LMRRA

Lower Mississippi River Resource Assessment

ASSESSMENT OF

INFORMATION NEEDED FOR RIVER RELATED MANAGEMENT

June 2013

Draft for Public Review

This Report was prepared in partnership with:

Executive Summary

This report assesses information needed for river-related management on the lower Mississippi River from Cairo, Illinois at its confluence with the Ohio River to the Head of Passes in Louisiana. The investigation was authorized in the Water Resources Development Act of 2000. The Nature Conservancy – Great Rivers Partnership is the lead study sponsor.

The study team identified issues raised during scoping; examined river management activities; and collated information sources. These steps revealed four areas of information needs for river management. The information needs are related to sediment, water quality, data storage and availability, and tributary management.

Many of the world's great rivers have sediment monitoring and management plans, but there is not one for the Mississippi River. Sediment is both a management problem and a valuable asset in the river. Sediment monitoring has not been done consistently on the Lower River. A systematic monitoring and measuring protocol and the development of predictive sediment models would give river mangers the tools to develop a sediment management plan. This would benefit flood risk management, navigation, fish and wildlife, coastal habitat, water supplies and Gulf of Mexico hypoxia.

Clean water is vital to the nation's economy. Water quality in the Mississippi River is generally good and continues to improve, but monitoring is not well coordinated among the seven states along the Lower River. The sources and fates of nutrients, pathogens and contaminants in the river have not been clearly delineated. A coordinated water monitoring and analysis program for the river and tributaries would give managers the tools to make informed decisions and develop comprehensive management plans to continue improving water quality. This would benefit fish and wildlife, recreation, water supplies, coastal habitat and Gulf of Mexico hypoxia.

Data availability is important for all river management. Much of the data for the Lower River is held in agency files and databases. A substantial amount of historic data only exists as paper files and maps that can only be accessed in person. River managers either make decisions without some information, or invest resources to generate information that may already exist. A centralized data management system that stores some information and provides linkages to the rest would give river managers and the public access to the best information available. This is vital to improved management of water quality and sediment.

Tributaries are some of the most significant sources of nutrients and sediment to the main-stem of the Lower Mississippi River. There has been very little geomorphic analysis of non-navigable tributary streams to better understand how they interact with the river. Tributary river restoration will be a necessary part of enhanced water quality and sediment monitoring programs and overall watershed based approaches for the systems. It is important for water quality, sediment, hypoxia, habitat, and fish and wildlife management.

This assessment is the first of three to be completed under the Lower Mississippi River Resource Assessment. A recreation needs assessment and a natural resource habitat needs assessment are to follow. These three assessments will be combined into a comprehensive plan to guide management of the Lower Mississippi River.

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I. Introduction

The Mississippi River watershed drains all or parts of 31 states and 2 Canadian Provinces. It is the third largest watershed in the world and it overlies one of the three most productive agricultural zones on the planet. The combination of a highly productive agricultural area and a large navigable river increases the value of the land and resources within the basin. The watershed of the river produces 92 percent of the country's agricultural exports.

The River creates $105 billion worth of U.S. Gross Domestic Product; provides drinking water for more than 18 million people; transports 62 percent of our nation's agricultural output; delivers nearly 400 million tons of coal and petroleum products annually; and directly supports one million jobs and millions more indirectly.

There are 124 cities and towns with a total population of over 3 million people living directly along the main stem of the Mississippi River from its headwaters to the Gulf of Mexico.

The Lower Mississippi River begins at its confluence with the Ohio River and extends 975 miles to the Gulf of Mexico. The Lower River is naturally navigable and includes no locks or dams. The Mississippi River and Tributaries Project levees, floodwalls, backwaters and floodways form the largest and most comprehensive flood risk management system in the world.

The Mississippi Flyway hosts over 300 species of migrating birds and over 20 threatened or endangered species rely on the habitat in the Lower River.

The area includes internationally recognized tourism markets; e.g. Memphis, the Mississippi Delta, and New Orleans.

Interest in the Mississippi River has been increasing over the last few years. Government agencies, industries, municipalities and non-governmental organizations are joining forces through America's Inner Coast Summit, America's Great Watershed Initiative and the Mississippi River Cities and Towns Initiative, to promote the river and highlight its needs.

The Mississippi River Commission recognized this new focus and developed a 200-year working vision for the river to insure that people can continue their lives on the Mississippi River. The vision balances the nation's needs for security and flood damage reduction with environmental sustainability and recreation, infrastructure and energy, water supply and water quality, and navigation. They committed to five goals for the Mississippi River to insure its value for future generations.

Lead secure lives on the river or tributary

Enjoy fresh air and the surrounding fauna, flora, and forests while hunting, fishing, and recreating

Travel easily, safely, and affordably

Drink from and use the abundant waters of any river, stream, or aquifer

Choose from an abundance of affordable basic goods and essential supplies that are grown, manufactured, and transported along the river to local and world markets

The Lower Mississippi River Resource Assessment will follow this vision and help to develop some of the tools necessary to implement it. This part of the Lower Mississippi River Resource Assessment considers the information river managers need to make decisions consistent with the Commission's 200-year vision.

Congressional Authority

The Lower Mississippi River Resource Assessment (LMRRA) is authorized by Section 402 of the Water Resources Development Act (WRDA) of 2000, Public Law 106-541. It 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.

Relevant Documents

The United States Army Corps of Engineers (USACE) Headquarters provided implementation guidance on 12 Feb 2003 and 6 June 2010 (Appendix A). Policy guidance for the project includes ER 1105-2-100 (Planning Guidance Notebook), EC 1105-2-411(Planning: Watershed Plans) and Policy Guidance Letter 61(Application of Watershed Perspective to Corps of Engineers Civil Works Programs and Activities).

The USACE Environmental Operating Principles and the Campaign Plan ensure sustainable environmental practices, command priorities, and transformation initiatives. http://www.usace.army.mil/Missions/Environmental/EnvironmentalOperatingPrinciples and http://www.usace.army.mil/About/CampaignPlan

A Lower Mississippi River Resource Assessment Reconnaissance Report was approved in 2010. (http://www.mvm.usace.army.mil/projects/LMRRA/Approved%20Section%20905(b)%20Analysis.pdf). It describes river and tributary conditions in the Lower Mississippi River (LMR) and includes a list of previous studies and reports about the river. The information in that report is not repeated here, but it established the foundation to continue the investigations.

Study Purpose

The purpose of the three Lower River assessments is to develop a strategic approach to managing habitat restoration, recreational opportunities and the information needed to make river management decisions. Historically, the Mississippi River has been managed primarily based on its navigation utility and flood risk management needs. There has been very little strategic planning for the river's other uses. The study area contains important habitat and recreational resources that deserve more focus.

The purpose of this first assessment is to address the information needs for the management activities that are ongoing or anticipated in the study area.

Goal

The goal of this first assessment is to identify the information needed to make river-related management decisions in a more holistic and sustainable manner and make it available for use.

Problems

Information has not been gathered, stored or analyzed to enable strategic decision-making. Various entities have generated river information to address specific interests. There is a need for more strategic management of the river and its inter-related issues.

River information is hard to find. Data is typically scattered among diverse government agencies, environmental organizations, industries and institutions. An integrated database or decision support system does not exist. System-wide assimilation and assessment of data is difficult.

Opportunities

Identify the information river managers need to make strategic decisions.

Compile river-related information and make it accessible.

Objectives

a. Evaluate the information needs of river managers.

b. Identify information gaps that could be filled to better guide Mississippi River projects for the foreseeable future.

c. Compile a list of available information that may be of interest to river managers and users now and into the foreseeable future.

d. Develop a strategy to make the river data accessible and maintain it for future users.

Study Area

The study area extends from River Mile 953 of the main-stem Mississippi River channel south of Cairo, Illinois, downstream to River Mile 0 (Head of Passes) in Louisiana (see map on page 7). The area encompasses the main river channel and the area between the Mississippi River and Tributaries project levees or natural high ground (batture), including the mouths of all tributaries between the levees. The study boundary extends 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; 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 floodway system in Louisiana is included in the study area.

Partnership

The Nature Conservancy (TNC) Great Rivers Partnership is the study sponsor. TNC signed legally binding agreements with a group of NGO (Non-Governmental Organization) partners who are providing Work-In-Kind services for the study. They are: The Nature Conservancy State Chapters (Tennessee, Louisiana and Mississippi), Lower Mississippi River Conservation Committee (LMRCC), National Audubon Society, Delta Wildlife, Mississippi River Corridor - Tennessee, and Mississippi River Wildlife. Collectively these groups represent thousands of river users. All of these groups focus on sustainable river management and conservation. The specific mission of each organization is given in Appendix B. The study team includes staff from these organizations.

The LMRCC is a coalition of 12 state natural resources conservation and environmental quality agencies representing Arkansas, Kentucky, Louisiana, Mississippi, Missouri and Tennessee. It

provides the only regional forum dedicated to conserving the natural resources of the Lower Mississippi River floodplain and focuses on habitat restoration, landscape level conservation planning, and natural resource-based economic development. The United States Fish and Wildlife Service (USFWS) leads the effort and provides a full time coordinator. The United States Geological Survey (USGS), USACE, United States Environmental Protection Agency (EPA), and United States Department of Agriculture Natural Resources Conservation Service (NRCS) are cooperating agencies.

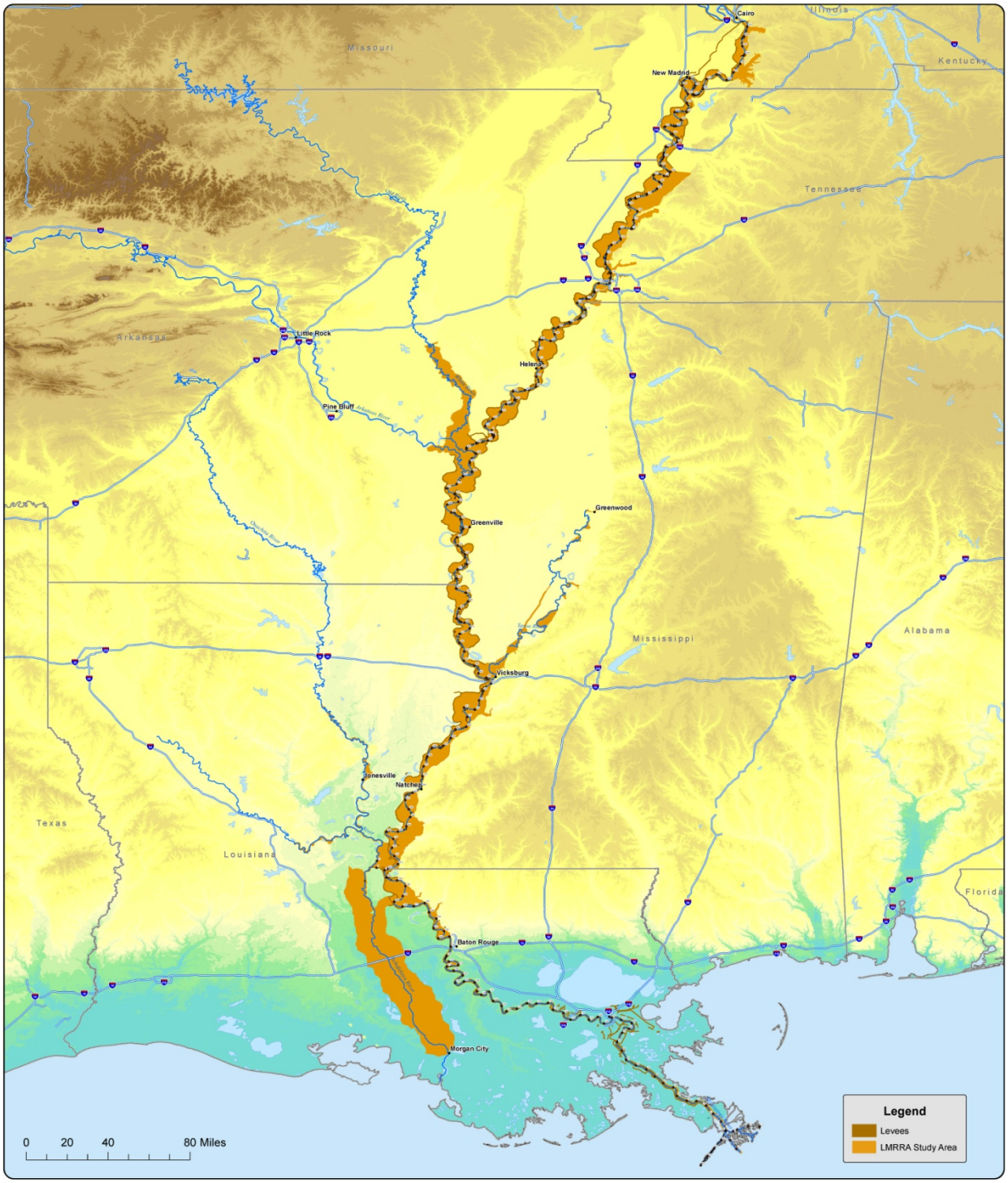
Methodology

The team defined "information needed for river-related management" as currently unavailable information that river managers would use to make risk-informed decisions to implement projects and conduct operations in the LMR. Information may be unavailable because it does not exist, is of too poor quality or it is not accessible to managers.

