Volume IV

APPENDIX B:

U.S. Fish and Wildlife Service Coordination Letter and Report

→ Bren Haase

United States Department of the Interior

FISH AND WILDLIFE SERVICE
646 Cajundome Blvd.
Suite 400
Lafayette, Louisiana 70506

January 21, 2010

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

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.

Terrebonne Basin Barrier Shoreline Restoration

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

This page intentionally left blank.

United States Department of the Interior

FISH AND WILDLIFE SERVICE
646 Cajundome Blvd.
Suite 400
Lafayette, Louisiana 70506

April 7, 2010

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

Dear Colonel Lee:

The U.S. Fish and Wildlife Service (Service) has reviewed the March 8, 2010, draft Louisiana Coastal Area (LCA) Program: LCA Small Diversion at Convent/Blind River Monitoring and Adaptive Management Plan developed by the LCA Adaptive Management Planning Team in collaboration with the U.S. Army Corps of Engineers (Corps), the Louisiana Office of Coastal Protection and Restoration (LOCPR), and the LCA Science and Technology Program. That feasibility level monitoring and adaptive management plan was developed in accordance with Section 2039 of the Water Resources Development Act of 2007 (WRDA 2007) and implementation guidance for Section 2039 of WRDA 2007 provided by the Corps Headquarters Civil Works Policy and Planning, and Programs Divisions (CECW-PB) Memo dated August 21, 2009. The Service submits the following comments in accordance with the National Environmental Policy Act of 1969 (83 Stat. 852, as amended; 42 U.S.C. 4321 et seq.), and the Fish and Wildlife Coordination Act (48 Stat. 401, as amended; 16 U.S.C. 661 et seq.). The Service has coordinated with NOAA's National Marine Fisheries Service and the Louisiana Department of Wildlife and Fisheries (LDWF), and their comments have been incorporated.

General

The Service recognizes that the monitoring and adaptive management plan has been developed to reflect a level of detail consistent with the project feasibility study, and that a detailed monitoring and adaptive management plan will be drafted as a component of the design document during planning, engineering and design phase. Project delivery team and natural resource agency involvement should continue throughout this iterative plan development process.

Specific

4.2. Monitoring Plan ... Convent/Blind River Project, Objective 1, Monitoring Design, page 9 –

The term "ecological success" appears to be a misnomer in the cited quotation. It is recommended that this term be replaced in the subsequent sections with "project objectives" or "environmental restoration."

4.2. Monitoring Plan … Convent/Blind River Project, Objectives, pages 9-11 – The organization of the monitoring plan is difficult to follow. We recommend for each objective that the "Desired Outcomes" be bulleted and followed by "Performance Measures", "Supporting Information Needs" and "Monitoring Design." It would also be beneficial to see the adaptive management measures outlined in this section once those measures have been more fully developed.

4.2. Monitoring Plan … Convent/Blind River Project, Objective 1, Monitoring Design, page 9 – To measure freshwater distribution during operational events, we recommend also including conductivity, turbidity, and pH parameters as tracers.

4.2. Monitoring Plan … Convent/Blind River Project, Objective 2, Desired Outcome, page 9 – Five years seems arbitrary for determining successful sediment accretion rates. An explanation of the target year for the desired outcome would be beneficial to the reader and future decision makers. Further, it is uncertain how long the project area may take to begin functioning as a healthy and sustainable swamp providing adequate biomass and sediment to achieve and sustain suitable elevations. As noted in Section 6.0, assessments will continue through the life of the project or until it is decided that the project is successful. As the project plans become more formalized we foresee more defined adaptive management measures and expanded monitoring target years should desired outcomes not be achieved.

4.2. Monitoring Plan … Convent/Blind River Project, Objective 2, Performance Measure B, Desired Outcome, page 10 - As we are aware Southeastern Louisiana University monitoring stations are not located within the project area, but are located within other areas of the Maurepas Swamp. Pre-construction measurements have also been obtained by LOCPR's contractor, CDM. We recommend that the Adaptive Management Team coordinate with LOCPR and CDM to obtain that data.

4.2. Monitoring Plan, Performance Measure C, Monitoring Design, page 10 – Hourly turbidity recorders within the outfall canal seem adequate to measure sediment discharge, and additional turbidity recorders at hydrologic sites may not be necessary if rod surface elevation tables are installed. The use of turbidity recorders at hydrologic sites should be reconsidered.

4.2. Monitoring Plan … Convent/Blind River Project, Objective 3, Performance Measure A, Desired Outcome, page 10 – Under "Desired Outcomes" it states that "Operations will determine dry periods." This should be clarified to state that the project will be operated to facilitate dry periods. We expect that dry periods will be dependent on the design and location of the outfall management measures, and adaptively managing those features will be necessary to achieve project goals.

Section 4.2., Objective 3, Performance Measure B, Desired Outcome, page 10 – Both cypress and tupelo are shade intolerant. The desired outcome should be revised to accurately depict the limits of this performance measure. Performance of this measure is dependent on achieving historic hydrologic patterns (extended dry periods) in the swamp and would be more probable in areas that allow sufficient light (i.e., deteriorated swamp habitats that are converting to marsh/open water).

Section 4.2., Objective 3, Performance Measure B, Monitoring Design, Page 10 – Changes in cover classes is not reflected in the Performance Measure. Documenting the increase or decrease in the number of cypress and tupelo should be adequate. If those species decline project success would not be obtained. If it is a goal to document cover class changes, that should be included as a performance measure.

Section 4.2., Objective 4, Page 10 – Hydrologic and water quality parameters are a significant portion of the monitoring procedures and should provide performance measures for improving aquatic habitat within the project area. We recommend revising Objective 4 to include performance measures, desired outcomes, and design relative to improving aquatic habitat based on water quality parameters (i.e., increased dissolved oxygen conditions).

Furthermore, improved fish and wildlife habitat could be also measured indirectly through fish surveys or wildlife surveys, and the Conceptual Ecological Model (page 15) indicates that fish sampling will be performed. The LDWF have historical data on Blind River and is still currently surveying it twice a year in their biological sampling program. We recommend coordinating with the LDWF to incorporate and expand their baseline data to develop performance measures and desired outcomes for this objective; please contact Robert Bourgeois and Heather Finley with LDWF at (225) 765-0765, and (225) 765-2956, respectively.

Section 4.2., Objective 4, Risk Endpoint, page 10 – It is unclear as to the implication of the monitoring decision point titled "Risk Endpoint," and it is only listed as an item under Objective 4. It may be beneficial to the reader to define this and other adaptive management terms in the plan.

Section 4.2.1. Monitoring Procedures, Vegetation, page 11 – This section states that diameter-at-breast height (DBH) of all tagged trees will be measured at regular fixed intervals. These intervals should be identified whether it is annually, biannually, or by using another protocol.

Section 4.2.1. Monitoring Procedures, Vegetation, page 11, and Sediment Accretion and Elevation, page 12 – Reference locations should be designated within the monitoring and adaptive management plan and should be coordinated with LOCPR and CDM who may have already implemented reference locations.

Section 4.2.1. Monitoring Procedures, Hydrology, page 11 – We recommend including conductivity and acidity (pH) in the hydrologic parameters of the interior swamp. We also recommend extending the sampling area and parameters of the open water habitats (i.e., Blind River and Mississippi River Outfall locations) to include the project area drainage channels which support local aquatic habitat. Collecting baseline conditions are important to understand changes to a system relative to an action; therefore, including pre-project sampling should be included.

In regards to tracking the distribution of freshwater and sediments, we recommend considering using satellite photography as an adaptive management tool. Yvonne Allen with the Corps' Engineer Research and Development Center and Eric Glisch with the Corps' New Orleans District have used satellite signatures and gauge data to identify flow paths (and flooding regimes) at different river discharges into the Atchafalaya and Breton basins, respectively. We suggest including this method to supplement the analysis and help identify areas not receiving flow (frequency/duration) and use that information to guide outfall management.

Section 4.2.1. Monitoring Procedures, Water Quality, page 12 – Higher salinity waters within the project area are a result of tropical storm events and possibly severe drought conditions. Hourly measurements seem unnecessary.

Section 6.0, Assessment, page 14 – We recommend development of a table that identifies each performance measure; anticipated completion dates for each phase of the planned assessment action, and expected dates for report dissemination to the Adaptive Management Team and the Program Management Team. We understand that assessment completion and report delivery dates will be tentative and subject to change; however, assurance should be provided that reasonable time frames will be established, and necessary modifications will be identified and brought to the attention of the program managers in a timely manner. In the absence of a schedule for action, data analysis and reporting and identification of needed modifications could be unacceptably delayed or not completed.

Annex 1, Conceptual Ecological Model, Section 2.2, Project Background, page 5 – The last sentence should be revised to state, "These factors combined with increasing occurrences of episodic high salinities …will result in a highly degraded swamp system which is at risk of conversion to open water."

Annex 1, Conceptual Ecological Model, Section 2.2, Project Background, page 6 – The project description should be revised to state that the proposed diversion project could introduce up to 3,000 cubic feet per second.

Annex 1, Conceptual Ecological Model, Section 3.1.2, Altered Hydrology, page 10 – While cypress and tupelo tress are able to grow in flooded conditions, prolonged flooding could result in decreased growth rates and eventually tree mortality. Increasing dry periods from existing conditions could be very beneficial to the existing forest stand. We recommend revising this section accordingly.

Annex 1, Conceptual Ecological Model, Section 3.4.2., Fish and Wildlife, pages 14-15 – The bald eagle was removed from the Federal list of threatened and endangered species on August 8, 2007. Further, the endangered West Indian manatee (*Trichechus manatus*) and pallid sturgeon (*Scaphirhynchus albus*) are likely to occur in the project area. This section should be revised accordingly.

We appreciate the opportunity to review and comment on the draft monitoring and adaptive management plan, and look forward to continued coordination with the LCA Adaptive Management Framework Team. Should you have any questions regarding our comments, please contact Angela Trahan (337/291-3137) of this office.

Sincerely,

James F. Boggs
Supervisor
Louisiana Field Office

cc: EPA, Dallas, TX
NMFS, Baton Rouge, LA
Corps, New Orleans, LA (Attention: Dr. William Klein, CEMVN-PM-RS)
LDWF, Region 7 Office, Baton Rouge, LA
LDWF, Baton Rouge, LA (Attn.: Kyle Balkum)
LDWF, Baton Rouge, LA (Attn.: Heater Finley)
LOCPR, Baton Rouge, LA

This page intentionally left blank.

United States Department of the Interior

FISH AND WILDLIFE SERVICE
646 Cajundome Blvd.
Suite 400
Lafayette, Louisiana 70506

April 30, 2010

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

Dear Colonel Lee:

The Louisiana Coastal Area – Small Diversion at Convent/Blind River Integrated Feasibility Report and Environmental Impact Statement (EIS) is being prepared by the U.S. Army Corps of Engineers (Corps), New Orleans District, in partnership with the Louisiana Office of Coastal Protection and Restoration, under the authority of Title VII of the Water Resources Development Act (WRDA) (Public Law 110-114, 121 STAT. 1270) of 2007. Enclosed is our Draft Fish and Wildlife Coordination Act Report for the LCA - Small Diversion at Convent/Blind River project. This report does not constitute the 2(b) report of the Fish and Wildlife Service (Service). This draft report has not been reviewed by the Louisiana Department of Wildlife and Fisheries (LDWF) or the National Marine Fisheries Service (NMFS); however, their comments will be incorporated into the final report.

Should your staff have any questions regarding the enclosed draft report, please have them contact Angela Trahan of this office at 337/291-3137.

Sincerely,

for James F. Boggs
Supervisor
Louisiana Field Office

Enclosures

cc: FWS, Atlanta, GA (ES/HC)
EPA, Dallas, TX
NMFS, Baton Rouge, LA
Corps, New Orleans, LA (Attention: Dr. William Klein, CEMVN-PM-RS)
LDWF, Region 7 Office, Baton Rouge, LA
LDWF, Baton Rouge, LA (Attn.: Kyle Balkum)
LDWF, Natural Heritage Program, Baton Rouge, LA
LDWF, Scenic Rivers Program, Baton Rouge, LA
LOCPR, Baton Rouge, LA

DRAFT
FISH AND WILDLIFE COORDINATION ACT REPORT

ON

LOUISIANA COASTAL AREA – SMALL DIVERSION AT CONVENT/BLIND RIVER

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

And

Louisiana Office of Coastal Protection and Restoration

Prepared by
Angela Trahan
Fish and Wildlife Biologist
U.S. Fish and Wildlife Service
Ecological Services
Lafayette, Louisiana

April 2010

TABLE OF CONTENTS

INTRODUCTION

The Louisiana Coastal Area – Small Diversion at Convent/Blind River Integrated Feasibility Report and Environmental Impact Statement (EIS) is being prepared by the U.S. Army Corps of Engineers (Corps), New Orleans District, in partnership with the Louisiana Office of Coastal Protection and Restoration (OCPR), under the authority of Title VII of the Water Resources Development Act (WRDA) (Public Law 110-114, 121 STAT. 1270) of 2007. This authorization was recommended by the Chief of Engineer's Report, dated January 31, 2005. That report recommended projects and features in the interest of hurricane protection, prevention of salt water intrusion, preservation of fish and wildlife, prevention of erosion, and related water resources purposes.

The Small Diversion at Convent/Blind River project was identified in the Louisiana Coastal Area Ecosystem Restoration Study, dated November 2004 (2004 LCA Plan), as a near term critical restoration feature. WRDA 2007 directed that a feasibility report for the Small Diversion at Convent/Blind River project be submitted to Congress by December 31, 2008. The WRDA also directed that a Report of the Chief of Engineers be completed by December 31, 2010. Specifically, Section 7006(e)(3) requires the Secretary of the Army to submit feasibility reports to Congress on six projects by December 31, 2008 and a Chief's Report by December 31, 2010. Due to delays in executing a Feasibility Cost Sharing Agreement for the projects the requested feasibility reports were not submitted to the Congress by the December 31, 2008 deadline. The contingent authorization provided in Section 7006(e)(3)(B) for the six projects however remains subject to the December 31, 2010 deadline for a Chief's report.

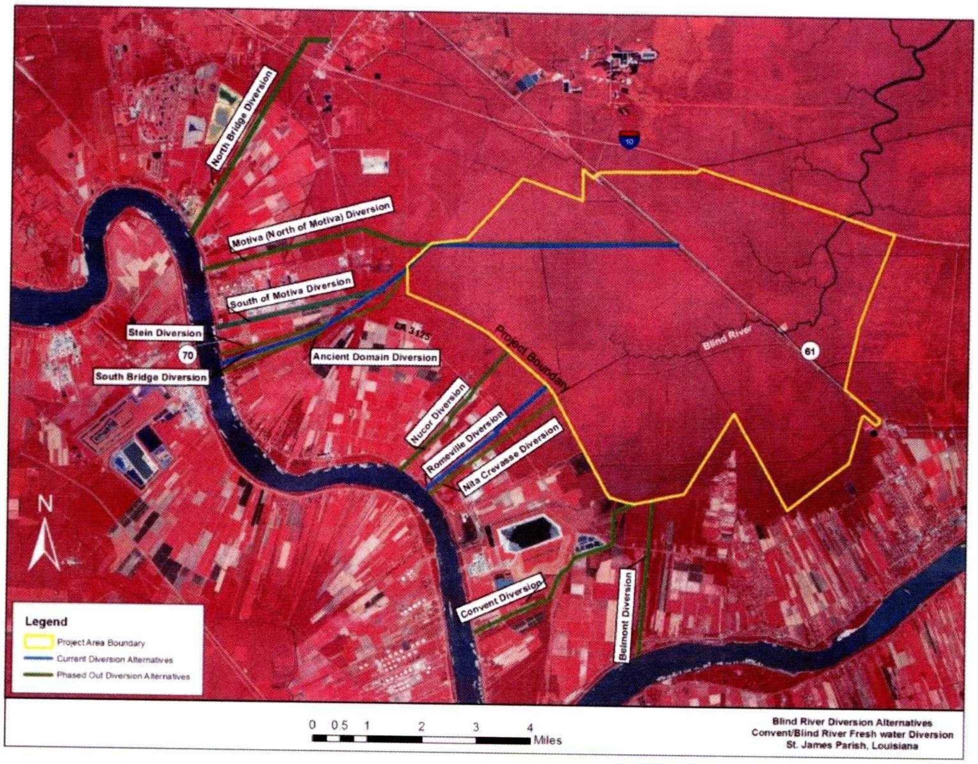
The LCA - Small Diversion at Convent/Blind River project includes the construction of a small diversion (i.e., less than 5,000 cubic feet per second) from the Mississippi River into Blind River through a new control structure to introduce sediments and nutrients along with freshwater into the southeast portion of Maurepas Swamp. Diverting Mississippi River water into the Maurepas Swamp will assist in improving biological productivity and restoring the natural hydrologic regime within that degraded swamp habitat. This diversion project in concert with two other LCA near-term critical features, the Small Diversion at Hope Canal project and the Amite River Diversion Channel Modification project, will help to restore Mississippi River water, sediment, and nutrient flows into the Maurepas Swamp ecosystem.

Previous U.S. Fish and Wildlife Service (Service) involvement includes a Final Programmatic Fish and Wildlife Coordination Act (FWCA) Report for the Near Term Plan for the LCA Study (Grouchy and Paille 2004); this draft report supplements that 2004 Programmatic Report. The Service has also submitted comments dated October 20, 2008, on the State of Louisiana, OCPR's Draft Interim Feasibility Study; comments dated January 30, 2009, were provided in regards to the Corps' Notice of Intent to prepare a Supplemental Environmental Impact Statement; and the Service provided a programmatic planning-aid Report dated January 21, 2010. Furthermore, Service comments were provided on the Draft Monitoring and Adaptive Management Plan dated April 7, 2010. 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 draft FWCA Report is being provided to the Louisiana Department of Wildlife and Fisheries (LDWF) and the National Marine Fisheries Service (NMFS); their comments will be incorporated into the final report.

DESCRIPTION OF THE STUDY AREA

The project area is located within the Maurepas Swamp west of Lake Pontchartrain and predominantly within St. James Parish with a small portion of the northern extent in Ascension Parish, LA (LCA Sub-province 1, Figure 1). The U.S. Interstate 10 (I-10) corridor defines the northern boundary with the remaining project boundary being defined by several parish drainage canals. The cities and towns that flank the Mississippi River extend further to the southeast, south, and southwest of the distribution area (i.e., diversion influence area). The Maurepas Swamp is one of the largest remaining tracts of coastal fresh water swamp in Louisiana. Including Lake Maurepas, the Maurepas Swamp area comprises an area that totals approximately 232,928 acres, most of which is swamp with some isolated areas of bottomland hardwood forest and fresh marsh. The Blind River flows from St. James Parish, through Ascension and Saint John the Baptist Parishes, and then discharges into Lake Maurepas. Much of the project area is situated within the LDWF, Maurepas Wildlife Management Area.

Figure 1. LCA- Small Diversion at Convent/Blind River Study Area and Alternative Diversion Locations.



Alternative locations for the proposed control structure have been investigated in the vicinity of Convent, Louisiana, located at Mississippi River mile 159. Prior to extensive human modification, overbank flow of the Mississippi River during spring floods and tidal inflow, through Pass Manchac, into Lake Maurepas, and southwest to the study area, significantly influenced the hydrologic conditions. Overbank flows from the Mississippi river brought nutrients, sediment, and freshwater that promoted productivity and sustained the health of the swamp ecosystem. As floodwaters receded, surface flows traveled eastward as sheet flow into existing channels and subsequently Lake Maurepas.

Some uncertainty surrounds the historic frequency of flooding events in the study area due to the natural variability of these events and limited historic record. Lopez (2003) estimated that flooding of the Mississippi River historically occurred once every 3.5 years in the Lake Pontchartrain Basin. Between 1799 and 1931, the frequency of major flood events for the Mississippi River was approximately every 2.8 years (Gagliano and van Beek, 1970), with twenty-three flood years recorded below Baton Rouge from 1849 to 1927 (Vogel 1930).

For an evaluation of potential sediment loading at Bayou Lafourche, Mashriqui and Kemp (1996) reported the mean sediment load of the Mississippi River at Tarbert's Landing to be 226 mg/l, of which about 26% was sand, with silts and clays each contributing between 30% and 40%. Shaffer et al. (2001a) concludes even if only clays are conveyed by the channel to the swamps north of I-10, about 30% of the river load could be expected to reach the swamps. If only 30% of that potential sediment load is delivered to the primary swamp receiving areas, and an exceedingly low capture efficiency by the swamp of only one-third is assumed, it will represent a loading per area of about 1098 g/m2/yr, or about twice the quantity needed as estimated by Templet and Meyer-Arendt (1988). It is, therefore, anticipated that sediments introduced with diverted water will increase accretion rates, likely holding or increasing existing swamp elevations against subsidence, at least for those areas within the high influence areas of the diversion. Thos sediments will also increase soil bulk densities, and with increased elevations contribute to increased tree health, survival, and productivity, and the potential for tree regeneration (Shaffer et al. 2001a).

Study evaluations conducted for the Small Diversion at Hope Canal project determined that the volume of water that would be delivered by a 1,500 cfs diversion running most of the year would be the equivalent of two complete replacements of lake volume per year. In addition, the diversion design would be capable of, on the average, operating at full flow even during the late summer and fall low-flow period, when high salinities and saltwater intrusion are the biggest threat. Thus, it is expected that Lake Maurepas would experience significant freshening as a benefit beyond direct benefits to the swamps. Such freshening could have a positive impact on fisheries as well as other ecosystem components (Shaffer et al. 2001a).

The MRSNFR study concluded that there were no issues of water or sediment quality that would preclude consideration of diversion of river water (and sediment) for restoration purposes. Only a few compounds, mainly mercury and some organochlorine pesticides that have been banned from use for well over a decade, were found to occasionally exceed water or sediment standards. However, the absence of significant observed bioaccumulation of these compounds was taken as evidence for no overall problems (Corps 2000). Furthermore, studies conducted for the Small Diversion at Hope Canal project determined that nutrients added with diverted river water would be essentially completely taken up within the swamp (Shaffer et al. 2001a).

The Maurepas Swamp serves as a buffer between the open water areas of Lakes Maurepas and Pontchartrain and developed areas along the I-10 and Airline Highway corridor. Development along the I-10 and Airline Highway corridor in this area includes residential, commercial, and industrial land use. The Maurepas swamp is used for fishing, hunting, and other recreational activities, and as a large contiguous tract of cypress/tupelo swamp near the New Orleans metropolitan area, has considerable cultural significance.

Since the construction of the Mississippi River flood control levees, the Maurepas Swamps have been virtually cut off from any freshwater, sediment, or nutrient input. Thus, the only soil building has come from organic production within the wetlands; and preliminary evaluations suggest that productivity in the stressed Maurepas Swamp may be substantially depressed compared to normal conditions. With minimal soil building and moderately high subsidence, there has been a net lowering of ground surface elevation, leading to a doubling in flood frequency over the last four decades (Thomson 2000), so that now the swamps are either permanently or semi-permanently flooded. With minimal ability to drain and persistent flooding, the typical seasonal drying of the swamp does not usually occur. Cypress and tupelo trees are able to grow in flooded conditions. Apparently, tupelo trees are more competitive in permanently flooded conditions (Conner et al. 1981, Dicke and Tolliver 1990), a condition that may explain the recent dominance of tupelo in the south Maurepas Swamp and the project area. However, a high mortality of tupelo trees also has occurred in the last few years within the Maurepas Swamp study area possibly as a result of salinity spikes. Neither cypress nor tupelo seeds can germinate when flooded. Seeds of both species remain viable when submerged in water and can germinate readily when floodwaters recede (Kozlowski 1984). The potential for re-establishment seems to be hindered by the relatively low numbers of viable seeds observed in swamp seed banks, as well as by flooding (Conner et al. 1986). Storm surge and accompanying episodic saltwater intrusion has also exacerbated degradation resulting in lack of tree regeneration and substrate accretion.

It is expected that without restoration, the factors and processes that are contributing to stress and deterioration of the south Maurepas Swamp will continue and result in loss of the swamp, with succession to open water (Shaffer et al. 2001). The Coast 2050 Report estimated wetland loss rates for the Amite/Blind Rivers mapping unit for 1974-90 to be 0.80 percent per year for swamp and fresh marsh habitat combined (LCWCRTF 1999). Based on these rates, approximately 50 percent of swamp and 1.2 percent of fresh marsh will be converted to open water within 60 years. Nearly 69,500 acres of swamp (50% of the 1990 total) and 40 acres of marsh are projected to be lost by 2050 (LCWCRTF 1999).

Subsidence in this area is classified as intermediate, at about 1.1 to 2.0 feet/century. Subsidence may be caused by compaction, oxidation, and consolidation of sediments, faulting, groundwater depletion, or decreased organic deposition as a result of decreased vegetation biomass production; while land elevations increase as a result of sediment accretion from direct sediment input from riverine sources or from organic vegetation deposition. The soil characteristics of the western Maurepas Swamp indicate a lack of riverine influence as evidenced by high soil organic matter content and low bulk density values (DeLaune et al. 1979, Hatton 1983, Messina and Conner 1998). Consequently, soil building within the Maurepas Swamp is almost exclusively a result of organic productivity (Shaffer et al. 2001, 2003, 2006, Rybczyk et al. 2002, Roberts 1985). With minimal soil building and moderately high subsidence, there has been a net lowering of ground surface elevation, doubling flood frequency over the last four decades (Thompson 2000), so that the swamps are now persistently flooded.

Hydrologic modeling for this project, as well as hydrologic investigations for the CWPPRA Maurepas (Hope Canal) Diversion project, has revealed in some areas of Maurepas Swamp floor elevations are often lower than Lake Maurepas. This results in Lake Maurepas stage exerting a significant influence (backflow) on water levels within Blind River and adjoining channels rendering swamp water levels and dry-out periods dependent on the water levels in Lake Maurepas. Flooding is essentially semi-permanent with low to very low water exchange and throughput. The observed doubling of flood durations from 1955 to present at Pass Manchac (Thomson et al. 2002) coupled with swamp elevations lower than lake elevations suggests that the duration of inundation within the project area has drastically increased over the last fifty years. Moreover, flood durations within the project area swamps are influenced by adjacent urban storm water runoff of areas to the northwest (i.e., Baton Rouge and surrounding cities) and hydrologic impoundments caused by major transportation corridors as well as parish canal embankments. These adjacent urban storm water drainage projects force storm water runoff via large drainage canals into the Blind River. These storm waters bypass the floodwater storage capabilities of adjacent forested wetlands and increase the water levels in Blind River resulting in back water flooding conditions upstream of the waterways confluence. Being that the project area is located at the headwaters of the Blind River and is impounded by several major hydrologic barriers [i.e., I-10, U.S. Highway 61, and Kansas City Southern Railroad (KCS RR)]; flood waters within the project area are the last to recede from the basin.

Saltwater intrusion has increased in this general area, partly due to net subsidence and the lack of riverine freshwater inputs. Salinities as low as three parts per thousand (ppt) can reduce growth of both bald cypress and water tupelo saplings (Pezeshki et al. 1990). Salinity, combined with flooding stress, can substantially reduce bald cypress growth. Consequently, salinity significantly contributes to swamp deterioration, particularly combined with stressors such as flooding and herbivory. Storm surges from Lake Maurepas caused by tropical cyclones also exert a stochastic but severe stress on the swamp habitat through salinity spikes in swamp surface waters. Embankments along the parish canals and associated with the railroad and highways prevent higher salinity water from being flushed out of the system. Storm surge waters remain in the impounded swamps cumulatively increasing salinities in impounded waters and soils.

FISH AND WILDLIFE RESOURCES

The Service has provided a Final FWCA Programmatic Report for the Near Term Plan for the LCA Study (Grouchy and Paille 2004). That report contains a through discussion of the significant fish and wildlife resources (including those habitats) that occur within the study area as well as fish and wildlife concerns that occurs within coastal Louisiana and future without project conditions. That discussion is incorporated by reference herein, but the following information is provided to update to that report and provide project specific information and recommendations.

Major Habitat Types

Cypress/Tupelo Swamps

The study influence area (distribution area) contains approximately 21,844 acres the majority of which is dominated by bald cypress/tupelo swamp habitat and is semi-permanently or permanently flooded. Persistent flooding has resulted in the impairment of cypress/tupelo seedling establishment/regeneration (CWPPRA Task Force 2002). Cypress/tupelo regenerates well when the seedbed is moist but not flooded during the time period of seed germination and seedling establishment. Cypress/tupelo seeds cannot germinate in standing water, and seedlings must grow tall enough during dry periods for their crowns to extend above the water surface to survive flooding during the growing season. Excessive flooding will reduce regeneration even though overstory trees may still be thriving. Ultimately, the lack of regeneration due to prolonged inundation will eliminate forest cover, resulting in the conversion of swamp habitat to open water over time (CWPPRA Task Force 2002). In addition, saltwater intrusion from storm events has stressed the swamp habitat along the Blind River.

Cypress swamps in the project area provide substantial fish and wildlife values. Wildlife species typical of cypress swamps include green tree frog, bullfrog, mud and musk turtles, American alligator, various species of water snakes, anhinga, barred owl, northern parula, great blue heron, great egret, white ibis, and mink. Often surrounding backwater lakes, these areas also provide essential habitat for aquatic species when inundated.

While bald cypress is the canopy dominant in a few locations within the study area, water tupelo was the predominant species across sites. In addition to bald cypress and water tupelo, Drummond red maple, green ash, and various oak species are also found in the cypress/tupelo swamp habitat within the study area, with Drummond red maple and green ash comprising sub-dominant midstory species (Conner and Day 1976; Hoeppner 2008; Shaffer et al. 2003). Scrub species, including black willow, wax myrtle, and common buttonbush are sporadically present, particularly in areas with diminished canopy cover caused by impaired health or mortality of overstory species. Shrub-scrub swamps provide important nesting habitat for colonial wading birds as well as various species of aquatic wildlife.

Bottomland Hardwoods

Bottomland hardwood forests are generally intolerant of inundation during the growing season (Putnam et al. 1960; Hodges 1997). Fluctuations in water level are more prevalent in the bottomland hardwood forest than bald cypress-tupelo swamp, with characteristic alternating wet and dry periods. Where bottomland hardwood forests experience increased flooding regimes the forest stand begins to transition into a more flood tolerant community composition and becomes more characteristic of a swamp habitat. Bottomland hardwoods are present within the distribution area as elevations increase near the natural levee of the Mississippi River and along several ridge remnants and spoil banks that traverse the study area. Also the alternative transmission canal alignments traverses bottomland hardwood forests along the natural levee and within the Mississippi River batture. Dominant tree species in the higher elevated area include

Drummond red maple, black willow, green ash, laurel oak, water oak, sweet gum, sugarberry, American elm, and Chinese tallow. The areas between the ridges and the swamp show a transition in species and are dominated by green ash and Drummond red maple. Wax myrtle, rough-leaf dogwood, black willow, Chinese tallow, Chinese privet, yaupon, and deciduous holly typically are common shrub species. Vines such as poison ivy, greenbriars, pepper vine, and trumpet creeper are present.

Bottomland hardwood forests typically provide high wildlife habitat values to a variety of species, including amphibians such as the Gulf coast toad and Cope's gray tree frog; reptiles such as the copperhead and green anole; many species of birds, including wood duck, barred owl, pileated woodpecker, red-shouldered hawk, Acadian flycatcher, Swainson's warbler and northern parula; and mammals including white-tailed deer, swamp rabbit, gray fox, bobcat, raccoon, opossum, and squirrels. In addition to terrestrial wildlife, many species of fish utilize flooded bottomland hardwoods as well; some species are specifically adapted for spawning in these backwater flood plains.

Fresh Marsh

Within the study area fresh marsh habitat mainly consists of pipeline and powerline easements. While some of these easements have ditches, many of the easements are slightly elevated above the adjacent swamp and are thickly vegetated with grasses and forbs. These areas are usually saturated to the surface, and flooded only during higher water periods. Therefore, it is unlikely that fresh marshes within the Study Area currently provide nursery habitat for estuarine species. However, these fresh marshes would provide habitat for other wildlife species such as reptiles and amphibians.

Open Water

The Blind River is the major waterway influencing the project area wetlands and is designated as a state water bottom along with the Mississippi River and Lake Maurepas also within the study area. Several parish canals, transmission line and pipeline canals, and borrow canals transect the study area swamp habitat. Because of the stagnant conditions, the loss of sediment inputs, reduced primary productivity, and limited consolidation, net phosphorus and organic matter export from the swamp is likely low. Therefore, support for dependent systems downstream (e.g., Lake Maurepas) is likely limited and substantially reduced from historic levels.

In their *2006 Water Quality Integrated Report*, the Louisiana Department of Environmental Quality (LDEQ) indicated that water within the study area (i.e., LDEQ sub-segment 040403) supports the designated standards for primary and secondary contact recreation, but does not support those standards for fish and wildlife propagation. Suspected sources of impairment include were mercury, nitrate/nitrite, non-native aquatic plants, total phosphorus (TP), and turbidity. The suspected sources for mercury were listed as atmospheric deposition and unknown sources. Site clearance (land development or redevelopment) and flow alterations from water diversions were listed as the suspected sources for nitrate/nitrite, dissolved oxygen, and TP. The suspected causes of impairment for the outstanding natural resource waters designation were sedimentation/siltation and turbidity, which are believed to be caused by site clearance.

Developed Areas

Developed areas within the study area occur along the Mississippi River levee and are dominated by industry facilitated by Mississippi River commerce and associated business and residential development. Historically, agriculture has been a major industry within both parishes and is still relevant today primarily in the form of sugarcane farming. Two railways run through the study area. The KCS RR transects the distribution area and parallels U.S. Highway 61 to the south. The Canadian National Railway extends to the south of the distribution area and would be transected by the Romeville and South Bridge transmission canals. U.S. Interstate 10 and U.S. Highway 61 pass through the distribution area. Where U.S. Highway 61 and Blind River intersect the St. James Boat Club, a boat launch facility, provides boat access to the upper Blind River. Also a second boat launch is located at the north terminus of Louisiana Highway 642 with access to Grand Point Canal. Numerous transmission and pipeline rights-of-way also intersect the study area.

Fishery Resources

Lower Mississippi River

Baker et al. (1991) noted at least 91 species of freshwater fishes occupy the Lower Mississippi River as their primary population center; 30 or more species may be present sporadically. From what is known of its physical attributes, few species could regularly inhabit the upper and middle water column in this habitat. Some larger fishes, such as paddlefish, white bass, and striped bass, and smaller actively swimming fishes such as skipjack herring and goldeye may often occupy this area for feeding or moving among other habitats (Baker et al. 1991).

Blind River /Swamp

Freshwater sport fishes likely present include white crappie, bluegill, warmouth, channel catfish, and blue catfish. Other fishes likely present include yellow bullhead, freshwater drum, bowfin, carp, buffaloes, and gars. In addition, aquatic and wetland habitats within the study area provide nursery and foraging habitats supportive of a variety of fishery species including economically important estuarine-dependent fishery species (e.g., the blue crab, striped mullet, and Gulf menhaden), some of which may serve as prey for other fish species.

During a survey conducted from January 1976 to August 1977, Watson et al. (1981) sampled fisheries species at six locations along Blind River from south of Highway 61 to Lake Maurepas. In doing so, 57 species of finfish were collected and included 12 estuarine, 43 freshwater, and two diadromous species. Freshwater species were dominant both spatially and temporally. Finfish diversity appeared to be higher at the lower stretches of Blind River, below the Amite River Diversion Canal and nearer Lake Maurepas. The lower Blind River had the greatest species diversity, primarily due to the presence of estuarine species.

A survey conducted by Davis et al. (1970) between 1967 and 1969 in the Lake Maurepas revealed forty species of finfishes and shell fishes. Some of the fishes included Gulf menhaden, gizzard shad, striped and bay anchovy, blue and channel catfish, sand and spotted seatrout, Atlantic croaker, striped mullet, southern flounder, largemouth bass, bluegill, several species of gar as well as shrimp. In a later fisheries survey of Lake Maurepas, Hastings et al. (1987) reported an equal proportion of freshwater (55 percent) and marine (40 percent) fish species with four-percent of individuals being diadromous. A correlation was observed between the fisheries species present in the lake and mouth of Blind River and salinity levels in Lake Maurepas: marine species exhibited a higher contribution to the fisheries of Lake Maurepas and had a greater likelihood of presence in Blind River with increasing salinity levels, with the opposite trend apparent for freshwater species.

Wildlife Resources

The coastal marshes and forested wetlands of the Lake Pontchartrain Basin have been identified by the North American Waterfowl Management Plan (NAWMP), Gulf Coast Joint Venture (GCLV): Mississippi River Coastal Wetlands Initiative as a key waterfowl wintering area. The Gulf Coast is the terminus of the Central and Mississippi Flyways and is therefore one of the most important waterfowl areas in North America, providing both wintering and migration habitat for significant numbers of the continental duck and goose populations that use both flyways. The Mississippi River Coastal Wetlands Initiative area is dominated by coastal marsh, forested swamps, and seasonally flooded bottomland hardwoods that provide habitat for several species of wintering waterfowl. Wood ducks are the primary waterfowl species in forested wetlands, while other ducks (e.g., mallard, American widgeon, gadwall, blue- and green-winged teal, Northern shovelers, ring-necked ducks, and lesser scaup) use those forested habitats to a lesser degree.

Strategies to achieve the goals and objectives of the GCJV include but are not limited to: 1) maintaining the existing functions and values of those habitats and preventing additional losses and degradation of those wetlands and 2) modifying existing spoil banks and canals to restore hydrology (Wilson et al. 2002). Numerous other game birds are present in or adjacent to the study area, including American coot, rails, gallinules, common snipe, and American woodcock. Non-game bird species also utilize the study area marshes, including least bittern, pied-billed grebe, black-necked stilt, American avocet, killdeer, black-bellied plover, willet, and various species of sandpipers, gulls, and terns. The study area supports many resident and transient hawks and owls including red-shouldered hawk, barn owl, common screech owl, great horned owl, and barred owl. Winter residents include red-tailed hawk, northern harrier, and American kestrel, while the Mississippi kite, swallow-tailed kite and broad-winged hawk are common summer residents. In addition, the project area supports many species of resident and migratory passerine birds. Some neo-tropical migrants that are currently experiencing a population decline (e.g., white-eyed vireo, northern parula) are dependent on large forested acreage to successfully reproduce. Also, present are cuckoos, swifts, hummingbirds, nighthawks, woodpeckers, and the belted kingfisher.

Invasive Species

Within the study area invasive mammal species present include nutria and feral hogs. Invasive plant species present within that area include: water hyacinth, alligator weed, hydrilla, common salvinia, giant salvinia, variable-leaf milfoil, Chinese tallow, and Chinese privet. Those species displace native aquatics and degrade water and/or habitat quality. In addition, Chinese tallow is tolerant to flooding and salt stress and can establish self-replacing monocultures that provide less foraging value to migrating birds and interrupt the natural succession of woody species (Louisiana Coastal Protection and Restoration 2008).

Threatened and Endangered Species

West Indian Manatee

Federally listed as an endangered species, West Indian manatees (*Trichechus manatus*) occasionally enter Lakes Pontchartrain and Maurepas, and associated coastal waters and streams during the summer months (i.e., June through September). Manatee occurrences appear to be increasing, and they have been regularly reported in the Amite, Blind, Tchefuncte, and Tickfaw Rivers, and in canals within the adjacent coastal marshes of Louisiana. 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.

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).

Gulf Sturgeon

The Gulf sturgeon (*Acipenser oxyrhynchus desotoi*), 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 Suwannee River, Florida. In Louisiana, Gulf sturgeon have been reported at Rigolets Pass, rivers and lakes of the Lake Pontchartrain 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. Sturgeon 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. The proposed project, however, does not occur within nor would it impact designated Gulf sturgeon critical habitat.

The Corps is responsible for determining whether the selected alternative is likely (or not likely) to adversely affect any listed species and/or critical habitat, and for requesting the Service's concurrence with that determination. If the Corps determines, and the Service concurs, that the selected alternative is likely to adversely affect listed species and/or critical habitat, a request for formal consultation in accordance with Section 7 of the ESA should be submitted to the Service. That request should also include the Corps' rationale supporting their determination.

<u>Pallid Sturgeon</u>

The pallid sturgeon (*Scaphirhynchus albus*) is an endangered fish found in Louisiana, 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 large, free-flowing, turbid rivers with a diverse assemblage of physical characteristics 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 loss through river channelization and dams has adversely affected this species throughout its range. Entrainment issues associated with dredging operations in the Mississippi and Atchafalaya Rivers and through diversion structures off the Mississippi River are two potential effects that should be addressed in future planning studies and/or in analyzing current project effects.

Impacts to the pallid sturgeon 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 will be necessary. If the affect would result in a take of a 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 National Environmental Policy Act document.

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. Several active and inactive bald eagle nests are documented within and adjacent to the study area. Other 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.

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:

1) 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).

2) 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

There are no U.S. Fish and Wildlife Service National Wildlife Refuges located within the study area. A majority of the study area is located within the state-operated Maurepas Swamp Wildlife Management Area. Please contact the LDWF, Region 7 Office in Baton Rouge, Louisiana, (225/765-2360) for their comments regarding potential project impacts to this area.

Blind River is designated as a Louisiana Natural and Scenic River. Please contact the LDWF, Scenic Rivers Program (318/343-4045) for further information regarding any additional permits that may be required to perform work on the above referenced river.

ALTERNATIVE EVALUATION

Based on a review and analysis of prior studies, initial site visits, and input received through the scoping process, an initial list of management measures (i.e., restoration features that are elements of an alternative) was developed. Examples of management measures includes water management modifications within Maurepas Swamp (e.g., weirs, flow control gates, and control valves); alternate measures and approaches to distributing freshwater throughout the distribution area (e.g., pumps and control structures); alternative transfer systems to transfer the freshwater from the diversion point to the swamp (e.g., trapezoidal earthen or concrete-lined channel, underground conduits, or existing natural and man-made drainage systems); and alternative diversion system features including alternative diversion locations and levee crossing measures (siphon vs. culverts). An example of nonstructural management measures includes alternative diversion operation plans to achieve certain restoration goals and planting cypress seedlings in targeted areas.

After management measures were screened and evaluated, the management measures were then grouped into an array of preliminary alternatives for further evaluation to achieve the overall project goals and objectives. The alternatives in the initial array underwent a screening and evaluation process to develop the final array of alternatives. The screening process analyzed the specific components or features that were included in the alternatives including diversion location, diversion flow rates, and diversion methods.

FINAL ARRAY OF ALTERNATIVES

The evaluation determined that the Romeville and Sunshine Bridge locations are hydraulically efficient locations from which to provide freshwater, nutrients, and sediments to an effective portion of the benefit area. It was determined that 3,000 cubic feet per second (cfs) of flow is needed to provide both prevention of saline backflow and inundation from Lake Maurepas and also achieve the overall goal of reversing the trend of degradation in the swamp. Further, an analysis of construction costs indicates that siphons are more cost effective for flow rates below 1,000 cfs and gated culvert systems are more cost effective for flow rates greater than 1,000 cfs. Considering the preliminary results of initial screen and evaluations efforts, the following five alternatives were identified for further consideration and inclusion in the final array:

No Action Alternative (Future without Project Conditions)
Alternative - 2 – 3,000 cfs Diversion at Romeville (Gated Culvert System)
Alternative - 4 – 3,000 cfs Diversion at South Bridge (Gated Culvert System)
Alternative - 4B – 3,000 cfs Diversion at South Bridge with split flows (Gated Culvert System)
Alternative - 6 – Two 1,500 cfs (3,000 cfs combined) Diversions at Romeville and South Bridge (Siphons)

Alternative 2 – 3,000 cfs Diversion at Romeville
This alternative adds a gated culvert system and transfer canal along the Romeville alignment, restores and improves the 160 existing berm cuts, adds 30 new 500-foot wide berm cuts, builds up to 6 control structures at strategic locations in the swamp and adds 3 new culverts under U.S. Highway 61.

Alternative 4 – 3,000 cfs Diversion at South Bridge
This alternative adds a gated culvert system and transfer canal along the "Cox" alignment located south of the U.S. Highway 70 Bridge, restores and improves the 160 existing berm cuts, adds 30 new 500-foot wide berm cuts, builds up to 6 control structures at strategic locations in the swamp and adds 3 new culverts under U.S. Highway 61.

Alternative 4B – 3,000 Split Diversion at South Bridge
This alternative adds a gated culvert system and transfer canal along the "Cox" alignment located south of the U.S. Highway 70 Bridge, restores and improves the 160 existing berm cuts, adds 30 new 500-foot wide berm cuts, builds up to six control structures at strategic locations in the swamp, and adds 3 new culverts under U.S. Highway 61. This alternative includes a modification to the distribution of the diversion provided by Alternative 4 by sending 1,500 cfs to the south through the St. James Parish Canal in order to achieve a similar distribution to Alternative 6.

Alternative 6 – 3,000 cfs Dual Diversion at Romeville and South Bridge
This alternative adds a gated culvert system- and a transfer canal- along the Romeville alignment and a gated culvert system- and transfer canals along the "Cox" alignment located south of the U.S. Highway 70 Bridge, restores and improves the 160 existing berm cuts, adds 30 new 500-foot wide berm cuts, builds up to 6 control structures at strategic locations in the swamp and adds 3 new culverts under U.S. Highway 61.

EVALUATION METHODOLOGY

Evaluation of project-related impacts on fish and wildlife resources was conducted using the Wetland Value Assessment (WVA) methodology developed for the evaluation of proposed CWPPRA projects (Louisiana Coastal Wetlands Conservation and Restoration Task Force [LCWCRTF] 2006). The WVA methodology is similar to the Service's Habitat Evaluation Procedures (HEP), in that habitat quality and quantity are measured for baseline conditions and predicted for future without-project (FWOP) and future with-project (FWP) conditions. Instead of the species-based approach of HEP, each 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 WVA methodology was first developed in 1991 by the CWPPRA Environmental Work Group (LCWCRTF 2006). Initially, emergent marsh habitat models were developed for fresh, intermediate, brackish and saline marsh types. Subsequently, models were also developed for swamps, barrier islands, barrier headlands, and coastal forested ridges. The habitat variable-habitat suitability relationships within the WVA models have not been verified by field experiments or validated through a rigorous scientific process. However, the variables were originally derived from HEP suitability indices taken from species models for species found in that habitat type. It should also be noted that some aspects of the WVA have been defined by policy and/or functional considerations of CWPPRA. However, habitat variable-habitat suitability relationships are, in most cases, supported by scientific literature and research findings. In other cases, best professional judgment by a team of fisheries biologists, wildlife biologists, ecologists, and university scientists may have been used to determine certain habitat variable-habitat suitability relationships. In addition, the WVA models have undergone a refinement process and habitat variable-habitat suitability relationships, HSIs, and other model aspects are periodically modified as more information becomes available regarding coastal fish and wildlife habitat suitability, coastal processes, and the efficacy of restoration projects being evaluated.

