Mississippi Valley Division,
Regional Planning and Environment Division South

Morganza to the Gulf, Louisiana, Hurricane and Storm Damage Risk Reduction Project

Appendix B – Descriptions of Each Proposed Levee Reach and Structure

December 2025

CONTENTS

1 Levees, Environmental Control Structures, Borrow Sites, Staging Areas, and Access

1.1 BARRIER REACH

1.1.1 Scope of Work

This reach includes 15.69 miles (82,822 linear feet) of earthen levee with seven environmental control structures and six floodwalls, four of which include gate features (see Table 1). The footprint of this reach would mainly be constructed on the flood-side of the existing NFS levee. The proposed reach runs southeast between Station 1000+00.00 (the beginning of the overall MTG levee project), located at LA 182 (Bayou Black Road) approximately 1,800 feet north of Zimmer Road near Gibson, Louisiana, to Station 1828+22.13 (the beginning of Reach A) approximately 0.5-mile southwest of the intersection of LA182 and Sportsman's Court road. Design details for the referenced structures are provided in separate descriptions.

Table 1: Summary of Barrier Reach Levee System

Feature	Description
Levee	borrow
Total length of reach alignment	15.69 miles (82,822 ft)
Length of Earthen Levee, including integrated structures	15.69 miles (82,822 ft)
Temporary Acres of Construction for Levee	5 acres
Permanent Acres for Levee	640 acres
Acres for Existing NFS Levee which overlaps Permanent Acres for Levee	71 acres
Net Acres Disturbed for Proposed Levee	569 acres
Hydraulic Design Elevation	10.5 ft (2035) 17.0 ft (2085)
Structures	
Environmental Control Structures	7
Fronting Protection for Existing Pump Stations	3

Navigation Floodgates	2
Floodwall and Roadway Swing Gate	1
Fill (Borrow Material) Required	7,517,446 cubic yards (for 2035 and 2085 levee lifts)

1.1.2 Levee Construction

1.1.2.1 2035 Design Levee Construction

This reach includes 15.69 miles (82,822 linear feet) of earthen levee running southeast to northwest between Station 1000+00.00 (the beginning of the overall MTG levee project) at the beginning of the reach, located at LA 182 (Bayou Black Road) approximately 1,800 feet north of Zimmer Road, to Station 1828+22.13 (the beginning of Reach A) located roughly 2,400 feet southwest of the intersection of LA182 and Sportsman's Court. The levee reach would also include three environmental control structures, as shown in Table 2, comprised of box culverts with sluice gates. A sluice gate is a structure that contains a movable gate or series of movable gates that, when lifted, allow material and water to flow under it. The sluice gate would provide an opening in the system to allow unimpeded tidal flow, except when a tropical system approaches the Gulf of America in which the gates would be closed. T-walls would extend from the control structures and tie into the adjacent levees.

The Barrier Reach levee would be constructed to a 2035 design elevation of 10.5 (plus 2.0 feet of overbuild to account for probable settlement of levee sediments), a base width (levee toe to levee toe) of 145 feet, with 6:1 flood side and 4:1 protected side slopes above the levee berm, and a crown width of 10 feet. Total permanent ROW for this portion of the reach would be 400 feet wide.

The proposed levee will be constructed along the alignment of the existing NFS constructed levee. The crown of the proposed levee will be shifted to the protected side of the existing NFS crown with flood side toes matching. The approximate elevation of the existing NFS levee is 6.0.

Future lifts will bring the levee up to the 2085 design elevation of 17.0 (not including overbuild).

Figures 1 and 2 provide a typical cross-section for the 2035 and 2085 design elevations.

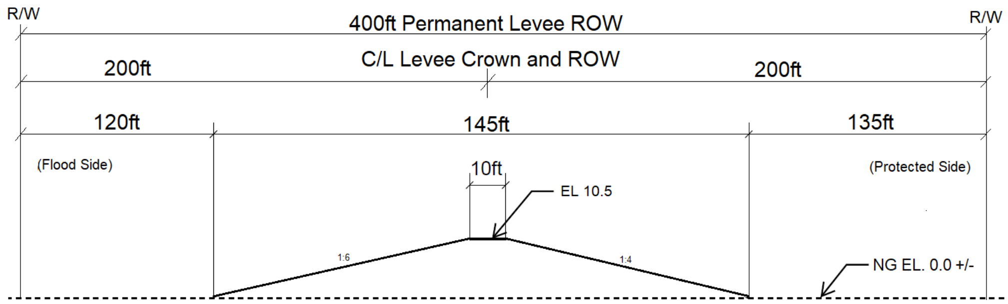


Figure 1. Typical levee section for 2035 design elevation

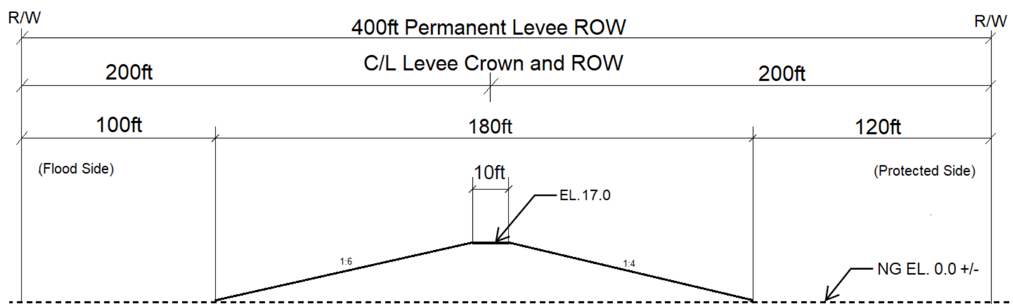


Figure 2. Typical levee section for 2085 design elevation

Table 2: Environmental Control Structure Summary

ECS	Type	Longitude	Latitude
ECS No. 1	6- 6’ x 6’ culverts	-91.0055	29.6664
ECS No. 2	6- 6’ x 6’ culverts	-90.9158	29.6199
ECS No. 3	6- 6’ x 6’ culverts	-90.8251	29.5774

Table 3: Preliminary list of equipment for levee construction and estimated duration of construction

Project Component	Duration (days)	Equipment used
2035 Elevation	1095	Dump Trucks
		Bull Dozers
2085 Elevation	1095	Fill Compactor
		Front End Loader / Backhoe
		Fuel Tanks
		Construction Trailer
		Portable Chemical Toilets

1.1.2.2 2085 Design Levee Construction

To construct the Barrier Reach levee to the 2085 design elevation of 17.0, approximately 3,168,156 cubic yards of additional embankment material would be required with all the embankment material for the Barrier Reach levee being hauled along the five haul routes. The borrow sites, staging areas, and haul routes utilized would be the same as used for construction of the Barrier Reach levee to the 2035 design elevation.

1.1.3 Borrow Sites, Haul Routes, Staging, and Disposal

1.1.3.1 Borrow Sites

Figure 3 shows the locations of the borrow pits that would be excavated for use in construction of project features, along with the haul routes to the construction ROW. Any wetlands or forested areas located within the borrow sites will be avoided and left undisturbed.

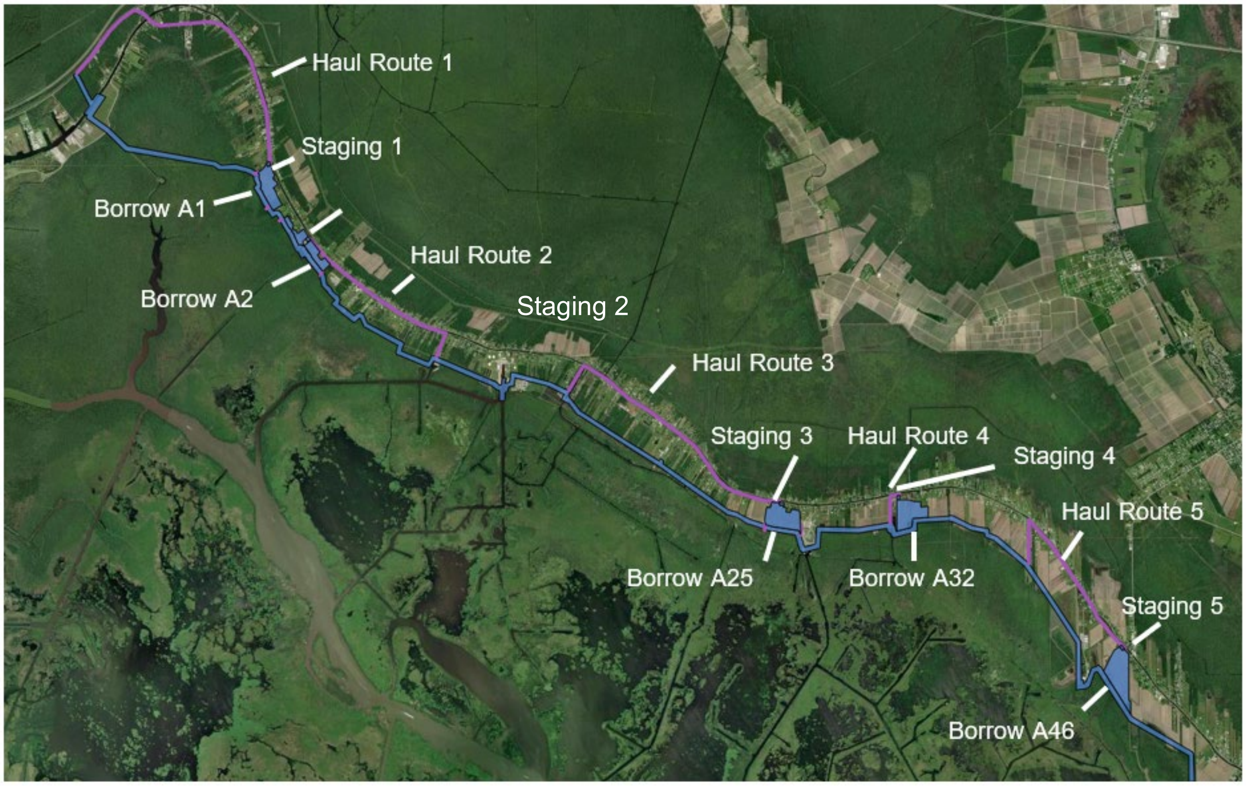


Figure 3. Borrow sites and haul routes for Barrier Reach.

To construct the Barrier Reach levee to the 2035 design elevation, approximately 4,349,290 cubic yards of borrow material would be excavated from the five borrow sites.

1.1.3.2 Haul Routes

The borrow would be hauled via dump trucks to the levee site from the borrow sites along the five haul routes as shown in Figure 3.

Proposed Haul Route 1 would utilize LA182 (Bayou Black Drive). Haul Route 1 would be utilized to bring trucks, embankment, and equipment from borrow site A1 and Staging Area 1 to the western terminus of the Barrier Reach levee.

Proposed Haul Route 2 would utilize LA182 (Bayou Black Drive) and Marina Drive. Haul Route 2 would be utilized to bring trucks, embankment, and equipment from borrow site A2 and Staging Area 2 to the western portion of the Barrier Reach levee.

Proposed Haul Route 3 would utilize LA182 (Bayou Black Drive) and Shell E&P Court. Haul Route 3 would be utilized to bring trucks, embankment, and equipment from borrow site A25 and Staging Area 3 to the western portion of the Barrier Reach levee east of the Shell Canal.

Proposed Haul Route 4 would utilize LA182 (Bayou Black Drive) and an existing NFS levee access road. Haul Route 4 would be utilized to bring trucks, embankment, and equipment from borrow site A32 and Staging Area 4 to the eastern portion of the Barrier Reach.

Proposed Haul Route 5 would utilize LA182 (Bayou Black Drive) and an existing farm access road/NFS levee access road. Haul Route 5 would be utilized to bring trucks, embankment, and equipment from borrow site A46 and Staging Area 4 to the eastern portion of the Barrier Reach.

Borrow material may also be hauled to the levee reach from the borrow pits where the borrow pits are adjacent to the levee reach.

1.1.3.3 Staging Areas

There would be five temporary staging areas for equipment and construction trailers. Approximately 6 inches of stone would be placed to provide a dry area as needed within the staging area limits. Upon completion of the project, the areas would be restored to original conditions.

1.1.3.4 Disposal of Debris

Material collected from clearing and grubbing of the levee Right of Way may be disposed of by either windrowing, burning, chipping, or removal from the site.

Windrowing, burning, and chipping would occur within the Right of Way. Debris resulting from clearing and grubbing the borrow site would be buried in the borrow pit.

Vegetative debris, including grass, organic material, and brush trees, may be placed in windrows on the either the protected side or the flood side of the levee. The windrows would extend from right of way to 15' from levee toe not to exceed the levee height.

Vegetative debris may be collected into piles and burned within the Right of Way. Approximately 310 burns over the duration of the project would be anticipated, with approximately 4000 cubic yards of material per burn.

Cut timber, down timber, dead timber, branches, and brush may be chipped. Chipping operations may be conducted over the duration of the project. The chips would be deposited in windrows. Windrows would extend from the limit of right of way to 15' from the levee toe not to exceed the levee height. At the option of the Contractor, the chips may be either sold or spread over worksite areas as a dust preventive measure or may be used within the project area as a mulch for plantings. However, disposal by spreading shall be acceptable only in areas where the wood chips cannot be washed either into ditches, streams, or off the right-of-way by rainfall runoff.

1.2 REACH B

1.2.1 Scope of Work

Reach B includes 5.06 miles (26,710 linear feet) of earthen levee running generally north to south constructed on top of the existing NFS levee along the west side of the existing Thibodeaux Canal, to the west and parallel to Bayou Dularge. The beginning of the reach, Station 2259+26, which starts at the south end of Reach A, is located approximately 1.08 miles northwest of the intersection of Dr. Beatrous Rd. and LA315. The reach ends at Station 2526+35 located approximately 1,200 feet south of the Falgout Canal, where Reach E begins. A summary of the features of this reach is provided in Table 1. Design details for the referenced structures are provided in separate project descriptions.

Table 1: Summary of Levee System

Feature	Description
Levee	
Total Length of alignment	5.06 miles (26,710 ft)
Length of Earthen Levee	5.06 miles (26,710 ft)
Temporary Acres of Construction for Levee	3 acres
Permanent Acres for Levee	257 acres
Acres for Existing NFS Levee which overlaps Permanent Acres for Levee	85 acres
Net Acres Disturbed for Proposed Levee	172 acres
Hydraulic Design Elevation	13.0’ (2035) 18.5’ (2085)
Structures	
Environmental Control Structures	0
Navigation Floodgates	2
Fill (Borrow Material) Required	4,411,700 cubic yards (for 2035 and 2085 levee lifts)

1.2.2 Levee Construction

1.2.2.1 2035 Design Levee Construction

The levee would be constructed to a 2035 design elevation of 13.0 NAVD88 (plus 2.0 feet of overbuild to account for probable settlement of levee sediments), a base width (levee toe to levee toe) of 300 feet, with 6:1 flood side and 4:1 protected side slopes above the levee berm, and a crown width of 10 feet. Total permanent ROW for this portion of the reach would be 600 feet wide, although this estimated width would be refined during designs and specifications.

The proposed levee will be constructed along the alignment of the existing NFS constructed levee. The crown of the proposed levee will be shifted to the floodside of the existing NFS crown with protected side toes matching. The approximate elevation of the existing NFS levee is 8.0.

Future lifts will bring the Reach B levee up to the 2085 design elevation of 18.5 (not including overbuild to address probably settlement of levee sediments).

Figures 1 and 2 provide a typical cross-section for the 2035 and 2085 design elevations. Table 2 provides a preliminary list of equipment anticipated to be utilized for the construction of Reach B.

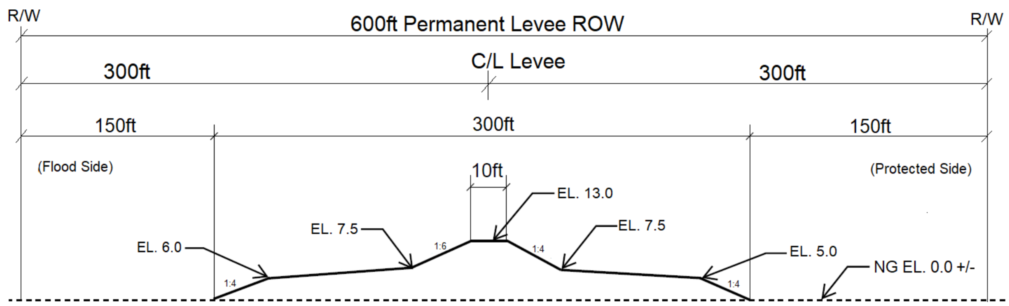


Figure 1. Typical levee section for 2035 design elevation.

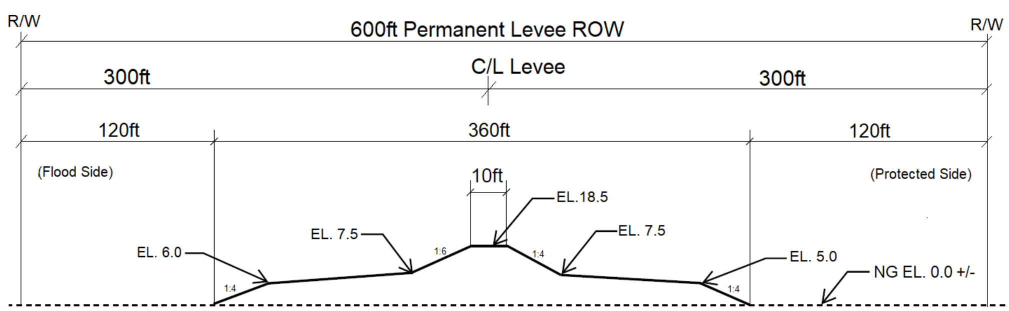


Figure 2. Typical levee section for 2085 design elevation

Table 2: Preliminary list of equipment for levee construction and estimated duration of construction

Project Component	Duration (days)	Equipment used
Levee Construction 2035 Elevation	730	Dump Trucks
		Bull Dozers
Levee Lift (2085 Design Elevation)	730	Fill Compactor
		Front End Loader / Backhoe
		Fuel Tanks
		Construction Trailer
		Portable Chemical Toilets

1.2.2.2 2085 Design Levee Construction

A levee lift would be required to bring the levee to the 2085 design elevation of 18.5. To construct Reach B to the 2085 design elevation, approximately 1,682,200 cubic yards of additional embankment material would be required with all the embankment material for Reach B being hauled along the four haul routes. The borrow sites, staging areas, and haul routes utilized would be the same as used for construction of Reach B to the 2035 design elevation.

1.2.3 Borrow Sites, Haul Routes, Staging, and Disposal

1.2.3.1 Borrow Sites

Figure 3 shows the locations of the borrow sites which would be excavated for use in construction of project features, along with the haul routes to the construction ROW. Any wetlands or forested areas located within the borrow sites will be avoided and left undisturbed.

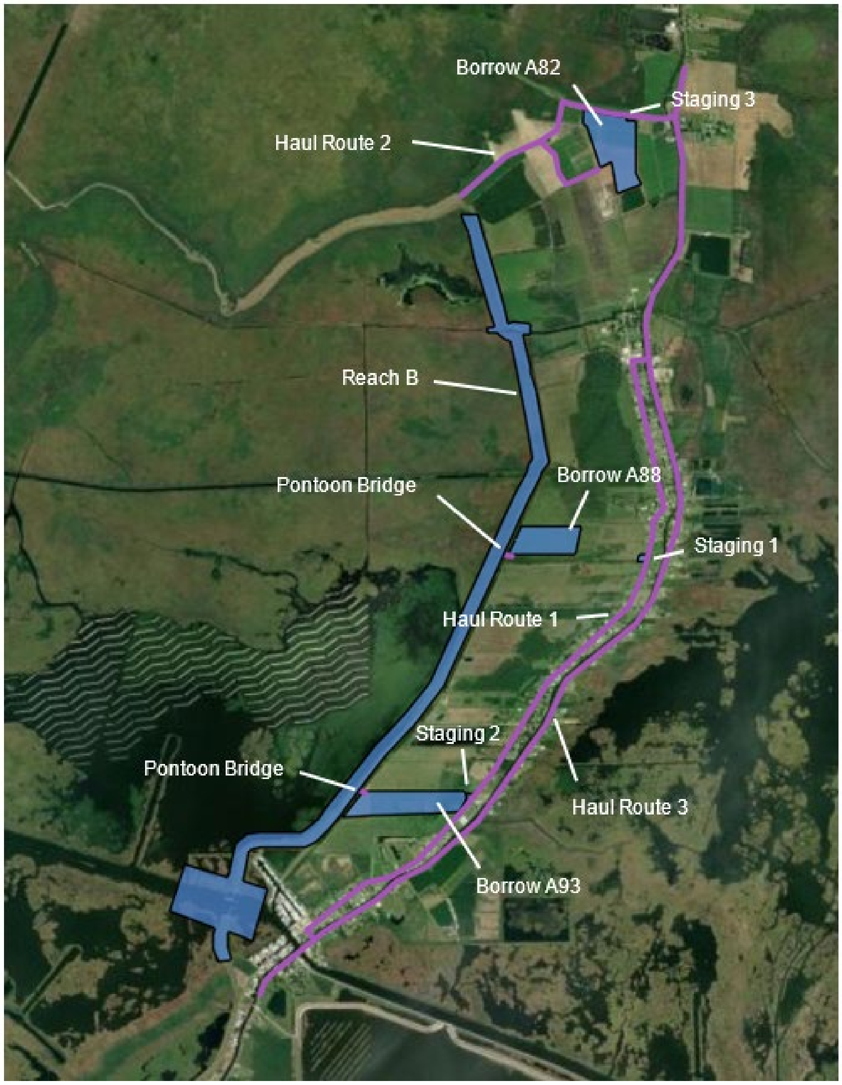


Figure 3. Borrow sites and haul routes for Reach B.

To construct Reach B to the 2035 design elevation, approximately 2,729,500 cubic yards of borrow material would be excavated from designated government furnished borrow sites.

1.2.3.2 Haul Routes

The borrow would be hauled via dump trucks to the levee site from the various borrow sites along the two haul routes as shown in Figure 3. Trucks and equipment would be brought to borrow site A88/staging area 1 and borrow site A93/staging area 2 via Haul Route 1 (Dr. Beatrous Road/Parish Road 59). A floating pontoon bridge consisting of sectional barges, spuds, and ramps would be installed across the canal to haul embankment material from each of these borrow sites to the levee reach (Figure 4).

Sectional barges would be assembled on site to span the canal and the upper travel surface of the barges would be covered with timber matting. Timber mats would be utilized at each end of the bridge to provide a hinged surface from the barge to the adjacent land that would allow for trucks to pass from land to the bridge. Temporary spud anchoring would be inserted through spud sleeves in the barge segments and embedded into the canal bottom to secure the connected barges in place. Once construction is complete, the bridge, anchors, and timber mat ramps would be disassembled and removed. No accommodation would be made for navigation within the waterway during construction because this canal is a drainage canal and not used for navigation.

Proposed Haul Route 2 would utilize an existing levee access route. Haul Route 2 would be used to bring trucks, embankment, and equipment from borrow site A82/Staging Area 3 to the northern terminus of the Reach B levee.

Proposed Haul Route 4 would utilize LA315 (Bayou Dularge Rd.) and an existing levee road and canal crossing to bring trucks, embankment, and equipment from borrow site A82/Staging Area 3 to the southern terminus of the Reach B levee south of Falgout Canal.

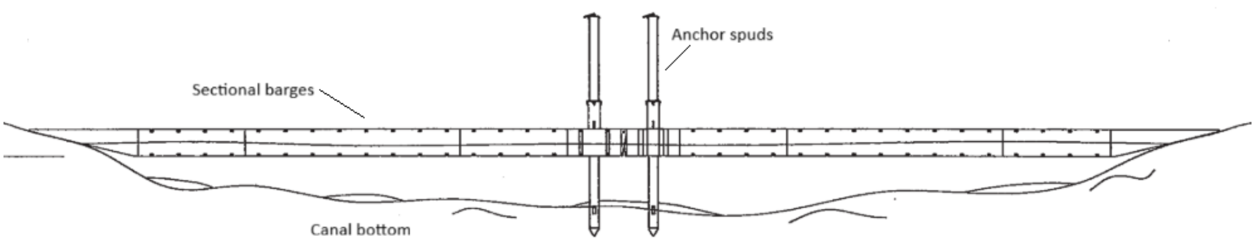


Figure 4: Cross-section of pontoon bridge with spud anchoring

1.2.3.3 Staging Areas

There would be three temporary staging areas for equipment and construction trailers adjacent to the haul route adjacent to the borrow sites. Approximately 6 inches of stone would be placed to provide a dry area as needed within the staging area limits. Upon completion of the project, the areas would be restored to original conditions.

1.2.3.4 Disposal of Debris

Material collected from clearing and grubbing of the levee Right of Way may be disposed of by either windrowing, burning, chipping, or removal from the site.

Windrowing, burning, and chipping would occur within the Right of Way. Debris resulting from clearing and grubbing the borrow site would be buried in the borrow pit.

Vegetative debris, including grass, organic material, and brush trees, may be placed in windrows on the either the protected side or the flood side of the levee. The windrows would extend from right of way to 15' from levee toe not to exceed the levee height.

Vegetative debris may be collected into piles and burned within the Right of Way. Approximately 100 burns over the duration of the project would be anticipated, with approximately 4000 cubic yards of material per burn.

Cut timber, down timber, dead timber, branches, and brush may be chipped. Chipping operations may be conducted over the duration of the project. The chips would be deposited in windrows. Windrows would extend from the limit of right of way to 15' from the levee toe not to exceed the levee height. At the option of the Contractor, the chips may be either sold or spread over worksite areas as a dust preventive measure or may be used within the project area as a mulch for plantings. However, disposal by spreading shall be acceptable only in areas where the wood chips cannot be washed either into ditches, streams, or off the right-of-way by rainfall runoff.

1.3 REACH E

1.3.1 Scope of Work

This reach entails construction of 4.40 miles (23,248 linear feet) of earthen levee running west to east primarily along the Falgout Canal between Bayou Dularge and the Houma Navigation Canal. The levee would be built primarily upon the NFS' existing levee, but with a wider footprint and taller height. The levee would incorporate the structures shown in Table 1 below. Design details for these structures are provided in separate project descriptions.

Table 1: Summary of Reach E Levee System and Structures

Feature	Description
Levee	
Total Length of Reach E	4.40 miles (23,248 ft)
Length of Earthen Levee	4.40 miles (23,248 ft)
Temporary Acres of Construction for Levee	3 acres
Permanent Acres for Levee	379 acres
Acres for Existing NFS Levee which overlaps Permanent Acres for Levee	81 acres
Net Acres Disturbed for Proposed Levee	298 acres
Hydraulic Design Elevation	17.0 E1, 17.5 E2 (2035) 20.0 E1, 21.0 E2 (2085)
Structures	
Environmental Control Structures	2
Navigation Floodgates	1
Vehicular Floodgate	1
Fill (Borrow Material) Required	3,668,300 cubic yards (for 2035 and 2085 levee lifts)

1.3.2 Levee Construction

1.3.2.1 2035 Design Levee Construction

This reach includes 4.40 miles (23,248 linear feet) of earthen levee running northwest/southeast primarily along the Falgout Canal between Bayou Dularge and the Houma Navigation Canal. The beginning of the reach, Sta. 2646+34 (the end of Reach

B), is located approximately 1,700 feet northwest of the intersection of Brady Rd. and LA315. The reach ends at Station 2758+84 (the beginning of Reach F), approximately 1,250 feet west of the Houma Navigation Canal. The levee reach would also include two environmental control structures, as shown in Table 2, comprised of box culverts with sluice gates. A sluice gate is a structure that contains a movable gate or series of movable gates that, when lifted, allow material and water to flow through it. The sluice gate would provide an opening in the system to allow unimpeded tidal flow, except when a tropical system approaches the Gulf of America in which the gates would be closed. T-walls would extend from the control structures and tie into the adjacent levees.

Table 2: Environmental Control Structure Summary

ECS	Type	Longitude	Latitude
ECS No. 1	9- 6’ x 6’ culverts	-90.7700	29.4057
ECS No. 2	9- 6’ x 6’ culverts	-90.3974	29.7470

Reach E is broken into two design reaches: Reach E1 (Sta. 2646+34 to Sta. 2758+84) and Reach E2 (Sta. 2526+35 to 2646+34).

The levee for Reach E1 would be constructed to a 2035 design elevation of 17.0 (plus 2.0 feet of overbuild), a base width (levee toe to levee toe) of 300 feet, with 6:1 flood side and 4:1 protected side slopes above the levee berm, and a crown width of 10 feet. Total permanent ROW for this portion of the reach would be 600 feet wide.

The levee for Reach E2 would be constructed to a 2035 design elevation of 17.5 (plus 2.0 feet of overbuild), a base width (levee toe to levee toe) of 300 feet, with 6:1 flood side and 4:1 protected side slopes above the levee berm, and a crown width of 10 feet. Total permanent ROW for this portion of the reach would be 600 feet wide.

The proposed levee will be constructed on top of or along the alignment of the existing NFS constructed levee straddling the existing levee. The approximate elevation of the existing NFS levee is 8.0.

Future lifts will bring the Reach E1 levee up to the 2085 design elevation of 20.0 and Reach E2 levee up to the 2085 design elevation of 21.0 (not including overbuild).

Figures 1 and 2 provide a typical cross-section for the 2035 and 2085 design elevations. Table 3 provides a preliminary list of equipment anticipated to be utilized for the construction of Reach E.

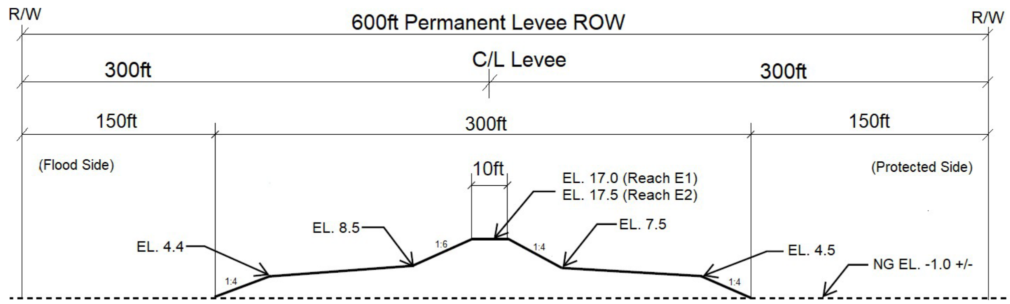


Figure 1. Typical levee section for 2035 design elevation.

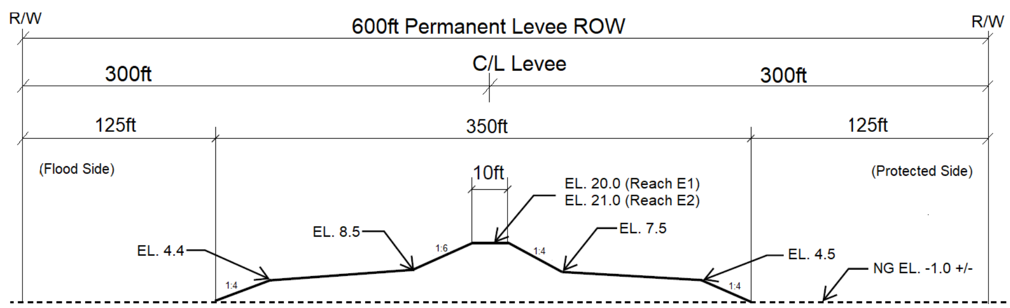


Figure 2. Typical levee section for 2085 design elevation

Table 3: Preliminary list of equipment for levee construction and estimated duration of construction

Project Component	Duration (days)	Equipment used
2035 Elevation	730	Dump Trucks
		Bull Dozers
2085 Elevation	730	Fill Compactor
		Front End Loader / Backhoe
		Fuel Tanks
		Construction Trailer
		Portable Chemical Toilets

1.3.2.2 2085 Design Levee Construction

To construct Reach E to the 2085 design elevations of 20.0 for Reach E1 and 21.0 for Reach E2, approximately 1,353,800 cubic yards of additional embankment material would be required with all the embankment material for Reach E being hauled along Haul Routes 1 and 2. The borrow sites, staging areas, and haul routes utilized would be the same as used for construction of Reach E to the 2035 design elevation.

1.3.3 Borrow Sites, Haul Routes, Staging, and Disposal

1.3.3.1 Borrow Sites

Figure 3 shows the locations of the borrow pits along with the haul routes to the construction ROW. Any wetlands or forested areas located within the borrow sites will be avoided and left undisturbed.

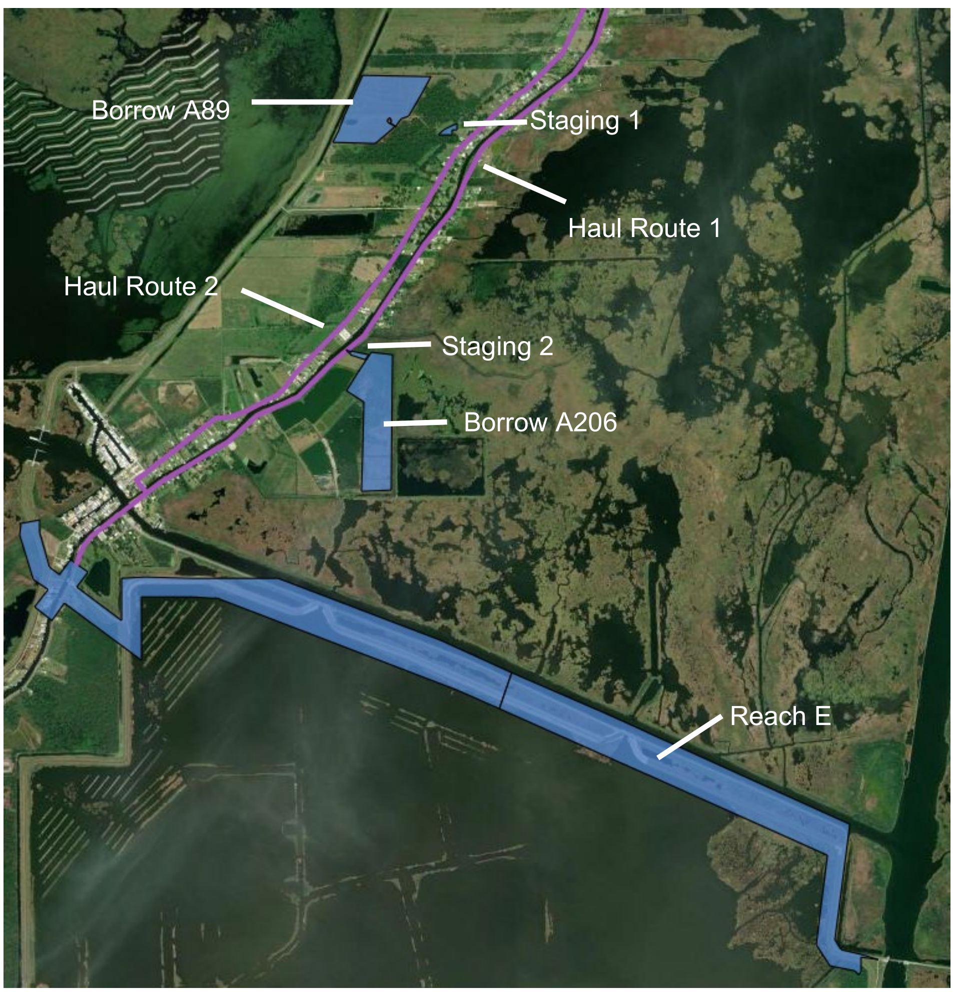


Figure 3. Borrow sites and haul routes for Reach E.

To construct Reach E to the 2035 design elevation, approximately 2,314,500 cubic yards of borrow material would be excavated from borrow sites.

1.3.3.2 Haul Routes

Haul Route 1 (LA315/Bayou Dularge Rd.) would be used to bring trucks, embankment, and equipment from both of the borrow sites and staging areas. Haul Route 2, (Dr. Beatrous Road/Parish Road 59) would be provide access between borrow site A89/staging area 1 and Haul Route 1.

1.3.3.3 Staging Areas

There would be two temporary staging areas for equipment and construction trailers adjacent to the haul route. Approximately 6 inches of stone would be placed to provide a dry area as needed within the staging area limits. Upon completion of the project, the areas would be restored to original conditions.

1.3.3.4 Disposal of Debris

Material collected from clearing and grubbing of the levee Right of Way may be disposed of by either windrowing, burning, chipping, or removal from the site.

Windrowing, burning, and chipping would occur within the Right of Way. Debris resulting from clearing and grubbing the borrow site would be buried in the borrow pit.

Vegetative debris, including grass, organic material, and brush trees, may be placed in windrows on the either the protected side or the flood side of the levee. The windrows would extend from right of way to 15' from levee toe not to exceed the levee height.

Vegetative debris may be collected into piles and burned within the Right of Way. Approximately 90 burns over the duration of the project would be anticipated, with approximately 4000 cubic yards of material per burn.

Cut timber, down timber, dead timber, branches, and brush may be chipped. Chipping operations may be conducted over the duration of the project. The chips would be deposited in windrows. Windrows would extend from the limit of right of way to 15' from the levee toe not to exceed the levee height. At the option of the Contractor, the chips may be either sold or spread over worksite areas as a dust preventive measure or may be used within the project area as a mulch for plantings. However, disposal by spreading shall be acceptable only in areas where the wood chips cannot be washed either into ditches, streams, or off the right-of-way by rainfall runoff.

1.4 REACH G

1.4.1 Scope of Work

Construction of 4.48 miles (23,677 linear feet) of earthen levee running west to east from the Houma Navigational Canal over the NFS' existing levee in Terrebonne Parish. A summary of the features of this reach is provided in Table 1.

Table 1: Summary of Levee System

Feature	Description
Levee	
Total Length of Alignment	4.48 miles (23,677 ft)
Length of Earthen Levee	4.48 miles (23,677 ft)
Temporary Acres of Construction for Levee	7 acres
Permanent Acres for Levee	239 acres
Acres for Existing NFS Levee which overlaps Permanent Acres for Levee	83 acres
Net Acres Disturbed for Proposed Levee	156 acres
Hydraulic Design Elevation	17.0 G1, 17.5 G2, 18.0 G3 (2035) 19.5 G1, 20.5 G2 & G3 (2085)
Structures	
Pump Stations	0
Environmental Control Structures	3
Number of Vehicular Floodgates	0
Number of Navigation Floodgates	0
Fill (Borrow Material) Required	3,767,600 cubic yards (for 2035 and 2085 levee lifts)

1.4.2 Levee Construction

1.4.2.1 2035 Design Levee Construction

This reach includes the construction of 4.48 miles (23,677 linear feet) of earthen levee running west to east from the Houma Navigational Canal, Station 2987+35 (the end of Reach F), to a point approximately 1.5 miles west of Bayou Petit Caillou, Station 3224+12 (the beginning of Reach H).

This reach would also include three environmental control structures, as shown in Table 2, comprised of box culverts with sluice gates. A sluice gate is a structure that contains a movable gate or series of movable gates that, when lifted, allow material and water to flow under it. The sluice gate would provide an opening in the system to allow unimpeded tidal flow, except when a tropical system approaches the Gulf of America inwhich the gates would be closed. T-walls would extend from the control structures and tie into the adjacent levees.

In addition to the levee, three environmental control structures would be constructed. The type, size, and location are shown in Table 2 below. For more detailed information regarding the environmental control structures, please refer to the structural section of this document.

Table 2: Environmental Control Structure Summary

ECS	Type	Longitude	Latitude
Structure No. 1	6- 6’ x6’ culverts	-90.6958	29.3166
Structure No. 2	4- 6’ x6’ culverts	-90.6938	29.3161
Structure No. 3	4- 6’ x6’ culverts	-90.6769	29.3109

Reach G is broken into three design reaches: Reach G1 (Sta. 2987+35 to Sta. 3098+96), Reach G2 (Sta. 3098+96 to Sta. 3147+00), and Reach G3 (Sta. 3147+00 to 3224+12).

The levee for Reach G1 would be constructed to a 2035 design elevation of 17.0 (plus 2.0 feet of overbuild), a base width (levee toe to levee toe) of 300 feet, with 6:1 flood side and 4:1 protected side slopes above the levee berm, and a crown width of 10 feet. Total permanent ROW for this portion of the reach would be 600 feet wide.

The levee for Reach G2 would be constructed to a 2035 design elevation of 17.5 (plus 2.0 feet of overbuild), a base width (levee toe to levee toe) of 300 feet, with 6:1 flood side and 4:1 protected side slopes above the levee berm, and a crown width of 10 feet. Total permanent ROW for this portion of the reach would be 600 feet wide.

The levee for Reach G3 would be constructed to a 2035 design elevation of 18.0 (plus 2.0 feet of overbuild), a base width (levee toe to levee toe) of 300 feet, with 6:1 flood side and 4:1 protected side slopes above the levee berm, and a crown width of 10 feet. Total permanent ROW for this portion of the reach would be 600 feet wide.

The proposed levee will be constructed along the alignment of the existing NFS constructed levee straddling the existing levee. The approximate elevation of the existing NFS levee is 8.0.

Future levee lifts would bring the Reach G1 levee up to the 2085 design elevation of

19.5 and the Reach G2 and G3 levees up to the 2085 design elevation of 20.5 (not including overbuild).

Figures 1 and 2 provide a typical cross-section for the 2035 and 2085 design elevations.

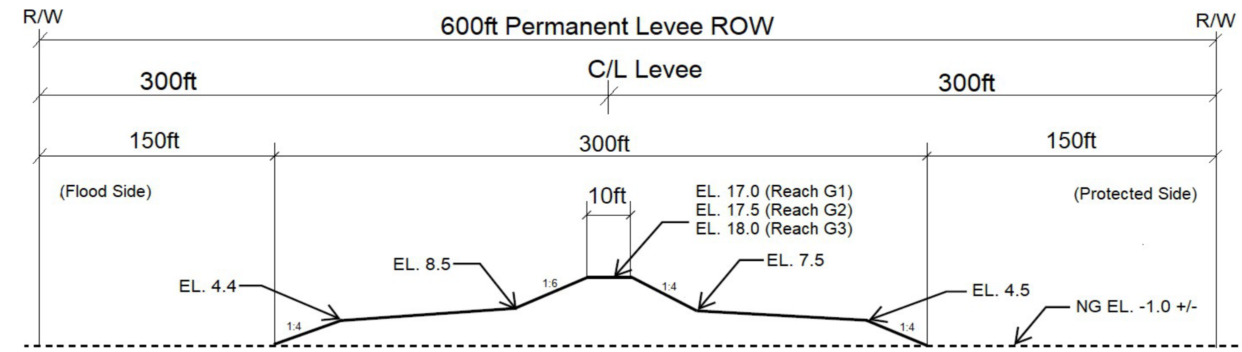


Figure 1. Typical levee section for 2035 design elevation

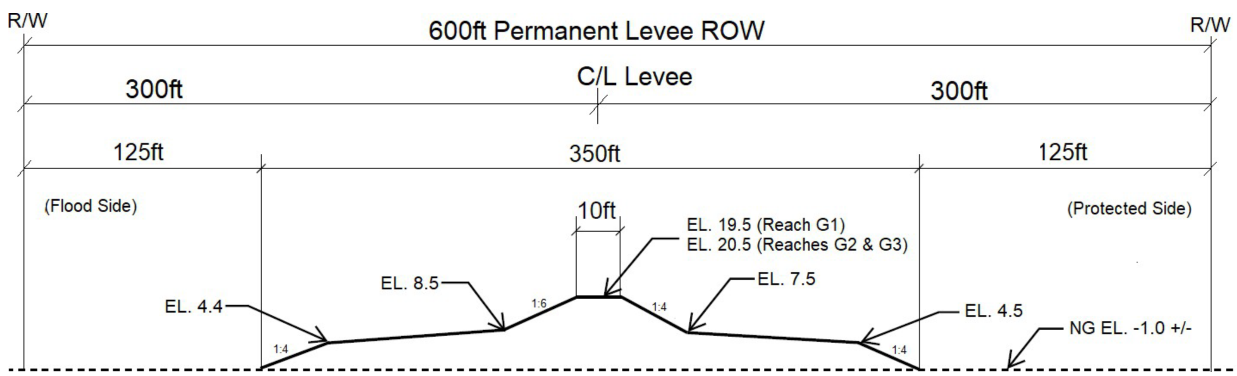


Figure 2. Typical levee section for 2085 design elevation

Table 3: Preliminary list of equipment for levee construction and estimated duration of construction

Project Component	Duration (days)	Equipment used
2035 Elevation	730	Dump Trucks
		Bull Dozers
2085 Elevation	730	Fill Compactor
		Front End Loader / Backhoe
		Fuel Tanks
		Construction Trailer
		Portable Chemical Toilets

1.4.2.2 2085 Design Levee Construction

A levee lift would be required to construct Reach G to the 2085 design elevation. Approximately 1,437,700 cubic yards of additional embankment material would be required to raise the levee to elevations varying from 19.5 for Reach G1 to 20.5 for Reaches G2 and G3. The borrow sites, staging areas, and haul routes utilized would be the same as used for construction of Reach G to the 2035 design elevation.

1.4.3 Borrow Sites, Haul Routes, Staging, and Disposal

1.4.3.1 Borrow Sites

Figure 3 shows the locations of the borrow sites which would be excavated for construction of project features, along with the haul routes to the construction ROW. Any wetlands or forested areas located within the borrow sites will be avoided and left undisturbed.

Figure 3. Borrow sites and haul routes for Reach G

To construct Reach G to the 2035 design elevation, approximately 2,329,900 cubic yards of borrow material would be excavated from government furnished borrow sites.

1.4.3.2 Haul Routes

The borrow would be hauled via dump trucks to the levee site from the various borrow sites along the two haul routes as shown in Figure 3.

Proposed Haul Route 1 would utilize LA315 (Bayou Dularge Rd.), Falgout Canal Rd., Reach E Levee, LA57 (Grand Caillou Rd.), LA3011, and Four Point Rd as well as an existing levee access road from Four Point Road to the western section of the Reach G levee allowing for the transportation of trucks, embankment, and equipment from all of the borrow sites and staging areas to the western section of the Reach G levee.

Proposed Haul Route 2 spurs off Haul Route 1 utilizing LA 57 (Bayou Sale Rd.) to bring trucks, embankment, and equipment from all the borrow sites and staging areas to the eastern section of the Reach G levee using an existing levee access road connecting to LA 57.

Approximately 50% of the embankment material would be delivered via Haul Route 1 with the remaining 50% being delivered via Haul Route 2.

Haul Route 3, an existing unnamed road, would provide access between borrow sites A82 and A203 Haul Route 1.

1.4.3.3 Staging Areas

There would be five temporary staging areas for equipment and construction trailers adjacent to the haul route adjacent to borrow sites A82, A204, A204, DE6, and A89. Approximately 6 inches of stone would be placed to provide a dry area as needed within the staging area limits. Upon completion of the project, the areas would be restored to original conditions.

1.4.3.4 Disposal of Debris

Material collected from clearing and grubbing of the levee Right of Way may be disposed of by either windrowing, burning, chipping, or removal from the site.

Windrowing, burning, and chipping would occur within the Right of Way. Debris resulting from clearing and grubbing the borrow site would be buried in the borrow pit.

Vegetative debris, including grass, organic material, and brush trees, may be placed in windrows on the either the protected side or the flood side of the levee. The windrows would extend from right of way to 15' from levee toe not to exceed the levee height. Vegetative debris may be collected into piles and burned within the Right of Way. Approximately 90 burns over the duration of the project would be anticipated, with approximately 4000 cubic yards of material per burn.

Cut timber, down timber, dead timber, branches, and brush may be chipped. Chipping operations may be conducted over the duration of the project. The chips would be deposited in windrows. Windrows would extend from the limit of right of way to 15' from the levee toe not to exceed the levee height. At the option of the Contractor, the chips may be either sold or spread over worksite areas as a dust preventive measure or may be used within the project area as a mulch for plantings. However, disposal by spreading shall be acceptable only in areas where the wood chips cannot be washed either into ditches, streams, or off the right-of-way by rainfall runoff.

1.5 REACH H

1.5.1 Scope of Work

Construction of 5.70 miles (30,109 linear feet) of earthen levee running south to north along the eastern side of Bayou Terrebonne from the Bush Canal to the Humble Canal Terrebonne Parish. A summary of the features of this reach is provided in Table 1.

Design details for the referenced floodgates are provided in separate project descriptions.

Table 1: Summary of Levee System

Feature	Description
Levee	
Total Length of Alignment	5.70 miles (30,109 feet)
Length of Earthen Levee	5.70 miles (30,109 feet)
Temporary Acres of Construction for Levee	6.35 acres
Permanent Acres for Levee	491 acres
Acreage of Existing NFS Levee which overlaps Permanent Acres for Levee	162 acres
Net Acres Disturbed for Proposed Levee	329 acres
Hydraulic Design Elevation	17.0 H1, 17.5 H2, 18.0 H3 (2035) Varies 20.0 to 24.0 (2085)
Structures	
Pump Stations	0
Environmental Control Structures	2
Number of Vehicular Floodgates	1
Number of Navigation Floodgates	2
Number of Railroad Gates	0
Number of Road Ramps	0
Fill (Borrow Material) Required	9,809,700 cubic yards (for 2035 and 2085 levee lifts)

1.5.2 Levee Construction

1.5.2.1 2035 Design Levee Construction

This reach includes 5.70 miles (30,109 linear feet) of earthen levee running south to north along the eastern side of Bayou Terrebonne from the Bush Canal, Station 3640+67 (end of Reach G), to the Humble Canal, Station 3941+75 (beginning of Reach I).

The levee reach would also include two environmental control structures, as shown in Table 2, comprised of culverts with sluice gates. A sluice gate is a structure that contains a movable gate or series of movable gates that, when lifted, allow material and water to flow under it. The sluice gate would provide an opening in the system to allow unimpeded tidal flow, except when a tropical system approaches the Gulf of America in which the gates would be closed. T-walls would extend from the control structures and tie into the adjacent levees.

Table 2: Environmental Control Structure Summary

ECS	Type	Longitude	Latitude
Structure No. 1	1-6' x 6' culvert	-90.6704	29.3020
Structure No. 2	6-6' x 6' culvert	-90.6589	29.2968

Reach H is broken into three design reaches: Reach H1 (Sta. 3640+67 to Sta. 3733+30), Reach H2 (Sta. 3733+30 to Sta. 3832+26), and Reach H3 (Sta. 3832+26 to 3941+75).

The levee for Reach H1 would be constructed to a 2035 design elevation of 17.0 (plus 2.0 feet of overbuild), a base width (levee toe to levee toe) of 450 feet, with 6:1 flood side and 4:1 protected side slopes above the levee berm, and a crown width of 10 feet. Total permanent ROW for this portion of the reach would be 600 feet wide.

The levee for Reach H2 would be constructed to a 2035 design elevation of 18.0 (plus 2.0 feet of overbuild), a base width (levee toe to levee toe) of 450 feet, with 6:1 flood side and 4:1 protected side slopes above the levee berm, and a crown width of 10 feet. Total permanent ROW for this portion of the reach would be 600 feet wide.

The levee for Reach H3 would be constructed to a 2035 design elevation of 20.0 (plus 2.0 feet of overbuild), a base width (levee toe to levee toe) of 450 feet, with 6:1 flood side and 4:1 protected side slopes above the levee berm, and a crown width of 10 feet. Total permanent ROW for this portion of the reach would be 600 feet wide.

The proposed levee will be constructed along the alignment of the existing NFS constructed levee straddling the existing levee. The approximate elevation of the existing NFS levee is 8.0.

Future lifts would bring the Reach H1 levee up to the 2085 design elevation of 20.0, Reach H2 levee up to the 2085 design elevation of 22.0, and Reach H3 levee up to the 2085 design elevation of 24.0 (not including overbuild).

Figures 1 and 2 provide a typical cross-section for the 2035 and 2085 design elevations.

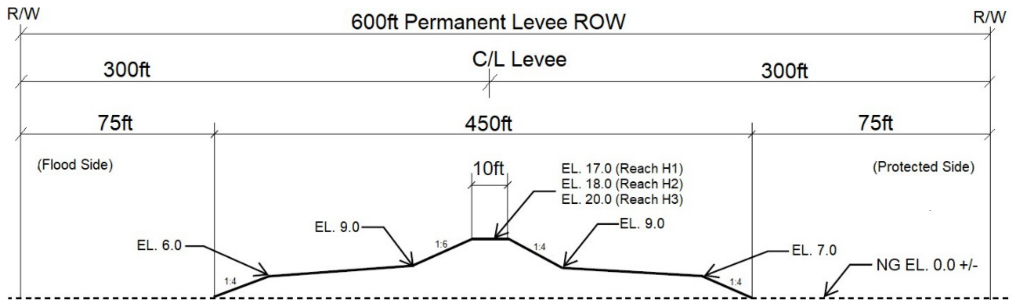


Figure 1. Typical levee section for 2035 design elevation.

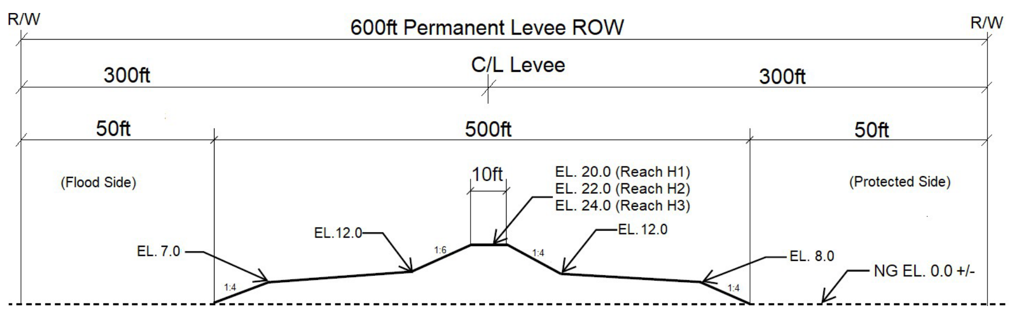


Figure 2. Typical levee section for 2085 design elevation

Table 3: Preliminary list of equipment for levee construction and estimated duration of construction

Project Component	Duration (days)	Equipment used
2035 Elevation	730	Dump Trucks
		Bull Dozers
2085 Elevation	730	Fill Compactor
		Front End Loader / Backhoe
		Fuel Tanks
		Construction Trailer
		Portable Chemical Toilets

1.5.2.2 2085 Design Levee Construction

To construct Reach H to the 2085 design elevations of 20.0 for Reach H1, 22.0 for Reach H2, and 24.0 for Reach H3. Approximately 3,139,100 cubic yards of additional embankment material would be required. The borrow sites, staging areas, and haul

routes utilized would be the same as used for construction of Reach H to the 2035 design elevation.

1.5.3 Borrow Sites, Haul Routes, Staging, and Disposal

1.5.3.1 Borrow Sites

Figure 3 shows the locations of the borrow sites along with the haul routes to the construction ROW. Any wetlands or forested areas located within the borrow sites will be avoided and left undisturbed.

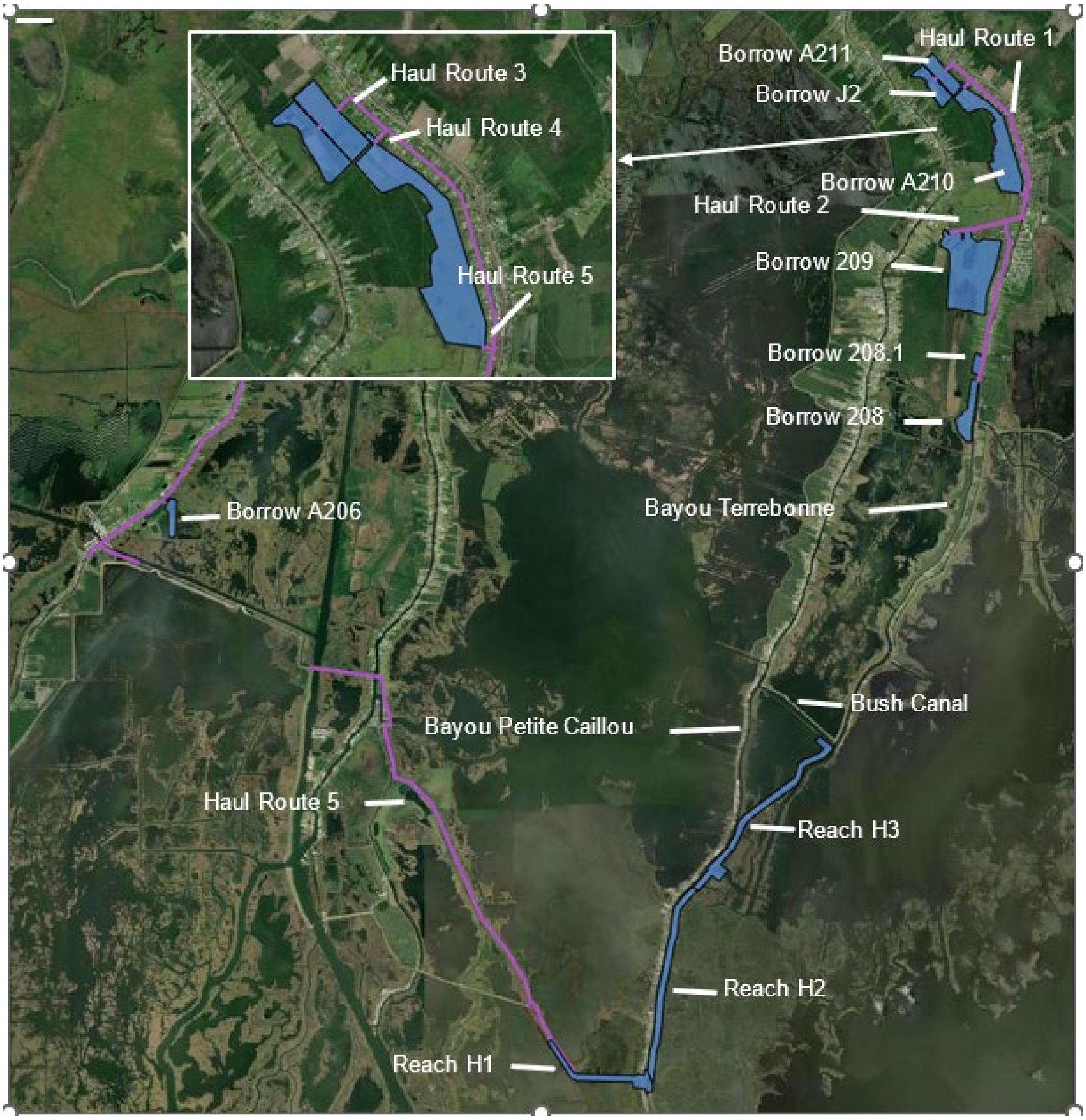


Figure 3. Borrow sites and haul routes for Reach H2 and H3.

To construct Reach H to the 2035 design elevation, approximately 6,670,600 cubic yards of borrow material would be excavated from government furnished borrow sites.

1.5.3.2 Haul Routes

Proposed Haul Route 1 (Crochetville Rd. and Aragon Rd.) would be used to bring trucks, embankment, and equipment from all of the borrow sites and staging areas to existing dock facilities along Bayou Terrebonne to be loaded onto barges. Barges carrying borrow material and construction equipment would travel along Bayou Terrebonne, Bush Canal, and Bayou Petite Caillou to one or more of the existing cleared areas marked in Figure 4 along the Reach H levee, where they would be anchored for borrow material and equipment offloading. An example of an existing cleared area to be used for barge offloading along the Reach H levee is shown in Figure 5. A temporary timber mat ramp would be placed within the existing cleared area, such that no vegetation or surface waters would be impacted, to offload equipment from the barge to the levee. An excavator on the levee or the barge would be used to move material from the barge into dump trucks for delivery along the levee reach.

Figure 4: Location of potential barge offloading sites

Figure 5: Example of existing cleared areas to be used for barge offloading

Haul Route 2 (Highway 58) would be used for access between borrow site A209 and Haul Route 1. Haul Route 3 (existing private road) would be used as access between borrow sites A211, borrow site J1 and Haul Route 1. Haul Routes 4 and 5 (existing private roads) would be used as access between borrow site A210 and Haul Route 1.

Haul Route 6 (LA315, Falgout Canal Rd., Reach E Levee, LA57, LA3011, and LA 57 would be used to bring trucks, embankment, and equipment borrow site A206.

1.5.3.3 Staging

There would be four temporary staging areas for equipment and construction trailers adjacent to the haul route adjacent to the borrow sites adjacent to borrow sites A206, A208.1, A209, and A210. Approximately 6 inches of stone would be placed to provide a dry area as needed within the staging area limits. Upon completion of the project, the areas would be restored to original conditions.

1.5.3.4 Disposal of Debris

Material collected from clearing and grubbing of the levee Right of Way may be disposed of by either windrowing, burning, chipping, or removal from the site.

Windrowing, burning, and chipping would occur within the Right of Way. Debris resulting from clearing and grubbing the borrow site would be buried in the borrow pit.

Vegetative debris, including grass, organic material, and brush trees, may be placed in windrows on the either the protected side or the flood side of the levee. The windrows would extend from right of way to 15' from levee toe not to exceed the levee height.

Vegetative debris may be collected into piles and burned within the Right of Way. Approximately 115 burns over the duration of the project would be anticipated, with approximately 4000 cubic yards of material per burn.

Cut timber, down timber, dead timber, branches, and brush may be chipped. Chipping operations may be conducted over the duration of the project. The chips would be deposited in windrows. Windrows would extend from the limit of right of way to 15' from the levee toe not to exceed the levee height. At the option of the Contractor, the chips may be either sold or spread over worksite areas as a dust preventive measure or may be used within the project area as a mulch for plantings. However, disposal by spreading shall be acceptable only in areas where the wood chips cannot be washed either into ditches, streams, or off the right-of-way by rainfall runoff.

1.6 REACH I

1.6.1 Scope of Work

Construction of 5.70 miles (30,109 linear feet) of earthen levee running south to north along the eastern side of Bayou Terrebonne from the Bush Canal to the Humble Canal over the NFS' existing levee in Terrebonne Parish. A summary of the features of this reach is provided in Table 1. Design details for the referenced navigation gate is provided in a separate project description.

Table 1: Summary of Levee System

Feature	Description
Levee	
Total Length of alignment	5.70 miles (30,109 ft)
Length of Earthen Levee	5.70 miles (30,109 ft)
Temporary Acres of Construction for Levee	6.3 acres
Permanent Acres for Levee	410 acres
Acres for Existing NFS Levee which overlaps Permanent Acres for Levee	103 acres
Net Acres Disturbed for Proposed Levee	307 acres
Hydraulic Design Elevation	20.0 I1, 21.0 I2, 20.0 I3 (2035) 24.0 I1, 25.0 I2, 24.5 I3 (2085)
Structures	
Pump Stations	1
Environmental Control Structures	0
Number of Vehicular Floodgates	0
Number of Navigation Floodgates	2
Fill (Borrow Material) Required	9,550,100 cubic yards (for 2035 and 2085 levee lifts)

1.6.2 Levee Construction

1.6.2.1 2035 Design Levee Construction

This reach includes 5.70 miles (30,109 linear feet) of earthen levee running south to north along the eastern side of Bayou Terrebonne from the Bush Canal, Station

3640+67 (the end of Reach H), to the Humble Canal, Station 3941+75 (the beginning of Reach J).

Reach I is broken into three design reaches: Reach I1 (Sta. 3640+67 to Sta. 3733+30), Reach I2 (Sta. 3733+30 to Sta. 3832+26), and Reach I3 (Sta. 3832+26 to 3941+75).

The levee for Reaches I1 and I3 would be constructed to a 2035 design elevation of 20.0-feet NAVD88 (plus 2.0 feet of overbuild), a base width (levee toe to levee toe) of 432 feet, with 6:1 flood side and 4:1 protected side slopes above the existing levee berm, and a crown width of 10 feet. Total permanent ROW for this section would be 600 feet wide.

The levee for Reach I2 would be constructed to a 2035 design elevation of 21.0-feet NAVD88 (plus 2.0 feet of overbuild), a base width (levee toe to levee toe) of 442 feet, with 6:1 flood side and 4:1 protected side slopes above the levee berm, and a crown width of 10 feet. Total permanent ROW for this portion of the reach would be 600 feet wide.

The proposed levee will be constructed along the alignment of the existing NFS constructed levee. The crown of the proposed levee will be shifted to the floodside of the existing NFS crown with protected side toes matching. The approximate elevation of the existing NFS levee is 8.0.

Future lifts would bring the Reach I1 levee up to the 2085 design elevation of 24.0-feet, Reach I2 levee up to the 2085 design elevation of 25.0-feet, and Reach I3 levee up to the 2085 design elevation of 24.5 (not including overbuild).

Figures 1 and 2 provide a typical cross-section for the 2035 and 2085 design elevations.

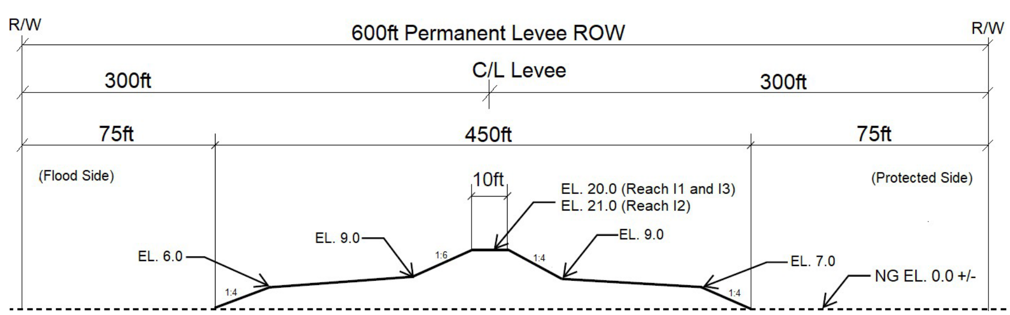


Figure 1. Typical levee section for 2035 design elevation.

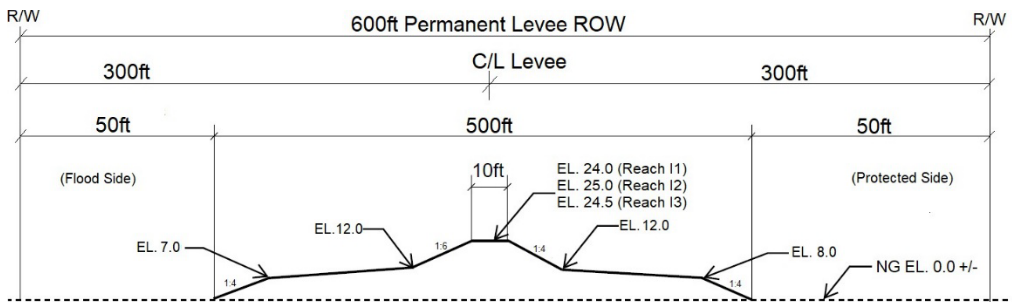


Figure 2. Typical levee section for 2085 design elevation

Table 2: Preliminary list of equipment for levee construction and estimated duration of construction

Project Component	Duration (days)	Equipment used
2035 Elevation	730	Dump Trucks
		Bull Dozers
2085 Elevation	730	Fill Compactor
		Front End Loader / Backhoe
		Fuel Tanks
		Construction Trailer
		Portable Chemical Toilets

1.6.2.2 2085 Design Levee Construction

To construct Reach I to the 2085 design elevations of 24.0 for I1, 25.0 for I2, and 24.5 for I3, approximately 2,748,300 cubic yards of additional embankment material would be required. The borrow sites, staging areas, and haul routes utilized would be the same as used for construction of Reach I to the 2035 design elevation.

1.6.3 Borrow Sites, Haul Routes, Staging, and Disposal

1.6.3.1 Borrow Sites

Figure 3 shows the locations of the borrow sites which would be excavated for use, along with the haul routes to the construction ROW. Any wetlands or forested areas located within the borrow sites will be avoided and left undisturbed.

Figure 3. Borrow sites and haul routes for Reach I.

To construct Reach I to the 2035 design elevation, approximately 6,801,800 cubic yards of borrow material would be excavated from borrow sites.

1.6.3.2 Haul Routes

The borrow would be hauled via dump trucks to the levee site from the various borrow sites along the haul routes as shown in Figure 3.

Proposed Haul Route 1 would utilize Crochetteville Road, Aragon Road, LA 55 (Montegut Road) to bring trucks, embankment, and equipment from all of the borrow sites and staging areas to the northern terminus of the Reach I levee.

Haul Route 2 (Highway 58) would be used for access between borrow site A209 and Haul Route 1. Haul Route 3 (existing private road) would be used as access between borrow site A211, borrow site J1 and Haul Route 1. Haul Routes 4 and 5 (existing private roads) would be used as access between borrow site A210 and Haul Route 1.

1.6.3.3 Staging Areas

There would be three temporary staging areas for equipment and construction trailers adjacent to the haul route and borrow sites A208.1, A209, and A210. Approximately 6 inches of stone would be placed to provide a dry area as needed within the staging area limits. Upon completion of the project, the areas would be restored to original conditions.

1.6.3.4 Disposal of Debris

Material collected from clearing and grubbing of the levee Right of Way may be disposed of by either windrowing, burning, chipping, or removal from the site.

Windrowing, burning, and chipping would occur within the Right of Way. Debris resulting from clearing and grubbing the borrow site would be buried in the borrow pit.

Vegetative debris, including grass, organic material, and brush trees, may be placed in windrows on the either the protected side or the flood side of the levee. The windrows would extend from right of way to 15' from levee toe not to exceed the levee height.

Vegetative debris may be collected into piles and burned within the Right of Way. Approximately 115 burns over the duration of the project would be anticipated, with approximately 4000 cubic yards of material per burn.

Cut timber, down timber, dead timber, branches, and brush may be chipped. Chipping operations may be conducted over the duration of the project. The chips would be deposited in windrows. Windrows would extend from the limit of right of way to 15' from the levee toe not to exceed the levee height. At the option of the Contractor, the chips may be either sold or spread over worksite areas as a dust preventive measure or may be used within the project area as a mulch for plantings. However, disposal by spreading shall be acceptable only in areas where the wood chips cannot be washed either into ditches, streams, or off the right-of-way by rainfall runoff.

1.7 REACH J

1.7.1 Scope of Work

Construction of 9.41 miles (49,710 linear feet) of earthen levee from the Humble Canal Floodgate to the Pointe Aux Chenes Floodgate over the NFS' existing levee in Terrebonne Parish. A summary of the features of this reach is provided in Table 1.

Table 1: Summary of Levee System

Feature	Description
Levee	
Total Length of alignment	9.41 miles (49,710 ft)
Length of Earthen Levee	9.41 miles (49,710 ft)
Temporary Acres of Construction for Levee	6.3 acres
Permanent Acres for Levee	641 acres
Acres for Existing NFS Levee which overlaps Permanent Acres for Levee	217 acres
Net Acres Disturbed for Proposed Levee	424 acres
Hydraulic Design Elevation	20.5 J1, 21.5 J2, 20.0 J3 (2035) 24.0 J1, 25.0 J2, 23.5 J3 (2085)
Structures	
Pump Stations	1
Environmental Control Structures	3
Number of Vehicular Floodgates	0
Number of Navigation Floodgates	1
Number of Railroad Gates	0
Number of Road Ramps	0
Fill (Borrow Material) Required	12,244,200 cubic yards (for 2035 and 2085 levee lifts)

1.7.2 Levee Construction

1.7.2.1 2035 Design Levee Construction

This reach includes 9.41 miles (49,710 linear feet) of earthen levee running west to east starting at the Humble Canal floodgate at Station 3941+75 (the end of Reach I) with its eastern terminus being located at the Pointe Aux Chenes floodgate located near Cutoff Canal at Station 4438+85 (the beginning of Reach K).

Reach J is broken into three design reaches: Reach J1 (Sta. 3941+75 to Sta. 4202+33), Reach J2 (Sta. 842+05 to Sta. 1116+44), and Reach J3 (Sta. 4367+74 to Sta.

4438+85).

The levee for Reach J1 would be constructed to a 2035 design elevation of 20.5 (plus 2.0 feet of overbuild), a base width (levee toe to levee toe) of 500 feet, with 6:1 flood side and 4:1 protected side slopes above the levee berm, and a crown width of 10 feet. Total permanent ROW for this portion of the reach would be 600 feet wide.

The levee for Reach J2 would be constructed to a 2035 design elevation of 21.5 (plus 2.0 feet of overbuild), a base width (levee toe to levee toe) of 500 feet, with 1V:4H flood side and 1V:4H protected side slopes above the levee berm, and a crown width of 10 feet. The levee enlargement will include a land side shift from Sta. 1116+44 to Sta. 870+00 and a flood side shift from Sta. 870+00 to Sta. 842+05. Stage one construction will consist of degrading the existing levee and placing embankment for the new levee to EL. 15 ft. Stage two construction will consist of finishing placement of levee embankment to EL. 23.5. Total permanent ROW for this portion of the reach would be 600 feet wide.

The levee for Reach J3 would be constructed to a 2035 design elevation of 20.0 (plus 2.0 feet of overbuild), a base width (levee toe to levee toe) of 500 feet, with 6:1 flood side and 4:1 protected side slopes above the levee berm, and a crown width of 10 feet. Total permanent ROW for this portion of the reach would be 600 feet wide.

The proposed levee will be constructed over the alignment of the existing NFS constructed levee.

Future lifts will bring the Reach J1 levee up to the 2085 design elevation of 24.0, the Reach J2 levee up to the 2085 design elevation of 25.0, and Reach J3 levee up to the 2085 design elevation of 23.5 (not including overbuild).

Figures 1 and 2 provide a typical cross-section for the 2035 and 2085 design elevations.

Table 2 provides a list of equipment that would be used to construct the levee reaches and the estimated duration of construction.

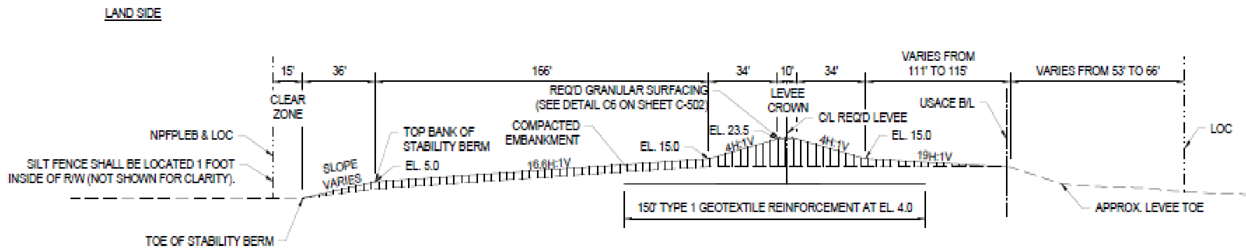


Figure 1. Typical levee section for 2035 design elevation

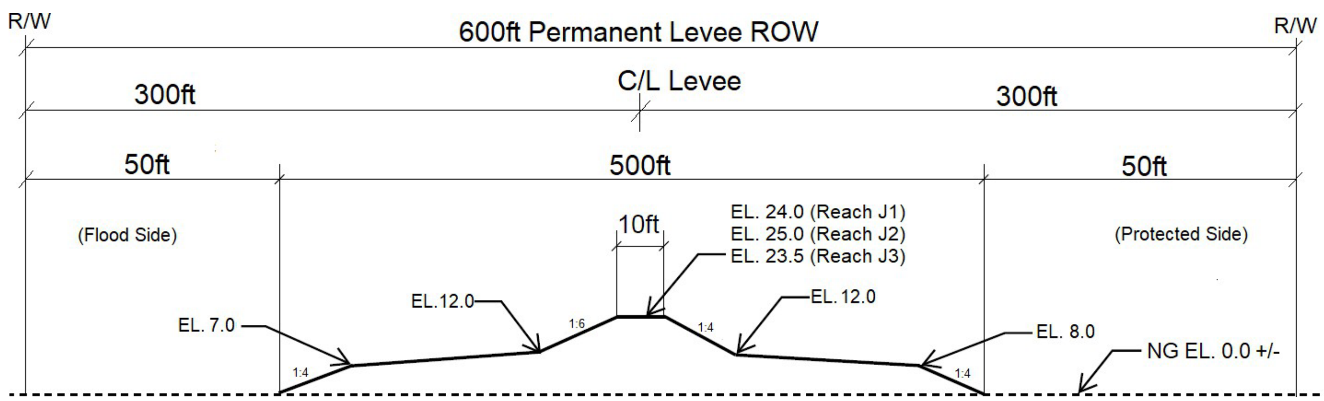


Figure 2. Typical levee section for 2085 design elevation

Table 2: Preliminary list of equipment for levee construction and estimated duration of construction

Project Component	Duration (days)	Equipment used
2035 Elevation	730	Dump Trucks
		Bull Dozers
2085 Elevation	730	Fill Compactor
		Front End Loader / Backhoe
		Fuel Tanks
		Construction Trailer
		Portable Chemical Toilets

There are three existing water control structures within the J-2 levee. The two westernmost structures are currently operated by the Louisiana Department of Wildlife and Fisheries (LDWF) to control water levels within the Point-aux-Chenes Wildlife Management Area. In consultation with the PDT, it was determined that these two structures can remain in place to manage water levels in the wildlife management area. The easternmost existing water control structure within the J-2 levee reach is operated by the NFS for hurricane and storm risk reduction (Figure 3). In order to accommodate the continued operation of the two existing westernmost control structures while increasing the level of risk reduction provided by the J-2 reach, floodwalls with a top elevation of +25 ft would be constructed adjacent to and within approximately 150 feet of, the existing control structures and tie into the adjacent levee section. In order to accommodate water flow through the new structures, sluice gates would be constructed within the new floodwall segments. The easternmost existing water control structure would be removed and replaced with a similar floodwall/sluice gate feature. A sluice gate is a movable gate or series of movable gates that, when lifted, allow material and water to flow under it (Figure 4). The sluice gate would provide an opening in the system to allow unimpeded tidal flow, except when a tropical system approaches the Gulf of America in which the gates would be closed by the NFS. These new floodwall segments and sluice gates in the location of the two westernmost structures would be built on either the floodside or protected side of the two existing control structures within the existing levee. The new floodwall segment and sluice gate built to replace the easternmost existing structure would be built on the protected side of the existing structure (Figures 5 and 6). Table 3 provides a list of equipment that would be used to construct the floodwall segments and sluice gate structures and the estimated duration of construction.

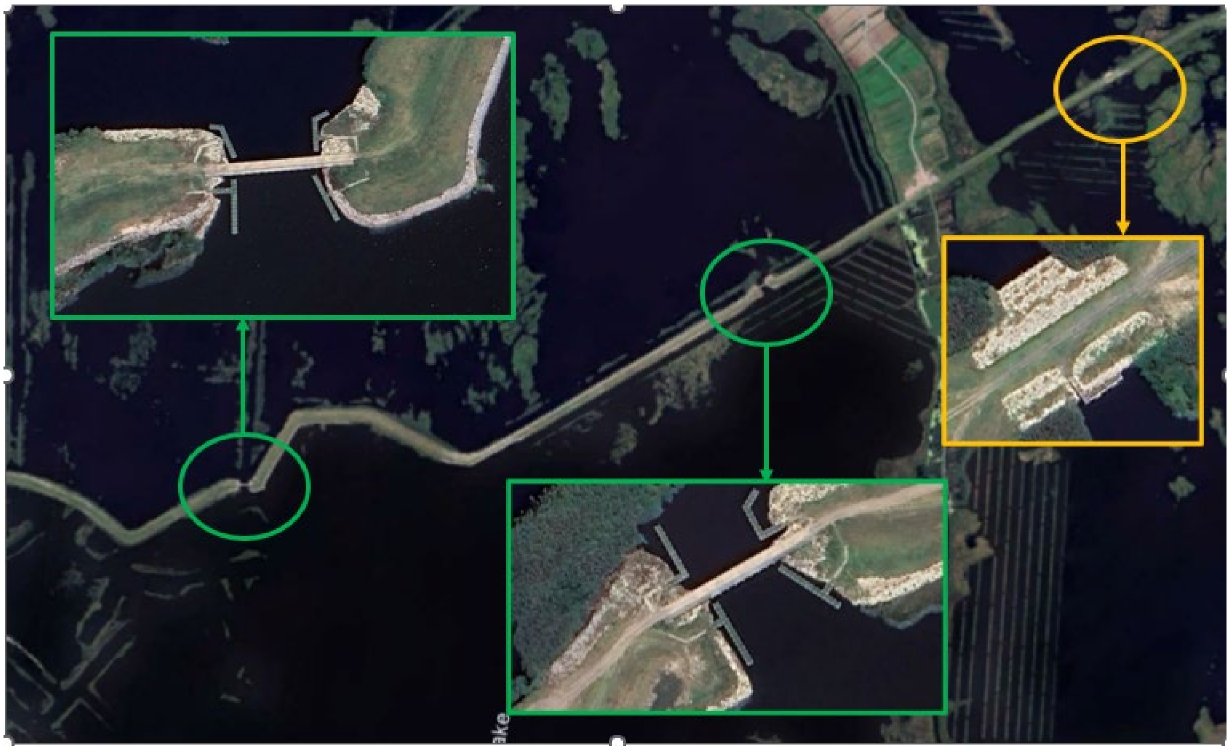


Figure 3. Location of existing environmental control structures. Structures operated by LDWF are marked in green. Structure operated by the NFS is marked in orange.

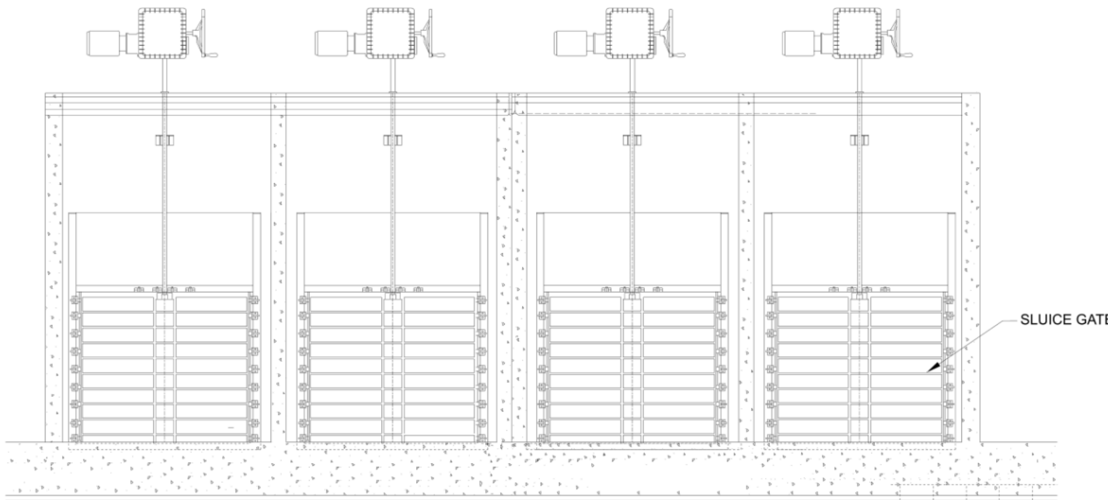


Figure 4. Example cross-section of sluice gates

Figure 5. Potential floodside alignment of floodwall segment

Figure 6. Potential protected side alignment of floodwall segment

Table 3: Preliminary list of equipment for structure construction and estimated duration of construction

Project Component	Duration (days)	Equipment Used
Structures	730	150-Ton Crane
		80-Ton Crane
		Excavator
		Pile Driver
		Concrete Trucks
		Concrete Vibrators
		Welding Machine, Cutting Torch
		Dump Trucks
		Bull Dozers
		Fill Compactor
		Front End Loader/Backhoe
		Fuel Tanks
		Generator

There are currently four docks located adjacent to each of the two westernmost existing environmental control structures. Every attempt during final design will be made to leave these docks in place, however, there may be situations where a dock must be removed to allow for the construction of the proposed structure. If the final design requires demolition of the existing dock, the docks will be replaced within the project footprint.

Construction may impact the natural flow patterns of the existing structures. If this is the case, allowances would be made to made in the construction contract to require the contractor to sequence the construction such that a hydrologic connection is maintained during installation of the T-wall segments and sluice gates.

1.7.2.2 2085 Design Levee Construction

To construct Reach J to the 2085 design elevations of 24.0 for J1, 25.0 for J2, and 23.5 for J3, approximately 4,514,400 cubic yards of additional embankment material would be required for future lifts with approximately 50% of the embankment material for Reach J being hauled along Haul Route 2 and 50% delivered via Haul Route 3. The borrow sites, staging areas and haul routes utilized would be the same as used for construction of Reach J to the 2035 design elevation.

1.7.3 Borrow Sites, Haul Routes, Staging, and Disposal

1.7.3.1 Borrow Sites

Figure 7 shows the locations of the borrow sites which would be excavated for use in construction of project features, along with the haul routes to the construction ROW. Any wetlands or forested areas located within the borrow sites will be avoided and left undisturbed.

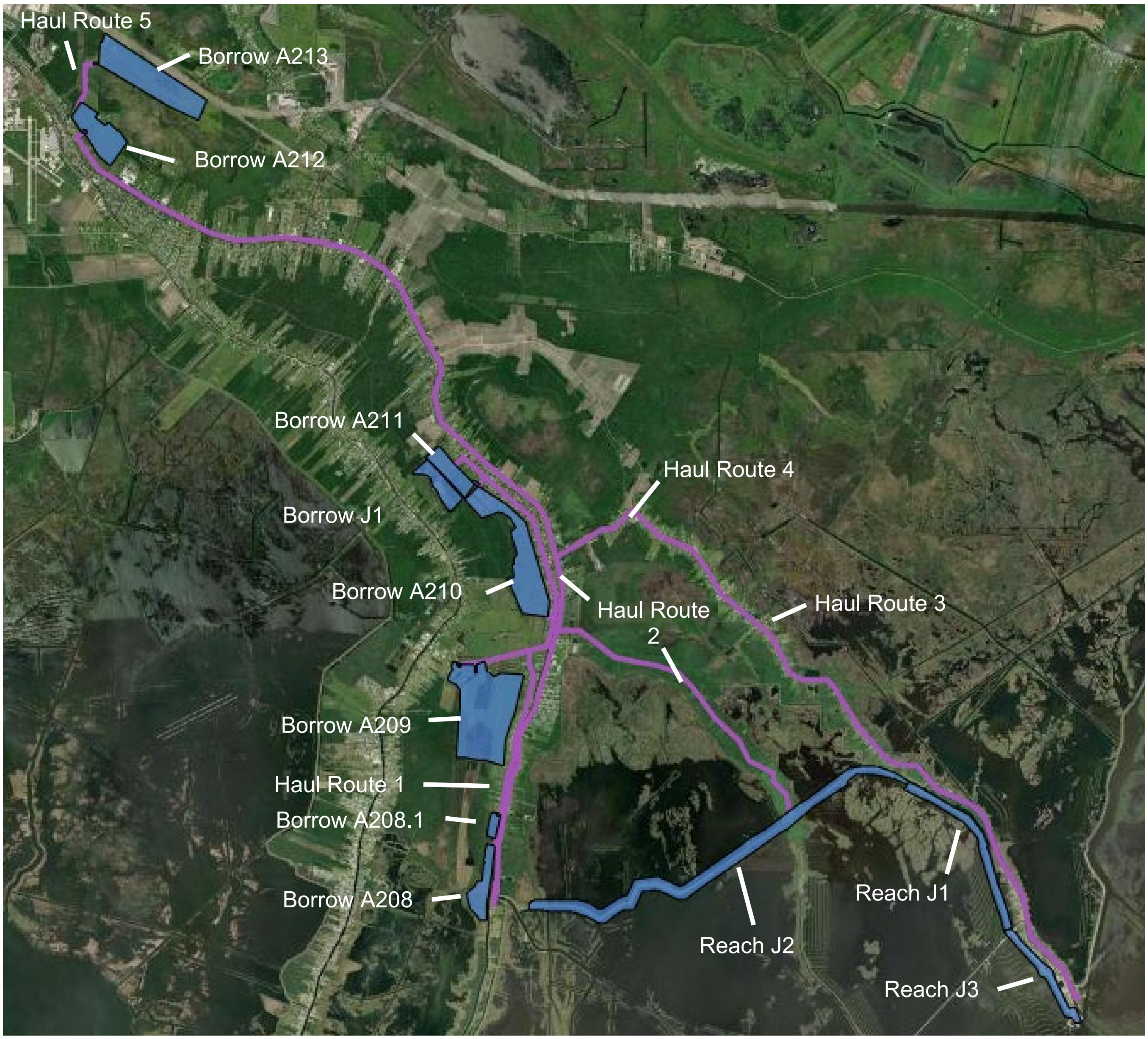


Figure 7. Borrow sites and haul routes for Reach J.

To construct Reach J to the 2035 design elevation, approximately 7,729,800 cubic yards of borrow material would be excavated from designated government furnished borrow sites.

1.7.3.2 Haul Routes

The borrow would be hauled via dump trucks to the levee site from the designed borrow locations along the two haul routes as shown in Figure 7.

Proposed Haul Route 1 would utilize Crochetteville Road, LA 58 and LA 55 to bring trucks, embankment, and equipment from borrow site A208, borrow site A208.1/Staging Area 1 and borrow site A209/Staging Area 2 staging area to the eastern terminus of the Reach J levee.

Proposed Haul Route 2 would use LA 55 and Point Farm Road to bring trucks, embankment, and equipment from all of the borrow sites and associated staging areas to the middle of the Reach J2 alignment where it would be transported along the J2 levee to the western end of the Reach J levee.

Proposed Haul Route 3 would utilize LA 665 to haul material from all borrow sites to the eastern end of the Reach J levee.

Haul Route 4 (existing private road) would be used as access between borrow site A211, borrow site J1 and Haul Route 2 and 3.

Haul Route 5 (existing private road) would provide access between borrow site A213 and Haul Route 1 (Figure 8).

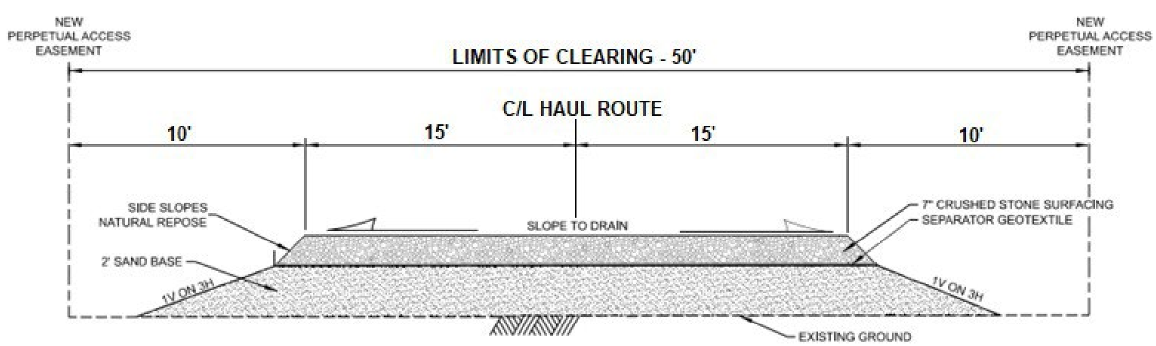


Figure 8. Cross-section of proposed constructed haul routes.

1.7.3.3 Staging Areas

There would be five temporary staging areas for equipment and construction trailers adjacent to the haul route adjacent to borrow sites A213, A212, A210, A209, and

A208.1. Approximately 6 inches of stone would be placed to provide a dry area as needed within the staging area limits. Upon completion of the project, the areas would be restored to original conditions.

1.7.3.4 Disposal of Debris

Material collected from clearing and grubbing of the levee Right of Way may be disposed of by either windrowing, burning, chipping, or removal from the site.

Windrowing, burning, and chipping would occur within the Right of Way. Debris resulting from clearing and grubbing the borrow site would be buried in the borrow pit.

Vegetative debris, including grass, organic material, and brush trees, may be placed in windrows on the either the protected side or the flood side of the levee. The windrows would extend from right of way to 15' from levee toe not to exceed the levee height.

Vegetative debris may be collected into piles and burned within the Right of Way. Approximately 190 burns over the duration of the project would be anticipated, with approximately 4000 cubic yards of material per burn.

Cut timber, down timber, dead timber, branches, and brush may be chipped. Chipping operations may be conducted over the duration of the project. The chips would be deposited in windrows. Windrows would extend from the limit of right of way to 15' from the levee toe not to exceed the levee height. At the option of the Contractor, the chips may be either sold or spread over worksite areas as a dust preventive measure or may be used within the project area as a mulch for plantings. However, disposal by spreading shall be acceptable only in areas where the wood chips cannot be washed either into ditches, streams, or off the right-of-way by rainfall runoff.

1.8 REACH K

1.8.1 Scope of Work

Construction 7.07 miles (37,315 linear feet) of earthen levee running from approximately 200 feet north of the intersection of LA 665 and High Tide Court, to the Grand Bayou Floodgate over the NFS' existing levee in Terrebonne Parish. A summary of the features of this reach is provided in Table 1.

Table 1: Summary of Levee System

Feature	Description
Levee	
Total Length of alignment	7.07 miles (37,315 ft)
Length of Earthen Levee	7.07 miles (37,315 ft)
Temporary Acres of Construction for Levee	6.3 acres
Permanent Acres for Levee	358 acres
Acres for Existing NFS Levee which overlaps Permanent Acres for Levee	71 acres
Net Acres Disturbed for Proposed Levee	287 acres
Hydraulic Design Elevation	20.5 (2035) 26.0 (2085)
Structures	
Pump Stations	0
Environmental Control Structures	2
Number of Vehicular Floodgates	0
Number of Navigation Floodgates	1
Fill (Borrow Material) Required	10,991,000 cubic yards (for 2035 and 2085 levee lifts)

1.8.2 Levee Construction

1.8.2.1 2035 Design Levee Construction

This reach includes 7.07 miles (37,315 linear feet) of earthen levee running south to south between Station 4438+85.25 (the end of Reach J) at the beginning of the reach, located approximately 200 feet north of the intersection of LA 665 and High Tide Court, to Station 4812+00.00 (the beginning of Reach L) at the Grand Bayou Floodgate. The levee would be constructed to a 2035 design elevation of 20.5 (plus 2.0 feet of overbuild), a base width (levee toe to levee toe) of 446 feet, with 6:1 flood side and 4:1 protected side slopes above the levee berm, and a crown width of 10 feet. Total permanent ROW for this portion of the reach would be 600 feet wide. The levee maintenance road will be located within this ROW beyond the protected side levee toe.

The levee reach would also include two environmental control structures, as shown in Table 2, comprised of box culverts with sluice gates. A sluice gate is a structure that contains a movable gate or series of movable gates that, when lifted, allow material and water to flow under it. The sluice gate would provide an opening in the system to allow unimpeded tidal flow, except when a tropical system approaches the Gulf of America in which the gates would be closed. T-walls would extend from the control structures and tie into the adjacent levees.

Table 2: Environmental Control Structure Summary

ECS	Type	Longitude	Latitude
ECS No. 1	6- 6’ x 6’ culverts	-90.4464	29.4464
ECS No. 2	6- 6’ x 6’ culverts	-90.4390	29.4651

The proposed levee will be constructed along the alignment of the existing NFS constructed levee. The crown of the proposed levee will be shifted to the protected side of the existing NFS crown with protected side toes matching. The approximate elevation of the existing NFS levee is 8.0.

Future lifts will bring the levee up to the 2085 design elevation of 26.0 (not including overbuild).

Figures 1 and 2 provide a typical cross-section for the 2035 and 2085 design elevations. Figure 3 shows the dimensions of the levee maintenance road that would be constructed on the protected side of the levee near the toe of the levee berm.

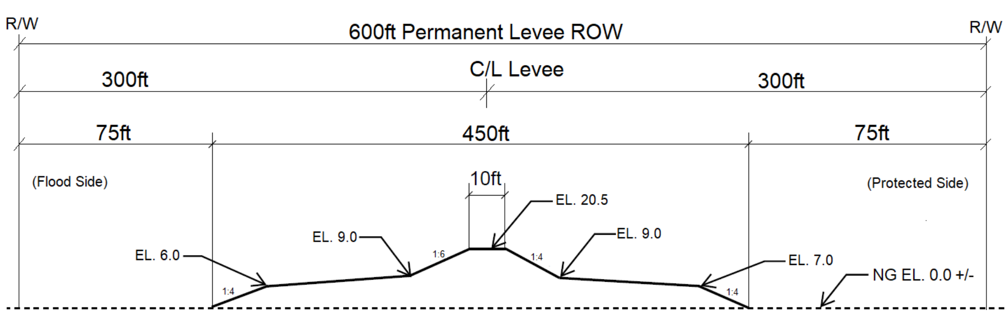


Figure 1. Typical levee section for 2035 design elevation

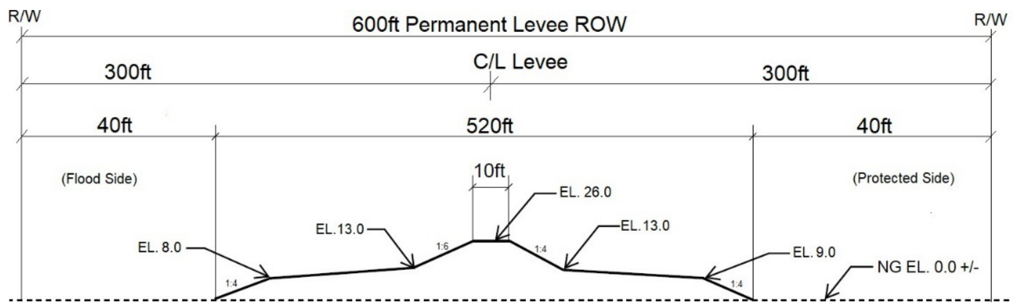


Figure 2. Typical levee section for 2085 design elevation

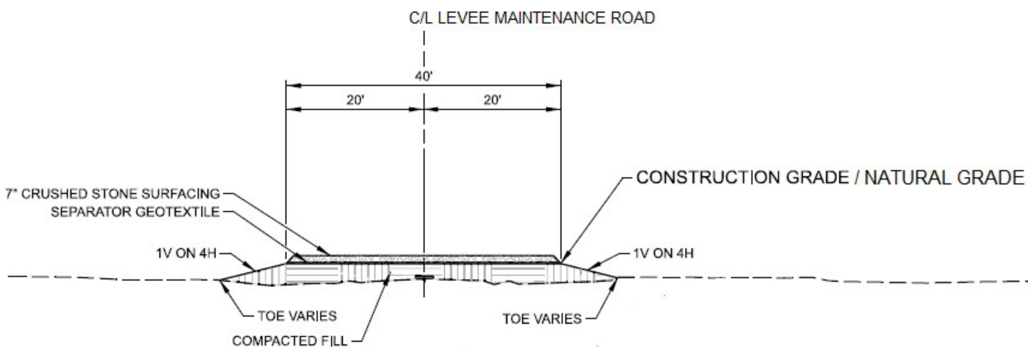


Figure 3. Typical levee maintenance road section

Table 3: Preliminary list of equipment for levee construction and estimated duration of construction

Project Component	Duration (days)	Equipment used
2035 Elevation	1095	Dump Trucks
		Bull Dozers
2085 Elevation	730	Fill Compactor
		Front End Loader / Backhoe
		Fuel Tanks
		Construction Trailer
		Portable Chemical Toilets

1.8.2.2 2085 Design Levee Construction

To construct Reach K to the 2085 design elevation of 26.0, approximately 3,038,000 cubic yards of additional embankment material.

.

1.8.3 Borrow Sites, Haul Routes, Staging, and Disposal

1.8.3.1 Borrow Sites

Figure 4 shows the location of the borrow pits which would be excavated for use in construction of project features, along with the haul route to the construction ROW. Any wetlands or forested areas located within the borrow sites will be avoided and left undisturbed.

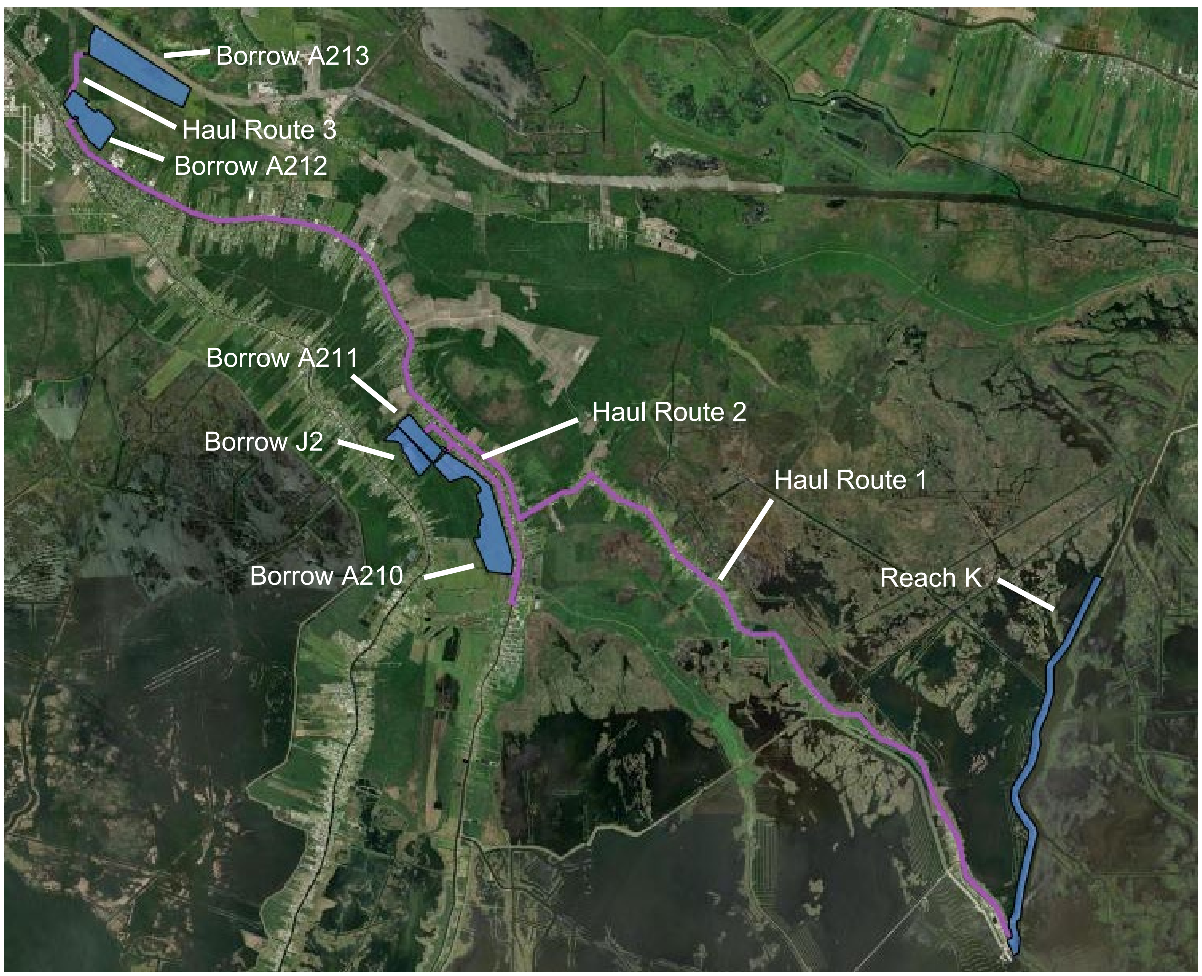


Figure 4. Reach K borrow site and haul route.

To construct each Reach K to the 2035 design elevation, approximately 7,953,000 cubic yards of borrow material would be excavated from borrow sites.

1.8.3.2 Haul Routes

The borrow would be hauled via dump trucks to the levee site from the various borrow sites as shown in Figure 4.

Proposed Haul Route 1 would utilize LA 24, LA 55 (Montegut Road) and Point Aux Chene Road to haul embankment material from borrow sites A212 and A213 and their associated staging areas to the southern end of the Reach K levee. Haul Route 2 (existing private road and Aragon Road) would be used as access between borrow sites A211, A210, J1, and Haul Route 1. Haul Route 3 would be a 30 foot wide constructed haul route that would provide access between borrow site A213 and Haul Route 1.

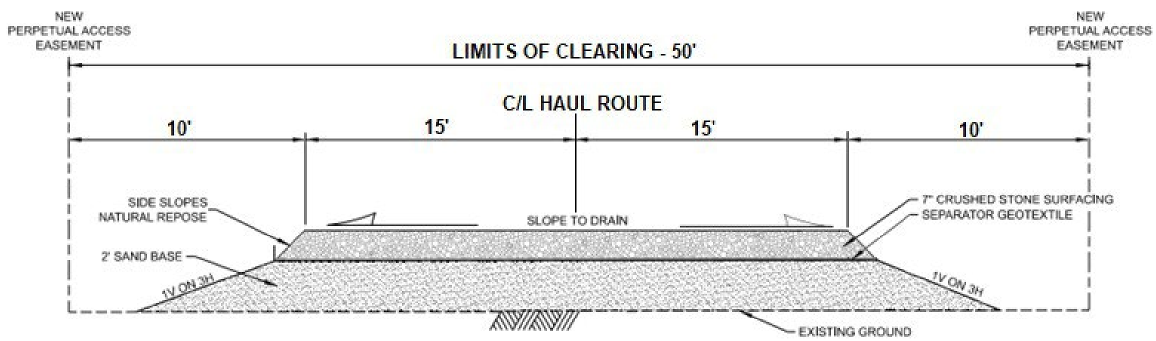


Figure 5. Cross-section of proposed constructed haul route.

1.8.3.3 Staging Areas

There would be three temporary staging areas for equipment and construction trailers adjacent to borrow sites A213, A212 and A210. Approximately 6 inches of stone would be placed to provide a dry area as needed within the staging area limits. Upon completion of the project, the areas would be restored to original conditions.

1.8.3.4 Disposal of Debris

Material collected from clearing and grubbing of the levee Right of Way may be disposed of by either windrowing, burning, chipping, or removal from the site.

Windrowing, burning, and chipping would occur within the Right of Way. Debris resulting from clearing and grubbing the borrow site would be buried in the borrow pit.

Vegetative debris, including grass, organic material, and brush trees, may be placed in windrows on the either the protected side or the flood side of the levee. The windrows would extend from right of way to 15' from levee toe not to exceed the levee height.

Vegetative debris may be collected into piles and burned within the Right of Way. Approximately 140 burns over the duration of the project would be anticipated, with approximately 4000 cubic yards of material per burn.

Cut timber, down timber, dead timber, branches, and brush may be chipped. Chipping operations may be conducted over the duration of the project. The chips would be deposited in windrows. Windrows would extend from the limit of right of way to 15' from the levee toe not to exceed the levee height. At the option of the Contractor, the chips may be either sold or spread over worksite areas as a dust preventive measure or may be used within the project area as a mulch for plantings. However, disposal by

spreading shall be acceptable only in areas where the wood chips cannot be washed either into ditches, streams, or off the right-of-way by rainfall runoff.

