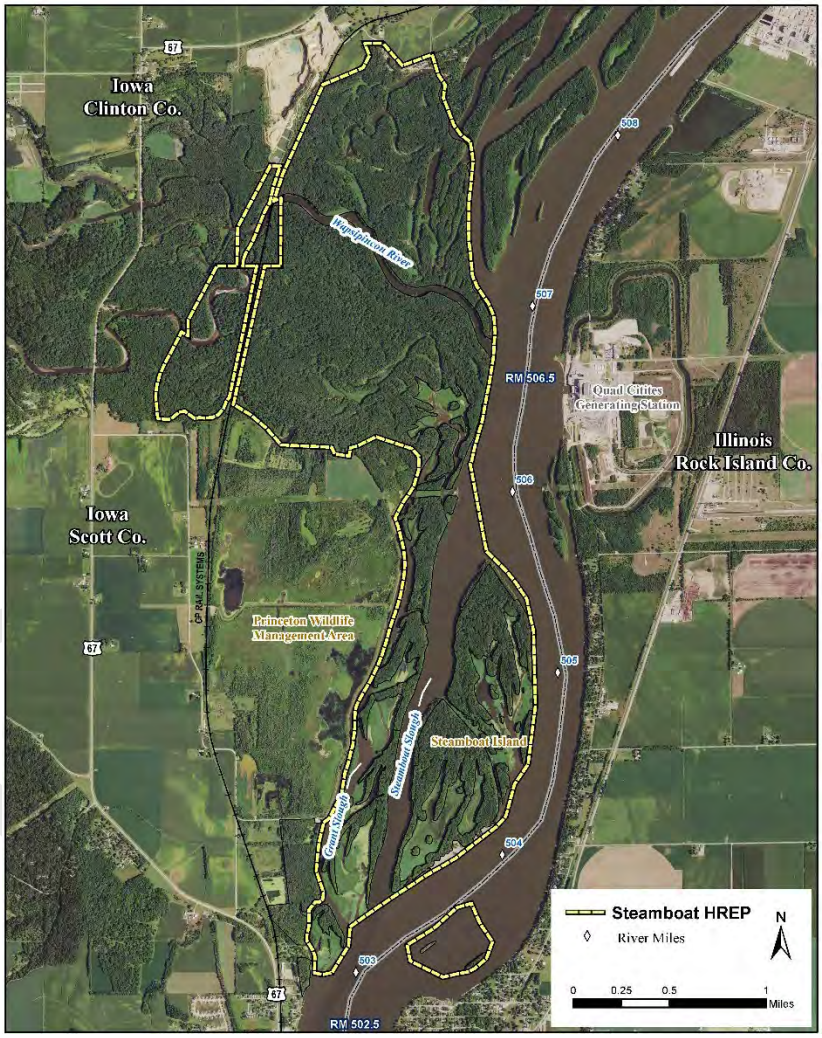
UPPER MISSISSIPPI RIVER RESTORATION
FEASIBILITY REPORT
WITH INTEGRATED ENVIRONMENTAL ASSESSMENT

STEAMBOAT ISLAND
HABITAT REHABILITATION AND ENHANCEMENT PROJECT

POOL 14, UPPER MISSISSIPPI RIVER MILES 502.5-508.0
CLINTON & SCOTT COUNTIES, IOWA,
AND ROCK ISLAND COUNTY, ILLINOIS



April 2020
ATR and MDM Version

US Army Corps
of Engineers
Rock Island District

UPPER MISSISSIPPI RIVER RESTORATION
FEASIBILITY REPORT
WITH INTEGRATED ENVIRONMENTAL ASSESSMENT

STEAMBOAT ISLAND
HABITAT REHABILITATION AND ENHANCEMENT PROJECT

POOL 14, UPPER MISSISSIPPI RIVER MILES 502.5-508.0
CLINTON & SCOTT COUNTIES, IOWA,
AND ROCK ISLAND COUNTY, ILLINOIS

EXECUTIVE SUMMARY

DRAFT

The *Steamboat Island Habitat Rehabilitation and Enhancement Project* (HREP) (Project) is located in Clinton & Scott Counties, Iowa, and Rock Island County, Illinois, in the middle section of Pool 14 of the Upper Mississippi River (UMR), between the town of Princeton, Iowa, river mile (RM) 502.5, and the Wapsipinicon River (RM 508.0). All Project lands are in Federal ownership and are managed by the U.S. Fish and Wildlife Service (USFWS) as part of the UMR National Wildlife and Fish Refuge (NWFR).

The Project area is comprised of approximately 2,620 acres of interconnected backwaters, secondary channels, wetlands, islands, floodplain habitat, and aquatic habitat. Though degraded, this important backwater area supports a diverse population of wildlife including waterfowl, migratory birds, fish, mussels, and mammals. Human activity within the UMR basin, floodplain, and channel has altered the hydrology, topography, and biotic communities present. Years of continual silt deposition has degraded aquatic and wetland habitats and, in some instances, converted them to low elevation terrestrial habitats characterized by reed canarygrass (*Phalaris arundinacea*) monocultures, a relatively low-quality habitat. Impoundment of the pool and permanently higher water elevations during the growing season have affected the health and diversity of floodplain habitat on islands and adjacent floodplain areas. Frequent inundation of floodplain forests are affecting forest composition and regeneration. All of these alterations have reduced the quality and diversity of aquatic and floodplain habitats and impaired ecosystem functions. Erosion and other stressors have reduced the acreage of Steamboat Island and other islands within Pool 14. While these stressors are likely to continue, as is the decline of the quality critical habitats, this Project provides an opportunity to restore the unique mosaic of habitats within the Project area and improve the quality, diversity, and sustainability of aquatic, wetland and floodplain habitats.

The goals of the Project are to maintain, enhance, and restore quality habitat for desirable native plant, animal, and fish species and maintain, enhance, restore, and emulate natural river processes, structures, and functions for a resilient and sustainable ecosystem. The objectives identified to meet these goals are to:

1. enhance and restore areal coverage and diversity of forest stands and habitat and increase diversity of bottomland hardwood forest, as measured in forested acres suitable to support hard mast species and structure, age, and species composition;

2. increase year-round aquatic habitat diversity, as measured by acres and limnophilic native fish use of overwintering habitat, as this habitat is the most limiting of seasonal habitats;

3. restore 50% of island acreage and topography lost since the 1950s and protect from erosion within the Project area, as measured by acres; and

4. protect existing backwater habitat from sediment deposition and enhance backwater and interior wetland areas, as measured by acres of backwater and survivability of scrub-shrub/pollinator habitat.

For planning purposes, the period of analysis was established as 50 years. The following enhancement measures considered to achieve the Project goals and objectives include (see Figure ES-1):

- excavate channels and restore overwintering habitat in backwater areas;
- construct topographic diversity, to include forest, scrub/shrub, and pollinator habitat restoration and enhancement;
- implement Timber Stand Improvement techniques;
- restore and protect islands; and
- incorporate fish and mussel habitat, where appropriate.

Cost and habitat benefits were estimated for each measure. Habitat benefits were estimated using Habitat Evaluation Procedures. Cost Effectiveness & Incremental Cost Analyses were conducted to identify cost effective plans and reveal changes in cost for increasing levels of environmental outputs.

The Tentatively Selected Plan will restore backwater habitat on Steamboat Island proper and the Grant Slough complex by excavating backwater channels to a depth of 8 feet or more below flat pool to provide overwintering and year-round habitat for fish. Excavated material will be used to elevate portions of the Project area and enhance topographic diversity. The placement sites, located at existing sites of reed canarygrass monocultures, will be planted with native floodplain forest or scrub-shrub/pollinator habitat, providing significant environmental benefit. Other forest restoration actions will also occur, such as opening the forest canopy with TSI techniques to provide light to understory seedlings and saplings and interspersed tree plantings. A Grade Control Structure will be constructed at the northwest opening of the Cut-Through Channel on Steamboat Island proper to reduce the transfer of sediment and other materials into the southern portion of Steamboat Island, including Lower Lake. The northernmost end of Steamboat Island proper, which has been greatly eroded over time, will be restored and protected, as well as the northeast bank near Upper Lake. West Southeast Island, located southeast of Steamboat Island proper, which has also been greatly eroded over time, will be restored and protected. Where appropriate, fish and mussel habitat enhancement measures will be incorporated to bring further benefit to the species and communities that use the Project area. Implementation of the TSP will mimic pre-settlement conditions and restore the unique mosaic of habitats in the landscape and increase the quality and quantity of the bottomland hardwood forest, aquatic habitat, island acreage and topography, and backwater and interior wetland habitat, as well as provide important linkages between similar habitats in Pool 14. The Project outputs meet site

DRAFT

management goals and objectives and support the overall goals and objectives of the UMRR Program and the UMR NWFR.

Section 906(e) of the 1986 Water Resources Development Act specifies that first-cost funding for enhancement measures located on lands managed as a national wildlife refuge will be 100% Federal. All Project measures will be located on federally-owned lands managed through a cooperative agreement with the USFWS; operation, maintenance, and repair of the lands will be the responsibility of the USFWS.

The Rock Island District's District Engineer has reviewed the Project outputs, a gain of 393.07 net Average Annual Habitat Units ($4,110 per Average Annual Habitat Unit), and determined that the implementation of the TSP is in the Federal interest. Therefore, the District Engineer recommends construction approval for the Steamboat Island HREP at an estimated construction expense of $25.7 million, including contingency and adaptive management measures. The total Estimated Cost, including planning, engineering and design, adaptive management measures, construction management, and contingency, is $32.6 million.

DRAFT

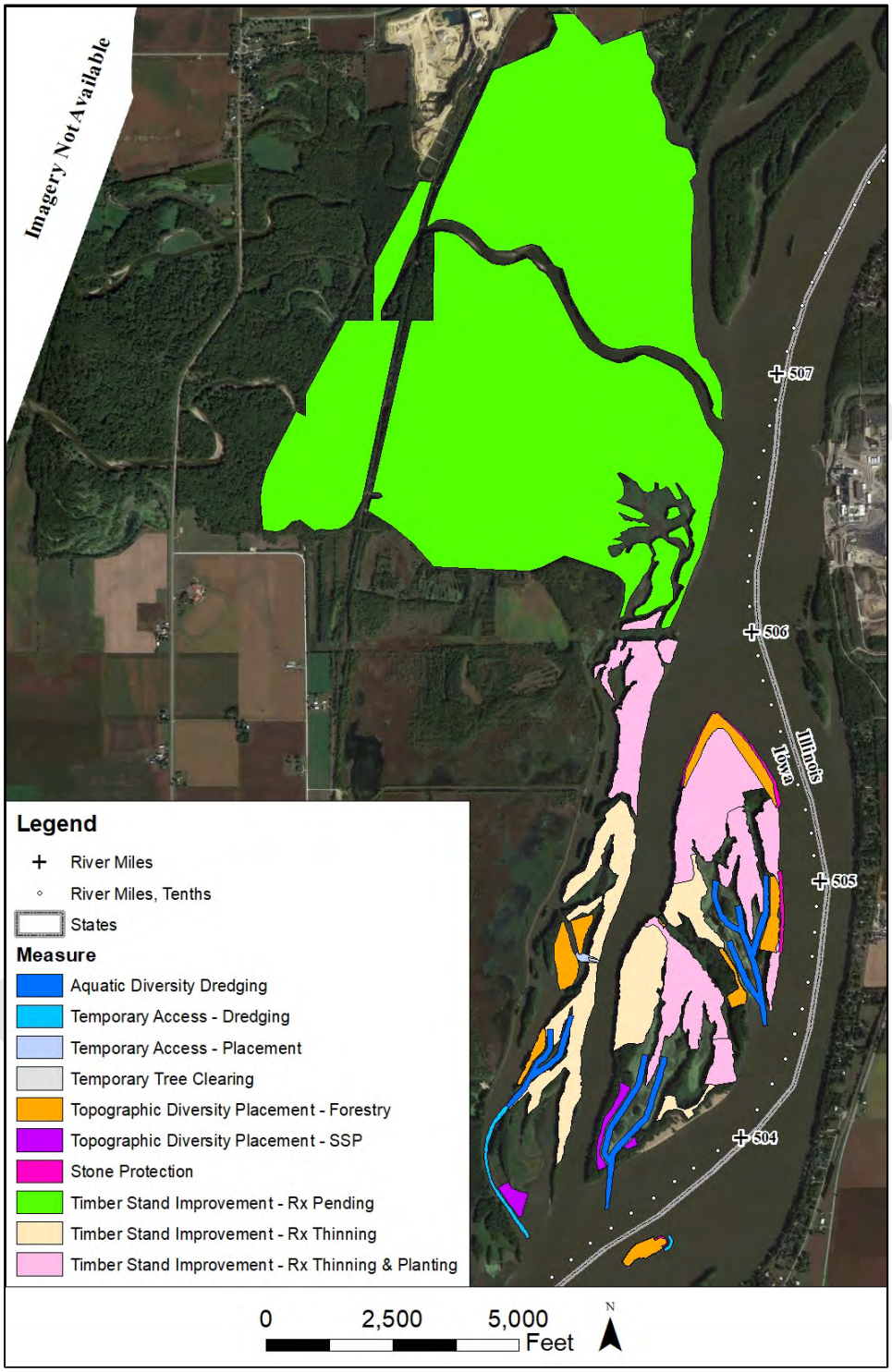


Figure ES-1. Project Measures

ACRONYMS

AAHUs - Average Annual Habitat Units
ADCP - Acoustic Doppler Current Profiler
AdH - Adaptive Hydraulics
APE - Area of Potential Effect
BIDEH - Biological Integrity, Diversity, and Environmental Health
CEDAS - Coastal Engineering Design and Analysis System
CEICA - Cost Effectiveness & Incremental Cost Analyses
CONUS - Continental United States
Corps - U.S. Army Corps of Engineers
CY – Cubic Yards
dbh - diameter at breast height
District - Rock Island District
DO - Dissolved Oxygen
DPR - Definite Project Report
EA - Environmental Assessment
EC - Engineering Circular
EHA - Essential Habitat Area
ER - Engineering Regulation
ERDC -Engineering Research and Development
ESA - Environmental Site Assessment
ESA - Endangered Species Act
FEMA - Federal Emergency Management Agency
FWCA - Fish and Wildlife Coordination Act
FWIC - Fish and Wildlife Interagency Committee
GCS - Grade Control Structure
GIS - Geographic Information System
GCMs - Global Circulation Models
HEC-EFM - Hydrologic Engineering Center-Ecosystem Functions Model
HEP - Habitat Evaluation Procedures
HNA-II - Habitat Needs Assessment-II
HREP - Habitat Rehabilitation and Enhancement Project
HSI - Habitat Suitability Index

DRAFT

HTRW - Hazardous, Toxic, and Radioactive Waste

IADNR - Iowa Department of Natural Resources

IDC – Interest During Construction

ILDNR - Illinois Department of Natural Resources

ISF - Iowa Site File

IWR - Institute for Water Resources

IWW - Illinois Waterway

L&D – Lock(s) and Dam

LiDAR – Light Detection and Ranging

LTRM - Long Term Resource Monitoring

MBTA - Migratory Bird Treaty Act

MSL - Mean Sea Level

MVD - USACE, Mississippi Valley Division

NAVD 88 - North American Vertical Datum of 1988

NGVD 29 - National Geodetic Vertical Datum

NEPA - National Environmental Policy Act

NRCS - Natural Resources Conservation Service

NRHP - National Register of Historic Places

NWFR -National Wildlife and Fish Refuge

O&M - Operation and Maintenance

P&S – Plans & Specifications

PDT - Project Delivery Team

POR – Period of Record

QC - Quad Cities

REC - Recognized Environmental Condition

RM - River Mile

RRCT - River Resources Coordinating Team

SHPO - State Historic Preservation Office

SMS - Surface Water Modeling System

SSP - Scrub-Shrub/Pollinator

TN – Ton

TPA – Trees Per Acre

TSI - Timber Stand Improvement

TSP - Tentatively Selected Plan

UMR - Upper Mississippi River

DRAFT

UMRR - Upper Mississippi River Restoration

UMRS - Upper Mississippi River System

UMRSFFS - Upper Mississippi River System Flow Frequency Study

URV - Unsubmerged Rigid Vegetation

USDA - United States Department of Agriculture

USFWS - U.S. Fish and Wildlife Service

USI - Upper Steamboat Island

WMA - Wildlife Management Area

WOWA - Weighted Order Weighted Average

WRDA - Water Resources Development Act

DRAFT

UPPER MISSISSIPPI RIVER RESTORATION
FEASIBILITY REPORT
WITH INTEGRATED ENVIRONMENTAL ASSESSMENT

STEAMBOAT ISLAND
HABITAT REHABILITATION AND ENHANCEMENT PROJECT

POOL 14, UPPER MISSISSIPPI RIVER MILES 502.5-508.0
CLINTON & SCOTT COUNTIES, IOWA, AND ROCK ISLAND COUNTY, ILLINOIS

DRAFT

DRAFT

FIGURES

DRAFT

DRAFT

TABLES

DRAFT

PHOTOGRAPH

APPENDICES

DRAFT

SECTION I. INTRODUCTION

A. Location

The *Steamboat Island Habitat Rehabilitation and Enhancement Project (HREP)* (Project) is located in Clinton and Scott Counties, Iowa, and Rock Island County, Illinois, in the middle section of Pool 14 of the Upper Mississippi River (UMR), between the town of Princeton, Iowa, river mile (RM) 502.5, and the Wapsipinicon River (RM 508.0) (Figure I-1). Areas considered as part of this Project and described as the Project area include Steamboat Island, Steamboat Slough, the adjacent secondary channel complex Grant Slough, smaller islands in the southeast portion of the Project area (West Southeast and East Southeast Islands), and the forested areas north and south of the Wapsipinicon River (Figure I-2). The Princeton State Wildlife Area (constructed as part of the Princeton Refuge HREP) is just west of the Project area. The Project area contains approximately 2,620 acres of interconnected backwaters, secondary channels, wetlands, islands, floodplain habitat, and aquatic habitat. Figures I-1 and I-2 and Plate 7 C-101 provide vicinity and specific location maps for the Project. All plates referenced in this document are included in Appendix P, *Plates.*

The Project lands, all of which are owned by the U.S. Army Corps of Engineers (Corps), Rock Island District (District), and the U.S. Fish and Wildlife Service (USFWS), are managed as a part of the UMR National Wildlife and Fish Refuge (NWFR) through a cooperative agreement between the USFWS and the Corps dated February 14, 1963, and an amended cooperative agreement dated July 31, 2001.

B. Purpose and Need

The District proposes to rehabilitate and enhance the Project area through construction of measures that will maintain, enhance, and restore quality habitat for native and desirable plant, animal, and fish species and maintain, enhance, restore, and emulate natural river processes, structures, and functions for a resilient and sustainable ecosystem. Though degraded, this important backwater area supports a diverse population of wildlife including waterfowl, migratory birds, fish, mussels, and mammals. Human activity within the UMR basin, floodplain, and channel has altered the hydrology, topography, and biotic communities present. Years of continual sediment deposition has degraded aquatic and wetland habitats and, in some instances, converted them to low elevation terrestrial habitats characterized by reed canarygrass monocultures, a relatively low-quality habitat. Impoundment of the pool and permanently higher water elevations during the growing season have affected the health of floodplain habitat on islands and adjacent floodplain areas. Frequent inundation of floodplain forests are affecting forest composition and regeneration. The largest concern is that without intervention, the Project area is likely to experience forest fragmentation and a continued influx of invasive species; essentially transitioning from forest to a reed canarygrass monoculture over time (Guyon et al., 2012). All of these alterations have reduced the quality and diversity of aquatic and floodplain habitats and impaired ecosystem functions. Erosion and other stressors have reduced the acreage of Steamboat Island and other islands within Pool 14. While these stressors are likely to continue, as is the decline of the quality critical habitats, this Project provides an opportunity to improve the quality, diversity, and sustainability of aquatic, wetland and floodplain habitats.

This Feasibility Report with Integrated Environmental Assessment (EA) presents a detailed account of the planning, engineering, construction details, and environmental considerations that resulted in the Tentatively Selected Plan (TSP).

DRAFT

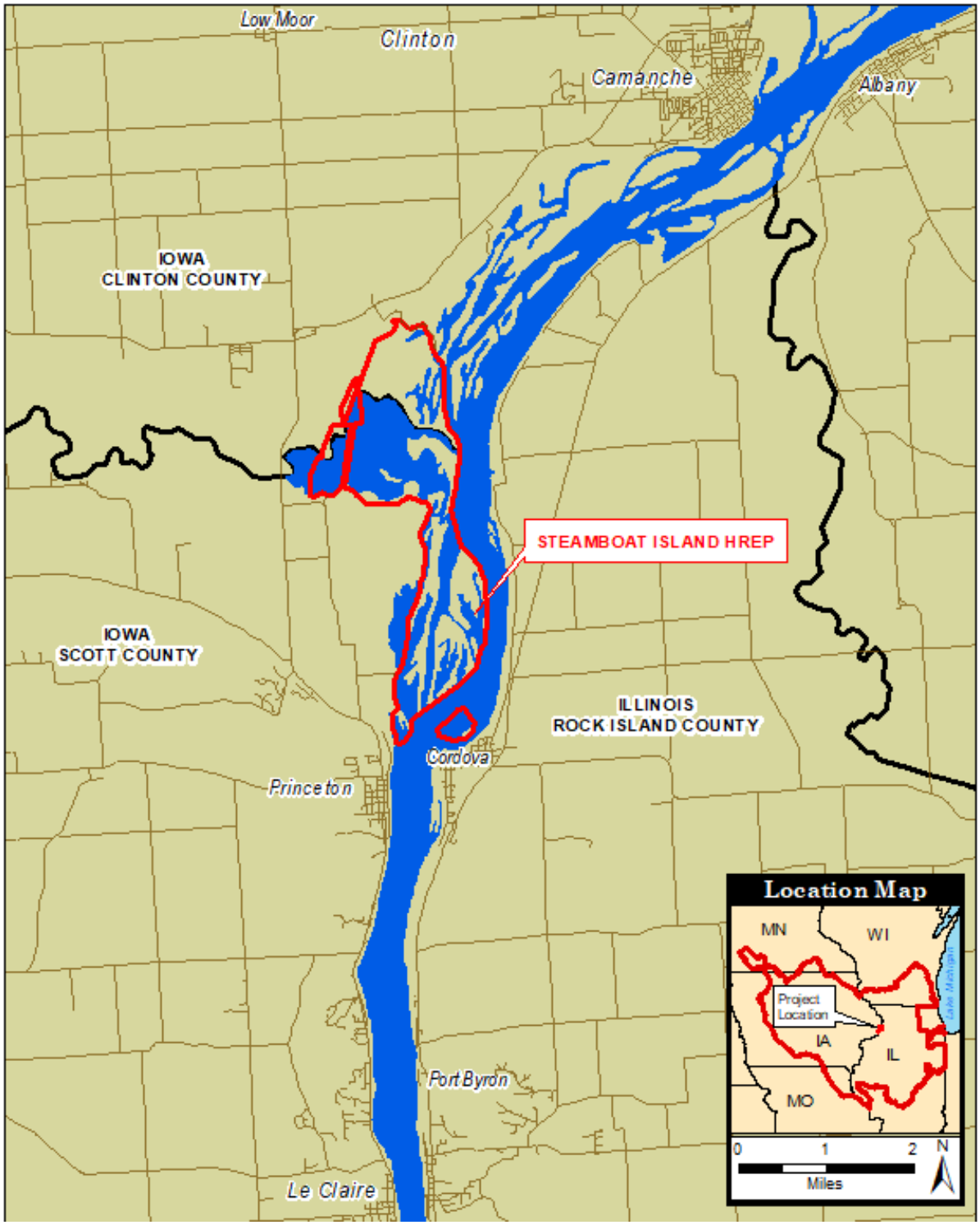


Figure I-1. Vicinity Map

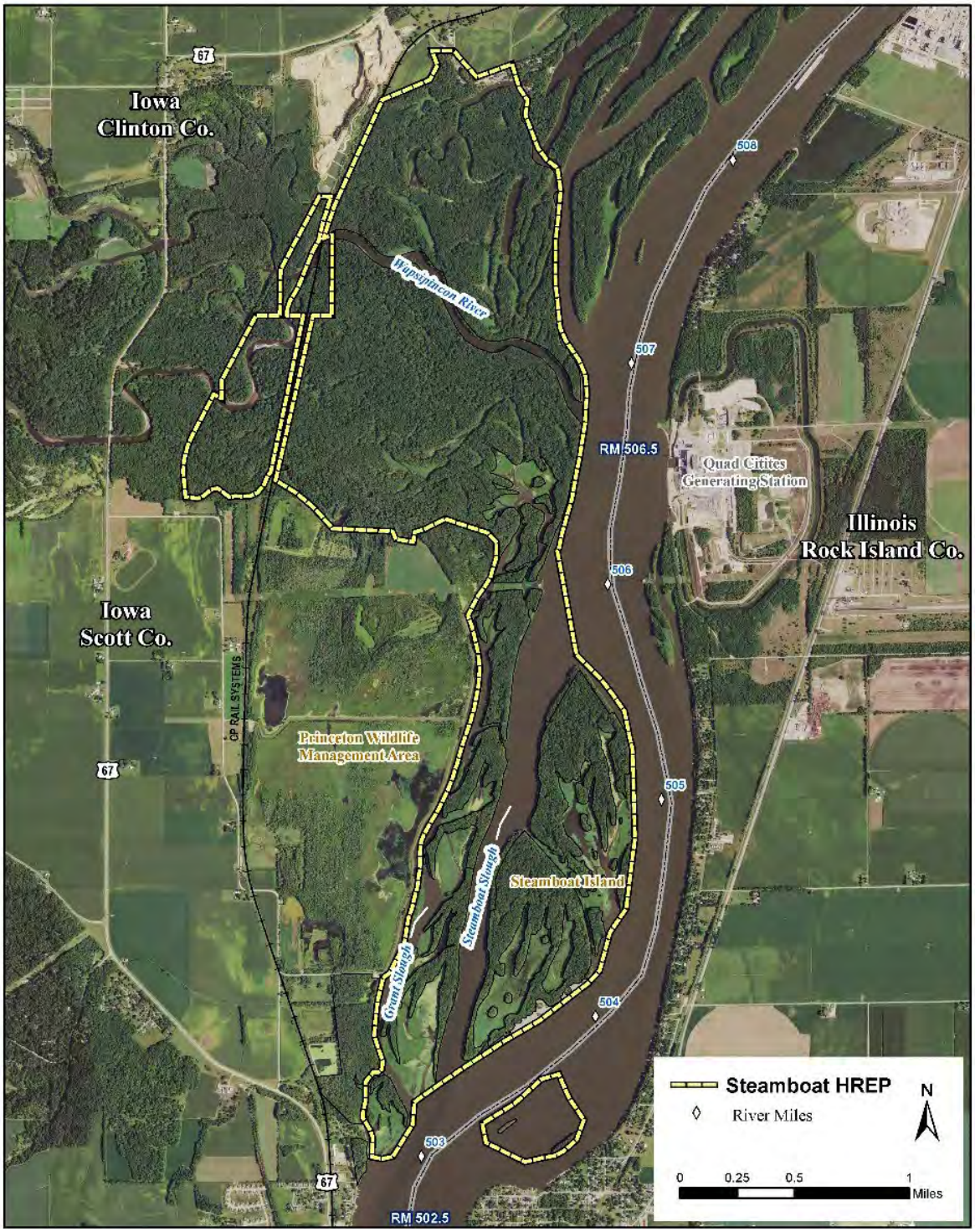


Figure I-2. Project Area Map

The need for rehabilitation and enhancement of the site is based on the following factors:

- Islands in the Project area have eroded and degraded over the course of time, as higher water levels, wind fetch, and erosion have caused loss in acreage and habitat quality.

