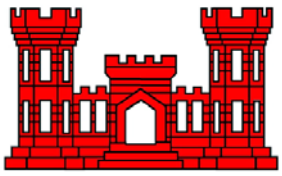
# Appendix Q
## Part 1

### U.S. Fish and Wildlife Coordination Act Report



**U.S. Army Corps of Engineers**
**Memphis District**

# ST. JOHNS BAYOU AND NEW MADRID FLOODWAY

# PROJECT

**Draft**
**Fish and Wildlife**
**Coordination Act Report**

By

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July 2013

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## Executive Summary

This is a summary of the findings and recommendations of the U.S. Fish and Wildlife Service (Service) and the Missouri Department of Conservation (MDC) contained in the Fish and Wildlife Coordination Act Report for the U.S. Army Corps of Engineers (Corps) St. Johns Bayou and New Madrid Floodway, Missouri, East Prairie Phase, Re-evaluation Study. The Corps has identified two alternatives that include: vegetative clearing along 4.3 miles of rural channels; channel enlargement along the St. Johns Bayou, the Setback Levee ditch, and St. James Ditch east of East Prairie; and a 1,000 cubic feet per second (cfs) pumping station near the existing gravity drainage outlet in St. Johns Bayou. The project also includes a 1,500 cfs pumping station at the mouth of the New Madrid Floodway in conjunction with a separately authorized levee closure.

The St. Johns Bayou basin and the New Madrid Floodway are drainages comprising part of the historic Mississippi River floodplain, and although highly altered, still perform floodplain functions critical to regional fish and wildlife resources. The New Madrid Floodway is unique in Missouri because it is the only significant portion of the historic Mississippi River floodplain still largely connected to the river. This ecologically valuable connection results in exchange of water, nutrients, and energy between the riverine and the wetland and terrestrial ecosystems inland. It is this regular exchange of water, nutrients, and energy (e.g., successional set back of plant communities) that makes this area so diverse and valuable to wildlife, while at the same time providing services to society in the form of flood-water storage and water filtration. Large portions of Mississippi and New Madrid counties, including the proposed project area, support fish and wildlife habitats and natural communities different from the rest of southeast Missouri (i.e., the Bootheel). High biodiversity is reflected by the large number of state-listed (Threatened and Endangered) plant, mussel, fish, amphibian, reptile, bird, mammal, and natural communities recorded in those counties, which is related in large part to the hydrologic influence of the Mississippi River on the lower St. Johns Bayou basin and New Madrid Floodway. The proposed project area still functions as an integral part of the Mississippi River ecosystem, and provides important habitats for neotropical migratory songbirds, and migratory waterfowl, waterbirds and shorebirds. The forested wetlands in the study area are only a small remnant of a once-extensive floodplain complex and are becoming increasingly scarce. That habitat has become so rare that it is now considered critical as refugia for a variety of scarce fish and wildlife species that formerly flourished throughout the lower Mississippi River. In spite of extensive modification, the river and its diverse connected wetlands within the proposed project area support nationally significant fish and wildlife resources that enhance biodiversity state-wide and regionally, and help preserve what is left of the ecological integrity of the lower Mississippi River.

The Tentatively Selected Plan (TSP) will eliminate spring overbank flooding that periodically inundates tens of thousands of acres in the St. Johns Bayou basin and the New Madrid Floodway. Upon receding, those flood waters produce thousands of acres of shallow, temporarily flooded wetlands in a variety of cover types. A wide variety of waterfowl, numerous other wetland dependent birds, amphibians, invertebrates, and mammals use those habitats during all or part of their life cycle. Some of the largest remaining forested wetland tracts in southeast Missouri are found in the project area and would be negatively affected by either project alternative. Approximately 27,731 acres of wetlands would no longer be seasonally inundated by backwater flooding under the TSP. Reduced flooding will result in a decrease of at least 900,000 and almost 4,200,000 Duck Use Days (in the St. Johns and New Madrid basins respectively) during spring

migration, a critical period for most ducks as they enter the reproduction phase of their life cycle. Project implementation will decrease fish spawning and rearing habitat values by approximately 50 percent in the St. Johns Bayou basin and at least 93 percent in the New Madrid Floodway. In addition, closing the levee to prevent natural spring flooding from the Mississippi River will virtually eliminate fish access to the Floodway during the critical spawning season.

We are greatly concerned about altering the extent and timing of seasonal flooding in the project area not only because of adverse impacts upon numerous Federal and State trust resources, but also because of the potential adverse impacts to the regional ecosystem and cumulative impacts in the Lower Mississippi Valley. The Corps has proposed reforesting 9,423 acres of frequently flooded croplands (i.e. farmed wetlands) near the project area to compensate for project-related fish and wildlife habitat losses. That plan, however, would result in a net loss of wetland acreage and functions within the project area, and a regional net loss of wetland acreage. In addition, although the proposed mitigation measures would compensate a portion of lost wetland value to fish and wildlife, they would not mitigate impacts to floodwater storage, nutrient cycling or detrital export/import, water quality changes, etc.. Fish and wildlife species with limited mobility (i.e., reptiles and amphibians) will experience a net loss of habitat within the project area that will not be compensated through the proposed mitigation lands. For those reasons, the Service urges the Corps to pursue measures to avoid project impacts rather than try to compensate for them after the fact.

## Summary and Recommendations

The TSP will eliminate spring overbank flooding that currently may cover tens of thousands of acres in the St. Johns Bayou basin and the New Madrid Floodway. Upon receding, those flood waters produce thousands of acres of shallow, temporarily flooded wetlands in a variety of cover types. A variety of waterfowl, numerous other wetland dependent birds, amphibians, invertebrates, and mammals benefit from those habitats. Some of the largest remaining forested wetland tracts in southeast Missouri are found in the project area and would be negatively affected by the TSP. Seasonal backwater flooding in the New Madrid Floodway provides important floodplain habitat that supports an extremely abundant and diverse fish fauna (both floodplain and riverine), some of which are becoming regionally scarce. The interchange between the Floodway and the river supports a sustainable ecosystem not found elsewhere along the Mississippi River in Missouri. Alterations in the extent and timing of seasonal flooding in the project area greatly concern the Service not only because of adverse impacts upon numerous Federal and State trust resources, but also because of the potential adverse impacts to the study area ecosystem and cumulative impacts in the Lower Mississippi Valley.

The Corps has proposed reforesting 9,423 acres of frequently flooded croplands (i.e. farmed wetlands) near the project area to compensate for project-related fish and wildlife habitat losses. That plan, however, would result in a net loss of wetland acreage and functions within the project area, and a regional net loss of wetland acreage. In addition, although the proposed mitigation measures would compensate a portion of lost wetland habitat value, they would not mitigate impacts to floodwater storage, nutrient cycling or detrital export/import, and water quality changes. Fish and wildlife species with limited mobility (i.e., reptiles, amphibians, and larval fishes) will experience a net loss of habitat within the project area that may not be compensated

through the proposed mitigation lands. For those reasons, the Service urges the Corps to pursue measures to avoid project impacts rather than try to compensate for them after the fact.

Because the project will negatively affect nationally significant fish and wildlife resources in the project area, the Service recommends that the Corps implement the following measures to ensure that fish and wildlife receive equal consideration with other project purposes:

1.) Construct the St. Johns Bayou Basin only alternative (2.1) that will avoid significant losses of fish and wildlife habitat and functions, while providing flood risk reduction focused on urban and residential areas, as well as public infrastructure.

2.) Minimize dredging and channel modifications to the maximum extent possible by implementing the following conservation measures:

a.) Installing gradient control structures at the upper end of all work reaches and at the mouths of all major tributaries to prevent headcutting.

b.) Installing transverse dikes in the Setback Levee Ditch and the St. Johns Bayou reach to offset fisheries habitat losses from shallower water depths. Those dikes should be designed to maintain a sinuous, continuous thalweg along the length of the channel.

c.) Constructing a low-head weir where the Lee Rowe ditch branches off the St. James ditch to prevent perching that channel during base flows.

d.) Constructing vortex weirs in the St. James Ditch to compensate for habitat losses from shallower water depths along those reaches. Vortex weirs may also function as grade control structures.

e.) Avoiding dredging impacts to the maximum extent possible in the entire reach of the St. James ditch that contains suitable habitat for the State-listed golden topminnow.

f.) Avoiding dredging in a 9-foot strip along the right descending side of the Setback Levee ditch to reduce dredging impacts to mussels and possibly leave a population to recolonize the ditch. In addition, a minimum of 1,500 mussels (species composition to be determined by the Service and MDC) should be relocated from selected sites within the dredge path to other appropriate areas in the St. Johns basin. A long-term monitoring plan should be developed, in coordination with the Service and MDC, to determine the success of those mitigation measures. In addition, that monitoring plan should contain a provision to evaluate the suitability of the above-mentioned dikes, weirs, and gradient control structures as mussel habitat.

3.) Evaluate non-structural measures (e.g., flooding easements) to address agricultural flood damages in the New Madrid Floodway. If those are infeasible, the Corps should investigate alternative levee closure locations, such as that proposed by MDC, further north in the Floodway to avoid significant adverse effects to fish and wildlife.

4.) If the Corps determines there are no feasible flood control measures other than the TSP, they should incorporate the following measures as integral features of the selected plan:

a.) Prevent the conversion of forested wetlands in both basins due to project-related hydrologic changes. This should be done by purchasing a conservation easement or other protective measure on forested wetlands between elevations 291 and 290.4 feet NGVD in the St. Johns basin, and between 292.1or 287.6 feet NGVD in the Floodway.

b.) Fully compensate all unavoidable losses to fish and wildlife resources. Compensation measures should include the following measures:

- Reforest cropland to compensate for forested wetlands habitat losses associated with channel enlargement, levee closure and pump operations (i.e., altered hydrology). If protective covenants have not been placed on bottomland hardwood forests as described in 4(b), the Corps should reforest an additional acres to compensate for induced forested wetland losses because project-related reductions in flooding.

- Reforest cropland to compensate for losses in spring waterfowl migration habitat. Acreage to compensate for forested wetland losses mentioned above could also meet waterfowl compensation needs, provided the sites were reforested with at least 50 percent red oak species and flooded during late winter and early spring to depths no greater than 24 inches.

- Reforest flooded cropland that has unimpeded access for river fish during the spawning season (i.e., March through June) to compensate fisheries spawning and rearing habitat losses on the floodplain (excluding seasonally-connected waterbodies - see below).

- To the maximum extent possible, mitigate in-kind (i.e., similar habitat) for fisheries habitat losses of permanent waterbodies. This could include improving existing permanent waterbodies, or reconnecting old chutes, sloughs, and oxbows with the Mississippi River. If in-kind mitigation is infeasible, reforest additional acres of flooded cropland to compensate for those losses. Those sites must be easily accessible to river and floodplain fishes during the spawning season (i.e., March through June). The Corps should ensure public access to those sites through fee-title purchase or easements.

- Provide shallow flooded (i.e., # 18 inches) land during spring and fall migration to compensate for project-related losses in shorebird migration habitat. Constructing moist soil areas to mitigate those losses would reduce the necessary acreage compare to cropland.

- Use both the Missouri Stream Mitigation Method and the Missouri Wetlands Assessment Method to assess project impacts and compensatory mitigation for wetlands and streams and conduct a review that includes the IRT.

- Acquisition of mitigation lands, reforestation, and shorebird management measures should be accomplished concurrently with most project construction activities, except for constructing the New Madrid Floodway Levee closure, and should be in place prior to

project operation. Closure of the 1,500-foot levee gap should not be constructed until all mitigation measures are in place and functioning as planned.

- Provide a detailed adaptive management program to manage all compensatory mitigation features as well as modifications to proposed project operations to fully offset losses of fish and wildlife resources.

- Do not include existing conservation lands (e.g., Ten Mile Pond Conservation Area) lands as part of compensatory mitigation for this project.

Should the Corps pursue a Floodway closure alternative, we recommend alternative 4.1 which would have the fewest effects to fish and wildlife with minimal changes to project benefits, and a higher cost:benefit ratio than the preferred alternative.

## Service Position

The proposed project TSP attempts to solve a local flooding problem for a select group of stakeholders within a river floodplain that influences populations of fish, wildlife, and people at much larger scales. The Corp treatise does not address larger scale conservation issues, including flood water storage and water filtration or the current and predicted dynamic nature of the Mississippi River and connecting wetland systems. Changes occurring in the rest of the Mississippi River watershed as well as our climate will likely add challenge to living in the floodplain. Expanding (not reducing) the area of natural communities providing buffering properties to society must increasingly be viewed as the preferred alternative (and less costly than engineered solutions) to flood control. Well placed fish and wildlife habitat conservation lands can serve to meet wildlife objectives while providing ecological goods and services, such as flood attenuation, to society.

Although replacement of the proposed fish and wildlife habitat losses in this unique system is nearly impossible, the Service and the Corps have strived to estimate measures that fully address project-related impacts to Federal trust resources. However, providing the appropriate area of cover types (i.e., bottomland hardwood forests, moist soil, borrow pits) only partially meets the needs of fish and wildlife. To fully compensate for project-related impacts, fish and wildlife habitat quality and functions must also be maintained. While the proposed mitigation plan could potentially compensate some portion of fish and wildlife habitat losses that can be quantified with current models for estimating wildlife effects of water development projects, it would not, unfortunately, retain ecological functions of a connected floodplain-river ecosystem in the project area.

The Service has been intimately involved with the Corps throughout the last several years of project planning and we continue to have significant concerns regarding potential project effects to fish and wildlife resources, as detailed in the Department of the Interior's August 26, 2011, letter to Assistant Secretary Darcy. In spite of our repeated concerns, current project plans remain little changed from the original alternative which previously was the subject of two referrals to the Council on Environmental Quality, and federal litigation. The project would

essentially eliminate a unique landscape and ecological feature in southeast Missouri and result in loss of thousands of acres of wetlands and their connection to the Mississippi River that cannot be adequately mitigated. This would occur as a result of a project with vaguely defined crop optimization benefits on some portions of both basins.

The Service opposes the New Madrid Floodway component of the preferred alternative because:

1.) As proposed, the New Madrid project features would cause substantial, irretrievable losses of nationally significant fish and wildlife resources, and greatly diminish rare and unique habitats found in southeast Missouri.

2.) We believe project-related wetlands losses are at odds with the federal conservation policy goals and sustainable water resources development.

3.) The St. Johns Basin only alternative (Alternative 2.1) is a technically and economically feasible alternative that would meet the project purpose while avoiding losses to nationally significant fish and wildlife resources.

If the Corps proceeds with project construction, at a minimum, they should include the Service's above-mentioned recommendations as integral components of the project.

## Introduction

The St. Johns Bayou and New Madrid Floodway Project was authorized for construction by the Water Resources Development Act of 1986. The original project included 130 miles of channel widening and clearing, construction of a 1,000 cubic-feet-per-second pump station at the outlet of St. Johns Bayou, construction of a 1,500 cfs pump station at the outlet of East Bayou (Mud) Ditch on the Floodway, and several mitigation features. The project also included closure of a 1,500-foot gap in the Mississippi River Frontline Levee at the lower end of the New Madrid Floodway authorized by the 1954 Flood Control Act. A Feasibility Report and Environmental Impact Statement for the original project were filed in 1976 and a Supplemental EIS was completed in 1982. The U.S. Army Corps of Engineers (Corps) completed the Phase II General Design Memorandum in 1986, and it serves as the basis for the current re-analysis. The original project was never constructed because the local sponsor(s) could not meet cost-share requirements.

In 1996, Congress appropriated funds for the Corps to reformulate the original project. At the same time, the U.S. Department of Agriculture (USDA) designated the community of East Prairie, Missouri, which lies within the St. Johns Bayou basin, an Enterprise Community. In addition, the 1996 Water Resources Development Act exempted the East Prairie Phase from normal cost-sharing requirements, allowing USDA funds allotted to the community of East Prairie to be used to fulfill non-federal cost share requirements for a reformulated East Prairie Phase of the project. The purpose of the East Prairie Phase of the St. Johns Bayou and New Madrid Floodway Project is economic and infrastructure development in the project area (U.S. Army Corps of Engineers 1997). It includes 23.4 miles of channel work within the St. Johns Bayou basin, the St. Johns Bayou pump station, the New Madrid Floodway pump station, and the frontline levee gap closure. The project will provide a 25-year level of flood protection to the immediate area in and around East Prairie, and a 1.1-year level of flood protection to the New Madrid Floodway.

The Corps issued a Final EIS for the project in October 2000. The Service, through the Department of the Interior (DOI) and the Environmental Protection Agency (EPA) referred the project to the Council on Environmental Quality (CEQ) because of adverse effects to fish, wildlife and nationally significant aquatic resources. The Corps prepared a Supplemental EIS in 2002. The Service continued to oppose the Corps' preferred alternative and recommended an alternative that avoided closure of the Floodway. The Service informed the Corps the 1999 Biological Opinion was still applicable as the project effects to listed species were essentially unchanged. Missouri Department of Natural Resources initially denied the Section 401 certification for the project, but eventually resolved the remaining issues with the Corps through modifications of the 401 cert. In September 2004, Environmental Defense and other conservation groups filed suit in Federal Court against the Corps because of concerns regarding NEPA and Clean Water Act violations.

In June 2005, the Corps filed a motion with the court to remove the case from consideration and correct inconsistencies in the Final EIS regarding fisheries and wetland losses. The Corps issued a revised SEIS (RSEIS 2) and ROD later that year. While the court case was pending, the Corps began constructions of the levee closure and acquisition of mitigation lands. In June 2007, the

Court ruled the Corps was arbitrary and capricious in their effects analysis and ordered the EIS vacated and all work on the project deconstructed. Corps began project deconstruction in 2009.

From 2009 through 2011, the Corps conducted a series of Independent External Peer Reviews (IEPR) on the previous NEPA documents, as well as the models/tools used for project impacts assessment, and best available science (both natural resource and economic). Based on that input, the Corps provided the Service and EPA with a July 2011 internal revised draft EIS on the project. The Corps transmitted a revised Biological Assessment (BA) in an October 2011 letter to the Service. That BA concluded that the project is not likely to adversely affect the federally listed pallid sturgeon and interior least tern. At that time, the Corps also conducted an Independent Expert Panel Review (IEPR) of the DEIS so the Service deferred responding to the October letter pending the results of the review. In a May 1, 2012, draft Supplemental Fish and Wildlife Coordination Act (FWCA) report, the Service informed the Corps that the Corps preferred alternative appeared to be essentially the same project addressed by the 1999 Biological Opinion. The Service concurred with the Corps determination for the pallid sturgeon, however we noted that the project is likely to adversely affect the ILT. Should the Corps pursue their preferred alternative, they should contact the Service to discuss next steps in formal consultation.

The Corps provided the Service a June 21, 2012, request for initiation of formal consultation due to the agencies differing views on effects to the federally endangered pallid sturgeon and the ILT. The bald eagle was officially removed from federal listing in 2007. In a July 9, 2012, response to the Corps, the Service noted that the October 2011 BA did not include a complete project description, including effects to the species under consideration. We also noted the Corps had put the project on hold during development of a summer 2012 revised draft EIS. Thus the Service informed the Corps that we will continue to defer action on the BA pending a project document containing the information necessary to constitute a complete initiation package.

The Corps provided the Service a January 3, 2013, internal draft EIS on the project for our review and comment, with an expected January 18, 2013, public release. The Service provided the Corps a January 18, 2013, letter, with our preliminary comments on the draft expressing our continued concern regarding the effects of the project to fish and wildlife resources.

The latest version of the DEIS lists flood damage reduction as the primary project purpose, along with several ancillary socioeconomic objectives for the local communities. The vast majority of benefits accrue to agricultural lands.

This report supplements the analyses and recommendations provided by the Service in previous FWCA reports, planning aid letters, and comments on prior Environmental Impact Statements, which are incorporated by reference, including:

> USFWS May 2000. St. Johns Bayou and New Madrid Floodway Project, East Prairie Phase, FWCA report and June 2000 transmittal letter.
>
> USFWS June 2001. St. Johns Bayou and New Madrid Floodway Project, Scoping comments for revised draft Supplemental EIS.

USFWS July 2001. St. Johns Bayou and New Madrid Floodway Project, Planning Aid input on Floodway.

USFWS October 2001 FWCA letter report for revised Supplemental EIS.

USFWS June 2002. St. Johns Bayou and New Madrid Floodway Project, Supplemental FWCA report.

USFWS March 2006. St. Johns Bayou and New Madrid Floodway Project, Revised Supplemental, FWCA report.

DOl August 2011. Department of the Interior letter to Assistant Secretary of Civil Works recommending project reformulation.

The above-noted documents memorialize our longstanding coordination as part of our continuing FWCA input on this project, and can serve as a useful reference in project planning.

**Description of Project Area**

The St. Johns Bayou and New Madrid Floodway Project is located in southeast Missouri, adjacent to the Mississippi River and includes all or portions of New Madrid and Mississippi Counties (Figure 1). The project area extends from the vicinity of Commerce to New Madrid, Missouri. The area is divided into two drainage basins; the St. Johns Bayou basin and the New Madrid Floodway. The St. Johns Bayou basin covers approximately 324,173 acres and is drained by St. Johns Bayou through the Birds Point to New Madrid Setback Levee ditch via a gravity drainage structure near the City of New Madrid. The area is approximately 40 miles from north to south and reaches a maximum width of 25 miles. The basin has very low relief, ranging from 280 to 325 feet National Geodetic Vertical Datum (NGVD).

The New Madrid Floodway is approximately 33 miles long with a maximum width of 10 miles and covers 132,602 acres. The Floodway was authorized by the Flood Control Act of 1928 and constructed in the 1930s. In the event of a Mississippi River project flood, the Corps would breach the mainline levee along the Floodway to reduce flood stages in the vicinity of Cairo, Illinois and Paducah, Kentucky. The Floodway is bounded on the west by the Setback Levee, on the east by the Mississippi River Frontline Levee, and on the south by the Mississippi River. The upper third of this basin drains through a culvert in the Frontline Levee or via the Peafield Pumping Station during high river stages. The lower two-thirds of the basin drain through St. Johns Diversion Canal and Wilkerson Ditch into East Bayou Ditch (Mud Ditch) and then into the Mississippi River. Similar to St. Johns Bayou basin, the Floodway has little relief; elevations range between 280 and 315 feet NGVD. The New Madrid Floodway is unique in that it is the only significant portion of the historic Mississippi River floodplain in Missouri still largely connected to the river.

Originally part of the Mississippi River floodplain, both basins have been highly modified by intensive agriculture, the primary land use. The project area has undergone major alterations that have converted the landscape from 93 percent forested to over 80 percent agriculture (US Army Corps of Engineers 2013). The primary crops are soybeans, corn, cotton, wheat and milo.

The New Madrid Floodway was operated only two times so far: 1937 and 2011. After both events, some residents in the Floodway chose to relocate. During the 2011 Flood, the Floodway held approximately 90,000 acres of water for weeks that could have contributed to the flooding threats to up and downstream communities had the Floodway not been accessible. In spite of record flooding, most of the Floodway was planted in 2011 following Floodway operation (Olson and Morton 2012). In fact, some believe the impacts of floodwaters gouging soils at crevasse sites was in part due to the delay in operating the Floodway because of legal challenges (Olson and Morton 2012).

## Fish and Wildlife Resources

### Wetlands

Historically, the project area was covered by a mosaic of river meanders, oxbows, natural levees, forested wetlands, marsh, and open water. Federal flood control projects and Federal and local drainage projects, however, significantly altered the hydrology of the project area. Of an original 2.5 million acres of forested wetlands in southeast Missouri, approximately 50,000 acres remain (L.H. Fredrickson, cited in MDC 1989). Recently, the Service contracted a National Wetlands Inventory update of the much of the proposed project area (Table 1, Appendix A). Table 1 includes and Environmental Protection Agency assessment of area wetlands as well as updated figures used by the Corps of Engineers for project planning.

Within the project area, there are approximately 10,207 acres of forested wetlands. Most of those acres are bottomland hardwood forests found along the lower reaches of St. Johns Ditch in the St. Johns Bayou basin, and adjacent to the Ten Mile Pond Conservation Area and Big Oak Tree State Park in the Floodway. Bottomland hardwood forests are subject to regular seasonal flooding most years.

The Missouri Department of Conservation (MDC) has identified several significant examples of this rare community that occur in the project area (MDC 1999). The extent and duration of flooding determines the vegetation structure in any particular area resulting in an extremely diverse plant community. Tree species typically found in those forests are overcup oak, Nuttall oak, pin oak, willow oak, swamp chestnut oak, cherrybark oak, bald cypress, tupelo gum, sweetgum, sugarberry, green ash, pumpkin ash, American elm, black willow, black gum, cottonwood, water hickory, and red maple. Many of the forests in the project area also contain understory composed of swamp privet, buttonbush, possumhaw, sweet greenbriar, poison ivy, trumpet creeper, Virginia creeper, blackberry, and various herbaceous species.