1.9 REACH L

1.9.1 Scope of Work

Construction 3.97 miles (20,978 linear feet) of earthen levee running west to east between the Grand Bayou Floodgate and a point approximately 3,150 feet west of the intersection of LA 3235 and LA 3161 over the NFS' existing levee in Terrebonne Parish. A summary of the features of this reach is provided in Table 1. Design details for the referenced floodgates are provided in separate project descriptions.

Table 1: Summary of Levee System

Feature	Description
Levee	
Total Length of alignment	3.97 miles (20,978 ft)
Length of Earthen Levee	3.97 miles (20,978 ft)
Temporary Acres of Construction for Levee	15.0 acres
Permanent Acres for Levee	418 acres
Acres for Existing NFS Levee which overlaps Permanent Acres for Levee	77 acres
Net Acres Disturbed for Proposed Levee	341 acres
Hydraulic Design Elevation	20.5 (2035) 24.5 (2085)
Structures	
Fronting Protection for Pump Stations	1
Environmental Control Structures	1
Number of Vehicular Floodgates	0
Number of Navigation Floodgates	1
Fill (Borrow Material) Required	6,059,000 cubic yards (for 2035 and 2085 levee lifts)

1.9.2 Levee Construction

1.9.2.1 2035 Design Levee Construction

This reach includes 3.97 miles (20,978 linear feet) of earthen levee running west to east between Station 4812+00.00 at the beginning of the reach, located at the Grand Bayou Floodgate (the end of Reach K), to Station 5021+78 approximately 3,150 feet west of the intersection of LA 3235 and LA 3161 (tying into the Larose-Golden Meadow Levee). The levee would be constructed to a 2035 design elevation of 20.5-feet NAVD88 (plus 2.0 feet of overbuild), a base width (levee toe to levee toe) of 446 feet, with 6:1 flood side and 4:1 protected side slopes above the levee berm, and a crown width of 10 feet. Total permanent ROW for this portion of the reach would be 600 feet wide. The levee maintenance road would be located within this ROW beyond the protected side levee toe.

The proposed levee will be constructed along the alignment of the existing NFS constructed levee. The approximate elevation of the existing NFS levee is 8.0. Future lifts will bring the levee up to the 2085 design elevation of 24.5 (not including overbuild).

Figures 1 and 2 provide a typical cross-section for the 2035 and 2085 design elevations. Figure 3 shows the dimensions of the levee maintenance road that would be constructed on the protected side of the levee near the toe of the levee berm.

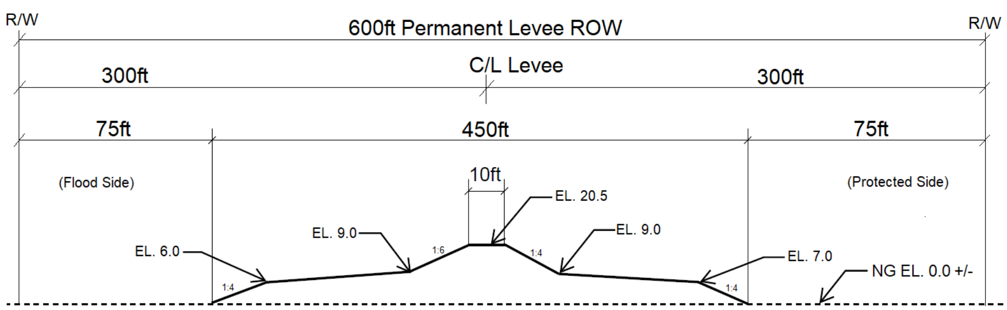


Figure 1. Typical levee section for 2035 design elevation

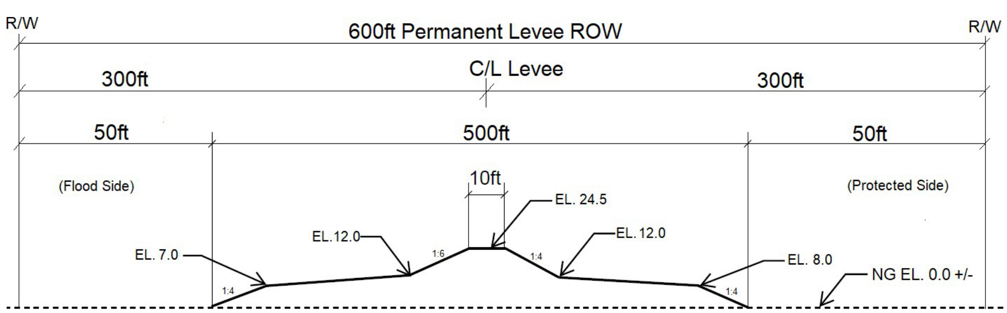


Figure 2. Typical levee section for 2085 design elevation

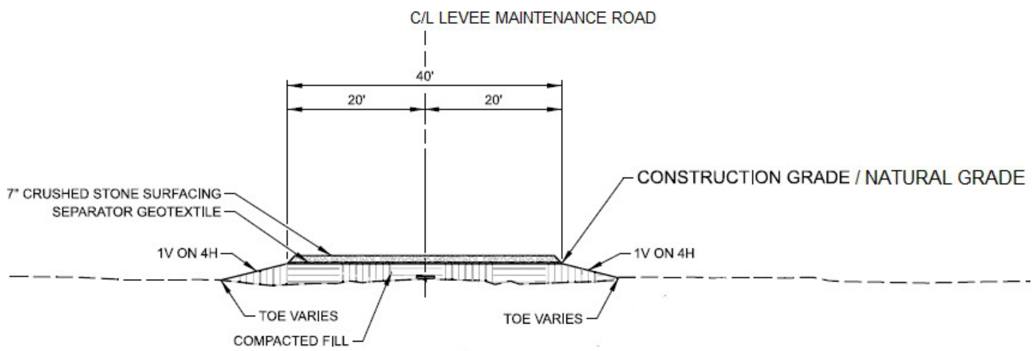


Figure 3. Typical levee maintenance road section

Table 2: Preliminary list of equipment for levee construction and estimated duration of construction

Project Component	Duration (days)	Equipment used
2035 Elevation	730	Dump Trucks
		Bull Dozers
2085 Elevation	730	Fill Compactor
		Front End Loader / Backhoe
		Fuel Tanks
		Construction Trailer
		Portable Chemical Toilets

1.9.3 2085 Design Levee Construction

To construct Reach L to the 2085 design elevation 24.5, approximately 1,893,000 cubic yards of additional borrow would be excavated. The staging area and haul route used would be the same as used for construction to the 2035 design elevation.

1.9.4 Borrow Sites, Haul Routes, Staging and Disposal

1.9.4.1 Borrow Sites

Figure 4 shows the location of the borrow pit which would be excavated for use in construction of project features. Any wetlands or forested areas located within the borrow sites will be avoided and left undisturbed.

Figure 4. Reach L borrow site and haul route.

To construct each Reach L to the 2035 design elevation, approximately 4,166,000 cubic yards of borrow material would be excavated from borrow site A214.

1.9.4.2 Haul Routes

The borrow would be hauled via dump trucks to the levee site directly from borrow site A214.

1.9.4.3 Staging Areas

There would be one staging area for equipment and construction trailers adjacent to the borrow site. Approximately 6 inches of stone would be placed to provide a dry area as needed within the staging area limits. Upon completion of the project, the area would be restored to original conditions.

1.9.4.4 Disposal of Debris

Material collected from clearing and grubbing of the levee Right of Way may be disposed of by either windrowing, burning, chipping, or removal from the site.

Windrowing, burning, and chipping would occur within the Right of Way. Debris resulting from clearing and grubbing the borrow site would be buried in the borrow pit.

Vegetative debris, including grass, organic material, and brush trees, may be placed in windrows on the either the protected side or the flood side of the levee. The windrows would extend from right of way to 15' from levee toe not to exceed the levee height.

Vegetative debris may be collected into piles and burned within the Right of Way. Approximately 80 burns over the duration of the project would be anticipated, with approximately 4000 cubic yards of material per burn.

Cut timber, down timber, dead timber, branches, and brush may be chipped. Chipping operations may be conducted over the duration of the project. The chips would be deposited in windrows. Windrows would extend from the limit of right of way to 15' from the levee toe not to exceed the levee height. At the option of the Contractor, the chips may be either sold or spread over worksite areas as a dust preventive measure or may be used within the project area as a mulch for plantings. However, disposal by spreading shall be acceptable only in areas where the wood chips cannot be washed either into ditches, streams, or off the right-of-way by rainfall runoff.

1.10 REACH LAROSE C-NORTH

1.10.1 Scope of Work

Construction of 7.37 miles (38,937 linear feet) of levee, from the end of the Reach L levee to the GIWW East Floodgate over the NFS' existing levee alignment in Lafourche Parish. A summary of the features of this reach is provided in Table 1.

Table 1: Summary of Levee System

Feature	Description
Levee	
Total Length of alignment	7.37 miles (38,937 ft)
Length of Earthen Levee	6.27 miles (33,127 ft)
Temporary Acres of Construction for Levee	2.0 acres
Permanent Acres for Levee	515 acres
Acres for Existing NFS Levee which overlaps Permanent Acres for Levee	28 acres
Net Acres Disturbed for Proposed Levee	487 acres
Hydraulic Design Elevation	18.0 (2035) 20.5 (2085)
Structures	
GIWW Floodwall	1.10 miles (5,810 ft)
Navigation Floodgates	2
Vehicular Floodgate	2
Environmental Control Structures	0
Fill (Borrow Material) Required	9,935,200 cubic yards (for 2035 and 2085 levee lifts)

1.10.2 Levee Construction

1.10.2.1 2035 Design Levee Construction

This reach includes 7.37 miles (38,937 linear feet) of levee running southeast to northwest between Station 2810+63 at the beginning of the reach, located at the end of Reach L to Station 3200+00 located adjacent the tie-in to the GIWW East Floodgate where the Lockport to Larose Reach 1 levee begins. The Reach C-North levee would be constructed to a 2035 design elevation of 18.0 (plus 2.0 feet of overbuild), a base width (levee toe to levee toe) of 450 feet, with 6:1 flood side and 4:1 protected side slopes above the levee berm, and a crown width of 10 feet. Total permanent ROW for this portion of the reach would be 600 feet wide. The levee maintenance road will be located within this ROW beyond the protected side levee toe.

The proposed levee will be constructed along the alignment of the existing NFS constructed levee. The crown of the proposed levee will be shifted to the protected side of the existing NFS crown with flood side toes matching.

The NFS's existing levee and structures along this alignment will have to be either modified or replaced as the Larose Golden Meadow loading condition is opposite what the Morganza to the Gulf loading would be.

Future lifts will bring the levee up to the 2085 design elevation of 20.5 (not including overbuild).

Figures 1 and 2 provide a typical cross-section for the 2035 and 2085 design elevations.

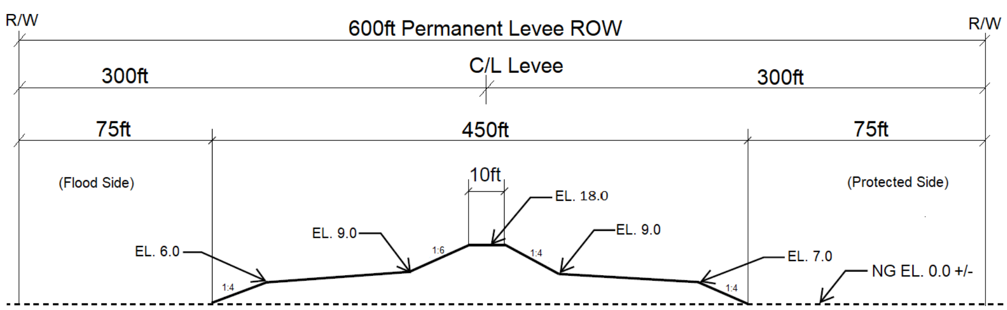


Figure 1. Typical levee section for 2035 design elevation

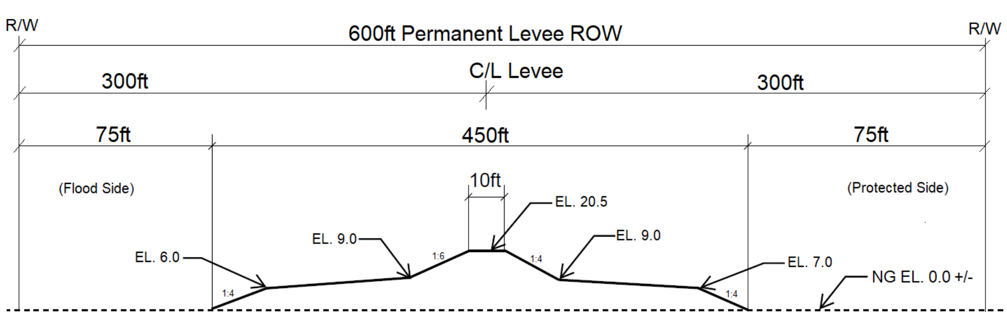


Figure 2. Typical levee section for 2085 design elevation

Table 2: Preliminary list of equipment for levee construction and estimated duration of construction

Project Component	Duration (days)	Equipment used
2035 Elevation	730	Dump Trucks
		Bull Dozers
2085 Elevation	730	Fill Compactor
		Front End Loader / Backhoe
		Fuel Tanks
		Construction Trailer
		Portable Chemical Toilets

1.10.2.2 2085 Design Levee Construction

To construct the Reach C-North levee to the 2085 design elevations of 20.5, approximately 2,900,500 cubic yards of additional embankment material would be required. The borrow site, haul routes and staging area utilized would be the same as used for construction of the Reach C-North levee to the 2035 design elevation.

1.10.3 Borrow Sites, Haul Routes, Staging, and Disposal

1.10.3.1 Borrow Sites

Figure 3 shows the location of the borrow pit which would be excavated for use in construction of project features, along with the haul route to the construction ROW. Any wetlands or forested areas located within the borrow sites will be avoided and left undisturbed.

Figure 3. Borrow Site and Staging Area Reach C North.

To construct the Reach C-North levee to the 2035 design elevation, approximately 7,034,700 cubic yards of borrow material would be excavated from borrow site A214.

1.10.3.2 Haul Routes

The borrow would be hauled via dump trucks from borrow site A214 either directly onto the levee ROW for the southern end of the reach or via Haul Route 1 (W. 48th St, Highway 3235, W. 15th St., E. Main St., E. 2nd St., and E. 3rd St) for the northern end of the reach.

1.10.3.3 Staging Areas

There would be a staging area for equipment and construction trailers adjacent to the borrow area. Approximately 6 inches of stone would be placed to provide a dry area as needed within the staging area limits. The staging area is located within Borrow Site A214. Upon completion of the project, the area would be restored to original conditions.

1.10.3.4 Disposal of Debris

Material collected from clearing and grubbing of the levee Right of Way may be disposed of by either windrowing, burning, chipping, or removal from the site.

Windrowing, burning, and chipping would occur within the Right of Way. Debris resulting from clearing and grubbing the borrow site would be buried in the borrow pit.

Vegetative debris, including grass, organic material, and brush trees, may be placed in windrows on the either the protected side or the flood side of the levee. The windrows would extend from right of way to 15' from levee toe not to exceed the levee height.

Vegetative debris may be collected into piles and burned within the Right of Way. Approximately 150 burns over the duration of the project would be anticipated, with approximately 4000 cubic yards of material per burn.

Cut timber, down timber, dead timber, branches, and brush may be chipped. Chipping operations may be conducted over the duration of the project. The chips would be deposited in windrows. Windrows would extend from the limit of right of way to 15' from the levee toe not to exceed the levee height. At the option of the Contractor, the chips may be either sold or spread over worksite areas as a dust preventive measure or may be used within the project area as a mulch for plantings. However, disposal by spreading shall be acceptable only in areas where the wood chips cannot be washed either into ditches, streams, or off the right-of-way by rainfall runoff.

1.11 REACH LOCKPORT TO LAROSE

1.11.1 Scope of Work

Construction of 10.78 miles (56,896 linear feet) of earthen levee, from the GIWW to the Company Canal, in virgin land in Reach 1 and over the NFS' existing levee for reaches 2 and 3 in Lafourche Parish. A summary of the features of this reach is provided in Table 1.

Table 1: Summary of Levee System

Feature	Description
Levee	
Total Length of alignment	10.78 miles (56,896 ft)
Length of Earthen Levee	10.78 miles (56,896 ft)
Temporary Acres of Construction for Levee	2.11 acres
Permanent Acres for Levee	640 acres
Acres for Existing NFS Levee which overlaps Permanent Acres for Levee	71 acres
Net Acres Disturbed for Proposed Levee	569 acres
Hydraulic Design Elevation	9.5 Reach 1 & 2, 7.5 Reach 3 (2035) 13.0 Reach 1 & 2, 11.0 Reach 3 (2085)
Structures	
Fronting Protection for Pump Stations	2
Environmental Control Structures	6
Fill (Borrow Material) Required	5,746,300 cubic yards (for 2035 and 2085 levee lifts)

1.11.2 Levee Construction

1.11.2.1 2035 Design Levee Construction

This reach includes 10.78 miles (56,896 linear feet) of earthen levee running southeast to northwest between Station 0+00.00 at the beginning of the reach, located immediately west of the GIWW Floodgate (tying into the Larose-Golden Meadow Levee system), to Station 568+96.00 located adjacent to the Company Canal (the overall end of the MTG Levee Project). The Lockport to Larose levee would be constructed to a 2035 design elevation of 9.5 (plus 2.0 feet of overbuild), a base width (levee toe to levee toe) of 145 feet, with 6:1 flood side and 4:1 protected side slopes above the levee berm, and a crown width of 10 feet. Total permanent ROW for this portion of the reach would be 400 feet wide. The levee maintenance road will be located within this ROW beyond the protected side levee toe.

The proposed levee will be constructed in virgin land in Reach 1 and along the alignment of the existing NFS constructed levee in Reaches 2 and 3. The approximate elevation of the existing NFS levee is 6.0.

Future lifts will bring the levee up to the 2085 design elevation of 13.0 (not including overbuild).

Figures 1 and 2 provide a typical cross-section for the 2035 and 2085 design elevations.

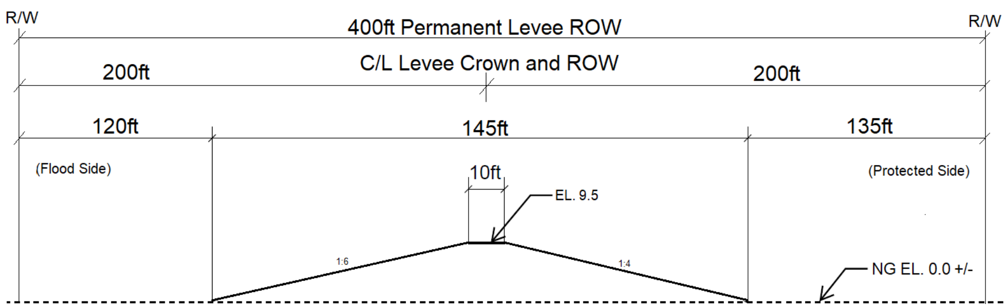


Figure 1. Typical levee section for 2035 design elevation

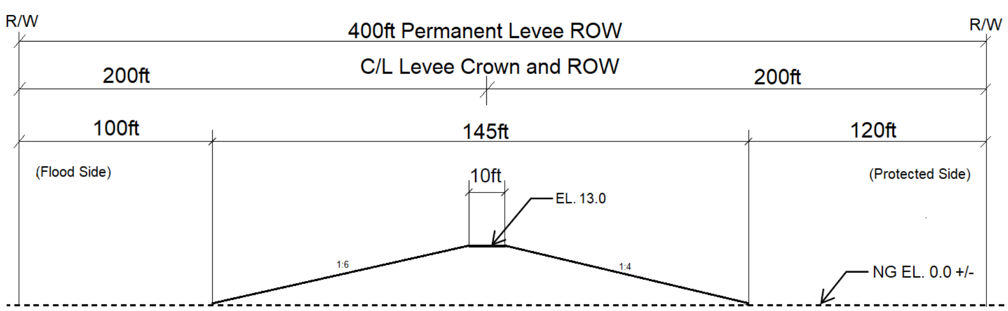


Figure 2. Typical levee section for 2085 design elevation

The levee reach would also include three environmental control structures, as shown in Table 2, comprised of culverts with sluice gates. A sluice gate is a structure that contains a movable gate or series of movable gates that, when lifted, allow material and water to flow under it. The sluice gate would provide an opening in the system to allow unimpeded tidal flow, except when a tropical system approaches the Gulf of America in which the gates would be closed. T-walls would extend from the control structures and tie into the adjacent levees.

Table 2: Environmental Control Structure Summary

ECS	Type	Longitude	Latitude
ECS No. 1	18’ culvert	-90.3978	29.6032
ECS No. 2	18-24’ culvert	-90.6017	29.4067
ECS No. 3	culvert matching existing culvert size	-90.4739	29.6283
ECS No. 4	culvert matching existing culvert size	-90.4741	29.6313
ECS No. 5	3’ culvert	-90.4689	29.6378
ECS No. 6	18-24’ culvert	-90.4927	29.6616

Table 3: Preliminary list of equipment for levee construction and estimated duration of construction

Project Component	Duration (days)	Equipment used
2035 Elevation	730	Dump Trucks
		Bull Dozers
2085 Elevation	730	Fill Compactor
		Front End Loader / Backhoe
		Fuel Tanks
		Construction Trailer
		Portable Chemical Toilets

1.11.2.2 2085 Design Levee Construction

To construct the Lockport to Larose levee to the 2085 design elevations of 13.0 for Reaches 1 and 2 and 11.0 for Reach 3, approximately 2,588,100 cubic yards of additional embankment material would be required. The borrow sites, staging areas, and haul routes utilized would be the same as used for construction of the Lockport to Larose levee to the 2035 design elevation.

1.11.3 Borrow Sites, Haul Routes, Staging, and Disposal

1.11.3.1 Borrow Sites

Figure 3 shows the locations of the borrow pits which would be excavated for use in construction of project features, along with the haul routes to the construction ROW. Any wetlands or forested areas located within the borrow sites will be avoided and left undisturbed.

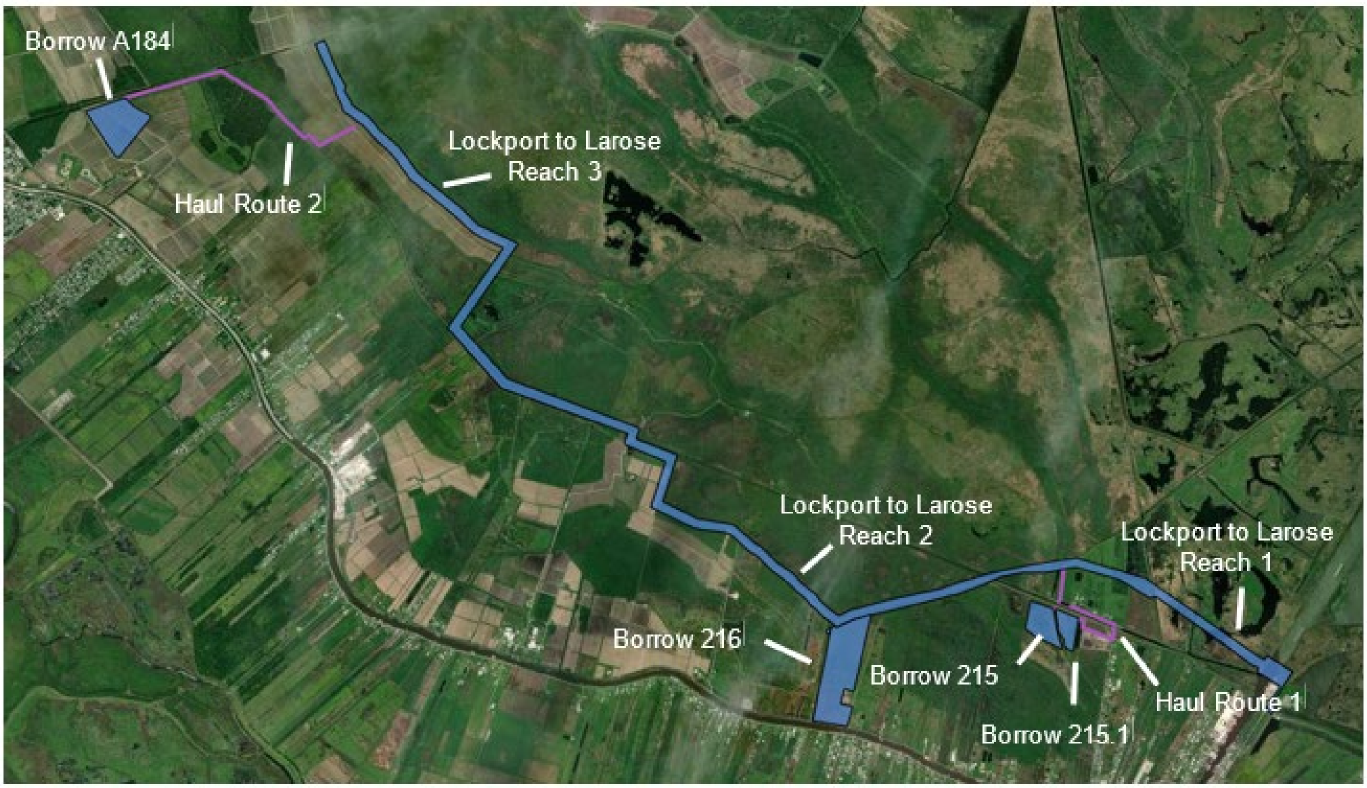


Figure 3. Borrow sites and haul routes for Lockport to Larose.

To construct the Lockport to Larose levee to the 2035 design elevation, approximately 3,158,200 cubic yards of borrow material would be excavated from four borrow sites.

1.11.3.2 Haul Routes

The borrow would be hauled via dump trucks to the levee site from the borrow sites along the haul routes as shown in Figure 3. Note that Borrow Site A216 is located immediately adjacent to the levee ROW (in the central portion of the alignment), thus a separate haul route would not be required for Borrow Site A216 or its associated staging area.

Proposed Haul Route 1 would be a temporary access route utilizing the NFS' existing haul route to Hamilton Street using Hamilton Street to cross the 40 Arpent Canal and access the levee right-of-way. Haul Route 1 would be utilized to bring trucks, embankment, and equipment from borrow site A215, A215.1, and Staging Area 1 to the eastern portion of the Lockport to Larose levee.

Haul Route 2 would be a newly constructed access road within a 40-foot wide crown and 60-foot wide ROW (Figure 4) along existing embankment and farm roads. Construction of Haul Route 2 would include clearing and grubbing of any vegetation within the ROW, placement of two feet of sand topped with geotextile fabric and 7 inches of crushed stone. This haul route would remain in place after construction, and a perpetual road easement would be acquired by the NFS from the landowner. Haul Route 2 would be utilized to bring trucks, embankment, and equipment from borrow site A184 the western section of the Lockport to Larose levee. A cross-section of the new haul route is provided in Figure 4.

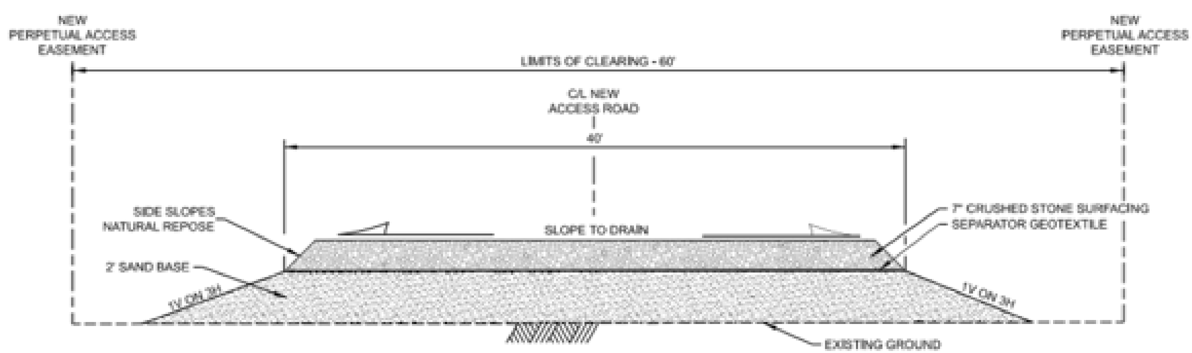


Figure 4. Cross-section of Haul Route 2

1.11.3.3 Staging Areas

There would be three temporary staging areas for equipment and construction trailers adjacent to Haul Route 1, borrow site A216, and Reach 3. Approximately 6 inches of stone would be placed to provide a dry area as needed within the staging area limits. Upon completion of the project, the areas would be restored to original conditions.

Windrowing, burning, and chipping would occur within the Right of Way. Debris resulting from clearing and grubbing the borrow site would be buried in the borrow pit.

Vegetative debris, including grass, organic material, and brush trees, may be placed in windrows on the either the protected side or the flood side of the levee. The windrows would extend from right of way to 15' from levee toe not to exceed the levee height.

Vegetative debris may be collected into piles and burned within the Right of Way. Approximately 215 burns over the duration of the project would be anticipated, with approximately 4000 cubic yards of material per burn.

Cut timber, down timber, dead timber, branches, and brush may be chipped. Chipping operations may be conducted over the duration of the project. The chips would be deposited in windrows. Windrows would extend from the limit of right of way to 15' from the levee toe not to exceed the levee height. At the option of the Contractor, the chips may be either sold or spread over worksite areas as a dust preventive measure or may be used within the project area as a mulch for plantings. However, disposal by spreading shall be acceptable only in areas where the wood chips cannot be washed either into ditches, streams, or off the right-of-way by rainfall runoff.

2 Structure Descriptions

2.1 BARRIER REACH, BAYOU BLACK FLOODGATE

2.1.1 Location

The Bayou Black Floodgate gate would be located on the Bayou Black canal within Terrebonne Parish and is located at latitude 29°40'25.57" N, longitude -91°00'24.81" W.

Figure 1: Location Map

2.1.2 Scope of Work

This contract would consist of a 56-foot-wide barge floodgate in Bayou Black floodwall tie-ins flanking each side of the floodgate. On both the inflow and the outflow of the gate bay, there would be timber guide walls and protection pile clusters. Finally, the transition between levee and floodwall would be protected with concrete or grouted riprap to prevent scour at this transition.

2.1.3 Structure Description

This floodgate would be a 56 ft wide barge floodgate (Figure 2) with a top elevation of +17.0 ft NAVD88, and a slab invert elevation of -12 ft NAVD88. The floodgate would provide an opening in the system to allow unimpeded navigation, except when a tropical system approaches the Gulf of America in which case the barge gate and sluice gates would be closed.

A barge gate is constructed of a braced steel frame with sheet metal or solid plate exterior in a hollow box configuration that resembles a hopper barge (see Figure 2). The gate normally contains several individual compartments that are watertight. The gate would have a pivot arm at one end that allows the gate to articulate in a 90° arc to open and close. The pivot arm would be mounted onto a fixed pivot pile that would allow the gate and pivot arm free travel in the vertical direction (for flotation). When the gate is in either the open or closed position, pumps fill the compartments with water until the buoyancy is overcome and the structure settles onto a receiving structure. While in the open position, the gate would also function as a guide wall to aid the vessels in navigating through the structure. In the closed position, the gate is ballasted down to an underwater foundation with gravity loads transferred through the base seal and the base support (see Figures 3 & 4). The flat top of the gate allows passage of either pedestrian or motorized ATV traffic. Lateral loads from high tides or storm surge on the barge gate are transferred into two concrete abutment reaction walls on either end of the gate structure.

Figure 2: Typical Barge Gate Example

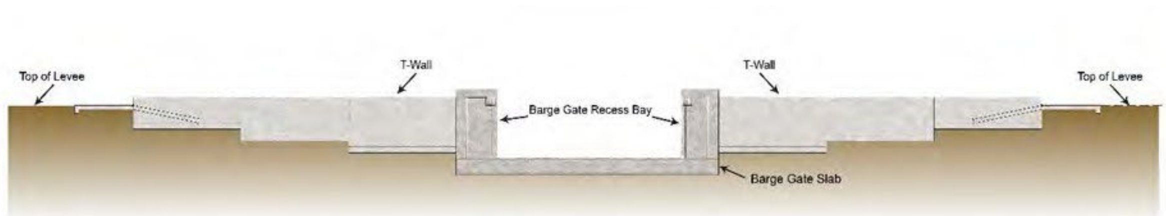


Figure 3: Conceptual Barge Gate - Elevation View with Gate in Open Position

Figure 4: Conceptual Barge Gate - Elevation View with Gate in Closed Position

Timber guide walls and pile clusters would be provided as aids to navigation and to protect the main flood gate structure from impact. The seven pile dolphin structures are constructed at the end of the guide wall to protect the guide walls from impact from vessels. The guide walls would be timber support frames currently spaced every 6 feet. Each timber support frame is constructed with a vertical pile braced by a batter pile driven at an angle from vertical. The outer end of each guide wall is anchored with a seven-pile dolphin structure. The dolphins would consist of 7 timber piles battered away from each other and tied together with a wire rope at the top of the dolphin. Please see figure 5, 6 and 7 for more details.

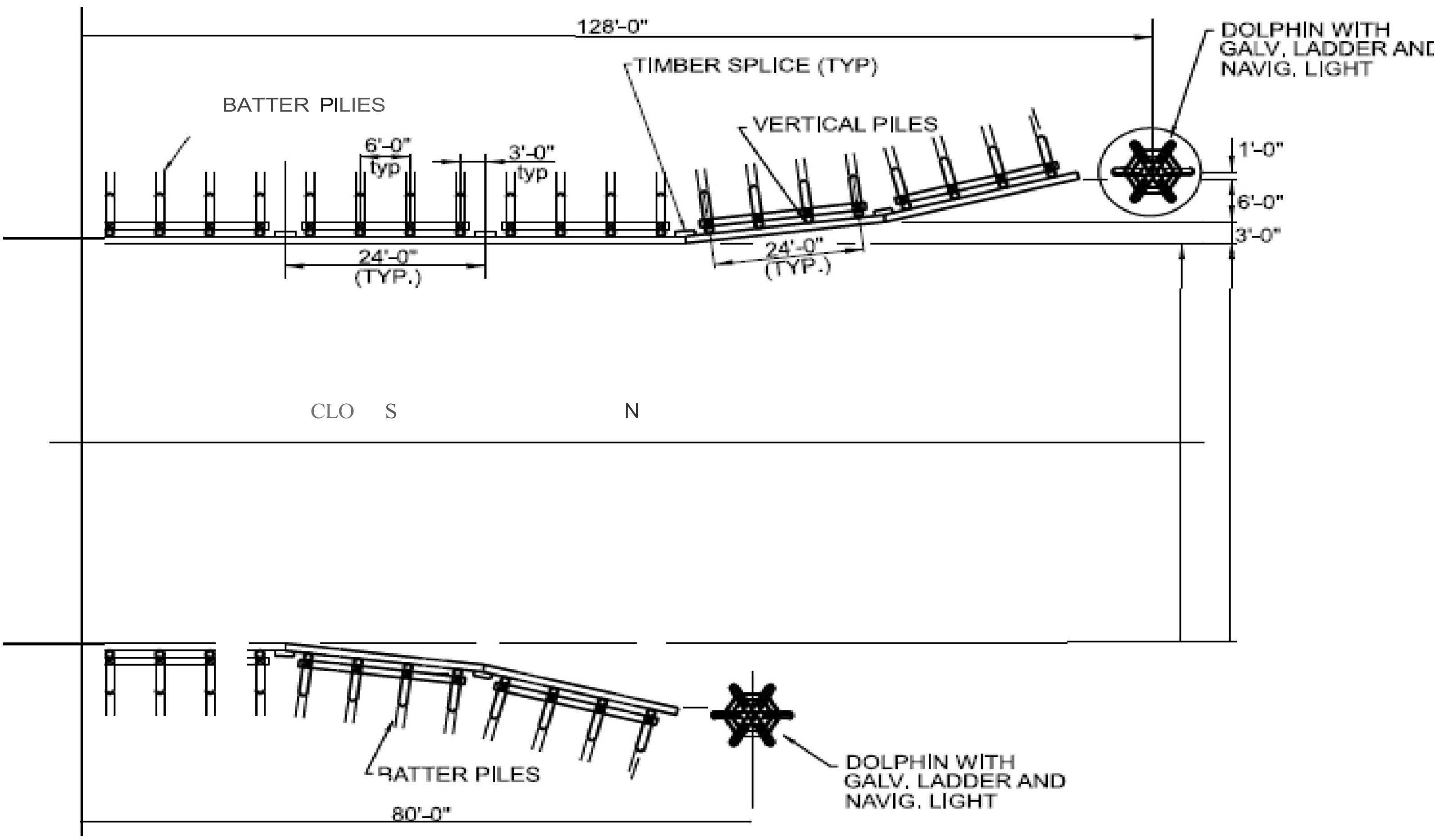


Figure 5: Plan – Guide walls, Fenders, and Dolphins

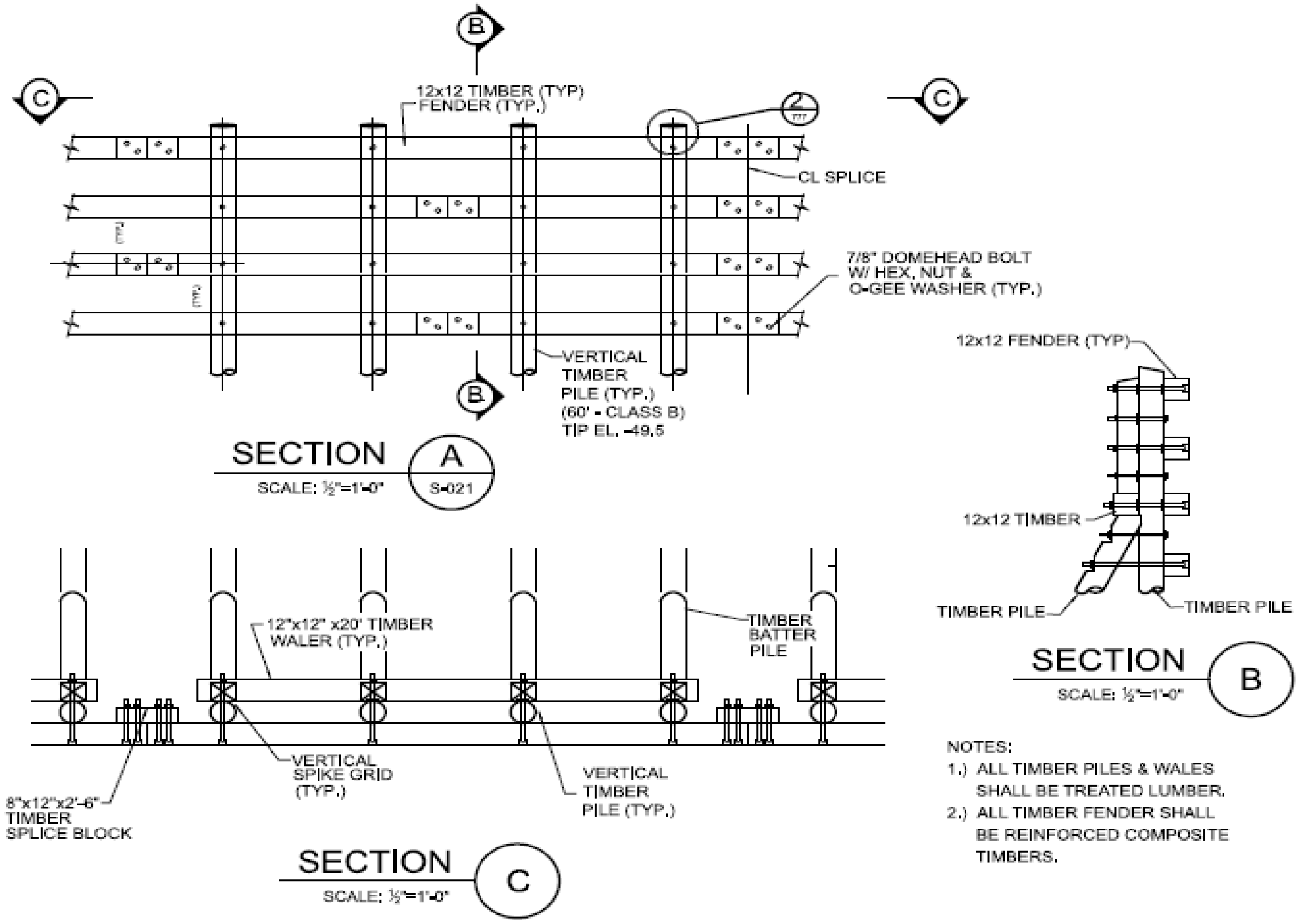


Figure 6: Guide wall Details

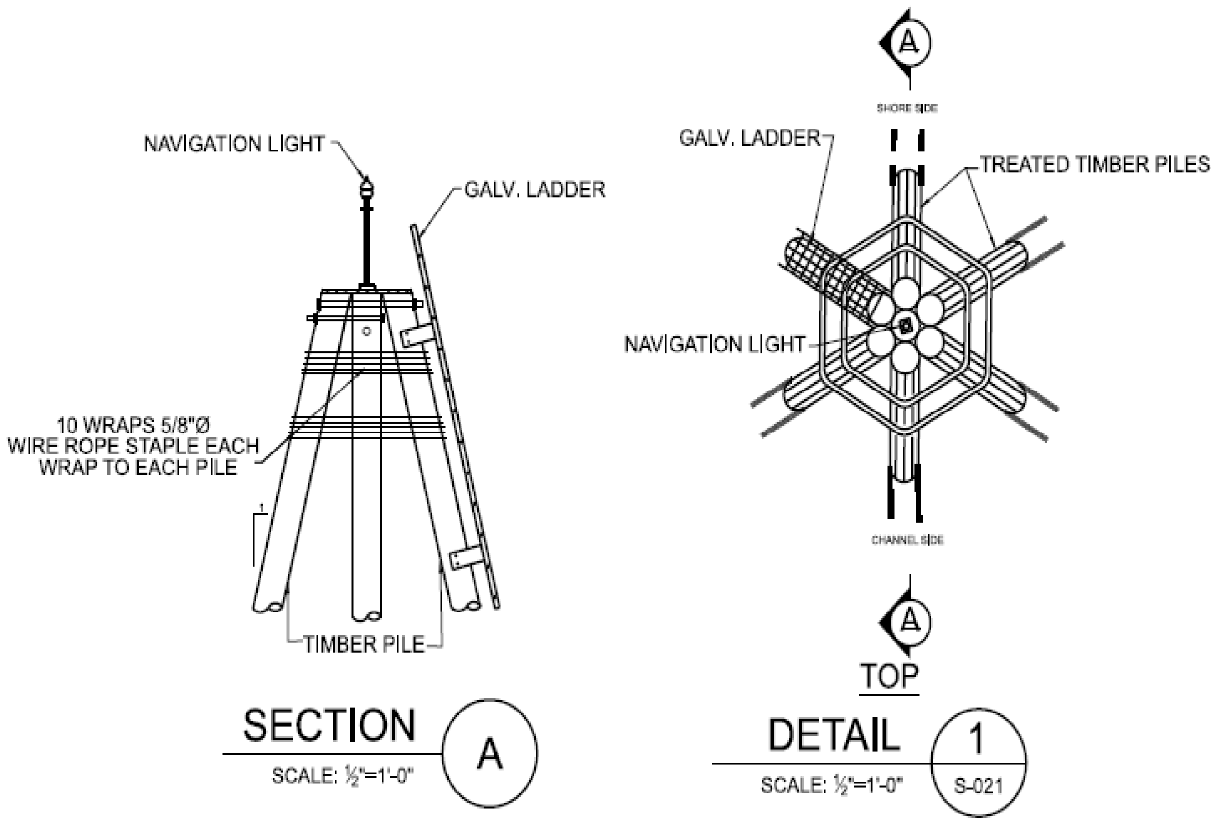


Figure 7: Dolphin Details

Approximately 610 total linear ft (305 linear ft on each side of the floodgate) of floodwalls, specifically T-walls, would extend from the sluice gates and tie into the adjacent levees. The floodwalls would have a top elevation of 17.0 ft NAVD88.

The height of the floodwall tie-ins would vary with the tallest walls adjacent to the barge gate and the shortest walls that tie into the adjacent levee. Details on typical section of floodwall is provided in Figure 8.

The design of the new barge gate and sluice gate structure and floodwalls, including the foundation is subject to change once detailed geotechnical investigations are conducted during detailed design.

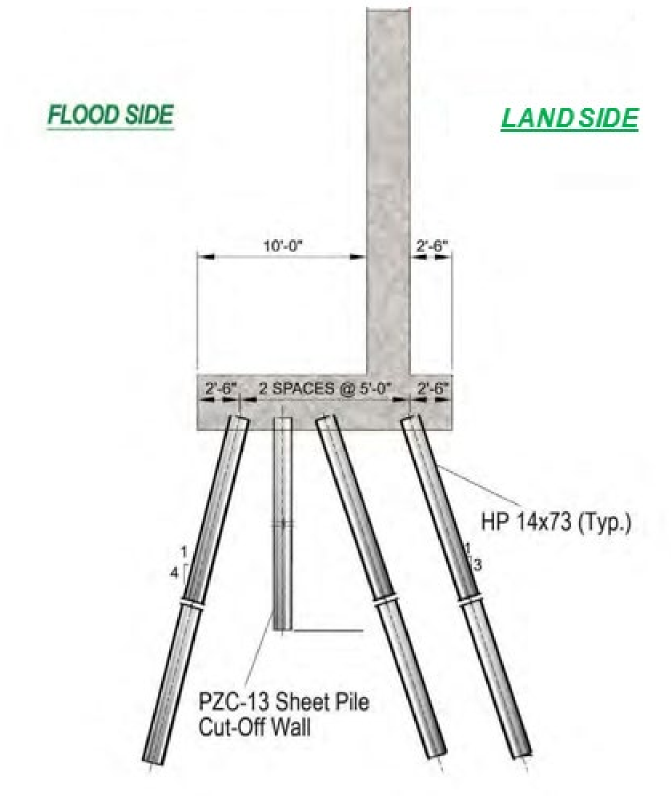


Figure 8: Typical Floodwall

Nine-inch concrete scour protection or grouted riprap would be used at the levee/T-wall transition. The concrete scour protection is located where the T-wall stem extends into the full levee section and extend down both levee slopes. The scour protection would continue for 30 linear feet past the end of the T-wall. Uncapped cut-off sheet piling would extend horizontally 30 feet into the full levee section for erosion and seepage control. See the sketch below for wall layout and cross-section. Please see Figure 9 below for an example of the proposed scour protection.

Figure 9: Concrete Scour Protection Example

The barge gate would be constructed north of the existing floodgate. The existing centerline of Bayou Black Canal has an approximate elevation of EL. -10 ft NAVD 88. For the construction of the gate foundation, the channel would be excavated to an approximate elevation -19.5 ft with the final constructed sill elevation being El. -12.0. Directly adjacent to the floodgate slab, both on the land and the flood side of the gate would be excavated to an El. -14.5 (NAVD 88) to place both the bedding stone and the riprap required. The channel bottom would remain at El. -12.0 (NAVD 88) for approximately 50-feet, both upstream and downstream of the newly constructed floodgate slab. The channel would then slope to allow a smooth transition from the sill elevation to existing grade over approximately 100-feet on both the land and flood side of the gate to afford aquatics the ability to migrate past gate sill.

The cross section at the gate location would be designed such that the pre and post project conditions would not impede the natural movement of aquatic organisms. The default operation would be open to avoid additional indirect impacts to vegetation and fish and wildlife due to changes in the natural hydrologic regime. The floodgate would be opened as soon as is safely possible after a closure for storm passage.

The velocities around and through the gate may require the channel bottom to be layered with 2-feet of riprap. After dredging the channel to El. -14.5, bedding would be placed on separator geotextile with the riprap on top of the bedding. A riprap gradation is assumed to be class 250 - 1000 lb stone (LADOTD 2016, Section 711). See Table 1 for example gradation limits for individual stone.

Table 1: Riprap Gradations

Gradation Limits Individual Stone Size (lbs)	Spherical Diameter (ft)	Percent Finer (By Weight)
1250	2.50	100
500	1.83	45-100
250	1.46	15-50
80	1.00	0-15

The barge gate would be constructed approximately in the center of the existing channel. A bypass channel would be constructed immediately adjacent to and to the right of the barge gate footprint prior to beginning construction of the floodgate to allow safe navigational passage of marine traffic, as well as all aquatic organisms to pass safely until the floodgate structure is complete (Figure 10).

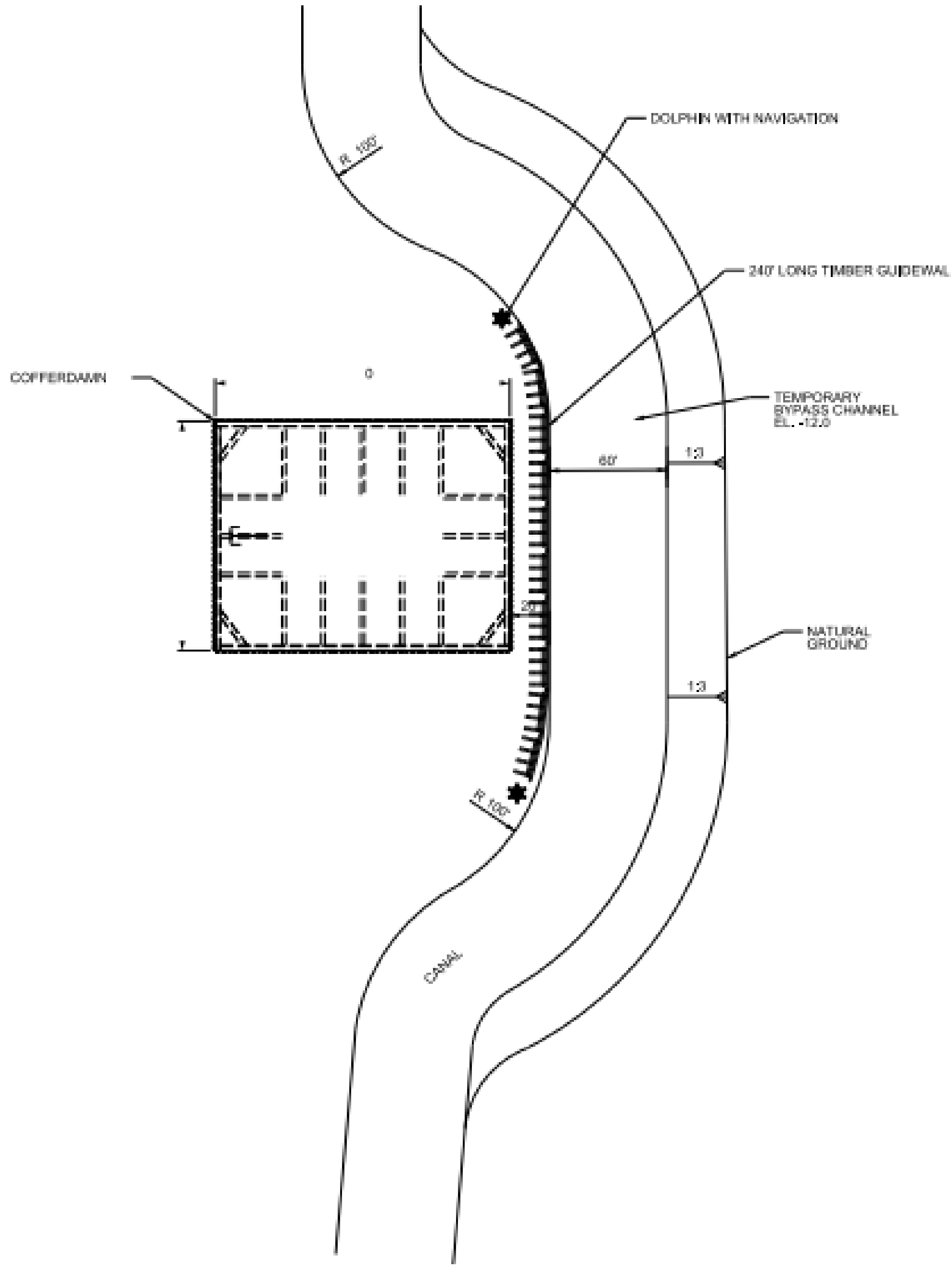


Figure 10: Preliminary bypass channel design

Preliminary designs of the bypass require a minimum bottom channel width of 60-foot temporary bypass channel with an invert of El. -12.0. Based on the preliminary design, the bypass channel would be approximately 650 feet long. However, navigation of common local vessels would be considered for the bypass channels, and design features of a navigable bypass channel would be developed during detailed design. At a minimum, to maintain pre-construction flow conditions, navigation and minimize environmental impacts during construction, the temporary bypass channels would be similarly sized to the channels being impacted. A timber guidewall (like the permanent guide wall shown in Figure 5) would be constructed between the bypass channel and the barge gate footprint to prevent the cofferdam (described below) from vessel impact while the cofferdam is in place.

A total of 22,063 cy of material would be excavated from the channel for gate complex, bypass channel, and floodwall tie-in construction. If the dredged material is found to be suitable for use within the project levee footprint, the material would be used within the levee or could potentially be utilized for marsh restoration within the overall project footprint, otherwise the material would be hauled off site and disposed in accordance with all state and federal laws.

Once navigation is routed through the temporary bypass channel, a Phase 1 cofferdam (approximately 150 feet x 118 feet) would be constructed to permit working in the dry when constructing the barge gate concrete landing slab, pivot arm assembly, and the receiving structure concrete monoliths. The cofferdam would be an internally braced cofferdam with wide flange walers and pipe braces supporting PZ sheet piling. Reduced power would be required for vessels passing through the construction area to reduce the risk of impact to the cofferdam. A timber guide wall and pile clusters would be provided along the bypass channel to prevent vessel impact on the cofferdam.

Once construction of the 56-foot barge gate landing slab, pivot arm assembly, receiving structure monoliths is completed, navigation would be re-routed through the permanent barge gate structure. Following routing the navigation traffic through the barge gate, the Phase 2 cofferdam, permanent guide walls and pile clusters, tie-in T-walls, and final civil site work can be completed. The Phase 2 cofferdams (approximately 120 feet x 80 feet on the east side and 60 feet x 80 feet on the west side of the floodgate) would be constructed to permit the construction of the adjacent T-walls to the barge gate structure that would be in the water. The same anchor forces, moments, and tips used for the Phase 1 cofferdams would be conservatively used for the Phase 2 cofferdams.

2.1.4 Construction Duration and Equipment

The construction duration of the Bayou Black Floodgate would be 24 months with an assumed work schedule of 5 days a week, 8 hours a day. The barge floodgate would be constructed using both floating equipment and land support. Below is the preliminary list of equipment anticipated to be utilized for the construction of the floodgate.

Table 2: Preliminary Equipment List for Sector Gate and Floodwall Construction

<table>
<tr><th>Project Component</th><th>Duration (days)</th><th>Equipment Used</th></tr>
<tr><td rowspan="7">Barge Gate Complex
& Tie-In Floodwall</td><td rowspan="13">730</td><td>150-Ton Crane</td></tr>
<tr><td>80-Ton Crane</td></tr>
<tr><td>Excavator</td></tr>
<tr><td>Pile Driver</td></tr>
<tr><td>Concrete Trucks</td></tr>
<tr><td>Concrete Vibrators</td></tr>
<tr><td>Welding Machine, Cutting Torch</td></tr>
<tr><td rowspan="6">Tie-In Levee</td><td>Dump Trucks</td></tr>
<tr><td>Bull Dozers</td></tr>
<tr><td>Fill Compactor</td></tr>
<tr><td>Front End Loader/Backhoe</td></tr>
<tr><td>Fuel Tanks</td></tr>
<tr><td>Generator</td></tr>
</table>

2.1.5 Access and Staging

Construction site access would be obtained by both barge and land. Vehicle access would be via LA Highway 182 and Geraldine Road to the project site. The construction staging area would be within the cleared area shown in Figure 11. It is assumed the staging area would be approximately 0.5 acres. The staging area would have a crushed stone on top of a separator fabric. Upon completion of the project, the staging area would be returned to pre-construction condition. The staging area would be used as an operations and materials storage area. The contractor would place the project trailers for both the Government and the contractor within the staging area. The contractor would store the project equipment and project building supplies within the staging area.

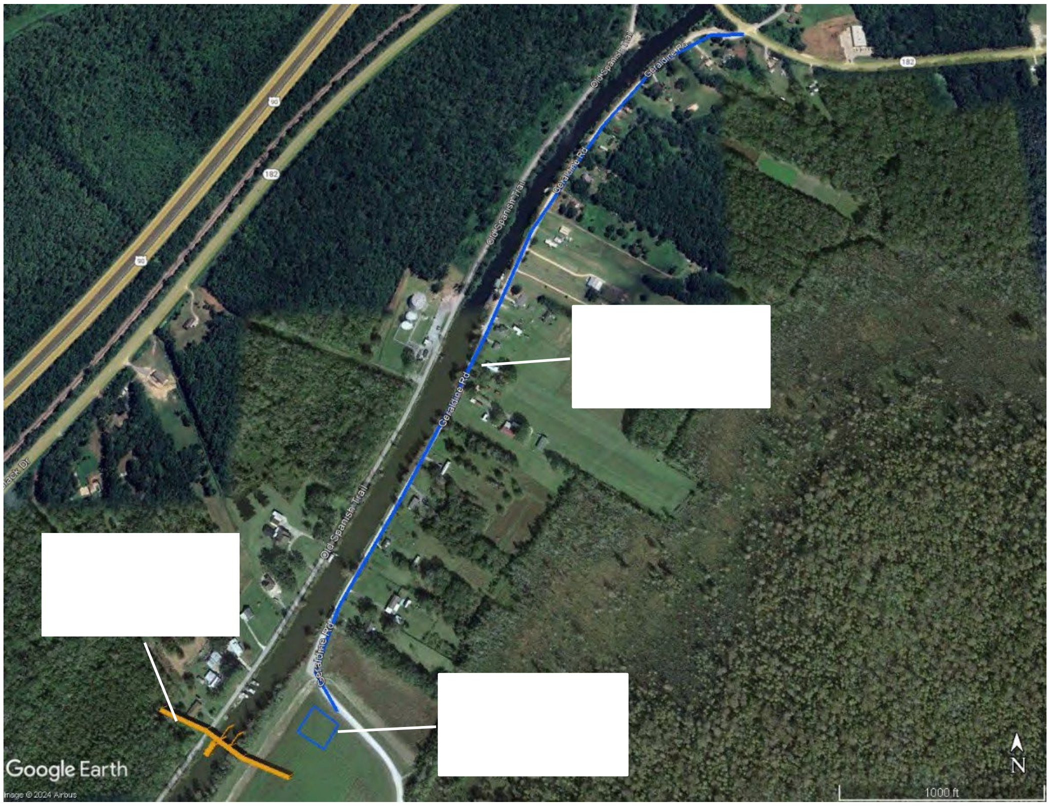


Figure 11: Project site access and staging

2.2 BARRIER REACH, ELLIOTT JONES PUMP STATION FRONTING PROTECTION

2.2.1 Location

The Elliott Jones Pump Station is located west of Houma in Terrebonne Parish, within the Barrier Reach of the larger MTG system at approximately latitude 29°37'25.08"N, longitude -90°55'16.07"W.

Figure 1: Location Map

2.2.2 Scope of Work

The proposed work consists of construction of a floodwall in front of an existing operating pump station. The floodwall would be constructed to fit between the existing pump station and the discharge basin (area where the pumps discharge the rainwater). In addition to the floodwall, the proposed action includes installing a valve within each of the existing pump station discharge pipes that could be closed to prevent storm surge from backflowing to the land side of the system through the discharge pipe. Finally, the transition between levee and floodwall would be protected with concrete or grouted riprap to prevent scour at this transition.

2.2.3 Structure Description

The existing walls at the Elliott Jones Pump Station do not have sufficient design capacity to provide protection from a 100-year storm surge event. The existing Pointe Aux Chenes Pump Station consists of four 60” diameter vertical pumps. A floodwall would be constructed in front of the existing station and the 60” diameter pipes would be extended through the newly constructed T-walls with a top elevation of 17.0 ft NAVD88 (Figure 2). A butterfly valve would be placed within each discharge pipe that would always remain open except when a name storm enters the Gulf. The butterfly valve would be able to be remotely operated from the pump station control panel as well locally at the butterfly valve itself. The pipe discharge bell would be relocated to the floodside of the system and discharge onto a portion of the t-wall slab and new riprap that would be placed as part of this contract.

The approximate length of the inverted T-type floodwall would be 660 total linear feet. The T-wall would be constructed on pile foundations with concrete base slabs and stems to the 2085 elevation 17.0 ft (NAVD 88) (Figure 2). It is anticipated that this floodwall would be constructed at grade minimizing the requirement for any significant excavation.

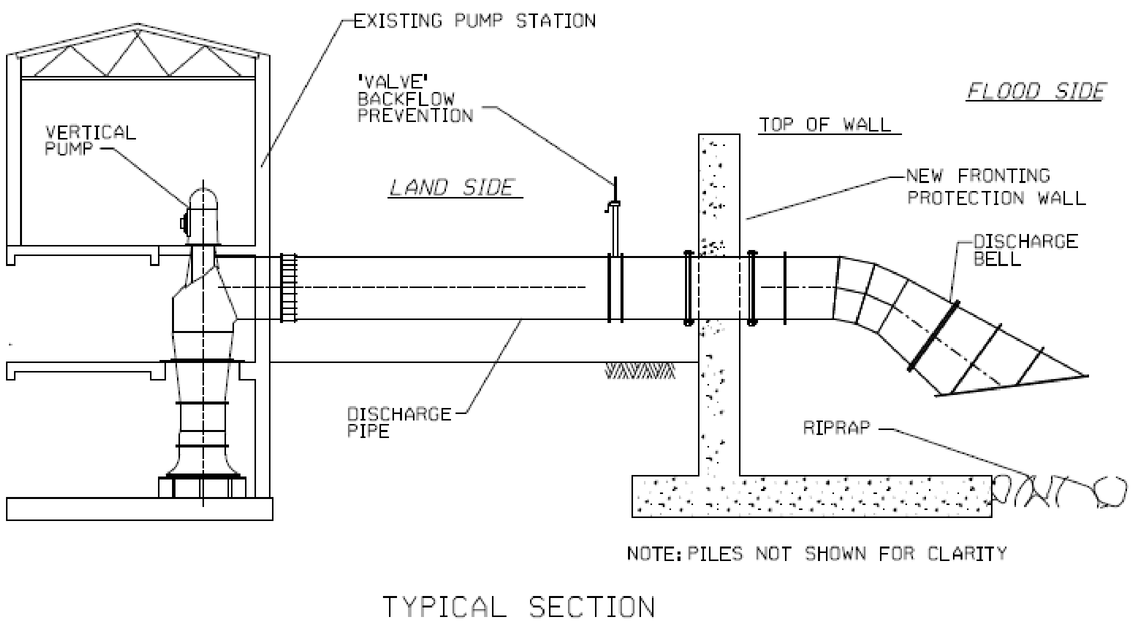


Figure 2: Typical Section of Fronting Protection Wall @ Pump Station

The T-wall monolith heights would vary with the tallest walls located in front of the pump station and the shortest walls tying into the adjacent levee. Figure 3 provides a sketch of the typical floodwall that would be used for this project.

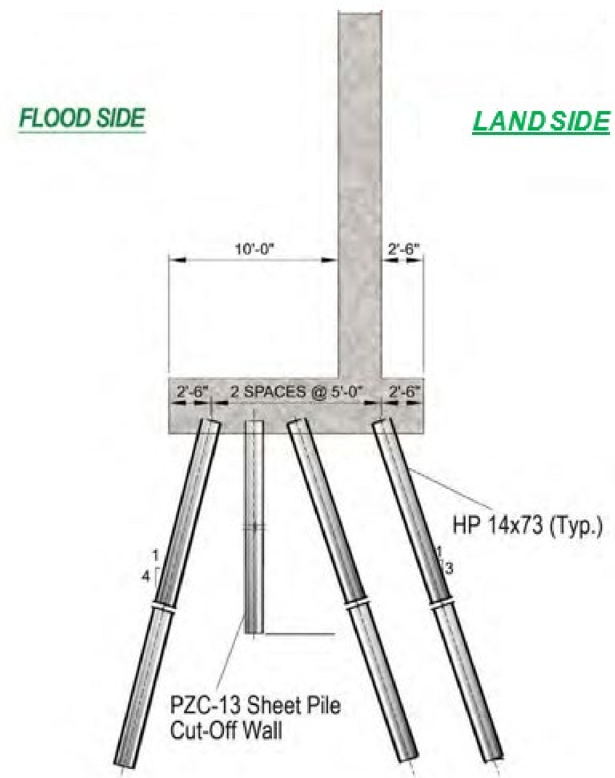


Figure 3: Typical Floodwall

Nine-inch concrete scour protection or grouted riprap would be used at the levee/ T-wall transition. The concrete scour protection will protect the levee where the T-wall stem extends into the full levee section and extend down both levee slopes. The scour protection would continue for 30 linear feet past the end of the T-wall. Uncapped cut-off sheet piling would extend horizontally 30 feet into the full levee section for erosion and seepage control. Reference Figure 4 as an example of the proposed scour protection.

Figure 4: Concrete Scour Protection Example

With the pipe discharge bell being relocated to the floodside of the system and discharging onto a portion of the t-wall slab, riprap would be required to dissipate the energy from the pumping of the rainwater out of the system, extending a distance to be determined during detailed design. A riprap gradation is assumed to be class 250 - 1000 lb stone (LADOTD 2016, Section 711). See Table 1 for example gradation limits for individual stone.

Table 1: Riprap Gradations

Gradation Limits Individual Stone Size (lbs)	Spherical Diameter (ft)	Percent Finer (By Weight)
1250	2.50	100
500	1.83	45-100
250	1.46	15-50
80	1.00	0-15

The floodwall would be constructed at grade minimizing the requirement for any significant excavation. The minimal excavated material from constructing the floodwalls may be used within the levee footprint or if determined suitable could be used for marsh mitigation. If deemed unsuitable, the material would be hauled off site and disposed in accordance with applicable state and federal laws.

2.2.4 Construction Duration and Equipment

The construction duration of the Elliott Jones Fronting Protection would be 24 months with an assumed work schedule of 5 days a week, 8 hours a day. The floodwalls in front of the pump station would be constructed using both floating equipment and land support. Below is the preliminary list of equipment anticipated to be utilized for the construction of the Elliott Jones Fronting Protection.

Table 2: Preliminary Equipment List for Sector Gate and Floodwall Construction

Project Component	Duration (days)	Equipment Used
Fronting Protection & Tie-In Floodwall	730	150-Ton Crane
		80-Ton Crane
		Excavator
		Pile Driver
		Concrete Trucks
		Concrete Vibrators
		Welding Machine, Cutting Torch
Tie-In Levee		Dump Trucks
		Bull Dozers
		Fill Compactor
		Front End Loaded/Backhoe
		Fuel Tanks
		Generator

2.2.5 Access and Staging

In general, construction site access would be obtained by land. Vehicle access would be via LA Highway 182 to the Shell E&P Road down to the project site. The construction staging area would be within the area shown in Figure 5 within a cleared lot. It is assumed the staging area would be 0.4 acres. The staging area would have a crushed stone on top of a separator fabric. Upon completion of the project, the staging area would be returned to pre-construction condition. The staging area would be used as an operations and materials storage area. The contractor would be allowed to place project trailers for both the Government and the contractor. The contractor would store the project equipment and project building supplies within the staging area.

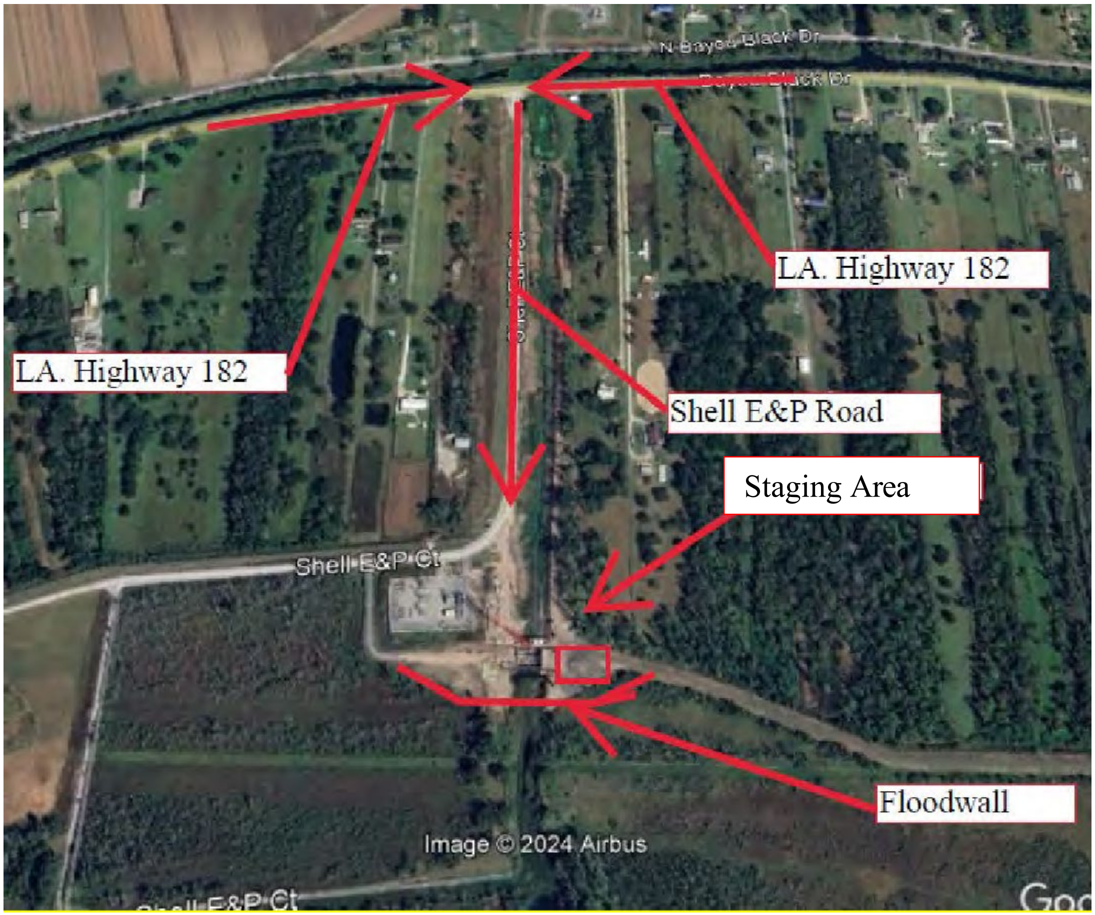


Figure 5: Access and Staging

Table 3: Latitude and longitude for location of staging areas.

Staging Area			
29°37'23.9359"N -90°55'14.6891"W	29°37'24.5661"N -90°55'14.2035"W	29°37'23.8915"N -90°55'13.3574"W	29°37'23.2530"N -90°55'13.8495"W

2.3 BARRIER REACH, SHELL CANAL EAST FLOODGATE

2.3.1 Location

The Shell Canal East Barge Floodgate gate is located on the Shell canal within Terrebonne Parish and is located at latitude 29°37'30.43", longitude -90°55'57.69".

Figure 1: Location Map

2.3.2 Scope of Work

This contract would consist of a Barge floodgate. On both the inflow and the outflow of the gate bay, there would be timber guide walls and protection pile clusters. Finally, the transition between levee and floodwall would be protected with concrete or grouted riprap to prevent scour at this transition.

2.3.3 Structure Description

This floodgate would be a 125' wide barge type floodgate with a top elevation of +17.0' NAVD88, and a slab invert elevation of -12.0' NAVD88. The floodgate would provide an opening in the system to allow unimpeded navigation, except when a tropical system approaches the Gulf of America in which case the barge gate and sluice gates would be closed.

A barge gate is constructed of a braced steel frame with sheet metal or solid plate exterior in a hollow box configuration that resembles a hopper barge (see Figure 2). The gate normally contains several individual compartments that are watertight. The gate would have a pivot arm at one end that allows the gate to articulate in a 90° arc to open and close. The pivot arm would be mounted onto a fixed pivot pile that would allow the gate and pivot arm free travel in the vertical direction (for flotation). When the gate is in either the open or closed position, pumps fill the compartments with water until the buoyancy is overcome and the structure settles onto a receiving structure. While in the open position, the gate would also function as a guide wall to aid the vessels in navigating through the structure. In the closed position, the gate is ballasted down to an underwater foundation with gravity loads transferred through the base seal and the base support (see Figures 3 & 4). The flat top of the gate allows passage of either pedestrian or motorized ATV traffic. Lateral loads from high tides or storm surge on the barge gate are transferred into two concrete abutment reaction walls on either end of the gate structure.

Figure 2: Typical Barge Gate Example

Figure 3: Conceptual Barge Gate - Elevation View with Gate in Open Position

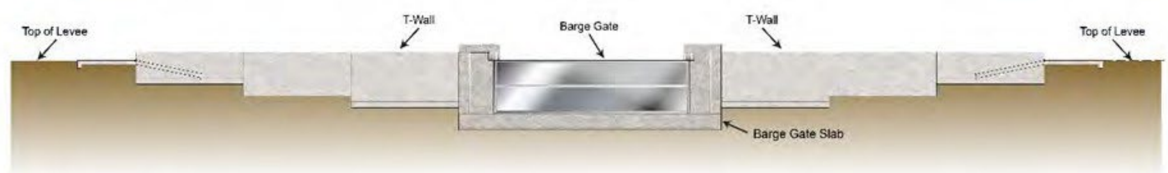


Figure 4: Conceptual Barge Gate - Elevation View with Gate in Closed Position

The floodgate would have timber guide walls and pile dolphin structures on both the land and flood side. The seven pile dolphin structures are constructed at the end of the guide wall to protect the guide walls from impact from vessels. The guide walls would be timber support frames currently spaced every 6 feet. Each timber support frame is constructed with a vertical pile braced by a batter pile driven at an angle from vertical. The outer end of each guide wall is anchored with a seven-pile dolphin structure. The dolphins would consist of 7 timber piles battered away from each other and tied together with a wire rope at the top of the dolphin. Please see figure 5, 6 and 7 for more details.

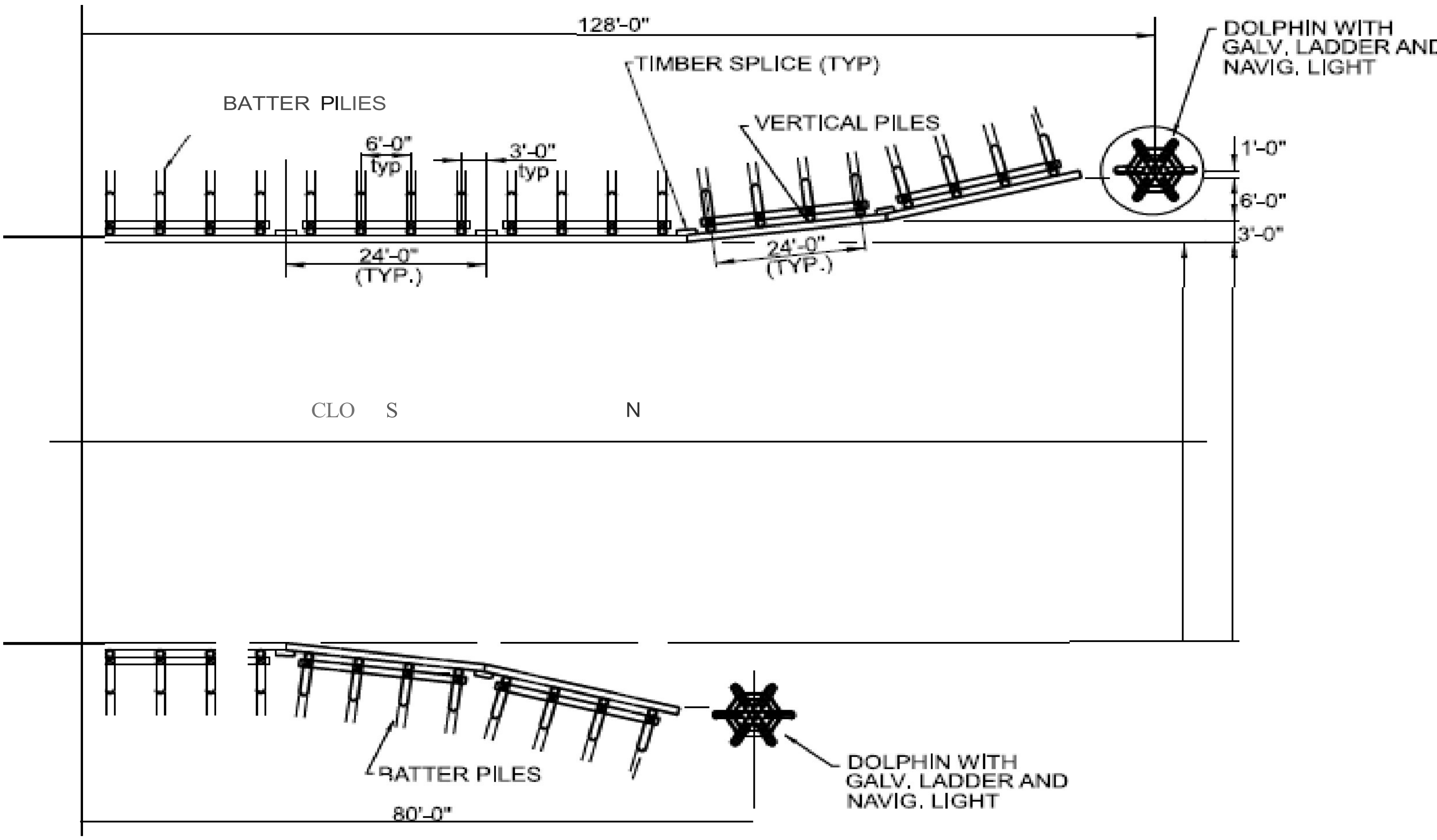


Figure 5: Plan – Guide walls, Fenders, and Dolphins

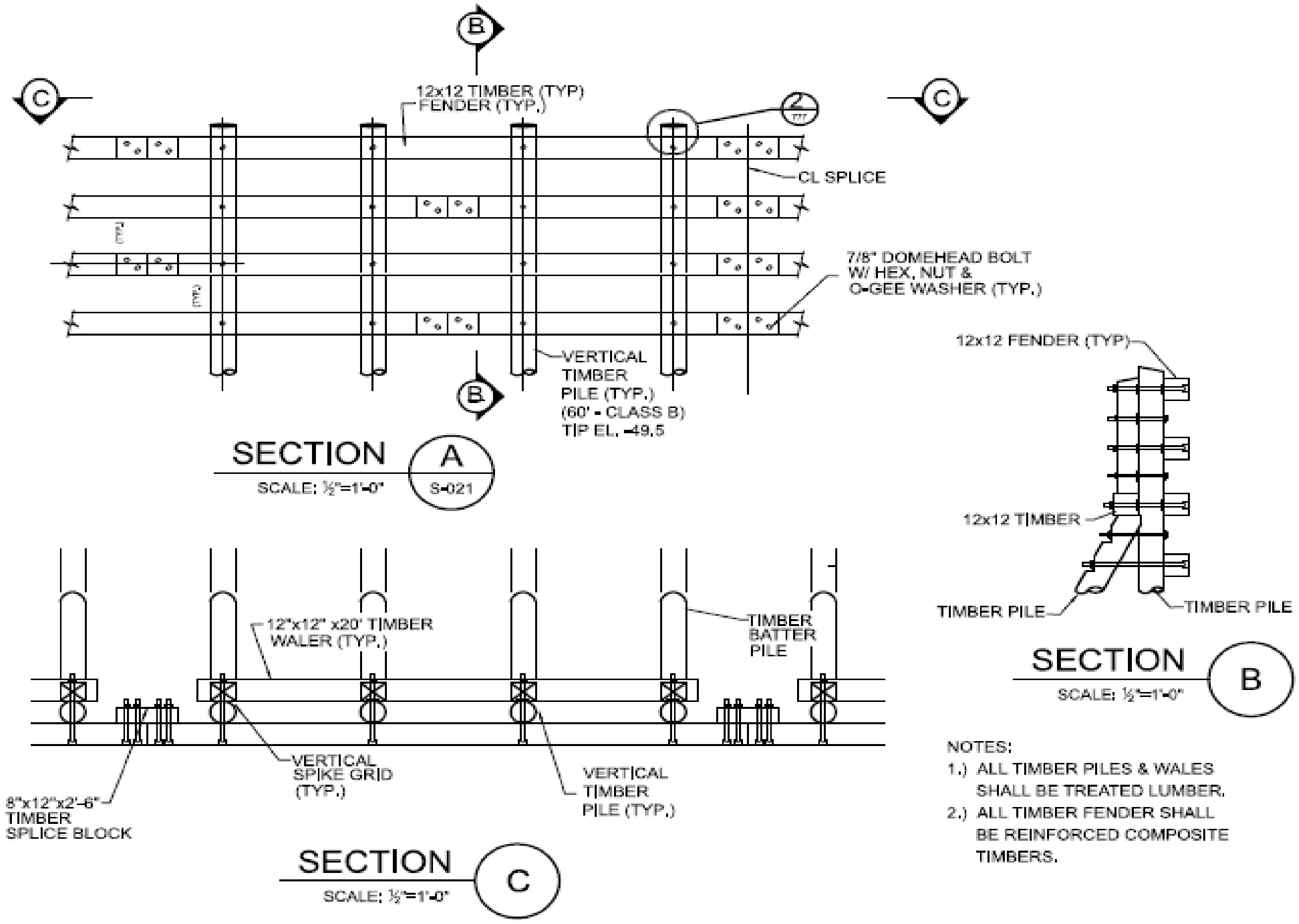


Figure 6: Guide wall Details

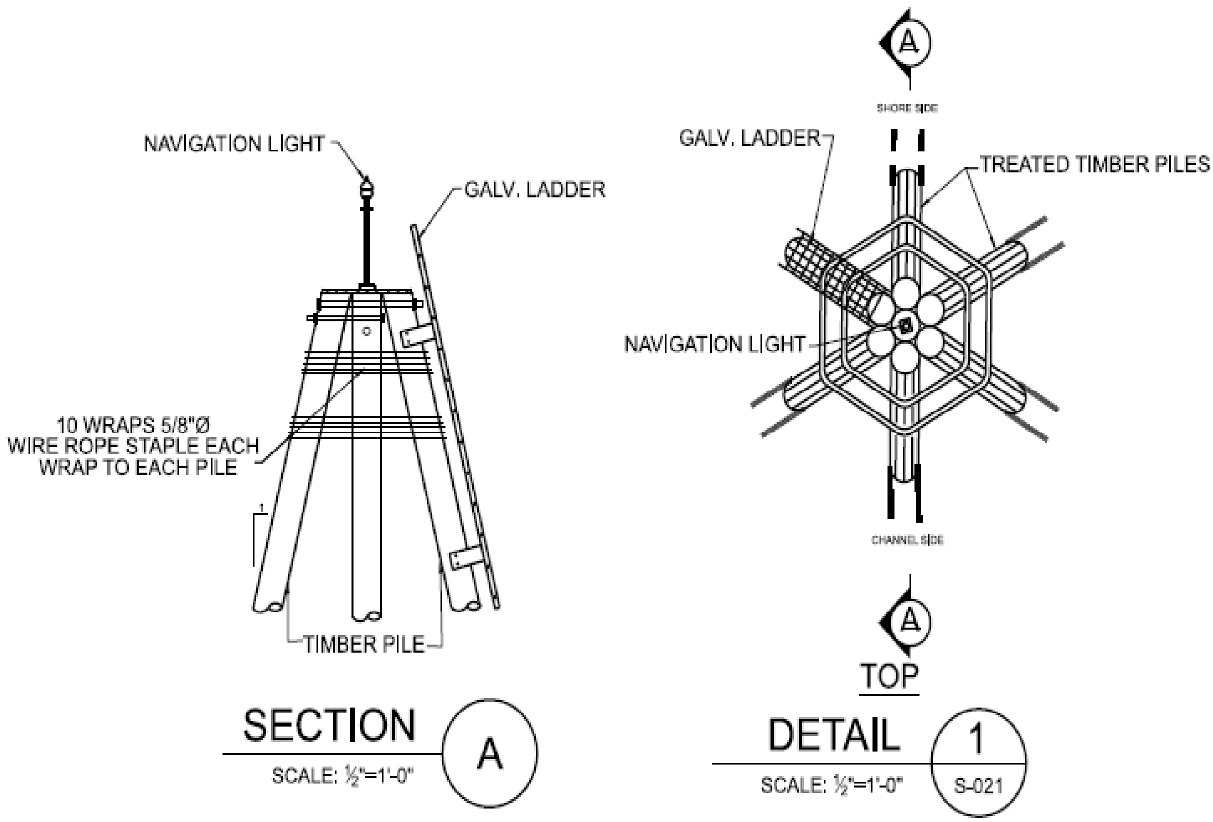


Figure 7: Dolphin Details

Approximately 610 total linear feet (305 linear feet on each side of the floodgate) of floodwalls, specifically T-walls, would extend from the sluice gates and tie into the adjacent levees. The floodwalls would have a top elevation of 17.0 NAVD88.

The T-wall monoliths vary with the tallest walls adjacent to the sluice gate and the shortest walls that tie into the adjacent levee. Details on typical section of floodwall is provided in Figure 8.

The design of the new barge gate and floodwalls, including the foundation is subject to change once detailed geotechnical investigations are conducted during detailed design.

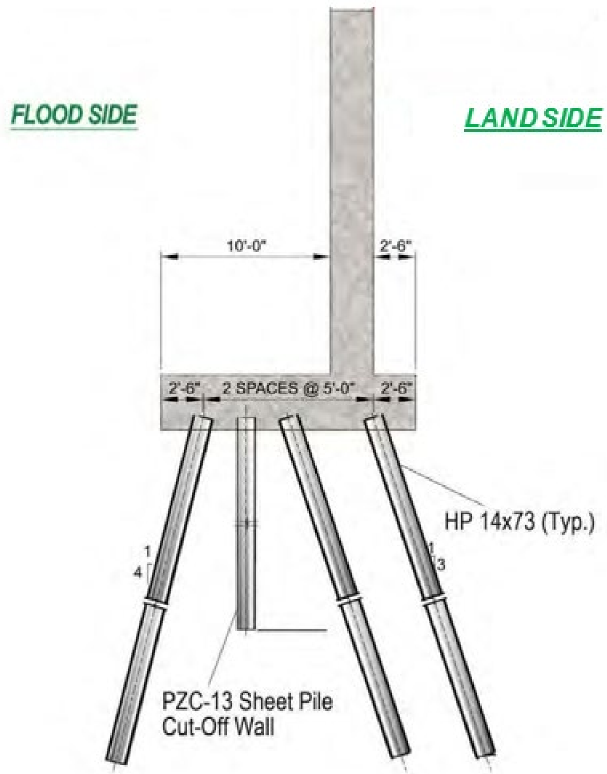


Figure 8: Typical Floodwall

Nine-inch-thick concrete scour protection or grouted riprap would be used at the levee-floodwall transition (tie-in). The concrete scour protection or grouted riprap protects the levee where the floodwall stem extends into the full levee section and

extends down both levee slopes. The scour protection would continue for 30 linear feet past the end of the floodwall. Uncapped, cut-off sheet piling would extend horizontally 30 feet into the full levee section for erosion and seepage control. Please see Figure 9 below for an example of the proposed scour protection.

Figure 9: Illustration of Scour Protection at Levee-Floodwall Tie-in.

In order for facility owners at the Shell canal east site to maintain existing operations once the floodgate is in place, excavation would be needed within two areas totaling 5.7 acres adjacent to the existing canal (Figure 10). These areas would be excavated to match the existing depth of the adjacent canal. The exact amount of excavation will be determined from the upcoming ship simulation.

Figure 10: Areas of additional excavation required

The barge gate would be constructed near the mouth of the Shell facility slip. The existing centerline of Shell Canal has an approximate elevation of EL. -10.0 (NAVD 88). For the construction of the gate foundation, the channel would be excavated to an approximate elevation -19.5 with the final constructed sill elevation being El. -12.0.

Directly adjacent to the floodgate slab, both on the land and the flood side of the gate would be excavated to an El. -14.5 (NAVD 88) to place both the bedding stone and the riprap required. The channel bottom would remain at El. -12.0 (NAVD 88) for approximately 50-feet, both upstream and downstream of the newly constructed floodgate slab. The channel would then slope to allow a smooth transition from the sill elevation to existing grade over approximately 100-feet on both the land and flood side of the gate to afford aquatics the ability to migrate past gate sill.

The cross section at the gate location would be designed such that the pre and post project conditions would not impede the natural movement of aquatic organisms. The default operation would be open to avoid additional indirect impacts to vegetation and

fish and wildlife due to changes in the natural hydrologic regime. The floodgate would be opened as soon as is safely possible after a closure for storm passage.

The velocities around and through the gate may require the channel bottom to be layered with 2-feet of riprap. After dredging the channel to El. -14.5, bedding would be placed on separator geotextile with the riprap on top of the bedding. A riprap gradation is assumed to be class 250 - 1000 lb stone (LADOTD 2016, Section 711). See Table *3* for example gradation limits for individual stone.

Table 3: Riprap Gradations

Gradation Limits Individual Stone Size (lbs)	Spherical Diameter (ft)	Percent Finer (By Weight)
1250	2.50	100
500	1.83	45-100
250	1.46	15-50
80	1.00	0-15

The barge gate would be constructed approximately in the center of the existing channel. A bypass channel would be constructed immediately adjacent to and to the east side of the barge gate cofferdam footprint prior to beginning construction of the floodgate to allow safe navigational passage of marine traffic, as well as all aquatic organisms to pass safely until the floodgate structure is complete (Figure 11).

Preliminary designs of the bypass require a minimum bottom channel width of 60 ft temporary bypass channel with an invert of El. -12.0 ft. Based on the preliminary design, the bypass channel would be approximately 650 feet long and affect approximately 2.0 acres of water bottom. However, navigation of common local vessels would be considered for the bypass channels, and design features of a navigable bypass channel would be developed during detailed design. At a minimum, to maintain pre-construction flow conditions, navigation and minimize environmental impacts during construction, the temporary bypass channels would be similarly sized to the channels being impacted. A timber guidewall (like the permanent guide wall shown in Figure 5) would be constructed between the bypass channel and the barge gate footprint to prevent the cofferdam (described below) from vessel impact while the cofferdam is in place.

A total of 19,202 cy of material would be excavated from the channel for gate complex, bypass channel, and floodwall tie-in construction. If the dredged material is found to be suitable for use within the project levee footprint, the material would be used within the levee or could potentially be utilized for marsh restoration within the overall project footprint, otherwise the material would be hauled off site and disposed in accordance with all state and federal laws.

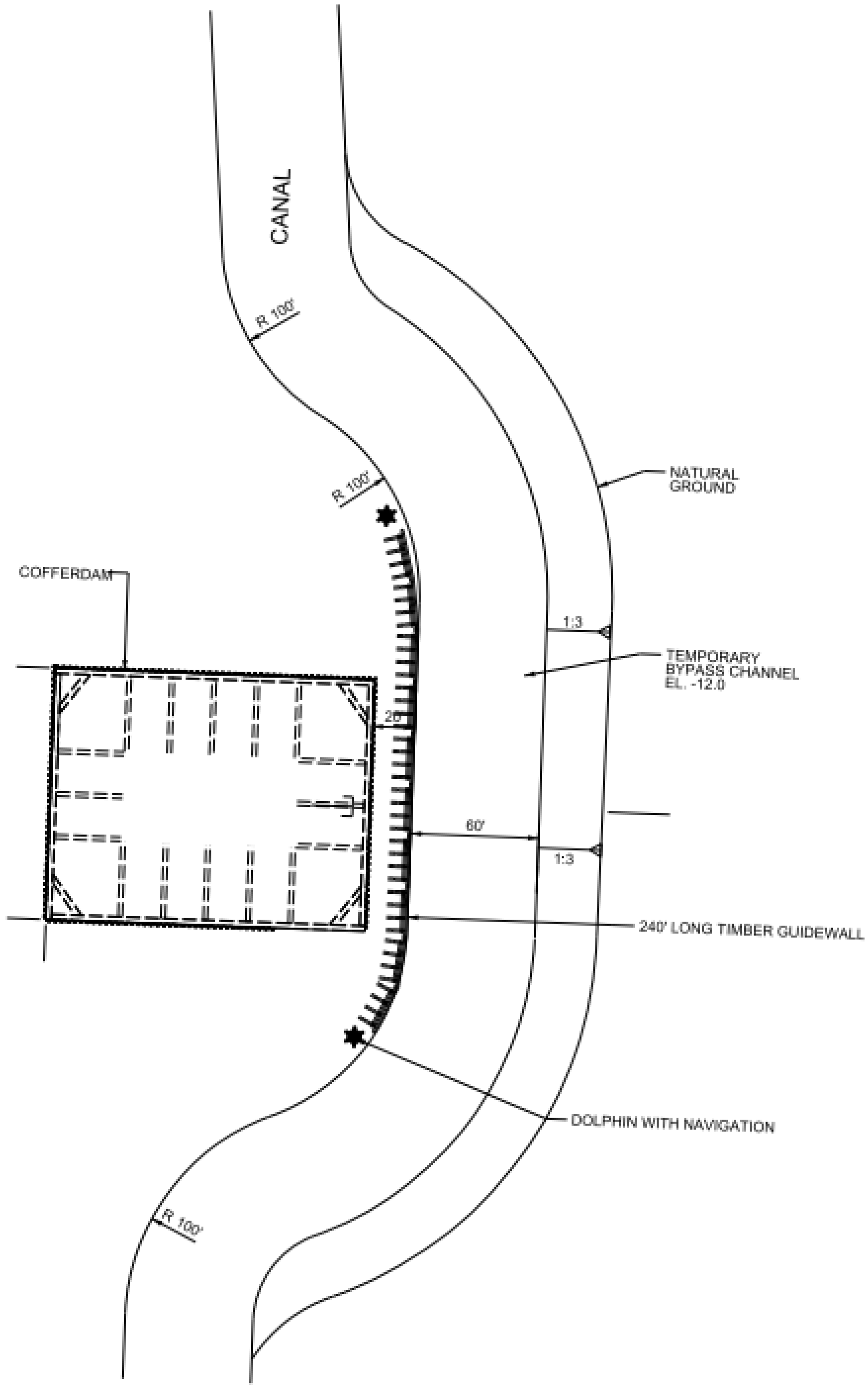


Figure 11: Preliminary bypass channel design

Once navigation is routed through the temporary bypass channel, a Phase 1 cofferdam (approximately 150 feet x 118 feet) would be constructed to permit the in the dry construction of the barge gate concrete landing slab, pivot arm assembly and the receiving structure concrete monoliths. The cofferdam would be an internally braced

cofferdam with wide flange wales and pipe braces supporting PZ sheet piling. Reduced power would be required for vessels passing through the construction area to reduce the risk of impact to the cofferdam.

Once construction of the barge gate landing slab, pivot arm assembly, receiving structure monoliths, and sluice gate monoliths are completed, navigation would be re-routed through the permanent barge gate structure. After construction, the bypass channel is assumed to be included in the footprint of the structure site and the channel flow would be rerouted through the new structure feature. Once navigation is re-routed through the new floodgate, the Phase 2 cofferdam would be constructed and permanent guidewalls and pile clusters, tie-in T-walls, and final civil site work can be completed.

The Phase 2 cofferdam (approximately 120 feet x 80 feet on the east side of the barge gate and approximately 60 feet x 80 feet the west side of the floodgate) would be constructed to permit the construction of the adjacent T-walls to the sluice gate structures that would be in the water.

2.3.4 Construction Duration and Equipment

The construction duration of the Shell Canal Floodgate would be 24 months with an assumed work schedule of 5 days a week, 8 hours a day. The barge floodgate would be constructed using both floating equipment and land support. Below is the preliminary list of equipment anticipated to be utilized for the construction of the floodgate.

Table 4: Preliminary Equipment List for Sector Gate and Floodwall Construction

Project Component	Duration (days)	Equipment Used
Barge Gate Complex & Tie-In Floodwall	730	150-Ton Crane
		80-Ton Crane
		Excavator
		Pile Driver
		Concrete Trucks
		Concrete Vibrators
		Welding Machine, Cutting Torch
Tie-In Levee		Dump Trucks
		Bull Dozers
		Fill Compactor
		Front End Loader/Backhoe
		Fuel Tanks
		Generator

2.3.5 Access and Staging

In general, construction site access would be obtained by both barge and land. Vehicle access would be via Highway 182 to the entrance for Empire Midstream and Shell Oil Company and from the Shell E&P Road on the east side of the project. From this road, the site is accessible on both sides of the canal. Barges and boats may be launched from nearby at Bob's Bayou Black Marina near Gibson, Louisiana and could then operate along the canal to the construction site (Figure 12). The construction staging area would be within the cleared grass area shown in Figure 12 within the existing berm of the levee. It is assumed the staging area would be approximately 0.7 acres. The staging area would have a crushed stone on top of a separator fabric. Upon completion of the project, the staging area would be returned to pre-construction condition. The staging area would be used as an operations and materials storage area. The contractor would place the project trailers for both the Government and the contractor within the staging area. The contractor would store the project equipment and project building supplies within the staging area.

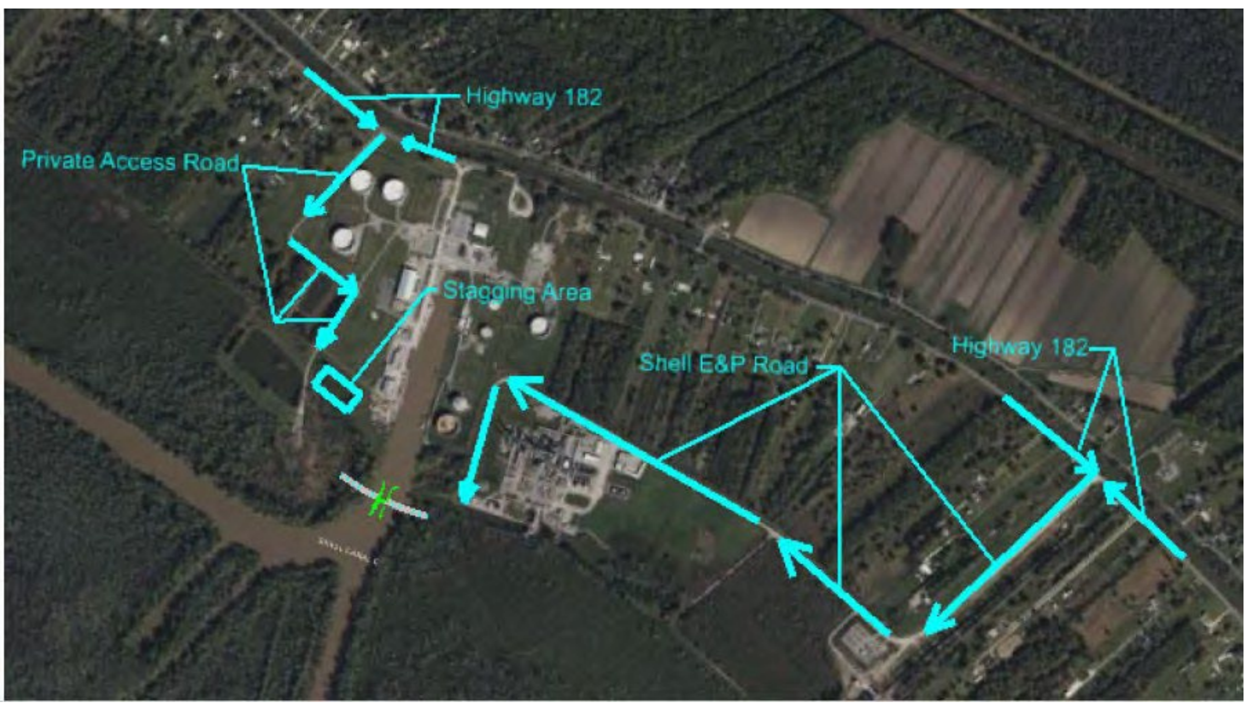


Figure 12: Staging and Access

2.4 BARRIER REACH, BAYOU BLACK PUMP STATION FRONTING PROTECTION

2.4.1 Location

The Bayou Black Pump Station is located west of Houma in Terrebonne Parish, within the Barrier Reach of the larger MTG system at approximately latitude 29°36'48.34", long -90°54'15.16" (Figure 1).

Figure 1: Location Map

2.4.2 Scope of Work

The proposed work consists of construction of a floodwall in front of an existing operating pump station. The floodwall would be constructed to fit between the existing

pump station and the discharge basin (area where the pumps discharge the rainwater). In addition to the floodwall, the proposed action includes installing a valve within each of the existing pump station discharge pipes that could be closed to prevent storm surge from backflowing to the land side of the system through the discharge pipe. Finally, the transition between levee and floodwall would be protected with concrete or grouted riprap to prevent scour at this transition.

2.4.3 Structure Description

The existing system at the Bayou Black pumping stations do not have sufficient design capacity to provide protection from a 100-year storm surge event. The existing Bayou Black Pump Station consists of two 42” diameter vertical pumps. A floodwall would be constructed in front of the existing station and the 42” diameter pipes would be extended through the newly constructed T-walls with a top elevation of 17.0 ft NAVD88 (Figure 2). A butterfly valve would be placed within each discharge pipe that would always remain open except when a name storm enters the Gulf. The butterfly valve would be able to be remotely operated from the pump station control panel as well locally at the butterfly valve itself. The pipe discharge bell would be relocated to the floodside of the system and discharge onto a portion of the t-wall slab and new riprap that would be placed as part of this contract.

The approximate length of the inverted T-type floodwall would be 860 total linear feet. The T-wall would be constructed on pile foundations with concrete base slabs and stems to the 2085 elevation +17.0 ft (NAVD 88) (Figure 3). It is anticipated that this floodwall would be constructed at grade minimizing the requirement for any significant excavation.

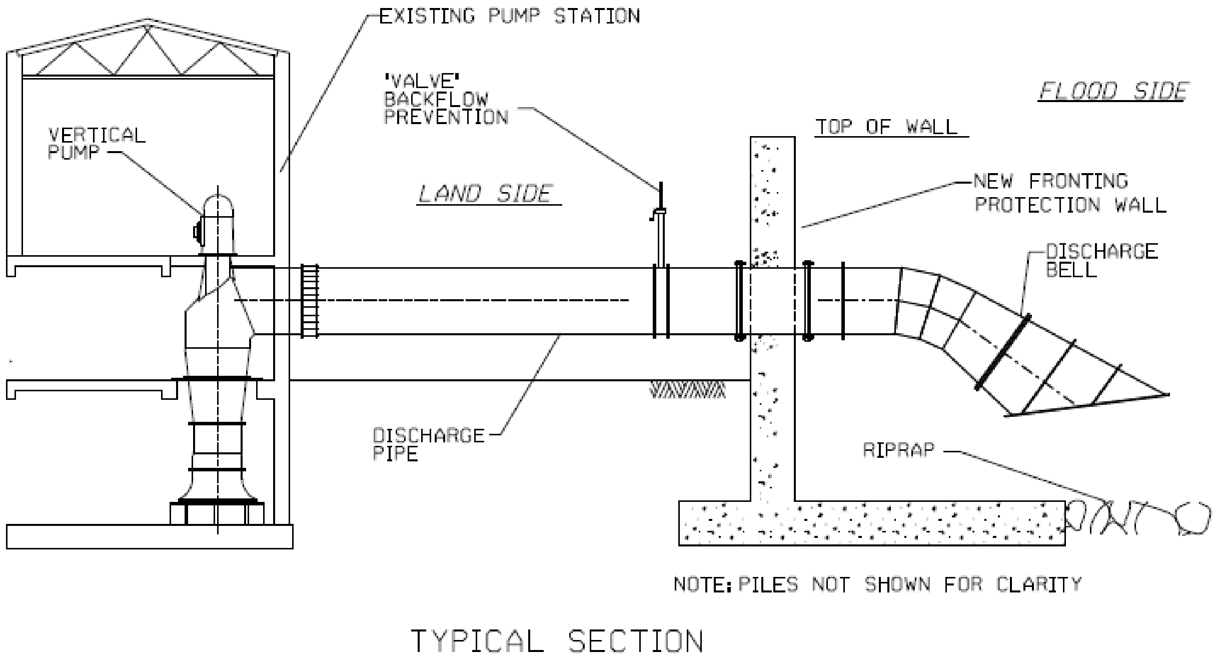


Figure 2: Typical Section of Fronting Protection Wall @ Pump

The T-wall monolith heights would vary with the tallest walls located in front of the pump station and the shortest walls tying into the adjacent levee. The T-wall stems would vary from seventeen feet near the pumping station to nine at the levee tie-in.

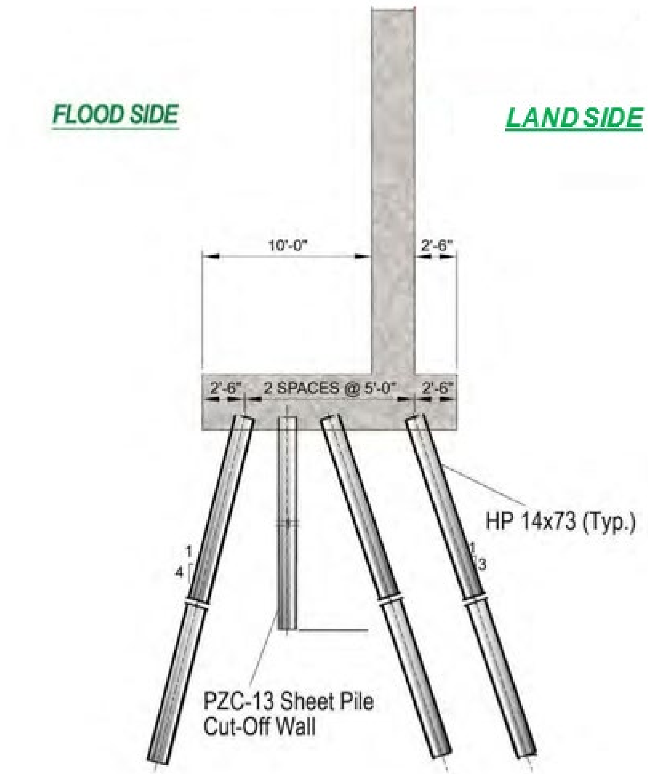


Figure 3: Typical Floodwall

Nine-inch concrete scour protection or grouted riprap would be used at the levee/ T-wall transition. The concrete scour protection would protect the levee where the T-wall stem extends into the full levee section and extend down both levee slopes. The scour protection would continue for 30 linear feet past the end of the T-wall. Uncapped cut-off sheet piling would extend horizontally 30 feet into the full levee section for erosion and seepage control. Reference Figure 4 as an example of the proposed scour protection.

Figure 4: Concrete Scour Protection Example

With the pipe discharge bell being relocated to the floodside of the system and discharging onto a portion of the t-wall slab, riprap would be required to dissipate the energy from the pumping of the rainwater out of the system, extending a distance to be determined during detailed design. A riprap gradation is assumed to be class 250 - 1000 lb stone (LADOTD 2016, Section 711). See Table 1 for example gradation limits for individual stone.