- The existing topography has limited conditions suitable for forest and scrub-shrub/pollinator vegetation diversity and frequent inundation of the floodplain has affected natural regeneration. Consequently, quality floodplain forest and vegetation growth and survival are reduced. Without action, floodplain habitat will decrease in diversity through succession to silver maple, open canopy, and/or invasive species.

- The existing backwater aquatic habitat currently lacks adequate fish overwintering habitat conditions important for year-round habitat functioning. Without action, the available overwintering habitat will continue to decrease.

C. Project Selection

The Upper Mississippi River Restoration (UMRR) Program, authorized by the Water Resources Development Act (WRDA) of 1986 under Section 1103 and extended indefinitely by the WRDA of 1999, is a Federal-State partnership program for planning, construction and evaluation of fish and wildlife habitat rehabilitation projects and for monitoring the natural resources of the river system. It is a regional program that includes the Corps' St. Paul, Rock Island, and St. Louis Districts. Interagency groups in each of the Corps Districts, such as the Fish and Wildlife Interagency Committee (FWIC) and River Resources Coordinating Team (RRCT), identify, prioritize and select the rehabilitation projects. Field managers from the aforementioned interagency groups determine the areas that have degraded aquatic, wetland, and bottomland forest habitats and which UMRR-authorized objectives are priority for the area. The Federal Sponsor, the USFWS, with support from the non-Federal Project Partner, the Iowa Department of Natural Resources (IADNR), nominated the Steamboat Island HREP for inclusion in the Corps' UMRR Program. The FWIC then ranked the Project habitat benefits based on critical habitat needs along the UMR and the Illinois Waterway (IWW).

After considering resource needs and deficiencies pool by pool, the FWIC and the RRCT supported and recommended the Project as providing significant aquatic, wetland, and floodplain benefits with opportunities for habitat enhancement. The Mississippi Valley Division (MVD) approved the original Fact Sheet on September 20, 2010. A revised Fact Sheet, which included an expanded Project area (additional 2,100 acres) to allow for maximum rehabilitation and enhancement activities, was approved on May 22, 2018.

D. Implementation Responsibilities

Participants in the planning of the Steamboat Island HREP included the Corps, USFWS, IADNR, and ILDNR (Table I-1). Under Federal regulations governing the implementation of NEPA, USFWS is a cooperating agency. Development of this Feasibility Report was actively coordinated with the participants during team meetings, phone conversations, and on-site visits to the Project area (Appendix A, *Correspondence*).

DRAFT

Table I-1. Participants in the Planning of the Steamboat Island HREP

U.S. ARMY CORPS OF ENGINEERS		
Marshall Plumley	Program Manager	Program Manager
Julie Millhollin	Project Manager	Project Manager
Rachel Perrine	Lead Planner	Study Manager, Plan Formulation
Davi Michl	Biologist	Environmental/HEP/Adaptive Mgmt
Lucie Sawyer	Hydraulic Engineer	Hydrology/Hydraulics
Anton Stork	Hydraulic Engineer	Hydrology/Hydraulics
Elizabeth Bruns	Hydraulic Engineer	Water Quality
Diane Karnish	Economist	Economics
Christine Nycz	Archaeologist	Cultural Resources
Felix Castro	Engineer	Geotechnical
John Lacina	Engineer	Costs & Specs
Kyle Nerad	Engineer	Civil/Design
Stephen Gustafson	Environmental Protection Specialist	HTRW
Samuel Bailey	Real Estate	Real Estate
Kaileigh Thomas	Geographer	GIS
U.S. FISH AND WILDLIFE SERVICE		
Sharonne Baylor	Environmental Engineer	UMR NWFR
Ed Britton	Refuge Manager	UMR NWFR, Savanna District
Nate Williams	Deputy Refuge Manager	UMR NWFR, Savanna District
Sara Schmuecker	Fish and Wildlife Biologist	IL-IA Ecological Services Office
Tyler Porter	Fish and Wildlife Biologist	IL-IA Ecological Services Office
James Myster	RHPO/Archaeologist	Regional Office
DEPARTMENTS OF NATURAL RESOURCES		
Kirk Hansen	Mississippi River Habitat Coordinator	IADNR
Scott Gritters	Fisheries Biologist	IADNR
Matt O'Hara	Middle Mississippi River Biologist	ILDNR

U.S. Army Corps of Engineers, Rock Island District. The District is responsible for Project management and coordination with the Sponsor, Project partners, and other affected agencies. The District will submit the Feasibility Report; program funds; finalize P&S; complete all NEPA requirements; advertise and award a construction contract; and perform construction contract supervision and administration. Section 906(e) of WRDA 1986 states that first cost funding for enhancement measures will be 100% Federal cost because the Project measures will be located on federally-owned land that is managed by the USFWS as a national wildlife refuge.

U.S. Fish and Wildlife Service. Because the project would be located on land managed by the UMR NWFR, the Regional Director of the USFWS, Region 3, will determine whether the project is compatible with Refuge goals and objectives and the Refuge Comprehensive Conservation Plan. The USFWS Regional Director will also determine if the USFWS approves the selected alternative for potential implementation and if the USFWS will assume operation and maintenance responsibilities. The Regional Director will also determine, based on the facts and recommendations contain herein, whether the final integrated Feasibility Report and EA meets the USFWS's obligation under NEPA, the Fish and Wildlife Coordination Act (FWCA) of 1965, the Endangered Species Act (ESA) of 1973, the Migratory Bird Treaty Act of 1918, and the Bald Eagle Protection Act of 1940. The USFWS has been a cooperating agency in the preparation of this EA and has been integral in the decision making process for the Feasibility Report.

The USFWS is the Federal Sponsor and has provided a Coordination Act Report. O&M, as described in Section VIII, *Cost Estimates*, Tables VIII-5 and VIII-6, is the responsibility of the USFWS in accordance with Section 107(b) of WRDA 1992, Public Law 102-580. The Corps will further specify these functions in the Project O&M Manual, which will be provided after construction completion and prior to transferring the Project to the USFWS.

Upon completion of the construction as determined by the District Engineer, the USFWS shall accept the Project as part of the General Plans lands managed by the USFWS. The USFWS shall operate, maintain, and repair the Project as defined in this Report; 100 percent of all costs associated with the operation, maintenance, and repair of the Project will be borne by the USFWS.

Iowa Department of Natural Resources. The IADNR, a non-Federal Project partner, has provided technical and other advisory assistance during all phases of the Project and will continue to provide assistance during implementation and monitoring.

Illinois Department of Natural Resources. The ILDNR, a non-Federal Project partner, has provided technical and other advisory assistance for measures in the Illinois portion of the Project area and will continue to provide assistance during implementation and monitoring.

E. Scope of Study

The scope of this study focuses on proposed Project measures that will increase the quality and quantity of the bottomland hardwood forest, aquatic habitat, island topography, and backwater and interior wetland habitats, provide important linkages between similar habitats in Pool 14, and enhance overall resource values. The Project is consistent with agency management goals and was planned for the benefit of resident and migratory birds, fish, and other wildlife. Field surveys and inventories, aerial photography, topographic surveys, Light Detection and Ranging (LiDAR) surveys, bathymetry surveys, wildlife and fisheries surveys, hydraulic modeling, soil borings, and habitat quantification procedures were completed to support the planning and assessment of proposed Project alternatives. Baseline water quality monitoring was performed to define present water quality conditions. A forest inventory was initiated in 2018 to evaluate the species composition and average age of the existing forest. These observations and surveys accomplished by the District, USFWS, and IADNR, along with future studies and monitoring, will assist in evaluating Project performance.

F. Discussion of Prior Studies, Reports, and Existing Water Projects

The following summarizes prior studies and reports and existing projects completed using UMRR authorities. Additional literature cited can be found in Appendix L and at the end of each Appendix.

Upper Mississippi River System-Environmental Management Program, Pool 14, Beaver Island HREP. This HREP is located in Clinton County, Iowa, upstream of the Steamboat Island Project at RMs 513.0 through 517.0. The Feasibility Report was completed in 2017 and construction began in 2019.

Upper Mississippi River System-Environmental Management Program, Pool 14, Princeton Refuge HREP. This HREP is located in Scott County, Iowa, adjacent to the Steamboat Island HREP at RMs 504.0 through 506.4. The Definite Project Report (DPR) was completed in

1995 and construction was completed by 2002, with subsequent operation and maintenance (O&M) manuals and inspection reports completed.

Upper Mississippi River System-Environmental Management Program, Pool 13, Potters Marsh HREP. This HREP is located in Carroll and Whiteside Counties, Illinois upstream of the Steamboat Island Project at RMs 522.5 through 526.0. The DPR was completed in 1992 and construction was completed by 1995, with subsequent O&M manuals and inspection reports completed.

Upper Mississippi River Restoration-Environmental Management Program, Pool 18, Huron Island HREP. This HREP is located in Des Moines County, Iowa downstream of the Steamboat Island Project at RMs 421.2 through 425.4. The DPR was completed in 2013 and is currently under construction.

Status and Trends of Selected Resources of the Upper Mississippi River System: A Report of the Long Term Resource Monitoring Program. U.S. Geological Survey (USGS), Upper Midwest Environmental Sciences Center, La Crosse, WI. 2008. Monitoring data is summarized for 24 indicators of the ecological condition of the UMR System (UMRS) and Illinois River into one report, alongside historical observation and other scientific findings. This report also serves as background material for the Corps' periodic Reports to Congress that provide recommendations for future environmental management of the UMRS.

Ecological status and trends of the Upper Mississippi River System 1998: A Report of the Long Term Resource Monitoring Program. USGS, Upper Midwest Environmental Sciences Center, La Crosse, WI. April 1999. Monitoring data is summarized for 24 indicators of the ecological condition of the UMRS and Illinois River into one report, alongside historical observation and other scientific findings.

A River That Works and a Working River: A Strategy for the Natural Resources of the Upper Mississippi River System. Upper Mississippi River Conservation Committee, Rock Island, IL, 2000. This report describes the critical elements of a strategy for the O&M of the natural resources of the UMRS and its tributaries, including the setting of restoration goals and objectives.

Upper Mississippi River System Habitat Needs Assessment: Summary Report 2000. Corps, St. Louis District, St. Louis, MO, 2000. The summary report and its supporting technical report were the result of a system-wide analysis of historical, existing, and forecasted habitat conditions. The information in the report was developed to help guide future HREPs on the UMRS.

Conservation Priorities for Freshwater Biodiversity in the Upper Mississippi River Basin, R. Weitzell, E. McKhoury, P. Gagnon, B. Schreurs, D. Grossman, and J. Higgins, Nature Serve and The Nature Conservancy, July 2003. This study evaluates the components and patterns for the freshwater biodiversity of the UMR Basin and identifies the most significant places to focus conservation opportunities.

DRAFT

Upper Mississippi River Restoration Environmental Management Program Environmental Design Handbook. Corps, Rock Island District, Rock Island, IL, August 2006 and December 2012. These handbooks evaluate project measures and incorporate lessons learned throughout the life of the program.

2004, 2010, and 2016 Reports to Congress, Upper Mississippi River System Environmental Management Program. Corps, Rock Island District, Rock Island, IL. Formal evaluations of the UMRR that evaluates the program, describes its accomplishments (including development of a systemic habitat needs assessment), and identifies certain program adjustments.

Upper Mississippi River-Illinois Waterway System Navigation Feasibility Study, Feasibility Report 2004. Corps, Rock Island, St. Paul, and St. Louis Districts. This feasibility study examines multiple navigation and environmental restoration alternatives, and contains the preferred integrated plan as a framework for modifications and operational changes to the UMR and the IWW System to provide for navigation efficiency and environmental sustainability.

Environmental Science Panel Report: Establishing System-wide Goals and Objectives for the Upper Mississippi River System. D. Galat, J. Barko, S. Bartell, M. Davis, B. Johnson, K. Lubinski, J. Nestler, and D. Wilcox, UMRS Navigation and Ecosystem Sustainability Program (NESP) Environmental Report 6, Rock Island, IL 2007. The report presents suggested refinements to system-wide ecosystem goals and objectives and proposed steps to take in the further development of objectives for the system.

Upper Mississippi River System Ecosystem Restoration Objectives, Corps, 2009. This report is the final product of a planning process initiated in 2008 for the purpose of identifying areas for new restoration projects and identifying knowledge gaps at a system scale. The Report serves as a backdrop for the formulation of specific restoration projects and their adaptive ecosystem management components.

UMR National Wildlife and Fish Refuge Comprehensive Conservation Plan. USFWS, 2006. This plan guides the administration and management of the UMR NWFR and contains six goals and 41 associated objectives, as well as implementation strategies to achieve the objectives.

Upper Mississippi River National Wildlife and Fish Refuge Habitat Management Plan. USFWS, 2019. On file at Upper Mississippi River National Wildlife and Fish Refuge Headquarters Office, Winona, MN. 127 pp + Appendices A-F. This plan guides the habitat management of the UMR NWFR lands.

Bottomland hardwood forests along the Upper Mississippi River, 1997. Yin, Y., Nelson, J.C., & K.S. Lubinski. Natural Areas Journal: 17 (2). This report summarizes the historical condition of bottomland hardwoods in the UMRS and evaluates the challenges caused by a modified river environment to restoring diverse, productive, and naturally-regenerating bottomland hardwoods in the UMR.

DRAFT

Habitat Needs Assessment-II, 2018. McCain, K.N.S., Schmuecker, S. and N.R. De Jager. This report combines data and surveys to evaluate how the existing conditions of the UMR compare to desired conditions identified by the UMRR partnership. The Habitat Needs Assessment-II (HNA-II) and the Indicators Report will be utilized to help inform habitat restoration activities into the future as the UMRR Program seeks to achieve the vision and goals of this multi-agency partnership.

Indicators of Ecosystem Structure and Function for the Upper Mississippi River System, 2018. De Jager, N.R., Rogala, J.T., Rohweder, J.J., Van Appledorn, M., Bouska, K.L., Houser, J.N., and J. Jankowski. U.S. Geological Survey Open-File Report 2018-1143. https://doi.org/10.3133/ofr20181143. This report documents the development of quantitative measures (indicators) of ecosystem structure and function for use in a Habitat Needs Assessment for the UMRS.

Developing a shared understanding of the Upper Mississippi River: the foundation of an ecological resilience assessment, 2018. Kristen Bouska, Jeffrey Houser, Nathan De Jager, Jon Hendrickson. Ecology and Society 23 (2):6. https://www.ecologyandsociety.org/vol23/iss2/art6/. This report articulates the temporal and spatial extent of the assessment of the UMRS, the relevant historical context, the valued services provided by the system, and the fundamental controlling variables that determine its structure and function.

Letter Report: Placing Dredged Material on the Princeton Wildlife Refuge Levee. Corps, Rock Island District. 15pp. This letter report discusses several placement options for the Princeton Wildlife Refuge levee, including corresponding environmental concerns, operational feasibility, and economic costs for each option.

G. Authority

The UMRR's original authorizing legislation was the 1986 WRDA, Section 1103 (33 U.S.C. 2201 et seq.; P.L. 99-662, 1986). The UMRR was originally comprised of five elements: HREPs, Long Term Resource Monitoring (LTRM), Recreation Projects, Economic Impacts of Recreation, and Navigation Monitoring. Currently, the UMRR is comprised of two elements: (1) plan, construct, and evaluate measures for fish and wildlife habitat improvement through HREPs, and (2) monitor the natural resources of the river system through the LTRM element. The other UMRR elements have either been successfully completed or are now carried out under other authorities.

The original authorizing legislation has been amended several times since its enactment. The 1990 WRDA, Section 405, extended the original UMRR authorization an additional five years to fiscal year 2002, which allowed for revitalization of the program. The 1992 WRDA, Section 107, amended the original authorization by allowing limited flexibility in how funds are allocated between the HREP program and the LTRM element. The 1992 WRDA also assigned sole responsibility for O&M of habitat projects to the agency that manages the lands on which the Project is located. The 1999 WRDA, Section 509, reauthorized UMRR as a continuing authority with reports to Congress every 6 years and changed the cost sharing percentage from 25% to 35%. The 1999 Water Resources Development Technical Corrections, Section 2, corrected paragraph deletions/additions. The 2007 WRDA, Section 3177, allowed for the inclusion of water quality research in the applied research program for development of remediation strategies on the Mississippi River.

SECTION II. AFFECTED ENVIRONMENT

A. Resource History of the Study Area

The Mississippi River, and what is presently Pool 14, has been very important to the social and economic development of the region. The earliest native cultures and explorers used the river for its ease of transportation and rich resources, which has continued into present time (USGS, 1998). Historical surveys indicate the area contained a mix of bottomland forests with a high proportion of oaks and other hard mast trees (Yin et al., 1997). River channels, seasonally flooded backwaters, floodplain lakes, and marshes were prevalent throughout the area (Theiling, 2010).

Channel manipulations to clear the channel and improve navigation on the UMR began around 1825. Measures to deepen the channel began in the 1880s. The completion of the lock and dam system, including Locks and Dam (L&D) 14 in 1939, changed the free-flowing river to a series of reservoirs and stabilized water levels and reduced lakes and marshes from the floodplain. These changes adversely affected the biological resources of the river and over time, the impacts of channel modification have contributed to a decrease in habitat structure, bottomland hardwood regeneration, and the amount of aquatic backwater habitat and isolated wetland habitat. This has led to a decrease in the habitat associated with each land cover type, as well as the fish and wildlife dependent on the habitat.

B. Description of Project Area and Current Management

All lands in the Project area are in Federal ownership and are managed by the USFWS as part of the UMR NWFR. Management of the Project was outgranted to the USFWS in 1963 (amended in 2001), but the Corps retained forestry management responsibility on Corps fee title lands. Mississippi River Project forestry management practices include timber harvest, thinning treatments, tree plantings, and follow-up vegetation control at tree planting areas. Typically, this is done on a small scale (2 to 20 acre treatment areas). The USFWS conducts no active habitat management on Steamboat Island and there are no water control structures or other infrastructure in place to maintain. There are no Closed Areas on Steamboat Island; it is open year-round to public access, including hunting. There are several public boat ramps providing access to the Project area located on both Iowa and Illinois shorelines, including the Cordova, IL, and Princeton, IA, boat ramps. Figure M-4 in Appendix M, *Engineering Design*, shows a map of all public access ramps in the Project area. There is a designated Slow No Wake Area within the backwaters of the Wapsipinicon Bottoms at RM 506.0 - 506.6. From March 16 through October 31, watercraft must travel at slow, no wake speeds, and no airboats or hovercraft are allowed.

The southeast shoreline of Steamboat Island, (a channel maintenance dredged material Historic Bankline Placement Site RM 503.5-504.1R, locally known as Princeton Beach) is a highly utilized public use area. Recreational boating, primitive camping, fishing, and other water- and recreation-related activities occur, especially on summer weekends when boats are typically crowded along the entire shoreline. The USFWS and the IADNR conduct routine law enforcement patrols of this area but otherwise there are no other active management programs. Historic Bankline Placement Site RM 503.5-504.1R also receives periodic re-nourishment from the Steamboat Slough dredge cut, as part of the Long-Term Management Plan for dredged material in Pool 14 (USACE, 1999). Figure M-3 in Appendix M, *Engineering Design*, shows a map of historical dredge cuts and placement sites in the Project area. The Rock Creek Marina and Campground, managed by the Clinton County, Iowa, Conservation Board, is another high-use recreation area in the backwaters of the Wapsipinicon Bottoms. Rock Creek offers dock, boat, and cabin rentals and is the site of the Mississippi River Eco Tourism Center.

DRAFT

Directly across the river from the Wapsipinicon Bottoms is the Quad Cities (QC) Generating Station, a nuclear-fueled steam electric generating facility located on the Illinois shore near RM 506.5, just upstream of Cordova, Illinois. The station consists of two boiling water nuclear reactors that withdraw cooling water from the Mississippi River at a maximum rate of 2,253 cubic feet per second (cfs). Prior to beginning operation, the QC Generating Station developed the Long-term Fisheries Monitoring Program in 1971 to annually assess the impacts of its operations on fisheries in Pool 14. The QC Generating Station has varied its operations over the past decades from open-to closed-cycle modes, discharging cooling water to the river via a side-jet canal that completely encircles the Station. The QC Generating Station is currently operating in open-cycle as a direct result of long-term fisheries monitoring in coordination with state and Federal agencies (Exelon Corp., 2019). The QC Generating Station is also home to the only privately-owned fish hatchery on the Mississippi River, having both raised and released millions of sport fish into the UMR.

C. Floodplain Resources

Islands within the Project area have eroded over time, resulting in the loss of acreage and floodplain forest. Historical imagery of the area provides approximate changes in land mass, as shown in Figure II-1, but does not fully account for differences in river levels shown in the imagery.

