APPENDIX B:
U.S. Fish and Wildlife Service Coordination Letter and Report

Volume III
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United States Department of the Interior

FISH AND WILDLIFE SERVICE
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January 21, 2009

Colonel Alvin B. Lee
District Engineer
New Orleans District
U.S. Army Corps of Engineers
Post Office Box 60267
New Orleans, Louisiana 70160-0267

Dear Colonel Lee:

The Fish and Wildlife Service (Service) has received the Corps of Engineers' (Corps) Notice of Intent (NOI) to prepare a Supplemental Environmental Impact Statement (SEIS) for the Louisiana Coastal Area, Louisiana, Convey Atchafalaya River Water to Northern Terrebonne Marshes restoration project (LCA Convey). The NOI was published in the Federal Register (Volume 73, No. 246, pg. 78341) on December 22, 2008 (Department of Interior No. ER 09/26). Our comments that follow are intended to serve as constructive, upfront input on important project-related considerations, and recommendations to assist in developing and evaluating project alternatives.

As described in the NOI, the LCA Convey project would identify and evaluate measures to increase the supply and distribution of Atchafalaya River fresh water in portions of the Terrebonne Basin. Among other things, the SEIS would evaluate and disclose the effects of the project, including potential direct, indirect, and cumulative impacts on fish and wildlife resources for which the Service has regulatory responsibility, including federally listed threatened and endangered species. The Service offers the following comments in accordance with the National Environmental Policy Act (NEPA) of 1969 (83 Stat. 852, as amended; 42 U.S.C. 4321 et seq.), the Fish and Wildlife Coordination Act (48 Stat. 401, as amended; 16 U.S.C. 661 et seq.), the Migratory Bird Treaty Act (MBTA) (40 Stat. 755, as amended; 16 U.S.C. 703 et seq.), the Endangered Species Act (ESA) of 1973 (87 Stat. 884, as amended; 16 U.S.C. 1531 et seq.), and the Bald and Golden Eagle Protection Act (BGEPA)(54 Stat. 250, as amended, 16 U.S.C. 668a-d).

The proposed project area encompasses much of Terrebonne Basin and potentially, portions of the Barataria Basin. The project area is dominated by coastal wetlands including forested wetlands (bottomland hardwoods and swamps), coastal marshes (fresh, intermediate, brackish, and saline) and associated shallow open water. These habitat types provide important escape, feeding, breeding/spawning, brood rearing/nursery, and wintering areas for a wide variety of aquatic, estuarine and wetland-dependent fish and wildlife (e.g., migratory waterfowl, wading birds, shorebirds, seabirds, other waterbirds, neotropical migratory songbirds, threatened and endangered species, and interjurisdictional fisheries) for which the Service has Federal-trust conservation responsibilities.

Critical Natural and Human Environmental Problems

Due to a variety of causative factors, Louisiana loses approximately 30 to 40 square miles of its coastal wetlands each year and the majority of those losses occur in the Deltaic Plain wetlands of the Barataria and Terrebonne Basins (Barras, Bernier, and Morton 2008). This situation is largely (but not solely) the result of human interruptions of the natural deltaic processes which built and sustained the Louisiana coastal wetland ecosystem. One of the foremost of those factors was the construction of levees along the Mississippi River which have disconnected the river from the adjacent coastal ecosystem, eliminating wetland building processes, and processes which helped to sustain existing wetlands.

Given the high rates of wetland loss within the Terrebonne Basin, the Service's over-arching goal for the Convey project is to achieve a self-sustaining coastal wetland ecosystem to the greatest extent possible. Given the severity and magnitude of Terrebonne's wetland loss, only large and aggressive project(s) will be able to effectively address those losses. Given the high subsidence rates throughout much of the Terrebonne Basin, restoration alternatives that maximize introduction of suspended sediments will be most likely to succeed. For this reason, the Service recommends that a Mississippi River diversion alternative be evaluated for comparison against the effectiveness of Atchafalaya River introduction alternatives. Given that Atchafalaya River freshwater would have to flow for approximately 50 miles via the Gulf Intracoastal Waterway (GIWW) to reach the rapidly deteriorating east Terrebonne Basin marshes, Atchafalaya River freshwater introduction alternatives should also consider inclusion of project features to increase the efficiency of freshwater conveyance through the GIWW, as well as measures to increase the retention time of introduced freshwater within receiving area marshes where canals and other hydrologic alterations would reduce retention of introduced flows.

Since GIWW freshwater flows were found to increase during the 1980s and 1990s (USGS 2003), the Corps and other natural resource agencies should work with the USGS to determine whether those trends will continue under future without-project conditions. Those investigations, as well as other investigations regarding measures to increase freshwater supply from the Atchafalaya River, should consider not only increases in freshwater volume but also increases in the duration of freshwater flows. Forecasted Morgan City stages produced under the Lower Atchafalaya Basin Re-Evaluation Study may be useful for determining future GIWW flow conditions.

To better illustrate the severity of Terrebonne's wetland loss crisis, its potential impacts to the economy of Terrebonne Parish, and to better illustrate the benefits of sustainable restoration measures, the Service recommends that the period of analysis be extended beyond 50 years if possible. To the extent possible, the Convey project should also consider possible interactions with other public works projects such as the Morganza to the Gulf Hurricane Protection Project, the Davis Pond Freshwater Diversion Project, and the Louisiana Coastal Area (LCA) Houma Navigation Canal Lock Multi-Purpose Operation project, and the LCA Small Bayou Lafourche

Re-Introduction project.

Significant Resources to be Addressed in the SEIS

Wetlands

Although the LCA Convey project is intended to protect wetlands from degradation and loss, construction of project features may result in direct wetland losses. The Service recommends that project features be designed and located to avoid un-necessary construction-related wetland impacts wherever possible. Where wetland impacts cannot be avoided, those impacts should be minimized to the greatest degree possible. The Service recommends that spoil material resulting from channel construction/enlargement should be used beneficially to create marshes and/or landscape features that would have a strategic ecologic and hydrologic value. The LCA Convey project should also quantify any possible freshwater deprivation impacts associated with the redistribution and/or alteration of existing freshwater distribution patterns.

Endangered Species

In addition to assessing project impacts and benefits to coastal habitats, the Corps also has a responsibility to determine potential project-related effects on threatened and endangered species. A biological assessment (BA) supporting that determination is required for major Federal construction activities if federally listed threatened or endangered species, or their critical habitat, may be present in the action area. If the Corps determines that project features, may affect listed species or their designated critical habitat, consultation with the Service is required pursuant to Section 7 of the ESA.

To assist you in complying with the ESA, species known to occur within the project area include the West Indian manatee (*Trichechus manatus*), the brown pelican (*Pelecanus occidentalis*), the piping plover (*Charadrius melodus*) and its' critical habitat, the pallid sturgeon (*Scaphirhynchus albus*), Gulf sturgeon (*Acipenser oxyrhynchus desotoi*), and 5 species of sea turtles. Habitat requirements of those species are described below to facilitate your evaluation of potential project-related impacts to those species. Your determination of project impacts to each of those species, their designated critical habitat, and the supporting rationale for that determination, should be provided to the Service for review and/or concurrence, either within the SEIS or as a separate BA. In either case, consultation under the ESA should be completed prior to issuance of the final SEIS. As a cooperating agency, the Service looks forward to assisting the Corps in meeting the ESA requirements for the LCA Convey project.

Federally listed as endangered, West Indian manatees occasionally enter Lakes Ponchatrain and Maurepas, and associated coastal waters and streams, during the summer months. Manatees have been reported in the Amite, Blind, Tchefuncte, and Tickfaw Rivers, and in canals within the adjacent coastal marshes of Louisiana. They have also been occasionally observed elsewhere along the Louisiana Gulf Coast. The manatee has declined in numbers due to collisions with boats and barges, entrapment in flood control structures, poaching, habitat loss, and pollution. Cold weather and outbreaks of red tide may also adversely affect these animals.

For any projects that would contain a dredging component, extensive boat use, pile driving, or similar types of activities within the aquatic environment, all contract personnel associated with the project should be informed of the potential presence of manatees and the need to avoid collisions with manatees, which are protected under the Marine Mammal Protection Act of 1972 and the Endangered Species Act of 1973. All construction personnel are responsible for observing water-related activities for the presence of manatee(s). Temporary signs should be posted prior to and during all construction/dredging activities to remind personnel to be observant for manatees during active construction/dredging operations or within vessel movement zones (i.e., work area), and at least one sign should be placed where it is visible to the vessel operator. Siltation barriers, if used, should be made of material in which manatees could not become entangled, and should be properly secured and monitored. If a manatee is sighted within 100 yards of the active work zone, special operating conditions should be implemented, including: no operation of moving equipment within 50 feet of a manatee; all vessels should operate at no wake/idle speeds within 100 yards of the work area; and siltation barriers, if used, should be re-secured and monitored. Once the manatee has left the 100-yard buffer zone around the work area on its own accord, special operating conditions are no longer necessary, but careful observations would be resumed. Any manatee sighting should be immediately reported to the Service's Lafayette, Louisiana Field Office (337/291-3100) and the Louisiana Department of Wildlife and Fisheries, Natural Heritage Program (225/765-2821).

Endangered brown pelicans are currently known to nest on Raccoon Point on Isles Dernieres, Queen Bess Island, Plover Island (Baptiste Collette), Wine Island, Rabbit Island in Calcasieu Lake, and islands in the Chandeleur chain. Pelicans change nesting sites as habitat changes occur. Thus, pelicans may also be found nesting on mud lumps at the mouth of South Pass (Mississippi River Delta) and on small islands in St. Bernard Parish. In winter, spring, and summer, nests are built in mangrove trees or other shrubby vegetation, although occasional ground nesting may also occur. Brown pelicans feed in shallow estuarine waters, using sand pits and offshore sand bars as rest and roost areas. Major threats to this species include chemical pollutants, colony site erosion, disease, and human disturbance.

Federally listed as a threatened species, the piping plover as well as its designated critical habitat, occur along the Louisiana coast. Piping plovers winter in Louisiana, and may be present for 8 to 10 months. They arrive from the breeding grounds as early as late July and remain until late March or April. Piping plovers feed extensively on intertidal beaches, mudflats, sandflats, algal flats, and wash-over passes with no or very sparse emergent vegetation; they also require unvegetated or sparsely vegetated areas for roosting. Roosting areas may have debris, detritus, or micro-topographic relief offering refuge to plovers from high winds and cold weather. In most areas, wintering piping plovers are dependent on a mosaic of sites distributed throughout the landscape, because the suitability of a particular site for foraging or roosting is dependant on local weather and tidal conditions. Plovers move among sites as environmental conditions change, and studies have indicated that they generally remain within a 2-mile area..

On July 10, 2001, the U.S. Fish and Wildlife Service designated critical habitat for wintering piping plovers (Federal Register Volume 66, No. 132). Their designated critical habitat identifies specific areas that are essential to the conservation of the species. The primary constituent elements for piping plover wintering habitat are those habitat components that support foraging, roosting, and sheltering and the physical features necessary for maintaining the natural processes that support those habitat components. Constituent elements are found in geologically dynamic coastal areas that contain intertidal beaches and flats (between annual low tide and annual high tide), and associated dune systems and flats above annual high tide. Important components (or primary constituent elements) of intertidal flats include sand and/or mud flats with no or very sparse emergent vegetation. Adjacent unvegetated or sparsely vegetated sand, mud, or algal flats above high tide are also important, especially for roosting plovers. Major threats to this species include the loss and degradation of habitat due to development, disturbance by humans and pets, and predation.

The pallid sturgeon is an endangered fish found in both the Mississippi and Atchafalaya Rivers (with known concentrations in the vicinity of the Old River Control Structure Complex); it is possibly found in the Red River as well. The pallid sturgeon is adapted to riverine conditions that can be described as large, free-flowing, turbid water with a diverse assemblage of physical habitats that are in a constant state of change. Detailed habitat requirements of this fish are not known, but it is believed to spawn in Louisiana. Habitat losses through river channelization and dam construction have affected this species throughout its range.

The Gulf sturgeon, federally listed as a threatened species, is an anadromous fish that occurs in many rivers, streams, and estuarine waters along the northern Gulf coast between the Mississippi River and the Suwanee River, Florida. In Louisiana, the Gulf sturgeon has been reported at Rigolets Pass, rivers and lakes of the Lake Basin, and adjacent estuarine areas. Spawning occurs in coastal rivers between late winter and early spring (i.e., March to May). Adults and sub-adults may be found in those rivers and streams until November, and in estuarine or marine waters during the remainder of the year. Sturgeons, less than two years old, appear to remain in riverine habitats and estuarine areas throughout the year, rather than migrate to marine waters. Habitat alterations such as those caused by water control structures that limit and prevent spawning, poor water quality, and over-fishing have negatively affected this species.

On March 19, 2003, the Service and the National Marine Fisheries Service (NMFS) published a final rule in the Federal Register (Volume 68, No. 53) designating critical habitat for the Gulf sturgeon in Louisiana, Mississippi, Alabama, and Florida. Portions of the Pearl and Bogue Chitto Rivers, Lake Ponchatrain east of the Lake Ponchatrain Causeway, all of Little Lake, The Rigolets, Lake St. Catherine, and Lake Borgne within Louisiana were included in that designation. The primary constituent elements essential for the conservation of Gulf sturgeon are those habitat components that support feeding, resting, sheltering, reproduction, migration, and physical features necessary for maintaining the natural processes that support those habitat components. The primary constituent elements for Gulf sturgeon critical habitat include:

- abundant prey items within riverine habitats for larval and juvenile life stages, and within estuarine and marine habitats for juvenile, sub-adult, and adult life stages;

- riverine spawning sites with substrates suitable for egg deposition and development, such as limestone outcrops and cut limestone banks, bedrock, large gravel or cobble beds, marl, soapstone, or hard clay;

- riverine aggregation areas, also referred to as resting, holding and staging areas, used by adult, sub-adult, and/or juveniles, generally, but not always, located in holes below normal riverbend depths, believed necessary for minimizing energy expenditures during freshwater residency and possibly for osmoregulatory functions;

- a flow regime (i.e., the magnitude, frequency, duration, seasonality, and rate-of-change of freshwater discharge over time) necessary for normal behavior, growth, and survival of all life stages in the riverine environment, including migration, breeding site selection, courtship, egg fertilization, resting, and staging; and necessary for maintaining spawning sites in suitable condition for egg attachment, egg sheltering, resting, and larvae staging;

- water quality, including temperature, salinity, pH, hardness, turbidity, oxygen content, and other chemical characteristics, necessary for normal behavior, growth, and viability of all life stages;

- sediment quality, including texture and other chemical characteristics, necessary for normal behavior, growth, and viability of all life stages; and

- safe and unobstructed migratory pathways necessary for passage within and between riverine, estuarine, and marine habitats (e.g., a river unobstructed by a permanent structure, or a dammed river that still allows for passage).

Additionally, as discussed in the Gulf Sturgeon critical habitat final rule (Federal Register Volume 68, No 53), the jurisdiction for Section 7 consultation is shared between the Service and NMFS. The Service is responsible for consultations on the Gulf sturgeon and its critical habitat in riverine units. In estuarine units, the NMFS will consult with the Corps (responsibilities are divided based upon the action agency). The NMFS is responsible for consultations in marine units. For Federal projects that extend into the jurisdication of both Services (such as the proposed project) the Service will be the lead consulting agency and will consult internally with NMFS.

Endangered and threatened sea turtles forage in the nearshore waters, bays and sounds of Louisiana. The NMFS is responsible for aquatic marine threatened or endangered species. Please contact Eric Hawk (727/570-5312) in St. Petersburg, Florida, for information concerning these species. However, the Service is responsible for endangered and threatened sea turtles when they are on land (i.e., nesting), which may occur on the Chandeleur Islands and/or other barrier islands.

The status of federally listed and proposed species is continually updated as new information becomes available. Therefore, if the potential effects of the proposed project on those species and their critical habitat have not been analyzed within one year, we recommend that you annually contact our Lafayette, Louisiana, Field Office for an updated list of species and/or critical habitat that may be affected. Likewise, if the scope or locations of proposed LCA Convey project features area changed, we recommend that you contact that office as soon as such changes are made.

The project-area forested wetlands may provide nesting habitat for the bald eagle (*Haliaeetus leucocephalus*), which was officially removed from the List of Endangered and Threatened Species on August 8, 2007. Bald eagles nest in Louisiana from October through mid-May. Eagles typically nest in mature trees (e.g., bald cypress, sycamore, willow, etc.) near fresh to intermediate marshes or open water in the southeastern Parishes. Areas with high numbers of nests include the Lake Verret Basin south to Houma, the marsh/ridge complex south of Houma to Bayou Vista, the north shore of Lake Pontchartrain, and the Lake Salvador area. Eagles also winter, and infrequently nest, in mature pine trees near large lakes in central and northern Louisiana. Major threats to this species include habitat alteration, human disturbance, and environmental contaminants (i.e., organochlorine pesticides and lead).

Breeding bald eagles occupy "territories" that they will typically defend against intrusion by other eagles, and that they likely return to each year. A territory may include one or more alternate nests that are built and maintained by the eagles, but which may not be used for nesting in a given year. Nest sites typically include at least one perch with a clear view of the water or area where the eagles usually forage. Shoreline trees or snags located near large waterbodies provide the visibility and accessibility needed to locate aquatic prey. Bald eagles are vulnerable to disturbance during courtship, nest building, egg laying, incubation, and brooding. Disturbance during this critical period may lead to nest abandonment, cracked and chilled eggs, and exposure of small young to the elements. Human activity near a nest late in the nesting cycle may also cause flightless birds to jump from the nest tree, thus reducing their chance of survival. Although the bald eagle has been removed from the List of Endangered and Threatened Species, it continues to be protected under the MBTA and the BGEPA. The Service developed the National Bald Eagle Management (NBEM) Guidelines to provide landowners, land managers, and others with information and recommendations to minimize potential project impacts to bald eagles, particularly where such impacts may constitute "disturbance," which is prohibited by the BGEPA. A copy of the NBEM Guidelines is available at: http://www.fws.gov/southeast/es/baldeagle/NationalBaldEagleManagementGuidelines.pdf. Those guidelines recommend: (1) maintaining a specified distance between the activity and the nest (buffer area); (2) maintaining natural areas (preferably forested) between the activity and nest trees (landscape buffers); and (3) avoiding certain activities during the breeding season. On-site personnel should be informed of the possible presence of nesting bald eagles within the project boundary, and should identify, avoid, and immediately report any such nests to this office. If a bald eagle nest is discovered within or adjacent to the proposed project area, then an evaluation must be performed to determine whether the project is likely to disturb nesting bald eagles. That evaluation may be conducted on-line at: http://www.fws.gov/southeast/es/baldeagle. Following completion of the evaluation, that website will provide a determination of whether additional consultation is necessary. A copy of that determination should be provided to this office. The Division of Migratory Birds for the Southeast Region of the Service (phone: 404/679-7051, e-mail: SEmigratorybirds@fws.gov) has the lead role in conducting such consultations. Should you need further assistance interpreting the guidelines or performing an on-line project evaluation, please contact this office.

The proposed project would be located in an area where colonial nesting waterbirds may be present. Colonies may be present that are not currently listed in the database maintained by the Louisiana Department of Wildlife and Fisheries. That database is updated primarily by monitoring the colony sites that were previously surveyed during the 1980s. Until a new, comprehensive coast-wide survey is conducted to determine the location of newly-established nesting colonies, we recommend that a qualified biologist inspect the proposed work site for the presence of undocumented nesting colonies during the nesting season. To minimize disturbance to colonial nesting birds, the following restrictions on activity should be observed:

1. For colonies containing nesting brown pelicans, all activity occurring within 2,000 feet of a rookery should be restricted to the non-nesting period (i.e., September 15 through March 31). Nesting periods vary considerably among Louisiana's brown pelican colonies, however, so it is possible that this activity window could be altered based upon the dynamics of the individual colony. The Louisiana Department of Wildlife and Fisheries' Fur and Refuge Division should be contacted to obtain the most current information about the nesting chronology of individual brown pelican colonies. Brown pelicans are known to nest on barrier islands and other coastal islands in St. Bernard, Plaquemines, Jefferson, Lafourche, and Terrebonne Parishes, and on Rabbit Island in lower Calcasieu Lake, in Cameron Parish.

2. For colonies containing nesting wading birds (i.e., herons, egrets, night-herons, ibis, and roseate spoonbills), anhingas, and/or cormorants, all activity occurring within 1,000 feet of a rookery should be restricted to the non-nesting period (i.e., September 1 through February 15, exact dates may vary within this window depending on species present).

3. For colonies containing nesting gulls, terns, and/or black skimmers, all activity occurring within 650 feet of a rookery should be restricted to the non-nesting period (i.e., September 16 through April 1, exact dates may vary within this window depending on species present).

In addition, we recommend that on-site contract personnel be informed of the need to identify colonial nesting birds and their nests, and should avoid affecting them during the breeding season.

Other significant resources that should be addressed in the forthcoming SEIS are the Federal lands consisting of Mandalay National Wildlife Refuge and the Jean Lafitte National and Historical Park and Preserve. State land resources to be addressed include the Louisiana Department of Wildlife and Fisheries operated Pointe au Chene Wildlife Management Area and the Lake Salvador Wildlife Management Area.

We look forward to working collaboratively with the Corps study team members as the LCA Convey study progresses. We appreciate the opportunity to provide initial scoping comments on the proposed Convey project. Should you have further questions regarding our comments, please contact Ronny Paille of this office, at 337/291-3117.

Sincerely yours,

for James F. Boggs
Supervisor
Louisiana Field Office

cc:

DOI, OEPC, Washington, D.C. (Attn.: Loretta Sutton)
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LDWF, Baton Rouge, LA
LDWF, Natural Heritage Program, Baton Rouge, LA
LDNR/CMD, Baton Rouge, LA

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United States Department of the Interior

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January 21, 2010

Colonel Alvin B. Lee
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Dear Colonel Lee

The U.S. Fish and Wildlife Service (Service) is collaborating with the U.S. Army Corps of Engineers (Corps) and the State of Louisiana's Office of Coastal Protection and Restoration (LOCPR) on the formulation and evaluation of six Louisiana Coastal Area (LCA) projects. LCA is a coastal ecosystem restoration authority that was authorized by the Water Resources Development Act of 2007 and includes both specific projects and general authorizations to aid in the restoration of Louisiana's coastal wetlands. Those wetlands, which support nationally important fish and wildlife resources, are being lost at an average rate of approximately 24 square miles per year due to a variety of causes. The purpose of this Planning-aid Report is to provide the Service's plan formulation-related comments and recommendations regarding four of the restoration projects and identify planning constraints that may influence the selection of project features and the ability of the Service to fulfill our reporting responsibilities under Section 2(b) of the Fish and Wildlife Coordination Act (FWCA, 48 Stat. 401, as amended; 16 U.S.C. 661 et seq.). The 4 projects that are being addressed in this report are:

Multi-purpose Operation of Houma Navigation Lock
Convey Atchafalaya River Water to Northern Terrebonne Marshes
Terrebonne Basin Barrier Shoreline Restoration
Small Diversion at Convent/Blind River

The Service will be providing project specific reports for the other 2 LCA projects in the planning phase. This Planning-Aid Report was prepared under the authority the FWCA; however it does not constitute the final report of the Secretary of the Interior as required by Section 2(b) of that Act. The Service has provided copies of this report to the National Marine Fisheries Service and the Louisiana Department of Wildlife and Fisheries (LDWF); if any comments are received on this report they will be forwarded under a separate cover. Comments in this report are also provided under the National Environmental Policy Act (NEPA) of 1969 (83 Stat. 852; 42 U.S.C. 4321 et seq.) as a cooperating agency for the Small Diversion at Convent/Blind River study.

The Service previously submitted draft FWCA Reports (i.e., September 26, 2003 [comprehensive plan], May 28, 2004 [draft near-term plan], and October 6, 2004 [final near term plan] during the development of the LCA near-term plan. Habitat values and fish and wildlife resources (but not habitat acreage) described in those previous reports remain relatively unchanged and are therefore incorporated herein by reference.

We recognize that the legislatively mandated study schedule (i.e., study completion within three years from authorization) was developed to respond to the significant and ongoing rapid loss of coastal wetlands. Considering the scope and complexity of the some of these LCA projects, that schedule, because of a one year delay in getting cost-sharing documents signed, should be acknowledged as a key planning constraint, and risks and uncertainties associated with meeting such an abbreviated study schedule (i.e., reduced to two years) should also be thoroughly considered in any planning and NEPA documents. We also recognize that relatively new policies requirements (i.e., model certification and analysis of sea-level rise) implemented by the Corps have also contributed to some delays in essential data analysis. Additionally, the Service recognizes that some of our comments provided below regarding the analyses and findings of the LCA projects may be of an interim nature as planning efforts proceed. General comments that apply to the overall-planning process are presented below and are followed by general project-type comments and then by project specific comments, recommendations, and data needs.

The expedited schedule of the impact (i.e., benefit) analyses has curtailed time available for hydrological modeling work, precluding the correction of known model limitations and errors and also required utilizing assumptions and data interpolations in the impacts analysis that would have normally been more refined. Currently, coastal fisheries impact assessments may be conducted without the use of models that would have otherwise provided an overall indication of the cumulative effect of multiple restoration (planned and operating) and flood protection projects on fishery resources within a coastal basin. The Corps has verbally indicated that use of those type models will be incorporated in future planning efforts. Future Service comments regarding cumulative impacts (that should be thoroughly examined in NEPA documents) may be contingent upon completion of such modeling efforts. During a more typical project planning study, when sufficient time to conduct detailed impact analyses is available, the Service would usually rely upon more robust data and assumptions than is currently available.

The shortened time frame of the planning process has also reduced the amount of time used to fully develop and refine alternatives and alternative features. While many good alternatives for each LCA project were developed, the reiterative process of alternative refinement and selection was reduced which could preclude the development of alternatives or alternative features which could increase restoration benefits. Therefore, while selection of a Tentatively Selected Plan (TSP) has occurred or is scheduled to soon occur, changes to the TSP may be warranted based on further planning efforts and review of existing assumptions and modeling (i.e., quality control).

All diversion projects should include monitoring that would not only measure the success of the project but, also facilitate the recognition of existing and future maintenance needs as sedimentation occurs within the project area. Failure to include such monitoring may result in decreased benefits as areas experience sedimentation, vegetative response, and debris collection which could isolate areas from the influence of the diversion. Implementation of an adaptive management/maintenance program throughout the project area and over the life of the project would also ensure such conditions would not prevail over the project life, significantly impacting the diversion's success. Varying the discharge of diversions during Mississippi River high water periods could increase their land building capabilities; however, the shortened study schedule has limited the examination of such adaptive management operations. The Service should be included in the development and implementation of both the monitoring and adaptive management/maintenance programs.

Convey Atchafalaya River Water to Northern Terrebonne Marshes and Multi-purpose Operation of Houma Navigation Lock

Both of the subject LCA projects involve water management within a very large and hydrologically complex area and because these projects have substantial interaction they have been combined into one project. Given those factors, intensive hydrologic modeling is needed to evaluate the effects of the combined projects. Time needed to obtain adequate computer capabilities delayed the initiation of necessary hydrologic modeling. Therefore, to meet the project schedule, the array of project alternatives will be limited such that additional model runs to optimize channel sizes will not be done. If initial modeling suggests that there are other potentially viable project alternatives, there will not be sufficient time to assess those. More detailed comments regarding these studies are presented below:

1. Because of the shortened planning period and reduced amount of time allowed for hydrologic modeling runs, there was no time to consider the many Grand Bayou channel size and configuration alternatives. The LCA study intended to select the channel alternative selected under the Coastal Wetlands Planning, Protection and Restoration Act (CWPPRA) Central and East Terrebonne Freshwater Delivery Project, which examined a number of channel size and configuration alternatives. In that CWPPRA effort, a 7,500 square foot (sq ft) east branch channel alternative (i.e., single channel) was selected as the preferred alternative. However, because the hydrologic model used in the CWPPRA effort failed to adequately simulate flows in the Cutoff Canal, those model results are flawed and inadequate to support a decision on a preferred alternative. Although intending to use that CWPPRA preferred alternative, the model mesh was set up for the 7,500 sq ft branched channel alternative (i.e., bifurcated channel).

2. The following structures were not included in the computer models, thus efforts to assess their impacts (especially when effects of the proposed Houma Navigation Channel Lock are considered) may be flawed.

   The 2 structures through the Morganza to the Gulf levee through the southbank of Falgout Canal.

   The Penchant Plan's Superior Canal water control structure is not in the future without project (FWOP) model projections.

3. The WD2 channel flows in Alternative 2 are predicted to exceed that of the predicted upstream source channel. The WD2 channel is also assumed to be functioning under FWOP conditions.

4. Time did not allow for the assessment of benefits for individual measures or groups of measures to improve the efficiency of measure combinations and the resulting alternatives. For example, in the Grand Bayou area, the proposed St. Louis Canal enlargement provides little additional freshwater input when combined with the proposed Grand Bayou enlargements. However, both features are combined in several alternatives, resulting in more costly alternatives.

5. Insufficient opportunity was provided to evaluate the effectiveness and benefits/value provided by individual outfall management features.

6. Because the diversion model allows only three loss rate changes, it is a less robust means of predicting future acreage trends than use of standard spreadsheet methods which can incorporate numerous loss rate changes over time. Because there was not sufficient time to upgrade this modeling tool, the more robust spreadsheet-predicted FWOP acreages are compared with the diversion model generated future with project (FWP) acreage. This may result in up to a 200-acre error by target year (TY) 100.

7. Because of the schedule, salinity outputs were not available to determine project and/or diversion influence areas from those model outputs. Instead, best professional judgment was used to determine the influence areas.

8. In some cases, salinity prediction models may not have been run long enough to fully illustrate project effects.

9. Polygons from which wetland loss rates were determined included fastlands.

10. Measured impacts did not remove spoil bank acreage – thus marsh impacts are overestimated.

14. Due to time constraints, diversion influence areas were assessed in the Wetland Value Assessments (WVA) as a single habitat type; separate WVAs on each habitat type are therefore needed.

15. To model project benefits, many assumptions have been made regarding the size and location of Morganza to the Gulf Project features. Those assumptions could later be found to be incorrect as that feasibility study work progresses.