The team did three things to identify information needed. They asked a general audience (public meetings) what information they believed was lacking for the Mississippi River (Section II of this report). They worked with river managers to describe river management and identify information gaps (Section III). They searched agency files and university libraries and consulted with experts to compile a list of published articles, databases, GIS layers and websites containing study area information. This list was categorized and examined for information gaps (Section IV and Appendix E).

US Army Corps of Engineers ®

LOWER MISSISSIPPI RIVER RESOURCE ASSESSMENT STUDY - OVERVIEW



II. Areas of Concern

The Mississippi River is a large, diverse and valuable resource. A lot of river knowledge lies within universities, companies, agencies, organizations, and the public.

The team conducted public meetings (see Appendix D), created a website, posted a Facebook page, used their own professional expertise and interviewed academics, researchers, industry leaders and others to identify the areas of most concern. The need for habitat improvement and the lack of recreational access were mentioned frequently and will be thoroughly addressed in the second and third assessments of this project. Four general issues related to information needs were identified consistently across a broad range of respondents.

Sediment

Sediment in the Mississippi River comes from erosion throughout the watershed, runoff from agricultural lands and urban areas, and in-channel scouring both in tributaries and the main channel. The USACE spends up to $170 million annually dredging excess sediment accumulations from navigation lanes and harbors. Shoaling can change flowlines in localized areas. Sediment is necessary to build sandbars, maintain stable channels and rebuild coastal marshes. It also plays a role in Gulf hypoxia.

Sediment quantity and grain sizes vary. Sediment is valuable in some areas and detrimental in others. River sediment volume and movement is not consistently monitored or quantified. Additionally, no analysis tool exists to analyze sediment sources, sinks and movement in the system. River managers need more information to develop a strategic sediment management plan to efficiently remove sediment from the areas where it is detrimental and move it to the areas where it is valuable.

Water Quality

Water quality in the Mississippi River is good and steadily improving, but the general public perception is that water quality in the river remains poor. Conflicting advisories on fish consumption add to the public's misperception. River managers recognize the need to develop education and outreach tools for the general public to explain or rate water quality. America's Great Watershed Initiative is working to develop a report card for the river to facilitate communication and understanding.

Nutrients and other water quality constituents can enter the Mississippi River from both point and non-point sources including air deposition. There are storm sewer systems, industrial discharges and agricultural runoff. Excess nutrients can lower dissolved oxygen in the river and stress fish. They also contribute to Gulf of Mexico hypoxia and eutrophication in side channels and oxbows. Contaminated water can affect fish and amphibians, require more treatment for drinking water, and carry human pathogens. The combination of nutrients and contaminants can lead to changes in water color and odor that can be off-putting to recreational users.

River managers need more information to develop consistent fish consumption advisories, regulate point and non-point sources, plan for treating drinking water, inform recreational users,

and understand amphibian and fish health. It may also be possible to better manage the batture to increase nutrient attenuation. Some of this information is also necessary for management of Gulf of Mexico hypoxia as described below.

Gulf of Mexico Hypoxia

Nutrients come from many sources as described above. The LMR serves as the collection point and conduit that transports nutrients from the entire Mississippi River watershed directly into the Gulf of Mexico.

An hypoxic zone forms in the northern Gulf of Mexico every summer. It has been as large as 5.5 million acres. Excess nutrients and seasonal stratification of Gulf waters cause the hypoxia. High concentrations of nutrients, especially phosphates and nitrates, promote excessive growth of algae. As the algae die and decompose, high levels of organic matter and the decomposing organisms deplete the water of available oxygen. Further, warm, fresh river water is less dense and remains above the colder, saline deep Gulf water. Stratification prevents the mixing of oxygen-rich surface water with oxygen-poor water on the bottom of the Gulf. Without mixing, oxygen in the bottom water is limited and the hypoxic condition remains. Hypoxic conditions stress and kill bottom-dwelling organisms and drive fish from the area.

The information needs outlined above in the water quality discussion include the necessary information for better management of Gulf of Mexico hypoxia.

Data Storage and Availability

Universities, government agencies, organizations and individuals have been studying and monitoring the many resources of the Mississippi River for nearly 200 years. This information is stored in paper files, proprietary electronic systems, and accessible databases (Appendix E). It is likely that much information has already been lost or destroyed.

There is no centralized data repository available to river managers or the public. A lot of research and mapping was done prior to the advent of GIS and that data has not been geo-referenced and converted to make it usable for managers. The available databases are not spatially or temporally comprehensive.

River managers make decisions using the best information that is available to them, but they have no way of knowing if it is the best that exists. Managers frequently must invest money and time collecting information that may have already been gathered. The public is less inclined to use the river because they cannot find answers to some of their questions.

River managers need a centralized data clearinghouse that catalogs and or stores all available information. This will insure managers have the best available information and will not invest time or money in collecting redundant data. It will also provide the public with the information they need to better connect with the river and understand its value.

III. RIVER MANAGEMENT

River management has made the river more predictable, safe and useful. The river is still subject to huge variations in water levels. Floods and droughts will continue and there will be times when the river is limited for navigation and times when it challenges the capacity of the levees in some areas. River management requires cooperation among federal and state agencies, local governments, industry, and the general public. Appendix B lists these organizations and describes their missions.

River management is a continuous process that must adapt to meet the commercial, agricultural, environmental, cultural, and societal needs of an ever-changing nation. The Mississippi River Commission's 200-Year vision for the Mississippi River Watershed describes the quality of life that can be achieved along this river. Bringing this vision to fruition will require active management of flood risks, navigation, habitat, fish and wildlife, tributaries, recreation and tourism, coastal areas, power, water supply, groundwater, water quality, and other site specific projects.

This section of the report describes these management categories. The types of information river managers need are listed and any gaps are indicated. The information categories listed are further described in Section IV of the report.

Flood Risk Management

USACE cooperates with local levee boards and drainage districts to provide flood risk management within the study area. The USACE channel improvement program accounts for most of the physical work in the river. The program integrates flood risk management and navigation requirements in the design of dikes and revetments and during dredging operations.

On June 28, 1879, Congress created the seven-member Mississippi River Commission, an advisory and consulting body responsible to the Chief of Engineers. The Presidentially appointed Mississippi River Commission has developed and matured plans for the general improvement of the Mississippi River from the Head of Passes to the Headwaters. In its current capacity, the Mississippi River Commission is charged with the implementation of the comprehensive Mississippi River and Tributaries (MR&T) Project, authorized in the Flood Control Act of 1928. The four major elements of the MR&T Project are levees for containing flood flow, floodways that provide room for excess flows to relieve stress on the levee system, channel improvement and stabilization that provide an efficient and reliable navigation channel while protecting the integrity of the levee system, and tributary basin improvements that improve interior drainage and maximize the benefits of the mainline levee system. The general duties of the Commission include recommendations on policy and work programs, the study of the necessity for modifications or additions to the flood risk management and navigation project, recommendations upon any matters authorized by law, inspection trips, and regular public hearings on the river.

The MR&T Project has been amended and expanded numerous times. The current system includes 3,787 miles of levees and floodwalls, four floodways and many river training structures

such as dikes and chevrons. The system is 89% complete and the uncompleted parts are primarily levees that are below grade and areas that need seepage control.

The MR&T Project reduces flood risk in the 36,000 square-mile Lower Mississippi River Alluvial Valley. It is the world's largest flood risk management project. The project features are designed to control a project design flood, which is the largest flood that has a reasonable probability of occurrence. It is a flood larger than the record floods of 1927 and 2011. Below the confluence with the Ohio River near Cairo, the project flood is estimated at 2,360,000 cfs. Following major high water events like that one, the design flood is reviewed to assess its adequacy and determine if there is a need to review the design flowline.

The MR&T Project levee system reduces flood risk for approximately 4 million people. USACE constructed (or improved existing) levees and local interests maintain them. Federal government assistance is available as necessary during and after major floods. Periodic levee inspections are done to insure they are in good condition and will function properly during floods. The river is surveyed every year for depth and areas of sediment aggradation and degradation are identified. Significant aggradation could alter localized flowlines.

Flood risk managers use climatic, cultural and historic, economic, geomorphic, and hydrologic information to make decisions about project construction, operation, and maintenance. Gage data is the most valuable information available to river managers. River stages combined with meteorological data are the basis for USACE and National Weather Service (NWS) forecasts.

The 2011 Post-Flood Report describes the operation and performance of the system during the 2011 flood event. The report includes many recommendations to improve system operation and performance. It identifies gages for specific areas, model improvement, an online environmental database for access to environmental information, developing consistent water quality monitoring, mapping nuisance and invasive species that may spread during floods, mapping areas with poor cell phone coverage, and development of a data center to compile and preserve information.
(www.mvd.usace.army.mil/Missions/FloodRiskManagement/RegionalFloodRiskManagementProgram/MRTPostFloodReport.aspx)

The significant information needs identified in the Post Flood Report echo needs identified during scoping – water quality monitoring, and data access and storage. Flood risk managers could also use better tools to track sediment aggradation and its affect on flowlines.

Navigation

The USACE manages the Lower Mississippi River navigation system. It connects to a network of inland navigable waterways, which form a system of about 12,350 miles in length, not including the Gulf Intracoastal Waterway. There are slack water, swift water and deep water harbors and fleeting areas in the system. The entire waterways system includes the Ohio, Missouri, Illinois, Arkansas, White, Red, Ouachita/Black, Yazoo and Tennessee Rivers. It extends into the agricultural Midwest and the industrial east, bringing products from Memphis and New Orleans to markets in Pittsburgh, Kansas City, Chicago and the rest of the world. The port of New Orleans is the number one grain port in the world.

The Rivers and Harbors Act of 1824 directed the removal of snags and other obstructions from river channels. This was the beginning of navigation management on the Mississippi River.

In 1896, Congress authorized a navigation channel 9 feet deep and 250 feet wide at low water between Cairo and Head of Passes. In 1928, the width was increased to 300 feet, and in 1944, the authorized channel depth from Cairo to Baton Rouge was increased to 12 feet at low water. In 1945, after the mouths of the Mississippi River had been opened and maintained in a navigable state, Congress authorized a channel for oceangoing traffic in the lower river.

The USACE maintains a 9-foot deep channel in the Mississippi River above Baton Rouge; a 40- foot channel from Baton Rouge to Philadelphia Point (Donaldsonville); and a 45-foot channel from there to the Gulf of Mexico. Maintaining this channel requires river-training structures like dikes, bank stabilization structures (revetments), and dredging. Every year the river is surveyed using sonar. The information is loaded into a GIS system and used to determine the priorities for dredging and building new structures.

Port Authorities manage the harbors on the Mississippi River in coordination with the USACE and the United States Coast Guard (USCG). The harbors are surveyed annually. The USACE dredges harbors within budget constraints according to priorities. Tonnage of cargo moved through the harbors determines priorities. When the USACE budget does not support dredging all of the harbors, the local harbor authorities work together to fund and manage dredging. The expansion of the Panama Canal will likely bring changes to the cargo shipped on the Mississippi River. It is likely more container barges will be moved on the river. Many harbors will have to expand their facilities to handle them. These changes may also spur changes in security at harbors along the river.

Navigation channels are managed on many of the tributaries – the Arkansas/White, Ouachita/Black, and Red Rivers. These channels are dredged, but otherwise maintenance is less intensive than on the LMR unless a specific problem is found.

A natural cutoff between the lower White and Arkansas rivers was closed during development of the navigation system to make it more reliable. A new cutoff developed in the 1970s and 1980s in the Melinda Channel-Owens Lake corridor that spawned construction of the Arkansas/White Cutoff Containment Structure. The structure requires frequent maintenance. A cutoff would cause significant need for dredging and dangerous cross-flows where the Arkansas River flows into the White River. A cutoff would potentially re-route the flow from the lower 10 miles of the White River into a non-navigable reach of the Arkansas River cutting off navigation between the Mississippi River and the 445-mile Arkansas River navigation system.

The USCG marks the active channel and regulates commercial barge traffic on the river. The USACE and USCG cooperate to facilitate barge movement during extreme events. Temporary

traffic closures are occasionally enforced in specific areas to allow flood fight operations or removal of hazards exposed at low water. The USCG sets and enforces commercial vessel regulations and responds to emergencies.

Navigation managers use aquatic, climatic, cultural and historic, economic, geomorphic, hydrologic, and sediment information to make decisions about construction, operations, and maintenance. Managers could use more sediment data and analysis tools.

Habitat Management

Most of the land within the study area is privately-owned. Lands are managed for crops, pasture, forest products, and wildlife and waterfowl habitat. Some landowners do not manage the land for any particular use. There are hunting clubs scattered throughout the study area.

The NRCS is providing technical and financial assistance to landowners for water quality and wetlands improvement projects in the Lower Mississippi River Basin. They plan to restore over 11,000 acres to wetland habitat and prevent sediment and nutrients from entering waterways, decrease flooding, and improve bird and fish habitat. Approximately two thirds of this acreage is within the batture. The Wetlands Reserve Enhancement Program, part of the agency's Wetlands Reserve Program, provides the funding. Since 2010, the NRCS has formalized agreements with 47 landowners in the Mississippi River Basin, investing $17.8 million in long-term conservation easements and wetland restoration projects.

