DEPARTMENT OF THE ARMY
MISSISSIPPI VALLEY DIVISION, CORPS OF ENGINEERS
P.O. BOX 80
VICKSBURG, MISSISSIPPI 39181-0080

REPLY TO
ATTENTION OF:

CEMVD-PD-KM

5 MAR 2010

MEMORANDUM FOR Commander, Memphis District

SUBJECT: Approval of Lower Mississippi River Resource Assessment Section 905(b) Analysis

1. References:

a. ER 1105-2-100, Planning Guidance Notebook, 22 April 2000.

b. Memorandum, CEMVD-MVD, Delegation of Approval Authority for Section 905(b) Reports, 3 May 2004.

c. EC 1105-2-410, Review of Decision Documents, 22 August 2008.

d. Memorandum, CEMVM-PM, 19 January 2010, subject as above (encl).

2. After review and consideration of the study recommendations, I hereby approve the Lower Mississippi River Resource Assessment 905(b) Analysis, subject to the following conditions:

a. The recommendation to conduct feasibility studies for aquatic habitat restoration projects should be deleted. If in the future you identify specific ecosystem restoration needs in the basin, then the Section 905(b) report can be supplemented to recommend further study for these studies.

b. Since a non-Federal sponsor has not been identified who is willing and ready to execute a Feasibility Cost Sharing Agreement for the watershed assessment, my concurrence in the recommendation to proceed with the watershed assessment is valid for only 1 year from the date of approval of the Section 905(b) Analysis. If a non-Federal sponsor cannot be identified in that length of time, then the 905(b) will need to be supplemented to ensure current information is used to determine Federal interest.

CEMVD-PD-KM
SUBJECT: Approval of Lower Mississippi River Resource Assessment Draft Section 905(b) Analysis

3. My point of contact for this action is Mike Warren, (601) 634-5070.

Encl

MICHAEL J. WALSH
Brigadier General(P), USA
Commanding

DEPARTMENT OF THE ARMY
MEMPHIS DISTRICT CORPS OF ENGINEERS
167 NORTH MAIN STREET B-202

MEMPHIS TN 38103-1894

REPLY TO
ATTENTION OF

CEMVM-PM

19 January 2010

MEMORANDUM FOR Commander, Mississippi Valley Division

SUBJECT: Approval of Lower Mississippi River Resource Assessment Draft Section 905(b) Analysis.

1. References:

a. 1st MVD Comments received in CEMVD-PD-KM email dated 20 August 2009, Subject: LMRRA Recon Report - MVD Comments

b. 2nd MVD Comments received in CEMVD-PD-KM email dated 7 December 2009, Subject: LMRRA Reconnaissance Report- Consolidated Comments

2. Attached for your approval is the LMRRA 905(b) report. This submission reflects extensive collaboration and Project Delivery Team (PDT) reviews. The formal comment process of August 2009 and December 2009 reflect an ongoing internal discussion with regard to identifying small Mississippi River ecosystem restoration or recreation feasibility studies or recommending a watershed analysis. This recommends the latter and reflects the input from the PDT and the potential non-Federal sponsor.

3. Enclosed are responses to MVD's second set of comments, first set of comments, and the 905(b) report which has been revised for your approval.

4. Please contact me or Ms. Leighann Gipson, Project Manager, at (901) 544-4015 if you have any questions.

THOMAS P. SMITH
COL, EN
Commanding

Encls

Encl

US Army Corps of Engineers®
Memphis District

LOWER MISSISSIPPI RIVER RESOURCE ASSESSMENT

DRAFT RECONNAISSANCE REPORT
SECTION 905(b) ANALYSIS
FINAL DRAFT

ARKANSAS, ILLINOIS, KENTUCKY, LOUSIANA, MISSISSIPPI, MISSOURI, and TENNESSEE

January 2010

EXECUTIVE SUMMARY

The Lower Mississippi River Resource Assessment was authorized by the Water Resources Development Act of 2000, Section 402. The objectives of the study are to assess data needs for river-related management, natural resource habitat needs, and river-related recreation and access needs. The project area includes the main channel Mississippi River between the Mississippi River Levees from river mile (RM) 0 at the Gulf of Mexico to RM 953 near Cairo, Illinois. The project area also includes portions of the White River, the Ouachita/Black Rivers, the Red River, the Yazoo River, and the Atchafalaya River. Existing conditions and future expected conditions for each assessment were determined, and from these data, problems, opportunities, and potential projects were determined. Some problems and opportunities in the project area are compiling a comprehensive natural resource database for the Lower Mississippi River (LMR), protecting and restoring natural resource habitat, developing a plan for managing the LMR, and providing additional public access points along LMR. This 905(b) report demonstrates federal interest and recommends conducting an integrated watershed analysis that would facilitate better management of the watershed. Analyses would be conducted on recommended projects to ensure that they would not adversely impact navigation and flood risk management. Any land required for construction of feasible projects would be acquired from willing sellers only.

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LOWER MISSISSIPPI RIVER RESOURCE ASSESSMENT
Section 905(b) Analysis
Arkansas, Illinois, Kentucky, Louisiana, Mississippi, Missouri, and Tennessee

1. STUDY AUTHORITY

This Section 905(b) Analysis was authorized by Section 402 of the Water Resources Development Act (WRDA) of 2000, Pub. L 106-541. Section 402 reads as follows:

(a) ASSESSMENTS- The Secretary, in cooperation with the Secretary of the Interior and the States of Arkansas, Illinois, Kentucky, Louisiana, Mississippi, Missouri, and Tennessee, shall undertake for the Lower Mississippi River system--

(1) an assessment of information needed for river-related management;

(2) an assessment of natural resource habitat needs; and

(3) an assessment of the need for river-related recreation and access.

(b) PERIOD- Each assessment referred to in subsection (a) shall be carried out for 2 years.

(c) REPORTS- Before the last day of the second year of an assessment under subsection (a), the Secretary, in cooperation with the Secretary of the Interior and the States of Arkansas, Illinois, Kentucky, Louisiana, Mississippi, Missouri, and Tennessee, shall transmit to Congress a report on the results of the assessment to Congress. The report shall contain recommendations for--

(1) the collection, availability, and use of information needed for river-related management;

(2) the planning, construction, and evaluation of potential restoration, protection, and enhancement measures to meet identified habitat needs; and

(3) potential projects to meet identified river access and recreation needs.

(d) LOWER MISSISSIPPI RIVER SYSTEM DEFINED- In this section, the term `Lower Mississippi River system' means those river reaches and adjacent floodplains within the Lower Mississippi River alluvial valley having commercial navigation channels on the Mississippi mainstem and tributaries south of Cairo, Illinois, and the Atchafalaya Basin floodway system.

(e) AUTHORIZATION OF APPROPRIATIONS- There is authorized to be appropriated $1,750,000 to carry out this section.

2. STUDY PURPOSE

The purpose of this reconnaissance study is to identify information needed for river-related management and to assess natural resource habitat, river-related recreation and access needs. It will also identify opportunities for addressing ecosystem restoration, watershed planning, and other water resource issues and opportunities in the Lower Mississippi River Alluvial Valley (LMRAV) in Arkansas, Illinois, Kentucky, Louisiana, Mississippi, Missouri, and Tennessee.

If federal interest is demonstrated in this reconnaissance report, the reconnaissance phase of the study would include the development of a Project Management Plan (PMP) and Feasibility Cost Share Agreements (FCSA) with non-federal sponsors for the next phase of the study.

Projects that have the potential to adversely impact navigation and flood risk management missions will not be recommended for construction.

This reconnaissance report was prepared in collaboration with an inter-agency team composed of U.S. Fish and Wildlife Service (USFWS), U.S. Environmental Protection Agency (USEPA) Regions 4 and 7, U.S. Geological Survey (USGS), Arkansas Department of Environmental Quality (ADEQ), Arkansas Game and Fish Commission (AGFC), Arkansas Natural Heritage Commission (ANHC), Arkansas Natural Resources Commission (ANRC), Missouri Department of Natural Resources (MDNR), Missouri Department of Conservation (MDC), Mississippi Department of Wildlife, Fisheries, and Parks (MDWFP), Mississippi Department of Environmental Quality (MDEQ), Louisiana Department of Environmental Quality (LDEQ), Louisiana Department of Wildlife and Fisheries (LDWF), Kentucky Department for Environmental Protection (KDEP), Kentucky Department of Fish and Wildlife Resources (KDFWR), Tennessee Department of Environment and Conservation (TDEC), Tennessee Wildlife Resource Agency (TWRA), Mississippi River Corridor – Tennessee, Port of Memphis, Natural Resources Conservation Service (NRCS), Yazoo-Mississippi Delta Levee Board (YMDLB), Mississippi Valley Flood Control Association (MVFCA), National Audubon Society (Audubon), The Nature Conservancy (TNC), Southeast Arkansas Levee District, and the St. Francis Levee Board (SFLB).

3. LOCATION, CONGRESSIONAL DISTRICTS

3.1 LOCATION, DESCRIPTION OF STUDY AREA

In Section 402 of the WRDA 2000, the LMR system is defined as "**those river reaches and adjacent floodplains within the Lower Mississippi River alluvial valley having commercial navigation channels on the Mississippi mainstem and tributaries south of Cairo, Illinois, and the Atchafalaya basin floodway system."** For the purposes of this study, the project area was delineated based on this language.

The Lower Mississippi River Resource Assessment (LMRRA) project area begins at RM 953 of the mainstem Mississippi River channel south of Cairo, Illinois, and extends downstream to RM 0 (Head of Passes) in Louisiana at the Gulf of Mexico. The project area encompasses the main channel of the river and the area between the existing Mississippi River and Tributaries project levees, including the mouths of all tributaries between the levees. The project boundaries extend up the following rivers and canals that have existing commercial navigation (i.e. commercial barge traffic) to the point of direct influence between each channel and the mainstem Mississippi River. These areas are the White River upstream to Clarendon, Arkansas; the Arkansas Post Canal upstream to Norrell Lock and Dam, Arkansas; the Yazoo River upstream to Greenwood, Mississippi; the Red River upstream to Lock and Dam No. 2 in Louisiana; the Ouachita/Black River upstream to Columbia Lock and Dam in Louisiana; and the Old River from the Old River Lock to its confluence with the Red and Atchafalaya Rivers in Louisiana. The Atchafalaya Basin in Louisiana is also included within the project area.

Five parameters were considered in delineating the project boundaries:

1. The project footprint was created based on areas included in the LMRAV as defined by Saucier 1994. The LMRAV is defined as that area characterized by landforms and deposits created since the last glacial maximum. The alluvial plain is defined as those areas such as the Mississippi River meander belts that are or were at one time, subject to flooding by the rivers in their present regime (Saucier 1994).

2. The project footprint was further refined based on regulatory jurisdiction under Section 10 of the Rivers and Harbors Act of 1899, 33 U.S.C. §401, which includes all currently and historically navigable waters of the United States.

3. Navigation boundaries were defined as channels currently supporting commercial barge traffic upstream to the farthest influence of backwater from the main channel of the Mississippi River, which is directed in the authorizing language. Available funding and report schedule do not permit collection of information on all historically navigable tributaries of the LMR. The point of direct influence for each tributary was determined using observed stage or elevation data and from observed flow measurements collected from the 1900s to present.

4. Readily available data were insufficient to determine how far up the tributaries Mississippi River fauna were present. Therefore, no biological boundaries were established in addition to the navigation boundaries, which were determined to be the confluences with the main channel of the Mississippi River upstream to the farthest point of hydrological interaction.

5. The Deltaic Plain was historically a part of the functioning floodplain of the LMR and created from its deposits. It is an integral functional element of the LMRAV from both hydrologic and sediment movement perspectives and is integral in the total function of the LMRAV. Since river-related management, natural resource habitat needs, and river-related recreation and access are objectives of this study in the authorizing language, this area is an important feature that shall be included.

A map of the project area and detailed maps of existing features are included in Appendix B.

3.2 CONGRESSIONAL DISTRICTS

The study area includes 15 Congressional Districts.

<u>Arkansas</u>
District 1: U.S. Representative Marion Berry
District 4: U.S. Representative Mike Ross

<u>Illinois</u>
District 12: U.S. Representative Jerry Costello

<u>Kentucky</u>
District 1: U.S. Representative Edward Whitfield

Louisiana
District 1: U.S. Representative Steve Scalise
District 2: U.S. Representative Anh Cao
District 3: U.S. Representative Charles Melancon
District 5: U.S. Representative Rodney Alexander
District 6: U.S. Representative Bill Cassidy

Mississippi
District 1: U.S. Representative Travis Childers
District 2: U.S. Representative Bennie Thompson
District 3: U.S. Representative Gregg Harper

Missouri
District 8: U.S. Representative Jo Ann Emerson

Tennessee
District 8: U.S Representative John Tanner
District 9: U.S. Representative Steve Cohen

4. EXISTING WATER PROJECTS AND PRIOR STUDIES, REPORTS

The USACE has a number of existing authorities and projects within the study area. These projects and the primary studies/authorities associated with them are discussed below.

4.1 EXISTING PROJECTS WITHIN THE LMRRA PROJECT BOUNDARIES

4.1.1 Mississippi River and Tributaries Projects

The Mississippi River and Tributaries project (MR&T) has several authorities which include those specified and provided under the Flood Control Acts (FCA) of 1928 Pub. L. 70-391, FCA 1936, Pub. L. 74-738, FCA 1938, Pub. L. 75-761, FCA 1941, Pub. L. 77-228, FCA 1944, Pub. L. 78-534, FCA 1946, Pub. L. 79-526, FCA 1950, Pub. L. 81-516, FCA 1954, Pub. L. 83-780, FCA 1962, Pub. L. 87-874, FCA 1965, Pub. L. 89-298, and FCA 1968, Pub. L. 90-483; the River Basin Monetary Authorization and Miscellaneous Civil Works Amendments Act of 1970, Pub. L. 91-292; the River Basin Monetary Authorization Act (RBMAA) 1971, Pub. L. 92-222, RBMAA 1974, Pub. L. 93-251, RBMAA 1975, Pub. L. 94-101, RBMAA 1976, 94-347, RBMAA 1977, Pub. L. 95-189; and the WRDA of 1986, Pub. L. 99-662. The MR&T Project encompasses the alluvial valley between Cape Girardeau, Missouri and the Head of Passes, Louisiana and provides protection from floods by means of levees, floodwalls, floodways, reservoirs, bank stabilization, and channel improvements in and along the river and its tributaries and outlet up to the point that is affected by backwater. Several different projects fall under the MR&T authority:

1. Mississippi River Mainline Levees (MRL) Project extends from Allenville, Missouri on the Little River Diversion Channel generally southward to Venice, Louisiana, on the west

bank and on the east bank from Hickman, Kentucky, to opposite Venice, Louisiana, except where interrupted by hills and tributary streams. Included in the system are the levees, which protect Mounds, Mound City and Cairo, Illinois, and the New Madrid Levee and Floodway. Improvement provides for raising, strengthening, and in some cases, extending existing levees to provide protection against the project flood. Other construction activities include installing relief wells, berms, and slurry trenches to protect the existing levees from seepage. Two primary documents support the MRL project: the MR&T Mississippi River Levees and Channel Improvement Environmental Impact Statement (EIS) of 1976 and the MRL Supplemental Environmental Impact Statement (SEIS) of 1998.

2. Channel Improvement project is located in the Mississippi River and along its banks from the vicinity of Cairo, Illinois, to the Head of Passes, Louisiana, a total distance of approximately 966 miles. The plan of improvement consists of stabilizing the banks of the river in a desirable alignment and obtaining the most efficient flow characteristics for flood risk management and navigation by means of revetments, dikes, foreshore protection, and improvement dredging. Construction and impacts are analyzed in the Channel Improvement EIS of 1976.

3. Mississippi River Levees Maintenance (MRL-M) project includes routine operation and maintenance activities, such as pumping station operations, levee slide repairs, floodwall renovation, lime flash injections, and culvert replacements along the Mississippi River levee system which extends from Allenville, Missouri, southward to Venice, Louisiana, on the west bank and on the east bank from Hickman, Kentucky, to opposite Venice, Louisiana, except where interrupted by hills and tributary streams.

4. The St. Johns Bayou and New Madrid Floodway, Missouri project is located in Mississippi and New Madrid counties in southeastern Missouri in the floodplain on the right descending bank of the Mississippi River. The project area encompasses portions of two drainage basins separated by the Birds Point-New Madrid Setback Levee. As part of the Mississippi River and Tributaries Project, the Birds Point-New Madrid Floodway was authorized by the Flood Control Act of 1928. Completed in 1933, the New Madrid Floodway was designed to lower flood stages upstream and adjacent to the Floodway during major flood events. Section 401(a) of WRDA 1986, authorized channel modifications and pumping stations for the St. Johns Bayou Basin and the New Madrid Floodway.

5. The Memphis Harbor (McKellar Lake) Maintenance Project was authorized under the FCA of 1928. This harbor is located near Memphis at Mississippi RM 725.5, in Shelby County, Tennessee. This is a slack-water harbor and is used primarily for importing industrial goods for local industry. The navigation channel extends 7.5 miles into the harbor with a 9-foot project depth and 300 to 500 foot width at various locations.

6. The Grand Prairie Area Demonstration Project (GPADP) provides agricultural water supply, water conservation, aquifer protection, waterfowl management, and prairie grass restoration. The GPADP area includes significant portions of Arkansas and Prairie

counties and small portions of Monroe and Lonoke counties in east central Arkansas. The project includes a 1,640-cubic feet per second (cfs) pumping station to divert surface water from the White River at DeValls Bluff to the 362,662-acre project area, canals, pipelines 8,849 acres of new on-farm irrigation reservoirs, on-farm tail water recovery systems, establishment of native prairie vegetation on approximately 3,000 acres of canal rights-of-way, and the annual flooding of 38,529 acres of harvested rice fields for waterfowl. The Final EIS for the GPADP was completed in 1999 and followed by an Environmental Assessment in 2004. Even though this project is outside of the LMRRA project boundaries, it has been included because water will be diverted from the White River upstream of Clarendon.

7. The Helena Phillips County Harbor was authorized by WRDA 1986. The harbor is located in Phillips County, about five miles south of Helena, Arkansas, at RM 652. This is a slack-water harbor used primarily for the export of agricultural goods. The approved channel dimensions are 9 feet deep by 300 feet wide by 3.85 miles long, with an additional 50 feet of width for berthing, a 100 foot by 1000 foot fleeting area, and a 600 foot by 600 foot turning basin.

8. The White River Backwater project is located approximately 20 miles south of Helena, near Elaine, AR, in Phillips and Desha Counties. It consists of 40.2 miles of levee, the Graham Burke Pumping Station, the Little Island Bayou Outlet Structure and Deep Bayou Culvert. The White River Backwater levee, together with the Mississippi River Levee between Old Town and Laconia Circle, protects the enclosed area against all but very large floods. The combined levee system reduces extreme crests on the White River by admitting drainage into the enclosed area thereby restoring the White River Backwater Pool.

9. The Bayou Meto Basin project was authorized by Section 402 of the FCA of 1950, deauthorized in Section 1001(b) of WRDA 1986, and reauthorized by Section 363(a) of WRDA 1996, Pub. L. 104-303, expanding the scope to include groundwater protection and conservation, agricultural water supply, and waterfowl management. The project is located in Lonoke, Prairie, Pulaski, Jefferson, and Arkansas Counties in east-central Arkansas. Project features include diversion excess water from the Arkansas River with delivery through a system of pump stations, new canals, existing streams, and pipelines to water-depleted areas; channel improvements, control structures, and a pumping station to provide for reduced flooding and water management; waterfowl conservation and management measures; and other ecosystem restoration and enhancement features. The General Reevaluation Report was approved 24 September 2007, and the Record of Decision (ROD) was signed on 17 November 2007.

10. The Yazoo Basin, Mississippi, Upper Yazoo projects (UYP) is a Flood Risk Management construction project, which was authorized by Section 4 and 8a of the FCA of 1936, Section 3b and 3g of the FCA of 1941, Section 3, 10f and 10q of the FCA of 1946, and Section 204 of the FCA of 1965, which authorized the Yazoo Headwater Projects to provide protection to the Yazoo Basin against Headwater floods. An environmental impact statement completed in 1975 and a supplemental environmental impact statement was completed in 1993. The UYP includes channel and levee features along the main

channel of the Yazoo, Tallahatchie, and Coldwater Rivers from the vicinity of Yazoo City, MS, to the vicinity of the confluence of Arkabutla Creek with the Coldwater River. The project will provide flood protection for 8,900 square miles in this region.

11. The Vicksburg Harbor, Mississippi, Navigation Operation and Maintenance (O&M) project was authorized by the FCA of 1928, as amended by the FCAs of 1946, 1954, and the WRDA of 1986. The Vicksburg Harbor is located in west-central Mississippi at Vicksburg, MS, with access to the Mississippi River by way of the Yazoo River Diversion Canal. The harbor channel is 500 feet wide and 12,000 feet long with a 500-foot-wide, 15,000-foot-long channel on the Yazoo River Diversion Canal from the Mississippi River to the harbor entrance. A minimum depth of 9 feet at the lowest Mississippi River stage is maintained. The project's purpose is to provide local businesses, industries and vessels navigating the Mississippi River access to the harbor facilities at Vicksburg.

12. The Yazoo Basin, Mississippi, Delta Headwaters Project was authorized by the Emergency Jobs Appropriations Act of 1982; WRDA 1986, Sec 103e. The project is in the eastern (hill) section of the Yazoo River Basin, MS. The project consists of 16 watersheds, ranging in size from 1 square mile (Town Creek) to over 600 square miles (Coldwater River), with features that include bank stabilization, grade control structures, floodwater-retarding structures, and channel modifications for flood damage reduction, bank stabilization and sedimentation/erosion control.

13. The Lower Atchafalaya Basin Floodway System (ABFS), Louisiana project was authorized by the FCA of 1928, and the Supplemental Appropriations Act of 1985. The project was reauthorized and amended by Section 601 of WRDA 1986. The Corps of Engineers, New Orleans District, completed a comprehensive feasibility study report for the ABFS in January 1982. The entire Atchafalaya Basin is located in south-central Louisiana and extends from the confluence of the Mississippi, Red and Atchafalaya rivers near Simmesport, Louisiana to the Gulf of Mexico south of Morgan City. The 833,000-acre ABFS is bounded on the north by U.S. 190, on the east and west by the Atchafalaya Basin protection levees, and extends south to the Gulf of Mexico. The ABFS project has two mutually supporting goals: to preserve the habitat of nation's largest and oldest river-basin swamp and to ensure that the Lower Atchafalaya Basin can pass a floodwater of 1.5 million cubic feet per second as required by the MR&T project. Other projects on the ABFS under MR&T authority are the ABFS Management Units (Buffalo Cove) and Flat Lake, ABFS Bayou Sorrel Boat Landing, ABFS Interpretive Center, ABFS Krotz Spring Boat Landing, ABFS Land Acquisition, ABFS Millet Point Boat Landing, ABFS Recreation, ABFS Water Management Units, ABFS WMU Buffalo Cove, Alexandria, Louisiana to the Gulf of Mexico feasibility study, ABFS, Louisiana, Atchafalaya Basin Maintenance, Old River Control Project, Old River Low Sill Control Structure, Overbank Control Structure, Auxiliary Control Structure, S.A. Murray Jr. Hydroelectric Power Plant, Old River Navigation Lock, Levee from Blach Hawk to Torras, Bank Stabilization, Old River Rehabilitation Program, Morganza Floodway, Morganza Combined Control Structure, Morganza Combined Control Structure, Morganza Floodway Levees, Pointe Coupee Drainage Structure (pumping station) and

Bayou Latenache, West Atchafalaya Floodway, Atchafalaya Basin Floodway, Atchafalaya Basin Bank Stabilization, Atchafalaya Basin Levees, East Atchafalaya Basin Protection Levee, West Atchafalaya Basin Protection Levee, East Atchafalaya River Levee, West Atchafalaya River Levee, Bayou des Glaises Fuseplug Levee, Mansura Hills to Hamburg Levee, Levees West of Berwick, East Atchafalaya Basin Project Levee, Landside Drainage Improvements, Lottie to Bayou Maringouin Borrow Pit Enlargement, Bayous Boeuf-Long Drainage Canal and Enlargements of Bayou Chene, West Atchafalaya Basin Project Levee Drainage Improvements, Bayou des Glaises Diversion Channel State Canal and Bayou Roseau, Bayou des Glaises Culvert, Borrow Pit Enlargement between Hamburg and Courtableau, Bayou Darbonne Drainage Structure, Bayou Courtableau Diversion Channels and Control Structure, Courtableau Drainage Structure and Channels, Bayou Berard Drainage Canal, Cypremort to Dauterive, Charenton Drainage Canal, Atchafalaya River Improvement Dredging, Atchafalaya Basin Main Channel Improvement Dredging, East and West Calumet Floodgates, Charenton Floodgate, Berwick Lock, Bayou Sorrel Lock, Bayou Boeuf Lock, and the Atchafalaya River Project.

14. The Atchafalaya Basin Floodway system (ABFS) resulted from a combination of a GI study with a Phase I General Design Memorandum (GDM). The GI study, Atchafalaya Basin (Water and Land Resources), Louisiana, was authorized by resolutions of the Senate and House Committees on Public Works in 1972. The Phase I GDM was authorized in June 1976 under the discretionary authority of the Secretary of the Army acting through the Chief of Engineers to address alternative plans for accomplishing the previously authorized purposes of the Atchafalaya Basin project. Because of the interrelationships of the separately authorized studies, they were combined into a single study. The primary goal of the study was to develop an implementable multipurpose plan that will protect southeast Louisiana from Mississippi River floods by ensuring safe passage of one-half the MR&T project design flood (PDF) through the Atchafalaya Basin Floodway system, while retaining and restoring the unique environmental values of the floodway and maintaining or enhancing the long-term productivity of the wetlands and woodlands. The new plan was recommended in the Atchafalaya Basin Floodway system final report/EIS, which was submitted to the Mississippi River Commission (MRC) in January 1982, and was approved by the Office of the Chief of Engineers in February 1983. Other studies in the Atchafalaya Basin are the Morgan City and Berwick Riverfront Floodproofing Measures **(**authorized in Section 21 l(g) of WRDA 1996, Improvements for Access, Fish and Wildlife, and Recreation, East and West Access Channels, East and West Freshwater Distribution Channels, Sherburne Structure, Retention Dikes, and Public Access Real Estate Feature.

15. The Baton Rouge Harbor/Devil’s Swamp Louisiana maintenance project Baton Rouge Harbor/Devil's Swamp, LA Maintenance is located in south-central Louisiana. The channel forms a junction with the Mississippi River near East Baton Rouge Parish. This project provides a slack water channel for barge traffic and provides and industrial expansion area for the port of Baton Rouge, Louisiana. The project provides a 12-foot deep by 200 foot wide channel, and is 2.5 miles long from the channel's junction with the

Mississippi River (RMs 2.5 to 5 of the project were deauthorized by WRDA 1974, Pub. L. 93-251).

16. The Donaldsonville to the Gulf project was authorized by a resolution adopted by the Committee on Transportation and Infrastructure of the United States House of Representatives on May 6, 1998. The study area is located in southeast Louisiana and includes portions of the Parishes of Ascension, Assumption, St. James, St. John the Baptist, Lafourche, St. Charles, Jefferson, Orleans, and Plaquemines. The area consists of an approximately 2,423 square mile, low-lying area of land and water known as the Barataria Basin or estuary. The basin boundaries include the developed natural levees on the east bank of Bayou Lafourche and the west bank Mississippi River levees on the east that extend southeast to Barataria Bay.The purpose of the project is to reduce the risk of flooding from coastal storm surge and rainfall to prevent further economic losses and environmental damage in the Barataria Basin. The scope is to study various alternatives that will provide flood protection from tidal, hurricane surges, and heavy rainfall events; determine the adequacy of the existing interior drainage systems and evaluate whether additional pumping capacity is required; and analyze recreational cultural, and environmental needs.

17. The Morganza to the Gulf of Mexico Risk Reduction project was authorized by WRDA 2007 (Sec. 1001,Pub. Law 110–114). This project aims to protect people and property as well as the remaining fragile marsh from hurricane storm surge in the vicinity of Houma, Louisiana. The area has been affected by an extreme deterioration of coastal marshes as a result of saltwater intrusion, land subsidence and the lack of sediment deposits from the Mississippi River and its tributaries. This deterioration has led to increased hurricane and storm surge inundation. The area is also significantly affected by tides emanating from the Gulf of Mexico. The proposed work is located in coastal Louisiana approximately 60 miles southwest of New Orleans and includes portions of Terrebonne and Lafourche Parishes. The area is bounded on the west by Bayou Du Large and State Highway 311 and on the east by Bayou Lafourche with the east and west boundaries forming an apex at Thibodaux, LA. The southern boundary is the Gulf of Mexico. Approximately 72-miles of earthen levee, nine 56-foot sector gate structures, three 125-foot floodgates, 13-floodgate structures, 13-tidal exchange structures and a lock complex consisting of a lock in the Houma Navigation Canal measuring 110-feet by 800-feet, an adjoining floodgate measuring 250 feet, and a dam closure. The structural features are integrated into the levee alignment to provide flood protection, drainage, environmental benefits, and navigational passage.