Table 1: Riprap Gradations

Gradation Limits Individual Stone Size (lbs)	Spherical Diameter (ft)	Percent Finer (By Weight)
1250	2.50	100
500	1.83	45-100
250	1.46	15-50
80	1.00	0-15

The floodwall would be constructed at grade minimizing the requirement for any significant excavation. There would be approximately 4000 CY of excavated material resulting from the construction of the floodwall. The excavated material from constructing the floodwalls may be used within the levee footprint or if determined suitable could be used for marsh mitigation. If deemed unsuitable, the material would be hauled off site and disposed in accordance with applicable state and federal laws.

2.4.4 Construction Duration and Equipment

The construction duration of the Bayou Black Fronting Protection would be 24 months with an assumed work schedule of 5 days a week, 8 hours a day. The floodwalls in front pump station would be constructed using both floating equipment and land support.

Below is the preliminary list of equipment anticipated to be utilized for the construction of the Bayou Black Fronting Protection.

Table 4: Preliminary Equipment List for Sector Gate and Floodwall Construction

Project Component	Duration (days)	Equipment Used
Fronting Protection & Tie-In Floodwall	730	150-Ton Crane
		80-Ton Crane
		Excavator
		Pile Driver
		Concrete Trucks
		Concrete Vibrators
		Welding Machine, Cutting Torch
Tie-In Levee		Dump Trucks
		Bull Dozers
		Fill Compactor
		Front End Loaded/Backhoe
		Fuel Tanks
		Generator

2.4.5 Access and Staging

In general, construction site access would be obtained by land. Vehicle access would be via LA Highway 182 to Gator Court down to the project site. The construction staging area would be within the area shown in Figure 6 within a cleared lot. It is assumed the staging area would be 0.2 acres. Upon completion of the project, the staging area would be returned to pre-construction condition. The staging area would be used as an operations and materials storage area. The contractor would be allowed to place project trailers for both the Government and the contractor. The contractor would store the project equipment and project building supplies within the staging area.

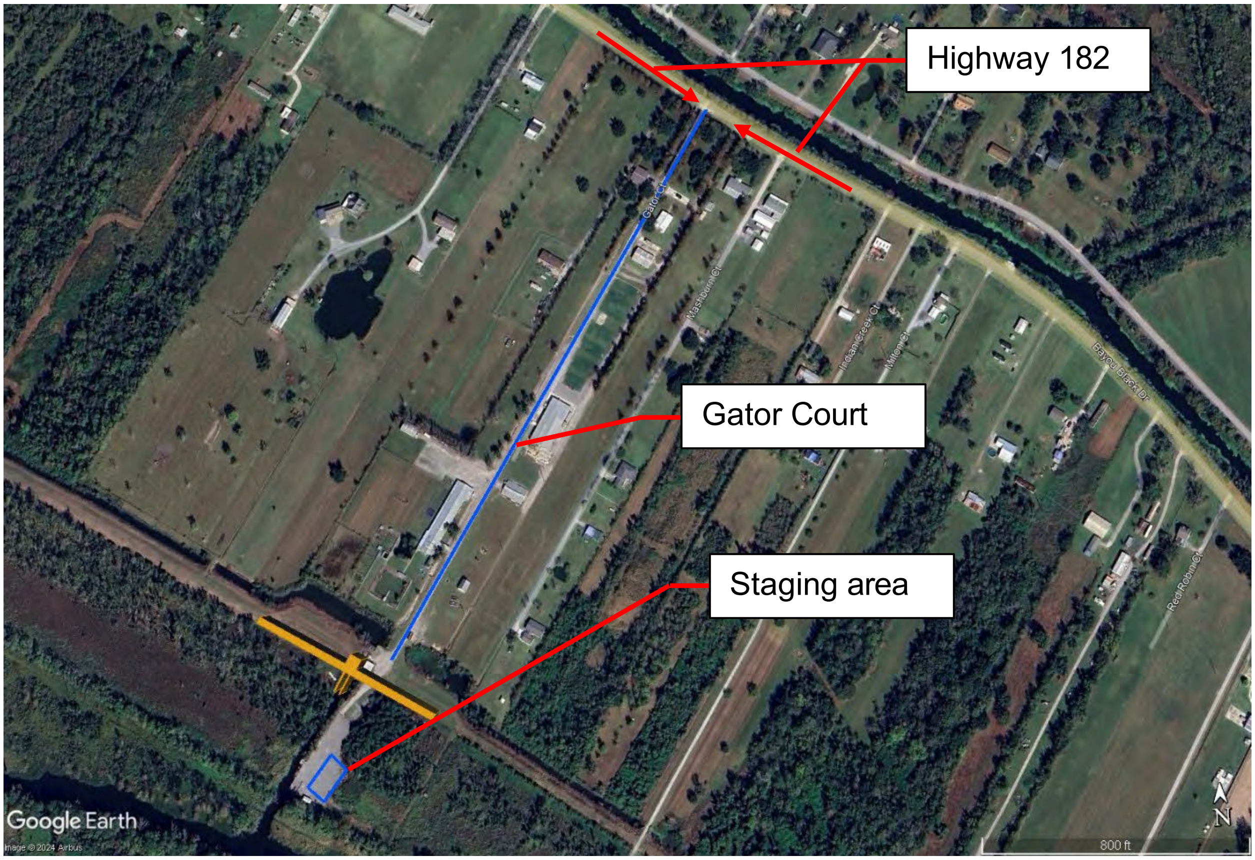


Figure 5: Access and Staging

2.5 BARRIER REACH, HANSON FRONTING PROTECTION

2.5.1 Location

The Hanson Canal Pumping station is positioned west of ouHoHouma in Terrebonne Parish within the alignment of the existing Morganza to the Gulf system at approximately latitude 29°36'09.8853", longitude -90°51'37.3991".

Figure 1: Location Map

2.5.2 Scope of Work

The proposed work would include construction of a floodwall in front of an existing operating pump station. The floodwall would be constructed to fit between the existing pump station and the discharge basin (area where the pumps discharge the rainwater).

In addition to the floodwall, the proposed action includes installing a valve within each of the existing pump station discharge pipes that could be closed to prevent storm surge from backflowing to the land side of the system through the discharge pipe. Finally, the transition between levee and floodwall would be protected with concrete or grouted riprap to prevent scour at this transition.

2.5.3 Structure Description

Hanson Canal Pump Station consists of two 42” diameter vertical pumps. A floodwall would be constructed in front of the existing station and the 42” diameter pipes would be extended through the newly constructed T-walls with a top elevation of 17.0 ft NAVD88 (Figure 2). A butterfly valve would be placed within each discharge pipe that would always remain open except when a name storm enters the Gulf. The butterfly valve would be able to be remotely operated from the pump station control panel as well locally at the butterfly valve itself. The pipe discharge bell would be relocated to the floodside of the system and discharge onto a portion of the t-wall slab and new riprap that would be placed as part of this contract.

The approximate length of the inverted T-type floodwall would be 860 total linear feet. The T-wall would be constructed on pile foundations with concrete base slabs and stems to the 2085 elevation +17.0 feet (NAVD 88) (Figure 2). It is anticipated that this floodwall would be constructed at grade minimizing the requirement for any significant excavation.

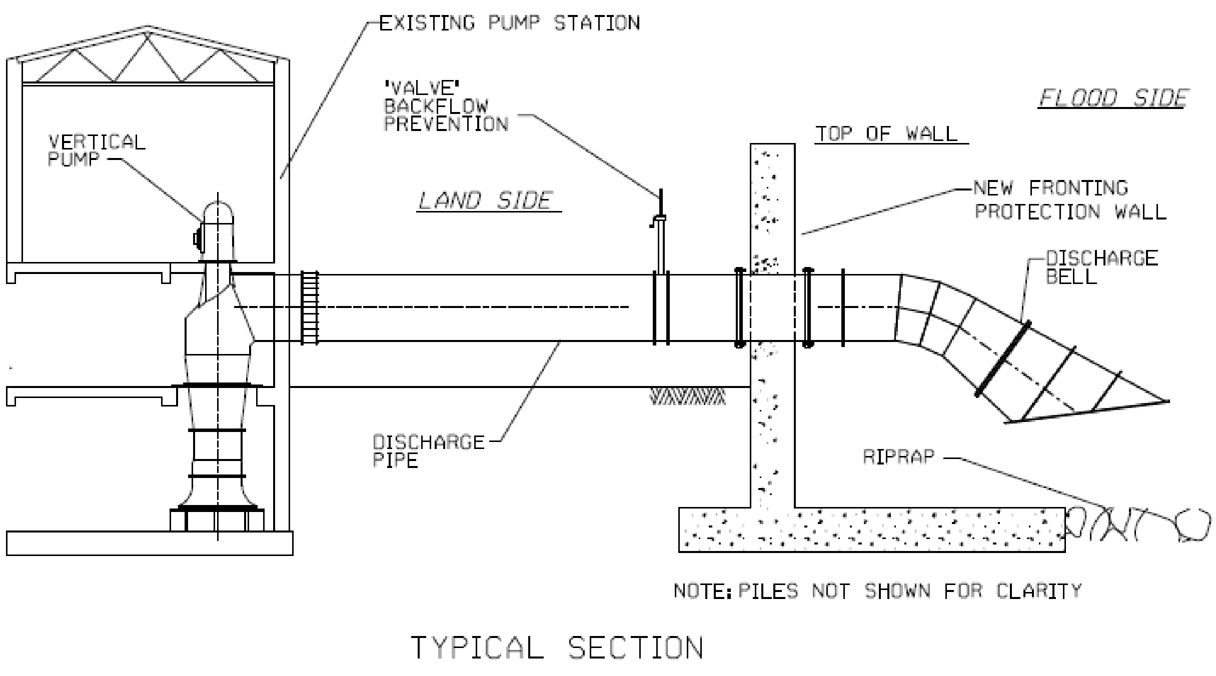


Figure 2: Typical Section of Fronting Protection Wall @ Pump Station

The T-wall monolith heights will vary with the tallest walls located in front of the pump station and the shortest walls tying into the adjacent levee. Figure 3 provides a sketch of the typical floodwall that would be used for this project.

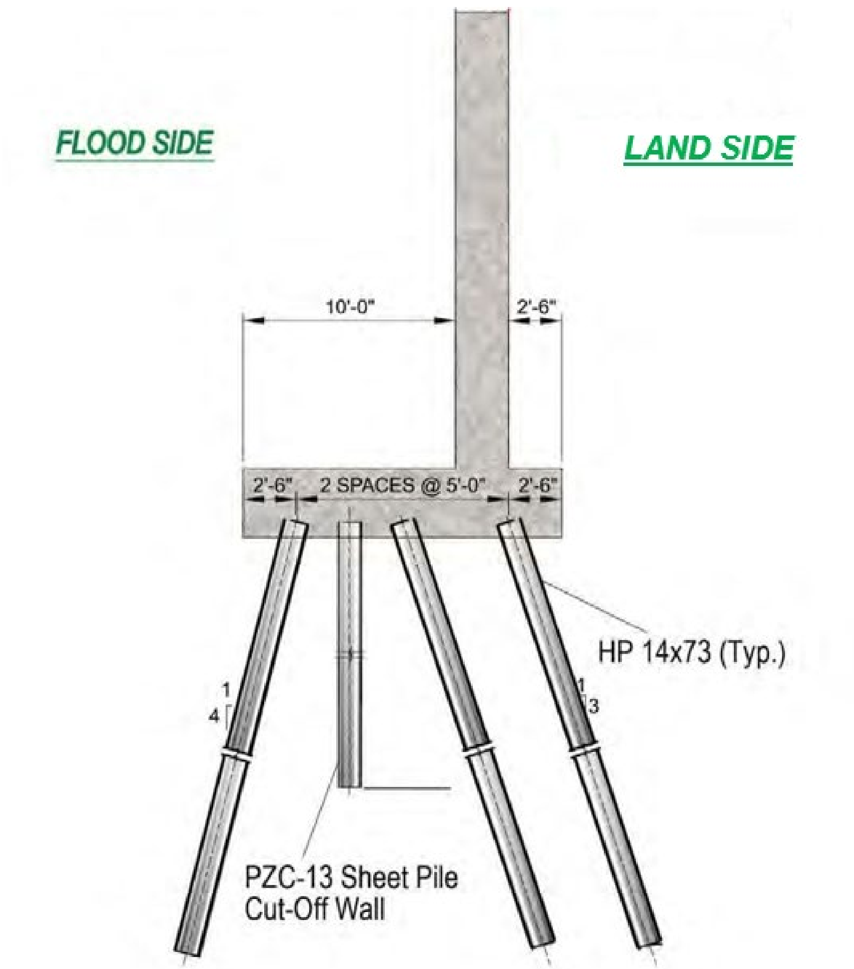


Figure 3: Typical Floodwall

Nine-inch concrete scour protection or grouted riprap would be used at the levee/ T-wall transition. The concrete scour protection will protect the levee where the T-wall stem extends into the full levee section and extend down both levee slopes. The scour protection would continue for 30 linear feet past the end of the T-wall. Uncapped cut-off sheet piling would extend horizontally 30 feet into the full levee section for erosion and seepage control. Reference Figure 4 as an example of the proposed scour protection.

Figure 4: Concrete Scour Protection Example

With the pipe discharge bell being relocated to the floodside of the system and discharging onto a portion of the t-wall slab and new riprap. The riprap is required to dissipate the energy from the pumping of the rainwater out of the system, extending a distance to be determined during detailed design. A riprap gradation is assumed to be class 250 - 1000 lb stone (LADOTD 2016, Section 711). See Table 1 for example gradation limits for individual stone.

Table 1: Riprap Gradations

Gradation Limits Individual Stone Size (lbs)	Spherical Diameter (ft)	Percent Finer (By Weight)
1250	2.50	100
500	1.83	45-100
250	1.46	15-50
80	1.00	0-15

The floodwall would be constructed at grade minimizing the requirement for any significant excavation. There would be approximately 4000 CY of excavated material resulting from the construction of the floodwall. The excavated material from constructing the floodwalls may be used within the levee footprint or if determined suitable could be used for marsh mitigation. If deemed unsuitable, the material would be hauled off site and disposed in accordance with applicable state and federal laws.

2.5.4 Construction Duration and Equipment

The construction duration of the Hanson Canal Fronting Protection would be 24 months with an assumed work schedule of 5 days a week, 8 hours a day. The floodwalls in front pump station would be constructed using both floating equipment and land support.

Below is the preliminary list of equipment anticipated to be utilized for the construction of the Fronting Protection.

Table 2: Preliminary Equipment List for Sector Gate and Floodwall Construction

Project Component	Duration (days)	Equipment Used
Fronting Protection & Tie-In Floodwall	730	150-Ton Crane
		80-Ton Crane
		Excavator
		Pile Driver
		Concrete Trucks
		Concrete Vibrators
		Welding Machine, Cutting Torch
Tie-In Levee		Dump Trucks
		Bull Dozers
		Fill Compactor
		Front End Loaded/Backhoe
		Fuel Tanks
		Generator

2.5.5 Access and Staging

In general, construction site access would be obtained by land. Vehicle access would be via Bayou Black Drive to a private access road down to the project site. Please see Figure 5 below for a map of the proposed access to the project site. The construction staging area would be within the area shown in Figure 6 within farmland. It is assumed the staging area would be 100 feet by 150 feet. The staging area would have a crushed stone on top of a separator fabric. Upon completion of the project, the staging area would be returned to pre-construction condition. The staging area would be used as an operations and materials storage area. The contractor would be allowed to place project trailers for both the Government and the contractor. The contractor would store the project equipment and project building supplies within the staging area.

Figure 5: Access and Staging

2.6 BARRIER REACH, NAFTA FLOODWALL AND ROADWAY FLOODGATE

2.6.1 Location

The NAFTA floodwall would be constructed in front of the NAFTA facility with the floodgate being located at approximately latitude 29°35'56.9225", long -90°52'36.0482".

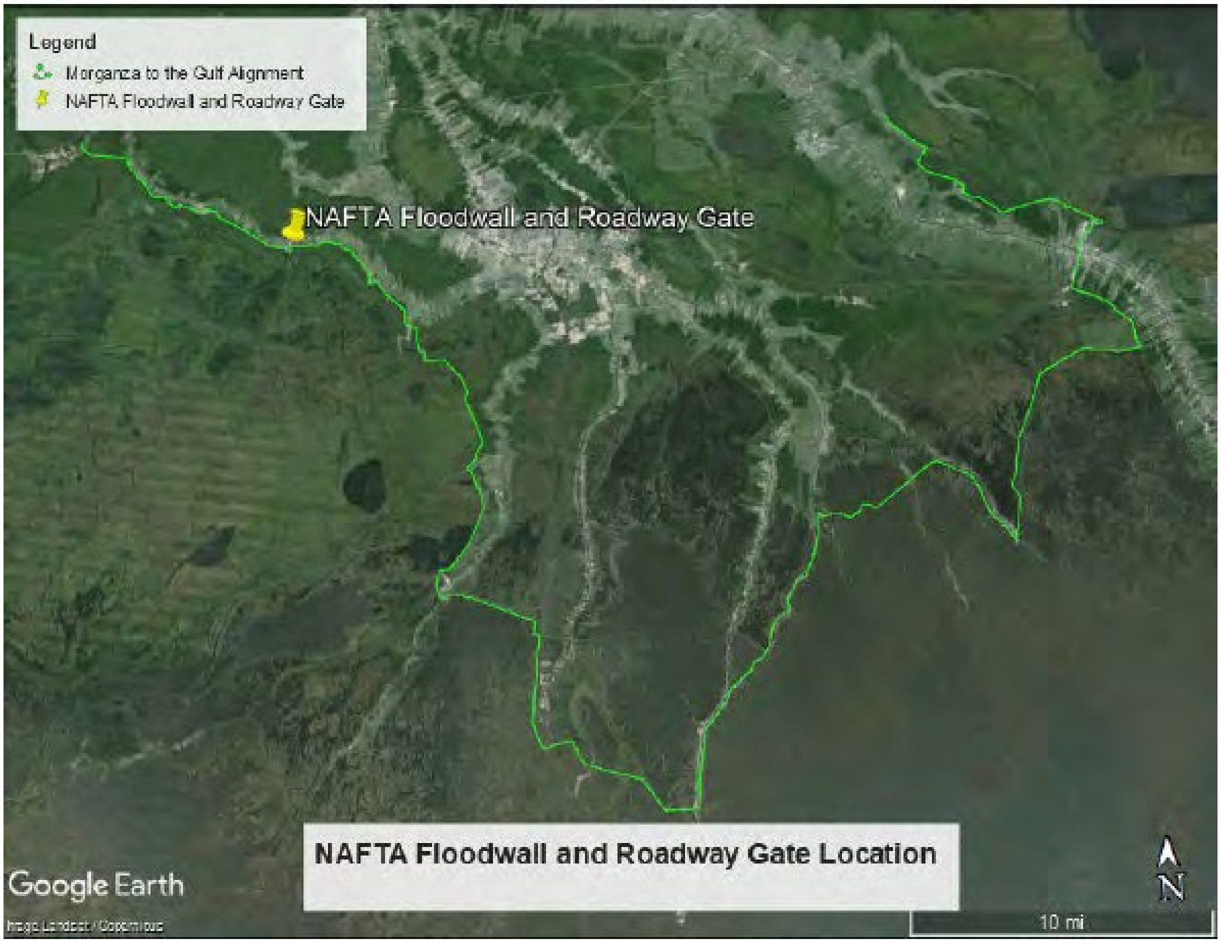


Figure 1: Location Map

2.6.2 Scope of Work

This contract would consist of the construction of flood wall and roadway flood gate in the vicinity of the NAFTA complex. In addition to the floodwall, this contract includes constructing a roadway floodgate that would remain in the stored position until an event and would provide access to the flood side of the system during normal everyday conditions. The tie-in floodwalls would extend into the existing MTG system to provide storm surge risk reduction. The transition between levee and floodwall would be protected with concrete or grouted riprap to prevent scour at this transition.

2.6.3 Structure Description

The structures to be constructed includes approximately 830 foot of floodwall with a 36 foot wide swing gate in front of the existing NAFTA facility with a top elevation of 17.0 NAVD88. The T-wall would be constructed on pile foundations with concrete base slabs and stems to the 2085 elevation +17.0 feet (NAVD 88). It is anticipated that this floodwall would be constructed at grade minimizing the requirement for any significant excavation. All construction would be from land-based equipment. The roadway gate concrete monoliths would be constructed in two halves to permit traffic flow during construction of the flood gate. All traffic control required under this contract would conform to LADOTD Standards. See Figure 2 below for conceptual floodwall cross section.

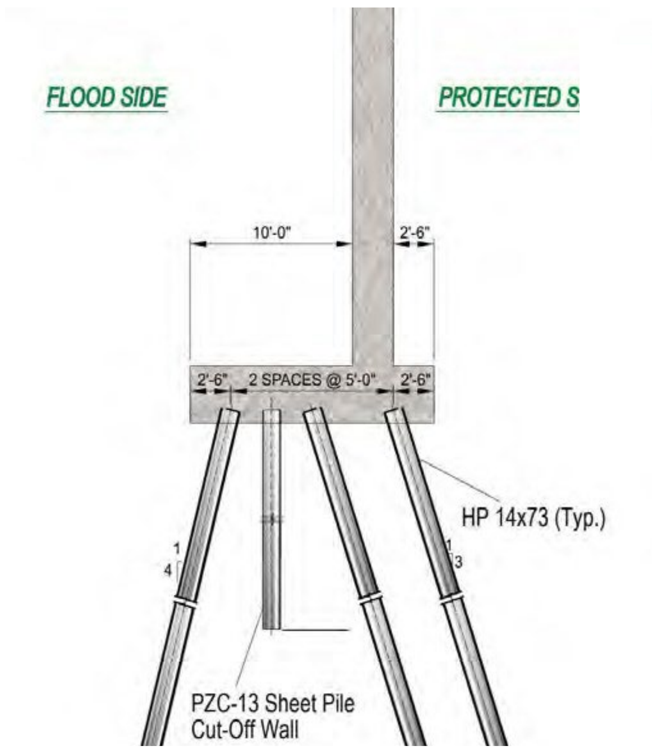


Figure 2: Typical Floodwall

A swing gate is a structure that is composed of two or more horizontal girders, vertical intercostals, vertical end diaphragms, a skin plate, and diagonal braces. In most cases, swing gate closures consist of a single gate leaf for openings up to 40-feet. Swing gates are mounted on hinges and swung open and closed like a door. The swing gate would provide an opening in the system to allow unimpeded traffic flow, except when a tropical system approaches the Gulf of America in which the gate would be closed. Please see Figure 3 and 4 below for more details on the swing gate.

Figure 3: Swing Gate Closure Structure

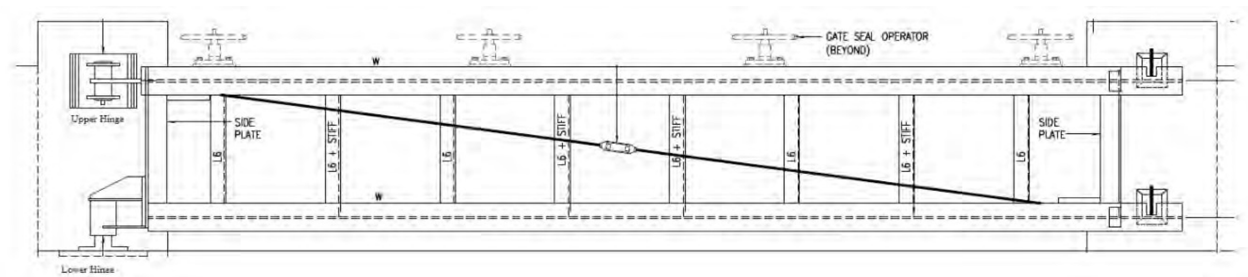


Figure 4: Typical Swing Gate Closure Structure Elevation

The design of the new T-walls and Swing gate, including the foundation, is subject to change once detailed geotechnical investigations and detailed design are conducted.

Nine-inch concrete scour protection or grouted riprap would be used at the levee/ T-wall transition. The concrete scour protection the levee where the T-wall stem extends into the full levee section and extend down both levee slopes. The scour protection would continue for 30 linear feet past the end of the T-wall. Uncapped cut-off sheet piling

would extend horizontally 30 feet into the full levee section for erosion and seepage control. Please see Figure 5 below for an example of the proposed scour protection.

Figure 5: Concrete Scour Protection Example

2.6.4 Construction Duration and Equipment

The construction duration of the NAFTA Floodwall and Swing Gate would be 24 months with an assumed work schedule of 5 days a week, 8 hours a day. The floodwalls and swing gate would be constructed using land supported equipment. Table 1 provides a preliminary list of equipment anticipated to be utilized for the construction of the NAFTA floodwall and floodgate.

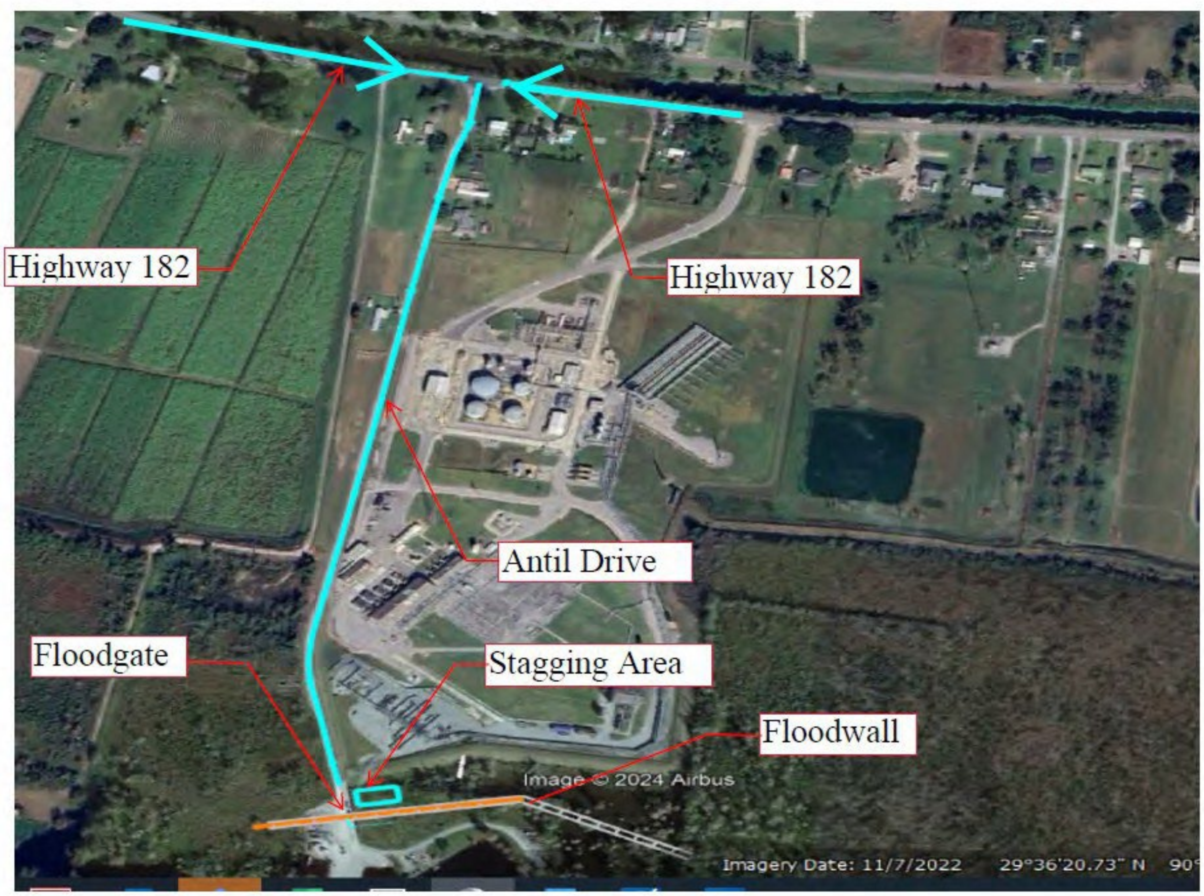
Table 1: Preliminary Equipment List for Floodwall Construction

Project Component	Duration (days)	Equipment Used
NAFTA Floodwall and Swing Gate	730	150-Ton Crane
		80-Ton Crane
		Excavator
		Pile Driver
		Concrete Trucks
		Concrete Vibrators
		Welding Machine, Cutting Torch
Tie-In Levee		Dump Trucks
		Bull Dozers
		Fill Compactor

		Front End Loaded/Backhoe
		Fuel Tanks
		Generator

2.6.5 Access and Staging

Construction site access would be obtained by land. Vehicular access would be via LA Highway 182 to Antil Drive down to the project site. The construction staging area would be within the area shown in Figure 6 within a cleared lot. It is assumed the staging area would be 100 feet by 50 feet. The staging area would have a crushed stone on top of a separator fabric. Upon completion of the project, the staging area would be returned to pre-construction condition. The staging area would be used as an operations and materials storage area. The contractor would place the project trailers for both the Government and the contractor. The contractor would store the project equipment and project building supplies within the staging area.



2.7 REACH B, MARMANDE CANAL STOPLOG FLOODGATE

2.7.1 Location

The Marmande Canal Stoplog floodgate would be located on the Marmande canal within Terrebonne Parish and is located at latitude 29°27'41.43"N, longitude - 90°45'50.07"W.

Figure 1: Location Map

2.7.2 Scope of Work

This contract would consist of a 30 ft wide stoplog floodgate in Marmande Canal floodwall tie-ins flanking each side of the floodgate. On both the inflow and the outflow of the gate bay, there would be timber guide walls and protection pile clusters. Finally, the transition between levee and floodwall would be protected with concrete or grouted riprap to prevent scour at this transition.

2.7.3 Structure Description

This floodgate would be a 30 ft wide stoplog floodgate (Figure 2) with a top elevation of 18.5 ft NAVD88, and a slab invert elevation of -8.0 ft NAVD88. The floodgate would provide an opening in the system to allow unimpeded navigation, except when a tropical system approaches the Gulf of America in which the stoplogs would be placed by the crane mounted on the adjacent monolith.

The stoplog gates would consist of horizontal wide-flanges supporting the vertical intercostals and skin plate. All connections would be welded connections. A crane mounted on an adjacent T-Wall would be used to lower the gate in place. All steel members on the gate would be painted with a coal tar epoxy paint system. (see Figures 3 & 4).

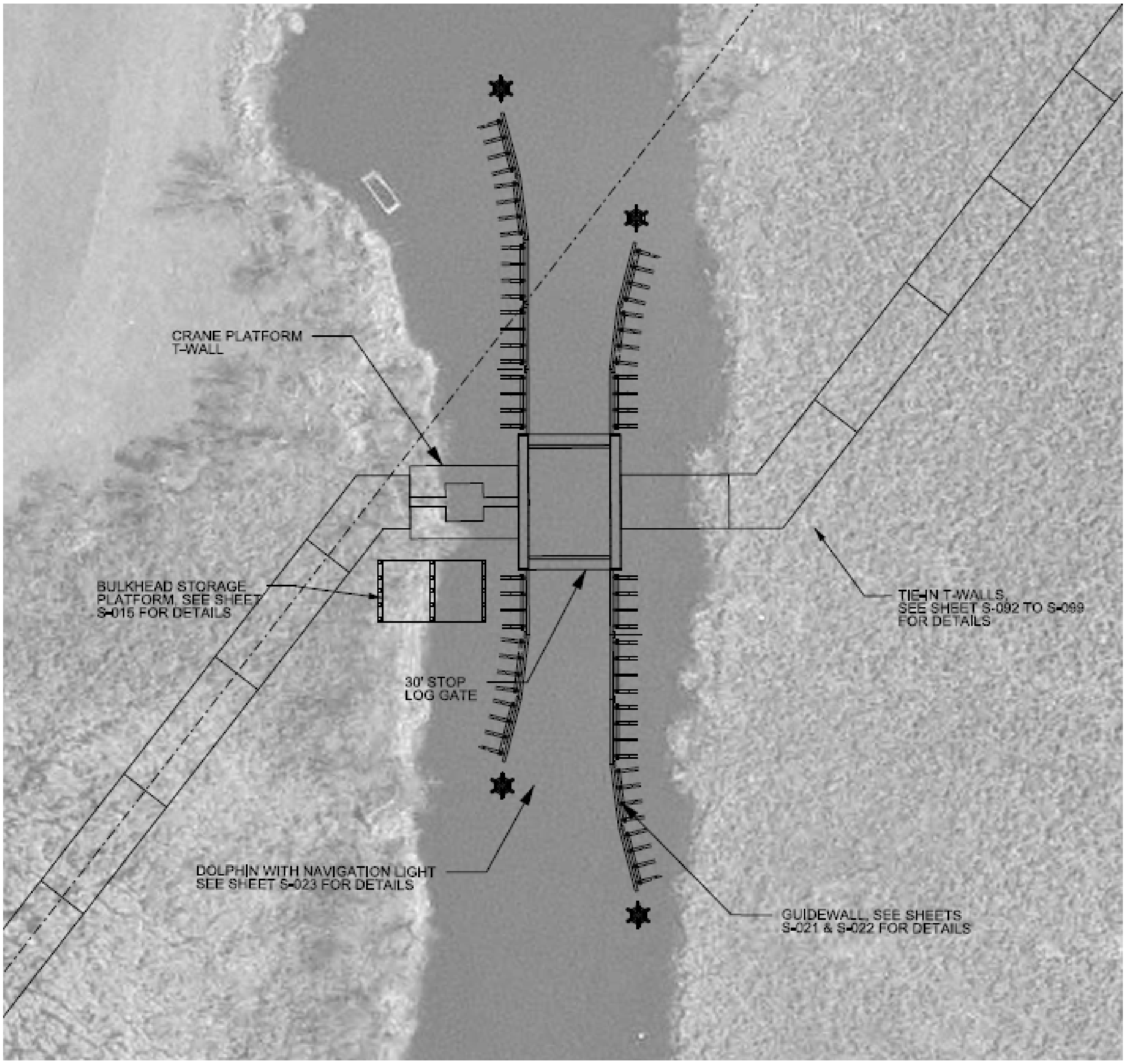


Figure 2: Typical Stoplog Gate Example

Figure 3: Conceptual Stoplog Gate - Elevation View with Gate in Open Position (Crane not shown for clarity)

Figure 4: Conceptual Stoplog Gate - Elevation View with Gate in Closed Position (Crane not shown for clarity)

Timber guide walls and pile clusters would be provided as aids to navigation and to protect the main flood gate structure from impact. The seven pile dolphin structures are constructed at the end of the guide wall to protect the guide walls from impact from vessels. The guide walls would be timber support frames currently spaced every 6 feet. Each timber support frame is constructed with a vertical pile braced by a batter pile driven at an angle from vertical. The outer end of each guide wall is anchored with a seven-pile dolphin structure. The dolphins would consist of 7 timber piles battered away from each other and tied together with a wire rope at the top of the dolphin. Please see figure 5, 6 and 7 for more details.

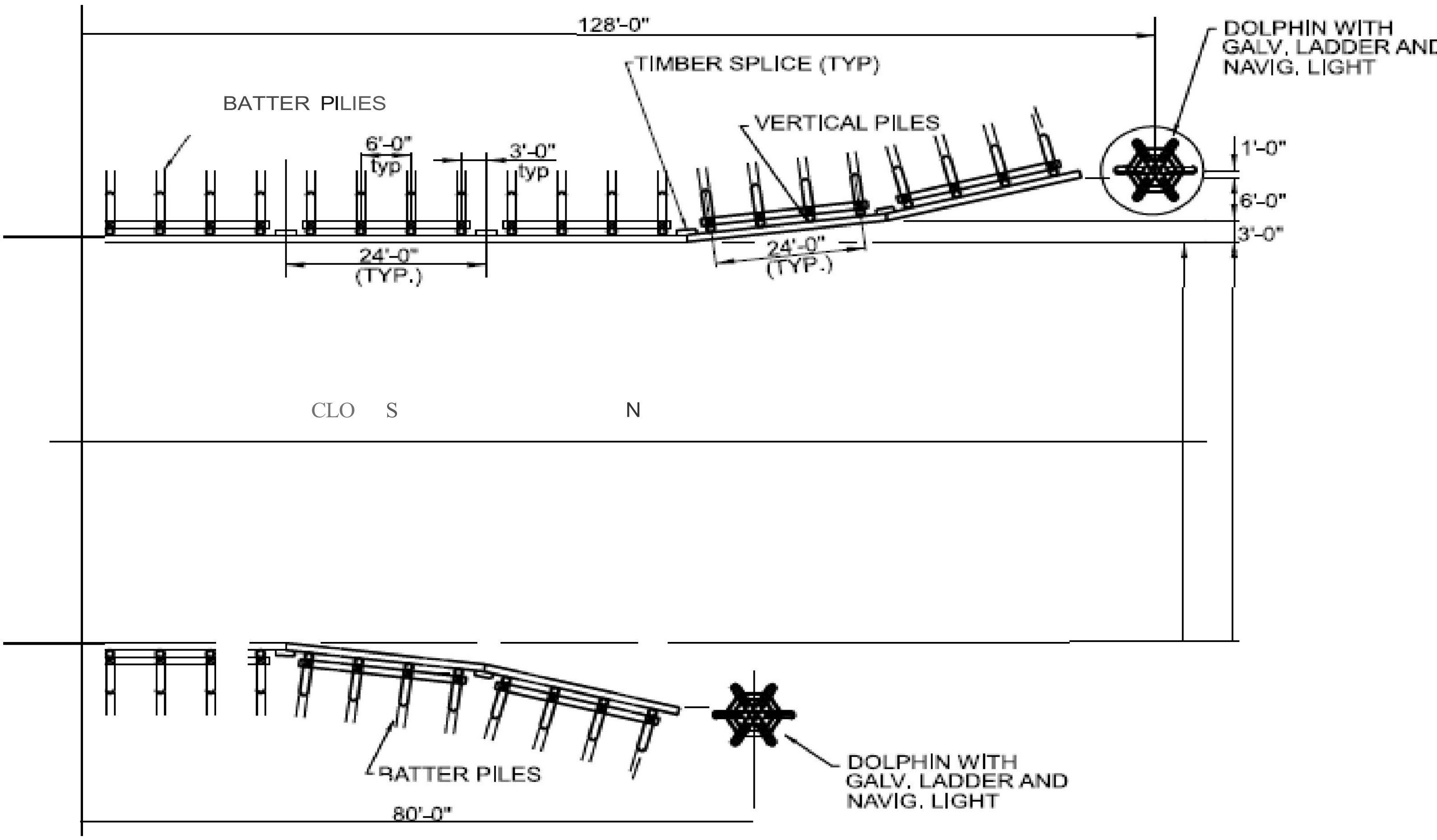


Figure 5: Plan – Guide walls, Fenders, and Dolphins

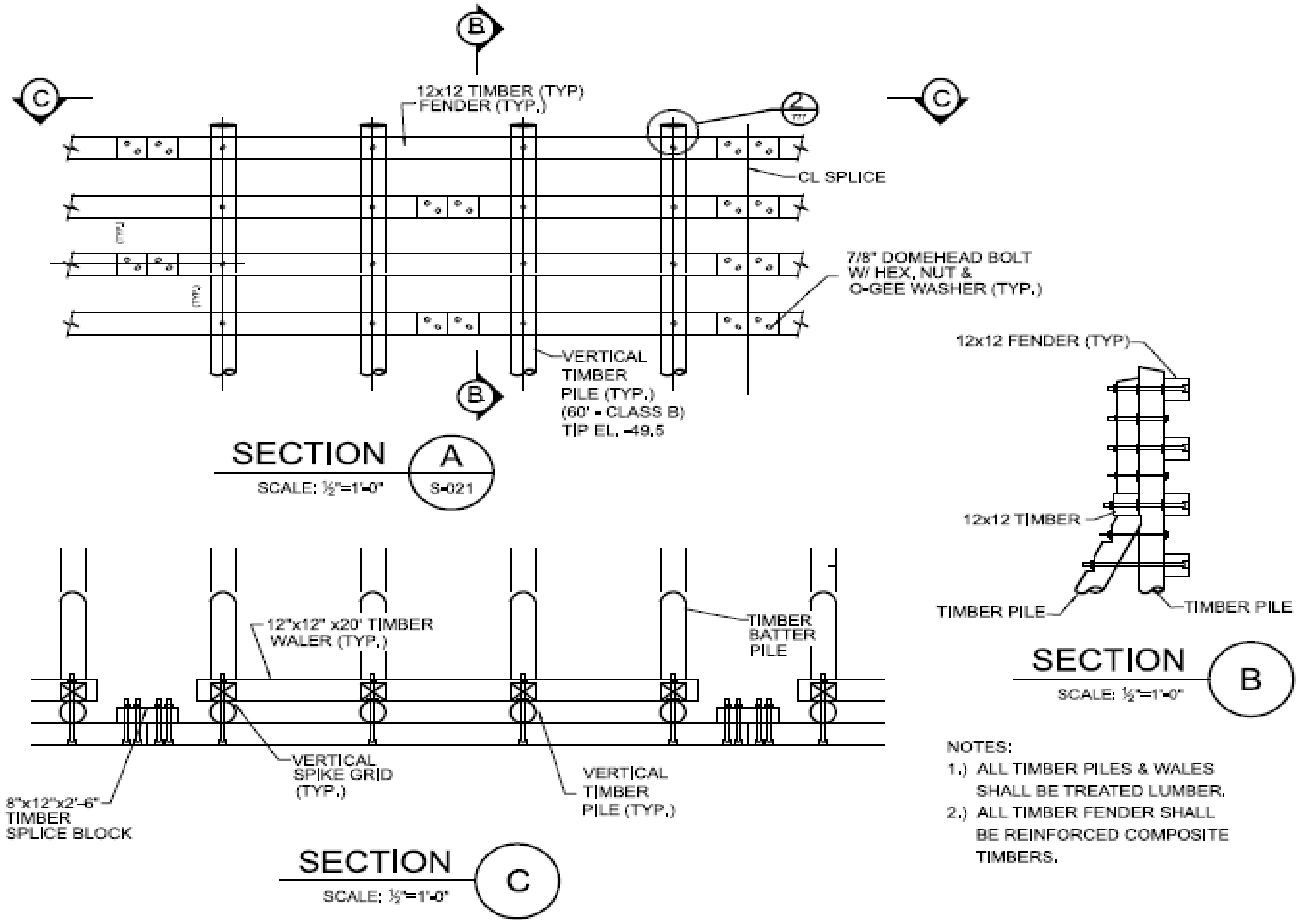


Figure 6: Guide wall Details

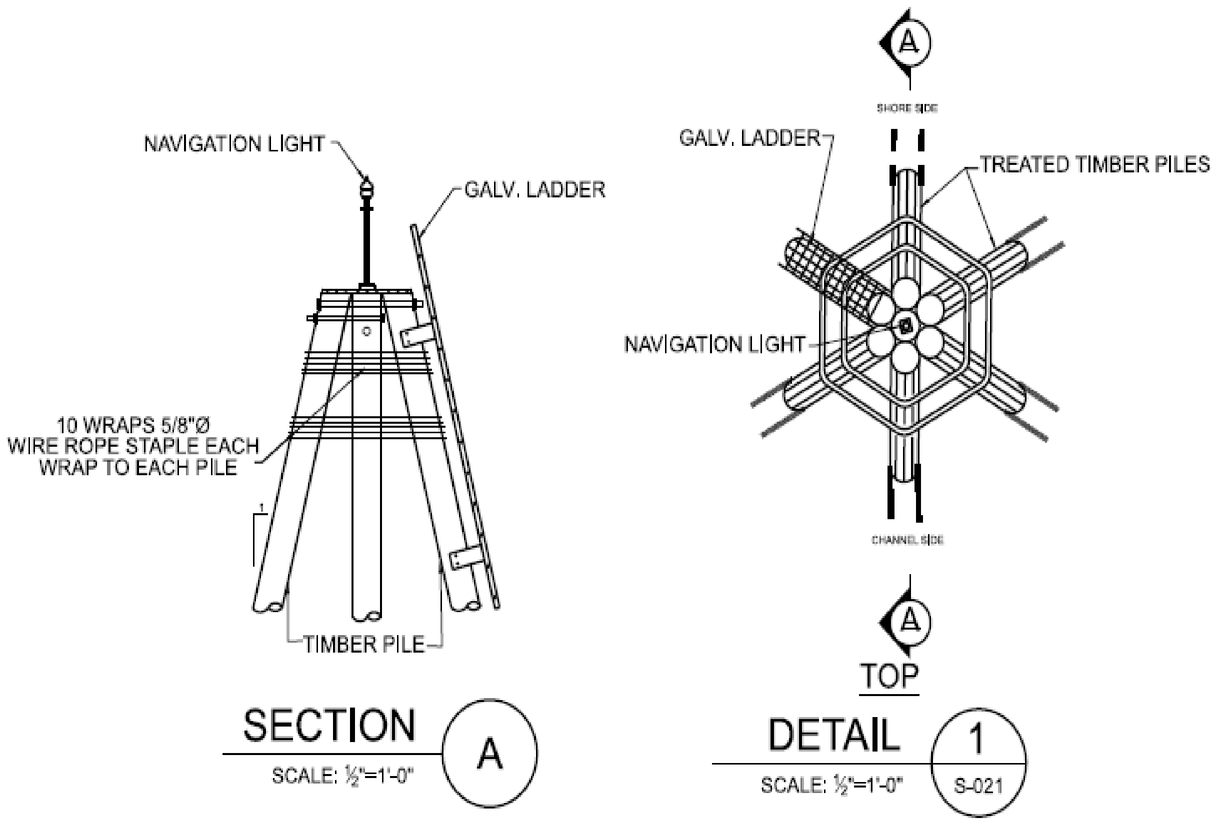


Figure 7: Dolphin Details

Approximately 960 total linear feet (480 linear feet on the south side of the floodgate and 480 linear feet on the north side of the floodgate) of floodwalls, specifically T-walls, would extend from the stoplog gate and tie into the adjacent levees. The floodwalls would have a top elevation of 18.5 ft NAVD88.

The height of the floodwall tie-ins would vary with the tallest walls adjacent to the stoplog gate and the shortest walls that tie into the adjacent levee. Details on typical section of floodwall is provided in Figure 8.

The design of the new stoplog gate and floodwalls, including the foundation is subject to change once detailed geotechnical investigations are conducted during detailed design.

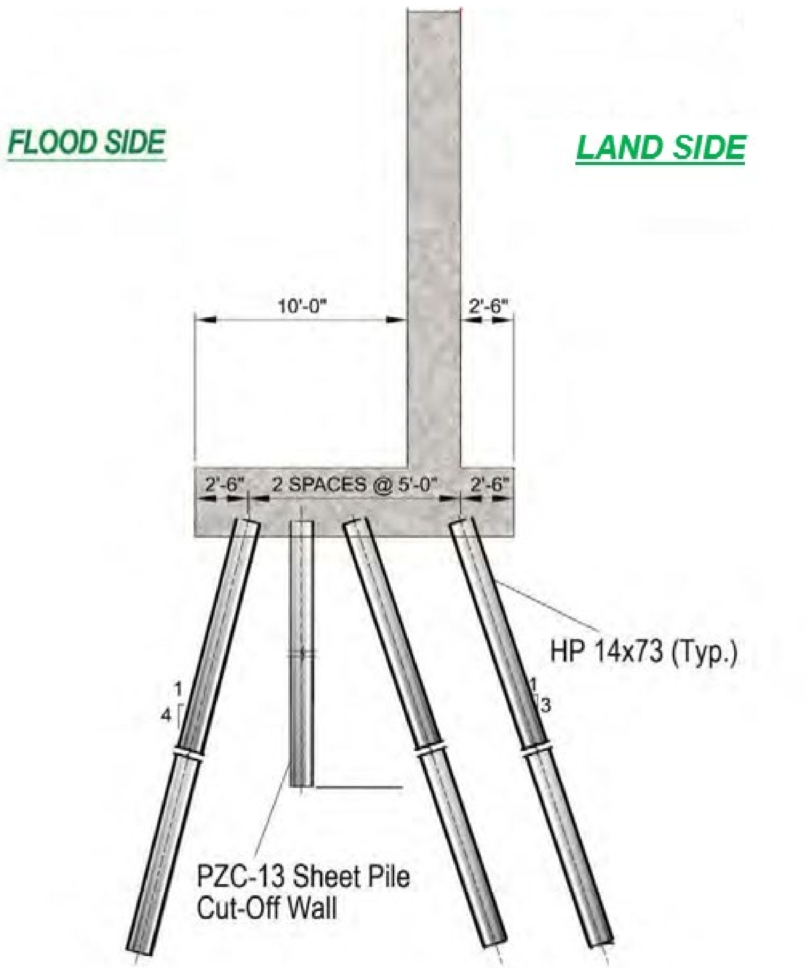


Figure 8: Typical Floodwall

Nine-inch concrete scour protection or grouted riprap would be used at the levee/T-wall transition. The concrete scour protection is located where the T-wall stem extends into the full levee section and extend down both levee slopes. The scour protection would continue for 30 linear feet past the end of the T-wall. Uncapped cut-off sheet piling would extend horizontally 30 feet into the full levee section for erosion and seepage control. See the sketch below for wall layout and cross-section. Please see Figure 9 below for an example of the proposed scour protection.

Figure 9: Concrete Scour Protection Example

The existing centerline of Marmande Canal has an approximate elevation of. -6 ft NAVD88. For the construction of the gate foundation, the channel would be excavated to an approximate elevation -12 ft with the final constructed sill elevation being -8.0 ft. Directly adjacent to the floodgate slab, both on the land and the flood side of the gate would be excavated to an El. -10.5 (NAVD 88) to place both the bedding stone and the riprap required. The channel bottom would remain at El. -8.0 (NAVD 88) for approximately 50-feet, both upstream and downstream of the newly constructed floodgate slab. The channel would then slope to allow a smooth transition from the sill elevation to existing grade over approximately 100-feet on both the land and flood side of the gate to afford aquatics the ability to migrate past gate sill.

The cross section at the gate location would be designed such that the pre and post project conditions would not impede the natural movement of aquatic organisms. The default operation would be open to avoid additional indirect impacts to vegetation and fish and wildlife due to changes in the natural hydrologic regime. The floodgate would be opened as soon as is safely possible after a closure for storm passage.

The velocities around and through the gate may require the channel bottom to be layered with 2-feet of riprap. After dredging the channel to El. -10.5, bedding would be placed on separator geotextile with the riprap on top of the bedding. A riprap gradation is assumed to be class 250 - 1000 lb stone (LADOTD 2016, Section 711). See Table 1 for example gradation limits for individual stone.

Table 1: Riprap Gradations

Gradation Limits Individual Stone Size (lbs)	Spherical Diameter (ft)	Percent Finer (By Weight)
1250	2.50	100

500	1.83	45-100
250	1.46	15-50
80	1.00	0-15

The stoplog gate would be constructed approximately in the center of the existing channel. A bypass channel would be constructed immediately adjacent to and to the right of the stoplog gate cofferdam footprint prior to beginning construction of the floodgate to allow safe navigational passage of marine traffic, as well as all aquatic organisms to pass safely until the floodgate structure is complete (Figure 10).

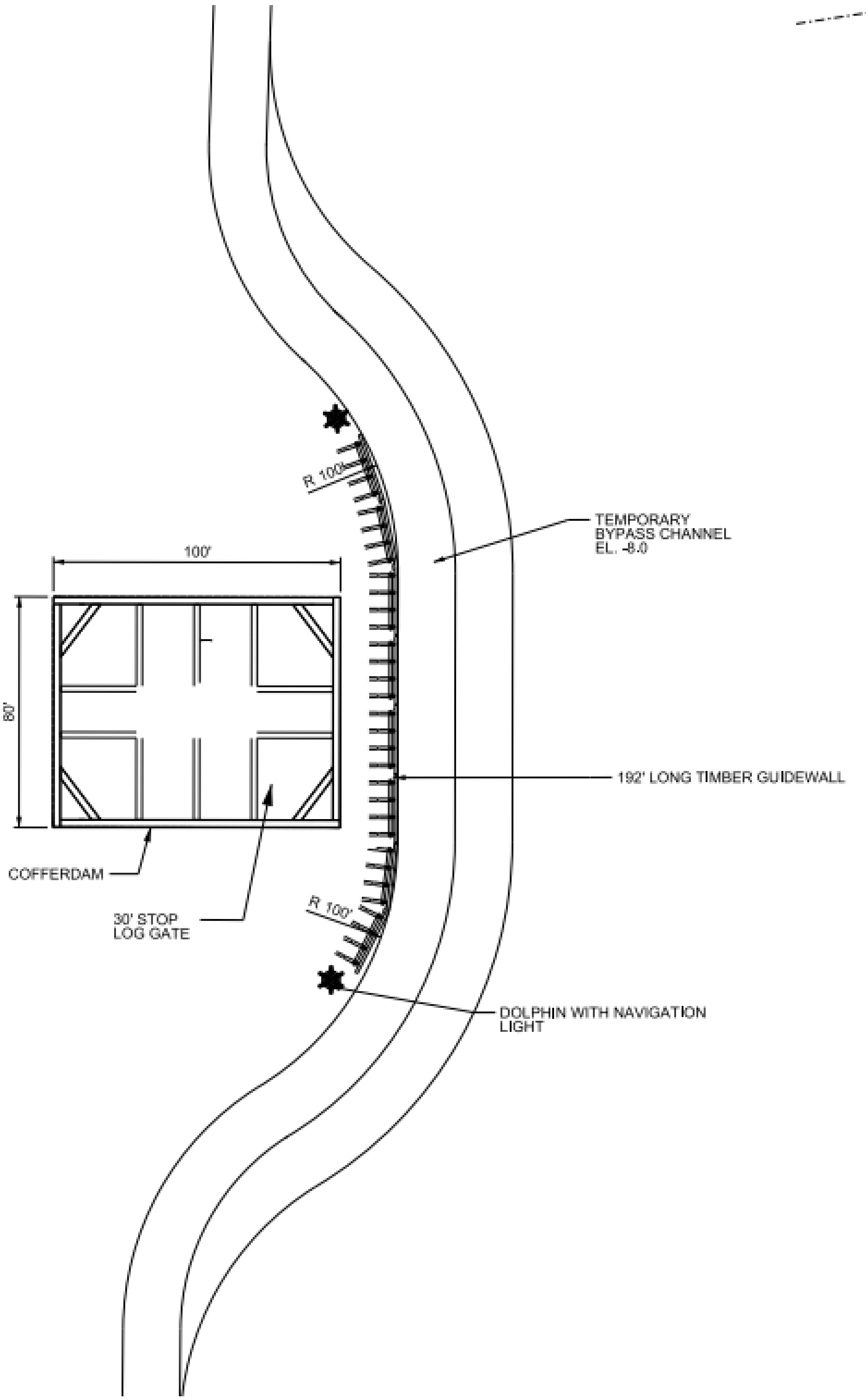


Figure 10: Preliminary bypass channel design

preliminary designs of the bypass require a minimum bottom channel width of 20-foot temporary bypass channel with an invert of -8.0 ft. Based on the preliminary design, the bypass channel would be approximately 650 feet long. However, navigation of common local vessels would be considered for the bypass channels, and design features of a navigable bypass channel would be developed during detailed design. At a minimum, to maintain pre-construction flow conditions, navigation and minimize environmental impacts during construction, the temporary bypass channels would be similarly sized to the channels being impacted. A timber guidewall (like the permanent guide wall shown in Figure 5) would be constructed between the bypass channel and the stoplog gate footprint to prevent the cofferdam (described below) from vessel impact while the cofferdam is in place.

A total of 10,858 cy of material would be excavated from the channel for gate and bypass channel construction. If the dredged material is found to be suitable for use within the project levee footprint, the material would be used within the levee or could potentially be utilized for marsh restoration within the overall project footprint, otherwise the material would be hauled off site and disposed in accordance with all state and federal laws.

Once navigation is routed through the temporary bypass channel, a Phase 1 cofferdam (approximately 100 feet x 80 feet) would be constructed to permit working in the dry when constructing the stoplog gate concrete gate monoliths. The cofferdam would be an internally braced cofferdam with wide flange walers and pipe braces supporting PZ sheet piling. Reduced power would be required for vessels passing through the construction area to reduce the risk of impact to the cofferdam. A timber guide wall and pile clusters would be provided along the bypass channel to prevent vessel impact on the cofferdam.

Once construction of the 30-foot stoplog concrete gate monoliths is completed, navigation would be re-routed through the permanent stoplog gate structure. Following routing the navigation traffic through the stoplog gate, the Phase 2 cofferdam, permanent guide walls and pile clusters, tie-in T-walls, and final civil site work can be completed. The Phase 2 cofferdam (approximately 50 feet x 60 feet on the right side of the floodgate) would be constructed to permit the construction of the adjacent T-walls to the stoplog gate structure that would be in the water. The same anchor forces, moments, and tips used for the Phase 1 cofferdams would be conservatively used for the Phase 2 cofferdams.

2.7.4 Construction Duration and Equipment

The construction duration of the Marmande Canal Floodgate would be 24 months with an assumed work schedule of 5 days a week, 8 hours a day. The stoplog floodgate would be constructed using both floating equipment and land support. Below is the preliminary list of equipment anticipated to be utilized for the construction of the floodgate.

Table 2: Preliminary Equipment List for Sector Gate and Floodwall Construction

Project Component	Duration (days)	Equipment Used
		150-Ton Crane
		80-Ton Crane

Stoplog Gate Complex & Tie-In Floodwall	730	Excavator
		Pile Driver
		Concrete Trucks
		Concrete Vibrators
		Welding Machine, Cutting Torch
Tie-In Levee		Dump Trucks
		Bull Dozers
		Fill Compactor
		Front End Loader/Backhoe
		Fuel Tanks
		Generator

2.7.5 Access and Staging

Construction site access would be obtained by both barge and land. Vehicle access would be via LA Highway 315 and then an existing levee access to the project site. The construction staging area would be within the farmland shown in Figure 11. It is assumed the staging area would be approximately 0.5 acres. The staging area would have a crushed stone on top of a separator fabric. Upon completion of the project, the staging area would be returned to pre-construction condition. The staging area would be used as an operations and materials storage area. The contractor would place the project trailers for both the Government and the contractor within the staging area. The contractor would store the project equipment and project building supplies within the staging area.

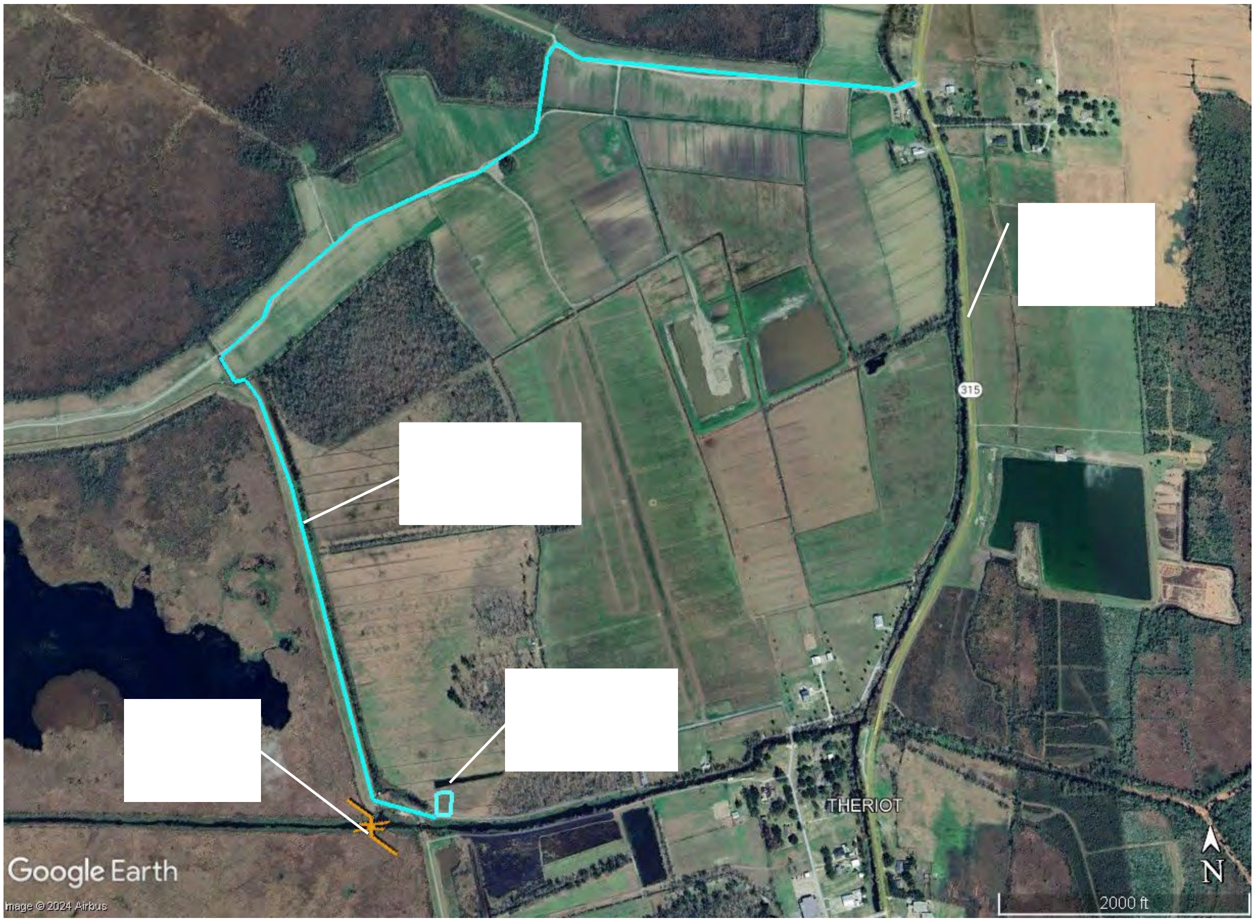


Figure 11: Project site access and staging

2.8 REACH B, FALGOUT CANAL BARGE FLOODGATE

2.8.1 Location

The Falgout Canal Barge Floodgate gate is located on the Falgout canal within Terrebonne Parish and is located at latitude 29°24'54.1296", longitude 90°47'13.7337".

Figure 1: Location Map

2.8.2 Scope of Work

This contract would consist of a Barge floodgate and 3 sluice gate monoliths within the Falgout canal with floodwalls flanking each side of the floodgate. Each sluice gate

monolith would contain three 16 feet by 16 feet sluice gates that would remain open unless there is an event. On both the inflow and the outflow of the gate bay, there would be timber guide walls and protection pile clusters. Finally, the transition between levee and floodwall would be protected with concrete or grouted riprap to prevent scour at this transition.

2.8.3 Structure Description

This floodgate would be a 56 ft wide barge type floodgate with a top elevation of +18.5 feet NAVD88, and a slab invert elevation of -9.0’ NAVD88. The floodgate would provide an opening in the system to allow unimpeded navigation, except when a tropical system approaches the Gulf of America in which case the barge gate and sluice gates would be closed. There would be six 16’x16’ sluice gates (117 linear feet) on the south side of the gate and three 16’x16’ sluice gates (60 linear feet) on the north side of the gate.

A barge gate is constructed of a braced steel frame with sheet metal or solid plate exterior in a hollow box configuration that resembles a hopper barge (see Figure 2). The gate normally contains several individual compartments that are watertight. The gate would have a pivot arm at one end that allows the gate to articulate in a 90° arc to open and close. The pivot arm would be mounted onto a fixed pivot pile that would allow the gate and pivot arm free travel in the vertical direction (for flotation). When the gate is in either the open or closed position, pumps fill the compartments with water until the buoyancy is overcome and the structure settles onto a receiving structure. While in the open position, the gate would also function as a guide wall to aid the vessels in navigating through the structure. In the closed position, the gate is ballasted down to an underwater foundation with gravity loads transferred through the base seal and the base support (see Figures 3 & 4). The flat top of the gate allows passage of either pedestrian or motorized ATV traffic. Lateral loads from high tides or storm surge on the barge gate are transferred into two concrete abutment reaction walls on either end of the gate structure.

Figure 2: Typical Barge Gate Example

Figure 3: Conceptual Barge Gate - Elevation View with Gate in Open Position

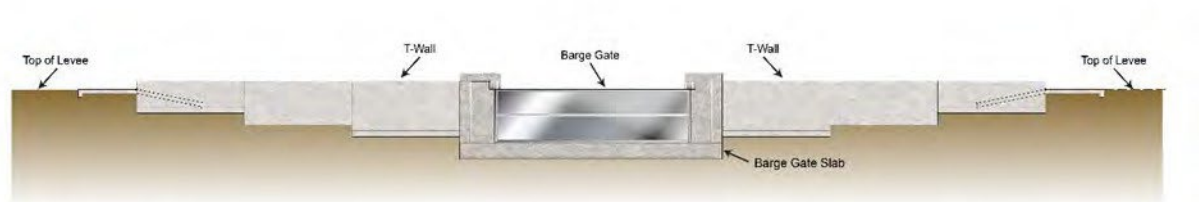


Figure 4: Conceptual Barge Gate - Elevation View with Gate in Closed Position

A sluice gate is a structure that contains a movable gate or series of movable gates that, when lifted, allow material and water to flow under it. The sluice gate would provide an opening in the system to allow unimpeded tidal flow, except when a tropical system approaches the Gulf of America in which the gates would be closed. Sluice gates are not navigable as they do not raise high enough, or they have fixed components that do not allow vessels to pass through. There are 3 separate sluice gate monolith structures at this project location. Each sluice gate structure would contain three (3) sluice gates. Each gate would be 16 feet wide by 16 feet tall with an invert elevation of elevation -9.0 feet. See Figure 5 and Figure 6 for conceptual plan and gate elevations.

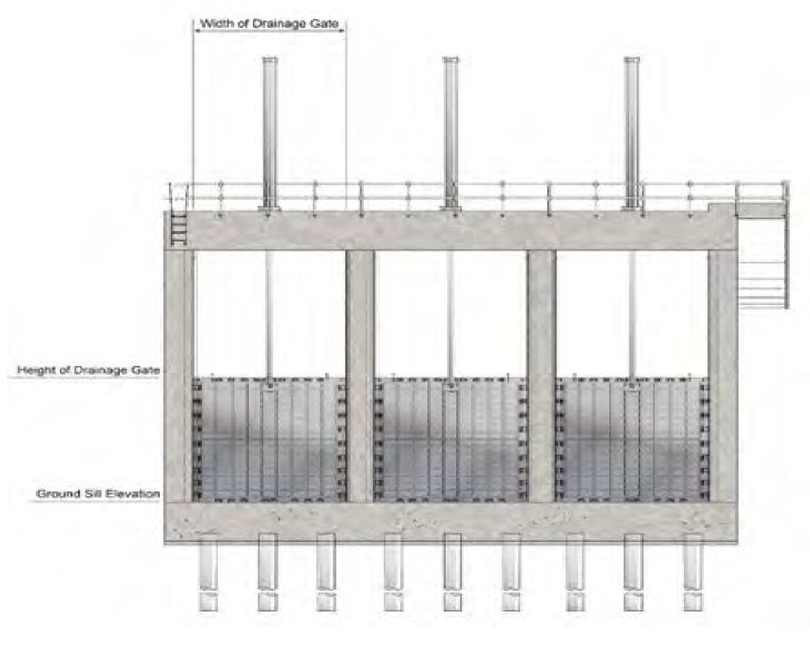
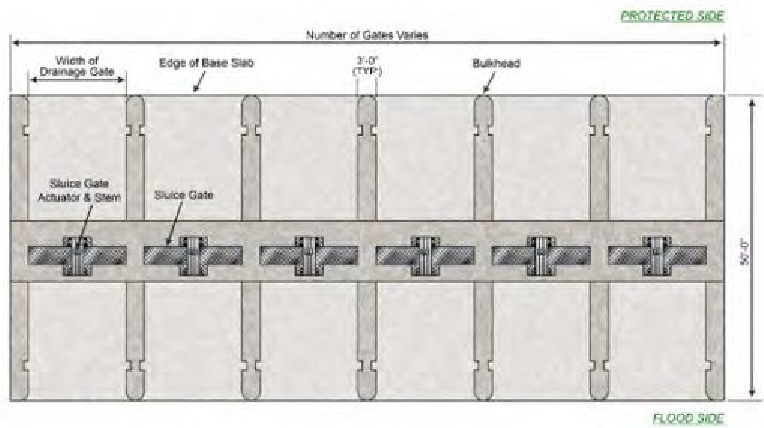


Figure 5: Conceptual Barge Gate - Elevation View with Gate in Closed Position



The floodgate would have timber guide walls and pile dolphin structures on both the land and flood side. The seven pile dolphin structures are constructed at the end of the guide wall to protect the guide walls from impact from vessels. The guide walls would be timber support frames currently spaced every 6 feet. Each timber support frame is constructed with a vertical pile braced by a batter pile driven at an angle from vertical. The outer end of each guide wall is anchored with a seven-pile dolphin structure. The dolphins would consist of 7 timber piles battered away from each other and tied together with a wire rope at the top of the dolphin. Please see figure 7, 8 and 9 for more details.

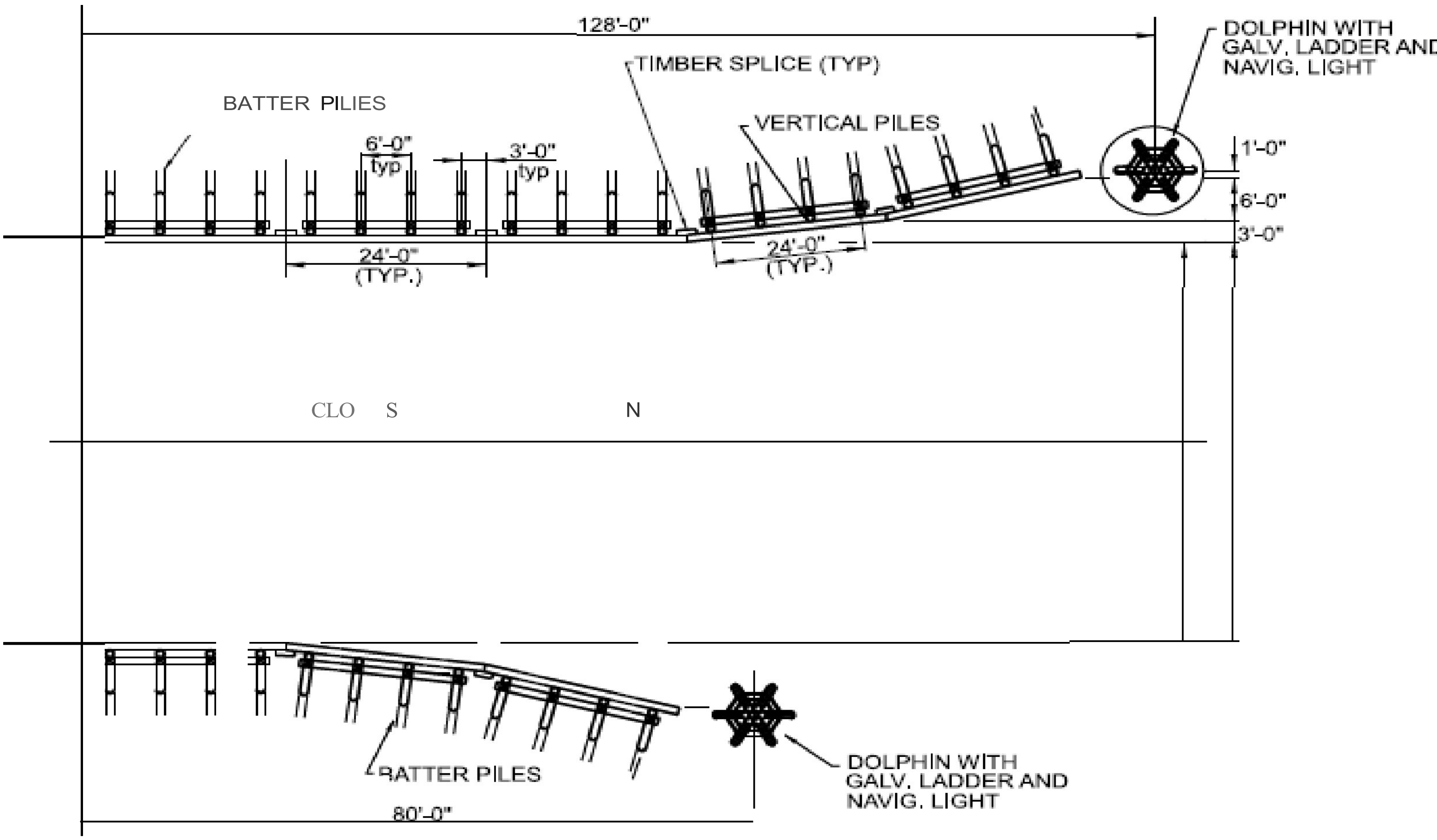


Figure 7: Plan – Guide walls, Fenders, and Dolphins

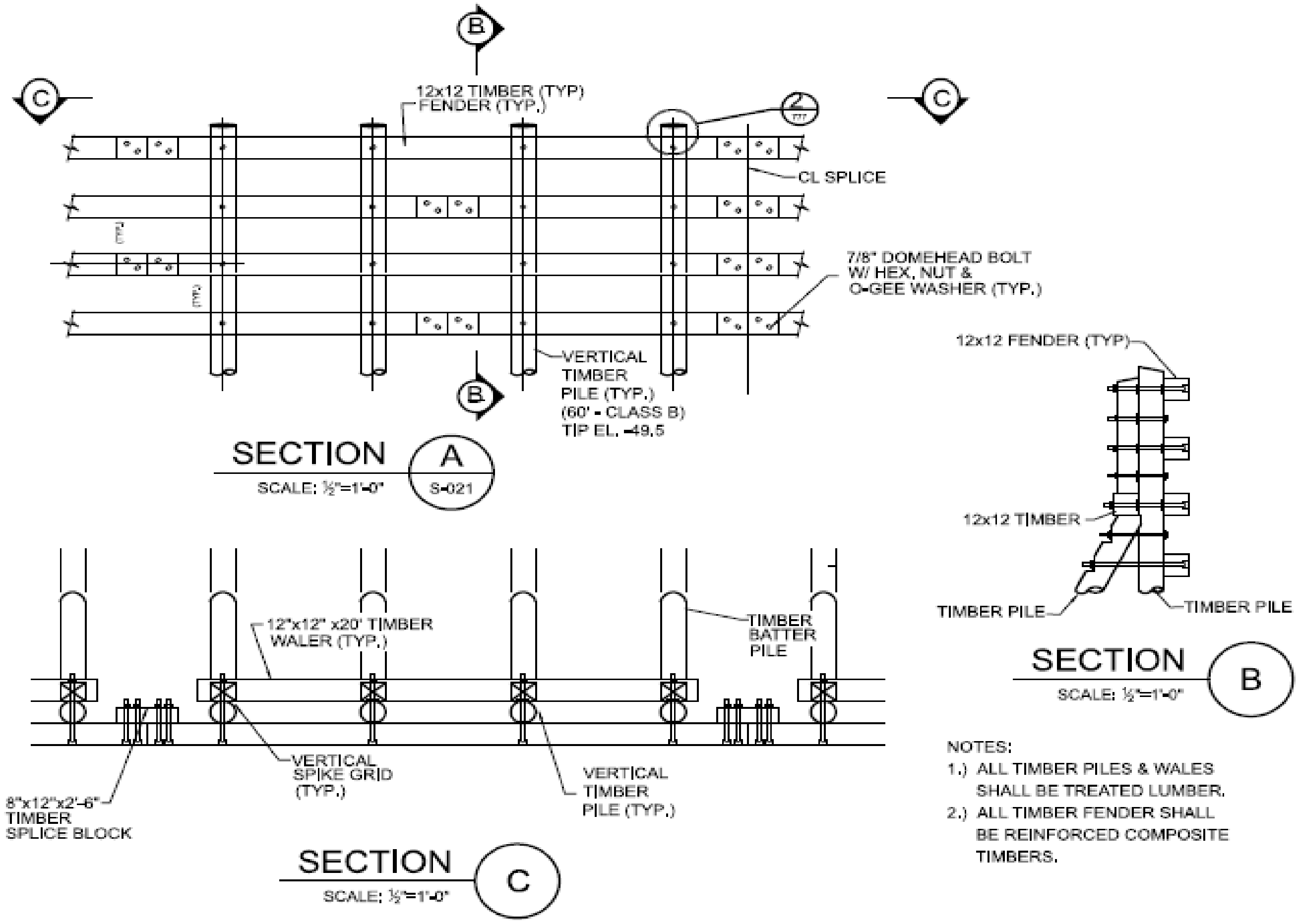


Figure 8: Guide wall Details

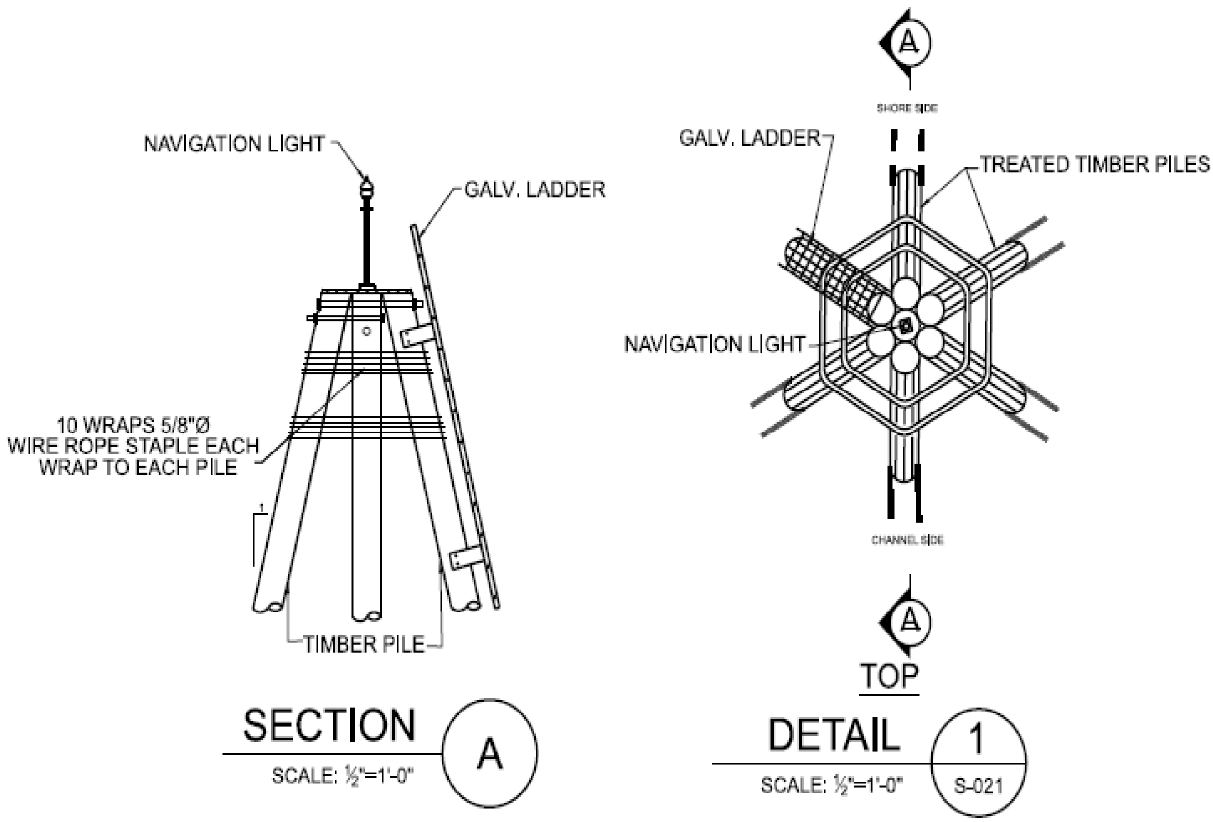


Figure 9: Dolphin Details

Approximately 940 total linear feet (470 linear feet on the north side of the floodgate and 470 linear feet on the south side of the floodgate) of floodwalls, specifically T-walls, would extend from the sluice gates and tie into the adjacent levees. The floodwalls would have a top elevation of 18.5 NAVD88.

The T-wall monoliths vary with the tallest walls adjacent to the sluice gate and the shortest walls that tie into the adjacent levee. Details on typical section of floodwall is provided in Figure 10.

The design of the new barge gate, sluice gate structure and floodwalls, including the foundation is subject to change once detailed geotechnical investigations are conducted during detailed design.

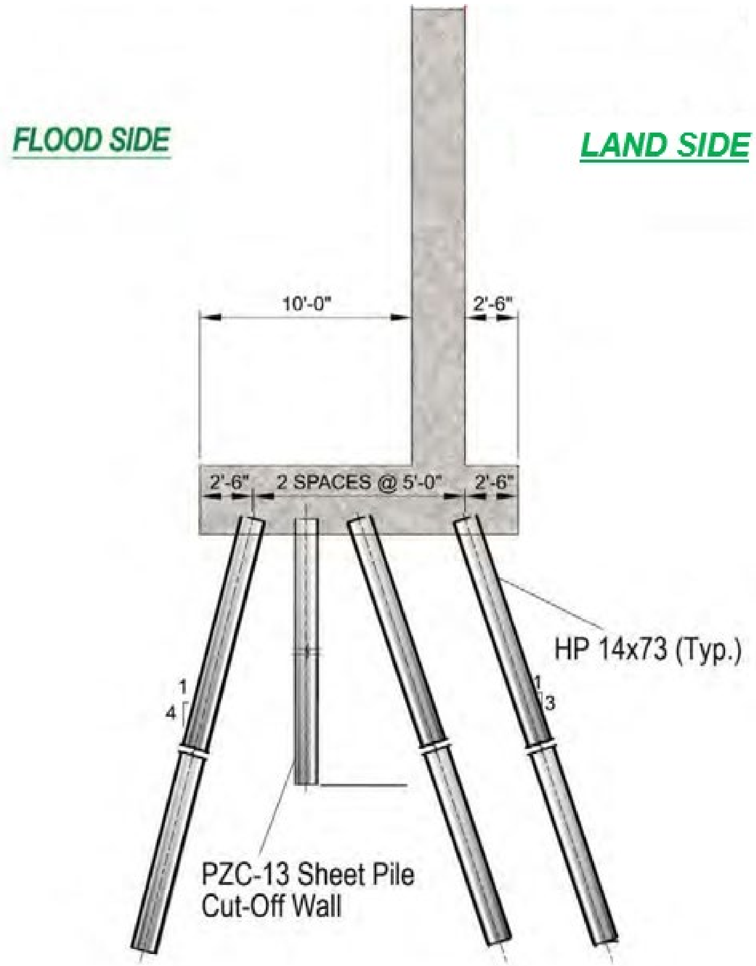


Figure 10: Typical Floodwall

Nine-inch-thick concrete scour protection or grouted riprap would be used at the levee-floodwall transition (tie-in). The concrete scour protection or grouted riprap protects the levee where the floodwall stem extends into the full levee section and extends down both levee slopes. The scour protection would continue for 30 linear feet past the end of the floodwall. Uncapped, cut-off sheet piling would extend horizontally 30 feet into the full levee section for erosion and seepage control. Please see Figure 11 below for an example of the proposed scour protection.

Figure 11: Illustration of Scour Protection at Levee-Floodwall Tie-in.

The barge gate would be constructed on the land side of the existing floodgate. The existing centerline of Falgout Canal has an approximate elevation ranging from -6.0 to -9.0 ft (NAVD 88). For the construction of the gate foundation, the channel would be excavated to an approximate elevation -16.0 with the final constructed sill elevation being El. -9.0. Directly adjacent to the floodgate slab, both on the land and the flood side of the gate would be excavated to an El. -11.5 ft (NAVD 88) to place both the bedding stone and the riprap required. The channel bottom would remain at El. -9.0 ft (NAVD 88) for approximately 50-feet, both upstream and downstream of the newly constructed floodgate slab. The channel would then slope up to allow a smooth transition from the sill elevation to approximately El. -8.0 over approximately 100-feet on both the land and flood side of the gate to afford aquatics the ability to migrate past gate sill.

The cross section at the gate location would be designed such that the pre and post project conditions would not impede the natural movement of aquatic organisms. The default operation would be open to avoid additional indirect impacts to vegetation and fish and wildlife due to changes in the natural hydrologic regime. The floodgate would be opened as soon as is safely possible after a closure for storm passage.

The velocities around and through the gate may require the channel bottom to be layered with 2-feet of riprap. The riprap is required in the channel, extending approximately 100 linear feet on both the land side and the flood side. After dredging the channel to El. -11.5, bedding would be placed on separator geotextile with the riprap on top of the bedding. A riprap gradation is assumed to be class 250 - 1000 lb stone

(LADOTD 2016, Section 711). See Table 1 for example gradation limits for individual stone.

Table 1: Riprap Gradations

Gradation Limits Individual Stone Size (lbs)	Spherical Diameter (ft)	Percent Finer (By Weight)
1250	2.50	100
500	1.83	45-100
250	1.46	15-50
80	1.00	0-15

The barge gate would be constructed approximately in the center of the existing channel. The by-pass channel would be constructed immediately adjacent to and to the west of the barge gate cofferdam footprint prior to beginning construction of the floodgate to allow safe navigational passage of marine traffic, as well as all aquatic organisms to pass safely until the floodgate structure is complete (Figure 11).

Preliminary designs of the bypass require a minimum bottom channel width of 60-foot for the temporary bypass channel with an invert of EL. -9.0'. Based on the preliminary design, the bypass channel would be approximately 650 feet long. However, navigation of common local vessels would be considered for the bypass channels, and design features of a navigable bypass channel would be developed during detailed design. At a minimum, to maintain pre-construction flow conditions, navigation and minimize environmental impacts during construction, the temporary bypass channels would be similarly sized to the channels being impacted. A timber guidewall (like the permanent guide wall) would be constructed to prevent the cofferdam from vessel impact while the cofferdam is in place.

A total of 13,416 cy of material would be excavated from the channel for gate complex, bypass channel, and floodwall tie-in construction. If the dredged material is found to be suitable for use within the project levee footprint, the material would be used within the levee or could potentially be utilized for marsh restoration within the overall project footprint, otherwise the material would be hauled off site and disposed in accordance with all state and federal laws.

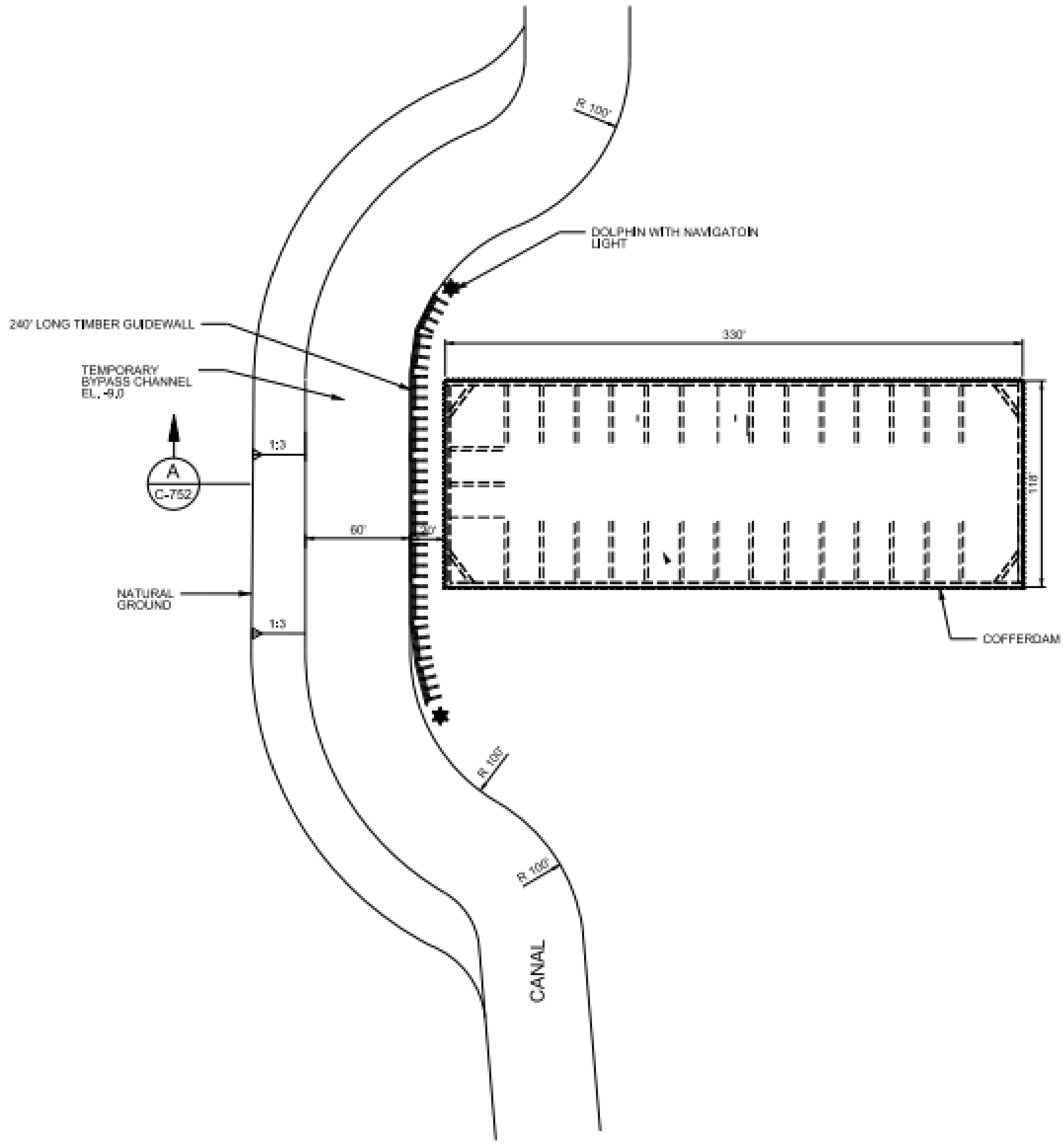


Figure 11: Preliminary bypass channel design

Once navigation is routed through the temporary bypass channel, a Phase 1 cofferdam (approximately 330 feet x 118 feet) would be constructed to permit the in the dry construction of the barge gate concrete landing slab, pivot arm assembly, receiving structure concrete monoliths, and the sluice gate concrete monoliths. The cofferdam would be an internally braced cofferdam with wide flange wales and pipe braces supporting PZ sheet piling. Reduced power would be required for vessels passing through the construction area to reduce the risk of impact to the cofferdam.

Once construction of the barge gate landing slab, pivot arm assembly, receiving structure monoliths, and sluice gate monoliths are completed, navigation would be re-routed through the permanent barge gate structure. After construction, the bypass channel is assumed to be included in the footprint of the structure site and the channel flow would be rerouted through the new structure feature. Once navigation is re-routed through the new floodgate, the Phase 2 cofferdam would be constructed and permanent guidewalls and pile clusters, tie-in T-walls, and final civil site work can be completed.

The Phase 2 cofferdam (approximately 120 feet x 80 feet on both sides of the floodgate) would be constructed to permit the construction of the adjacent T-walls to the sluice gate structures that would be in the water.

2.8.4 Construction Duration and Equipment

The construction duration of the Falgout Canal Floodgate would be 24 months with an assumed work schedule of 5 days a week, 8 hours a day. The barge floodgate would be constructed using both floating equipment and land support. Below is the preliminary list of equipment anticipated to be utilized for the construction of the floodgate.

Table 2: Preliminary Equipment List for Sector Gate and Floodwall Construction

Project Component	Duration (days)	Equipment Used
Barge Gate Complex & Tie-In Floodwall	730	150-Ton Crane
		80-Ton Crane
		Excavator
		Pile Driver
		Concrete Trucks
		Concrete Vibrators
		Welding Machine, Cutting Torch
Tie-In Levee		Dump Trucks
		Bull Dozers
		Fill Compactor
		Front End Loader/Backhoe
		Fuel Tanks
		Generator

2.8.5 Access and Staging

In general, construction site access would be obtained by both barge and land. Vehicle access would be via LA Highway 315 to Brady Road. When Brady Road ends the contractor would have to drive along the Levee Access Road. Please see Figure 12 below for a map of the proposed access route to the project site. The construction staging area would be on floating barges due to the lack of available land in the vicinity of the floodgate. There would be floating barges anchored within 500 feet of the project footprint that would be used for staging on this project.

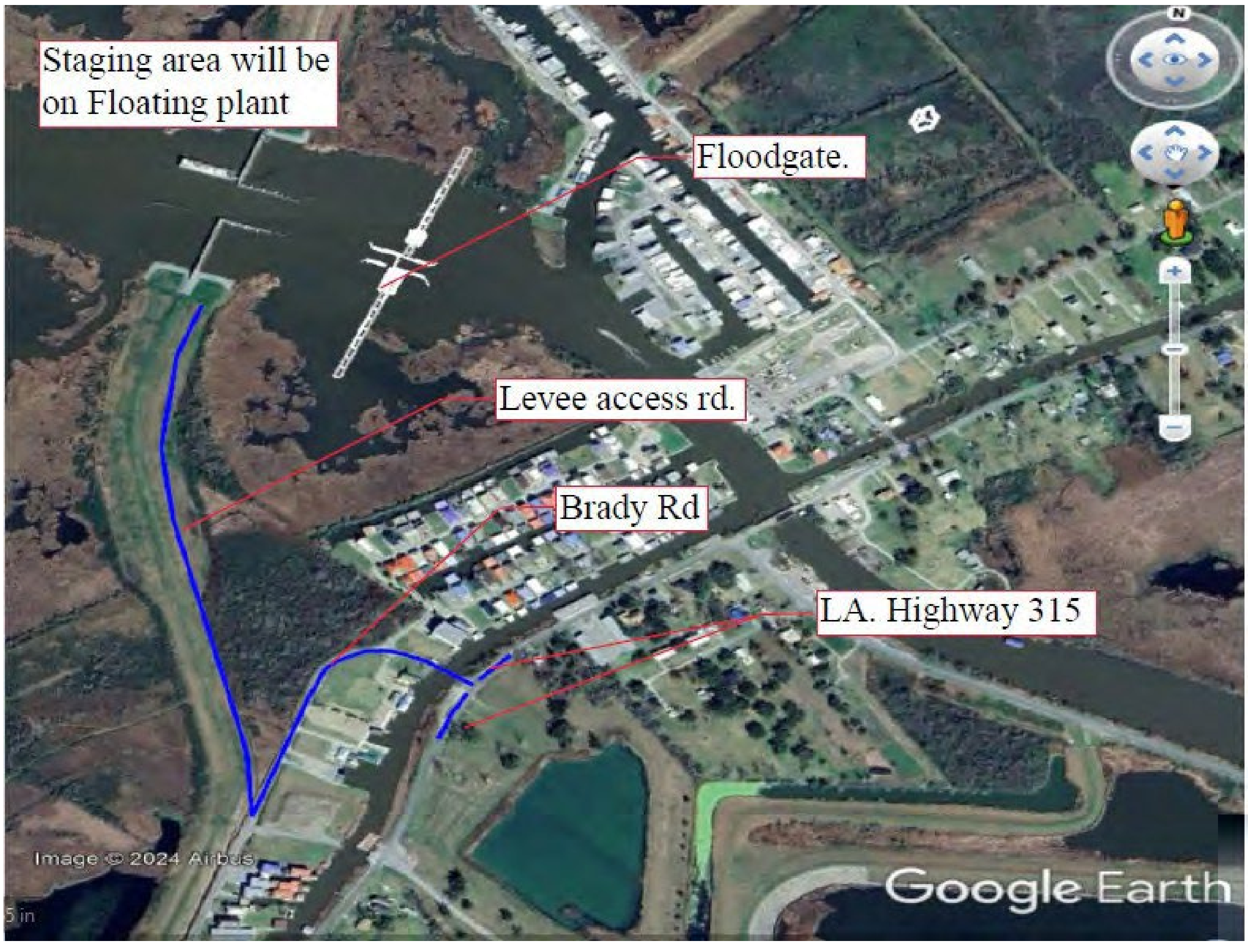


Figure 12: Project site access

2.9 REACH E-2, BAYOU DU LARGE FLOODGATE & HWY 315 SWING GATE

2.9.1 Location

The Bayou Dularge Floodgate would be located in Bayou Dularge within Terrebonne Parish (latitude 29°24'26.95"N, longitude -90°47'13.85"W) (Figure 1).

Figure 1: Location Map

2.9.2 Scope of Work

This contract would consist of construction of a 56 ft wide barge floodgate within Bayou Dularge with floodwall tie-ins flanking each side of the floodgate and a 40 ft wide swing gate where the eastern floodwall tie-in crosses Highway 315. On both the inflow and the outflow of the gate bay, there would be timber guide walls and protection pile clusters.

Finally, the transition between the floodwall tie-ins and Reach E-2 levee would be protected with concrete or grouted riprap to prevent scour at this transition.

2.9.3 Structure Description

2.9.3.1 Bayou Dularge Floodgate

This floodgate would be a 56 ft wide barge floodgate (Figure 2) with a top elevation of
21.0 ft NAVD88, and a slab invert elevation of -7.0-ft NAVD88. The floodgate would provide an opening in the system to allow unimpeded navigation, except when a tropical system approaches the Gulf of America in which the gate would be closed.

A barge gate is constructed of a braced steel frame with sheet metal or solid plate exterior in a hollow box configuration that resembles a hopper barge (see Figure 2). The gate normally contains several individual compartments that are watertight. The gate would have a pivot arm at one end that allows the gate to articulate in a 90° arc to open and close. The pivot arm would be mounted onto a fixed pivot pile that would allow the gate and pivot arm free travel in the vertical direction (for flotation). When the gate is in either the open or closed position, pumps fill the compartments with water until the buoyancy is overcome and the structure settles onto a receiving structure. While in the open position, the gate would also function as a guide wall to aid the vessels in navigating through the structure. In the closed position, the gate is ballasted down to an underwater foundation with gravity loads transferred through the base seal and the base support (see Figures 3 & 4). The flat top of the gate allows passage of either pedestrian or motorized ATV traffic. Lateral loads from high tides or storm surge on the barge gate are transferred into two concrete abutment reaction walls on either end of the gate structure.

Figure 2: Typical Barge Gate Example

Figure 3: Conceptual Barge Gate - Elevation View with Gate in Open Position

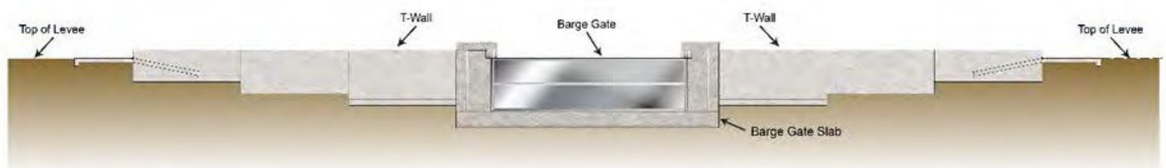


Figure 4: Conceptual Barge Gate - Elevation View with Gate in Closed Position

Timber guide walls and pile clusters would be provided as aids to navigation and to protect the main flood gate structure from impact. The seven pile dolphin structures are constructed at the end of the guide wall to protect the guide walls from impact from vessels. The guide walls would be timber support frames currently spaced every 6 feet. Each timber support frame is constructed with a vertical pile braced by a batter pile driven at an angle from vertical. The outer end of each guide wall is anchored with a seven-pile dolphin structure. The dolphins would consist of 7 timber piles battered away from each other and tied together with a wire rope at the top of the dolphin. Please see figure 5, 6 and 7 for more details.

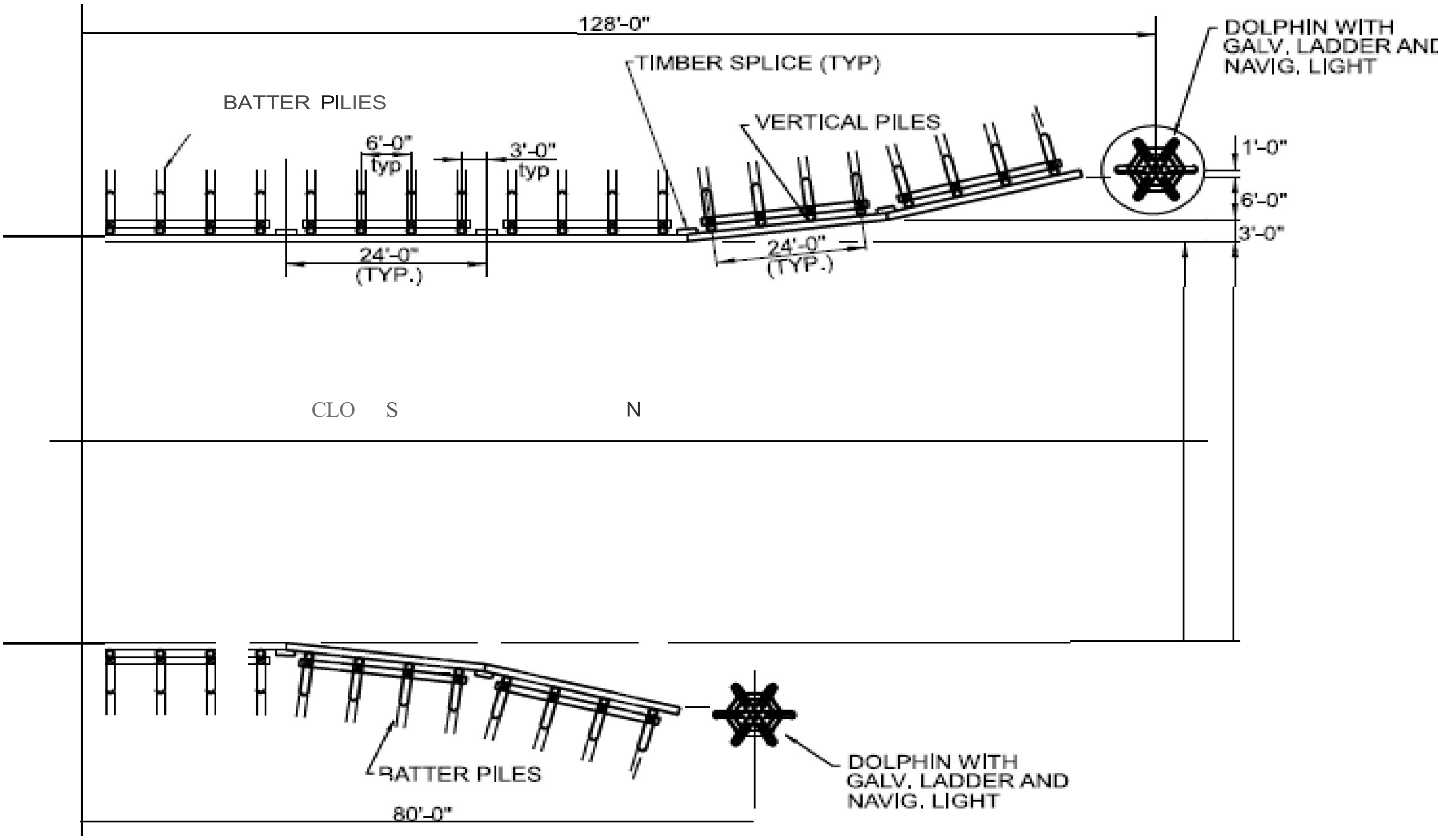


Figure 5: Plan – Guide walls, Fenders, and Dolphins

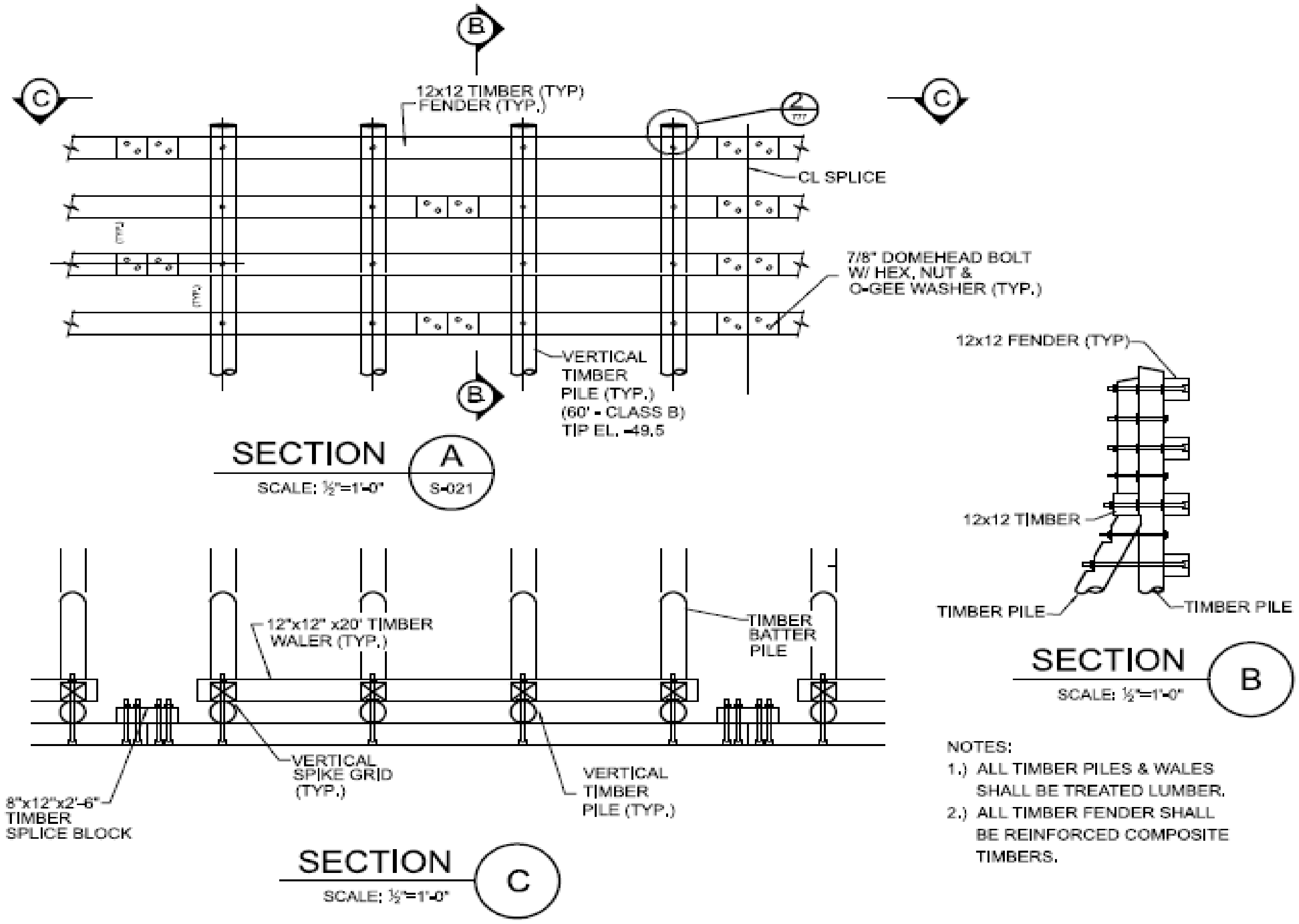


Figure 6: Guide wall Details

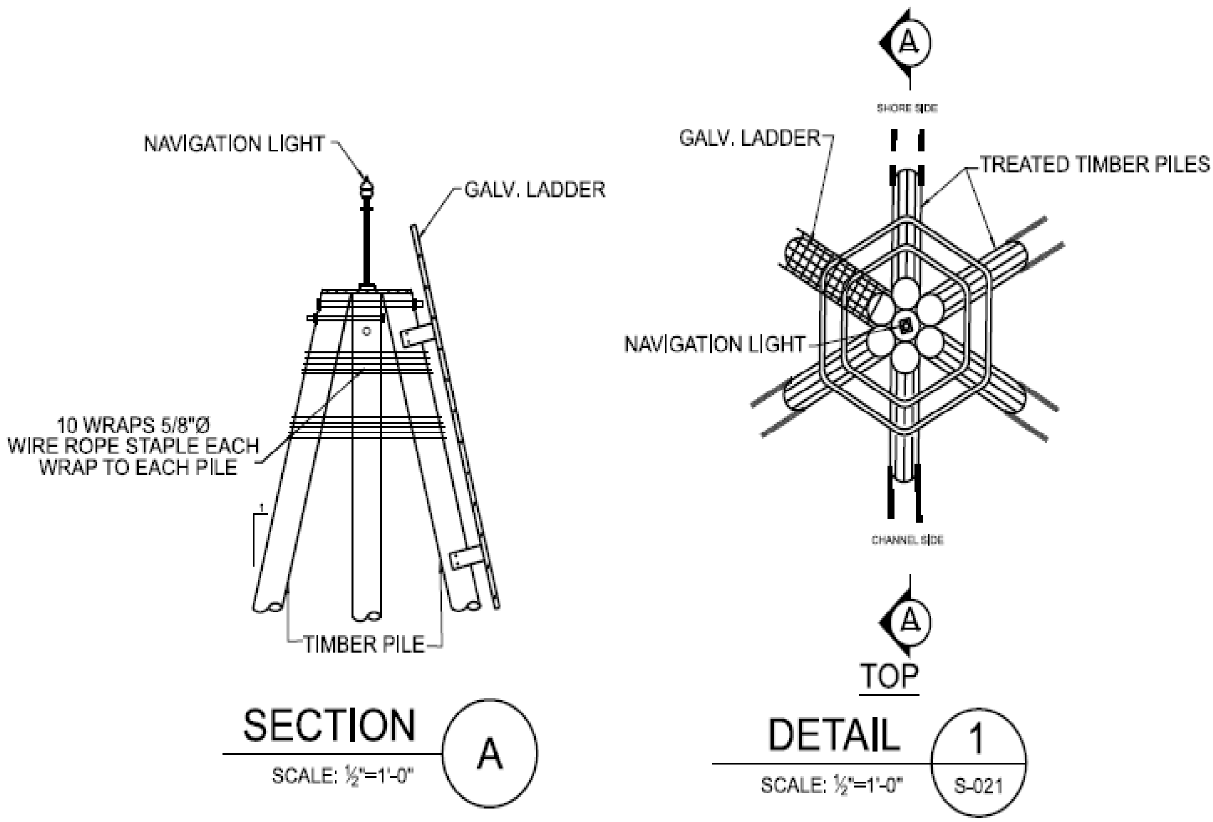


Figure 7: Dolphin Details

Approximately 1,060 total linear feet (510 linear feet on the west side of the floodgate and 550 linear feet on the east side of the floodgate) of floodwalls, specifically T-walls, would extend from the gate and tie into the adjacent levees. The floodwalls would have a top elevation of 21.0 ft NAVD88.