The USACE works with the USFWS and NGO partners to notch dikes and has restored flow to 40 miles of side channels. The USACE also constructed weirs at Tunica Cutoff and Lake Perry Martin to restore oxbow water levels.

There are National Wildlife Refuges in the project area (e.g. Cat Island & St. Catherine Creek) and many state Wildlife Management Areas (WMA). Each refuge and WMA has a management plan with a long-term vision, goals, and objectives. The management plans typically include a 5-10 year implementation plan and best management practices for ongoing activities.

Habitat managers use aquatic, climatic, cultural and historic, economic, geomorphic, hydrologic, terrestrial, and water quality information to construct, operate, and maintain projects. Projects should be monitored to determine if they are functioning as planned and to inform designs of future projects. Overall, habitat management is accomplished as opportunities arise and no system wide plan for managing terrestrial habitats in the entire corridor exists. The LMRCC has developed the Restoring America’s Greatest River Plan which identifies potential aquatic habitat restoration projects.

The LMRRA Habitat Needs Assessment will develop a plan for habitat in the study area and consider the need for a potential natural vegetation analysis for the batture among other things.

Fish and Wildlife Management

The USFWS and the individual states monitor populations of game species and set hunting and fishing regulations to manage their populations. Duck hunting, deer hunting and fishing are popular activities in the area. There is some commercial fishing and mussel harvesting as well. Trapping is still common in the Atchafalaya Basin.

There are a variety of federally listed Threatened and Endangered species which are known or believed to occur in the project area or immediately adjacent to it. They include Mussels (Alabama heelsplitter, fat pocketbook, Louisiana pearlshell, orangefoot pimpleback, pink mucket, rabbitsfoot, scaleshell), Plants (Decurrent false aster, Geocarpon minimum, pondberry), birds (brown pelican, interior least tern, ivory-billed woodpecker, piping plover, red-cockaded woodpecker, Sprague's pipit), mammals (Indiana bat, Louisiana black bear), and fish (pallid sturgeon, relict darter). The USFWS has prepared Recovery Plans which detail the life history, habitat needs, threats and status for all of these species. The National Marine Fisheries Service also manages several listed marine species which occur just outside the study area (West Indian manatee, leatherback sea turtle, Kemp's Ridley sea turtle, hawksbill sea turtle, green sea turtle, gulf sturgeon). Individual specimens of these species occasionally enter the project area (e.g. a manatee made it to Memphis, TN in 2006) but they are managed as marine species.

Fish and Wildlife Managers use aquatic, climatic, hydrologic, terrestrial, and water quality information to manage populations. They also coordinate with flood risk managers, navigation managers and others to insure their projects do not impact threatened or endangered species. Many of the fish and mussels in the river depend on the connected habitat in the tributaries for spawning, rearing, and other life stages. Managers need more information on the habitat quality in these tributaries.

Tributary Management

Most of the tributaries that feed the LMR lie primarily within a single state. These rivers receive more direct attention from the states than the Mississippi River does. The rivers generally have a single designated use under the CWA. The quality of water these rivers deliver into the Mississippi is well monitored and most efforts to improve water quality are focused here. The Mississippi River exerts an influence on these streams and many experience some backwater flooding. Changes in the Low Water Reference Plain of the Mississippi River can cause aggradation or degradation in the tributary channels. These channels are not monitored as part of the annual bathymetric surveys of the navigable rivers and there is no information regarding the habitat changes that may be occurring in these rivers in response to changes in the Mississippi

River channel. Fish and mussels in the main channel rely on habitats in these tributaries to support some life stages. Scouring in the tributary channels is a significant source of sediment for the Mississippi River.

Tributary managers use aquatic, cultural and historic, economic, geomorphic, hydrologic, sediment, terrestrial, and water quality information to manage tributaries. They could use more information about how changes in the low water reference plain affect the tributaries.

Recreation Management & Tourism

A variety of Federal, state and commercial entities provide recreation facilities along the LMR. Most of these facilities were built in conjunction with other projects or where opportunities existed. Commercial enterprises and NGOs are working with local governments to expand and develop tourism and ecotourism throughout the LMR.

The major recreational activities on the water are fishing, boating, canoeing, kayaking, river cruises and gambling. Activities along or near the river include picnicking, camping, birding, sightseeing, photography, wildlife watching, bicycling, horseback riding, running, and hiking. There are numerous cultural festivals in the river towns and competitive boating, skiing and kayaking events. Commercial enterprises now offer opportunities to combine paddling (canoe or kayak), birding and wildlife viewing, photography and historic and cultural interpretation. Recreational opportunities are constantly changing; the American Queen resumed cruises on the river two years ago.

Recreational use of the Mississippi River is increasing. Safety on water bodies is always a concern. The USCG keeps records of accidents and provides safety training and information for boaters to avoid accidents with commercial vessels. In the LMRRA project area, including IL, MO, KY, TN, AR, MS and LA, there were four collisions on the Mississippi River in 2011 involving recreational vessels; three in IL and one in MO. All of these accidents involved motorized watercraft. Over the last three years, there were no collisions on the River between recreational and commercial vessels.

There are a variety of recreational facilities and attractions in place including: boat ramps, fishing piers, picnic areas, trails, campgrounds, RV parks, observation areas, riverside parks, scenic byways, museums, blueways, historic sites, casinos, and river boat landings. There are also several cultural trails – Blues Trail, Boudin Trail, Gumbo Trail and the Great River Road.

Recreation managers use aquatic, cultural and historic, economic, terrestrial and water quality information to manage and promote recreation and tourism in the LMR. The third LMRRA assessment will consider recreational access needs and will use Statewide Comprehensive

Outdoor Recreation Plan (SCORP) data, demographics, and recreational trend data to prioritize needs for new facilities. The assessment will also consider such issues as: how far apart should canoe/kayak access ramps be, what kinds of surfaces are necessary for the various types of trails, what types of amenities are necessary for recreational users, how far will people drive to recreate, how much do they spend, what safety issues are associated with each activity etc. Much of this information can be developed locally in partnership with user groups. This information will be useful to develop a strategic plan for locating facilities.

Coastal Management

Historically, the Mississippi River discharged fresh water and sediments into southeastern Louisiana estuaries like Breton Sound and the Barataria Basin. Over time these alluvial deposits created vast subdeltas and diverse coastal wetlands habitats. Human activities and natural forces have reshaped coastal Louisiana over the past three hundred years. Since the 1930s, over 1,800 square miles of coastal wetlands have eroded in Louisiana. Factors contributing to this problem include storms, subsidence, sea level rise, development, energy exploration and production, navigation channels, and flood works. Today, the LMR carries less sediment than in the past and levee systems prevent most of the available sediment from entering the estuaries. The management of freshwater and sediment offers opportunities for ecosystem restoration in the coastal marshes.

Coastal managers use aquatic, hydrologic, sediment, and water quality information. The USACE and the Louisiana Coastal Protection and Restoration Authority plan, construct, operate, and maintain diversion structures along the Mississippi River to divert some of the freshwater and sediment back into the estuaries north of Head of Passes (and in some cases below). The operational analysts need data on sediment size, quantity, and timing in the Mississippi River. Much of this data is not available. Efforts are underway, through the Louisiana Coastal Area Program's Mississippi River Hydrodynamic and Delta Management study, to collect river information and to use it in the development of science and engineering tools to support joint USACE-Louisiana coastal ecosystem restoration planning.

Gulf of Mexico Hypoxia

The Mississippi River/Gulf of Mexico Watershed Nutrient Task Force was established in 1997 to understand the causes and effects of eutrophication in the Gulf of Mexico; coordinate activities to reduce the size, severity, and duration of the hypoxia; and ameliorate its effects. The Task Force includes five Federal agencies – USACE, USDA, DOI (Department of the Interior), EPA, and NOAA (National Oceanic and Atmospheric Administration) – twelve states and the tribes. The primary priority of the Federal agencies is to provide broad support to the development and implementation of the state prepared nutrient reduction strategies.

The Task Force has identified five priorities: 1) monitoring to demonstrate water quality progress; 2) in-basin and Gulf modeling to demonstrate water quality progress; 3) regulatory program activities; 4) outreach, education, and initiatives; and 5) innovation to expand partnerships and technical assistance. A variety of programs and tools are being used and improved to accomplish these priorities. They include: the Mississippi Atchafalaya River Basin

Monitoring Collaborative, Gulf of Mexico Hypoxia Monitoring Implementation Plan, the Water Quality Portal, The Midwest Stream Quality Assessment, National Water Quality Assessment Program, National Stream Quality Accounting Network, Cooperative Water Program, Conservation Effects Assessment Program, Water Quality Index for Agriculture Runoff, Spatially Referenced Regressions On Watershed attributes, Decision Support System, Ecosystem Forecast Roadmap Initiative, Discharge Monitoring Report Pollutant Loading Tool, Advanced Nutrient Monitoring, and many others.

The NRCS has recently developed and released two new technical standards for edge-of-field water quality monitoring. They serve three purposes: 1) evaluate conservation system performance; 2) validate and calibrate models; and 3) inform on-farm adaptive management.

A number of initiatives and projects are underway throughout the basin to reduce nutrient input into the river. USDA Agricultural Research Service scientists developed a new field study that applies poultry litter to fields in shallow bands, reducing runoff of excess phosphorus and nitrogen. Since 2005, over $1 million has been provided to landowners in Arkansas for installation of on-farm structures to reduce sediment and nutrient runoff. Public participation and interest has created additional opportunities for implementation of nutrient reduction programs in other Mississippi River tributary watersheds. Many of the states in the basin are developing nutrient reduction strategies.

The NOAA provides the scientific foundation for hypoxic zone management in the Gulf of Mexico. NOAA research led to enhanced predictive models, and provides information on how hypoxia affects commercially and ecologically important species in the region. These models integrate oceanographic physical data and coastal biogeochemistry to improve quantification of the duration, timing, and extent of the hypoxic zone, and their relationship to causative factors such as nutrients and stratification. These model predictions of complex processes will continue to allow for the comprehensive assessment of alternative management strategies to mitigate hypoxia in the Gulf of Mexico.

Mangers use aquatic, climatic, geomorphic, hydrologic, sediment, and water quality information to manage hypoxia. Coordinated water quality monitoring would help managers assess the impacts of management initiatives and develop new ones.

Energy and Power

The Mississippi River is important for national energy security. It is a major corridor for shipping coal, fuel, and agricultural crops for ethanol. The river also supplies water for power plants.

The Lower Mississippi River does not have any main-stem hydropower facilities. Development of hydrokinetic power on the Mississippi River is just beginning and is expected to expand. Submerged turbines will harness energy from flowing water without dams or diversions. There are numerous designs being tested for installation on the river. Most of the proposals locate the facilities near cities with easy access to the existing power grid.

Managers will use hydrology information and site-specific data (bathymetric surveys, location of other features, etc) to determine the feasibility of installing these devices. They will have to be located in areas with sufficient flow to operate, but they must also be located in areas where they will not interfere with navigation or other uses.

Water Supply and Groundwater

The LMR supplies 11 billion gallons of water per day for industrial and agricultural use. Most of this water is self-sourced and the users maintain the necessary infrastructure. Water users monitor river stages during low water and some sought emergency permits to modify the intake elevations as river stages dropped to near historic lows in 2012.

Public water supply systems drawing on surface water have $51 million in annual revenues.

There are 13 municipal water supply facilities that provide more than 140 million gallons of drinking water per day to approximately 500,000 people in the greater New Orleans area. Drinking water for this area is provided from the Mississippi River. The 2012 drought lowered water levels in the Mississippi River allowing saltwater to intrude farther up the river than usual threatening the city drinking water and affecting water intakes in the surrounding areas. By design, when saltwater intrusion is an issue, the USACE plan is to construct a temporary low water sill in the river to prevent saltwater intrusion from affecting the city. During construction river salinity levels increased causing the Point A La Hache and Port Sulphur intakes to shut down and reduced production capacity at Belle Chase. The USACE barged 3 million gallons of water per day to provide water to the affected communities while the sill was under construction. Salinity levels decreased when the construction was complete and the communities returned to normal operations. This has been done before to protect the New Orleans drinking water and supply the surrounding areas.

The Mississippi embayment is a basin that slopes toward the Gulf of Mexico and is filled with sediments of alternating sand, silt, and clay layers. There are two principal aquifers in the embayment—the Mississippi River Valley alluvial aquifer and the middle Claiborne aquifer. The shallow alluvial aquifer is the primary source of groundwater for irrigation in the largely agricultural region. The deeper middle Claiborne aquifer is a primary drinking water source.

Groundwater dominates domestic public supplies in most parts of the LMR corridor. Memphis uses 175 artesian wells to supply water to an estimated 250,000 commercial, industrial, and residential customers in Shelby County, TN. Memphis is the largest city in the study area to rely on aquifer supplied water alone.