18. The Alexandria, Louisiana to the Gulf of Mexico was authorized by a 23 July 1997 resolution of the Committee on Transportation and Infrastructure of the U.S. House of Representatives. To address urban and agricultural flooding problems and agricultural water supply needs in the area drained by the West Atchafalaya Basin Protection Levee landside drainage system, between Alexandria, Louisiana, and the Gulf of Mexico. The purpose of this project is to address urban and agricultural flooding problems and agricultural water supply needs in the area drained by the West Atchafalaya Basin

Protection Levee landside drainage system, between Alexandria, Louisiana and the Gulf of Mexico.

The MR&T levees project which includes 3,727 miles of authorized levees is 95.5% complete. The revetment feature is 95.8 % complete, and authorized dike construction is 90.3% complete as of August 2009. A complete list of all MR&T projects (USACE 2007) is located in Appendix C.

4.1.2 Other Projects and Studies

Other projects located within the LMRRA project boundaries that are not part of the MR&T project are summarized below.

1. The Elvis Stahr Harbor O&M Project was authorized by the Rivers and Harbors Act of 1960 and Section 107 of WRDA 1988. This harbor is located near the city of Hickman in Fulton County, Kentucky. Its primary use is the export of agricultural products. The project provides for maintenance of an off-river harbor channel extending from the main channel (RM 922) of the Mississippi River along the city front for about 0.3 miles below the junction of Obion Creek and Bayou Du Chien. The approved channel dimensions are 9 feet deep, 250 feet wide, and 5,800 feet long, with a 500 by 600 foot turning basin at the upstream end.

2. The Northwest Tennessee Harbor project was authorized under Section 107 of the River and Harbors Act of 1960 and is under the Continuing Authorities Program (CAP). The project is located at Mississippi RM 900 on the left descending bank in Lake County near Tiptonville, Tennessee. This project provides for a 9,000-foot long and 130-foot wide slack water harbor at approximately river mile 900 known as Cates Landing. The sponsor is the Northwest Tennessee Regional Port Authority. Construction was initiated in October 2006.

3. The New Madrid County Harbor O&M Project was authorized by Section 102(n) of WRDA 1992. The locally constructed harbor is located at Mississippi RM 885, south of the city of New Madrid, in New Madrid County, Missouri. It is a slack water harbor used primarily for the export of agricultural goods. The project provides for maintenance of the navigation channel for year-round access to barge transportation for the existing facilities. The approved channel dimensions are 9 feet deep by 150 feet wide by 1,500 feet long.

4. The Caruthersville Harbor O&M Project was authorized by Section 107 of the Rivers and Harbors Act of 1960. This harbor is located at Mississippi RM 853 at Caruthersville in Pemiscot County, Missouri. This is a slack-water harbor used primarily for the export of agricultural goods. The project provides for maintenance of the navigation channel for year-round access to barge transportation for the existing facilities. The approved channel dimensions are 9 feet deep by 150 feet wide by 3,500 feet long with a 300-foot radius turning basin at the upper end.

5. The Osceola Harbor O&M Project was authorized by Section 107 of the Rivers and Harbors Act of 1960. This harbor is located on the Mississippi River (mile 785.0) at Osceola, in Mississippi County, Arkansas. This is a slack-water harbor used primarily for the export of agricultural goods. The project provides for maintenance of a navigation channel for year-round access for barge transportation. The approved channel dimensions are 9 feet deep by 250 feet wide by 6,500 feet long, with a 250-foot radius turning basin at the upstream end.

6. The Wolf River Harbor O&M Project was authorized by the National Industrial Recovery Act of 1933 and modified by the FCA of 1958. This harbor is located at Mississippi RM 737, near Memphis in Shelby County, Tennessee. It is a slack-water harbor and is used primarily for the import of industrial materials. The project provides for a navigation channel that is 9 feet deep by 250 feet wide at low water.

7. The Helena Harbor O&M Project was authorized by Section 107 of the Rivers and Harbors Act of 1960. This harbor is located on the Mississippi River (mile 663.0) at Helena in Phillips County, Arkansas. This is a slack-water harbor used primarily for the export of agricultural goods. The project provides for maintenance of the navigation channel for year-round access to barge transportation for the existing facilities. The approved channel dimensions are 9 feet deep by 450 feet wide by 3,200 feet long.

8. The White River Navigation to Batesville, Arkansas Study was authorized in Section 363 of WRDA 1996 and Section 131 of the Consolidated Appropriations Act of 2008, Pub. L. 110-161. This shallow draft navigation project is located in central Arkansas on the White River. The purpose of the reevaluation is to determine if navigation improvements, along with recreation and environmental elements, are feasible. Reevaluation of the lower end (Arkansas Post Canal, Mile 10 to Newport, Mile 255) was initiated in fiscal year 1998. Reevaluation of the upper end (Newport, Mile 255 to Batesville, Mile 296), authorized by the 2008 Consolidated Appropriations Act, will be initiated upon receipt of appropriations.

9. The White River Comprehensive Study was authorized in Section 729 of WRDA 1986. WRDA 2000 established the cost sharing of Section 729 studies at 50% federal/50% non-federal, half of which can be in-kind services and increased the authorization ceiling from $5,000,000 to $15,000,000. In Section 2010 of WRDA 2007, cost sharing was modified to 75% federal/25%non-federal, 100% of which can be in-kind services. The White River Basin comprises approximately 28,000 square miles in northeastern Arkansas and southern Missouri. The basin contains five large multi-purpose reservoirs and one reservoir primarily for flood risk management; over 150 miles of flood control levees along the White River and its tributaries; 2 major national wildlife refuges; and the largest remaining concentration of seasonally flooded bottomland hardwood forests (BLH) in the Mississippi Valley. The study will identify water resources needs and opportunities. Potential study outputs address water resources needs for water supply, flood risk management, waste water management, navigation, recreation, power generation, ecosystem restoration needs, and other water resources related needs identified in the comprehensive study. Cost-sharing sponsors include the ANRC, AGFC, ANHC, Arkansas Waterways Commission, MDC, MDNR, and TNC.

10. The Rivers and Harbors Act of 1946, Pub. L. 79-525, authorized the development of the Arkansas River and its tributaries for the purposes of navigation, flood risk management, hydropower, water supply, recreation, and fish and wildlife. Congress subsequently designated the project as the McClellan-Kerr Arkansas River Navigation System (MKARNS). Several reservoirs on the Arkansas River and its tributaries support water control on the MKARNS and are operated as part of the navigation system. MKARNS project purposes include navigation, flood risk management, hydropower, water supply, recreation, and fish and wildlife. Development of and construction on the MKARNS began in 1952 and was completed in 1971 at a cost of $1.3 billion. The Final EIS was completed August 2005, and the ROD was signed in September 2005. The recommended plan consisted of a navigation channel maintenance component, operations only flow management component, and a 12-foot channel depth for the entire MKARNS component.

11. The Claiborne County Port, Mississippi, Navigation O&M project was authorized by Section 107 of the Rivers and Harbor Act of 1960, Pub. L 86-645. Claiborne County Port is a slack-water, shallow draft harbor, located along the Mississippi River. This project's purpose is to provide a transportation need for water-oriented industry in Claiborne County, Mississippi. The project was constructed in 1982.

12. Ouachita/Black Navigation project, Red River to Camden, Louisiana and Arkansas, Navigation O&M Project was authorized by the Rivers and Harbor Act of 1950, Pub. L. 81-516, as amended by the Rivers and Harbor Act of 1960, Pub. L. 90-483. The project for navigation on the Red, Black, and Ouachita Rivers extends 382 miles from Old River to Camden, Arkansas, and consists of four locks and dams with a 9- by 100-foot navigation channel. The project also includes a diversion channel through Catahoula Lake near Jonesville, Louisiana, for ecological reasons.

13. The Mouth of Yazoo River, Mississippi, Navigation O&M project was authorized by Section 107 of the Rivers and Harbors Act of 1960. The mouth of the Yazoo River starts at the Mississippi River and continues for 9.3 miles to the junction of Old Mississippi River and Yazoo Rivers at Vicksburg, Mississippi. The channel is 150 feet wide, and a minimum operating depth of 9 feet below the lowest water of record is maintained in the channel. This project's purpose is to provide access to the Yazoo River, the Upper Vicksburg Harbor, and the Vicksburg Harbor.

14. J. Bennett Johnston Waterway, Mississippi River to Shreveport, Louisiana is a navigation construction and O&M project which was authorized by Section 101, River and Harbors Act 1968, Pub. L. 90-483; Section 187, WRDA 1976, Pub L. 94-487; Section 1305, Supplemental Appropriations Act of 1984, Pub. L. 98-181; Section 601, WRDA 1986; Section 4, WRDA 1988 Pub. L. 100-676; Section 102, WRDA 1990, Pub. L. 101-640; Section 301, WRDA 1996; Section 316, WRDA 2000, Pub. L. 106-541; Energy and Water Development Appropriations Acts of 1994, Pub. L. 103-126; Energy and Water Resources Development Act of 1996, Pub. L. 104-46, Energy and Water Development Appropriations Act, 1997, Pub. L. 104-206 Sec. 3080, WRDA 2007, Pub. L. 110-114. An

EIS was completed in 1983. The project is located in central and northwest Louisiana and provides for a 9- by 200-foot navigation channel extending about 236 miles from the Mississippi River through Old River and Red River to the vicinity of Shreveport, Louisiana. Five locks and adjacent dams provide a lift of about 141 feet. Facilities to provide recreation and mitigation of fish and wildlife losses are also an integral part of the project.

15. The Yazoo River, Mississippi, Navigation O&M project was authorized by WRDA 1986. The Yazoo River provides navigation from Mouth of the Yazoo River, Vicksburg, Mississippi, to Greenwood, Mississippi. Clearing and snagging of the channel provides a clear channel to Yazoo City. The project depth of 9 feet is authorized, but not dredged, to Greenwood, a distance of over 158 miles.

16. The Lake Providence Harbor, Louisiana, Navigation O&M project is an inland harbor, located along the Mississippi River in East Carroll Parish, Louisiana. Lake Providence Harbor is an inland harbor, located along the Mississippi River in East Carroll Parish, Louisiana. This project's purpose is to meet transportation needs for water-oriented industry in East Carroll Parish, Louisiana. This port services many small communities and farmers in Louisiana. The project was constructed in 1963 and has been maintained annually. This project was authorized by Section 107 of the Rivers and Harbor Act of 1960.

17. The Madison Parish Port in Louisiana is a navigation O&M project, authorized by Section 107 of the Rivers and Harbor Act of 1960. Madison Parish Port is a fast water, shallow draft port, located on the Mississippi River in Madison Parish, Louisiana. This project's purpose is to meet transportation needs for water-oriented industry in Madison Parish, Louisiana. This port services many small communities and farmers in Louisiana. The project was constructed in 1980 and has been maintained annually.

18. The Coastal Wetlands Planning, Protection and Restoration Act program (CWPPRA or "Breaux Act"), Pub. L. 105-178 provides for targeted funds to be used for planning and implementing projects that create, protect, restore and enhance wetlands in coastal Louisiana. It was passed in 1990, and is authorized until 2019. By July 2008, 145 active CWPPRA projects have been approved, 74 have been constructed, 17 are under construction, and 26 have been de-authorized or transferred to another program. The CWPPRA program anticipates receiving $84M in Federal funds for FY09 and is managed by the CWPPRA Task Force. The Task Force is composed of the State of Louisiana and five Federal agencies: the USACE, USEPA, USFWS, NRCS, and the National Oceanic Atmospheric Administration (NOAA) – National Marine Fisheries Service. The Governor’s Office of Coastal Activities represents the state of Louisiana. The USACE administers accounting and tracks project status of all CWPPRA projects. The USACE also constructs those approved CWPPRA projects whenever the USACE is assigned lead agency for that project. All other projects are constructed by one of four other federal agencies.

4.2 PRIOR STUDIES/REPORTS

The States of Arkansas, Kentucky, Louisiana, Mississippi, Missouri, and Tennessee and the Nation have recognized the importance of the Lower Mississippi River's resources since the LMRAV was settled. Consequently, numerous USACE studies and reports have been prepared on developing the river and its associated water and land resources. From a development perspective, the Flood Control Act of 1928 had the greatest economic and environmental impacts on the LMRAV. Widespread damage caused by recurring floods in the LMRAV, especially in 1849 and 1850, made it apparent that establishing a centralized organization to coordinate regulation of the LMR was essential to economic development in the LMRAV. In 1879 the U.S. Congress established the MRC and assigned it the tasks of improving navigation, preventing destructive floods, and facilitating commerce, trade, and the postal service. Major floods again occurred in the LMRAV in 1882, 1912, 1913, and 1927. The flood of 1927 was the most disastrous flood on record in the LMRAV, devastating an area of about 26,000 square miles. As a result, Congress passed the FCA of 1928, which authorized the MR&T project, the Nation's first comprehensive flood risk management and navigation act.

One of the most important reports to date has been the Lower Mississippi Region Comprehensive Study - Main Report (1974, Appendix D). It acknowledged that meeting the future water and land resource development needs of the LMRAV would require judicious planning but could be achieved without sacrificing significant environmental quality features. Land use recommendations in the report contained specific provisions for ensuring that sufficient areas would be available to meet projected recreation, fish and wildlife resources, and environmental quality needs. However, the report also noted that satisfaction of higher priority needs (urban, infrastructure, and agriculture) would infringe upon the area of BLH in the LMRAV.

5. ASSESSMENTS

5.1 RIVER-RELATED MANAGEMENT INFORMATION

5.1.1 Existing Conditions for the Mainstem Lower Mississippi River

5.1.1.a Geology, Topography, and Soils

Geology

The LMR lies within the Central Gulf Coastal Plain physiographic province. A northward extending lobe, the Mississippi Embayment of this province follows the axis of the Mississippi Basin and comprises the northern part of the LMRAV (Schumm et al. 1982). Virtually all LMRAV landforms and deposits are the result of fluvial, eolian, or marine processes. All three geomorphic processes function in both constructional and erosional modes, i.e., landforms are both being created and destroyed but, of these, fluvial processes are predominant. Glaciation, climate, relative sea level, tectonism, and subsidence are regarded as the dominant geologic controls influencing the Valley during the Quartenary, a period estimated at 2.48 million years (Beard, Sangree, and Smith 1982).

Unquestionably, the single most significant geologic process affecting the geomorphology of the Valley has been continental glaciation. Eight major glaciation cycles are recognized (Beard, Sangree, and Smith 1982) and maximum glaciation occurred about 18,000 years before present (BP). Although glaciers may have actually contacted only the northernmost portion of the LMRAV, their advances generally resulted in dissection and widening of the LMRAV while their retreats typically led to alluviation. Advancing ice sheets completely disrupted northward flowing streams in the eastern Great Plains, Great Lakes, and south-central Canada and diverted their flow into the Mississippi River system. Variations in sea level had the greatest geomorphic effect by causing changes in stream gradients in the LMRAV (Saucier 1994).

During glacial stages when sea levels fell, streams downcut and formed entrenched valleys; alternatively when sea levels rose during interglacial stages, streams aggraded and filled the entrenchments. This response was strongest nearest the Gulf shoreline and on those streams directly tributary to the Gulf. The most tectonically active portion of the LMRAV is the New Madrid Seismic Zone, an extensive area centered in the St. Francis River Basin, Arkansas that has been the site of large-magnitude earthquakes, faulting, doming, and subsidence (Saucier 1994).

Exclusive of the New Madrid Seismic Zone, consolidation of sediments is the only one of the five dominant geologic controls that is active. However, subsidence amounts and rates are low in the LMRAV because fine-grained alluvial deposits are not especially susceptible to compaction. In the deltaic plain, all five factors involved in subsidence are present and subsidence is a major control in the area's geomorphology (Kolb and Van Lopik 1958). In the New Orleans area, drainage has lowered water tables causing subsidence of as much as 6 to 7 feet within several decades over a large part of the city and groundwater withdrawals for industrial use have caused subsidence of about 1.7 feet (Kazmann and Heath 1968).

Topography

The LMRAV varies in width between 40 and 110 miles and includes parts of seven states - Missouri, Illinois, Tennessee, Kentucky, Arkansas, Mississippi, and Louisiana, with the largest area being in Arkansas, Mississippi, and Louisiana. The topography of the 53,000 square mile LMRAV is characterized by a flat to slightly undulating surface underlain by alluvial and terrace deposits. Average floodplain elevations in the LMRAV decline from about 325 feet mean sea level (msl) in extreme southern Illinois to about 40 feet msl at the northern edge of the deltaic plain, an average down valley slope of only 0.6 feet/mile. Average relief in the upper part of the LMRAV approximates 25 feet and declines progressively southward. Uplands bordering the LMRAV typically attain elevations of 200 feet above those of the adjacent floodplain. Upland elevations also steadily decline southward, eventually reaching sea level at the Donaldsonville-Franklin line. Upland remnants and terraces subdivide the LMRAV into six major basins - Western Lowlands, St. Francis Basin, Yazoo Basin, Arkansas Lowland, Boeuf Basin, and Tensas Basin. Crowley's Ridge, a major topographical feature in the alluvial plain, is a narrow, segmented ridge about 200 miles long. It is an erosional remnant extending from near the

Mississippi River in east-central Arkansas into southeastern Missouri and is as much as 250 feet higher than the surrounding alluvial plain (Saucier 1994).

Soils

All of the river basins within the LMRAV occur at elevations lower than the LMR due to depositional features in the alluvial plain and faulting of underlying rocks (Hunt 1967). The depositional history of the alluvial plain was determined by two interacting forces, the sediment loads carried by meltwater from the retreating Laurentide ice sheets in the northern United States and Canada and fluctuations in sea level during glacial and interglacial periods.

The LMRAV is characterized by landforms and deposits created during the last 10,000 years. Coarse soil particles (sands) are generally deposited near the Mississippi River channel; medium-textured soil particles (very fine sand and silt) are deposited away from the channel, and fine-textured soil particles (clays) are deposited on almost level or gently sloping backwater areas where stream energy is lowest (Hodges 1997; Stanturf and Schoenholtz 1998).

Soils in the LMRAV range up to 300 feet in depth and consist mainly of sands and silt, grading progressively to very fine sands and silts in the lower portion of the area with extensive deposits of clay scattered through these formations. Typical of streams flowing through alluvial valleys, the LMR developed a highly sinuous course, creating numerous meander loops, bends, and oxbow lakes. Historically, the river shifted its channel frequently and reworked parts of its alluvial meander belt, thus contributing to the complexity of the soils structure and hydrology of the area (Saucier 1994).

One distinct feature of the LMRAV is the formation of natural levees along the banks of rivers and the associated backswamp deposits dominated by dense alluvial clays that historically supported extensive wetland areas. For this reason, the banks of the river could be as much as 10 to 15 feet higher than the lowlands farther back from the river. Because of these natural levees, drainage was generally away from the Mississippi River to lower elevations near the valley walls, except near tributary confluences. Bottomland drainage is provided by streams running parallel to the river and joining it through major tributaries or at points where the river meandered close to the valley wall. This pattern of parallel drainage was well developed in the LMRAV. These clays have created low permeability soils, which limit the ability of rainwater to infiltrate the ground surface and may cause runoff from agricultural fields to rapidly enter rivers and streams (Kleiss et al. 2000). Soils formed in backwater areas have some of the highest clay content (sometimes greater than 90 percent) in the United States, very poor internal drainage, and seem to limit the susceptibility of the ground water to surface activities in intense agricultural areas.

5.1.1.b Climate

The climate is generally mild throughout the study area, with summers that are typically long, hot, and humid and short, moderate winters. During winter months, the prevailing wind is from the north and northwest; in the other seasons, winds are from the south and southwest. The normal annual temperature averages about 60 degrees F with observed temperature extremes

ranging from 115 to -16 F. The normal length of the frost-free growing season is approximately 7 months. The northern portion of the study area averages snowfall of 8 to 10 inches annually, most of which occurs from January to February. The southern region experiences freezing rain and snow one or two times annually, with snow depths, ranging from 1 to 3 inches.

Precipitation in the study area is usually abundant and well distributed. Normal annual precipitation ranges from 46 to 62 inches from north to south. Heaviest rainfalls occur during the months of December to April, while minimum rainfall normally occurs during August through October. However, severe rainfall, producing locally intense runoff, can occur at any time of the year. During winter and spring, intrusions of polar air into the region are usually accompanied by widespread and persistent cloudiness and general rainfall, plus some thunderstorm activity within the frontal zone. The least amount of precipitation in the region occurs during autumn.

Climate change has become an issue in the LMRAV in recent years. The NOAA's State of the Climate Report and the National Aeronautics and Space Administration's (NASA) Surface Temperature Analysis indicate the average temperature of the Earth's surface has increased by about 1.2 to 1.4ºF since 1900.

5.1.1.c Hydrology

The Mississippi River has the third largest drainage basin in the world, exceeded in size only by the watersheds of the Amazon and Congo Rivers. It drains 41 percent of the 48 contiguous states of the United States. The Basin covers more than 1,245,000 square miles, including all or parts of 31 states and 2 Canadian provinces. Prior to European settlement, the LMRAV contained approximately 24.6 million acres of swamps, bayous and BLH that were periodically inundated by the floodwaters of the Mississippi and its tributaries. The LMRAV is a relatively flat plain comprised of approximately 35,000 square miles of alluvial lands that were subject to inundation during extensive flood periods prior to the construction of manmade protective works in the early 1700's.

Tuttle and Pinner (1982) noted that high flows originating in the upper Mississippi River system generally occur in late spring and early summer. Major floods on the LMR usually originate in the Ohio River Basin and can crest in any month from January to May. Fluctuation of the LMR hydrograph is strongly influenced by the Ohio River and can average nearly 32 feet annually. Water from the Ohio River provides about 60% of the LMR discharge and increases LMR discharge 150 % (Meade 1995).

Average flow of the Mississippi River at Vicksburg, Mississippi, which includes flow from the Arkansas River and its tributaries, is 573,000 cfs and 250 million tons of sediment are transported past that point annually (Bolton and Metzger 1998). Discharges during floods can be 3 to 4 times greater than the average flow; peak discharge of the 1927 flood at Vicksburg was approximately 2,278,000 cfs (Tuttle and Pinner 1982). Seventeen major floods have occurred on the Lower Mississippi River since 1879, an average of one every seven years but the actual interval between major flood events has ranged from 1 to 23 years (U.S. Army Engineer Division, Mississippi Valley 1998).

The LMRAV is subject to frequent and severe floods from the middle of December through July as a result of spring rains and melting of the snow pack in the upper Mississippi River and Ohio River Basins and/or other major tributaries of the lower Mississippi River. Major floods on the Ohio River generally occur between the middle of January and the middle of April; on the upper Mississippi and Missouri Rivers between the middle of April and the last of July; and, on the Arkansas and White Rivers between the first of April and end of June.

Approximately 1,678 miles of levees along the LMR have disconnected it from 90% of its historic 25.4 million-acre floodplain (Mac et al. 1998). Changes in river stages produce pronounced variations in surface area, volume, depth, and relative spatial distribution in LMR habitats. Alterations to the hydrologic regime and fluvial processes have increased the water surface slope and stream power of the main channel, reduced accretion adjacent to the main channel, altered river stage fluctuations, and reduced the magnitude and duration of high- and low-flow events. Modifications to the LMR channel and floodplain have impacted lateral channel migration, flood pulses, and point bar and cutoff formation, which drive biogeochemical cycles in low-gradient alluvial floodplain ecosystems (Biedenharn et al. 2000; Franklin et al. 2003).

5.1.2 General Information for the Red River Basin

5.1.2.a Existing Conditions

The J. Bennett Johnston Waterway (formerly known as the Red River Waterway) consists of a 9-foot deep by 200-foot wide navigation channel that commences at the confluence of Old and Red Rivers and proceeds upstream for 236 miles to the Shreveport-Bossier City area. Five navigation locks with usable dimensions of 84-feet wide by 705-feet long provide the necessary lift of approximately 141 feet. The locks can accommodate a standard 6-barge tow and towboat in a single lockage. The project also provides for realigning the Red River by means of dredging, cutoffs, channel training works and bank stabilization by means of revetments, dikes, and other structural methods. Facilities to provide recreation and fish and wildlife habitat are also integral to the project. This analysis addresses the Red River up to the John H. Overton Lock and Dam (L&D 2).

The lower Red River Basin is characterized by a humid subtropical climate with hot summers, mild winters, and ample precipitation throughout the year. Maritime tropical gulf air masses predominate from mid-spring through mid-fall bringing warm to hot temperatures, high humidity, and frequent convective precipitation. Severe thunderstorms, expiring hurricanes, and tornadoes constitute major severe weather threats to the region.

5.1.2.b Hydrologic Setting

The Red River Basin, exclusive of the Ouachita-Black River Basin which enters the Red River approximately 30 miles above its confluence with Old River, encompasses approximately 69,200 square miles. The basin extends from eastern New Mexico across portions of Texas and Oklahoma into Arkansas and Louisiana. The lower basin, below Denison Dam, covers about 29,500 square miles; most of which is located within the Red River alluvial valley. The valley is

flanked by gently rolling terrain with elevations generally below 400 feet National Geodetic Vertical Datum (NGVD). The width of the lower basin narrows from about 90 miles at Shreveport to about 20 miles in the reach below Alexandria, LA. The generally wide, flat flood plain contains sinuous stream channels, many of them abandoned, natural and manmade levees, and numerous oxbow lakes.

The modern alluvial valley of the Red River has been formed since the late Pleistocene, within the last 17,000 years. It is characterized by typical point-bar sediment deposits on the inside curves of migrating meanders, abandoned meanders and meander scars (some occupied by oxbow lakes or swamps), abandoned channels now with smaller, underfit streams, and natural levees with backslope areas of poor drainage. Various changes in the mouth of the Red River over the last 6,000 years greatly affected its lower valley until its upstream entrenchment was halted by the resistant siltstone knickpoint or gradient check at the Alexandria rapids. The valley is level to gently sloping and subject to frequent flooding.

Average annual precipitation ranges from 50 to 60 inches throughout the lower basin with monthly maxima generally associated with the rainy spring months. Heavy thunderstorms are common during the warm season; hurricanes occur chiefly from August to October.

5.1.3 General Information for the Black/Ouachita Rivers Basin

5.1.3.a Existing Conditions

The Ouachita River originates in Polk County, Arkansas, and flows 510 miles in a southerly direction to Jonesville, Louisiana, where it converges with the Tensas and Little Rivers to form the Black River. The Black River meets the Red River (J. Bennett Johnston Waterway) 41 miles south of Jonesville, Louisiana. About 28 miles below the mouth of the Black River, the Red River comes to a junction with the Atchafalaya River and the western end of the seven mile long Old River, which historically connected these rivers to the Mississippi River.

The Ouachita-Black Rivers Navigation Project was begun in 1902 and is a 337-mile long waterway. The navigable area begins in Camden, Arkansas, and extends to Jonesville, Louisiana, where it converges with the Tensas and Little Rivers to form the Black River. In 1924 construction was completed on the system of six locks and dams. In later years outdated locks were replaced and presently there are four locks and dams on the waterway, each with lock chambers 84 feet wide and 600 feet in length equipped with 3 to 5 tainter gates. The locks and dams have a lift from 12 feet up to 30 feet, which provides a minimum 9-foot deep and 100-foot wide navigation channel to accommodate barge traffic from the Red River north to Camden, AR.

5.1.3.b Hydrologic Setting

The Ouachita River Basin ranges from the Mississippi River levees west to the Red River Basin and covers approximately 24,000 square miles. The river is a stable stream with flat slopes and low velocities in the lower section of the river. Stream gradients range from 12 feet per mile in the upper reaches of the Ouachita River to between 0.9 and 0.2 foot per mile near the mouth of

the Black River. Channel widths vary from 300 feet in upstream areas to 800 feet in the Felsenthal Basin and 500 feet in the lower reaches of the Ouachita River.

The high moisture content of Gulf air frequently results in summer convective thunderstorm activity. Prolonged rains are infrequent, except during the winter months when 60 percent of the precipitation falls. Average annual precipitation is about 51 inches. In nearly all years, temperatures of 70 degrees F or higher are reached on one or more days in every month. Summer daytime temperatures are uniformly high, averaging over 90 degrees F, and relative humidity averages 79 percent.