The WVA models assess the suitability of each habitat type for providing resting, foraging, breeding, and nursery habitat to a diverse assemblage of fish and wildlife species. This standardized, multi-species, habitat-based methodology facilitates the assessment of project-induced impacts on fish and wildlife resources. The CWPPRA swamp WVA model used consists of four variables: 1) stand structure; 2) stand maturity; 3) water regime; and 4) mean high salinity during the growing season.

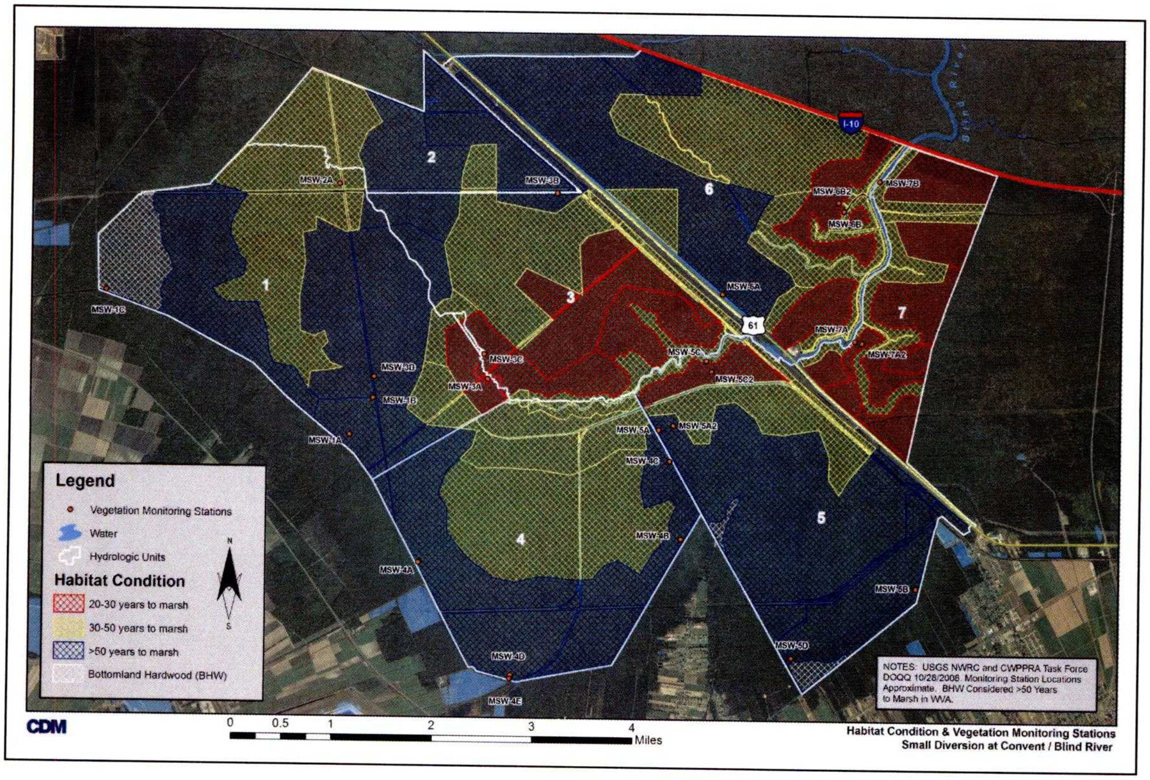
Using the WVA methodology, impact assessments were conducted by the Habitat Evaluation Team (HET), which included representatives from the Service, the Corps, Office of Coastal Protection and Restoration, LDWF, NMFS, Southeast Louisiana University (SLU), and CDM, Incorporated. To assess impacts the HET used habitat information collected during four separate field trips from March through September of 2009, surveys, expert opinions, knowledge of the area, experience with similar projects, Digital Ortho-quarter Quadrangle aerial photographs (DOQQ), and preliminary hydraulics and hydrology modeling information.

For the LCA - Small Diversion at Convent/Blind River project those elements above were used in conjunction with the WVA models to compute an HSI value for each target year (TY). Selection of target years is based on anticipated changes in the area being evaluated. Three levels of habitat condition class were defined within the project area (i.e., 20-30 years-to-marsh, 30-50 years-to-marsh, and greater than 50-years-to-marsh) based on the degree of degradation and according to classifications used by Dr. Gary Shaffer (SLU) at other areas within the Maurepas swamp (Figure 2). Because we can not accurately determine when these swamps will convert to marsh or open water, these habitat condition classifications are meant to define the level of degradation and not necessarily the target years that the habitats will convert to marsh. Alternatives were analyzed using target years reflective of those habitat condition classes. The target years used for this project were TY0, TY1, TY20, TY30, and TY 50. The standard period of analysis for Corps projects is 50 years.

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.

Prior to running the WVA analysis, the hydrologic units (i.e., benefit areas) associated with each alternative were designated based on the location of the hydrologic unit within the watershed in relation to the diversion outfall. It was assumed that certain hydrologic units would receive different levels of influence (i.e., high, moderate, low, or no influence). For purposes of the WVA, the Service assumed that the high influence areas would receive the most benefits from sediments, nutrients, and freshwater flow (i.e., freshwater throughput); moderate influence areas would receive benefits from nutrients and freshwater flows; and low influence areas would experience benefits as a result of freshwater flow. However, assuming the diversion would be operated to maximize dry-out frequency, all hydrologic units see increased benefits in the form of dry-out frequency as a result of the berm cuts.

Figure 2. Hydrologic Units and Habitat Condition Classes for the Convent/Blind River Freshwater Diversion.



Subsequent to the mapping of influence areas for each alternative, WVAs were run for each habitat condition class (i.e., 20-30 years to marsh, 30-50 years to marsh, and greater than 50 years to marsh) present within those areas. Once benefits were calculated, adverse temporary and permanent impacts to swamp and bottomland hardwood habitats associated with construction of the transmission channels were calculated. The change in AAHUs for each FWP scenario, compared to FWOP project conditions, provides a measure of anticipated impacts. A net gain in AAHUs indicates that the project is beneficial to the habitat being evaluated; a net loss of AAHUs indicates that the project is damaging to that habitat type.

The WVA initial analysis was completed on the benefit areas for all alternatives under the intermediate sea level rise (SLR) scenario. As requested by the Corps, additional WVAs were later run to quantify impacts under the low and high SLR scenarios for the Tentatively Selected Plan (TSP) and the National Ecosystem Restoration (NER) Plan. A combined total of 96 WVA evaluations have been completed.

The Project Information Sheet (including assumptions used by the HET) for the project are presented in Appendix A. The complete WVA analysis can be obtained from the Service's

Lafayette, Louisiana Ecological Services Office upon request.

FUTURE WITHOUT-PROJECT FISH AND WILDLIFE RESOURCES

According to the Coast 2050 Report (LCWCRTF 1999), in 1990, this unit contained approximately 138,930 acres of swamp and 3,440 acres of marsh. Under future without-project conditions continued impoundment, flooding, subsidence, and herbivory are expected to increasingly stress area swamps in the future. The current problems associated with altered hydrology are expected to continue. The lack of overbank flooding from the Mississippi River into the swamp and hydrologic connectivity within the swamp would result in the continued impoundment of the project-area swamp, with an associated reduction in canopy cover, degradation of water quality, and transition of swamp habitat to marsh, with the eventual conversion to open-water habitat similar to areas further east. Storm surges from tropical cyclone events would increase salinity levels and the frequency of saltwater inundation is expected to increase with relative sea level rise (RSLR). Nearly 69,500 acres of swamp (50% of the 1990 total) and 40 acres of marsh are projected to be lost by 2050 (LCWCRTF 1999).

The lack of freshwater, sediments, and nutrients would continue to reduce tree vigor and growth, increase tree mortality, increase the presence of invasive species, and reduce ecological functions. In addition, the assumed RSLR, would exacerbate swamp degradation in the future. The anticipated conversion of swamp habitats to marsh and open water would result in the loss of wetland values and functions. While the Service recognizes the ecological importance of freshwater marshes, in this case, the anticipated conversion of swamp to marsh habitat is a transitional phase resulting from habitat deterioration and conversion and is not indicative of a healthy sustainable ecosystem. Keddy et al. (2007) reports that the vast majority of the Maurepas Swamp is typical of swamps identified as either nutrient poor and stagnant or near-continuously flooded. Flood durations in the Maurepas Swamp have doubled, on average, over the past half-century (Thomson et al. 2002). The flooding and impoundment within the study area prevents seed germination and recruitment and, as a result, swamps are converting to marsh and open water.

Keddy et al. (2007) identified priority actions for habitat restoration within the Maurepas Swamp. Two of the primary recommendations addressed include diverting several freshwater diversions into the area and re-establishing sheet flow via removal or gapping of spoil banks and road and railroad beds. That report noted that pulsing of water flow from the river was a historical occurrence and that a sufficient volume to carry sediment and nutrients at least as far as the Manchac land bridge is necessary. That report further explains that sheet flow (or shallow water flow over the surface of the soil) was, most likely, the principle way in which water and nutrients moved through this system. Now, however, the presence of man-made hydrologic barriers impedes sheet flow. Canals decrease overbank flooding and accelerate the flow of water, sediment, and nutrients out of the area, while spoil banks and other such man-made features block sheet flow. Implementation of the proposed project would restore an historic ecosystem and increase the fish and wildlife habitat values of the project area.

This project would work in concert with other recently constructed and proposed projects to restore the Lake Pontchartrain Basin ecosystem including the de-authorization and closure of the Mississippi River Gulf Outlet (MRGO) channel at Bayou La Loutre authorized under WRDA 2007; and three Near-Term LCA projects, the MRGO Ecosystem Restoration Project, the Amite River Diversion Channel Modification project, and Small Diversion at Hope Canal (Maurepas Swamp) Project.

DESCRIPTION OF NATIONAL ECOSYSTEM RESTORATION PLAN AND TENTATIVELY SELECTED PLAN

After comparing the four alternative plans carried forward for detailed analysis and the No Action Alternative, the NER Plan, Alternative 2, a 3,000 cfs diversion at Romeville was selected, as the TSP. Alternative 2 best meets the screening criteria; would accomplish the planning objectives and goals; would be consistent with the Corps' Environmental Operating Principles; and would contribute to reversing the trend of deterioration in the southeast part of the Maurepas Swamp. Alternative 2 would improve a total of 21,369 acres of baldcypress-tupelo swamp that are in various stages of deterioration.

Alternative 2 has the following six major components:

1. **Diversion structure** – three, 10 x 10-foot concrete box culverts with sluice gates are proposed under the Mississippi River's east bank levee and Louisiana Highway 44. The sluice gates would include motor operators on the culvert inlets. The diversion structure would also include trash racks, an inlet canal across the batture, and other ancillary structures.

2. **Transmission canal** - the transmission canal will be designed for 3,750 cfs and will transfer the diverted water approximately three miles from the diversion culvert facility to an existing drainage channel at the perimeter of the swamp. The canal will be an earthen trapezoidal channel section, with a 155-foot wide bottom, 4:1 (H:V) side slopes, and a depth of approximately 12 feet, including a 2-foot freeboard. The top width will be approximately 250 feet. A railroad and highway crossing will require eight, 12 x 8-foot concrete box culverts.

3. **Control structures** - Control structures will be installed at key locations in the existing channels to distribute the diverted flow throughout and into the swamp. The control structure locations and designs will be determined during more detailed planning and engineering.

4. **Berm gaps (spoil bank gaps)** - new 500-foot wide berm gaps will be excavated in the spoil banks at an approximate spacing of 2,500 feet on center. The gaps will be excavated to the elevation of the adjacent swamp natural ground elevations, and the spoil will be disposed behind the existing spoil banks. As proposed, the spoil will be placed up to Elevation +6 North American Vertical Datum of 1988 (NAVD 88) to provide additional refuge areas for wildlife during flood events in the swamp.

5. **Cross culverts** - at four locations along U.S. Highway 61 and KSC RR. Each installation will consist of three, 3 x 4-foot concrete box culverts. There may be sufficient cross drainage openings at the KCS RR, and additional culverts may not be required. Earthen channels (large ditches) will be excavated across the 500-foot space between the KCS RR and U.S. Highway 61 to interconnect the drainage capacity at the railroad with the new culverts at U.S. Highwy 61.

6. **Water level and flow rate instrumentation** – instrumentation to monitor and control the diversion flow rate and the water surface elevations in the diversion, transmission, and distribution system in the swamp will be installed. Additional instrumentation may be required as part of monitoring and adaptive management.

EVALUATION OF NATIONAL ECOSYSTEM RESTORATION PLAN AND TENTATIVELY SELECTED PLAN

Alternative 2 is one of three cost-effective and best-buy alternatives. Alternative 2 provides over 90 percent of the benefits for about 67% of the cost of Alternative 6, the cost per AAHU is much lower for Alternative 2 than that for the other two alternatives and the incremental cost per habitat unit in going from Alternative 2 to Alternative 4B and/or Alternative 6 is quite high. Current habitat analysis indicates that the highest net benefits would be achieved through implementation of Alternative 6 (7,114 AAHUs). However, due to the high incremental cost per habitat unit going from Alternative 2 to Alternative 4B or 6, those alternatives were not considered to be justified. Alternative 2 is the alternative that reasonably maximizes ecosystem restoration benefits compared to costs and is designated as the NER Plan and the TSP.

Based on preliminary hydrologic modeling results, which at this stage of the study have focused on transfer of flow between benefit areas, Alternative 2 directly influences a larger area (i.e., hydrologic units 1 and 4) providing 8,088 acres with sediments, nutrients, and freshwater. Approximately 3,415 acres of swamp would benefit through the addition of freshwater and nutrients, and an additional 4,535 acres would experience freshwater benefits. Aside from the benefits achieved from diverting freshwater into the system, the project area will experience increased throughput, hydrologic connectivity, and dryout periods as a result of in swamp management measures. The WVA analysis indicates that the NER and TSP for the project would result in net gains of 6,741; 6,421; and 5,459 AAHUs under the low, intermediate, and high SLR scenarios, respectively.

Swamp habitat for fish and wildlife species would be restored, mimicking as closely as possible, conditions which occurred historically in the area. Restored hydrologic connections would: 1) increase the nutrient and sediment input, 2) increase acreage of high-quality swamp habitats used by fish and wildlife for shelter, nesting, feeding, roosting, cover, nursery, and other life requirements, and 3) increase vegetative growth and productivity. In addition, when compared to the future without project scenario, implementation of this alternative would significantly reduce the likelihood of existing swamp habitat converting to marsh and eventual open water habitat over the life of the project.

Because of the expedited schedule many specific details regarding the design, operation, and associated effects of the TSP are not yet available at the current level of planning, we cannot, therefore, complete our evaluation of project feature effects on fish and wildlife resources, and thus we cannot entirely fulfill our reporting responsibilities under Section 2(b) of the Fish and Wildlife Coordination Act. Therefore, extensive additional Service involvement during subsequent detailed planning, engineering, design, and construction of specific project measures, along with more-definitive project information that will be available during those planning design and analysis phases will be required so that we can fulfill our responsibilities under that Act.

FISH AND WILDLIFE CONSERVATION AND MITIGATION MEASURES

Swamp habitats are considered by the Service to be aquatic resources of national importance due to their increasing scarcity and high habitat value for fish and wildlife within Federal trusteeship (i.e., migratory waterfowl, wading birds, other migratory birds, threatened and endangered species, and interjurisdictional fisheries). Restoring coastal swamp habitat through implementation of the proposed project would be preferable to the continued loss and degradation of coastal wetlands and Louisiana's nationally significant fish and wildlife resources.

A critical design challenge for the Maurepas Swamp will be the distribution of flow into and throughout the swamp habitat. Modifications to drainage patterns, distribution channels, and installation of control structures will be necessary to distribute water, sediment, and nutrients throughout the swamp and avoid adverse impacts to existing drainage features. To accommodate changing goals and restoration needs for the region, the diversion structure, as well as the outfall management system, should be designed to incorporate operational flexibility to address changing environmental conditions through an adaptive management program.

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 loss of coastal wetlands. Considering the scope and complexity of the some of the projects, that schedule, because of a one year delay in getting cost-sharing documents signed, should be acknowledged as a key potential 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.

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. 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 the LCA - Small Diversion at Convent/ Blind River 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 TSP has occurred changes to the TSP and/or the TSP features may be warranted based on further planning efforts and review of existing assumptions and modeling (i.e., quality control).

The intent of the habitat assessment is to provide a comparison of alternative benefit areas and potential direct impacts associated with project construction to support the selection of a TSP. To fully evaluate the benefits of the TSP the following additional information and actions will be required:

- Additional results of hydrologic modeling efforts that better identify/quantify influence areas and how water (sediment and nutrients) moves through the system and within each hydrologic unit under the operational plan identified.
- Water levels and swamp floor elevations need to be determined on a refined scale and incorporated into the hydrologic modeling.
- Salinity predictions need to be re-evaluated and changes, if necessary, be undertaken.
- Accretion rates need to be determined and incorporated into the hydrologic modeling (e.g., flood durations and depths should decrease). Benefits cannot be fully addressed without including this in the analysis.
- Due to time constraints, impacts associated with the transmission canal were assessed in the habitat assessment as a single habitat type; separate WVAs on each habitat type are therefore needed.

SERVICE POSITION AND RECOMMENDATIONS

The TSP will benefit the fish and wildlife resources that depend on the Maurepas Swamp by providing freshwater, nutrients, and sediments to the study area thus facilitating sediment deposition, increase organic production, increase biological productivity, and reduce conversion of swamp habitat to open water. Approximately 21,369 acres would benefit from the proposed project resulting in 6,421 AAHUs of swamp habitat at the end of the project life. The Service supports implementation of Alternative 2, a 3,000 cfs diversion at Romeville, provided the following fish and wildlife recommendations are implemented concurrently with project implementation:

1. Because of the expedited schedule, we recommend that the Corps continue to coordinate with the agencies during the remaining Feasibility phase and the Preconstruction, Engineering, and Design (PED) phase to ensure any new project features, development of the operational plan, and/or changes in the design fully incorporate adequate fish and wildlife conservation measures and that those features can be adequately evaluated with regards to impacts to fish and wildlife resources.

2. We recommend that hydrologic modeling efforts better identify/quantify influence areas and how water (sediment and nutrients) moves through the system and within

each hydrologic unit under the proposed operational plan. Those hydrologic modeling results should be provided to the habitat evaluation team with adequate time to evaluate the results and conduct detailed impacts analysis. Accretion rates need to be determined and incorporated into the hydrologic modeling (e.g., flood durations and depths should decrease). Benefits cannot be fully addressed without including this in the analysis.

3. To accommodate changing goals and restoration needs for the region, we recommend that the diversion structure, as well as the outfall management system, be designed to incorporate operational flexibility to address changing environmental conditions through an adaptive management program.

4. We recommend that water levels and swamp floor elevations be determined on a refined scale and incorporated into the hydrologic modeling.

5. Salinity predictions should be included in the hydrologic modeling efforts and re-evaluated, and, if necessary, changes be undertaken.

6. Due to time constraints, impacts associated with the transmission canal were assessed in the habitat assessment as a single habitat type; separate WVAs on each habitat type are recommended.

7. If a proposed project feature is changed significantly or is not implemented within one year of the Endangered Species Act consultation letter, we recommend that the Corps reinitiate coordination with our office to ensure that the proposed project would not adversely affect any Federally listed threatened or endangered species or their critical habitat.

8. 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).

9. To minimize disturbance to 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.

10. Because bald eagles are known to nest within the proposed study area, we recommend that an evaluation 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 and those results should be forwarded to this office.

11. Please coordinate with the LDWF, Region 7 Office (225/765-2360), for further information regarding any additional permits that may be required to perform work on the Maurepas Swamp Wildlife Management Area (WMA).

12. Please contact the LDWF, Scenic Rivers Program (318/343-4045) for further information regarding any additional permits that may be required to perform work on the above referenced river.

13. Land clearing associated with project features should be conducted during the fall or winter to minimize impacts to nesting migratory birds, when practicable.

14. Further detailed planning of project features (e.g., Design Documentation Report, Engineering Documentation Report, Plans and Specifications, or other similar documents) and any adaptive management and monitoring plans should be coordinated with the Service and other State and Federal natural resource agencies, and shall be provided an opportunity to review and submit recommendations on the all work addressed in those reports.

15. A report documenting the status of implementation, maintenance and adaptive management measures should be prepared every three years by the managing agency and provided to the Corps, the Service, National Marine Fisheries Service, U.S. Environmental Protection Agency, Louisiana Department of Natural Resources, Office of Coastal Protection and Restoration, and the Louisiana Department of Wildlife and Fisheries. That report should also describe future management activities, and identify any proposed changes to the existing management plan.

LITERATURE CITED

Baker, J.A., K.J. Killgore, and R.L. Kasul. 1991. Aquatic habitats and fish communities in the Lower Mississippi River. Reviews in Aquatic Sciences 3: 313-356.

Coastal Wetlands Planning, Protection, and Restoration Act Task Force. 2002. 12th Priority Project List Report (Appendices).

Conner, W. H. and J.W. Day, Jr. 1976. Productivity and composition of a baldcypress-water tupelo site and a bottomland hardwood site in a Louisiana swamp. American Journal of Botany 63:1354-1364.

Conner, W.H., J.G. Gosselink, and R.T. Parrondo. 1981. Comparison of the vegetation of three Louisiana swamp sites with different flooding regimes. Am J Bot 68: 320-331.

Conner, W.H., J.R. Toliver, and F.H. Sklar. 1986. Natural regeneration of baldcypress (*Taxodium distichum* (L.) Rich.) in a Louisiana swamp. Forest Ecology and Management 14: 305-317.

Davis, J.T., B.J. Fontenot, C.E. Hoenke, A.M. Williams and J.S. Hughes. 1970. Ecological Factors Affecting Anadromous Fishes of Lake Pontchartrain and its Tributaries. Louisiana Wild Life and Fisheries Commission. Fisheries Bulletin No. 9. 63 pp.

DeLaune, R.D., R.J. Buresh, and W.H. Patrick, Jr. 1979. Relationship of soil properties to standing crop biomass of *Spartina alterniflora* in a Louisiana marsh. Estuarine Coastal Marine Science 8: 477-487.

DeLaune, R.D., J.C. Callaway, W.H. Patrick, Jr., and J.A. Nyman. 2004. An analysis of marsh accretionary processes in Louisiana coastal wetlands. Pages 113-130 *in* D.W. Davis and M. Richardson, (eds). The Coastal Zone: Papers in Honor of H. Jesse Walker. Geoscience Publications, Dept. Geography Anthropology, Louisiana State University, Baton Rouge, LA.

Dicke, S.G. and J.R. Toliver. 1990. Growth and development of baldcypress/water tupelo stands under continuous versus seasonal flooding. For Ecol Manage 33/34: 523-530.

Gagliano, S.M. and J.L. Van Beek. 1970. Geologic and geomorphic aspects of deltaic processes, Mississippi delta system. Hydrologic and geologic studies of coastal Louisiana. Center for Wetland Resources, Louisiana State University, Baton Rouge, LA.

Grouchy, C. and R. Paille. October 2004. Near-Term Ecosystem Restoration Plan for the Louisiana Coastal Area Report (recommending a TSP). Final Fish and Wildlife Coordination Act Report. 28 pp.

Hastings, R.W., D.A. Turner, and R.G. Thomas. 1987. The fish fauna of Lake Maurepas, an oligohaline part of the Lake Pontchartrain estuary. Northeast Gulf Science 9(2): 89-98.

Hodges, J.D. 1997. Development and ecology of bottomland hardwood sites. Forest Ecology and Management 90: 117-125.

Hatton, R.S., R.D. DeLaune, and W.H. Patrick, Jr. 1983. Sedimentation, accretion and subsidence in marshes of Barataria Basin, Louisiana. Limnol. Oceanogr. 28/3:494-502.

Hoeppner, S. 2008. Swamp Ecology in a Dynamic Coastal Landscape: An Investigation through Field Study and Simulation Modeling. Ph.D. Dissertation. Louisiana State University, Baton Rouge, LA.

Keddy, P.A., D. Campbell, T. McFalls, G.P. Shaffer, R. Moreau, C. Dranguet, and R. Heleniak. 2007. The Wetlands and Lakes Pontchartrain and Maurepas: Past, Present and Future. Environmental Review 15:43-77.

Kozlowski, T.T. 1984. Responses of woody plants to flooding. Pages 129-163 *in* T.T. Kozlowski (ed.). Flooding and Plant Growth. New York: Academic Press.

Lopez, J.A. 2003. Chronology and analysis of environmental impacts within the Pontchartrain basin of the Mississippi Delta Plain: 1718-2002. Ph.D. Dissertation, Engineering and Applied Sciences Program, University of New Orleans, New Orleans, LA, USA.

Louisiana Coastal Protection and Restoration. 2008. USACE Louisiana Coastal Protection and Restoration (LACPR): Draft Technical Report.

Louisiana Coastal Wetlands Conservation and Restoration Task Force (LCWCRTF). 2006. Coastal Wetlands Planning, Protection, and Restoration Act - Wetland Value Assessment Methodology: Procedural Manual. Environmental Work Group. 23 pp.

Louisiana Coastal Wetlands Conservation and Restoration Task Force and the Wetlands Conservation and Restoration Authority (LCWCRTF). 1999. Coast 2050: Toward a Sustainable Coastal Louisiana, The Appendices. **Appendix C**— Region 1 Supplemental Information. Louisiana Department of Natural Resources. Baton Rouge, La.

Louisiana Department of Environmental Quality. 2007. 2006 Water Quality Integrated Report. Louisiana Department of Environmental Quality, Water Quality Assessment Division, Water Quality Inventory Section 305(b). Baton Rouge, LA.

Mashriqui, H.S. and G.P. Kemp. 1996. Restoring the capacity of Bayou Lafourche to convey increased discharges from the Mississippi River. Natural Systems Management and Engineering Group, Center for Coastal, Energy and Environmental Resources, Louisiana State University, Baton Rouge, LA.

Messina, M.G. and W.H. Conner (eds.). 1998. Southern Forested Wetlands: Ecology and

Management. Lewis publishers, New York, NY.

Pezeshki, S.R., R.D. DeLaune, and W.H. Patrick, Jr. 1990. Flooding and saltwater intrusion: potential effects on survival and productivity of wetland forests along the U.S. Gulf Coast. Forest Ecology and Management 33/34:287-301.

Putnam, J.A., G.M. Furnival, and J.S. McKnight. 1960. Management and inventory of southern hardwoods. U.S. Department of Agriculture, Agriculture Handbook No. 181, Washington, D.C.

Roberts, H.H. 1985. A study of sedimentation and subsidence in South-Central Coastal Plain of Louisiana. Final Report to the U. S. Army Corps of Engineers, New Orleans District, New Orleans, Louisiana. 53 pp.

Rybczyk, J.M., J.W. Day, Jr., and W.H. Conner. 2002. The impact of wastewater effluent on accretion and decomposition in a subsiding forested wetland. Wetlands, 22, 18-32.

Shaffer, G.P., J. Willis, S.S. Hoeppner, A.C. Parsons, and M. Hester. 2001. Characterization of Ecosystem Health of the Maurepas Swamp, Lake Pontchartrain Basin, Louisiana: Feasibility and Projected Benefits of a Freshwater Diversion. CWPPRA PPL 11.

Shaffer G.P., M. Hester, P. Kemp, H. Mashriqui, J. Day, and R. Lane. 2001a. Diversion into the Maurepas Swamps: A Complex Project under the Coastal Wetlands Planning, Protection, and Restoration Act. U.S. Environmental Protection Agency, Region 6, Dallas, Texas.

Shaffer, G.P., T.E. Perkins, S.S. Hoeppner, S. Howell, H. Benard, and A.C. Parsons. 2003. Ecosystem Health of the Maurepas Swamp: Feasibility and Projected Benefits of a Freshwater Diversion. Final Report for the Environmental Protection Agency, Region 6.

Shaffer, G.P., P.C. Stouffer, and M.A. Pourrier. 2006. A Whole System Approach for Restoring the Wetlands of Western Lake Pontchartrain Basin. Lake Pontchartrain Basin Research Program. 2006 Annual Report. 164 pp.

Templet, P.H. and K.J. Meyer-Arendt. 1988. Louisiana wetland loss: A regional water management approach to the problem. Environmental Management 12(2):181-192.

Thomson, D.A. 2000. The influence of hydrological alterations upon wetland hydrodynamics and plant growth on the Manchac Landbridge, Southeastern Louisiana, USA. M.S. Thesis. Southeastern Louisiana University, Hammond, LA.

Thomson, D.A., G.P. Shaffer, and J.A. McCorquodale. 2002. A potential interaction between sea-level rise and global warming: implications for coastal stability on the Mississippi River Deltaic Plain. Global Planet. Change. 32: 49-59.

Vogel, H.D. 1930. Report on control of floods of the Lower Mississippi River, Annex no. 5, basic data Mississippi River. House Doc. 798, 71st Congress, 3rd session: 61-137.

U.S. Army Corps of Engineers (Corps). 2000. Mississippi River Sediment, Nutrient, and Freshwater Redistribution Study. Draft Report for the Louisiana Coastal Wetlands Conservation and Restoration Task Force. July 2000. 90 pp.

Watson, M.B., C.J. Killebrew, M.H. Schurtz, and J.L. Landry. 1981. A Preliminary Survey of Blind River, Louisiana. In L.A. Krumholtz, ed. The Warmwater Fisheries Symposium, A National Symposium on Fisheries Aspects of Warmwater Streams. American Fisheries Society, Knoxville, TN. Pp. 303-319.

Wilson, B.C., C.A. Manlove, and C.G. Esslinger. 2002. North American Waterfowl Management Plan, Gulf Coast Joint Venture: Mississippi River Coastal Wetlands Initiative. North American Waterfowl Management Plan, Albuquerque, NM. 28 pp. + appendix.

APPENDIX A

PROJECT INFORMATION SHEET WITH ASSUMPTIONS
FOR
LCA- SMALL DIVERSION AT CONVENT/ BLIND RIVER

Draft

Wetland Value Assessment Project Information Sheet

Comparing Final Array of Alternatives

April 29, 2010

Prepared for:
U.S. Army Corps of Engineers
and
Louisiana Department of Natural Resources

Prepared by
U.S. Fish and Wildlife Service

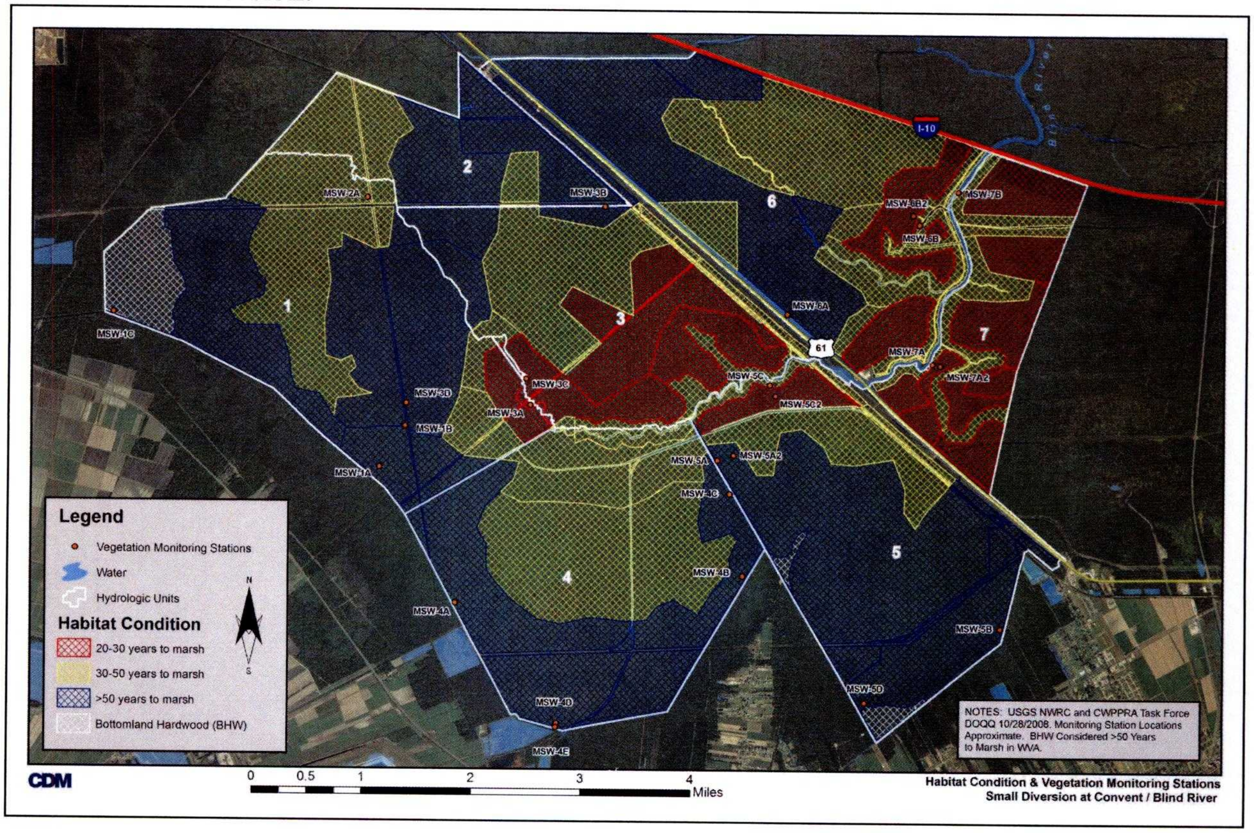
Project Name: Louisiana Coastal Area – Small Freshwater Diversion at Convent/Blind River

Project Type(s): Freshwater diversion and hydrologic restoration within swamp habitat

Project Area: The project area is within the Maurepas swamp west of Lake Pontchartrain and predominantly within St. James Parish with a small portion of the northern extent in Ascension Parish, LA (LCA Sub-province 1). The U.S. Interstate 10 corridor defines the northern boundary with the remaining project boundary being defined by several parish drainage canals. The cities and towns that flank the Mississippi River extend further to the southeast, south, and southwest of the project area. The Maurepas swamp is one of the largest remaining tracts of coastal fresh water swamp in Louisiana. Including Lake Maurepas, the Maurepas swamp area comprises an area that totals approximately 232,928 acres, most of which is swamp with some isolated areas of bottomland hardwood forest and fresh marsh. The Blind River flows from St. James Parish, through Ascension and Saint John the Baptist Parishes, and then discharges into Lake Maurepas. Much of the project area is situated within the Louisiana Department of Wildlife and Fisheries, Maurepas Wildlife Management Area.

For planning and hydrologic modeling purposes, the project area was divided into three benefit areas (i.e., benefit area 1, 2, and 3) and within those benefit areas are several sub-basins. Benefit areas and sub-basins are defined by topographic high areas (e.g., spoil banks, relict railroad grade, road embankments) or channels, natural or artificial (e.g., rivers, canals, channels, intermittent tributaries) that would serve to impede or intercept hydrologic flows. The area south and southwest of Blind River is defined as benefit area 1 (i.e., 100 sub-basin series). The area north of Blind River and west of U.S. Highway 61 is benefit area 2 (i.e., 200 sub-basin series), and the area north of Blind River and east of U.S. Highway 61 is benefit area 3 (i.e., 300 sub-basin series). For the purposes of the Wetland Value Assessment (WVA) the sub-basins are grouped into hydrologic units (Figure 1), or units that are considered to be under the same hydrological influences.

Figure 1. Hydrologic Units and Habitat Condition Classes for the Convent/Blind River Freshwater Diversion.



Problem: Since the construction of the Mississippi River flood control levees, the Maurepas swamps have been virtually cut off from any freshwater, sediment, or nutrient input. Thus, the only soil building has come from organic production within the wetlands; and preliminary evaluations suggest that productivity in the stressed Maurepas swamps may be substantially depressed compared to normal conditions. With minimal soil building and moderately high subsidence, there has been a net lowering of ground surface elevation, leading to a doubling in flood frequency over the last four decades (Thomson 2000), so that now the swamps are either permanently or semi-permanently flooded. With minimal ability to drain and persistent flooding, the typical seasonal drying of the swamp does not usually occur. Cypress and tupelo trees are able to grow in flooded conditions. Apparently, tupelo trees are more competitive in permanently flooded conditions (Conner et al. 1981, Dicke and Tolliver 1990), a condition that may explain the recent dominance of tupelo in the south Maurepas swamps and the project area. However, a high mortality of tupelo trees also has occurred in the last few years within the Maurepas study area possibly as a result of salinity spikes. Neither cypress nor tupelo seeds can germinate when flooded. Seeds of both species remain viable when submerged in water and can germinate readily when floodwaters recede (Kozlowski 1984). The potential for re-establishment seems to be hindered by the relatively low numbers of viable seeds observed in swamp seed banks, as well as by flooding (Conner et al. 1986). Storm surge and accompanying episodic saltwater intrusion has also exacerbated degradation resulting in lack of tree regeneration and substrate accretion.

It is expected that without restoration, the factors and processes that are contributing to stress and deterioration of the south Maurepas swamps will continue and result in loss of the swamp, with succession to open water (Shaffer et al. 2001). The Coast 2050 Report estimated wetland loss rates for the Amite/Blind Rivers mapping unit for 1974-90 to be 0.80 percent per year for swamp and fresh marsh habitat combined. Based on these rates, approximately 50 percent of swamp and 1.2 percent of fresh marsh will be converted to open water within 60 years. Nearly 69,500 acres of swamp (50% of the 1990 total) and 40 acres of marsh are projected to be lost by 2050 (LCWCRTF 1999).

U.S. Army Corps of Engineers guidance requires project performance to be assessed using three sea level change scenarios, a low estimate, an intermediate estimate, and a high estimate. Using the rate of 9.20 mm/yr, a starting year of 2011, and a 50-year project life, a sea-level rise of 1.5 feet is projected for the year 2061 (Table 1). A historic rate considered to be representative of the project area is calculated using the West End at Lake Pontchartrain gage (85625). The rate of 9.20 mm/yr is considered to include both the eustatic and local subsidence contributions to the estimated total sea-level rise.

In order to estimate the local subsidence rate for the project area, the global eustatic rate (1.7 mm/yr) is subtracted from the local sea level rate or:

Local subsidence rate = 9.20 mm/yr – 1.7 mm/yr = 7.50 mm/yr.

Table 1. Summary of total sea level rise (i.e., considers subsidence) for each scenario.

Project year	Scenario 1, Low Rate (feet)	Scenario 2, Intermediate Rate (feet)	Scenario 3, High Rate (feet)
2011	0.0	0.0	0.0
2016	0.2	0.2	0.2
2021	0.3	0.3	0.5
2026	0.5	0.5	0.8
2031	0.6	0.7	1.1
2036	0.8	0.9	1.4
2041	0.9	1.1	1.7
2046	1.1	1.3	2.0
2051	1.2	1.5	2.4
2056	1.4	1.7	2.8
2061	1.5	1.9	3.2

The estimate for the local subsidence rate is used in conjunction with estimates for the eustatic rates using NRC curves I and III to determine the intermediate and high projections of sea level rise for the project area. The following formula is used to estimate the total rise in eustatic sea level for the project life for the intermediate and high rate scenarios of sea level rise:

$$E(t_2) - E(t_1) = 0.0017(t_2 - t_1) + b(t_2^2 - t_1^2)$$

where:

b is the acceleration factor related to NRC curves I and III or 2.36E-5 and 1.005E-4 respectively,
t_1 is the time in years between the project's construction date and 1986,
and
t_2 is the time between a future date at which one wants an estimate for sea-level rise and 1986.

These eustatic estimates are added to the local subsidence estimate to get the total sea-level rise for the intermediate and high rate scenarios. For the purposes of hydrologic modeling for this project the intermediate rate was used.

Project Goal: Reverse the trend of degradation in the southeast portion of the Maurepas Swamp, so as to contribute toward achieving and sustaining a coastal ecosystem that can support and protect the environment, economy, and culture of southern Louisiana and thus contribute to the well-being of the Nation.

Objectives:

1. Promote water distribution in the swamp which, in turn, will increase freshwater throughput and nutrient input thereby increasing swamp productivity and wetland assimilation.
2. Facilitate swamp building: by increasing swamp productivity and sediment input by up to 1000 g/sq meter per year to decrease the annual subsidence rate (or accretion deficit).
3. Establish hydroperiod fluctuation in the swamp to improve bald cypress and tupelo productivity and seed germination and survival. This is proposed by decreasing flood duration for high flood events within the swamp, increasing the length of dry periods in the swamp, and increasing the number of cypress and tupelo saplings per acre from existing conditions.
4. Improve fish and wildlife habitat in the swamp and in Blind River by increasing sediment and nutrient input, freshwater flow, and dry periods which will contribute to an increase in swamp productivity. This will result in a diversity of stand structure components (tree species composition and a combination of herbaceous, midstory and overstory vegetation), thus improving fish and wildlife habitat needs. Direct project related benefits fish and wildlife resources (i.e., swamp habitat) are quantified by acreage and habitat quality using the Wetland Value Assessment, and are defined by average annual habitat units or AAHUs.

Alternatives:

Alternative 2 – Diversion at Romeville, 3,000 cfs

This proposed alternative includes constructing a gated culvert system and transfer canal along the Romeville alignment. In-swamp management measures include restoring and improving 160 existing canal spoil bank (berm) gaps that have silted in to an appropriate width (TBD), adding 30 new 500-foot wide berm gaps, building 7 water control structures at strategic locations in the swamp along man-made drainage canals to force river diversion water through the swamp, and adding 3 new culverts under U.S. Highway 61.

Alternative 4a – Diversion South of the HWY 70 Bridge, 3,000 cfs

This proposed alternative includes constructing a gated culvert system and transfer canal along the Cox alignment south of the Louisiana Hwy 70 Bridge and constructing in-swamp management measures as noted above.

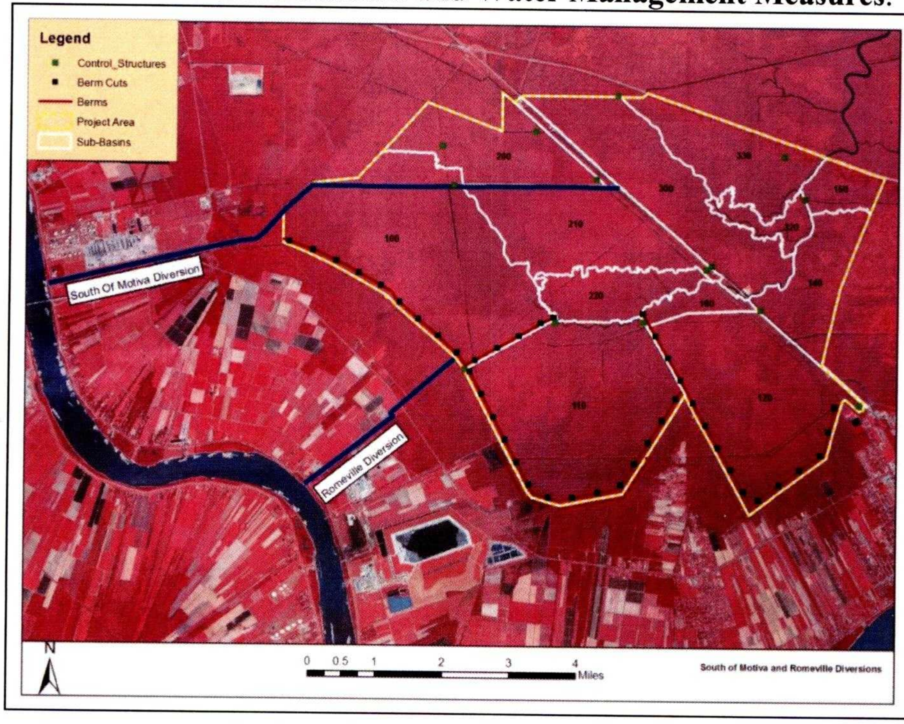
Alternative 4b – Diversions South of the HWY 70 Bridge, 3,000 cfs

This proposed alternative includes constructing a gated culvert system and transfer canal along the Cox alignment south of the Louisiana Hwy 70 Bridge and constructing in-swamp management measures as noted above. Additionally, in order to achieve a similar distribution as in the dual diversion alternative (Alternative 6) the distribution of the single diversion would be modified by diverting 1,500 cfs to the south at the junction of the St. James Parish Canal.

Alternative 6 – Dual Diversions at Romeville and South of the HWY 70 Bridge, 3,000 cfs (1,500 cfs for each diversion)

This proposed alternative includes constructing a gated culvert system and transfer canal along both the Romeville and Cox alignments and constructing in-swamp management measures as noted above.

Figure 2. Alternative Diversion Locations and Water Management Measures.



HEC-RAS and HEC-HMS Modeling

The Hydrologic Engineering Centers - River Analysis System (HEC-RAS) is designed to perform one-dimensional hydraulic calculations for a full network of natural and constructed channels to determine hydrologic flow simulation, sediment transport, and water quality analysis. The HEC - Hydrologic Modeling System (HEC-HMS) is designed to simulate the precipitation-runoff processes of dendritic watershed systems. It is designed to be applicable in a wide range of geographic areas for solving the widest possible range of problems including large river basin water supply and flood hydrology, and small urban or natural watershed runoff. Hydrographs produced by the program are used directly or in conjunction with other software for studies of water availability, urban drainage, flow forecasting, future urbanization impact, flood damage reduction, floodplain regulation, and systems operation.

Preliminary HEC-RAS and HMS modeling has been conducted by the contractor, CDM. The HEC-RAS was simulated over an average year, 2003 being the representative average water year. HEC-HMS used a 15-year simulation period from 1989-2004. One of the major constraints with directing freshwater into the study area is the efficiency of the Blind River to remove water from the system greatly reducing the exchange and widespread distribution of water throughout the system. A diversion directed to the southern portion of the project area and within benefit area 1 has limited influence on the other benefit areas because Blind River acts as a hydrologic barrier, and vice versa.

Modeling for this project, as well as the Coastal Wetlands Planning, Protection and Restoration Act (CWPPRA) Maurepas ("Hope Canal") Diversion project, has revealed that the Maurepas swamps are often lower in elevation than Lake Maurepas. This results in swamp water levels and dry-out periods being dependent on the water levels in Lake Maurepas, and essentially, flooding is semi-permanent with low to very low water exchange and throughput (EPA 2001).