The Mississippi River Valley is one of the three most productive agricultural areas in the world. Cotton, soybeans, corn, and rice are the main crops and all require irrigation. Irrigation water is drawn from both surface and groundwater. The Lower Mississippi Valley is the second largest area of groundwater depletion in the United States. Projects are under construction on the Arkansas and White Rivers to divert river water for irrigation and reduce the reliance on groundwater. Similar projects may be implemented in other areas to insure safe drinking water supplies.

Water supply and groundwater managers use climatic, economic, groundwater, hydrologic and water quality information. Groundwater research is ongoing.

Water Quality Management

Nutrients and contaminants enter the Mississippi River from both point and non-point sources including air deposition. There are storm sewer systems, industrial discharges and agricultural runoff. The basin contains sewage treatment plants, old pesticide factories, landfills and many other contaminant sources. The water coming into the river may contain nitrogen, phosphorus, cadmium, mercury, chlordane, atrazine, PCB, *E.coli* and many other nutrients and contaminants. The river, side channels and batture lands attenuate some of the nutrients that enter the river.

Water quality regulations were set forth in the Clean Water Act. The EPA delegates most of the responsibility for enforcing the Act to the individual states. Each state has broken the Mississippi River into segments and designated uses for each segment. Water quality standards have been established to protect the existing and designated uses. The states conduct water quality monitoring and periodically report the status of compliance with attainment/non-attainment of the water quality standards. Not all of the states conduct monitoring on the Lower Mississippi River. The Clean Water Act in 1972, spurred more water quality monitoring for the Lower River. Monitoring data are housed in EPA's STORET (storage and retrieval) database and are readily available for download over the internet.

In addition to Clean Water Act-driven water quality monitoring, various Federal agencies have conducted water quality sampling for more than 100 years. Typically, the sampling was short-term and focused on specific problems and research questions, although some was more general with the goal of providing a river-wide "snapshot" picture of water quality conditions. Much of the USGS data are available through the National Water Information System database. The USACE and EPA studies and some USGS data are not available through widely-accessible portals, though typically they are published in internal and external reports and publications that can be accessed at technical libraries. Hypoxia in the Gulf of Mexico, as described previously, is now driving much of the water quality monitoring and research on the Mississippi River.

Site Specific Management

Most of the management activities mentioned above are large scope projects that can be managed comprehensively. Almost all of these activities will at some point require site specific management, analysis, and possibly permitting. Permits are the main tool for protecting water quality, wetlands, and endangered species. Permits are required for intake pipes, discharge

pipes, fleeting areas, and any construction along the bank or in a wetland. Information needed to design and analyze these projects is gathered from the specific sites at the time the activity is proposed. Projects also need to be monitored after construction to determine if they are functioning well and to guide design and implementation of future projects.

River Management Initiatives

The value of the Mississippi River is well recognized. Numerous initiatives, task forces and studies are underway to increase understanding of the resources and collaboration among the river users (Appendix C). They are gathering, generating, and analyzing data; and developing models and analysis tools. Some of the initiatives are broad ranging like the America's Great Watershed Initiative ("a collaboration that seeks solutions for meeting the multiple demands placed on the vast and complex Mississippi watershed system by integrating issues, partners and ideas at the full watershed scale"). Others are focused on a single issue like the Mississippi River Gulf of Mexico Watershed Nutrient Task Force (Hypoxia Task Force) and the Mississippi River Embayment Regional Aquifer Study. There are many efforts focused on single site opportunities like the Harahan Bridge Project.

River initiatives will use all of the river data available to analyze, design, and market projects. Funding from grant organizations is available for project implementation and is already being used for a variety of projects in the area. Strategic plans are often a requirement for qualifying for grant funding. The Habitat and Recreation Assessments will produce strategic plans and help agencies and non-governmental organizations leverage public money with private money to accomplish many projects.

IV. DATA

It is not surprising that a river as large and important as the Mississippi has been studied, inventoried, monitored, measured, analyzed, evaluated, and researched extensively. It is surprising that this information remains scattered among hundreds of agencies, universities, non-profit organizations, and individuals.

The words "data" and "information" are often used interchangeably, but they are not the same. Data are raw facts that can be measured or described and without analysis or context is not useful. For example, water quality measurements may find a dissolved oxygen concentration of 3 parts per million (ppm) in a particular location. That is data. Managers cannot use that fact to make decisions. Information is created when data is analyzed, processed and placed into a context. Trout need at least 6 ppm to survive so the particular location mentioned above is not suitable for trout. That is information managers can use to decide whether or not to stock trout.

The intent of this assessment is to identify information needs. This section of the report describes data to determine its utility for decision-making. Much of this data has been analyzed and processed to answer specific questions, but it may not support decision-making on other issues. Some of it can be placed into a different context and used. In some cases, a lot of data exists on a particular topic, but the analysis tools are not sophisticated enough to process the data into information. The utility of most of this information depends on consistent monitoring. The Mississippi River is a dynamic system and conditions change over time. Models are constantly being developed, adjusted, and improved. The need for better analysis tools may be part of the information needed.

Appendix E contains lists of over 750 references, databases, websites and geospatial layers related to the Lower Mississippi River. Over one hundred scientists, professors and agency professionals were given the opportunity to review this list and provide additions. The information has been organized into categories (sometimes two categories) and described. River managers use this information to make decisions about construction, natural resource protection, operations, maintenance, marketing, and innovations.

Aquatic (188 references)

The aquatic information references include publications on species life histories, habitat models, species distribution, marcoinvertebrates, recreational and commercial fishing, and a variety of other topics. The USFWS and states maintain databases of fisheries data. The Mississippi River remains of interest to universities and resource agencies and data gathering and monitoring is likely to continue subject to budgetary constraints of the various agencies and institutions.

There are several invasive aquatic species which are of concern to river managers – carp (silver, grass, bighead, & black), Asiatic clams, zebra mussels, hydrilla and northern snakehead. Common carp is also an invasive, exotic species, but it was released into the system about 100 years ago and is often overlooked.

Fish and wildlife managers are always developing more information about the fish, reptiles, amphibians, and invertebrates endemic to the study area. Information helps managers protect, restore, and enhance habitats for these species. The information currently available on aquatic resources is useful to protect these species, but management will improve with more information. Species distribution and populations are dynamic and surveys should continue to monitor changes. Invasive species have likely not reached their full areal or numerical extents and need to be monitored more closely. Research should also continue to develop and support control of these species.

Climate (5 references)

The NOAA gathers and maintains climate data and analyzes patterns and trends. The Climate Prediction Center (CPC) of the National Weather Service (NWS) compiles data on historic and current atmospheric and oceanic conditions, El Niño Southern Oscillations, Tropical Intraseasonal Oscillations, Arctic Oscillation, Tropical Atlantic Hurricane Potential, Tropical East-Pacific Hurricane Potential and other climate patterns such as the North Atlantic and Pacific Decadal Oscillations, and stratospheric ozone and temperature. They produce daily and monthly data, time series and maps for various climate parameters, such as temperature, snow cover and degree days. The CPC monitors the Medium Range Forecast model outputs, multiple member ensemble runs, and experimental parallel model runs. This helps the CPC forecasters determine where and under what regimes the models perform well and not so well.

Precipitation data is linked to river stage data and the NWS works with the USACE to prepare for floods and low river levels on the Mississippi River. The climate information that is available supports decision-making, but the models are constantly being improved. Research into changes in climate and weather patterns is ongoing. Managers will continue to use the most up-to-date information available.

Cultural and Historic (8 references)

Information on recorded archaeological sites (site forms and mapped locations), historic properties (National Register eligible archaeological sites/buildings/structures), National Register of Historic Places listed sites (archaeological and architectural nomination forms), and National Historic Landmarks is available to Federal agencies as needed. Some of this information is sensitive and is not released to the general public to protect the sites from damage.

The National Park Service maintains the National Register. Under Section 106 of the National Historic Preservation Act, undertakings such as construction projects occurring on Federal lands, as well as those where Federal agencies provide funding or issue licenses or permits for actions on non-Federal lands, including tribal, state, municipal, and private property require review as to their impact on cultural resources. These often include surveys to identify and evaluate archaeological and historic sites for their eligibility for listing in the National Register.

Consultations are required among stakeholders, including the State Historic Preservation Officers (SHPO), on ways that any adverse affects on those sites can be avoided, minimized or mitigated. States also have their own applicable preservation laws. SHPOs and Federal agencies are charged with the protection of sensitive cultural resources. SHPOs maintain records of sites, but that information is not available to the general public. Federal and state agencies and Federally recognized tribes review archaeological site information and conduct site surveys to insure proposed projects will not damage resources. If a site is found during construction, activity is halted until the site can be surveyed and a plan for its protection is developed.

Most tribes' historic preservation officers now maintain confidential databases on traditional cultural properties that may include both natural (e.g. landforms and plant resources) and cultural resources (archaeological sites). Federal agencies and tribes will negotiate access to that information if necessary.

This process of checking existing records, conducting surveys and managing construction provides information for river managers to protect the resources.

Deltaic Plain and Gulf of Mexico (26 references)

The State of Louisiana contains three million acres of coastal wetlands. It supports vital ecosystems, national energy security, thousands of jobs, and a unique culture. However, wetlands loss, erosion, subsidence, climate change, sea level rise, storms and storm surge, drought, repeated flooding, hypoxia, and saltwater intrusion all threaten the Gulf coast. The problems and causes are well documented. The Mississippi River supplies the freshwater and sediments that are vital for maintaining the deltaic plain and coast. In 2012, Louisiana's Comprehensive Master Plan for a Sustainable Coast was approved. The plan outlines the state's research, design, construction, and management strategy for the coastal area. Sediment and water quality data are needed to support decisions and is being collected through a Louisiana Coastal Area study focused on the Mississippi River's hydrodynamics and the management of its delta.

Economic and Social (74 references)

The value of the land and resources associated with the Lower Mississippi River is well documented. The LMRCC is updating the Economic Profile of the Lower Mississippi River Region. The last report was published in 2004. The report summarizes published information on the economics of commercial fish and mussel harvesting, outdoor recreation, tourism, silviculture, water supply, agriculture, mineral resources, sand and gravel, energy, navigation, and manufacturing. The economic references also include demographic and demand data.

Economic data for the commodities shipped on the LMR navigation system is available along with calculations of estimated costs of shipping the same cargo via rail or truck. The data show commercial barges provide a substantial cost savings per ton over other shipping methods. This data also shows lower fuel usage and emissions. The value of the land and resources that would be subject to flooding without the MR&T is available and kept up to date.

There is growing interest in understanding the value of resources that are not bought and sold. Work is ongoing to quantify Natural Resource Services not directly reflected in the commercial economy, i.e. value of carbon sequestration, nutrient trading, and green infrastructure.

Geomorphology (57 references)

The geomorphology of the Lower Mississippi River has been studied extensively. Much of this work preceded geographic information systems (GIS), but some has been geo-referenced and made available to river managers.

The geomorphology information tracks changes in the river and major tributaries over the centuries. The studies detail man-made changes in the river system: revetments, dikes, levees, cutoffs, locks and dams on the Upper River, and dams on many tributaries. Geomorphology information is useful to understand wetlands, vegetation patterns, aquatic habitat, and sediment dynamics. It is valuable for developing restoration plans.

Geomorphology is one of the three pieces of information used to build hydrogeomorphic models (HGM). The HGM Approach is a wetland assessment procedure that is based on three fundamental factors that influence how wetlands function: position in the landscape (geomorphic setting), water source (hydrology), and the flow and fluctuation of the water once in the wetland (hydrodynamics). The HGM Approach first classifies wetlands based on their differences in functioning, second it defines functions that each class of wetland performs, and third it uses reference to establish the range of functioning of the wetland. Regional assessment models are developed based on the functional profile that describes the physical, biological, and chemical characteristics of a regional wetland subclass.

Groundwater (52 references)

The USGS is conducting large-scale, multidisciplinary, regional studies of groundwater availability for the Nation. Studies comprise individual assessments of regional groundwater-flow systems that encompass varied terrains and document a comprehensive regional and national perspective of groundwater resources. Collectively, these studies are the foundation for the national assessment of groundwater availability and are conducted in cooperation with other Federal, state, local governments, and the private sector. Numerical groundwater-flow models are used in these studies to document effects of human activities and climate variability on groundwater levels, changes in aquifer storage, and flow between groundwater and surface-water bodies.

As part of the Mississippi Embayment Regional Aquifer Study, a numerical model was constructed of 13 layers over 78,000 square miles representing multiple aquifers and confining units for the period of 1870 to 2007. The model is a tool that was used to assess and better understand groundwater resources.

The USGS has also completed a multi-year study of water availability in the shallow aquifers of the Mississippi River Alluvial Aquifer and surface water flows in regions of Arkansas and northern Louisiana within the study area. The focus of this study was to establish sustainable

yields for groundwater and surface water within the Delta region of Arkansas and northernmost Louisiana.

Gulf of Mexico Hypoxia (5 references)

The Task Force described in the previous sections produces an annual report which tracks the hypoxia in the Gulf of Mexico. Work is still underway to quantify nitrogen and phosphorus inputs into the river. Hypoxia data overlaps water quality information in the Lower River. The information gaps for hypoxia are a subset of those identified for water quality.