5.1.4 General Information for the Yazoo River Basin

5.1.4.a Existing Conditions

The pattern of land use changes along the Yazoo River is similar to what has occurred in the entire Lower Mississippi River Alluvial Plain. Prior to European settlement there were approximately 24.6 millions acres of swamps, bayous and BLH, most of which were presumably wetlands that were regularly inundated by the floodwaters of the Mississippi and its tributaries. Federal flood risk management projects, agricultural economics, and climatic conditions within the broader Lower Mississippi Alluvial Plain have influenced BLH conversion outside the immediate study area. By the late 1940's only 10.5 million acres remained in the LMRAV. By the 1980's only 5.3 million acres, 22 percent of the original acreage remained. (see section on Mississippi River).

The Yazoo River lies in the alluvial valley of the Mississippi River. The topography is characterized by relatively flat, poorly drained land with slopes of 0.3 to 0.9 foot per mile. Elevations range from 135 to 90 feet NGVD from north to south, respectively. The alluvial valley was formed during the early Pleistocene epoch, or glacial period, at which time the Mississippi River became deeply incised in the coastal plain. The river gradually filled the valley with deposits of sand, silt, clay, and gravel during the Quaternary period. The deposits generally grade from coarse to fine, proceeding from deep to shallow with a clay cap typically found on the surface. This material has been reworked as streams have meandered throughout the area. Depositional features resulting from this activity include abandoned course, abandoned channel, point bar, backswamp, braided stream, and natural levee.

The channel of the Yazoo River has been modified from Vicksburg to Greenwood, the point at which the Tallahatchie and Yalobusha Rivers become confluent. Works completed include 160.2 miles of channel modification (including nine cutoffs) and 107.7 miles of levee construction. Levees on the east bank have been constructed intermittently from Yazoo City to north of Marks, Mississippi. On the west bank a levee has been constructed from opposite Yazoo City to the head of the Will M. Whittington Auxiliary Channel and from the Auxiliary Channel to a connection with the local levee near Black Democrat Bayou. The Yazoo River provides navigation from the mouth of the Yazoo River at Vicksburg, MS to Greenwood, MS. A channel depth of 9 feet is authorized, but not dredged. Routine clearing of the channel is conducted.

The climate of the Yazoo Basin is subtropical with long, hot summers and short, moderate winters. The normal length of the frost-free growing season is slightly longer than 7 months. The average annual temperature over the Yazoo Basin is about 65 degrees F. Average monthly temperatures at Greenwood range from about 44 in January to about 81 degrees F in July. The Yazoo Basin lies in a moderate to moderately heavy rainfall belt with an average annual rainfall of 52 inches. During the period 1900 to 1988 the annual rainfall at Greenwood has ranged from a minimum of 30.16 inches in 1965 to a maximum of 83.35 inches in 1973. The heaviest rainfall usually occurs during the months of December through May, with the least amount occurring from August through October. However, excessive rainfall producing locally intense runoff can occur at any time during the year.

Based on data collected for the 1993 Upper Yazoo Projects Reformulation Supplemental Environmental Impact Statement, land use along the Yazoo River has shifted from 100 percent BLH, cypress and water bodies to a landscape dominated by 75 percent agricultural activities.

5.1.4.b Hydrologic Setting

From its formation above Greenwood, the Yazoo River flows southward about 169 miles to discharge into the Mississippi River at Vicksburg. Major Yazoo River headwater tributaries include Pelucia Creek, Alligator-Catfish Bayou, Abiaca and Chicopa Creeks, Tchula Lake, and the Hillside Floodway, which carries flows from Fannegusha and Black Creeks. The Will M. Whittington Auxiliary Channel diverts a portion of the Yazoo River flow from near Silver City opposite the lower end of Tchula Lake. The diverted flow reenters the Yazoo River near the mouth of the Big Sunflower River. Principal tributaries include the Little Tallahatchie, Yocona, and Yalobusha Rivers in the hills and Cassidy Bayou, Coldwater River, Big Sunflower River and Steele Bayou in the delta.

The majority of the streamflow generated in the Yazoo Basin originates in the tributary basins in the hill portions of the headwater area. The sequence of flows discharged from some of these tributaries is affected by the operation of four reservoirs (Arkabutla, Enid, Grenada, and Sardis Lakes). The lakes control about 60 percent of the total drainage area of the Yazoo River at Greenwood; hence, daily flows from stations at or above Greenwood are greatly affected by short-term changes in lake release rates. However, the main stem channel capacity is not sufficient to contain runoff from the remaining 40 percent of the drainage area which is uncontrolled by the lakes. Recent major floods within the basin have been the result of this uncontrolled runoff exceeding the available channel capacity. Approximately 67 percent of the annual runoff occurs during the months of December through May.

Flooding in the Yazoo Headwater area usually occurs during the winter and spring months and may result from a single storm of a few days or from a series of storms extending over a period of several months. During the period for which streamflow records are available, major floods occurred during the years 1931-1932, 1932-1933, 1935, 1937, 1939, 1946, 1948, 1950, 1953, 1955, 1958, 1968, 1973, 1974, 1979, 1983, and 1991. Delineations of the April-May 1991 flood and March-April 1973 flood are shown on Plates 31 and 32. Rainfall data and available gage records prior to 1928 indicate that flooding occurred in 1911, 1912, 1913, 1917,

1920, 1921, 1922,1926, and 1927, with the 1927 flood being well-documented as one of the most devastating floods of history.

5.1.5 General Information for the White River Basin

5.1.5.a Existing Conditions

The White River Basin (WRB) comprises approximately 27,765 square miles, of which 10,622 square miles are in the southern part of Missouri and the remaining 17,143 square miles are in northern and eastern Arkansas. Interest in the WRB includes flood risk management, water supply, hydropower, navigation, ecosystem restoration and protection, and recreation (USACE 2001). The USACE Little Rock District manages 5 multi-purpose lakes in the WRB - Beaver, Table Rock, Bull Shoals, Norfork, and Greers Ferry. Clearwater Lake, also operated by the USACE, is a smaller lake used primarily for flood control. Flood control in the upper reach of the WRB is provided by these Corps lakes, which serve as flood control reservoirs, and in the lower reach by a 150 mile-long system of levees.

These lakes also provide recreation, hydropower and water supply for the area. The lakes provide a unique environment for enhancing fish and wildlife values in the basin. Much of the historical bottomland forest in the WRB was cleared and is being utilized for agricultural production. However, the lower end of the White River has one of the largest remaining tracts of seasonally flooded BLH left in the LMRAV. Groundwater in the Grand Prairie area of the basin meets the criteria for being designated a critical aquifer. Agriculture is a major user of the groundwater in the lower basin.

5.1.5.b Hydrologic Setting

Channel maintenance to improve navigation on the White River was authorized in 1892. This dredging occurs from RM 9.8 to RM 255, near Newport to provide maintenance of the navigation channel by clearing and snagging, dredging, and construction work. Maintenance dredging begins during July and generally ends in October of each year. Channel depth and width in the White River vary by river reach. The existing channel dimensions are 8 feet by 125 feet from mile 9.8 to 198 at 12 feet on the Clarendon gage, including a 5 foot minimum draft at low river stages; and 4.5 feet by 100 feet from mile 198 to 255 at 3.5 feet on the Newport gage.

5.1.6 General Information for the Atchafalaya River Basin

5.1.6.a Existing Conditions

The Atchafalaya River flows approximately 140 miles through southeast Louisiana from Simmesport to the Gulf of Mexico with an average headwater discharge of 218,400 cubic feet per second (cfs). The river, which is a combination of waters from both the Red and diverted Mississippi Rivers via the Old River Control Structure and hydroelectric plant, is the largest distributary of the Mississippi River. The Atchafalaya Basin floodway is, on average, 15 miles wide and is designed to allow floodwaters to pass safely pass floodwaters to the Gulf of Mexico at the rate of 1.5 million cfs. The USACE Atchafalaya Basin Floodway project has two mutually

supporting goals: to preserve the habitat of nation's largest and oldest river-basin swamp and to ensure that the Lower Atchafalaya Basin can pass 1.5 million cubic feet per second of floodwater as required by the MR&T Project.

The Atchafalaya River is the primary source of water to one of the largest wetland complexes in the world. The Atchafalaya River Basin, bounded on the east and west by artificial levees that were constructed in the 1930's as a direct result of the flood of 1927, is extremely rich in biodiversity and highly productive from a biological standpoint. There are primarily three eco-regions in the Atchafalaya Basin: the northern part, which is comprised of BLH; the middle, which is comprised of cypress-willow-tupelo swamps; and, the lower, which is comprised of freshwater and brackish marshes. The most ecologically important parts of the Atchafalaya Basin are 885,000 acres of forested wetlands and 517,000 acres of marshland that combine to make this the largest river swamp in North America.

The climate of the Atchafalaya River Basin area is humid subtropical. Warm, moist southeasterly winds from the Gulf of Mexico prevail throughout most of the year, with occasional cool, dry fronts dominated by northeast high pressure systems. Average annual temperature in the area is 68 ^{o}F, with monthly temperatures varying from 82 ^{o}F in July to 53 ^{o}F in January. Average annual precipitation is 57.0 inches, varying from a monthly average of 8.3 inches in July, to an average of 3.4 inches in October. Summer tropical storms are common, and hurricanes occur more infrequently.

5.1.6.b Hydrologic Setting

In the early 1500s, the Mississippi River captured the lower Red River and established the Atchafalaya River as a distributary. Until the 1950s the Mississippi River was diverting an increasing amount of its discharge into the Atchafalaya, an indication that the Mississippi was about to shift course. In the 1960s the Old River Control Structure was completed to prevent the Atchafalaya from capturing, or taking over, the Mississippi. By Congressional mandate, 30% of the flow of the Mississippi River and Red River are combined at the Old River Control Structure to form the Atchafalaya River. As highlighted in the Mississippi Rivers and Tributaries Project, the Atchafalaya Basin Floodway is designed to pass one half of the Mississippi River project flood (1.5 million cfs) to the Gulf of Mexico. Today the Atchafalaya River is the main distributary of the Mississippi.

Discharge into the Atchafalaya River is on average 218,400 cfs and has been measured at the Simmesport, Louisiana gaging station since 1963. The Basin's natural hydrology has been altered by flood protection works including navigation features, dredging operations, protection levees, and borrow-pits. The East and West Atchafalaya River Protection Levees, combined with channel closures, confine Atchafalaya River flows to the main river channel during low stage, and reduce the extent of backwater habitat previously available during the low-water season. The resulting impediments to water circulation during low river stages have reduced water quality in various areas within the Basin. Access and pipeline canals for oil and gas production have further disrupted historical interior water circulation patterns and north-to-south flow through the interior swamps.

5.1.7 General Information on the Arkansas Post Canal

5.1.7.a Existing Conditions

The Arkansas Post Canal is part of the McClellan-Kerr Arkansas River Navigation System (MKARNS). This system begins on the Arkansas River at the Port of Catoosa near Tulsa, Oklahoma and extends downstream to its confluence with the Mississippi River in southeastern Arkansas. It also includes 11 reservoirs in Oklahoma that influence river flow within the MKARNS. The MKARNS is approximately 445 miles in length and consists of a series of 18 locks and dams.

A series of navigation pools connected by locks enable vessels to overcome a 420-foot difference in elevation from the Mississippi River to the head of navigation at Catoosa, Oklahoma. The navigation system was designed for ease of navigation by multi-barge tows, with ample channel and lock dimensions and bridge clearances. Maintenance dredging provides a 9-foot deep channel is open year round. The locks and dams are operated 24 hours a day by the USACE and the U.S. Coast Guard maintains channel markers and other commercial navigation aids.

Currently, the Corps is authorized to maintain the MKARNS at a 9-foot channel depth. Due to ongoing maintenance dredging of the existing navigation channel and natural stream scour, approximately 80-90% of the system is already at least 12 feet deep. Reaches less than 12-feet in depth are scattered along the length of the MKARNS (USACE 2005).

5.1.7.b Hydrologic Setting

The Mississippi River dominates the hydrology of the area, with lesser influences exerted by the Arkansas and White Rivers. These rivers frequently have out of bank flows during the year. In Arkansas, available groundwater along the MKARNS comes largely from the alluvial aquifers of the Arkansas and Mississippi Rivers. These high-yielding aquifers consist of sand, gravel, silt and clay. Highest water storage is found in the Mississippi River Alluvial Plain physiographic region from Little Rock to the confluence of the MKARNS with the Mississippi River.

Current MKARNS channel widths are 300 feet on the White River Entrance Channel, Arkansas Post Canal, and Lake Langhofer; 250 feet on the Arkansas River; 150 feet on the Verdigris River; and 225 feet on San Bois Creek. For most of the MKARNS, channel width is sufficient to allow tows to pass each other at any location, but passing on the Verdigris River is restricted to wider locations.

5.1.8 General Information for the Deltaic Plain

5.1.8.a Existing Conditions

The Louisiana coastal plain remains the largest expanse of coastal wetlands in the contiguous United States. The Louisiana coast comprises more than 40% of America's coastal wetlands. These coastal wetlands are built by the Mississippi River.

The Louisiana Coastal Plain consists of a complex of habitat types, including natural levees, lakes, swamps, marshes, and bayous formed from sediments of abandoned Mississippi River deltas. Throughout the coastal plain, natural hydrology has been altered by canals,

pipelines, hydrocarbon removal, roads, railroads, navigation channels, levees, and marsh management structures. The entire area is subsiding, which results in a large-scale land loss. The loss rate equals nearly 11 square miles per year.

Commercial, industrial, residential and agricultural assets characterize the developed areas. The area of wetland and agricultural lands with numerous communities are generally located adjacent to major highways and adjacent to the bayous and rivers. Before construction of the Mississippi River levees, the area was subjected to periodic flooding from the Mississippi River. The area is subject to rainfall, tidal, tropical storm events, and hurricane related winds and flooding, resulting in damages to structures, agricultural, and the local environment.

Long term study of the coastal plain system has generated consensus among scientific and engineering communities. Studies have identified problems in the area including loss of wildlife and aquatic habitat modification, loss of water quality needed to sustain a variety of terrestrial and aquatic systems, introduction of toxic substances into waterways, stressed cypress-tupelo swamps caused by impounded water regimes, and disrupted hydrology.

5.1.8.b Climate

The climate along the Louisiana coast is subtropical, with long, hot summers and brief, mild winters. Winds during the summer are generally from the south, bringing warm, moist air from the Gulf of Mexico, which can produce periods of intense rainfall associated with thunderstorms. In the winter months the area experiences alternating cold and warm air as continental fronts pass through from the northwest. Annual precipitation averages 25 to 55 inches and temperature averages 68 to 70 degrees Fahrenheit. The growing season lasts 280 to 320 days.

5.1.8.c Geomorphology

The predominate landform in the Louisiana Coastal Plain is a flat, weakly dissected alluvial plain formed by deposition of continental sediments onto submerged, shallow continental shelf, which was later exposed by sea level subsidence. Along the coast, fluvial deposition and shore zone processes are active in developing and maintaining swamps and mud flats. Local relief ranges from 0 to 50 ft. All soils of this area are poorly drained and subject to flooding and high water tables. These soils have thermic temperature regime and an aquic moisture regime.

5.1.8.d Hydrologic Setting

Louisiana's coastal wetlands were built up by Mississippi River floodwaters that deposited enormous volumes of sediment and nutrients onto the continental shelf at its mouth. These sediments were eroded from the lands of the vast Mississippi River basin in the interior of North America. For the last several thousand years, the dominance of the deltaic processes resulted in a net increase of more than 4 million acres of coastal wetlands. In addition, these deltaic processes created an extensive skeleton of higher natural levee ridges along the past and present Mississippi River channels, distributaries, and bayous in the deltaic plain and created the beach ridges of the chenier deltaic plain. The landscape that these processes produced gave rise to one of the most productive ecosystems on earth. Only the most intensively managed agricultural systems that are artificially subsidized by large inputs of energy and fertilizer could

possibly rival the ability of these estuarine wetlands to convert sunlight and carbon dioxide into biomass (USACE 2008).

5.1.9 Current Management of the Lower Mississippi River

5.1.9.a The Mississippi River Commission

By the mid-to-late nineteenth century, the need for navigation improvements and flood risk management on the Mississippi River was obvious. Following several decades of constitutional squabbles, engineering disputes, and regional bickering dating back to the early 1800s, Congress recognized the need to harmonize river improvements on the Mississippi River through a central organization. On June 28, 1879, the federal legislature established the MRC as an executive body reporting to the Secretary of War.

The originating legislation granted the MRC extensive jurisdiction on the Mississippi River from its headwaters at Lake Itasca, Minnesota, to the Head of Passes at the Gulf of Mexico. The act also empowered the MRC to make surveys and investigations necessary to prepare plans to improve the river channel, protect its banks, improve navigation, prevent destructive floods, and promote commerce. The legally mandated membership of the MRC consists of three officers from the USACE, one member from the U.S. Coast and Geodetic Survey (now the National Oceanic and Atmospheric Administration), and three civilians—all of which must be nominated by the President of the United States and confirmed by the Senate.

The act creating the MRC also authorized the Secretary of War to detail officers, men, vessels, and instruments from both the USACE and the Coast and Geodetic Survey to the MRC to enable the Commission to carry out its mission. The first meeting of the MRC was held in Washington, D.C., on August 19, 1879, and its headquarters were established in St. Louis, Missouri. Three years later, the MRC divided the lower Mississippi into four districts for administrative purposes: the First MRC District at Cairo, Illinois, the Second MRC District at Memphis, Tennessee, the Third MRC District at Vicksburg, Mississippi, and the Fourth MRC District in New Orleans, Louisiana. Officers from the USACE were detailed as District Engineers in charge of the MRC district offices under the direction of the Commission. The Commission added the MRC Dredging District in 1898 to administer its growing fleet of dredges, followed by the Northern MRC District in 1918 to oversee levee work from Cairo, Illinois to Rock Island, Illinois, which was initiated by the 1916 Rivers and Harbors Act.

The establishment of the MRC in 1879 represented the next logical step in the process of improving the Mississippi River, and the next five decades marked an era of experimentation. In 1880 the MRC, relying heavily on input from local partners, developed a general plan of improvement based on contracting the low-water channel with permeable dikes and protecting the riverbanks from erosion with various forms of revetment. During the course of implementing this plan, the MRC learned many valuable lessons that advanced the evolution of river regulation and engineering. At the same time, however, lingering fiscal and legal issues retarded that maturation process. The 1886 Rivers and Harbors Act, for example, forced the MRC to abandon revetment as a bank stabilization method at a point when technical advancements were finally providing effective bank protection.

The first federal flood control act, passed in 1917, facilitated the final implementation of a “levees-only” program. Ten years later, the Mississippi River flood of 1927 forced a wholesale reappraisal of the federal government's levee policy and galvanized legislative, engineering, and popular support for a comprehensive river improvement plan by large Congressional appropriations. The support for this plan was manifested through the Flood Control Act of 1928.

Today the MRC oversees the implementation of the comprehensive MR&T project under the supervision of the Chief of Engineers. The MR&T project is unarguably the most successful civil works project ever initiated by Congress. From 1928 through 2004, the nation contributed nearly $12 billion toward the MR&T project and received an estimated $425.5 billion return on that investment, including savings on transportation costs and flood damages.

Despite its changing mission over the years, the MRC is still comprised of its original framework of Army engineers, National Oceanic and Atmospheric Administration representatives, and civilian members prescribed by the organization’s founding act of 1879. The general duties of the MRC include the recommendation of policy and work programs, the study of and reporting upon the necessity for modifications or additions to the flood control and navigation project, recommendation upon any matters authorized by law, inspection trips, and holding public hearings. The work of the MRC is directed by its president and carried out by the St. Paul, Rock Island, St. Louis, Memphis, Vicksburg, and New Orleans USACE Districts, the latter five of which absorbed the former MRC districts in 1928.

Current activities of the MRC are performed in three broad categories: general investigations to determine needed improvements, construction of new facilities, and maintenance and operation of existing systems. Included in its responsibilities are the mainstem Mississippi River from Cairo to Head of Passes, and the basins of the St. Francis, Tensas, Yazoo, Atchafalaya, Lower Red, Lower Arkansas, Lower White, a portion of the Ouachita-Black River system, and west Tennessee rivers. Authorizations for the projects have been established by various Congresses upon the recommendations of the MRC and the Chief of Engineers as changes to the basic policies of the Flood Control Act of 1928. Current and ongoing activities of the MRC and the MR&T Project are reviewed every year as part of the Report of the Secretary of the Army on Civil Works Activities to Congress (USACE 2007).

5.1.9.b Navigation on the LMR

Without question the Nation's principal river, the Mississippi, is the main stem of a network of inland navigable waterways which form a system of about 12,350 miles in length, not including the connecting Gulf Intracoastal Waterway (of around 1,300 miles) and its connecting inland and Gulf Coast streams. The Mississippi River plays a central role not only in the U.S. ecosystem but also as a commercial shipping hub. The five ports on the lower Mississippi combine to form the nation's largest port complex, in terms of tonnage. The largest of the five, the Port of South Louisiana, ranked first in the nation (with 225 million short tons) in total (domestic and foreign) trade in 2006. Its companion ports also ranked high: The Port of New Orleans was eighth (77 million short tons), the Port of Baton Rouge 12th (56.3 million short

tons), and the Port of Plaquemines 13th (55.9 million short tons). The St. Bernard Port handled nearly four million short tons in 2006.

The LMR is the most heavily traveled component of the Mississippi River system. More than 450 million tons of goods (peak) travel the Mississippi River each year (USACE 2007). Waterborne commerce on the Mississippi River increased from 30 million tons in 1940 to nearly 500 million tons today. More than 50% of America's grain exports move down the Mississippi River system (Texas Transportation Institute). The port of New Orleans is the number one grain port in the world and the number one port in the United States. This heavy commercial traffic includes grains, coal and coke, petroleum products, sand and gravel, salt, sulphur and chemicals, and building materials among others. It also serves as the nation's primary transportation channel for fertilizer, industrial chemicals, lumber, pulp and paper, sand and gravel, steel and coal (English 2008).

Statistics from the U.S. Maritime Administration (MARAD) highlight the advantages of shipping on inland waterways. According to MARAD, domestic waterborne shipping for all waterways in the United States moves 14 percent of the national cargo tonnage for less than 2 percent of the freight bill. It also provides an estimated 124,000 direct jobs, generates $10 billion in annual freight revenue, and provides $300 million and $55 million in federal and state tax revenue, respectively.

5.1.9.c Flood Risk Management of the LMR

The MR&T project provides protection to the 36,000 square-mile LMRAV and is the largest flood risk management project in the world. The project features are designed to control a project flood condition, which is the largest reasonable flood that is expected to occur. It is a flood larger than the record flood of 1927. At Cairo, the project flood is estimated at 2,360,000 cubic feet per second (cfs). The project flood is 11 percent greater than the flood of 1927 at the mouth of the Arkansas River and 29 percent greater at the latitude of Red River Landing, amounting to 3,030,000 cfs at that location, about 60 miles below Natchez.

Approximately $345.9 billion in flood damages prevented since 1928. Approximately 4 million people are protected by the MR&T levee system (USACE 2009). The levees are constructed by the federal government and are maintained by local interests, except for government assistance as necessary during major floods. Periodic inspections of maintenance are made by personnel from the USACE and from local levee and drainage districts as it is essential that the levees be maintained in good condition for their proper functioning in the flood control plan.

5.1.10 Expected Future Conditions

The Mississippi River is a dynamic force that requires constant vigilance. Since its inception, the MRC has initiated tremendous advances in hydraulic engineering and in the design and construction of regulating works, levees, and bank revetment; but the commission's work is far from over. In conjunction with the USACE, the MRC continues to gather and create new information to shape policy that affects the Mississippi watershed. The MR&T Project was

authorized by the 1928 FCA. In the wake of the devastating 1927 flood, it was deemed necessary to put into place a comprehensive, unified system of public works within the lower Mississippi Valley that would provide protection from floods and an efficient navigation channel.

The ongoing need to study the relationship between human activity and the river represents an enduring and evolving challenge for the MRC. The Commission's vision for the future includes multiple basin water resource engineering that is comprehensive and developed with broad based, regularly scheduled interest and stakeholder participation.

The MRC, through the continuation of its tested and proven process of listening, inspecting, and partnering, will lead the Nation's engineering solutions for river transportation infrastructure, flood risk management, and environmental management. Any potential projects identified in the LMRRA study will not adversely impact navigation or flood risk management goals of the MR&T project.

5.2 NATURAL RESOURCE/HABITAT NEEDS

5.2.1 Existing Conditions for the Lower Mississippi River

5.2.1.a Water Quality

There is a widespread, but unfounded, perception among the general public that the Mississippi River is contaminated by a wide variety of toxic compounds. As the river flows southward from its headwaters in Minnesota, its discharge is doubled by the Illinois and Missouri Rivers; its discharge is more than doubled again by the Ohio River. Historically, water pollution control efforts often depended on the river's ability to dilute contaminants rather than controlling their discharge. The river carries dissolved contaminants and bacteria that originate from a variety of municipal, agricultural, and industrial sources which can be assigned to two classes - point and nonpoint sources. Water quality problems occur throughout the length of the Mississippi River but their type and seriousness vary greatly.

Although about 2 percent of the Mississippi River's average discharge comes from municipal and industrial point sources, the more severe water quality problems tend to occur in the immediate vicinity of and downstream from major metropolitan areas. This is the result of point source pollution from industry, power plants and wastewater treatment plants, as well as polluted runoff from city streets, parking lots, and construction sites. The major statutory influence on point source water quality in the Mississippi River has been the Clean Water Act (CWA), 33 U.S.C. 1251, which set far-reaching federal goals for cleaning up the Nation's waters. The CWA established three primary principles: 1. restoring and maintaining the chemical, physical, and biological integrity of the Nation's waters, 2. establishing a national goal that the discharge of pollutants into navigable waters be eliminated by 1985, and 3. making all waters swimmable and fishable. Significant progress has been made in controlling water pollution since the early 1970s because the private and public sectors have spent more than $500 billion on remedial measures, much of which was directed toward municipal and industrial point sources.

Although some violations still occur, the CWA legislation has had a significant positive effect on limiting point source contaminants entering streams.

Nonpoint polluted runoff impairs more water bodies, surface and ground, urban and rural, than any other pollution source in the Nation. Progress in controlling point source pollution has not yet been matched by control of contaminated runoff from nonpoint sources, including fertilizers and pesticides applied in agricultural and urban areas, and nutrients from human and animal wastes. Addressing nonpoint source pollution is one of the greatest challenges because the CWA does not provide for its direct regulation, in contrast to point source pollution, which is regulated under the act (National Research Council 2008). The CWA has been amended extensively since its passage, most notably in 1977 and 1987 when Congress adopted new programs to address polluted runoff from farms, factories, and city streets.

When considered at the scale of the entire Mississippi River, nutrients (primarily nitrogen and phosphorus from fertilizers) and sediment are the two primary nonpoint source contaminants impacting water quality system wide. The majority of all pesticides and fertilizers used in the United States are applied to several million acres of cropland in the Mississippi River Basin. Much of the dissolved and suspended material carried by streams in this region eventually flows into the Mississippi River and is ultimately discharged into the Gulf of Mexico. Excessive nutrient concentrations have been linked to hypoxic conditions (dissolved oxygen $\leq$2 ppm) (The McKnight Foundation Environment Program 2008), such as those found in the Gulf of Mexico, which can harm fish and shellfish that are economically and ecologically important to the Nation. About 90 percent of the nitrate load to the Gulf of Mexico comes from nonpoint sources - 56 percent enters the Upper Mississippi River Basin and an additional 34 percent enters from the Ohio River Basin (Mississippi River/Gulf of Mexico Watershed Nutrient Task Force 2001).

A major study of contaminants in the Mississippi River and its major tributaries, the Illinois, Missouri, and Ohio Rivers, was conducted by the USGS from 1987 - 1992. Sampling and analytical efforts were focused on the presence and concentrations of contaminants (dissolved solids, metals, nitrates, herbicides, pesticides, polychlorinated biphenyls [PCBs], wastewater treatment plant effluent, etc.) in three contaminant phases - dissolved, adsorbed (associated with suspended silts and colloids), and stored in bottom sediments (Upper Mississippi River navigation pools). Although fecal coliform bacteria survive only briefly in river water, their average concentrations exceed the USEPA maximum contaminant level for recreational use (2,000 colonies/liter) in much of the Mississippi River because of incomplete wastewater treatment. Because it is consumed only by humans, caffeine is an indicator of domestic sewage and illustrates the extent to which sewage is diluted by the river. Although caffeine concentrations in municipal wastewater discharges usually range between 20 and 300 micrograms/liter, much lower concentrations of 0.02-0.04 micrograms/liter in the Mississippi River indicate that these discharges may be diluted as much as a thousand fold after they are well mixed. Nitrate concentrations in the river come primarily from fertilizers and their concentrations fluctuate seasonally. Atrazine, a pre-emergent herbicide used mainly on cornfields, is nearly ubiquitous in the Mississippi River. Concentrations vary seasonally and occasionally exceed the USEPA maximum contaminant level for treated drinking water of 3 micrograms/liter during the spring runoff. Ethylenediamintetraacetic acid (EDTA) is the dissolved organic chemical contaminant present at the greatest concentration in the Mississippi

River. Commonly considered nontoxic, it is a general indicator of industrial contamination and is found in the Mississippi River at about one-fourth of the concentration in some European rivers (Meade 1995).