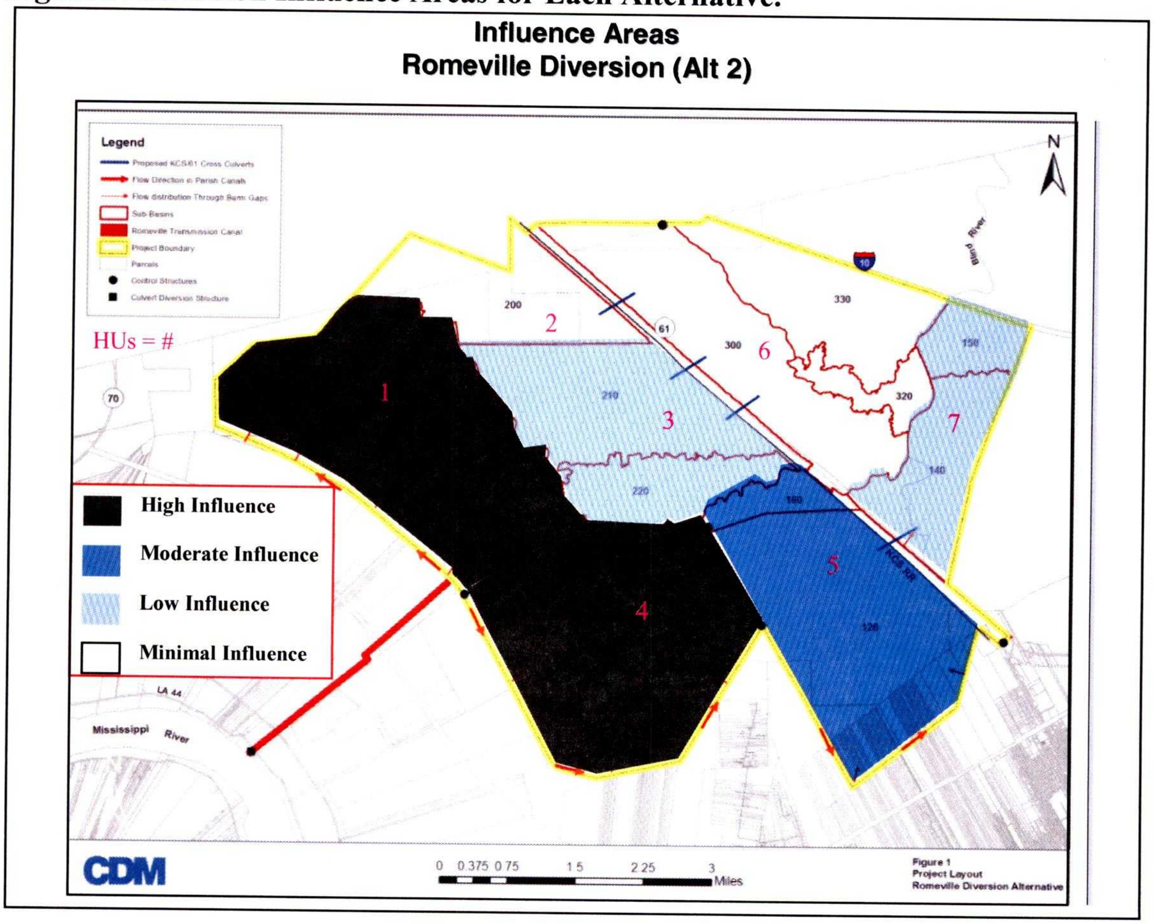
Investigations into diversion capacity determined that changes related to swamp productivity within the system require a minimum diversion flow of 1,000 cubic feet per second (cfs), and 1,500 cfs is required to prevent backflow from Lake Maurepas into the Blind River and swamps. Modeling results also indicate that hydrologic benefits within the system (described by modeling reports as average water depth, water depth exceedence, frequency above Lake Maurepas, and average annual freshwater inflow) either stabilize or do not see incremental benefits as a diversion flow magnitude exceeds 3,000 cfs. Another constraint affecting diversion operations is the availability of water from the Mississippi River. To meet design flow rates Mississippi River water elevations need to be at a minimum of 11 feet; the Mississippi River is at or above that elevation 60 % of the year. It was determined that a 3,000 cfs diversion would be required to provide enough water when available to offset unavailability during low flow periods in the Mississippi River.

Table 2. Diversion Influence for Each Alternative by Habitat Condition Class (construction impacts considered).

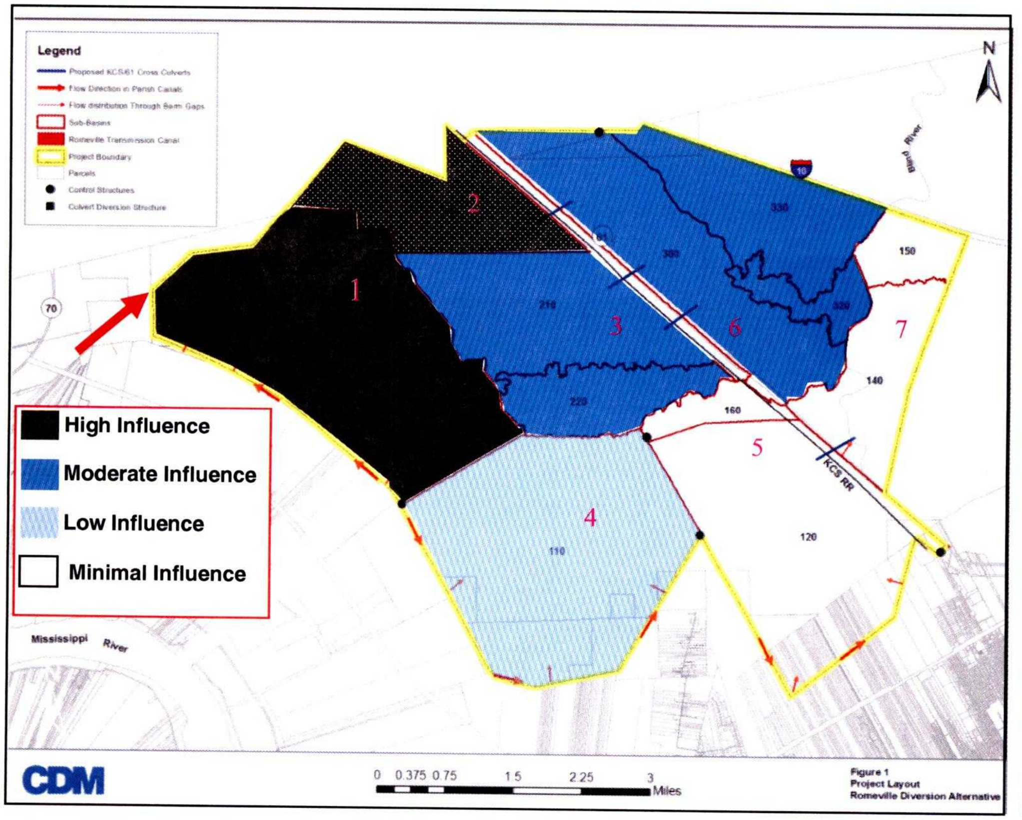
	Degree of Diversion Influence	20-30 Years to Marsh[1]		30-50 Years to Marsh		>50 Years to Marsh	
		HUs[2]	acres	HUs	acres	HUs	acres
Alternative 2 (Romeville)	High	1,4	169	1,4	3364	1,4	4555
	Moderate	5	204	5	604	5	2607
	Low	3,7	2397	3,7	1669	3	469
	No /Minimal	2,6	525	2,6	2297	2,6	2509
Alternative 4 (Hwy 70 Bridge)	High	1,2	169	1,2	1827	1,2	3550
	Moderate	6,3	1837	6,3	2972	6,3	2070
	Low	4	0	4	2013	4	1799
	No /Minimal	5,7	1289	5,7	1073	5	2607
Alternative 6 (Total Div)	High	1,2,4	169	1,2,4	3848	1,2,4	5361
	Moderate	3,5,6	2041	3,5,6	3579	3,5,6	4691
	Low	7	1085	7	469	--	0
	No /Minimal	--	0	--	0	--	0

[1]Habitat Classes as defined under Habitat Assessment Method [2]Hydrologic Units (see Figure 1)

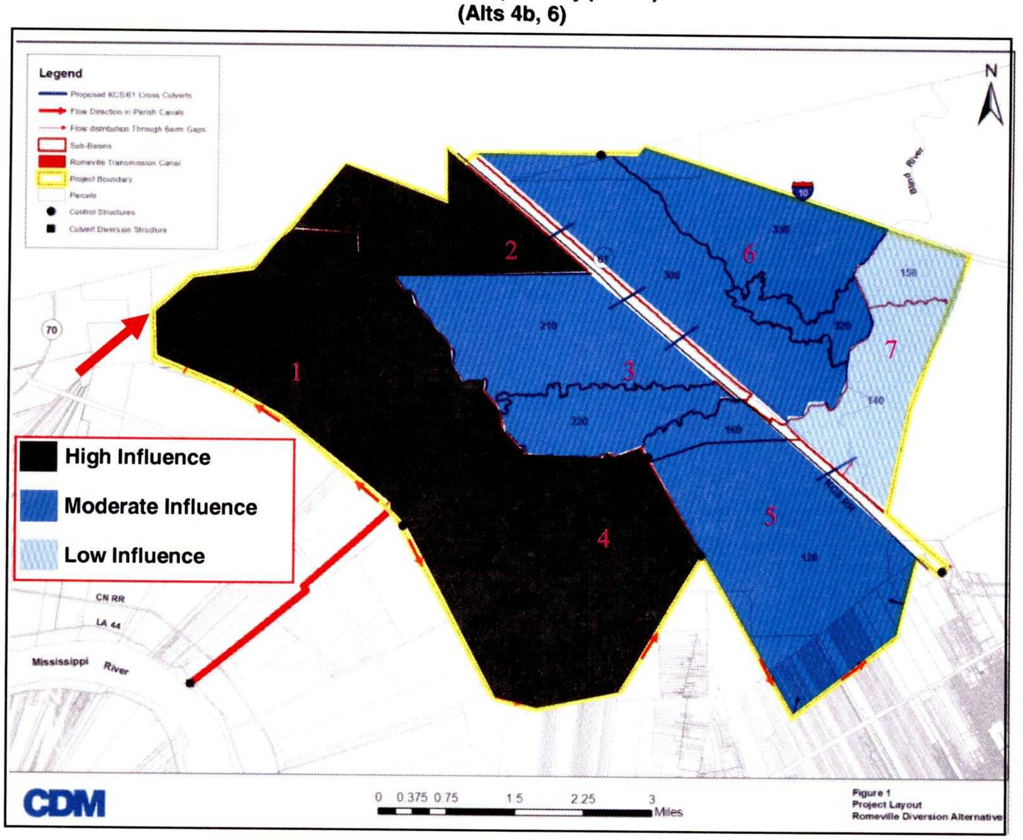
Figure 3. Diversion Influence Areas for Each Alternative.



Influence Areas
Sunshine Bridge Diversion (Alt 4)
(Original – No split southward)



Influence Areas
2 Diversions (or entry points)
(Alts 4b, 6)



Habitat Assessment Method

The procedure for evaluating project benefits on swamp habitats, the WVA swamp model, uses a series of variables that are intended to capture the most important conditions and functional values of a swamp. Values for these variables are derived for existing conditions and are estimated for conditions projected into the future if no restoration efforts are applied (i.e., future-without-project), and for conditions projected into the future if the proposed diversion project is implemented (i.e., future-with-project), providing an index of quality or habitat suitability of the swamp for the given time period. The habitat suitability index (HSI) is combined with the acres of swamp to get a number that is referred to as "habitat units". Expected project benefits are estimated as the difference in habitat units between the future-with-project (FWP) and future-without project (FWOP). To allow comparison of WVA benefits to costs for overall project evaluation, total benefits are averaged over a 50-year period, with the result reported as Average Annual Habitat Units (AAHUs).

<u>Existing and Future without Project Conditions</u>

To characterize existing conditions CDM established 28 vegetation monitoring stations throughout and adjacent to the project area during four separate field trips from March through September of 2009. A trend apparent to Shaffer et al. (2003) in the Maurepas swamp was increasing habitat degradation with proximity to Lake Maurepas. Therefore, two vegetation stations were positioned outside of the project area, closer to Lake Maurepas, to reference and track the progression of more degraded habitat conditions and to suggest potential future conditions for the project area under the no-action alternative. Data was collected on hydrology, wildlife, vegetation, community structure, composition, and health (per WVA methodology) at all vegetation monitoring stations. Soils data were also recorded at most monitoring stations.

On October 7, 2009, the team met with Dr. Gary Shaffer (Southeastern Louisiana University) and Bernard Wood (Research Assistant, SELU) to inspect the project area and compare habitat quality and swamp degradation to other areas of the Maurepas swamp that they are currently studying. Based on observations made during that field trip, data collected during previous field trips, knowledge of the habitat condition of the entire Maurepas swamp by Dr. Shaffer and Mr. Wood, and aerial photography, a habitat condition class map was then developed to categorize the different areas of swamp habitat (levels of degradation) according to classifications used by Dr. Shaffer at other areas within the Maurepas swamp (Figure 1). The intersection of diversion influence and habitat condition class defines the different areas that would require a separate WVA for each alternative (32 WVAs, not including WVAs for construction related impacts).

Three levels of habitat condition class were defined within the project area: 20-30 years-to-marsh, 30-50 years-to-marsh, and greater than 50-years-to-marsh. Data obtain from representative vegetation monitoring stations were then summarized according to each habitat class to get a representative value for each habitat class for the WVA. Because we can not accurately determine when these swamps will convert to marsh or open water, these habitat condition classifications are meant to define the level of degradation and not necessarily the target years that the habitats will be removed from the habitat assessment.

Variable V_1 – Stand Structure (Table 3)

Most swamp tree species do not produce hard mast; consequently, wildlife foods predominantly consist of soft mast, other edible seeds, invertebrates, and vegetation. Because most swamp tree species produce some soft mast or other edible seeds, the actual tree species composition is not usually a limiting factor. More limiting is the presence of stand structure to provide resting, foraging, breeding, nesting, and nursery habitat and the medium for invertebrate production. This medium can exist as herbaceous vegetation, scrub-shrub/midstory cover, or overstory canopy and preferably as a combination of all three. This variable assigns the lowest suitability to sites with a limited amount of all three stand structure components, the highest suitability to sites with a significant amount of all three stand structure components, and mid-range suitability to various combinations when one or two stand structure components are present.

Conversion of forested wetlands to open water or marsh within the project area has not been observed during field investigations. Minimal windthrow of canopy trees was observed; however, light to moderate crown damage and windthrow of midstory trees was evident and likely occurred from recent hurricanes and tropical storm events. Similar damage was observed throughout Maurepas swamp, with data suggesting that midstory windthrow was inversely related to canopy density (Effler et al. 2007, Shaffer personal communication per DEIS). Decreasing canopy is also indicative of stress due to prolonged inundation and/or stagnant water conditions. Decreased vigor may increase susceptibility of trees to tropical storm damage.

Plant diversity in baldcypress-tupelo swamps is typically low due to low light penetration into the understory and the extended hydroperiod, which limit the establishment and survival of understory vegetation. Baldcypress (*Taxodium distichum*) and water tupelo (*Nyssa aquatica*) are common codominant canopy species in this habitat, with swamp red maple (*Acer rubrum var. drummondii*) predominant and green ash (*Fraxinus pennsylvanica*) codominant, in the midstory and understory strata. Common herbaceous species include arrow arum (*Peltandra virginica*), pennywort (*Hydrocotyle* spp.), smartweed (*Polygonum punctatum*), and lizard's tail (*Saururus cernuus*). Salvinia (*Salvinia* spp.), a non-native invasive aquatic fern, is prolific in many areas. Savanna panicum (*Phanopyrum gymnocarpon),* thought to be an indicator of flow and nutrients, was also observed in the higher quality swamps. A complete list of species and existing habitat conditions at each vegetation monitoring station is provided in CDM's October 2, 2009, "Existing Environmental Condition of Project Area" Memorandum.

<u>Stand Structure for 20-30 Years-to-Marsh</u>

Existing –The 20-30 years-to-marsh habitat class is characterized by having 23 percent canopy cover, 33 percent midstory cover, and 80 percent herbaceous or ground cover (Class 1). Of the overstory canopy cover, 81 percent is tupelo and other species, and the remaining 18 percent is cypress, with some monitoring sites being comprised of 100 percent tupelo. While basal area averages 113.85 ft^2/ac (moderately dense), one monitoring site has a basal area of 34.52 ft^2/ac which is considered open, and one site is 64.43 ft^2/ac which is considered to be moderately open. One aspect of stand structure that is not reflected in the data is crown damage or loss of tree tops. While this is localized within the project area it is expected to be a common characteristic in the future as conditions deteriorate which is evident in other areas of Maurepas swamp. Crown damage also contributes to the low canopy cover phenomenon in an area were basal area is moderately dense, which consequently results in a high herbaceous cover. Water tolerance by tupelo has allowed the swamp stand structure to be dominated by tupelo in those areas experiencing prolonged flooding. Coupled with occasional salinity spikes, some tupelo dominated areas are experiencing either canopy top-off or complete canopy die off.

FWOP – Conditions are expected to continue to degrade as lack of nutrients, accretion, and freshwater, and an increase in sea level rise, subsidence, episodic salt water intrusion, and storm events all take a toll on the swamp. As a result of these deteriorating conditions, tree mortality, will continue resulting in lower tree density. The canopy will continue to thin, and canopy cover will persist below 33 percent (Table 3).

Table 3. Future-with and Future-without Project Stand Structure Conditions.

FWOP

Habitat Condition Class	TY0					TY1	TY20				TY30				TY50			
		%O	%M	%H	Class	Class	%O	%M	%H	Class	%O	%M	%H	Class	%O	%M	%H	Class
20-30 yrs. to marsh		23	33	80	1	1	<33			1	<33			1	<33			1
30-50 yrs. to marsh		38	39	51	5	5	33<50	<33	<33	2	33<50	<33	<33	2	<33			1
>50 yrs. to marsh		64	46	22	4	4	50<75	>33	<33	4	50<75	>33	<33	4	33<50	<33	<33	2

FWP

Habitat Condition Class	Level of Influence	TY0				TY1				TY20				TY30				TY50			
		%O	%M	%H	Class	%O	%M	%H	Class	%O	%M	%H	Class	%O	%M	%H	Class	%O	%M	%H	Class
20-30 yrs. to marsh	High Influence	23	33	80	1	23	33	80	1	33<50	>33	>33	5	33<50	>33	>33	5	50<75	>33	<33	4
	Moderate Influence	23	33	80	1	23	33	80	1	33<50	>33	>33	5	33<50	>33	>33	5	50<75	>33	<33	4
	Low Influence	23	33	80	1	23	33	80	1	33<50	>33	>33	5	33<50	>33	>33	5	33<50	>33	<33	3
	No Influence**	23	33	80	1	23	33	80	1	33<50	>33	>33	5	<33			1	<33			1
30-50 yrs. to marsh	High Influence	38	39	51	5	38	39	51	5	33<50	>33	>33	5	≥50	>33	>33	6	≥50	>33	<33	4
	Moderate Influence	38	39	51	5	38	39	51	5	33<50	>33	>33	5	≥50	>33	>33	6	≥50	>33	<33	4
	Low Influence	38	39	51	5	38	39	51	5	33<50	>33	>33	5	33<50	>33	>33	5	33<50	>33	<33	3
	No Influence**	38	39	51	5	38	39	51	5	33<50	>33	>33	5	33<50	>33	>33	5	33<50	>33	<33	3
>50 yrs. to marsh	High Influence	64	46	22	4	64	46	>33	6	≥50	>33	>33	6	50<75	>33	<33	4	50<75	>33	<33	4
	Moderate Influence	64	46	22	4	64	46	>33	6	≥50	>33	>33	6	50<75	>33	<33	4	50<75	>33	<33	4
	Low Influence	64	46	22	4	64	46	>33	6	≥50	>33	>33	6	50<75	>33	<33	4	50<75	>33	<33	4
	No Influence**	64	46	22	4	64	46	>33	6	≥50	>33	>33	6	50<75	>33	<33	4	50<75	>33	<33	4

FWP – Depending on the location of this habitat class within the influence of the diversion, the 20-30 years to marsh is expected to see some benefits as a result of increased sediments, nutrients, and/or freshwater. Increased throughput is also expected to provide benefits as a result of berm cuts and other in-swamp management measures. Consequently, canopy, midstory and herbaceous cover is projected to increase through time. According to FWP modeling of "existing conditions with berm cuts", the project area is expected to be constantly inundated with an average annual water depth throughout the project area of 1.01 feet by target year 20 and 1.75 feet by target year 50. Additional flows from a 3,000 cfs diversion would only increase flood duration. Flood duration was estimated based on hydrologic modeling data presented for "berm cuts without diversions" scenario assuming that the diversion would be operated to mimic the natural historic Mississippi River overbank flooding cycle and would allow for the longest possible dry out period in some years. With the diversion average annual water depths are predicted to be in some areas as high as 3.71 feet (Alternative 6, hydrologic sub-basin series 200) and 5.82 feet (Alternative 4, hydrologic sub-basin series 200) during operation of the diversion. Therefore, the stand structure class was reduced at target year 50 (Table 3) to reflect prolonged inundation and a reduced herbaceous and midstory component.

Areas not affected by the diversion should see some benefits of increased hydrologic flow/throughput as a result of the in-swamp management measures. However, these benefits are short term as total sea level rise contributes to these areas returning to a persistent flooding regime by target year 20. It is projected that those areas of 20-30 years-to-marsh habitat class within areas not influenced by the diversion will not have enough time and benefits to regenerate and maintain a healthy forested stand, and, therefore, returns to a Class 1 by target year 30.

Stand Structure for 30-50 Years-to-Marsh

Existing – The 30-50 years-to-marsh habitat class is characterized by having 38 percent canopy cover, 39 percent midstory cover, and 51 percent herbaceous or ground cover (Class 5). Of the overstory canopy cover, 85 percent is tupelo and other species and the remaining 15 percent is cypress. Similar to the 20-30 years-to-marsh habitat class, several of the monitoring vegetation sites were 100 percent tupelo. Basal area varied from 133.42 ft^2/ac to 320.79 ft^2/ac, or moderately dense to dense; however, light penetration appears to be suitable enough to support a midstory and herbaceous cover component.

FWOP – Conditions are expected to continue to degrade as lack of nutrients, accretion, and freshwater, and an increase in sea level rise, subsidence, episodic salt water intrusion, and storm events all take a toll on the swamp. As a result of these deteriorating conditions, tree mortality, especially to tupelo, will continue resulting in lower tree density. The canopy will continue to thin, and canopy cover is predicted to drop below 33 percent by target year 50.

FWP – High to moderate influenced areas are predicted to see benefits as a result of increased sediments, nutrients, and/or freshwater. Increased throughput is also expected to provide benefits as a result of berm cuts and other in-swamp management measures. Consequently, canopy, midstory and herbaceous cover is projected to increase through time. As noted above, flood duration is expected to increase as total sea level rise increases, resulting in an eventual decrease in herbaceous cover by target year 50.

Areas that are not affected (no influence areas) or are minimally affected (low influence areas) by the diversion see no increase in stand structure, but rather maintain the existing stand structure until target year 50. Consistent with the previously mentioned hydrologic conditions, stand structure is reduced at target year 50 as a result of a reduced herbaceous component.

Stand Structure for Greater than 50 Years-to-Marsh

Existing – The greater than 50 years-to-marsh habitat class is characterized by having 64 percent canopy cover, 46 percent midstory, and 22 percent herbaceous or ground cover. Of the overstory canopy cover, 44 percent is tupelo and other species and 56 percent is cypress. While the percentage indicates an even distribution, the individual monitoring vegetation sites were dominated by either one or the other species. Basal area and percent canopy cover is considered optimal, or dense, with an average basal area of 256.09 ft^2/ac. The midstory is also considered suitable; however, herbaceous cover is less than optimal likely due to lack of light penetration and nutrients.

FWOP – In comparison to other areas of the Maurepas swamp, this habitat class is considerably healthier and is expected to maintain a Class 4 stand structure through much of the FWOP life. By target year 50 conditions will begin to deteriorate and the canopy begins to thin.

FWP – This habitat class is expected to see benefits as a result of increased sediments, nutrients, and freshwater from the diversion, and due to increased throughput as a result of in-swamp management measures. Consequently, an increase in herbaceous cover is expected within the short term for all areas of influence. However, as canopy closure becomes even more prevalent and as flood duration is expected to increase as total sea level rise increases, a decrease in herbaceous cover by target year 30 is predicted.

Variable V_2 – Stand Maturity (Table 8)

The suitability graph for this variable assumes that snags, cavities, downed treetops, and invertebrate production are present in suitable amounts when the average diameter-at-breast height (DBH) of canopy-dominant and canopy-codominant trees is above 16 inches for baldcypress and above 12 inches for tupelogum and other species. Therefore, stands with those characteristics are considered optimal for this variable (SI = 1.0).

Another important component of this variable is stand density, measured in terms of basal area. A scenario sometimes encountered in mature swamp ecosystems is an overstory consisting of a very few, widely-scattered, mature baldcypress. If stand density was not considered, but only average DBH, then those stands would receive a high SI for this variable without providing many of the important habitat components of a mature swamp ecosystem, specifically an adequate number of trees for nesting, foraging, and other habitat functions. Therefore, the SI for this variable is dependent on average DBH and basal area which is used as a measure of stand density.

Existing Conditions
Seven vegetation monitoring stations were identified that were representative of the 20-30 years-to-marsh class. Basal area averaged 113.85 ft^2/acre. The average DBH measured 11.21 inches

for cypress and 13.08 inches for tupelo and other canopy co-dominant species. Even though this is the most degraded habitat, class basal area is still considered to be moderate.

Six vegetation monitoring stations were identified that were representative of the 30-50 years-to-marsh class. Basal area averaged 222.73 ft^2/acre. The average DBH measured 14.71 inches for cypress and 14.20 inches for tupelo and other canopy co-dominant species.

Nine vegetation monitoring stations were identified that were representative of the greater-than 50 years-to-marsh class. Basal area averaged 256.09 ft^2/acre. The average DBH measured 15.76 inches for cypress and 13.97 inches for tupelo and other canopy co-dominant species.

FWOP

Numerous bald cypress and tupelo growth rates have been documented in deep water swamp habitats and are summarized by Visser and Sasser (1995). For FWOP conditions we assumed mean annual growth rates documented by Dr. Shaffer (unpublished) (Table 4) for target years 1-20. These assumptions are similar to what was used for the LCA, Amite River Diversion Channel Modification project. Since subsidence, total sea level rise and associated stresses are expected to continue mean annual growth rates were reduced for target years 20-50.

Table 4. Cypress and Tupelo Annual Growth Rates FWOP

	Cypress (inches)	Tupelo et al (inches)
TY 0-20		
20-30 yrs to marsh	0.11	0.08
30-50 yrs to marsh	0.15	0.1
>50 yrs to marsh	0.15	0.1
TY 20-50		
20-30 yrs to marsh	*0.064	**0.073
30-50 yrs to marsh	*0.064	0.08
>50 yrs to marsh	*0.064	0.08

*Visser and Sasser (1995) ** Day (1985) from Visser and Sasser (1995)

Increase in basal area was estimated by species and habitat condition class by calculating and projecting the increase in basal area using the predicted growth rates and tree mortality. Percent composition of canopy trees in the FWOP was estimated based on best professional judgment of expected mortality of tupelo among the habitat condition classes taking into consideration assumptions made for the CWPPRA Maurepas ("Hope Canal") Diversion Project. The CWPPRA (Hope Canal) Diversion Project estimated that 50% of tupelo would die over the 20 year FWOP life, but that actual mortality of cypress would be minimal. Because habitat conditions within the Convent/Blind River project area are more favorable and are not at the same stage of degradation we assumed a reduced tupelo mortality rate for the first 20 years and for higher quality habitat condition classes (Table 5). Because tupelo is more flood tolerant highly degraded areas have become dominated by tupelo. Those areas have also experienced continued degradation as a result of seasonal salinity spikes and are seeing increased tupelo mortality and reduced vigor. In order to be conservative only tupelo mortality was assumed when determining FWOP mortality and projected project benefits because lower quality habitats were dominated by tupelo.

Table 5. Tupelo Mortality FWOP

	TY 20	*TY 50
20-30 yrs to marsh	50%	50%
30-50 yrs to marsh	25%	50%
>50 yrs to marsh	25%	25%

*percent mortality is of the TY 0 (existing) stand

Table 6. Tupelo Mortality FWP

	TY 1	TY 20	TY 50	Total Mortality
High Influence				
20-30 yrs to marsh	0%	0%	5%*	5%
30-50 yrs to marsh	0%	0%	5%*	5%
> 50 yrs to marsh	0%	0%	0%	0%
Moderate Influence				
20-30 yrs to marsh	0%	0%	10%*	10%
30-50 yrs to marsh	0%	0%	10%*	10%
> 50 yrs to marsh	0%	0%	0%	0%
Low Influence				
20-30 yrs to marsh	0%	0%	20%*	20%
30-50 yrs to marsh	0%	0%	20%*	20%
> 50 yrs to marsh	0%	0%	10%*	10%
No Direct Influence				
20-30 yrs to marsh	0%	40%*	40%*	80%
30-50 yrs to marsh	0%	10%*	40%*	50%
> 50 yrs to marsh	0%	10%*	20%*	30%

*% of existing stand @ TY0

Table 8. Future-with and Future-without Project Stand Maturity Conditions.

Future Without Project:

Habitat Condition Class	Level of Influence	Species Group	AVERAGE DIAMETER (inches) TY1	TY20	TY30	TY50	% Contribution by Number of Individuals TY1	TY20	TY30	TY50	BASAL AREA (ft^2/ac) TY1	TY20	TY30	TY50
20-30 yrs. to marsh	FWOP	baldcypress	11.87	13.96	14.60	15.88	10.42	18.87	18.87	100.00	122.35	82.98	90.81	18.42
		tupelo et al.	13.56	15.08	15.81	0.00	89.58	81.13	81.13	0.00				
30-50 yrs. to marsh	FWOP	baldcypress	15.61	18.46	19.10	20.38	17.57	22.13	22.13	46.02	241.96	247.88	269.12	157.24
		tupelo et al.	14.80	16.70	17.50	19.10	82.43	77.87	77.87	53.98				
>50 years to marsh	FWOP	baldcypress	16.66	19.51	20.15	21.43	41.51	48.62	48.62	58.67	280.03	320.24	345.15	338.32
		tupelo et al.	14.57	16.47	16.47	18.87	58.49	51.38	51.38	41.33				

Future With Project:

Habitat Condition Class	Level of Influence	Species Group	AVERAGE DIAMETER (inches) TY1	TY20	TY30	TY50	% Contribution by Number of Individuals TY1	TY20	TY30	TY50	BASAL AREA (ft^2/ac) TY1	TY20	TY30	TY50
20-30 yrs. to marsh	High Influence	baldcypress	11.98	16.16	17.25	18.91	10.42	10.42	10.42	10.91	123.80	185.60	213.14	247.37
		tupelo et al.	13.64	16.68	17.92	19.82	89.58	89.58	89.58	89.09				
	Moderate Influence	baldcypress	11.95	15.50	16.33	17.61	10.42	10.42	10.42	11.44	123.37	174.97	195.25	208.04
		tupelo et al.	13.62	16.20	17.15	18.61	89.58	89.58	89.58	88.56				
	Low Influence	baldcypress	11.91	14.62	15.26	16.54	10.42	10.42	10.42	12.69	122.79	161.30	176.18	170.34
		tupelo et al.	13.59	15.56	16.29	17.75	89.58	89.58	89.58	87.31				
	No Influence**	baldcypress	11.87	13.96	14.60	15.88	10.42	16.23	16.23	36.76	122.35	96.67	105.81	54.07
		tupelo et al.	13.56	15.08	15.81	17.27	89.58	83.77	83.77	63.24				
30-50 yrs. to marsh	High Influence	baldcypress	15.56	21.26	22.35	24.01	17.57	17.57	17.57	18.32	241.69	383.85	435.66	500.91
		tupelo et al.	14.80	18.60	19.96	22.04	82.43	82.43	82.43	81.68				
	Moderate Influence	baldcypress	15.52	20.36	21.19	22.47	17.57	17.57	17.57	19.15	240.70	359.05	397.06	423.01
		tupelo et al.	14.77	18.00	19.04	20.64	82.43	82.43	82.43	80.85				
	Low Influence	baldcypress	15.46	19.16	19.80	21.08	17.57	17.57	17.57	21.04	239.40	327.36	355.08	348.08
		tupelo et al.	14.73	17.20	18.00	19.60	82.43	82.43	82.43	78.96				
	No Influence**	baldcypress	15.41	18.26	18.90	20.18	17.57	19.15	19.15	29.89	238.42	280.58	305.05	232.82
		tupelo et al.	14.70	16.60	17.40	19.00	82.43	80.85	80.85	70.11				
>50 yrs. to marsh	High Influence	baldcypress	16.81	22.51	23.60	25.27	41.51	41.51	41.51	41.51	275.69	454.73	510.25	601.75
		tupelo et al.	14.67	18.47	19.83	21.91	58.49	58.49	58.49	58.49				
	Moderate Influence	baldcypress	16.77	21.61	22.45	23.73	41.51	41.51	41.51	41.51	274.46	423.36	464.05	530.56
		tupelo et al.	14.64	17.87	18.91	20.51	58.49	58.49	58.49	58.49				
	Low Influence	baldcypress	16.71	20.41	21.05	22.33	41.51	41.51	41.51	44.09	272.83	383.33	412.97	450.44
		tupelo et al.	14.60	17.07	17.87	19.47	58.49	58.49	58.49	55.91				
	No Influence**	baldcypress	16.66	19.51	20.15	21.43	41.51	44.09	44.09	50.34	271.61	336.31	363.08	372.21
		tupelo et al.	14.57	16.47	17.27	18.87	58.49	55.91	55.91	49.66				

**NO INFLUENCE GROWTH RATES SET AS FWOP.

FWP

The proposed diversion is expected to substantially stimulate productivity, and so stimulate growth of the cypress and tupelo (as well as other species). The amount of stimulation is assumed to be related to level of influence of the diversion. Depending on the alternative diversion location certain hydrologic units will receive different levels of influence. Those areas within the high influence area will receive freshwater, nutrients, and sediments; so it is assumed those hydrologic units will see the greatest increase in growth. Results of studies by John Day in wetlands receiving secondary treated sewage suggest that introduction of nutrients as well as sediments from river water could stimulate production by 3-5 fold (EPA 2001). Comparison of productivity in swamps that are either managed, have more favorable hydrology, and/or are receiving nutrient enrichment suggest that the existing levels of productivity in Maurepas are ½ to ¼ of average values (EPA 2001). Southeast Louisiana University study sites within the Maurepas swamp that receive non-point source runoff (i.e., containing nutrients and sediment) have documented an average 1 centimeter of diameter increase per year. When sewage effluent is involved some study sites average 1.5 cm of growth per year close to such a source (Bernard Wood, personal communication). As a very conservative projection, a 2-fold increase in growth rate (i.e., 200% of growth rates listed in Table 4) was applied to the high influence areas for the first 19 years to capture the anticipated stimulation of growth from the diversion. Reduced growth rates were assumed as the level of influence decreased and as the area returned to a more semi-permanent flooding regime (Table 7). DBH and basal area in the FWP were estimated as for FWOP, by applying the increased growth rates and mortality rates.

Table 7. Percent Increase in DBH growth rate based on Level of Diversion Influence (50 yr project life) FWP

	TY 1	TY 20	TY 30
High Influence Area	200%	170%	130%
Moderate Influence Area	170%	130%	100%
Low-Direct Influence Area	130%	100%	100%

Areas not affected by the diversion may still experience benefits as a result of the berm cuts and in-swamp management modifications. Tupelo mortality was assumed based on flood duration and existing stand health. Flood duration was estimated based on hydrologic modeling data presented for "berm cuts without diversions" scenario assuming that the diversion would be operated to mimic the natural historic Mississippi River overbank flooding cycle and would allow for the longest possible dry out period in some years.

Variable V_3 – Water Regime (Table 9)

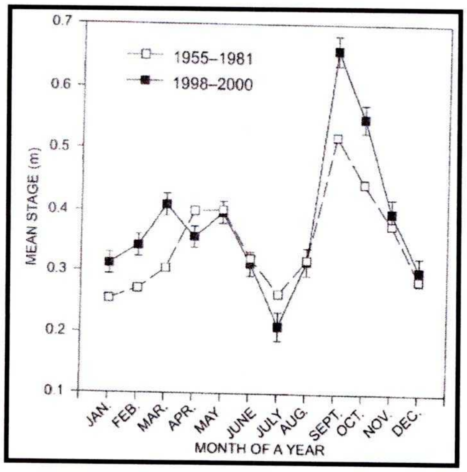
The optimal water regime is assumed to be seasonally flooded with abundant and consistent riverine/tidal input and water flow-through (SI=1.0). Seasonal flooding with periodic drying cycles is assumed to contribute to increased nutrient cycling (primarily through oxidation and decomposition of accumulated detritus), increased vertical structure complexity (due to growth of other plants on the swamp floor), and increased recruitment of dominant overstory trees. In addition, abundant and consistent input and water flow-through is optimal, because under that regime the full functions and values of a swamp in providing fish and wildlife habitat are assumed to be maximized. Temporary flooding is also assumed to be desirable. Habitat suitability is assumed to decrease as water exchange between the swamp and adjacent systems is reduced. The combination of permanently flooded conditions and no water exchange (e.g., an impounded swamp where the only water input is through rainfall and the only water loss is through evapotranspiration and ground seepage) is assumed to be the least desirable (SI=0.1). Those conditions can produce poor water quality during warm weather, reducing fish use and crawfish production (WVA Procedure Manual).

Existing

Hydrologic modeling for this project, as well as hydrologic investigations for the CWPPRA Maurepas (Hope Canal) Diversion project, has revealed that the Maurepas swamp floor elevations (i.e., 1.12 feet NAVD per CRMS station 5167) are often lower than Lake Maurepas bottom elevations. This results in swamp water levels and dry-out periods being dependent on the water levels in Lake Maurepas, and essentially, flooding is semi-permanent with low to very low water exchange and throughput. The observed doubling of flood durations from 1955 to present at Pass Manchac (Thomson et al. 2002) coupled with swamp elevations lower than lake elevations suggests that the duration of inundation within the project area has drastically increased over the last fifty years. Moreover, flood durations within the project area swamps are influenced by adjacent urban storm water runoff of areas to the northwest (i.e., Baton Rouge and surrounding cities) and the hydrologic impoundments caused by major transportation corridors. Adjacent urban storm water drainage projects force storm water runoff via large drainage canals into the Blind River. These storm waters bypass the floodwater storage capabilities of adjacent forested wetlands and increase the water levels in Blind River resulting in back water flooding conditions upstream of the waterways confluence. Being that the project area is located at the headwaters of the Blind River and is impounded by several major hydrologic barriers [i.e., U.S. Interstate 10, U.S. Highway 61, and Kansas City Southern Railroad (KCSRR)]; flood waters within the project area are the last to recede from the basin. It is appears that within hydrologic unit 3 interior elevations are low enough to allow ponding of water for longer periods of time, and is, therefore, considered permanently flooded with low water exchange.

Lunar tidal fluxes in Maurepas swamp average 30 cm but are typically overwhelmed by meteorological tidal fluxes. Wind is also a significant forcing agent for water level in Maurepas swamp and may exhibit daily and seasonal variability. During the summer and early fall, storms and prevailing winds from the southeast raise water levels in the swamp as they push Gulf water into the system. Conversely, during the winter months, continental fronts with prevailing winds from the northeast often lower water levels in the swamp as they push water out of the system and towards the Gulf. Fluctuations in water level are generally expected to be similar throughout Maurepas swamp, acknowledging slight variability associated with landscape position and elevation. Within any given year, water stage is characterized by a bimodal hydrograph (Figure 4). Water level rises in the spring, then falls to its lowest level during the summer, rises to its highest level in the fall, and again falls to low levels in the winter (Thomson 2000, Keddy et al. 2007). The intensity of peaks and troughs is typically associated with those meteorological events.

Figure 4. Intra-annual variability of montly mean stage comparing the periods 1955-1981 (historical) and 1998-2000 (drought period). The duration of flooding (percentage of the year that the marshes by Schleider's Ditch flood) more than doubled over the period of record for the USACE tide gage (from Thomson 2000, referenced in Keddy 2007)



Water exchange between the project area swamps and adjacent swamps is reduced to what the Blind River and other small tributaries can exchange across the embankments of the three transportation corridors (i.e., U.S. Interstate 10, U.S. Highway 61, and KCSRR). These embankments act as hydrologic barriers and reduce flow-through across the project area swamp. Within the project area interior drainage and hydrologic exchange has been altered by the construction of drainage canals and associated berms, pipeline and transmission line rights-of-way, and remnant logging infrastructure (i.e., roads, pull boat ditches, and temporary railroad track embankments). Historically, seasonal overbank flooding over the natural Mississippi River levees facilitated hydrologic exchange and freshwater input on average every three to five years. Today the only additional freshwater input is through rainwater runoff, and even those contributions can by-pass the wetland system through the many storm water drainage canals that direct floodwaters directly into Blind River and Lake Maurepas. The project area swamp habitat has been altered and disrupted to a point that adequate water exchange does not exist, and is considered to have low water exchange.

<u>FWOP</u>

Future without project conditions flood durations are expected to worsen as sea level rise and subsidence continues and storm water control projects continue to force storm water into an already flooded system. It is assumed that the entire project area swamp habitat will become permanently flooded and continue to have low flow exchange.

Table 9. Summary for Average Annual Water Depth (ft)

No Sea Level Rise (existing conditions)

Alternatives	Scenario/Sub-basin	HU1 100	HU2 200	HU3 210, 220	HU4 110	HU5 120, 160	HU6 300, 320, 330	HU7 140, 150	Total Project Site Average
	Existing Conditions	1.90	1.73	1.83	2.09	1.34	1.53	1.61	1.72
	Existing Conditions; With Berm Cuts	0.78	0.74	0.69	0.82	0.55	0.58	0.65	0.69
2	Romeville Diversion	2.13	0.74	1.30	2.18	0.55	0.59	0.66	1.16
4	South of Highway 70 Bridge Diversion	1.79	3.40	1.62	0.85	0.54	0.59	0.65	1.35
6	Total Diversion	1.82	2.08	1.47	1.54	0.55	0.59	0.65	1.24

20-year Sea Level Rise

Alternatives	Scenario/Sub-basin	HU1 100	HU2 200	HU3 210, 220	HU4 110	HU5 120, 160	HU6 300, 320, 330	HU7 140, 150	Total Project Site Average
	Existing Conditions	1.92	1.76	1.84	2.11	1.37	1.56	1.65	1.75
	Existing Conditions; With Berm Cuts	1.10	1.08	0.99	1.20	0.81	0.89	1.02	1.01
2	Romeville Diversion	2.75	1.08	2.03	2.93	0.82	0.90	1.02	1.65
4	South of Highway 70 Bridge	2.42	4.66	2.46	1.27	0.81	0.89	1.02	1.93
6	Total Diversion	2.44	2.84	2.30	2.13	0.81	0.90	1.02	1.78

30-year Sea Level Rise

Alternatives	Scenario/Sub-basin	100	200	210, 220	110	120, 160	300, 320, 330	140, 150	Total Project Site Average
	Existing Conditions	1.95	1.82	1.87	2.14	1.42	1.61	1.71	1.79
	Existing Conditions; With Berm Cuts	1.29	1.30	1.17	1.42	0.98	1.08	1.26	1.21
2	Romeville Diversion	2.99	1.30	2.38	3.21	0.99	1.12	1.27	1.89
4	South of Highway 70 Bridge	2.77	5.13	2.91	1.54	0.98	1.09	1.26	2.24
6	Total Diversion	2.76	3.16	2.70	2.45	0.99	1.10	1.27	2.06

50-year Sea Level Rise

Alternatives	Scenario/Sub-basin	100	200	210, 220	110	120, 160	300, 320, 330	140, 150	Total Project Site Average
	Existing Conditions;	2.15	2.07	2.04	2.33	1.64	1.83	2.02	2.01
	Existing Conditions; With Berm Cuts	1.83	1.88	1.68	1.96	1.48	1.58	1.86	1.75
2	Romeville Diversion	3.49	1.88	3.06	3.73	1.51	1.68	1.88	2.46
4	South of Highway 70 Bridge	3.52	5.82	3.83	2.16	1.48	1.60	1.85	2.90
6	Total Diversion	3.42	3.71	3.47	3.16	1.51	1.69	1.88	2.69

<u>FWP</u>

Depending on the location of the hydrologic unit within the watershed in relation to the diversion outfall it was assumed that certain hydrologic units would receive different levels of influence (i.e., high, moderate, low, or no influence). However, all HUs see increased benefits in the form of dry-out frequency as a result of the berm cuts assuming the diversion would be operated to maximize dry-out frequency. At this time an operational plan has not been developed. In target year 1 (defined as "existing conditions with berm cuts" in Table 9), without a diversion water depths are lower than existing conditions throughout all hydrologic units for all alternatives, and below swamp floor elevations in most hydrologic units (Table 9).

Hydrologic data indicates that by TY 20 water levels within all areas are at or above swamp floor elevations. Within areas of high influence sediment accretion is expected and should keep up with total sea level rise. Nutrient input into areas moderately influenced would facilitate increased growth rates contributing to above ground biomass. While this has been taken into consideration, accretions rates have not been predicted or analyzed at this time. As displayed in Table 10, FWP water regime was evaluated by each hydrologic unit for each alternative and grouped according to level of influence by the diversion.

Table 10. Future With Project Water Regime Conditions.