<u>Terrebonne Basin Barrier Shoreline Restoration</u>

Project area acreages - Barrier island project boundaries encompass all emergent and subtidal habitat (i.e., 0.0 to -1.5 NAVD88) associated with the island, while deep ocean water habitat around the island is omitted. Subtidal habitat extends bayward to the -1.5 ft NAVD88 contour or a maximum distance of 1,000 feet from the island. In many instances, a barrier island project area changes throughout the evaluation period (i.e., 50 years) as the island erodes, migrates, and/or shrinks in size. As the island erodes, areas converting to deep ocean water (>-1.5 NAVD88) are removed from the project area and the boundary shrinks as the island shrinks. This information needs to be determined for all alternatives.

Barrier Island Wetland Value Assessment V1, V2, and V3 values - Recent changes to the Final Array of Alternatives resulted in the deletion of some and the addition of new alternatives to that array. The acreage of each of the habitat components (i.e., dune supratidal, and intertidal) should be provided as soon as possible for all new alternatives added to the revised Final Array (distributed to the Project Delivery Team on January 11, 2010).

Impacts to the threatened piping plover (*Charadrius melodus*) and/or its critical habitat via dredged material placement on the islands should be addressed in planning studies. Should the proposed project directly or indirectly affect the plover or its critical habitat, further consultation with this office will be necessary. If the effect would adversely affect piping plovers or would affect its critical habitat, formal consultation with the Service would be necessary. Formal consultation has specific timelines that the Service must adhere to and must be completed prior to completion of any NEPA document.

<u>Small Diversion at Convent/Blind River</u>

The TSP for Convent/Blind River Freshwater Diversion includes constructing a gated culvert system and transfer canal along the Romeville alignment to divert as much as 3,000 cubic feet per second of freshwater from the Mississippi River into the Maurepas swamps. In-swamp management measures (e.g. gapping spoil banks, installing additional culverts under U.S. Highway 61 and installing water control structures in existing canals) are proposed to facilitate and maximize freshwater throughput within the swamp. The LCPR has requested that a new alternative be formulated and evaluated in the final array of alternatives. That alternative would include all of the features of the TSP with the exception of water control structures within existing canals due to concern that water control structures will be difficult to operate and maintain.

To fully evaluate the benefits of the Convent/Blind River Freshwater Diversion TSP and compare alternatives, the following additional information and actions will be required:

1. Additional results of hydrologic modeling efforts that identify/quantify influence areas at a more detailed level indicating how water, sediment, and nutrients move through the system and within each hydrologic unit.

2. Water levels and swamp floor elevations need to be determined on a refined scale and incorporated into the hydrologic modeling.

3. Salinity predictions need to be re-evaluated and changes in future-with and future-without assumptions, if necessary, be undertaken.

4. Diversion operations need to be developed for each alternative and incorporated into the hydrologic modeling.

5. Accretion rates need to be determined and incorporated into the hydrologic modeling (e.g., flood durations and depths should decrease).

Furthermore, in conjunction with the development of an operational plan, plan formulation should also include the development of a long-term monitoring plan. That monitoring plan should include measures to monitor project success, facilitate adaptive management, and support operation and maintenance of project features to ensure that the project is fully successful and capitalize on the availability of freshwater.

Impacts to the endangered pallid sturgeon (*Scaphirhynchus albus*) via entrainment through the diversion structure should be addressed in planning studies. Should the proposed project directly or indirectly affect the pallid sturgeon or its habitat, further consultation with this office would be necessary. If the project would adversely affect (i.e., take) the pallid sturgeon, formal consultation with the Service would be necessary. Formal consultation has specific timelines that the Service must adhere to and must be completed prior to completion of any NEPA document.

For all the above projects, much of the recommendations, information and data needs identified above will be needed to complete our evaluation of alternatives and of the individual TSP effects on fish and wildlife resources, so that we can fulfill our reporting responsibilities under Section 2(b) of the FWCA. Therefore, extensive additional Service involvement during ongoing detailed planning, engineering, and design of specific project measures and associated maintenance, along with more-definitive project information that will be available during those planning phases, will be required so that we can fulfill our responsibilities under that Act.

The Service has actively participated throughout plan formulation and evaluation of the LCA projects. Each of those LCA projects would, to varying degrees, reduce coastal wetland loss. Hence, implementing any of the proposed projects would be preferable to the continued loss and degradation of coastal wetlands and Louisiana's nationally significant fish and wildlife resources. We remain committed to working closely with all agencies involved in LCA planning effort to further explore alternatives and alternative features and refine models and model assumptions in order to reduce the current degree of risk and uncertainty associated with their outputs and to ensure optimum fish and wildlife resource benefits are achieved. The Service recognizes the formidable challenge that the Corps has been tasked with (i.e., balancing sufficient planning with meeting abbreviated Congressionally mandated deadlines) and we look forward to continuing the ongoing LCA planning efforts to restore Louisiana's nationally significant coastal wetlands and resources.

Sincerely,

James F. Boggs
Supervisor
Louisiana Field Office

cc: EPA, Dallas, TX
CEMVN-PM-R
National Marine Fisheries Service, Baton Rouge, LA
LA Dept. of Wildlife and Fisheries, Baton Rouge, LA
LA Dept. of Natural Resources (CMD), Baton Rouge, LA
LOCPR, Baton Rouge, LA
Natural Resource Conservation Service, Alexandria, LA

REVISED DRAFT
FISH AND WILDLIFE COORDINATION ACT REPORT

on the

LOUISIANA COASTAL AREA – CONVEY ATCHAFALAYA RIVER WATER TO NORTHERN TERREBONNE MARSHES PROJECT

AND THE

MULTI-PUPOSE OPERATIONS OF THE HOUMA NAVIGATION CANAL LOCK PROJECT

Submitted To
New Orleans District
U.S. Army Corps of Engineers

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August 2010

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INTRODUCTION

The Feasibility Study Report and Supplemental Environmental Impact Statement (SEIS) for the Louisiana Coastal Area – Convey Atchafalaya River Water to Northern Terrebonne Marshes (ARTM) was prepared by the St. Louis District U.S. Army Corps of Engineers (USACE), on behalf of the New Orleans District USACE, under the authority of Title VII of the Water Resources Development Act (WRDA) of 2007. This SEIS tiers-off of an earlier Programmatic Environmental Impact Statement (PEIS) provided in the November 2004 Louisiana Coastal Area (LCA), Louisiana, Ecosystem Restoration Study, conducted by the New Orleans District USACE. That PEIS, and the subsequent Chief of Engineer's Report dated January 31, 2005, recommend implementation of the ARTM project to reduce high coastal wetland loss rates in the Terrebonne Basin of Louisiana.

The PEIS and Chief of Engineer's Report also recommended implementation of the Louisiana Coastal Area - Multi-Purpose Operations of the Houma Navigation Canal (HNC) Lock Project to further reduce coastal wetland losses in the Terrebonne Basin marshes. As one of the primary goals of this project is to improve distribution of Atchafalaya River freshwater in areas impacted by the HNC, its effects are very much related to that of the ARTM project. Given their interdependence, it was decided to include the feasibility study for the LCA Houma Navigation Canal Lock Multi-Purpose Operations Project with that of the LCA ARTM Project to ensure proper coordination between the two efforts.

The ARTM Project and the HNC Lock Multi-Purpose Operations Project were developed to implement the Coast 2050 Regional Strategy# 4 to "Enhance Atchafalaya River influence to Terrebonne Marshes, excluding upper Penchant marshes" (Louisiana Coastal Wetlands Conservation and Restoration Task Force and the Wetlands Conservation and Restoration Authority. 1998). The ARTM Project addresses that strategy by considering project features to repair Gulf Intracoastal Waterway (GIWW) banks and enlarge GIWW constrictions to improve water conveyance, as well as features to divert additional freshwater from the Atchafalaya River through the Avoca Island Levee into Bayou Chene/GIWW system. Other evaluated features include enlargement of Grand Bayou Canal and other waterways to improve freshwater inputs to wetlands isolated from or receiving only a limited volume of Atchafalaya River freshwater. Outfall management measures to increase retention times of introduced freshwater were also evaluated.

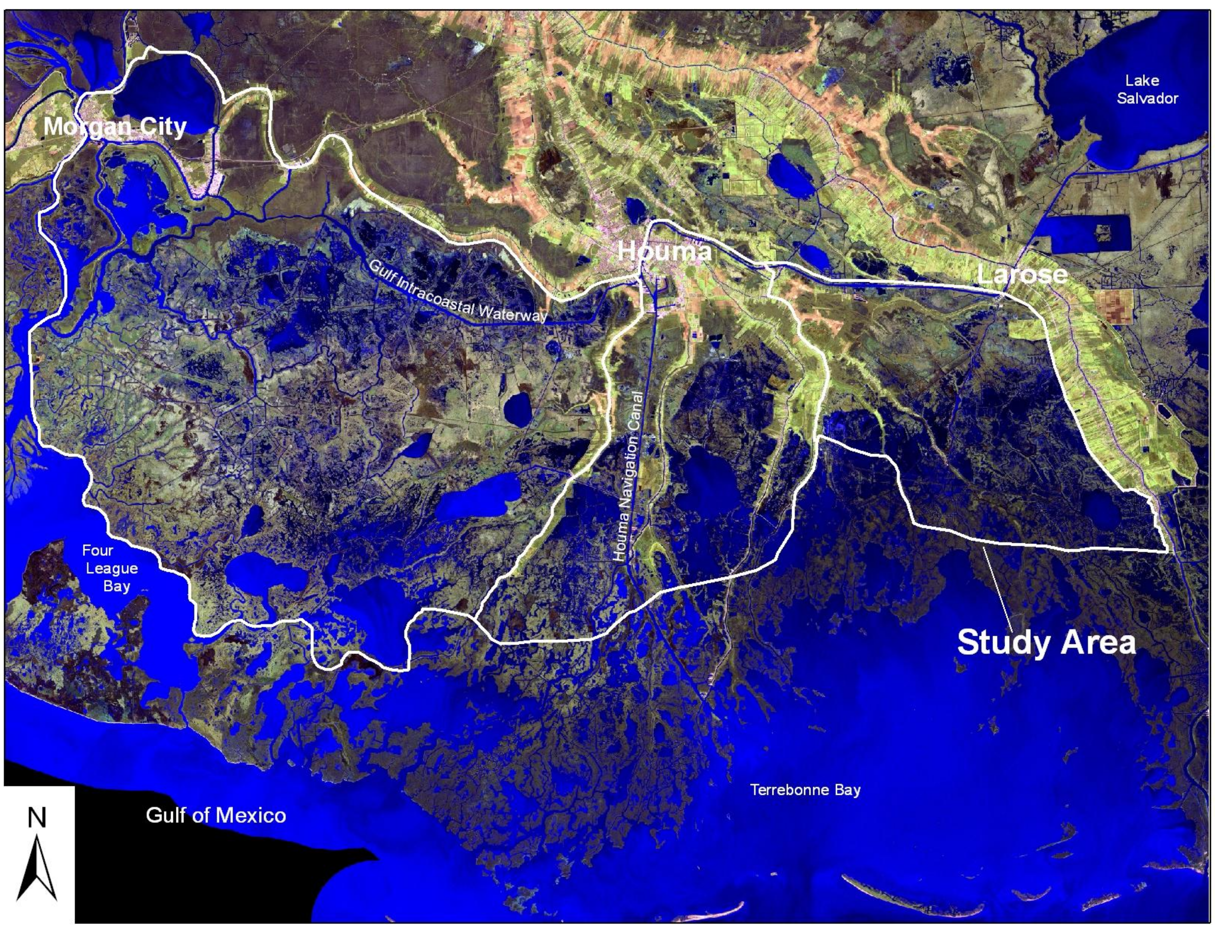
This draft report contains a description of existing fish and wildlife resources in the project area, discusses future with-project (FWP) and future without-project (FWOP) habitat conditions, identifies fish and wildlife-related impacts, and provides recommendations to address major errors and problems with the benefit assessment methods and results. Unfortunately, the complexity of these projects, and the short study schedule, has precluded correction of several major issues and the disclosure of final results. Consequently, we cannot complete our evaluation of project alternatives on fish and wildlife resources and, therefore, cannot entirely fulfill our reporting responsibilities under Section 2(b) of the Fish and Wildlife Coordination Act (48 Stat. 401, as amended; 16 U.S.C. 661 et seq.) for the Tentatively Selected Plan alternative. Therefore, additional Service involvement during subsequent detailed planning, engineering, design, and construction of specific project measures, will be required so that we can fulfill our responsibilities under that Act.

When finalized, this report will be submitted in fulfillment of the requirements of the Fish and Wildlife Coordination Act (FWCA; 48 Stat. 401, as amended; 16 U.S.C. 661 et seq.), and will constitute the report of the Secretary of the Interior as required by Section 2(b) of that Act. This revised draft FWCA Report incorporates comments provided by the Louisiana Department of Wildlife and Fisheries (LDWF) and the National Marine Fisheries Service (NMFS) on the Service's May 2010 draft FWCA Report. Copies of the LDWF and NMFS comment letters may be found in Appendix A of this report.

DESCRIPTION OF THE STUDY AREA

The study area extends from the Atchafalaya River eastward to Bayou Lafourche. It includes a large portion of the Terrebonne Basin wetlands (Figure 1), located in the Louisiana central coastal Deltaic Plain (within LCA Subprovince 3). Study area habitat types range from freshwater bald cypress swamps and natural levee forests, to saline marshes bordering Terrebonne and Timbalier Bays.

Figure 1. Map delineating the project study area.



EXISTING FISH AND WILDLIFE RESOURCES

Brief descriptions of the study-area's principal fish and wildlife resources are provided in this section. More detailed information is available in the Service's Final Fish and Wildlife Coordination Act Report on the Louisiana Coastal Area (LCA), Louisiana, Ecosystem Restoration Study, and is incorporated herein by reference.

Major Habitat Types

Forested Wetlands - Forested wetlands in the study area consist primarily of bottomland hardwood forests and cypress-tupelo swamps. Bottomland hardwood forests found in coastal portions of the project area occur primarily on the natural levees of distributary channels and older spoil banks. Dominant vegetation may include sugarberry, water oak, live oak, bitter pecan, black willow, American elm, Drummond red maple, Chinese tallow-tree, boxelder, green ash, baldcypress, and elderberry. Extensive cypress-tupelo swamps are located in the northwestern portion of the study area (i.e., the northwestern Penchant Basin) and along the flanks of larger distributary ridges as a transition zone between bottomland hardwoods and lower-elevation marsh or scrub-shrub habitats. Cypress-tupelo swamps exist where there is little or no salinity and (usually) minimal daily tidal action.

Scrub-Shrub - Scrub-shrub habitat is often found along the flanks of distributary ridges and spoil banks. Typically, it is bordered by marsh at lower elevations and by developed areas, cypress-tupelo swamp, or bottomland hardwoods at higher elevations. Typical scrub-shrub vegetation includes elderberry, wax myrtle, buttonbush, black willow, Drummond red maple, Chinese tallow-tree, and groundselbush.

Fresh Marsh - Fresh marshes occur at the upper ends of interdistributary basins and are often characterized by floating or semi-floating organic soils. Most fresh marshes exhibit minimal daily tidal action; however, fresh marshes in the Mississippi and Atchafalaya River deltas and adjacent to Atchafalaya Bay are the exceptions. Vegetation may include maidencane, bulltongue, cattail, California bulrush, pennywort, giant cutgrass, American cupscale, spikerushes, bacopa, and alligatorweed. Associated open-water habitats may often support extensive beds of floating-leaved and submerged aquatic vegetation including water hyacinth, Salvinia, duckweeds, American lotus, white water lily, water lettuce, coontail, Eurasian milfoil, hydrilla, pondweeds, naiads, fanwort, wild celery, water stargrass, elodea, and others.

Intermediate Marsh - Intermediate marshes are a transitional zone between fresh and brackish marshes, and are often characterized by organic, semi-floating soils. Typically, intermediate marshes experience low levels of daily tidal action. Salinities are negligible or low throughout much of the year, with salinity peaks occurring during late summer and fall. Vegetation includes saltmeadow cordgrass, deer pea, three-cornered grass, cattail, bulltongue, California bulrush, seashore paspalum, wild millet, fall panicum, and bacopa. Ponds and lakes within the intermediate marsh zone often support extensive submerged aquatic vegetation including southern naiad, Eurasian milfoil, and wigeongrass.

Brackish Marsh - Brackish marshes are characterized by low-to-moderate daily tidal energy and by soils ranging from firm mineral soils to organic semi-floating soils. Freshwater conditions may prevail for several months during early spring; however, low- to-moderate salinities occur during much of the year, with peak salinities in the late summer to fall. Vegetation is usually dominated by saltmeadow cordgrass, but also includes saltgrass, three-cornered grass, leafy three-square, and deer pea. Shallow brackish marsh ponds occasionally support abundant beds of wigeongrass.

Saline Marsh - Saline marshes occur along the southern fringe of the coastal wetlands. Those marshes usually exhibit fairly firm mineral soils and experience moderate to high daily tidal energy. Vegetation is dominated by saltmarsh cordgrass, but may also include saltgrass, saltmeadow cordgrass, black needlerush, and leafy three-square. Submerged aquatic vegetation is rare. Within the study area, intertidal mud flats are most common in saline marshes.

Ponds and Lakes - Natural marsh ponds and lakes interspersed throughout the coastal wetlands are typically shallow, ranging in depth from 6 inches to more than 2 feet. The smaller ponds are typically shallow and the larger lakes are deeper. In fresh and low-salinity areas, ponds and lakes may support varying amounts of submerged and/or floating-leaved aquatic vegetation. Brackish and, much less frequently, saline marsh ponds and lakes may support wigeongrass beds.

Canals and Bayous - Canals and larger bayous typically range in depth from 4 or 5 feet, to more than 15 feet. Strong tidal flows may occur at times through those waterways, especially where they provide hydrologic connections to other large waterbodies. Such canals and bayous may have mud or clay bottoms that range from soft to firm. Dead-end canals and small bayous are typically shallow and their bottoms may be filled to varying degrees with semi-fluid organic material. Erosion, due to wave action and boat wakes, together with shading from overhanging woody vegetation, may retard the amount of intertidal marsh vegetation growing along the edges of those waterways.

Navigation Channels - Navigation channels, such as the GIWW and HNC, have been dredged within the study area. Boat wake erosion and water displacement surges from the passage of large vessels have resulted in significant widening of those channel, in some cases to over 1,000 feet wide. Channels depths may range from 12 to 15 feet or more. The GIWW traverses the study area from east to west. The HNC extends southward from the GIWW at Houma, into the Gulf of Mexico. Because the GIWW is connected to the Atchafalaya River via Bayou Chene and the Avoca Island Cutoff Channel, it serves as a seasonal distributary of the Atchafalaya River during periods of moderate to high river discharge. During periods of low river discharge, the HNC may allow saltwater intrusion to move northward into adjoining fresh and low-salinity wetlands.

Developed Areas - Most developed areas are located on higher elevations of former distributary channels and are typically well-drained. They include agricultural lands, and commercial and residential developments.

Fishery Resources

Wetlands throughout the study area abound with small resident fishes and shellfishes such as least killifish, mosquitofish, sailfin molly, grass shrimp, and others. Those species are typically found along marsh edges or among submerged aquatic vegetation, and provide forage for a variety of fish and wildlife. Fresh and low-salinity marshes provide habitat for commercially and recreationally important resident freshwater fishes such as largemouth bass, black crappie, bluegill, readear sunfish, blue catfish, buffalo, freshwater drum, gar, and others.

The intermediate and more saline study area marshes provide important nursery habitat for many estuarine-dependent commercially and recreationally important fishes and shellfishes such as blue crab, white shrimp, brown shrimp, Gulf menhaden, red drum, black drum, spotted seatrout, southern flounder, striped mullet, and others. Because of their important nursery habitat function, commercial shrimp harvests have been positively correlated with the area of emergent tidal marshes (Turner 1977).

Essential Fish Habitat

Essential Fish Habitat (EFH) is defined as those waters and substrates necessary to federally managed fish species for spawning, breeding, feeding or growth to maturity. The proposed project is located in an area identified as EFH for larval, postlarval, juvenile, subadult, and adult life stages of brown shrimp (Farfantepenaeus aztecus), white shrimp (Litopenaeus setiferus), and red drum (Sciaenops ocellatus). Categories of EFH that have been designated in the project area include estuarine wetlands, water column, and mud, sand, and shell substrates. Detailed information on federally managed fisheries and their EFH is provided in the 1998 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 Magnuson-Stevens Act.

In addition to being designated as EFH for the above species and life stages, wetlands and water bottoms in the project area provide nursery and foraging habitats supportive of a variety of forage species that serve as prey for other fish species managed under the Magnuson-Stevens Act by the GMFMC (e.g., mackerels, snappers, and groupers) and highly migratory species managed by the NMFS (e.g., billfishes and sharks). Some prey species include striped mullet, white mullet, Atlantic croaker, sand seatrout, silver perch, pinfish, spot, anchovies, silversides, and killifish, as well as various shellfish species and benthic organisms. These wetlands also produce nutrients and detritus, important components of the aquatic food web, which contribute to the overall productivity of the various estuaries included in the study area.

Wildlife Resources

Study area coastal forested habitats provide important resting and feeding habitat for songbirds migrating across the Gulf of Mexico, as well as habitat for numerous species of birds and raptors such as bald eagle, osprey, barred owl, and others. Mammals utilizing coastal forested wetlands may include white-tailed deer, swamp rabbit, and many other species. Amphibians and reptiles, such as American alligator, bullfrog, red-eared turtle, various snakes and other species also use those habitats.

Study area marshes provide high quality habitat for migratory waterfowl such as gadwall, teal, and others. Areas characterized by large open water areas are preferred by diving ducks such as lesser scaup, redhead, ringnecked duck and others. Other migratory game birds using study area marshes would include rails, American coot, moorhens, and snipe. Wading birds such as egrets, herons, ibis, would also use these areas as would brown pelicans, white pelicans, shorebirds, cormorants, and others.

Area marshes would also provide habitat for mammals such as nutria, muskrat, mink, river otter, raccoon, and swamp rabbit. Reptiles and amphibians such as American alligator, water snakes, turtles, bullfrog, and others, prefer the lower salinity marshes.

Threatened and Endangered Species

The Service provided a January 21, 2009, letter to the Corps identifying Federally listed threatened and endangered species, their critical habitat, and migratory birds that may be found in or near the study area. The species listed in that letter included the West Indian manatee (*Trichechus manatus*), the brown pelican (*Pelecanus occidentalis*), the piping plover (*Charadrius melodus*) and its critical habitat, the pallid sturgeon (*Scaphirhynchus albus*), Gulf sturgeon (*Acipenser oxyrhynchus desotoi*), and 5 species of sea turtles. Since the date that letter was provided, the brown pelican has been removed from the list of endangered species. Otherwise, the information supplied in that letter has not changed and remains valid as of May 2010.

Although potential impacts to threatened and endangered species and their critical habitat associated with the proposed Louisiana Coastal Area Ecosystem Restoration Study Near-Term Plan have been addressed at the programmatic level, an additional Biological Assessment should be prepared when individual projects that tier off that plan/PEIS may affect a Federally listed threatened or endangered species and/or adversely affect designated critical habitats. In keeping with the consultation requirements of the Endangered Species Act (ESA), informal and formal (if needed) consultation must be completed regarding the ARTM and HNC Lock Multi-Purpose Operations Projects before the Record of Decision for these LCA projects can be signed.

Species of Special Interest

<u>Bald Eagle</u>

The project-area forested wetlands provide nesting habitat for the bald eagle (*Haliaeetus leucocephalus*), which was officially removed from the List of Endangered and Threatened Species on August 8, 2007. There are numerous active bald eagle nests known to exist within the northwestern portion of the study area. New nests may also be present that are not currently listed in the database maintained by the Louisiana Department of Wildlife and Fisheries.

Bald eagles nest in Louisiana from October through mid-May. Eagles typically nest in mature trees (e.g., bald cypress, sycamore, willow, etc.) near fresh to intermediate marshes or open water in the southeastern Parishes. Areas with high numbers of nests include the north shore of Lake Pontchartrain and the Lake Salvador area. Major threats to this species include habitat alteration, human disturbance, and environmental contaminants (i.e., organochlorine pesticides and lead).

Breeding bald eagles occupy "territories" that they will typically defend against intrusion by other eagles, and that they likely return to each year. A territory may include one or more alternate nests that are built and maintained by the eagles, but which may not be used for nesting in a given year. Potential nest trees within a nesting territory may, therefore, provide important alternative bald eagle nest sites. Bald eagles are vulnerable to disturbance during courtship, nest building, egg laying, incubation, and brooding. Disturbance during this critical period may lead to nest abandonment, cracked and chilled eggs, and exposure of small young to the elements. Human activity near a nest late in the nesting cycle may also cause flightless birds to jump from the nest tree, thus reducing their chance of survival.

Although the bald eagle has been removed from the List of Endangered and Threatened Species, it continues to be protected under the MBTA and the Bald and Golden Eagle Protection Act (BGEPA). The Service developed the National Bald Eagle Management (NBEM) Guidelines to provide landowners, land managers, and others with information and recommendations to minimize potential project impacts to bald eagles, particularly where such impacts may constitute "disturbance," which is prohibited by the BGEPA. A copy of the NBEM Guidelines is available at:
http://www.fws.gov/southeast/es/baldeagle/NationalBaldEagleManagementGuidelines.pdf.
Those guidelines recommend: (1) maintaining a specified distance between the activity and the nest (buffer area); (2) maintaining natural areas (preferably forested) between the activity and nest trees (landscape buffers); and (3) avoiding certain activities during the breeding season. On-site personnel should be informed of the possible presence of nesting bald eagles within the project boundary, and should identify, avoid, and immediately report any such nests to this office. If a bald eagle nest is discovered within or adjacent to the proposed project area, then an evaluation must be performed to determine whether the project is likely to disturb nesting bald eagles. That evaluation may be conducted on-line at:
http://www.fws.gov/southeast/es/baldeagle. Following completion of the evaluation, that website will provide a determination of whether additional consultation is necessary. A copy of that determination should be provided to this office.

Brown Pelican

Although the brown pelican has been removed from the List of Endangered and Threatened Species, brown pelicans and their nests continue to be protected under the Migratory Bird Treaty Act. To minimize disturbance to nesting colonies of brown pelicans, all activity occurring within 2,000 feet of a rookery should be restricted to the non-nesting period (i.e., September 15 through March 31).

Colonial Nesting Birds

The proposed project would be located in an area where colonial nesting waterbirds may be present. Colonies may be present that are not currently listed in the database maintained by the Louisiana Department of Wildlife and Fisheries. That database is updated primarily by monitoring the colony sites that were previously surveyed during the 1980s. Until a new, comprehensive coast-wide survey is conducted to determine the location of newly-established nesting colonies, we recommend that a qualified biologist inspect the proposed work site for the presence of undocumented nesting colonies during the nesting season. To minimize disturbance to colonial nesting birds, the following restriction on activity should be observed:

> For colonies containing nesting wading birds (i.e., herons, egrets, night-herons, ibis, and roseate spoonbills), anhingas, and/or cormorants, all activity occurring within 1,000 feet of a rookery should be restricted to the non-nesting period (i.e., September 1 through February 15, exact dates may vary within this window depending on species present).

In addition, we recommend that on-site contract personnel be informed of the need to identify colonial nesting birds and their nests, and should avoid affecting them during the breeding season.

Refuges and Wildlife Management Areas

The Mandalay National Wildlife Refuge is located on the GIWW west of Houma, Louisiana. No proposed project features would be located on that refuge, and no significant indirect project effects are expected to occur there. The state-owned Pointe-aux-Chenes Wildlife Management Area is located within the Grand Bayou watershed and would be directly affected by the proposed measures to increase freshwater introduction into that area. State owned and managed oyster seed grounds in Lake Mechant, Caillou Lake (Sister Lake), Lake Chien, and other areas may be affected by project-related freshwater introduction. Please contact the Louisiana Department of Wildlife and Fisheries in Baton Rouge, Louisiana, (225/765-2360) for their comments regarding potential project impacts to these areas.

EVALUATION METHODOLOGY

Given the compressed study schedule and the time necessary to conduct hydraulic modeling of project measures and alternatives, the benefits methodology had to be conducted quickly. Because the WVA and the SAND2 model are desktop models that can be run quickly, and were already in the Corps' model certification process, they were selected for use.

To evaluate benefits of individual project measures, the study area was subdivided into numerous subunits or polygons representing wetlands of similar characteristics and wetland loss patterns (Figure 2). The U.S. Geological Survey (USGS) provided wetland acreage data (1985-2008) for each of the subunits. Future-without-project (FWOP) subunit wetland acreages were determined via a linear trendline through those data (Figure 3). Where applicable, annual net acreage

Figure 2. Map delineating study area subunits.

