Mississippi River Valley Division,
Regional Planning and Environment Division South

South Central Coast Louisiana

Feasibility Study with Integrated Environmental Impact Statement

Hurricane Ike flooding in Delcambre, Louisiana.

Appendix B – Engineering Appendix

November 2019

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Section 1
Purpose

This engineering report summarizes the preliminary engineering and design work completed to support the components of the South Central Coastal Louisiana Study. This report includes engineering analyses, including levee design and hydrologic control structure designs.

1.1 INTRODUCTION

The study area includes three parishes along the Louisiana coast beginning near Morgan City, LA and extending west to Delcambre, LA. The coastal parishes are adjacent to the Gulf of Mexico and extend inland or north approximately 90 miles near Arnaudville, LA. The area consists of St. Martin Parish, Iberia Parish, St. Mary Parish and the coastal boundary of the latter two parishes.

The eastern study boundary includes the western portion of the Atchafalaya Basin, beginning on the north near Arnaudville, LA, and extending south to Morgan City, LA. The Atchafalaya Basin is the largest wetland and swamp in the United States. It includes the Lower Atchafalaya River, Wax Lake Outlet, Atchafalaya Bay, and the Atchafalaya River and bayous Chêne, Boeuf, and Black navigation channel. During the early 20th century, the Atchafalaya River Basin was designated as a spillway for floods of the Mississippi River. Numerous large access canals and pipeline canals were dredged through deep swamp areas, across bayous, and across the Atchafalaya River. The Atchafalaya Basin is bordered on the west by the West Atchafalaya Basin Protection Levee (WABPL) separating the Atchafalaya Basin from primarily agricultural lands in the western part of the study area. The Atchafalaya Basin is bordered on the east by the East Atchafalaya Basin Protection Levee (EABPL), represents the western boundary of the Atchafalaya Floodway.

The western part of the study area is dominated by Bayou Teche, a former main channel of the Mississippi River, and is primarily agricultural in nature. Agriculture land use dominates the natural terraces adjacent to Bayou Teche that have developed from 1000's of years of flood events. These natural terraces are characterized by fine grained soil deposits such as clays and silts, but can include some sands. They are traditionally rich in nutrients and are well suited for agriculture. Bayou Teche is bordered in the south by the U.S. Hwy 90 and by the north and west study boundaries.

South of U.S. Hwy 90, the study area is characterized by coastal plains and marshes and influenced by tides and brackish waters. This is area has significant oil and gas development and infrastructure. Salt domes and associated extraction industries are a major occurrences along the Gulf Coast. Avery Island, Weeks Island and Cote Blanche Island are domes located within the study area. The coastal plain area on the eastern study area boundary includes both the Atchafalaya River bay where the Atchafalaya River meets the Gulf of Mexico and the Wax Lake Outlet. Both the Atchafalaya River and the Wax Lake

Outlet are outlets for the Atchafalaya Basin. It should be noted that due to the high sediment load, the Wax Lake Outlet and Atchafalaya River delta area are the only developing deltas along the Louisiana coast. Approaching from the east and south of U.S. Hwy 90, the Gulf Intracoastal Waterway (GIWW) intersects the study area just north of Avoca Island, near Morgan City, LA. GIWW continues west toward Texas, however the western boundary of Iberia Parish serves as the boundary of the study area.

1.2 STUDY PURPOSE

The purpose of this study is to provide hurricane and storm damage risk reduction to reduce the risk of flood damages caused by hurricane and storm surges.

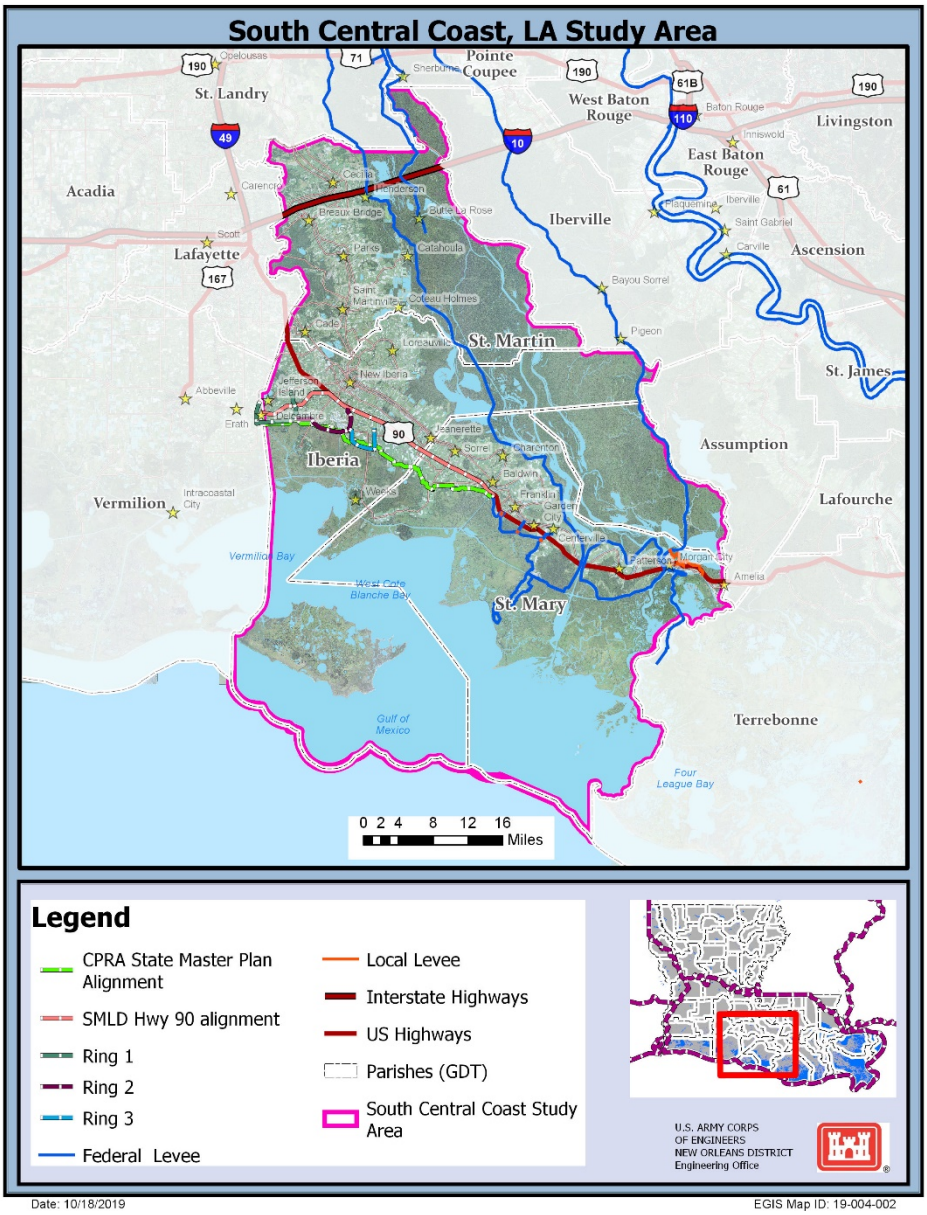

Figure 1 - Study Area

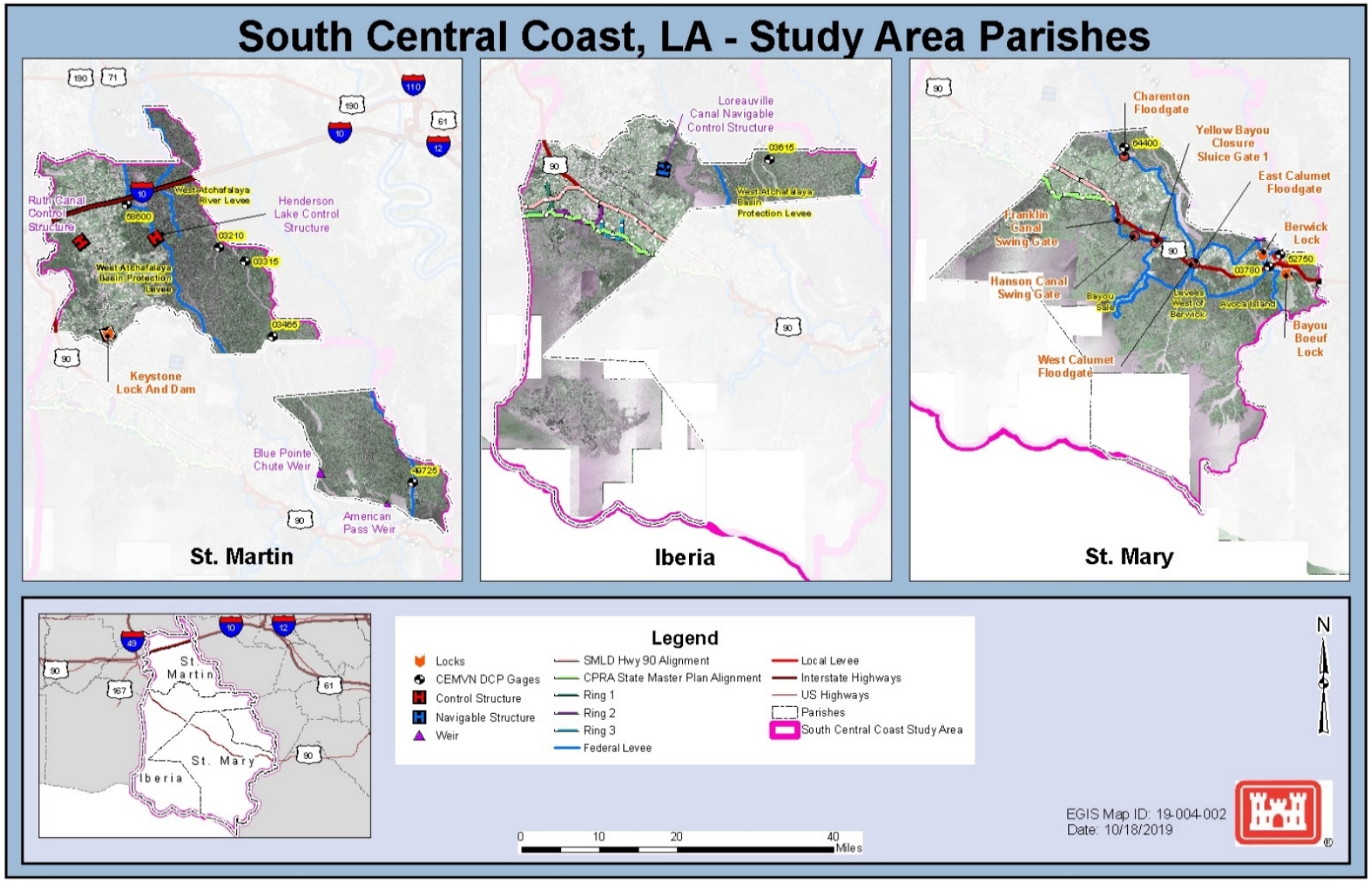

Figure 2 - Study Area

1.3 STUDY OVERVIEW

Hurricane and storm damage risk reduction measures were developed and screened using parametric costs and benefits to identify a focused array of alternatives. Measures carried through to the focused array are discussed in Section 1.2.

1.4 MEASURES

Measures USACE analyzed consists of the structural measures and nonstructural measures. Measures descriptions and screening methodology is discussed in Section 3 of the Main Report. Measures include:

Measure 1 Construct Comprehensive Levee System A with associated pump and gates.
Measure 5 Raise existing Morgan City Back levees (all segments).
Measure 6- Raise existing Levees West of Berwick (all segments).
Measure 7 Construction of new Ring Levee alignment 1 with associated pumps and gates.
Measure 8 Construction of new Ring Levee alignment 2 with associated pumps and gates.
Measure 9 Construction of new Ring Levee alignment 3 with associated pumps and gates.
Measure 16 Acquisition and relocation of structures within the 25 year Floodplain.
Measure 11 variation A Elevate and floodproofing structures within the 25 year storm surge floodplain.
Measure 11 variation B Elevate and floodproofing structures within the 50 year storm surge floodplain.
Measure 11 variation C Elevate and floodproofing structures within the 100 year storm surge floodplain.

Each structural levee measure were evaluated at the 0.01% AEP level of risk reduction.

In a coastal environment, flood risk can be caused by a combination of hurricane surge, waves, wave overtopping of structures, rainfall flooding including riverine flooding due to rainfall, or other sources. In the SCCL project area the 0-10-year events, a majority of the damages are caused by rainfall events. The 50-100-year events, economic damages are associated with storm surge events. Storm surge and wave design considerations were the primary drivers for project measures. Risk in the case of the levee designs is defined as the probability that an area will be flooded by storm surge, resulting in undesirable consequences. EM 1110-2-1913 was used a guide to develop design cross sections for new levees. Performance criteria considerations were informed by ER 1105-2-101. USACE policies require project performance to be described in terms of annual chance or exceedance probability and long-term risk rather than level of protection. In terms of annual chance or

exceedance probability, a 0.01 Annual Exceedance Probability (AEP) levee is designed to withstand a storm surge that has a 1 in 100 chance of occurring in any given year.

Designs and costs were developed for each level of risk reduction for each measure. The levee alignments referred to above are shown in 3 through 6. Further details on these alignments and how they were developed can be found in the Main Report. Details of the analysis and selection of the nonstructural plan can be found in the Appendix D Economic.

Figure 3 – Ring Levee Alignments 1 +2 and 3

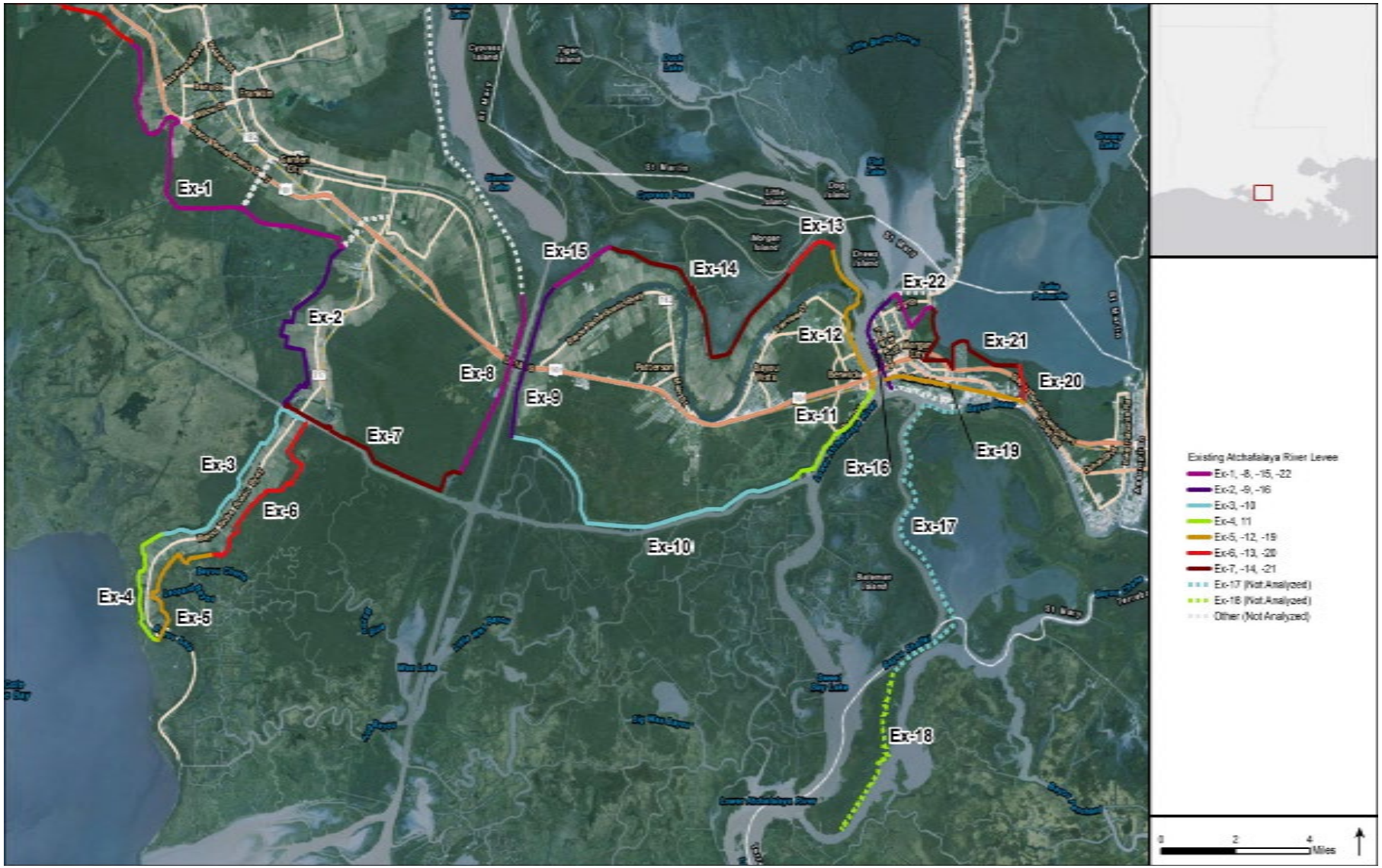

Figure 4 – Existing Levee EX 1, EX 19 and EX 21

Figure 5 – Woodland Road Levee (Part of EX 19)

2.0 SURVEYS

No new surveys were completed for the analysis of the final array of alternatives. Existing statewide data was used for measure development and evaluation. Site-specific surveys for the detailed design on measures included in the recommended plan will be completed in implementation documents during Planning Engineering and Design (PED). Future surveys will be performed in accordance with the New Orleans District Minimum Survey Standards and the District Datum Coordinator will approve the respective survey plans.

3.0 GEOTECHNICAL

This appendix summarizes the preliminary geotechnical design results for the SCCL Study. The results presented in this appendix are only intended for cost estimating purposes and determining the technical feasibility of the proposed alternatives. A full range of geotechnical analyses will have to be performed if any of the proposed alternatives are selected for construction. Figure 7 shows the general location of the alternatives discussed in this appendix:

Measure 1: Ring Levee 1+2, starting near Delcambre, LA and ending near Lydia, LA,
Measure 2 Ring Levee 2, starting near New Iberia and ending near Lydia, LA,
Measures 3: Raising existing sub-segments of Levees West of Berwick (EX 1)
Measure 4: Raising existing sub-segment of existing Morgan City Back Levees (Ex-19) & new I-wall Ex - 21)

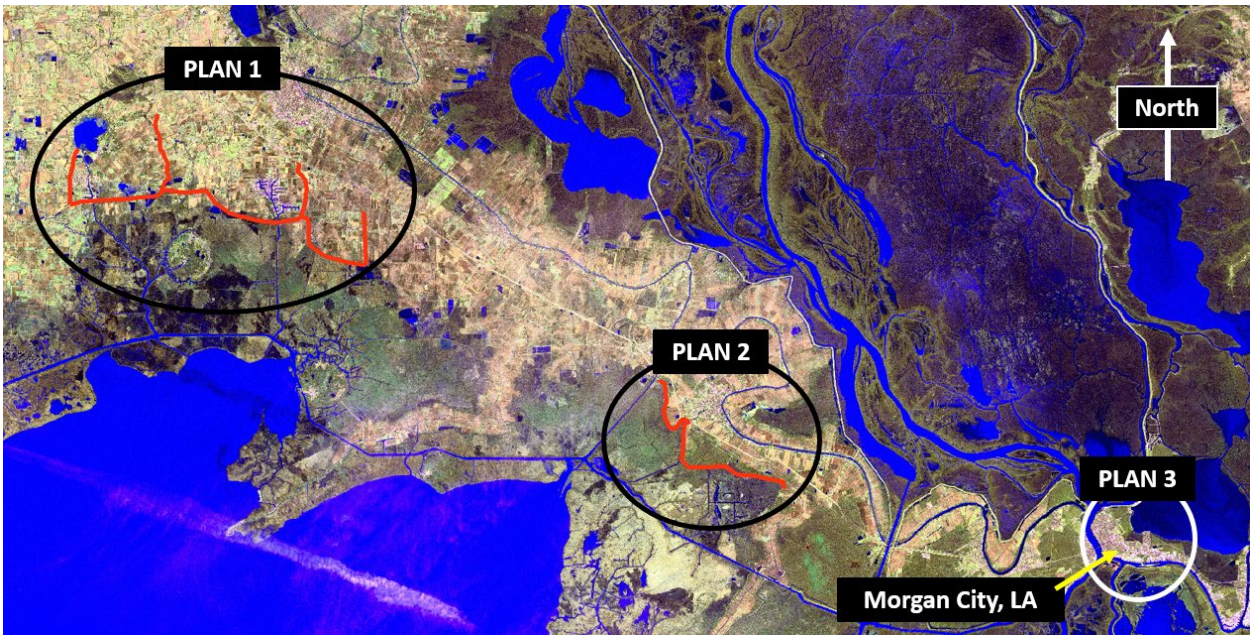

Figure 6. Structural Measures locations within the SCCL Study Area

3.1 GEOLOGY

The SCCL study area is composed of Pleistocene Prairie Terraces and several types of Holocene deposits including: a northeast section of majority back swamp deposits, a central area of riverine deposits, and a southwest section of deltaic deposits.

The northeast section is primarily composed of back swamp deposits. These back swamp deposits consist of clay with thin peat layers and plant/wood material. Back swamp deposits in this area typically reach depths of 120-140 ft below the surface. At the southern end of the northeast section, the Atchafalaya River and adjacent lakes produce surficial deposits of fat and lean clays with sandy silt of natural levees (0-5 ft above sea-level), overlying lacustrine clay (0-15 ft below sea-level). These deposits overlie back swamp deposits that extend 15-130 ft below sea-level (Dunbar, 1994).

In the central section of the study area, a former channel of the Mississippi River (which fed the then-active Teche delta) created a stratigraphy of inter-fingering layers of fat and lean clays and sandy silt of natural levees (5-15 ft above sea level). From five feet above sea-level to sixty feet below sea-level, the stratigraphy is made up of back swamp organic clays and point bar sand. Distributary sand can also be found at this depth or up to 120 ft below sea-level. Then from 60-200 ft below sea-level, substratum sand deposits dominate (Dunbar, 1994).

Deltaic deposits in the southwest section consist of Mississippi deltaic deposits (Teche delta lobe) and Atchafalaya deltaic deposits. These deposits are predominantly composed of a cyclic pattern of inter-distributary organics and clay, distributary sand, natural levee clay and silt, delta-front silt, and prodelta clay. These deposits overlie the Maringouin delta lobe of similar pattern and the Pleistocene Prairie Terrance. The Pleistocene Prairie Terrace consists of low, flat plains that slope gently towards the Gulf of Mexico (Mange and Otvos, 2005). These deposits are made up of green-grey clay with sand and silt layers, extending hundreds of feet into the subsurface.

Dunbar, J.B., Blaes, M.R., Dueitt, S.E., May, J.R., Stroud, K.W., 1994. *Geological investigation of the Mississippi River Deltaic Plain. Report 2, Technical Report GL-84-15*. Prepared for the U.S. Army Corps of Engineers, New Orleans.

Mange, M. and Otvos, E., 2005. *Gulf Coastal Plain Evolution in West Louisiana: Heavy mineral Provenance and Pleistocene Alluvial Chronology*. Sedimentary Geology. *182* (1-4), 29-57.

3.2 GEOTECHNICAL DESIGN

The design assumptions used for analyzing each alternative are discussed in the following sections.

Soil borings were not taken and soil testing was not performed for this study. Soil unit weights and shear strengths were assigned based on USACE geotechnical experience in the region and limited boring information. The design sections were developed using the following Engineering Manuals (EM) and Engineering Circulars (EC):

EM 1110-2-1913: Design and Construction of Levees (April 2000)
EM 1110-2-1902: Slope Stability (October 2003)
EM 1110-1-1904: Settlement Analysis (September 1990)
EC 1110-2-6066: Design of I-Walls (April 2000)

The Hurricane and Storm Damage Risk Reduction System (HSDRRS) design criteria was also used as a reference but not used for establishing design criteria for measures included in the final array.

It was assumed that the levee elevations will need to remain above the 0.01 (100 year storm surge) AEP (Annual Exceedance Probability) levee elevation for the project design life. It was also assumed new borrow pits adjacent to the levee alignments would not be necessary. Seepage analyses were not performed for parametric design and evaluations. All elevations discussed in the following sections are NAVD88 unless noted otherwise.

3.3.1 PLAN 1 – RING LEVEES 1+2, 2,

Plan 1 – Design Assumptions

Ring Levees 1, 2, and 3 would be located between Erath, LA (to the west) and Lydia, LA (to the east). Ring Levees 1, 2, and 3 were originally known as Ring Levees A, B, and C, respectively, at the initiation of the study. Figures 8, 9, and 10 show the approximate alignment and length for Ring Levees 1, 2, and 3, respectively. Profiles for the 0.01 AEP levee elevation were provided for geotechnical review. Table 1 summarizes the design assumptions related to the 0.01 AEP levee elevations for the Ring Levees.