Hydrology (13 references)

River gage data is the linchpin that ties together almost all of the other information on the river. There are over 250 gages within the study area. In addition to active gages, records are available for many gages that have been replaced or moved. The gage at the upper end of the study area (Ohio River at Cairo) has been in place since 1858. Many gages have a period of record of one hundred years or more. The vertical datums for the gages and the Low Water Reference Plain of the river change through time. Gage data must be corrected based on these to compare stage and discharges from different years. The information is used to monitor potential flooding, manage navigation, and schedule river construction projects. Terrestrial and aquatic habitat usage is related to river stage. Recreational boaters use the information to determine when activities are safe and when side channels have water.

The gages vary in the frequency they record stage data, the data collection platform, telemetry, and sensor type. The gages in key locations record stage data hourly and transmit the data via satellite. Other gages have data loggers and the information has to be downloaded on site. Temporary gages are sometimes established in areas of particular interest

Every year the river is surveyed using single beam sonar. The information is loaded into a GIS system and used to determine the priorities for dredging and structures. Doppler surveys are also performed at specific locations as needed for construction projects, division of flow into side channels, and for tow traffic needs. The river is constantly changing and the data must be updated frequently for management use, but the older data is useful to analyze trends in sediment and geomorphology.

River managers have the hydrologic information necessary to make strategic level decisions. As mentioned above, site specific projects may require additional temporary gages or river surveys.

Recreation & Tourism (89 references)

Recreation and tourism information includes usage, demand, and value information. It also includes data on recreation related accidents. Recreation and tourism are market driven and highly variable. New recreational activities like posh camping are on the rise while water skiing has declined. State agencies and NGOs are using long-term data showing declines in hunting and fishing to promote those activities and plan for budget changes related to declining license sales.

Sediment (36 references)

The changes in sediment sources and sinks are well documented. The USACE and USGS are working together to develop and improve models used to predict sediment flow through diversions and spillways. Better analytical tools and more coordinated sampling are needed to better understand and manage sediment in the river. The USGS has proposals for more comprehensive studies.

Terrestrial (188 references)

In 1986, the Emergency Wetlands Resources Act mandated the mapping and digitizing of the Nation's wetlands. This is the Wetlands Geospatial Data Layer. This data layer houses all of the USFWS digital geospatial wetlands data, and forms the Wetlands Spatial Data Layer of the National Spatial Data Infrastructure. This database classifies all of the wetlands within the project area. Cover type and land use mapping are also available.

Waterfowl, bear, songbird, shorebird, and other game species' habitats are well studied and mapped in the LMR. State natural heritage databases contain some information on reptiles and amphibians, but it is very limited. Bottom land hardwoods occur throughout the area and restoration projects often focus on them.

Invasive species in the LMR include privet, kudzu and nutria. Kudzu is often mapped as part of sedimentation studies, but it spreads fast Control of these species is important for restoration of habitats. These will be discussed further in the Habitat Needs Assessment.

Water Quality (78 references)

State and Federal agencies have produced a large amount of water quality data for surface waters throughout the LMR. However, most of this data collection was state or study area specific, synthesis of a river-wide water quality assessment is problematic. Several attempts at summarizing and assessing water quality data (e.g. LMRCC 1996) are able to reach general conclusions about river-wide water quality questions, but ultimately resort to state-by-state summaries. Published research (see Appendix D) has provided a system-wide picture of the LMR water chemistry with regard to nutrients, general water quality and contaminants such as heavy metals and hydrophobic organics. The majority of available data are suitable for addressing state-wide and smaller scale questions, but a river-wide consistent methodology for water quality sampling and data analysis does not exist. Nutrient attenuation is not well understood or quantified.

Water quality information collected for CWA compliance includes measurements of pH, dissolved oxygen, nutrients, solids, alkalinity, turbidity, fecal coliform, six metals, phenol, 31 volatile organics (following USEPA Procedures 601 and 602), and any other specialized constituents local conditions dictate.

Permittees under the National Pollution Discharge Elimination systems (NPDES) are another source of water quality data. States maintain a database of active NPDES permits, though the

permittee submitted data is not universally entered into electronic databases. NPDES monitoring is focused on permit compliance and the monitoring is restricted to just the parameters necessary. Such data are of limited use in assessing regional and system-wide water quality questions

Unique to lower river states, Louisiana maintains an additional water quality monitoring network of nine stations on the main-stem of the Mississippi River from Baton Rouge LA to New Orleans Algiers water treatment plant. Data for the Early Warning Organic Compound Detection (EWOCD) network is collected a minimum of twice daily at all stations, and as frequently as hourly at one station. In addition to the same parameters as the CWA monitoring, the samples from the EWOCD system are tested for 62 semivolatile organic chemicals that include 7 polynuclear aromatic hydrocarbons, 7 polychlorinated biphynels, and 18 pesticides (following USEPA procedure 625) at two stations.

Water quality data has not been collected based on a system-wide plan for monitoring and analyzing the data. Gaps in understanding about the source and fate of nutrients and chemicals in the system is an obstacle in managing Gulf hypoxia. Inconsistency in the use of fish consumption advisories confuses and discourages anglers in the Mississippi River. The LMRCC is conducting an updated water quality assessment of the study area and will summarize existing water quality information in the project area; identify gaps in knowledge and inconsistencies in monitoring; and provide recommendations for improvements.

Geographic Information Systems

Most of the categories of information discussed above have a geospatial component. GIS is used for all of the river management activities previously described. Each of the state, county and Federal agencies in the LMR has GIS layers covering its area of responsibility. Each USACE District maintains its own. The agencies share data and the USGS has a GIS data warehouse to promote data sharing. However, the data is not all the same standard and it is in different projections. Data shared among agencies has to be corrected and is not always kept updated.

The LMRCC is developing a pilot geospatial tool to provide data storage, retrieval, and data viewing capabilities using web technologies. This project will serve as a tool for the LMRRA Habitat and Recreation Needs Assessments. It will use existing geospatial data for the project area, and will provide an example of how a regional data repository could be developed.

VI. CONCLUSIONS

The Mississippi River Commission's 200-year working vision for the Mississippi River seeks to leverage science, engineering, technology and public policy to meet the Nation's needs for our largest river. Accomplishing the five goals set out in the vision will require more collaboration among all river managers. The vision includes the following tenets:

Lead secure lives on the river or tributary.

Enjoy fresh air and the surrounding fauna, flora, and forests while hunting, fishing, and recreating.

Travel easily, safely, and affordably.

Drink from and use the abundant waters of any river, stream, or aquifer.

Choose from an abundance of affordable basic goods and essential supplies that are grown, manufactured, and transported along the river to local and world markets.

An examination of the scoping issues, the description of river management, and review of the existing data found four, river-related management information gaps that tie directly into the goals of the Commission's vision. Closing these gaps can help advance the goals of the 200-year vision and produce efficiencies that benefit taxpayers at multiple levels of government and produce tangible results for river managers, resource agencies, and the citizens residing in the world's third largest watershed.

Sediment

Respected river researchers, federal and state agencies, and interested members of the public all raised sediment in the river as an issue during scoping. Understanding sediment dynamics is important for flood risk management, navigation, coastal management, and habitat management. A thorough review of available information found insufficient sediment monitoring and analysis tools to support collaborative and broadly informed decision-making. A strategic sediment management plan for the river could be developed with more information and analytic tools. Sediment management plans are in place for many of the world's great rivers: the Rhine (Europe), the Blue Nile (Africa), the Yangtze (Asia), the Columbia (North America), and the Darling (Australia). These plans are benefitting coastal areas, navigation management, hydropower facilities, and land conservation around the world.

The USACE spends up to $170 million annually dredging sediment in the Lower Mississippi River to maintain the navigation channel. This investment supports transportation of 62 percent of our nation's agricultural output; delivers nearly 400 million tons of coal and petroleum products; and directly supports one million jobs and millions more indirectly. Various plans for the restoration of coastal wetlands in Louisiana call for more than $25 billion to be spent on a variety of projects, most involving water and sediment management. A sediment monitoring

program and analysis tool for the Lower Mississippi River could allow for greater efficiency in managing river sediment and lead to cost savings in one or both of these important national programs.

The monitoring and analysis of sediment would cover the area beginning at Melvin Price Locks and Dam (Lock and Dam No. 26) above St. Louis and on the Ohio beginning at the site of the Olmstead Locks and Dam in Illinois and continue downstream to Head of Passes in Louisiana. The analysis would determine sediment sources, sizes, quantities, fates, and transport parameters. It should build on the work underway in the Mississippi River Hydrodynamic and Delta Management Study and the work of the Mississippi River/Gulf of Mexico Watershed Nutrient Task Force. Given the billions of dollars expected to be spent on sediment management in the lower river, a sediment management plan that identifies any efficiencies could save taxpayers significant dollars.

Water Quality

Water quality is important for river management, coastal management, fish and wildlife management, water supply and groundwater management, Gulf of Mexico hypoxia, and recreation and tourism. Existing water quality information is stored in a variety of locations and was not all collected according to the same standards or methodology. The data was useful for developing localized, point-in-time assessments of water quality. Managers need more consistent monitoring to understand trends and the impact of management activities and to guide water quality management.

Clean water is vital to the economy of the nation and the quality of life in the lower Mississippi River Valley. Manufacturing companies in the United States use nine trillion gallons of fresh water every year. The beverage industry uses more than 12 billion gallons of water annually to produce products valued at $58 billion. Delivering water and treating wastewater is an energy-intensive effort. The water is treated, pumped to homes and businesses, and pumped to wastewater facilities to be treated again. The Environmental Protection Agency estimates 3-4 percent of national electricity consumption, equivalent to approximately 56 billion kilowatts, or $4 billion, is used in providing drinking water and wastewater services each year. Water and wastewater utilities are typically the largest consumers of energy in municipalities, often accounting for 30-40 percent of total energy consumed. Lower Mississippi River valley municipal water systems that rely on surface water, generated $51 million in annual revenue in 2006. Clean water is big business.

The hypoxic zone in the Gulf of Mexico is the second largest in the world and the largest affecting the United States. The area of oxygen poor water along the coast has been as large as 5.5 million acres (8,593 square miles). For comparison the entire Chesapeake Bay and its major tributaries covers only about half of that amount of area. This hypoxic zone sits atop one of the most productive fisheries in the world, and the ecological and economic impacts of it are still being researched.

American anglers spend $45 billion annually to fish in rivers, lakes, ponds, oceans, and other water bodies. Fishing is a very popular recreational activity on the Lower Mississippi River and

many local communities depend on the money it generates for private enterprise and public coffers. There are numerous fishing tournaments on the lower River and in many oxbows and other water-bodies in the area. There is one large tournament and several smaller ones annually that benefit St. Jude Children's Research Hospital. Activities such as these are important for recreational enthusiasts, charitable organizations, and host communities. Clean water and healthy habitats are essential for fishing and other river-based recreation.

The demand for good water quality in the lower Mississippi River far exceeds the capacity of any one agency or state to oversee and provide. A dedicated water quality monitoring program for the entire Lower Mississippi River would be valuable to develop more effective programs to manage water quality and protect this economic driver and important component of public health. The USGS, EPA, USACE, DOI, NOAA, the twelve states and tribes that are part of the Mississippi River/Gulf of Mexico Watershed Nutrient Task Force and the LMRCC are working on such a program. Since the formation of the Mississippi River/Gulf of Mexico Watershed Nutrient Task Force, the hypoxic zone in the Gulf of Mexico has begun to shrink. Continued and enhanced cooperation will produce benefits for fish and wildlife, recreation, municipal water supplies, coastal habitat, and Gulf of Mexico hypoxia reduction.

Data Storage and Availability

Data availability is important for all river management. This issue was noted in the 2011 Post-Flood Report and during development of the Upper Mississippi River Restoration – Environmental Monitoring Program. The Long Term Resource Monitoring Program was created to assess the status and trends in the health of the Upper River. It provides managers with the information to improve management of valuable ecological resources. State scientists collect information on water quality, aquatic vegetation, and fisheries. All data collection follows strict quality assurance and control standards. The USGS Upper Midwest Environmental Management Center oversees and manages the data collected from all of the upper river states. These data sets are the largest standardized sets for any large river in the world.

A data management program to capture, store and make available all of the existing and future data for the Lower Mississippi River is vital. Better sediment and water quality management depends on the consistency, quality, and availability of river data.

This assessment and the LMRCC pilot GIS project are making some information more available, but time and budget limits the scope of this effort. The data management program should include: an exhaustive data inventory, a long-term storage and management agreement, an internet portal, geo-referencing databases and reports where possible, and scanning and geo-referencing maps and studies that preceded the development of GIS. The data management program will insure that all sensitive information (e.g. Federally- listed species and cultural resource sites) is protected. The LMRCC, USGS, USACE, USEPA, universities, and various state agencies are already engaged in data collection and storage but generally agree a standardized and broadly utilized information sharing structure would be valuable to river managers and other groups.