The remaining forested wetlands in the proposed project area include riparian forest and deeper-water swamp, located in relatively low-lying areas. Riparian forests have vegetation similar to bottomland hardwood forests, and are found along the St. Johns Bayou, St. Johns Ditch, Mud Ditch, and most of the large drainage ditches. Deep-water swamps are found along old oxbows and permanently flooded lakes and ponds. They are typically flooded through much of the growing season, and in some cases all year. While swamps may contain tree species found in other forest types, the majority of vegetation consists of bald cypress, tupelo gum, red swamp maple, black willow, box elder, buttonbush, swamp privet, duckweeds, lizard's tail, and numerous other herbaceous species. MDC has identified several examples of this increasingly rare community occurring in the proposed project area including Big Oak Tree State Park, Ten Mile Pond and Weasel Woods (MDC 1999).

Scrub/shrub marsh and freshwater marsh are found in much smaller quantities in both basins, most of which is located on public land (e.g., Ten Mile Pond Conservation Area and Big Oak Tree State Park) and along perennial stream and lakes. Common shrub species in those habitats include young black willow, box elder, red maple, buttonbush, and swamp privet. Herbaceous species include rushes, cattail, giant cane, lizard's tail, smartweeds, and aquatic plants such as water lotus, coontail, duckweeds, Elodea, and water primrose. Although such plant communities have been highly altered, they can provide valuable wintering, migration, and breeding habitat for numerous species of fish and wildlife depending on the period and depth of inundation.

Open Waters

Permanent open water in the project area consists of natural streams, oxbows and ponds, ditches, and borrow pits. The sand and gravel alluvium underlying area lowlands act as a reservoir for storing precipitation. This water reserve is released slowly into the ditches creating well-sustained base flows (Pflieger 1997). Forested riparian corridors along reaches of major drainage ditches, streams, and borrow pits provide shade needed to sustain aquatic life by maintaining moderate summer water temperatures. These waterways vary greatly in size, water-current velocity, water clarity, depth, and amount of aquatic vegetation. Some ditches also contain deeper pools, woody debris, and a variety of emergent and submergent vegetation (Pflieger 1997). Lentic communities (i.e., borrow pits, oxbow lakes, and ponds) also contribute to diversity in the project area, which in turn supports an extremely diverse shellfish and finfish fauna.

Although more temporary, another aquatic component of the study-area critical to fish and wildlife are ephemeral ponds and overflow areas. Rainfall can produce these water features locally, particularly in the St. Johns Bayou basin. However, inundation from the Mississippi River produces up to tens of thousands of acres of this habitat annually. Such areas hold water for only days or weeks, yet are critical to migratory birds and breeding reptiles, amphibians, and fish.

Terrestrial Wildlife Resources

The Lower Mississippi River Valley extends nearly 500 miles from southern Illinois to the gulf coast and encompasses approximately 24 million acres. The New Madrid region includes southern Illinois and Indiana, the Missouri Bootheel, and western Kentucky. These are areas that have traditionally been important to migrating and wintering mallards. Wetlands in the New

Madrid region have been altered or lost at a rate even higher than wetlands in the main stem of the Lower Mississippi River Valley of Arkansas, Mississippi, Louisiana, and Tennessee.

In the project area, waterfowl are present throughout the year; wood duck, and to a lesser extent mallard, hooded merganser, and blue-winged teal, breed locally. However, it is non-breeding periods when the study are provides greatest value to waterfowl. The Lower Mississippi River Valley is the most important region for wintering mallards in North America. Mid-January census figures for the years 1970-89 ranged from 1.2 to 3.9 million mallards in the region. Five – 25 percent of the mallards observed during mid-winter surveys were recorded in the New Madrid Region. Surveys indicate that about 40,000 ducks (90 percent mallards) and 10,000 Canada geese use the periodically flooded areas of the St. Johns Bayou/New Madrid Floodway project area in late winter. Aerial surveys in December and January revealed an average of 31 percent (15,400) of Missouri's wintering Lower Mississippi River Valley mallard population occurring in this area. Large shallow-water areas (including farmed wetland) across the St. Johns Bayou basin and the New Madrid Floodway provide feeding and resting habitat for waterfowl during migration staging and wintering. Depending on continental population status, estimates of duck numbers migrating to southeast Missouri and northeast Arkansas range from 5-9 million (Figure 2, Bellrose 1980).

Migration is an important period of the waterfowl life cycle, where many species are pairing and building nutrient reserves, especially during late winter and spring. Hundreds of thousands of dabbling ducks (i.e., mallard, gadwall, green and blue-winged teal, northern pintail, American wigeon, shoveler, and American black duck), coots, and geese have been observed at the proposed project area following overflow of the Mississippi River and associated establishment of vast shallow-water conditions. In addition, diving ducks, such as lesser scaup, ring-necked duck, and canvasback use the deeper waters of the project area, with lesser scaup being a species of continental concern due to loss of quality migration habitat (Anteau et al. 2009). Wetlands available during these periods provide habitat to maintain birds in peak condition prior to winter and, even more importantly, provide essential dietary components to prepare mallards for reproduction in the spring.

Earliest fall migrations of waterfowl occur in mid-August when the first flocks of blue-wing teal arrive in the study area. Fall migration continues through late December and even early January as more winter-hardy species make their way south. Fall/winter migration has barely concluded before early migrants begin returning from the south, using the study area before most continue north to breeding areas in the mid-continent region. Wintering occurs at various latitudes and is dictated by habitat availability and freeze up, making the study area significant to waterfowl some years and less important other years. Warming winters in recent decades, has resulted northward patterns for wintering ducks in the Midwest (Soulliere et al. 2007) and the prediction is for still more birds to spend winters farther north as the climate continues to warm. Spring migration through the project area generally concludes by mid-March as the last of the shovelers and blue-wing teal depart. Because of their importance to waterfowl, wetlands in the proposed project area are a key component in the Lower Mississippi Valley Joint Venture conservation effort, a feature of the North American Waterfowl Management Plan (NAWMP 2004, 2012). Beyond waterfowl, the diverse aquatic communities in the project area also support hundreds of water-dependent and terrestrial bird species, both during breeding and migration. Although there are no rookeries (waterbird nest colonies) have been recorded in the study area for many years,

wading birds such as the great blue heron, little blue heron, great egret, snowy egret, and yellow-crowned night heron depend on project area wetlands for foraging.

During migration thousands of shorebirds, such as greater yellowlegs, killdeer, dunlin, short-billed dowitcher, American golden-plover, semipalmated plover and solitary sandpiper, rely on shallow water, overflow areas to forage, replenishing critical energy supplies for the flight to northern breeding grounds. Some experts estimate between 60-80% of the world population of American golden-plover utilize the Lower and Mid-Mississippi River valley in spring, several hundred thousand birds in all (Bob Russell, USFWS, pers. comm.). As many as 1,800 birds have been recorded in nearby Mississippi County Missouri on April 1 (Robbins and Easterla 1992) and similar numbers would be expected to occur within the proposed project area during optimum water and foraging conditions. These birds prefer shallowly flooded agricultural lands, exposed flats in wetland complexes, and occasionally Mississippi River sandbars where they only occur in small numbers. When agricultural lands dry out, migrating shorebirds will move on to other foraging sites along the flyway. Flooded field conditions lasting until May 1 provide optimal potential as staging and short-term stopover habitat for these species. Although shorebird migration through the study area may occur from late March through early November in most years, significant peaks when the majority of the bird move are approximately April through mid-May in the spring and mid-August through mid-October in the fall. During the winter months, there are very few shorebirds present in the study area, except for scattered killdeer and Wilson's snipe. American woodcock also winter in the study area in very low numbers, in bottomland forests.

Forested wetlands support a significantly higher abundance and diversity of birds species compared to upland forests (Brinson et al. 1981). In the project area, numerous species of raptors, woodpeckers, warblers, thrushes and flycatchers use bottomland hardwood forests as migration and breeding habitat. Mississippi kite and Swainson's warbler, both species of conservation concern, breed in the study area, as do many other species dependent on bottomland hardwood forests, such as red-shouldered hawks, prothonotary warbler, wood thrush, and Kentucky warbler among others. During peak spring and fall migration (late April thru mid-May and late August through September, respectively) huge numbers of migrating landbirds travel along the Mississippi River floodplain, with remaining forest fragments acting as critical stop over sites for these birds on their long journeys. Documented abundances of Dickcissels (60.4 average/year) in the Deventer Breed Bird Survey (U.S.G.S.), which includes in the New Madrid Floodway, is one of the highest averages of any count for this species in the Mississippi River Valley or further east (B. Russell, USFWS, pers. comm.).

Research has pointed to sharp population declines in several neotropical migratory songbird species (e.g., white-eyed vireo, northern parula, cerulean warbler), particularly those that require large forested tracts to successfully reproduce (Robbins et al. 1989, Askins et al. 1990). In the Lower Mississippi Valley, the Partners in Flight bird conservation partnership is focusing on forested wetlands conservation because 13 of their 14 priority species require bottomland hardwood forests for breeding. The Service, state agencies and the private sector are developing management objectives to protect forest breeding birds and their habitats in the Mississippi Alluvial Valley. As part of that effort they have identified Abirds conservation areas@ (i.e., forest

patches 10,000 acres or greater to support long-term, self-sustaining populations of forest breeding birds) that contain cleared areas to potentially be reforested.

Important game mammals that occur in the project area include white-tail deer, eastern gray and fox squirrels, State-listed rare swamp rabbit and eastern cottontail rabbit. The mink, beaver, raccoon, and muskrat are economically important furbearers found in the proposed project area. Other mammals found in or adjacent to the project area are striped skunk, coyote, red fox, various rodents, and big and little brown bats, tri-colored bat, Rafinesque's big-eared bat, northern long-eared bat and southeastern myotis.

Johnson (1997) notes that the native swamplands of southeast Missouri provide unmatched habitat for many species of amphibians and reptiles. Amphibians expected to occur on stream and lake edges, ponds, and in forested wetlands in the project area include the western lesser siren, marbled and small mouth salamanders, Fowler's toad, eastern narrow-mouthed toad, spring peeper, green treefrog, and bronze frog. Wetlands in the project area also support a number of State-listed rare species including the three-toed amphiuma, Illinois chorus frog, and the eastern spadefoot toad. Reptiles found in sloughs, swamps, ditches, oxbows, and ponds in the project area include Mississippi mud turtle, stinkpot, southern painted turtle, State-listed rare western chicken turtle, red-eared slider, alligator snapping turtle and the eastern spiny softshell, broadhead skink, black rat snake, State-listed rare dusky hognose snake, speckled king snake, water snakes, western ribbon snake, eastern garter snake, and rough green snake. This exceptional floral and faunal diversity at the study area can be traced to dynamic water levels, nutrients, and energy associated with connection to the Mississippi River.

Aquatic Wildlife Resources

The network of drainage ditches in southeast Missouri was largely constructed at the turn of the century when the much of region was converted to agricultural land. This development replaced the majority of the natural landscape leaving the ditches as the principal habitat for aquatic resources (Pflieger 1997). Changes in the aquatic fauna were undocumented, but this large-scale disturbance undoubtedly altered the original assemblage of species. Many species characteristic of lowlands have managed to persist in the area, but not necessarily in their former abundance. Other species that were able to exploit ditch environments may have benefitted from the altered conditions.

The proposed project area supports a remarkably rich and distinctive fishery. In all, 114 species representing 22 families have been collected from the project area-drainages and the Mississippi River. Of these species, 93 have been collected from ditches and bayous in the project-area drainage (Sheehan et al. 1998, MDC 1997). The remaining 21 species have been collected from the Mississippi River proper (U.S.G.S. 1991-1996, MDC 1997). Of the 93 species collected from the project area, 10 are considered endangered, rare, or on the watch list in the state of Missouri. One species, the golden topminnow, once believed to be extirpated from Missouri, was collected recently from the St. James Ditch (Sheehan et al. 1998). Many fish species collected in the St. Johns Bayou basin and the Floodway are either confined to the Mississippi lowlands or occur only occasionally elsewhere in the state (Pflieger 1997). The diversity and abundance of the fish fauna reflects the regionally-rare and diverse aquatic habitats in the project area (see above).

The New Madrid Floodway is the only portion of the historic Mississippi River floodplain in Missouri still connected to the river. Like all floodplains, annual flooding in the Floodway is an important part of its natural cycle, with exceptional plant, fish, and wildlife diversity and productivity related to regular nutrient and energy exchange with the Mississippi River. Backwater flooding in that area provides significant spawning, nursery, and foraging habitat for river fish (Sheehan et al. 1998). This event greatly enhances fish stocks and plays an important role in maintaining fish diversity in the Mississippi River and its floodplain. Most of the fish species that have been collected in the project area use the inundated floodplain for rearing and spawning or depend on free access to small tributaries such as Mud Ditch during their reproductive season in the spring (Sheehan et al. 1998). Baker et al. (1991) noted that floodplain ponds support some of the most unusual fish communities in river systems. Uncommon species characteristic of that habitat include chain pickerel, golden topminnow, flier, banded pygmy sunfish, and the cypress, mud, bluntnose and slough darters, all of which have been documented from the project area (MDC 1997, Sheehan et al. 1998, U.S.G.S. 1991-1996).

Sampling in the project area has documented significant fish production resulting from flood waters. Sampling of Mud Ditch and St. Johns Bayou below the outlet structure in 1993 and 1994 (mid-May to early July) collected large numbers of young-of-the-year (YOY) fishes. Those collections were made as backwaters drained to the Mississippi River (John Tibbs, Texas Wildlife and Parks, pers. comm.). The YOY specimens represented 27 and 17 species in 1993 and 1994, respectively. Similar results were reported by Sheehan et al. (1998) after collecting fishes from inundated floodplain and channel habitats during a time period which coincided with a rise and fall of flood waters in the project area. Adult and YOY fish collected represented 24 species from the New Madrid Floodway and 11 species from the St. Johns Basin. Adults of many species showed a reduction in gamete presence starting from the beginning of the flood pulse which suggested that spawning occurred during the flood event. The majority of species reported by Tibbs and Sheehan are river species that require quiet, off-channel habitat for spawning and rearing of young including sportfishes such as white bass and channel catfish and three species of commercially important buffalo (black, bigmouth, and smallmouth). These collections also contained extremely large numbers of YOY gizzard shad, which are a principal prey species for predaceous fishes (e.g. largemouth bass, white bass, catfishes, sauger, crappie, and gar). More recent sampling during the 2011 Flood also documented higher fish community diversity, densities, and growth rates in the Floodway than the adjacent river (Phelps et al. 2012). Eighty-six species were sampled in the Floodway contributing to a diversity index of 2.13, compared to 62 species from the river with a diversity index of 1.99. The authors speculate that higher growth rates can improve potential for recruitment to the population. The majority of fish captured in the Floodway were YOY and juveniles,-while the Mississippi River had a mix of adult, juvenile and YOY fishes. YOY sportfish abundance was much higher in Floodway than the adjacent river. Silver carp, an invasive species, was equally abundant in both the Floodway and the river. However, some speculate the Floodway, as a floodplain habitat, provides a competitive advantage to native fish species by supporting higher densities and growth rates (D. Herzog, MDC, pers. comm.). Although YOY shovelnose sturgeon and paddlefish were primarily collected in river samples, both species were also captured in the floodplain (Phelps et al.2012).

Sheehan et al. (1998) also reported differences in species composition between the St. Johns Bayou basin and New Madrid Floodway. Although more shad were collected in the St. Johns Bayou basin, the New Madrid Floodway yielded twice as many YOY fish species other than shad, including white bass and buffalo species. Sampling data also suggested either a single, protracted or more than one major white bass run occurring in the New Madrid Floodway. Those species differences are believed to be related to the hydrologic connectivity (i.e., fish access) between the Mississippi River and the Floodway during the spring spawning period.

Project-area waters also support diverse sport-fish communities in both the St. Johns and the New Madrid basins that provide significant angling opportunities for the public. The recreational fisheries provided by Mud Ditch, St. Johns Bayou, and the Mississippi River are important to this area of the state because of the lack of other fishable waters in the Bootheel. The lower New Madrid Floodway is the site of an important white bass fishery. In the spring, white bass from the Mississippi River enter Mud Ditch in large numbers to spawn. This annual event attracts anglers from New Madrid as well as surrounding areas of Sikeston and Dexter, Missouri (Randy McDonough, MDC, pers. comm.). During spring flooding, several species of buffalo and carp also enter the floodway from the Mississippi River to spawn. Anglers take these fish by gigging in shallow floodplain waters. In spring, Mud Ditch also provides significant angling opportunities for crappie, channel catfish, and flathead catfish as far as Ten Mile Pond Conservation Area (Dave Wissehr, MDC, pers. comm.). Those fisheries depend on that open connection between Mud Ditch and the Mississippi River to allow those species access into the Floodway to spawn.

In addition to seasonally abundant sportfishes, the project area supports a diversity of resident sport fishes. Abundant species include channel catfish, flathead catfish, largemouth bass, bluegill, white crappie, freshwater drum, and common carp. While fishing for any of the above species, anglers can also anticipate occasional action from a variety of less common sport fishes depending on the fishing technique used. These species include: spotted bass, blue catfish, yellow bass, sauger, rock bass, black crappie, longear sunfish, warmouth, black bullhead, yellow bullhead, chain pickerel, grass pickerel, bowfin, quillback, river carpsucker, northern hogsucker, river redhorse, shorthead redhorse, golden redhorse, spotted sucker, grass carp, and bighead carp.

The drainage ditches of southeast Missouri provide significant freshwater mussel habitat. The combination of moderate depth and current velocity, stable flows, sandy substrates, substantial groundwater flow, and abundant fish hosts found in these ditches provide good conditions for a variety of unionid species. Relative to natural rivers of similar size, mussel populations in these ditches are relatively diverse, abundant, and rather uniformly distributed (Barnhart 1998). Recent studies in the lowland region show that at least 30 species of unionids presently inhabit the lowland drainage ditches (Jenkinson and Ahlstedt 1987, Ahlstedt and Jenkinson 1991, Roberts et al. 1997). Such numbers are particularly significant in light of the dramatic decline in freshwater mussels in the southeastern United States which has one of the richest mussel fauna in the world (Williams et al. 1993). That decline is attributed to habitat destruction by dams, channel improvements and siltation (Neves 1993). In addition, competition from exotic species such as the Asian clam *(Corbicula fluminea)* and the zebra mussel (*Dreissena polymorpha*) is believed to be hastening the demise of native mussel fauna (Williams et al. 1993).

In a survey of project-area drainages, Barnhart (1998) collected 24 unionid species, representing over one-third of those known to occur in Missouri. The highest species diversity and greatest abundance of individuals was found in the lower portions of Lee Rowe Ditch and in the Setback Levee Ditch. Species composition differed between the Floodway and St. Johns Bayou basin. Thirteen species found in the St. Johns basin were not found in the Floodway. Only one species, *Obliquaria reflexa*, was found in the New Madrid ditches and not in the St. Johns ditches. Four species that occur in the project area, the rock pocketbook (*Arcidens confragosus*), flat floater (*Anodonta suborbiculata*), wartyback (*Quadrula nodulata*), and Texas liliput (*Toxolasma texasensis*) are considered rare in Missouri. Of these species, the rock pocketbook and flat floater are among the rarest unionids in the State (Oesch 1995). The ditches of the Bootheel lowlands have provided some of the most important habitat for these four species within the State (Barnhart 1998). Unfortunately, mussel diversity within project area ditches has decreased in recent years (U.S. Army Corps of Engineers 2013.) In Corps surveys of the same sites Barnhart (1998) sampled, mussels declined from 933 individuals representing 23 species, to 523 individuals representing 13 species (2005), to 160 individuals representing 15 species). The Corps speculated this decline reflects disturbance from periodic ditch maintenance. The Corps speculates the 1998 sampling period had time to recover from a period of channel maintenance in 1984 and 1988. Following the 2011 Flood, the USDA cleaned out 109 miles of ditches in the project area, likely setting back any potential recolonization. Nonetheless, the findings of Barnhart (1998) suggest ditch habitat is suitable for a diverse mussel fauna provided disturbance is minimized.

Crayfish are one of the dominant groups of invertebrates occurring in a variety of flowing and standing-water habitats (Pflieger 1997). They are an important food source for many fish (Momot et al. 1978) and are a major food item in the diet of bullfrogs in ponds, lakes and streams (Korschgen and Moyle 1963, Korschgen and Moyle 1955). A wide variety of other wildlife species, including snapping turtles, raccoon, mink, great blue heron, and belted kingfisher also prey heavily on crayfish (Pflieger 1997).

Although crayfish surveys specific to the project area have not been conducted, the Lowland Region in Missouri's Bootheel, supports a small but distinctive crayfish fauna. A State-wide crayfish survey conducted by the MDC found 10 species representing six genera in southeast Missouri (Pfleiger 1997). These species include, the shrimp crayfish (*Orconectes lancifer*), grey-speckled crayfish (*O. palmeri*), devil crayfish (*Cambarus diogenes*), White River crayfish, (*Procambarus acutus*), red swamp crayfish (*P. clarkii*), vernal crayfish (*P. viaeveridus*), Cajun dwarf crayfish (*Cambarellus puer*), Shufiddt's dwarf crayfish, (*C. shufeldtii*), digger crayfish (*Fallicambarus fodiens*), and shield crayfish (*Faxonella clypeata*). While most of these species have large distributions nationwide, the occurrence of several of those species in Missouri is limited to the bootheel. The State-listed species are the shrimp crayfish, the shield and digger crayfish, and the Cajun and Shufeldt's crayfish. Swamp and seasonally flooded roadside ditches and sloughs are important habitat these macroinvertebrates (Pfleiger 1997). The variety of ditch habitats is also important for crayfish.

Available data on the benthic larval insect fauna from the project area is limited to a small number of collections made in St. Johns ditch in 1995 and 1996. Those samples revealed a surprisingly diverse non-dipteran insect community (Samuel McCord, QST Environmental, pers. comm.).

Several "intolerant" taxa were found including *Perlesta* (Plecoptera), *Brachyucentrus* (Trichoptera, caddisflies) and *Ploycentropus* (Trichoperta). The presence of these species indicates good water quality and favorable conditions. Dominance of dipteran (flies) taxa usually indicates polluted waters.

Endangered Species

Two federally listed endangered species, the Interior least tern (*Sterna antillarum athalassos*), and pallid sturgeon (*Scaphirhynchus albus*), occur in the project area. That area is also within the historic range of the endangered fat pocketbook pearly mussel (*Potamilus capax*).

Interior least terns (ILT) nest in colonies on barren sandbars in the Mississippi River adjacent to the New Madrid Floodway. Based on annual surveys of the many tern colonies along the Mississippi River adjacent to the project area, terns numbers have ranged from 128 to 3295 (average = 672, USFWS 2013). Both adult birds and chicks require an abundant supply of small fish. In the Missouri River drainage, telemetered ILTs have been documented foraging for fish in shallow water habitats an average of 10 miles from their nesting sites (Stucker 2011). In the Lower Mississippi River, foraging terns have been observed feeding in a variety of habitats within 2 mi of colony sites (Jones 2012). Large numbers of adult terns have been observed foraging in the spring (mid to late May) in the lower end of St. Johns Bayou below the outlet structure and its confluence with Mud Ditch, because of the availability of large numbers of forage fish (Katie Dugger, University of Missouri, pers. comm.) as the backwater drained to the river. In addition, approximately 200 least terns have been observed in the 10-Mile Pond Conservation Area in the New Madrid Floodway (A. Forbes, USFWS, pers. comm. 2013).

Both adult and juvenile pallid sturgeon are reported from the Mississippi River and associated off-channel habitats in the project area. MDC documented a juvenile pallid sturgeon that was released in the Middle Mississippi River and later caught in a river backwater near Point Pleasant, Missouri (River Mile 878) in 1994. Nine of the sub-adult pallid sturgeon released by MDC into the Mississippi and Missouri rivers have been recaptured in tributaries or tributary confluence areas. Commercial fishermen report capturing adult pallid sturgeon in these same habitats. While these data suggest that connected tributaries and backwaters of the Mississippi River, such as Mud Ditch and the New Madrid Floodway, may be important feeding habitats or refugia for some life stages of pallid sturgeon, most adult pallid sturgeon from the lower river have been captured over sand in deep, main channel habitats with current (Reed and Ewing 1993, Constants et al. 1997).

