13,226	CY	21,161	TN
0005	EXCAVATION	0	CY		
0006	COMPACTED FILL/Backfill (Based on Stone E	0	CY		
0007	REINFORCED STEEL	264	TON		
0010	OPERATION AND MAINTENANCE PER YEAR				
0011	STONE BEDDING	9,822	CY	14,732	TN
0012	EXCAVATION SPOILS	0	CY		

CHANNEL CO2-REACH 23-MINIMUM CHANNEL MODIFICATION

Item Number	Description	QUANTITY	Unit
0001	DIVERSION OF WATER	1	LS
0002	CLEAR SITE AND REMOVE OBSTRUCTION	1	LS
0003	CONCRETE VOLUME	0	CY
0004	RIPRAP REMOVAL	0	CY
0005	EXCAVATION	0	CY
0006	COMPACTED FILL	0	CY
0007	CONCRETE REMOVAL	0	CY
0008	GRAVEL BASE REMOVAL	0	CY
0009	REINFORCED STEEL	0	TON
0010	OPERATION AND MAINTENANCE		
0011	SHEET PILE	320,786	SF
0014	EXCAVATION SPOILS	0	CY

WESTMINSTER FEASIBILITY QUANTITY CALCULATIONS
CHANNEL CO5-REACH 1-MAXIMUM CHANNEL MODIFICATION

Item Number	Description	QUANTITY	Unit	QUANTITY	Unit
0001	DIVERSION OF WATER	1	LS		
0002	CLEAR SITE AND REMOVE OBSTRUCTIONS	1	LS		
0003	CONCRETE VOLUME	29,200	CY		
0004	SHEET PILE REMOVAL	411,001	SF		
0005	EXCAVATION	342,755	CY		
0006	COMPACTED FILL	7,097	CY		
0007	CONCRETE REMOVAL	9,589	CY	15,343	TN
0008	GRAVEL BASE REMOVAL	0	CY	0	TN
0009	REINFORCED STEEL	1,698	TON		
0010	OPERATION AND MAINTENANCE (ANNUAL)				
0011	TEMPORARY SHORING	1	LS		
0012	SHEET PILE	1,096,003	SF		
0013	STONE BEDDING	74,025	CY	111,037	TN
0014	EXCAVATION SPOILS	335,657	CY		

CHANNEL CO5-REACH 2-MAXIMUM CHANNEL MODIFICATION

Item Number	Description	QUANTITY	Unit	QUANTITY	Unit
0001	DIVERSION OF WATER	1	LS		
0002	CLEAR SITE AND REMOVE OBSTRUCTIONS	1	LS		
0003	CONCRETE VOLUME	20,335	CY		
0004	RIPRAP REMOVAL	0	CY		
0005	EXCAVATION	54,953	CY		
0006	COMPACTED FILL	3,077	CY		
0007	CONCRETE REMOVAL	6,771	CY	10,834	TN
0008	GRAVEL BASE REMOVAL	2,009	CY	3,615	TN
0009	REINFORCED STEEL	1,280	TON		
0010	OPERATION AND MAINTENANCE (ANNUAL)				
0011	TEMPORARY SHORING	1	LS		
0013	STONE BEDDING	27,250	CY	40,875	TN
0014	EXCAVATION SPOILS	51,877	CY		

CHANNEL CO5-REACH 3-MAXIMUM CHANNEL MODIFICATION

Item Number	Description	QUANTITY	Unit	QUANTITY	Unit
0001	DIVERSION OF WATER	1	LS		
0002	CLEAR SITE AND REMOVE OBSTRUCTIONS	1	LS		
0003	CONCRETE VOLUME	26,584	CY		
0004	RIPRAP REMOVAL	23,888	CY		
0005	EXCAVATION	77,211	CY		
0006	COMPACTED FILL	7,087	CY		
0007	CONCRETE REMOVAL	4,922	CY	7,875	TN
0008	GRAVEL BASE REMOVAL	2,593	CY	4,668	TN
0009	REINFORCED STEEL	1,623	TON		
0010	OPERATION AND MAINTENANCE (ANNUAL)				
0011	TEMPORARY SHORING	1	LS		
0013	STONE BEDDING	37,572	CY	56,358	TN
0014	EXCAVATION SPOILS	70,123	CY		

CHANNEL CO5-REACH 4-MAXIMUM CHANNEL MODIFICATION

Item Number	Description	QUANTITY	Unit	QUANTITY	Unit
0001	DIVERSION OF WATER	1	LS		
0002	CLEAR SITE AND REMOVE OBSTRUCTIONS	1	LS		
0003	CONCRETE VOLUME	26,681	CY		
0004	RIPRAP REMOVAL	33,690	CY		
0005	EXCAVATION	106,029	CY		
0006	COMPACTED FILL	10,426	CY		
0007	CONCRETE REMOVAL	0	CY	-	TN
0008	GRAVEL BASE REMOVAL	0	CY	-	TN
0009	REINFORCED STEEL	1,811	TON		
0010	OPERATION AND MAINTENANCE (ANNUAL)				
0011	TEMPORARY SHORING	1	LS		
0013	STONE BEDDING	39,660	CY	59,491	TN
0014	EXCAVATION SPOILS	95,603	CY		

CHANNEL CO5-REACH 5-MAXIMUM CHANNEL MODIFICATION

Item Number	Description	QUANTITY	Unit	QUANTITY	Unit
0001	DIVERSION OF WATER	1	LS		
0002	CLEAR SITE AND REMOVE OBSTRUCTIONS	1	LS		
0003	CONCRETE VOLUME	29,576	CY		
0004	RIPRAP REMOVAL	33,439	CY		
0005	EXCAVATION	113,406	CY		
0006	COMPACTED FILL	10,284	CY		
0007	CONCRETE REMOVAL	1,613	CY	2,581	TN
0008	GRAVEL BASE REMOVAL	576	CY	1,036	TN
0009	REINFORCED STEEL	1,897	TON		
0010	OPERATION AND MAINTENANCE (ANNUAL)				
0011	TEMPORARY SHORING	1	LS		
0013	STONE BEDDING	45,032	CY	67,548	TN
0014	EXCAVATION SPOILS	103,122	CY		

CHANNEL CO5-REACH 6-MAXIMUM CHANNEL MODIFICATION

Item Number	Description	QUANTITY	Unit	QUANTITY	Unit
0001	DIVERSION OF WATER	1	LS		
0002	CLEAR SITE AND REMOVE OBSTRUCTIONS	1	LS		
0003	CONCRETE VOLUME	4,556	CY		
0004	RIPRAP REMOVAL	0	CY		
0005	EXCAVATION	6,943	CY		
0006	COMPACTED FILL	3,801	CY		
0007	CONCRETE REMOVAL	2,289	CY	3,662	TN
0008	GRAVEL BASE REMOVAL	869	CY	1,564	TN
0009	REINFORCED STEEL	274	TON		
0010	OPERATION AND MAINTENANCE (ANNUAL)				
0011	TEMPORARY SHORING	1	LS		
0013	STONE BEDDING	6,858	CY	10,287	TN
0014	EXCAVATION SPOILS	3,142	CY		

CHANNEL CO5-REACH 7-MAXIMUM CHANNEL MODIFICATION

Maintain Baseline Conditions

Item Number	Description	QUANTITY	Unit
0001	DIVERSION OF WATER	0	LS
0002	CLEAR SITE AND REMOVE OBSTRUCTIONS	0	LS
0003	CONCRETE VOLUME	0	CY
0004	RIPRAP REMOVAL	0	CY
0005	EXCAVATION	0	CY
0006	COMPACTED FILL	0	CY
0007	CONCRETE REMOVAL	0	CY
0008	GRAVEL BASE REMOVAL	0	CY
0009	REINFORCED STEEL	0	TON
0010	OPERATION AND MAINTENANCE (ANNUAL)		

CHANNEL CO5-REACH 8-MAXIMUM CHANNEL MODIFICATION

Item Number	Description	QUANTITY	Unit	QUANTITY	Unit
0001	DIVERSION OF WATER	1	LS		
0002	CLEAR SITE AND REMOVE OBSTRUCTIONS	1	LS		
0003	CONCRETE VOLUME	12,891	CY		
0004	RIPRAP REMOVAL	0	CY		
0005	EXCAVATION	23,165	CY		
0006	COMPACTED FILL	1,695	CY		
0007	CONCRETE REMOVAL	5,347	CY	8,555	TN
0008	GRAVEL BASE REMOVAL	1,167	CY	2,101	TN
0009	REINFORCED STEEL	783	TON		
0010	OPERATION AND MAINTENANCE (ANNUAL)				
0011	TEMPORARY SHORING	1	LS		
0013	STONE BEDDING	19548	CY	29,321	TN
0014	EXCAVATION SPOILS	21,471	CY		

CHANNEL CO5-REACH 9-MAXIMUM CHANNEL MODIFICATION

Item Number	Description	QUANTITY	Unit	QUANTITY	Unit
0001	DIVERSION OF WATER	1	LS		
0002	CLEAR SITE AND REMOVE OBSTRUCTIONS	1	LS		
0003	CONCRETE VOLUME	2,392	CY		
0004	RIPRAP REMOVAL	0	CY		
0005	EXCAVATION	14,184	CY		
0006	COMPACTED FILL	2,847	CY		
0007	CONCRETE REMOVAL	10,873	CY	17,397	TN
0008	GRAVEL BASE REMOVAL	1,240	CY	2,233	TN
0009	REINFORCED STEEL	139	TON		
0010	OPERATION AND MAINTENANCE (ANNUAL)				
0011	TEMPORARY SHORING	1	LS		
0013	STONE BEDDING	20,256	CY	30,385	TN
0014	EXCAVATION SPOILS	11,337	CY		

CHANNEL CO5-REACH 10-MAXIMUM CHANNEL MODIFICATION

Maintain Baseline Conditions

Item Number	Description	QUANTITY	Unit
0001	DIVERSION OF WATER	0	LS
0002	CLEAR SITE AND REMOVE OBSTRUCTIONS	0	LS
0003	CONCRETE VOLUME	0	CY
0004	RIPRAP REMOVAL	0	CY
0005	EXCAVATION	0	CY
0006	COMPACTED FILL	0	CY
0007	CONCRETE REMOVAL	0	CY
0008	GRAVEL BASE REMOVAL	0	CY
0009	REINFORCED STEEL	0	TON
0010	OPERATION AND MAINTENANCE (ANNUAL)		

CHANNEL CO5-REACH 11-MAXIMUM CHANNEL MODIFICATION

Maintain Baseline Conditions

Item Number	Description	QUANTITY	Unit
0001	DIVERSION OF WATER	0	LS
0002	CLEAR SITE AND REMOVE OBSTRUCTIONS	0	LS
0003	CONCRETE VOLUME	0	CY
0004	RIPRAP REMOVAL	0	CY
0005	EXCAVATION	0	CY
0006	COMPACTED FILL	0	CY
0007	CONCRETE REMOVAL	0	CY
0008	GRAVEL BASE REMOVAL	0	CY
0009	REINFORCED STEEL	0	TON
0010	OPERATION AND MAINTENANCE (ANNUAL)		

CHANNEL CO5-REACH 12-MAXIMUM CHANNEL MODIFICATION

Maintain Baseline Conditions

Item Number	Description	QUANTITY	Unit
0001	DIVERSION OF WATER	0	LS
0002	CLEAR SITE AND REMOVE OBSTRUCTIONS	0	LS
0003	CONCRETE VOLUME	0	0
0004	RIPRAP REMOVAL	0	0
0005	EXCAVATION	0	0
0006	COMPACTED FILL	0	0
0007	CONCRETE REMOVAL	0	CY
0008	GRAVEL BASE REMOVAL	0	CY
0009	REINFORCED STEEL	0	0
0010	OPERATION AND MAINTENANCE (ANNUAL)		

NOTE 1: CY refers to Bank Cubic Yard or Embankment Cubic Yard

NOTE 2: Clear site and remove obstruction wherever there are existing natural bottom need to be modified.

NOTE 3: These quantity calculations do not include crossings (bridges)

WESTMINSTER FEASIBILITY QUANTITY CALCULATION
CHANNEL CO6-REACH 13-MAXIMUM CHANNEL MODIFICATION

Item Number	Description	QUANTITY	Unit	QUANTITY	Unit
0001	DIVERSION OF WATER	1	LS		
0002	CLEAR SITE AND REMOVE OBSTRUCTIONS	1	LS		
0003	CONCRETE VOLUME	13,011	CY		
0004	RIPRAP REMOVAL	21,381	CY		
0005	EXCAVATION	27,776	CY		
0006	COMPACTED FILL	1,768	CY		
0007	CONCRETE REMOVAL	0	CY	-	TN
0008	GRAVEL BASE REMOVAL	0	CY	-	TN
0009	REINFORCED STEEL	792	TON		
0010	OPERATION AND MAINTENANCE (ANNUAL)				
0011	STONE BEDDING	16,968	CY	25,452	TN
0012	EXCAVATION SPOILS	26,008	CY		

CHANNEL CO6-REACH 14-MAXIMUM CHANNEL MODIFICATION

Item Number	Description	QUANTITY	Unit
0001	DIVERSION OF WATER	1	LS
0002	CLEAR SITE AND REMOVE OBSTRUCTIONS	1	LS
0003	CONCRETE VOLUME	384	CY
0004	RIPRAP REMOVAL	0	CY
0005	EXCAVATION	0	CY
0006	COMPACTED FILL	0	CY
0007	CONCRETE REMOVAL	325	CY
0008	GRAVEL BASE REMOVAL	126	CY
0009	REINFORCED STEEL	23	TON
0010	OPERATION AND MAINTENANCE (ANNUAL)		
0011	STONE BEDDING	628	CY
0012	TEMPORARY SHORING	1	LS
0013	EXCAVATION SPOILS	-	CY

CHANNEL CO6-REACH 15-MAXIMUM CHANNEL MODIFICATION

Item Number	Description	QUANTITY	Unit	QUANTITY	Unit
0001	DIVERSION OF WATER	0	LS		
0002	CLEAR SITE AND REMOVE OBSTRUCTIONS	0	LS		
0003	CONCRETE VOLUME	0	CY		
0004	RIPRAP REMOVAL	0	CY		
0005	EXCAVATION	0	CY		
0006	COMPACTED FILL	0	CY		
0007	CONCRETE REMOVAL	0	CY	-	TN
0008	GRAVEL BASE REMOVAL	0	CY	-	TN
0009	REINFORCED STEEL	0	TON		
0010	OPERATION AND MAINTENANCE (ANNUAL)				
0011	TEMPORARY SHORING	1	LS		
0012	STONE BEDDING	-	CY	-	TN
0013	EXCAVATION SPOILS	-	CY		

CHANNEL CO6-REACH 16-MAXIMUM CHANNEL MODIFICATION

Item Number	Description	QUANTITY	Unit	QUANTITY	Unit
0001	DIVERSION OF WATER	1	LS		
0002	CLEAR SITE AND REMOVE OBSTRUCTIONS	1	LS		
0003	CONCRETE VOLUME	4,882	CY		
0004	RIPRAP REMOVAL	0	CY		
0005	EXCAVATION	11,924	CY		
0006	COMPACTED FILL	0	CY		
0007	CONCRETE REMOVAL	3,143	CY	5,028	TN
0008	GRAVEL BASE REMOVAL	1,292	CY	2,325	TN
0009	REINFORCED STEEL	307	TON		
0010	OPERATION AND MAINTENANCE (ANNUAL)				
0011	TEMPORARY SHORING	1	LS		
0013	STONE BEDDING	7,210	CY	10,815	TN
0014	EXCAVATION SPOILS	11,924	CY		

CHANNEL CO6-REACH 17-MAXIMUM CHANNEL MODIFICATION

Item Number	Description	QUANTITY	Unit	QUANTITY	Unit
0001	DIVERSION OF WATER	1	LS		
0002	CLEAR SITE AND REMOVE OBSTRUCTIONS	1	LS		
0003	CONCRETE VOLUME	8,113	CY		
0004	RIPRAP REMOVAL	9,947	CY		
0005	EXCAVATION	20,812	CY		
0006	COMPACTED FILL	0	CY		
0007	CONCRETE REMOVAL	0	CY	-	TN
0008	GRAVEL BASE REMOVAL	0	CY	-	TN
0009	REINFORCED STEEL	504	TON		
0010	OPERATION AND MAINTENANCE (ANNUAL)				
0013	STONE BEDDING	13,111	CY	19,667	TN
0014	EXCAVATION SPOILS	20,812	CY		

CHANNEL CO6-REACH 18-MAXIMUM CHANNEL MODIFICATION

Item Number	Description	QUANTITY	Unit	QUANTITY	Unit
0001	DIVERSION OF WATER	0	LS		
0002	CLEAR SITE AND REMOVE OBSTRUCTIONS	0	LS		
0003	CONCRETE VOLUME	0	0		
0004	RIPRAP REMOVAL	0	0		
0005	EXCAVATION	0	0		
0006	COMPACTED FILL	0	0		
0007	CONCRETE REMOVAL	0	0	-	TN
0008	GRAVEL BASE REMOVAL	0	0	-	TN
0009	REINFORCED STEEL	0	0		
0010	OPERATION AND MAINTENANCE (ANNUAL)				
0013	STONE BEDDING	-	CY	-	TN
0014	EXCAVATION SPOILS	-	CY		

CHANNEL CO6-REACH 19-MAXIMUM CHANNEL MODIFICATION

Item Number	Description	QUANTITY	Unit	QUANTITY	Unit
0001	DIVERSION OF WATER	1	LS		
0002	CLEAR SITE AND REMOVE OBSTRUCTIONS	1	LS		
0003	CONCRETE VOLUME	4,529	CY		
0004	RIPRAP REMOVAL	8,332	CY		
0005	EXCAVATION	3,828	CY		
0006	COMPACTED FILL	0	CY		
0007	CONCRETE REMOVAL	0	CY	-	TN
0008	GRAVEL BASE REMOVAL	0	CY	-	TN
0009	REINFORCED STEEL	283	TON		
0010	OPERATION AND MAINTENANCE (ANNUAL)				
0013	STONE BEDDING	8,259	CY	12,388	TN
0014	EXCAVATION SPOILS	3,828	CY		

NOTE 1: CY refers to Bank Cubic Yard or Embankment Cubic Yard

NOTE 2: These quantity calc. do not include crossings (bridges)

WESTMINSTER FEASIBILITY QUANTITY CALCULATIONS
CHANNEL CO4-REACH 20-MAXIMUM CHANNEL MODIFICATION

Item Number	Description	QUANTITY	Unit	QUANTITY	Unit
0001	DIVERSION OF WATER	1	LS		
0002	CLEAR SITE AND REMOVE OBSTRUCTIONS	1	LS		
0003	CONCRETE VOLUME	67,545	CY	ACOUNTS FOR DIVERSI	
0004	RIPRAP REMOVAL	24,534	CY		
0005	EXCAVATION	283,912	CY		
0006	COMPACTED FILL	26,915	CY		
0007	CONCRETE REMOVAL	0	CY	-	TN
0008	GRAVEL BASE REMOVAL	0	CY	-	TN
0009	REINFORCED STEEL	3,442	TON		
0010	OPERATION AND MAINTENANCE				
0011	TEMPORARY SHORING	1	LS		
0013	STONE BEDDING	104,683	CY	**157,025**	TN
0014	EXCAVATION SPOILS	256,997	CY		

CHANNEL CO4-REACH 21-MAXIMUM CHANNEL MODIFICATION

Item Number	Description	QUANTITY	Unit	QUANTITY	Unit
0001	DIVERSION OF WATER	1	LS		
0002	CLEAR SITE AND REMOVE OBSTRUCTIONS	1	LS		
0003	CONCRETE VOLUME	8,309	CY	ACOUNTS FOR DIVERSI	
0004	RIPRAP REMOVAL	0	CY		
0005	EXCAVATION	13,973	CY		
0006	COMPACTED FILL	0	CY		
0007	CONCRETE REMOVAL	6,143	CY	**9,829**	TN
0008	GRAVEL BASE REMOVAL	3,435	CY	**6,184**	TN
0009	REINFORCED STEEL	654	TON		
0010	OPERATION AND MAINTENANCE				
0011	TEMPORARY SHORING	1	LS		
0013	STONE BEDDING	12,653	CY	**18,979**	TN
0014	EXCAVATION SPOILS	13,973	CY		

CHANNEL CO4-REACH 22-MAXIMUM CHANNEL MODIFICATION

Item Number	Description	QUANTITY	Unit	QUANTITY	Unit
0001	DIVERSION OF WATER	1	LS		
0002	CLEAR SITE AND REMOVE OBSTRUCTIONS	1	LS		
0003	CONCRETE VOLUME	37,679	CY		
0004	RIPRAP REMOVAL	17,094	CY		
0005	EXCAVATION	98,569	CY		
0006	COMPACTED FILL	14,207	CY		
0007	CONCRETE REMOVAL	15,078	CY	**24,126**	**TN**
0008	GRAVEL BASE REMOVAL	6,035	CY	**10,864**	**TN**
0009	REINFORCED STEEL	2,080	TON		
0010	OPERATION AND MAINTENANCE				
0011	TEMPORARY SHORING	1	LS		
0013	STONE BEDDING	58,436	CY	**87,655**	**TN**
0014	EXCAVATION SPOILS	84,362	CY		

CHANNEL CO2-REACH 23-MAXIMUM CHANNEL MODIFICATION

Item Number	Description	QUANTITY	Unit
0001	DIVERSION OF WATER	1	LS
0002	CLEAR SITE AND REMOVE OBSTRUCTIONS	1	LS
0003	CONCRETE VOLUME	0	CY
0004	RIPRAP REMOVAL	0	CY
0005	EXCAVATION	116,839	CY
0006	COMPACTED FILL	0	CY
0007	CONCRETE REMOVAL	0	CY
0008	GRAVEL BASE REMOVAL	0	CY
0009	REINFORCED STEEL	0	TON
0010	OPERATION AND MAINTENANCE		
0011	SHEET PILE	534,643	SF
0014	EXCAVATION SPOILS	116,839	CY

NOTE 1: CY refers to Bank Cubic Yard or Embankment Cubic Yard

NOTE 2: Clear site and remove obstruction wherever there are existing natural bottom need to be modified.

NOTE 3: These quantity calculations do not include crossings (bridges)

5.4 OCPW O&M Costs

ORANGE COUNTY PublicWorks

Project Title: Westminster Watershed Feasibility Study
Description: Annual Channel Maintenance Cost Estimate
Summary of Actual Annual O&M Costs FY 07/08 - 17/18

	Channel Type		
	Concrete	**Riprap**	**Earthen**
County-Wide Average Annual O&M Cost	$ 3,083,801	$ 1,513,355	$ 1,864,415
County-Wide Sq. Footage	687,472,439	43,250,191	22,707,968
County-Wide Average Cost (per sq. ft.)	$ 0.0045	$ 0.0350	$ 0.0821
Percentage within Westminster Watershed	6.8%	1.1%	37.8%
Estimated Annual O&M Cost	$ 210,000	$ 17,000	$ 705,000
Estimated LPP Annual Benefit	-	$ (15,000)	$ (666,000)

Methodology

Step 1: Pull all O&M channel maintenance activities and associated cost for the past 10 fiscal years (07/08 - 17/18)
- FY 09/10 and 10/11 excluded from study due to pilot years of in-house management of Maintenance Management System (as opposed to consultants)
- Channel maintenance activities filtered from all O&M Activities (Referred to as Activity No.)

Step 2: Categorize O&M activities per channel material type (Concrete, Riprap, Earthen)

Step 3: Average planned O&M activities costs and actual O&M activities costs
- This average provides the Total Average Annual Channel Maintenance Cost per channel type (Pages 2-4 of this package)

Step 4: Delineate Channel Types County-Wide, as well as within the Westminster Watershed
- Dimension data used to calculate square footage of each channel type

Step 5: Apply area ratio of County-Wide channel maintenance to Westminster Watershed channel maintenance to average annual cost per square foot per channel type

Step 6: Calculate Locally Preferred Plan (LPP) Benefit (Conversion of riprap and earthen channels to concrete channels) using the difference between "County-Wide Average Cost (per sq. ft.)" per channel material type

ORANGE COUNTY PublicWorks

Project Title: Westminster Watershed Feasibility Study
Description: Annual Channel Maintenance Cost Estimate
Concrete Channels

Job Code Number:
Page:
Date: 1/4/2018

				FY																	
				07/08		08/09		11/12		13/14		14/15		15/16		16/17		17/18		Annual Average	
				Plan	Actual	Plan	Actual	Plan	Actual	Plan	Actual	Plan	Actual	Plan	Actual	Plan	Actual	Plan	Actual	Plan	Actual
Activity No.	**Activity Description**	**Channel Type**	**Unit**	**Total Cost**	**Total Cost**	**Total Cost**	**Total Cost**	**Total Cost**	**Total Cost**	**Total Cost**	**Total Cost**	**Total Cost**	**Total Cost**	**Total Cost**	**Total Cost**	**Total Cost**	**Total Cost**	**Total Cost**	**Total Cost**	**Total Cost**	**Total Cost**
108	CONCRETE LINING REMOVE/REPLA	Concrete	SF	$134,969	$378,626	$168,306	$294,916	$38,148	$124,918	$77,848	$109,051	$89,661	$7,418	$79,152	$58,589	$102,903	$305,118	$251,563	$165,920	$117,819	$180,569
109	MISC. CONCRETE/BRICK CONST	Concrete	Labor HR	$370,440	$356,220	$476,424	$233,648	$252,428	$531,004	$329,868	$198,914	$312,039	$112,179	$256,568	$171,513	$282,555	$178,282	$288,383	$260,808	$321,088	$255,321
119	DEBRIS BOOM MAINTENANCE	All	Quantity	$0	$0	$0	$0	$0	$0	$0	$0	$0	$16,734	$0	$0	$0	$20,015	$0	$9,367	$0	$5,764
122	CONC CHNL SILT RMLV - LOADER	Concrete	CY	$114,912	$79,051	$117,504	$2,781	$46,173	$107,184	$40,983	$658,268	$36,134	$4,369,253	$73,680	$10,342,561	$90,640	$264,652	$82,912	$548,387	$75,367	$2,046,517
123	CONC CHNL SILT RMLV - BOBCAT	Concrete	CY	$254,467	$151,580	$244,750	$56,815	$0	$0	$67,080	$166,917	$80,086	$242,276	$81,464	$63,606	$86,250	$130,546	$89,055	$129,483	$112,894	$117,653
141	GRADE SERVICE ROADS	All	MI	$73,078	$71,838	$273,958	$78,468	$123,016	$113,702	$103,218	$111,630	$101,962	$64,404	$103,218	$15,053	$108,501	$32,075	$80,809	$40,715	$120,970	$65,986
302	MAINTENANCE SUPERVISION	All	Labor HR	$366,944	$429,375	$412,515	$411,266	$448,911	$400,294	$485,210	$195,554	$501,470	$320,657	$501,470	$515,151	$562,722	$512,371	$578,246	$511,254	$482,186	$411,990
			Total	$1,314,810	$1,466,690	$1,693,456	$1,077,895	$908,675	$1,277,102	$1,104,208	$1,440,334	$1,121,352	$5,132,920	$1,095,552	$11,166,472	$1,233,571	$1,443,059	$1,370,967	$1,665,933	$1,230,324	$3,083,801

Total Sq. Ft Concrete Channel =	687,472,439
Planned Cost per Sq. Ft. =	$0.0018
Actual Cost per Sq. Ft. =	$0.0045

ORANGE COUNTY PublicWorks

Project Title: Westminster Watershed Feasibility Study
Description: Annual Channel Maintenance Cost Estimate
Riprap Channels

