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NEW ORLEANS DISTRICT, CORPS OF ENGINEERS
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NEW ORLEANS, LOUISIANA 70160-0267

Regional Planning and
Environmental Division, South
New Orleans Environmental Branch

Decision Record

Individual Environmental Report #11 Tier 2 Pontchartrain
IMPROVED PROTECTION ON THE INNER HARBOR NAVIGATION CANAL
ORLEANS AND ST. BERNARD PARISH, LOUISIANA

IER #11 Tier 2 Pontchartrain

Description of Proposed Action. The proposed action consists of a sector gate and two vertical lift gates in the IHNC 540 feet south of the Senator Ted Hickey Bridge (also known as Seabrook Bridge) and the Bascule Railroad Bridge with floodwall tie-ins to LPV 104 to the west and LPV 105 to the east. This alternative would also include a 20 ft-wide vehicle gate in the eastern floodwall to provide access to Jourdan Road.

Draft IER #11 Tier 2 Pontchartrain, which detailed the impacts of the proposed action, was released for public review on December 8, 2009. Stakeholders had until January 27, 2010 to comment on the document. Comments were received from two businesses, one law firm representing two businesses, two state agencies and three Federal agencies. Public meetings pertaining to IER #11 Tier 2 Pontchartrain occurred on 10 January 2009, 3 March 2009, 5 March 2009, 27 October 2009, 3 December 2009 and 27 January 2010.

Factors Considered in Determination. CEMVN has assessed the impacts of the proposed action on significant resources in the project area, including hydrology, water quality, wetlands, aquatic resources and fisheries, essential fish habitat, wildlife, threatened and endangered species, upland resources, cultural resources, recreational resources, aesthetic (visual) resources, air quality, noise, transportation, socioeconomic resources, and environmental justice.

All jurisdictional wetlands were assessed in cooperation with the US Fish and Wildlife Service (USFWS) under National Environmental Policy Act, Fish and Wildlife Coordination Act, and Section 906 (b) WRDA 1986 requirements. The impacts for the proposed action are as follows:

- **Hydrology –** Significant temporary impacts during construction due to the complete closure of the IHNC for approximately 6 months to 12 months. Alterations in tidal range to the south of the proposed action are anticipated to be greater than to the north due to filling of the existing scour hole. With the implementation of the proposed action, water surface elevations would continue to decrease and velocities are expected to increase during March and September conditions according to ADH modeling. Velocities would be expected to be on the order of those historically experienced (prior to the MRGO closure at Bayou La Loutre and Borgne Barrier in place) within the channel.

- **Water Quality –** Temporary impacts to DO and turbidity during construction. Significant temporary impacts to salinity during construction and minimal permanent impacts (0.1 ppt to 0.3 ppt decrease) above those caused by the closure of the MRGO and Borgne Barrier. Possible permanent positive impacts to DO and turbidity due to the filling of the scour hole.

- **Wetlands –** No direct impacts are expected due to that fact that no wetlands occur in the project vicinity.

- **Aquatic Resources and Fisheries –** Significant temporary impacts including decreased larval recruitment and altered DO levels that could potentially result in fish kills may result from the complete closure of the IHNC for approximately 6 months to 12 months. Minimal, temporary impacts from construction noise and increased turbidity. Permanent loss of approximately 7 acres of low-quality open water and benthic habitat, including deep water habitat used by large predatory species. Possible cumulative impacts to larval fish recruitment due to the MRGO closure structure, Borgne Barrier, and the GIWW gate.

- **Essential Fish Habitat –** Temporary impacts to EFH in the vicinity of the project area during construction, and up to 7 acres of open water and waterbottoms in the IHNC would be permanently lost to the new structure and associated ROW. Loss of deep-water habitat but possible beneficial impacts related to improved DO concentrations in the scour hole. Permanent impacts due to changes in hydrology (salinity, DO, and velocity) and possible cumulative impacts to larval fish recruitment due to the MRGO closure structure, Borgne Barrier, and the GIWW gate.

- **Wildlife –** Temporary displacement impacts to wildlife within the vicinity of the project area during construction.

- **Threatened and Endangered Species –** USFWS concurrence on 2 February 2009 with CEMVN finding of not likely to adversely affect the West Indian manatee, provided that standard manatee protection measures would be followed. NMFS concurrence on 31 August 2009 with the finding of not likely to adversely affect the Gulf sturgeon or its designated critical habitat, or Kemp's Ridley, loggerhead, and green sea turtles, provided that standard measures to protect these turtles would be followed.

- **Upland Resources –** No natural uplands in the project area. Temporary impacts during construction to approximately 10 acres of man-made, non-wet upland. Permanent loss of approximately 7 upland acres would have minimal impacts.

- **Cultural Resources –** No direct adverse impacts to cultural resources would be expected, but beneficial indirect and cumulative impacts (from reduced flood risk and storm damage) to the New Orleans Metropolitan Area would be experienced.

- **Recreational Resources –** Temporary construction-related impacts on fish habitat and navigation would reduce recreational opportunities. The MRGO closure at La Loutre, the Borgne Barrier, and the proposed action would cumulatively result in decreased recruitment of recreational fishery species due to the permanent alterations in flow (transport) and salinity.

- **Aesthetic (Visual) Resources –** Localized and minor impacts.

- **Air Quality –** Temporary impacts during construction.

- **Noise –** Temporary impacts to receptors within 1,000 ft of the project area during construction.

- **Transportation –** Waterborne transportation and worker/truck traffic resulting from the project would temporarily impact traffic on local waterways and roads within the vicinity of the project area. Industries currently using the IHNC to connect to Lake Pontchartrain would be impacted due to the complete closure for approximately 6 months to 12 months.

- **Socioeconomic Resources –** Beneficial impacts on population, land use, and employment due to heightened flood risk reduction and construction-generated employment. Temporary significant impacts to businesses operating in the IHNC which use the Seabrook passage to gain access to Lake Pontchartrain during the 12 month closure.

- **Environmental Justice –** Adverse human health and environmental effects are not expected to disproportionately impact minority and/or low income communities. Direct, temporary impacts from project construction activities would occur, but would be limited to within 1-mile of the project area and would equally impact non-minority/non-low populations as well.

Environmental Design Commitments. Recommendations made by US Fish and Wildlife Service have been incorporated into the final IER under Section 6.2. Manatee, Gulf sturgeon and sea turtle protection measures to be implemented during construction and operation of this project are provided in Section 3.2.7. Additionally, during coordination with the resource agencies in the development of the Water Control Plan and OMRR&R plan, the CEMVN commits to further consider partial opening scenarios and coordination of closure events to minimize impacts to resources.

As a precautionary measure, before the cofferdam is dewatered for construction activities to commence, the area would be surveyed for the presence of Gulf sturgeon. The construction contractor will advise the government when the cofferdam is scheduled to be dewatered and the government will coordinate with the interagency team to have biologists on hand, if necessary, to relocate Gulf sturgeon to appropriate habitat. If any sturgeon are observed, the USACE will reinitiate consultation with NMFS on the appropriate means for relocating Gulf sturgeon to a safe location away from the project area.

The CEMVN will conduct monitoring to obtain observed rather than predicted dissolved oxygen data. If the results of this monitoring demonstrate the need for modeling and/or actions to address adverse impacts, the CEMVN will coordinate with the resource agencies to complete modeling, within authorization and funding, to evaluate alternatives for providing rectification and/or mitigation to offset adverse impacts. The outcomes of the monitoring and modeling will be disclosed in the future Comprehensive Environmental Document and Final Mitigation IER which will include overall cumulative impacts, including those associated with project operations and maintenance.

If any unrecorded cultural resources are determined to exist within the proposed project site, then no work will proceed in the area containing these cultural resources until a CEMVN staff archeologist has been notified and final coordination with the Louisiana State Historic Preservation Officer (SHPO) and Tribal Historic Preservation Officer has been completed.

Agency & Public Involvement. Various governmental agencies, non-governmental organizations, and stakeholders were engaged throughout the preparation of IER #11 Tier 2 Pontchartrain. Agency staff from US Fish and Wildlife Service, National Marine Fisheries Service, US Environmental Protection Agency, US Geologic Survey, National Park Service, Louisiana Department of Natural Resources, Louisiana Department of Environmental Quality, and the Louisiana Department of Wildlife and Fisheries were part of an interagency team that has and will continue to have input throughout the HSDRRS planning process (IER #11 Tier 2 Pontchartrain, Appendix D).

There have been over 100 public meetings since March 2007 about proposed HSDRRS work in the New Orleans area. Issues relating to draft IER #11 Tier 2 Pontchartrain have been discussed at five of these meetings. CEMVN sends out public notices in local and national newspapers, news releases (routinely picked up by television and newspapers in stories and scrolls), e-mails, and mail notifications to stakeholders for each public meeting. In addition, www.nolaenvironmental.gov was set up to provide information to the public regarding proposed HSDRRS work. Below is a list of the comments received. Responses to these comments can be found in Appendices C and E.

1. Public Comments (found in IER #11 Tier 2 Pontchartrain, Appendix C)
    a. Lake Pontchartrain Properties, LLC, Pontchartrain Landing RV Park letter dated January 6, 2010
    b. Kinney and Ellinghausen, on behalf of Seabrook Marine and Trinity Yachts, letter dated January 6, 2010
    c. Halliburton letter received January 8, 2010

2. Agency Comments (found in IER #11 Tier 2 Pontchartrain, Appendix E)
    a. Natural Resources Conservation Service letter dated December 31, 2010

b. Port of New Orleans letter dated January 5, 2010
c. U.S. Fish and Wildlife Service letter dated January 5, 2010
d. State of Louisiana, Department of Health and Hospitals, Office of Public Health letter dated January 7, 2010
e. National Marine Fisheries Service letter dated January 7, 2010

Decision. In accordance with the Alternative Arrangements for NEPA Compliance, as published in the Federal Register on March 13, 2007, CEMVN has assessed the potential environmental impacts of the proposed action described in this IER, and performed a review of the above comments received for Draft IER #11 Tier 2 Pontchartrain, as well as public meetings held 10 January 2009, 3 March 2009, 5 March 2009, 27 October 2009, 3 December 2009 and 27 January 2010.

Furthermore, all practicable means to avoid or minimize adverse environmental effects have been incorporated into the recommended plan.

The public interest will be best served by implementing the proposed action in IER #11 Tier 2 Pontchartrain in accordance with the design commitments discussed above. CEMVN will prepare a Comprehensive Environmental Document (CED) that may contain additional information related to IER #11 Tier 2 Pontchartrain that becomes available after the execution of the Final IER. The CED will provide a final system wide mitigation plan, comprehensive cumulative impacts analysis, and any additional information that addresses outstanding data gaps in any of the IERs in accordance with the Federal Register notice dated March 13, 2007.

I have reviewed IER #11 Tier 2 Pontchartrain, and have considered agency comments and recommendations and comments received from the public during the scoping phase and comment periods. I find the recommended plan fully addresses the objectives as set forth by the Administration and Congress.

The plan is justified, in accordance with environmental statutes, and it is in the public interest to construct the actions as described in this document and IER #11 Tier 2 Pontchartrain, which is attached hereto and made a part hereof.

4/1/2010
Date

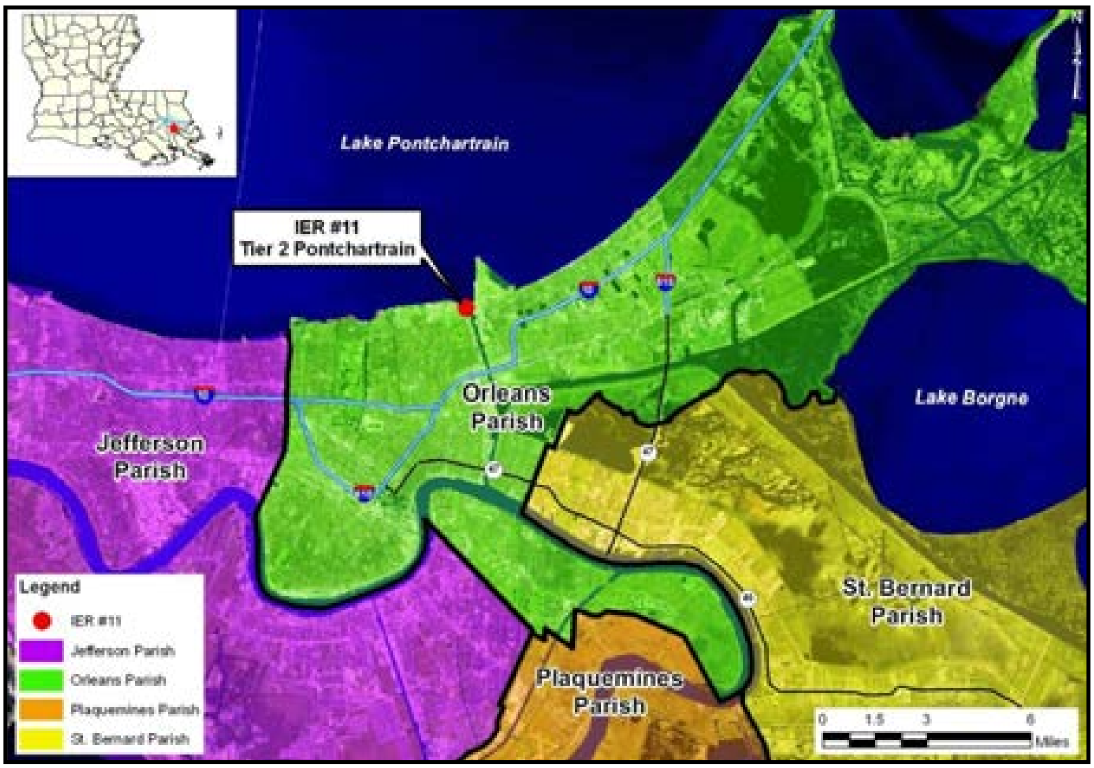
Alvin B. Lee
Colonel, US Army
District Commander

FINAL INDIVIDUAL ENVIRONMENTAL REPORT

IMPROVED PROTECTION ON THE INNER HARBOR NAVIGATION CANAL

ORLEANS PARISH, LOUISIANA

IER #11 – TIER 2 PONTCHARTRAIN



US Army Corps of Engineers

April 2010

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1.0 INTRODUCTION

The United States (U.S.) Army Corps of Engineers (USACE), Mississippi Valley Division, New Orleans District (CEMVN), has prepared this Individual Environmental Report (IER) #11 – Tier 2 Pontchartrain for Improved Protection on the Inner Harbor Navigation Canal (IHNC), Orleans Parish, Louisiana. This IER has been prepared as a second tier evaluation for the portion of the flood risk reduction project that occurs near Lake Pontchartrain and is referred to as "Tier 2 Pontchartrain." This document provides an evaluation of the potential impacts associated with the proposed construction of a storm surge risk reduction structure on the IHNC where it meets Lake Pontchartrain (figure 1). While officially the IHNC is a navigation channel, the use of the term "IHNC" for the purposes of this document include all of the waters and shoreline bounded on the east where the Mississippi River Gulf Outlet (MRGO) navigation channel and the Gulf Intracoastal Waterway (GIWW) diverge; to the south at the IHNC lock complex; and the north at the point where the IHNC intersects with Lake Pontchartrain.

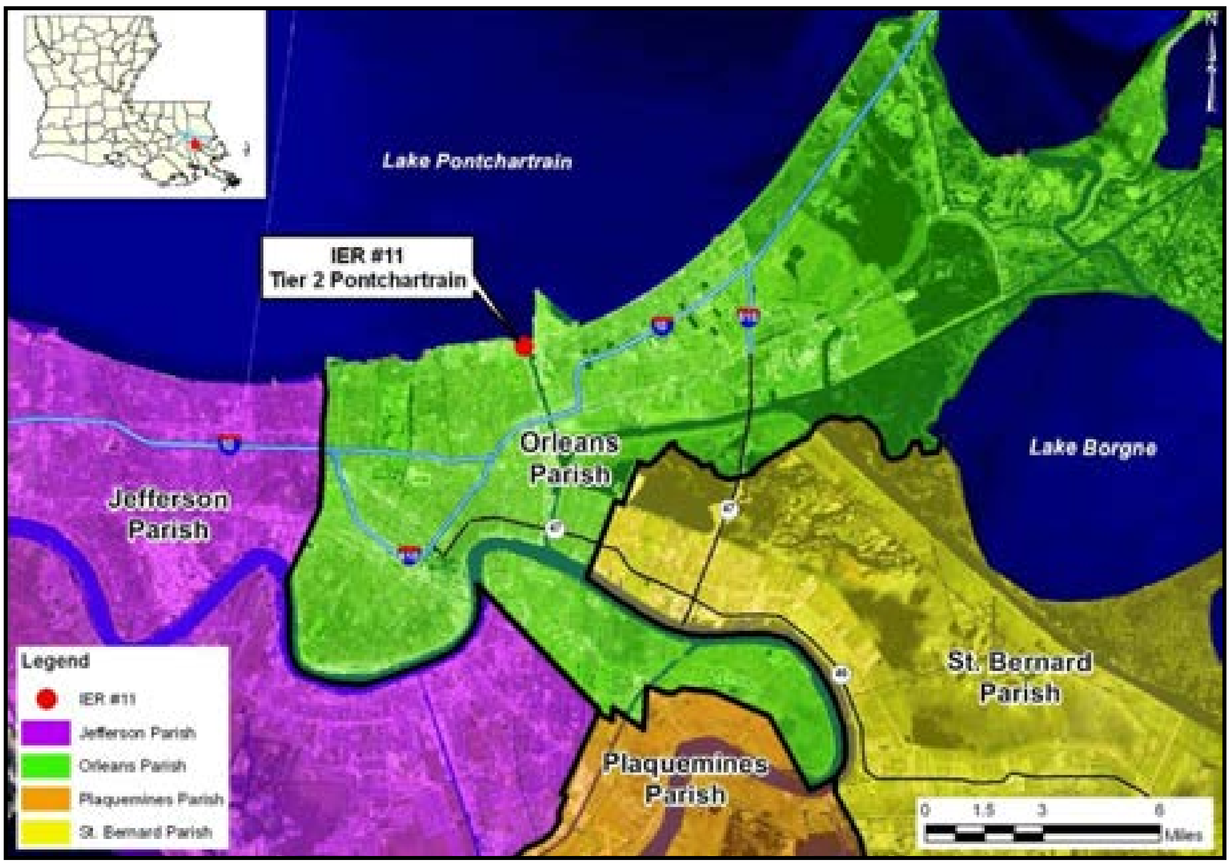


Figure 1. IER #11 Tier 2 Pontchartrain Project Vicinity Map

IER #11 – Tier 2 Pontchartrain has been prepared in accordance with the National Environmental Policy Act (NEPA) of 1969 and the Council on Environmental Quality's (CEQ) Regulations (40 Code of Federal Regulations [CFR] 1500-1508), and the USACE Engineering Regulation (ER), ER 200-2-2 Environmental Quality, Procedures for Implementing NEPA (33 CFR 230). The execution of an IER, in lieu of a traditional Environmental Assessment (EA) or Environmental Impact Statement (EIS), is provided for in ER 200-2-2, Procedures for

Implementing NEPA (33 CFR 230), and pursuant to the CEQ Regulations for Implementing NEPA (40 CFR 1506.11). The Alternative Arrangements can be found at www.nolaenvironmental.gov, and are herein incorporated by reference.

The CEMVN implemented Alternative Arrangements on 13 March 2007, under the provisions of the CEQ Regulations for Implementing NEPA (40 CFR 1506.11). The Alternative Arrangements were developed and implemented in the aftermath of Hurricanes Katrina and Rita in order to evaluate environmental impacts arising from hurricane and storm damage risk reduction (HSDRRS) projects in a timely manner, utilizing the NEPA emergency procedures found at 40 CFR 1506.11. The Alternative Arrangements were published on 13 March 2007 in 72 FR 11337, and are available for public review at www.nolaenvironmental.gov.

The Alternative Arrangements were developed and implemented in order to expeditiously complete environmental analysis for any changes to the authorized system and the 100-year level of the HSDRRS, formerly known as the Hurricane Protection System (HPS), authorized and funded by Congress and the George W. Bush Administration.

The area described in this IER is located in southeastern Louisiana and is part of the Federal effort to rebuild and complete construction of the HSDRRS in the New Orleans Metropolitan area as a result of Hurricanes Katrina and Rita. This document, referred to as Tier 2 Pontchartrain, is a second tier document off the IER #11 “Improved Protection on the Inner Harbor Navigation Canal, Orleans and St. Bernard Parishes, Louisiana” (Tier 1) to address surges from the Lake Pontchartrain-IHNC-GIWW complex (hereafter referred to as “Pontchartrain complex”). Tiering is a staged approach to NEPA described in the CEQ Regulations for Implementing the Procedural Provisions of NEPA (40 CFR 1500-1508). The Tier 1 document investigates a range of alternatives for providing the 100-year level of risk reduction to communities surrounding the IHNC. The alternative selected included two location ranges, “Borgne 1” and “Pontchartrain 2,” within which separate storm surge structures could be built to address storm surges originating from the MRGO-GIWW-Lake Borgne complex and Lake Pontchartrain, respectively. The first Tier 2 document, IER #11 Tier 2 Borgne, which investigates a range of alignments and design alternatives within the Borgne l location range, has been completed. This document, IER #11 Tier 2 Pontchartrain, provides a more detailed description and analysis of footprints and alignments, construction materials and methods, and other design details than what was provided in IER #11 Tier 1 for the Pontchartrain location range.

The draft IER was distributed for a 30-day public review and comment period on 8 December 2009. Due to a high volume of comments, the comment period was extended to run through 27 January 2010. Comments were also made during additional public meetings which were held on 3 December 2009, and 27 January 2010. Comments were received during the public review and comment period and during public meetings from Federal resource agencies, state agencies, industry, and individual citizens (Appendix C). The CEMVN District Commander reviewed public, industry, and agency comments, as well as interagency correspondence. The District Commander’s decision on the proposed action is documented in the IER Decision Record.

1.1 PURPOSE AND NEED FOR THE PROPOSED ACTION

It is the intent of the CEMVN to employ an integrated, comprehensive, and systems-based approach to hurricane and storm damage risk reduction by raising the HSDRRS to the 100-year level of risk reduction. The proposed action would satisfy the CEMVN’s purpose and need to provide the 100-year level of risk reduction from flood damage due to flooding from hurricanes and other tropical storms in the New Orleans Metropolitan area. The term “100-year level of risk reduction,” as it is used throughout this document, refers to a level of risk reduction which reduces the risk of hurricane surge and wave-driven flooding that the New Orleans Metropolitan Area has a 1 percent chance of experiencing each year.

The elevations of the existing Lake Pontchartrain and Vicinity (LPV) HSDRRS in the project area are below the 100-year design elevation. The proposed action resulted from a defined need to reduce flood risk and storm damage to residences, businesses, and other infrastructure from hurricanes (100-year storm events), and other high water events. The completed HSDRRS would lower the risk of damage to property and infrastructure during a storm event. The safety of people in the region is the highest priority of the CEMVN.

1.2 AUTHORITY FOR THE PROPOSED ACTION

The authority for the proposed action was provided as part of a number of HSDRRS projects spanning southeastern Louisiana, including the LPV project and the West Bank and Vicinity (WBV) project. Congress and the George W. Bush Administration granted a series of supplemental appropriations acts following Hurricanes Katrina and Rita to repair and upgrade the project systems damaged by the storms and gave additional authority to the USACE to construct 100-year HSDRRS projects.

The LPV project was authorized under the Flood Control Act of 1965 (Public Law [PL] 89-298, Title II, Sec. 204) as amended, which authorized a "project for hurricane protection on Lake Pontchartrain, Louisiana … substantially in accordance with the recommendations of the Chief of Engineers in House Document 231, Eighty-ninth Congress." The original statutory authorization for the LPV project was amended by the Water Resources Development Act (WRDA) of 1974 (PL 93-251, Title I, Sec. 92), 1986 (PL 99-662, Title VIII, Sec. 805), 1990 (PL 101-640, Sec. 116), 1992 (PL 102-580, Sec. 102), 1996 (PL 104-303, Sec. 325), 1999 (PL 106-53, Sec. 324), and 2000 (PL 106-541, Sec. 432); and the Energy and Water Development Appropriations Acts of 1992 (PL 102-104, Title I, Construction, General), 1993 (PL 102-377, Title I Construction, General), and 1994 (PL 103-126, Title I Construction, General).

The Department of Defense, Emergency Supplemental Appropriations to Address Hurricanes in the Gulf of Mexico, and Pandemic Influenza Act of 2006 (3rd Supplemental - PL 109-148, Chapter 3, Construction, and Flood Control and Coastal Emergencies) appropriated funds to accelerate the completion of the previously authorized project and to restore and repair the project at full Federal expense. The Emergency Supplemental Appropriations Act for Defense, the Global War on Terror, and Hurricane Recovery of 2006 (4th Supplemental - PL 109-234, Title II, Chapter 3, Construction, and Flood Control and Coastal Emergencies) appropriated funds and added authority to raise levee heights where necessary, reinforce and replace floodwalls, and otherwise enhance the project to provide the levels of risk reduction necessary to achieve the certification required for participation in the National Flood Insurance Program. Additional Supplemental Appropriations include the U.S. Troop Readiness, Veterans' Care, Katrina Recovery, and Iraq Accountability Appropriations Act, 2007 (PL 110-28) Title IV, Chapter 3, Flood Control and Coastal Emergencies, Section 4302 (5th Supplemental), and the 6th Supplemental (PL 110-252), Title III, Chapter 3, Construction.

1.3 PRIOR REPORTS

A number of studies and reports on water resources development in the proposed action area have been prepared by the USACE, other Federal, state, and local agencies, research institutes, and individuals. Pertinent studies, reports, and projects not previously discussed in IER #11 Tier 2 Borgne are summarized below:

- On 9 February 2010, the CEMVN Commander signed a Decision Record on Individual Environmental Report Supplemental (IERS) # 14.a entitled "West Bank and Vicinity, Westwego to Harvey Levee, Jefferson Parish, Louisiana." The document evaluates the potential effects associated with proposed project revisions to the original IER #14, including a proposed flood side shift of approximately 3.29 miles of earthen levees, and proposed revisions to fronting protection and floodwall alignment at the Ames and Mount Kennedy Pumping Stations.

- On 8 February 2010, the CEMVN Commander signed a Decision Record on IER #9 entitled "Lake Pontchartrain and Vicinity, Caernarvon Floodwall, St. Bernard Parish, Louisiana." The document evaluates the potential effects associated with the replacement of two floodgates, approximately 1,500 feet (ft) of floodwall, and a levee tie-in at the southwestern terminus of the Chalmette Loop Levee.

- On 8 February 2010, the CEMVN Commander signed a Decision Record on IERS #6 entitled "Lake Pontchartrain and Vicinity, East Citrus Lakefront Levee, Orleans Parish, Louisiana." The document evaluates the potential effects associated with the proposed project modifications to the original IER #6, including construction of new I-walls and a T-wall.

- On 22 January 2010, the CEMVN Commander signed a Decision Record on IER #32 entitled "Contractor-Furnished Borrow Material #6, Ascension, Plaquemines, and St. Charles Parishes, Louisiana." The document evaluates the potential effects associated with the possible excavation of the proposed Bocage, Citrus Lands, Conoco Phillips, Idlewild Stage 1, Nairn, Plaquemines Dirt & Clay, and 3C Riverside Phase 3 contractor-furnished borrow areas.

- On 18 December 2009, the CEMVN Commander signed a Decision Record on IERS #3.a entitled "Lake Pontchartrain and Vicinity, Jefferson East Bank, Jefferson Parish, Louisiana." The document evaluates the potential effects associated with the proposed project revisions within the IER #3 project area such as the construction of wave attenuation berms and foreshore along the Jefferson Parish lakefront and a T-wall, overpass bridge, and traffic detour lane bridge spans at the Lake Pontchartrain Causeway Bridge abutment.

- On 10 December 2009, the CEMVN Commander signed a Decision Record on IERS #11 Tier 2 Borgne entitled "Improved Protection on the Inner Harbor Navigation Canal, Orleans and St. Bernard Parishes, Louisiana." The document evaluates the potential effects associated with proposed project revisions to the original IER #11 Tier 2 Borgne construction schedule and sequencing.

- On 4 December 2009, the CEMVN Commander signed a Decision Record on IER #13 entitled "West Bank and Vicinity, Hero Canal Levee and Eastern Tie-In, Plaquemines Parish, Louisiana." The document evaluates the potential effects associated with the proposed enlargement to the Hero Canal levee, and construction of the Eastern Tie In portion of the West Bank and Vicinity.

- On 29 October 2009, the CEMVN Commander signed a Decision Record on IERS #2 entitled "Lake Pontchartrain and Vicinity, West Return Floodwall, Jefferson and St. Charles Parishes, Louisiana." The supplemental document evaluates the potential effects associated with proposed project revisions to the original IER #2.

- On 28 September 2009, the CEMVN Commander signed a Decision Record on IER #30 entitled "Contractor-Furnished Borrow Material #5, St. Bernard and St. James Parishes, Louisiana, and Hancock County, Mississippi." The document evaluates the potential impacts associated with the possible excavation of three proposed contractor-furnished borrow areas.

- On 8 September 2009, the CEMVN Commander signed a Decision Record on IER #29 entitled "Contractor Furnished Borrow Material #4, Orleans, St. John the Baptist, and St. Tammany Parishes, Louisiana." The document evaluates the potential effects associated with the possible excavation of three proposed contractor-furnished borrow areas.

- On 30 June 2009, the CEMVN Commander signed a Decision Record on IER #5 entitled "Lake Pontchartrain and Vicinity, Permanent Protection System for the Outfall Canals Project on 17th Street, Orleans Avenue, and London Avenue Canals, Jefferson and Orleans Parishes, Louisiana." The document evaluates the potential effects associated with the construction and maintenance of a permanent risk reduction system for the 17th Street, Orleans Avenue, and London Avenue Canals.

- On 29 June 2009, the CEMVN Commander signed a Decision Record on IERS #1 entitled "Lake Pontchartrain and Vicinity, LA Branche Wetlands Levee, St. Charles Parish, Louisiana." The supplemental document evaluates the potential effects associated with revisions to the original proposed action in IER #1.

- On 25 June 2009, the CEMVN Commander signed a Decision Record on IER #6 entitled "Lake Pontchartrain and Vicinity, New Orleans East Citrus Lakefront Levee, Orleans Parish, Louisiana." The document evaluates the potential effects associated with proposed improvements to three reaches of the East Orleans Hurricane Risk Reduction Levee that were originally constructed as part of the LPV project.

- On 23 June 2009, the CEMVN Commander signed a Decision Record on IER #8 entitled "Lake Pontchartrain and Vicinity, Bayou Dupre Control Structure, St. Bernard Parish, Louisiana." The document evaluates the potential effects associated with the proposed replacement of a flood control structure on Bayou Dupre.

- On 19 June 2009, the CEMVN Commander signed a Decision Record on IER #7 entitled "Lake Pontchartrain and Vicinity, New Orleans Lakefront to Michoud Canal, Orleans Parish, Louisiana." The document evaluates the potential effects associated with proposed improvements to three reaches of the East Orleans Hurricane Risk Reduction Levee that were originally constructed as part of the LPV project.

- On 26 May 2009, the CEMVN Commander signed a Decision Record on IER #10 entitled "Lake Pontchartrain and Vicinity, Chalmette Loop Levee, St. Bernard Parish, Louisiana." The document evaluates the potential impacts associated with the proposed construction of a T-wall floodwall on top of the existing Chalmette Loop levee.

- On 13 March 2009, the CEMVN Commander signed a Decision Record on IER #4 entitled "Lake Pontchartrain and Vicinity, New Orleans Lakefront Levee, West of Inner Harbor Navigation Canal, Orleans Parish, Louisiana." The document evaluates the potential impacts associated with a proposed action that would include changes involving multiple gates and ramps, as well as a sector gate structure along the south shore of Lake Pontchartrain.

- On 18 February 2009, the CEMVN Commander signed a Decision Record on IER #12 entitled "GIWW, Harvey, and Algiers Levees and Floodwalls, Jefferson, Orleans, and Plaquemines Parishes, Louisiana." The document was prepared to evaluate potential impacts associated with the proposed construction and upgrades of levees, floodwalls, floodgates, and pumping station(s) within a portion of the WBV HSDRRS.

- On 3 February 2009, the CEMVN Commander signed a Decision Record on IER #25 entitled "Government Furnished Borrow Material #3, Orleans, Jefferson, and Plaquemines Parishes, Louisiana." The document was prepared to evaluate the potential impacts associated with the possible excavation of four Government Furnished borrow areas.

- On 21 October 2008, the CEMVN Commander signed a Decision Record on IER #11 Tier 2 Borgne entitled "Improved Protection on the Inner Harbor Navigation Canal, Tier 2 Borgne Orleans and St. Bernard Parishes, Louisiana." The document was prepared to evaluate the potential impacts associated with constructing a surge barrier on Lake Borgne.

- On 20 October 2008, the CEMVN Commander signed a Decision Record on IER #26 entitled "Pre-Approved Contractor Furnished Borrow Material #3, Jefferson, Plaquemines, and St. John the Baptist Parishes, Louisiana, and Hancock County, Mississippi." The document was prepared to evaluate the potential impacts associated with the actions taken by commercial contractors as a result of excavating borrow areas for use in construction of the HSDRRS.

- On 26 August 2008, the CEMVN Commander signed a Decision Record on IER #14, entitled "Westwego to Harvey Levee, Jefferson Parish, Louisiana." The proposed action includes enlarging earthen levees, rebuilding floodwalls, constructing fronting protection for three pump stations, replacing a floodgate with a swing gate, and raising an existing ramp to ensure a continuous line of risk reduction in the levee and floodwall system.

- On 25 July 2008, the CEMVN Commander signed a Decision Record on IER #3, entitled "Lake Pontchartrain and Vicinity, Lakefront Levee, Jefferson Parish, Louisiana." The proposed action includes the rebuilding of 9.5 miles of earthen levees, upgrading of foreshore protection, replacement of two floodgates, and construction of fronting protection and construction or modification of breakwaters at four pumping stations along the lakefront in Jefferson Parish, Louisiana.

- On 18 July 2008, the CEMVN Commander signed a Decision Record on IER #2, entitled "Lake Pontchartrain and Vicinity, West Return Floodwall, Jefferson and St. Charles Parishes, Louisiana." The proposed action includes replacing 3.4 miles of floodwall in Jefferson and St. Charles Parishes, Louisiana.

1.4 INTEGRATION WITH OTHER INDIVIDUAL ENVIRONMENTAL REPORTS

In addition to this IER, the CEMVN is preparing a draft Comprehensive Environmental Document (CED) that will describe the work completed and the work remaining to be constructed. The purpose of the draft CED will be to document the work completed by the CEMVN on a system-wide scale. The draft CED will describe the integration of individual IERs into a systematic planning effort. Overall cumulative impacts and future operation, maintenance, rehabilitation, repair, and replacement (OMRR&R) requirements will also be included. Additionally, the draft CED will contain updated information for any IER that had incomplete or unavailable data at the time it was posted for public review.

A public scoping meeting for the CED was held in New Orleans, Louisiana on 2 September 2009. Once completed, a draft CED will be available for a 60-day public review period. The document will be posted on www.nolaenvironmental.gov, or it can be requested by contacting the CEMVN. A notice of availability will be mailed/e-mailed to interested parties advising them of the availability of the draft CED for review. Additionally, a notice will be placed in national and local newspapers. Upon completion of the 60-day review period, all comments will be compiled and appropriately addressed. Upon resolution of any comments received, a final CED will be prepared, signed by the District Commander, and made available to any stakeholders requesting a copy.

Mitigation for unavoidable impacts to the human and natural environment described in this and other IERs will be addressed in separate mitigation IERs. The CEMVN has partnered with Federal and state resource agencies to form an interagency mitigation team that is working to assess and verify these impacts and to look for potential mitigation sites in the appropriate hydrologic basin. This effort is occurring concurrently with the IER planning process in an effort to complete mitigation work and construct mitigation projects expeditiously. As with the planning process of all other IERs, the public will have the opportunity to give input about the proposed work. These mitigation IERs will, as described in this IER, be available for a 30-day public review and comment period.