The height of the floodwall tie-ins would vary with the tallest walls adjacent to the barge gate and the shortest walls that tie into the adjacent levee. Details on a typical section of floodwall are provided in Figure 8.

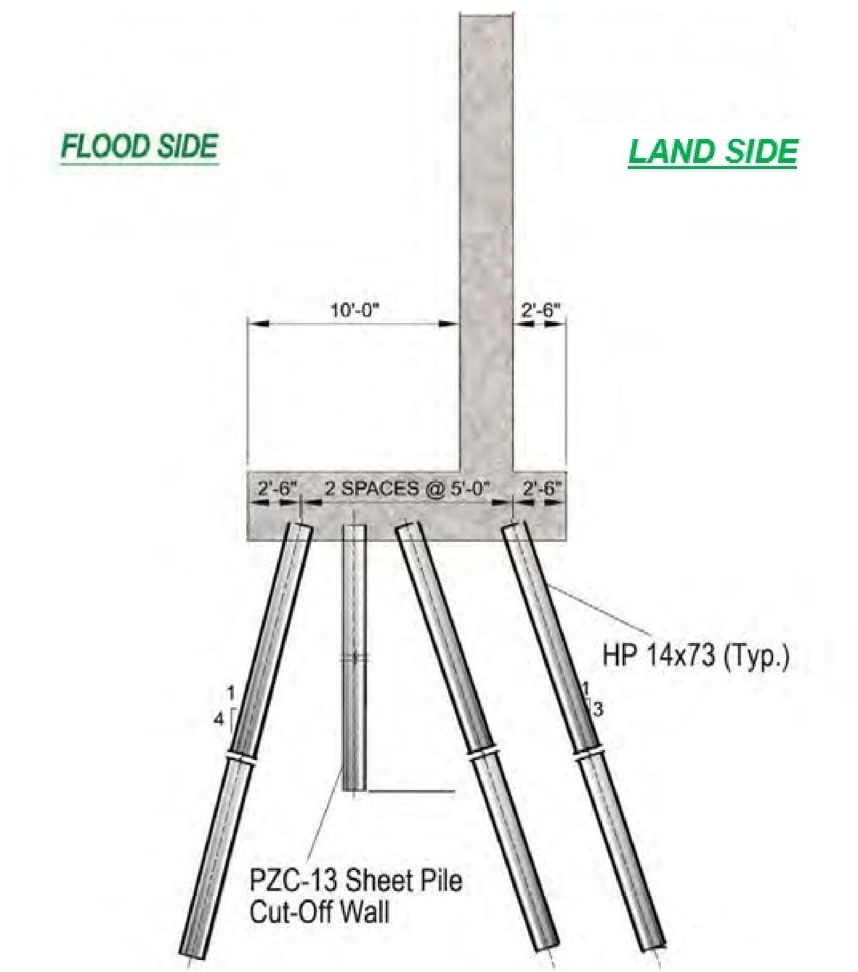


Figure 8: Typical Floodwall

The design of the new barge gate, floodwalls and roadway floodgate including the foundation is subject to change once detailed geotechnical investigations are conducted during detailed design.

Nine-inch concrete scour protection or grouted riprap would be used at the levee/T-wall transition. The concrete scour protection is located where the T-wall stem extends into the full levee section and extend down both levee slopes. The scour protection would continue for 30 linear feet past the end of the T-wall. Uncapped cut-off sheet piling would extend horizontally 30 feet into the full levee section for erosion and seepage control. See the sketch below for wall layout and cross-section. Please see Figure 9 below for an example of the proposed scour protection.

Figure 9: Concrete Scour Protection Example

2.9.3.2 Highway 315 Swing Gate

Where the eastern floodwall tie-in crosses Highway 315, a 36 ft wide swing gate would be constructed to provide an opening in the system to allow unimpeded traffic flow, except when a tropical system approaches the Gulf of America in which the gate would be closed (Figure 10 and 11).

A swing gate is a structure that is composed of two or more horizontal girders, vertical intercostals, vertical end diaphragms, a skin plate, and diagonal braces. In most cases, swing gate closures consist of a single gate leaf for openings up to 40-feet. Swing gates are mounted on hinges and swung open and closed like a door.

Figure 10: Swing Gate Closure Structure

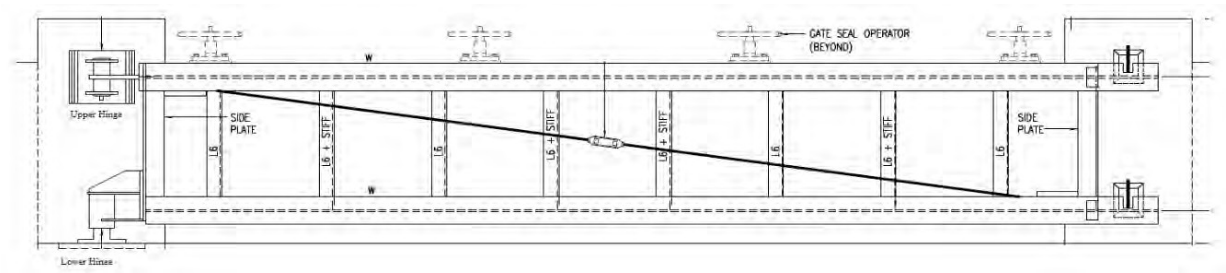


Figure 11: Typical Swing Gate Closure Structure Elevation

The existing centerline of Bayou Dularge has an approximate elevation of -4.0 ft. For the construction of the gate foundation, the channel would be excavated to an approximate elevation -14.0 ft NAVD88 with the final constructed sill elevation being El.

-7.0 ft. Directly adjacent to the floodgate slab, both on the land and the flood side of the gate would be excavated to elevation -9.5 ft (NAVD 88) to place both the bedding stone and the riprap required. The channel bottom would remain at elevation -7.0 ft for approximately 50 ft, both upstream and downstream of the newly constructed floodgate slab. The channel would then slope to allow a smooth transition from the sill elevation to existing grade over approximately 100-feet on both the land and flood side of the gate to afford aquatics the ability to migrate past gate sill.

The cross section at the gate location would be designed such that the pre and post project conditions would not impede the natural movement of aquatic organisms. The default operation would be open to avoid additional indirect impacts to vegetation and fish and wildlife due to changes in the natural hydrologic regime. The floodgate would be opened as soon as is safely possible after a closure for storm passage.

The velocities around and through the gate may require the channel bottom to be layered with 2-feet of riprap. After dredging the channel to El. -9.5, bedding would be placed on separator geotextile with the riprap on top of the bedding. A riprap gradation is assumed to be class 250 - 1000 lb stone (LADOTD 2016, Section 711). See Table 1 for example gradation limits for individual stone.

Table 1: Riprap Gradations

Gradation Limits Individual Stone Size (lbs)	Spherical Diameter (ft)	Percent Finer (By Weight)
1250	2.50	100
500	1.83	45-100
250	1.46	15-50
80	1.00	0-15

The barge gate would be constructed approximately in the center of the existing channel. A bypass channel would be constructed immediately adjacent to and to the west of the barge gate footprint prior to beginning construction of the floodgate to allow safe navigational passage of marine traffic, as well as all aquatic organisms to pass safely until the floodgate structure is complete (Figure 12).

Preliminary designs of the bypass require a minimum bottom channel width of 60 ft temporary bypass channel with an invert of El. -7.0 ft. Based on the preliminary design, the bypass channel would be approximately 650 feet. However, navigation of common local vessels would be considered for the bypass channels, and design features of a navigable bypass channel would be developed during detailed design. At a minimum, to maintain pre-construction flow conditions, navigation and minimize environmental impacts during construction, the temporary bypass channels would be similarly sized to the channels being impacted. A timber guidewall (like the permanent guide wall shown in Figure 5) would be constructed between the bypass channel and the barge gate footprint to prevent the cofferdam (described below) from vessel impact while the cofferdam is in place.

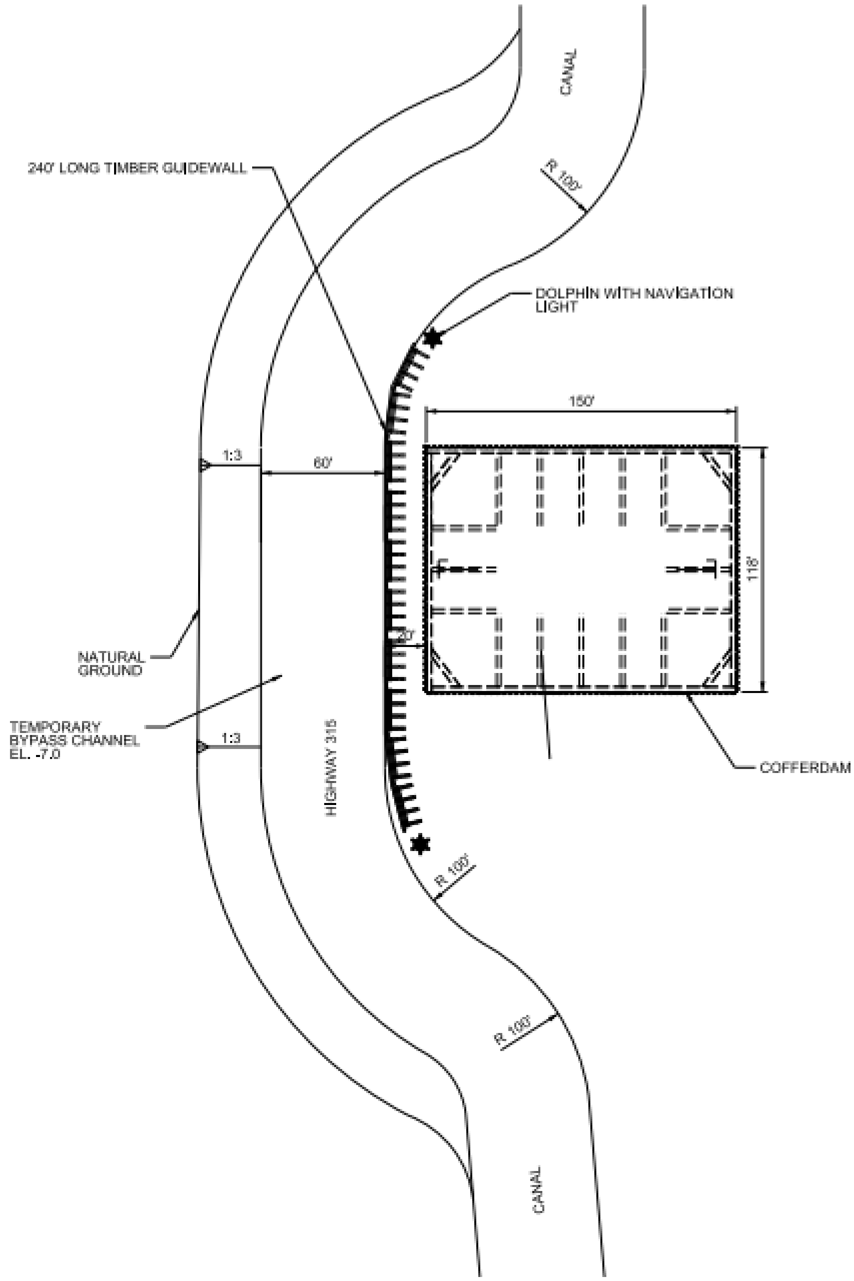


Figure 11: Preliminary bypass channel design

A total of 13,516 cy of material would be excavated from the channel for gate complex, bypass channel, and floodwall tie-in construction. If the dredged material is found to be suitable for use within the project levee footprint, the material would be used within the levee or could potentially be utilized for marsh restoration within the overall project footprint, otherwise the material would be hauled off site and disposed in accordance with all state and federal laws.

Once navigation is routed through the temporary bypass channel, a Phase 1 cofferdam (approximately 150 feet x 118 feet) would be constructed to permit working in the dry when constructing the barge gate concrete landing slab, pivot arm assembly, and the receiving structure concrete monoliths. The cofferdam would be an internally braced cofferdam with wide flange walers and pipe braces supporting PZ sheet piling. Reduced power would be required for vessels passing through the construction area to reduce the risk of impact to the cofferdam. A timber guide wall and pile clusters would be provided along the bypass channel to prevent vessel impact on the cofferdam.

Once construction of the 56-foot barge gate landing slab, pivot arm assembly, receiving structure monoliths is completed, navigation would be re-routed through the permanent barge gate structure. Following routing the navigation traffic through the barge gate, the Phase 2 cofferdam, permanent guide walls and pile clusters, tie-in T-walls, and final civil site work can be completed. The Phase 2 cofferdam (approximately 120 feet x 80 feet on the west side and 60 feet x 80 feet on the east side of the floodgate) would be constructed to permit the construction of the adjacent T-walls to the barge gate structure that would be in the water. The same anchor forces, moments, and tips used for the Phase 1 cofferdams would be conservatively used for the Phase 2 cofferdams.

2.9.4 Construction Duration and Equipment

The construction duration of the Bayou Dularge Floodgate would be 24 months with an assumed work schedule of 5 days a week, 8 hours a day. The barge floodgate would be constructed using both floating equipment and land support. Below is the preliminary list of equipment anticipated to be utilized for the construction of the Bayou Terrebonne Floodgate.

Table 1: Preliminary Equipment List for Sector Gate and Floodwall Construction

Project Component	Duration (days)	Equipment Used
Barge Gate Complex & Tie-In Floodwall	730	150-Ton Crane
		80-Ton Crane
		Excavator
		Pile Driver
		Concrete Trucks
		Concrete Vibrators
		Welding Machine, Cutting Torch
Tie-In Levee		Dump Trucks
		Bull Dozers
		Fill Compactor
		Front End Loaded/Backhoe
		Fuel Tanks
		Generator

2.9.5 Access and Staging

Construction site access would be obtained by both barge and land. Vehicle access would be via LA Highway 315 and Parish Road 111 to the project site (Figure 12). The construction staging area would be within the cleared area shown in Figure 12. It is assumed the staging area would be approximately 0.5 acres. The staging area would have a crushed stone on top of a separator fabric. Upon completion of the project, the staging area would be returned to pre-construction condition. The staging area would be used as an operations and materials storage area. The contractor would place the project trailers for both the Government and the contractor within the staging area. The contractor would store the project equipment and project building supplies within the staging area.

Figure 12: Staging and Access

2.10 REACH F-1, BAYOU GRAND CAILLOU BARGE GATE & SLUICE GATE

2.10.1 Location

The Bayou Grand Caillou Floodgate would be located in Bayou Grand Caillou within Terrebonne Parish (latitude 29°20'31.80"N, longitude -90°44'20.95"W), just west of the existing Bayou Grand Caillou gate system (Figure 1).

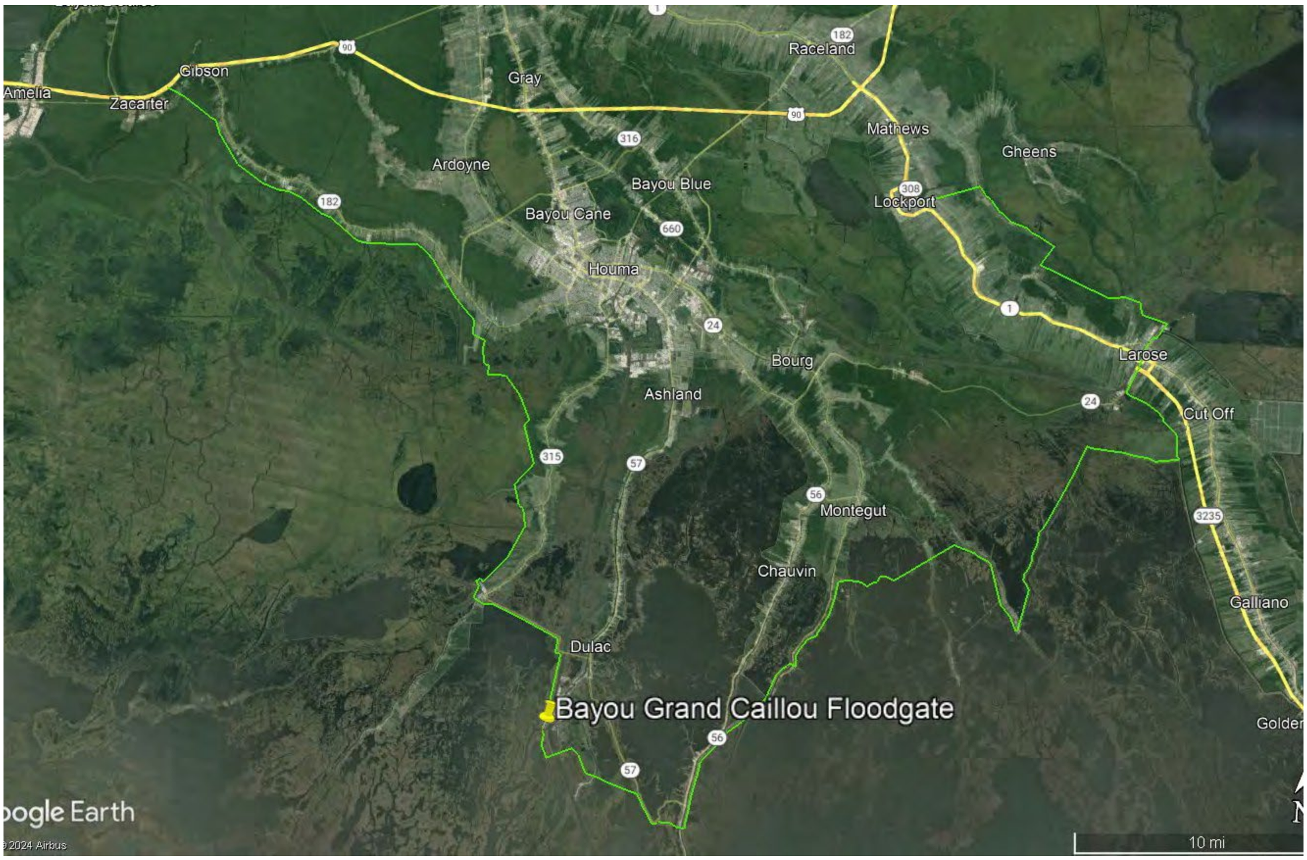


Figure 1: Location Map

2.10.2 Scope of Work

This contract would consist of construction of a 56 ft wide barge floodgate within Bayou Grans Caillou with floodwall tie-ins flanking each side of the floodgate. In addition to the floodgate, this contract includes 3 sluice gate monoliths with each monolith housing 3 – 16 feet by 16 feet sluice gates within each gate monolith that would remain open unless there is a storm event. On both the inflow and the outflow of the gate bay, there would be timber guide walls and protection pile clusters. Finally, the transition between the floodwall tie-ins and Reach F-1 levee would be protected with concrete or grouted riprap to prevent scour at this transition.

2.10.3 Structure Description

This floodgate would be a 56 ft wide barge floodgate (Figure 2) with a top elevation of 18.5 ft NAVD88, and a slab invert elevation of -12.0 ft NAVD88. The floodgate would provide an opening in the system to allow unimpeded navigation, except when a tropical system approaches the Gulf of America in which the gate would be closed.

A barge gate is constructed of a braced steel frame with sheet metal or solid plate exterior in a hollow box configuration that resembles a hopper barge (see Figure 2). The gate normally contains several individual compartments that are watertight. The gate would have a pivot arm at one end that allows the gate to articulate in a 90° arc to open and close. The pivot arm would be mounted onto a fixed pivot pile that would allow the gate and pivot arm free travel in the vertical direction (for flotation). When the gate is in either the open or closed position, pumps fill the compartments with water until the buoyancy is overcome and the structure settles onto a receiving structure. While in the open position, the gate would also function as a guide wall to aid the vessels in navigating through the structure. In the closed position, the gate is ballasted down to an underwater foundation with gravity loads transferred through the base seal and the base support (see Figures 3 & 4). The flat top of the gate allows passage of either pedestrian or motorized ATV traffic. Lateral loads from high tides or storm surge on the barge gate are transferred into two concrete abutment reaction walls on either end of the gate structure.

Figure 2: Typical Barge Gate Example

Figure 3: Conceptual Barge Gate - Elevation View with Gate in Open Position

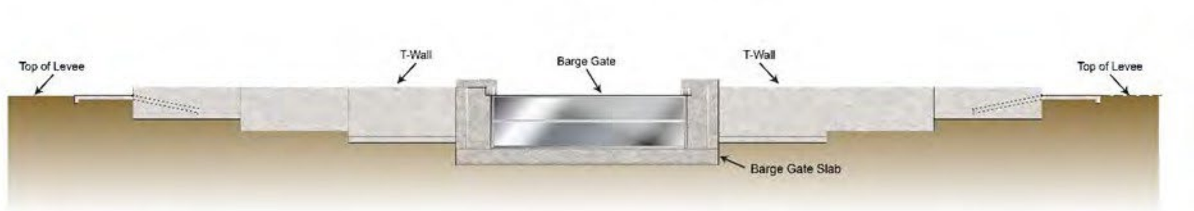


Figure 4: Conceptual Barge Gate - Elevation View with Gate in Closed Position

Adjacent to the barge gate, there would also be 3 separate sluice gate monoliths at this project location. Each sluice gate structure would contain 3 sluice gates, each 16' wide by 16' tall with an invert elevation of elevation -12.0.There would be one monolith on the south side of the gate, and two monoliths on the north side of the gate, for a total of 3 monoliths and nine sluice gates within the gate complex.

A sluice gate is a structure that contains a movable gate or series of movable gates that, when lifted, allow material and water to flow under it. The sluice gate would provide an opening in the system to allow unimpeded tidal flow, except when a tropical system approaches the Gulf of America in which the gates would be closed. Sluice gates are not navigable as they do not raise high enough, or they have fixed components that do not allow vessels to pass through. See Figure 5 and Figure 6 for a typical conceptual plan view and cross section of a sluice gate system.

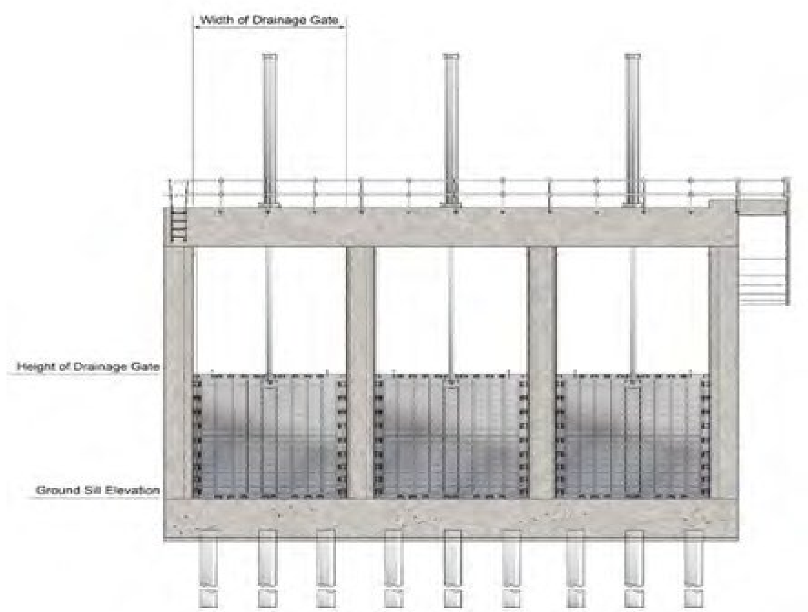


Figure 5: Conceptual Barge Gate - Elevation View with Gate in Closed Position

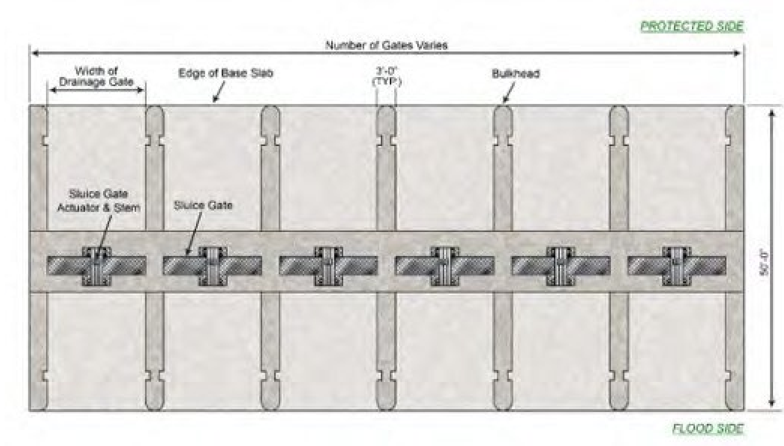


Figure 6: Typical Sluice Gate Control Structure (6 gates) - Plan View

Timber guide walls and pile clusters would be provided as aids to navigation and to protect the main flood gate structure from impact. The seven pile dolphin structures are constructed at the end of the guide wall to protect the guide walls from impact from vessels. The guide walls would be timber support frames currently spaced every 6 feet. Each timber support frame is constructed with a vertical pile braced by a batter pile driven at an angle from vertical. The outer end of each guide wall is anchored with a seven-pile dolphin structure. The dolphins would consist of 7 timber piles battered away from each other and tied together with a wire rope at the top of the dolphin. Please see figure 7, 8 and 9 for more details.

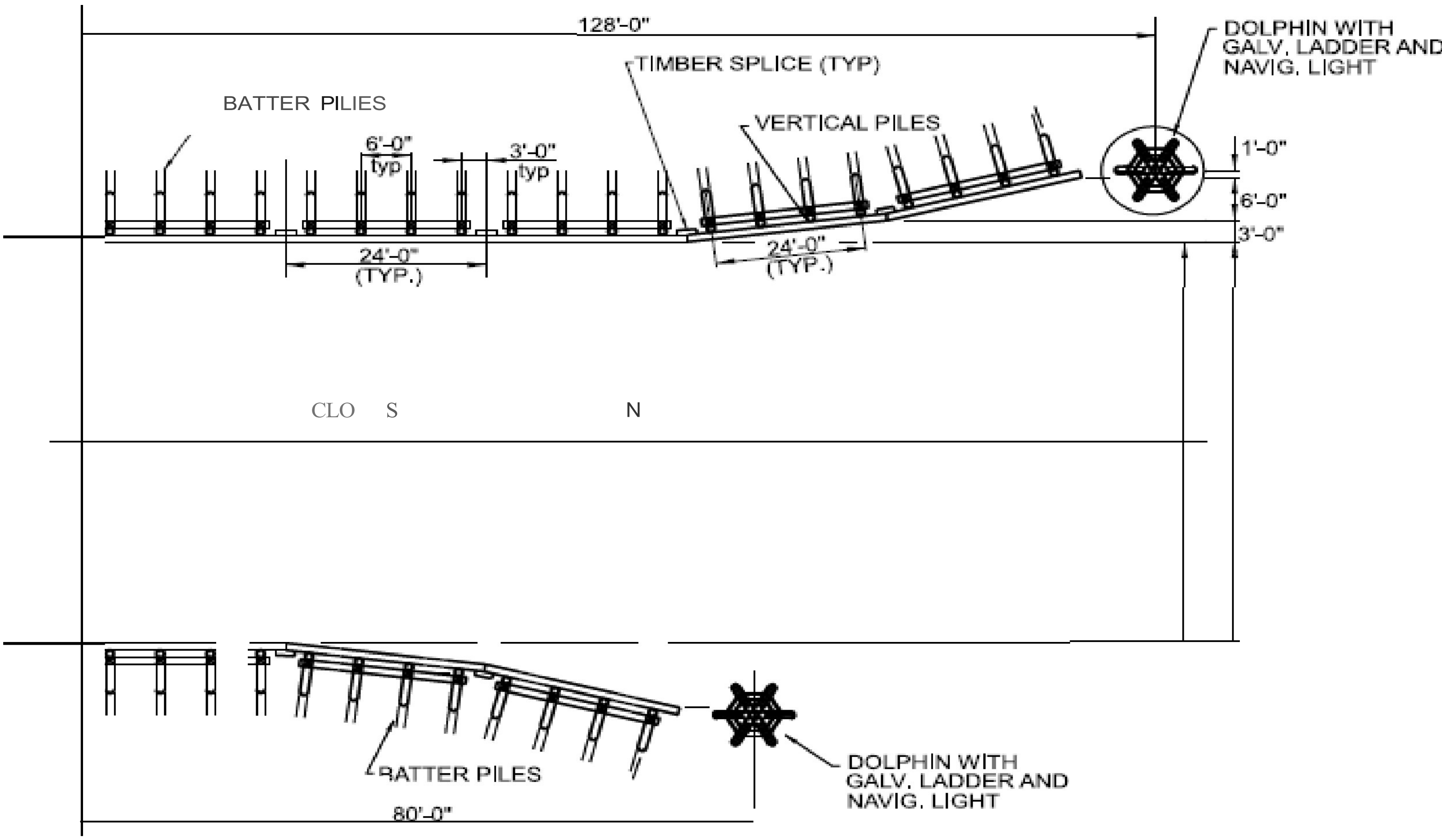


Figure 7: Plan – Guide walls, Fenders, and Dolphins

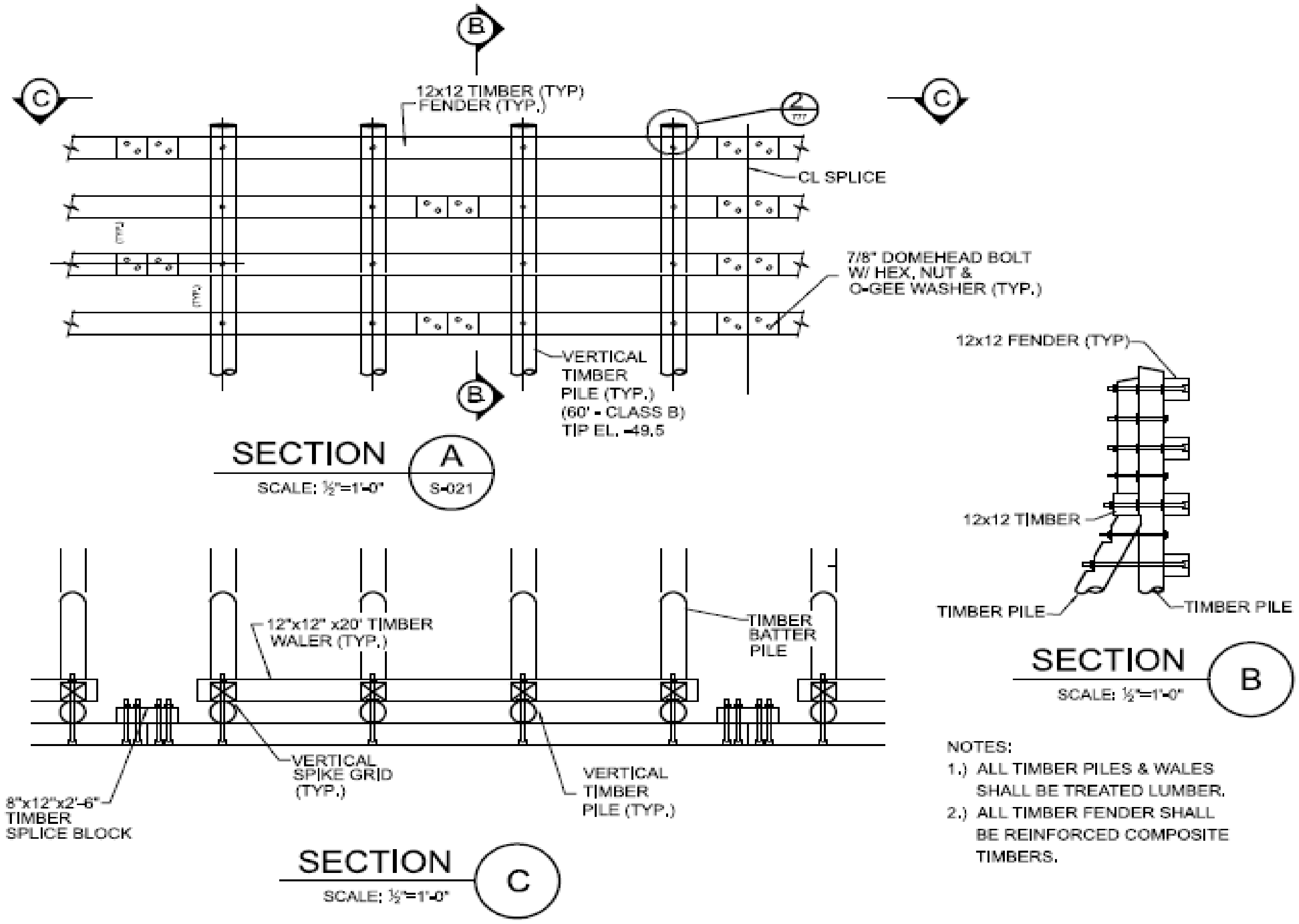


Figure 8: Guide wall Details

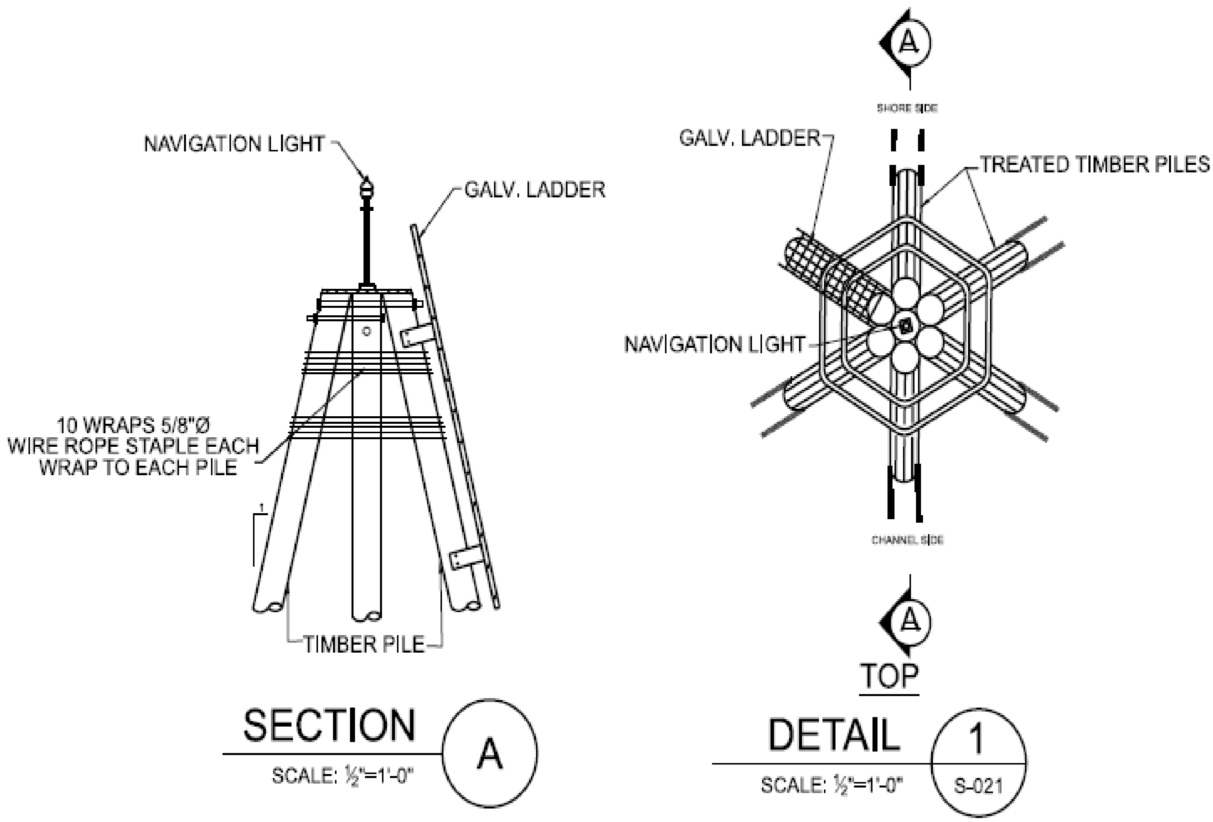


Figure 9: Dolphin Details

Approximately 970 total linear feet (485 linear feet on the north side of the floodgate and 485 linear feet on the south side of the floodgate) of floodwalls, specifically T-walls, would extend from the gate complex and tie into the adjacent levees. The floodwalls would have a top elevation of 18.5 ft NAVD88.

The height of the floodwall tie-ins would vary with the tallest walls adjacent to the barge gate and the shortest walls that tie into the adjacent levee. Details on a typical section of floodwall are provided in Figure 10.

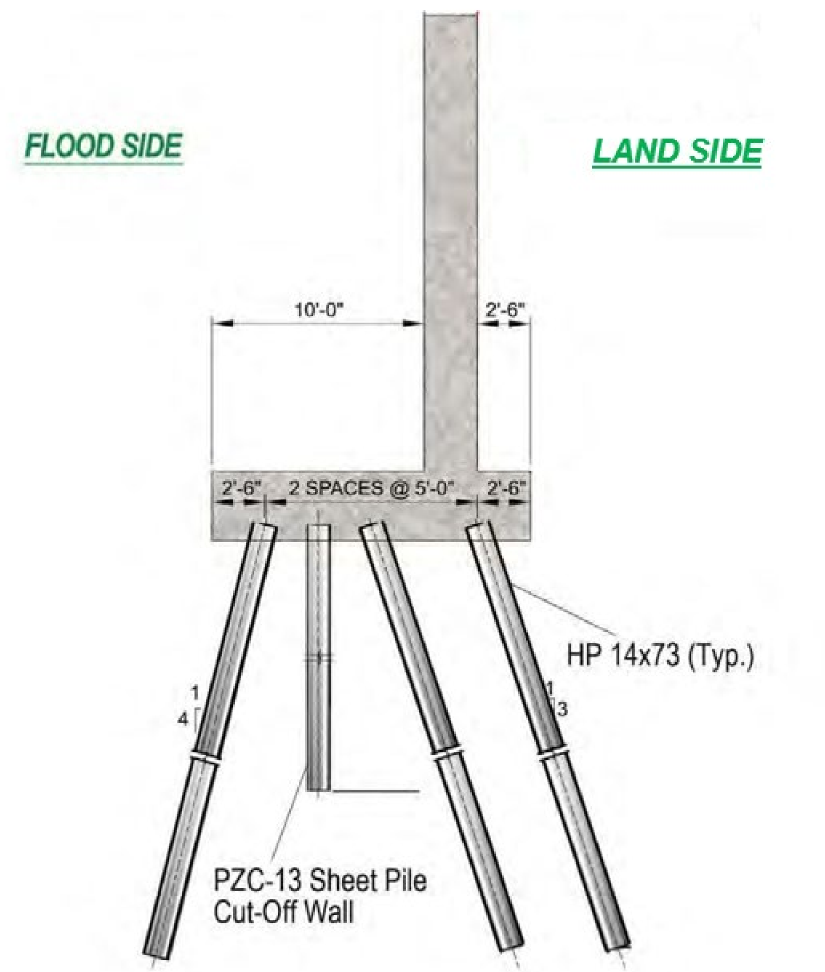


Figure 10: TypicalFloodwall

The design of the new barge gate, floodwalls and sluice gate structure including the foundation is subject to change once detailed geotechnical investigations are conducted during detailed design.

Nine-inch concrete scour protection or grouted riprap would be used at the levee/T-wall transition. The concrete scour protection is located where the T-wall stem extends into the full levee section and extend down both levee slopes. The scour protection would continue for 30 linear feet past the end of the T-wall. Uncapped cut-off sheet piling would extend horizontally 30 feet into the full levee section for erosion and seepage control. See the sketch below for wall layout and cross-section. Please see Figure 11 below for an example of the proposed scour protection.

Figure 11: Concrete Scour Protection Example

The barge gate would be constructed on the flood side of the existing floodgate. The existing centerline of Bayou Grand Caillou has an approximate elevation of -10.0 ft. For the construction of the gate foundation, the channel would be excavated to an approximate elevation -20 ft NAVD88 with the final constructed sill elevation being El. -12.0 ft. Directly adjacent to the floodgate slab, both on the land and the flood side of the gate would be excavated to an El. -14.5 ft NAVD 88 to place both the bedding stone and the riprap required. The channel bottom would remain at elevation -12.0 ft for approximately 50 ft, both upstream and downstream of the newly constructed floodgate slab. The channel would then slope to allow a smooth transition from the sill elevation to existing grade over approximately 100-feet on both the land and flood side of the gate to afford aquatics the ability to migrate past gate sill.

The cross section at the gate location would be designed such that the pre and post project conditions would not impede the natural movement of aquatic organisms. The default operation would be open to avoid additional indirect impacts to vegetation and fish and wildlife due to changes in the natural hydrologic regime. The floodgate would be opened as soon as is safely possible after a closure for storm passage.

The velocities around and through the gate may require the channel bottom to be layered with 2-feet of riprap. After dredging the channel to El. -14.5, bedding would be placed on separator geotextile with the riprap on top of the bedding. A riprap gradation is assumed to be class 250 - 1000 lb stone (LADOTD 2016, Section 711). See Table 1 for example gradation limits for individual stone.

Table 1: Riprap Gradations

Gradation Limits Individual Stone Size (lbs)	Spherical Diameter (ft)	Percent Finer (By Weight)
1250	2.50	100

500	1.83	45-100
250	1.46	15-50
80	1.00	0-15

The barge gate would be constructed approximately in the center of the existing channel. A bypass channel would be constructed immediately adjacent to and to the south of the barge gate cofferdam footprint prior to beginning construction of the floodgate to allow safe navigational passage of marine traffic, as well as all aquatic organisms to pass safely until the floodgate structure is complete (Figure 12).

Preliminary designs of the bypass require a minimum bottom channel width of 60 ft temporary bypass channel with an invert of El. -12.0 ft. Based on the preliminary design, the bypass channel would be approximately 650 feet long. However, navigation of common local vessels would be considered for the bypass channels, and design features of a navigable bypass channel would be developed during detailed design. Ata minimum, to maintain pre-construction flow conditions, navigation and minimize environmental impacts during construction, the temporary bypass channels would be similarly sized to the channels being impacted. A timber guidewall (like the permanent guide wall shown in Figure 5) would be constructed between the bypass channel and the barge gate footprint to prevent the cofferdam (described below) from vessel impact while the cofferdam is in place.

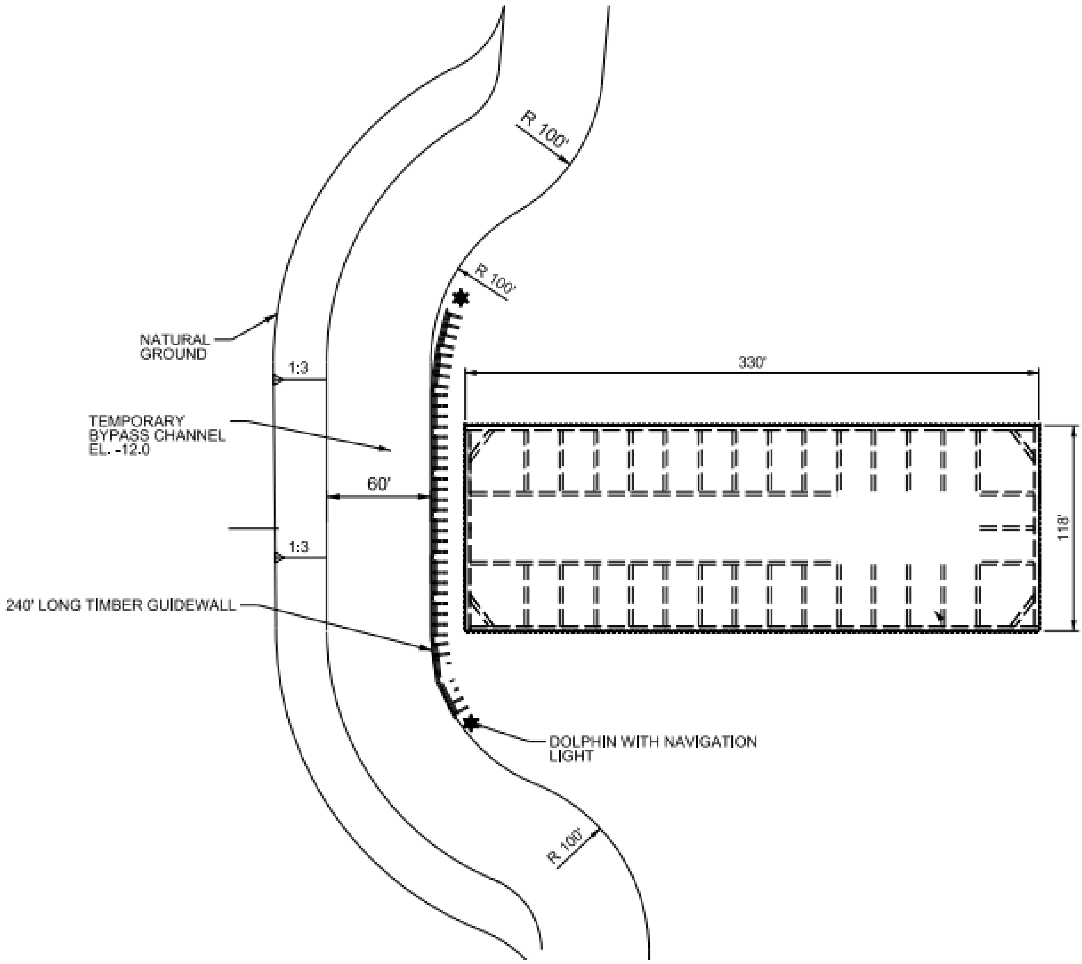


Figure 12: Preliminary bypass channel design

A total of 27,270 cy of material would be excavated from the channel for gate complex and bypass channel construction. If the dredged material is found to be suitable for use within the project levee footprint, the material would be used within the levee or could potentially be utilized for marsh restoration within the overall project footprint, otherwise the material would be hauled off site and disposed in accordance with all state and federal laws.

Once navigation is routed through the temporary bypass channel, a Phase 1 cofferdam (approximately 330 feet x 118 feet) would be constructed to permit working in the dry when constructing the barge gate concrete landing slab, pivot arm assembly, and the receiving structure concrete monoliths. The cofferdam would be an internally braced cofferdam with wide flange walers and pipe braces supporting PZ sheet piling. Reduced power would be required for vessels passing through the construction area to reduce the risk of impact to the cofferdam. A timber guide wall and pile clusters would be provided along the bypass channel to prevent vessel impact on the cofferdam.

Once construction of the 56-foot barge gate landing slab, pivot arm assembly, receiving structure monoliths is completed, navigation would be re-routed through the permanent barge gate structure. Following routing the navigation traffic through the barge gate, the

Phase 2 cofferdam, permanent guide walls and pile clusters, tie-in T-walls, and final civil site work can be completed. The Phase 2 cofferdam (approximately 120 feet x 80 feet on both sides of the floodgate) would be constructed to permit the construction of the adjacent T-walls to the barge gate structure that would be in the water. The same anchor forces, moments, and tips used for the Phase 1 cofferdams would be conservatively used for the Phase 2 cofferdams.

2.10.4 Construction Duration and Equipment

The construction duration of the Bayou Grand Caillou Floodgate would be 24 months with an assumed work schedule of 5 days a week, 8 hours a day. The barge floodgate would be constructed using both floating equipment and land support. Below is the preliminary list of equipment anticipated to be utilized for the construction of the Bayou Grand Caillou Floodgate.

Table 1: Preliminary Equipment List for Sector Gate and Floodwall Construction

Project Component	Duration (days)	Equipment Used
Barge Gate Complex & Tie-In Floodwall	730	150-Ton Crane
		80-Ton Crane
		Excavator
		Pile Driver
		Concrete Trucks
		Concrete Vibrators
		Welding Machine, Cutting Torch
Tie-In Levee		Dump Trucks
		Bull Dozers
		Fill Compactor
		Front End Loaded/Backhoe
		Fuel Tanks
		Generator

2.10.5 Access and Staging

Construction site access would be obtained by both barge and land. Vehicle access would be via LA Highway 315 to Falgout Canal Road to the Levee Access Road. There would be floating barges anchored within 500 feet of the project footprint that would be used for staging for this project. The staging area would be used as an operations and materials storage area.

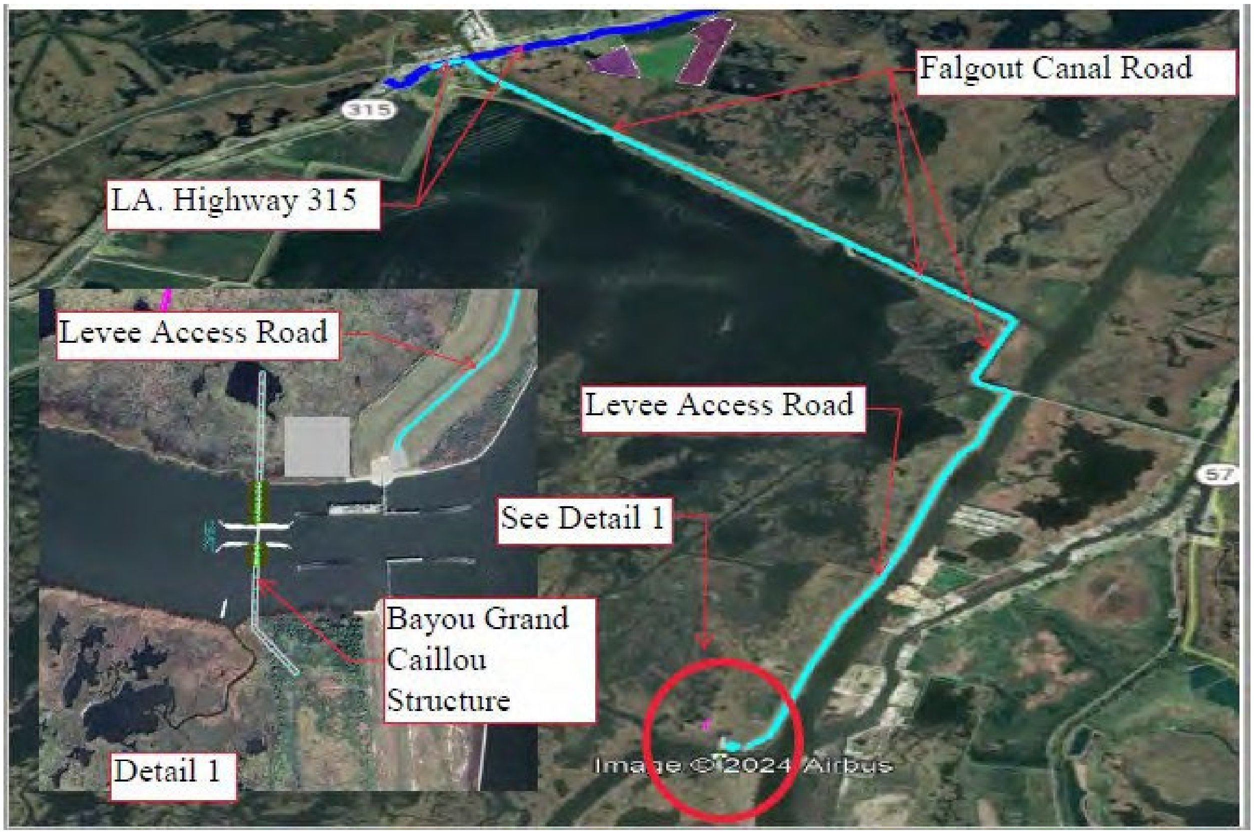


Figure 13: Staging and Access

2.11 HOUMA NAVIGATION CANAL LOCK

2.11.1 Location

The Houma Navigation Lock Complex would be located on the Houma Navigation Canal within Terrebonne Parish and is located at latitude 29°19'48.24"N, longitude -90°43'43.30"W.

2.11.2 Scope of Work

This contract would consist of a lock complex located at the intersection of levee reach F-1 and G-1 of the Morganza to the Gulf project. The Houma Navigation Canal Lock Complex (HNC Lock Complex) consists of the following features (Figures 2 and 3):

- An 800’ long Lock Chamber with sector gates that provides 110’ of clear width for navigation.
- Integration of and improvements to the existing Bubba Dove barge gate that provides 250’ of clear width for navigation.
- A floodwall that consists of braced concrete and steel flood walls connecting the lock complex to the existing adjacent levees.

- An Operations Area that contains a maintenance building, boat ramp, boat shed, and other facilities to maintain the complex.
- A control building that contains back-up generators, a control room, a safe house, and other facilities to operate the structures.
- A road to provide land-based access to the project.
- Fendering, protection dolphins, and nose piers for protection of the structures.
- Dewatering bulkheads for lock gate maintenance and on-site bulkhead storage.

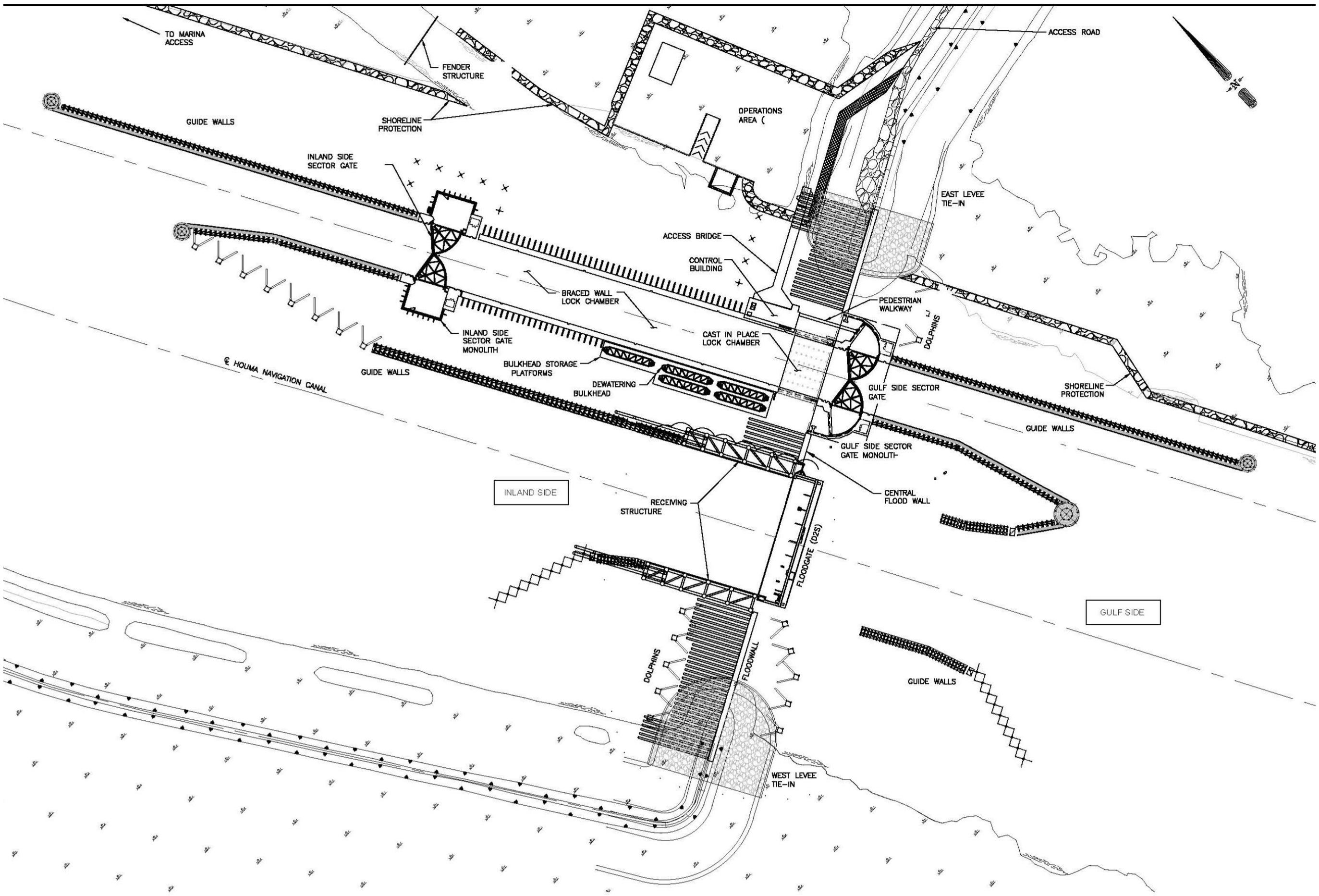
The HNC lock complex will serve two purposes: Flood control and salinity control. Based on the Flood Closure Criteria from the Final RPEIS dated May 2013, the HNC Lock and Floodgate will be closed once a watch has been issued by the National Hurricane Center AND the stage measured at the gate location reaches +2.5 ft NAVD88. The gates can only be reopened once the watch has been discontinued AND the stages on the differential between the interior water level and exterior water level is equal to or less than the +1.0 feet as measured on the upstream and downstream staff gage and the channel has been cleared of obstructions

The HNC Lock and floodgate would be closed for salinity only if:. 1) Flows in the Atchafalaya River are below 100,000 cfs as measured at Simmesport gage (USGS 07381490) or 2) If a gage on the outside of the Lock Complex exceeds a salinity value that has been correlated with preventing exceedance of the maximum allowable chloride level of 250 ppm as defined in EPA's secondary drinking water standard at the Houma Treatment Plant. The structure should be closed for at least 12 hours and fluctuations in chloride levels should be monitored and recorded hourly. he HNC Lock complex may be opened after monitoring chloride levels over the 12 hour period at the new gage on the outside of the Lock complex drops below the salinity closure trigger.

2.11.3 HNC Lock Complex Project Features

Figure 3 provides an overview of the main features of the lock complex and Figure 4 provides a cross-section of the lock complex. Figures 5a and 5b provide an overview of the existing features that have been constructed and features to be constructed in future phases under USACE Permit MVN 2015-01590-COO.


Figure 2: HNC Lock Complex Rendering



PROPOSED PROJECT FEATURES

SCALE: 1"=100'

100' 0' 100' 200' 300'

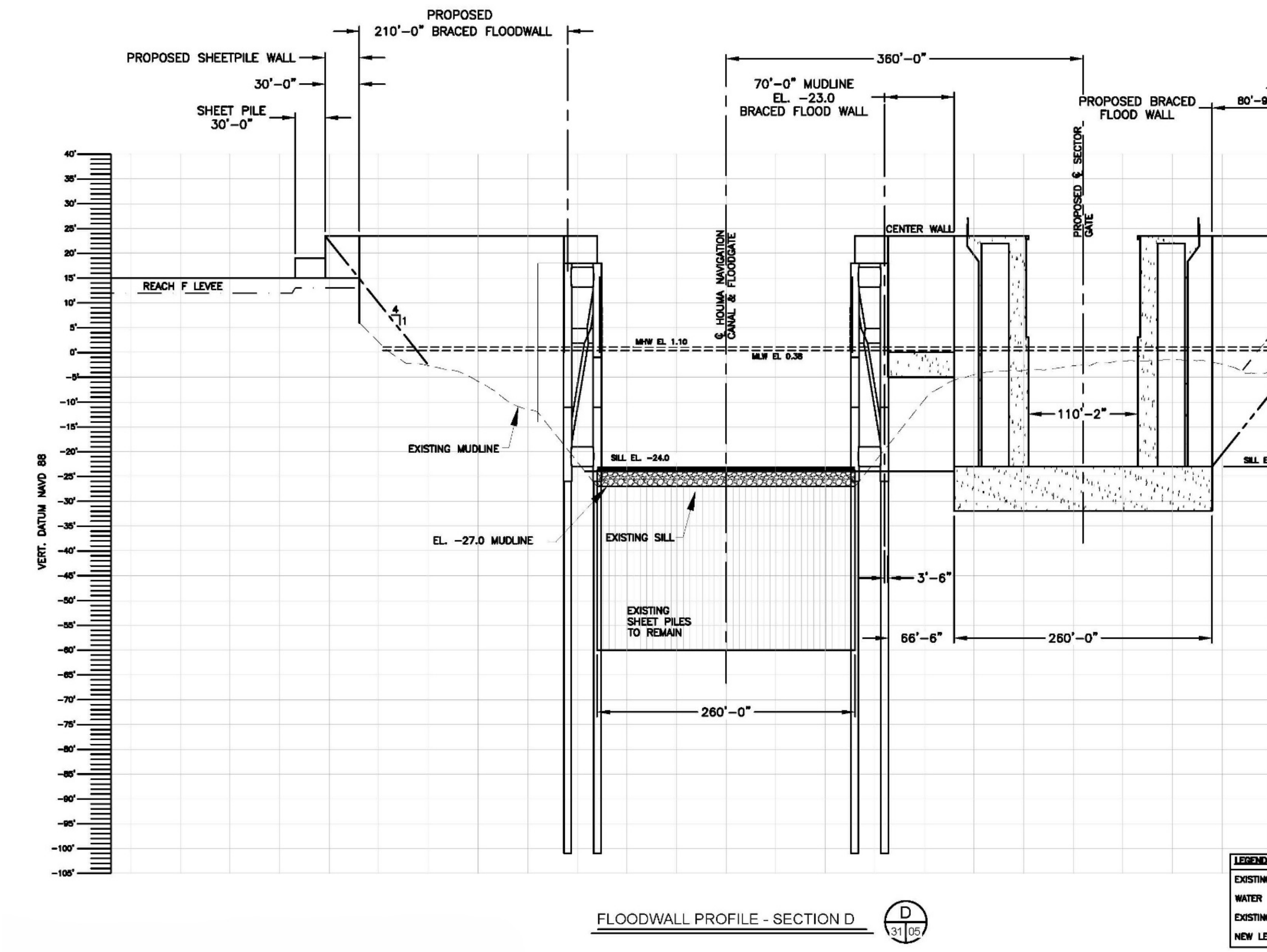
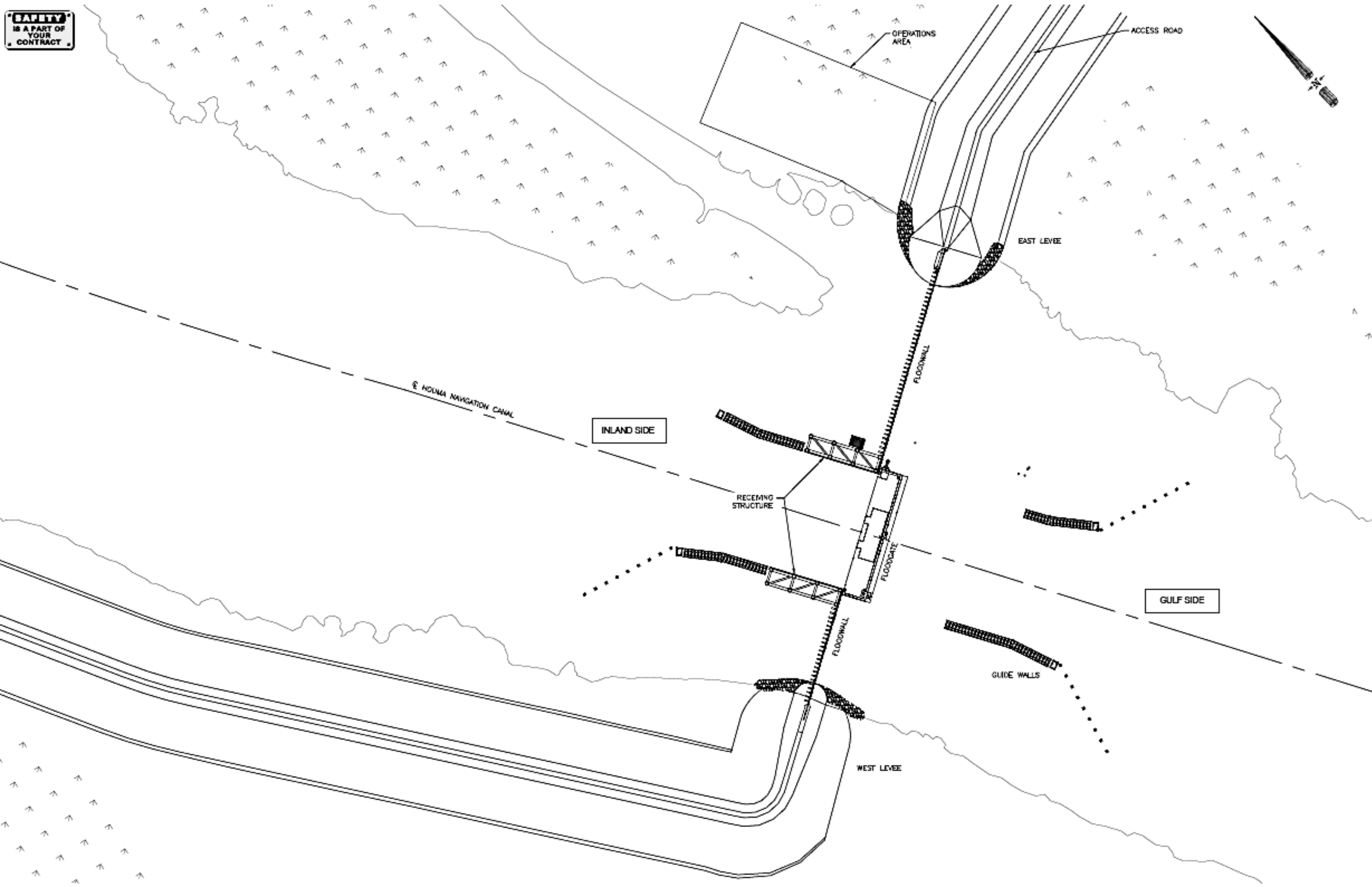
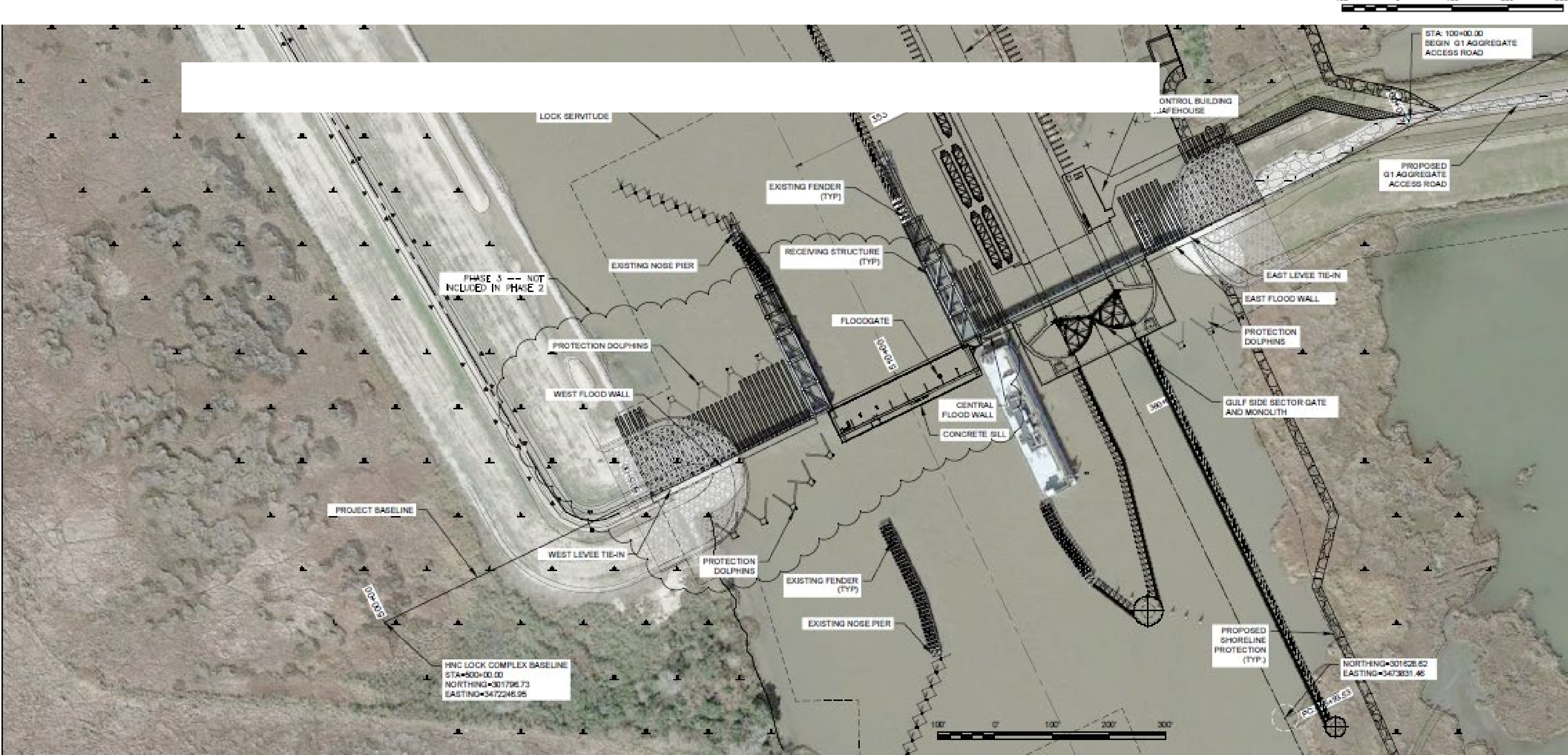


Figure 4: HNC Lock Complex Cross-section



EXISTING PROJECT FEATURES
SCALE: 1"=100'



The lock chamber would consist of two sector gates (gulf side and inland side) connected by 683.5 linear feet of braced walls on either side of the 110' wide chamber. The walls would be comprised of 36" pipe pile and 24" battered pipe pile, and the base would be lined with riprap. The gulf side sector gate (GSSG) would be 110 ft wide with a top elevation of +23.5 ft and a slab invert elevation of -23 ft NAVD88). The inland side sector gate (ISSG) will also have a slab invert elevation of -23 ft, but because it is not part of the storm risk reduction system it would have a top elevation of +10.0 ft.

A sector gate consists of two leaves joined at the center of the navigable channel width that rotate into gatebay recesses when opened. Each gate leaf is shaped as a sector of a cylinder, or pie-shape, with a vertical axis. The floodgate will provide an opening in the hurricane and storm damage risk reduction system (HSDRRS) to allow unimpeded navigation. The floodgate will be closed when a tropical system approaches the Gulf of America. Figures 6 through 9 show the two sector gates in the open and closed positions.

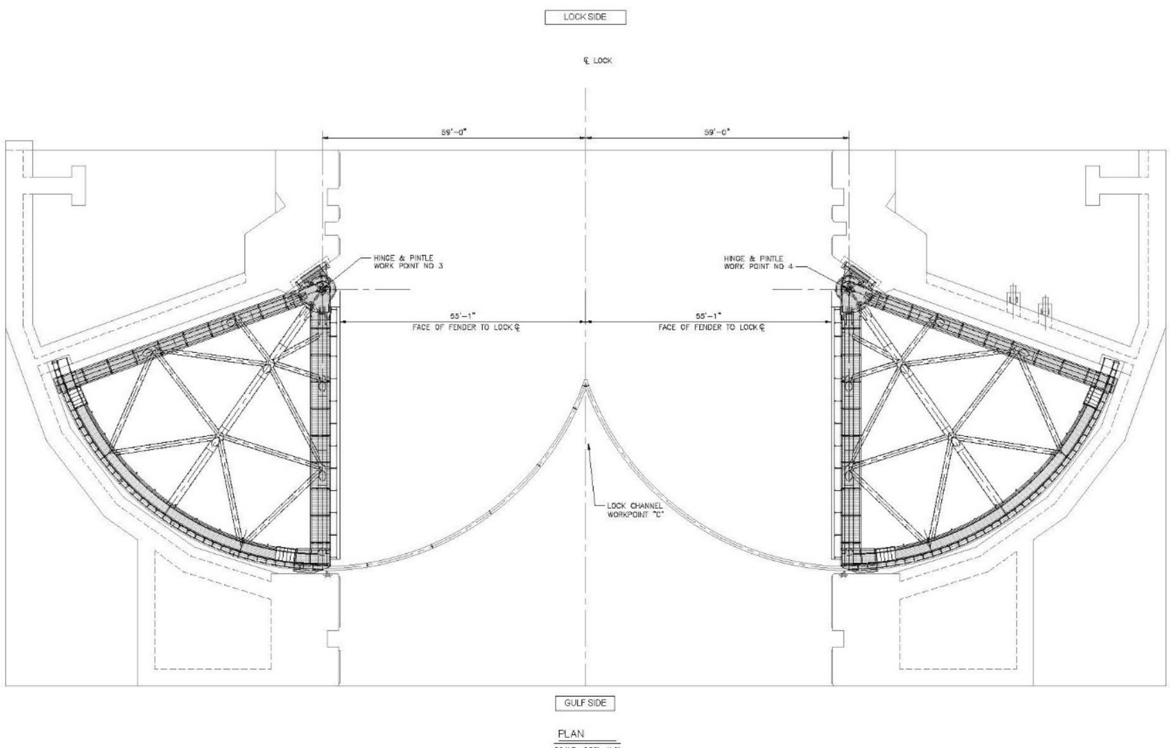


Figure 6: Gulf side sector gate in open position

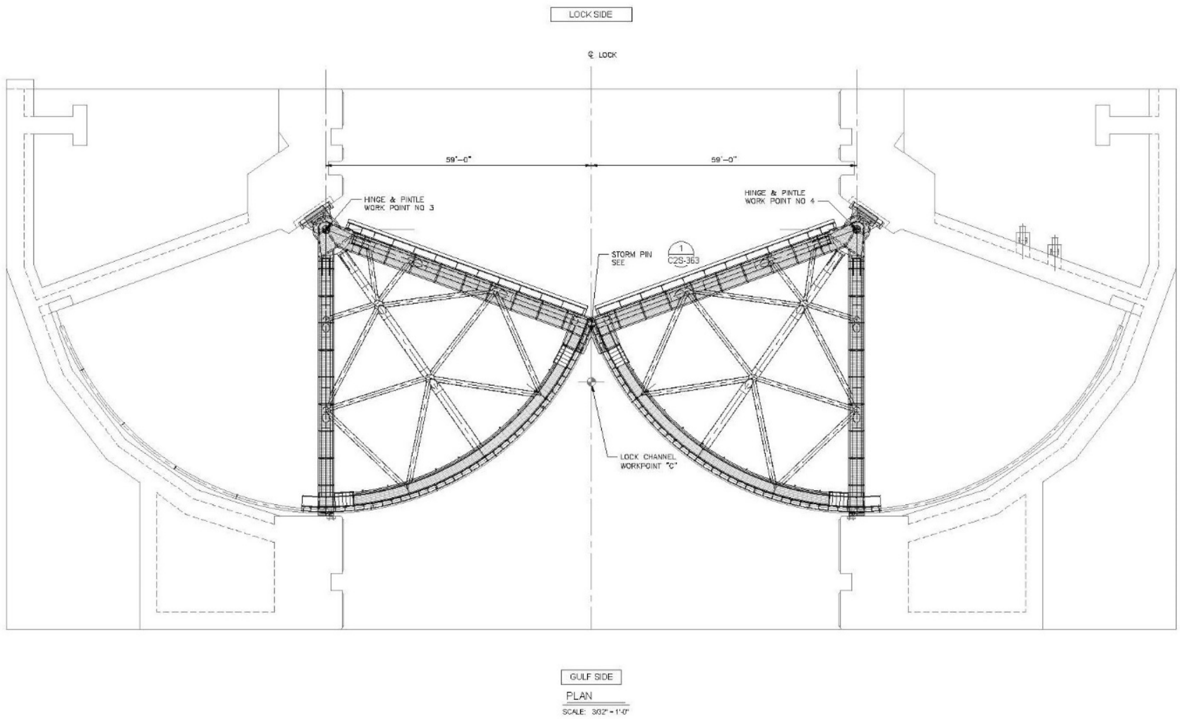


Figure 7: Gulf side sector gate in closed position

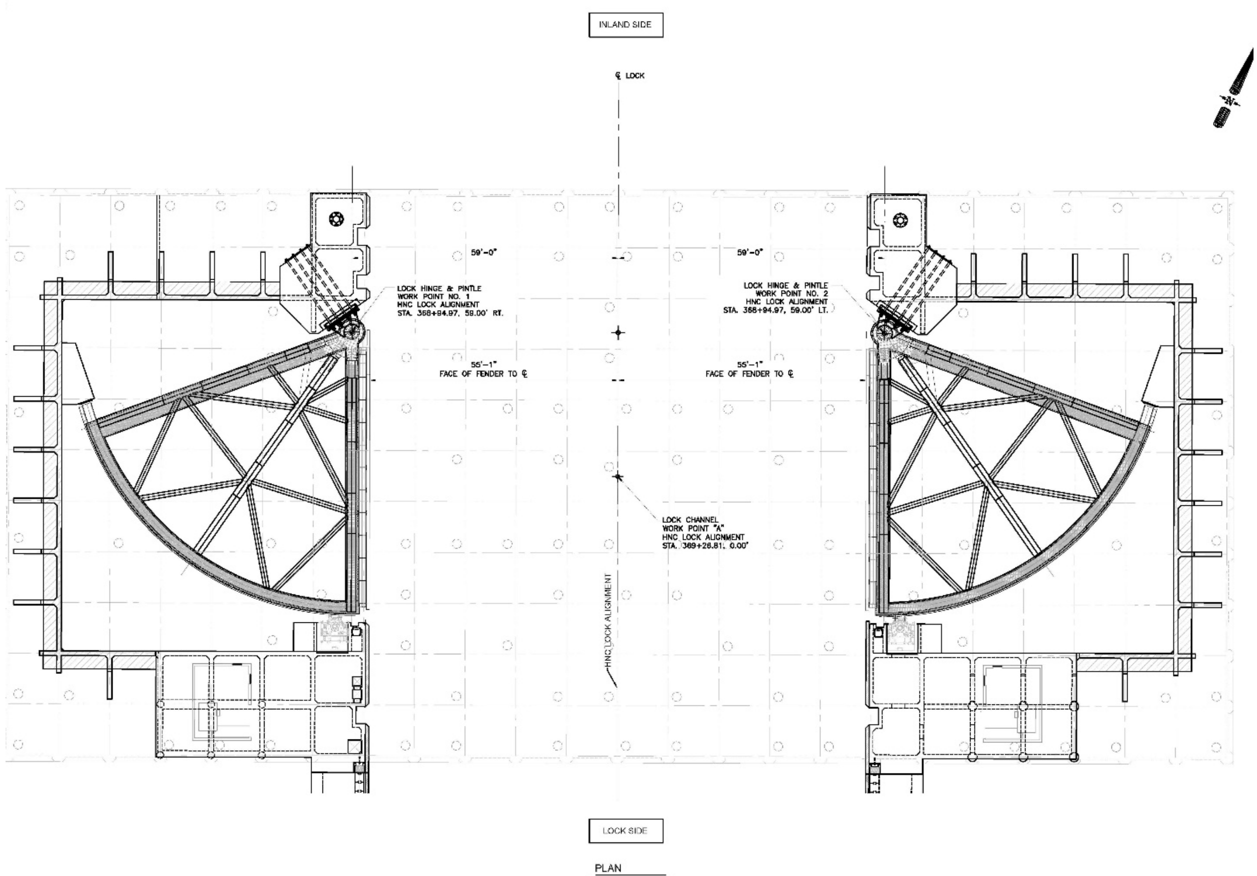
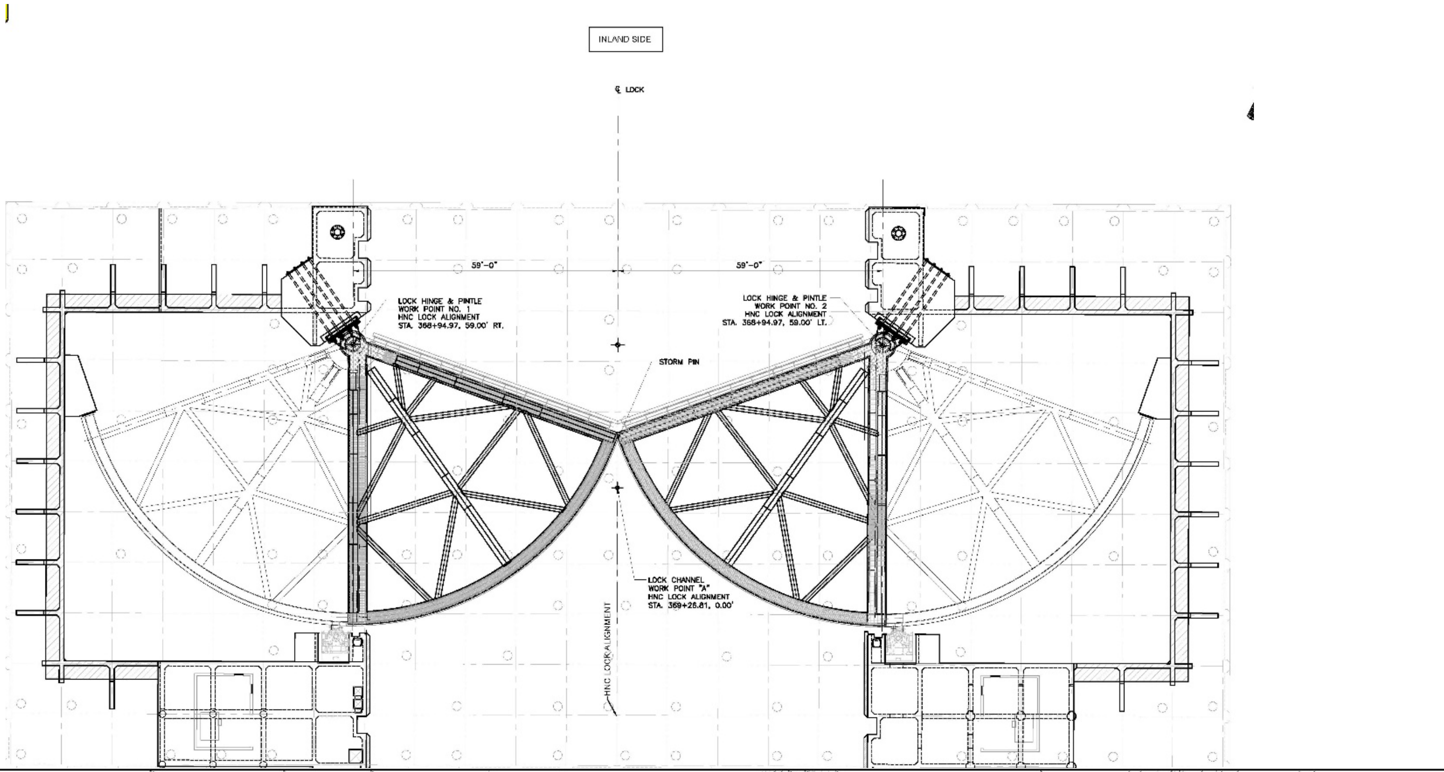
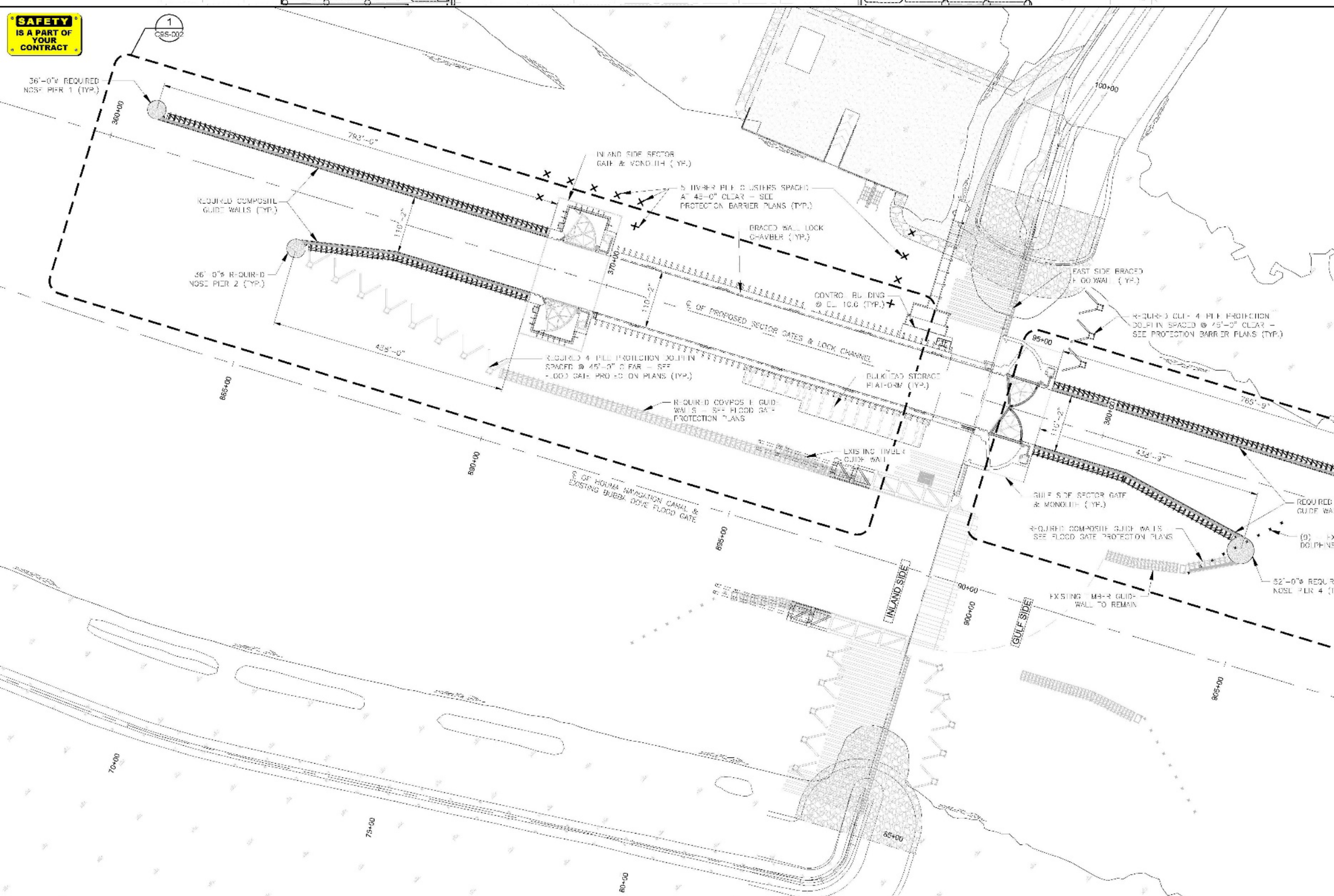


Figure 8: Inland side sector gate in open position





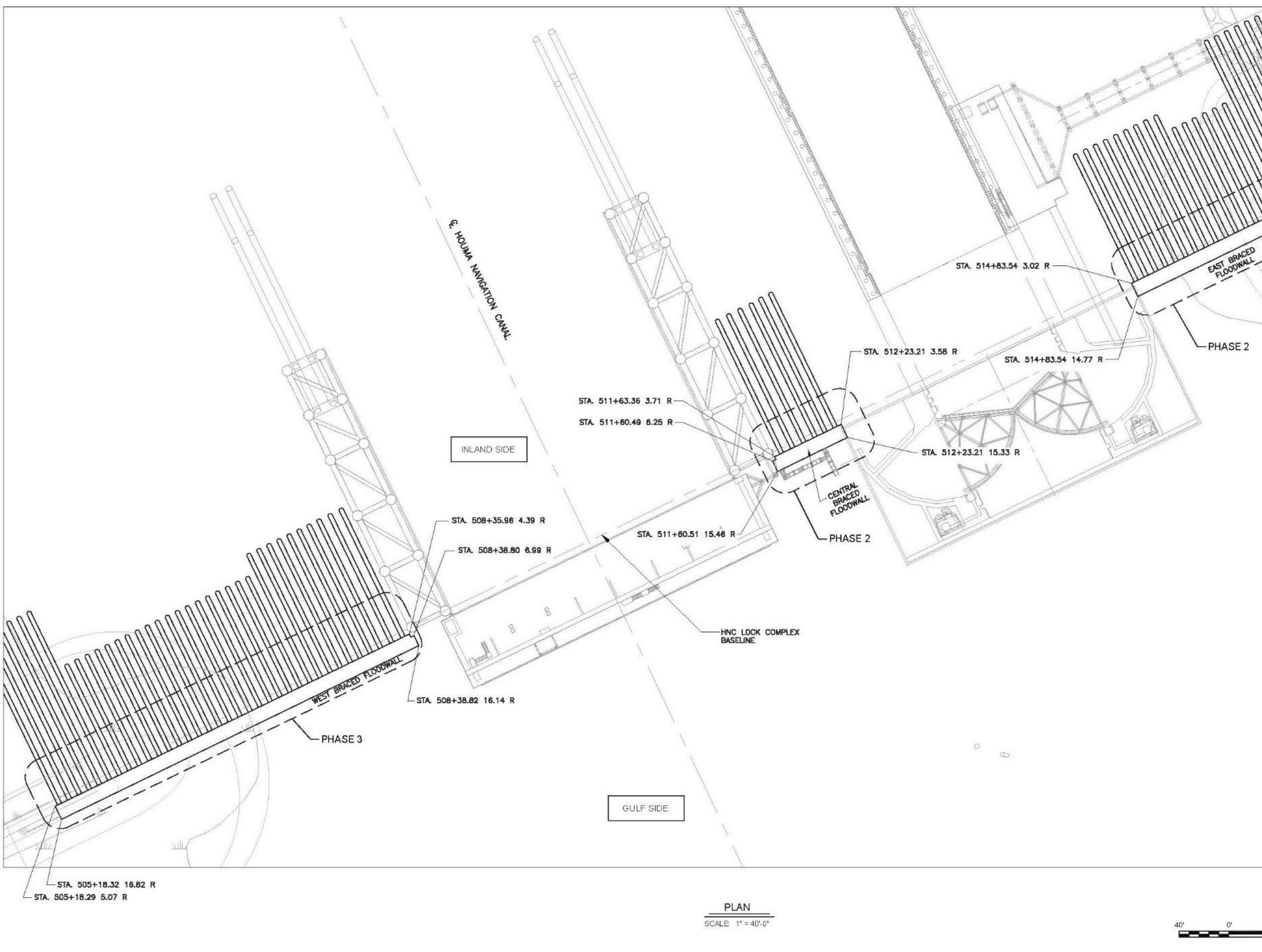
LOCK GUIDEWALL SYSTEM - SITE PLAN

SCALE: 1" = 100'

Figure 10: Lock guidewall system

On the east side of the gulf side sector gate, a floodwall with top elevation of +23.5 ft would tie in to the adjacent Reach G levee. On the west side of the gulf side sector gate, a floodwall with top elevation of +23.5 ft would tie in to the adjacent 250 ft wide barge floodgate. The existing floodgate receiving structure would be modified to add an additional 80 linear feet on each side with a top elevation of +23.5 ft. The existing eastern timber guidewall will be modified to add an additional 520 feet on the inland side of the floodgate. On the west side of the existing barge floodgate, the existing 321 linear foot floodwall tie-in to the existing Reach F levee will be modified through addition of new piles and a new concrete pile cap to reach a top elevation of +23.5 ft. A plan view of these floodwalls is provided in Figure 11.

The existing 3.5 acre embankment area on the eastern bank of the HNC on the protected side of Reach G levee would be further developed into an Operations Area (Figure 12). The proposed Operations Area will serve two purposes. It will provide a laydown/staging area for the contractor during construction, and after construction the site will be utilized the site for the operations and maintenance of the HNC Lock Complex. The final grade will be raised to EL 5.0’. A steel bulkhead (approximately 500’ in length) will be constructed to EL 5.5’ along the western side of the area that abuts Bayou Plat. The area next to the bulkhead will be dredged to EL -8.0’ to allow vessels of



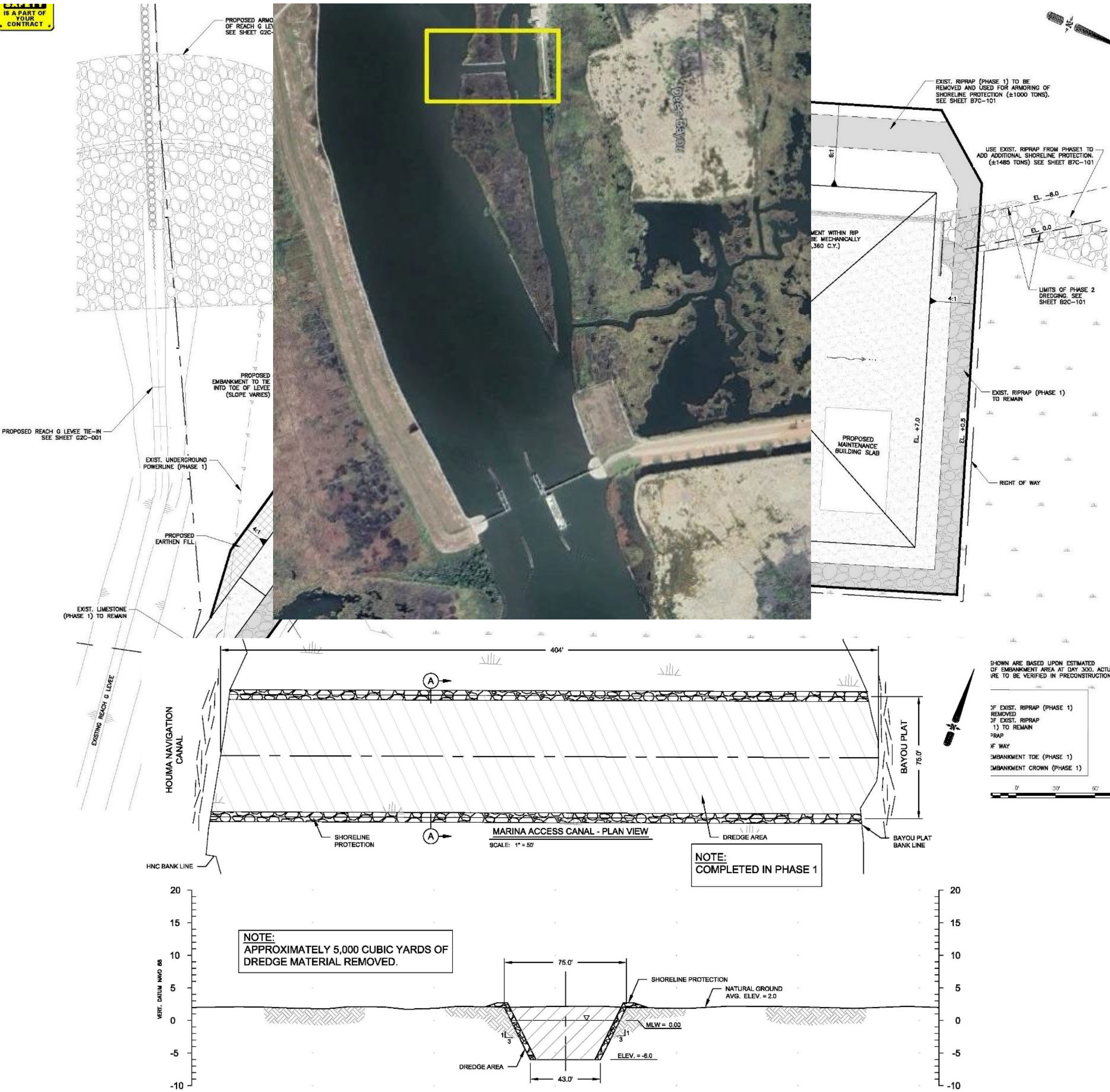


Figure 13: Marina access channel location (in yellow) and plan view and crossection

2.11.4 Past and Future Construction Details

PHASE 1 (Completed dredging shown in Figure 14)

- Approximately 1,100,000 cubic yards of material was dredged during Phase 1 construction and deposited in the Marsh Creation Areas.
- Approximately 5,000 cubic yards of material was dredged for marina canal and placed in the HNC for re-handling into the Marsh Creation Areas in Phase 1. Approximately 500 cubic yards of material was dredged to create a hydrologic connection via a trenasse and be place in the HNC for re-handling into the Marsh Creation Areas.
- Approximately 112,022 cubic yards of material dredged and placed for containment dikes for the Marsh Creation Areas.
- Approximately 9,800 cubic yards of riprap was placed for bank line stabilization during Phase 1.
- Approximately 930 cubic yards of limestone was used for the access road in Phase 1.
- Approximately 8,600 cubic yards of hauled in material was used to backfill the utility locations in Phase 1.
- Approximately 59,000 cubic yards of hauled in material was installed to construct the Operations Area in Phase 1.
- Approximately 1,791 cubic yards of rip-rap was installed for the bank line stabilization of the Operations Area in Phase 1.

PHASE 2 (Ongoing dredging shown in Figure 15)

- Approximately 734,300 cubic yards of material will be dredged form the HNC during Phase 2 and used to construct Marsh Creation Area 3 and the remaining portion of Area 6 shown on Sheet 44.
- Approximately 28,500 cubic yards of hauled in material will be used for the levee tie-in along with approximately 16,000 cubic yards of rip-rap.
- Approximately 77,000 cubic yards of riprap will be placed for bank line stabilization and scour protection during Phase 2 construction.
- Approximately 9,700 cubic yards of hauled in material will be used to backfill the utility line locations in Phase 2.
- Approximately 5,000 cubic yards of limestone will be installed for the Access Road in Phase 2.

- Approximately 5,000 cubic yards of limestone will be installed for the Operations Area in Phase 2.

PHASE 3 (Ongoing Construction Features)

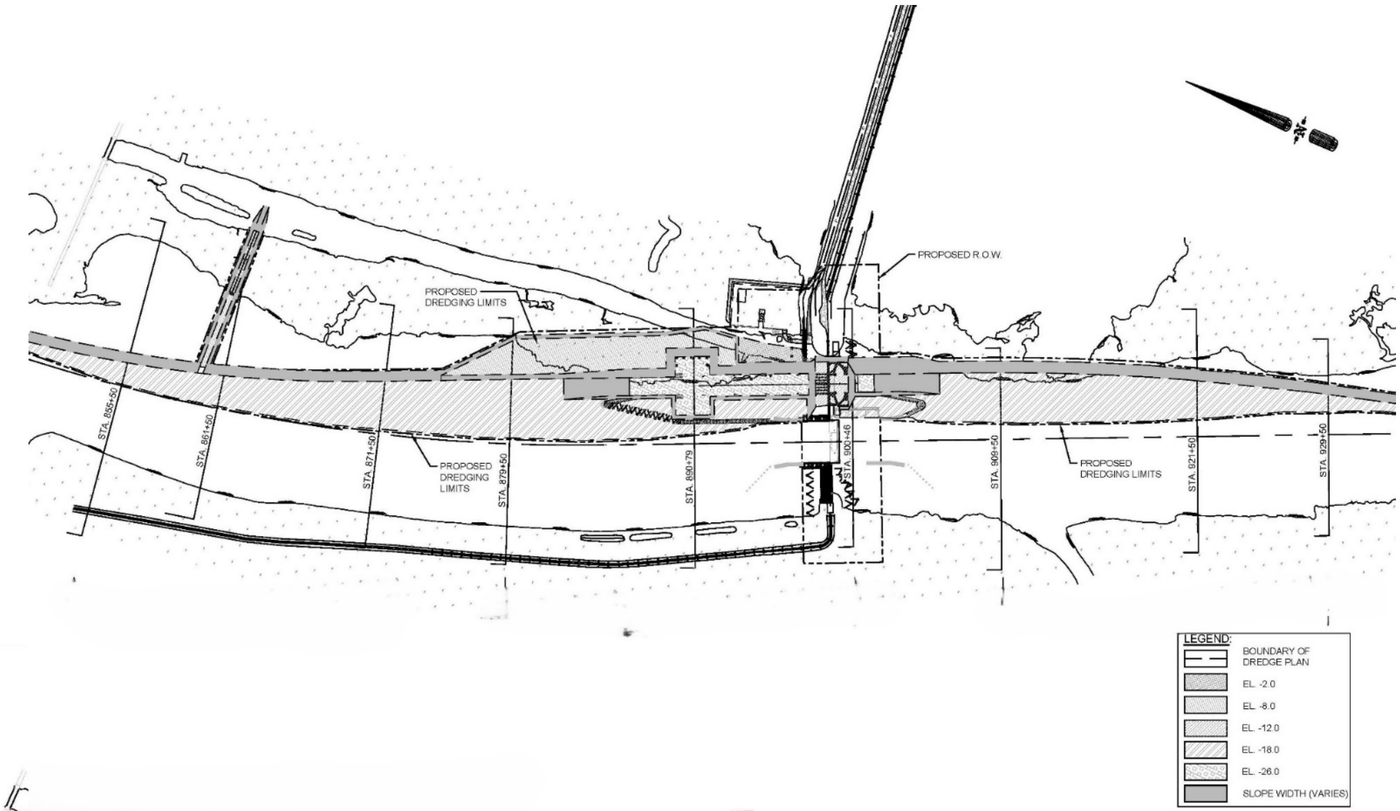
- Installation of 36' and 52' nose piers has been completed on the inland and gulf sides.
- Vertical and battered piles have been installed for the gulf side sector gate.
- Approximately 28,500 cubic yards of hauled in material will be used for the levee tie-in along with approximately 16,000 cubic yards of rip-rap in.
- Approximately 14,500 cubic yards of riprap will be placed for bank line stabilization and scour protection. Rip rap will be placed over a geotextile fabric.
- Approximately 6,000 cubic yards of Asphalt will be used for the Four Point Road.
- Approximately 300 cubic yards of limestone will be installed for the Operations Area.
- Approximately 17.2 acres of wetlands will be impacted by this activity.
- The existing 250' floodgate and flood walls constructed under permit # MVN 2009-00559-WJJ and P 2009 0205 will be removed or incorporated into the proposed floodgate and lock complex.
- The Dredge Material will be used to create approximately 274.23 acres of Marsh Habitat.
- The gulf and inland SSGs will be constructed and installed, including the isolation joint, grout, bulkhead slots, trench pit and ladder slots, fabricating the SSG components, and installing SSG components
- The braced lock wall will be constructed, including installing vertical and battered steel pipe piles and pile caps.
- The submerged Tremie slabs will be constructed
- The cast-in-place lock chamber will be constructed, including installing 24" and 36" piles, building the cofferdam, excavation, and gravel backfill of the cofferdam.
- The hydraulic power unit (HPU) building will be constructed at the GSSG and ISSG.