	TY0		TY1		TY20		TY30		TY50	
	duration-exchange	**SI**	**duration-exchange**	**SI**	**duration-exchange**	**SI**	**duration-exchange**	**SI**	**duration-exchange**	**SI**
Alternative 2										
high influence	semiperm-low	0.45	seasonal-high	1.00	semipermanent-high	0.75	semiperm-high	0.75	semiperm-high	0.75
moderate	semiperm-low	0.45	seasonal-high	1.00	semipermanent-high	0.75	semiperm-high	0.75	semiperm-high	0.75
low	semiperm/perm-low	0.40	seasonal-moderate	0.85	semiperm-moderate	0.65	perm/semiperm-moderate	0.55	perm/semiperm-moderate	0.55
no influence	semiperm-low	0.45	seasonal-low	0.70	semiperm-low	0.45	semiperm-low	0.45	semiperm-low	0.45
Alternative 4										
high influence	semiperm-low	0.45	seasonal-high	1.00	semiperm-high	0.75	semiperm-high	0.75	semiperm-high	0.75
moderate	semiperm/perm-low	0.40	seasonal-high	1.00	semiperm-high	0.75	semiperm/perm-high	0.70	semiperm/perm-high	0.70
low	semiperm/-low	0.45	seasonal-moderate	0.85	semiperm-moderate	0.65	semiperm-moderate	0.65	semiperm-moderate	0.65
no influence	perm-low	0.30	seasonal-low	0.70	semiperm-low	0.45	perm-low	0.30	perm-low	0.30
Alternative 6										
high influence	semiperm-low	0.45	seasonal-high	1.00	semiperm-high	0.75	semiperm-high	0.75	semiperm-high	0.75
moderate	semiperm/perm-low	0.40	seasonal-high	1.00	semiperm-high	0.75	semiperm/perm-high	0.70	semiperm/perm-high	0.70
low	permanent-low	0.30	semiperm-moderate	0.65	semiperm-moderate	0.65	permanent-moderate	0.45	permanent-moderate	0.45
no influence	-	-	-	-	-	-	-	-	-	-

Variable V_4 - Mean high salinity during the growing season.

Swamps can tolerate increased salinities; however increased salinity spikes coupled with prolonged flooding has been shown to be detrimental to those forested swamps. Baldcypress is able to tolerate higher salinities compared to other swamp species such as tupelogum and many herbaceous species which are salinity-sensitive. Salinity recorded at Pass Manchac during the 1999-2000 drought spiked at 8 parts-per-thousand (ppt) and averaged around 5 ppt until heavy rains in July 2000 ended the drought (Keddy et al. 2007). For the Swamp WVA optimal conditions for salinity are assumed when mean high salinities during the growing season are equal to or less than 1.0 ppt. Habitat suitability is assumed to decrease rapidly at mean high salinities in excess of 1.0 ppt.

For the CWPPRA Maurepas (Hope Canal) Freshwater Diversion project the lowest existing salinities documented were 1.53 ppt for the "Hope" station group (EPA 2001). The Convent/Blind River Diversion project area is located further inland from the "Hope" station group and is landward of several hydrologic barriers (i.e., I-10, US 61, KCSRR), thereby being protecting from the higher salinity waters coming from the Gulf. Because of these barriers it is likely salinity levels remain relatively consistent throughout the project area and do not fluctuate within the project area. While salinity spikes still affect the project area through the hydrologic connectivity of Blind River and other small tributaries, those salinity spikes are not representative of typical salinities and are not represented in this variable. For 2008, average salinities during the growing season recorded at CRMS stations (0065 and 5167) located west of U.S. Hwy 61 were measured at 0.25 ppt. The highest salinity measured during the growing season was 0.33 ppt. Salinities have been collected periodically in Blind River at US Hwy 61 by LDEQ (LA040403), and average annual salinities taken from 1981 to 1998 were 0.95 ppt. Average salinities recorded during the growing season at that station range from 0.15 ppt in 1996 to 0.70 ppt in 1995. However, those values were only obtained from the months of April, June, August, and October. For two CRMS stations located west of U.S. Hwy 61 and in the project area average salinities in the growing season were measured at 0.35 ppt (CRMS0039) and 0.53 ppt (CRMS5167), slightly higher than the interior sites.

According to the data available for the entire project area it appears that mean high salinity during the growing season is less than 1.0 ppt. Should restoration projects proposed for the Lake Pontchartrain Basin not be implemented, it is highly likely that the project area will continue to see slight increases in average salinities and a greater frequency in salinity spikes. This is evident from the salinity trends observed in the forested swamps to the east and closer to Lake Maurepas. However, average high salinities during the growing season are not expected to exceed 1.0 ppt over the project life. The suitability index for salinities 1.0 ppt or less is 1.0.

It is assumed that the project area can be subdivided into two salinity regions. Areas east of U.S. Hwy 61 and south of Interstate 10 experience slightly higher salinity levels as a result of being closer to the lake. Areas further inland and west of U.S. Hwy 61 are slightly fresher due to the hydrologic barriers impeding the salinity gradient and the contribution of freshwater run-off from the adjacent upland areas.

Existing conditions for areas east of U.S. Hwy 61 are estimated based on the CRMS data for 0065 and 5167. Salinities were consistent throughout the 2008 growing season so mean high salinities were not calculated. Because of freshwater runoff and the hydrologic barriers, average mean high salinities are not expected to increase; however, salinity will still be a detrimental factor to swamp sustainability in the form of seasonal and drought induced salinity spikes. Average high salinities during the growing season are not expected to exceed 1.0 ppt over the 50-year future without project life.

Existing conditions for areas west of U.S. Hwy 61 are estimated using data from the two CRMS stations (0039 and 5167) within the area. It is likely that in the 50-year future without project life the area will experience a slight increase in salinities, but will still be within the optimal range. Project area salinities are greatly influenced by adjacent storm water and agricultural freshwater runoff, and hydrologic barriers prevent high saline waters from entering the swamps. Salinity will still be a detrimental factor to swamp sustainability in the form of seasonal and drought induced salinity spikes.

Modeling conducted for the closure of the MRGO at Bayou La Loutre showed that salinities would decrease within the adjacent marshes and associated waterways on the order of 1.0 to 3.0 ppt as a result of that closure (Draft IER 11 Tier 2 Pontchartrain 2009). Higher saline waters that commonly entered through the MRGO into the southern end of Lake Pontchartrain have been cut off as a result of that closure and the Lake Borgne surge barrier currently being constructed.

Summary/Results

According to initial results from the hydrologic modeling, benefits are achieved through gapping spoil banks and modifying other hydrologic barriers to allow the redistribution of hydrologic flow throughout the swamp system. Because in-swamp management is a feature of all three alternatives, all three alternatives see considerable WVA benefits in the first 20 years as a result of those features; therefore, the difference in AAHUs between alternatives is minimized. The analysis then becomes a comparison of diversion influence areas. Based on preliminary hydrologic modeling results which at this stage of the study has focused on transfer of flow between benefit areas, the Romeville diversion alternative (Alternative 2) directly influences a larger area (i.e., HUs 1 and 4) compared to Alternative 4, the South of Hwy 70 Bridge diversion alternative (i.e., HUs 1 and 2). The "Total diversion" alternative (i.e., Alternative 6 and 4b) consequently has the highest benefits because sediments, nutrients, and freshwater are influencing a larger receiving area. Another observation in the analysis is that basal area throughout most of the project area is considered to be within the optimal range (i.e., >161 sq. ft./ac) to support wildlife habitat. The WVA, therefore, does not show a distinction (or change in suitability indices) between habitat classes and between FWP and FWOP for this variable. Because of these factors, alternative evaluations have placed an emphasis on stand structure and water regime. The project area is semi-permanently flooded and future-with-project modeling projections indicates that the flooding regime within most of the project area will return to pre-project conditions by target year 20 as a result of total sea level rise. However, hydrologic flow will be improved and will provide additional benefits by increasing forest stand vigor, accretion, water quality and back flow prevention.

<u>Data Gaps and Additional Information Needs for Analyzing Benefits of the Tentatively Selected Plan (TSP)</u>

Because of the expedited schedule, limited data was available at the time of this analysis. Therefore, the intent of this habitat analysis is to provide a comparison of alternative benefit areas and potential direct impacts associated with project construction to support the selection of a TSP. To fully evaluate the benefits of the TSP the following additional information and actions will be required:

- Additional results of hydrologic modeling efforts that better identify/quantify influence areas and how water (sediment and nutrients) moves through the system and within each hydrologic unit.
- Water levels and swamp floor elevations need to be determined on a refined scale and incorporated into the hydrologic modeling.
- Salinity predictions need to be re-evaluated and changes, if necessary, be undertaken.
- Diversion operations need to be developed by alternative and incorporated into the hydrologic modeling.
- Accretion rates need to be determined and incorporated into the hydrologic modeling (e.g., flood durations and depths should decrease). Benefits cannot be fully addressed without including this in the analysis.

IMPACTS

For each alternative, impacts to swamp habitat are associated with the transmission channel from the Mississippi River to the outfall area (benefit area) and with transmission canal construction and modification within the outfall area (Tables 11 & 12). For FWP all habitat suitability index (HSI) values are 0.0 to reflect the removal of forested habitat as a result of the proposed alternative.

Table 11. Forested Wetland Impacts (Acres)

	Alternative 2 Romeville 3000cfs	**Alternative 4** Southbridge 3000cfs	**Alternative 4B** Southbridge 3000 cfs split flows	**Alternative 6** Romeville 1500 cfs Soutbridge 1500 cfs
Diversion Channel	53	107	107	160
Northern Transmission Canal	-	163	126	126
Widening of St James Canal	-	-	72	-
Total	**53**	**270**	**305**	**286**

Impacts associated with the transmission channel were quantified using the highest quality habitat (i.e., greater than 50 years-to-marsh) variable assumptions from the WVA assessing benefits. Field data was not obtained along the proposed transmission channels due to limited time associated with the expedited schedule; therefore, variable assumptions were made to give advantage to the forested resources being impacted (e.g., stand structure and maturity were assumed to have the highest suitability index value). Forested areas closer to, and associated with, the natural levee of the Mississippi River are at higher elevations, and prolonged inundation is not expected. Therefore, for areas where water regime is currently classified as seasonal or temporary, stand structure class is expected to increase through the 50-year project life. Water regime was determined using classifications by National Wetlands Inventory 1988. Forested habitat at higher elevations along the natural levee of the Mississippi River is not expected to experience marked salinity influences through the project life. See WVA worksheets for the discrete variable assumptions.

The proposed northern transmission canal (i.e., Alternatives 4A, 4B, and 6) traverses through the "benefit area" and the associated acreage was previously included in the habitat analyses evaluating benefits. Those analyses were revised, and the associated acres impacted were subtracted from the respective analysis by habitat condition class. The associated impacts were then evaluated using the same variable assumptions from those previous habitat analyses assessing benefits for FWOP. Again, for FWP, all habitat suitability index (HSI) values are 0.0 to reflect the removal of forested habitat as a result of the proposed project.

Alternative 4B would include expanding the St. James Parish Canal and constructing channel berms to achieve a head differential sufficient to move diverted water to the southern portion of the project area. While additional indirect impacts would be associated with impounding areas of swamp by constructing these berms, only direct impacts to wetlands were evaluated. Much of this area was already classified in the habitat condition class and the same variable assumptions for FWOP were used. Again, for FWP all habitat suitability index (HSI) values are 0.0 to reflect the removal of forested habitat as a result of the proposed project.

Figure 5. Forested Impacts Associated with the Romeville Diversion Channel (Alts. 2 & 6)

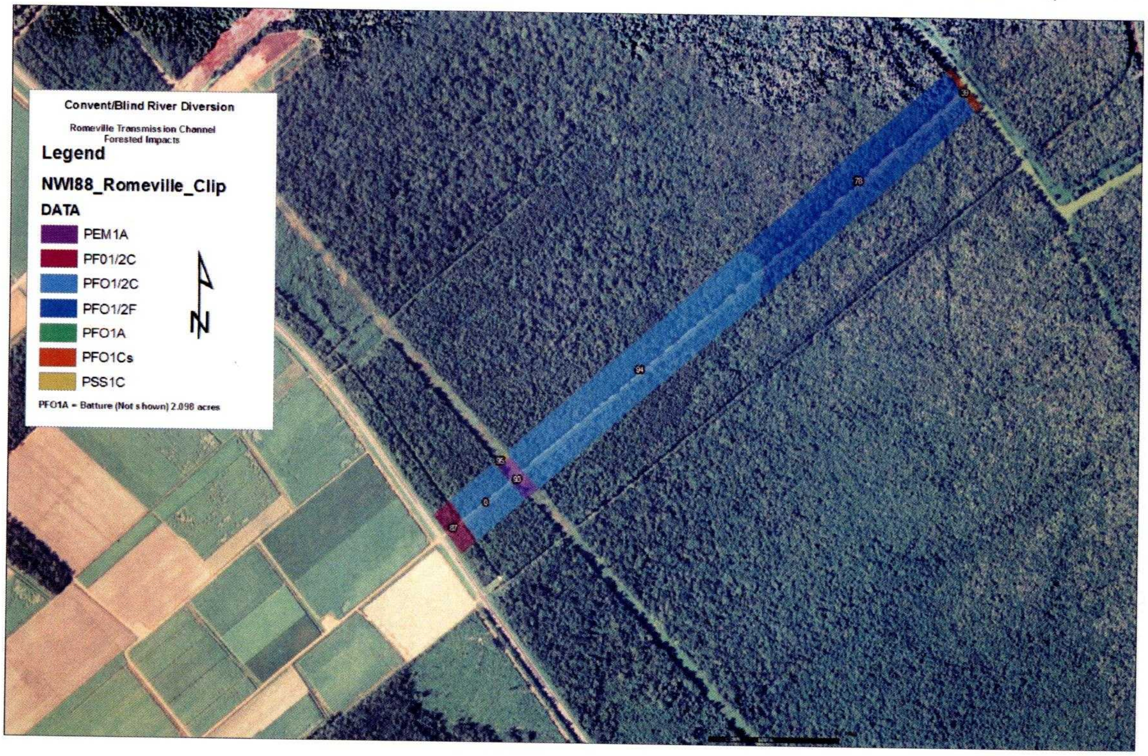


Figure 6. Forested Impacts Associated with the South Bridge Transmission Channel (Alternative 4A and 6)

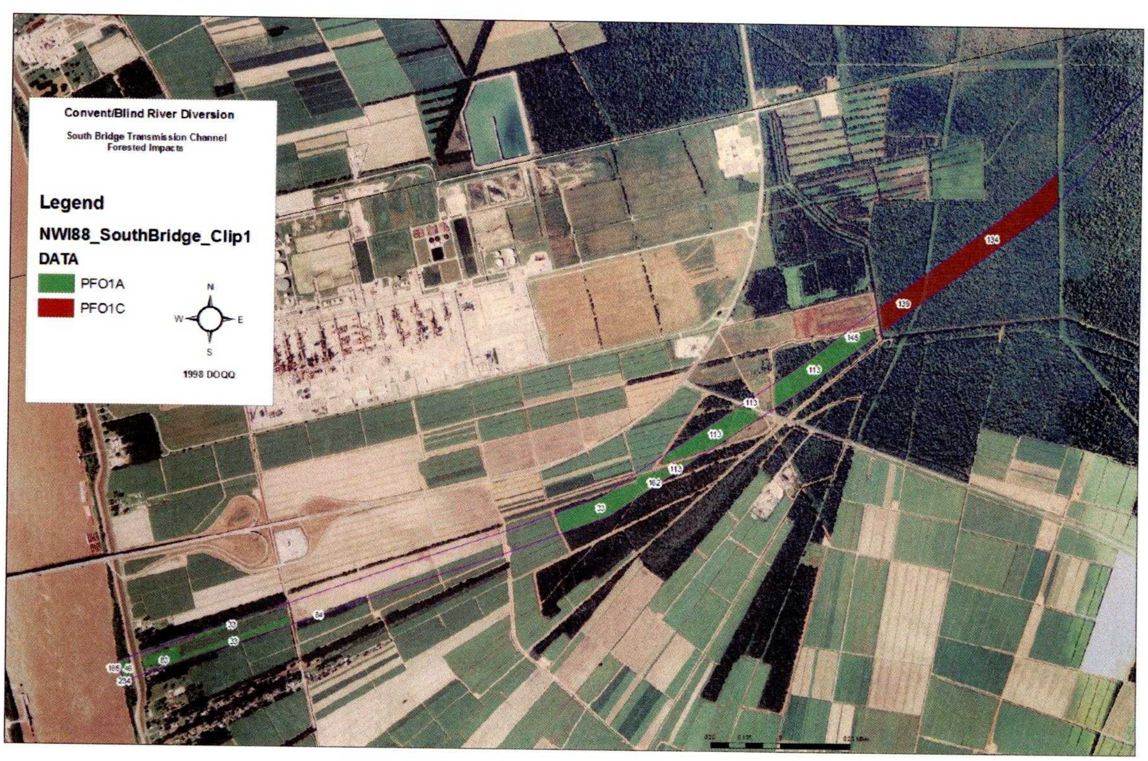


Figure 7. Forested Impacts Associated with the Outfall Canal (Alternatives 4A, 4B, & 6).

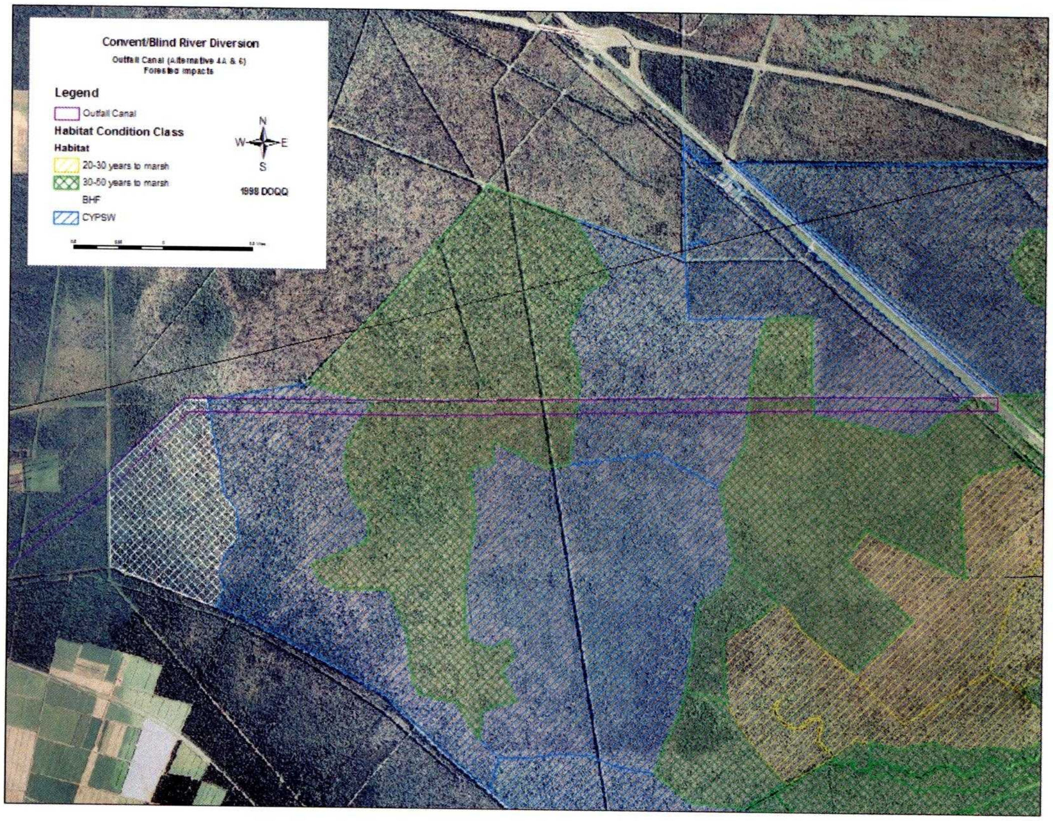


Figure 8. Forested Impacts Associated with Widening St. James Parish Canal (Alt. 4B)

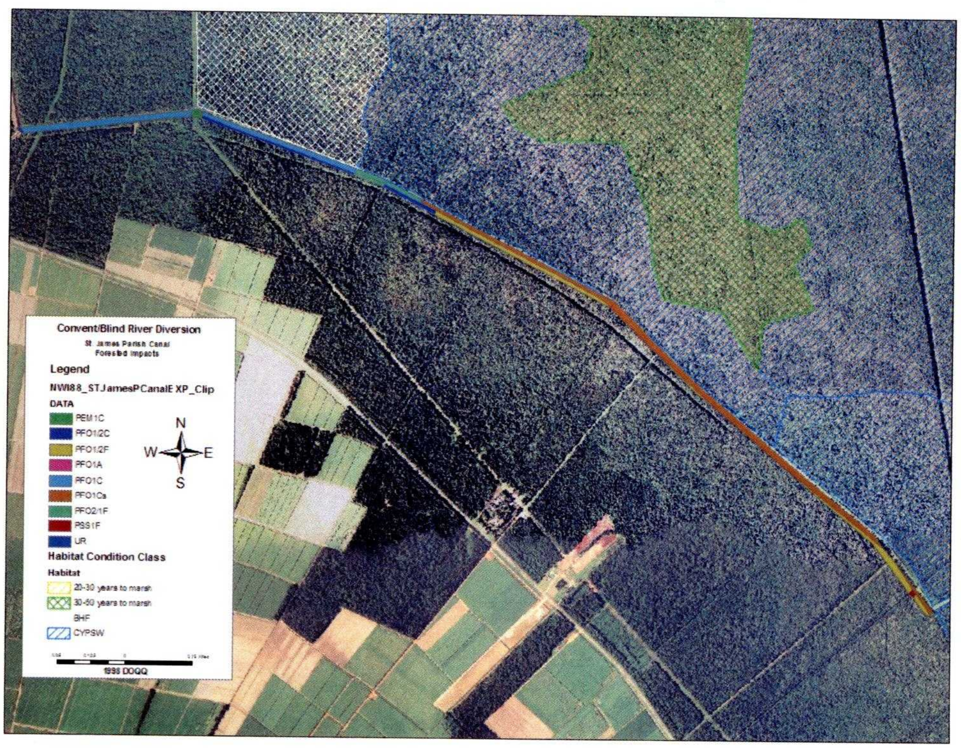


Table 12. Summary of Total Acres Benefited and Impacted.

	Acres			
Benefits	Alternative 2	Alternative 4A	Alternative 6,	4B
High IA, 20-30 years to marsh	169	169	169	169
High IA, 30-50 years to marsh	3364	1827	3848	3848
High IA, >50 years to marsh	4555	3550	5361	5361
Moderate IA, 20-30 years to marsh	204	1837	2041	2041
Moderate IA, 30-50 years to marsh	604	2972	3579	3579
Moderate IA, >50 years to marsh	2607	2070	4691	4691
Low IA, 20-30 years to marsh	2397	0	1085	1085
Low IA, 30-50 years to marsh	1669	2013	469	469
Low IA, >50 years to marsh	469	1799	0	0
No IA, 20-30 years to marsh	525	1289	0	0
No IA, 30-50 years to marsh	2297	1073	0	0
No IA, >50 years to marsh	2509	2607	0	0
Benefits Total	21,369	21,206	21,243	21,243
Impacts				
Outfall Area				
High IA, 30-50 years to marsh	0	36	28	28
High IA, >50 years to marsh	0	52	40	40
Moderate IA, 30-50 years to marsh	0	13	10	10
Moderate IA, >50 years to marsh	0	62	48	48
Transmission Channel				
FWetlands, Seasonally Flooded	31	39	70	39
FWetlands, Temporarily Flooded	2	69	71	69
FWetlands, Semipermanent Flooded	20	0	20	0
St. James Parish Canal Modificaitons				
FWetlands, Seasonally Flooded	0	0	0	22
FWetlands, Semipermanent Flooded	0	0	0	50
Impacts Total	53	271	287	306
Combined Total Acres	21,422	21,477	21,530	21,549

Table 13. Summary of Total AAHUs.

	Average Annual Habitat Units (AAHUs)			
Benefits	Alternative 2	Alternative 4A	Alternative 6,	4B
High IA, 20-30 years to marsh	77	77	77	77
High IA, 30-50 years to marsh	1350	733	1545	1545
High IA, >50 years to marsh	1293	1014	1532	1532
Moderate IA, 20-30 years to marsh	93	828	919	919
Moderate IA, 30-50 years to marsh	243	1182	1423	1423
Moderate IA, >50 years to marsh	745	585	1325	1325
Low IA, 20-30 years to marsh	935	0	354	354
Low IA, 30-50 years to marsh	527	663	137	137
Low IA, >50 years to marsh	110	447	0	0
No IA, 20-30 years to marsh	72	163	0	0
No IA, 30-50 years to marsh	585	237	0	0
No IA, >50 years to marsh	431	373	0	0
Benefits Total	**6,462**	**6,302**	**7,313**	**7,313**
Impacts				
Outfall Area				
High IA, 30-50 years to marsh	0	-17.07	-13.28	-13.28
High IA, >50 years to marsh	0	-30.19	-23.22	-23.22
Moderate IA, 30-50 years to marsh	0	-6.09	-4.69	-4.69
Moderate IA, >50 years to marsh	0	-35.69	-27.63	-27.63
Transmission Channel				
FWetlands, Seasonally Flooded	-25.87	-32.55	-58.43	-32.55
FWetlands, Temporarily Flooded	-1.67	-56.33	-57.96	-56.33
FWetlands, Semipermanent Flooded	-13.5	0	-13.5	0
St. James Parish Canal Modificaitons				
FWetlands, Seasonally Flooded	0	0	0	-18.36
FWetlands, Semipermanent Flooded	0	0	0	-33.76
Impacts Total	-41.04	-177.92	-198.71	-209.82

Literature Cited

Conner, W.H., J.G. Gosselink, and R.T. Parrondo. 1981. Comparison of the vegetation of three Louisiana swamp sites with different flooding regimes. Amer. J. Bot. 68(3): 320-331.

Conner, W.H., J.R. Toliver, and F.H. Sklar. 1986. Natural regeneration of baldcypress (*Taxodium distichum* (L.) Rich) in a Louisiana swamp. Forest Ecology and Management 14:305-317.

Day, F.P., Jr., 1985. Tree growth rates in the periodically flooded Great Dismal Swamp. Castanea, 50: 89-95.

Dicke, S.G. and J.R. Toliver. 1990. Growth and development of baldcypress-water tupelo stands under continuous versus seasonal flooding. Forest Ecology and Management 33.34:523-530.

R. Effler, G. Shaffer, S. Hoeppner and R. Goyer, Ecology of the Maurepas Swamp: effects of salinity, nutrients, and insect defoliation. In: W.H. Conner, T.W. Doyle and K.W. Krauss, Editors, Ecology of Tidal Freshwater Forested Wetlands of the Southeastern United States, Springer, Dordrecht, The Netherlands (2007), pp. 349–384.

P.A. Keddy, D. Campbell, T. McFalls, G.P. Shaffer, R. Moreau, C. Dranguet, and R. Heleniak. 2007. The Wetlands of Lakes Pontchartrain and Maurepas: Pass, Present and Future. Environmental Reviews. 15: 43-77.

Kozlowski, TT. 1984. Plant responses to flooding of soil. BioScience 34:162-167.

Louisiana Coastal Wetlands Conservation and Restoration Task Force (LCWCRTF) and the Wetlands Conservation and Restoration Authority. 1999. Coast 2050: Toward a Sustainable Coastal Louisiana, The Appendices. **Appendix C**— Region 1 Supplemental Information. Louisiana Department of Natural Resources. Baton Rouge, La.

U.S. Environmental Protection Agency (EPA). 2001. Wetland Value Assessment Revised Project Information Sheet: Diversions into the Swamps South of Lake Maurepas.

Shaffer, G.P., Perkins, T.E., Hoeppner, S., Howell, S., Bernard, H., and A.C. Parsons. 2003. Ecosystem health of the Maurepas Swamp: feasibility and projected benefits of a freshwater diversion. U.S. Environmental Protection Agency, Region 6, Dallas, TX.

Shaffer G.P., M. Hester, P. Kemp, H. Mashriqui, J. Day, and R. Lane. 2001. Diversion into the Maurepas Swamps: A Complex Project under the Coastal Wetlands Planning, Protection, and Restoration Act. U.S. Environmental Protection Agency, Region 6, Dallas, Texas.

Thomson, D.A. 2000. The influence of hydrological alterations upon wetland hydrodynamics and plant growth on the Manchac Landbridge, Southeastern Louisiana, USA. Master's Thesis, Southeastern Louisiana University, Hammond, LA. 90 pp.

Thomson, D.A., Shaffer, G.P. and McCorquodale, J.A. 2002. A potential interaction between sea-level rise and global warming: implications for coastal stability on the Mississippi River Deltaic Plain. Global Planet. Change, 32: 49-59.

U.S. Army Corps of Engineers 2009. Draft Individual Environmental Report (IER) 11, Tier 2 Pontchartrain: Improved Protection on the Inner Harbor Navigation Canal, Orleans Parish, Louisiana.

Visser, J.M. and C.E. Sasser 1995. Changes in tree species composition, structure and growth in a bald cypress-water tupelo swamp forest, 1980- 1990. Forest Ecology and Management 72: 19- 129.

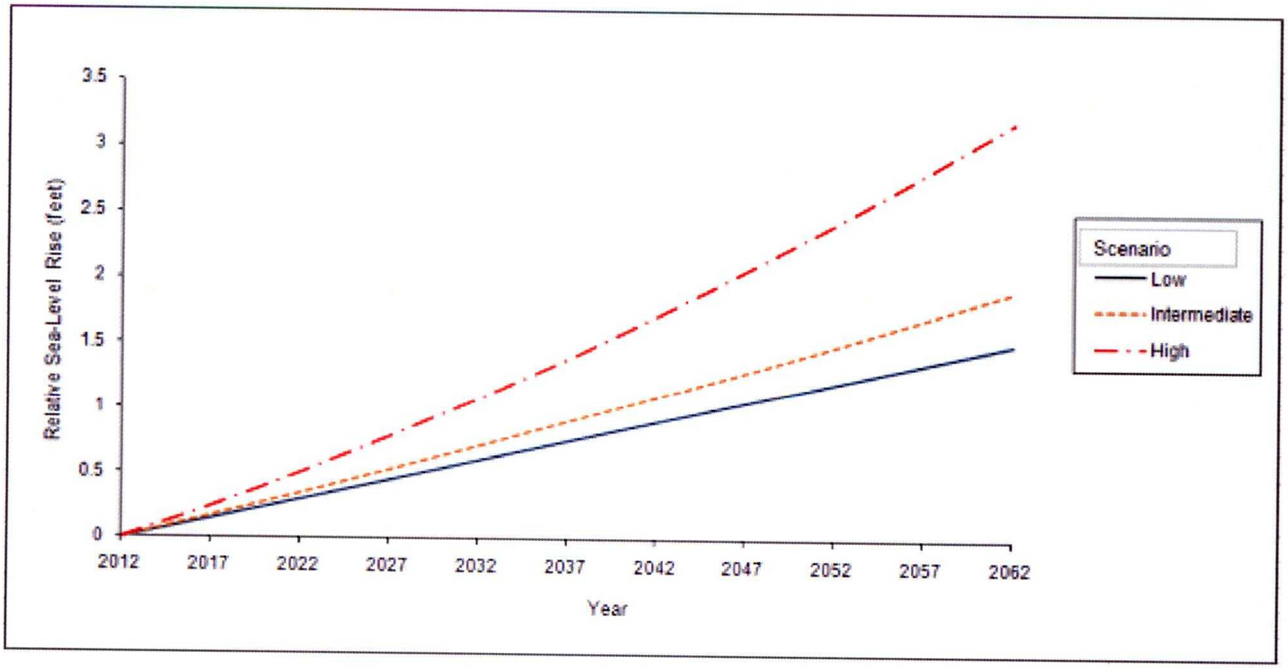
The direct impact of the diversion of water from the Mississippi River at Romeville for the low sea level rise scenario would be a reduction in the average water depth relative to the existing condition in the Blind River and Maurepas Swamp for 20 years and 30 years. For the intermediate sea level rise scenario there would be a reduction in the average water depth relative to the existing condition for 20 years. For the high sea level rise scenario there would be no reduction in the average water depth relative to the existing condition. As sea level rises water depth can be expected to increase accordingly throughout the swamp.

Based on hydrologic and hydrodynamic modeling, CDM has projected that for the low relative sea level rise scenario the project area will experience average annual water depths of 1.46, 1.67, and 2.11 feet in target years 20, 30, and 50, respectively. For the high sea level rise scenario the project area will experience average annual water depths of 1.79, 2.26, and 3.46 feet in target years 20, 30, and 50, respectively. Finally, for the intermediate sea level rise scenario the project area will experience average annual water depths of 1.54, 1.80, and 2.42 feet in target years 20, 30, and 50, respectively (Figure 1).

Table 1. Projected relative sea-level rise (feet) over the project life (2012-2062) in 5-year increments for low, intermediate, and high scenarios in the project area based on West End at Lake Pontchartrain tide gage daily stage data from 1959-2009 and USACE Circular No. 1165-2-211 (2009).

YEAR	Relative Sea Level Rise (feet)		
	LOW	**INTERMEDIATE**	**HIGH**
2012	0	0	0
2017	0.15	0.17	0.24
2022	0.30	0.35	0.51
2027	0.45	0.53	0.78
2032	0.60	0.72	1.08
2037	0.75	0.90	1.39
2042	0.91	1.10	1.72
2047	1.06	1.29	2.06
2052	1.21	1.49	2.42
2057	1.36	1.70	2.80
2062	1.51	1.90	3.19

Figure 1. Projected relative sea-level Rise (Ft) over the project life (2011-2061) for low, intermediate and high scenarios.



Based on the available hydrologic hydrodynamic modeling the following assumptions were made (Table 2). The direct impact of the diversion of water from the Mississippi River at Romeville for the low sea level rise scenario would be a reduction in the average water depth relative to the existing condition in the Blind River and Maurepas Swamp for 20 years and 30 years. For the intermediate sea level rise scenario there would be a reduction in the average water depth relative to the existing condition for 20 years. For the high sea level rise scenario there would be no reduction in the average water depth relative to the existing condition. As sea level rises water depth can be expected to increase accordingly throughout the swamp.

Table 2: Alternative 2, Water Regime Relative to Sea Level Rise

	TY0	TY1	TY20	TY30	TY50

RSLR*	duration-exchange	SI	duration-exchange	SI	duration-exchange	SI	duration-exchange	SI	duration-exchange	SI
Intermediate										
FWOP	semiperm-low	0.45	perm-low	0.45	perm-low	0.30	perm-low	0.30	perm-low	0.30
high influence	semiperm-low	0.45	seasonal-high	1.00	semipermanent-high	0.75	semiperm-high	0.75	semiperm-high	0.75
moderate	semiperm-low	0.45	seasonal-high	1.00	semipermanent-high	0.75	semiperm-high	0.75	semiperm-high	0.75
low	semiperm/perm-low	0.40	seasonal-moderate	0.85	semiperm-moderate	0.65	perm/semiperm-moderate	0.55	perm/semiperm-moderate	0.55
no influence	semiperm-low	0.45	seasonal-low	0.70	semiperm-low	0.45	semiperm-low	0.45	semiperm-low	0.45
Low										
FWOP	semiperm-low/ perm/low	0.45 /0.4	semiperm-low/ perm/low	0.45 /0.4	semiperm-low/ perm-low	0.45 /0.4	semiperm-low/ perm-low	0.45 /0.4	perm-low	0.4
high influence	semiperm-low	0.45	seasonal-high	1.00	seasonal-high	1.00	seasonal-high	1.00	semiperm-high	0.75
moderate	semiperm-low	0.45	seasonal-high	1.00	seasonal-high	1.00	seasonal-high	1.00	semiperm-high	0.75
low	semiperm/perm-low	0.40	seasonal-moderate	0.85	seasonal-moderate	0.85	semiperm-mod	0.65	semiperm-moderate	0.65
no influence	semiperm-low	0.45	seasonal-low	0.70	seasonal-low	0.70	seasonal-low	0.70	semiperm-low	0.45
High										
FWOP	semiperm-low	0.45	semiperm-low	0.45	perm-mod	0.45	perm-mod	0.45	perm-mod	0.45
high influence	semiperm-low	0.45	seasonal-high	1.00	semiperm-high	0.75	semiperm-high	0.75	perm-high	0.65
moderate	semiperm-low	0.45	seasonal-high	1.00	semiperm-high	0.75	semiperm-high	0.75	perm-high	0.65
low	semiperm/perm-low	0.40	seasonal-moderate	0.85	perm-moderate	0.45	perm-mod	0.45	perm/high	0.65
no influence	semiperm-low	0.45	seasonal-low	0.70	semiperm-moderate	0.65	semiperm-moderate	0.65	perm-mod	0.45

* Accretion rates were not considered

Table 3: Comparison of Benefits under Low, Intermediate, and High Sea Level Rise Scenarios

Average Annual Habitat Units (AAHUs)

Benefits	Alternative 2	Low SLR	High SLR
High IA, 20-30 years to marsh	77	81	71
High IA, 30-50 years to marsh	1350	1399	1189
High IA, >50 years to marsh	1293	1291	1004
Moderate IA, 20-30 years to marsh	93	98	86
Moderate IA, 30-50 years to marsh	243	251	213
Moderate IA, >50 years to marsh	745	744	580
Low IA, 20-30 years to marsh	935	1008	788
Low IA, 30-50 years to marsh	527	594	405
Low IA, >50 years to marsh	110	114	69
No IA, 20-30 years to marsh	72	81	74
No IA, 30-50 years to marsh	585	651	607
No IA, >50 years to marsh	431	470	415
Benefits Total	**6,462**	**6,782**	**5,500**
Impacts			
Transmission Channel			
FWetlands, Seasonally Flooded	-25.87	-26	-26
FWetlands, Temporarily Flooded	-1.67	-2	-2
FWetlands, Semipermanent Flooded	-13.5	-14	-13
Impacts Total	-41.04	-41	-41
Combined Total AAHUs	6,421	6,741	5,459

Table 4. Metric Analysis Summary for Average Annual Water Depth, Frequency of Dryout, and Backflow Prevention for Sea Level Rise (SLR) over 20, 30 and 50 years for the entire project site.

Existing Conditions (with Berm Cuts)				
	Project Life (yr)	**Low SLR**	**Intermediate SLR**	**High SLR**
Average Annual Water Depth (ft)	20	0.96	1.01	1.21
	30	1.11	1.22	1.62
	50	1.48	1.76	2.69
Frequency of Dryout Conditions (%) (<0.5 ft)	20	14%	13%	6%
	30	8%	6%	2%
	50	3%	2%	1%
Backflow Prevention (%)	20	11%	9%	6%
	30	7%	6%	3%
	50	4%	3%	1%

Table 5. Metric Analysis Summary for Average Annual Water Depth, Frequency of Dryout, and Backflow Prevention for Sea Level Rise (SLR) over 20, 30 and 50 years for the entire project site.

Alternative 2: Romeville Diversion = 3,000 cfs

	Project Life (yr)	**Low SLR**	**Intermediate SLR**	**High SLR**
Average Annual Water Depth (ft)	20	1.46	1.54	1.79
	30	1.67	1.8	2.26
	50	2.11	2.42	3.46
Frequency of Dryout Conditions (%) (< 0.5ft)	20	8%	6%	2%
	30	4%	2%	1%
	50	1%	1%	0%
Backflow Prevention (%)	20	38%	36%	33%
	30	34%	33%	29%
	50	31%	28%	21%
Average Annual TSS Loading (mm/yr)	20	2.1	2.2	2.4
	30	2.3	2.4	2.6
	50	2.6	2.7	2.8

United States Department of the Interior

FISH AND WILDLIFE SERVICE
646 Cajundome Blvd.
Suite 400
Lafayette, Louisiana 70506

September 8, 2010

Colonel Edward R. Fleming
District Commander
U.S. Army Corps of Engineers
Post Office Box 60267
New Orleans, Louisiana 70160-0267

Dear Colonel Fleming:

The Louisiana Coastal Area – Small Diversion at Convent/Blind River Integrated Feasibility Report and Environmental Impact Statement (EIS) is being prepared by the U.S. Army Corps of Engineers (Corps), New Orleans District, in partnership with the Louisiana Office of Coastal Protection and Restoration, under the authority of Title VII of the Water Resources Development Act (WRDA) (Public Law 110-114, 121 STAT. 1270) of 2007. Enclosed is our Final Fish and Wildlife Coordination Act Report for the LCA - Small Diversion at Convent/Blind River project. Comments provided by the Louisiana Department of Wildlife and Fisheries (LDWF) and the National Marine Fisheries Service (NMFS) have been incorporated into the final report.

Should your staff have any questions regarding the enclosed draft report, please have them contact Angela Trahan of this office at 337/291-3137.

Sincerely,

James F. Boggs
Supervisor
Louisiana Field Office

Enclosures

cc: FWS, Atlanta, GA (ES/HC)
EPA, Dallas, TX
NMFS, Baton Rouge, LA
Corps, New Orleans, LA (Attention: Dr. William Klein, CEMVN-PM-RS)
LDWF, Region 7 Office, Baton Rouge, LA
LDWF, Baton Rouge, LA (Attn.: Kyle Balkum)
LDWF, Natural Heritage Program, Baton Rouge, LA
LDWF, Scenic Rivers Program, Baton Rouge, LA
LOCPR, Baton Rouge, LA

United States Department of the Interior

FISH AND WILDLIFE SERVICE
646 Cajundome Blvd.
Suite 400
Lafayette, Louisiana 70506

September 8, 2010

Mr. Rick Hartman
Branch Chief
Habitat Conservation Division
National Marine Fisheries Service
C/O LSU Center for Wetland Resources
Baton Rouge, Louisiana 70803-7535

Dear Mr. Hartman:

The Louisiana Coastal Area – Small Diversion at Convent/Blind River Integrated Feasibility Report and Environmental Impact Statement (EIS) is being prepared by the U.S. Army Corps of Engineers (Corps), New Orleans District, in partnership with the Louisiana Office of Coastal Protection and Restoration, under the authority of Title VII of the Water Resources Development Act (WRDA) (Public Law 110-114, 121 STAT. 1270) of 2007. Enclosed is our Final Fish and Wildlife Coordination Act Report for the LCA - Small Diversion at Convent/Blind River project. Your comments have been incorporated into this final report.

Should your staff have any questions regarding the enclosed draft report, please have them contact Angela Trahan of this office at 337/291-3137.

Sincerely,

James F. Boggs
Supervisor
Louisiana Field Office

Enclosure

United States Department of the Interior

FISH AND WILDLIFE SERVICE
646 Cajundome Blvd.
Suite 400
Lafayette, Louisiana 70506

September 8, 2010

Mr. Robert Barham
Secretary
Louisiana Department of Wildlife and Fisheries
Post Office Box 98000
Baton Rouge, Louisiana 70898-9000

Dear Mr. Barham:

The Louisiana Coastal Area – Small Diversion at Convent/Blind River Integrated Feasibility Report and Environmental Impact Statement (EIS) is being prepared by the U.S. Army Corps of Engineers (Corps), New Orleans District, in partnership with the Louisiana Office of Coastal Protection and Restoration, under the authority of Title VII of the Water Resources Development Act (WRDA) (Public Law 110-114, 121 STAT. 1270) of 2007. Enclosed is our Final Fish and Wildlife Coordination Act Report for the LCA - Small Diversion at Convent/Blind River project. Your comments have been incorporated into the final report.

Should your staff have any questions regarding the enclosed draft report, please have them contact Angela Trahan of this office at 337/291-3137.

Sincerely,

James F. Boggs
Supervisor
Louisiana Field Office

Enclosure

FINAL
FISH AND WILDLIFE COORDINATION ACT REPORT

ON

LOUISIANA COASTAL AREA – SMALL DIVERSION AT CONVENT/BLIND RIVER

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

And

Louisiana Office of Coastal Protection and Restoration

Prepared by
Angela Trahan
Fish and Wildlife Biologist
U.S. Fish and Wildlife Service
Ecological Services
Lafayette, Louisiana

September 2010

TABLE OF CONTENTS

INTRODUCTION

The Louisiana Coastal Area (LCA) – Small Diversion at Convent/Blind River Integrated Feasibility Report and Environmental Impact Statement (EIS) is being prepared by the U.S. Army Corps of Engineers (Corps), New Orleans District, in partnership with the Louisiana Office of Coastal Protection and Restoration (OCPR), under the authority of Title VII of the Water Resources Development Act (WRDA) (Public Law 110-114, 121 STAT. 1270) of 2007. This authorization was recommended by the Chief of Engineer's Report, dated January 31, 2005. That report recommended projects and features in the interest of hurricane protection, prevention of salt water intrusion, preservation of fish and wildlife, prevention of erosion, and related water resources purposes.

The Small Diversion at Convent/Blind River Project was identified in the Louisiana Coastal Area Ecosystem Restoration Study, dated November 2004 (2004 LCA Plan), as a near-term critical restoration feature. WRDA 2007 directed that a feasibility report for the Small Diversion at Convent/Blind River project be submitted to Congress by December 31, 2008. The WRDA also directed that a Report of the Chief of Engineers be completed by December 31, 2010. Specifically, Section 7006(e)(3) requires the Secretary of the Army to submit feasibility reports to Congress on six projects by December 31, 2008, and a Chief's Report by December 31, 2010. Due to delays in executing a Feasibility Cost Sharing Agreement for the projects the requested feasibility reports were not submitted to the Congress by the December 31, 2008 deadline. The contingent authorization provided in Section 7006(e)(3)(B) for the six projects however remains subject to the December 31, 2010 deadline for a Chief's report.

The LCA - Small Diversion at Convent/Blind River Project includes the construction of a small diversion (i.e., less than 5,000 cubic feet per second) from the Mississippi River into Blind River through a new control structure to introduce sediments and nutrients along with freshwater into the southeast portion of Maurepas Swamp. Diverting Mississippi River water into the Maurepas Swamp will assist in improving biological productivity and restoring the natural hydrologic regime within that degraded swamp habitat. This diversion project in concert with two other LCA near-term critical features, the Small Diversion at Hope Canal Project and the Amite River Diversion Channel Modification Project, will help to restore Mississippi River water, sediment, and nutrient flows into the Maurepas Swamp ecosystem.