Job Code Number:
Page:
Date: 1/4/2018

				FY																	
				07/08		08/09		11/12		13/14		14/15		15/16		16/17		17/18		Annual Average	
				Plan	Actual	Plan	Actual	Plan	Actual	Plan	Actual	Plan	Actual	Plan	Actual	Plan	Actual	Plan	Actual	Plan	Actual
Activity No.	**Activity Description**	**Channel Type**	**Unit**	**Total Cost**	**Total Cost**	**Total Cost**	**Total Cost**	**Total Cost**	**Total Cost**	**Total Cost**	**Total Cost**	**Total Cost**	**Total Cost**	**Total Cost**	**Total Cost**	**Total Cost**	**Total Cost**	**Total Cost**	**Total Cost**	**Total Cost**	**Total Cost**
119	DEBRIS BOOM MAINTENANCE	All	Quantity	$0	$0	$0	$0	$0	$0	$0	$0	$0	$16,734	$0	$0	$0	$20,015	$0	$9,367	$0	$5,764
126	SLOPE PREP FOR RIP RAP	Rip Rap	CY	$59,359	$169,142	$60,564	$523,236	$157,165	$582,881	$172,131	$510,731	$188,125	$114,816	$175,267	$65,157	$94,599	$301,194	$98,932	$443,672	$125,768	$338,854
127	INSTALL RIP RAP	Rip Rap	TONS	$113,484	$191,002	$114,919	$870,692	$399,528	$1,119,657	$408,295	$1,786,871	$420,298	$376,023	$169,168	$104,334	$90,832	$537,181	$677,427	$540,326	$299,244	$690,761
141	GRADE SERVICE ROADS	All	MI	$73,078	$71,838	$273,958	$78,468	$123,016	$113,702	$103,218	$111,630	$101,962	$64,404	$103,218	$15,053	$108,501	$32,075	$80,809	$40,715	$120,970	$65,986
302	MAINTENANCE SUPERVISION	All	Labor HR	$366,944	$429,375	$412,515	$411,266	$448,911	$400,294	$485,210	$195,554	$501,470	$320,657	$501,470	$515,151	$562,722	$512,371	$578,246	$511,254	$482,186	$411,990
			Total	$612,864	$861,357	$861,956	$1,883,663	$1,128,619	$2,216,534	$1,168,855	$2,604,786	$1,211,855	$892,634	$949,123	$699,695	$856,654	$1,402,837	$1,435,414	$1,545,333	$1,028,167	$1,513,355

Total Sq. Ft Riprap Channel =	43250191
Planned Cost per Sq. Ft. =	$0.0238
Actual Cost per Sq. Ft. =	$0.0350

ORANGE COUNTY PublicWorks

Project Title: Westminster Watershed Feasibility Study
Description: Annual Channel Maintenance Cost Estimate
Earthen Channels

Job Code Number:
Page:
Date: 1/4/2018

				FY																	
				07/08		08/09		11/12		13/14		14/15		15/16		16/17		17/18		Annual Average	
				Plan	Actual	Plan	Actual	Plan	Actual	Plan	Actual	Plan	Actual	Plan	Actual	Plan	Actual	Plan	Actual	Plan	Actual
Activity No.	**Activity Description**	**Channel Type**	**Unit**	**Total Cost**	**Total Cost**	**Total Cost**	**Total Cost**	**Total Cost**	**Total Cost**	**Total Cost**	**Total Cost**	**Total Cost**	**Total Cost**	**Total Cost**	**Total Cost**	**Total Cost**	**Total Cost**	**Total Cost**	**Total Cost**	**Total Cost**	**Total Cost**
119	DEBRIS BOOM MAINTENANCE	All	Quantity	$0	$0	$0	$0	$0	$0	$0	$0	$0	$16,734	$0	$0	$0	$20,015	$0	$9,367	$0	$5,764
124	DIRT CHNLSILT REMVL/DAYLIGHT	Earthen	CY	$58,546	$1,409,945	$111,996	$172,776	$383,874	$606,695	$383,874	$244,011	$354,946	$1,179,340	$254,240	$2,154,577	$284,060	$128,807	$168,050	$252,522	$249,948	$768,584
125	COMPACT CHANNEL SLOPE	Earthen	K SF	$33,204	$12,828	$33,704	$30,830	$32,244	$39,201	$29,205	$0	$10,377	$0	$10,620	$69,685	$11,430	$1,974	$12,731	$2,001	$21,689	$19,565
141	GRADE SERVICE ROADS	All	MI	$73,078	$71,838	$273,958	$78,468	$123,016	$113,702	$103,218	$111,630	$101,962	$64,404	$103,218	$15,053	$108,501	$32,075	$80,809	$40,715	$120,970	$65,986
144	AB MAINTAIN LEVEE	Earthen	CY	$199,135	$605,522	$239,044	$372,242	$192,413	$518,029	$190,951	$752,987	$336,105	$514,120	$338,310	$291,964	$418,509	$332,681	$440,134	$46,217	$294,325	$429,220
161	EARTHEN SLOPE REPAIR	Earthen	SF	$0	$0	$0	$0	$0	$0	$0	$0	$230,560	$96,748	$79,800	$69,740	$166,200	$706,962	$256,000	$432,988	$91,570	$163,305
302	MAINTENANCE SUPERVISION	All	Labor HR	$366,944	$429,375	$412,515	$411,266	$448,911	$400,294	$485,210	$195,554	$501,470	$320,657	$501,470	$515,151	$562,722	$512,371	$578,246	$511,254	$482,186	$411,990
			Total	$730,907	$2,529,508	$1,071,216	$1,065,582	$1,180,458	$1,677,922	$1,192,459	$1,304,182	$1,535,420	$2,192,002	$1,287,658	$3,116,171	$1,551,422	$1,734,886	$1,535,970	$1,295,063	$1,260,689	$1,864,415

Total Sq. Ft Earthen Channel =	22707968
Planned Cost per Sq. Ft. =	$0.0555
Actual Cost per Sq. Ft. =	$0.0821

	DATE	6/27/2019				
FY19	EARTH	O&M U/P	$0.0939	per SF-YR		USER DEFINED
FY19	CONC	O&M U/P	$0.0050	per SF-YR		
FY19	RIPRAP	O&M U/P	$0.0400	per SF-YR		
		Contingency	35%			

CHANNEL	REACH	EX COND	EX SF	EX O&M	MIN COND	MIN SF	MIN O&M	MIN DELTA
C05	1	EARTH	610,802	$ 57,354	CONC	610,802	$ 4,123	$ (53,231)
C05	3	RIPRAP	312,706	$ 12,508	CONC	312,706	$ 2,111	$ (10,397)
C05	4	RIPRAP	370,780	$ 14,831	CONC	370,780	$ 2,503	$ (12,328)
C05	5	RIPRAP	359,497	$ 14,380	CONC	359,497	$ 2,427	$ (11,953)
C06	13	RIPRAP	212,586	$ 8,503	CONC	212,586	$ 1,435	$ (7,068)
C06	17	RIPRAP	126,846	$ 5,074	CONC	126,846	$ 856	$ (4,218)
C06	19	RIPRAP	91,755	$ 3,670	CONC	91,755	$ 619	$ (3,051)
C04	20	EARTH	971,957	$ 91,267			$ -	$ (91,267)
C04	20	RIPRAP	268,079	$ 10,723	CONC	1,240,036	$ 8,370	$ (2,353)
C04	22	EARTH	49,641	$ 4,661			$ -	$ (4,661)
C04	22	RIPRAP	165,260	$ 6,610	CONC	214,900	$ 1,451	$ (5,160)

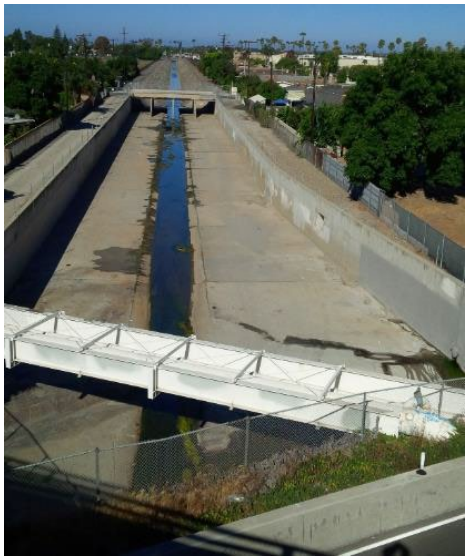
	DATE	6/27/2019				
FY19	EARTH	O&M U/P	$0.0939	per SF-YR		USER DEFINED
FY19	CONC	O&M U/P	$0.0050	per SF-YR		
FY19	RIPRAP	O&M U/P	$0.0400	per SF-YR		

CHANNEL	REACH	EX COND	EX SF	EX O&M	MAX COND	MAX SF	MAX O&M	MAX DELTA	
C05	1	EARTH	1,216,665	$ 114,245	EARTH	1,517,895	$ 192,416	$ 78,171	
C05	1			$ -	CONC	304,186	$ 2,053	$ 2,053	including steel sheet pile in "concrete"
C05	2	EARTH	278,422	$ 26,144			$ -	$ (26,144)	
C05	2	CONC	115,965	$ 580	CONC	437,504	$ 2,953	$ 2,373	
C05	3	RIPRAP	271,961	$ 10,878	CONC	489,660	$ 3,305	$ (7,573)	
C05	3	CONC	112,623	$ 563			$ -	$ (563)	
C05	4	RIPRAP	369,537	$ 14,781	CONC	488,915	$ 3,300	$ (11,481)	
C05	5	RIPRAP	359,497	$ 14,380			$ -	$ (14,380)	
C05	5	CONC	56,449	$ 282	CONC	541,805	$ 3,657	$ 3,375	
C05	6	CONC	79,564	$ 398	CONC	84,123	$ 568	$ 170	
C05	8	CONC	196,840	$ 984	CONC	237,482	$ 1,603	$ 619	
C05	9	CONC	187,345	$ 937	CONC	203,446	$ 1,373	$ 437	
C06	13	RIPRAP	240,268	$ 9,611	CONC	263,722	$ 1,780	$ (7,831)	
C06	14	CONC	7,116	$ 36	CONC	7,116	$ 48	$ 12	
C06	16	CONC	68,948	$ 345	CONC	90,849	$ 613	$ 268	
C06	17	CONC	126,846	$ 634	CONC	157,642	$ 1,064	$ 430	
C06	19	RIPRAP	82,544	$ 3,302			$ -	$ (3,302)	
C06	19	EARTH	9,211	$ 865	CONC	86,235	$ 582	$ (283)	
C04	20	EARTH	911,362	$ 85,577	EARTH	649,611	$ 82,348	$ (3,229)	
C04	20	RIPRAP	305,574	$ 12,223			$ -	$ (12,223)	
C04	20	CONC	8,704	$ 44	CONC	690,235	$ 4,659	$ 4,616	
C04	21	CONC	330,254	$ 1,651	CONC	382,472	$ 2,582	$ 930	
C04	22	CONC	383,818	$ 1,919	CONC	793,433	$ 5,356	$ 3,437	
C04	22	EARTH	224,774	$ 21,106	EARTH	188,569	$ 23,904	$ 2,798	
C04	22	RIPRAP	166,305	$ 6,652			$ -	$ (6,652)	
C02	23	EARTH	2,743,314	$ 257,597	EARTH	2,422,021	$ 307,028	$ 49,430	
C02	23			$ -	CONC	298,333	$ 2,014	$ 2,014	including steel sheet pile in "concrete"

5.5 CSRA

US Army Corps
of Engineers®

Westminster East Garden Grove Feasibility Study
Cost and Schedule Risk Report



Prepared by:

Chicago District USACE

25 November 2019
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LPP & NED Risk Registers and Risk Models..... APPENDIX A

EXECUTIVE SUMMARY

This report presents a recommendation for the project cost and schedule contingencies for the Westminster East Garden Grove Feasibility Study. A formal risk analysis study was conducted for the development of contingency on the construction contract cost. The purpose of this risk analysis study was to identify risks and to establish project contingencies by identifying and measuring the cost and schedule impact of project uncertainties with respect to the estimated Construction Contract.

The project is currently assumed as a Firm Fixed Price Design Bid Build Construction Contract (FFPDBB) with multi-phase solicitation. The baseline schedule from NTP to substantial completion of construction is estimated at 170 months for the Locally Preferred Plan (LPP) and 139 months for the National Economic Development plan (NED).

The Cost and Schedule Risk Analysis (CSRA) resulted in a Cost/Schedule contingency value at 80% confidence of 39/35% for the LPP and 30/21% for the NED respectively.

The PDT is working to mitigate risks identified in the study.

The key risk drivers identified through study of the LPP and NED Cost/Risk Model and sensitivity analysis are:

> Contract Acquisition Strategy will play a significant role in the overall cost of the project. As the Prime Contractor performs increasingly more of the work the markup layers diminish and overall contract cost decreases. Contracting will perform a market analysis as the project progresses towards solicitation. Maintaining fully competitive contracts will typically draw more contractor interest keeping cost competitive as well.
>
> The Construction Schedule can be impacted by contractor's performance and various external conditions. As the schedule is delayed or extended the pricing will typically increase due to inflation.
>
> The Engineering and Design as well as Construction Administration assumptions may overstate the actual costs by applying a historical percentage used on projects of smaller magnitude. Therefore the dollar volume is expected to be a smaller percentage of the total project cost.
>
> Smaller contract sizes may impact cost due to limiting job site and overall quantities. Additional contracts may require alternative contractors, additional mobilization and demobilization of equipment and less fluidity between channel reaches delaying the project completion schedule and adding cost.
>
> Utility conflicts are a risk primarily to the schedule as coordination with other agencies and utility members can be time consuming.

Presence of Endangered Species may limit construction activities, equipment selection, and the overall construction operating windows for specific reaches.

The methodology for modeling the crossing costs system wide may over/under state actual conditions at each specific crossing. With approximately 45 crossings total in the LPP, six representative crossings were estimated in detail and scaled up or down with site specific criteria for the remaining crossing classified in one of the six groups. The model was calibrated with historical data for reasonableness though the risk remains within each crossings uniqueness.

Recommendations, as detailed within the main report, include the implementation of further investigations and the development of mitigation plans to reduce cost and schedule contingencies, the further iterative study of risks throughout the project life-cycle, development of potential mitigation strategies throughout the remaining construction, and proactive monitoring and control of risk identified in this study.

MAIN REPORT

1.0 PURPOSE

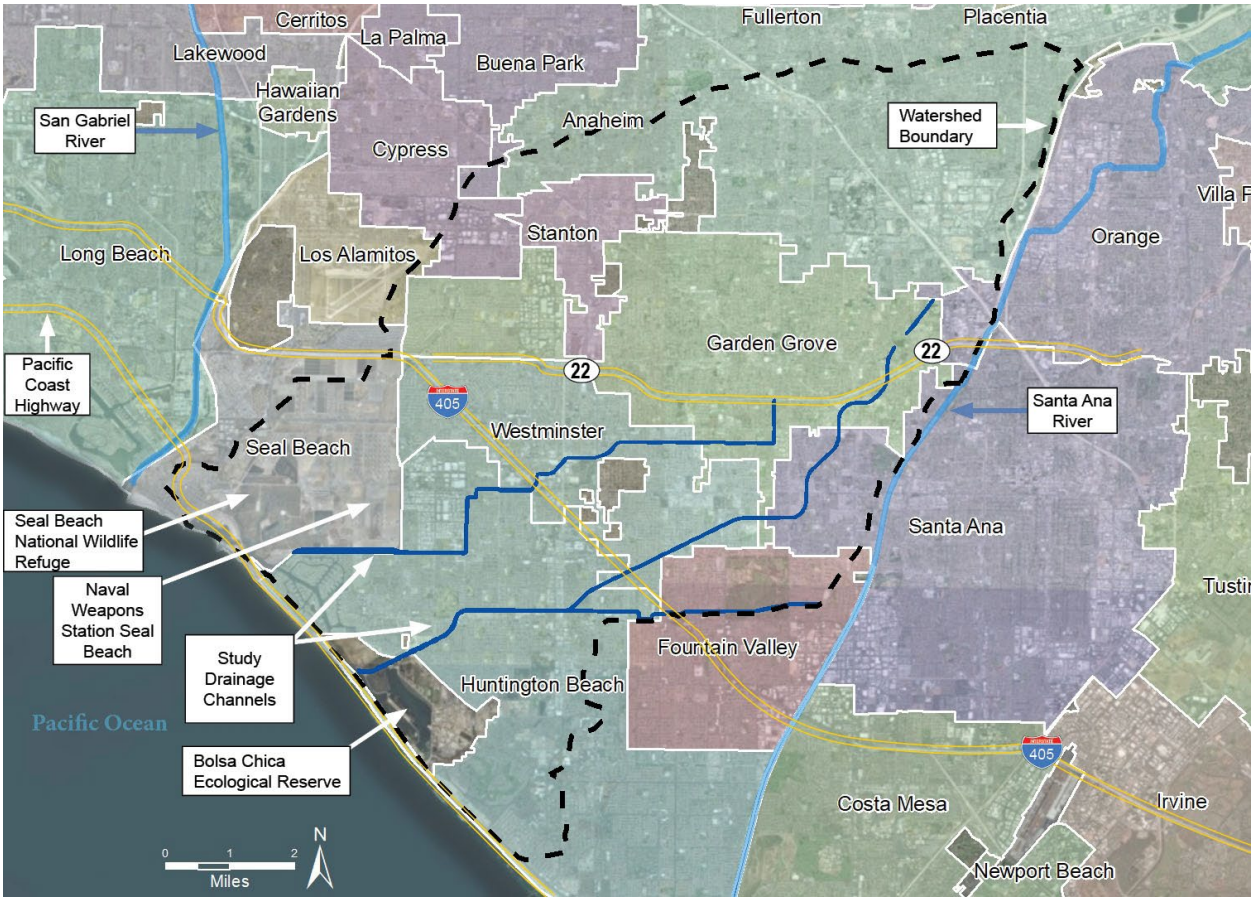
This report presents a recommendation for the project cost and schedule contingencies for the Westminster East Garden Grove Feasibility Study.

2.0 BACKGROUND

The study area is located within the Westminster watershed in western Orange County, California, approximately 25 miles southeast of the City of Los Angeles. The watershed is approximately 87 square miles in area and is almost entirely urbanized. Cities in the watershed include Anaheim, Stanton, Cypress, Garden Grove, Westminster, Fountain Valley, Los Alamitos, Seal Beach, and Huntington Beach. Preliminary analysis shows that flooding overtops the existing drainage channel infrastructure in the study area between the 20% and 10% annual chance of exceedance storm events (5 and 10 year recurrence intervals, respectively), putting approximately 400,000 area residents and 44,000 structures at risk of inundation. Study analyses were focused on modifications to the existing channels that include: C02 Bolsa Chica Channel; C04 Westminster Channel; C05 East Garden Grove-Wintersburg Channel; and the C06 Ocean View Channel.

The Minimum Channel Modifications Plan is the TSP. It reduces flood risk by lining the existing drainage channels with concrete, thus increasing conveyance efficiency. The Maximum Channel Modifications Plan has been identified as the LPP. It reduces flood risk by altering the geometry of existing drainage channels to increase conveyance efficiency and storage capacity. Both of these plans include additional downstream measures to address the impacts of increased flood flow conveyance resulting from the channel modifications. The downstream measures include increasing the span of Warner Avenue Bridge, replacing the tide gates on C05, and constructing a floodwall along Pacific Coast Highway at Outer Bolsa Bay. Compatible nonstructural measures were also included in the TSP to lessen the life safety risk associated with flooding in the project area. Each plan will require mitigation to address the loss of habitat.

Figure 1. Proposed Construction Site



3.0 REPORT SCOPE

The scope of this report is to calculate cost estimate contingencies using the risk analysis process, as developed by USACE. The report presents the results as a comparison of project cost, including contingencies and escalation. The study and presentation excludes consideration for operation and maintenance or life cycle costs.

3.1 Project Scope

The process included a risk analysis meeting with the Product Delivery Team (PDT) for risk identification and the development of the risk register. The analysis process evaluated the base case cost estimate and schedule, identified potential risks then quantified and modeled them using Crystal Ball software in Monte Carlo simulation per the guidance in Engineer Technical Letter (ETL) CONSTRUCTION COST ESTIMATING GUIDE FOR CIVIL WORKS, dated September 30, 2008.

The current construction cost estimate and project construction schedule serve as the basis for the risk analysis.

3.2 USACE Risk Analysis Process

The risk analysis process for this study follows the USACE Headquarters requirements as well as the guidance provided by the Cost Engineering MCX. The risk analysis process reflected within this report uses probabilistic cost and schedule risk analysis methods within the framework of the Crystal Ball software. Furthermore, the scope of the report includes the identification and communication of important steps, logic, key assumptions, limitations, and decisions to help ensure that risk analysis results can be appropriately interpreted.

Risk analysis results are also 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 the project progresses through planning and implementation. To fully recognize its benefits, cost and schedule risk analysis should be considered as an ongoing process conducted concurrent to, 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 broadly defined risk analysis standards and recommended practices, this risk analysis was performed to meet the requirements and recommendations of the following documents and sources:

- Cost and Schedule Risk Analysis Process guidance prepared by the USACE Civil Works Cost Engineering MCX.
- Engineer Regulation (ER) 1110-2-1302 CIVIL WORKS COST ENGINEERING, dated 30 June 2016.
- Engineer Technical Letter (ETL) CONSTRUCTION COST ESTIMATING GUIDE FOR CIVIL WORKS, dated September 30, 2008.

4.0 METHODOLOGY / PROCESS

The Cost Engineering MCX provided a PDT member to develop the risk model, also relying on the Project Manager and PDT staff to further augment expertise and information gathering.

A CSRA workshop, held July 17, 2019, was implemented to capture input and discussion by key local sponsor members as well as the PDT. The CSRA focused on the critical highly problematic issues with the project as well as lessons learned from previous channel construction projects in Orange County, CA. It is recommended that a follow on risk management approach with updates to the risk register and CSRA be conducted as the project moves forward.

The risk analysis process used is intended to determine the probability of various cost outcomes and quantify the required contingency needed in the cost estimate to achieve any desired level of cost confidence. A parallel process was also used to determine the probability of various project schedule duration outcomes and quantify the required schedule contingency (float) needed in the schedule to achieve any desired level of schedule confidence.

In simple terms, contingency is an amount added to an estimate (cost or schedule) 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 being incurred or additional time being required. The amount of contingency included in project control plans depends, at least in part, on the project leadership's willingness to accept 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 MCX guidance for cost and schedule risk analysis generally focuses on the eighty-percent level of confidence (P80) for cost contingency calculation. The P80 confidence level is the standard normally provided to Congress by USACE and other agencies to establish funding at project approval.

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 (Crystal Ball) that is an add-in to Microsoft Excel. The cost estimates were developed in MCACES and provided in a live file format, and information was extracted into Microsoft Excel for cost risk analysis purposes.
The primary steps, in functional terms, of the risk analysis process are described in the following subsections. Risk analysis results are provided in Section 6.

4.1 Identify and Assess Risk Factors

Risk factors are events and conditions that may influence or drive uncertainty in 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 risk factor identification. However, key risk factors are often unique to a project and not readily derivable from historical information. Therefore, input from the entire PDT was obtained using 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 and was considered.

The team met the week of 17-19 July 2019 for the purposes of completing the identification and assessment of risk factors for the CSRA. The meeting included numerous members of the Product Delivery Team and key members of the Orange County Public Works (OCPW) staff.
The risk meeting focused primarily on risk factor identification using brainstorming techniques, the meeting also included risk factor assessment and quantification.

The following is the list of invited members, and indication of those in HALF or FULL time attendance for the risk meeting:

Cost and Schedule Risk Analysis			**Westminster, East Garden Grove, CA Flood Risk Management Study**
Risk Facilitator	Jeremiah Gadbois	CELRC	

Risk Register Meeting

Date: 7/17/2019

Attendance	Name	Office	Representing
FULL	Alex Hoxsie	CELRC	Lead Planner
	Casey Pittman	CELRC	Environmental
HALF	COL Aaron Risinger	CELRC	Chicago District
FULL	David Force	CELRC	Structural
	Dena Abou-El-Seoud	CELRC	Economics
	Eric Sampson	CELRC	Structural
FULL	George Chartouni	CELRC	Cost RTS
FULL	Jason Zylka	CELRC	Environmental Planning
	Joel Schmidt	CELRC	H&H
FULL	Joel Schulenberg	CELRC	Geotech

	John Wethington	CELRC	Planning
FULL	Justin Golliher	OCPW	Traffic & Design
FULL	Richard Patricelli	OCPW	Traffic & Design
	Kelly Granberg	CELRC	Environmental
	Kevin Jerbi	CELRC	OC
FULL	Mark Cooke	CELRC	Cost
	Michael Hallisy	CESPL	Lead Econ (Chief)
HALF	Michael Rohde	CELRC	Real Estate
FULL	Mike Padilla	CELRC	PM
FULL	Rana Mishra	CELRC	Civil Lead
FULL	Shawna Herleth-King	CELRC	Planning Biologist
FULL	Sue Davis	CELRC	Planning Chief
FULL	Toshio Warren	CELRC	Project Management
FULL	Jennifer Miller	CELRC	Environmental (HTRW)

4.2 Quantify Risk Factor Impacts

The quantitative impacts of risk factors on the project were analyzed using a combination of professional judgment, empirical data and analytical techniques. Risk factor impacts were quantified using probability distributions (density functions).

Similar to the identification and assessment process, risk factor quantification involved multiple project team disciplines and functions. However, the quantification process relied more extensively on collaboration between cost engineering and risk analysis team members with lesser inputs from other functions and disciplines. This process used 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 was captured within a risk register as presented in Section 6 for. Note that the risk register records the PDT's risk concerns, discussions related to those concerns and potential impacts to the current cost and or schedule estimates.

4.3 Analyze Cost Estimate and Schedule Contingency

Contingency was analyzed using the Crystal Ball software as an add-in to the Microsoft Excel format of the cost estimate and schedule. *Monte Carlo* simulations were performed by applying the risk factors (quantified as probability density functions) to the appropriate estimated cost and schedule elements identified by the PDT. Cost variances were calculated by estimating the risks probable effects to the construction cost estimate. Contingencies were calculated by applying probability of cost variance, and by risk of occurrence. Each resultant risk is summed to determine the total cost risk for the project. The contingency is calculated as the difference between the sum of the risks and the base cost estimate.

For schedule contingency analysis, the potential delays for moderate and high impact schedule risks that are on the projects critical path are modeled with the same likelihood of occurrences for the cost risk. The resultant schedule effect is entered into the crystal ball model as the potential schedule variance. The sum of the models schedule variances models is the resultant schedule risk. The contingency for schedule is calculated as the difference between the sum of the risks and the base cost estimate. Any resultant cost risk due to the schedule risk is calculated and added to the cost risk. This schedule risk analysis is somewhat limited in that it does not use a Program Evaluation and Review Techniques (PERT) to calculate the overall duration but instead relies on judgment with regard to the overall effect of each risk on the critical path of the schedule.

5.0 KEY ASSUMPTIONS

Key assumptions are those that are most likely to affect significantly the determinations and/or estimates of risk presented in the risk analysis. The key assumptions are important to help ensure that project leadership and other decision makers understand the steps, logic, limitations, and decisions made in the risk analysis, as well as any resultant limitations on the use of outcomes and results.

The Cost Engineering Team has identified the following key assumptions for the risk analysis:

1. Level of Design: The cost comparisons and risk analyses performed and reflected within this report are based upon generally low detailed design scope.

2. Design Scope: Channel and crossing modifications design based largely on the existing channel As-builts with emphasis on the more recently completed reaches.

3. Operation and Maintenance: Operation and maintenance cost and activities for the facility were not included in the cost estimate or schedule. Therefore, a full lifecycle cost risk analysis was not performed. (The customer does have some requests for design restrictions/requirements that will lower long term O&M costs.) It is assumed that incorporation of operation and maintenance activities in the risk analysis would not result in significantly different conclusions for the construction acquisition.

4. Confidence Levels: The Cost Engineering MCX guidance generally focuses on the eighty-percent level of confidence (P80) for cost contingency calculation. For this risk analysis, the eighty-percent level of confidence (P80) was used. It should be noted that the use of P80 as a decision criteria is a risk adverse approach, generally resulting in higher cost contingencies. However, the P80 level of confidence also assumes a small degree of risk that the recommended contingencies may be inadequate to completely capture actual project costs. As the project matures lower confidence levels may be appropriate for reporting purposes.

5. Impacts Studied: Moderate and High impacts, as identified in the risk meeting and entered into the risk register, were considered for the purposes of calculating cost contingency. Moderate and high level risk impacts were only applied to critical path and near critical path schedule tasks for the purposes of calculating schedule contingency. Low and moderate level risk impacts may need further study and should be maintained in project management documentation, and reviewed at each project milestone to determine if they should be placed on the risk “watch list” for further monitoring and evaluation. Omissions and or errors identified in the base case estimate and schedule were added in the analysis with the estimated correction value modeled as the “Most Likely” cost.

6.0 RESULTS

The cost and schedule risk analysis results are provided in the following sections. In addition to contingency calculation results, sensitivity analyses are presented to provide decision makers with an understanding of variability and the key contributors to the cause of this variability.