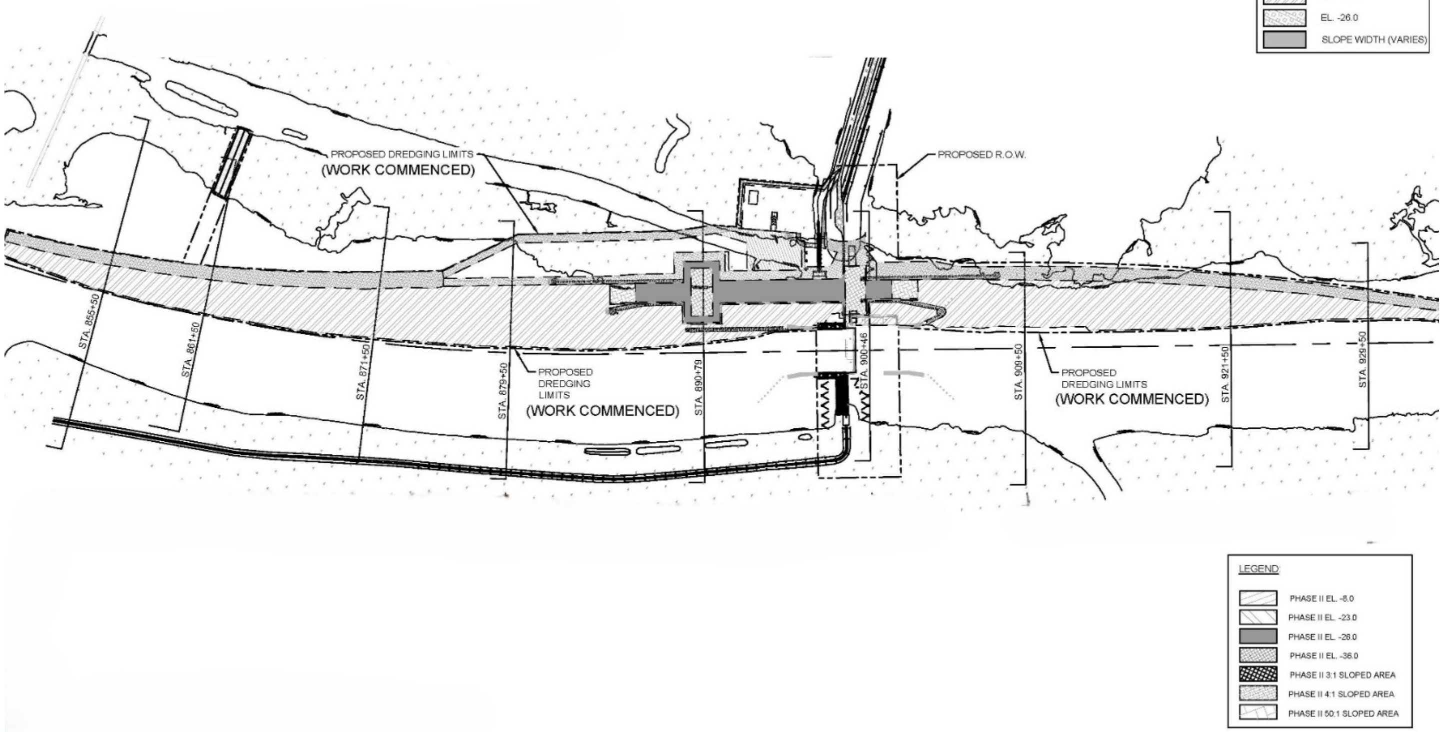
- Lock & Floodgate approach structures will be constructed, including installation of 42” diameter steel pipe jacket, 30” diameter piles, timber piles, and timber guide wall system.
- The protection dolphin will be constructed, which consists of a five-pile cluster east of the HNC centerline.
- The Access Bridge will be constructed, including installing 24” x 24” and 18” x 18” piles, installing the concrete super structure, placing the aggregate surface and bedding course, and seeding & fertilizing.
- The control building will be constructed including the fabrication and installation of 24” x 24”, 30” x 30” and 36” x 36” piles, constructing the reinforced concrete base slab, erecting pre-cast concrete wall panels, and installing electrical and mechanical systems.
- The pedestrian walkway bridge will be constructed using 36” x 36” PPC piles, pre-cast concrete pile caps, and emplacing the super structure..

Both sector gates would be built within temporary cofferdams. In order to construct the gulf side sector gate, portions of the existing floodwall would removed for construction of a 120’ x 260’ of the cofferdam. The inside of the cofferdam would be dredged to elevation -38.0 ft before placement of a tremie slab and dewatering of the cofferdam.

The lock area would be dredged to elevation -23.0 ft to the north and south of the lock chamber and to -26.0 ft within the lock chamber. Between the lock chamber and the operations area, the canal would be dredged to elevation -8.0 ft (Figure 11). Approximately 597,200 cy of material would be excavated to reach these bottom elevation. The majority of the dredging would be completed using a hydraulic dredge, but a mechanical dredge may be used to create required slopes between dredge elevations or between existing structures. Dredged material has been and would continue to be conveyed to marsh creation areas via dredge pipe as shown in Figure 16.

The existing floodgate would remain in place and allow unimpeded navigation during construction of the lock chamber and sector gates.


PROPOSED R.O.W.
PROPOSED DREDGING LIMITS
STA. 855+50
STA. 861+50
STA. 871+50
STA. 879+50
STA. 890+79
STA. 900+46
STA. 909+50
STA. 921+50
STA. 929+50
PROPOSED DREDGING LIMITS
PROPOSED DREDGING LIMITS
LEGEND:
BOUNDARY OF DREDGE PLAN
EL. -2.0
EL. -8.0
EL. -12.0
EL. -18.0
EL. -26.0
SLOPE WIDTH (VARIES)


PROPOSED DREDGING LIMITS
(WORK COMMENCED)
PROPOSED R.O.W.
STA. 855+50
STA. 861+50
STA. 871+50
STA. 879+50
PROPOSED DREDGING LIMITS
(WORK COMMENCED)
STA. 890+79
STA. 900+46
STA. 909+50
PROPOSED DREDGING LIMITS
(WORK COMMENCED)
STA. 921+50
STA. 929+50
LEGEND:
PHASE II EL. -8.0
PHASE II EL. -23.0
PHASE II EL. -26.0
PHASE II EL. -36.0
PHASE II 3:1 SLOPED AREA
PHASE II 4:1 SLOPED AREA
PHASE II 50:1 SLOPED AREA

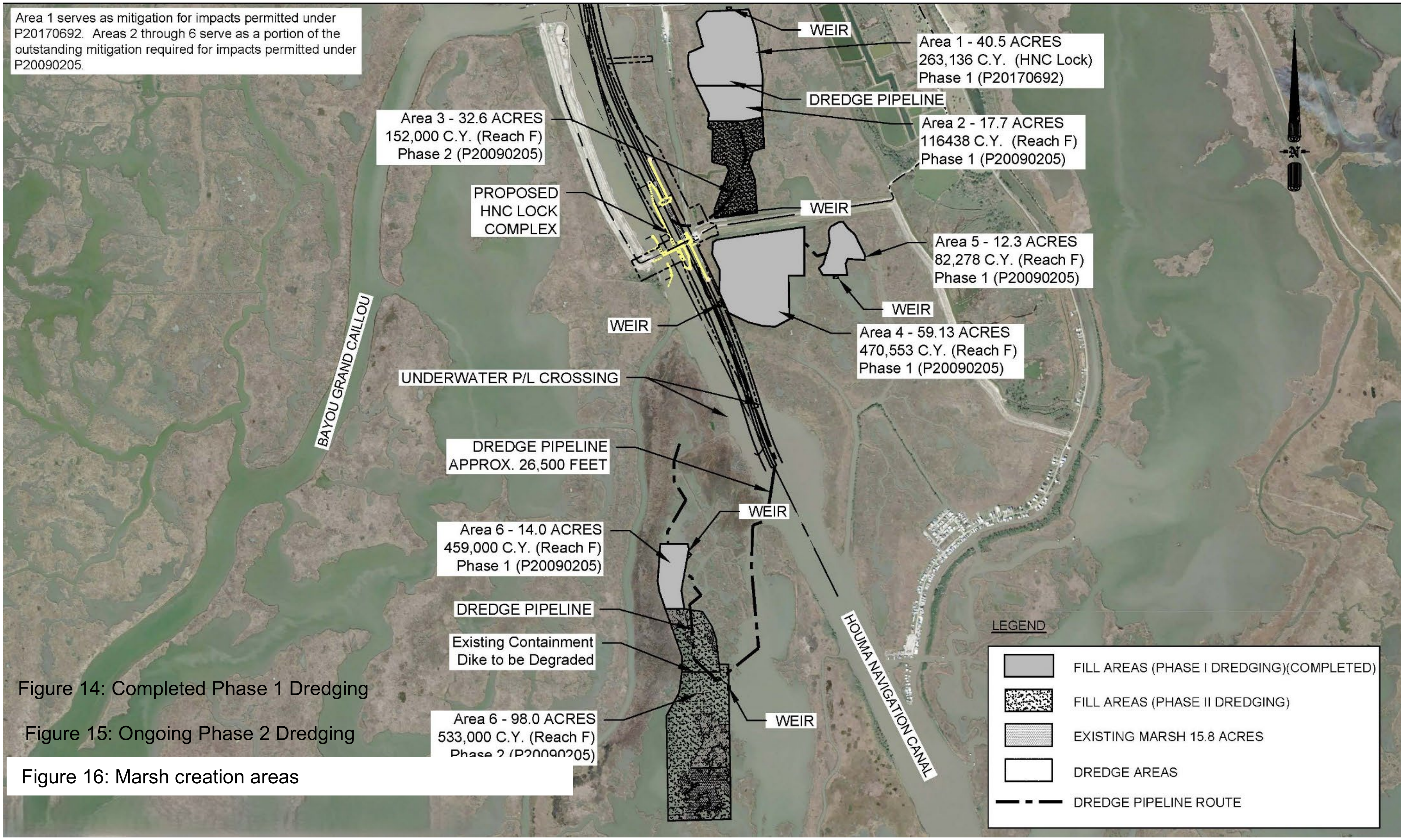


Figure 14: Completed Phase 1 Dredging

Figure 15: Ongoing Phase 2 Dredging

Figure 16: Marsh creation areas

2.11.5 Construction Duration and Equipment

The construction duration of the HNC lock complex would be six years with an assumed work schedule of 5 days a week, 8 hours a day. The floodgate would be constructed using both floating equipment and land support. Below is the preliminary list of equipment anticipated to be utilized for the construction of the floodgate.

Table 1: Preliminary Equipment List for Sector Gate and Floodwall Construction

Project Component	Duration (days)	Equipment Used
Sector Gate Complex & Tie-In Floodwall	2,190	150-Ton Crane
		80-Ton Crane
		Excavator
		Pile Driver
		Concrete Trucks
		Concrete Vibrators
		Welding Machine, Cutting Torch
Tie-In Levee		Dump Trucks
		Bull Dozers
		Fill Compactor
		Front End Loader/Backhoe
		Fuel Tanks
		Generator

2.11.6 ACCESS AND STAGING

Construction site access would be obtained by both the HNC and land. A newly constructed access road between the lock complex and Four Point Road to the east provides land access to the staging area (Figures 17 through19). The staging area would be remain after construction to allow for access to the floodgate and would be developed into an operations and materials storage area. The contractor would place the project trailers for both the Government and the contractor within the staging area. The contractor would store the project equipment and project building supplies within the staging area. There would also be floating barges anchored within 500 feet of the project footprint that would be used for staging on this project

Figure 17: G-1 Access Road

Figure 18: G-1 Access Road

Figure 19: G-1 Access Road and intersection with Four Point Road

2.12 REACH H-2, BAYOU PETITE CAILLOU BARGE FLOODGATE

2.12.1 Location

The Bayou Petite Caillou Barge Floodgate gate is located on Bayou Petite Caillou within Terrebonne Parish and is located at latitude 29°17'47.28" N, longitude -90°38'54.52" W.

Figure 1: Location

2.12.2 Scope of Work

This contract would consist of a Barge floodgate and 2 sluice gate monoliths within Bayou Petite Caillou with floodwalls flanking each side of the floodgate. Each sluice gate monolith would contain three 16 foot x 16 foot sluice gates that would remain open unless there is an event. There would be a highway floodgate located on Highway 56. On both the inflow and the outflow of the gate bay, there would be a timber guidewalls and protection pile clusters. Finally, the transition between levee and floodwall would be protected with concrete or grouted riprap to prevent scour at this transition.

2.12.3 Structure Description

2.12.3.1 Bayou Petite Caillou Barge Floodgate and Sluice Gates

This floodgate would be a 56 ft wide barge type floodgate with a top elevation of +20.0 feet NAVD88, and a slab invert elevation of -8.0 feet NAVD88 and would replace the existing gate structure. The new floodgate would provide an opening in the system to allow unimpeded navigation, except when a tropical system approaches the Gulf of America in which case the barge gate and sluice gates would be closed. There would be three 16 foot x16 foot sluice gates (60 linear feet) on the west side of the gate and three 16 foot x16 foot sluice gates (60 linear feet) on the east side of the gate. A swing gate would be constructed within the west side floodwall alignment to allow unimpeded traffic flow along Highway 56.

A barge gate is constructed of a braced steel frame with sheet metal or solid plate exterior in a hollow box configuration that resembles a hopper barge (see Figure 2). The gate normally contains several individual compartments that are watertight. The gate would have a pivot arm at one end that allows the gate to articulate in a 90° arc to open and close. The pivot arm would be mounted onto a fixed pivot pile that would allow the gate and pivot arm free travel in the vertical direction (for flotation). When the gate is in either the open or closed position, pumps fill the compartments with water until the buoyancy is overcome and the structure settles onto a receiving structure. While in the open position, the gate would also function as a guide wall to aid the vessels in navigating through the structure. In the closed position, the gate is ballasted down to an underwater foundation with gravity loads transferred through the base seal and the base support (see Figures 3 & 4). The flat top of the gate allows passage of either pedestrian or motorized ATV traffic. Lateral loads from high tides or storm surge on the barge gate are transferred into two concrete abutment reaction walls on either end of the gate structure.

Figure 2 – Typical Barge Gate Example

Figure 3: Conceptual Barge Gate - Elevation View with Gate in Open Position

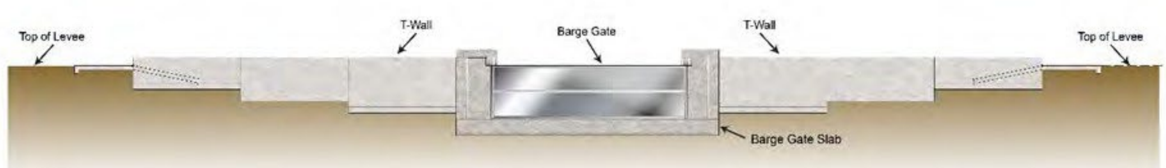


Figure 4: Conceptual Barge Gate - Elevation View with Gate in Closed Position

A sluice gate is a structure that contains a movable gate or series of movable gates that, when lifted, allow material and water to flow under it. The sluice gate would provide an opening in the system to allow unimpeded tidal flow, except when a tropical system approaches the Gulf of America in which the gates would be closed. Sluice gates are not navigable as they do not raise high enough, or they have fixed components that do not allow vessels to pass through. There are 2 separate sluice gate monolith structures at this project location. Each sluice gate structure would contain three (3) sluice gates. Each gate would be 16 feet wide by 16 feet tall with an invert elevation of elevation -8.0 feet. See Figure 5 and Figure 6 for conceptual plan and gate elevations.

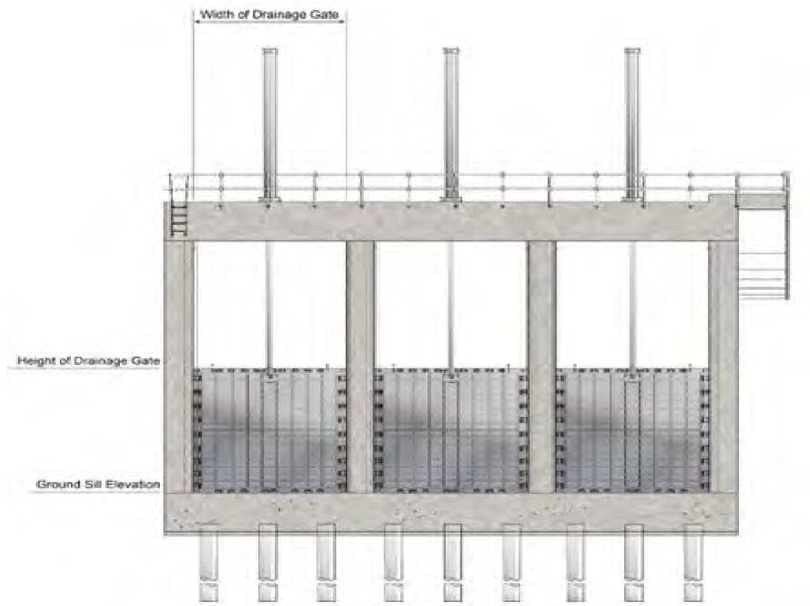
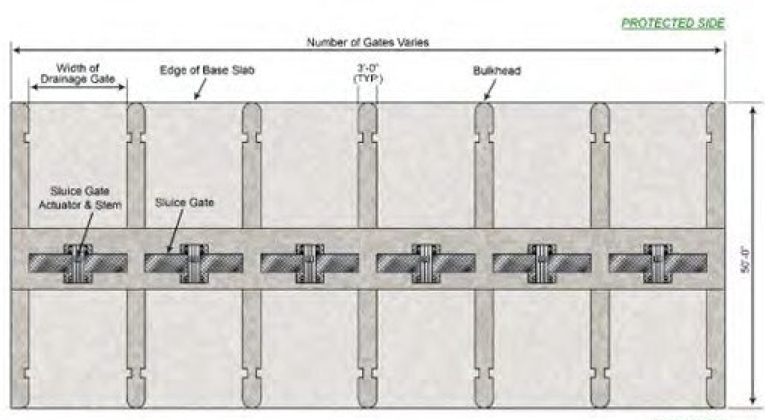


Figure 5: Typical Sluice Gate - Elevation View with Gate in Closed Position



The floodgate would have timber guide walls and pile dolphin structures on both the land and flood side. The 7-pile dolphin structures are constructed at the end of the guide wall to protect the guide walls from impact from vessels. The guide walls would be timber support frames currently spaced every 6 feet. Each timber support frame is constructed with a vertical pile braced by a batter pile driven at an angle from vertical. The outer end of each guide wall is anchored with a 7-pile dolphin structure. The dolphins would consist of 6 timber piles battered away from each other encircling a center pile and tied together with a wire rope at the top of the dolphin. Please see figure 7, 8 and 9 for more details.

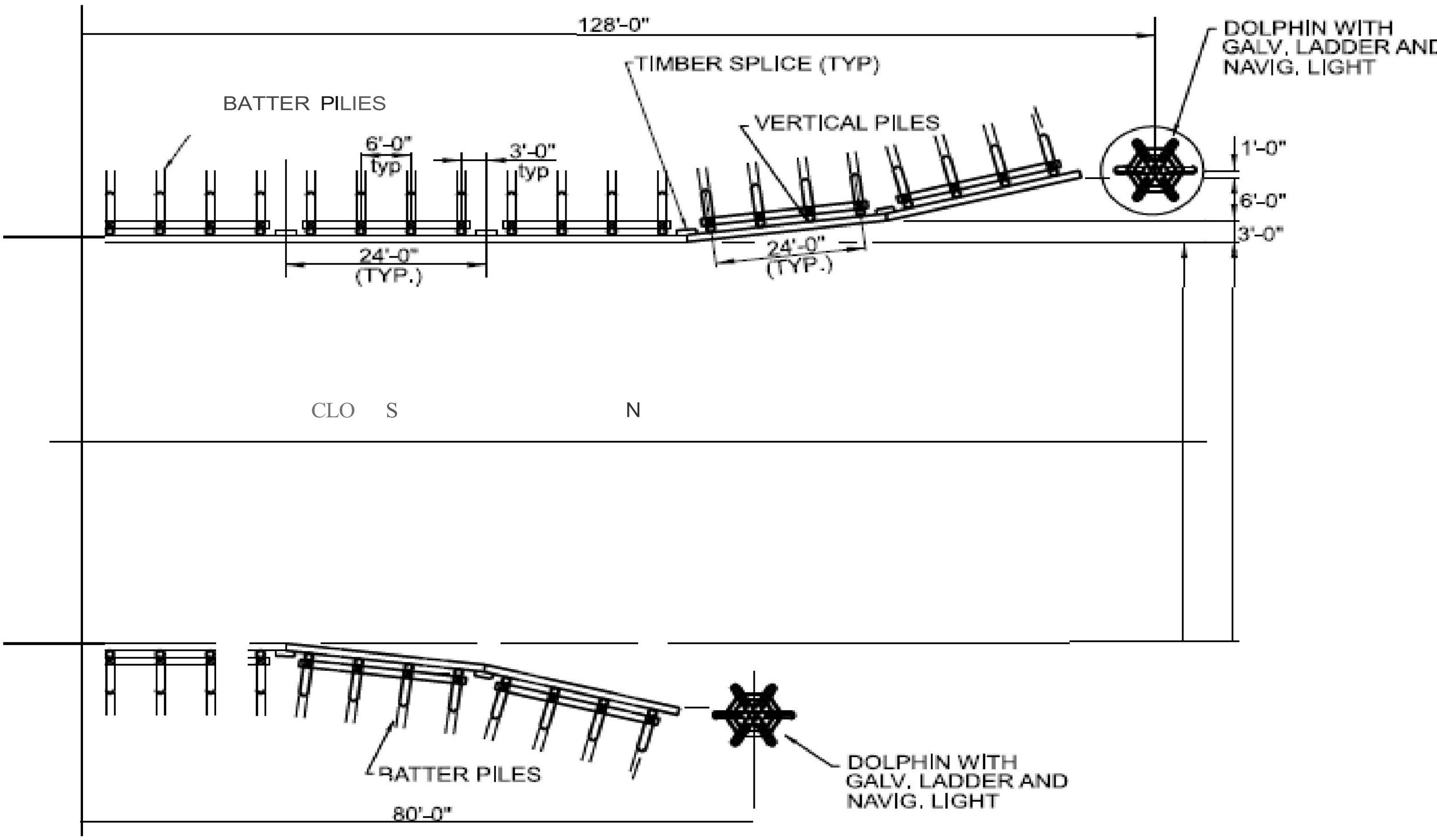


Figure 7: Plan – Guide walls, Fenders, and Dolphins

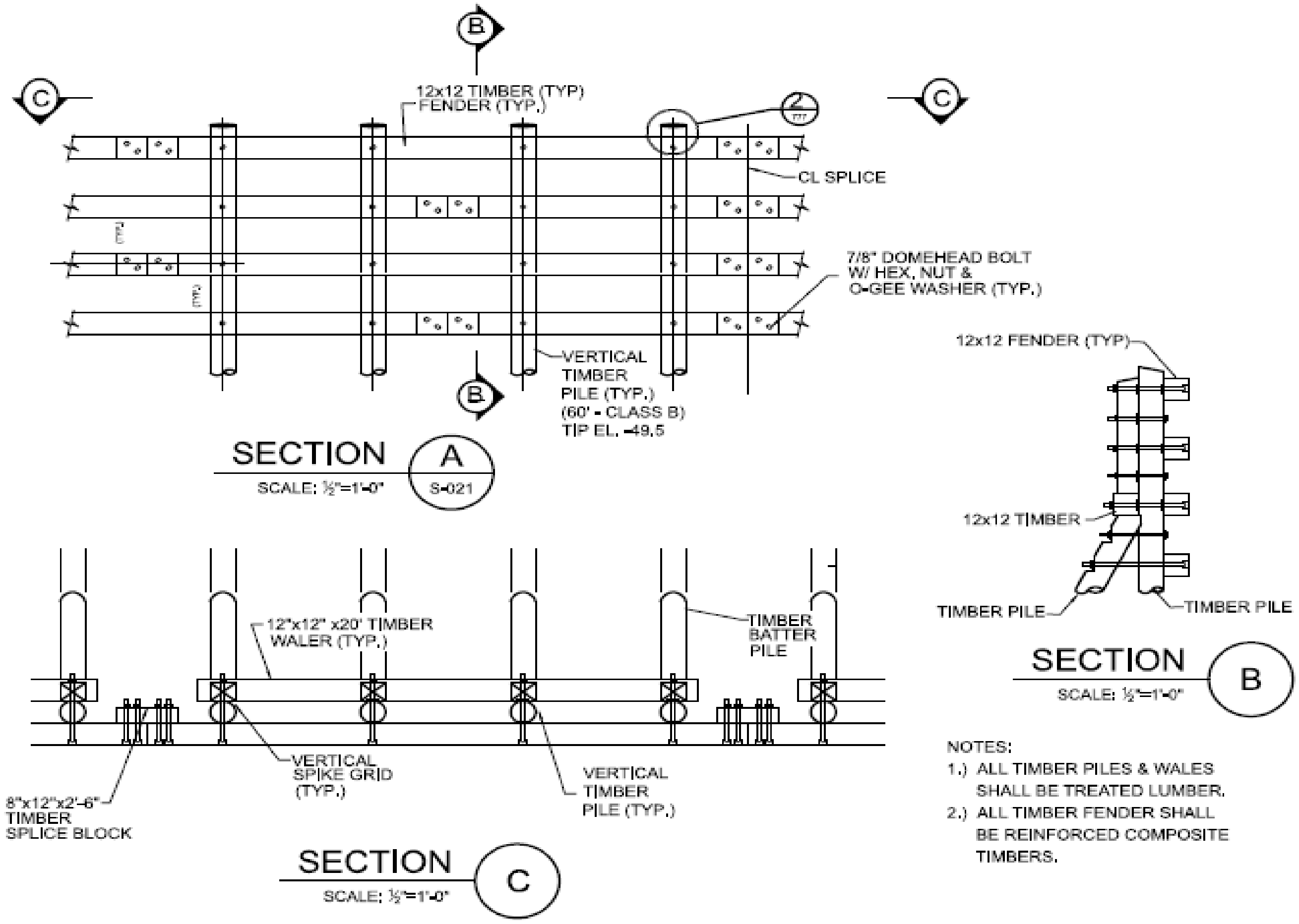


Figure 8: Guide wall Details

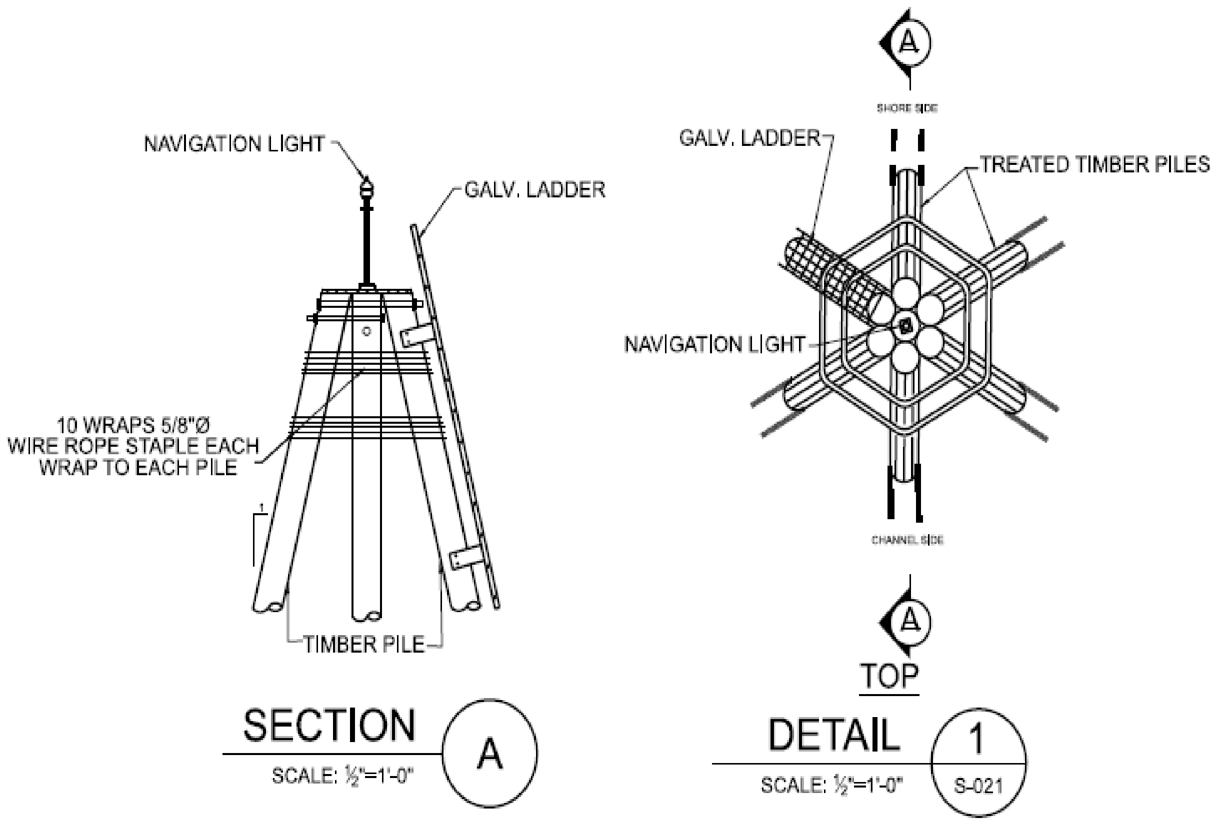


Figure 9: Dolphin Details

Approximately 950 total linear feet (430 linear feet on east side and 460 on the west side of the floodgate) of floodwalls, specifically T-walls, would extend from the sluice gates and tie into the adjacent levees. The floodwalls would have a top elevation of 20.0 ft.

The T-wall monoliths vary with the tallest walls adjacent to the sluice gate and the shortest walls that tie into the adjacent levee. Details on a typical section of floodwall is provided in Figure 10.

The design of the new barge gate, roadway gate, floodwalls and sluice gate structure, including the foundation, is subject to change once detailed geotechnical investigations are conducted during detailed design.

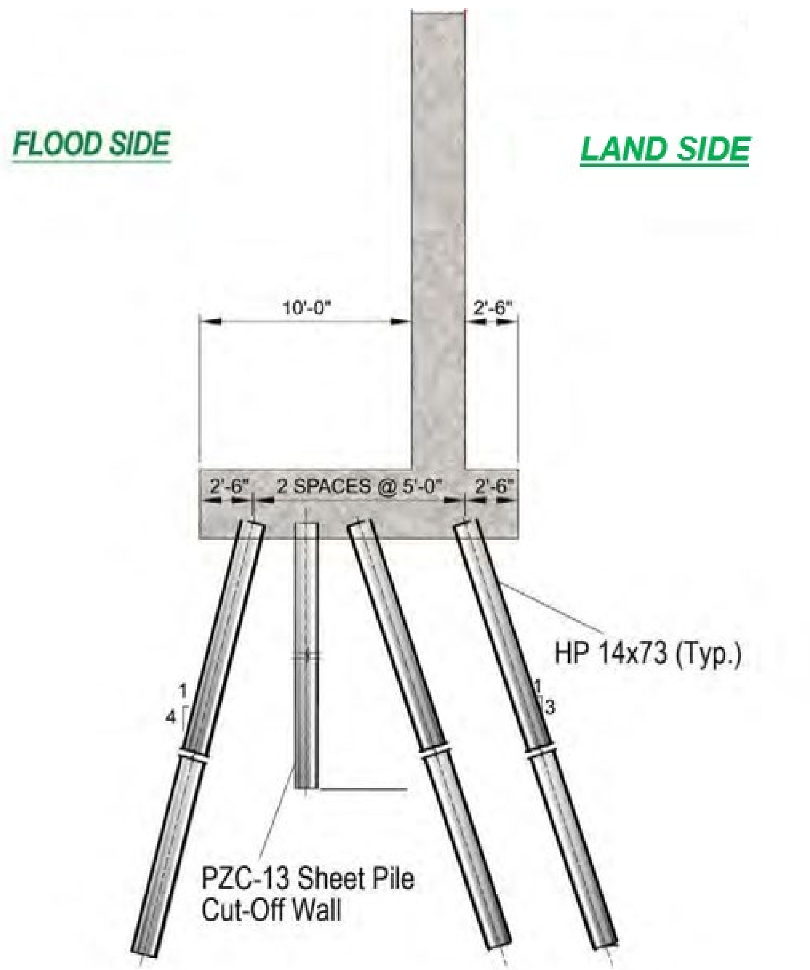


Figure 10: Typical Floodwall

Nine-inch-thick concrete scour protection or grouted riprap would be used at the levee-floodwall transition (tie-in). The concrete scour protection or grouted riprap protects the levee where the floodwall stem extends into the full levee section and extends down both levee slopes. The scour protection would continue for 30 linear feet past the end of the floodwall. Uncapped, cut-off sheet piling would extend horizontally 30 feet into the full levee section for erosion and seepage control. Please see Figure 11 below for an example of the proposed scour protection.

Figure 11: Illustration of Scour Protection at Levee-Floodwall Tie-in.

2.12.3.2 Highway 56 Swing Gate

Where the eastern floodwall tie-in crosses Highway 56, a 36 ft wide swing gate would be constructed to provide an opening in the system to allow unimpeded traffic flow, except when a tropical system approaches the Gulf of America in which the gate would be closed (Figure 12 and 13).

A swing gate is a structure that is composed of two or more horizontal girders, vertical intercostals, vertical end diaphragms, a skin plate, and diagonal braces. In most cases, swing gate closures consist of a single gate leaf for openings up to 40-feet. Swing gates are mounted on hinges and swung open and closed like a door. The swing gate would provide an opening in the system to allow unimpeded traffic flow, except when a tropical system approaches the Gulf of America in which the gate would be closed.

Figure 12: Swing Gate Closure Structure

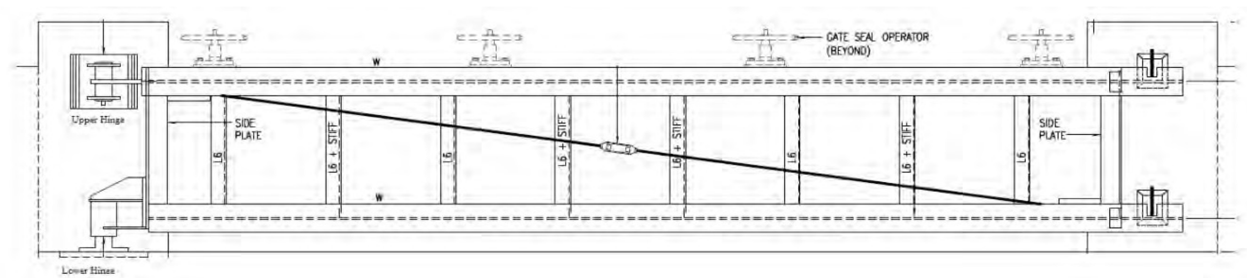


Figure 13: Typical Swing Gate Closure Structure Elevation

The barge gate would be constructed on the flood side of the existing floodgate. The existing centerline of Bayou Petite Caillou has an approximate elevation of -9.0 feet (NAVD 88). For the construction of the gate foundation, the channel would be excavated to an approximate elevation of -16.0 feet with the final constructed sill elevation being -8.0 feet. Directly adjacent to the floodgate slab, both on the land and the flood side of the gate, would be excavated to EL. -10.5 (NAVD 88) to place both the bedding stone and the riprap required. The channel bottom would remain at EL. -8.0 feet (NAVD 88) for approximately 50 feet, both upstream and downstream of the newly constructed floodgate slab. The channel would then slope up to allow a smooth transition from the sill elevation to an approximate EL. -7.0 feet over approximately 100-feet on both the land and flood side of the gate to afford aquatics the ability to migrate past gate sill.

The cross section at the gate location would be designed such that the pre and post project conditions would not impede the natural movement of aquatic organisms. The default operation would be open to avoid additional indirect impacts to vegetation and

fish and wildlife due to changes in the natural hydrologic regime. The floodgate would be opened as soon as is safely possible after a closure for storm passage.

The velocities around and through the gate may require the channel bottom to be layered with 2-feet of riprap. After dredging the channel to El. -10.5, bedding would be placed on separator geotextile with the riprap on top of the bedding. A riprap gradation is assumed to be class 250 - 1000 lb stone (LADOTD 2016, Section 711). See Table 1 for example gradation limits for individual stone.

Table 1: Riprap Gradations

Gradation Limits Individual Stone Size (lbs)	Spherical Diameter (ft)	Percent Finer (By Weight)
1250	2.50	100
500	1.83	45-100
250	1.46	15-50
80	1.00	0-15

The barge gate would be constructed approximately in the center of the existing channel. The bypass channel would be constructed immediately adjacent to and to the east of the barge gate cofferdam footprint prior to beginning construction of the floodgate to allow safe navigational passage of marine traffic, as well as all aquatic organisms to pass safely until the floodgate structure is complete (Figure 14).

Preliminary designs of the bypass require a minimum bottom channel width of 60-foot for the temporary bypass channel with an invert of EL. -8.0 feet. Based on the preliminary design, the bypass channel would be approximately 650 feet long.

However, navigation of common local vessels would be considered for the bypass channels, and design features of a navigable bypass channel would be developed during detailed design. At a minimum, to maintain pre-construction flow conditions, navigation, and minimize environmental impacts during construction, the temporary bypass channels would be similarly sized to the channels being impacted. A timber guidewall (similar to the permanent guide wall) would be constructed to prevent the cofferdam from vessel impact while the cofferdam is in place.

A total of 21,576 cy of material would be excavated from the channel for gate complex, bypass channel, and floodwall tie-in construction. If the dredged material is found to be suitable for use within the project levee footprint, the material would be used within the levee or could potentially be utilized for marsh restoration within the overall project footprint, otherwise the material would be hauled off site and disposed in accordance with all state and federal laws.

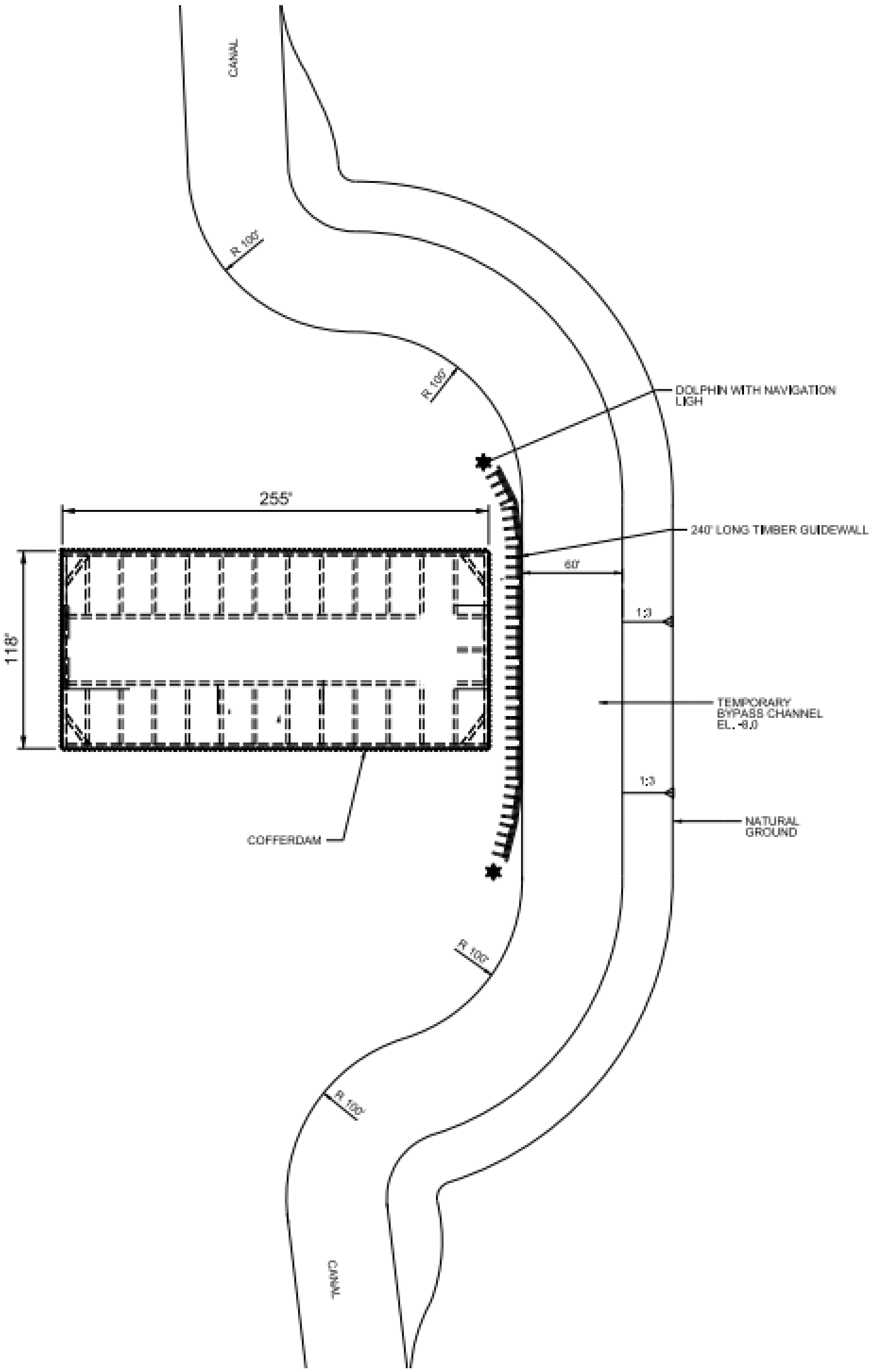


Figure 14: Preliminary bypass channel design

Once navigation is routed through the temporary bypass channel, a Phase 1 cofferdam (approximately 255 feet x 118 feet) would be constructed to permit in-the-dry construction of the barge gate concrete landing slab, pivot arm assembly, receiving structure concrete monoliths, and the sluice gate concrete monoliths. The cofferdam would be an internally braced cofferdam with wide flange wales and pipe braces supporting PZ sheet piling. Reduced power would be required for vessels passing through the construction area to reduce the risk of impact to the cofferdam.

Once construction of the barge gate landing slab, pivot arm assembly, receiving structure monoliths, and sluice gate monoliths are completed, navigation would be re-routed through the permanent barge gate structure. After construction, the bypass channel is assumed to be included in the footprint of the structure site and the channel flow would be rerouted through the new structure feature. Once navigation is re-routed through the new floodgate, the Phase 2 cofferdam would be constructed and permanent guidewalls and pile clusters, tie-in T-walls, and final civil site work can be completed.

The Phase 2 cofferdam (approximately 120 feet x 80 feet on both sides of the floodgate) would be constructed to permit the construction of the T-walls adjacent to the sluice gate structures that would be in the water.

2.12.4 Construction Duration and Equipment

The construction duration of the Bayou Petite Caillou Floodgate would be 24 months with an assumed work schedule of 5 days a week, 8 hours a day. The barge floodgate would be constructed using both floating equipment and land support. Below is the preliminary list of equipment anticipated to be utilized for the construction of the floodgate.

Table 2: Preliminary Equipment List for Sector Gate and Floodwall Construction

Project Component	Duration (days)	Equipment Used
Barge Gate Complex, Sluice Gate & Tie-In Floodwall	730	150-Ton Crane
		80-Ton Crane
		Excavator
		Pile Driver
		Concrete Trucks
		Concrete Vibrators
		Welding Machine, Cutting Torch
Tie-In Levee		Dump Trucks
		Bull Dozers
		Fill Compactor
		Front End Loader/Backhoe
		Fuel Tanks
		Generator

2.12.5 Access and Staging

In general, construction site access would be obtained by both barge and land. Vehicle access would be via Little Caillou Road south from Chauvin. Please see Figure 15 below for a map of the proposed access routes to the project site. The construction staging area would be within the area shown in Figure 16 within the existing berm of the levee. It is assumed the staging area would be approximately 175 feet by 380 feet. The staging area would have a crushed stone on top of a separator fabric. Upon completion of the project, the staging area would be returned to pre-construction condition. The staging area would be used as an operations and materials storage area. The contractor would place the project trailers for both the Government and the contractor within the staging area. The contractor would store the project equipment and project building supplies within the staging area. There would also be floating barges anchored within 500 feet of the project footprint that would be used for staging for this project.

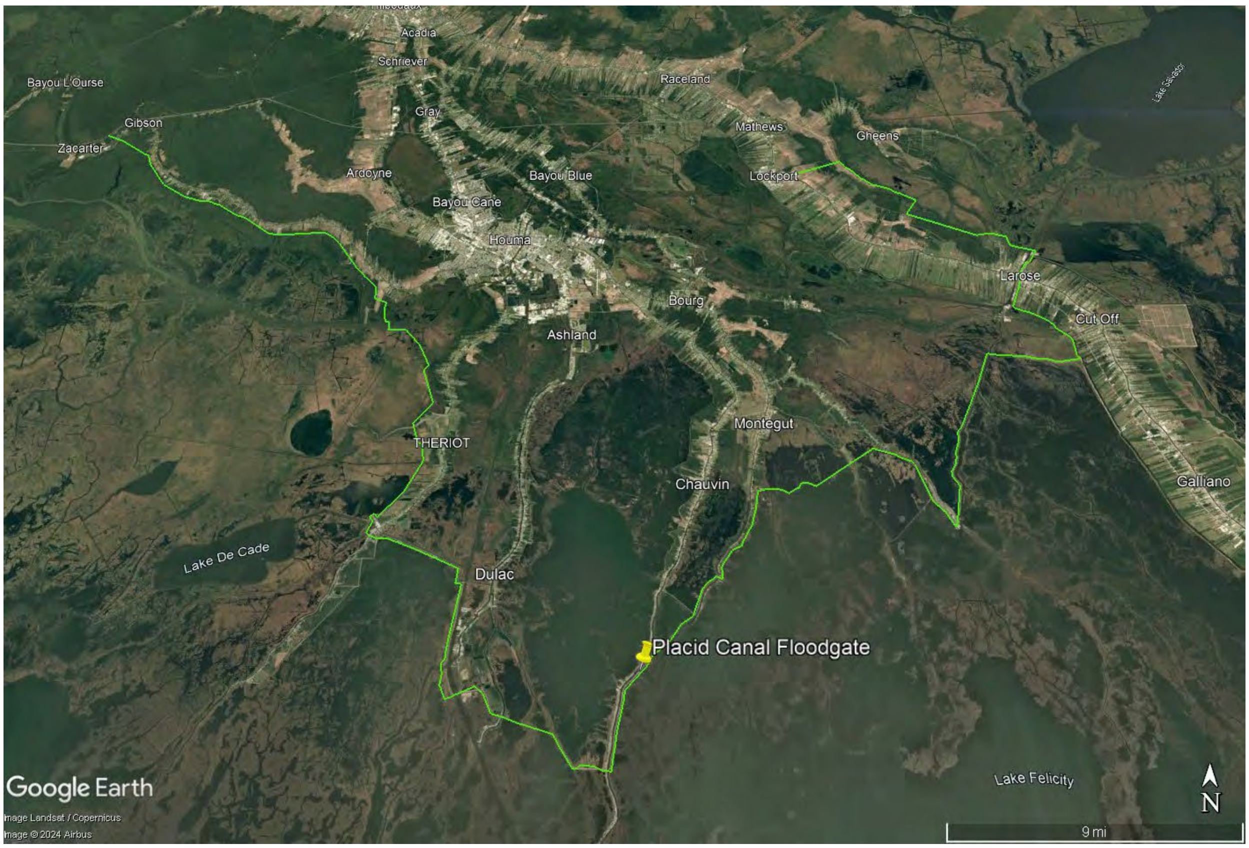
Figure 15: Project site access

Figure 16: Proposed locations of new floodgate and construction staging area

2.13 REACH H-2-, PLACID CANAL BARGE FLOODGATE

2.13.1 Location

The Placid Canal Barge Floodgate gate connects Bayou Terrebonne and Bayou Petit Caillou within Terrebonne Parish and is located at latitude 29°20'28.9556", longitude -90°37'50.0508".



2.13.2 Scope of Work

This contract would consist of a Barge floodgate and two sluice gate monoliths in the vicinity where Bayou Terrebonne and Bayou Petit Caillou connect with floodwalls flanking each side of the floodgate. Each sluice gate monolith would contain three 16 feet by 16 feet sluice gates that would remain open unless there is an event. On both the inflow and the outflow of the gate bay, there would be timber guide walls and protection pile clusters. Finally, the transition between levee and floodwall would be protected with concrete or grouted riprap to prevent scour at this transition.

2.13.3 Structure Description

This floodgate would be a 56 ft wide barge type floodgate with a top elevation of +22.0' NAVD88, and a slab invert elevation of -8.0' NAVD88. The floodgate would provide an opening in the system to allow unimpeded navigation, except when a tropical system approaches the Gulf of America in which case the barge gate and sluice gates would be closed. There would be three 16’x16’ sluice gates (60 linear feet) on the south side of the gate and three 16’x16’ sluice gates (60 linear feet) on the north side of the gate.

A barge gate is constructed of a braced steel frame with sheet metal or solid plate exterior in a hollow box configuration that resembles a hopper barge (see Figure 2). The gate normally contains several individual compartments that are watertight. The gate would have a pivot arm at one end that allows the gate to articulate in a 90° arc to open and close. The pivot arm would be mounted onto a fixed pivot pile that would allow the gate and pivot arm free travel in the vertical direction (for flotation). When the gate is in either the open or closed position, pumps fill the compartments with water until the buoyancy is overcome and the structure settles onto a receiving structure. While in the open position, the gate would also function as a guide wall to aid the vessels in navigating through the structure. In the closed position, the gate is ballasted down to an underwater foundation with gravity loads transferred through the base seal and the base support (see Figures 3 & 4). The flat top of the gate allows passage of either pedestrian or motorized ATV traffic. Lateral loads from high tides or storm surge on the barge gate are transferred into two concrete abutment reaction walls on either end of the gate structure.

Figure 2: Typical Barge Gate Example

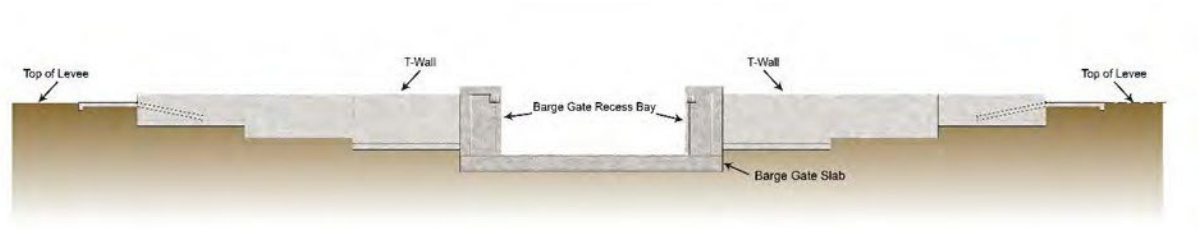


Figure 3: Conceptual Barge Gate - Elevation View with Gate in Open Position

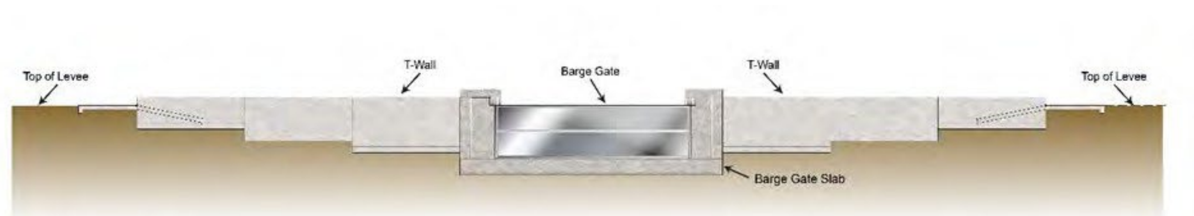


Figure 4: Conceptual Barge Gate - Elevation View with Gate in Closed Position

A sluice gate is a structure that contains a movable gate or series of movable gates that, when lifted, allow material and water to flow under it. The sluice gate would provide an opening in the system to allow unimpeded tidal flow, except when a tropical system approaches the Gulf of America in which the gates would be closed. Sluice gates are not navigable as they do not raise high enough, or they have fixed components that do not allow vessels to pass through. There are 2 separate sluice gate monolith structures at this project location. Each sluice gate structure would contain three (3) sluice gates. Each gate would be 16 feet wide by 16 feet tall with an invert elevation of elevation -8.0 feet. See figures 5 and 6 and for conceptual plan and gate elevations.

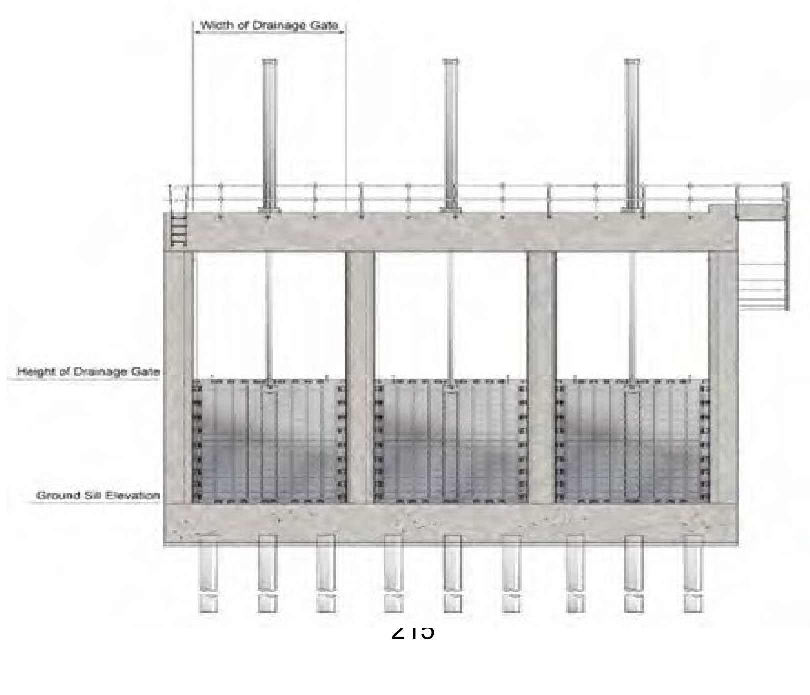


Figure 5: Conceptual Barge Gate - Elevation View with Gate in Closed Position

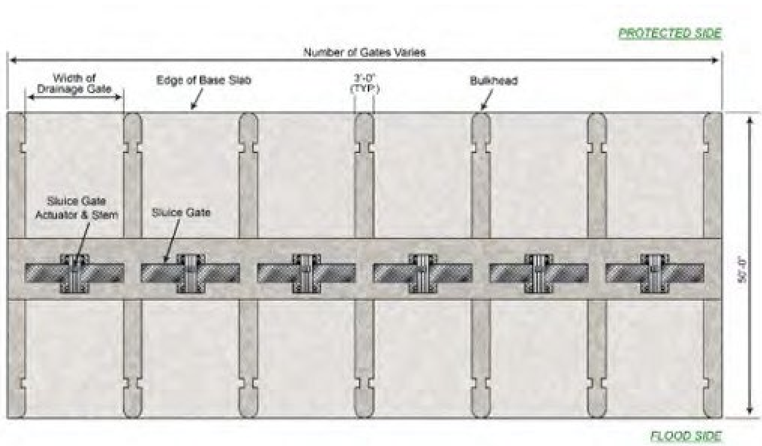


Figure 6: Typical Sluice Gate Control Structure (6 gates) - Plan View

The floodgate would have timber guide walls and pile dolphin structures on both the land and flood side. The seven pile dolphin structures are constructed at the end of the guide wall to protect the guide walls from impact from vessels. The guide walls would be timber support frames currently spaced every 6 feet. Each timber support frame is constructed with a vertical pile braced by a batter pile driven at an angle from vertical. The outer end of each guide wall is anchored with a seven-pile dolphin structure. The dolphins would consist of 7 timber piles battered away from each other and tied together with a wire rope at the top of the dolphin. Please see figure 7, 8 and 9 for more details.

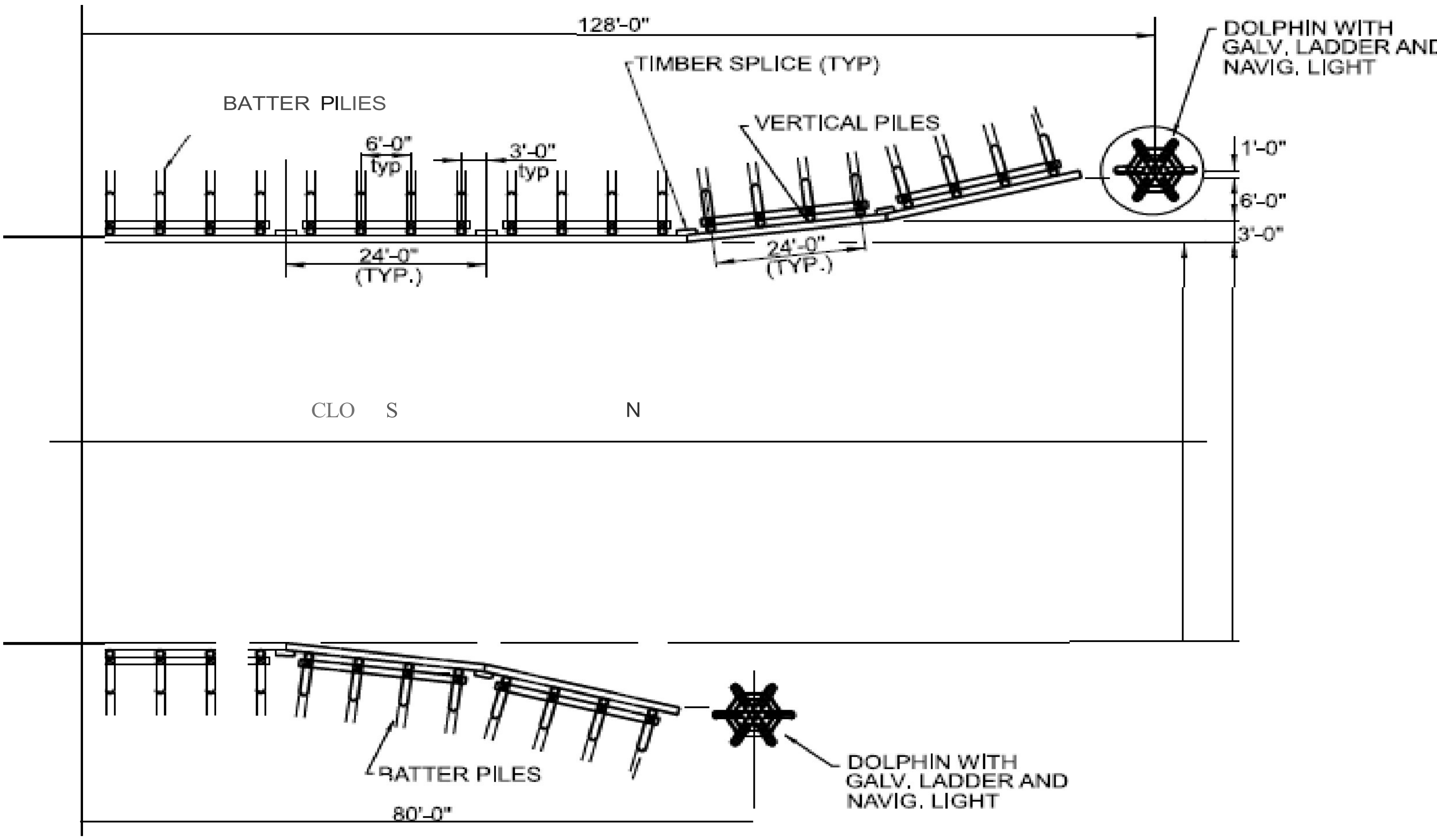


Figure 7: Plan – Guide walls, Fenders, and Dolphins

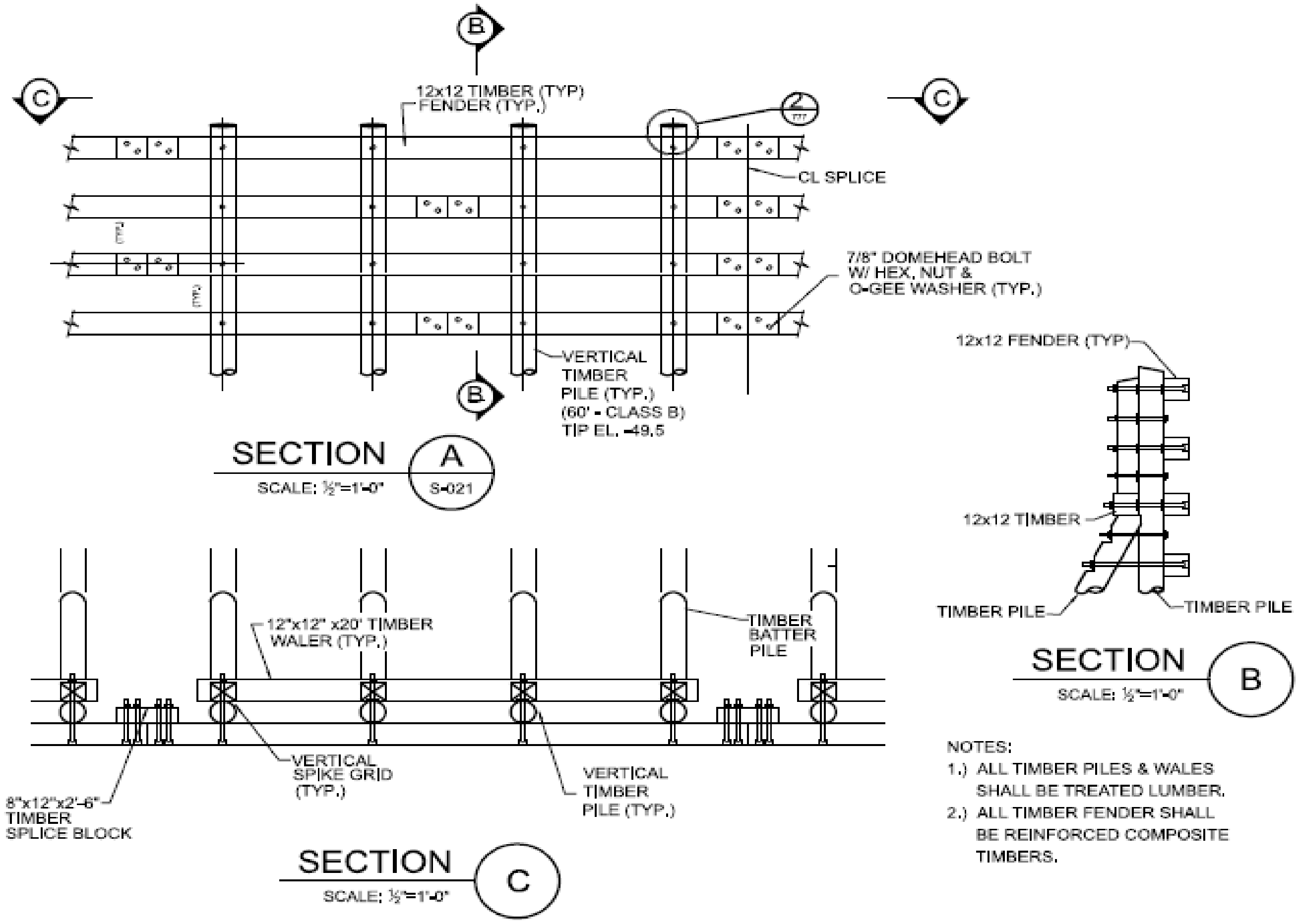


Figure 8: Guide wall Details

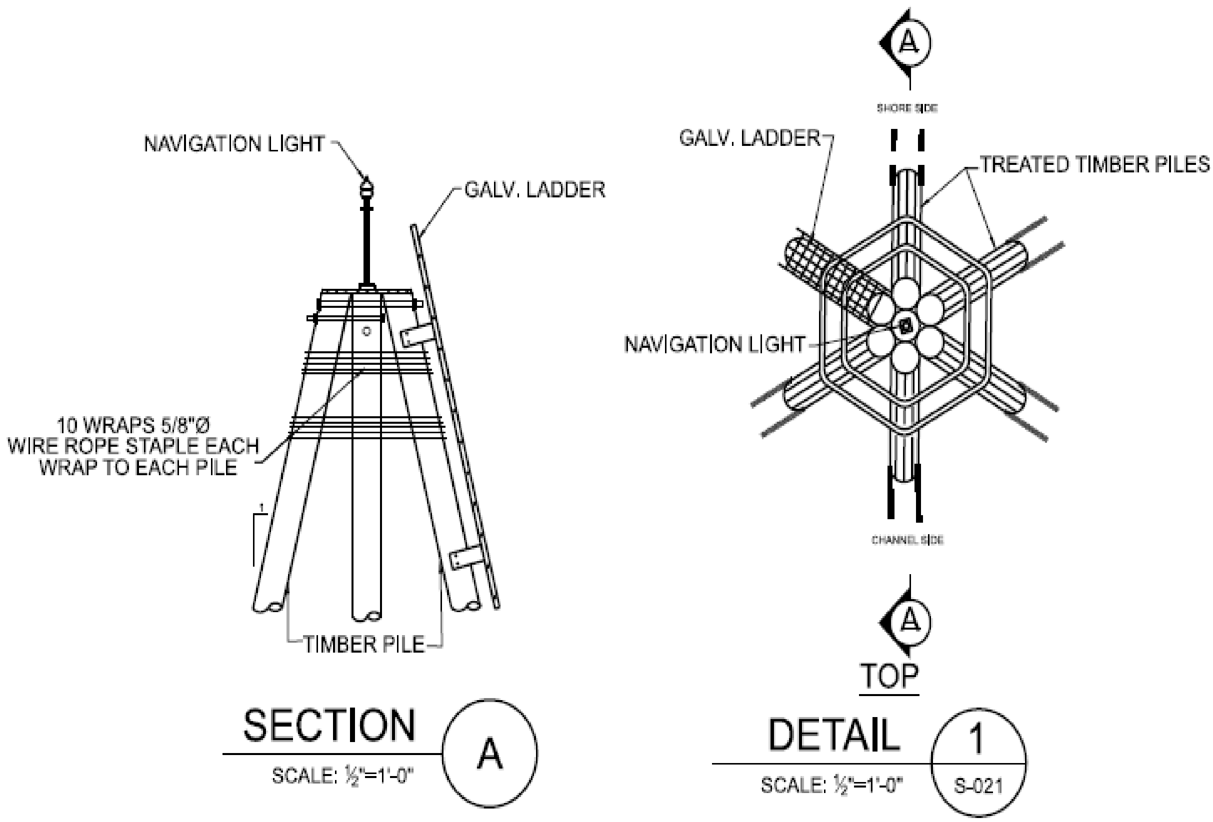


Figure 9: Dolphin Details

Approximately 870 total linear feet (435 linear feet on each side of the floodgate) of floodwalls, specifically T-walls, would extend from the sluice gates and tie into the adjacent levees. The floodwalls would have a top elevation of 22.0 NAVD88.

The T-wall monoliths vary with the tallest walls adjacent to the sluice gate and the shortest walls that tie into the adjacent levee. Details on typical section of floodwall is provided in figure 10.

The design of the new barge gate, sluice gate structure and floodwalls, including the foundation is subject to change once detailed geotechnical investigations are conducted during detailed design.

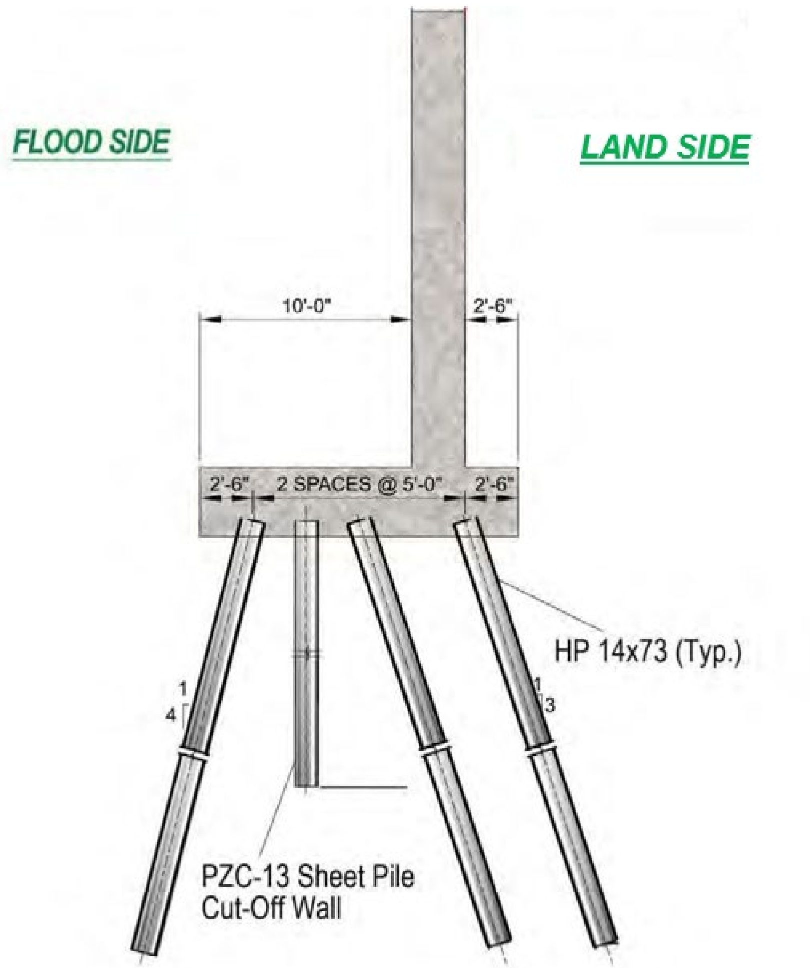


Figure 10: Typical Floodwall

Nine-inch-thick concrete scour protection or grouted riprap would be used at the levee-floodwall transition (tie-in). The concrete scour protection or grouted riprap protects the levee where the floodwall stem extends into the full levee section and

extends down both levee slopes. The scour protection would continue for 30 linear feet past the end of the floodwall. Uncapped, cut-off sheet piling would extend horizontally 30 feet into the full levee section for erosion and seepage control. Please see Figure 11 below for an example of the proposed scour protection.

Figure 11: Illustration of Scour Protection at Levee-Floodwall Tie-in.

The barge gate would be constructed on the land side of the existing floodgate. The existing centerline of for this gate location has an approximate elevation of. -8.0 ft (NAVD 88). For the construction of the gate foundation, the channel would be excavated to an approximate elevation -16.5 ft with the final constructed sill elevation being -8.0 ft. Directly adjacent to the floodgate slab, both on the land and the flood side of the gate would be excavated to an elevation of -10.0 ft (NAVD 88) to place both the bedding stone and the riprap required. The channel bottom would remain at El. -8.0 ft (NAVD 88) for approximately 50-feet, both upstream and downstream of the newly constructed floodgate slab. The channel would then slope up to allow a smooth transition from the sill elevation to approximately El. -7.0 ft over approximately 100-feet on both the land and flood side of the gate to afford aquatics the ability to migrate past gate sill.

The cross section at the gate location would be designed such that the pre and post project conditions would not impede the natural movement of aquatic organisms. The default operation would be open to avoid additional indirect impacts to vegetation and fish and wildlife due to changes in the natural hydrologic regime. The floodgate would be opened as soon as is safely possible after a closure for storm passage.

The velocities around and through the gate may require the channel bottom to be layered with 2 feet of riprap. The riprap is required in the channel, extending approximately 100 linear feet on both the land side and the flood side. After dredging the channel to El. -10.0, bedding would be placed on separator geotextile with the riprap on top of the bedding. A riprap gradation is assumed to be class 250 - 1000 lb stone (LADOTD 2016, Section 711). See Table 1 for example gradation limits for individual stone.

Table 1: Riprap Gradations

Gradation Limits Individual Stone Size (lbs)	Spherical Diameter (ft)	Percent Finer (By Weight)
1250	2.50	100
500	1.83	45-100
250	1.46	15-50
80	1.00	0-15

The barge gate would be constructed approximately in the center of the existing pass. The bypass channel would be constructed immediately adjacent to and to the west of the barge gate cofferdam footprint prior to beginning construction of the floodgate to allow safe navigational passage of marine traffic, as well as all aquatic organisms to pass safely until the floodgate structure is complete (Figure 12).

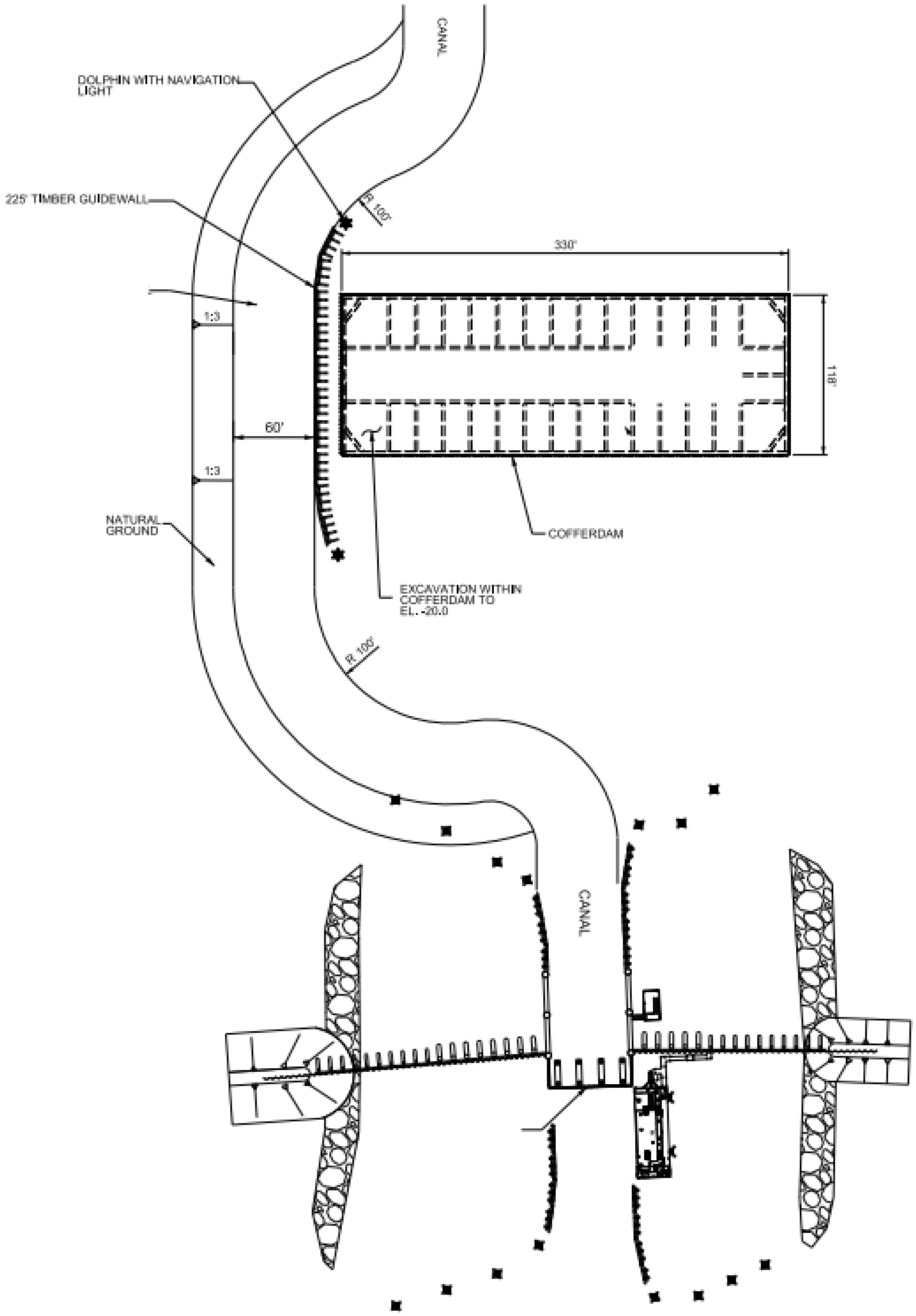


Figure 12: Illustration of bypass during construction.

Preliminary designs of the bypass require a minimum bottom channel width of 60-foot for the temporary bypass channel with an invert of EL. -8.0'. Based on the preliminary design, the bypass channel would be approximately 650 feet long. However, navigation of common local vessels would be considered for the bypass channels, and design features of a navigable bypass channel would be developed during detailed design. At a minimum, to maintain pre-construction flow conditions, navigation and minimize environmental impacts during construction, the temporary bypass channels would be similarly sized to the channels being impacted. A timber guidewall (like the permanent guide wall) would be constructed to prevent the cofferdam from vessel impact while the cofferdam is in place.

A total of 9,500 cy of material would be excavated from the channel for gate complex, bypass channel, and floodwall tie-in construction. If the dredged material is found to be suitable for use within the project levee footprint, the material would be used within the levee or could potentially be utilized for marsh restoration within the overall project footprint, otherwise the material would be hauled off site and disposed in accordance with all state and federal laws.

Once navigation is routed through the temporary bypass channel, a Phase 1 cofferdam (approximately 330 feet x 118 feet) would be constructed to permit the in the dry construction of the barge gate concrete landing slab, pivot arm assembly, receiving structure concrete monoliths, and the sluice gate concrete monoliths. The cofferdam would be an internally braced cofferdam with wide flange wales and pipe braces supporting PZ sheet piling. Reduced power would be required for vessels passing through the construction area to reduce the risk of impact to the cofferdam.

Once construction of the barge gate landing slab, pivot arm assembly, receiving structure monoliths, and sluice gate monoliths are completed, navigation would be re-routed through the permanent barge gate structure. After construction, the bypass channel is assumed to be included in the footprint of the structure site and the channel flow would be rerouted through the new structure feature. Once navigation is re-routed through the new floodgate, the Phase 2 cofferdam would be constructed and permanent guidewalls and pile clusters, tie-in T-walls, and final civil site work can be completed.

The Phase 2 cofferdam (approximately 120 feet x 80 feet on both sides of the floodgate) would be constructed to permit the construction of the adjacent T-walls to the sluice gate structures that would be in the water.

2.13.4 Construction Duration and Equipment

The construction duration of the Placid Canal Floodgate would be 24 months with an assumed work schedule of 5 days a week, 8 hours a day. The barge floodgate would be constructed using both floating equipment and land support. Below is the preliminary list of equipment anticipated to be utilized for the construction of the floodgate.

Table 2: Preliminary Equipment List for Sector Gate and Floodwall Construction

Project Component	Duration (days)	Equipment Used
		150-Ton Crane
		80-Ton Crane

Barge Gate Complex & Tie-In Floodwall	730	Excavator
		Pile Driver
		Concrete Trucks
		Concrete Vibrators
		Welding Machine, Cutting Torch
Tie-In Levee		Dump Trucks
		Bull Dozers
		Fill Compactor
		Front End Loader/Backhoe
		Fuel Tanks
		Generator

2.13.5 Access and Staging

Construction site access would be obtained by barge only. Vehicle access to the project site is not available. Staging would be from floating barges anchored within 500 feet of the project footprint.

2.14 REACH I, BAYOU TERREBONNE FLOODGATE AND HIGHWAY 59 SWING GATE

2.14.1 Location

The Bayou Terrebonne Floodgate would be located in Bayou Terrebonne within Terrebonne Parish (latitude 29°23'24.10", longitude -90°35'16.19"), just north of the existing Bayou Terrebonne gate system (Figure 1).

Figure 1: Location Map

2.14.2 Scope of Work

This contract would consist of construction of a 56 ft wide barge floodgate within Bayou Terrebonne with floodwall tie-ins flanking each side of the floodgate and a 36 ft wide swing gate where the eastern floodwall tie-in crosses Highway 55. On both the inflow and the outflow of the gate bay, there would be timber guide walls and protection pile clusters. Finally, the transition between the floodwall tie-ins and Reach I levee would be protected with concrete or grouted riprap to prevent scour at this transition.

2.14.3 Structure Description

2.14.3.1 Bayou Terrebonne Floodgate

This floodgate would be a 56 ft wide barge floodgate (Figure 2) with a top elevation of 25.0-ft NAVD88, and a slab invert elevation of -9.0-ft NAVD88. The floodgate would provide an opening in the system to allow unimpeded navigation, except when a tropical system approaches the Gulf of America in which the gate would be closed.

A barge gate is constructed of a braced steel frame with sheet metal or solid plate exterior in a hollow box configuration that resembles a hopper barge (see Figure 2). The gate normally contains several individual compartments that are watertight. The gate would have a pivot arm at one end that allows the gate to articulate in a 90° arc to open and close. The pivot arm would be mounted onto a fixed pivot pile that would allow the gate and pivot arm free travel in the vertical direction (for flotation). When the gate is in either the open or closed position, pumps fill the compartments with water until the buoyancy is overcome and the structure settles onto a receiving structure. While in the open position, the gate would also function as a guide wall to aid the vessels in navigating through the structure. In the closed position, the gate is ballasted down to an underwater foundation with gravity loads transferred through the base seal and the base support (see Figures 3 & 4). The flat top of the gate allows passage of either pedestrian or motorized ATV traffic. Lateral loads from high tides or storm surge on the barge gate are transferred into two concrete abutment reaction walls on either end of the gate structure.

Figure 2: Typical Barge Gate Example

Figure 3: Conceptual Barge Gate - Elevation View with Gate in Open Position

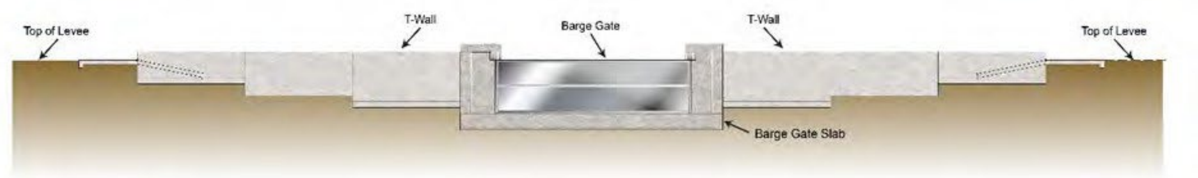


Figure 4: Conceptual Barge Gate - Elevation View with Gate in Closed Position

Timber guide walls and pile clusters would be provided as aids to navigation and to protect the main flood gate structure from impact. The seven pile dolphin structures are constructed at the end of the guide wall to protect the guide walls from impact from vessels. The guide walls would be timber support frames currently spaced every 6 feet. Each timber support frame is constructed with a vertical pile braced by a batter pile driven at an angle from vertical. The outer end of each guide wall is anchored with a seven-pile dolphin structure. The dolphins would consist of 7 timber piles battered away from each other and tied together with a wire rope at the top of the dolphin. Please see figure 5, 6 and 7 for more details.

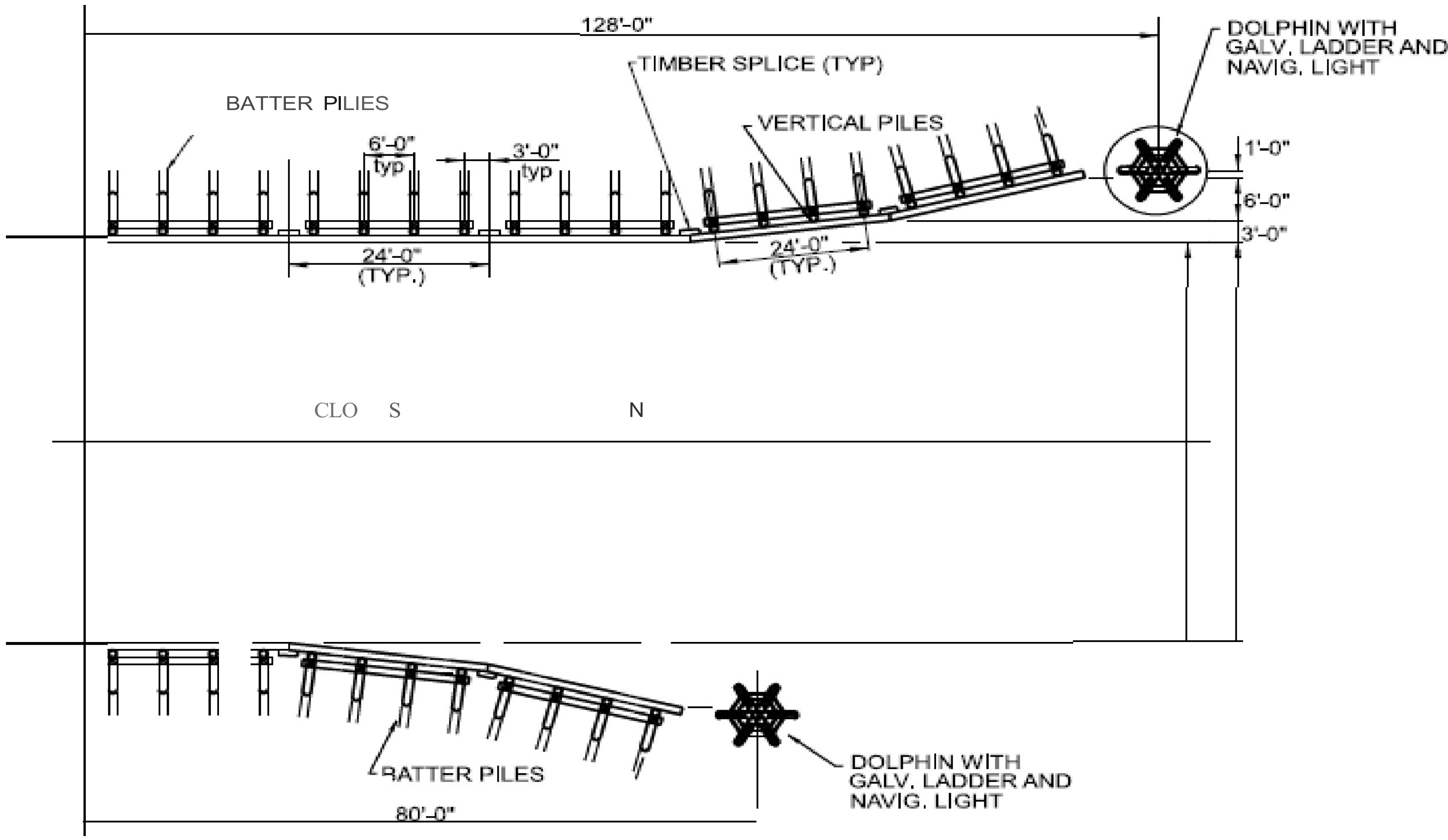


Figure 5: Plan – Guide walls, Fenders, and Dolphins

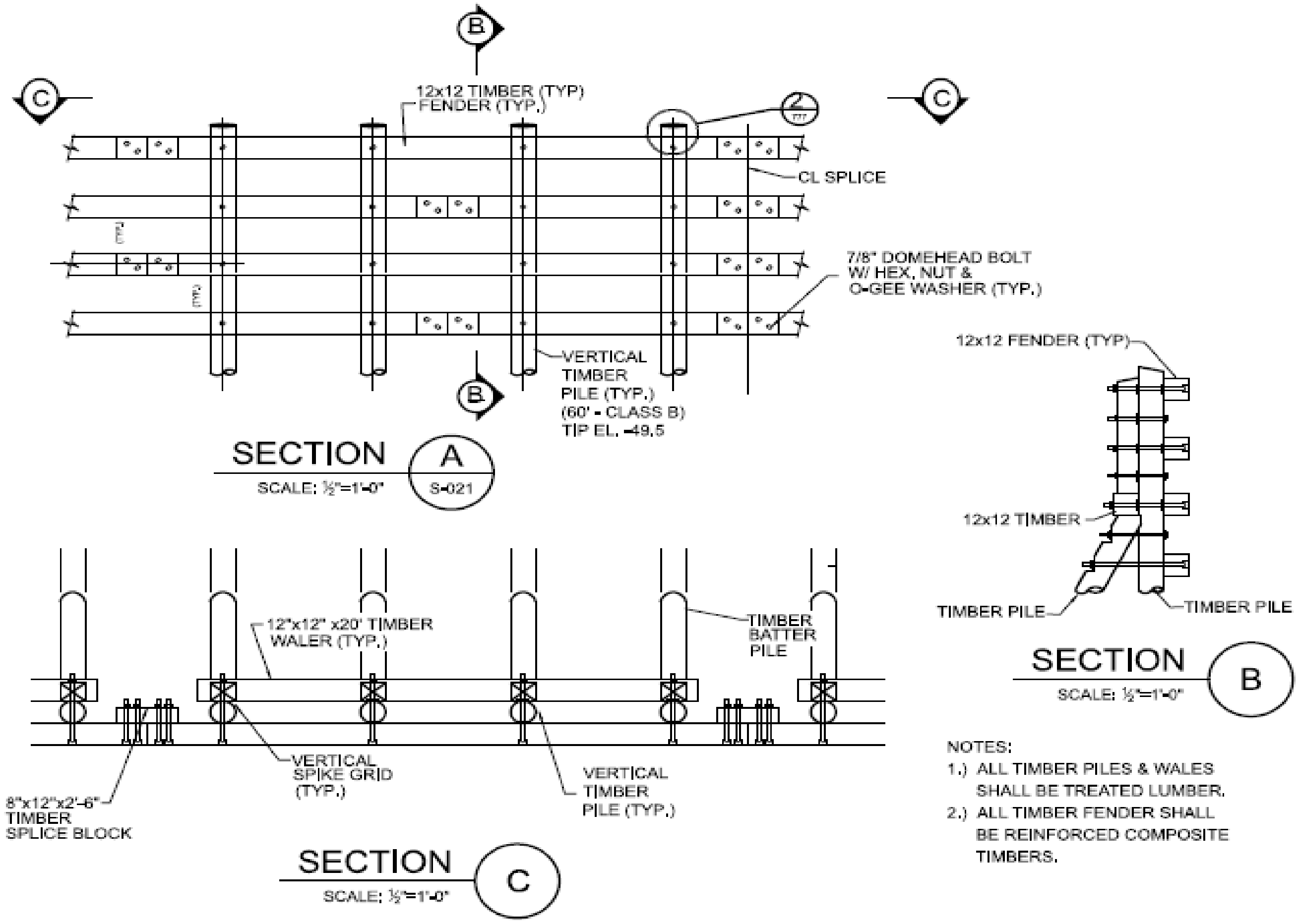


Figure 6: Guide wall Details

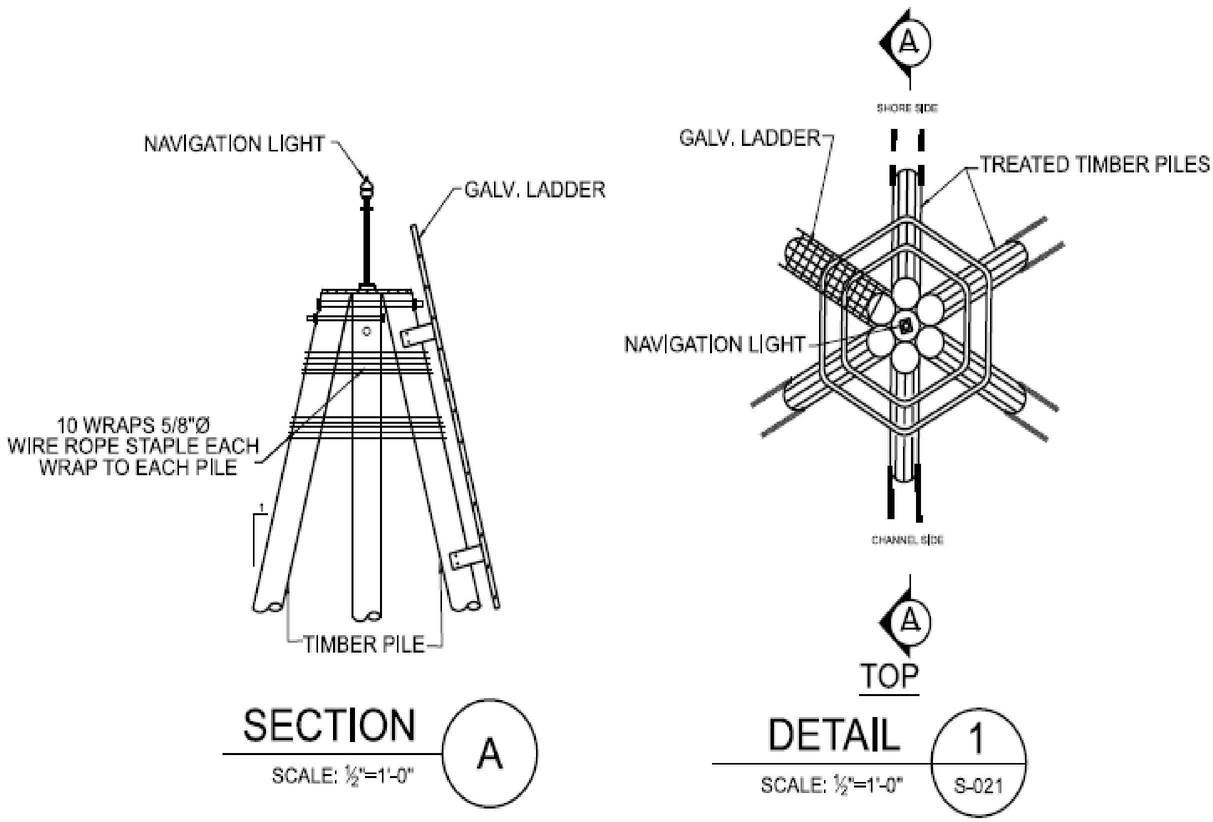
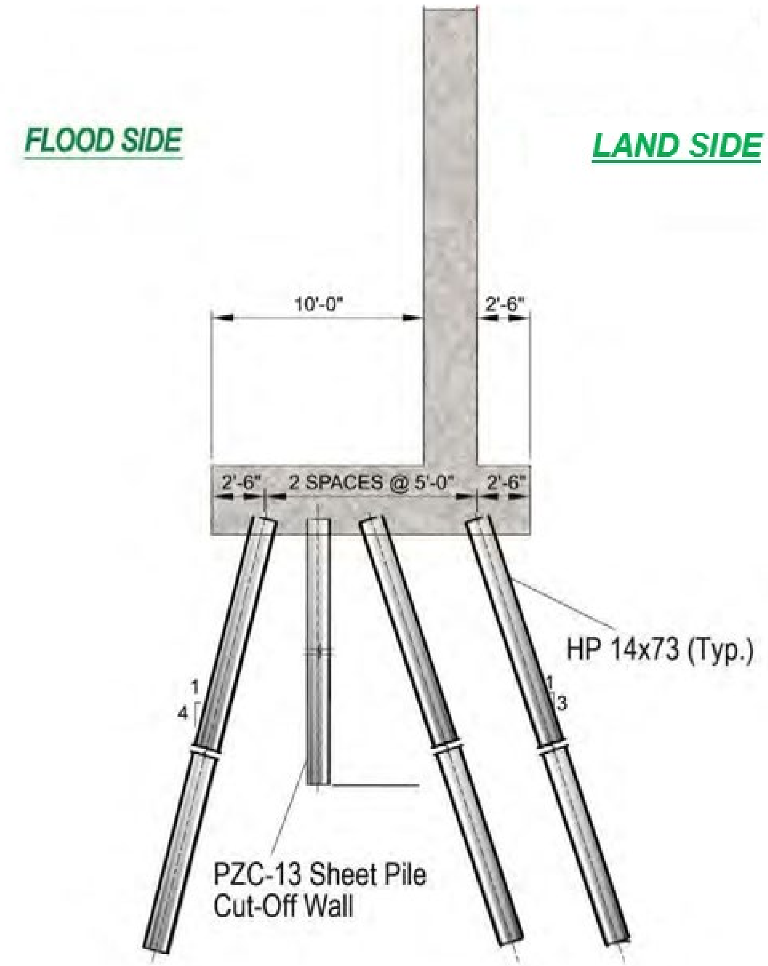


Figure 7: Dolphin Details

Approximately 1,065 total linear feet (490 linear feet on the west side of the floodgate and 575 linear feet on the east side of the floodgate) of floodwalls, specifically T-walls, would extend from the gate and tie into the adjacent levees. The floodwalls would have a top elevation of 25.0-ft NAVD88.

The height of the floodwall tie-ins would vary with the tallest walls adjacent to the barge gate and the shortest walls that tie into the adjacent levee. Details on a typical section of floodwall are provided in Figure 8.



The design of the new barge gate, floodwalls and roadway floodgate including the foundation is subject to change once detailed geotechnical investigations are conducted during detailed design.

Nine-inch concrete scour protection or grouted riprap would be used at the levee/T-wall transition. The concrete scour protection is located where the T-wall stem extends into the full levee section and extend down both levee slopes. The scour protection would continue for 30 linear feet past the end of the T-wall. Uncapped cut-off sheet piling would extend horizontally 30 feet into the full levee section for erosion and seepage control. See the sketch below for wall layout and cross-section. Please see Figure 9 below for an example of the proposed scour protection.

Figure 9: Concrete Scour Protection Example

2.14.3.2 Highway 55 Swing Gate

Where the eastern floodwall tie-in crosses Highway 55, a 36 ft wide swing gate would be constructed to provide an opening in the system to allow unimpeded traffic flow, except when a tropical system approaches the Gulf of America in which the gate would be closed (Figure 10 and 11).

A swing gate is a structure that is composed of two or more horizontal girders, vertical intercostals, vertical end diaphragms, a skin plate, and diagonal braces. In most cases, swing gate closures consist of a single gate leaf for openings up to 40-feet. Swing gates are mounted on hinges and swung open and closed like a door.

Figure 10: Swing Gate Closure Structure

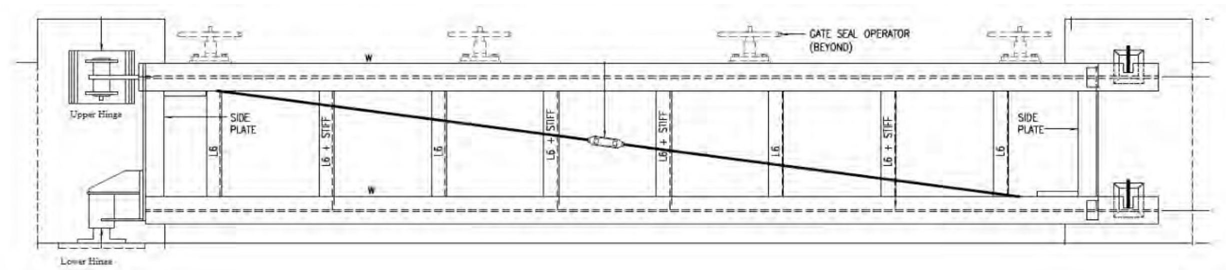


Figure 11: Typical Swing Gate Closure Structure Elevation

The barge gate would be constructed on the land side of the existing floodgate. The existing centerline of Bayou Terrebonne has an approximate elevation of -9.0 ft. For the construction of the gate foundation, the channel would be excavated to an approximate elevation -11 ft NAVD88 with the final constructed sill elevation being El. -9.0 ft. Directly adjacent to the floodgate slab, both on the land and the flood side of the gate would be excavated to an El. -11.5 (NAVD 88) to place both the bedding stone and the riprap required. The channel bottom would remain at elevation -9.0 ft for approximately 50 ft, both upstream and downstream of the newly constructed floodgate slab. The channel would then slope to allow a smooth transition from the sill elevation to existing grade over approximately 100-feet on both the land and flood side of the gate to afford aquatics the ability to migrate past gate sill.

The cross section at the gate location would be designed such that the pre and post project conditions would not impede the natural movement of aquatic organisms. The default operation would be open to avoid additional indirect impacts to vegetation and fish and wildlife due to changes in the natural hydrologic regime. The floodgate would be opened as soon as is safely possible after a closure for storm passage.

The velocities around and through the gate may require the channel bottom to be layered with 2-feet of riprap. The riprap is required in the channel, extending approximately 150 linear feet on both the land side and the flood side. After dredging the channel to an elevation of -11.5 feet, bedding would be placed on separator geotextile with the riprap on top of the bedding. A riprap gradation is assumed to be class 250 - 1000 lb stone (LADOTD 2016, Section 711). See Table 3 for example gradation limits for individual stone.

Table 3: Riprap Gradations

Gradation Limits Individual Stone Size (lbs)	Spherical Diameter (ft)	Percent Finer (By Weight)
1250	2.50	100
500	1.83	45-100
250	1.46	15-50
80	1.00	0-15

The barge gate would be constructed approximately in the center of the existing channel. A bypass channel would be constructed immediately adjacent to and to the east of the barge gate cofferdam footprint prior to beginning construction of the floodgate to allow safe navigational passage of marine traffic, as well as all aquatic organisms to pass safely until the floodgate structure is complete (Figure 12).

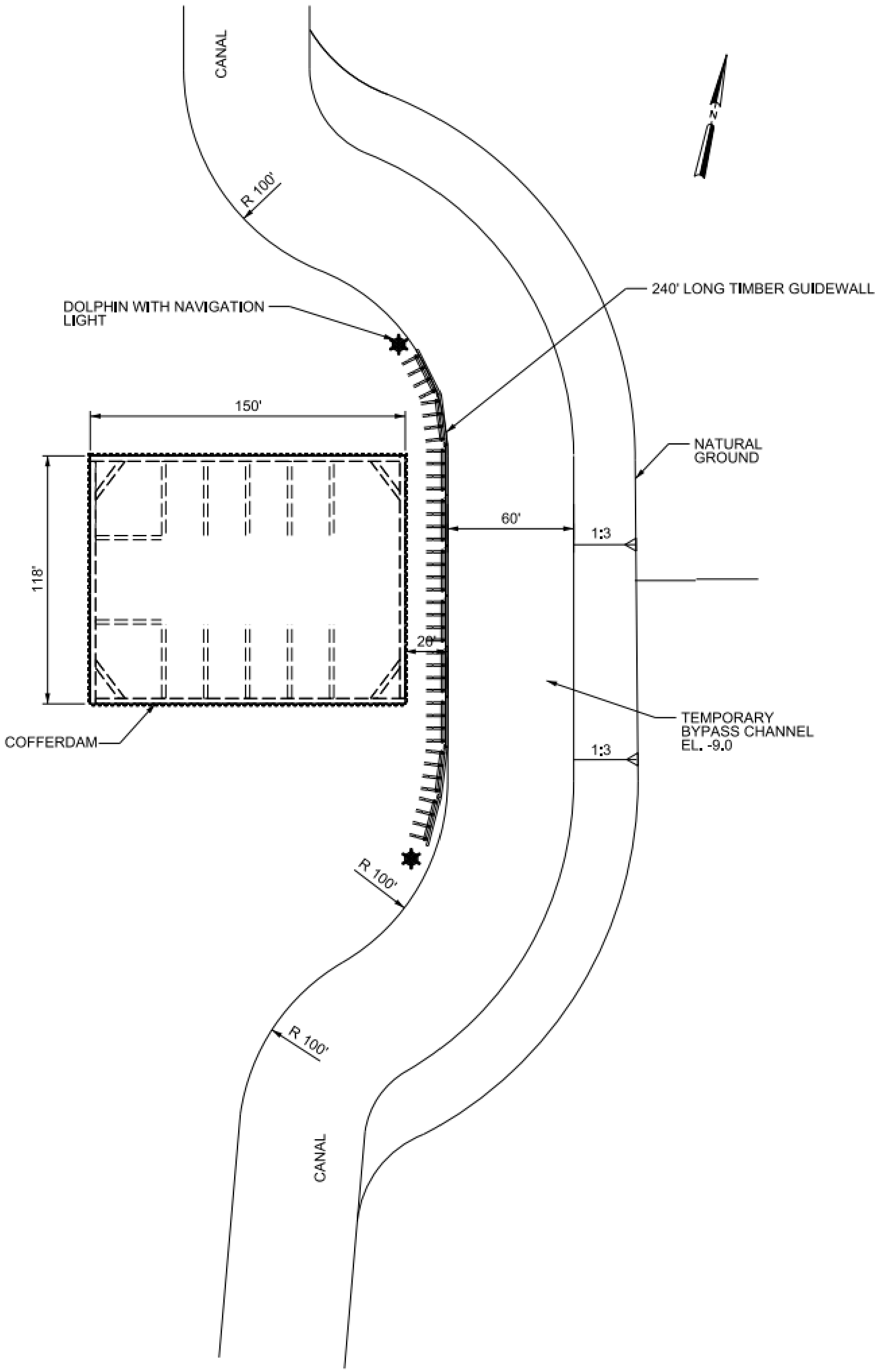


Figure 12: Preliminary bypass channel design

Preliminary designs of the bypass require a minimum bottom channel width of 60 ft temporary bypass channel with an invert of El. -9.0 ft. Based on the preliminary design, the bypass channel would be approximately 650 feet long. However, navigation of common local vessels would be considered for the bypass channels, and design features of a navigable bypass channel would be developed during detailed design. At a minimum, to maintain pre-construction flow conditions, navigation and minimize environmental impacts during construction, the temporary bypass channels would be similarly sized to the channels being impacted. A timber guidewall (like the permanent guide wall shown in Figure 5) would be constructed between the bypass channel and the barge gate footprint to prevent the cofferdam (described below) from vessel impact while the cofferdam is in place.

A total of 20,987 cy of material would be excavated from the channel for gate and bypass channel construction. If the dredged material is found to be suitable for use within the project levee footprint, the material would be used within the levee or could potentially be utilized for marsh restoration within the overall project footprint, otherwise the material would be hauled off site and disposed in accordance with all state and federal laws.

Once navigation is routed through the temporary bypass channel, a Phase 1 cofferdam (approximately 150 feet x 118 feet) would be constructed to permit working in the dry when constructing the barge gate concrete landing slab, pivot arm assembly, and the receiving structure concrete monoliths. The cofferdam would be an internally braced cofferdam with wide flange walers and pipe braces supporting PZ sheet piling. Reduced power would be required for vessels passing through the construction area to reduce the risk of impact to the cofferdam. A timber guide wall and pile clusters would be provided along the bypass channel to prevent vessel impact on the cofferdam.

Once construction of the 56-foot barge gate landing slab, pivot arm assembly, receiving structure monoliths is completed, navigation would be re-routed through the permanent barge gate structure. Following routing the navigation traffic through the barge gate, the Phase 2 cofferdam, permanent guide walls and pile clusters, tie-in T-walls, and final civil site work can be completed. The Phase 2 cofferdam (approximately 120 feet x 80 feet on the east side and approximately 60 feet x 80 feet on the west side of the floodgate) would be constructed to permit the construction of the adjacent T-walls to the barge gate structure that would be in the water. The same anchor forces, moments, and tips used for the Phase 1 cofferdams would be conservatively used for the Phase 2 cofferdams.

2.14.4 Construction Duration and Equipment

The construction duration of the Bayou Terrebonne Floodgate would be 24 months with an assumed work schedule of 5 days a week, 8 hours a day. The barge floodgate would be constructed using both floating equipment and land support. Below is the preliminary list of equipment anticipated to be utilized for the construction of the Bayou Terrebonne Floodgate.

Table 1: Preliminary Equipment List for Sector Gate and Floodwall Construction

Project Component	Duration (days)	Equipment Used
		150-Ton Crane

Barge Gate Complex & Tie-In Floodwall	730	80-Ton Crane
		Excavator
		Pile Driver
		Concrete Trucks
		Concrete Vibrators
		Welding Machine, Cutting Torch
Tie-In Levee		Dump Trucks
		Bull Dozers
		Fill Compactor
		Front End Loaded/Backhoe
		Fuel Tanks
		Generator

2.14.5 Access and Staging

Construction site access would be obtained by both barge and land. Vehicle access would be via LA Highway 55 to the project site. The construction staging area would be within the cleared area shown in Figure 13. It is assumed the staging area would be approximately 0.4 acres. The staging area would have a crushed stone on top of a separator fabric. Upon completion of the project, the staging area would be returned to pre-construction condition. The staging area would be used as an operations and materials storage area. The contractor would place the project trailers for both the Government and the contractor within the staging area. The contractor would store the project equipment and project building supplies within the staging area.