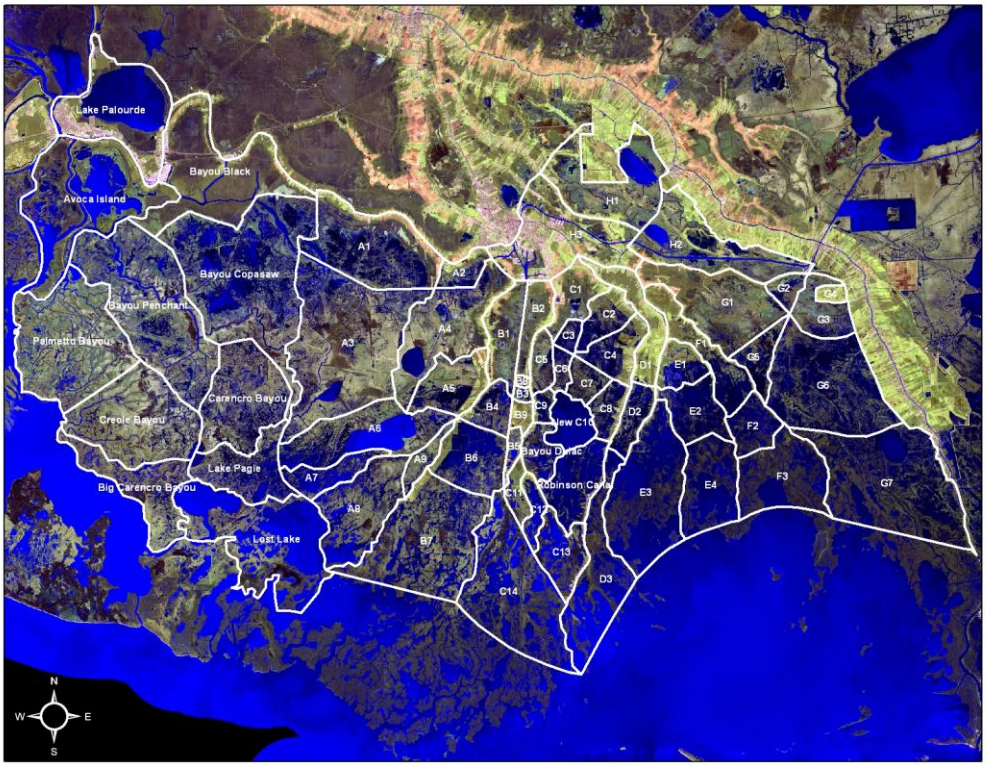
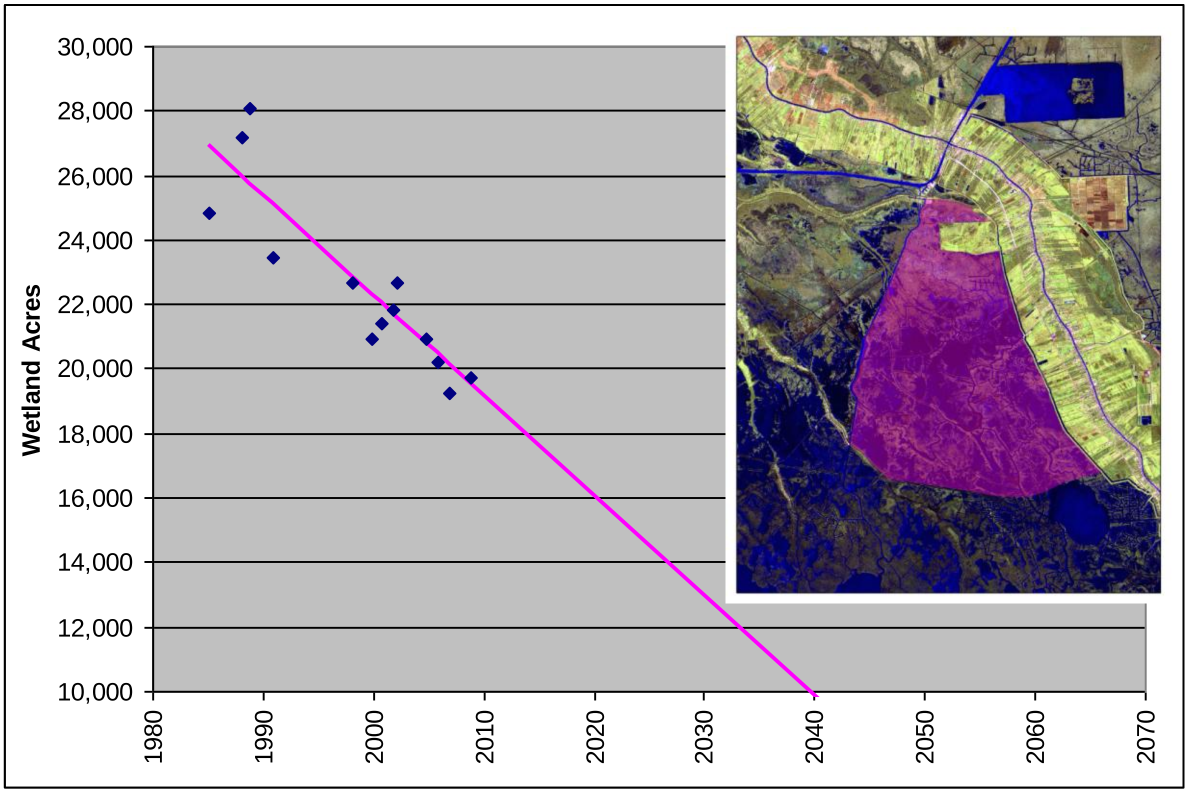


Figure 3. Actual and predicted wetland acreage in the G2,G3,G6 area.



benefits associated with pre-existing or soon to be constructed restoration projects (Table 1) were added to the subunit FWOP acreages to obtain revised FWOP subunit acreages.

Table 1. Projects incorporated into the FWOP wetland acreage predictions.

Year Constr.	Effected Subunit(s)	Project
2009	C9	CWPPRA West Lake Boudreaux Shoreline Protection Project and Marsh Creation Project (TE-46)
2009	A7,L.Pagie	CWPPRA North Lake Mechant Landbridge Restoration Project (TE-44)
2000	A6,A7,L.Pagie	CWPPRA Brady Canal Hydrologic Restoration Project (TE-28)
2010	A6,A7,L.Pagie	CWPPRA Penchant Basin Natural Resources Plan, Increment 1 (TE-34)
2010	A7	CWPPRA South Lake De Cade Freshwater Introduction Project (TE-39)
2010	A3	CWPPRA GIWW Bank Restoration of Critical Areas in Terrebonne Project (TE-43)

Those FWOP wetland acreages were used in conjunction with the Wetland Value Assessment (WVA) methodology to determine project-related impacts on fish and wildlife resources. The Wetland Value Assessment (WVA) methodology, developed for the evaluation of proposed CWPPRA projects under the Louisiana Coastal Wetlands Planning, Protection and Restoration Act program, is similar to the Service's Habitat Evaluation Procedures (HEP) in that habitat quality and quantity are measured for baseline conditions and predicted for FWOP and future with-project (FWP) conditions. However, instead of the species-based approach of HEP, each WVA model utilizes an assemblage of variables considered important to the suitability of a given habitat type for supporting a diversity of fish and wildlife species. As with HEP, these models allow a numeric comparison of each future condition and provide a combined quantitative and qualitative estimate of project-related impacts to fish and wildlife resources.

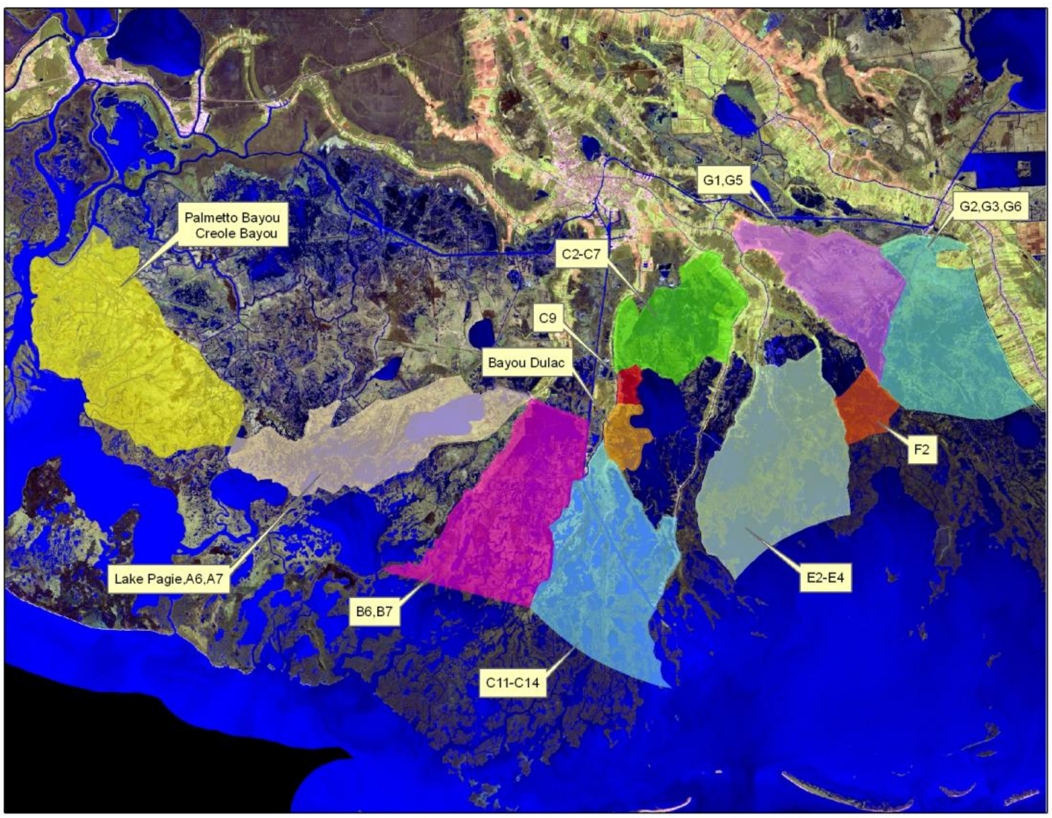
The WVA models operate under the assumption that optimal conditions for fish and wildlife habitat within a given coastal wetland type can be characterized, and that existing or predicted conditions can be compared to that optimum to provide an index of habitat quality. Habitat quality is estimated and expressed through the use of a mathematical model developed specifically for each habitat type. Each model consists of: 1) a list of variables that are considered important in characterizing fish and wildlife habitat; 2) a Suitability Index graph for each variable, which defines the assumed relationship between habitat quality (Suitability Indices) and different variable values; and 3) a mathematical formula that combines the Suitability Indices for each variable into a single value for wetland habitat quality, termed the Habitat Suitability Index (HSI).

The product of an HSI and the acreage of available habitat for a given target year is known as the Habitat Unit (HU). The HU is the basic unit for measuring project effects on fish and wildlife habitat. Future HUs change according to changes in habitat quality and/or quantity. Results are annualized over the project life to determine the Average Annual Habitat Units (AAHUs) available for each habitat type. The AAHU outputs provide a measure of the suitability of each habitat type for providing resting, foraging, breeding, and nursery habitat to a diverse assemblage of fish and wildlife species. The FWP action alternatives were evaluated by comparing their net

AAHUs (FWP AAHUs minus FWOP AAHUs). The 2009 version of the WVA methodology/models were used to conduct the ARTM assessments (LCWCRTF 2009). In addition to the baseline condition in 2015 (TY0), WVA target years of 1, 10, and 50 were chosen as target tears (TYs).

A Service biologist familiar with the project area supplied WVA input values for variables 2-4, (submerged aquatic vegetation coverage, marsh edge and interspersion, percent shallow open water, respectively) and variable 6 (aquatic organism access), based on knowledge of the area, experience with similar projects, and examination of Digital Ortho-quarter Quadrangle aerial photographs (DOQQ). Inputs for variable 5 (salinity) were derived from hydraulic modeling conducted specifically for this purpose. For portions of the study area affected by freshwater inputs, variable 1 (percent emergent marsh), was determined through the use of the SAND2 model (ERDC-Boustany diversion benefits model) for each target year. A listing of variables used in the assessment of project measures is provided in Appendix A. More detailed information regarding these methods may be found in the ARTM Main report and Supplemental EIS. Because there was not sufficient time to conduct detailed hydraulic modeling to determine the extent of each specific freshwater introduction influence area, one or more of the study area subunits were identified as the benefit area based on knowledge of area hydrology (Figure 4).

Figure 4. Map delineating freshwater input benefit areas throughout the study area.



Using the FWOP wetland acreage forecasts (discussed above) for a specific benefit area, the SAND2 model predicts FWP wetland acreage for that area, based on benefits associated with increased discharge and the concentration of nitrogen and suspended sediment in that discharge. Because portions of the study area currently receive some Atchafalaya River freshwater input, the SAND2 model was run using the net increase or decrease in freshwater input. Although the SAND2 model is capable of predicting wetland gains associated with deltaic land-building, the study team felt that it would be inappropriate to generate land-building benefits given that deltaic land-building is not currently occurring throughout most of the area, and because the modest increases in Atchafalaya River water inputs would not be of sufficient magnitude to initiate deltaic land-building. Consequently, suspended sediment inputs in the SAND2 model were set to zero. Where project measures would decrease freshwater input, the SAND2 model was run "in reverse" by entering the net flow decrease as a flow increase. The model-predicted wetland acreage gain was then multiplied by -1.0 to convert the gain into a net wetland acreage loss.

Indirect effects of outfall management measures were captured in the hydraulic model-generated net discharges used to predict wetland acreage via the SAND2 model and model-generated salinities (used as variable 5 in the WVA marsh models). Benefits associated with marsh creation measures located within the freshwater input influence areas were incorporated into the benefits generated by the SAND2 model as the nutrient additions associated with freshwater inputs were assumed to reduce both the loss rates of existing natural marshes and the created marshes. Similarly, wetland impacts associated with channel enlargements were in most cases also incorporated into SAND2 model results. If not, those impacts were quantified independent of the SAND2 modeling. Some proposed marsh creation or outfall measures were located outside of the previously determined freshwater influence area(s). Those measures were considered independent of freshwater introduction measures and their benefits were quantified using the WVA alone.

The 1985 – 2008 USGS wetland acreage data used in these assessments were assumed to incorporate a low rate of sea-level rise (SLR). U.S. Army Corps of Engineers guidance now requires that benefit assessments also be conducted under anticipated medium and high SLRs. Wetland loss rates under low SLR were used as a basis for calculating wetland loss rates under increased SLR scenarios. Water level rise data from the Grand Isle and Eugene Island gages was used to determine that the baseline (year 2004) relative sea level rise rate (RSLR) equals 11.15 mm/yr. This gage-derived RSLR rate was then reduced by the average study area back-marsh accretion value of 10.2 mm/yr to calculate a baseline accretion-adjusted RSLR rate of 0.95 mm/yr. By adding predicted eustatic SLR estimates provided by the Corps, future RSLR rates were determined annually for the medium and high SLR scenarios. According to Corps estimates, increased SLR rates begin to occur in 2005. Likewise, wetland loss rates would begin to accelerate in 2005. To calculate future wetland loss rates under the medium and high SLR scenarios, the baseline wetland loss rate, in acres lost per year, was multiplied by the year X submergence rate ratio (i.e., accretion-adjusted RSLR year X/baseline accretion-adjusted RSLR Rate from 2004). In this manner, future wetland loss rates under the medium and high SLR scenarios were calculated for every year of the 50-year project life.

Because of accelerating SLR, the wetland loss rates increase every year under the medium and high SLR scenarios. Given that the SAND2 model can incorporate only 3 different loss rates, the 50-year project life was split evenly into 3 periods and an average loss rate was determined for each period. All freshwater introduction wetland acreage benefits under the medium and high SLR scenarios used the average loss rates from those 3 periods. In addition to using those increased wetland loss rates, the average water depth input to the SAND2 model was increased to reflect increased water depths. Given that the medium SLR scenario would result in approximately a 6-inch water level increase by TY25, the average water depth used in the SAND2 model runs was increased by 0.5 feet.

With the accelerating SLR forecasted under medium and high scenarios, the submergence of coastal marshes is assumed to reach a point at which feedback processes result in rapid marsh collapse. Based on Nyman et al. 1993, the collapse threshold was assumed to occur when the accretion-adjusted RSLR rate reached 10 mm/yr. Under the medium SLR scenario, this threshold would not be reached within the 50-year project life, however, it would be reached in year 2032 under the high SLR scenario. The study team agreed that once the collapse threshold was reached, all marsh would be lost within 10 years. Given the limited amount of time available to conduct the benefits analysis, the team agreed to assess TSP benefits under the medium SLR scenario only, since the catastrophic wetland loss under the high SLR scenario would provide little if any benefit prior to system collapse.

FUTURE WITHOUT-PROJECT FISH AND WILDLIFE RESOURCES

FWOP wetland acreages were predicted by extrapolation of loss rates observed from 1985 to 2008. Consequently, wetland degradation and loss is assumed to continue throughout much of the study area, except for the northwestern portion of the study area, which is heavily influenced by Atchafalaya River freshwater inputs and is relatively stabile. Central and eastern portions of the study area, which are generally isolated from or receive little beneficial riverine input, generally exhibit the greatest wetland loss rates (Figure 5). Some portions of the eastern study area will lose all their marshes prior to the end of the project life.

Over the last 39 years, brackish marshes in western portions of the project area have experienced a conversion to intermediate marshes (Figure 6). Based on current information, the intermediate marsh-brackish marsh interface has moved southward into an area of high marsh loss, and just north of Lost Lake and Lake Mechant. Given the rapid marsh loss in these areas, and the very steep salinity gradient in the marshes north of Lake Mechant, it is unlikely that those brackish marshes will continue transitioning to lower salinity habitat types. Conversely, the continued subsidence of the Mauvious Bios ridge (which once served as a barrier to marine invasion of the Penchant Basin fresh marshes), and the continuing degradation of buffering tidal marshes south of the Mauvois Bois ridge, may not only halt the past freshening trend, but may also result in increased degradation of southern Penchant Basin fresh marshes.

These observed habitat shifts are likely related to hydrology effects of man-made canals constructed decades ago. The Avoca Island Cutoff Channel, Bayou Chene, and the GIWW provide a direct connection between the northwestern study area (Penchant Basin) and the Atchafalaya River. The USGS has determined that Bayou Chene and the GIWW become a distributary of the lower Atchafalaya River (LAR) when Morgan City stages reach and/or exceed +3.0 feet NAVD88. Under such conditions, GIWW flows just west of Houma respond very well

Figure 5. Subunits with no predicted wetland loss and with total FWOP wetland loss by 2065.

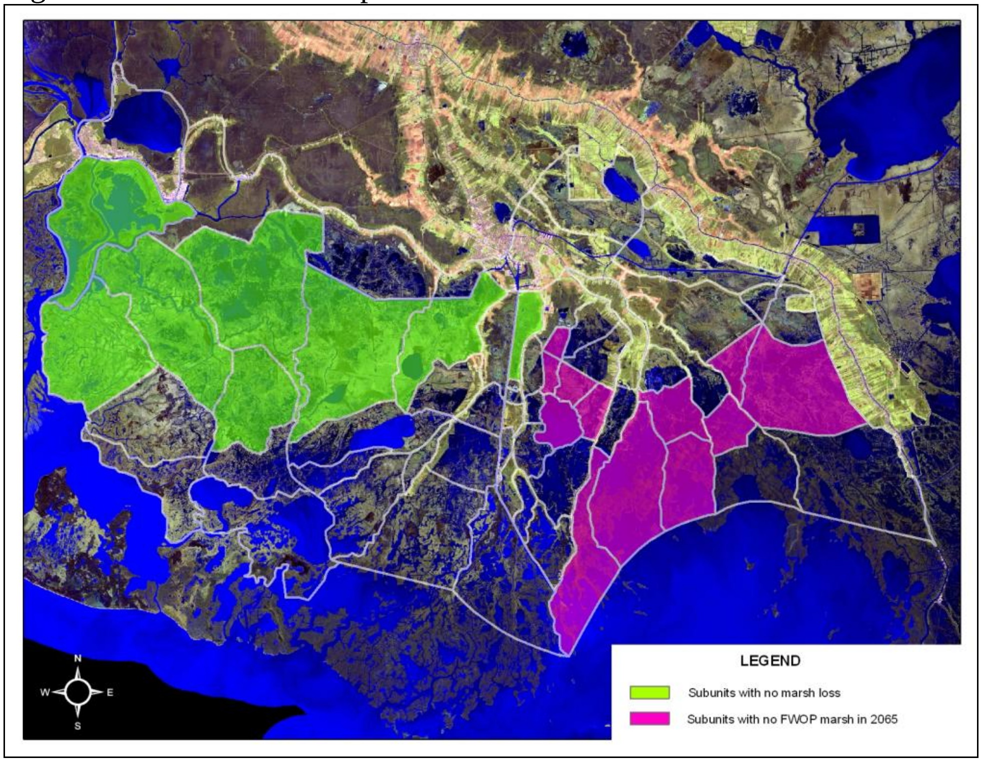
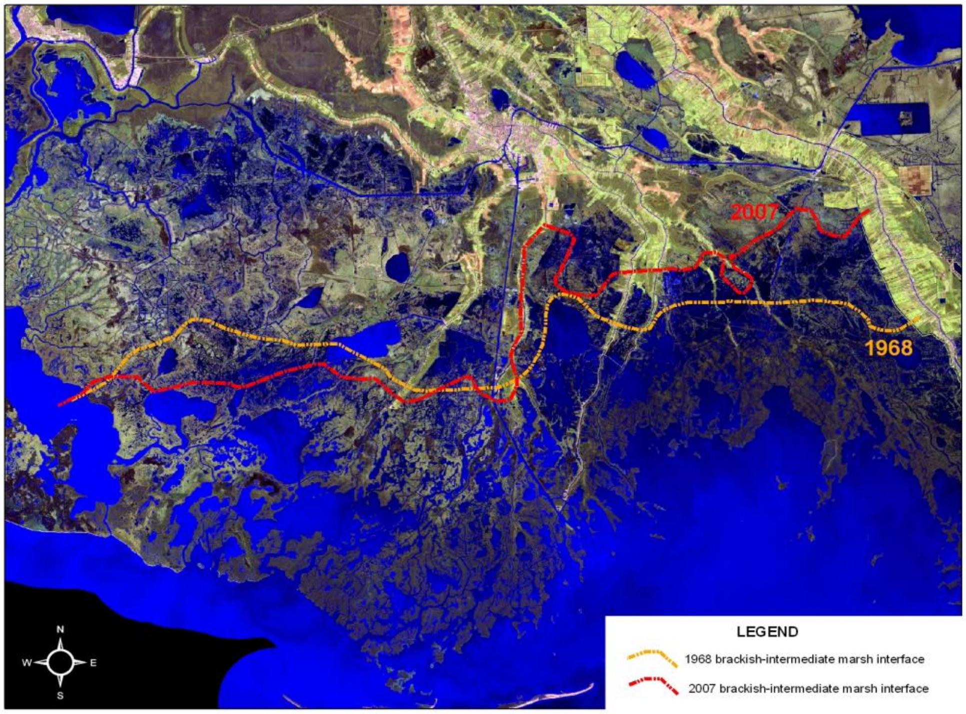


Figure 6. Location of the brackish-intermediate marsh interface in 1968 and 2007.



to stages of the Atchafalaya River at Morgan City (Swarzenski 2003). Additionally, the USGS found that those GIWW eastward flows have increased considerably from the mid 1980s to the late 1990s, due in part to "the downstream emergence of the Atchafalaya Delta in the later 1970s and the aggradation of the river bed." The USGS has also indicated that if those processes continue, "The percent of time when stage of the LAR is greater than 3 feet above NAVD88 could increase in the future with further aggradation of the river bed." The above-mentioned GIWW freshwater flow increases, combined with the numerous waterways connecting the GIWW with Penchant Basin marshes to the south, has resulted in the Penchant Basin being one of two or three areas statewide where non-impounded freshmarsh habitats have not experienced substantial conversion to more saline habitats.

The lack of northward shifting saline habitats is also apparent along the HNC, and is likely related to the fact that the majority of eastward GIWW freshwater exits the GIWW via the HNC (Swarzenski 2003). That this trend exists despite the opposing seasonal saltwater intrusion events occurring on the HNC, illustrates the magnitude of the seasonal freshwater resource available along the HNC, a resource that is apparently not available to eastern study area marshes. Because the HNC so efficiently discharges water to the Gulf on falling tides, HNC freshwater is distributed laterally into adjoining marshes primarily on the rising tide. Falgout Canal and Bayou Grand Caillou are major conduits for carrying HNC freshwater laterally into adjoining marshes.

Wetlands in the central and eastern portions of the study area have experienced a conversion of fresher marsh types to more saline habitat types (Figure 6). The Lake Boudreaux Basin, located east of the HNC and immediately south of Houma, is isolated from Atchafalaya River freshwater inputs. During periods of high Atchafalaya River stages, incoming tides on the HNC may push freshwater northeastward up Bayou Grand Caillou into the southwest portion of that basin. However, that freshwater has a minimal beneficial effect given the large volumes of saltwater which enter that basin through Robinson Canal and Boudreaux Canal.

Because of increased basin-wide salinities, the bald cypress swamps within the upper basin have been virtually eliminated, as have been the upper basin freshmarsh habitat. Most of those former freshwater habitats in the northern basin have converted to open water, however some of the marshes closer to Lake Boudreaux have converted to degraded brackish marsh.

East of Houma, GIWW freshwater may flow southward into Bayou Terrebonne via Company Canal. The majority of those minimal freshwater flows exit Bayou Terrebonne via Humble Canal and flow into the Bayou Barre system. During periods of high Atchafalaya flows, a weak salinity gradient may be observed in the Bayou Barre area. Because most of the marsh in this area has been lost, those minimal freshwater inputs likely result in little if any benefit.

GIWW freshwater may also flow southward into the Grand Bayou system via Bayou L'Eau Bleu. Those freshwater inputs range up to 500 cubic feet per second (cfs), according to U.S. Fish and Wildlife Service measurements. Despite those beneficial freshwater inflows, much of the Grand Bayou system has experienced substantial habitat shift toward more brackish and degraded conditions, due in part to construction of the Cutoff Canal through the Bayou Pointe aux Chene ridge. That canal has connected Bayou Jean LaCroix and Lake Chien to the south, with Grand Bayou, in roughly the middle of the Grand Bayou Basin. With the collapse of the southern rim of Lake Chien and Lake Felicity in the 1950s, saline waters of Timbalier Bay were then readily able to flow northward into the middle of the Grand Bayou system, which was dominated by fresh and intermediate marshes in 1968. Wetland losses in the Grand Bayou basin have been severe, especially in the organic soil marshes of the former fresh marsh zone. Low salinity marshes still remain in the extreme northwest end of the Grand Bayou basin due in part to a lack of canals and waterways capable of readily transmitting brackish water into this intact area. Loss rates within these areas are lower than in most portions of the basin, but losses there have begun to increase in more recent years.

Despite the high wetland loss rates and the corresponding need for freshwater inputs in the central and eastern study areas, most of the GIWW freshwater flowing east past Houma remains in the GIWW where it continues eastward into the Barataria Basin. The need for freshwater there is less than in the Terrebonne Basin since the Davis Pond Freshwater Diversion Project is operated to maintain the Barataria Basin's salinity regime. Compared to eastward GIWW freshwater flows at Houma, the eastward GIWW flows at Larose are much less consistent (USGS 2003). However, USGS gage data[1] reveal that annually, peak flows range up to 4,000 cfs or more.

Continued degradation and loss of marshes in central and eastern portions of the study area will have drastic adverse effects on fish and wildlife resources. Wildlife will be especially impacted as the few remaining areas of low-salinity habitats continue to transition to more saline habitat types that provide lesser quality habitat for many wildlife species. Impacts on estuarine-dependent fishes and shellfishes will be less obvious initially as continued marsh degradation will replace nursery habitat lost through mash degradation in other areas. Ultimately, however, when area wetland acreage is further reduced and the remaining marshes are sufficiently degraded, fisheries productivity may experience a steep decline.

Because of abundant freshwater resources, western study area marshes will likely not experience the decline in habitat diversity that has for the most part already occurred in the central and eastern portions of the study area. Future adverse impacts to wildlife will therefore not be as severe in the western areas as it will be in the central and eastern study area. Because marsh loss rates of brackish marshes are lower in the western portion of the study area, adverse impacts to estuarine-dependent fisheries will also be less there than in the central and eastern study area.

ALTERNATIVE PLAN DESCRIPTIONS

Due to the many wetland restoration measures identified during the scoping process, and the limited time available to conduct hydrologic modeling on individual or small groups of measures, numerous measures were combined to create an array of alternatives that focused on the major study-area restoration strategies (Table 2). Tables 3 and 4, respectively, provide a

[1] http://waterdata.usgs.gov/la/nwis/uv/?site_no=07381235&PARAmeter_cd=00065,72020,63160,00060

listing of measures within each alternative and a brief description of those measures. All alternatives included the Multi-Purpose HNC Lock Operations (year-round closure of the HNC Lock to improve distribution of HNC freshwater).

Table 2. Descriptions of evaluated project alternatives.

ARTM 1: No Action. Alternatives developed under this strategy will include no measures from this project. The future condition will include sea level rise, subsidence, and other projects that are under construction or are likely to be constructed.
ARTM 2: Utilize Flow Management Measures to Maximize Benefits of Existing Freshwater Flows. Alternatives developed under this strategy will focus on eliminating GIWW constrictions and constructing flow management features in the interior portions of the
ARTM 3: Increase Atchafalaya River Inflows and Utilize Flow Management Measures to Maximize Restoration Efforts. Alternatives developed under this strategy will focus on increasing supply from the Atchafalaya River to introduce additional freshwater in a
ARTM 4: Utilize Pump at Grand Bayou and Flow Management Measures to Maximize Restoration Efforts. Alternatives developed under this strategy will focus on attempting to utilize existing GIWW flows from the west and potentially drawing water from the east
ARTM 5: Increase Atchafalaya River Inflows, Utilize Pump at Grand Bayou, and implement Flow Management Measures to Maximize Restoration Efforts. Alternatives developed under this strategy will focus on maximizing flow inputs from both the Atchafalaya Riv
ARTM 6: Increase Atchafalaya River Inflows and Utilize Grand Bayou Dredging with no Flow Management Measures. Alternatives developed under this strategy will focus on maximizing flow inputs from the Atchafalaya River, removing GIWW constrictions, and imp
ARTM 7: Utilize modified operation of the Houma Navigation Canal Lock Complex to distribute freshwater and
ARTM 8: Utilize Flow Management Measures to Maximize Benefits of Existing Freshwater Flows in Central and Eastern Sub-Areas. Alternatives developed under this strategy will focus on constructing flow management features in the interior portions of the Ce

Table 3. List of measures within each alternative.