6.1 Risk Register

A risk register is a tool commonly used in project planning and risk analysis. The risk register reflects the results of risk factor identification and assessment, risk factor quantification, and contingency analysis. The actual risk register is provided in Appendix A. The risk registers in include all identified risks, as well as additional information regarding the specific nature and impacts of each risk. Table 2 includes a

draft risk summary and mitigation recommendations for consideration in reducing project cost and schedule risk.

It is important to note that a risk register can be an effective tool for managing identified risks throughout the project lifecycle. 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:

- 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 risk analysis feedback and project control input.
- Identifying risk transfer, elimination or mitigation actions required for implementation of risk management plans.

The specific risk register for this project is included in appendix A.

6.2 Cost Contingency and Sensitivity Analysis

The resultant cost and schedule contingency value is calculated and overall percentage is calculated based on the base case estimate of construction cost. Intuitively each item could have more or less risk than other items however, by carrying the risk as an overall percentage of cost allows risk sharing across the overall project and allows flexibility in the management of the overall project contingency.

Table 1 provides the LPP followed by the NED construction cost contingencies calculated for the P80 confidence level.

Table 1. LPP Construction Contract Estimate Cost Contingency Summary

	CWWBS	Feature of Work	Contract Cost	% Contingency	$ Contingency	Total
	Risk Not included within CSRA Model					
	01 LANDS AND DAMAGES	Real Estate	$ 3,870,000	10%	$ 387,000	$ 4,257,000
	Risk included within CSRA Model					
1	02 03 CEMETERIES, UTILITIES, AND STRUCTURES, Constru	**Channel & Crossing Utilities**	$ 15,506,577	39%	$ 6,047,565	$ 21,554,142
2	06 FISH AND WILDLIFE FACILITIES	**Wetland Mitigation**	$ 4,496,739	39%	$ 1,753,728	$ 6,250,467
3	08 ROADS, RAILROADS, AND BRIDGES	**Channel Crossings**	$ 197,985,109	39%	$ 77,214,193	$ 275,199,302
4	09 01 CHANNELS	**Channel Modifications**	$ 482,184,076	39%	$ 188,051,790	$ 670,235,866
5	15 FLOODWAY CONTROL AND DIVERSION STRUCTURES	**Tide Gate Removal**	$ 2,181,764	39%	$ 850,888	$ 3,032,652
6			$ -	0%	$ -	$ -
7			$ -	0%	$ -	$ -
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**	$ 119,400,225	39%	$ 46,566,088	$ 165,966,313
24	31 CONSTRUCTION MANAGEMENT	**Construction Management**	$ 56,188,341	39%	$ 21,913,453	$ 78,101,794
XX	FIXED DOLLAR RISK ADD (EQUALLY DISPERSED TO ALL, MUST INCLUDE JUSTIFICATION SEE BELOW)				$ -	

Totals				
Real Estate	$ 3,870,000	10%	$ 387,000	$ 4,257,000.00
Total Construction Estimate	$ 702,354,265	39%	$ 273,918,163	$ 976,272,428
Total Planning, Engineering & Design	$ 119,400,225	39%	$ 46,566,088	$ 165,966,313
Total Construction Management	$ 56,188,341	39%	$ 21,913,454	$ 78,101,795
Fixed Dollar Risk Equally Distributed	$ -	0%	$ -	$ -
Total	$ 881,812,831	39%	$ 342,784,705	$ 1,224,597,536

Table 2. NED Construction Contract Estimate Cost Contingency Summary

	CWWBS	Feature of Work	Contract Cost	% Contingency	$ Contingency	Total
	Risk Not included within CSRA Model					
	01 LANDS AND DAMAGES	Real Estate	$ 2,368,000	10%	$ 236,800	$ 2,604,800
	Risk included within CSRA Model					
1	02 03 CEMETERIES, UTILITIES, AND STRUCTURES, Constru	**Channel & Crossing Utilities**	$ 2,304,383	30%	$ 691,315	$ 2,995,698
2	06 FISH AND WILDLIFE FACILITIES	**Wetland Mitigation**	$ 4,496,739	30%	$ 1,349,022	$ 5,845,761
3	08 ROADS, RAILROADS, AND BRIDGES	**Channel Crossings**	$ 37,398,433	30%	$ 11,219,530	$ 48,617,963
4	09 01 CHANNELS	**Channel Modifications**	$ 236,126,502	30%	$ 70,837,950	$ 306,964,452
5	15 FLOODWAY CONTROL AND DIVERSION STRUCTURES	**Tide Gate Removal**	$ 2,181,764	30%	$ 654,529	$ 2,836,293
6			$ -	0%	$ -	$ -
7			$ -	0%	$ -	$ -
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**	$ 48,026,329	30%	$ 14,407,899	$ 62,434,228
24	31 CONSTRUCTION MANAGEMENT	**Construction Management**	$ 22,600,626	30%	$ 6,780,188	$ 29,380,814
XX	FIXED DOLLAR RISK ADD (EQUALLY DISPERSED TO ALL, MUST INCLUDE JUSTIFICATION SEE BELOW)				$ -	

Totals				
Real Estate	$ 2,368,000	10%	$ 236,800	$ 2,604,800.00
Total Construction Estimate	$ 282,507,820	30%	$ 84,752,346	$ 367,260,166
Total Planning, Engineering & Design	$ 48,026,329	30%	$ 14,407,899	$ 62,434,228
Total Construction Management	$ 22,600,626	30%	$ 6,780,188	$ 29,380,814
Fixed Dollar Risk Equally Distributed	$ -	0%	$ -	$ -
Total	**$ 355,502,775**	**30%**	**$ 106,177,233**	**$ 461,680,008**

Table 3. LPP Contingency per Confidence Level

INITIAL CONSTRUCTION

Contingency Analysis

Base Case Estimate (Excluding 01)	$702,354,265	
Confidence Level	**Contingency Value**	**Contingency**
0%	-154,517,938	-22%
10%	28,094,171	4%
20%	63,211,884	9%
30%	84,282,512	12%
40%	112,376,682	16%
50%	140,470,853	20%
60%	175,588,566	25%
70%	224,753,365	32%
80%	273,918,163	39%
90%	358,200,675	51%
100%	604,024,668	86%

Table 4. NED Contingency per Confidence Level

INITIAL CONSTRUCTION
Contingency Analysis

Base Case Estimate (Excluding 01)	$282,507,820	
Confidence Level	**Contingency Value**	**Contingency**
0%	-93,227,581	-33%
10%	-14,125,391	-5%
20%	11,300,313	4%
30%	25,425,704	9%
40%	33,900,938	12%
50%	42,376,173	15%
60%	50,851,408	18%
70%	64,976,799	23%
80%	84,752,346	30%
90%	110,178,050	39%
100%	200,580,552	71%

6.2.1 Sensitivity Analysis

Sensitivity analysis generally ranks the relative impact of each risk/opportunity as a percentage of total cost uncertainty. The Crystal Ball software uses a statistical measure (contribution to variance) that approximates the impact of each risk/opportunity contributing to variability of cost outcomes during *Monte Carlo* simulation.

Key cost drivers identified in the sensitivity analysis can be used to support development of a risk management plan that will facilitate control of risk factors and their potential impacts throughout the project lifecycle. Together with the risk register, sensitivity analysis results can also be used to support development of strategies to eliminate, mitigate, accept or transfer key risks. In general items with the largest “range” of costs will migrate to the top of the sensitivity analysis chart. This may not correlate to the items that correlate the largest actual contribution to the contingency. This is

explained as follows: We study risks based on their potential high and low variance from the base cost estimate. So in general most items should have a “most likely” cost in the model of $0 implying that you have the item in the cost estimate and most likely would expect the actual value to approach the estimate value. The high and low values would capture the range of variance you would expect to see based on the risk assessment of the item. With sensitively analysis the magnitude of this variance implies a higher sensitivity. For example something that has a most likely cost of 0 but a range of plus or minus $1M has a $2M range and would show up higher on the chart than an item with a most likely cost of $5M and a range of plus or minus $100K. In this case the most likely cost of $5M could impart a significantly higher cost to the final contingency than the item with the plus or minus $10M range but a most likely variance of $0.

6.2.2 Sensitivity Analysis Results

The risks/opportunities considered as key or primary cost drivers are ranked in order of importance in contribution to variance bar charts. A longer bar in the sensitivity analysis chart represents a greater range of potential impact to total project cost. It may be misleading as to its actual contribution to the project contingency as it is based on the overall range; not necessarily the overall contingency impact. Below in Figure 2 is the LPP followed by NED cost model output and sensitivity chart, Figure 3, for the project.

Figure 2. LPP Cost Model Output & Sensitivity Analysis

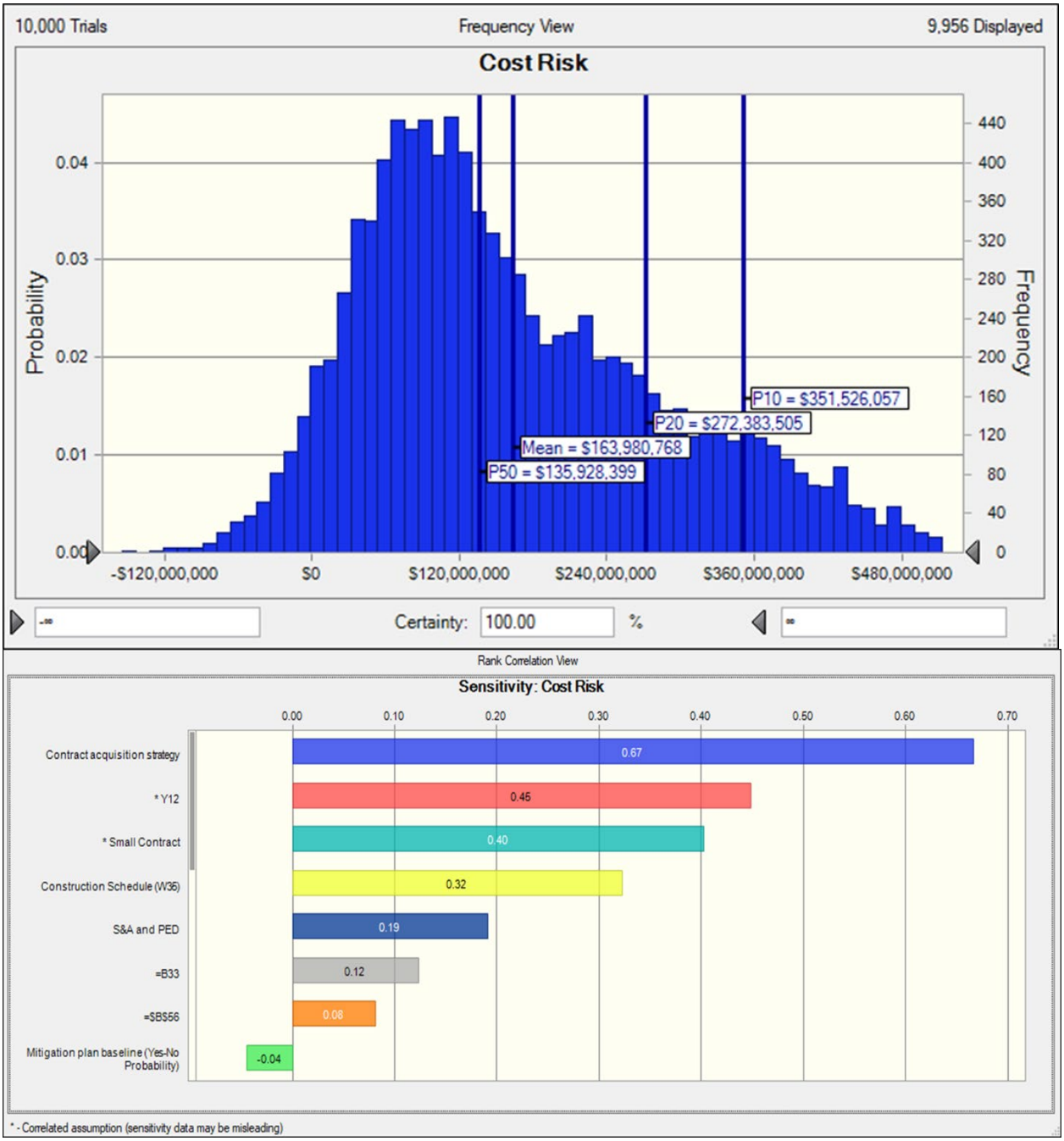
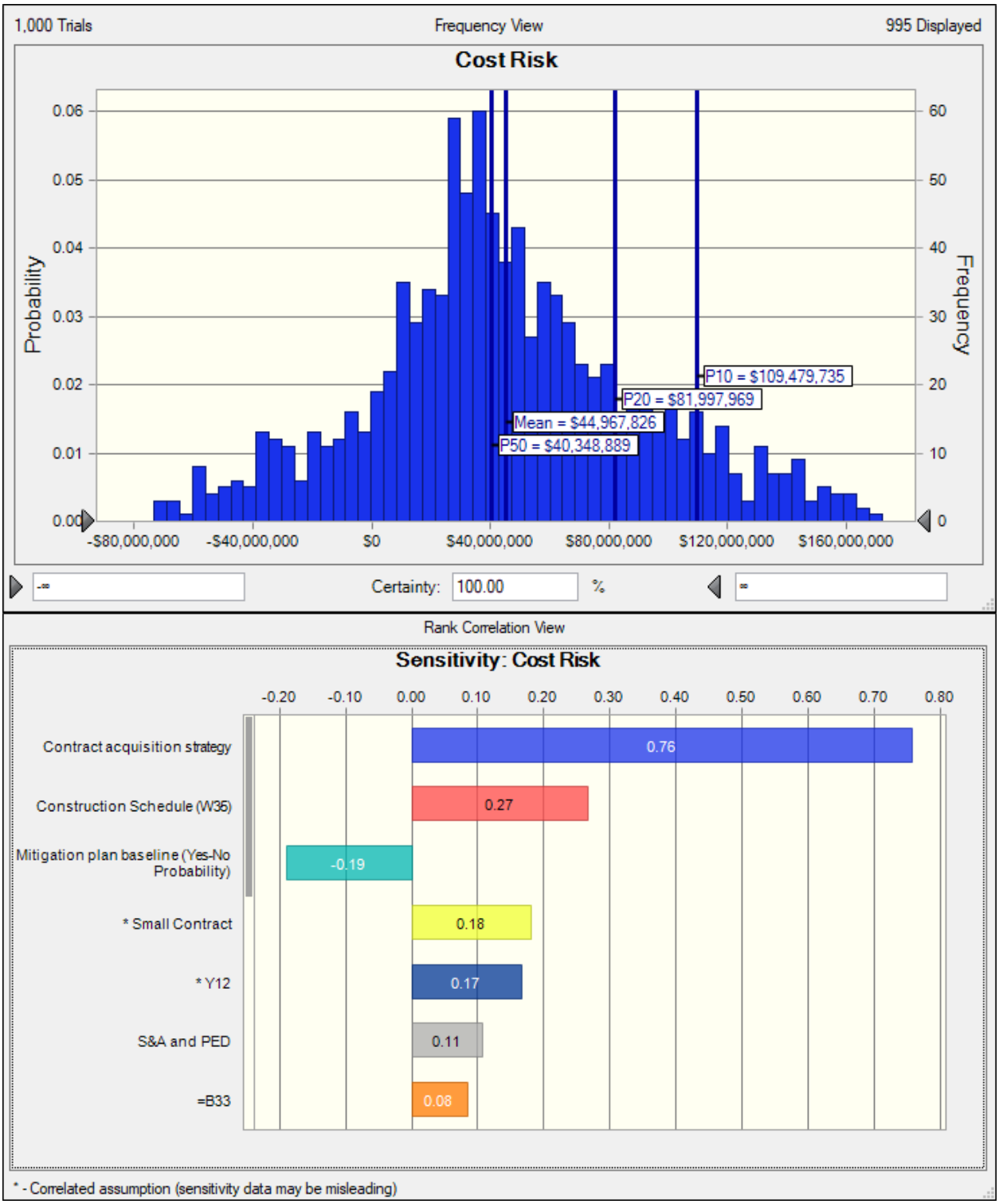


Figure 3. NED Cost Model Output & Sensitivity Analysis



The key LPP and NED cost risk drivers identified through sensitivity analysis with the largest potential variance are:

Contract Acquisition Strategy will play a significant role in the overall cost of the project. As the Prime Contractor performs increasingly more of the work the markup layers diminish and overall contract cost decreases. Contracting will perform a market analysis as the project progresses towards solicitation. Maintaining fully competitive contracts will typically draw more contractor interest keeping cost competitive as well.

The Construction Schedule can be impacted by contractor's performance and various external conditions. As the schedule is delayed or extended the pricing will typically increase due to inflation.

The Engineering and Design as well as Construction Administration assumptions may overstate the actual costs by applying a historical percentage used on projects of smaller magnitude. Therefore the dollar volume is expected to be a smaller percentage of the total project cost.

Smaller contract sizes may impact cost due to limiting job site and overall quantities. Additional contracts may require alternative contractors, additional mobilization and demobilization of equipment and less fluidity between channel reaches delaying the project completion schedule and adding cost.

The methodology for modeling the crossing costs system wide may over/under state actual conditions at each specific crossing. With approximately 45 crossings total in the LPP, six representative crossings were estimated in detail and scaled up or down with site specific criteria for the remaining crossing classified in one of the six groups. The model was calibrated with historical data for reasonableness though the risk remains within each crossings uniqueness

6.3 Schedule Risk Analysis

The schedule contingency was quantified as 59.5 months for the LPP and 27.8 months for the NED at the 80% confidence level.

Key points of the LPP and NED schedule sensitivity drives are:

The key risk drivers identified through study of the LPP and NED Cost/Risk Model and sensitivity analysis are:

The Construction Schedule can be impacted by contractor's performance and various external conditions. As the schedule is delayed or extended the pricing will typically increase due to inflation.

Presence of Endangered Species may limit construction activities, equipment selection, and the overall construction operating windows for specific reaches.

Utility conflicts are a risk primarily to the schedule as coordination with other agencies and utility members can be time consuming.
Presence of Endangered Species may limit construction activities, equipment selection, and the overall construction operating windows for specific reaches.

Rain Events of significance may interfere with the channel construction schedule. Channel flooding will halt channel construction activities until receded.

The graphical model output of the LPP followed by the NED schedule risk model and the sensitivity charts are shown below in Figures 4 and 5 respectively:

Figure 4. LPP Schedule Model Output & Sensitivity Analysis

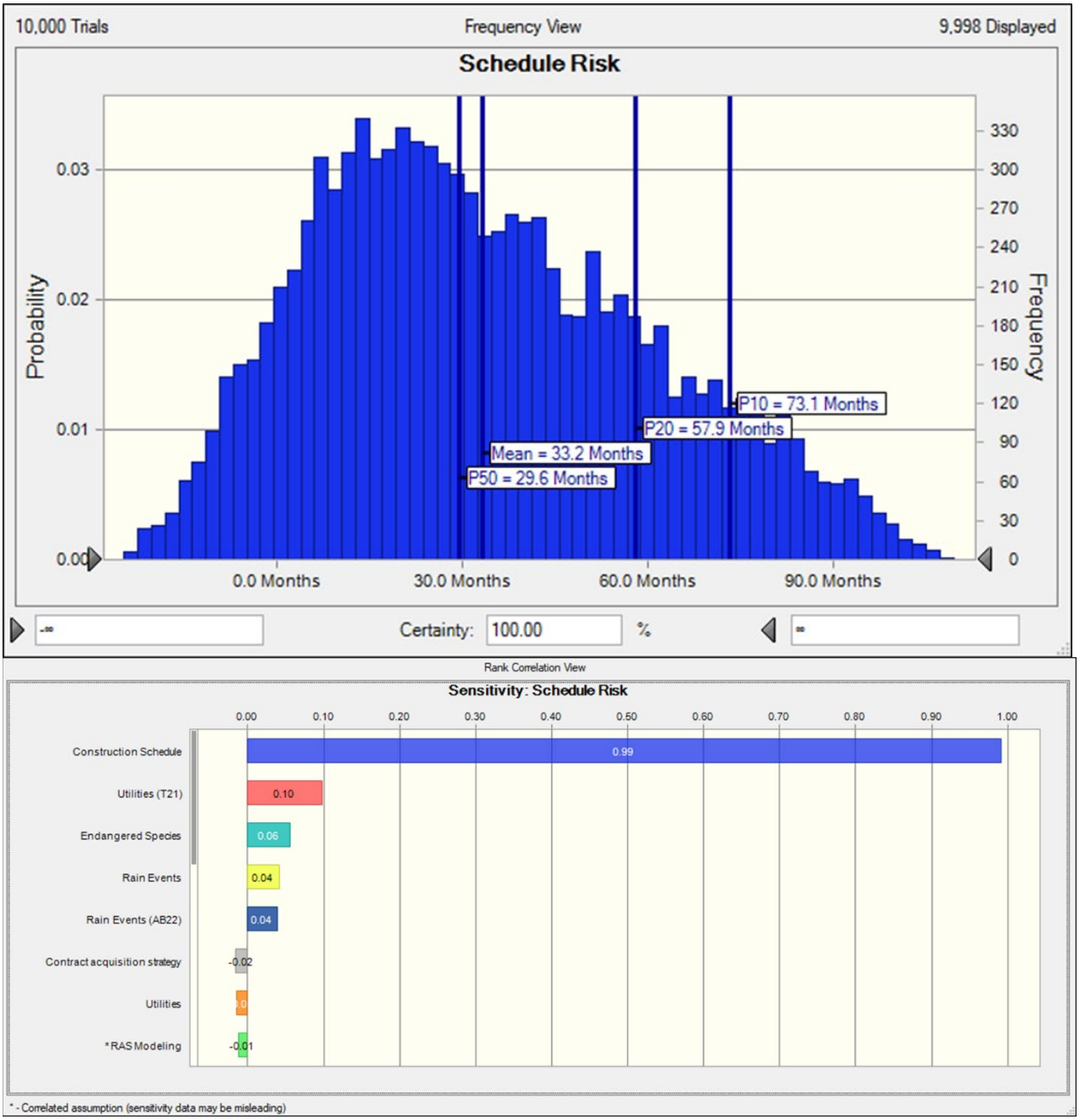
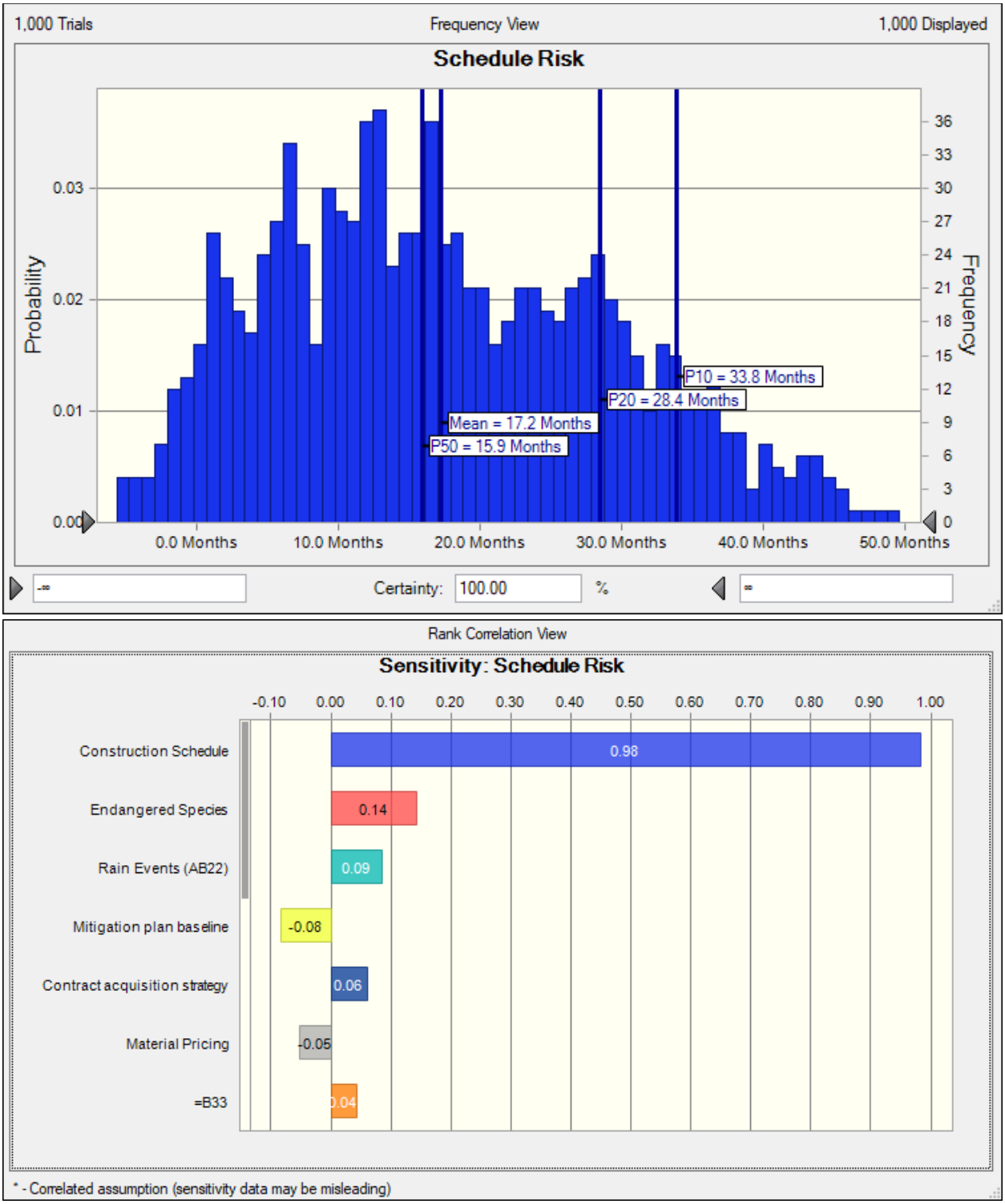


Figure 5. NED Schedule Model Output & Sensitivity Analysis



7.0 MAJOR FINDINGS/OBSERVATIONS/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.

7.1 Findings/Observations

Major findings and observations of the project and risk analysis are listed below:

7.1.1) The PDT is aware of the potential cost variance with Contract Acquisition Strategy and believes a Design Bid Build contract will be implemented that is fair and open to full competition considering the estimated dollar volume.

7.1.2) Considering the potential cost impacts discovered from multiple smaller contracts verses fewer larger contracts, the PM believes the contracts will be structured with larger dollar volumes up to $100M. OCPW typically implements $10-35M contracts which on the high end is in line with 35/65 cost sharing between the local sponsor and federal dollars at individual contract magnitudes of 100M.

7.1.3) Allowing the contractor to utilize the most productive means and methods could minimize the construction schedule and overall cost due to the anticipated increasing dollar value.

7.1.4) Avoiding and minimizing contract modifications by reducing unknowns and refining scope of work quantification during PED may prevent associated costs.

7.1.5) Applying a more realistic dollar volume for the estimated PED and S&A rather than percentages of construction typical of smaller projects reduces the overall estimated project cost and produces a reasonable burn rate.

7.1.6) With approximately 45 crossings in the LPP, gathering additional crossing specific data and producing site/crossing specific design moving forward

may reduce the risk of cost variance due to modeling scaled crossings from representative crossings with limited data.

7.1.7) Utility conflicts may impact the construction schedule if unexpected.

7.1.8) Environmental windows regarding endangered species as well as rainy season construction may extend the life of the project

7.2 Recommendations

Risk Management is an all-encompassing, iterative, and life-cycle process of project management. The Project Management Institute's (PMI) *A Guide to the Project Management Body of Knowledge (PMBOK® Guide)*, *4th edition*, states that "project risk management includes the processes concerned with conducting risk management planning, identification, analysis, responses, and monitoring and control on a project." Risk identification and analysis are processes within the knowledge area of risk management. Its outputs pertinent to this effort include the risk register, risk quantification (risk analysis model), 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 following table section provides a list of risks, their effects and potential recommendations for mitigation of the risks identified and analyzed in this study. Note that this list is not all-inclusive.

