CAUTION: Analysis for this report was completed prior to the issuance of Engineer Technical Letter (ETL) 1110-2-575, EVALUATION OF I-WALLS, dated 1 September 2011.

http://publications.usace.army.mil/publications/eng-tech-ltrs/ETL_1110-2-575/ETL_1110-2-575.pdf

The Corps is performing additional evaluation of the I-walls along the 17th, Orleans and London outfall canals to address the 2011 ETL.

As of June 11, 2013, the new evaluation reports have not been finalized.

Any reference to this report should include this notice.

U. S. ARMY CORPS OF ENGINEERS
NEW ORLEANS DISTRICT

USACE CONTRACT No. W912P8-09-D0014
Task Order 0026

for the

New Orleans Hurricane Protection Office

Remediation of Floodwalls on the London Avenue Canal OFC-03C

Design Documentation Report (DDR)

Final DDR Submittal

November 2010

URS PROJECT No. 10004027

Prepared by:

URS JEG JV

3500 N. Causeway Blvd., Suite 900
Metairie, LA 70002
(504) 837-6326
Fax (504) 831-8860

DESIGN DOCUMENTATION REPORT (DDR)

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1. Project Information

Project Number: A/E Contract No. W912P8-09-D0014, Task Order No. 0026, Remediation of Floodwalls on the London Avenue Canal OFC-03C, Rev. 2, Orleans Parish, Louisiana, issued August 23, 2010.

2. Project Location

The project is located between Drainage Pump Station (DPS) #3 and Lake Pontchartrain on the London Avenue Canal, Orleans Parish, New Orleans, LA. Figure 1 shows the location of the project.

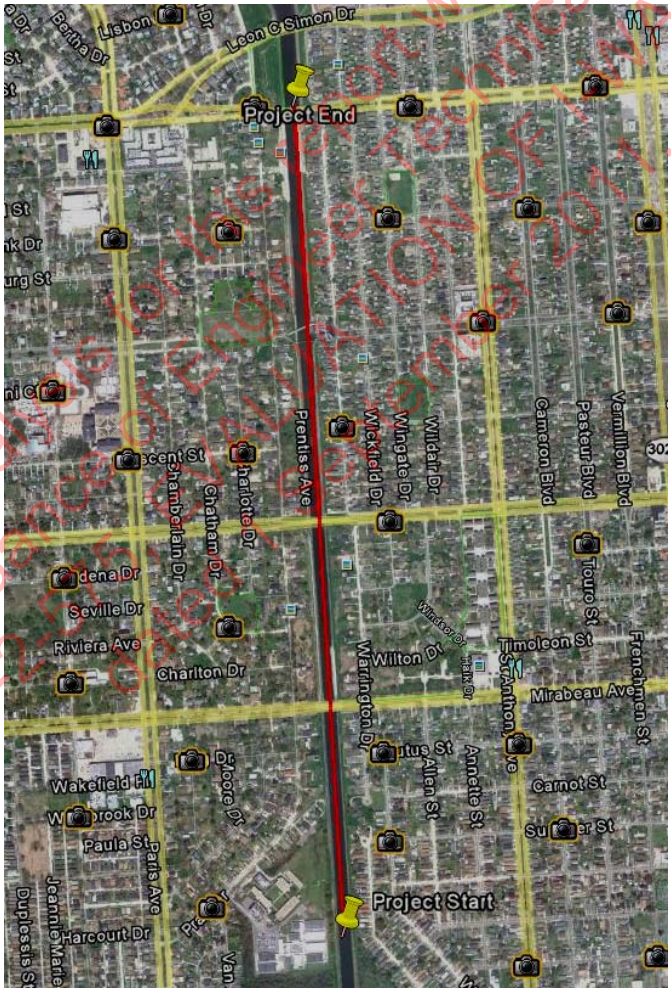

Figure 1 Project Location

A. Project Description

The London Avenue Canal has been constructed and modified over several decades by both private and public entities. Excavation of the first iteration of the canal was

accomplished in the early 1800's. Since this time, the canal has been enlarged and expanded numerous times, and pump stations have been added to facilitate drainage from New Orleans to Lake Pontchartrain. The London Avenue Canal collects storm water extracted from pump stations from the northern portions of Orleans Parish and discharges into Lake Pontchartrain, which forms the northern boundary of New Orleans. The London Avenue Canal levees were constructed during several periods. The subsurface conditions vary along the length of the canal. Based on the expansions and varying subsurface conditions, the structures vary over the length of the canal in cross-section, foundation conditions, flood wall dimensions, and sheet pile embedment depths.

The existing London Avenue Canal is approximately 2.6 miles long and extends from Pump Station No. 3 (located near Benefit Street) to Lake Pontchartrain. The earthen levees on the east and west banks of the canal were designed to provide parallel protection from tidal inundation via the lake-canal connection. I-Walls were constructed at the crest of the levee to provide additional protection from higher water elevations during storm events. The London Avenue Canal has an average width of approximately 60' at the base. The top width of the canal averages approximately 100 feet, and the bottom of the canal ranges from elevation -6 feet to -10 feet, with the deepest section located near Lake Pontchartrain.