The project area is within the range of the federally endangered fat pocketbook mussel, *Potamilus capax*. This species was historically widespread and ranged from the Mississippi River, Minnesota, southeast to the Wabash and Ohio rivers and west to the St. Francis River drainage of Arkansas. Currently, fat pocketbook mussels are limited to the St. Francis River drainage in Arkansas, the lower Wabash and Ohio Rivers in Illinois, Indiana, and Kentucky, and possibly in stretches of the upper Mississippi River adjacent to Missouri (U.S. Fish and Wildlife Service 1989, Cummings et al. 1990). The most significant remaining population of *P. capax* resides in ditch

tributaries of the St. Francis River in northeast Arkansas and southeast Missouri (Jenkinson and Lasted 1993-1994, Roberts et al. 1997).

An environmental survey reported *P. capax* in the project area from Fish Lake Ditch at Hwy 80, just northeast of the Ten Mile Pond Conservation Area (CA) (Environmental Science and Engineering, Inc., (ESEI) 1978), however, no voucher specimens were provided. A 1980 survey of Fish Lake Ditch by Alan Buchanan, MDC, failed to find this species. He believed the mussel reported by ESEI to be *P. capax* was actually mistaken for *L. ventricular* (*cardium*), a similar species. The most comprehensive mussel survey of the St. Johns and New Madrid basins did not find any evidence of this species (Barnhart 1998). However, many of the ditches in the project area may be suitable habitat (Brian Obermeyer, Kansas Wildlife and Parks, pers. comm.).

The project area is also within the range of the federally endangered Indiana bat. Although the Indiana bat has not been recorded from the project area, it does occur in forested habitats across the Mississippi River in Kentucky.

Species of Conservation Concern

Two previously classified candidate fish species, the sicklefin chub and sturgeon chub, occur in the main channel of the Mississippi River in the project area. The chubs are small-bodied, native riverine cyprinids. Both those fish occur along and over sandbars in main channel border areas and chutes between the mainland and sandbar islands. Typically, they are found over sand and gravel substrate and in current velocities of 0-1.3 feet-per-second. The range of current velocities, however, reflects chub life history stage (Ridenour et al. 2009); larval and young chubs tend to be found in habitats that represent the slower end of the current velocity range not directly in main-channel flow while adults transition out the main channel flow habitat that represent the faster end of the current velocity range. Sicklefin chub and sturgeon chub are also an important component of the riverine food web because they are a significant component of pallid sturgeon diet (Gerrity et al. 2006). The reformulated project may affect availability of slow backwater habitat as nursery for these species.

Low numbers of wintering and nesting bald eagles (*Haliaeetus leucocephalus*) occur along the Mississippi River in New Madrid and Mississippi counties. In early 1998, three bald eagle nests were observed in the project area near Hubbard Lake. That year the active nest contained one chick (Chris Mills, pers. comm.) In 1999, that nest fledged 2 young. Since that time, that nest has been lost as the tree fell down. Bald eagles generally build nests in the tops of large bald cypress or cottonwood trees near water. Their diet consists of fish, although waterfowl and small mammals will also be taken. Ducks are particularly important food item for wintering bald eagles which often are associated with major waterfowl concentration areas. Just south of the Floodway, eagles successfully fledged young at Donaldson Point Conservation Area and have made several nest attempts elsewhere in Mississippi County.

Recently, many cave-hibernating bats have been affected by White Nose Syndrome, pathogen-caused illness that may lead to death. Estimates of bat losses are in the millions. As a result, the Service has been petitioned to list the northern long-eared bat, and is conducting a status review of the little brown bat. Both these species likely occur in or in the vicinity of the project

area. Both species, as well as the Indiana bat, form maternity colonies in the summer, most often using mature trees with crevices or exfoliating bark. Little brown bats will also roost in buildings or man-made structures. The two species could possibly be added to the federal endangered or threatened species list over the next few years.

Public Lands

The MDC manages two conservation areas in the proposed project area. The Ten Mile Pond CA covers 3,793 acres of cropland, wetlands and forest. It is located in the Floodway along an old oxbow lake formed when the Mississippi River meandered over that section of floodplain. The ditches, ponds and lake on the CA provide significant opportunities for anglers. That area also provides opportunities for small and big game hunting, as well as waterfowl. Throughout the year, many species of migratory birds use the varied habitats found on the CA, including the federally endangered least tern.

The Donaldson Point CA lies largely outside the frontline levee along the Floodway. Most of that 5,785-acre area, is bottomland hardwood forest and woodland. Donaldson Point is home to several species not usually seen in Mississippi lowlands. These include the state endangered Swainson's warbler that nest in giant cane, Mississippi Kites, southeastern bat, Rafinesque's big-eared bat, swamp rabbit, and cotton mice. Bald eagles have established nesting territories in that area.

Big Oak Tree State Park is managed by the Missouri Department of Natural Resources. It includes approximately 1,000 acres of rare swamp and bottomland hardwood forest. Because it is one of the few remaining forested wetlands in southeast Missouri, it serves as a refugia for many increasingly rare plant and wildlife species and contributes significantly to the biodiversity of the region. The Park claims two national and three state champion trees. Several State-listed rare plant and animal species have also been recorded in the Park. Unfortunately, conditions in the park have to deteriorate because continuing drainage projects on surrounding lands slowly eliminates hydrologic conditions necessary to sustain these remnant native wetland communities.

Floodplain Ecology

The St. Johns Bayou basin and the New Madrid Floodway were originally part of the historic Mississippi River floodplain, and although highly altered, still perform floodplain functions critical to nationally significant fish and wildlife resources. As previously mentioned, the Floodway, in particular, is still largely connected to the Mississippi River which annually inundates much of the lower study area, providing an important exchange between terrestrial habitats and the aquatic system. Such flood pulses have been called the principal driving force(s) for the existence, productivity, and interactions of the major biota in river-floodplain systems (Junk et al. 1989). Not only do flood waters rejuvenate aquatic habitats (e.g., bayous, oxbows, sloughs, ditches, ponds and wetlands) on the floodplain, they also provide access to the floodplain productivity which is far greater than that of the river main stem (Junk et al. 1989, Guillory 1979).

Much of that productivity is organic detritus (e.g., leaves, grasses, etc.), however invertebrate levels are also significant. Eckblad et al. (1984) found the number of macroinvertebrates drifting

from an upper Mississippi River backwater was three to eight times higher than in the main channel upstream of the backwater. Hrabik (1994) notes that floodplain production is high relative to the other macrohabitats based on estimated zooplankton densities and biological oxygen demand rates. In 1993, zooplankton density was 500 times greater in the wide versus the moderately-wide floodplain near Cape Girardeau (Hrabik 1994). That productivity in turn supports the fisheries and other aquatic resources of the river proper (Junk et al. 1989, Amoros 1991, Lambou 1990, Welcomme 1979). Based on post-flood studies on the Missouri River, Galat et al. (1998) noted that river flooding can facilitate zooplankton colonization of floodplain habitats as documented by higher cumulative species richness in scour holes that were continuously or periodically connected to the river than scour holes with no such connection.

The variability of natural flooding regimes and associated ecologic processes, both within and among years, creates and maintains diverse habitats and differential species success that supports the greatest biodiversity (Poff et al. 1997, Galat et al. 1998). Because of Mississippi River flooding, the study-area floodplain provides diverse habitats essential for spawning, rearing, foraging, and refuge to numerous aquatic species. Fishes that seasonally use the floodplain dominate the fisheries, biomass, and production in river-floodplain systems (Junk et al. 1989). Approximately half of the fish species of the lower Mississippi River use the floodplain as a nursery (Gallagher 1979). In most years, rising river levels inundate the floodplain in the spring, while rising temperatures and increased photoperiod trigger spawning in numerous fish species. In their work on a southern bottomland hardwood forest along the Tallahatchie River, Turner et al. (1994) collected more larval and juvenile fish from the floodplain than from the adjacent river, consistent with several other studies. Unlike the main stem of the river, the floodplain is characterized by slack waters, beds of aquatic vegetation, and organically rich substrates (Guillory 1979, Rissoto and Turner 1985), important habitat for fish spawning and rearing. Those areas often have aquatic vegetation, snags, and logs that also provide refuge from predators (Killgore and Hoover 1998). Other wildlife also benefit from spring floods.

Many species of amphibians throughout the project area require shallow waters to successfully reproduce. In addition to permanent ponds, sloughs, and ditches, spring flooding can cover up to 75,000 acres in the New Madrid Floodway alone. As those waters recede, they create thousands of ephemeral ponds critical to maintaining a healthy and diverse amphibian population. Habitats with variable flooding regimes have been shown to support highly diverse herptofauna. Work by Galat et al. (1998) documented differential use and abundance of reptiles and amphibians in a variety of wetland types. For example, connected scours were dominated by false map turtles and softshells; remnant wetlands had more sliders and painted and snapping turtles. Scour holes contained to the river contained the highest species richness. Remnant wetlands had the more species of salamanders and snakes than other types of wetlands. Those various wetland types also supported a diverse bird assemblage, where species use of a particular type of wetlands appeared to depend on wetland size, structural diversity, and depth. In addition, flooding increases invertebrate biomass, which becomes an important protein source for waterfowl and shorebirds on their migration to northern breeding grounds (Helmers 1992, Reinecke et al. 1989).

Mississippi and New Madrid counties, including the project area, support more diverse habitats and natural communities than elsewhere in the Bootheel. That increased diversity is reflected in the number of State-listed plant, mussel, fish, amphibian, reptile, bird, mammal, and natural

communities reported for the two-county area (Table 2), and is due in part to the influence of the river's annual hydrologic regime on the lower St. Johns Bayou basin and New Madrid Floodway. Although greatly altered, the project area still functions as an integral part of the Mississippi River ecosystem, and provides important breeding, migration and overwintering habitat for numerous species. The forested wetlands in the project area, a small remnant of a once extensive forest complex, are becoming increasingly scarce. At the same time, they become more and more critical as refugia to numerous species that once flourished on the floodplain. In spite of numerous modifications, the varied habitats within the project area contribute significantly to the State's biodiversity and the ecological integrity of the lower Mississippi River.

## Fish and Wildlife Concerns and Planning Objectives

In the last 100 years, there has been a dramatic decline in wetland habitats essential to maintaining waterfowl populations. Less than 2 percent of the historic regional wetland acreage remains today, and wetlands continue to be lost or degraded at an alarming rate. The St. Johns Bayou/New Madrid Floodway Project could affect up to 53,556 acres of wetland. In particular, forested wetlands will be impacted by the New Madrid Floodway portion of the project. The Service anticipated impacts to 90 percent of the existing bottomland hardwoods.

Historically, the Mississippi River Alluvial Valley was the largest bottomland forested wetland in North America covering approximately 25 million acres. Most of that area was subject to periodic flooding by the Mississippi River, providing invaluable habitat for fish and wildlife. Since the early 1700s, however, channelization and levee construction have reduced the natural floodplain of the lower Mississippi River by 90 percent (Fremling et al. 1989). Most of the forested wetlands have been converted to cropland. Private and publicly funded flood control and drainage projects have drastically changed the hydrologic relationship between the floodplain and the river, essentially eliminating seasonal interchange. Baker et al. (1991) called the reduction of seasonally inundated floodplain due to levee construction the single most deleterious alteration to the lower Mississippi River. Today, drainage ditches are the principal remaining year-round aquatic habitat for fish in much of the Bootheel (Pflieger 1997).

Past alterations to the Mississippi River floodplain have been accompanied by marked declines in both the abundance and diversity of fish and wildlife of the region. Many once-common species are becoming scarce and several are federally listed as endangered or threatened. Most of the remaining unique flora, fauna, and natural communities in the proposed project area are associated with wetlands remaining in portions of the St. Johns Bayou basin and the Floodway. Those wetlands, however, will lose most their wetland functions, and will be undoubtedly converted to agriculture once they are no longer subject to backwater flooding.

In recognition of the critical functions wetlands provide to fish, wildlife, and humans (e.g., improve water quality, store storm water, reduce flood stages, etc.), Congress enacted legislation (i.e., Clean Water Act) to protect remaining wetlands and to reverse historic wetland losses (e.g., 1985 and 1990 Farm Bills; Emergency Wetlands Protection Act of 1986; Water Resources Development Acts of 1986, 1992, and 1996; Agriculture Credit Act of 1987; Conservation Reserve Program; Food Security Act of 1992; Wetlands Reserve Program (WRP);

and Federal Agriculture Improvement and Reform Act of 1996). According to the Corps, as of 2010, there were 5,781 acres of Wetlands Reserve Program lands within both basin, most of which occur in the St. Johns basin below highway 80 (U.S. Army Corps of Engineers 2013).

The National Research Council (1992) noted that the cornerstone of modern floodplain restoration and integrated floodplain management rests on the understanding that Arivers and their floodplains are so intimately linked that they should be understood, managed, and restored as integral parts of a single system.@ To underscore the importance of floodplains as an integral part of the river ecosystem, Executive Order 11988 on floodplain management states that Federal agencies should avoid undertaking actions that directly or indirectly adversely affect natural floodplain functions and values. The above authorities' direct agencies to take advantage of every opportunity to protect, improve and restore wetland habitat in the study area and enhance regional fish and wildlife resources.

More recently, scientific recognition of our changing climate has led to greater considerations of effects of climate change on federal infrastructure investment and planning. In 2012, the Department of the Interior added policy guidance to it Manual to address climate change in project planning. Among the policies are:

1.) Promote Landscape-scale ecosystem-based management approaches to enhance resilience and sustainability of linked human and natural systems.
2.) Protect diversity of habitat communities and species
3.) Protect and restore core, unfragmented habitat areas and the key habitat linkages among them
4.) Maintain key ecosystem services

To address the previously noted problems and ensure that fish and wildlife resources receive equal consideration with other project purposes, the Service developed the following planning objectives to be incorporated into the St. Johns Bayou and New Madrid Floodway Project:

1. Avoid and/or minimize adverse impacts on fish and wildlife resources by minimizing negative impacts to marshes, forested wetlands and aquatic habitats in the project area, and ensuring fish access to the Floodway during spring for spawning and nursery habitat.;

2. Incorporate the goals of the North American Waterfowl Management Plan and other Administration wetland-related initiatives in project planning;

3. Provide compensatory mitigation to fully offset unavoidable project-related losses of wetlands and other aquatic habitat in the study area.

4. Implement a scientifically robust adaptive management (AM) program with clearly identified decision points, alternative actions, and costs. The AM program should ensure achievement of objective 3 above.

## Evaluation Methodology

Estimation of project-related habitat changes is a fundamental technique used to assess project impacts to fish and wildlife resources. Those estimates also form the basis of other evaluations conducted by the Corps. In previous evaluations of project impacts, the Service closely coordinated with the Corps and MDC to document project-related effects to fish and wildlife resources. For this revised DEIS, however, neither the Service nor MDC was involved in the analyses. The following sections rely on the figures provided by Corps models, and notes on the limitations or inadequacies where applicable.

Wetlands were estimated several ways, as shown in Table 1, that illustrate significant differences between areas the EPA and the Service consider wetlands and those the Corps is using in its analyses as part of the EIS. The Service's estimates were done using standard NWI protocols that use remotely sensed photography, soil and on-site ground trothing. The method is based on functionality not regulatory status. The EPA wetlands assessment used a regulatory definition of wetlands (33 CFR 328.3(b)), although the assessment was not a jurisdictional determination. They used a probability-based survey design to estimate wetland acreage per protocols that EPA developed with the Corps. The methodology was adapted from a similar approach used on the Yazoo Pumps project, and included randomly selected points and surveys of NWI, National Landcover Dataset, Soil data and aerial photos to identify wetland signatures, including wetlands in agricultural production. Within the 5-Year Floodplain alone, the results in the EPA and NWI methodologies indicate a difference of roughly 10,000 acres in the St. Johns Bayou Basin and 30,000 acres in the New Madrid Floodway. Despite various methodologies, the EPA assessment and the NWI update are surprisingly consistent in their estimates of wetlands within the proposed project area.

The Corps based their wetlands analysis on jurisdictional status, maintaining that much of the acreage in the project area was delineated by NRCS as prior converted croplands, regardless of hydrology. This accounts for the biggest divergence between the three agencies' estimates. The Corps believes the functional species models (i.e., Waterfowl Assessment Methodology (WAM), shorebird model, and fisheries Habitat Evaluation Procedures (HEP)) capture the functional aspects of these wetlands to fish and wildlife and thus do not need to be considered as part of the wetlands analyses. However, not only does the Fish HEP fail to evaluate effects beyond the 5-year flood elevation, the Corps' model erroneously equates the fisheries value of flooded agricultural land to developed land (e.g., roads, parking lots, etc.) further discounting large portions of the project area. Similarly, the Corps' Hydrogeomorphic Methodology (HGM) functional modeling of wetlands effects does not evaluate wetlands above the 5-year flood elevation. The Corps asserts those areas would be unaffected by the project, which is directly contradicted by their analyses of economic agricultural benefits due to the proposed project drainage in areas above the 5-year flood elevation. The above 5-Year Floodplain results are even more at odds-roughly 20,000 acres and 50,000 acres for the St. Johns Bayou Basin and the New Madrid Floodway respectively. The Service does not consider the Corps' approach to be scientifically valid because it overlooks the value of tens of thousands of acres of connected floodplain habitats that provide significant and unique value to fish and wildlife resources.

In 1998, an interagency team that included the Corps, MDC, and the Service, used several tools to evaluate project-related changes in the quantity and quality of habitat for fish and wildlife. Most of those tools are based on the HEP (USFWS 1980). HEP is a method of estimating habitat suitability for evaluation species based on field measurements of parameters that limit the relative population density of a selected species. Using HEP (and similar tools), habitat quantity and quality can be measured for baseline conditions, and can be predicted for future without-project and future with-project conditions. The standardized, species-based method numerically compares future with-project and future-without project conditions to provide an estimate of project impacts on fish and wildlife resources. The Corps has continued to use the HEP methodology, however, the application of the HEP models and results for the current evaluation were not conducted collaboratively by the interagency team.

As we understand it, the Memphis District Corps of Engineers used a Geographic Information System to determine acreage of various land cover types within the study area based on satellite imagery. Those cover types and acreage were used to determine available habitat for the HEP analyses. The Corps then used stage area curves based on hydrologic modeling of the project area to determine the acreage that is inundated in the various evaluation models (i.e., HGM, terrestrial HEP, Fish HEP, Shorebird model, and WAM).

## Fish and Wildlife Resources - Future Without the Project

Fish and wildlife resource conditions in the proposed project area are unlikely to change appreciably without project implementation. Existing wetland protection should minimize conversion of small wetlands to other uses. Some additional landowners may even take advantage of several wetland programs that offer financial incentives to restore functional wetlands on their property. Mature forested wetlands, such as in Big Oak Tree State Park, will continue to degrade (e.g., no regeneration) from previous hydrologic alterations unless water control programs are implemented to restore historic water levels. Forested wetlands along the lower reaches of St Johns Bayou may change to include species with greater water tolerance (e.g., cypress, buttonbush, etc.), responding to the high water levels when the St. Johns gravity drainage structure is closed.

Fish resources will continue to have access to the Floodway ensuring nursery and spawning habitat and refugia, as well as contributing to the productivity of the river system. Project area ditches will be disturbed periodically during channel maintenance. Those events, however, generally occur over small reaches, several years apart, allowing the much of the ditch biota to recolonize the affected area. Both waterfowl and shorebirds will continue to benefit from seasonal flooding in the project area during spring migration, with increasing numbers of waterfowl as our climate warms. Tens of thousands of acres of permanent, seasonal and ephemeral ponding will help meet the life requirements of those birds as well as numerous mammals, reptiles and amphibians.

## Description of the Tentatively Selected Plan (TSP)

The Corps' TSP, also referred to as the Avoid and Minimize (A&M) or 3.1 alternative, includes vegetative clearing and channel enlargement along approximately 23 miles of rural channels in the St. Johns basin. The enlarged channel would be 120 feet-wide along 3.7 miles of the lower St.

Johns Bayou to the Setback Levee Ditch where it would narrow to 50 feet for 8.1 miles. The material removed would be deposited on a 120-foot wide embankment and allowed to revegetate naturally and placed under a conservation easement. The lower 3.5-miles of the St. James ditch would become 45-feet wide and the top bank along northern most reach (7.8 miles) would be widened to 80 feet, with the material placed in a 100-foot wide embankment. Bank work along the St. James Ditch would be restricted to one side of the channel to minimize impacts to riparian corridors; the upper reach of the St. James ditch would be avoided. The proposed project also includes a 1,000 cubic-foot-per second (cfs) pump station near the existing gravity drainage outlet to accommodate interior runoff. Impoundment of water in the St. Johns Basin would be managed between December 1 and January 31 to an elevation of 285'.

As part of the TSP in the New Madrid Floodway, the Corps proposes to construct a 1,500-cfs pump station in conjunction with a separately authorized project that includes four gated 10-foot by 10-foot box culverts across Mud Ditch and levee closure of the existing 1,500-foot gap at the southern end of the Floodway to a grade equivalent of 317.0'. Fourteen miles of the Setback Levee would be raised using 2.4 million cubic yards of material. Pump operations would include three periods:

| | Gates (culverts) close |
|---|---|
| - Nov. 15 – Feb 28 – pump to elevation of 288.5' | 288 |
| - March 1 – April 15 – pump to elevation of 287' | 286 |
| - April 16 – May 31 – pump to elevation of 282' | 284 |
| - June 1 -14 Nov – pump to elevation of 278.5' | 278.5 |

The Corps proposes to compensate project-related impacts to fish and wildlife resources in the St. Johns Basin by:

- Constructing nine transverse dikes in the lower 3.7 miles of St. Johns Bayou to create a low flow sinuous channel.
- Constructing a bank stability structure (*i.e.*, weir) at the confluence of St. Johns Bayou and Setback Levee Ditch to provide stability as well as structure.
- Constructing a bank stability structure at the confluence of Setback Levee Ditch and St. James Ditch.
- Creating stream bank slopes that are designed to prevent erosion and maximize fish and wildlife habitat.
- Restoring vegetated wetlands on 400 acres of agricultural land below an elevation of 285 feet.
- Restoring vegetated wetlands on 1,816 acres below the post project 5-year floodplain.
- Seasonally inundate 244 acres of farmland during the spring shorebird migration

The Corps proposes to compensate project-related impacts to fish and wildlife resources in the New Madrid Floodway and Mississippi River by:

- Providing a river connection to Big Oak Tree State Park via a gated culvert through the Mississippi River Frontline Levee.
- Restoring vegetated wetlands on a minimum of 1,800 acres of farmland surrounding Big Oak Tree State Park.

- Restoring vegetated wetlands on 387 acres of farmland below an elevation of 285'.
- Restore vegetated wetlands on 1,970 acres of farmland below the post project 5- year floodplain.
- Removing 3,050 acres of cropland from production in the batture to revegetate naturally to a bottomland hardwood or riverfront forest community.
- Seasonally inundating 1,286 acres of agricultural lands during spring shorebird migration period crediting 993 acres of conservation lands already owned and managed by the Missouri Department of Conservation (MDC) (i.e., Ten Mile Pond Conservation Area). The remainder would consist of 293 acres of agricultural lands in the basin.
- Restoring 432 acres of floodplain lakes (potential sites to be determined).

The TSP has been modified from the Authorized Project to include measures to reduce project effects on fish and wildlife species. The channel work along the St. James Ditch would be restricted to one bank to minimize impacts to forested riparian corridors and the work reaches would be designed with buffer strips consisting of both woody vegetation and warm season grasses with conservation easements. Combined with other Best Management Practices (BMPs) (e.g., adjusting ditch slopes) those measures would help minimize future sloughing and ditch maintenance. Pump operations would not lower spring water levels in the Floodway as much as the Authorized Project, allowing marginally greater fish access and potentially retaining more wetlands. The project would also employ BMPs in the design of borrow pits needed for the levee upgrade. The design of those areas would include features (i.e., low slopes, irregular edges, multiple depths, woody debris) to benefit fish and wildlife. Although the Corps has proposed mitigation for the project, it is unknown whether that mitigation will occur in the project area, elsewhere along the Mississippi River. In addition, engineered mitigation to replace functions of dynamic, natural environmental systems rarely work as planned. Furthermore, these mechanical solutions and associated infrastructure will require attention by fish and wildlife agency personnel potentially resulting in long-term/indefinite commitment of resources not consider in project costs and opportunity costs (i.e., the cost related to lost opportunities for completing other conservation work).

## Project Impacts

Wetlands

As previously noted, the Service was not involved with impact assessment and future project conditions development. Therefore, the following comments are based on limited information provided in the DEIS. Under "Future with Project Scenarios," the Corps includes increasing acreage of WRP based on the assumption that future trends in WRP sign up in the project area will continue over at least the first 25 years of implementation. The Service finds this assumption highly uncertain given record commodity prices and declining funding for farm conservation programs. The Corps does not provide figures for future conditions without increasing WRP acreage, so we used Tables 3.1 and 3.2 showing existing conditions, to conservatively estimate forested wetlands future with project (i.e., without additional WRP signup) conditions.