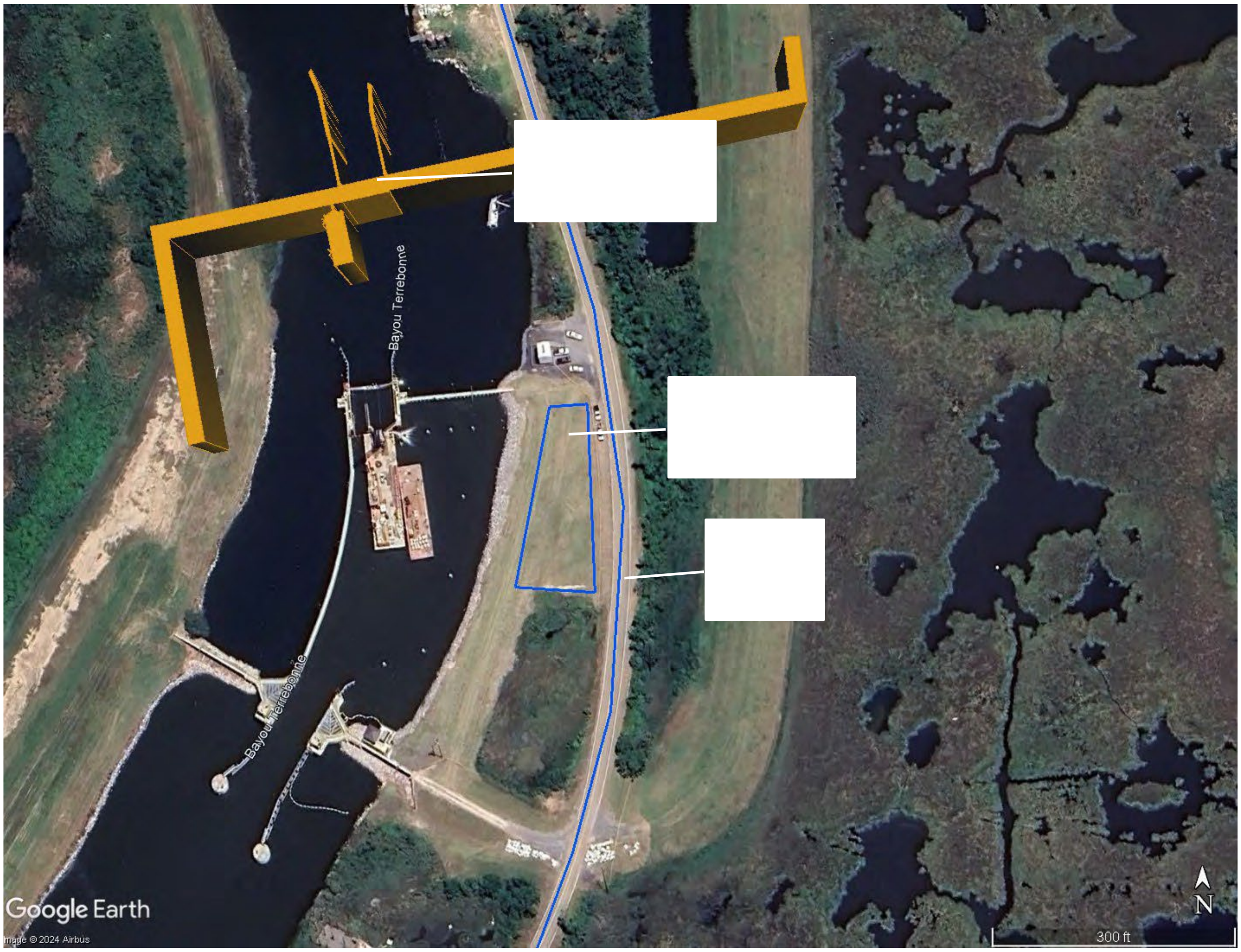


Figure 13: Staging and Access

2.15 REACH I-1, BUSH CANAL BARGE FLOODGATE

2.15.1 Location

The Bush Canal Barge Floodgate gate is located on the Bush canal within Terrebonne Parish and is located at latitude 29°22'07.1619", longitude -90°36'07.8191".

Figure 1: Location Map

2.15.2 Scope of Work

This contract would consist of a Barge floodgate and three sluice gate monoliths within the Bush canal with floodwalls flanking each side of the floodgate. Each sluice gate monolith would contain three 16 feet by 16 feet sluice gates that would remain open unless there is an event. On both the inflow and the outflow of the gate bay, there would be timber guide walls and protection pile clusters. Finally, the transition between levee and floodwall would be protected with concrete or grouted riprap to prevent scour at this transition.

2.15.3 Structure Description

This floodgate would be a 56 ft wide barge type floodgate with a top elevation of +24.0' NAVD88, and a slab invert elevation of -12.0' NAVD88. The floodgate would provide an opening in the system to allow unimpeded navigation, except when a tropical system approaches the Gulf of America in which case the barge gate and sluice gates would be closed. There would be six 16'x16' sluice gates (117 linear feet) on the south side of the gate and three 16'x16' sluice gates (60 linear feet) on the north side of the gate.

A barge gate is constructed of a braced steel frame with sheet metal or solid plate exterior in a hollow box configuration that resembles a hopper barge (see Figure 2). The gate normally contains several individual compartments that are watertight. The gate would have a pivot arm at one end that allows the gate to articulate in a 90° arc to open and close. The pivot arm would be mounted onto a fixed pivot pile that would allow the gate and pivot arm free travel in the vertical direction (for flotation). When the gate is in either the open or closed position, pumps fill the compartments with water until the buoyancy is overcome and the structure settles onto a receiving structure. While in the open position, the gate would also function as a guide wall to aid the vessels in navigating through the structure. In the closed position, the gate is ballasted down to an underwater foundation with gravity loads transferred through the base seal and the base support (see Figures 3 & 4). The flat top of the gate allows passage of either pedestrian or motorized ATV traffic. Lateral loads from high tides or storm surge on the barge gate are transferred into two concrete abutment reaction walls on either end of the gate structure.

Figure 2: Typical Barge Gate Example

Figure 3: Conceptual Barge Gate - Elevation View with Gate in Open Position

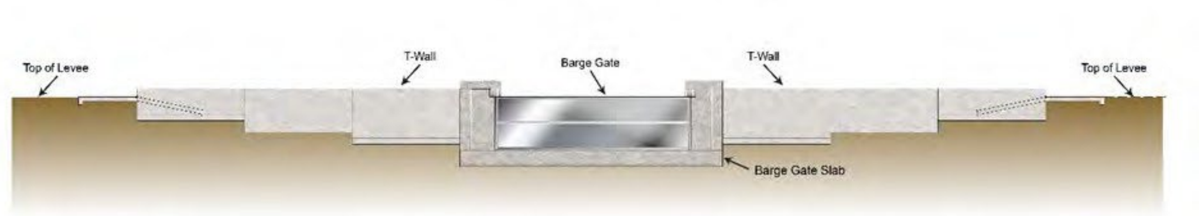


Figure 4: Conceptual Barge Gate - Elevation View with Gate in Closed Position

A sluice gate is a structure that contains a movable gate or series of movable gates that, when lifted, allow material and water to flow under it. The sluice gate would provide an opening in the system to allow unimpeded tidal flow, except when a tropical system approaches the Gulf of America in which the gates would be closed. Sluice gates are not navigable as they do not raise high enough, or they have fixed components that do not allow vessels to pass through. There are 3 separate sluice gate monolith structures at this project location. Each sluice gate structure would contain three (3) sluice gates. Each gate would be 16 feet wide by 16 feet tall with an invert elevation of elevation -12.0 feet. See Figure 5 and Figure 6 for conceptual plan and gate elevations.

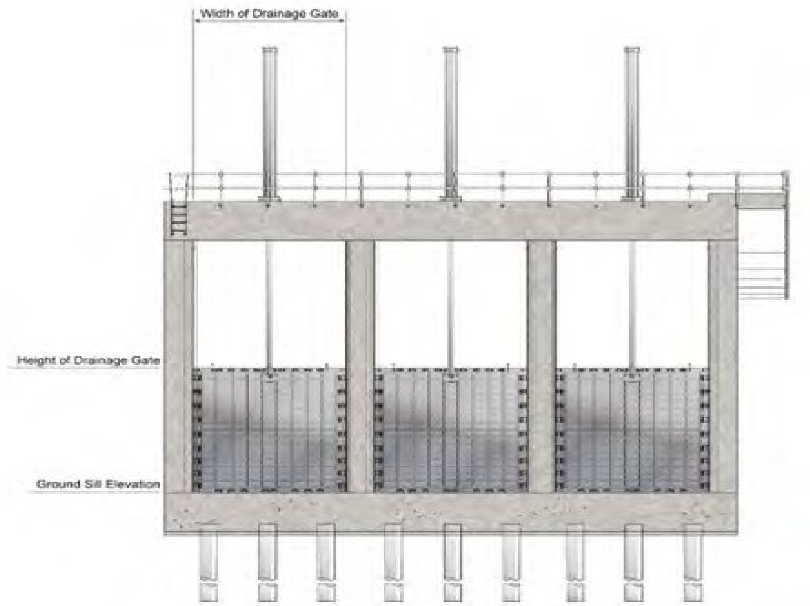


Figure 5: Conceptual Barge Gate - Elevation View with Gate in Closed Position

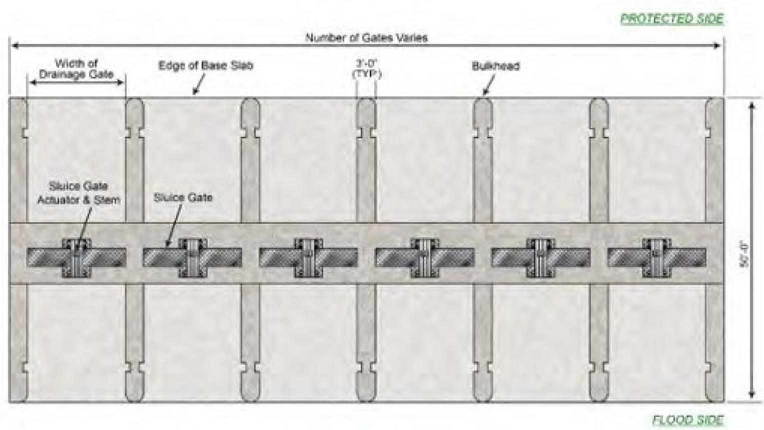


Figure 6: Typical Sluice Gate Control Structure (6 gates) - Plan View

The floodgate would have timber guide walls and pile dolphin structures on both the land and flood side. The seven pile dolphin structures are constructed at the end of the guide wall to protect the guide walls from impact from vessels. The guide walls would be timber support frames currently spaced every 6 feet. Each timber support frame is constructed with a vertical pile braced by a batter pile driven at an angle from vertical. The outer end of each guide wall is anchored with a seven-pile dolphin structure. The dolphins would consist of 7 timber piles battered away from each other and tied together with a wire rope at the top of the dolphin. Please see figure 7, 8 and 9 for more details.

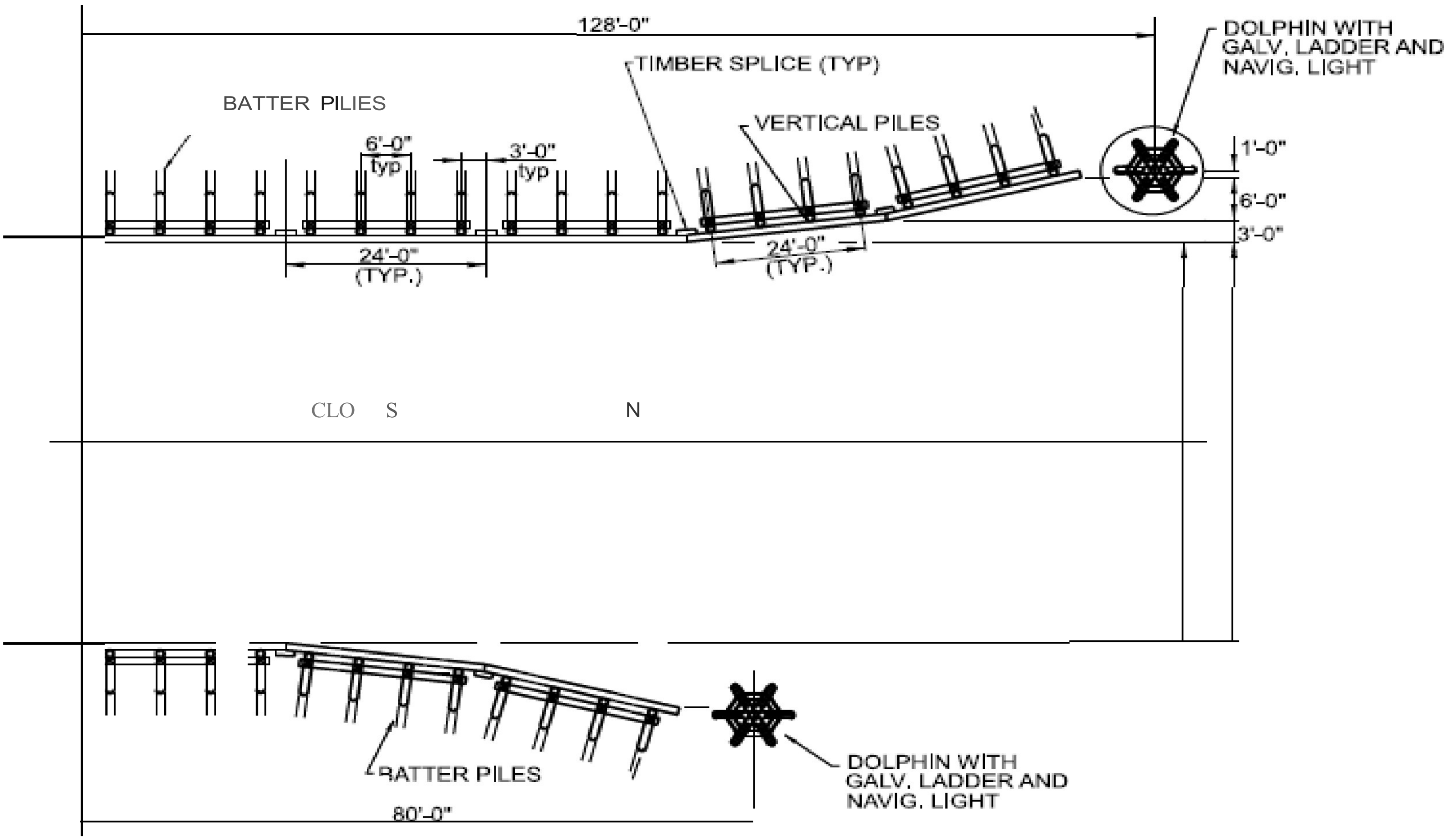


Figure 7: Plan – Guide walls, Fenders, and Dolphins

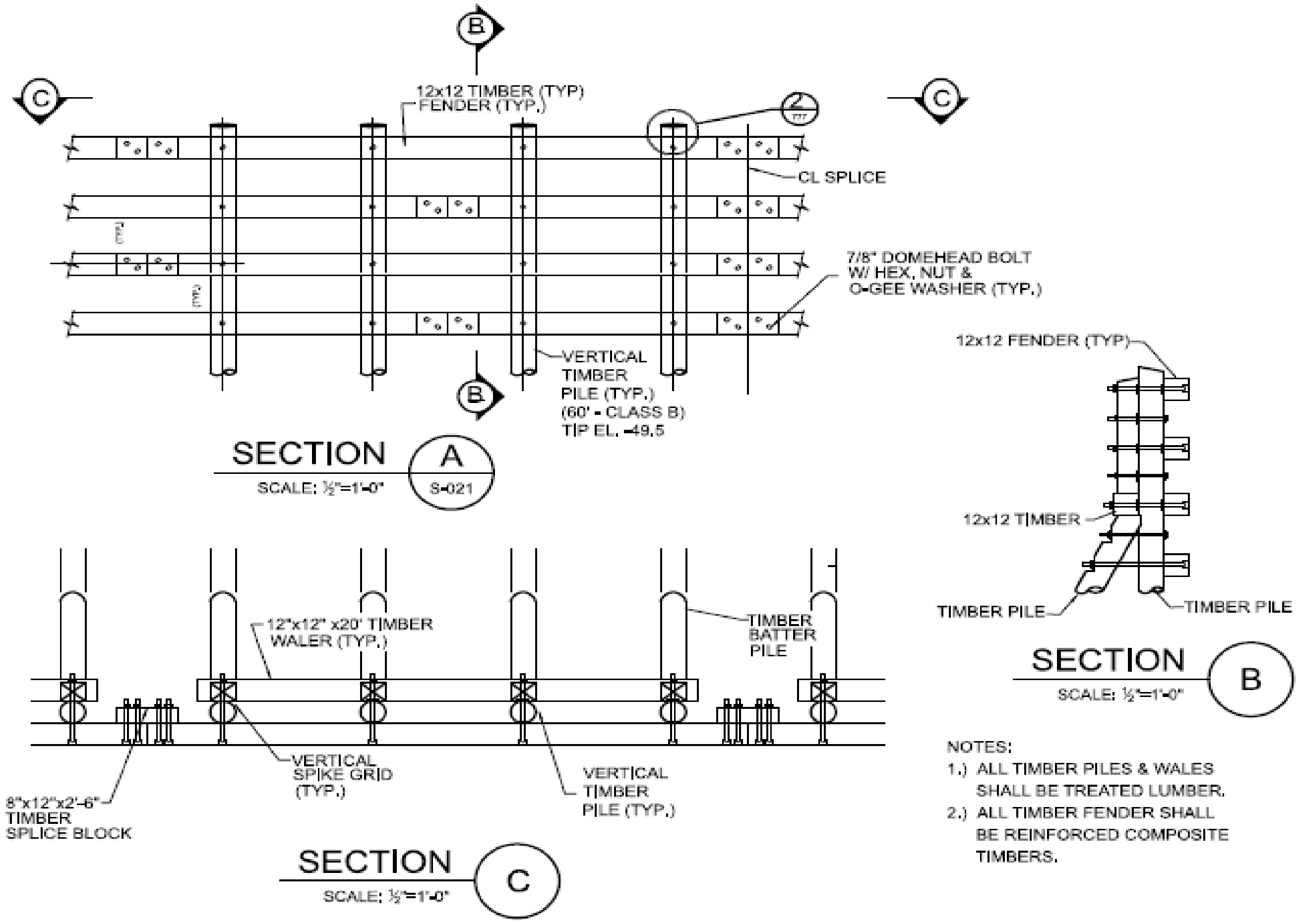


Figure 8: Guide wall Details

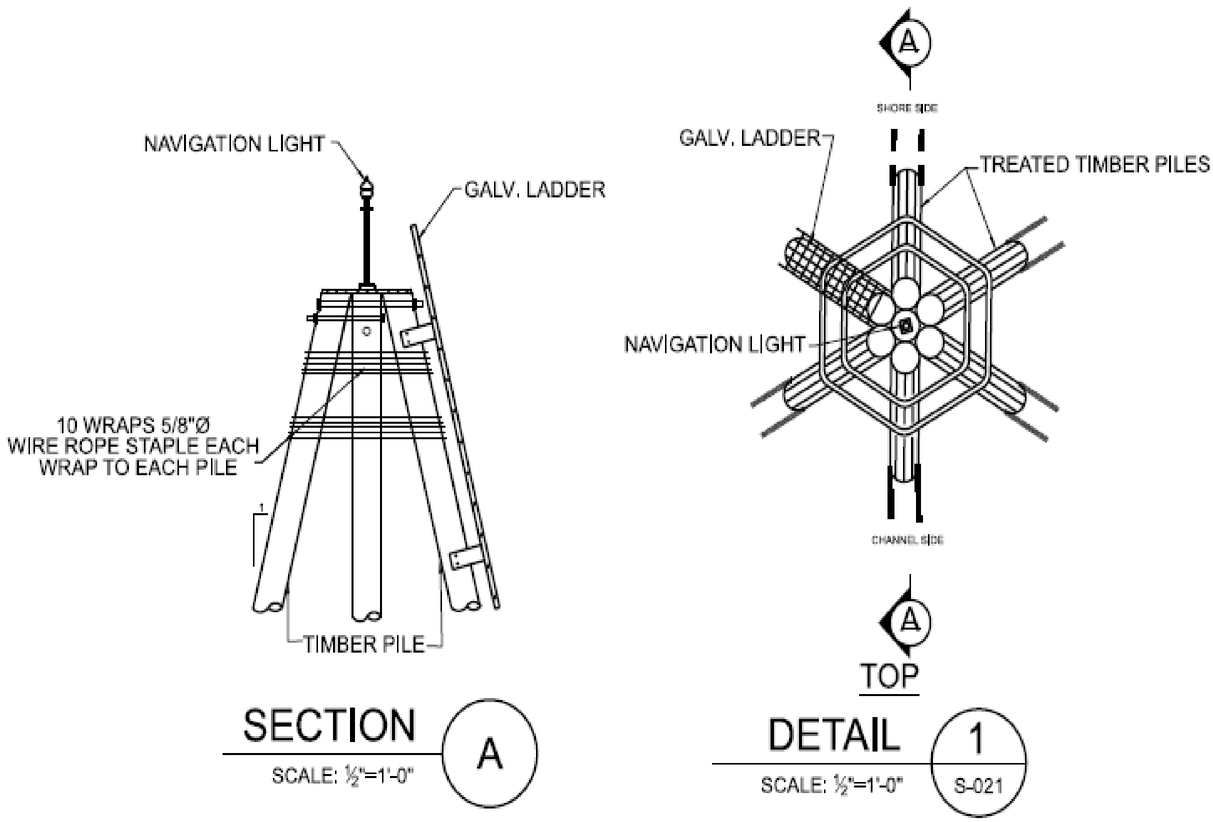


Figure 9: Dolphin Details

Approximately 1080 total linear feet (540 linear feet on each side of the floodgate) of floodwalls, specifically T-walls, would extend from the sluice gates and tie into the adjacent levees. The floodwalls would have a top elevation of 24.0 NAVD88.

The T-wall monoliths vary with the tallest walls adjacent to the sluice gate and the shortest walls that tie into the adjacent levee. Details on typical section of floodwall is provided in Figure 10.

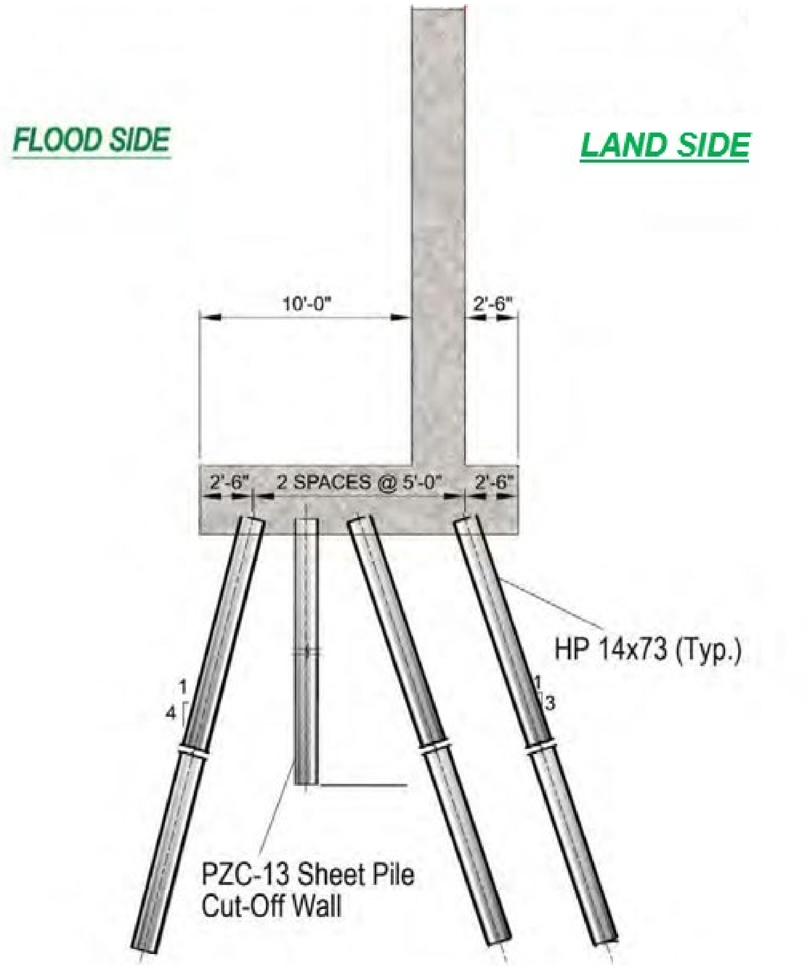


Figure 10: Typical Floodwall

The design of the new barge gate, sluice gate structure and floodwalls, including the foundation is subject to change once detailed geotechnical investigations are conducted during detailed design.

Nine-inch-thick concrete scour protection or grouted riprap would be used at the levee-floodwall transition (tie-in). The concrete scour protection or grouted riprap protects the levee where the floodwall stem extends into the full levee section and extends down both levee slopes. The scour protection would continue for 30 linear feet past the end of the floodwall. Uncapped, cut-off sheet piling would extend horizontally 30 feet into the full levee section for erosion and seepage control. Please see Figure 11 below for an example of the proposed scour protection.

Figure 11: Illustration of Scour Protection at Levee-Floodwall Tie-in.

The barge gate would be constructed on the land side of the existing floodgate. The existing centerline of Bush Canal has an approximate elevation of. -12.0 ft (NAVD 88). For the construction of the gate foundation, the channel would be excavated to an approximate elevation -21.5 ft with the final constructed sill elevation being -12.0 ft.

Directly adjacent to the floodgate slab, both on the land and the flood side of the gate would be excavated to an elevation of -14.5 ft (NAVD 88) to place both the bedding stone and the riprap required. The channel bottom would remain at El. -12.0 ft (NAVD 88) for approximately 50-feet, both upstream and downstream of the newly constructed floodgate slab. The channel would then slope up to allow a smooth transition from the sill elevation to approximately El. -11.0 ft over approximately 100-feet on both the land and flood side of the gate to afford aquatics the ability to migrate past gate sill.

The cross section at the gate location would be designed such that the pre and post project conditions would not impede the natural movement of aquatic organisms. The default operation would be open to avoid additional indirect impacts to vegetation and fish and wildlife due to changes in the natural hydrologic regime. The floodgate would be opened as soon as is safely possible after a closure for storm passage.

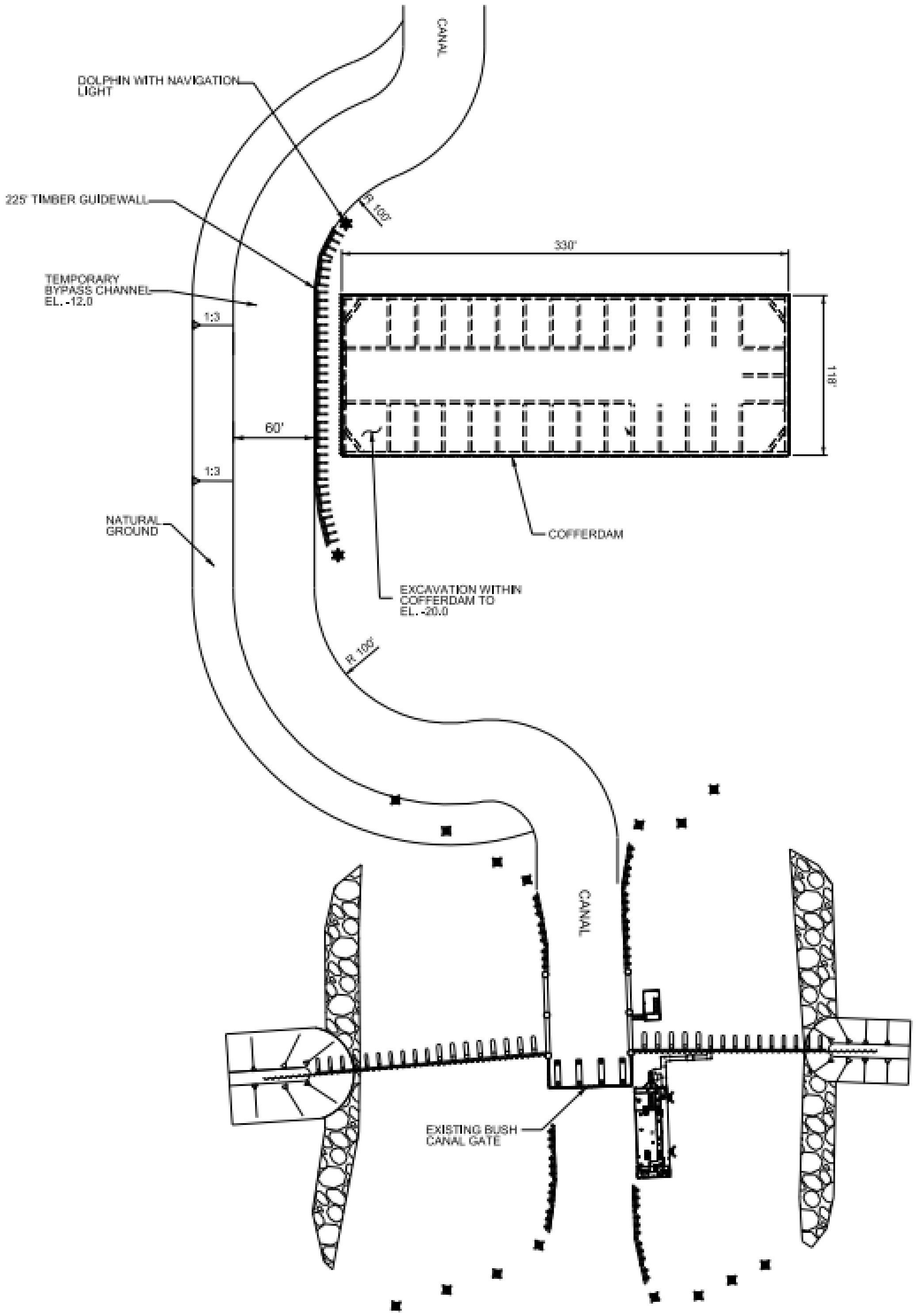
The velocities around and through the gate may require the channel bottom to be layered with 2-feet of riprap. The riprap is required in the channel, extending approximately 100 linear feet on both the land side and the flood side. After dredging the channel to El. -14.5, bedding would be placed on separator geotextile with the riprap on top of the bedding. A riprap gradation is assumed to be class 250 - 1000 lb stone

(LADOTD 2016, Section 711). See Table 1 for example gradation limits for individual stone.

Table 1: Riprap Gradations

Gradation Limits Individual Stone Size (lbs)	Spherical Diameter (ft)	Percent Finer (By Weight)
1250	2.50	100
500	1.83	45-100
250	1.46	15-50
80	1.00	0-15

The barge gate would be constructed approximately in the center of the existing channel. The by-pass channel would be constructed immediately adjacent to and to the west of the barge gate cofferdam footprint prior to beginning construction of the floodgate to allow safe navigational passage of marine traffic, as well as all aquatic organisms to pass safely until the floodgate structure is complete (Figure 12).



Preliminary designs of the bypass require a minimum bottom channel width of 60-foot for the temporary bypass channel with an invert of EL. -12.0'. Based on the preliminary design, the by-pass channel would be approximately 650 feet long. However, navigation of common local vessels would be considered for the bypass channels, and design features of a navigable bypass channel would be developed during detailed design. At a minimum, to maintain pre-construction flow conditions, navigation and minimize environmental impacts during construction, the temporary bypass channels would be similarly sized to the channels being impacted. A timber guidewall (like the permanent guide wall) would be constructed to prevent the cofferdam from vessel impact while the cofferdam is in place.

A total of 40,735 cy of material would be excavated from the channel for gate complex, bypass channel, and floodwall tie-in construction. If the dredged material is found to be suitable for use within the project levee footprint, the material would be used within the levee or could potentially be utilized for marsh restoration within the overall project footprint, otherwise the material would be hauled off site and disposed in accordance with all state and federal laws.

Once navigation is routed through the temporary bypass channel, a Phase 1 cofferdam (approximately 330 feet x 118 feet) would be constructed to permit the in the dry construction of the barge gate concrete landing slab, pivot arm assembly, receiving structure concrete monoliths, and the sluice gate concrete monoliths. The cofferdam would be an internally braced cofferdam with wide flange wales and pipe braces supporting PZ sheet piling. Reduced power would be required for vessels passing through the construction area to reduce the risk of impact to the cofferdam.

Once construction of the barge gate landing slab, pivot arm assembly, receiving structure monoliths, and sluice gate monoliths are completed, navigation would be re-routed through the permanent barge gate structure. After construction, the bypass channel is assumed to be included in the footprint of the structure site and the channel flow would be rerouted through the new structure feature. Once navigation is re-routed through the new floodgate, the Phase 2 cofferdam would be constructed and permanent guidewalls and pile clusters, tie-in T-walls, and final civil site work can be completed.

The Phase 2 cofferdam (approximately 120 feet x 80 feet on both sides of the floodgate) would be constructed to permit the construction of the adjacent T-walls to the sluice gate structures that would be in the water.

2.15.4 Construction Duration and Equipment

The construction duration of the Bush Canal Floodgate would be 24 months with an assumed work schedule of 5 days a week, 8 hours a day. The barge floodgate would be constructed using both floating equipment and land support. Below is the preliminary list of equipment anticipated to be utilized for the construction of the floodgate.

Table 2: Preliminary Equipment List for Sector Gate and Floodwall Construction

Project Component	Duration (days)	Equipment Used
Barge Gate Complex & Tie-In Floodwall	730	150-Ton Crane
		80-Ton Crane
		Excavator

		Pile Driver
		Concrete Trucks
		Concrete Vibrators
		Welding Machine, Cutting Torch
Tie-In Levee		Dump Trucks
		Bull Dozers
		Fill Compactor
		Front End Loader/Backhoe
		Fuel Tanks
		Generator

2.15.5 Access and Staging

Construction site access would be obtained by both barge and land. Vehicle access would be via Bayouside Drive and Hwy 55 to the project site. The construction staging area would be within the area shown in the Figure 13 along the bank of the Bush Canal. It is assumed the staging area would be approximately 100 feet by 300 feet. The staging area would have a crushed stone on top of a separator fabric. Upon completion of the project, the staging area would be returned to pre-construction condition. The staging area would be used as an operations and materials storage area. The contractor would place the project trailers for both the Government and the contractor within the staging area. The contractor would store the project equipment and project building supplies within the staging area. There would also be floating barges anchored within 500 feet of the project footprint that would be used for staging on this project.

Figure 12: Project site access

Figure 13: Proposed locations of new floodgate and construction staging area

2.16 REACH I-2, MADISON PUMP STATION FRONTING PROTECTION

2.16.1 Location

The Madison Black Pump Station is located west of Houma in Terrebonne Parish, within the Barrier Reach of the larger MTG system at approximately latitude 29°24'19.62"N, longitude -90°34'28.92"W.

Figure 1: Location Map

2.16.2 Scope of Work

The proposed work consists of construction of a floodwall in front of an existing operating pump station. The floodwall would be constructed to fit between the existing pump station and the discharge basin (area where the pumps discharge the rainwater).

In addition to the floodwall, the proposed action includes installing a valve within each of the existing pump station discharge pipes that could be closed to prevent storm surge from backflowing to the land side of the system through the discharge pipe. Finally, the transition between levee and floodwall would be protected with concrete or grouted riprap to prevent scour at this transition.

2.16.3 Structure Description

The existing system at the Madison (Nettleton) pumping station does not have sufficient design capacity to provide protection from a 100-year storm surge event. The existing Madison Pump Station consists of two 48" diameter vertical pumps. A floodwall would be constructed in front of the existing station and the 48" diameter pipes would be extended through the newly constructed T-walls with a top elevation of 25.0 feet NAVD88 (Figure 2). A butterfly valve would be placed within each discharge pipe that would always remain open except when a name storm enters the Gulf. The butterfly valve would be able to be remotely operated from the pump station control panel as well locally at the butterfly valve itself. The pipe discharge bell would be relocated to the floodside of the system and discharge onto a portion of the t-wall slab and new riprap that would be placed as part of this contract.

The approximate length of the inverted T-type floodwall would be 1280 total linear feet. The T-wall would be constructed on pile foundations with concrete base slabs and stems to the 2085 elevation 25.0 feet (NAVD 88). It is anticipated that this floodwall would be constructed at grade minimizing the requirement for any significant excavation.

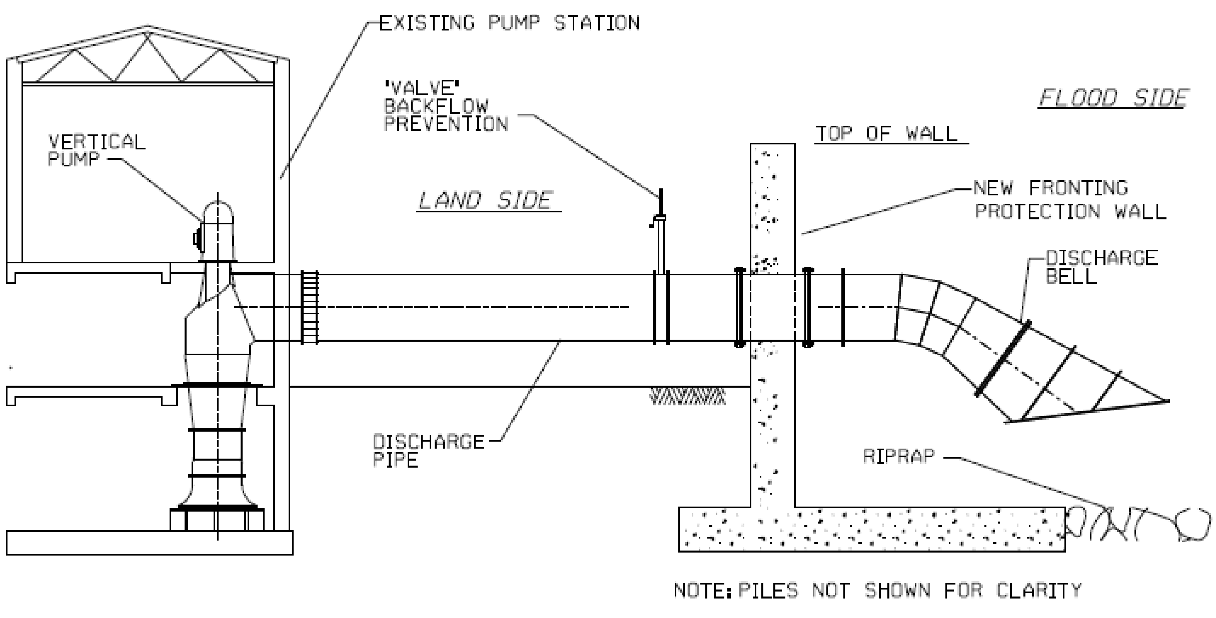
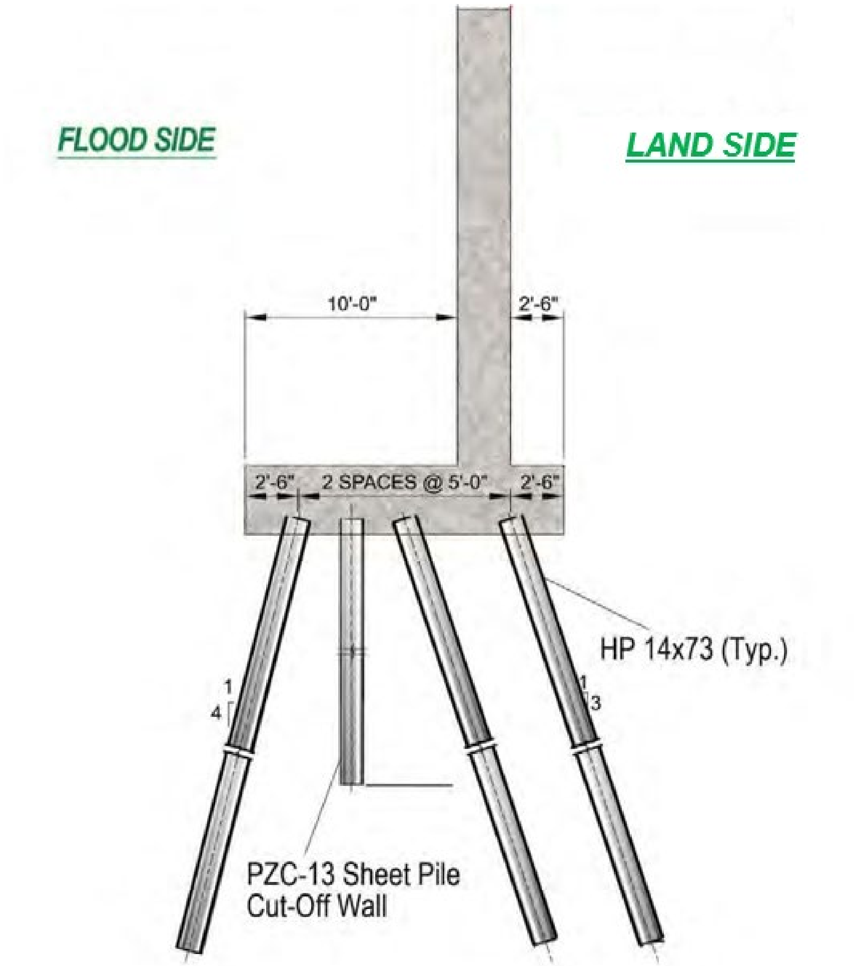


Figure 2: Typical Section of Fronting Protection Wall @ Pump Station

The T-wall monolith heights would vary with the tallest walls located in front of the pump station and the shortest walls tying into the adjacent levee. Figure 3 provides a sketch of the typical floodwall that would be used for this project.



Nine-inch concrete scour protection or grouted riprap would be used at the levee/ T-wall transition. The concrete scour protection will protect the levee where the T-wall stem extends into the full levee section and extend down both levee slopes. The scour protection would continue for 30 linear feet past the end of the T-wall. Uncapped cut-off sheet piling would extend horizontally 30 feet into the full levee section for erosion and seepage control. Reference Figure 4 as an example of the proposed scour protection.

Figure 4: Concrete Scour Protection Example

With the pipe discharge bell being relocated to the floodside of the system and discharging onto a portion of the t-wall slab, riprap would be required to dissipate the energy from the pumping of the rain water out of the system, extending a distance to be determined during detailed design. A riprap gradation is assumed to be class 250 - 1000 lb stone (LADOTD 2016, Section 711). See Table 1 for example gradation limits for individual stone.

Table 1: Riprap Gradations

Gradation Limits Individual Stone Size (lbs)	Spherical Diameter (ft)	Percent Finer (By Weight)
1250	2.50	100
500	1.83	45-100
250	1.46	15-50
80	1.00	0-15

The floodwall would be constructed at grade minimizing the requirement for any significant excavation. There would be approximately 8300 CY of excavated material resulting from the construction of the floodwall. The excavated material from constructing the floodwalls may be used within the levee footprint or if determined suitable could be used for marsh mitigation. If deemed unsuitable, the material would be hauled off site and disposed in accordance with applicable state and federal laws.

2.16.4 Construction Duration and Equipment

The construction duration of the Madison Pump Station Fronting Protection would be 24 months with an assumed work schedule of 5 days a week, 8 hours a day. The floodwalls in front pump station would be constructed using both floating equipment and land support. Below is the preliminary list of equipment anticipated to be utilized for the construction of the Madison Pump Station Fronting Protection.

Table 2: Preliminary Equipment List for Sector Gate and Floodwall Construction

Project Component	Duration (days)	Equipment Used
Fronting Protection & Tie-In Floodwall	730	150-Ton Crane
		80-Ton Crane
		Excavator
		Pile Driver
		Concrete Trucks
		Concrete Vibrators
		Welding Machine, Cutting Torch
Tie-In Levee		Dump Trucks
		Bull Dozers
		Fill Compactor
		Front End Loaded/Backhoe
		Fuel Tanks
		Generator

2.16.5 Access and Staging

In general, construction site access would be obtained by land. Vehicle access would be via LA Highway 55 (Montegut Road) to Private Access Road down to the project site. The construction staging area would be within the area shown in Figure 5 within the cleared area adjacent to the pump station. It is assumed the staging area would be 125 feet by 50 feet. The staging area would have a crushed stone on top of a separator fabric. Upon completion of the project, the staging area would be returned to pre-construction condition. The staging area would be used as an operations and materials storage area. The contractor would be allowed to place project trailers for both the Government and the contractor. The contractor would store the project equipment and project building supplies within the staging area.

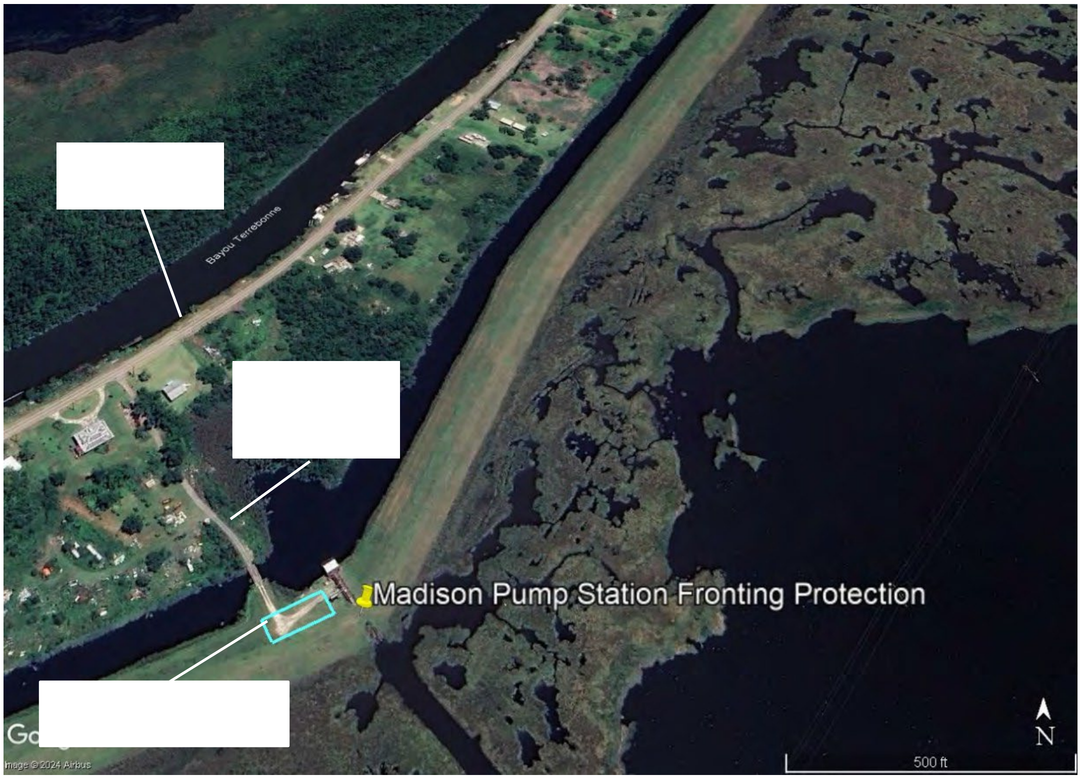


Figure 5: Access and Staging

2.17 REACH J-2, HUMBLE CANAL FLOODGATE

2.17.1 Location

The Humble Canal Floodgate would be located on the Humble Canal within Terrebonne Parish and would be located at latitude 29°26'09.02"N, longitude -90°33'43.87"W.

Figure 1: Location Map

2.17.2 Scope of Work

This contract would consist of a 56-foot-wide sector floodgate in Humble Canal floodwall tie-ins flanking each side of the floodgate. On both the inflow and the outflow of the gate bay, there would be timber guide walls and protection pile clusters. Finally, the transition between levee and floodwall would be protected with concrete or grouted riprap to prevent scour at this transition.

2.17.3 Structure Description

This floodgate would be a 56 ft wide sector gate (Figure 2) with a top elevation of +24.5 ft NAVD88, and a slab invert elevation of -10 ft NAVD88. The floodgate would provide an opening in the system to allow unimpeded navigation, except when a tropical system approaches the Gulf of America in which case the gate would be closed.

The sector gate consists of two leaves joined at the center of the navigable channel width that rotate into gatebay recesses when opened. Each gate leaf is shaped as a sector of a cylinder, or pie-shape, with a vertical axis. The floodgate would provide an opening in the risk reduction system to allow unimpeded navigation. The floodgate would be closed when a tropical system approaches the Gulf of America. (see Figures 3 & 4). The sector gate would have concrete control houses provided for each gate leaf to shelter the gate control systems and machinery. The gate structure would be designed such that each gatebay can be dewatered independently using needle girder beams and needle girders.

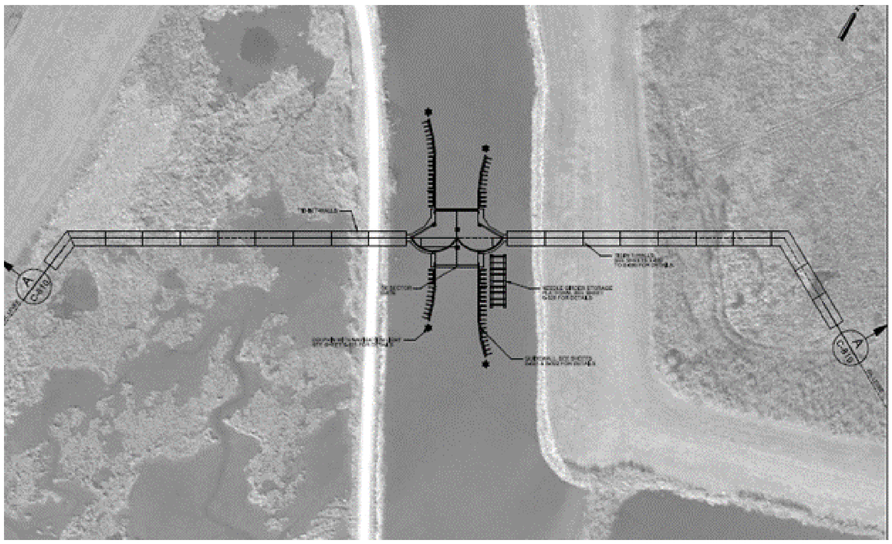


Figure 2: Typical Sector Gate Example

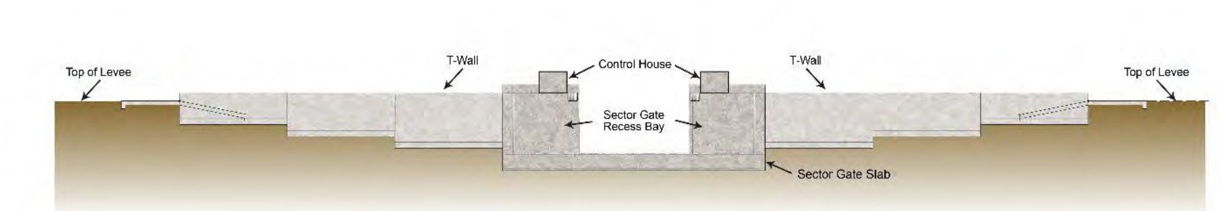


Figure 3: Conceptual Sector Gate - Elevation View with Gate in Open Position

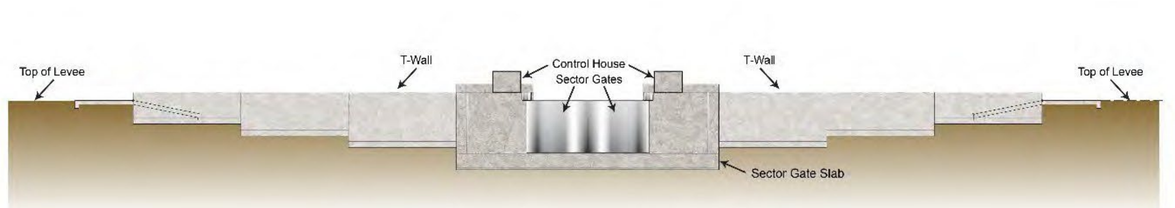


Figure 4: Conceptual Sector Gate - Elevation View with Gate in Closed Position

Timber guide walls and pile clusters would be provided as aids to navigation and to protect the main flood gate structure from impact. The seven pile dolphin structures are constructed at the end of the guide wall to protect the guide walls from impact from vessels. The guide walls would be timber support frames currently spaced every 6 feet. Each timber support frame is constructed with a vertical pile braced by a batter pile driven at an angle from vertical. The outer end of each guide wall is anchored with a seven-pile dolphin structure. The dolphins would consist of 7 timber piles battered away from each other and tied together with a wire rope at the top of the dolphin. Please see figure 5, 6 and 7 for more details.

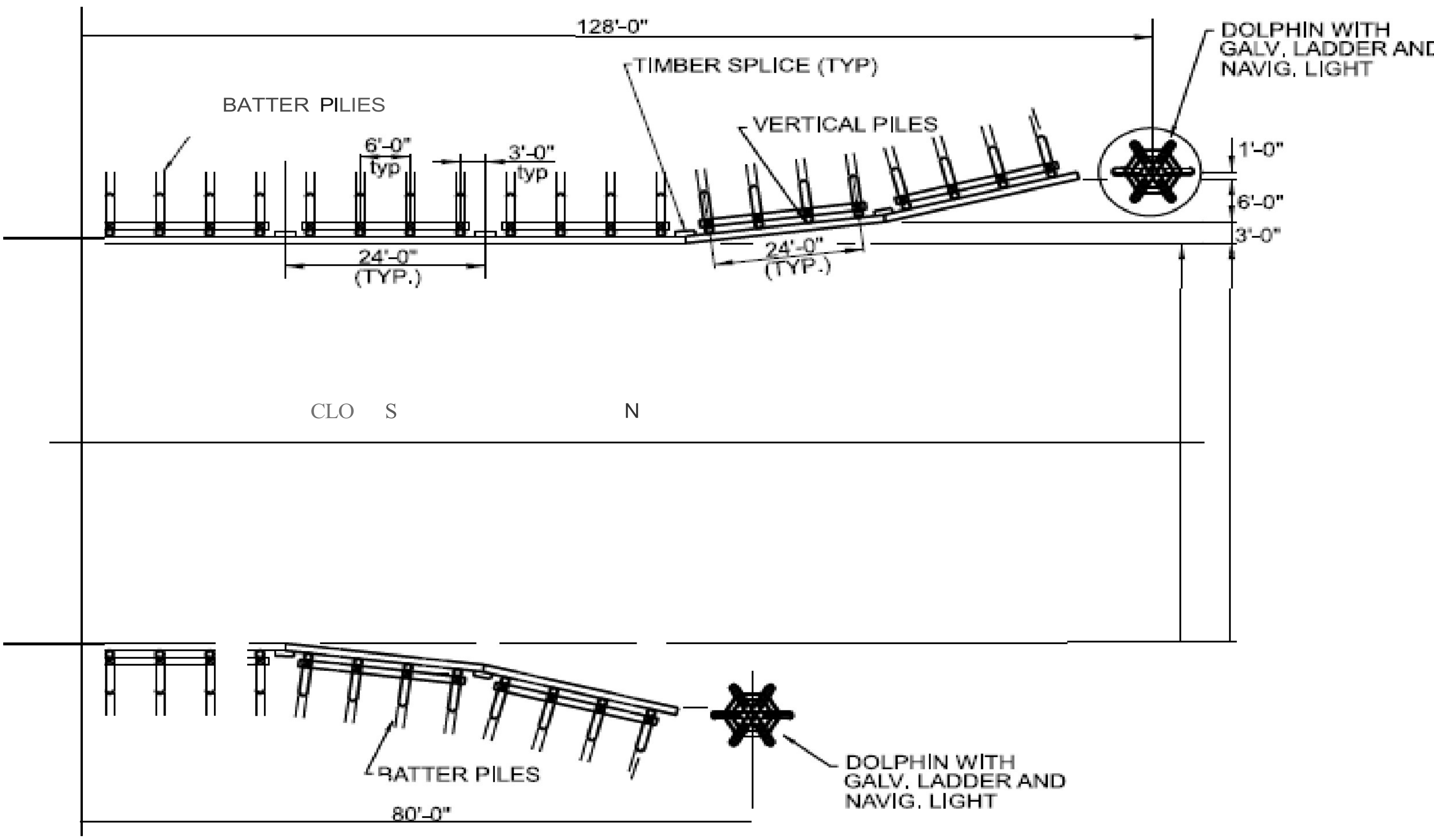


Figure 5: Plan – Guide walls, Fenders, and Dolphins

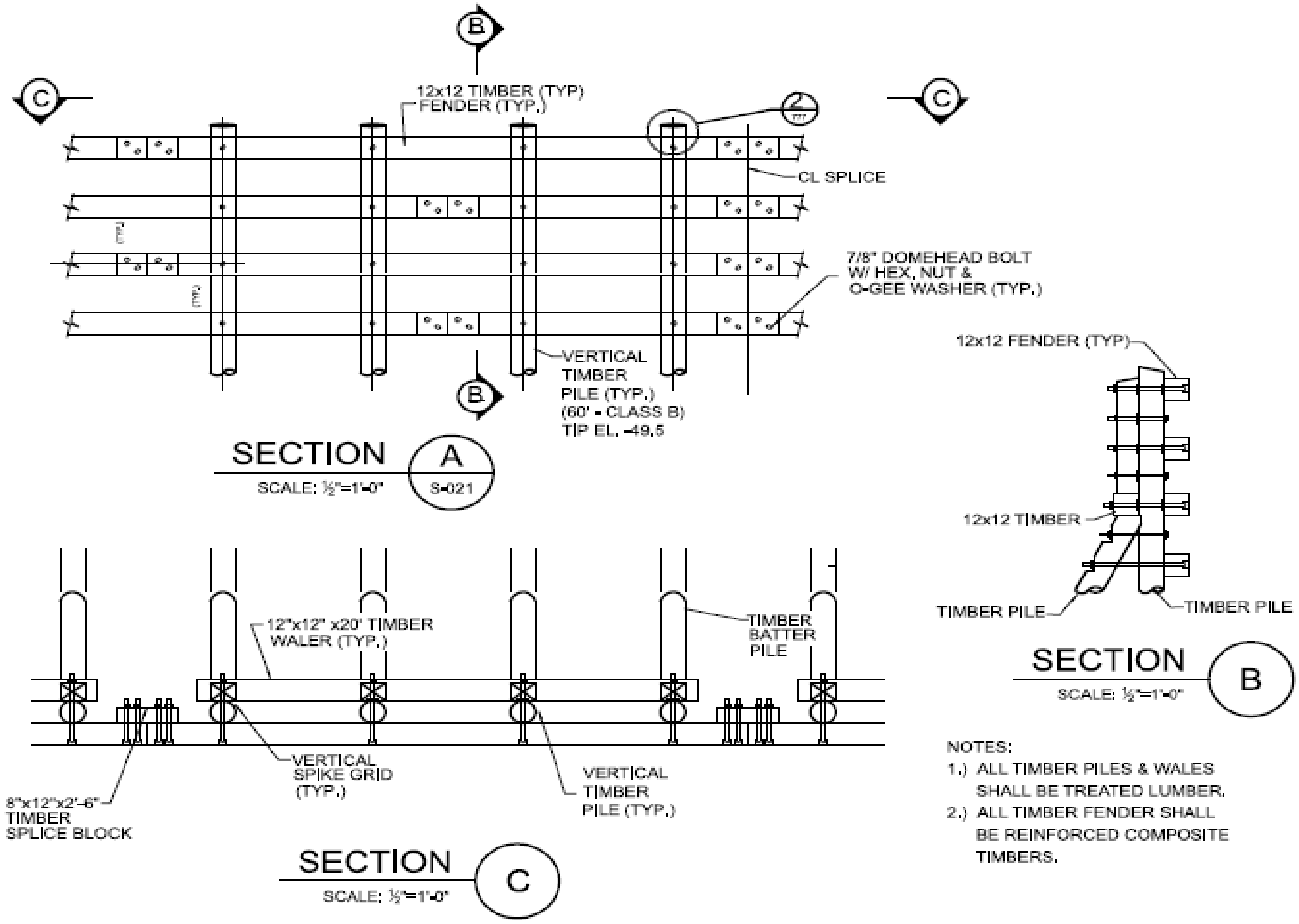


Figure 6: Guide wall Details

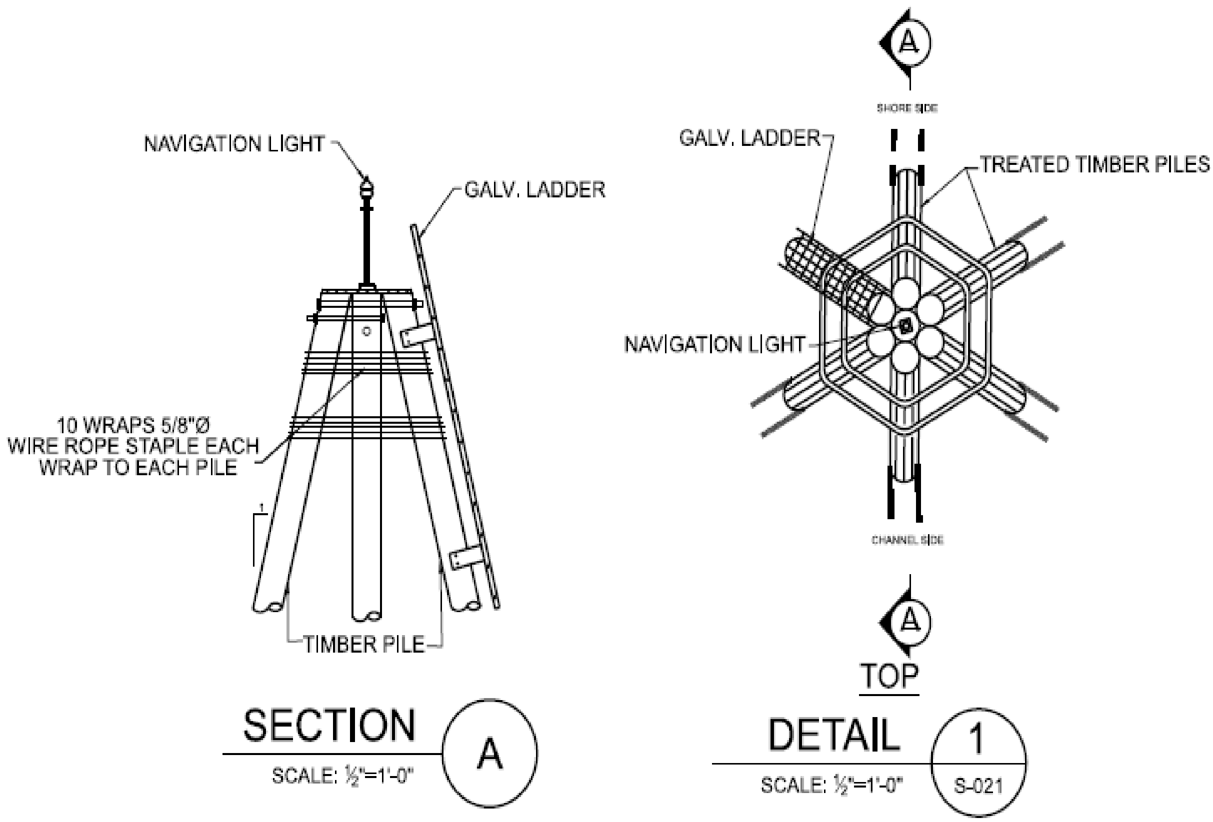


Figure 7: Dolphin Details

Approximately 980 total linear ft (490 linear ft on each side of the floodgate) of floodwalls, specifically T-walls, would extend from the sluice gates and tie into the adjacent levees. The floodwalls would have a top elevation of 24.5 ft NAVD88.

The height of the floodwall tie-ins would vary with the tallest walls adjacent to the sector gate and the shortest walls that tie into the adjacent levee. Details on typical section of floodwall is provided in Figure 8.

The design of the new sector gate structure, sluice gates and floodwalls, including the foundation is subject to change once detailed geotechnical investigations are conducted during detailed design.

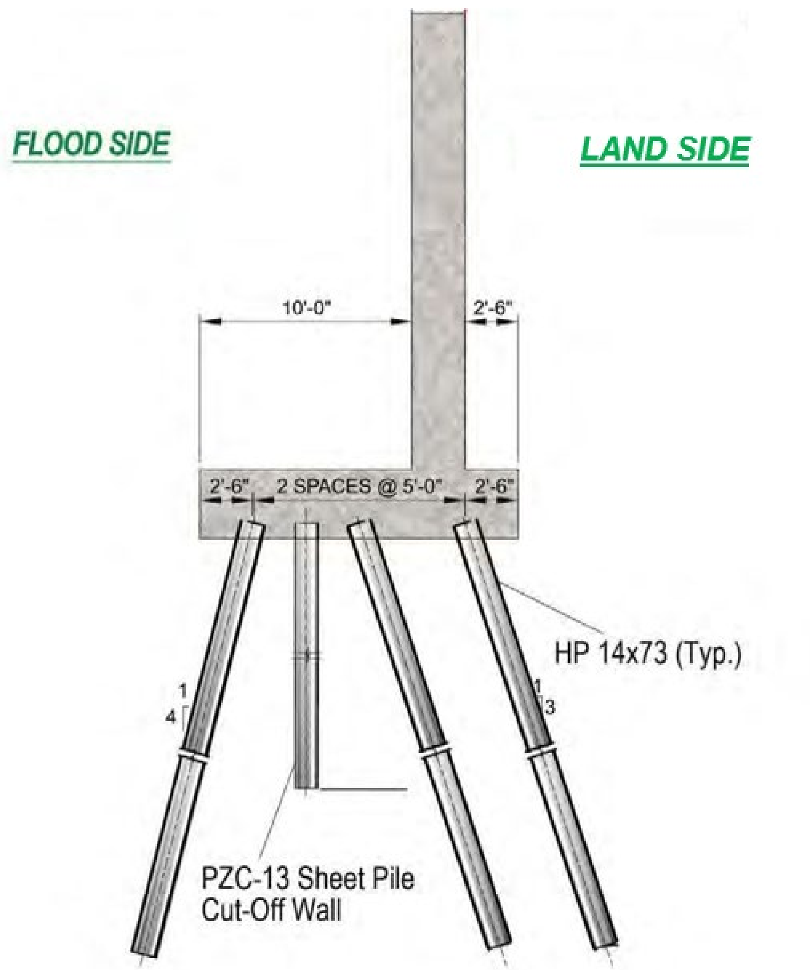


Figure 8: Typical Floodwall

Nine-inch concrete scour protection or grouted riprap would be used at the levee/T-wall transition. The concrete scour protection is located where the T-wall stem extends into the full levee section and extend down both levee slopes. The scour protection would continue for 30 linear feet past the end of the T-wall. Uncapped cut-off sheet piling would extend horizontally 30 feet into the full levee section for erosion and seepage control. See the sketch below for wall layout and cross-section. Please see Figure 9 below for an example of the proposed scour protection.

Figure 9: Concrete Scour Protection Example

The sector gate would be constructed southeast of the existing floodgate. The existing centerline of Humble Canal has an approximate elevation of EL. -13 ft NAVD 88. For the construction of the gate foundation, the channel would be excavated to an approximate elevation -19.0 ft with the final constructed sill elevation being El. -10.0.

Directly adjacent to the floodgate slab, both on the land and the flood side of the gate would be excavated to an El. -12.5 (NAVD 88) to place both the bedding stone and the riprap required. The channel bottom would remain at El. -10.0 (NAVD 88) for approximately 50-feet, both upstream and downstream of the newly constructed floodgate slab. The channel would then slope to allow a smooth transition from the sill elevation to existing grade over approximately 100-feet on both the land and flood side of the gate to afford aquatics the ability to migrate past gate sill.

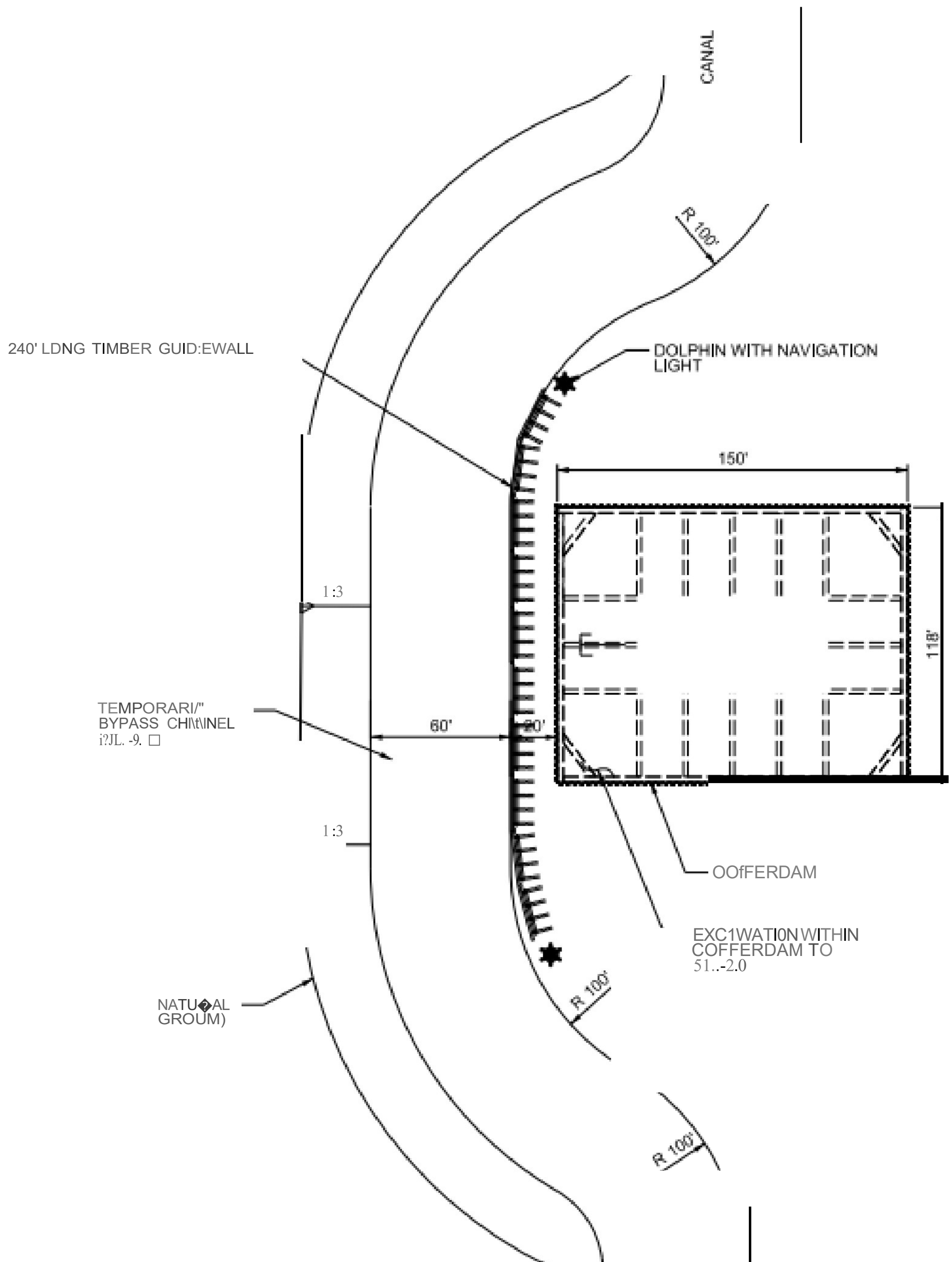
The cross section at the gate location would be designed such that the pre and post project conditions would not impede the natural movement of aquatic organisms. The default operation would be open to avoid additional indirect impacts to vegetation and fish and wildlife due to changes in the natural hydrologic regime. The floodgate would be opened as soon as is safely possible after a closure for storm passage.

The velocities around and through the gate may require the channel bottom to be layered with 2-feet of riprap. After dredging the channel to El. -12.5, bedding would be placed on separator geotextile with the riprap on top of the bedding. A riprap gradation is assumed to be class 250 - 1000 lb stone (LADOTD 2016, Section 711). See Table *3* for example gradation limits for individual stone.

Table 3: Riprap Gradations

Gradation Limits Individual Stone Size (lbs)	Spherical Diameter (ft)	Percent Finer (By Weight)
1250	2.50	100
500	1.83	45-100
250	1.46	15-50
80	1.00	0-15

The sector gate would be constructed approximately in the center of the existing channel. A bypass channel would be constructed immediately adjacent to and to the west side of the sector gate cofferdam footprint prior to beginning construction of the floodgate to allow safe navigational passage of marine traffic, as well as all aquatic organisms to pass safely until the floodgate structure is complete (Figure 10).



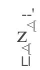


Figure 10: Preliminary bypass channel design

Preliminary designs of the bypass require a minimum bottom channel width of 60-foot temporary bypass channel with an invert of El. -10.0. Based on the preliminary design, the bypass channel would be approximately 650 feet long. However, navigation of common local vessels would be considered for the bypass channels, and design features of a navigable bypass channel would be developed during detailed design. At a minimum, to maintain pre-construction flow conditions, navigation and minimize environmental impacts during construction, the temporary bypass channels would be similarly sized to the channels being impacted. A timber guidewall (like the permanent guide wall shown in Figure 5) would be constructed between the bypass channel and the sector gate footprint to prevent the cofferdam (described below) from vessel impact while the cofferdam is in place.

A total of 13,430 cy of material would be excavated from the channel for gate complex, bypass channel, and floodwall tie-ins construction. If the dredged material is found to be suitable for use within the project levee footprint, the material would be used within the levee or could potentially be utilized for marsh restoration within the overall project footprint, otherwise the material would be hauled off site and disposed in accordance with all state and federal laws.

Once navigation is routed through the temporary bypass channel, a Phase 1 cofferdam (approximately 150 feet x 118 feet) would be constructed to permit working in the dry when constructing the sector gatebay. The cofferdam would be an internally braced cofferdam with wide flange walers and pipe braces supporting PZ sheet piling. Reduced power would be required for vessels passing through the construction area to reduce the risk of impact to the cofferdam. A timber guide wall and pile clusters would be provided along the bypass channel to prevent vessel impact on the cofferdam.

Once construction of the sector gatebay is completed, navigation would be re-routed through the permanent gate structure. Following routing the navigation traffic through the sector gate, the Phase 2 cofferdam, permanent guide walls and pile clusters, tie-in T-walls, and final civil site work can be completed. The Phase 2 cofferdam (approximately 120 feet x 80 feet on west side of the sector gate and approximately 60 feet x 80 feet on east side of the sector gate.) would be constructed to permit the construction of the adjacent T-walls to the gate structure that would be in the water on each side of the sector gate. The same anchor forces, moments, and tips used for the Phase 1 cofferdams would be conservatively used for the Phase 2 cofferdams.

2.17.4 Construction Duration and Equipment

The construction duration of the Humble Canal Floodgate would be 24 months with an assumed work schedule of 5 days a week, 8 hours a day. The floodgate would be constructed using both floating equipment and land support. Below is the preliminary list of equipment anticipated to be utilized for the construction of the floodgate.

Table 4: Preliminary Equipment List for Sector Gate and Floodwall Construction

Project Component	Duration (days)	Equipment Used
Sector Gate Complex & Tie-In Floodwall	730	150-Ton Crane
		80-Ton Crane
		Excavator
		Pile Driver
		Concrete Trucks
		Concrete Vibrators
		Welding Machine, Cutting Torch
Tie-In Levee		Dump Trucks
		Bull Dozers
		Fill Compactor
		Front End Loader/Backhoe
		Fuel Tanks
		Generator

2.17.5 Access and Staging

Construction site access would be obtained by both barge and land. Vehicle access would be via Montegut and the Humble Canal Access Road with access directly to the project site/staging area (Figure 11). The construction staging area would be approximately 0.5 acres along the bank of the Humble Canal Floodgate. The staging area would have a crushed stone on top of a separator fabric. Upon completion of the project, the staging area would be returned to pre-construction condition. The staging area would be used as an operations and materials storage area. The contractor would place the project trailers for both the Government and the contractor within the staging area. The contractor would store the project equipment and project building supplies within the staging area. There would also be floating barges anchored within 500 feet of the project footprint that would be used for staging on this project.

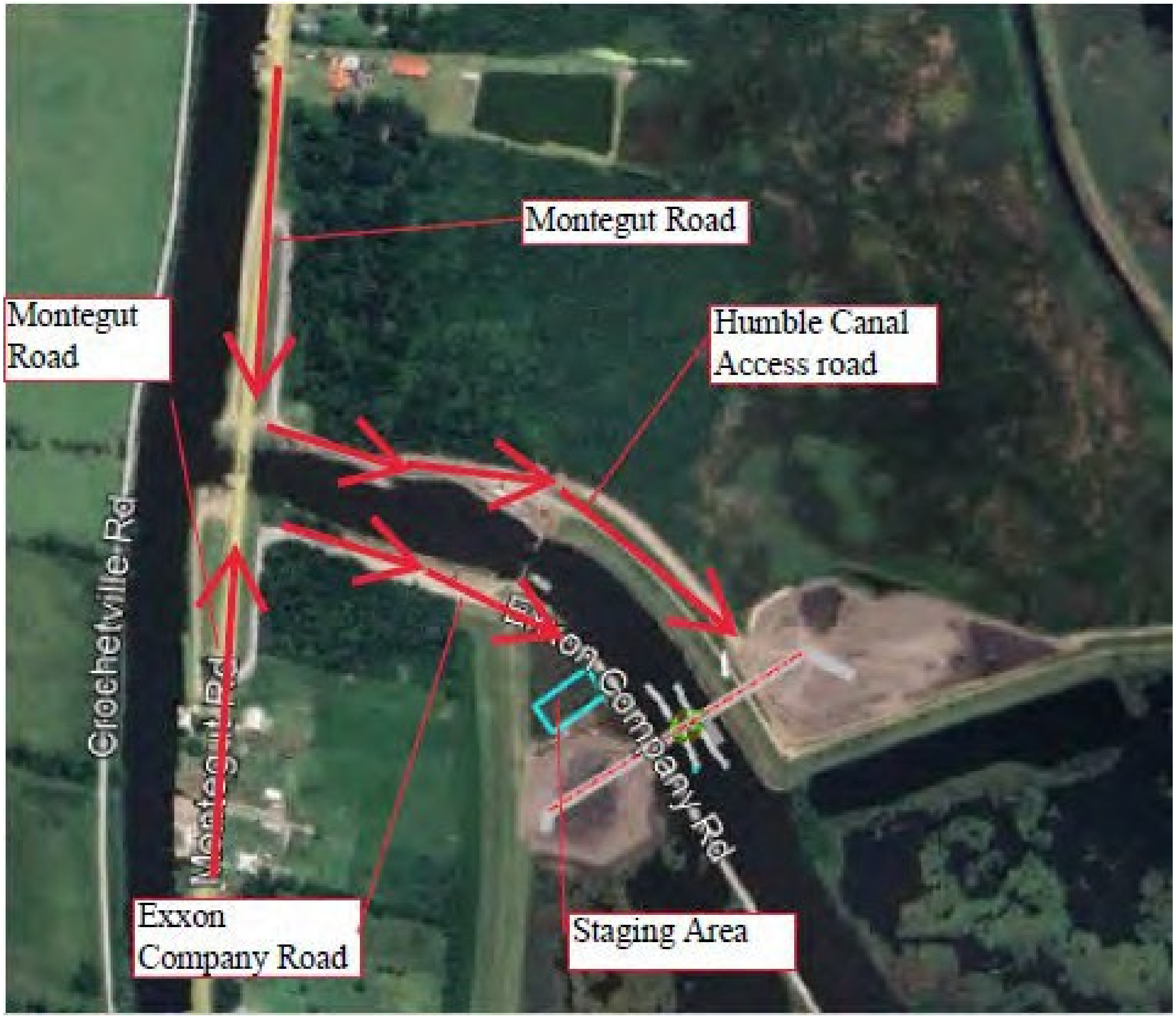


Figure 11. Project Access

2.18 REACH J-3, POINTE AUX CHENES PUMP STATION FRONTING PROTECTION

2.18.1 Location

The Point Aux Chene Pump Station is located west of Houma in Terrebonne Parish, within the Reach J-2 of the larger MTG system at approximately latitude 29°25'28.98"N, longitude -90°27'15.38"W.

Figure 1: Location Map

2.18.2 Scope of Work

The proposed work consists of construction of a floodwall in front of an existing operating pump station. The floodwall would be constructed to fit between the existing pump station and the discharge basin (area where the pumps discharge the rainwater). In addition to the floodwall, the proposed action includes installing a valve within each of the existing pump station discharge pipes that could be closed to prevent storm surge from backflowing to the land side of the system through the discharge pipe. Finally, the transition between levee and floodwall would be protected with concrete or grouted riprap to prevent scour at this transition.

2.18.3 Structure Description

The existing levee at the Pointe Aux Chenes Pump Station does not have sufficient design elevation to provide protection from a 100-year storm surge event. The existing

Pointe Aux Chenes Pump Station consists of two 20" diameter vertical pumps. A floodwall would be constructed in front of the existing station and the 20" diameter pipes would be extended through the newly constructed T-walls with a top elevation of 23.5 ft NAVD88 (Figure 2). A butterfly valve would be placed within each discharge pipe that would always remain open except when a name storm enters the Gulf. The butterfly valve would be able to be remotely operated from the pump station control panel as well locally at the butterfly valve itself. The pipe discharge bell would be relocated to the floodside of the system and discharge onto a portion of the t-wall slab and new riprap that would be placed as part of this contract.

The approximate length of the inverted T-type floodwall would be 1280 total linear feet. The T-wall would be constructed on pile foundations with concrete base slabs and stems to the 2085 elevation +23.5 ft (NAVD 88) (Figure 2). It is anticipated that this floodwall would be constructed at grade minimizing the requirement for any significant excavation.

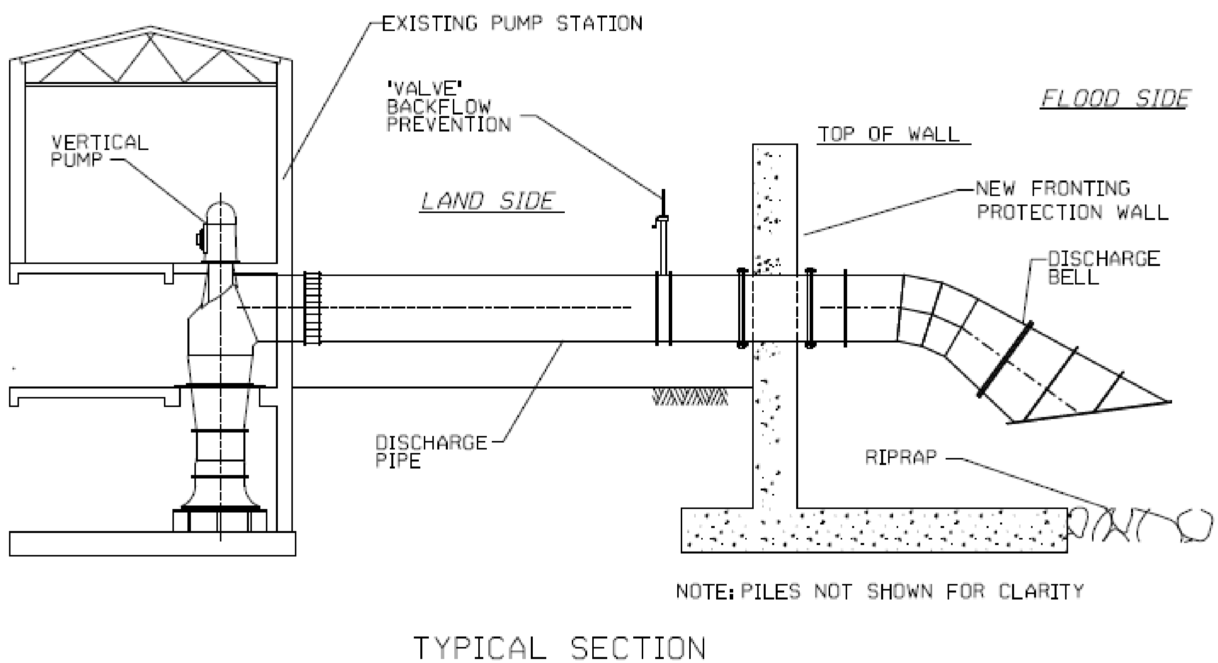
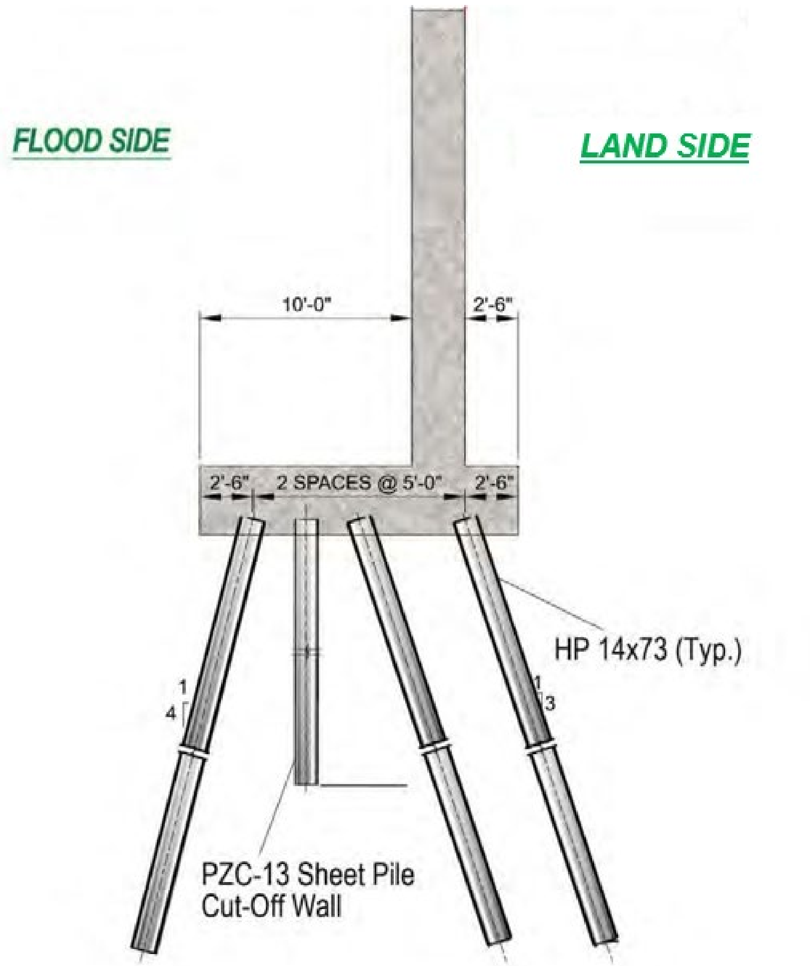


Figure 2: Typical Section of Fronting Protection Wall @ Pump Station

The T-wall monolith heights would vary with the tallest walls located in front of the pump station and the shortest walls tying into the adjacent levee. The T-wall stems would vary from greatest near the pumping station to the shortest at the levee tie-in. Figure 3 provides a sketch of the typical floodwall that would be used for this project.



Nine-inch concrete scour protection or grouted riprap would be used at the levee/ T-wall transition. The concrete scour protection will protect the levee where the T-wall stem extends into the full levee section and extend down both levee slopes. The scour protection would continue for 30 linear feet past the end of the T-wall. Uncapped cut-off sheet piling would extend horizontally 30 feet into the full levee section for erosion and seepage control. Reference Figure 4 as an example of the proposed scour protection.

Figure 4: Concrete Scour Protection Example

With the pipe discharge bell being relocated to the floodside of the system and discharging onto a portion of the t-wall slab, riprap would be required to dissipate the energy from the pumping of the rainwater out of the system, extending a distance to be determined during detailed design. A riprap gradation is assumed to be class 250 - 1000 lb stone (LADOTD 2016, Section 711). See Table 1 for example gradation limits for individual stone.

Table 1: Riprap Gradations

Gradation Limits Individual Stone Size (lbs)	Spherical Diameter (ft)	Percent Finer (By Weight)
1250	2.50	100
500	1.83	45-100
250	1.46	15-50
80	1.00	0-15

The floodwall would be constructed at grade minimizing the requirement for any significant excavation. There would be approximately 10,176 CY of excavated material resulting from the construction of the floodwall. The excavated material from constructing the floodwalls may be used within the levee footprint or if determined suitable could be used for marsh mitigation. If deemed unsuitable, the material would be hauled off site and disposed in accordance with applicable state and federal laws.

2.18.4 Construction Duration and Equipment

The construction duration of the Point Aux Chenes Fronting Protection would be 24 months with an assumed work schedule of 5 days a week, 8 hours a day. The floodwalls in front pump station would be constructed using both floating equipment and land support. Below is the preliminary list of equipment anticipated to be utilized for the construction of the Bayou Black Fronting Protection.

Table 2: Preliminary Equipment List for Sector Gate and Floodwall Construction

Project Component	Duration (days)	Equipment Used
Fronting Protection & Tie-In Floodwall	730	150-Ton Crane
		80-Ton Crane
		Excavator
		Pile Driver
		Concrete Trucks
		Concrete Vibrators
		Welding Machine, Cutting Torch
Tie-In Levee		Dump Trucks
		Bull Dozers
		Fill Compactor
		Front End Loaded/Backhoe
		Fuel Tanks
		Generator

2.18.5 Access and Staging

In general, construction site access would be obtained by land. Vehicle access would be via LA Highway 665 to Private Access Road down to the project site. The construction staging area would be within the area shown in Figure 5 within a cleared lot. It is assumed the staging area would be 0.25 acres. The staging area would have a crushed stone on top of a separator fabric. Upon completion of the project, the staging area would be returned to pre-construction condition. The staging area would be used as an operations and materials storage area. The contractor would be allowed to place project trailers for both the Government and the contractor. The contractor would store the project equipment and project building supplies within the staging area.

Figure 5: Access and Staging

2.19 REACH K, POINTE AUX CHENES BARGE FLOODGATE

2.19.1 Location

The Pointe Aux Chenes Barge Floodgate gate is located on Bayou Pointe Aux Chenes within Terrebonne Parish and is located at latitude 29°25'04.8163" N, longitude - 90°26'53.2014" W.

Figure 1: Location

2.19.2 Scope of Work

This contract would consist of a barge floodgate, floodwalls flanking each side of the floodgate, a swing gate for the roadway opening, floodwalls that tie into the M2G levee system, and timber guidewalls with protection pile clusters on both the inflow and the outflow of the gate bay. Finally, the transition between levee and floodwall would be protected with concrete or grouted riprap to prevent scour at this transition.

2.19.3 Structure Description

This floodgate would be a 56 ft wide barge type floodgate with a top elevation of +23.5 feet (NAVD88), and a slab invert elevation of -6.0 feet (NAVD88) and would replace the existing gate structure. The new floodgate would provide an opening in the system to allow unimpeded navigation, except when a tropical system approaches the Gulf of America in which case the barge gate would be closed.

A barge gate is constructed of a braced steel frame with sheet metal or solid plate exterior in a hollow box configuration that resembles a hopper barge (see Figure 2). The gate normally contains several individual compartments that are watertight. The gate would have a pivot arm at one end that allows the gate to articulate in a 90° arc to open and close. The pivot arm would be mounted onto a fixed pivot pile that would allow the gate and pivot arm free travel in the vertical direction (for flotation). When the gate is in either the open or closed position, pumps fill the compartments with water until the buoyancy is overcome and the structure settles onto a receiving structure. While in the open position, the gate would also function as a guide wall to aid the vessels in navigating through the structure. In the closed position, the gate is ballasted down to an underwater foundation with gravity loads transferred through the base seal and the base support (see Figures 3 & 4). The flat top of the gate allows passage of either pedestrian or motorized ATV traffic. Lateral loads from high tides or storm surge on the barge gate are transferred into two concrete abutment reaction walls on either end of the gate structure.

Figure 2 – Typical Barge Gate Example

Figure 3: Conceptual Barge Gate - Elevation View with Gate in Open Position

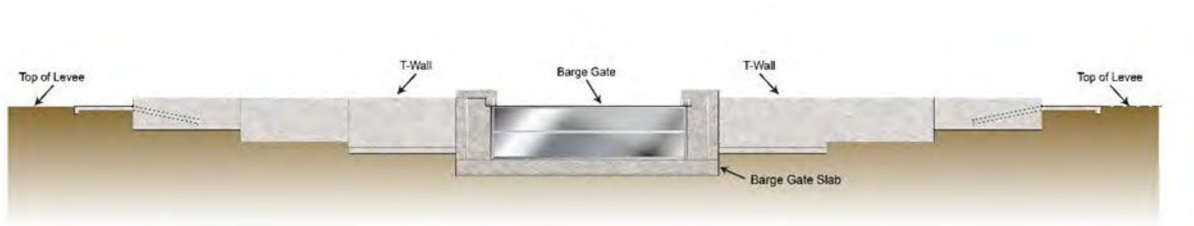


Figure 4: Conceptual Barge Gate - Elevation View with Gate in Closed Position

The floodgate would have timber guide walls and pile dolphin structures on both the land and flood side. The 7-pile dolphin structures are constructed at the end of the guide wall to protect the guide walls from impact from vessels. The guide walls would be timber support frames currently spaced every 6 feet. Each timber support frame is constructed with a vertical pile braced by a batter pile driven at an angle from vertical. The outer end of each guide wall is anchored with a 7-pile dolphin structure. The dolphins would consist of 7 timber piles battered away from each other encircling a center pile and tied together with a wire rope at the top of the dolphin. Please see figure 5, 6 and 7 for more details.

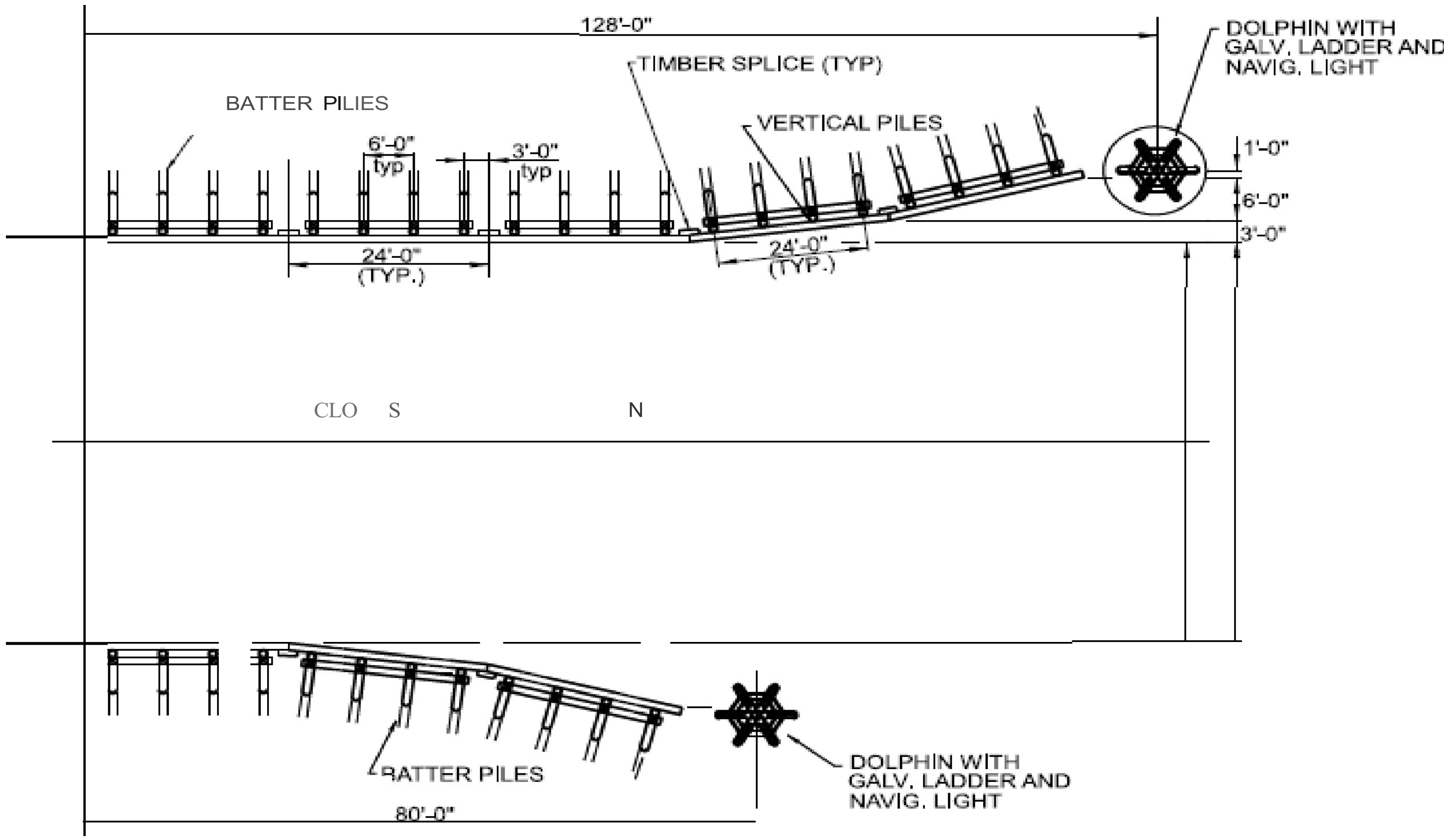


Figure 5: Plan – Guide walls, Fenders, and Dolphins

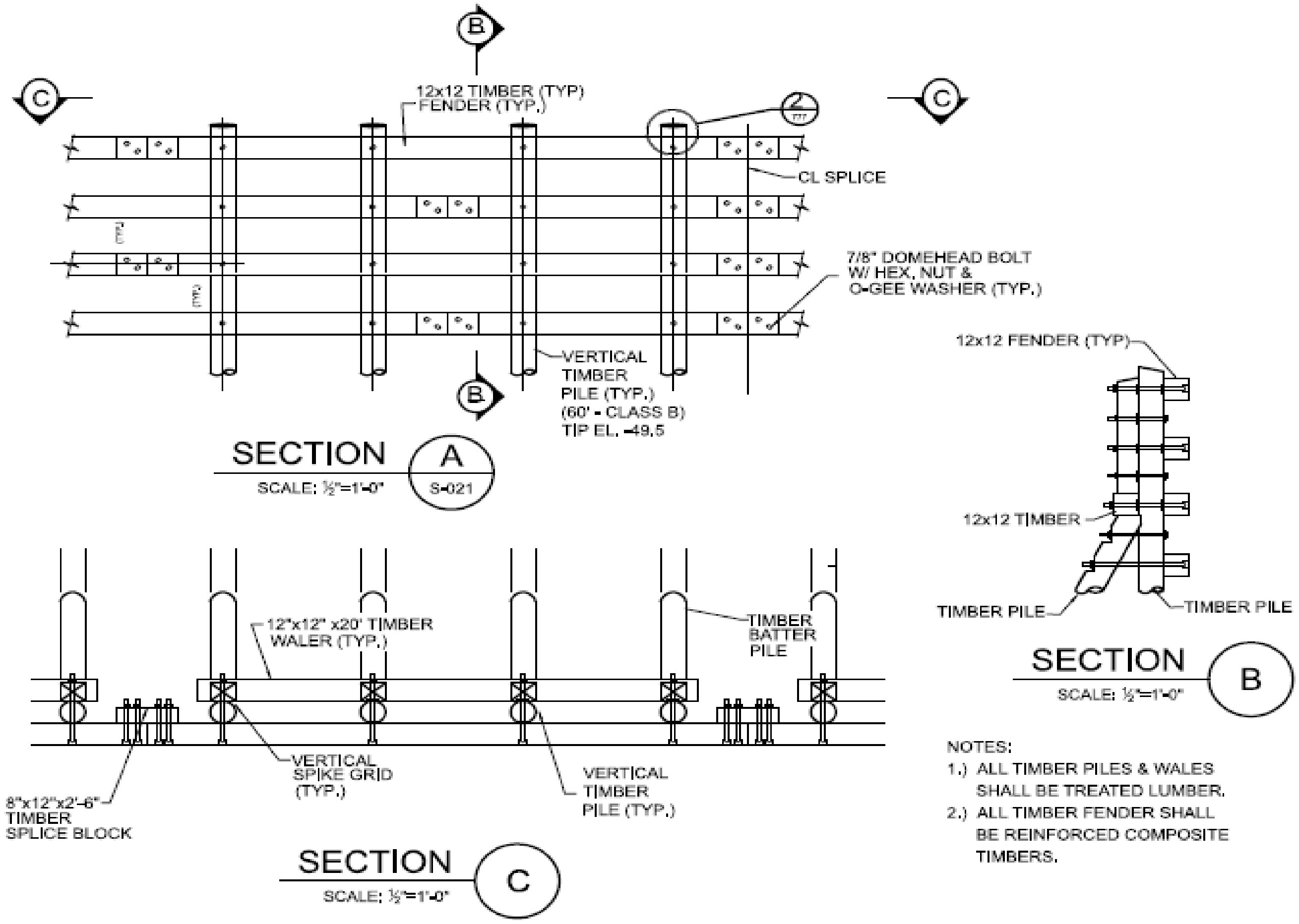


Figure 6: Guide wall Details

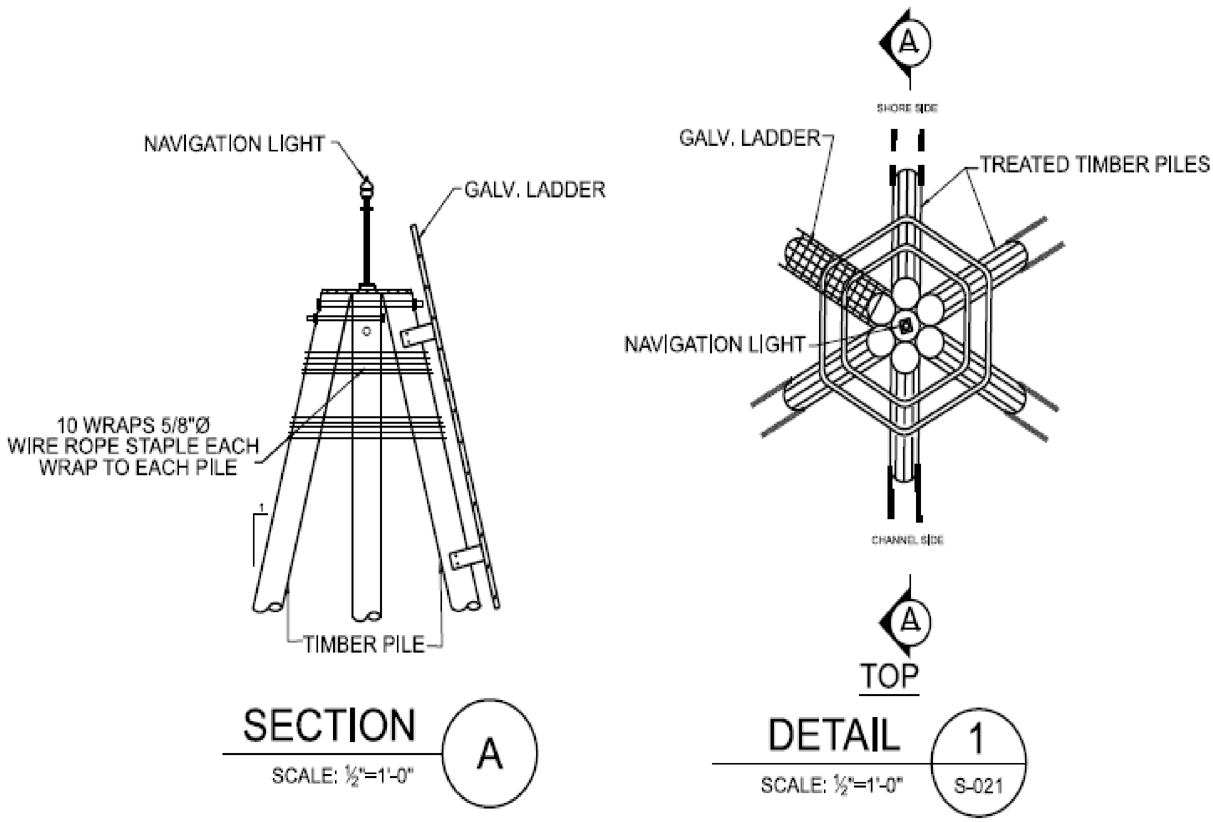


Figure 7: Dolphin Details

Approximately 935 total linear feet (545 linear feet on the north side of the floodgate and 390 linear feet on the north side of the floodgate) of floodwalls, specifically T-walls, would extend from the sluice gates and tie into the adjacent levees. The floodwalls would have a top elevation of 23.5-foot NAVD88.

The T-wall monoliths vary with the tallest walls adjacent to the barge gate and the shortest walls that tie into the adjacent levee. Details on a typical section of floodwall is provided in Figure 8.

The design of the new barge gate, roadway gate and floodwalls, including the foundation, is subject to change once detailed geotechnical investigations are conducted during detailed design.

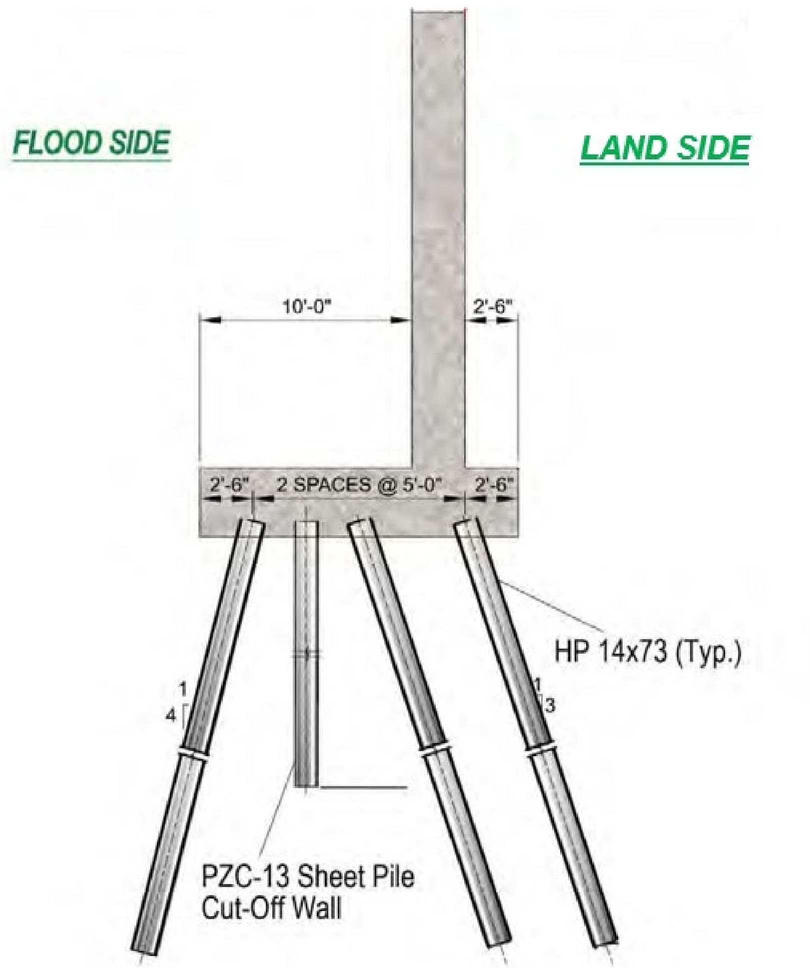


Figure 8: Typical Floodwall

Nine-inch-thick concrete scour protection or grouted riprap would be used at the levee-floodwall transition (tie-in). The concrete scour protection or grouted riprap protects the levee where the floodwall stem extends into the full levee section and extends down both levee slopes. The scour protection would continue for 30 linear feet past the end of the floodwall. Uncapped, cut-off sheet piling would extend horizontally 30 feet into the full levee section for erosion and seepage control. Please see Figure 9 below for an example of the proposed scour protection.