The majority of the lengths of the east and west banks of the London Avenue Canal are adjacent to residential neighborhoods. The University of New Orleans is also located along the east bank of the canal, north of Leon C. Simon Blvd. As the city has grown, single and multi-unit homes, apartments, condominiums, businesses, infrastructure, roads, bridges and other urban developments have been constructed in close proximity to the canal and, in some cases, encroaching on the toe of the levees.

B. Alignment and Survey

The alignments used for the SWE London Avenue Canal project were provided by the USACE. This project is located along several segments of the existing London Avenue Canal on both the west and east sides. The proposed sheet pile wall is offset 4' to 5' of the existing I-Wall. Wall line stationing was established based on the data points provided to URS for each side of the canal. The wall lines are located along the approximate protected side face of floodwalls. These wall lines were used by USACE to define limits of work along the reaches and are labeled as such on the drawings. USACE also provided a survey baseline, which is located a varying distance west of the west side floodwall. A survey baseline table was also provided in the plans for reference.

C. Limits of Right-of-Way

The right-of-way for the SWE London Avenue Canal project is based on information provided by the USACE and other government agencies. URS has not received any viable information or drawings to accurately determine the exact location of right-of-way points. The right-of-way used in the plan set is an apparent right-of-way. URS has used as-built drawings from past projects to estimate where the right-of way line should be. The apparent existing Orleans Levee District right-of-way is located approximately 6' beyond the existing protected side levee toe, as per a representative from the O.L.D. URS was able to verify this by locating painted sign posts on the survey, which appear to be right-of-way markers. According to USACE, the Sewerage and Water Board of New Orleans right-of-way is located at the flood side levee toe, which is approximately 20' from the flood side of the floodwall. URS requested right-of-way information from the City of New Orleans (CNO) and Louisiana Department of Transportation and Development (LADOTD) but received no directives from these agencies regarding their right-of-way locations. URS plotted the CNO and LADOTD right-of-way lines by using topographic features such as sidewalks, curbs, medians, tree lines and utility corridors as a means to establish boundaries that are in accordance with reasonable engineering judgment.

D. Project/Contract Description

The project includes raising the Maximum Operating Level (MOL) of the London Avenue Canal to create a minimum MOL of +8 feet for the reach from station 21+00 to the location of the permanent pump station north of Leon C. Simon Blvd.. The following sections outline the MOL and specific reaches that will be remediated under this project.

1. MOL +8 Sta. 21+00 to Permanent Pump Station West

   Sheet pile cut-off to insure that the flood protection meets the Hurricane and Storm Damage Reduction System Design Guidelines (HSDRSDG) criteria for piping (gradient).

   a) Reach 10 - Approximately Sta. 74+00 to 79+50
   b) Reach 11 - Approximately Sta. 79+50 to 84+54
   c) Reach 13 – Approximately Sta. 93+00 to 96+00

2. MOL +8 Sta. 21+00 to Permanent Pump Station East

   Sheet pile cut-off to insure that the flood protection meets the HSDRSDG criteria for piping (gradient).

   a) Reach 27 - Approximately Sta. 48+50 to 58+50
   b) Reach 32-Reach 34 - Approximately Sta. 84+41 to 99+53
   c) Reach 35A – Approximately Sta. 102+42 to 103+50**

3. MOL +8 Station 21+00 to ICS West– 4’ Stick-Up
   a) Reach 10 to Reach 11 – Approximately Sta. 74+00 to 83+54

4. MOL +8 Station 21+00 to ICS East – 4' Stick-Up
    a) Reach 30 to Reach 31 - Approximately Sta. 74+13 to 83+73 *
    b) Reach 32 to Reach 34 - Approximately Sta. 84+41 to 99+53
    c) Reach 35 - Approximately Sta. 102+42 to 114+66 **
5. MOL +8 Station 21+00 to ICS East – Stability
    a) Reach 30 to Reach 31 - Approximately Sta. 74+13 to 83+73 *
    b) Reach 34 - Approximately Sta. 93+00 to 99+53
    c) Reach 35A - Approximately Sta. 102+42 to 103+50**

* The DDR for this reach is being done under another contract (OFC-03B) is included as an appendix to the DDR for this project.

** The DDR for this reach is being done under another contract (OFC-03A) is included as an appendix to the DDR for this project.

Remediation work and connection to existing adjacent structures will be included in the contract documents. Additional design efforts necessary to provide a complete design including final Plans and Specifications as final Construction Documents and a Design Documentation Report (DDR) is included in the scope of the project.

3. Pertinent Data (source: USACE)

A. Controlling Elevations:

The top of existing I-wall is at El. 13± feet NAVD88 (2004.65) along east bank of the London Avenue Canal. All the elevations in this report are in feet and refer to NAVD88 (2004.65) unless noted otherwise.