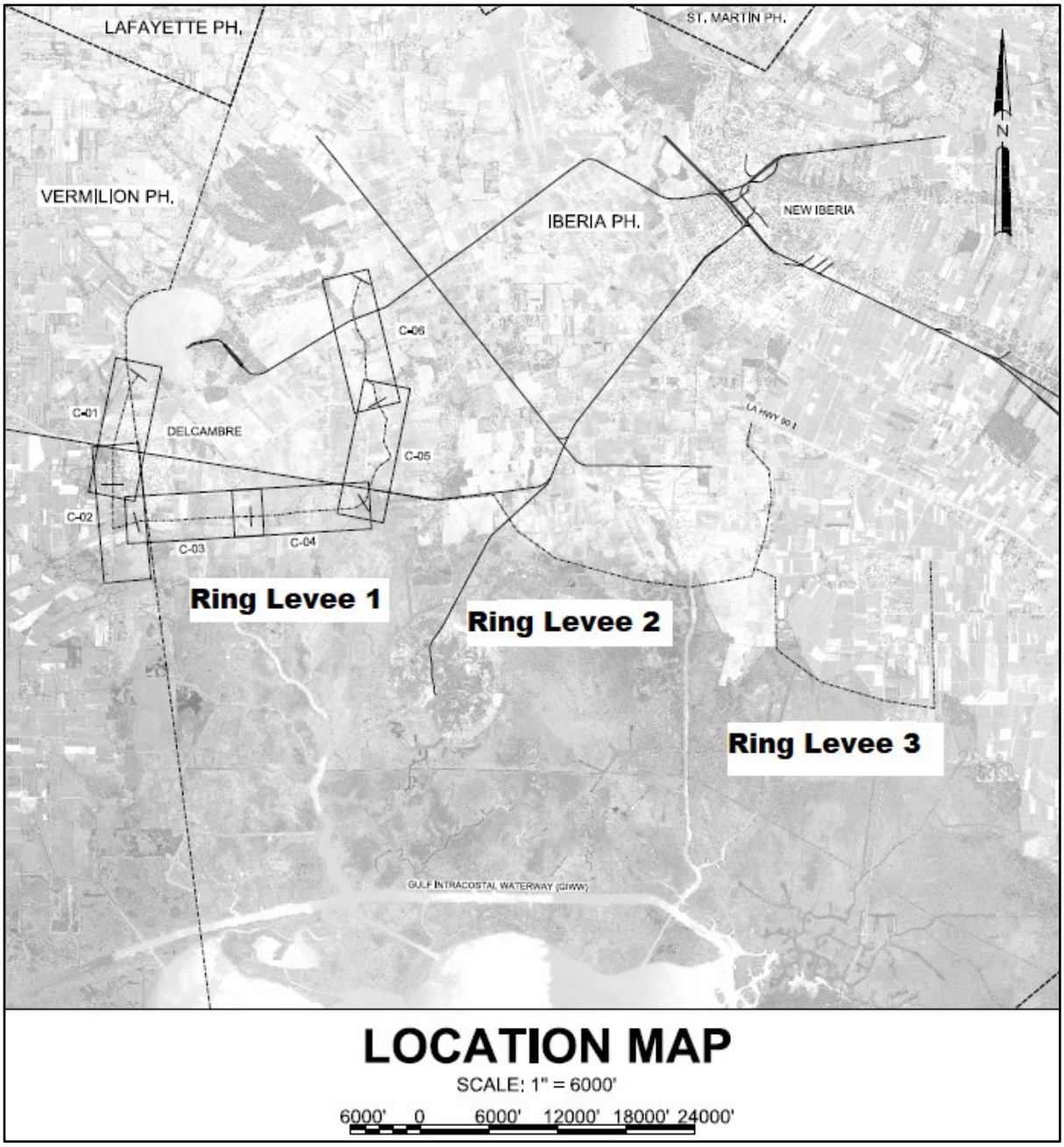

Figure 7. Map with Length and Alignment of Ring Levee 1

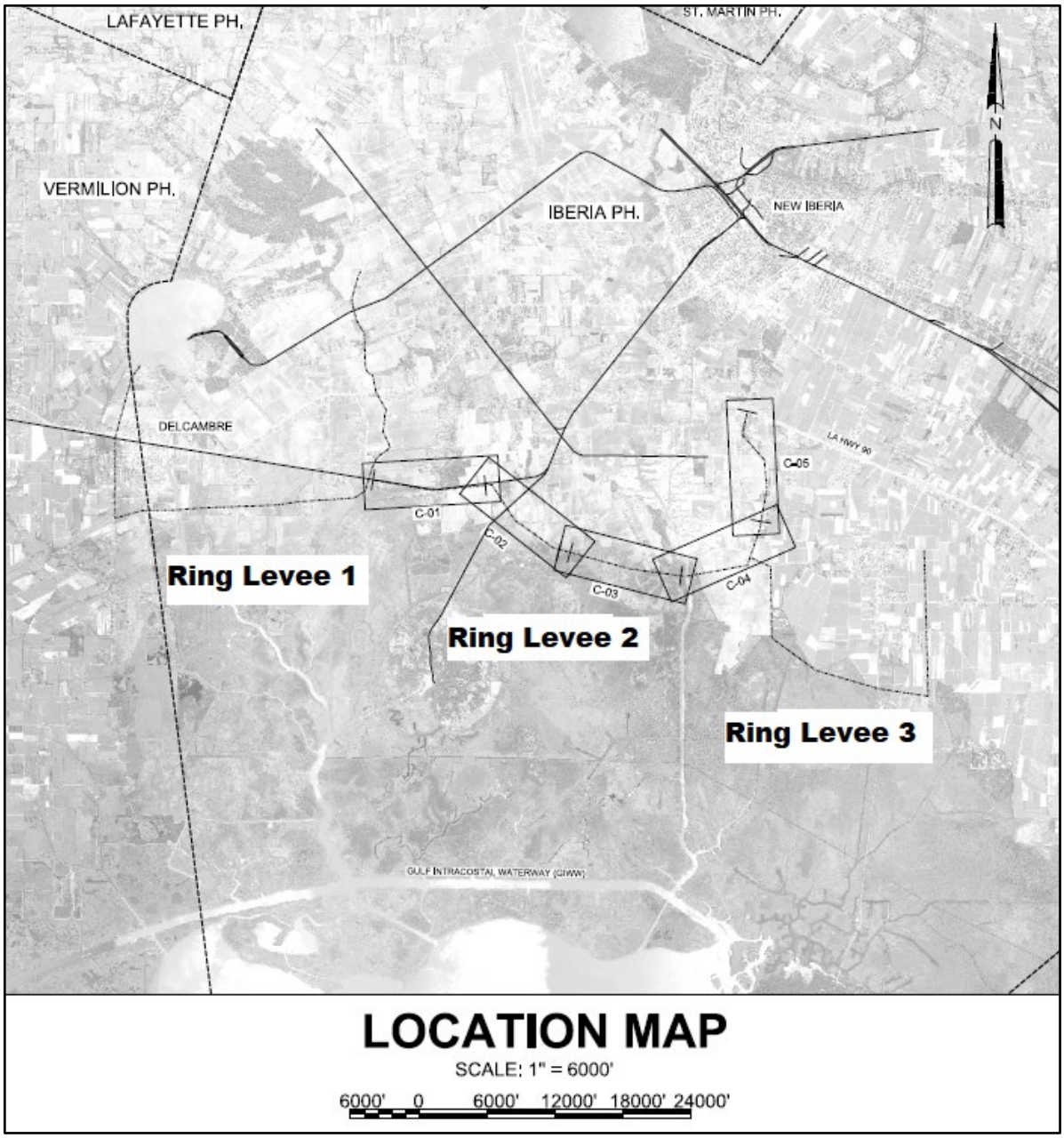

Figure 8. Map with Length and Alignment of Ring Levee 2

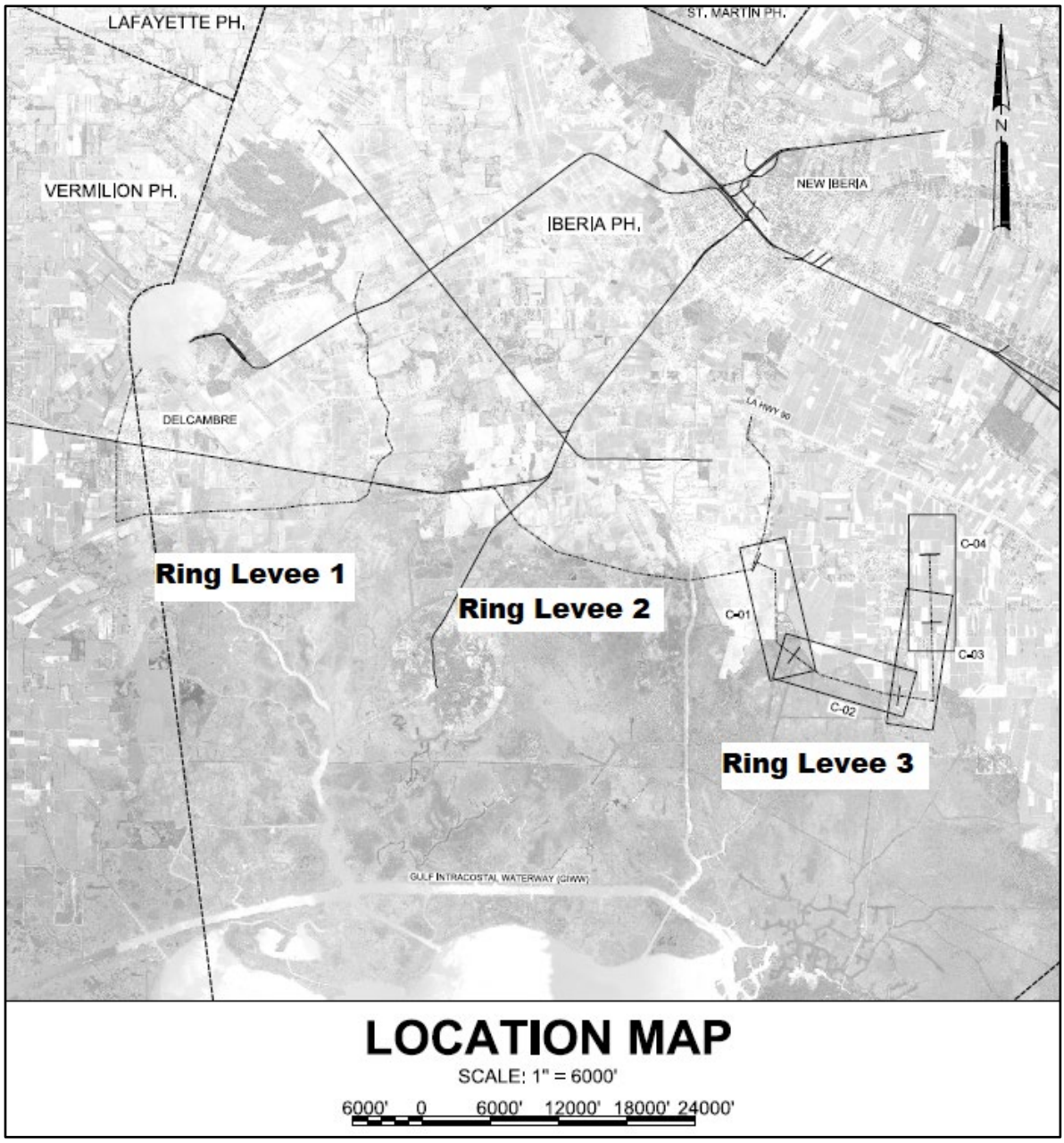

Figure 9. Map with Length and Alignment of Ring Levee 3.

Table 1. Summary of 0.01 AEP Ring Levee Elevations.[A]

Ring Levee	Minimum Current 1% AEP Elevation (ft)	Maximum Current 1% AEP Elevation (ft)	Current Representative 1% AEP Elevation [B] (ft)	50-year Representative 1% AEP Elevation [B] (ft)
1	15.5	19.4	17.6	21.6
2	12.0	17.5	15.5	
3	14.5	15.0	14.8	

[A] All elevations are in NAVD88 (ft). Minimum and maximum elevations taken from USACE (2019) Plan & Profiles for the 0.01 and 0.02 AEP Elevations for Ring Levees 1, 2, and 3.
[B] Representative elevations are based on weighted averages of the 0.01 AEP elevations along the length of the alignments.

A review of existing boring information along the proposed levee alignments was performed. Strength testing data was only found for one boring within 2,000 ft of the proposed alignments. This data was used to perform basic slope stability analyses. Recent LIDAR data was not available but the available data showed existing ground elevations between 0 and 10 ft.

Consolidation testing data was not available for any of the reviewed borings. However, the geotechnical appendix from the following report contained settlement analyses that were recently performed for a different nearby alternative being considered for the South Central Coast Study: ARCADIS, U.S., Inc. 2017. *South Central Coast Louisiana Flood Protection Study. Appendix M – Geotechnical Report*. Prepared for the Coastal Protection and Restoration Authority.

The alignment for this nearby alternative is shown in Figure 11. The alignment is in close proximity to the Ring Levee measures alternative and is oriented roughly parallel to the Gulf side of the proposed ring levees.

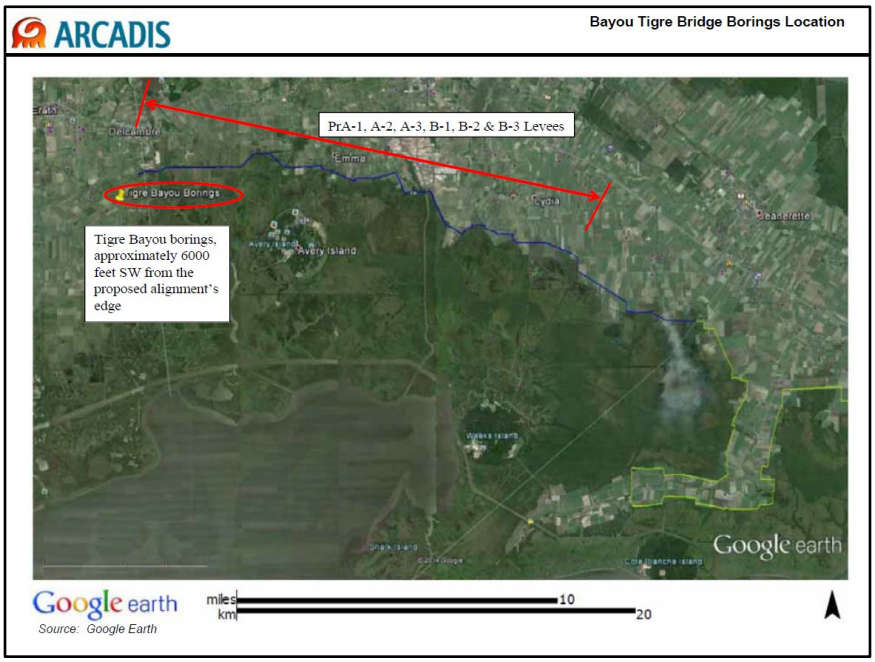

Figure 10. Map showing alignment used in CPRAB (2019) to analyze settlement.

It should be noted that due to lack of data, the CPRAB (2017) settlement analyses were based on testing data from borings taken on the western end of the proposed alignments for a different project. The analyses were reviewed and considered to have been completed using reasonable cost estimating purposes. The proposed lift schedule from the CPRAB (2017) report is shown in Figure 12.

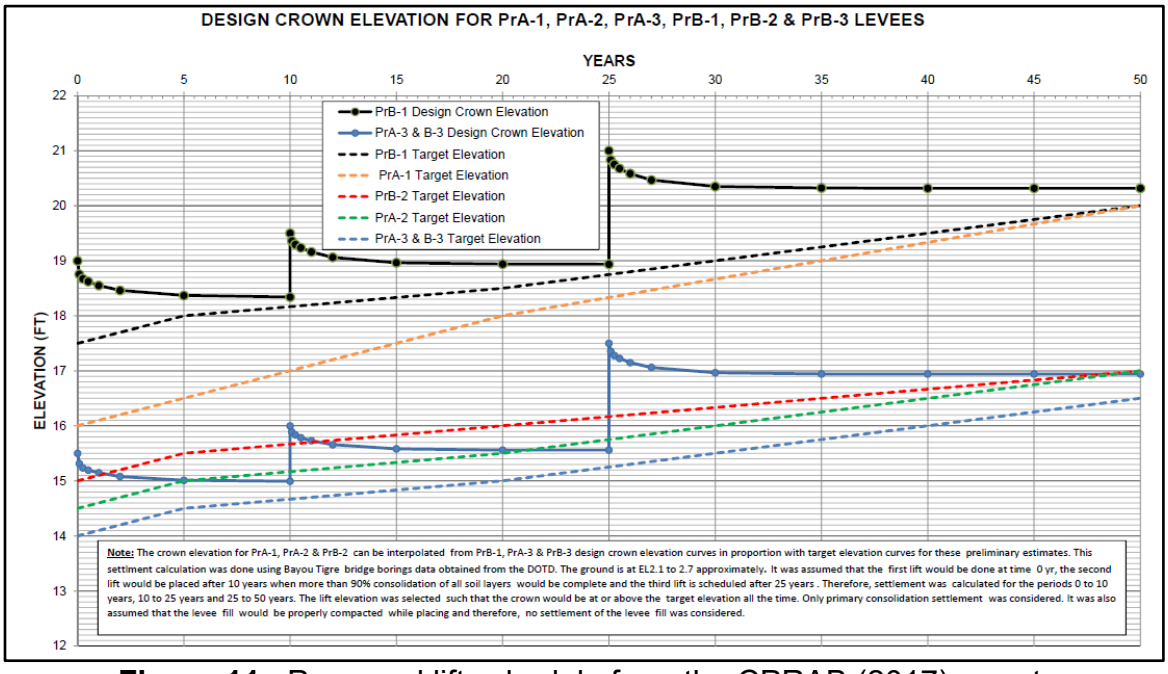

Figure 11. Proposed lift schedule from the CPRAB (2017) report.

Plan 1 – Design Development

Using the available information and design assumptions, a typical design section was developed to analyze settlement and slope stability. The methodology used to develop the typical design section considered the following:

Selection of the initial construction grade elevation should be conservative since this would result in higher total settlement values and reduce cost estimating risk. As a result, the current 0.01 AEP representative levee elevation for Ring 3 was selected for the typical design section. This value is shown as 17.6 on Table 1.

Based on the CPRAB (2017) report and USACE experience in the area, 1 to 2 ft of settlement is anticipated within 10 years of initial construction. As a result, 2 ft of overbuild was added to the typical section which raised the initial construction grade elevation to 19.6.

Due to lack of high quality consolidation and survey data, there is significant uncertainty in the estimated settlement that will occur for individual segments of the ring levees. As a result, a representative 0.01 AEP levee elevation was selected for a target elevation in order to develop a lift schedule for the typical levee section. Based on the available 50 year predictions, a representative target elevation of 21.6 ft was selected. This is a weighted average of the 50-year predictions for all segments of the ring levees.

Based on the design assumptions and settlement analyses performed in the CPRAB (2017) report, the lift schedule for the typical ring levee section would consist of (Figure 13):

Lift 0 – Initial construction with 1 to 2 ft of overbuild.
Lift 1 – Levee lift of 2.5 ft performed within 5 to 10 years from initial construction.
Lift 2 – Levee lift of 1.5 ft performed within 15 to 20 years of initial construction.
Lift 3 – Levee lift of 1 ft performed around 30 years after initial construction.

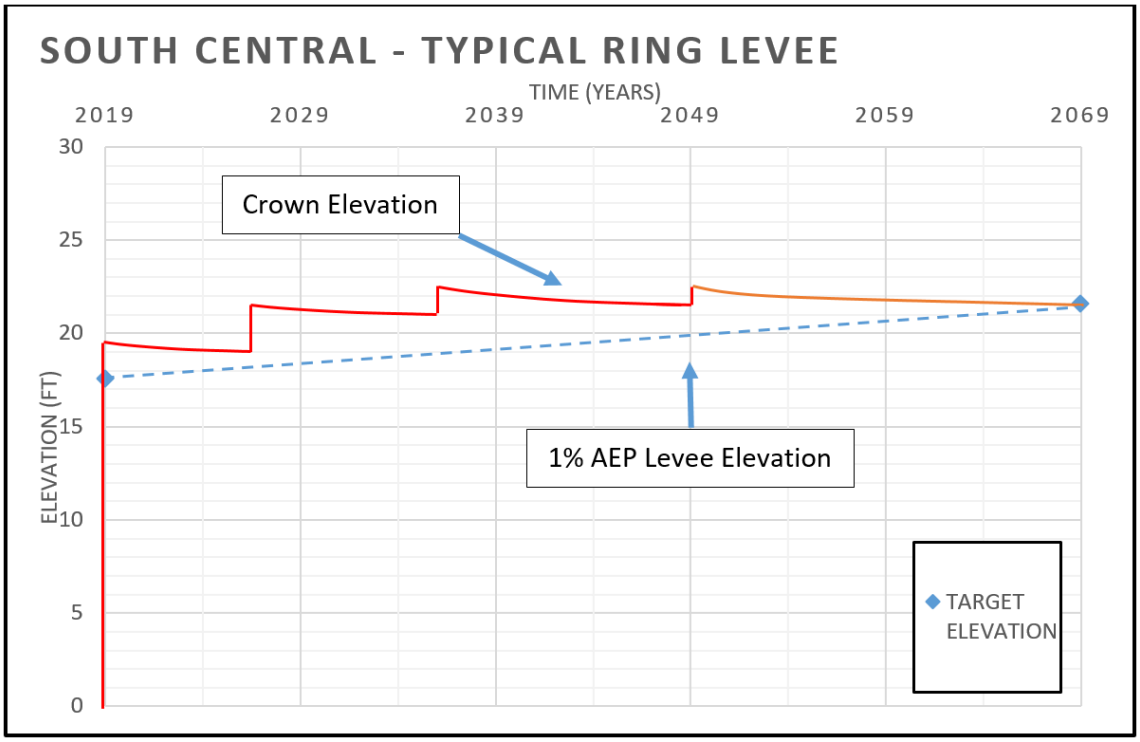

Figure 12. Graphical representation of lift schedule for typical ring levee section.

Once the lift schedule was developed, basic slope stability analyses were performed using GeoStudio's Slope/W (version 10.0.0.17401) computer program. EM 1110-2-1913 and EM 1110-2-1902 were reviewed to evaluate which design conditions would be most critical for design and appropriate factors of safety were selected. Based on this review, it was determined that the following conditions should be analyzed using the selected factors of safety:

Water at Construction Grade (Top of Levee): Factor of Safety = 1.2
Still Water Elevation: Factor of Safety = 1.3
Low Water Elevation: Factor of Safety = 1.4

The 50-year 0.01 AEP ring levee elevations were then reviewed in conjunction with the estimated lift schedule. The maximum 50-year 0.01 AEP elevation was estimated as 25.0 ft with a corresponding Still Water elevation of 13.1 ft. This would require a maximum construction grade elevation of 26.0 ft. This maximum construction grade was used in the analyses along with 10 ft wide crowns and 1 vertical to 4 horizontal side slopes. For the Still Water analysis, the water elevation was increase to 14.1 ft to account for uncertainties in the 50-year 0.01 AEP predictions. The soil stratification and soil strengths were based on the data from boring POI-4U. The Boring Plate for POI-4U is illustrated in Figure 14. Since this is only a feasibility level study, stability analyses were only performed using Spencer's Method.

Stability analyses results for the Water at Construction Grade, Still Water Elevation, and Low Water conditions are shown in Figure 15, 16, and 17, respectively. All of the analyses met or exceeded the factors of safety used for this alternative.

Plan 1 – Conclusions

Based on the available information, the typical levee section for the ring levees will require a 10 foot wide crown with 1V on 4H side slopes for both the landside and waterside. Depending on actual site conditions, geotextile may be necessary for increased levee stability; particularly if slopes steeper than 1V on 4H are considered. Figure 18 shows the typical levee section for the ring levees. All conclusions are subject to change once site specific boring information becomes available.

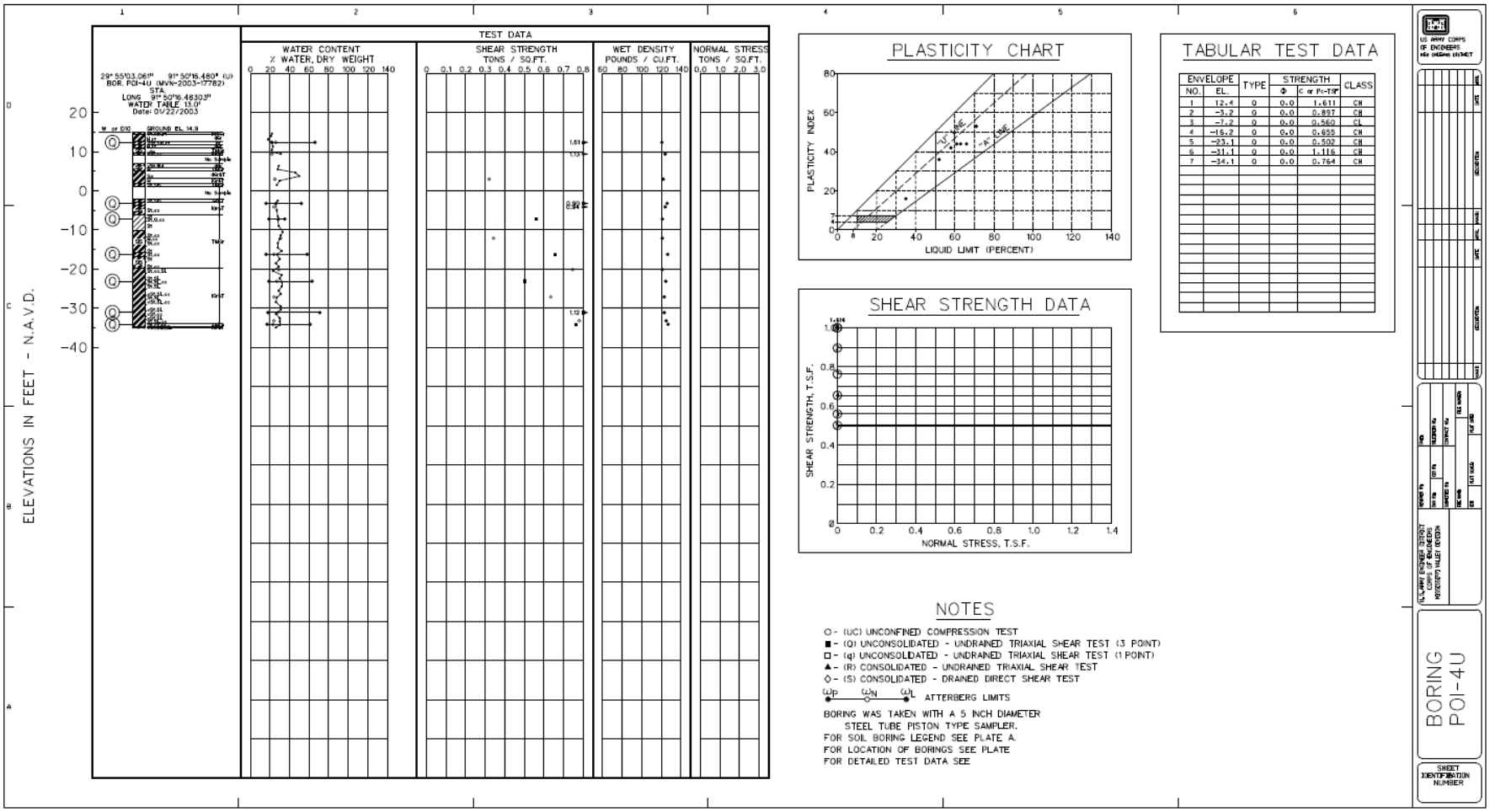

Figure 13. Boring plate for boring POI-4U.