Implementation of the preferred alternative would greatly alter the hydrologic regime of tens of thousands of acres of wetlands. According to the Corps stage area curves, projected 2-year flood

elevations (approximate wetland level), and land cover, under the TSP, approximately 27,731 acres would no longer be seasonally flooded. In the St. Johns Bayou basin, the preferred alternative would decrease the acreage of existing forested wetlands receiving riverine backwater flooding by approximately 13 percent. In the New Madrid Floodway, implementing the TSP would reduce forested wetlands flooded by backwater by 58 percent. The Floodway would also have a 13 percent decrease in herbaceous wetland acreage affected by riverine flooding. Such changes in the hydrology of those wetlands would greatly diminish their contribution to the riverine ecosystem. Those remaining wetlands not dependent on backwater flooding would become isolated, depressional systems. Wharton et al. (1982) noted that the productivity and ecologic value of forested wetlands depend on the "...primary driving force, the fluctuating water levels of the riverine system." As previously mentioned, the New Madrid Floodway currently is the only tributary floodplain still connected to the Mississippi River in Missouri. Implementation of either project alternative would sever that connection, essentially decoupling the floodplain from the river.

Project-related hydrologic changes would also lead to widespread dewatering of the remaining wetlands. Currently, 9720 acres of forested wetlands occur in the project area. Some of the largest unprotected, contiguous stands of bottomland hardwood forests remaining in southeast Missouri occur in the lower St. Johns Bayou basin and will be most affected by project implementation. Under existing conditions, forested wetlands account for approximately 8.0 and 7.5 percent of the wetlands in the area below 300 feet NGVD (the area to be affected by either alternative) in the St Johns and New Madrid basins respectively. That figure includes public land, timber company land, and WRP land.

Big Oak Tree State Park

Although the remaining wetland areas are characterized by very heavy soils and a high water table, the same is true for much of the cropland in the project area. Overlaying the Corps' landcover data on the wetland map shows that most of the remaining undeveloped wetlands, particularly forested wetlands, correspond most closely to property lines and drainage networks, not the underlying soils. In many cases, modifications to the project area's natural hydrology and land owner practices have a greater effect on the distribution of wetlands than does the presence of hydric soils.

Although the Mississippi River seasonally recharges the groundwater in the eastern portions of the proposed project area, the interaction between surface water, groundwater and river seepage is poorly understood (U.S.G.S., per. comm.). Currently, the Corps is working on several seepage control features in the Floodway as part of the Mississippi River Mainline Levee enlargement that will further modify water patterns in the project area. In addition, the cropping patterns in areas previously subject to backwater flooding are likely to emphasize more profitable crops and increase the use of irrigation, increasing surface and groundwater demands. Both project alternatives would lower portions of the Setback Levee Ditch and the St. James Ditches by 5 feet. In a study of the effects of channelization on forested wetlands, Maki et al. (1980) noted that outside of seasonal effects, the greatest differences in ground water levels were caused by channel modification. They noted that deepened channels intercepted the groundwater table and depleted soil moisture in adjacent bottomlands. The water table in channelized basins remained at least 1.3 feet below the level found in natural watersheds regardless of land use. Luckey (1985) also found a similar pattern in southeast Missouri; namely that enhanced drainage lowers the groundwater levels in the soil. Maki et al. (1980) further noted that channelization not only reduces the amount of ponding on floodplains, but shortens ponding duration. During spring, summer, and fall, evapotranspiration demands can effectively eliminate surface ponding.

In light of the above factors, it is difficult to predict with certainty post-project surface water patterns in either basin. Under either project alternative, however, spring water levels will be significantly lower than existing conditions. The Corps believes that there will be no indirect project-related changes in jurisdictional wetlands because they anticipate that rainfall and groundwater seepage will maintain saturated soils in the existing wetlands sufficient to meet the wetland criteria. However, widespread changes in the hydrology of existing farmed wetlands, from pre-project inundation to post-project saturation, would have significant implications under the Food Security Act (FSA). The FSA stipulates that farmed wetlands must have a 50 percent chance of being seasonally ponded or flooded at least 15 days during or 10 percent of the growing season, whichever is less. Although the USDA, Natural Resources Conservation Service (NRCS), has previously called many of the farmed wetlands in the project area prior converted croplands, discussions with NRCS (Pat Graham, pers. comm.) indicate that the mapping protocols used for those uncertified determinations were very limited, and that using current wetland protocols would show far more wetlands in the same area. The NRCS analysis included in the DEIS, Appendix E, does not have enough detail to demonstrate the methods employed can distinguish the inundation criteria (15 days) of farmed wetlands. The is particularly confusing given the dramatically larger acreages of farmed wetlands indicated by the EPA and NWI assessment, as well as the Corps hydrologic modeling of the project area. Based on the Corps

modeling results, project-related hydrologic changes may remove inundation on up to 20,000 acres of cropped wetlands in the Floodway alone. Without surface-water flooding or ponding during the growing season, those acres would not provide wetland functions to support fish and wildlife.

Furthermore, project implementation will replace a naturally-variable flooding regime with a well-regulated, fairly predictable flooding pattern. The level of risk to farmers who chose to crop previously marginal areas is greatly lowered. Considering the changes in future surface-water levels throughout the project area, reasonably foreseeable modifications to the project area's drainage patterns, existing land practices, and the USDA projections of future wetland conversion to agriculture, the Service believes most of the privately-owned forested wetlands no longer subject to backwater and overland flooding will face greater development pressure and likely will be converted to agriculture use.

Project implementation would not only reduce riverine flooding in both basins, but it would also significantly alter the temporal and spatial variability of that flooding. As proposed, pumping operations in the St. Johns Bayou basin and the New Madrid Floodway would replace a natural, highly variable flooding regime with a flooding pattern that would be the same each year; higher water levels (i.e., + 11 to 17 feet) in the winter, and lower water levels (i.e., - 4 to 8 feet) throughout much of the spring. This will eliminate years of high water that infrequently but regularly rejuvenate higher elevation marshes, forested wetlands, and riparian areas. Based on the Corps' hydrologic analyses, the preferred alternative would eliminate such flooding on 393 acres of forested tracts in the St. Johns Bayou basin, and 3475 acres in the New Madrid Floodway. In addition, the proposed pumping operations will maintain artificially high winter water levels in the lower portions of both basins, further stressing the forested wetlands in those areas.

In their treatise on green-tree reservoir management, Fredrickson and Batema (1992) underscore the importance of fluctuating water regimes to the maintenance of high productivity in forested wetlands. They noted several characteristic flooding patterns in unaltered forested wetlands that should be emulated in managed systems. Those include ensuring flooding after trees break dormancy in the spring; minimizing flooding that overtops red oak species during the dormant season that could lead to high mortality and prevent regeneration; and ensuring hydrologic variability within and among years (Fredrickson and Batema 1992). The TSP pumping operational plan does not incorporate those measures. Consequently, we believe those few forested wetlands remaining after project implementation will progressively degrade.

Floodplain wetlands provide an extremely important function at a landscape-level. Their capacity to store flood waters can greatly reduce river stages and destructive flood potential downstream (Taylor et al. 1990). In fact, cumulative losses of floodplain storage capacity in the Mississippi River Valley have led to increased flood stages in the lower river (U.S. Army Corps of Engineers 1998). Those higher stages, in turn, lead to additional flood control projects (e.g., levee enlargements) to protect lives, property, and existing infrastructure. The Corps, recognizing the importance of that storage capacity, has designated certain floodplains along the lower river valley as "floodways." Those floodways are integral components of the Mississippi River and Tributaries Project. For example, the New Madrid Floodway was constructed to lower stages in Cairo, IL and Paducah, KY during a" project flood." The proposed levee closure at the

mouth of the Floodway would significantly decrease the available floodplain storage capacity along the lower river during river stages lower than a "project flood" (when the Corps would operate the Floodway), possibly affecting flood stages along this reach of the Mississippi River. As previously noted, the Floodway accommodated 90,000 acres of water prior to operation during the 2011 Flood, water that would have been forced against levees elsewhere on the river. Ecological functions, such as flood attenuation to help prevent property damage currently provided by the Floodway are not included in the cost:benefit calculations, but are extremely important to river communities.

Terrestrial Wildlife Resources

Although difficult to assess in a dynamic environment, estimates of project-related impacts that have been quantified to date include winter carrying capacity for waterfowl, habitat value for forest wildlife and foraging habitat for migratory shorebirds. Effects on other wildlife (e.g., reptiles and amphibians, wading birds), although not quantified, will be discussed qualitatively.

Implementation of the proposed project alternatives would greatly alter the habitat available for wintering and migrating waterfowl. One negative impact will be the loss of diversity resulting from a dynamic river connection and associated flooding. Implementation of the proposed project will control flood timing, duration, and depth through pump operations, removing natural variability which contributes to the overall health and sustainability of wetland ecosystems. The Waterfowl Assessment Methodology (WAM) was used to quantify changes in the potential carrying capacity (i.e., food) for wintering and spring migrating waterfowl in the project area. We understand the WAM assumed increases in WRP lands in all future scenarios, thus the results likely overestimate the availability of suitable duck habitat. WAM results indicate that the TSP would potentially produce an increase of 978,809 duck-use days (DUDs) in December and January, while reducing DUDs by 995,104 in February and March. In the New Madrid Floodway, WAM result indicate the TPS would potentially increase DUDs by 1,376,754 in winter and decrease DUDs by at least 3,290,786 during spring migration significantly reducing habitat that provides necessary protein sources particularly important to waterfowl migrating to their breeding grounds (Fredrickson and Heitmeyer 1988). Increased DUDs indicated by WAM during December and January for both basins are the result of ponding in the sump as specified by the operational plan. Those potential gains, however, are very questionable.

Traditional use of wintering waterfowl habitats in southeast Missouri is closely linked to the relative wetness (i.e., rainfall) within the regions during late October through January (Bellrose and Crompton 1970, Nichols et al. 1983). Forty-nine hundred acres of ponded water in an otherwise dry St. Johns basin and New Madrid Floodway is a relatively small tract of habitat to migrating waterfowl. For example, over the last several years, the Eagles Nest Wetland Reserve Program tract and rice fields on Hunter Farms have been annually flooded using pumps during fall and winter for hunting. Those habitats, however, receive significantly less waterfowl use in dry years than in years when the region is wet (D. Wissehr and B. Allen, MDC, pers. comm.). Under the proposed alternatives, bottomland hardwoods in the sump area would be flooded annually to great depths for extended periods. Such inundation is detrimental to bottomland hardwood species (Fredrickson and Batema 1992) and could undermine their long-term survival. Moreover, the WAM assumed current forested and herbaceous wetland area would increase with additional

WRP lands. In reality, disconnection from the river and increased drainage will likely result in few additional WRP tracts and additional conversion of wetland to cropland in much of the project area. In light of the above, we strongly recommend that the operational plan be altered to allow for the greatest possible diversity of flood timing, duration, and depth November through March. We believe such a plan would realize more benefits to waterfowl, as well as other species. Altering the operational plan would also allow the river to ebb and flow into both basins during that time, also greatly benefitting fisheries resources by maintaining connectivity between the river and its floodplain.

The WAM does not consider the increasing importance of invertebrates in waterfowl diets during late winter and spring, when the project area traditionally has the highest waterfowl use (D. Wissehr and B. Allen, MDC, pers. comm.). Furthermore, the WAM does not consider other forested wetland habitat components necessary for healthy waterfowl populations. During spring migration, waterfowl are forming pairs, molting, and preparing to breed (Heitmeyer 1985). Forested wetlands fulfill special seasonal waterfowl habitat requirements not found in open land (i.e., moist soil areas and farmed wetlands). In addition to producing nutritious food for waterfowl, wooded habitats provide secure roosting areas, cover during inclement weather, loafing sites, protection from predators, and isolation for pair formation. Both project alternatives would eliminate backwater flooding on thousands of acres of forested wetland and moist soil areas during spring migration, significantly reducing habitat that provides necessary protein sources particularly important to waterfowl at that time of year. Under existing conditions, those waterfowl acres occur during spring flooding and are distributed over up to 75,000 acres. Large flooded areas such as those are critical for waterfowl, especially as they form breeding pairs. Because of the differing seasonal habitat requirements of waterfowl, potential fall migration and winter habitat benefits cannot replace significant spring migration habitat losses that would occur with either project alternative. A similar situation would be trying to plant corn during November, December, and January, assuming the same acreage provides similar value to that crop regardless of the season.

The TSP would also negatively affect forested wetland habitat value for other wildlife. Channel enlargement will include clearing large portions of the riparian corridor within the channel work rights-of-way and, in some reaches, removing the banks to enlarge the channel. A narrow berm would be constructed adjacent to the new channel, seeded and periodically maintained. An elevated spoil area would be located landslide of the berm. The Corps modeled direct impacts with assumption that a protective easement will be placed over the construction rights-of-way for channel work in the St. Johns basin and the levee closure in the Floodway, and that berm maintenance along the enlarged ditches will be minimal, allowing all rights-of-way to revegetate naturally. Levee construction will directly affect only a small acreage of forested wetlands in the Floodway.

The indirect effects of the TSP will be far greater on plant communities, particularly in the Floodway. The Service has not been involved in the updated HEP analyses, including model assumptions and applications, so has not had an opportunity to develop quantitative habitat losses using the most recent hydrology. However, qualitatively, the Service believes implementation of either project alternative will lead to conversion of significant tracts of forested wetlands that are no longer subject to backwater flooding. Based on historic and existing land use patterns, and the

enhanced drainage system throughout the project area, the 1998 HEP team originally predicted that most of privately owned forested wetlands no longer subject to riverine flooding (because of the project) would be converted to another land use over the 50-year project life. That acreage excluded lands enrolled in WRP and wetland mitigation tracts anticipated to be managed as forests.

All wildlife evaluation species are expected to have significant losses in habitat due to induced wetland impacts. In addition to impacts that can be quantified through HEP analyses, wildlife using the remaining forested tracts will also be negatively affected by increasing forest fragmentation which is particularly detrimental to certain neotropical migratory bird species (Robbins et al 1989, Askins et al. 1990). Fragmentation can lead to higher rates of nest parasitism and competition from bird species that prefer edge habitat.

Three species (i.e., muskrat, red-winged blackbird, and great blue heron) were used to evaluate project-related changes in marsh habitat values. Most of the marsh in the study area is found in the New Madrid Floodway, primarily along borrow pits. The HEP analysis assumed those acres would remain the same because those areas should receive enough rainfall and runoff to maintain marsh vegetation. Based on that assumption, HEP results indicate that project-related changes in marsh habitat values will be insignificant. Proposed deeper ditches and a lower water table coupled with removal of river backwater could invalidate that assumption.

To quantify project-related changes in shorebird migration habitat value, a HEP-based model was developed by the Corps (Appendix H part 1). Shorebird habitat is generally considered that area shallowly flooded (>0.2 foot), with declining suitability in depths between 0.2 and 0.5 feet. Appendix H part 1 did not include additional appendices with model results identified by the author, nor the assumptions in cropping pattern. Therefore, the Service referred to the DEIS text to summarize project-related effects.

Implementation of the TSP would significantly reduce shorebird migration habitat value in both basins:

(Expressed in optimal equivalent shorebird acres).

| | Spring | % net change | Fall | % net change |
|---|---|---|---|---|
| St. Johns Bayou basin | 116.46 | -31.4 | 5.68 | -39.4 |
| New Madrid Floodway | 614.67 | -71.1 | 23.39 | -97.1 |
| Total study area | 731.13 | | 29.07 | |

In the New Madrid Floodway, the TSP would nearly eliminate shorebird habitat in the fall. In addition, the TSP would greatly lower water levels in April and May (up to eight feet), significantly reducing of the suitable shorebird habitat acreage in the years following project completion. It is important to note that the shorebird HEP analyses address only spring migration habitat. In years when high river stages occur in June and July (e.g., 1993, 1995, 1996, 1997,

2008, 2011), backwater flooding and the thousands of acres of ephemeral ponds left behind provide important habitat for shorebirds which begin migrating south in late July and early August.

Project implementation is also expected to negatively affect reptiles and amphibians in the project area. Eliminating seasonal backwater flooding over thousands of acres, and the ephemeral ponds that remain after flood waters recede will significantly reduce suitable habitat for reptiles and amphibians, particularly during spring breeding. In addition, project-related changes to surface water patterns may eliminate ponding in many areas in all but the wettest years. This would not only reduce available habitat, but further fragment and isolate tracts of remaining habitat and their reptile and amphibian populations.

Aquatic Wildlife Resources

The most significant project impact to aquatic resources is the loss of seasonal flooding in the St. Johns and New Madrid basins. Under the TSP, the levee closure and pumping operations will eliminate Mississippi River backwaters from entering the New Madrid Floodway and significantly reduce interior flooding in both basins. That, in turn, reduces spawning and rearing habitat for river and floodplain fishes. Killgore and Hoover (1998) used HEP procedures to quantify project-related reductions in flooding on fish spawning and rearing habitat in both basins. The Fish HEP is based on inundation and habitat type only. The Corps most recent analyses apply results of a study of fish access in the St. Johns Basin to modify the results of the Fish HEP, and estimate the effects of both the levee closure and pumping operations on fisheries in the project area. As previously noted, the Service was not involved in the most recent analyses, model assumptions and applications. Therefore we refer to the Corps results presented in the text, with additional recommendations to more accurately evaluate project-related impacts to fish. The Service views the post-project results as overestimates of fisheries benefits in the Floodway for reasons detailed below. Also as noted above, failure to include any analyses of fisheries benefits of events greater than the 5-year flood (only the 2-year event for farmed wetlands) is significantly underestimating current floodplain value, particularly for species that appear to rely on larger events for recruitment (e.g., paddlefish).

According to Corps modeling rearing habitat in the St. Johns Bayou basin will be reduced from 13,356.4 to 11,280.6 functional floodplain acres (excludes farmed wetlands above the 2-year flood elevation) with the TSP. That lost acreage represents 1082.2 HUs. Floodplain habitat losses are substantially higher in the Floodway. Functional floodplain acres would be reduced by 23,478.6, representing 4,956.4 HU s. During the spawning period, it is expected that the gravity gates at the levee closure will remain open until the water level reaches an elevation of 286 feet NGVD in the New Madrid (on average of 18.2 in March, and 16.4 days in April) which will allow for some fish access. It is unknown whether such actions will ensure fisheries access to the Floodway because fish movement through structures (e.g., box culverts) can be confounded by high velocities, restricted openings, and head differentials.

Although the Corps attempted to estimate future fish movement through the proposed New Madrid drainage structure, their study fell short in a number of ways. First and foremost, as designed the study cannot not quantitatively compare the currently unimpeded access of the New Madrid

Floodway with the existing conditions in the St. Johns Bayou which has a drainage structure. Not only did not study fail to sample fish access in the Floodway to provide a baseline for comparison, but the study did not attempt to sample recruitment which is one of the primary outputs from spawning and rearing. The conclusions regarding differences in fish communities in both basins are not well supported (See Appendix C for detailed technical comments). In addition, the relevance of the reproductive guilds is not explained. Given the limited sampling, conclusions based on relative abundance and composition of fish communities in the basins may be premature. For example, study results indicate half the fishes collected in the St. Johns Basin were non-native, highly tolerant western mosquitofish, almost twice as abundant as in the New Madrid Floodway. General conclusions about relative habitat value do not appear to a study objective, are no support by the data and thus are not convincingly presented.

Spawning and rearing habitat losses quantified in the HEP analysis were based on average annual acres of fisheries habitat at and below 2-year frequency flood for agricultural lands and a 5-year frequency for other lands (U.S. Army Corps of Engineers 2013). The acres of floodplain habitat that are inundated during larger flood events can be far higher. While such flooding occurs less frequently, a substantially greater portion of floodplain habitat is available to fish during those events. For example, a 10-year flood event can inundate approximately 70,000 acres in the New Madrid Floodway and benefit fish by greatly increasing available spawning and rearing habitat, as well as primary and secondary productivity associated with those areas. It should be noted that habitat losses associated with permanent waterbodies may be overestimated under both alternatives. Although those areas will no longer be available to riverine fish, they will continue to provide habitat for resident fish.

Severing the link between the New Madrid Floodway the Mississippi River will deprive the riverine ecosystem of productivity that is released by the floodplain during periods of high water from its only remaining connected tributary floodplain in Missouri. Bryan and Sabins (1979) attributed the productivity and resiliency of the populations of commercial and sport [fish] species in the Atchafalaya Basin to wide variations in annual water level that was the transport mechanism for distribution of nutrients to support the food web. River fishes, such as white bass, will lose most, if not all the extensive spawning, rearing, and foraging habitat provided by the Floodway. Numerous studies have examined the relationship between floodplain habitat and fisheries productivity. Lambou (1962) noted over 50 years ago that the timing and extent of overflow on the floodplain can significantly affect year class strength of fishes. Barnickol and Starrett (1951) documented a reduction in game fish in a reach of the Mississippi River with reduced backwater habitat. As one of many more recent examples, Dutterer et al. (2012) again confirmed that reduced floodplain inundation reduces stream fish recruitment in river-floodplain ecosystems, and Janáč et al. (2010) highlighted the benefits of long inundation periods over flooded terrestrial vegetation as protective shelter for survival of native age-0 fishes. Expansive floodplains with a capacity for a wide range of flood elevation potential and long inundation periods will promote recruitment of fishes that use floodplains as nursery habitat.

Eliminating fish access to floodplain areas can also alter the composition of river fish communities by limiting recruitment of certain species (Turner et al. 1994). For example, the plains minnow (*Hybognathus placitus*), Western silvery minnow (*H. argyritis*) and Mississippi silvery minnow (*H. nuchalis*) are rare in the contemporary lower Missouri River where the channel is disconnected

from the floodplain (Ridenour et al. 2012a). Levees in southeastern Missouri are associated with reduced fish diversity and abundance of characteristic floodplain species such as starhead topminnow, banded pygmy sunfish and bantam sunfish (Finger and Stewart 1978, as cited in Hoover and Killgore 1998). A 100 percent reduction in fishery value occurred where adjoining backwaters along the lower Colorado River were drained (Beland 1953). Karr and Schlosser (1978) suggested that standing fish stocks may decline as much as 98 percent when floodplains are disconnected from the channel.

Even archetypical big river species like sturgeon chub (*Macrhybopsis gelida*) that inhabit the main channel of rivers during most of their life history are negatively impacted by reduced connectivity because their young experience ontogenetic shifts through slow backwater-like habitat adjacent to the river channel for nursery to improve recruitment opportunity (Ridenour et al. 2009). Further, because *Macrhybopsis* spp. chubs have been reported to make up to 79 percent of pallid sturgeon diet (Gerrity et al. 2006), they represent an important link in the food web that ties survival of a federally listed fish that may never directly use the floodplain during its life history cycle to the functional processes and productivity of connected floodplains and backwater habitats. Given the significant project-related decrease in the extent and variability of fIoodplain habitat that would be available, it is likely that both floodplain resident and main river channel fishes will decline as a result of project implementation.

The loss of fish spawning and rearing habitat in the project area could potentially affect freshwater mussel populations through alteration of the fish community. Mussels are susceptible to such changes because their life cycle includes an obligatory parasitic stage on fish. The larval stage (glochidia) of mussels must attach to the appropriate fish host to complete development (Neves 1993). The representative fish species used by Killgore and Hoover (1998) to report the losses in spawning and rearing habitat described previously include largemouth bass, white crappie, channel catfish and freshwater drum. Those fish species are important hosts for the majority of mussel species found in the project area. Several species, including the abundant threeridge, use sunfish (i.e., largemouth bass, bluegill and white crappie) as hosts. Catfishes serve as hosts for members of the genus *Quadrula*, and the yellow sandshell utilize gar. Several species appear to rely solely on freshwater drum. These include *Leptodea*, *Potamilus*, and *Truncilla* species. Currently, those fish species are common in the project area. Reduction or loss of those fish populations and suitable habitat, however, could potentially reduce recruitment into, or exchange among mussel populations throughout the project-area.

Unquantified hydrologic changes associated with the proposed channel widening may create unsuitable conditions for some aquatic life. The reduced water depths, uniform shaping and smoothing of the channel for flow conveyance, and loss of woody debris will decrease habitat diversity and food supplies for the fish community in St. Johns Bayou, and in some cases could make certain ditch reaches completely unusable by fish. The TSP would significantly reduce riparian forests in the St. Johns Bayou basin. Maximum water temperatures may increase substantially because of increased light absorption through removal of riparian corridor, decreased current, decreased water depths, and expanded surface water (Ebert 1993). Stern and Stern (1980) documented summer temperatures up to 12.8 degrees Celsius (E C) warmer and winter temperatures 4EC cooler in farm streams than in similar woodland streams. Similar patterns in unforested stream reaches have been noted by Hansen (1971) and Karr and Schlosser (1978). In

addition, removal of the riparian corridor will reduce influxes of leaf litter to the aquatic community. Such influxes are the primary energy source for instream communities (Brinson et al. 1981). Brinson et al. (1981) note that because of shading and organic inputs, riparian vegetation plays a profound role in the structure of invertebrate communities, and indirectly in fish community structure. Because project implementation will remove (temporarily or permanently) much of the riparian forests in St. Johns Bayou basin (and to a lesser extent in the Floodway) aquatic communities are expected to be negatively affected as well.