B Material and Unit Weights

Table 3-1 Material Unit Weights

Material	Unit Wt (lb/ft^3)
Water	62.4
Concrete	150
Steel	490
Semi-Compacted Granular Fill	110
Fully-Compacted Granular Fill, Wet	122
Fully-Compacted Granular Fill, Effective	60
Fully-Compacted Clay Fill, Wet	115
Fully-Compacted Clay Fill, Effective	53

4. References

The EM web link is the following:
http://www.usace.army.mil/publications/eng-manuals/em.htm

A. Civil References

1. Hurricane and Storm Damage Reduction System Design Guidelines, New Orleans District Engineering Division, Interim. October 2007, with revisions dated June 2008.
2. ER 1110-2-1200, Engineering and Design, Plans and Specifications, dated 14 March 1989.
3. EC 1110-1-87, Standards for Maps, Drawings, Engineering Surveys, Construction Site Plans, and Related Geospatial Data Products, dated 1 July 1996.
4. Technical Report CADD-95-April 1995, Part 2, Tri-Service CADD/GIS Technology Center.
5. American Association of State Highway Transportation Officials (AASHTO), "A Policy on Geometric Design of Highways and Streets" 2004, 5th edition.
6. Manual on Traffic Uniform Control Devices for Streets and Highways (MUTCD), Washington D.C., 2003 edition.
7. Louisiana Department of Transportation and Development, Roadway Design Procedures and details, July 2002 edition.

B. Structural References

1. Hurricane and Storm Damage Reduction System Design Guidelines, New Orleans District Engineering Division, Interim. October 2007, with revisions up to June 2008.
2. U.S. Army Corps of Engineers, Engineer Research and Development Center, Analysis of Pile Group (CPGA), March 1993.
3. U.S. Army Corps of Engineers, Engineer Research and Development Center, Pile Group Graphic Display Postprocessor for CPGA (CPGG), October 1992.
4. U.S. Army Corps of Engineers, Engineer Research and Development Center, Pile Head Stiffness or Complete Analysis of Vertical Piles (CPGS), May 1990.
5. US Army Corps of Engineers, Engineer Research and Development Center, Design/Analysis of Sheet-Pile Walls by Classical Methods (CWALSHT), April 2006.

6. U.S. Army Corps of Engineers, Engineer Manual EM 1110-2-322, Retaining and Flood Walls, (Oct 90).
7. U.S. Army Corps of Engineers, Engineer Manual EM 1110-2-2000, Standard Practice for Concrete, Change 2 (Mar. 01).
8. U.S. Army Corps of Engineers, Engineer EM 1110-2-2102, Waterstops and Other Joint Materials (Sep. 95).
9. U.S. Army Corps of Engineers, Engineer Manual 1110-2-2104, Strength Design for Reinforced Concrete Hydraulic Structures, June 1992 (including Change 1, August 2003).
10. U.S. Army Corps of Engineers, Engineer EM 1110-2 2502, Retaining and Floodwalls (Sep. 89).
11. U.S. Army Corps of Engineers, Engineer Manual 1110-2-2504, Design of Sheet Pile Walls, 31 March 1994
12. U.S. Army Corps of Engineers, Engineer Manual 1110-2-2705, Structural Design of Closure Structures for Local Flood Protection Projects, 31 March 1994.
13. U.S. Army Corps of Engineers, Engineer Manual 1110-2-2906, Design of Pile Foundations, 15 January 1991.
14. American Concrete Institute, Building Code Requirements for Structural Concrete, (ACI 318-02) and Commentary (ACI 318R-02).
15. American Institute of Steel Construction (AISC), Manual of Steel Construction Allowable Stress Design, (9th Edition).
16. American Welding Society, Structural Welding Code, Steel, (AWS-D 1.1-2000)
17. Concrete Reinforcing Steel Institute, CRSI Handbook.

C. Geotechnical References

1. Hurricane and Storm Damage Reduction System Design Guidelines, New Orleans District Engineering Division, Interim. October 2007, with revisions up to June 2008.
2. Stability Modeling with SLOPE/W, GeoStudio 2007 V7.1, GEO-SLOPE/W International Ltd.
3. U.S. Army Corps of Engineers, New Orleans District Engineering Division, Stability with Uplift (MVD Method of Planes).
4. U.S. Army Corps of Engineers, Engineer Manual 1110-2-1901, Seepage Analysis and Control for Dams, 30 April 1993.

5. U.S. Army Corps of Engineers, Engineer Manual 1110-2-1902 Slope Stability, 31 October 2003.
6. U.S. Army Corps of Engineers, Engineer Manual 1110-2-1913 Design and Construction of Levees, 30 April 2000.
7. U.S. Army Corps of Engineers, Engineer Manual 1110-2-2502, Retaining and Flood Walls, 29 September 1989.
8. U.S. Army Corps of Engineers, Engineer Manual 1110-2-2504, Design of Sheet Pile Walls, 31 March 1994.
9. U.S. Army Corps of Engineers, Engineer Manual 1110-2-2906 Design of Pile Foundations, 15 January 1991.
10. U.S. Army Corps of Engineers, ETL 1110-2-569, Design Guidance for Levee Underseepage, 2005.
11. U.S. Army Corps of Engineers, Engineer Manual 1110-2-1904 Settlement, 30 September 1990.
12. U.S. Army Corps of Engineers, Engineer Manual 1110-2-1905 Bearing Capacity of Soils, 30 October 1992.
13. U.S. Army Corps of Engineers, Engineer Manual 1110-2-1906 Laboratory Soils Testing, 20 August 1986
14. Harr, M.E, "Groundwater and Seepage" McGraw-Hill Book Company, New York, 1962.
15. US Army Corps of Engineers, New Orleans District, Elevations for Design of Hurricane Protection Levees and Structures, Lake Pontchartrain, Louisiana And Vicinity, Hurricane Protection Project, 9 October 2007.
16. US Army Corps of Engineers, Performance Evaluation of the New Orleans and Southeast Louisiana Hurricane Protection System, Draft Final Report of the Interagency Performance Evaluation Task Force, Volume I – Executive Summary and Overview, 1 June 2006.
17. US Army Corps of Engineers, Performance Evaluation of the New Orleans and Southeast Louisiana Hurricane Protection System, Draft Final Report of the Interagency Performance Evaluation Task Force, Volume V – The Performance – Levees and Floodwalls, 1 June 2006.
18. US Army Corps of Engineers (GCAT), "Stability Analysis of I-Walls Containing Gaps between the I-wall and Backfill Soils" with additional examples by GCAT, (adapted from paper by Brandon, Thomas L., Stephen G. Wright, and J. Michael Duncan (2008)), Version 6.0, 14 Sep 09