1.5 PUBLIC CONCERNS

Throughout southern Louisiana, one of the greatest areas of public concern is reducing the risk of hurricane, storm, and flood damage for businesses and residences and providing for public safety during major storm events. Hurricane Katrina forced residents from their homes, temporarily or permanently closed businesses and, due to extensive flooding, made returning to communities in a timely manner unsafe.

In public meetings held 10 January 2009, 3 March 2009, 5 March 2009, 27 October 2009, 3 December 2009, and 27 January 2010 several public concerns were raised regarding improved risk reduction on the IHNC.

Public concerns were raised regarding the effect that this project could have on any planned or existing freshwater diversion projects in the vicinity, and both the salinity of the water and the hypoxic area in Lake Pontchartrain. Citizens expressed concerns regarding wetland restoration and environmental impacts, specifically the cumulative impacts of this project and other HSDRRS projects in the area. Residents inquired about the potential human environmental impacts that could be experienced during construction including an increase in noise, damage to transportation infrastructure, damage to homes and businesses from vibration during pile driving and construction equipment operation, and destruction of historical and cultural resources. In addition, residents wanted to know if the new sector gate could be operated manually during a possible complete loss of power, who would be responsible for operation, and whether or not the gate would be left open if there was not an immediate storm threat.

Additional public concerns have been raised regarding potential impacts to navigation from the proposed action. Local citizens and business owners would like for all barges and ships to be evacuated from the protected IHNC area during storm events. The Port of New Orleans and local businesses, specifically those located along the IHNC, have expressed concern regarding impacts to navigation from construction. Specifically, the port and owners are worried about the impacts that could occur to their businesses, including the recreational boating industry, as a result of the possible closure of the IHNC pass through placement of a cofferdam across the IHNC for 6 months to 12 months of the 36-month construction duration. Some businesses rely on the Seabrook pass and the Turning Basin as means of transporting and delivering materials. Any interruption of these areas during construction would impact their ability to function. They requested information on the width of the cofferdam structure, the speed of the currents experienced in the IHNC, and the ability to off-load barges adjacent to the turning basin.

Concerns about flood risk reduction during construction were raised, particularly with regard to the relationship between the project timeline and the closure structures on the GIWW (IER #11

Tier 2 Borgne). Businesses are worried that if the GIWW is closed, there is a possibility that water levels would rise much higher in the IHNC and not only flood businesses within it, but could add additional stress to the existing floodwalls protecting the adjacent neighborhoods. Business owners expressed interest in the construction of a pump in the IHNC to alleviate possible flooding during a storm event from the existing pumps that drain adjacent neighborhoods into the IHNC. They also requested information on the concurrent projects in the IHNC, including the west and east wall modifications. The temporary loss of a lane of France Road would add to the impacts of the closure of the Seabrook access, thus increasing the length of the interruption of business.

The primary concern of IHNC business owners relates to potential impacts to navigation safety. They question the safety of navigating the existing currents at Seabrook and are afraid that these currents could worsen both during and after construction of the proposed action, thereby making navigation by both small craft and barges potentially unsafe. Additional concerns were made regarding flow through the new structures potentially undermining the integrity and/or stability of the existing bridges, specifically the 100-year old, pile-founded Bascule Railroad Bridge.

The U.S. Coast Guard (USCG) commented on the existing hazardous conditions in the mouth of the IHNC during tidal fluctuations. The addition of a cofferdam during construction of the sector gate would increase this danger. Subsequently, the USCG is expected to recommend the IHNC pass at Seabrook be closed to all navigation during the construction period. In addition, the USCG relies on the pass as a route for emergency response, so the construction would necessitate the positioning of a vessel and staff on either side of the IHNC in order to ensure the half hour response time that is required of the USCG. If a sector gate is built, the USCG would have to acquire additional funding to supply these additional resources. The USCG has also requested coordination with the Levee Board as they have a fender system replacement project in progress at Seabrook.

Some are concerned that either closure of the Seabrook structure or currents through the Seabrook structure could negatively impact migration of aquatic species, recreation, and the fishing industry.

1.6 DATA GAPS AND UNCERTAINTY

At the time of completion of this report, complete engineering designs and documentation had not been completed for all of the alternatives. This environmental impact analysis is based on preliminary designs and best professional judgment by the technical experts regarding the proposed actions and alternatives. Final engineering details of the proposed action could vary based on the final design. Estimates of materials necessary to construct the project were developed from best professional judgment and preliminary designs reports. The alternative features and associated numbers developed were used to quantify the magnitude of the proposed actions and not to prescribe detailed materials, quantities, or design specifications. Potential impacts on society (people and property and historical and cultural resources) that can be caused by storms and hurricanes create a critical and vital necessity for hurricane and storm damage risk reduction in the Metropolitan Statistical Area; therefore, construction of this HSDRRS project is not being delayed pending future information.

Uncertainty in the final engineering design and construction as well as slight changes to existing conditions in the future could change the impact assessments discussed in this document. For example, access routes to the construction areas are dependent upon many variables that frequently change (weather, traffic conditions, road conditions, construction materials used, fuel prices, etc.). Construction materials would be delivered to the project area, as well as to other ongoing 100-year level of risk reduction projects in the New Orleans Metropolitan Statistical

Area. The sources for these materials and the transportation routes for delivering them have not been fully determined. Transportation of materials to construction sites could have localized short-term impacts to transportation corridors. Long-term impacts to road surfaces cannot be fully quantified until the sources of all materials and transportation routes have been fully defined. All applicable new data will be reviewed as it becomes available, and the CEMVN is currently completing a system-wide transportation analysis to better quantify these impacts.

Secondly, an engineering alternatives report is underway for the existing levees and floodwalls on the IHNC and GIWW between Lake Pontchartrain and the MRGO. These studies are intended to determine whether any modifications or remedial actions are necessary to ensure that these levees and floodwalls meet current design criteria and future conditions with a barrier at Seabrook and within the Tier 2 Pontchartrain location range.

New data for design, transportation, and environmental justice (EJ) will be reviewed as they become available. This data and any changes to the assessment provided in this document will be incorporated into future documents (including the draft CED).

Studies done by the USACE indicate that occasionally unfavorable navigational conditions could arise at the GIWW gate within the Borgne Barrier given typical weather and tidal conditions. This refers to an event during "normal conditions" and not classified as a tropical event. A reasonable, conservative estimate of 10 closures per year for non-storm related events was used for analysis purposes. These unfavorable conditions could be mitigated by closure of the Seabrook gate which is amongst others, an option that is being studied. This reduces the flow through the IHNC basin system and velocities at the GIWW gate. Although the high flow event is estimated to last only 3 hours on average, closure of the Seabrook structure (if mandated) could be done for a full tidal period (~1 day). Other options which are still part of the study are to either allow for passage of barges by means of tripping the barges or ultimately accept navigational delays for these rare events. The action “tripping of barges” refers to a combination of multiple barges pushed by a single tow; a combination of four barges in this case, would navigate the structure in two passages with two barges per passage. Criteria for closing of the Seabrook Gate Complex are still being analyzed and final details will be described in a future Water Control Plan.

Apart from possible closure for adverse flow conditions at the GIWW gate, the Seabrook structure will be closed in a storm event or for maintenance and operation conditions. Once again, exact details on frequency of such events and duration are currently being established. Preliminary estimates presented here give a first indication on the duration and frequency of such closure events. Typically large operation and maintenance works for flood defense structures are carried out once every 10 years. It is assumed that all 3 gates would be closed for approximately a week for maintenance. It should be noted that maintenance of the lift gates happens in the dry and does not require closure. For regular and routine operation and maintenance it is estimated that the structure will be tested every month and only in the cases where there has not been a mandated closure. Such routine testing is expected to take 1 to 2 hours.

Table 1 presents the frequency of tropical events in the New Orleans area. In 79 years, 102 tropical events were observed. From this historical record it is estimated that the frequency of closure for storm surge would be in the order of once per year. A storm event typically lasts in the order of a couple of days. The approximate frequency and duration of the events that would require closure are summarized in table 2.

Table 1.
New Orleans Monthly Storm Occurrences* From 1900-1979

Landfall Intensity	May-June	July	August	September	October-November	Total
Hurricane	2	3	9	21	5	**40**
Tropical Storm	8	6	7	21	9	**51**
Tropical Depression	1	3	2	4	1	**11**

* All storms passed within 180 nautical miles of New Orleans, Louisiana.
Source: http://pubs.usgs.gov/of/2002/of02-206/phy-environment/cyclones1980-99.html.

Table 2.
Approximate Frequency and Duration of Gate Closure Events

Event Type	Approximate Frequency	Approximate Duration	Remarks
Routine Operation and maintenance	once a month	~1 to 2 hours	The entire structure is closed
Major maintenance	once per 10 years	~1 to 2 weeks	The entire structure is closed
high flow events	0-10 times a year	~1 day	draft numbers, details will be worked out in the Water Control Plan
storm surge/storm event	once a year	~2 to 3 days	draft numbers, details will be worked out in the Water Control Plan

In order to determine the operating conditions of the Seabrook barrier a study will be performed by USACE in which the ADH model will be run to simulate hydraulic conditions throughout the IHNC system (in its final configuration) for the period of a year. Based upon current velocity exceedance curves the percentage of time that flow thresholds are exceeded would be determined. Equally frequency and duration of adverse flow conditions would be better refined to establish criteria for a Seabrook closure during normal conditions. Closure criteria and system constraints will be documented in the Water Control Plan, which will be finished once the structures go into operation and are turned over to the local sponsor.

Hydraulic modeling from the Engineering Research and Development Center (ERDC) has shown that flow velocity in the GIWW gate could exceed 3 mph (4.4 feet per second [fps]) various times during the year due to wind and tidal effects which would limit navigation due to unfavorable conditions (Martin et al. 2009a). This hydrodynamic analysis has been based on a one year simulation (2006) with the GIWW gate, barge gate, and Bayou Bienvenue gate open, and no restriction at Seabrook. Detailed analysis of the velocity time series for the year 2006 in the opening of the GIWW gate shows that this velocity threshold is exceeded 2 percent of the year (Martin et al. 2009a). Visual inspection of the data set reveals that this 4.4 fps exceedance could happen about 60 times per year. The average time window of this velocity exceedance is about 3 hours (= 2 percent x 365 x 24/60).

Navigation simulations were carried out to test which barge tow configuration could experience navigational problems under different velocity conditions at the GIWW gate (Webb 2009). Most of tow configurations for this area could pass the structure safely. However, for the 2 by 2 loaded barges (configuration of two barges in width and two barges in length; photo 1), some of the pilots did have problems with this configuration under the maximum current conditions, while others did not. Thus, there is chance that a loaded 2 by 2 pack may experience navigation problems through the GIWW gate if the velocity exceeds 4.4 fps. Based on existing tow statistics from 2004 to 2008, the passage frequency in the GIWW of these 2 by 2 loaded barges is 10 per week on average (1.4 per day).

Photo 1. View of a 2 by 2 pack barge configuration (red outline)

To assess the impact the joint probability of a simultaneous event of a 2 by 2 pack passage and exceedance of the velocity threshold needs to be considered. The joint probability, which is the chance that multiple events occur at the same time, of having a velocity higher than 4.4 fps in combination with a passage of a 2 by 2 pack equals 0.35 percent every 3 hours during the year (= 2 percent x 1.4 tows per 24 hours/8). Thus, there will be approximately 10 windows of 3 hours per year on average (= 365 x 24/3 x 0.35 percent) when these two independent events (high velocities and passage of a 2 by 2 pack) occur simultaneously.

2.0 ALTERNATIVES

2.1 ALTERNATIVES DEVELOPMENT AND PRELIMINARY SCREENING CRITERIA

NEPA requires that in analyzing alternatives to a proposed action a Federal agency consider an alternative of “No Action.” Likewise, Section 73 of the WRDA of 1974 (PL 93-251) requires Federal agencies to give consideration to non-structural measures to reduce or prevent flood damage. As part of the Tier 1 IER #11, the no action alternative as well as the non-structural and create wetlands alternatives were evaluated and eliminated from further consideration for the Tier 2 Pontchartrain project area because none accomplished the purpose and need of the project.

The no action alternative was evaluated in detail in the Tier 1 document. Because this alternative did not meet the defined purpose and need in the Tier 1 document, it was not selected for further consideration in this Tier 2 document. Likewise, although non-structural measures are widely recognized as reasonable complementary measures to other HSDRRS measures, they were eliminated from further analysis in the Tier 1 document because they would not meet the needs of the project as a stand-alone alternative for providing the 100-year level of risk reduction. Additionally, the wetlands creation alternative was not considered an effective engineering solution in providing 100-year hurricane risk reduction as a stand-alone alternative.

A range of reasonable alternatives for this Tier 2 document was formulated through input by the CEMVN Project Delivery Team (PDT), Value Engineering Team, engineering and design consultants, as well as local government, the public, and resource agencies to achieve the purpose and need of this project. Once a full range of alternatives was established, a preliminary screening was conducted by the CEMVN to identify alternatives that would proceed through further analysis. The criteria used to make this determination included engineering effectiveness, risk reduction, navigation safety, economic efficiency, and environmental and social acceptability. Those alternatives that did not adequately meet these criteria were considered infeasible and, therefore, were eliminated from further study in this IER.

2.2 DESCRIPTION OF THE ALTERNATIVES

Regardless of the alignment, each alternative would include the following common features, discussed in detail here: T-wall floodwalls, a sector gate, and two flow augmentation gates (vertical lift gates). T-wall floodwall sections (tie-ins between the floodgates and the existing HSDRRS) would be built to a construction grade elevation of +16.0 ft North American Vertical Datum 1988 (NAVD88). A sector gate would be built with a top of gate elevation of approximately + 16.0 ft to +18.0 ft NAVD88 and a sill elevation no deeper than -20.0 ft NAVD88. This sector gate would have a 95-ft wide navigation opening, which is the width of the existing navigational channel and concrete dolphins.

The two non-navigable vertical lift gates would be installed on either side of and adjacent to the sector gate. These vertical lift gates would be necessary to maintain existing flow velocities through the sector gate since higher velocities would make navigation through the sector gate difficult (and potentially unsafe) and also cause problems for fish and crustaceans migrating through the gate. The lift gates would be strictly auxiliary structures; navigation through these gates would be prohibited. Each lift gate would have a width of no greater than 60 ft and sill elevations no deeper than -20.0 ft NAVD88. The tops of the lift gates would be flush with the adjacent sector gate.

Five potential alternatives were carried forward after initial screening and are shown in figure 2.

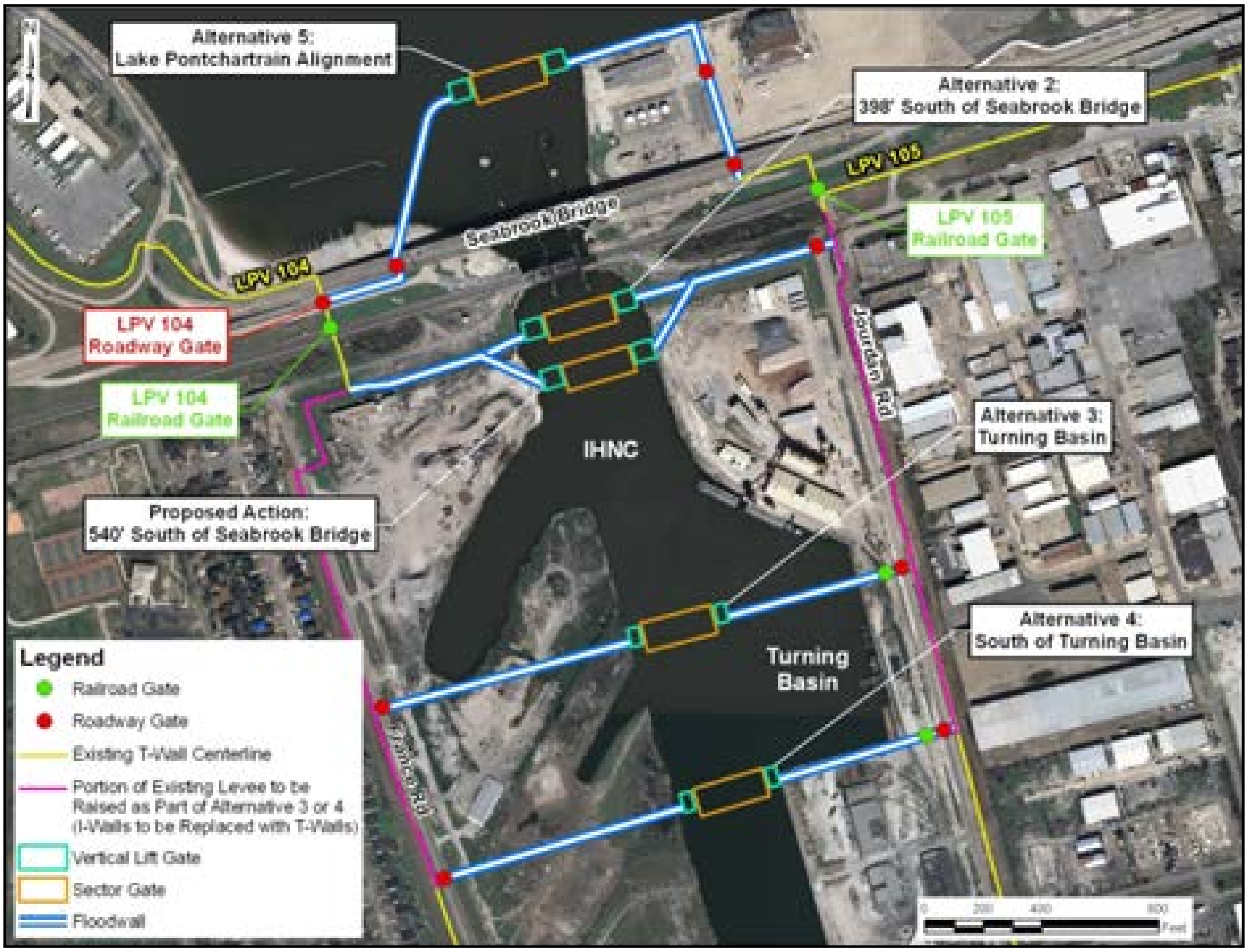


Figure 2. IER #11 Tier 2 Pontchartrain Alternative Alignments

2.3 PROPOSED ACTION

Proposed Action (Alternative #1) - Bridgeside Alignment: Sector Gate located 540 ft south of Seabrook Bridge and approximately 1,500 ft of T-walls built on Existing Levees

The proposed action consists of a sector gate (figure 3) and two vertical lift gates (figures 3 and 4) in the IHNC 540 ft south of the Senator Ted Hickey Bridge (henceforth referred to as Seabrook Bridge) and the Bascule Railroad Bridge with T-wall floodwall tie-ins to LPV 104 to the west and LPV 105 to the east. This alternative would also include a 20 ft-wide vehicle gate in the eastern floodwall to provide access to Jourdan Road.

A USACE technical review of the Seabrook closure system indicated that a combination of gate types would allow flow to pass through with velocities that allow safe navigation through the Seabrook structure (USACE 2009a). These additional gates are necessary to meet the design goal of meeting or improving historical velocity conditions through the Seabrook pass. The two types of gates that would be utilized for the Tier 2 Pontchartrain project are sector gates and vertical lift gates. The navigable sector gate would be designed in a traditional configuration (see figure 3). It would consist of two steel, prefabricated gates that swing from abutments on both sides of the channel opening. Guide walls would be provided to facilitate the movement of vessels through the sector gate opening, which would be aligned with the Seabrook Bridge and the railroad navigation openings. The sector gate structure itself would be housed within a concrete monolith. During regular channel traffic conditions (gate open) the sector gate leaves would each rest within the recess in the gate bay walls on either side of the channel. Final design would include features such as ramps and baffles to minimize impacts to fish and crustacean migration through the gate.

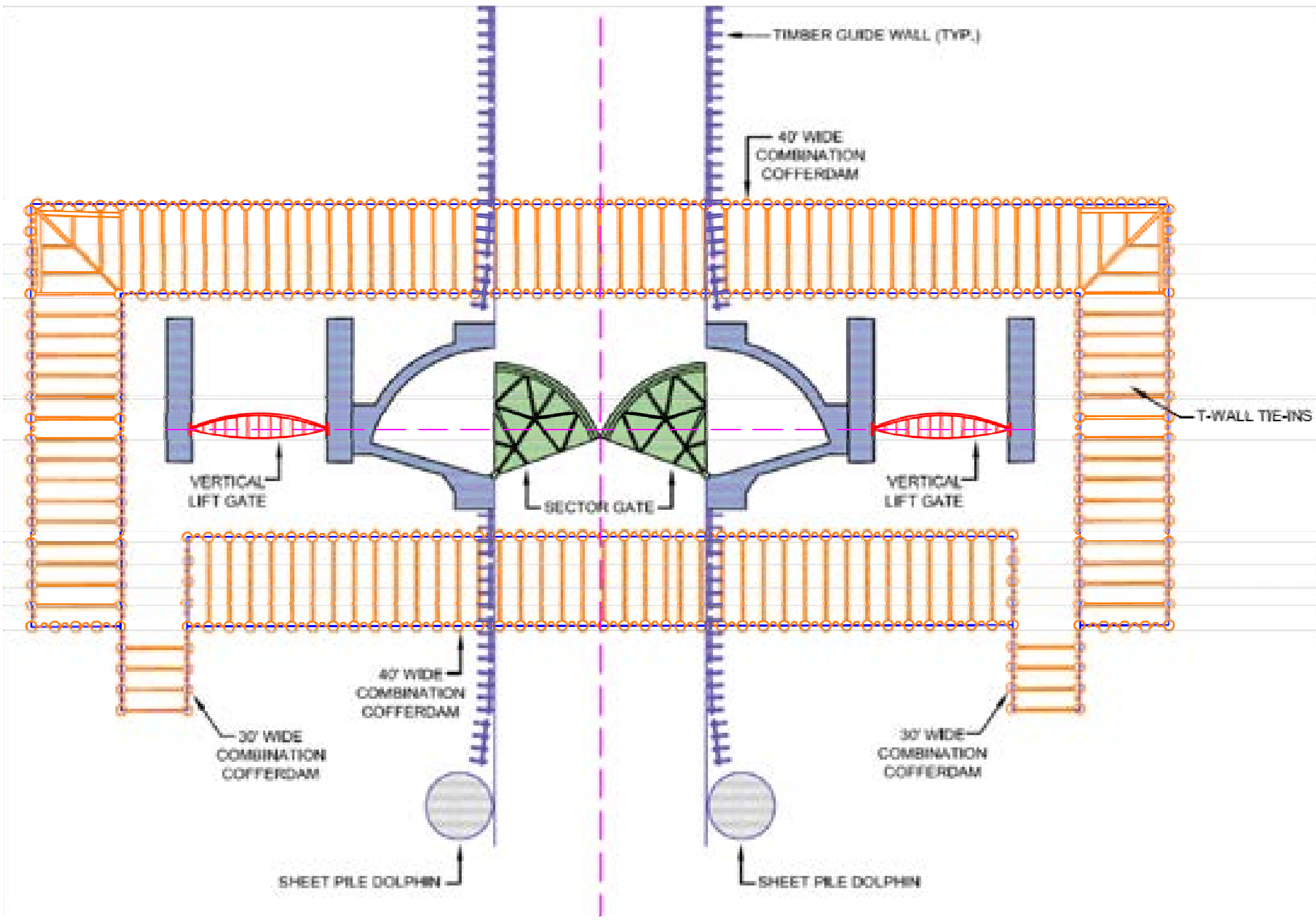


Figure 3. Diagram of Floodgates and Temporary Cofferdam

During construction, a temporary braced cofferdam would be installed across the channel around the approximate perimeter of the sector and vertical lift gates for a period of approximately 6 months to 12 months (figure 3). This portion of the channel would likely be closed to navigation and recreational vessels for the duration of the construction of the sector gate and vertical lift gates; however, ingress and egress to and from the Seabrook area of the IHNC via the GIWW would remain available. The construction schedule may include work up to 24 hours per day and 7 days per week. The USACE carefully reviewed the option to provide a navigable 'bypass' through the cofferdam structure, but determined that regardless of the construction sequence, a bypass would be infeasible due to the potential for high flow rates, which raised public safety concerns associated with navigating directly through an active construction area in a high current situation. Additionally, the construction sequence necessary to provide such bypass could potentially add approximately 8 months to the construction schedule, and would result in a substantial cost increase.

With the cofferdam in place, a tremie seal (concrete placed underwater using a tremie) would be placed around the piles to the approximate bottom of the sector gate structure base slab to counteract the hydrostatic uplift force once the cofferdam is dewatered. The base slab of the sector gate structure would rest on hollow steel pipe piles, a sheet pile wall, and the thick tremie seal.

The non-navigable vertical lift gates for all alternatives would consist of two concrete pilasters that support a concrete or steel bridge that spans the channel and provides maintenance access and structural support for the vertical floodgates (figure 4). Coast Guard approved warning devices will be installed to direct navigation away from the lift gates as the difference between the height of the lift gates in the open position and the typical water elevations in the IHNC will not provide sufficient clearance for boats or barges to pass thru the gates. Electric motors would be required to operate the vertical lift gates. The purpose of these gates would be to allow enough of an open area for flow through the risk reduction structure to maintain existing velocities in the Seabrook area.

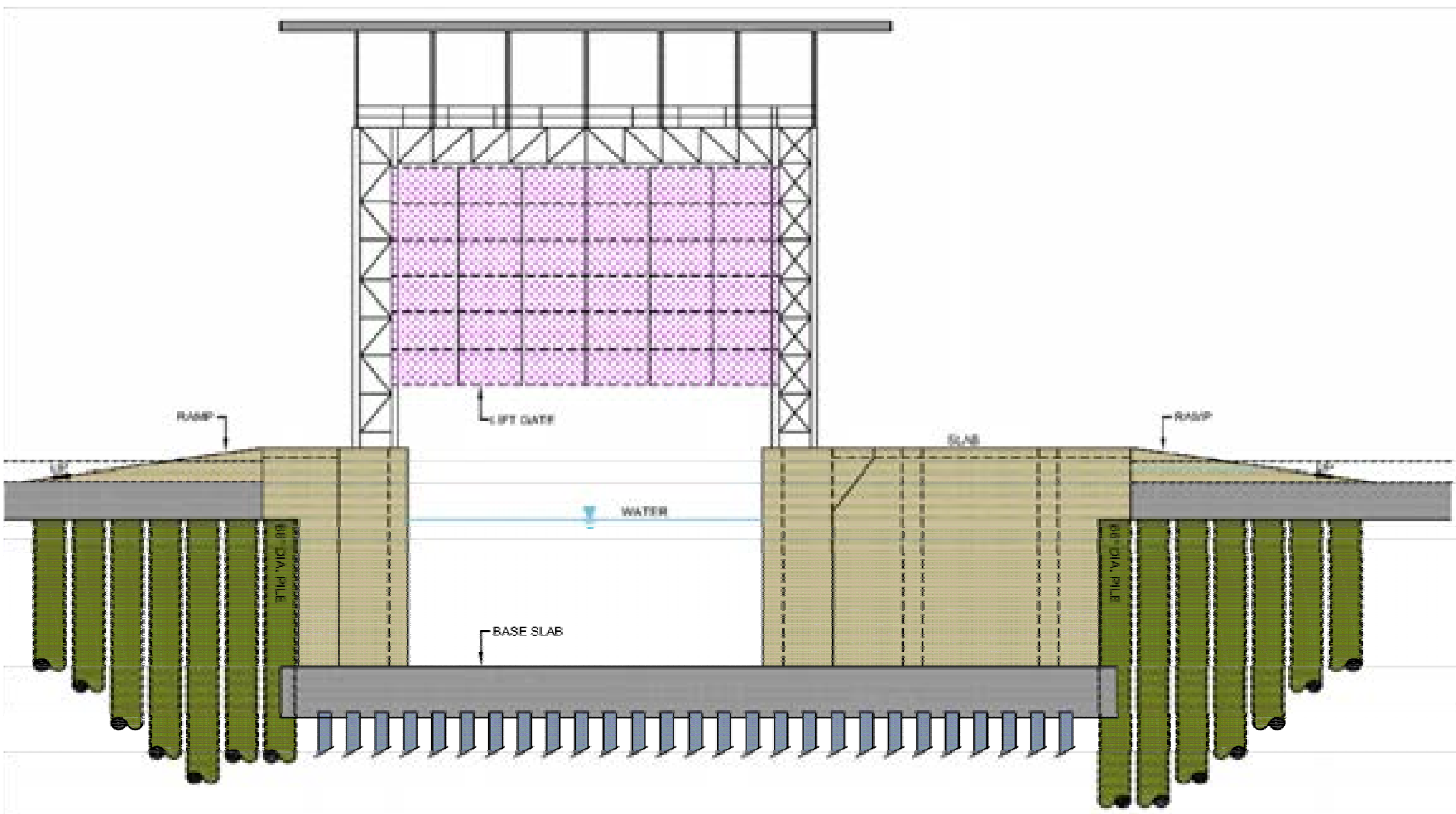


Figure 4. Example of a Non-Navigable Vertical Lift Gate

A site plan of the proposed action is shown in figure 5. In order to design and construct the proposed action, the total area that may be required for structure right-of-way (ROW), construction access, staging areas, and office trailer locations is estimated to be 26 acres (figure 6). This total area would include approximately 14 acres for permanent easements (i.e., floodwall/floodgate ROW, perpetual access easement, etc.) and 12 acres for temporary construction easements. A portion of the temporary staging area could be converted to permanent staging by the non-Federal sponsor upon project completion.

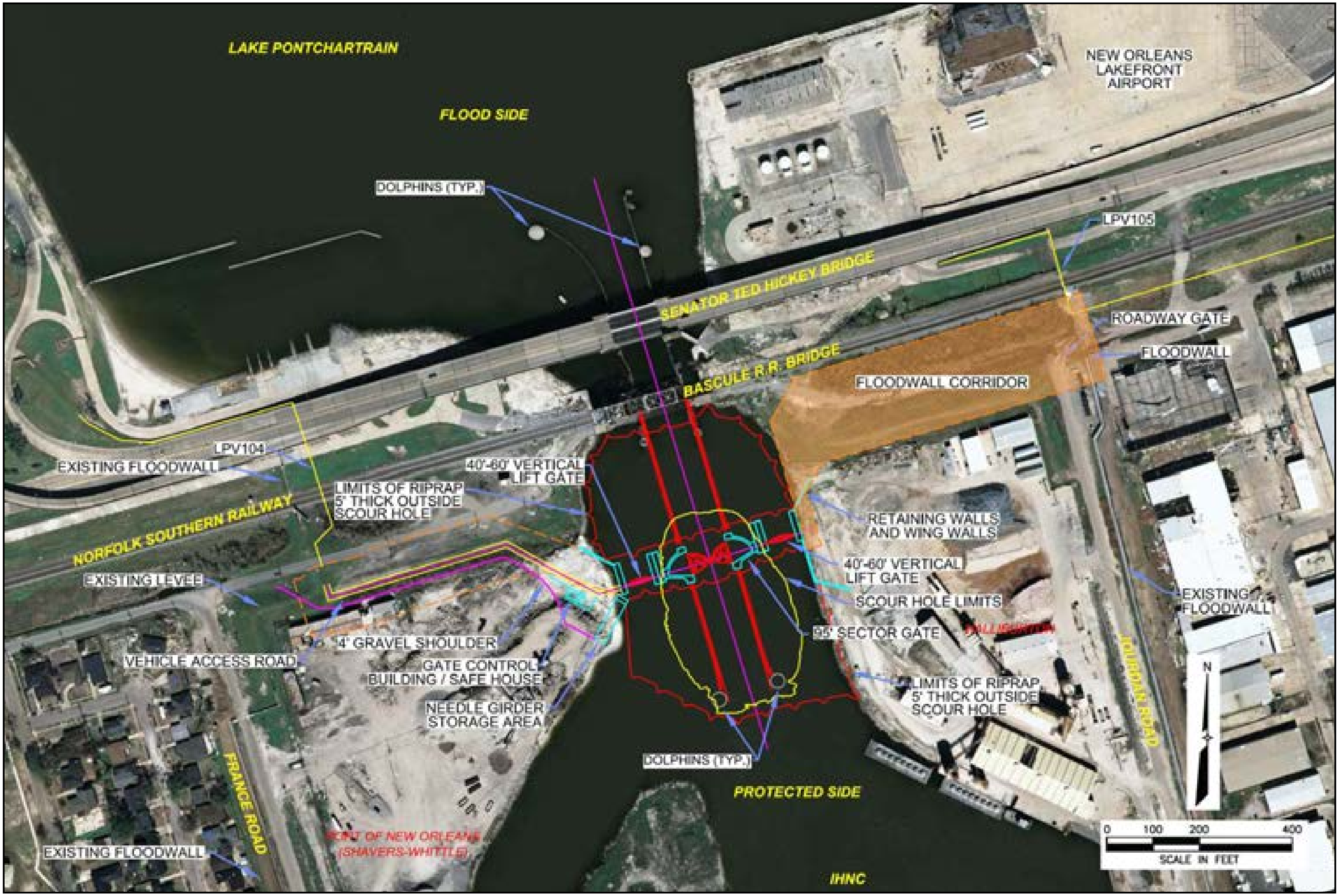


Figure 5. Diagram of Proposed Action - Bridgeside Alignment 540 ft South of Seabrook Bridge

Figure 6. Permanent and Temporary Easements for the Proposed Action

Two scour holes, most likely the result of extreme storm event tidal flow into and out of the lake, are located approximately 300 ft to the north and 300 ft to the south of the Seabrook Bridge (distance from bridge to nearest edge of each hole) within the IER #11 Tier 2 Pontchartrain project area (figure 7). The north scour hole is approximately 300 ft wide, 525 ft long, and 100 ft deep, and the south scour hole is approximately 275 ft wide, 450 ft long, and 90 ft deep.

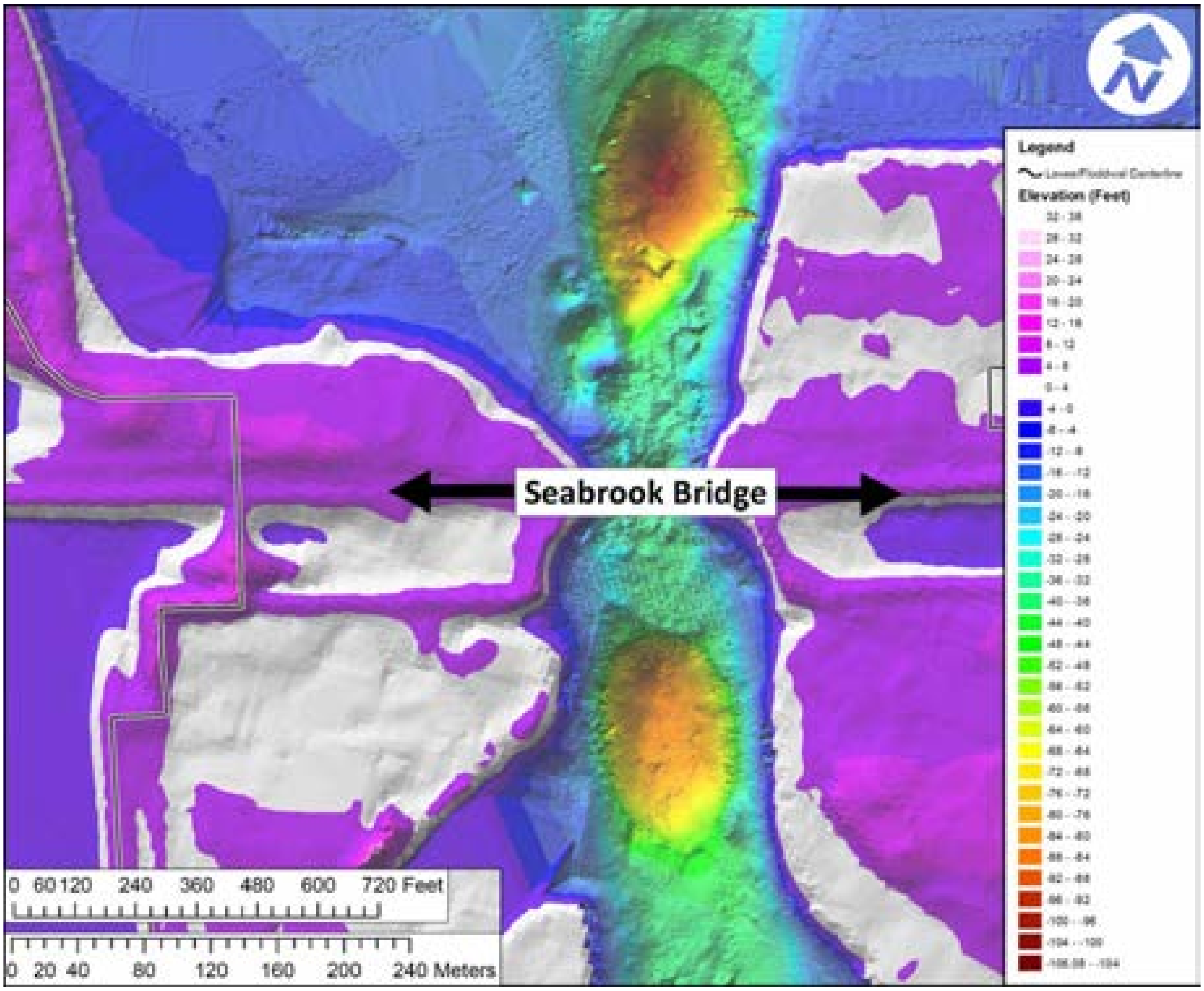


Figure 7. Locations and Depths of Scour Holes near the Project Area

Since the proposed action would encroach into the south scour hole, this alignment would require filling the existing scour hole before construction of the cofferdam and foundation could begin. The scour hole would be filled in to provide lateral support for the pilings. The lower portion of the scour hole would be filled with coarse sand to El -42.0 ft NAVD88 before the guide wall and supporting piling are driven; then, stone riprap would be placed around the support piling to El -37.0 ft NAVD88. The IHNC in the project vicinity ranges from approximately -30 ft to -41 ft in depth outside the scour hole.