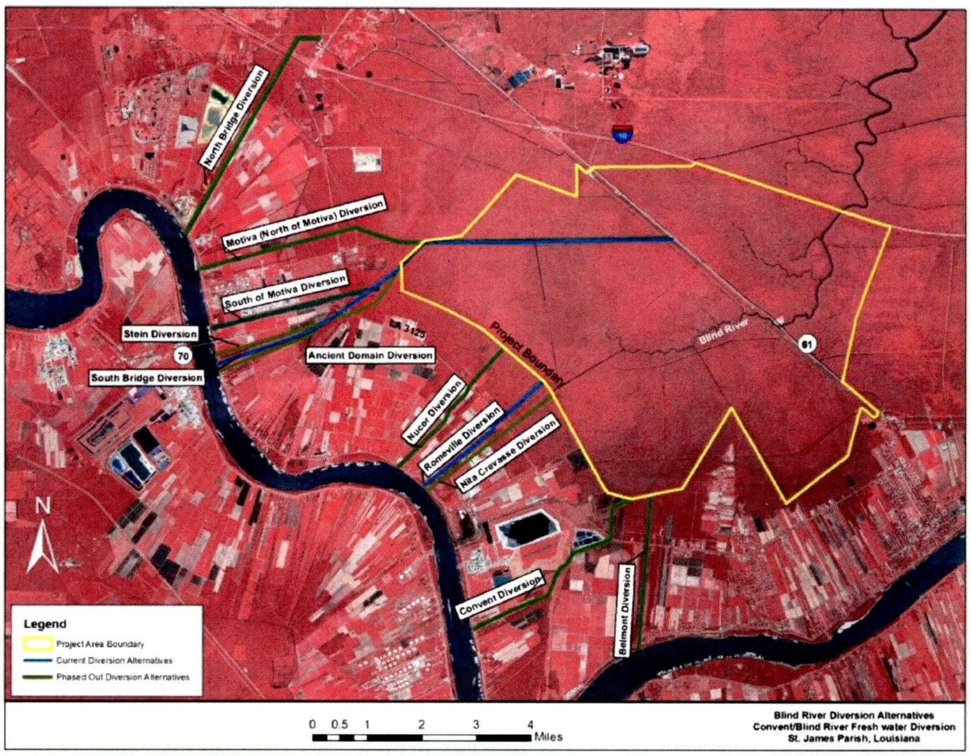
Previous U.S. Fish and Wildlife Service (Service) involvement includes a Final Programmatic Fish and Wildlife Coordination Act (FWCA) Report for the Near Term Plan for the LCA Study (Grouchy and Paille 2004); this draft report supplements that 2004 Programmatic Report. The Service has also submitted comments dated October 20, 2008, on the State of Louisiana, OCPR's Draft Interim Feasibility Study; comments dated January 30, 2009, were provided in regards to the Corps' Notice of Intent to prepare a Supplemental Environmental Impact Statement; and the Service provided a programmatic planning-aid Report dated January 21, 2010. Furthermore, Service comments were provided on the Draft Monitoring and Adaptive Management Plan dated April 7, 2010. This report constitutes the report of the Secretary of the Interior as required by Section 2(b) of the FWCA (48 Stat. 401, as amended; 16 U.S.C. 661 et seq.). This report has been reviewed by the Louisiana Department of Wildlife and Fisheries (LDWF) and the National

Marine Fisheries Service (NMFS), and their comments have been incorporated within the report and are included as an appendix.

DESCRIPTION OF THE STUDY AREA

The project area is located within the Maurepas Swamp west of Lake Pontchartrain and predominantly within St. James Parish with a small portion of the northern extent in Ascension Parish, LA (LCA Sub-province 1, Figure 1). The U.S. Interstate 10 (I-10) corridor defines the northern boundary with the remaining project boundary being defined by several parish drainage canals. The cities and towns that flank the Mississippi River extend further to the southeast, south, and southwest of the distribution area (i.e., diversion influence area). The Maurepas Swamp is one of the largest remaining tracts of coastal fresh water swamp in Louisiana. Including Lake Maurepas, the Maurepas Swamp area comprises an area that totals approximately 232,928 acres, most of which is swamp with some isolated areas of bottomland hardwood forest and fresh marsh. The Blind River flows from St. James Parish, through Ascension and Saint John the Baptist Parishes, and then discharges into Lake Maurepas. Much of the project area is situated within the LDWF, Maurepas Swamp Wildlife Management Area.

Figure 1. LCA- Small Diversion at Convent/Blind River Study Area and Alternative Diversion Locations.



Alternative locations for the proposed control structure have been investigated in the vicinity of Convent, Louisiana, located at Mississippi River mile 159. Prior to extensive human modification, overbank flow of the Mississippi River during spring floods and tidal inflow, through Pass Manchac, into Lake Maurepas, and southwest to the study area, significantly influenced the hydrologic conditions. Overbank flows from the Mississippi River brought nutrients, sediment, and freshwater that promoted productivity and sustained the health of the swamp ecosystem. As floodwaters receded, surface flows traveled eastward as sheet flow into existing channels and subsequently Lake Maurepas.

The Maurepas Swamp serves as a buffer between the open water areas of Lakes Maurepas and Pontchartrain and developed areas along the I-10 and Airline Highway corridor. Development along the I-10 and Airline Highway corridor in this area includes residential, commercial, and industrial land use. The Maurepas Swamp is used for fishing, hunting, and other recreational activities, and as a large contiguous tract of cypress/tupelo swamp near the New Orleans metropolitan area, has considerable cultural significance.

Since the construction of the Mississippi River flood control levees, the Maurepas Swamp has been virtually cut off from any freshwater, sediment, or nutrient input. Thus, the only soil building has come from organic production within the wetlands; and preliminary evaluations suggest that productivity in the stressed Maurepas Swamp may be substantially depressed compared to normal conditions. With minimal soil building and moderately high subsidence, there has been a net lowering of ground surface elevation, leading to a doubling in flood frequency over the last four decades (Thomson 2000), so that now the swamps are either permanently or semi-permanently flooded. With minimal ability to drain and persistent flooding, the typical seasonal drying of the swamp does not usually occur. Cypress and tupelo trees are able to grow in flooded conditions. Apparently, tupelo trees are more competitive in permanently flooded conditions (Conner et al. 1981, Dicke and Tolliver 1990), a condition that may explain the recent dominance of tupelo in the south Maurepas Swamp and the project area. However, a high mortality of tupelo trees also has occurred in the last few years within the Maurepas Swamp study area possibly as a result of salinity spikes. Neither cypress nor tupelo seeds can germinate when flooded. Seeds of both species remain viable when submerged in water and can germinate readily when floodwaters recede (Kozlowski 1984). The potential for re-establishment seems to be hindered by the relatively low numbers of viable seeds observed in swamp seed banks, as well as by flooding (Conner et al. 1986). Storm surge and accompanying episodic saltwater intrusion has also exacerbated degradation resulting in lack of tree regeneration and substrate accretion.

It is expected that without restoration, the factors and processes that are contributing to stress and deterioration of the south Maurepas Swamp will continue and result in loss of the swamp, with succession to open water (Shaffer et al. 2001). The Coast 2050 Report estimated wetland loss rates for the Amite/Blind Rivers mapping unit for 1974-90 to be 0.80 percent per year for swamp and fresh marsh habitat combined (LCWCRTF 1999). Based on these rates, approximately 50 percent of swamp and 1.2 percent of fresh marsh will be converted to open water within 60 years. Nearly 69,500 acres of swamp (50% of the 1990 total) and 40 acres of marsh are projected to be lost by 2050 (LCWCRTF 1999).

Subsidence in this area is classified as intermediate, at about 1.1 to 2.0 feet/century. Subsidence may be caused by compaction, oxidation, and consolidation of sediments, faulting, groundwater depletion, or decreased organic deposition as a result of decreased vegetation biomass production; while land elevations increase as a result of sediment accretion from direct sediment input from riverine sources or from organic vegetation deposition. The soil characteristics of the western Maurepas Swamp indicate a lack of riverine influence as evidenced by high soil organic matter content and low bulk density values (DeLaune et al. 1979, Hatton 1983, Messina and Conner 1998). Consequently, soil building within the Maurepas Swamp is almost exclusively a result of organic productivity (Shaffer et al. 2001, 2003, 2006, Rybczyk et al. 2002, Roberts 1985). With minimal soil building and moderately high subsidence, there has been a net lowering of ground surface elevation, doubling flood frequency over the last four decades (Thompson 2000), so that the swamps are now persistently flooded.

Hydrologic modeling for this project, as well as hydrologic investigations for the CWPPRA - River Reintroduction into Maurepas Swamp Project, has revealed in some areas of Maurepas Swamp floor elevations are often lower than Lake Maurepas. This results in Lake Maurepas stage exerting a significant influence (backflow) on water levels within Blind River and adjoining channels rendering swamp water levels and dry-out periods dependent on the water levels in Lake Maurepas. Flooding is essentially semi-permanent with low to very low water exchange and throughput. The observed doubling of flood durations from 1955 to present at Pass Manchac (Thomson et al. 2002) coupled with swamp elevations lower than lake elevations suggests that the duration of inundation within the project area has drastically increased over the last fifty years. Moreover, flood durations within the project area swamps are influenced by adjacent urban storm water runoff of areas to the northwest (i.e., Baton Rouge and surrounding cities) and hydrologic impoundments caused by major transportation corridors as well as parish canal embankments. These adjacent urban storm water drainage projects force storm water runoff via large drainage canals into the Blind River. These storm waters bypass the floodwater storage capabilities of adjacent forested wetlands and increase the water levels in Blind River resulting in back water flooding conditions upstream of the waterways confluence. Being that the project area is located at the headwaters of the Blind River and is impounded by several major hydrologic barriers [i.e., I-10, U.S. Highway 61, and Kansas City Southern Railroad (KCS RR)]; flood waters within the project area are the last to recede from the basin.

Saltwater intrusion has increased in this general area, partly due to net subsidence and the lack of riverine freshwater inputs. Salinities as low as three parts per thousand (ppt) can reduce growth of both bald cypress and water tupelo saplings (Pezeshki et al. 1990). Salinity, combined with flooding stress, can substantially reduce bald cypress growth. Consequently, salinity significantly contributes to swamp deterioration, particularly combined with stressors such as flooding and herbivory. Storm surges from Lake Maurepas caused by tropical cyclones also exert a stochastic but severe stress on the swamp habitat through salinity spikes in swamp surface waters. Embankments along the parish canals and associated with the railroad and highways prevent higher salinity water from being flushed out of the system. Storm surge waters remain in the impounded swamps cumulatively increasing salinities in impounded waters and soils.

Some uncertainty surrounds the historic frequency of flooding events in the study area due to the natural variability of these events and limited historic record. Lopez (2003) estimated that flooding of the Mississippi River historically occurred once every 3.5 years in the Lake Pontchartrain Basin. Between 1799 and 1931, the frequency of major flood events for the

Mississippi River was approximately every 2.8 years (Gagliano and van Beek, 1970), with twenty-three flood years recorded below Baton Rouge from 1849 to 1927 (Vogel 1930).

While the LCA - Small Diversion at Convent/Blind River Project is primarily a freshwater diversion project; the project area is expected to receive some sediment from the proposed diversion contributing to swamp productivity. For an evaluation of potential sediment loading at Bayou Lafourche, Mashriqui and Kemp (1996) reported the mean sediment load of the Mississippi River at Tarbert's Landing to be 226 mg/l, of which about 26% was sand, with silts and clays each contributing between 30% and 40%. Lee Wilson & Associates, Inc. (2001) concluded even if only clays are conveyed by the channel to the swamps north of I-10 along Hope Canal, about 30% of the river load could be expected to reach the swamps. If only 30% of that potential sediment load is delivered to the primary swamp receiving areas, and an exceedingly low capture efficiency by the swamp of only one-third is assumed, it will represent a loading per area of about 1,098 g/m2/yr, or about twice the quantity needed as estimated by Templet and Meyer-Arendt (1988). It is, therefore, anticipated that sediments introduced with diverted water will increase accretion rates, likely holding or increasing existing swamp elevations against subsidence, at least for those areas within the high influence areas of the diversion. Those sediments will also increase soil bulk densities, and with increased elevations contribute to increased tree health, survival, and productivity, and the potential for tree regeneration (Lee Wilson & Associates, Inc. 2001).

Study evaluations conducted for the River Reintroduction into Maurepas Swamp Project (PO-29) and funded through the Coastal Wetlands Planning, Protection and Restoration Act (CWPPRA) program determined that the volume of water that would be delivered by a 1,500 cubic feet per second (cfs) diversion running most of the year would be the equivalent of two complete replacements of lake volume per year. In addition, the diversion design would be capable of, on the average, operating at full flow even during the late summer and fall low-flow period, when high salinities and saltwater intrusion are the biggest threat. Thus, it is expected that Lake Maurepas would experience significant freshening as a benefit beyond direct benefits to the swamps as a result of the River Reintroduction into Maurepas Swamp CWPPRA Project. Such freshening could have a positive impact on fisheries as well as other ecosystem components (Lee Wilson & Associates, Inc. 2001).

The Mississippi River Sediment, Nutrient, and Freshwater Redistribution (MRSNFR) Study conducted by the Corps (2000) concluded that there were no issues of water or sediment quality that would preclude consideration of diversion of river water (and sediment) for restoration purposes. Only a few compounds, mainly mercury and some organochlorine pesticides that have been banned from use for well over a decade, were found to occasionally exceed water or sediment standards. However, the absence of significant observed bioaccumulation of these compounds was taken as evidence for no overall problems (Corps 2000). Furthermore, studies conducted for the CWPPRA - River Reintroduction into Maurepas Swamp Project determined that nutrients added with diverted river water would be essentially completely taken up within the swamp (Lee Wilson & Associates, Inc. 2001).

FISH AND WILDLIFE RESOURCES

The Service has provided a Final FWCA Programmatic Report for the Near Term Plan for the LCA Study (Grouchy and Paille 2004). That report contains a through discussion of the significant fish and wildlife resources (including those habitats) that occur within the study area as well as fish and wildlife concerns that occurs within coastal Louisiana and future without project conditions. That discussion is incorporated by reference herein, but the following information is provided to update to that report and provide project specific information and recommendations.

Major Habitat Types

Cypress/Tupelo Swamps

The study influence area (distribution area) contains approximately 21,844 acres the majority of which is dominated by bald cypress/tupelo swamp habitat and is semi-permanently or permanently flooded. Persistent flooding has resulted in the impairment of cypress/tupelo seedling establishment/regeneration (CWPPRA Task Force 2002). Cypress/tupelo regenerates well when the seedbed is moist but not flooded during the time period of seed germination and seedling establishment. Cypress/tupelo seeds cannot germinate in standing water, and seedlings must grow tall enough during dry periods for their crowns to extend above the water surface to survive flooding during the growing season. Excessive flooding will reduce regeneration even though overstory trees may still be thriving. Ultimately, the lack of regeneration due to prolonged inundation will eliminate forest cover, resulting in the conversion of swamp habitat to open water over time (CWPPRA Task Force 2002). In addition, saltwater intrusion from storm events has stressed the swamp habitat along the Blind River.

Cypress swamps in the project area provide substantial fish and wildlife values. Wildlife species typical of cypress swamps include green tree frog, bullfrog, mud and musk turtles, American alligator, various species of water snakes, anhinga, barred owl, northern parula, great blue heron, great egret, white ibis, and mink. Often surrounding backwater lakes, these areas also provide essential habitat for aquatic species when inundated.

While bald cypress is the canopy dominant in a few locations within the study area, water tupelo was the predominant species across sites. In addition to bald cypress and water tupelo, Drummond red maple, green ash, and various oak species are also found in the cypress/tupelo swamp habitat within the study area, with Drummond red maple and green ash comprising sub-dominant midstory species (Conner and Day 1976; Hoeppner 2008; Shaffer et al. 2003). Scrub species, including black willow, wax myrtle, and common buttonbush are sporadically present, particularly in areas with diminished canopy cover caused by impaired health or mortality of overstory species. Shrub-scrub swamps provide important nesting habitat for colonial wading birds as well as various species of aquatic wildlife.

Bottomland Hardwoods

Bottomland hardwood forests are generally intolerant of inundation during the growing season

(Putnam et al. 1960; Hodges 1997). Fluctuations in water level are more prevalent in the bottomland hardwood forest than bald cypress-tupelo swamp, with characteristic alternating wet and dry periods. Where bottomland hardwood forests experience increased flooding regimes the forest stand begins to transition into a more flood tolerant community composition and becomes more characteristic of a swamp habitat. Bottomland hardwoods are present within the distribution area as elevations increase near the natural levee of the Mississippi River and along several ridge remnants and spoil banks that traverse the study area. Also the alternative transmission canal alignments traverses bottomland hardwood forests along the natural levee and within the Mississippi River batture. Dominant tree species in the higher elevated area include Drummond red maple, black willow, green ash, laurel oak, water oak, sweet gum, sugarberry, American elm, and Chinese tallow. The areas between the ridges and the swamp show a transition in species and are dominated by green ash and Drummond red maple. Wax myrtle, rough-leaf dogwood, black willow, Chinese tallow, Chinese privet, yaupon, and deciduous holly typically are common shrub species. Vines such as poison ivy, greenbrier, pepper vine, and trumpet creeper are present.

Bottomland hardwood forests typically provide high wildlife habitat values to a variety of species, including amphibians such as the Gulf coast toad and Cope's gray tree frog; reptiles such as the copperhead and green anole; many species of birds, including wood duck, barred owl, pileated woodpecker, red-shouldered hawk, Acadian flycatcher, Swainson's warbler and northern parula; and mammals including white-tailed deer, swamp rabbit, gray fox, bobcat, raccoon, opossum, and squirrels. In addition to terrestrial wildlife, many species of fish utilize flooded bottomland hardwoods as well; some species are specifically adapted for spawning in these backwater flood plains.

Fresh Marsh

Within the study area fresh marsh habitat mainly consists of pipeline and powerline easements. While some of these easements have ditches, many of the easements are slightly elevated above the adjacent swamp and are thickly vegetated with grasses and forbs. These areas are usually saturated to the surface, and flooded only during higher water periods. Therefore, it is unlikely that fresh marshes within the Study Area currently provide nursery habitat for estuarine species. However, these fresh marshes would provide habitat for other wildlife species such as reptiles and amphibians.

Open Water

The Blind River is the major waterway influencing the project area wetlands and is designated as a state water bottom along with the Mississippi River and Lake Maurepas also within the study area. Several parish canals, transmission line and pipeline canals, and borrow canals transect the study area swamp habitat. Because of the stagnant conditions, the loss of sediment input, reduced primary productivity, and limited consolidation, net phosphorus and organic matter export from the swamp is likely low. Therefore, support for dependent systems downstream (e.g., Lake Maurepas) is likely limited and substantially reduced from historic levels.

In their *2006 Water Quality Integrated Report*, the Louisiana Department of Environmental Quality (LDEQ) indicated that water within the study area (i.e., LDEQ sub-segment 040403) supports the designated standards for primary and secondary contact recreation, but does not support those standards for fish and wildlife propagation. Suspected sources of impairment include were mercury, nitrate/nitrite, non-native aquatic plants, total phosphorus (TP), and turbidity. The suspected sources for mercury were listed as atmospheric deposition and unknown sources. Site clearance (land development or redevelopment) and flow alterations from water diversions were listed as the suspected sources for nitrate/nitrite, dissolved oxygen, and TP. The suspected causes of impairment for the outstanding natural resource waters designation were sedimentation/siltation and turbidity, which are believed to be caused by site clearance.

Developed Areas

Developed areas within the study area occur along the Mississippi River levee and are dominated by industry facilitated by Mississippi River commerce and associated business and residential development. Historically, agriculture has been a major industry within both parishes and is still relevant today primarily in the form of sugarcane farming. Two railways run through the study area. The KCS RR transects the distribution area and parallels U.S. Highway 61 to the south. The Canadian National Railway extends to the south of the distribution area and would be transected by the Romeville and South Bridge transmission canals. U.S. Interstate 10 and U.S. Highway 61 pass through the distribution area. Where U.S. Highway 61 and Blind River intersect the St. James Boat Club, a boat launch facility, provides boat access to the upper Blind River. Also a second boat launch is located at the north terminus of Louisiana Highway 642 with access to Grand Point Canal. Numerous transmission and pipeline rights-of-way also intersect the study area.

Fishery Resources

Lower Mississippi River

Baker et al. (1991) noted at least 91 species of freshwater fishes occupy the Lower Mississippi River as their primary population center; 30 or more species may be present sporadically. From what is known of its physical attributes, few species could regularly inhabit the upper and middle water column in this habitat. Some larger fishes, such as paddlefish, white bass, and striped bass, and smaller actively swimming fishes such as skipjack herring and goldeye may often occupy this area for feeding or moving among other habitats (Baker et al. 1991).

Blind River /Swamp

Freshwater sport fishes likely present include white crappie, bluegill, warmouth, channel catfish, and blue catfish. Other fishes likely present include yellow bullhead, freshwater drum, bowfin, carp, buffaloes, and gars. In addition, aquatic and wetland habitats within the study area provide nursery and foraging habitats supportive of a variety of fishery species including economically important estuarine-dependent fishery species (e.g., the blue crab, striped mullet, and Gulf menhaden), some of which may serve as prey for other fish species.

During a survey conducted from January 1976 to August 1977, Watson et al. (1981) sampled fisheries species at six locations along Blind River from south of Highway 61 to Lake Maurepas. In doing so, 57 species of finfish were collected and included 12 estuarine, 43 freshwater, and two diadromous species. Freshwater species were dominant both spatially and temporally. Finfish diversity appeared to be higher at the lower stretches of Blind River, below the Amite River Diversion Canal and nearer Lake Maurepas. The lower Blind River had the greatest species diversity, primarily due to the presence of estuarine species.

A survey conducted by Davis et al. (1970) between 1967 and 1969 in the Lake Maurepas revealed forty species of finfishes and shell fishes. Some of the fishes included Gulf menhaden, gizzard shad, striped and bay anchovy, blue and channel catfish, sand and spotted seatrout, Atlantic croaker, striped mullet, southern flounder, largemouth bass, bluegill, and several species of gar as well as shrimp. In a later fisheries survey of Lake Maurepas, Hastings et al. (1987) reported an equal proportion of freshwater (55 percent) and marine (40 percent) fish species with four-percent of individuals being diadromous. A correlation was observed between the fisheries species present in the lake and mouth of Blind River and salinity levels in Lake Maurepas: marine species exhibited a higher contribution to the fisheries of Lake Maurepas and had a greater likelihood of presence in Blind River with increasing salinity levels, with the opposite trend apparent for freshwater species.

Essential Fish Habitat

Lake Maurepas is designated as Essential Fish Habitat (EFH) postlarval and juvenile life stages of white shrimp and red drum. Detailed information on Federally-managed fisheries and their EFH is provided in the most recently updated 2005 generic amendment of the Fishery Management Plans for the Gulf of Mexico, prepared by the Gulf of Mexico Fishery Management Council (GMFMC). That generic amendment was prepared in accordance with the Magnuson-Stevens Fishery Conservation and Management Act (MSFCMA), (P.L. 104-297).

In addition to being designated as EFH for red drum and white shrimp, water column and water bottoms, in Lake Maurepas provide nursery and foraging habitats that support a variety of economically important marine fishery species such as Atlantic croaker, sand seatrout, black drum, southern flounder, blue crab, and striped mullet. Some of these species serve as prey for other fish species managed under the MSFCMA by the GMFMC (e.g., mackerels, snappers, and groupers) and highly migratory species (e.g., billfishes and sharks) managed by the NOAA-Fisheries.

According to the Corps analysis the TSP could influence Lake Maurepas although Lake Maurepas is not designated within the study area. The level of change and adverse impacts to EFH, if any, are considered by the Corps to be minor. NOAA's NMFS determined EFH consultation requirements in accordance with the MSFCMA to be complete. That determination was based on the project being completed and operated as proposed in the Supplemental EIS. However, should the project scope change or should additional hydrologic modeling determine that the proposed project would significantly influence Lake Maurepas water quality, additional consultation with NOAA's NMFS will be necessary.

Wildlife Resources

The coastal marshes and forested wetlands of the Lake Pontchartrain Basin have been identified by the North American Waterfowl Management Plan (NAWMP), Gulf Coast Joint Venture (GCJV): Mississippi River Coastal Wetlands Initiative as a key waterfowl wintering area. The Gulf Coast is the terminus of the Central and Mississippi Flyways and is therefore one of the most important waterfowl areas in North America, providing both wintering and migration habitat for significant numbers of the continental duck and goose populations that use both flyways. The Mississippi River Coastal Wetlands Initiative area is dominated by coastal marsh, forested swamps, and seasonally flooded bottomland hardwoods that provide habitat for several species of wintering waterfowl. Wood ducks are the primary waterfowl species in forested wetlands, while other ducks (e.g., mallard, American widgeon, gadwall, blue- and green-winged teal, Northern shovelers, ring-necked ducks, and lesser scaup) use those forested habitats to a lesser degree.

Strategies to achieve the goals and objectives of the GCJV include but are not limited to: 1) maintaining the existing functions and values of those habitats and preventing additional losses and degradation of those wetlands and 2) modifying existing spoil banks and canals to restore hydrology (Wilson et al. 2002). Numerous other game birds are present in or adjacent to the study area, including American coot, rails, gallinules, common snipe, and American woodcock. Non-game bird species also utilize the study area marshes, including least bittern, pied-billed grebe, black-necked stilt, American avocet, killdeer, black-bellied plover, willet, and various species of sandpipers, gulls, and terns. The study area supports many resident and transient hawks and owls including red-shouldered hawk, barn owl, common screech owl, great horned owl, and barred owl. Winter residents include red-tailed hawk, northern harrier, and American kestrel, while the Mississippi kite, swallow-tailed kite and broad-winged hawk are common summer residents. In addition, the project area supports many species of resident and migratory passerine birds. Some neo-tropical migrants that are currently experiencing a population decline (e.g., white-eyed vireo, northern parula) are dependent on large forested acreage to successfully reproduce. Also, present are cuckoos, swifts, hummingbirds, nighthawks, woodpeckers, and the belted kingfisher.

Invasive Species

Within the study area invasive mammal species present include nutria and feral hogs. Invasive plant species present within that area include: water hyacinth, alligator weed, hydrilla, common salvinia, giant salvinia, variable-leaf milfoil, Chinese tallow, and Chinese privet. Those species displace native aquatics and degrade water and/or habitat quality. In addition, Chinese tallowtree is tolerant to flooding and salt stress and can establish self-replacing monocultures that provide less foraging value to migrating birds and interrupt the natural succession of woody species (Louisiana Coastal Protection and Restoration 2008).

Threatened and Endangered Species

West Indian Manatee

Federally listed as an endangered species, West Indian manatees (*Trichechus manatus*) occasionally enter Lakes Pontchartrain and Maurepas, and associated coastal waters and streams during the summer months (i.e., June through September). Manatee occurrences appear to be increasing, and they have been regularly reported in the Amite, Blind, Tchefuncte, and Tickfaw Rivers, and in canals within the adjacent coastal marshes of Louisiana. 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.

Gulf Sturgeon

The Gulf sturgeon (*Acipenser oxyrhynchus desotoi*), 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 Suwannee River, Florida. In Louisiana, Gulf sturgeon have been reported at Rigolets Pass, rivers and lakes of the Lake Pontchartrain 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. Sturgeon 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. The proposed project, however, does not occur within nor would it impact designated Gulf sturgeon critical habitat.

By letter dated June 29, 2010, the Service, through the Department of Interior, concurred with the Corps determination of not likely to adversely impact the West Indian manatee and the Gulf sturgeon. However, should there be changes in the scope or location of the proposed project or should the project not been initiated within one year, follow-up consultation should be accomplished with the Service prior to making expenditures because our threatened and endangered species information is updated annually. If the scope or location of the proposed project is changed, consultation should occur as soon as such changes are made. Furthermore, should additional hydrologic modeling determine that the proposed would influence Lake Maurepas salinities and water temperatures, additional consultation regarding the Gulf sturgeon will be necessary.

Pallid Sturgeon

The pallid sturgeon (*Scaphirhynchus albus*) is an endangered fish found in Louisiana, 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 large, free-flowing, turbid rivers with a diverse assemblage of physical characteristics 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 loss through river channelization and dams has adversely affected this species throughout its range. Entrainment issues associated with dredging operations in the Mississippi and Atchafalaya Rivers and through diversion structures off the Mississippi River are two potential effects that should be addressed in future planning studies and/or in analyzing current project effects. Impacts to the pallid sturgeon via entrainment through the diversion structure should be addressed in planning studies.

By letter dated July 14, 2010, the Corps initiated formal ESA, Section 7 consultation with the Service for potential impacts to the pallid sturgeon. The Service expects to provide the Corps with our biological opinion no later than October 13, 2010.

Species of Special Interest

Bald Eagle

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. Several active and inactive bald eagle nests are documented within and adjacent to the study area. Other 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.

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:

1) 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).

2) 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

There are no U.S. Fish and Wildlife Service National Wildlife Refuges located within the study area. A majority of the study area is located within the state-operated Maurepas Swamp Wildlife Management Area. Please contact the LDWF, Region 7 Office in Baton Rouge, Louisiana, (225/765-2360) for their comments regarding potential project impacts to this area.

Blind River is designated as a Louisiana Natural and Scenic River. Please contact the LDWF, Scenic Rivers Program (318/343-4045) for further information regarding any additional permits that may be required to perform work on the above referenced river.

ALTERNATIVE EVALUATION

Based on a review and analysis of prior studies, initial site visits, and input received through the scoping process, an initial list of management measures (i.e., restoration features that are elements of an alternative) was developed. Examples of management measures includes water management modifications within Maurepas Swamp (e.g., weirs, flow control gates, and control valves); alternate measures and approaches to distributing freshwater throughout the distribution area (e.g., pumps and control structures); alternative transfer systems to transfer the freshwater from the diversion point to the swamp (e.g., trapezoidal earthen or concrete-lined channel, underground conduits, or existing natural and man-made drainage systems); and alternative diversion system features including alternative diversion locations and levee crossing measures (siphon vs. culverts). An example of nonstructural management measures includes alternative diversion operation plans to achieve certain restoration goals and planting cypress seedlings in targeted areas.

After management measures were screened and evaluated, the management measures were then grouped into an array of preliminary alternatives for further evaluation to achieve the overall project goals and objectives. The alternatives in the initial array underwent a screening and evaluation process to develop the final array of alternatives. The screening process analyzed the specific components or features that were included in the alternatives including diversion location, diversion flow rates, and diversion methods.

FINAL ARRAY OF ALTERNATIVES

The evaluation determined that the Romeville and Sunshine Bridge locations are hydraulically efficient locations from which to provide freshwater, nutrients, and sediments to an effective portion of the benefit area. It was determined that 3,000 cubic feet per second (cfs) of flow is needed to provide both prevention of saline backflow and inundation from Lake Maurepas and also achieve the overall goal of reversing the trend of degradation in the swamp. Further, an analysis of construction costs indicates that siphons are more cost effective for flow rates below 1,000 cfs and gated culvert systems are more cost effective for flow rates greater than 1,000 cfs. Considering the preliminary results of initial screen and evaluations efforts, the following five alternatives were identified for further consideration and inclusion in the final array:

No Action Alternative (Future without Project Conditions)
Alternative - 2 – 3,000 cfs Diversion at Romeville (Gated Culvert System)
Alternative - 4 – 3,000 cfs Diversion at South Bridge (Gated Culvert System)
Alternative - 4B – 3,000 cfs Diversion at South Bridge with split flows (Gated Culvert System)
Alternative - 6 – Two 1,500 cfs (3,000 cfs combined) Diversions at Romeville and South Bridge (Siphons)

Alternative 2 – 3,000 cfs Diversion at Romeville
This alternative adds a gated culvert system and transfer canal along the Romeville alignment, restores and improves the 160 existing berm cuts, adds 30 new 500-foot wide berm cuts, builds up to 6 control structures at strategic locations in the swamp and adds 3 new culverts under U.S.

Highway 61.

Alternative 4 – 3,000 cfs Diversion at South Bridge
This alternative adds a gated culvert system and transfer canal along the "Cox" alignment located south of the U.S. Highway 70 Bridge, restores and improves the 160 existing berm cuts, adds 30 new 500-foot wide berm cuts, builds up to 6 control structures at strategic locations in the swamp and adds 3 new culverts under U.S. Highway 61.

Alternative 4B – 3,000 Split Diversion at South Bridge
This alternative adds a gated culvert system and transfer canal along the "Cox" alignment located south of the U.S. Highway 70 Bridge, restores and improves the 160 existing berm cuts, adds 30 new 500-foot wide berm cuts, builds up to six control structures at strategic locations in the swamp, and adds 3 new culverts under U.S. Highway 61. This alternative includes a modification to the distribution of the diversion provided by Alternative 4 by sending 1,500 cfs to the south through the St. James Parish Canal in order to achieve a similar distribution to Alternative 6.

Alternative 6 – 3,000 cfs Dual Diversion at Romeville and South Bridge
This alternative adds a gated culvert system- and a transfer canal- along the Romeville alignment and a gated culvert system- and transfer canals along the "Cox" alignment located south of the U.S. Highway 70 Bridge, restores and improves the 160 existing berm cuts, adds 30 new 500-foot wide berm cuts, builds up to 6 control structures at strategic locations in the swamp and adds 3 new culverts under U.S. Highway 61.

EVALUATION METHODOLOGY

Evaluation of project-related impacts on fish and wildlife resources was conducted using the Wetland Value Assessment (WVA) methodology developed for the evaluation of proposed CWPPRA projects (Louisiana Coastal Wetlands Conservation and Restoration Task Force [LCWCRTF] 2006). The WVA methodology is similar to the Service's Habitat Evaluation Procedures (HEP), in that habitat quality and quantity are measured for baseline conditions and predicted for future without-project (FWOP) and future with-project (FWP) conditions. Instead of the species-based approach of HEP, each 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 WVA methodology was first developed in 1991 by the CWPPRA Environmental Work Group (LCWCRTF 2006). Initially, emergent marsh habitat models were developed for fresh, intermediate, brackish and saline marsh types. Subsequently, models were also developed for swamps, barrier islands, barrier headlands, and coastal forested ridges. The habitat variable-habitat suitability relationships within the WVA models have not been verified by field experiments or validated through a rigorous scientific process. However, the variables were originally derived from HEP suitability indices taken from species models for species found in that habitat type. It should also be noted that some aspects of the WVA have been defined by policy and/or functional considerations of CWPPRA. However, habitat variable-habitat suitability relationships are, in most cases, supported by scientific literature and research findings. In other cases, best professional judgment by a team of fisheries biologists, wildlife biologists, ecologists, and university scientists may have been used to determine certain habitat variable-habitat suitability relationships. In addition, the WVA models have undergone a refinement process and habitat variable-habitat suitability relationships, HSIs, and other model aspects are periodically modified as more information becomes available regarding coastal fish and wildlife habitat suitability, coastal processes, and the efficacy of restoration projects being evaluated.

The WVA models assess the suitability of each habitat type for providing resting, foraging, breeding, and nursery habitat to a diverse assemblage of fish and wildlife species. This standardized, multi-species, habitat-based methodology facilitates the assessment of project-induced impacts on fish and wildlife resources. The CWPPRA swamp WVA model used consists of four variables: 1) stand structure; 2) stand maturity; 3) water regime; and 4) mean high salinity during the growing season.

Using the WVA methodology, impact assessments were conducted by the Habitat Evaluation Team (HET), which included representatives from the Service, the Corps, Office of Coastal Protection and Restoration, LDWF, NMFS, Southeast Louisiana University (SLU), and CDM, Incorporated. To assess impacts the HET used habitat information collected during four separate field trips from March through September of 2009, surveys, expert opinions, knowledge of the area, experience with similar projects, Digital Ortho-quarter Quadrangle aerial photographs (DOQQ), and preliminary hydraulics and hydrology modeling information.

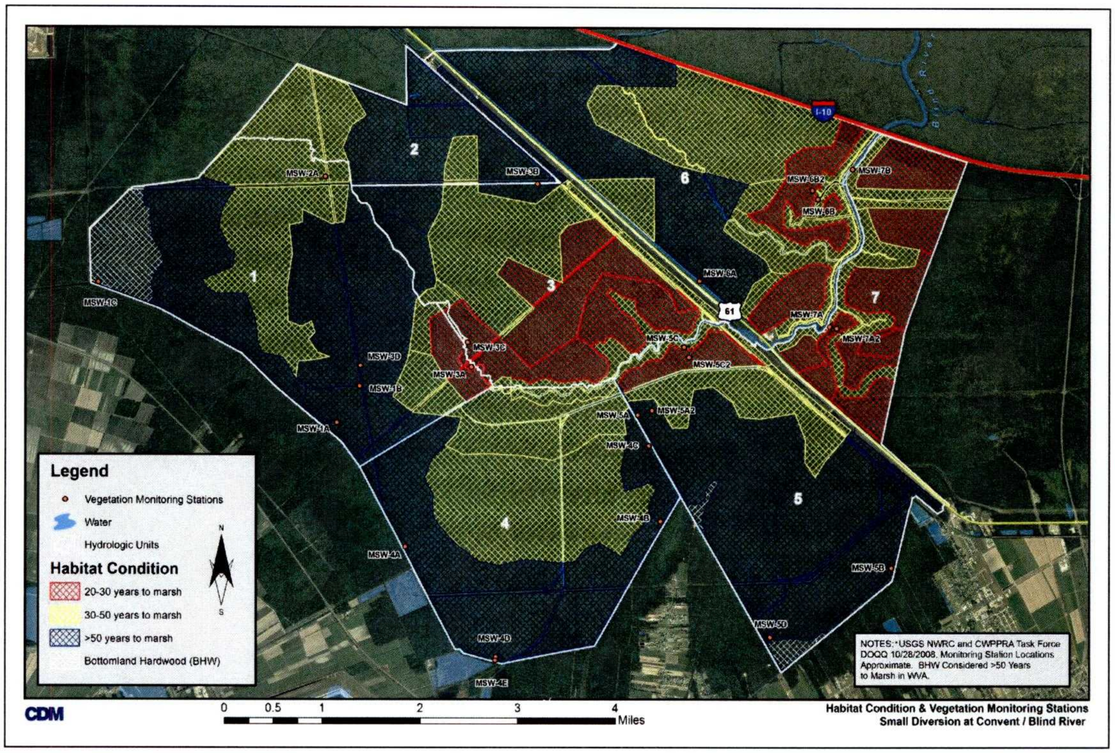
For the LCA - Small Diversion at Convent/Blind River Project those elements above were used in conjunction with the WVA models to compute an HSI value for each target year (TY). Selection of target years is based on anticipated changes in the area being evaluated. Three levels of habitat condition class were defined within the project area (i.e., 20-30 years-to-marsh, 30-50 years-to-marsh, and greater than 50-years-to-marsh) based on the degree of degradation and according to classifications used by Dr. Gary Shaffer (SLU) at other areas within the Maurepas Swamp (Figure 2). Because we can not accurately determine when these swamps will convert to marsh or open water, these habitat condition classifications are meant to define the level of degradation and not necessarily the target years that the habitats will convert to marsh.

Alternatives were analyzed using target years reflective of those habitat condition classes. The target years used for this project were TY0, TY1, TY20, TY30, and TY 50. The standard period of analysis for Corps projects is 50 years.

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.

Prior to running the WVA analysis, the hydrologic units (i.e., benefit areas) associated with each alternative were designated based on the location of the hydrologic unit within the watershed in relation to the diversion outfall. It was assumed that certain hydrologic units would receive different levels of influence (i.e., high, moderate, low, or no influence). For purposes of the WVA, the Service assumed that the high influence areas would receive the most benefits from sediments, nutrients, and freshwater flow (i.e., freshwater throughput); moderate influence areas would receive benefits from nutrients and freshwater flows; and low influence areas would experience benefits as a result of freshwater flow. However, assuming the diversion would be operated to maximize dry-out frequency all hydrologic units see increased benefits in the form of dry-out frequency as a result of the berm cuts.

Figure 2. Hydrologic Units and Habitat Condition Classes for the Convent/Blind River Freshwater Diversion.



Subsequent to the mapping of influence areas for each alternative, WVAs were run for each habitat condition class (i.e., 20-30 years to marsh, 30-50 years to marsh, and greater than 50 years to marsh) present within those areas. Once benefits were calculated, adverse temporary and permanent impacts to swamp and bottomland hardwood habitats associated with construction of the transmission channels were calculated. The change in AAHUs for each FWP scenario, compared to FWOP project conditions, provides a measure of anticipated impacts. A net gain in AAHUs indicates that the project is beneficial to the habitat being evaluated; a net loss of AAHUs indicates that the project is damaging to that habitat type.

The WVA initial analysis was completed on the benefit areas for all alternatives under the intermediate sea level rise (SLR) scenario. As requested by the Corps, additional WVAs were later run to quantify impacts under the low and high SLR scenarios for the Tentatively Selected Plan (TSP) and the National Ecosystem Restoration (NER) Plan. A combined total of 79 WVA evaluations has been completed.

The Project Information Sheet (including assumptions used by the HET) for the project are presented in Appendix A. The complete WVA analysis can be obtained from the Service's Lafayette, Louisiana Ecological Services Office upon request.

FUTURE WITHOUT-PROJECT FISH AND WILDLIFE RESOURCES

According to the Coast 2050 Report (LCWCRTF 1999), in 1990, this unit contained approximately 138,930 acres of swamp and 3,440 acres of marsh. Under future without-project conditions continued impoundment, flooding, subsidence, and herbivory are expected to increasingly stress area swamps in the future. The current problems associated with altered hydrology are expected to continue. The lack of overbank flooding from the Mississippi River into the swamp and hydrologic connectivity within the swamp would result in the continued impoundment of the project-area swamp, with an associated reduction in canopy cover, degradation of water quality, and transition of swamp habitat to marsh, with the eventual conversion to open-water habitat similar to areas further east. Storm surges from tropical cyclone events would increase salinity levels and the frequency of saltwater inundation is expected to increase with relative sea level rise (RSLR). Nearly 69,500 acres of swamp (50% of the 1990 total) and 40 acres of marsh are projected to be lost by 2050 (LCWCRTF 1999).

The lack of freshwater, sediments, and nutrients would continue to reduce tree vigor and growth, increase tree mortality, increase the presence of invasive species, and reduce ecological functions. In addition, the assumed RSLR would exacerbate swamp degradation in the future. The anticipated conversion of swamp habitats to marsh and open water would result in the loss of wetland values and functions. While the Service recognizes the ecological importance of freshwater marshes, in this case, the anticipated conversion of swamp to marsh habitat is a transitional phase resulting from habitat deterioration and conversion and is not indicative of a healthy sustainable ecosystem. Keddy et al. (2007) reports that the vast majority of the Maurepas Swamp is typical of swamps identified as either nutrient poor and stagnant or near-continuously flooded. Flood durations in the Maurepas Swamp have doubled, on average, over the past half-century (Thomson et al. 2002). The flooding and impoundment within the study area prevents seed germination and recruitment and, as a result, swamps are converting to marsh and open water.

Keddy et al. (2007) identified priority actions for habitat restoration within the Maurepas Swamp. Two of the primary recommendations addressed include diverting several freshwater diversions into the area and re-establishing sheet flow via removal or gapping of spoil banks and road and railroad beds. That report noted that pulsing of water flow from the river was a historical occurrence and that a sufficient volume to carry sediment and nutrients at least as far as the Manchac land bridge is necessary. That report further explains that sheet flow (or shallow water flow over the surface of the soil) was, most likely, the principle way in which water and nutrients moved through this system. Now, however, the presence of man-made hydrologic barriers impedes sheet flow. Canals decrease overbank flooding and accelerate the flow of water, sediment, and nutrients out of the area, while spoil banks and other such man-made features block sheet flow. Implementation of the proposed project would restore an historic ecosystem and increase the fish and wildlife habitat values of the project area.

This project would work in concert with other recently constructed and proposed projects to restore the Lake Pontchartrain Basin ecosystem including the de-authorization and closure of the Mississippi River Gulf Outlet (MRGO) channel at Bayou La Loutre authorized under WRDA 2007; and three Near-Term LCA projects, the MRGO Ecosystem Restoration Project, the Amite River Diversion Channel Modification Project, and Small Diversion at Hope Canal (Maurepas Swamp) Project.

DESCRIPTION OF NATIONAL ECOSYSTEM RESTORATION PLAN AND TENTATIVELY SELECTED PLAN

After comparing the four alternative plans carried forward for detailed analysis and the No Action Alternative, the NER Plan, Alternative 2, a 3,000 cfs diversion at Romeville was selected, as the TSP. Alternative 2 best meets the screening criteria; would accomplish the planning objectives and goals; would be consistent with the Corps' Environmental Operating Principles; and would contribute to reversing the trend of deterioration in the southeast part of the Maurepas Swamp. Alternative 2 would improve a total of 21,369 acres of baldcypress-tupelo swamp that are in various stages of deterioration.

Alternative 2 has the following six major components:

1. **Diversion structure** – three, 10 x 10-foot concrete box culverts with sluice gates are proposed under the Mississippi River's east bank levee and Louisiana Highway 44. The sluice gates would include motor operators on the culvert inlets. The diversion structure would also include trash racks, an inlet canal across the batture, and other ancillary structures.

2. **Transmission canal** - the transmission canal will be designed for 3,750 cfs and will transfer the diverted water approximately three miles from the diversion culvert facility to an existing drainage channel at the perimeter of the swamp. The canal will be an earthen

trapezoidal channel section, with a 155-foot wide bottom, 4:1 (H:V) side slopes, and a depth of approximately 12 feet, including a 2-foot freeboard. The top width will be approximately 250 feet. A railroad and highway crossing will require eight, 12 x 8-foot concrete box culverts.

3. **Control structures** - Control structures will be installed at key locations in the existing channels to distribute the diverted flow throughout and into the swamp. The control structure locations and designs will be determined during more detailed planning and engineering.

4. **Berm gaps (spoil bank gaps)** - new 500-foot wide berm gaps will be excavated in the spoil banks at an approximate spacing of 2,500 feet on center. The gaps will be excavated to the elevation of the adjacent swamp natural ground elevations, and the spoil will be disposed behind the existing spoil banks. As proposed, the spoil will be placed up to Elevation +6 North American Vertical Datum of 1988 (NAVD 88) to provide additional refuge areas for wildlife during flood events in the swamp.

5. **Cross culverts** - at four locations along U.S. Highway 61 and KSC RR. Each installation will consist of three, 3 x 4-foot concrete box culverts. There may be sufficient cross drainage openings at the KCS RR, and additional culverts may not be required. Earthen channels (large ditches) will be excavated across the 500-foot space between the KCS RR and U.S. Highway 61 to interconnect the drainage capacity at the railroad with the new culverts at U.S. Highway 61.

6. **Water level and flow rate instrumentation** – instrumentation to monitor and control the diversion flow rate and the water surface elevations in the diversion, transmission, and distribution system in the swamp will be installed. Additional instrumentation may be required as part of monitoring and adaptive management.

Operation Plan

Currently the operation plan will be designed to divert the water from the Mississippi River at 3,000 cfs for 6 to 9 months each year. The remaining 3 to 6 months will be operated at a lower flow to allow the swamp to drain and for the seeds to germinate ensure survival of saplings. The exact flow rates will be determined once all of the parameters of the system area determined and operational plan elements are defined. Operational plan elements will include such things as target water surface elevations necessary within the swamp to efficiently assimilate nutrient loads and nutrient level thresholds within Blind River and Lake Maurepas. The operation plan will allow for seasonal and annual flexibility and will be operated to achieve the defined goals of the operational plan elements.