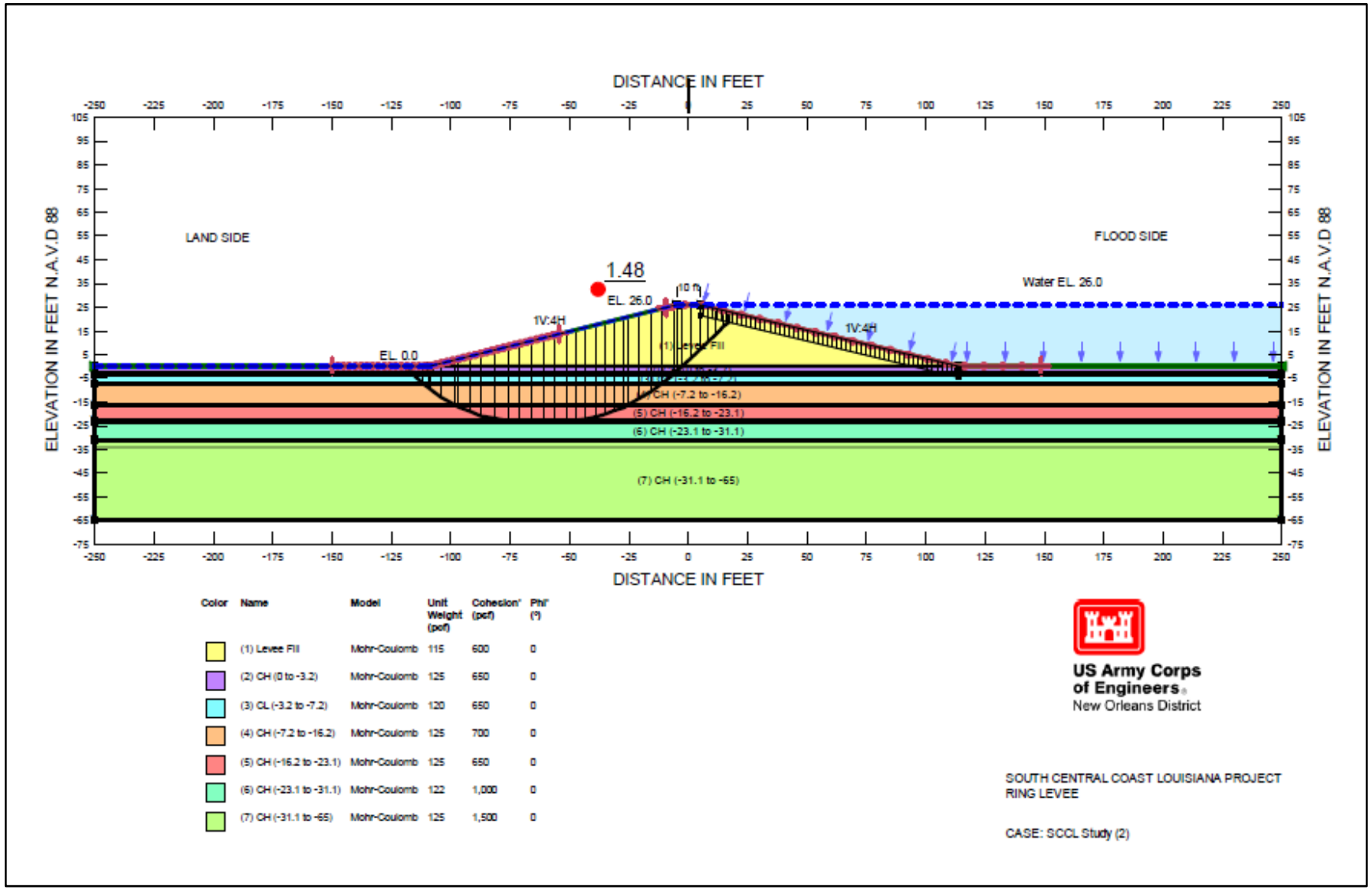

Figure 14. Ring Levees – Slope Stability Analysis for Water at Construction Grade.

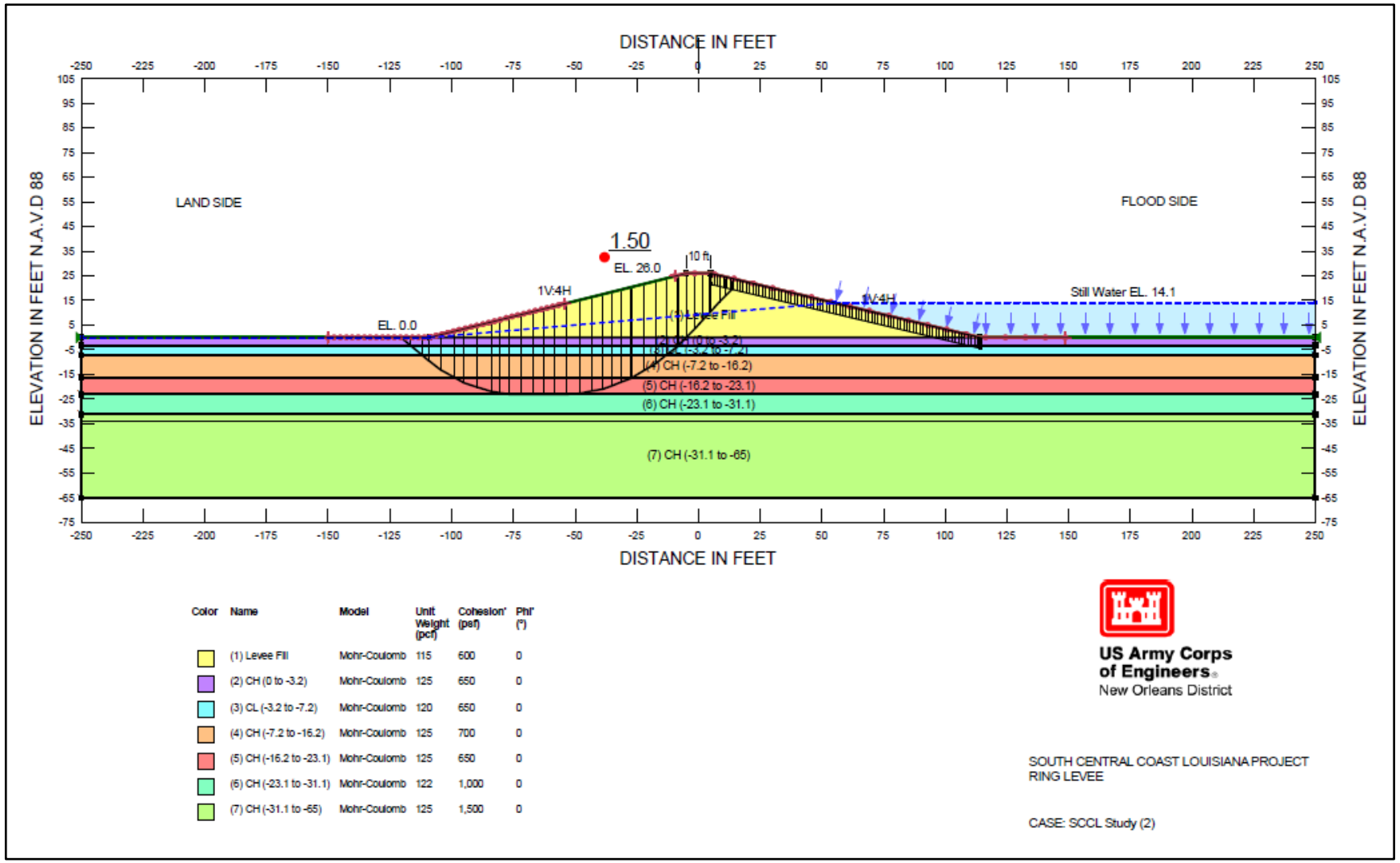

Figure 15. Ring Levees – Slope Stability Analysis for Still Water Elevation.

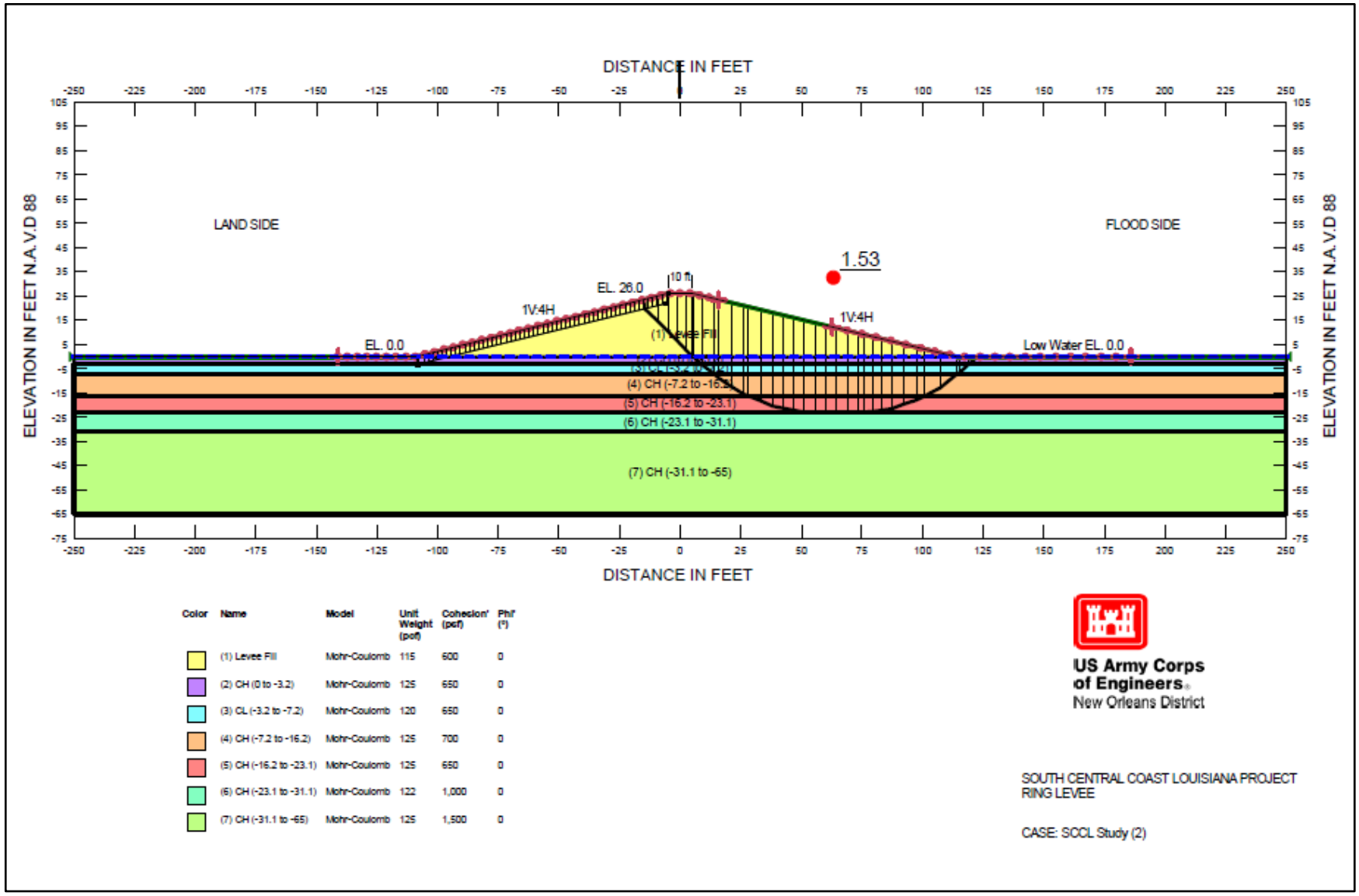

Figure 16. Ring Levees – Slope Stability Analysis for Low Water Condition.

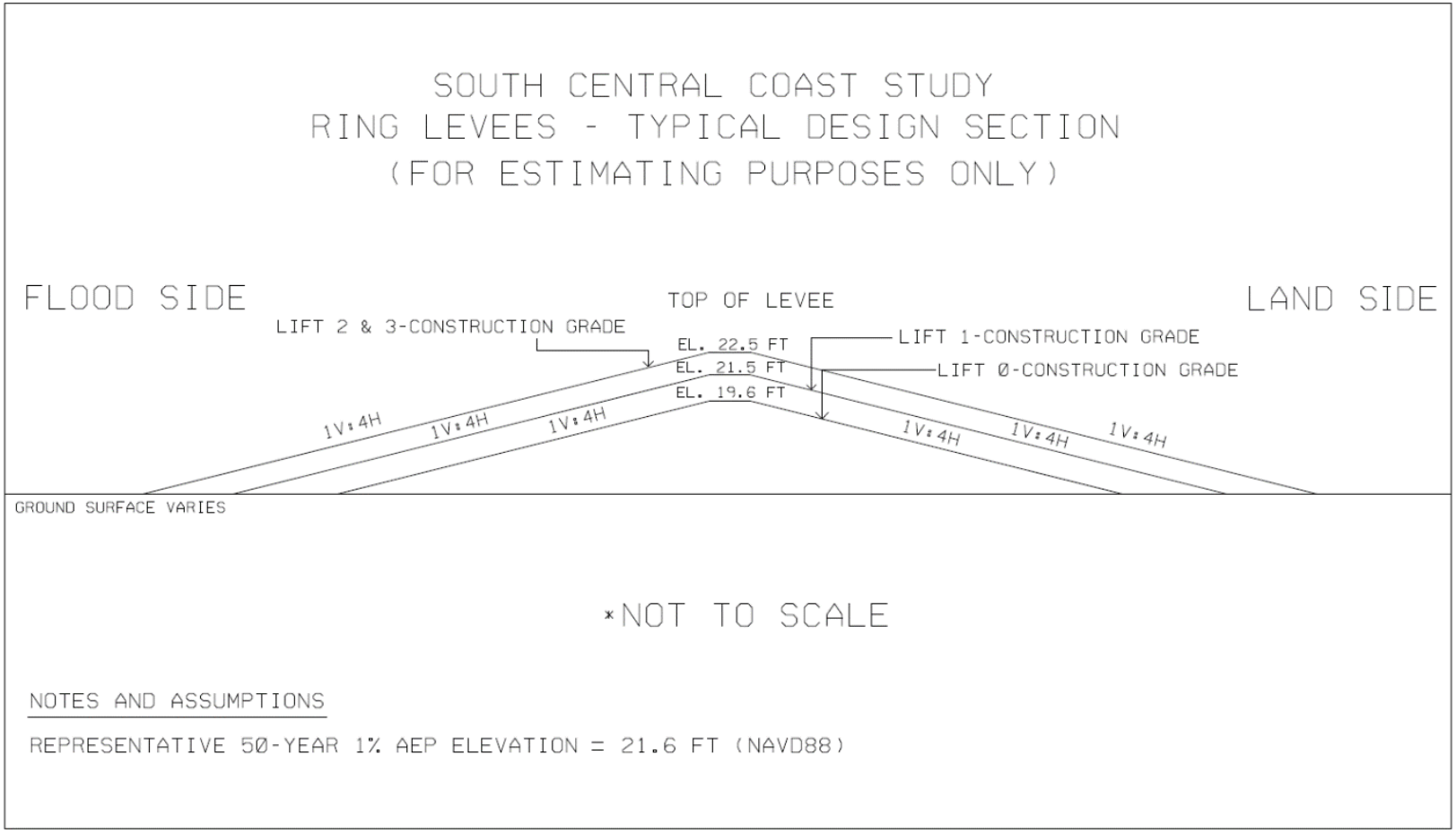

Figure 17. Typical Levee Section for Plan 1 – Ring Levees.

3.3.2 Plan 2 – Design Assumptions

The Ex-1 levee alignment consists of the existing Atchafalaya Basin – Levees West of Berwick from stations 1535+00 to 1690+00 and stations 1845+00 to 2260+00. Portions of Ex-1 were recently raised by the St. Mary Levee and Drainage District to an elevation of 10.5 ft which meets the 0.01 AEP storm surge levee elevation for this portion of the study area. These recent levee raises occurred between stations 2084+65 to 2260+00. The Ex-1 alignment description is organized in this section as follows:

EX1-A: Ex-1 alignment between stations 1535+00 to 1690+00.
EX1-B: Ex-1 alignment between stations 1845+00 to 2084+65.
EX1-C: Ex-1 alignment between stations 2084+65 to 2260+00 recently raised by local sponsor.

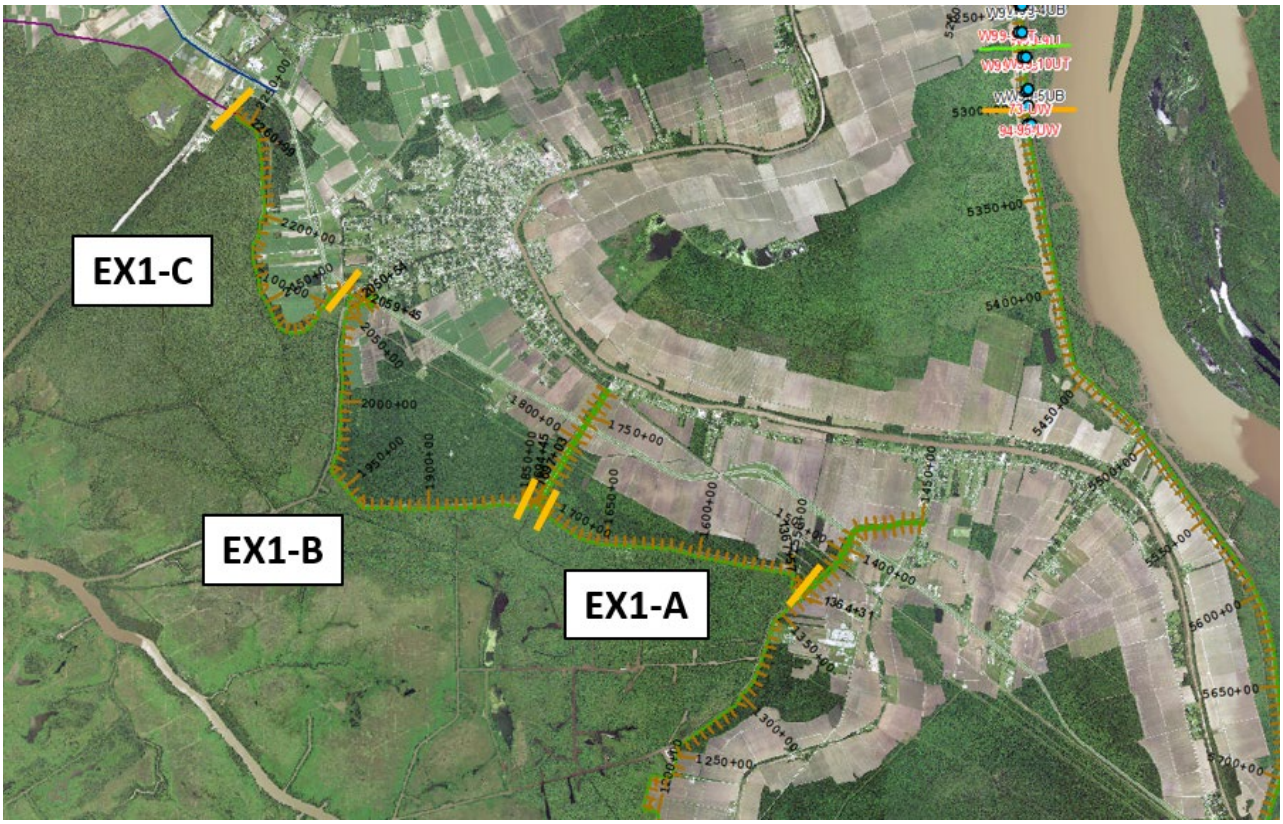

Figure 18. Map showing alignment of Ex-1 and boundaries for EX1-A, EX1-B, and EX1-C.

The most recent plans and profiles from 2012, identify the 0.01 AEP elevation along the entire length of Ex-1 alignment at 10.5 ft. Currently the 0.01 AEP levee elevation has not been forecasted for the 50-year project life of this alternative. However, based on USACE experience in the region, the 0.01 AEP levee elevation is roughly estimated to increase between 4 and 6 ft in the next 50 years. Therefore, a 50-year 0.01 AEP levee elevation of 15.5 ft was assumed for the purposes for estimating a lift schedule.

Plan 2 – Design Development

The design development for Ex-1 focused heavily on reviewing historic design reports for the existing levees along the Ex-1 alignment. The reports reviewed for this study included:

> ***EX1-A***: U.S. Army Corps of Engineers (USACE), 1989. Levees West of Berwick, LA, Teche Ridge Levees, Centerville Area, Station 0+00 to Station 276+00, Design Report with Plans & Profiles, USACE, New Orleans District, New Orleans, LA.
> ***EX1-B***: U.S. Army Corps of Engineers (USACE). 1992, Levees West of Berwick, LA, Teche Ridge Levees – Franklin Area, Station 1785+00 to Station 1990+00, Design Study with Plans & Profiles, USACE, New Orleans District, New Orleans, LA.
> ***EX1-C***: U.S. Army Corps of Engineers (USACE), Cappel, Tousley & Moses, Inc., and Kramer & Miller, Inc., 1972. Franklin and Vicinity Area, Design Memorandum No. 1 – General Design, Morgan City, Louisiana and Vicinity, USACE, New Orleans District, New Orleans, LA.

The historic design reports for EX1-A and EX1-B presented slope stability and settlement analyses for an all-earth-straddle enlargement design. The reports recommended 10 ft levee crowns with 1 vertical to 4 horizontal side slopes. The reports estimated less than 1 ft of settlement after construction. Based on the accompanying Plans & Profiles, the average height of fill added for the levee enlargements was generally less than 5 ft.

Historic slope stability and settlement analyses for EX1-C could not be located for review during this study. However, the historic design report recommended 10 ft levee crowns with 1 vertical to 4 horizontal side slopes. Based on the accompanying Plans & Profiles, the average height of fill added for the levee enlargement was less than 7 ft.

Due to lack of recent consolidation data, updated settlement analyses could not be performed. The historic consolidation data showed that there is a high likelihood that the soils in this area may have been exposed to high pre-consolidation pressures in the past compared to existing in-situ stresses. This is suggested by the settlement parameters used in the historic reports and the relatively low values of estimated settlement (less than 1 ft). However, these conditions would need to be verified with updated testing results. Furthermore, since hydraulic modeling was not performed to estimate the future 0.01 AEP levee elevations, there is a large degree of uncertainty in predicting settlement for a lift schedule since consolidation and

settlement are highly time dependent. For these reasons, it is recommended that a lift schedule similar to that of Plan 1 be used for cost estimating purposes.

A typical lift schedule is presented in Figure 20 which consists of:

Lift 0 – Initial lift with 1 to 2 ft of overbuild.
Lift 1 – Levee lift of 2.5 ft performed within 5 to 10 years from initial construction.
Lift 2 – Levee lift of 1.5 ft performed within 15 to 20 years of initial construction.
Lift 3 – Levee lift of 1 ft performed around 30 years after initial construction.

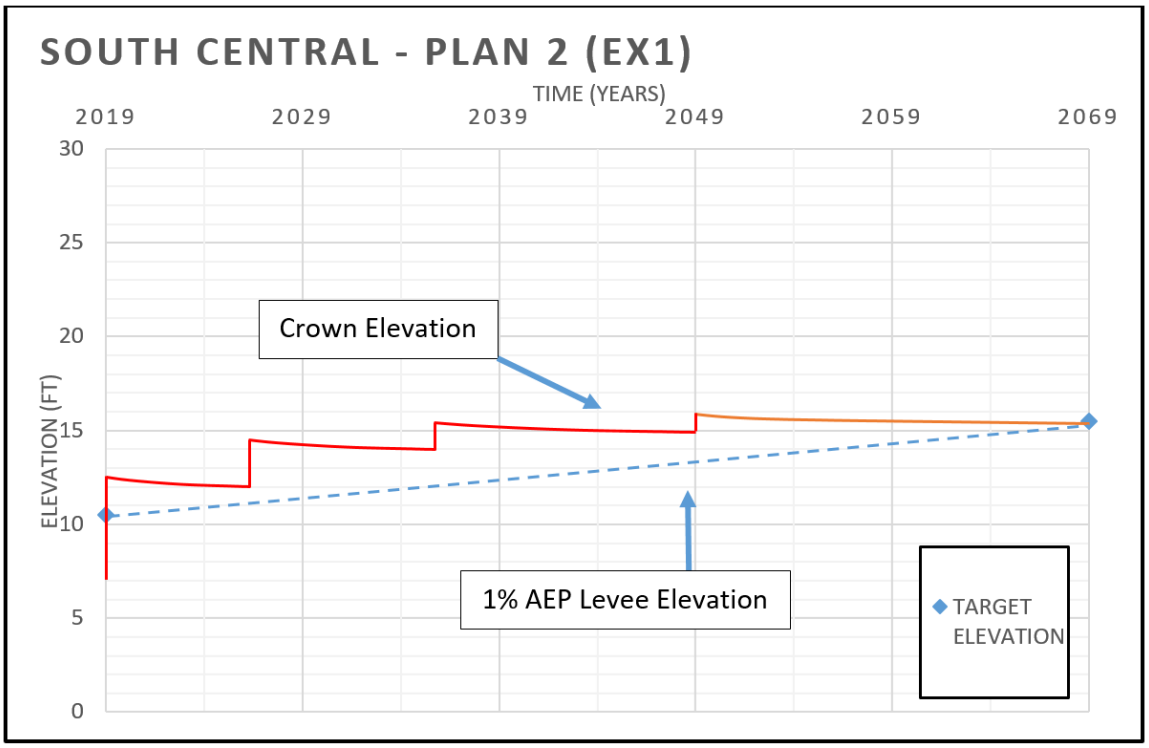

Figure 19. Typical lift schedule for Plan 2.

Characterization of site conditions for the purposes of performing slope stability analyses were problematic for numerous reasons. Based on the historic reports and Plans & Profiles, the existing surface conditions are expected to vary significantly due to the presence of existing borrow pits and drainage canals in close proximity to the levee alignment. The available sources indicate varying distances from these features to the levee toes. However, 10 ft crown widths with 1 vertical to 4 horizontal side slopes are consistently recommended in the historic reports. Additionally, there currently no forecasted predictions for the 50-year 1% AEP levee elevation.

Due to these conditions and lack of data, only a set of basic stability analyses were performed using the historic strength lines and a rough estimate for the maximum construction grade in 50 years. The maximum construction grade was taken as elevation 16.5 ft which is the estimated 50-year 0.01 AEP levee elevation with an additional 1 ft for overbuild. These

analyses were primarily performed to evaluate the likelihood for requiring stability berms for this alternative.

EM 1110-2-1913 and EM 1110-2-1902 were reviewed to evaluate which design conditions would be most critical for design and appropriate factors of safety were selected. Based on this review, it was determined that the following controlling cases should be analyzed using the selected factors of safety:

Water at Construction Grade (Top of Levee): Factor of Safety = 1.2
Still Water Elevation: Factor of Safety: 1.3

The Water at Construction Grade analysis is presented in Figure 15 and the Still Water Elevation analysis is shown in Figure 16. A distance of 40 ft from the borrow pit to the levee toe was selected for analysis since this is the minimum distance shown in the historic design reports; actual site conditions may vary. Since the 50-year 0.01 AEP Still Water Elevation was unknown for this study, it was estimated to be 3 ft below the estimated 50-year 0.01 AEP levee elevation of 16.5 ft.

It should be noted that although the factors of safety were met for the conditions analyzed in this study, there is large level of uncertainty in the location and depths of nearby borrow pits and drainage canals. These features can have significant influence on the factors of safety for slope stability which could impact the levee design. Furthermore, some gains in soil shear strengths are expected to have occurred between the last time the levees were raised and today.

Plan 2 – Conclusions

Based on the review of the available data and historic reports, it is recommended that any levee raises for Plan 2 use 10 foot wide crowns and 1 vertical to 4 horizontal side slopes. Based on the results of the slope stability analyses, it is expected that the design section will need to be changed if stricter design criteria are used for geotechnical analysis.

Since the estimated 50-year 0.01 AEP levee elevation was not based on modeling results, it is recommended that a lift schedule similar to that of Plan 1 be used for estimating purposes. The typical design section for Plan 2 is shown in Figure 21. All conclusions are subject to change once site specific boring information becomes available.