Approximately 1,500 ft of T-walls would be required under the proposed action (figure 8). T-wall floodwall tie-in sections would connect the gate structures in the IHNC to the T-walls built on existing levees on either bank of the IHNC. The exact alignment of the east bank T-wall built on existing levees has not yet been determined; however, the floodwall would be constructed within the 'floodwall corridor' shown on figure 5 and would have a similar final footprint as the floodwall on the west bank.

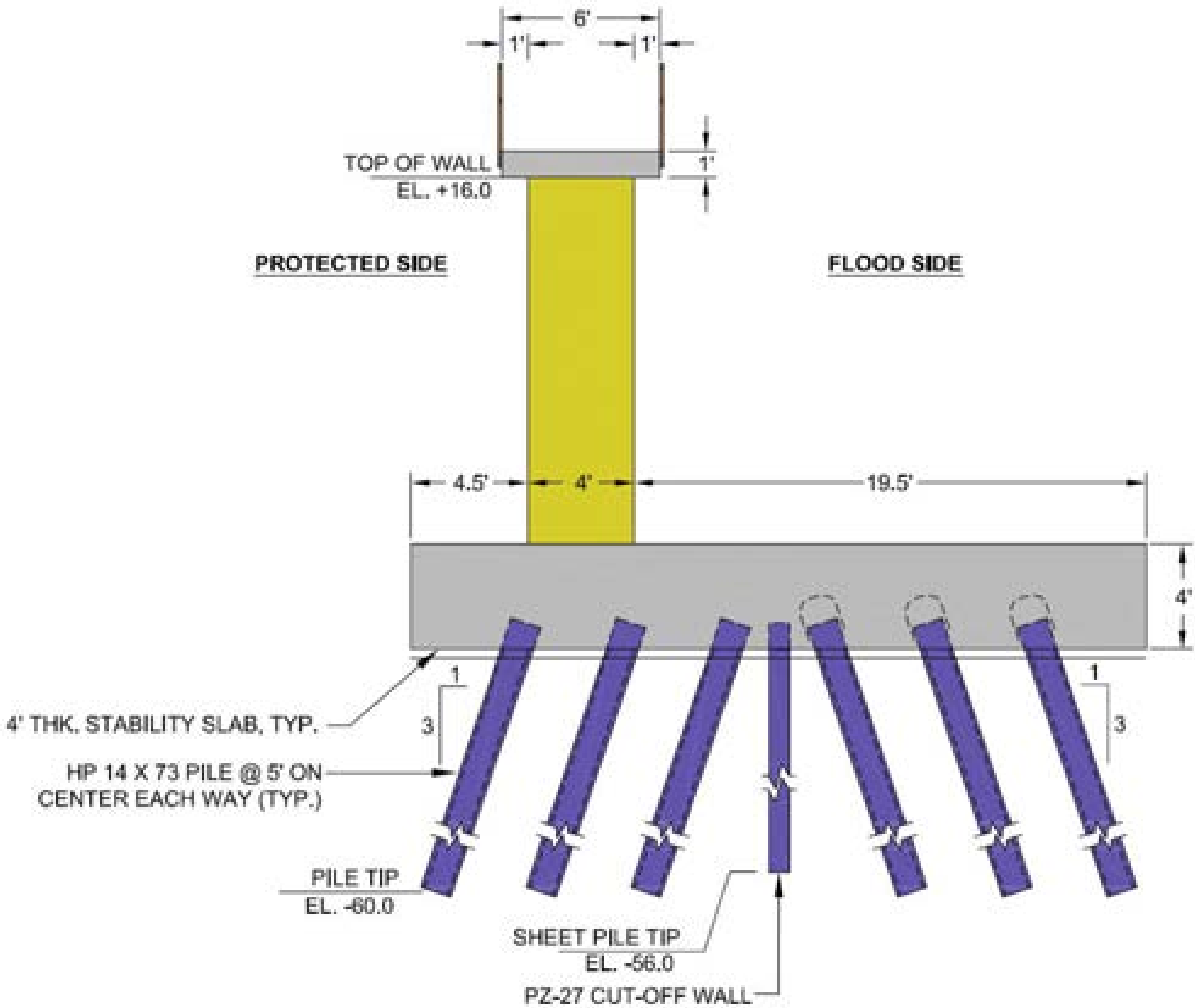


Figure 8. Typical T-Wall Floodwall Cross-section

Steel sheetpiles would connect the adjacent gates to the banks and provide confinement for placement of sand and riprap to create new levee sections to approximately El +4.0 ft NAVD88. These sheetpiles would be used as retaining walls to contain the soil backfill and protect the gate structures themselves from any type of sliding of the soil backfill. T-wall tie-ins would be placed on the backfill and founded on sheetpiles. The 19.5-ft wide toe of the tie-in would provide for vehicular access to the outer side of either vertical lift gate structure (figure 8).

T-walls on top of the existing levees that run parallel to the Seabrook Bridge would be built over a sheetpile cutoff wall to El -56.0 ft NAVD88 to prevent seepage. Figure 9 illustrates a cross-section of a T-wall floodwall built on an existing levee. The T-walls would be placed on the existing levees and would transition laterally to LPV 104 and LPV 105 at El +16.0 ft NAVD88. The 15-ft-wide toe of the wall would provide vehicular access to the outer side of either vertical lift gate structure. The floodwall on the east side of the channel would include a 20-ft-wide vehicle flood gate with a sill at existing ground elevation to provide access to Jourdan Road. A 12-ft-wide asphalt access road would run from the control building along the south toe of the slope to France Road.

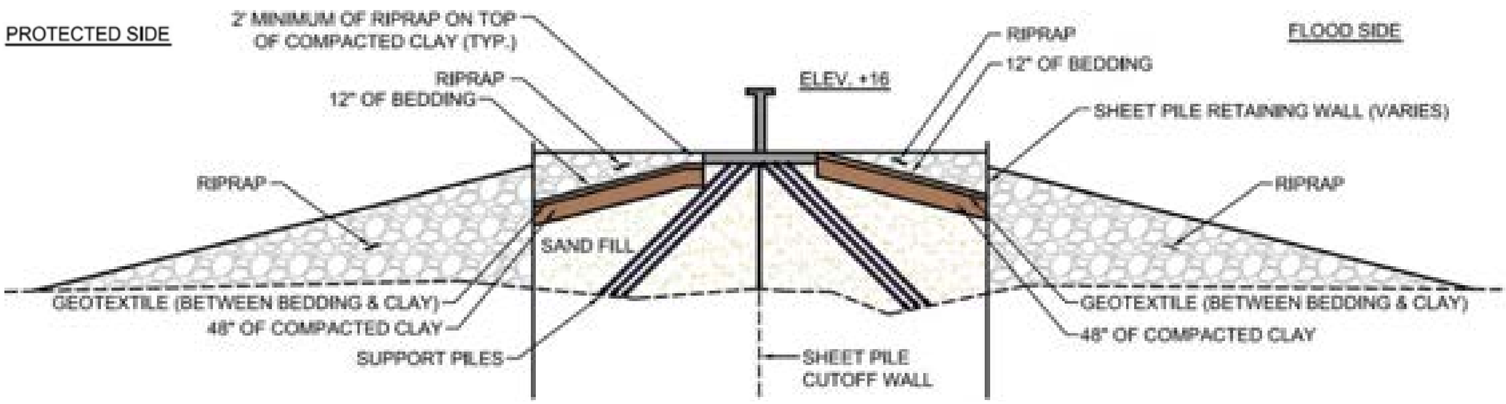


Figure 9. Cross-section of a T-Wall built on an Existing Levee (Proposed Action and Alternative #2)

To prevent the forming of new scour holes or eroding the banks of the IHNC, scour protection and riprap bank protection would be placed over the approximate area shown in figure 5. In addition, the sill would be sloped to direct water flow through the center of the channel and a training wall would be constructed to further reduce bank erosion.

A control building would be constructed to house a safe room area, standby generators, power distribution, and programmable logic controller (PLC) communications/monitoring system for the gates. This hurricane-proof structure would have an estimated 15-ft by 30-ft footprint and would be located on the protected side, to the west of the western vertical lift gate structure near the east end of the west bank floodwall (figure 5). The control building would be accessible by a vehicle access drive for refueling, operation, and maintenance purposes.

The proposed sector gate and two vertical lift gates would remain open except during extreme storm events, high flow events, and routine maintenance. Specific conditions (i.e., high velocities through the navigable gate on the GIWW) could arise that would require the Seabrook floodgates to be closed at times other than during a storm event. Analysis of historical wind, tide, and velocity data suggests that a reasonable, conservative estimate of 10 closures per year for non-storm related events could be required to help control/reduce velocities through the gates on the GIWW. However, the operational scenario will be determined at a later date in cooperation with the local sponsor, as described in section 1.6. A simulated rendering of the proposed action alignment in both the open (normal operating conditions) and closed (during a storm event) positions is illustrated in figure 10.

Figure 10. Simulated Image of Proposed Action Alignment in the Open and Closed Positions
(During storm conditions when gates are closed, water level will be higher on the floodside of gates)

Armoring of Levees and Floodwalls

Armoring could be incorporated as an additional feature to protect against erosion and scour on the protected, flood, or both sides of critical portions of levees and floodwalls. These critical areas include: transition points (where levees and floodwalls transition into any hardened feature such as floodwalls, pump stations, etc.), utility pipeline crossings, floodwall-protected side slopes, and earthen levees that are exposed to wave and surge overtopping during a 500-year storm event. The proposed method of armoring could be one of the following: cast-in-place reinforced concrete slabs; articulated concrete blocks (ACB) covered with soil and grass; turf reinforcement mattress (TRM); ACB/TRM; TRM/grass; or good grass cover. The armoring would be incorporated into the existing levee or floodwall footprint and no additional environmental impacts would be anticipated.

Construction-Related Information for Proposed Action

Phase 1 of the construction would consist of two concurrent components, Phase 1a and Phase 1b. Phase 1a would focus on the construction of the portion of the structure below water and fabrication of the gates. This would include filling the scour hole, driving guide wall piling, driving foundation piling and cutoff wall piling, constructing the braced cofferdam, constructing the tremie concrete seal and sill slab, constructing the lower portion of the gate bays to an elevation above normal water height, and constructing the guide walls.

Phase 1b, which could proceed concurrently with Phase 1a, would include the relocation of roads, utilities, and other facilities; and installation of access roads and fencing and construction of the T-wall floodwalls.

Phase 2 of the construction would include completion of the gate bays, head walls, and wing walls; installation of gates using stop logs and dewatering the bays; completion of tie-in floodwalls; construction of the gate control building with safe room; installation of operating equipment; construction of guide walls; construction of riprap stability measures; construction of riprap erosion measures; installation of upstream and downstream scour protection; completion of site development and surfacing of service roads; installation of electrical supply lines; completion of all electrical and mechanical work; testing the operation of the gates; preparing the operation manual; and training the operation staff.

Borrow material for the project reaches within the IHNC channel, including sand fill for filling the scour hole, would come from a government-approved source. The sand fill would be protected by layers of graded stone riprap and topped with a layer of cover stone. This material would be stock piled, as needed, along the protected-side of the new proposed action alignment. Concrete would likely be transported to the site via ready mix concrete trucks and pumped on-site. Steel sheet piling and H-piling would likely be shipped by rail or by barge into the city from the manufacturer. Surfacing would likely be provided by a local supplier and transported via truck to the project site.

Construction activities would be expected to last for approximately 36 months. It is possible that construction of the floodwalls for the proposed action could not be accomplished concurrently with construction of the floodgates in the IHNC due to logistical issues such as accessibility, man power, and material staging and delivery. A significant amount of construction equipment would be required to conduct the work, including bulldozers, hydraulic cranes, mechanical cranes, hydraulic excavators, welders, concrete pump trucks, rollers, pile hammers, graders, tractors, front-end loaders, flatbed trucks, and pickup trucks.

Table 3 provides information on the approximate volumes of materials that would be required for construction of the proposed action.

Table 3.
Estimated Construction Material Quantities Required to Complete the Proposed Action*

Major Classification	Specific Sub Item	Units of Measure	Quantity
Concrete	Tremie Seal	cubic yards (cy)	20,273
	Grout	cy	292
	2,500 PSI Concrete	cy	318
	4,000 to 5,000 PSI Concrete	cy	33,922
Structural steel	Walers and Struts	tons	776.8
	Grade 50 Structural Steel	tons	599
	Hand Rail	linear feet (LF)	1,308
Sheet piles	PZ 22	square feet (sq ft)	243,720
	PZ 27	sq ft	528,960
	PS 27.5	sq ft	18,086
H-piles	HP 14x89	vertical linear feet	14,976
	HP 14x73	vertical linear feet	51,025
Steel Pipe Piles	54” Steel Pipe Pile	vertical linear feet	28,500
	24” Steel Pipe Pile	vertical linear feet	37,278
Sand	Sand fill	cy	184,322
Asphalt, Riprap & Aggregate	Asphalt	square yards	1,067
	Riprap - Type I	tons	10,340
	Riprap - unclassified	tons	75,314
	Aggregate Base Course	cy	1,067
	1” Riprap Bedding Stone	square yards	8,837
Embankment Material	Clay	cy	18,409

* *Includes materials estimated for partially filling the scour hole.*

2.4 ALTERNATIVES TO THE PROPOSED ACTION

Four alternatives to the proposed action were considered in detail; three in-channel alternatives south of the bridge, and one alternative north of the bridge within Lake Pontchartrain. For each alternative, all T-walls would be built to an elevation of +16.0 ft NAVD88 and the dimensions and combination of floodgate structures (a sector gate and two vertical lift gates, illustrated in figures 3 and 4) would be the same as described for the proposed action.

Alternative #2 - Bridgeside Alignment: Sector Gate located 398 ft south of Seabrook Bridge and approximately 1,300 ft of T-walls built on Existing Levees

Alternative #2 is similar to the proposed action except the gates would be aligned across the IHNC approximately 150 ft closer to the Seabrook Bridge and all features would be in line with one another (figures 2 and 11). Approximately 1,300 ft of T-walls would be constructed to transition the floodgate structures laterally to LPV 104 and LPV 105 at El +16.0 ft NAVD88. Similar to the proposed action, a 20-ft wide vehicle swing gate would be required along the eastern floodwall to provide access to Jourdan Road.

Construction activities for alternative #2 would be expected to last for approximately 36 months. During construction, a temporary braced cofferdam would be installed across the channel around the approximate perimeter of the sector gate and vertical lift gates for a period of approximately 6 months to 12 months. This portion of the channel could be closed to navigation and recreational vessels for the duration of the construction of the sector gate and vertical lift gates. The construction schedule may include work up to 24 hours per day and 7 days per week.

Under this alternative, the lower portion of the scour hole would be partially filled with sand to El -60.0 ft NAVD88 before the guide wall and supporting piling are driven; then, stone riprap would be placed around the support piling to El -30.0 ft NAVD88.

The total area that may be required for ROW, construction access, construction easements, storage areas, and office trailer locations for this alternative is estimated to be 27 acres. This total area is comprised of approximately 12 acres for permanent easements (i.e., floodwall/floodgate ROW, perpetual access easement, etc.) and 15 acres for temporary construction easements.

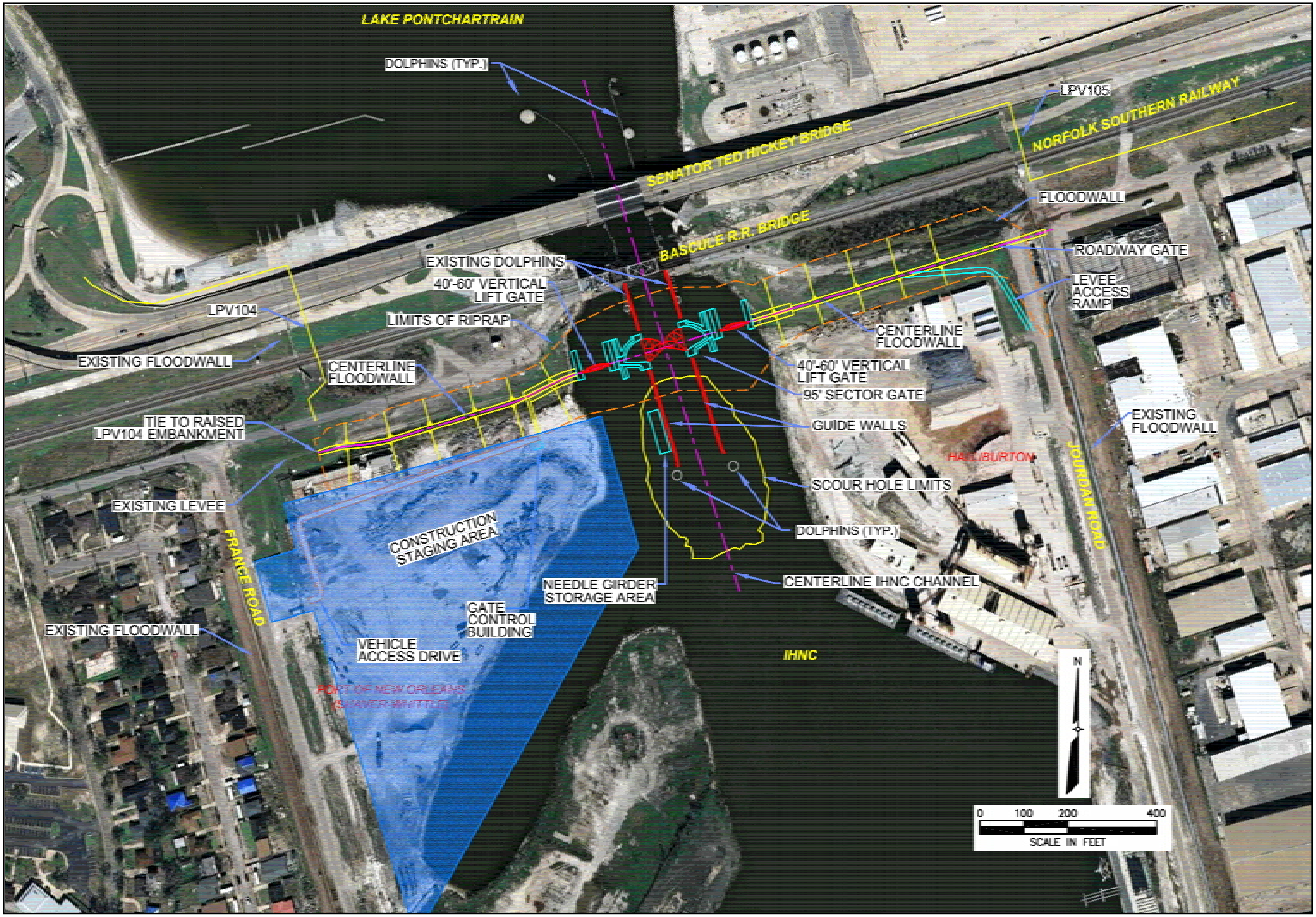


Figure 11. Diagram of Alternative #2 - Bridgeside Alignment 398 ft south of Seabrook Bridge

Alternative #3 - Turning Basin Alignment: Sector Gate located 1,500 ft south of Seabrook Bridge and approximately 1,500 ft of T-walls

Alternative #3 includes similar features to the proposed action; however, the gate structures would be aligned across the IHNC 960 ft farther to the south of the Seabrook Bridge, requiring that the floodwalls, which comprise the east side of the alignment run across the IHNC Turning Basin. This alignment would also include 20-ft wide vehicle swing gates in the western and eastern floodwalls to provide access to France Road and Jourdan Road, respectively. An 18-ft wide railroad swing gate would also be included in the eastern floodwall for the existing railway.

Under this alternative, approximately 1,500 ft of T-walls would tie-in the floodgates to the existing HSDRRS on the eastern and western banks of the IHNC by transitioning laterally to LPV 104 and LPV 105 at El +16.0 ft. Additionally, the existing I-walls along the existing western and eastern sides of the IHNC would be replaced with T-walls as part of this raising process. A site plan of alternative #3 is shown in figure 12.

Unlike the proposed action, no scour holes are known to be present near the alternative #3 alignment; therefore filling the scour hole would not be included in the construction. However, during construction a temporary braced cofferdam would be installed in the channel around the approximate perimeter of the sector gate and vertical lift gates for a period of approximately 6 months to 12 months. Construction activities for alternative #3 would be expected to last for approximately 39 months and the construction schedule may include work up to 24 hours per day and 7 days per week. Sufficient space may be available around the temporary cofferdam structure for passage of canal traffic until the gate opening is placed in service, thus allowing for continuous navigation. However, it is likely that out of concern for safety, the IHNC may be closed to all navigation while the cofferdam is in place.

The total area that may be required for ROW, construction access, staging areas, and office trailer locations for this alternative is estimated to be 37 acres. This total area is comprised of approximately 18 acres for permanent easements, 12 acres for temporary easements, and 7 acres for ROW associated with replacing the existing I-walls along the IHNC with T-walls. This alternative crosses twice the amount of water as the proposed action and alternatives #2 and #4.

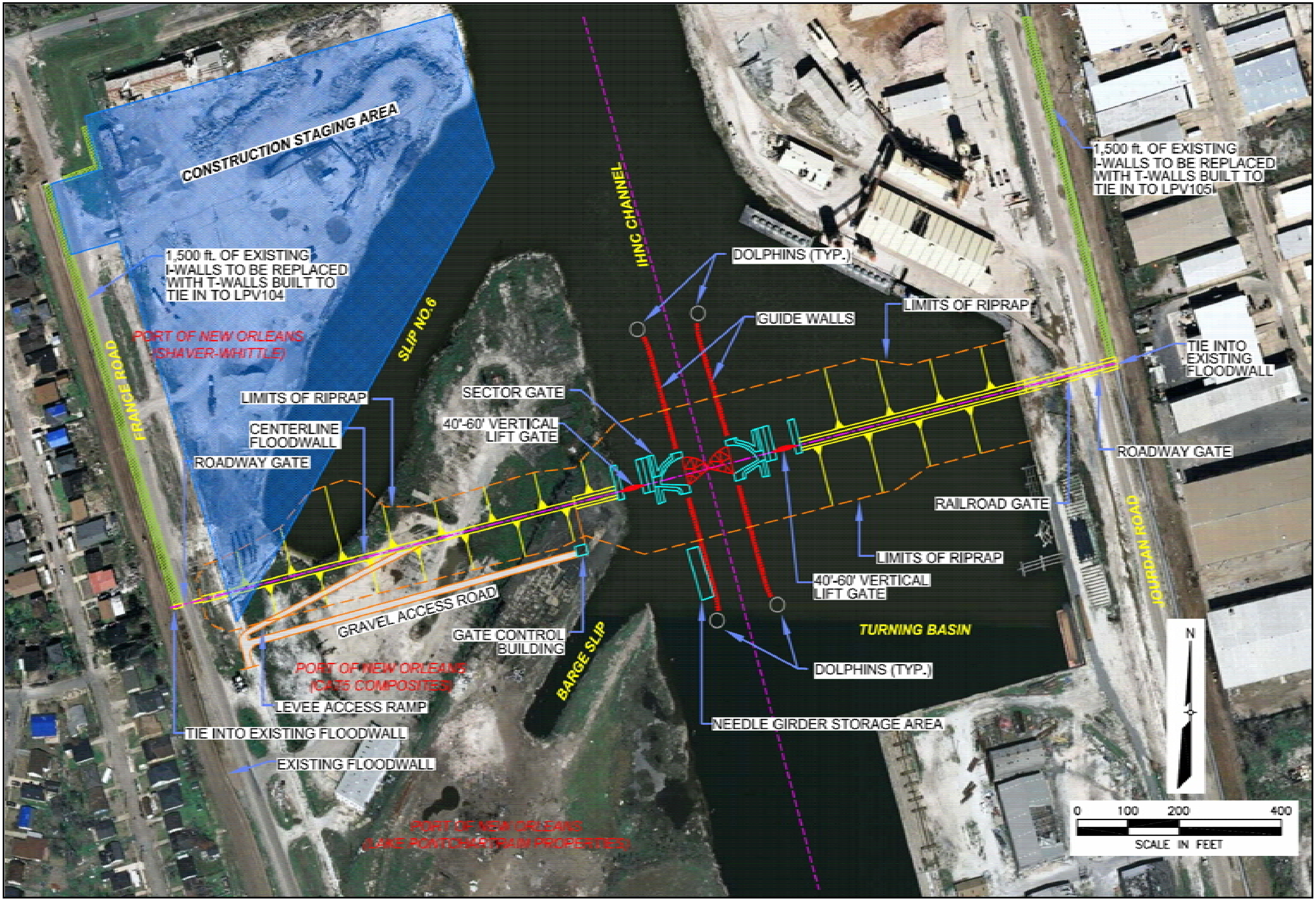


Figure 12. Diagram of Alternative #3 – Turning Basin Alignment

Alternative #4 – South of Turning Basin Alignment: Sector Gate located 2,000 ft south of Seabrook Bridge and approximately 1,450 ft of T-walls

Alternative #4 includes similar features to the proposed action, but is the southernmost alignment. The sector and lift gates would be aligned across the IHNC 2,000 ft south of the Seabrook Bridge, immediately south of the IHNC Turning Basin. This alignment would also include 20-ft wide vehicle swing gates in the western and eastern floodwalls to provide access to France Road and Jourdan Road, respectively. An 18 ft wide railroad swing gate would also be included in the eastern floodwall for the existing railway.

Approximately 1,450 ft of T-walls would tie-in the floodgates to the existing HSDRRS on the eastern and western banks of the IHNC by transitioning laterally to LPV 104 and LPV 105 at El +16.0 ft. Additionally, the existing I-walls along the western and eastern sides of the IHNC would be replaced with T-walls as part of this raising process. A site plan of alternative #4 is shown in figure 13.

Unlike the proposed action, no scour holes are present near the alternative #4 alignment; therefore, filling the scour hole would not be included in the construction. However, for this alternative a temporary braced cofferdam would be installed in the channel around the approximate perimeter of the sector gate and vertical lift gates. This portion of the channel could be closed to navigation and recreational vessels for the duration of the construction of the sector gate and vertical lift gates, which is anticipated to last approximately 6 months to 12 months. The construction schedule may include work up to 24 hours per day and 7 days per week. The construction duration for alternative #4 would be approximately 40 months.

The total area that may be required for ROW, construction access, staging areas, and office trailer locations for this alternative is estimated to be 36 acres. This total area is comprised of approximately 15 acres for permanent easements, 12 acres for temporary easements, and 9 acres for ROW associated with replacing the existing I-walls along the IHNC with T-walls. This alternative would utilize the same 12-acre staging area (blue shaded area on figures 6, 11, and 12) as the proposed action and all other alternatives.

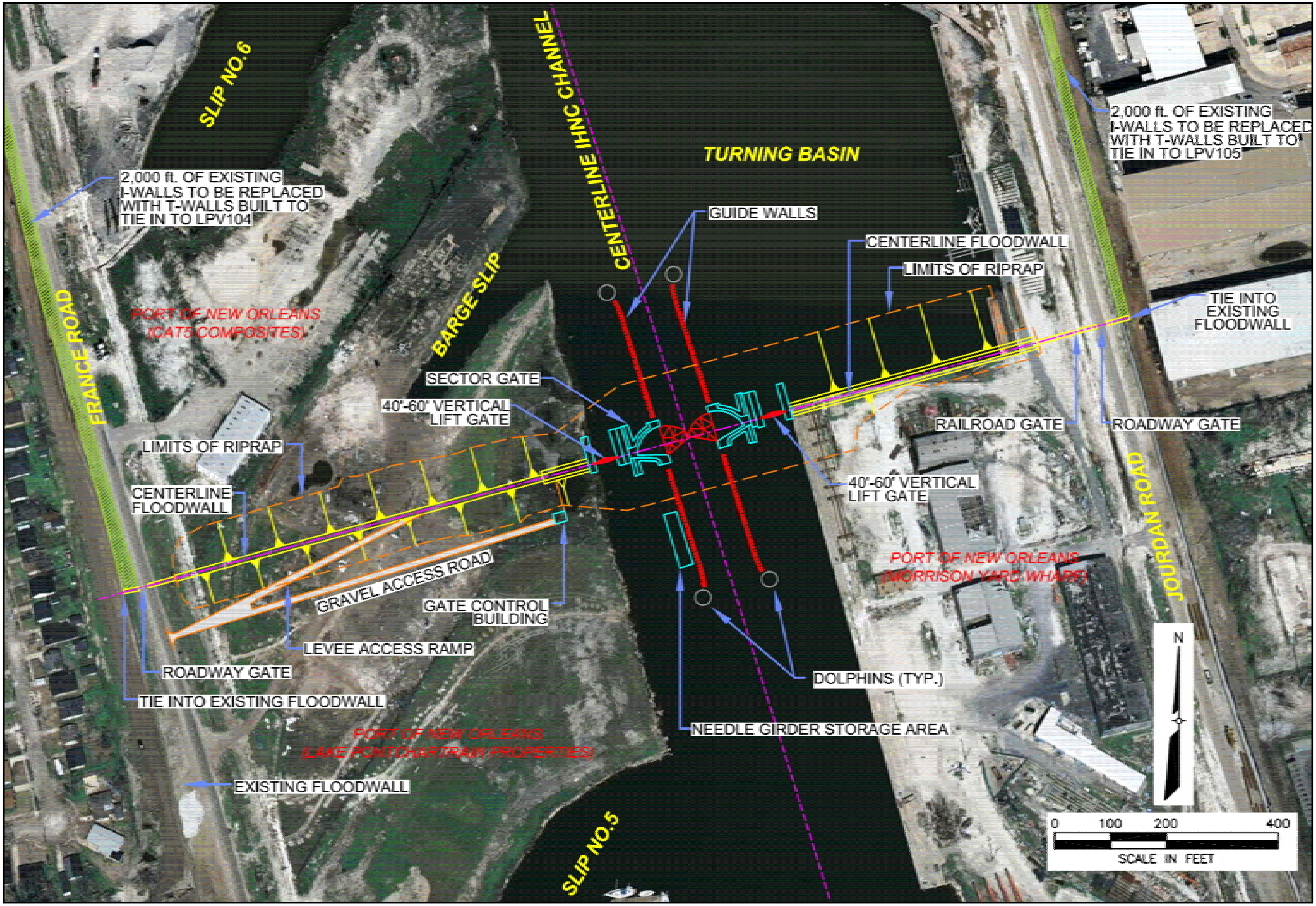


Figure 13. Diagram of Alternative #4 – South of Turning Basin Alignment

Alternative #5 – Lake Pontchartrain Alignment: Sector Gate located 502 ft north of the Seabrook Bridge and approximately 1,800 ft of T-walls

Alternative #5, the northern-most alignment, is the only alternative located within Lake Pontchartrain. The sector and lift gates would be built in Lake Pontchartrain 502 ft north of the Seabrook Bridge, aligned on the eastern bank with the edge of the New Orleans Lakefront Airport property. Approximately 1,800 ft of T-walls would transition laterally to LPV 104 and LPV 105 at El +16.0 ft. This alignment would also include a 20-ft wide vehicle swing gate along the eastern floodwall to provide access to the airport's jet fuel storage area and two vehicle swing gates would be built across access roads that run under the Seabrook Bridge.

Alternative #5 would span the deepest portion of the north scour hole in Lake Pontchartrain, north of the Seabrook Bridge. The lower portion of the scour hole would be partially filled with sand before the guide wall and supporting piling are driven; then, stone riprap would be placed around the support piling. A site plan of alternative #5 is shown in figure 14.

Alternative #5 would cause the least amount of disruption to navigation of all alternatives considered. Construction in the lake would permit staged construction, which would allow limited navigation during construction, but would also extend the construction duration (approximately 45 months). The construction schedule may include work up to 24 hours per day and 7 days per week.

The total area that may be required for ROW, construction access, staging areas, and office trailer locations for this alternative is estimated to be 34 acres. This total area is comprised of approximately 12 acres for permanent easements and 21 acres for temporary easements. Alternative #5 would utilize the same 12-acre staging area (blue shaded area on figures 6, 11, and 12) as the proposed action and all other alternatives.

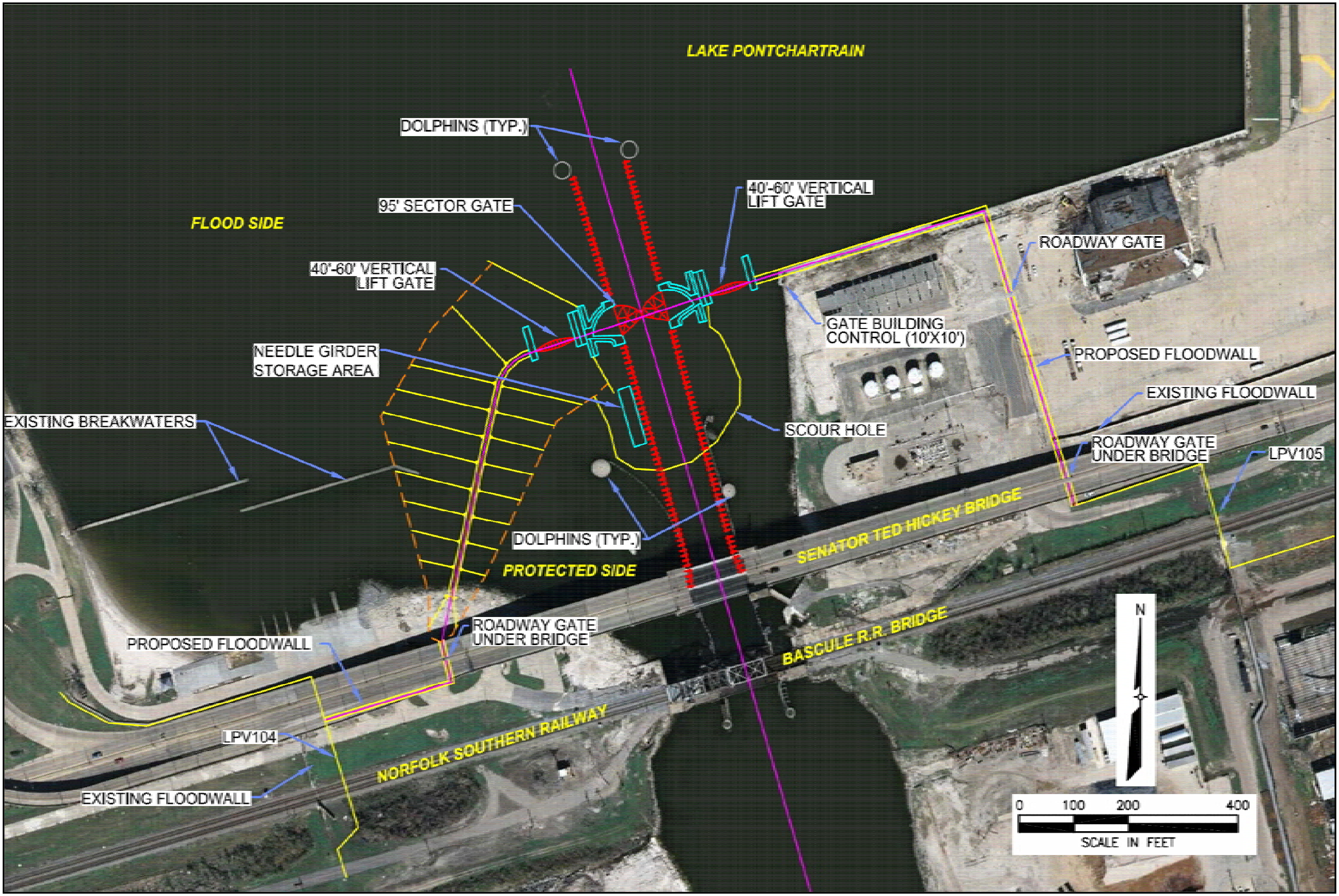


Figure 14. Diagram of Alternative #5 - Lake Pontchartrain Alignment

2.5 ALTERNATIVES ELIMINATED FROM FURTHER CONSIDERATION

In addition to the alternatives already eliminated from further consideration as part of the Tier 1 IER #11 document, two additional alternatives and one feature were eliminated from further consideration because they did not adequately meet the screening criteria under the Tier 2 evaluation.