Project-area ditches have been periodically dredged to maintain adequate drainage. Unfortunately, the timing of the faunal population recovery and species succession following dredging in those ditches is unknown. The altered environmental conditions left by dredging may benefit some species, but may threaten the existence of many others including those endemic to this region. Dredging can disrupt the entire aquatic ecosystem and cause significant losses of biodiversity. The process removes macroinvertebrate assemblages and trapped organic matter that form integral parts of the trophic web (Cummings et al. 1973, Ebert 1993). Habitat heterogeneity is reduced by the elimination of instream cover (i.e., woody debris and vegetation) which is important to the production and diversity of both invertebrates and fish (Benke et al. 1985, Marzolf 1978, Cobb and Kaufman 1993).

Other effects of dredging extend beyond the excavated area. Aquatic organisms may be adversely affected by burial, exposure to contaminants, increased turbidity, and decreased dissolved oxygen levels (Ebert 1993). Headcutting, the upstream progression of bank erosion and substrate destabilization, has occurred following dredging in low-gradient ditches similar to those found in the project area (Hartfield 1993). Headcutting has been associated with the following: extensive bank erosion; wide, degraded channels; meander cutoffs; whole trees within the channel; quicksand or otherwise loose, unstable sediments; perched tributaries at low water; and the absence of bald cypress and tupelo trees where those species are characteristic components of stable riparian ecosystems.

Dredging and widening in the St. Johns Basin will also severely impact the local mussel fauna. The most direct effect will be the physical removal and destruction of the majority of mussels in the dredge path. Potentially, some individual mussels could be missed by the dredge and survive. Barnhart (1998) found a number of mussels in Setback Levee Ditch whose ages predated the last dredging event. Those individuals were generally found along the wooded bank at sites where only one side was cleared at the time of the dredging. Since the proposed project also involves widening, the impacts to mussel are likely to be far more extensive than past dredging events.

As noted previously, the mussel assemblage in the proposed project area appears to be particularly vulnerable to dredging and channel maintenance as shown by the greatly reduced mussel populations in project-area ditched over the last 15 years (U.S. Army Corps of Engineers 2013). Twenty of the 24 species found by Barnhart (1998) each made up less than 5 percent of the 1998 individual mussels collected. A large-scale disturbance, such as dredging, has the potential to cause localized extirpation of some mussel species.

Since mussels are relatively immobile, recovery of depleted populations will depend upon recruitment of juveniles transported by fish hosts from adjacent populations unaffected by the

dredging. Those "seed" populations would largely be restricted to the upper Setback Levee Ditch and the St. Johns Ditch. The mussels in those areas are relatively less abundant and species rich compared to the proposed dredged area. It is uncertain whether the Lee Rowe Ditch would serve as an adequate seed population. Although this ditch is not in the proposed dredge path, it may be severely altered. Dredging will lower the bottom of the Setback Levee Ditch and St. James Ditch. As a result, the Lee Rowe Ditch could become perched during base flows resulting in decreased water velocity. The natural succession to follow may transform this area into a more lentic environment suitable for very few mussel species (Fuller 1974, Oesch 1995).

The timing of the population recovery and species succession following dredging in lowland ditches is unknown. The degraded habitat left by the dredging is unlikely to be suitable for colonization by juvenile mussels and may require several years to recover. Since mussels are obligate parasites of fish, the recovery of specific host populations is a prerequisite to the restoration of habitat for juveniles. Considerable time may be required to restore adequate spawning habitat (i.e., snags and aquatic vegetation) for these fishes.

Endangered Species

Two federally listed species occur in the project area: the pallid sturgeon and the Interior least tern. Project implementation will significantly reduce backwater flooding in the project area during spring, particularly in the New Madrid Floodway. That, in turn, will virtually eliminate seasonal use of the floodplain by Mississippi River fishes. Several least tern colonies occur adjacent to and downstream of the project area. Because of the importance of fish in the diets of both species, significant project-related impacts to fisheries production may also affect those species. The Corps has submitted a Biological Assessment to the Service and requested formal consultation on those species. The Service has concurred with the Corps that the project is not likely to adversely affect the pallid sturgeon based on insignificant effects (i.e., effects that cannot be meaningfully measured or detected.). The Service prepared a May 2013 draft biological opinion on project effects to the least tern. In that biological opinion, the Service determined that the project is likely to adversely affect the interior least tern, and we developed a list of reasonable and prudent measures to minimize incidental take.

## Fish and Wildlife Conservation Measures

The proposed project alternatives will have significant adverse impacts on fish and wildlife resources. The TSP will have substantial direct effects on fish and wildlife. Of equal or greater concern are the indirect, project-related hydrological changes that will result in degradation and loss of fish and wildlife habitat due to the levee closure and pumping operations. Closing the gap in the New Madrid Floodway will severe the link between the Mississippi River and its only connected tributary-floodplain complex in Missouri. The riverine ecosystem will lose the productivity that is released by the floodplain during high water. River fishes, such as white bass, will lose 100 percent of the extensive spawning, rearing, and foraging habitat provided by the Floodway. Because of the significant project-related impacts to fish and wildlife resources, the Service believes that project plans can and should be further modified to mitigate those negative impacts.

The President's Council on Environmental Quality defined the term "mitigation" in the National Environmental Policy Act regulations to include:

> (a) avoiding the impact altogether by not taking a certain action or parts of an action; (b) minimizing impacts by limiting the degree or magnitude of the action and its implementation; (c) rectifying the impact by repairing, rehabilitating, or restoring the affected environment; (d) reducing or eliminating the impact over time by preservation and maintenance operations during the life of the actions; and (e) compensation for the impact by replacing or providing substitute resources or environments.

The Service's Mitigation Policy (U.S. Fish and Wildlife Service 1981) supports and adopts that definition of mitigation and considers its specific elements to represent the proper sequence of steps in the mitigation planning process. That policy identifies four resource categories to ensure that the level of mitigation recommended by Service biologists is consistent with the fish and wildlife resources affected by the project. Considering the high fish and wildlife value and relative scarcity of the forested wetlands to be impacted by the proposed project, those habitats have been designated Resource Category 2 habitats. The upper ditch reaches in the St. Johns basin contain valuable instream habitat (i.e. logs, debris, and submerged vegetation) and support diverse freshwater mussel populations which are becoming rare both regionally and nationally, and thus are also considered Resource Category 2. The mitigation goal for that resource category is no net loss of in-kind habitat value. The majority of wetlands in the project area are composed of croplands, pasture, and fallow fields. Because those wetlands provide high to medium habitat value to fish and wildlife, and are relatively abundant nationally, those habitats are considered Resource Category 3 with the mitigation goal of no net loss of habitat value while minimizing loss of in-kind habitat value. What makes those areas especially important to fish and wildlife is periodic inundation during high river stages. In fact, backwater flooding is a critical factor in determining the habitat value of most of the wetlands in the project area. Such flooding provides not only habitat, but also makes floodplain productivity accessible to the riverine system. Unfortunately, such systems are also becoming increasingly scarce at both the regional and national level. Gore and Shield (1995) noted that the stability and functioning of large river ecosystems depends on maintaining watershed and floodplain integrity. Consequently, mitigation measures should ensure, to the maximum extent possible, continued connectivity between the floodplain and the river to maintain the functions of those habitats and the ecologic integrity of the floodplain-river ecosystem.

Wetlands

While the Service, Corps and MDC planning team initially agreed to use HEP procedures to capture project-related losses to fish and wildlife, as well as potential benefits of various mitigation measures, the Corps' more recent analyses were not conducted collaboratively with the planning team. Thus using the Corps' fish and wildlife habitat modeling results leaves out significant losses of wetland functions not included in either the Corps' HGM or the species models. Therefore, the Service provides the following comments as context for mitigation recommendations for wetlands.

The Corps used the HGM and the Missouri Stream Mitigation Method (MSMM) to determine project impacts on wetlands and streams, respectively (U.S. Army Corps of Engineers 2013). The HGM method is not being used in Missouri to evaluate project impacts and compensatory mitigation under Section 404 of the Clean Water Act because it involves multiple assumptions and complex computations making complicated to use and difficult to interpret. In addition, there are no protocols within the method for tradeoffs among wetland types. That, coupled with its limited application (i.e., not applied to all wetlands in the project area) for this project do not provide a credible wetlands functional evaluation in the Service's opinion, In addition, we believe the public will find the HGM and its results almost indecipherable, failing one of the fundamental objectives of the DEIS.

An Interagency Review Team (IRT) made up of the Corps, EPA, the Service, NRCS, MDC, and the MDNR has developed the Missouri Stream Mitigation Method (MSMM). The IRT is also developing the Missouri Wetland Assessment Method (MWAM) still in draft form. The two methods will serve as the preferred method for quantifying unavoidable stream and wetland impacts associated with the Section 404 permit applications as well as compensatory mitigation benefits.

Aquatic resource types under the MSMM are based on the suite of functions provided by the habitat under consideration. For example, using the MWAM, the acreage required to compensate for the draining of forested wetlands in the project area could be up to 11.25 times the affected acreage**.** Those areas are considered a Type A habitat (multiplying factor of 3) in a primary priority category (waters officially designated by the Corps as high priority, multiplying factor of 2) that are lightly impaired to fully functional would (multiplying factor of 2.25), with duration of impacts to last over 10 years (temporal lag) (multiplying factor of 2) and a dominant impact of draining (multiplying fact of 2).

MDNR developed the Aquatic Resources Mitigation Guidelines with the cooperation of the MDC, EPA, the Service, NRCS and the COE. Compensation ratios for project impacts are between 1 - 3 times the affected acreage for emergent wetlands, and 2 -5 times for forested wetlands. These ratios may be increased when mitigation is not conducted before or concurrently with a development project, out-of-watershed mitigation is required, and when projects impact functioning mitigation sites (as is the case in the Floodway). MDNR's guidelines also indicate that rare and unique aquatic habitats may not be appropriate for any mitigation and therefore no impacts should occur in these areas. These areas include fens, mature bottomland woodland, or other areas as described by the NRCS Missouri categorical exclusion and "red flag**"** areas, including Bootheel forested wetlands. This is yet another reason why MDNR should be included in development of the compensatory mitigation plan before it is proposed for public review and input.

Mitigation in batture lands would not adequately compensate for wetland losses. Batture lands are already connected to the Mississippi River and subject to the flood pulse. Much of the batture is wetland already, although many areas experience far harsher velocities and temperatures that the adjacent floodplain wetlands. The Corps' compensatory mitigation package does not demonstrate compliance with the Compensatory Mitigation Final Rule because of the

uncertainties surrounding the timing, location, duration and nature of the mitigation measures.

The Service reviewed the Adverse Impact Factors for Riverine Systems Worksheet, the In-stream Work Stream Channel/Stream Restoration or Enhancement and Relocation Worksheet and the Riparian Buffer Creation, Enhancement, Restoration and Preservation Worksheet. There is little or no supportive information showing how numbers were put into the worksheet. The worksheet indicated that approximately 15 miles of stream would be adversely impacted and the DEIS stated channel work would occur in 23 miles of stream. If impacts will occur in 23 miles of stream, then mitigation credits required would increase to 1,045,656. The DEIS does not show how recurring impacts would occur in Type 3 and 4.

There is little or no supportive information to show how the Corps determined the net benefit, monitoring/contingency, control/site protection, mitigation construction timing in the DEIS. In Section 6.3, Compliance with Mitigation Rule, the stream restoration is described as:

1. Construction nine transverse dikes in the lower 3.7 miles of St. Johns Bayou to create a low flow sinuous channel following construction.
2. Construct a bank stability structure at the confluence of St. Johns Bayou and Setback Levee Ditch to provide stability and structure.
3. Construct a bank stability structure at the confluence of Setback Levee Ditch and St. James Ditch.
4. Incorporate stable stream slopes along channel rights-of-ways.

We do not agree that the net benefits for items 1 and 2 should be 2 (rated as good). The stream enhancement activities are more accurately described as moderate (1.0). Only construction of the transverse dikes would provide an ecological lift to the stream system. We question whether the sinuosity pattern in the channel would be allowed to persist or if periodic "channel cleanout" as is described in the project, would affect that feature. Restoration activities 2-4 are considered best management practices that would be required of any stream construction activity, and thus the project should not receive any restoration/enhancement credits for activities 2-4. Therefore, only credits should be allotted for the lower 3.7 miles of the project.

Woody vegetation will be planted on one side of the channel and warm season grasses on the other side of the channel for approximately 159,318 lineal feet of the stream. In Section 6.3, Compliance with the mitigation rule, the riparian buffer creation/enhancement is described as establishing buffer strips along the right-of way as:

1. Ditches would be excavated from one side. Excavated material disposal piles would be placed a minimum of 40 feet from the newly constructed top bank. Spoil piles would be allowed to revegetate naturally. Spoil piles would be used for any future ditch maintenance.
2. Within the 40-foot berm, warm season grasses would be planted to create a grass buffer. This grass buffer strip would be maintained and would serve as future maintenance/inspection access.
3. A riparian buffer would be created along the opposite bank by the establishment and or preservation of woody vegetation.

We do not believe the side of the channel where grasses will be planted should receive any mitigation credit. The 40-foot wide strip would be "maintained," which we assume means mowed, and will be used for future maintenance/inspection access. Historically, the Bootheel was bottomland forested habitat and any riparian restoration should be limited to revegetating with

woody species. A twenty-five foot wide woody riparian corridor provides little habitat benefits along a perennial stream. The IRT generally recommends a minimum100-foot buffer along perennial streams. The Corps must provide supportive information with the assessment to verify the credits and debits in report. Ideally, they should include the IRT in project analyses for these assessment tools, and also recalculate debits and credits based on our recommendation.

St. Johns Bayou Basin

According to the Corps, the New Madrid Floodway is hydrologically separate from the St. Johns basin. Therefore, flood control efforts in the Floodway would not address flood damage in and around East Prairie. The Service and MDC fully support measures to protect homes, businesses, and public infrastructure from flooding. However, we believe there are several alternatives to better address flooding problems in and around East Prairie that would avoid all or most of the adverse environmental impacts associated with the proposed alternatives. According to the Corps, local drainage improvements are necessary to significantly reduce municipal flooding. The Service has previously recommended several measures regarding alternate pump operations and non-structural alternatives. Such measures would avoid fish and wildlife impacts in the St. Johns Bayou basin associated with channel enlargement and lower water levels while ensuring the public safety. Focusing flood risk reduction efforts on public infrastructure and urban areas in the St. Johns Basin only, would also avoid adverse impacts to the New Madrid Floodway and retain the connectivity between the Floodway and the Mississippi River, as well as the habitat values and functions of the system.

If the Corps determines that more extensive work is necessary to reduce flooding in East Prairie, such work should be limited to that basin. Channel enlargement impacts to both the riparian corridor and in-stream habitat along the St. James and Setback Levee ditches, and St. Johns Bayou should be minimized to the greatest extent possible. The TSP would avoid some impacts to the riparian corridor by limiting channel enlargement of the St. Johns Bayou to 120 feet, and working from only one bank, switching work in the St. James Ditch to the right bank between Missouri Highways 80 and OO. The Corps has proposed construction of transverse dikes every half mile on alternating banks in the lower four miles of St. Johns Bayou to mitigate for in-stream habitat losses. Such dikes are reported to create a more natural stream morphology and provide riverbank habitat (Killgore and Hoover 1998). Before such measures can be fully evaluated, however, it should be determined whether sedimentation will occur between the rocks, which would reduce the habitat quality of those structures.

No mitigation measures have been proposed by the Corps to compensate for in-stream habitat losses in the Setback Levee or St. James ditches. Vortex weirs, a relatively new technology to provide in-stream cover, have been proposed by MDC (Mark Boone, pers. comm.). Vortex weirs are a low-head structure consisting of series of large rocks or boulders anchored across the channel. The rocks are spaced apart to allow water to flow through. Vortex weirs have been used successfully in streams with high bedloads (similar to the project area ditches) because they allow sediment transport. In addition to providing habitat for host fishes, the weirs may also create habitat for freshwater mussels by providing substrate stability and a wide range of current velocities without creating backwater and sediment deposition which most species of unionids

cannot tolerate (Fuller 1974). MDC recommends the weirs to be a minimum of 25 feet long and installed every 0.25 miles.

The TSP would avoid the upper 3.7 miles of the St. James Ditch to protect the aquatic vegetation that provides habitat for the golden topminnow. While this will leave the upper reach of habitat intact, additional habitat may still be affected downstream. Similar habitat occurs in the St. James ditch as far south as County Road 525. In that reach, Service and MDC biologists observed another rare species, the northern starhead topminnow, which has similar habitat requirements. Because the range of the topminnow species and its habitat in the project area have not been determined, and it is uncertain if that habitat will reestablish itself after dredging, the Corps should minimize dredging and channel modifications in the entire reach of St. James Ditch that contains the topminnow's preferred habitat (i.e., quite waters with aquatic vegetation).

Several additional actions could be taken by the Corps to mitigate loss of aquatic habitat diversity, shallower water depths, higher water temperatures during the low flows, headcutting, and perching caused by channel enlargements. Transverse dikes could be constructed to offset losses from a shallower, wider channel in all work reaches. The dikes should be designed to scour a continuous, sinuous thalweg along the entire channel. The Corps has proposed such structures in the lower four miles of St. Johns Bayou (discussed previously), but as a means to create riverbank habitat. The reaches that will be affected most by reduced water depths will be the Setback Levee and St. James ditches.

Gradient control structures to prevent headcutting should be placed at the upper end of all work reaches including the St. James and Setback Levee ditches. Those structures should also be placed at the mouth of all major tributaries including the St. Johns and Lee Rowe ditches. Vortex weirs, discussed previously as a means to create in-stream fish habitat, are also designed to provide gradient control. Therefore, installing weirs may compensate for habitat losses as well as prevent headcutting. A low water weir should also be installed where the Lee Rowe Ditch branches off St. James Ditch to prevent perching this channel during base flows. Without these measures, aquatic habitat losses from dredging and channel widening will go unmitigated.

The dredging plan should also be modified to reduce impacts to freshwater mussels. Of the reaches surveyed in the project area, the Setback Levee ditch contained the highest mussel diversity and abundance (Barnhart 1998). Most individuals collected from that ditch were in a 6.5-foot strip along the wooded bank (right descending side). To reduce impacts to mussels and increase the potential for recolonization, at least a 9-foot strip along the right descending side of the channel should be avoided entirely. This measure is intended to leave enough mussel breeding stock to repopulate the dredged reaches. (It should be noted that avoiding one side of the ditch would also minimize negative impacts to wildlife such as wading birds, mink, otter, and numerous reptiles and amphibians.) Because survival of mussels in that strip is uncertain, that effort should be supplemented with mussel relocation from sites within the dredge path to other areas in the project area. In addition, a monitoring plan should be developed, in coordination with the Service and MDC, to determine the success of mussel mitigation measures. Although the dikes, weirs, and gradient control structures all have potential to provide suitable mussel habitat, mussel use of those structures has not been evaluated. Therefore, the mussel monitoring plan should also include long-term monitoring to determine the value of those structures as mussel habitat. The

monitoring program should quantify changes in population densities and habitat conditions over time and determine the timing of population recovery in dredged reaches. Given the longevity of unionids, populations should be monitored prior to project construction and for at least 15 years post project. That timeframe should be sufficient to document mussel recolonization, if any occurs. The information gained from that study could be used to better evaluate and manage impacts to mussels in future projects.

New Madrid Floodway

The proposed work in the New Madrid Floodway will have significant negative effects on fish and wildlife resources. Therefore, if the Corps determines that flood control measures are required in the Floodway, we strongly encourage them to consider other alternatives that would avoid most of the adverse environmental impacts associated with either of the proposed alternatives. For example, a non-structural alternative such as the use of flood easements in the lower portion of the Floodway could reduce flood-related agricultural damages while ensuring that area will continue to provide habitat to nationally significant fish and wildlife resources. (That measure could also be considered for the St. Johns Basin.) The Service has recently learned of efforts coordinated by the Business Council for Sustainable Development, Gulf of Mexico, to reforest up to 1 million acres of marginal farmlands in the lower Mississippi River Valley. The goals of the program are to improve water quality, recreation, and fish and wildlife habitat; provide an economically viable alternative to farming flood-prone lands; ensure adequate future supplies of forestry products, and provide communities with a sustainable way to diversify their economic base. The Service strongly supports such efforts and believes the Corps should further consider this and similar efforts as a way to reduce flood damages in the project area while enhancing fish and wildlife resources, and providing diverse, sustainable benefits to the local and regional economies.

The Service and MDC have previously recommended alternative alignments of the levee closure to preserve thousands of acres of floodplain as habitat for numerous fish and wildlife, and also maintain the ecologic functions (e.g., primary and secondary productivity export to the river, flood water storage, etc.) of floodplain wetlands by ensuring hydrologic connectivity between the floodplain and the river.

The TSP would have significant impacts to fish and wildlife in the Floodway. The Service and MDC, however, believe there are additional measures that would further reduce fish and wildlife impacts. In the TSP, the drainage structures will remain open in the St. Johns basin and New Madrid Floodway an average of 14.4 and 12.9 days (i.e., the average number of days interior water levels are expected to be higher than river stages, and thus allow drainage to the river) in March and April respectively. Although that operation plan potentially provides Mississippi River fish limited access to floodplain habitats during part of the spawning season, the extent of fish movement through the box culverts is unknown. Furthermore, that alternative would still cause significant losses of floodplain spawning and rearing habitat. If river fish were able to access those basins, little if any of the existing floodplain would be inundated at that time under either proposed project alternative. Of the proposed Floodway closure alternatives, the Service recommends alternative 4.1 as the alternative with the fewest adverse impacts on fish and wildlife resources, including minimized anticipated take of the federally listed Interior least tern.

St. Johns Bayou Basin and New Madrid Floodway

The most effective measures to mitigate project impacts would maintain the natural connectivity and water level variability of the floodplain which, in turn, would protect the ecologic functions of project-area wetlands. The Service has suggested to the Corps that the pumps be operated according to a "Rule Curve" that would ensure the greatest interchange possible between the Floodway and the river. Such a plan would have both outlet structures open to allow flooding up to the elevation that avoids inundation of important public infrastructure. Pump operations could be determined that would have specified target elevations during the spring fish spawning season. The purpose of a "Rule Curve" is to use a combination of gate openings, target elevations, and pumping to prevent damaging water levels, while allow some interchange between the river and the Floodway. For example, if river stages exceeded the trigger elevation, the gates could be closed and water levels reduced (via pumping) to (or slightly below) the trigger elevation, so that the gates could be reopened. Such measures would allow for more floodplain-river interchange (and fish and wildlife habitat) in the St. Johns Basin while reducing some of the negative project impacts to the New Madrid Floodway by increasing the time the drainage structures would remain open.

An operational rule curve would also promote the long-term variability in water depths important to wetland invertebrate production, wetland plant response during the growing season, and overall wetland health. In addition, such operations would allow much of the lower basins to flood naturally during wet years when they would have the greatest waterfowl use. In addition to the fish and wildlife benefits, we believe that such a plan has the potential to lower long-term pumping costs in comparison to the proposed plans. Alternative 4.1, which was suggested by the IEPR, appears to minimize losses to fish and wildlife resources while also protecting public infrastructure. The difference in "excess benefits" between the preferred alternative and Alternative 4.1 appear to be within the confidence limits of the methods, thus essentially insignificant.

Because the Service was not involved with the most recent project impact analyses, we have not developed quantitative estimates of compensatory habitat requirements for the proposed project. As previously noted, the Service believes Corps project impacts are significantly underestimated. We will study the current DEIS in greater detail during the public comment period, and provide quantitative estimates of compensatory mitigation needs in our final report. This may require additional information from the Corps to adequately capture all project impacts reasonably certain to occur.