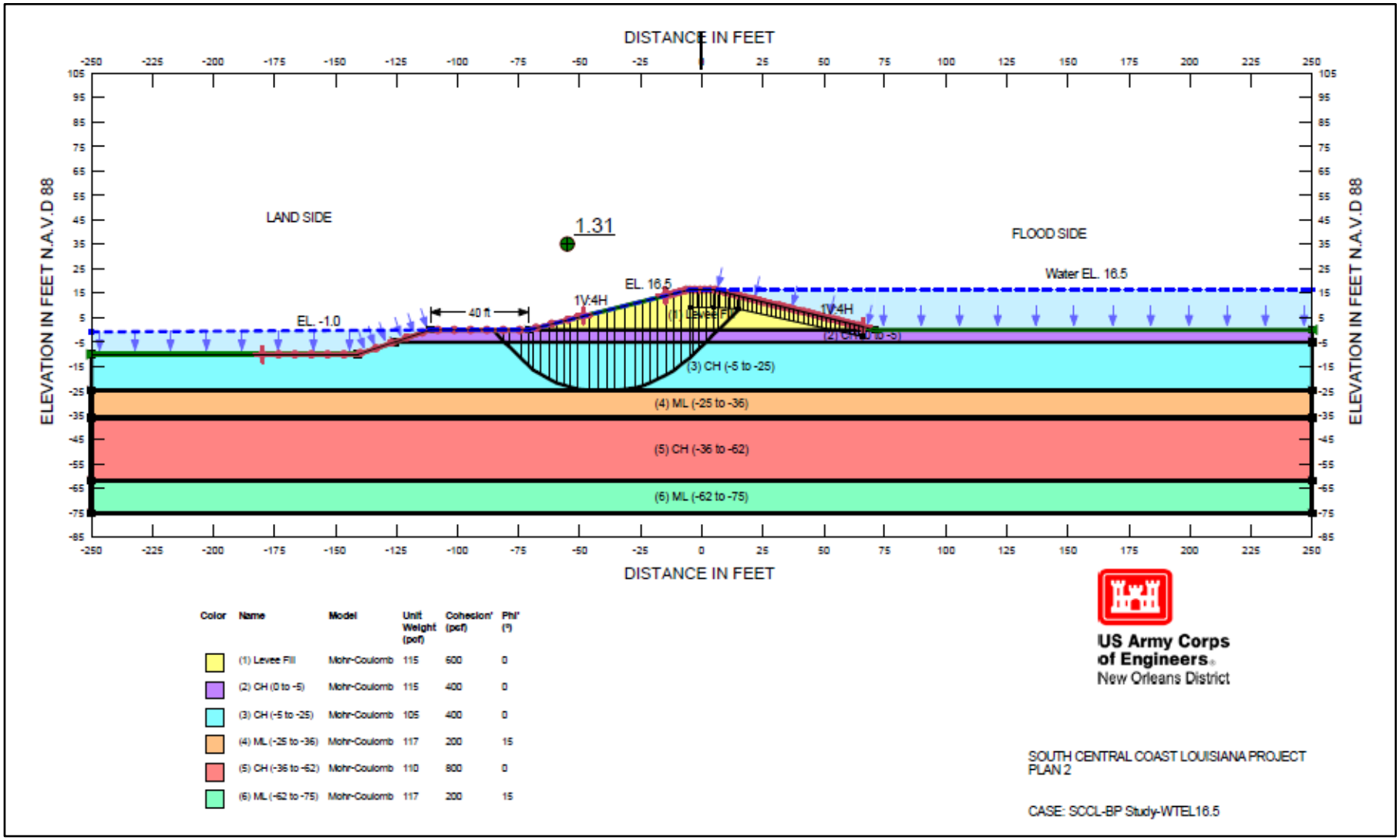

Figure 20. Plan 2 Levees – Slope Stability Analysis for Water at Construction Grade.

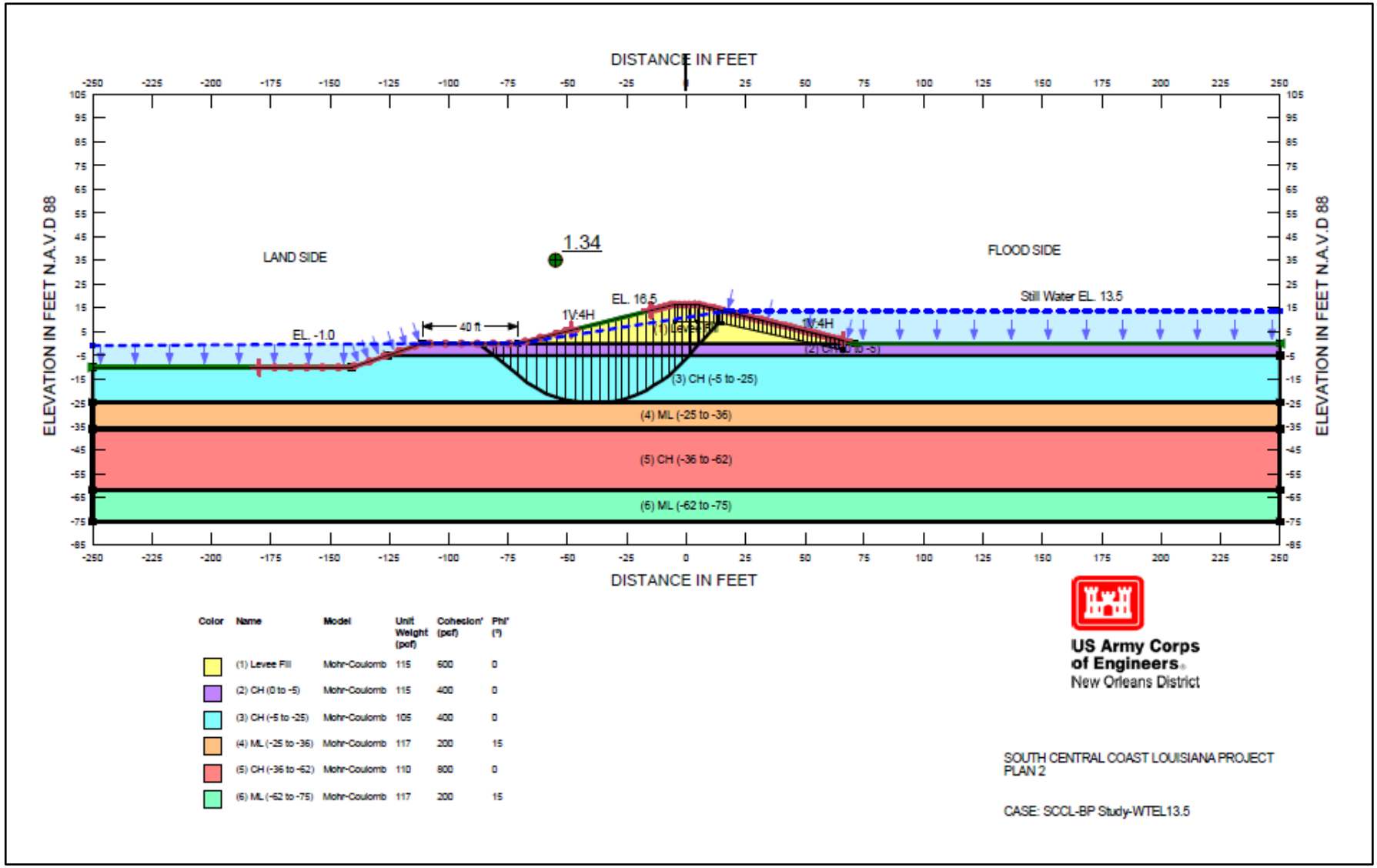

Figure 21. Plan 2 Levees – Slope Stability Analysis for Still Water Elevation.

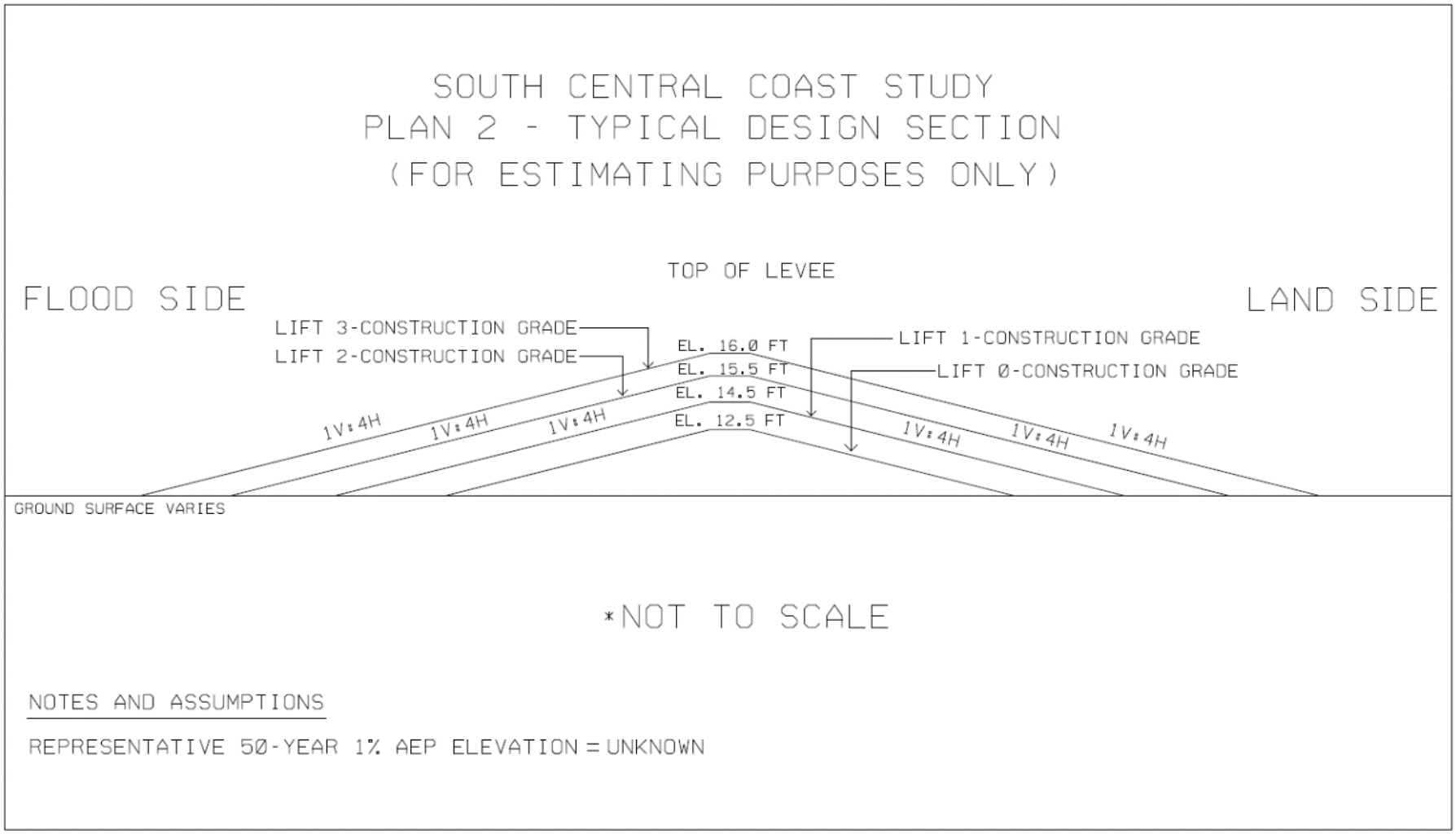

Figure 22. Typical Design Section for Plan 2.

3.3.3 PLAN 3 – NEW LEVEE WOODLAND RD IN EX19 AND NEW I-WALL IN LAKESHORE AREA IN EX21

Plan 3 – Design Assumptions

The Plan 3 alternative is located in Morgan City, LA as shown in Figure 24. The proposed alternative consists of: (i) installing a new I-Wall along the lakeshore area adjacent to Lake Palourde and (ii) construction of new levee along Woodland Road in southwest Morgan City.

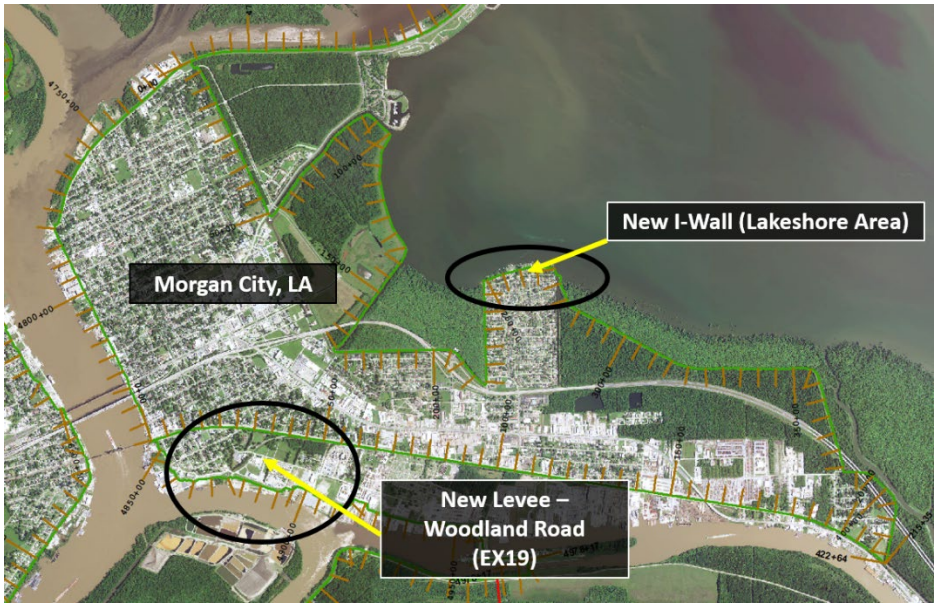

Figure 23. Map showing proposed work areas for Plan 3 alternative.

The new I-wall would be installed between stations 250+00 and 270+00 along the alignment of the Morgan City back levees as shown in Figure 25 and 26. There are no existing levees along this portion of the alignment but the ground surface is higher than the adjacent lake. There was limited boring information available for review along this portion of the alignment. The closest boring with any testing data is boring 13-AIUT-A which is approximately 3,500 ft away from the proposed I-wall. The boring was only taken to depth of 11.3 ft. The information from this boring could not be used for geotechnical analysis of the I-wall since the lakeshore area is expected to have significantly different subsurface conditions from those of boring 13-AIUT-A.

Based on the available information, the current (2012) 0.01 AEP levee elevation for this area is approximately 11.0 ft and the existing ground surface along the proposed alignment is approximately at elevation 3.0 ft as shown in Figure 23. The 50-year 0.01 AEP levee elevation was unknown at the time of this study.

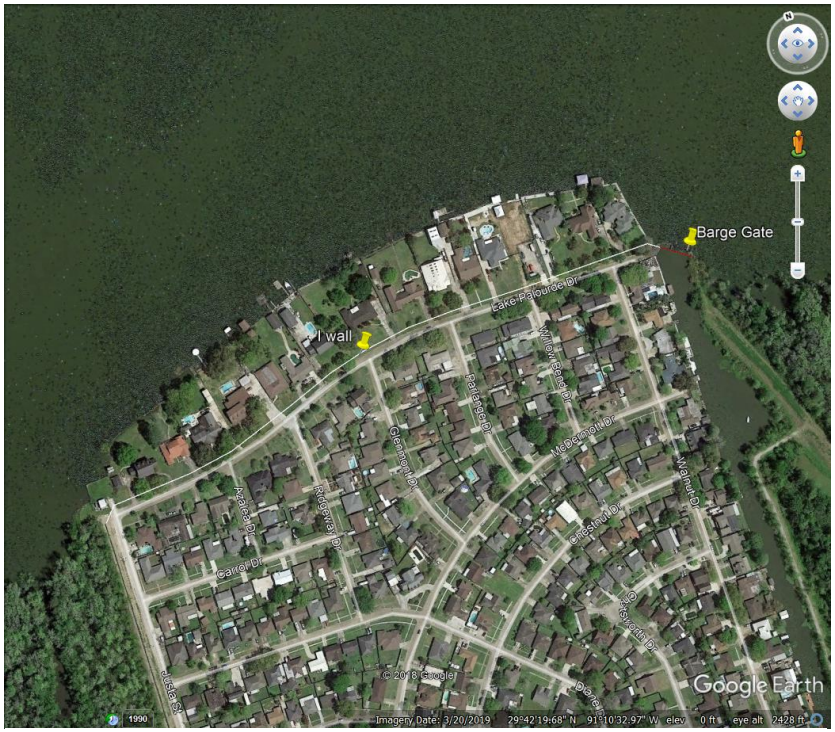

Figure 24. Map showing alignment of new I wall and replacement Barge gate adjacent to Lake Palourde.

Figure 25. Map showing ground surface elevations along lakeshore area.

Figure 26. Map showing BNSF Railway embankment and Atchafalaya Basin levee alignments. Nearby boring locations are also shown.

Figure 27. Map showing alignment of new levee along Youngs Road.

The alignment for the proposed levee along Youngs Road is shown in Figure 28. The new levee would raise the elevation in a low area between the Morgan City BNSF Railway embankment (to the north) and the Atchafalaya Basin – East Atchafalaya Basin Protection Levees (to the south) as shown in Figure 27.

The available boring information along the proposed levee alignment was reviewed and shows that the subsurface consists of 8 to 35 ft of predominantly fat clays (CH) underlain by 20 to 55 ft of silts (ML). However, none of the nearby borings contained strength testing data that could be used to perform slope stability analyses. Additionally, the 50-year 0.01 AEP levee elevation was not forecasted at the time of this study. Due to this incomplete data, it was not possible to develop a typical lift schedule for this alternative.

Plan 3 – Design Development

Based on the limited data for both parts of this alternative, geotechnical analyses were not performed for this plan. However, the following guidelines from Engineering Circular (EC) 1110-2-6066 should be considered for estimating cost of the I-wall:

- I-walls are restricted to a maximum 4 ft stick-up and shall extend into the ground at least 3 times the length that extends above the ground (or at least 10 ft into the ground, whichever is greater).
- I-walls are not allowed along navigation routes due to the potential for barge impacts.
- Scour protection (e.g., unreinforced concrete, rip rap with grout, etc.) shall be placed at least 10 ft wide on the landside of the I-wall for the entire length of I-wall and shall wrap around on the floodside wherever the I-wall transitions into levee. The I-wall shall extend 30 ft into a full levee transition.

For the proposed levees, 10 ft crown widths with 1 vertical to 4 horizontal slopes can be used for cost estimating purposes based USACE experience in this region. The typical lift schedules presented for Plans 1 and 2 can be used for cost estimating purposes.

Plan 3 – Conclusions

Due limited data, geotechnical analyses were not performed for this alternative. Levees with 10 ft crown widths and 1 vertical to 4 horizontal side slopes can be used for cost estimating purposes. The typical lift schedules presented for Plans 1 and 2 can be used for cost estimating purposes. All conclusions are subject to change once site specific boring information becomes available.

4.0 Structural Features

The SCCL developed a Class 4 parametric cost estimates for multiple coastal storm surge risk reduction measures. The structures and sizes are included below in Tables 2 through 6. The structure locations are along, two proposed alignments that were evaluated and reviewed. For the purposes of a parametric cost estimate all gate widths were sized based on navigational passage interests design criteria. Size estimates were informed by the the following study: ARCADIS, U.S., Inc. 2017. *South Central Coast Louisiana Flood Protection Study. Appendix M – Geotechnical Report*. Prepared for the CPRAB.

No design analysis were performed as part of this report. The unit costs were derived based upon historical projects (HSDRRS, NOV, LPV, etc.), where similar structures were designed and constructed. Further design, in addition to updated costs can be provided at the PED level if structures are included in the recommended plan.

4.1 HIGHWAY AND RAILROAD CROSSING

As part of this study, several highway gates were identified for flood protection along Existing Ring Levee 1 and 2 alignments. The required gate opening width that was used as part of this study is 40 linear feet, proposed across a two lane roadway. For cost estimating purposes, an opening width of 34.25-ft was used (similar to WBV-75 project). For the railroad gates, looking at the alignment in google earth, it appears that most of the crossings are single tracks which will traverse our proposed concrete gate monolith and sill. As part of this study, the below locations were identified for potential road or rail gate crossings. These locations are also shown on the maps attached to this appendix.

Table 2 – Proposed Two-Lane, Two Rail (40-ft width) Highway & Railroad Gates

Reach	Location	Reach Elevation	Parish
Ring Levee 1			
Road	Hwy 14 East, Sta. 65+50	17.0	Iberia
Road	Highway 330	16.5	Iberia
Road	Country Drive	15.5	Iberia
Railroad	Railroad Gate, Sta. 373+00	17.0	Iberia
Road	Highway 14 East, Sta. 461+00	16.5	Iberia
Road	Highway 14 East, Sta. 461+00	16.5	Iberia
Ring Levee 2			
Road	Lee Station Road Gate, Sta. 50+00	17.0	Iberia
Road	Hayes Road Gate, Sta. 121+00	15.5	Iberia
Road	Hwy 329/Avery Island Rd Gate, Sta. 130+00	16.0	Iberia
Road	Hwy 83/Weeks Island Road Gate (3)	16.5	Iberia
Road	Par Road 271 Road Gate		Iberia
Road	Hwy 90 E Frontage Road Gate, Sta. 502+00		Iberia
Ring Levee 1			
Road	Hwy 14 East, Sta. 65+50	17.0	Iberia
Road	Highway 330	16.5	Iberia
Road	Country Drive	15.5	Iberia
Railroad	Railroad Gate, Sta. 373+00	17.0	Iberia
Road	Highway 14 East, Sta. 461+00	16.5	Iberia
Road	Highway 14 East, Sta. 461+00	16.5	Iberia
Ring Levee 2			
Road	Lee Station Road Gate, Sta. 50+00	17.0	Iberia
Road	Hayes Road Gate, Sta. 121+00	15.5	Iberia
Road	Hwy 83/Weeks Island Road Gate (3)	16.5	Iberia
Road	Par Road 271 Road Gate		Iberia
Road	Hwy 90 E Frontage Road Gate, Sta. 502+00		Iberia

Table 3 – Proposed Cost of the Railroad and Highway Gates

Gate Type:	**Estimated Total Costs:**
Two-Lane Highway Crossing Gate	$4.75 - 5.5M
Railroad Gate	$5.0M

***Note that these costs above are for an average wall height of 9.0 to 9.5-feet.

The proposed levee alignments were analyzed using the Louisiana Department of Transportation and Development geographic information system (GIS) database, along with satellite aerial photography, to identify and size all major road and railroad crossings. Minor crossings, such as rural roads in agricultural fields, were not included in this analysis because slight levee grade alterations could be made to accommodate agricultural equipment in future studies. All gates were sized to maintain current service capacity. All roadway gates were assumed to be two-lane roller gates. All required railroad gates service single track crossings and were sized accordingly.

4.3 PUMPING STATIONS

The CPRAB, U.S., Inc. 2017 study, identified necessary pumping capacity and floodgates identified using hydrologic and hydraulic modeling. The model included several canals listed below which provided information for preliminary design for pump stations. As with the identification and sizing of the drainage structures, forced drainage of storm water runoff was separated into two basic classifications: areas with existing levee and forced drainage systems including the existing Atchafalaya levee system and Morgan City Back Levees; and those areas with no existing levee or forced drainage systems including the proposed Iberia and St. Mary Parish alignments, which are currently served through a vast network of gravity drainage natural bayous, canals ditches, and conduits.

As part of this study, an assessment of pumping and floodgate requirements was made for the following canals that intersect the proposed levee reaches. The canals shown below in Table 4 also include the estimated pumping capacity per canal location. EDS used this capacity to develop a ROM Cost Estimate. A total cost of $25,000 per cfs was used for cost estimating purposes. This cost below include the structure, mechanical & electrical components, foundation, and fronting T-Walls. Updated design and costs can be provided at PED level of the project.

Table 4 – Proposed Pump Stations Locations & Costs (which include required Pumping Capacity):

		Pump Station (cfs)	Total Costs
Iberia Parish	Delcambre/Avery Canal	1,530	$ 38,250,000.00
	Poufette Canal	3,720	$93,000,000.00
	Petit Anse Canal	5,800	$127,600,000.00
	Commercial/Rodere Canal	5,200	$114,400,000.00
	Delahoussey Canal	2,420	$60,500,000.00
St. Mary Parish	Ivanhoe Canal	90	$2,250,000.00
	Bayou Cypremort	790	$19,750,000.00
	Bayou Choupique	2,440	$61,000,000.00
	Bayou Teche/Charenton Canal	4,000	$88,000,000.00

4.4 NAVIGABLE GATES

The navigable gate structures along the alignment facilitate transportation, maritime navigation, and/or storm water runoff drainage. These structures were identified through a three-step process. The initial step was to use the structures identified in previous studies as a baseline inventory. For existing structures, top-of-structure elevations from LSER surveys were compared with required 0.01 AEP storm surge elevations to discern if they were acceptable. As discussed later in Section 5, no replacements of existing gates or locks were deemed necessary. In a parallel effort, the baseline inventory of proposed gates was compared to the proposed Iberia and St. Mary alignments and the existing reaches requiring lifts to refine the number, type, and location of required structures. Finally, through research of planned future transportation and navigation enhancement projects, remote sensing data analysis of channel cross sections, and satellite imagery analysis, the structures were categorized by the types of gates required. For this study, all newly proposed navigable gate structures were categorized into three basic groups:

Small, 30-foot-wide sinkable barge swing-type steel gates;
Large, 110-foot-wide sinkable barge swing-type steel gates; and
Extra-large, 200-foot sinkable barge swing-type steel gates.

For cost estimating purposes, EDS used a cost per linear feet of $275,000 per gate location based upon the required opening size. EDS used the costs and opening width of previous hurricane projects to derive the ROM cost per linear feet. The costs below include construction of the steel gate, concrete monolith (walls & base slab), monolith foundation, electrical and mechanical components, and control house. Updated costs will be provided during PED level if measures are included in recommended plan.

Table 5 – Proposed Navigational Gate (Steel Barge Gate):

		Barge Gate Size	Total Costs
Iberia Parish	Delcambre/Avery Canal	110	$30,250,000.00
	Poufette Canal	30	$8,250,000.00
	Petit Anse Canal	30	$8,250,000.00
	Commercial/Rodere Canal	200	$55,000,000.00

4.5 DRAINAGE STRUCTURES

For the existing alignment ring levee 1 +2, and 2 alignment, several drainage structures were identified and required across several drainage canals. The proposed drainage structures and locations are shown below in table 6. The unit costs for the drainage structures were taken from existing project WBV-72a and NOV-5a.1, which utilized similar structures and wall heights.