Alternative #3a: Just North of Slip No. 5 Alignment - Sector Gate approximately 2,500 ft south of Seabrook Bridge and T-wall

This alignment would be similar to the proposed action except for the location of the alignment across the IHNC. This alternative would be built approximately 320 ft south of alternative #4, just north of Slip No. 5. The west side of this alignment would tie-in to the existing floodwall, run east across France Road and across the recreational vehicle (RV) park property and into the IHNC. The east side of the alignment would run through the Morrison Yard Wharf dock board, through the entrance gate to the Morrison Property, and tie-in to the existing floodwall east of Jourdan Road.

On the western side of this alignment, the Pontchartrain Landing, New Orleans Waterfront Park lies between the Barge Slip and Slip No. 5 of the IHNC. Within the park, there is a central operation building (pavilion) for the park with outside decking, landscaping, and a pool. Behind the pavilion, there is a detention pond with a fountain in the center. The RV park itself includes 122 full-service sites with water, electric and cable hookups; 33 of these sites are waterfront sites. There are also numerous dolphins lining the water's edge in the IHNC and the slips in various conditions of repair. Sanitary sewer and water lines run parallel to France Road between the road and the RV park.

On the eastern side of this alignment, railroad tracks run parallel to Jourdan Road. Additionally, there are railroad tracks within the Morrison Yard Wharf property that once provided rail access to the docked barges. A security fence borders the Halliburton Property along Jourdan Road. Raised electric lines and elevated hydrants (water lines) run between the security fence and the railroad tracks. Inside the security fence there are railroad tracks that run parallel to the road and the fence. Water lines and electric lines run throughout the area between the road and the dock board. The dock board has open areas where the concrete is broken and the rebar is exposed. The buildings in this area have been abandoned, post Hurricane Katrina. There are miscellaneous pieces of equipment, steel, tires, and general large debris across the site.

This alignment was not considered a discrete alternative that offered any engineering advantages over other similar alternatives. Based on the utility locations, the condition of the dock board, and the property conflict for the RV park, this alignment was considered not to offer any additional benefits not already found in the other alternatives, but would have additional negative impacts on the human environment.

Lock Alternative: Navigation Lock Structure Placed in Any of the Alternative Alignments

In lieu of a traditional gate structure, the use of a navigation lock in any of the five alignments was included in the initial alternatives evaluation. For the evaluation process, construction of the lock along the alternative #2 alignment was examined, with an understanding that the lock option could be transposed to other alignments to determine the best location. The 200-ft long and 84-ft wide lock structure with a sill elevation of -16.0 ft National Geodetic Vertical Datum of 1929 (NGVD29) would be patterned after a lock that was originally designed for this location in the 1970s (USACE 1970). The gates in the lock structure would be sector gates. Culverts could be provided to allow for movement of fish and other aquatic species during periods when the gates are closed. The lock would require full-time operation for control of velocities and for passage of water craft. Operation would involve keeping one lock gate closed to stop canal flow until the water craft is inside the lock chamber, then closing the second gate and opening the first gate to allow passage of the vessel out the opposite end. The lock would also be open for certain tidal conditions.

A properly operated lock would remove adverse hydraulic issues, but would also bring significant environmental and OMRR&R issues. A lock would be more detrimental to fish and crustaceans than the other alternatives. OMRR&R costs for this alternative would be much higher than for other alternatives that do not require full-time operation. OMRR&R, not including major maintenance, is estimated to cost approximately $1.2 million to $1.5 million per year. In addition, the time required for construction of this alternative would be longer than that for all other alternatives being considered except alternative #5.

Single 95-ft wide Navigation Opening with a -16.0 ft Sill

The initial alternatives evaluated each included a single 95-ft wide navigation opening with a sill elevation of -16.0 ft. The initial evaluations of these alternatives determined that an alignment similar to that in alternative #2 with a single 95-ft wide sector gate closure with a sill elevation of -16.0 ft best served the requirements for that area and was chosen for further development. At the initiation of the detailed design for this alignment, it was determined that the size of the navigation opening was not adequate to pass the required flow without exceeding the acceptable flow velocities. Therefore, this feature was eliminated from further consideration and a larger opening and different gate configurations that would pass the flow at velocities that are acceptable for navigation and human and natural environmental factors were developed and further evaluated as part of various alignments.

2.6 SUMMARY TABLE

Table 4 provides a summary of the preliminary alternatives screening results.

Table 4.
Preliminary Alternatives Screening Results

Structure	Proposed Action	Alternative #2	Alternative #3	Alternative #4	Alternative #5	Alternative #3a
Sector Gate	☑	☑	☑	☑	☑	X
Vertical Lift Gates	☑	☑	☑	☑	☑	X
T-wall Floodwalls	☑	☑	☑	☑	☑	X
T-walls on Existing Levees	☑	☑	---	---	---	X
Roadway Gate	☑	☑	☑	☑	☑	X
Railroad Gate	---	---	☑	☑	---	X
Lock	X	X	X	X	---	X

X = eliminated from further consideration.
☑= considered in detail.
--- = not applicable – this option was not formulated for this alternative.

3.0 AFFECTED ENVIRONMENT AND ENVIRONMENTAL CONSEQUENCES

3.1 ENVIRONMENTAL SETTING

General

The Tier 2 Pontchartrain project area is located on the south shore of Lake Pontchartrain in the northeastern portion of the Mississippi River deltaic plain (figure 15). The study area is located at the confluence of the IHNC and Lake Pontchartrain and extends approximately 2,500 ft south of the Seabrook Bridge. The study area lies completely within Orleans Parish; however, it defines the dividing line for two sub-basins of the larger Pontchartrain Basin: Orleans East Bank and New Orleans East (figure 16). The Orleans East Bank sub-basin extends westward from the IHNC to the 17th Street Canal and is bordered to the north by Lake Pontchartrain and to the south by the Mississippi River. The New Orleans East sub-basin extends eastward from the IHNC toward the Rigolets Pass and is bordered by Lake Pontchartrain and the GIWW to the north and south, respectively (USACE 1984).

Figure 15. Regional Map of the Tier 2 Pontchartrain Study Area

Figure 16. Tier 2 Pontchartrain Project Area and Pontchartrain sub-basins

Climate

Orleans Parish is located within a subtropical latitude. The climate is influenced by the many water surfaces of the nearby wetlands, rivers, lakes, streams, and the Gulf of Mexico. Throughout the year, these water bodies modify relative humidity and temperature conditions, decreasing the range between the extremes. Summers are long and hot, with an average daily temperature of 81 degrees Fahrenheit (°F) and high average humidity. Winters are characterized by cold, dry, polar air masses moving southward from Canada, with an average daily temperature of 53°F. Average annual precipitation is approximately 61 inches with monthly averages varying from 2.8 inches in October to 6.5 inches in July (USACE 1974; National Oceanic and Atmospheric Administration [NOAA] 1987).

Precipitation in Louisiana is largely due to convectional activity in the summer and tropical storms during the winter. Due to its proximity to the Gulf of Mexico, the study area is susceptible to tropical waves, tropical depressions, tropical storms, and hurricanes. These weather events can produce significant amounts of precipitation over a very short period of time and are often accompanied by strong winds, tornadoes, and storm surge along the coastal areas. Analysis of historic data from the National Hurricane Center dataset on tropical cyclones (including tropical depressions, tropical storms, and hurricanes) of the Louisiana coast from 1900 to 1999 shows a total of 63 storms, of which 49 were Category 3 or less. Not all of these storms had direct contact with the New Orleans metro area (U.S. Geological Survey [USGS] 2002a). Since 1999, a total of 10 storms, of which 7 were Category 3 or less, have impacted Louisiana (USACE 2006a).

Geology and Soils

Dominant physiographic features in the vicinity include Lake Pontchartrain, the lakefront levee, and the IHNC. The surface and shallow subsurface in the study area is composed of up to 18 ft of hydraulic fill from Lake Pontchartrain. Fill deposits contain sand, silt, and clay, overlying lacustrine and beach deposits. Lacustrine deposits are characterized by soft to medium clays with some silt and sand layers and shells and are approximately 10 ft thick. Beach deposits are approximately 30 ft thick and are related to the Pine Island Beach Ridge that trends east-west across the area. The beach deposit is generally composed of silty sand and sand with shells. Beach deposits overlie 5 ft to 10 ft of bay-sound deposits which are characterized by soft to medium clays, silts, and some sand containing shell fragments. Pleistocene deposits are located beneath bay-sound deposits at approximate elevation of -50 ft NAVD88. These deposits are mainly stiff to very stiff, oxidized clays, silts, and sands. The study area also contains Aquent soils, which are poorly drained soils that are stratified and clayey to mucky throughout, resulting from hydraulically dredged material (U.S. Department of Agriculture, Soil Conservation Service 1989). Groundwater has been artificially lowered at the study area by forced drainage. The sands and silts in the fill and beach deposits may be hydraulically connected to Lake Pontchartrain or the IHNC (USACE 2008a).

As part of the Seabrook Phase II Environmental Site Assessment (ESA), four boreholes were drilled in the IHNC near the proposed action alignment (USACE 2007a). Sample locations were based on site conditions, such as water depth, due to limitations of the drilling equipment. The sampling locations were also influenced by the geologist’s discretion to represent potential construction areas. Each hole was drilled to a depth of 5 ft and the material sampled was described as medium to dark grey, very moist, odorless sand or sandy clay (USACE 2007a).

Soil borings collected from the project vicinity can provide information on the nature and extent of soils and shallow sediments, along with their physical and engineering properties. The Phase II – 100 percent Submittal Engineering Analysis Report for Seabrook Floodgate reported that subsurface conditions at the site of the proposed action were based primarily on 11 borings (USACE 2008b). The majority of borings were drilled in March 2008, and with the exception of one boring taken at the limits of the scour hole and one within the footprint of the gate, most borings occurred along or near the alignment of proposed levees that would connect to the gate structure. The subsurface along the alignment of the proposed action consists of a 4 ft to 10 ft think layer of silt, atop a 7 ft to 12 ft thick layer of clay. Underneath the clay is a relatively thick sequence of sand (approximately 38 ft thick), followed by another layer of clay. This clay layer is approximately 10 ft in thickness, and is present across the entire site area. A second sequence of sand exists under this clay and is also present across the site. The sand is underlain by a third layer of sand. Sand found along the alignment of the proposed action is dense to very dense and appears to be part of the Pleistocene Prairie Formation. Elevation of the Pleistocene layer tends to vary along the alignment but generally, on the west side of the IHNC the top is located between El -85.0 ft and -90.0 ft NAVD88, and on the east side of the channel between El -100.0 ft and -140.0 ft NAVD88 (USACE 2009b).

Figure 17 illustrates past and future soil borings within the project area. Historical boring locations are represented on figure 17 by purple dots, whereas proposed soil boring and proposed cone penetrometer test (CPT) dots are colored yellow and pink, respectively. The proposed borings have been completed and the CPTs will be conducted prior to construction.

Additional information related to geologic history and setting can be found in section 3.1.1 of the IER #11 Tier 1 document.

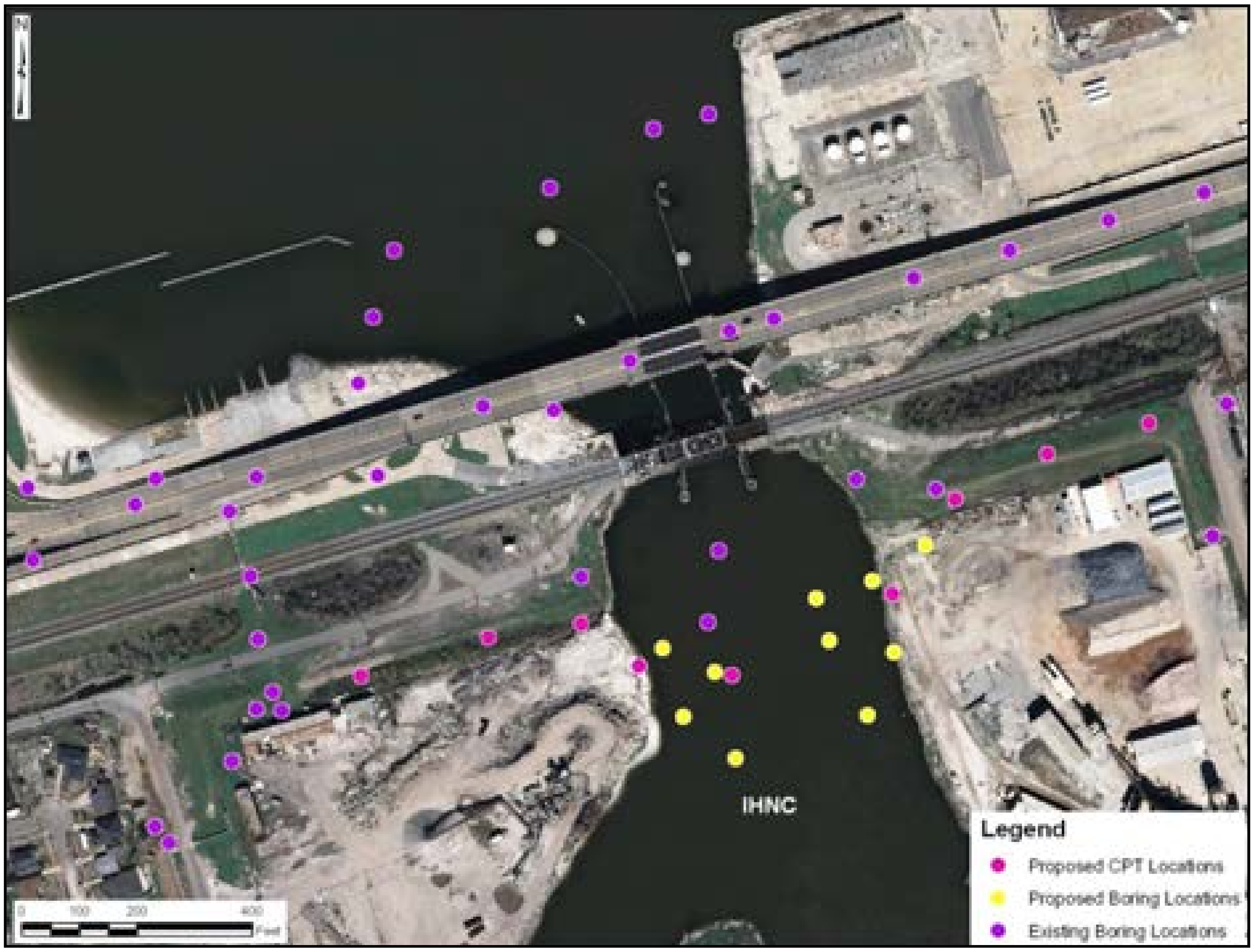


Figure 17. Soil Boring Locations in the Tier 2 Pontchartrain Project Area

Hurricane Katrina and On-going Construction Activities

On 29 August 2005, Hurricane Katrina made landfall near Buras on the Louisiana Coast south of New Orleans. At landfall, Hurricane Katrina was at the upper end of Category 3 intensity range with maximum sustained winds estimated at 123 miles per hour (mph). As a result of storm surge, large areas of New Orleans East and St. Bernard Parish were flooded due to the over-topping and breaching of levees and floodwalls on the INHC, the GIWW, and the MRGO. Additionally, the Orleans East Bank was flooded due to breaching of levees and floodwalls associated with Lake Pontchartrain, located within the Orleans East Bank sub-basin and areas west.

On 24 September 2005, Hurricane Rita hit the western part of Louisiana and the storm surge inflicted additional damage in the project vicinity, re-flooding areas in the ninth ward and Gentilly prior to making landfall near the Texas-Louisiana border. The damages to Orleans Parish's residences were widespread, and at least 10 of the 29 historic districts in the parish suffered extensive damage from flooding.

3.2 SIGNIFICANT RESOURCES

This section contains a list of the significant resources located in the vicinity of the proposed action, and describes in detail those resources that would be impacted, directly or indirectly, by the alternatives. Direct impacts are those that would be caused by the action taken and occur at the same time and place (40 CFR 1508.8(a)). Indirect impacts are those that would be caused by the action and would be later in time or farther removed in distance, but are still reasonably foreseeable (40 CFR 1508.8(b)). Cumulative impacts are discussed in section 4.

The resources described in this section are those recognized as significant by laws, executive orders, regulations, and other standards of National, state, or regional agencies and organizations; technical or scientific agencies, groups, or individuals; and the general public. Further detail on the significance of each of these resources can be found by contacting the CEMVN, or on www.nolaenvironmental.gov, which offers information on the ecological and human value of these resources, as well as the laws and regulations governing each resource. Search for "Significant Resources Background Material" in the website's digital library for additional information.

Table 5 shows those significant resources found within the project area, and notes whether they would be impacted by any of the alternatives analyzed in this IER.

Table 5.
Significant Resources in the Project Study Area

Significant Resource	Impacted	Not Impacted
Hydrology	X	
Water Quality	X	
Wetlands	X	
Fisheries	X	
Essential Fish Habitat	X	
Wildlife		X
Threatened and Endangered Species	X	
Non-wet Uplands		X
Cultural Resources		X
Recreational Resources	X	
Aesthetic (Visual) Resources		X
Air Quality	X	
Noise	X	
Navigation	X	
Transportation	X	
Socioeconomic Resources		
Land Use, Population, Employment	X	
Environmental Justice (EJ)		X

3.2.1 Hydrology

<u>Existing Conditions</u>

As described in IER #11 Tier 1 (USACE 2008a), the Lake Pontchartrain Basin includes the estuarine areas of Lake Pontchartrain and Lake Borgne. The basin has been substantially altered by a system of waterways, levees, and hydraulic control structures which range in size from the Mississippi River to oil well access canals. Navigable waterways within the basin that have been previously dredged, such as the GIWW and the IHNC, contribute to the alteration of the natural hydrology of the area.

The IHNC is hydrologically connected to the GIWW, the MRGO, the Mississippi River, and Lake Pontchartrain. The IHNC is approximately 35 ft deep, with a minimum 150 ft bottom width and 300 ft top width. The IHNC lock is located at the southern terminus of the IHNC and allows waterborne traffic to transit to and from the Mississippi River, the GIWW, and Lake Pontchartrain. From the GIWW/MRGO confluence to the IHNC Lock is an authorized deep draft navigation channel, 36 ft deep and 500 ft wide. The GIWW west of the Michoud Canal is authorized as a 36-ft deep, 500-ft bottom wide waterway. The MRGO was deauthorized as a Federal waterway on 5 June 2008 with a rock closure structure at Bayou La Loutre.

The major influences on water levels within the basin are wind and tide. Tidal ranges average approximately 1 ft and 2 ft at Lake Pontchartrain and Lake Borgne, respectively (Westerink et al. 2006). Average flow velocity in the IHNC is about 0.6 feet per second (fps); however, surface ebb and bottom velocities may exceed 2 fps (USACE 1997). More recent velocity modeling (USACE 2009c) has indicated that closures of the MRGO at Bayou La Loutre and south of Bayou Bienvenue results in decreased velocities within the IHNC.

The basin is susceptible to flooding from hurricane storm surge. Lake Pontchartrain levels are increased by the influx of surges from Lake Borgne and the Gulf of Mexico that accompany hurricanes from the southeast, south, and southwest, as well as from local wind setup (USACE 1967; USACE 1995; USACE 2007b; Westerink et al. 2006).

Modeling conducted by the Interagency Performance Evaluation Task Force (IPET) indicates that the HSDRRS has effects on storm surge within the area of the IHNC and GIWW due to its connection with Lake Borgne and Lake Pontchartrain (USACE 2007c). Storm surge experienced in the GIWW and the IHNC is a function of that generated from both Lake Borgne in the east and Lake Pontchartrain in the north.

During major storm events, storm surges can propagate north into Lake Borgne and are then redirected west into the IHNC, resulting in higher surge levels. Modeling analysis of conditions during Hurricane Katrina suggests that waves up to 4 ft high occurred within the IHNC (USACE 2007c). Observed peak water levels in the IHNC during Hurricane Katrina indicated a maximum water level increase of at least 6 ft between the confluence of the MRGO/GIWW and Lake Pontchartrain.

The historic gage record (1923 to 2006) at the IHNC Lock shows that the median range of low to high water levels is -0.79 to 3.71 ft National Geodetic Vertical Datum of 1929 (NGVD29). However, water levels reached 10.61 ft (NGVD29) during Hurricane Betsy and the highest recorded water level (high water mark) at the IHNC Lock, due to Hurricane Katrina, was recorded at 14.3 ft (NGVD29; USACE 2007c).

In addition to flows and water levels, sediment transport is another aspect of hydrology. The conveyance of sediment in the water column can significantly affect aquatic habitat, including benthic fauna and emergent wetland plants. Suspended sediment is important to the biological structure and function of a water body or wetland, and the amount and composition of suspended sediments is affected by both natural and human factors. Sediment can also be attributed to erosion. The bank erosion is partially due to wave action, tidal movement, vessel traffic, and the effect of storm surges. Dredging can be required to remove deposited sediment after severe storms in addition to normal annual maintenance dredging activities (USACE 2007d).

Discussion of Impacts

Impacts to hydrology were assessed based on the potential for changes in velocity, surface water elevation and circulation within the Lake Pontchartrain Basin. The key hydrodynamic model applied during this study was an Adaptive Hydraulics (ADH) code utilizing 2-dimensional shallow water equations. Water surface analyses examined 16 locations within the modeling domain including points within Lake Pontchartrain, Chef Menteur Pass, the Rigolets, the IHNC, Lake Borgne, the GIWW, and the MRGO. Circulation changes were assessed by determining velocity signals at two locations within the GIWW, one on the eastern side of the MRGO and one on the western side (USACE 2009c). The ADH model was validated utilizing 2008 field data on surface water elevations, discharge, and velocity. While modeling results were closely aligned with field data, it should be noted that the modeled scenarios do not include culverts within the Borgne Barrier through Bayou Bienvenue, which will be installed to allow some flow, during construction of the Bayou Bienvenue gate structure.

ADH modeling efforts included analysis of a base condition and four plan scenarios that were simulated for two, 2-week periods. March 2008 (referred to as "spring") and September 2007 (referred to as "fall") were selected as the simulation periods. These time periods were chosen by the interagency team to best coincide with high tide events and aquatic organism migration seasons. ADH modeling scenarios are presented in table 6.

Table 6.
ADH Modeling Scenarios (USACE 2009c)

Scenario	MRGO at La Loutre	Borgne Barrier	Seabrook	Comments
Base	No closure	No structures	No structures	The base condition simulates conditions within the Pontchartrain Basin prior to the closure of the MRGO at Bayou La Loutre and prior to completion of the Borgne Barrier.
Plan 1	Closure	No structures	No structures	Simulates hydrologic conditions following the MRGO closure at Bayou La Loutre.
Plan 2	Closure	Structures on Bayou Bienvenue and GIWW	No structures	Simulates existing conditions for purposes of IER 11 Tier 2 Pontchartrain, includes the Plan 1 scenario with the addition of the Borgne Barrier.
Plan 3	Closure	Structures on Bayou Bienvenue and GIWW	95 ft by 16 ft sector gate	Plan 3 includes the Plan 2 scenario with a simulated 95 ft x 16 ft gate at Seabrook.
Plan 3 final	Closure	Structures on Bayou Bienvenue and GIWW	95 ft by 20 ft sector gate with two 50 ft by 16 ft auxiliary gates	Plan 3 Final simulates a 95 ft x 20 ft sector gate with two additional 50 ft x 16 ft auxiliary gates (e.g., proposed action).

The results of these modeling scenarios are summarized in the following sections. Information on accessing the modeling reports, which provide further information on model limitations, can be found in appendix B.

Proposed Action (Alternative #1) - Bridgeside Alignment: Sector Gate located 540 ft south of Seabrook Bridge and approximately 1,500 ft of T-walls built on Existing Levees

Direct Impacts to Hydrology

Modeling has shown that the proposed structure could result in permanent velocity changes within the navigable waterways of the project area. Modeling results, based on a point located in the center of the proposed sector gate within the IHNC, predicted average flood and ebb flows with the proposed action in place on the order of 2.13 fps to 2.24 fps during the fall and 2.33 fps to 2.63 fps during the spring; a maximum velocity of 4.97 fps was noted. Simulated average velocities for the existing conditions within the IHNC are 1.32 fps to 1.37 fps during the fall and 1.46 fps to 1.62 fps during the spring, with a maximum expected velocity of 3.23 fps. Although with implementation of the proposed action there would be expected to be an increase in velocities within the Seabrook gate above the existing conditions, velocities would be expected to be on the order of those historically experienced (prior to the MRGO closure at Bayou La Loutre and Borgne Barrier in place) within the channel. Historical average velocities range from approximately 2.40 fps during the fall to 2.73 fps in the spring, with a maximum velocity of 4.98 fps (USACE 2009c).

With implementation of the proposed action, changes in the tidal range within the IHNC would also be expected. This is partially due to the restriction of flow that would result from placing floodgates across the IHNC. Alterations in tidal range to the south of the proposed structures are anticipated to be greater than to the north due to filling of the existing scour hole. This influence extends southward within the IHNC to the point at which the IHNC and GIWW intersect. Changes in tidal range within the IHNC are depicted in figures 18, 19, and 20 (USACE 2009c).

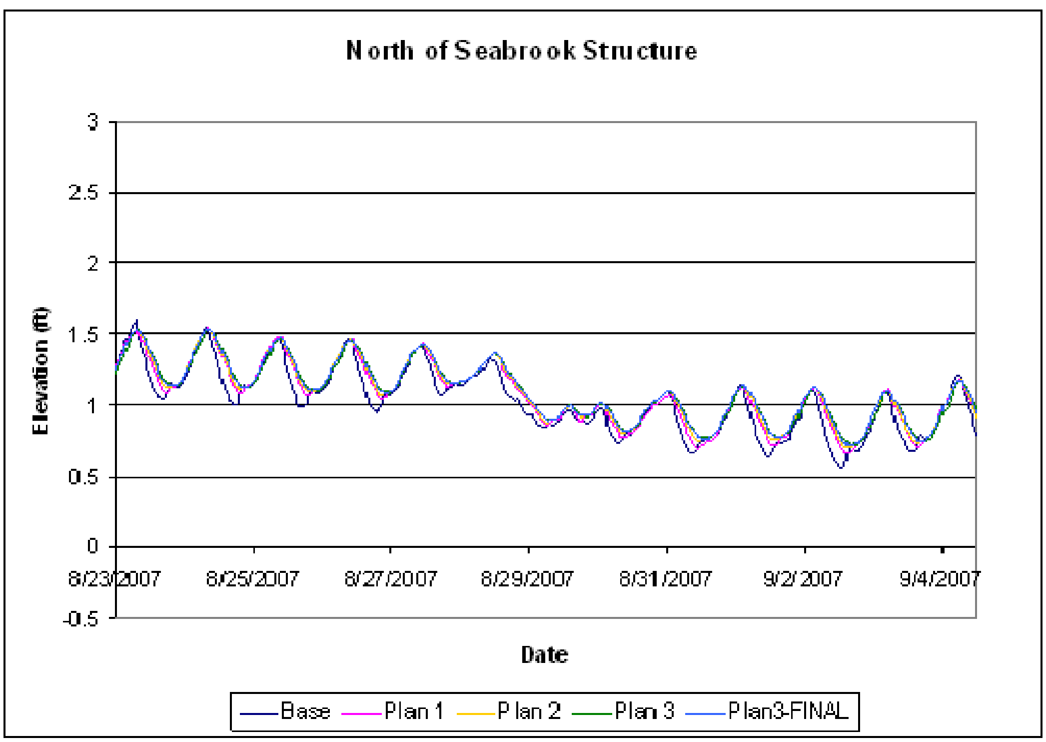


Figure 18. Water Surface Elevations North of Seabrook Structure (September)

Existing conditions with the MRGO closure structure at La Loutre and the Borgne Barrier in place are reflected within modeling scenario 'plan 2' and the proposed action is represented by the 'plan 3-Final' modeling scenario.

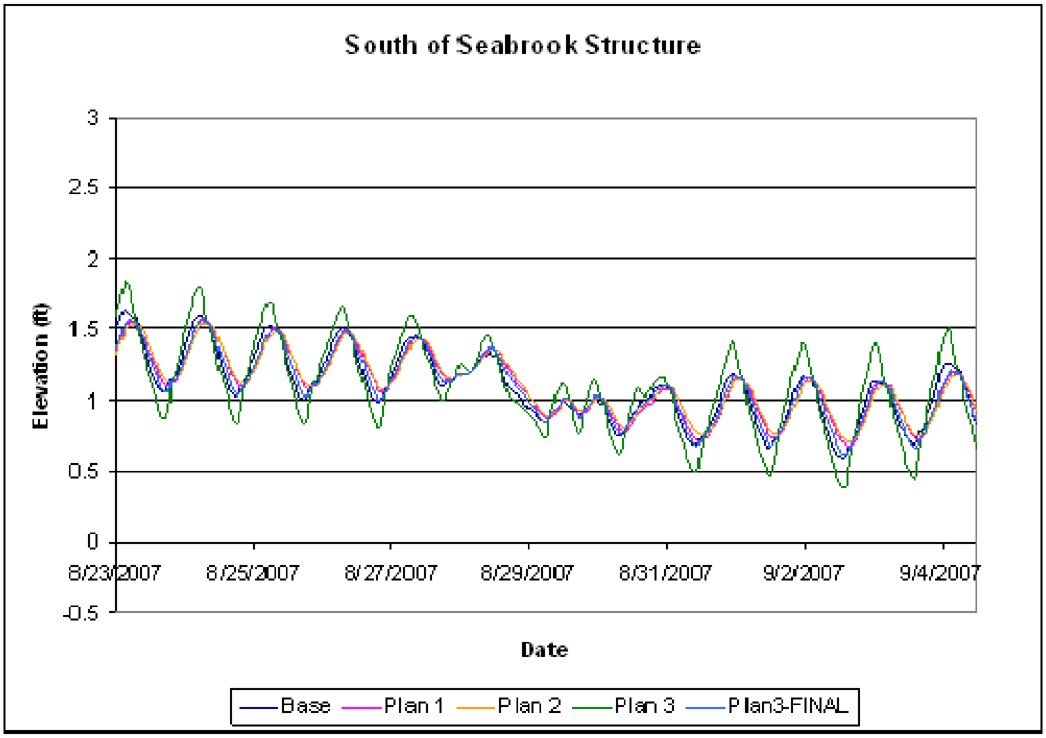


Figure 19. Water Surface Elevations South of Seabrook Structure (September)

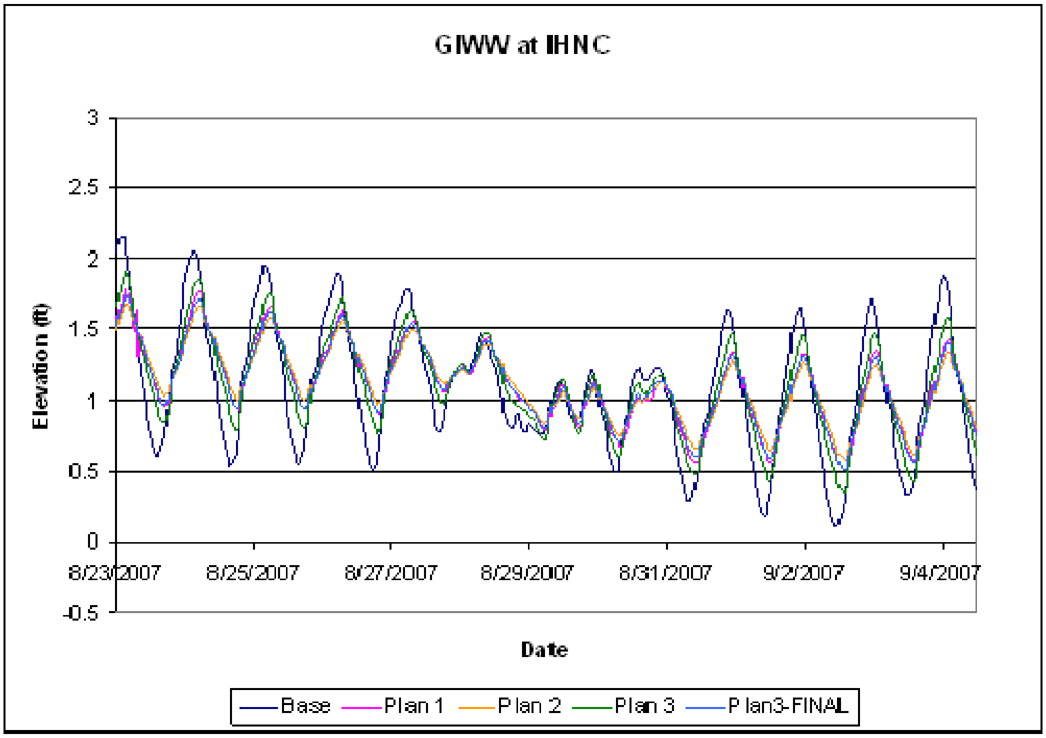


Figure 20. Water Surface Elevations in GIWW at IHNC (September).

Temporary direct impacts to hydrology would also be expected during construction of the gate structures. Velocity and circulation would be cut off between Lake Pontchartrain and the IHNC by the placement of a cofferdam that would span the width of the IHNC for approximately 6 months to 12 months.

In addition to routine maintenance once the Seabrook gates are in place, a reasonable, conservative estimate of 10 non-storm related closures per year could occur in order to control/reduce velocities of the gates on the GIWW. These temporary closures would result in impacts similar to those described for the period of time when the cofferdam is in place.

The construction of the Lake Borgne Barrier and the Seabrook Gate Structure will provide significant reduction in risk to New Orleans metropolitan area by preventing storm surges from entering the IHNC and GIWW system, here referred to as the IHNC basin. Businesses already located on the floodside of the existing parallel protection that would experience a 15-ft storm surge on average (a range from 10 ft to 20 ft is experienced throughout the system) during the 1 percent annual flood exceedance event without the construction of the barriers would experience a reduced water elevation of 8 ft with the barriers in place. The elevation of 8 ft is derived considering the following factors:

- Base water elevation of the IHNC and GIWW of 3 ft at gate closure.
- Allowable overtopping of the Lake Borgne Barrier.
- Rainfall runoff collected by the city's drainage/pump system.
- Rainfall directly over the IHNC and GIWW.
  - *The rainfall used for this calculation is a 10-year, 24-hour event that occurs coincidentally with the 1 percent annual flood exceedance event.*
  - *Drainage pumping assumes all rainfall collected and all pumps operating at 100 percent efficiency.*

The operating plan for the Borgne Barrier and Seabrook Structure is currently being developed. Development of this plan is being done in coordination with the local sponsors to include Office of Coastal Protection and Restoration (OCPR) and Southeast Louisiana Flood Protection Authority-East, the U.S. Coast Guard, navigation industry, and numerous U.S. Army Corps of Engineers offices.