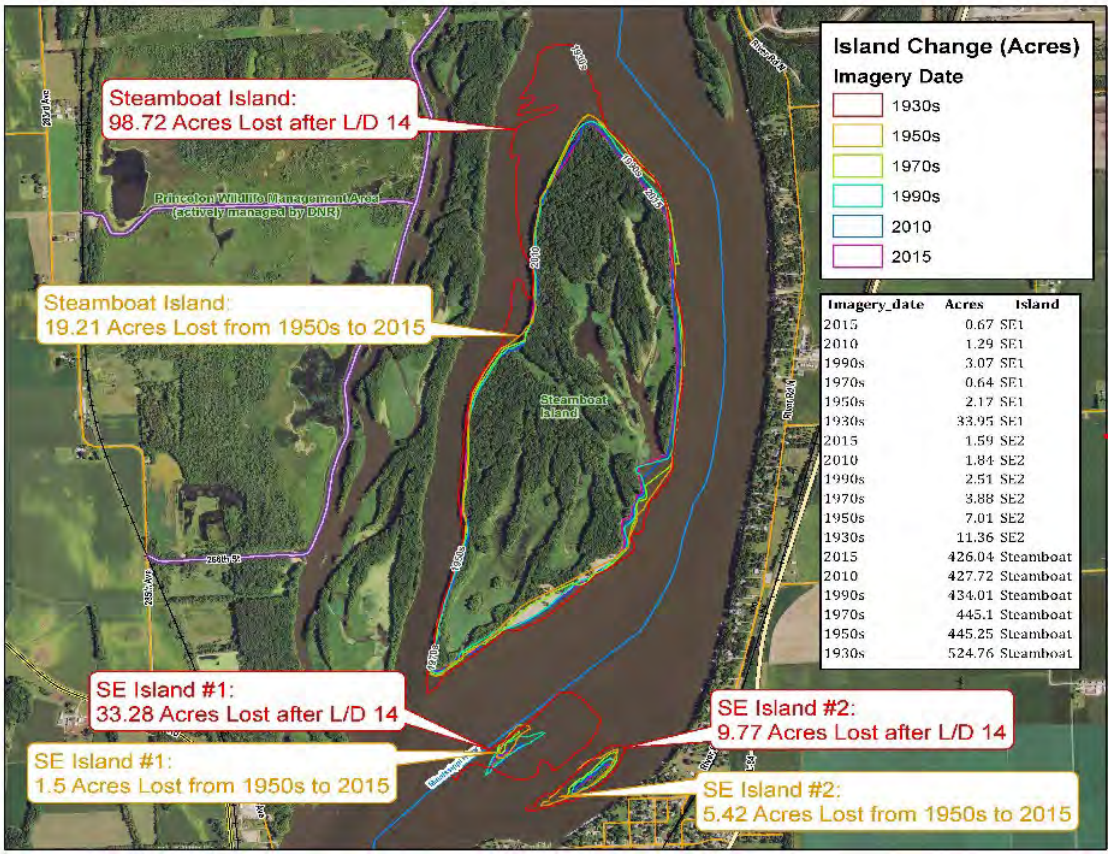


Figure II-1. Island Loss in the Project Area from 1930s to 2015

The most quantifiable loss occurred after construction of L&D 14 at LeClaire, Iowa, as some portion of this loss may be contributed to inundation of the land instead of erosive loss. Comparing 1930s imagery (pre-lock and dam) to 2015 imagery, Steamboat Island proper lost 98.7 acres, the West Southeast (SE) Island lost 33.3 acres, and the East SE Island lost 9.8 acres. Comparing 1950s (post-lock and dam) imagery to 2015 imagery, Steamboat Island proper lost 19.2 acres, the West SE Island lost 1.5 acres, and the East SE Island lost 5.4 acres. All acreages are approximate.

As such, it can be estimated that approximately 80 acres of Steamboat Island proper were lost due to inundation and erosion in the first 20 years following construction of L&D 14. Additionally, approximately 20 acres have been lost since the 1950s, resulting in an average of 0.3 acre of loss per year over those 65 years. Since the start of this study in 2017, visual observations have confirmed active erosion at Steamboat Island proper and the Southeast Islands, including trees falling off banks into the river as a result of erosion and bank undercutting. Additional erosion of these islands was observed following near-record spring flooding in 2019, but these recent observations remain unmeasured at the time of this Report.

The Project area contains approximately 2,013 acres of floodplain habitat (Table II-1), defined as elevations above the aquatic threshold of the 70% exceedance duration profile corresponding with an elevation of 571.7 feet at river mile 504.5. 2010 LTRM land cover data (http://www.umesc.usgs.gov/data_library/land_cover_use) was utilized to calculate the floodplain forest habitat. The floodplain located within the Project area is comprised of 1,674 acres (83%) of floodplain forest habitat, 292 acres of emergent wetland (15%), and about 47 acres (2%) of predominantly scrub-shrub/pollinator habitat (of which 35 acres are reed canarygrass, a non-native invasive species). Scrub-shrub/pollinator habitat was identified as elevations above the 55-day inundation duration with 50% exceedance. Scrub-shrub/pollinator habitat may occupy a small percentage of floodplain but can also occur at upper elevations amongst other habitats. Sections II.C.1 and C.2 further describe the forest and wildlife communities and their habitats.

Table II-1. Steamboat Island Floodplain Habitat Distribution

Habitat Type	Acres	Percent	Criteria
Total Floodplain Area	2,013		
Emergent Wetland	292	15%	Area between aquatic and scrub-shrub/pollinator
Scrub-shrub/Pollinator	47	2%	Above 55-day inundation duration elevation exceeded ½ years (50% exceedance probability)
Floodplain Forest	1,674	83%	LTRM Land Cover data classified through aerial imagery and field observations

All elevations (Figure II-2) used in this report are expressed using the North American Vertical Datum of 1988 (NAVD88), unless otherwise stated. The conversion from NAVD88 to Mean Sea Level (MSL) 1912 at the Camanche, IA, river gage is (+0.77 feet) and (+0.73 feet) at L&D 14. See Appendix H, *Hydrology and Hydraulics*, for a complete table of datum conversions by river mile. Due to having a partial forest inventory identifying acreages of habitat types, assumptions regarding the flood tolerance for different habitat types within the Project area were made to estimate the existing habitat distribution.

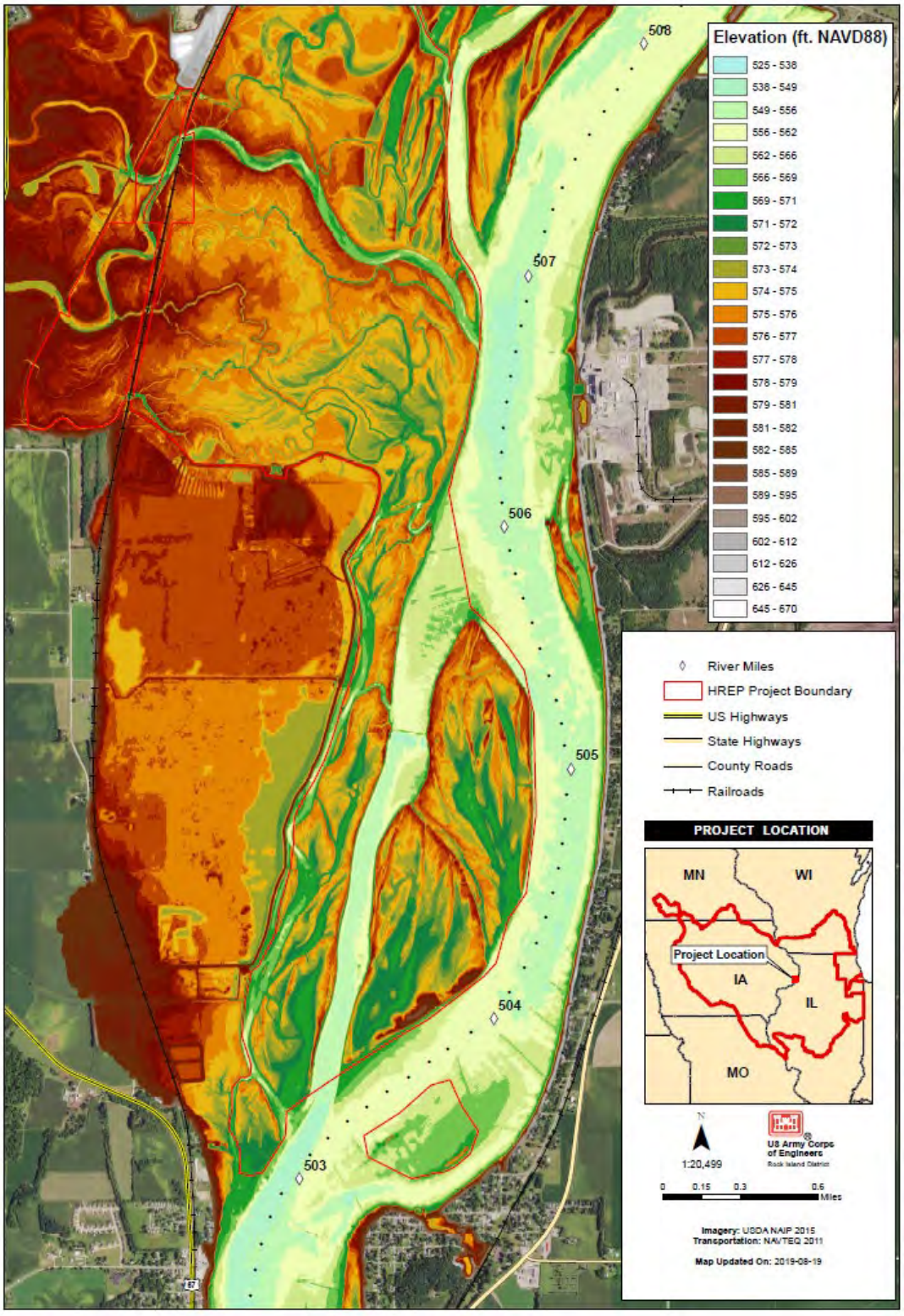


Figure II-2. Topographic and Bathymetric Elevation Map for Steamboat Island

1. Forest Diversity and Habitat. Large floodplain forests present in the Project area are important features of the landscape. As dynamic habitats exposed to frequent disturbances, they provide scarce resources for many groups of animals.

Since the completion of the UMR lock and dam system, water levels in Pool 14 are generally higher over the entire year, and periods of very low flow formerly common in the fall have been eliminated. Consequently, the majority of islands are located at or below elevations where increased flood duration and frequency exceeds thresholds for optimal survival, growth, and sustainability of a floodplain forest that includes hard mast trees (i.e., oaks and hickories) (De Jager et al., 2012; Guyon et al., 2012). Hard mast (acorns, hickories, etc) is an important food source for many species of floodplain wildlife.

Approximately 51% of the Project area is at an elevation (>574 feet) suitable to contain hard mast-producing trees. For more detailed information, see Appendix D, *Habitat Evaluation and Benefits Quantification*, and Appendix H, *Hydrology and Hydraulics*. Eighteen different species in the overstory were recorded during a 2018 forest inventory consisting primarily [10 or more average trees per acre (TPA)] of silver maple (*Acer saccharinum*), common hackberry (*Celtis occidentalis*), American elm (*Ulmus Americana*), green ash (*Fraxinus pennsylvanica*), eastern cottonwood (*Populus deltoids*), red mulberry (*Morus rubra*), black willow (*Salix nigra*) and pin oak (*Quercus palustris*) (Figure II-3). Silver maple was the most encountered tree species ranging from 35 to 171 average TPA. Areas with hard mast trees present were, on average, over 88 years old (range of 1874-1964) and were characterized by limited tree regeneration in the understory. This lack of production is directly related to increased water inundation and duration. Additional tree species found during this inventory can be found in Table II-2.

The existing stands of even-aged mature silver maple are a concern. Eventual mortality due to old age can be expected at nearly the same time for much of the forest, resulting in open canopies with limited understory tree seedlings and saplings available for regeneration. These conditions will likely facilitate the spread and dominance of non-desirable herbaceous vegetation, such as reed canarygrass, which prevents further recruitment of desirable tree species through direct competition with tree saplings. Examples of this can be found at numerous locations in the UMRS, where mortality of mature trees has been followed by invasion from reed canarygrass, further limiting recruitment of desirable trees. Refer to Section II.F., *Invasive Species,* for invasive terrestrial plants found during the 2018 forest inventory.

DRAFT

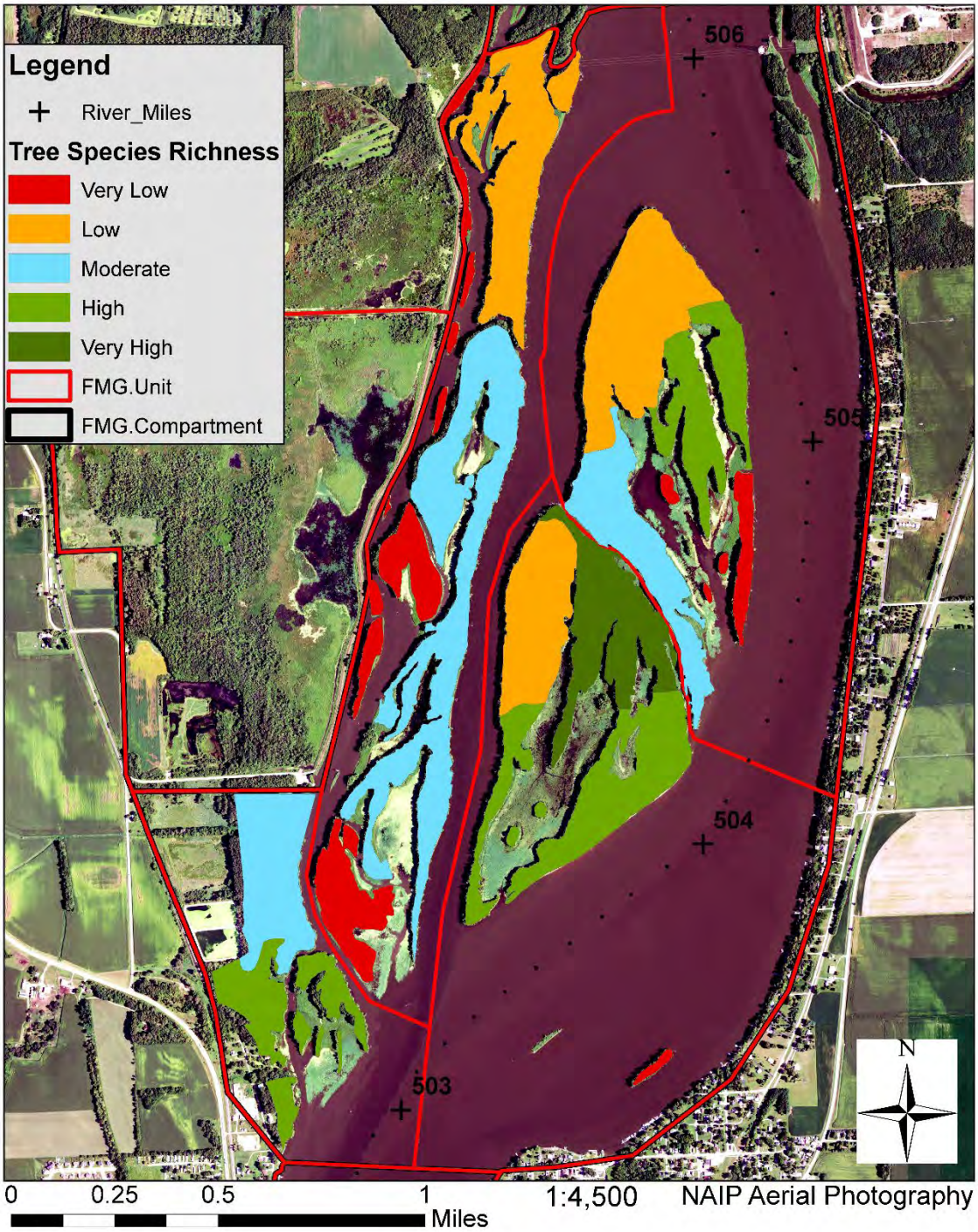


Figure II-3. Species Richness Results of the Steamboat Island Forest Inventory Conducted in 2018

Table II-2. Overstory and Understory Woody Tree and Shrub Species

Common Name	Scientific Name
Boxelder	*Acer negundo*
Silver Maple	*Acer saccharinum*
River Birch	*Betula nigra*
Bitternut Hickory	*Carya cordiformis*
Northern Pecan	*Carya illinoinensis*
Shellbark Hickory	*Carya laciniosa*
Northern Catalpa	*Catalpa speciosa*
Hackberry	*Celtis occidentalis*
Buttonbush	*Cephalanthus*
Eastern Redbud	*Cercis canadensis*
Silky Dogwood	*Cornus amomum*
Grey Dogwood	*Cornus racemosa*
Redosier Dogwood	*Cornus sericea*
Green Hawthorn	*Crataegus viridis*
Eastern Wahoo	*Euonymus atropurpureus*
Green Ash	*Fraxinus pennsylvanica*
Honey Locust	*Gleditsia triacanthos*
Kentucky Coffeetree	*Gymnocladus dioicus*
Black Walnut	*Juglans nigra*
White Mulberry	*Morus alba*
Red Mulberry	*Morus rubra*
American Sycamore	*Plantanus occidentalis*
Cottonwood	*Populus deltoides*
Swamp White Oak	*Quercus bicolor*
Bur Oak	*Quercus macrocarpa*
Pin Oak	*Quercus palustris*
Black Locust	*Robinia pseudoacacia*
Sandbar Willow	*Salix interior*
Black Willow	*Salix nigra*
American Elm	*Ulmus Americana*

2. Wetlands Diversity and Habitat. Wetlands provide habitat for an array of wildlife including breeding and migratory waterfowl and other waterbirds, breeding and migratory landbirds, herptiles (reptiles and amphibians), and semi-aquatic mammals. Through a desktop delineation, approximately 1,295 acres of wetlands at the Project area are frequently flooded and hydraulically connected to the Mississippi River. In general, floodplain wetlands for this Project were defined as areas lying between elevations 571.7–574.9 feet (Table II-1). Below elevation 571.7 is open water aquatic habitat, addressed in Section II.D., *Aquatic Resources*. The upper limit of wetland habitat was established as the 14-day inundation duration exceeded 50% of the time. Approximately 26% of the wetland habitat is classified as scrub-shrub/pollinator and emergent wetland habitat and 74% is considered to be bottomland hardwood forest. Emergent wetlands can be found in low-lying depressions sporadically located throughout the Project area. Inundation and increased water levels limits the establishment and function of emergent wetland habitat.

3. Bat Habitat. Bats typically travel, forage, and roost within a variety of interconnected forested habitats, including riparian corridors, bottomlands, and uplands. Trees in excess of 3 inches dbh

appear to provide suitable foraging and maternity roosting habitat (USFWS, 2019b). Exfoliating bark, cavities of dead and live trees, and snags (i.e., dead trees or dead portions of live trees) are important components of potentially suitable bat habitat. The Project area contains numerous large trees and snags, which potentially serve as roosting habitat, and open forest dominated by large trees adjacent to open water, which may provide foraging habitat for the federally-endangered Indiana bat (*Myotis sodalis*), federally-threatened northern long-eared bat (*Myotis septentrionalis*), and many other bat species. Refer to Section II.E for details on federally-listed species. A mist net survey conducted in the summer of 2015 for the Beaver Island HREP, which contains similar habitat, yielded 190 bats, representing seven species. No federally-threatened Indiana bats and 14 federally-threatened northern long-eared bats were captured at the site; however acoustic surveys indicated presence of both listed species in the Project area (USACE, 2017). The most common species captured were the little brown bat (*Myotis lucifugus)*, big brown bat (*Eptesicus fuscus)* and evening bat (*Nycticeius humeralis*). Due to Beaver Island HREP's proximity to Steamboat Island and similar habitat structure, these survey results provide a good indication of bat species diversity likely present in the Project area.

4. Pollinator Habitat. Pollinator species, such as bees, butterflies, other insects, and hummingbirds, are indicators of ecosystem health and provide benefits to habitat diversity. Pollinators play a crucial role in flowering plant reproduction and in the production of most fruits and vegetables. This group of species have the potential to provide higher quality crops and benefits to the agricultural community. Pollinators are currently in decline due to habitat loss and degradation and pesticide use. In the Midwest, the federally-listed endangered rusty patched bumble bee (*Bombus affinis)* and the candidate species monarch butterfly (*Danaus plexippus*) are two species that have garnered public and agency attention. Protection, restoration, and enhancement of flowering trees, shrubs, and forbs that produce pollen and nectar resources are vital to pollinator conservation. The Project area currently has limited wildflower production due to reed canarygrass domination. The areas that have the potential to establish flower producing shrubs and vegetation are overtaken by this invasive species.

5. Avian Community

a. Bald Eagle *(Haliaeetus leucocephalus)*. Bald eagles winter along the Mississippi River, including Pool 14, typically using large trees for roosting and building nests. Suitable perch trees where eagles can loaf and perch are numerous, including the forested areas of Steamboat Island. The bald eagle is a common inhabitant of the Project area during the breeding and non-breeding seasons. The bald eagle is protected under the Bald and Golden Eagle Protection Act of 1940. There is at least one known bald eagle nest within the Project area, which was last observed as active in 2017 (**https://www.mvr.usace.army.mil/Missions/Recreation/Mississippi-River-Project/Education/Eagle-Watching/Eagle-Counts/**).

b. Red-Shouldered Hawk (*Buteo lineatus*). Red-shouldered hawks generally require large tracts of forest with relatively high amount of canopy closure. Bottomland forests of the UMR are important breeding habitat for this species.

c. Heron Rookeries. Herons are wading birds that typically utilize the shorelines of aquatic areas, as well as emergent wetlands to forage for fish and other small prey. Great blue herons and great egrets usually breed in colonies in trees close to wetlands and other aquatic habitats. A colony, or rookery, can be as large as 500 nests. Heron rookeries in the UMR are vulnerable because the availability of suitable nesting habitat is declining. While the Project area contains suitable habitat for

heron foraging, roosting, and nesting, there are no known heron rookeries in the Project area. The Beaver Island HREP, approximately 6 miles upstream from the Project area, also contains suitable habitat for heron foraging, roosting, and nesting.

d. Waterfowl. Waterfowl use wetlands to forage for a variety of wetland plants and invertebrate foods. The seasonal water conditions within the backwater lakes of the Project area are ideal for seed production by many wetland plants. Princeton Marsh Wildlife Management Area (WMA) is another HREP immediately adjacent to the Project area and continues to attract ducks and other waterfowl during fall and spring migrations, according to seasonal surveys conducted by the IADNR in 2015.

e. Secretive Marsh Birds. Secretive marsh birds include sora, pied-billed grebe, American bittern, and king rail. Species in this group are typically considered to be high priority species within USFWS Region 3 and the Eastern Tallgrass Prairie and Prairie Hardwood Transition Bird Conservation Regions. Members of this group have habitat requirements that vary from dense stands of vegetation without open water to emergent wetlands that are in proximity to deeper submersed marshes, or wetlands that have a mix of both emergent and submersed vegetation.

f. Neotropical Migratory Birds. The Migratory Bird Treaty Act (MBTA) of 1918 regulates the taking, possession, transportation, sale, purchase, barter, exportation, and importation of migratory birds. As of March 31, 2010, the MBTA regulates and protects 1,007 species. As one of the four major migration flyways in North America, the Mississippi River Flyway offers ideal conditions for migratory birds and the UMR floodplain corridor is an important corridor for neotropical migratory birds that use forest habitat. Floodplain complexes and the habitat provided are highly important to migratory bird species, such as neotropical migrants. The diverse array of habitat types floodplain forests typically provide tend to support higher abundances of species and individuals. Knutson et al. (1998) found relative abundances of all birds and total numbers of neotropical migratory birds were almost twice as high in the UMR floodplain as in the adjacent uplands.

Healthy populations of floodplain forest wildlife, including migratory birds, require adequate habitat. Since impoundment, the forest community in the Project area has become less diverse and the dominance of silver maple and invasive reed canarygrass have increased. The changes in tree species composition, structure, and function have contributed to a reduction in diversity of habitat over time. These changes are likely to continue, and without intervention, Steamboat Island and the surrounding area will cease to provide migration, dispersal, breeding, nesting, and cover habitat for a wide range of migratory birds.

D. Aquatic Resources

The Project area contains approximately 614 acres of aquatic habitat. The site offers both lentic (i.e., a body of standing water; 127 acres) and lotic (i.e., actively moving water; 487 acres) aquatic habitat types. Although the site offers a diverse array of interconnected channels and backwaters, the habitat provided by these resources for aquatic organisms is limiting at times. The following sections describe the typical aquatic community composition and habitat that currently exist in the Project area.