In 1973, the USGS initiated its National Stream Quality Accounting Network (NASQAN) Program, which applied a basin wide perspective in order to better understand water quality on a regional scale. Although NASQAN measures a broad range of chemical constituents for which well-established collection and analytical protocols exist, it was unable to explain the reasons for the presence or absence of trends in water quality data. This led Congress to appropriate funds in 1991 for the USGS to initiate the National Water-Quality Assessment Program (NAWQA), a more comprehensive program than NASQAN. NAWQA focused on water quality objectives identified in NASQAN in more than 50 small to medium river basins and aquifers in the United States but it did not include the Nation's largest rivers. NASQAN was subsequently redesigned and implemented in 1996 to address five major regional issues: 1. describing and comparing yields of nonpoint-source contaminants among large regional basins 2. describing long-term trends in the mass flux and concentration of constituents at key locations 3. calculating loads to receiving waters 4. providing a framework for more detailed assessments, and 5. testing regional models that concern the influence of land use on water quality. Significant research conducted under these programs included a major study of contaminants in the Mississippi River and its major tributaries: the Illinois, Missouri, and Ohio Rivers from 1987 - 1992 (Meade 1995); the status of water quality in the Mississippi Embayment Study Unit, that part of the Mississippi River alluvial plain in Arkansas, Kentucky, Louisiana, Mississippi, Missouri, and Tennessee (Kleiss et al. 2000); and, the Mississippi River Basin NASQAN Program (Hooper et al. 1997).

A study of water quality in the Mississippi Embayment Study Unit (MISE) reported a variety of contaminants in streams draining predominantly agricultural or mixed-use basins. Herbicides were frequently detected and pesticides were detected less often, but they exceeded aquatic life guidelines in more than 60 percent of the samples collected in the MISE. Nitrate concentrations generally were in the middle range of the national data; total phosphorus concentrations were in the 67th to 93rd percentile. However, no samples exceeded the guidelines and standards for nitrate or ammonia. Although the sale of DDT, an organochlorine insecticide, was halted in 1972, DDT or one of its metabolites was detected in every fish tissue sample collected in 67 percent of streambed-sediment samples and in 14 percent of surface-water samples (Kleiss et al. 2000).

In 2008, the USEPA initiated a National Rivers and Streams Assessment (NRSA) Program on the LMR. This survey combined a first-ever assessment of the Nation's rivers with the second National Wadeable Streams Assessment to provide statistically valid estimates of river and stream conditions on a regional and national basis. Parameters such as water chemistry, nutrients, chlorophyll-a, sediment enzymes, enterococci, fish tissue, physical habitat characteristics, and biological assessments including sampling of phytoplankton, periphyton, benthic macroinvertebrates, and fish communities were sampled to characterize the condition of the Nation’s flowing waters. Analysis of aquatic sampling data collected in 2008 is scheduled for completion in 2011.

Water quality in the LMR remains a concern. Of the six LMRAV states, Louisiana conducts the most extensive water quality monitoring program on the LMR. The Louisiana reach of the LMR is 504 river miles long and forms the eastern boundary of 17 Louisiana parishes from Arkansas to the Gulf of Mexico. Within that reach, Louisiana also shares a 202 river-mile border with Mississippi. Presently the Mississippi River in Louisiana receives discharges from approximately 300 permitted industrial and municipal point sources. The river also supplies feedstock for several drinking water treatment plants that serve approximately 1.5 million Louisiana consumers. The LDEQ has monitored water quality of the Mississippi and Atchafalaya Rivers for more than 40 years. Seven water quality monitoring stations are operated on the Mississippi River, located from Lake Providence (near LA -AR border [river mile 484]) to Pointe a La Hache (south of New Orleans [river mile 49]). Presently active stations are located at St. Francisville (42 years), Plaquemine (42 years) and Belle Chasse (42 years). Two monitoring stations are operated on the Atchafalaya River at Krotz Springs and Morgan City. Samples are collected monthly and transported to the LDEQ Laboratory for analysis; bacteria samples are analyzed by Louisiana Department of Health and Hospitals laboratories. Twenty-five conventional water quality parameters are monitored monthly at each active station and historical records are available for the same parameters at discontinued stations. In addition, over 50 volatile and semi-volatile organic compounds, pesticides, and PCBs are monitored quarterly at two stations and historical monthly data is available for some stations. The monitoring program provides data for Clean Water Act river water quality assessments.

5.2.1.b Environmental Resources

The LMR leveed floodplain (batture lands and backwater areas) is a dynamic freshwater ecosystem, often changing markedly in response to the river's annual hydrologic regime. The 2.8 million-acre leveed floodplain is interspersed with abandoned channels, meander scars, and large expanses of forested wetlands that provide a diverse array of aquatic habitat types frequently reconnected to the river by flooding. The batture encompasses approximately 2,113,074 acres, which consists of 981,887 acres of BLH, 478,345 acres of agricultural lands, 515,656 acres of water, and 137,186 acres of lands classified as other (LMRCC 2000). This area does not include 680,800 acres in four major Lower Mississippi River backwater areas - Bird's Point-New Madrid Floodway, Missouri (~132,605 acres), Arkansas-White Rivers Backwater, Arkansas (~217,886 acres) (J. Krystofik USFWS, personal communication), Yazoo Backwater Area, Mississippi (~125,000 acres [5-year floodplain]), and Red River Backwater, Louisiana, (~205,000) (LMRCC 2000). The abundant wildlife and fisheries resources in the batture and backwater areas of the LMR are widely recognized as making significant contributions to the economies of the six LMRAV states (IEC 2004; USDI and USDC 2006).

The LMR, its tributaries, the adjoining floodplain, borrow pits, and oxbow lakes are important fishery habitat. The BLH in the batture are important habitat for fish during flood periods. Spring flooding allows fish such as gars, buffalo, largemouth bass, white crappie, bluegill and other sunfish to spawn in the forested wetlands. Borrow pits and lake areas in the project area also support a total of over 80 species of fish. Riverside borrow areas and lakes support several uncommon and imperiled wetland species (e.g. pugnose minnow, taillight shiner, paddlefish and alligator gar. The total standing stock of fish in the LMR averages approximately 600 pounds per acre in borrow areas. This value is comparable to or exceeds standing crop

estimates of fishes in productive southeast reservoirs, indicating high fishery production (USFWS PAL 1998).

The main and side channels of the Mississippi River can comprise over half of the total aquatic area during low to moderate stages. Virtually all fishes in the basin use the main channel as either permanent or transitional habitat for spawning, rearing, feeding, or dispersal. The endangered pallid sturgeon lives in the main channel, but also found are a variety of minnows, darters, suckers, and catfishes. Dike pools are particularly productive habitats, with standing stock estimates that can exceed 1,000 pounds/acre (Baker et al. 1991). White and striped bass are often found along dikes feeding on shad transported from the pools. Gravel bars are widespread in the main channel and are important spawning habitats for sturgeon, paddlefish, and other species of special concern.

BLH are one of the most productive habitats in the United States and provide important habitat for wildlife in the project area. Historically, the LMR contained 24 million acres of BLH forested wetlands; however, only five million acres remain to date (USFWS PAL 1998). Heitmeyer et al. (2005) described avian and mammalian communities commonly occurring in BLH in the southeastern U.S. (Appendix E).

The LMR ecosystem may support as many as 91 species of freshwater fishes and 30 or more species may be present sporadically (Baker et al. 1991). Schramm (2004) reported 109 species of fish in the open portion of the Mississippi River, that section below Lock & Dam 27 at Granite City, IL and noted that 24 were considered rare. Fish diversity increases going downstream in the Mississippi River, with as many as 150 taxa occurring in the Lower Mississippi and Atchafalaya Rivers including estuarine species (Fremling et al. 1989).

Thirteen primary aquatic habitat types occur in the LMR - six in the mainstem of the river and seven on the floodplain. Mainstem aquatic habitats include: 1. the channel (main channel and secondary channel) 2. natural steep bank (concave [cut bank] sides of river bends, in secondary channels, and some straight channels) 3. revetted bank (protective materials placed over river banks to prevent erosion) 4-5. lotic and lentic sandbars (gently sloping habitats that occur along point bars, along the borders of islands and middle bars, and in association with dike systems), and 6. pools (relatively deep, slack- or slow-water areas within main river banks often associated with dike fields). Floodplain aquatic habitats include: 1-2. contiguous and isolated sloughs (moderate-sized, slackwater floodplain habitats that are usually narrower and shallower remnants of abandoned river channels) 3. oxbow lakes (former river channels isolated by the cutoff of large meander loops) 4. borrow pits (formed by the excavation of fill material during levee construction) 5. seasonally inundated floodplain (formed when high river stages inundate nearby low-lying lands) 6. floodplain ponds (permanent but relatively small, shallow, isolated bodies of water located in alluvial river swamps), and 7. tributaries (downstream-most portions of tributary streams) (Baker et al. 1991).

Biological dynamics in the LMR are heavily dependent on organic materials of terrestrial origin. Although input of these organic materials from riparian zones occurs to some extent throughout the year, pulses, such as seasonal inundation and autumn leaf fall, typically dominate ecosystem processes. Fish populations in floodplain river ecosystems exhibit strong

relationships to flow regimes because they utilize the inundated floodplain for spawning and nursery habitat, and for refuge and feeding. Larval fish densities in the LMR are highest in backwaters, which are important nurseries for fishes and which contain a larval fish assemblage differing from that of the mainstem river (Beckett and Pennington 1986). Many fishes, including gars, bowfin, common carp, buffalos, river carpsucker, channel catfish, blue catfish, white bass, crappie, and freshwater drum, move laterally onto the LMR floodplain to forage when it is inundated by high water levels (Baker et al. 1991) . Numerous artificial floodplain ponds (primarily borrow pits excavated during levee construction) also serve as important nursery areas for fishes in the LMR floodplain (Sabo and Kelso 1991; Sabo et al. 1991).

The following mussel species have been reported in the LMR: three-ridge mussel (*Amblema plicata*), flat floater (*Anodonta suborbiculata*), rock-pocketbook (*Arcidens confragosus*), ebonyshell (*Fusconaia ebena*), yellow sandshell (*Lampsilis teres*), fragile papershell (*Leptodea fragilis*), threehorn wartyback (*Obliquaria reflexa*), hickorynut (*Obovaria olivaria*), fat pocketbook (*Potamilus capax*), bleufer (*P. purpuratus*), pink papershell (*P. ohiensis*), giant floater (*Pyganodon grandis*), mapleleaf (*Quadrula quadrula*), creeper (*Strophitus undulatus*), lilliput (*Toxolasma parvus*), Texas lilliput (*T. texasiensis*), and the non-native Asian clam (*Corbicula fluminea*) and zebra mussel (*Dreissena polymorpha*) (Hartfield personal communication). Mussels are natural filters, feeding on algae, plankton, and silts, which help purify the aquatic system. The presence of diverse, reproducing populations of mussels is usually indicative of a healthy aquatic system and relatively good water quality.

Aquatic organisms in some LMR tributaries are typical of those found in impacted or degraded streams. A combination of natural and anthropogenic factors results in tributary stream conditions in the alluvial valley that stress or adversely affect aquatic communities. Agriculture is intensive and widespread, channels have been modified for flood damage reduction, and aquifer depletion is impacting low flows in Delta streams. These streams have low gradients that result in sluggish flows, slow rates of reaeration, an abundance of decaying organic material, and seasonally high water temperatures that contribute to low dissolved oxygen concentrations. Fish communities are frequently dominated by fish tolerant of poor water quality conditions; aquatic insects and algal communities generally were tolerant of turbid, silty conditions (Kleiss et al. 2000).

5.2.1.c Species of Special Concern Within the LMRAV

5.2.1.c.1 Federally Threatened and Endangered Species:

Four threatened and endangered species occur in or near the Mississippi River: pallid sturgeon (*Scaphirhynchus albus*), fat pocketbook pearly mussel (*Potamilus capax*), interior least tern (*Sterna antillarum*), and the Louisiana black bear (*Ursus americanus luteolus*). During FY 2008, the Southeast Region USFWS Fisheries Program expended $1,531,645 on 29 aquatic-dependent species that were listed as either endangered, threatened, and candidates for listing. Two of these, the pallid sturgeon and fat pocketbook pearly mussel, occur widely within the LMRAV. The bald eagle (*Haliaeetus leucocephalus*), which is protected under the Bald Eagle Protection Act of 1940, also occurs in the LMRAV. The Indiana bat (*Myotis sodalis*), may also occur in BLH in the batture of the LMRAV, if conditions are appropriate.

5.2.1.c.1.a Pallid Sturgeon

The pallid sturgeon (*Scaphiryhnchus albus*) was federally listed as an endangered species in 1990 (Federal Register 1990), and a recovery plan was approved in 1993 (Dryer and Sandvol 1993). Presently, pallid sturgeon occur throughout the Missouri River, the un-impounded middle Mississippi River between the mouths of the Missouri and Ohio rivers (MMR), and the lower Mississippi River (LMR) below the mouth of the Ohio River (Bailey and Cross 1954; Carlander 1969; Constant et al. 1997; Dryer and Sandvol 1993; Etnier and Starnes 1993; Kallemeyn 1983; Tranah et al. 2001). The southernmost distribution of pallid sturgeon is at New Orleans (RM 100) (Bailey and Cross 1954). Although sampling by the Engineer Research and Development Center (ERDC) has occurred between New Orleans and Head-of-Passes (LMR), pallid sturgeon have not been documented in this reach. The pallid sturgeon occurs sympatrically with the shovelnose sturgeon (*S. platorynchus*) in parts of the Mississippi-Missouri River Basin. The shovelnose sturgeon, however, occurs over a wider geographic range than the pallid sturgeon, inhabiting the impounded upper Mississippi River, Ohio River and tributaries, and formerly inhabiting the Rio Grande Basin in which the pallid sturgeon has not occurred (Lee 1980a and b; Everett et al. 2003).

Juvenile and adult pallid sturgeon inhabit the channel and channel border of the LMR. They are occasionally found in secondary channels or near the shoreline, but for the most part, they are a main channel species (Hurley et al. 2004). Habitat preferences have been difficult to determine because they constantly move along the bottom exploiting boundary layers where water velocity is reduced. Extensive sampling over a seven year period has confirmed that pallid sturgeon are often found associated with steep-sloping banks or near the thalweg, but other habitats are also utilized (Killgore et al. 2007a). Pallid sturgeon are large, long-lived, and slow-to-mature. In the LMR, they can attain sizes of over 100 cm TL and 5 kg (Killgore et al. 2007b). However, latitudinal differences in body morphology and size occur; smaller adults are found in the lowermost reach of the LMR below Baton Rogue and average body size gradually increases in an upstream direction (Killgore et al. 2007b; Murphy et al. 2007). The oldest pallid sturgeon documented in the LMR has been 23 years, although this species is known to live over 40 years in the upper Missouri River (Killgore et al. 2007b; Bailey and Cross 1954). Males mature faster than females; some reports suggest that females may not reach sexual maturity until age nine or greater (Keenlyne et al. 1992; Keenlyne and Jenkins 1993). Spawning occurs in the spring when fertilized eggs are deposited over gravel or other hard-packed substrates in flowing water. Larvae initially drift, but once the yolk-sac is absorbed, they may settle out in various habitats (Kynard et al. 2007). Recent sampling by ERDC in the LMR has found larval sturgeon associated with steep-sloping banks or in large eddies associated with dike fields. Pallid sturgeon feed on aquatic insects, but as adults, also consume fish (Hoover et al. 2007).

5.2.1.c.1.b Louisiana Black Bear

The Louisiana black bear (*Ursus americanus luteolus*) is one of 16 subspecies of the American black bear. These bears originally inhabited forests of Louisiana, southern Mississippi and eastern Texas, but land clearing primarily for agriculture has reduced their habitat by more than 80 percent. The remaining core populations exist in the Tensas River basin, the upper Atchafalaya River Basin, and coastal St. Mary and Iberia parishes in Louisiana.

The Louisiana black bear was listed as threatened in the Federal Register on January 7, 1992 (50 CFR Part 17). Specific language affording protection to den trees (Cypress/Tupelo > 36 in. dbh) was also included in the listing. Critical habitat for the Louisiana black bear was recently designated in the Federal Register on March 10, 2009 (50 CFR Part 17). Critical habitat is defined in Section 3 of the Endangered Species Act in part as the specific areas within the geographical area occupied by a species at the time it is listed, on which are found those physical or biological features: (I) Essential to the conservation of the species and (II) which may require special management considerations or protection. In addition to food, water and cover, the key habitat requirements of the bear also include denning sites which are spatially arranged across sufficiently large and relatively remote blocks of land.

5.2.1.c.1.c Least Tern

The interior least tern was listed as an endangered species on June 27, 1985 (50 Federal Register 21.784-21, 792), in the following states: Arkansas, Colorado, Illinois, Indiana, Iowa, Kansas, Kentucky, Louisiana, Missouri, Montana, Nebraska, New Mexico, North Dakota, Oklahoma, South Dakota, Tennessee, and a portion of Texas. Interior populations are found in the spring and summer along the Mississippi, Red, Arkansas, Ohio, Missouri, Platte, and Rio Grande Rivers (USFWS 1990). On the Mississippi River, least terns are most abundant from Cape Girardeau, Missouri southward to Vicksburg, Mississippi.

Sparsely vegetated portions of sandbars and islands are the primary habitat used by least terns for breeding, nesting, rearing, and roosting along the Mississippi River. Least terns are approximately 21 – 24 centimeters (cm) long with a 51 cm wingspan. They are characterized by a black-capped crown, grayish back and dorsal wing surfaces, white forehead, white undersurfaces, and black-tipped bills (USFWS 1990). Least terns are almost exclusively piscivorus, preying on small fish. Foraging usually occurs in close proximity to the nesting colonies. Least terns are present along the Mississippi River beginning in late April to mid-May, reproduce from May to August, and migrate to wintering grounds in late August to early September (USACE 1999).

5.2.1.c.1.d Fat Pocketbook Mussel

Historically *Potamilus capax* (Green 1832), commonly known as the fat pocketbook mussel, was widely distributed within the Mississippi River Basin. The historic range included the Upper Mississippi River in Minnesota, mainstem and several tributaries of the Ohio River, the White and St. Francis Rivers in Arkansas, and much of the Lower Mississippi River. Since being listed as Endangered under the Endangered Species Act in 1976, the last remaining viable

population was thought to exist in the St. Francis River and associated drainage ditches of eastern Arkansas. Recently, however, populations have been discovered in the backwater areas of the lower Mississippi River in Southern Arkansas and Mississippi and after not being seen in the White River for nearly 40 years, one individual was found in 2005. This species seems to prefer areas with a soft sandy-clay substrate and areas of low to moderate velocities and uses the wide ranging and migratory freshwater drum as its host fish which helps explain its wide historic range. Though this species is currently listed as endangered, down-listing and even de-listing are considered to be realistic conservation goals.

5.2.1.c.2 Invasive Aquatic Species

Aquatic nuisance species are nonindigenous aquatic organisms introduced into new habitats throughout the United States and other areas of the world that produce harmful impacts on aquatic ecosystems and on the human use of these resources. Frequently they threaten the diversity and/or abundance of native species, the ecological stability of infested waters, or commercial, agricultural, aquacultural, or recreational activities dependent on such waters.

Native aquatic biota in the LMR ecosystem may be severely damaged by five species of Asian carp that have been introduced into the LMR: 1. grass carp (*Ctenopharyngodon idella*) 2. common carp (*Cyprinus carpio*) 3. silver carp (*Hypophthalmichthys molotrix*) 4. bighead carp (*H. nobilis*), and 5. black carp (*Mylopharyngodon piceus*). Two of these carp species, the silver and the bighead, escaped into the Mississippi River from southern aquaculture facilities when they were flooded in the early 1990s. These carp have steadily expanded their range throughout the Mississippi River and, in terms of biomass, have become the most abundant species in some reaches. They constitute a serious threat to native fish because they compete with them for food (Koel et al. 2000). At least one species, the black carp, is a molluscivore and potentially capable of severely impacting populations of native mussel. The silver carp's jumping behavior has caused injuries to boaters, skiers, and other waterways users.

Zebra mussel infestations have the potential to cause pronounced ecological changes in the major rivers of the central United States. Their rapid reproduction, coupled with consumption of microscopic plants and animals, affects the aquatic food web and places valuable commercial and sport fisheries at risk. Large blooms of potentially toxic blue-green algae have also been observed in zebra mussel infested waters. Zebra mussels can also impact native species through displacement and clog intake pipes for municipal and industrial water supplies. Uncontrolled, zebra mussels can cost municipal and industrial water users tens of millions of dollars annually.

Nonindigenous aquatic plants, such as giant salvinia, purple loosestrife, Eurasian watermilfoil, water hyacinth, water lettuce, hydrilla, etc., can quickly establish themselves and often replace native plants. Environmental and economic problems caused by the dense growth of these plants include impairment of water-based recreation, navigation and flood control, degradation of water quality and fish and wildlife habitat, accelerated filling of lakes and reservoirs, and depressed property values.

5.2.1.d Gulf Hypoxia

Water quality, especially hypoxia, in the northern Gulf of Mexico has received significant scientific and public attention because of its potential to cause large-scale ecological and economic impacts. Hypoxia is an area of depleted oxygen (>2 parts per million that forms in the Gulf of Mexico each summer as a result of excess nutrients (primarily nitrogen and phosphorus) carried by the Mississippi River and seasonal stratification (layering) of Gulf waters. These excess nutrients promote algal growth and, as these dead algae decompose, they deplete oxygen levels. The Gulf of Mexico hypoxic zone is recognized as the second largest in the world and was approximately 8,000 square miles in 2008, an area similar to the size of the state of New Jersey. However, recent scientific evidence analyzed by the National Oceanic and Atmospheric Administration (NOAA)-supported scientists suggests that the 2009 hypoxic zone in the Gulf of Mexico is smaller than originally predicted, approximately 3,000 square miles, but is unusually severe in some places. It is believed that the smaller than expected dead zone is due to unusual weather patterns that re-oxygenated the waters, among other factors (LUMCON 2009).

Since 1985 the distribution of hypoxia on the Louisiana shelf (the relatively shallow [up to 200 meters] seabed extending outward from the shoreline) has been mapped annually during its expected maximal extent, usually mid June to early August. Between 1985 and 1992, hypoxic zones averaging 3,088 - 3,475 miles^2 generally formed in two distinct areas west of the Mississippi and Atchafalaya River deltas. Since the Mississippi River flood of 1993 in the mid-western United States, the hypoxic zone has been twice the average size of areas in 1985-1992, with the largest area (nearly 8,500 miles^2) occurring in July 2002 (LUMCON 2008). Mobile aquatic organisms leave the hypoxic zone and those unable to do so die or are weakened, depending on how low the oxygen level becomes and how long it persists. Hypoxia may impact marine habitat and commercially important fisheries that have yielded annual landings of approximately 1 billion pounds since 1969 (Chesney et al. 2000).

Gulf hypoxia also has important implications for non-point source nutrient management strategies in the Mississippi River Basin. Intensive use of agricultural chemicals creates nonpoint source contamination of streams and groundwater throughout the basin. The Mississippi River Basin produces about 80 percent of the corn and soybeans grown in the United States. Although the Upper Mississippi and Ohio River Basins represent only 32 percent of the drainage area in the Mississippi River Basin and 52 percent of the annual flow of the Mississippi River into the Gulf of Mexico, they contribute disproportionally large quantities of the total annual nitrogen flux (61 percent) and total annual phosphorous flux (75 percent) into the Gulf of Mexico (Coupe and Goolsby 1999). The USDA and USEPA estimate that more than 100,000 metric tons of pesticides and more than 6.3 million tons of nitrogen fertilizer were applied to cropland in the Mississippi River Basin in 1991 to produce these crops. However, some of this nutrient load also comes from other sources, including golf courses and suburban lawns; erosion of nutrient-rich soils; discharges from wastewater treatment plants; decomposing organic material; lightning storms; and, deposition of atmospheric nitrogen.

The Mississippi River/Gulf of Mexico Watershed Nutrient Task Force was established in 1997 to increase decision makers' understanding of the causal effects of hypoxia in the Gulf of Mexico; coordinate activities to reduce the size, severity, and duration of the hypoxic zone; and

ameliorate its effects. Released in 2001, the *Action Plan for Reducing, Mitigating, and Controlling Hypoxia in the Northern Gulf of Mexico* calls for states and tribes in the Mississippi River Basin to establish sub-basin committees to coordinate its implementation by major sub-basins. States, tribes, and federal agencies within the MR/AR Basin are directed to work through local partnerships and coordinate their efforts through sub-basin committees to use available data and tools to develop viable strategies for nutrient reduction. These strategies include setting targets for reduction of nitrogen losses to surface waters, establishing a baseline of existing efforts for nutrient management, identifying opportunities to restore floodplain wetlands contiguous to the Mississippi River, identifying additional assistance needed to meet their goals, and promoting additional programmatic funding.

The Lower Mississippi River Subbasin Committee on Gulf Hypoxia was formed in 2003 as part of the 2001 *Action Plan* and joins the states of Arkansas, Louisiana, Mississippi, Missouri, and Tennessee, along with federal partner agencies and interested stakeholders. The Committee has established a process of coordination and communication to support implementation of the Plan in the lower river basin, and has sought federal funding to support its activities. Its overall goals include nutrient reduction, wetlands restoration, water quality improvement, policy development, development/implementation of Best Management Practices (BMPs), education/information sharing, organizing/networking/coordinating, and monitoring. The Committee carried out an inventory of nutrient loading and reduction activities, as called for by the first *Action Plan*, and more recently a summary of data sources for the lower river basin, including the mainstem river and tributaries. The Action Plan was updated in 2008 to track progress, update the science, and adapt actions to improve the effectiveness of the efforts throughout the basin. It also reiterates the long term goals and continues the Task Force's commitment to an adaptive management approach to reduce the size and impact of the Gulf hypoxic zone and improve water quality in the basin.

Under section 303(d) of the Clean Water Act, states, territories, and authorized tribes are required to develop lists of impaired waters. These are waters that are too polluted or otherwise degraded to meet the water quality standards set by states, territories, or authorized tribes. The law requires that these jurisdictions establish priority rankings for waters on the lists and develop Total Maximum Daily Loads (TMDL) for these waters. A TMDL is a calculation of the maximum amount of a pollutant that a water body can receive and still safely meet water quality standards. TMDLs that establish limits on various pollutants have already been developed for the Mississippi River by several states and/or the U. S. Environmental Protection Agency. Tennessee recently established Mississippi River TMDLs for PCBs, dioxins, and pesticides; Mississippi has established TMDLs for pesticides; and, Minnesota has established TMDLs for mercury and pathogens. In addition, the states of Iowa, Minnesota, Illinois, Missouri, and Tennessee (and possibly others) have listed segments of the Mississippi River on their Clean Water Act Section 303(d) lists of impaired waters. TMDLs will have to be developed for all waterbody-pollutant combinations contained on the state 303(d) list.

5.2.2 Existing Conditions for the Red River

5.2.2.a Terrestrial Habitat

The area is within the low-lying Red River Backwater system of poorly drained land with numerous slight ridges and low areas, and various open lakes, bayous, bays, sloughs, and streams. Overstory species include overcup oak, Nuttall oak, honey locust, hackberry, bitter pecan, willow oak, sweetgum, cypress, water elm, and water locust. The presence of water from seasonal flooding is essential to use of the area by waterfowl, wading birds, and certain furbearers, reptiles and amphibians. Thirty-four mammalian, 164 avian, 39 reptilian, and 20 amphibian species have been documented as occurring in the area.