Stage and rainfall data from 18 historic named storms that occurred over the past 20 years have been evaluated. These historical stages were compared to the estimated stages that would have occurred for these same events (under the condition with the Seabrook Structure and Borgne Barrier in place) to determine the risk reduction that the barriers provide to the IHNC basin. Analysis of historical records showed that greater risk reduction would be obtained for all these historical storm events had the barriers been in place. Included in this analysis is rainfall and runoff being pumped into the system as well as overtopping. In all cases, water levels in the system would have been equal to or reduced as outlined in table 7. Water would not be stored in the system longer than if the barriers were not constructed. Once lake and internal water levels allow, the gates would be opened.

The storm damage and risk reduction function of the barriers is clearly illustrated by the examples of the severe events; Georges (1998), Katrina (2005) and Gustav (2008).

Table 7.
Water levels within the IHNC basin for two cases:
1) existing conditions without barriers in place and 2) conditions with barriers in place

Storm	Name	year	max observed still water level [ft] (case 1)	rainfall [inch]	Water level increase in IHNC basin due to pumps [ft]	Water level increase due to overtopping [ft]	estimated IHNC basin water level (case 2)	storm damage risk reduction [ft]
Tropical Storm	Beryl	1988	6.2	7.0	1.6	0.0	5.2	-1
Hurricane	Florence	1988	7.0	1.0	0.3	0.0	3.3	-4
Hurricane	Andrew	1992	5.0	3.0	0.8	0.0	4.0	-1
Tropical Storm	Dean	1995	5.0	5.0	1.2	0.0	4.6	0
Hurricane	Opal	1995	5.0	1.0	0.3	0.0	3.3	-2
Hurricane	Danny	1997	5.5	1.0	0.3	0.0	3.3	-2
Hurricane	Earl	1998	5.0	1.0	0.3	0.0	3.4	-2
Hurricane	Georges	1998	9.0	1.0	0.3	0.0	3.3	-6
Tropical Storm	Isidore	2002	8.0	10.0	2.2	0.0	6.0	-2
Hurricane	Lili	2002	6.5	3.0	0.8	0.0	4.0	-3
Tropical Storm	Bill	2003	6.0	7.0	1.6	0.0	5.2	-1
Hurricane	Ivan	2004	7.5	1.0	0.3	0.0	3.3	-4
Hurricane	Cindy*	2005	7.0	7.0	1.6	0.0	5.2	-2
Hurricane	Katrina**	2005	13.0	13.0	2.8	0.5	6.9	-6
Hurricane	Rita**	2005	7.0	1.0	0.3	0.0	3.3	-4
Hurricane	Gustav	2008	11.0	7.0	1.6	0.0	5.2	-6
Hurricane	Ike	2008	9.0	1.0	0.3	0.0	3.3	-6
Hurricane	Ida	2009	5.1	1.0	0.3	0.0	3.3	-2

* For Hurricane Cindy no water levels were recorded in the vicinity of the IHNC, +4.5ft water levels were observed at the Rigolets. Based on linear correlation between the two stations, stages are estimated to be approximately 7ft.;

** For Katrina and Rita estimates are based upon model runs and high water mark observations due to the fact that most gages were destroyed during the peak of Katrina.

Indirect Impacts to Hydrology

Hydrologic changes may indirectly correlate to both temporary and permanent impacts to water quality and aquatic habitat. These indirect impacts are primarily due to changes in salinity and dissolved oxygen (DO) that are heavily influenced by hydrologic changes. These changes have the potential to impact both aquatic and terrestrial species. These impacts are discussed in further detail in sections 3.2.4 through 3.2.7.

Cumulative Impacts to Hydrology

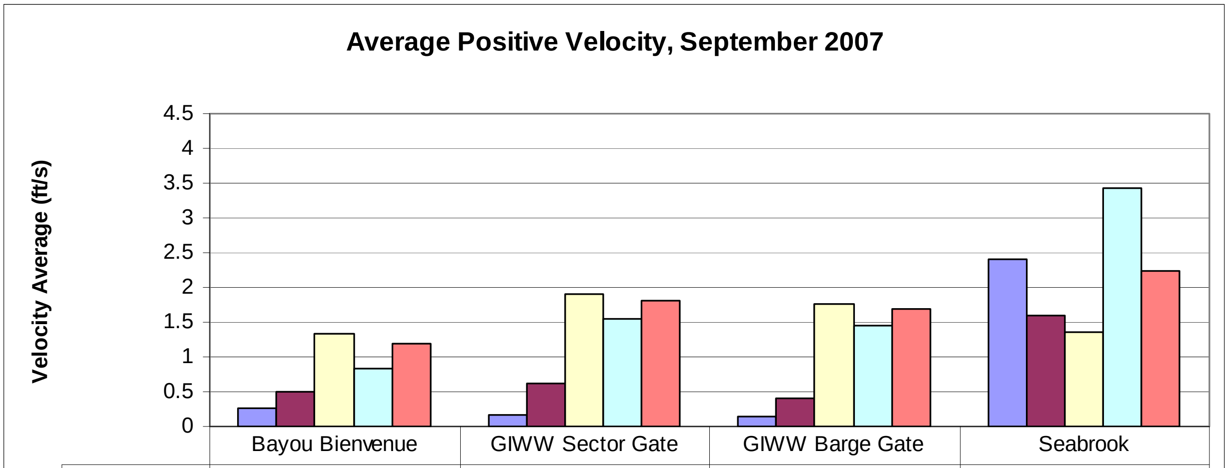
Cumulative impacts from the proposed action would involve the combined effects from the multiple HSDRRS projects and Coastal Wetlands Planning, Protection, and Restoration Act (CWPPRA) projects throughout the project vicinity; the Violet freshwater diversion project; and MRGO closure structure at La Loutre. The combined effects of other projects including the Borgne Barrier, the closure of the MRGO at Bayou La Loutre, and the Violet Diversion would result in varying degrees of altered hydrology throughout the project area. Direct and indirect changes to the project area are discussed previously, but the changes from the combination of IER and CWPPRA projects would lead to substantial long term cumulative impacts to the hydrology of the Lake Pontchartrain Basin and nearby vicinity.

By providing a storm surge barrier across the IHNC, the incremental effect of the proposed action, in combination with other projects in the vicinity, would significantly reduce the effect of surges from extreme events up to the 100-year storm level. This would result in further enhancement of the entire proposed 100-year HSDRRS throughout the area (USACE 2008a).

By incrementally adding structures to the modeling plans, the ERDC ADH model was designed to simulate the cumulative impacts of the MRGO closure at Bayou La Loutre, the Borgne Barrier, and the proposed action. Modeling results indicate that closing the MRGO at La Loutre (plan 1) creates large changes to surface water velocities, surface water elevations, and circulation patterns within the Lake Pontchartrain Basin. These parameters would continue to change with the implementation of the Borgne Barrier (plan 2) and the proposed action (plan 3 final).

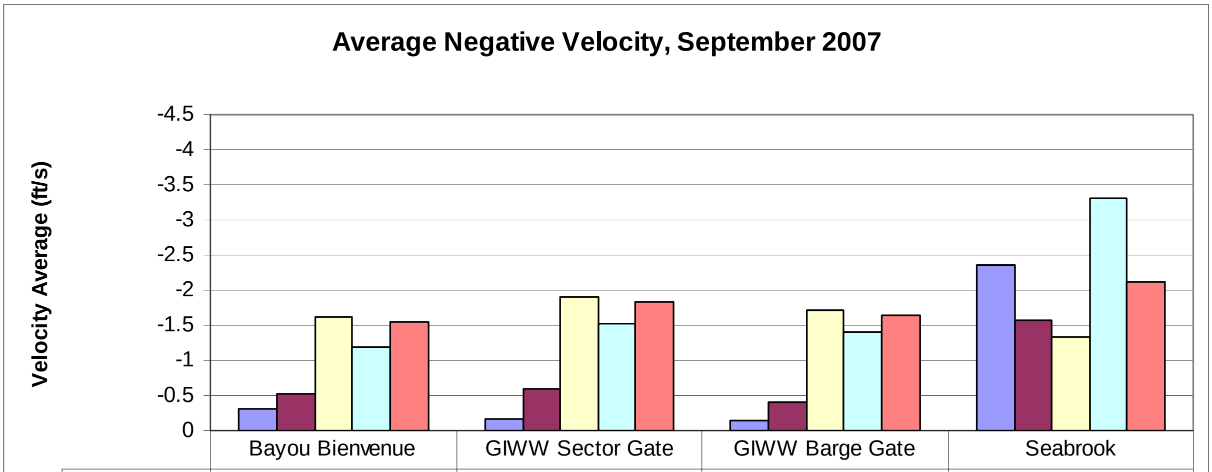
Modeling results are reported in positive and negative numbers to demonstrate flood and ebb tidal movement. Positive velocity numbers represent directional flow to the north or east and negative numbers represent directional flow to the south and west. Modeled data for plan 1 predict average velocities in the IHNC of 1.59 fps and -1.57 fps in September along with 1.87 fps and -1.68 fps in March (USACE 2009c). With the addition of the Borgne Barrier (plan 2), modeled data predicts a decrease in average velocities in the IHNC. Under plan 3 final (proposed action), velocities would be expected to increase during March and September conditions. Average velocities during March would increase to 2.63 fps and -2.33 fps and the average velocity during September would increase to 2.24 fps and - 2.13 fps.

Similar impacts as described previously within the IHNC would also be experienced within the GIWW and Bayou Bienvenue. Figures 21 through 24 provide the average positive and negative velocities modeled for the September and March timeframes.



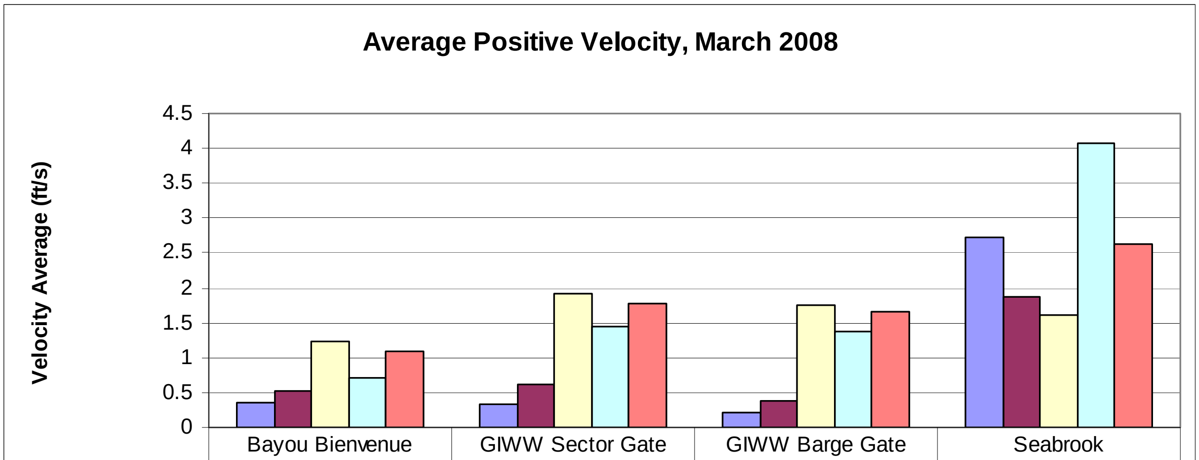
	Bayou Bienvenue	GIWW Sector Gate	GIWW Barge Gate	Seabrook
Base	0.261	0.163	0.145	2.410
Plan 1	0.500	0.628	0.407	1.585
Plan 2	1.332	1.910	1.752	1.368
Plan 3	0.843	1.545	1.460	3.435
Plan 3 Final	1.194	1.804	1.682	2.240

Figure 21. Velocity Average for September (positive)



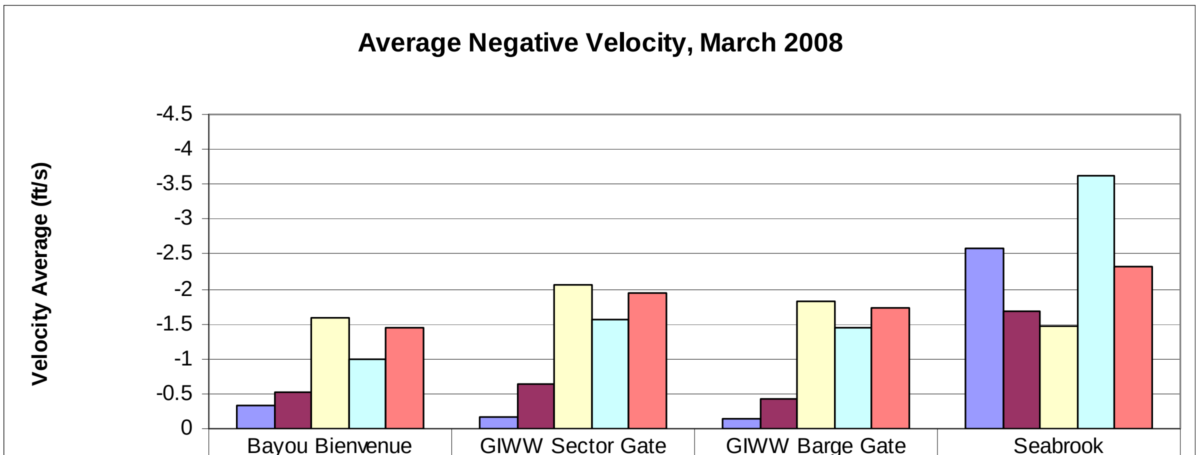
	Bayou Bienvenue	GIWW Sector Gate	GIWW Barge Gate	Seabrook
Base	-0.32	-0.16	-0.15	-2.36
Plan 1	-0.51	-0.60	-0.41	-1.57
Plan 2	-1.62	-1.91	-1.72	-1.32
Plan 3	-1.20	-1.52	-1.40	-3.30
Plan 3 Final	-1.54	-1.83	-1.64	-2.13

Figure 22. Velocity Average for September (negative)



	Bayou Bienvenue	GIWW Sector Gate	GIWW Barge Gate	Seabrook
Base	0.36	0.32	0.21	2.73
Plan 1	0.51	0.61	0.39	1.87
Plan 2	1.23	1.92	1.76	1.62
Plan 3	0.70	1.46	1.38	4.07
Plan 3 Final	1.08	1.78	1.65	2.63

Figure 23. Velocity Average for March (positive)



	Bayou Bienvenue	GIWW Sector Gate	GIWW Barge Gate	Seabrook
Base	-0.33	-0.18	-0.14	-2.59
Plan 1	-0.53	-0.65	-0.42	-1.68
Plan 2	-1.58	-2.06	-1.83	-1.46
Plan 3	-1.01	-1.56	-1.45	-3.63
Plan 3 Final	-1.43	-1.93	-1.73	-2.33

Figure 24. Velocity Average for March (negative)

Water Surface Analysis

Changes in water surface elevations are most noticeable at the MRGO closure at Bayou La Loutre according to the ADH model simulations. North of the closure, a 2.5 hour lag in tidal phasing is predicted. With the implementation of the Borgne Barrier and the proposed action, the elevation ranges continue to drop; however, these differences are less extreme (USACE 2009c).

Water Circulation Analysis

The ADH model results for both September and March predict a clear change in circulation once the MRGO is cut off from the Gulf of Mexico. Figure 25 shows the direction of flow when the tide is rising for the model base condition. The flow moves up the MRGO and splits at the GIWW, with a portion moving west and up the IHNC and a portion moving east down the GIWW.

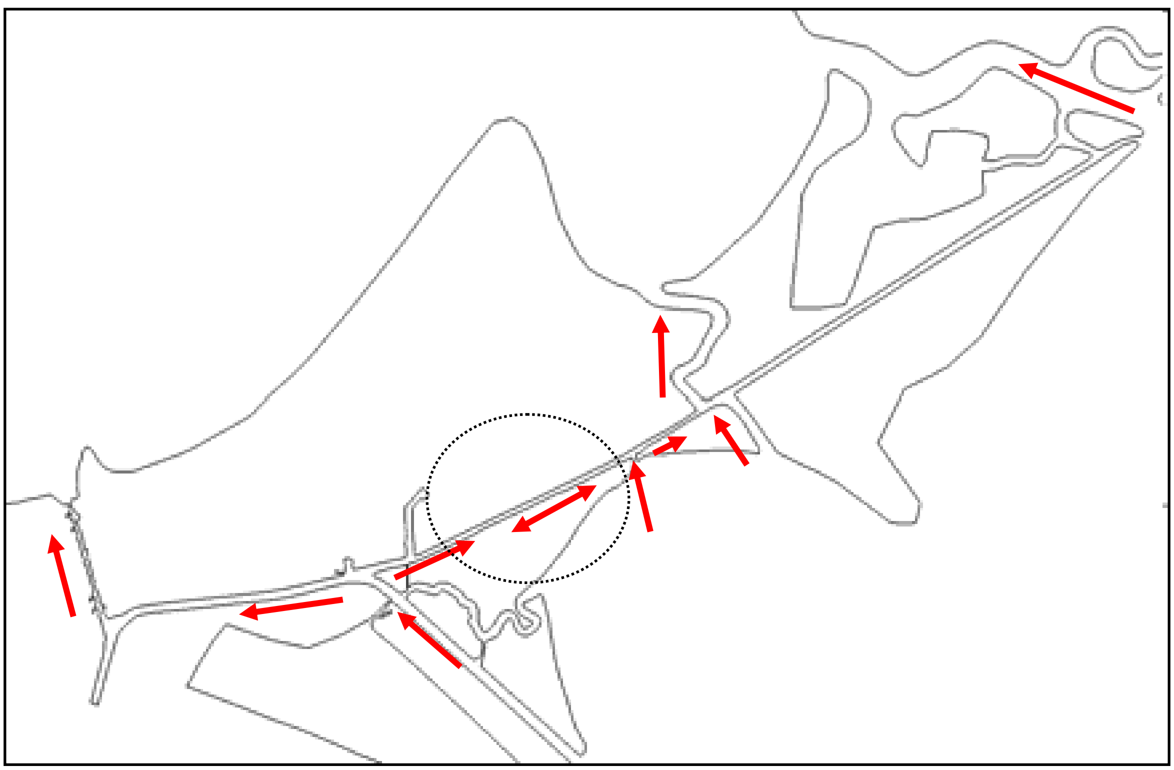


Figure 25. Direction of Flow for Incoming Tide under Base Conditions

Figure 26 shows the direction of flow for the incoming tide under plans 1, 2, 3, and plan 3 final. Once the MRGO is cut off from the Gulf of Mexico at La Loutre, the tide cannot move up this channel as it previously did. Therefore the flow only enters the GIWW at its connections at Lake Borgne. Flow does move through Bayou Bienvenue, but the amount of water it transports is much less than the flows that move up the MRGO or enter through Lake Borgne, and it has little effect on the overall circulation pattern through the GIWW. These changes show a clear direction of flow along the GIWW as opposed to a direction that may vary at times.

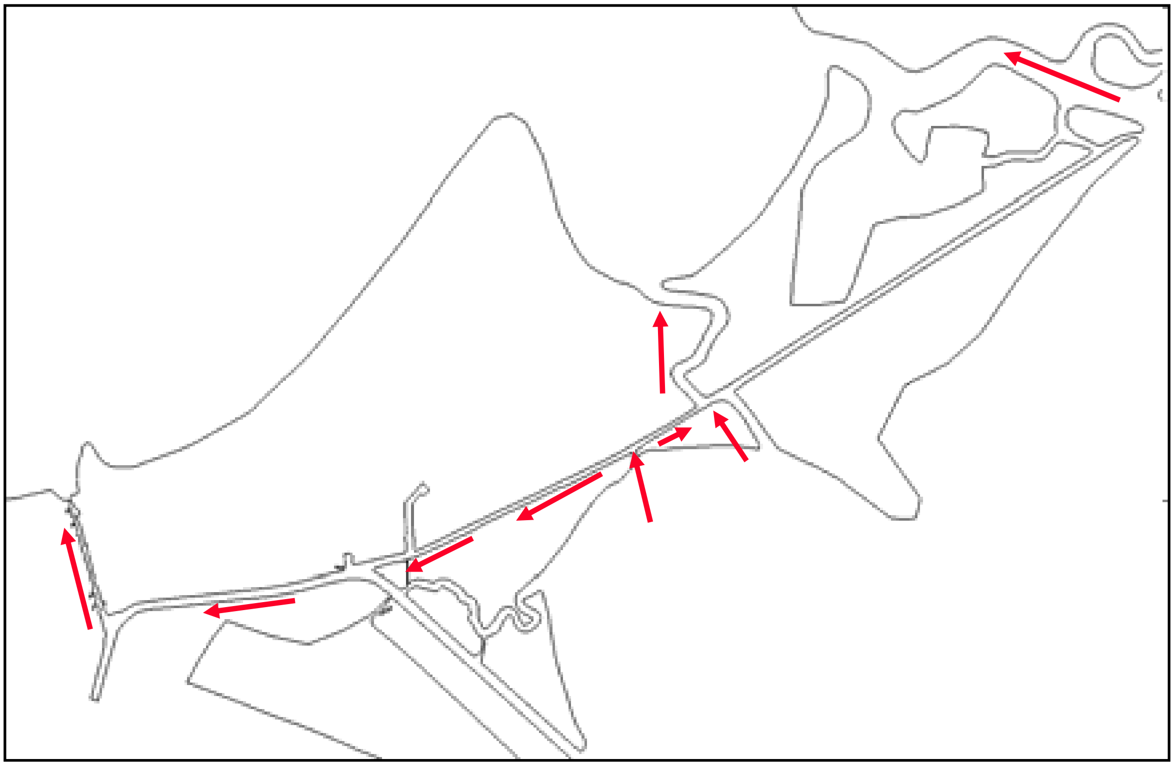


Figure 26. Direction of Flow for Incoming Tide under Plans 1, 2, 3, and Plan 3 Final

The implications of changes in velocity, water surface elevation, and circulation patterns to aquatic resources and fisheries, essential fish habitat (EFH), and navigation are discussed in the in detail in sections 3.2.4, 3.2.5, and 3.3.

Alternative #2 - Bridgeside Alignment: Sector Gate located 398 ft south of Seabrook Bridge and approximately 1,300 ft of T-walls built on Existing Levees

Direct Impacts to Hydrology

Hydrologic changes such as changes in surface water velocities and circulation patterns would be similar to those discussed for the proposed action. Temporary impacts from construction activities and temporary placement of the cofferdam would also be similar to the proposed action. Alternative #2 requires only partial filling of the scour hole, which would potentially result in fewer changes to tidal flow than would be expected under the proposed action. Filling the scour hole has been modeled to also contribute to a reduction in cross-sectional flow within the IHNC beyond that caused simply by the floodgates.

Indirect Impacts to Hydrology

Indirect impacts to hydrology in the study area would be similar to those experienced with implementation of the proposed action. As with the proposed action, hydrologic changes resulting from implementation of this alternative may indirectly correlate to both temporary and permanent impacts to water quality and aquatic habitat. These impacts are discussed in further detail in sections 3.2.4 through 3.2.7.

Cumulative Impacts to Hydrology

Cumulative impacts to hydrology under alternative #2 would be similar to those described under the proposed action.

Alternative #3 - Turning Basin Alignment: Sector Gate located 1,500 ft south of Seabrook Bridge and approximately 1,500 ft of T-walls

Direct Impacts to Hydrology

Direct impacts to hydrology from alternative #3 would be similar to those discussed under the proposed action. Unlike the proposed action however, no scour hole would require filling under this alternative. Therefore, changes in tidal flow would be experienced immediately around the vicinity of the gate structures, but not as a result of constriction of the channel due to the filling of the scour holes.

During construction, a temporary braced cofferdam would be installed around the approximate perimeter of the floodgates for a period of approximately 6 months to 12 months. Due to the location of alternative #3, this cofferdam would not block all flow between Lake Pontchartrain and the IHNC. As a result, temporary impacts to hydrology such as changes in velocity, water surface elevations, and circulation patterns would be less with alternative #3 when compared to the proposed action because some flow would be allowed into Lake Pontchartrain between the shoreline and the cofferdam.

Indirect Impacts to Hydrology

Indirect impacts to hydrology from alternative #3 would be similar to those described under the proposed action. As with the proposed action, hydrologic changes resulting from implementation of this alternative may indirectly correlate to both temporary and permanent impacts to water quality and aquatic habitat. These impacts are discussed in further detail in sections 3.2.4 through 3.2.7.

Cumulative Impacts to Hydrology

Cumulative impacts to hydrology under alternative #3 would be similar to those described under the proposed action, with the exception of impacts associated with filling the scour hole and the cofferdam blocking flow.

Alternative #4- South of Turning Basin Alignment: Sector Gate located 2,000 ft south of Seabrook Bridge and approximately 1,450 ft of T-walls

Direct Impacts to Hydrology

Direct permanent impacts to hydrology from alternative #4 would be similar to those discussed under alternative #3. Alternative #4 also requires no filling of the scour holes existing within the IHNC.

As with the proposed action, alternative #4 would require a temporary braced cofferdam during construction installed in the channel around the approximate perimeter of the sector gate and vertical lift gates for a period of approximately 6 months to 12 months. As a result, temporary impacts to hydrology such as changes in velocity, water surface elevation, and circulation patterns, would be similar to the proposed action.

Indirect Impacts to Hydrology

Indirect impacts to hydrology would be similar to those described under the proposed action, however, the scour hole would not require filling. As with the proposed action, hydrologic changes resulting from implementation of alternative #4 may indirectly correlate to both temporary and permanent impacts to water quality and aquatic habitat. These impacts are discussed in further detail in sections 3.2.4 through 3.2.7.

Cumulative Impacts to Hydrology

Cumulative impacts to hydrology under alternative #4 would be similar to those described under the proposed action with the exception of impacts associated with filling the scour hole.

Alternative #5 – Lake Pontchartrain Alignment: Sector Gate located 502 ft north of the Seabrook Bridge and approximately 1,800 ft of T-walls

Direct Impacts to Hydrology

Alternative #5 is the northern-most alignment and is the only alternative located within Lake Pontchartrain. This alternative would span the deepest portion of the northern scour hole and the lower portion of this scour hole would be partially filled. Velocities in the IHNC under alternative #5 would be expected to be similar to the proposed action.

Alternative #5 would cause the least amount of disruption of all alternatives considered during construction. Construction would be staged in Lake Pontchartrain so that flow between Lake Pontchartrain and the IHNC would not be completely blocked. Since flow would be maintained, the temporary impacts due to the cofferdam experienced with the proposed action would not be experienced with this alternative, however, the construction duration would be longer.

Indirect Impacts to Hydrology

Under alternative #5, flow would be maintained throughout the construction process; therefore, indirect impacts to DO and salinity would be less than the proposed action. However, the increase in overall construction duration would result in a longer timeframe in which the impacts would be experienced.

As with the proposed action, hydrologic changes resulting from implementation of alternative #5 may indirectly correlate to both temporary and permanent impacts to water quality and aquatic habitat. These impacts are discussed in further detail in sections 3.2.4 through 3.2.7.

Cumulative Impacts to Hydrology

Cumulative impacts to hydrology under alternative #5 would be similar to those described under the proposed action. Overall similar impacts would occur because the majority of changes such as reduced tidal amplitude are due to the implementation of the Borgne Barrier and the closure of the MRGO at Bayou La Loutre. Direct and indirect changes to the project area as discussed previously, along with the changes from the combination of IER and CWPPRA projects would lead to substantial long term cumulative impacts to the hydrology of the Lake Pontchartrain Basin and nearby vicinity. The implications of changes in circulation patterns, water surface elevations, and velocity to Aquatic Resources and Fisheries, EFH, and navigation are discussed in sections 3.2.4, 3.2.5, and 3.3.

3.2.2 Water Quality

Existing Conditions

The Tier 2 Pontchartrain project area falls within the Eastern Louisiana Coastal Watershed, USGS Cataloging Unit 08090203 (U.S. Environmental Protection Agency [USEPA] 2008). Watershed water quality is evaluated in several riverine, estuarine, and wetland/freshwater systems and is reported by the State of Louisiana for inclusion in the USEPA's National Assessment Database. State water quality assessments are typically based on five types of monitoring data: biological integrity, chemical, physical, habitat, and toxicity. The State of Louisiana's program consists of a fixed station long-term network, intensive surveys, special studies, and wastewater discharge compliance sampling (Louisiana Department of Environmental Quality [LaDEQ] 2006).

For Louisiana's 2006 Water Quality Integrated Report, the LaDEQ used the USEPA's Consolidated Assessment and Listing Methodology to designate water quality within their major water systems. Water quality within the Tier 2 Pontchartrain project area was given a rating of Integrated Report Category 1, indicating the water can support all primary contact, secondary contact, and fish and wildlife propagation uses (LaDEQ 2006). In the past, fish kills have been reported along the south shore of Lake Pontchartrain during the months of August and September, possibly due to low DO, high temperatures, and increased turbidity. Additional descriptions of the water resources within the project area can be found within section 3.2.4, Aquatic Resources and Fisheries.

Discussion of Impacts

Independent of the alternative, construction would temporarily increase turbidity from increased suspension of inorganic sediments. Construction activities would disturb the bottom and suspend inorganic sediments. Scour patterns around temporary structures, such as the cofferdam, may erode bottom material and suspend it in the water column. Best management practices (BMPs) would be employed to minimize the suspension of sediments and any potential turbidity effects. Nonetheless, suspended sediments could settle on the bottom a relatively short distance from the construction site where turbulence decreases and particles can settle. Areas of accumulated sediment would be relatively small and would not be expected to cause a measurable impact to waterbottoms in the project area.

Scour holes exist approximately 300 ft north and 300 ft south of the Seabrook Bridge (figure 7). These scour holes contain hypoxic water with relatively high salinity, up to 22 ppt. Changes in patterns of turbulence and scour caused by construction activities may force hypoxic, relatively saline water from the scour holes into the overlying water column. The temporal and geographic extent of possible impact from disturbance of the scour holes would depend on the degree of hypoxia and the amount of disturbance. If DO concentrations in the scour holes are near 0 mg/l, then hydrogen sulfide, which is toxic to aquatic organisms, could enter the water column along with low oxygen water. Rapid increases in salinity, accompanied by exposure to low oxygen levels and hydrogen sulfide may occur temporarily in the vicinity of the project. Dilution of water from the scour holes with overlying water is expected to limit effects of these conditions to the area around the construction site.

DO levels may be affected by construction activities in other ways; suspension of organic sediments from the bottom may create relatively small regions where oxygen concentrations drop below normal. Bacterial respiration associated with decomposition of organic sediments could decrease oxygen concentrations although dilution and re-aeration by physical mixing of the water would probably prevent oxygen levels from dropping below critical levels for aquatic life. Increased turbidity from suspension of both inorganic and organic sediments may reduce photosynthetic production of oxygen by floating and attached algae. Reduction in photosynthesis would not be expected to lower oxygen concentrations below critical concentrations. Additionally, suspension of chemically-reduced substances such as sulfides may lower oxygen concentrations through increased chemical oxygen demand (COD). Despite the variety of factors which may lower DO concentrations, it is believed those processes would not substantially lower oxygen levels beyond the area of construction. The scouring nature of flows through this portion of the IHNC suggests there is not likely to be substantial deposits of organic and inorganic sediments or concentrations of chemically reduced substances that could be moved into the water column by construction activities or resultant changes in scouring flows.

Turbidity caused by construction may slightly increase water temperature. Suspended particles near the surface absorb more solar energy than water molecules, resulting in warmer water near the surface than in less turbid water. Temperature increases overall would be slight and localized around the construction.

Due to expected hydrologic changes as described in section 3.2.1, impacts to salinity would be expected with implementation of the project. Salinities in Lake Pontchartrain would be expected to average 0.1 ppt to 0.3 ppt lower than if a barrier structure near Seabrook were not in place. Historical salinities in the vicinity of the proposed action (prior to the MRGO closure at Bayou La Loutre and the Borgne Barrier) range from approximately 6 ppt to 8 ppt depending on the season (USACE 2009d). The MRGO closure at La Loutre is modeled to decrease salinities within the project area on the order of 1.0 ppt to 3.0 ppt. To validate the decreases experienced as a result of the closure at La Loutre, the USGS is currently gathering field data which measures actual salinities at 10 ft below the surface along the MRGO and into the IHNC (USGS 2009). With the addition of the Borgne Barrier and the proposed action, additional decreases in salinity would be expected (as described later in this section).

Proposed Action (Alternative #1) - Bridgeside Alignment: Sector Gate located 540 ft south of Seabrook Bridge and approximately 1,500 ft of T-walls built on Existing Levees

Direct Impacts to Water Quality

Filling the scour hole south of the Seabrook Bridge may cause permanent beneficial changes to DO levels in the IHNC after construction is complete and has the potential to ultimately improve water quality conditions in the project area and nearby areas of Lake Pontchartrain (USACE 2009d). Possible long-term effects of the project on DO were modeled using a steady-state mass balance for a continuously-stirred tank reaction (CSTR). This modeling approach is commonly used for screening DO impacts associated with wastewater discharges in ponds, lakes, lagoons, bayous, and bays. It is a simplified approach that provides useful screening-level estimates of DO impacts. Surface water and bottom layer salinities were provided by the USACE ERDC and were used in the simulations (USACE 2009d). Long-term survey data from Lake Pontchartrain near the IHNC show DO and salinity gradients are greater in the scour holes near the IHNC and can persist as far as 8 miles north of the Seabrook Bridge. These gradients occur between 10 ft to 20 ft below the water surface and salinity can be as high as 22 ppt (USGS 2002b). Modeled DO values south of the proposed structures range from 1.9 mg/L to 2.5 mg/L with open channel flow through Seabrook. These values are below the standard for estuarine systems (4.0 mg/L).

To avoid the movement of sediments north into Lake Pontchartrain, the contractor would fill in the south scour hole and construct the cofferdam only during slack tide in the IHNC, when water is moving from Lake Pontchartrain into the IHNC. In addition, if possible with the flows experienced in the project area, the contractor would install and maintain a Type III silt barrier/curtain at a distance not to exceed 500 ft upstream and downstream from the point of discharge of the fill. The contractor would be required to take three readings per work day with a turbidity meter at locations not to exceed 500 ft upstream and downstream from the point of discharge to ensure that at no time is a difference in turbidity of 50 nephelometric turbidity units (NTU) exceeded.

The north scour hole would not be modified under the proposed action. This scour hole would continue to accumulate higher salinity water which would also become hypoxic as it does now. These high salinity/low oxygen conditions would continue to create a hypoxic zone along the bottom of a portion of Lake Pontchartrain near the IHNC. However the extent of this high salinity/low oxygen zone would be expected to be smaller than that created by alternatives #3 and #4 in which both scour holes would persist in their present condition.

During construction, a cofferdam would span the IHNC for approximately 6 months to 12 months. This would alter circulation patterns, salinities, and DO levels on the north and south sides of the cofferdam. The IHNC is ebb dominated and salinities directly north of the cofferdam may become slightly lower than the current levels, and conversely salinities south of the cofferdam would increase slightly over current levels. Modeling suggests that when flow through the IHNC is closed off (such as when the cofferdam is in place during construction or when the proposed structures are closed), higher DO values on the order of 4.0 mg/L to 4.2 mg/L can be expected south of the proposed structure. North of the proposed structure, closure of the channel would result in reduced DO values that range from 5.2 mg/L to 5.3 mg/L down to 4.1 mg/L to 4.2 mg/L (USACE 2009d).

Indirect Impacts to Water Quality

Although the proposed action is designed to allow for flows similar to those historically measured within the IHNC, boaters would have to navigate through the new sector gate where they could potentially encounter higher velocities and at times, more turbulent flow. These conditions would increase the risk for damage to occur to vessels that pass through the gates, which could result in fuel spills into the water. This may indirectly cause temporary impacts to water quality. The potential for these impacts to occur is lessened by the incorporation of design parameters that allow “safe” passage velocities, and navigational aids such as guidewalls, fendering, dolphins, and USCG signage.

Cumulative Impacts to Water Quality

The incremental effects of the proposed action would not be expected to have a significant long-term effect on large-scale water quality conditions in the study area since water quality would continue to be influenced by industrial and commercial uses. Concurrent construction of other 100-year HSDRRS projects could cause short-term impacts to water quality that could exceed the LaDEQ water quality standards. The cumulative construction impacts of the proposed action would be additive to similar impacts caused by other HSDRRS projects. The implementation of BMPs and Stormwater Pollution Prevention Plans (SWPPPs) would minimize cumulative impacts from construction.