Tributary Management

There are over forty tributary watersheds to the Lower Mississippi River that are large enough to have significant impacts on the river. Management of sediment and water quality will begin in these tributaries. They are some of the most significant sources of nutrients and sediment to the main-stem of the Lower Mississippi River. As such, watershed based management of these systems could offer benefits both locally and downstream.

Tributary management is important for water quality, sediment, hypoxia, habitat, and fish and wildlife management. There has been very little geomorphic analysis of non-navigable tributary streams. Project implementation is more manageable for states at the tributary scale than at the main-stem scale.

Tributary rivers should be surveyed for stability issues, like those occurring on the Loosahatchie River in Tennessee. If stability issues are noted, a plan to restore these rivers should be developed. The river restoration plans will be a necessary part of enhanced water quality and sediment monitoring programs and overall watershed based approaches for the systems. The habitat needs assessment will consider the importance of these waters to support life stages of certain fish and wildlife.

Future Information Needs

The Lower Mississippi River Resource Assessment will produce three separate assessments and one comprehensive plan combining those three assessments. This report is the "assessment of information needed for river-related management." It examined the known and anticipated information needs based on current and foreseeable plans and operations.

It is likely more information needs will be identified during the "assessment of natural resource habitat needs" and the "assessment of the need for river-related recreation and access." These assessments may also recommend projects and programs which will generate even more information needs. The final comprehensive plan will combine the results of all of these. It will include recommendations for meeting all of the information needs identified in the three assessments.

APPENDIX A

Relevant Documents

DEPARTMENT OF THE ARMY
U.S. Army Corps of Engineers
WASHINGTON, D.C. 20314-1000

REPLY TO
ATTENTION OF:

CECW-PM

12 FEB 2003

MEMORANDUM FOR Commander, Mississippi Valley Division (CEMVD-MD-PM)

SUBJECT: Implementation Guidance for Section 402 of the Water Resources Development Act of 2000 (WRDA 2000) – Lower Mississippi River Resource Assessment

1. Section 402 authorizes the Secretary, in cooperation with the Secretary of the Interior and area states, to assess needs for management information, habitat, and recreation and access for the river and adjacent floodplains for the Mississippi River and tributaries below Cairo, and the Atchafalaya basin floodway system. Section 402 states the Secretary shall forward a report to Congress on the assessment results within two years of initiating each assessment. Section 402 states the reports shall include recommendations for: (1) the collection, availability, and use of data needed for river management; (2) the implementation of measures to restore, protect, and enhance habitat; and (3) potential projects for river recreation and access. The authorized Federal cost is $1,750,000. A copy of section 402 is enclosed.

2. The development of the assessment should be approached consistent with watershed planning. The basic policy related to watershed activities is found in Policy Guidance Letter No. 61. The objective of the assessment will be to prepare a watershed planning document that furthers watershed resource management. The objectives and the scope of this document will be agreed upon by the Corps and sponsor(s) and outlined in a negotiated agreement. This agreement should identify actions to be undertaken by the various partners and stakeholders in order to meet the objectives of the plan.

3. Upon receipt of funds in the initial work allowance, up to $500,000 of Federal funds may be used to prepare an initial assessment collaboratively with Federal resource agencies and the states cited in section 402, and negotiate a cost sharing agreement with a non-Federal partner. HQUSACE approval of the initial assessment and execution of a cost sharing agreement is required before proceeding with the next phase. This agreement should follow the model Feasibility Cost Sharing Agreement and should be approved in the same manner. Since this assessment will be conducted as a watershed study, the activities included in the agreement will be cost shared 50/50. In-kind services may not exceed 25 percent of the assessment costs.

4. The final assessment should address the needs and recommendations for actions cited in section 402. The completed final assessment will be submitted to HQUSACE for review and processing to the Assistant Secretary of the Army (Civil Works) and Congress as appropriate.

CECW-PM
SUBJECT: Implementation Guidance for Section 402 of the Water Resources Development Act of 2000 (WRDA 2000) – Lower Mississippi River Resource Assessment

Any potential Corps of Engineers projects identified for further study or implementation in the assessment may be pursued through the normal authorization and budget processes.

FOR THE COMMANDER:

Encl

for JAMES F. JOHNSON
Chief, Planning and Policy Division
Directorate of Civil Works

DEPARTMENT OF THE ARMY
U.S. ARMY CORPS OF ENGINEERS
WASHINGTON DC 20314-1000

REPLY TO
ATTENTION OF:

CECW-MVD

JUN 0 6 2010

MEMORANDUM FOR: Commander, Mississippi Valley Division (CEMVD-PD-KM)

SUBJECT: Request to Update Implementation Guidance for the Lower Mississippi River Resources Assessment (LMRRA)

1. Reference CEMVD-PD-KM Memorandum, dated 5 April 2010, for Chief, Planning and Policy Division, CECW-MVD, subject as above.

2. The request to update implementation guidance for Section 402 of the Water Resources Development Act (WRDA), 2000, issued for the LMRRA on 12 February 2003, to reflect current cost sharing for watershed studies is approved. The cost sharing for the LMRRA watershed assessment shall be 75 percent Federal and 25 percent non-Federal, and the non-Federal Sponsor may provide its share, in whole or in part, through in-kind contributions.

3. Upon completion, the final assessment will be submitted to HQUSACE for review and processing in accordance with Appendix H of ER 1105-2-100. Any potential Corps of Engineers projects identified for further study in the assessment will be considered a new start feasibility study and will be cost shared 50/50 between the Federal and the non-Federal sponsor.

FOR THE COMMANDER:

Theodore A. Brown

THEODORE A. BROWN, P.E.
Chief, MVD Regional Integration Team
Directorate of Civil Works

Printed on Recycled Paper

May 28, 2009

M·N·R·G **Midwest Natural Resources Group**

Midwest Natural Resources Group

The Mississippi River Watershed:
"America's River...America's Heritage"

An Opportunity for Action and Resource Sustainability

The twenty-first century presents unprecedented challenges to the sustainability of the world's great river systems. These challenges impact the livelihoods of those who depend on freshwater and the ecosystem services provided by rivers and their environments. Economic and environmental sustainability of entire river systems are in jeopardy from the combination of competing use, protracted drought or flooding, changing flows, pollution and nutrient loading, and need for improved land management. Growing populations and development, increased competition for freshwater resources, threats to native biodiversity including exotic species, and ever-changing environmental conditions serve to lower the sustainable environmental quality and value of our nation's waterways. As the largest river system in North America, and the third largest watershed in the world, the Mississippi River demands our attention, vigilance, and dedicated action.

Efforts to sustain the Mississippi River system will require a unified vision and intergenerational commitment to realize that vision. Such a vision is essential if we hope to achieve sustainable development that protects and preserves the integrity and biodiversity of this crucial system. The Federal interagency Midwest Natural Resources Group (MNRG) shares this concern. The vision must be holistic and comprehensive, addressing economic, cultural, ecological, and sociological needs in the context of a single interdependent system. This holistic approach should encourage the development of collaborative projects that recognize and address multiple aspects of that vision.

The issues that threaten the future of the Mississippi River and its tributaries and watersheds are deeply interwoven and stem from myriad natural forces and human actions. The scale, complexity, and urgency of these issues demand a coordinated response that is guided by vision, grounded in good science, and implemented with unprecedented speed, vigor, and discipline. To successfully lead this response requires recognition that:

1. River systems worldwide are experiencing similar stresses;
2. While large river research exists, a centralized clearinghouse or network is needed to ensure data is synthesized for broad accessibility and wide availability for informed decision making;
3. Governmental agencies at all levels are encouraged to work in an integrated manner and with a unified vision to ensure the best use of strengths and synergies;
4. A single-agency approach is not effective, a networked cross-agency approach that fosters and provides incentives for government to work with non-governmental agencies, industry, and stakeholders to realize defined goals is desired;
5. Outreach and education are fundamental to the achievement of natural resources goals; and
6. Leadership is required to drive the progress of policies and projects that support sustainable development and management strategies that will ultimately form the basis of a long-term blueprint for river system sustainability.

Detrimental environmental impacts that affect the future sustainability of the Mississippi River should be recognized, emphasized, and addressed in the context of a progressive, interdependent watershed system. Leadership and action within this watershed perspective is urgently required.

We, the undersigned representatives of the Midwest Natural Resources Group, provide this united message as a call to action to urgently address the sustainability of natural resources within the Mississippi River watershed. We believe that the MNRG is in an excellent position to facilitate the development of an integrated vision for natural resources sustainability, support partnerships to achieve integrated goals, and promote a holistic approach to the long-term stewardship of the Mississippi River watershed.

BG Michael J. Walsh, Commander, Mississippi Valley Division
U.S. Army Corps of Engineers

Max M. Ethridge, Regional Executive North Central Area
U.S. Geological Survey

Terrance Virden, Regional Director
Bureau of Indian Affairs

Juan Palma, State Director
Bureau of Land Management, Eastern States

BG John Peabody, Commander, Ohio River and Great Lakes Division
U.S. Army Corps of Engineers

T.D. Hoogm, CAPT, USCG
CDR Timothy Cummins, Deputy, Prevention Division
Ninth Coast Guard District

Bharat Mathur, Acting Regional Administrator Region 5
Environmental Protection Agency

FOR Jeri Alles, Manager, Great Lakes Airport Division
Federal Aviation Administration

Janet M. Odeshoo, Acting Regional Administrator
Department of Homeland Security/ Federal Emergency Management Agency

Joyce Curtis, Director of Field Services – North
Federal Highway Administration

Tom Melius, Region 3 Director
U.S. Fish and Wildlife Service

Kent Connaughton, Eastern Regional Forester
U.S. Forest Service

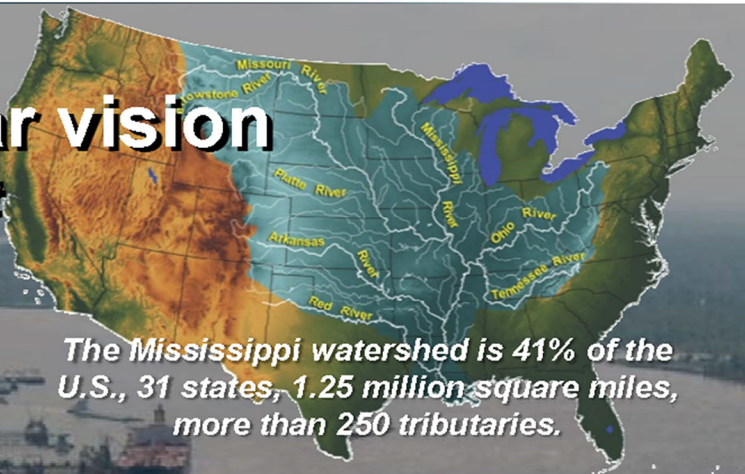
Marie Colton, ~~Great Lakes Environmental Research Laboratory~~
National Oceanic and Atmospheric Administration

for Ernie Quintana, Regional Director
National Park Service

Tom Krapf, Wisconsin Assistant State Conservationist
Natural Resources Conservation Service

America's Watershed: A 200-year vision

An Intergenerational Commitment



The Mississippi watershed is 41% of the U.S., 31 states, 1.25 million square miles, more than 250 tributaries.

Our people enjoy a quality of life unmatched in the world. We ...

- Lead secure lives along the river or tributary.
- Enjoy fresh air and the surrounding fauna, flora, and forests while hunting, fishing, and recreating.
- Travel easily, safely, and affordably.
- Drink from and use the abundant waters of any river, stream, or aquifer.
- Choose from an abundance of affordable basic goods and essential supplies that are grown, manufactured, and transported along the river to local and world markets.

Balancing the Nation's needs for ...