D. Project Design Reports

1. Final Safe Water Elevation, Evaluation, London Avenue Canal, United States Army Corps of Engineers, Hurricane Protection Office, New Orleans District, July 17, 2010.
2. Design Documentation Report (100% Design Submittal), Remediation to Raise the Safe Water Elevation for a Section of the London Avenue Canal, PCCP-03B, by Burns Cooley Dennis, Inc. for ECM-GEC JV and U.S. Army Corps of Engineers – HPO, July 16, 2010

E. Project-Specific Criteria

1. Elevations for Design of Hurricane Protection Levees and Structures, Lake Pontchartrain, Louisiana and Vicinity, Hurricane Protection Project, West Bank and Vicinity, Hurricane Project, U.S. Army Corps of Engineers, New Orleans District (09 October 2007).
2. 16 Dec 2009, Memorandum, CEMVD_RB_T, Waiver for Steel Piles Corrosion Protection

F. Other Design Criteria and Information

1. EM 385-1-1, General Safety Requirements, September 2008.
2. ER 415-1-11, Biddability, Constructability, Operability, and Environmental Review
3. ER 1110-2-1302, Civil Works Cost Engineering. 31 Mar 94.
4. Design Memorandum 19A, General Design, London Avenue Outfall Canal, Volumes I and II, U.S. Army Corps of Engineers, New Orleans District, January 1989

G. Computer Program Manuals

1. Stability With Uplift program (Method of Planes), U.S. Army Corps of Engineers, New Orleans District, P.O. Box 60267, New Orleans, LA 70160.
2. Stability Modeling with SLOPE/W 2007, An Engineering Methodology, GEOSLOPE/W International, Ltd, 2007.
3. SEEP/W 2007, Groundwater seepage analysis, GEOSLOPE International, Ltd, 2007.
4. US Army Corps of Engineers, Engineer Research and Development Center, Design/Analysis of Sheet-Pile Walls by Classical Methods (CWALSHT), April 2006.

5. Criteria Waivers

To this point in the design, there are no additional criteria waivers considered necessary.

6. Geotechnical Design Criteria

A. Slope Stability

Table 3-1 of the HSDRS Design Guidelines updated 12 June 2008 lists factor of safety criteria for slope stability analyses. The criteria applicable to the global stability of I-walls by Spencer's Method and Method of Planes (MOP) are reproduced in the table below.

Table 6-1 Minimum Factors of Safety for Slope Stability Analyses

Analysis Condition	Required Minimum FS	
	Spencer	MOP
Extreme Hurricane – Top of Wall/Maximum Operating Level (MOL)	1 4	1.3
Low Water (Hurricane Condition) – Q-Case [1]	1.4	1.3
Low Water (Non-Hurricane Condition) – Walls – S-Case [2]	1.4	1.3

Note 1: Flood side of walls only.
Note 2: Flood and protected sides of walls.

For I-wall analyses, the Method of Planes is intended as a design check only; it does not control the analysis.

Gap analyses were also performed on the I walls in accordance with the document "Stability Analysis of I-Walls Containing Gaps between the I-Wall and Backfill Soils."

B. Seepage

ETL 1110-2 569 provides interim guidance for design of levees to minimize adverse effects of levee under seepage. The ETL recommends a design procedure using a hydraulic exit gradient of 0.5 with the requirements that there be at least 3 borings every 1,000 ft, seepage information from past floods is used to correct computer models, seepage control measures are implemented for any levee that has sustained significant seepage distress, and the saturated unit weight of the blanket soil is at least 110 pcf. Regardless of the other factors, this approach is not acceptable for the reaches within this study because of the unit weight criterion for blanket materials.

The Hurricane and Storm Damage Reduction System (HSDRS) Design Guidelines (updated 12 Jun 08) provide guidance for seepage design in paragraph 3.1.4, which is based on ETL 1110-2-569 and more recent design guidance except that factors of

safety are presented instead of seepage gradients because of the lighter weight blanket materials that may be encountered in the local region.

These criteria are summarized in the table below which is based on Tables 3.5(a) and 3.5(b), paragraph 3.1.4 (Seepage Analysis) and Paragraphs 3.2.2.3 (I-Wall Piping and Seepage Analysis) and 3.2.2.4 (I-Wall Heave Analysis) of the HSDRS Design Guidelines, DIVR 1110-2-400, and previous design guidance from HPO reviewers on reduced factors of safety landward of the levee toe. It is understood that the criteria for heave factor of safety described in Paragraph 3.2.2.4 of the HSDRSDG are no longer used in accordance with a recent directive from GCAT (Source: Brian Bonanno, Pre-Design Meeting, May 24, 2010).