Although the proposed action, when combined with the closure structures along the GIWW and Bayou Bienvenue indicate changes in DO and salinity values, the changes described would be minimal compared to the shift that has been measured due to the MRGO closure at Bayou La Loutre (USGS 2009). The MRGO closure at Bayou La Loutre could produce environmental benefits through partial restoration of estuarine salinity gradients. Modeling conducted by ERDC illustrated that the closure of the MRGO at Bayou La Loutre would have a significant effect on monthly average bottom salinity values not only in MRGO/GIWW/IHNC complex, but also in the Lake Pontchartrain area. Most areas would be expected to show decreases of 3 ppt to 4 ppt, with the MRGO channel showing the highest decrease in the region just north of the La Loutre closure at approximately 10 ppt (Martin et al. 2009b).

Continued industrial activities, urban wastewater discharges, and construction activities contribute to a continued decline in water quality within the study area. However, state and Federal programs are in place to regulate and improve water quality, so the net cumulative impact over time could be improvement of water quality for the study area.

Alternative #2 - Bridgeside Alignment: Sector Gate located 398 ft south of Seabrook Bridge and approximately 1,300 ft of T-walls built on Existing Levees

Direct Impacts to Water Quality

Overall, direct impacts to water quality would be similar to those discussed under the proposed action. The south scour hole would be only partially filled in this alternative. This partial filling of the scour hole may result in the continued existence of a low DO/high salinity zone in the remaining portion of the scour hole.

Indirect and Cumulative Impacts to Water Quality

Indirect and cumulative impacts under alternative #2 would be the same as those discussed under the proposed action.

Alternatives #3 - Turning Basin Alignment: Sector Gate located 1,500 ft south of Seabrook Bridge and approximately 1,500 ft of T-walls

Direct Impacts to Water Quality

Direct impacts under alternative #3 would be similar in part to those discussed under alternative #2. Low DO conditions may result from reduced physical aeration of the water. Low oxygen conditions can occur when localized rainfall runoff or other conditions substantially increase the load of oxygen-demanding materials to the IHNC without substantially increasing flushing. The Turning Basin and nearby portions of the IHNC may also be more susceptible to algal blooms during periods of reduced water exchange. Algal blooms can cause increased oxygen uptake as a result of increased algal respiration and bacterial decomposition of dying algae. These conditions might occur on either side of the project in the Turning Basin or IHNC.

Both scour holes are located north of the alternative #3 alignment and therefore neither scour hole would be modified. The scour holes would persist although the structure may prevent passage of the highest salinity waters at the bottom of the saltwater wedge past the project into Lake Pontchartrain. The scour holes could continue to accumulate higher salinity water which would also become hypoxic as it does now.

Indirect and Cumulative Impacts to Water Quality

Indirect and cumulative impacts under alternative #3 would be the same as those discussed under the proposed action.

Alternative #4 - South of Turning Basin Alignment: Sector Gate located 2,000 ft south of Seabrook Bridge and approximately 1,450 ft of T-walls

Direct Impacts to Water Quality

Direct impacts under alternative #4 would be similar to those described for alternative #3.

Indirect and Cumulative Impacts to Water Quality

Indirect and cumulative impacts under alternative #4 would be similar to those described for the proposed action.

Alternative #5 – Lake Pontchartrain Alignment: Sector Gate located 502 ft north of the Seabrook Bridge and approximately 1,800 ft of T-walls

Direct Impacts to Water Quality

Direct impacts to water quality would be similar to those discussed under the proposed action. Unlike the proposed action, alternative #5 requires filling of the north scour hole and not the southern scour hole. Filling of the north scour hole in Lake Pontchartrain would occur in a less constricted area therefore the effects on water quality are expected to be less. Elimination of the north scour hole may reduce creation of high salinity/low oxygen waters in Lake Pontchartrain north of alternative #5.

The south scour hole would persist and may trap higher salinity water from the saltwater wedge. This higher salinity water may be more resistant to mixing because of increased density. Events that mix water from the south scour hole may create low oxygen/high hydrogen sulfide conditions in the upper water column which could stress or kill aquatic organisms in the IHNC.

Indirect and Cumulative Impacts to Water Quality

Indirect and cumulative impacts under alternative #5 would be similar to those described for the proposed action.

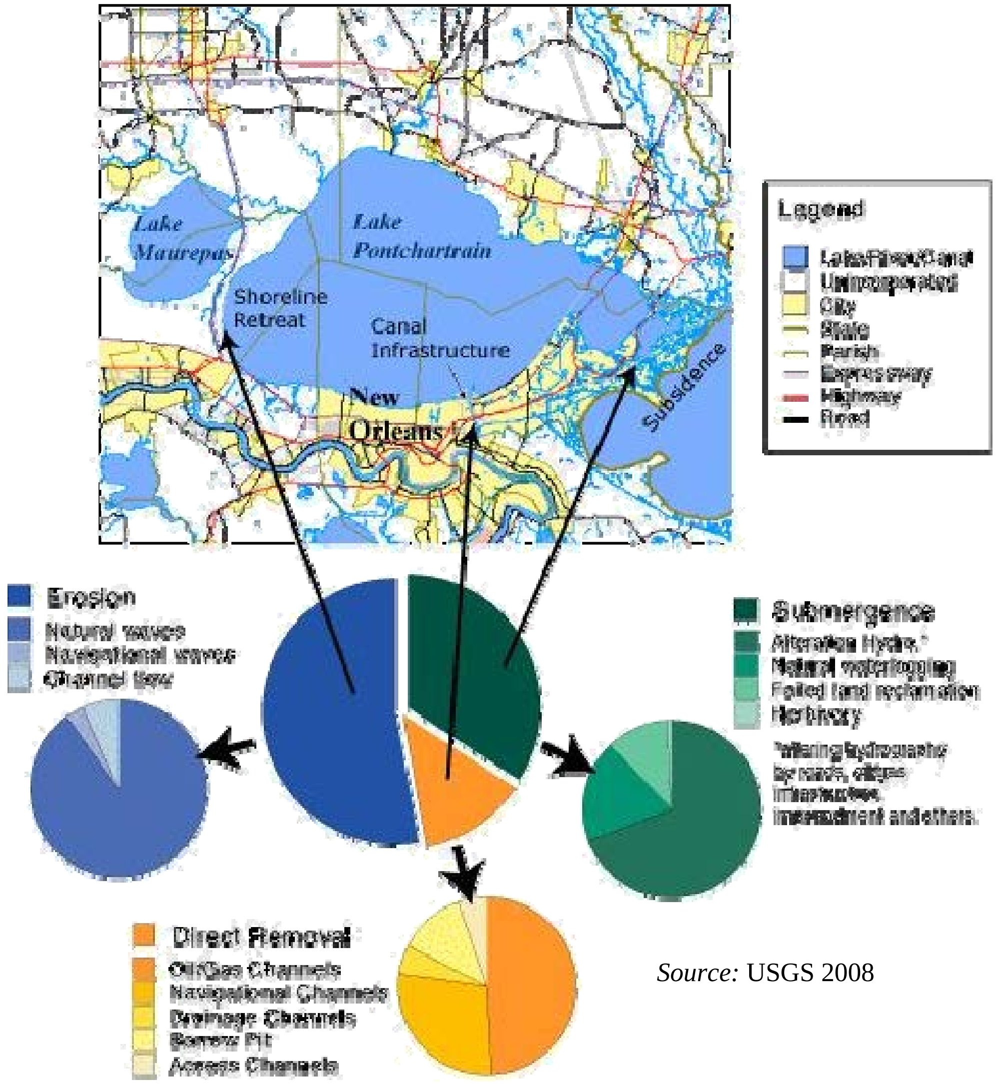
3.2.3 Wetlands

Existing Conditions

The Lake Pontchartrain Basin is a large, dynamic system consisting of Lake Pontchartrain and the areas along the GIWW and the IHNC near Lake Borgne. The area has been heavily altered for both flood control purposes and through the excavation of navigation canals. Land loss trends are represented in figure 27 (USGS 2008).

Coastal vegetation resources within the Lake Pontchartrain Basin formerly consisted of bottomland forest and freshwater/intermediate, brackish, and saline marshes. Historically, the influx of high volumes of freshwater from the Mississippi River system maintained predominantly freshwater/intermediate/brackish marshes in the study area. Changes in the extent of habitat types in the study area are a result of both biotic (living) and abiotic (non-living) forces. These forces, many related to the geophysical processes of deltas, are consistent across Louisiana's deltaic marshes. Natural subsidence and the development of human infrastructure are the main causes of a general decline of marsh and other wetland habitats (USACE 2007b).

Specifically, there is a continuing progression toward open water that is partially driven by constant subsidence of marsh. Human alteration of the landscape for risk reduction or navigation purposes can block the sediments associated with normal freshwater flow from entering the coastal marshes. Consequently, wetlands are not being replenished through the natural deltaic process (USACE 2004). In addition, steady population growth and land development over the past century continue to contribute to the shoreline and wetland loss currently experienced.



Source: USGS 2008

Figure 27. Land Loss Trends within the Lake Pontchartrain Basin

According to information provided in the Interagency Performance Evaluation Taskforce report, there is no indication flooding and subsequent floodwater pumping from greater New Orleans contributed to loss in delta, wetland, and/or Gulf of Mexico areas outside the city (USACE 2007c). Physical damage or alteration of habitats has a much greater impact to regional habitat and biological resources (USACE 2007c). These impacts include the loss of bottomland hardwoods and cypress-tupelo swamps to wind and storm surge damage and the intrusion of saltwater into previously freshwater/intermediate or brackish marshes initiated through breaches or overtopping of the levees (USACE 2007c).

The Lake Pontchartrain Basin consists primarily of three wetland marsh types: freshwater marsh, brackish-intermediate marsh, and salt marsh. Marshland type and distribution was determined for this study using Louisiana Department of Wildlife and Fisheries (LaDWF) data (LaDWF 2001). This data is part of the Louisiana GIS Digital Map, May 2007 Compilation DVD. The areas immediately adjacent to the IHNC within the Tier 2 Pontchartrain project boundaries are classified as Urban Developed land and contain no wetlands. Figure 28 illustrates the habitat types that currently exist within the Lake Pontchartrain Basin.

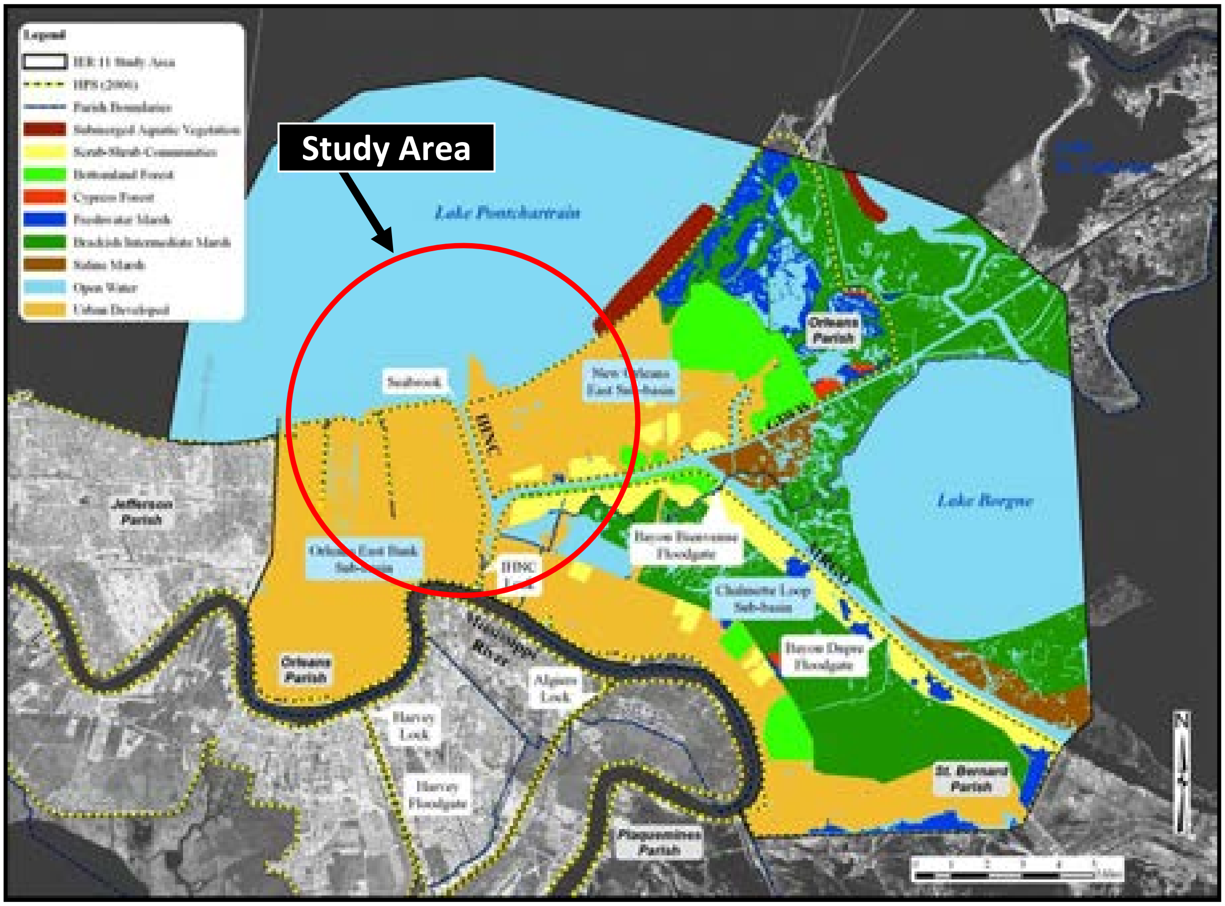


Figure 28. Map of Habitat Types in the Study Area and Vicinity

<u>Discussion of Impacts</u>

Proposed Action (Alternative #1) - Bridgeside Alignment: Sector Gate located 540 ft south of Seabrook Bridge and approximately 1,500 ft of T-walls built on Existing Levees

Direct Impacts to Wetlands

As illustrated in figure 28, the wetland habitat within the larger project area is primarily located in the area commonly referred to as the Golden Triangle, the marsh area bounded by the GIWW, MRGO, and Lake Borgne, and not within the immediate study area. For this reason no direct impacts to wetland habitat would be anticipated.

Indirect Impacts to Wetlands

No indirect impacts would be expected to occur under the proposed action due to the lack of existing wetland habitat in or around the project area.

Cumulative Impacts to Wetlands

As discussed in the IER #11 Tier 2 Borgne document, indirect impacts to marsh habitats within the Golden Triangle can be expected as a result of the alteration of water circulation and sediment processes caused by the combination of the MRGO closure at Bayou La Loutre, the

Borgne Barrier, and the proposed action (USACE 2008c). While the hydrologic connection is maintained through the proposed HSDRRS structures and modeled resulting flows would be similar to historical conditions, these openings do not fully replicate existing conditions. Modeling results indicate that the proposed action could result in altered hydrology and inundation levels which may indirectly contribute to the continued trend of marsh loss. While there is no marsh habitat within the immediate vicinity of the proposed action, hydraulic modeling of velocity magnitude and direction, water surface elevation, and overall circulation has shown that the changes that are initiated within the area of the GIWW by the closure of the MRGO at La Loutre and the construction of the Borgne Barrier continue with the addition of the proposed action although on a smaller scale (USACE 2009c). A more detailed discussion of the changes in hydrology can be found in section 3.2.1.

Alternative #2 - Bridgeside Alignment: Sector Gate located 398 ft south of Seabrook Bridge and approximately 1,300 ft of T-walls built on Existing Levees

Direct and Indirect Impacts to Wetlands

Alternative #2 is in close proximity to the alignment of the proposed action and contains similar project features. No direct or indirect impacts to wetland habitat would be anticipated due to a lack of existing wetlands in or around the project area.

Cumulative Impacts to Wetlands

While similar to the proposed action, alternative #2 requires only a partial fill of the southern scour hole resulting in a lesser impact to hydrologic changes within the IHNC and GIWW. This reduced impact equates to potentially a slight reduction in wetland inundation within the Golden Triangle Marsh area. A more detailed discussion of the changes in hydrology can be found in section 3.2.1.

Alternatives #3 and #4 - Turning Basin Alignment: Sector Gate located 1,500 ft south of Seabrook Bridge and approximately 1,500 ft of T-walls and South of Turning Basin Alignment: Sector Gate located 2,000 ft south of Seabrook Bridge and approximately 1,450 ft of T-walls

Direct, Indirect, and Cumulative Impacts to Wetlands

Direct, indirect, and cumulative impacts under alternatives #3 and #4 would be the same as those described for the proposed action.

Alternative #5 – Lake Pontchartrain Alignment: Sector Gate located 502 ft north of the Seabrook Bridge and approximately 1,800 ft of T-walls

Direct Impacts to Wetlands

Alternative #5 is located within Lake Pontchartrain and north of the alignment of the proposed action. Although this alignment would have greater impacts to open water habitat, no direct impacts to wetlands would be expected due to the lack of marsh habitat within the project area as depicted in figure 28.

Indirect Impacts to Wetlands

No indirect impacts under alternative #5 would be anticipated due to the lack of existing wetland habitat in or around the project area.

Cumulative Impacts to Wetlands

As discussed for the proposed action, with the construction of a new structure at Seabrook, indirect impacts to marsh habitats within the Golden Triangle would be expected as a result of the alteration of water circulation and sediment processes (USACE 2008c). Unlike the proposed action however, alternative #5 would not require filling of the south scour hole, which modeling has shown results in the greatest impacts to circulation patterns. A more detailed discussion of the changes in hydrology can be found in section 3.2.1.

3.2.4 Aquatic Resources and Fisheries

For the purposes of this section (3.2.4) and section 3.2.5 (EFH), the study area is a 5-mile radius circle with the center point located at the convergence of the IHNC and Lake Pontchartrain (figure 28). The project vicinity encompasses a much larger area including the Tier 2 Borgne Study Area (color area on figure 28). The project vicinity extends from the southern portion of Lake Pontchartrain, south to the MRGO closure at Bayou La Loutre, east to the Rigolets Pass, and includes the Golden Triangle Marsh, a portion of the GIWW, and the western lobe of Lake Borgne. The project vicinity is influenced by urbanized landscape, various canals, and armored embankments. It is also influenced to a lesser degree by the Bonnet Carré Spillway when the Mississippi River is in flood stage (O'Connell et al. 2004). Other influences on the project area in the IHNC and the GIWW are periodic dredging that causes impacts to existing water quality, and organisms, freshwater inflow from the Mississippi River Lock at the southern terminus of the IHNC, and freshwater inflow from numerous rivers in Lake Pontchartrain. Periodic dredging maintains these navigable waterways.

Existing Conditions for Aquatic Resources

Aquatic resources within the study area change yearly (due to El Niño Southern Oscillation and La Niña events), seasonally (water quality, hydrology, and weather), and daily (tides and freshwater inflow). Aquatic resources that occur within the project area include habitat (open water, benthic, and submerged aquatic vegetation [SAV]) and organisms (bivalves, crustaceans, phytoplankton, and fishes) that work together synergistically to cycle nutrients and food energy through the coastal ecosystem in Louisiana.

The project area consists of a portion of the IHNC from 1,800 ft north of the convergence with Lake Pontchartrain south to 2,500 ft south of the Seabrook Bridge. The areas of open water habitat in the project area were calculated and are presented in table 8.

Table 8.
Permanent and Temporary Habitat Impacts from Proposed and Alternative Actions

Alternative/Nature of Area	Habitat Impacts (in acres)							
	Open Water Areas					Total Open Water	Upland (non-marsh)	TOTAL
	Lake Pontchartrain	IHNC main channel	Slip No. 6	Barge Slip	Turning Basin			
Proposed Action								
Permanent Floodwall / Gate ROW		6.9				6.9	7.1	**14**
Temporary Construction Easement			2.5			2.5	9.5	**12**
Total		**6.9**	**2.5**			**9.4**	**16.6**	**26**
Alternative # 2								
Permanent Floodwall / Gate ROW		4.3				4.3	8	**12.3**
Temporary Construction Easement		1.8	2.5			4.3	10.5	**14.8**
Total		**6.1**	**2.5**			**8.6**	**18.5**	**27.1**
Alternative # 3								
Permanent Floodwall / Gate ROW		5.7	0.7	0.1	3.2	9.7	8.5	**18.2**
Temporary Construction Easement			2.5			2.5	9.5	**12**
Raise Existing IHNC I-walls to T-walls							6.9	**6.9**
Total		**5.7**	**3.2**	**0.1**	**3.2**	**12.2**	**24.9**	**37.1**
Alternative # 4								
Permanent Floodwall / Gate ROW		5.8			1.2	7	7.5	**14.5**
Temporary Construction Easement			2.5			2.5	9.5	**12**
Raise Existing IHNC I-walls to T-walls							9.2	**9.2**
Total		**5.8**	**2.5**		**1.2**	**9.5**	**26.2**	**35.7**
Alternative # 5								
Permanent Floodwall / Gate ROW	10	0.4				10.4	2	**12.4**
Temporary Construction Easement	2	3.7	2.5			8.2	13.2	**21.4**
Total	**12**	**4.1**	**2.5**			**18.6**	**15.2**	**33.8**

Open water habitat in the study area consists of the IHNC, a man-made canal approximately 250 ft wide by 35 ft deep, and Lake Pontchartrain a 1,630 km^2 brackish estuary with an average depth of 11 ft (O'Connell et al. 2004). Other habitats and organisms in the study area discussed in the sections below are SAV, eastern oysters (*Crassostrea virginica*), common rangia (*Rangia cuneata*), and substrate under open water habitat. In addition to oysters and *Rangia* clams, mud crabs, blue crabs (*Callinectes sapidus*), shrimp, and other invertebrates are also discussed because they play an important role in the trophic system of Lake Pontchartrain.

The estuarine open water in the study area is influenced by diurnal tides (± 11 centimeters; Sikora and Kjerfve 1985) from two natural tidal passes on the east: the Rigolets and Chef Menteur Pass. In addition, the IHNC serves as a third tidal pass. Given the numerous past, ongoing, and authorized flood control projects in the vicinity of Tier 2 Pontchartrain, "existing conditions" is herein defined as conditions with the following structures in place: the MRGO closure structure at Bayou La Loutre and the Borgne Barrier. The Rigolets is flood-tide dominant, while the IHNC and Chef Menteur Pass are ebb-tide dominated (Sikora and Kjerfve 1985; figure 43).

Estuarine bottom habitat in the project area includes marsh deposits, subaqueous delta formations, limited amounts of offshore deposits, and hummus (Darnell 1961). Marsh deposits are the dominant type of sediment and consist of a mixture of very soft to soft organic clays and peat with some silt. Water quality of open water resources has been discussed in detail in section 3.2.2 and wetlands are discussed in section 3.2.3.

SAV is a diverse assembly of rooted macrophytes found in Lake Pontchartrain between water depths of 0.5 ft and 6 ft. SAV provides food and habitat for estuarine organisms and is an excellent indicator of water quality (USGS 2002c). There are four dominant species of SAV commonly found in Lake Pontchartrain; three freshwater species: Eurasian watermilfoil (*Myriophyllum spicatum*), wild celery (*Vallisneria americana*), and southern waternymph (*Najas guadalupensis*), and one primarily saltwater species: widgeon grass (*Ruppia maritima*) (Montz 1978).

Historically, wild celery has been the most dominant SAV species in Lake Pontchartrain, with widgeon grass being the second most dominant. In recent years widgeon grass has become dominant over wild celery. It is not known whether the increase in widgeon grass is a short-term response to a temporary drought or a long-term increase due to increased saltwater intrusion and changes to water quality. Figure 28 shows the distribution of SAV within the study area and the project vicinity. The area near Lincoln Beach appears to be the nearest occurrence of SAV to the project location. According to the USGS (2002c), an infrequent occurrence of SAV is located approximately 4.0 miles to the northeast of the project location. SAV does not occur in the footprint of the project area but does occur in the project vicinity.

Lake Pontchartrain and the IHNC play an important role in the cycling of nutrients and food energy through the coastal ecosystem in Louisiana. Autochthonous (originates from Lake Pontchartrain) and allochthonous (originates from outside Lake Pontchartrain) sources of detritus are the foundation of the trophic system. Food energy is transferred to higher trophic levels via phytoplankton, zooplankton, bivalves, crustaceans, and small fishes. Organisms comprising intermediate stages of the food web utilize habitats that occur within the project area such as open water, benthic, epibenthic, and nearshore areas. Balance of populations of zooplankton and phytoplankton is important for a healthy ecosystem or estuary. The dominant groups of phytoplankton are diatoms and dinoflagellates. These phytoplankton, along with green and blue-green algae, are responsible for naturally occurring large blooms in the study area waters, particularly in the summer when high temperatures and low turbidity stimulate their proliferation. Large phytoplankton blooms are also linked to nutrient-rich runoff from the developed and agricultural portions of the contributing watershed.

The dominant groups of zooplankton present in the study area include calanoid copepods, larval penaeid shrimp, and adult schizopods (Darnell 1961). Other species such as oysters and *Rangia* clams resemble plankton only in their early life stages and become sessile benthic organisms as adults. Zooplankton abundance varies with salinity and seasonal patterns of abundance have also been observed. The majority of plankton use flood-dominated tidal currents to enter Lake Pontchartrain through the Rigolets, wind driven currents to move throughout the estuary, and ebb-dominated tidal currents of the IHNC and Chef Menteur Pass to migrate back to the Gulf of Mexico.

Other important benthic species likely to occur in the study area are isopods, amphipods, chironomids, and mud crabs (*Rhithropanopeus harrisii*, *Neopanope texana*, and *Panopeus herbstii*), serpulid worms (polychaetes), gastropods such as the oyster drill (*Stramonita haemastoma*), and the moon snail (*Euspira lewisii*). Economically important crustacean species that occur throughout the project area include blue crabs, brown shrimp (*Farfantepenaeus aztecus),* and white shrimp (*Litopenaeus setiferus).* Other common invertebrates that occur within the project area on hard surfaces are *Rangia* clams and oysters (Hoese and Moore 1998). Many of these species are dominant food items in the diet of fish, including sciaenids, flounder, and other large marine fishes such as grouper and snapper.

Three major passes, the Rigolets, Chef Menteur Pass, and the IHNC are used by plankton, macroinvertebrates and fishes to migrate into and out of Lake Pontchartrain. Larval and post larval life stages of some species (such as blue crab, several drum species, and shrimp) use flood tides to migrate into Lake Pontchartrain through these three passes. A previous assessment of macroplankton (i.e. larval fishes and crustaceans) movement through these passes determined there was no significant difference in unit catch between the passes and concluded that migration through the passes was necessary to maintain the populations in Lake Pontchartrain (Fannaly 1979). Swenson and Chaung (1983) conducted studies on water volume exchange in estuarine systems and found that the Rigolets is primarily flood-dominated whereas Chef Menteur Pass and the IHNC are primarily ebb-dominated. These findings are supported by the Hydrodynamic Validation modeling which found that under existing conditions velocities of ebb tides in the IHNC ranged from about 3 fps to 6 fps versus flood tides which ranged from about 0 fps to 1 fps (validation modeling data was only looked at for one 24-hour period in October 2008 and that no data was collected during peak flow conditions; USACE 2009c).

Existing Conditions for Fisheries

Recreational and Commercial Fisheries

Recreational and commercial fisheries are considered a vital part of Louisiana's economy. In 2006, two of the top commercial fishing ports in the U.S. were in Louisiana (NOAA 2006), and over 33 percent of commercial fish harvested in the lower 48 states came from the Louisiana coastal zone (Coalition to Restore Coastal Louisiana [CRCL] 2000). The landings of all the fisheries species combined in the State of Louisiana for 2005, 2006, and 2007 are shown in table 9, including finfish, shrimp, crabs, and benthic fauna such as clams and oysters.

Table 9.
Annual Landing Statistics for all Fisheries Species
Combined for the State of Louisiana, 2005 – 2007

Year	Metric Tons	Pounds	Value ($)
2005	385,231	849,280,372	251,687,265
2006	416,628	918,498,167	278,111,830
2007	452,382	997,322,084	286,954,135
Grand Totals	1,254,241	2,765,100,623	816,753,230

Source: NOAA 2007.

These species fill a variety of ecological niches and support commercial and recreational harvests either directly (in the form of takes) or by providing prey for harvested species. Movement between fresher and more saline waters is essential to the life history of many of these species. Some marine species have increased in abundance following hurricanes, perhaps due to a decrease in fishing effort. For example, trawl surveys conducted in the fall of 2005 (after Hurricanes Katrina and Rita) found no indication of reductions in offshore fish or shrimp populations and no evidence of fish kills (for saltwater species). In fact, trawl catches of certain species averaged 30 percent greater than average pre-Katrina catches (USACE 2006b).

Waters of the project area occur in the Lake Pontchartrain Basin. As previously discussed, two natural tidal passes (Chef Menteur Pass and The Rigolets) currently serve as major pathways between the Gulf of Mexico and Lake Pontchartrain. They act as migration routes to and from the Gulf of Mexico, connecting spawning and nursery grounds for species such as the blue crab, red drum (*Sciaenops ocellatus*), black drum (*Pogonias cromis*), and spotted seatrout (*Cynoscion nebulosus*). These routes are necessary to these species to complete their life cycle, particularly given that each of these species is an important component to recreational or commercial fisheries in Southeast Louisiana.

Recreational fisheries accounted for $194.9 million in revenue (including recreational boating) for Louisiana statewide during 2006 (LaDWF 2008). The five fish species most encountered during recreational fishing in Louisiana are the red drum, black drum, spotted seatrout, Atlantic croaker (*Micropogonias undulatus*), and sand seatrout (*Cynoscion arenarius*) (Pattillo et al. 1997). Other important sport fish species of fresh to slightly brackish waters include the black crappie (*Pomoxis nigromaculatus*), white crappie (*Pomoxis annularis*), bluegill (*Lepomis macrochirus*), redear sunfish (*Lepomis microlophus*), largemouth bass (*Micropterus salmoides*), spotted sunfish (*Lepomis punctatus*), yellow bass (*Morone mississippiensis*), channel catfish (*Ictalurus punctatus*), and Gulf menhaden (*Brevoortia patronus*) (USACE 1984). Although not encountered during fishing directly, bay anchovy (*Anchoa mitchilli*) are the most abundant fish in Lake Pontchartrain and serve an important ecological function as a prey species and supports the fish mentioned previously (O'Connell et al. 2004). Although recreational fishing occurs within all portions of the IHNC, the Seabrook area is anecdotally reported to be the second best fishing site in Louisiana (refer to Section 3.2.10 for additional information).

Economically important commercial fisheries exist within Lake Pontchartrain for brown shrimp, white shrimp, and blue crab. Lake Pontchartrain is classified by the LaDWF as an un-leased state water bottom, and therefore, harvesting oysters is illegal (LaDWF 2009b). However, oysters do occur in Lake Pontchartrain and on hard surfaces (riprap, pilings, and guidewalls) in the project area. Commercial catches of catfish, drum, buffalo (*Ictiobus* spp.), and alligator gar (*Atractosteus spatula*) are confined to fresher waters (USACE 1984). Table 10 lists the commercially and recreationally important fishes grouped by fishery classification and the statewide value for each group.

Table 10.
State-wide Dollar Value of Representative Game and Commercial Fisheries Species Occurring in or near the Tier 2 Pontchartrain Project Area

Common Name	**Scientific Name**	**Value in 2007 Dollars ($)**
Marine Species		
Brown shrimp	*Farfantepenaeus aztecus*	43,303,937
White shrimp	*Litopenaeus setiferus*	94,074,290
Pink shrimp	*Farfantepenaeus duorarum*	28,342
Tarpon	*Megalops atlanticus*	--
Atlantic croaker	*Micropogonias undulates*	54,662
Red drum	*Sciaenops ocellatus*	--
Black drum	*Pogonias cromis*	1,785,663
Gafftopsail catfish	*Bagre marinus*	--
Seatrout	*Cynoscion* sp.	26,051
Sheepshead	*Archosargus probatocephalus*	266,959
Southern flounder	*Paralichthys lethostigma*	109,689
Striped mullet	*Mugil cephalus*	685,585
Gulf menhaden	*Brevoortia patronus*	41,367,977
Herrings	Clupeiformes	172,285
Sea catfish	*Arius felis*	--
Atlantic rangia	*Rangia cuneata*	--
Eastern oyster	*Crassostrea virginica*	40,135,806
Blue crab	*Callinectes sapidus*	34,801,488
Freshwater Species		
Alligator gar	*Atractosteus spatula*	598,068
Catfish	*Ictalurus* sp.	2,213,170
Flathead catfish	*Pylodictis olivaris*	140,889
Gizzard shad	*Dorosoma cepedianum*	134,126
Buffalo	*Ictiobus* sp.	728,919
Threadfin shad	*Dorosoma petenense*	--
Bass	*Micropterus* sp. and *Morone* sp.	--
Temperate bass	*Morone* sp.	--
Crappie	*Pomoxis* spp.	--
Freshwater drum	*Aplodinotus grunniens*	77,268
Sunfishes	*Lepomis* sp.	--

Source: Gulf States Marine Fisheries Commission (GSMFC) 2009.
-- = data unavailable.

Brown and White shrimp

In 2007, the two most commercially valuable fisheries species in Louisiana were brown and white shrimp (table 10). NOAA's National Marine Fisheries Service (NMFS) annual shrimp landing data from 1988 to 2000 documents brown shrimp landings continually exceed those of white shrimp in the combined areas of Lake Pontchartrain. With the exception of 1985, which showed exceptionally high landings of brown shrimp, peak landings of brown shrimp and white shrimp were similar to those observed in the 1970s. Life history strategies and habitat preferences of brown and white shrimp are described in section 3.2.6.

Blue crab

The Gulf of Mexico is responsible for a considerable percentage of the nation's blue crab landings. In the 1990s, the Gulf of Mexico produced 29 percent of the commercial and recreational harvest of blue crabs in the U.S. In Louisiana, blue crab landings were consistently higher than any other Gulf of Mexico state representing 72.2 percent of the total Gulf of Mexico production in 1993. An annual average of 44.2 million pounds was valued at $22.4 million. The state also led the nation in blue crab landings in 1987, 1988, 1991 (Guillory and Perret 1998), and 2002. More recently in 2007, Louisiana produced a total of 44.8 million pounds of blue crab valued at $34.3 million (GSMFC 2009).

In general, there has been a decline in blue crab abundance. The decline in legal-sized crabs (50 centimeters [cm] has been linked to excessive fishing pressure on larger individuals or "gross over fishing" (Hammerschmidt et al. 1998), while the decline of early life stage crabs and juveniles is associated with high predation rates in the northern Gulf of Mexico estuaries and more importantly the loss of valuable nursery habitat as Louisiana continues to experience accelerated rates of coastal land loss (Boesch et al. 1994; Duffy 1989; Guillory 1997; Perry et al. 1998; Rabalais et al. 1995).

Blue crab is an important commercial species for Lake Pontchartrain spending the majority of its life migrating throughout the entire estuary (estuarine-dependent) to complete its life cycle. Wind-driven currents and the presence of adequate habitat are the driving forces behind abundance and life stages of blue crabs in a given region of the estuary at a given season (Lyncker 2008). They inhabit salinity ranges from 0 ppt to nearly 35 ppt. Temperature is another important factor throughout the life of a blue crab, because growth of the species is regulated by water temperature. Growth through molting of the exoskeleton (outer shell) occurs when water temperatures are greater than 59°F. However, water temperatures above 91°F are lethal (USACE 2004). When air temperatures drop below 50°F, males and immature females will bury themselves and remain in a state of torpor throughout the winter, while mature female crabs will leave the shallow, inshore waters and seek higher saline, warmer waters. This migration of mature female crabs, during which they travel considerable distances over just a few days to reach the higher salinity, is also a migration towards spawning areas. Female blue crabs will use tidal transport to migrate down the estuary towards the Gulf of Mexico during fall months to spawn (Perry et al. 1998).