*Figure 9: Illustration of Scour Protection at Levee-Floodwall Tie-in***.**

Where the western floodwall tie-in crosses Highway 655, a 36 ft wide swing gate would be constructed to provide an opening in the system to allow unimpeded traffic flow, except when a tropical system approaches the Gulf of America in which the gate would be closed (Figure 10 and 11).

A swing gate is a structure that is composed of two or more horizontal girders, vertical intercostals, vertical end diaphragms, a skin plate, and diagonal braces. In most cases, swing gate closures consist of a single gate leaf for openings up to 40-feet. Swing gates are mounted on hinges and open and closed like a door. The swing gate would provide an opening in the system to allow unimpeded traffic flow, except when a tropical system approaches the Gulf of America and the gate would be closed (Figure 5 and Figure 6).

Figure 10: Swing Gate Closure Structure

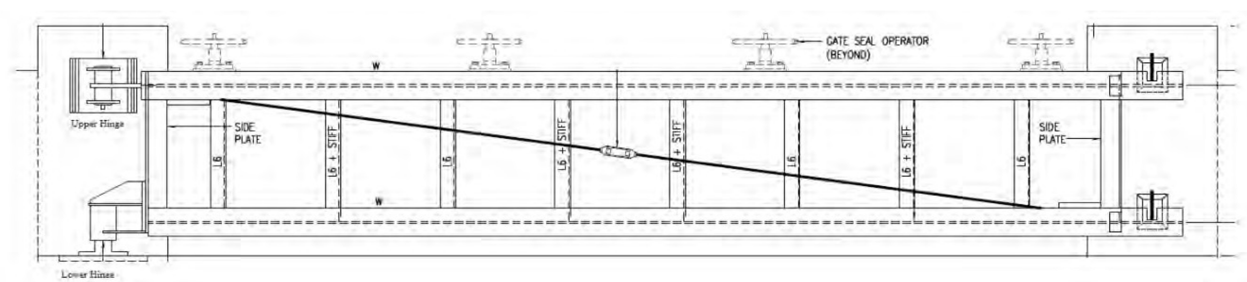


Figure 11: Typical Swing Gate Closure Structure

The barge gate would be constructed on the flood side of the existing floodgate. The existing centerline of Bayou Pointe Aux Chenes has an approximate elevation of -6.0 feet (NAVD 88). For the construction of the gate foundation, the channel would be excavated to an approximate elevation of -14.5 feet with the final constructed sill elevation being -6.0 feet. Directly adjacent to the floodgate slab, both on the land and the flood side of the gate, would be excavated to EL. -8.5 feet (NAVD 88) to place both the bedding stone and the riprap required. The channel bottom would remain at

EL. -6.0 feet (NAVD 88) for approximately 50 feet, both upstream and downstream of the newly constructed floodgate slab. The channel would then slope up to allow a smooth transition from the sill elevation to an approximate EL. -5.0 feet over approximately 100-feet on both the land and flood side of the gate to afford aquatics the ability to migrate past gate sill.

The cross section at the gate location would be designed such that the pre and post project conditions would not impede the natural movement of aquatic organisms. The default operation would be open to avoid additional indirect impacts to vegetation and fish and wildlife due to changes in the natural hydrologic regime. The floodgate would be opened as soon as is safely possible after a closure for storm passage.

The velocities around and through the gate may require the channel bottom to be layered with 2-feet of riprap. The riprap is required in the channel, extending approximately 100 linear feet on both the land side and the flood side. After dredging the channel to El. -8.5, bedding would be placed on separator geotextile with the riprap on top of the bedding. A riprap gradation is assumed to be class 250 - 1000 lb stone (LADOTD 2016, Section 711). See Table 1 for example gradation limits for individual stone.

Table 1: Riprap Gradations

Gradation Limits Individual Stone Size (lbs)	Spherical Diameter (ft)	Percent Finer (By Weight)
1250	2.50	100
500	1.83	45-100
250	1.46	15-50
80	1.00	0-15

The barge gate would be constructed approximately in the center of the existing channel. The by-pass channel would be constructed immediately adjacent to and to the east of the barge gate footprint prior to beginning construction of the floodgate to allow safe navigational passage of marine traffic, as well as all aquatic organisms to pass safely until the floodgate structure is complete (Figure 12).

Preliminary designs of the bypass require a minimum bottom channel width of 60-foot for the temporary bypass channel with an invert of EL. -6.0 ft. Based on the preliminary design, the by-pass channel would be approximately 650 feet long. However, navigation of common local vessels would be considered for the bypass channels, and design features of a navigable bypass channel would be developed during detailed design. At a minimum, to maintain pre-construction flow conditions, navigation and minimize environmental impacts during construction, the temporary bypass channels would be similarly sized to the channels being impacted. A timber guide wall (similar to the permanent guide wall) would be constructed to prevent the cofferdam from vessel impact while the cofferdam is in place.

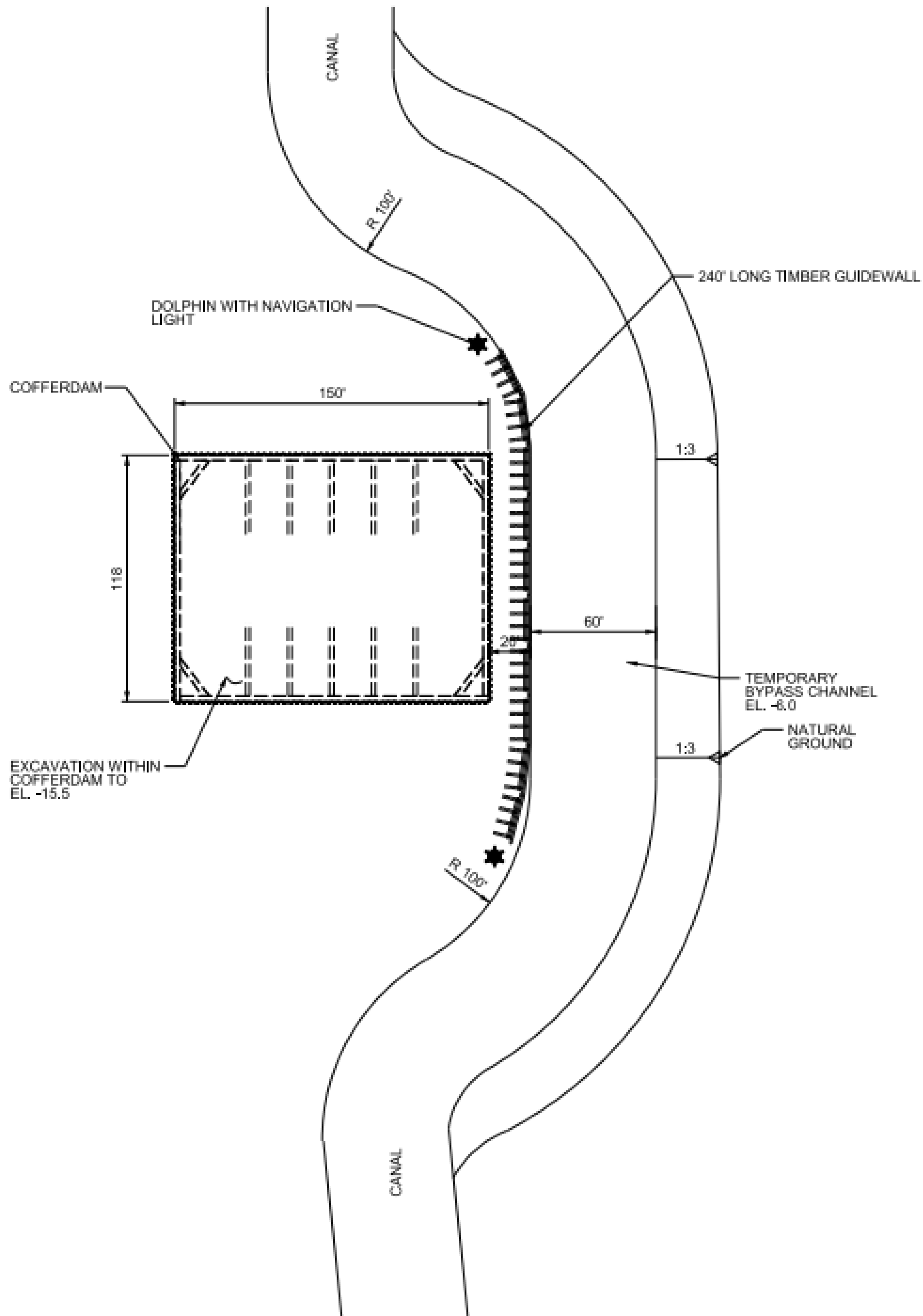


Figure 12: Preliminary bypass channel design

A total of 21,051 cy of material would be excavated from the channel for gate complex, bypass channel, and floodwall tie-in construction. If the dredged material is found to be suitable for use within the project levee footprint, the material would be used within the levee or could potentially be utilized for marsh restoration within the overall project footprint, otherwise the material would be hauled off site and disposed in accordance with all state and federal laws.

Once navigation is routed through the temporary bypass channel, a Phase 1 cofferdam (approximately 150 feet x 118 feet) would be constructed to permit in-the-dry construction of the barge gate concrete landing slab, pivot arm assembly, receiving structure concrete monoliths, and the sluice gate concrete monoliths. The cofferdam would be an internally braced cofferdam with wide flange wales and pipe braces supporting PZ sheet piling. Reduced power would be required for vessels passing through the construction area to reduce the risk of impact to the cofferdam.

Once construction of the barge gate landing slab, pivot arm assembly, receiving structure monoliths, and sluice gate monoliths are completed, navigation would be re-routed through the permanent barge gate structure. After construction, the bypass channel is assumed to be included in the footprint of the structure site and the channel flow would be rerouted through the new structure feature. Once navigation is re-routed through the new floodgate, the Phase 2 cofferdam would be constructed and permanent guidewalls and pile clusters, tie-in T-walls, and final civil site work can be completed.

The Phase 2 cofferdam (approximately 120 feet x 80 feet on the east side of the floodgate) would be constructed to permit the construction of the T-walls adjacent to the gate structures that would be in the water.

2.19.4 Construction Duration and Equipment

The construction duration of the Pointe Aux Chenes Floodgate would be 24 months with an assumed work schedule of 5 days a week, 8 hours a day. The barge floodgate would be constructed using both floating equipment and land support. Below is the preliminary list of equipment anticipated to be utilized for the construction of the floodgate.

Table 2: Preliminary Equipment List for Sector Gate and Floodwall Construction

Project Component	Duration (days)	Equipment Used
Barge Gate Complex, Roadway Gate & Tie-In Floodwall	730	150-Ton Crane
		80-Ton Crane
		Excavator
		Pile Driver
		Concrete Trucks
		Concrete Vibrators
		Welding Machine, Cutting Torch
Tie-In Levee		Dump Trucks
		Bull Dozers

		Fill Compactor
		Front End Loader/Backhoe
		Fuel Tanks
		Generator

2.19.5 Access and Staging

In general, construction site access would be obtained by both barge and land. Vehicle access would be via Little Caillou Road south from Chauvin. Please see Figure 13 below for a map of the proposed access routes to the project site. The construction staging area would be within the area shown in Figure 14 within the existing berm of the levee. It is assumed the staging area would be approximately 75 feet by 125 feet. The staging area would have a crushed stone on top of a separator fabric. Upon completion of the project, the staging area would be returned to pre-construction condition. The staging area would be used as an operations and materials storage area. The contractor would place the project trailers for both the Government and the contractor within the staging area. The contractor would store the project equipment and project building supplies within the staging area.

Figure 13: Project site access

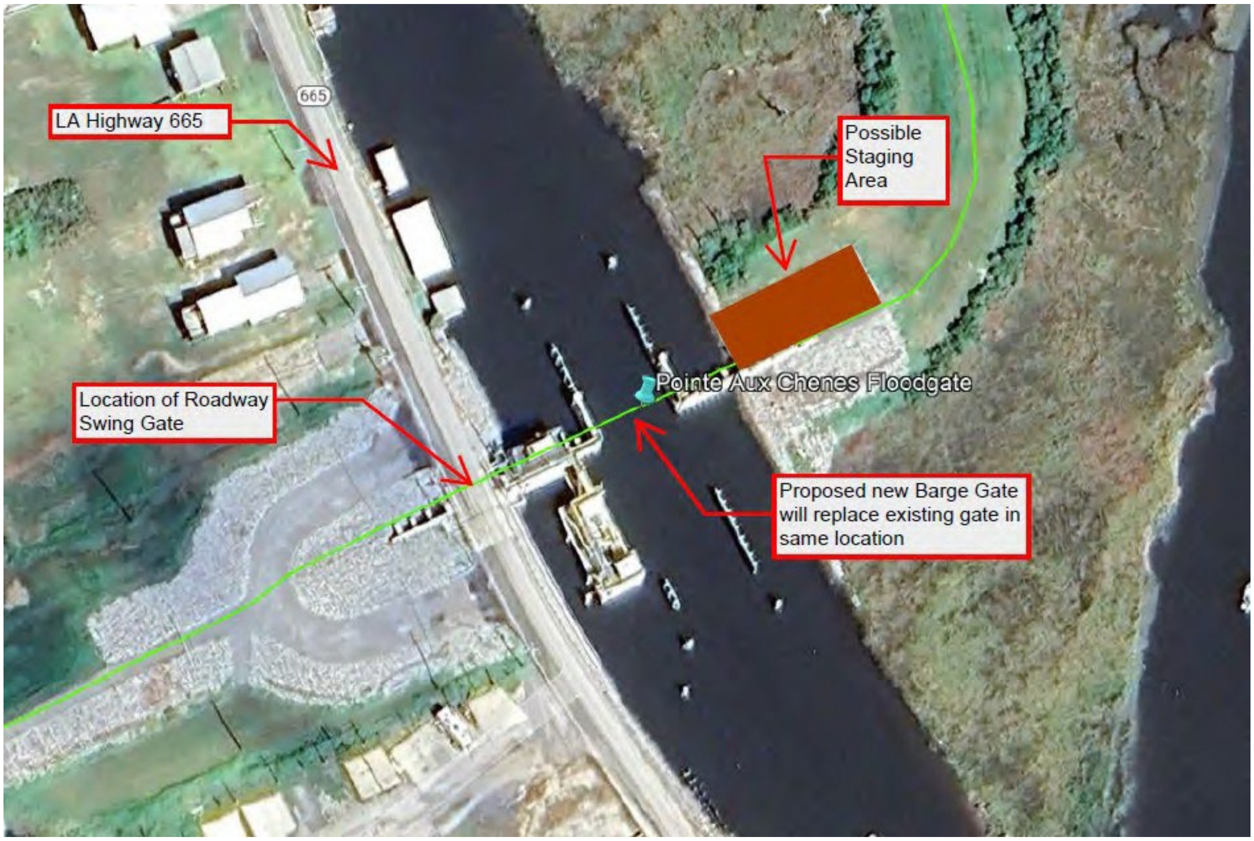


Figure 14: Proposed locations of new floodgate and construction staging area

2.20 REACH K, GRAND BAYOU FLOODGATE & SLUICE GATE

2.20.1 Location

The Grand Bayou Floodgate would be located in Grand Bayou within Terrebonne Parish (latitude 29°30'11.17"N, longitude -90°25'9.09"W), just south of the existing Grand Bayou gate system.

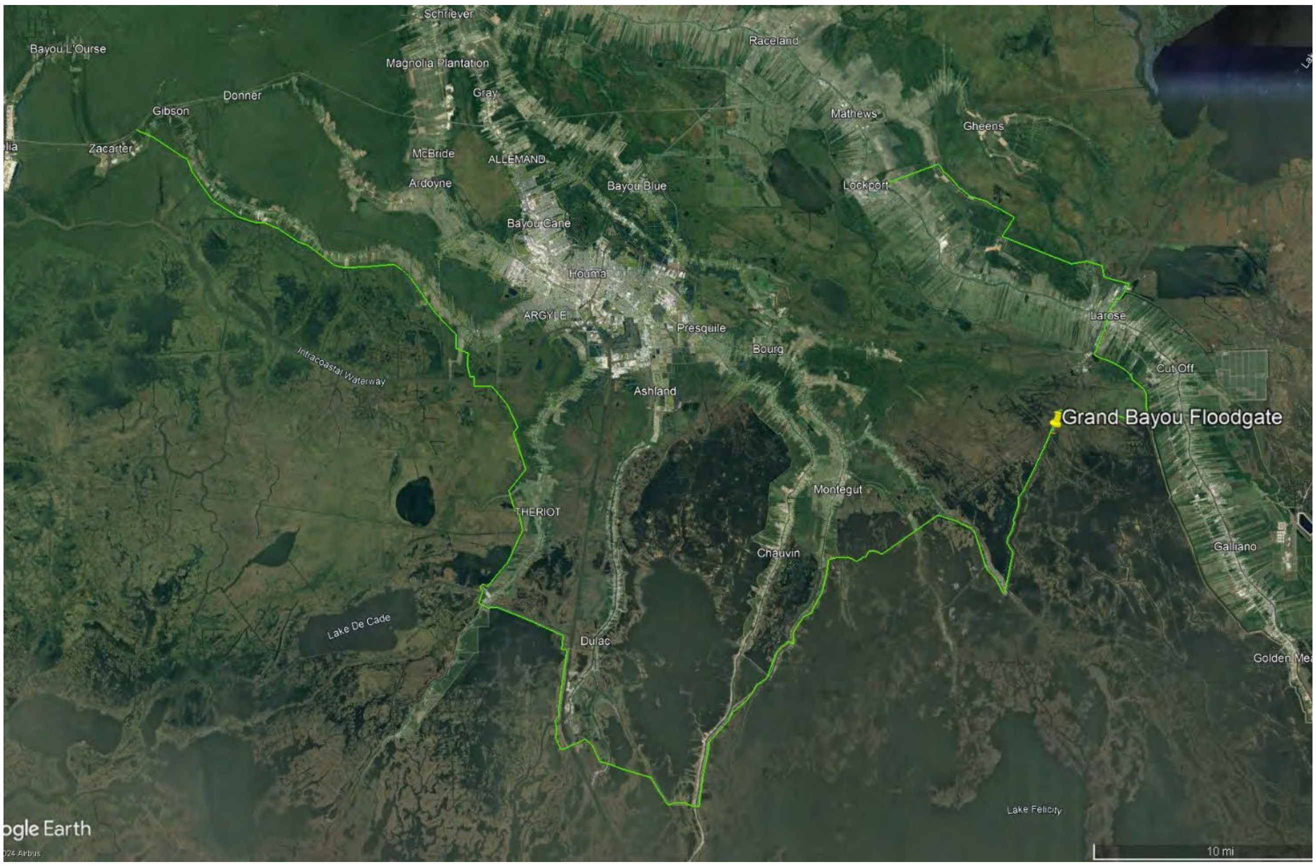


Figure 1: Location Map

2.20.2 Scope of Work

This contract would consist of construction of a 56 ft wide barge floodgate within Grand Bayou with floodwall tie-ins flanking each side of the floodgate. In addition to the floodgate, this contract includes 3 sluice gate monoliths with each monolith housing 3 – 16 feet by 16 feet sluice gates within each gate monolith that would remain open unless there is a storm event. On both the inflow and the outflow of the gate bay, there would be timber guide walls and protection pile clusters. Finally, the transition between the floodwall tie-ins and Reach L levee would be protected with concrete or grouted riprap to prevent scour at this transition.

2.20.3 Structure Description

This floodgate would be a 56 ft wide barge floodgate (Figure 2) with a top elevation of +24.5 ft NAVD88, and a slab invert elevation of -9.0 ft NAVD88. The floodgate would provide an opening in the system to allow unimpeded navigation, except when a tropical system approaches the Gulf of America in which the gate would be closed.

A barge gate is constructed of a braced steel frame with sheet metal or solid plate exterior in a hollow box configuration that resembles a hopper barge (see Figure 2). The gate normally contains several individual compartments that are watertight. The gate would have a pivot arm at one end that allows the gate to articulate in a 90° arc to open and close. The pivot arm would be mounted onto a fixed pivot pile that would allow the gate and pivot arm free travel in the vertical direction (for flotation). When the gate is in either the open or closed position, pumps fill the compartments with water until the buoyancy is overcome and the structure settles onto a receiving structure. While in the open position, the gate would also function as a guide wall to aid the vessels in navigating through the structure. In the closed position, the gate is ballasted down to an underwater foundation with gravity loads transferred through the base seal and the base support (see Figures 3 & 4). The flat top of the gate allows passage of either pedestrian or motorized ATV traffic. Lateral loads from high tides or storm surge on the barge gate are transferred into two concrete abutment reaction walls on either end of the gate structure.

Figure 2: Typical Barge Gate Example

Figure 3: Conceptual Barge Gate - Elevation View with Gate in Open Position

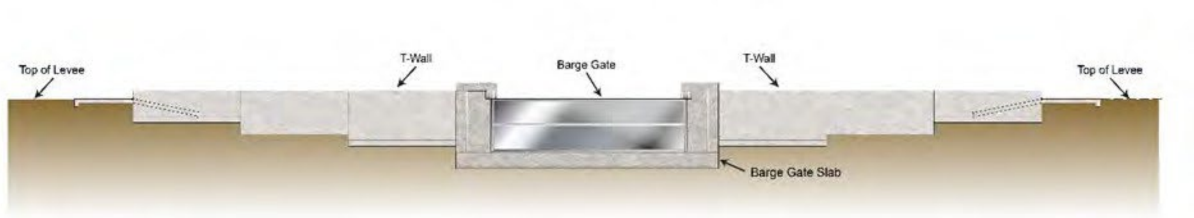


Figure 4: Conceptual Barge Gate - Elevation View with Gate in Closed Position

Adjacent to the barge gate, there would also be 3 separate sluice gate monoliths at this project location. Each sluice gate structure would contain 3 sluice gates, each 16’ wide by 16’ tall with an invert elevation of elevation -9.0 ft. There would be one monolith on

the west side of the gate, and two monoliths on the east side of the gate, for a total of 3 monoliths and nine sluice gates within the gate complex.

A sluice gate is a structure that contains a movable gate or series of movable gates that, when lifted, allow material and water to flow under it. The sluice gate would provide an opening in the system to allow unimpeded tidal flow, except when a tropical system approaches the Gulf of America in which the gates would be closed. Sluice gates are not navigable as they do not raise high enough, or they have fixed components that do not allow vessels to pass through. See Figure 5 and Figure 6 for a typical conceptual plan view and cross section of a sluice gate system.

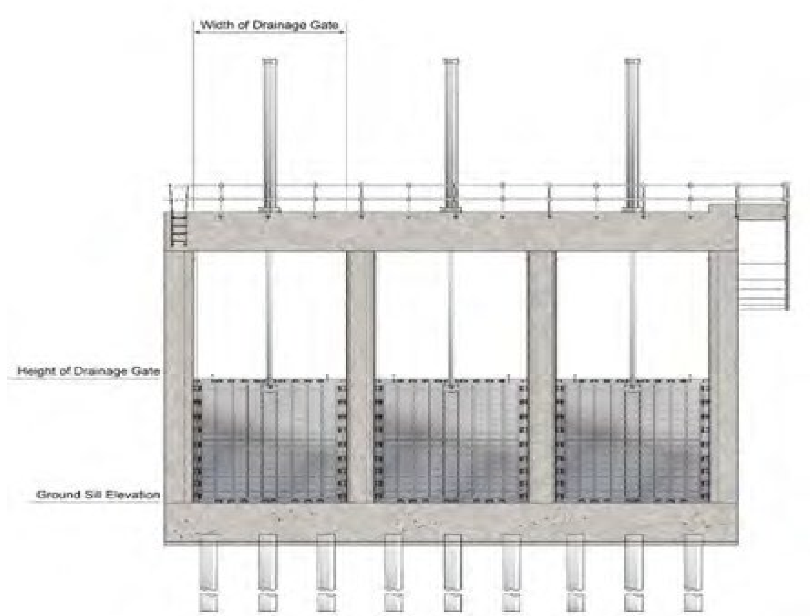


Figure 5: Conceptual Barge Gate - Elevation View with Gate in Closed Position

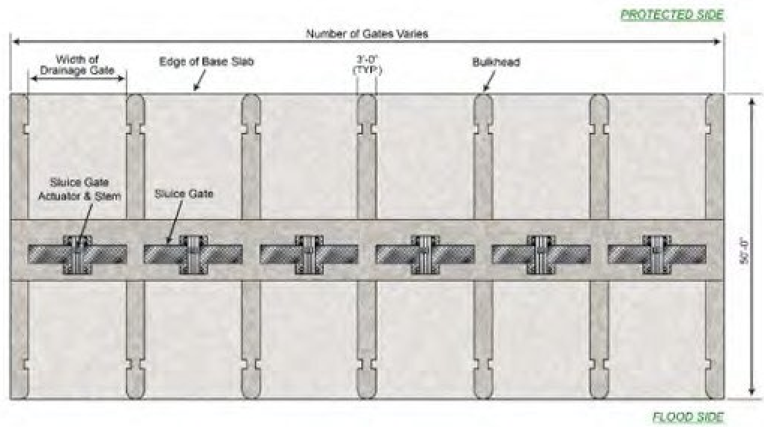


Figure 6: Typical Sluice Gate Control Structure (6 gates) - Plan View

Timber guide walls and pile clusters would be provided as aids to navigation and to protect the main flood gate structure from impact. The seven pile dolphin structures are constructed at the end of the guide wall to protect the guide walls from impact from vessels. The guide walls would be timber support frames currently spaced every 6 feet. Each timber support frame is constructed with a vertical pile braced by a batter pile driven at an angle from vertical. The outer end of each guide wall is anchored with a seven-pile dolphin structure. The dolphins would consist of 7 timber piles battered away from each other and tied together with a wire rope at the top of the dolphin. Please see figure 7, 8 and 9 for more details.

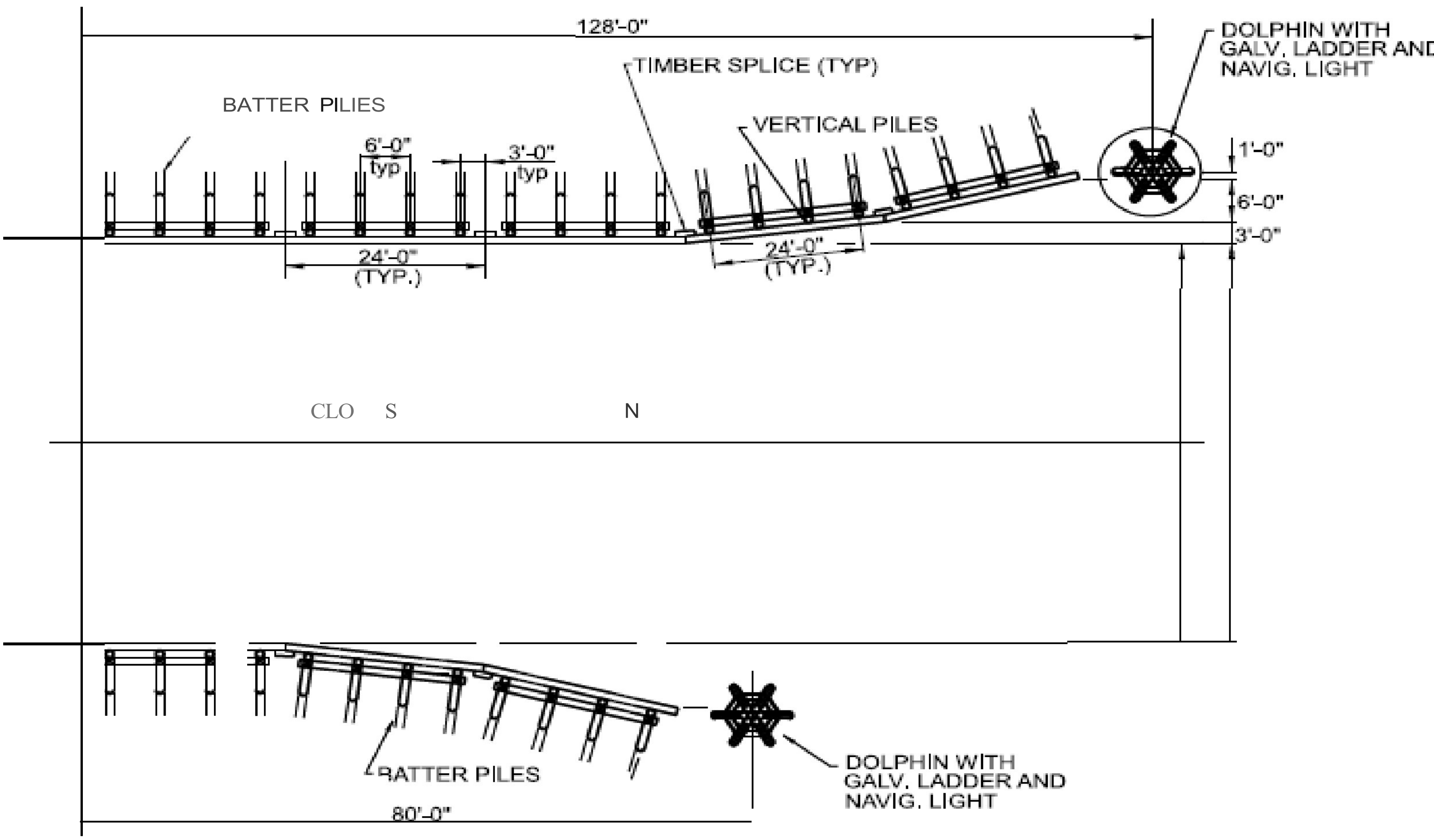


Figure 7: Plan – Guide walls, Fenders, and Dolphins

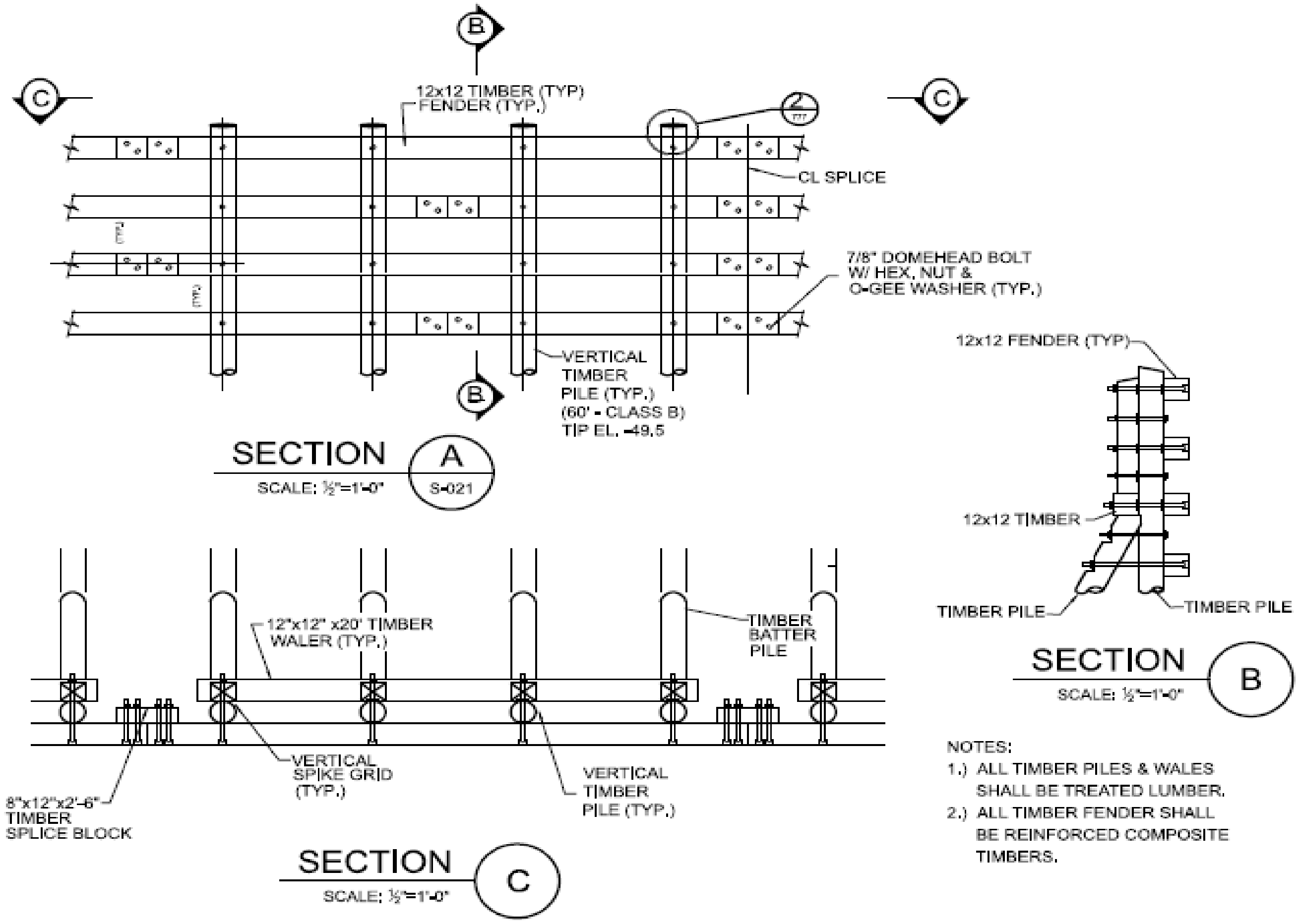


Figure 8: Guide wall Details

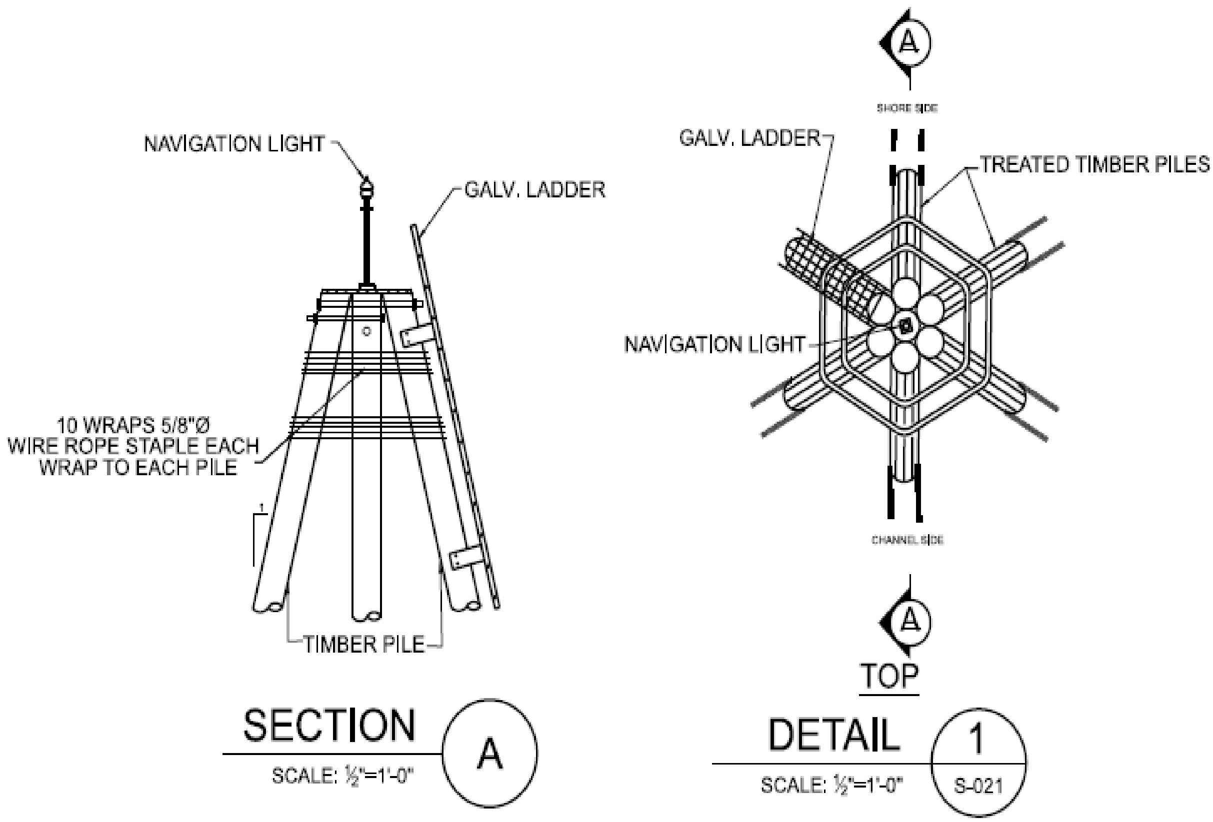


Figure 9: Dolphin Details

Approximately 990 total linear feet (495 linear feet on the west side of the floodgate and 495 linear feet on the east side of the floodgate) of floodwalls, specifically T-walls, would extend from the gate complex and tie into the adjacent levees. The floodwalls would have a top elevation of 24.5 ft NAVD88.

The height of the floodwall tie-ins would vary with the tallest walls adjacent to the barge gate and the shortest walls that tie into the adjacent levee. Details on a typical section of floodwall are provided in Figure 10.

The design of the new barge gate, floodwalls and sluice gate structures including the foundation is subject to change once detailed geotechnical investigations are conducted during detailed design.

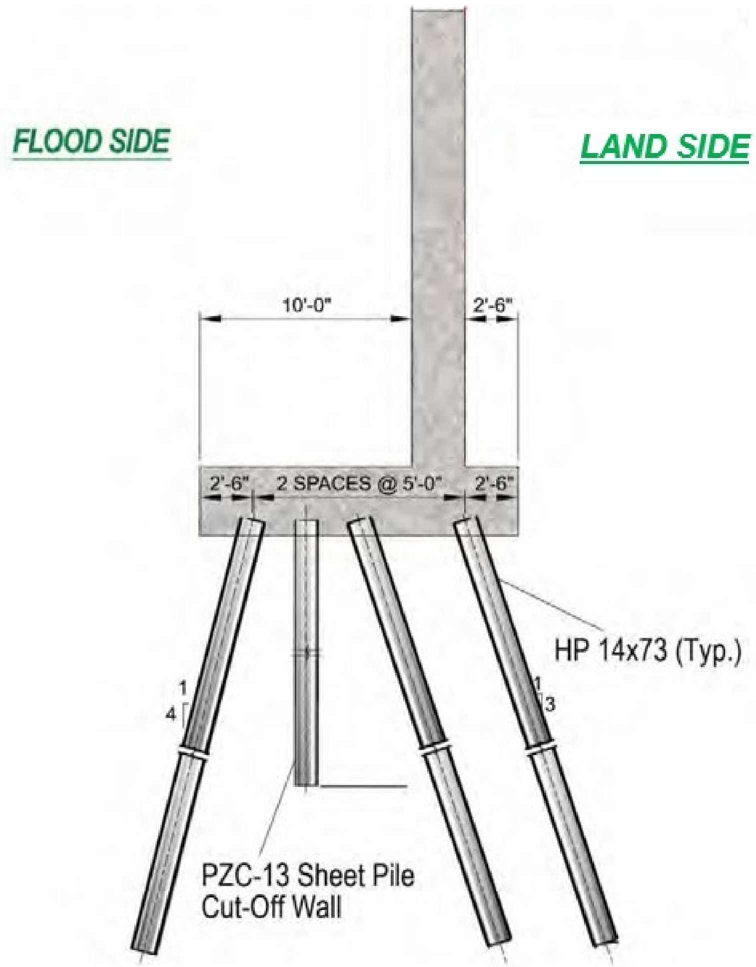


Figure 10: Typical Floodwall

Nine-inch concrete scour protection or grouted riprap would be used at the levee/T-wall transition. The concrete scour protection is located where the T-wall stem extends into the full levee section and extend down both levee slopes. The scour protection would continue for 30 linear feet past the end of the T-wall. Uncapped cut-off sheet piling would extend horizontally 30 feet into the full levee section for erosion and seepage control. See the sketch below for wall layout and cross-section. Please see Figure 11 below for an example of the proposed scour protection.

Figure 11: Concrete Scour Protection Example

The barge gate would be constructed on the flood side of the existing floodgate. The existing centerline of Grand Bayou has an approximate elevation of -7.0 ft. For the construction of the gate complex foundation, the channel would be excavated to an approximate elevation -17 ft NAVD88 with the final constructed sill elevation being El. -

9.0 ft. Directly adjacent to the floodgate slab, both on the land and the flood side of the gate would be excavated to an El. -11.5 ft NAVD 88 to place both the bedding stone and the riprap required. The channel bottom would remain at elevation -9.0 ft for approximately 50 ft, both upstream and downstream of the newly constructed floodgate slab. The channel would then slope to allow a smooth transition from the sill elevation to existing grade over approximately 100-feet on both the land and flood side of the gate to afford aquatics the ability to migrate past gate sill.

The cross section at the gate location would be designed such that the pre and post project conditions would not impede the natural movement of aquatic organisms. The default operation would be open to avoid additional indirect impacts to vegetation and fish and wildlife due to changes in the natural hydrologic regime. The floodgate would be opened as soon as is safely possible after a closure for storm passage.

The velocities around and through the gate may require the channel bottom to be layered with 2-feet of riprap. After dredging the channel to El. -11.5, bedding would be placed on separator geotextile with the riprap on top of the bedding. A riprap gradation is assumed to be class 250 - 1000 lb stone (LADOTD 2016, Section 711). See Table 3 for example gradation limits for individual stone.

Table 3: Riprap Gradations

Gradation Limits Individual Stone Size (lbs)	Spherical Diameter (ft)	Percent Finer (By Weight)
1250	2.50	100
500	1.83	45-100
250	1.46	15-50
80	1.00	0-15

The barge gate would be constructed approximately in the center of the existing channel. A bypass channel would be constructed immediately adjacent to and to the east of the barge gate cofferdam footprint prior to beginning construction of the floodgate to allow safe navigational passage of marine traffic, as well as all aquatic organisms to pass safely until the floodgate structure is complete (Figure 12).

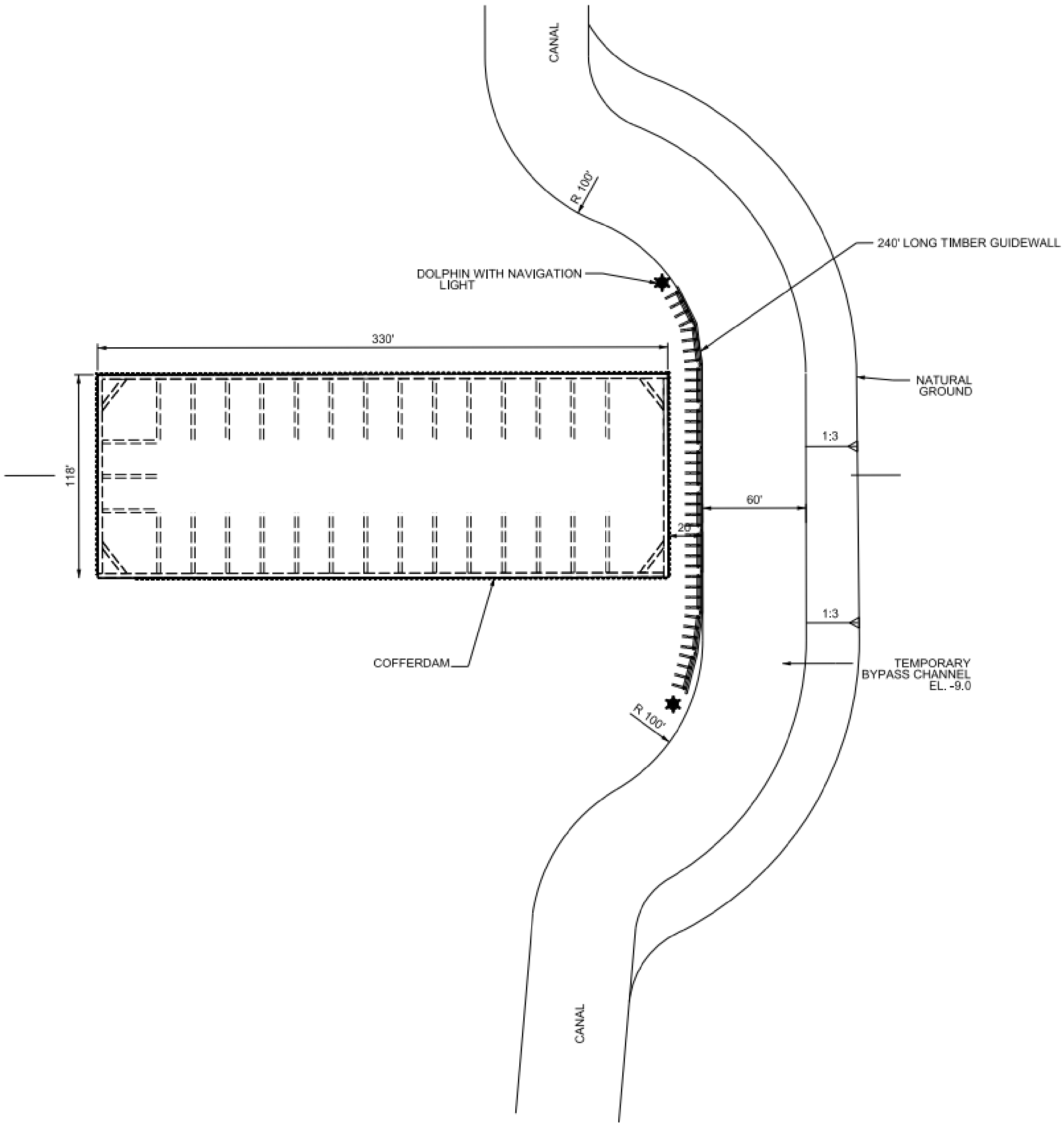


Figure 12: Preliminary bypass channel design

Preliminary designs of the bypass require a minimum bottom channel width of 60 ft temporary bypass channel with an invert of El. -9.0 ft. Based on the preliminary design, the bypass channel would be approximately 650 feet long. However, navigation of common local vessels would be considered for the bypass channels, and design features of a navigable bypass channel would be developed during detailed design. At a minimum, to maintain pre-construction flow conditions, navigation and minimize environmental impacts during construction, the temporary bypass channels would be similarly sized to the channels being impacted. A timber guidewall (like the permanent guide wall shown in Figure 5) would be constructed between the bypass channel and the barge gate footprint to prevent the cofferdam (described below) from vessel impact while the cofferdam is in place.

A total of 31,898 cy of material would be excavated from the channel for gate complex, bypass channel, and floodwall tie-ins. If the dredged material is found to be suitable for use within the project levee footprint, the material would be used within the levee or could potentially be utilized for marsh restoration within the overall project footprint, otherwise the material would be hauled off site and disposed in accordance with all state and federal laws.

Once navigation is routed through the temporary bypass channel, a Phase 1 cofferdam (approximately 330 feet x 118 feet) would be constructed to permit working in the dry when constructing the barge gate concrete landing slab, pivot arm assembly, sluice gates monoliths and the receiving structure concrete monoliths. The cofferdam would be an internally braced cofferdam with wide flange walers and pipe braces supporting PZ sheet piling. Reduced power would be required for vessels passing through the construction area to reduce the risk of impact to the cofferdam. A timber guide wall and pile clusters would be provided along the bypass channel to prevent vessel impact on the cofferdam.

Once construction of the 56-foot barge gate landing slab, pivot arm assembly, receiving structure monoliths and sluice gate monoliths are completed, navigation would be re-routed through the permanent barge gate structure. Following routing the navigation traffic through the barge gate, the Phase 2 cofferdam, permanent guide walls and pile clusters, tie-in T-walls, and final civil site work can be completed. The Phase 2 cofferdam (approximately 120 feet x 80 feet on both sides of the floodgate) would be constructed to permit the construction of the adjacent T-walls to the barge gate structure that would be in the water. The same anchor forces, moments, and tips used for the Phase 1 cofferdams would be conservatively used for the Phase 2 cofferdams.

2.20.4 Construction Duration and Equipment

The construction duration of the Grand Bayou Floodgate would be 24 months with an assumed work schedule of 5 days a week, 8 hours a day. The barge floodgate would be constructed using both floating equipment and land support. Below is the preliminary list of equipment anticipated to be utilized for the construction of the floodgate complex.

Table 1: Preliminary Equipment List for Sector Gate and Floodwall Construction

Project Component	Duration (days)	Equipment Used
Barge Gate Complex & Tie-In Floodwall	730	150-Ton Crane
		80-Ton Crane
		Excavator
		Pile Driver
		Concrete Trucks
		Concrete Vibrators

		Welding Machine, Cutting Torch
Tie-In Levee		Dump Trucks
		Bull Dozers
		Fill Compactor
		Front End Loaded/Backhoe
		Fuel Tanks
		Generator

2.20.5 Access and Staging

Construction site access would be obtained by both barge and land. Vehicle access would be via West 15th Street to Louisiana Highway 3225 continuing along West 48th street, finally, West 48th Street terminates into the existing levee which would serve as the vehicular access to the project site (Figure 13). The construction staging area would be within the area shown in Figure 13, adjacent to the existing Grand Bayou floodgate. It is assumed the staging area would impact approximately 1 acre of marsh habitat. The staging area would have a crushed stone on top of a separator fabric. After construction completion, the site would be returned to pre-construction condition. The staging area would be used as an operations and materials storage area. The contractor would place the project trailers for both the Government and the contractor within the staging area. The contractor would store the project equipment and project building supplies within the staging area. There would also be floating barges anchored within 500 feet of the project footprint that would be used for staging on this project.

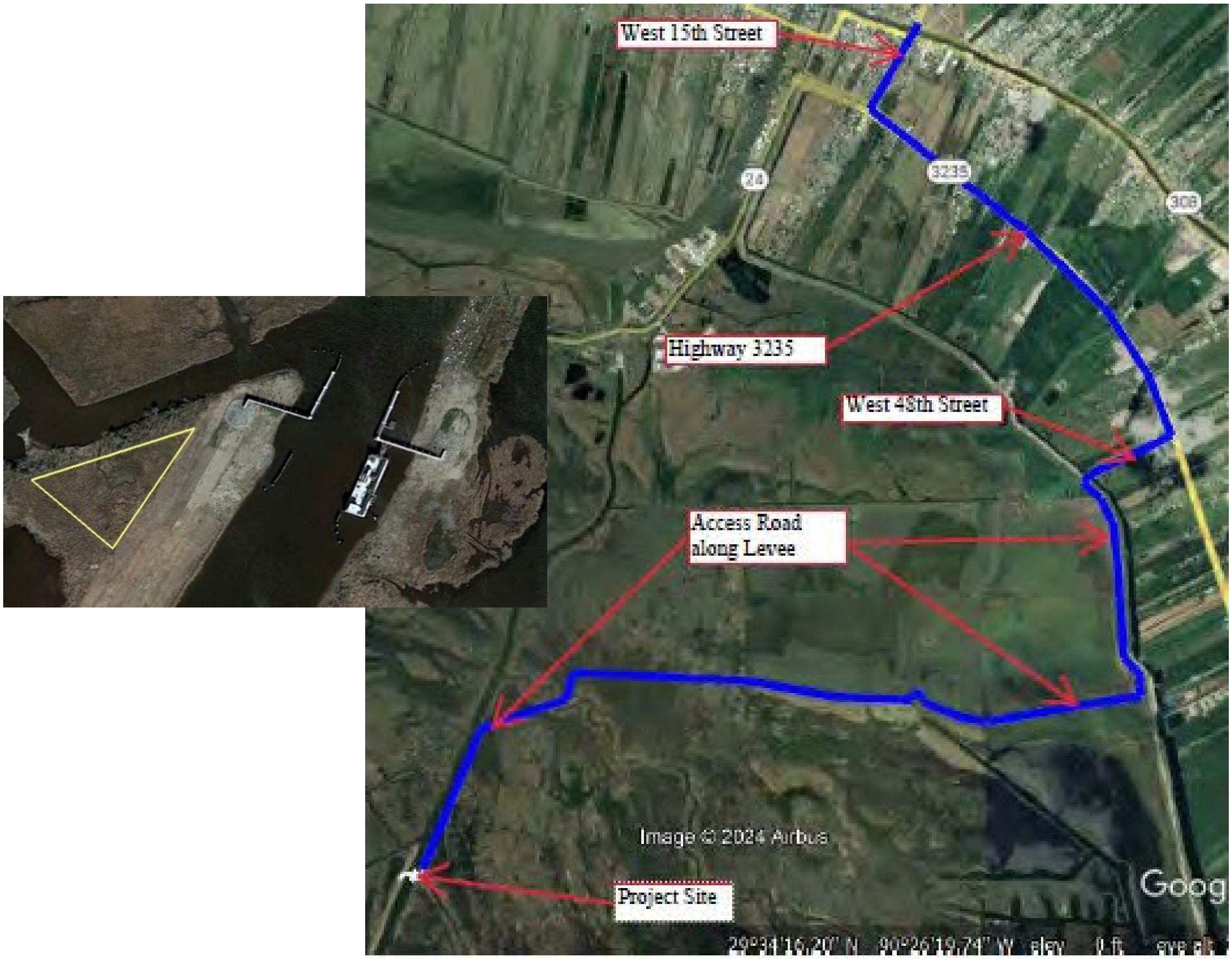


Figure 13: Staging and Access

2.21 REACH L, BAYOU L'BLEU STOPLOG FLOODGATE AND ENVIRONMENTAL CONTROL STRUCTURE

2.21.1 Location

The Bayou L'Bleu Stoplog floodgate and Environmental Control Structure complex would be located on the Bayou L'Bleu canal within Terrebonne Parish and is located at latitude 29°30'54.86"N N, longitude - 90°24'25.80"W.

Figure 1: Location Map

2.21.2 Scope of Work

This contract would consist of a 15ft wide stoplog floodgate in Bayou L'Bleu with floodwall tie-ins flanking each side of the floodgate. In addition to the floodgate, this contract includes a sluice gate monolith with the monolith housing 4 sluice gates within the gate monolith that would remain open unless there is a storm event. On both the inflow and the outflow of the gate bay, there would be timber guide walls and protection pile clusters. Finally, the transition between levee and floodwall would be protected with concrete or grouted riprap to prevent scour at this transition.

2.21.3 Structure Description

Bayou L'Bleu Stoplog Floodgate and Sluice Gates would be a 15 ft wide stoplog floodgate (Figure 2) with a top elevation of 24.5 ft NAVD88, and a slab invert that is yet to be determined. The floodgate would provide an opening in the system to allow unimpeded navigation, except when a tropical system approaches the Gulf of America in which the stoplogs would be placed by the crane mounted on the adjacent monolith.

The stoplog gates would consist of horizontal wide-flanges supporting the vertical intercostals and skin plate. All connections would be welded connections. A crane mounted on an adjacent T-Wall would be used to lower the gate in place. All steel members on the gate would be painted with a coal tar epoxy paint system. (see Figures 3 & 4).

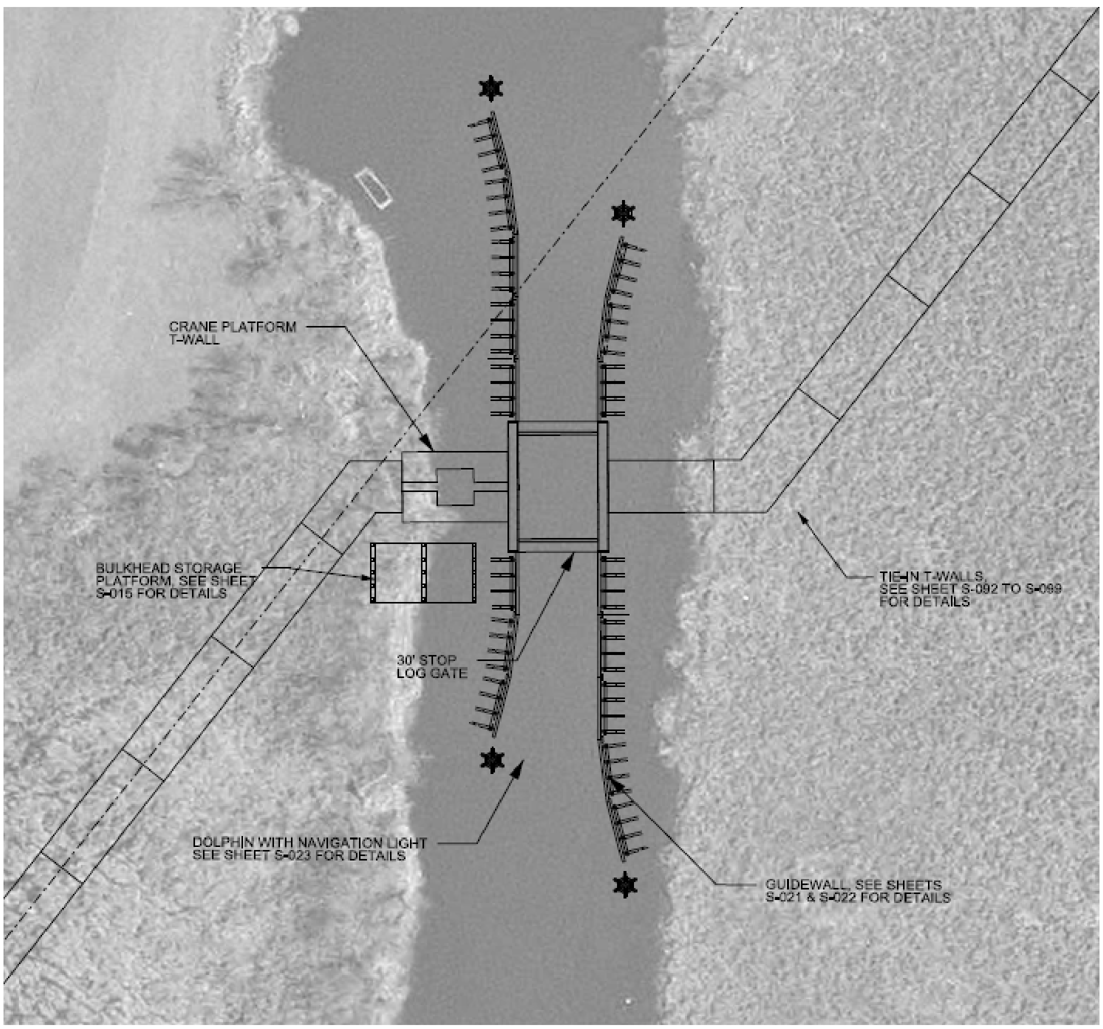


Figure 2: Typical Stoplog Gate Example

Figure 3: Conceptual Stoplog Gate - Elevation View with Gate in Open Position (Crane not shown for clarity)

Figure 4: Conceptual Stoplog Gate - Elevation View with Gate in Closed Position (Crane not shown for clarity)

Adjacent to the stop log gate, there would be a separate sluice gate monolith at this project location. The sluice gate structure would contain 4 sluice gates with an invert elevation yet to be determined.

A sluice gate is a structure that contains a movable gate or series of movable gates that, when lifted, allow material and water to flow under it. The sluice gate would provide an opening in the system to allow unimpeded tidal flow, except when a tropical system approaches the Gulf of America in which the gates would be closed. Sluice gates are not navigable as they do not raise high enough, or they have fixed components that do not allow vessels to pass through. See Figure 5 and Figure 6 for a typical conceptual plan view and cross section of a sluice gate system.

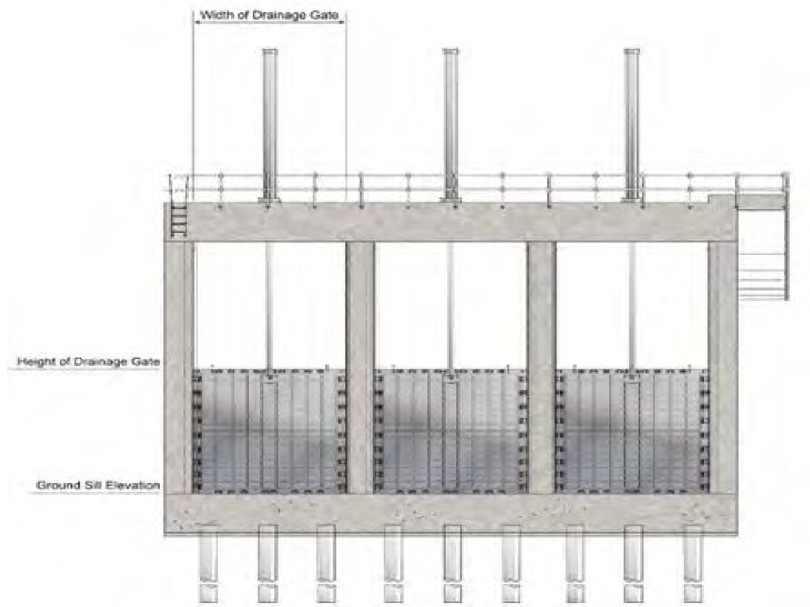


Figure 5: Conceptual Sluice Gate - Elevation View with Gate in Closed Position

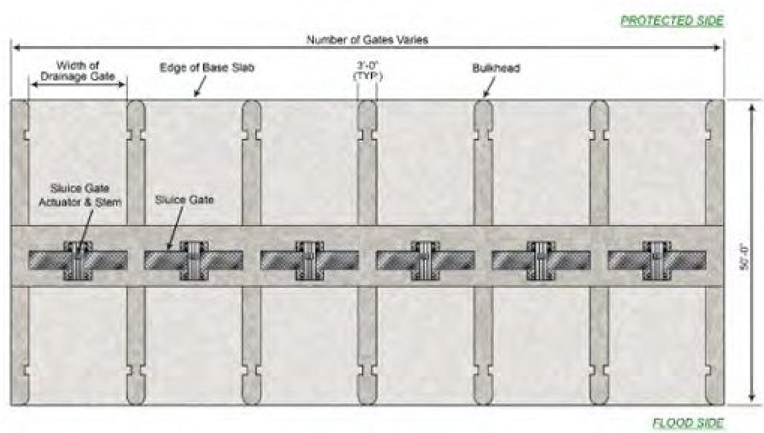


Figure 6: Typical Sluice Gate Control Structure (6 gates shown) - Plan View

Timber guide walls and pile clusters would be provided as aids to navigation and to protect the main flood gate structure from impact. The seven pile dolphin structures are constructed at the end of the guide wall to protect the guide walls from impact from vessels. The guide walls would be timber support frames currently spaced every 6 feet. Each timber support frame is constructed with a vertical pile braced by a batter pile driven at an angle from vertical. The outer end of each guide wall is anchored with a seven-pile dolphin structure. The dolphins would consist of 7 timber piles battered away from each other and tied together with a wire rope at the top of the dolphin. Please see figure 7, 8 and 9 for more details.

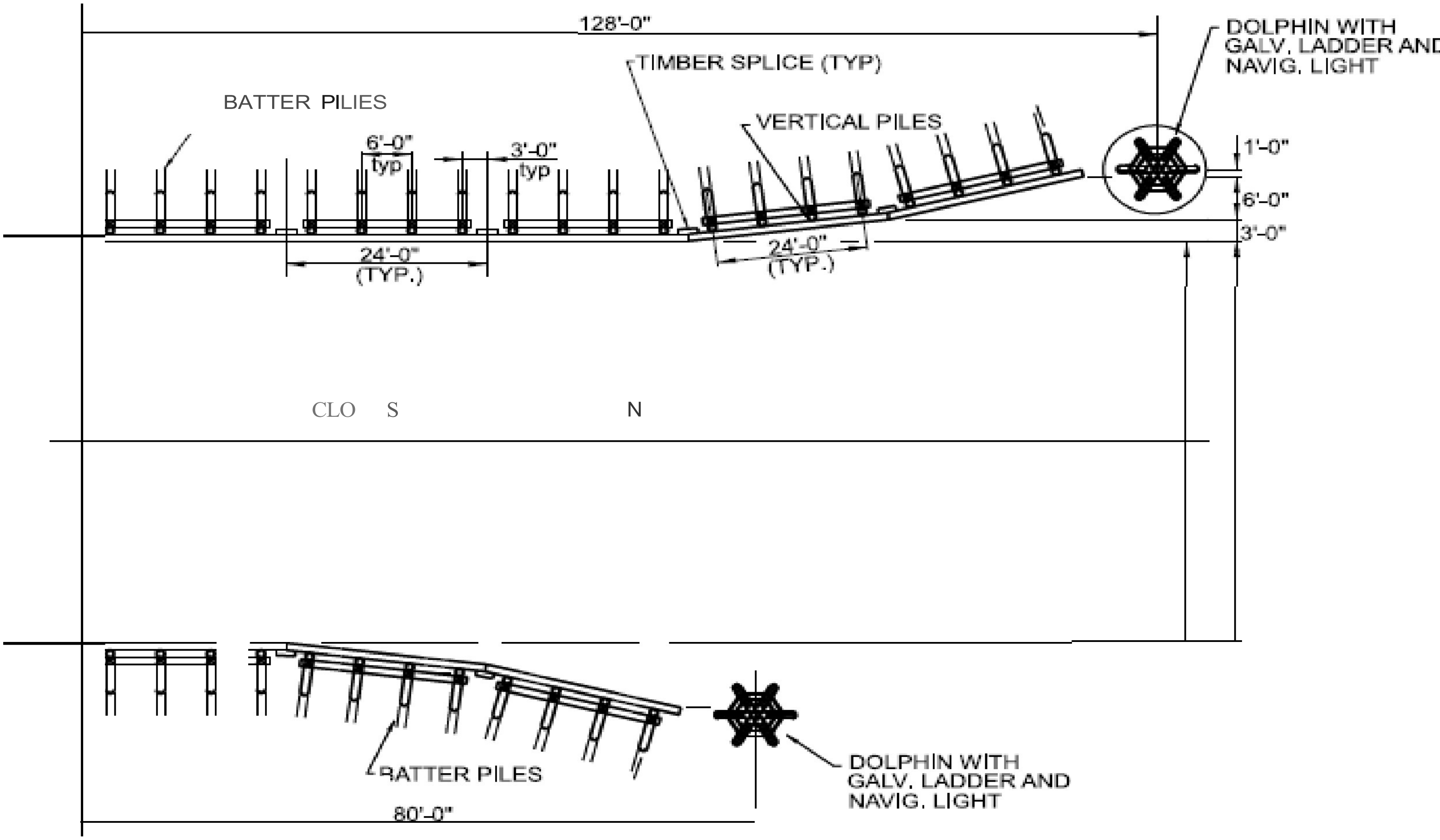


Figure 7: Plan – Guide walls, Fenders, and Dolphins

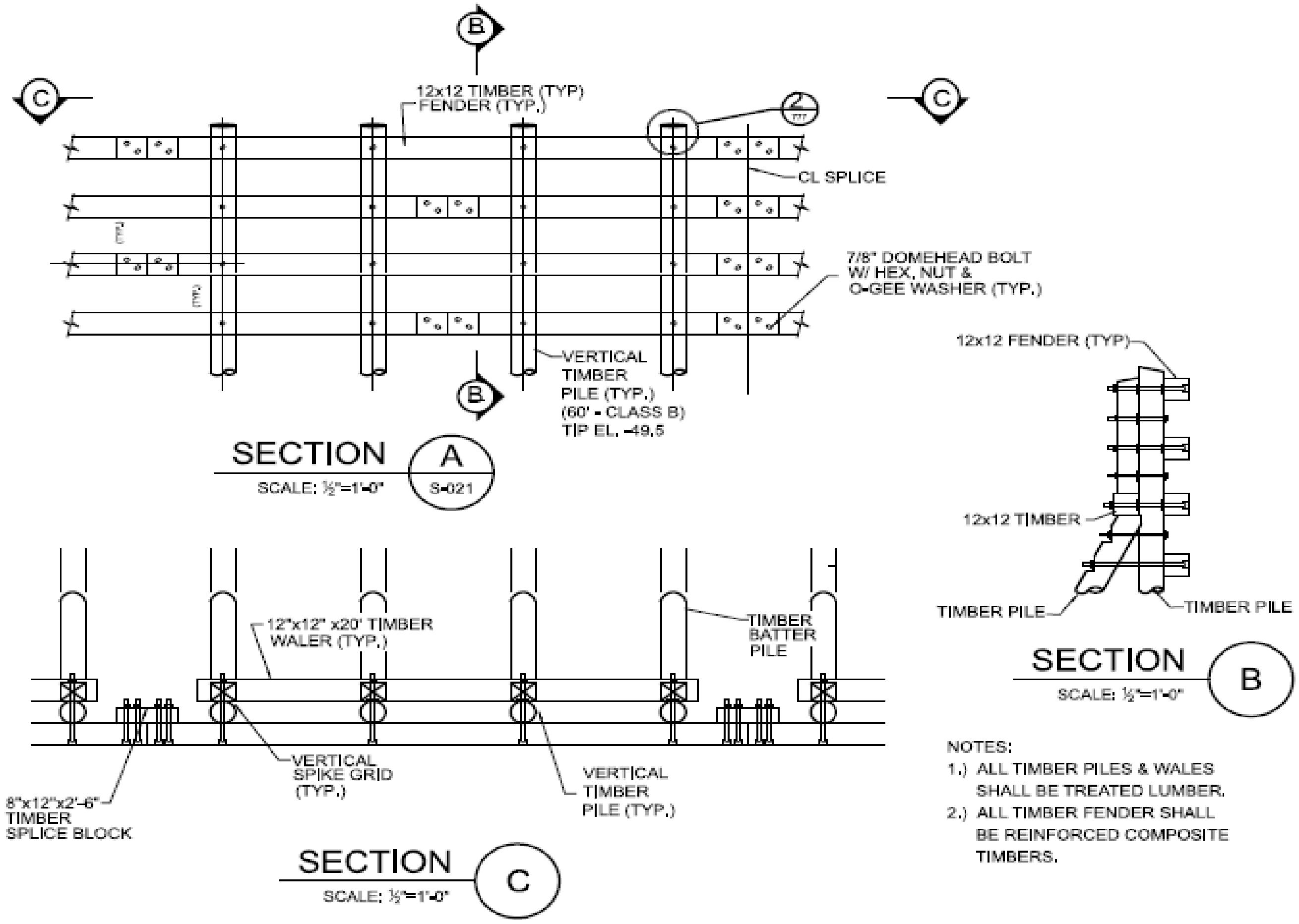


Figure 8: Guide wall Details

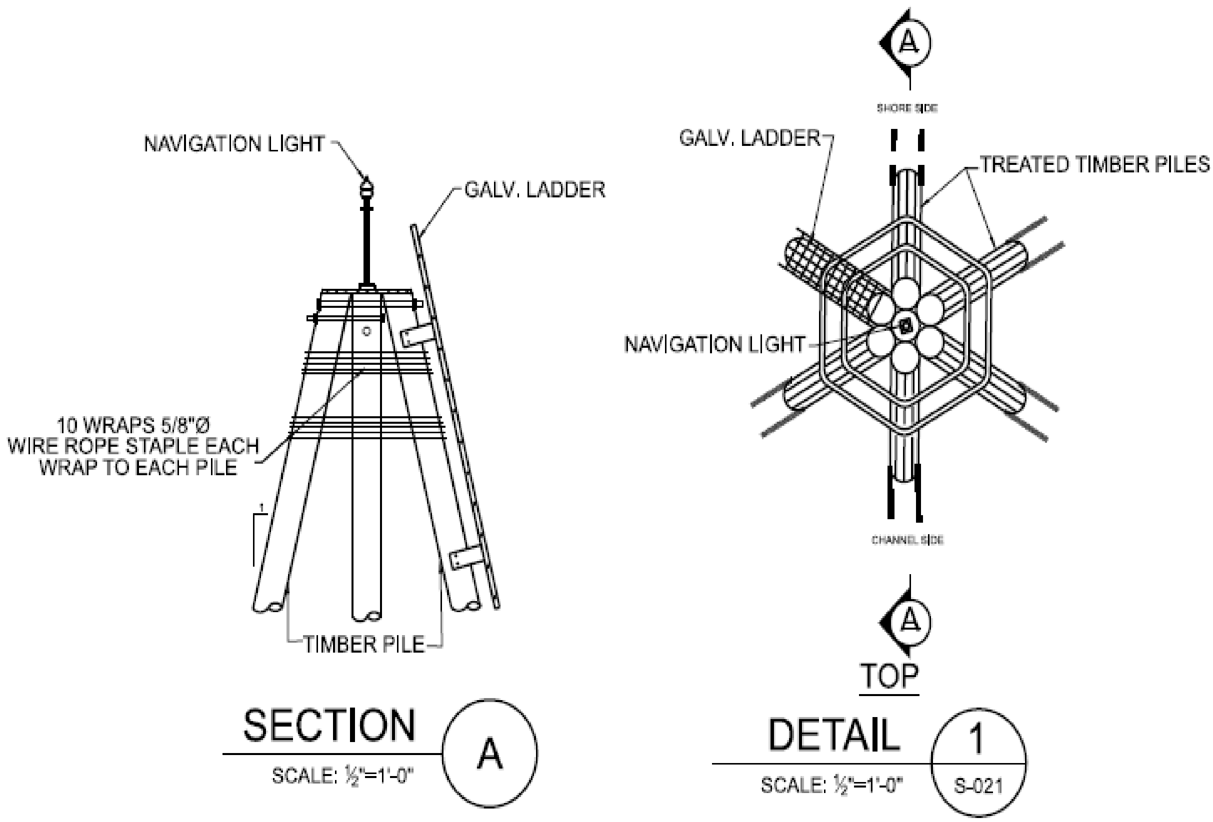


Figure 9: Dolphin Details

T-walls would extend from the stoplog gate and tie into the adjacent levees. The floodwalls would have a top elevation of 24.5 ft NAVD88.

The height of the floodwall tie-ins would vary with the tallest walls adjacent to the stoplog gate and the shortest walls that tie into the adjacent levee. Details on typical section of floodwall is provided in Figure 10.

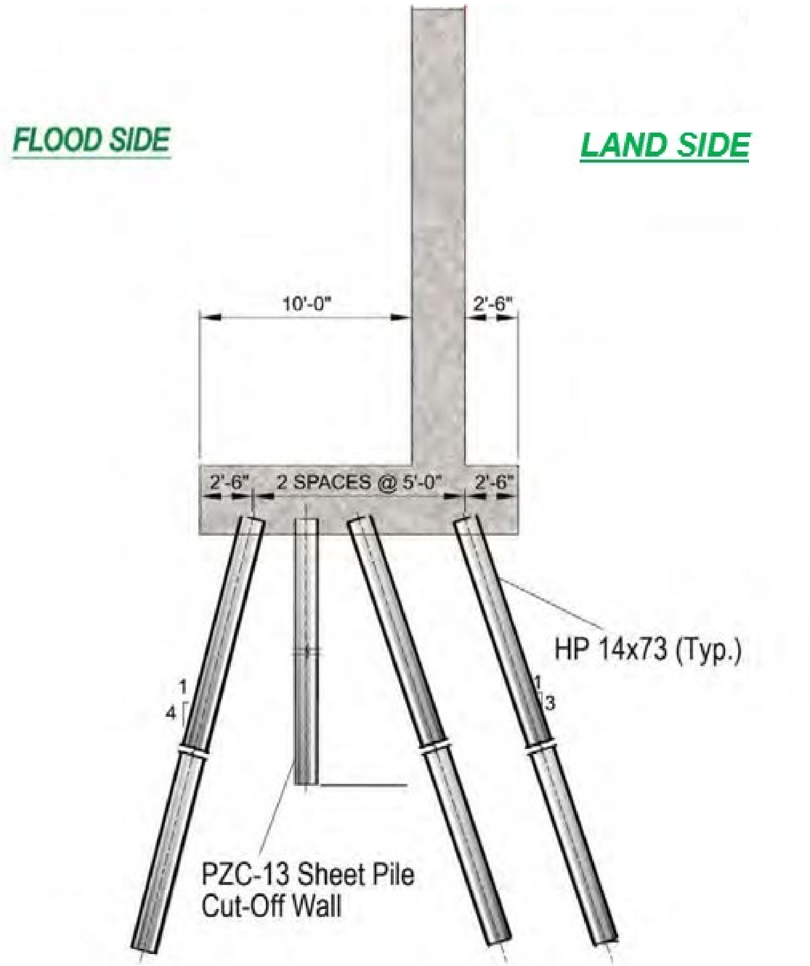


Figure 10: Typical Floodwall

The design of the new stoplog gate and sluice gate structure and floodwalls, including the foundation is subject to change once detailed geotechnical investigations are conducted during detailed design.

Nine-inch concrete scour protection or grouted riprap would be used at the levee/T-wall transition. The concrete scour protection is located where the T-wall stem extends into the full levee section and extend down both levee slopes. The scour protection would continue for 30 linear feet past the end of the T-wall. Uncapped cut-off sheet piling would extend horizontally 30 feet into the full levee section for erosion and seepage control. See the sketch below for wall layout and cross-section. See Figure 11 below for an example of the proposed scour protection.

Figure 11: Concrete Scour Protection Example

The cross section at the gate location would be designed such that the pre and post project conditions would not impede the natural movement of aquatic organisms. The default operation would be open to avoid additional indirect impacts to vegetation and fish and wildlife due to changes in the natural hydrologic regime. The floodgate would be opened as soon as is safely possible after a closure for storm passage.

The velocities around and through the gate may require the channel bottom to be layered with 2-feet of riprap. Bedding would be placed on separator geotextile with the riprap on top of the bedding. A riprap gradation is assumed to be class 250 - 1000 lb stone (LADOTD 2016, Section 711). See Table 1 for example gradation limits for individual stone.

Table 1: Riprap Gradations

Gradation Limits Individual Stone Size (lbs)	Spherical Diameter (ft)	Percent Finer (By Weight)
1250	2.50	100
500	1.83	45-100

250	1.46	15-50
80	1.00	0-15

The existing Bayou L'Blue channel has been plugged by the existing levee and thus, navigation does not need to be maintained until the structure is completed so a bypass channel will not be required.

One cofferdam can be used to construct the structure to permit working in the dry. The cofferdam would be an internally braced cofferdam with wide flange walers and pipe braces supporting PZ sheet piling.

2.21.4 Construction Duration and Equipment

The construction duration of the Bayou L'Bleu Floodgate would be 24 months with an assumed work schedule of 5 days a week, 8 hours a day. The stoplog floodgate would be constructed using both floating equipment and land support. Below is the preliminary list of equipment anticipated to be utilized for the construction of the floodgate.

Table 4: Preliminary Equipment List for Sector Gate and Floodwall Construction

Project Component	Duration (days)	Equipment Used
	730	150-Ton Crane
		80-Ton Crane
Stoplog Gate Complex & Tie-In Floodwall		Excavator
		Pile Driver
		Concrete Trucks
		Concrete Vibrators
		Welding Machine, Cutting Torch
Tie-In Levee		Dump Trucks
		Bull Dozers
		Fill Compactor
		Front End Loader/Backhoe
		Fuel Tanks
		Generator

2.21.5 Access and Staging

Construction site access and staging will be the same as that listed in the Reach L project description, please see that description for more details.

2.22 REACH L PUMP STATION FRONTING PROTECTION

2.22.1 Location

The Reach L Fronting Protection Pump Station is located near Larose in Lafourche, within the Reach L of the larger MTG system at approximately latitude 29°30'54.79", -90°22'31.18" (Figure 1).

Figure 1: Location Map

2.22.2 Scope of Work

The proposed work consists of construction of a floodwall in front of an existing operating pump station. The floodwall would be constructed to fit between the existing pump station and the discharge basin (area where the pumps discharge the rainwater). In addition to the floodwall, the proposed action includes installing a valve within each of the existing pump station discharge pipes that could be closed to prevent storm surge from backflowing to the land side of the system through the discharge pipe. Finally, the transition between levee and floodwall would be protected with concrete or grouted riprap to prevent scour at this transition.

2.22.3 Structure Description

A floodwall would be constructed in front of the existing station and the discharge pipes would be extended through the newly constructed T-wall with a top elevation of 24.5 ft NAVD88 (Figure 2). A butterfly valve would be placed within each discharge pipe that would always remain open except when a named storm enters the Gulf. The butterfly valve would be able to be remotely operated from the pump station control panel as well locally at the butterfly valve itself. The pipe discharge bell would be relocated to the floodside of the system and discharge onto a portion of the t-wall slab and new riprap that would be placed as part of this contract.

The approximate length of the inverted T-type floodwall would be 500 total linear feet. The T-wall would be constructed on pile foundations with concrete base slabs and stems to the 2085 elevation +24.5 ft (NAVD 88) (Figure 3). It is anticipated that this floodwall would be constructed at grade minimizing the requirement for any significant excavation.

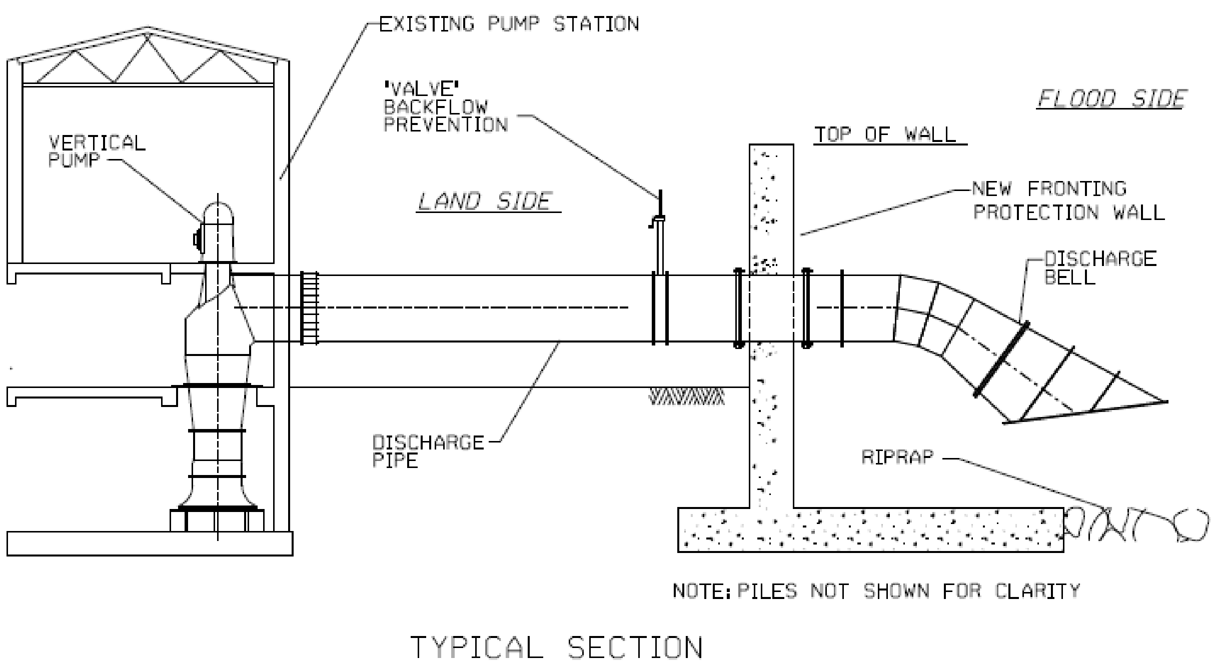


Figure 2: Typical Section of Fronting Protection Wall @ Pump

The T-wall monolith heights would vary with the tallest walls located in front of the pump station and the shortest walls tying into the adjacent levee.

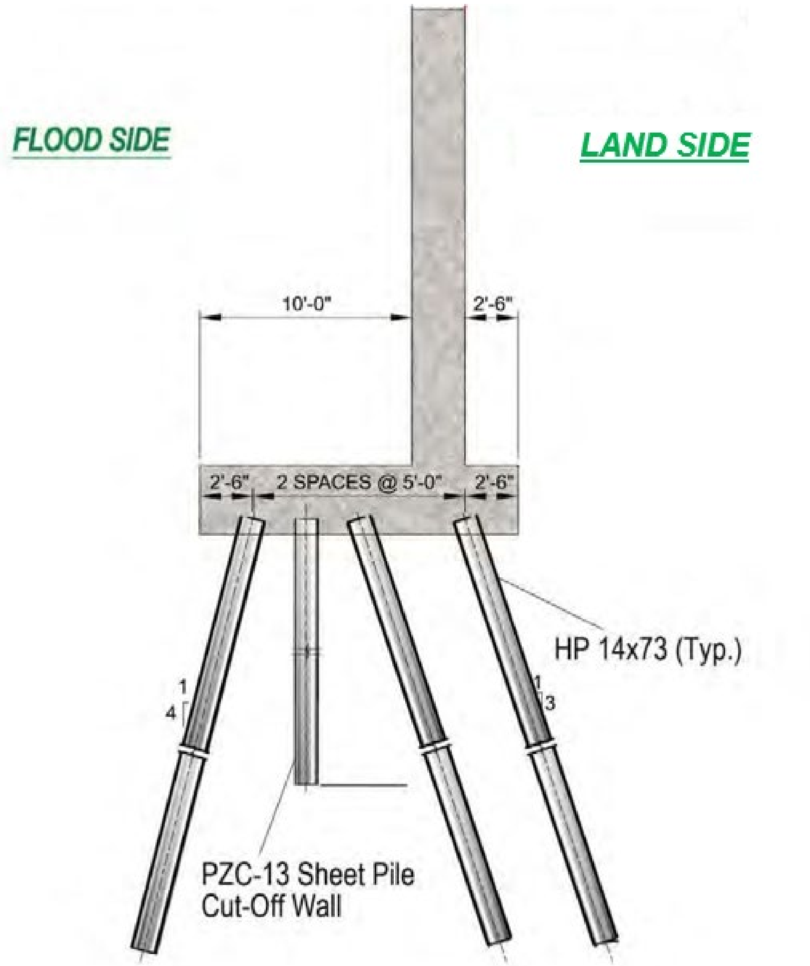


Figure 3: Typical Floodwall

Nine-inch concrete scour protection or grouted riprap would be used at the levee/ T-wall transition. The concrete scour protection would protect the levee where the T-wall stem extends into the full levee section and extend down both levee slopes. The scour protection would continue for 30 linear feet past the end of the T-wall. Uncapped cut-off sheet piling would extend horizontally 30 feet into the full levee section for erosion and seepage control. Reference Figure 4 as an example of the proposed scour protection.

Figure 4: Concrete Scour Protection Example

With the pipe discharge bell being relocated to the floodside of the system and discharging onto a portion of the t-wall slab, riprap would be required to dissipate the energy from the pumping of the rainwater out of the system, extending a distance to be determined during detailed design. A riprap gradation is assumed to be class 250 - 1000 lb stone (LADOTD 2016, Section 711). See Table 1 for example gradation limits for individual stone.

Table 1: Riprap Gradations

Gradation Limits Individual Stone Size (lbs)	Spherical Diameter (ft)	Percent Finer (By Weight)
1250	2.50	100
500	1.83	45-100
250	1.46	15-50
80	1.00	0-15

The floodwall would be constructed at grade minimizing the requirement for any significant excavation. The excavated material from constructing the floodwalls may be used within the levee footprint or if determined suitable could be used for marsh mitigation. If deemed unsuitable, the material would be hauled off site and disposed in accordance with applicable state and federal laws.

2.22.4 Construction Duration and Equipment

The construction duration of the Reach L Fronting Protection would be 24 months with an assumed work schedule of 5 days a week, 8 hours a day. The floodwalls in front pump station would be constructed using both floating equipment and land support.

Below is the preliminary list of equipment anticipated to be utilized for the construction of the Bayou Black Fronting Protection.

Table 4: Preliminary Equipment List for Fronting Protection Construction

<table>
<tr><th>Project Component</th><th>Duration (days)</th><th>Equipment Used</th></tr>
<tr><td rowspan="7">Fronting Protection & Tie-In Floodwall</td><td rowspan="13">730</td><td>150-Ton Crane</td></tr>
<tr><td>80-Ton Crane</td></tr>
<tr><td>Excavator</td></tr>
<tr><td>Pile Driver</td></tr>
<tr><td>Concrete Trucks</td></tr>
<tr><td>Concrete Vibrators</td></tr>
<tr><td>Welding Machine, Cutting Torch</td></tr>
<tr><td rowspan="6">Tie-In Levee</td><td>Dump Trucks</td></tr>
<tr><td>Bull Dozers</td></tr>
<tr><td>Fill Compactor</td></tr>
<tr><td>Front End Loaded/Backhoe</td></tr>
<tr><td>Fuel Tanks</td></tr>
<tr><td>Generator</td></tr>
</table>

2.22.5 Access and Staging

Construction site access and staging will be the same as that listed in the Reach L levee.

2.23 REACH LAROSE C-NORTH, GIWW EAST FLOODGATE

2.23.1 Location

The GIWW East Floodgate would be located on the GIWW within Terrebonne Parish and is located at latitude 29°35'28.28"N, longitude -90°22'13.25"W.

Figure 1: Location Map

2.23.2 Scope of Work

This contract would consist of a 225 ft wide sector floodgate and floodwall tie-ins within the Lockport to Larose Reach of the Morganza to the Gulf project, located approximately at mile 34 along the GIWW. Bull nose dolphins will be constructed on all four corners of the sector gate structure to protect the structure from barge impact and facilitate safe navigation through the structure. Finally, on the west side of the floodgate, the transition between levee and floodwall would be protected with concrete or grouted riprap to prevent scour at this transition.

2.23.3 Structure Description

This floodgate would be a 225 ft wide sector gate (Figure 2) with a top elevation of +16.5 ft NAVD88, and a slab invert elevation of -16 ft NAVD88. The floodgate would provide an opening in the system to allow unimpeded navigation, except when a tropical system approaches the Gulf of America in which case the gate would be closed.

The sector gate consists of two leaves joined at the center of the navigable channel width that rotate into gatebay recesses when opened. Each gate leaf is shaped as a sector of a cylinder, or pie-shape, with a vertical axis. The floodgate will provide an opening in the hurricane and storm damage risk reduction system (HSDRRS) to allow unimpeded navigation. The floodgate will be closed when a tropical system approaches the Gulf of America. (see Figures 3 & 4). The sector gate would have concrete control houses provided for each gate leaf to shelter the gate control systems and machinery. The gate structure will be designed such that each gatebay can be dewatered independently using needle girder beams and needle girders.

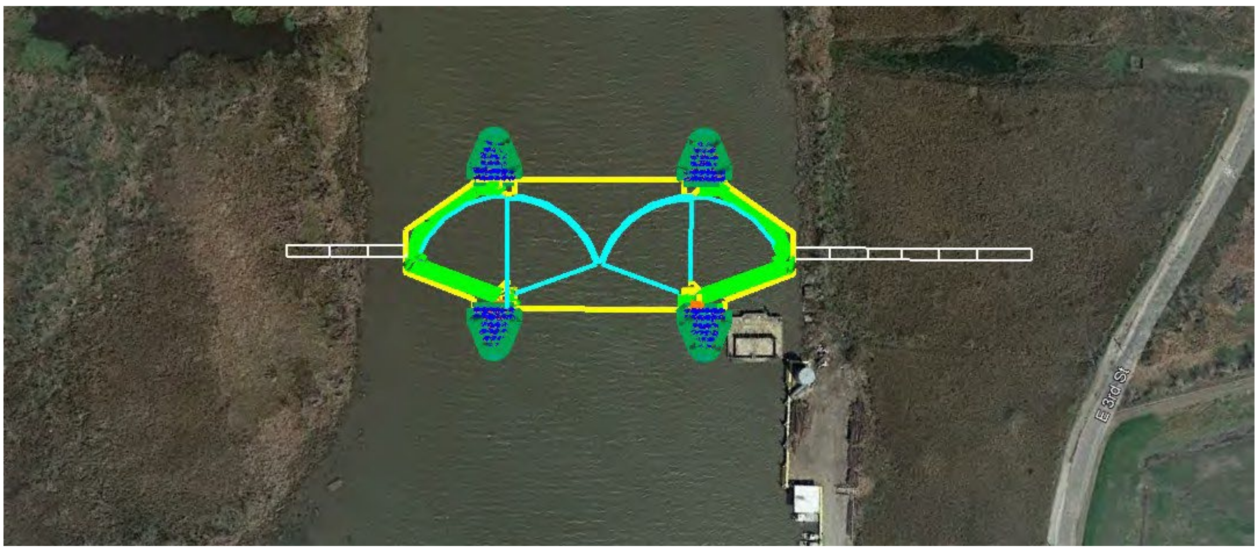


Figure 2: Conceptual Sketch of Sector Gate Complex with Bullnose Dolphins

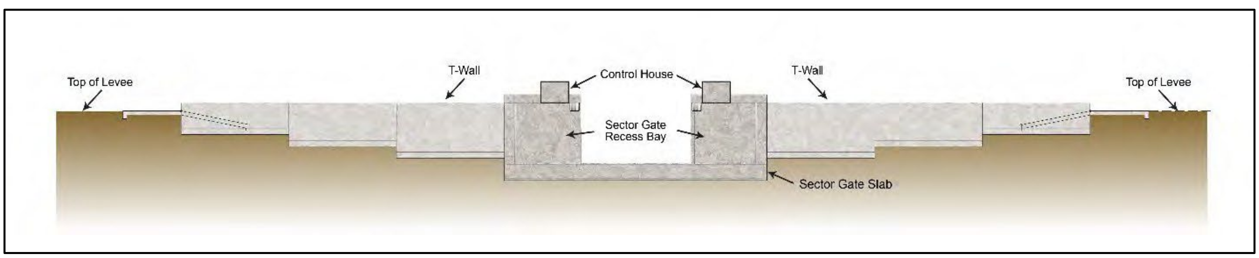


Figure 3: Conceptual Sector Gate - Elevation View with Gate in Open Position

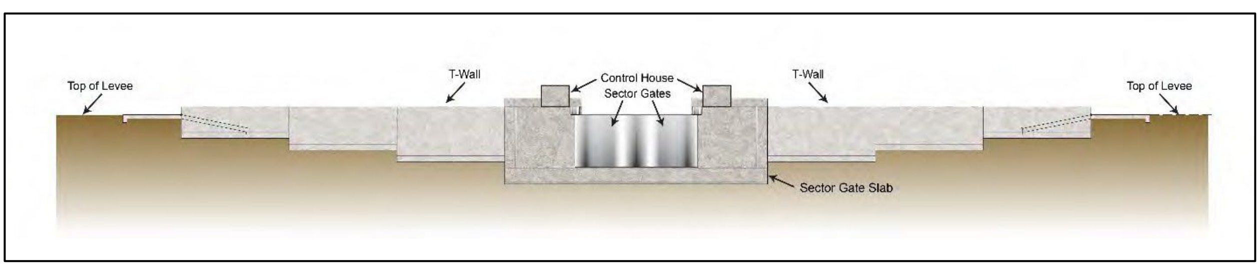


Figure 4: Conceptual Sector Gate - Elevation View with Gate in Closed Position

Approximately 465 total linear feet of concrete floodwalls, specifically T-walls, will be constructed to tie into the adjacent levees of the Lockport to Larose Reach and the Larose C North Reach. The height of the floodwall tie-ins would vary with the tallest walls adjacent to the sector gate and the shortest walls that tie into the adjacent levee. Details on typical section of floodwall is provided in Figure 5.

The design of the new gate and floodwalls, including the foundation is subject to change once detailed geotechnical investigations are conducted during detailed design.

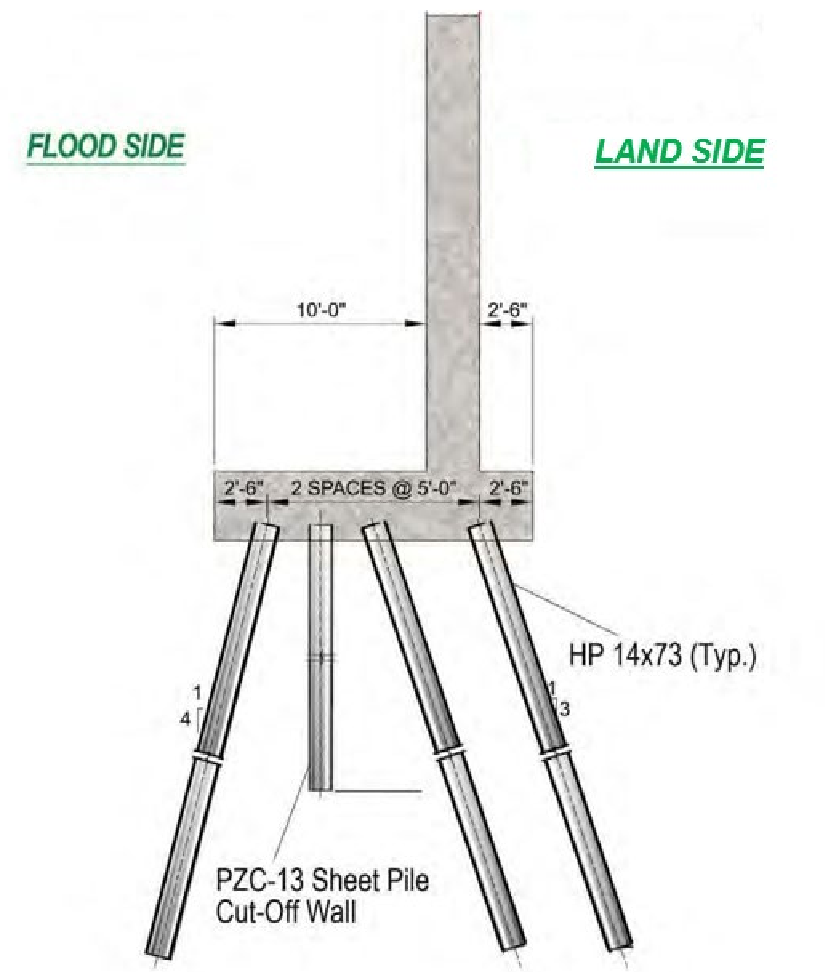


Figure 5: Typical Floodwall

Nine-inch concrete scour protection or grouted riprap would be used at the levee/T-wall transition on the west side of the floodgate. The concrete scour protection is located where the T-wall stem extends into the full levee section and extend down both levee slopes. The scour protection would continue for 30 linear feet past the end of the T-wall. Uncapped cut-off sheet piling would extend horizontally 30 feet into the full levee section for erosion and seepage control. See the sketch below for wall layout and cross-section. Please see Figure 6 below for an example of the proposed scour protection.

Figure 6: Concrete Scour Protection Example

The existing centerline of GIWW has an approximate elevation of EL. -16 ft NAVD 88. For the construction of the gate foundation, the channel would be excavated to an approximate elevation -27.0 ft with the final constructed sill elevation being El. -16.0. Directly adjacent to the floodgate slab, both on the land and the flood side of the gate would be excavated to an El. -18.5 (NAVD 88) to place both the bedding stone and the riprap required. The channel bottom would remain at El. -16.0 (NAVD 88) for approximately 50-feet, both upstream and downstream of the newly constructed floodgate slab.

The cross section at the gate location would be designed such that the pre and post project conditions would not impede the natural movement of aquatic organisms. The default operation would be open to avoid additional indirect impacts to vegetation and fish and wildlife due to changes in the natural hydrologic regime. The floodgate would be opened as soon as is safely possible after a closure for storm passage.

The velocities around and through the gate may require the channel bottom to be layered with 2-feet of riprap. After dredging the channel to El. -18.5.0, bedding would be placed on separator geotextile with the riprap on top of the bedding. A riprap gradation is assumed to be class 250 - 1000 lb stone (LADOTD 2016, Section 711). See Table *3* for example gradation limits for individual stone.

Table 3: Riprap Gradations

Gradation Limits Individual Stone Size (lbs)	Spherical Diameter (ft)	Percent Finer (By Weight)
1250	2.50	100
500	1.83	45-100
250	1.46	15-50
80	1.00	0-15

The sector gate structure gatebays would be constructed in the dry within an internally braced cofferdam (Figure 7), leaving a minimum of 160-foot clear opening on the east side of the cofferdam to allow for continuous navigation during the construction of the gatebays. A temporary impact protection system would be installed to protect the structure from vessel impacts during construction.

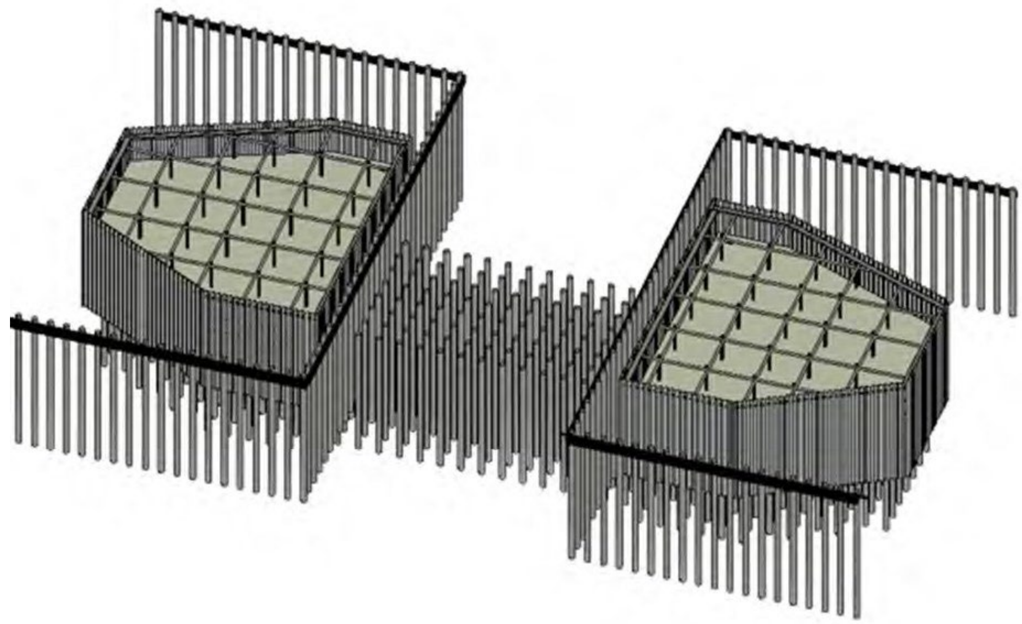


Figure 7: Internally Braced Cofferdam to Construct Gatebays

Reduced power may be required for vessels passing through the construction area to reduce the risk of impact to the cofferdam. A temporary impact protection system consisting of large vertical pipe piles with wales spanning between each vertical pile, would be installed to protect the structure from vessel impacts during construction.

The center slab would be constructed completely in the wet. Piles would be driven to grade with a follower. The center slab may be floated in place, lifted in place, or cast in the wet.

A Phase 2 cofferdam would be required for the T-walls adjacent to the sector gate structure. Once navigation is re-routed, the Phase 2 cofferdam, needle girder storage platform, bull nose dolphins, tie-in T-walls, and final civil site work can be completed.

It is assumed that minimal material would be removed from the channel. Only the material required to construct the structure foundation would be excavated and it is assumed this material would not be suitable for use in the project. The material would be hauled off site and disposed of in accordance with all state and federal laws.

2.23.4 Construction Duration and Equipment

The construction duration of the GIWW East Floodgate would be 36 months with an assumed work schedule of 5 days a week, 8 hours a day. The floodgate would be constructed using both floating equipment and land support. Below is the preliminary list of equipment anticipated to be utilized for the construction of the floodgate.

Table 4: Preliminary Equipment List for Sector Gate and Floodwall Construction

<table>
<tr><th>Project Component</th><th>Duration (days)</th><th>Equipment Used</th></tr>
<tr><td rowspan="7">Sector Gate Complex & Tie-In Floodwall</td><td rowspan="13">1455</td><td>150-Ton Crane</td></tr>
<tr><td>80-Ton Crane</td></tr>
<tr><td>Excavator</td></tr>
<tr><td>Pile Driver</td></tr>
<tr><td>Concrete Trucks</td></tr>
<tr><td>Concrete Vibrators</td></tr>
<tr><td>Welding Machine, Cutting Torch</td></tr>
<tr><td rowspan="6">Tie-In Levee</td><td>Dump Trucks</td></tr>
<tr><td>Bull Dozers</td></tr>
<tr><td>Fill Compactor</td></tr>
<tr><td>Front End Loader/Backhoe</td></tr>
<tr><td>Fuel Tanks</td></tr>
<tr><td>Generator</td></tr>
</table>

2.23.5 Access and Staging

Construction site access would be obtained by both barge and land. Vehicle access would be via Highway 657 (E. 3rd Street) with access directly to the project site/staging area. (Figure 8). The construction staging area would be approximately 1.0 acre along the east bank of the GIWW. The staging area would have a crushed stone on top of a separator fabric. The staging area would be remain after construction to allow for access to the floodgate. . The staging area would be used as an operations and materials storage area. The contractor would place the project trailers for both the Government and the contractor within the staging area. The contractor would store the project equipment and project building supplies within the staging area. There would also be floating barges anchored within 500 feet of the project footprint that would be used for staging on this project.

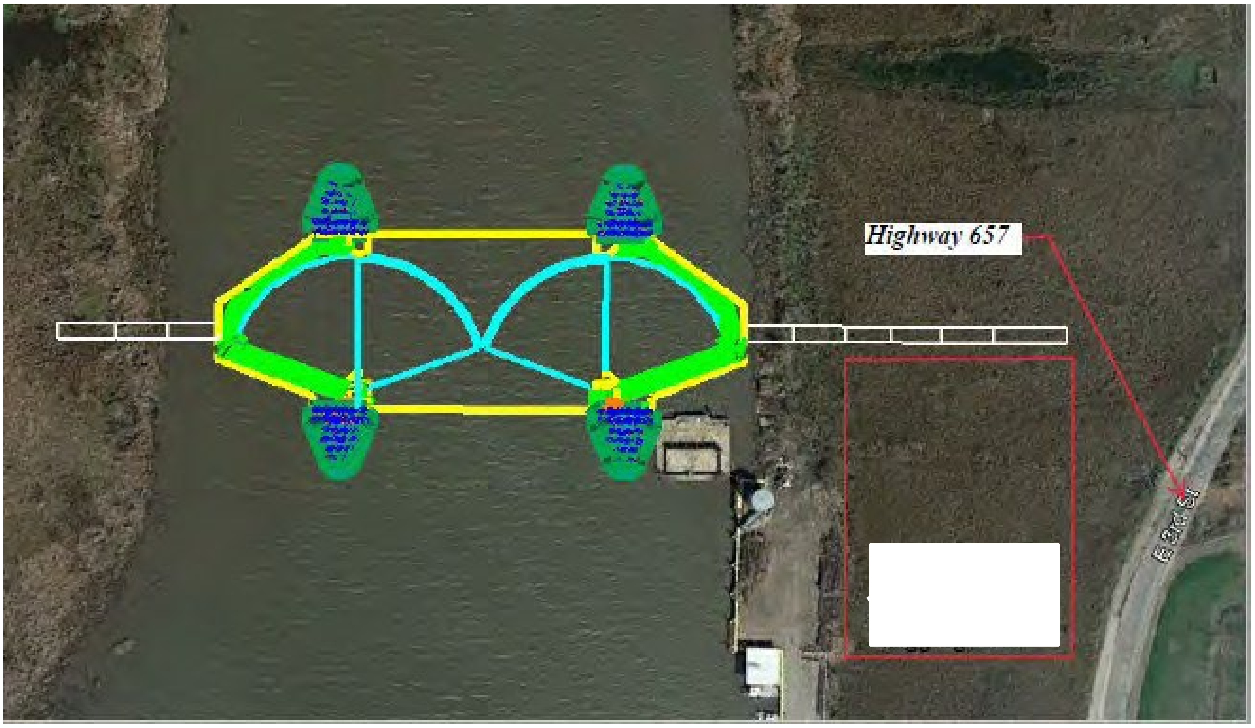


Figure 8: Project site access and staging

2.24 REACH LAROSE C-NORTH, LAROSE BARGE GATE FLOODGATE

2.24.1 Location

The Larose Barge Gate Floodgate is located on Bayou Lafourche within Lafourche Parish and is located at latitude 29°34'13.1859"N, longitude -90°22'47.7157"W.