DRAFT

1. Backwater Fishery Habitat. The IADNR and the QC Generating Station have conducted fish sampling at several sites in the Project area and Pool 14 (Exelon Corp., 2019). Fish species sampled are similar to most other Mississippi River species. Many of the important recreational and commercial fish species (e.g., bluegill *Lepomis macrochirus*, largemouth bass *Micropterus salmoides*, black crappie *Pomoxis nigromaculatus)* are commonly found in the backwaters and Steamboat Slough during different times of the year. A 2017 IADNR fall fish survey yielded 221 fish of 14 species, including 2 redfin pickerel (or grass pickerel, *Esox americanus*), a species listed as threatened in the state of Iowa.

In general, the backwater aquatic areas can be described as relatively shallow backwaters (Table II-3 and Figure II-4) that contain some aquatic vegetation. Large woody debris serves as important habitat. Substrates consist of various mixtures of silts, sands, and clays. Water quality is generally acceptable with intermittent high temperatures in the summer and occasional low dissolved oxygen (DO) levels in the winter (Appendix F, *Water Quality*).

Spawning habitat for centrarchid fish species does not appear to be limiting within the Project area. The apparent successful spawning is most likely due to the relatively stable high water during June and July (i.e., average water level change from June 10 to July 31 is a drop of 2.08 feet). These prolonged conditions provide the opportunity to utilize the floodplain to seek out low velocity (<3.0 cm/sec), warm water temperature (>18.0 °C), and stable substrates near structures (e.g., trees, scrub/shrub, miscellaneous vegetation) to successfully spawn.

Table II-3. Steamboat Island HREP Aquatic Habitat Depth Intervals, Acres per Depth Contour, Percent of Total, and Cumulative Percent

Depth Contour	Acres	Total	Cumulative
0 - 1'	140.0	22.8%	22.8%
1 - 2'	85.0	13.8%	36.7%
2 - 3'	53.6	8.7%	45.4%
3 - 4'	35.2	5.7%	51.1%
4 -5'	41.7	6.8%	57.9%
> 5'	258.5	42.1%	100.0%
Total Below WS	613.9	100.0%	--

Reference Water Surface (70% annual duration, elevation 571.7 feet at RM 504.5)

DRAFT

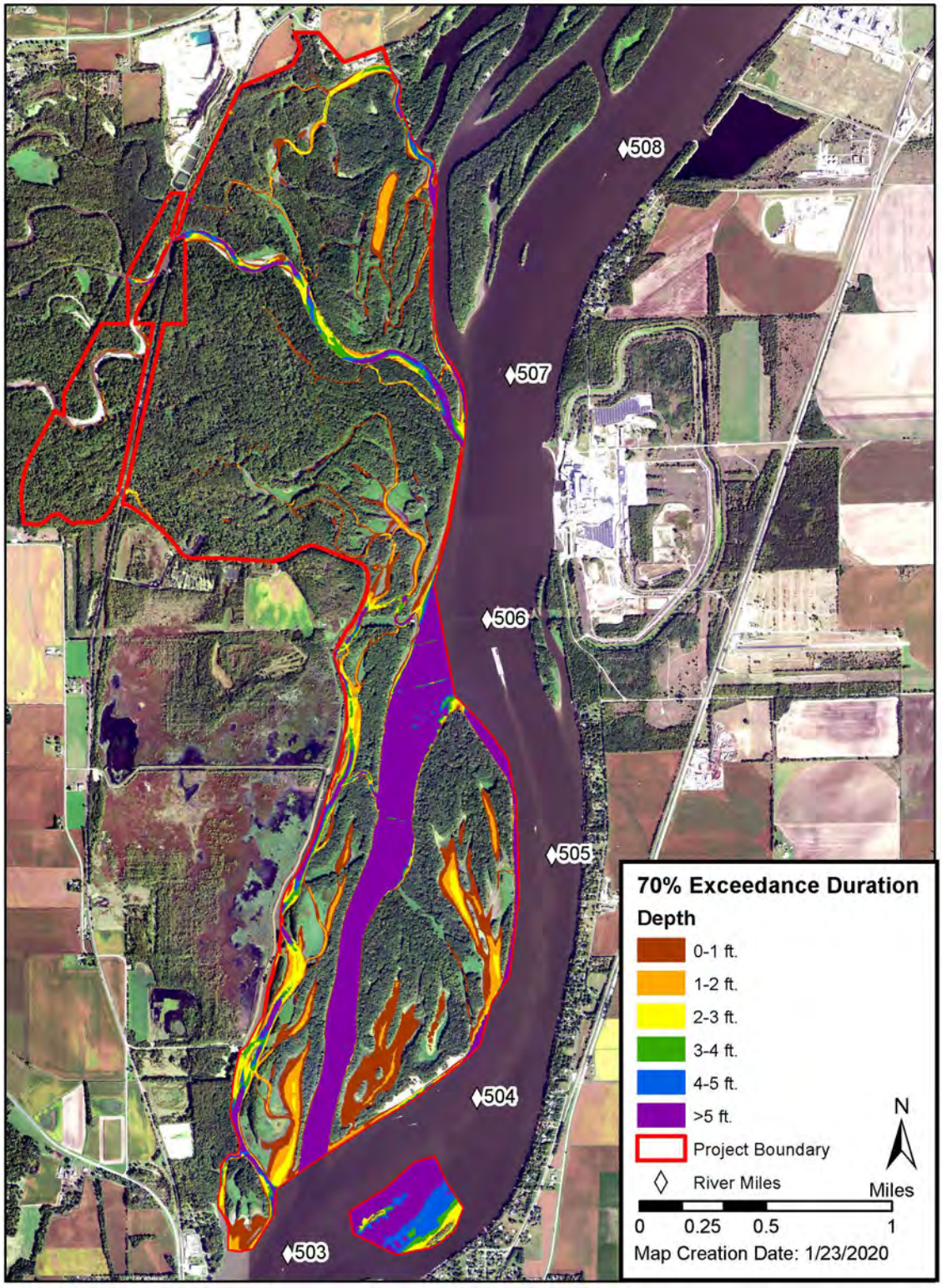


Figure II-4. Steamboat Island HREP – Aquatic Habitat Depth Intervals at 70% Exceedance Duration

Post-spawning rearing and foraging habitat for centrarchids in the summer and early fall typically consists of areas with adequate water quality (i.e., water temperatures 24-30°C, >8.0 mg/L DO, and abundant foraging opportunities for maximum growth). The average water temperature during the growing season (July–September) within the Project area is approximately 24.8°C. However, due to the shallow nature of the backwaters, midsummer water temperatures intermittently exceed 30.0°C, and DO concentrations dip below 5.0 mg/L.

Late fall and early winter, when the water temperatures begin to drop below 10.0°C, centrarchids will initiate movements from foraging areas to overwintering areas. Preferred habitat consists of deep water (>4 feet), low velocity (<1 cm/sec), high DO concentrations (> 5.0 mg/L), and warmer water temperatures (≥1.0°C). Ideally, this habitat is directly connected with the aforementioned fall foraging habitat and spawning habitat. The connection of these habitats reduces energy expenditure during times of low metabolic activity. This is especially important for young fish spawned the previous spring. Copeland and Noble (1994) noted yearling largemouth bass movements were limited through the first winter and the second growing season, indicating the need for connected spawning, overwintering, and fall foraging habitat in close proximity.

The existing backwaters in the Project area are limited with respect to high quality overwintering habitat (depth ≥ 4 feet in depth, average winter water velocity ≤ 1 cm/sec, DO concentrations ≥ 5 mg/L on average in winter, and temperatures ≥ 1.0°C in winter. Refer to Appendix D, *Habitat Evaluation and Benefits Quantification*. Of the available backwater habitat (127 acres), only about 0.14 acres are suitable depth for overwintering, which is located mainly in Upper Steamboat Lake (see Appendix D, *Habitat Evaluation and Benefits Quantification*). The physical characteristics of the backwaters are suboptimal for year-round habitat. Overwintering habitat is the most limited habitat type and should be restored to increase off-channel habitat (UMRCC Fisheries Plan, 2010).

2. Riverine Fishery Habitat. Riverine fishery habitat under consideration for this Project includes approximately 487 acres of Grant and Steamboat Sloughs and a portion of the Mississippi River main channel (main channel). Steamboat Slough has an average depth of 9 feet and flows, temperatures, and water quality measurements are similar to the main channel throughout the course of the year. Grant Slough is shallower than Steamboat Slough, but does provide a variety of aquatic habitats and supports fish and mussel species. Sedimentation and flow from the upstream Wapsipinicon River provide input to the sloughs. Steamboat Island and the land along Grant Slough provide side channel habitat suitable for freshwater mussel colonization. Without the existence of these areas, only main channel border habitat is available, which would likely have a negative impact on the riverine fish and mussel community currently inhabiting the sloughs.

3. Mussel Habitat. The USFWS's recovery plan for Higgins eye pearlymussel (USFWS, 2004) focuses on the recovery of the species within Essential Habitat Areas (EHA). In the recovery plan, the USFWS documented 10 EHAs and an additional 4 EHAs were documented in 2008. One EHA in Pool 14, the Cordova EHA, occurs across the main channel from Steamboat Island near Cordova, Illinois (RM 502.8 – 505.6). A portion of the Project area does intersect with the Cordova EHA boundary (an area of approximately 11 acres). The Cordova EHA was first surveyed in 2000, then in approximate increments of every four years with the latest survey occurring in 2018. Survey results indicate the Cordova EHA harbors a rich (over 23 species) and dense (average 10 live mussels/m^2) mussel community. The QC Generating Station has monitored mussels in Pool 14 since 2004 with the purpose of better understanding the local mussel conditions and identifying potential thermal impacts

the nuclear plant may have on the mussel beds. The QC Generating Station applied for and received an adjusted thermal standard from state water quality standards in 2015 because of the data obtained during the fish and mussel monitoring programs. The facility also received an Incidental Take Permit (and approved Habitat Conservation Plan) for any potential impacts that could occur during the permit duration (J. Hass, pers. comm., 2019).

Mussel surveys have been conducted in Pool 14 as early as 1987, and regularly since the USFWS's Draft Biological Opinion in 2000 (USFWS, 2004). These studies include surveys at Cordova EHA (last surveyed 2018), surveys conducted for the QC Generating Station (last surveyed in 2017), and an additional survey conducted by IADNR in 2017. Each of the surveys provide insight into the potential mussel community within Steamboat Island (see Appendix A, *Correspondence* for survey information).

An October 2018 mussel survey recovered 601 mussels (27 total species) at 7 different sample sites within the Project area. Grant Slough yielded the highest collection of around 315 live individuals of 17 species, including 3 individual yellow sandshell mussels (*Lampsilis teres)*, an Iowa state-endangered species. The East SE Island, located within the established Cordova EHA, included 161 live individuals of 16 species, including 6 individuals federally-endangered Higgins eye pearlymussel (*Lampsilis higginsii*) and 21 individuals Illinois state threatened species black sandshell *(Ligumia recta*). The most abundant mussel species (40.5% of the mussels collected) found were threeridge (*Amblema plicata*), plain pocketbook (*Lampsilis cardium*), and threehorn wartybak (*Obliquaria reflexa*), each species comprising 11% of the collected individuals (Appendix A, *Correspondence*). Refer to Section II.E for federally-listed species results.

4. Aquatic Vegetation. The UMRR-LTRM Land Cover/Land Use datasets document the coverage of submergent, emergent, and rooted floating aquatic vegetation within the Project area (Figure II-5). While coverage has varied over the years due to variability in the environmental conditions (e.g., backwaters filling in), submergent, emergent, and floating-leaved aquatic vegetation exists today in localized patches within the Project area (Johnson and Hagerty, 2008).

DRAFT

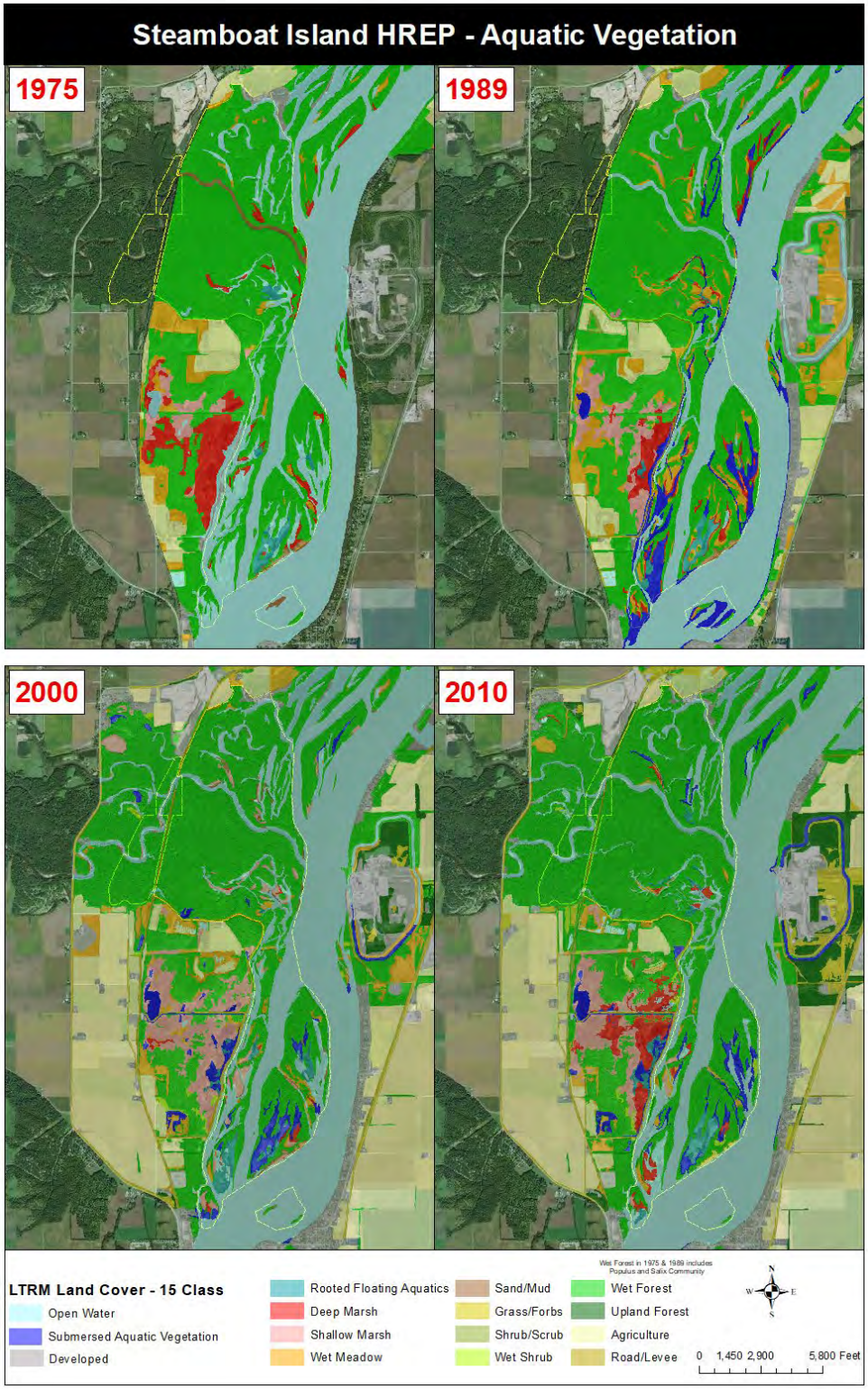


Figure II-5. Steamboat Island HREP – Aquatic Vegetation

E. Endangered and Threatened Species

The USFWS, through their Information for Planning and Consultation (IPaC) website, has identified the following as federally-endangered or threatened species with the potential to occur within Clinton and Scott Counties, IA and Rock Island, IL: Indiana bat, northern long-eared bat, eastern massasauga (*Sistrurus catenatus*), prairie bush clover (*Lespedeza leptostachya*), western prairie fringed orchid (*Platanthera praeclara*), eastern prairie fringed orchid (*Platanthera leucophaea*), Higgins eye pearlymussel, sheepnose mussel (*Plethobasus cyphyus*), spectaclecase mussel (*Cumberlandia monodonta*), and Iowa Pleistocene snail (*Discus macclintocki*).

1. Indiana Bat. The federally-endangered Indiana bat's range includes the eastern half of the United States, from Oklahoma, Iowa, and Wisconsin east to Vermont, and south to northwestern Florida. Indiana bats hibernate during the winter months in limestone caves and abandoned underground mines known as hibernacula. After hibernation, most females depart from the caves and abandoned underground mines during April, while males typically remain longer before migrating to summer habitats. Females migrate to summer habitats where they congregate to bear and raise young in what are known as maternity colonies. A habitat survey conducted by the Corps identified potentially suitable roosting trees throughout the Project area's forested areas that could also serve as primary or secondary maternity roosts (Appendix M, *Engineering Design*, Attachment F). Critical habitat has not been listed in Iowa. Due to the existing ideal habitat for bat use and identified species of Indiana bat from previous surveys conducted throughout Pool 14, presence is assumed within the Project area. Avoidance and minimization efforts in limiting tree clearing, including during the active season, have been implemented. Based on these efforts, additional surveys will not be required (see Appendix A, *Correspondence*).

2. Northern Long-Eared Bat. The northern long-eared bat is a federally-threatened bat and is found in the United States from Maine to North Carolina on the Atlantic Coast, westward to eastern Oklahoma and north through the Dakotas, even reaching into eastern Montana and Wyoming. They hibernate during the winter months in caves. After hibernation, they migrate to wooded areas to roost and forage during late spring and summer. During the summer, northern long-eared bats roost singly or in colonies under bark, in cavities or crevices of both live and dead trees. A habitat survey conducted by the Corps identified potentially suitable roosting trees throughout the Project area's forested areas that could also serve as secondary or primary maternity roosts (Appendix M, *Engineering Design*, Attachment F). Critical habitat has not been listed in Iowa. Due to the existing ideal habitat for bat use and identified species of northern long-eared bat from previous surveys conducted throughout Pool 14, presence is assumed within the Project area. Avoidance and minimization efforts in limiting tree clearing, including during the active season, have been implemented. Based on these efforts, additional surveys will not be required (Appendix A, *Correspondence*).

3. Eastern Massasauga. The eastern massasauga rattlesnake is a federally-threatened rattlesnake that is found in the United States from central New York to south-central Illinois and eastern Iowa. They live in wet areas including low areas along rivers and lakes and use adjacent uplands during part of the year. There was an identified presence adjacent to the Project area dated in 1999; however, a survey was not required based on the lack of suitable habitat within the Project area (Appendix A, *Correspondence*).

DRAFT

4. Prairie Bush Clover. The prairie bush clover is a federally-threatened prairie plant endemic to the tallgrass prairie region of the UMR Valley. Collection history and current distribution indicate the species is most abundant in an area which lies on drift of the Des Moines Lobe of the Wisconsin stage of glaciation, in northern Iowa and southern Minnesota. Habitat in this area typically consists of gentle, usually north-facing slopes, with fine silty loam, fine sandy loam or clay loam. The USFWS lists potential habitat statewide. However, the species has not previously been recorded in the area nor does the Steamboat Island floodplain offer suitable habitat for establishment or survival.

5. Eastern Prairie Fringed Orchid. The eastern prairie fringed orchid is a federally-threatened terrestrial orchid known to persist in 59 populations in 6 states. Most populations are in Wisconsin, Illinois, Michigan, and Ohio (USFWS, 1999). It occurs in a wide variety of habitats, from mesic prairie to wetlands such as sedge meadows, marsh edges, even bogs. It requires full sun for optimum growth and flowering and a grassy habitat with little or no woody encroachment.

The USFWS lists potential habitat statewide. However, the species has not previously been recorded in the Project area and the current state of invasive species domination limits the opportunity for establishment or survival.

6. Western Prairie Fringed Orchid. The western prairie fringed orchid is a federally-threatened terrestrial orchid known to occur at 175 sites in 8 ecoregions, including 41 counties across 6 states and one population in Manitoba (USFWS, 1996). Preferred habitat consists of unplowed, calcareous prairies and sedge meadows. Populations are mostly associated with poorly drained to moderately well drained, nearly level to gently sloping soils formed on loamy and clayey glacial till. Approximately 90% of known western prairie fringed orchids in the United States occurs in the Red River Valley of North Dakota and Minnesota.

According to the 1996 USFWS Recovery Plan, extant populations existed at 23 locations in 15 counties in Iowa, with Guthrie, Cherokee, and Mills counties containing the maximum number of documented flowering plants. The USFWS lists potential habitat statewide. However, the species has not previously been recorded in the Project area and the current state of invasive species domination limits the opportunity for establishment or survival.

7. Higgins Eye Pearlymussel. The Higgins eye pearlymussel is a federally-endangered freshwater mussel that has been found in parts of the UMR, Iowa River, St. Croix River, Wisconsin River, and Rock River. Higgins eye is characterized as a large river species and is usually found in areas with deep water and moderate currents. They typically inhabit areas with stable substrates varying from sand to boulders, but not firmly packed clay, flocculent silt, organic material, bedrock, concrete, or unstable sand.

Higgins eye pearlymussel has been found to occur within the Project area, including six individuals found during the 2018 survey at the small island in the southeast portion of the Project area immediately within the Cordova EHA.

8. Sheepnose Mussel. The sheepnose mussel is a federally-endangered freshwater mussel that has been found across the Midwest and Southeast. However, it has been eliminated from approximately two-thirds of the streams from which it was known historically; 25 streams are currently occupied compared to 76 in the past (USFWS, 2012). These mussels prefer larger rivers and streams with

shallow areas that exhibit moderate to swift currents that flow over coarse sand and gravel. However, they have also been found in other substrates, such as mud, cobble and boulders, and in large rivers they may be found in deep runs.

According to the 2018 mussel survey, no individuals of sheepnose were collected. A past survey conducted in 2006 resulted in one live sheepnose identified outside of the Project area, indicating a low probability of presence within the Project area.

9. Spectaclecase Mussel. The spectaclecase mussel is a federally-endangered freshwater mussel that has been found in the Mississippi, Ohio, and Missouri River basins. Spectaclecase mussels are typically found in large rivers and in areas sheltered from the main force of current, such as under boulders or between interstitial spaces within a wingdam. It has been determined that this mussel species has declined significantly and is now known to be found in only 20 of 44 historical streams, representing a 55% decline (USFWS, 2014).

According to the most recent mussel survey (2018), no individuals of spectaclecase were collected nor preferred habitat encountered. Past surveys have not resulted with any spectaclecase records near the Project area, indicating a low probability of presence.

10. Iowa Pleistocene Snail. The endangered Iowa Pleistocene snail is found on north-facing slopes of the driftless area in Clayton, Clinton, Dubuque, Fayette, and Jackson Counties, Iowa. It occupies algific (cold producing) talus slopes at the outlet of underground ice caves along limestone bluffs within a narrow regime of soil moisture and temperature.

There is no critical habitat designated. The species has not previously been recorded in the area nor does the Project area offer suitable habitat for establishment or survival.

11. State Threatened or Endangered Species. In addition to federally-listed species, the IADNR and ILDNR identified state-threatened or endangered species that have the potential to occur within Clinton and Scott Counties, Iowa, and Rock Island County, Illinois (Table II-4).