Female crabs release larvae into the higher saline waters to be transported out over the continental shelf where larvae will undergo various stages of development. Early life stage crabs then use tidal transport to migrate from offshore to upper estuarine, lower saline, protective, benthic habitat such as internal marsh areas, the marsh edge, and SAV in Lake Pontchartrain (Perry et al. 1998). Welch et al. (1999) found that megalopae use exogenous cues (turbulence and salinity) to detect flood tides and ascend into the water column and utilize water movement to migrate to the upper estuary. Early life stage blue crabs are transported into the estuary two times throughout the year (early summer and fall) to settle in suitable, protective habitat near the migration corridors and inlets to the estuarine system (Etherington and Eggleston 2000). During a 12-month study of blue crab migration, blue crabs migrated into Lake Pontchartrain specifically from May to June through the IHNC (Lyncker 2008) during nocturnal flood tides (Welch et al. 1999). In September and October, blue crabs entered Lake Pontchartrain via The Rigolets and Chef Menteur Pass (Lyncker 2008). Juvenile and sub-adult crabs move from dense vegetation into the open water, lower saline areas of the upper estuary containing unstructured habitat (Pile et al. 1996). Once adults, female blue crabs migrate to the Gulf of Mexico where they will reach sexual maturity at 10 months to 12 months old (Guillory 1997).

Atlantic croaker

The Atlantic croaker is an estuarine-dependent species, meaning it migrates throughout the entire estuary during various stages of its life cycle. This species inhabits emergent marsh habitats as a juvenile and deep coastal habitat near passes and channels as an adult (Lassuy 1983a). Spawning typically takes place between October and February, with a peak in spawning occurring in December in the central Gulf of Mexico (Louisiana, Mississippi, and Alabama). Croakers typically spend their first two years in the estuary before migrating back to deeper water. Atlantic croaker grow at faster rates in mesohaline habitats (5 ppt to 18 ppt) and are found at higher densities in marsh edge habitats (Weber 2004).

According to Pattillo et al. (1997), all life history stages of this species are abundant in Lake Pontchartrain. There is a high probability of sub-adult and adult Atlantic croaker occurring in the open water habitat with the soft-bottomed substrates it prefers (Lassuy 1983a) commonly found within the project area. Juvenile Atlantic croaker are also associated with emergent marsh habitats over silt/mud or oyster shell substrate, and there is a high probability of occurrence in tidally-flooded marshes (Weber 2004).

Atlantic croaker is one of the most widely encountered fish during commercial and recreational fishing. The adult fish are often caught for consumption while the juveniles and sub-adults are used for live bait to catch trophy-size spotted seatrout.

Black drum

The black drum is an estuarine-dependent species which spawns in nearshore habitats and passes between November and May. Juveniles prefer non-vegetated habitats with muddy substrate, and adults occur over non-vegetated sand, mud habitats, and over oyster reefs. The open water habitats that occur within the project area have characteristics similar to those preferred by juvenile black drum (i.e., non-vegetated, muddy, open water), and they are considered common as juveniles in the project area. Adult black drum may also occur in non-vegetated habitat all year round in the project area (Pattillo et al. 1997).

Sand seatrout

The sand seatrout is an estuarine resident species that occurs throughout the Gulf of Mexico in nearshore habitats (Pattillo et al. 1997). It spawns primarily in shallow, higher salinity habitats (Sutter and McIlwain 1987) between February and October (Ditty et al. 1988). Juvenile sand seatrout typically prefer habitats such as flooded marshes and seagrass meadows with soft organic substrates (Benson 1982). Adults are found in open water over most substrate types (Pattillo et al. 1997). Juveniles typically inhabit flooded estuarine marshes of the project area between June and September (Pattillo et al. 1997). Pattillo et al. (1997) consider juvenile sand seatrout to be abundant in Lake Pontchartrain. Adults are common from May through September.

Spotted seatrout

Spotted seatrout are estuarine residents, spending their entire life cycle in estuarine waters. Spawning typically occurs from March to October, with a peak between April and August (Ditty et al. 1988). Spawning takes place in passes, as well as in shallow, grassy areas in bays with moderate salinities. Spotted seatrout larvae appear to use currents to travel into marsh habitats. Larvae originally found offshore travel west from spawning locations (Shaw et al. 1982). Spotted seatrout feed on zooplankton as larvae, larger invertebrates and small fish as juveniles, and primarily fish as adults (Pattillo et al. 1997). Juvenile and adult spotted seatrout are common throughout the project area with adults being more abundant during spring and early summer, and abundance peaking during late summer and early fall for juveniles (Pattillo et al. 1997).

Gulf menhaden

The Gulf menhaden support the largest single fishery (by weight) in the U.S., and their young are prey to many other species of sport or commercial importance. The maintenance of large parcels of surrounding marsh and of inflowing freshwater tributary systems is considered necessary to sustain suitable habitat for supporting menhaden populations in estuaries. The eastern half of Lake Pontchartrain is included in the coastal distribution of this species (Lassuy 1983b).

Bay anchovy

The bay anchovy is the predominant fish species (by mass) in Lake Pontchartrain. It is considered a prey species for many commercially and recreationally important species such as red drum, spotted seatrout, and sand seatrout. Bay anchovies spawn year round in estuarine waters where salinity is greater than 10 ppt (Robinette 1983). The pelagic eggs of the bay anchovy are found throughout the water column but tend to be concentrated near the surface, in salinities of 8 ppt to 15 ppt (Morton 1989). Bay anchovy feed on copepod nauplii and copepodids. Mass starvation of bay anchovy larvae occurs at low food concentrations, which occurs mostly in subtropical marine ecosystems if the larvae do not encounter a “patch” of suitable food (Morton 1989). The “critical period” during which these larvae must feed was determined to be within 2.5 days after hatching. Robinette (1983) found that bay anchovy larvae were most susceptible to starvation mortality during the first 6 days after hatching. Larval bay anchovies may require high and stable prey densities to survive and grow under natural conditions. At low prey concentrations, larval bay anchovies may be required to expend a relatively large amount of energy to obtain the minimum amount of food required for growth and maintenance, and would therefore, be susceptible to starvation and predation (Leak and Houde 1987). Adults primarily feed on mysids, copepods, rotifers, detritus, macrozooplankton, small shrimp, and larval fishes (Robinette 1983). Larger specimens consume an array of benthic crustaceans, especially amphipods, mysids, harpacticoid copepods, ostracods, and small mollusks. Bay anchovy eggs and larvae accounted for 96 percent and 88 percent, respectively, of all ichthyoplankton eggs and larvae collected in the lower Chesapeake Bay between 1971 and 1976. Data revealed peaks in bay anchovy egg abundance between May and August, and peaks of larvae between July and August (Morton 1989).

Bay anchovy is the primary forage item for many economically important predators and is an important link in the estuarine food web. The bay anchovy tolerates a wide range of temperatures and salinity has little influence on its distribution. Adult bay anchovy inhabit shallow to moderately deep waters and are found in a variety of habitats in nearshore and offshore waters. Bay anchovies appear to show little preference for habitat type as they regularly occupy open bays to small muddy coves; beaches to the mouths of rivers; and small bayous to seagrass beds in freshwater rivers (Morton 1989). In the Chesapeake, densities were highest in salinities of 4.2 ppt to 6.0 ppt, or shortly after the time of maximum water temperature (Morton 1989). Mature bay anchovies move downstream to spawn when water temperatures reach at least 12 degrees Celsius (^{o}C) and salinities are generally 10 ppt or greater (Robinette 1983). Newly hatched larvae then move upstream to waters of less than 10 ppt salinity to feed. Larval and juvenile bay anchovies begin to move into more saline waters in early fall. By late November, anchovies occur only in saltwater. Schultz et al. (2003) found the smallest larvae in the lower portions of the river and lower estuary, while larger larvae were more concentrated in upriver/ upper estuary sections. Anchovies were more concentrated at deeper depths where they are able to use upstream residual flow to promote movement up stream or up estuary. Bay anchovy are thought to use depth preferences (vertical movement) and neap tides to rapidly move toward the upper estuary to feed.

Oysters and Rangia Clams

Eastern oysters are sessile bivalves that occur throughout the Gulf of Mexico in shallow bays, mud flats, and offshore sandy bars (Stanley and Sellers 1986). Oysters grow well on a variety of substrates ranging from rocky bottoms to some type of mud. Oysters also depend on currents to deliver food, remove feces, and prevent burial. The presence and growth of oysters are closely correlated to salinity and other abiotic variables. According to Pattillo et al. (1997), salinity, DO, and pH may affect the locations where oysters occur and thrive. DO concentrations ranging from 7.41 mg/L to 8.62 mg/L, pH ranging from 8.23 to 8.78, and salinity levels ranging from 21.43 ppt to 21.93 ppt are the preferred habitat conditions for this species.

Harvesting oysters is illegal in Lake Pontchartrain, but anecdotal information suggests that scattered populations of eastern oysters occur in Lake Pontchartrain and in the project area near the convergence of the IHNC on man-made structures (LaDWF 2009a). Lyncker (2008) also mentions oysters in the northeast region of Lake Pontchartrain near Goose Point.

Rangia clams are those found embedded in the mud bottom throughout the lake. These organisms are responsible for purifying the lake water. *Rangia* clams are more abundant throughout the estuary than oysters, occurring over soft mud and sand substrate adjacent to emergent vegetation and SAV throughout the lake (Lyncker 2008). *Rangia* clams are present along Pontchartrain Beach in sand substrate mixed with pebbles and detritus (Lyncker 2008). Additional information about the role of *Rangia* clams in the ecology of Lake Pontchartrain and how it pertains to EFH is discussed in sections 3.2.5.

Larval Prey Transport for Fisheries Resources

Extensive research on larval transport and fish migration has been conducted on the east coast for species that also occur in Lake Pontchartrain. When possible, research from Lake Pontchartrain and nearby estuaries on the Gulf of Mexico has been used to draw conclusions about the impacts of the proposed action, but where data gaps exist for southern Louisiana, research conducted in estuaries such as Chesapeake Bay has been used. Although these studies were not conducted in Lake Pontchartrain, similar cues and processes are expected to occur in Lake Pontchartrain because both estuaries contain some of the same or similar species and have similar abiotic and biotic conditions. The following paragraph describes work that has been conducted in Chesapeake Bay.

Larvae are capable of using internal cues (hormonal, behavioral or biological) and/or external cues (environmental) that transport them to the tidal prism of the estuary and to nursery areas. An example of an internal cue is vertical migration that coincides with flood tides or residual bottom inflow. External cues are active movements toward an area of the water column when an organism detects changes in wind forcing, turbulence, and/or salinity. Hare et al. (2005) found that a combination of wind forcing, residual bottom inflow, and selective tidal stream transport is responsible for the ingress of larval fishes into the Chesapeake Bay, and that the relative importance of the three mechanisms differs among species and changes with larval development. All three mechanisms of ingress contributed to the net up-estuary flux of larvae, but tidal mechanisms become more important for larger organisms. Net up-estuary flux is defined as movement from one habitat (usually offshore) toward the upper estuary or the location where freshwater flows into the estuary. Net movement up-estuary of the Atlantic menhaden (*Brevoortia tyrannus)* was dominated by residual bottom inflow and wind forcing. Ingress of the summer flounder (*Paralichthys dentatus)* was dominated by tidal mechanisms, and the importance of tides increased with developmental stage. Schultz et al. (2003) found that residual bottom flow was also important in the ingress of bay anchovy and Welch et al. (1999) found that blue crabs primarily use turbulence and salinity as cues to determine when flood and slack tides occur. Spotted seatrout appear to use currents to move into marsh habitats in estuaries.

Discussion of Impacts

Aquatic resources and fisheries rely on a combination of favorable abiotic (salinity, temperature, turbidity, and DO) and biotic (protection from predators and food availability) characteristics that are necessary for survival, growth, and reproduction in order to maintain the synergy of the ecosystem (Peterson 2003). The assessment of potential impacts to aquatic resources and fisheries resources is based on scientific literature and modeling of water quality (DO and salinity), velocity, fish passage, as well as particle tracking modeling (PTM) for eight larval organisms with three general behavior characteristics (brown shrimp, white shrimp, blue crab, bay anchovy, Gulf menhaden, Atlantic croaker, red drum, and spotted seatrout) in the project area. Larval organisms were used in the modeling because there is insufficient data available on the behavior of juvenile and fully grown organisms and larval organisms behave in a much simpler manner and can therefore be modeled with certain native tendencies (USACE 2009c).

This discussion describes in detail how the proposed action would cause relative changes in the project area. Impacts from alternatives #2 through #5 will be discussed in relation to the various alternatives and to other associated projects in the project vicinity.

Temporary and permanent impacts to aquatic resources and fisheries that will be discussed, when applicable, under the standard subheadings of direct, indirect, and cumulative impacts include:

- Direct impacts to estuarine open water and estuarine substrate;
- Direct impacts to the bathymetry of the IHNC;
- Effects on migratory movements;
- Impacts on active and passive transport of eggs and larvae;
- Impacts to water characteristics (temperature, salinity, turbidity, DO);
- Access of organisms to suitable abiotic (temperature, salinity, turbidity and DO) and biotic (predator-prey interactions and marsh edge) habitat;
- Incidental mortality of some fish and prey species specifically during construction activities; and
- Alterations to hydrology, tidal prism, and velocity.

Proposed Action (Alternative #1) - Bridgeside Alignment: Sector Gate located 540 ft south of Seabrook Bridge and approximately 1,500 ft of T-walls built on Existing Levees

Direct Impacts to Aquatic Resources and Fisheries

Under the proposed action, estuarine open water and benthic habitat would be directly impacted by the footprint of the sector gate, two lift gates, and associated floodwall tie-ins. During construction, approximately 2.5 acres of open water would be temporarily impacted by the cofferdam structure, construction easements, and staging areas. Approximately 7 acres of open water and waterbottoms would be expected to be permanently lost to the new flood control structures at Seabrook (table 8). The proposed action would not be expected to have any direct impacts to SAV.

Even though the IHNC is an artificial channel with bulkheads along the shoreline and has been previously dredged to maintain the navigable waterway, it currently serves as a major conduit between the Gulf of Mexico and Lake Pontchartrain for many aquatic resource species. Significant alterations to this conduit could cause positive and negative impacts to multiple benthic and pelagic species including *Rangia* clam, fish, shrimps, and crabs because mechanisms that drive transport/migration patterns would be altered.

Mobile organisms (e.g. shrimp, crab, and fish) may have a longer travel time to reach appropriate salinities which support the habitats where suitable prey items may be found. However, migrating species may use salinity gradients and tidal flow to sense direction to the Gulf. These species may make a smoother transition into and out of the lake, through Chef Menteur Pass and The Rigolets, provided there are suitable prey items and habitat to sustain the additional individuals using this area. Once construction of the proposed action is complete the Seabrook gates would allow aquatic resources and fisheries into and out of Lake Pontchartrain except during storm events, such as the 100-year storm level high flow event, necessary closures to prevent excessive velocities, and monthly OMRR&R (discussed in section 1.6). These infrequent closure events would not likely last longer than a few days and should have a minimal effect on migration and transport of aquatic resources and fisheries.

Although certain construction activities, particularly those associated with the cofferdam, could result in mortality of individuals that are considered aquatic resources and fisheries resources, the number affected by the proposed alignment is not expected to impact invertebrate and vertebrate populations. Most individuals would be expected to move away from the impacted area. Eggs, larvae, and juvenile fisheries species may experience greater impacts than adults because it takes smaller organisms more energy to travel the same distance as larger, adult organisms. Sessile organisms may be impacted more than motile ones. All invertebrate life stages could potentially be more greatly impacted than adult fishes because of the greater travel time required for most small organisms to move through the project area. Although these impacts would be temporary, they could occur during the entire construction period (approximately 36 months).

During construction a braced cofferdam would be temporarily installed across the channel around the approximate perimeter of the sector gate and vertical lift gates for a period of approximately 6 months to 12 months. During this phase of construction, the IHNC would be closed to flow exchange with Lake Pontchartrain.

While the cofferdam is in place movement and transport of organisms between the IHNC and Lake Pontchartrain would be temporarily blocked. The duration of this construction phase would impact at least one spawning season of most species since larvae and juveniles moving along the GIWW and Bayou Bienvenue/MRGO north of the Bayou Bienvenue closure would be unable to enter Lake Pontchartrain through the IHNC. The life cycle of these organisms depends on reaching the lower salinity waters of Lake Pontchartrain and various habitat types in the lake. Although two conduits (Chef Menteur Pass and the Rigolets) would remain open and organisms could use these as routes to reach nursery areas in the lake, those individuals transported to the INHC during this time would mostly likely be unable to travel against the directional flow through the GIWW toward Chef Menteur Pass or the Rigolets. Larvae would most likely not recruit to Lake Pontchartrain nursery areas during this construction phase. Conversely, the cofferdam could also concentrate prey items, thus attracting larger fish/predators to the area; however, the expected poor water quality in the vicinity of the cofferdam may negate fish from taking advantage of this opportunity.

Closure of the IHNC while the cofferdam is in place may cause larvae, juveniles, and adult stages of some species to become unable to exit the IHNC and find an alternate route to a suitable supply of food, potentially resulting in starvation or heightened predation. These dietary and behavioral impacts could cause decreases in populations of lower trophic level species, and in turn, the species that rely on them entering Lake Pontchartrain. Influx of blue crab larvae through the IHNC would be disrupted by the cofferdam placement (approximately 6 months to 12 months), which could overlap with at least two breeding cycles of this species.

Temporary, but potentially lethal disturbance would also occur as the area inside the cofferdam (approximately 95,000 sq ft) is dewatered. This construction activity may cause mortality to individuals trapped in the cofferdam. Also, depending on the time necessary to construct the cofferdam, the environment inside the cofferdam may become anoxic before the area is dewatered causing mortality to the majority of organisms inside. Similar impacts may occur after the placement of retaining walls for the T-walls after the cofferdam is in place as a result of blocking water behind the sheet piles before fill is placed to construct the T-wall. Additionally, placement of riprap outside the retaining walls would also likely cause burial of some individuals.

Under the proposed action a scour hole (figure 7) would have to be filled prior to construction of the new flood control alignment. During these construction activities there is a potential for burial and/or suffocation of benthic organisms such as polychaetes, oysters, and *Rangia* clams that occur in the footprint. Mobile organisms such as shrimp, fish, and crab are expected to move from the area but still have the potential of being buried. Impacts from suffocation and burial would only occur during filling activities; however impacts would be temporary and benthic communities would be expected to rapidly recolonize (Montagna et al. 1998).

Localized mortality of some individuals may occur as a result of the filling of the scour hole in the IHNC associated with construction of the proposed action. Filling in the hole would decrease the area of deep water and bottom habitat available to aquatic resources and fisheries. Sessile organisms would incur a greater impact than motile ones; however, few sessile organisms are likely to occur in the scour hole. Deep water habitat is sparse in the study area; however, another scour hole exists just north of the Seabrook Bridge (figure 7). It is expected that fish, crustaceans, and other motile benthic organisms displaced from the scour hole by construction would move to the northern scour hole.

Noise and vibration from construction activities would most likely deter many organisms, including predatory fish, from the project area while construction activities are carried out each day. Sessile benthic organisms that reside in the project area, and cannot remove themselves from noise and vibration would be impacted. These negative impacts could range from stress that prevents them from feeding, to death from cracked shells caused by vibration. Noise occurring from construction activities could cause behavioral changes and sub-lethal impairments to the hearing of mobile organisms (including some aquatic resources and fisheries; Hastings and Popper 2005).

After the proposed action is constructed, flow through the IHNC at Seabrook would be narrowed from 250 ft to three openings that total approximately 195 ft in width. Although the width of the channel is reduced, design of the gate structures provides a 3,000 sq ft to 3,500 sq ft flow area, which hydraulic modeling has indicated results in velocities similar to those experienced historically within the IHNC.

Indirect Impacts to Aquatic Resources and Fisheries

The proposed action would cause both temporary and long-term (permanent) indirect impacts to aquatic resources and fisheries in the study area. These impacts would be expected to occur during construction activities (approximately 36 months) because of substantial changes in turbidity, salinity, DO levels, and velocities, specifically for approximately 6 months to 12 months while the cofferdam is blocking flow in the IHNC. After construction is complete, changes in velocities and salinity would be expected to be minor the majority of the time during times when the gates are open. The following paragraphs discuss indirect impacts related to turbidity, DO, salinity, velocity, and transport and migration.

<u>Turbidity</u>

Siltation from filling the scour hole, constructing the cofferdam, and other construction activities could choke benthic organisms and siltation plumes of long duration could stress and kill benthic fauna. Diminished sunlight penetration may affect phytoplankton populations in the project area. Both these disturbances would impact species in the project area by decreasing the abundance of prey available, as well as their ability to catch prey. These impacts would be expected to be considerable while the scour hole is being filled and during construction of the cofferdam even though BMPs would be used to the maximum extent possible. Indirect impacts would only occur for approximately 36 months. Although some increased turbidity levels would be expected for the duration of construction, these increases would be less than the turbidity levels expected during filling of the scour hole and constructing the cofferdam.

Dissolved Oxygen

DO modeling for the construction scenario and operation scenario were conducted to predict changes in DO from the implementation of various projects in the project vicinity. Modeling conditions, limitations, and results are discussed in detail in section 3.2.2 (Water Quality).

Indirect impacts to aquatic resources and fisheries may occur during construction due to changes in water characteristics. Impacts would most likely be temporary and caused by the displacement of organisms from localized areas due to elevated turbidity levels, decreased DO, and increased biological oxygen demand (BOD) associated with construction and filling activities. Sessile organisms would be expected to be negatively influenced during construction. Organisms that are not buried during construction and filling activities could be suffocated or would have to overcome 6 months to 12 months of low DO conditions. It is possible that the portion of the IHNC in the project area could become a “dead zone” for sessile organisms until the proposed action is complete. Calibration verification of the DO model and additional monitoring is being investigated to demonstrate whether the low DO observed in the past would reoccur annually.

The temporary blockage of the IHNC (approximately 6 to 12 months) during construction, has the potential to cause fish kills north and south of the cofferdam. Although fish kills have been previously documented along the south shore of Lake Pontchartrain during August and September, the impacts from the cofferdam would be expected to be greater than impacts that have been documented in the past. Similar occurrences have been documented at the closure of the MRGO at Bayou La Loutre. If kills do occur they would be caused by persistent low DO levels, from the blocked flow. These would only occur while the cofferdam is in place and would not be expected to occur after the sector gate and two vertical lift gates are in place. If fish kills occur, they would cause similar results to aquatic/fisheries species such as *Rangia* clams, shrimps, and crabs. It is not likely that the number of individuals killed would have a long-term impact on the basin-wide populations of aquatic/fisheries species. Temporary, localized impacts on populations may occur. If large numbers of individuals are killed, populations would rebound; however, this may take several years as the system comes to a new equilibrium from all the other ongoing projects in the area.

Filling the scour hole south of the Seabrook Bridge may cause permanent beneficial changes to DO levels in the INHC after construction is complete and while it has the potential to ultimately improve water quality conditions in the project area and the study area, DO levels are still predicted to be less than the standard of 4.0 mg/L (Dortch and Martin 2008). Research on the Patuxent River, Chesapeake Bay, found that hypoxia may affect fish larvae through decreased growth and survival, limitation of habitat availability, and by altering predator-prey interactions (Keister et al. 2000). The effect of any disturbance in the physical habitat is likely to differ among species, leading to altered growth or predation mortality through changes in predator and prey distributions. The beneficial impact of improving DO conditions in the IHNC may result in organisms using less energy for respiration, which would allow them to allocate more energy to find food, hiding from predators and traveling to nursery areas or spawning grounds. This anticipated improvement in DO conditions would be anticipated to especially benefit *Rangia* clams and other benthic organisms.

Salinity

TABS-Multi- Dimensional Sediment (MDS) hydrodynamic numerical model (Tate et al. 2002) used for salinity modeling was conducted by ERDC to predict changes in salinity in the project vicinity (Martin et al. 2009b). Modeling conditions, limitations and results are discussed in detail in section 3.2.2 (Water Quality).

Blocked flow between the IHNC and Lake Pontchartrain while the cofferdam is in place would cause salinities to be slightly lower than the current levels to the north of the project area, and therefore, alter water quality parameters and benthic habitat. Alterations would include potential benefits to benthic communities (benthic habitat and water quality) in the southeastern portion of the lake.

Partially filling the scour hole in the IHNC may result in positive changes to salinity in this area of the IHNC by removing a sink for heavier saline water that gets trapped in the deeper portion of the hole. However, due to the origin of the scour hole (most likely the result of extreme storm event tidal flow into and out of the lake), mixing in the scour hole during these storm events may eliminate salinity stratification and this habitat may provide a refuge for fish and crustaceans.

Organisms that utilize tidal flow and salinity gradients for passage may follow the altered gradients to the Rigolets and Chef Menteur Pass instead to access nursery and breeding grounds closer to the Gulf of Mexico. Accessibility of the marsh areas such as those near Bayou Bienvenue, which may already contain altered salinity due to the MRGO closures at Bayou La Loutre and Bayou Bienvenue, may be less accessible for organisms due to changes in tidal velocity and passage constraints. Alternatively, changes to tidal flow within the GIWW due to the MRGO closures at Bayou La Loutre and Bayou Bienvenue may make traversing this reach of the waterway more direct because of the sloshing effect from several waterways. If carrying capacity has been reached in the foraging and nursery areas of northeastern portions of Lake Pontchartrain, then additional population loads may be disadvantageous. Additional organisms or entire populations could increase resource pressure during the construction period and cause temporary effects to population numbers. Density and distribution of SAV beds along the eastern shore of Lake Pontchartrain may increase as a result of lower salinity levels.

Velocity

ADH modeling was conducted by the ERDC to predict velocities in the proposed action area and is discussed in detail in section 3.2.1 (hydrology). Once the proposed action is in place, velocities would exceed 2.6 fps in several locations throughout the project vicinity. High velocities are predicted to occur in the GIWW periodically and in the channel that runs north-south between Bayou Bienvenue and Bayou La Loutre and connects the MRGO to Lake Borgne. In the IHNC, velocities greater than 2.6 fps would be expected to occur 40 percent of the time under September conditions and 55 percent of the time under March conditions (see arrows on figures 29 and 30).

According to the modeling results, velocities greater than 2.6 fps would be expected to occur both during construction and after the proposed action is in place (see dashed lines and arrows on figures 29 and 30). These conditions would inhibit fish and crustacean passage and would cause greater adverse impacts to those aquatic organisms unable to swim as proficiently as most fish. Given these results, the proposed action would make it difficult for aquatic resources and fisheries such as shrimp smaller than 100 mm, blue crabs, and fish smaller than 40 mm to traverse the project area in the IHNC (Smith 2008). However, since aquatic resources and fisheries most likely already experience unfavorable conditions for passage given historic average velocities, this increase in velocity is not expected to cause significant adverse impacts to these aquatic organisms.

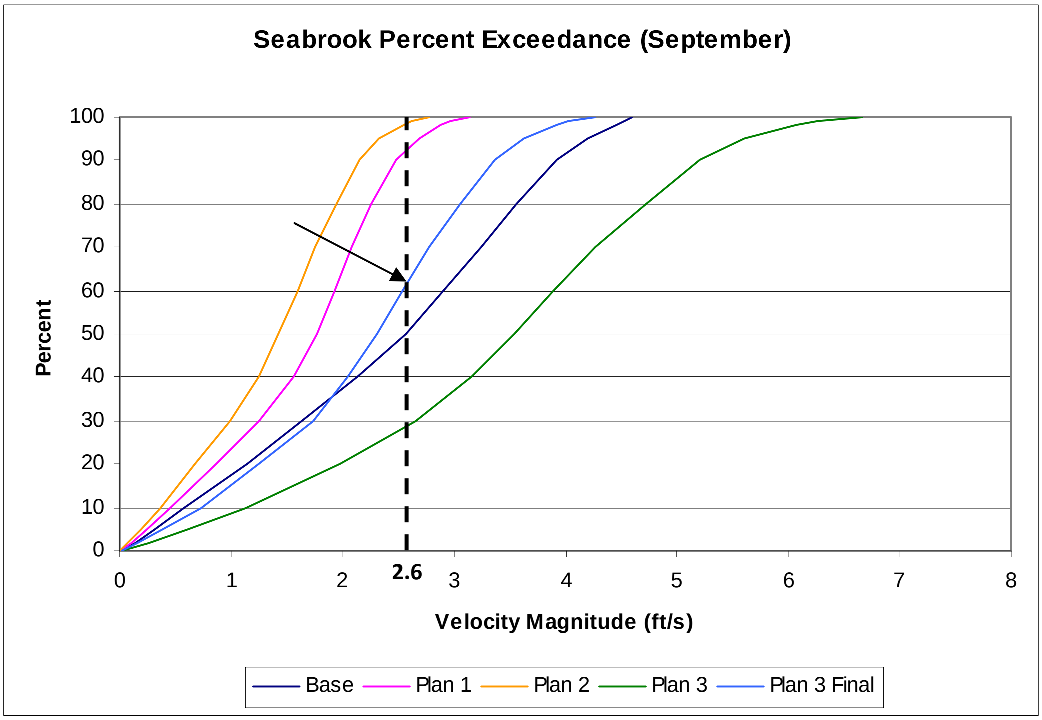


Figure 29. Seabrook Percent Exceedance Plot for September

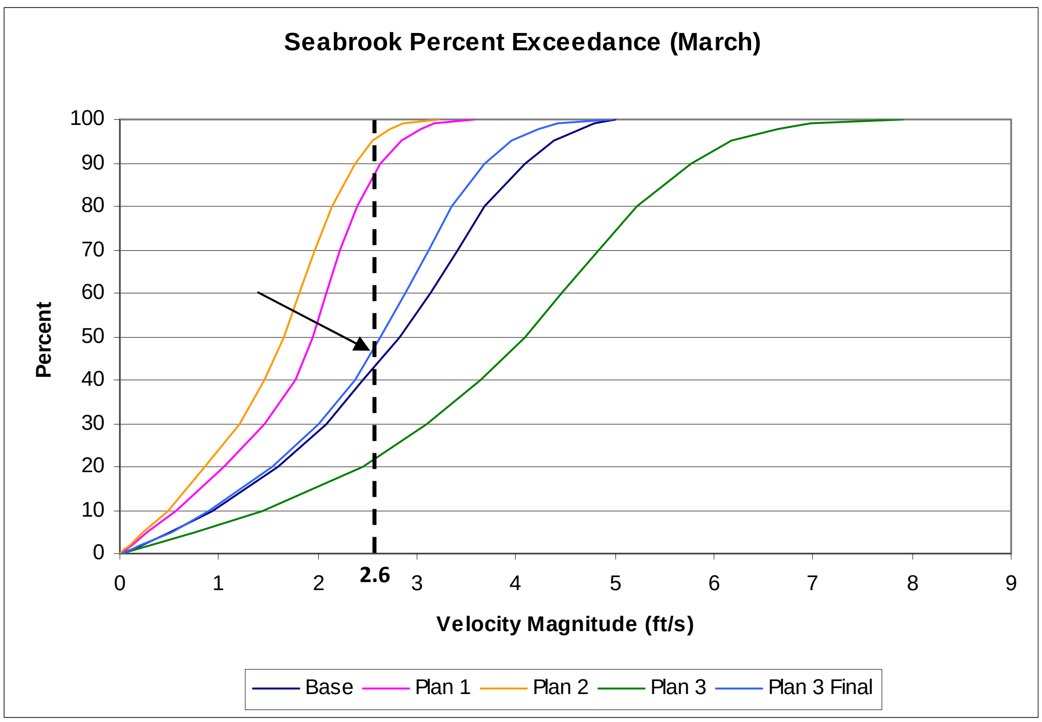


Figure 30. Seabrook Percent Exceedance Plot for March

After project completion, aquatic resources and fisheries such as blue crabs and shrimp would be expected to emerge into Lake Pontchartrain predominantly through the northeastern passes as the result of tidal flow. Swimming aquatic organisms and those organisms that use passive transport or rely on cues to migrate in flood tide that moved to the west in the GIWW would have a longer travel time through the IHNC to reach areas of suitable habitat. This could be especially important for tidal lateral moving larvae such as shrimp and blue crab.

The proposed action could also have an impact on the productivity of some aquatic species and fisheries that utilize Lake Pontchartrain as a nursery area since plankton, macroinvertebrates, and fishes use three passes (the Rigolets, Chef Menteur Pass, and the IHNC) to migrate into and out of Lake Pontchartrain (see Existing Conditions for Aquatic Resources for more detail). Larval and post larval life stages of some species (such as blue crab, several drum species, and shrimp) use flood tides to migrate into Lake Pontchartrain through the three passes and any reduction in tidal flows would lower migration opportunities. Swenson and Chaung (1983) conducted studies on water volume exchange in estuarine systems and found that the Rigolets is primarily flood-dominated whereas Chef Menteur Pass and the IHNC are primarily ebb-dominated. These findings are supported by the Hydrodynamic Validation modeling which found that under existing conditions velocities of ebb tides in the IHNC ranged from about 3 fps to 6 fps versus flood tides which ranged from about 0 fps to 1 fps (validation modeling data was only looked at for one 24-hour period in October 2008 and no data was collected during peak flow conditions; USACE 2009c). As a result of this information, it is reasonable to assume that larval transport into Lake Pontchartrain occurs mainly through the Rigolets and transport out of the lake through Chef Menteur Pass and the IHNC. If tidal flow is reduced through the IHNC, greater impacts may occur to species such as blue crab, white shrimp, and brown shrimp which utilize the estuarine and marine ecosystem to complete their life cycles compared to *Rangia* clams.

Transport and Migration

PTM was used to simulate larval transport for eight dominant fish/macroinvertebrate species using four larval behavior types (lateral, vertical, bottom, and passive) assigned to particles. Limitations to PTM applied to larval fish behaviors are that these particles do not have the many types of realistic life traits which may or may not affect the transport of living organisms and that the minimum velocity used in PTM is a best estimate due to knowledge of certain larval species (USACE 2009c). The species selected all play key roles in the trophic system of Lake Pontchartrain. These species include bay anchovy, Gulf menhaden, red drum, brown shrimp, white shrimp, spotted seatrout, blue crab, and Atlantic croaker. Model scenarios were coordinated with the interagency team made up of representatives from NMFS, USEPA, Louisiana Department of Natural Resources (LaDNR), LaDWF, U.S. Fish and Wildlife Service (USFWS), and USACE. In addition, work is being reviewed by experts from the Netherlands, ERDC, and University of New Orleans (UNO).

The movement or transport of larvae between the coastal estuaries and Lake Pontchartrain was simulated by the PTM at several locations with the aquatic ecosystem (MRGO, the GIWW, and Lake Borgne; figure 31). Two analysis periods, September 2007 and March 2008, were chosen by the interagency team; March is indicative of more erratic conditions due to rain events and frontal passages, and September represents lower wind speeds and more typical diurnal tides expected in the Gulf of Mexico (USACE 2009c).