- National Security & Flood Damage Reduction
- Environmental sustainability & recreation
- Infrastructure & energy
- Water supply & water quality
- Movement of goods; agriculture & manufacturing

Leveraging science, engineering, technology, and public policy

APPENDIX B

List of Organizations with Management Activities on the Lower Mississippi River

Organization	Management Activities	Operational Area
	FEDERAL AGENCIES	
U.S. Army Corps of Engineers	Operation and maintenance of navigation channels and facilities Design, construction, and operation of river control structures Dredging operations Operation and maintenance of levees, floodways, and other flood control structures River-wide coordination of flood fight activities Operation and maintenance of recreational facilities Operation and management of the Mississippi River Commission Development of long-term vision and planning Research and development activities related to river management and impacts of river operations	Entire Study Area
U.S. Coast Guard	Maintenance and operation of navigation aids Enforcement of navigation codes and laws Spill response and cleanup Emergency response	Navigable Areas
U.S. Environmental Protection Agency	Enforcement of Clean Water Act and other relevant natural resource cleanup and protection laws Spill response and cleanup Coordination of science and technology issues related to Gulf of Mexico hypoxia	Entire Study Area
U.S. Fish and Wildlife Service	Operation and maintenance of National Wildlife Refuges Enforcement of Endangered Species Act Issuance of Biological Opinions regarding river management actions Coordination of the Lower Mississippi River Conservation Committee Coordination and operation of the Lower Mississippi Joint Venture Enforcement of federal fish and game regulations Mapping of wetlands, critical habitats, etc	Entire Study Area
U.S. Geological Survey	Measurement and documentation of water quality and sediment transport trends Measurement and documentation of stage-discharge trends on the main channel and tributaries	Entire Study Area
Federal Energy Regulatory Commission	Licensing and regulation of in-stream power generation installations Licensing and regulation of flow-of-the-river power generation facilities associated with dams and locks on major tributary and distributaries	Individual Sites within Entire Study Area
National Marine Fisheries Service	Manages Endangered marine fish and wildlife Manages Essential Fish Habitat	Coastal Areas adjacent to study area
National Oceanic and Atmospheric Association	Collection and archival of precipitation and climatic data within the LMRRA study area and adjoining regions Flood forecasts Analysis and documentation of climatic trends Maintenance of navigation charts and tide data	Entire Study Area

	STATE AGENCIES	
Lower Mississippi River Conservation Committee	The LMRCC is a coalition of 12 state natural resources conservation and environmental quality agencies representing Arkansas, Kentucky, Louisiana, Mississippi, Missouri and Tennessee. It provides the only regional forum dedicated to conserving the natural resources of the Lower Mississippi River floodplain and focuses on habitat restoration, landscape level conservation planning and natural resource-based economic development. The United States Fish and Wildlife Service (USFWS) leads the effort and provides a full time coordinator.	Entire Project Area
Arkansas Department of Environmental Quality	Ensure chemical emissions and waste discharges are within safe limits, waste is transported and disposed of safely, and communities are protected from the adverse effects of pollution.	State Boundary
Arkansas Game and Fish Commission	Oversee the protection, conservation and preservation of various species of fish and wildlife in Arkansas Generate awareness of ethical and sound management principles	State Boundary
Arkansas Natural Resources Commission	Manage and protect Arkansas water and land resources for the health, safety and economic benefit of the State	State Boundary
Arkansas Historic Preservation Program	Educate Arkansans about the importance of preserving our heritage and our myriad historic resources. Provide leadership, assistance, and guidance for Arkansans involved in historic preservation activities on all levels. Provide resources to support historic preservation in Arkansas.	State Boundary
Arkansas Natural Heritage Commission	Central repository for data on rare plants and animals and natural communities in Arkansas. Provide long-term protection to some of the state's most ecologically significant lands. Ensure that Arkansas's biological diversity and natural heritage are not lost.	State Boundary
Arkansas Waterways Commission	Responsible for developing, promoting and protecting waterborne transportation in Arkansas	State Boundary
Arkansas Geological Commission	Provide geological information in order to develop and enable effective management of the State's mineral, fossil fuel and water resources while protecting the environment	State Boundary
Illinois Environmental Protection Agency	Monitor and regulate clean air in Illinois and comply with priority aspects of the Clean Air Act Amendments. Address outstanding solid and hazardous waste management concerns and participate in the national reauthorization of the hazardous waste program. Address the priority needs for clean and safe water in Illinois and participate in the national reauthorization of the water programs. Fund environmental cleanup Promote pollution prevention and market-based approaches for continued environmental progress.	State Boundary
Illinois Historic Preservation Agency	Oversees the nomination of sites to the National Register of Historic Places Conducts surveys of historic and archaeological resources Reviews federal and state undertakings (such as road	State Boundary

	projects) for their impact on cultural resources Works with local governments in developing local historic preservation programs in preparation for designation as Certified Local Governments Administers rehabilitation tax incentives for qualified historic buildings Provides Main Street design services Provides education, training, and technical assistance to the public in historic preservation matters	
Illinois Department of Natural Resources	Manages and maintains IDNR-owned land and recreational sites Responsibly regulates mining and oil and gas production Oversees the state water supply. Protects millions of acres of land by ensuring the sufficiency of engineering designs of levees and levee modifications Manages the state's fishing, hunting, wildlife watching, trapping, commercial forestry and fisheries, endangered and threatened species, and natural heritage protection programs. Manages all IDNR land acquisition and other property interests; Provides planning for greenways and trail sites.	State Boundary
Kentucky Department of Environmental Protection	Achieve and maintain acceptable air quality. Manage, protect, and enhance the quality and quantity of Kentucky's water resources Preserve and restore Kentucky's land through the development and implementation of waste management programs. Ensure environmental compliance using a clear and consistent approach of enforcement. Promote responsible environmental stewardship.	State Boundary
Kentucky Heritage Council	Encourage economic development Provide affordable housing Revitalize downtowns and neighborhoods Provide life-long learning opportunities Enhance Kentucky's quality of life	State Boundary
Kentucky Department of Fish and Wildlife Resources	Conserve and enhance fish and wildlife populations and their habitats. Increase opportunity for hunting, fishing, trapping, boating and other wildlife-related activities. Foster a more informed and involved public.	State Boundary
Louisiana Department of Natural Resources	Preserve and enhance the nonrenewable natural resources of the state, consisting of land, water, oil, gas, and other minerals, through conservation, regulation, management and development.	State Boundary
Louisiana Department of Wildlife and Fisheries	Manage, conserve, and promote wise utilization of Louisiana's renewable fish and wildlife resources and their supporting habitats through replenishment, protection, enhancement, research, development, and education. Provide opportunities for knowledge of and use and enjoyment of these resources. Promote a safe and healthy environment for the users of the resources.	State Boundary
Louisiana Office of Cultural Development	Record, protect, and distribute information about the state's archaeological sites. Development and promotion of the arts Preservation of Louisiana's significant historic sites.	State Boundary

Louisiana Department of Environmental Quality	Protect public safety, health and welfare by protecting and improving the environment (land, water, and air). Increase compliance with environmental laws (both voluntary and mandatory compliance) that meet state and federal mandates.	State Boundary
Mississippi Department of Wildlife, Fisheries, and Parks	Conserve and enhance Mississippi's wildlife, fisheries, and parks, provide quality outdoor recreation, and engage the public in natural resource conservation.	State Boundary
Mississippi Department of Environmental Quality	Protect the state's air, land, and water. Safeguard the health, safety, and welfare of present and future generations of Mississippians by conserving and improving our environment and fostering wise economic growth through focused research and responsible regulation.	State Boundary
Missouri Division of Natural Resources	Ensures clean air, land and water by cleaning up pollution from the past and identifying potential pollution issues of the future Enforces environmental rules and regulations related to air and water pollution; hazardous and solid waste; land reclamation; soil and water conservation and safe public drinking water Interprets the state's geological and hydrological setting Preserve and restore our natural landscapes Identify, evaluate and protect the state's diverse range of historic, architectural and archaeological resources Funds and coordinates surveys to identify historic, architectural and archaeological resources throughout Missouri	State Boundary
Missouri Department of Conservation	Ensure healthy and sustainable forest, fish, and wildlife resources throughout the state. Manage lands held in public trust and associated infrastructure to ensure continued benefit to citizens and to forest, fish, and wildlife resources. Provide opportunities for active citizen involvement in services and conservation education in both rural and urban areas. Engage partners at all levels to enhance natural resources and effective delivery of conservation services.	State Boundary
Tennessee Department of Environment and Conservation	Safeguard the health and safety of Tennessee citizens from environmental hazards; Protect and improve the quality of Tennessee's land, air and water; Manage the Tennessee State Parks system.	State Boundary
Tennessee Wildlife Resources Agency	Preserve, conserve, manage, protect, and enhance the fish and wildlife of the state and their habitats for the use, benefit, and enjoyment of the citizens of Tennessee and its visitors. Foster the safe use of the state's waters through a program of law enforcement, education, and access	State Boundary
Tennessee Historic Preservation Office	Encourage the diverse study of Tennessee's history for the benefit of future generations; Protect, preserve, interpret, operate, maintain, and administer historic sites; Mark important locations, persons, and events in Tennessee	

	history; Assist in worthy publication projects; Review, comment on, and identify projects that will potentially impact state-owned and non-state-owned historic properties; Locate, identify, record and nominate to the National Register of Historic Places all properties which meet National Register criteria, and to implement other programs of the National Historic Preservation Act of 1966 as amended.	
	LOCAL GOVERNMENT ENTITIES	
Irrigation Districts	Obtain and distribute water for irrigation of lands within the district.	District Boundary
Municipal water supply and sewage districts	Water withdrawals for drinking water Outfalls for disposal of treated sewage and municipal effluent	Site specific
State Levee & Flood Districts	Are non-federal sponsors for the MR&T system and conduct minor maintenance	District Boundary
	INDUSTRIES	
Industrial Facilities	Withdrawal of water for chemical manufacture, petroleum refining, and heavy industrial manufacturing Withdrawal of water for cooling at electrical power generation Outfalls for disposal of permitted industrial wastes and thermally altered waters Design and construction of new power generation and industrial facilities	Site specific
Navigation Industries	Fleeting and transportation of barge tows Recommendations regarding navigation structure improvements and improved river operations Traffic management and communications	Navigable Areas
	NON-GOVERNMENTAL ORGANIZATIONS	
The Nature Conservancy	Protect habitats Address threats to conservation Support public policies that protect our lands and waters	Entire Study Area
National Audubon Society	To conserve and restore natural ecosystems, focusing on birds, other wildlife, and their habitats.	Entire Study Area
Delta Wildlife	Develop, implement, and monitor science based projects and programs that address wildlife, wildlife habitat, and natural resource concerns in the region. Educate children, sportsmen, land managers, landowners, & the general public with information to help them make better decisions as conservationists, hunters, fishermen, or wildlife managers.	Mississippi
Ducks Unlimited	Conserve, restore, and manage wetlands and associated habitats for North America's waterfowl	Entire Study Area
Wildlife Mississippi	Wildlife Mississippi is on the forefront of an effective conservation philosophy. It is based on three basic principles: 1) a strong economy provides incentives, 2) encourage conservation stewardship while recognizing private property rights and 3) polluters should be liable for harm they cause others. Now is the time to establish conservation philosophy that contains effective and cost-efficient programs to improve Mississippi's fish and wildlife resources for years to come.	Entire Study Area
Mississippi River	Work to identify, conserve, and interpret the region's	Tennessee

Corridor – TN	natural, cultural and scenic resources to improve the quality of life and prosperity in West Tennessee	
Local Chambers of Commerce	Local Chambers of Commerce work on the local level to bring the business community together to develop strong local networks, which can result in a business-to-business exchange. In most cases, local Chambers work with their local government, such as their mayor, their city council and local representatives to develop pro-business initiatives.	Local

APPENDIX C

List of Initiatives on the Lower Mississippi River

Name of Organization	Mission	Geographic Scope
America's Great Watershed Initiative	America's Great Watershed Initiative (AGWI) is a collaboration that seeks solutions for meeting the multiple demands placed on the vast and complex Mississippi watershed system by integrating issues, partners and ideas at the full watershed scale.	Entire Mississippi River watershed
America's Great Outdoors	President Obama launched the America's Great Outdoors (AGO) Initiative to develop a 21st Century conservation and recreation agenda. AGO takes as its premise that lasting conservation solutions should rise from the American people – that the protection of our natural heritage is a non-partisan objective shared by all Americans.	Entire study area
Mississippi River/Gulf of Mexico Watershed Nutrient (Hypoxia) Task Force	The Task Force was established in 1997 to reduce and control hypoxia in the Gulf of Mexico. Since then, the Task Force has undertaken a variety of efforts to achieve these goals.	12 states and the tribes within the Mississippi/ Atchafalaya River Basin (MARB).
The Big River Works	*THE BIG RIVER WORKS: Building Cooperation to Sustain the Mississippi River System*, the foundation is bringing together key stakeholders for an analysis of the Mississippi River that will detail the consequences of inaction and outline opportunities for cooperation that will lead to a more sustainable system.	.Entire Watershed
Harahan Bridge Project	Recreation	Memphis, TN
Joint Venture	The Lower Mississippi Valley Joint Venture functions as the forum in which the private, state, and federal conservation community develops a shared vision of bird conservation for the Lower Mississippi Valley and West Gulf Coastal Plain regions; cooperates in its implementation; and collaborates in its refinement.	Lower Mississippi River
America's Inner Coast Summit	The goal of the Summit is to develop high-level recommendations to be considered in developing sustainable MRV projects and initiatives including influencing Federal, state and local guidelines and policy. This Summit will also further the exchange of information regarding progress and barriers/constraints on current projects, programs and activities.	Mississippi River Valley & entire Mississippi River watershed
Mississippi River Parkway Commission	The Mississippi River Parkway Commission (MRPC) is a multi-state organization which works collectively to preserve, promote, and enhance the scenic, historic, and recreational resources of the Mississippi River, to foster economic growth in the corridor, and to develop the national, scenic and historic parkway known as the Great River Road.	Entire River
Mississippi River Network & 1 Mississippi	To encourage River Citizens through education, inspiration and opportunities to embrace the Mississippi River. The goal of the Network is to protect the land, water and people of the United States' greatest River. Founded in 2005, the Network has grown into a diverse coalition of 43 nonprofit organizations and businesses from the River's headwaters in Minnesota, to where it drains into the Gulf of Mexico.	Entire River
Mississippi River Cities and Towns Initiative	Members are mayors of towns along the river. Formed in 2012 to lobby for improved economic development, habitat restoration, recreation and other actions.	Cities and towns along the entire river
Restore the Mississippi River Delta	Advocates for sustainable coastal management; modeling scenarios for building land-building Mississippi River	Louisiana Coast

Name of Organization	Mission	Geographic Scope
	diversions and management of the Atchafalaya River Basin; restoring coastal habitat.	
Gulf Coastal Plains and Ozarks Landscape Conservation Cooperative	The mission of the Gulf Coastal Plains and Ozarks Landscape Conservation Cooperative (GCPO LCC) is to define, design and deliver landscapes capable of sustaining natural and cultural resources at desired levels now and into the future**.** Develops science protocols and decision support tools for habitat conservation.	Entire study area
Mississippi River Trust	To develop a comprehensive program to restore 250,000 acres of quality habitat in the Lower Mississippi River Valley (LMRV) primarily utilizing the conservation provisions of the 2008 Farm Bill through the U.S. Department of Agriculture's (USDA) Natural Resources Conservation Service (NRCS) and Farm Service Agency (FSA).	Entire study area
Restoring America's Greatest River Initiative	This plan was coordinated and endorsed by all six lower river basin states and the twelve agencies that manage water quality, fisheries and wildlife resources. From 2001 until 2004 this management plan became the base of an exhaustive and systematic process to define the project elements necessary to restore ecological integrity in this portion of the Mississippi River. In all, 239 comprehensive project elements were defined as necessary to recover more natural river dynamics that will in turn increase hydraulic residence time, improve nutrient and sediment assimilation and improve both aquatic and terrestrial habitat availability	

APPENDIX D

Results of Public Scoping

Results of Public Meetings

Three Public Meetings for the Information Needs Assessment were held.