DRAFT

Table II-4. Clinton and Scott Counties, Iowa, and Rock Island County, Illinois, Threatened or Endangered Species

Common Name	Scientific Name	Class
Central Newt (T)	*Notophthalmus viridescens*	Amphibian
Four-toed Salamander (T)	*Hemidactylium scutatum*	Amphibian
Barn Owl (E)	*Tyto alba*	Bird
Cerulean Warbler (T)	*Dendroica cerulea*	Bird
Yellow-crowned Night Heron (E)	*Nyctanassa violacea*	Bird
Black-crowned Night Heron (E)	*Nycticorax nycticorax*	Bird
Yellow-headed Blackbird (E)	*Xanthocephalus xanthocephalus*	Bird
Grass Pickerel (T)	*Esox americanus*	Fish
Lake Sturgeon (E)	*Acipenser fulvescens*	Fish
Western Sand Darter (E)	*Ammocrypta clarum*	Fish
Longnose Sucker (T)	*Catostomus catostomus*	Fish
Crystal Darter (T)	*Crystallaria asprella*	Fish
Gravel Chub (T)	*Erimystax x-punctatus*	Fish
Banded Killifish (T)	*Fundulus diaphanus*	Fish
Pallid Shiner (E)	*Hybopsis amnis*	Fish
Running Pine (E)	*Lycopodium clavatum*	Fish
River Redhorse (T)	*Moxostoma carinatum*	Fish
Mudpuppy (T)	*Necturus maculosus*	Fish
Pugnose Shiner (E)	*Notropis anogenus*	Fish
American Eel (T)	*Anguilla rostrata*	Eel
Butterfly (T)	*Ellipsaria lineolata*	Freshwater Mussel
Spike (T)	*Elliptio dilatata*	Freshwater Mussel
Creeper (T)	*Strophitus undulatus*	Freshwater Mussel
Higgins Eye Pearlymussel (E)	*Lampsilis higginsii*	Freshwater Mussel
Pistolgrip (E)	*Tritogonia verrucosa*	Freshwater Mussel
Round Pigtoe (E)	*Pleurobema sintoxia*	Freshwater Mussel
Yellow Sandshell (E)	*Lampsilis teres*	Freshwater Mussel
Sheepnose (E)	*Plethobasus cyphyus*	Freshwater Mussel
Spectaclecase (E)	*Cumberlandia monodonta*	Freshwater Mussel
Purple Wartyback (T)	*Cyclonaias tuberculata*	Freshwater Mussel
Ebonyshell (E)	*Fusconaia ebena*	Freshwater Mussel
Black Sandshell (T)	*Ligumia recta*	Freshwater Mussel
Byssus Skipper (T)	*Problema byssus*	Insect
Indiana Bat (E)	*Myotis sodalis*	Mammal
Northern Long-eared Bat (T)	*Myotis septentrionalis*	Mammal
Southern Bog Lemming (T)	*Synaptomys copperi*	Mammal
Schreber's Aster (E)	*Aster schreberi*	Plant
Downy Yellow Painted Cup (E)	*Castilleja sessiliflora*	Plant
Sweet Indian Plantain (T)	*Cacalia suaveolens*	Plant
Spotted Coral-root Orchid (E)	*Corallorhiza maculata*	Plant
Mead's Milkweed (E)	*Asclepias meadii*	Plant
Waxleaf Meadowrue (E)	*Thalictrum revolutum*	Plant
Orange Grass St. John's Wart (E)	*Hypericum gentianoides*	Plant
Slender Dayflower (T)	*Commelina erecta*	Plant
Slender Ladies' tresses (T)	*Spiranthes lacera*	Plant
Pink Turtlehead (E-IL)	*Chelone obliqua*	Plant
Blanding's Turtle (E-IL,T-IA)	*Emydoidea blandingii*	Reptile
Eastern Massasauga Rattlesnake (E)	*Sistrurus catenatus*	Reptile
Ornate Box Turtle (T)	*Terrapene ornata*	Reptile

F. Invasive Species

Common invasive species known to be present in Pool 14 include purple loosestrife *(Lythrum salicaria);* curly-leaf pondweed (*Potamogeton crispus)*; Eurasian watermilfoil (*Myriophyllum spicatum)*; Asian clam *(Corbicula fluminea)*; zebra mussel *(Dreissena polymorpha)*; common carp *(Cyprinus carpio)*; reed canarygrass *(Phalaris arundinacea);* silver carp *(Hypophthalmichthys molitrix)*; Emerald Ash Borer *(Agrilus planipennis);* and bighead carp *(H. nobilis)*.

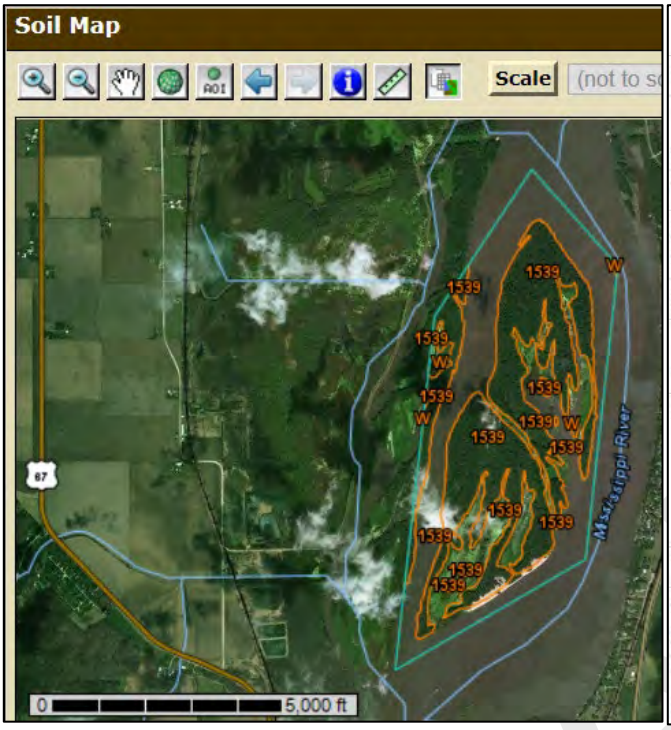
Invasive terrestrial plants found during the 2018 forest inventory include winter creeper (*Euonymus fortune*), Amur honeysuckle (*Lonicera maackii*), white mulberry (*Morus alba*), and reed canarygrass (*Phalaris arundinacea*). Non-native terrestrial plants found during the forest inventory include barnyardgrass (*Robinia pseudoacacia*).

G. Subsurface Soil Characterization

The Natural Resources Conservation Service (NRCS) publishes soil surveys for most counties in the United States. Information in a pre-published soil survey indicated that the dominant soil type present in the Project area is generally classified as Ambraw-Perks-Lawson complex, which is described as an alluvium product in the NRCS classification system. This series is described as frequently flooded, poorly drained soil with a water table that varies between ground surface and 1 foot deep (Figure II-6).

Below ground surface materials, to depths ranging between 4.5 and 6.0 feet, are composed of lean and fat clays with varying silt and sand contents. The clays generally indicate a gradual change in stiffness with increased depth. Medium to fine sand lenses were found sporadically in most borings. Detailed subsurface soil characteristics can be found in Appendix G, *Geotechnical Considerations*.

DRAFT



Scott County, Iowa (IA163)
Rock Island County, Illinois (IL161)

Rock Island County, Illinois (IL161)

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
W	Water	0.7	0.1%
Subtotals for Soil Survey Area		**0.7**	**0.1%**

Scott County, Iowa (IA163)

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
1539	Ambraw-Perks-Lawson complex, frequently flooded, 0 to 2 percent slopes	343.4	45.5%
W	Water	410.0	54.4%
Subtotals for Soil Survey Area		**753.4**	**99.9%**
Totals for Area of Interest		**754.0**	**100.0%**

Figure II-6. Results of Project Area NRCS Web Soil Survey (https://websoilsurvey.sc.egov.usda.gov/App/WebSoilSurvey.aspx)

H. Subsurface Explorations

District Geotechnical Branch personnel conducted subsurface exploration using a 4-inch diameter Iwan-style hand-auger on October 3, 2018 and a 2 ¾ -inch Outer Diameter vibrocore sampler on October 4, 2018 in order to characterize the composition and engineering properties of the soils present at Steamboat Island. Borings were taken at the locations shown in Appendix G, *Geotechnical Considerations*.

Borings SB-18-06, 07, 08, and 09 were taken within the Grant Slough Complex. Borings SB-18-01, 02, 03, 04, and 05 were taken within the downstream end of Steamboat Island. Borings SB-18-10, 11, 12, 13, 14, and 15 were taken within the upstream end of Steamboat Island. On each boring, samples were taken at sufficient intervals to classify all the strata encountered. Representative samples were taken for visual soil classification and moisture content from all recovered soils. Atterberg limit tests were performed on several of the clay samples gathered throughout the site to verify soil classifications and to characterize stratigraphy. Boring logs can be found in the Geotechnical Appendix (see Appendix G, *Geotechnical Considerations*).

The borings ranged up to approximately 12 feet deep from average water surface elevation (575.35 NAVD88). Below ground surface materials, to depths ranging between 4.5 and 6.0 feet, are composed of lean and fat clays generally showing a gradual change in stiffness with increased depth. Medium to

fine sand lenses were found sporadically in most borings. Results for moisture contents ranged between 21 and 100 expressed as percentage of total sample weight.

I. Water Quality

Baseline water quality monitoring was initiated at Steamboat Island by the District on December 19, 2014 at site W-M504.7S (Figure II-7; Plate 27, O-101; and Appendix F, *Water Quality*). Sites W-M504.9P, W-M505.7C, and W-M505.0B were added on June 6, 2017, and site W-M504.1E on December 8, 2017. Baseline monitoring continued through March 11, 2019, with eight samples collected during the summer months and two or three samples during the winter months each full year. For summaries of discrete grab samples, refer to Table F-1, Appendix F, *Water Quality*. In addition to grab samples, multi-parameter water quality monitoring instruments, or sondes, were used to collect more frequent data. Refer to Appendix F for more details.

DRAFT

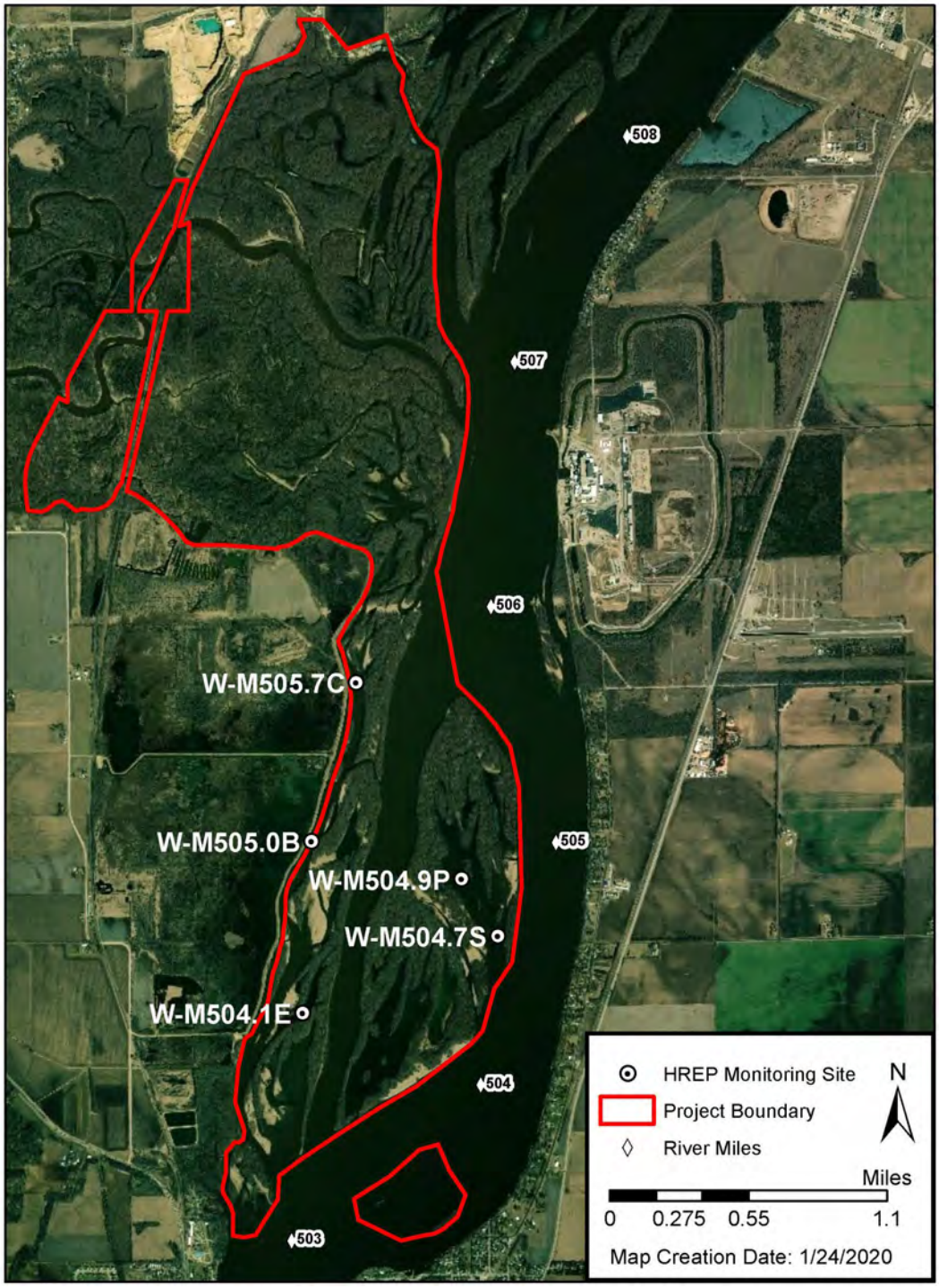


Figure II-7. Water Quality Monitoring Locations

Grab sample results readily indicate the lotic (river like) versus lentic (lake like) nature of the five monitoring sites, Figure II-8. Sites W-M505.0B and W-M505.7C exhibited lotic characteristics, while

the remaining three sites were more lentic in nature. The summer and winter median velocity values for the lotic sites (W-M505.0B and W-M505.7C) were ≥ 16 cm/sec; whereas, the highest median velocity at the remaining three sites (with lentic characteristics) was < 4 cm/sec (summer at site W-M504.7S). At all sites, median summer velocity values were significantly greater than winter values. The maximum winter velocity recorded at any of the three lentic sites was 2.82 cm/sec at site W-M504.7S. This value was recorded on March 9, 2016, when the site was ice free and water levels had risen above winter lows. The site with the lowest year-round median velocities was W-M504.9P. The maximum winter velocity here was only 0.90 cm/sec.

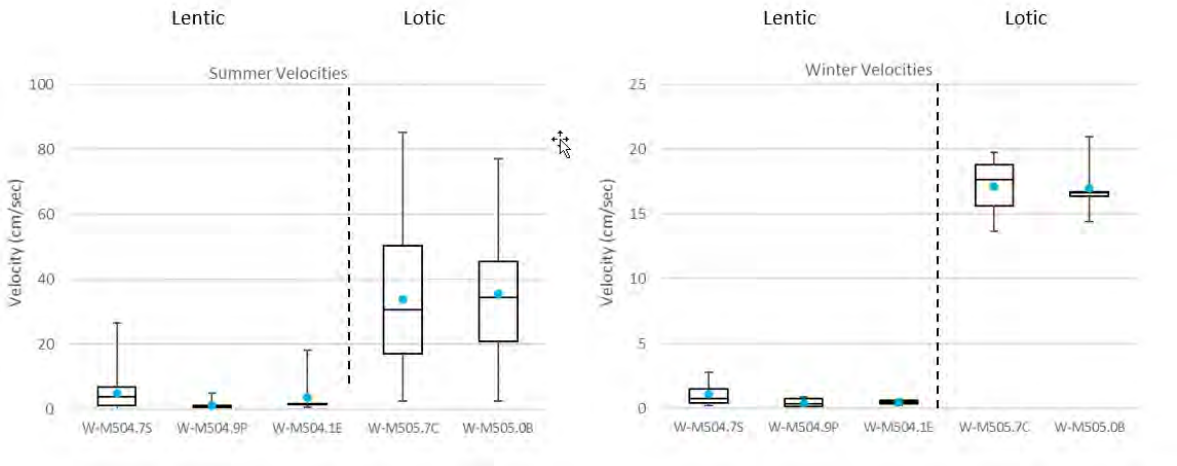


Figure II-8. Lentic vs Lotic Velocity Characteristics of Water Quality Sites

The lotic versus lentic nature of the five monitoring sites was also shown in measurements reflective of water clarity: Secchi disk depth, turbidity and total suspended solids. Summer median values of turbidity and total suspended solids at the lotic sites W-M505.0B and W-M505.7C exceeded values at the remaining three sites, while Secchi disk depth median values were less (Figure II-9).

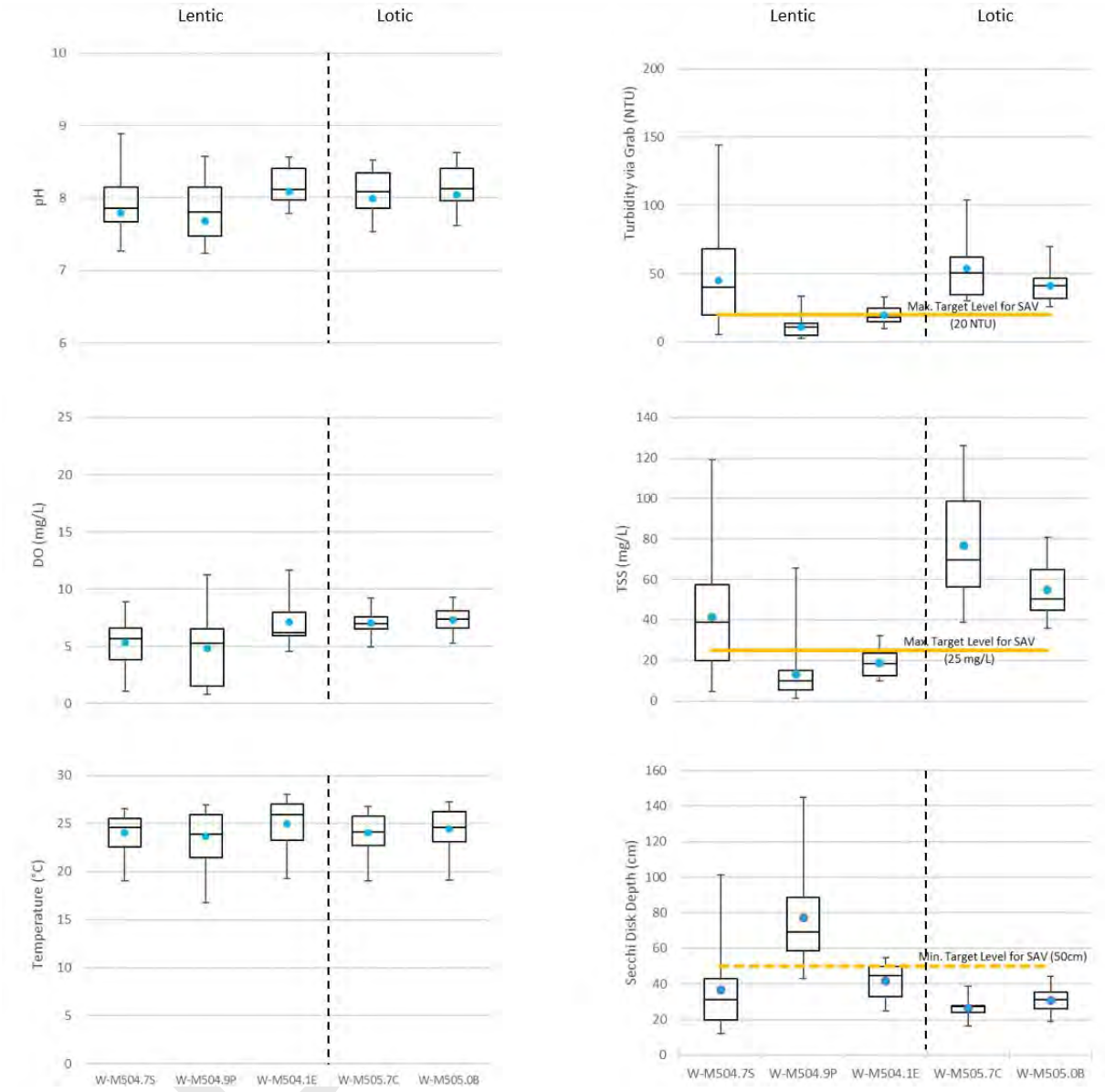


Figure II-9. Summer Grab Sample Data

Mean indicated by dot (●). pH mean calculated from mean [H+]. Summer target levels (▬) are from *UMRCC Proposed Light-Related Water Quality Criteria Necessary to Sustain Aquatic Vegetation in the Upper Mississippi River* (UMRCC, 2003).

As shown in Figure II-9 and Figure II-10, DO concentrations ranged from 0.82 mg/L (summer at site W-M504.9P) to 23.22 mg/L (winter at site W-M504.9P). Of the five sites monitored, W-M504.9P visually contained the most aquatic vegetation (and also the lowest median velocity values), so it was not surprising to see both the minimum and maximum DO concentrations occur here. Median summer DO concentrations ranged from 5.31 mg/L at site W-M504.9P to 7.37 mg/L at site W-M505.0B, while median winter values were significantly higher, ranging from 11.75 mg/L at site W-M504.1E to 13.59 mg/L at site W-M504.7S. Twenty-two grab sample DO concentrations were less than the target level

of 5 mg/L, with all but one occurring during the summer months (Appendix F). Most of the DO concentrations below the target level occurred at sites W-M504.7S (12) and W-M504.9P (7). The sole winter value below the target level was 4.98 mg/L at site W-M504.1E. Only one DO concentration was below the target level at the lotic sites W-M505.0B and W-M505.7C (4.95 mg/L on June 19, 2018 at site W-M505.7C).

Water temperatures ranged from a minimum of 0.1°C at site W-M504.7S to a maximum of 28.1°C at sites W-M504.7S and W-M504.9P. Winter median water temperatures ranged from 1.2°C at site W-M505.7C to 2.9°C at sites W-M504.1E and W-M504.9P.

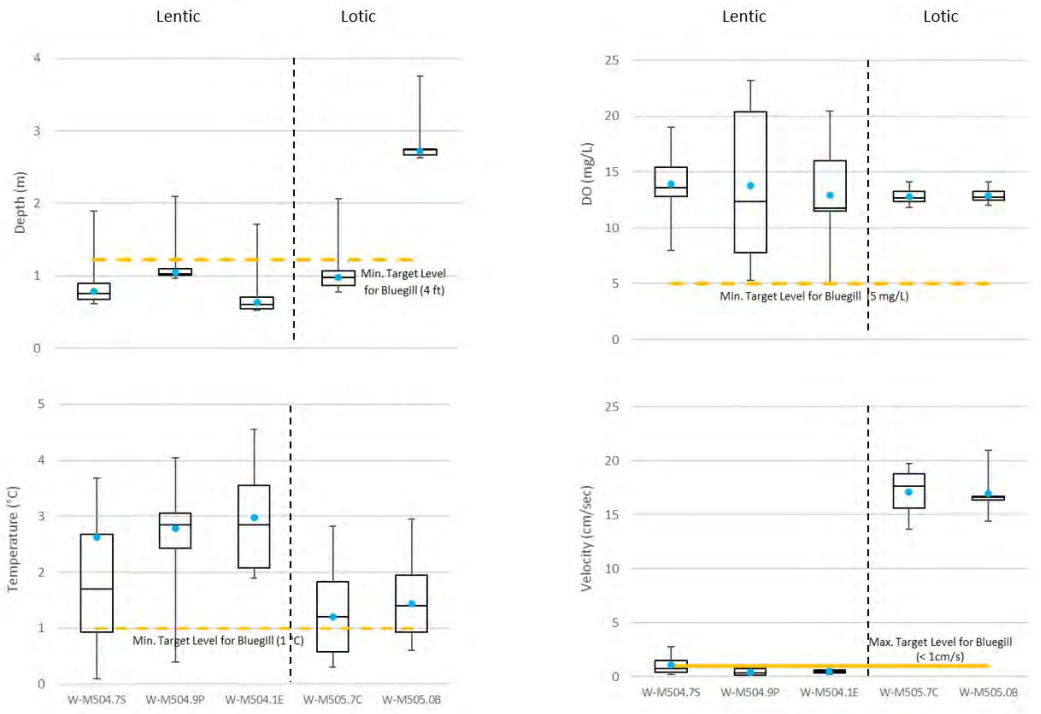


Figure II-10. Winter Grab Sample Data.

Mean indicated by dot (●). pH mean calculated from mean [H+]. Winter target levels (▬) are from *Bluegill Winter Habitat Suitability Index Model* (USACE, 1990)

Continuous water quality monitors were deployed at Steamboat Island sampling sites W-M504.7S and W-M504.9P during grab sample collection trips. They were typically positioned 1 to 2 feet above the river bottom and were programmed to collect data every 2 hours for a period of about 2 to 4 weeks during the summer and 6 to 14 weeks during the winter. Sondes were initially deployed at site W-M504.7S during the winter of 2014-2015 and at site W-M504.9P during the summer of 2017.

During the summer at site W-M504.7S, it was common to see nighttime DO concentrations fall below the target level of 5.0 mg/L (Appendix F). On occasion, continuous extended low DO concentrations were observed. There were no extended periods of low DO at this site during the summer of 2015; however, during the summer of 2016, most DO concentrations were below 5 mg/L, including a continuous period from July 22 to August 19. The summers of 2017 and 2018 were similar to 2015 in

that it was common to see nighttime concentrations below 5 mg/L but there were no extended periods of continuous low DO. At site W-M504.9P, there were extended periods of low DO during both summers monitored (2017 and 2018). During 2017, the DO concentration was below 5 mg/L from July 2 to August 6 and again from August 14 to September 12, while in 2018, low DO concentrations extended from June 9 to June 20.