Figure 1: Location

2.24.2 Scope of Work

This contract would consist of a barge floodgate within Bayou Lafourche with floodwalls flanking each side of the floodgate. On both the inflow and the outflow of the gate bay, there would be timber guidewalls and protection pile clusters on the south end. A section of the timber guidwalls would extend approximately 500 feet to the north to join with the guide walls on an existing sector gate floodgate in Bayou Lafourche Because the gate location is near an urban area, floodwalls would extend a long distance from the floodgate before transitioning to adjacent T-wall projects.

2.24.3 Structure Description

This floodgate would be a 56 ft wide barge floodgate with a top elevation of +16.5 feet (NAVD88), and a slab invert elevation of -12.3 feet (NAVD88) and would work in tandem with the existing sector gate structure. The new floodgate would provide an opening in the system to allow unimpeded navigation, except when a tropical system approaches the Gulf of America in which case the barge gate would be closed.

A barge gate is constructed of a braced steel frame with sheet metal or solid plate exterior in a hollow box configuration that resembles a hopper barge (see Figure 2). The gate normally contains several individual compartments that are watertight. The gate would have a pivot arm at one end that allows the gate to articulate in a 90° arc to open and close. The pivot arm would be mounted onto a fixed pivot pile that would allow the gate and pivot arm free travel in the vertical direction (for flotation). When the gate is in either the open or closed position, pumps fill the compartments with water until the buoyancy is overcome and the structure settles onto a receiving structure. While in the open position, the gate would also function as a guide wall to aid the vessels in navigating through the structure. In the closed position, the gate is ballasted down to an underwater foundation with gravity loads transferred through the base seal and the base support (see Figures 3 & 4). The flat top of the gate allows passage of either pedestrian or motorized ATV traffic. Lateral loads from high tides or storm surge on the barge gate are transferred into two concrete abutment reaction walls on either end of the gate structure.

Figure 2 – Typical Barge Gate Example

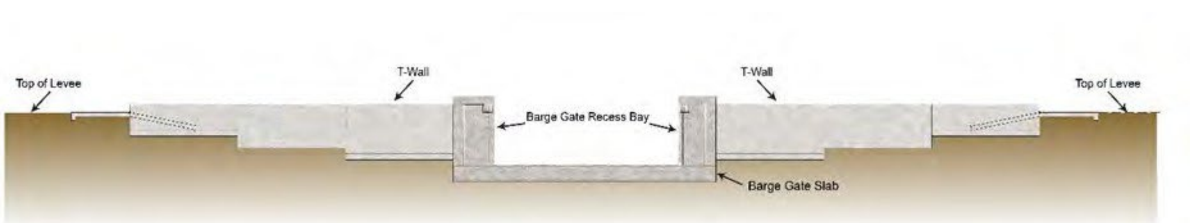


Figure 3: Conceptual Barge Gate - Elevation View with Gate in Open Position

Figure 4: Conceptual Barge Gate - Elevation View with Gate in Closed Position

The floodgate would have timber guide walls and pile dolphin structures on both the land and flood side. The seven pile dolphin structures are constructed at the end of the guide wall to protect the guide walls from impact from vessels. The guide walls would be timber support frames currently spaced every 6 feet. Each timber support frame is constructed with a vertical pile braced by a batter pile driven at an angle from vertical. The outer end of each guide wall is anchored with a seven-pile dolphin structure. The dolphins would consist of 7 timber piles battered away from each other and tied together with a wire rope at the top of the dolphin. Please see figure 5, 6 and 7 for more details.

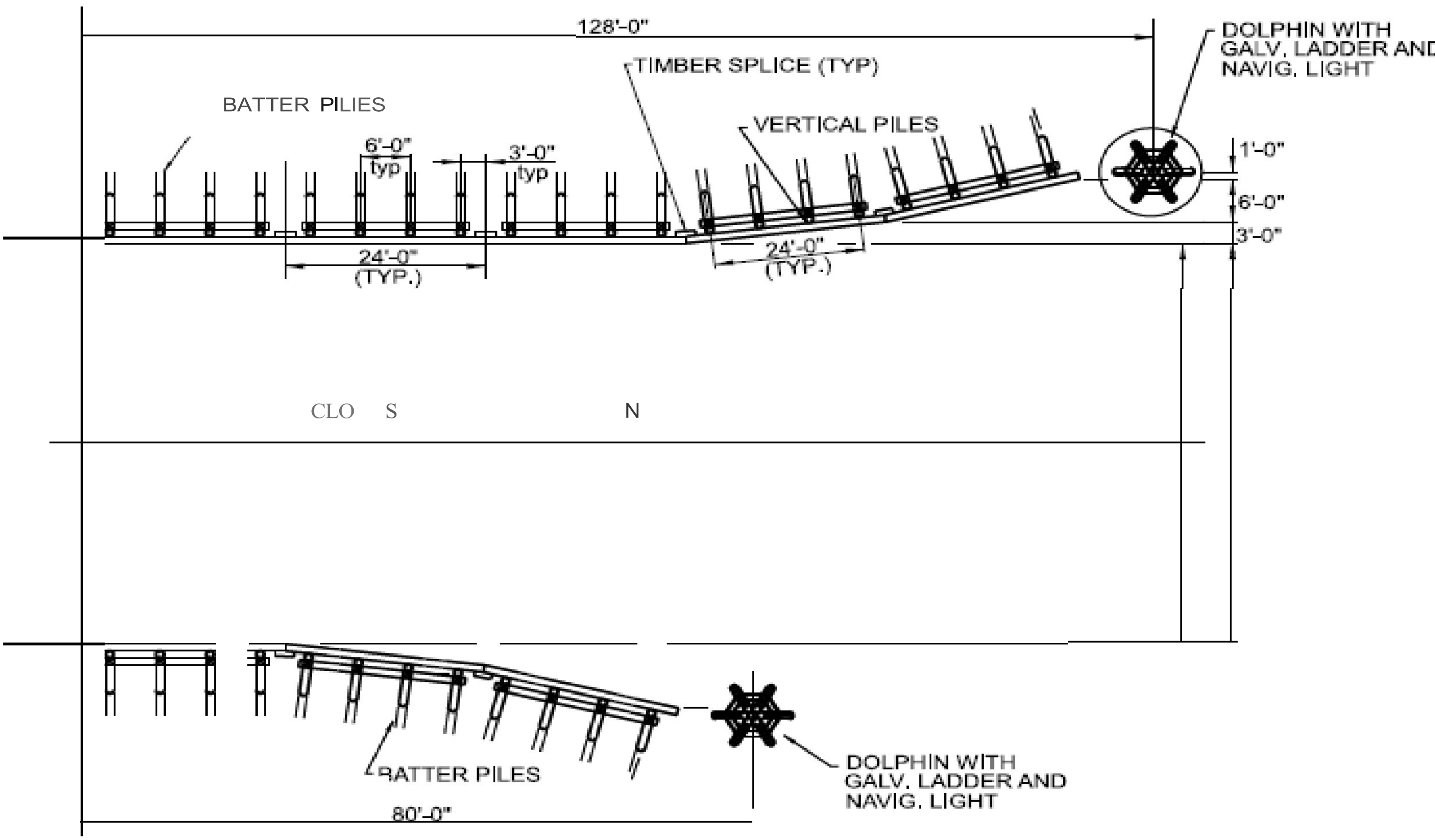


Figure 5: Plan – Guide walls, Fenders, and Dolphins

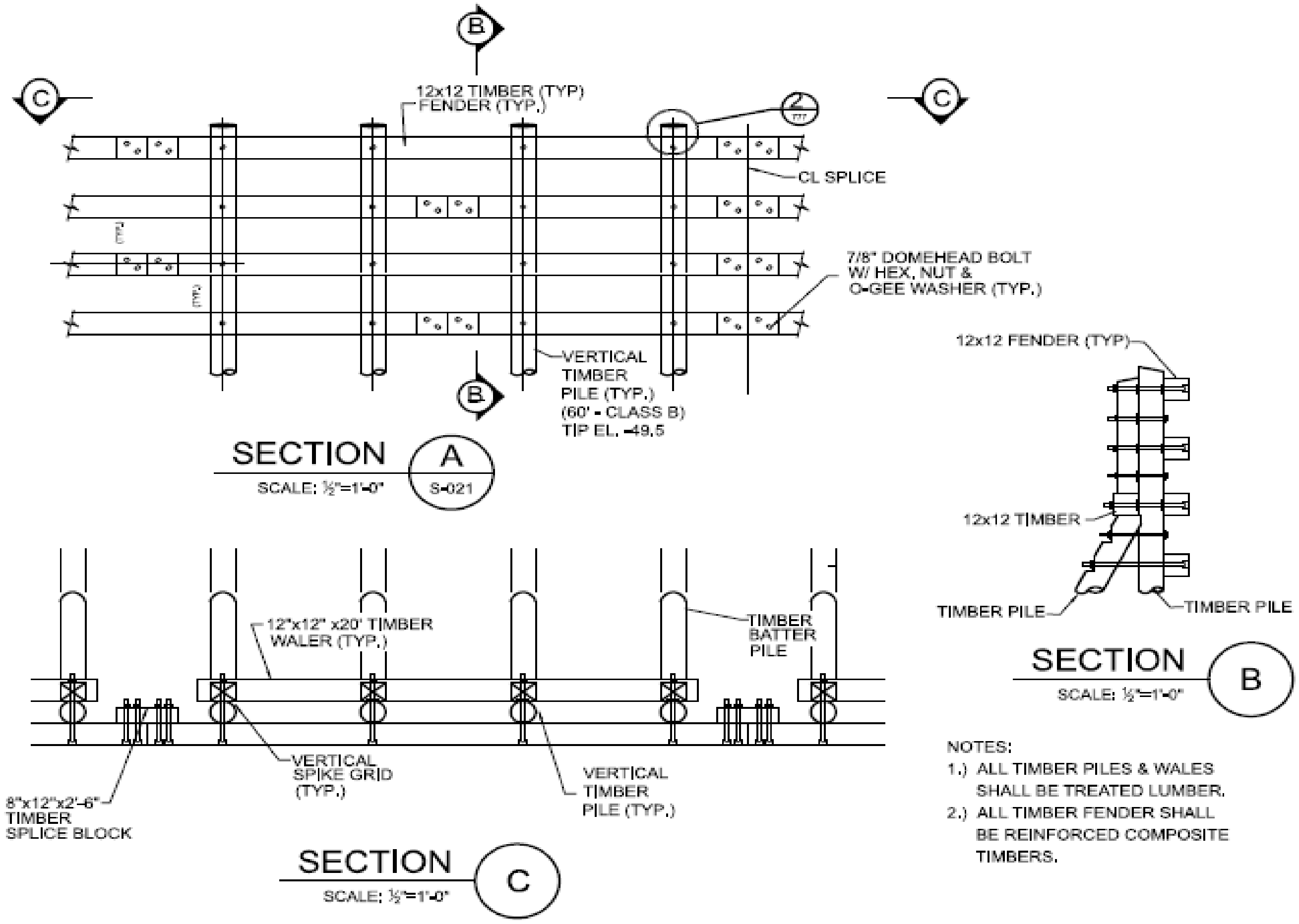


Figure 6: Guide wall Details

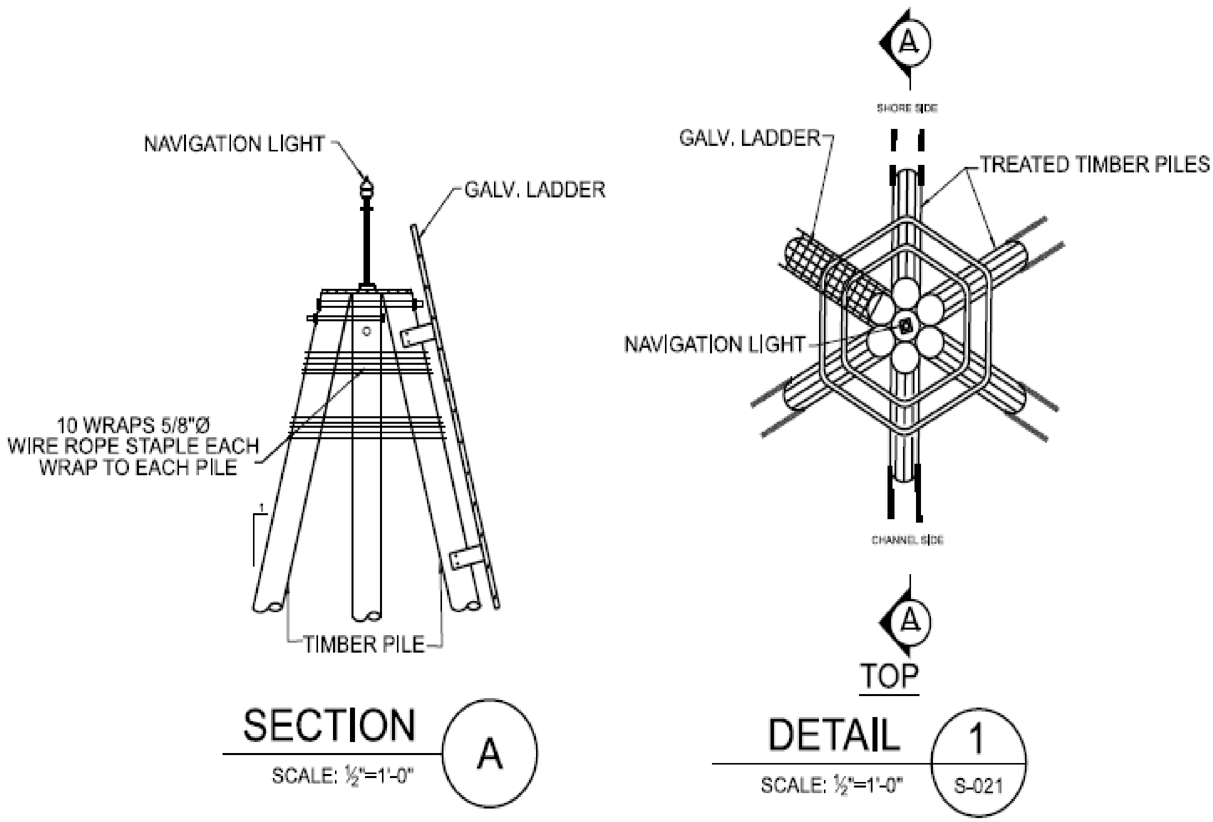


Figure 7: Dolphin Details

T-walls would extend from each side of the floodgate and tie into the adjacent levees. The floodwalls would have a top elevation of +16.50 feet (NAVD88). The T-wall monoliths vary with the tallest walls adjacent to the barge gate and the shortest walls that tie into the adjacent levee. Details on a typical section of floodwall are provided in Figure 8.

The design of the new barge gate and floodwalls, including the foundation, is subject to change once detailed geotechnical investigations are conducted during detailed design.

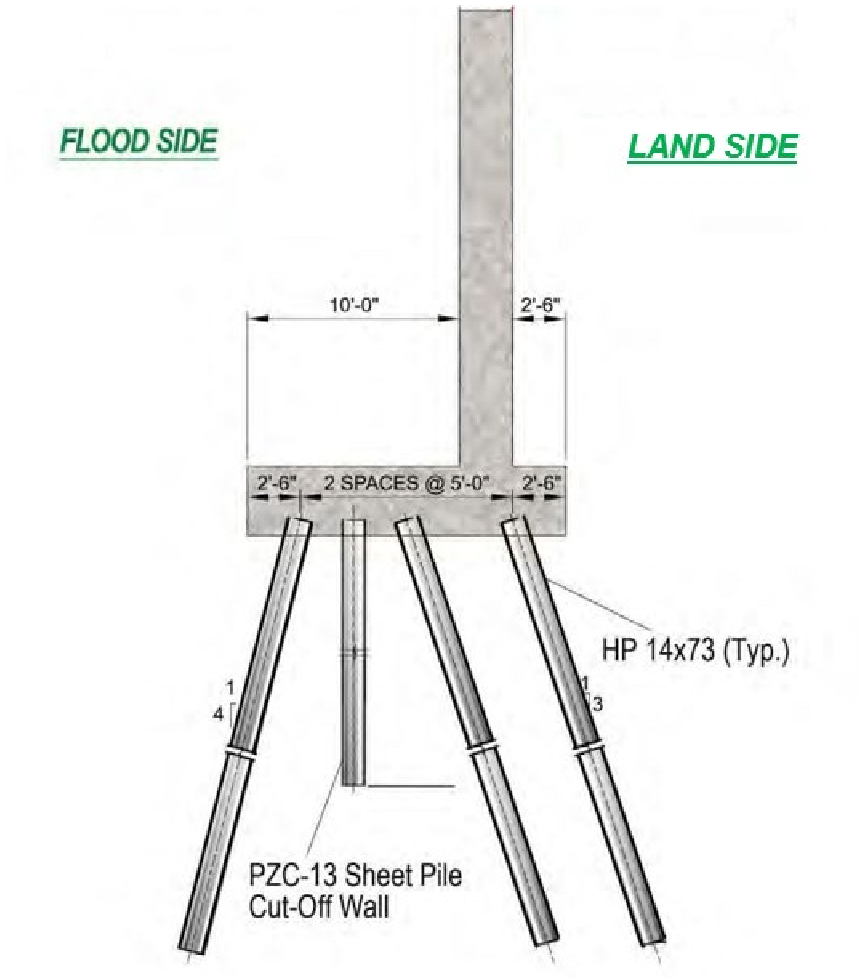


Figure 8: Typical Floodwall

The barge gate would be constructed approximately 600 feet south of the existing sector gate floodgate in Bayou Lafourche. The existing centerline of Bayou Lafourche has an approximate elevation of -12.3 feet (NAVD 88). For the construction of the gate foundation, the channel would be excavated to an approximate elevation of -18.8 feet with the final constructed sill elevation being -12.3 feet. Directly adjacent to the floodgate slab, both on the land and the flood side of the gate, would be excavated to EL. -15.3 feet (NAVD 88) to place both the bedding stone and the riprap required. The channel bottom would remain at EL. -12.3 feet (NAVD 88). The channel would match the sill elevation at approximately EL. -12.3 feet (NAVD 88) on both the land and flood side of the gate to afford aquatics the ability to migrate past gate sill.

The cross section at the gate location would be designed such that the pre and post project conditions would not impede the natural movement of aquatic organisms. The default operation would be open to avoid additional indirect impacts to vegetation and

fish and wildlife due to changes in the natural hydrologic regime. The floodgate would be opened as soon as is safely possible after a closure for storm passage.

The velocities around and through the gate may require the channel bottom to be layered with 2-feet of riprap. The riprap is required in the channel, extending approximately 100 linear feet on both the land side and the flood side. After dredging the channel to El. -15.3, bedding would be placed on separator geotextile with the riprap on top of the bedding. A riprap gradation is assumed to be class 250 - 1000 lb stone (LADOTD 2016, Section 711). See Table 1 for example gradation limits for individual stone.

Table 1: Riprap Gradations

Gradation Limits Individual Stone Size (lbs)	Spherical Diameter (ft)	Percent Finer (By Weight)
1250	2.50	100
500	1.83	45-100
250	1.46	15-50
80	1.00	0-15

The barge gate would be constructed approximately in the center of the existing channel. The bypass channel would be constructed immediately adjacent to and to the west of the barge gate cofferdam footprint prior to beginning construction of the floodgate to allow safe navigational passage of marine traffic, as well as all aquatic organisms to pass safely until the floodgate structure is complete (Figure 10).

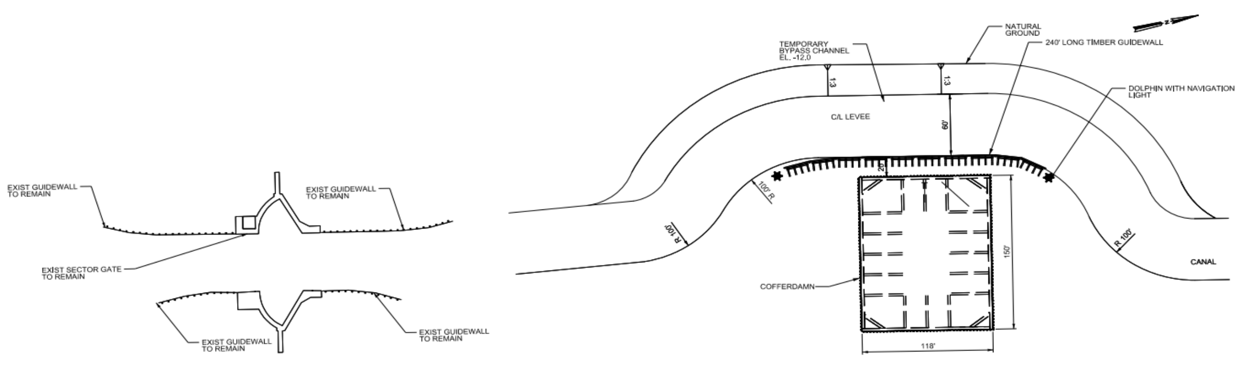


Figure 10: Preliminary design for bypass channel

Preliminary designs of the bypass require a minimum bottom channel width of 60-foot for the temporary bypass channel with an invert of EL. -12.3'. Based on the preliminary design, the by-pass channel would be approximately 650 feet long. However, navigation of common local vessels would be considered for the bypass channels, and design features of a navigable bypass channel would be developed during detailed design. At a minimum, to maintain pre-construction flow conditions, navigation and minimize environmental impacts during construction, the temporary bypass channels would be similarly sized to the channels being impacted. A timber guide wall (similar to the permanent guide wall) would be constructed to prevent the cofferdam from vessel impact while the cofferdam is in place.

A total of 27,665 cy of material would be excavated from the channel for gate complex, bypass channel, and floodwall tie-in construction. If the dredged material is found to be suitable for use within the project levee footprint, the material would be used within the levee or could potentially be utilized for marsh restoration within the overall project footprint, otherwise the material would be hauled off site and disposed in accordance with all state and federal laws.

Once navigation is routed through the temporary bypass channel, a Phase 1 cofferdam (approximately 150 feet x 118 feet) would be constructed to permit the in the dry construction of the barge gate concrete landing slab, pivot arm assembly, receiving structure concrete monoliths, and the sluice gate concrete monoliths. The cofferdam would be an internally braced cofferdam with wide flange wales and pipe braces supporting PZ sheet piling. Reduced power would be required for vessels passing through the construction area to reduce the risk of impact to the cofferdam.

Once construction of the barge gate landing slab, pivot arm assembly and receiving structure monoliths are completed, navigation would be re-routed through the permanent barge gate structure. After construction, the bypass channel is assumed to be included in the footprint of the structure site and the channel flow would be rerouted through the new structure feature. Once navigation is re-routed through the new floodgate, the Phase 2 cofferdam would be constructed and permanent guidewalls and pile clusters, tie-in T-walls, and final civil site work can be completed. The Phase 2 cofferdam (approximately 60 feet x 80 feet on both sides of the floodgate) would be constructed to permit the construction of the T-walls adjacent to the sluice gate structures that would be in the water.

2.24.4 Construction Duration and Equipment

The construction duration of the Larose Floodgate would be 24 months with an assumed work schedule of 5 days a week, 8 hours a day. The barge floodgate would be constructed using both floating equipment and land support. Below is the preliminary list of equipment anticipated to be utilized for the construction of the floodgate.

Table 2: Preliminary Equipment List for Sector Gate and Floodwall Construction

Project Component	Duration (days)	Equipment Used

Barge Gate Complex & Tie-In Floodwall	730	150-Ton Crane
		80-Ton Crane
		Excavator
		Pile Driver
		Concrete Trucks
		Concrete Vibrators
		Welding Machine, Cutting Torch
Tie-In Levee		Dump Trucks
		Bull Dozers
		Fill Compactor
		Front End Loader/Backhoe
		Fuel Tanks
		Generator

2.24.5 Access and Staging

In general, construction site access would be obtained by traveling down LA Highway 1 into the town of Larose. Please see Figure 11 below for a map of the proposed access routes to the project site. Due to the suburban residential location of the new floodgate, the construction staging area is currently unknown and would need to be negotiated onto available space nearby. The staging area would have a crushed stone on top of a separator fabric. Upon completion of the project, the staging area would be returned to pre-construction condition. The staging area would be used as an operations and materials storage area. The contractor would place the project trailers for both the Government and the contractor within the staging area. The contractor would store the project equipment and project building supplies within the staging area.

Figure 11: Project site access

2.25 REACH LAROSE C-NORTH, GIWW FLOODWALL & HIGHWAY 24, 657 & 3235 ROADWAY FLOODGATE

2.25.1 Location

The GIWW floodwall would be constructed along the Gulf Intercoastal Waterway with multiple start and stop points. The floodwall starts near the intersection of Highway 24 and Highway 3235 with a latitude 29°33'50.0249", long -90°23'05.5395" and continues to latitude 29°34'14.5688", long -90°22'54.3931". The floodwall begins again at latitude 29°34'19.7321", long -90°22'59.1906" and continues to latitude 29°35'25.2275", long -90°22'10.7087".

Figure 1: Location Map

2.25.2 Scope of Work

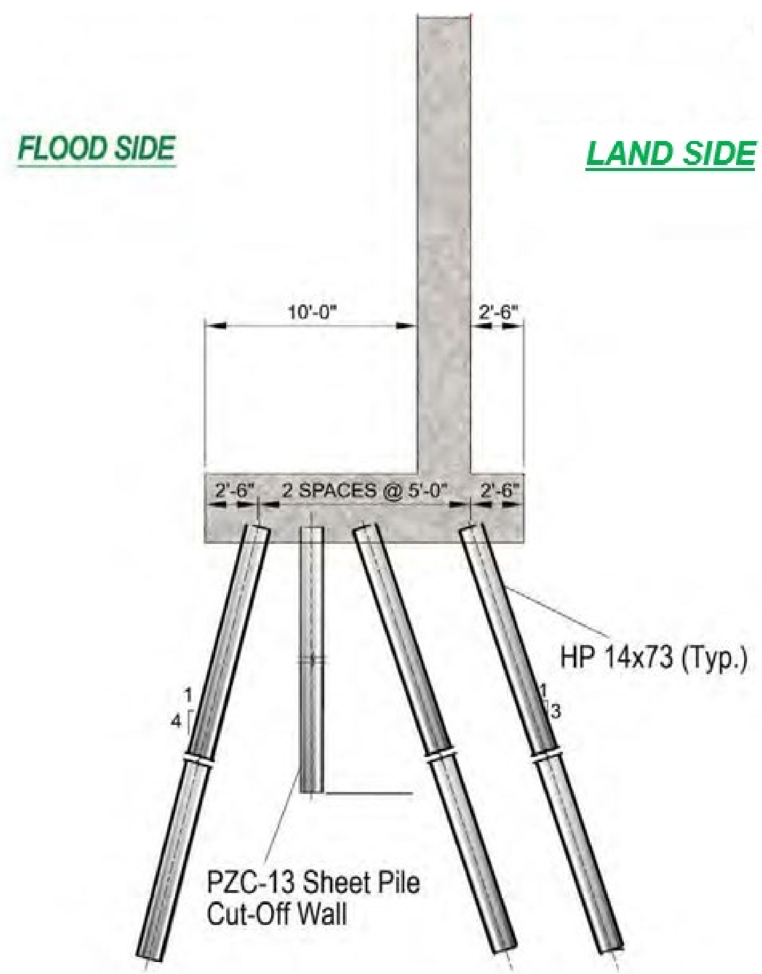
This contract would consist of the construction of floodwall and 3 roadway floodgates, one at Highway 3235, another floodgate at Highway 24 and finally a roadway floodgate at Highway 657. The construction will be done from both land and water-based equipment. Where the floodwalls tie into adjacent levee sections the transition between levee and floodwall would be protected with concrete or grouted riprap to prevent scour at this transition.

2.25.3 Structure Description

The structures to be constructed as part of this contract includes approximately 2.5 miles of floodwall with 3 roadway swing gates: one at Highway 3235, another floodgate at Highway 24 and finally a roadway floodgate at Highway 657 with a top elevation of

16.5 NAVD88 and a width of 36-ft for all floodgates. The T-wall would be constructed on pile foundations with concrete base slabs and stems to the 2085 elevation +16.5 feet (NAVD 88). It is anticipated that this floodwall would be constructed at grade minimizing the requirement for any significant excavation. The roadway gate concrete monoliths will be constructed in two halves to permit traffic flow during construction of the flood gate. All traffic control required under this contract would conform to LADOTD Standards. See Figure 2 below for conceptual floodwall cross section.

A swing gate is a structure that is composed of two or more horizontal girders, vertical intercostals, vertical end diaphragms, a skin plate, and diagonal braces. In most cases, swing gate closures consist of a single gate leaf for openings up to 40-feet. Swing gates are mounted on hinges and swung open and closed like a door. The swing gate would provide an opening in the system to allow unimpeded traffic flow, except when a tropical



system approaches the Gulf of America in which the gate would be closed. Please see Figure 3 and 4 below for more details on the swing gate.

Figure 3: Swing Gate Closure Structure

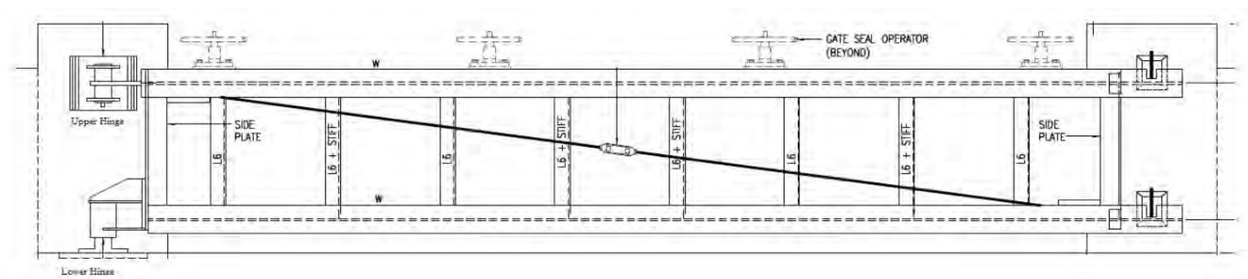


Figure 4: Typical Swing Gate Closure Structure Elevation

The design of the new T-walls and Swing gate, including the foundation, is subject to change once detailed geotechnical investigations and detailed design are conducted.

Nine-inch concrete scour protection or grouted riprap would be used at the levee/ T-wall transition. The concrete scour protection the levee where the T-wall stem extends into the full levee section and extend down both levee slopes. The scour protection would continue for 30 linear feet past the end of the T-wall. Uncapped cut-off sheet piling would extend horizontally 30 feet into the full levee section for erosion and seepage control. Please see Figure 5 below for an example of the proposed scour protection.

Figure 5: Concrete Scour Protection Example

2.25.4 Construction Duration and Equipment

The construction duration of the GIWW Floodwall and Swing Gates would be 36 months with an assumed work schedule of 5 days a week, 8 hours a day. The floodwalls and swing gate will be constructed using both floating and land supported equipment. For a large portion of the floodwall, a sheetpile cofferdam will be constructed on floodside of the existing wall to enable to construction of the floodwall in the dry. Below you'll find **Table 3**, the preliminary list of equipment anticipated to be utilized for the construction of the Bayou Black Floodgate.

Table 3: Preliminary Equipment List for Floodwall Construction

Project Component	Duration (days)	Equipment Used
GIWW Floodwall and Swing Gates	1080	150-Ton Crane
		80-Ton Crane
		Excavator
		Pile Driver
		Concrete Trucks
		Concrete Vibrators
		Welding Machine, Cutting Torch
		Dump Trucks
		Bull Dozers

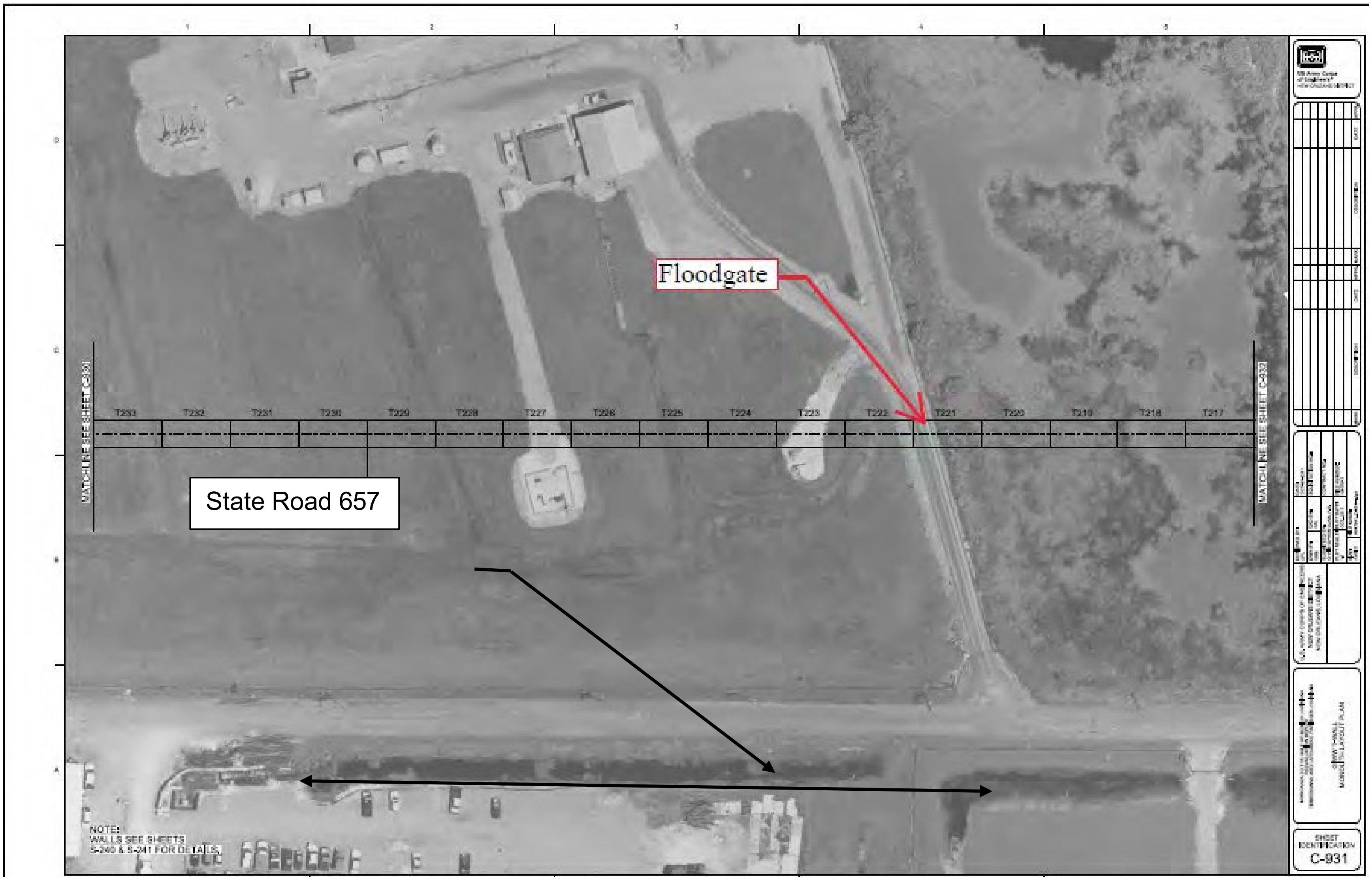
Tie-In Levee		Fill Compactor
		Front End Loaded/Backhoe
		Fuel Tanks
		Generator

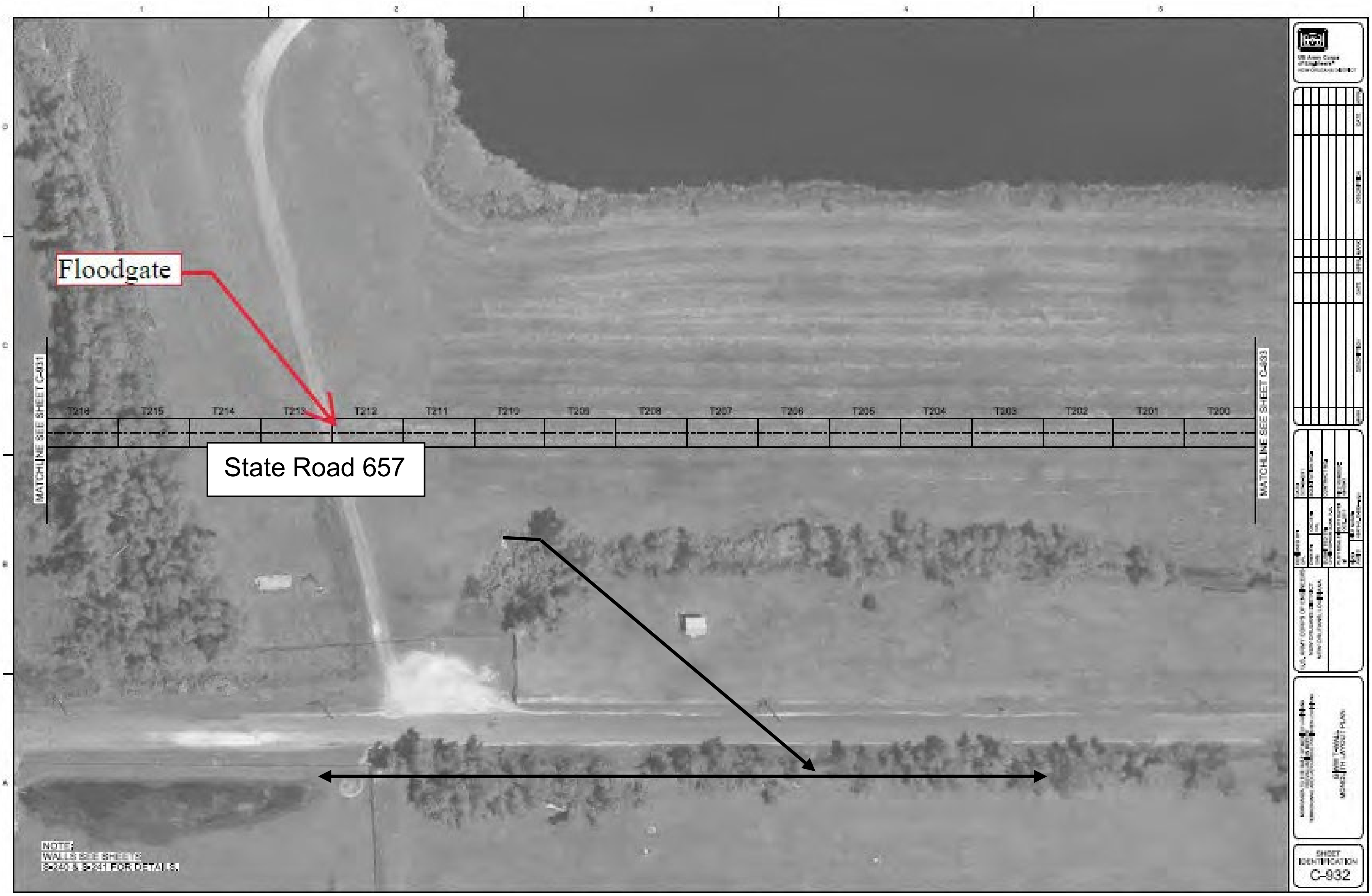
2.25.5 Access and Staging

Construction site access would be obtained by both water and land. Please see Figure 6 through 20 below for a map of the proposed access to the project site. There will be two construction staging area sites within the areas shown in Figure 6 through Figure

20. Staging area 1 would be within the neutral ground of Highway 3235, shown on Figure 20 and Staging area 2 will be within a cleared lot shown Figure 16. It is assumed the staging area 1 will be 100 feet by 300 feet and staging area 2 will be 100 feet by 100 feet. The staging area would have a crushed stone on top of a separator fabric. Upon completion of the project, the staging area would be returned to pre-construction condition. The staging area will be used as an operations and materials storage area. The contractor will place the project trailers for both the Government and the contractor. The contractor will store the project equipment and project building supplies within the staging area.

State Road 657


Floodgate
State Road 657
T233
T232
T231
T230
T229
T228
T227
T226
T225
T224
T223
T222
T221
T220
T219
T218
T217
NOTE:
WALLS SEE SHEETS
S-240 & S-241 FOR DETAILS.
SHEET IDENTIFICATION
C-931



Floodgate
State Road 657
T216
T215
T214
T213
T212
T211
T210
T209
T208
T207
T206
T205
T204
T203
T202
T201
T200
MATCHLINE SEE SHEET C-931
MATCHLINE SEE SHEET C-933
US Army Corps of Engineers
SHEET IDENTIFICATION
C-932

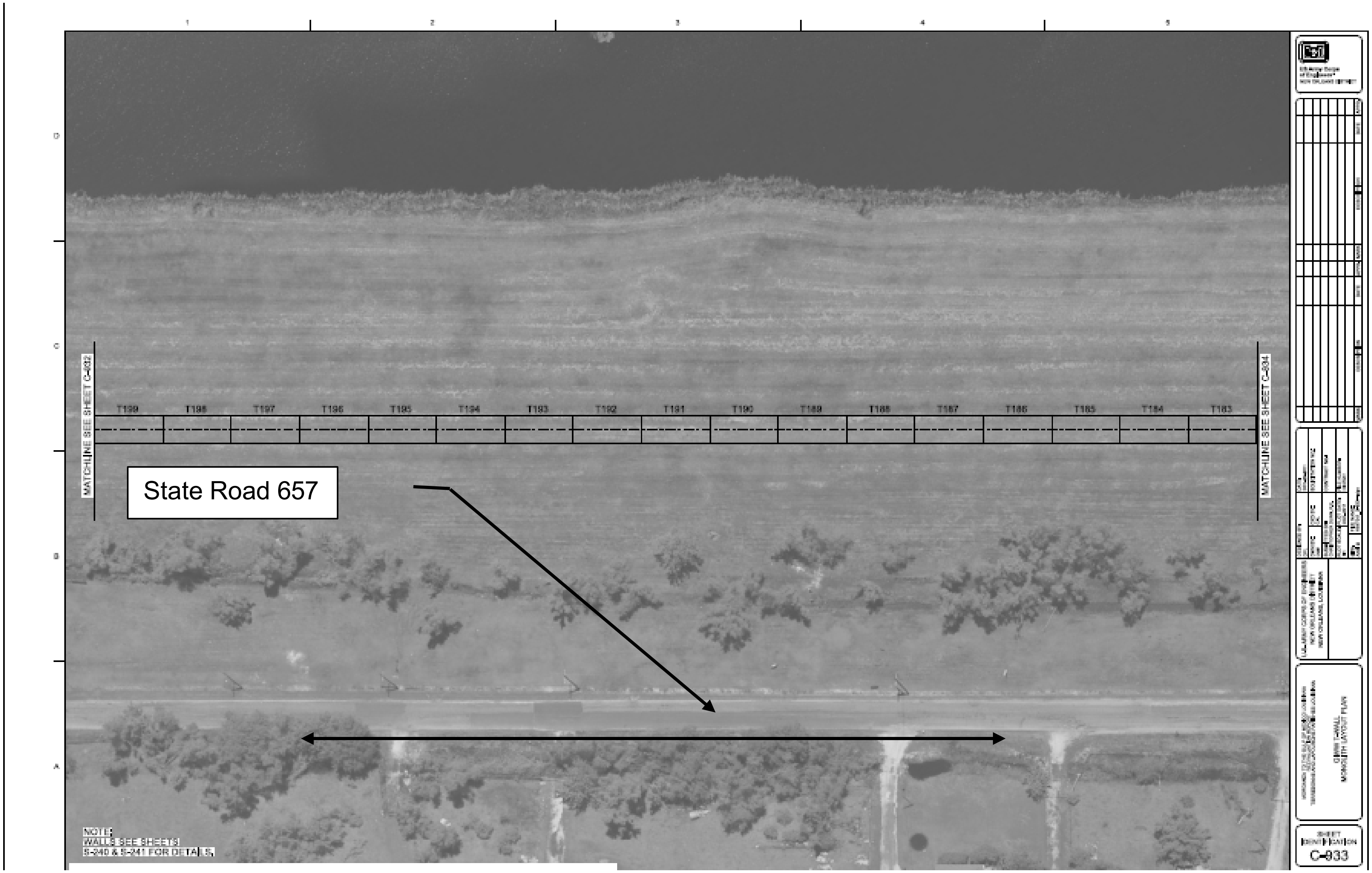


Figure 9: Access Map

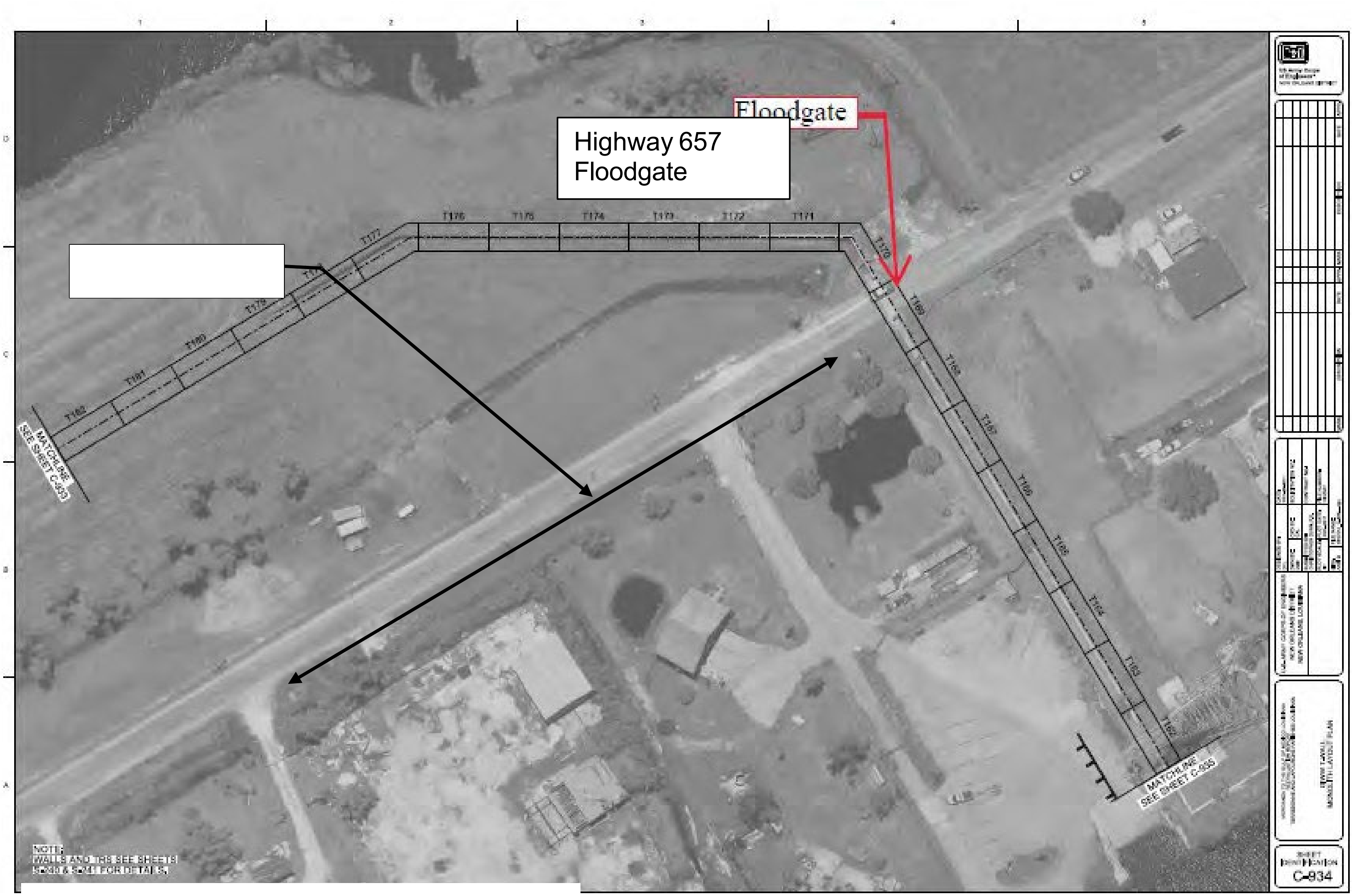
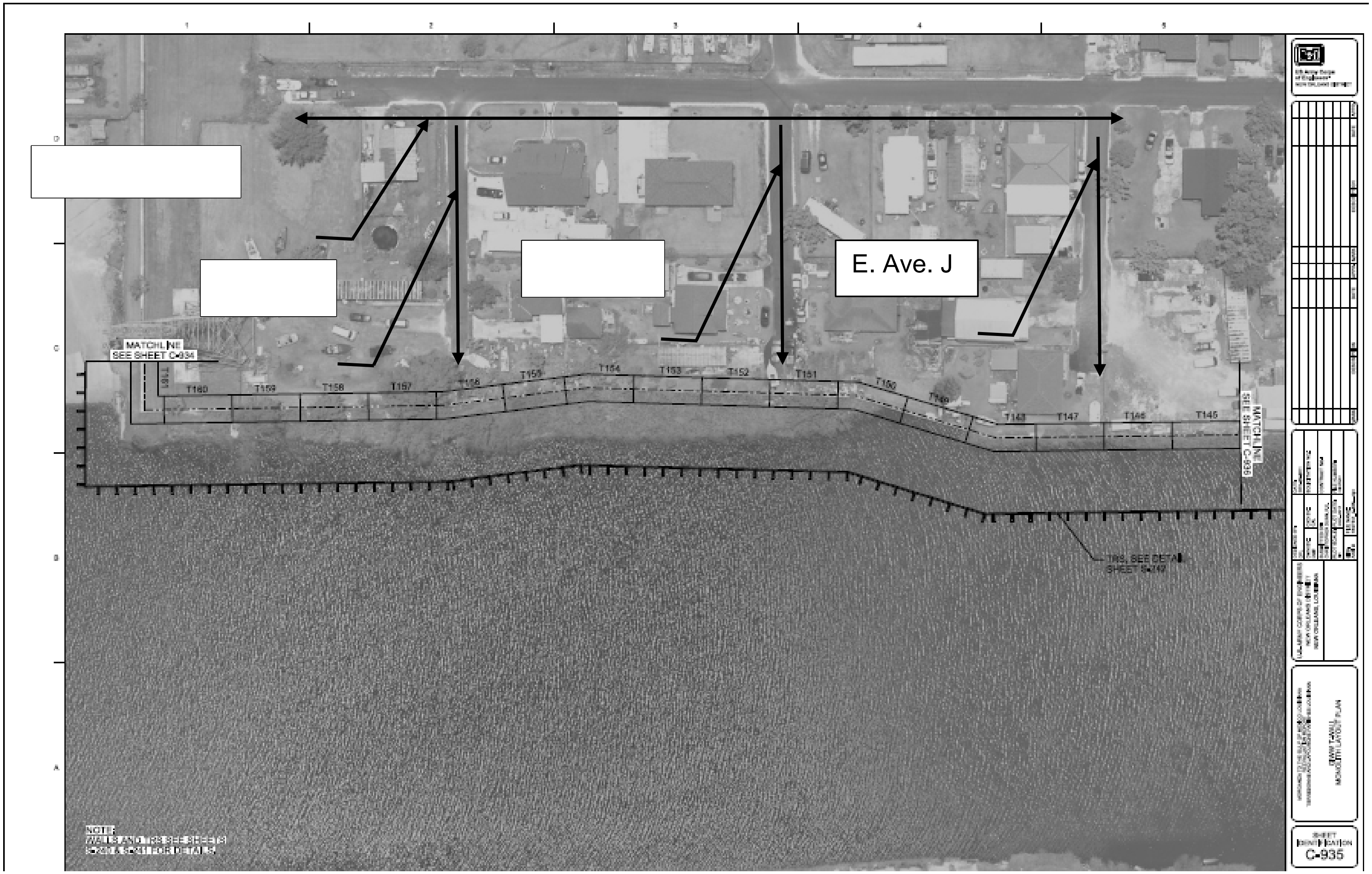
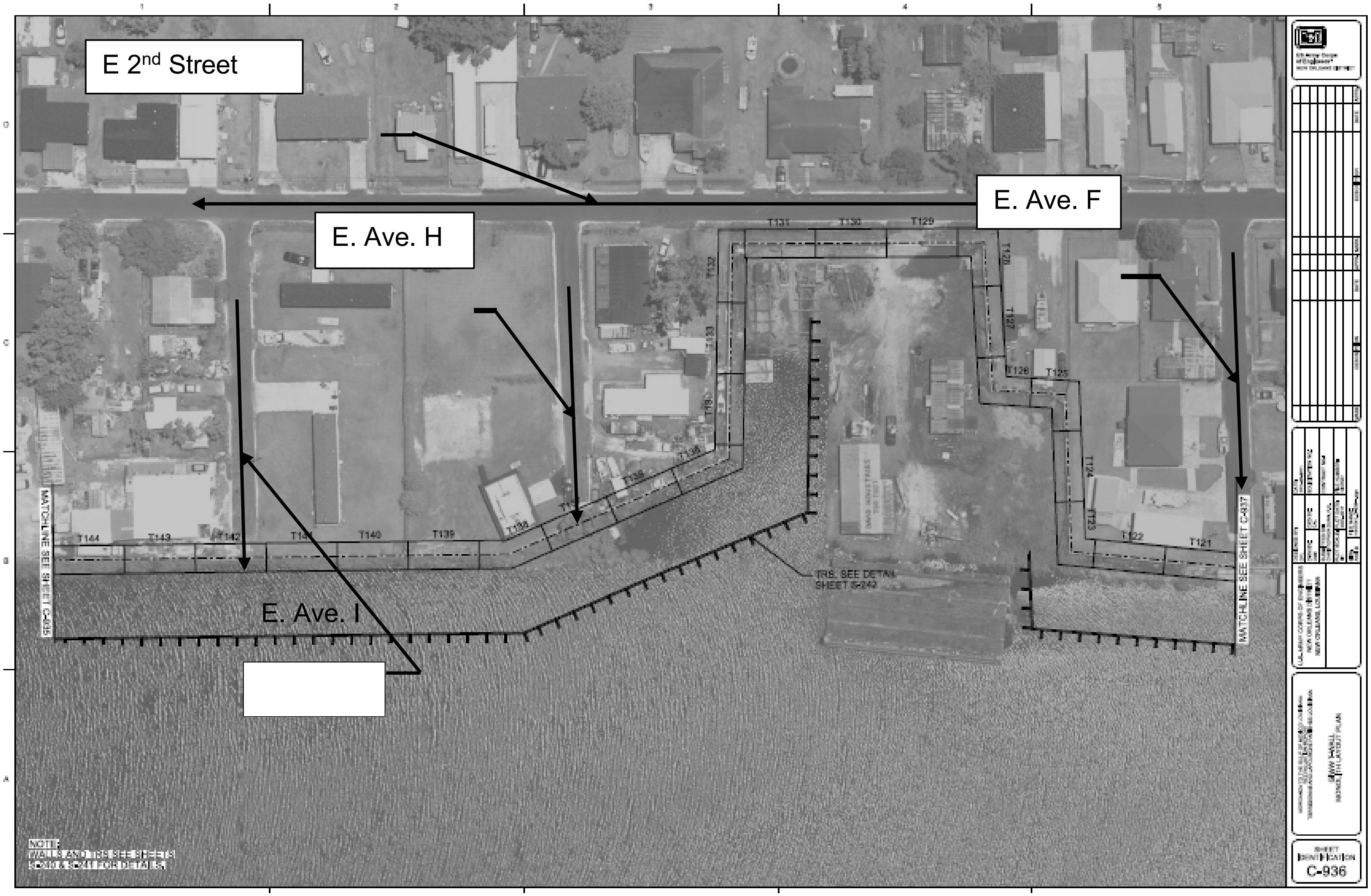
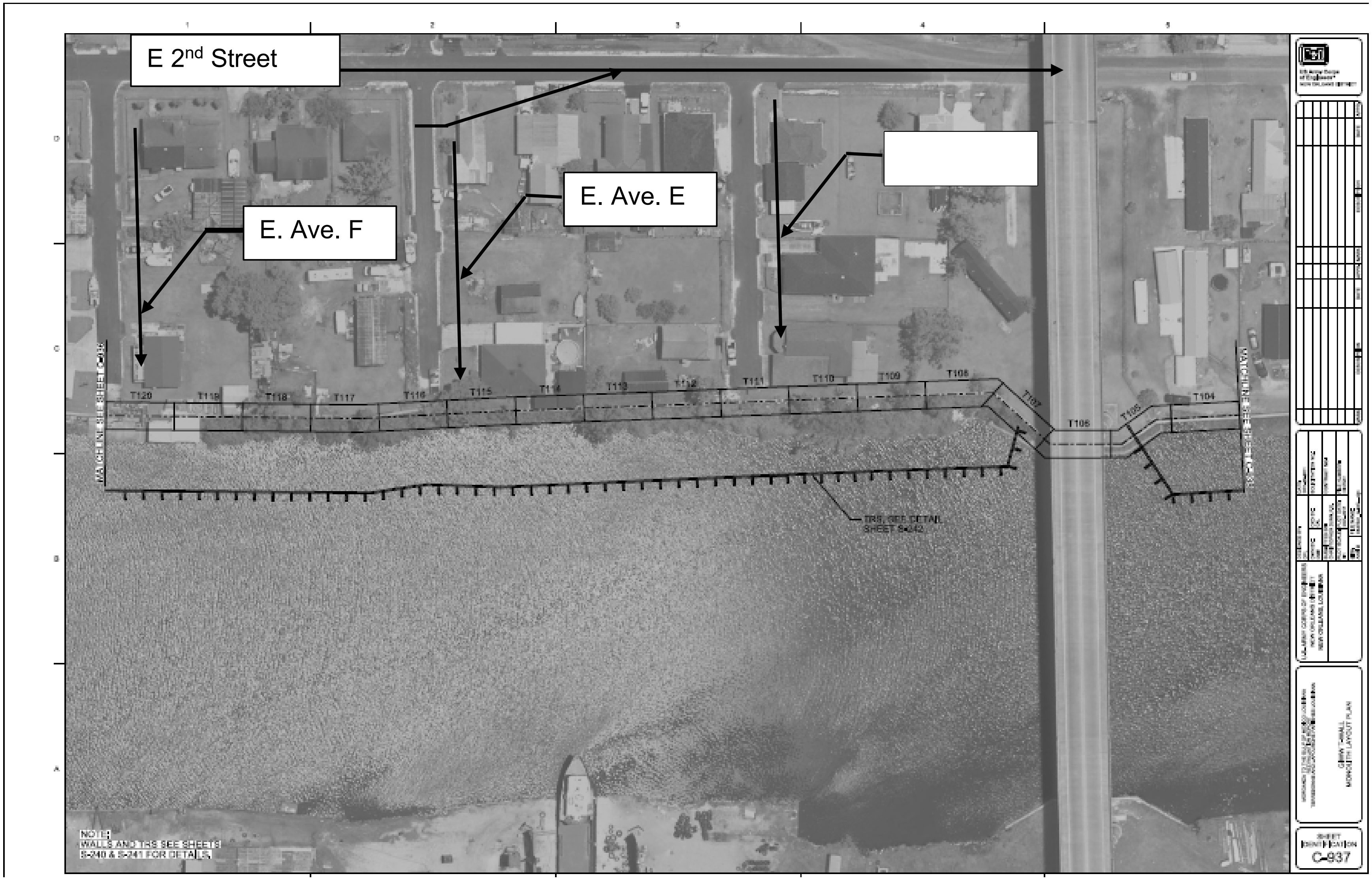


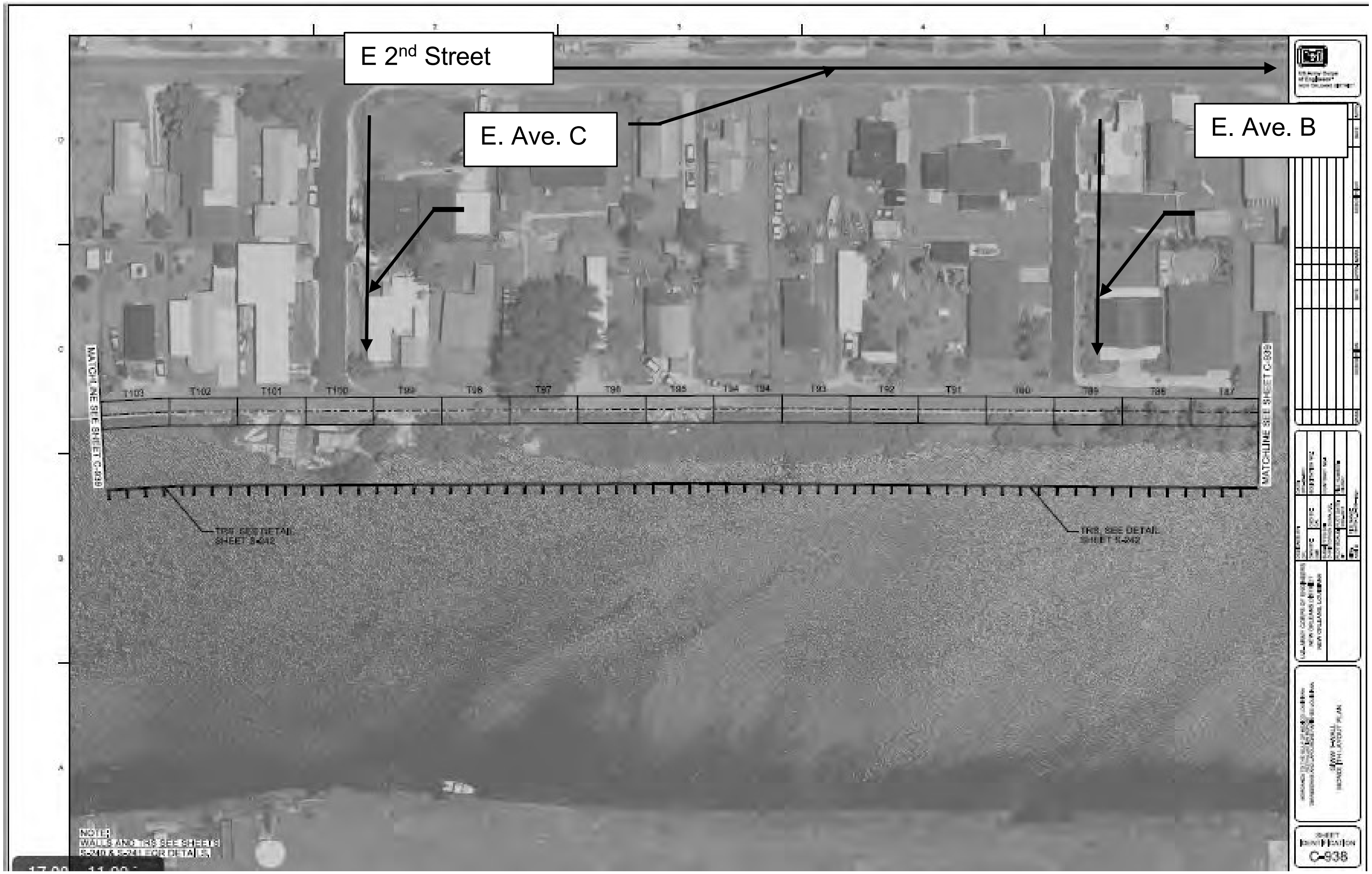
Figure 10: Access Map

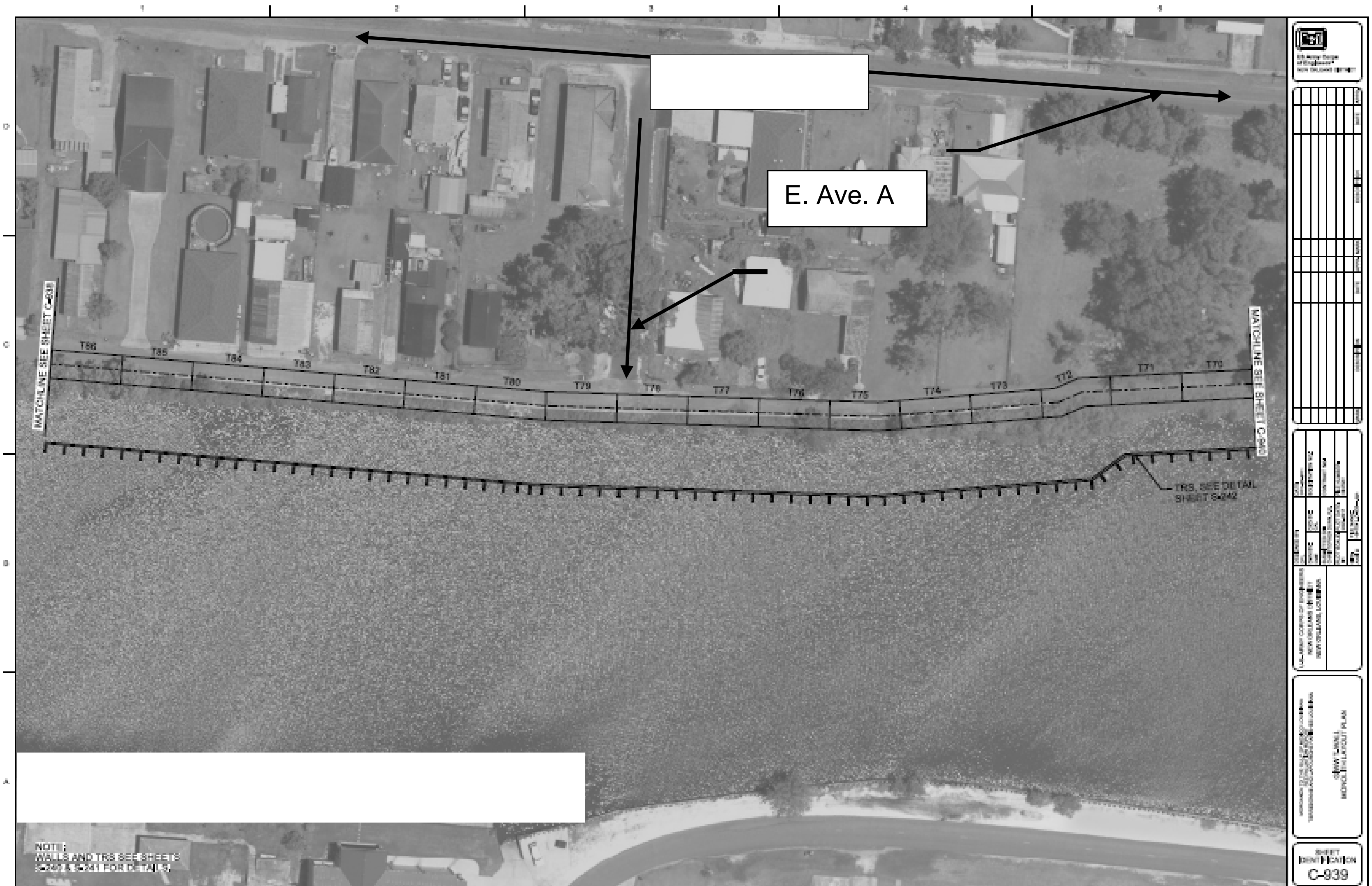

E. Ave. J
MATCHLINE
SEE SHEET C-934
T161
T160
T159
T158
T157
T156
T155
T154
T153
T152
T151
T150
T149
T148
T147
T146
T145
C-935

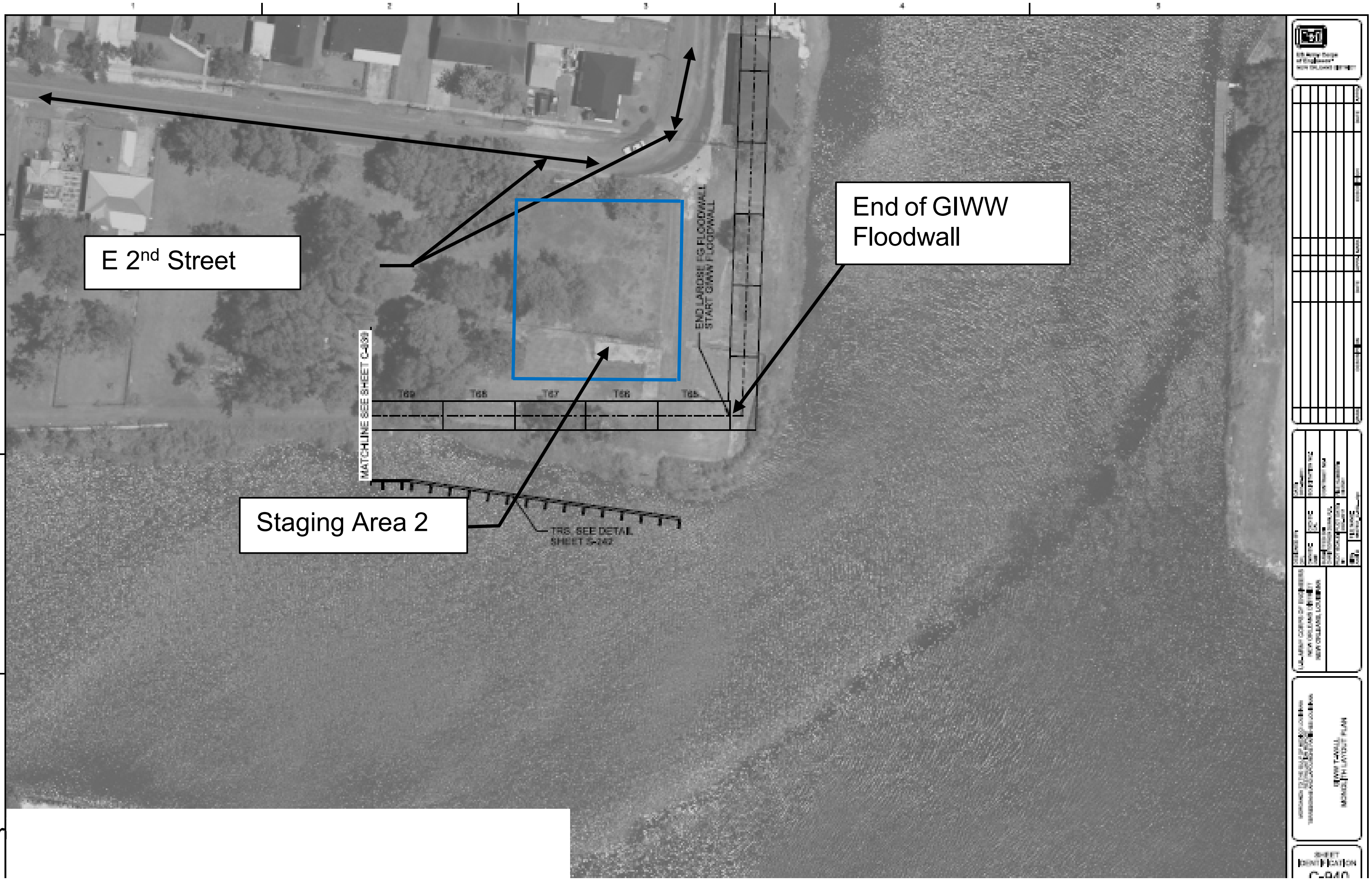


E 2nd Street
E. Ave. F
E. Ave. H
E. Ave. I
MATCHLINE SEE SHEET C-935
MATCHLINE SEE SHEET C-937
TRS. SEE DETAIL SHEET S-240
NOTE:
WALLS AND TRS SEE SHEETS S-240 & S-241 FOR DETAILS.
C-936

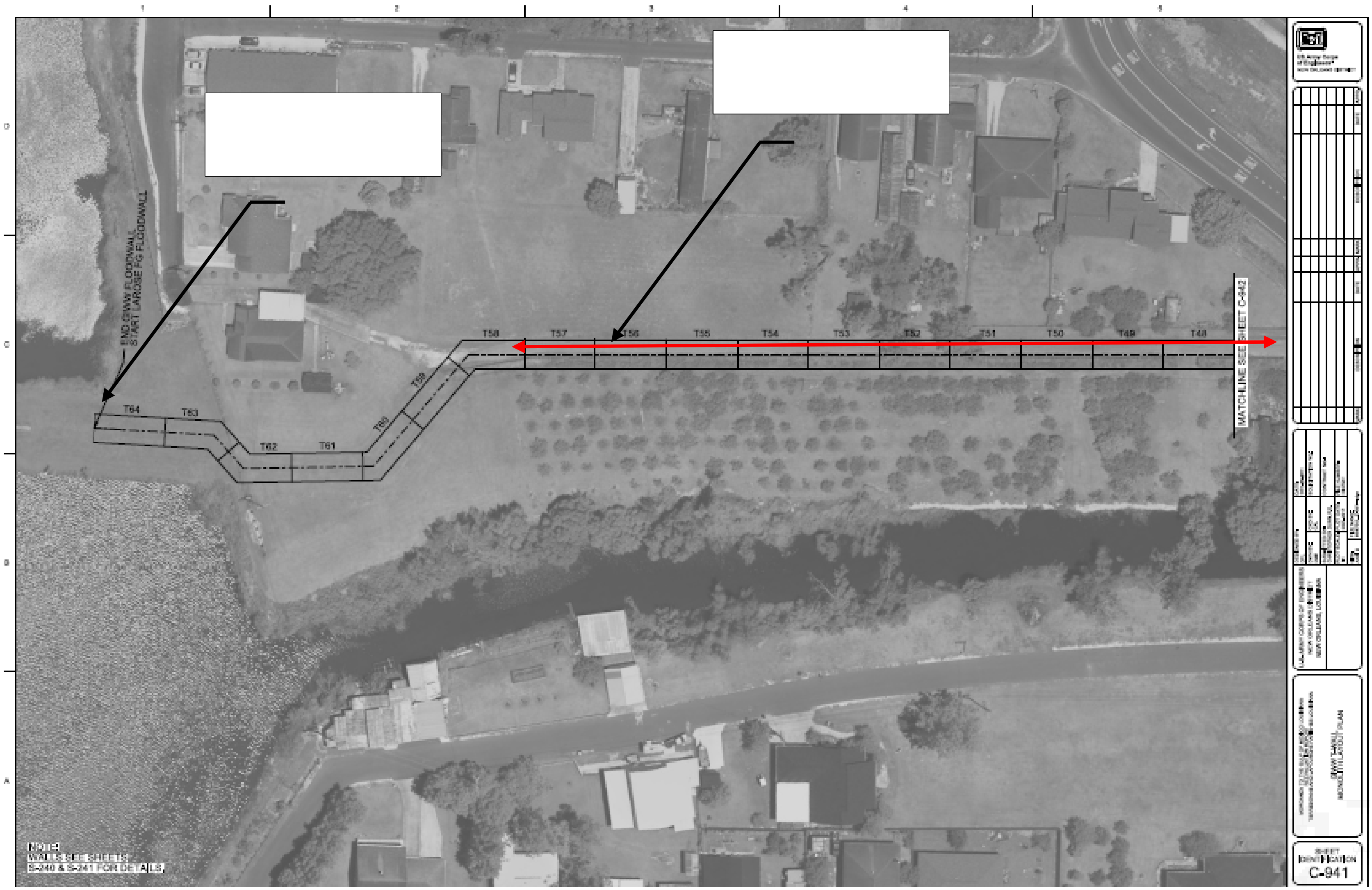

E 2nd Street
E. Ave. E
E. Ave. F
T120
T119
T118
T117
T116
T115
T114
T113
T112
T111
T110
T109
T108
T107
T106
T105
T104
TRS, SEE DETAIL SHEET S-242
NOTE:
WALLS AND TRS SEE SHEETS
S-240 & S-241 FOR DETAILS.
C-937

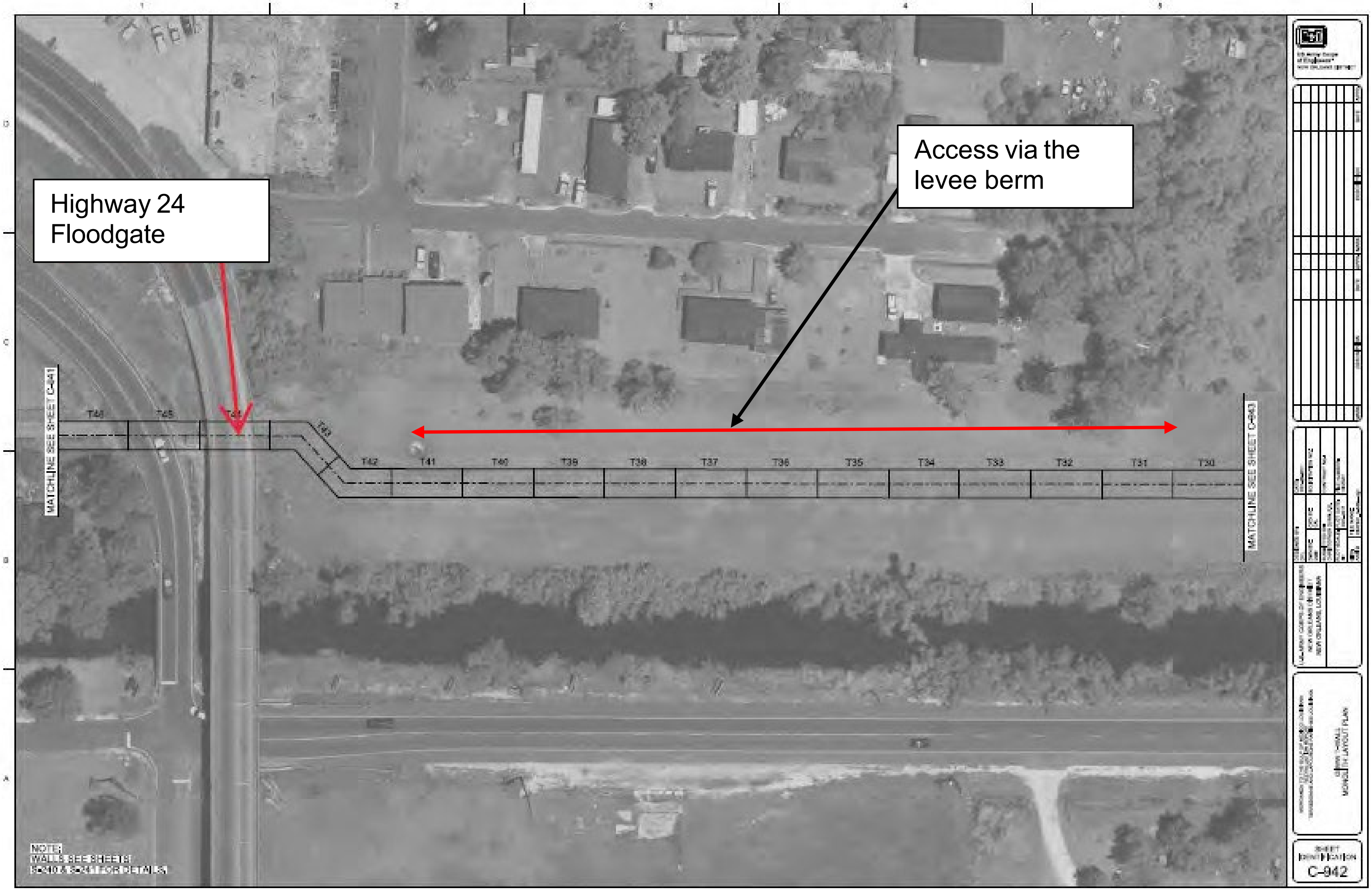

E 2nd Street
E. Ave. C
E. Ave. B
MATCHLINE SEE SHEET C-939
TRS, SEE DETAIL SHEET S-242
NOTE:
WALLS AND TRS SEE SHEETS S-240 & S-241 FOR DETAILS.
C-938


E. Ave. A
T86
T85
T84
T83
T82
T81
T80
T79
T78
T77
T76
T75
T74
T73
T72
T71
T70
MATCHLINE SEE SHEET C-940
TRS, SEE DETAIL SHEET S-242
NOTE:
WALLS AND TRS SEE SHEETS S-240 & S-241 FOR DETAILS
SHEET IDENTIFICATION
C-939

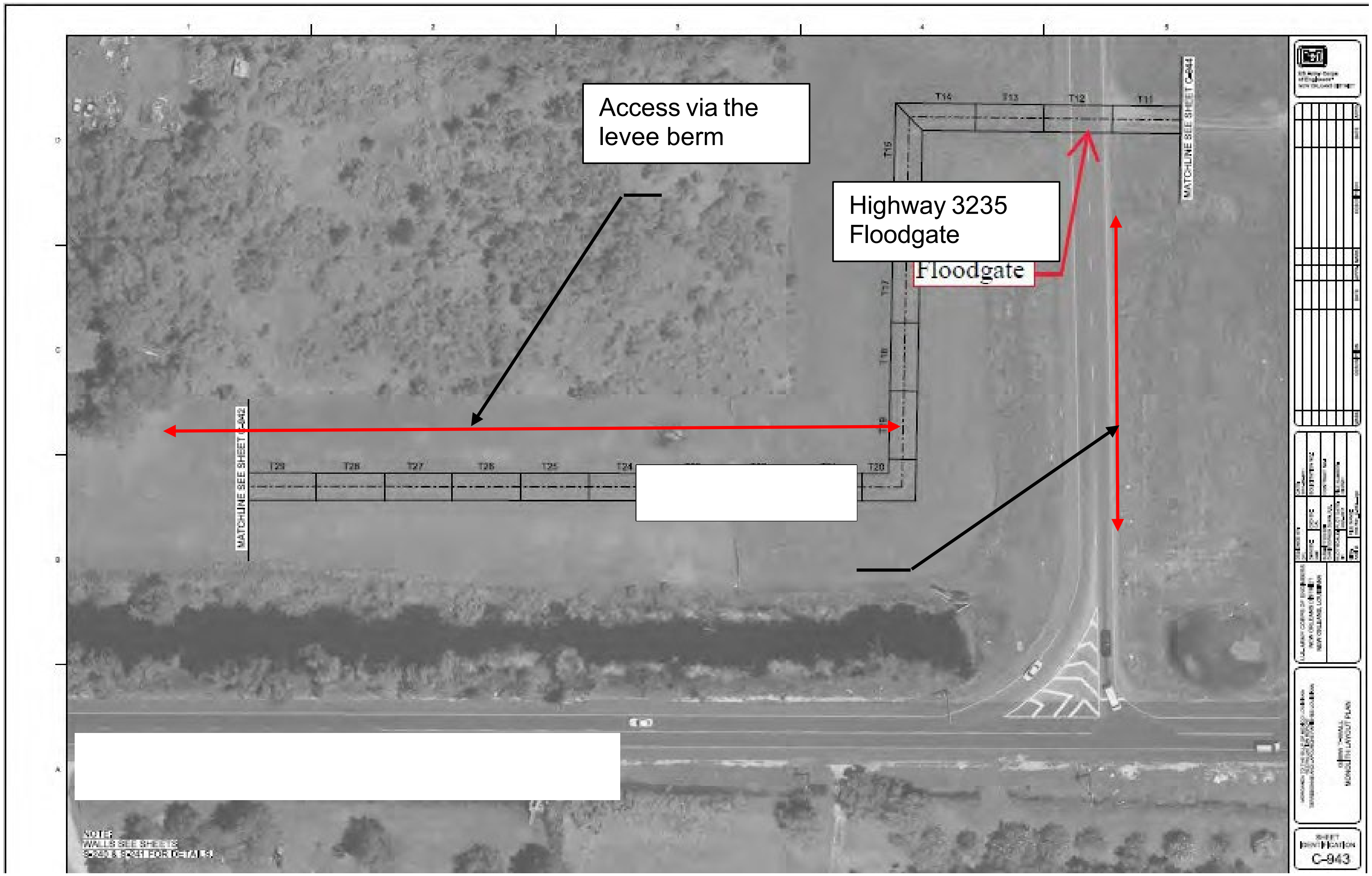

E 2nd Street
End of GIWW Floodwall
Staging Area 2
TRS. SEE DETAIL SHEET S-242

Figur


END GIWW FLOODWALL
START LAROSE FG FLOODWALL
T64
T63
T62
T61
T60
T59
T58
T57
T56
T55
T54
T53
T52
T51
T50
T49
T48
MATCHLINE SEE SHEET C-942
NOTE:
WALLS SEE SHEETS
S-240 & S-241 FOR DETAILS.
C-941



Highway 24 Floodgate
Access via the levee berm
T46
T45
T44
T43
T42
T41
T40
T39
T38
T37
T36
T35
T34
T33
T32
T31
T30
MATCHLINE SEE SHEET C-941
MATCHLINE SEE SHEET C-943
C-942



Access via the levee berm
Highway 3235 Floodgate
Floodgate
T14
T13
T12
T11
T15
T17
T18
T19
T20
T24
T25
T26
T27
T28
T29
MATCHLINE SEE SHEET C-942
MATCHLINE SEE SHEET C-944
NOTE:
WALLS SEE SHEETS
S-240 & S-241 FOR DETAILS
C-943

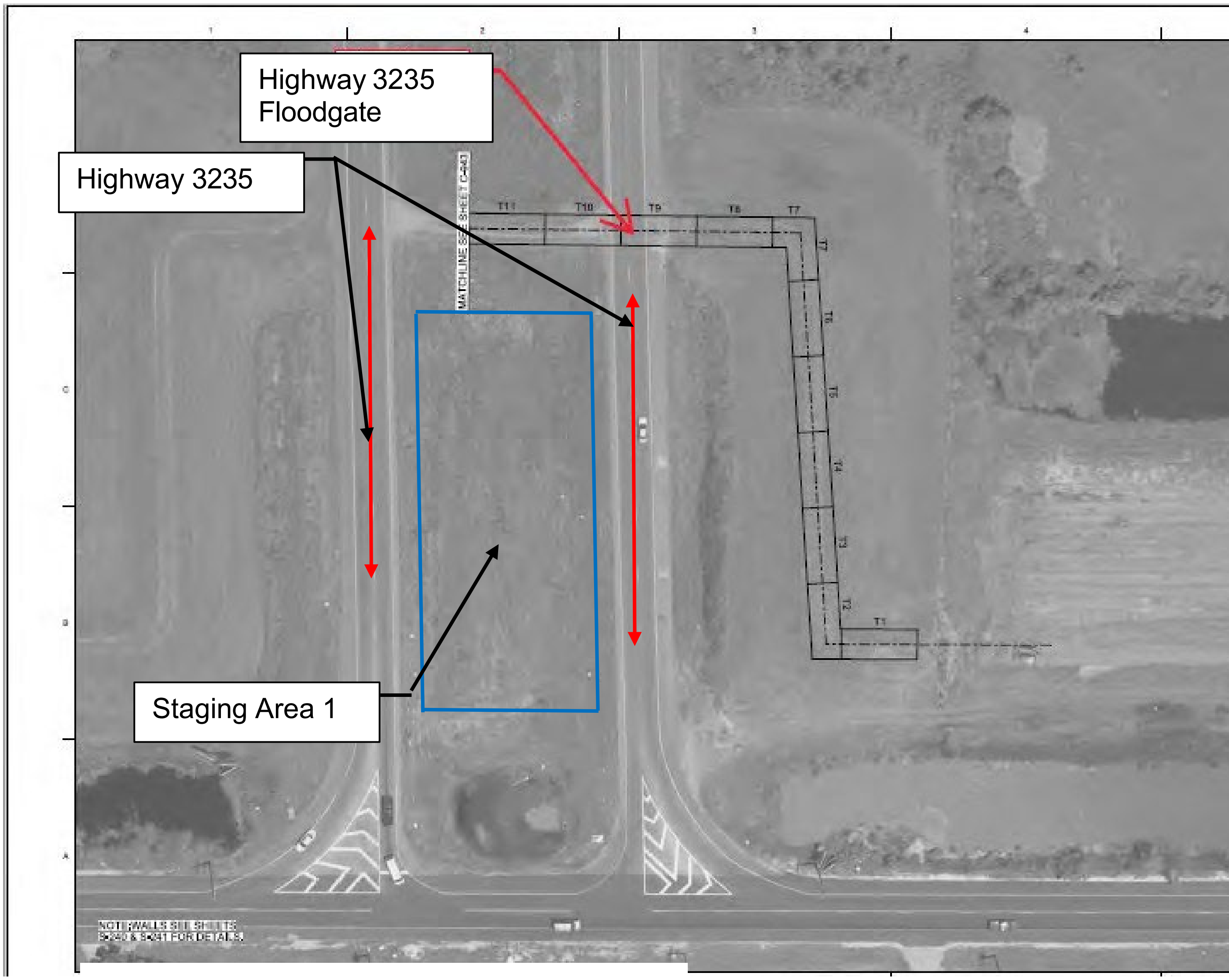


Figure 20: Access Map

Figure 20: Access Map

2.26 LOCKPORT TO LAROSE, PUMP STATION FRONTING PROTECTION #1

2.26.1 Location

The Lockport to Larose, Pump Station #1 Fronting Protection is located near Larose in Lafourche Parish, within the Lockport to Larose Reach of the larger MTG system at approximately latitude 29°35'54.75", Longitude -90°25'09.33" (Figure 1).

Figure 1: Location Map

2.26.2 Scope of Work

The proposed work consists of construction of a floodwall in front of an existing operating pump station. The floodwall would be constructed to fit between the existing pump station and the discharge basin (area where the pumps discharge the rainwater). In addition to the floodwall, the proposed action includes installing a valve within each of the existing pump station discharge pipes that could be closed to prevent storm surge from backflowing to the land side of the system through the discharge pipe. Finally, the transition between levee and floodwall would be protected with concrete or grouted riprap to prevent scour at this transition.

2.26.3 Structure Description

A floodwall would be constructed in front of the existing station and the discharge pipes would be extended through the newly constructed T-walls with a top elevation of +13 ft NAVD88 (Figure 2). A butterfly valve would be placed within each discharge pipe that would always remain open except when a name storm enters the Gulf. The butterfly valve would be able to be remotely operated from the pump station control panel as well locally at the butterfly valve itself. The pipe discharge bell would be relocated to the floodside of the system and discharge onto a portion of the t-wall slab and new riprap that would be placed as part of this contract.

The approximate length of the inverted T-type floodwall would be 500 total linear feet. The T-wall would be constructed on pile foundations with concrete base slabs and stems to the 2085 elevation +13 ft (NAVD 88) (Figure 3). It is anticipated that this floodwall would be constructed at grade minimizing the requirement for any significant excavation.

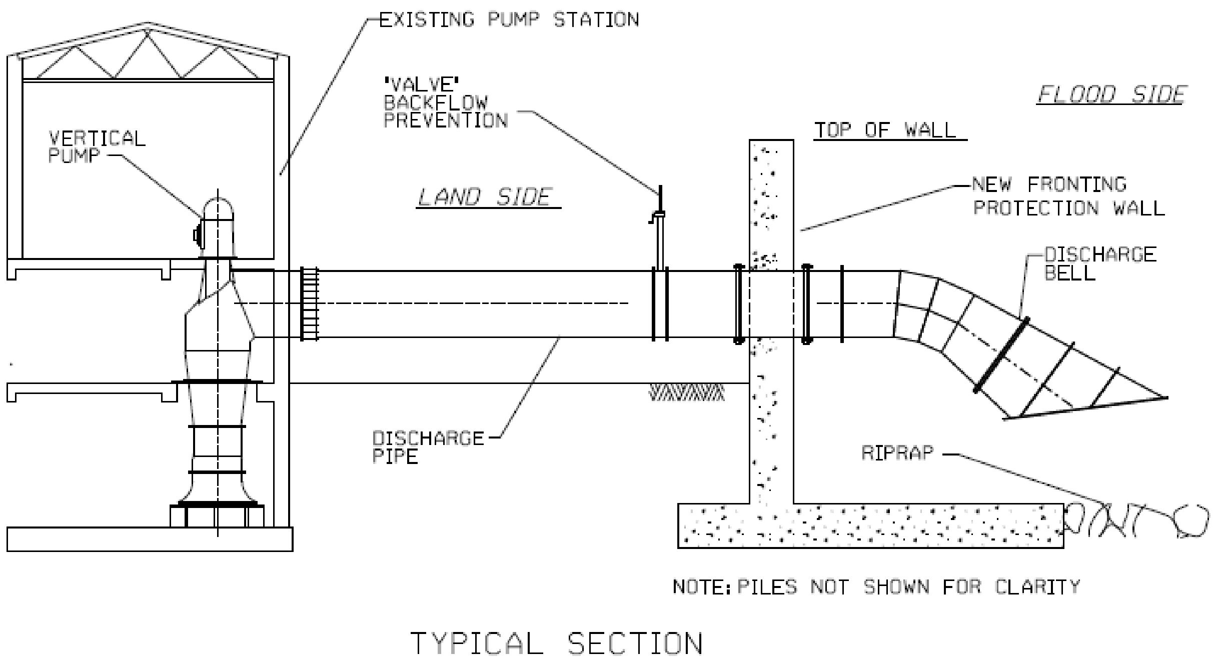
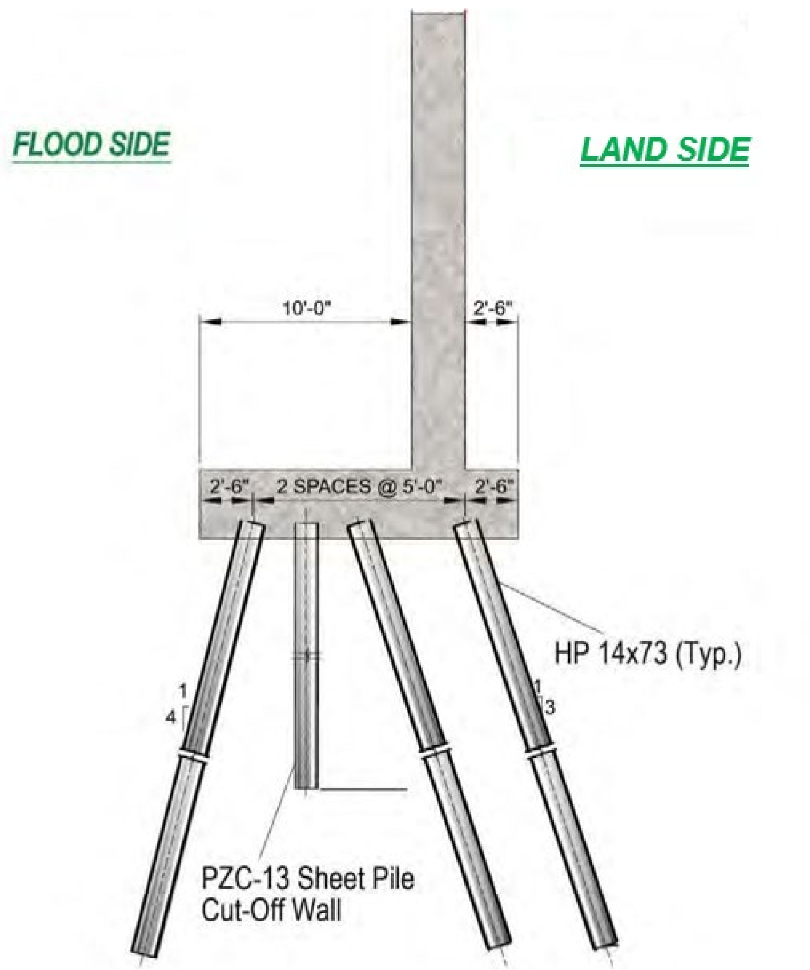


Figure 2: Typical Section of Fronting Protection Wall @ Pump

The T-wall monolith heights would vary with the tallest walls located in front of the pump station and the shortest walls tying into the adjacent levee.



Nine-inch concrete scour protection or grouted riprap would be used at the levee/ T-wall transition. The concrete scour protection would protect the levee where the T-wall stem extends into the full levee section and extend down both levee slopes. The scour protection would continue for 30 linear feet past the end of the T-wall. Uncapped cut-off sheet piling would extend horizontally 30 feet into the full levee section for erosion and seepage control. Reference Figure 4 as an example of the proposed scour protection.

Figure 4. Concrete Scout Protection Example

With the pipe discharge bell being relocated to the floodside of the system and discharging onto a portion of the t-wall slab, riprap would be required to dissipate the energy from the pumping of the rainwater out of the system, extending a distance to be determined during detailed design. A riprap gradation is assumed to be class 250 - 1000 lb stone (LADOTD 2016, Section 711). See Table 1 for example gradation limits for individual stone.

Table 1: Riprap Gradations

Gradation Limits Individual Stone Size (lbs)	Spherical Diameter (ft)	Percent Finer (By Weight)
1250	2.50	100
500	1.83	45-100
250	1.46	15-50
80	1.00	0-15

The floodwall would be constructed at grade minimizing the requirement for any significant excavation. The excavated material from constructing the floodwalls may be used within the levee footprint or if determined suitable could be used for marsh mitigation. If deemed unsuitable, the material would be hauled off site and disposed of in accordance with applicable state and federal laws.

2.26.4 Construction Duration and Equipment

The construction duration of the Lockport to Larose Reach Fronting Protection #1 would be 24 months with an assumed work schedule of 5 days a week, 8 hours a day. The floodwalls in front pump station would be constructed using both floating equipment and land support. Below is the preliminary list of equipment anticipated to be utilized for the construction of the Fronting Protection.

Table 2: Preliminary Equipment List for Fronting Protection Construction

Project Component	Duration (days)	Equipment Used
Fronting Protection & Tie-In Floodwall	730	150-Ton Crane
		80-Ton Crane
		Excavator
		Pile Driver
		Concrete Trucks
		Concrete Vibrators
		Welding Machine, Cutting Torch
Tie-In Levee		Dump Trucks
		Bull Dozers
		Fill Compactor
		Front End Loaded/Backhoe
		Fuel Tanks
		Generator

2.26.5 Access and Staging

Construction site access and staging will be the same as that listed in the Lockport to Larose Levee Reach project description.

2.27 LOCKPORT TO LAROSE, PUMP STATION FRONTING PROTECTION #2

2.27.1 Location

The Lockport to Larose, Pump Station #2 Fronting Protection is located near Larose in Lafourche Parish, within the Lockport to Larose Reach of the larger MTG system at approximately latitude 29°37'03.07", Longitude -90°27'09.83" (Figure 1).

Figure 1: Location Map

2.27.2 Scope of Work

The proposed work consists of construction of a floodwall in front of an existing operating pump station. The floodwall would be constructed to fit between the existing pump station and the discharge basin (area where the pumps discharge the rainwater). In addition to the floodwall, the proposed action includes installing a valve within each of the existing pump station discharge pipes that could be closed to prevent storm surge from backflowing to the land side of the system through the discharge pipe. Finally, the transition between levee and floodwall would be protected with concrete or grouted riprap to prevent scour at this transition.

2.27.3 Structure Description

A floodwall would be constructed in front of the existing station and the discharge pipes would be extended through the newly constructed T-walls with a top elevation of +13 ft

NAVD88 (Figure 2). A butterfly valve would be placed within each discharge pipe that would always remain open except when a name storm enters the Gulf. The butterfly valve would be able to be remotely operated from the pump station control panel as well locally at the butterfly valve itself. The pipe discharge bell would be relocated to the floodside of the system and discharge onto a portion of the t-wall slab and new riprap that would be placed as part of this contract.

The approximate length of the inverted T-type floodwall would be 500 total linear feet. The T-wall would be constructed on pile foundations with concrete base slabs and stems to the 2085 elevation +13 ft (NAVD 88) (Figure 3). It is anticipated that this floodwall would be constructed at grade minimizing the requirement for any significant excavation.

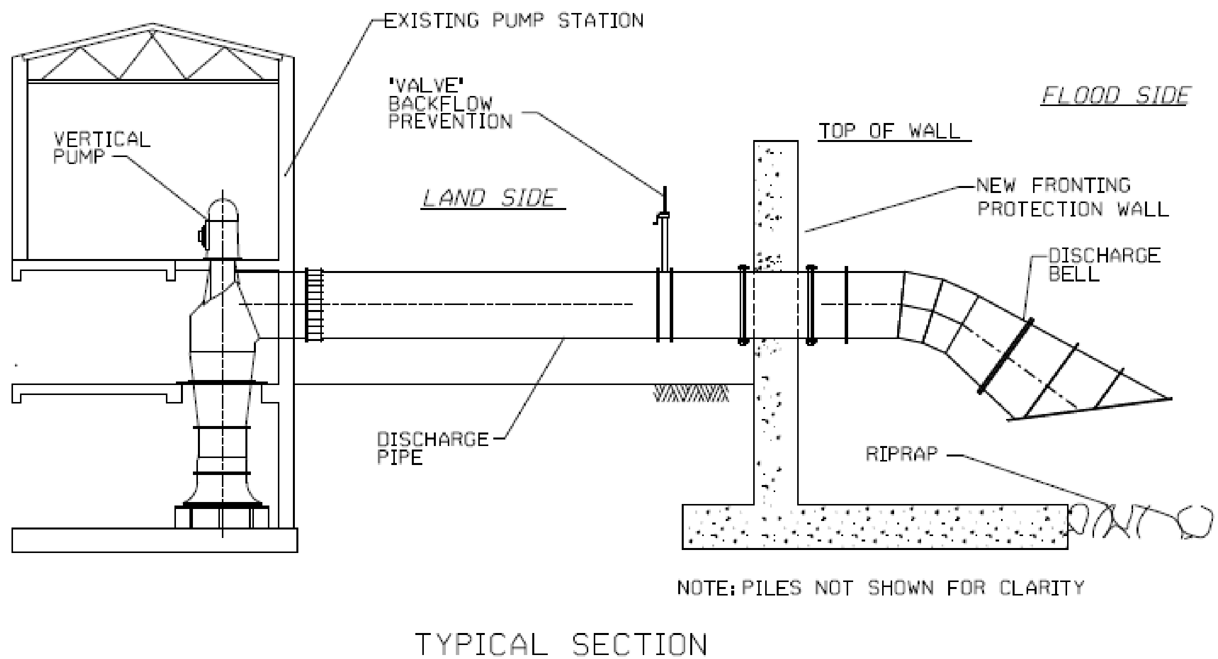


Figure 2: Typical Section of Fronting Protection Wall @ Pump

The T-wall monolith heights would vary with the tallest walls located in front of the pump station and the shortest walls tying into the adjacent levee.

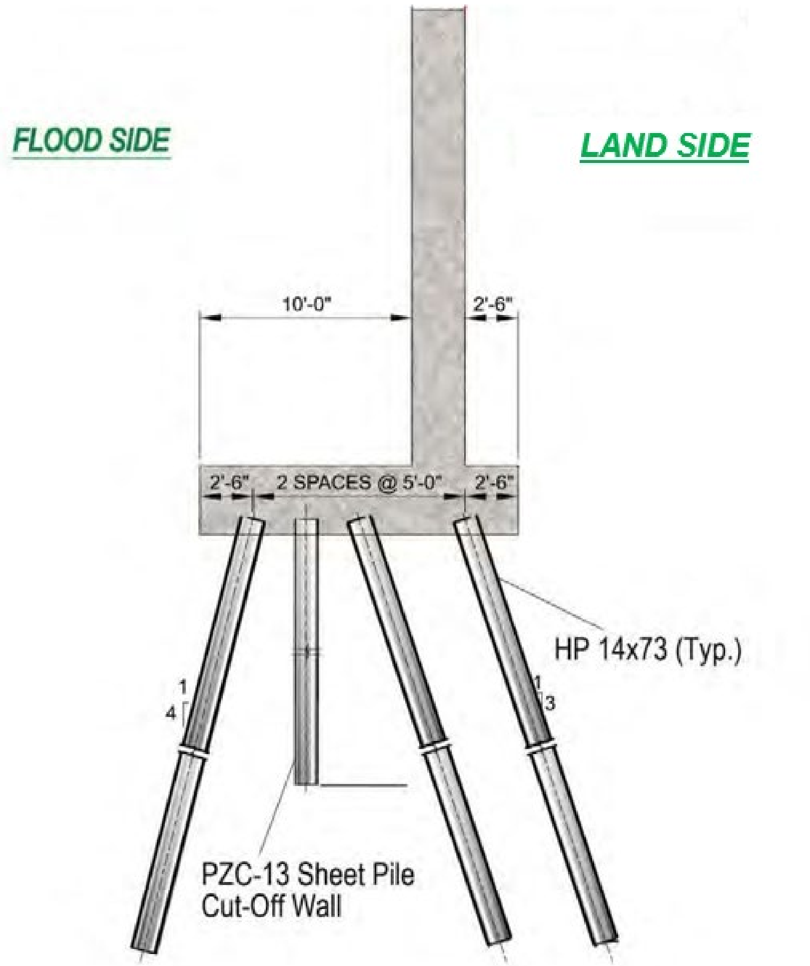


Figure 3: Typical Section of Fronting Protection Wall @ Pump

Nine-inch concrete scour protection or grouted riprap would be used at the levee/ T-wall transition. The concrete scour protection would protect the levee where the T-wall stem extends into the full levee section and extend down both levee slopes. The scour protection would continue for 30 linear feet past the end of the T-wall. Uncapped cut-off sheet piling would extend horizontally 30 feet into the full levee section for erosion and seepage control. Reference Figure 4 as an example of the proposed scour protection.

With the pipe discharge bell being relocated to the floodside of the system and discharging onto a portion of the t-wall slab, riprap would be required to dissipate the energy from the pumping of the rainwater out of the system, extending a distance to be determined during detailed design. A riprap gradation is assumed to be

Figure 4: Concrete Scour Protection Example

class 250 - 1000 lb stone (LADOTD 2016, Section 711). See Table 1 for example gradation limits for individual stone.

Table 1: Riprap Gradations

Gradation Limits Individual Stone Size (lbs)	Spherical Diameter (ft)	Percent Finer (By Weight)
1250	2.50	100
500	1.83	45-100
250	1.46	15-50
80	1.00	0-15

The floodwall would be constructed at grade minimizing the requirement for any significant excavation. The excavated material from constructing the floodwalls may be used within the levee footprint or if determined suitable could be used for marsh mitigation. If deemed unsuitable, the material would be hauled off site and disposed of in accordance with applicable state and federal laws.

2.27.4 Construction Duration and Equipment

The construction duration of the Lockport to Larose Reach Fronting Protection #2 would be 24 months with an assumed work schedule of 5 days a week, 8 hours a day. The floodwalls in front pump station would be constructed using both floating equipment and land support. Below is the preliminary list of equipment anticipated to be utilized for the construction of the Fronting Protection.

Table 2: Preliminary Equipment List for Fronting Protection Construction

Project Component	Duration (days)	Equipment Used
Fronting Protection & Tie-In	730	150-Ton Crane

Project Component	Duration (days)	Equipment Used
Floodwall		80-Ton Crane
		Excavator
		Pile Driver
		Concrete Trucks
		Concrete Vibrators
		Welding Machine, Cutting Torch
Tie-In Levee		Dump Trucks
		Bull Dozers
		Fill Compactor
		Front End Loaded/Backhoe
		Fuel Tanks
		Generator

2.27.5 Access and Staging

Construction site access and staging will be the same as that listed in the Lockport to Larose Levee Reach project description.