EVALUATION OF NATIONAL ECOSYSTEM RESTORATION PLAN AND TENTATIVELY SELECTED PLAN

Alternative 2 is one of three cost-effective and best-buy alternatives. Alternative 2 provides over

90 percent of the benefits for about 67% of the cost of Alternative 6, the cost per AAHU is much lower for Alternative 2 than that for the other two alternatives and the incremental cost per habitat unit in going from Alternative 2 to Alternative 4B and/or Alternative 6 is quite high. Current habitat analysis indicates that the highest net benefits would be achieved through implementation of Alternative 6 (7,114 AAHUs). However, due to the high incremental cost per habitat unit going from Alternative 2 to Alternative 4B or 6, those alternatives were not considered to be justified. Alternative 2 is the alternative that reasonably maximizes ecosystem restoration benefits compared to costs and is designated as the NER Plan and the TSP.

Based on preliminary hydrologic modeling results, which at this stage of the study have focused on transfer of flow between benefit areas, Alternative 2 directly influences a larger area (i.e., hydrologic units 1 and 4) providing 8,088 acres with sediments, nutrients, and freshwater. Approximately 3,415 acres of swamp would benefit through the addition of freshwater and nutrients. An additional 4,535 acres would experience freshwater benefits. Aside from the benefits achieved from diverting freshwater into the system, the project area will experience increased throughput, hydrologic connectivity, and dryout periods as a result of in swamp management measures benefiting an additional 5,331 acres. The WVA analysis indicates that the NER and TSP for the project would result in net gains of 6,741; 6,421; and 5,459 AAHUs under the low, intermediate, and high SLR scenarios, respectively.

Swamp habitat for fish and wildlife species would be restored, mimicking as closely as possible, conditions which occurred historically in the area. Restored hydrologic connections would: 1) increase the nutrient and sediment input, 2) increase acreage of high-quality swamp habitats used by fish and wildlife for shelter, nesting, feeding, roosting, cover, nursery, and other life requirements, and 3) increase vegetative growth and productivity. In addition, when compared to the future without project scenario, implementation of this alternative would significantly reduce the likelihood of existing swamp habitat converting to marsh and eventual open water habitat over the life of the project.

Because of the expedited schedule many specific details regarding the design, operation, and associated effects of the TSP are not yet available at the current level of planning. Therefore, the habitat analysis conducted provides a comparison of alternative benefit areas and potential direct impacts associated with project construction to support the selection of a TSP. Subsequent detailed planning, engineering, design, and construction of specific project measures, along with more-definitive project information should be made available during planning, engineering, design (PED) phase. Additional Service and natural resource agency involvement during those phases will be prudent to ensure impacts and benefits on fish and wildlife resources are addressed. Should future analyses result in significant changes in hydrodynamic data outputs and/or the project scope, additional evaluations of project feature effects on fish and wildlife resources will be necessary to ensure our reporting responsibilities under Section 2(b) of the Fish and Wildlife Coordination Act are complete.

To fully evaluate the benefits of the TSP the following additional information and actions should be considered:

- Additional results of hydrologic modeling efforts that better identify/quantify influence areas and how water (sediment and nutrients) moves through the system and within each hydrologic unit under the operational plan identified.
- Water levels and swamp floor elevations need to be determined on a refined scale and incorporated into the hydrologic modeling.
- Salinity predictions need to be re-evaluated and changes, if necessary, be undertaken.
- Accretion rates need to be determined and incorporated into the hydrologic modeling (e.g., flood durations and depths should decrease).

FISH AND WILDLIFE CONSERVATION AND MITIGATION MEASURES

Swamp habitats are considered by the Service to be aquatic resources of national importance due to their increasing scarcity and high habitat value for fish and wildlife within Federal trusteeship (i.e., migratory waterfowl, wading birds, other migratory birds, threatened and endangered species, and interjurisdictional fisheries). Restoring coastal swamp habitat through implementation of the proposed project would be preferable to the continued loss and degradation of coastal wetlands and Louisiana's nationally significant fish and wildlife resources.

A critical design challenge for the Maurepas Swamp will be the distribution of flow into and throughout the swamp habitat. Modifications to drainage patterns, distribution channels, and installation of control structures will be necessary to distribute water, sediment, and nutrients throughout the swamp and avoid adverse impacts to existing drainage features. To accommodate changing goals and restoration needs for the region, the diversion structure, as well as the outfall management system, should be designed to incorporate operational flexibility to address changing environmental conditions through an adaptive management program.

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 loss of coastal wetlands. Considering the scope and complexity of the some of the projects, that schedule, because of a one year delay in getting cost-sharing documents signed, should be acknowledged as a key potential 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.

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. 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 the LCA - Small Diversion at Convent/ Blind River 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 TSP has occurred changes to the TSP and/or the TSP features may be warranted based on further planning efforts and review of existing assumptions and modeling (i.e., quality control).

The intent of the habitat assessment is to provide a comparison of alternative benefit areas and potential direct impacts associated with project construction to support the selection of a TSP. As the interagency team moves forward in developing project design and operation plans and more extensive hydrologic modeling is conducted, habitat assessments previously conducted may need to be revised. Careful consideration should be given to include relative sea level rise and accretion rates in assessments of salinity changes for future with and future without project conditions.

Artificial structures within the swamp system can impede organism ingress and egress and result in individual organism entrainment and mortality. When designing water control structures and culverts within the project area, consideration should be given to providing adequate access to fish and wildlife. For example, water control structures should include shoreline baffles and/or ramps and should maintain the pre-project cross section when the diversion is not in operation.

Additionally, the Service recommends project designs for cross culverts proposed under U.S. Highway 61 and the Kansas City Southern Railroad and other bridge openings incorporate fish and wildlife passage. This should not be a burden to the design of the project as culverts and bridge crossings designed to provide organism access would also facilitate other restoration initiatives of the project (e.g., improving hydrology, and the movement of sediment and nutrients). Please refer to the following websites for additional information:

- Wildlife and Roads: A resource for mitigating the effects of roads on wildlife using wildlife crossings such as overpasses, underpasses, and crosswalks.

  http://www.wildlifeandroads.org/decisionguide/

- Evaluation of the Use and Effectiveness of Wildlife Crossings, Final Report Prepared by U.S. Geological Survey for the National Cooperative Highway Research Program Transportation Research Board of The National Academies

  http://www.trb.org/NotesDocs/25-27_FR.pdf

SERVICE POSITION AND RECOMMENDATIONS

The TSP will benefit the fish and wildlife resources that depend on the Maurepas Swamp by providing freshwater, nutrients, and sediments to the study area thus facilitating sediment deposition, increase organic production, increase biological productivity, and reduce conversion of swamp habitat to open water. Approximately 21,369 acres would benefit from the proposed project resulting in 6,421 AAHUs of swamp habitat at the end of the project life. The Service supports implementation of Alternative 2, a 3,000 cfs diversion at Romeville, provided the following fish and wildlife recommendations are implemented concurrently with project implementation:

1. Because of the expedited schedule, we recommend that the Corps continue to coordinate with the agencies during the remaining Feasibility phase and the Preconstruction, Engineering, and Design (PED) phase to ensure any new project features, development of the operational plan, finalization of the monitoring and adaptive management plan, and/or changes in the design fully incorporate adequate fish and wildlife conservation measures and that those features can be adequately evaluated with regards to impacts to fish and wildlife resources.

2. We recommend that hydrologic modeling efforts better identify/quantify influence areas and how water (sediment and nutrients) moves through the system and within each hydrologic unit under the proposed operational plan. Those hydrologic modeling results should be provided to the habitat evaluation team with adequate time to evaluate the results and conduct detailed impacts analysis. Accretion rates need to be determined and incorporated into the hydrologic modeling (e.g., flood durations and depths should decrease).

3. To accommodate changing goals and restoration needs for the region, we recommend that the diversion structure, as well as the outfall management system, be designed to incorporate operational flexibility to address changing environmental conditions through an adaptive management program.

4. We recommend that water levels and swamp floor elevations be determined on a refined scale and incorporated into the hydrologic modeling.

5. We recommend that hydrologic modeling address future with and without project salinity conditions.

6. If the proposed project feature is changed significantly, is not implemented within one year of the Endangered Species Act consultation letter, or additional modeling reveals additional potential impacts, we recommend that the Corps reinitiate coordination with our office to ensure that the proposed project would not adversely affect any Federally listed threatened or endangered species or their critical habitat.

7. Should additional hydrodynamic modeling determine impacts to Lake Maurepas water quality (e.g., salinity and temperature), we recommend that the Corps reinitiate coordination with the NMFS regarding EFH consultation.

8. 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).

9. To minimize disturbance to 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.

10. Because bald eagles are known to nest within the proposed study area, we recommend that an evaluation 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 and those results should be forwarded to this office.

11. Please coordinate with the LDWF, Region 7 Office (225/765-2360), for further information regarding any additional permits that may be required to perform work on the Maurepas Swamp Wildlife Management Area (WMA).

12. Please contact the LDWF, Scenic Rivers Program (318/343-4045) for further information regarding any additional permits that may be required to perform work on the above referenced river.

13. Land clearing associated with project features should be conducted during the fall or winter to minimize impacts to nesting migratory birds, when practicable. Land clearing for access to the maintenance canals should be limited to one side of the channel bank to minimize fish and wildlife impacts.

14. Project designs for cross culverts proposed under U.S. Highway 61 and the Kansas City Southern Railroad and other bridge openings and water control structures should incorporate fish and wildlife passage. We recommend coordinating with the natural resource agencies during the PED phase to ensure fish and wildlife conservation measures are incorporated into the design of those structures.

15. Further detailed planning of project features (e.g., Design Documentation Report, Engineering Documentation Report, Plans and Specifications, or other similar documents) and any adaptive management and monitoring plans should be coordinated with the Service and other State and Federal natural resource agencies, and shall be provided an opportunity to review and submit recommendations on the all work addressed in those reports.

16. A report documenting the status of implementation, maintenance and adaptive management measures should be prepared every three years by the managing agency and provided to the Corps, the Service, National Marine Fisheries Service, U.S. Environmental Protection Agency, Louisiana Department of Natural Resources, Office

of Coastal Protection and Restoration, and the Louisiana Department of Wildlife and Fisheries. That report should also describe future management activities, and identify any proposed changes to the existing management plan.

LITERATURE CITED

Baker, J.A., K.J. Killgore, and R.L. Kasul. 1991. Aquatic habitats and fish communities in the Lower Mississippi River. Reviews in Aquatic Sciences 3: 313-356.

Coastal Wetlands Planning, Protection, and Restoration Act Task Force. 2002. 12th Priority Project List Report (Appendices).

Conner, W. H. and J.W. Day, Jr. 1976. Productivity and composition of a baldcypress-water tupelo site and a bottomland hardwood site in a Louisiana swamp. American Journal of Botany 63:1354-1364.

Conner, W.H., J.G. Gosselink, and R.T. Parrondo. 1981. Comparison of the vegetation of three Louisiana swamp sites with different flooding regimes. Am J Bot 68: 320-331.

Conner, W.H., J.R. Toliver, and F.H. Sklar. 1986. Natural regeneration of baldcypress (*Taxodium distichum* (L.) Rich.) in a Louisiana swamp. Forest Ecology and Management 14: 305-317.

Davis, J.T., B.J. Fontenot, C.E. Hoenke, A.M. Williams and J.S. Hughes. 1970. Ecological Factors Affecting Anadromous Fishes of Lake Pontchartrain and its Tributaries. Louisiana Wild Life and Fisheries Commission. Fisheries Bulletin No. 9. 63 pp.

DeLaune, R.D., R.J. Buresh, and W.H. Patrick, Jr. 1979. Relationship of soil properties to standing crop biomass of *Spartina alterniflora* in a Louisiana marsh. Estuarine Coastal Marine Science 8: 477-487.

DeLaune, R.D., J.C. Callaway, W.H. Patrick, Jr., and J.A. Nyman. 2004. An analysis of marsh accretionary processes in Louisiana coastal wetlands. Pages 113-130 *in* D.W. Davis and M. Richardson, (eds). The Coastal Zone: Papers in Honor of H. Jesse Walker. Geoscience Publications, Dept. Geography Anthropology, Louisiana State University, Baton Rouge, LA.

Dicke, S.G. and J.R. Toliver. 1990. Growth and development of baldcypress/water tupelo stands under continuous versus seasonal flooding. For Ecol Manage 33/34: 523-530.

Gagliano, S.M. and J.L. Van Beek. 1970. Geologic and geomorphic aspects of deltaic processes, Mississippi delta system. Hydrologic and geologic studies of coastal Louisiana. Center for Wetland Resources, Louisiana State University, Baton Rouge, LA.

Grouchy, C. and R. Paille. October 2004. Near-Term Ecosystem Restoration Plan for the Louisiana Coastal Area Report (recommending a TSP). Final Fish and Wildlife Coordination Act Report. 28 pp.

Hastings, R.W., D.A. Turner, and R.G. Thomas. 1987. The fish fauna of Lake Maurepas, an oligohaline part of the Lake Pontchartrain estuary. Northeast Gulf Science 9(2): 89-98.

Hodges, J.D. 1997. Development and ecology of bottomland hardwood sites. Forest Ecology and Management 90: 117-125.

Hatton, R.S., R.D. DeLaune, and W.H. Patrick, Jr. 1983. Sedimentation, accretion and subsidence in marshes of Barataria Basin, Louisiana. Limnol. Oceanogr. 28/3:494-502.

Hoeppner, S. 2008. Swamp Ecology in a Dynamic Coastal Landscape: An Investigation through Field Study and Simulation Modeling. Ph.D. Dissertation. Louisiana State University, Baton Rouge, LA.

Keddy, P.A., D. Campbell, T. McFalls, G.P. Shaffer, R. Moreau, C. Dranguet, and R. Heleniak. 2007. The Wetlands and Lakes Pontchartrain and Maurepas: Past, Present and Future. Environmental Review 15:43-77.

Kozlowski, T.T. 1984. Responses of woody plants to flooding. Pages 129-163 *in* T.T. Kozlowski (ed.). Flooding and Plant Growth. New York: Academic Press.

Lee Wilson & Associates, Inc. 2001. Diversion into the Maurepas Swamps: A Complex Project under the Coastal Wetlands Planning, Protection, and Restoration Act. U.S. Environmental Protection Agency, Region 6, Dallas, Texas.

Lopez, J.A. 2003. Chronology and analysis of environmental impacts within the Pontchartrain basin of the Mississippi Delta Plain: 1718-2002. Ph.D. Dissertation, Engineering and Applied Sciences Program, University of New Orleans, New Orleans, LA, USA.

Louisiana Coastal Protection and Restoration. 2008. USACE Louisiana Coastal Protection and Restoration (LACPR): Draft Technical Report.

Louisiana Coastal Wetlands Conservation and Restoration Task Force (LCWCRTF). 2006. Coastal Wetlands Planning, Protection, and Restoration Act - Wetland Value Assessment Methodology: Procedural Manual. Environmental Work Group. 23 pp.

Louisiana Coastal Wetlands Conservation and Restoration Task Force and the Wetlands Conservation and Restoration Authority (LCWCRTF). 1999. Coast 2050: Toward a Sustainable Coastal Louisiana, The Appendices. **Appendix C**— Region 1 Supplemental Information. Louisiana Department of Natural Resources. Baton Rouge, La.

Louisiana Department of Environmental Quality. 2007. 2006 Water Quality Integrated Report. Louisiana Department of Environmental Quality, Water Quality Assessment Division, Water Quality Inventory Section 305(b). Baton Rouge, LA.

Mashriqui, H.S. and G.P. Kemp. 1996. Restoring the capacity of Bayou Lafourche to convey increased discharges from the Mississippi River. Natural Systems Management and Engineering Group, Center for Coastal, Energy and Environmental Resources, Louisiana State University, Baton Rouge, LA.

Messina, M.G. and W.H. Conner (eds.). 1998. Southern Forested Wetlands: Ecology and Management. Lewis publishers, New York, NY.

Pezeshki, S.R., R.D. DeLaune, and W.H. Patrick, Jr. 1990. Flooding and saltwater intrusion: potential effects on survival and productivity of wetland forests along the U.S. Gulf Coast. Forest Ecology and Management 33/34:287-301.

Putnam, J.A., G.M. Furnival, and J.S. McKnight. 1960. Management and inventory of southern hardwoods. U.S. Department of Agriculture, Agriculture Handbook No. 181, Washington, D.C.

Roberts, H.H. 1985. A study of sedimentation and subsidence in South-Central Coastal Plain of Louisiana. Final Report to the U. S. Army Corps of Engineers, New Orleans District, New Orleans, Louisiana. 53 pp.

Rybczyk, J.M., J.W. Day, Jr., and W.H. Conner. 2002. The impact of wastewater effluent on accretion and decomposition in a subsiding forested wetland. Wetlands, 22, 18-32.

Shaffer, G.P., J. Willis, S.S. Hoeppner, A.C. Parsons, and M. Hester. 2001. Characterization of Ecosystem Health of the Maurepas Swamp, Lake Pontchartrain Basin, Louisiana: Feasibility and Projected Benefits of a Freshwater Diversion. CWPPRA PPL 11.

Shaffer, G.P., T.E. Perkins, S.S. Hoeppner, S. Howell, H. Benard, and A.C. Parsons. 2003. Ecosystem Health of the Maurepas Swamp: Feasibility and Projected Benefits of a Freshwater Diversion. Final Report for the Environmental Protection Agency, Region 6.

Shaffer, G.P., P.C. Stouffer, and M.A. Pourrier. 2006. A Whole System Approach for Restoring the Wetlands of Western Lake Pontchartrain Basin. Lake Pontchartrain Basin Research Program. 2006 Annual Report. 164 pp.

Templet, P.H. and K.J. Meyer-Arendt. 1988. Louisiana wetland loss: A regional water management approach to the problem. Environmental Management 12(2):181-192.

Thomson, D.A. 2000. The influence of hydrological alterations upon wetland hydrodynamics and plant growth on the Manchac Landbridge, Southeastern Louisiana, USA. M.S. Thesis. Southeastern Louisiana University, Hammond, LA.

Thomson, D.A., G.P. Shaffer, and J.A. McCorquodale. 2002. A potential interaction between sea-level rise and global warming: implications for coastal stability on the Mississippi River Deltaic Plain. Global Planet. Change. 32: 49-59.

Vogel, H.D. 1930. Report on control of floods of the Lower Mississippi River, Annex no. 5, basic data Mississippi River. House Doc. 798, 71st Congress, 3rd session: 61-137.

U.S. Army Corps of Engineers (Corps). 2000. Mississippi River Sediment, Nutrient, and

Freshwater Redistribution Study. Draft Report for the Louisiana Coastal Wetlands Conservation and Restoration Task Force. July 2000. 90 pp.

Watson, M.B., C.J. Killebrew, M.H. Schurtz, and J.L. Landry. 1981. A Preliminary Survey of Blind River, Louisiana. In L.A. Krumholtz, ed. The Warmwater Fisheries Symposium, A National Symposium on Fisheries Aspects of Warmwater Streams. American Fisheries Society, Knoxville, TN. Pp. 303-319.

Wilson, B.C., C.A. Manlove, and C.G. Esslinger. 2002. North American Waterfowl Management Plan, Gulf Coast Joint Venture: Mississippi River Coastal Wetlands Initiative. North American Waterfowl Management Plan, Albuquerque, NM. 28 pp. + appendix.

APPENDIX A

AGENCY COMMENTS

08-FA-2841 DW

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 14, 2010 F/SER46/KC,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) titled "Louisiana Coastal Area – Small Diversion at Convent/Blind River Project". The Report discusses the U.S. Fish and Wildlife Service's findings and recommendations associated with plans to construct a small diversion, less than 5,000 cubic feet per second (cfs), from the Mississippi River into Blind River through a new control structure to introduce sediments, nutrients, and fresh water into the southeast portion of Maurepas Swamp in St. James, Ascension, and St. John the Baptist Parishes, Louisiana.

As described in the Report, after comparing the four alternative plans carried forward for detailed analysis and the No Action Alternative, a 3,000 cfs diversion at Romeville was identified as the Tentatively Selected Plan (TSP). The TSP meets the screening criteria; would accomplish the planning objectives and goals; would be consistent with the Corp of Engineer's Environmental Operating Principles; and would contribute to reversing the trend of deterioration in the southeast part of the Maurepas Swamp. To facilitate fresh water flow within the project area, the selected plan proposes: 1) a gated culvert system and transfer canal along the Romeville alignment for the diversion; 2) to restore and improve 160 existing berm cuts; 3) the addition of 30 new 500-foot wide berm cuts; 4) the construction of up to six control structures at strategic locations in the swamp; and, 5) the addition of three culverts under U.S. Highway 61. The TSP would improve a total of 21,369 acres of bald cypress-tupelo gum swamp that are in various stages of deterioration.

NMFS has reviewed the description of the fish and wildlife resources contained in the Report. While we understand that NMFS has not previously identified essential fish habitat (EFH) as being in the project area, we had no expectation that the project would impact portions of Lake Maurepas. However, the third paragraph on page 3 of the Report indicates that "Lake Maurepas would experience significant freshening" as a result of project implementation. If this is correct, project implementation has a potential to reduce the quantity and quality of EFH in Lake Maurepas. As such, NMFS recommends the Report be revised to indicate that water bottom and water column habitat categories of Lake Maurepas have been categorized as EFH for juvenile life stages of white shrimp and red drum. The Report should then discuss the likely impacts of project implementation on those categories of EFH and associated fishery life stages. Not knowing the expected changes in monthly salinities in Lake Maurepas or hydrodynamics of tidal flows at Pass Manchac, we are unable to provide input on likely impacts to EFH or the utilization of those habitats by marine fishery resources. If such information is available, NMFS recommends it be provided to NMFS and further discussions be held regarding revisions to the Report. If that information is not available, the Report should be revised to discuss, in general terms, the potential for project implementation to reduce the quantity and quality of EFH in Lake Maurepas, or the capability of early life stages of marine fishery species to access those habitats.

We appreciate the opportunity to review and comment on this Report.

Sincerely,

for Miles M. Croom
Assistant Regional Director
Habitat Conservation Division

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

BOBBY JINDAL
GOVERNOR

State of Louisiana

ROBERT J. BARHAM
SECRETARY

DEPARTMENT OF WILDLIFE AND FISHERIES
OFFICE OF WILDLIFE

JIMMY L. ANTHONY
ASSISTANT SECRETARY

July 1, 2010

Attn: Dr. William Klein Jr.
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 Convent/Blind River Diversion*
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 supports the implementation of Alt 2 and we concur with the positions and recommendations outlined by the U.S. Fish and Wildlife Service in their April 30, 2010 draft report.

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.

The operation plan should allow for a drawdown or dry out period every 3-5 years to promote woody species regeneration. This period should coincide with naturally drier years and lower ambient water levels (as they are identified) to maximize the likelihood of a successful draw down

The control structures in the swamp should be designed to allow for fish passage.

Portions of the proposed activity are within Maurepas Swamp Wildlife Management Area. No activities shall occur on any LDWF Wildlife Management Area or Refuge without obtaining a Special Use Permit from LDWF. Please contact Chris Davis at (985) 543-4777 for more information.

This project is located in the vicinity of the Blind River, a Louisiana designated Natural and Scenic River. The applicant must obtain authorization from the Louisiana Department of Wildlife and Fisheries, Scenic Rivers Program prior to initiating any of the proposed activities within or adjacent to the banks of the Blind River. Scenic Rivers Coordinator Keith Cascio can be contacted at 318-343-4045.

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

mw

c: Matthew Weigel, Biologist
Chris Davis, Biologist
Keith Cascio, Scenic Rivers Coordinator
EPA, Marine & Wetlands Section
USFWS Ecological Services

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

July 1, 2010 F/SER46/KC:jk
225/389-0508

Ms. Joan M. Exnicios, Chief
Environmental Planning and Compliance Branch
Planning, Programs, and Management Division
New Orleans District, U.S. Army Corps of Engineers
Post Office Box 60267
New Orleans, Louisiana 70160-0267

Dear Ms. Exnicios:

NOAA's National Marine Fisheries Service (NMFS) has reviewed the Draft Integrated Feasibility Study and Supplemental Environmental Impact Statement for the Louisiana Coastal Area Small Diversion at Convent/Blind River, in St. James Parish, Louisiana. The document was transmitted for our review by your letter dated May 21, 2010. Your letter indicates that submittal of the document to NMFS initiates essential fish habitat consultation as required by provisions of the Magnuson-Stevens Fishery Conservation and Management Act. It should be noted that NMFS has agreed to serve as a cooperating agency on this project under provisions of the National Environmental Policy Act.

The overall study area is located in the vicinity of Romeville, Louisiana. The tentatively selected plan (Alternative 2) calls for construction of a water diversion system, near Romeville, with the capacity to divert 3,000 cubic feet per second of Mississippi River water into Maurepas Swamp to facilitate maintenance and rebuilding of the swamp's ecosystem. Specific components of the project include a gated culvert system and transfer canal, restoration and improvement of 160 existing berm cuts, addition of 30 new 500-foot-wide berm cuts, construction of up to six water control structures at strategic locations in the swamp, and addition of three new culverts under U.S. Highway 61. The tentatively selected plan is estimated to improve and protect 21,369 acres of bald cypress-tupelo swamp projected to be lost over the 50-year period of analysis, including: 1) 3,300 acres of bald cypress-tupelo swamp that would convert to marsh in 20 to 30 years; 2) 7,900 acres of bald cypress-tupelo swamp that would convert to marsh in 30 to 50 years; and 3) 10,140 acres of bald cypress-tupelo swamp that would convert to marsh in more than 50 years. The project would negatively impact 53 acres of forested wetland and is estimated to have a net value of 6,421 Average Annual Habitat Units over the 50-year period of analysis.

The enclosed comments are provided in accordance with provisions of the Fish and Wildlife Coordination Act (16 U.S.C. 661 et seq.) and 600.920 of the Magnuson-Stevens Fishery Conservation and Management Act.

Related correspondence should be directed to the attention of Mr. Richard Hartman at the NMFS Southeast Region, Habitat Conservation Division office at: c/o LSU, Baton Rouge, Louisiana 70803-7535. He may be contacted by telephone at (225) 389-0508, ext. 203 or by e-mail at richard.hartman@noaa.gov. The NMFS Protected Resources Division is responsible for issues pertaining to threatened and endangered species and marine mammals. The contact person for that Division is Mr. David Bernhart. He may be contacted at the letterhead address, by telephone at (727) 824-5312, or by e-mail at david.bernhart@noaa.gov.

Sincerely,

Miles M. Croom

Miles M. Croom
Assistant Regional Administrator
Habitat Conservation Division

Enclosure

cc:
FWS, Lafayette, Walther
EPA, Dallas, Ettinger
LA DNR, Consistency, Ducote
F/SER46, Swafford
F/SER4, Dale
NOAA PPI, Reid
Files

NOAA's National Marine Fisheries Service (NMFS) Comments on the Draft Supplemental Environmental Impact Statement (SEIS) for the Louisiana Coastal Area (LCA)
Small Diversion at Convent/Blind River, St. James Parish, Louisiana
Authorized under the 2007 Water Resources Development Act

<u>Essential Fish Habitat (EFH) Consultation</u>

Based on our review of the SEIS, NMFS has determined the document and related coordination with the NMFS fulfills consultation requirements contained in section 600.920 of the essential fish habitat (EFH) rules and regulations of the Magnuson-Stevens Fishery Conservation and Management Act.

According to the SEIS, Lake Maurepas, which adjoins the project area, is designated EFH for red drum (*Sciaenops ocellatus*) and white shrimp (*Litopeneaus setiferus*). Although Lake Maurepas is technically located outside of the study area, the SEIS notes that some shift and possible decrease in "optimal habitat" for red drum and white shrimp is possible with the tentatively selected plan. The SEIS indicates the level of change and adverse impact, if any, to EFH would be minor; while considerable benefit to EFH is possible since ongoing conversion of wetlands to open water would be reduced. Best management practices, environmental monitoring, and adaptive management would be implemented with the preferred plan.

Based on the preceding, NMFS has no EFH conservation recommendations to offer at this time. Provided that the project is completed and operated as proposed, no further consultation is required.

<u>General comments</u>

The SEIS for the proposed action is generally well written and sufficiently describes the affected environment and environmental impacts. The information presented supports the determination that the selected plan is environmentally acceptable and would promote the long-term recovery and health of one of Louisiana's largest tracts of freshwater swamp and a major ecological component of the Lake Pontchartrain Basin.

<u>Specific comments</u>

SECTION 1.0 STUDY INFORMATION
1.5 Prior Reports and Existing Projects
1.5.3 Existing Water Projects
1.5.3.3 Coastal Restoration Projects

<u>Page 1-15, lines 37-42</u> According to this section, the LCA Small Diversion at Hope Canal consists of diverting approximately 1,500 cubic feet per second from the

Mississippi River into the Hope Canal at Garyville, Louisiana. Information is needed concerning the duration and seasonal timing of the diversion period.

SECTION 3.0 ALTERNATIVES
3.3 Preliminary Alternatives Plans
3.3.1 Development of Preliminary Alternative Plans
CB-6 Obtain Total Maximum Daily Load (TMDL) waiver for diversion into Blind River

Page 3-27, lines 26-30 According to this section, the overall project has an extensive monitoring plan and includes costs for adaptive management "to assure that the overall water quality in the Blind River is not degraded." Also, as noted in section 3.7.7 (page 3-104, line 28) water quality impairment is a potential risk endpoint of the project. NMFS recommends that both the final SEIS and the Monitoring and Adaptive Management Plan (MAMP) (Appendix I) clearly state that water quality in Blind River and Lake Maurepas will be monitored and that management measures will be implemented when needed to remedy project-related water quality degradation.

Also according to this section: "The State agencies will work together to monitor the diversion operation to assist with the overall environmental improvement of the Blind River." This section should be modified to note that federal resource agencies, including the NMFS and U.S. Fish and Wildlife Service (FWS), would be consulted with regard to environmental monitoring and adaptive management measures needed to protect and restore fish and wildlife resources and habitat, including EFH in Lake Maurepas.

3.7 Plan Selection – Tentatively Selected Plan
3.73 Components

Page 3-95, lines 12-17 NMFS recommends the description for the control structures in the selected plan include a map of the project area illustrating the expected locations of the various features including the control structures. NMFS recommends the map be accompanied by a diagram depicted the design plans and specifications of the control structures, as well as a detailed operational scheme.

3.7.6 Operations and Maintenance Considerations

Page 3-99, lines 35-38 NMFS understands the need to provide access to the maintenance canal; however, the final SEIS should address the possibility that mowing be limited to one side of the canal and shrubs and trees be allowed to grow on the un-mowed bank. Establishment of trees along one side of the canal would reduce maintenance and disturbance, lessen water temperature increases in summer, and provide cover for wildlife.

Page 3-100, lines 24-25 The diversion flow period (six to nine months per year) should be identified and discussed, as appropriate, throughout the final SEIS. Currently, the diversion flow period is not mentioned elsewhere in the document.

Page 3-101, lines 6-10 NMFS recommends this section be modified to note that planned maintenance excavation within the transmission canal will be coordinated with state and Federal resource agencies. Coordination should address beneficial use of excavated material, excavation and disposal methodologies, timing, and other considerations as needed to protect fish and wildlife.

3.7.7 Monitoring Plan and Adaptive Management

Pages 3-101 through 3-104 The MAMP is an essential component of the project. Environmental monitoring is needed to assess project related impacts and establish operational changes needed to protect and restore EFH and other habitat and resources. By letter dated April 7, 2010, the FWS, in consultation with NMFS, provided detailed comments concerning needed changes in the project's MAMP. NMFS recommends the MAMP be modified in accordance with FWS and NMFS recommendations. Also, as noted below (see "APPENDIX I"), the MAMP should be modified to include performance measures that call for water quality monitoring and adaptive management to remedy water quality problems in Blind River if they should occur.

The MAMP also should include water quality monitoring and adaptive management as needed to remedy potential water quality problems in Lake Maurepas if such problems occur. Depending on the amount and rate of nutrient assimilation by wetlands after repeated or long term nutrient loading, NMFS is concerned the proposed diversion of river water could create algal blooms in and eutrophication of waterways in the project area. The MAMP should identify sampling locations, frequency, and duration for measuring dissolved oxygen levels in Lake Maurepas, which is designated as EFH for red drum and white shrimp, with particular emphasis on collecting data during the summer months. Potential adverse impacts to EFH in Lake Maurepas also include displacement of these designated fishery species from the area due to extreme turbidity and salinity changes, as well as colder water temperatures. These water quality parameters should be included in the MAMP for the lake.

Page 3-101, line 27 The feasibility level MAMP is provided in Appendix I, not Appendix J, as stated.

3.8 Risk and Uncertainty
3.8.2 Environmental Uncertainties

Page 3-113, lines 9-21 This section should be expanded to note that uncertainty exists regarding salinity change and nutrient input into Blind River and other downstream waters and that this uncertainty will be addressed through project monitoring and adaptive management.

Page 3-114, lines 19-24 NMFS supports plans to conduct salinity monitoring. As noted in comments below (APPENDIX I), the final SEIS should acknowledge that salinity monitoring will be conducted in the lower reaches of Blind River and, if warranted, the southeastern portion of Lake Maurepas.

This section also should be expanded to note that uncertainty exists regarding the need for increases in frequency and duration of operational closures of the project area water control structures and that this uncertainty will be addressed through project monitoring and adaptive management.

SECTION 4.0 AFFECTED ENVIRONMENT
4.2 Significant Resources
4.2.10 Essential Fish Habitat (EFH)

Page 4-82, lines 12-13 According to this section, the February 20, 2009, letter from NMFS states that no EFH exists in the project area. However, NMFS did state that Lake Maurepas is designated as EFH for red drum and white shrimp. NMFS recommended water quality impacts be modeled to evaluate the potential for the proposed freshwater diversion to influence changes in salinity, water temperature, and dissolved oxygen levels in the lake. Those potential impacts should be addressed in the document and included in the monitoring and adaptive management plan.

SECTION 5.0 ENVIRONMENTAL CONSEQUENCES
5.3 Water Quality and Salinity
5.3.4 Salinity

Page 5-71, lines 21-27 This section provides summary statistics regarding the expected project impacts on salinity in Lake Maurepas. For example, the SEIS indicates a 2,500 cfs diversion would reduce salinities in Lake Maurepas by 30% and a larger diversion would likely reduce salinities more than that. Section 4.2.3.3 of the SEIS provides data on historical salinity levels at various locations relevant to the project. Given the discussion in other sections of the document pertaining to marine fishery species and EFH, this section should be revised to indicate what the expected future salinities will be at various locations with project implementation. NMFS suggests a table be provided in the final SEIS identifying mean and maximum historic salinities at various locations in the project area and what the modeled salinities would be at those locations with project implementation.

5.10 Essential Fish Habitat (EFH)

Page 5-110, lines 11-30 The first sentence in this section (lines 12-14) is confusing and should be rewritten to clarify where and to what extent salinity might decrease and how this might affect "optimal habitat" for red drum and white shrimp. NMFS recommends the final SEIS indicate that any reduction in salinity in Lake Maurepas would represent movement in the direction of historical conditions that existed prior to anthropogenic alteration (disruption) of water flow into the Maurepas Swamp.

Salinity monitoring as called for in section 3.8.2.1 (page 3-114; line 19) is vital to a determination of the level of habitat alteration in Lake Maurepas. As such, NMFS recommends this section be modified to note that while the consequences of salinity modification are expected to be negligible, salinity and water quality monitoring are planned, as well as the implementation of adaptive management, as needed, to preclude significant adverse impacts to EFH.

APPENDIX I

Page 10; Objective 4: Improve fish and wildlife habitat in the swamp and in Blind River

According to the Alternatives Analysis (page 3-27; lines 26-30) "The overall project has an extensive monitoring plan and includes costs for adaptive management to assure that the overall water quality in the Blind River is not degraded." Despite this statement, the MAMP performance measures contain no parameters associated with water quality monitoring for nutrient input or modification of dissolved oxygen and salinity. NMFS recommends this be addressed in the SEIS and that the MAMP be modified to specifically state that water quality monitoring for nutrients, salinity, and dissolved oxygen will be undertaken and adaptive management will be implemented, if needed, to remedy water quality problems in the Blind River. As noted in preceding comments concerning page 3-27; lines 26-30, NMFS further recommends the SEIS and MAMP be modified to state that federal resource agencies, including NMFS and FWS, will be consulted with regard to environmental monitoring and adaptive measures needed to protect and restore fish and wildlife resources and habitat in the study area, including EFH in Lake Maurepas.

APPENDIX B

PROJECT INFORMATION SHEET WITH ASSUMPTIONS
FOR
LCA- SMALL DIVERSION AT CONVENT/ BLIND RIVER

Wetland Value Assessment Project Information Sheet
Comparing Final Array of Alternatives

September 8, 2010

Prepared for:
U.S. Army Corps of Engineers
and
Louisiana Department of Natural Resources

Prepared by
U.S. Fish and Wildlife Service

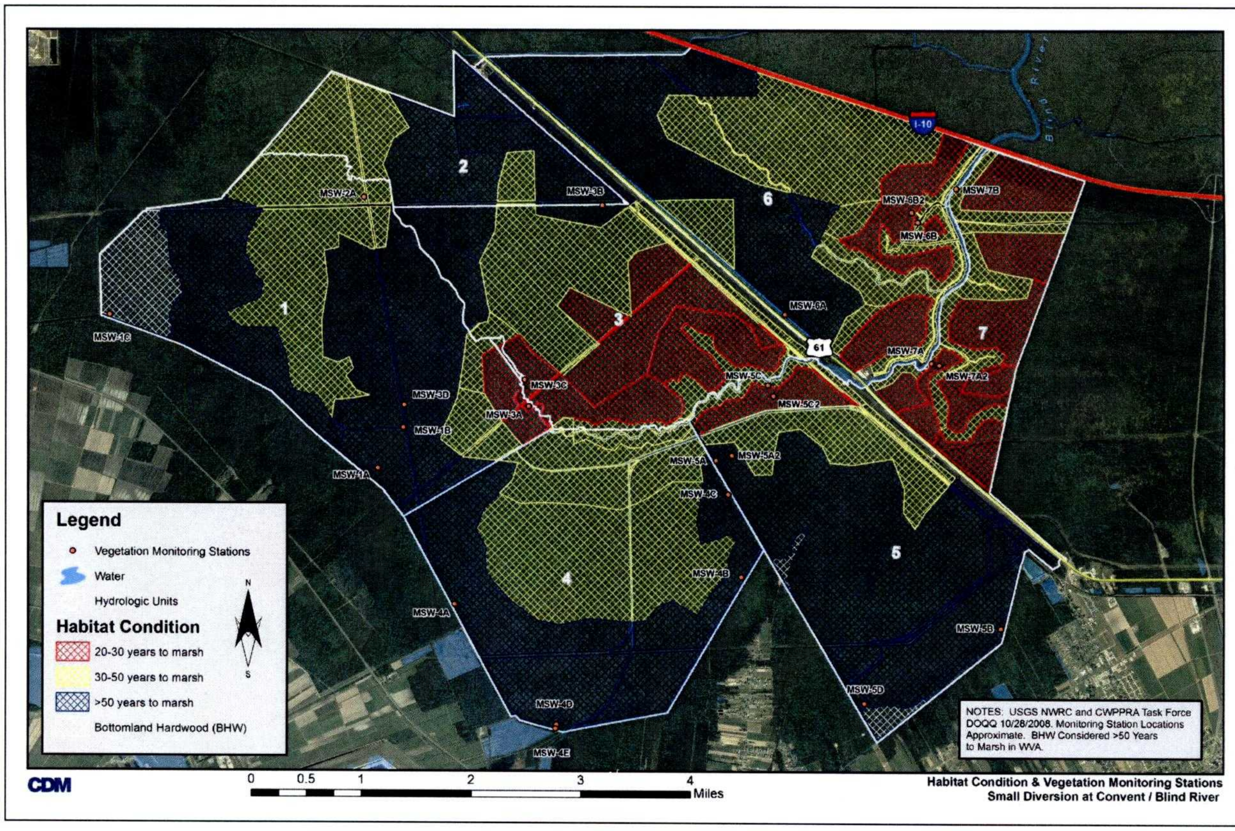
Project Name: Louisiana Coastal Area – Small Freshwater Diversion at Convent/Blind River

Project Type(s): Freshwater diversion and hydrologic restoration within swamp habitat

Project Area: The project area is within the Maurepas Swamp west of Lake Pontchartrain and predominantly within St. James Parish with a small portion of the northern extent in Ascension Parish, LA (LCA Sub-province 1). The U.S. Interstate 10 corridor defines the northern boundary with the remaining project boundary being defined by several parish drainage canals. The cities and towns that flank the Mississippi River extend further to the southeast, south, and southwest of the project area. The Maurepas swamp is one of the largest remaining tracts of coastal fresh water swamp in Louisiana. Including Lake Maurepas, the Maurepas Swamp area comprises an area that totals approximately 232,928 acres, most of which is swamp with some isolated areas of bottomland hardwood forest and fresh marsh. The Blind River flows from St. James Parish, through Ascension and Saint John the Baptist Parishes, and then discharges into Lake Maurepas. Much of the project area is situated within the Louisiana Department of Wildlife and Fisheries, Maurepas Swamp Wildlife Management Area.

For planning and hydrologic modeling purposes, the project area was divided into three benefit areas (i.e., benefit area 1, 2, and 3) and within those benefit areas are several sub-basins. Benefit areas and sub-basins are defined by topographic high areas (e.g., spoil banks, relict railroad grade, road embankments) or channels, natural or artificial (e.g., rivers, canals, channels, intermittent tributaries) that would serve to impede or intercept hydrologic flows. The area south and southwest of Blind River is defined as benefit area 1 (i.e., 100 sub-basin series). The area north of Blind River and west of U.S. Highway 61 is benefit area 2 (i.e., 200 sub-basin series), and the area north of Blind River and east of U.S. Highway 61 is benefit area 3 (i.e., 300 sub-basin series). For the purposes of the Wetland Value Assessment (WVA) the sub-basins are grouped into hydrologic units (Figure 1), or units that are considered to be under the same hydrological influences.

Figure 1. Hydrologic Units and Habitat Condition Classes for the Convent/Blind River Freshwater Diversion.



Problem: Since the construction of the Mississippi River flood control levees, the Maurepas Swamps have been virtually cut off from any freshwater, sediment, or nutrient input. Thus, the only soil building has come from organic production within the wetlands. Preliminary evaluations suggest that productivity in the stressed Maurepas Swamps may be substantially depressed compared to normal conditions. With minimal soil building and moderately high subsidence, there has been a net lowering of ground surface elevation, leading to a doubling in flood frequency over the last four decades (Thomson 2000), so that now the swamps are either permanently or semi-permanently flooded. With minimal ability to drain and persistent flooding, the typical seasonal drying of the swamp does not usually occur. Cypress and tupelo trees are able to grow in flooded conditions. Apparently, tupelo trees are more competitive in permanently flooded conditions (Conner et al. 1981, Dicke and Tolliver 1990), a condition that may explain the recent dominance of tupelo in the south Maurepas swamps and the project area. However, a high mortality of tupelo trees also has occurred in the last few years within the Maurepas study area possibly as a result of salinity spikes. Neither cypress nor tupelo seeds can germinate when flooded. Seeds of both species remain viable when submerged in water and can germinate readily when floodwaters recede (Kozlowski 1984). The potential for re-establishment seems to be hindered by the relatively low numbers of viable seeds observed in swamp seed banks, as well as by flooding (Conner et al. 1986). Storm surge and accompanying episodic saltwater intrusion has also exacerbated degradation resulting in lack of tree regeneration and substrate accretion.

It is expected that without restoration, the factors and processes that are contributing to stress and deterioration of the south Maurepas Swamps will continue and result in loss of the swamp, with succession to open water (Shaffer et al. 2001). The Coast 2050 Report estimated wetland loss rates for the Amite/Blind Rivers mapping unit for 1974-90 to be 0.80 percent per year for swamp and fresh marsh habitat combined. Based on these rates, approximately 50 percent of swamp and 1.2 percent of fresh marsh will be converted to open water within 60 years. Nearly 69,500 acres of swamp (50% of the 1990 total) and 40 acres of marsh are projected to be lost by 2050 (LCWCRTF 1999).

U.S. Army Corps of Engineers guidance requires project performance to be assessed using three sea level change scenarios, a low estimate, an intermediate estimate, and a high estimate. Using the rate of 9.20 mm/yr, a starting year of 2011, and a 50-year project life, a sea-level rise of 1.5 feet is projected for the year 2061 (Table 1). A historic rate considered to be representative of the project area is calculated using the West End at Lake Pontchartrain gauge (85625). The rate of 9.20 mm/yr is considered to include both the eustatic and local subsidence contributions to the estimated total sea-level rise.

In order to estimate the local subsidence rate for the project area, the global eustatic rate (1.7 mm/yr) is subtracted from the local sea level rate or:

Local subsidence rate = 9.20 mm/yr – 1.7 mm/yr = 7.50 mm/yr.

Table 1. Summary of total sea level rise (i.e., considers subsidence) for each scenario.

Project year	Scenario 1, Low Rate (feet)	Scenario 2, Intermediate Rate (feet)	Scenario 3, High Rate (feet)
2011	0.0	0.0	0.0
2016	0.2	0.2	0.2
2021	0.3	0.3	0.5
2026	0.5	0.5	0.8
2031	0.6	0.7	1.1
2036	0.8	0.9	1.4
2041	0.9	1.1	1.7
2046	1.1	1.3	2.0
2051	1.2	1.5	2.4
2056	1.4	1.7	2.8
2061	1.5	1.9	3.2

The estimate for the local subsidence rate is used in conjunction with estimates for the eustatic rates using NRC curves I and III to determine the intermediate and high projections of sea level rise for the project area. The following formula is used to estimate the total rise in eustatic sea level for the project life for the intermediate and high rate scenarios of sea level rise:

$$E(t_2) - E(t_1) = 0.0017(t_2 - t_1) + b(t_2^2 - t_1^2)$$

where:

b is the acceleration factor related to NRC curves I and III or 2.36E-5 and 1.005E-4 respectively,
t_1 is the time in years between the project's construction date and 1986,
and
t_2 is the time between a future date at which one wants an estimate for sea-level rise and 1986.

These eustatic estimates are added to the local subsidence estimate to get the total sea-level rise for the intermediate and high rate scenarios. For the purposes of hydrologic modeling for this project the intermediate rate was used.

Project Goal: Reverse the trend of degradation in the southeast portion of the Maurepas Swamp, so as to contribute toward achieving and sustaining a coastal ecosystem that can support and protect the environment, economy, and culture of southern Louisiana and thus contribute to the well-being of the Nation.