Winter DO concentrations at site W-M504.7S never fell below the target level during the five seasons monitored. The lowest DO concentration observed was 5.20 mg/L on December 12, 2018. Approximately half of the values were supersaturated. During both winters monitored at site W-M504.9P (2017-2018 and 2018-2019), DO concentrations less than 5 mg/L were measured. During the winter of 2017-2018, only a few instances were observed (minimum of 3.84 mg/L on February 15, 2018); whereas, during the next winter, three extended periods of low DO occurred: November 30 to December 16, 2018, February 1-8, 2019 and February 14-25, 2019. Supersaturated DO concentrations also occurred during these two winters but were not as frequent relative to site W-M504.7S. Bacterial decomposition of organic matter, coupled with little oxygenated inflow likely contributed to the extended periods of low DO during the winter at site W-M504.9P, the more heavily vegetated of the two sites.

J. Hydrology and Hydraulics

Steamboat Island is located in the middle of Pool 14, approximately 9 miles upstream of Lock and Dam 14 and 16 miles downstream of Lock and Dam 13. Lock and Dam 14 is located near LeClaire, Iowa, and was placed into operation in June 1939 to provide navigable channel depths by maintaining a water surface elevation of 571.2 feet NAVD88 (flat pool) or higher. The annual river stage hydrograph is affected by river regulation such that low river stages are maintained higher by the dam during low discharge periods. Pool 14 is regulated using a dam control point, therefore the degree of influence of the impounding dam decreases as you move upstream of the dam where there is increasing fluctuation in river stage (Figure II-11).

DRAFT

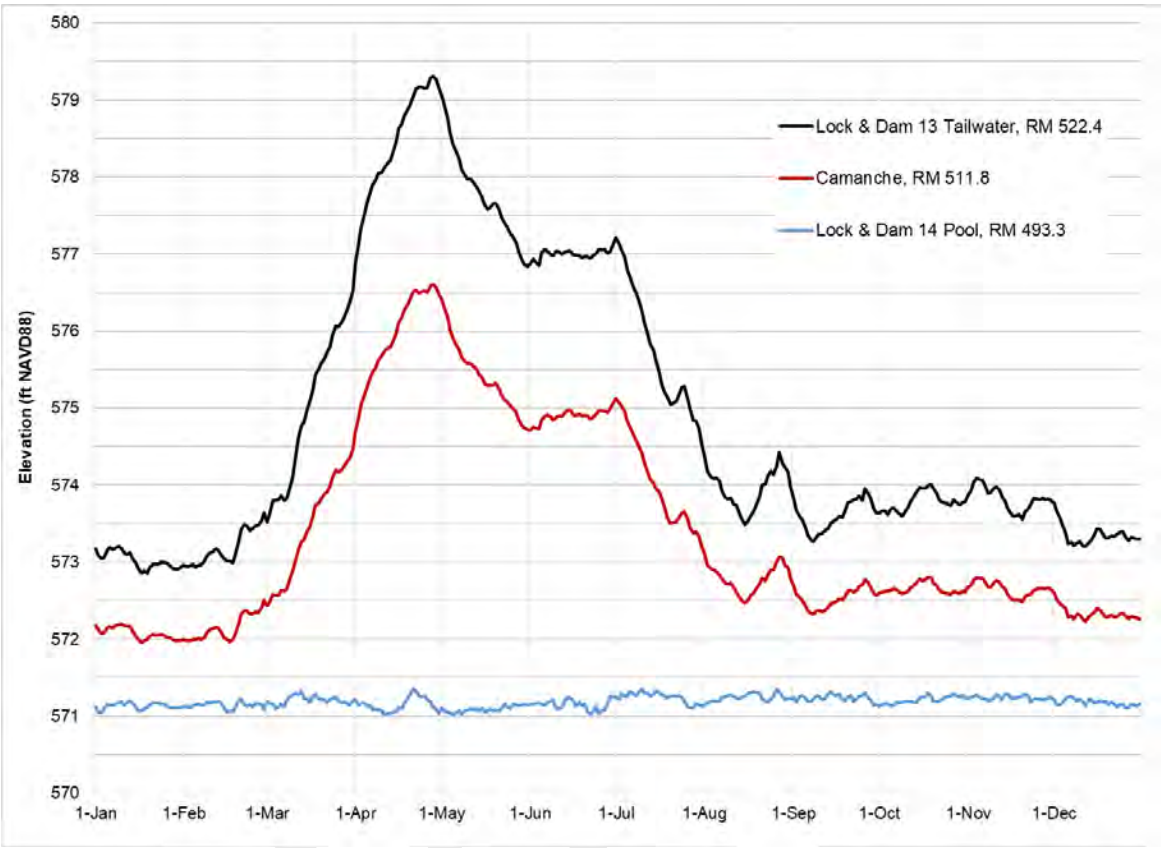


Figure II-11. Average Annual Stage Hydrographs – Upper, Middle, and Lower Portions of Pool 14 1987-2016

The USGS Clinton gage, co-located with the Corps' Camanche gage, is approximately four miles upstream of the Project area (RM 511.8) and drains an area of 85,600 square miles. Average annual discharge at Clinton/Camanche gage is 56,300 cfs (period of record 1987-2016). The long-term average annual elevation hydrograph (Figure II-12) illustrates a spring to early summer flood followed by mid to late summer low flows. There is generally a slight pulse through the fall followed by low and more stable flows through the winter.

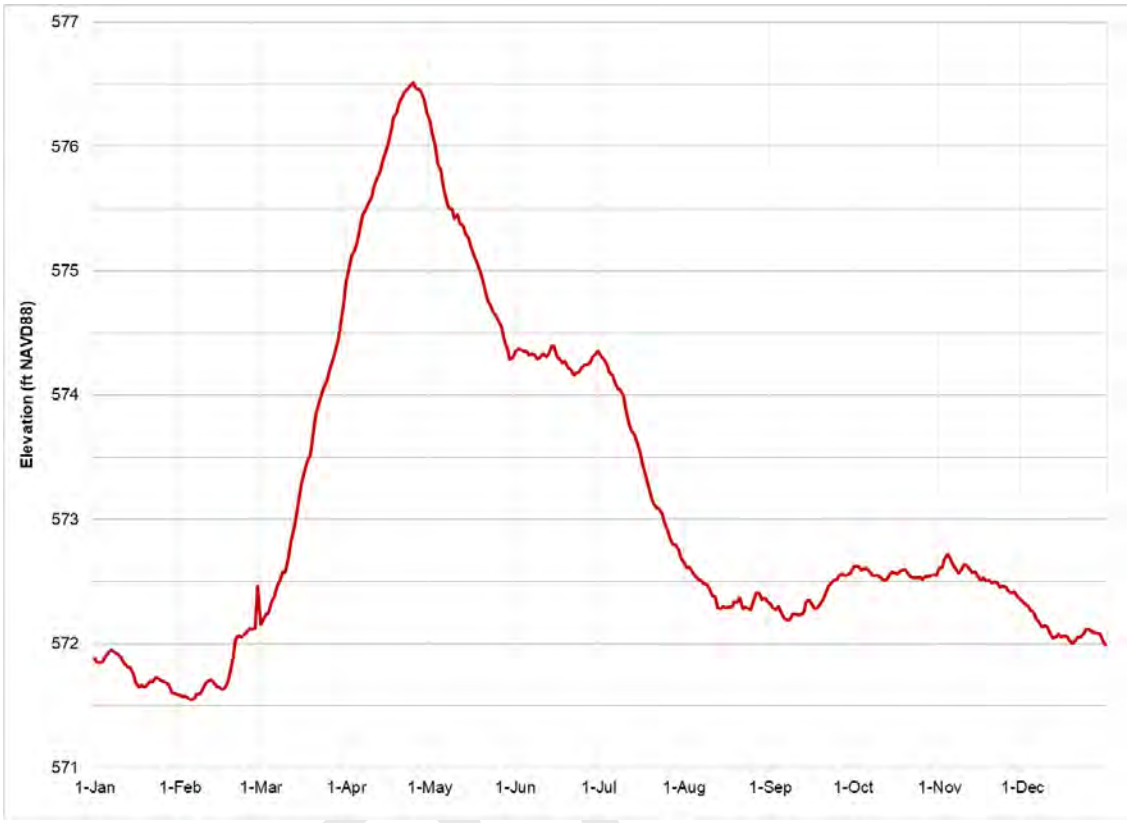


Figure II-12. Long-term Average Annual Elevation Hydrograph at the Camanche Gage – 1940-2016

A comparison of annual elevation duration curves for the most recent 30-year period with the prior 30-year period for the Clinton/Camanche gage is shown in Figure II-13. The annual elevation duration curve for the current 30-year period (1987-2016) indicates a median river elevation of 572.6 feet and 572.3 feet for the prior 30-year period (1957-1986). This comparison indicates median river stage has increased since the last 30-year period. Appendix H, *Hydrology and Hydraulics*, includes additional hydrology and hydraulics information including a qualitative assessment of climate change impacts to hydrology at the Project. High water events at the Camanche gage have occurred in 1965, 2001, 1993, 2019 and 2011 (listed in order of decreasing magnitude). The highest flood on record occurred in April 1965 with a river elevation of 587.06 feet.

The Project area is comprised of side channels, secondary channels, smaller backwater channels, tributary channels, braided floodplain channels and island interior backwater lakes. Backwater areas include Upper Lake, Lower Lake, Northwest Grant Slough, and Southwest Grant Slough. Among the larger channels are the Wapsipinicon River tributary, main channel, Steamboat Slough side channel, and Grant Slough secondary channel. Some of the smaller interior channels convey water throughout the year and others are ephemeral. The East and West SE Islands are small islands located near the lower left-descending bank of Steamboat Island, south of Cordova, IL. During 50% chance exceedance flood conditions, approximately 75% of the Steamboat Island proper is inundated (Figure II-14).

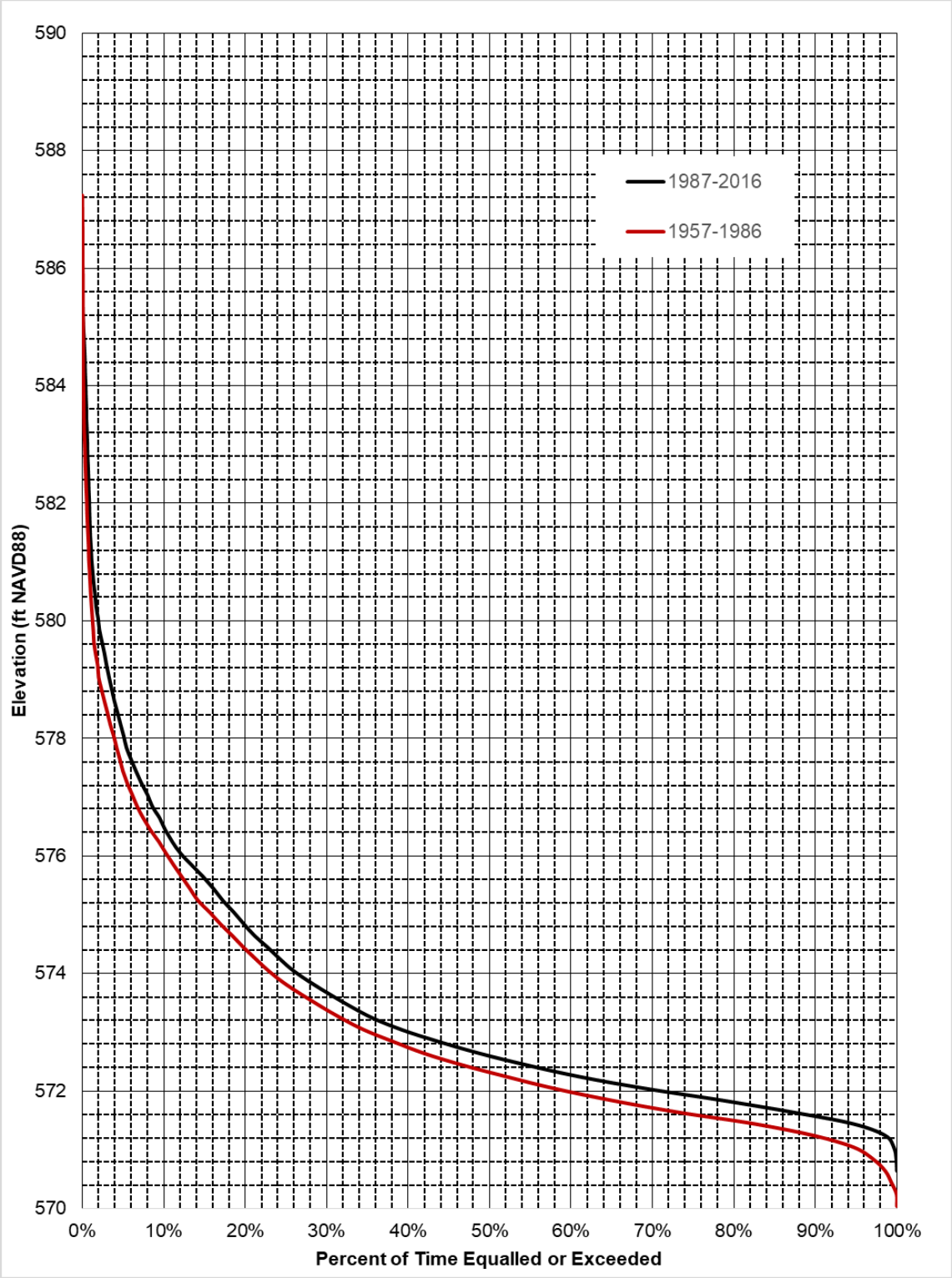


Figure II-13. Comparison of Annual Elevation-Duration Curves for Different Time Periods at the Camanche Gage

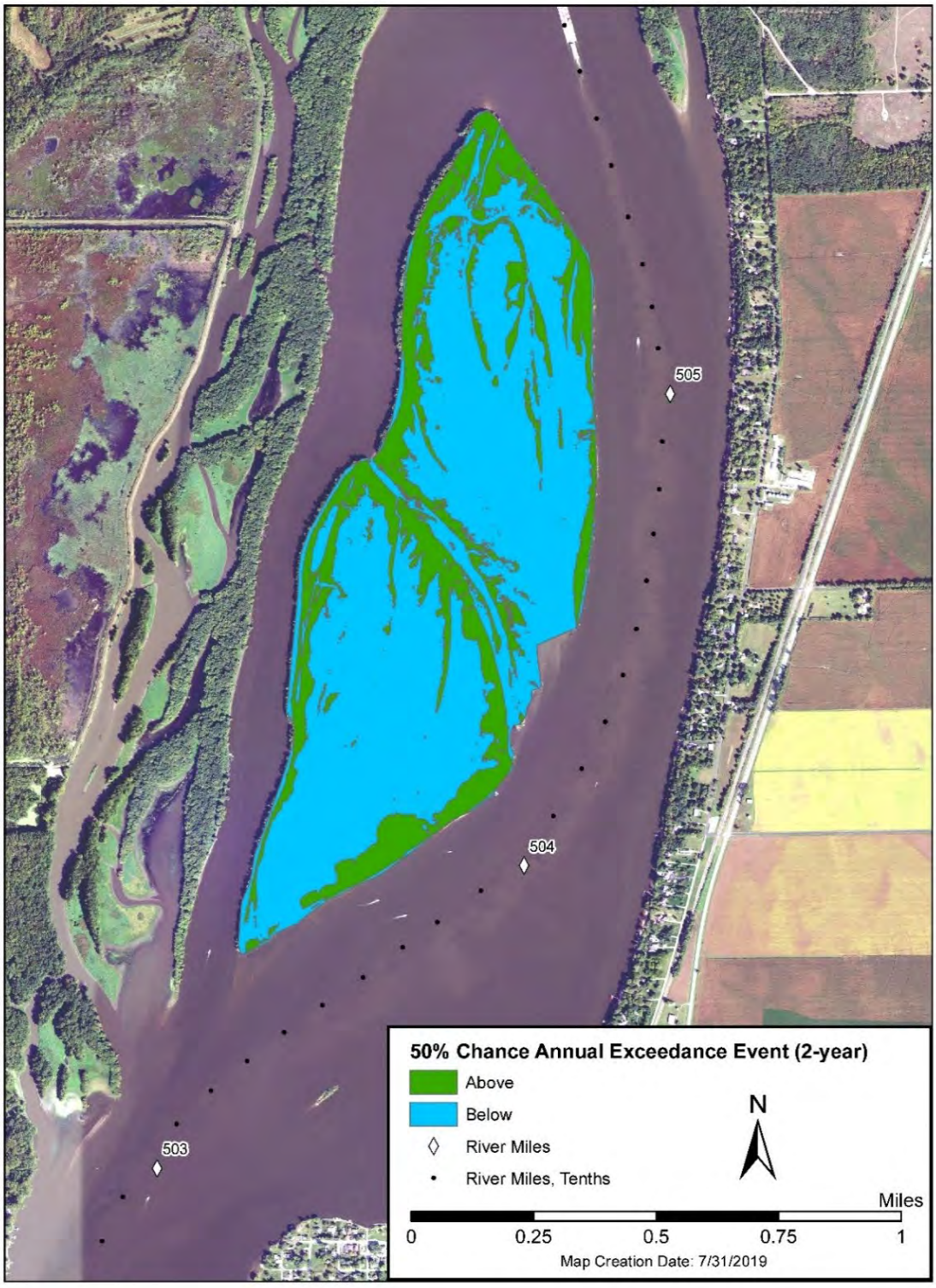


Figure II-14. Steamboat Island Inundation Under 50% Chance Exceedance Discharge

Several seasonal duration curves were computed based on the periods critical to habitat targeted for restoration for the Project. Low water conditions, which threaten DO concentrations and fish habitat, can occur during the winter (November through February) and summer (July through August) months. As shown in Figure II-15, the period between November and February represents the more critical conditions for fish. The reference water surface elevation used to distinguish floodplain (above water) from aquatic (below water) habitat was the 70% annual exceedance duration. The elevation at the Project site (approximately mid-Project, RM 504.5) that meets this criteria is 571.7 feet.

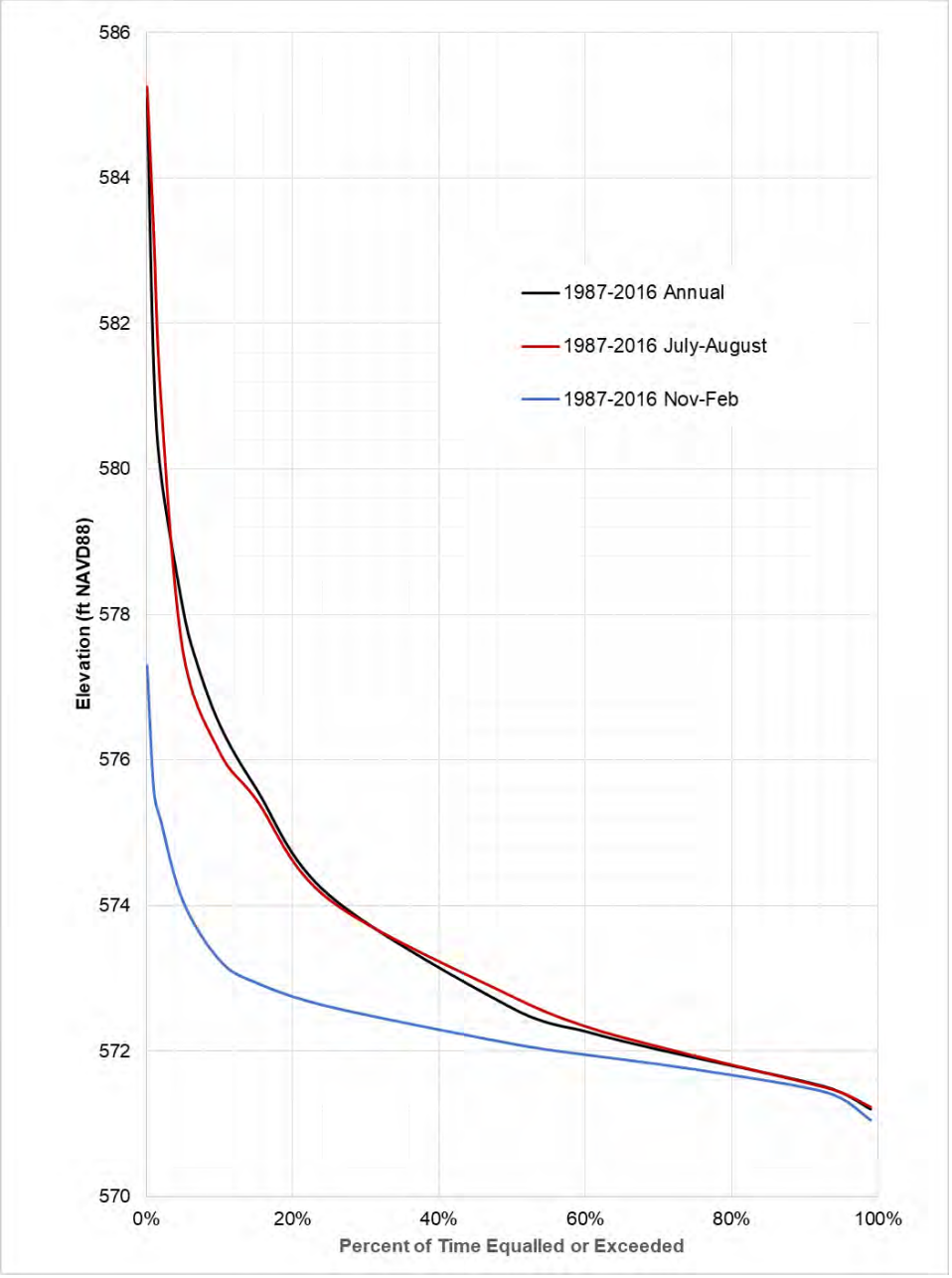


Figure II-15. Comparison of Seasonal and Annual Elevation Duration Curves at the Camanche Gage

Hard mast trees are most vulnerable to flood-induced mortality during the growing season, therefore, a growing season (April 15 to October 15) duration analysis was also completed. A comparison of the median growing season stage for the current 30-year period and the median growing season stage for the prior 30-year period indicates an increase in median stage of over 0.5 feet (Figure II-16). The stage record that shaped the existing conditions (Figure II-16) shows water levels have seen increased exceedance durations, which has contributed to the observed decline in species and age diversity among the floodplain forest community. See Appendix H, *Hydrology and Hydraulics*, for a qualitative assessment of climate change impacts to hydrology at the Project.