Table 6 – Proposed Drainage Structures (Sluice Gates):

Reach	Location
Iberia	Jefferson Canal (Drainage Structure), Sta. 300+00
Iberia	Hayes Coulee (Drainage Structure), Sta. 70+00
Iberia	Emma (Drainage Structure), Sta. 139+00
Iberia	Segura Road West (Drainage Structure), Sta. 166+00
Iberia	Segura Road East (Drainage Structure), Sta. 185+00
Iberia	Peebles Coulee (Drainage Structure) (4)

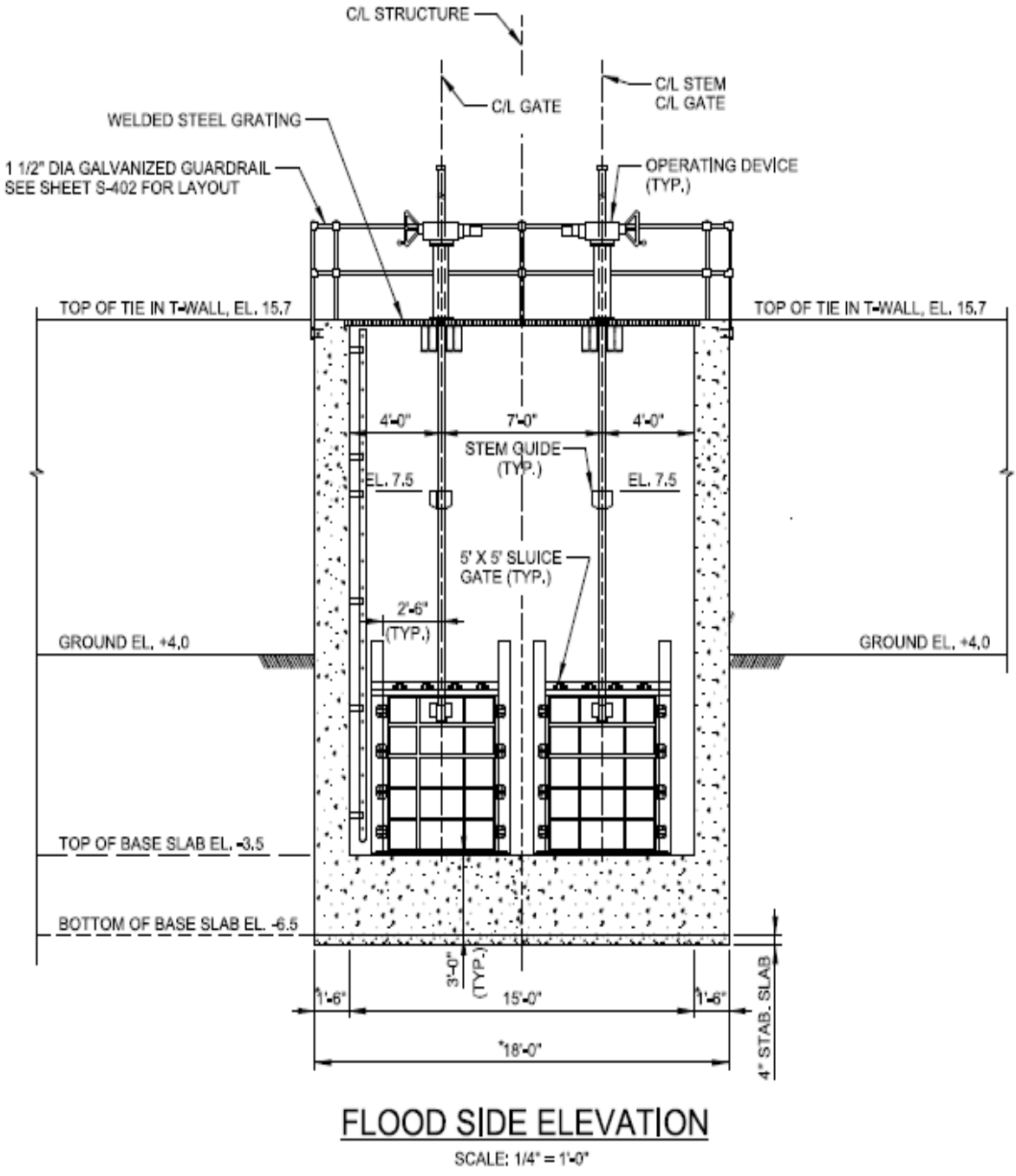

Figure 28 - Typical Drainage Structure

5.0 OPERATION, MAINTENANCE, REPAIR, REPLACEMENT, AND REHABILITATION (OMRR&R)

OMRR&R estimates have not yet been determined for structural measures identified in this study.

6.0 COST ESTIMATES

The cost estimates for the measures and alternatives were prepared based on readily available New Orleans District data and quantities provided by the PDT. The cost estimate was developed in the TRACES Mii cost estimating software and used the standard approaches for a feasibility estimate structure regarding labor, equipment, materials, crews, unit prices, quotes, sub- and prime contractor markups. All features were estimated based on standard construction methods which are common to the New Orleans District and South Louisiana. The estimates assumed access was available to proposed areas unless otherwise stated. This philosophy was taken wherever practical. It was supplemented with estimating information from other sources where necessary such as quotes, historical bid data, A-E estimates, and previously approved similar studies (Southwest Coastal Louisiana Study, Morganza to the Gulf). The intent was to provide or convey a “fair and reasonable” estimate that which depicts the local market conditions. Estimates for new alternatives will follow at the end of this section.

6.1 Structural Measures Estimate Assumptions

Estimate Structure: The estimate is structured to reflect the projects performed. The estimates are subdivided by alternative alignments.

Bid competition: It is assumed that there will not be an economically saturated market and that bidding competition will be present.

Contract Acquisition Strategy: It is assumed that the contract acquisition strategy will be similar to past projects with some negotiated contracts, focus and preference of small business/8(a), and large, unrestricted design/bid/build contracts. There is no declared contract acquisition plan/types at this time, so typical MVN goals have been included.

Labor Shortages: It is assumed there will be a normal labor market.

Labor Rates: Local labor market wages are above the local Davis-Bacon Wage Determination and actual rates have been used. This is based upon local information and payroll data received from the New Orleans District Construction Representatives and estimators with experiences in past years.

Materials: Cost quotes are used on major construction items when available. Recent quotes may include borrow material, concrete, steel and concrete piling, rock, gravel and sand. Assumptions include:

a. materials will be purchased as part of the construction contract. The estimate does not anticipate government furnished materials. Prices include delivery of materials.

b. Concrete - will be purchased from commercial batch plants.

c. Borrow Material and Haul - Borrow material is considered the highest risk in the contracts, given the large quantities required, uncertainties of sources and materials near the many contract locations. Specific borrow sources have not been established so a conservative estimated haul distance was used when using off-site material. Borrow pits currently in use are within this distance. Borrow material for the alternatives is assumed Government furnished. Borrow.

The borrow quantity calculations followed the MVN Geotechnical guidance:

- Hauled Levee: 10 BCY (bank cubic yards) of borrow material = 12 LCY (loose cubic yards) hauled = 8 ECY (embankment cubic yards) compacted.
- An assumed average one-way haul distance of 20 miles was used unless a committed borrow source has been confirmed available. This decision is based upon discussions with the New Orleans District cost engineers and Project Delivery Team (PDT).

Haul speeds are estimated using 40 mph speed average given the long distances and rural areas.

Rock and stone - The Louisiana area has no rock sources. Historically, rock is barged from northern sources on the Mississippi River. This decision is based upon local knowledge, experience and supported with cost quotes.

Equipment: Rates used are based from the latest USACE EP-1110-1-8, Region III. Adjustments are made for fuel, filters, oil and grease (FOG) prices and facility capital cost of money (FCCM). Use of owned verses rental rates was considered based on small business, large business, and local equipment availability.

a. Trucking: The estimate assumed independent self-employed trucking subcontractors due to the large numbers of trucks required.

b. Dozers: dozers of the D-5/D-6 variety were chosen based on historical knowledge. Heavier equipment gets mired in the mud and soft soils.

c. Severe Rates: Severe equipment rates were used where appropriate.

Fuel: Fuels (gasoline, on and off-road diesel) were based on local market averages for on-road and off-road. The Team found that fuels fluctuate irrationally; thus, used an average.

Crews: Major crew and productivity rates were developed and studied by senior USACE estimators familiar with the type of work. All of the work is typical to the New Orleans District. The crews and productivities were checked by local MVN estimators, discussions with contractors and comparisons with historical cost data. Major crews include haul, earthwork, piling, concrete, and deep soil mixing.

Unit Prices: The unit prices found within the various project estimates will fluctuate within a range between similar construction units such as floodwall concrete, earthwork, and piling. Variances are a result of differing haul distances (trucked or barged), small or large business markups, subcontracted items, designs and estimates by others.

Relocation Cost: Relocation costs are defined as the relocation of public roads, bridges, railroads, and utilities required for project purposes. Due to the limited time available for investigation, only pipeline utility costs were computed.

Mobilization: Contractor mobilization and demobilization are based on the assumption that many of the contractors will be coming from within a 500 mile radius. Based on historical studies, Pre-Katrina detailed Government estimates for mobilization averaged 4.9 to 5% of the construction costs. The estimate utilizes the approx. 5% value at each contract. The 5% value matches well with the 5% value prescribed by Walla Walla District, which has studied historical rates.

Field Office Overhead: The estimate used a field office overhead rate of 12% for the prime contractor at budget level development. Based on historical studies and experience, Walla Walla District has recommended typical rates ranging from 9% to 12% for large civil works projects. The 12% rate considers the possibility of maintenance and management of work camps and kitchens. The applied rates were previously discussed on similar projects among numerous USACE District cost engineers including Walla Walla, Vicksburg, Norfolk, Huntington, St. Paul and New Orleans.

Overhead assumptions include: Superintendent, office manager, pickups, periodic travel, costs, communications, temporary offices (contractor and government), office furniture, office supplies, computers and software, as-built drawings and minor designs, tool trailers, staging setup, utility service, toilets, safety equipment, security and fencing, small hand and power tools, project signs, traffic control, surveys, temp fuel tank station, generators, compressors, lighting, and minor miscellaneous.

Home Office Overhead: Estimate percentages range based upon consideration of 8(a), small business and unrestricted prime contractors. The rates are based upon estimating and negotiating experience, and consultation with local construction representatives. Different percents are used when considering the contract acquisition strategy regarding small business 8(a), competitive small business and large business, high to low respectively. The applied rates were previously discussed on similar projects among numerous USACE District cost engineers including Walla Walla, Vicksburg, Norfolk, Huntington, St. Paul and New Orleans.

Taxes: Local taxes will be applied, using an average between the parishes that contain the work. Reference the LA parish tax rate website: http://www.laota.com/pta.htm

Bond: Bond is assumed 1% applied against the prime contractor, assuming large contracts. No differentiation was made between large and small businesses.

E&D and S&A: USACE Costs to manage design (PED) and construction (S&A) are based on New Orleans District Programmatic Cost Estimate guidance:

a. Planning, Engineering & Design (PED): The PED cost includes such costs as project management, engineering, planning, designs, investigations, studies, reviews, value engineering and engineering during construction (EDC). Historically New Orleans District has used an approximate 12% rate for E&D/EDC, applied against the estimated construction costs. Other USACE civil works districts such as St. Paul, Memphis and St.

Louis have reported values ranging from 10-15%. A rate of 12% for E&D/EDC was applied.

b. Supervision & Administration (S&A): Historically, New Orleans District used a range from 5% to 15% depending on project size and type applied against the estimated construction costs. Other USACE civil works districts such as St. Paul, Memphis and St. Louis report values ranging from 7.5-10%. Consideration includes that a portion of the S&A effort could be performed by contractors. An S&A rate of 8% was applied.

Table 7 – Ring Levee 1 Cost Estimate

Alternative 1 - Ring Levee 1					
	10/15/2019				
Estimate of Probable Cost for Alternate 1					
WBS	DESCRIPTION	QUANTITY	UNITS		COST
01	**Lands and Damges**				
	Real Estate		-		**$26,809,000**
02	**Relocations**				
	Pipeline/Utility Crossings	33	EA		**$11,632,000**
06	**Fish and Wildlife Facilities**				
	Mitigation		-		**-**
11	**Levees and Floodwalls**				**$340,484,000**
	Construction of 10.9 miles of levee to EL. 21.8'	4,961,400	CY	$120,252,000	
	Levee Lift Phase I to 2.5'	1,164,500	CY	$32,280,000	
	Levee Lift Phase Iii to 1.5'	756,000	CY	$24,274,000	
	Levee Lift Phase Ii to 1'	530,900	CY	$19,928,000	
	Railroad Gates*	1	EA	$4,500,000	
	Two Lane Highway Gates**	5	EA	$23,750,000	
	Pump Station - Pumping Capacity and	5,250	CFS	$115,500,000	
	Fronting Protection***				
15	**Floodway Control & Diversion Structure**				**$42,000,000**
	30-Foot Barge Gate****	1	EA	$8,250,000	
	110-Foot Barge Gate****	1	EA	$30,250,000	
	Drainage Structure******	1	EA	$3,500,000	
18	**Cultural Resource Preservation**				**-**
	Surveys & Cultural Mitigation	-	-		
30	**Planning, Engineering and Design (20%)**	-	-		**$78,824,000**
31	**Construction Management (9%)**	-	-		**$35,471,000**
			TOTAL		**$535,220,000**
Notes					
*	Based on the floodgate for WBV-75				
**	Based on the floodgate for WBV-14D				
***	Unit cost based on historical data from several pump station projects (WBV, NOV, SELA, LPV, WCC)				
****	Unit cost taken from Arcaidis, Cost Library for a 100' Barge Gate				
*****	Based on the drainage structure for WBV-72A				

Table 8 – Ring Levee 2 Cost Estimate

Alternative 2 - Ring Levee 2					
	10/15/2019				
Estimate of Probable Cost for Alternate 2					
WBS	DESCRIPTION	QUANTITY	UNITS		COST
01	**Lands and Damges**				
	Real Estate	-	-		**$9,416,000**
02	**Relocations**				
	Pipeline/Utility Crossings	30	EA		**$18,343,000**
06	**Fish and Wildlife Facilities**				
	Mitigation				**$19,450,000**
11	**Levees and Floodwalls**				**$438,888,000**
	Construction of 9.6 miles of levee to EL. 19.6'	3,732,400	CY	$90,743,000	
	Levee Lift Phase I to 2.5'	951,900	CY	$26,506,000	
	Levee Lift Phase II to 1.5'	622,400	CY	$20,077,000	
	Levee Lift Phase III to 1'	437,200	CY	$16,812,000	
	Two Lane Highway Gates*	9	EA	$42,750,000	
	Pump Station - Pumping Capacity and	11,000	CFS	$242,000,000	
	Fronting Protection**				
15	**Floodway Control & Diversion Structure**				**$87,750,000**
	30-Foot Barge Gate***	1	EA	$8,250,000	
	200-Foot Barge Gate***	1	EA	$55,000,000	
	Drainage Structure****	7	EA	$24,500,000	
18	**Cultural Resource Preservation**				**$520,000**
	Surveys & Cultural Mitigation	-	-	$520,000	
30	**Planning, Engineering and Design (20%)**	-	-		**$112,991,000**
31	**Construction Management (9%)**	-	-		**$50,846,000**
			TOTAL		**$738,204,000**
Notes					
*	Based on the floodgate for WBV-14D				
**	Unit cost based on historical data from several pump station projects (WBV, NOV, SELA, LPV, WCC)				
***	Unit cost taken from Arcaidis, Cost Library for a 100' Barge Gate				
****	Based on the drainage structure for WBV-72A				

Table 9 – Ring Levee 3 Cost Estimates

Alternative 3 - Ring Levee 3					
	10/15/2019				
Estimate of Probable Cost for Alternate 3					
WBS	DESCRIPTION	QUANTITY	UNITS		COST
01	**Lands and Damges**				
	Real Estate	-	-		**$2,151,000**
02	**Relocations**				
	Pipeline/Utility Crossings	22	EA		**$21,536,000**
06	**Fish and Wildlife Facilities**				
	Mitigation				**-**
11	**Levees and Floodwalls**				**$128,429,000**
	Construction of 6.8 miles of levee to EL. 17'	2,031,000	CY	$49,911,000	
	Levee Lift Phase I to 2.5'	597,400	CY	$16,788,000	
	Levee Lift Phase Iii to 1.5'	395,200	CY	$12,877,000	
	Levee Lift Phase Ii to 1'	278,800	CY	$10,603,000	
	Pump Station - Pumping Capacity and	1,530	CFS	$38,250,000	
	Fronting Protection*				
15	**Floodway Control & Diversion Structure**				**$137,750,000**
	30-Foot Barge Gate**	1	EA	$8,250,000	
	110-Foot Barge Gate**	1	EA	$60,500,000	
	200-Foot Barge Gate**	1	EA	$55,000,000	
	Drainage Structure***	4	EA	$14,000,000	
18	**Cultural Resource Preservation**				**-**
	Surveys & Cultural Mitigation	-	-		
30	**Planning, Engineering and Design (20%)**	-	-		**$57,543,000**
31	**Construction Management (9%)**	-	-		**$25,895,000**
			TOTAL		**$373,304,000**
Notes					
*	Unit cost based on historical data from several pump station projects (WBV, NOV, SELA, LPV, WCC)				
**	Unit cost taken from Arcaidis, Cost Library for a 100' Barge Gate				
***	Based on the drainage structure for WBV-72A				

Table 10 – Ring Levee 1+2 Cost Estimate

Alternative 4 - Ring Levee 1 + 2					
10/15/2019					
Estimate of Probable Cost for Alternate 2					
WBS	DESCRIPTION	QUANTITY	UNITS		COST
01	**Lands and Damges**				
	Real Estate	-	-		**$33,546,000**
02	**Relocations**				
	Pipeline/Utility Crossings	49	EA		**$25,319,000**
06	**Fish and Wildlife Facilities**				
	Mitigation				**$16,309,000**
11	**Levees and Floodwalls**				**$709,342,000**
	Construction of 16.7 miles of levee to EL. 21.8'	7,624,700	CY	$184,233,000	
	Levee Lift Phase I to 2.5'	1,789,600	CY	$49,333,000	
	Levee Lift Phase II to 1.5'	1,140,100	CY	$34,607,000	
	Levee Lift Phase III to 1'	800,700	CY	$26,919,000	
	Railroad Gates*	1	EA	$4,500,000	
	Two Lane Highway Gates**	11	EA	$52,250,000	
	Pump Station - Pumping Capacity and	16,250	CFS	$357,500,000	
	Fronting Protection***				
15	**Floodway Control & Diversion Structure**				**$125,000,000**
	30-Foot Barge Gate****	2	EA	$8,250,000	
	110-Foot Barge Gate****	1	EA	$30,250,000	
	200-Foot Barge Gates****	1	EA	$55,000,000	
	Drainage Structure*****	9	EA	$31,500,000	
18	**Cultural Resource Preservation**				**$114,675,000**
	Surveys & Cultural Mitigation	-	-	$114,675,000	
30	**Planning, Engineering and Design (20%)**	-	-		**$198,129,000**
31	**Construction Management (9%)**	-	-		**$89,159,000**
			TOTAL		**$1,311,479,000**
Notes					
*	Based on the floodgate for WBV-75				
**	Based on the floodgate for WBV-14D				
***	Unit cost based on historical data from several pump station projects (WBV, NOV, SELA, LPV, WCC)				
****	Unit cost taken from Arcaidis, Cost Library for a 100' Barge Gate				
*****	Based on the drainage structure for WBV-72A				

Table 11 – Levee EX1 Cost Estimate

Alternative 5 - Ex-1, Berwick Levee Raises					
	10/15/2019				
Estimate of Probable Cost for Alternate 5					
WBS	DESCRIPTION	QUANTITY	UNITS		SUBTOTAL
01	**Lands and Damges**				
	Real Estate	-	-		**$1,560,000**
02	**Relocations**				
	Pipeline/Utility Crossings	12	EA		**$3,324,000**
06	**Fish and Wildlife Facilities**				
	Mitigation				**$923,000**
11	**Levees and Floodwalls**				**$96,612,000**
	Initial Construction	254,775	CY	$9,826,000	
	Levee Lift Phase I to 2.5'	938,900	CY	$28,161,000	
	Levee Lift Phase II to 1.5'	650,000	CY	$21,397,000	
	Levee Lift Phase III to 1'	469,500	CY	$17,228,000	
	Pump Station - Fronting Protection	4	EA	$20,000,000	
	.				
15	**Floodway Control & Diversion Structure**				**-**
18	**Cultural Resource Preservation**				**$100,000**
	Surveys & Cultural Mitigation	-	-	$100,000	
30	**Planning, Engineering and Design (20%)**	-	-		**$20,192,000**
31	**Construction Management (9%)**	-	-		**$9,087,000**
			TOTAL		**$131,798,000**

Table 12 – Morgan City Cost Estimate

Alternative 6 - Ex-1, Morgan City Levee Raise					
	10/15/2019				
Estimate of Probable Cost for Alternate 6					
WBS	DESCRIPTION	QUANTITY	UNITS		COST
01	**Lands and Damges**				
	Real Estate	-	-		**$841,000**
02	**Relocations**				
					$0
06	**Fish and Wildlife Facilities**				
	Mitigation				**$0**
11	**Levees and Floodwalls**				**$32,515,000**
	Lakeside Gap	9,500	CY	$1,093,000	
	Levee Lift Phase I to 2.5'	29,500	CY	$1,512,000	
	Levee Lift Phase II to 1.5'	20,360	CY	$1,309,000	
	Levee Lift Phase III to 1'	14,800	CY	$1,193,000	
	I - Wall *	2,143	LF	$7,008,000	
	Flood Gates **	12	EA	$20,400,000	
15	**Floodway Control & Diversion Structure**				**$30,000,000**
	Barge Gate ***	1	EA	$30,000,000	
18	**Cultural Resource Preservation**				**$195,000**
	Surveys & Cultural Mitigation	-	-	$195,000	
30	**Planning, Engineering and Design (20%)**	-	-		**$12,542,000**
31	**Construction Management (9%)**	-	-		**$5,644,000**
			TOTAL		**$81,737,000**
Notes					
*	Unit cost derived from an assumed design section and cost data from MRL, Baton Rouge Front Phase 4				
**	Derived from cost data from LPV 16.2 Bonnable Boat Launch Floodwall and Gate				
***	Unit cost taken from Arcaidis, Cost Library for a 100' Barge Gate				

Table 13 – PRA/B-1 Cost Estimate (Arcadis, 2017)

Itemized Cost Summary PrA/B-1								
Item No.	**Item Description**	**Quantity**	**Unit**	**Unit Cost**	**Total**	**25% Contingency**	**Total with Contingency**	**Subtotals**
0	**Reach Characteristics**							
0.1	Reach Name	PrA/B-1						
0.2	Parish	Iberia						
0.3	Updated Reach Length	31,229	ft					
0.4	Conversion factor	43,560	ft^2/acre					
0.5	Month	5						
0.6	Year	2017						
0.7	CPI Inflation Rate	1.05						
1	**Planning, Engineering, Design, Permitting, and Construction Management**							**Sum PED, Perm., and CM**
1.1	Planning, Engineering, and Design			6.5%	$18,106,122	$4,526,530	$22,632,652	**$43,524,331**
1.2	Permitting			1.0%	$2,785,557	$696,389	$3,481,946	
1.3	Construction Management			5.0%	$13,927,786	$3,481,946	$17,409,732	
2	**Levee Construction**							**Sum First Lift**
	Width: Total + ROW (Incl. Borrow Canal)	395	ft					**$25,649,803**
	Width: Levee Surface	133	ft					
	Height	19.0	ft					
2.1	Mobilization & Demobilization	*All other unit costs are loaded costs and include mob/demod*						
2.2	Clearing & Grubbing	283	Ac	$4,293	$1,215,815	$303,954	$1,519,769	
2.3	Local Borrow Fill	1,390,860	CY	$14	$18,934,249	$4,733,562	$23,667,811	
2.4	Fertilize, Seed & Mulch	95	Ac	$3,875	$369,778	$92,445	$462,223	
3	**Drainage Structures**							**Sum Drainage Structures**
3.1	Total 10'X10' Box with Sluice Drainage Structures	3	EA	$2,263,115	$6,789,346	$1,697,337	$8,486,683	**$8,486,683**
4	**T-Walls**							**Sum Walls**
4.1	Total Length of T-Wall	0	LF	$8,377	$0	$0	$0	**$0**
5	**2-Lane Highway Gates**							**Sum Hwy Gates**
5.1	Total Count of Highway Gates	0	LS	$6,178,362	$0	$0	$0	**$0**
6	**Railroad Gates**							**Sum RR Gates**
6.1	Total Count of Railroad Gates	0	LS	$4,921,746	$0	$0	$0	**$0**
7	**Pipeline/Utility Crossings**							**Sum Crossings**
7.1	Total Crossings	7	LS	$211,530	$1,480,713	$370,178	$1,850,891	**$1,850,891**
8	**Pump Station Frontal Protection**							**Sum Frontal Protection**
8.1	Total Length of Protection	0	LF	$25,132	$0	$0	$0	**$0**
9	**New Pump Stations**							**Sum New PS's**
9.1	Total Capacity	11,050	CFS	$15,812	$174,727,851	$43,681,963	$218,409,814	**$218,409,814**
10	**Navigation Gates**							**Sum Nav. Gates**
10.1	30' Barge Gates	2	LS	$11,100,108	$22,200,216	$5,550,054	$27,750,270	**$62,027,089**
10.2	110' Barge Gates	1	LS	$27,421,455	$27,421,455	$6,855,364	$34,276,819	
10.3	200' Barge Gates	0	LS	$49,358,620	$0	$0	$0	
11	**Real Estate**							**Sum ROW**
11.1	Right-of-Way (Total Levee Footprint)	283	Ac	$5,000	$1,415,900	$353,975	$1,769,875	**$3,063,677**
11.2	Title Research and Legal Proceedings	5.9	Mi	$175,000	$1,035,042	$258,760	$1,293,802	
12	**Mitigation Acreages**							**Sum Mitigation**
12.1	Forested Wetlands	57	Ac	$232,474	$13,309,615	$3,327,404	$16,637,018	**$28,706,693**
12.2	Emergent Wetlands	114	Ac	$84,403	$9,655,740	$2,413,935	$12,069,674	
13	**First Levee Lift, Year 10**							**Sum 2nd Lift**
	Width: Total + ROW (No Borrow Canal)	214	ft					**$4,765,547**
	Width: Levee Surface	137	ft					