The following sections address qualitatively the mitigation requirements to compensate for project-related losses to fish and wildlife habitat value. Ideally, those measures would be conducted within the affected basin to ensure that wetland and floodplain ecologic functions were conserved in the project area. In this case, however, it will be impossible to compensate habitat losses within the project area. Even with the TSP, fisheries access through the drainage structure to the floodplain will be drastically reduced in the Floodway. The 1,500-foot gap in the levee that currently provides river fish access to floodplain habitats throughout the spring spawning season (i.e., March - June) will be restricted to a single 10-foot by 10-foot box culvert that would be open only periodically during part of the spawning season (i.e., an average of 18.2 and 16.4 days in

March and April respectively), generally during lower river stages. There are no measures within the project area to fully mitigate the loss of the natural connectivity between the Mississippi River and the New Madrid Floodway as a result of the preferred alternative. In addition, after project implementation, not only would fisheries access into the basins be reduced, but suitable habitat would be almost eliminated. In April, during the spring spawning season and waterfowl and shorebird migration, water levels in the project area would reduce average flooded acres in the Floodway by 72%.

Floodplain habitats that will be substantially reduced by the project include cropped agricultural land (CAG) (including farmed wetlands), fallow land, bottomland hardwood forests, and seasonally connected large and small permanent water bodies. The Corps has proposed to convert flooded agricultural land to bottomland hardwood forest to compensate fisheries habitat losses of seasonally inundated CAG, fallow land, and forested wetlands. Since forested wetlands generally have higher fisheries habitat value than seasonally inundated CAG or fallow land, well as wildlife, we believe that re-establishing forested wetlands can be an effective measure to compensate losses of floodplain fisheries habitat losses, provided the site has significant access for riverine fish from March through June (See details on reforestation below). Previous interactions of the fisheries HEP model shows substantial early-season rearing losses in both basins, much of those losses are attributable to changes in white bass habitat. Sheehan (1998), however, did not record white bass in spring sampling in the St. Johns Basin. In addition, according to the HEP model, agricultural fields, rather than forested wetlands, appear to have a higher suitability index for larval white bass, which would derive minimal benefit from reforestation as a compensation measure. Therefore, we believe mid-season habitat losses better reflect habitat changes to a larger number of both floodplain and riverine species, and compensation based on those losses would benefit the majority of the fish fauna.

The Service recommends that rearing acres be mitigated because of their importance to fisheries and their ecological functions. Since little is known of the distribution of larval fishes in floodplain habitats, there has been some debate on the need to mitigate rearing habitat losses of areas less than one foot deep and flooded agriculture fields (including farmed wetlands). However, Ridenour (2007) demonstrated that waters less than one foot deep provided significant nursery habitat for fishes around main-channel sandbars; these extreme shallow waters provided warmer temperature and food resources for fast growth, and provided a refuge from fish predators. Available data on fish use of flooded agricultural fields is varied. Hoover and Killgore (1996) collected larval fish from various floodplain habitats in the Big Sunflower River system in Mississippi. Invasive and ubiquitous species such as carp and shad were most often found on flooded agricultural and fallow land. Other species were concentrated around bottomland hardwoods. In contrast, data from extensive fish sampling of floodplain habitats near Cape Girardeau, Missouri show other fish species use agricultural fields as rearing habitat. In 1993, large numbers of larval fish were collected by trawl from agricultural fields up to 3/4 of a mile away from permanent waterbodies. The most abundant larval fishes were drum, silversides, various species of minnows, and several species of darters (Bob Hrabik, Cape Girardeau Long-term Resource Monitoring Station, pers. comm., 1998). Ridenour et al. (2012b) found age-0 size *Macrhybopsis* spp. chubs were six-times more abundant in sites with connected floodplain backwater areas than sites without connected floodplain backwater areas.

Killgore and Hoover (1996) sampled fishes from the Yazoo River system in Mississippi to quantify the relationship between water depth and larval fishes. From these collections, they concluded that water less than one foot deep was not extensively used by larval fishes in the Yazoo River system in Mississippi. Bob Hrabik (pers. comm.), however, collected various species of minnows from flooded agricultural fields in water less than one foot deep. He believed that larval fish were most likely present in those areas but are not often sampled with common and conventional electroshocking methods. While Yazoo River larval fishes may prefer slightly deeper water, their depth use distribution may be driven by other factors such as pressure from terrestrial and avian predators that often hunt in littoral riparian zones of rivers (Power 1987; Schlosser 1987). Ridenour (2007) concluded that extreme shallow waters, where conventional electroshocking methods are ineffective, do provide significant nursery habitat in main-channel areas for larval and age-0 fishes that are too small to be sampled with conventional electroshocking methods. Extreme shallow waters in floodplains likely also facilitate significant floodplain functions (detrital input, nutrient cycling, floodwater storage, etc.) in their role as part of the aquatic-terrestrial-transition-zone *ATTZ* (Junk et al. 1989). The wide-spread, shallow flooding in the project area provides a large surface area for planktonic production driven by sunlight and warm temperatures. It is generally accepted that floodplain waters (including shallow waters) are important for the production of phytoplankton and zooplankton (Robert Sheehan, pers. comm.), which are the principle food source for larval fish (Pflieger 1997). In addition, a major factor involved in the transition of larval fish from endogenous (yolk sac) to exogenous nutrition is the density of food organisms (Hall and Lambou 1990). As previously mentioned, Hrabik (1994) noted the extremely high zooplankton productivity on a wide floodplain near Cape Girardeau. Because larval fish use shallow-water habitat and because of the contribution of that habitat to the primary and secondary productivity of the floodplain, the Service recommends that all fish rearing habitat losses, including those habitats shallower than one foot deep, be fully compensated. From a practical standpoint, it would be very difficult to ensure that all compensation acres meet the spawning criteria (i.e., flooding > 1 foot for 8 days or more) to replace spawning habitat losses over an area of such small topographic relief. Although water depth and duration depend on the characteristics of a particular site, Corps hydrologic modeling shows that spawning acres account for only a portion of the area inundated under natural flooding patterns. Therefore, achieving the necessary compensation acres to meet the spawning criteria may involve inundating considerably more acreage.

Ideally, mitigation lands should be located in an area currently not subject to flooding, but with potential to restore the hydrology to a functioning forested wetland. The greatest habitat gains would result from reforesting an area that does not flood (hence no existing fisheries value), but has the potential for restored wetland hydrology. Such a site, however, would most likely involve significant water management and fisheries access issues. Locating compensation area(s) on farmed wetlands would provide the hydrology, but result in a net loss of wetland acreage due to the project. In addition, the value of restoration lands designed to compensate lost fisheries habitat differs greatly with location and flooding regime. The estimated acreage is an annual average over the life of the project (consistent with the methods used to assess existing habitat value). That means over the next 50 years, the mitigation tract(s) must provide functions equivalent to those acres, taking into account effects of variable river flooding. For example, a selected track is inundated only 60 percent of the years, then additional acres may be required to provide the remaining 40 percent of the mitigation value necessary to compensate for those habitat losses. It is

important to provide mitigation lands as similar as possible to the lands affected. For example, mitigation lands in the batture will not provide the same habitat conditions as backwater and floodplain habitats that are so rare along the Lower Mississippi. As noted above, fisheries communities and life stages differ significantly between the floodplain and main channel of the Mississippi River, and robust native fish communities need both the survive.

Another confounding factor is flooding duration. If the mitigation tracts are inundated March through June, they could potentially compensate for the early, mid, and late spawning and nursery needs. Unfortunately, such an extended flooding period is not compatible with reforestation of bottomland hardwood tree species. Many previous reforestation projects in the lower Mississippi River Valley have met with poor success because of problems with modified flooding regimes that can drown seedlings and/or acorns. Although reforestation benefits many fish species, the proposed compensation acreage will not meet the substantial spawning and rearing needs of the white bass. Flooded cropland and fallow fields provide greater habitat value for that species. Therefore, we recommend that the Corps consider measures to seasonally inundate cropland during the month of March to meet the habitat needs of white bass. Possibly such flooding could also be used to compensate for spring shorebird habitat losses (see below).

The Corps had previously suggested creating borrow pits to partially mitigate for habitat losses of seasonally connected large and small permanent water bodies on the floodplain, including natural oxbow lakes. Although the functional similarity of borrow pits and oxbow lakes is unknown, borrow pits have been shown to function as effective fish nurseries if they are properly constructed (Sabo and Kelso 1991; Tibbs and Galat 1997; Whitledge et al. 2005). The Corps has adopted guidelines for borrow pit construction along the lower Mississippi River (Aggus and Ploskey 1986). Several features important to fisheries are high shoreline to surface-area ratio; various depths, both shallow and deep (as refuge); various substrate materials; and riparian vegetation. Those guidelines stressed the importance of maintaining connections to the Mississippi River so that spawning adults can access the ponds and young-of-the-year fish can escape when conditions in the ponds become stressful. Permanent waterbodies appear to be particularly important as nursery habitat for larval fish (J. Killgore, pers. comm.). Killgore and Hoover (1996) noted that larval fish were found most often in waters greater than 1 foot deep. Because of the expense of borrow pit construction, the Corps' original proposal would result in only a small portion of permanent waterbody habitat losses mitigated in-kind.

More recently, the Corps is recommending reforesting flooded croplands to compensate for permanent waterbody habitat losses. In light of the cost constraints and minimal habitat gains from the proposed borrow pit construction, the Service has agreed to reforestation as an appropriate mitigation measure. Given the importance of permanent waterbody habitat to larval fish, however, we recommend that the Corps provide in-kind habitat compensation for those losses to the maximum extent possible. This could be done by purchasing mitigation lands that include permanent waterbodies that could be improved (i.e., reforest or regrade old borrow pits) or reconnected to the Mississippi River (i.e., old chutes, sloughs, or oxbows). Such areas should allow *significant* fisheries access to riverine species from March through June to realize the estimated habitat benefits. In addition, to compensate for losses to recreational fishing we recommend the Corps ensure public access to those waterbodies through fee-title purchase or easements.

Habitat value of forested wetlands in the project area will decline significantly because of channel enlargement, levee closure, and pumping operations. To compensate for that habitat loss, we recommend that the Corps purchase croplands in fee-title to be reforested. Reforestation can be a very effective and efficient compensation measure. Depending on the location and flooding regime, restoration of forested wetlands could meet the needs of forest wildlife, waterfowl, and fisheries. Ideally, those lands should be located in an area currently not subject to flooding, but with potential to restore the hydrology to a functioning forested wetland. As previously mentioned, locating compensation area(s) on farmed wetlands would result in a net loss of wetland acreage due to the project. In addition, as shown in the fisheries analyses, farmed wetlands have important habitat value and their use would further increase the acreage required to compensate habitat losses. Specific details on species mix and reforestation methods will depend on the location of the compensation site(s) (e.g., soil, flooding regime, size, etc.) and will be developed by the Service and MDC. In general, however, compensation acres should be directly seeded, weeds controlled for a minimum of five years, and 70 percent tree survival attained at the end of five years. If necessary, at the end of five years, the area should be replanted and weed control implemented until the 70 percent survival threshold is met.

It should be noted that full replacement of forested wetland functions will not occur for many years given the time needed to grow large, mature trees. We estimate that it will take at least 50 years for a mitigation site to approach the habitat quality that currently exists in the project area. In addition, using the direct seeding method, the mitigation site will not compensate for lost habitat value for such species as the pileated woodpecker (an evaluation species) which require the large trees and structural complexity found only in mature forested wetlands. There is an experimental method, however, that may provide some of that habitat value within the project life. The root production method (RPM) has been shown to give young trees a several years Ahead start@ (i.e., mast production within 7-10 years)(B. Allen and D. Wissehr, MDC, pers. comm.). Because of this potential and its experimental nature, we recommend that the Corps plant a portion (# 15 percent) of the compensation area with trees subject to RPM to possibly compensate for mature bottomland hardwood forest habitat losses. In rare instances, preservation of an existing high quality tract of forested wetlands may be an acceptable compensation measure. Such cases, however, occur when there is no suitable acreage to reforest. Preservation is another instance where compensating wetland habitat losses with existing wetlands results in a net loss of wetlands in a project area.

We believe there will be significant indirect, project-related effects to forested wetlands because of hydrologic changes (i.e., eliminating seasonal inundation). The Phase I General Design Memorandum for the St. Johns and New Madrid Floodway project recognized the value and vulnerability of remaining forested wetland in the project area (U.S. Army Corps of Engineers 1980). We believe that it is still appropriate to protect important bottomland hardwood wetland habitats in the project area from future conversion. Under any project alternative, the most effective means to avoid the complete loss of forested wetland function within the project area is to maintain hydrologic conditions. Short of that, measure to prevent the conversion of those remaining forested areas through protective covenants can provide significant benefits to fish and wildlife. A restrictive covenant or some other appropriate protective measure should be used to

prevent the clearing of all existing unprotected forested wetlands that will no longer be seasonally inundated. Those include privately owned tracts that are not being managed for timber or enrolled in wetlands restoration programs (i.e., WRP). Based on the Corps hydrologic analyses, such measures should cover forested wetlands between elevations 291 and 290.4 feet NGVD in the St. Johns Bayou basin, and 292.1 and 287.6 feet NGVD in the New Madrid Floodway. Those measures would also preserve the habitat value of mature bottomland hardwood forests, which is unlikely to develop on reforested compensation areas over the project life. If the protective measures for forested wetlands mentioned above are not implemented, we recommend that the Corps purchase in fee-title, sufficient croplands to fully compensate habitat losses from induced development of those wetlands.

Implementation of either project alternative will greatly reduce waterfowl habitat values during spring migration. Therefore, we recommend that the Corps re-establish forested wetlands, as previously described, to compensate for those habitat losses. Not only will reforestation meet the food requirement of migrating waterfowl, but forested wetlands will also provide secure roosting areas, cover during inclement weather, loafing sites, protection from predators, and isolation for pair formation. Acres reforested to compensate for bottomland hardwood forest wetland losses could also compensate waterfowl habitat losses, provided the flooding regime and conditions are appropriate. Acreage to compensate for spring waterfowl habitat losses should be flooded only to a depth of 18 to 24 inches to be accessible to most dabbling and diving ducks in the project area.

Spring shorebird migration habitat will also be significantly reduced under either of the proposed project alternatives. In the St. Johns basin, habitat value would decrease approximately 30 percent, while in the Floodway the TSP would cause a 70-90 percent decrease in spring and fall shorebird habitat value respectively. To compensate for those habitat losses, we recommend the Corps secure, either through fee-title or easements, appropriate acreage (that would not be flooded under future project conditions) to be managed for shorebirds during spring and fall migrations. Moist soil areas provide more habitat value per acre than flooded cropland, so fewer compensation acres of that habitat type would be needed. In addition, depending on the depths of and access to an area, shallow flooded croplands or moist soil acreage could be used to offset a small portion of the habitat losses to fisheries and waterfowl. Structures within the existing drainage network in the project area could possibly be used to seasonally trap rainwater on agricultural lands to provide spring shorebird habitat. Alternatively, areas could be engineered, by installing small dikes and pumping systems, to control water levels regardless of precipitation or backwater flooding (i.e., moist soil units). Both those measures, however, would largely reduce or eliminate fisheries access at that site. Furthermore, although shallow water along the edges of borrow ditches may be suitable for shorebirds, existing borrow pits in the project area do not receive much shorebird use (B. Allen and D. Wissehr, MDC, pers. comm.). That may be related to the size of the borrow pits, or the presence of tall riparian vegetation and proximity to the Setback Levee both of which could obstruct the birds long-range vision. ***Regardless of the specific measures employed, use of existing conservation lands to meet compensatory mitigation, as the Corps has proposed, is not acceptable. It contradicts Service policy and guidance, as well as fails to meet the Corps own objectives for compensatory mitigation.***

The Corps has proposed reforesting (or allowing to revegetate) 9,423 acres of frequently flooded lands in or possibly adjacent to the project area to compensate for habitat losses in both basins.

Although the Corps recognizes the importance of mitigation in the area of project impacts, we have noted previously that there will not be suitable habitat under post-project conditions to reestablish the required forested wetlands within the basins. In addition, the Corps has noted to the Service that restoration of significant acreage of lands within the proposed project area could greatly reduce the economic benefits of the project, although this is not addressed in the economic analyses in the DEIS.

Another important factor in the feasibility of implementing the recommended mitigation measures is Corps policy that relies on purchasing mitigation lands from willing sellers. Considering the strong local support for the project and recent increases in commodity prices, finding enough interested willing sellers with suitable lands is extremely unlikely. Furthermore, while it is also Corps policy to compensate project impacts concurrently with project construction, reliance on willing sellers places significant constraints on both the timing of land acquisition as well as the location of those acquired lands. The mitigation acreage necessary for each species group is based on those acres *in place and functioning* when project construction is complete. In addition, for lands to offset both wetland and fisheries impacts, they must have significant inundation and fisheries acres in the spring while also able to support viable bottomland hardwood forest species. Acres that mitigate waterfowl impacts must be flooded no more than 24 inches to be accessible to most dabbling and diving ducks in the project area. Given the hydrology and large acreage necessary to compensate project impacts, acquiring suitable land from willing sellers in a timely manner would seem to present a great challenge to the Corps and the local sponsors.

Because the location of potential mitigation sites is unknown, it is impossible to validate the numerous assumptions used in modeling compensatory mitigation acreage. Those assumptions can significantly influence the modeled benefits of a tract and thus greatly change both the acreage as well as the costs of adequately implementing compensatory mitigation. Without far more detailed information on the mitigation sites, there is no assurance what portion of project losses would be offset. The mitigation plan should also identify the parties responsible for ownership and all long-term management of the compensatory mitigation. In addition, the AM plan for the mitigation portfolio should be far more developed, with specific monitoring parameters, decision points, operational triggers, and alternative operations clearly identified. The long-term management plan should also include a description of long-term management needs, annual cost estimates for these needs, and identify the funding mechanism that will be used to meet those needs. The Corps as well as the Service is increasingly aware of the time, effort and cost it takes to develop a fully functioning adaptive management plan for a project of this size. The details should not be left to an unspecified group at an unspecified time in the future. MDC and MDNR will be critical partners in developing and adequate AM program. We recommend that the Corps refer the mitigation bank guidelines as an example of the level of detail necessary to address specific mitigation designs, conduct compliance reviews, consult and approve adaptive management plans and ensure corrective measures are implemented if needed.

The Service supports the Corps policy of mitigation acquisition during project construction because it is critical to adequately compensate project-related impacts to fish and wildlife. However, we also recognize that circumstances beyond the Corps control may significantly delay or otherwise impede timely implementation of the mitigation plan. That could result in significant unmitigated adverse impacts to fish and wildlife resources. Therefore, to ensure that fish and

wildlife resources are conserved, we recommend that the Corps not construct closure of the 1500-foot gap in the mainline levee of the New Madrid Floodway and not operate either of the pump stations until mitigation for that project feature is in place. The Corps should include that condition as part of the operation plans for both pumping stations. To provide some flexibility, if a significant portion of the mitigation for the pump stations is in place by the time project construction is complete, the Service offers to work with the Corps to develop an alternative pump operation plan that would ensure those operations result in impacts no greater than what has been mitigated for at that time. The Service recommends that such operation guidelines become an integral part of the either alternative. We believe adherence to those guidelines is the only way to ensure that fish and wildlife resources receive equal consideration with other project purposes.

## Summary and Recommendations

The project purpose is to provide an unspecified amount of flood risk reduction to the proposed project area. As currently proposed, the overwhelming majority of project benefits are related to agricultural intensifications and flood protection. It is impossible to determine the meta data used for the Corps cost:benefit analysis in the DEIS, which appears to be driving the decision to proceed with a project. For example, when calculating "benefit" values associated with agricultural, only the net increase in commodity value resulting from a project should be used (not total agricultural income). Agricultural production has occurred in the area for decades and will continue to occur without the project, so it is the **net-added** benefit of various proposal alternatives that must be carefully determined and used in the calculation. Moreover, there is no accounting for losses in ecological goods and services provided by existing wetlands; values that would be reduced or eliminated by conversion wetlands to agriculture lands. Outcome of the Corps' cost:benefit analysis drives project decisions, thus using an inflated benefit or deflated cost estimate elevates a proposal score, giving it a Corps "justifiable" rating. The cost:benefit calculation must be complete from an environmental and various social perspectives, especially considering the irreversible intent of land conversion behind the proposed barriers between the river and floodplain.

The TSP will eliminate spring overbank flooding that currently may cover tens of thousands of acres in the St. Johns Bayou basin and the New Madrid Floodway. Upon receding, those flood waters produce thousands of acres of shallow, temporarily flooded wetlands in a variety of cover types. A variety of waterfowl, numerous other wetland dependent birds, amphibians, invertebrates, and mammals benefit from those habitats. Some of the largest remaining forested wetland tracts in southeast Missouri are found in the project area and would be negatively affected by the TSP. Seasonal backwater flooding in the New Madrid Floodway provides important floodplain habitat that supports an extremely abundant and diverse fish fauna (both floodplain and riverine), some of which are becoming regionally scarce. The interchange between the Floodway and the river supports a sustainable ecosystem not found elsewhere along the Mississippi River in Missouri. Alterations in the extent and timing of seasonal flooding in the project area greatly concern the Service not only because of adverse impacts upon numerous Federal and State trust resources, but also because of the potential adverse impacts to the study area ecosystem and cumulative impacts in the Lower Mississippi Valley.

The Corps has proposed reforesting 9,423 acres of frequently flooded croplands (i.e. farmed wetlands) near the project area to compensate for project-related fish and wildlife habitat losses. That plan, however, would result in a net loss of wetland acreage and functions within the project area, and a regional net loss of wetland acreage. In addition, although the proposed mitigation measures would compensate losses of wetland habitat value, they would not mitigate impacts to floodwater storage, nutrient cycling or detrital export/import, and water quality changes. Fish and wildlife species with limited mobility (i.e., reptiles, amphibians, and larval fishes) will experience a net loss of habitat within the project area that may not be compensated through the proposed mitigation lands. For those reasons, the Service urges the Corps to pursue measures to avoid project impacts rather than try to compensate for them after the fact.

Because the project will negatively affect nationally significant fish and wildlife resources in the project area, the Service recommends that the Corps implement the following measures to ensure that fish and wildlife receive equal consideration with other project purposes:

1.) Construct a St. Johns Bayou Basin only alternative that will avoid significant losses of fish and wildlife habitat and functions, while providing flood risk reduction focused on urban and residential areas, as well as public infrastructure.

2.) Minimize dredging and channel modifications to the maximum extent possible by implementing the following conservation measures:

a.) Installing gradient control structures at the upper end of all work reaches and at the mouths of all major tributaries to prevent headcutting.

b.) Installing transverse dikes in the Setback Levee Ditch and the St. Johns Bayou reach to offset fisheries habitat losses from shallower water depths. Those dikes should be designed to maintain a sinuous, continuous thalweg along the length of the channel.

c.) Constructing a low-head weir where the Lee Rowe ditch branches off the St. James ditch to prevent perching that channel during base flows.

d.) Constructing vortex weirs in the St. James Ditch to compensate for habitat losses from shallower water depths along those reaches. They may also function as grade control structures.

e.) Avoiding dredging impacts to the maximum extent possible in the entire reach of the St. James ditch that contains suitable habitat for the State-listed golden topminnow.

f.) Avoiding dredging in a 9-foot strip along the right descending side of the Setback Levee ditch to reduce dredging impacts to mussels and possibly leave a population to recolonize the ditch. In addition, a minimum of 1,500 mussels (species composition to be determined by the Service and MDC) should be relocated from selected sites within the dredge path to other appropriate areas in the St. Johns basin. A long-term monitoring plan should be developed, in coordination with the Service and MDC, to determine the success of those mitigation measures. In addition, that monitoring plan should contain a provision

to evaluate the suitability of the above-mentioned dikes, weirs, and gradient control structures as mussel habitat.

3.) Evaluate non-structural measures (e.g., flooding easements, etc.) to address agricultural flood damages in the New Madrid Floodway. If those are infeasible, the Corps should investigate alternative levee closure locations, such as that proposed by MDC, further north in the Floodway to avoid significant adverse effects to fish and wildlife.

4.) If the Corps determines there are no feasible flood control measures other than the TSP, they should incorporate the following measures as integral features of the selected plan:

a.) Prevent the conversion of forested wetlands in both basins due to project-related hydrologic changes. This should be done by purchasing a conservation easement or other protective measure on forested wetlands between elevations 291 and 290.4 feet NGVD in the St. Johns basin, and between 292.1or 287.6 feet NGVD in the Floodway.

b.) Fully compensate all unavoidable losses to fish and wildlife resources. Compensation measures should include the following measures:

- Reforest cropland to compensate for forested wetlands habitat losses associated with channel enlargement, levee closure and pump operations (i.e., altered hydrology). If protective covenants have not been placed on bottomland hardwood forest as described in 4(b), the Corps should reforest an additional acres to compensate for induced forested wetland losses because project-related reductions in flooding.

- Reforest cropland to compensate for losses in spring waterfowl migration habitat. Acreage to compensate for forested wetland losses mentioned above could also meet waterfowl compensation needs, provided the sites were reforested with at least 50 percent red oak species and flooded during late winter and early spring to depths no greater than 24 inches.