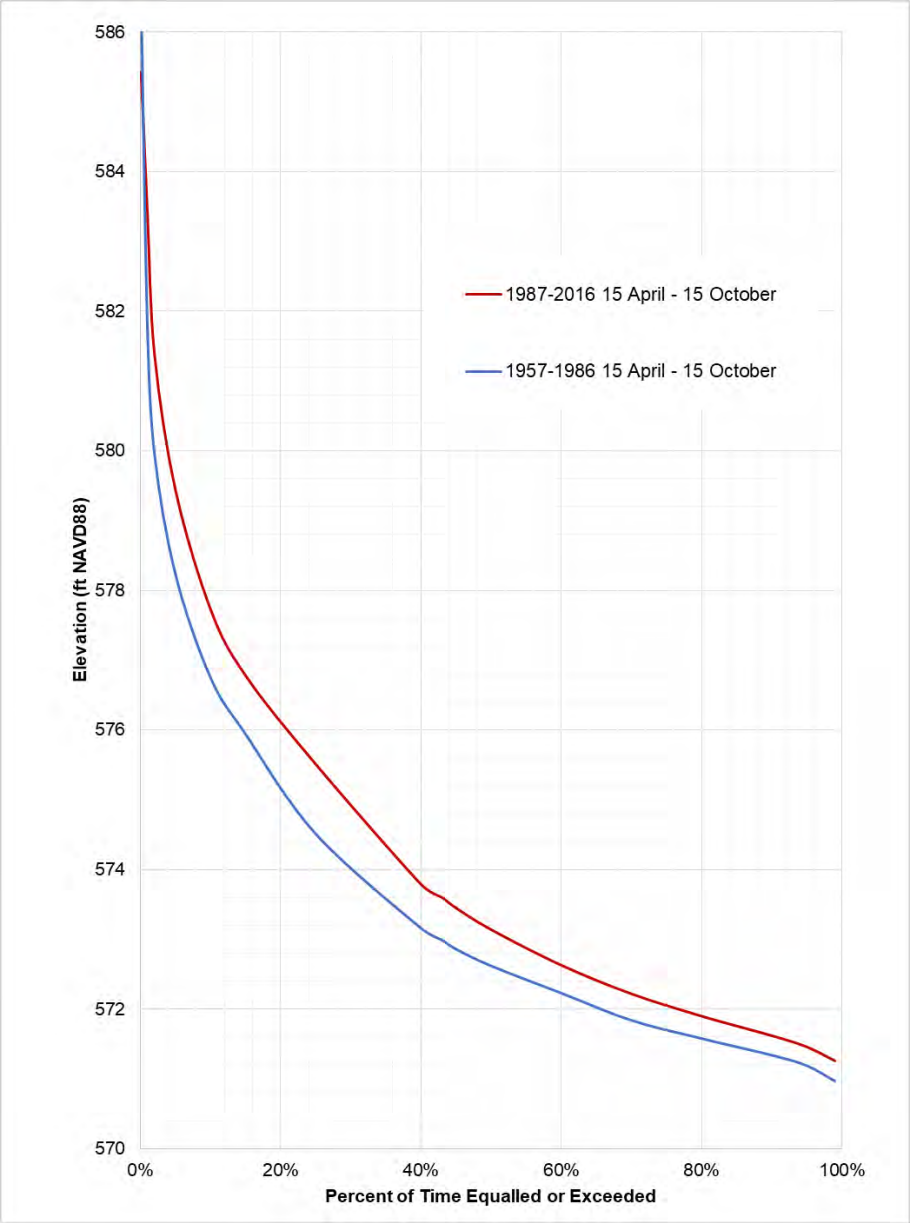


Figure II-16. Comparison of Growing Season Elevation-Duration Curves for Different Time Periods at the Camanche Gage

K. Sediment Deposition

The Wapsipinicon River is the largest tributary to Pool 14 and outlets on the Iowa side north of Steamboat Island. Maintenance dredging within Pool 14 occurs as needed to address shoaling issues impacting navigation. Table II-5 summarizes the historical dredging activity near the Project area and Figure II-17 illustrates the dredging locations. Additional dredging occurs within Pool 14 and placement may occur at Historic Bankline Placement Site RM 503.5-504.1R.

Table II-5. Historical Dredge Cuts near Steamboat Island HREP Project Area

Steamboat Island	Year	Cubic Yards	Dredging Events	Placement Site	Placement Type
Total Cubic Yards: 883,794	1961	72,766	503.3-503.7	503.5-503.8R	
# of Events: 18	1968	150,731	503.4-504.0	503.6-503.8R, 503.8R, 503.9-504.1R, 503.6-504.1L	
Avg per Event: 49,099	1972	119,999	503.3-503.9	503.3-503.6R, 503.6-504.0R	
	1973	72,506	503.5-504.0	503.3-503.4L, 503.5-503.7L	
	1985	26,666	503.6-503.9	503.7R, 503.8-504.0R	
	1986	34,222	503.6-504.0	503.5-503.7R	
	1988	23,400	503.6-503.9	503.5-503.9R	
	1990	56,495	503.7-504.0	502.9 (38,444; Thalweg); 503.5-503.7R (18,051)	Thalweg
	1991	48,729	503.4-504.0	502.7-503.1	Thalweg
	1995	29,193	503.2-503.8	2 events	Thalweg
	1995	13,738	503.2-503.8	2 events	Thalweg
	1999	24,352	503.3-503.8	503.7-504.0R (20,741; Bank), 503.0 (3,611; Thalweg)	Bank/Thalweg
	2002	24,148	503.3-503.8	503.7-504.0R (8,650; Bank); 503.0 (15,498; Thalweg)	Bank/Thalweg
	2006	35,143	503.3-503.7	502.7-503.1	Thalweg
	2009	21,308	503.3-503.8	503.7-503.9R (16,871 Bank); 502.9T (4,437; Thalweg)	Bank/Thalweg
	2011	37,507	503.3-503.9	503.7-503.8R (19,085; Bank); 502.8T (18,422; Thalweg)	Bank/Thalweg
	2014	23,411	503.5-503.9	502.9-503.2R	Thalweg
	2019	69,480	503.2-503.9	502.8	Thalwag

DRAFT

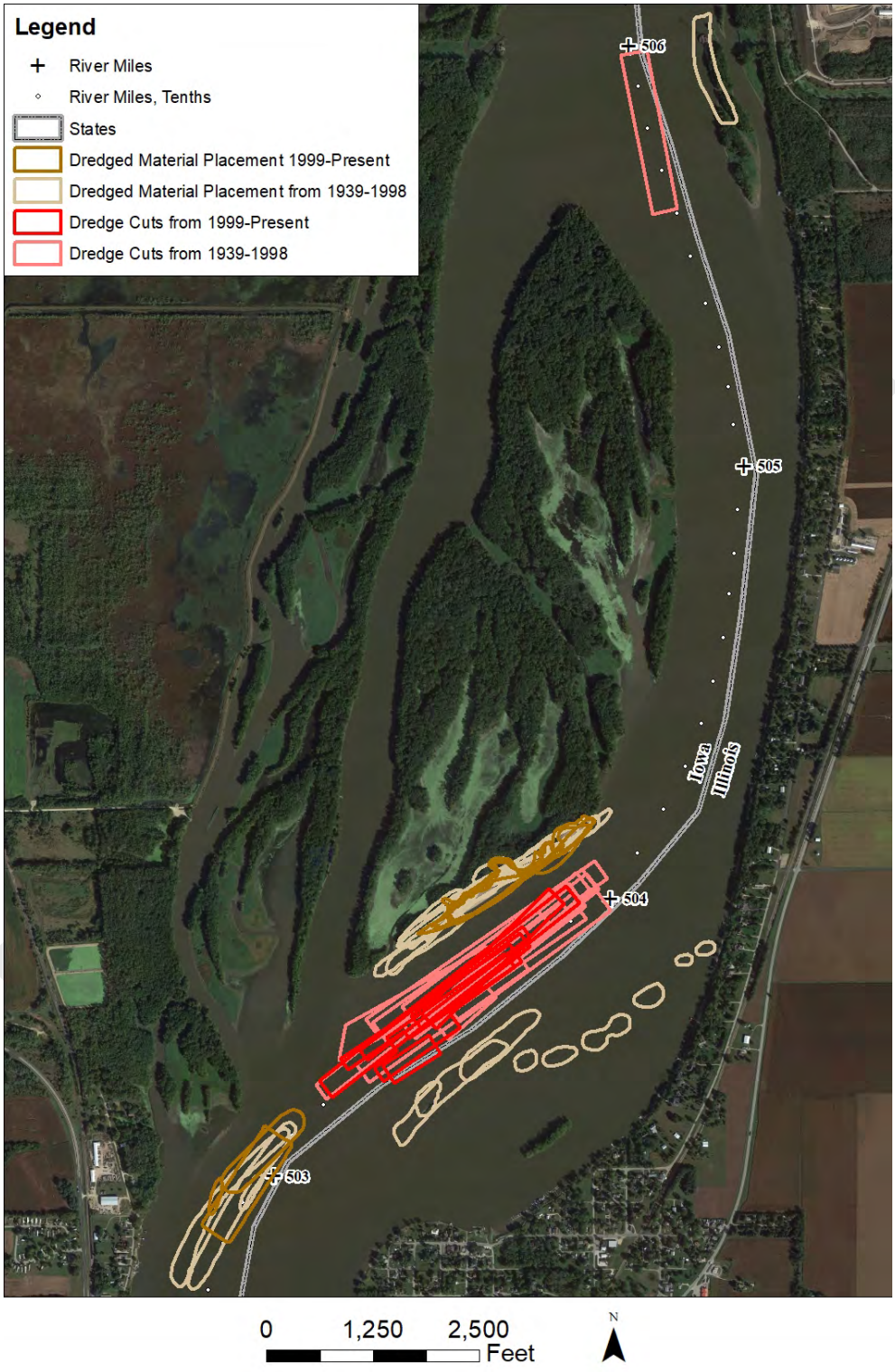


Figure II-17. Dredge Locations near Steamboat Island

Temporal and spatial variability are inherent in the numerous processes that drive sediment deposition, thereby sediment deposition rates are also dynamic. Some of the watershed features impacting backwater sediment deposition rates include geology and soils, land use, and other rainfall runoff characteristics of the contributing watershed, in addition to spatial and temporal variability of natural impoundments such as beaver dams.

To date, backwater sediment deposition studies within the UMR have focused on Pools 4-10 and Pool 13 (Aspelmeier, 1994; Eckblad et al., 1977; Korschgen et al., 1987; McHenry et al., 1984; Rogala & Boma, 1996; Rogala et al., 1997). Results from these studies vary from as much as 1.57 in/year (4.0 cm/year) (Pools 4-10) and as little as 0.08 in/year (0.2 cm/year) (Pool 7). A sediment deposition rate of 0.31 in/year (0.8 cm/year) was reported for Navigation Pool 13 (Rogala, et al., 1997). The Cumulative Effects Study indicates backwater sediment deposition rates derived from the sediment budget that vary from 0.2 in/year (0.5 cm/year) for Pools 12-19 to 0.12 in/year (0.31 cm/year) for Pools 20-26 (WEST Consultants, Inc., 2000). Seven backwater sites within Pool 14 were monitored for sediment deposition from 1984 through 2000 (Aspelmeier, 1994). Four of these sites were located in the Project area; one in Grant Slough near the Princeton Wildlife Management Area (Station 1), one in a backwater complex in Grant Slough (Station 2), one in the middle of Upper Lake (Station 3), and one in the middle of Lower Lake (Station 7). Annual measurements along a transect at Stations 1-3 were collected from 1984-1989. Stations 1 and 2 had repeated measurements in 1994. Measurements at the transect in Lower Lake (Station 7) were taken annually from 1987-1989 then in 2000 and most recently in 2017. During this observation period, flooding occurred in 1986, 1993, 1997, 2001, 2008, 2011, 2014 and 2019. Rates range from -0.8 in/year (erosion) to 2.2 in/year of deposition, however the overall trend is toward deposition. The average sediment deposition rate at Stations 1, 2, 3 and 7, based on the varying study periods, are 0.9 in/year (2.3 cm/year), -0.2 in/year (-0.5 cm/year), 0.6 in/year (1.5 cm/year) and 0.1 in/year (0.3 cm/year), respectively. As a result of the variability in reported values and the inherent variability in sediment deposition rates, an average annual sediment deposition rate of 0.4 in/year (1 cm/year) was assumed for the Project.

L. Historic and Cultural Resources

Examining an area's mapped Landform Sediment Assemblages (LSA) assists in understanding prehistoric archeological potential, as documented in the report, *Landform Sediment Assemblage (LSA) Units in the Upper Mississippi River Valley, United States Army Corps of Engineers, Rock Island District* (Bettis et.al., 1996). Mapped Project LSAs are Island, Early to Middle Holocene Channel Belt, and Tributary Fan. A large portion of the HREP is shown as underwater or seasonally inundated on 1930s plane table maps; those areas have no or extremely low potential to contain significant cultural resources.

Three prior archeological surveys overlap with small portions of the Project. The 1985 report entitled *Phase I Cultural Resources Survey: Archaeological and Geomorphic Reconnaissance at the Proposed Pipeline Crossing of the Northern Plains Natural Gas Company, Mississippi River Navigation Pool 14* (Anderson and Overstreet, 1985), documents survey of a pipeline proposed north of Steamboat Island proper. The limited excavations associated with the 1985 work do not conform to modern archeological fieldwork standards as provided in the Secretary of the Interior's *Standards and Guidelines for Identification and Evaluation* (48 FR 44720-23). The authors note that two cores excavated on the Tributary Fan west of the north tip of the island contained historic alluvium over 2.9-m thick.

The report *Archaeology, Geomorphology and Historic Surveys in Pools 13-14, Upper Mississippi River, Volume I: An Overview and Intensive Sample Survey of the Geomorphology and Cultural Resources of Mississippi River Pools 13 & 14* (Benn et al., 1989) primarily documented the area's geomorphology.

At the northwest corner of the Project, the report *Phase I Intensive Archaeological Survey and Geomorphological Investigation for Historic Properties, Rock Creek Marina and Campground, Clinton County Conservation Board, Clinton County, Iowa* (Stanley, 1996), assessed the possible impacts of marina and campground's improvements. The author found that prehistoric archeological potential is high within the upper 1.5 m of the Early to Middle Holocene soil column there.

The Corps reviewed the report, *An Investigation of Submerged Historic Properties in the Upper Mississippi River and Illinois Waterway* (American Resources Group, 1997), prepared by American Resources Group, Ltd. (Contract No. DACW25-93-D-0012, Delivery Order No. 37). No underwater historic properties are documented between RM 502 and 509.

A query of the Iowa Site File (ISF) Geographic Information System (GIS) archeological file database revealed three previously recorded terrestrial sites within the Steamboat Island HREP boundaries.

Archeologist Charles R. Keyes noted a possible historic Sauk or Meskwaki village at the mouth of the Wapsipinicon River. Designated site 13CN36, this village appears in the ISF GIS database as an upward-facing triangle, meaning both the site's location and boundaries are uncertain. Site 13CN59 is a historic Euro-American scatter recorded in the ISF GIS database as a downward-facing triangle, meaning the site's location is known, but its boundaries are uncertain. These two sites are discussed in the 1989 Benn et al. report; this report recommended site 13CN59 be preserved. The site 13CN36 recommendation called for subsurface testing to pinpoint the definite site location.

The final previously recorded site, isolated prehistoric find 13CN78, is documented in Stanley's 1996 report, where he mentions finding two pieces of flaking debris, one each found in the upper 10 cm of two shovel tests. Stanley recommended the site ineligible for National Register of Historic Places (NRHP) listing. The Iowa State Historic Preservation Office (SHPO) Database of Section 106 Review and Compliance Decisions for specific sites (accessible through the ISF GIS database) notes that, on 17 May 1996, the SHPO determined the site ineligible for NRHP listing.

Review of the 1930s Corps land acquisition/topographic maps reveals a variety of buildings and structures once stood within the Project area. These include fences, a log race related to timber harvests, a bridge, a pump, a small "stone dam," the side channel closing dam (labeled "stone retarding dam"), and several small buildings which likely functioned as hunting or fishing cabins.

Based on the nature of the Project, the Corps contracted Wapsi Valley Archaeology, Inc. of Anamosa, Iowa, to conduct an archaeological and geomorphological evaluation of the Project area. The work is yet to be conducted and will be coordinated in accordance to the stipulations outlined in the Programmatic Agreement (Appendix O, *Programmatic Agreement for Cultural Resources*).

DRAFT

M. Socioeconomic Resources

The Project area is dominated by an undeveloped forested area and has little residential populations within the Project area. The Project is located in Pool 14 on the Mississippi River, which flows through Clinton and Scott Counties, Iowa, and Rock Island County, Illinois. The land in these three counties is used primarily for agriculture, but there is also significant industrial development, especially adjacent to the Beaver Island HREP in the City of Clinton, Iowa (approximately 6 miles upstream of the Project area) as shown on Figure II-18 and Table II-6. Table II-7 shows cumulative acreage totals for Clinton, Scott, and Rock Island Counties classified by land and water resource descriptions. This information was retrieved from the 2018 USDA National Agricultural Statistics Service Cropland Data Layer.

DRAFT

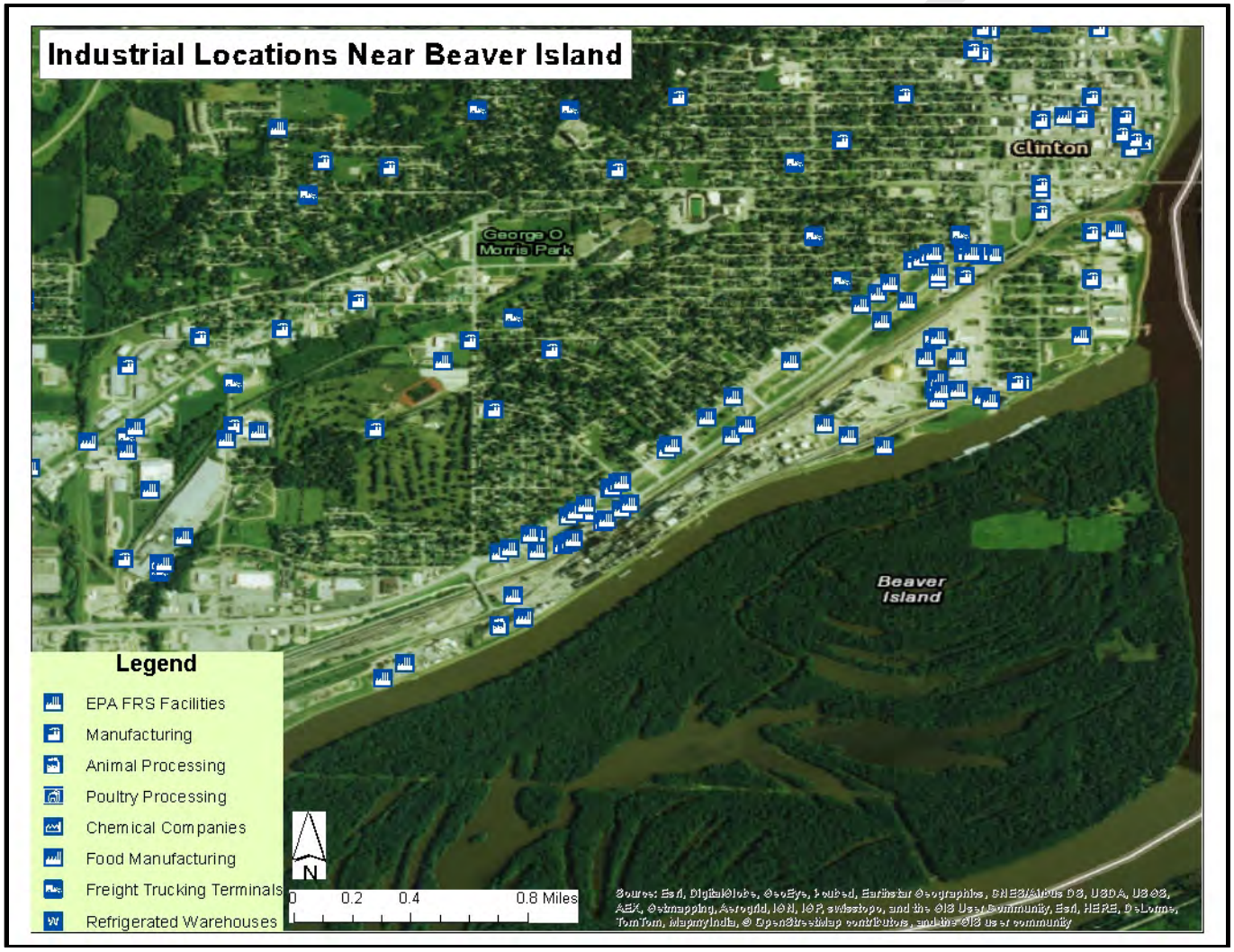


Figure II-18. Industrial Locations near Beaver Island HREP

Table II-6. Mississippi River Pool 14 Business and Industry Distribution by County

	Number of Establishments				
Major Industry	**Scott County, Iowa**	**Clinton County, Iowa**	**Rock Island County, IL**	**Total**	**% of Total**
Agriculture, forestry, fishing and hunting	4	8	2	14	0.2
Mining, quarrying, and oil and gas extraction	6	2	7	15	0.2
Utilities	11	4	9	24	0.3
Construction	448	114	235	797	9.2
Manufacturing	161	49	136	346	4.0
Wholesale trade	285	51	153	489	5.6
Retail trade	632	180	440	1252	14.4
Transportation and warehousing	129	62	108	299	3.4
Information	61	21	46	128	1.5
Finance and insurance	310	85	213	608	7.0
Real estate and rental and leasing	185	36	121	342	3.9
Professional, scientific, and technical services	397	59	279	735	8.5
Management of companies and enterprises	40	2	29	71	0.8
Administrative and support and waste management and remediation services	238	51	134	423	4.9
Educational services	50	6	38	94	1.1
Health care and social assistance	525	131	422	1078	12.4
Arts, entertainment, and recreation	73	22	53	148	1.7
Accommodation and food services	423	105	335	863	10.0
Other services (except public administration)	417	146	374	937	10.8
Industries not classified	7	1	1	9	0.1
Total	**4402**	**1135**	**3135**	**8672**	
% of Total	50.8	13.1	36.2		

Source: U.S. Census – 2016 County Business Patterns and 2016 North American Industry Classification System Codes

Table II-7: Land and Water Resource Acreages for Pool 14 Counties
(USDA- National Agricultural Statistics Service)

Class Name	Acres
Corn	362,968
Soybeans	233,995
Grassland/Pasture	100,965
Deciduous Forest	96,294
Developed/Open Space	68,292
Developed/Low Intensity	46,326
Open Water	33,459
Woody Wetlands	39,863
Developed/Medium Intensity	23,295
Alfalfa	10,400
Developed/High Intensity	9,737
Herbaceous Wetlands	9,778

Existing socio-economic information for Iowa and Illinois counties near the Project area is as follows (U.S. Census, 2010):

DRAFT

Clinton and Scott Counties, Iowa. With an average population density of 71 people per each of its 695 square miles (2010), Clinton County, Iowa, experienced a 4.2% decrease in total population from 50,149 to 48,051 people during the years 2000 to 2014 (2014 estimated). The median household income is estimated at $49,559, with 14% of persons living below the poverty level (2009-2013). Income per capita is $25,966 (2013). Of persons over 25 years of age, 90% have a high school education or higher and 17.7% have a Bachelor's degree or higher (2009-2013).

With an average population density of 361 people per each of its 459 square miles (2010), Scott County, Iowa, experienced an 8.0% increase in total population from 158,668 to 171,387 people during the years 2000 to 2014 (2014 estimated). The median household income is estimated at $52,735, with 13.1% of persons living below the poverty level (2009-2013). Income per capita is $28,948 (2013). Of persons over 25 years of age, 92.3% have a high school education or higher and 31.6% have a bachelor's degree or higher (2009-2013).

Rock Island County, Illinois. With an average population density of 345 people per each of its 427 square miles (2010), Rock Island County experienced a 2.2% decrease in total population from 149,374 to 146,063 people during the years 2000 to 2014 (2014 estimated). The median household income is estimated at $48,702, with 13.3% of persons living below the poverty level (2009-2013). Income per capita is $26,455 (2013). Of persons over 25 years of age, 87.4% have a high school education or higher and 21.8% have a Bachelor's degree or higher (2009-2013).

Along with non-monetary ecosystem restoration benefits that are measured in terms of increased habitat units per targeted species, potential economic benefits of habitat restoration also exist. These benefits can include an enhanced quality of life for humans, making it a more attractive location for business and new residential development. In addition, recreational activities tend to increase in relation to cleaner, more inhabitable water. Increased recreation then creates an economic multiplier, or ripple effect for tourism growth in affected areas. Affected areas of successful ecosystem restoration projects will almost certainly extend far beyond the boundaries of the Project area itself.

N. Hazardous, Toxic, and Radioactive Waste

A Phase I Hazardous, Toxic, and Radioactive Waste (HTRW) Environmental Site Assessment (ESA) for the Steamboat Island HREP was conducted. The Phase I ESA was completed in accordance with Engineering Regulation (ER) 1165-2-132, *HTRW Guidance for Civil Works Projects*; ER 405-1-12, *Real Estate Handbook*; ASTM Practice E 1527-13, and ASTM Practice E 1903-11.

The Phase I ESA revealed no evidence of a Recognized Environmental Condition (REC) that could potentially affect the Project area.

Based on the Phase 1 ESA, no further HTRW assessment is recommended. In addition, no restrictions are required on the proposed HREP measures (Appendix E, *Hazardous, Toxic, and Radioactive Waste*).

O. Future Without Project Conditions. Under the National Environmental Policy Act (NEPA) the No Action alternative is necessary to provide a reference point, enabling a comparison of environmental effects of the action alternatives. Due to either avoidance or no existing resources present, cultural, HTRW, socioeconomics, and man-made resources were all determined as not having

DRAFT

foreseeable impacts both with and without the Project. The Project Delivery Team (PDT) determined hydrology and hydraulics, aquatic habitat, and floodplain habitat to be resources that would have significant impacts with the No Action alternative. In other words, without intervention, these resources will continue to degrade, emphasizing the importance of the Project.