	Height	19.5	ft					
	Mobilization & Demobilization	*All other unit costs are loaded costs and include mob/demod*						
13.1	Opposite Cast	252,145	CY	$14	$3,432,541	$858,135	$4,290,677	
13.2	Fertilize, Seed & Mulch	98	Ac	$3,875	$379,897	$94,974	$474,871	
14	**Second Levee Lift, Year 25**							**Sum 3rd Lift**
	Width: Total + ROW (No Borrow Canal)	215	ft					**$1,527,960**
	Width: Levee Surface	148	ft					
	Height	21.0	ft					
	Mobilization & Demobilization	*All other unit costs are loaded costs and include mob/demod*						
14.1	Opposite Cast	59,656	CY	$14	$812,116	$203,029	$1,015,146	
14.2	Fertilize, Seed & Mulch	106	Ac	$3,875	$410,252	$102,563	$512,815	
15	**Operations and Maintenance (50 Years)**							**Sum O&M**
15.1	Right of Way Maintenance	283	Ac/yr	$157	$2,224,052	$556,013	$2,780,065	**$35,295,004**
15.2	Gate Maintenance	3	EA/yr	$73,303	$10,995,390.00	$2,748,848	$13,744,238	
15.3	Pump Station Maintenance	3	EA/yr	$100,110	$15,016,561.20	$3,754,140	$18,770,702	
	Total Cost				**$346,645,994**	**$86,661,499**	**$433,307,493**	**$433,307,493**

Table 14 – PRA/B-2 Cost Estimate (Arcadis, 2017)

Itemized Cost Summary PrA/B-2								
Item No.	**Item Description**	**Quantity**	**Unit**	**Unit Cost**	**Total**	**25% Contingency**	**Total with Contingency**	**Subtotals**
0	**Reach Characteristics**							
0.1	Reach Name	PrA/B-2						
0.2	Parish	Iberia						
0.3	Updated Reach Length	13,993	ft					
0.4	Conversion factor	43,560	ft^2/acre					
0.5	Month	5						
0.6	Year	2017						
0.7	CPI Inflation Rate	1.05						
1	**Planning, Engineering, Design, Permitting, and Construction Management**							**Sum PED, Perm., and CM**
1.1	Planning, Engineering, and Design			6.5%	$2,555,742	$638,936	$3,194,678	**$6,143,611**
1.2	Permitting			1.0%	$393,191	$98,298	$491,489	
1.3	Construction Management			5.0%	$1,965,956	$491,489	$2,457,444	
2	**Levee Construction**							**Sum First Lift**
	Width: Total + ROW (Incl. Borrow Canal)	349	ft					**$8,330,859**
	Width: Levee Surface	111	ft					
	Height	16.5	ft					
2.1	Mobilization & Demobilization	*All other unit costs are loaded costs and include mob/demod*						
2.2	Clearing & Grubbing	112	Ac	$4,293	$480,659	$120,165	$600,824	
2.3	Local Borrow Fill	444,089	CY	$14	$6,045,538	$1,511,385	$7,556,923	
2.4	Fertilize, Seed & Mulch	36	Ac	$3,875	$138,490	$34,622	$173,112	
3	**Drainage Structures**							**Sum Drainage Structures**
3.1	Total 10'X10' Box with Sluice Drainage Structures	9	EA	$2,263,115	$20,368,038	$5,092,010	$25,460,048	**$25,460,048**
4	**T-Walls**							**Sum Walls**
4.1	Total Length of T-Wall	0	LF	$8,377	$0	$0	$0	**$0**
5	**2-Lane Highway Gates**							**Sum Hwy Gates**
5.1	Total Count of Highway Gates	1	LS	$6,178,362	$6,178,362	$1,544,591	$7,722,953	**$7,722,953**
6	**Railroad Gates**							**Sum RR Gates**
6.1	Total Count of Railroad Gates	0	LS	$4,921,746	$0	$0	$0	**$0**
7	**Pipeline/Utility Crossings**							**Sum Crossings**
7.1	Total Crossings	6	LS	$211,530	$1,269,182	$317,296	$1,586,478	**$1,586,478**
8	**Pump Station Frontal Protection**							**Sum Frontal Protection**
8.1	Total Length of Protection	0	LF	$25,132	$0	$0	$0	**$0**
9	**New Pump Stations**							**Sum New PS's**
9.1	Total Capacity	0	CFS	$15,812	$0	$0	$0	**$0**
10	**Navigation Gates**							**Sum Nav. Gates**
10.1	30' Barge Gates	0	LS	$11,100,108	$0	$0	$0	**$0**
10.2	110' Barge Gates	0	LS	$27,421,455	$0	$0	$0	
10.3	200' Barge Gates	0	LS	$49,358,620	$0	$0	$0	
11	**Real Estate**							**Sum ROW**
11.1	Right-of-Way (Total Levee Footprint)	112	Ac	$5,000	$559,760	$139,940	$699,700	**$1,279,438**
11.2	Title Research and Legal Proceedings	2.7	Mi	$175,000	$463,790	$115,948	$579,738	
12	**Mitigation Acreages**							**Sum Mitigation**
12.1	Forested Wetlands	15	Ac	$232,474	$3,424,668	$856,167	$4,280,835	**$4,769,115**
12.2	Emergent Wetlands	5	Ac	$84,403	$390,624	$97,656	$488,280	
13	**First Levee Lift, Year 10**							**Sum 2nd Lift**
	Width: Total + ROW (No Borrow Canal)	188	ft					**$664,538**
	Width: Levee Surface	114	ft					
	Height	16.9	ft					

	Mobilization & Demobilization	*All other unit costs are loaded costs and include mob/demod*						
13.1	Opposite Cast	28,613	CY	$14	$389,513	$97,378	$486,892	
13.2	Fertilize, Seed & Mulch	37	Ac	$3,875	$142,117	$35,529	$177,646	
14	**Second Levee Lift, Year 25**							**Sum 3rd Lift**
	Width: Total + ROW (No Borrow Canal)	189	ft					**$1,740,218**
	Width: Levee Surface	122	ft					
	Height	18.0	ft					
	Mobilization & Demobilization	*All other unit costs are loaded costs and include mob/demod*						
14.1	Opposite Cast	91,093	CY	$14	$1,240,083	$310,021	$1,550,104	
14.2	Fertilize, Seed & Mulch	39	Ac	$3,875	$152,092	$38,023	$190,114	
15	**Operations and Maintenance (50 Years)**							**Sum O&M**
15.1	Right of Way Maintenance	112	Ac/yr	$157	$879,254	$219,813	$1,099,067	**$5,680,480**
15.2	Gate Maintenance	1	EA/yr	$73,303	$3,665,130.00	$916,283	$4,581,413	
15.3	Pump Station Maintenance	0	EA/yr	$100,110	$0.00	$0	$0	
	Total Cost				**$50,702,189**	**$12,675,547**	**$63,377,737**	**$63,377,737**

Table 15 – PRA/B-3 Cost Estimate (Arcadis, 2017)

Itemized Cost Summary PrA/B-3								
Item No.	**Item Description**	**Quantity**	**Unit**	**Unit Cost**	**Total**	**25% Contingency**	**Total with Contingency**	**Subtotals**
0	**Reach Characteristics**							
0.1	Reach Name	PrA/B-3						
0.2	Parish	Iberia						
0.3	Updated Reach Length	32,810	ft					
0.4	Conversion factor	43,560	ft^2/acre					
0.5	Month	5						
0.6	Year	2017						
0.7	CPI Inflation Rate	1.05						
1	**Planning, Engineering, Design, Permitting, and Construction Management**							**Sum PED, Perm., and CM**
1.1	Planning, Engineering, and Design			6.5%	$13,803,237	$3,450,809	$17,254,046	**$33,180,858**
1.2	Permitting			1.0%	$2,123,575	$530,894	$2,654,469	
1.3	Construction Management			5.0%	$10,617,875	$2,654,469	$13,272,343	
2	**Levee Construction**							**Sum First Lift**
	Width: Total + ROW (Incl. Borrow Canal)	334	ft					**$17,775,843**
	Width: Levee Surface	103	ft					
	Height	15.5	ft					
2.1	Mobilization & Demobilization	*All other unit costs are loaded costs and include mob/demod*						
2.2	Clearing & Grubbing	252	Ac	$4,293	$1,080,112	$270,028	$1,350,140	
2.3	Local Borrow Fill	943,136	CY	$14	$12,839,233	$3,209,808	$16,049,041	
2.4	Fertilize, Seed & Mulch	78	Ac	$3,875	$301,330	$75,333	$376,663	
3	**Drainage Structures**							**Sum Drainage Structures**
3.1	Total 10'X10' Box with Sluice Drainage Structures	12	EA	$2,263,115	$27,157,385	$6,789,346	$33,946,731	**$33,946,731**
4	**T-Walls**							**Sum Walls**
4.1	Total Length of T-Wall	0	LF	$8,377	$0	$0	$0	**$0**
5	**2-Lane Highway Gates**							**Sum Hwy Gates**
5.1	Total Count of Highway Gates	1	LS	$6,178,362	$6,178,362	$1,544,591	$7,722,953	**$7,722,953**
6	**Railroad Gates**							**Sum RR Gates**
6.1	Total Count of Railroad Gates	0	LS	$4,921,746	$0	$0	$0	**$0**
7	**Pipeline/Utility Crossings**							**Sum Crossings**
7.1	Total Crossings	10	LS	$211,530	$2,115,304	$528,826	$2,644,130	**$2,644,130**
8	**Pump Station Frontal Protection**							**Sum Frontal Protection**
8.1	Total Length of Protection	0	LF	$25,132	$0	$0	$0	**$0**
9	**New Pump Stations**							**Sum New PS's**
9.1	Total Capacity	5,200	CFS	$15,812	$82,224,574	$20,556,143	$102,780,717	**$102,780,717**
10	**Navigation Gates**							**Sum Nav. Gates**
10.1	30' Barge Gates	1	LS	$11,100,108	$11,100,108	$2,775,027	$13,875,135	**$75,573,410**
10.2	110' Barge Gates	0	LS	$27,421,455	$0	$0	$0	
10.3	200' Barge Gates	1	LS	$49,358,620	$49,358,620	$12,339,655	$61,698,275	
11	**Real Estate**							**Sum ROW**
11.1	Right-of-Way (Total Levee Footprint)	252	Ac	$5,000	$1,257,864	$314,466	$1,572,330	**$2,931,643**
11.2	Title Research and Legal Proceedings	6.2	Mi	$175,000	$1,087,451	$271,863	$1,359,313	
12	**Mitigation Acreages**							**Sum Mitigation**
12.1	Forested Wetlands	72	Ac	$232,474	$16,691,054	$4,172,763	$20,863,817	**$22,071,439**
12.2	Emergent Wetlands	11	Ac	$84,403	$966,097	$241,524	$1,207,621	
13	**First Levee Lift, Year 10**							**Sum 2nd Lift**
	Width: Total + ROW (No Borrow Canal)	182	ft					**$1,440,871**
	Width: Levee Surface	107	ft					
	Height	16.0	ft					

	Mobilization & Demobilization	*All other unit costs are loaded costs and include mob/demod*						
13.1	Opposite Cast	61,758	CY	$14	$840,736	$210,184	$1,050,920	
13.2	Fertilize, Seed & Mulch	81	Ac	$3,875	$311,961	$77,990	$389,951	
14	**Second Levee Lift, Year 25**							**Sum 3rd Lift**
	Width: Total + ROW (No Borrow Canal)	184	ft					**$3,801,543**
	Width: Levee Surface	118	ft					
	Height	17.5	ft					
	Mobilization & Demobilization	*All other unit costs are loaded costs and include mob/demod*						
14.1	Opposite Cast	198,143	CY	$14	$2,697,382	$674,345	$3,371,727	
14.2	Fertilize, Seed & Mulch	89	Ac	$3,875	$343,853	$85,963	$429,816	
15	**Operations and Maintenance (50 Years)**							**Sum O&M**
15.1	Right of Way Maintenance	252	Ac/yr	$157	$1,975,814	$493,954	$2,469,768	**$22,470,906**
15.2	Gate Maintenance	3	EA/yr	$73,303	$10,995,390.00	$2,748,848	$13,744,238	
15.3	Pump Station Maintenance	1	EA/yr	$100,110	$5,005,520.40	$1,251,380	$6,256,901	
	Total Cost				**$261,072,834**	**$65,268,208**	**$326,341,042**	**$326,341,042**

Table 16 – PRA/B-4 Cost Estimate (Arcadis, 2017)

Itemized Cost Summary PrA/B-4								
Item No.	**Item Description**	**Quantity**	**Unit**	**Unit Cost**	**Total**	**25% Contingency**	**Total with Contingency**	**Subtotals**
0	**Reach Characteristics**							
0.1	Reach Name	PrA/B-4						
0.2	Parish	Iberia						
0.3	Updated Reach Length	25,629	ft					
0.4	Conversion factor	43,560	ft^2/acre					
0.5	Month	5						
0.6	Year	2017						
0.7	CPI Inflation Rate	1.05						
1	**Planning, Engineering, Design, Permitting, and Construction Management**							**Sum PED, Perm., and CM**
1.1	Planning, Engineering, and Design			6.5%	$8,122,850	$2,030,713	$10,153,563	**$19,526,082**
1.2	Permitting			1.0%	$1,249,669	$312,417	$1,562,087	
1.3	Construction Management			5.0%	$6,248,346	$1,562,087	$7,810,433	
2	**Levee Construction**							**Sum First Lift**
	Width: Total + ROW (Incl. Borrow Canal)	341	ft					**$13,359,511**
	Width: Levee Surface	100	ft					
	Height	14.7	ft					
2.1	Mobilization & Demobilization	*All other unit costs are loaded costs and include mob/demod*						
2.2	Clearing & Grubbing	201	Ac	$4,293	$861,410	$215,352	$1,076,762	
2.3	Local Borrow Fill	705,126	CY	$14	$9,599,120	$2,399,780	$11,998,900	
2.4	Fertilize, Seed & Mulch	59	Ac	$3,875	$227,079	$56,770	$283,849	
3	**Drainage Structures**							**Sum Drainage Structures**
3.1	Total 10'X10' Box with Sluice Drainage Structures	17	EA	$2,263,115	$38,472,961	$9,618,240	$48,091,202	**$48,091,202**
4	**T-Walls**							**Sum Walls**
4.1	Total Length of T-Wall	0	LF	$8,377	$0	$0	$0	**$0**
5	**2-Lane Highway Gates**							**Sum Hwy Gates**
5.1	Total Count of Highway Gates	0	LS	$6,178,362	$0	$0	$0	**$0**
6	**Railroad Gates**							**Sum RR Gates**
6.1	Total Count of Railroad Gates	0	LS	$4,921,746	$0	$0	$0	**$0**
7	**Pipeline/Utility Crossings**							**Sum Crossings**
7.1	Total Crossings	2	LS	$211,530	$423,061	$105,765	$528,826	**$528,826**
8	**Pump Station Frontal Protection**							**Sum Frontal Protection**
8.1	Total Length of Protection	0	LF	$25,132	$0	$0	$0	**$0**
9	**New Pump Stations**							**Sum New PS's**
9.1	Total Capacity	2,419	CFS	$15,812	$38,252,769	$9,563,192	$47,815,961	**$47,815,961**
10	**Navigation Gates**							**Sum Nav. Gates**
10.1	30' Barge Gates	2	LS	$11,100,108	$22,200,216	$5,550,054	$27,750,270	**$27,750,270**
10.2	110' Barge Gates	0	LS	$27,421,455	$0	$0	$0	
10.3	200' Barge Gates	0	LS	$49,358,620	$0	$0	$0	
11	**Real Estate**							**Sum ROW**
11.1	Right-of-Way (Total Levee Footprint)	201	Ac	$5,000	$1,003,170	$250,793	$1,253,963	**$2,315,788**
11.2	Title Research and Legal Proceedings	4.9	Mi	$175,000	$849,460	$212,365	$1,061,824	
12	**Mitigation Acreages**							**Sum Mitigation**
12.1	Forested Wetlands	42	Ac	$232,474	$9,712,032	$2,428,008	$12,140,040	**$16,347,096**
12.2	Emergent Wetlands	40	Ac	$84,403	$3,365,645	$841,411	$4,207,056	
13	**First Levee Lift, Year 10**							**Sum 2nd Lift**

	Width: Total + ROW (No Borrow Canal)	186	ft					**$1,916,487**
	Width: Levee Surface	106	ft					
	Height	15.6	ft					
	Mobilization & Demobilization	*All other unit costs are loaded costs and include mob/demod*						
13.1	Opposite Cast	94,845	CY	$14	$1,291,163	$322,791	$1,613,953	
13.2	Fertilize, Seed & Mulch	62	Ac	$3,875	$242,027	$60,507	$302,533	
14	**Second Levee Lift, Year 25**							**Sum 3rd Lift**
	Width: Total + ROW (No Borrow Canal)	186	ft					**$2,959,610**
	Width: Levee Surface	116	ft					
	Height	17.0	ft					
	Mobilization & Demobilization	*All other unit costs are loaded costs and include mob/demod*						
14.1	Opposite Cast	154,437	CY	$14	$2,102,410	$525,602	$2,628,012	
14.2	Fertilize, Seed & Mulch	68	Ac	$3,875	$265,278	$66,320	$331,598	
15	**Operations and Maintenance (50 Years)**							**Sum O&M**
15.1	Right of Way Maintenance	201	Ac/yr	$157	$1,575,750	$393,937	$1,969,687	**$17,389,412**
15.2	Gate Maintenance	2	EA/yr	$73,303	$7,330,260.00	$1,832,565	$9,162,825	
15.3	Pump Station Maintenance	1	EA/yr	$100,110	$5,005,520.40	$1,251,380	$6,256,901	
	Total Cost				**$158,400,196**	**$39,600,049**	**$198,000,245**	**$198,000,245**

Table 17 – PRA-4 Cost Estimate (Arcadis, 2017)

Itemized Cost Summary PrA-4								
Item No.	**Item Description**	**Quantity**	**Unit**	**Unit Cost**	**Total**	**25% Contingency**	**Total with Contingency**	**Subtotals**
0	**Reach Characteristics**							
0.1	Reach Name	PrA-4						
0.2	Parish	St. Mary						
0.3	Updated Reach Length	56,907	ft					
0.4	Conversion factor	43,560	ft^2/acre					
0.5	Month	5						
0.6	Year	2017						
0.7	CPI Inflation Rate	1.05						
1	**Planning, Engineering, Design, Permitting, and Construction Management**							**Sum PED, Perm., and CM**
1.1	Planning, Engineering, and Design			6.5%	$5,279,613	$1,319,903	$6,599,517	**$12,691,378**
1.2	Permitting			1.0%	$812,248	$203,062	$1,015,310	
1.3	Construction Management			5.0%	$4,061,241	$1,015,310	$5,076,551	
2	**Levee Construction**							**Sum First Lift**
	Width: Total + ROW (Incl. Borrow Canal)	333	ft					**$24,311,672**
	Width: Levee Surface	92	ft					
	Height	13.5	ft					
2.1	Mobilization & Demobilization	*All other unit costs are loaded costs and include mob/demod*						
2.2	Clearing & Grubbing	434	Ac	$4,293	$1,864,985	$466,246	$2,331,232	
2.3	Local Borrow Fill	1,257,372	CY	$14	$17,117,026	$4,279,257	$21,396,283	
2.4	Fertilize, Seed & Mulch	121	Ac	$3,875	$467,326	$116,832	$584,158	
3	**Drainage Structures**							**Sum Drainage Structures**
3.1	Total 10'X10' Box with Sluice Drainage Structures	8	EA	$2,263,115	$18,104,923	$4,526,231	$22,631,154	**$22,631,154**
4	**T-Walls**							**Sum Walls**
4.1	Total Length of T-Wall	0	LF	$8,377	$0	$0	$0	**$0**
5	**2-Lane Highway Gates**							**Sum Hwy Gates**
5.1	Total Count of Highway Gates	1	LS	$6,178,362	$6,178,362	$1,544,591	$7,722,953	**$7,722,953**
6	**Railroad Gates**							**Sum RR Gates**
6.1	Total Count of Railroad Gates	1	LS	$4,921,746	$4,921,746	$1,230,437	$6,152,183	**$6,152,183**
7	**Pipeline/Utility Crossings**							**Sum Crossings**
7.1	Total Crossings	12	LS	$211,530	$2,538,364	$634,591	$3,172,955	**$3,172,955**
8	**Pump Station Frontal Protection**							**Sum Frontal Protection**
8.1	Total Length of Protection	0	LF	$25,132	$0	$0	$0	**$0**
9	**New Pump Stations**							**Sum New PS's**
9.1	Total Capacity	790	CFS	$15,812	$12,491,810	$3,122,953	$15,614,763	**$15,614,763**
10	**Navigation Gates**							**Sum Nav. Gates**
10.1	30' Barge Gates	0	LS	$11,100,108	$0	$0	$0	**$0**
10.2	110' Barge Gates	0	LS	$27,421,455	$0	$0	$0	
10.3	200' Barge Gates	0	LS	$49,358,620	$0	$0	$0	
11	**Real Estate**							**Sum ROW**
11.1	Right-of-Way (Total Levee Footprint)	434	Ac	$5,000	$2,171,903	$542,976	$2,714,879	**$5,072,538**
11.2	Title Research and Legal Proceedings	10.8	Mi	$175,000	$1,886,128	$471,532	$2,357,660	
12	**Mitigation Acreages**							**Sum Mitigation**
12.1	Forested Wetlands	51	Ac	$232,474	$11,921,495	$2,980,374	$14,901,869	**$16,852,810**
12.2	Emergent Wetlands	18	Ac	$84,403	$1,560,753	$390,188	$1,950,941	
13	**First Levee Lift, Year 10**							**Sum 2nd Lift**
	Width: Total + ROW (No Borrow Canal)	179	ft					**$3,895,375**
	Width: Levee Surface	100	ft					
	Height	14.5	ft					

	Mobilization & Demobilization	*All other unit costs are loaded costs and include mob/demod*						
13.1	Opposite Cast	191,878	CY	$14	$2,612,097	$653,024	$3,265,121	
13.2	Fertilize, Seed & Mulch	130	Ac	$3,875	$504,203	$126,051	$630,254	
14	**Second Levee Lift, Year 25**							**Sum 3rd Lift**
	Width: Total + ROW (No Borrow Canal)	183	ft					**$8,011,097**
	Width: Levee Surface	114	ft					
	Height	16.5	ft					
	Mobilization & Demobilization	*All other unit costs are loaded costs and include mob/demod*						
14.1	Opposite Cast	428,324	CY	$14	$5,830,921	$1,457,730	$7,288,651	
14.2	Fertilize, Seed & Mulch	149	Ac	$3,875	$577,957	$144,489	$722,446	
15	**Operations and Maintenance (50 Years)**							**Sum O&M**
15.1	Right of Way Maintenance	434	Ac/yr	$157	$3,411,559	$852,890	$4,264,448	**$19,684,174**
15.2	Gate Maintenance	2	EA/yr	$73,303	$7,330,260.00	$1,832,565	$9,162,825	
15.3	Pump Station Maintenance	1	EA/yr	$100,110	$5,005,520.40	$1,251,380	$6,256,901	
	Total Cost				**$116,650,441**	**$29,162,610**	**$145,813,051**	**$145,813,051**

Table 18 – PRA-5 Cost Estimate (Arcadis, 2017)

Itemized Cost Summary PrA-5								
Item No.	**Item Description**	**Quantity**	**Unit**	**Unit Cost**	**Total**	**25% Contingency**	**Total with Contingency**	**Subtotals**
0	**Reach Characteristics**							
0.1	Reach Name	PrA-5						
0.2	Parish	St. Mary						
0.3	Updated Reach Length	29,791	ft					
0.4	Conversion factor	43,560	ft^2/acre					
0.5	Month	5						
0.6	Year	2017						
0.7	CPI Inflation Rate	1.05						
1	**Planning, Engineering, Design, Permitting, and Construction Management**							**Sum PED, Perm., and CM**
1.1	Planning, Engineering, and Design			6.5%	$3,134,924	$783,731	$3,918,655	**$7,535,876**
1.2	Permitting			1.0%	$482,296	$120,574	$602,870	
1.3	Construction Management			5.0%	$2,411,480	$602,870	$3,014,350	
2	**Levee Construction**							**Sum First Lift**
	Width: Total + ROW (Incl. Borrow Canal)	365	ft					**$18,851,051**
	Width: Levee Surface	111	ft					
	Height	16.0	ft					
2.1	Mobilization & Demobilization	*All other unit costs are loaded costs and include mob/demod*						
2.2	Clearing & Grubbing	249	Ac	$4,293	$1,070,286	$267,572	$1,337,858	
2.3	Local Borrow Fill	1,007,662	CY	$14	$13,717,645	$3,429,411	$17,147,056	
2.4	Fertilize, Seed & Mulch	76	Ac	$3,875	$292,909	$73,227	$366,137	
3	**Drainage Structures**							**Sum Drainage Structures**
3.1	Total 10'X10' Box with Sluice Drainage Structures	3	EA	$2,263,115	$6,789,346	$1,697,337	$8,486,683	**$8,486,683**
4	**T-Walls**							**Sum Walls**
4.1	Total Length of T-Wall	0	LF	$8,377	$0	$0	$0	**$0**
5	**2-Lane Highway Gates**							**Sum Hwy Gates**
5.1	Total Count of Highway Gates	1	LS	$6,178,362	$6,178,362	$1,544,591	$7,722,953	**$7,722,953**
6	**Railroad Gates**							**Sum RR Gates**
6.1	Total Count of Railroad Gates	0	LS	$4,921,746	$0	$0	$0	**$0**
7	**Pipeline/Utility Crossings**							**Sum Crossings**
7.1	Total Crossings	5	LS	$211,530	$1,057,652	$264,413	$1,322,065	**$1,322,065**
8	**Pump Station Frontal Protection**							**Sum Frontal Protection**
8.1	Total Length of Protection	0	LF	$25,132	$0	$0	$0	**$0**
9	**New Pump Stations**							**Sum New PS's**
9.1	Total Capacity	0	CFS	$15,812	$0	$0	$0	**$0**
10	**Navigation Gates**							**Sum Nav. Gates**
10.1	30' Barge Gates	0	LS	$11,100,108	$0	$0	$0	**$0**
10.2	110' Barge Gates	0	LS	$27,421,455	$0	$0	$0	
10.3	200' Barge Gates	0	LS	$49,358,620	$0	$0	$0	
11	**Real Estate**							**Sum ROW**
11.1	Right-of-Way (Total Levee Footprint)	249	Ac	$5,000	$1,246,421	$311,605	$1,558,027	**$2,792,267**
11.2	Title Research and Legal Proceedings	5.6	Mi	$175,000	$987,392	$246,848	$1,234,240	
12	**Mitigation Acreages**							**Sum Mitigation**
12.1	Forested Wetlands	52	Ac	$232,474	$12,099,213	$3,024,803	$15,124,016	**$21,111,987**
12.2	Emergent Wetlands	57	Ac	$84,403	$4,790,377	$1,197,594	$5,987,971	
13	**First Levee Lift, Year 10**							**Sum 2nd Lift**
	Width: Total + ROW (No Borrow Canal)	199	ft					**$1,412,194**
	Width: Levee Surface	114	ft					