Memphis, TN on 11 July 2012
Vicksburg, MS on 9 August 2012
Baton Rouge, LA 13 September 2012

The Lower Mississippi River Conservation Committee was in Memphis for its annual meeting at the same time as the public meeting. LMRCC members representing all of the states attended the meeting. Other meeting attendees at the three locations included members of local recreation groups, conservation organizations, agricultural interests, media and the general public for a total of approximately 170 people attendees.

The meetings were Open House format and attendees were invited to submit written answers in response to general questions about the current condition, challenges, opportunities and future uses of the Mississippi River. There were four comment forms with 3 questions each provided to the attendees. The questions were intended to broad and invited comments beyond the strict scope of the assessment of information needed for river-related management. Members of the study team were on hand to listen to the attendees and capture their unwritten comments.

Existing Conditions:
What is special about the Mississippi River?
What is your experience of the river?
What do you know about the river?

Challenges:
What are the problems with the Mississippi River?
What concerns do you have about the river?
What information do you need about the river?

Opportunities:
What would make the Mississippi River better?
What would make the river better for you?
What information about the river would you like to have?

Future Conditions:
What changes do you expect on the Mississippi River?
How do you expect to use the river in the future?
What should people know about the river?

Existing Conditions

What is special about the Mississippi River?	***What is your experience with the river?***	***What do you know about the river?***	***Mtg Location***
The wildlife and remoteness below Memphis	I have fished, hunted, paddled and bird watched b/w Randolf Landing TN and Dennis Landing MS	1. Respect it. 2. I love being on the river 3. One of our country's greatest resources	Memphis
Iconic; good opportunity for recreation/tourism	Very little	What I learned in school	Memphis
Vast amenity, 3000 miles of levee	I feel like I have been kept at a distance	Lots of water passes the city each day	Memphis
Everything	Canoeing % camping, fishing, etc	Not enough	Memphis
History	Work w/it, love it. Live on it.	Diversity – land and history; commerce; tourism	Memphis
It is part of the largest river basin in North America. It is a unique ecosystem.	More than most	I am a knowledgeable person on the Miss.	Memphis
Fish, water quality, recreation, history, habitat	I grew up on the MS River. Boating, fishing, etc. Spent time recreating on the sandbars.	Most of the information is found on transportation and navigation. Most people are afraid of the water.	Memphis
Major navigational waterway for the transport of agricultural products. Must be protected!	No direct experience with the Mississippi but with tributaries; Wolf, Loosahatchie, Hatchie	Levee system protected by the Corps of Engineers must be maintained for the protection of agricultural lands and landowners.	Memphis
Navigation	4th generation river rat. My father, grandfather and great-grandfather were tow boat captains. I started as a deckhand at 16 and decked for 4 years before joining and retiring from the US Navy. I grew up on and around the River and its contributaries.	It drains about 2/3 of the continental US. Is important to commerce.	Memphis
Length-flow-connection to so many communities	Member of the River Partnership of Community Foundations	Many tributaries flow into it. Empties into the 'Dead Zone'	Memphis
History	Paddling, bird-watching	History	Vicksburg
	Not much – would like to boat safely on the river; we need a marina		Vicksburg
Size, length, volume, beauty	From the sidelines, want to get a kayak	Vast history; tremendous economic experience	Vicksburg
Wonderful place to kayak, surfski, & outrigger canoe	Teach water workshops on the river for kayak and canoe	That local people think it is unsafe – need more info to get to them that it is not if taught how to use it.	Vicksburg
Extend to Missouri River to capture input of sand garavel;	Atch River Basin US Floodway; History of river	Sinking Missouri River hazardous – could damage	Baton Rouge

downstream impacts of dams – habitat; social	lobes. Losses deposits, Wax Lake Outlet; growing Delta	bridges, communities (attached AP article); Contaminants, water quality-coordination	

Challenges

What are the problems with the Mississippi River?	***What concerns do you have about the river?***	***What information do you need about the river/***	***Mtg Location***
Pollution- farming source, urban run-off, sewage	Invasive plants & aquatic sources-non-native	Current condition of river regarding 1&2 above (columns to left)	Memphis
The river does not have the opportunity to use its floodplain in a flood	One of my concerns is that if it fails it fails catastrophically	The impacts of MR&T on the ecosystem	Memphis
I see the river as a great asset that those who live near have not taken advantage of. I would love to see bike trails on the levees!!	Water quality is a long-term concern	Total sq acres between the levees St. Louis to New Orleans	Memphis
Over controlled. The river needs to be allowed to be more of a river. Levee setbacks, side channel restoration and island restoration can go a long way toward providing habitat and recreation ops for more people while allowing for natural ecological processes to occur as well	Flooding in the Dleta. Loss of wetlands and backwaters. High costs of maintain an aging infrastructure. Long term change and adaptation need to be part of this river management system. Cooperative projects that meet the need of the ecological aspects of the river system and human needs for that don't negatively impact navigation and commerce can happen. And should be openly explored.	What are the future plans and how can stakeholders have input?	Memphis
Pollution and litter	During low water the more narrow bends for water traffic	Water levels – where deep and shallow waters are located	Memphis
MS-lack of access; no recreational opport.	Protection		Memphis
	Water Quality		Memphis
Lack of access	Not getting enough use or value from it besides shipping		Memphis
Lack of knowledge; fear; pollution	Memphis not taking full advantage of river opportunities		Memphis
	Fish & wildlife – restoration		Memphis
Flood control. It is important that the river be navigable, but this must be accomplished in such a way that allows the river to behave as a river. It must be allowed to flood at times.	Nitrogen and phosphorus runoff form farming and crating Dead Zones in the Gulf. Improperly designed or maintained municipal sewer system. Dams prevent silt from reaching the Gulf. Yes I	What is being done to address my concerns?	Memphis

	know the Lower MS has no dams.		
		Interpretive walking trail; We need a recreation area for our kids to learn about the wildlife	Vicksburg
Lack of information and access to river		Information on access – water levels	Vicksburg
Lack of understanding of history	Not enough access points; pollution	Ways to access for different activities	Vicksburg
None	That it would become too channelized	None	Vicksburg
Public access	It seems to be ignored by the public	Levee maps	Vicksburg
Channelization; run-off of nutrients	The health of the Delta, floodplains and related habitats		Baton Rouge

Opportunities

What would make the Mississippi River better?	***What would make the river better for you?***	***What information about the river would you like to have?***	***Mtg Location***
Complete the Chickasaw Bluff Trail	Port @ Randolf 2nd Bluff		Memphis
More access in MS –DeSoto, Tunica, Coahoma Co.			Memphis
If boat ramps were made for low waters not just for high waters	If barges would stop throwing trash in the river that would make my life a lot easier	More water maps	Memphis
Better access	More ability to use it		Memphis
More opportunities for viewing and recreation	Ditto	Family activities; viewing, recreation. Why it's so important	Memphis
Bike trails on levee; access for all to levee trails	More access, public boat ramps (RDL ramp is Not public)	Sq acres of land between levees, from St. Louis to New Orleans	Memphis
A river program similar to the environmental management program in the upper river	A more stable aquatic ecosystem with attributes of the natural river	How the river now is similar and different than the historic river and what ecosystem goods and services can be enhanced	Memphis
Bike trails on levees; increased accessibility	Increased non-motorized boating; access to waterfront	Birding, boating, access points	Memphis
More recreational ops. More land protected & in conservation. Levee setbacks, wildlife preserves. More partnerships with states & NGOs to increase resource protection & build public			Memphis

awareness about the river & its floodplain			
Access, water quality; small craft navigation information e.g. canoeing, kayaking, fishing, hunting. Where are the major whirlpools or most dangerous obstacles on the lower Mississippi	Small boat access information; info on listed above (left)	Where is the worst pollution coming from? How can it be reduced?	Memphis
More restoration in the side channels-backwater habitat for fish and wildlife	Flood storage that provides wildlife habitat; reconnect the river to the floodplain	Would like to see information on proposed projects or have the opportunity to comment on possible projects made available to general public. Announce these meetings on the radio, at marinas, morning television	Memphis
Reduce pollutants from entering river; find a way to allow silt building up behind dams to travel to the Gulf			Memphis
Vanity Fair article on the ecosystem service values (get river into the public conscience); Value of commodity transportation translated into the costs for a boutique type item(shoes, cotton jeans)	Wildlife cameras – big screen TVs in local restaurants (Least terns nesting – like the condor camera in NYC)	What has changed in the quality of water since the Clean Water Act? – How much better are things now?; How many people use drinking water from the River, Where? ; How are fish populations doing?	Vicksburg
Access points for boats and recreation	Info on water levels & where access is available at certain water levels	Water level; tourism sites and event schedules	Vicksburg
Better access points on river for kayaking and canoeing or ability to use private land to access – need contacts or organization to contacts	Easier access	Flow speeds/ tug schedule	Vicksburg
To have more recreational & boating facilities at ports		Nothing	Vicksburg
Better boat ramps in: Memphis, Tallaluh & Natchez; would help in events hosted on river such as fishing tourneys or canoe racing, etc.			Vicksburg
Connection to Louisiana wetlands freshwater and sediment	Access		Baton Rouge
Better habitat for birds			Baton Rouge

Future Conditions

What changes do you expect on the Mississippi River?	***How do you expect to use the river in the future?***	***What should people know about the river in the***	***Mtg Location***

		future?	
This is one of the world's largest rivers and our country's largest river system. Managing the river the same way we have "managed" it for the past century will not help us in the future. More partnerships and more opportunities for adaptation (adaptation to changes in flooding, climate change& more species protection needs) need to be sought out. The river will not be used so heavily for barge navigation- this industry is dwindling. There are better ways to spend tax dollars. More money needs to be spent on restoration.		How money is spent	Memphis
		Better education of sources of pollution and the impact to the Gulf	Memphis
Water quality, wetlands expansion	Canoeing, paddling, hunting, fishing, bird watching	This is the heart of our country. It's a great resource and beautiful river like no other	Memphis
People to obey the rules of the water when boating , fishing, etc. & to have the information about the river more readily available to the general public	For recreational uses like fishing, camping, swimming	Mainly water levels & water traffic	Memphis
More knowledge to citizens	I'm interested in learning how to boat or kayak on a tributary	It's a great natural resource. Not just something to "drive by"	Memphis
Increased accessibility	Biking on levees – birding	How to get close/access river in unique ways	Memphis
More access for general public	Biking on the levees!!	What a great resource	Memphis
Increased accessibility; bikeways on levees	Biking, birding, paddle	History, natural resource	Vicksburg
Little change in water levels – more recreation, tourism & industry	Sportfish & recreation	Future use – water level, new development	Vicksburg
Would like to see bike trails on the levees	Walk, ride on the levee; want to buy a kayak	What a fantastic asset we have	Vicksburg
Access & information; flow rates; boat ramp locations; public access areas; private access areas that can be used by public	Kayak; fishing; competitive sports; wind surfing; kite boarding	That it is safe. Have respect for it. Safety classes.	Vicksburg
Greater attention from all user groups on multi-use; more flooding/more droughts (climate change); greater	Wildlife watching; fishing; drinking water; transportation of commodities	Valuation of ecosystem services; the value of water; their reliance on water; the peace that many find in	Vicksburg

management cooperation		outdoor settings	
I expect navigation to become more difficult as sea level rises and the resultant siltation increases	As a sediment source to build marshes		Baton Rouge

APPENDIX E

List of Information Sources Pertaining to the Lower Mississippi River

Databases
Reports and Scientific Literature
Geospatial
Websites

(These are contained in an attached Excel spreadsheet.)