Objectives:

1. Promote water distribution in the swamp which, in turn, will increase freshwater throughput and nutrient input thereby increasing swamp productivity and wetland assimilation.
2. Facilitate swamp building: by increasing swamp productivity and sediment input by up to 1000 g/sq meter per year to decrease the annual subsidence rate (or accretion deficit).
3. Establish hydroperiod fluctuation in the swamp to improve bald cypress and tupelo productivity and seed germination and survival. This is proposed by decreasing flood duration for high flood events within the swamp, increasing the length of dry periods in the swamp, and increasing the number of cypress and tupelo saplings per acre from existing conditions.
4. Improve fish and wildlife habitat in the swamp and in Blind River by increasing sediment and nutrient input, freshwater flow, and dry periods which will contribute to an increase in swamp productivity. This will result in a diversity of stand structure components (tree species composition and a combination of herbaceous, midstory and overstory vegetation), thus improving fish and wildlife habitat needs. Direct project related benefits fish and wildlife resources (i.e., swamp habitat) are quantified by acreage and habitat quality using the Wetland Value Assessment, and are defined by average annual habitat units or AAHUs.

Alternatives:

No Action Alternative (Future without Project Conditions)
Alternative - 2 – 3,000 cfs Diversion at Romeville (Gated Culvert System)
Alternative - 4 – 3,000 cfs Diversion at South Bridge (Gated Culvert System)
Alternative - 4B – 3,000 cfs Diversion at South Bridge with split flows (Gated Culvert System)
Alternative - 6 – Two 1,500 cfs (3,000 cfs combined) Diversions at Romeville and South Bridge (Siphons)

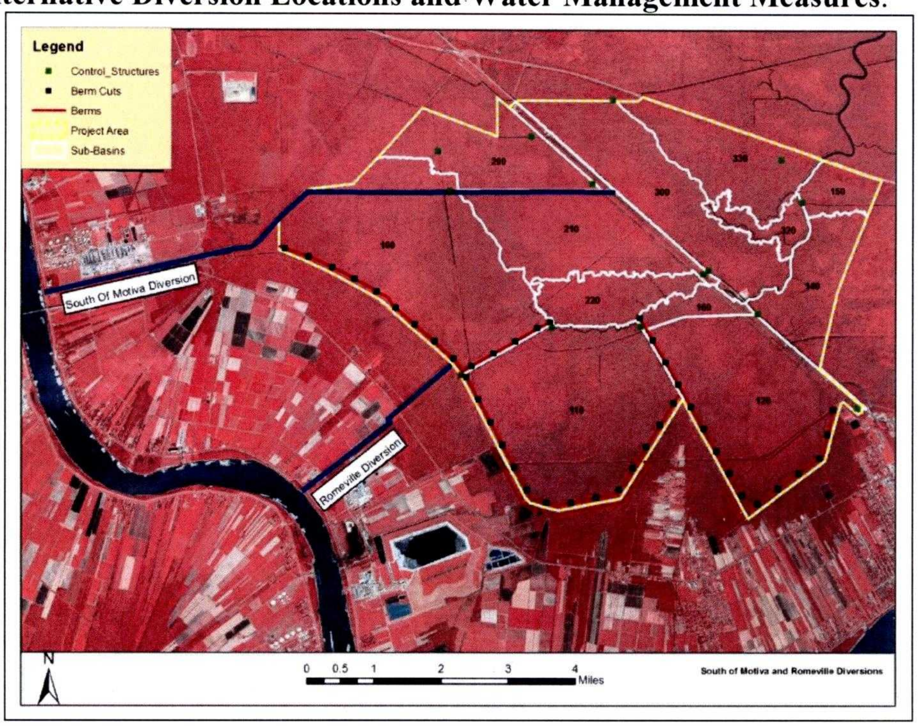
Alternative 2 – 3,000 cfs Diversion at Romeville
This alternative adds a gated culvert system and transfer canal along the Romeville alignment, restores and improves the 160 existing berm cuts, adds 30 new 500-foot wide berm cuts, builds up to 6 control structures at strategic locations in the swamp and adds 3 new culverts under U.S. Highway 61.

Alternative 4 – 3,000 cfs Diversion at South Bridge
This alternative adds a gated culvert system and transfer canal along the "Cox" alignment located south of the U.S. Highway 70 Bridge, restores and improves the 160 existing berm cuts, adds 30 new 500-foot wide berm cuts, builds up to 6 control structures at strategic locations in the swamp and adds 3 new culverts under U.S. Highway 61.

Alternative 4B – 3,000 Split Diversion at South Bridge
This alternative adds a gated culvert system and transfer canal along the "Cox" alignment located south of the U.S. Highway 70 Bridge, restores and improves the 160 existing berm cuts, adds 30 new 500-foot wide berm cuts, builds up to six control structures at strategic locations in the swamp, and adds 3 new culverts under U.S. Highway 61. This alternative includes a modification to the distribution of the diversion provided by Alternative 4 by sending 1,500 cfs to the south through the St. James Parish Canal in order to achieve a similar distribution to Alternative 6.

Alternative 6 – 3,000 cfs Dual Diversion at Romeville and South Bridge
This alternative adds a gated culvert system- and a transfer canal- along the Romeville alignment and a gated culvert system- and transfer canals along the "Cox" alignment located south of the U.S. Highway 70 Bridge, restores and improves the 160 existing berm cuts, adds 30 new 500-foot wide berm cuts, builds up to 6 control structures at strategic locations in the swamp and adds 3 new culverts under U.S. Highway 61.

Figure 2. Alternative Diversion Locations and Water Management Measures.



HEC-RAS and HEC-HMS Modeling

The Hydrologic Engineering Centers - River Analysis System (HEC-RAS) is designed to perform one-dimensional hydraulic calculations for a full network of natural and constructed channels to determine hydrologic flow simulation, sediment transport, and water quality analysis. The HEC - Hydrologic Modeling System (HEC-HMS) is designed to simulate the precipitation-runoff processes of dendritic watershed systems. It is designed to be applicable in a wide range of geographic areas for solving the widest possible range of problems including large river basin water supply and flood hydrology, and small urban or natural watershed runoff. Hydrographs produced by the program are used directly or in conjunction with other software for studies of water availability, urban drainage, flow forecasting, future urbanization impact, flood damage reduction, floodplain regulation, and systems operation.

Preliminary HEC-RAS and HMS modeling has been conducted by the contractor, CDM. The HEC-RAS was simulated over an average year, 2003 being the representative average water year. HEC-HMS used a 15-year simulation period from 1989-2004. One of the major constraints with directing freshwater into the study area is the efficiency of the Blind River to remove water from the system greatly reducing the exchange and widespread distribution of water throughout the system. A diversion directed to the southern portion of the project area and within benefit area 1 has limited influence on the other benefit areas because Blind River acts as a hydrologic barrier, and vice versa.

Modeling for this project, as well as the Coastal Wetlands Planning, Protection and Restoration Act (CWPPRA) River Reintroduction into Maurepas Swamp Project (PO-29) has revealed that the Maurepas Swamps are often lower in elevation than Lake Maurepas. This results in swamp water levels and dry-out periods being dependent on the water levels in Lake Maurepas, and essentially, flooding is semi-permanent with low to very low water exchange and throughput (EPA 2001).

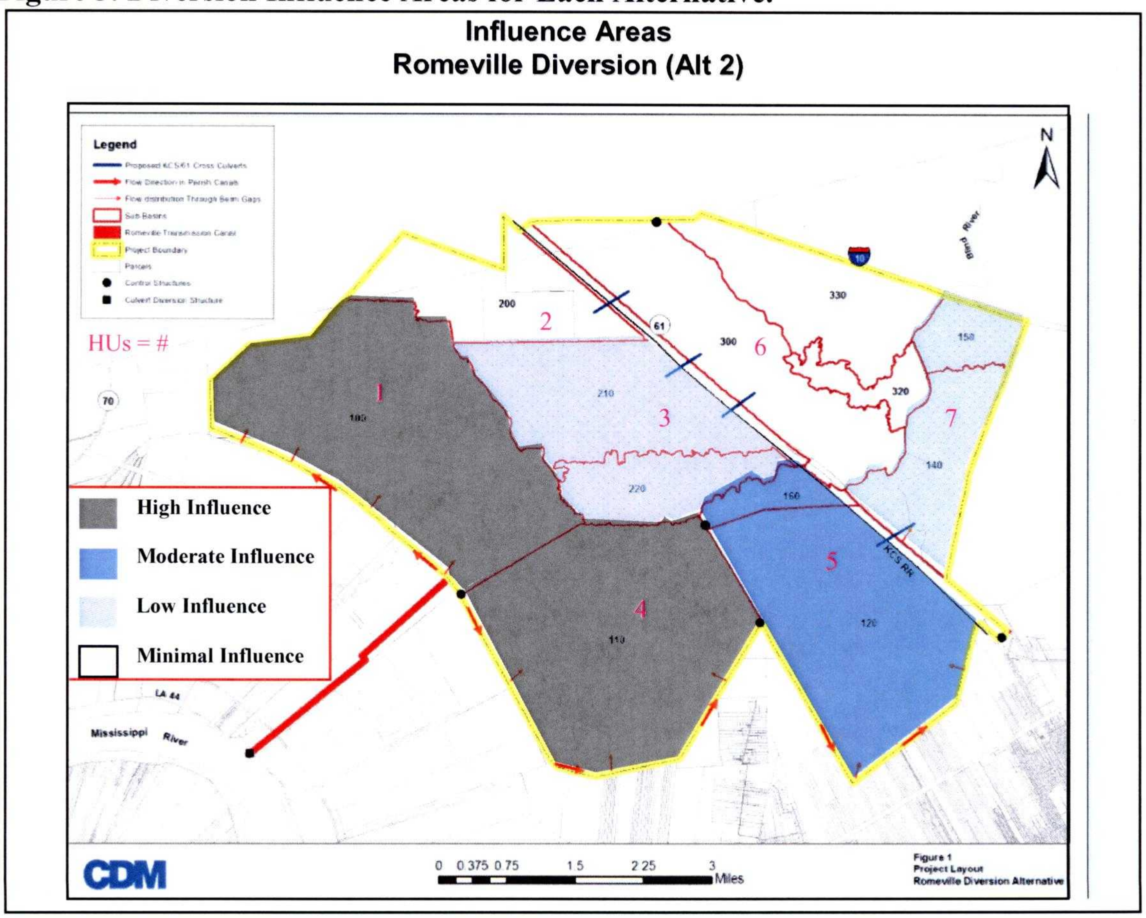
Investigations into diversion capacity determined that changes related to swamp productivity within the system require a minimum diversion flow of 1,000 cubic feet per second (cfs), and 1,500 cfs is required to prevent backflow from Lake Maurepas into the Blind River and swamps. Modeling results also indicate that hydrologic benefits within the system (described by modeling reports as average water depth, water depth exceedence, frequency above Lake Maurepas, and average annual freshwater inflow) either stabilize or do not see incremental benefits as a diversion flow magnitude exceeds 3,000 cfs. Another constraint affecting diversion operations is the availability of water from the Mississippi River. To meet design flow rates Mississippi River water elevations need to be at a minimum of 11 feet; the Mississippi River is at or above that elevation 60 % of the year. It was determined that a 3,000 cfs diversion would be required to provide enough water when available to offset unavailability during low flow periods in the Mississippi River.

Table 2. Diversion Influence for Each Alternative by Habitat Condition Class (construction impacts considered).

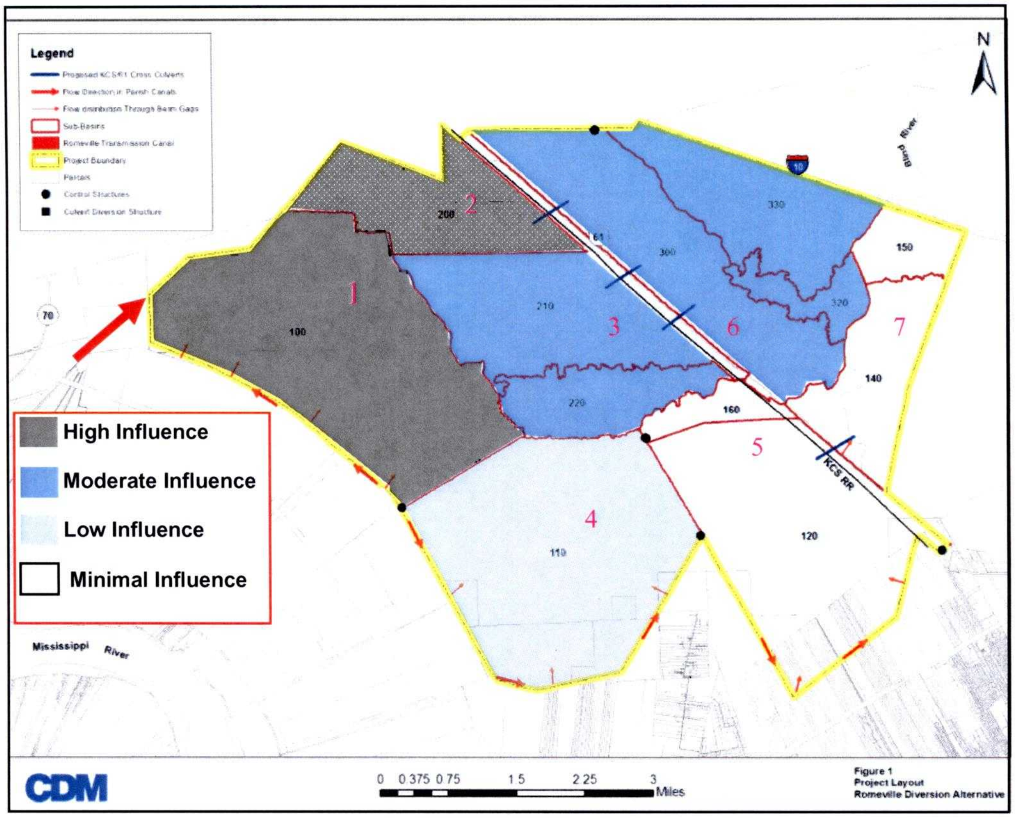
	Degree of Diversion Influence	20-30 Years to Marsh[1]		30-50 Years to Marsh		>50 Years to Marsh	
		HUs[2]	acres	HUs	acres	HUs	acres
Alternative 2 (Romeville)	High	1,4	169	1,4	3364	1,4	4555
	Moderate	5	204	5	604	5	2607
	Low	3,7	2397	3,7	1669	3	469
	No /Minimal	2,6	525	2,6	2297	2,6	2509
Alternative 4 (Hwy 70 Bridge)	High	1,2	169	1,2	1827	1,2	3550
	Moderate	6,3	1837	6,3	2972	6,3	2070
	Low	4	0	4	2013	4	1799
	No /Minimal	5,7	1289	5,7	1073	5	2607
Alternative 6 (Total Div)	High	1,2,4	169	1,2,4	3848	1,2,4	5361
	Moderate	3,5,6	2041	3,5,6	3579	3,5,6	4691
	Low	7	1085	7	469	--	0
	No /Minimal	--	0	--	0	--	0

[1]Habitat Classes as defined under Habitat Assessment Method [2]Hydrologic Units (see Figure 1)

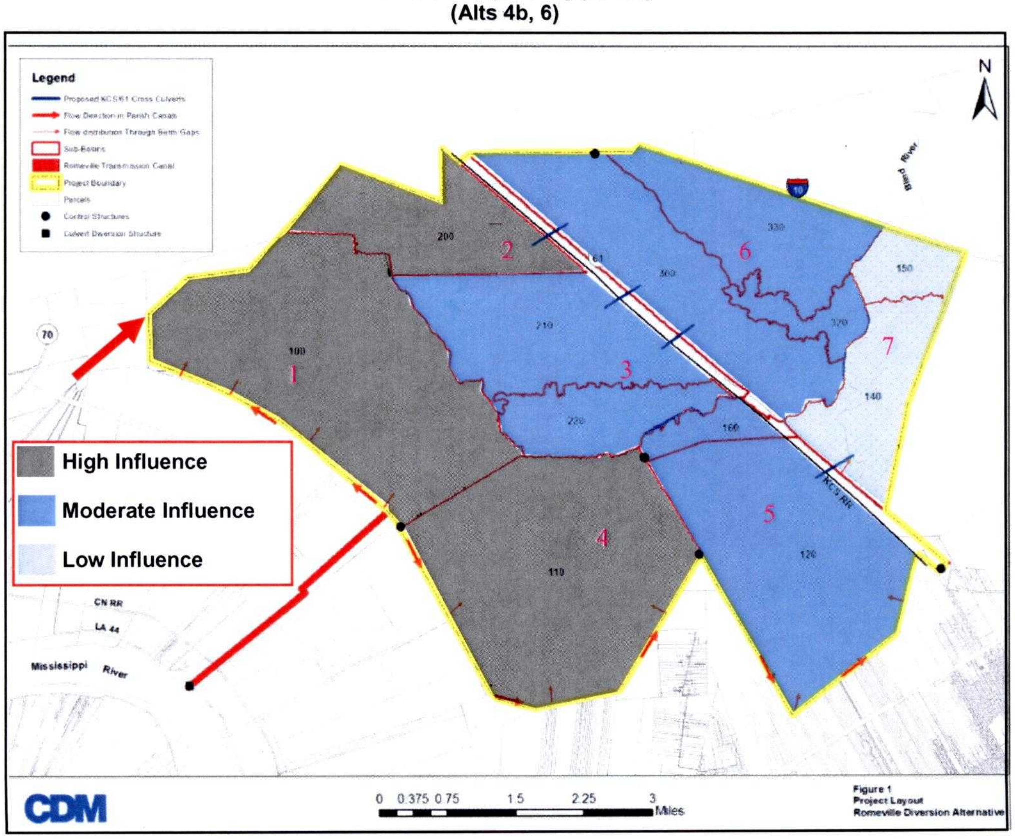
Figure 3. Diversion Influence Areas for Each Alternative.



Influence Areas
Sunshine Bridge Diversion (Alt 4)
(Original – No split southward)



Influence Areas
2 Diversions (or entry points)
(Alts 4b, 6)



Habitat Assessment Method

The procedure for evaluating project benefits on swamp habitats, the WVA swamp model, uses a series of variables that are intended to capture the most important conditions and functional values of a swamp. Values for these variables are derived for existing conditions and are estimated for conditions projected into the future if no restoration efforts are applied (i.e., future-without-project), and for conditions projected into the future if the proposed diversion project is implemented (i.e., future-with-project), providing an index of quality or habitat suitability of the swamp for the given time period. The habitat suitability index (HSI) is combined with the acres of swamp to get a number that is referred to as "habitat units". Expected project benefits are estimated as the difference in habitat units between the future-with-project (FWP) and future-without project (FWOP). To allow comparison of WVA benefits to costs for overall project evaluation, total benefits are averaged over a 50-year period, with the result reported as Average Annual Habitat Units (AAHUs).

Existing and Future without Project Conditions

To characterize existing conditions CDM established 28 vegetation monitoring stations throughout and adjacent to the project area during four separate field trips from March through September of 2009. A trend apparent to Shaffer et al. (2003) in the Maurepas swamp was increasing habitat degradation with proximity to Lake Maurepas. Therefore, two vegetation stations were positioned outside of the project area, closer to Lake Maurepas, to reference and track the progression of more degraded habitat conditions and to suggest potential future conditions for the project area under the no-action alternative. Data was collected on hydrology, wildlife, vegetation, community structure, composition, and health (per WVA methodology) at all vegetation monitoring stations. Soils data were also recorded at most monitoring stations.

On October 7, 2009, the team met with Dr. Gary Shaffer [Southeastern Louisiana University, (SELU)] and Bernard Wood (Research Assistant, SELU) to inspect the project area and compare habitat quality and swamp degradation to other areas of the Maurepas swamp that they are currently studying. Based on observations made during that field trip, data collected during previous field trips, knowledge of the habitat condition of the entire Maurepas swamp by Dr. Shaffer and Mr. Wood, and aerial photography, a habitat condition class map was then developed to categorize the different areas of swamp habitat (levels of degradation) according to classifications used by Dr. Shaffer at other areas within the Maurepas swamp (Figure 1). The intersection of diversion influence and habitat condition class defines the different areas that would require a separate WVA for each alternative (32 WVAs, not including WVAs for construction related impacts).

Three levels of habitat condition class were defined within the project area: 20-30 years-to-marsh, 30-50 years-to-marsh, and greater than 50-years-to-marsh. Data obtain from representative vegetation monitoring stations were then summarized according to each habitat class to get a representative value for each habitat class for the WVA. Because we can not accurately determine when these swamps will convert to marsh or open water, these habitat condition classifications are meant to define the level or rate of degradation and not necessarily the target years that the habitats will be removed from the habitat assessment or converted to marsh habitat.

Variable V_1 – Stand Structure (Table 3)

Most swamp tree species do not produce hard mast; consequently, wildlife foods predominantly consist of soft mast, other edible seeds, invertebrates, and vegetation. Because most swamp tree species produce some soft mast or other edible seeds, the actual tree species composition is not usually a limiting factor. More limiting is the presence of stand structure to provide resting, foraging, breeding, nesting, and nursery habitat and the medium for invertebrate production. This medium can exist as herbaceous vegetation, scrub-shrub/midstory cover, or overstory canopy and preferably as a combination of all three. This variable assigns the lowest suitability to sites with a limited amount of all three stand structure components, the highest suitability to sites with a significant amount of all three stand structure components, and mid-range suitability to various combinations when one or two stand structure components are present.

Conversion of forested wetlands to open water or marsh within the project area has not been observed during field investigations. Minimal windthrow of canopy trees was observed; however, light to moderate crown damage and windthrow of midstory trees was evident and likely occurred from recent hurricanes and tropical storm events. Similar damage was observed throughout Maurepas swamp, with data suggesting that midstory windthrow was inversely related to canopy density (Effler et al. 2007, Shaffer personal communication per DEIS). Decreasing canopy is also indicative of stress due to prolonged inundation and/or stagnant water conditions. Decreased vigor may increase susceptibility of trees to tropical storm damage.

Plant diversity in baldcypress-tupelo swamps is typically low due to low light penetration into the understory and the extended hydroperiod, which limit the establishment and survival of understory vegetation. Baldcypress (*Taxodium distichum*) and water tupelo (*Nyssa aquatica*) are common codominant canopy species in this habitat, with swamp red maple (*Acer rubrum var. drummondii*) predominant and green ash (*Fraxinus pennsylvanica*) codominant, in the midstory and understory strata. Common herbaceous species include arrow arum (*Peltandra virginica*), pennywort (*Hydrocotyle* spp.), smartweed (*Polygonum punctatum*), and lizard's tail (*Saururus cernuus*). Salvinia (*Salvinia* spp.), a non-native invasive aquatic fern, is prolific in many areas. Savanna panicum (*Phanopyrum gymnocarpon*), thought to be an indicator of flow and nutrients, was also observed in the higher quality swamps. A complete list of species and existing habitat conditions at each vegetation monitoring station is provided in CDM's October 2, 2009, "Existing Environmental Condition of Project Area" Memorandum.

<u>Stand Structure for 20-30 Years-to-Marsh</u>

Existing –The 20-30 years-to-marsh habitat class is characterized by having 23 percent canopy cover, 33 percent midstory cover, and 80 percent herbaceous or ground cover (Class 1). Of the overstory canopy cover, 81 percent is tupelo and other species, and the remaining 18 percent is cypress, with some monitoring sites being comprised of 100 percent tupelo. While basal area averages 113.85 ft^2/ac (moderately dense), one monitoring site has a basal area of 34.52 ft^2/ac

which is considered open, and one site is 64.43 ft^2/ac which is considered to be moderately open. One aspect of stand structure that is not reflected in the data is crown damage or loss of tree tops. While this is localized within the project area it is expected to be a common characteristic in the future as conditions deteriorate which is evident in other areas of Maurepas swamp. Crown damage also contributes to the low canopy cover phenomenon in an area were basal area is moderately dense, which consequently results in a high herbaceous cover. Water tolerance by tupelo has allowed the swamp stand structure to be dominated by tupelo in those areas experiencing prolonged flooding. Coupled with occasional salinity spikes, some tupelo dominated areas are experiencing either canopy top-off or complete canopy die off.

FWOP – Conditions are expected to continue to degrade as lack of nutrients, accretion, and freshwater, and an increase in sea level rise, subsidence, episodic salt water intrusion, and storm events all take a toll on the swamp. As a result of these deteriorating conditions, tree mortality, will continue resulting in lower tree density. The canopy will continue to thin, and canopy cover will persist below 33 percent (Table 3).

FWP – Depending on the location of this habitat class within the influence of the diversion, the 20-30 years to marsh is expected to see some benefits as a result of increased sediments, nutrients, and/or freshwater. Increased throughput is also expected to provide benefits as a result of berm cuts and other in-swamp management measures. Consequently, canopy, midstory and herbaceous cover is projected to increase through time. According to FWP modeling of "existing conditions with berm cuts", the project area is expected to be constantly inundated with an average annual water depth throughout the project area of 1.01 feet by target year 20 and 1.75 feet by target year 50. Additional flows from a 3,000 cfs diversion would only increase flood duration. Flood duration was estimated based on hydrologic modeling data presented for "berm cuts without diversions" scenario assuming that the diversion would be operated to mimic the natural historic Mississippi River overbank flooding cycle and would allow for the longest period of drying. With the diversion average, annual water depths are predicted to be in some areas as high as 3.71 feet (Alternative 6, hydrologic sub-basin series 200) and 5.82 feet (Alternative 4, hydrologic sub-basin series 200) during operation of the diversion. Therefore, the stand structure class was reduced at target year 50 (Table 3) to reflect prolonged inundation and a reduced herbaceous and midstory component.

Areas not affected by the diversion should see some benefits of increased hydrologic flow/throughput as a result of the in-swamp management measures. However, these benefits are short term as total sea level rise contributes to these areas returning to a persistent flooding regime by target year 20. It is projected that those areas of 20-30 years-to-marsh habitat class within areas not influenced by the diversion will not have enough time and benefits to regenerate and maintain a healthy forested stand, and, therefore, returns to a Class 1 by target year 30.

Table 3. Future-with and Future-without Project Stand Structure Conditions.

FWOP

Habitat Condition Class	TY0					TY1	TY20				TY30				TY50			
		%O	%M	%H	Class	Class	%O	%M	%H	Class	%O	%M	%H	Class	%O	%M	%H	Class
20-30 yrs. to marsh		23	33	80	**1**	**1**	<33			**1**	<33			**1**	<33			**1**
30-50 yrs. to marsh		38	39	51	**5**	**5**	33<50	<33	<33	**2**	33<50	<33	<33	**2**	<33			**1**
>50 yrs. to marsh		64	46	22	**4**	**4**	50<75	>33	<33	**4**	50<75	>33	<33	**4**	33<50	<33	<33	**2**

FWP

Habitat Condition Class	Level of Influence	TY0				TY1				TY20				TY30				TY50			
		%O	%M	%H	Class	%O	%M	%H	Class	%O	%M	%H	Class	%O	%M	%H	Class	%O	%M	%H	Class
20-30 yrs. to marsh	High Influence	23	33	80	**1**	23	33	80	**1**	33<50	>33	>33	**5**	33<50	>33	>33	**5**	50<75	>33	<33	**4**
	Moderate Influence	23	33	80	**1**	23	33	80	**1**	33<50	>33	>33	**5**	33<50	>33	>33	**5**	50<75	>33	<33	**4**
	Low Influence	23	33	80	**1**	23	33	80	**1**	33<50	>33	>33	**5**	33<50	>33	>33	**5**	33<50	>33	<33	**3**
	No Influence**	23	33	80	**1**	23	33	80	**1**	33<50	>33	>33	**5**	<33			**1**	<33			**1**
30-50 yrs. to marsh	High Influence	38	39	51	**5**	38	39	51	**5**	33<50	>33	>33	**5**	≥50	>33	>33	**6**	≥50	>33	<33	**4**
	Moderate Influence	38	39	51	**5**	38	39	51	**5**	33<50	>33	>33	**5**	≥50	>33	>33	**6**	≥50	>33	<33	**4**
	Low Influence	38	39	51	**5**	38	39	51	**5**	33<50	>33	>33	**5**	33<50	>33	>33	**5**	33<50	>33	<33	**3**
	No Influence**	38	39	51	**5**	38	39	51	**5**	33<50	>33	>33	**5**	33<50	>33	>33	**5**	33<50	>33	<33	**3**
>50 yrs. to marsh	High Influence	64	46	22	**4**	64	46	>33	**6**	≥50	>33	>33	**6**	50<75	>33	<33	**4**	50<75	>33	<33	**4**
	Moderate Influence	64	46	22	**4**	64	46	>33	**6**	≥50	>33	>33	**6**	50<75	>33	<33	**4**	50<75	>33	<33	**4**
	Low Influence	64	46	22	**4**	64	46	>33	**6**	≥50	>33	>33	**6**	50<75	>33	<33	**4**	50<75	>33	<33	**4**
	No Influence**	64	46	22	**4**	64	46	>33	**6**	≥50	>33	>33	**6**	50<75	>33	<33	**4**	50<75	>33	<33	**4**

Stand Structure for 30-50 Years-to-Marsh

Existing – The 30-50 years-to-marsh habitat class is characterized by having 38 percent canopy cover, 39 percent midstory cover, and 51 percent herbaceous or ground cover (Class 5). Of the overstory canopy cover, 85 percent is tupelo and other species and the remaining 15 percent is cypress. Similar to the 20-30 years-to-marsh habitat class, several of the monitoring vegetation sites were 100 percent tupelo. Basal area varied from 133.42 ft^2/ac to 320.79 ft^2/ac, or moderately dense to dense; however, light penetration appears to be suitable enough to support a midstory and herbaceous cover component.

FWOP – Conditions are expected to continue to degrade as lack of nutrients, accretion, and freshwater, and an increase in sea level rise, subsidence, episodic salt water intrusion, and storm events all take a toll on the swamp. As a result of these deteriorating conditions, tree mortality, especially to tupelo, will continue resulting in lower tree density. The canopy will continue to thin, and canopy cover is predicted to drop below 33 percent by target year 50.

FWP – High to moderate influenced areas are predicted to see benefits as a result of increased sediments, nutrients, and/or freshwater. Increased throughput is also expected to provide benefits as a result of berm cuts and other in-swamp management measures. Consequently, canopy, midstory and herbaceous cover is projected to increase through time. As noted above, flood duration is expected to increase as total sea level rise increases, resulting in an eventual decrease in herbaceous cover by target year 50.

Areas that are not affected (no influence areas) or are minimally affected (low influence areas) by the diversion see no increase in stand structure, but rather maintain the existing stand structure until target year 50. Consistent with the previously mentioned hydrologic conditions, stand structure is reduced at target year 50 as a result of a reduced herbaceous component.

Stand Structure for Greater than 50 Years-to-Marsh

Existing – The greater than 50 years-to-marsh habitat class is characterized by having 64 percent canopy cover, 46 percent midstory, and 22 percent herbaceous or ground cover. Of the overstory canopy cover, 44 percent is tupelo and other species and 56 percent is cypress. While the percentage indicates an even distribution, the individual monitoring vegetation sites were dominated by either one or the other species. Basal area and percent canopy cover is considered optimal, or dense, with an average basal area of 256.09 ft^2/ac. The midstory is also considered suitable; however, herbaceous cover is less than optimal likely due to lack of light penetration and nutrients.

FWOP – In comparison to other areas of the Maurepas swamp, this habitat class is considerably healthier and is expected to maintain a Class 4 stand structure through much of the FWOP life. By target year 50 conditions will begin to deteriorate and the canopy begins to thin.

FWP – This habitat class is expected to see benefits as a result of increased sediments, nutrients, and freshwater from the diversion, and due to increased throughput as a result of in-swamp management measures. Consequently, an increase in herbaceous cover is expected within the short term for all areas of influence. However, as canopy closure becomes even more prevalent and as flood duration is expected to increase as total sea level rise increases, a decrease in herbaceous cover by target year 30 is predicted.

Variable V_2 _ Stand Maturity (Table 8)

The suitability graph for this variable assumes that snags, cavities, downed treetops, and invertebrate production are present in suitable amounts when the average diameter-at-breast height (DBH) of canopy-dominant and canopy-codominant trees is above 16 inches for baldcypress and above 12 inches for tupelogum and other species. Therefore, stands with those characteristics are considered optimal for this variable (SI = 1.0).

Another important component of this variable is stand density, measured in terms of basal area. A scenario sometimes encountered in mature swamp ecosystems is an overstory consisting of a very few, widely-scattered, mature baldcypress. If stand density was not considered, but only average DBH, then those stands would receive a high SI for this variable without providing many of the important habitat components of a mature swamp ecosystem, specifically an adequate number of trees for nesting, foraging, and other habitat functions. Therefore, the SI for this variable is dependent on average DBH and basal area which is used as a measure of stand density.

Existing Conditions
Seven vegetation monitoring stations were identified that were representative of the 20-30 years-to-marsh class. Basal area averaged 113.85 ft^2/acre. The average DBH measured 11.21 inches for cypress and 13.08 inches for tupelo and other canopy co-dominant species. Even though this is the most degraded habitat, class basal area is still considered to be moderate.

Six vegetation monitoring stations were identified that were representative of the 30-50 years-to-marsh class. Basal area averaged 222.73 ft^2/acre. The average DBH measured 14.71 inches for cypress and 14.20 inches for tupelo and other canopy co-dominant species.

Nine vegetation monitoring stations were identified that were representative of the greater-than 50 years-to-marsh class. Basal area averaged 256.09 ft^2/acre. The average DBH measured 15.76 inches for cypress and 13.97 inches for tupelo and other canopy co-dominant species.

FWOP
Numerous bald cypress and tupelo growth rates have been documented in deep water swamp habitats and are summarized by Visser and Sasser (1995). For FWOP conditions we assumed mean annual growth rates documented by Dr. Shaffer (unpublished) (Table 4) for target years 1-20. These assumptions are similar to what was used for the LCA, Amite River Diversion Channel Modification project. Since subsidence, total sea level rise and associated stresses are expected to continue mean annual growth rates were reduced for target years 20-50.

Increase in basal area was estimated by species and habitat condition class by calculating and projecting the increase in basal area using the predicted growth rates and tree mortality. Percent composition of canopy trees in the FWOP was estimated based on best professional judgment of expected mortality of tupelo among the habitat condition classes taking into consideration

Table 4. Cypress and Tupelo Annual Growth Rates FWOP

	Cypress (inches)	Tupelo et al (inches)
TY 0-20		
20-30 yrs to marsh	0.11	0.08
30-50 yrs to marsh	0.15	0.1
>50 yrs to marsh	0.15	0.1
TY 20-50		
20-30 yrs to marsh	*0.064	**0.073
30-50 yrs to marsh	*0.064	0.08
>50 yrs to marsh	*0.064	0.08

*Visser and Sasser (1995) ** Day (1985) from Visser and Sasser (1995)

assumptions made for the CWPPRA River Reintroduction into Maurepas Swamp Project. The CWPPRA River Reintroduction into Maurepas Swamp Project estimated that 50% of tupelo would die over the 20 year FWOP life, but that actual mortality of cypress would be minimal. Because habitat conditions within the Convent/Blind River project area are more favorable and are not at the same stage of degradation we assumed a reduced tupelo mortality rate for the first 20 years and for higher quality habitat condition classes (Table 5). Because tupelo is more flood tolerant highly degraded areas have become dominated by tupelo. Those areas have also experienced continued degradation as a result of seasonal salinity spikes and are seeing increased tupelo mortality and reduced vigor. In order to be conservative only tupelo mortality was assumed when determining FWOP mortality and projected project benefits because lower quality habitats were dominated by tupelo.

Table 5. Tupelo Mortality FWOP

	TY 20	*TY 50
20-30 yrs to marsh	50%	50%
30-50 yrs to marsh	25%	50%
>50 yrs to marsh	25%	25%

*percent mortality is of the TY 0 (existing) stand

Table 6. Tupelo Mortality FWP

	TY 1	TY 20	TY 50	Total Mortality
High Influence				
20-30 yrs to marsh	0%	0%	5%*	5%
30-50 yrs to marsh	0%	0%	5%*	5%
> 50 yrs to marsh	0%	0%	0%	0%
Moderate Influence				
20-30 yrs to marsh	0%	0%	10%*	10%
30-50 yrs to marsh	0%	0%	10%*	10%
> 50 yrs to marsh	0%	0%	0%	0%
Low Influence				
20-30 yrs to marsh	0%	0%	20%*	20%
30-50 yrs to marsh	0%	0%	20%*	20%
> 50 yrs to marsh	0%	0%	10%*	10%
No Direct Influence				
20-30 yrs to marsh	0%	40%*	40%*	80%
30-50 yrs to marsh	0%	10%*	40%*	50%
> 50 yrs to marsh	0%	10%*	20%*	30%

*% of existing stand @ TY0

ble 8. Future-with and Future-without Project Stand Maturity Conditions.

Future Without Project:

Habitat Condition Class	Level of Influence	Species Group	AVERAGE DIAMETER (inches) TY1	TY20	TY30	TY50	% Contribution by Number of Individuals TY1	TY20	TY30	TY50	BASAL AREA (ft²/ac) TY1	TY20	TY30	TY50
20-30 yrs. to marsh	FWOP	baldcypress	11.87	13.96	14.60	15.88	10.42	18.87	18.87	100.00	122.35	82.98	90.81	18.42
		tupelo et al.	13.56	15.08	15.81	0.00	89.58	81.13	81.13	0.00				
30-50 yrs. to marsh	FWOP	baldcypress	15.61	18.46	19.10	20.38	17.57	22.13	22.13	46.02	241.96	247.88	269.12	157.24
		tupelo et al.	14.80	16.70	17.50	19.10	82.43	77.87	77.87	53.98				
		baldcypress	16.66	19.51	20.15	21.43	41.51	48.62	48.62	58.67	280.03	320.24	345.15	338.32
>50 years to marsh	FWOP	tupelo et al.	14.57	16.47	16.47	18.87	58.49	51.38	51.38	41.33				

Future With Project:

Habitat Condition Class	Level of Influence	Species Group	AVERAGE DIAMETER (inches) TY1	TY20	TY30	TY50	% Contribution by Number of Individuals TY1	TY20	TY30	TY50	BASAL AREA (ft²/ac) TY1	TY20	TY30	TY50
20-30 yrs. to marsh	High Influence	baldcypress	11.98	16.16	17.25	18.91	10.42	10.42	10.42	10.91	123.80	185.60	213.14	247.37
		tupelo et al.	13.64	16.68	17.92	19.82	89.58	89.58	89.58	89.09				
	Moderate Influence	baldcypress	11.95	15.50	16.33	17.61	10.42	10.42	10.42	11.44	123.37	174.97	195.25	208.04
		tupelo et al.	13.62	16.20	17.15	18.61	89.58	89.58	89.58	88.56				
	Low Influence	baldcypress	11.91	14.62	15.26	16.54	10.42	10.42	10.42	12.69	122.79	161.30	176.18	170.34
		tupelo et al.	13.59	15.56	16.29	17.75	89.58	89.58	89.58	87.31				
	No Influence**	baldcypress	11.87	13.96	14.60	15.88	10.42	16.23	16.23	36.76	122.35	96.67	105.81	54.07
		tupelo et al.	13.56	15.08	15.81	17.27	89.58	83.77	83.77	63.24				
30-50 yrs. to marsh	High Influence	baldcypress	15.56	21.26	22.35	24.01	17.57	17.57	17.57	18.32	241.69	383.85	435.66	500.91
		tupelo et al.	14.80	18.60	19.96	22.04	82.43	82.43	82.43	81.68				
	Moderate Influence	baldcypress	15.52	20.36	21.19	22.47	17.57	17.57	17.57	19.15	240.70	359.05	397.06	423.01
		tupelo et al.	14.77	18.00	19.04	20.64	82.43	82.43	82.43	80.85				
	Low Influence	baldcypress	15.46	19.16	19.80	21.08	17.57	17.57	17.57	21.04	239.40	327.36	355.08	348.08
		tupelo et al.	14.73	17.20	18.00	19.60	82.43	82.43	82.43	78.96				
	No Influence**	baldcypress	15.41	18.26	18.90	20.18	17.57	19.15	19.15	29.89	238.42	280.58	305.05	232.82
		tupelo et al.	14.70	16.60	17.40	19.00	82.43	80.85	80.85	70.11				
>50 yrs. to marsh	High Influence	baldcypress	16.81	22.51	23.60	25.27	41.51	41.51	41.51	41.51	275.69	454.73	510.25	601.75
		tupelo et al.	14.67	18.47	19.83	21.91	58.49	58.49	58.49	58.49				
	Moderate Influence	baldcypress	16.77	21.61	22.45	23.73	41.51	41.51	41.51	41.51	274.46	423.36	464.05	530.56
		tupelo et al.	14.64	17.87	18.91	20.51	58.49	58.49	58.49	58.49				
	Low Influence	baldcypress	16.71	20.41	21.05	22.33	41.51	41.51	41.51	44.09	272.83	383.33	412.97	450.44
		tupelo et al.	14.60	17.07	17.87	19.47	58.49	58.49	58.49	55.91				
	No Influence**	baldcypress	16.66	19.51	20.15	21.43	41.51	44.09	44.09	50.34	271.61	336.31	363.08	372.21
		tupelo et al.	14.57	16.47	17.27	18.87	58.49	55.91	55.91	49.66				

**NO INFLUENCE GROWTH RATES SET AS FWOP.

FWP

The proposed diversion is expected to substantially stimulate productivity, and so stimulate growth of the cypress and tupelo (as well as other species). The amount of stimulation is assumed to be related to level of influence of the diversion. Depending on the alternative diversion location certain hydrologic units will receive different levels of influence. Those areas within the high influence area will receive freshwater, nutrients, and sediments; so it is assumed those hydrologic units will see the greatest increase in growth. Results of studies by John Day in wetlands receiving secondary treated sewage suggest that introduction of nutrients as well as sediments from river water could stimulate production by 3-5 fold (EPA 2001). Comparison of productivity in swamps that are either managed, have more favorable hydrology, and/or are receiving nutrient enrichment suggest that the existing levels of productivity in Maurepas are ½ to ¼ of average values (EPA 2001). Southeast Louisiana University study sites within the Maurepas swamp that receive non-point source runoff (i.e., containing nutrients and sediment) have documented an average 1 centimeter of diameter increase per year. When sewage effluent is involved some study sites average 1.5 cm of growth per year close to such a source (Bernard Wood, personal communication). As a very conservative projection, a 2-fold increase in growth rate (i.e., 200% of growth rates listed in Table 4) was applied to the high influence areas for the first 19 years to capture the anticipated stimulation of growth from the diversion. Reduced growth rates were assumed as the level of influence decreased and as the area returned to a more semi-permanent flooding regime (Table 7). DBH and basal area in the FWP were estimated as for FWOP, by applying the increased growth rates and mortality rates.

Table 7. Percent Increase in DBH growth rate based on Level of Diversion Influence (50 yr project life) FWP

	TY 1	TY 20	TY 30
High Influence Area	200%	170%	130%
Moderate Influence Area	170%	130%	100%
Low-Direct Influence Area	130%	100%	100%

Areas not affected by the diversion may still experience benefits as a result of the berm cuts and in-swamp management modifications. Tupelo mortality was assumed based on flood duration and existing stand health. Flood duration was estimated based on hydrologic modeling data presented for "berm cuts without diversions" scenario assuming that the diversion would be operated to mimic the natural historic Mississippi River overbank flooding cycle and would allow for the longest possible dry out period in some years.

Variable V_3 – Water Regime (Table 9)

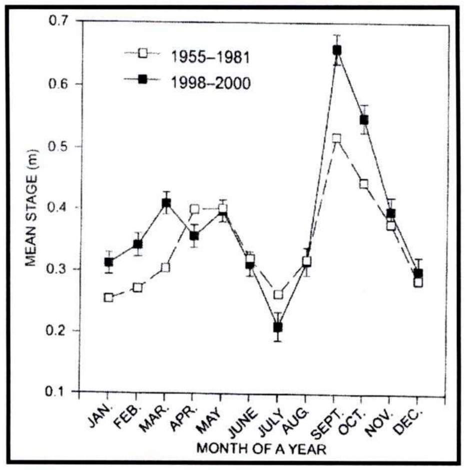
The optimal water regime is assumed to be seasonally flooded with abundant and consistent riverine/tidal input and water flow-through (SI=1.0). Seasonal flooding with periodic drying cycles is assumed to contribute to increased nutrient cycling (primarily through oxidation and decomposition of accumulated detritus), increased vertical structure complexity (due to growth of other plants on the swamp floor), and increased recruitment of dominant overstory trees. In addition, abundant and consistent input and water flow-through is optimal, because under that regime the full functions and values of a swamp in providing fish and wildlife habitat are assumed to be maximized. Temporary flooding is also assumed to be desirable. Habitat suitability is assumed to decrease as water exchange between the swamp and adjacent systems is reduced. The combination of permanently flooded conditions and no water exchange (e.g., an impounded swamp where the only water input is through rainfall and the only water loss is through evapotranspiration and ground seepage) is assumed to be the least desirable (SI=0.1). Those conditions can produce poor water quality during warm weather, reducing fish use and crawfish production (WVA Procedure Manual).

Existing

Hydrologic modeling for this project, as well as hydrologic investigations for the CWPPRA River Reintroduction into Maurepas Swamp project, has revealed that the Maurepas swamp floor elevations [i.e., 1.12 feet NAVD per the CWPPRA, Coastwide Reference Monitoring System (CRMS) station 5167] are often lower than Lake Maurepas bottom elevations. This results in swamp water levels and dry-out periods being dependent on the water levels in Lake Maurepas, and essentially, flooding is semi-permanent with low to very low water exchange and throughput. The observed doubling of flood durations from 1955 to present at Pass Manchac (Thomson et al. 2002) coupled with swamp elevations lower than lake elevations suggests that the duration of inundation within the project area has drastically increased over the last fifty years. Moreover, flood durations within the project area swamps are influenced by adjacent urban storm water runoff of areas to the northwest (i.e., Baton Rouge and surrounding cities) and the hydrologic impoundments caused by major transportation corridors. Adjacent urban storm water drainage projects force storm water runoff via large drainage canals into the Blind River. These storm waters bypass the floodwater storage capabilities of adjacent forested wetlands and increase the water levels in Blind River resulting in back water flooding conditions upstream of the waterways confluence. Being that the project area is located at the headwaters of the Blind River and is impounded by several major hydrologic barriers [i.e., U.S. Interstate 10, U.S. Highway 61, and Kansas City Southern Railroad (KCSRR)]; flood waters within the project area are the last to recede from the basin. It is appears that within hydrologic unit 3 interior elevations are low enough to allow ponding of water for longer periods of time, and is, therefore, considered permanently flooded with low water exchange.