TABLE 5. LPP Risk Issues, Effects, and Potential Mitigation

CREF	Risk/Opportunity Event	Risk Event Description	PDT Discussions on Impact and Likelihood	Risk Mitigation Measures
Contract Acquisition (CA)				
CA1	Contract acquisition strategy	Currently, acquisisiton strategy is not defined.	Deviation from full and open competition may add cost layers. Cost may increase if contract acquisition is constrained leading to less competition and increased subcontracting. Market research…(LPP currently 46/54% sub/prime and NED 45/55% is currently included in DBB. Work in kind may be design-build. Work performed by USACE will typically be design, bid, build. The PDT believes that DBB will be fair and open because of the $ volumes involved. WIK may be CM or design build.	Maintaining fully competitive contracts will reduce the risk of increased bid pricing.
CA2	Small Contract	Smaller numerous contracts will cost more than larger contracts.	Contracts are typically ranging from $12-$35M for Orange County. PM believes that contracts will be larger in dollar volume up to $100M. PDT feels it is unlikely that the project will be broken up into many smaller contracts though mitigation and the like may be smaller contracts.	Structuring larger contracts will reduce the risk of additional mobilization and demobilization equipment costs related to additional smaller constracts.
Construction (CO)				
CO1	Utilities	There may be conflicts in existing utilities in the construction areas.	Impact construction schedule and potential modifications due to unknowns. NED Street crossings would not be modified therefore a lower risk. The LPP would be more likely to experience this risk. Existing conditions are known and defined. For example, there is a risk that abandoned or undefined oil lines may be encountered. Other undocumented utilities may be encountered as well. Depending on who executes the work (OC or USACE), they will be responsible for finding out who owns the line to remove it. The site is big enough that the contractor may be able to work on another portion of the work while this is being engineered. It is highly likely that this will happen in the LPP plan, less likely in the NED.	Identifying and incorporating existing utilities during PED will reduce unknowns allowing reasonble time for utility member coordination before and during construction reducing the risk of set backs during construction
CO2	Rain Events	Excessive rain may be encountered.	Storm water may impede work flow and construction activities in the channel. Increased construction delays, additional dewatering and erosion control, 10 yr storms. A rain event may cause the contractor to slow down to dry down the area of work. One rain event could impact the schedule by two weeks. A normal USACE contract requires the contractor to build in weather delays. Contracts executed as WIK will also have similar requirements. Time may be allowed, but no additional cost. Delays are less than three months.	Expediting contracts allowing the contractor to perform channel activities during optimum seasonal timeframes may reduce the risk of a named event impacting the overall project schedule.
CO6	Endangered Species	Nesting birds, sea turtles and other species may impact schedule.	This shuts down areas of the project. The area is coastal. We try to keep areas active to prevent nesting but it still occurs. Reach 1 and Reach 23 would be impacted the most. Delays could be over six months. FEB-AUG.	Identifying potential conflicts with endangered species and related construction windows early may reduce the risk of critical path schedule impacts by optimizing the contract solicitation and execution.
CO13	Construction Modifications	There may be modification issues that have not been captured in current risks.	Construction modifications due to differing site conditions and unanticipated items of work are likely to occur.	Avoiding and minimizing contract modifications by reducing unknowns and refining scope of work quantification during PED may prevent associated costs.

Cost and Schedule (ES)				
ES1	Construction Schedule	Production rates can impact the cost and schedule.	Production rate based on historical durations. (SSP HIST 64-182 LF/WK, 150 LF/WK used) (TRAP-VERT HIST 65-93 LF/WK and small channel 60 LF/WK, 75 LF/WK used)(TRAP-PCC TRAP HIST 55-60 LF/WK, 57 LF/WK used). Increased/Decreased production potential. Upstream contracts dependant on completion of downstream contracts. Concurrent work assumed between C02/C04 & C05/C06 channels.	Identifying and coordinating contract solicitation for ideal construction seasons may increase the contractors estimated productivity therefore potentially reducing construction costs.
ES2	Quantities	Quantity development will change as the RAS model develops.	Variance with design development and QTO methodology. Recent survey data of earthen channel not fully incorporated into model only lower end of C04. Increased precision from 3-D CADD modeling compared to avg end area method at incremental sections. As design develops quantities will change. NED may require additional excavation from bed and additional fill for embankments. Material waste factors (concrete, steel cuttoffs, etc.).	New channel survey data may reduce the risk of uncertain channel geometry and related quantities
ES4	Material Pricing	Economic factors/Tarrifs	Uncertainties with steel pricing. Increased costs related to economic factors. Rebar, SSP, crossing beams/girders. Tarrifs on imports. AIS already in-place… (determine % of contract and potential fluctuations). Buy American Act (AIS)	Maintaining the latest vendor quotes for material cost drivers such as concrete and steel may reduce the risk of late PED cost variances due to material cost.
ES5	S&A and PED	% -vs- Actual	% based. What is actual $ historically? What contingency to apply? Actual cost of 30 and 31 account likely less than % of high dollar volume for typical design and construction management. THIS DISCUSSION WILL OCCUR WITH THE PM AND TS-DC OFFLINE.	Rather than reduce the historical percentage rate for engineering and design, the PDT considered the opportunity of reduced dollar volumes built into the modeled contingency value based on the project magnitude.
Technical Design (TD) / Project Scope Growth				
TD1	RAS Modeling	Defines SOW	Hydraulic changes directly impact cost. currently the RAS model defines SOW (channel dimensions, crossings, etc.) TALK TO JOEL SCHMIDT.	Minimizing RAS model changes may reduce the risk of cost variance associated with changes in the proposed channel geometry. Thorough DQC and ATR may reduce the risk of variance during PED.
TD2	Crossings	Global application	6 Representative crossings applied to approx 39 remaining crossings. Scale factors used (channel TW, lanes, and modification of XS geometry) and verified with historical cost. Common cost factor added for smaller scale and deducted for larger. Utilities stc. scaled up/down with similar methodology.	Developing crossing specific scope, design, and related quantities may reduce the risk of cost variance during PED but for risk modeling purposed the assumed reduction is negated.
TD11	Mitigation plan baseline	The current mitigation plan is conservative.	The mitigation plan for the CO5 channel would spill water into the muted tidal pocket which would reduce the sheet pile quantities significantly. Balance with water quality imparements. The worst case is already included in the estimate. It is possible that this work could be reduced up to $40M.	Identifying the mitigation plan and refining the scope in PED has the opportunity to reduce the estimated mitigation cost
External				
EX5	Best Practices	Agencies establish best practices which drive design. For example, flood stages and other factors (driving the design) may change.	This may be a risk for the LPP. It would impact the cost of the LPP. Not likely to happen, but if it does, there would be a significant re-design for this and all other similar projects. THIS RISK IS A SHOW STOPPER	Staying current on Best Practices may be the best remedy for minimizing related cost variance late in PED.
END				

TABLE 6. NED Risk Issues, Effects, and Potential Mitigation

CREF	Risk/Opportunity Event	Risk Event Description	PDT Discussions on Impact and Likelihood	Risk Mitigation Measures
Contract Acquisition (CA)				
CA1	Contract acquisition strategy	Currently, acquisiiton strategy is not defined.	Deviation from full and open competition may add cost layers. Cost may increase if contract acquisition is constrained leading to less competition and increased subcontracting. Market research…(NED is 45/55% Prime/Sub work) is currently included in DBB. Work in kind may be design-build. Work performed by USACE will typically be design, bid, build. The PDT believes that DBB will be fair and open because of the $ volumes involved. WIK may be CM or design build.	Maintaining fully competitive contracts will reduce the risk of increased bid pricing.
CA2	Small Contract	Smaller numerous contracts will cost more than larger contracts.	Contracts are typically ranging from $12-$35M for Orange County. PM believes that contracts will be larger in dollar volume up to $100M. PDT feels it is unlikely that the project will be broken up into many smaller contracts though mitigation and the like may be smaller contracts.	Structuring larger contracts will reduce the risk of additional mobilization and demobilization equipment costs related to additional smaller constracts.
Construction (CO)				
CO2	Rain Events	Excessive rain may be encountered.	Storm water may impede work flow and construction activities in the channel. Increased construction delays, additional dewatering and erosion control, 10 yr storms. A rain event may cause the contractor to slow down to dry down the area of work. One rain event could impact the schedule by two weeks. A normal USACE contract requires the contractor to build in weather delays. Contracts executed as WIK will also have similar requirements. Time may be allowed, but no additional cost. Delays are less than three months.	Expediting contracts allowing the contractor to perform channel activities during optimum seasonal timeframes may reduce the risk of a named event impacting the overall project schedule.
CO6	Endangered Species	Nesting birds, sea turtles and other species may impact schedule.	This shuts down areas of the project. The area is coastal. We try to keep areas active to prevent nesting but it still occurs. Reach 1 and Reach 23 would be impacted the most. Delays could be over six months. FEB-AUG.	Identifying potential conflicts with endangered species and related construction windows early may reduce the risk of critical path schedule impacts by optimizing the contract solicitation and execution.
CO13	Construction Modifications	There may be modification issues that have not been captured in current risks.	Construction modifications due to differing site conditions and unanticipated items of work are likely to occur.	Avoiding and minimizing contract modifications by reducing unknowns and refining scope of work quantification during PED may prevent associated costs.
Cost and Schedule (ES)				
ES1	Construction Schedule	Production rates can impact the cost and schedule.	Production rate based on historical durations. (SSP HIST 64-182 LF/WK, 150 LF/WK used) (TRAP-VERT HIST 65-93 LF/WK and small channel 60 LF/WK, 75 LF/WK used)(TRAP-PCC TRAP HIST 55-60 LF/WK, 57 LF/WK used). Increased/Decreased production potential. Upstream contracts dependant on completion of downstream contracts. Concurrent work assumed between C02/C04 & C05/C06 channels.	Identifying and coordinating contract solicitation for ideal construction seasons may increase the contractors estimated productivity therefore potentially reducing construction costs.
ES2	Quantities	Quantity development will change as the RAS model develops.	Variance with design development and QTO methodology. Recent survey data of earthen channel not fully incorporated into model only lower end of C04. Increased precision from 3-D CADD modeling compared to avg end area method at incremental sections. As design develops quantities will change. NED may require additional excavation from bed and additional fill for embankments. Material waste factors (concrete, steel cuttoffs, etc.).	New channel survey data may reduce the risk of uncertain channel geometry and related quantities
ES4	Material Pricing	Economic factors/Tarrifs	Uncertainties with steel pricing. Increased costs related to economic factors. Rebar, SSP, crossing beams/girders. Tarrifs on imports. AIS already in-place… (determine % of contract and potential fluctuations). Buy American Act (AIS)	Maintaining the latest vendor quotes for material cost drivers such as concrete and steel may reduce the risk of late PED cost variances due to material cost.
ES5	S&A and PED	% -vs- Actual	% based. What is actual $ historically? What contingency to apply? Actual cost of 30 and 31 account likely less than % of high dollar volume for typical design and construction management. THIS DISCUSSION WILL OCCUR WITH THE PM AND TS-DC OFFLINE.	Rather than reduce the historical percentage rate for engineering and design, the PDT considered the opportunity of reduced dollar volumes built into the modeled contingency value based on the project magnitude.
Technical Design (TD) / Project Scope Growth				
TD11	Mitigation plan baseline	The current mitigation plan is conservative.	The mitigation plan for the CO5 channel would spill water into the muted tidal pocket which would reduce the sheet pile quantities significantly. Balance with water quality imparements. The worst case is already included in the estimate. It is possible that this work could be reduced up to $40M.	Identifying the mitigation plan and refining the scope in PED has the opportunity to reduce the estimated mitigation cost
END				

7.3 Risk Management:

1. Cost Engineering MCX recommends use of 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. As an example, recommended uses of the risk register include:

- 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 risk analysis feedback and project control input.
- Identifying risk transfer, elimination or mitigation actions required for implementation of risk management plans.

2. 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).

APPENDIX A
LPP & NED RISK REGISTERS AND RISK MODELS

				Project Cost			Project Schedul		
CREF	Risk/Opportunity Event	Risk Event Description	PDT Discussions on Impact and Likelihood	Likelihood ©	Impact ©	Risk Level ©	Likelihood (S)	Impact (S)	Risk Level (S)
Contract Acquisition (CA)									
CA1	Contract acquisition strategy	Currently, acquisisiton strategy is not defined.	Deviation from full and open competition may add cost layers. Cost may increase if contract acquisition is constrained leading to less competition and increased subcontracting. Market research…(LPP currently 46/54% sub/prime and NED 45/55% is currently included in DBB. Work in kind may be design-build. Work performed by USACE will typically be design, bid, build. The PDT believes that DBB will be fair and open because of the $ volumes involved. WIK may be CM or design build.	Unlikely	Critical	Medium	Unlikely	Negligible	Low
CA2	Small Contract	Smaller numerous contracts will cost more than larger contracts.	Contracts are typically ranging from $12-$35M for Orange County. PM believes that contracts will be larger in dollar volume up to $100M. PDT feels it is unlikely that the project will be broken up into many smaller contracts though mitigation and the like may be smaller contracts.	Unlikely	Significant	Medium	Unlikely	Negligible	Low
Lands and Damages (LD)									
LD1	Real Estate	ROW/Work Limits	Tetra Tech had conflicting easement/ROW shown for representative crossing Staging/Access: May require additional land acquisition near Warner Ave, Tide Gates, and widened channels Orange County does not have land rights so they will have to partner with the State of California.	Possible	Negligible	Low	Possible	Negligible	Low
LD2	Mitigation	The final mitigation plan is not yet approved.	The mitigation plan will be before we submit this study. The dollar volume is around $10M. Not likely to impact cost or schedule.	Unlikely	Negligible	Low	Unlikely	Negligible	Low
LD3	Staging Areas	There is a risk that needed staging areas may not be acquired.	If staging areas are not acquired, the contractor will have to work in the exising ROW. This is captured currently in the Real Estate Plan. Estimate and Schedule assumes staging in the ROW. See LD1	Possible	Negligible	Low	Possible	Negligible	Low
LD3	Existing Owners	There are existing buildings and landowners that are directly adjacent to our work areas. Our work will affect their businesses and access.	The PDT believes that the construction will be phased in a manner that it will minimally impact the land/business owner. There is one case where this condition exists, Edwards and Bolsa Ave. The current estimate includes work to protect the existing land owners by phasing, sheet piling and traffic control. The working assumption is that everything will be built in the existing ROW's. The posibility exists that other cases may exist but not too likely.	Unlikely	Negligible	Low	Unlikely	Negligible	Low
LD3	Acquisition Timing	Real estate may not be aquired in the time frame needed (for mitigation only)	Coordination is required to come with an acceptable agreement (non-standard or other) to acquire the real estate. This is typically resolved before authorization so it should not impact the cost or schedule.	Unlikely	Negligible	Low	Unlikely	Negligible	Low
Construction (CO)									

				Project Cost			Project Schedul		
CREF	Risk/Opportunity Event	Risk Event Description	PDT Discussions on Impact and Likelihood	Likelihood ©	Impact ©	Risk Level ©	Likelihood (S)	Impact (S)	Risk Level (S)
CO1	Utilities	There may be conflicts in existing utilities in the construction areas.	Impact construction schedule and potential modifications due to unknowns. NED Street crossings would not be modified therefore a lower risk. The LPP would be more likely to experience this risk. Existing conditions are known and defined. For example, there is a risk that abandoned or undefined oil lines may be encountered. Other undocumented utilities may be encountered as well. Depending on who executes the work (OC or USACE), they will be responsible for finding out who owns the line to remove it. The site is big enough that the contractor may be able to work on another portion of the work while this is being engineered. It is highly likely that this will happen in the LPP plan, less likely in the NED.	Very Likely	Moderate	High	Very Likely	Marginal	Medium
CO2	Rain Events	Excessive rain may be encountered.	Storm water may impede work flow and construction activities in the channel. Increased construction delays, additional dewatering and erosion control, 10 yr storms. A rain event may cause the contractor to slow down to dry down the area of work. One rain event could impact the schedule by two weeks. A normal USACE contract requires the contractor to build in weather delays. Contracts executed as WIK will also have similar requirements. Time may be allowed, but no additional cost. Delays are less than three months.	Very Likely	Negligible	Low	Very Likely	Moderate	High
CO3	Equipment Availability	Silent sheet pile driving equipment availability is limited.	If delays occurred where the equipment would be demobilized, there could be a delay in getting it back. Driving equipment is scheduled two years out. Equipment can be operated in any weather. This would be if there was a material delay. Linked to sheet pile availability. Impact is less than three months.	Possible	Negligible	Low	Possible	Marginal	Low
CO4	Site Access	Densly populated area may limit site access.	The PDT does not think that this will impact the schedule significantly. The area is pretty well known.	Unlikely	Negligible	Low	Unlikely	Negligible	Low
CO5	Scouring	Additional scouring may have occurred creating differing conditions.	This will affect the estimated quantities. There has not been excessive scouring experienced. More investigation will be done during design. The only areas this might be an issue are Reach 20, 23 and Reach 1.	Possible	Negligible	Low	Possible	Negligible	Low
CO6	Endangered Species	Nesting birds, sea turtles and other species may impact schedule.	This shuts down areas of the project. The area is coastal. We try to keep areas active to prevent nesting but it still occurs. Reach 1 and Reach 23 would be impacted the most. Delays could be over six months. FEB-AUG.	Likely	Negligible	Low	Likely	Marginal	Medium
CO7	Sheet Pile Availability	Sheet pile availability may impact cost and schedule. Availability and fabrication time may impact the schedule.	The sheet pile is a marine grade steel (A690). This is a long lead time item for the contractor (NOT GOV FURN). The contractor and designer should be able to factor this into his schedule. This is a problem if they need to order more material, it may be a six month delay with no cost impact (delay caused by contractor)	Unlikely	Negligible	Low	Unlikely	Marginal	Low

				Project Cost			Project Schedul		
CREF	Risk/Opportunity Event	Risk Event Description	PDT Discussions on Impact and Likelihood	Likelihood ©	Impact ©	Risk Level ©	Likelihood (S)	Impact (S)	Risk Level (S)
CO8	Permitting	Timeline for obtaining permits prior to construction may impact the schedule.	Transportaiton, water, construction, air. There is always schedule impacts but mitigated through early and often coordination. Not likely	Unlikely	Negligible	Low	Unlikely	Moderate	Low
CO9	HTRW	See utility		Unlikely	Negligible	Low	Unlikely	Marginal	Low
CO10	Subcontractors	Subcontractor capability may be limited.	This is normally not encountered with OC. They have enough capacity.	Unlikely	Negligible	Low	Unlikely	Negligible	Low
CO11	Labor Force	Availablity of skilled tradesmen may be limited.	No problem.	Unlikely	Negligible	Low	Unlikely	Negligible	Low
CO12	Traffic Control	Traffic control will be required to phase the construction.	The baseline estimate includes traffic control at historic rates. Phasing is included where needed in the schedule. It is possible that our assumptions may be inadequate. Every one implemented by OC has been changed but has minor affect on cost and no impact on schedule.	Possible	Marginal	Low	Possible	Negligible	Low
CO13	Construction Modifications	There may be modification issues that have not been captured in current risks.	Construction modifications due to differing site conditions and unanticipated items of work are likely to occur.	Very Likely	Critical	High	Possible	Negligible	Low
Cost and Schedule (ES)									
ES1	Construction Schedule	Production rates can impact the cost and schedule.	Production rate based on historical durations. (SSP HIST 64-182 LF/WK, 150 LF/WK used) (TRAP-VERT HIST 65-93 LF/WK and small channel 60 LF/WK, 75 LF/WK used)(TRAP-PCC TRAP HIST 55-60 LF/WK, 57 LF/WK used). Increased/Decreased production potential. Upstream contracts dependant on completion of downstream contracts. Concurrent work assumed between C02/C04 & C05/C06 channels.	Unlikely	Negligible	Low	Possible	Critical	High
ES2	Quantities	Quantity development will change as the RAS model develops.	Variance with design development and QTO methodology. Recent survey data of earthen channel not fully incorporated into model only lower end of C04. Increased precision from 3-D CADD modeling compared to avg end area method at incremental sections. As design develops quantities will change. NED may require additional excavation from bed and additional fill for embankments. Material waste factors (concrete, steel cuttoffs, etc.).	Likely	Marginal	Medium	Likely	Negligible	Low
ES3	Environmental Windows	Construction schedule	Increased biological monitoring cost. Constrained schedule due to nesting and migration…verify if current schedule reflects environmental features. Imbedded in historical construction durations…	Likely	Negligible	Low	Likely	Negligible	Low

				Project Cost			Project Schedul		
CREF	Risk/Opportunity Event	Risk Event Description	PDT Discussions on Impact and Likelihood	Likelihood ©	Impact ©	Risk Level ©	Likelihood (S)	Impact (S)	Risk Level (S)
ES4	Material Pricing	Economic factors/Tarrifs	Uncertainties with steel pricing. Increased costs related to economic factors. Rebar, SSP, crossing beams/girders. Tarrifs on imports. AIS already in-place… (determine % of contract and potential fluctuations). Buy American Act (AIS)	Likely	Marginal	Medium	Unlikely	Negligible	Low
ES5	S&A and PED	% -vs- Actual	% based. What is actual $ historically? What contingency to apply? Actual cost of 30 and 31 account likely less than % of high dollar volume for typical design and construction management. THIS DISCUSSION WILL OCCUR WITH THE PM AND TS-DC OFFLINE.	Likely	Significant	High	Unlikely	Negligible	Low
ES6	Material Classificaiton	Shrink, swell and compaction factors have been approximated	5-15%. Bank Cubic Yard to Loose Cubic Yard currently factored for excavation and stone. There are expansive clays and granular fill on the project. TO BE COORDINATE W GEOTECH.	Likely	Negligible	Low	Unlikely	Negligible	Low
ES7	Time value of Money	Current regulations require us to use CWCCIS. This may not track current conditions.	ENR has shown to be more conservative for these areas. Timeline is more than 7 years.	Very Likely	Negligible	Low	Unlikely	Negligible	Low
ES8	Fuel and Energy Costs	Fuel and energy are cost drivers as the project is heavily equipment dependent.	Fuel cost fluxuate greatly from year to year. Current fuel costs are incorporated into the estimate. A five year floating average of fuel costs may impact the estimate.	Likely	Negligible	Low	Unlikely	Negligible	Low
Project & Program Management (PM)									
PM1	Project Funding	Contract size	Federal and sponsor funds may be limited due to current economic conditions. OCPW annual budget and allocated spending. Number of contracts and multi-contract magnitude. Contract size per reach length, crossing-crossing, dollar volume??? Larger contracts may have less MOB/DEMOB and allow more fluid construction scheduling between reaches. More or less contracts over the project entirety… NEED TO MODEL ESCALATION IMPACTS FOR COST	Possible	Marginal	Low	Possible	Marginal	Low
PM2	Staffing	No control over staff priorities.	Being a project this large, it is typically not a concern for schedule or cost as it is on smaller projects.	Unlikely	Negligible	Low	Unlikely	Negligible	Low
PM3	Scope	Scope and schedule are subject to change.	Funding issues can cause delays in the project. SEE PM1	Unlikely	Negligible	Low	Possible	Negligible	Low
PM4	WIK	Local sponsor must meet their commitments.	The local sponsor is heavily engaged in the success of this project. They have demonstrated their capabilities with past USACE projects.	Unlikely	Negligible	Low	Unlikely	Negligible	Low
Regulatory & Environmental (RE)									

				Project Cost			Project Schedul		
CREF	Risk/Opportunity Event	Risk Event Description	PDT Discussions on Impact and Likelihood	Likelihood ©	Impact ©	Risk Level ©	Likelihood (S)	Impact (S)	Risk Level (S)
RE1	Permitting	Timely acquisition	construction schedule delays awaiting permits REPEAT??	Unlikely	Negligible	Low	Unlikely	Negligible	Low
RE2	Multi-Agency Coordination	Consensus needed among agencies to coordinate the entire project.	Costal Commission, Orange County, the State of California, Fish and Wildlife, and others require coordination. This is more of a study phase risk. This coordination will be addressed before PED.	Possible	Negligible	Low	Possible	Marginal	Low
RE3	Utilities	There may be conflicts in existing utilities in the construction areas.	Impact construction schedule and potential modifications due to unknowns NED Street crossings would not be modified therefore a lower risk. The LPP would be more likely to experience this risk. Existing conditions are known and defined. For example, there is a risk that abandoned or undefined oil lines may be encountered. Other undocumented utilities may be encountered as well. Depending on who executes the work (OC or USACE), they will be responsible for finding out who owns the line to remove it. The site is big enough that the contractor may be able to work on another portion of the work while this is being engineered. It is highly likely that this will happen in the LPP plan, less likely in the NED. REPEATinHTRW	Very Likely	Negligible	Low	Very Likely	Negligible	Low
RE4	Sediment Quality	Sediment will be disturbed during the Warner Ave. Bridge widening and other times.	Sediment sampling is needed to characterize the material needed for disposal and determine water quality impacts for permitting. This is primarily done during PED by an A/E. It is a potential schedule delay. Could cause a year or more delay but is unlikely. Not so much a cost impact.	Possible	Negligible	Low	Unlikely	Marginal	Low
RE5	Total Air Emissions	General conformity is needed for air emissions.	This will be complete for the EIS but the general conformity shows 3-10 excess tons of NOX produced in one year. An emissions credit is needed. The cost and schedule impacts are **unknown**.	Very Likely	Negligible	Low	Very Likely	Negligible	Low
RE6	Air Dispersion Modeling	Needed to identify localized air quality impacts during construction.	This modeling might be pushed to PED. It is considered likely that the modeling will show some significant impacts. We will have to make environmental commitments (which would restrict construction times, working conditions, or methods. In general, California contractors will be accustomed to this issue. Should not impact cost or schedule.	Unlikely	Negligible	Low	Unlikely	Negligible	Low
Technical Design (TD) / Project Scope Growth									
TD1	RAS Modeling	Defines SOW	Hydraulic changes directly impact cost. currently the RAS model defines SOW (channel dimensions, crossings, etc.) TALK TO JOEL SCHMIDT.	Possible	Moderate	Medium	Possible	Marginal	Low

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TD3	HTRW	Excavation	Potential HTRW with excavation and dewatering. Special handling and waste disposal may increase equipment & handeling cost and construction duration (sampling). REVISIT to see if it is a Title D landfill or not…	Unlikely	Marginal	Low	Very Likely	Negligible	Low
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TD5	Soil Borings	Soil borings for the structures is limited.	Currently we do not have detailed geotechnical investigations. The risk is that there may be a change to a foundation type. This will be flushed out in PED.	Possible	Marginal	Low	Likely	Negligible	Low
TD6	Traffic Studies	We have traffic studies.	WORD SMITH W ECON	Unlikely	Negligible	Low	Unlikely	Negligible	Low
TD7	Reach 23	Scope not accounted for on the North side of CO2, Reach 23.	We are not carrying any work here for the NED. For the LPP we have a vegitated confinement cell. This may not be realistic. The PDT believes that there will be NO additional scope in the North side. IT SHOULD BE REMOVED FROM THE LPP. Orange County will address through maintenance.	Unlikely	Negligible	Low	Unlikely	Negligible	Low
TD8	Innovative	Innovative structural	Some current construction methods are based on existing structures. These methods may not meet USACE standards. This may impact cost and schedule by $5-20M	Possible	Marginal	Low	Possible	Negligible	Low
TD9	Biological Surveys		Bird surveys need to be done a week prior to construction. These surveys should be scheduled into the work and accounted for. Not a risk	Unlikely	Negligible	Low	Unlikely	Negligible	Low
TD10	Seismic	May increase the rigor of design.	This is a part of the normal design. Structural designs are matching existing, but new requirements may not be included (older structures) such as seismic upgrades. This could impcat costs by 10% (levees, bridges). MEET W DAVE FORCE.	Unlikely	Negligible	Low	Unlikely	Negligible	Low

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External									
EX1	Economy	Economic conditions	Bids reflect economy. Fuel Prices, Cost-of-Money, Resource availability. MIGHT BE A DUPLICATE W ESTIMATE RISK. Funding comes from property values. If there is an economic down-turn, funding levels from the local sponsor may change. This would primarily impact schedule as resources would not be efficiently provided.	Possible	Negligible	Low	Possible	Negligible	Low
EX2	Political	Support/Opposition	Multi-agency and stakeholder coordination. Potential Schedule Impacts. There is support from the local government and residents. There is opposition with the regulatory agencies for the methods (concrete lining) and concerned stakeholders. This project is generally well supported.	Unlikely	Negligible	Low	Possible	Negligible	Low
EX3	Climate/Weather Extremes	Differing site conditions	Sea level changes, frequency and magnitude of events. Tidal influence in channels directly impacts activities. Impacts of removing R01 tide gates??? Potential Schedule Impacts. If an earthquake and major storm occur at the same time, during construction, the Contractor's builders risk policy would cover this causing a schedule delay.	Unlikely	Negligible	Low	Unlikely	Negligible	Low
EX4	Sales Tax	Increased material cost	Potential Increase in sales tax	Possible	Marginal	Low	Unlikely	Negligible	Low
EX5	Best Practices	Agencies establish best practices which drive design. For example, flood stages and other factors (driving the design) may change.	This may be a risk for the LPP. It would impact the cost of the LPP. Not likely to happen, but if it does, there would be a significant re-design for this and all other similar projects. THIS RISK IS A SHOW STOPPER	Unlikely	Significant	Medium	Unlikely	Negligible	Low
END									