Significant wildlife areas include the Catahoula and Grand Cote National Wildlife Refuges. Catahoula National Wildlife Refuge is approximately 20 miles from the Red River. It was established in 1958 as a wintering area for migratory waterfowl. The refuge contains 25,162 acres. The habitat found at the refuge is primarily lowland hardwood forest subject to seasonal backwater flooding from the Ouachita, Black, and Red Rivers. Waterfowl are abundant during the winter. Peak waterfowl populations of 75,000 ducks have been recorded. Grand Cote National Wildlife Refuge was established in 1989 to provide valuable waterfowl habitat in the Mississippi/Red River floodplain as part of the North American Waterfowl Management Plan. The 6,000-acre refuge is located in Avoyelles Parish outside of Marksville, Louisiana. Although Northern pintails, mallards, wood ducks, and green-winged teal are the dominant species, blue-winged teal, northern shovelers, gadwall and American wigeon are also common on these refuges. During the spring and summer months, a variety of migratory songbirds utilize the bayous, scattered forested tracts, and shallow marsh habitat.

5.2.2.b Aquatic Habitat

The area provides three major fish habitat types: the main river channel; river backwater, bayous, and swamps; and oxbows and borrow pits. The backwater swamps, oxbows and main river channel contain by far the greatest diversity of species. At least 119 fish species may occur in the area. Dominant groups, in terms of number of species, are minnows, 23 species; the perches, 12 species; the sunfishes, 14 species; the suckers, 9 species; and the catfishes, 4 species. About one half of these species are considered rough fishes, one-fourth commercial species, and one-fourth sport species.

Although the silt content of the Red River is high, the river supports a sport fish population. Principal sport species are largemouth bass, yellow bass, white bass, crappie, sunfish, and catfish. Major bayous have outstanding potential for fishery resources. Seasonal flooding of the forest areas also makes a positive contribution to the aquatic resources of lakes and streams by providing extensive feeding, spawning, and nursery areas.

5.2.2.c Wetland Resources

Land use in Avoyelles, Catahoula and Concordia parishes is predominately agricultural land, with remnants of BLH and swamp. However, Catahoula Nation Wildlife Refuge, located

in the western portion of Catahoula parish is predominately BLH and swamp. Catahoula Lake was recognized as a Wetland of International Importance (RAMSAR site) in 1991: a historic concentration area for shorebirds, waterbirds, and migrating and wintering waterfowl.

The five state Wildlife Management Areas (Three Rivers, Red River, Spring Bayou, Grassy Lake and Pomme de Terre) and the three national wildlife refuges (Catahoula Lake Ophelia and Grand Cote) provide over 120,000 acres of publicly-protected wetlands in the area. These bottomland hardwood and swamps, along with remaining private tracts still provide a variety of important wetland functional values, including sediment detention, floodwater storage and nutrient cycling.

5.2.2.d Threatened and Endangered Species

The federally-protected threatened Louisiana black bear (*Ursus americanus luteolus*) and the endangered pallid sturgeon (Scaphirhynchus a1bus) are species known to occur in the region.

5.2.3 Existing Conditions for the Ouachita-Black Rivers Basin

5.2.3.a Terrestrial Habitat

The BLH of the Ouachita-Black Rivers Basin are populated by forest-, edge-, and wetland- dependent wildlife species including deer, squirrel, rabbit, turkey, bobwhite, mourning dove, and a various species of migratory waterfowl. Nongame species include red and grey fox, coyote, bobcat, armadillo, predator birds, songbirds, water birds, and a variety of reptiles and amphibians.

Catahoula National Wildlife Refuge is approximately 10 miles from Jonesville Lock and Dam. It was established in 1958 as a wintering area for migratory waterfowl. The refuge contains 25,162 acres divided into two units. The 6,671-acre Headquarters Unit borders nine miles of the northeast shore of Catahoula Lake, a 26,000-acre natural wetland renowned for its large concentrations of migratory waterfowl. The 18,491-acre Bushley Bayou Unit, located 8 miles west of Jonesville, was established May 16, 2001. The habitat found at the refuge is primarily lowland hardwood forest subject to seasonal backwater flooding from the Ouachita, Black, and Red Rivers. Waterfowl are abundant during the winter. Peak waterfowl populations of 75,000 ducks have been recorded. In 1979, the Duck Lake Impoundment was created to provide 1200 acres of waterfowl habitat. Management of the impoundment is to manipulate water levels to promote the growth of aquatic and moist soil vegetation. In 2001, Catahoula NWR was designated a Globally Important Bird Area. Several other state Wildlife Management Areas (WMAs) located in the Ouachita-Black River Basin.

5.2.3.b Aquatic Habitat

Fish species in the Ouachita-Black Rivers Basin include white, yellow, spotted and largemouth bass; chain pickerel; crappie; bluegill and redear sunfish; and channel, blue, and flathead catfish. Although these fish are found mainly in the adjacent oxbow lakes and sloughs, the river is conducive to fishing, especially in the dam tailwaters. Commercial fishing is

prominent on both the main river channel and the major lakes, with channel, flathead, and blue catfish, smallmouth buffalo, and freshwater drum being the main species caught.

5.2.3.c Wetland Resources

Land use in Catahoula and Concordia parishes is predominately agricultural land, with remnants of BLH and swamp. However, the western portion of Catahoula parish, location of Catahoula National Wildlife Refuge, is predominately BLH and swamp. The BLHand swamps provide a variety of wetland functional values. Catahoula Lake, approximately 10 miles from the Jonesville Lock and Dam, is recognized as a Wetlands of International Importance (RAMSAR site): a historic concentration area for shorebirds, waterbirds, and migrating/wintering waterfowl. Catahoula NWR also borders a portion of the Dewey Wills Wildlife Management Area. Together, these areas provide a haven for wildlife and preserve representative samples of the unique habitats originally found in the LMR.

5.2.3.d Threatened and Endangered Species

The federally-protected threatened Louisiana black bear (*Ursus americanus luteolus*) and the endangered pallid sturgeon (Scaphirhynchus a1bus) are species known to occur in the region.

5.2.4 Existing Conditions for the Yazoo River Basin

5.2.4.a Terrestrial Habitat

Terrestrial habitats range from open, agricultural monocu1tures to diverse and productive bottom-land hardwoods. Agricultural fields and edges between bottom-land hardwoods and agricultural fields provide habitat for some species. The bottom-land hardwoods (including cypress-tupelo areas) provide the highest quality and most stable habitat. The USFWS considers BLH habitat a resource that is relatively scarce or becoming scarce on a national basis or in the LMR ecoregion.

Terrestrial wildlife species associated with BLH include deer, raccoon, woodpeckers, owls, various songbirds, rabbits, mice, wild turkey and squirrel. Semi-aquatic mammals that inhabit the terrestrial habitat within the project area include such species as muskrat, nutria, swamp rabbit, mink, river otter, and beaver. Other land mammals present include wild turkey, white-tailed deer, striped skunk, cottontail rabbit, and bobcat. Aquatic foragers such as herons, egrets, and migratory waterfowl also use the area and wood ducks are a common resident. Typical species that use the agricultural lands include cottontail rabbit, mourning dove, raccoon, coyote, and opossum.

Numerous areas along the Yazoo River are considered to be prime wintering waterfowl areas for migratory waterfowl in Mississippi. Many of the higher quality waterfowl areas along the Yazoo River are currently privately owned.

5.2.4.b Aquatic Habitat

The Yazoo River is one of the few remaining large tributaries of the lower Mississippi River without manmade barriers to fish movement. Historically, it was meandering with deep, swift channels and slack-water areas associated with sandbars and cutbanks. Undercut banks and bank indentations are rare due to sloughing of unconsolidated bank sediments. Sand or clay substrates are characteristic and logs, debris, and live trees are the most abundant riverbank structure. Black willow is the most common tree, often abundant on sandy shores and log jams are common in the outside bends of the rivers. Channel modification has straightened and smoothed sides and bottoms; removed sediment-trapping snags, vegetation, and debris; provided auxiliary channels; and cut off meander loops.

Seventy-seven fish species occur in the Yazoo River, including minnows, sunfishes, catfishes, darters, suckers, gizzard shad, blacktail shiner, white crappie, bullhead minnow, bluntface shiner, bluegill, and Yazoo shiner. Commercial species are also abundant and include channel, flathead, and blue catfish; smallmouth buffalo; and freshwater drum.

5.2.4.c Wetland Resources

In addition to their well-recognized wildlife value, wetlands provide floodflow alteration, sediment and toxicant retention, nutrient removal and transformation, sediment stabilization, and production export. Based on data collected for the 1993 Upper Yazoo Projects Reformulation Supplemental Environmental Impact Statement, forested and farmed wetland cover types along the Yazoo River account for approximately 45 percent of the area's wetlands. The remaining areas are considered prior converted wetlands and have no functional wetland values. About 37 percent of the forested and 2 percent of the cropland areas along the Yazoo River are classified as wetlands.

5.2.4.d Threatened and Endangered Species

The plant pondberry (Lindera melissifo1ia) and the pallid sturgeon (Scaphirhynchus a1bus) are endangered species that have been documented to occur near the Yazoo River.

5.2.5 Existing Conditions for the White River Basin

5.2.5.a Terrestrial Habitat

Much of the historical bottomland forest in the White River Basin has been cleared and is currently used for agricultural production. However, the lower portion of the White River Basin encompasses the largest remaining tract of BLH left in the LMRAV. This seasonally-flooded area, which includes several national wildlife refuges and state wildlife management areas. Approximately 40 percent (1.5 million) of the mid-continent mallard population winters in the LMRAV and it is widely considered as one of the most significant wintering area for mallards in North America.

5.2.5.b Aquatic Habitat

A total of 97 fish species collected in the channel of the White River were taxonomically dominated by minnows (26 species), darters (19 species), sunfishes (13 species), and suckers (11 species) (Killgore and Hoover 2003). Six species listed as having special status by the Arkansas Natural Heritage Commission and/or the American Fisheries Society were collected. The White River supports one of the most diverse fish assemblages of any tributary of the Lower Mississippi River.

Thirty-four species of mussels, including the pink mucket pearly mussel (*Lampsilis abrupta*), were collected during a mussel survey of the White River from the vicinity of Batesville, Arkansas to its mouth (Christian 1995). This survey identified numerous mussel beds with densities ranging from one mussel/meter^2 to greater than 10 mussels/meter^2.

5.2.5.c Wetland Resources

Because the lower White River comprises one of the most important BLH wetland ecosystems in the world, the area has been designated as a Ramsar Wetland of International Importance (Ramsar 2000). Aquatic plant communities in the BLH swamps of this region are among the most biologically diverse and productive systems in the world (Mitsch and Gosselink 1993). Studies will be conducted as part of the White River Comprehensive Study to identify the effects of the current flow regime and the impacts that the future flow regimes could have on wetlands (USFWS 2001).

5.2.5.d Threatened and Endangered Species

The federally endangered pallid sturgeon (Scaphirhynchus albus), pink mucket pearly mussel (*Lampsilis abrupta*), the fat pocketbook mussel (*Potamilus capax*), the scaleshell mussel (*Leptodea leptodon*), and interior least tern (Sterna antillarum) are known to occur in the region. The USFWS along with scientific studies has concluded that the ivory-billed woodpecker(s) (*Campephilus principalis*) were sighted on multiple occasions and captured on video in 2004, and subsequent searches and surveys have produced additional scientific evidence supporting the species existence or living status. There is also the potential for pallid sturgeon to inhabit this area, if only seasonally, and may not have been detected due to inadequate surveys (Comm. with Lindsey Lewis, USFWS).

5.2.6 Existing Conditions for the Atchafalaya River Basin

5.2.6.a Terrestrial Habitat

A series of connected lakes (Tensas Pass, Lake Mongouluis, Lake Chicot, Lake Fausse Point, Grand Lake, Six Mile Lake, and Flat Lake) historically transported water through the Atchafalaya Basin to the Gulf of Mexico where active delta building occurred at the mouth of the Atchafalaya River. However, diversion of the Mississippi River and Red River waters to the Atchafalaya River since the mid-19th century has forced the lakes to act as settling basins (sediment traps), leaving only small remnants of the original lakes. Additionally, construction of

the ABFS has accelerated natural and artificial trends that are currently altering the character of the basin's fish and wildlife habitats. These trends include high sedimentation rates, hydrological changes, and changes in vegetation composition and development.

5.2.6.b Aquatic Habitat

The Atchafalaya River Basin's cypress tupelo swamps, BLH, overflow lakes and bayous provide a tremendous diversity of habitat for fish and wildlife. Sedimentation in swamps and lowlands has raised ground elevations, effectively reducing the extent and duration of over-bank flooding throughout the basin. Sediment is filling lacustrine areas in the Atchafalaya Basin, causing its sequential evolution to a system dominated by palustrine, scrub-shrub, and forested wetland types (classifications based on Cowardin et al. 1979). BLH have replaced cypress swamps in many areas, with a corresponding loss of aquatic habitat.

The Atchafalaya River is a distributary of the Mississippi River and supports a comparable fish community and offers similar fish habitat. Because the point of diversion from the Mississippi into the Atchafalaya lies above Baton Rouge, Louisiana, the Atchafalaya is not as affected by anthropogenic activity as the LMRAV. As a result, water quality is better in the Atchafalaya than in the LMR.

5.2.6.c Wetland Resources

The Atchafalaya River supplies water to more than half a million acres of forested wetlands. The forested wetlands are generally of three major types: 1) typical BLH on levees and higher flood plains, 2) cypress-tupelo swamps on low-lying backwater flood plains, and 3) young stands of black willow that have developed on recently aggraded point and longitudinal channel bars (silt and sand). Most of the relatively young forests ($\geq$ 70 years) have regenerated since lumbering of old growth cypress and BLH was completed by the early 1930s.

The Atchafalaya Basin is unique among Louisiana river basins because it has a growing delta system with nearly stable wetlands. Compared to other basins, wetland loss is minor in the areas north of Atchafalaya Bay. Wetland loss in this area is site dependent; loss is primarily due to erosion, human activities, and natural conversion through sedimentation. Oil and gas infrastructure (e.g. pipelines and canals) disrupt the natural movement of flow and sediment within the wetlands. The development of the Lower Atchafalaya River from a tidal to a riverine system has created natural levees along the banks of the river, disrupting the movement of flow and sediment into the wetlands.

Although wetlands are increasing in the Atchafalaya Bay, natural processes and human activity limit the effectiveness of flow and sediment resources in creating new wetlands by affecting sediment delivery, deposition, and retention. Winter storm fronts, waves, and currents refine and reshape the deltas in the bay by eroding and reworking sediments. MR&T project features such as the Wax Lake Outlet Control Structure affect the location and quantity of flow and sediment entering the bay. Sediments available for delta building in the Lower Atchafalaya River delta are deposited in the channel above Atchafalaya Bay and only reach the delta during significant high water events. The majority of sediments conveyed by the Lower Atchafalaya

River do not reach the delta; sands fall out in the navigation channel and are dredged to maintain navigation. The lack of sediments available for delta growth in the Lower Atchafalaya River delta is evident when the growth rate of this delta is compared to that of the Wax Lake Outlet delta. Although the Wax Lake Outlet delta receives approximately one-third the amount of flow and sediment of the Lower Atchafalaya River delta, its size increases at a rate three times as great.

5.2.6.d Threatened and Endangered Species

The Atchafalaya River Basin is home to two federally listed species, the threatened Louisiana Black Bear and the endangered Pallid Sturgeon. The Basin also contains 567,316 acres of designated critical habitat of the Louisiana Black Bear.

5.2.7 Existing Conditions for the Arkansas Post Canal

5.2.7.a Terrestrial Habitat

The main habitat type for wildlife along the Arkansas Post Canal is BLH. Wildlife in the area include beavers, minks, bobcats, white-tailed deer, squirrels, foxes, coyotes, raccoons, feral hogs, river otters, skunks, opossums, and muskrats. Black bears occupy the area in limited numbers and are not hunted (Montgomery Point Lock and Dam [(MPLD)] EIS 2005).

5.2.7.b Aquatic Habitat

Fisheries in the area are diverse and commercial and sport fishing are prominent along the White River. Baker et al. (1989) reported a total of 58 fish species in the area, including blue suckers, gars, catfish, buffalo, crappie, bass, and numerous species of forage fishes (MPLD EIS 2005). The Arkansas Post Canal may provide for passage of fish between the White, Arkansas, and Mississippi Rivers.

5.2.7.c Wetland Resources

The lower reach of the MKARNS is in the LMRAV. Wetland areas, BLH, and oak-hickory pine forests once dominated this area; however, these habitats have been altered and approximately 91-95 percent of the original riparian and BLH systems have been lost. The remaining floodplain forests include river swamp forests, backwater and flat forests, and upland transitional forests. Forest resources in many of the remaining wetland areas are not economically feasible to exploit (USFWS CAR 2005). The Arkansas River has extensive backwater areas that are relatively shallow and heavily vegetated, which provide habitat for wetland species. Mouths of tributaries and large floodplain lakes also support wetland fauna.

5.2.7.d Endangered Species

Endangered species in the area are the interior least tern, and the pink mucket pearly mussel. Although mention is made of the Florida panther, it has not been sighted in this area during the last several years and is a doubtful resident (MPLD EIS 2005). There is also the

potential for the ivory-billed woodpecker, pallid sturgeon and the fat pocketbook to inhabit this area, if only seasonally, and may not have been detected due to inadequate surveys (Comm with Lindsey Lewis, USFWS 2009).

5.2.8 Existing Conditions for the Deltaic Plain

5.2.8.a Water Quality

Historic and current water quality issues for rivers and streams in coastal Louisiana include the transport of nutrients, pesticides, synthetic organic compounds, trace elements, suspended sediment, and bacteria. The database for the Mississippi River at St. Francisville and the Atchafalaya River at Melville is extensive, with comprehensive water quality datasets beginning in the mid-1970s. Historically, sites have been operated in cooperation with the USACE and the Louisiana Department of Transportation and Development. These two sites are currently sampled as part of the USGS National Stream Quality Accounting Network (NASQAN). The database for the Mississippi River is extensive enough that several general conclusions can be made concerning its suitability for coastal restoration efforts:

1. Trace elements, including heavy metals, are generally not considered a water quality issue in the Mississippi River.

2. Nitrate concentrations average around 1.4–1.6 mg/L in the LMR. This is the result of natural and human inputs, particularly agricultural fertilizers in the midcontinent. Nitrate at these concentrations can cause excessive algal growth and eutrophication in coastal water bodies and contribute to the hypoxia problem in the Gulf of Mexico.

3. Fecal coliform bacteria in the lower Mississippi River have declined dramatically with more effective sewage treatment at Baton Rouge and New Orleans since the mid- to late-1980s.

4. The primary pesticides detected in the Mississippi River are the herbicides atrazine, metolachlor, and acetochlor.

5. Per LDEQ's database[1], organic compounds are typically not detected in the Mississippi River.

6. For conventional parameters in LDEQ's database[1], there is essentially no difference in water quality spatially along the length of the Mississippi River between Pointe a la Hache and the Louisiana State line.

[1]LDEQ performs collection and analysis for 29 conventional parameters and fecal coliform through the Surface Water Monitoring Program with a priority pollutant scan quarterly at the Mississippi River sites.

The most common individual designated uses in the coastal plain of Louisiana include primary contact recreation, secondary contact recreation, fish and wildlife propagation, shellfish

propagation, and drinking water supply. Primary contact recreation is defined by LDEQ as any recreational activity that involves or requires prolonged body contact with the water, such as swimming, water skiing, tubing, snorkeling, and skin-diving. Secondary contact recreation is defined as any recreational activity that may involve incidental or accidental body contact with the water and during which the probability of ingesting appreciable quantities of water is minimal, such as fishing, wading, and recreational boating. Fish and wildlife propagation is defined as the use of water for preservation and reproduction of aquatic biota such as indigenous species of fish and invertebrates, as well as reptiles, amphibians, and other wildlife associated with the aquatic environment. This also includes the maintenance of water quality at a level that prevents contamination of aquatic biota consumed by humans. Shellfish propagation is the use of water to sufficiently maintain biological systems that support economically important species of oysters, clams, mussels, or other mollusks so that their productivity is preserved and the health of human consumers of these species is protected (USACE 2004).

5.2.8.b Wetlands

In human terms, these coastal wetlands have historically been a culturally diverse center for social development. Additionally, the coastal wetlands protect an internationally significant commercial-industrial complex from the destructive forces of storm-driven waves and tides. This complex includes deep-draft ports that handle the Nation's waterborne commerce and the most active segment of the Nation's Intracoastal Waterway. In conservation terms, Louisiana's coast is at the end of the Central and Mississippi Flyways, and nearly 70 percent of the waterfowl migrating along these flyways winter there. Coastal Louisiana also provides critical stopover habitat for Neotropical migratory songbirds, as well as for other avian species. Furthermore, coastal Louisiana provides critical nesting habitat for many species of water birds such as the endangered brown pelican. These economic and habitat values, which depend on the biological productivity of Louisiana's coastal wetlands, merit national attention.

Today, most of the Mississippi River's fresh water, nutrients, and sediments are channeled out to the deep waters of the Gulf of Mexico, bypassing the coastal wetlands where they would otherwise naturally build land and nourish the estuarine ecosystems. Deprived of the sediments provided by the deltaic processes, the estuarine wetlands continue to sink, or subside, as they have always done, but now lack the net land- building effect of unconstrained deltaic processes. Deprived of the natural sustenance provided by nutrients in the intermittently flooded zones in which they are adapted to live, the plants that define the surface of the coastal wetlands die off. Once the coastal wetlands are denuded, the fragile substrate is left exposed to — and unprotected from — the erosive tidal environment.

Coastal Louisiana has lost over 900,000 acres since the 1930s. As recently as the 1970s, the loss rate for Louisiana's coastal wetlands was as high as 25,600 acres per year. The current rate of loss is about 16,000 acres per year. It is estimated that coastal Louisiana will experience a 320,000-acre net loss by the year 2050. The cumulative effect of human activities in the coastal area has been to drastically tilt the natural balance from the net land- building deltaic processes to land loss caused by altered hydrology, subsidence, and erosion. Approximately 30 percent of the land losses being experienced in coastal Louisiana are due to natural causes; the remaining 70 percent are attributable to the effects on the environment, both direct and indirect.

5.2.8.c Endangered Species

Within the State of Louisiana there are 25 animal and 3 plant species (some with critical habitats) under the jurisdiction of the USFWS and/or NMFS, which are presently classified as threatened or endangered. The USFWS and NMFS share jurisdictional responsibility for sea turtles and the gulf sturgeon. Of the animals and plants under USFWS and/or NMFS jurisdiction, only 16 animal and 1 plant species are within the study area (Table 1).

Table 1. Table from USACE Final Programmatic EIS listing the Threatened and Endangered Species of Louisiana.

Table 3.8
Threatened and Endangered Species in Louisiana
(E=Endangered; T= Threatened; C=Candidate)
(Species in bold are those found within the study area)

Species Under Jurisdiction of the USFWS **Status Common Name Scientific Name**	**Species Under Jurisdiction of NMFS** **Status Common Name Scientific Name**
Mammals E1 -- Florida Panther (*Felis concolor coryl*) E1 -- Red wolf (*Canis rufus*) **E -- West Indian manatee (*Trichechus manatus*)** **T -- Louisiana black bear (*Ursus americanus luteolus*)** Birds E2 -- Bachmans's warbler (*Vermivora bachmanii*) **E -- Brown pelican (*Pelecanus occidentalis*)** E1 -- Eskimo curlew (*Numenius borealis*) E1 -- Ivory-billed woodpecker (*Campephilus principalis*) E -- Least tern; interior population (*Sterna antillarum*) **E -- Red-cockaded woodpecker (*Picoides borealis*)** **T -- Bald eagle (*Haliaeetus leucocephalus*)** **T -- Piping plover (*Charadrius melodus*)** Reptiles **E -- Hawksbill sea turtle (*Eretomchelys imbricata*)** **E -- Kemp's (Atlantic) ridley sea turtle (*Lepidochelys kempii*)** **E -- Leatherback sea turtle (*Dermochelys coriacea*)** **T(S/A)3 --American alligator (*Alligator mississippiensis*)** **T -- Gopher tortoise (*Gopherus polyphemus*)** **T -- Green sea turtle (*Chelonia mydas*)** **T -- Loggerhead sea turtle (*Caretta caretta*)** **T -- Ringed sawback turtle (*Graptemys oculifera*)** C -- Snake, Louisiana pine (*Pituophis ruthveni*) Fish **E -- Pallid sturgeon (*Scaphirhynchus albus*)** **T -- Gulf sturgeon (*Acipenser oxyrinchus desotoi*)** Invertebrates E – Mussel, Fat pocketbook (*Potamilus capax*) E -- Pink pearlymussel Mucket (*Lampsilis abrupta*) **T -- Inflated (Alabama) heelsplitter (*Potamilus inflatus*)** T -- Louisiana pearlshell (*Margaritifera hembeli*) Plants E -- American chaffseed (*Schwalbea americana)* **E -- Louisiana quillwort (*Isoetes louisianensis*)** T -- Earth fruit (*Geocarpon minimum*)	Marine Mammals E -- Sperm whale (*Physeter macrocephalus*) E -- Sei whale (*Balaenoptera borealis*) E -- Humpback whale (*Megaptera novaeangliae*) E -- Finback whale (*Balaenoptera physalus*) E -- Blue Whale (*Balaenoptera musculus*) Sea Turtles4 **E -- Hawksbill sea turtle (*Eretomchelys imbricata*)** **E -- Kemp's (Atlantic) ridley sea turtle *Lepidochelys kempii*)** **E -- Leatherback sea turtle (*Dermochelys coriacea*)** **T -- Green sea turtle (*Chelonia mydas*)** **T -- Loggerhead Sea Turtle (*Caretta caretta*)** Fish **T -- Gulf sturgeon (*Acipenser oxyrinchus desotoi*)** Candidate Species5 Dusky shark (*Carcharhinus obscurus*) Sand tiger shark (*Odontaspis taurus*) Night shark (*Carcharinus signatus*) Speckled hind (*Epinephelus drummondhayi*) Saltmarsh topminnow (*Fundulus jenkensi*) Jewfish (*Epinephelus itajara*) Warsaw grouper (*Epinephelus striatus*) E1 The Florida panther, red wolf, Eskimo curlew, and ivory-billed woodpecker are presumed to be extinct in the state. E2 There has been no confirmed Bachman's warbler U.S. nesting ground sighting since the mid-1960s, however, several sightings of the species have occurred on wintering grounds during the last decade. This species may be extirpated in Louisiana. T(S/A) 3 For law enforcement purposes, the alligator in Louisiana is classified as "Threatened due to Similarity of Appearance." They are biologically neither endangered nor threatened. Regulated harvest is permitted under state law. 4 The USFWS and NOAA share jurisdictional responsibility for sea turtles and the gulf sturgeon. 5 Candidate species are not protected under the ESA, but concerns about their status indicate that they may warrant listing in the future. Federal agencies and the public are encouraged to consider these species during project planning so that future listings may be avoided.

5.2.9 Expected Future Conditions

5.2.9.a Land Use

Recent conservation and reforestation efforts in the LMRAV seek to return less-productive agricultural land to its original ecological condition. The Wetland Reserve Program (WRP), a voluntary land retirement program initially authorized in the 1990 Food, Agriculture, Conservation and Trade Act (1990 Farm Bill) and implemented by the U.S. Department of Agriculture Natural Resources Conservation Service, has resulted in restoration of approximately 450,000 to 550,000 acres in the LMRAV (Haynes 2004). More recent estimates indicate that more than 681,269 acres have been enrolled in WRP in the LMRAV, with the largest amount of restoration occurring in Louisiana (217,091 acres), Arkansas (190,617 acres), and Mississippi (153,422 acres) (D. Difiore, NRCS, personal communication). A total of 89 percent of the easements are permanent, while the remainder is in 30-year easements. Although the WRP plays a major role in landscape-scale wildlife habitat restoration programs being implemented in the LMRAV (King and Keeland 1999; Schoenholtz et al. 2001), the Lower Mississippi River Joint Venture (LMVJV 2007) noted that restoration methods may not result in stand conditions favorable to all species of wildlife. If Congress continues funding the WRP, significant acreage of marginal agricultural habitat within the LMRAV may be restored for conservation purposes as prices for agricultural commodities fluctuate and policy dictated by USDA farm programs changes.

5.2.9.c Fish and Wildlife Resources

The project area harbors a diversity of aquatic habitats and species – numerous species of fish, freshwater mussels, freshwater snails, turtles, and crayfish can be found. Many of these species are endemic to the watersheds in the seven-state study area. The quality and quantity of these aquatic resources have been in decline since European colonization began and many species have become extinct across the region in the last century.

The decline and/or extirpation of these species is due to many factors, including hydrologic alteration, habitat destruction, loss of hydrologic connectivity, and the negative effects of nonindigenous species. Degraded water quality is also an important fish and wildlife issue facing the southeastern states. The long-term status of the region's water resources is of particular concern because of its relative importance to the health of people, as well as fish and wildlife resources.