Alternative	West						
Alt 1 - No Action	~~WD2~~	~~WD3~~	~~WP1~~	~~WO1~~	~~WO2~~	~~WS4~~	~~WW2~~
Alt 2 - Flow Mgmt Measures Only	WD2	WD3	WP1	~~WO1~~	~~WO2~~	~~WS4~~	WW2
Alt 3 - Increased Atchafalaya Inflows plus Flow Mgmt Measures	WD2	WD3	WP1	~~WO1~~	WO2	WS4	WW2
Alt 4 - Pump at Grand Bayou plus Flow Mgmt Measures	WD2	WD3	WP1	~~WO1~~	~~WO2~~	~~WS4~~	WW2
Alt 5 - Increased Atchafalaya Inflows and Pump at Grand Bayou plus Flow Mgmt Measures	WD2	WD3	WP1	~~WO1~~	WO2	WS4	WW2
Alt 6 - Increased Atchafalaya Inflows with no Flow Mgmt Measures	~~WD2~~	WD3	~~WP1~~	~~WO1~~	WO2	WS4	~~WW2~~
Alt 7 - Modified Lock Operation only	~~WD2~~	~~WD3~~	~~WP1~~	~~WO1~~	~~WO2~~	~~WS4~~	~~WW2~~
Alt 8	~~WD2~~	~~WD3~~	~~WP1~~	~~WO1~~	~~WO2~~	~~WS4~~	~~WW2~~

Alternative	Central																																			
Alt 1 - No Action	~~CC1~~	~~CC2~~	~~CC3~~	~~CC4~~	~~CC5~~	~~CC6~~	~~CC7~~	~~CC8~~	~~CC9~~	~~CC10~~	~~CC11~~	~~CC12~~	~~CC13~~	~~CC14~~	~~CC15~~	~~CD1~~	~~CD2~~	~~CD3~~	~~CD4~~	~~CD6~~	~~CD7~~	~~CL1~~	~~CLV1~~	~~CLV2~~	~~CM2~~	~~CM3~~	~~CM4~~	~~CP1~~	~~CP2~~	~~CS1~~	~~CT1~~	~~CT2~~	~~CT3~~	~~CT6~~	~~CT7~~	~~CT8~~
Alt 2 - Flow Mgmt Measures Only	CC1	CC2	CC3	CC4	CC5	CC6	CC7	CC8	CC9	CC10	CC11	CC12	CC13	CC14	CC15	CD1	CD2	CD3	CD4	CD6	CD7	CL1	CLV1	CLV2	CM2	CM3	CM4	CP1	CP2	CS1	CT1	CT2	CT3	CT6	CT7	CT8
Alt 3 - Increased Atchafalaya Inflows plus Flow Mgmt Measures	CC1	CC2	CC3	CC4	CC5	CC6	CC7	CC8	CC9	CC10	CC11	CC12	CC13	CC14	CC15	CD1	CD2	CD3	CD4	CD6	CD7	CL1	CLV1	CLV2	CM2	CM3	CM4	CP1	CP2	CS1	CT1	CT2	CT3	CT6	CT7	CT8
Alt 4 - Pump at Grand Bayou plus Flow Mgmt Measures	CC1	CC2	CC3	CC4	CC5	CC6	CC7	CC8	CC9	CC10	CC11	CC12	CC13	CC14	CC15	CD1	CD2	CD3	CD4	CD6	CD7	CL1	CLV1	CLV2	CM2	CM3	CM4	CP1	CP2	CS1	CT1	CT2	CT3	CT6	CT7	CT8
Alt 5 - Increased Atchafalaya Inflows and Pump at Grand Bayou plus Flow Mgmt Measures	CC1	CC2	CC3	CC4	CC5	CC6	CC7	CC8	CC9	CC10	CC11	CC12	CC13	CC14	CC15	CD1	CD2	CD3	CD4	CD6	CD7	CL1	CLV1	CLV2	CM2	CM3	CM4	CP1	CP2	CS1	CT1	CT2	CT3	CT6	CT7	CT8
Alt 6 - Increased Atchafalaya Inflows with no Flow Mgmt Measures	CC1	CC2	~~CC3~~	~~CC4~~	~~CC5~~	~~CC6~~	~~CC7~~	~~CC8~~	~~CC9~~	~~CC10~~	~~CC11~~	~~CC12~~	~~CC13~~	~~CC14~~	~~CC15~~	~~CD1~~	~~CD2~~	~~CD3~~	CD4	~~CD6~~	~~CD7~~	CL1	~~CLV1~~	~~CLV2~~	~~CM2~~	~~CM3~~	~~CM4~~	~~CP1~~	~~CP2~~	~~CS1~~	~~CT1~~	~~CT2~~	~~CT3~~	~~CT6~~	~~CT7~~	~~CT8~~
Alt 7 - Modified Lock Operation only	~~CC1~~	~~CC2~~	~~CC3~~	~~CC4~~	~~CC5~~	~~CC6~~	~~CC7~~	~~CC8~~	~~CC9~~	~~CC10~~	~~CC11~~	~~CC12~~	~~CC13~~	~~CC14~~	~~CC15~~	~~CD1~~	~~CD2~~	~~CD3~~	~~CD4~~	~~CD6~~	~~CD7~~	CL1	~~CLV1~~	~~CLV2~~	~~CM2~~	~~CM3~~	~~CM4~~	~~CP1~~	~~CP2~~	~~CS1~~	~~CT1~~	~~CT2~~	~~CT3~~	~~CT6~~	~~CT7~~	~~CT8~~
Alt 8	~~CC1~~	~~CC2~~	CC3	~~CC4~~	CC5	CC6	CC7	CC8	CC9	CC10	CC11	CC12	CC13	CC14	CC15	CD1	CD2	~~CD3~~	~~CD4~~	CD6	CD7	CL1	CLV1	CLV2	~~CM2~~	~~CM3~~	~~CM4~~	CP1	CP2	CS1	~~CT1~~	~~CT2~~	~~CT3~~	~~CT6~~	~~CT7~~	~~CT8~~

Alternative	East																		
Alt 1 - No Action	~~EC2~~	~~EC3~~	~~EC5~~	~~EC6~~	~~EC7~~	~~ED2~~	~~ED3~~	~~ED5~~	~~ED6~~	~~ED7~~	~~EM1~~	~~EM3~~	~~EG1~~	~~EG2~~	~~EP7~~	~~EP8~~	~~ES2~~	~~EX1~~	~~EX2~~
Alt 2 - Flow Mgmt Measures Only	EC2	EC3	EC5	EC6	EC7	ED2	ED3	ED5	ED6	ED7	EM1	EM3	EG1	EG2	EP7	~~EP8~~	~~ES2~~	EX1	EX2
Alt 3 - Increased Atchafalaya Inflows plus Flow Mgmt Measures	EC2	EC3	EC5	EC6	EC7	ED2	ED3	ED5	ED6	ED7	EM1	EM3	EG1	EG2	EP7	~~EP8~~	~~ES2~~	EX1	EX2
Alt 4 - Pump at Grand Bayou plus Flow Mgmt Measures	EC2	EC3	~~EC5~~	EC6	EC7	ED2	ED3	ED5	ED6	ED7	EM1	EM3	EG1	EG2	EP7	EP8	ES2	EX1	EX2
Alt 5 - Increased Atchafalaya Inflows and Pump at Grand Bayou plus Flow Mgmt Measures	EC2	EC3	~~EC5~~	EC6	EC7	ED2	ED3	ED5	ED6	ED7	EM1	EM3	EG1	EG2	EP7	EP8	ES2	EX1	EX2
Alt 6 - Increased Atchafalaya Inflows with no Flow Mgmt Measures	~~EC2~~	~~EC3~~	EC5	~~EC6~~	~~EC7~~	~~ED2~~	ED3	ED5	~~ED6~~	~~ED7~~	~~EM1~~	~~EM3~~	~~EG1~~	~~EG2~~	~~EP7~~	~~EP8~~	~~ES2~~	~~EX1~~	~~EX2~~
Alt 7 - Modified Lock Operation only	~~EC2~~	~~EC3~~	~~EC5~~	~~EC6~~	~~EC7~~	~~ED2~~	~~ED3~~	~~ED5~~	~~ED6~~	~~ED7~~	~~EM1~~	~~EM3~~	~~EG1~~	~~EG2~~	~~EP7~~	~~EP8~~	~~ES2~~	~~EX1~~	~~EX2~~
Alt 8	EC2	EC3	EC5	~~EC6~~	~~EC7~~	~~ED2~~	ED3	ED5	ED6	~~ED7~~	~~EM1~~	~~EM3~~	EG1	EG2	EP7	~~EP8~~	~~ES2~~	EX1	EX2

Figure 7. Map illustrating the locations of Alternative 2 measures.

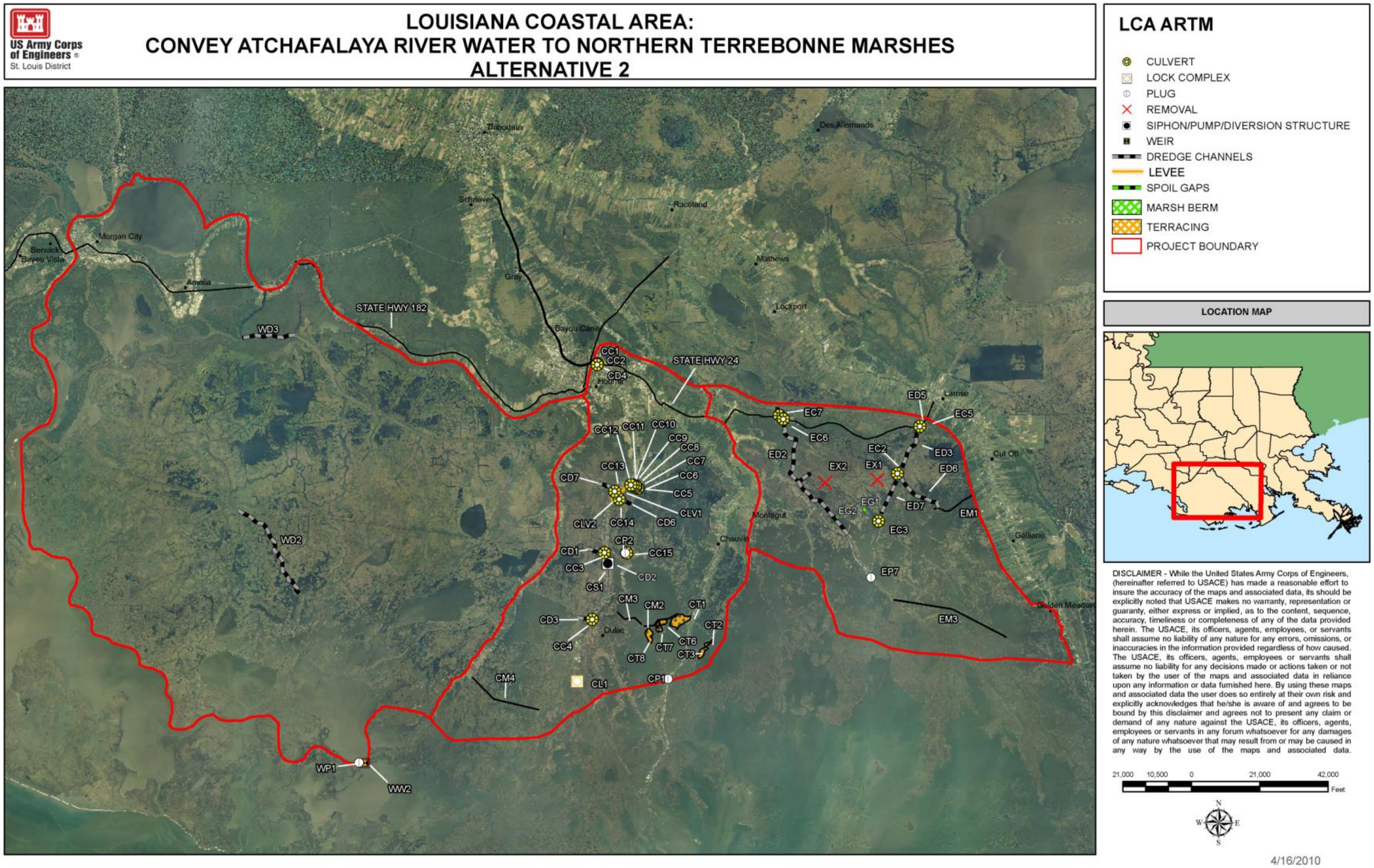


Figure 8. Map illustrating the locations of Alternative 3 measures.

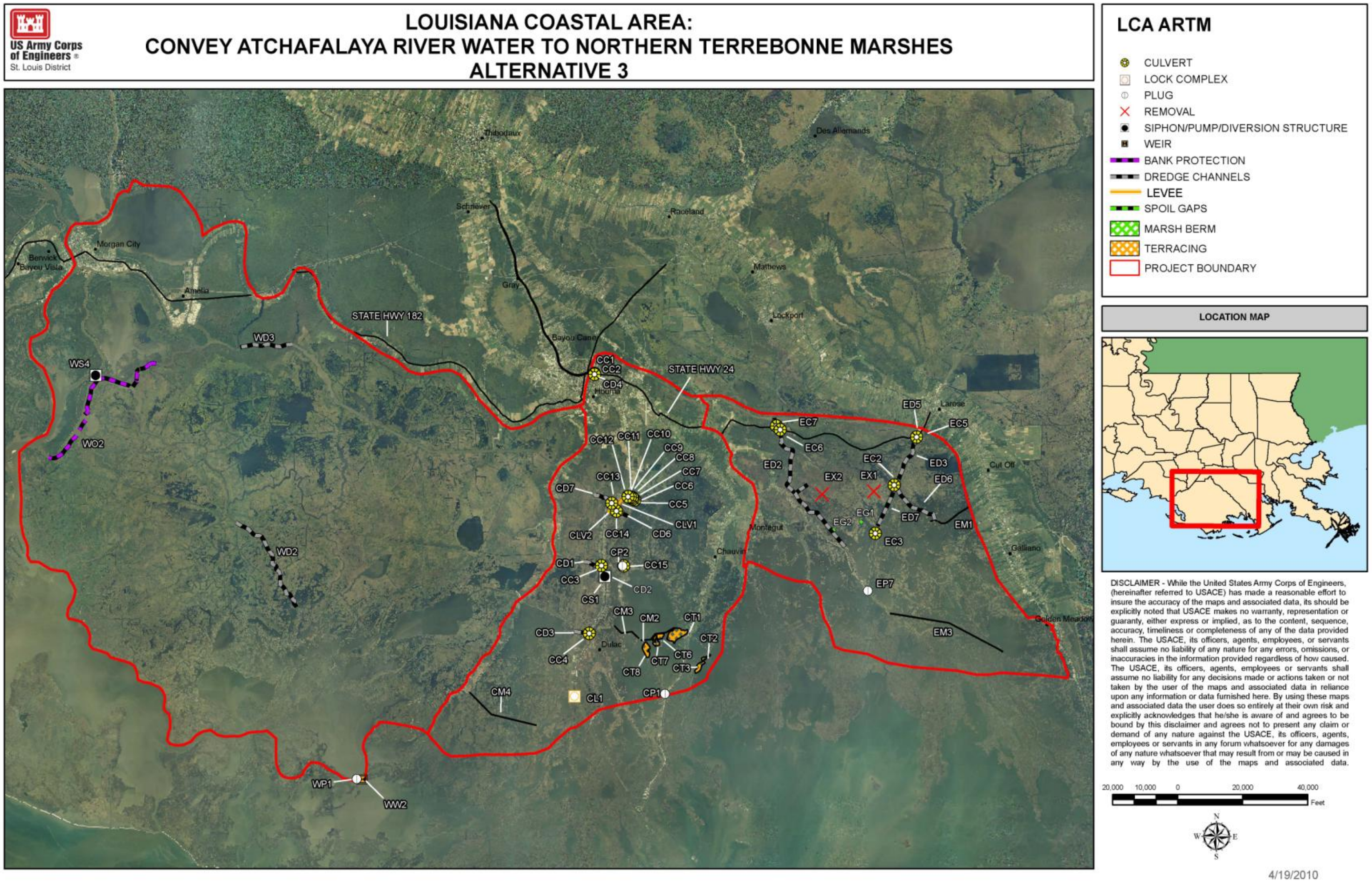


Figure 9. Map illustrating the locations of Alternative 4 measures.

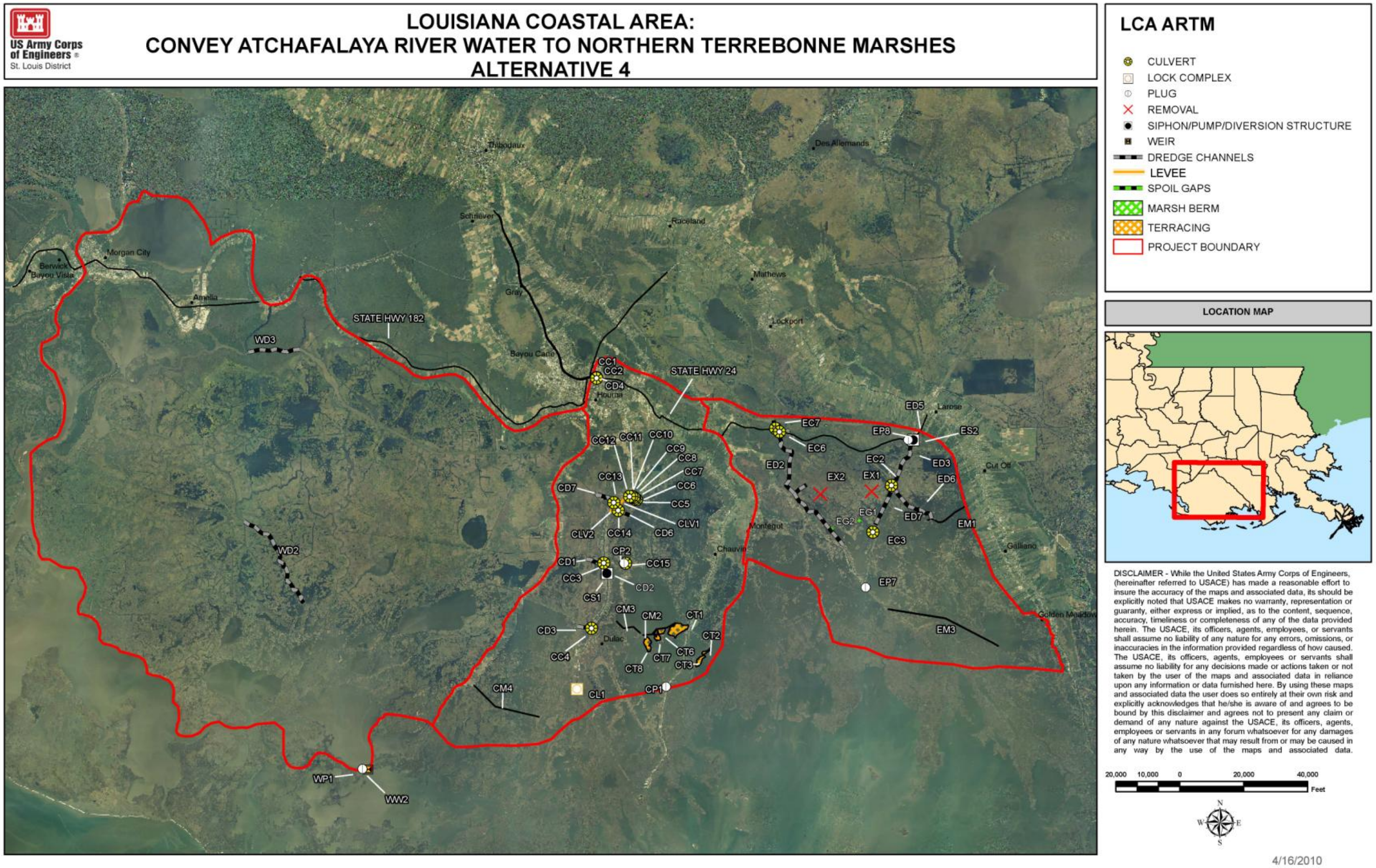


Figure 10. Map illustrating the locations of Alternative 5 measures.

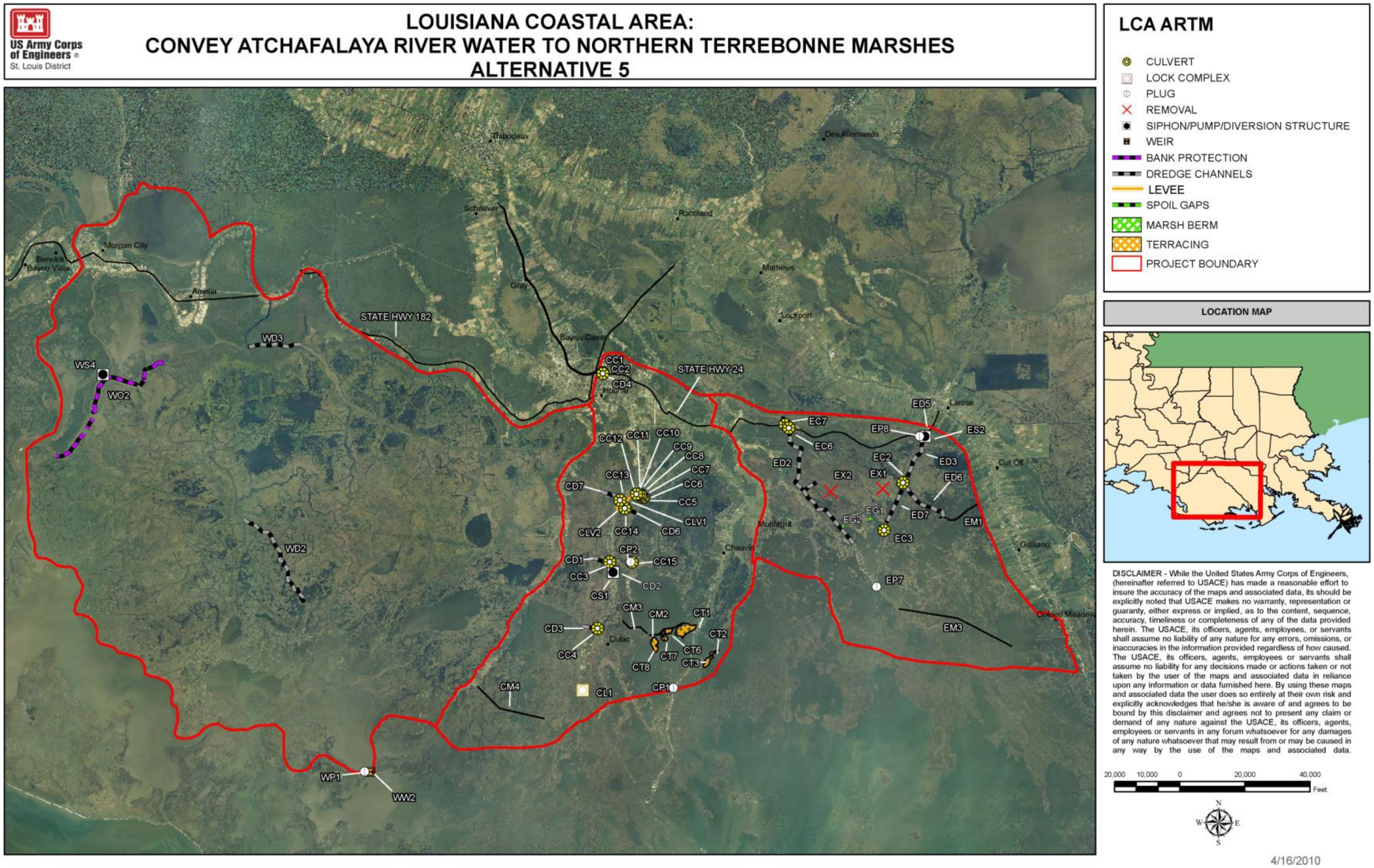


Figure 11. Map illustrating the locations of Alternative 6 measures.

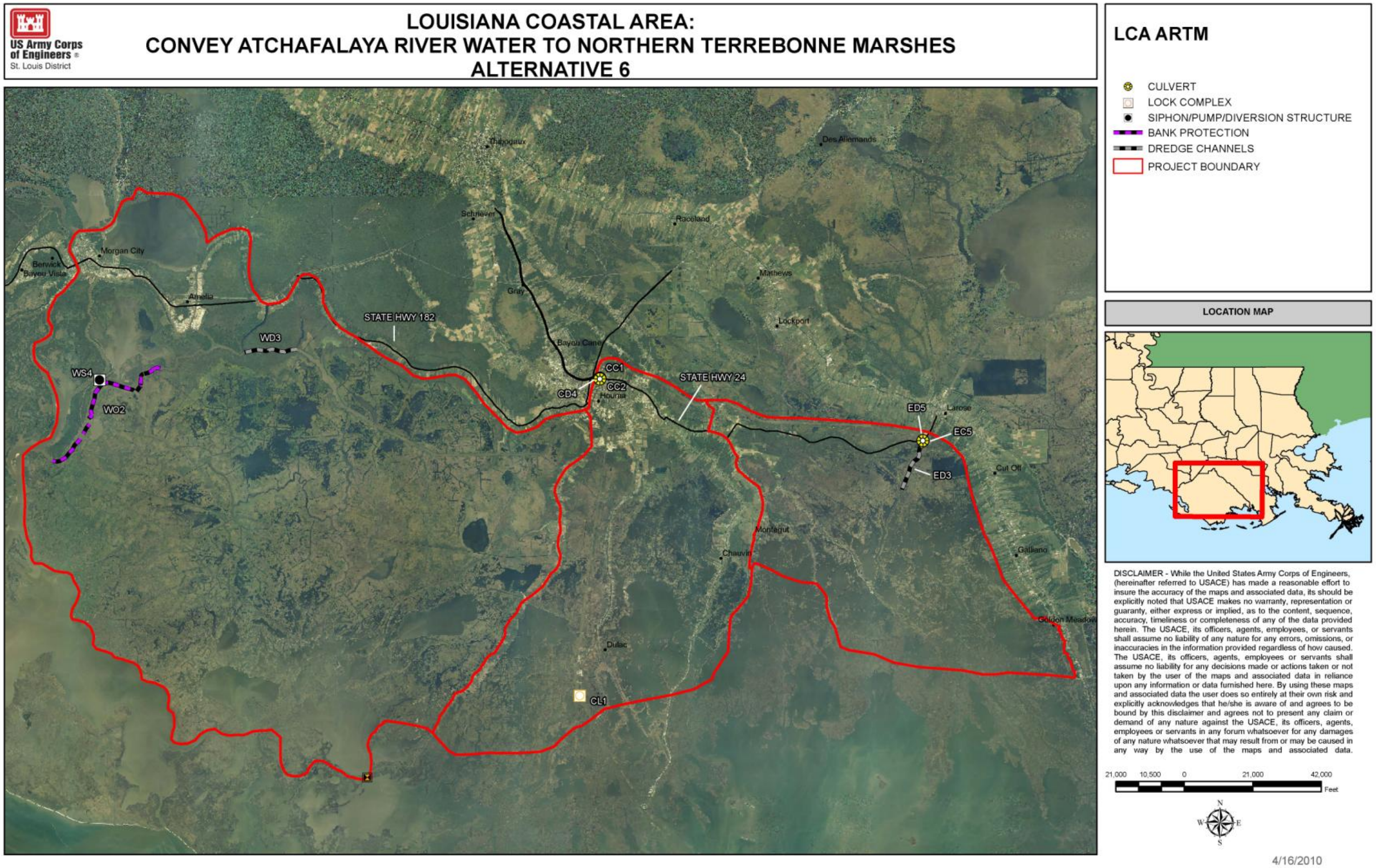


Figure 12. Map illustrating the locations of Alternative 7 measures.

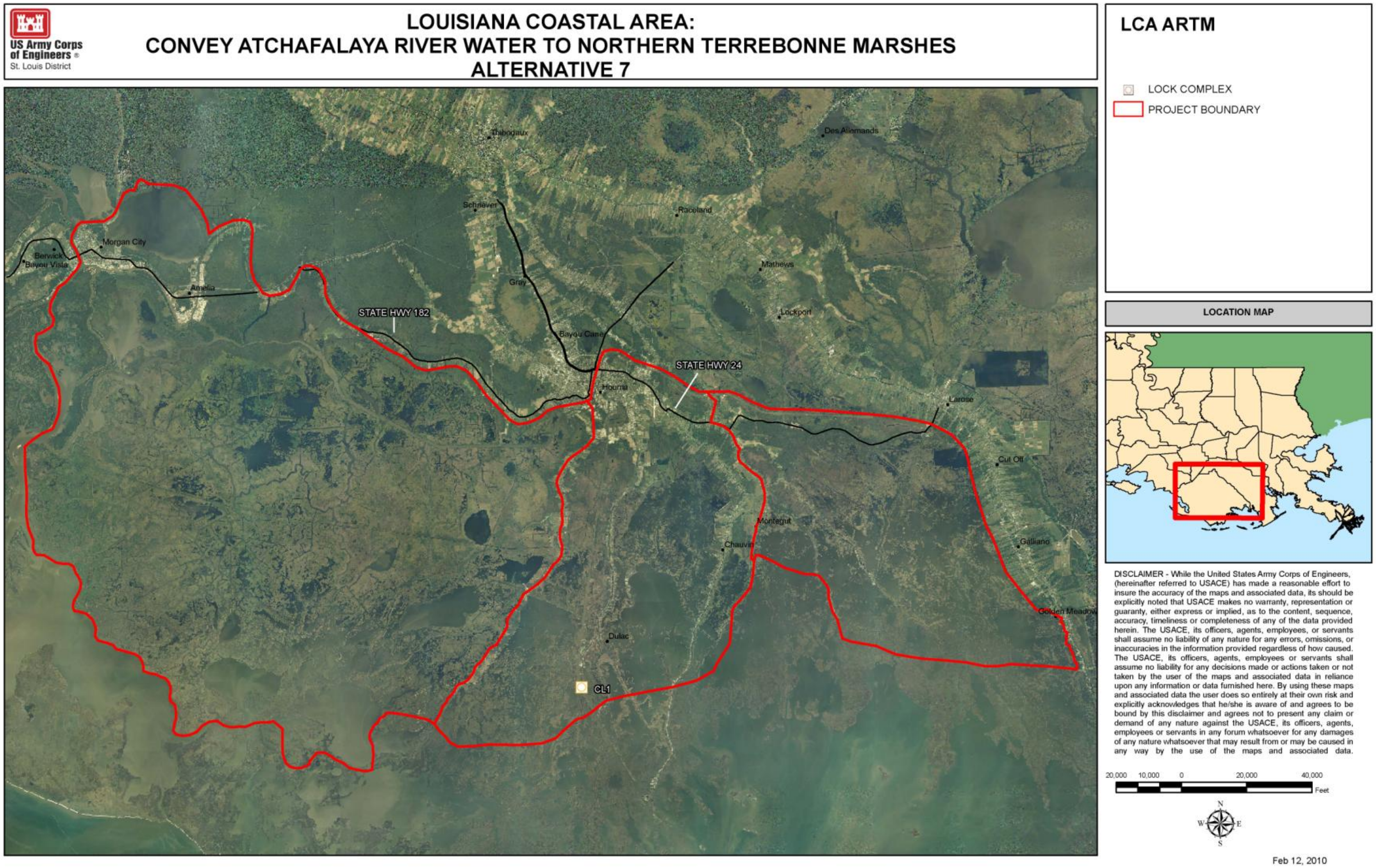


Figure 13. Map illustrating the locations of Alternative 8 measures.