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CREF	Risk/Opportunity Event	Risk Event Description	PDT Discussions on Impact and Likelihood	Likelihood ©	Impact ©	Risk Level ©	Likelihood (S)	Impact (S)	Risk Level (S)
Contract Acquisition (CA)									
CA1	Contract acquisition strategy	Currently, acquisisiton strategy is not defined.	Deviation from full and open competition may add cost layers. Cost may increase if contract acquisition is constrained leading to less competition and increased subcontracting. Market research…(NED is 45/55% Prime/Sub work) is currently included in DBB. Work in kind may be design-build. Work performed by USACE will typically be design, bid, build. The PDT believes that DBB will be fair and open because of the $ volumes involved. WIK may be CM or design build.	Unlikely	Critical	Medium	Unlikely	Negligible	Low
CA2	Small Contract	Smaller numerous contracts will cost more than larger contracts.	Contracts are typically ranging from $12-$35M for Orange County. PM believes that contracts will be larger in dollar volume up to $100M. PDT feels it is unlikely that the project will be broken up into many smaller contracts though mitigation and the like may be smaller contracts.	Unlikely	Significant	Medium	Unlikely	Negligible	Low
Lands and Damages (LD)									
LD1	Real Estate	ROW/Work Limits	Tetra Tech had conflicting easement/ROW shown for representative crossing Staging/Access: May require additional land acquisition near Warner Ave, Tide Gates, and widened channels Orange County does not have land rights so they will have to partner with the State of California.	Possible	Negligible	Low	Possible	Negligible	Low
LD2	Mitigation	The final mitigation plan is not yet approved.	The mitigation plan will be before we submit this study. The dollar volume is around $10M. Not likely to impact cost or schedule.	Unlikely	Negligible	Low	Unlikely	Negligible	Low
LD3	Staging Areas	There is a risk that needed staging areas may not be acquired.	If staging areas are not acquired, the contractor will have to work in the exising ROW. This is captured currently in the Real Estate Plan. Estimate and Schedule assumes staging in the ROW. See LD1	Possible	Negligible	Low	Possible	Negligible	Low
LD3	Existing Owners	There are existing buildings and landowners that are directly adjacent to our work areas. Our work will affect their businesses and access.	The PDT believes that the construction will be phased in a manner that it will minimally impact the land/business owner. There is one case where this condition exists, Edwards and Bolsa Ave. The current estimate includes work to protect the existing land owners by phasing, sheet piling and traffic control. The working assumption is that everything will be built in the existing ROW's. The posibility exists that other cases may exist but not too likely.	Unlikely	Negligible	Low	Unlikely	Negligible	Low
LD3	Acquisition Timing	Real estate may not be aquired in the time frame needed (for mitigation only)	Coordination is required to come with an acceptable agreement (non-standard or other) to acquire the real estate. This is typically resolved before authorization so it should not impact the cost or schedule.	Unlikely	Negligible	Low	Unlikely	Negligible	Low
Construction (CO)									

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CREF	Risk/Opportunity Event	Risk Event Description	PDT Discussions on Impact and Likelihood	Likelihood ©	Impact ©	Risk Level ©	Likelihood (S)	Impact (S)	Risk Level (S)
CO1	Utilities	There may be conflicts in existing utilities in the construction areas.	Impact construction schedule and potential modifications due to unknowns. NED Street crossings would not be modified therefore a lower risk. The LPP would be more likely to experience this risk. Existing conditions are known and defined. For example, there is a risk that abandoned or undefined oil lines may be encountered. Other undocumented utilities may be encountered as well. Depending on who executes the work (OC or USACE), they will be responsible for finding out who owns the line to remove it. The site is big enough that the contractor may be able to work on another portion of the work while this is being engineered. It is highly likely that this will happen in the LPP plan, less likely in the NED.	Possible	Negligible	Low	Possible	Marginal	Low
CO2	Rain Events	Excessive rain may be encountered.	Storm water may impede work flow and construction activities in the channel. Increased construction delays, additional dewatering and erosion control, 10 yr storms. A rain event may cause the contractor to slow down to dry down the area of work. One rain event could impact the schedule by two weeks. A normal USACE contract requires the contractor to build in weather delays. Contracts executed as WIK will also have similar requirements. Time may be allowed, but no additional cost. Delays are less than three months.	Very Likely	Negligible	Low	Very Likely	Moderate	High
CO3	Equipment Availability	Silent sheet pile driving equipment availability is limited.	If delays occurred where the equipment would be demobilized, there could be a delay in getting it back. Driving equipment is scheduled two years out. Equipment can be operated in any weather. This would be if there was a material delay. Linked to sheet pile availability. Impact is less than three months.	Possible	Negligible	Low	Possible	Marginal	Low
CO4	Site Access	Densly populated area may limit site access.	The PDT does not think that this will impact the schedule significantly. The area is pretty well known.	Unlikely	Negligible	Low	Unlikely	Negligible	Low
CO5	Scouring	Additional scouring may have occurred creating differing conditions.	This will affect the estimated quantities. There has not been excessive scouring experienced. More investigation will be done during design. The only areas this might be an issue are Reach 20, 23 and Reach 1.	Possible	Negligible	Low	Possible	Negligible	Low
CO6	Endangered Species	Nesting birds, sea turtles and other species may impact schedule.	This shuts down areas of the project. The area is coastal. We try to keep areas active to prevent nesting but it still occurs. Reach 1 and Reach 23 would be impacted the most. Delays could be over six months. FEB-AUG.	Likely	Negligible	Low	Likely	Marginal	Medium
CO7	Sheet Pile Availability	Sheet pile availability may impact cost and schedule. Availability and fabrication time may impact the schedule.	The sheet pile is a marine grade steel (A690). This is a long lead time item for the contractor (NOT GOV FURN). The contractor and designer should be able to factor this into his schedule. This is a problem if they need to order more material, it may be a six month delay with no cost impact (delay caused by contractor)	Unlikely	Negligible	Low	Unlikely	Marginal	Low

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CO8	Permitting	Timeline for obtaining permits prior to construction may impact the schedule.	Transportaiton, water, construction, air. There is always schedule impacts but mitigated through early and often coordination. Not likely	Unlikely	Negligible	Low	Unlikely	Moderate	Low
CO9	HTRW	See utility		Unlikely	Negligible	Low	Unlikely	Marginal	Low
CO10	Subcontractors	Subcontractor capability may be limited.	This is normally not encountered with OC. They have enough capacity.	Unlikely	Negligible	Low	Unlikely	Negligible	Low
CO11	Labor Force	Availablity of skilled tradesmen may be limited.	No problem.	Unlikely	Negligible	Low	Unlikely	Negligible	Low
CO12	Traffic Control	Traffic control will be required to phase the construction.	The baseline estimate includes traffic control at historic rates. Phasing is included where needed in the schedule. It is possible that our assumptions may be inadequate. Every one implemented by OC has been changed but has minor affect on cost and no impact on schedule.	Possible	Marginal	Low	Possible	Negligible	Low
CO13	Construction Modifications	There may be modification issues that have not been captured in current risks.	Construction modifications due to differing site conditions and unanticipated items of work are likely to occur.	Very Likely	Critical	High	Possible	Negligible	Low
Cost and Schedule (ES)									
ES1	Construction Schedule	Production rates can impact the cost and schedule.	Production rate based on historical durations. (SSP HIST 64-182 LF/WK, 150 LF/WK used) (TRAP-VERT HIST 65-93 LF/WK and small channel 60 LF/WK, 75 LF/WK used)(TRAP-PCC TRAP HIST 55-60 LF/WK, 57 LF/WK used). Increased/Decreased production potential. Upstream contracts dependant on completion of downstream contracts. Concurrent work assumed between C02/C04 & C05/C06 channels.	Unlikely	Negligible	Low	Possible	Critical	High
ES2	Quantities	Quantity development will change as the RAS model develops.	Variance with design development and QTO methodology. Recent survey data of earthen channel not fully incorporated into model only lower end of C04. Increased precision from 3-D CADD modeling compared to avg end area method at incremental sections. As design develops quantities will change. NED may require additional excavation from bed and additional fill for embankments. Material waste factors (concrete, steel cuttoffs, etc.).	Likely	Marginal	Medium	Likely	Negligible	Low
ES3	Environmental Windows	Construction schedule	Increased biological monitoring cost. Constrained schedule due to nesting and migration…verify if current schedule reflects environmental features. Imbedded in historical construction durations…	Likely	Negligible	Low	Likely	Negligible	Low
ES4	Material Pricing	Economic factors/Tarrifs	Uncertainties with steel pricing. Increased costs related to economic factors. Rebar, SSP, crossing beams/girders. Tarrifs on imports. AIS already in-place… (determine % of contract and potential fluctuations). Buy American Act (AIS)	Likely	Marginal	Medium	Unlikely	Negligible	Low

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ES5	S&A and PED	% -vs- Actual	% based. What is actual $ historically? What contingency to apply? Actual cost of 30 and 31 account likely less than % of high dollar volume for typical design and construction management. THIS DISCUSSION WILL OCCUR WITH THE PM AND TS-DC OFFLINE.	Likely	Moderate	Medium	Unlikely	Negligible	Low
ES6	Material Classificaiton	Shrink, swell and compaction factors have been approximated	5-15%. Bank Cubic Yard to Loose Cubic Yard currently factored for excavation and stone. There are expansive clays and granular fill on the project. TO BE COORDINATE W GEOTECH.	Likely	Negligible	Low	Unlikely	Negligible	Low
ES7	Time value of Money	Current regulations require us to use CWCCIS. This may not track current conditions.	ENR has shown to be more conservative for these areas. Timeline is more than 7 years.	Very Likely	Negligible	Low	Unlikely	Negligible	Low
ES8	Fuel and Energy Costs	Fuel and energy are cost drivers as the project is heavily equipment dependent.	Fuel cost fluxuate greatly from year to year. Current fuel costs are incorporated into the estimate. A five year floating average of fuel costs may impact the estimate.	Likely	Negligible	Low	Unlikely	Negligible	Low
Project & Program Management (PM)									
PM1	Project Funding	Contract size	Federal and sponsor funds may be limited due to current economic conditions. OCPW annual budget and allocated spending. Number of contracts and multi-contract magnitude. Contract size per reach length, crossing-crossing, dollar volume??? Larger contracts may have less MOB/DEMOB and allow more fluid construction scheduling between reaches. More or less contracts over the project entirety… NEED TO MODEL ESCALATION IMPACTS FOR COST	Possible	Marginal	Low	Possible	Marginal	Low
PM2	Staffing	No control over staff priorities.	Being a project this large, it is typically not a concern for schedule or cost as it is on smaller projects.	Unlikely	Negligible	Low	Unlikely	Negligible	Low
PM3	Scope	Scope and schedule are subject to change.	Funding issues can cause delays in the project. SEE PM1	Unlikely	Negligible	Low	Possible	Negligible	Low
PM4	WIK	Local sponsor must meet their commitments.	The local sponsor is heavily engaged in the success of this project. They have demonstrated their capabilities with past USACE projects.	Unlikely	Negligible	Low	Unlikely	Negligible	Low
Regulatory & Environmental (RE)									
RE1	Permitting	Timely acquisition	construction schedule delays awaiting permits REPEAT??	Unlikely	Negligible	Low	Unlikely	Negligible	Low
RE2	Multi-Agency Coordination	Consensus needed among agencies to coordinate the entire project.	Costal Commission, Orange County, the State of California, Fish and Wildlife, and others require coordination. This is more of a study phase risk. This coordination will be addressed before PED.	Possible	Negligible	Low	Possible	Marginal	Low

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EX4	Sales Tax	Increased material cost	Potential Increase in sales tax	Possible	Marginal	Low	Unlikely	Negligible	Low
EX5	Best Practices	Agencies establish best practices which drive design. For example, flood stages and other factors (driving the design) may change.	This may be a risk for the LPP. It would impact the cost of the LPP. Not likely to happen, but if it does, there would be a significant re-design for this and all other similar projects. THIS RISK IS A SHOW STOPPER	Unlikely	Marginal	Low	Unlikely	Negligible	Low

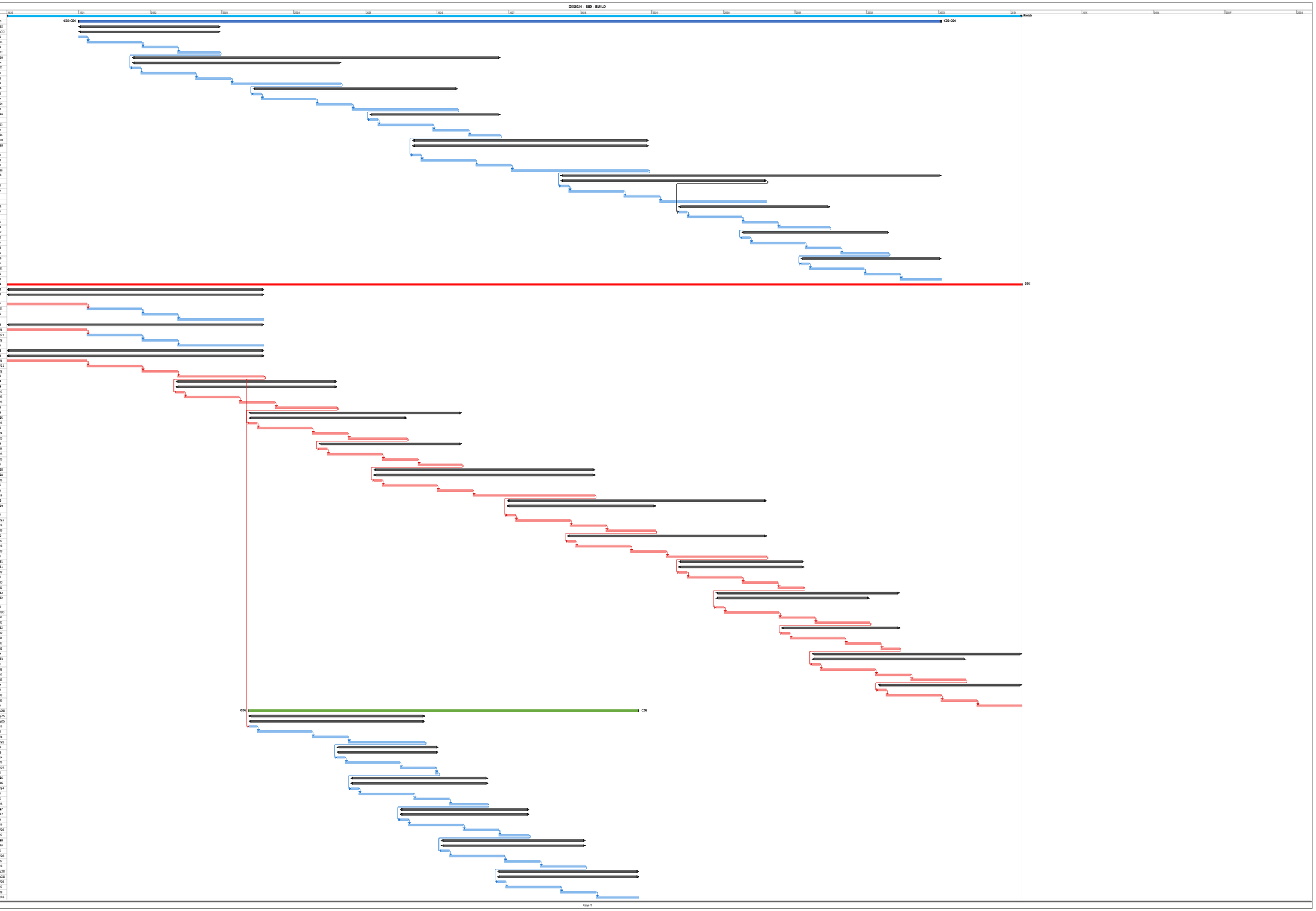
END

5.6 Construction Schedule

PROJECT SCHEDULE:

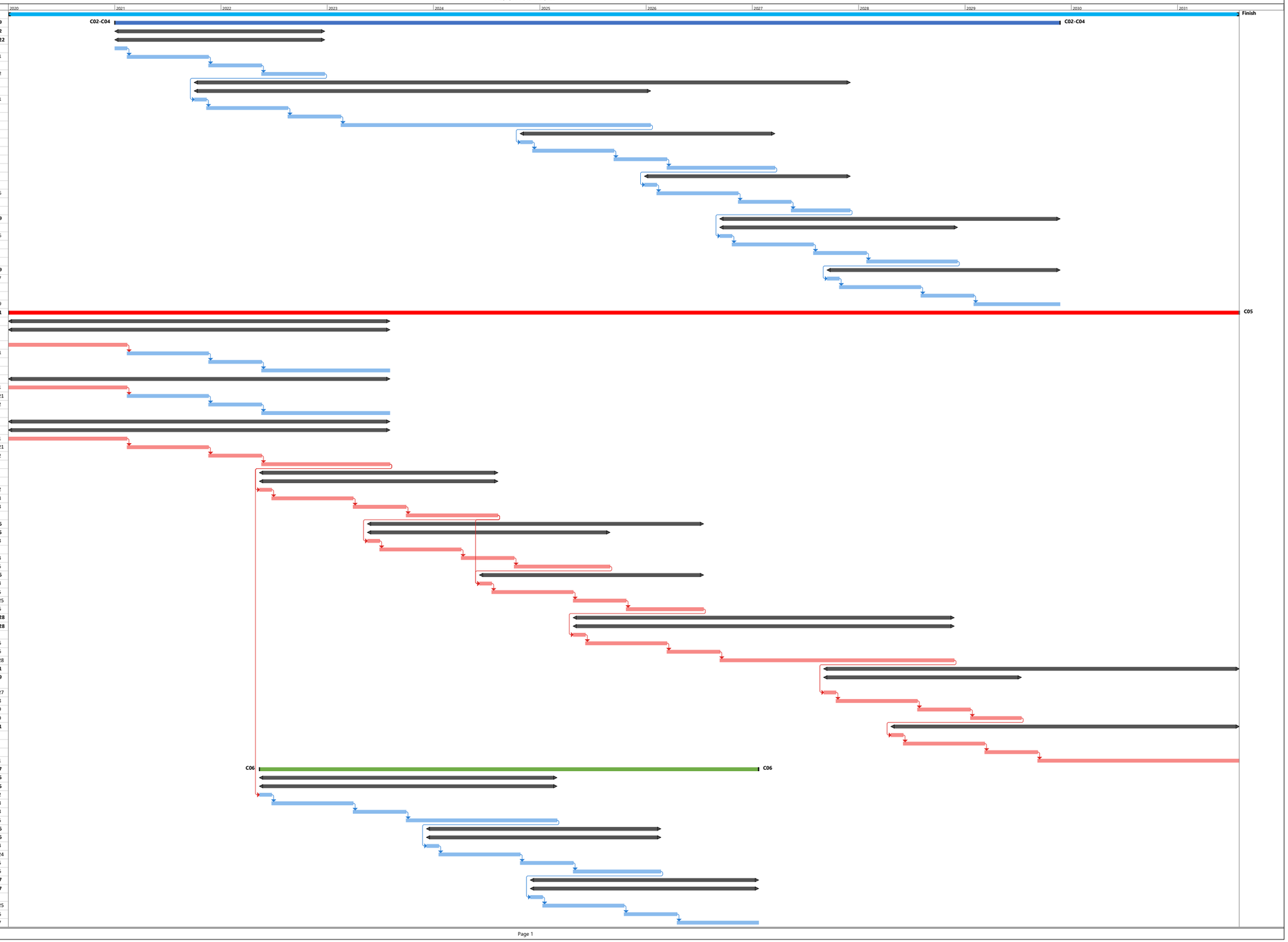
DESIGN - BID - BUILD

ID	Task Name	Duration	Start	Finish
1	**Westminster Watershed Project_LPP**	**3697 days**	**Wed 1/1/20**	**Thu 3/2/34**
2	**C02-C04**	**3140 days**	Fri 1/1/21	**Thu 1/3/33**
3	**REACH 23_C02**	**515 days**	**Fri 1/1/21**	**Thu 12/22/22**
4	**Huntington Harbour to C04**	**515 days**	**Fri 1/1/21**	**Thu 12/22/22**
5	Preliminary Engineering & Design	6 wks	Fri 1/1/21	Thu 2/11/21
6	Design	40 wks	Fri 2/12/21	Thu 11/18/21
7	Advertise & Award	26 wks	Fri 11/19/21	Thu 5/18/22
8	Construction	31 wks	Fri 5/20/22	Thu 12/22/22
9	**REACH 20_C04**	**1340 days**	**Fri 10/1/21**	**Thu 11/19/26**
10	**Balsa Chica to Springdale/Edinger**	**760 days**	**Fri 10/1/21**	**Thu 8/29/24**
11	Preliminary Engineering & Design	6 wks	Fri 10/1/21	Thu 11/11/21
12	Design	40 wks	Fri 11/12/21	Thu 8/18/22
13	Advertise & Award	26 wks	Fri 8/19/22	Thu 2/16/23
14	Construction	80 wks	Fri 2/17/23	Thu 8/29/24
15	**Springdale/Edinger to D/S Balsa Ave**	**745 days**	**Fri 4/6/23**	**Thu 4/16/26**
16	Preliminary Engineering & Design	6 wks	Fri 4/8/23	Thu 7/20/23
17	Design	40 wks	Fri 7/21/23	Thu 4/26/24
18	Advertise & Award	26 wks	Fri 4/26/24	Thu 10/24/24
19	Construction	77 wks	Fri 10/25/24	Thu 4/16/26
20	**D/S Balsa Ave to U/S Edwards**	**475 days**	**Fri 1/24/25**	**Thu 11/19/26**
21	Preliminary Engineering & Design	6 wks	Fri 1/24/25	Thu 3/6/25
22	Design	40 wks	Fri 3/7/25	Thu 12/11/25
23	Advertise & Award	26 wks	Fri 12/12/25	Thu 6/11/26
24	Construction	23 wks	Fri 6/12/26	Thu 11/19/26
25	**REACH 21_C04**	**860 days**	**Fri 8/29/25**	**Thu 12/14/28**
26	**DIVERSION: U/S Edwards St. to D/S Hoover St.**	**860 days**	**Fri 8/29/25**	**Thu 12/14/28**
27	Preliminary Engineering & Design	6 wks	Fri 8/29/25	Thu 10/9/25
28	Design	40 wks	Fri 10/10/25	Thu 7/16/26
29	Advertise & Award	26 wks	Fri 7/17/26	Thu 1/14/27
30	Construction	100 wks	Fri 1/15/27	Thu 12/14/28
31	**REACH 22_C04**	**1185 days**	**Fri 9/24/27**	**Thu 1/13/33**
32	**D/S Beach Blvd. to U/S Magnolia**	**750 days**	**Fri 9/24/27**	**Thu 8/8/30**
33	Preliminary Engineering & Design	6 wks	Fri 9/24/27	Thu 11/4/27
34	Design	40 wks	Fri 11/5/27	Thu 8/30/28
35	Advertise & Award	26 wks	Fri 8/31/28	Thu 2/8/29
36	Construction	78 wks	Fri 2/9/29	Thu 8/8/30
37	**D/S Brookhurst to U/S Ward**	**550 days**	**Fri 5/18/29**	**Thu 6/26/31**
38	Preliminary Engineering & Design	6 wks	Fri 5/18/29	Thu 6/28/29
39	Design	40 wks	Fri 6/29/29	Thu 4/4/30
40	Advertise & Award	26 wks	Fri 4/5/30	Thu 10/3/30
41	Construction	38 wks	Fri 10/4/30	Thu 6/26/31
42	**U/S Ward to U/S Westminster**	**535 days**	**Fri 4/5/30**	**Thu 4/22/32**
43	Preliminary Engineering & Design	6 wks	Fri 4/5/30	Thu 5/16/30
44	Design	40 wks	Fri 5/17/30	Fri 2/20/31
45	Advertise & Award	26 wks	Fri 2/21/31	Thu 8/21/31
46	Construction	35 wks	Fri 8/22/31	Thu 4/22/32
47	**U/S Westminster to SR-22**	**510 days**	**Fri 1/31/31**	**Thu 1/14/33**
48	Preliminary Engineering & Design	6 wks	Fri 1/31/31	Thu 3/13/31
49	Design	40 wks	Fri 3/14/31	Thu 12/18/31
50	Advertise & Award	26 wks	Fri 12/19/31	Thu 6/17/32
51	Construction	30 wks	Fri 6/18/32	Thu 1/13/33
52	**C05**	**3697 days**	**Wed 1/1/20**	**Thu 3/2/34**
53	**REACH 1a**	**937 days**	**Wed 1/1/20**	**Thu 8/3/23**
54	**Warner Ave Bridge and Huntington Harbour Armoring**	**937 days**	**Wed 1/1/20**	**Thu 8/3/23**
55	Preliminary Engineering & Design	58.4 wks	Wed 1/1/20	Thu 2/11/21
56	Design	40 wks	Fri 2/12/21	Thu 11/18/21
57	Advertise & Award	26 wks	Fri 11/19/21	Thu 5/18/22
58	Construction	63 wks	Fri 5/20/22	Thu 8/3/23
59	**Tidegates to 2600' D/S Graham**	**937 days**	**Wed 1/1/20**	**Thu 8/3/23**
60	Preliminary Engineering & Design	58.4 wks	Wed 1/1/20	Thu 2/11/21
61	Design	40 wks	Fri 2/12/21	Thu 11/18/21
62	Advertise & Award	26 wks	Fri 11/19/21	Thu 5/19/22
63	Construction	63 wks	Fri 5/20/22	Thu 8/3/23
64	**REACH 1b**	**937 days**	**Wed 1/1/20**	**Thu 8/3/23**
65	**U/S Warner to D/S Goldenwest**	**937 days**	**Wed 1/1/20**	**Thu 8/3/23**
66	Preliminary Engineering & Design	58.4 wks	Wed 1/1/20	Thu 2/11/21
67	Design	40 wks	Fri 2/12/21	Thu 11/18/21
68	Advertise & Award	26 wks	Fri 11/19/21	Thu 5/19/22
69	Construction	63 wks	Fri 5/20/22	Thu 8/3/23
70	**REACH 2**	**585 days**	**Fri 5/13/22**	**Thu 8/8/24**
71	**U/S Goldenwest to D/S Gothard**	**585 days**	**Fri 5/13/22**	**Thu 8/8/24**
72	Preliminary Engineering & Design	6 wks	Fri 5/13/22	Thu 6/23/22
73	Design	40 wks	Fri 6/24/22	Thu 3/30/23
74	Advertise & Award	26 wks	Fri 3/31/23	Thu 9/28/23
75	Construction	45 wks	Fri 9/29/23	Thu 8/8/24
76	**REACH 3**	**775 days**	**Fri 9/19/23**	**Thu 5/7/26**
77	**C06 Confluence to U/S Beach**	**575 days**	**Fri 9/19/23**	**Thu 7/31/25**
78	Preliminary Engineering & Design	6 wks	Fri 9/19/23	Thu 8/29/23
79	Design	40 wks	Fri 8/30/23	Thu 4/4/24
80	Advertise & Award	26 wks	Fri 4/5/24	Thu 10/3/24
81	Construction	43 wks	Fri 10/4/24	Thu 7/31/25
82	**U/S Beach to Woodruff**	**520 days**	**Fri 5/10/24**	**Thu 5/7/26**
83	Preliminary Engineering & Design	6 wks	Fri 5/10/24	Thu 6/20/24
84	Design	40 wks	Fri 6/21/24	Thu 3/27/25
85	Advertise & Award	26 wks	Fri 3/28/25	Thu 9/25/25
86	Construction	32 wks	Fri 9/26/25	Thu 5/7/26
87	**REACH 4**	**805 days**	**Fri 2/14/25**	**Thu 3/16/28**
88	**U/S Quarte to D/S Brookhurst**	**805 days**	**Fri 2/14/25**	**Thu 3/16/28**
89	Preliminary Engineering & Design	6 wks	Fri 2/14/25	Thu 3/27/25
90	Design	40 wks	Fri 3/28/25	Thu 1/5/26
91	Advertise & Award	26 wks	Fri 1/6/26	Thu 7/2/26
92	Construction	89 wks	Fri 7/3/26	Thu 3/16/28
93	**REACH 5**	**945 days**	**Fri 12/25/26**	**Thu 8/8/30**
94	**U/S McFadden/Brookhurst to U/S Ward**	**540 days**	**Fri 12/25/26**	**Thu 1/18/29**
95	Preliminary Engineering & Design	6 wks	Fri 12/25/26	Thu 2/4/27
96	Design	40 wks	Fri 2/5/27	Thu 11/11/27
97	Advertise & Award	26 wks	Fri 11/12/27	Thu 5/11/28
98	Construction	36 wks	Fri 5/12/28	Thu 1/18/29
99	**U/S Ward to U/S 1st (Bolsa)**	**725 days**	**Fri 10/29/27**	**Thu 8/8/30**
100	Preliminary Engineering & Design	6 wks	Fri 10/29/27	Thu 12/9/27
101	Design	40 wks	Fri 12/10/27	Thu 9/14/28
102	Advertise & Award	26 wks	Fri 9/15/28	Thu 3/15/29
103	Construction	73 wks	Fri 3/16/29	Thu 8/8/30
104	**REACH 6**	**455 days**	**Fri 5/18/29**	**Thu 2/13/31**
105	**U/S 1st to 900' D/S Hazard**	**455 days**	**Fri 5/18/29**	**Thu 2/13/31**
106	Preliminary Engineering & Design	6 wks	Fri 5/18/29	Thu 6/28/29
107	Design	40 wks	Fri 6/29/29	Thu 4/4/30
108	Advertise & Award	26 wks	Fri 4/5/30	Thu 10/3/30
109	Construction	19 wks	Fri 10/4/30	Thu 2/13/31
110	**REACH 8**	**670 days**	**Fri 11/23/29**	**Thu 8/17/32**
111	**D/S Hazard/Newhope to U/S Westminster**	**560 days**	**Fri 11/23/29**	**Thu 1/15/32**
112	Preliminary Engineering & Design	6 wks	Fri 11/23/29	Thu 1/3/30
113	Design	40 wks	Fri 1/4/30	Thu 10/30/30
114	Advertise & Award	26 wks	Fri 10/31/30	Thu 4/30/31
115	Construction	40 wks	Fri 4/1/31	Thu 1/15/32
116	**U/S Westminster to OCTA**	**430 days**	**Fri 10/25/30**	**Thu 6/17/32**
117	Preliminary Engineering & Design	6 wks	Fri 10/25/30	Thu 12/5/30
118	Design	40 wks	Fri 12/6/30	Thu 9/11/31
119	Advertise & Award	26 wks	Fri 9/12/31	Thu 3/11/32
120	Construction	14 wks	Fri 3/12/32	Thu 6/17/32
121	**REACH 9**	**765 days**	**Fri 3/28/31**	**Thu 3/2/34**
122	**OCTA to U/S Trask**	**560 days**	**Fri 3/28/31**	**Thu 1/19/33**
123	Preliminary Engineering & Design	6 wks	Fri 3/28/31	Thu 5/8/31
124	Design	40 wks	Fri 5/9/31	Thu 2/12/32
125	Advertise & Award	26 wks	Fri 2/13/32	Thu 8/12/32
126	Construction	40 wks	Fri 8/13/32	Thu 5/19/33
127	**U/S Trask to U/S Aspenwood Ln.**	**525 days**	**Fri 2/27/32**	**Thu 3/2/34**
128	Preliminary Engineering & Design	6 wks	Fri 2/27/32	Thu 4/8/32
129	Design	40 wks	Fri 4/9/32	Thu 1/13/33
130	Advertise & Award	26 wks	Fri 1/14/33	Thu 7/14/33
131	Construction	33 wks	Fri 7/15/33	Thu 3/2/34
132	**C06**	**1420 days**	**Fri 5/19/23**	**Thu 10/26/28**
133	**REACH 13**	**640 days**	**Fri 5/19/23**	**Thu 10/30/25**
134	**U/S Beach to D/S Ross**	**640 days**	**Fri 5/19/23**	**Thu 10/30/25**
135	Preliminary Engineering & Design	6 wks	Fri 5/19/23	Thu 6/29/23
136	Design	40 wks	Fri 6/30/23	Thu 4/4/24
137	Advertise & Award	26 wks	Fri 4/5/24	Thu 10/3/24
138	Construction	56 wks	Fri 10/4/24	Thu 10/30/25
139	**REACH 14**	**370 days**	**Fri 8/9/24**	**Thu 1/8/26**
140	**U/S Ruart to R15**	**370 days**	**Fri 8/9/24**	**Thu 1/8/26**
141	Preliminary Engineering & Design	6 wks	Fri 8/9/24	Thu 9/19/24
142	Design	40 wks	Fri 9/20/24	Thu 6/26/25
143	Advertise & Award	26 wks	Fri 6/27/25	Thu 12/25/25
144	Construction	2 wks	Fri 12/26/25	Thu 1/8/26
145	**REACH 15**	**500 days**	**Fri 10/18/24**	**Thu 9/17/26**
146	**U/S Ruart to I-405**	**500 days**	**Fri 10/18/24**	**Thu 9/17/26**
147	Preliminary Engineering & Design	6 wks	Fri 10/18/24	Thu 11/28/24
148	Design	40 wks	Fri 11/29/24	Thu 9/4/25
149	Advertise & Award	26 wks	Fri 9/5/25	Thu 3/5/26
150	Construction	28 wks	Fri 3/6/26	Thu 9/17/26
151	**REACH 16**	**470 days**	**Fri 6/27/25**	**Thu 4/15/27**
152	**U/S I-405 to D/S Bushard**	**470 days**	**Fri 6/27/25**	**Thu 4/15/27**
153	Preliminary Engineering & Design	6 wks	Fri 6/27/25	Thu 8/7/25
154	Design	40 wks	Fri 8/8/25	Thu 5/14/26
155	Advertise & Award	26 wks	Fri 5/15/26	Thu 11/12/26
156	Construction	22 wks	Fri 11/13/26	Thu 4/15/27
157	**REACH 17**	**525 days**	**Fri 1/23/26**	**Thu 1/27/28**
158	**D/S Bushard to D/S Brookhurst**	**525 days**	**Fri 1/23/26**	**Thu 1/27/28**
159	Preliminary Engineering & Design	6 wks	Fri 1/23/26	Thu 3/5/26
160	Design	40 wks	Fri 3/6/26	Thu 12/10/26
161	Advertise & Award	26 wks	Fri 12/11/26	Thu 6/10/27
162	Construction	33 wks	Fri 6/11/27	Thu 1/27/28
163	**REACH 19**	**515 days**	**Fri 11/6/26**	**Thu 10/26/28**
164	**U/S Euclid to D/S Newhope**	**515 days**	**Fri 11/6/26**	**Thu 10/26/28**
165	Preliminary Engineering & Design	6 wks	Fri 11/6/26	Thu 12/17/26
166	Design	40 wks	Fri 12/18/26	Thu 9/23/27
167	Advertise & Award	26 wks	Fri 9/24/27	Thu 3/23/28
168	Construction	31 wks	Fri 3/24/28	Thu 10/26/28