Forests provide essential habitat for numerous species of birds and mammals, including threatened or endangered species. Permanent loss of forest cover results in a reduction in available habitat and in habitat fragmentation, which causes conditions unsuitable for bird and mammal species that require large, contiguous forested landscapes (Fahrig 1999). Wildlife and bird species displaced by a loss of forest cover in general cannot successfully relocate to other forests because other suitable habitat is normally already occupied by the same species.

Consequently, forest-dependent wildlife and bird populations have decreased as forests were permanently converted to non-forest land uses.

5.2.9.d Water Quality

Changes in land use and water quality are likely to continue in the Mississippi River Basin as agricultural production increases in response to increasing worldwide demand for food, fiber, and fuel. This is especially true when considered in the context of the rapidly emerging biofuel industry. Former President Bush proposed accelerating production of biofuels to meet 15 percent of domestic fuel usage by 2017 and 30 percent of domestic fuel usage as an ultimate goal. A joint study of the U.S. Department of Agriculture (USDA) and the U.S. Department of Energy (USDOE) concluded that the United States could produce 60 billion gallons of ethanol by 2030 through a combination of grain and cellulosic feedstocks, an amount sufficient to replace 30 percent of projected U. S. gasoline demand (USDOE/USDA 2005). Long-term sustainability of ground and surface water resources used for biofuel feedstock and production facilities will become key water quality issues to consider if total biofuel production increases to meet these goals (National Research Council of the National Academies 2008).

The 1982 National Water Quality Inventory noted estimated decreases of 46 percent and 71 percent nationally in municipal and industrial loads biochemical oxygen demand, respectively, in the decade after passage of the Clean Water Act in 1972. Isolated instances of illegal point source discharges into the Mississippi River will likely continue but, based on past performance, it appears reasonable to expect that water quality degradation attributable to point sources will decrease even further (Sabins 2009; Wise 2009). However, Smith et al. (1987) and McCuen (1986) noted that nonpoint-source pollution may prevent achievement of national water-quality goals, even after complete implementation of planned point-source controls mandated by the Clean Water Act. Turner and Rabalais (1991) documented changes in Lower Mississippi River water quality that suggested significant reduction of eutrophication in Gulf of Mexico waters was not likely to occur without corresponding reductions in the use of agricultural fertilizer.

Although excess sediment is a problem in the Upper Mississippi River, a lack of sediment is a primary contributor to the catastrophic losses of coastal wetlands in Louisiana. Upstream dams and downstream levees on the Mississippi River prevent coastal wetlands in Louisiana from receiving the river water, nutrients, and sediment needed to nourish wetland vegetation and counteract natural subsidence. Louisiana's three million acres of wetlands represent about 40 percent of the Nation's continental wetlands, but account for nearly 80 percent of its wetland losses (25-35 miles^2 annually). At the present net rate of wetland loss, Louisiana will have lost this crucial habitat in about 200 years. Its disappearance threatens the productivity of the state's coastal ecosystems, the economic viability of its industries, and the safety of its residents due to the increased vulnerability of coastal areas to rising sea level and storms (Louisiana Coastal Wetlands Conservation and Restoration Task Force and the Wetlands Conservation and Restoration Authority 1998).

5.2.9.e Hypoxia

The Mississippi River/Gulf of Mexico Watershed Nutrient Task Force developed an Action Plan in 2001, which set forth a national strategy to reduce Gulf hypoxia. This Plan set a goal of reducing the 5-year running average of the size of the Gulf hypoxic zone to less than 1,930 miles^2 by 2015. Although the Plan suggested that a 30 percent decrease in nitrogen load would be sufficient to achieve this goal, more recent models suggest that 40-45 percent reductions in total nitrogen flux may be required to reduce the areal extent of the hypoxic zone below the 2001 goal. The 2001 Action Plan was updated in 2008 in order to reassess trends in the basin and reassess progress toward the goals. Goals of the Action Plan are to restore and protect the waters within the LMRAV and improve the communities and economic conditions throughout the LMRAV, including the agriculture, fisheries, and recreation sectors.

5.3 RIVER-RELATED RECREATION AND ACCESS

5.3.1 Existing Conditions for the Lower Mississippi River

5.3.1.a Historic Properties

Prehistoric Indians have lived along the LMR for the past 5,000+ years and some historic tribes remain along the river today. Historic Native American occupation of the Mississippi River Valley was not documented until the first Europeans (e.g., DeSoto) arrived here in the mid-sixteenth century. At that time, many large village sites were still inhabited by indigenous tribal peoples. As time passed, Euro-Americans displaced native populations ravaged by epidemics and warfare and the locations of many of these village sites were lost. This apparent loss of the archaeological record came as a result of both topographic changes on the landscape (e.g. the New Madrid earthquakes of 1811-1812) and the influx of new inhabitants who had little knowledge of the great extent of past Indian occupation within the Valley.

Between 1940 and 1947, university archaeologists Philip Phillips (Harvard), James A. Ford (LSU), and James B. Griffin (Michigan) surveyed the Mississippi River Valley and adjoining watersheds to gather information on the number of archeological sites still existing in the LMRAV and cataloged 385 sites, the majority of which remain unassessed by professional archeologists for eligibility on the National Register.

The USACE, St. Louis District surveys have cataloged many prehistoric, historic, and architectural sites, including old French towns, e.g. St. Genevieve. During the late 1970s, the USACE Memphis District commissioned a study that surveyed 15% (on average, 1,000 feet on either side of the levee) of the west bank levee system between Cairo, IL and the lower district boundary at the mouth of the White River. Over 50 new prehistoric and more than 65 new historic archeological sites were discovered and recorded, and almost 900 architectural sites were recorded. This is a significant number of sites for such a limited area of survey.

Between 1989 and 1993, a large scale (10,000+ acres) cultural survey and testing program was conducted in a portion of the New Madrid Floodway. Two hundred and forty-five (245) sites were recorded, and all but five of these sites were tested for significance. One

hundred and twenty-five (125) of these sites were determined significant and eligible for nomination to the National Register of Historic Places. In 1988 when the Mississippi River was at an extremely low level, most districts within the MVD conducted aerial surveys in an attempt to locate and count the number of sunken vessels in and adjacent to the river. A large number of vessels was found and photographed. However, at this time, that information has not been compiled into a formal report.

Numerous studies conducted in the Vicksburg and New Orleans districts identified large numbers of prehistoric, historic, and architectural sites. Additionally, these districts probably contain higher numbers of sunken vessels and historic Civil War sites than districts to the north.

Since humans entered the Americas at the end of Pleistocene, the LMRAV has been of great importance, both as a transportation corridor and an area rich in species diversity. Despite all of the previous surveys conducted in close proximity to the river itself, only a small amount of the total land and river surface area has been scientifically surveyed for cultural resources. A great amount of archaeological research still remains to be done before the cultural history of this reach of river is clearly understood.

5.3.1.b Socioeconomic Resources

Using data from the late 1990's and early 2000's, the U.S. Bureau of Labor Statistics (BLS 2004) summarized the primary economic characteristics of 113 counties in seven states in the LMR corridor portion of the project area. The last section of the report summarizes and compares information on population, personal income, per capita personal income, average earnings per job, numbers of non-farm and farm proprietors for all 113 LMRAV corridor counties, and the seven states containing the 113 counties and the U.S. for the years 1996 and 2006. The data used were the most recent available from the U.S. Department of Commerce Bureau of Economic Analysis and the Bureau of Labor Statistics. All dollar figures have been adjusted for inflation to 2008 dollars (BLS 2008).

- Commercial Harvest of Natural Resources: Resources harvested in and around the LMRAV include timber, finfish, shellfish, pelts, and alligator hides. Available data suggest revenues of roughly $529 million each year, with saltwater fish landings and forestry each accounting for over $182 million.

- Outdoor Recreation: Anglers, hunters, and wildlife viewers take over 30 million trips in the LMR region each year, spending approximately $959 million and supporting thousands of jobs. State parks and National Wildlife Refuges are key recreational resources, although many hunters and other recreationalists lease private land. The effects of resource management in the LMRAV corridor are felt nationwide; for instance, condition and survival rates of waterfowl populations wintering in the LMRAV contribute to hunting opportunities in the northern portions of the Mississippi flyway in the following year.

- Tourism and Cultural/Historical Resources: Tourism is the largest non-manufacturing sector examined in this economic profile. Tourists visiting the LMRAV corridor spend

over $15 billion each year, supporting over 180,000 jobs in the regional economy. Major attractions include cultural and historical sites, riverboat tours and gaming, and riverfront festivals.

- Water Supply: Water users in the corridor use nearly 11 billion gallons of surface water each day, with energy and manufacturing operations accounting for the greatest withdrawals. Although some cities rely on surface water for domestic use, most household water is supplied from subsurface withdrawals. Revenue and employment in the public water supply sector is a minor component of the corridor economy.

- Agriculture and Aquaculture: Agriculture dominates land use in the corridor, with soybeans, cotton, rice, sugar cane, corn, catfish, and livestock representing major products. In total, agriculture produces revenues of over $8.3 billion each year, employing over 100,000 individuals.

- Mineral Resources: Extraction of fuel and non-fuel minerals generates nearly $11 billion in revenues annually and employs approximately 41,000 people. Most of this economic activity is concentrated in Louisiana's oil and natural gas industries.

- Energy Production: Over 100 power plants in the corridor supply electricity to industrial, commercial and residential users. Fossil fuels such as natural gas and coal are the dominant power sources in the region. This sector produces annual revenues greater than $5.7 billion and employs over 11,000 individuals.

- Commercial Navigation: The waterway transportation industry provides a cost-effective means of transporting goods to and from a variety of other sectors. More than 470 million tons of commodities were shipped on the LMRAV in 2001, generating approximately $7.3 billion in revenue and 29,000 jobs. Food and petroleum products account for the largest share of good shipped.

- Manufacturing: Major manufacturing industries in the LMRAV corridor include chemical manufacturing, petroleum refining, and food processing. Overall, the sector generates about $81 billion in output and employs roughly 294,000 individuals.

- Natural Resource Services not Reflected in the Commercial Economy: The river provides many services that may not be directly reflected in the commercial economy, including the following.

  ♦ **Wastewater Treatment**: Roughly 1,800 facilities discharge wastewater to the Lower Mississippi River and its tributaries in the corridor. These facilities include manufacturing operations as well as municipal sewage treatment plants.

  ♦ **Wetland Services**: Millions of acres of wetlands in the corridor provide natural and cost-effective flood risk management, water quality protection, and other services. Major wetland resources include forested wetlands in the Mississippi River Alluvial Plain (MRAP) and coastal wetlands in Louisiana.

♦ **Wildlife Habitat**: Distinct from their human-centered uses, wetlands, forests, and other environments in the corridor support a diverse array of wildlife. Abundant as well as endangered species of fish, birds, waterfowl, and mammals rely on these resources. The value of these species is reflected in the numerous ongoing efforts to protect and restore wildlife habitat in the LMRAV.

An economic base area was also developed as part of the 1998 MRL SEIS. This economic base area, which extended roughly from Cape Girardeau to the Gulf of Mexico, encompasses approximately 50,000 square miles in seven states--Arkansas, Illinois, Kentucky, Louisiana, Mississippi, Missouri, and Tennessee. The following text was taken from the 1998 MRL SEIS:

> Historically, population totals for the overall region have gradually increased. Growth statistics show the overall study area population has increased by over 500,000 people since 1960 or 14 percent over the 30-year period. However, there have been periods of outmigration in localized rural areas during which the number of persons moving out of an area was greater than the combined number of immigrating residents and natural population growth. The Mississippi Delta suffered the greatest reduction in the total number of persons living in the area.
>
> Population growth within the study area has fluctuated based on varying factors. In many cases, areas within counties in close proximity to large metropolitan centers have enjoyed substantial population growth. This is evident in reviewing the population trends of counties which encompass Baton Rouge, Monroe, and New Orleans, Louisiana, and Memphis, Tennessee. These centers offer a diversified economic base of jobs, industry, and services provide for the basic needs of a large population--employment, income, and housing.
>
> Although the area is predominantly rural, there are 55 cities within the study area that have populations of 10,000 people or greater. Additionally, there were an estimated 109 towns with populations between 2,500 and 10,000 people in 1990. Five Metropolitan Statistical Areas (MSA's) are located within the economic base area which include Baton Rouge, Monroe, and New Orleans, Louisiana; Memphis, Tennessee; and Pine Bluff, Arkansas. These MSA's serve as the major commercial, services, and industrial centers for their regional areas. In addition to their close proximity to the Mississippi River, each of the major metropolitan centers has international air service and is accessible by multiple interstate and federal highway systems.

5.3.1.c Recreation Resources

An array of recreational resources is available in the LMR corridor. According to the 1998 MRL SEIS, these resources include more than 250 state-managed parks, natural areas, historic sites, fish and wildlife areas, recreation areas, scenic areas, and trails. More than 3 million visitors a year take advantage of these state resources. The National Park Service (NPS) and USFWS administer federally owned recreational resources within the project area. Combined the 15 areas managed by the NPS and the 21 refuges managed by USFWS receive more than

9 million visits each year.

Each year more than six million people participate in boating, the single most popular outdoor recreational activity in the project area. There are 59 developed boat-launch access points into the Mississippi River along the length of the project. Over half of the boat-launch access points are located within the upper portion of the project area between Cairo, Illinois, and Memphis, Tennessee. Water bodies within the project area provide valuable recreational and commercial fisheries. These waters, which total approximately 500,000 acres, can be divided into three basic categories: the main channel and secondary channels of the Mississippi River, oxbow lakes, and borrow areas. The LMR and its associated oxbow lakes comprise approximately 98 percent of the fishery habitat in the project area and offer numerous opportunities for recreational and commercial fishing. Although they comprise only about 2 percent of fishery habitat within the project area, borrow areas also represent a valuable fisheries resource.

Forested areas within the LMRRA project area total in excess of 1,000,000 acres and consist of predominantly BLH. Public and private forested areas provide numerous opportunities for hunting, hiking, photography, bird watching, camping, and other outdoor recreation-related activities. In urban areas such as New Orleans and Memphis, walking and biking trails are often provided as an integral part of recreational development along the river. Within the main line levees, numerous timber companies and private landowners have leased land to hunting clubs and state and federal wildlife areas are available to the general public.

The Mississippi River, the largest river in the United States, offers a wide range of aesthetically attractive conditions to people of varied tastes. The river is the most visually outstanding aspect of the project area landscape. Large bodies of water serve as an important element of visual composition because of their horizontal extent, color and texture. Inactive parts of the river, such as oxbows, fulfill a similar role. The Mississippi River's sinuosity provides the additional visual characteristic of surprise. Natural and cultural land uses within the project area complement the river by their contrasting geometry, color and texture or are aesthetically significant in their own right, as in the case with BLH.

The project area contains many manmade features which either contribute to or detract from the aesthetic quality of the project area, depending upon the perception of the particular individual. The river is constrained on the west bank by levees for almost the entire distance from Cairo, IL to the Gulf of Mexico. The east bank of the river has considerably fewer miles of levee. Other manmade features along the river include the revetments constructed on both banks to protect the river channel. From Cairo, IL to the Gulf of Mexico, dikes several hundred feet to one mile in length have been built into the river. These dikes have greatly influenced the development of sandbars as a result of still water areas created downstream from the dikes. Other manmade features are the river crossings for roadways, railroads and overhead utilities. The project area is relatively poor in architecturally outstanding manmade structures that can be considered aesthetically pleasing because they are used primarily for flood control, protection of adjacent areas, and navigation. Manmade features which exist in the project area are generally of a utilitarian nature.

5.2.1.d Real Estate Information

Real estate information that is available and accessible can be found by using the following:

Much of the land within the LMRRA project area is privately owned. The USACE, Memphis District has been placing revetment along both sides of the LMR for many years. The real estate division must acquire Rights-of-Entry (ROE) for construction from the landowners before any work is done. A list of over 100 landowners by RM or location has been complied from Cairo, Illinois, at RM 953 to the Big Island Weirs, Arkansas, RM 599 (MVM-RE files).

Maps and plat books have been printed for lands that are located on the west side of the LMR. In the states of Arkansas and Missouri, plat books have been printed for each county showing the ownership and size of the parcel next to the river by Section, Township, and Range. In Arkansas, the following plat books for each county are available: Chicot (1992), Crittenden (2002), Desha (2006), Lee (2005), Mississippi (2000), and Phillips (2004). In the state of Missouri, the following plat books are available: Cape Girardeau (1998), Clark (2005), Jefferson (2005), Lewis (2003), Lincoln (2003), Mississippi (1998), New Madrid (2001), Pemiscot (2006), Perry (2003), Pike (2000), Ralls (2002), St. Charles (2001), Ste. Genevieve (2007), and Scott (2004). Some of these plat books are several years old and the owners may have changed, however, the parcels usually remain the same at the county court house. For up to date ownership and home addresses, the information can be collected from the County Recorder's office for each county.

The east side of the Mississippi River land is described in different terms using metes and bounds. There are no plat books for each county on the east side of the river. Land is listed by parcel number at the County Court House in the Register's office. To obtain the parcel number of the land next to the river, you must go to each Court House and go through their parcel maps. With the parcel number, you will be able to get the ownership records.

There are several sites on the internet that can be used to find some real estate data by county. In Tennessee, the Real Estate Assessment Data is used by the county assessor of property for tax purposes. Lake, Dyer, Lauderdale, Tipton, and Shelby Counties can be found at the following site: http://www.assessment.state.tn.us/. The parcel ID, address, or owners name must be known to access the data. This site is free to the public.

Another internet site that can be used as a reference tool is "Assessor Links USA" which can be found at the following site: http://www.realmarketing.com/index.htm. This site is organized on a state-by-state basis with directory links to state and county tax assessors. Not all counties have an internet site, and the information that is put on the different county sites depends on what the county decides to make available for the public to use.

As time goes by, more and more data is added to the internet. At this time, the Tennessee internet site has more information available to the public than the other states that are located along the Mississippi River. The only true method of acquiring land ownership data is by going to the county court house of each county and making copies of their parcel maps and the name

and address of the owner. There is no simple and easy way to gather this information. This task would involve a significant effort to obtain real estate information for the LMRRA project area.

5.3.2 Existing Conditions for the Red River

5.3.2.a Socioeconomic

The area is predominantly rural in nature and Marksville, the Avoyelles Parish seat, is the largest town in the area with a 2007 population of 5,668, and it has experienced a 3.7 percent increase in population since 2000. The median annual income was $25,650, and the median house value in 2007 was $89,538. The population of Avoyelles Parish in 2000 was 41,481. The median annual income for a household in Avoyelles Parish was $23,851. Income of 27.1% of families and 25.9% of the parish population was below the national poverty level.

5.3.2.b Recreation

Boating, hunting and fishing are common activities in the area. There are two recreation areas, Ben Routh and Brouillette, between Lock and Dams 1 and 2 managed by the Red River Waterway Commission. There are also three state wildlife management areas and two National Wildlife Refuges that provide a variety of hunting, fishing and other outdoor recreation opportunities, such as Grassy Lake WMA, Spring Bayou WMA, Pomme de Terre WMA, Catahoula NWR, and Grand Cote NWR.

The sport fishing industry has increased on the J. Bennett Johnston Waterway with the construction of the lock and dam system. The Bassmaster Classic, the most prestigious event in professional bass fishing, was held Shreveport-Bossier City in February 2009.

5.3.3 Existing Conditions for the Ouachita-Black Rivers Basin

5.3.3.a Socioeconomic

The area is predominantly rural in nature. Jonesville is the largest town in the area with a 2007 population of 2,300, and its population has declined by 6.8 percent since 2000. The median household income in 2007 was $24,255 with a median house value of $52,000. Agriculture, forestry and fishing and hunting are the largest revenue producers. The population of Catahoula parish in 2007 was 10,452. Industries providing employment include educational, health and social services (20.0%) agriculture, forestry, fishing and hunting, and mining (18.2%) and retail trade (10.7%). The 2000 population of Concordia parish was 20,247, and the median annual income for a household in the parish was $22,742. About 24.30% of families and 29.10% of the population were below the national poverty level.

5.3.3.b Recreation

Boating, hunting and fishing are common activities in the area. There are three public use areas managed by the USACE, including Jonesville Landing, Litter River, and Jonesville

Lock and Dam. The USFWS manages the Catahoula National Wildlife Refuge are located in the area.

Jonesville Landing Recreation Area is in the city of Jonesville, Louisiana. This recreation area is just minutes by boat from the convergence of the Ouachita, Black, Tensas, and Little Rivers. A boat ramp, a water-borne comfort station and parking are available. The Little River Recreation Area is at the intersection of Highways 84 and 28. This recreation area has a boat ramp, picnic sites, and restrooms. The Jonesville Lock and Dam Recreation Area is located 12 miles south of the town of Jonesville on Hwy 124 near Glade, Louisiana. This recreation area has picnic sites, boat ramp, and a water-borne comfort station.

Catahoula National Wildlife Refuge is approximately 10 miles from Jonesville Lock and Dam. It was established in 1958 as a wintering area for migratory waterfowl. Recreational activities include an auto tour route, hiking trails, boardwalk and observation tower, fishing pier for the disabled, wildlife observation, photography, fishing, and hunting for small game, waterfowl, and deer.

5.3.4 Existing Conditions for the Yazoo River Basin

5.3.4.a Socioeconomic

Population in the eastern portion of Yazoo Basin Delta has steadily declined approximately 46 percent since the 1940's. However, the population in Greenwood, the only major urban area (>10,000 persons) located along the Yazoo River has increased 15 percent during the same reporting period. This reflects a broad trend of relocation rural to urban areas in response to technological changes in agricultural operations and increased industrial employment opportunities.

Transportation resources include federal and state highways, railroads, air transport, and the Yazoo River. The convergence of the Yazoo River, highways, and a railway in Greenwood enable it to serve as a leading manufacturing, trade, and transportation center. Greenwood maintains the major barge port on the Yazoo River and has the only 24-hour airport in the study area. The Illinois-Central, the Columbus and Greenville railroads provide connections to larger urban areas, including Jackson, Mississippi, and Memphis, Tennessee.

Although farming is the major enterprise, industry has become increasingly important to the area's economy as service, trade, and manufacturing sectors began emerging in the 1970's. From 1963 to 1982, value added by manufacturing increased almost 93 percent. Although these figures represent a favorable business climate, agriculture is still the major source of economic growth in the area. Cropland is the major agricultural use category, accounting for 75 percent of land use, and average farm size increased from 76 to 736 acres from 1954 to 1987.

5.3.4.b Recreation

Recreational activities along the Yazoo River center on hunting, fishing, and water-oriented sports. Esthetic opportunities are provided by the area's historical background and

remaining natural areas throughout the basin. Four areas along the Yazoo River are considered unique ecological features, Gayden Brake, Mathews Brake NWR, Beckham Swamp, and Eagle Brake, and several oxbow lakes provide recreational opportunities.

5.3.5 Existing Conditions for the White River Basin

5.3.5.a Socioeconomic

The population of northwest Arkansas and southwest Missouri has increased over the years. Confined animal feeding operations have become numerous in the upper basin and contribute greatly to the local economy. Most of the economy in the lower basin revolves around agriculture, and the use of barges to move agricultural commodities to market has become very important. The White River is seasonally navigable for approximately 250 miles.

5.3.5.b Recreation

Hunting and fishing are the two main recreational activities within the basin. Waterfowl, white-tailed deer, black bear, turkey, and small game hunting are extremely popular in the White River National Wildlife Refuge and other woodlands in the area. Fishing for crappie and catfish are popular outdoor activities in the lower White River Basin. Canoeing, hiking, camping, wildlife watching (especially birdwatching), and other forms of nonconsumptive recreation are also popular in the basin. A total of eight dams, tow in MO and six in AR, impound the upper White River and trout fishing has become a major recreational industry in the upper reaches of the basin.

5.3.6 Existing Conditions for the Atchafalaya River Basin

5.3.6.a Socioeconomic

The economy within this region is largely based on commercial fishing and trapping, outdoor recreation, and the extraction of oil and gas. About 100 species of fish, crawfish, shrimp and crabs support sport and commercial fishing industries. Other wildlife common in the Atchafalaya home are the Louisiana Black Bear, white tail deer, bobcat, coyote, alligator, nutria, mink, otter, musk rat, beaver, armadillo, fox and opossum.

Commercially important furbearers found in the Atchafalaya River Basin include raccoon, mink, bobcat, nutria, muskrat, river otter, and beaver. Crawfish are the most important component of the commercial fisheries in the Basin, with an estimated annual harvest of 22 million pounds. Important commercial fin fish species present in the river include catfish, buffalo, and freshwater drum.

The Atchafalaya River also provides a significant industrial shipping channel for the state of Louisiana. A thriving oil and gas industry accounts for a significant share of the local economy in the area, either directly or indirectly.

Although much of the basin is wetland and unsuitable for agriculture, some lands (mainly in the north) are highly productive. The latest Census of Agriculture reports that the market value of agricultural crops produced in the area total almost $900 million, comprising about 45% of the state's total. Major crops include soybeans, cotton, rice and sugarcane. The value of livestock products sold was about 168 million, or about 28% of the state's total.

5.3.6.b Recreation

The entire Atchafalaya River is noted for having high esthetic values, although in many areas these values have been degraded by the construction and operational activities of the oil and gas industry. Extensive sedimentation has filled in many areas that were formerly open water. Many parts of the area are riddled with a maze of access and pipeline canals that have destroyed the wilderness nature of the swamplands. Numerous portions, however, remain in a scenic, semi-wilderness state.

The Atchafalaya River also offers abundant and diverse recreational opportunities. The two major recreational activities, hunting and fishing, are sustained by the great abundance of wildlife and fishery resources of the area. Other opportunities for recreation include wildlife observation, boating, photography, camping, and hiking. Public access is achieved by public or commercial boat ramps. Six major public recreation areas abut the river and include Sherburne Wildlife Management Area (WMA), Atchafalaya NWR, Bayou des Ourses, Indian Bayou, Atakapas Island WMA, Atchafalaya Delta WMS.

Sherburne WMA, located in the Morganza Floodway of the Atchafalaya Basin, is situated in portions of Pointe Coupee, St. Martin, and Iberville Parishes between the Atchafalaya River and the East Protection Guide Levee. The Sherburne WMA, a 44,000 acre tract managed by the LDWF, is comprised of 11,780 acres owned by LDWF,15,220 acres owned by the USFWS, and 17,000 acres owned by the USACE. The area is classified as BLH and offers waterfowl, large and small game hunting, fishing, boating, hiking and camping.

Indian Bayou, situated on the opposite side of the Atchafalaya River from the Sherburne WMA, is also a BLH that offers hunting, camping, hiking trails, and lakes, creeks and bayous that are home to abundant commercial and recreational fisheries. As part of the America's Wetland Birding Trail, the area provides opportunities to observe birds and other wildlife. This area is also home to several endangered, threatened, and special-concern species such as the Louisiana black bear, bald eagle, and American alligator. A 17-mile network of paddling trails allows visitors to navigate the area's streams and bayous without a guide. Hikers, cyclist, and horseback riders access Indian Bayou through 25 miles of trails, 13 miles of which are designated for hiking only.

The Atakapas WMA, comprised primarily of 28,000 acres of accretion lands located in Grand Lake, is subject to seasonal overflow from the Atchafalaya River. The area contains cypress-tupelo swamp and early successional stage bottomland hardwood forests. Important game animals in the area are deer, swamp rabbits, squirrels and wood ducks. In addition to hunting, both fishing and crawfishing are important recreational activities in the area.

The Atchafalaya Delta WMA, comprised of emergent and semi-emergent delta lands at the mouth of the Atchafalaya River, contains fresh to intermediate marshlands, bayous, shallow bay areas,

and extensive mudflats. This area contains high quality habitat for wintering waterfowl and is considered one of the best duck hunting sites in the state.

New boat landings have recently been constructed at Simmesport and Millet Point. Additional boat landings are planned for Bayou Sorrel, Krotz Springs, Butte LaRose, and Bayou Pigeon. These sites will include launch ramps, parking, access roads, rest rooms, drinking water, lighting, piers and other features.

5.3.7 Existing Conditions for the Arkansas Post Canal

5.3.7.a Socioeconomic

The lower Arkansas River and the MKARNS provide a variety of economic benefits to adjoining communities including commercial navigation, water supply (municipal, industrial and agricultural), hydroelectric power generation, commercial fishing, and recreation. The MKARNS has been responsible for the direct creation of 54,000 jobs over the past 25 years and provides a major economic impact to the area. This direct employment, in turn, has been responsible for the creation of thousands of indirect jobs in the transportation, industrial, trade and service sectors. The direct and indirect employment impacts the economy in the form of wages paid, business volume, tax revenue, etc. (USACE 2005).