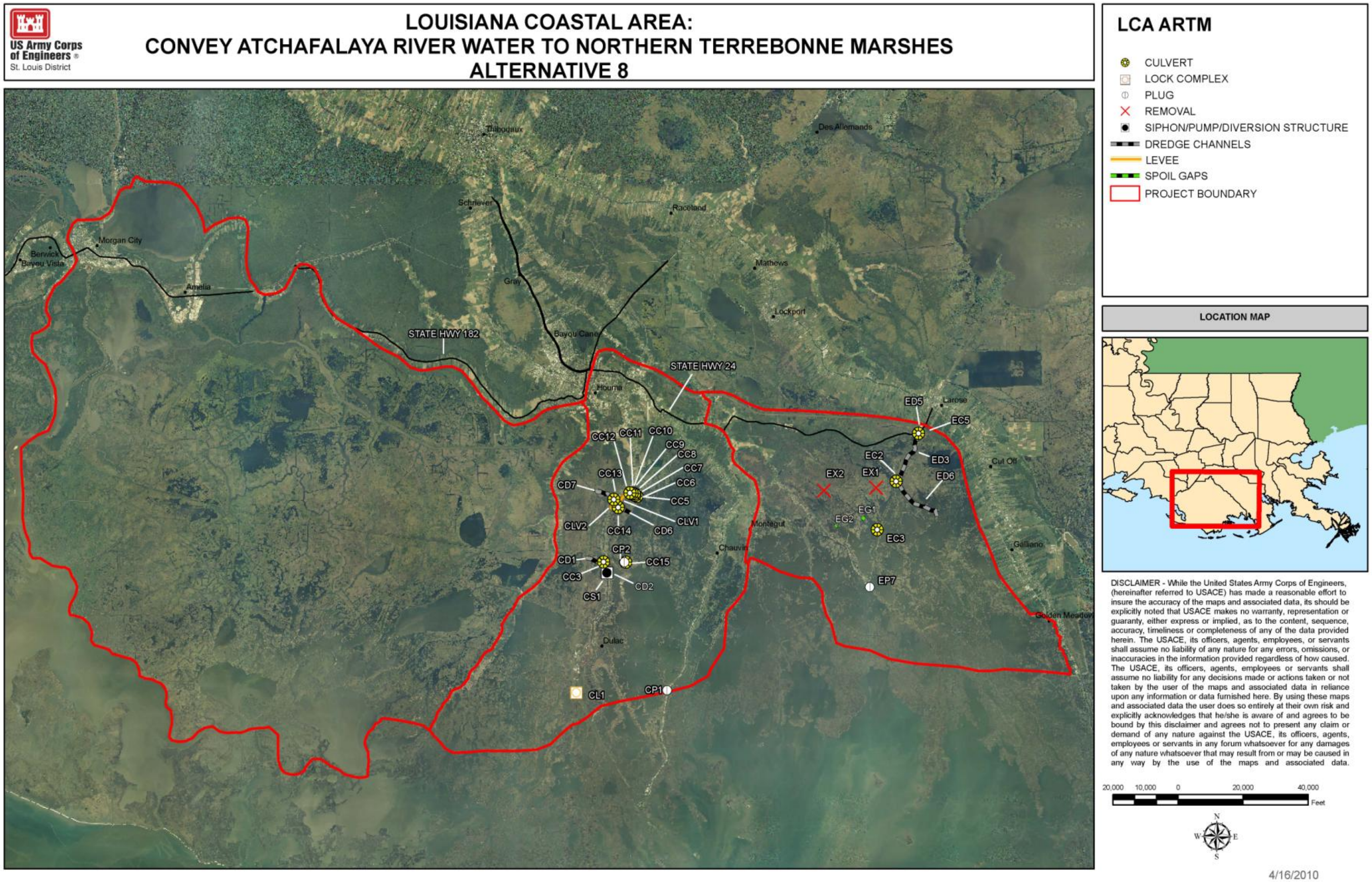


Table 4. Descriptions of proposed measures.

Feature ID	Feature Name	Description	Purpose	Source
~~EC1~~	~~East Culvert #1~~	~~FLAP GATED CULVERT~~	~~Prevent saltwater movement to west~~	~~CWPPRA - GRAND BAYOU/GIWW FRESHWATER DIVERSION (TE-10)~~
EC2	East Culvert #2	BOX CULVERT	Allow water movement from Grand Bayou to southwest	CWPPRA - GRAND BAYOU/GIWW FRESHWATER DIVERSION (TE-10)
EC3	East Culvert #3	FLAP GATED BOX CULVERTS W/VARIABLE CREST OUTFALL	Allow fresh water movement from Grand Bayou to northwest; prevent saltwater movement from Grand Bayou to northwest; allow control of water levels in marshes to northwest	CWPPRA - GRAND BAYOU/GIWW FRESHWATER DIVERSION (TE-10)
EC5	East Culvert #5	FLAP GATED BOX CULVERTS	Allow water movement from GIWW to Grand Bayou under highway	LCA
EC6	East Culvert #6	FLAP GATED BOX CULVERTS	Allow water movement down St. Louis Canal under road	LCA
EC7	East Culvert #7	FLAP GATED BOX CULVERTS	Allow water movement down St. Louis Canal under road	LCA
ED2	East Dredge Channel #2	43,000' OF CANAL DREDGING	Allow water movement from GIWW to Grand Bayou basin	LCA
ED3	East Dredge Channel #3	16,000' OF CANAL DREDGING	Allow water movement from GIWW to Grand Bayou basin	CWPPRA - GRAND BAYOU/GIWW FRESHWATER DIVERSION (TE-10)
~~ED4~~	~~East Dredge Channel #4~~	~~7000' OF CANAL DREDGING~~	~~Allow water movement from GIWW to Grand Bayou basin~~	~~CWPPRA - GRAND BAYOU/GIWW FRESHWATER DIVERSION (TE-10)~~
ED5	East Dredge Channel #5	1000' OF CANAL DREDGING	Allow water movement from GIWW to Grand Bayou	LCA
ED6	East Dredge Channel #6	17,000' OF CANAL DREDGING	Allow water movement from Grand Bayou to eastern marshes	CWPPRA - GRAND BAYOU/GIWW FRESHWATER DIVERSION (TE-10)
ED7	East Dredge Channel #7	13,000' OF CANAL DREDGING	Allow water movement further down Grand Bayou	CWPPRA - GRAND BAYOU/GIWW FRESHWATER DIVERSION (TE-10)
EM1	East Marsh Creation #1	13,000 LINEAR FEET OF MARSH CREATION	Retain fresh water in marshes to north; prevent saltwater intrusion from south	LCA
EM3	East Marsh Creation #3	37,000 LINEAR FEET OF MARSH CREATION	Retain fresh water in marshes to north; prevent saltwater intrusion from south	LCA
EG1	East Spoil Gap #1	GAP IN CANAL SPOIL BANK	Allow movement of fresh water from canal to marshes to the south/southwest	CWPPRA - GRAND BAYOU/GIWW FRESHWATER DIVERSION (TE-10)
EG2	East Spoil Gap #2	GAP IN CANAL SPOIL BANK	Allow movement of fresh water from canal to marshes to the east	CWPPRA - GRAND BAYOU/GIWW FRESHWATER DIVERSION (TE-10)
EP7	East Plug #7	CUTOFF CANAL PLUG	Retain fresh water in marshes to north; prevent saltwater intrusion from south	LCA
EP8	East Plug #8	PLUG CHANNEL	Plug bayou L'eau Bleu to prevent recirculation of water from ES2	LCA
~~ER1~~	~~East Gated Structure #1~~	~~FLOOD GATES W/VARIABLE CREST OUTFALL~~	~~Retain freshwater; prevent saltwater intrusion~~	~~CWPPRA - GRAND BAYOU/GIWW FRESHWATER DIVERSION (TE-10)~~
ES2	East Diversion Structure #2	PUMP	Pump water from GIWW to Grand Bayou	LCA
EX1	East Removal #1	WEIR REMOVAL	Increase water movement through canal - distribute fresh water from Grand Bayou	CWPPRA - GRAND BAYOU/GIWW FRESHWATER DIVERSION (TE-10)
EX2	East Removal #2	PLUG REMOVAL	Increase water movement through canal - distribute fresh water from Grand Bayou/St. Louis Canal	CWPPRA - GRAND BAYOU/GIWW FRESHWATER DIVERSION (TE-10)
CC1	Central Culvert #1	BOX CULVERT	Increase volume of water moving past constriction in GIWW	LCA
CC2	Central Culvert #2	BOX CULVERT	Increase volume of water moving past constriction in GIWW	LCA
CC3	Central Culvert #3	GATED CONTROL STRUCTURE	Increase fresh water delivery from HNC to Bayou Grand Caillou/Lake Boudreaux	LCA
CC4	Central Culvert #4	GATED CONTROL STRUCTURE	Increase fresh water movement from HNC to Bayou Grand Caillou/Lake Boudreaux	LCA

Feature ID	Feature Name	Description	Purpose	Source
CC5	Central Culvert #5	24IN. X 40FT ALUMINUM FLAP-GATED CROSS DRAIN	Allow fresh water movement from north to south into North Lake Boudreaux system	CWPPRA - NORTH LAKE BOUDREAUX BASIN FRESHWATER INTRODUCTION AND HYDROLOGIC MANAGEMENT (TE-32a)
CC6	Central Culvert #6	24IN. X 40FT ALUMINUM FLAP-GATED CROSS DRAIN	Allow fresh water movement from north to south into North Lake Boudreaux system	CWPPRA - NORTH LAKE BOUDREAUX BASIN FRESHWATER INTRODUCTION AND HYDROLOGIC MANAGEMENT (TE-32a)
CC7	Central Culvert #7	24IN. X 40FT ALUMINUM FLAP-GATED CROSS DRAIN	Allow fresh water movement from north to south into North Lake Boudreaux system	CWPPRA - NORTH LAKE BOUDREAUX BASIN FRESHWATER INTRODUCTION AND HYDROLOGIC MANAGEMENT (TE-32a)
CC8	Central Culvert #8	24IN. X 40FT ALUMINUM FLAP-GATED CROSS DRAIN	Allow fresh water movement from north to south into North Lake Boudreaux system	CWPPRA - NORTH LAKE BOUDREAUX BASIN FRESHWATER INTRODUCTION AND HYDROLOGIC MANAGEMENT (TE-32a)
CC9	Central Culvert #9	24IN. X 40FT ALUMINUM FLAP-GATED CROSS DRAIN	Allow fresh water movement from north to south into North Lake Boudreaux system	CWPPRA - NORTH LAKE BOUDREAUX BASIN FRESHWATER INTRODUCTION AND HYDROLOGIC MANAGEMENT (TE-32a)
CC10	Central Culvert #10	24IN. X 40FT ALUMINUM FLAP-GATED CROSS DRAIN	Allow fresh water movement from north to south into North Lake Boudreaux system	CWPPRA - NORTH LAKE BOUDREAUX BASIN FRESHWATER INTRODUCTION AND HYDROLOGIC MANAGEMENT (TE-32a)
CC11	Central Culvert #11	24IN. X 40FT ALUMINUM FLAP-GATED CROSS DRAIN	Allow fresh water movement from north to south into North Lake Boudreaux system	CWPPRA - NORTH LAKE BOUDREAUX BASIN FRESHWATER INTRODUCTION AND HYDROLOGIC MANAGEMENT (TE-32a)
CC12	Central Culvert #12	24IN. X 40FT ALUMINUM FLAP-GATED CROSS DRAIN	Allow fresh water movement from north to south into North Lake Boudreaux system	CWPPRA - NORTH LAKE BOUDREAUX BASIN FRESHWATER INTRODUCTION AND HYDROLOGIC MANAGEMENT (TE-32a)
CC13	Central Culvert #13	SIX 10'X10' BOX CULVERTS WITH SLUICE GATES UNDER HWY 57	Increase fresh water movement from HNC/Bayou Grand Caillou to North Lake Boudreaux	CWPPRA - NORTH LAKE BOUDREAUX BASIN FRESHWATER INTRODUCTION AND HYDROLOGIC MANAGEMENT (TE-32a)
CC14	Central Culvert #14	THREE 48IN. FLAPGATES EACH WITH STOPLOG BAY	Allow fresh water movement from new conveyance channel to marshes to north	CWPPRA - NORTH LAKE BOUDREAUX BASIN FRESHWATER INTRODUCTION AND HYDROLOGIC MANAGEMENT (TE-32a)
CC15	Central Culvert #15	TIMBER BOAT WEIR	Prevent shortcircuiting of fresh water through the north/south GSP canal	CWPPRA - NORTH LAKE BOUDREAUX BASIN FRESHWATER INTRODUCTION AND HYDROLOGIC MANAGEMENT (TE-32a)
CD1	Central Dredge Channel #1	6000' OF CANAL DREDGING	Increase fresh water delivery from HNC to Bayou Grand Caillou/Lake Boudreaux	LCA
CD2	Central Dredge Channel #2	1000' OF CANAL DREDGING	Increase fresh water movement from HNC to Bayou Grand Caillou/Lake Boudreaux	LCA
CD3	Central Dredge Channel #3	4000' OF CANAL DREDGING	Increase fresh water movement from HNC to Bayou Grand Caillou/Lake Boudreaux	LCA
CD4	Central Dredge Channel #4	2000' OF CANAL DREDGING	Increase volume of water moving past constriction in GIWW	LCA
~~CD5~~	~~Central Dredge Channel #5~~	~~2000' OF CANAL DREDGING~~	~~Increase volume of water moving past constriction in GIWW~~	~~LCA~~
CD6	Central Dredge Channel #6	7000' OF CANAL DREDGING - NEW WATER CONVEYANCE CHANNEL	Provide conveyance of water from Bayou Pelton enlargement to North Lake Boudreaux marshes	CWPPRA - NORTH LAKE BOUDREAUX BASIN FRESHWATER INTRODUCTION AND HYDROLOGIC MANAGEMENT (TE-32a)
CD7	Central Dredge Channel #7	6000' OF CANAL DREDGING - BAYOU PELTON ENLARGEMENT	Increase fresh water movement from HNC to Bayou Grand Caillou/North Lake Boudreaux	CWPPRA - NORTH LAKE BOUDREAUX BASIN FRESHWATER INTRODUCTION AND HYDROLOGIC MANAGEMENT (TE-32a)
CL1	Central Lock Complex #1	MULTI-PURPOSE OPERATION OF PROPOSED HNC LOCK COMPLEX	Optimize operation of lock complex for distribution of fresh water and prevention of saltwater intrusion	LCA
CLV1	Central Levee #1	5000' NEW FORCED DRAINAGE LEVEE	Prevent potential flooding from proposed North Lake Boudreaux project	CWPPRA - NORTH LAKE BOUDREAUX BASIN FRESHWATER INTRODUCTION AND HYDROLOGIC MANAGEMENT (TE-32a)
CLV2	Central Levee #2	2000' NEW FORCED DRAINAGE LEVEE	Prevent potential flooding from proposed North Lake Boudreaux project	CWPPRA - NORTH LAKE BOUDREAUX BASIN FRESHWATER INTRODUCTION AND HYDROLOGIC MANAGEMENT (TE-32a)
CM2	Central Marsh Berm #2	11,000 LINEAR FEET OF MARSH CREATION	Retain fresh water in marshes to north; prevent saltwater intrusion from south	LCA
CM3	Central Marsh Berm #3	9,000 LINEAR FEET OF MARSH CREATION	Retain fresh water in marshes to north; prevent saltwater intrusion from south	LCA
CM4	Central Marsh Berm #4	23,000 LINEAR FEET OF MARSH CREATION	Retain fresh water in marshes to north; prevent saltwater intrusion from south	LCA
~~CMC1~~	~~Central Marsh Creation #1~~	~~7 ACRES OF MARSH CREATION~~	~~Disposal area for Bayou Pelton dredging~~	~~CWPPRA - NORTH LAKE BOUDREAUX BASIN FRESHWATER INTRODUCTION AND HYDROLOGIC MANAGEMENT (TE-32a)~~
~~CMC2~~	~~Central Marsh Creation #2~~	~~12 ACRES OF MARSH CREATION~~	~~Disposal area for Bayou Pelton dredging~~	~~CWPPRA - NORTH LAKE BOUDREAUX BASIN FRESHWATER INTRODUCTION AND HYDROLOGIC MANAGEMENT (TE-32a)~~

Table 4 - continued. Descriptions of proposed measures.

Feature ID	Feature Name	Description	Purpose	Source
~~CMC3~~	~~Central Marsh Creation #3~~	~~60 ACRES OF MARSH CREATION~~	~~Disposal area for Bayou Pelton dredging~~	~~CWPPRA - NORTH LAKE BOUDREAUX BASIN FRESHWATER INTRODUCTION AND HYDROLOGIC MANAGEMENT (TE-32a)~~
~~CMC4~~	~~Central Marsh Creation #4~~	~~23 ACRES OF MARSH CREATION~~	~~Disposal area for Bayou Pelton dredging~~	~~CWPPRA - NORTH LAKE BOUDREAUX BASIN FRESHWATER INTRODUCTION AND HYDROLOGIC MANAGEMENT (TE-32a)~~
CP1	Central Plug #1	CANAL PLUG	Retain fresh water in Lake Boudreaux basin; prevent saltwater intrusion into Lake Boudreaux basin from Bayou Petit Caillou	LCA
CP2	Central Plug #2	CANAL PLUG	Prevent shortcircuiting of fresh water through the north/south GSP canal	CWPPRA - NORTH LAKE BOUDREAUX BASIN FRESHWATER INTRODUCTION AND HYDROLOGIC MANAGEMENT (TE-32a)
CS1	Central Diversion Structure #1	BOX CULVERT WITH SLUICE GATES	Increase fresh water movement from HNC to Bayou Grand Caillou/Lake Boudreaux	LCA
CT1	Central Terracing #1	360 ACRES OF TERRACING	Retain fresh water and prevent saltwater intrusion	CWPPRA - SOUTH TERREBONNE PARISH MARSH TERRACING (PPL 15 Candidate)
CT2	Central Terracing #2	40 ACRES OF TERRACING	Retain fresh water and prevent saltwater intrusion	CWPPRA - SOUTH TERREBONNE PARISH MARSH TERRACING (PPL 15 Candidate)
CT3	Central Terracing #3	110 ACRES OF TERRACING	Retain fresh water and prevent saltwater intrusion	CWPPRA - SOUTH TERREBONNE PARISH MARSH TERRACING (PPL 15 Candidate)
CT6	Central Terracing #6	70 ACRES OF TERRACING	Retain fresh water and prevent saltwater intrusion	CWPPRA - SOUTH TERREBONNE PARISH MARSH TERRACING (PPL 15 Candidate)
CT7	Central Terracing #7	80 ACRES OF TERRACING	Retain fresh water and prevent saltwater intrusion	CWPPRA - SOUTH TERREBONNE PARISH MARSH TERRACING (PPL 15 Candidate)
CT8	Central Terracing #8	150 ACRES OF TERRACING	Retain fresh water and prevent saltwater intrusion	CWPPRA - SOUTH TERREBONNE PARISH MARSH TERRACING (PPL 15 Candidate)
~~CX1~~	~~Central Removal #1~~	~~REMOVAL OF TUNNEL UNDER GIWW~~	~~Provide improved conveyance of water through GIWW~~	~~LCA~~
~~WC1~~	~~West Culvert #1~~	~~MULTIPLE FLAPGATED 36" CULVERTS~~	~~Allow movement of lower salinity water from Lake Decade into marshes to south~~	~~CWPPRA - SOUTH LAKE DE CADE FRESHWATER INTRODUCTION (TE-39)~~
~~WC2~~	~~West Culvert #2~~	~~SHEETPILE STRUCTURE WITH FLAPGATED 48" OPENINGS~~	~~Allow movement of lower salinity water from Lake Decade into marshes to south~~	~~CWPPRA - SOUTH LAKE DE CADE FRESHWATER INTRODUCTION (TE-39)~~
~~WC3~~	~~West Culvert #3~~	~~SHEETPILE STRUCTURE WITH FLAPGATED 48" OPENINGS~~	~~Allow movement of lower salinity water from Lake Decade into marshes to south~~	~~CWPPRA - SOUTH LAKE DE CADE FRESHWATER INTRODUCTION (TE-39)~~
~~WD1~~	~~West Dredge Channel #1~~	~~2000' OF CANAL DREDGING~~	~~Allow more efficient movement of water from Minors Canal to Lake Decade~~	~~CWPPRA - CENTRAL TERREBONNE FRESHWATER ENHANCEMENT (TE-66)~~
WD2	West Dredge Channel #2	35,000' OF CANAL DREDGING	Allow more efficient movement of fresh water from Bayou Penchant to southeast Penchant Basin marshes	LCA
WD3	West Dredge Channel #3	16,000' OF GIWW DREDGING	Eliminate constriction in GIWW	LCA
~~WD4~~	~~West Dredge Channel #4~~	~~2700' OF CANAL DREDGING~~	~~Allow movement of lower salinity water from Lake Decade into marshes to south~~	~~CWPPRA - SOUTH LAKE DE CADE FRESHWATER INTRODUCTION (TE-39)~~
WP1	West Plug #1	CANAL PLUG	Retain fresher water and prevent saltwater intrusion	CWPPRA - CENTRAL TERREBONNE FRESHWATER ENHANCEMENT (TE-66)
WO1	West Shoreline Protection #1	50,000' OF SHORELINE PROTECTION	Protect Penchant basin marshes from GIWW flows/wave wash	CWPPRA - GIWW BANK RESTORATION OF CRITICAL AREAS IN TERREBONNE (TE-43)
WO2	West Shoreline Protection #2	50,000' OF SHORELINE PROTECTION	Protect Penchant basin marshes from increased project-related flows	LCA
~~WS1~~	~~West Diversion Structure #1~~	~~GATED BOX CULVERTS~~	~~Increase flow to GIWW by moving water through Lake Palourde~~	~~LCA~~
~~WS2~~	~~West Diversion Structure #2~~	~~GATED BOX CULVERTS~~	~~Increase flow from Atchafalaya River to GIWW by moving water from Bayou Shaffer to the Avoca Island Cutoff/Bayou Chene~~	~~LCA~~
~~WS3~~	~~West Diversion Structure #3~~	~~GATED BOX CULVERTS~~	~~Increase flow from Atchafalaya River to GIWW by moving water from Bayou Shaffer to the Avoca Island Cutoff/Bayou Chene~~	~~LCA~~
WS4	West Diversion Structure #4	GATED BOX CULVERTS	Increase flow from Atchafalaya River to GIWW by moving water from Bayou Shaffer to the Avoca Island Cutoff/Bayou Chene	LCA
WW2	West Weir #2	ROCK BARGE BAY	Constrict Grand Pass to minimize water exchange	CWPPRA - CENTRAL TERREBONNE FRESHWATER ENHANCEMENT (TE-66)

EVALUATION OF ALTERNATIVE PLANS

Unless otherwise stated, the results presented below pertain to the low SLR scenario. Because of the study schedule time constraints, the process of editing and correcting benefit estimates for this very complex project could not be fully completed prior to the deadline for report preparation. Consequently, the information provided below contains some errors. The net benefits (in AAHUs) provided below are without project-related impacts to estuarine dependent fisheries via WVA variable 6 (Table 5). Benefits in net TY50 wetland acres, are presented in Table 6. A listing of all WVA variables is available in the Supplemental EIS.

Based on the high construction and operation/maintenance costs of the pumping alternatives (Alts), Alts 4 and 5, those alternatives were eliminated from further consideration. Likewise, Alt3 exceeded the cost limit and was also eliminated. Because the most beneficial alternative within the cost limit is Alt2, it was selected as the Tentatively Selected Plan (TSP).

The Avoca Island Cutoff Channel, Bayou Chene, and the GIWW serve as a conduit carrying Atchafalaya River freshwater across the entire Terrebonne Basin, and into the Barataria Basin (Figure 14). Alternatives 3 and 6, are the only alternatives that would introduce additional water from the river into the Avoca Island Cutoff Channel via a water control structure (measure WS4). To avoid exacerbating the existing backwater flooding problem for communities east of Morgan City, the WS4 structure was assumed to discharge water only when Morgan City stages were less than +4.0 feet. Consequently the structure was assumed not to operate during peak stages on the lower Atchafalaya River (Table 7). The size of the WS4 structure was limited to avoid excessive costs and only one structure size was evaluated. Given the average February

Table 5 Net benefits for project alternatives, in AAHUs (without fisheries impacts).

Diversion Influence Area	ALT 2	ALT 3	ALT 4	ALT 5	ALT 6	ALT 7	ALT 8
E2-E4	-1.90	-1.90	-1.90	-1.90	0.01	0.00	0.00
F2	-12.80	-12.80	-11.83	-11.83	2.26	0.16	-12.89
A6,A7,L.Pagie	2132.48	2154.16	2118.62	2313.35	285.97	429.54	259.06
B6, B7	821.89	871.74	613.15	614.02	782.43	797.29	728.92
Bayou Dulac	-267.01	-265.74	-230.17	12.39	98.96	69.57	-299.56
C2-C7	391.10	393.69	373.08	376.54	0.00	0.00	393.29
C9	260.75	262.93	249.73	252.05	0.00	0.00	209.16
G1-G5	-216.52	-216.38	-210.49	-210.49	0.00	0.00	0.00
G2,G3,G6 (G7)	1189.93	1202.70	2444.33	2444.54	610.78	-40.94	938.24
Palm-Creole	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C11-C14	-924.04	-920.94	-931.14	-926.24	-1012.06	-1012.42	-991.64
SUBTOTAL	3373.87	3467.46	4413.39	4862.44	768.35	243.20	1224.58
Diversion Independent Measures							
WD2	-164.73	-164.73	-164.73	-164.73	0.00	0.00	0.00
WO2	0.00	11.97	0.00	11.97	11.97	0.00	0.00
CD1	-1.22	-1.22	-1.22	-1.22	0.00	0.00	-1.22
CD3	-2.64	-2.64	-2.64	-2.64	0.00	0.00	0.00
CD7	-1.30	-1.30	-1.30	-1.30	0.00	0.00	-4.62
CT1,6,7,8	18.63	18.63	18.63	18.63	0.00	0.00	0.00
EM3	1.83	1.83	0.00	0.00	0.00	0.00	0.00
ED5	-4.55	-4.55	-4.55	-4.55	-4.55	0.00	-4.55
SUBTOTAL	-153.98	-142.01	-155.80	-143.84	7.42	0.00	-10.39
TOTAL	**3,219.90**	**3,325.45**	**4,257.59**	**4,718.61**	**775.77**	**243.20**	**1,214.19**

Table 6. Benefits for project alternatives, in net TY50 wetland acres.

Diversion Influence Area	Alt 2	Alt 3	Alt 4	Alt 5	Alt 6	Alt 7	Alt 8
E2-E4	0	0	0	0	0	0	0
F2	0	0	0	0	0	0	0
A6,A7,L.Pagie	7,887	8,018	7,783	7,932	862	851	667
B6,B7	2,789	2,833	2,766	2,816	2,191	2,190	2,336
Bayou Dulac	-260	-252	-266	849	1,433	1,312	-418
C2-C7	841	855	757	765	-63	-48	847
C9	595	602	559	567	0	0	398
G1-G5	-253	-253	-253	-253	0	0	0
G2,G3,G6(G7)	4,823	4,880	7,698	7,700	2,176	0	3,964
Palm-Creole	0	0	0	0	0	0	0
C11-C14	-6,527	-6,508	-6,550	-6,525	-6,953	-6,956	-6,781
SUBTOTAL	9,895	10,174	12,495	13,850	-354	-2,651	1,013
Diversion Independent Measures							
WD2	-319.0	-319.0	-319.0	-319.0			
WO2		375.0		375.0	375.0		
CD1	-3.4	-3.4	-3.4	-3.4			-3.4
CD3	-7.6	-7.6	-7.6	-7.6			
CD7	-6.4	-6.4	-6.4	-6.4			-6.4
CT1,6,7,8	59.0	59.0	59.0	59.0			
EM3	51.2	51.2					
ED5	-14.1	-14.1	-14.1	-14.1	-14.1		-14.1
SUBTOTAL	-240.3	134.7	-291.5	83.5	360.9	0.0	-23.9
TOTAL	**9,654.8**	**10,308.4**	**12,204.0**	**13,933.6**	**7.1**	**-2,650.7**	**989.2**

Figure 14. Locations along the GIWW, HNC, and Grand Bayou where predicted discharges were obtained.

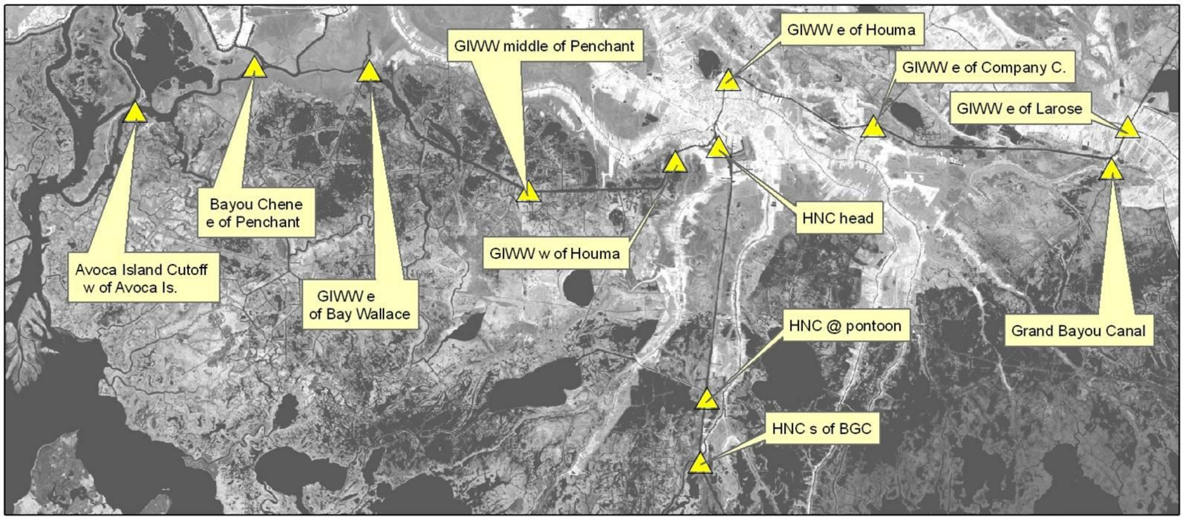


Table 7. Average monthly WS4 discharge into the Avoca Island Cutoff Channel.