Table 6-2 Design Criteria for Seepage Analysis

Design Condition	Min. Gradient Factor of Safety
Levee or Wall Toe for Still Water Level (SWL) at Design Water Surface Elevation (DWSE)	1.6
Levee or Wall Toe for SWL at Project Grade (Top of Protection)	1.3
4 Times Levee Height from Toe	1.5
8 Times Levee Height from Toe	1.3
12 Times Levee Height from Toe	1.1
≥16 Times Levee Height from Toe	1.0

7. Structural Design

A. Structural Design Criteria

The allowable stresses used in the design of conventionally reinforced concrete structures are according to the ACI Building Code Requirements for Structural Concrete (ACI 318-02) except for strength reduction factor (ϕ) for shear. A value of $\phi = 0.85$ for shear and 0.90 for bending were used. Values contained in the ACI Code will be modified by the strength requirements for reinforced concrete hydraulic structures by EM 110-2-2104 (including Change 1). This includes use of the Single Load Factor Method (1.7) and the Hydraulic Factor of 1.3 for both shear and moment. A Hydraulic Factor of 1.65 was used for members in direct tension, including base slab sections that have a net tensile stress due to applied load and pile reactions. In general, the specified 28-day compressive strength (f'_c) was 4,000 psi.

Reinforcing will conform to ASTM A615 Gr. 60, $f_y = 60$ ksi and steel reinforcing for

prestressed concrete will be Grade 270 strands, f_y = 270 ksi. The maximum flexural reinforcing requirements was generally be established based on 0.25 ρ_b, but 0.375 ρ_b was permitted. Minimum requirements for reinforcing were based on ACI 318. In addition, enough reinforcement was included to meet the temperature reinforcement requirements in EM 1110-2-2104 that specifies area of reinforcement in both faces must be at least the product of 0.0028 and the gross cross-sectional area of the section.

B. Sheet Pile Design

Steel sheet pile stresses were limited to $f_b = 0.5f_y$ and $f_v = 0.3f_y$ for all cases. Minimum thickness for corrosion control was 0.375 inches. Sheet pile PZC-18 was used throughout the project because no unbalanced forces exist on this project.

C. Stick-up Determination

In the design of this project it is assumed that this stick-up height of 4'-0" for I-walls required by Hurricane and Storm Damage Reduction System (HSDRS) Design Guidelines updated 12 June 2008 is determined as the unbraced height of the wall between the maximum operating level (MOL) and the soil embankment/tie-in slab on the protected side, See Figure 2. It is assumed that the water in the canal will never be above the maximum operating level. If the level of water in the canal exceeds the maximum operating level it is possible that the walls may be overstressed.

8. Loads & Load Cases

The following conditions were applied for each component contributing to the loading of the structure:

A. Concrete

Unit weight of concrete

B Still Water

Hydrostatic pressure

MOL at El. 8 ft

C. Soil

Vertical loads – use unit weight

D. Impact Load

Impact loading is not considered for the design of the tie-in slab.

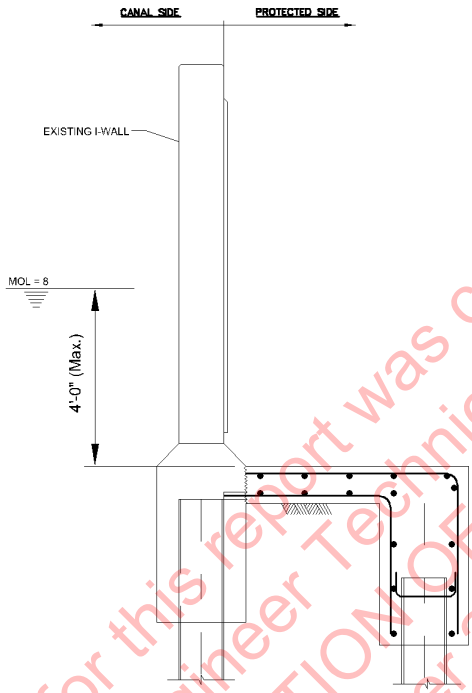

Figure 2 HSDRS Stick-up requirements

E. Wind load

It was assumed that the existing I-wall was adequately designed for the wind loads. The wind loads will not be transferred to the tie-in slab.

F. Uplift

Two load cases were considered with respect to the sheet pile cut-off:

i Impervious exist sheet pile cut-off

ii. Pervious exist sheet pile cut-off

The impervious exist sheet pile cut-off assumed that the existing sheet pile below the existing I-wall is 100% effective in cutting off the seepage. No uplift was assumed in the design of the cut-off slab. The pervious exist sheet pile cut-off assumed that the sheet pile below the existing I-wall is not effective in controlling seepage. An uplift head equal to SWL was applied on the tie-in slab.

G. Vehicular Loads

A 200 psf allowance for equipment load was made in the design of the tie-in slab.

H. Wave Load

Since the location is shielded from the lake, no wave loads were used in the design.

9. Load Cases

Two load cases (2) load cases were used to perform the designs of the cut-off slab and sheet pile cap. A description of each load case and design check is provided in Table 9-1.