5.3.7.b Recreation

The USACE, Little Rock District Arkansas Post Field Office is a sub-office of the Pine Bluff Project Office. It maintains an area along the Arkansas River downstream of the Joe Hardin Lock and Dam (No. 3) to the confluence of the Arkansas, White, and Mississippi Rivers. This area includes the Wilbur D. Mills Lock and Dam, Lock No. 2, and Norrell Lock and Dam No. 1.

Nine USACE parks are located near Wilbur D. Mills Lock and Dam along the Arkansas River and Arkansas Post Canal. Four parks permit overnight camping. Merrisach Lake Park is situated along the eastern shore of Merrisach Lake near Lock No. 2 on the Arkansas Post Canal. Two USACE parks, Wild Goose Bayou and Morgan Point, provide boat ramps and parking areas but no camping or picnic areas. Wild Goose Bayou Park is located on the White River near Norrell Lock and Dam. Morgan Point Park is located on Morgan Bendway below Wilbur D. Mills Dam on the Arkansas River. Water is held in the oxbow by a recently constructed weir near its confluence with the Arkansas River.

The Arkansas Post National Memorial, located on a peninsula near the western terminus of the Arkansas Post Canal (Navigation Mile 19), provides a unique recreational experience for visitors. This monument was erected to recognize the many historic events that occurred in the area. A trading post was the first known semi-permanent French settlement in the lower Mississippi River Valley. It continued to be a critical trading post due to its position near the two major rivers and had strategic military importance during the Revolutionary and Civil Wars.

Fishing for largemouth bass, crappie, sunfish, bluegill, catfish, sauger, striped and smallmouth bass, and snagging catfish on the downstream side of Wilbur D. Mills Dam are productive in this stretch of the MKARNS.

The USACE manages about 10,000 acres downstream from Pendleton Bridge (at Navigation mile 22.5) for public hunting. This area is managed as part of the Trusten Holder WMA in conjunction with the Arkansas Game and Fish Commission. The main section of the Trusten Holder WMA is located a few thousand feet off of the Arkansas Post Canal between Lock No. 2 and Norrell Lock and Dam (No. 1). In addition, the White River NWR, which straddles the Arkansas Post Canal as it converges with the White River, provides additional fishing, hunting, and wildlife viewing opportunities (USACE 2005).

5.3.8 Existing Conditions for the Deltaic Plain

5.3.8.a Socioeconomic

Nearly two million people, representing approximately 43 percent of the state's population, reside within south Louisiana. The rich soil conditions, mild climate, natural waterways, and abundance of water and other natural resources have long attracted and supported economic development in coastal Louisiana. The diversified economy that exists in the region today includes oil and gas production and transportation, navigation, commercial fishing, agriculture, recreation, and tourism. Employment has varied widely with periods of rapid growth and contraction; in 2000 there were more than 800,000 jobs in coastal Louisiana. The most influential industries for the study area's economy include oil, gas and pipeline; navigation; commercial and recreational fishing and hunting; and agriculture, all of which are essential for supporting Louisiana's economy.

The trapping of animals in south Louisiana began with Native Americans and continued on into the 1900s. Otter, muskrat, and nutria were trapped in the marshes and provided furs for the garment industry all over the world. Hunting camps and processing stations were located throughout the marsh. The demand for furs has declined over the years. Nutria are trapped today for food and bounties, to keep the population from expanding and destroying the marsh, or from causing problems in municipal canals. Seafood, one of the most important natural resources in south Louisiana, has continued to
become more important to the economy of Louisiana. In the middle of the 19th century,
methods of preservation (such as the drying of shrimp and canning of oysters) made it possible to export seafood. The introduction of the gasoline motor and refrigeration allowed fishermen greater access to markets in New Orleans and the larger towns inland from the coast. Seafood processing camps that had been established all over the coast in the 1800s, including Manila Village, Bayou St. Malo, and the Isle de Caminada, were abandoned after being hit by numerous tropical storms and hurricanes.

In the 1900s, many of these fishermen established new settlement and seafood processing businesses along the major waterways leading away from the coast. Fishing remains a major economic activity in south Louisiana. Rice and sugar remained major cash crops across the coastal parishes. By the eve of World War II, large sugar companies had developed after bad weather, plant diseases, and economic policies had almost destroyed sugar production in south Louisiana. Truck farming of vegetables and citrus to towns and cities provided fresh vegetables at local markets. Cameron and Vermilion Parishes are, today, the top two cattle producing parishes in Louisiana.

Other industries developed in south Louisiana in the 1900s that have shaped the economy of the state. The oil industry began in the early 1900s and continues to be a major industry. Large oil fields are located in the marshy areas of south Louisiana and offshore. Pockets of sulfur and salt are located across south Louisiana. The extraction of these natural resources became major industrial activities. All of these economic activities have contributed to the constructed environment of south Louisiana. In addition to the residential homes, public buildings, and commercial buildings, these industries have contributed to the south Louisiana landscape and to the heritage of the area. Historic standing structures, archaeological sites, and landscape features associated with man's activities in the coastal area may be significant cultural resources. The Division of Archaeology maintains information on over 12,000 archaeological sites and thousands of historic standing structures.

5.3.8.b Recreation

The present day recreational activities are deeply rooted in historic vocational and cultural traditions of southern Louisiana. Vocations centuries old have become today's avocations. Greatly exemplifying this are the hundreds of festivals celebrated throughout the coastal zone, many of which focus on harvests of rice, sugar cane, shrimp, crawfish, oyster, and alligator, and celebrating cultures and heritage such as Cajun, Creole, Isleno, and many European cultures.

South Louisiana is rich in recreational resources, with nearly half of Louisiana's campgrounds, state historic sites, National historic parks, NWRs, WMAs, state parks and commemorative areas, important bird areas, and other sites of interest scattered throughout thecoastal zone. From the Texas coast on the west to the Mississippi state line on the east, therecreating public has access to fresh, estuarine and marine resources for fishing, hunting, boating, swimming, camping, crabbing and crawfishing. Traditional non-consumptive recreation includes, but is not exclusive to, tennis, golf, zoos, aquariums, baseball, picnicking, biking, hiking, wildlife viewing, photography, and other activities. Sportspersons and wildlife watchers spend $110 billion annually, 1.1 percent of the Nation's gross domestic product. Preliminary findings in the State of Louisiana, from the USFWS 2001 FHWAR, show that 970,000 sportspersons participated in fishing with expenditures of $694,978 and 333,000 participated in hunting with expenditure of $416,953. Wildlife-watching participants numbered 802,000 resident and 314,000 nonresident with expenditures of $165,746. In this region of the country, 19 percent of the population are anglers, 9 percent are hunters, and 25 percent participate in wildlife-watching activities. Americans traveling to Louisiana spent approximately $8.1 billion in 2001. This supported over 113,000 jobs in the state with annual income of about $1.8 billion.

Tax revenues associated with recreation and tourism in Louisiana were about $1.1 billion for all levels of government. Thus, tourism is an important resource in the State of Louisiana. The Louisiana SCORP included some general needs and needs for specific regions. Some of the general needs included the need for more quality accommodations and camping facilities with more activities; the need to improve access to lakes for the average public; the need to enlarge buffer strips of timber along streams, roads, and lakes to preserve plant communities; the need for more and improved local recreational opportunities; the need for more intense trail systems;

the need for more regional promotion and packaging of outdoor recreation; the need for urban wilderness parks; and the need for public education on conservation and facility use.

5.3.9 Expected Future Conditions

5.3.9.a Historic Properties

The National Park Service (NPS) has drafted a comprehensive heritage study and environmental assessment for the Lower Mississippi River Valley (NPS 2007 http://www.nps.gov/history/delta/dhsea.htm) in response to Lower Mississippi Delta Region Initiatives, Pub. L. 103-433. Approaching the Mississippi River's natural and cultural resources from the perspective of heritage tourism, the NPS noted that cultural resources in the Lower Mississippi Valley are exceptionally diverse, including Mississippian mound sites, French Colonial towns, Civil War sites, and engineering structures such as the Old River Control Structure that now meet the criteria for inclusion in the National Register of Historic Places. The NPS team noted that museums, historic sites, visitor centers, and the levee system and river control structures could be utilized to tell the story of the Mississippi River and its impact on the cultural landscape of the Delta region. Table 2, one of nine NPS concept themes identified in the heritage study, illustrates the rich diversity of historic properties in the study area. Many historic districts within the old river towns, such as Natchez Under- the-Hill, on the east side of the Mississippi River are located within the LMRRA study area. Located adjacent to the Mississippi River levees, the Great River Road provides an important transportation network that facilitates heritage tourism in the LMRRA study area.

Table 2**.** NPS Concept Theme: River Towns along the Lower Mississippi River System

St. Genevieve, Missouri	Historic (French Colonial) St. Genevieve
Cape Girardeau,	Historic Downtown and Riverfront
New Madrid, Missouri	New Madrid Museum
Cairo, Illinois	Confluence of the Mississippi and Ohio Rivers
Paducah, Kentucky	Historic Downtown and Lower Town
Wickliffe, Kentucky	Wickliffe Mounds
Columbus, Kentucky Columbus	Belmont Battlefield State Park
Hickman, Kentucky	Buchanan Street Historic District
Memphis, Tennessee	Overton Park Historic District
Helena, Arkansas	Delta Cultural Center, slave and Confederate soldier cemeteries
Greenville, Mississippi	Mississippi's Largest City on the Mississippi River
Vicksburg, Mississippi	Historic Downtown
Natchez, Mississippi	Natchez Bluffs and Under-the-Hill Historic District, Natchez-on-top-of-the-Hill Historic District; Cemetery Bluffs Historic District; Clifton Heights Historic District; Upriver Residential Historic District; Holy Family Catholic Church Historic District; and Woodlawn Historic District
Baton Rouge, Louisiana	Historic Downtown

New Orleans, Louisiana	Vieux Carré Historic District and Garden District

Five thousand years ago, Native Americans established large communities in the Lower Mississippi Delta Region marked by large elaborate earthen mound structures, e.g. the Poverty Point site in northeastern Louisiana. Around 1,000 A.D., larger, more complex mounds were erected by the Mississippian cultures. After Monk's Mound at Cahokia, Illinois, Emerald Mound, located on the Natchez Trace north of Natchez, Mississippi, is the second largest Mississippian mound in the Lower Mississippi Valley. Circular and conical mounds of the earliest inhabitants and the flat-topped earthen mounds within large towns of the Mississippian peoples are still evident in the LMRAV.

During the early historic period the Natchez, Tunica, Quapaw, Choctaw and Chickasaw Indians constructed villages in close proximity to the Mississippi River and its major tributaries. While some of these sites have been preserved, many have been lost due to channel meandering and bank erosion, levee and revetment construction, erosion, and catastrophic natural events such as the New Madrid earthquake of 1811-1812. During the 1830s, the Mississippi River and its major tributaries such as the Arkansas River, served as transportation corridors for the forced removal of the Five Civilized Tribes after passage of the Indian Removal Act of 1830.

During the colonial period of French-English-Spanish territorial competition, higher ground immediately adjacent to the main channel of the LMR was highly valued because it was well suited for growing sugarcane and provided easy access to waterborne commerce. During the 18th and 19th centuries there were hundreds of plantation complexes of varied sizes within the project corridor. Many iconic plantation homes, such as Oak Alley near Vacherie, Louisiana, have survived intact and are listed on the National Register of Historic Places. The USACE has decades of corridor survey data associated with levee and revetment construction. Remnants of more than 300 19th century plantation sites have been recorded in the New Orleans District and many of them, most notably Nina Plantation in Point Coupee Parish, have been investigated. The archeological remnants of residential structures, sugar mills, tramways, slave quarters, etc. destroyed by river meandering contribute to the development of an accurate historical account of a river-oriented economy that encompassed both banks of the Mississippi River for hundreds of miles. Combining land use data with historic navigation charts containing information on river landings could provide a wealth of interpretive data useful in developing an enhanced public appreciation and understanding of the historic riverscape.

Remnants of 19th century steamboat wrecks are located within the LMRRA study area. Although once numerous and described so vividly in Mark Twain's classic *Life on the Mississippi*, historic vessels are a relatively rare find. In 1988, record low water levels provided the Arkansas Archaeological Survey with an opportunity to examine several of these shipwrecks when the Mississippi River fell to 10 feet below zero on the Memphis gauge and exposed four and a half acres of 19th century water craft remains on the riverbed near Memphis. The Survey's archaeological fieldwork received national media attention and wide publication in academic and popular journals. A few 19th century vessels have been recorded by Corps of Engineers surveys in advance of channel maintenance dredging. High concentrations have been found in the New Orleans area and individual vessels associated with Civil War naval skirmishes have also been

located by side-scan sonar surveys. Like plantation homes, individual wrecks tell only a part of the Nation's navigation history. Steamboats, ironclads, and smaller non-steam vessels were part of a larger shipping industry that required boatwrights, maintenance yards at river ports, landings at plantations and stores along the River Road, and warehouses in riverside communities. The high density of previously unknown shipwrecks in Memphis and New Orleans may also exist at other large river towns (e.g. Vicksburg and Natchez) in the study area. However, these other sites have not been identified and evaluated for the National Register of Historic Places for lack of systematic underwater surveys using side-scan sonar and magnetometers. As the NPS study hints, the riverine corridor within the study area has a rich history that has been only partially tapped for public benefit.

5.3.9.b Socioeconomic and Recreation

Environmental tourism and outdoor recreation have a demonstrated capability to provide sustainable economic development in the LMRAV. The Travel Industry Association of America (2002) projected that the number of geotourists would increase from 55 million (2003) to 100 million by 2010. This "experience tourism" sustains or enhances the geographical character of the place being visited - its environment, culture, aesthetics, heritage and the well being of its residents (Vistas 2002).

A 2006 overview of the outdoor recreation indicates industry reported that it provided an annual economic input of $628 billion, provided 5.5+ million jobs, generated $77+ billion in federal and state taxes, and accounted for 7.2% of all consumer spending in the U.S. Opportunities for participating in six of these types of outdoor recreation are abundant in the LMR corridor. The report indicated that, on a national basis, there were 66 million people participating in wildlife viewing, 60 million in bicycling, 56 million in trail-based recreation, 45 million in camping, 33 million in fishing, and 24 million in paddling. These six activities generated direct expenditures of $249 billion, which resulted in a ripple effect of $628 billion annually to the U.S. economy (Outdoor Industry Association 2006).

International tourist arrivals are projected to reach 1 billion annually and generate $2 billion daily by 2010. Nature tourism is also the fastest growing market segment in the international tourism industry with an annual growth rate of 5% worldwide. The industry of nature tourism accounts for 6% of the world gross domestic market and 11.4% of all consumer spending worldwide.

In 2007, (most current data available) 604 boating accidents, 86 of which involved fatalities, were reported in the Lower Mississippi Valley states. The total number of boating fatalities for the six-state region encompassing Arkansas (18), Kentucky (13), Louisiana (30), Mississippi (7), Missouri (7), and Tennessee (17) was 92. An additional six-state total of 518 accidents were reported, in which 479 boaters were injured and property damage estimated at $2,728,060 occurred.

5.4 METADATA ON NATURAL RESOURCES AND HABITAT

Because the project area encompasses all or parts of 235 counties and parishes in the 7 states within the LMRAV south from Cairo, IL to the Head of Passes in the Gulf of Mexico, the decision was made to evaluate metadata, rather than actual datasets for this report. This decision was predicated primarily upon the geographic magnitude of the project area and the complexity of the extant data. In addition, this decision was further necessitated by financial and temporal constraints associated with the LMRRA authorizing legislation.

Metadata are used to provide documentation for data products; essentially, they consist of data about data. Metadata provides context for data, i.e., the interrelated conditions in which the data occurs - who, what, when, where, why, and how about every facet of the data that are being documented. It consists of information that facilitates the understanding, characteristics, management, and usage of data. The metadata required for effective data management varies with the type of data and context of use. Metadata is frequently stored in a central location (metadata registry) and used by organizations to standardize their data. Predictability of metadata is assured only by conformance to the Content Standard for Digital Geospatial Metadata (Standard). The Federal Geographic Data Committee originally adopted this Standard in 1994 and revised it in 1998. Executive Order 12096 ordered all federal agencies to utilize it to document geospatial data created as of January 1995. It is extremely difficult for anyone other than the person(s) who collected the original data, to create metadata from raw data because the first step in creating metadata is to fully understand the data being described and its potential relationship to the Standard. Consequently, a lack of basic knowledge (who collected it, data description, when it was collected, purpose, methodology) about any datatset precludes its conversion to the Standard.

Although new data were not developed during this study, metadata of existing datasets required to identify data gaps were assessed. Meetings were conducted or attended on May 13, 2008; June 17-18, 2008; and, August 28, 2008 to identify organizations holding, having access to, or aware of geospatial or other data specific to: 1. the main channel and leveed floodplain of the LMR (the area between the mainline levees) from the confluence of the Mississippi and Ohio Rivers at Cairo IL, to the Head of Passes at the Gulf of Mexico, and, 2. the following rivers and canals that have existing commercial navigation (i.e. commercial barge traffic) to the point of direct influence between each channel and the mainstem Mississippi River. These included the White River up to Clarendon; Arkansas Post Canal up to Norrell Lock and Dam, Arkansas; Yazoo River to Greenwood, Mississippi; Red River up to Lock and Dam No. 2 in Louisiana; Ouachita/Black River up to the Columbia Lock and Dam in Louisiana; Old River from the Old River Lock to its confluence with the Red and Atchafalaya Rivers in Louisiana; and, Atchafalaya Basin in Louisiana.

Metadata were specifically requested for geospatial data in the following themes - flora and fauna, hydrology, topography, geomorphology, soils, socioeconomics, bathymetry, land use, water quality, land cover, wildlife habitat, cadastral, infrastructure, and wetlands. Data in the following categories of general topics were also requested: agriculture, biota, boundaries, climatology/meteorology/atmosphere, elevation, environment, geoscientific information, imagery base maps/earth cover, inland waters, location, planning cadastre, structure,

transportation, and utilities/communication. Specific conditional elements requested for metadata included geographic location by coordinates, dataset character set, spatial resolution, distribution format, spatial representation type, reference system, lineage statement, on-line resource, metadata file identifier, metadata standard name, metadata standard version, metadata language, and metadata character set. Additionally, the USACE PDT requested that the stakeholders present at the May 2008 meeting advise of any other sources of geospatial data or information deemed relevant to this assessment other than that held by their respective organizations. Tables 3-5 list project area-specific metadata or data identified by federal and state agencies, non-governmental organizations, and other stakeholders.

Table 3. Project Area-Specific Metadata Identified By Federal and State Agencies, and Non-Governmental Organizations

Agency	**Data Available**
United States Geological Survey (USGS)	National Hydrology Dataset, Land Cover, Topographic, Geologic, Socioeconomic, National Elevation Dataset
U S Department of Agriculture Natural Resource Conservation Services	Soil, Wetland Reserve Program
U S Army Corp of Engineers - Memphis District	Bathymetry, Habitat, Endangered Threatened Species
United States Environmental Protection Agency (EPA), Regions 4, 6 and 7	Water quality
USGS Earth Resources Observation and Science Center (EROS)	Land cover
Arkansas Game and Fish	Topographic, Cadastral
The Nature Conservancy- Arkansas	MS River, Wetland Reserve Program Boundary
Missouri Department of Natural Resources	Water quality, Topographic, Elevation
Mississippi Automated Resource Information System (MARIS)	Cadastral, Census, Hydrology, Physiography, Political, Cultural, Geodetic/ Cadastral, Satellite Imagery
Arkansas Geospatial Data Clearinghouse (GeoStor)	Geology, Environment, Biology, Cultural, Cadastral, Economic, Transportation, Inland Water Resources, Elevation, Structures
Arkansas Gap Analysis Program (AR-GAP)	Animal (Vertebrate), Satellite Imagery
Kentucky Geography Network (KYGEONET)	Biologic, Agriculture, Geologic, Environmental, Cadastral, Elevation, Geophysical, Satellite Imagery, Historic, Inland Water Resources
Missouri Spatial Data Information Service (MSDIS)	Cultural, Geologic, Political, Ecologic, Satellite Imagery, Land Cover, Historic
Tennessee Spatial Data Server	Biologic, Economic, Cadastral, Geologic, Inland Water Resources, Recreation, Satellite Imagery, Environmental Monitoring, Biologic
Louisiana Geographic Information Center (LAGIC)	Biologic, Cadastral, Environmental, Economic, Elevation, Infrastructure, Transportation,

Louisiana Department of Environmental Quality	Hydrography, Geophysical, Satellite Imagery Water quality data

Table 4. Project Area-Specific Data Identified By Federal and State Agencies.

Agency	Data Available
USFWS-Cookville Tennessee Field Office	Endangered species & critical habitat areas in TN
Tennessee Wildlife Resources Agency (TWRA)	Mississippi River Annual Fish Survey: 1998 – 2004
Arkansas Game and Fish	Collecting fish community data and endangered pallid sturgeon data
Mississippi Department Wildlife Fisheries and Parks	Fish Sampling Data MS Museum of Natural Sciences – Natural Heritage Inventory
Louisiana Dept of Wildlife & Fisheries	Fish Sampling Data
Tennessee Dept of Environment & Conservation	Fish Tissue Data, Water Quality Data
Missouri Department of Conservation	Fish sampling data Natural Heritage Data- rare plants, animals and high quality natural communities Mussel sampling data for tributaries Public lands boundaries State Wildlife Action Plan Opportunity Areas
Arkansas Natural Heritage Commission	Rare plant and animal species inventory for AR

Table 5. Federal and State Agencies Reporting No Project Area-Specific Data

Agency	Data Available
U S Fish and Wildlife Service Arkansas Ecological Services Field Office-Arkansas Delta Suboffice	No project area specific data available
Yazoo- Mississippi Levee Board	No project area specific data available

5.5 PROBLEMS AND OPPORTUNITIES

A scoping meeting was held in Memphis, TN, on 13 May 2008. At that meeting federal and state agencies, non-governmental organizations (NGOs), and navigation and flood risk management interests were invited. Among the attendees were U.S. Fish and Wildlife Service, U.S. Environmental Protection Agency Regions 4 and 7, U.S. Geological Survey, Arkansas Department of Environmental Quality, Arkansas Game and Fish Commission, Arkansas Natural Heritage Commission, Arkansas Natural Resources Commission, Missouri Department of Natural Resources, Missouri Department of Conservation, Mississippi Department of Wildlife, Fisheries, and Parks, Mississippi Department of Environmental Quality, Louisiana Department of Environmental Quality, Louisiana Department of Wildlife and Fisheries, Kentucky

Department of Environmental Protection, Kentucky Department of Fish and Wildlife Resources, Tennessee Department of Environment and Conservation, Tennessee Wildlife Resources Agency, Mississippi River Corridor – Tennessee, Port of Memphis, Natural Resources Conservation Service, Yazoo-Mississippi Delta Levee Board, Mississippi Valley Flood Control Association, The National Audubon Society, The Nature Conservancy, Southeast Arkansas Levee District, and the St. Francis Levee Board. Over 40 people from these organizations attended and participated in breakout sessions where they identified potential concerns as well as ideas about the direction, scope and opportunities of this study. Participation at the meeting represented different interests in the LMRAV, and many of their concerns overlapped. Most concerns were with the environmental aspects of the study. Additional comments were received concerning recreation, economic opportunities, navigation and flood risk management. Cooperators expressed a strong desire to develop an understanding of the needs of the LMR and the LMRAV in order to identify existing data that could be utilized to facilitate its conservation and management. Identification of data gaps was also identified as a high priority aspect of the project. Specific concerns/opportunities identified at the scoping meeting (organized by topic) include:

- **Environmental**

1. Develop understanding of overall conservation needs in the LMRAV:

    a. create a model for river management that is environmentally and economically sustainable
    b. document land use changes
    c. support and encourage locally-led watershed management planning and implementation that include protection priorities as well as restoration priorities
    d. integrate states' watershed management priorities with federal priorities
    e. develop protection of wetlands through natural resources development
    f. identify data on endangered species in study area, habitat availability and deficiencies
    g. identify data on resident and migratory fish and bird populations in the study area, their habitat needs and relative habitat availability
    h. identify historical data on fish, wildlife and habitat
    i. identify data on levee maintenance techniques that could benefit wildlife and ecosystem function
    j. ensure new projects have full compliance with existing environmental laws and regulations

2. Compile list or database of existing natural resource habitat, water quality (point and non-point), and fish and wildlife information of the LMR and ID data needs

    a. increase public awareness of water quality status and fish and wildlife resources of the LMR
    b. invest in/increase research in large river ecology
    c. identify data hydrologic relationships between mainstem and tributaries as they relate to ecosystem function and stability

d. identify public use (fish and wildlife related) opportunities
e. identify public awareness needs (fish and wildlife related outdoor activities)
f. integrate/align with conservation efforts occurring in the Upper MS River

3. Provide a diversity of habitats within the LMR for fish and wildlife resources

a. conservation and preservation of natural habitat
b. improve habitat for wildlife and fisheries
c. fish/wildlife resource restoration, enhancement and management areas
d. gravel habitat conservation

4. Ecosystem management/restoration

a. floodplain restoration (hydrology: habitat)
b. bottomland hardwood ecosystem restoration
c. wetland and stream restoration
d. backwater/side channel conservation/restoration
e. riparian habitat conservation/restoration
f. protect/restore trust resources
g. floodplain/batture restoration (hydrology/habitat)

- **Navigation and Flood Risk Management**

1. Develop process to facilitate multiple use of the river

a. not impact or hamper the progress of MR&T projects
b. not dilute or adversely impact any public or private development that may become available now or in the future.
c. not give up control of mainline levee system and thereby endanger lives and property
d. determine impacts of low water flows on navigation – economic sustainability

- **Recreation**

1. Develop balanced approach to evaluate economic versus recreational usage and evaluate public use/access

a. document economic value and potential value of natural resource based tourism for the six LMR states
b. document existing recreational opportunities along the MS River and improve/develop outdoor recreation access opportunities along LMR
c. promote recreational opportunities (access and brochures, guides)
d. integrate recreational and cultural amenities

- **River Resources:**

1. Emphasize economic development, work force development and education, public outreach

    b. clarify public vs. private impacts to system (outside of the LMRRA project area)
    c. determine genuine interest of the public as a whole on financial support of effort
    d. develop an integrated library of geodatabases for the LMV that can be used for a wide variety of analyses on a watershed scale
    e. all projects and activities undertaken through this initiative should be voluntary public-private partnerships
    f. identify data hydrologic relationships between mainstem and tributaries as related to ecosystem function and stability; a comprehensive study of the AR-White-MS Rivers is needed to address erosion and headcutting problems that are causing environmental damage and endangering maintenance of the McClellen-Kerr AR River navigation system
    g. evaluate tributary contribution/connections
    h. educate public on river issues and the values of the river

- **Issues Identified Through This Study**

Issues identified during the course of this study and through external scoping include

- Existing data are not easily accessible and there are gaps that exist in the data needed to manage LMR resources

Opportunities: Compile a comprehensive natural resource database that incorporates existing data into a common format available to the public. Design studies/collect data on federally threatened and endangered species in the project area, state species of special concern, monitoring and evaluation of LMR habitat restoration projects. Conduct a watershed study to analyze holistic impacts of habitat restoration projects.

- Conservation of existing LMR habitat

Opportunities: Conserve gravel bars in the LMR, protect tributaries from headcutting, conserve wetlands and oxbow lakes.

- Natural resource habitat loss in the mainstem LMR

Opportunities: Restore aquatic habitat in the LMR by reestablishing flow in secondary channels, restoring water levels to oxbow lakes, and restoring floodplain habitat.

- Assess water quality conditions in the LMR

Opportunities: Conduct systematic water quality monitoring in the LMR to ensure that data are consistent.

- Assess public access points on the LMR

Opportunities: Construct boat ramps within the LMRRA project area so that the public may access the LMR.

- Assess LMR recreational areas

Opportunities: Create additional recreational areas in the project area; link existing recreational areas and trails.

- Issues relating to safety for river-related recreation

Opportunities: Promote/support recreational safety programs. The LMRCC completed a draft LMR Fishing Guide that contains a section on boating safety in large rivers and contact information for federal and state boating safety courses. Input has been solicited from the navigation industry on interaction between commercial navigation vessels and recreational boaters. The U.S. Coast Guard also offers information about boating safety, lists the Navigation Rules, and offers boating safety classes online at http://www.navcen.uscg.gov/mwv/navrules/navrules.htm.

- Reduce Gulf hypoxia

Opportunities: Support the MS River/Gulf of Mexico Watershed Nutrient Task Force Action Plan. Use practices in planning projects that contribute to the plans goals.

- Conduct watershed planning and management for the LMR.

Opportunities: Perform watershed planning to more effectively define management objectives across the LMRAV and identify management techniques to meet those objectives.