Lunar tidal fluxes in Maurepas swamp average 30 cm but are typically overwhelmed by meteorological tidal fluxes. Wind is also a significant forcing agent for water level in Maurepas swamp and may exhibit daily and seasonal variability. During the summer and early fall, storms and prevailing winds from the southeast raise water levels in the swamp as they push Gulf water into the system. Conversely, during the winter months, continental fronts with prevailing winds from the northeast often lower water levels in the swamp as they push water out of the system and towards the Gulf. Fluctuations in water level are generally expected to be similar throughout Maurepas swamp, acknowledging slight variability associated with landscape position and elevation. Within any given year, water stage is characterized by a bimodal hydrograph (Figure 4). Water level rises in the spring, then falls to its lowest level during the summer, rises to its highest level in the fall, and again falls to low levels in the winter (Thomson 2000, Keddy et al. 2007). The intensity of peaks and troughs is typically associated with those meteorological events.

Figure 4. Intra-annual variability of montly mean stage comparing the periods 1955-1981 (historical) and 1998-2000 (drought period). The duration of flooding (percentage of the year that the marshes by Schleider's Ditch flood) more than doubled over the period of record for the USACE tide gage (from Thomson 2000, referenced in Keddy 2007)



Water exchange between the project area swamps and adjacent swamps is reduced to what the Blind River and other small tributaries can exchange across the embankments of the three transportation corridors (i.e., U.S. Interstate 10, U.S. Highway 61, and KCSRR). These embankments act as hydrologic barriers and reduce flow-through across the project area swamp. Within the project area interior drainage and hydrologic exchange has been altered by the construction of drainage canals and associated berms, pipeline and transmission line rights-of-way, and remnant logging infrastructure (i.e., roads, pull boat ditches, and temporary railroad track embankments). Historically, seasonal overbank flooding over the natural Mississippi River levees facilitated hydrologic exchange and freshwater input on average every three to five years. Today the only additional freshwater input is through rainwater runoff, and even those contributions can by-pass the wetland system through the many storm water drainage canals that direct floodwaters directly into Blind River and Lake Maurepas. The project area swamp habitat has been altered and disrupted to a point that adequate water exchange does not exist, and is considered to have low water exchange.

FWOP

Future without project conditions flood durations are expected to worsen as sea level rise and subsidence continues and storm water control projects continue to force storm water into an already flooded system. It is assumed that the entire project area swamp habitat will become permanently flooded and continue to have low flow exchange.

Table 9. Summary for Average Annual Water Depth (ft)

No Sea Level Rise (existing conditions)

		HU1	HU2	HU3	HU4	HU5	HU6	HU7	
Alternatives	**Scenario/Sub-basin**	**100**	**200**	**210, 220**	**110**	**120, 160**	**300, 320, 330**	**140, 150**	**Total Project Site Average**
	Existing Conditions	1.90	1.73	1.83	2.09	1.34	1.53	1.61	1.72
	Existing Conditions; With Berm Cuts	0.78	0.74	0.69	0.82	0.55	0.58	0.65	0.69
2	Romeville Diversion	2.13	0.74	1.30	2.18	0.55	0.59	0.66	1.16
4	South of Highway 70 Bridge Diversion	1.79	3.40	1.62	0.85	0.54	0.59	0.65	1.35
6	Total Diversion	1.82	2.08	1.47	1.54	0.55	0.59	0.65	1.24

20-year Sea Level Rise

		HU1	HU2	HU3	HU4	HU5	HU6	HU7	
	Scenario/Sub-basin	**100**	**200**	**210, 220**	**110**	**120, 160**	**300, 320, 330**	**140, 150**	**Total Project Site Average**
	Existing Conditions	1.92	1.76	1.84	2.11	1.37	1.56	1.65	1.75
	Existing Conditions; With Berm Cuts	1.10	1.08	0.99	1.20	0.81	0.89	1.02	1.01
2	Romeville Diversion	2.75	1.08	2.03	2.93	0.82	0.90	1.02	1.65
4	South of Highway 70 Bridge	2.42	4.66	2.46	1.27	0.81	0.89	1.02	1.93
6	Total Diversion	2.44	2.84	2.30	2.13	0.81	0.90	1.02	1.78

30-year Sea Level Rise

	Scenario/Sub-basin	**100**	**200**	**210, 220**	**110**	**120, 160**	**300, 320, 330**	**140, 150**	**Total Project Site Average**
	Existing Conditions	1.95	1.82	1.87	2.14	1.42	1.61	1.71	1.79
	Existing Conditions; With Berm Cuts	1.29	1.30	1.17	1.42	0.98	1.08	1.26	1.21
2	Romeville Diversion	2.99	1.30	2.38	3.21	0.99	1.12	1.27	1.89
4	South of Highway 70 Bridge	2.77	5.13	2.91	1.54	0.98	1.09	1.26	2.24
6	Total Diversion	2.76	3.16	2.70	2.45	0.99	1.10	1.27	2.06

50-year Sea Level Rise

	Scenario/Sub-basin	**100**	**200**	**210, 220**	**110**	**120, 160**	**300, 320, 330**	**140, 150**	**Total Project Site Average**
	Existing Conditions;	2.15	2.07	2.04	2.33	1.64	1.83	2.02	2.01
	Existing Conditions; With Berm Cuts	1.83	1.88	1.68	1.96	1.48	1.58	1.86	1.75
2	Romeville Diversion	3.49	1.88	3.06	3.73	1.51	1.68	1.88	2.46
4	South of Highway 70 Bridge	3.52	5.82	3.83	2.16	1.48	1.60	1.85	2.90
6	Total Diversion	3.42	3.71	3.47	3.16	1.51	1.69	1.88	2.69

FWP

Depending on the location of the hydrologic unit within the watershed in relation to the diversion outfall it was assumed that certain hydrologic units would receive different levels of influence (i.e., high, moderate, low, or no influence). However, all HUs see increased benefits in the form of dry-out frequency as a result of the berm cuts assuming the diversion would be operated to maximize dry-out frequency. At this time an operational plan has not been developed. In target year 1 (defined as "existing conditions with berm cuts" in Table 9), without a diversion water depths are lower than existing conditions throughout all hydrologic units for all alternatives, and below swamp floor elevations in most hydrologic units (Table 9).

Hydrologic data indicates that by TY 20 water levels within all areas are at or above swamp floor elevations. Within areas of high influence sediment accretion is expected and should keep up with total sea level rise. Nutrient input into areas moderately influenced would facilitate increased growth rates contributing to above ground biomass. While this has been taken into consideration, accretions rates have not been predicted or analyzed at this time. As displayed in Table 10, FWP water regime was evaluated by each hydrologic unit for each alternative and grouped according to level of influence by the diversion.

Table 10. Future With Project Water Regime Conditions.

	TY0		TY1		TY20		TY30		TY50	
	duration-exchange	**SI**	**duration-exchange**	**SI**	**duration-exchange**	**SI**	**duration-exchange**	**SI**	**duration-exchange**	**SI**
Alternative 2										
high influence	semiperm-low	0.45	seasonal-high	1.00	semipermanent-high	0.75	semiperm-high	0.75	semiperm-high	0.75
moderate	semiperm-low	0.45	seasonal-high	1.00	semipermanent-high	0.75	semiperm-high	0.75	semiperm-high	0.75
low	semiperm/perm-low	0.40	seasonal-moderate	0.85	semiperm-moderate	0.65	perm/semiperm-moderate	0.55	perm/semiperm-moderate	0.55
no influence	semiperm-low	0.45	seasonal-low	0.70	semiperm-low	0.45	semiperm-low	0.45	semiperm-low	0.45
Alternative 4										
high influence	semiperm-low	0.45	seasonal-high	1.00	semiperm-high	0.75	semiperm-high	0.75	semiperm-high	0.75
moderate	semiperm/perm-low	0.40	seasonal-high	1.00	semiperm-high	0.75	semiperm/perm-high	0.70	semiperm/perm-high	0.70
low	semiperm/-low	0.45	seasonal-moderate	0.85	semiperm-moderate	0.65	semiperm-moderate	0.65	semiperm-moderate	0.65
no influence	perm-low	0.30	seasonal-low	0.70	semiperm-low	0.45	perm-low	0.30	perm-low	0.30
Alternative 6										
high influence	semiperm-low	0.45	seasonal-high	1.00	semiperm-high	0.75	semiperm-high	0.75	semiperm-high	0.75
moderate	semiperm/perm-low	0.40	seasonal-high	1.00	semiperm-high	0.75	semiperm/perm-high	0.70	semiperm/perm-high	0.70
low	permanent-low	0.30	semiperm-moderate	0.65	semiperm-moderate	0.65	permanent-moderate	0.45	permanent-moderate	0.45
no influence	-	-	-	-	-	-	-	-	-	-

Variable V_4 - Mean high salinity during the growing season.

Swamps can tolerate increased salinities; however increased salinity spikes coupled with prolonged flooding has been shown to be detrimental to those forested swamps. Baldcypress is able to tolerate higher salinities compared to other swamp species such as tupelogum and many herbaceous species which are salinity-sensitive. Salinity recorded at Pass Manchac during the 1999-2000 drought spiked at 8 parts-per-thousand (ppt) and averaged around 5 ppt until heavy rains in July 2000 ended the drought (Keddy et al. 2007). For the Swamp WVA optimal conditions for salinity are assumed when mean high salinities during the growing season are equal to or less than 1.0 ppt. Habitat suitability is assumed to decrease rapidly at mean high salinities in excess of 1.0 ppt.

For the CWPPRA River Reintroduction into Maurepas Swamp project the lowest existing salinities documented were 1.53 ppt for the "Hope" station group (EPA 2001). The Convent/Blind River Diversion project area is located further inland from the "Hope" station group and is landward of several hydrologic barriers (i.e., I-10, US 61, KCSRR), thereby being protecting from the higher salinity waters coming from the Gulf. Because of these barriers it is likely salinity levels remain relatively consistent throughout the project area and do not fluctuate within the project area. While salinity spikes still affect the project area through the hydrologic connectivity of Blind River and other small tributaries, those salinity spikes are not representative of typical salinities and are not represented in this variable. For 2008, average salinities during the growing season recorded at CRMS stations (0065 and 5167) located west of U.S. Hwy 61 were measured at 0.25 ppt. The highest salinity measured during the growing season was 0.33 ppt. Salinities have been collected periodically in Blind River at US Hwy 61 by LDEQ (LA040403), and average annual salinities taken from 1981 to 1998 were 0.95 ppt. Average salinities recorded during the growing season at that station range from 0.15 ppt in 1996 to 0.70 ppt in 1995. However, those values were only obtained from the months of April, June, August, and October. For two CRMS stations located west of U.S. Hwy 61 and in the project area average salinities in the growing season were measured at 0.35 ppt (CRMS0039) and 0.53 ppt (CRMS5167), slightly higher than the interior sites.

According to the data available for the entire project area it appears that mean high salinity during the growing season is less than 1.0 ppt. Should coastal restoration and protection projects (e.g., MRGO Ecosystem Restoration Project and features of the Federal Hurricane and Storm Damage Risk Reduction System) proposed for the Lake Pontchartrain Basin not be implemented, it is highly likely that the project area will continue to see slight increases in average salinities and a greater frequency in salinity spikes. This is evident from the salinity trends observed in the forested swamps to the east and closer to Lake Maurepas. However, average high salinities during the growing season are not expected to exceed 1.0 ppt over the project life. The suitability index for salinities 1.0 ppt or less is 1.0.

It is assumed that the project area can be subdivided into two salinity regions. Areas east of U.S. Hwy 61 and south of Interstate 10 experience slightly higher salinity levels as a result of being closer to the lake. Areas further inland and west of U.S. Hwy 61 are slightly fresher due to the hydrologic barriers impeding the salinity gradient and the contribution of freshwater run-off from the adjacent upland areas.

Existing conditions for areas east of U.S. Hwy 61 are estimated based on the CRMS data for 0065 and 5167. Salinities were consistent throughout the 2008 growing season so mean high salinities were not calculated. Because of freshwater runoff and the hydrologic barriers, average mean high salinities are not expected to increase; however, salinity will still be a detrimental factor to swamp sustainability in the form of seasonal and drought induced salinity spikes. Average high salinities during the growing season are not expected to exceed 1.0 ppt over the 50-year future without project life.

Existing conditions for areas west of U.S. Hwy 61 are estimated using data from the two CRMS stations (0039 and 5167) within the area. It is likely that in the 50-year future without project life the area will experience a slight increase in salinities, but will still be within the optimal range. Project area salinities are greatly influenced by adjacent storm water and agricultural freshwater runoff, and hydrologic barriers prevent high saline waters from entering the swamps. Salinity will still be a detrimental factor to swamp sustainability in the form of seasonal and drought induced salinity spikes.

Modeling conducted for the closure of the MRGO at Bayou La Loutre showed that salinities would decrease within the adjacent marshes and associated waterways on the order of 1.0 to 3.0 ppt as a result of that closure (Draft IER 11 Tier 2 Pontchartrain 2009). Higher saline waters that commonly entered through the MRGO into the southern end of Lake Pontchartrain have been cut off as a result of that closure and the Lake Borgne surge barrier currently being constructed.

Summary/Results

According to initial results from the hydrologic modeling, benefits are achieved through gapping spoil banks and modifying other hydrologic barriers to allow the redistribution of hydrologic flow throughout the swamp system. Because in-swamp management is a feature of all three alternatives, all three alternatives see considerable WVA benefits in the first 20 years as a result of those features; therefore, the difference in AAHUs between alternatives is minimized. The analysis then becomes a comparison of diversion influence areas. Based on preliminary hydrologic modeling results which at this stage of the study has focused on transfer of flow between benefit areas, the Romeville diversion alternative (Alternative 2) directly influences a larger area (i.e., HUs 1 and 4) compared to Alternative 4, the South of Hwy 70 Bridge diversion alternative (i.e., HUs 1 and 2). The "Total diversion" alternative (i.e., Alternative 6 and 4b) consequently has the highest benefits because sediments, nutrients, and freshwater are influencing a larger receiving area. Another observation in the analysis is that basal area throughout most of the project area is considered to be within the optimal range (i.e., >161 sq. ft./ac) to support wildlife habitat. The WVA, therefore, does not show a distinction (or change in suitability indices) between habitat classes and between FWP and FWOP for this variable. Because of these factors, alternative evaluations have placed an emphasis on stand structure and water regime. The project area is semi-permanently flooded and future-with-project modeling projections indicates that the flooding regime within most of the project area will return to pre-project conditions by target year 20 as a result of total sea level rise. However, hydrologic flow will be improved and will provide additional benefits by increasing forest stand vigor, accretion, water quality and back flow prevention.

<u>Data Gaps and Additional Information Needs for Analyzing Benefits of the Tentatively Selected Plan (TSP)</u>

Because of the expedited schedule, limited data was available at the time of this analysis. Therefore, the intent of this habitat analysis is to provide a comparison of alternative benefit areas and potential direct impacts associated with project construction to support the selection of a TSP. To fully evaluate the benefits of the TSP the following additional information and actions will be required:

- Additional results of hydrologic modeling efforts that better identify/quantify influence areas and how water (sediment and nutrients) moves through the system and within each hydrologic unit.
- Water levels and swamp floor elevations need to be determined on a refined scale and incorporated into the hydrologic modeling.
- Salinity predictions need to be re-evaluated and changes, if necessary, be undertaken.
- Diversion operations need to be developed by alternative and incorporated into the hydrologic modeling.
- Accretion rates need to be determined and incorporated into the hydrologic modeling (e.g., flood durations and depths should decrease). Benefits cannot be fully addressed without including this in the analysis.

IMPACTS

For each alternative, impacts to swamp habitat are associated with the transmission channel from the Mississippi River to the outfall area (benefit area) and with transmission canal construction and modification within the outfall area (Tables 11 & 12). For FWP all habitat suitability index (HSI) values are 0.0 to reflect the removal of forested habitat as a result of the proposed alternative.

Table 11. Forested Wetland Impacts (Acres)

	Alternative 2 Romeville 3000cfs	**Alternative 4** Southbridge 3000cfs	**Alternative 4B** Southbridge 3000 cfs split flows	**Alternative 6** Romeville 1500 cfs Soutbridge 1500 cfs
Diversion Channel	53	107	107	160
Northern Transmission Canal	-	163	126	126
Widening of St James Canal	-	-	72	-
Total	**53**	**270**	**305**	**286**

Impacts associated with the transmission channel were quantified using the highest quality habitat (i.e., greater than 50 years-to-marsh) variable assumptions from the WVA assessing benefits. Field data was not obtained along the proposed transmission channels due to limited time associated with the expedited schedule; therefore, variable assumptions were made to give advantage to the forested resources being impacted (e.g., stand structure and maturity were assumed to have the highest suitability index value). Forested areas closer to, and associated with, the natural levee of the Mississippi River are at higher elevations, and prolonged inundation is not expected. Therefore, for areas where water regime is currently classified as seasonal or temporary, stand structure class is expected to increase through the 50-year project life. Water regime was determined using classifications by National Wetlands Inventory 1988. Forested habitat at higher elevations along the natural levee of the Mississippi River is not expected to experience marked salinity influences through the project life. See WVA worksheets for the discrete variable assumptions.

The proposed northern transmission canal (i.e., Alternatives 4A, 4B, and 6) traverses through the "benefit area" and the associated acreage was previously included in the habitat analyses evaluating benefits. Those analyses were revised, and the associated acres impacted were subtracted from the respective analysis by habitat condition class. The associated impacts were then evaluated using the same variable assumptions from those previous habitat analyses assessing benefits for FWOP. Again, for FWP, all habitat suitability index (HSI) values are 0.0 to reflect the removal of forested habitat as a result of the proposed project.

Alternative 4B would include expanding the St. James Parish Canal and constructing channel berms to achieve a head differential sufficient to move diverted water to the southern portion of the project area. While additional indirect impacts would be associated with impounding areas of swamp by constructing these berms, only direct impacts to wetlands were evaluated. Much of this area was already classified in the habitat condition class and the same variable assumptions for FWOP were used. Again, for FWP all habitat suitability index (HSI) values are 0.0 to reflect the removal of forested habitat as a result of the proposed project.

Figure 5. Forested Impacts Associated with the Romeville Diversion Channel (Alts. 2 & 6)

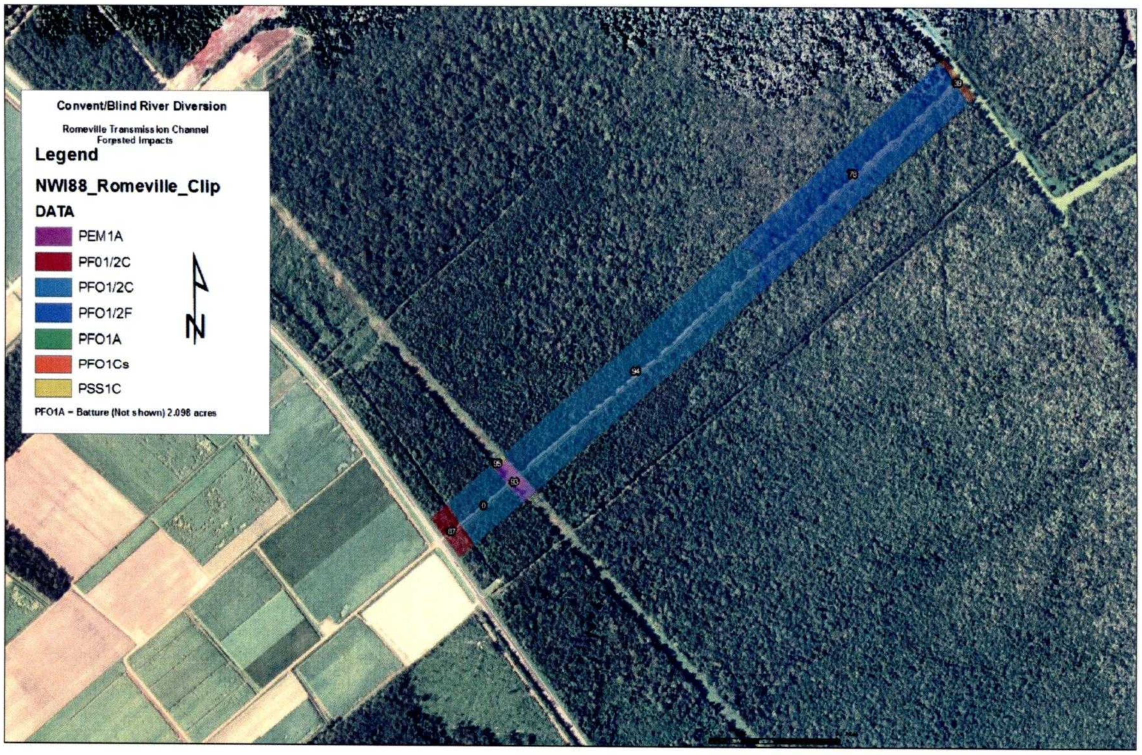


Figure 6. Forested Impacts Associated with the South Bridge Transmission Channel (Alternative 4A and 6)

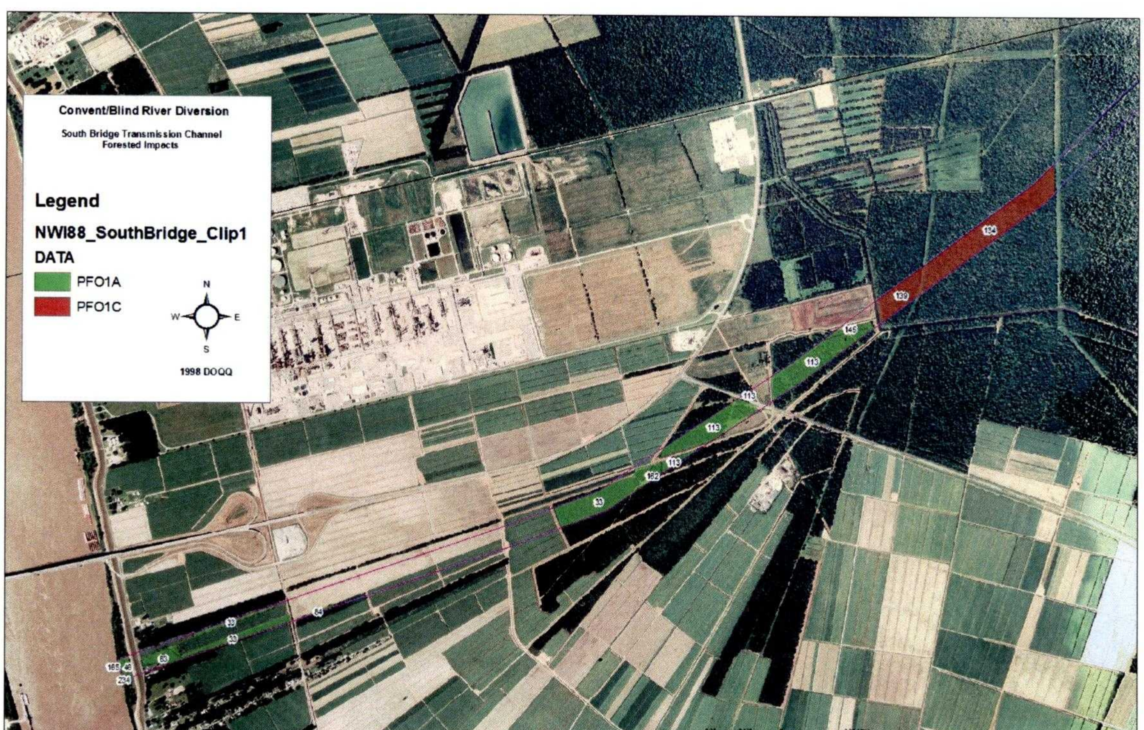


Figure 7. Forested Impacts Associated with the Outfall Canal (Alternatives 4A, 4B, & 6).

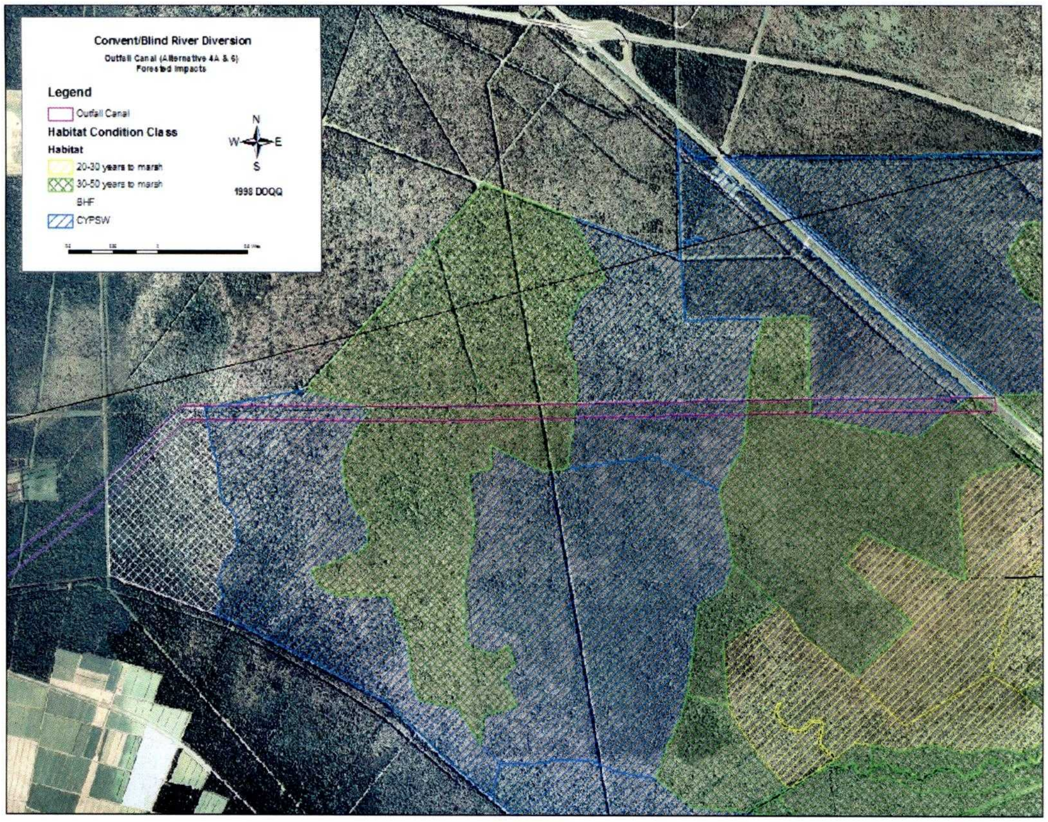


Figure 8. Forested Impacts Associated with Widening St. James Parish Canal (Alt. 4B)

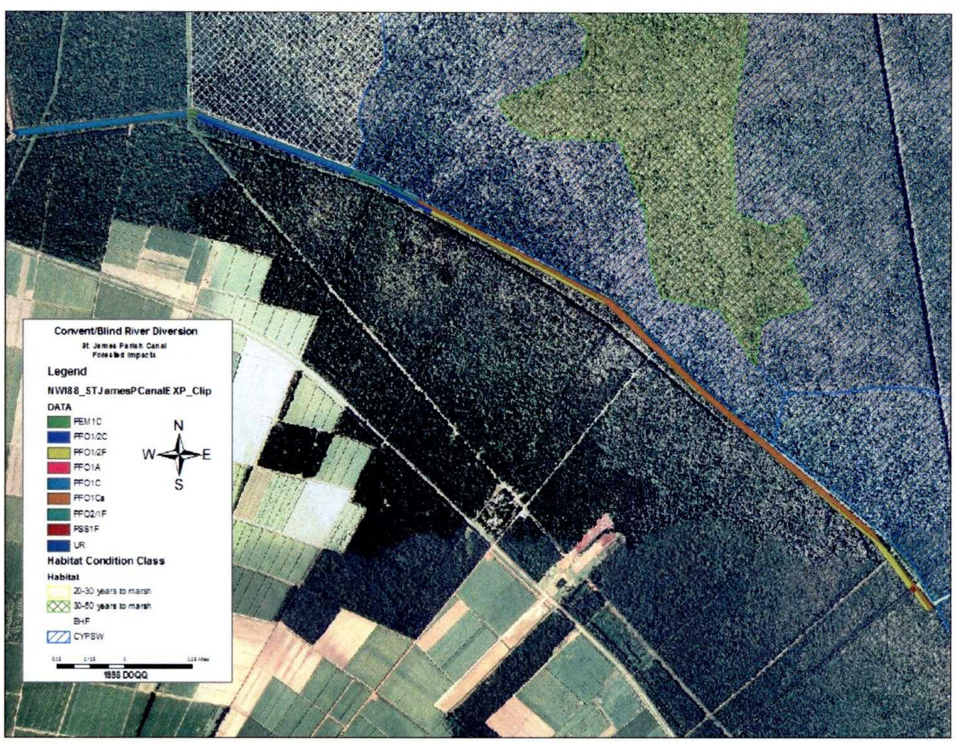


Table 12. Summary of Total Acres Benefited and Impacted.

	Acres			
Benefits	Alternative 2	Alternative 4A	Alternative 6,	4B
High IA, 20-30 years to marsh	169	169	169	169
High IA, 30-50 years to marsh	3364	1827	3848	3848
High IA, >50 years to marsh	4555	3550	5361	5361
Moderate IA, 20-30 years to marsh	204	1837	2041	2041
Moderate IA, 30-50 years to marsh	604	2972	3579	3579
Moderate IA, >50 years to marsh	2607	2070	4691	4691
Low IA, 20-30 years to marsh	2397	0	1085	1085
Low IA, 30-50 years to marsh	1669	2013	469	469
Low IA, >50 years to marsh	469	1799	0	0
No IA, 20-30 years to marsh	525	1289	0	0
No IA, 30-50 years to marsh	2297	1073	0	0
No IA, >50 years to marsh	2509	2607	0	0
Benefits Total	21,369	21,206	21,243	21,243
Impacts				
Outfall Area				
High IA, 30-50 years to marsh	0	36	28	28
High IA, >50 years to marsh	0	52	40	40
Moderate IA, 30-50 years to marsh	0	13	10	10
Moderate IA, >50 years to marsh	0	62	48	48
Transmission Channel				
FWetlands, Seasonally Flooded	31	39	70	39
FWetlands, Temporarily Flooded	2	69	71	69
FWetlands, Semipermanent Flooded	20	0	20	0
St. James Parish Canal Modificaitons				
FWetlands, Seasonally Flooded	0	0	0	22
FWetlands, Semipermanent Flooded	0	0	0	50
Impacts Total	53	271	287	306
Combined Total Acres	21,422	21,477	21,530	21,549

Table 13. Summary of Total AAHUs.

	Average Annual Habitat Units (AAHUs)			
Benefits	Alternative 2	Alternative 4A	Alternative 6,	4B
High IA, 20-30 years to marsh	77	77	77	77
High IA, 30-50 years to marsh	1350	733	1545	1545
High IA, >50 years to marsh	1293	1014	1532	1532
Moderate IA, 20-30 years to marsh	93	828	919	919
Moderate IA, 30-50 years to marsh	243	1182	1423	1423
Moderate IA, >50 years to marsh	745	585	1325	1325
Low IA, 20-30 years to marsh	935	0	354	354
Low IA, 30-50 years to marsh	527	663	137	137
Low IA, >50 years to marsh	110	447	0	0
No IA, 20-30 years to marsh	72	163	0	0
No IA, 30-50 years to marsh	585	237	0	0
No IA, >50 years to marsh	431	373	0	0
Benefits Total	**6,462**	**6,302**	**7,313**	**7,313**
Impacts				
Outfall Area				
High IA, 30-50 years to marsh	0	-17.07	-13.28	-13.28
High IA, >50 years to marsh	0	-30.19	-23.22	-23.22
Moderate IA, 30-50 years to marsh	0	-6.09	-4.69	-4.69
Moderate IA, >50 years to marsh	0	-35.69	-27.63	-27.63
Transmission Channel				
FWetlands, Seasonally Flooded	-25.87	-32.55	-58.43	-32.55
FWetlands, Temporarily Flooded	-1.67	-56.33	-57.96	-56.33
FWetlands, Semipermanent Flooded	-13.50	0	-13.5	0
St. James Parish Canal Modificaitons				
FWetlands, Seasonally Flooded	0	0	0	-18.36
FWetlands, Semipermanent Flooded	0	0	0	-33.76
Impacts Total	-41.04	-177.92	-198.71	-209.82
Combined Total AAHUS	**6,421**	**6,124**	**7,114**	**7,103**

Literature Cited

Conner, W.H., J.G. Gosselink, and R.T. Parrondo. 1981. Comparison of the vegetation of three Louisiana swamp sites with different flooding regimes. Amer. J. Bot. 68(3): 320-331.

Conner, W.H., J.R. Toliver, and F.H. Sklar. 1986. Natural regeneration of baldcypress (*Taxodium distichum* (L.) Rich) in a Louisiana swamp. Forest Ecology and Management 14:305-317.

Day, F.P., Jr., 1985. Tree growth rates in the periodically flooded Great Dismal Swamp. Castanea, 50: 89-95.

Dicke, S.G. and J.R. Toliver. 1990. Growth and development of baldcypress-water tupelo stands under continuous versus seasonal flooding. Forest Ecology and Management 33.34:523-530.

R. Effler, G. Shaffer, S. Hoeppner and R. Goyer, Ecology of the Maurepas Swamp: effects of salinity, nutrients, and insect defoliation. In: W.H. Conner, T.W. Doyle and K.W. Krauss, Editors, Ecology of Tidal Freshwater Forested Wetlands of the Southeastern United States, Springer, Dordrecht, The Netherlands (2007), pp. 349–384.

P.A. Keddy, D. Campbell, T. McFalls, G.P. Shaffer, R. Moreau, C. Dranguet, and R. Heleniak. 2007. The Wetlands of Lakes Pontchartrain and Maurepas: Pass, Present and Future. Environmental Reviews. 15: 43-77.

Kozlowski, TT. 1984. Plant responses to flooding of soil. BioScience 34:162-167.

Louisiana Coastal Wetlands Conservation and Restoration Task Force (LCWCRTF) and the Wetlands Conservation and Restoration Authority. 1999. Coast 2050: Toward a Sustainable Coastal Louisiana, The Appendices. **Appendix C**— Region 1 Supplemental Information. Louisiana Department of Natural Resources. Baton Rouge, La.

U.S. Environmental Protection Agency (EPA). 2001. Wetland Value Assessment Revised Project Information Sheet: Diversions into the Swamps South of Lake Maurepas.

Shaffer, G.P., Perkins, T.E., Hoeppner, S., Howell, S., Bernard, H., and A.C. Parsons. 2003. Ecosystem health of the Maurepas Swamp: feasibility and projected benefits of a freshwater diversion. U.S. Environmental Protection Agency, Region 6, Dallas, TX.

Shaffer G.P., M. Hester, P. Kemp, H. Mashriqui, J. Day, and R. Lane. 2001. Diversion into the Maurepas Swamps: A Complex Project under the Coastal Wetlands Planning, Protection, and Restoration Act. U.S. Environmental Protection Agency, Region 6, Dallas, Texas.

Thomson, D.A. 2000. The influence of hydrological alterations upon wetland hydrodynamics and plant growth on the Manchac Landbridge, Southeastern Louisiana, USA. Master's Thesis, Southeastern Louisiana University, Hammond, LA. 90 pp.

Thomson, D.A., Shaffer, G.P. and McCorquodale, J.A. 2002. A potential interaction between sea-level rise and global warming: implications for coastal stability on the Mississippi River Deltaic Plain. Global Planet. Change, 32: 49-59.

U.S. Army Corps of Engineers 2009. Draft Individual Environmental Report (IER) 11, Tier 2 Pontchartrain: Improved Protection on the Inner Harbor Navigation Canal, Orleans Parish, Louisiana.

Visser, J.M. and C.E. Sasser 1995. Changes in tree species composition, structure and growth in a bald cypress-water tupelo swamp forest, 1980- 1990. Forest Ecology and Management 72: 19- 129.

Comparison of Relative Sea-level Rise Scenarios

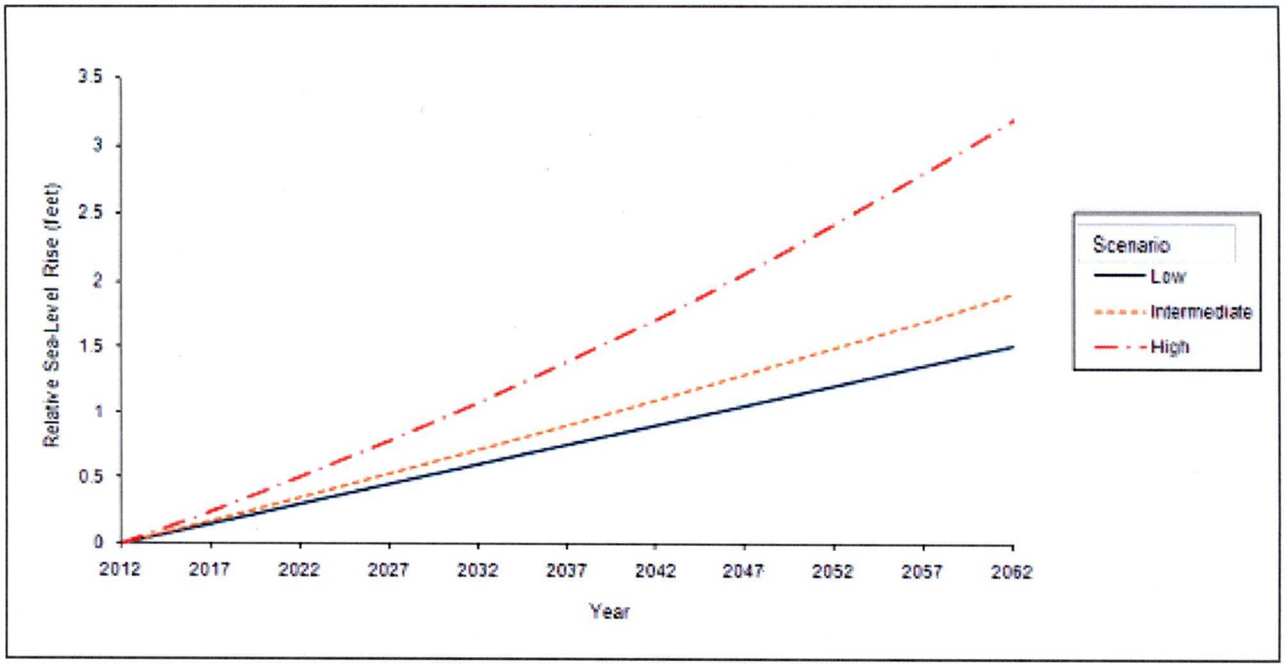
The direct impact of the diversion of water from the Mississippi River at Romeville for the low sea level rise scenario would be a reduction in the average water depth relative to the existing condition in the Blind River and Maurepas Swamp for 20 years and 30 years. For the intermediate sea level rise scenario there would be a reduction in the average water depth relative to the existing condition for 20 years. For the high sea level rise scenario there would be no reduction in the average water depth relative to the existing condition. As sea level rises water depth can be expected to increase accordingly throughout the swamp.

Based on hydrologic and hydrodynamic modeling, CDM has projected that for the low relative sea level rise scenario the project area will experience average annual water depths of 1.46, 1.67, and 2.11 feet in target years 20, 30, and 50, respectively. For the high sea level rise scenario the project area will experience average annual water depths of 1.79, 2.26, and 3.46 feet in target years 20, 30, and 50, respectively. Finally, for the intermediate sea level rise scenario the project area will experience average annual water depths of 1.54, 1.80, and 2.42 feet in target years 20, 30, and 50, respectively (Figure 1).

Table 1. Projected relative sea-level rise (feet) over the project life (2012-2062) in 5-year increments for low, intermediate, and high scenarios in the project area based on West End at Lake Pontchartrain tide gage daily stage data from 1959-2009 and USACE Circular No. 1165-2-211 (2009).

	Relative Sea Level Rise (feet)		
YEAR	LOW	INTERMEDIATE	HIGH
2012	0	0	0
2017	0.15	0.17	0.24
2022	0.30	0.35	0.51
2027	0.45	0.53	0.78
2032	0.60	0.72	1.08
2037	0.75	0.90	1.39
2042	0.91	1.10	1.72
2047	1.06	1.29	2.06
2052	1.21	1.49	2.42
2057	1.36	1.70	2.80
2062	1.51	1.90	3.19

Figure 1. Projected relative sea-level Rise (ft) over the project life (2011-2061) for low, intermediate and high scenarios.



Based on the available hydrologic hydrodynamic modeling the following assumptions were made (Table 2). The direct impact of the diversion of water from the Mississippi River at Romeville for the low sea level rise scenario would be a reduction in the average water depth relative to the existing condition in the Blind River and Maurepas Swamp for 20 years and 30 years. For the intermediate sea level rise scenario there would be a reduction in the average water depth relative to the existing condition for 20 years. For the high sea level rise scenario there would be no reduction in the average water depth relative to the existing condition. As sea level rises water depth can be expected to increase accordingly throughout the swamp.

Table 2: Alternative 2, Water Regime Relative to Sea Level Rise

	TY0		TY1		TY20		TY30		TY50	
RSLR*	**duration-exchange**	**SI**	**duration-exchange**	**SI**	**duration-exchange**	**SI**	**duration-exchange**	**SI**	**duration-exchange**	**SI**
Intermediate										
FWOP	semiperm-low	0.45	perm-low	0.45	perm-low	0.30	perm-low	0.30	perm-low	0.30
high influence	semiperm-low	0.45	seasonal-high	1.00	semipermanent-high	0.75	semiperm-high	0.75	semiperm-high	0.75
moderate	semiperm-low	0.45	seasonal-high	1.00	semipermanent-high	0.75	semiperm-high	0.75	semiperm-high	0.75
low	semiperm/perm-low	0.40	seasonal-moderate	0.85	semiperm-moderate	0.65	perm/semiperm-moderate	0.55	perm/semiperm-moderate	0.55
no influence	semiperm-low	0.45	seasonal-low	0.70	semiperm-low	0.45	semiperm-low	0.45	semiperm-low	0.45
Low										
FWOP	semiperm-low/ perm/low	0.45 /0.4	semiperm-low/ perm/low	0.45 /0.4	semiperm-low/ perm-low	0.45 /0.4	semiperm-low/ perm-low	0.45 /0.4	perm-low	0.4
high influence	semiperm-low	0.45	seasonal-high	1.00	seasonal-high	1.00	seasonal-high	1.00	semiperm-high	0.75
moderate	semiperm-low	0.45	seasonal-high	1.00	seasonal-high	1.00	seasonal-high	1.00	semiperm-high	0.75
low	semiperm/perm-low	0.40	seasonal-moderate	0.85	seasonal-moderate	0.85	semiperm-mod	0.65	semiperm-moderate	0.65
no influence	semiperm-low	0.45	seasonal-low	0.70	seasonal-low	0.70	seasonal-low	0.70	semiperm-low	0.45
High										
FWOP	semiperm-low	0.45	semiperm-low	0.45	perm-mod	0.45	perm-mod	0.45	perm-mod	0.45
high influence	semiperm-low	0.45	seasonal-high	1.00	semiperm-high	0.75	semiperm-high	0.75	perm-high	0.65
moderate	semiperm-low	0.45	seasonal-high	1.00	semiperm-high	0.75	semiperm-high	0.75	perm-high	0.65
low	semiperm/perm-low	0.40	seasonal-moderate	0.85	perm-moderate	0.45	perm-mod	0.45	perm/high	0.65
no influence	semiperm-low	0.45	seasonal-low	0.70	semiperm-moderate	0.65	semiperm-moderate	0.65	perm-mod	0.45

* Accretion rates were not considered

Table 3: Comparison of Benefits under Low, Intermediate, and High Sea Level Rise Scenarios

Average Annual Habitat Units (AAHUs)			
Benefits	Intermediate SLR (Alternative 2)	Low SLR	High SLR
High IA, 20-30 years to marsh	77	81	71
High IA, 30-50 years to marsh	1350	1399	1189
High IA, >50 years to marsh	1293	1291	1004
Moderate IA, 20-30 years to marsh	93	98	86
Moderate IA, 30-50 years to marsh	243	251	213
Moderate IA, >50 years to marsh	745	744	580
Low IA, 20-30 years to marsh	935	1008	788
Low IA, 30-50 years to marsh	527	594	405
Low IA, >50 years to marsh	110	114	69
No IA, 20-30 years to marsh	72	81	74
No IA, 30-50 years to marsh	585	651	607
No IA, >50 years to marsh	431	470	415
Benefits Total	**6,462**	**6,782**	**5,500**
Impacts			
Transmission Channel			
FWetlands, Seasonally Flooded	-25.87	-26	-26
FWetlands, Temporarily Flooded	-1.67	-2	-2
FWetlands, Semipermanent Flooded	-13.5	-14	-13
Impacts Total	-41.04	-41	-41
Combined Total AAHUs	6,421	6,741	5,459

Table 4. Metric Analysis Summary for Average Annual Water Depth, Frequency of Dryout, and Backflow Prevention for Sea Level Rise (SLR) over 20, 30 and 50 years for the entire project site.

Existing Conditions (with Berm Cuts)				
	Project Life (yr)	**Low SLR**	**Intermediate SLR**	**High SLR**
Average Annual Water Depth (ft)	20	0.96	1.01	1.21
	30	1.11	1.22	1.62
	50	1.48	1.76	2.69
Frequency of Dryout Conditions (%) (<0.5 ft)	20	14%	13%	6%
	30	8%	6%	2%
	50	3%	2%	1%
Backflow Prevention (%)	20	11%	9%	6%
	30	7%	6%	3%
	50	4%	3%	1%

Table 5. Metric Analysis Summary for Average Annual Water Depth, Frequency of Dryout, and Backflow Prevention for Sea Level Rise (SLR) over 20, 30 and 50 years for the entire project site.

Alternative 2: Romeville Diversion = 3,000 cfs

	Project Life (yr)	Low SLR	Intermediate SLR	High SLR
Average Annual Water Depth (ft)	20	1.46	1.54	1.79
	30	1.67	1.8	2.26
	50	2.11	2.42	3.46
Frequency of Dryout Conditions (%) (< 0.5ft)	20	8%	6%	2%
	30	4%	2%	1%
	50	1%	1%	0%
Backflow Prevention (%)	20	38%	36%	33%
	30	34%	33%	29%
	50	31%	28%	21%
Average Annual TSS Loading (mm/yr)	20	2.1	2.2	2.4
	30	2.3	2.4	2.6
	50	2.6	2.7	2.8