	Alt3 TY1	Alt3 TY10	Alt6 TY1	Alt6 TY10
Jan	2,483	2,588	2,475	2,592
Feb	3,504	3,649	3,499	3,660
Mar	107	113	103	110
Apr	112	118	109	116
May	0	0	0	0
Jun	57	60	55	59
Jul	2,275	2,372	2,267	2,374
Aug	801	840	788	832
Sep	782	821	769	812
Oct	725	762	712	753
Nov	480	506	465	496
Dec	971	1,017	958	1,010

FWOP Avoca Island Cutoff Channel discharge of 20,883 cubic feet per second (cfs), the WS4 structure would provide an additional 17.5% discharge (cfs). From the analysis conducted, it can not be determined where this additional water goes. Without sensitivity analysis, the benefits provided by this additional freshwater cannot be conclusively determined. However, inspection of the available data suggests that minimal benefits are provided for this magnitude of additional freshwater input.

The tentatively selected plan (TSP) does not does not include measure WS4. Instead, the TSP focuses primarily on improving the distribution of existing freshwater. However, the TSP includes measures to eliminate the GIWW constriction between Bayou Black and Bay Wallace (measure WD3), plus a system of culverts in downtown Houma (measures CC1, CC2, and CD4) to bypass the GIWW constriction at the Bayou Terrebonne junction. Those measures are intended to passively increase the supply of GIWW freshwater to the central and eastern study area.

TSP TY1 flows are greater than TY1 FWOP flows along the entire GIWW conduit (Tables 8a and 8b), except that less water enters the Barataria Basin under the TSP due to increased discharge from the GIWW southward into the Grand Bayou system. The TSP-related GIWW flow increases in the Penchant area may be related to the combined effects of increased discharge from Bayou Penchant (measure WD2), the GIWW constriction removal

Table 8a. GIWW flows in cfs for FWOP and Alt2 FWP.

	Avoca Island Cutoff W of Avoca Is				Bayou Chene E of Penchant				GIWW east of Bay Wallace				GIWW middle of Penchant Basin			
	FWOP	FWP	FWOP	FWP	FWOP	FWP	FWOP	FWP	FWOP	FWP	FWOP	FWP	FWOP	FWP	FWOP	FWP
	TY1	TY1	TY10	TY10	TY1	TY1	TY10	TY10	TY1	TY1	TY10	TY10	TY1	TY1	TY10	TY10
Jan	13,697	13,778	14,154	14,309	10,892	11,199	11,367	11,731	7,482	8,669	7,830	9,031	3,890	4,119	4,099	4,175
Feb	16,314	16,372	16,909	17,077	13,700	13,991	14,320	14,691	8,803	10,145	9,244	10,570	5,066	5,362	5,352	5,403
Mar	18,398	18,438	19,103	19,282	15,936	16,214	16,671	17,048	9,855	11,320	10,370	11,795	6,002	6,351	6,350	6,381
Apr	18,253	18,294	18,950	19,128	15,780	16,059	16,507	16,884	9,781	11,238	10,292	11,710	5,937	6,282	6,280	6,313
May	21,210	21,224	22,061	22,256	18,951	19,213	19,842	20,228	11,274	12,905	11,890	13,448	7,264	7,686	7,695	7,701
Jun	19,707	19,735	20,480	20,666	17,340	17,610	18,147	18,529	10,515	12,058	11,078	12,564	6,590	6,973	6,976	6,996
Jul	13,164	13,250	13,593	13,745	10,320	10,630	10,766	11,128	7,213	8,369	7,542	8,718	3,651	3,866	3,844	3,925
Aug	9,383	9,502	9,614	9,745	6,264	6,598	6,501	6,851	5,305	6,237	5,499	6,495	1,953	2,071	2,034	2,151
Sep	9,334	9,454	9,563	9,694	6,212	6,546	6,447	6,797	5,280	6,210	5,473	6,467	1,931	2,048	2,011	2,128
Oct	9,189	9,310	9,400	9,540	6,056	6,391	6,280	6,632	5,207	6,128	5,441	6,381	1,866	1,979	1,969	2,060
Nov	8,559	8,686	8,742	8,874	5,380	5,719	5,573	5,919	4,889	5,772	5,107	6,011	1,583	1,680	1,675	1,764
Dec	9,819	9,935	10,073	10,207	6,732	7,063	6,993	7,345	5,525	6,483	5,735	6,752	2,149	2,278	2,243	2,356
Ave.	13,919	13,998	14,387	14,544	11,130	11,436	11,618	11,982	7,594	8,795	7,958	9,162	3,990	4,225	4,279	4,279

Table 8b. GIWW and Grand Bayou Canal flows in cfs for FWOP and Alt2 FWP.

	GIWW west of Houma				GIWW east of Houma				GIWW east of Company Canal				GIWW east of Larose				Grand Bayou Canal (-flow to south)			
	FWOP	FWP	FWOP	FWP	FWOP	FWP	FWOP	FWP	FWOP	FWP	FWOP	FWP	FWOP	FWP	FWOP	FWP	FWOP	FWP	FWOP	FWP
	TY1	TY1	TY10	TY10	TY1	TY1	TY10	TY10	TY1	TY1	TY10	TY10	TY1	TY1	TY10	TY10	TY1	TY1	TY10	TY10
Jan	6,044	6,598	6,396	6,398	2,549	3,005	2,914	3,176	1,579	1,953	1,827	1,977	1,509	1,372	1,968	1,487	-235	-1,119	-203	-1,273
Feb	7,957	8,791	8,447	8,452	3,101	3,820	3,619	4,121	1,819	2,421	2,180	2,500	1,834	1,603	2,504	1,732	-352	-1,722	-307	-1,953
Mar	9,481	10,538	10,080	10,088	3,541	4,468	4,180	4,873	2,011	2,794	2,461	2,917	2,092	1,787	2,932	1,927	-445	-2,202	-389	-2,494
Apr	9,374	10,416	9,966	9,973	3,510	4,423	4,141	4,821	1,998	2,768	2,441	2,887	2,074	1,774	2,902	1,914	-439	-2,168	-384	-2,457
May	11,536	12,893	12,283	12,293	4,133	5,343	4,937	5,888	2,269	3,296	2,839	3,479	2,441	2,035	3,508	2,191	-571	-2,850	-501	-3,225
Jun	10,437	11,634	11,106	11,114	3,817	4,876	4,533	5,346	2,131	3,028	2,637	3,178	2,254	1,902	3,200	2,050	-504	-2,503	-441	-2,834
Jul	5,654	6,151	5,978	5,980	2,437	2,840	2,771	2,984	1,530	1,858	1,756	1,870	1,443	1,325	1,858	1,437	-211	-996	-182	-1,135
Aug	2,890	2,983	3,015	3,013	1,639	1,663	1,752	1,619	1,183	1,182	1,247	1,114	974	992	1,083	1,084	-41	-125	-33	-152
Sep	2,855	2,942	2,977	2,975	1,629	1,648	1,739	1,601	1,178	1,173	1,240	1,104	968	988	1,073	1,079	-39	-114	-31	-140
Oct	2,749	2,821	2,748	2,861	1,598	1,603	1,600	1,549	1,165	1,147	1,119	1,075	950	975	1,111	1,065	-33	-81	-37	-102
Nov	2,288	2,293	2,267	2,367	1,466	1,407	1,409	1,321	1,107	1,035	1,020	949	872	919	974	1,006	-5	65	-11	62
Dec	3,209	3,349	3,357	3,356	1,731	1,799	1,870	1,776	1,223	1,260	1,305	1,201	1,028	1,030	1,173	1,124	-61	-226	-50	-266
Ave.	6,206	6,784	6,552	6,573	2,596	3,075	2,955	3,256	1,600	1,993	1,839	2,021	1,537	1,392	2,024	1,508	-245	-1,170	-214	-1,331

(measure WD3), bank armoring measures (WO2 and WO1), the GIWW constriction by-pass in Houma, the Grand Pass plug (measure WP1), the enlargement of Grand Bayou Canal in the eastern study area, and possibly other measures. GIWW flow increases in the central and eastern study areas may also be due to Grand Bayou enlargement, the GIWW constriction by-pass in Houma and other measures.

The Morganza to the Gulf Hurricane Protection Project was assumed to become functional in TY10. FWOP HNC Lock operations, were simulated as lock closure during the months of October and November for the purpose of saltwater intrusion abatement. Otherwise, the Morganza Project was assumed to have no effects. FWP HNC Lock Multi-Purpose Operations (MPO), were simulated as the year-round closure of the HNC Lock (beginning in TY10). The HNC Lock operations appear to generally increase eastward GIWW flows under both FWOP and FWP. The Morganza Project's GIWW floodgate east of Bayou Lafourche was not included in the hydraulic model, hence, effects of that structure on area hydrology were not simulated. Depending on its size and depth, that floodgate might further impede GIWW flow entering the Barataria Basin and increase freshwater flow down Grand Bayou.

FWOP and TSP flows through un-improved channels that typically carry GIWW southward are provided (Table 9). The predicted FWOP northward flow in both Bayou Copasaw and Minors Canal is contrary to observed flow direction. Consequently, the predicted TSP northward flows are also questionable. Predicted Minors Canals flows were among several discharge measurements used to calculate FWP flow increases and associated TSP wetland benefits in subunits A6, A7, Lake Pagie. Southward freshwater discharge in Grand Bayou would be substantially increased there under the TSP and other alternatives which include those same channel enlargement measures (Table 8b).

Table 9. FWOP and TSP discharge in un-improved channels connected to the GIWW.

	Bayou Pechant mouth (+flow to south)				Bayou Copasaw head (-flow to south)				Minors Canal (+flow to south)				Company Canal south of GIWW (-flow to south)			
	FWOP TY1	FWP TY1	FWOP TY10	FWP TY10	FWOP TY1	FWP TY1	FWOP TY10	FWP TY10	FWOP TY1	FWP TY1	FWOP TY10	FWP TY10	FWOP TY1	FWP TY1	FWOP TY10	FWP TY10
Jan	1,614	2,456	2,622	2,539	1,004	1,004	1,087	1,031	-112	-199	-171	-181	-200	839	-154	-110
Feb	1,629	2,922	3,125	3,022	1,283	1,256	1,414	1,330	-222	-362	-312	-336	-305	997	-235	-162
Mar	1,642	3,293	3,525	3,407	1,505	1,457	1,674	1,569	-309	-491	-425	-460	-388	1,123	-300	-204
Apr	1,641	3,268	3,497	3,380	1,489	1,443	1,656	1,552	-303	-482	-417	-451	-382	1,114	-296	-201
May	1,659	3,794	4,066	3,926	1,804	1,728	2,025	1,891	-427	-666	-577	-626	-501	1,292	-388	-260
Jun	1,650	3,527	3,777	3,649	1,644	1,583	1,838	1,719	-364	-573	-496	-537	-440	1,202	-341	-230
Jul	1,611	2,361	2,519	2,440	947	953	1,020	970	-89	-166	-142	-150	-179	807	-137	-100
Aug	1,588	1,688	1,793	1,742	544	589	548	537	70	69	63	74	-27	579	-19	-24
Sep	1,588	1,679	1,783	1,733	539	584	541	532	72	72	65	77	-25	576	-18	-23
Oct	1,587	1,653	1,751	1,706	523	570	464	515	78	81	79	86	-20	567	-19	-20
Nov	1,583	1,541	1,635	1,590	456	509	384	443	104	121	110	123	6	529	1	-8
Dec	1,591	1,765	1,876	1,823	591	631	602	587	51	42	39	48	-45	605	-33	-33
Ave.	1,615	2,496	2,664	2,580	1,027	1,025	1,104	1,056	-121	-213	-182	-194	-209	852	-162	-115

Normally, the majority of GIWW freshwater entering Houma exits to the Gulf via the HNC. Under the TSP, the additional discharges from the Bay Chene/GIWW system via measure WD2 and the Grand Bayou enlargement measures, may be responsible for the slight TY1 reduction in southward HNC flows (Table 10). Although it can not be determined from the presented information, measure WD3 (enlargement of the GIWW constriction between Bayou Black and Bay Wallace) likely compensates for those additional discharges from the GIWW, thus minimizing FWP flow reductions to the HNC and elsewhere. Once the Morganza system becomes operational in TY10, the FWOP HNC Lock would be closed during October and November for saltwater intrusion abatement. Those Lock closures substantially reduce exchange through the HNC Lock during those months (as per flows at the HNC south of BGC). The MPO result in a substantial year-round reduction in southward flows (see Table 10, HNC south of BGC, FWP TY10).

Table 10. FWOP and TSP discharge at locations on the HNC

	HNC head				HNC @ pontoon bridge				HNC south of BGC			
	FWOP TY1	FWP TY1	FWOP TY10	FWP TY10	FWOP TY1	FWP TY1	FWOP TY10	FWP TY10	FWOP TY1	FWP TY1	FWOP TY10	FWP TY10
Jan	4,329	4,140	4355	3261	5,206	5,468	5357	3417	5,128	5,592	5422	1773
Feb	5,269	5,207	5260	4234	5,950	6,021	6039	3946	5,523	6,017	5760	1874
Mar	6,017	6,056	5981	5009	6,542	6,462	6582	4368	5,838	6,356	6029	1954
Apr	5,965	5,997	5931	4955	6,501	6,431	6544	4338	5,816	6,333	6011	1948
May	7,027	7,202	6953	6054	7,341	7,056	7314	4936	6,262	6,813	6393	2062
Jun	6,487	6,590	6434	5495	6,914	6,739	6923	4632	6,035	6,569	6199	2004
Jul	4,138	3,923	4171	3062	5,054	5,355	5218	3309	5,048	5,505	5353	1753
Aug	2,780	2,382	2863	1656	3,979	4,556	4233	2545	4,477	4,890	4864	1607
Sep	2,763	2,362	2847	1638	3,965	4,545	4221	2535	4,470	4,882	4858	1605
Oct	2,711	2,303	1812	1584	3,924	4,515	2259	2505	4,448	4,859	1527	1600
Nov	2,484	2,046	1578	1350	3,745	4,381	2087	2378	4,353	4,756	1510	1575
Dec	2,937	2,560	3014	1819	4,103	4,648	4347	2633	4,543	4,961	4921	1624
Ave.	4,409	4,231	4,267	3,343	5,269	5,515	5,094	3,462	5,162	5,628	4,904	1,782

Measure WD2 (the enlargement of the relic Carencro Bayou), a 140-foot-wide freshwater conveyance channel from Bayou Penchant to Little Carencro Bayou (Figure 15), provides the first major freshwater introduction opportunity from the Bayou Chene/GIWW conduit. Consequently, WD2 captures more discharge than any other gravity-flow freshwater introduction measure (up to 4,100 cfs), and hence, it provides more benefit than any other evaluated measure.

Although WD2 and all freshwater introduction measures were evaluated as providing no sediment input benefits, the occasional presence of turbid water in Bayou Penchant suggests that some sediment accretion benefits might be possible at times in the area influenced by WD2. The 319-acre construction impact for WD2 would be located in the Carencro subunit, and was assessed independently of the freshwater introduction benefits, which were assumed to be confined to the A6, A7, and Lake Pagie subunits. FWOP salinity modeling incorrectly incorporated salinity reduction effects associated with an assumed smaller FWOP WD2 channel. Consequently, the FWP salinity reduction benefits for the affected area may underestimate WD2 salinity lowering effects.

Alt7 does not include measure WD2. The resulting Alt7 benefits to the A6, A7, Lake Pagie area of 430 AAHUs are much less than those alternatives which include WD2. This illustrates the significant benefit associated with measure WD2. Measure WD2 did not include a salinity control structure to preclude northward saltwater intrusion during periods of low Atchafalaya River discharge. However, predicted Carencro subunit average monthly FWP salinities did not differ from FWOP average monthly salinities. The other major project TSP (Alt2) effect in the western study area is the anticipated salinity reduction associated with the combined effects of the proposed Grand Pass plug (measure WP1), in combination with the increased freshwater via WD2 (Table 11).

Figure 15. Location of measure WD2.

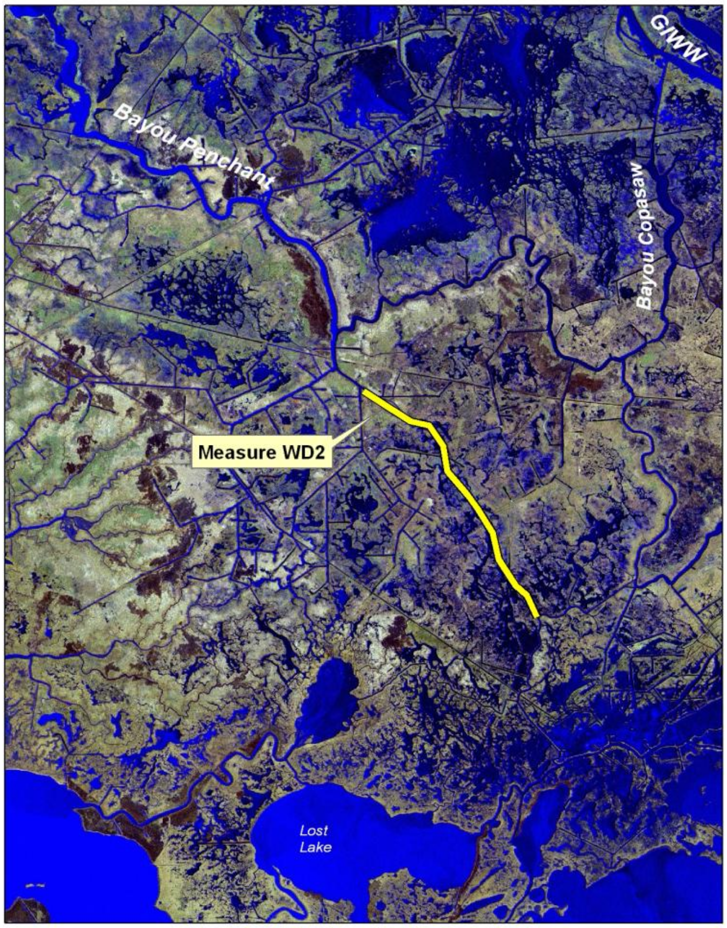


Table 11. FWOP and TSP (Alt2) predicted average annual salinities in the subunits above the Grand Pass plug.

	Lost Lake subunit		
	TY1 (ppt*)	TY10 (ppt)	TY50 (ppt)
FWOP	7.71	7.72	7.44
Alt2	5.19	4.95	4.17

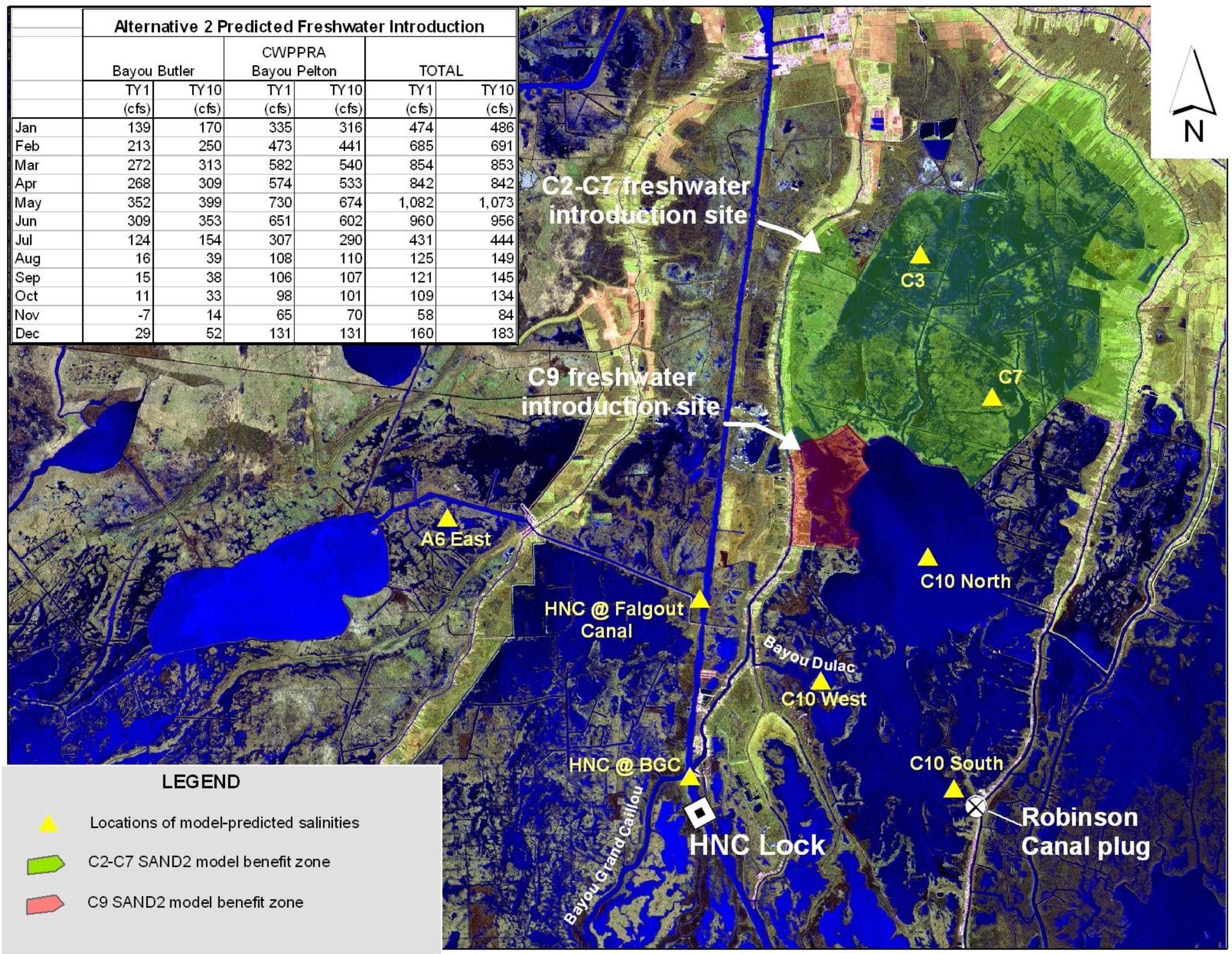
* parts per thousand

	A8 subunit		
	TY1 (ppt)	TY10 (ppt)	TY50 (ppt)
FWOP	3.43	3.36	2.98
Alt2	2.38	2.01	1.46

Alternatives 2-5 and Alt8 included the CWPPRA program's North Lake Boudreaux Basin Freshwater Introduction Project (TE-32a). This project would seasonally introduce HNC freshwater into the upper basin marshes via enlargement of Bayou Pelton and construction of a new conveyance channel (Figure 16). The associated freshwater introduction benefits to the north Lake Boudreaux Basin marshes (subunits C2 through C7), are fairly consistent across alternatives (Tables 5 and 6), suggesting that the water introduced into this area from the upper HNC tends to be fairly independent of other measures. Because the Grand Bayou pumping alternatives (Alts 4 and 5) draw large volumes of water out of the GIWW, it appears they may reduce the availability of freshwater to the HNC as indicated by the slightly reduced C2-C7 benefits for those alternatives. Salinity effects associated with freshwater inputs into the basin at Bayou Pelton and Bayou Butler (measure CS1), in combination with the Robinson Canal plug (measure CP1), and HNC Lock operations, appear to occur throughout all but the southeastern portion of the basin (Table 12). The increased salinity in the southwestern portion of the basin may be due to insufficient model-predicted mixing of water masses. Despite near basin-wide salinity reductions, the CWPPRA Bayou Pelton freshwater introduction benefits are limited to the upper basin (subunits C2-C7), and the benefits of the Bayou Bulter introduction are limited to subunit C9 (Figure 16).

Figure 16. Lake Boudreaux Basin freshwater introduction sites and locations of salinity outputs.

	Alternative 2 Predicted Freshwater Introduction					
	Bayou Butler		CWPPRA Bayou Pelton		TOTAL	
	TY1 (cfs)	TY10 (cfs)	TY1 (cfs)	TY10 (cfs)	TY1 (cfs)	TY10 (cfs)
Jan	139	170	335	316	474	486
Feb	213	250	473	441	685	691
Mar	272	313	582	540	854	853
Apr	268	309	574	533	842	842
May	352	399	730	674	1,082	1,073
Jun	309	353	651	602	960	956
Jul	124	154	307	290	431	444
Aug	16	39	108	110	125	149
Sep	15	38	106	107	121	145
Oct	11	33	98	101	109	134
Nov	-7	14	65	70	58	84
Dec	29	52	131	131	160	183



TY1 modeling indicates that Bayou Dulac serves to discharge water from the basin under both FWOP and the TSP. Although the FWP waters discharged from the basin range from 7 to 8 ppt, the HNC receiving area apparently increased to over 9 ppt. In TY10, Bayou Dulac flow under both FWOP and the TSP are reversed such that Bayou Dulac provides net inflow to the basin

Table 12. Lake Boudreaux Basin predicted salinities, FWOP and TSP (Alt2).

	Station "C3"		Station "C7"		Station "C10 North"		Station "C10 West"		Station "C10 South"	
	FWOP (ppt)	Alt2 (ppt)	FWOP (ppt)	Alt2 (ppt)	FWOP (ppt)	Alt2 (ppt)	FWOP (ppt)	Alt2 (ppt)	FWOP (ppt)	Alt2 (ppt)
TY1	6.70	1.59	7.55	6.50	8.66	6.12	9.21	7.39	10.52	10.01
TY10	6.71	1.24	7.55	7.21	8.64	6.28	9.17	8.37	10.49	11.17
TY50	6.82	1.86	7.95	7.59	8.97	6.73	9.45	8.26	10.73	10.78

from the HNC. Nevertheless, average annual salinities within portions of the HNC at Bayou Grand Caillou and at Falgout Canal exhibit FWP salinity increases (Table 13). Those salinity increases also occur within Falgout Canal and in eastern portions of subunit A6. The HNC salinity increases might be explained by saltwater moving northward through the lock's sluice gates during the late summer and early fall. The cause of this FWP salinity increase needs to be confirmed. If it is related to operation of the lock sluice gates, revised sluice gate operations should be evaluated to preclude this saltwater intrusion effect.

Table 13. FWOP and TSP (Alt2) predicted salinities north of the HNC lock.

	Station "C10 West"		Station "HNC @ Falgout Canal"		Station "HNC A Bayou Grand		Station "A6 east"	
	FWOP (ppt)	Alt2 (ppt)	FWOP (ppt)	Alt2 (ppt)	FWOP (ppt)	Alt2 (ppt)	FWOP (ppt)	Alt2 (ppt)
TY1	9.21	7.39	3.62	5.41	8.14	9.44	1.24	2.94
TY10	9.17	8.37	3.17	3.91	8.26	9.32	1.03	2.24
TY50	9.45	8.26	2.84	4.18	8.80	9.68	0.86	2.21

Because of the uncertainty regarding the cause of this effect, the benefits of the MPO are difficult to determine. Model parameters governing mixing within the Lake Boudreaux Basin should also be re-examined to confirm that the TY1 mixing value(s) reflect conditions in a relatively shallow open water body subject to tidal currents and considerable wind/wave action. Details regarding the size and operation of sluice gates should be provided and the effects of alternative sluice gate operations should be evaluated.

The estimation of benefits associated with the HNC Lock operation were also hampered to an extent by the accidental omission of the Morganza Project's 2 freshwater introduction structures located along the reach of Falgout Canal between Bayou DuLarge and the HNC. Since then, Corps modelers have estimated that the maximum combined discharge of those structures would be approximately 1,500 cfs (after the Morganza system becomes operational in TY10). The benefits for areas B6 and B7 disclosed in this report do not include the effects associated with the Falgout Canal structures. Preliminary evaluations suggest that benefits to areas B6 and B7 would increase with the additional freshwater input. Because MPO would increase discharge down lower Bayou Grand Caillou (and into B6 via the Falgout Canal structures), it would also reduce freshwater discharge below the Lock. Given that salinity monitoring conducted by the Service has demonstrated that the lateral distribution of freshwater into marshes adjoining the lower HNC is rather limited due apparently to the efficiency and size of the lower HNC, the

Service expected the freshwater deprivation effects to marshes in this area to be minor. According to the methods used, however, those impacts were substantial. Although it is possible that the predicted results are more accurate than initially thought, there are a number of shortcomings that may have resulted in an overestimation of those impacts.

For the hydraulic model to accurately represent this landscape, the model grid should depict the channels, natural bayou banks and other landforms that influence area hydrology. If the model accurately represented area bathymetry/topography, then model results might be used to define an impact area. Because of the shortened study schedule, this more desirable approach could not be taken. Instead, a fairly large impact area was defined (subunits C11 through C14). Because the degree of impact likely decreases with distance from the HNC, use of an excessively large impact area may contribute to an overestimation of impacts.

Wetland acreage losses resulting from freshwater deprivation were quantified by running the SAND2 model "in reverse" so that net freshwater input reductions were input as flow increases. The sign of the resulting positive wetland acreage gains was then changed to a negative (wetland loss). In this very atypical use of the SAND2 model, the results are subject to an increased degree of uncertainty.

The average TY10 monthly Alt2 reduction in freshwater flow south of the HNC Lock is 3,122 cfs (Table 10). However, lower Bayou Grand Caillou receives only an additional 1,277 cfs. Those increased flows account for only 41% of the flow lost to the lower HNC. If the model has the unaccounted 1,845 cfs returning to the HNC through the marsh, then impacts to marshes below the HNC are certainly overestimated. Conversely, if the uncounted for flow is entering areas B6 and B7 through the marsh, then the benefits provided by that flow are not captured in the current analysis. Because of the limited study schedule, there was not sufficient time to address this issue. Consequently, the predicted benefits/impacts associated with the MPO are subject to a high degree of uncertainty.

TSP-related freshwater introduction benefits to eastern study area marshes are limited to Bayou Terrebonne, St. Louis Canal, and Grand Bayou. Although Bayou Terrebonne connects directly to the GIWW, the majority of GIWW water enters Bayou Terrebonne via Company Canal. Most of the fresh water flowing southward down Bayou Terrebonne exits the bayou via Humble Canal to enter subunits E2, E3, and E4. Some Bayou Terrebonne flows may continue down Bayou Terrebonne into subunit D3. However, the increased discharge from the Lake Boudreaux Basin via Boudreaux Canal is likely the primary cause of the observed FWP salinity decreases there. At both TY1 and TY10, the TSP Bayou Terrebonne discharge north of Humble Canal is reduced compared to FWOP. Although this effect might be correct, hydraulic model calibration was difficult in this area as the model was calibrated without simulating the actual Bayou Terrebonne floodgate closure for high water conditions which occurred during the period when model calibration data were collected. Although this issue has increased uncertainty regarding project benefits in this area, the very high loss rates in this area would likely overwhelm any small to medium freshwater flow increase.