5.6 POTENTIAL STUDIES AND PROJECTS

The LMRRA study team reviewed the 239 ecosystem restoration projects previously identified by the states and determined that they could be implemented in the LMR leveed floodplain in conjunction with the Corps of Engineers' management of the LMR. These projects resulted from the Mississippi River Conservation Initiative (MRCI), a state-level conservation planning process initiated by the Lower Mississippi River Conservation Committee (LMRCC). In 2001, a workgroup comprised of the six LMRCC-member states, USACE, and several federal and private sector partners (Partners) was established. The Partners conducted public meetings in Arkansas, Kentucky, Louisiana, Mississippi, Missouri, and Tennessee to discuss potential restoration of the LMR ecosystem's nationally significant natural resources. During the period 2001- 2004 they identified 239 aquatic habitat restoration projects and public access needs that would: 1. rehabilitate the Lower Mississippi River leveed floodplain ecosystem, 2. expand public recreational opportunities, and 3. stimulate natural resource-based economic development in the LMRAV region.

Throughout the MRCI planning process and compilation of the LMRRA report, the study team has remained cognizant of the fact that the activities it proposes be conducted within the context of the Corps of Engineers' Congressionally mandated navigation and flood risk management missions. MVD and District Channel Improvement Teams, comprised of river engineers and biologists, interacted with the workgroup to ensure that navigation and flood management would not be negatively impacted by any recommendations included in this report.

In 2006, the 239 projects identified in the MRCI planning process were incorporated into the Restoring America's Greatest River Plan, a landscape-scale conservation plan that will facilitate ecosystem restoration in the LMR leveed floodplain and natural resource-based economic development benefits to riverside communities. Construction of high priority aquatic habitat restoration projects was cooperatively begun by the USACE Memphis District and MVD, USFWS, and LMRCC in 2006. To date, four projects have been constructed - Island 63 Secondary Channel (Mississippi) in 2006, Redman Point – Loosahatchie Bar (Arkansas – Tennessee), Kangaroo Point (Arkansas), and Below Ludlow (Arkansas) in 2008. Cumulatively, these four project have improved >20 miles of degraded secondary channels by restoring controlled flow through them. Pre- and post-construction monitoring of responses of biological organisms to improvement of habitat conditions in the rehabilitated channels is being conducted by state natural resource management agency biologists, USACE Engineer Research and Development Center research biologists, and MVD and Memphis District biologists, and other conservation organizations. The Memphis District River Engineering Team is also conducting post-construction potomology assessments of the four projects.

Table 6 lists the number of projects for each state by river reach while Table 7 identifies the potential projects by restoration type. A list of all project locations and descriptions is included in Appendix F.

Table 6. State-Level Conservation Planning Meetings Conducted in the Project Area and Numbers of Projects Identified by River Reach During the Mississippi River Conservation Initiative

State	River Reach	MRCI Meeting	# Projects
Tennessee	RM 897 – RM 715	November 2001	28
Missouri	RM 954 - RM 828	September 2002	26
Kentucky	RM 954 – RM 897	October 2002	15
Arkansas	RM 828 – RM 507	May 2003	64
Mississippi	RM 715 – RM 305	November 2003	80
Louisiana	RM 0 – RM 506	March 2004	46

Table 7. Type and Number of 239 Potential Ecosystem Restoration Projects Identified During the Mississippi River Conservation Initiative

Habitat Project Type	**Number of Projects**
Notch Dikes	86
Restore Secondary/Side Channel Flow	22
Restore Hydrology	33
Install Water Management Structures	22
Assess Need for Habitat Restoration Potential	17
Conserve/Restore Gravel Bars	11
Improve Access	30
Acquire Public Access Lands	10
Remove Sediment and Contamination	4
Drain/Deepen Borrow Areas	3
Other	1
TOTAL PROJECTS	**239**

The next authorized phase of the LMRRA is a watershed study that would analyze construction of the 239 projects identified by the MRCI workgroup and develop a comprehensive plan for management of the LMR. Prior to construction, project feasibility studies would be conducted to analyze each alternative in detail and determine that no adverse impacts to the USACE's navigation and flood risk management missions would occur. In addition, studies would be conducted during the watershed phase to determine the holistic impacts on the project area if all potential projects were constructed. In 2002, the USGS developed an FY04 LMR Budget Initiative specifically for aquatic resource research in the LMR leveed floodplain. The proposed budget (Appendix G) outlines study scopes and associated costs but would need to be updated for the watershed study. The USACE MVD developed a database of land use in the batture; however, these data were collected in 1992 and require an update. The USGS also drafted a proposal in the fall 2008, for mapping the LMR batture areas (Appendix H). These studies would provide information to develop a management plan for the LMR that encompasses existing habitat and habitat restoration.

An important component of the watershed study would be establishing a comprehensive natural resource database. Although data are available from numerous sources, they are often incomplete, disparate, and not readily accessible to resource managers and policy makers. Establishing criteria for inclusion in and use of such a database would include several important factors, such as consideration of metadata standards, access to the data access sharing among the stakeholders and interagency team, and determination of most effective type(s) of database to be used by the planning team..

5.7 NATIONAL OBJECTIVES

The national or federal objective of water and related land resources planning is to contribute to National Economic Development (NED) consistent with protecting the Nation's environment, pursuant to national environmental statues, applicable executive orders, and other federal planning requirements. Contributions to NED are increases in the net value of the

national output of goods and services, expressed in monetary units. Contributions to NED are the direct net benefits that accrue in the planning area and the rest of the Nation.

The USACE has a second national objective for Ecosystem Restoration in response to legislation and Administration policy. This objective is to contribute to the Nation's ecosystem through ecosystem restoration, with contributions measured by changes in the output of ecosystem goods and services of value to human society.

5.8 PLANNING OBJECTIVES

The planning objectives for land and water resources in the LMRRA project area include the following:

1. Conduct a watershed management study to develop a comprehensive land and water resource management plan that does not impact the authorized navigation and flood risk management activities
2. Restore wetland, stream, river, lake, and riparian habitat
3. Improve public access to waterbodies
4. Support/promote recreational safety in the LMR
5. Protect rare/unique aquatic resources (e.g., listed species)
6. Reduce soil erosion and sediment loading/nutrient loading to the LMR
7. Support existing LMR plans/programs that improve water quality, and reduce Gulf hypoxia
8. Stabilize stream channels
9. Collect data necessary for river-related management

5.9 PLANNING CONSTRAINTS

Planning constraints include ecological, economic, engineering, legal, and administrative constraints. Legislation or rule making imposes other constraints. Planning constraints include the following:

1. All applicable federal, state, and local laws, regulations, and policy.

2. The scope and products of the reconnaissance study as stated in WRDA 2000, Section 402.
3. Funding and time limits.

4. Restriction to water and related land resources in the LMR basin.

5. The existing population, land use, communities, and economy in the LMRRA project area.

6. The existing constructed water resources projects in the LMRRA project area.

7. The climate, geology, soils, and native biota of the LMR.

5.10 ALTERNATIVES

5.10.1 Watershed Management Plan for the LMRRA Project Area

A comprehensive LMR management plan encompassing facets of river management, including, but not limited to, flood risk management, navigation, ecosystem restoration, and recreation would be developed. Although significant natural resources remain intact in the LMR, their conservation needs to be assured. The watershed study would consist of studies to help determine the cumulative impacts of constructing the 239 habitat restoration/recreation projects created by the LMRCC and make recommendations on future management of the river. The watershed study would also provide recommendations on how to improve habitat in the project area, protect/improve habitat for federally listed species, and promote best management practices (BMPs) for future work. These BMPs will aid in improving water quality and aquatic habitat in the LMRAV, but the sediment load in the Mississippi River will still be capable of supporting Louisiana coastal restoration efforts. A literature search for nutrient and sediment loads from these areas will be conducted during the watershed study, and a mass balance analysis will be conducted for the project area, as it impacts the Gulf of Mexico. Holistic effects of constructing restoration projects would also be analyzed in the watershed study, (i.e. effects on river management, hypoxia, water quality, climate change, hydrology. etc.). The study will work in concert with other LMR programs and initiatives, including ongoing USACE projects and studies and efforts by other federal, state, and local agencies/organizations.

Cost estimates and study parameters for this effort are indeterminate. This necessitates further definition of study goals and revision of the scopes and costs of proposed studies, during the development of the PMP.

5.10.2 Feasibility Studies for Construction

With appropriate authority and funding, multiple feasibility studies could result from the reconnaissance study. Studies would include analysis of the 239 projects proposed by the LMRCC for construction and could be organized by RMs, type of project, by state reach, etc. If interest is shown in conducting any feasibility studies, this report will be supplemented to provide detail for these studies.

5.11 PRELIMINARY EVALUATION OF ALTERNATIVES

5.11.1 Resource Significance

The Mississippi River flows 2,339 miles from Lake Itasca, Minnesota to the Gulf of Mexico and serves as the Nation’s major commercial navigation artery. It is a nationally significant resource and ranks third in size among the world’s rivers, encompassing 1.25 million square miles (41% of the continental United States) in 31 States and 2 Canadian Provinces. It is a major highway for commerce, an extensive corridor for wildlife, the fourth longest river in the world, and largest river in North America. At its mouth in the Gulf of Mexico, the Mississippi River supports 4.5 million acres of coastal marsh. The coastal areas (prairies and marshes) are an ecological extension of the forested alluvial valley and together form a wetland complex of

unrivaled scope in the temperate zone of the western hemisphere. The Lower Mississippi River and its tributaries encompass the largest floodplain fishery (>91 species of freshwater fish have been reported) and the largest BLH in North America. River - BLH forest floodplain connectivity during the annual hydrological cycle is critical to many species of large river fishes because it increases the availability of food resources and provides critical spawning and nursery areas requisite for maintaining populations. Oxbow lakes within the leveed floodplain that typically provide the most productive recreational fishing are being degraded. Their outlet channels, which are hydrologically connected to the mainstem of the river, are deepening with each flooding cycle. As flood waters return to normal levels, water levels in these lakes are often of such poor quality and diminished in area to the extent that fish kills occur during low water.

Prior to European settlement, there were approximately 24.6 million acres of swamps, bayous, and BLH, most of which were presumably wetlands regularly inundated by the floodwaters of the Mississippi River and its tributaries. Although different classification schemes and inventory techniques were often used, most studies indicate a rapid rate of wetland loss in the United States, at least prior to the 1970's (Giudice and Ratti 1995). Federal flood risk management projects, agricultural economics, and climatic conditions within the LMRAV have influenced BLH conversion outside the immediate study area (U.S. Department of Interior 1988). By the late 1940's, only 10.5 million acres remained in the LMRAV (Table 8). By the 1980's, only 5.3 million acres remained, <22 percent of the original acreage. The wetlands of the LMRAV are among the most important, but most seriously depleted and threatened, in the U.S. Nationwide wetland losses have reached 50 percent, but nearly 80 percent of the original wetlands in the BLH region of the LMRAV have been lost (U.S. Department of Interior 1988). Other authors (Mitsch and Gosselink 1986) also reported that the greatest wetland losses in the U.S. were occurring in the LMRAV. Although it was estimated the losses would continue at a rate of 2 percent per year (U.S. Department of Interior 1988), there were 1.3 million more acres of forest in the LMRAV in 2001 than there were in the 1980's. The importance of the LMRAV's forested wetlands was stressed in a report to Congress by the Secretary of the Interior.

These BLH areas are prime wintering grounds for waterfowl and numerous other migratory birds (60% of all bird species in the U.S. migrate through the LMRAV) that utilize the river as the core of their migratory corridor. Nearly 40% of North America's waterfowl utilize the Mississippi Flyway. More than 80 percent (2.5 million) of the 3.0 million mallards utilizing the Mississippi Flyway and nearly 4 million wood ducks are dependent on its BLH to meet some or all of their annual life cycle requirements. The river and its predominantly forested, 2.8 million-acre leveed floodplain provide an extensive array of habitat diversity and serve as a 954-river mile long travel corridor for seasonal movements of numerous aquatic and terrestrial species of wildlife.

Table 8. Pattern of BLH Acreages in the LMRAV since the late 1940's

Years(s)	Acres	Percent of the LMRAV
1940's	10,524,552	43
1970's	6,382,893	26
1980's	5,354,256	22
1990's	5,917,582	24
2001 (Mature stands only)	6,135,793	25
2001 (with reforestation)	6,613,464	27

The study area covers portions of seven states along the LMR and will provide a vehicle for multi-agency collaborative planning and resultant watershed plan to Congress could provide a platform to make recommendations for long-term institutional measures, forecast data needs, determine recreational demand, explore habitat restoration opportunities, ascertain financial resource needs, and influence public policy directives along the LMRAV. The LMR is a nationally significant ecosystem, critical to waterborne commerce, waterfowl management, and economic development in countless river communities. Restoring BLH corridors to connect larger tracts would provide habitat for black bear (USFWS 1995). Notching dikes and restoring side channels would provide spawning habitat for pallid sturgeon (USFWS 1993). Opportunities to restore hydrology to oxbow lakes would improve habitat for aquatic resources. There are opportunities to restore geomorphic processes within the LMR basin. Two hundred thirty-nine potential projects identified during the reconnaissance study could enhance current productivity on LMR by reestablishing significant habitat diversity (LMRCC 2000). This study also contributes to goals of North American Waterfowl Plan (1986), White River\Lower Arkansas River Landscape Conservation Project (Lynch et al 1992), LMRCC LMR Aquatic Resource Management Plan (2000), the USFWS LMR Joint Venture (LMRJV) mission, and the Action Plan (LUMCON 2008).

Although freshwater ecosystems are the central component of sustainability in the LMRAV, the scope of freshwater-related environmental issues in the LMRAV is so broad as to be beyond the ability of any single discipline, institution, or agency to resolve. Effective management of the LMR's natural resources is especially problematic because, rather than flowing entirely within any one state, it forms a common boundary between the six states that comprise the Lower Valley. Although responsibility for managing the LMR is shared by several federal agencies (USACE, USEPA, USGS, USFWS), the primary responsibility for providing flood risk management to the LMRAV and maintaining a commercial navigation channel is assigned to the USACE MVD.

5.11.2 Preliminary Estimate of Project Costs

5.11.2.a Watershed Management Plan for the LMRRA Project Area

The authorized total cost for the watershed study is $2,500,000 (50% federal funds and 50% non-federal funds). The authorizing language in Section 402 of WRDA 2000 authorized $1,750,000 to complete the study. Implementation guidance from HQUSACE in 2003, stated that $500,000 in federal dollars would be used to complete the reconnaissance study. After the reconnaissance report is approved and feasibility cost share agreements are initiated, the

remaining federal funds ($1,250,000) would be used to prepare a watershed assessment. This assessment would be cost shared 50/50 with a non-federal sponsor whose in-kind credit may not exceed 25% of the total cost of the study (USACE 2003).

5.11.2.b Real Estate Costs

Appropriate real estate costs as defined in ER 405-1-12 will be developed during the watershed phase of the study for any additional feasibility studies identified, and real estate plans will be developed during the feasibility phase. Acquisition of private lands required for project construction would be from willing sellers only.

5.11.3 Preliminary Estimate of Project Benefits

5.11.3.a Integrated Watershed Analysis

Existing land uses, projected decreases in regional population, and further loss of internationally significant wetland habitat in the Nation's largest riverine ecosystem could further degrade environmental and social values in the LMRAV region. Conducting an integrated watershed analysis of the LMRAV region would provide a current assessment of the data and information needed in three primary Lower Mississippi River-related areas: 1. river management; 2. environmental condition, and 3. public recreational needs. The proposed watershed study represents a holistic approach to system-wide management of the LMR.

Effective long-term competition in a rapidly emerging global economy requires that countries worldwide incorporate environmental, as well as economic, objectives into their sustainable water resources development planning processes. To achieve the Nation's vision of developing comprehensive, multiple-basin water resource engineering solutions with broad-based stakeholder participation the USACE consistently must utilize an objective, science-based approach. This watershed study will identify river management data needs that will be used to facilitate decisions of national importance related to USACE general investigations to determine the feasibility of needed improvements, construction of new facilities, and maintenance and operation of existing systems. Federal and state agencies and NGOs would provide assistance during the study and contribute data. Actions identified during the watershed study outside USACE authorities may be addressed under other agencies/organizations' missions.

The watershed study will facilitate a system-wide, comprehensive assessment of the status of the LMR's nationally significant natural resources; identify critical management needs; provide biological data to guide long-term management and conservation efforts; and, propose strategies for evaluating and monitoring progress of ecosystem management and restoration efforts without impacting authorized navigation and flood risk management activities. Completion of the watershed study will result in the acquisition of presently unavailable data that will enable planners to make science-based decisions about managing the Nation's largest riverine ecosystem. Data collected during the watershed analysis and subsequent studies could also be utilized to compile a comprehensive study of the LMR, the most recent of which was published by the USACE in 1974. Implementation of the watershed study recommendations in the LMR ecosystem will increase the distribution and abundance of aquatic and terrestrial

wildlife resources, including four federal trust species; increase biodiversity and, enhance water quality in the LMR and Gulf of Mexico.

Despite an abundance of relatively unique natural resource assets, the LMRAV persists as one of the Nation's most economically distressed regions. River access and recreation needs data collected during the watershed study will be of substantial value in clarifying the viability of a natural resource-based economic development solution as a means to increase the quality of life in the region.

This strategy is based on the premise that conservation of the natural resources within the river's leveed floodplain will be beneficial in promoting outdoor recreation and environmental tourism. This approach could be used in the LMRAV. Geotourists in the United States are projected to increase from 55 million in 2003 to 100 million in 2010; by 2010, international tourist arrivals worldwide are projected to reach 1 billion annually and generate $2 billion in revenue daily. Nature tourism has been identified as the fastest growing market segment (5% worldwide) in the international tourism industry.

6. ADDITIONAL PROJECT INTERESTS

There are many other areas of interest in the LMRAV. Numerous resource agencies/organizations are interested in areas outside the LMRRA project boundaries, such as the restoration work in the portion of the Lower Arkansas River that connects to the Mississippi River, constructing/planning navigation and flood risk management projects in the LMR, and headcutting and erosion problems in other tributaries of the LMR. These interests could be addressed under existing USACE authorities, or they could be studied under additional authorities and appropriations. Other interests could be studied/constructed by other agencies/organizations under their authorities.

7. FEDERAL INTEREST

7.1 GENERAL

The Mississippi River's watershed is third largest among the world's rivers. The active floodplain encompasses approximately 1.8 million acres; including 1,600 lakes and 145 river side-channels. The LMRAV supports 241 species of fish, 50 species of mammals, 45 species of reptiles and amphibians, and 37 species of mussels. Four federally endangered species are found within the project area. Scientists estimate that nearly 40% of North America's waterfowl and 60% of all bird species migrate through the river valley. There are numerous protected areas within the LMRAV (Table 9), including State and federal parks, wildlife management areas, and forest areas. Interests in the basin include flood risk management, hydropower, navigation, environmental restoration and protection, and recreation.

Table 9. Acres of protected areas in the counties in the LMRAA project area

Type of Area	Acres
Vegetated Land Areas	58,884
Wildlife Management Areas	769,259
National Forest Areas	81,063
National Park Areas	20,778
National Wildlife Refuge Areas	541,612
Total	**1,471,596**

The LMR is a major highway for commerce that provides much of the nation's oil, gas, and food and provides a major corridor for wildlife including federally threatened and endangered species and state species of concern. Because of these natural resources and their economic development potential, there is federal interest in conducting a watershed study within the LMRRA project area.

Though the watershed study will concentrate on identification and quantification of problems and opportunities, it is likely that additional tools that can be identified for use in meeting ecosystem restoration objectives will be developed. There are over 35 USACE civil works projects (Table 10) in the project area and approximately 1.5 million acres of federal or state-owned natural areas within the LMRRA project area. Improvements to these projects and lands are in the federal interest.

Structural and nonstructural measures could be considered by the USACE as future projects or implemented by other federal, state, or local governments. These alternatives would be further analyzed in the watershed study to determine the cumulative impacts for the entire LMRRA study area, and federal interest in their implementation. Each of the alternatives could then be examined for implementation authority; many of the alternatives may be recommended for funding and implementation under existing authorities, such as the Continuing Authorities Program (CAP) of the USACE.

Table 10. Civil Works Projects within the LMRRA Study Area

Project	**State**	**Main Waterbody**
MS River Levees	Multiple	MS River
MS River Channel Improvement	Multiple	MS River
MS River Levees - Maintenance	Multiple	MS River
St. Johns Bayou/New Madrid Floodway	MO	MS River
Memphis Harbor	TN	McKellar Lake
Grand Prairie Area Demonstration Project	AR	White River
Helena, Phillip County Harbor	AR	MS River
White River Backwater	AR	White River
Bayou Meto	AR	AR River
Upper Yazoo Projects	MS	Yazoo River
Vicksburg Harbor	MS	MS River
Claiborne County Port	MS	MS River
Ouachita/Black Navigation Project	AR, LA	Red, Ouachita, Black Rivers

J. Bennett Johnston Waterway	MS, LA	Red River
Lower Atchafalaya Basin Floodway System	LA	Atchafalaya River
Baton Rouge/Devil's Swamp	LA	MS River
Donaldsonville to the Gulf	LA	Bayou Lafourche, Barataria Basin, MS River
Morganza to the Gulf	LA	MS River
Alexandria to the Gulf	LA	Atchafalaya River
Lake Providence Harbor	LA	MS River
Madison Parish Port	LA	MS River
Elvis Stahr Harbor	KY	MS River
Northwest TN Harbor	TN	MS River
New Madrid County Harbor	MO	MS River
Caruthersville Harbor	MO	MS River
Osceola Harbor	AR	MS River
Wolf River Harbor	TN	MS River
Helena Harbor	AR	MS River
White River Navigation	AR	White River
White River Comprehensive Study	AR	White River
McClellan-Kerr AR River Navigation System	AR	AR River
Mouth of Yazoo River	MS	Yazoo, MS Rivers
Yazoo River	MS	Yazoo River
Yazoo Basin, MS Delta Headwaters Project	MS	Yazoo River
Atchafalaya Basin Floodway System	LA	Atchafalaya River
Coastal Wetlands Planning, Protection & Restoration Act Program	LA	Gulf of Mexico

7.2 INTEGRATED WATERSHED ANALYSIS

The watershed perspective, per Policy Guidance Letter No. 61, applies to all Civil Works programs through planning, design, construction, operation, maintenance, restoration, rehabilitation, and regulatory activities. The application of this perspective into the Civil Works program encourages opportunities for enhancing the operations and maintenance of existing projects, especially the management of the natural resources. Because there are more than 35 civil works projects in the LMRRA project area, and some of these projects encompass a large portion of the MR&T civil works project. Additionally, there are approximately 1.5 million acres of federal and states lands, and the four federally endangered species within the LMRRA project limits shows a federal interest in conducting the study. The federal interest will be determined by the analytical framework founded on factual scientific, social, and economic information, allowing for the assessment, evaluation, and comparison of alternative plans, including positive and negative effects on economic development, the environment, and social well-being. Additionally, this includes identification of future water resource use demands, including local, tribal, regional, and national goals and the evaluation of the monetary and non-monetary trade-offs.

8. PRELIMINARY FINANCIAL ANALYSIS

8.1 INTEGRATED WATERSHED ANALYSIS

Non-federal sponsors will be required to provide 50 percent (25% cash, 25% in-kind services) of the watershed study cost. Sixteen letters of support, five letters of intent and two letters of non-support for the watershed study have been received to date. Letter of intent offered $2,000 in cash and $135,000 of in-kind services for the watershed study. Copies of all letters are in Appendix I. The MRC also made comments on the final draft prior to revision. Their letter is included in Appendix J.

The watershed study will involve multiple state agencies, local agencies, and non-profit organizations that could contribute cash and/or in-kind services. The LMRCC has expressed interest in participating in the watershed study as a non-federal sponsor. The PDT anticipates that six states along the LMR (AR, KY, LA, MI, MO, and TN) will participate under the LMRCC. Specific expectations on cost share will be developed in the PMP for the study.

9. SUMMARY OF WATERSHED ASSUMPTIONS

The following criteria assumptions will provide a basis for the feasibility study(ies):

1. A PMP(s) and FCSA(s) will be executed for a watershed study addressing the LMRRA project area. The products of this study will provide information to conduct detailed alternative analyses of proposed projects and recommend future studies to develop a comprehensive management plan for the LMR.

2. Multiple PMPs and FCSA would be executed for feasibility studies that develop from the reconnaissance report and the watershed study.

10. WATERSHED STUDY MILESTONES

Given the geographic scope of the area, the sensitivity and value of the resource, and the extremely large number of stakeholders, it is estimated that a study of this magnitude would take at least three years to complete. The proposed watershed study for the LMRRA project area is subject to availability of funds. Both federal and non-federal funding would need to be obtained before the watershed study could be initiated. The milestone schedule for the watershed study is shown in Table 11.

Table 11. Draft Milestone Schedule for Watershed Study Scheduled to Begin in the Third Quarter of 2010 Subject to Appropriations

	Draft Schedule for Watershed Study	Year 1				Year 2				Year 3			
ID	**Task Name**	Qtr 1	Qtr 2	Qtr 3	Qtr 4	Qtr 1	Qtr 2	Qtr 3	Qtr 42	Qtr 1	Qtr 2	Qtr 3	Qtr 4
1	Start Project												
2	Initial Stakeholder Meetings												
3	Define Scope of Watershed Study												
4	Identify Desired Future Condition												
5	Initial Technical Team Meetings												
6	Identify Data Needs												
7	In-Progress Review with MVD												
8	Collect Data												
9	Identify Alternatives to Meet Desired Future Conditions												
10	Identify Future Scenarios for Analysis												
11	In-Progress Review with MVD												
12	Coordinate Results with Stakeholders												
13	Prepare Draft Watershed Management Plan												
14	Review Draft Watershed Management Plan												
15	Agency Technical Review												
16	Revise Plan												
17	Deliver Final Watershed Management Plan												

11. STUDY COST ESTIMATES

11.1 INTEGRATED WATERSHED ANALYSIS

The total cost for the watershed study is $2.5 million (50% federal, 50% non-federal). Generalized costs for study activities are listed in Table 12.

Table 12. Watershed Study Analysis and Planning

	Activity	**Cost (1,000s)**
1	Planning & Project Management	$400
2	Identification of Study Goals/Objectives	$600
3	Coordination	$200
4	Baseline Data Collection	$600
5	Future Scenario Formulation and Analysis	$400
6	Report Preparation	$300
7	Total	**$2,500**

11.2 FEASIBILITY STUDIES FOR CONSTRUCTION

Cost estimates for any identified feasibility studies would be presented in a supplement to this 905(b) report.

12. POTENTIAL ISSUES AFFECTING INITIATION

12.1 WATERSHED STUDY

This 905(b) report includes letters from the project stakeholders. Letters were sent to potential sponsors requesting support or Letters of Intent in June 2009. Appendix I contains letters that address both interest and concerns for the study. Comments were also received from the Mississippi Valley Flood Control Association stating opposition of the project. These comments (Appendix I with letter of non-support) were addressed.

Based on these letters, the potential non-federal contributions for the watershed study are $2,000 in cash and $125,000 of work in-kind. Due to the large project area and number of potential non-federal sponsors, building FCSA(s) for the total cost of the watershed study is a potential issue affecting its initiation.

13. RECOMMENDATIONS

We recommend that this 905(b) analysis report be approved as a basis for proceeding with the following studies in the LMRRA project area.

1. Conduct a comprehensive, integrated watershed analysis for the LMRRA study area that meets the requirements of WRDA 2000, Section 402 and investigates opportunities for aquatic restoration and recreation while ensuring current levels of flood risk management and navigation are maintained.

Conducting an integrated watershed analysis at the LMRRA study area level would facilitate better management of the watershed, identify specific opportunities for the USACE and other stakeholders to work more effectively together, and result in the integration of the efforts of a wide range of agencies currently working independently to conserve the LMR's natural resources.

Remaining tasks in the reconnaissance phase include developing PMP(s) and finalizing FCSA(s) with the non-federal sponsors. The watershed study of the studies would begin upon

execution of cost sharing agreements and receipt of federal and non-federal funds. It is also recommended that this report serve as the basis for future reconnaissance studies not specifically described herein. Supplemental 905(b) analyses would be developed, as appropriate and additional opportunities arise.

There are sufficient indications that cost-effective solutions to watershed management in the LMRRA project area can be formulated that will result in appropriate environmental outputs for the identified project costs. These potential solutions are consistent with Army and budgetary policies, and the projects meet criteria for federal participation in project implementation. No project that would adversely impact navigation and/or flood risk management would be implemented under Section 402. Real estate for project construction would be obtained from willing sellers only.

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