PROJECT SCHEDULE: **DESIGN - BID - BUILD**

ID	Task Name	Duration	Start	Finish
1	**Westminster Watershed Project_NED**	**3022 days**	**Wed 1/1/20**	**Thu 7/31/31**
2	**C02-C04**	**2320 days**	**Fri 1/1/21**	**Thu 11/22/29**
3	**REACH 23_C02**	**515 days**	**Fri 1/1/21**	**Thu 12/22/22**
4	**Huntington Harbour to C04**	**515 days**	**Fri 1/1/21**	**Thu 12/22/22**
5	Preliminary Engineering & Design	6 wks	Fri 1/1/21	Thu 2/11/21
6	Design	40 wks	Fri 2/12/21	Thu 11/18/21
7	Advertise & Award	26 wks	Fri 11/19/21	Thu 5/19/22
8	Construction	31 wks	Fri 5/20/22	Thu 12/22/22
9	**REACH 20_C04**	**1610 days**	**Fri 10/1/21**	**Thu 12/2/27**
10	**Bolsa Chica to McFadden Ave**	**1120 days**	**Fri 10/1/21**	**Thu 1/15/26**
11	Preliminary Engineering & Design	6 wks	Fri 10/1/21	Thu 11/11/21
12	Design	40 wks	Fri 11/12/21	Thu 8/18/22
13	Advertise & Award	26 wks	Fri 8/19/22	Thu 2/16/23
14	Construction	152 wks	Fri 2/17/23	Thu 1/15/26
15	**McFadden Ave to D/S Bolsa Ave**	**625 days**	**Fri 10/25/24**	**Thu 3/18/27**
16	Preliminary Engineering & Design	6 wks	Fri 10/25/24	Thu 12/5/24
17	Design	40 wks	Fri 12/6/24	Thu 9/11/25
18	Advertise & Award	26 wks	Fri 9/12/25	Thu 3/12/26
19	Construction	53 wks	Fri 3/13/26	Thu 3/18/27
20	**D/S Bolsa Ave to U/S Edwards**	**505 days**	**Fri 12/26/25**	**Thu 12/2/27**
21	Preliminary Engineering & Design	6 wks	Fri 12/26/25	Thu 2/5/26
22	Design	40 wks	Fri 2/6/26	Thu 11/12/26
23	Advertise & Award	26 wks	Fri 11/13/26	Thu 5/13/27
24	Construction	29 wks	Fri 5/14/27	Thu 12/2/27
25	**REACH 22_C04**	**835 days**	**Fri 9/11/26**	**Thu 11/22/29**
26	**D/S Brookhurst to U/S Ward**	**582.5 days**	**Fri 9/11/26**	**Tue 12/5/28**
27	Preliminary Engineering & Design	6 wks	Fri 9/11/26	Thu 10/22/26
28	Design	40 wks	Fri 10/23/26	Thu 7/29/27
29	Advertise & Award	26 wks	Fri 7/30/27	Thu 1/27/28
30	Construction	44.5 wks	Fri 1/28/28	Tue 12/5/28
31	**U/S Ward to U/S Westminster**	**572.5 days**	**Tue 9/14/27**	**Thu 11/22/29**
32	Preliminary Engineering & Design	6 wks	Tue 9/14/27	Tue 10/26/27
33	Design	40 wks	Tue 10/26/27	Tue 8/1/28
34	Advertise & Award	26 wks	Tue 8/1/28	Tue 1/30/29
35	Construction	42.5 wks	Tue 1/30/29	Thu 11/22/29
36	**C05**	**3022 days**	**Wed 1/1/20**	**Thu 7/31/31**
37	**REACH 1a**	**937 days**	**Wed 1/1/20**	**Thu 8/3/23**
38	**Warner Ave Bridge and Huntington Harbour Armoring**	**937 days**	**Wed 1/1/20**	**Thu 8/3/23**
39	Preliminary Engineering & Design	58.4 wks	Wed 1/1/20	Thu 2/11/21
40	Design	40 wks	Fri 2/12/21	Thu 11/18/21
41	Advertise & Award	26 wks	Fri 11/19/21	Thu 5/19/22
42	Construction	63 wks	Fri 5/20/22	Thu 8/3/23
43	**Tidegates to 2600' D/S Graham**	**937 days**	**Wed 1/1/20**	**Thu 8/3/23**
44	Preliminary Engineering & Design	58.4 wks	Wed 1/1/20	Thu 2/11/21
45	Design	40 wks	Fri 2/12/21	Thu 11/18/21
46	Advertise & Award	26 wks	Fri 11/19/21	Thu 5/19/22
47	Construction	63 wks	Fri 5/20/22	Thu 8/3/23
48	**REACH 1b**	**937 days**	**Wed 1/1/20**	**Thu 8/3/23**
49	**U/S Warner to D/S Goldenwest**	**937 days**	**Wed 1/1/20**	**Thu 8/3/23**
50	Preliminary Engineering & Design	58.4 wks	Wed 1/1/20	Thu 2/11/21
51	Design	40 wks	Fri 2/12/21	Thu 11/18/21
52	Advertise & Award	26 wks	Fri 11/19/21	Thu 5/19/22
53	Construction	63 wks	Fri 5/20/22	Thu 8/3/23
54	**REACH 2**	**585 days**	**Fri 5/13/22**	**Thu 8/8/24**
55	**U/S Goldenwest to D/S Gothard**	**585 days**	**Fri 5/13/22**	**Thu 8/8/24**
56	Preliminary Engineering & Design	6 wks	Fri 5/13/22	Thu 6/23/22
57	Design	40 wks	Fri 6/24/22	Thu 3/30/23
58	Advertise & Award	26 wks	Fri 3/31/23	Thu 9/28/23
59	Construction	45 wks	Fri 9/29/23	Thu 8/8/24
60	**REACH 3**	**825 days**	**Fri 5/19/23**	**Thu 7/16/26**
61	**C06 Confluence to U/S Beach**	**595 days**	**Fri 5/19/23**	**Thu 8/28/25**
62	Preliminary Engineering & Design	6 wks	Fri 5/19/23	Thu 6/29/23
63	Design	40 wks	Fri 6/30/23	Thu 4/4/24
64	Advertise & Award	26 wks	Fri 4/5/24	Thu 10/3/24
65	Construction	47 wks	Fri 10/4/24	Thu 8/28/25
66	**U/S Beach to 405**	**550 days**	**Fri 6/7/24**	**Thu 7/16/26**
67	Preliminary Engineering & Design	6 wks	Fri 6/7/24	Thu 7/18/24
68	Design	40 wks	Fri 7/19/24	Thu 4/24/25
69	Advertise & Award	26 wks	Fri 4/25/25	Thu 10/23/25
70	Construction	38 wks	Fri 10/24/25	Thu 7/16/26
71	**REACH 4**	**935 days**	**Fri 4/25/25**	**Thu 11/23/28**
72	**U/S Quartz to D/S Brookhurst**	**935 days**	**Fri 4/25/25**	**Thu 11/23/28**
73	Preliminary Engineering & Design	6 wks	Fri 4/25/25	Thu 6/5/25
74	Design	40 wks	Fri 6/6/25	Thu 3/12/26
75	Advertise & Award	26 wks	Fri 3/13/26	Thu 9/10/26
76	Construction	115 wks	Fri 9/11/26	Thu 11/23/28
77	**REACH 5**	**1020 days**	**Fri 9/3/27**	**Thu 7/31/31**
78	**U/S McFadden/Brookhurst to U/S Ward**	**485 days**	**Fri 9/3/27**	**Thu 7/12/29**
79	Preliminary Engineering & Design	6 wks	Fri 9/3/27	Thu 10/14/27
80	Design	40 wks	Fri 10/15/27	Thu 7/20/28
81	Advertise & Award	26 wks	Fri 7/21/28	Thu 1/18/29
82	Construction	25 wks	Fri 1/19/29	Thu 7/12/29
83	**U/S Ward to U/S 1st (Bolsa)**	**855 days**	**Fri 4/21/28**	**Thu 7/31/31**
84	Preliminary Engineering & Design	6 wks	Fri 4/21/28	Thu 6/1/28
85	Design	40 wks	Fri 6/2/28	Thu 3/8/29
86	Advertise & Award	26 wks	Fri 3/9/29	Thu 9/6/29
87	Construction	99 wks	Fri 9/7/29	Thu 7/31/31
88	**C06**	**1225 days**	**Fri 5/13/22**	**Thu 1/21/27**
89	**REACH 13**	**730 days**	**Fri 5/13/22**	**Thu 2/27/25**
90	**U/S Beach to D/S Ross**	**730 days**	**Fri 5/13/22**	**Thu 2/27/25**
91	Preliminary Engineering & Design	6 wks	Fri 5/13/22	Thu 6/23/22
92	Design	40 wks	Fri 6/24/22	Thu 3/30/23
93	Advertise & Award	26 wks	Fri 3/31/23	Thu 9/28/23
94	Construction	74 wks	Fri 9/29/23	Thu 2/27/25
95	**REACH 17**	**575 days**	**Fri 12/8/23**	**Thu 2/19/26**
96	**D/S Bushard to D/S Brookhurst**	**575 days**	**Fri 12/8/23**	**Thu 2/19/26**
97	Preliminary Engineering & Design	6 wks	Fri 12/8/23	Thu 1/18/24
98	Design	40 wks	Fri 1/19/24	Thu 10/24/24
99	Advertise & Award	26 wks	Fri 10/25/24	Thu 4/24/25
100	Construction	43 wks	Fri 4/25/25	Thu 2/19/26
101	**REACH 19**	**560 days**	**Fri 11/29/24**	**Thu 1/21/27**
102	**U/S Euclid to D/S Newhope**	**560 days**	**Fri 11/29/24**	**Thu 1/21/27**
103	Preliminary Engineering & Design	6 wks	Fri 11/29/24	Thu 1/9/25
104	Design	40 wks	Fri 1/10/25	Thu 10/16/25
105	Advertise & Award	26 wks	Fri 10/17/25	Thu 4/16/26
106	Construction	40 wks	Fri 4/17/26	Thu 1/21/27



5.7 Construction Cost Estimate - MCACES (MII) Reports

Westminister - East Garden Grove_FEAS_NED Formulation

Minimum Channel Improvements focus on improving the efficiency of the C056/C06 anc C02/C04 channel systems by replacing all riprap with concrete and lining exisitng earthen channels with concrete. Existing concrete channel sections remain in place. The existing channel geometry is maintained in all reaches. All work is confined within the existing righ-of-way to prevent impacts to structures adjacent to the channel. Typical channel right-of-way width is the top width of the channel + 15ft for reaches with a single accress road and the top width of the channel + 30 feet for reaches with an access road on each bank of the channel. The existing invert elevation is maintained due to the limited change in elevation across the watershed

Estimated by	LRC
Designed by	LRC
Prepared by	USACE
Preparation Date	9/9/2019

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Designed by
LRC
Estimated by
LRC
Prepared by
USACE

Design Document	Westminster Excised Scope from Report for Cost ATR
Document Date	8/22/2019
District	Chicago
Contact	Jeremiah Gadbois 312.846.5464
Budget Year	2020
UOM System	Original

Direct Costs
LaborCost
EQCost
MatlCost
SubBidCost
UserCost1
UserCost2
UserCost3
UserCost4
UserCost5

Timeline/Currency

Preparation Date	9/9/2019
Escalation Date	9/30/2026
Eff. Pricing Date	9/30/2026
Estimated Duration	365 Day(s)
Currency	US dollars
Exchange Rate	1.000000

Costbook CB16EN: 2016 MII English Cost Book

Labor CAOr072619: July 2019 - Orange County, CA

tp://www.wdol.gov/ (A web site address to find these wage rates.) is the website where these labor wage rates may be obtained. Fringes paid to the laborers are taxable. In a non-union job the whole

Labor Rates
LaborCost1
LaborCost2
LaborCost3
LaborCost4

Equipment EP16R07: MII Equipment 2016 Region 07

07 WEST

Sales Tax	7.95
Working Hours per Year	1,630
Labor Adjustment Factor	1.00
Cost of Money	2.63
Cost of Money Discount	25.00
Tire Recap Cost Factor	1.50
Tire Recap Wear Factor	1.80
Tire Repair Factor	0.15
Equipment Cost Factor	1.00
Standby Depreciation Factor	0.50

Fuel

Electricity	0.112
Gas	3.635
Diesel Off-Road	3.097
Diesel On-Road	3.973

Shipping Rates

Over 0 CWT	28.91
Over 240 CWT	21.98
Over 300 CWT	18.50
Over 400 CWT	16.24
Over 500 CWT	19.65
Over 700 CWT	18.73
Over 800 CWT	10.52

Date	Author	Note
8/7/2018	LRC JDG	Updated Cost Book 2016
8/7/2018	LRC JDG	Updated Equipment Library to 2016 Region 07
8/7/2018	LRC JDG	Updated Labor Library to Orange County, CA 21-MAY-2018 and reduced labor adjustment factor to 1
8/7/2018	LRC JDG	Updated Fuel (Gasoline and Diesel) per LA, CA and CA respectively per EIA fuel report 21-MAY-2018 https://www.eia.gov/petroleum/gasdiesel/
8/7/2018	LRC JDG	Updated Off-road Diesel to EIA rates less CA State & Fed tax (-$0.8756 per gal)
8/7/2018	LRC JDG	Cost of Money Updated per US Dept of Treasury Prompt Pay Interest Rate (2.625) Jan-18 to Jun-18
8/7/2018	LRC JDG	A690 PZ-35 SSP Pricing updated per LB Foster and Skyline Steel quotes for Southern California MAY 2018 from $34/SF to $30/SF to include pricing for misc cap, connection bolts, and splice material.
8/7/2018	LRC JDG	Concrete material pricing updated per typ 4000 psi mix design 3 vendor Avg per MAY-2018 local redi-mix quotes (includes AB219 Teamster haul rate) $110 (was $82.50/CY)
9/4/2019	Profit	Degree of Risk: 0.07 Relative Difficulty of Work: 0.075 Size of Job: 0.03 Period of Performance: 0.12 Contractor's Investment: 0.07 Assistance by Government: 0.12 Subcontracting: 0.12

Description	ProjectCost
Project Items	**278,011,081.23**
02 RELOCATIONS (UTILITIES)	**2,304,383.16**
02 03 CEMETERIES, UTILITIES, AND STRUCTURES, Construction Activities	**2,304,383.16**
BRIDGE & CROSSING UTILITIES	**967,377.05**
WIDEN WARNER AVE & HUNTINGTON HARBOR ARMORING UTILITIES	**166,308.96**
Relocate Utilities & Poles	**166,308.96**
C05 CROSSING UTILITIES	**801,068.09**
R01	**801,068.09**
CHANNEL UTILITIES	**1,337,006.12**
C05 CHANNEL UTILITIES	**772,324.26**
C05_REACH 1 - 9506 LF (1.80 miles)	**258,919.69**
C05_REACH 2 - 4081 LF (0.77 miles)	**319,527.62**
C05_REACH 3 - 4,849 LF (0.92 miles)	**56,543.35**
C05_REACH 4 - 6,560 LF (1.24 miles)	**68,518.17**
C05_REACH 5 - 7,071 LF (1.34 miles)	**68,815.42**
C06 CHANNEL UTILITIES	**165,951.14**
C06_REACH 13 - 6,004 LF (1.14 miles)	**46,616.53**
C06_REACH 17 - 2,478 LF (0.47 miles)	**43,639.57**
C06_REACH 19 - 2,303 LF (0.44 miles)	**75,695.05**
C04 CHANNEL UTILITIES	**169,743.73**
C04_REACH 20 - 13,364 LF (2.53 miles)	**114,155.52**
C04_REACH 22 - 4,964 LF (0.94 miles)	**55,588.21**
C02 CHANNEL UTILITIES	**228,986.99**
C02_REACH 23 - 10,285 LF (1.95 miles)	**228,986.99**
02 RELOCATION (BRIDGES & CROSSINGS)	**37,398,432.92**
WIDEN WARNER AVE & HUNTINGTON HARBOR ARMORING	**21,064,320.57**
Mob and Demob - 5%	**1,352,773.47**
TRAFFIC CONTROL	**1,331,903.12**
SWPP (assumes 1% of construction)	**270,554.69**
Demo (EX) Bridge	**1,055,109.16**

Description	ProjectCost
Bridge	159,797.12
Load, Haul & Disposal	711,456.10
Remove AC/AB and Haul Out	181,626.70
Surface Removal - AC - Road	6,798.93
Load, Haul & Disposal	174,827.77
Demolition	2,229.24
Channel Excavation	3,613,874.93
Rock Berm Install & Removal	456,019.16
Channel Excavation & Haul	1,233,473.42
Slope Protection	384,167.73
Care and Diversion of Water	1,540,214.62
Mob and Demob	23,203.73
Install and develop Wells	1,225,669.99
Install Eductor Pump Station Equipment	71,311.71
Pipe Installation	23,784.85
Operation	196,244.34
New Bridge Structure	1,419,048.65
Dewatering	376,051.08
Abutment Construction	131,029.69
Pile and Bent Construction	324,008.31
Bridge Deck	365,685.65
Pedestrian Path and Parapet Wall	222,273.92
Road & Parking Raise	6,394,066.49
Pavement Demolition	42,324.40
Surface Removal - AC - Road	9,894.28
Hauling Requirment	32,430.12
Fill Placement	2,228,450.73
Material & Haul	1,964,365.64
ABC for Paving and Sidewalk (Aggregate Base Course)	1,992,908.74
Asphalt Concrete Paving, thickness various	2,023,096.64

Description	ProjectCost
Pavement Striping	70,738.06
Gaurd Rail	36,547.92
Harbor Wall Armoring	5,626,990.05
Place Armor Stone (First 20,000 Tons)	5,459,700.10
Marine Mobilization	167,289.95
C05 CROSSINGS	16,334,112.35
R01	16,334,112.35
Crossing TYP 40 SPECIAL_08 - Roads, Railroads & Bridges	2,322,842.01
Mob, Demob & Site Prep	75,420.43
Traffic Control	107,117.79
Earthwork	25,688.24
Bridge Work	1,993,581.30
Roadway and Site Work	107,779.17
RipRap	13,255.09
Crossing TYP 60_08 - Roads, Railroads, & Bridges	2,854,911.52
Demolition	2,229.24
Replace	2,852,682.28
Crossing TYP 40_08 - Roads, Railroads & Bridges	7,913,066.62
Mob, Demob & Site Prep	368,051.68
Traffic Control	522,734.80
Demolition	1,584,681.06
Earthwork	112,518.68
Bridge Work	4,879,938.67
Roadway and Site Work	445,141.74
Crossing TYP 40_08 - Roads, Railroads & Bridges	3,243,292.20
Mob, Demob & Site Prep	150,840.85
Traffic Control	214,235.57
Demolition	649,526.03
Earthwork	46,127.48
Bridge Work	2,000,127.12

Description	ProjectCost
Roadway and Site Work	182,435.14
09 CHANNELS & CANALS	236,126,501.50
C05 CHANNEL	173,061,640.57
C05_REACH 1 - 9506 LF (1.80 miles)	129,459,846.46
09 01 CHANNELS	129,459,846.46
MOB/DEMOB	3,770,675.14
SWPPP	169,472.28
TRAFFIC CONTROL	625,743.79
DUST CONTROL	346,825.90
DEWATERING	874,433.80
CLEAR SITE AND REMOVE OBSTRUCTIONS	104,712.25
CONCRETE REMOVAL	2,385,663.28
SHEET PILE REMOVAL	385,491.99
EXCAVATION	8,836,275.49
TEMPORARY SHORING	2,459,067.33
SUBSURFACE DRAIN	1,159,479.32
AGGREGATE BASE LAYER	6,167,209.94
SHEET PILE & SOIL-CEMENT MIXING COLUMNS	88,533,561.94
REINFORCED STEEL	3,240,803.97
CONCRETE VOLUME	9,487,188.40
COMPACTED FILL	329,975.40
CHAIN LINK FENCE	583,266.24
C05_REACH 2 - 3,389 LF (0.64 miles)	17,751,534.40
09 01 CHANNELS	17,751,534.40
MOB/DEMOB	845,311.16
SWPPP	60,418.85
TRAFFIC CONTROL	223,084.97
DUST CONTROL	123,647.48
DEWATERING	376,580.78
CLEAR SITE AND REMOVE OBSTRUCTIONS	38,077.18

Description	ProjectCost
CONCRETE REMOVAL	1,684,568.37
GRAVEL BASE REMOVAL	58,549.63
EXCAVATION	1,282,501.68
TEMPORARY SHORING	1,416,445.96
AGGREGATE BASE LAYER	2,270,266.41
REINFORCED STEEL	2,443,008.88
CONCRETE VOLUME	6,578,066.54
COMPACTED FILL	143,065.28
CHAIN LINK FENCE	207,941.23
C05_REACH 3 - 4,849 LF (0.92 miles)	7,539,113.48
09 CHANNELS AND CANALS (4,849 LF)	7,539,113.48
MOB/DEMOB	254,945.87
SWPPP	26,599.27
TRAFFIC CONTROL	139,646.15
DUST CONTROL	16,083.23
DEWATERING	491,686.58
CLEAR SITE AND REMOVE OBSTRUCTIONS	11,404.07
RIPRAP REMOVAL	933,809.94
EXCAVATION	42,923.99
CONCRETE VOLUME	3,412,866.88
REINFORCED STEEL	1,021,101.37
COMPACTED FILL	48,740.69
AGGREGATE BASE LAYER	841,781.99
CHAIN LINK FENCE	297,523.46
C05_REACH 4 - 6,560 LF (1.24 miles)	9,135,756.51
09 CHANNELS AND CANALS (6,560 LF)	9,135,756.51
MOB/DEMOB	308,938.63
SWPPP	35,984.99
TRAFFIC CONTROL	188,921.17
DUST CONTROL	21,758.30