Although the St. Louis Canal once allowed a small volume of GIWW freshwater to flow southward into Bayou Pointe au Chene, recently constructed plugs have eliminated those freshwater inputs. Model results did not include the effects of those plugs, and have incorrectly indicated the presence of FWOP flows. Additionally, the TSP was determined to reduce those FWOP freshwater inputs. This FWP flow reduction may be related to model issues regarding the influence of the larger volumes being introduced via Grand Bayou. Use of the provided FWOP and FWP model-predicted flows result in a predicted FWP reduction of freshwater inputs into areas G1and G5. Hence, this measure was determined as causing net wetland loss due primarily to channel construction impacts. There was not sufficient time to correct this and other errors.

The proposed enlargement of Grand Bayou is the second most beneficial measure(s) evaluated. Much of the GIWW flow that would otherwise continue eastward into the Barataria Basin is redirected southward into the Grand Bayou system (Table 8b). Wetland impacts associated with channel enlargement initially result in TY1 impacts. However, benefits associated with the freshwater introduction soon begin producing net benefits. Because there was insufficient time to evaluate various alternative channel sizes and designs, only one enlargement design was modeled. The design chosen for evaluation in this study, an "east-branch" 7,500 square foot cross-section channel which was the preferred design among the alternative channels evaluated under the CWPPRA program's Central and East Terrebonne Freshwater Delivery Project. However, modeling difficulties experienced under the CWPPRA effort may have affected results to the extent that selection of a preferred design would be inadvisable. Given this situation, it was assumed the ARTM modeling would correct and re-evaluate alternative channel designs, but the ARTM study schedule did not allow for that. Also, the channel design evaluated under the ARTM modeling included dredging measure ED7, which was not part of the CWPPRA design. Hence, the ARTM-determined construction impacts are in excess of that needed as the ARTM design included more channel enlargements than did the CWPPRA-preferred design. Consequently, without further evaluation, it cannot be determined that the most cost-effective and least damaging Grand Bayou alternative channel was selected.

Table 14. FWOP and FWP freshwater inputs into the Grand Bayou system.

	Predicted freshwater inputs to Grand Bayou Canal (- flow to south)							
	FWOP	Alt2	Alt3	Alt4	Alt5	Alt6	Alt7	Alt8
	TY1	TY1	TY1	TY1	TY1	TY1	TY1	TY1
	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)	(cfs)
Jan	-235	-1,119	-1,152	-3,999	-3,999	-843	-235	-987
Feb	-352	-1,722	-1,770	-3,999	-3,999	-1,276	-352	-1,514
Mar	-445	-2,202	-2,203	-3,999	-3,999	-1,574	-445	-1,934
Apr	-439	-2,168	-2,170	-3,999	-3,999	-1,551	-439	-1,905
May	-571	-2,850	-2,850	-3,999	-3,999	-2,025	-571	-2,501
Jun	-504	-2,503	-2,504	-3,999	-3,999	-1,784	-504	-2,198
Jul	-211	-996	-1,027	-3,999	-3,999	-755	-211	-880
Aug	-41	-125	-135	-3,999	-3,999	-131	-41	-118
Sep	-39	-114	-123	-3,999	-3,999	-123	-39	-108
Oct	-33	-81	-89	-3,999	-3,999	-99	-33	-79
Nov	-5	65	60	-3,999	-3,999	5	-5	48
Dec	-61	-226	-238	-3,999	-3,999	-203	-61	-206
Ave.	-245	-1,170	-1,183	-3,999	-3,999	-863	-245	-1,032

The Grand Bayou area FWP salinity reductions are proportional to the additional freshwater input (Table 14). The pumping alternatives (Alts 4 and 5) would introduce the most additional freshwater. In reality, however, pump discharge would likely have to greatly reduced or halted during the fall months as pump operation would likely pull in brackish waters from the Barataria Basin or elsewhere. Gravity flow alternatives would introduce up to 1,300 cfs of additional freshwater to the Grand Bayou system.

The TSP and other gravity flow alternatives would result in FWP salinity reductions southward through subunit G6 and into G7 (Table 15). However, the freshwater introduction influence area was extended southward to include G7 only for the pumping alternatives (Alts 4 and 5), as the G7 area experiences a more significant salinity lowering than for the gravity-flow alternatives. Although the gravity flow alternatives would theoretically provide salinity reduction benefits to area G7, the average annual salinity used in the WVA analysis (i.e., Variable 5) does not capture those benefits as salinities ranging from 0 to 20 ppt are considered optimal and of equal suitability for saline marshes.

Monthly salinity data also reveal that project-related channel enlargement may encourage salinity increases during the fall months when Atchafalaya River inputs are at their lowest (Table 15). Those saltwater intrusion effects appear to be greatest near the northern end of the enlarged channels (subunit G2) and least in areas south of the enlarged channel. Effects of FWP salinity change for the brackish marshes of the Grand Bayou freshwater influence area would be captured by the WVA's Variable 5 (average annual salinity value). Since optimal brackish marsh average annual salinities range from 0 to 10 ppt in the brackish marsh WVA model, that model does not capture many of the FWP salinity reduction effects for the G2, G3, and G6 influence areas (Table 16).

In the Grand Bayou marshes and other areas where wetland acreage declined rapidly during the project life, a flaw in the application of the SAND2 model was discovered which causes an overestimation of freshwater introduction benefits toward the end of the project life. Because there was not sufficient time to correct this problem, the results presented here (Tables 5 and 6) may overestimate the actual freshwater introduction benefits. The -40 AAHU benefit for area G2,G3,G6 under Alt7 is also an error. This alternative does not include measures in the Grand Bayou area, and therefore, there should be no benefits or impacts.

Alternatives 2 - 5 and alternative 8, include a plug on the Cutoff Canal (measure EP7) where it was dredged through the Bayou Pointe au Chene ridge. Theoretically, this outfall management feature would increase benefits to the upstream G2, G3, and G6 areas. However, the Cutoff Canal plug would also reduce freshwater input benefits to the downstream subunit F2. Consequently, F2 shows net impacts under alts 2-5, and Alt8 (Table 5). Those impacts were generated using the SAND2 model "in reverse" as if freshwater were being introduced directly into F2. However, the TY1 average annual FWOP F2 salinity of 16.0 ppt, and the FWP salinity of 16.9 ppt illustrate that the plug does not appear to markedly affect F2 salinities. If nutrient inputs would exhibit the same minimal changes due to the Cutoff Canal plug as the salinities, then the SAND2 model-predicted impacts for area F2 may be overestimated.

Table 15. FWOP and FWP monthly salinities for areas G2, G6, and G7.

G2 Salinities								
TY1	**FWOP**	**Alt2**	**Alt3**	**Alt4**	**Alt5**	**Alt6**	**Alt7**	**Alt8**
Jan	3.87	3.49	3.02	2.07	2.02	2.85	3.87	3.85
Feb	3.53	2.67	1.97	1.67	1.61	1.86	3.53	3.33
Mar	3.26	2.01	2.00	1.36	1.35	1.99	3.26	2.91
Apr	3.28	2.06	2.05	1.38	1.37	2.04	3.28	2.94
May	2.90	1.12	1.12	0.93	0.93	1.19	2.90	2.35
Jun	3.10	1.60	1.59	1.16	1.16	1.62	3.10	2.65
Jul	3.94	3.66	3.23	2.15	2.10	3.05	3.94	3.96
Aug	4.43	4.86	4.75	2.72	2.70	4.49	4.43	4.72
Sep	4.44	4.87	4.77	2.73	2.71	4.51	4.44	4.73
Oct	4.46	4.92	4.83	2.75	2.73	4.56	4.46	4.75
Nov	4.54	5.12	5.08	2.85	2.83	4.80	4.54	4.88
Dec	4.38	4.72	4.58	2.66	2.63	4.32	4.38	4.63
Avg	3.85	3.42	3.25	2.04	2.01	3.11	3.85	3.81
TY10	**FWOP**	**Alt2**	**Alt3**	**Alt4**	**Alt5**	**Alt6**	**Alt7**	**Alt8**
Jan	4.08	3.77	3.73	2.03	2.02	3.01	3.93	3.69
Feb	3.74	2.87	2.83	1.65	1.65	1.96	3.59	2.91
Mar	3.47	2.16	2.15	1.36	1.36	2.15	3.32	2.30
Apr	3.49	2.21	2.20	1.38	1.38	2.19	3.34	2.34
May	3.11	1.20	1.20	0.96	0.96	1.31	2.96	1.46
Jun	3.30	1.71	1.71	1.17	1.17	1.76	3.15	1.91
Jul	4.15	3.95	3.91	2.10	2.09	3.22	4.00	3.85
Aug	4.63	5.24	5.21	2.64	2.63	4.74	4.49	4.97
Sep	4.64	5.26	5.22	2.65	2.64	4.76	4.49	4.99
Oct	4.51	5.31	5.27	2.67	2.66	4.81	4.51	5.03
Nov	4.59	5.52	5.49	2.76	2.75	5.07	4.59	5.22
Dec	4.58	5.09	5.06	2.58	2.57	4.56	4.43	4.84
Avg	4.02	3.69	3.66	2.00	1.99	3.29	3.90	3.63
TY50	**FWOP**	**Alt2**	**Alt3**	**Alt4**	**Alt5**	**Alt6**	**Alt7**	**Alt8**
Jan	5.00	4.59	4.43	2.50	2.48	4.35	4.73	3.94
Feb	4.60	3.47	3.28	2.07	2.07	3.40	4.39	2.98
Mar	4.28	2.57	2.55	1.74	1.73	2.65	4.13	2.21
Apr	4.30	2.64	2.62	1.76	1.75	2.70	4.14	2.26
May	3.85	1.37	1.37	1.28	1.28	1.63	3.77	1.17
Jun	4.08	2.01	2.00	1.52	1.52	2.17	3.96	1.73
Jul	5.08	4.82	4.67	2.59	2.57	4.54	4.80	4.13
Aug	5.65	6.44	6.34	3.20	3.17	5.91	5.28	5.53
Sep	5.66	6.46	6.36	3.21	3.18	5.93	5.29	5.54
Oct	5.30	6.52	6.42	3.23	3.21	5.98	5.30	5.60
Nov	5.39	6.79	6.70	3.33	3.31	6.21	5.39	5.83
Dec	5.59	6.25	6.14	3.13	3.10	5.75	5.22	5.37
Avg	4.90	4.50	4.41	2.46	2.45	4.27	4.70	3.86

G6 Average Salinities								
TY1	**FWOP**	**Alt2**	**Alt3**	**Alt4**	**Alt5**	**Alt6**	**Alt7**	**Alt8**
Jan	11.29	8.68	8.26	1.76	1.76	8.73	11.29	8.75
Feb	9.90	5.99	5.38	1.38	1.38	5.69	9.90	6.30
Mar	8.79	3.86	3.85	1.09	1.08	5.18	8.79	4.34
Apr	8.86	4.01	4.00	1.11	1.10	5.32	8.86	4.47
May	7.29	0.97	0.97	0.68	0.68	2.46	7.29	1.70
Jun	8.09	2.52	2.51	0.90	0.90	3.91	8.09	3.11
Jul	11.57	9.23	8.85	1.84	1.83	9.35	11.57	9.25
Aug	13.59	13.10	13.01	2.38	2.37	13.74	13.59	12.81
Sep	13.61	13.15	13.06	2.39	2.38	13.79	13.61	12.85
Oct	13.69	13.30	13.22	2.41	2.40	13.96	13.69	12.99
Nov	14.03	13.95	13.92	2.50	2.49	14.69	14.03	13.58
Dec	13.35	12.66	12.53	2.32	2.31	13.23	13.35	12.40
Avg	11.17	8.45	8.30	1.73	1.72	9.17	11.17	8.55
TY10	**FWOP**	**Alt2**	**Alt3**	**Alt4**	**Alt5**	**Alt6**	**Alt7**	**Alt8**
Jan	11.71	9.06	9.00	1.85	1.84	8.84	11.21	8.92
Feb	10.26	6.25	6.18	1.51	1.51	5.76	9.87	6.24
Mar	9.10	4.02	4.01	1.25	1.25	5.28	8.81	4.11
Apr	9.18	4.17	4.16	1.27	1.27	5.42	8.88	4.26
May	7.53	1.00	1.00	0.90	0.90	2.53	7.37	1.23
Jun	8.37	2.61	2.61	1.09	1.09	4.00	8.14	2.77
Jul	12.01	9.64	9.57	1.91	1.91	9.47	11.49	9.46
Aug	14.11	13.69	13.65	2.39	2.39	13.92	13.42	13.33
Sep	14.14	13.75	13.70	2.40	2.39	13.97	13.45	13.38
Oct	13.52	13.90	13.86	2.42	2.41	14.14	13.52	13.53
Nov	13.84	14.58	14.54	2.50	2.49	14.89	13.84	14.17
Dec	13.87	13.22	13.18	2.34	2.33	13.40	13.20	12.88
Avg	11.47	8.83	8.79	1.82	1.82	9.30	11.10	8.69
TY50	**FWOP**	**Alt2**	**Alt3**	**Alt4**	**Alt5**	**Alt6**	**Alt7**	**Alt8**
Jan	13.08	10.36	9.83	3.38	3.38	11.25	12.57	10.29
Feb	11.46	7.37	6.75	2.95	2.95	8.60	10.95	7.44
Mar	10.16	4.98	4.91	2.61	2.60	6.58	9.65	5.17
Apr	10.25	5.15	5.07	2.63	2.63	6.73	9.74	5.33
May	8.42	1.77	1.77	2.14	2.14	3.76	7.91	2.11
Jun	9.35	3.49	3.45	2.39	2.39	5.27	8.84	3.75
Jul	13.41	10.97	10.46	3.46	3.46	11.79	12.90	10.88
Aug	15.76	15.29	14.92	4.08	4.08	15.62	15.25	14.99
Sep	15.79	15.34	14.98	4.09	4.08	15.67	15.28	15.05
Oct	15.37	15.51	15.15	4.12	4.11	15.82	15.37	15.21
Nov	15.77	16.23	15.89	4.22	4.21	16.46	15.77	15.89
Dec	15.49	14.79	14.40	4.01	4.01	15.18	14.98	14.52
Avg	12.86	10.10	9.80	3.34	3.34	11.06	12.44	10.05

G7 Average Salinities								
TY1	**FWOP**	**Alt2**	**Alt3**	**Alt4**	**Alt5**	**Alt6**	**Alt7**	**Alt8**
Jan	16.88	14.64	12.82	5.13	5.13	12.96	16.88	14.70
Feb	14.53	11.09	8.35	4.53	4.53	8.45	14.53	11.27
Mar	12.66	8.27	8.26	4.05	4.05	10.62	12.66	8.55
Apr	12.79	8.46	8.46	4.08	4.08	10.79	12.79	8.74
May	10.13	4.45	4.45	3.40	3.40	7.42	10.13	4.86
Jun	11.48	6.49	6.49	3.75	3.75	9.13	11.48	6.83
Jul	17.36	15.36	13.73	5.25	5.25	13.88	17.36	15.40
Aug	20.76	20.49	20.18	6.12	6.12	20.40	20.76	20.35
Sep	20.81	20.55	20.26	6.13	6.13	20.49	20.81	20.41
Oct	20.94	20.75	20.51	6.17	6.16	20.74	20.94	20.60
Nov	21.50	21.61	21.59	6.31	6.31	21.82	21.50	21.43
Dec	20.37	19.90	19.44	6.02	6.02	19.65	20.37	19.78
Avg	16.68	14.34	13.71	5.08	5.08	14.70	16.68	14.41
TY10	**FWOP**	**Alt2**	**Alt3**	**Alt4**	**Alt5**	**Alt6**	**Alt7**	**Alt8**
Jan	17.00	14.78	14.69	6.08	6.09	12.82	16.82	14.85
Feb	14.61	11.21	11.08	5.38	5.39	8.36	14.47	11.40
Mar	12.70	8.36	8.36	4.82	4.83	10.61	12.61	8.66
Apr	12.84	8.56	8.56	4.86	4.87	10.77	12.74	8.85
May	10.13	4.52	4.52	4.08	4.08	7.47	10.09	4.96
Jun	11.51	6.57	6.57	4.48	4.48	9.15	11.44	6.94
Jul	17.49	15.51	15.43	6.22	6.23	13.73	17.30	15.55
Aug	20.94	20.68	20.65	7.23	7.24	20.19	20.68	20.53
Sep	20.99	20.74	20.71	7.24	7.25	20.27	20.73	20.59
Oct	20.86	20.94	20.91	7.28	7.29	20.52	20.86	20.79
Nov	21.42	21.80	21.78	7.44	7.46	21.60	21.42	21.62
Dec	20.55	20.08	20.04	7.11	7.12	19.44	20.29	19.96
Avg	16.75	14.48	14.44	6.02	6.03	14.58	16.62	14.56
TY50	**FWOP**	**Alt2**	**Alt3**	**Alt4**	**Alt5**	**Alt6**	**Alt7**	**Alt8**
Jan	17.24	15.56	14.75	10.02	10.02	16.32	17.04	15.64
Feb	14.80	12.20	11.16	8.75	8.76	13.45	14.59	12.42
Mar	12.86	9.52	9.44	7.74	7.74	11.30	12.64	9.86
Apr	12.99	9.71	9.62	7.81	7.81	11.46	12.77	10.04
May	10.24	5.90	5.90	6.38	6.38	8.27	10.00	6.40
Jun	11.64	7.84	7.79	7.11	7.11	9.89	11.41	8.25
Jul	17.73	16.25	15.48	10.27	10.28	16.90	17.54	16.30
Aug	21.25	21.11	20.68	12.10	12.11	21.04	21.08	20.95
Sep	21.30	21.17	20.74	12.13	12.14	21.09	21.12	21.01
Oct	21.26	21.36	20.94	12.20	12.21	21.25	21.26	21.19
Nov	21.85	22.17	21.81	12.50	12.51	21.94	21.85	21.96
Dec	20.85	20.55	20.08	11.89	11.90	20.56	20.67	20.41
Avg	17.00	15.28	14.87	9.91	9.91	16.12	16.83	15.37

Shaded cells indicate FWP salinity increases relative to FWOP.

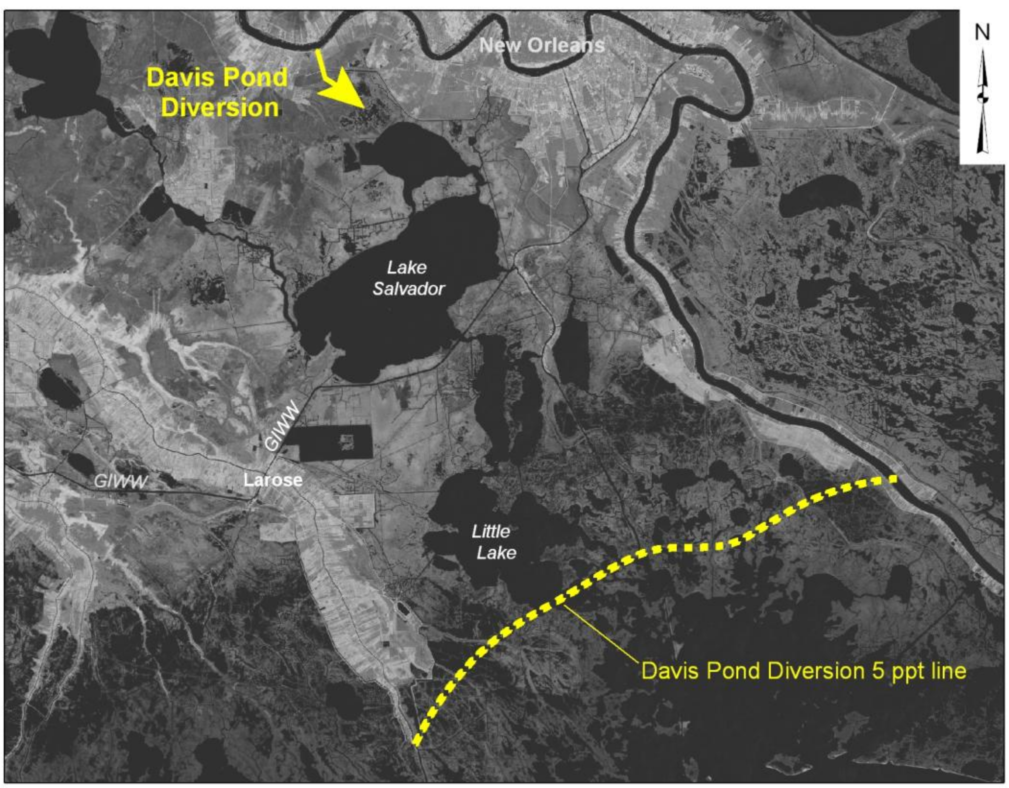
Table 16. FWOP and FWP average annual salinities for influence area G2,G3,G6.

	Alt2 (ppt)	Alt3 (ppt)	Alt4* (ppt)	Alt5* (ppt)	Alt6 (ppt)	Alt7 (ppt)	Alt8 (ppt)
FWOP TY1	8.3	8.3	8.3	8.3	8.3	8.3	8.3
FWP TY1	6.6	6.4	2.8	2.8	6.8	8.3	6.9
FWOP TY10	8.6	8.6	8.6	8.6	8.6	8.6	8.6
FWP TY10	6.9	6.9	3.2	3.2	6.9	8.3	6.8
FWOP TY50	10.0	10.0	10.0	10.0	10.0	10.0	10.0
FWP TY50	8.0	7.8	5.2	5.2	8.4	9.6	7.8

* *pumping alternatives*

Measures to introduce freshwater into the Grand Bayou system would result in up to a 1,300 cfs reduction in freshwater inputs to the Barataria Basin (Table 6a) and an average monthly reduction of 516 cfs. Because the Davis Pond Freshwater Diversion Project operation schedule is designed to introduce freshwater to maintain salinities at the designated 5 ppt isohaline across the basin below Little Lake (Figure 17), the study team assumed that the operation of the Davis Pond Diversion could compensate for the loss of GIWW freshwater inputs to that basin. Consequently, an assessment of GIWW freshwater losses was not conducted within the Barataria Basin.

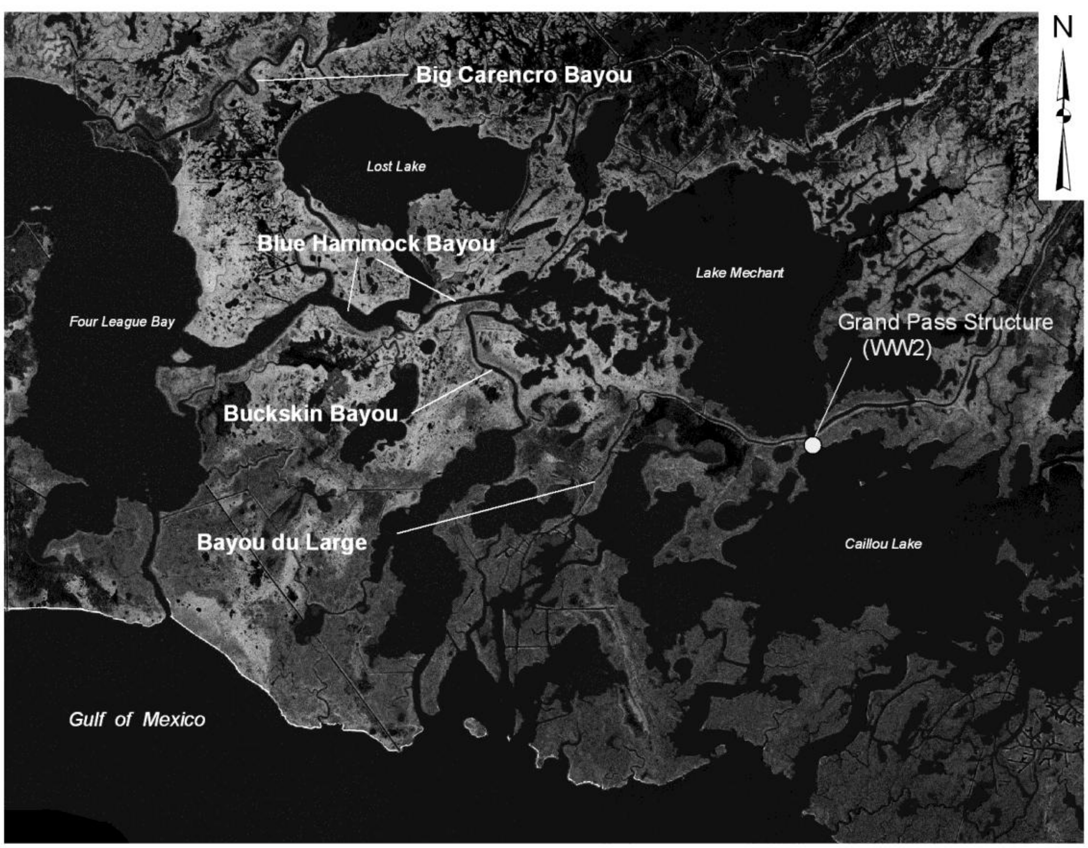
Figure 17. Map depicting the location of the Davis Pond Diversion and the 5 ppt isohaline.



The AAHU benefits presented in Table 5 were calculated without fisheries impacts (WVA Variable 6 = 1.0 for all model runs) for the proposed Grand Pass plug (measure WP1), the Robinson Canal plug (CP1), the Cutoff Canal plug (EP7), and the year-round closure of the HNC Lock associated with the proposed HNC Lock Multi-purpose operations (measure CL1). Each of those measures would correct significant hydrologic alterations on man-made canals which are thought to have been significant causes of wetland degradation and loss. Additionally, the Grand Pass plug would also serve as outfall management for WD2 and other Penchant Basin freshwater introductions. The Robinson Canal plug would provide outfall management for Lake Boudreaux Basin freshwater introduction measures, and the Cutoff Canal plug would provide outfall management for Grand Bayou and St. Louis Canal freshwater introduction measures. Theoretically, those outfall management features would increase the benefits associated with their respective freshwater introduction measures. However, the preliminary application of WVA Variable 6 (fish access variable) results in negative AAHUs for all alternatives, despite net gains in wetland acres.

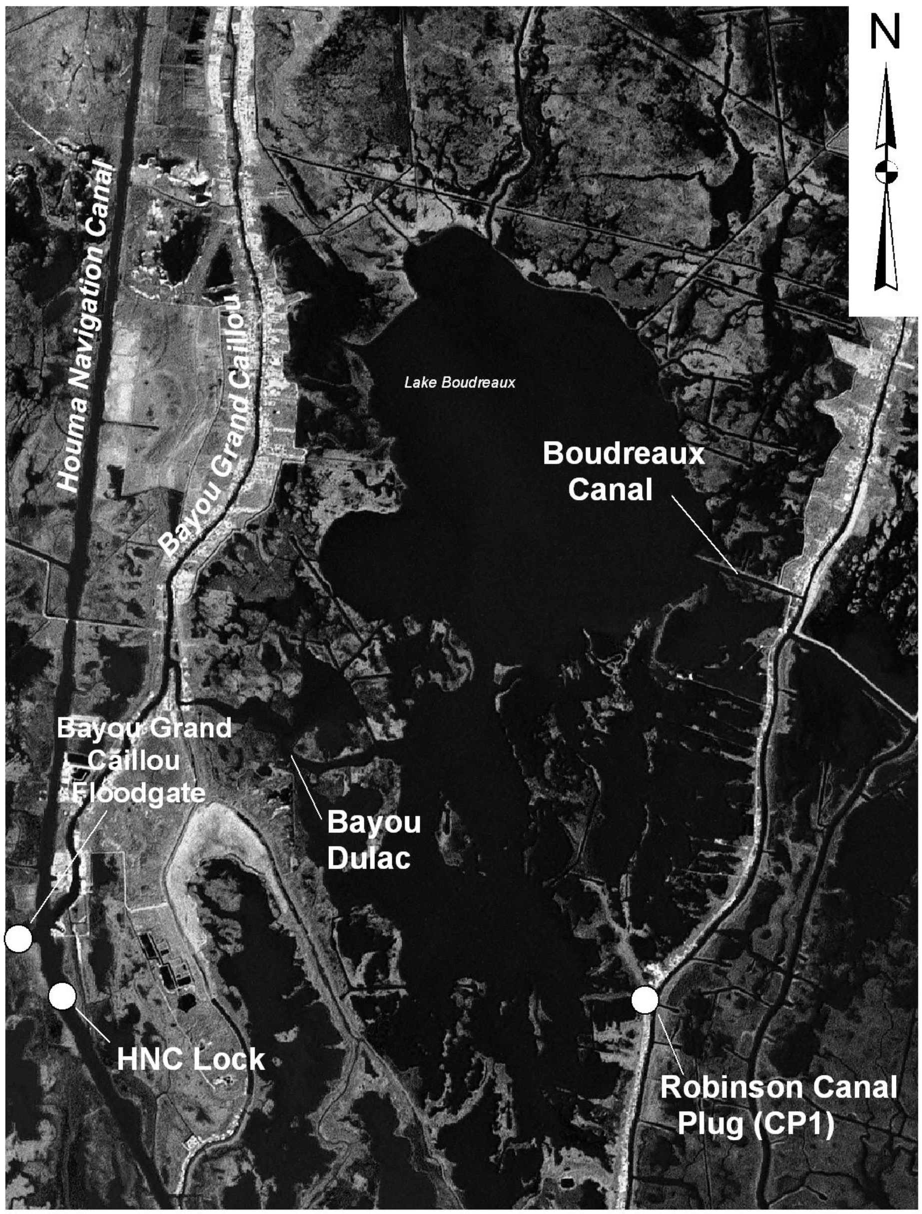
The decision not to apply the typical fisheries access impacts was justified in part by the presence of other pathways for fisheries access. For example, channel cross-section data provided by the Corps indicates that the structure on Grand Pass (measure WW2) would reduce the available cross section of Grand Pass by 94%. However, Big Carencro Bayou, Blue Hammock Bayou, Buckskin Bayou, and Bayou du Large would continue to provide unrestricted water exchange and fisheries access to areas affected by WW2 (Figure 18).

Figure 18. Map delineating alternative fisheries routes for Measure WW2.