- Reforest flooded cropland that has unimpeded access for river fish during the spawning season (i.e., March through June) to compensate fisheries spawning and rearing habitat losses on the floodplain (excluding seasonally-connected waterbodies - see below).

- To the maximum extent possible, mitigate in-kind (i.e., similar habitat) for fisheries habitat losses of permanent waterbodies. This could include improving existing permanent waterbodies, or reconnecting old chutes, sloughs, and oxbows with the Mississippi River. If in-kind mitigation is infeasible, reforest additional acres of flooded cropland to compensate for those losses. Those sites must be easily accessible to river and floodplain fishes during the spawning season (i.e., March through June). The Corps should ensure public access to those sites through fee-title purchase or easements.

- Provide shallow flooded (i.e., # 18 inches) land during spring and fall migration to compensate for project-related losses in shorebird migration habitat. Constructing moist soil areas to mitigate those losses would reduce the necessary acreage compare to cropland.

- Use both the Missouri Stream Mitigation Method and the Missouri Wetlands Assessment Method to assess project impacts and compensatory mitigation for wetlands and streams and conduct a review that includes the Interagency Review Team.

- Acquisition of mitigation lands, reforestation, and shorebird management measures should be accomplished concurrently with most project construction activities, except for constructing the New Madrid Floodway Levee closure, and should be in place prior to project operation. Closure of the 1,500-foot levee gap should not be constructed until all mitigation measures are in place and functioning as planned.

- Provide a detailed adaptive management program to manage all compensatory mitigation features as well as modifications to proposed project operations to fully offset losses of fish and wildlife resources.

- Do not include existing conservation lands (e.g., Ten Mile Pond Conservation Area) lands as part of compensatory mitigation for this project.

Should the Corps pursue a Floodway closure alternative, we recommend alternative 4.1 which would have the fewest effects to fish and wildlife with minimal changes to project benefits, and a higher cost:benefit ratio than the preferred alternative.

**Service Position**

The Service and the Corps have strived to develop measures that fully address project-related impacts to Federal trust resources. However, providing the appropriate cover types (i.e., bottomland hardwood forest, moist soil, borrow pits), only partially meets the needs of fish and wildlife. To fully compensate for project-related impacts, habitat functions must also be maintained. While the proposed mitigation plan would potentially compensate fish and wildlife habitat losses that can be quantified with current models for estimating wildlife effects of water development projects, it would not sustain all the important ecological functions of the floodplain-river ecosystem in the project area.

The Service opposes the St. Johns Bayou and New Madrid Floodway preferred alternative because:

1.) As proposed, the preferred alternative would cause substantial, irretrievable losses of nationally significant fish and wildlife resources, and greatly diminish rare and unique habitats found in southeast Missouri.

4.) We believe project-related wetlands losses are at odds with the Administration's conservation policy goals and those of the Clean Water Action Plan.

5.) The St. Johns Basin only alternative (Alternative 2.1) is a technically and economically feasible alternative that would meet the project purpose while avoiding losses to nationally significant fish and wildlife resources.

If the Corps proceeds with project construction, at a minimum, they should include the Service's above-mentioned recommendations as integral components of the project.

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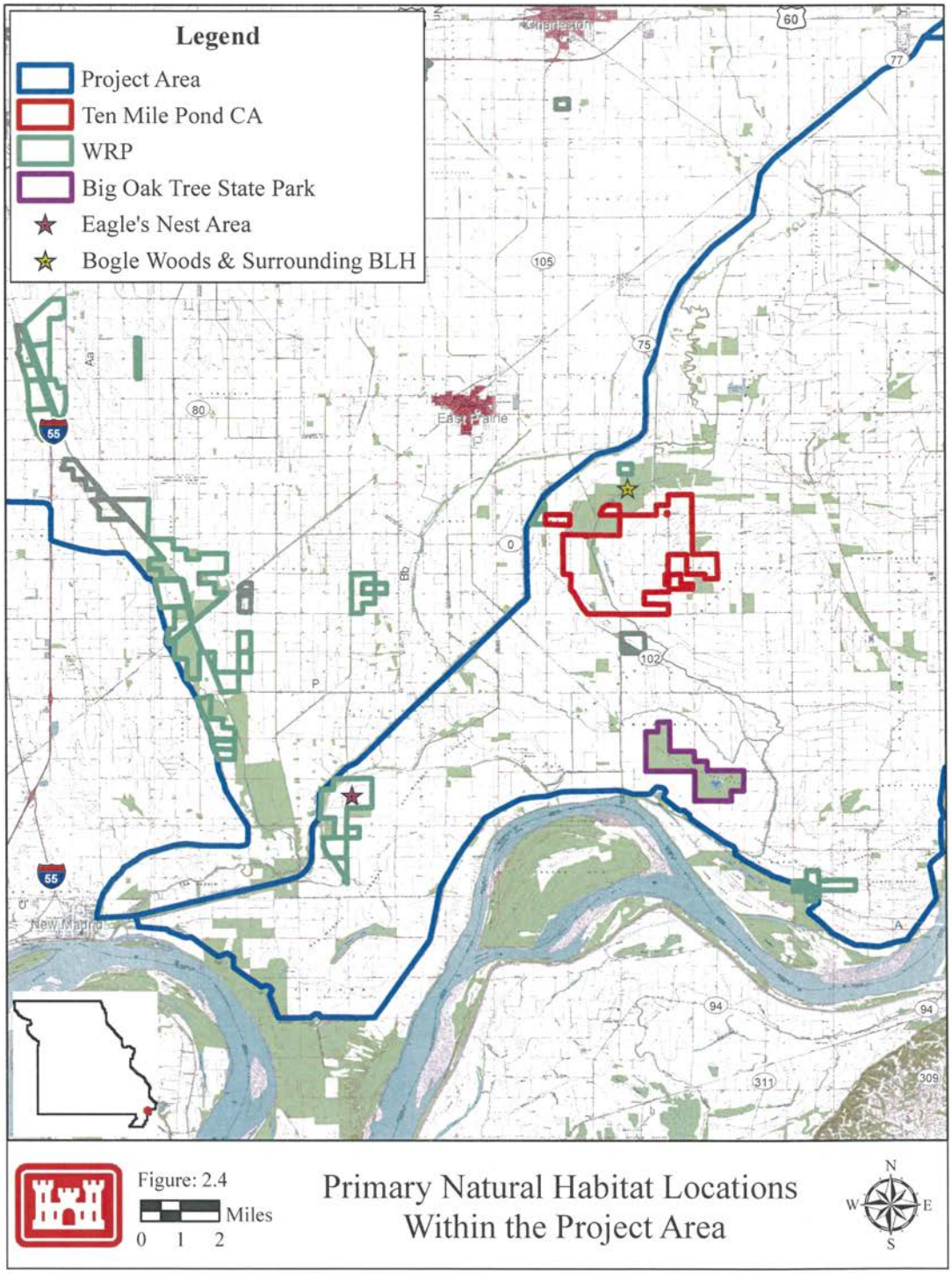


Figure 1. Project area with conservation lands identified

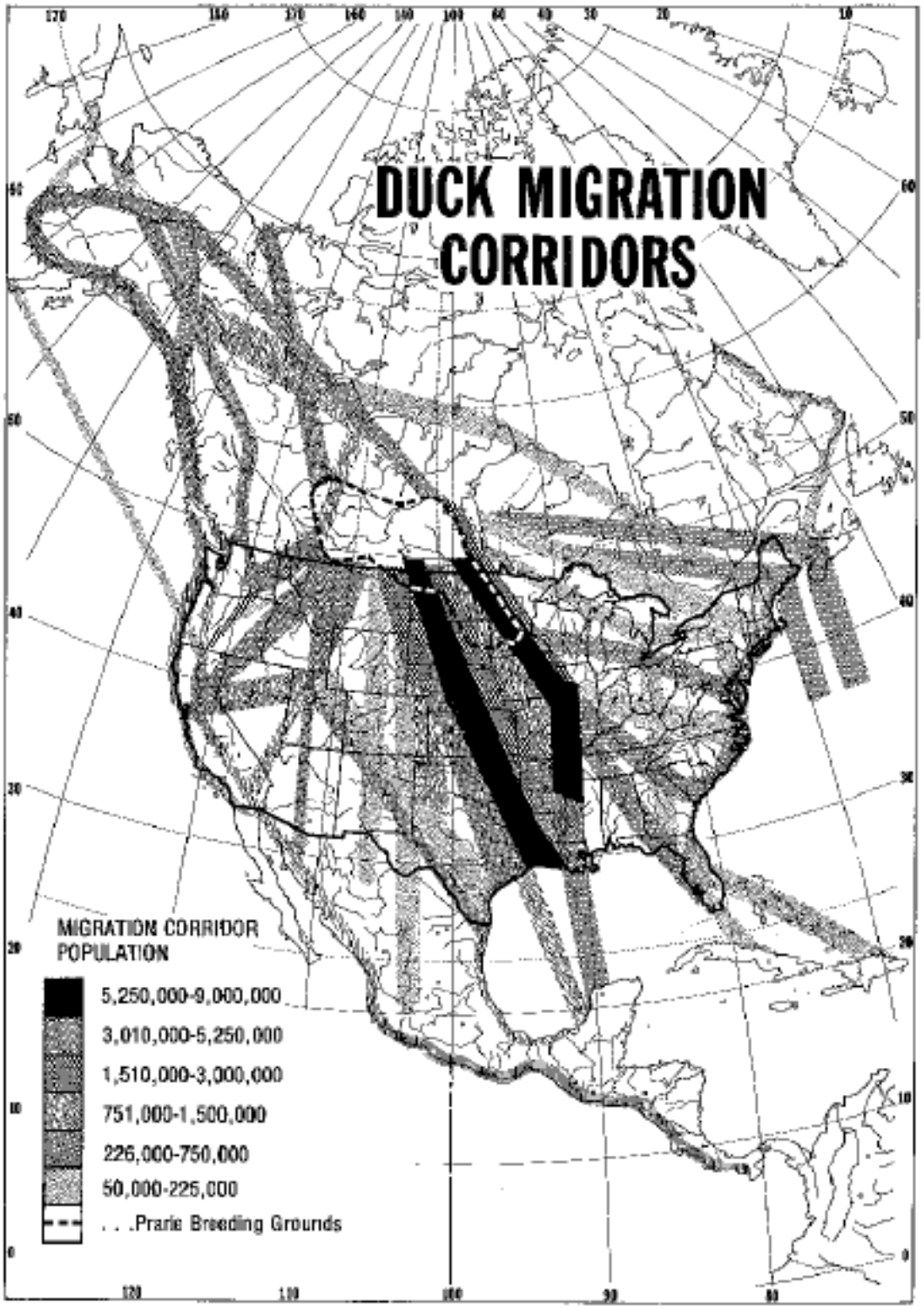


Figure 2. Duck Migration Corridors

**Table 1 Wetlands in the St. Johns Bayou and New Madrid Basins**

| **Wetlands** | **St. Johns Bayou** | | | **New Madrid Floodway** | | |
|---|---|---|---|---|---|---|
| **5-Year Flood Zone** | EPA[1] | Corps[2] | NWI[3] | EPA | Corps | NWI |
| Naturally vegetated | 6352 | 5767 | 5749 | 7631 | 7884 | 9664 |
| Wetlands in Ag. | 11494 | 145 | 15454 | 29717 | 175 | 35049 |
| **Total** | **17846** | **5912** | **21203** | **37348** | **8059** | **44713** |
| | | | | | | |
| **Above 5-Year Flood Zone** | | | | | | |
| Naturally vegetated | 1614 | * | 577 | 1402 | * | 1221 |
| Wetlands in Ag. | 9366 | * | 5224 | 21024 | * | 7622 |
| **Total** | **10980** | | **5801** | **22426** | | **8843** |
| | | | | | | |
| **Total wetlands** | | | | | | |
| Naturally vegetated | 7966 | 5767 | 6326 | 9033 | 7884 | 10885 |
| Wetlands in Ag. | 20860 | 145 | 20678 | 50741 | 175 | 42671 |
| **Total** | **28826** | 5912 | **27004** | **59774** | 8059 | **53556** |

[1] EPA assessment, March 2012 Draft St. Johns Bayou and New Madrid Floodway Wetlands Assessment
[2] CE PWD EIS October 2011* Corps limited impact analyses to wetlands within the 5 Year Flood zone, although benefits in this zone are counted in the economic analyses
[3] NWI 2011. St. Johns New Madrid Update Summary Draft

**Table 2. Species of Conservation Concern in New Madrid and Mississippi counties**

| Plants | Mississippi | New Madrid |
|---|---|---|
| Gourd (*Cayaponia grandifolia*) | S1 | |
| Juniper leaf (*Polypremum procumbens*) | S2 | S2 |
| Trepocarpus (*Trepocarpus aethusae*) | S1 | S1 |
| Primrose willow (*Ludwigia leptocarpa*) | S2 | |
| Yellow false mallow (*Malvastrum hispidum*) | S3 | |
| Arrow arum (*Peltandra virginica*) | S2 | |
| American frogbit (*Limnobium spongia*) | S2 | |
| American cupsale (*Sacciolepis striata*) | S1 | |
| Swamp loosestrife (*Decondon verticillatus*) | S1 | |
| Bristly sedge *(Carex comosa*) | S2 | |
| Sedge (*Carex socialis*) | S2 | |
| Corydalis (*Corydalis micrantha*) | | S2 |
| Leatherflower (*Clematis viorna*) | | S1 |
| Finger dog-shade (*Cynosciadium digitatum*) | | S2 |
| Weak nettle (*Urtica chamaedryoides*) | S1 | S1 |
| Narrow-leaved wild crabapple (*Malus augustifolia*) | | S2 |
| Eastern blue-eyed grass (*Sisyrinchium atlanticum*) | S2 | S2 |
| An umbrella sedge (*Cyperus retroflexus*) | S1 | |
| An umbrella sedge (*Cyperus grayoidies*) | S3 | S3 |
| Many-spiked cyperus (*Cyperus polystachos*) | | S2/S3 |
| Baldwin's cyperus (*Cyperus croceus*) | | S1 |
| Lake cress (*Rorippa aquatic*) | S2 | |
| Gaping panic grass (*Panicum hians)* | S3 | |
| Horsemint (*Monarda punctate var. villicaulis*) | | S3 |
| Saltmarsh aster (*Syphyotrichum subulatum*) | | S2 |
| Triangular sedge (*Carex triangularis*) | | |
| | | |
| Invertebrates | | |
| Rock pocketbook (*Aricidens confragosus*) | S3 | S3 |
| Wartyback (*Quadrula nodulata*) | S3 | S3 |
| Flat floater (*Anodenta suberbiculata*) | S2 | S2 |
| Texas lilliput (*Toxolasma texasensis*) | S3 | S3 |

E - State listed endangered

Rank:

S1 - Critically imperiled in state because of rarity or other factors; vulnerable to extirpation from state (typically 5 or fewer individuals, very few remaining individuals).

S2 - Imperiled instate because of rarity or other factors; vulnerable to extirpation from state (6 to 20 occurrences or few remaining individuals or acres).

S3 - Rare and uncommon in the state (21 to 100 occurrences).

SU - unknown

**Table 2 (cont'd.). Species of Conservation Concern in New Madrid and Mississippi counties.**

| Invertebrates | Mississippi | New Madrid |
|---|---|---|
| Shufeldt's dwarf crayfish (*Cambarellus shufeldtii)* | S3(?) | |
| Vernal crayfish (*Procambarus viaeviridis)* | S3(?) | |
| A mayfly (*Baetisca obesa*) | S3 | S3 |
| Bald cypress katydid (*Inscudderia taxodii)* | S1 | |
| Hoosier grasshopper (*Paroxya hoosieri*) | S1 | S1 |
| **Mammals** | | |
| Swamp rabbit (*Sylvilagus aquaticus*) | S2 | S2 |
| Cotton mouse (*Peromyscus gossypinus*) | | S2 |
| Rafinesque's Big-eared bat (*Corynorhinus rafinequii*) | | SU |
| Southeastern bat (*Myotis austroriparious*) | | S1 |
| **Birds** | | |
| Bald eagle (*Haliaeetus leucocephalus*) | S3 | S3 |
| Mississippi kite (*Ictinia mississippiensis*) | S3 | S3 |
| Great egret (*Ardea alba)* | S3 | |
| Interior least tern (*Sternula antillarum athalossos)* | (E)S1 | (E)S1 |
| Barn owl (*Tyto alba*) | (E) | (E)S3 |
| Swainson's warbler *(Limnothlypis swainsonii)* | | (E)S2 |
| Black-crowned night heron (*Nycticorax nyctiocorax*) | S3 | |
| Little blue heron *(Egretta caerulea)* | S3 | |
| Snowy egret *(Egretta thula)* | (E)S1 | |
| Loggerhead shrike (*Lanius ludovicianus)* | S2 | |
| **Fish** | | |
| Harlequin darter (*Etheostoma histrio*) | (E)S2 | S2 |
| Flier (*Centrarchus macropterus*) | S3 | S3 |
| Ironcolor shiner (*Notropis chalybaeus*) | S1 | S1 |
| Weed Shiner (*Notropis texanus)* | S3 | S3 |

E - State listed endangered

Rank:

S1 - Critically imperiled in state because of rarity or other factors; vulnerable to extirpation from state (typically 5 or fewer individuals, very few remaining individuals).

S2 - Imperiled instate because of rarity or other factors; vulnerable to extirpation from state (6 to 20 occurrences or few remaining individuals or acres).

S3 - Rare and uncommon in the state (21 to 100 occurrences).

SU – unknown

**Table 2 (cont'd.). Species of Conservation Concern in New Madrid and Mississippi counties.**

| Fish | Mississippi | New Madrid |
|---|---|---|
| Pallid sturgeon (*Scaphirynchus albus*) | (E)S1 | (E)S1 |
| River darter (*Percina shumardi*) | S3 | S3 |
| Lake chubsucker (*Erimyzon sucetta*) | S2 | S2 |
| Brown bullhead (*Ameiurus nebulosus*) | | S3 |
| Mooneye (*Hiodon tergisus*) | R | S2 |
| Golden topminnow (*Fundulus chrysotus*) | S1 | |
| Starhead topminnow (*Fundulus dispar)* | S2 | |
| Sturgeon chub (*Macrhybopis gelida)* | S3 | |
| Flathead chub (*Platygobio gracilis)* | (E)S1 | |
| Western sand darter (*Ammocrypta clara*) | | S2S3 |
| Scaly Sand darter (*Ammocrypta vivax)* | | S3 |
| Taillight shiner (*Notropis maculaus)* | | (E)S1 |
| Central mudminnow (*Umbra limi*) | | (E)S1 |
| Pugnose minnow (*Opsopoeodus emiliea)* | S4 | S4 |
| Mississippi silvery minnow (*Hybognathus nuchalis*) | S3/S4 | |
| Plains minnow (*Hybognathus placitus)* | S2 | |
| Cypress minnow (*Hybognathus hayi)* | | (E)S1 |
| Mississippi silvery minnow (*Hybognathus nuchalis*) | | S3S4 |
| Reptiles and Amphibians | | |
| Illinois chorus frog (*Pseudacris streckeri illinoensis*) | S2 | S2 |
| Western chicken turtle (*Deirochelys recticularia miaria*) | (E)S1 | |
| Eastern spadefoot *(Scaphiopus holbrookii*) | S2 | S2 |
| Alligator snapping turtle (*Macroclemys temminckii*) | S2 | S2 |
| Western mudsnake *(Farancia abacura reinwardtii)* | S2 | S2 |

E - State listed endangered

Rank:

S1 - Critically imperiled in state because of rarity or other factors; vulnerable to extirpation from state (typically 5 or fewer individuals, very few remaining individuals).

S2 - Imperiled instate because of rarity or other factors; vulnerable to extirpation from state (6 to 20 occurrences or few remaining individuals or acres).

S3 - Rare and uncommon in the state (21 to 100 occurrences).

SU - unknown

Source: MDC (2013), Carter and Bryson (1991), Barnhart (1998), MDNR (1997)

# Appendix A. National Wetlands Inventory Update

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## National Wetland Inventory Update Draft and Summary Statistics for New Madrid Floodplain and Saint John's Basin Area

**Project Title:**

New Madrid Floodway National Wetland Inventory (NWI) Update

- **Project Number:** 2219

**Cooperator:**

GeoSpatial Services of Saint Mary's University of Minnesota

- **Project Manager:** Andrew Robertson
  - email: aroberts@smumn.edu
- **Wetland Scientist:** John Anderson
  - email: janders@smumn.edu
- **QAQC Specialist:** David Rokus
  - email: ddroku04@smumn.edu

United States Army Corps of Engineers

United States Department of Agriculture

United States Environmental Protection Agency

**Project Area:**

- **Area:** 270,000 acres, or approximately eight, 24K quadrangles of the New Madrid Floodplain (NMF) and Saint John's Basin (SJB).
- **Location:** Eastern portions of Mississippi and New Madrid Counties in Southeast Missouri.
- **Map:**
  - See attached graphic below
- **Collateral Data:**
  - 2009, color-infrared, NAIP image, in Mr. SID format from U.S. Department of Agriculture.
  - Hydric soils in shapefile format from SSURGO.
  - Digital elevation models (DEM) from the United States Geological Survey (USGS) packaged into a seamless internet map display by ESRI.
  - One-foot contours in shapefile format from the Army Corps Of Engineers.
- **Deliverables:**
  - One file geodatabase containing NWI polygons and the NMF and SJB study area boundary.
  - One file geodatabase containing restorable wetland polygons and the NMF and SJB study area boundary.

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- Six file geodatabases containing wetland and restorable wetland polygons intersected and parsed by class and water regime to the five-year, ten-year, and beyond the ten-year floodplain, for both the NMF and SJB.
- One Excel spreadsheet summarizing the acreage of NWI and restorable wetland polygons within the five-year, ten-year, or beyond the ten-year floodplain for both NMF and SJB.

- **Status:**
  Wetland data update draft and summary statistics have been finalized and submitted for review.

**Purpose:**

The U.S. Fish and Wildlife Service (USFWS) is the principal federal agency that provides information to the public on the extent and status of the nation's wetlands using mapping and sampling techniques. The agency has developed a series of topical maps to show wetlands and deepwater habitats. This geospatial information is used by federal, state, and local agencies, academic institutions, private industry, tribes, and citizens; for management, research, policy development, education, and planning activities.

Wetlands provide a multitude of ecological, economic, and social benefits. They provide habitat for fish, wildlife, and a variety of plants. Wetlands are nurseries for many saltwater and freshwater fishes and shellfish of commercial and recreational importance. Wetlands are also important landscape features that hold and slowly release flood water and snow melt, recharge groundwater, act as filters to cleanse water of impurities, recycle nutrients, store carbon, and provide recreation and wildlife viewing opportunities for millions of people.

**Project Tasks:**

1. Administration:

   This task includes overall project management activities such as: assigning duties and responsibilities; tracking project progress; reconciling project expenses; submitting reimbursement requests; processing contract amendments; tracking match contributions; and preparing budget information for reports.

   Responsible Staff: Andrew Robertson

2. Preliminary Meeting and Image Acquisition:
   Discussions items will include:

   - Identification of primary and secondary image sources for wetland mapping.
   - Review of collateral datasets that will be used to support wetland mapping.
   - Confirmation of classification systems including valid Cowardin codes and potential subclasses and special modifiers.

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It is anticipated that this initial meeting will be conducted remotely using the GSS license of Go-To-Meeting and the GSS FTP site for data and file transfers. GSS will be represented by Andrew Robertson and John Anderson, Senior Wetland Photo Interpreter and Certified Wetland Scientist.

Responsible Staff: Andrew Robertson, John Anderson

3. Quality Assurance Project Plan Development:

Quality control is a critical component of this wetland mapping project. As an initial step, GSS will use the USFWS NWI ArcGIS master geodatabase verification tool version in ESRI, ArcGIS 10.0 Tool Box for data validation. Secondarily, GSS will develop and apply customized quality control assessment scripts in ArcGIS in order to check for and resolve data integrity issues (e.g. topology, gaps, overlaps, ghosts and adjacent attributes).

These automated tools will complement a rigorous visual quality control process undertaken by a second professional wetland photo interpreter. The purpose of this visual check is to assess classification and delineation accuracy as well as search for errors of omission and commission. In this process, 100% of the data is reviewed to ensure that the accuracy of the final product meets the specifications of the FGDC National Wetland Mapping Standard.

Responsible Staff: David Rokus

4. Geodatabases Assembly:

GeoSpatial Services will assemble an ArcGIS version 10.0 file geodatabase using a projection in UTM Zone 16 North and referenced to the NAD83 geodetic datum. This geodatabase will contain a project area boundary and NWI polygons layers, and a topology verification rules. GSS will also request a checkout geodatabase from the USFWS NWI National Standards and Support Team in order to flag this area in the national wetlands geodatabase as being checked out for update.