	Height	16.5	ft					
	Mobilization & Demobilization	*All other unit costs are loaded costs and include mob/demod*						
13.1	Opposite Cast	60,763	CY	$14	$827,193	$206,798	$1,033,992	
13.2	Fertilize, Seed & Mulch	78	Ac	$3,875	$302,562	$75,640	$378,202	
14	**Second Levee Lift, Year 25**							**Sum 3rd Lift**
	Width: Total + ROW (No Borrow Canal)	200	ft					**$3,679,965**
	Width: Levee Surface	125	ft					
	Height	18.0	ft					
	Mobilization & Demobilization	*All other unit costs are loaded costs and include mob/demod*						
14.1	Opposite Cast	191,904	CY	$14	$2,612,452	$653,113	$3,265,565	
14.2	Fertilize, Seed & Mulch	86	Ac	$3,875	$331,519	$82,880	$414,399	
15	**Operations and Maintenance (50 Years)**							**Sum O&M**
15.1	Right of Way Maintenance	249	Ac/yr	$157	$1,957,841	$489,460	$2,447,301	**$7,028,713**
15.2	Gate Maintenance	1	EA/yr	$73,303	$3,665,130.00	$916,283	$4,581,413	
15.3	Pump Station Maintenance	0	EA/yr	$100,110	$0.00	$0	$0	
	Total Cost				**$63,955,002**	**$15,988,750**	**$79,943,752**	**$79,943,752**

Table 19 – PRA-6 Cost Estimate (Arcadis, 2017)

Itemized Cost Summary PrA-6								
Item No.	**Item Description**	**Quantity**	**Unit**	**Unit Cost**	**Total**	**25% Contingency**	**Total with Contingency**	**Subtotals**
0	**Reach Characteristics**							
0.1	Reach Name	PrA-6						
0.2	Parish	St. Mary						
0.3	Updated Reach Length	57,051	ft					
0.4	Conversion factor	43,560	ft^2/acre					
0.5	Month	5						
0.6	Year	2017						
0.7	CPI Inflation Rate	1.05						
1	**Planning, Engineering, Design, Permitting, and Construction Management**							**Sum PED, Perm., and CM**
1.1	Planning, Engineering, and Design			6.5%	$14,305,602	$3,576,401	$17,882,003	**$34,388,467**
1.2	Permitting			1.0%	$2,200,862	$550,215	$2,751,077	
1.3	Construction Management			5.0%	$11,004,309	$2,751,077	$13,755,387	
2	**Levee Construction**							**Sum First Lift**
	Width: Total + ROW (Incl. Borrow Canal)	337	ft					**$24,185,570**
	Width: Levee Surface	90	ft					
	Height	13.2	ft					
2.1	Mobilization & Demobilization	*All other unit costs are loaded costs and include mob/demod*						
2.2	Clearing & Grubbing	441	Ac	$4,293	$1,895,006	$473,751	$2,368,757	
2.3	Local Borrow Fill	1,248,484	CY	$14	$16,996,034	$4,249,008	$21,245,042	
2.4	Fertilize, Seed & Mulch	118	Ac	$3,875	$457,417	$114,354	$571,771	
3	**Drainage Structures**							**Sum Drainage Structures**
3.1	Total 10'X10' Box with Sluice Drainage Structures	16	EA	$2,263,115	$36,209,846	$9,052,462	$45,262,308	**$45,262,308**
4	**T-Walls**							**Sum Walls**
4.1	Total Length of T-Wall	0	LF	$8,377	$0	$0	$0	**$0**
5	**2-Lane Highway Gates**							**Sum Hwy Gates**
5.1	Total Count of Highway Gates	0	LS	$6,178,362	$0	$0	$0	**$0**
6	**Railroad Gates**							**Sum RR Gates**
6.1	Total Count of Railroad Gates	2	LS	$4,921,746	$9,843,492	$2,460,873	$12,304,365	**$12,304,365**
7	**Pipeline/Utility Crossings**							**Sum Crossings**
7.1	Total Crossings	13	LS	$211,530	$2,749,895	$687,474	$3,437,368	**$3,437,368**
8	**Pump Station Frontal Protection**							**Sum Frontal Protection**
8.1	Total Length of Protection	0	LF	$25,132	$0	$0	$0	**$0**
9	**New Pump Stations**							**Sum New PS's**
9.1	Total Capacity	6,442	CFS	$15,812	$101,865,178	$25,466,294	$127,331,472	**$127,331,472**
10	**Navigation Gates**							**Sum Nav. Gates**
10.1	30' Barge Gates	1	LS	$11,100,108	$11,100,108	$2,775,027	$13,875,135	**$48,151,954**
10.2	110' Barge Gates	1	LS	$27,421,455	$27,421,455	$6,855,364	$34,276,819	
10.3	200' Barge Gates	0	LS	$49,358,620	$0	$0	$0	
11	**Real Estate**							**Sum ROW**
11.1	Right-of-Way (Total Levee Footprint)	441	Ac	$5,000	$2,206,863	$551,716	$2,758,579	**$5,122,201**
11.2	Title Research and Legal Proceedings	10.8	Mi	$175,000	$1,890,897	$472,724	$2,363,621	
12	**Mitigation Acreages**							**Sum Mitigation**
12.1	Forested Wetlands	27	Ac	$232,474	$6,234,529	$1,558,632	$7,793,161	**$9,312,497**
12.2	Emergent Wetlands	14	Ac	$84,403	$1,215,469	$303,867	$1,519,336	
13	**First Levee Lift, Year 10**							**Sum 2nd Lift**
	Width: Total + ROW (No Borrow Canal)	177	ft					**$5,489,142**
	Width: Levee Surface	92	ft					
	Height	13.4	ft					

	Mobilization & Demobilization	*All other unit costs are loaded costs and include mob/demod*						
13.1	Opposite Cast	288,430	CY	$14	$3,926,502	$981,626	$4,908,128	
13.2	Fertilize, Seed & Mulch	120	Ac	$3,875	$464,811	$116,203	$581,014	
14	**Second Levee Lift, Year 25**							**Sum 3rd Lift**
	Width: Total + ROW (No Borrow Canal)	177	ft					**$4,235,720**
	Width: Levee Surface	103	ft					
	Height	15.0	ft					
	Mobilization & Demobilization	*All other unit costs are loaded costs and include mob/demod*						
14.1	Opposite Cast	210,427	CY	$14	$2,864,613	$716,153	$3,580,766	
14.2	Fertilize, Seed & Mulch	135	Ac	$3,875	$523,963	$130,991	$654,954	
15	**Operations and Maintenance (50 Years)**							**Sum O&M**
15.1	Right of Way Maintenance	441	Ac/yr	$157	$3,466,474	$866,618	$4,333,092	**$35,172,543**
15.2	Gate Maintenance	4	EA/yr	$73,303	$14,660,520.00	$3,665,130	$18,325,650	
15.3	Pump Station Maintenance	2	EA/yr	$100,110	$10,011,040.80	$2,502,760	$12,513,801	
	Total Cost				**$283,514,885**	**$70,878,721**	**$354,393,607**	**$354,393,607**

Table 20 – PRB-4 Cost Estimate (Arcadis, 2017)

Itemized Cost Summary PrB-4								
Item No.	**Item Description**	**Quantity**	**Unit**	**Unit Cost**	**Total**	**25% Contingency**	**Total with Contingency**	**Subtotals**
0	**Reach Characteristics**							
0.1	Reach Name	PrB-4						
0.2	Parish	St. Mary						
0.3	Updated Reach Length	25,707	ft					
0.4	Conversion factor	43,560	ft^2/acre					
0.5	Month	5						
0.6	Year	2017						
0.7	CPI Inflation Rate	1.05						
1	**Planning, Engineering, Design, Permitting, and Construction Management**							**Sum PED, Perm., and CM**
1.1	Planning, Engineering, and Design			6.5%	$2,537,177	$634,294	$3,171,471	**$6,098,983**
1.2	Permitting			1.0%	$390,335	$97,584	$487,919	
1.3	Construction Management			5.0%	$1,951,675	$487,919	$2,439,593	
2	**Levee Construction**							**Sum First Lift**
	Width: Total + ROW (Incl. Borrow Canal)	341	ft					**$13,400,129**
	Width: Levee Surface	100	ft					
	Height	14.7	ft					
2.1	Mobilization & Demobilization	*All other unit costs are loaded costs and include mob/demod*						
2.2	Clearing & Grubbing	201	Ac	$4,293	$864,029	$216,007	$1,080,036	
2.3	Local Borrow Fill	707,270	CY	$14	$9,628,305	$2,407,076	$12,035,381	
2.4	Fertilize, Seed & Mulch	59	Ac	$3,875	$227,770	$56,942	$284,712	
3	**Drainage Structures**							**Sum Drainage Structures**
3.1	Total 10'X10' Box with Sluice Drainage Structures	6	EA	$2,263,115	$13,578,692	$3,394,673	$16,973,365	**$16,973,365**
4	**T-Walls**							**Sum Walls**
4.1	Total Length of T-Wall	0	LF	$8,377	$0	$0	$0	**$0**
5	**2-Lane Highway Gates**							**Sum Hwy Gates**
5.1	Total Count of Highway Gates	1	LS	$6,178,362	$6,178,362	$1,544,591	$7,722,953	**$7,722,953**
6	**Railroad Gates**							**Sum RR Gates**
6.1	Total Count of Railroad Gates	0	LS	$4,921,746	$0	$0	$0	**$0**
7	**Pipeline/Utility Crossings**							**Sum Crossings**
7.1	Total Crossings	6	LS	$211,530	$1,269,182	$317,296	$1,586,478	**$1,586,478**
8	**Pump Station Frontal Protection**							**Sum Frontal Protection**
8.1	Total Length of Protection	0	LF	$25,132	$0	$0	$0	**$0**
9	**New Pump Stations**							**Sum New PS's**
9.1	Total Capacity	90	CFS	$15,812	$1,428,652	$357,163	$1,785,815	**$1,785,815**
10	**Navigation Gates**							**Sum Nav. Gates**
10.1	30' Barge Gates	0	LS	$11,100,108	$0	$0	$0	**$0**
10.2	110' Barge Gates	0	LS	$27,421,455	$0	$0	$0	
10.3	200' Barge Gates	0	LS	$49,358,620	$0	$0	$0	
11	**Real Estate**							**Sum ROW**
11.1	Right-of-Way (Total Levee Footprint)	201	Ac	$5,000	$1,006,221	$251,555	$1,257,776	**$2,322,829**
11.2	Title Research and Legal Proceedings	4.9	Mi	$175,000	$852,042	$213,011	$1,065,053	
12	**Mitigation Acreages**							**Sum Mitigation**
12.1	Forested Wetlands	14	Ac	$232,474	$3,208,525	$802,131	$4,010,656	**$5,000,295**
12.2	Emergent Wetlands	9	Ac	$84,403	$791,711	$197,928	$989,639	
13	**First Levee Lift, Year 10**							**Sum 2nd Lift**
	Width: Total + ROW (No Borrow Canal)	186	ft					**$1,922,314**
	Width: Levee Surface	106	ft					
	Height	15.6	ft					

	Mobilization & Demobilization	*All other unit costs are loaded costs and include mob/demod*						
13.1	Opposite Cast	95,134	CY	$14	$1,295,088	$323,772	$1,618,861	
13.2	Fertilize, Seed & Mulch	63	Ac	$3,875	$242,762	$60,691	$303,453	
14	**Second Levee Lift, Year 25**							**Sum 3rd Lift**
	Width: Total + ROW (No Borrow Canal)	186	ft					**$2,968,609**
	Width: Levee Surface	116	ft					
	Height	17.0	ft					
	Mobilization & Demobilization	*All other unit costs are loaded costs and include mob/demod*						
14.1	Opposite Cast	154,907	CY	$14	$2,108,802	$527,201	$2,636,003	
14.2	Fertilize, Seed & Mulch	69	Ac	$3,875	$266,085	$66,521	$332,606	
15	**Operations and Maintenance (50 Years)**							**Sum O&M**
15.1	Right of Way Maintenance	201	Ac/yr	$157	$1,580,540	$395,135	$1,975,676	**$12,813,989**
15.2	Gate Maintenance	1	EA/yr	$73,303	$3,665,130.00	$916,283	$4,581,413	
15.3	Pump Station Maintenance	1	EA/yr	$100,110	$5,005,520.40	$1,251,380	$6,256,901	
	Total Cost				**$58,076,606**	**$14,519,151**	**$72,595,757**	**$72,595,757**

Table 21 – PRB-5 Cost Estimate (Arcadis, 2017)

Itemized Cost Summary PrB-5								
Item No.	**Item Description**	**Quantity**	**Unit**	**Unit Cost**	**Total**	**25% Contingency**	**Total with Contingency**	**Subtotals**
0	**Reach Characteristics**							
0.1	Reach Name	PrB-5						
0.2	Parish	St. Mary						
0.3	Updated Reach Length	38,640	ft					
0.4	Conversion factor	43,560	ft^2/acre					
0.5	Month	5						
0.6	Year	2017						
0.7	CPI Inflation Rate	1.05						
1	**Planning, Engineering, Design, Permitting, and Construction Management**							**Sum PED, Perm., and CM**
1.1	Planning, Engineering, and Design			6.5%	$13,217,813	$3,304,453	$16,522,266	**$31,773,589**
1.2	Permitting			1.0%	$2,033,510	$508,377	$2,541,887	
1.3	Construction Management			5.0%	$10,167,548	$2,541,887	$12,709,436	
2	**Levee Construction**							**Sum First Lift**
	Width: Total + ROW (Incl. Borrow Canal)	322	ft					**$16,677,711**
	Width: Levee Surface	90	ft					
	Height	13.2	ft					
2.1	Mobilization & Demobilization	*All other unit costs are loaded costs and include mob/demod*						
2.2	Clearing & Grubbing	286	Ac	$4,293	$1,226,337	$306,584	$1,532,921	
2.3	Local Borrow Fill	867,240	CY	$14	$11,806,029	$2,951,507	$14,757,536	
2.4	Fertilize, Seed & Mulch	80	Ac	$3,875	$309,803	$77,451	$387,254	
3	**Drainage Structures**							**Sum Drainage Structures**
3.1	Total 10'X10' Box with Sluice Drainage Structures	16	EA	$2,263,115	$36,209,846	$9,052,462	$45,262,308	**$45,262,308**
4	**T-Walls**							**Sum Walls**
4.1	Total Length of T-Wall	0	LF	$8,377	$0	$0	$0	**$0**
5	**2-Lane Highway Gates**							**Sum Hwy Gates**
5.1	Total Count of Highway Gates	0	LS	$6,178,362	$0	$0	$0	**$0**
6	**Railroad Gates**							**Sum RR Gates**
6.1	Total Count of Railroad Gates	1	LS	$4,921,746	$4,921,746	$1,230,437	$6,152,183	**$6,152,183**
7	**Pipeline/Utility Crossings**							**Sum Crossings**
7.1	Total Crossings	8	LS	$211,530	$1,692,243	$423,061	$2,115,304	**$2,115,304**
8	**Pump Station Frontal Protection**							**Sum Frontal Protection**
8.1	Total Length of Protection	0	LF	$25,132	$0	$0	$0	**$0**
9	**New Pump Stations**							**Sum New PS's**
9.1	Total Capacity	6,442	CFS	$15,812	$101,865,178	$25,466,294	$127,331,472	**$127,331,472**
10	**Navigation Gates**							**Sum Nav. Gates**
10.1	30' Barge Gates	1	LS	$11,100,108	$11,100,108	$2,775,027	$13,875,135	**$48,151,954**
10.2	110' Barge Gates	1	LS	$27,421,455	$27,421,455	$6,855,364	$34,276,819	
10.3	200' Barge Gates	0	LS	$49,358,620	$0	$0	$0	
11	**Real Estate**							**Sum ROW**
11.1	Right-of-Way (Total Levee Footprint)	286	Ac	$5,000	$1,428,153	$357,038	$1,785,191	**$3,386,043**
11.2	Title Research and Legal Proceedings	7.3	Mi	$175,000	$1,280,682	$320,170	$1,600,852	
12	**Mitigation Acreages**							**Sum Mitigation**
12.1	Forested Wetlands	13	Ac	$232,474	$3,069,233	$767,308	$3,836,541	**$5,111,737**
12.2	Emergent Wetlands	12	Ac	$84,403	$1,020,157	$255,039	$1,275,196	
13	**First Levee Lift, Year 10**							**Sum 2nd Lift**
	Width: Total + ROW (No Borrow Canal)	177	ft					**$3,735,379**
	Width: Levee Surface	92	ft					
	Height	13.4	ft					

	Mobilization & Demobilization	*All other unit costs are loaded costs and include mob/demod*						
13.1	Opposite Cast	196,388	CY	$14	$2,673,492	$668,373	$3,341,865	
13.2	Fertilize, Seed & Mulch	81	Ac	$3,875	$314,811	$78,703	$393,513	
14	**Second Levee Lift, Year 25**							**Sum 3rd Lift**
	Width: Total + ROW (No Borrow Canal)	177	ft					**$2,877,073**
	Width: Levee Surface	103	ft					
	Height	15.0	ft					
	Mobilization & Demobilization	*All other unit costs are loaded costs and include mob/demod*						
14.1	Opposite Cast	143,006	CY	$14	$1,946,785	$486,696	$2,433,481	
14.2	Fertilize, Seed & Mulch	92	Ac	$3,875	$354,874	$88,718	$443,592	
15	**Operations and Maintenance (50 Years)**							**Sum O&M**
15.1	Right of Way Maintenance	286	Ac/yr	$157	$2,243,299	$560,825	$2,804,124	**$29,062,162**
15.2	Gate Maintenance	3	EA/yr	$73,303	$10,995,390.00	$2,748,848	$13,744,238	
15.3	Pump Station Maintenance	2	EA/yr	$100,110	$10,011,040.80	$2,502,760	$12,513,801	
	Total Cost				**$257,309,531**	**$64,327,383**	**$321,636,914**	**$321,636,914**

Table 22 – EX2 Cost Estimate (Arcadis, 2017)

Itemized Cost Summary Ex-2								
Item No.	**Item Description**	**Quantity**	**Unit**	**Unit Cost**	**Total**	**25% Contingency**	**Total with Contingency**	**Subtotals**
0	**Reach Characteristics**							
0.1	Reach Name	Ex-2						
0.2	Parish	St. Mary						
0.3	Updated Reach Length	30,320	ft					
0.4	Conversion factor	43,560	ft^2/acre					
0.5	Month	5						
0.6	Year	2017						
0.7	CPI Inflation Rate	1.05						
1	**Planning, Engineering, Design, Permitting, and Construction Management**							**Sum PED, Perm., and CM**
1.1	Planning, Engineering, and Design			6.5%	$2,315,098	$578,775	$2,893,873	**$5,565,140**
1.2	Permitting			1.0%	$356,169	$89,042	$445,211	
1.3	Construction Management			5.0%	$1,780,845	$445,211	$2,226,056	
2	**Levee Construction**							**Sum First Lift**
	Width: Total + ROW (Incl. Borrow Canal)	101	ft					**$15,143,623**
	Width: Levee Surface	105	ft					
	Height	13.0	ft					
2.1	Mobilization & Demobilization	*All other unit costs are loaded costs and include mob/demod*						
2.2	Clearing & Grubbing	0	Ac	$4,293	$0	$0	$0	
2.3	Local Borrow Fill	418,496	CY	$28	$11,832,502	$2,958,126	$14,790,628	
2.4	Fertilize, Seed & Mulch	73	Ac	$3,875	$282,396	$70,599	$352,995	
3	**Drainage Structures**							**Sum Drainage Structures**
3.1	Total 10'X10' Box with Sluice Drainage Structures	0	EA	$2,263,115	$0	$0	$0	**$0**
4	**T-Walls**							**Sum Walls**
4.1	Total Length of T-Wall	0	LF	$8,377	$0	$0	$0	**$0**
5	**2-Lane Highway Gates**							**Sum Hwy Gates**
5.1	Total Count of Highway Gates	0	LS	$6,178,362	$0	$0	$0	**$0**
6	**Railroad Gates**							**Sum RR Gates**
6.1	Total Count of Railroad Gates	0	LS	$4,921,746	$0	$0	$0	**$0**
7	**Pipeline/Utility Crossings**							**Sum Crossings**
7.1	Total Crossings	0	LS	$211,530	$0	$0	$0	**$0**
8	**Pump Station Frontal Protection**							**Sum Frontal Protection**
8.1	Total Length of Protection	850	LF	$25,132	$21,362,472	$5,340,618	$26,703,090	**$26,703,090**
9	**New Pump Stations**							**Sum New PS's**
9.1	Total Capacity	0	CFS	$15,812	$0	$0	$0	**$0**
10	**Navigation Gates**							**Sum Nav. Gates**
10.1	30' Barge Gates	0	LS	$11,100,108	$0	$0	$0	**$0**
10.2	110' Barge Gates	0	LS	$27,421,455	$0	$0	$0	
10.3	200' Barge Gates	0	LS	$49,358,620	$0	$0	$0	
11	**Real Estate**							**Sum ROW**
11.1	Right-of-Way (Total Levee Footprint)	70	Ac	$5,000	$351,511	$87,878	$439,389	**$1,695,563**
11.2	Title Research and Legal Proceedings	5.7	Mi	$175,000	$1,004,940	$251,235	$1,256,175	
12	**Mitigation Acreages**							**Sum Mitigation**
12.1	Forested Wetlands	3	Ac	$232,474	$605,201	$151,300	$756,501	**$978,843**
12.2	Emergent Wetlands	2	Ac	$84,403	$177,873	$44,468	$222,342	
13	**First Levee Lift, Year 10**							**Sum 2nd Lift**
	Width: Total + ROW (No Borrow Canal)	N/A	ft					**$0**
	Width: Levee Surface	N/A	ft					
	Height	N/A	ft					

	Mobilization & Demobilization	*All other unit costs are loaded costs and include mob/demod*						
13.1	Opposite Cast	0	CY	$28	$0	$0	$0	
13.2	Fertilize, Seed & Mulch	0	Ac	$3,875	$0	$0	$0	
14	**Second Levee Lift, Year 25**							**Sum 3rd Lift**
	Width: Total + ROW (No Borrow Canal)	N/A	ft					**$0**
	Width: Levee Surface	N/A	ft					
	Height	N/A	ft					
	Mobilization & Demobilization	*All other unit costs are loaded costs and include mob/demod*						
14.1	Opposite Cast	0	CY	$28	$0	$0	$0	
14.2	Fertilize, Seed & Mulch	0	Ac	$3,875	$0	$0	$0	
15	**Operations and Maintenance (50 Years)**							**Sum O&M**
15.1	Right of Way Maintenance	70	Ac/yr	$157	$552,143	$138,036	$690,179	**$690,179**
15.2	Gate Maintenance	0	EA/yr	$73,303	$0.00	$0	$0	
15.3	Pump Station Maintenance	0	EA/yr	$100,110	$0.00	$0	$0	
	Total Cost				**$40,621,150**	**$10,155,288**	**$50,776,438**	**$50,776,438**

Table 23 – EX3 Cost Estimate (Arcadis, 2017)

Itemized Cost Summary Ex-3								
Item No.	**Item Description**	**Quantity**	**Unit**	**Unit Cost**	**Total**	**25% Contingency**	**Total with Contingency**	**Subtotals**
0	**Reach Characteristics**							
0.1	Reach Name	Ex-3						
0.2	Parish	St. Mary						
0.3	Updated Reach Length	30,772	ft					
0.4	Conversion factor	43,560	ft^2/acre					
0.5	Month	5						
0.6	Year	2017						
0.7	CPI Inflation Rate	1.05						
1	**Planning, Engineering, Design, Permitting, and Construction Management**							**Sum PED, Perm., and CM**
1.1	Planning, Engineering, and Design			6.5%	$1,477,168	$369,292	$1,846,460	**$3,550,884**
1.2	Permitting			1.0%	$227,257	$56,814	$284,071	
1.3	Construction Management			5.0%	$1,136,283	$284,071	$1,420,354	
2	**Levee Construction**							**Sum First Lift**
	Width: Total + ROW (Incl. Borrow Canal)	115	ft					**$17,519,254**
	Width: Levee Surface	119	ft					
	Height	15.0	ft					
2.1	Mobilization & Demobilization	*All other unit costs are loaded costs and include mob/demod*						
2.2	Clearing & Grubbing	0	Ac	$4,293	$0	$0	$0	
2.3	Local Borrow Fill	484,155	CY	$28	$13,688,921	$3,422,230	$17,111,152	
2.4	Fertilize, Seed & Mulch	84	Ac	$3,875	$326,482	$81,620	$408,102	
3	**Drainage Structures**							**Sum Drainage Structures**
3.1	Total 10'X10' Box with Sluice Drainage Structures	0	EA	$2,263,115	$0	$0	$0	**$0**
4	**T-Walls**							**Sum Walls**
4.1	Total Length of T-Wall	0	LF	$8,377	$0	$0	$0	**$0**
5	**2-Lane Highway Gates**							**Sum Hwy Gates**
5.1	Total Count of Highway Gates	0	LS	$6,178,362	$0	$0	$0	**$0**
6	**Railroad Gates**							**Sum RR Gates**
6.1	Total Count of Railroad Gates	0	LS	$4,921,746	$0	$0	$0	**$0**
7	**Pipeline/Utility Crossings**							**Sum Crossings**
7.1	Total Crossings	0	LS	$211,530	$0	$0	$0	**$0**
8	**Pump Station Frontal Protection**							**Sum Frontal Protection**
8.1	Total Length of Protection	250	LF	$25,132	$6,283,080	$1,570,770	$7,853,850	**$7,853,850**
9	**New Pump Stations**							**Sum New PS's**
9.1	Total Capacity	0	CFS	$15,812	$0	$0	$0	**$0**
10	**Navigation Gates**							**Sum Nav. Gates**
10.1	30' Barge Gates	0	LS	$11,100,108	$0	$0	$0	**$0**
10.2	110' Barge Gates	0	LS	$27,421,455	$0	$0	$0	
10.3	200' Barge Gates	0	LS	$49,358,620	$0	$0	$0	
11	**Real Estate**							**Sum ROW**
11.1	Right-of-Way (Total Levee Footprint)	81	Ac	$5,000	$406,194	$101,548	$507,742	**$1,782,618**
11.2	Title Research and Legal Proceedings	5.8	Mi	$175,000	$1,019,901	$254,975	$1,274,876	
12	**Mitigation Acreages**							**Sum Mitigation**
12.1	Forested Wetlands	4	Ac	$232,474	$898,195	$224,549	$1,122,744	**$1,251,353**
12.2	Emergent Wetlands	1	Ac	$84,403	$102,888	$25,722	$128,609	
13	**First Levee Lift, Year 10**							**Sum 2nd Lift**
	Width: Total + ROW (No Borrow Canal)	N/A	ft					**$0**
	Width: Levee Surface	N/A	ft					
	Height	N/A	ft					