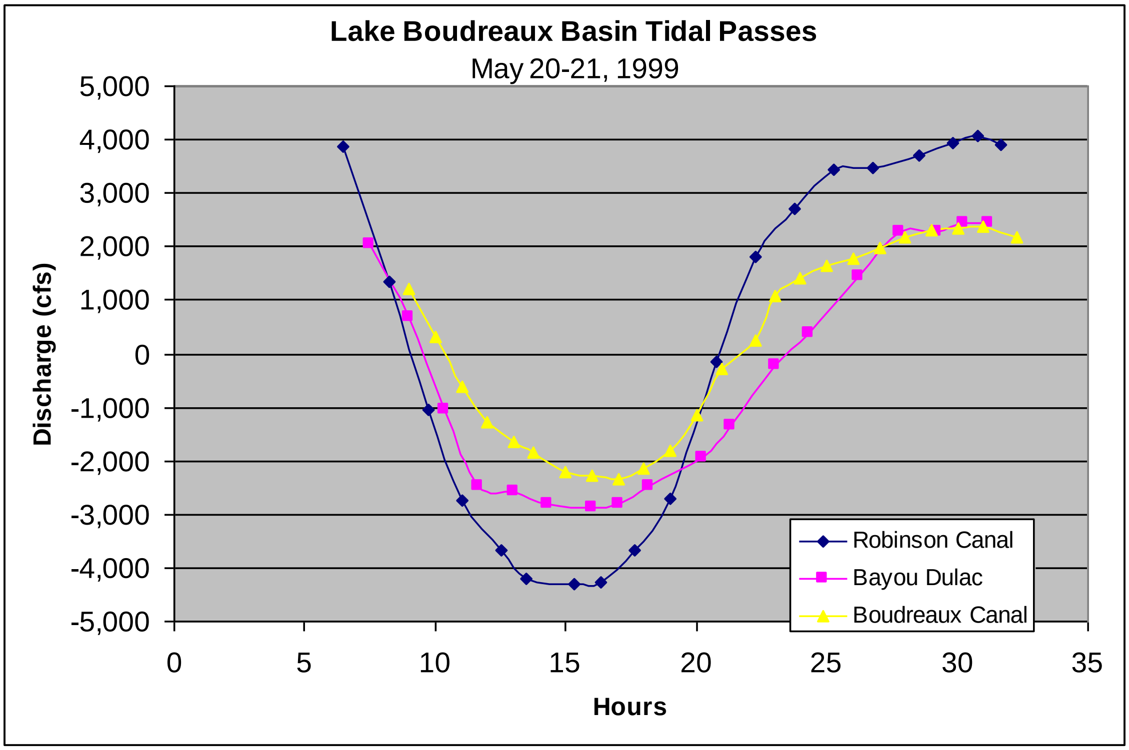
Similarly, the Robinson Canal Plug (measure CP1) would eliminate all fisheries access to the Lake Boudreaux Basin through Robinson Canal (Figure 19). The ARTM project would not affect fisheries access to the Lake Boudreaux Basin via Boudreaux Canal. ARTM-related increased closure duration of the HNC Lock would affect fisheries access to upper Bayou Grand Caillou and thereby to Bayou Dulac

Figure 19. Map delineating alternative fish access routes for Measure CP1.



Comparison of FWOP and FWP (ARTM) total cross channel cross-section may provide a measure of fisheries exchange reduction. However, natural and artificial variations in waterway cross section may make such an analysis questionable depending on where cross section measurements are taken. Concurrent FWOP discharge measurements made by the USGS (Figure 20) indicate that Robinson canal provides 44 to 45% of the total Lake Boudreaux Basin water exchange. Provided that installation of that plug results in no compensatory flow increases, measure CP1 might thereby reduce fisheries access to the basin by 44 to 46%.

Figure 20. Lake Boudreaux Basin tidal pass discharges.

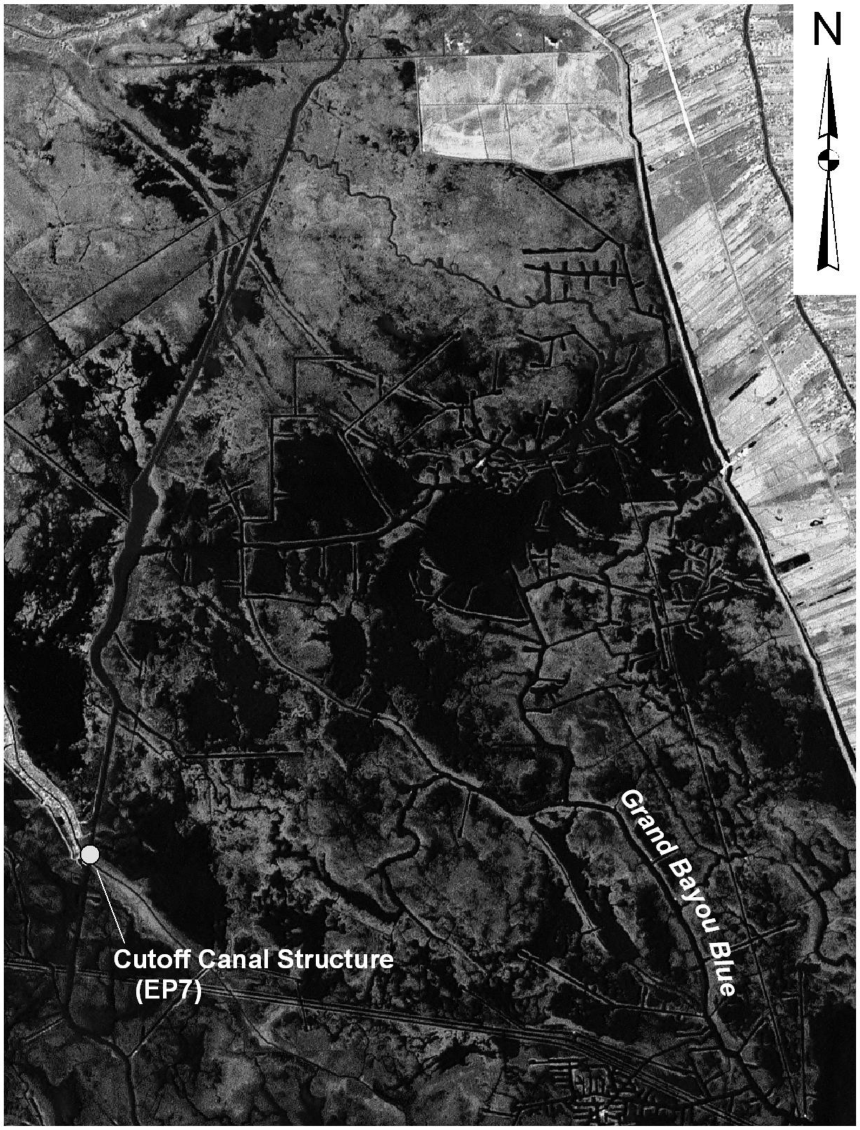


Because ARTM-related HNC Lock closures would impact fisheries access via Bayou Dulac, a further reduction in fisheries access would likely occur. Those impacts, however, affect access provided by man-made canals and it could be argued that they would restore a more natural level of fisheries access.

FWOP water exchange through Bayou Dulac would be affected by the HNC Lock and the Bayou Grand Caillou Floodgate (both are features of the Morganza to the Gulf Hurricane Protection Project). Those Morganza affects, considered as part of the FWOP ARTM condition, have not yet been fully determined as design work for those features is not yet complete, and operation of those Morganza features has not been determined.

According to Corps channel cross-section data, the Cutoff Canal Structure (EP7), would reduce the existing cross section of the Cutoff Canal by 96%. This value may be high because the structure is located in an unusually deep portion of the Cutoff Canal. Grand Bayou Blue also provides a natural alternative fisheries access route to the area impacted by EP7 (Figure 21). When the Grand Bayou Blue cross-section of 2,426 square feet (roughly at the same latitude as EP7) is considered, the total FWP cross section provided by both channels is reduced 52%, from a FWOP value of 5,301 square feet, to a FWP Alt2 value of 2,546 square feet. Given the degraded condition of marshes in the Grand Bayou Blue area, there are also many other unnamed small alternative routes for fisheries access into the area that would further reduce the fisheries access impacts of measure EP7.

Figure 21. Map delineating alternative fisheries access routes for Measure EP7.



Further assessment work is needed to address this apparent conflict between fisheries access and restoration of canal-related hydrologic impacts. That work should include staff from the National Marine Fisheries Service and other interested natural resource agencies.

The results discussed above are for the low SLR scenario. Benefits under the medium SLR scenario were prepared when initial indications suggested that Alt3 was the TSP (Table 17). Time did not allow for the actual TSP (Alt2), to be evaluated under the medium SLR scenario. However, the degree of benefit reduction should be very similar to the 66% reduction in Alt3 TY50 AAHUs.

Table 17. Comparison of TY50 Alt3 benefits under low and medium SLR.

Diversion Influence Area	Alt3 low SLR (AAHUs)	Alt3 med SLR (AAHUs)	Alt3 low SLR (acres)	Alt3 med SLR (acres)
E2-E4	-2	-1	0	0
F2	-13	0	0	0
A6,A7,L.Pagie	2,154	781	8,018	0
B6, B7	872	408	2,833	2,090
Bayou Dulac	-266	5	-252	0
C2-C7	394	145	855	0
C9	263	52	602	0
G1-G5	-216	-169	-253	-222
G2,G3,G6 (G7)	1,203	170	4,880	0
Palm-Creole	0	0	0	0
C11-C14	-921	-198	-6,508	0
SUBTOTAL	3,467	1,192	10,175	1,868
Diversion Independent Measures				
WD2	-165	-165	-319.0	-164.7
WO2	12	67	375.0	67.4
CD1	-1	-1	-3.4	-0.6
CD3	-3	-2	-7.6	-2.4
CD7	-1	3	-6.4	2.9
CT1,6,7,8	19	12	59.0	12.1
EM3	2	23	51.2	23.0
ED5	-5	-4	-14.1	-4.2
SUBTOTAL	-142	-67	134.7	-66.6
TOTAL	3,325	1,126	10,310	1,801

In summary, the TSP's freshwater introduction measures would restore and re-establish natural processes which promote a more self-sustaining ecosystem. Under the low SLR scenario, the TSP would provide an additional 3,220 AAHUs (Table 5), and would reduce wetland loss rates, saving over 9,600 acres of marsh by the end of the 50-year project life (Table 18). Given the FWOP loss of over 101,000 acres by TY50, the TSP (Alt2) would reduce this loss by only 10%. Changes in future habitat types can not be predicted using the methods available, however, the proposed freshwater introduction measures may temporarily halt or reverse the FWOP shift toward more brackish habitat types in the central and eastern study area. Alt2 benefits also include increased habitat diversity (primarily in central and eastern portions of the study area), greater abundance of submerged aquatic vegetation, and a greater proportion of shallow open water habitats.

Table 18. Summary of FWOP and FWP study area acreages by target year.

	FWOP (acres)	FWOP Acres Lost	Alt2 Net (acres)	FWP (acres)
TY0	560,321	0	0	560,321
TY1	557,901	-2,419	-214	557,687
TY10	534,330	-25,991	1,832	536,162
TY50	458,894	-101,427	9,655	468,549

Although the TSP provides much needed wetland restoration benefits, those benefits will not be of sufficient magnitude to prevent all the wetland losses in the central and eastern portions of the study area. While the Service supports implementation of a restoration project within the study area, project cost-constraints have precluded evaluation of larger measures/projects that might provide significantly greater benefits. To significantly increase area self-sustainability, those measures/projects must include larger volumes of freshwater inputs and those inputs must contain reasonable quantities of suspended sediments to counter effects of subsidence and sea level rise. Ideally, such efforts should also integrate hurricane protection planning with coastal wetland restoration so that one does not preclude the other. The Service encourages such planning efforts and is willing to assist in such efforts however possible.

FISH AND WILDLIFE CONSERVATION AND MITIGATION MEASURES

Plan formulation and evaluation shortcomings

Given the very high study area wetland loss rates and the hydrologic complexity of the study area, effective and/or large-scale wetland restoration efforts will likely be costly. Evaluation of such large-scale and more costly restoration opportunities were precluded by project cost limits established in the authorizing legislation (Water Resources Development Act 2007, Title VII, Section 7006). Additionally, because of the time required to complete hydraulic modeling runs and conduct the subsequent analyses, the modeling of numerous alternatives was also precluded by the compressed study schedule. These constraints may have precluded development and analysis of more costly and potentially more effective alternatives, such as larger water control structures in the Avoca Island Cutoff Levee capable of introducing greater volumes of Atchafalaya River water into the Bayou Chene/GIWW conduit.

Although the proposed alternative plans were developed to protect and restore rapidly degrading coastal wetlands, some of the proposed measures would result in direct wetland impacts associated with the dredging of new channels and/or the enlargement of existing channels (Table 19).

Table 19. Summary of construction impacts by habitat type.

Feature Id	Feature Name	Swamp/Wetland Forest (acres)	Fresh Marsh (acres)	Intermediate Marsh (acres)	Brackish Marsh (acres)	Saline Marsh (acres)	Measure Total (acres)
ED2	St. Louis Canal enlargement	98.8		114.0	40.5		253.3
ED3	Upper Grand Bayou Canal enlargement	20.6		120.0	46.8		187.4
ED6	Grand Bayou East Branch enlargement				74.0		74.0
ED7	Lower Grand Bayou Canal enlargement				20.9		20.9
CD1	Bayou Provost enlargement	2.6		5.4			8.0
CD3	East Falgout Canal extension			8.5			8.5
CD7	Bayou Pelton enlargement*	1.5	7.7				9.2
CD6	Lake Boudreaux Water Conveyence Channel*	2.7		48.0			50.7
CLV1	North Forced Drainage Levee			4.9			4.9
CLV2	South Forced Drainage Levee			4.6			4.6
WD2	Relic Carencro Bayou enlargement		319.1				319.1
	TOTAL	126.2	326.8	305.4	182.2	0.0	940.6
	* *Impact estimates from CWPPRA Lake Boudreaux Basin Freshwater Introduction Project (TE-32a)*						

Due to the complexity of this project and the compressed study schedule, there was no opportunity to evaluate alternative sizing of proposed channel construction/enlargement measures to optimize channel size and thereby ensure that unnecessary wetland impacts were avoided. Because model-predicted salinities demonstrate that proposed Grand Bayou channel enlargement measures would result in higher average salinities during the fall months (Table 15), a size/design analysis of the proposed St. Louis Canal and Grand Bayou Canal enlargement measures would also provide an opportunity to determine if other channel sizes or designs might reduce this undesired effect and result in a design with comparable benefits but less impacts.

The only enlargement design of Grand Bayou Canal (in the eastern study area) was the design determined to be most effective under the CWPPRA "Central and East Terrebonne Freshwater Delivery Project." Although that design was based on a hydraulic modeling analysis of various sizes and designs (branching versus straight channels), modeling flaws known to have occurred may have invalidated the results of that modeling effort. Correction of those modeling flaws and modeling re-analysis would be the only way to indentify the most effective Grand Bayou enlargement alternative. Because of the compressed study schedule, this re-analysis could not be done. Instead, the ARTM project had to rely on the faulty CWPPRA project modeling.

A number of known errors and problems affect the ability to determine the benefits/impacts of the proposed HNC Lock Multi-Purpose Operations Project. Those issues include the omission of the Morganza Project's Falgout Canal structures, model mesh detail below the HNC Lock, unexplained increased salinities above the HNC Lock, potential impacts associated with the HNC Lock sluice gate operations, unaccounted for freshwater inputs, and several errors regarding application of the SAND2 model. These issues should be addressed in concert with the National Marine Fisheries Service, the Louisiana Department of Wildlife and Fisheries, and other interested natural resource agencies.

The study schedule also precluded an opportunity to assess the effectiveness of measures to improve delivery of fresh water to central and eastern portions of the study area by enlarging constricted segments of the GIWW. If those measures were found ineffective in increasing freshwater inputs to desired locations, then the associated construction expense may be unnecessary and may result in a project with reduced cost effectiveness. Similarly, the compressed study schedule also precluded opportunities to assess benefits of individual outfall management measures or small groups of outfall management measures. Because these assessments could not be undertaken, the selected plan may not be as cost-effective as possible.

More significantly, the TSP includes 4 plugs on man-made channels (one being the HNC Lock). Although those channels have resulted in major hydrology impacts and are suspected of having increased loss rates of affected wetlands, the proposed plugs would reduce canal-enhanced fisheries access. Preliminary indications are that use of the standard assessment methods for evaluating those fisheries access impacts would result in negative AAHUs for project alternatives containing those plugs. The Service believes that it would be inappropriate to assess full fisheries impacts to those features because they are located on man-made canals and because those features would correct canal-induced adverse hydrologic alterations. Hence, the Service has not proceeded with the standard fisheries access impact assessments.

Methodology shortcomings

The potential fisheries access impacts associated with the Grand Pass plug, the Robinson Canal plug, the Cutoff Canal plug, and the HNC Lock MPO, are not included in the current analysis. Although those plugs would address harmful canal-related wetland impacts, they would also reduce canal-enhanced fisheries access and would therefore result in overall AAHU impacts, according to the standard methodology for assessing such impacts. Because the standard fisheries impact assessments do not consider the fisheries access increases associated with the canal construction, that assessment approach can not only subordinate coastal wetland restoration to fisheries access, but it can also serve to discourage wetland restoration and maintain the status quo. Accordingly, the Service believes that it is inappropriate to assign full fisheries access impacts in cases where natural waterways and/or other canals would remain open to provide access more typical of the natural system.

The Service will proceed with a potentially modified assessment of fisheries impacts in consultation with the National Marine Fisheries Service (NMFS), the Louisiana Department of Wildlife and Fisheries (LDWF), and other interested natural resource agencies. Possible methodology modifications would likely include the consideration of compensatory water exchange increases at other locations due to plug installation. Other modification may also be considered.

Several errors occurred in the “reverse” application of the SAND2 model for determining impacts of project-related freshwater input reductions. Correction of those errors might reduce the negative impacts of freshwater input reductions. Late in the study, it was also discovered that the SAND2 model may begin providing unrealistic freshwater introduction related net wetland acreage gains in areas where marsh loss rates decrease dramatically over time. This methodology error could not be fully corrected prior to preparation of project reports.

Benefits associated with project-related salinity change would normally be captured through use of the WVA marsh models. However, in many cases, both the reduced FWP average salinities and FWOP salinities remained within the broad optimal ranges for the particular marsh model used. As a result, benefits for those salinity reductions were rarely if ever captured in the benefit assessments. Recently developed models are now available which would predict wetland acreage benefits based on salinity-related change using salinity vs primary productivity relationships. Use of those models would allow the project-related salinity change benefits to be captured. However, because those models are not yet certified, Corps policy will not allow them to be used. Because few Corps-approved benefits assessment models/tools are currently available, an undetermined amount of project benefits may be unquantified.

FUTURE SERVICE INVOLVEMENT

Because of the issues discussed above, vital information needed to conduct a proper and reasonable assessment of alternatives and project impacts is unavailable. Consequently, further evaluations are needed. Due to the extent and complexity of remaining benefits assessment work, extensive funding will be needed by the Service to conduct the needed work and participate throughout future detailed planning and post-authorization engineering studies, and to facilitate fulfillment of our reporting responsibilities under Section 2(b) of the Fish and Wildlife Coordination Act. Accordingly, the Service plans to work closely with the Corps and the State of Louisiana to prepare detailed funding estimates to support our continued involvement in this project.

Under provisions of Section 7 of the Endangered Species Act of 1973, as amended, the Service will also assist the Corps to ensure that they will not jeopardize the continued existence of threatened and endangered species, or adversely modify any designated critical habitat. The required consultations will build on the programmatic consultation contained in the Programmatic Environmental Impact Statement for the LCA study.

SUMMARY AND SERVICE POSITION

Having worked very closely with the Corps throughout the formulation and evaluation of project alternatives, we are very familiar with the study's substantial cost and schedule-related constraints, as well as the benefits assessment errors discussed previously. Unfortunately, those constraints have precluded the consideration of truly large-scale ecosystem restoration efforts that are needed in the study area, perhaps more so than anywhere else along the Louisiana coast, due to the hydrologic complexity of the area and its rapid wetland loss rate. Consequently, the TSP should be viewed as an array of short-term measures, and that the assessment of long-term and more effective alternatives remain to be undertaken.

Study schedule constraints have also precluded opportunities for iterative project refinement based on earlier analysis. Because such project refinement could not be undertaken, the TSP may result in unnecessary wetland impacts and reduced project cost effectiveness. The study schedule constraints have also precluded correction of many of the known planning and evaluation errors. However, some of those errors and issues are likely of lesser magnitude than those resulting from the significant uncertainties associated with hydrologic modeling inaccuracies and those of the associated benefits assessment methodologies. When the study schedule precludes correction of known errors and assessment deficiencies, proceeding with authorization and construction of projects is far from ideal. Yet, the need to take quick action to stem rapid degradation and wetland loss may to some extent counterbalance the reasonable expectation to achieve higher-quality planning and benefits assessments. Accordingly, the Service supports implementation of the TSP, provided that the following additional assessment work is continued during the remaining planning phase and completed during the preconstruction, engineering, and design phase, to address outstanding major issues that could result in substantial improvements and/or modifications to the selected plan. Failure to make significant progress on the following recommendations would result in quality of impact/benefits disclosure significantly less than that typically associated with feasibility-level planning and assessment. Furthermore, because of the schedule-driven decision to accept errors, the Service is unable to entirely fulfill our Coordination Act responsibilities until the following major issues are addressed:

1. The Corps shall pursue additional hydrologic modeling and benefit analysis of various sized and designed enlargements of Grand Bayou Canal/Bayou L'Eau Bleu (measures ED3, ED5, ED6, and ED7) to avoid unnecessary construction impacts and unnecessary canal-induced saltwater intrusion impacts. That work should also include efforts to assess project-related effects of reduced freshwater inflows to the Barataria Basin. The Service and other interested natural resource agencies should be involved in this effort.

2. The Corps shall pursue additional hydrologic modeling and benefits analysis of various sized and designed enlargements of St. Louis Canal (measure ED2) to avoid unnecessary construction impacts and unnecessary canal-induced saltwater intrusion impacts. Following those additional assessments (qualitatively or quantitatively), the cost effectiveness of the Grand Bayou and St. Louis Canal enlargements should be ranked to determine whether they both should be included in the TSP. The Service and other interested natural resource agencies should be involved in this effort.

3. The Corps shall pursue additional hydrologic modeling and assessment of benefits and impacts resulting from the HNC Lock Multi-purpose Operations Project to more accurately assess anticipated benefits and impacts, especially that of impacts below the Lock. This revised assessment of HNC Lock Multi-purpose Operations should include the following:
   a) Assess whether the existing model grid in the area south of the HNC Lock is adequate to simulate lock-related hydrology there. If not, revisions to the model grid should be undertaken.
   b) Less than half of the water rerouted from the lower HNC via HNC Lock's MPO is currently accounted for elsewhere. Model results should be re-examined to find the unaccounted for flow and determine a benefit for that flow.
   c) The Morganza Project's Falgout Canal water control structures should be included in the hydraulic model.
   d) Review and correct if necessary, the Lake Boudreaux water mixing parameters within the hydraulic model to validate/correct the predicted trends of FWP increasing salinities north of the HNC Lock.
   e) The FWP increasing salinity trend north of the HNC Lock may be related to operation of the HNC Lock sluice gates. The size and operation of those sluice gates should be described.
   f) If those sluice gates are determined to be the cause of increased FWP salinities north of the HNC Lock, the Service recommends that alternative sluice gate operations should be assessed to avoid FWP salinity increases. The Service and other interested natural resource agencies should be involved in this effort.

4. The Corps shall avoid adverse impacts to bald eagle nesting locations and wading bird colonies through careful design of project features and timing of construction. A qualified biologist should inspect the proposed work site for the presence of undocumented wading bird nesting colonies and bald eagles during the nesting season

(i.e., February 16 through October 31 for wading bird nesting colonies, and October through mid-May for bald eagles).

5. Unless needed for construction of spoil banks, dredged material should be used to create marsh in strategic locations (to the greatest degree possible). The Service and other interested natural resource agencies should be involved in this effort.

6. Operation plans for project water control structures should be developed in coordination with the Service and other interested natural resource agencies. Those operation plans should incorporate flexibility to respond to changing environmental conditions.

7. The Corps shall establish and continue coordination with the Louisiana Department of Wildlife and Fisheries (225/765-2360) regarding the planning of project features that will impact the Pointe-aux-Chenes Wildlife Management Area and State owned and managed oyster seed grounds. Coordination shall also be re-established prior to construction and any subsequent maintenance.

LITERATURE CITED

Louisiana Coastal Wetlands Conservation and Restoration Task Force and the Wetlands Conservation and Restoration Authority. 1998. Coast 2050: Toward a Sustainable Coastal Louisiana. 161 pp.

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Swarzenski, C.M. 2003. Surface-water hydrology of the Gulf Intracoastal Waterway in South-Central Louisiana, 1996-1999. U.S. Geological Survey Professional Paper 1672; prepared in cooperation with the U.S. Army Corps of Engineers, New Orleans District.

Turner, R.E. 1977. Intertidal vegetation and commercial yields of penaeid shrimp. Trans. Am. Fish. Soc. 106:411-416.

APPENDIX A

Letters from the

National Marine Fisheries Service
and the
Louisiana Department of Wildlife and Fisheries

Providing comments on the U.S. Fish and Wildlife Service's
May 2010 Draft Fish and Wildlife Coordination Act Report

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Southeast Regional Office
263 13th Avenue, South
St. Petersburg, Florida 33701

May 19, 2010 F/SER46/RH:jk
225/389-0508

Mr. James F. Boggs, Field Supervisor
Louisiana Field Office
U.S. Fish and Wildlife Service
646 Cajundome Blvd., Suite 400
Lafayette, Louisiana 70506

Dear Mr. Boggs:

NOAA's National Marine Fisheries Service (NMFS) has received the draft Fish and Wildlife Coordination Act Report (Report) on the Louisiana Coastal Area – Convey Atchafalaya River Water to Northern Terrebonne Marshes project and the Multi-purpose Operations of the Houma Navigation Canal Lock project. The Report discusses the U.S. Fish and Wildlife Service's (FWS) findings and recommendations associated with plans to widen and deepen a number of existing distributary channels, install various types of water control structures, and conduct dredging to create marsh. The purpose of the project is to help divert fresh water, nutrients and sediments originating from the Atchafalaya River to help reduce marsh loss rates in portions of Terrebonne and Lafourche Parishes, Louisiana.

As identified in the Report, the Grand Pass plug, Robinson Canal plug, Cutoff Canal plug and year-round closure of the Houma Navigation Canal lock would result in impediments to marine fishery movement over existing conditions. The Report indicates that the use of the standard Wetland Value Assessment methodology would result in negative benefits being attributed to all project alternatives due to required scoring of Variable 6 (the fishery access variable). As such, the FWS decided to deviate from that methodology and left Variable 6 unchanged under future-with and future-without project scenarios. While NMFS understands the rationale for that decision, we recommend the Report be revised to clearly identify alternative fishery access routes where existing migratory pathways are proposed for closure. In addition, the FWS should attempt to quantify existing cross-sectional areas for fishery migrations future-with and future-without the project to support the decision to leave Variable 6 unchanged.

NMFS is aware that the construction of several components, primarily the distributary channels, would result in initial destruction of wetlands. While Table 6 appears to quantify those impacts, the habitat type impacted is not identified. NMFS recommends the Report be revised to identify those components which result in adverse construction impacts to wetlands and to quantify those impacts, by habitat type, as accurately as possible.

According to the Report, implementation of the Tentatively Selected Plan would result in an additional 9,654 acres of marsh over the 50-year life of the project. While detailed review of the Report indicates that wetland loss would occur even with project implementation, it is not clear from the review of tables provided in the document. NMFS recommends a table be added that quantifies acres of various habitat types at various target years, including baseline, future-with and future-without project implementation. NMFS also recommends additional discussion be added that clearly identifies that project implementation would result in a reduction in wetland loss rates, not a net gain in wetland acreage over the future. Lacking that discussion, readers may mistakenly believe that project implementation successfully results in a net gain in wetland acres and that additional restoration efforts may not be warranted.

We appreciate the opportunity to review and comment on this Report. If you have questions concerning our comments, please contact Richard Hartman of my staff at (225) 389-0508, ext 203.

Sincerely,

Richard Hartman

for Miles M. Croom
Assistant Regional Director
Habitat Conservation Division

c:
LA DNR, Consistency, Ducote
F/SER46, Swafford
F/SER4, Dale
Files

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DEPARTMENT OF WILDLIFE AND FISHERIES
OFFICE OF WILDLIFE

ROBERT J. BARHAM
SECRETARY

JIMMY L. ANTHONY
ASSISTANT SECRETARY

July 1, 2010

Attn: Nathan Dayan
Planning, Programs, and Project Management Division
Environmental Planning and Compliance Branch
United States Army Corps of Engineers
P. O. Box 60267
New Orleans, LA 70160-0267

RE: *Application Number: draft EIS LCA-Convey Atchafalaya Water to Northern Terrebonne Marshes*
Applicant: U.S. Army Corps of Engineers-New Orleans Division
Notice Date: May 21, 2010

Dear Mr. Serio:

The professional staff of the Louisiana Department of Wildlife and Fisheries (LDWF) has reviewed the above referenced notice. Based upon this review, the following has been determined:

LDWF believes that operational flexibility should be incorporated into the operation plan and that the plan be modified as needed in response to monitoring and recommendations of regulatory and resource agencies.

All water control structures should be designed to allow for fish passage using the best available science.

Portions of the proposed activity may impact LDWF Wildlife Management Areas. No activities shall occur on any LDWF Wildlife Management Area or Refuge without obtaining a Special Use Permit from LDWF. Please contact Vaughn McDonald at (504) 284-5267 for more information.

The Louisiana Department of Wildlife and Fisheries appreciates the opportunity to review and provide recommendations to you regarding this proposed activity. Please do not hesitate to contact Habitat Section biologist Matthew Weigel at 225-763-3587 should you need further assistance.

Sincerely,

Kyle F. Balkum
Biologist Program Manager

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AN EQUAL OPPORTUNITY EMPLOYER

mw/rb

c: Matthew Weigel, Biologist
Vaughn McDonald, Biologist
Rob Bourgeois, Fisheries Biologist
EPA Marine & Wetlands Section
USFWS Ecological Services