Responsible Staff: David Rokus

5. Pre-Mapping Field Review and Mapping Classification:

GeoSpatial Services will conduct a multiple day pre-mapping field trip. The purpose of this trip is to: orient the project photo interpreters to the study area, correlate typical and atypical image signatures to ground conditions for the full range of wetland types included the project, review classification standards for all systems that will be mapped during the project, and develop a set of project photo interpretation conventions to ensure consistent mapping and classification throughout the project. The conventions document will correlate photosignature "keys" (colors, tones, size, shapes, patterns, textures, associations, and shadows) with associated ground features and will form the primary reference for project photo interpreters. Finally, an NWI Field Data Sheet will be prepared for each site

documenting presence or absence of hydric soils, hydrophytic vegetation, and wetland hydrology.

Equipment that will be provided by GeoSpatial Services in support of the field review includes: two Garmin Colorado 550t GPS receivers; soil spade, soil probe, Munsell Color charts; interpretive field guides including the National List of Vascular Plants that Occur in Wetlands, sample collection bags, and a digital camera. Prior to embarking on any field site visits, land owner approval will be obtained for sample locations which require access to private land.

Field Trip Dates: July 18 – July 22, 2011
Responsible Staff: John Anderson, David Rokus

6. Mapping and Wetlands Interpretation:

GeoSpatial Services has developed a wetlands mapping workflow process that is based on a combination of fully digital mapping supported by field investigation to interpret and refine wetland boundaries, classification types and functional characteristics. GSS will implement the following technical approach for this project:

i. Perform on-screen delineations of wetlands for each of the +/- eight, USGS 7.5 minute quadrangles included in the project using heads-up digitizing and editing tools in ArcMap with the primary digital imagery and other collateral data as a backdrop. For quadrangles along the State of Missouri, NWI mapping will only be completed for the portion of the quadrangle within the project study area.
ii. All wetland polygons will be classified using the "Classification of Wetlands and Deepwater Habitats of the United States", i.e. Cowardin classification standards.
iii. Undertake quality assurance and quality control reviews as wetland delineation for each 7.5 minute quadrangle is completed. Reviews will consist of a complete visual inspection by a wetland photo interpreter to assess delineation and classification accuracy, check for errors of omission and commission, identify revisions that are necessary to meet the FDGC Federal Wetlands Mapping Standard, and validate the quality of digitized line work. In addition, each quadrangle will be reviewed using internally developed error-checking scripts that search for gaps between adjacent polygons, and adjacent (joined) polygons that contain the same attributes.
iv. Progressively complete edge matching and topological structuring of adjacent 7.5 minute quadrangles. Once all of the quadrangles have been completed, then the entire dataset will be merged to form a seamless file geodatabase for final delivery. The USGS NWI verification tool and other topology validation scripts will be run on the final merged data to ensure data integrity following final processing.
v. Progressively submit the draft of wetland updates to NWI Region 3 coordinator for review and correct any deficiencies that are identified.
vi. Develop full project metadata for the final, seamless wetlands geodatabase. This metadata will meet the requirements of USFWS NWI metadata and will be formatted according to FGDC Metadata Guidelines.

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The target mapping unit for this project is the capture of all wetlands greater than one-half acre in size. On-screen wetland delineation will occur at a zoom scale of 1:5,000 and wetland/upland boundary determination will use a maximum zoom scale of 1:3,500. All wetland delineation and classification will be consistent with the primary imagery used for the project and final mapping products will meet the FGDC Federal Wetlands Mapping Standard.

Responsible Staff: John Anderson, David Rokus, Andrew Robertson

7. NWI and Restorable Wetland Statistics Generation:

   i. Establish a working directory and file geodatabase titled Contours, for data extraction and analysis. Import NWI polygons, restorable wetlands, and project area boundary features from finalized NWI file geodatabase. Import shapefiles SJB 296 foot, SJB 300 foot, NMF 297 foot, and NMF 305 foot contours to working geodatabase. These elevations represent the five-year, the ten-year, and outside the ten-year flood zones respectively.

   ii. Add a field titled "Elevation" to each of the four contour sets and populate accordingly: NMF_297, NMF_305, SJB_296, and SJB_300. The fifth polygon should have an attribute of NoData.

   iii. Perform a union between NMF_305 and the project study area and title the feature data class Flood_Zones. Append the remaining three contour sets, NMF_297, SJB_296, and SJB_300 to the Flood_Zones features to create one feature class with two flood zones per basin.

   iv. Select polygons NMF_297, merge and clip. Select polygons SJB_296, merge and clip. Select polygons NMF_305, merge and clip. Select polygons SJB_300, merge, clip, and save edits. Below the five-year and below the ten-year flood zone for NMF and SJB is established.

   v. To create the division between the NMF and SJB above the ten-year flood zone an editing process needs to take place in ArcMap. Cut the NoData polygon in the southwest portion where the SJB_296 and NMF_297 lobes nearly meet. Using the ESRI seamless topography map as a guide, cut the NoData polygon along the SJB Levee and save edits. The portion to the West of the levee is attributed SJB_301 and the portion to the East is attributed NMF_306. The remaining polygon which includes the Mississippi River and the portion to the west of elevation contours remains NoData.

   vi. Export the polygon attributed SJB_296 to a feature data class titled SJB_296_Below. This feature represents the five-year flood zone within SJB. Export the polygon attributed SJB_300 to a feature data class titled SJB_300_Below. This feature represents the ten-year flood zone within SJB. Export the polygon attributed SJB_301 to a feature data class titled SJB_300_Above. This feature represents the area outside the ten-year flood zone within SJB. Export the polygon attributed NMF_297 to a feature data class titled NMF_297_Below. This feature represents the five-year flood zone within NMF. Export the polygon attributed NMF_305to a feature data class titled NMF_305_Below. This feature represents the ten-year flood zone within NMF. Export the polygon

attributed NMF_306 to a feature data class titled NMF_305_Above. This feature represents the area outside the ten-year flood zone within NMF.

vii. Intersect NMF_297_Below with NWI_polygons and title NMF_Wetlands_297_Below, (wetlands within the five-year flood zone of the NMF). Intersect NMF _305_Below with NWI_polygons and title NMF_ Wetlands_305_Below, (wetlands within the ten-year flood zone of the NMF). Intersect NMF_305_Above with NWI_polygons and title NMF_Wetlands_305_Above, (wetlands beyond the ten-year flood zone of the NMF). Intersect SJB_296_Below with NWI_polygons and title SJB_ Wetlands_296_Below, (wetlands within the five-year flood zone of the SJB). Intersect SJB_300_Below with NWI_polygons and title SJB_ Wetlands_300_Below, (wetlands within the ten-year flood zone of the SJB). Intersect SJB_300_Above with NWI_polygons and title SJB_ Wetlands_300_Above, (wetlands beyond the ten-year flood zone of the SJB).

viii. Intersect SJB_296_Below with Restorable_Wetlands and title SJB_Restorable_297_Below, (restorable wetlands within the five-year flood zone of the SJB). Intersect SJB_300_Below with Restorable_Wetlands and title SJB_Restorable_300_Below, (restorable wetlands within the ten-year flood zone of the SJB). Intersect SJB_300_Above with Restorable_Wetlands and title SJB_ Restorable_300_Above, (restorable wetlands beyond the ten-year flood zone of the SJB). Intersect NMF_297_Below with Restorable_Wetlands and title NMF_ Restorable_297_Below, (restorable wetlands within the five-year flood zone of the NMF). Intersect NMF_300_Below with Restorable_Wetlands and title NMF_ Restorable_300_Below, (restorable wetlands within the ten-year flood zone of the NMF). Intersect NMF_305_Above with Restorable_Wetlands and title NMF_Restorable_305_Above, (restorable wetlands beyond the ten-year flood zone of the NMF).

ix. Create six final databases which will contain the vegetation class and water regime query selections: AB – aquatic bed, EM – emergent, FO – forested, SS – scrub shrub, UB – open water, US – mud or sand, A – temporarily flooded, C – seasonally flooded, F – semi-permanently flooded, G – intermittently exposed, H – permanently flooded, and K – artificially flooded. Title the six file geodatabases: NMF_297_Below, NMF_305_Below, NMF_305_Above, SJB_296_Below, SJB_300_Below, andSJB_300_Above.

x. Select by attribute from NMF_Wetlands_296_Below features "ATTRIBUTE" LIKE '%AB%'. Remove all non AB dominant classes, i.e. PEM/AB4F. Export selection to NMF_296_Below file geodatabase and title the feature data class 'AB'. Repeat this process for all six vegetated classes and all six water regime selections listed in ix.

xi. Repeat the selection and export process for the remaining five basin flood zones.

xii. Open the feature data class 'AB' from NMF_297_Below file geodatabase in an ArcMap project. Right click on the Shape_Area field and select, Statistics. Copy and paste the value under Sum to a Microsoft Office Excel spreadsheet. Repeat the above process for the remaining vegetation class and water regime feature data classes of NMF_297_Below.

xiii. Repeat the above process for NMF_ Wetlands_305_Below, NMF_ Wetlands_305_Above, SJB_ Wetlands_296_Below, SJB_ Wetlands_300_Below, and SJB_ Wetlands_300_Above, feature data classes.

xiv. Select by Attribute from SJB_Restorable_297_Below, "ATTRIBUTE" = 'PEM1Adf'. Right click on the Shape_Area field and select Statistics. Copy and paste the Sum value into an Excel spreadsheet. Repeat the process for the following restorable wetland codes: PEM1Adf, PEM1Af, PEM1Afx, PEM1Ahf, PEM1Adf, PEM1Af, PEM1Afx, PEM1Ahf, and PEM1Kf.

xv. Repeat the above process for NMF_ Restorable_305_Below, NMF_ Restorable_305_Above, SJB_ Restorable_296_Below, SJB_ Restorable_300_Below, and SJB_ Restorable_300_Above, feature data classes.

xvi. Convert all of the Shape_Area copy and pastes from square meters to acres. Select a cell for output and type =. Then select the first cell to convert / 4046.86. This will divide the chosen cell by the above number and give an output in acres.

xvii. Click in the output cell and drag down to through the remainder of the column. This will convert the remainder of the associated column to acres.

xviii. Copy and paste special, select values and two decimal places to retain the final output conversion from square meters to acres. Delete the square meters column and repeat for the remainder of the columns. Save when finished.

Responsible Staff: David Rokus

8. Reports and Final Version of Map, Report on Methodology:
Reporting is a key step in documenting progress, methods and techniques for the lifecycle of any project. GeoSpatial Services will provide the above listed deliverables packaged into a zipped file for submission.

The final project report will include all procedures, tools, metadata and other resources used for preparing the final wetlands map product and will summarize the accuracy and completeness of the final map product.

Responsible Staff: Andrew Robertson, David Rokus

**Supplements:**

Wetlands in agricultural areas that are for crop harvest or planted for pulp production are delineated and classified as restorable wetlands. This data is created based on the identification of representative signatures corroborated in the field at site-specific investigations and through analysis of collateral imagery, soils, and topographic maps. Tom Dahl, Chief, National Standards and Support Team, for NWI, confirms that current photointerpretation methods allowed for the capture of restorable wetlands covering broad areas, such as the Mississippi River Floodplain.

Mr. Dahl's guidance provides assurance that these types of farmed wetlands are mapped within NWI standards. *In the past, the farmed "f" wetland modifier, had been limited to the application of 1) farmed prairie potholes and pothole type depressions, 2) farmed intermittent lake bottoms (playa lakes), 3) cranberry bogs, and 4) diked, former tidelands.

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In addition, NWI Region 3 coordinator Brian Huberty approves the use of dual special modifers to properly represent these wetlands are tilled and drained - PEM1Afd, Permission was granted to combine the farmed modifier with scrub shrub class to represent cottonwood trees planted for paper pulp production - PSS1Af. The farmed special modifier is used with artificially flooded regime to attribute rice farm fields - PEM1Kf.

These attributes are flagged as incorrect by the NWI Verification Tool 10.0. The emergent farmed wetlands – PEM1Adf, PEM1Cfh, PEM1Kf and etc. were exported to a separate feature class titled, Restorable_Wetlands. The wet cottonwood plantations – PFO1Af, PSS1Af, and PSS1Cf remain in the final database, NWI_polygons or CONUS_wet_poly.

*NWI (National Wetlands Inventory). 1995. Photointerpretation conventions for the National Wetlands Inventory. St. Petersburg, FL: U.S. Fish and Wildlife Service.

**Disclaimer:**

This data is a preliminary draft of the final NWI update that will be submitted to the USFWS and NWI Program for review. Once USFWS quality control is complete, the data will be added to the National Wetlands Mapper site for public distribution.

The intention of the NWI is to provide habitat (not jurisdictional) wetland maps for a variety of management activities such as to help estimate fisheries and wildlife populations, document habitat change, and landscape restoration. The users of this information should note that these maps are a snapshot in time and the landscape constantly changes. There may be errors in the dataset because it is impossible to physically visit and verify every wetland. Through the art and science of geospatial analysis and image interpretation, these maps reflect a relative accuracy given the data sources, technology and funding limits at the time of the project.

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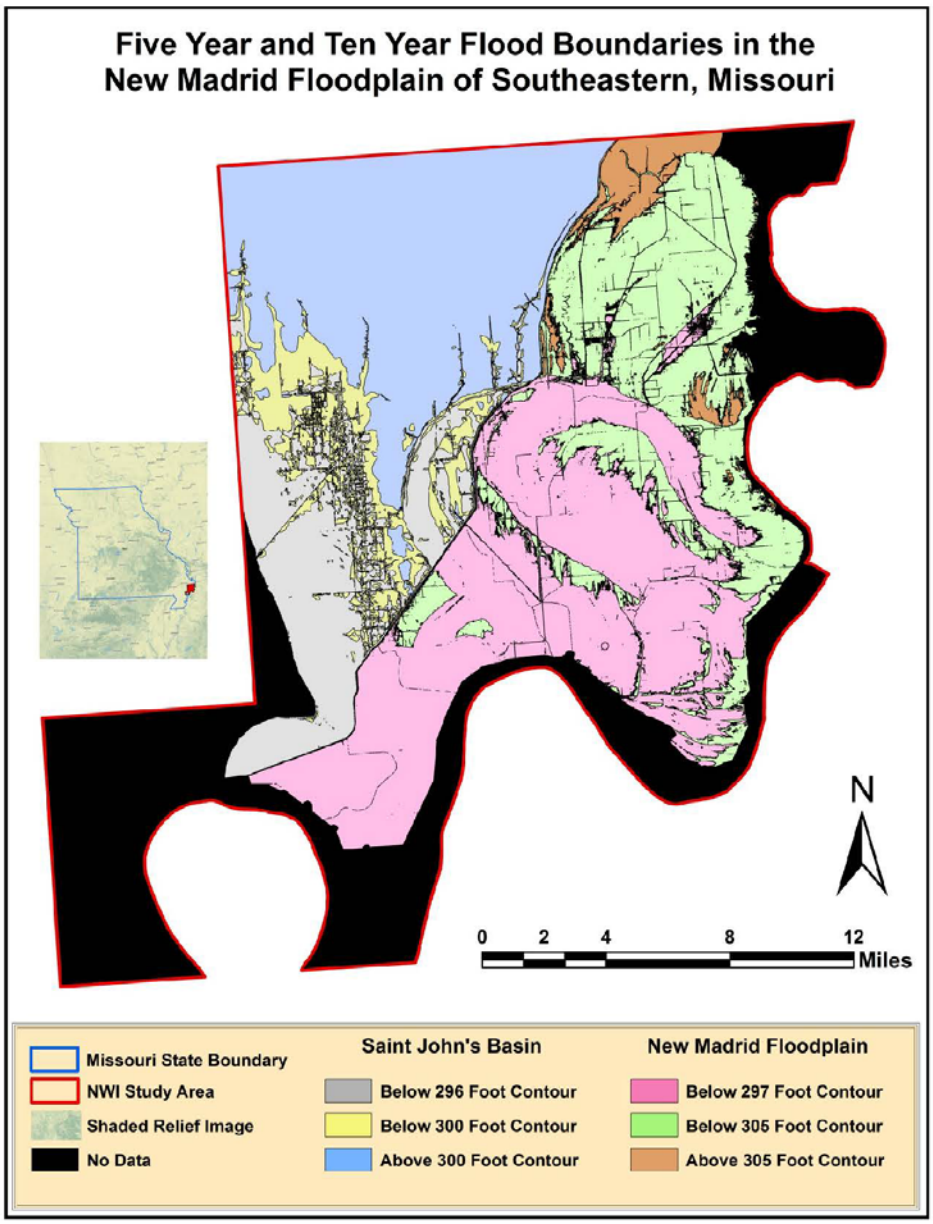


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# Appendix B

# Technical Comments on

# USACE 2013 Appendix G

# Fish Access Study

**USFWS Technical Review Comments Appendix G , DEIS St. Johns Bayou New Madrid Floodway Project, July 2013**

Comments are organized following Appendix G report structure

**General comments on Appendix G and Background Section**

The study is intended to address fish passage through a control structure. There are few empirical data of the effects of a control structure on the ecosystem processes that drive floodplain benefits for fisheries ecology. As the Authors note in the Introduction for Part 1, "*…alluvial floodplain deposits are typically rich in organic material*…." Eliminating those rich organic deposits may make the issue of fish access to the floodplain irrelevant. For example, closing the gates during flood events may starve the floodplain ecosystem of critical allochthonous carbon inputs that would fuel floodplain productivity. In turn, the benefits of floodplain productivity to the main channel of Mississippi River may be limited if gates are closed.

It does not appear that alternative hypotheses to explain the data results were considered, and is a consistent theme throughout the Appendix G report. We suggest more rigorous critical consideration for alternative explanations to the data would improve the report's value to managers and decision makers, and offer perspective on the uncertainties inherent in the proposed hypothesis.

Objective 2 in the Background section seems incomplete because it addresses only one component (i.e., fish access) of the proposed culvert on the functional processes required to benefit floodplain fishes. The study's focus on only passage for fish ingress and egress fails to address the culvert's effect on critical ecological processes inside the floodplain. Thus, the study will have limited utility in predicting the full extent of impacts to complex floodplain processes relevant to fisheries ecology. The proposed project area (130,000+ acres) dwarfs the scope of any other study of "important species" (e.g., species of conservation concern, recreationally and commercially significant species) in an off-channel habitat. Thus, the study area is unique and carries sufficient weight to effect implications about the complexity of floodplain processes relevant to fisheries ecology, such that appropriate data to address fisheries issues beyond simple fish passage should be included as a fundamental objective of this study. Such information is critical to adequately inform management decisions as part of project planning and eventual implementation should that occur. Results from this fish passage study should not be used beyond the study's scope to speculate that there are no ecosystem level effects of a closing structure culvert on the interactions between river and floodplain to support functional processes and floodplain productivity.

## Part 1

### Analyses

The authors used square root transformation on fish abundance data for use in multivariate analyses. However, square root transformation is usually more appropriate for percent formatted data, thus we suggest using a version of a log transformation to address the dataset assumptions.

### Results and Discussion

**Comparison of Fish Fauna**:

We do not think the one-way analysis of similarity (ANOSIM) global *R* statistic of $R = 0.329$ necessarily support the author's conclusion that the fish assemblage was significantly different between the two systems (St. Johns vs. New Madrid). The authors cite Clarke and Warwick (2001) to support their interpretation of the global *R* statistic; however, Clarke and Gorley (2001) provide a more detailed guide to interpreting the *R* statistic from ANOSIM procedures. According to Clarke and Gorley (2001), fish assemblage similarity among sampled populations tested with an ANOSIM procedure can be interpreted as follows: $R > 0.75$ is "well separated"; $R > 0.50$ is "overlapping but clearly different"; $R < 0.25$ is "barely separable at all." Using that approach, an $R = 0.329$ would indicate a "significant overlap in fish assemblage composition with minor variation between the two systems," rather than "significantly different" as the authors assert.

**Environmental Conditions**:

Based on the one-way analysis of similarity (ANOSIM) global *R* statistic of $R = 0.282$, it does not appear that environmental conditions were significantly different between the two systems (St. Johns vs. New Madrid), in contrast to the authors' conclusions. The authors cite Clarke and Warwick (2001) to support their interpretation of the global *R* statistic; however, Clarke and Gorley (2001) provide a more detailed guide to interpreting the *R* statistic from ANOSIM procedures. According to Clarke and Gorley (2001), environmental condition similarity among sampled populations tested with an ANOSIM procedure can be interpreted as follows: $R > 0.75$ is "well separated"; $R > 0.50$ is "overlapping but clearly different"; $R < 0.25$ is "barely separable at all." Using that approach, an $R = 0.282$ would indicate a "significant overlap in fish assemblage composition with any variation between the two systems being barely separable at all," rather than "significantly different" as the authors assert.

The authors conclude this subsection by stating that the fish assemblages in both systems were dominated by tolerant, ubiquitous species. This statement seems counter to their

assertion that both the fish assemblage composition and environmental conditions were significantly different between the two systems. The authors should provide additional justification for and clarity to their study conclusions.

**Summary**

The summary should clarify how the information about reproductive guilds is relevant to Part 1, Objectives. In addition, the Methods and Results sections should include relevant information about the use of reproductive guilds to compare fish assemblages between the two systems.

The authors suggest that a higher abundance (although not supported by objective statistical rigor) of darters and minnows in St. Johns Basin indicate that it has higher habitat value than the New Madrid Floodway. However, in contrast to that assertion, Table I-1 shows half the fishes collected in St. Johns Basin were the non-native, highly "tolerant" western mosquitofish, and that western mosquitofish were nearly twice as abundant in St. Johns Basin than in the New Madrid Floodway (where they accounted for only one-third of the catch). Based on the information presented, the reader is not left with any clear conclusions or recommendations about habitat quality in the two basins. The inconsistencies in interpreting results (e.g., St. Johns purported higher habitat value) and lack of objectivity in Methods (e.g., ANOSIM R statistic) raises questions about how well the general study purpose fits the stated study objectives.

For example, the authors devote a surprisingly (given this is a *Summary* section) lengthy block of text to asserting floodplain fishes are "tolerant," then provide a subtle clue about their perceived relationship between tolerant fishes and low habitat/species value. Providing a habitat quality assessment, however, was not part of the study objectives. We recommend the authors consider alternative interpretations and explanations for their study results. For example, the processes of natural selection and the fluctuating nature of floodplain environments dictates that fishes using floodplains be adaptable to rapid and/or extreme shifts in conditions (e.g., water level, water chemistry). Such tolerance is not a signal of low "value," but instead a specialized adaptation to harsh and unstable environments (e.g., see Matthews 1987) that should be protected and conserved, similar to the adaptions of fishes in coastal marshes.

**Part 2**

This study appears to have little relevance to fish spawning and rearing habitat that was identified as a driving issue in the Background and Part 1 Summary sections. While using telemetry techniques to assess fish passage through the proposed culverts is an interesting question it is only part of the equation. Just as relevant to address with the methods used is the extent that fishes used the floodplain for spawning and whether or not residence time

was related to water level. A second, but equally important task is to quantify the relationship between offspring recruitment success and water levels.

**Part 3**

**Objectives**

Objective 1, "Document methodology and assumptions used to calculate impacts", was not addressed.

**HSI values Assumptions**

Does not address progressive life stages with 15-50 year floods, nor does it account for ecosystem processes for filter feeders. In addition, it does not address growth potential with reduced competition. The model only assumes spawning and early life recruitment rather than attempting to quantify it.

**Impact Assessment**

Limiting model function to within the two-year flood frequency largely ignores long lived fishes that can have varying spawning responses that are tied to flood height, like paddlefish. Pallid sturgeon have been known to hold eggs (i.e., not spawn) if conditions are not appropriate (e.g., spawning cues not met).

Justification under bullet number 6) a. (pg. 34) is weak because paddlefish move hundreds of miles and can stay on floodplains for extended periods. Also, the data reported in Part 2 Table II-3 shows that average total distance moved by fishes was 36.9 miles.

**Fish Access**

An equally, or more important, concern than fish access is rearing capacity and function on the floodplain. Access seems somewhat irrelevant if functional rearing habitat is not available. The study methods should indicate where tagged fish were released as well as how far they had to move before passing through the culvert. In addition, all assumptions should be explicitly addressed by the data.

References used by Reviewers:

Clarke, K.R. and R.N. Gorley. 2001. PRIMER v6: User Manual/Tutorial. PRIMER-E Ltd., Plymouth.

Matthews, W. J. 1987. Physiochemical tolerance and selectivity of stream fishes as related to their geographic ranges and local distributions. Pages 111-120 *in* W. J. Matthews and D. C. Heins, editors. Community and evolutionary ecology of North American stream fishes. University of Oklahoma Press, Norman, OK.