Description	ProjectCost
DEWATERING	634,009.48
CLEAR SITE AND REMOVE OBSTRUCTIONS	15,200.78
RIPRAP REMOVAL	1,114,190.81
CONCRETE VOLUME	4,261,912.53
REINFORCED STEEL	1,055,456.18
COMPACTED FILL	15,160.87
AGGREGATE BASE LAYER	1,081,716.31
CHAIN LINK FENCE	402,506.48
C05_REACH 5 - 7,071 LF (1.34 miles)	9,175,389.72
09 CHANNELS AND CANALS (7,071 LF)	9,175,389.72
MOB/DEMOB	310,278.88
SWPPP	38,788.08
TRAFFIC CONTROL	203,637.44
DUST CONTROL	23,453.19
DEWATERING	670,100.09
CLEAR SITE AND REMOVE OBSTRUCTIONS	16,722.15
RIPRAP REMOVAL	1,080,584.74
CONCRETE VOLUME	4,292,809.58
REINFORCED STEEL	1,026,827.17
COMPACTED FILL	6,820.22
AGGREGATE BASE LAYER	1,071,507.92
CHAIN LINK FENCE	433,860.26
C06 CHANNEL	11,776,237.64
C06_REACH 13 - 3,936 LF (0.75 miles)	4,661,652.57
09 CHANNELS AND CANALS (6,004 LF)	4,661,652.57
MOB/DEMOB	221,983.46
SWPPP	21,590.99
TRAFFIC CONTROL	113,352.70
DUST CONTROL	13,054.98
DEWATERING	423,225.41

Description	ProjectCost
CLEAR SITE AND REMOVE OBSTRUCTIONS	9,120.47
RIPRAP REMOVAL	556,983.53
CONCRETE VOLUME	2,137,433.53
REINFORCED STEEL	530,590.99
COMPACTED FILL	295,050.57
AGGREGATE BASE LAYER	97,762.06
CHAIN LINK FENCE	241,503.89
C06_REACH 17 - 2,478 LF (0.47 miles)	2,909,304.48
09 CHANNELS AND CANALS (2,478 LF)	2,909,304.48
MOB/DEMOB	138,538.31
SWPPP	13,593.11
TRAFFIC CONTROL	71,363.82
DUST CONTROL	8,219.06
DEWATERING	298,862.49
CLEAR SITE AND REMOVE OBSTRUCTIONS	5,803.48
RIPRAP REMOVAL	344,115.32
CONCRETE VOLUME	1,318,068.07
REINFORCED STEEL	307,284.71
COMPACTED FILL	176,152.84
AGGREGATE BASE LAYER	75,258.90
CHAIN LINK FENCE	152,044.37
C06_REACH 19 - 2,303 LF (0.44 miles)	4,205,280.59
09 CHANNELS AND CANALS (2,303 LF)	4,205,280.59
MOB/DEMOB	275,111.81
SWPPP	41,057.72
TRAFFIC CONTROL	151,597.72
DUST CONTROL	84,024.83
DEWATERING	232,561.47
CLEAR SITE AND REMOVE OBSTRUCTIONS	28,557.89
RIPRAP REMOVAL	372,843.80

Description	ProjectCost
EXCAVATION	122,818.67
AGGREGATE BASE LAYER	688,078.17
REINFORCED STEEL	540,134.00
CONCRETE VOLUME	1,527,187.74
CHAIN LINK FENCE	141,306.77
C04 CHANNEL	28,389,924.53
C04_REACH 20 - 13,364 LF (2.53 miles)	22,831,103.99
09 CHANNELS AND CANALS (13,364 LF)	22,831,103.99
MOB/DEMOB	664,983.61
SWPPP	73,308.44
TRAFFIC CONTROL	384,869.29
DUST CONTROL	44,325.89
DEWATERING	1,183,285.16
CLEAR SITE AND REMOVE OBSTRUCTIONS	31,416.67
RIPRAP REMOVAL	1,048,365.89
EXCAVATION	1,326,734.98
CONCRETE VOLUME	10,584,571.38
REINFORCED STEEL	3,320,965.20
COMPACTED FILL	309,472.95
AGGREGATE BASE LAYER	3,038,820.30
CHAIN LINK FENCE	819,984.23
C04_REACH 22 - 4,964 LF (0.94 miles)	5,558,820.54
09 CHANNELS AND CANALS (4,964 LF)	5,558,820.54
MOB/DEMOB	264,705.74
SWPPP	27,230.10
TRAFFIC CONTROL	142,958.03
DUST CONTROL	16,464.66
DEWATERING	504,936.78
CLEAR SITE AND REMOVE OBSTRUCTIONS	11,622.13
RIPRAP REMOVAL	591,842.55

Description	ProjectCost
CONCRETE VOLUME	2,458,736.18
REINFORCED STEEL	503,870.58
AGGREGATE BASE LAYER	731,874.19
CHAIN LINK FENCE	304,579.60
C02 CHANNEL	22,898,698.76
C02_REACH 23 - 8,898 LF (1.69 miles)	22,898,698.76
09 01 CHANNELS	22,898,698.76
MOB/DEMOB	682,488.66
SWPPP	79,313.86
TRAFFIC CONTROL	292,851.19
DUST CONTROL	162,316.24
CLEAR SITE AND REMOVE OBSTRUCTIONS	47,596.48
SOUTH LEVEE SHEET PILE	15,179,872.20
SOUTH LEVEE SSP TIEBACK	989,831.24
CHAIN LINK FENCE	272,971.49
SOUTH LEVEE SLOPE PROTECTION	5,191,457.41
15 FLOODWAY CONTROL AND DIVERSION STRUCTURES	2,181,763.65
TIDE GATE REMOVAL	2,181,763.65
MOB/DEMOB	105,300.57
EROSION CONTROL	1,769.60
TURBIDITY CURTAIN (SILT/SEDIMENT)	45,366.94
Turbidity Testing	1,620.21
Daily Curtain Inspection	2,968.46
Curtain Installation	4,407.85
Curtain Removal	2,158.88
Turbidity Curtain Materials	34,211.54
DEWATERING	141,844.30
SURVEY	6,711.20
DEMOLITION & REMOVAL(DEBRIS REMOVAL)	1,592,100.19
Large Isolated Debris Removal	262,966.67

Description	ProjectCost
Hauling and Disposal Isolated Debris	**1,329,133.52**
EARTHWORK & REGRADING (GRADING IMPORTED MATERIAL)	**288,670.85**
Backfill Removal Areas with Imported Fill and Regrade with Amended Topsoil	**288,670.85**

Westminister - East Garden Grove_FEAS_LPP Formulation

This channel improvement option is based on plans developed by OCPW to convey the 1% ACE storm event. Improvements include replacing trapezoidal channels with concrete rectangular channels, widening the channel in select reaches and limited flood wall construction near channel crossings.

Estimated by	LRC
Designed by	LRC
Prepared by	LRC
Preparation Date	9/9/2019

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Designed by
LRC
Estimated by
LRC
Prepared by
LRC

Design Document	Westminster Excised Scope from Report for Cost ATR
Document Date	8/22/2019
District	Chicago
Contact	Gadbois 312.846.5464
Budget Year	2020
UOM System	Original

Direct Costs
LaborCost
EQCost
MatlCost
SubBidCost
UserCost1
UserCost2
UserCost3
UserCost4
UserCost5

Timeline/Currency

Preparation Date	9/9/2019
Escalation Date	3/30/2029
Eff. Pricing Date	3/30/2029
Estimated Duration	365 Day(s)
Currency	US dollars
Exchange Rate	1.000000

Costbook CB16EN: 2016 MII English Cost Book

Labor CAOr072619: July 2019 - Orange County, CA

tp://www.wdol.gov/ (A web site address to find these wage rates.) is the website where these labor wage rates may be obtained. Fringes paid to the laborers are taxable. In a non-union job the whole

Labor Rates
LaborCost1
LaborCost2
LaborCost3
LaborCost4

Equipment EP16R07: MII Equipment 2016 Region 07

07 WEST

Sales Tax	7.95
Working Hours per Year	1,630
Labor Adjustment Factor	1.00
Cost of Money	2.63
Cost of Money Discount	25.00
Tire Recap Cost Factor	1.50
Tire Recap Wear Factor	1.80
Tire Repair Factor	0.15
Equipment Cost Factor	1.00
Standby Depreciation Factor	0.50

Fuel

Electricity	0.112
Gas	3.635
Diesel Off-Road	3.097
Diesel On-Road	3.973

Shipping Rates

Over 0 CWT	28.91
Over 240 CWT	21.98
Over 300 CWT	18.50
Over 400 CWT	16.24
Over 500 CWT	19.65
Over 700 CWT	18.73
Over 800 CWT	10.52

Date	Author	Note
8/31/2018	LRC JDG	Updated Cost Book 2016
8/31/2018	LRC JDG	Updated Equipment Library to 2016 Region 07
8/31/2018	LRC JDG	Updated Labor Library to Orange County, CA 21-MAY-2018 and reduced labor adjustment factor to 1
8/31/2018	LRC JDG	Updated Fuel (Gasoline and Diesel) per LA, CA and CA respectively per EIA fuel report 21-MAY-2018 https://www.eia.gov/petroleum/gasdiesel/
8/31/2018	LRC JDG	Updated Off-road Diesel to EIA rates less CA State & Fed tax (-$0.8756 per gal)
8/31/2018	LRC JDG	Cost of Money Updated per US Dept of Treasury Prompt Pay Interest Rate (2.625) Jan-18 to Jun-18
8/31/2018	LRC JDG	A690 PZ-35 SSP Pricing updated per LB Foster and Skyline Steel quotes for Southern California MAY 2018 from $34/SF to $30/SF to include pricing for misc cap, connection bolts, and splice material.
8/31/2018	LRC JDG	Concrete material pricing updated per typ 4000 psi mix design 3 vendor Avg per MAY-2018 local redi-mix quotes (includes AB219 Teamster haul rate) $110 (was $82.50/CY)
6/7/2019	LRC JDG	Tide Gate replacement Crossing updated per Major quantities from June 2019 Structural Appendix Figure 9. Estimated Quantities - Channel Outlet Structure Bridge Replacement. Titled TYP 40 SPECIAL Crossing
6/7/2019	LRC JDG	09 Chanals and Canals C02_R23 eliminated north levee SSP wall system and excavation qty
9/4/2019	Profit	Degree of Risk: 0.07 Relative Difficulty of Work: 0.075 Size of Job: 0.03 Period of Performance: 0.12 Contractor's Investment: 0.07 Assistance by Government: 0.12 Subcontracting: 0.12

Description	ProjectCost
Project Items	**697,857,525.88**
02 RELOCATIONS (UTILITIES)	**15,506,576.87**
02 03 CEMETERIES, UTILITIES, AND STRUCTURES, Construction Activities	**15,506,576.87**
WIDEN WARNER AVE & HUNTINGTON HARBOR ARMORING UTILITIES	**166,308.96**
Relocate Utilities & Poles	**166,308.96**
Utilities	**129,014.13**
Utility Pole Relocations	**37,294.83**
C05 CHANNEL UTILITIES	**2,509,612.83**
C05_REACH 1 - 9506 LF (1.80 miles)	**258,919.69**
UTILITY COORDINATION	**258,919.69**
C05_REACH 2 - 4081 LF (0.77 miles)	**319,527.62**
UTILITY COORDINATION	**319,527.62**
C05_REACH 3 - 5,606 LF (1.06 miles)	**432,261.58**
UTILITY COORDINATION	**432,261.58**
C05_REACH 4 - 6,669 LF (1.26 miles)	**449,249.84**
UTILITY COORDINATION	**449,249.84**
C05_REACH 5 - 8,181 LF (1.55 miles)	**515,310.52**
UTILITY COORDINATION	**515,310.52**
C05_REACH 6 - 1,409 LF (0.27 miles)	**87,008.33**
UTILITY COORDINATION	**87,008.33**
C05_REACH 8 - 4,057 LF (0.77 miles)	**228,919.65**
UTILITY COORDINATION	**228,919.65**
C05_REACH 9 - 5,496 (1.04 miles)	**218,415.60**
UTILITY COORDINATION	**218,415.60**
C06 CHANNEL UTILITIES	**493,609.64**
C06_REACH 13 - 6113 LF (1.16 miles)	**176,395.56**
UTILITY COORDINATION	**176,395.56**
C06_REACH 14 - 170 LF (0.03 miles)	**9,906.72**
UTILITY COORDINATION	**9,906.72**
CO6_REACH 16 - 55 LF (0.01 miles)	**118,813.58**

Description	ProjectCost
UTILITY COORDINATION	118,813.58
CO6_REACH 17 - 2478 LF (0.47 miles)	112,798.73
UTILITY COORDINATION	112,798.73
CO6_REACH 19 - 2303 LF (0.44 miles)	75,695.05
UTILITY COORDINATION	75,695.05
C04 CHANNEL UTILITIES	2,838,633.32
C04_REACH 20 - 13,467 LF (2.55 miles)	1,024,452.31
UTILITY COORDINATION	1,024,452.31
C04_REACH 21 - 5,678 LF (1.08 miles)	1,103,095.69
UTILITY COORDINATION	170,415.96
UTILITY COORDINATION	932,679.73
C04_REACH 22 - 13,529 LF (2.56 miles)	711,085.32
UTILITY COORDINATION	711,085.32
C02 CHANNEL UTILITIES	565,931.23
C02_REACH 23 - 10,285 LF (1.95 miles)	565,931.23
UTILITY COORDINATION	565,931.23
C05 CROSSING UTILITIES	4,095,515.22
R01	801,068.09
Crossing TYP 40 SPECIAL_02 - Relocations	96,257.79
Crossing TYP 60_02 - Relocations	42,621.26
Crossing TYP 40_02 - Relocations	469,696.09
Crossing TYP 40_02 - Relocations	192,492.95
R03	346,268.85
Crossing TYP 60_02 - Relocations	11,613.42
Crossing TYP 30_02 - Relocations	334,655.43
R04	335,779.83
Crossing TYP 30_02 - Relocations	204,144.12
Crossing TYP 60_02 - Relocations	16,026.52
Crossing TYP 10_02 - Relocations	115,609.19
R05	839,174.78

Description	ProjectCost
Crossing TYP 30_02 - Relocations	338,071.10
Crossing TYP 60_02 - Relocations	16,026.52
Crossing TYP 10_02 - Relocations	92,767.30
Crossing TYP 10_02 - Relocations	92,767.30
Crossing TYP 20_02 - Relocations	138,272.20
Crossing TYP 10_02 - Relocations	161,270.35
R06	92,767.30
Crossing TYP 10_02 - Relocations	92,767.30
R07	200,836.73
Crossing TYP 30_02 - Relocations	200,836.73
R08	323,997.80
Crossing TYP 10_02 - Relocations	92,767.30
Crossing TYP 10_02 - Relocations	92,767.30
Crossing TYP 10_02 - Relocations	138,463.20
R09	1,048,588.69
Crossing TYP 30_02 - Relocations	769,782.57
Crossing TYP 20_02 - Relocations	92,479.24
Crossing TYP 60_02 - Relocations	32,169.18
Crossing TYP 10_02 - Relocations	92,767.30
Crossing TYP 10_02 - Relocations	61,390.40
R10	107,033.14
Crossing TYP 30_02 - Relocations	107,033.14
C06 CROSSING UTILITIES	2,455,934.56
R13	173,493.61
Crossing TYP 20_02 - Relocations	86,415.78
Crossing TYP 10_02 - Relocations	87,077.83
R15	2,282,440.95
Crossing TYP 30 SPECIAL_02 - Relocations	2,282,440.95
C04 CROSSING UTILITIES	2,381,031.12
R20	929,169.41

Description	ProjectCost
Crossing TYP 30_02 - Relocations	384,809.27
Crossing TYP 10_02 - Relocations	142,742.41
Crossing TYP 30_02 - Relocations	401,617.72
R22	1,451,861.71
Crossing TYP 30_02 - Relocations	602,346.17
Crossing TYP 60_02 - Relocations	16,026.52
Crossing TYP 10_02 - Relocations	92,767.30
Crossing TYP 10_02 - Relocations	184,124.35
Crossing TYP 10_02 - Relocations	161,270.35
Crossing TYP 10_02 - Relocations	122,745.26
Crossing TYP 20_02 - Relocations	184,088.59
Crossing TYP 50_02 - Relocations	17,698.63
Crossing TYP 50_02 - Relocations	17,698.63
Crossing TYP 50_02 - Relocations	17,698.63
Crossing TYP 50_02 - Relocations	17,698.63
Crossing TYP 50_02 - Relocations	17,698.63
02 RELOCATIONS (BRIDGES & CROSSINGS)	197,985,109.34
WIDEN WARNER AVE & HUNTINGTON HARBOR ARMORING	21,064,320.57
Mob and Demob - 5%	1,352,773.47
TRAFFIC CONTROL	1,331,903.12
SWPP (assumes 1% of construction)	270,554.69
Demo (EX) Bridge	1,055,109.16
Bridge	159,797.12
Load, Haul & Disposal	711,456.10
Remove AC/AB and Haul Out	181,626.70
Surface Removal - AC - Road	6,798.93
Load, Haul & Disposal	174,827.77
Demolition	2,229.24
Channel Excavation	3,613,874.93
Rock Berm Install & Removal	456,019.16

Description	ProjectCost
Channel Excavation & Haul	1,233,473.42
Slope Protection	384,167.73
Care and Diversion of Water	1,540,214.62
Mob and Demob	23,203.73
Install and develop Wells	1,225,669.99
Install Eductor Pump Station Equipment	71,311.71
Pipe Installation	23,784.85
Operation	196,244.34
New Bridge Structure	1,419,048.65
Dewatering	376,051.08
Abutment Construction	131,029.69
Pile and Bent Construction	324,008.31
Bridge Deck	365,685.65
Pedestrian Path and Parapet Wall	222,273.92
Road & Parking Raise	6,394,066.49
Pavement Demolition	42,324.40
Surface Removal - AC - Road	9,894.28
Hauling Requirment	32,430.12
Fill Placement	2,228,450.73
Material & Haul	1,964,365.64
ABC for Paving and Sidewalk (Aggregate Base Course)	1,992,908.74
Asphalt Concrete Paving, thickness various	2,023,096.64
Pavement Striping	70,738.06
Gaurd Rail	36,547.92
Harbor Wall Armoring	5,626,990.05
Place Armor Stone (First 20,000 Tons)	5,459,700.10
Marine Mobilization	167,289.95
C05 CROSSINGS	81,691,557.79
R01	16,334,112.35
Crossing TYP 40 SPECIAL_08 - Roads, Railroads & Bridges	2,322,842.01

Description	ProjectCost
Mob, Demob & Site Prep	75,420.43
Traffic Control	107,117.79
Earthwork	25,688.24
Bridge Work	1,993,581.30
Roadway and Site Work	107,779.17
RipRap	13,255.09
Crossing TYP 60_08 - Roads, Railroads, & Bridges	2,854,911.52
Demolition	2,229.24
Replace	2,852,682.28
Crossing TYP 40_08 - Roads, Railroads & Bridges	7,913,066.62
Mob, Demob & Site Prep	368,051.68
Traffic Control	522,734.80
Demolition	1,584,681.06
Earthwork	112,518.68
Bridge Work	4,879,938.67
Roadway and Site Work	445,141.74
Crossing TYP 40_08 - Roads, Railroads & Bridges	3,243,292.20
Mob, Demob & Site Prep	150,840.85
Traffic Control	214,235.57
Demolition	649,526.03
Earthwork	46,127.48
Bridge Work	2,000,127.12
Roadway and Site Work	182,435.14
R03	6,801,083.98
Crossing TYP 60_08 - Roads, Railroads, & Bridges	795,131.52
Demolition	17,833.90
Replace	777,297.62
Crossing TYP 30_08 - Roads, Railroads & Bridges	6,005,952.46
Mob, Demob & Site Prep	251,326.26
Traffic Control	510,387.03

Description	ProjectCost
Diversion and Control of Water	234,102.81
Temporary Shoring	1,215,201.82
Demolition	549,436.56
Earthwork	811,064.51
Culvert	2,252,782.30
Roadway and Site Work	181,651.16
R04	6,923,133.72
Crossing TYP 30_08 - Roads, Railroads & Bridges	3,662,122.98
Mob, Demob & Site Prep	153,309.02
Traffic Control	311,336.09
Diversion and Control of Water	142,802.71
Temporary Shoring	742,159.79
Demolition	335,116.86
Earthwork	494,786.05
Culvert	1,375,293.02
Roadway and Site Work	107,319.44
Crossing TYP 60_08 - Roads, Railroads, & Bridges	1,097,281.50
Demolition	24,610.78
Replace	1,072,670.72
Crossing TYP 10_08 - Roads, Railroads & Bridges	2,163,729.24
Mob, Demob & Site Prep	146,972.86
Traffic Control	223,802.15
Diversion and Control of Water	141,228.74
Temporary Shoring	522,252.53
Demolition	188,262.46
Earthwork	253,797.04
Culvert	605,964.80
Roadway and Site Work	81,448.66
R05	17,101,122.80
Crossing TYP 30_08 - Roads, Railroads & Bridges	6,066,590.98

Description	ProjectCost
Mob, Demob & Site Prep	253,839.53
Traffic Control	515,490.90
Diversion and Control of Water	236,443.84
Temporary Shoring	1,227,986.38
Demolition	554,925.06
Earthwork	819,215.87
Culvert	2,275,221.74
Roadway and Site Work	183,467.67
Crossing TYP 60_08 - Roads, Railroads, & Bridges	1,097,281.50
Demolition	24,610.78
Replace	1,072,670.72
Crossing TYP 10_08 - Roads, Railroads & Bridges	1,735,324.34
Mob, Demob & Site Prep	117,941.19
Traffic Control	179,594.32
Diversion and Control of Water	113,331.71
Temporary Shoring	417,886.21
Demolition	151,247.45
Earthwork	203,612.60
Culvert	486,350.84
Roadway and Site Work	65,360.03
Crossing TYP 10_08 - Roads, Railroads & Bridges	1,735,324.34
Mob, Demob & Site Prep	117,941.19
Traffic Control	179,594.32
Diversion and Control of Water	113,331.71
Temporary Shoring	417,886.21
Demolition	151,247.45
Earthwork	203,612.60
Culvert	486,350.84
Roadway and Site Work	65,360.03
Crossing TYP 20_08 - Roads, Railroads & Bridges	3,450,222.61

Description	ProjectCost
Mob, Demob & Site Prep	241,345.37
Traffic Control	364,812.87
Diversion and Control of Water	231,173.29
Temporary Shoring	714,790.55
Demolition	320,295.47
Earthwork	490,805.77
Culvert	960,832.40
Roadway and Site Work	126,166.90
Crossing TYP 10_08 - Roads, Railroads & Bridges	3,016,379.03
Mob, Demob & Site Prep	205,036.22
Traffic Control	312,217.81
Diversion and Control of Water	197,022.82
Temporary Shoring	727,128.35
Demolition	262,732.21
Earthwork	353,975.91
Culvert	844,639.81
Roadway and Site Work	113,625.90
R06	1,735,324.34
Crossing TYP 10_08 - Roads, Railroads & Bridges	1,735,324.34
Mob, Demob & Site Prep	117,941.19
Traffic Control	179,594.32
Diversion and Control of Water	113,331.71
Temporary Shoring	417,886.21
Demolition	151,247.45
Earthwork	203,612.60
Culvert	486,350.84
Roadway and Site Work	65,360.03
R07	3,604,565.09
Crossing TYP 30_08 - Roads, Railroads & Bridges	3,604,565.09
Mob, Demob & Site Prep	150,795.76

Description	ProjectCost
Traffic Control	306,232.22
Diversion and Control of Water	140,461.69
Temporary Shoring	729,487.32
Demolition	329,705.00
Earthwork	486,696.01
Culvert	1,352,196.40
Roadway and Site Work	108,990.69
R08	6,061,548.21
Crossing TYP 10_08 - Roads, Railroads & Bridges	1,735,324.34
Mob, Demob & Site Prep	117,941.19
Traffic Control	179,594.32
Diversion and Control of Water	113,331.71
Temporary Shoring	417,886.21
Demolition	151,247.45
Earthwork	203,612.60
Culvert	486,350.84
Roadway and Site Work	65,360.03
Crossing TYP 10_08 - Roads, Railroads & Bridges	1,735,324.34
Mob, Demob & Site Prep	117,941.19
Traffic Control	179,594.32
Diversion and Control of Water	113,331.71
Temporary Shoring	417,886.21
Demolition	151,247.45
Earthwork	203,612.60
Culvert	486,350.84
Roadway and Site Work	65,360.03
Crossing TYP 10_08 - Roads, Railroads & Bridges	2,590,899.54
Mob, Demob & Site Prep	176,004.54
Traffic Control	268,009.98
Diversion and Control of Water	169,125.78

Description	ProjectCost
Temporary Shoring	624,725.71
Demolition	225,587.26
Earthwork	303,878.93
Culvert	726,030.05
Roadway and Site Work	97,537.28
R09	21,206,989.18
Crossing TYP 30_08 - Roads, Railroads & Bridges	13,812,125.81
Mob, Demob & Site Prep	578,050.40
Traffic Control	1,173,890.18
Diversion and Control of Water	538,436.46
Temporary Shoring	2,795,534.53
Demolition	1,263,569.11
Earthwork	1,865,504.68
Culvert	5,179,342.78
Roadway and Site Work	417,797.66
Crossing TYP 20_08 - Roads, Railroads & Bridges	2,307,795.92
Mob, Demob & Site Prep	161,399.71
Traffic Control	243,968.60
Diversion and Control of Water	154,597.14
Temporary Shoring	478,046.15
Demolition	214,189.72
Earthwork	328,214.78
Culvert	643,005.70
Roadway and Site Work	84,374.11
Crossing TYP 60_08 - Roads, Railroads, & Bridges	2,202,514.32
Demolition	49,399.90
Replace	2,153,114.42
Crossing TYP 10_08 - Roads, Railroads & Bridges	1,735,324.34
Mob, Demob & Site Prep	117,941.19
Traffic Control	179,594.32

Description	ProjectCost
Diversion and Control of Water	113,331.71
Temporary Shoring	417,886.21
Demolition	151,247.45
Earthwork	203,612.60
Culvert	486,350.84
Roadway and Site Work	65,360.03
Crossing TYP 10_08 - Roads, Railroads & Bridges	1,149,228.79
Mob, Demob & Site Prep	78,022.63
Traffic Control	118,808.55
Diversion and Control of Water	74,973.28
Temporary Shoring	277,164.89
Demolition	99,952.48
Earthwork	134,742.57
Culvert	322,326.21
Roadway and Site Work	43,238.18
R10	1,923,678.12
Crossing TYP 30_08 - Roads, Railroads & Bridges	1,923,678.12
Mob, Demob & Site Prep	80,424.40
Traffic Control	163,323.85
Diversion and Control of Water	74,912.90
Temporary Shoring	388,881.39
Demolition	175,756.81
Earthwork	259,535.62
Culvert	722,714.78
Roadway and Site Work	58,128.37
C06 CROSSINGS	44,736,071.85
R13	3,785,561.78
Crossing TYP 20_08 - Roads, Railroads & Bridges	2,156,209.30
Mob, Demob & Site Prep	150,840.85
Traffic Control	228,008.04

Description	ProjectCost
Diversion and Control of Water	144,483.31
Temporary Shoring	446,752.91
Demolition	200,133.04
Earthwork	306,698.69
Culvert	600,438.15
Roadway and Site Work	78,854.31
Crossing TYP 10_08 - Roads, Railroads & Bridges	1,629,352.48
Mob, Demob & Site Prep	110,683.27
Traffic Control	168,542.36
Diversion and Control of Water	106,357.45
Temporary Shoring	393,024.00
Demolition	141,752.89
Earthwork	191,076.79
Culvert	456,577.84
Roadway and Site Work	61,337.88
R15	40,950,510.07
Crossing TYP 30 SPECIAL_08 - Roads, Railroads & Bridges	40,950,510.07
Mob, Demob & Site Prep	1,714,045.11
Traffic Control	3,480,839.57
Diversion and Control of Water	1,596,581.16
Temporary Shoring	8,289,137.13
Demolition	3,746,696.54
Earthwork	5,531,610.77
Culvert	15,352,738.89
Roadway and Site Work	1,238,860.89
C04 CROSSINGS	50,493,159.13
R20	16,785,735.07
Crossing TYP 30_08 - Roads, Railroads & Bridges	6,907,074.02
Mob, Demob & Site Prep	289,025.20
Traffic Control	586,945.09