Table 9-1 Load Cases for Structural Design

LC No.	Overstress Allowed Slab.	Load Case Name	Description
LC 1	0	Construction/Normal Operations	Dead load 200 psf equipment surcharge No uplift
LC 2	0	Water at SWL (pervious)	Dead load No unbalanced load Pervious exist sheet pile cut-off

10. Civil Design

A. Existing Levee Slopes

The tie-in slab, concrete cap and cut-off sheet pile will be designed to maintain the current levee slopes and accommodate the operation and maintenance of the turf with mowing equipment. Maximum allowable side slopes for levees is 1V:3H. A concrete scour protection pad was provided for reaches where this requirement could not be met. No servitude is required.

B. Traffic Control Design

For this project, the contractor will be required to stage his operations from the London Avenue Canal and designated areas for staging shown on the plans. Three bridges have been designated as sites where the Contractor can launch equipment. In order to provide a safe working area for both the Contractor and the travelling public, each bridge will be closed to traffic during the launch operations. The traffic control plan for the remediation for MOL for the London Avenue Canal project consists of closing the Robert E. Lee Blvd. Bridge over the London Avenue Canal and detouring traffic to the Leon C. Simon Dr. Bridge located north of the Robert E. Lee Blvd. Bridge. When the Mirabeau Ave. Bridge is closed, traffic will be detoured to the Filmore Ave. Bridge. When the Filmore Ave. Bridge is closed, traffic will be detoured to the Mirabeau Ave. Bridge. All detour routes, signage, and barricade

locations are called out on the Bridge Closure Detour plans. Traffic control plans will comply with the latest edition of the Manual on Uniform Traffic Control Devices (MUTCD), Louisiana Department of Transportation and Development (LADOTD) Traffic Control Details, and City of New Orleans traffic control requirements.

11. Design Related Documents

A. Task Order Schedule

See Table 11-1.

Table 11-1 Task Order Schedule

	Work Item	Time Interval for Work Item	Time from NTP	Expected Schedule	Actual Schedule
1	NTP	0	0	4-Aug	4-Aug
2	Pre-Design Conference	3	3	7-Aug	6-Aug
2a	SWE Evaluation Report (GFI)		10	14-Aug	16-Aug
3	DQCP	7	10	14-Aug	11-Aug
4	**Draft ROW Drawings**	**10**	**20**	**24-Aug**	**24-Aug**
4a	Review of ROW Drawings	7	27	31-Aug	
5	**100% ROW Drawings with utility relocations**	**10**	**30**	**3-Sep**	**21-Sep**
5a	100% ROW Drawings review	7	37	10-Sep	
6	**60% P&S Draft Geotechnical Report and Draft DDR**	**10**	**40**	**13-Sep**	**13-Sep**
6a	Review of 60% P&S, Draft Geotech Report & Draft DDR	7	47	20-Sep	27-Sep
7	60% Cost Estimate	5	45	18-Sep	23-Sep
7a	Review of 60% Cost Estimate	7	52	25-Sep	27-Sep
8	**95% P&S, Responses complete to 60% Review Comments, Completed "A-E Contractor Statement of Technical Review" , 100% Geotechnical Report and 100% DDR**	**10**	**55**	**28-Sep**	**28-Sep**
8a	Review of 95% P&S	7	62	5-Oct	1-Oct
9	95% Cost Estimate	5	60	3-Oct	
9a	Review of 95% Cost Estimate	7	67	10-Oct	
10	**100% P&S (Ready to Advertise), responses complete to 95% BCOE Review**	**5**	**65**	**8-Oct**	
11	100% Cost Estimate	5	70	13-Oct	
12	Engineering Support During Advertisement	40	110	22-Nov	

12. Engineering Studies, Investigations and Design

A. Project Features

This section includes basic descriptions of the project features as well as basic plans for construction of these features based on analysis. For further description of the project features as well as full analyses narratives and computations, please refer to the appropriate appendix following this report.

B. Geotechnical Investigation and Analysis

See Appendix C.

C. Civil Design

1. Topographic Surveys and Survey Control

- Vertical Datums. The establishment and use of vertical datums in the design work follows the guidance provided in "USACE New Orleans District Guide for Minimum Surveying Standards for 1`Performing Hydrographic, Topographic, and Geodetic Surveys", Dec 2006; "Hurricane Storm and Damage Reduction System Design Guidelines", Oct 07 with changes in May 08 and Jun 08.

- Horizontal and Vertical control. Horizontal data is tied to the State Plane Coordinate System using North American Datum of 1983 (NAD83. Horizontal data shall be tied to the State Plane Coordinate System using North American Datum of 1983 (NAD83, LA Southern 702). Distances are in feet by horizontal measurement. Coordinates are Louisiana Lambert South Zone. Vertical data is tied to the North American Vertical Datum of 1988, Epoch 2004.65 (NAVD88-2004.65). Elevations are in feet. Horizontal and vertical accuracies are of third order.

- Benchmarks:
  Figure 3 shows the locations of the benchmarks used on the project.