	Mobilization & Demobilization	*All other unit costs are loaded costs and include mob/demod*						
13.1	Opposite Cast	0	CY	$28	$0	$0	$0	
13.2	Fertilize, Seed & Mulch	0	Ac	$3,875	$0	$0	$0	
14	**Second Levee Lift, Year 25**							**Sum 3rd Lift**
	Width: Total + ROW (No Borrow Canal)	N/A	ft					**$0**
	Width: Levee Surface	N/A	ft					
	Height	N/A	ft					
	Mobilization & Demobilization	*All other unit costs are loaded costs and include mob/demod*						
14.1	Opposite Cast	0	CY	$28	$0	$0	$0	
14.2	Fertilize, Seed & Mulch	0	Ac	$3,875	$0	$0	$0	
15	**Operations and Maintenance (50 Years)**							**Sum O&M**
15.1	Right of Way Maintenance	81	Ac/yr	$157	$638,037	$159,509	$797,546	**$797,546**
15.2	Gate Maintenance	0	EA/yr	$73,303	$0.00	$0	$0	
15.3	Pump Station Maintenance	0	EA/yr	$100,110	$0.00	$0	$0	
	Total Cost				**$26,204,404**	**$6,551,101**	**$32,755,505**	**$32,755,505**

Table 24 – EX4 Cost Estimate (Arcadis, 2017)

Itemized Cost Summary Ex-4								
Item No.	**Item Description**	**Quantity**	**Unit**	**Unit Cost**	**Total**	**25% Contingency**	**Total with Contingency**	**Subtotals**
0	**Reach Characteristics**							
0.1	Reach Name	Ex-4						
0.2	Parish	St. Mary						
0.3	Updated Reach Length	17,368	ft					
0.4	Conversion factor	43,560	ft^2/acre					
0.5	Month	5						
0.6	Year	2017						
0.7	CPI Inflation Rate	1.05						
1	**Planning, Engineering, Design, Permitting, and Construction Management**							**Sum PED, Perm., and CM**
1.1	Planning, Engineering, and Design			6.5%	$1,678,605	$419,651	$2,098,257	**$4,035,109**
1.2	Permitting			1.0%	$258,247	$64,562	$322,809	
1.3	Construction Management			5.0%	$1,291,235	$322,809	$1,614,044	
2	**Levee Construction**							**Sum First Lift**
	Width: Total + ROW (Incl. Borrow Canal)	143	ft					**$22,586,055**
	Width: Levee Surface	148	ft					
	Height	19.0	ft					
2.1	Mobilization & Demobilization	*All other unit costs are loaded costs and include mob/demod*						
2.2	Clearing & Grubbing	0	Ac	$4,293	$0	$0	$0	
2.3	Local Borrow Fill	630,956	CY	$28	$17,839,556	$4,459,889	$22,299,445	
2.4	Fertilize, Seed & Mulch	59	Ac	$3,875	$229,288	$57,322	$286,610	
3	**Drainage Structures**							**Sum Drainage Structures**
3.1	Total 10'X10' Box with Sluice Drainage Structures	0	EA	$2,263,115	$0	$0	$0	**$0**
4	**T-Walls**							**Sum Walls**
4.1	Total Length of T-Wall	0	LF	$8,377	$0	$0	$0	**$0**
5	**2-Lane Highway Gates**							**Sum Hwy Gates**
5.1	Total Count of Highway Gates	0	LS	$6,178,362	$0	$0	$0	**$0**
6	**Railroad Gates**							**Sum RR Gates**
6.1	Total Count of Railroad Gates	0	LS	$4,921,746	$0	$0	$0	**$0**
7	**Pipeline/Utility Crossings**							**Sum Crossings**
7.1	Total Crossings	0	LS	$211,530	$0	$0	$0	**$0**
8	**Pump Station Frontal Protection**							**Sum Frontal Protection**
8.1	Total Length of Protection	250	LF	$25,132	$6,283,080	$1,570,770	$7,853,850	**$7,853,850**
9	**New Pump Stations**							**Sum New PS's**
9.1	Total Capacity	0	CFS	$15,812	$0	$0	$0	**$0**
10	**Navigation Gates**							**Sum Nav. Gates**
10.1	30' Barge Gates	0	LS	$11,100,108	$0	$0	$0	**$0**
10.2	110' Barge Gates	0	LS	$27,421,455	$0	$0	$0	
10.3	200' Barge Gates	0	LS	$49,358,620	$0	$0	$0	
11	**Real Estate**							**Sum ROW**
11.1	Right-of-Way (Total Levee Footprint)	57	Ac	$5,000	$285,079	$71,270	$356,348	**$1,075,898**
11.2	Title Research and Legal Proceedings	3.3	Mi	$175,000	$575,640	$143,910	$719,550	
12	**Mitigation Acreages**							**Sum Mitigation**
12.1	Forested Wetlands	2	Ac	$232,474	$528,350	$132,087	$660,437	**$765,069**
12.2	Emergent Wetlands	1	Ac	$84,403	$83,705	$20,926	$104,631	
13	**First Levee Lift, Year 10**							**Sum 2nd Lift**
	Width: Total + ROW (No Borrow Canal)	N/A	ft					**$0**
	Width: Levee Surface	N/A	ft					
	Height	N/A	ft					

	Mobilization & Demobilization	*All other unit costs are loaded costs and include mob/demod*						
13.1	Opposite Cast	0	CY	$28	$0	$0	$0	
13.2	Fertilize, Seed & Mulch	0	Ac	$3,875	$0	$0	$0	
14	**Second Levee Lift, Year 25**							**Sum 3rd Lift**
	Width: Total + ROW (No Borrow Canal)	N/A	ft					**$0**
	Width: Levee Surface	N/A	ft					
	Height	N/A	ft					
	Mobilization & Demobilization	*All other unit costs are loaded costs and include mob/demod*						
14.1	Opposite Cast	0	CY	$28	$0	$0	$0	
14.2	Fertilize, Seed & Mulch	0	Ac	$3,875	$0	$0	$0	
15	**Operations and Maintenance (50 Years)**							**Sum O&M**
15.1	Right of Way Maintenance	57	Ac/yr	$157	$447,793	$111,948	$559,741	**$559,741**
15.2	Gate Maintenance	0	EA/yr	$73,303	$0.00	$0	$0	
15.3	Pump Station Maintenance	0	EA/yr	$100,110	$0.00	$0	$0	
	Total Cost				**$29,500,577**	**$7,375,144**	**$36,875,722**	**$36,875,722**

Table 25 – EX5 Cost Estimate (Arcadis, 2017)

Itemized Cost Summary Ex-5								
Item No.	**Item Description**	**Quantity**	**Unit**	**Unit Cost**	**Total**	**25% Contingency**	**Total with Contingency**	**Subtotals**
0	**Reach Characteristics**							
0.1	Reach Name	Ex-5						
0.2	Parish	St. Mary						
0.3	Updated Reach Length	19,701	ft					
0.4	Conversion factor	43,560	ft^2/acre					
0.5	Month	5						
0.6	Year	2017						
0.7	CPI Inflation Rate	1.05						
1	**Planning, Engineering, Design, Permitting, and Construction Management**							**Sum PED, Perm., and CM**
1.1	Planning, Engineering, and Design			6.5%	$1,611,822	$402,956	$2,014,778	**$3,874,573**
1.2	Permitting			1.0%	$247,973	$61,993	$309,966	
1.3	Construction Management			5.0%	$1,239,863	$309,966	$1,549,829	
2	**Levee Construction**							**Sum First Lift**
	Width: Total + ROW (Incl. Borrow Canal)	133	ft					**$21,641,900**
	Width: Levee Surface	137	ft					
	Height	17.5	ft					
2.1	Mobilization & Demobilization	*All other unit costs are loaded costs and include mob/demod*						
2.2	Clearing & Grubbing	0	Ac	$4,293	$0	$0	$0	
2.3	Local Borrow Fill	603,829	CY	$28	$17,072,580	$4,268,145	$21,340,724	
2.4	Fertilize, Seed & Mulch	62	Ac	$3,875	$240,940	$60,235	$301,176	
3	**Drainage Structures**							**Sum Drainage Structures**
3.1	Total 10'X10' Box with Sluice Drainage Structures	0	EA	$2,263,115	$0	$0	$0	**$0**
4	**T-Walls**							**Sum Walls**
4.1	Total Length of T-Wall	0	LF	$8,377	$0	$0	$0	**$0**
5	**2-Lane Highway Gates**							**Sum Hwy Gates**
5.1	Total Count of Highway Gates	1	LS	$6,178,362	$6,178,362	$1,544,591	$7,722,953	**$7,722,953**
6	**Railroad Gates**							**Sum RR Gates**
6.1	Total Count of Railroad Gates	0	LS	$4,921,746	$0	$0	$0	**$0**
7	**Pipeline/Utility Crossings**							**Sum Crossings**
7.1	Total Crossings	0	LS	$211,530	$0	$0	$0	**$0**
8	**Pump Station Frontal Protection**							**Sum Frontal Protection**
8.1	Total Length of Protection	0	LF	$25,132	$0	$0	$0	**$0**
9	**New Pump Stations**							**Sum New PS's**
9.1	Total Capacity	0	CFS	$15,812	$0	$0	$0	**$0**
10	**Navigation Gates**							**Sum Nav. Gates**
10.1	30' Barge Gates	0	LS	$11,100,108	$0	$0	$0	**$0**
10.2	110' Barge Gates	0	LS	$27,421,455	$0	$0	$0	
10.3	200' Barge Gates	0	LS	$49,358,620	$0	$0	$0	
11	**Real Estate**							**Sum ROW**
11.1	Right-of-Way (Total Levee Footprint)	60	Ac	$5,000	$299,632	$74,908	$374,540	**$1,190,755**
11.2	Title Research and Legal Proceedings	3.7	Mi	$175,000	$652,972	$163,243	$816,215	
12	**Mitigation Acreages**							**Sum Mitigation**
12.1	Forested Wetlands	0	Ac	$232,474	$52,835	$13,209	$66,044	**$440,973**
12.2	Emergent Wetlands	4	Ac	$84,403	$299,944	$74,986	$374,929	
13	**First Levee Lift, Year 10**							**Sum 2nd Lift**
	Width: Total + ROW (No Borrow Canal)	N/A	ft					**$0**
	Width: Levee Surface	N/A	ft					
	Height	N/A	ft					

	Mobilization & Demobilization	*All other unit costs are loaded costs and include mob/demod*						
13.1	Opposite Cast	0	CY	$28	$0	$0	$0	
13.2	Fertilize, Seed & Mulch	0	Ac	$3,875	$0	$0	$0	
14	**Second Levee Lift, Year 25**							**Sum 3rd Lift**
	Width: Total + ROW (No Borrow Canal)	N/A	ft					**$0**
	Width: Levee Surface	N/A	ft					
	Height	N/A	ft					
	Mobilization & Demobilization	*All other unit costs are loaded costs and include mob/demod*						
14.1	Opposite Cast	0	CY	$28	$0	$0	$0	
14.2	Fertilize, Seed & Mulch	0	Ac	$3,875	$0	$0	$0	
15	**Operations and Maintenance (50 Years)**							**Sum O&M**
15.1	Right of Way Maintenance	60	Ac/yr	$157	$470,653	$117,663	$588,316	**$5,169,729**
15.2	Gate Maintenance	1	EA/yr	$73,303	$3,665,130.00	$916,283	$4,581,413	
15.3	Pump Station Maintenance	0	EA/yr	$100,110	$0.00	$0	$0	
	Total Cost				**$32,032,706**	**$8,008,176**	**$40,040,882**	**$40,040,882**

Table 26 – EX6 Cost Estimate (Arcadis, 2017)

Itemized Cost Summary Ex-6								
Item No.	**Item Description**	**Quantity**	**Unit**	**Unit Cost**	**Total**	**25% Contingency**	**Total with Contingency**	**Subtotals**
0	**Reach Characteristics**							
0.1	Reach Name	Ex-6						
0.2	Parish	St. Mary						
0.3	Updated Reach Length	27,555	ft					
0.4	Conversion factor	43,560	ft^2/acre					
0.5	Month	5						
0.6	Year	2017						
0.7	CPI Inflation Rate	1.05						
1	**Planning, Engineering, Design, Permitting, and Construction Management**							**Sum PED, Perm., and CM**
1.1	Planning, Engineering, and Design			6.5%	$656,260	$164,065	$820,325	**$1,577,549**
1.2	Permitting			1.0%	$100,963	$25,241	$126,204	
1.3	Construction Management			5.0%	$504,816	$126,204	$631,019	
2	**Levee Construction**							**Sum First Lift**
	Width: Total + ROW (Incl. Borrow Canal)	112	ft					**$10,360,241**
	Width: Levee Surface	116	ft					
	Height	14.5	ft					
2.1	Mobilization & Demobilization	*All other unit costs are loaded costs and include mob/demod*						
2.2	Clearing & Grubbing	0	Ac	$4,293	$0	$0	$0	
2.3	Local Borrow Fill	283,116	CY	$28	$8,004,770	$2,001,193	$10,005,963	
2.4	Fertilize, Seed & Mulch	73	Ac	$3,875	$283,423	$70,856	$354,278	
3	**Drainage Structures**							**Sum Drainage Structures**
3.1	Total 10'X10' Box with Sluice Drainage Structures	0	EA	$2,263,115	$0	$0	$0	**$0**
4	**T-Walls**							**Sum Walls**
4.1	Total Length of T-Wall	0	LF	$8,377	$0	$0	$0	**$0**
5	**2-Lane Highway Gates**							**Sum Hwy Gates**
5.1	Total Count of Highway Gates	0	LS	$6,178,362	$0	$0	$0	**$0**
6	**Railroad Gates**							**Sum RR Gates**
6.1	Total Count of Railroad Gates	0	LS	$4,921,746	$0	$0	$0	**$0**
7	**Pipeline/Utility Crossings**							**Sum Crossings**
7.1	Total Crossings	0	LS	$211,530	$0	$0	$0	**$0**
8	**Pump Station Frontal Protection**							**Sum Frontal Protection**
8.1	Total Length of Protection	0	LF	$25,132	$0	$0	$0	**$0**
9	**New Pump Stations**							**Sum New PS's**
9.1	Total Capacity	0	CFS	$15,812	$0	$0	$0	**$0**
10	**Navigation Gates**							**Sum Nav. Gates**
10.1	30' Barge Gates	0	LS	$11,100,108	$0	$0	$0	**$0**
10.2	110' Barge Gates	0	LS	$27,421,455	$0	$0	$0	
10.3	200' Barge Gates	0	LS	$49,358,620	$0	$0	$0	
11	**Real Estate**							**Sum ROW**
11.1	Right-of-Way (Total Levee Footprint)	71	Ac	$5,000	$352,660	$88,165	$440,824	**$1,582,422**
11.2	Title Research and Legal Proceedings	5.2	Mi	$175,000	$913,278	$228,320	$1,141,598	
12	**Mitigation Acreages**							**Sum Mitigation**
12.1	Forested Wetlands	2	Ac	$232,474	$451,499	$112,875	$564,374	**$677,725**
12.2	Emergent Wetlands	1	Ac	$84,403	$90,681	$22,670	$113,351	
13	**First Levee Lift, Year 10**							**Sum 2nd Lift**
	Width: Total + ROW (No Borrow Canal)	N/A	ft					**$0**
	Width: Levee Surface	N/A	ft					
	Height	N/A	ft					

	Mobilization & Demobilization	*All other unit costs are loaded costs and include mob/demod*						
13.1	Opposite Cast	0	CY	$28	$0	$0	$0	
13.2	Fertilize, Seed & Mulch	0	Ac	$3,875	$0	$0	$0	
14	**Second Levee Lift, Year 25**							**Sum 3rd Lift**
	Width: Total + ROW (No Borrow Canal)	N/A	ft					**$0**
	Width: Levee Surface	N/A	ft					
	Height	N/A	ft					
	Mobilization & Demobilization	*All other unit costs are loaded costs and include mob/demod*						
14.1	Opposite Cast	0	CY	$28	$0	$0	$0	
14.2	Fertilize, Seed & Mulch	0	Ac	$3,875	$0	$0	$0	
15	**Operations and Maintenance (50 Years)**							**Sum O&M**
15.1	Right of Way Maintenance	71	Ac/yr	$157	$553,947	$138,487	$692,434	**$692,434**
15.2	Gate Maintenance	0	EA/yr	$73,303	$0.00	$0	$0	
15.3	Pump Station Maintenance	0	EA/yr	$100,110	$0.00	$0	$0	
	Total Cost				**$11,912,296**	**$2,978,074**	**$14,890,370**	**$14,890,370**

Table 27– EX7 Cost Estimate (Arcadis, 2017)

Itemized Cost Summary Ex-7								
Item No.	**Item Description**	**Quantity**	**Unit**	**Unit Cost**	**Total**	**25% Contingency**	**Total with Contingency**	**Subtotals**
0	**Reach Characteristics**							
0.1	Reach Name	Ex-7						
0.2	Parish	St. Mary						
0.3	Updated Reach Length	30,937	ft					
0.4	Conversion factor	43,560	ft^2/acre					
0.5	Month	5						
0.6	Year	2017						
0.7	CPI Inflation Rate	1.05						
1	**Planning, Engineering, Design, Permitting, and Construction Management**							**Sum PED, Perm., and CM**
1.1	Planning, Engineering, and Design			6.5%	$1,521,306	$380,327	$1,901,633	**$3,656,987**
1.2	Permitting			1.0%	$234,047	$58,512	$292,559	
1.3	Construction Management			5.0%	$1,170,236	$292,559	$1,462,795	
2	**Levee Construction**							**Sum First Lift**
	Width: Total + ROW (Incl. Borrow Canal)	105	ft					**$6,157,009**
	Width: Levee Surface	108	ft					
	Height	13.5	ft					
2.1	Mobilization & Demobilization	*All other unit costs are loaded costs and include mob/demod*						
2.2	Clearing & Grubbing	0	Ac	$4,293	$0	$0	$0	
2.3	Local Borrow Fill	163,665	CY	$28	$4,627,448	$1,156,862	$5,784,310	
2.4	Fertilize, Seed & Mulch	77	Ac	$3,875	$298,159	$74,540	$372,699	
3	**Drainage Structures**							**Sum Drainage Structures**
3.1	Total 10'X10' Box with Sluice Drainage Structures	0	EA	$2,263,115	$0	$0	$0	**$0**
4	**T-Walls**							**Sum Walls**
4.1	Total Length of T-Wall	800	LF	$8,377	$6,701,952	$1,675,488	$8,377,440	**$8,377,440**
5	**2-Lane Highway Gates**							**Sum Hwy Gates**
5.1	Total Count of Highway Gates	0	LS	$6,178,362	$0	$0	$0	**$0**
6	**Railroad Gates**							**Sum RR Gates**
6.1	Total Count of Railroad Gates	0	LS	$4,921,746	$0	$0	$0	**$0**
7	**Pipeline/Utility Crossings**							**Sum Crossings**
7.1	Total Crossings	0	LS	$211,530	$0	$0	$0	**$0**
8	**Pump Station Frontal Protection**							**Sum Frontal Protection**
8.1	Total Length of Protection	400	LF	$25,132	$10,052,928	$2,513,232	$12,566,160	**$12,566,160**
9	**New Pump Stations**							**Sum New PS's**
9.1	Total Capacity	0	CFS	$15,812	$0	$0	$0	**$0**
10	**Navigation Gates**							**Sum Nav. Gates**
10.1	30' Barge Gates	0	LS	$11,100,108	$0	$0	$0	**$0**
10.2	110' Barge Gates	0	LS	$27,421,455	$0	$0	$0	
10.3	200' Barge Gates	0	LS	$49,358,620	$0	$0	$0	
11	**Real Estate**							**Sum ROW**
11.1	Right-of-Way (Total Levee Footprint)	74	Ac	$5,000	$371,083	$92,771	$463,854	**$1,745,558**
11.2	Title Research and Legal Proceedings	5.9	Mi	$175,000	$1,025,363	$256,341	$1,281,704	
12	**Mitigation Acreages**							**Sum Mitigation**
12.1	Forested Wetlands	1	Ac	$232,474	$235,356	$58,839	$294,195	**$409,725**
12.2	Emergent Wetlands	1	Ac	$84,403	$92,424	$23,106	$115,531	

13	**First Levee Lift, Year 10**							**Sum 2nd Lift**
	Width: Total + ROW (No Borrow Canal)	N/A	ft					**$0**
	Width: Levee Surface	N/A	ft					
	Height	N/A	ft					
	Mobilization & Demobilization	*All other unit costs are loaded costs and include mob/demod*						
13.1	Opposite Cast	0	CY	$28	$0	$0	$0	
13.2	Fertilize, Seed & Mulch	0	Ac	$3,875	$0	$0	$0	
14	**Second Levee Lift, Year 25**							**Sum 3rd Lift**
	Width: Total + ROW (No Borrow Canal)	N/A	ft					**$0**
	Width: Levee Surface	N/A	ft					
	Height	N/A	ft					
	Mobilization & Demobilization	*All other unit costs are loaded costs and include mob/demod*						
14.1	Opposite Cast	0	CY	$28	$0	$0	$0	
14.2	Fertilize, Seed & Mulch	0	Ac	$3,875	$0	$0	$0	
15	**Operations and Maintenance (50 Years)**							**Sum O&M**
15.1	Right of Way Maintenance	74	Ac/yr	$157	$582,887	$145,722	$728,608	**$728,608**
15.2	Gate Maintenance	0	EA/yr	$73,303	$0.00	$0	$0	
15.3	Pump Station Maintenance	0	EA/yr	$100,110	$0.00	$0	$0	
	Total Cost				**$26,913,190**	**$6,728,297**	**$33,641,487**	**$33,641,487**

6.2 Nonstructural Measure Elevation, Floodproofing, and Acquisition and Relocation

Table 28– Nonstructural Cost Estimate (See Economics Appendix for additional information)

Residential Acquisiton/Relocation Cost		
Price Level:	2019	
Acquisition Costs		
Land Costs	2	sf
Acquisition Land Costs (Moving from)	$39,800	
Demolition, Deed, Legal, Regrading	$47,000	
Cultural Resources Arch Survey	$2,000	
Structure Value		
Total Acquisition Costs	$88,800	
Total Acquisition Costs w/ Contingency	$119,436	
Relocation Costs		
Relocation Costs	$38,000	
Relocation Land Value (Moving to)	$39,800	
Total Relocation Costs	$77,800	
Total Relocation Costs w/ Contingency	$104,641	

Non-Residential Acquisiton/Relocation Cost		
Price Level:	2019	
Acquisition Costs		
Land Costs	3	sf
Acquisition Land Costs (Moving from)	$300,000	
Demolition, Deed, Legal, Regrading	$141,000	
Cultural Resources Arch Survey	$2,000	
Structure Value		
Total Acquisition Costs	$443,000	
Total Acquisition Costs w/ Contingency	$595,835	
Relocation Costs		
Relocation Costs	$50,000	
Relocation Land Value (Moving to)	$300,000	
Total Relocation Costs	$350,000	
Total Relocation Costs w/ Contingency	$470,750	

*Land Costs include the cost of suitable land to relocate a new structure to and is computed for the entire parcel
*Average Land Costs for res computed by using the average parcel size for a 1,500 sq ft house, which is 19,900 sq ft lot
*Average Land Costs for non-res computed by using average parcel size for a COM structure, which is 100,000 sq ft lot
*Relocation costs include moving costs and incidentals for residential structures. It includes Uniform Relocation Act
*Relocation costs include moving costs, searching expenses, and re-establishing costs for non-residential
*34.5% contingency added to depreciated replacement values

Sources:
Land Costs - MVN Real Estate Office
Land Value - MVN Real Estate Office
Cultural Survey - MVN Cultural Resources Office
Demo, et al - 2010 MVR Des Moines River Feasibility Study

7.0 RISK AND UNCERTAINTY

Risk and uncertainty associated with a parametric cost analysis include:

1. Emergent and forested wetlands were not accounted for in Real Estate costs.
2. Relocation costs are defined as the relocation of public roads, bridges, railroads, and utilities required for project purposes. Due to the limited time available for investigation, only pipeline utility costs were computed.
3. Foundation Design: No site specific boring data was available for this effort. Existing data in the vicinity was used to develop levee designs. One levee design was done for use in all new levee alternatives.
4. Structures: An effort was made to identify the major structures that would be required but it is possible that more structures would be needed.
5. Mitigation requirements not required.
6. A conservative estimate was assumed for Real Estate Requirements for all levee alternatives.
7. Pumping requirements used were considered minimal amounts. Actual requirements may be different. Additional drainage work may be needed to get the water to the pumping stations.
8. Levee alignments were developed using existing mapping. These preliminary alignments were used to develop cost estimates. Alignments may need to be shifted to avoid existing structures or for other reasons.
9. Quantities developed assume levee for the entirety of each alignment. There is a possibility that some reaches of floodwall may be needed in more developed areas.
10. Because no borrow sites have been identified, borrow was assumed to be available within a 20 mile radius. Borrow may be available at a closer distance.
11. No costs for railroad gates two-lane highway gates were included in the estimate.
12. The base estimate assumes open and competition bidding which is the traditional employed contract procurement method. However often competition will be limited due to certain small groups of pre-approved contractors, or with the intent of improving overall quality of construction (best value procurements). The house elevating costs are based on the limited pool available in the LA area, so some limited competition could be considered to already be built into the costs. There is a risk not knowing exact implementation plan could cause increased levels of tiered subcontracting and/or limit the pool of contractors.
13. Due to the extended period of completion there could be future design/technical changes to design criteria or hydraulic analysis that would result in increased requirements and cost.
14. One typical ROW width for Real Estate estimates was utilized for parametric cost estimates. This width will be used to develop a Real Estate estimate for measure and alternative alignment costs.
15. Use of limited data may result in under designing project features.
16. Future levee lifts were included in future with project cost estimates. All final array alternatives did not include straight O&M costs. Following TSP develop O&M estimates

for included project features. Costs may be underestimated leading to an unrealistic expectation by the Local Sponsor as to their requirements.

17. There is the potential for a high water event to occur during construction which could result in longer construction period and additional cost due to storm damage.
18. Engineering and cost estimates on structural project features were developed from other similar studies and constructed projects. Future lifts and OMRR&R estimate for the recommended plan will be further refined during feasibility level of design.
19. Abbreviated Cost Risk Analysis will be not be completed prior to TSP selection. Risk analysis will be completed prior to release of draft public document. Completion of assessment may result in a modification to final array of alternatives benefit cost ratios resulting in updates to technical appendices and main report.
20. Borrow material was assumed that environmental resources investigations would allow for significant impacts to be avoided. Cost estimates assume 20 mile haul costs for source material. Source material distance may change. Investigations for environmental re- sources may result in an impact to project schedule during final design.
21. Change in Corps design guidance and or interpretation could result in redesign and/or reanalysis.
22. Using existing data including geotechnical and H&H from outside sources, data may be several years old and not representative of current conditions.
23. LOP raises affected structure foundations which would result in structures needing to be replaced in lieu of raising.
24. Unknown subsurface conditions, or assumptions based on regional data that may not represent conditions within project area
25. LSAC rating could change on levees within study area resulting in changes to risk or consequences
26. Seepage or stability berms may occur during study or in PED phase resulting in additional berms, increasing costs.
27. HTRW material may be within the project area and areas of Levee alignment, resulting in increased costs.

8.0 REFERENCES

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EM 1110-2-1902: Slope Stability (October 2003)

EM 1110-1-1904: Settlement Analysis (September 1990)

EC 1110-2-6066: Design of I-Walls (April 2000)