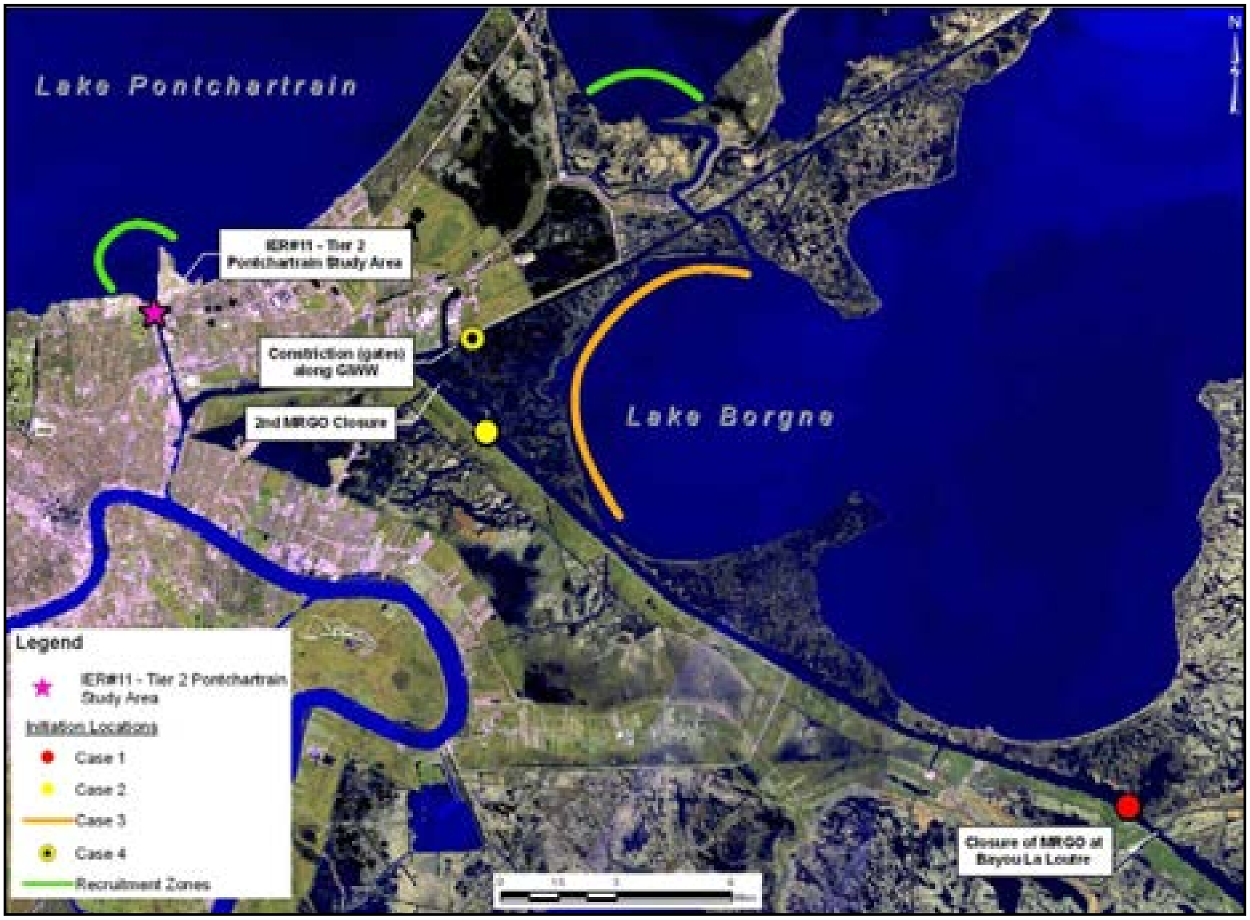


Figure 31. Larval Modeling Initiation Locations (Case 1-4) and Recruitment Zones

Due to the complex nature of tidal flow through the study area the model required designated consistent directions for incoming (flood) and outgoing (ebb) tides for a given scenario. To evaluate all the possible changes to larval migration, flood tide was set as east or west and each scenario was run with flood tide going east and flood tide going west. The initiation point of the larval organism-like particles (GIWW or Lake Borgne) and the direction of the incoming tide both have an impact on the predicted percentage of recruitment into Lake Pontchartrain with the five scenarios run. The modeled scenarios discussed in this section include:

- Base – All open (similar to historical conditions for the area);
- plan 1 – Closure of the MRGO at Bayou La Loutre;
- plan 2 – Closure of the MRGO at Bayou La Loutre plus the Borgne Barrier;
- plan 3 – plan 2 plus a Seabrook gate with a single 95 ft by 16 ft opening; and
- plan 3 final - plan 2 plus the proposed action.

PTM results indicate that the proposed action, in conjunction with the Borgne Barrier and the MRGO closure at Bayou La Loutre, may cause a 6 percent to 10 percent decrease in the dispersion of larval organisms into Lake Pontchartrain. However, there is no predicted impact on the recruitment of larval organisms when particles are initiated in Lake Borgne (change of < 1 percent). When particles are initiated in the GIWW and incoming tide in the GIWW is west, recruitment declines 7.81 percent in September (from 49.86 percent to 42.05 percent) and 6 percent in March (from 57.58 percent to 51.58 percent; USACE 2009c). The majority of the particles recruit into Lake Pontchartrain via the IHNC with most of the impact occurring to tidal lateral behavior types (e.g. brown shrimp, white shrimp, Gulf menhaden, Bay anchovy, and red drum). When particles are initiated in the GIWW and incoming tide in the GIWW is east, recruitment declines 9.77 percent in September (from 33.72 percent to 23.95 percent) and 7.56 percent in March (from 32.79 percent to 25.23 percent) (USACE 2009c; figures 32 and 33). The majority of the particles recruit into Lake Pontchartrain via Chef Menteur Pass with most of the impact occurring to bottom movers (e.g. Atlantic croaker) and tidal lateral behavior types (e.g. brown shrimp, white shrimp, Gulf menhaden, bay anchovy and red drum). The somewhat larger decline in recruitment with the east incoming tide could be due to the time and distance associated with navigating through Chef Menteur Pass. This predicted 6 percent to 10 percent decline in recruitment could have some direct impacts to the overall population of these organisms because fewer organisms would occur in the system. Indirect impacts could be less prey available for seatrout and other predator fish if recruitment of shrimp and Atlantic croaker decline.

Figure 32. Comparison of Larvae Recruitment Time Series for Case 4 during March 2008

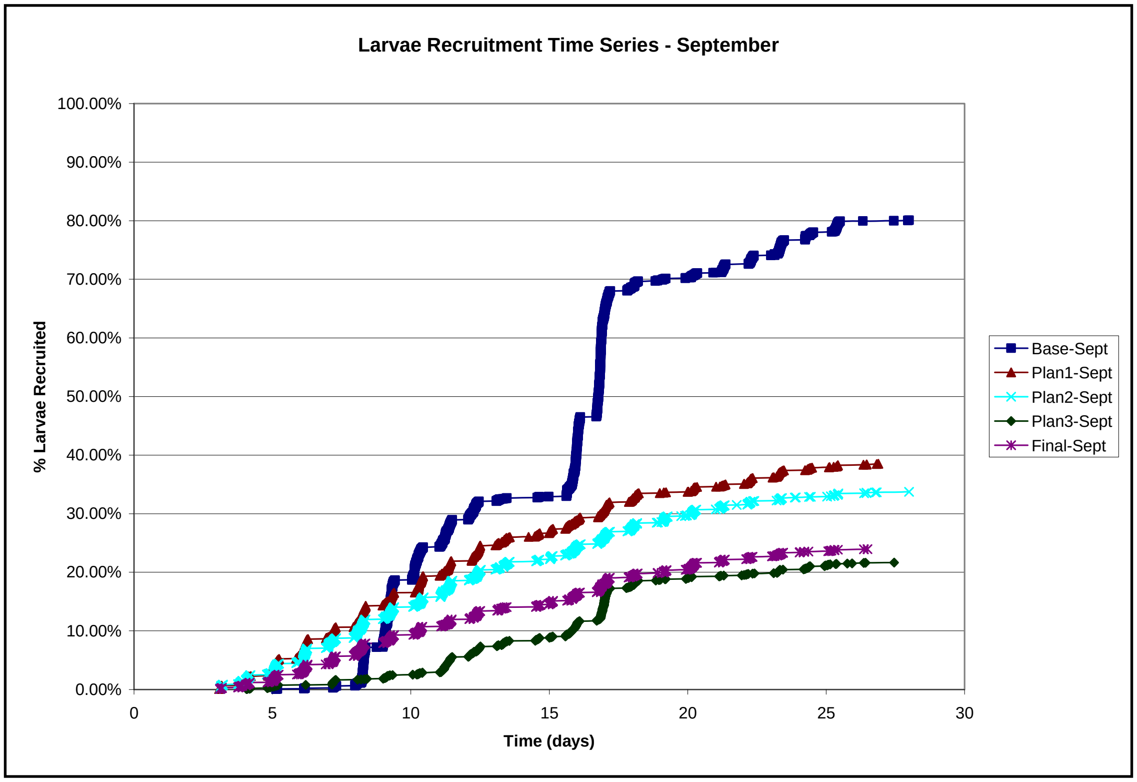


Figure 33. Comparison of Larvae Recruitment Time Series for Case 4 during September 2007

When model organisms were initiated in the GIWW east of the proposed GIWW gates, and in the MRGO south of the Bayou Bienvenue closure, there was an overall decrease in the percentage of larvae that arrived at the recruitment areas during a 4-week period. The majority of this decrease occurred due to the closure of the MRGO at Bayou La Loutre but an additional decrease in recruitment occurred in both September and March (times of fall and spring high tides) due to the proposed action. Of the behaviors implemented in the model, the tidal vertical and tidal lateral behaviors were more greatly impacted than the bottom and passive movers. One reason for this is that initially, more tidal vertical and lateral organisms successfully recruited within the base scenario. When model organisms were initiated in Lake Borgne (case 3, figure 31), the proposed action did not have any additive impacts to recruitment compared to existing conditions (comparison of plan 2 and plan 3 final). It is important to note that even though particles are unable to the recruit to the “recruitment zones” designated in the model, they are still in the system and could reach the recruitment zones at a time later than the four week analysis; they have not died. Therefore, recruitment declines in Lake Pontchartrain through the three passes may indicate that organisms are recruiting to other areas in the project vicinity such as Lake Borgne. If this is true the decline in recruitment into the lake would be partially offset by an equal sized increase in Lake Borgne. Conversely, bottle necks that occur in the GIWW between the junction of the GIWW with the IHNC and the GIWW sector gate in the plan 3 final (Case 4) scenario may be one indication that organisms trying to recruit to nursery areas may not be able to make it due to “clogging” at the various constrictions in the project vicinity.

Currently there are several limitations to these applied behaviors. Even though the ultimate goal is to model the behavior of the larvae, larval behavior is not completely understood. PTM is applied with the understanding that the program is modeling particles that have the aforementioned characteristics and not actual larvae which can die, consume, and have other life traits which may or may not affect their transport. Modeled particles have simplistic character traits which are suspected to affect transport and recruitment time. Additionally, model prediction values are variable depending on where the particles are initiated, and the overall percent of recruitment (even under the base scenario) is most likely underestimated.

Based on the results of PTM discussed previously, slowed velocities along the GIWW into the IHNC and changes in directional flow would increase migratory time to enter the lake through the IHNC and reduce recruitment of larval life stages of fisheries species. Blockage of access during the construction phase of the project would potentially trap and separate all life stages of prey (bay anchovy, Gulf menhaden, and *Rangia* clams) and predatory species (spotted seatrout, and red drum) from the less saline waters necessary for life cycle requirements and from adequate habitat for protection and foraging, thus resulting in possible starvation or increased predation pressure. Flow in the waterways due to the temporary blind end of the IHNC would still be affected by tide reversal which would generally influence bottom waters to move into and surface waters to move out of the INHC through the GIWW (Dortch and Martin 2008). This is expected to disrupt larval migration and any advantage that many of these organisms may have had in exiting the IHNC after arrival, depending on their migratory behavior in utilizing tidal flow. This could have localized effects on population year class strength.

Once the cofferdam is removed, obstruction created by the gate placement near the Seabrook Bridge could provide “protected” areas in the vicinity of the structure for some organisms, but could also create a trap or gyre for many organisms which do not have sufficient control to manage any resulting eddies. Food depletion and increased predation stress could result. Resulting impacts could range from changes in behavior to slower growth rates to starvation and death and increased predation mortality. Sloping the sill and directing the flow to the center of the channel combined with construction of a training wall is intended to decrease this impact as well as reduce bank erosion. These impacts would be minimized and possibly negated if a training wall was designed and installed to prevent eddies and gyres. This design feature will be utilized to the maximum extent possible.

During construction, fisheries in Lake Pontchartrain would experience significant, adverse effects, at least in the immediate project area and migratory patterns would be significantly altered for the rest of the Lake Pontchartrain Basin due to a lack of passage into and out of the lake at this location. This would affect populations of bait fish (bay anchovy, Gulf menhaden and Atlantic croaker) and other commercially important species, such as blue crabs, which migrate inshore at this location in May to June (Lyncker 2008) and shrimp species which historically utilize this passage. Therefore, commercial and recreational fishing activities would be significantly altered and possibly economically affected as well during the 6 months to 12 months that the cofferdam is in place.

Blue crab migration into Lake Pontchartrain specifically occurs from May to June through the IHNC. This influx of larvae would be disrupted by the construction phase of the project (approximately 36 months) and could adversely overlap more than one breeding cycle of this species, as well as the breeding cycles of other migratory species which may depend on this man-made conduit into Lake Pontchartrain. This would affect juvenile and adult fisheries populations, specifically those such as the red drum and black drum which favor blue crab stocks for prey.

Once the proposed action is complete, access to Lake Pontchartrain would be restored and effects from construction should be alleviated. Population-level impacts may be experienced if closure of the channel exceeds the anticipated duration of approximately 6 months to 12 months. Fisheries species would be able to pass into and out of Lake Pontchartrain through the floodgates. When the gates are in the closed position during a storm event, high flow event, or monthly OMRR&R, organisms would be cut off from passage to and from Lake Pontchartrain through the IHNC; however, this would be temporary (described further in section 1.6) and should have a minimal effect.

Cumulative Impacts to Aquatic Resources and Fisheries

Cumulative impacts from the proposed action would involve the combined effects from multiple IERs, Louisiana Coastal Area Study projects (e.g., Maurepas Diversions), and restoration projects throughout the project vicinity, including the Violet Freshwater Diversion project; the MRGO closure at La Loutre, and several other wetland restoration projects which would reduce potential adverse cumulative impacts by positively affecting aquatic resources and fisheries within the project area. While these restoration projects would help to offset habitat loss from the proposed action, restoration projects are largely aimed at creating wetlands and not deep water habitat that would be lost with the proposed action. The combined restoration projects, if funded and constructed, would enhance marsh edge and shallow water habitat, which have been shown to be more productive than habitats currently found in the project area; therefore, the overall net effect would be positive. The combined effects of other projects including the Borgne Barrier, the closure of the MRGO at Bayou La Loutre, and the Violet Diversion would result in varying degrees of altered hydrology, salinity, DO, and velocities throughout the project area. The net cumulative effects of the IER and CWPPRA projects will be complex and difficult to quantify. There would be both positive and negative effects to aquatic resources and fisheries throughout the project area and vicinity.

Potential cumulative impacts to aquatic resources and fisheries in the project vicinity could occur from construction-related activities (e.g., turbidity from dredging, noise) and from the various on-going, completed, and authorized projects (e.g., changes in salinity, velocity, and circulation/flow). Although the project area has already been altered by construction and maintenance of navigable waterways and the existing HSDRRS, the proposed action would contribute to changes both beneficial (improving salinity and DO concentrations in some areas) and negative (temporary and permanent decrease in dispersion of organisms related to adverse DO and tidal passage) to aquatic resources and fisheries including prey species, phytoplankton, zooplankton, adult bivalves, and crustaceans.

Improving water conditions would help organismal respiration allowing them to use more energy for finding prey, hiding from predators and finding suitable habitat. Improving water conditions may also provide more productive habitats for oysters, *Rangia* clams and SAV to increase their distribution in Lake Pontchartrain. Hydrology changes may negatively affect fisheries resources by decreasing recruitment of larvae (especially tidal lateral movers such as shrimp, bay anchovy, Gulf menhaden, and red drum).

The proposed action, in combination with other projects occurring in the New Orleans area, would have both positive and negative cumulative impacts to aquatic resources and fisheries. Changes in salinity are occurring from closure of the MRGO at Bayou La Loutre, the Borgne Barrier, and minor contributions in salinity change are expected from the proposed action. Modeling conducted by ERDC illustrated that the closure of the MRGO at Bayou La Loutre would have a significant effect on monthly average bottom salinity values not only in MRGO/GIWW/IHNC, but also in the Lake Borgne area and in some areas of Lake Pontchartrain. Most areas showed decreases of 3 ppt to 4 ppt, with the highest decrease (approximately 10 ppt) occurring in the MRGO region just north of the La Loutre closure, and minimal changes occurring at Seabrook (< 1 ppt change) (Martin et al. 2009b). The overall change to salinity could be both positive and negative to aquatic resources and fisheries.

It is expected that due to the MRGO closure at Bayou La Loutre, environmental conditions would be freshened. Although salinity would be freshened closer to historic conditions, species inhabiting the project vicinity are accustomed to salinity conditions prior to the implementation of these projects and these conditions would impact the existing habitats and resources as organisms adapt to the new environmental conditions. Reductions in salinity would impact the existing system in the short-term by creating localized community and habitat shifts, a disconnection between predators and prey species, changes in behavior, decreases in growth rates, and shifts in populations of some species. The direct impacts from closure (construction, velocity, and OMRR&R closures) may substantially affect the distribution and relative abundance of fisheries species. However, the project would be potentially beneficial in the long-term because valuable habitats for aquatic resources and fisheries would be more productive after the ecosystem is restored to near-historical conditions. This would be especially beneficial for benthic organisms because poor DO and salinity conditions would show the most improvement at the bottom of the water column. Benefits may include increases in the populations of oysters and *Rangia* clams. Shrimp and crabs able to make it into Lake Pontchartrain (by overcoming changes to tidal direction and tidal pulse) may also benefit from improved water quality conditions. Although, the proposed action alone would not affect the distribution, abundance or health of SAV in Lake Pontchartrain the additive impact of the projects discussed previously and the proposed action may have a positive impact on SAV by allowing it to restore closer to historic abundances.

Dispersion of all life stages of aquatic resources and fisheries would experience an additive effect from the MRGO closure at La Loutre, the Borgne Barrier, and the proposed action (figures 32 and 33). Organisms would be unable to use the MGRO and access through the Golden Triangle marsh would be restricted to a small opening at Bayou Bienvenue for transport or migration to Lake Pontchartrain; however, the IHNC via the GIWW (except for 6 months to 12 months during construction of the proposed action) and two passes in the eastern portion of the lake would be available. Even though larval transport and migration of other life stages may be reduced into Lake Pontchartrain through the IHNC, organisms could see a benefit from the overall change in flow direction from the implementation of the MRGO closure at La Loutre, the Borgne Barrier, and the proposed action. If organisms used alternate routes such as the Rigolets and Chef Menteur Pass they could enter and settle out in the east portion of Lake Pontchartrain, which contains more abundant high quality habitat, including natural shorelines bordered with complex habitat mosaics (SAV, *Rangia* clams, and oyster shells). Recruiting into a higher quality habitat could result in higher growth rates, less predation, and a greater chance of individuals successfully growing to maturity and spawning. However, if habitats have already met carrying capacity, then the required transitory migration of additional organisms into this area could create pressure on resources due to competition and overuse. This could be disadvantageous to all species that utilize this ecosystem.

For 6 months to 12 months during construction of the proposed action a cofferdam would block flow between the IHNC and Lake Pontchartrain. Additionally, the timing of the construction sequence of Seabrook and various features of the Borgne Barrier including the GIWW sector gate and Bayou Bienvenue gate may overlap for up to 11 months. The GIWW would still allow flow and navigation through the gate during this phase of construction, but the channel opening would be reduced from 300 ft to 150 ft. A cofferdam would be placed at Bayou Bienvenue constricting the flow to four 48-inch culverts. The cofferdam at Seabrook, along with the constriction on the GIWW and cofferdam at Bayou Bienvenue (closed except culverts to allow some flow) would severely restrict access of aquatic resources and fisheries species to quality habitat. Migration and recruitment to available habitats in the vicinity of the IHNC by fish and other aquatic species would be blocked during construction. This restriction could cause an increase in predation of some lower trophic level species, change the prey items that are available to predators, and cause predators to travel longer distances during construction and would extend an already lengthy trip, thereby decreasing growth rates, overall health, and possibly the ability of some individual aquatic resources and fisheries to reproduce.

These temporary constrictions could cause fish kills due to low DO, decreased flow, and increased temperatures and turbidity. Fish kills in multiple areas within the project vicinity would impact a larger number of individuals and could cause slower growth rates in individuals subjected to this environment, and would decrease survival of some species causing changes in overall community structure near the closures. Greater impacts are expected from the MRGO closure due to the higher salinities and deeper water depth in the area as compared to the proposed action.

One possible positive benefit of the closures along the MRGO, the Borgne Barrier, and the proposed action would be that the Golden Triangle marsh and associated canals would become less saline. This overall freshening of water conditions is predicted to increase habitat value in the project vicinity which could assist in increasing the productivity of some aquatic and fisheries resources. However, this potential increase in productivity could be minimized or changed due to interactions between the freshening, the subsidence of wetlands, and relative sea level rise that is expected to occur. The impact to aquatic resources and fisheries resource due to interactions between subsidence, sea level rise, and the current and future projects proposed in the foreseeable future is currently a data gap and is discussed in the section 1.6 (Data gaps and Uncertainty).

Additionally, multiple gate structures and barriers across the marsh will alter tidal flow in the system thus increasing travel times for tidally dependent organisms. This would have significant negative impacts to recruitment of some aquatic resources and fisheries into Lake Pontchartrain. USACE (2009c) predicted that the cumulative impact would be a 6 percent to 10 percent decline in recruitment of larvae during March and a 3 percent to 7 percent decline during September for all behavior types when particles are released in Lake Borgne. Tidal lateral movers (white shrimp and brown shrimp) experienced the largest decline in recruitment as compared to tidal vertical (blue crabs), and passive movers. This decline was experienced equally through both Chef Menteur Pass and the IHNC. If this reduction in recruitment occurs, Lake Pontchartrain could experience an overall decrease in populations of several species that play key roles in its community structure. It is expected that not only larval organisms, but all life stages of species that rely on the various migration/transportation routes (the MRGO, GIWW, and interdispersed wetlands in the Golden Triangle) would be impacted by the collective implementation and operation of the Borgne barrier, the MRGO closure at Bayou La Loutre, and the Seabrook gate. The Seabrook gate alone has the least amount of anticipated impacts among these projects.

Alternative #2 - Bridgeside Alignment: Sector Gate located 398 ft south of Seabrook Bridge and approximately 1,300 ft of T-walls built on Existing Levees

Direct Impacts to Aquatic Resources and Fisheries

Overall, direct impacts to aquatic resources and fisheries would be similar to those discussed under the proposed action; alternative #2 would impact the same total area of open water as the proposed action, approximately 9 acres. The scour hole would also require partial filling under this alternative which would result in similar but slightly fewer impacts than the proposed action since the alignment for alternative #2 would not directly cross the hole. The filling of the scour hole for alternative #2 would not have the same level of beneficial impacts of improved DO and salinity conditions as was described under the proposed action.

The alternative #2 alignment may trap water between its structures and the railroad bridge. The obstruction created by the gate placement near the Seabrook Bridge could provide “protected” areas in the vicinity of the structure for some organisms, but could also create a trap or gyre for many organisms which do not have sufficient control to manage any resulting eddies. Sloping the sill and directing the flow to the center of the channel is intended to decrease this impact as well as reduce bank erosion. Depletion of food sources and increased predation stress could result. Resulting impacts could range from changes in behavior to slower growth rates to starvation and death and increased predation mortality. These impacts would be minimized and possibly negated if a training wall was designed and installed to prevent eddies and gyres. This design feature would be utilized to the maximum extent possible.

Temporary impacts to aquatic resources and fisheries due to construction activities and from placement of the cofferdam across the channel would be similar to the proposed action. Noise occurring from construction activities would occur for a similar period of time, therefore similar impacts from noise would occur from alternative #2.

Indirect Impacts to Aquatic Resources and Fisheries

Indirect impacts to aquatic resources and fisheries in the study area would be similar to those experienced with implementation of the proposed action. Partial filling of the scour hole would result in fewer construction impacts, would still leave some deep water habitat in the IHNC, but would not have the same positive impacts of improved DO and salinity conditions.

Cumulative Impacts to Aquatic Resources and Fisheries

Cumulative impacts to aquatic resources and fisheries under alternative #2 would be similar to those described under the proposed action.

Alternative #3 - Turning Basin Alignment: Sector Gate located 1,500 ft south of Seabrook Bridge and approximately 1,500 ft of T-walls

Direct Impacts to Aquatic Resources and Fisheries

Some direct impacts to aquatic resources and fisheries would be similar to those discussed under the proposed action; however, alternative #3 would impact approximately 12 acres of open water (10 acres of permanent easements and 2 acres of temporary easement) as compared with approximately 9 acres for the proposed action. Unlike the proposed action, no scour holes are present near the alternative #3; therefore filling a scour hole would not be included in the construction.

During construction a temporary, braced cofferdam would be installed in the channel around the approximate perimeter of the sector gate and vertical lift gates for a period of approximately 6 months to 12 months. Due to the location of alternative #3, this cofferdam would not block all flow between Lake Pontchartrain and the IHNC because water would still be able to flow around the cofferdam through the Turning Basin (figure 12). Temporary impacts to aquatic resources and fisheries (benthic invertebrates, zooplankton, phytoplankton, and larvae) from construction of the cofferdam in a wider section of the channel (as compared to the proposed action) may result in fewer temporary impacts because some volume of water would be allowed to flow into Lake Pontchartrain between the shoreline and the cofferdam.

The location of alternative #3 would not trap water between the alignment and the railroad bridge because alternative #3 is 1,500 ft south of the Seabrook Bridge, but gyres and eddies may be possible in the Turning Basin north and south of the floodwall and within the Barge Slip. Noise occurring from construction activities would occur for a period of time similar to that of the proposed action.

Although alternative #3 spans twice the amount of water as the proposed action, the expanded footprint would not result in a larger area of open water and bottom habitat disturbance than the proposed action since the proposed action would require a large amount of ROW to be required to fill in the existing south scour hole.

Indirect Impacts to Aquatic Resources and Fisheries

Indirect impacts to aquatic resources and fisheries would be similar to those described under the proposed action. However, increases in disturbance would result from the longer construction time to build the gate structure and would result in longer disturbance to the water clarity, salinity, and DO. Additionally, under alternative #3, the scour hole would not require filling, thereby preserving this deep water habitat for some species and decreasing mortality to species that use this area as a refuge. However, according to model results, DO conditions in the IHNC may remain low if this highly stratified deep habitat is not filled, possibly causing more stress of some species traversing the IHNC.

Cumulative Impacts to Aquatic Resources and Fisheries

Cumulative impacts to aquatic resources and fisheries under alternative #3 would be similar to those described under the proposed action with the exception of impacts associated with filling the scour hole and the cofferdam blocking flow.

Alternative #4 – South of Turning Basin Alignment: Sector Gate located 2,000 ft south of Seabrook Bridge and approximately 1,450 ft of T-walls

Direct Impacts to Aquatic Resources and Fisheries

Overall, direct impacts to aquatic resources and fisheries would be similar to those discussed under the proposed action; however, alternative #4 would permanently impact approximately 10 total acres of open water (approximately 7 acres for permanent ROW and 3 acres for temporary easements) as compared with approximately 9 acres for the proposed action. Unlike the proposed action and alternative #2, no scour holes are present near the alternative #4 alignment; therefore filling a scour hole and associated positive and negative impacts would not occur.

Indirect Impacts to Aquatic Resources and Fisheries

Indirect impacts to aquatic resources and fisheries would be similar to those described under the proposed action. However, under alternative #4, the scour hole would not require filling, thereby preserving this deep water habitat for some species and decreasing mortality to species that use this area as a refuge. According to model results, DO conditions in the IHNC may remain low if this highly stratified deep habitat is not filled, possibly causing more stress to some species traversing the IHNC.

Cumulative Impacts to Aquatic Resources and Fisheries

Cumulative impacts to aquatic resources and fisheries under alternative #4 would be similar to those described under the proposed action with the exception of impacts associated with filling the scour hole.

Alternative #5 – Lake Pontchartrain Alignment: Sector Gate located 502 ft north of the Seabrook Bridge and approximately 1,800 ft of T-walls

Direct Impacts to Aquatic Resources and Fisheries

Overall, direct impacts to aquatic resources and fisheries would be similar to those discussed under the other alternatives; however, alternative #5 would impact approximately 18 total acres of open water (approximately 10 acres of permanent easements and 8 acres of temporary easements) as compared with approximately 9 acres for the proposed action. Instead of filling the southern scour hole, the northern scour hole would be partially filled in Lake Pontchartrain. Temporary impacts to aquatic resources and fisheries due to construction activities and from placement of the cofferdam would be less as compared to alternatives #1 through #4 except for noise impacts and scour hole impacts. Noise occurring from construction activities would be less contained because construction would occur in the lake. Additionally, construction in the lake would most likely impact a larger number of *Rangia* clams (because they are more abundant in the lake), and large fishes (because the scour hole is deeper, larger, and more accessible from other habitats).

Indirect Impacts to Aquatic Resources and Fisheries

Under alternative #5, indirect impacts to aquatic resources and fisheries would be greater with regard to siltation, but less with regard to velocity, DO, and salinity than the proposed action. During construction, partial filling of the northern scour hole would result in fewer construction impacts from burial and/or suffocation of organisms and would still provide some deep water habitat in the IHNC because the southern scour hole would not be filled. Construction in the lake would occur in phases that would allow flow between the IHNC and Lake Pontchartrain to be maintained throughout construction. However, phased construction would also extend the construction duration. Maintaining flow through the IHNC would lessen the possibility of persistent anoxic conditions leading to fish kills, and would allow organisms to continue to be transported or migrate through the IHNC. Alleviating these impacts would have less negative effect on the behavior, growth rate, feeding, recruitment, and growth to maturity compared to the other alternatives. The increase in overall construction duration could impact aquatic resources and fisheries such as *Rangia* clams located near the project area, but once construction was complete populations would be able to recover. SAV would not be expected to be negatively impacted by the location of this project during construction. Turbidity would be controlled to the maximum extent possible and the nearest SAV bed is 4 miles northeast of the project. The duration of construction and associated noise may cause some behavioral changes to aquatic resources and fisheries and their prey occupying the project area for longer durations as compared to the other alternatives, but the types of impacts would be similar to the proposed action.

After alternative #5 is complete, DO, and salinity conditions would not improve as much with the proposed action because only partial filling of the northern scour hole would occur.

Cumulative Impacts to Aquatic Resources and Fisheries

Cumulative impacts to aquatic resources and fisheries under alternative #5 would be similar to those described under the proposed action with some slight differences due to placement of the alignment in the lake, partial filling of the northern scour hole, and phased construction that would not require blocking flow between the lake and the IHNC for approximately 6 months to 12 months. Overall, similar impacts would occur because the majority of changes such as salinity reductions, reduced tidal pulse, and increases in DO are due to the implementation of the Borgne Barrier, the Violet Diversion, and the closure of MRGO at Bayou La Loutre.

Slight differences to cumulative impacts would include an increase in direct impacts to habitat (open water and substrate) from the physical placement of alternative #5 in the lake, which would result in a larger footprint as compared to the proposed action. This slight increase in the footprint would partially deplete the deep water habitat where large red drum and spotted seatrout are known to occur. Partially depleting this habitat could create increased competition for space, small decreases in growth rates, and increased predation by fishing of mature fish capable of spawning. The number of fish and crustaceans impacted by the partial filling of the scour hole would not be expected to cause changes in population for these species in Lake Pontchartrain.

Phased construction would reduce the cumulative impacts to aquatic resources and fisheries species by reducing the possibility of fish kills that would occur with the proposed action (from the IHNC cofferdam). Fish kills would not be expected with alternative #5 because flow between the lake and the IHNC would remain open during construction. This would reduce the additive impact on the overall number of organisms killed by anoxic conditions even though construction would occur for a longer period of time. A reduction in the number of fish kills in the project vicinity would result in an increase in successful recruitment of larvae and juveniles into the lake thus more organisms would have a chance to grow to maturity.

3.2.5 Essential Fish Habitat

Existing Conditions

The Magnuson-Stevens Fishery Conservation and Management Act (MSA) (50 CFR 600) defines EFH as "those waters and substrate necessary to fish for spawning, breeding, feeding or growth to maturity" (16 United States Code [USC] 1802(10); 50 CFR 600.10). The 1996 amendments to the MSA set forth a mandate for the NMFS of the NOAA, regional Fishery Management Council (FMC), and other Federal agencies to identify and protect EFH of economically important marine and estuarine fisheries. A provision of the MSA requires that FMCs identify and protect EFH for every species managed by a Fishery Management Plan ([FMP] 16 USC 1853). Detailed information on federally managed species and their EFH is provided in the 2005 generic amendment of the Fishery Management Plans for the Gulf of Mexico prepared by the Gulf of Mexico Fishery Management Council (GMFMC). The generic amendment was prepared as required by the MSA.

The IHNC, Lake Pontchartrain, and associated wetlands, canals, and bayous have been designated as EFH in the project vicinity for certain life stages of managed species. Subcategories of EFH identified in the project vicinity include non-vegetated, silty, fine sand, shell, and soft mud bottom, estuarine water column, with limited amounts of SAV and oysters, in the IHNC and in Lake Pontchartrain. Species managed by the MSA use this habitat for feeding, protection from predators, spawning, growth to maturity, and for migration to and from a variety of saline/brackish environments. They also use the IHNC, Rigolets, Chef Menteur Pass, and Bayou Bienvenue as conduits to travel to and from spawning grounds in the Gulf of Mexico and nursery areas in Lake Pontchartrain.

EFH species (eggs, larvae, juveniles, and adults) utilize the IHNC, Chef Menteur Pass, and The Rigolets as conduits to recruit to nursery areas. Larval life stages of EFH species use a tidal lateral behavior to move toward the center of flow during flood tides to migrate into Lake Pontchartrain through these three passes. Swenson and Chaung (1983) conducted studies on water volume exchange in estuarine systems and found that The Rigolets is primarily flood-dominated, whereas Chef Menteur Pass and the IHNC are primarily ebb-dominated. These findings are supported by the Hydrodynamic Validation modeling which found that under existing conditions velocities of ebb tides in the IHNC range from approximately 3 fps to 6 fps, versus flood tides which ranged from about 0 fps to 1 fps (validation modeling data used only one 24-hour period in October 2008 and no data was collected during peak flow conditions) (USACE 2009c). As a result of this information, it is reasonable to assume that larval transport into Lake Pontchartrain occurs mainly through The Rigolets, and transport out of the lake occurs through Chef Menteur Pass and the IHNC.

Additional habitat features that occur in the project area which may provide EFH for some species are two scour holes (figure 7), which are presently located approximately 300 ft to the north and 300 ft to the south of the Seabrook Bridge in Lake Pontchartrain and the IHNC, respectively. These deep depressions were likely the result of extreme storm event tidal flow into and out of Lake Pontchartrain. Also included topographically in this area is a dredge hole approximately 2,000 ft north of the bridge that covers an area of approximately 3 million sq ft. This dredge hole is approximately 30 ft to 60 ft deep and lies between the bulkhead of the New Orleans Lakefront Airport (east) and the seawall of the bank of Lake Pontchartrain on the west. The scour and dredge holes attract many recreationally-popular fish species and are particularly well known for spotted seatrout. The Seabrook area is known for catches of croaker, sand seatrout, red drum, black drum, mullet, shad, blue crab, and toadfish. Oysters have also been hooked from the fishing pier under the bridge.

SAV, which is often found within EFH areas, occur in the vicinity of the Tier 2 Pontchartrain project. Two SAV beds occur along the southern shore of the New Orleans East Area floodwall (IER #6) in Lake Pontchartrain (approximately 4 miles away from the project area) and on the eastern side of South Point heading toward Irish Bayou and Lake St. Catherine (approximately 15 miles away from the project area). Additionally, anecdotal information indicates that an eastern oyster population may exist at the mouth of the IHNC, which also attracts red drum and other fish species. This oyster population is also evident on man-made structures throughout Lake Pontchartrain (LaDWF 2009a). A more detailed discussion of SAV is provided in section 3.2.4, Aquatic Resources and Fisheries.

A population of the *Rangia* clam covers the bottom of Lake Pontchartrain and is an integral part of the local ecosystem. This clam species is found naturally burrowed into the mud over the entire lake bottom. It provides food for a variety of species such as red drum, black drum, and blue crab. Its most important function however, is its ability to continuously siphon water, which aids in maintaining good water quality in the lake. At their highest densities, the population would have the capacity to filter all the water in Lake Pontchartrain in approximately 3 days. Dredging of this clam in Lake Pontchartrain for its shell which was used in road construction and cement production occurred until its ban in 1990. Dredging operations conducted prior to 1990 suspended large amounts of silt from the mud bottom into the waters of Lake Pontchartrain and according to Michael Porrier with UNO (Porrier 2009), the population of *Rangia* clams in Lake Pontchartrain has been slow to recover.

Currently, *Rangia* clams exist in the entire lake except for a triangular area that spans from approximately the Orleans/Jefferson Parish line to the SAV beds at South Point near Irish Bayou and into the lake approximately 12 miles. *Rangia* clams are considered EFH because they provide 3-dimensional structure on the soft mud bottom which enhances the habitat for fishes. They are also eaten by the red drum and numerous prey species (such as black drum and blue crabs) which makes them an important link in the food web of Lake Pontchartrain. *Rangia* clams live in a wide range of salinity conditions but prefer low salinity habitats less than 6 ppt (USGS 2002b).

EFH in the project area has been designated for certain life stages of five managed species that commonly occur in the project area (table 11). Detailed information on federally managed EFH as it relates to EFH species in the project area is provided below. A more detailed description of