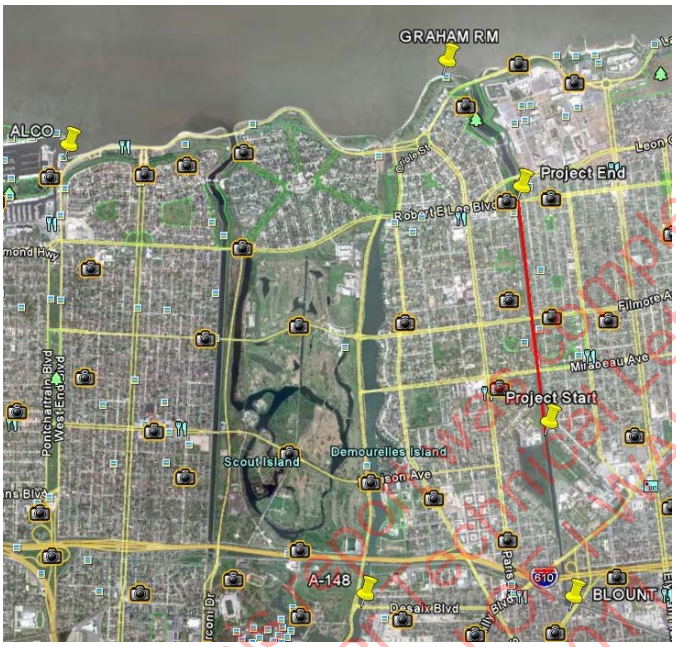

Figure 3 Bench Mark Locations

1) Project Construction Benchmark, ALCO
The station is located in New Orleans on a sea wall beside Joe's (Landry's) Restaurant at the Lake Shore. It is next to a green and white light house. . The station is located in New Orleans, LA, 3.8 miles Northeast of Metairie, LA, 8.7 miles North-Northwest of Harvey LA and 13.9 miles Northwest of Belle Chase, LA. To reach the station from the intersection Lakeshore Dr. and Robert E. Lee Blvd in New Orleans, LA, travel North on Lakeshore Dr. for 0.4 miles to the mark on the left next to Landry's Seafood House The monument is a brass cap found flush with the top of a seawall, found in good condition and stamped "ALCO 1931". The station is 68.5 feet East of the corner of the seawall, 54.3 feet Northwest of a storm drain and 24.0 feet Northeast of a light pole.
Northing 557,299.70, Easting 3,667,048.43, Elevation 6.14

2) Verification Benchmark, GRAHAM RM
The station is located in Orleans Parish, LA, 5.6 miles Northeast of Metairie, LA, 5.3 miles North of New Orleans, LA and 6.8 miles Northwest of Arabi, LA. Monument Location: 0.10 miles northwesterly along Lake Terrace Drive from junction of Lakeshore Drive in New Orleans, in a concrete retaining wall along the south shore of lake Pontchartrain, 168 ft Northeast of utility light pole number LB 134, 83.3 ft west of triangulation station Graham, 56.3 ft North of the Drive Center, 15.4 ft north of Utility Light Pole, and 1.0 ft above the level of the drive. To reach the station from the intersection of Franklin Ave. and Lakeshore Dr., travel West along Lakeshore Dr. for 1.6 miles to park entrance

on right, then travel Northwest in the park for 0.1 miles to the disk on top of a retaining wall and North of a bench. The monument is a U.S. Coast & Geodetic brass disk reference mark, stamped "GRAHAM 1931". The station is on top of a retaining wall, 83.3 feet West of triangulation brass monument "GRAHAM 1931", 56.8 feet North of the centerline of park road and 18.0 feet Northeast of an 18 inch live oak tree.
Northing 559,308.98, Easting 3,678,375.72, Elevation 6.19

3) Verification Benchmark, BLOUNT
The station is located in New Orleans, LA, 4.4 miles Northwest of Arabi, LA, 5.1 miles North of Gretna, LA and 5.1 miles East of Metairie, LA. To reach the station from the intersection of Elysian Fields Ave. and HWY 90 (North Broad St.), travel Northwest on North Broad St. for 0.6 miles to the station on the left of the highway. The monument is a triangulation station survey disk found in good condition, stamped "BLOUNT 1972". The station is on a concrete apron of pump station 3, 102.9 feet South of the Southeast corner of the pump station, 2.9 feet North of an iron witness sign, 42.2 feet West of a red light and 6.7 feet Northwest of a chain link fence.
Northing 543352.65, Easting 3,681, 458.34, Elevation -1.35'

4) Verification Benchmark, A 148
The station is located in New Orleans, LA, 3.9 miles East of Metairie, LA, 5.5 miles North-Northwest of Gretna, LA and 8.1 miles Northwest of Chalmette, LA. To reach the station from the intersection of St. Bernard Ave. and Desaix Blvd., travel West on Desaix Blvd for 0.8 miles to the station on the left. The station is on the East bound lane at the end of a sidewalk that is on a bridge over Bayou St. John. The monument is a bench mark disk found in good condition, stamped "A 148 1951". The station is 15.9 feet South of the centerline of the East bound lane of Desaix Blvd., 37.0 feet West of the a light pole on the South side of Desaix Blvd., 0.3 feet North of a concrete pier and 3.4 feet South of the North edge of the sidewalk on the bridge.
Northing 543696.38733, Easting 3675282.99350, Elevation 5.81'

- Approximate Conversion Equation Between NGVD and NAVD 88 (2004.65) Elevations:
The surveyed top of the existing I-wall is at El. 13± ft, NAVD 88. The as-built drawings (File H-4-40295) for the existing wall indicate the top elevation is 14.4 ft, NGVD. Therefore the approximate conversion equation (including settlement) is El. Ft, NAVD88 = El. Ft, NGVD – 1.5.