Description	ProjectCost
Diversion and Control of Water	269,218.23
Temporary Shoring	1,397,802.54
Demolition	631,711.42
Earthwork	932,721.68
Culvert	2,590,751.03
Roadway and Site Work	208,898.83
Crossing TYP 10_08 - Roads, Railroads & Bridges	2,671,124.23
Mob, Demob & Site Prep	181,447.98
Traffic Control	276,298.95
Diversion and Control of Water	174,356.47
Temporary Shoring	645,098.53
Demolition	232,482.48
Earthwork	313,242.33
Culvert	747,643.59
Roadway and Site Work	100,553.90
Crossing TYP 30_08 - Roads, Railroads & Bridges	7,207,536.82
Mob, Demob & Site Prep	301,591.52
Traffic Control	612,464.44
Diversion and Control of Water	280,923.37
Temporary Shoring	1,458,933.10
Demolition	659,252.26
Earthwork	973,289.48
Culvert	2,703,101.27
Roadway and Site Work	217,981.39
R22	33,707,424.06
Crossing TYP 30_08 - Roads, Railroads & Bridges	10,808,940.73
Mob, Demob & Site Prep	452,387.27
Traffic Control	918,696.66
Diversion and Control of Water	421,385.06
Temporary Shoring	2,187,546.39

Description	ProjectCost
Demolition	**989,012.37**
Earthwork	**1,459,924.16**
Culvert	**4,053,016.73**
Roadway and Site Work	**326,972.08**
Crossing TYP 60_08 - Roads, Railroads, & Bridges	**1,097,281.50**
Demolition	**24,610.78**
Replace	**1,072,670.72**
Crossing TYP 10_08 - Roads, Railroads & Bridges	**1,735,324.34**
Mob, Demob & Site Prep	**117,941.19**
Traffic Control	**179,594.32**
Diversion and Control of Water	**113,331.71**
Temporary Shoring	**417,886.21**
Demolition	**151,247.45**
Earthwork	**203,612.60**
Culvert	**486,350.84**
Roadway and Site Work	**65,360.03**
Crossing TYP 10_08 - Roads, Railroads & Bridges	**3,443,983.38**
Mob, Demob & Site Prep	**234,067.89**
Traffic Control	**356,425.64**
Diversion and Control of Water	**224,919.85**
Temporary Shoring	**830,521.07**
Demolition	**299,845.97**
Earthwork	**404,099.03**
Culvert	**964,389.40**
Roadway and Site Work	**129,714.53**
Crossing TYP 10_08 - Roads, Railroads & Bridges	**3,016,379.03**
Mob, Demob & Site Prep	**205,036.22**
Traffic Control	**312,217.81**
Diversion and Control of Water	**197,022.82**
Temporary Shoring	**727,128.35**

Description	ProjectCost
Demolition	262,732.21
Earthwork	353,975.91
Culvert	844,639.81
Roadway and Site Work	113,625.90
Crossing TYP 10_08 - Roads, Railroads & Bridges	2,295,426.43
Mob, Demob & Site Prep	156,045.26
Traffic Control	237,617.10
Diversion and Control of Water	149,946.57
Temporary Shoring	552,664.79
Demolition	200,054.93
Earthwork	269,417.79
Culvert	643,203.65
Roadway and Site Work	86,476.35
Crossing TYP 10_08 - Roads, Railroads & Bridges	5,684,458.80
Mob, Demob & Site Prep	386,484.19
Traffic Control	588,516.76
Diversion and Control of Water	371,379.29
Temporary Shoring	1,370,561.88
Demolition	495,231.03
Earthwork	667,218.25
Culvert	1,590,887.59
Roadway and Site Work	214,179.80
Crossing TYP 50_08 - Roads, Railroads & Bridges	1,125,125.97
Mob, Demob & Site Prep	120,233.73
Traffic Control	107,281.85
Diversion and Control of Water	84,736.97
Temporary Shoring	315,355.00
Demolition	74,568.82
Earthwork	117,341.91
Culvert	249,236.66

Description	ProjectCost
Roadway and Site Work	56,371.03
Crossing TYP 50_08 - Roads, Railroads & Bridges	1,125,125.97
Mob, Demob & Site Prep	120,233.73
Traffic Control	107,281.85
Diversion and Control of Water	84,736.97
Temporary Shoring	315,355.00
Demolition	74,568.82
Earthwork	117,341.91
Culvert	249,236.66
Roadway and Site Work	56,371.03
Crossing TYP 50_08 - Roads, Railroads & Bridges	1,125,125.97
Mob, Demob & Site Prep	120,233.73
Traffic Control	107,281.85
Diversion and Control of Water	84,736.97
Temporary Shoring	315,355.00
Demolition	74,568.82
Earthwork	117,341.91
Culvert	249,236.66
Roadway and Site Work	56,371.03
Crossing TYP 50_08 - Roads, Railroads & Bridges	1,125,125.97
Mob, Demob & Site Prep	120,233.73
Traffic Control	107,281.85
Diversion and Control of Water	84,736.97
Temporary Shoring	315,355.00
Demolition	74,568.82
Earthwork	117,341.91
Culvert	249,236.66
Roadway and Site Work	56,371.03
Crossing TYP 50_08 - Roads, Railroads & Bridges	1,125,125.97
Mob, Demob & Site Prep	120,233.73

Description	ProjectCost
Traffic Control	107,281.85
Diversion and Control of Water	84,736.97
Temporary Shoring	315,355.00
Demolition	74,568.82
Earthwork	117,341.91
Culvert	249,236.66
Roadway and Site Work	56,371.03
09 CHANNELS & CANALS	482,184,076.02
09 01 CHANNELS	482,184,076.02
C05 CHANNEL	254,498,353.98
C05_REACH 1 - 9506 LF (1.80 miles)	129,459,846.46
09 01 CHANNELS	129,459,846.46
C05_REACH 2 - 3,389 LF (0.64 miles)	17,751,534.40
09 01 CHANNELS	17,751,534.40
C05_REACH 3 - 5,627 LF (1.07 miles)	24,014,532.01
09 01 CHANNELS	24,014,532.01
C05_REACH 4 - 6,560 LF (1.24 miles)	24,958,324.63
09 01 CHANNELS	24,958,324.63
C05_REACH 5 - 8,181 LF (1.55 miles)	28,628,362.21
09 01 CHANNELS	28,628,362.21
C05_REACH 6 - 1,410 LF (0.27 miles)	4,833,795.93
09 01 CHANNELS	4,833,795.93
C05_REACH 8 - 3,940 LF (0.75 miles)	12,717,758.44
09 01 CHANNELS	12,717,758.44
C05_REACH 9 - 5,336 (1.01 miles)	12,134,199.90
09 01 CHANNELS	12,134,199.90
C06 CHANNEL	27,422,758.03
C06_REACH 13 - 3,991 LF (0.76 miles)	9,799,753.40
09 01 CHANNELS	9,799,753.40
C06_REACH 14 - 169 LF (0.03 miles)	550,373.34

Description	ProjectCost
09 01 CHANNELS	550,373.34
CO6_REACH 16 - 1,622 LF (0.31 miles)	6,600,754.46
09 01 CHANNELS	6,600,754.46
CO6_REACH 17 - 2478 LF (0.47 miles)	6,266,596.23
09 01 CHANNELS	6,266,596.23
CO6_REACH 19 - 2303 LF (0.44 miles)	4,205,280.59
09 01 CHANNELS	4,205,280.59
C04 CHANNEL	143,669,840.89
C04_REACH 20 - 13,329 LF (2.52 miles)	56,914,016.96
09 01 CHANNELS	56,914,016.96
C04_REACH 21 - 2,549 LF (0.48 miles)	47,251,083.77
09 01 CHANNELS	9,467,553.32
09 CHANNELS AND CANALS (I-405 Diversion)	37,783,530.44
C04_REACH 22 - 13,529 LF (2.56 miles)	39,504,740.15
09 01 CHANNELS	39,504,740.15
C02 CHANNEL	56,593,123.12
C02_REACH 23 - 8,911 LF (1.69 miles)	56,593,123.12
09 01 CHANNELS	56,593,123.12
15 FLOODWAY CONTROL AND DIVERSION STRUCTURES	2,181,763.65
TIDE GATE REMOVAL	2,181,763.65
MOB/DEMOB	105,300.57
EROSION CONTROL	1,769.60
TURBIDITY CURTAIN (SILT/SEDIMENT)	45,366.94
Turbidity Testing	1,620.21
Daily Curtain Inspection	2,968.46
Curtain Installation	4,407.85
Curtain Removal	2,158.88
Turbidity Curtain Materials	34,211.54
DEWATERING	141,844.30
SURVEY	6,711.20

Description	ProjectCost
DEMOLITION & REMOVAL(DEBRIS REMOVAL)	**1,592,100.19**
Large Isolated Debris Removal	**262,966.67**
Hauling and Disposal Isolated Debris	**1,329,133.52**
EARTHWORK & REGRADING (GRADING IMPORTED MATERIAL)	**288,670.85**
Backfill Removal Areas with Imported Fill and Regrade with Amended Topsoil	**288,670.85**

5.8 Cost MCX ATR Certification

WALLA WALLA COST ENGINEERING MANDATORY CENTER OF EXPERTISE

COST AGENCY TECHNICAL REVIEW

CERTIFICATION STATEMENT

For Project No. 465002

SPL – Westminster, East Garden Grove, CA
Flood Risk Management
Feasibility Study

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

As of November 19, 2019, the Cost MCX certifies the estimated total project cost:

National Economic Development (NED)
FY20 Project First Cost: $483,855,000
Fully Funded Amount: $586,786,000

Locally Preferred Plan (LPP)
FY20 Project First Cost: $1,224,598,000
Fully Funded Amount: $1,546,629,000

It remains the responsibility of the District to correctly reflect these cost values within the Final Report and to implement effective project management controls and implementation procedures including risk management through the period of Federal Participation.

HILL.DAVID.E.1384235731

Digitally signed by HILL.DAVID.E.1384235731
Date: 2019.11.19 15:47:05 -08'00'

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

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

PROJECT: WESTMINSTER EAST GARDEN GROVE FEASIBILITY STUDY
PROJECT NO: P2# 465002
LOCATION: Westminster, East Garden Grove, CA

DISTRICT: Chicago District
POC: CHIEF, COST ENGINEERING, Rana S. Mishra

PREPARED: 11/19/2019

This Estimate reflects the scope and schedule in report; Feasibility Study

Nationally Economic Development (NED)

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

Civil Works Work Breakdown Structure		ESTIMATED COST				PROJECT FIRST COST (Constant Dollar Basis)						TOTAL PROJECT COST (FULLY FUNDED)			
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-19 ($K)	TOTAL FIRST COST ($K)	INFLATED (%)	COST ($K)	CNTG ($K)	FULL ($K)
A	B	C	D	E	F	G	H	I	J		K	L	M	N	O
02	RELOCATIONS (MAX CHANNEL UTILITIES)	$654	$255	39.0%	$909	0.0%	$654	$255	$909	$0	$909	19.6%	$783	$305	$1,088
02	RELOCATIONS (MIN CHANNEL UTILITIES)	$683	$205	30.0%	$888	0.0%	$683	$205	$888	$0	$888	19.6%	$817	$245	$1,062
02	RELOCATIONS (BRIDGE & CROSSING UTILITIES)	$967	$377	39.0%	$1,345	0.0%	$967	$377	$1,345	$0	$1,345	19.6%	$1,157	$451	$1,609
02	RELOCATIONS (BRIDGES & CROSSINGS)	$37,398	$14,585	39.0%	$51,984	0.0%	$37,398	$14,585	$51,984	$0	$51,984	19.6%	$44,744	$17,450	$62,195
06	FISH & WILDLIFE FACILITIES	$4,497	$1,754	39.0%	$6,250	0.0%	$4,497	$1,754	$6,250	$0	$6,250	19.6%	$5,380	$2,098	$7,478
09	CHANNELS & CANALS (MAX CONDITION)	$151,417	$59,052	39.0%	$210,469	0.0%	$151,417	$59,052	$210,469	$0	$210,469	19.6%	$181,156	$70,651	$251,806
09	CHANNELS & CANALS (MIN CONDITION)	$84,710	$25,413	30.0%	$110,123	0.0%	$84,710	$25,413	$110,123	$0	$110,123	19.6%	$101,347	$30,404	$131,752
15	FLOODWAY CONTROL & DIVERSION STRUCTUR	$2,182	$851	39.0%	$3,033	0.0%	$2,182	$851	$3,033	$0	$3,033	19.6%	$2,610	$1,018	$3,628
	CONSTRUCTION ESTIMATE TOTALS:	$282,508	$102,493		$385,001	0.0%	$282,508	$102,493	$385,001	$0	$385,001	19.6%	$337,995	$122,623	$460,618
01	LANDS AND DAMAGES	$2,368	$237	10.0%	$2,605	0.0%	$2,368	$237	$2,605	$0	$2,605	19.6%	$2,833	$283	$3,116
30	PLANNING, ENGINEERING & DESIGN	$48,026	$17,424	36.3%	$65,450	0.0%	$48,026	$17,424	$65,450	$0	$65,450	27.8%	$61,400	$22,276	$83,675
31	CONSTRUCTION MANAGEMENT	$22,601	$8,199	36.3%	$30,800	0.0%	$22,601	$8,199	$30,800	$0	$30,800	27.8%	$28,894	$10,483	$39,377
	PROJECT COST TOTALS:	$355,503	$128,353	36.1%	$483,855		$355,503	$128,353	**$483,855**	$0	**$483,855**	21.3%	$431,122	$155,665	$586,786

ESTIMATED NED TOTAL PROJECT COST ($K): **$586,786**

_____ CHIEF, COST ENGINEERING, Rana S. Mishra

_____ PROJECT MANAGER, Michael C Padilla

_____ CHIEF, REAL ESTATE, Michael B. Rohde

_____ CHIEF, PLANNING, Susanne J. Davis

_____ CHIEF, ENGINEERING, John A. Groboski

_____ CHIEF, OPERATIONS, Timothy J. Kroll

_____ CHIEF, CONSTRUCTION, Philip A. Stavrides

_____ CHIEF, CONTRACTING, Regina G. Blair

_____ CHIEF, PM-PB, Sherrie Barham

_____ CHIEF, DPM, Steve Fischer

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

**** CONTRACT COST SUMMARY ****

PROJECT: WESTMINSTER EAST GARDEN GROVE FEASIBILITY STUDY
LOCATION: Westminster, East Garden Grove, CA
This Estimate reflects the scope and schedule in report; Feasibility Study

DISTRICT: Chicago District
POC: CHIEF, COST ENGINEERING, Rana S. Mishra
PREPARED: 11/19/2019

Civil Works Work Breakdown Structure		ESTIMATED COST				PROJECT FIRST COST (Constant Dollar Basis)				TOTAL PROJECT COST (FULLY FUNDED)				
		Estimate Prepared: 9-Sep-19; Effective Price Level: 1-Oct-19				Program Year (Budget EC): 2020; Effective Price Level Date: 1 OCT 19								
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
	PHASE 1 or CONTRACT 1													
02	RELOCATIONS (MAX CHANNEL UTILITIES)	$654	$255	39.0%	$909	0.0%	$654	$255	$909	2026Q1	19.6%	$783	$305	$1,088
02	RELOCATIONS (MIN CHANNEL UTILITIES)	$683	$205	30.0%	$888	0.0%	$683	$205	$888	2026Q1	19.6%	$817	$245	$1,062
02	RELOCATIONS (BRIDGE & CROSSING UTILITIES)	$967	$377	39.0%	$1,345	0.0%	$967	$377	$1,345	2026Q1	19.6%	$1,157	$451	$1,609
02	RELOCATIONS (BRIDGES & CROSSINGS)	$37,398	$14,585	39.0%	$51,984	0.0%	$37,398	$14,585	$51,984	2026Q1	19.6%	$44,744	$17,450	$62,195
06	FISH & WILDLIFE FACILITIES	$4,497	$1,754	39.0%	$6,250	0.0%	$4,497	$1,754	$6,250	2026Q1	19.6%	$5,380	$2,098	$7,478
09	CHANNELS & CANALS (MAX CONDITION)	$151,417	$59,052	39.0%	$210,469	0.0%	$151,417	$59,052	$210,469	2026Q1	19.6%	$181,156	$70,651	$251,806
09	CHANNELS & CANALS (MIN CONDITION)	$84,710	$25,413	30.0%	$110,123	0.0%	$84,710	$25,413	$110,123	2026Q1	19.6%	$101,347	$30,404	$131,752
15	FLOODWAY CONTROL & DIVERSION STRUCTUR	$2,182	$851	39.0%	$3,033	0.0%	$2,182	$851	$3,033	2026Q1	19.6%	$2,610	$1,018	$3,628
	CONSTRUCTION ESTIMATE TOTALS:	$282,508	$102,493	36.3%	**$385,001**		$282,508	$102,493	$385,001			$337,995	$122,623	$460,618
01	LANDS AND DAMAGES	$2,368	$237	10.0%	$2,605	0.0%	$2,368	$237	$2,605	2026Q1	19.6%	$2,833	$283	$3,116
30	PLANNING, ENGINEERING & DESIGN													
1.00%	Project Management	$2,825	$1,025	36.3%	$3,850	0.0%	$2,825	$1,025	$3,850	2026Q1	27.8%	$3,612	$1,310	$4,922
0.50%	Planning & Environmental Compliance	$1,413	$512	36.3%	$1,925	0.0%	$1,413	$512	$1,925	2026Q1	27.8%	$1,806	$655	$2,461
10.50%	Engineering & Design	$29,663	$10,762	36.3%	$40,425	0.0%	$29,663	$10,762	$40,425	2026Q1	27.8%	$37,923	$13,758	$51,682
0.50%	Reviews, ATRs, IEPRs, VE	$1,413	$512	36.3%	$1,925	0.0%	$1,413	$512	$1,925	2026Q1	27.8%	$1,806	$655	$2,461
0.25%	Life Cycle Updates (cost, schedule, risks)	$706	$256	36.3%	$963	0.0%	$706	$256	$963	2026Q1	27.8%	$903	$328	$1,231
0.25%	Contracting & Reprographics	$706	$256	36.3%	$963	0.0%	$706	$256	$963	2026Q1	27.8%	$903	$328	$1,231
2.00%	Engineering During Construction	$5,650	$2,050	36.3%	$7,700	0.0%	$5,650	$2,050	$7,700	2026Q1	27.8%	$7,224	$2,621	$9,844
0.50%	Planning During Construction	$1,413	$512	36.3%	$1,925	0.0%	$1,413	$512	$1,925	2026Q1	27.8%	$1,806	$655	$2,461
0.50%	Adaptive Management & Monitoring	$1,413	$512	36.3%	$1,925	0.0%	$1,413	$512	$1,925	2026Q1	27.8%	$1,806	$655	$2,461
1.00%	Project Operations	$2,825	$1,025	36.3%	$3,850	0.0%	$2,825	$1,025	$3,850	2026Q1	27.8%	$3,612	$1,310	$4,922
31	CONSTRUCTION MANAGEMENT													
6.00%	Construction Management	$16,950	$6,150	36.3%	$23,100	0.0%	$16,950	$6,150	$23,100	2026Q1	27.8%	$21,671	$7,862	$29,532
1.00%	Project Operation:	$2,825	$1,025	36.3%	$3,850	0.0%	$2,825	$1,025	$3,850	2026Q1	27.8%	$3,612	$1,310	$4,922
1.00%	Project Management	$2,825	$1,025	36.3%	$3,850	0.0%	$2,825	$1,025	$3,850	2026Q1	27.8%	$3,612	$1,310	$4,922
	CONTRACT COST TOTALS:	$355,503	$128,353		$483,855		$355,503	$128,353	**$483,855**			$431,122	$155,665	**$586,786**

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

PROJECT: WESTMINSTER EAST GARDEN GROVE FEASIBILITY STUDY
PROJECT NO: P2# 465002
LOCATION: Westminster, East Garden Grove, CA

DISTRICT: Chicago District
POC: CHIEF, COST ENGINEERING, Rana S. Mishra
PREPARED: 11/19/2019

This Estimate reflects the scope and schedule in report; Feasibility Study

Locally Preferred Plan (LPP)

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

Civil Works Work Breakdown Structure		ESTIMATED COST				PROJECT FIRST COST (Constant Dollar Basis)						TOTAL PROJECT COST (FULLY FUNDED)			
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-19 ($K)	TOTAL FIRST COST ($K)	INFLATED (%)	COST ($K)	CNTG ($K)	FULL ($K)
A	B	C	D	E	F	G	H	I	J		K	L	M	N	O
02	RELOCATIONS (BRIDGE & CROSSING UTILITIES)	$15,507	$6,048	39.0%	$21,554	0.0%	$15,507	$6,048	$21,554	$0	$21,554	24.2%	$19,254	$7,509	$26,763
02	RELOCATIONS (BRIDGES & CROSSINGS)	$197,985	$77,214	39.0%	$275,199	0.0%	$197,985	$77,214	$275,199	$0	$275,199	24.2%	$245,830	$95,874	$341,703
06	FISH & WILDLIFE FACILITIES	$4,497	$1,754	39.0%	$6,250	0.0%	$4,497	$1,754	$6,250	$0	$6,250	24.2%	$5,583	$2,178	$7,761
09	CHANNELS & CANALS	$482,184	$188,052	39.0%	$670,236	0.0%	$482,184	$188,052	$670,236	$0	$670,236	24.2%	$598,703	$233,494	$832,197
15	FLOODWAY CONTROL & DIVERSION STRUCTUR	$2,182	$851	39.0%	$3,033	0.0%	$2,182	$851	$3,033	$0	$3,033	24.2%	$2,709	$1,057	$3,765
	CONSTRUCTION ESTIMATE TOTALS:	$702,354	$273,918		$976,272	0.0%	$702,354	$273,918	$976,272	$0	$976,272	24.2%	$872,079	$340,111	$1,212,190
01	LANDS AND DAMAGES	$3,870	$387	10.0%	$4,257	0.0%	$3,870	$387	$4,257	$0	$4,257	24.2%	$4,805	$481	$5,286
30	PLANNING, ENGINEERING & DESIGN	$119,400	$46,566	39.0%	$165,966	0.0%	$119,400	$46,566	$165,966	$0	$165,966	34.9%	$161,025	$62,800	$223,824
31	CONSTRUCTION MANAGEMENT	$56,188	$21,913	39.0%	$78,102	0.0%	$56,188	$21,913	$78,102	$0	$78,102	34.9%	$75,776	$29,553	$105,329
	PROJECT COST TOTALS:	$881,813	$342,785	38.9%	$1,224,598		$881,813	$342,785	**$1,224,598**	$0	**$1,224,598**	26.3%	$1,113,685	$432,944	$1,546,629

ESTIMATED LPP TOTAL PROJECT COST ($K): **$1,546,629**

_____ CHIEF, COST ENGINEERING, Rana S. Mishra

_____ PROJECT MANAGER, Michael C. Padilla

_____ CHIEF, REAL ESTATE, Michael B. Rohde

_____ CHIEF, PLANNING, Susanne J. Davis

_____ CHIEF, ENGINEERING, John A. Groboski

_____ CHIEF, OPERATIONS, Timothy J. Kroll

_____ CHIEF, CONSTRUCTION, Philip A. Stavrides

_____ CHIEF, CONTRACTING, Regina G. Blair

_____ CHIEF, PM-PB, Sherrie Barham

_____ CHIEF, DPM, Steve Fischer

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

**** CONTRACT COST SUMMARY ****

PROJECT: WESTMINSTER EAST GARDEN GROVE FEASIBILITY STUDY
LOCATION: Westminster, East Garden Grove, CA
This Estimate reflects the scope and schedule in report; Feasibility Study

DISTRICT: Chicago District
POC: CHIEF, COST ENGINEERING, Rana S. Mishra
PREPARED: 11/19/2019

Civil Works Work Breakdown Structure		ESTIMATED COST				PROJECT FIRST COST (Constant Dollar Basis)				TOTAL PROJECT COST (FULLY FUNDED)				
		Estimate Prepared: 9-Sep-19; Effective Price Level: 1-Oct-19				Program Year (Budget EC): 2020; Effective Price Level Date: 1 OCT 19								
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*
	PHASE 1 or CONTRACT 1													
02	RELOCATIONS (BRIDGE & CROSSING UTILITIES)	$15,507	$6,048	39.0%	$21,554	0.0%	$15,507	$6,048	$21,554	2027Q2	24.2%	$19,254	$7,509	$26,763
02	RELOCATIONS (BRIDGES & CROSSINGS)	$197,985	$77,214	39.0%	$275,199	0.0%	$197,985	$77,214	$275,199	2027Q2	24.2%	$245,830	$95,874	$341,703
06	FISH & WILDLIFE FACILITIES	$4,497	$1,754	39.0%	$6,250	0.0%	$4,497	$1,754	$6,250	2027Q2	24.2%	$5,583	$2,178	$7,761
09	CHANNELS & CANALS	$482,184	$188,052	39.0%	$670,236	0.0%	$482,184	$188,052	$670,236	2027Q2	24.2%	$598,703	$233,494	$832,197
15	FLOODWAY CONTROL & DIVERSION STRUCTUR	$2,182	$851	39.0%	$3,033	0.0%	$2,182	$851	$3,033	2027Q2	24.2%	$2,709	$1,057	$3,765
	CONSTRUCTION ESTIMATE TOTALS:	$702,354	$273,918	39.0%	**$976,272**		$702,354	$273,918	$976,272			$872,079	$340,111	$1,212,190
01	LANDS AND DAMAGES	$3,870	$387	10.0%	$4,257	0.0%	$3,870	$387	$4,257	2027Q2	24.2%	$4,805	$481	$5,286
30	PLANNING, ENGINEERING & DESIGN													
1.00%	Project Management	$7,024	$2,739	39.0%	$9,763	0.0%	$7,024	$2,739	$9,763	2027Q2	34.9%	$9,472	$3,694	$13,166
0.50%	Planning & Environmental Compliance	$3,512	$1,370	39.0%	$4,881	0.0%	$3,512	$1,370	$4,881	2027Q2	34.9%	$4,736	$1,847	$6,583
10.50%	Engineering & Design	$73,747	$28,761	39.0%	$102,509	0.0%	$73,747	$28,761	$102,509	2027Q2	34.9%	$99,456	$38,788	$138,244
0.50%	Reviews, ATRs, IEPRs, VE	$3,512	$1,370	39.0%	$4,881	0.0%	$3,512	$1,370	$4,881	2027Q2	34.9%	$4,736	$1,847	$6,583
0.25%	Life Cycle Updates (cost, schedule, risks)	$1,756	$685	39.0%	$2,441	0.0%	$1,756	$685	$2,441	2027Q2	34.9%	$2,368	$924	$3,292
0.25%	Contracting & Reprographics	$1,756	$685	39.0%	$2,441	0.0%	$1,756	$685	$2,441	2027Q2	34.9%	$2,368	$924	$3,292
2.00%	Engineering During Construction	$14,047	$5,478	39.0%	$19,525	0.0%	$14,047	$5,478	$19,525	2027Q2	34.9%	$18,944	$7,388	$26,332
0.50%	Planning During Construction	$3,512	$1,370	39.0%	$4,881	0.0%	$3,512	$1,370	$4,881	2027Q2	34.9%	$4,736	$1,847	$6,583
0.50%	Adaptive Management & Monitoring	$3,512	$1,370	39.0%	$4,881	0.0%	$3,512	$1,370	$4,881	2027Q2	34.9%	$4,736	$1,847	$6,583
1.00%	Project Operations	$7,024	$2,739	39.0%	$9,763	0.0%	$7,024	$2,739	$9,763	2027Q2	34.9%	$9,472	$3,694	$13,166
31	CONSTRUCTION MANAGEMENT													
6.00%	Construction Management	$42,141	$16,435	39.0%	$58,576	0.0%	$42,141	$16,435	$58,576	2027Q2	34.9%	$56,832	$22,165	$78,997
1.00%	Project Operation:	$7,024	$2,739	39.0%	$9,763	0.0%	$7,024	$2,739	$9,763	2027Q2	34.9%	$9,472	$3,694	$13,166
1.00%	Project Management	$7,024	$2,739	39.0%	$9,763	0.0%	$7,024	$2,739	$9,763	2027Q2	34.9%	$9,472	$3,694	$13,166
	CONTRACT COST TOTALS:	$881,813	$342,785		$1,224,598		$881,813	$342,785	**$1,224,598**			$1,113,685	$432,944	**$1,546,629**