2. Design Development
The new sheet pile wall is designed to be driven 4'to 8' behind the existing I-wall alignment on the protected side. This allows the new tie-in slab to be on the crown

of the levee and provides sufficient space to drive new sheet pile behind the existing I-wall and existing abandoned sheet. The tip elevation of the sheet pile was determined by a review of the top elevation of the bay sound clay in all of the available borings and CPTs near the location of the new wall, Table 12-1 shows the sheet pile tip elevations. The sheet pile is embedded in the Bay Sound Clay layer to effectively cut off the seepage flow from the flood side to the protected side.

Table 12-1 Sheet Pile Tip Elevations for Seepage Cut-off

Reach	Approx. Sta.	S/P Tip Elev (ft)
10W	74+00 to 79+50	-55
11W	79+50 to 84+54	55
13W	93+00 to 96+00	-56
27E	48+50 to 58+50	49
32E	84+41 to 90+00	-55
33E	90+00 to 93+00	-55
34E	93+00 to 99+69	-55
35AE	102+42 to 103+50	-53

3. Traffic Control and Detour Design

The road closures and detours will be coordinated with the City of New Orleans. The contractor is required to inform local emergency services and the City of New Orleans prior to the roadway closures. The roadway closures and detours were designed in accordance with MUTCD, AASHTO and LADOTD criteria.

D. Structural Analysis and Design

See Appendix D.

E. Water Control Plan

The existing I-wall will remain in place throughout construction, and there are no excavations on the flood side of the I-wall. Therefore no water control plan is included in the project.

F. Relocations

In order to meet the expedited construction schedule, this project is being designed to minimize utility relocations by using alternative engineering methods such as jet

grouting around the conflict utilities where feasible.

1. The only utilities that are identified to be relocated are Entergy owned gas valve manholes located at WBL Sta. 84+24.64 and EBL Sta. 83+34.26. The disposition on these utilities is "To be relocated by the owner concurrent with the construction".
2. There are several other utilities along the project such as drainage inlets, piezometers, electric feeders, overhead power /communications lines, water line, and telephone conduits. The disposition on these utilities is "Do not disturb".

G. Water Quality

The contractor is responsible for the development and implementation of the Storm Water Pollution Prevention Plan (SWPPP) as required by the Louisiana Department of Environmental Quality and as listed in the specifications.

H. Disposal Areas

The contractor is responsible for the disposal of debris, trash, and excess excavated material per the specifications.

I. Government Furnished Property

No government furnished property is anticipated for this project.

J. Borrow Material

All Embankment material is supplied by the contractor in accordance with the specifications.

13. Cost Estimates

A. Quantities

Quantities were determined by the designers of each individual discipline. Submitted quantities were then reviewed by the project manager for completeness and project integration.

Assumptions for quantity computations include:

1. Civil quantities for earthwork were determined using InRoads software from Bentley. Existing surfaces were subtracted from proposed surfaces.
2. Embankment fill quantities were computed based upon volumes of embankment fill

in place. Embankment quantities do not account for the increased quantity of borrow required by compaction but does include an estimate for increased volume due to foundation settlement and/or larger term consolidation.

3. Miscellaneous civil quantities were generally determined from direct measurement in Microstation model files and were compiled using Microsoft Excel spreadsheets.

4. Structure excavation quantities are based upon plan limits of structures plus two feet larger in each plan direction. The depth of structure excavation is based upon the existing ground surface or the bottom of surface assumed for general excavation, whichever is lower.

The quantity detail computations can be found in Appendix F.

B. MCACES

The cost estimate is prepared in MCACES MII version 3.01. The MCACES cost estimate is prepared within the HPO Template provided by the New Orleans district of the U.S. Army Corps of Engineers, New Orleans.

The detailed cost estimate including explanation, details, methodology, and assumptions of the HPO Template can be found in Appendix F.

14. Construction Schedule

A. General

The schedule was developed using Microsoft Project software and is presented in bar chart format using the critical path method of scheduling. The full construction schedule is provided in Appendix F.

Many options and methods are available in the planning and execution of a construction schedule covering multiple tasks in multiple locations. The schedule included with this report is not represented as the only way of accomplishing the work.

For the purposes of this report, the schedule is presented as a way in which the project can be accomplished in an efficient manner with a midsize contractor able to mobilize in two locations at the same time.

B. Weather Restraints

Hurricane season runs from 1 June to 30 November and construction within this time

frame will invoke the Hurricane Plan and the Emergency Gap Closure Plan noted in the General Provisions of the New Orleans district (MVN) Specifications.

The schedule presented does not include any time necessary to accommodate the mandates of the Hurricane Plan or the Emergency Gap Closure Plan. Our schedule does not anticipate creating any gaps in the current line of protection during the hurricane season.

C. Construction and Scheduling Sequence

The construction schedule provides time for mobilization as well as demobilization for the contractor and staging of the project from the London Avenue Canal. It is assumed that the project will be constructed sequentially starting at one end of the project and finishing on the other end.

D. Project Close Out

We have projected project completion for June 2011. This assumes that the site is cleaned up, trailers and equipment removed, the staging area and access roads are re-graded, seeded and mulched, and the project is closed out. The projected project duration is approximately 6 months.