1. Hydrology and Hydraulics. Flooding attributes such as duration, frequency, depth and timing have been identified throughout the literature as being the primary drivers of floodplain forest ecology. Elevations supportive of hard mast tree recruitment were characterized for this study based on growing season inundation duration and annual exceedance probability. As discussed in Section II.K, stage durations have increased at the Camanche gage, thereby increasing the duration of island inundating flows in the Project area. Although the qualitative climate change assessment in Appendix H, *Hydrology and Hydraulics*, did not identify a statistically significant increasing trend in the 77-year inundation duration records, observed increases in stage duration support the need for a more resilient floodplain forest design through increased elevations in an uncertain future hydrologic regime. If stage durations continue to increase, inundation duration of forested areas will increase, resulting in associated tree mortality and greater loss of floodplain forest diversity and function, as well as the species that use floodplain forest habitat. Island acreage and function will also be lost, effecting aquatic habitat and function and the species that use these areas. It is assumed that increased flows and flooding, as well as the reduction of the islands southeast of Steamboat Island proper, will impact habitat suitability in the Cordova EHA, as shown in the HREP mussel model (see Appendix M, *Engineering Design*, Attachment C).

Without action, sediment deposition within the Project area backwater lakes is expected to continue. If sediment deposition rates as high as 0.4 in/year (1 cm/year), continue over the 50-year period of analysis, deposition of as much as 1.6 feet of sediment or greater may occur within the backwater areas, including overwintering habitat and wetlands.

2. Aquatic Habitat. Existing backwater habitat is very limited (less than 1 acre). Over time, this backwater area will be further reduced. If the Project area was subjected to an average sediment deposition rate of 0.4 in/year (1 cm/year) over the next 50 years (1.6 feet total), quality overwintering habitat would be reduced to near zero. It is unlikely the loss would be linear, as sediment deposition varies depending on water levels and flooding events.

It is anticipated that existing interior flowing channels will continue to exist, but may shift location. Remaining lentic habitat will consist of isolated interior shallow pools with fish access only during high water events. Estimates for the Project area are comparable to predictions made for Pool 14 during the Cumulative Effects Study (WEST Consultants, Inc., 2000) (Table II-8). The study also projected an overall loss of backwater aquatic habitat, but minimal loss of flowing channels.

Table II-8: Cumulative Effect Study: Predicted Future Conditions for Pool 14 Aquatic Habitats (WEST Consultants Inc., 2000)

		Acres of Aquatic Habitat by Strata					
	Year	**Main Channel**	**Secondary**	**Contiguous Backwater**	**Isolated Backwater**	**Island Area**	**Island Perimeter**
Pool 14	1989	6,597	1,396	1195	254	3,408	432,550
	2050	6,597	1,396	908	195	3,408	295,495
	% Change	**0%**	**0%**	**-25%**	**-23%**	**0%**	**-32%**

DRAFT

It is probable that Steamboat Island and other portions of the Project area will continue to provide spawning habitat based on future floodplain conditions. Rearing and foraging habitat currently provided by the interior backwaters will be substantially reduced as remaining pool habitat will have impaired water quality or restricted access during average flows. Consequently, summer habitat will either shift to another backwater complex or other flowing channels, if available, in Pool 14. Finally, overwintering habitat will continue to be of low quality within the interior backwaters of the Project.

3. Floodplain Habitat. Influencing factors in the Project area have resulted in a lack of topographic diversity due to increased water levels. This has led to limited forest regeneration due to increased inundation height and duration. As such, the forest is dominated by over-mature even-aged silver maple stands, with limited regeneration, and decreasing numbers of hard mast-producing trees. Current topography shows a significant portion of the Project area is low in elevation and below the threshold for producing a sustainable hard mast-producing tree population. Without intervention, it is highly unlikely that the existing forest will regenerate in the next 50 years.

Based on the current age structure, it is anticipated that a large percentage of the current forest will experience mortality over the next 50 years. Without a new cohort of trees in the understory, canopy openings will likely be filled with non-desirable and invasive species. Essentially, the forest will slowly convert to a monoculture of reed canarygrass or other invasive species, which has far less habitat value to floodplain wildlife.

Achievement of a healthy age distribution and species diversity of floodplain trees increases the numbers of hard mast-producing trees and provides the conditions (i.e., increased elevation) to restore a sustainable diverse forest. This is important to neotropical migratory birds and other floodplain wildlife. A conversion of diverse forest to low quality reed canarygrass habitat or silver maple monoculture would alter the structure of the wildlife community. Although silver maple habitat provides high value for generalist bird species, the loss of forested areas is detrimental to migratory and specialist bird communities that require cottonwood, elm, and oak for migration and breeding. Consequently, neotropical and other migratory birds, bald eagles, hawks, herons, bats, and the other floodplain species that rely on the forest resources will be severely impacted.

Over time, non-forested floodplain habitat (wetlands, scrub-shrub habitat) will experience similar impacts, the loss of which will impact pollinator species, herons, waterfowl species, and secretive marsh birds.

Islands on the UMR, and within the Project area, have eroded over time from inundation, high water events, and changes in hydraulic forces. In the Project area specifically, it can be estimated that approximately 100 acres of Steamboat Island proper and over 40 acres of the Southeast Islands have been lost due to inundation and erosion. Active erosion is occurring in the Project area, including after the near-record Spring 2019 flood. The West SE Island is especially at risk of disappearing altogether if no action is taken to restore acreage and protect the island (Photograph II-1). It has been greatly reduced and has no method of protection against the flow of the main channel. The West SE Island is one of two islands that remain in the vicinity of the Cordova EHA and provide a buffer from the hydraulic forces of the main channel. The East SE Island and Cordova EHA both support federally-listed mussel species. Without action, the West SE Island will disappear, making the East SE Island and Cordova EHA more vulnerable and subject to adverse impacts.

DRAFT

Photograph II-1: West SE Island, September 2019

DRAFT

SECTION III. PROBLEMS AND OPPORTUNITIES

A. Problems and Opportunities Identification

Historically, Steamboat Island contained a number of small backwater lakes, sloughs, cuts, and flowing side channels. Similar habitats were found in the Grant Slough complex and Wapsipinicon Bottoms as well. These habitats provided valuable overwintering, spawning, and feeding areas for a variety of fish, especially centrarchids. Migratory birds, including waterfowl, and wading birds, also used the area extensively.

Human activity within the UMR basin, floodplain, and channel has altered the hydrology, topography, and biotic communities present. Years of continual sediment deposition has degraded aquatic and wetland habitats and, in some instances, converted them to low elevation terrestrial habitats characterized by reed canarygrass monocultures, a relatively low-quality habitat. Impoundment of the pool and permanently higher water tables have affected the health of floodplain forest habitat on islands and adjacent floodplain areas. These higher water tables are affecting forest composition and regeneration. All of these alterations have reduced the quality and diversity of aquatic and floodplain habitats, impaired ecosystem functions, and reduced the acreage of Steamboat Island and other smaller islands in the area.

Problem. Loss of acreage, resiliency, structure and diversity of native floodplain forest and scrub-shrub habitats. The entire UMRS has undergone dramatic changes in the extent, composition, and structure of its floodplain forests over the last two centuries. The report *Ecological Status and Trends of the Upper Mississippi River System* (USGS, 1999), found that what was once a diverse forest composed of mixed silver maple, willow, cottonwood, oak-hickory, and shrub communities is now nearly 80% mixed silver maple. Lack of tree regeneration, reduction of species diversity, and increased tree mortality can be directly attributed to the increase in flood frequency and duration over time and higher water tables. These losses in habitat value limit the present and future ability of the Project area to attract and sustain a diverse community of resident and migratory wildlife species.

Opportunity. There is an opportunity to restore and enhance the age, composition and structure of the current floodplain forest and scrub-shrub habitat in the Project area and to enhance the diversity of these habitats. Floodplain forests are essential life support systems to a tremendous array of wildlife species, including but not limited to bats, birds, herptiles, insects, and mammals. The variety of floodplain forest types and the associated plant and tree communities historically found on Steamboat Island provide necessary habitat for a large number of animal species.

Problem. Loss of acreage of Steamboat Island and smaller islands in the Project area. Typically, the lower third of a pool represents the area where water levels were increased the most by the UMR lock and dam system, resulting in the inundation and eventual erosion of what were formerly islands and other terrestrial floodplain features. Islands serve many roles in the Mississippi River's ecosystem, including habitat and a source of food for various aquatic, wetland, and terrestrial species, and protection of aquatic vegetation by deflecting the current and breaking up waves as they roll across the large expanses of water immediately above the locks and dams. Erosion has reduced the number and acreage of islands in the lower sections of many Mississippi pools. When an island is lost, many of the aforementioned functions and benefits are also lost. Approximately 100 acres of Steamboat Island and 40 acres of the small islands near Cordova have been lost since the construction of L&D 14 (Section II, *Affected Environment*).

DRAFT

Opportunity. There is an opportunity to restore and protect some of the island acreage that has been lost in the Project area, in order to provide resilient and high quality habitat and ecosystem function to benefit an array of aquatic and wildlife species. There is also an opportunity to construct a small flow diversity structure in Steamboat Slough, which would create diverse flows, and may also capture sediment, creating an island over time.

Problem. Loss of acreage, resiliency, structure and diversity of aquatic habitat. Backwater fish and mussel habitat is an important component of the Mississippi River ecosystem. This type of habitat has declined in most of the UMRS with the leveling effects of sediment deposition in off-channel areas. The regular occurrence of maintenance dredging in Pool 14 exemplifies the sediment deposition problem occurring in this reach. Benthic organisms, such as freshwater mussels, play a significant role in aquatic ecosystems. North America has the highest diversity of freshwater mussels in the world, with the highest mussel richness is found in the Mississippi ecoregion. Currently more than half of the 78 known species are in some form of Federal or state listing.

Opportunity. There is an opportunity to restore backwater areas and improve habitat conditions for a large variety of backwater and channel fish species, including host species for a variety of freshwater mussels. There is an opportunity to enhance and increase overwintering habitat, improve spawning habitat, and increase nursery/rearing habitat to produce year round habitat within the Project area. Year-round habitat would include a diversity of water velocities (including <1 cm/sec during winter), adequate water depths (≥4 feet), aquatic vegetation, desirable DO concentrations (≥5 mg/L), and a diversity of substrates and structure. There is also an opportunity to enhance and protect the integrity of high quality lentic habitats that do exist in the interior of Steamboat Island and Grant Slough.

B. Resource Significance

Due to the challenges associated with comparing non-monetized benefits, the concept of output significance plays an important role in ecosystem restoration evaluation. Along with information from cost effectiveness and incremental cost analyses, information on the significance of ecosystem outputs will help determine whether the proposed investment is worth its cost and whether a particular alternative should be recommended. Statements of significance provide qualitative information to help decision makers evaluate whether the value of the resources of any given restoration alternative are worth the costs incurred to produce them. ER 1105-2-100 define significance in terms of institutional, public, and technical recognition.

Institutional Recognition: Institutional recognition means that the importance of an environmental resource is acknowledged in the laws, adopted plans, and other policy statements of public agencies, tribes, or private groups. Sources of institutional recognition include public laws, executive orders, rules and regulations, treaties, and other policy statements of the Federal Government; plans, laws, resolutions, and other policy statements of states with jurisdiction in the planning area; laws, plans, codes, ordinances, and other policy statements of regional and local public entities with jurisdiction in the planning area; and charters, bylaws, and other policy statements of private groups.

Public Recognition: Public recognition means that some segment of the general public recognizes the importance of an environmental resource, as evidenced by people engaged in activities

DRAFT

that reflect an interest or concern for that particular resource. Such activities may involve membership in an organization, financial contributions to resource-related efforts, and providing volunteer labor and correspondence regarding the importance of the resource.

Technical Recognition: Technical recognition means that the resource qualifies as significant based on its "technical" merits, which are based on scientific knowledge or judgment of critical resource characteristics. Whether a resource is determined to be significant may of course vary based on differences across geographical areas and spatial scale. While technical significance of a resource may depend on whether a local, regional, or national perspective is undertaken, typically a watershed or larger (e.g., ecosystem, landscape, or ecoregion) context should be considered. Technical significance should be described in terms of one or more of the following criteria or concepts: scarcity, representativeness, status and trends, connectivity, limiting habitat, and biodiversity.

- *Scarcity* is a measure of a resource's relative abundance within a specified geographic range. Generally, scientists consider a habitat or ecosystem to be rare if it occupies a narrow geographic range (i.e., limited to a few locations) or occurs in small groupings. Unique resources, unlike any others found within a specified range, may also be considered significant, as well as resources that are threatened by interference from both human and natural causes.
- *Representativeness* is a measure of a resource's ability to exemplify the natural habitat or ecosystems within a specified range. The presence of a large number and percentage of native species, and the absence of exotic species, implies representation as does the presence of undisturbed habitat.
- *Status and Trend* measures the relationship between previous, current and future conditions.
- *Connectivity* is the measure of the potential for movement and dispersal of species throughout a given area or ecosystem. A resource's connection to other significant natural habitats.
- *Critical Habitat* is habitat that is essential for the conservation, survival, or recovery of one or more species.
- *Limiting Habitat* is the measure of resources present supporting significant species.
- *Biodiversity* is a measure of the variety of distinct species and the genetic variability within them.

The UMR and the Project area and its unique mosaic of habitats are a significant resource, as outlined in Table III-1.

DRAFT

Table III-1: Steamboat Island HREP Resource Significance

Resource	Institutional Recognition	Public Recognition	Technical Recognition
Aquatic Habitat (including backwater)	Fish and Wildlife Conservation Act of 1980 Clean Water Act UMR NWFR Comprehensive Conservation Plan (USFWS, 2006) UMR NWFR Habitat Management Plan (USFWS, 2019) National Wildlife Refuge System Biological Integrity, Diversity, and Environmental Health Policy UMR Wildlife and Fish Refuge Act of 1924 FWCA, as amended (16 U.S.C. § 661) National Wildlife Refuge System Administrative Act of 1966 National Wildlife Refuge System Improvement Act of 1997	In 1986, Congress designated the UMRS as both a nationally-significant ecosystem and a nationally-significant navigation system. The UMR Floodplain Wetlands are designated as a Ramsar Wetland of International Importance and Globally Important Bird Area. The National Research Council's Committee on Restoration of Aquatic Ecosystems has targeted the UMR and the Illinois River for restoration as 2 of only 3 large river-floodplain ecosystems so designated. The UMR Basin Association advocates for restoration of habitat on the UMR. The UMR Coordinating Committee (UMRCC), made up of UMR resource professionals, is also a strong advocate for habitat restoration on the river. The FWIC, a committee of state and Federal natural resource specialists working on Pools 11-22, developed Draft Environmental Pool Plans to address navigation and restoration needs. The FWIC has identified backwater complexes in Pool 14 as priority areas in need of habitat restoration, which are priority areas for restoration as part of the UMR-IWW System Navigation Study (DeHaan et al. 2003). American Rivers, a non-governmental organization dedicated to protecting and restoring healthy, natural rivers, listed the Mississippi River in America's Top Ten Endangered Rivers for 2004. The River was a "special mention" on the 2011 list. The public recognizes the backwaters and side channels of Pool 14 as a locally and regionally important recreational fishery.	***Representativeness:*** Many of the important recreational and commercial fish species (e.g., bluegill, largemouth bass, black and white crappie, catfish, and buffalo species) are commonly found in the backwaters of the Project area and Pool 14 during different times of the year. ***Scarcity/Limiting Habitat*:** The Project area contains approximately 614 acres of aquatic habitat. The site offers both lentic (i.e., backwater; 127 acres) and lotic (i.e., riverine; 487 acres) general aquatic habitat types. The existing backwaters are limited with respect to high quality overwintering habitat. Of the available backwater habitat, only about .02% is suitable depth for overwintering. Even so, much of the existing overwintering area experiences higher flows or low DO (<3 mg/L) in the winter. Over time, overwintering habitat in Pool 14 has been reduced, due to sediment deposition and geomorphic change, leading to eutrophication , and degraded aquatic habitat. Other efforts in Pool 14 have been accomplished to help restore limiting habitat.

DRAFT

Table III-1: Steamboat Island HREP Resource Significance

Resource	Institutional Recognition	Public Recognition	Technical Recognition
Aquatic Habitat (including backwater)		Fisheries biologists recognize the importance of off-channel deep water habitat to overwintering and year-round habitat to fish. Fisheries biologists have identified overwintering habitat as a limiting factor for centrarchid populations (Bodensteiner and Lewis, 1992 and 1994, Gent et al.,1995, Sheehan et al., 2000a and 2000b) and are continuing research on winter habitat selection of centrarchid fishes (Pitlo, 2003, Steuck, 2010).	
Threatened & Endangered Species	FWCA, as amended (16 U.S.C.§ 661) ESA of 1973, as amended UMR NWFR Comprehensive Conservation Plan (USFWS, 2006) UMR NWFR Habitat Management Plan (USFWS, 2019) National Wildlife Refuge System Biological Integrity, Diversity, and Environmental Health Policy USFWS's recovery plan for Higgins eye (USFWS, 2004) National Wildlife Refuge System Administrative Act of 1966 National Wildlife Refuge System Improvement Act of 1997 UMR Wildlife and Fish Refuge Act of 1924	Congress has recognized the Nation's rich natural heritage is of "esthetic, ecological, educational, recreational, and scientific value to our Nation and its people."	***Representativeness:*** The USFWS has identified the Indiana bat; northern long-eared bat; eastern massasauga rattlesnake; rusty patched bumble bee; prairie bush clover; western prairie fringed orchid; Higgins eye pearlymussel; sheepnose mussel; and spectaclecase mussel; as federally-endangered or threatened species that have the potential to occur within Clinton and Scott Counties, Iowa. USFWS has identified the Indiana bat; northern long-eared bat; rusty patched bumble bee; eastern prairie fringed orchid; Higgins eye pearlymussel; sheepnose mussel; and spectaclecase mussel; as federally-endangered or threatened species that have the potential to occur within Rock Island County, Illinois. ***Scarcity/Limiting Habitat:*** There is 1 EHA listed in the Higgins eye recovery plan in Pool 14, with the next closest EHA located in Pool 16. The federally-endangered Higgins eye pearlymussel has been found in the Project area, with 6 found within the Cordova EHA during the 2018 survey. Even with the presence of the Cordova EHA and identified listed species, T&E species abundance and their habitat is still limited in the Project area and Pool 14.

DRAFT

Table III-1: Steamboat Island HREP Resource Significance

Resource	Institutional Recognition	Public Recognition	Technical Recognition
Migratory Birds	Migratory Bird Conservation Act of 1929, and associated treaties Migratory Bird Treaty Act of 1918 EO 13186 – Responsibilities of Federal Agencies to Protect Migratory Birds Bald and Golden Eagle Protection Act of 1940 FWCA, as amended (16 U.S.C.§ 661) National Wildlife Refuge System Administrative Act of 1966 National Wildlife Refuge System Improvement Act of 1997 UMR Wildlife and Fish Refuge Act of 1924 UMR NWFR Comprehensive Conservation Plan (USFWS, 2006) UMR NWFR Habitat Management Plan (USFWS, 2019) UMR NWFR Comprehensive Conservation Plan (USFWS 2006)	Migratory birds provide the public with recreational opportunities, such as bird watching and hunting.	***Representativeness:*** Numerous migratory birds utilize Steamboat Island and the surrounding areas; the following as the most relevant in the area: Bald Eagle, Great Blue Heron, Waterfowl, and neotropical migratory birds. ***Representativeness:*** Knutson et al. (1998) found relative abundances of all birds and total numbers of neotropical migratory birds were almost twice as high in the UMR floodplain as in the adjacent uplands. ***Status and Trend:*** Changes in the Steamboat Island, Grant Slough, and Wapsipinicon River forest community have contributed to a reduction in diversity of habitat over time. These changes are likely to continue, and without intervention, the Project area will cease to provide migration, dispersal, breeding, nesting, and cover habitat for a wide range of migratory birds.
Floodplain Forests and Island Habitat	FWCA, as amended (16 U.S.C.§ 661) UMR NWFR Comprehensive Conservation Plan (USFWS, 2006). UMR NWFR Habitat Management Plan (USFWS, 2019) National Wildlife Refuge System Biological Integrity, Diversity, and Environmental Health Policy National Wildlife Refuge System Administrative Act of	The UMR Floodplain Wetlands are designated as a Ramsar Wetland of International Importance and Globally Important Bird Area. The UMRCC recognized the importance of the floodplain forest to the fish and wildlife of the UMR in the report, *Upper Mississippi and Illinois River Floodplain Forests* (Urich et al., 2002). The report describes the habitat significance of the forest, describes changes in the floodplain forests, and recommends management actions to restore the	***Representativeness:*** The Project area contains approximately 2,014 acres of floodplain habitat. ***Status and Trend:*** The majority of the island is located at or below elevations where increased flood duration and frequency exceeds thresholds for optimal survival, growth, and sustainability of hard mast trees (i.e., nut producing trees) (De Jager et al., 2012; Guyon et al., 2012).

DRAFT

Table III-1: Steamboat Island HREP Resource Significance

Resource	Institutional Recognition	Public Recognition	Technical Recognition
	1966 National Wildlife Refuge System Improvement Act of 1997 UMR Wildlife and Fish Refuge Act of 1924	species, age, and structural diversity of the forest. Knutson et al. (1996) described the importance of floodplain forest in the conservation and management of neotropical migratory birds. Regional groups recognize the importance of floodplain forests.	The areas with hard mast trees present were on average over 88 years (ranged 1874 to 1964) old and contained little production in the understory. The largest concern is without intervention, the Project area is likely to experience forest fragmentation and an influx of invasive species, essentially transitioning from forest to grassland over time (Guyon et al., 2012). Consequently, neotropical and other migratory birds, bats, and the other floodplain species that rely on the forest resources will be severely impacted. Islands serve a variety of functions and provide varying habitat to the fish, birds, and wildlife that use them. Since the 1930's (pre-impoundment) to 2019, approximately 140 acres of Steamboat Island proper and the West and East Southeast Islands have been lost due to erosion. Approximately 26 acres of loss has happened since the 1950s. The continued erosion and loss of the habitat and function will impact hydraulic relationships in the river, the habitat types islands provide, and the species that use them. The West and SE Islands currently support many fish and mussel species, including federally-listed species. ***Limiting Habitat:*** During a 2018 forest inventory, a total of 18 different species were recorded in the overstory, including Eastern redbud black walnut. Those species are not normally found in the floodplain in this region due to flood intolerance. The West and SE Islands are essential for conservation of federally- and state-listed mussel species, as they currently provide direct or indirect benefits to the federally-endangered Higgins eye pearlymussel, state-threatened black sandshell, and Cordova EHA.

DRAFT

Table III-1: Steamboat Island HREP Resource Significance

Resource	Institutional Recognition	Public Recognition	Technical Recognition
Mussels	FWCA, as amended (16 U.S.C.§ 661) ESA of 1973, as amended UMR NWFR Comprehensive Conservation Plan (USFWS, 2006) UMR NWFR Habitat Management Plan (USFWS, 2019) National Wildlife Refuge System Biological Integrity, Diversity, and Environmental Health Policy National Wildlife Refuge System Administrative Act of 1966 National Wildlife Refuge System Improvement Act of 1997 UMR Wildlife and Fish Refuge Act of 1924	Freshwater mussels are of unique ecological value as natural biological filters, food for fish and wildlife, and indicators of good water quality. In the United States, some species are commercially harvested for their shells and pearls.	***Representativeness:*** 601 mussels (27 total species) were collected at seven different sample sites within the Project area during the October 2018 mussel survey. The most abundant mussel species (41% of the mussels collected) found were threeridge, plain pocketbook, and threehorn wartybak, each comprising 11% of the collected individuals. ***Scarcity:*** The Cordova EHA appears to harbor around 16 live unionid species, including the federally-endangered Higgins eye pearlymussel. ***Status and Trend:*** Without island restoration and protection, increased flows will likely have a negative impact on the diverse mussel community currently inhabiting the Cordova EHA.

DRAFT

C. Upper Mississippi River System Ecosystem Restoration Objectives

Formal planning for UMRS ecosystem management and restoration has been an ongoing process that was institutionalized in the 1970s with a Comprehensive Master Plan completed by the Upper Mississippi River Basin Commission in 1982. The Master Plan proposed an outline for the UMRR Environmental Management Program, which was authorized in WRDA 1986. The UMRR has been a National leader in ecosystem restoration planning and implementation for 30 years. UMRR partners have participated in several project planning cycles to develop regional ecosystem restoration needs and priorities. Their prior experience and strong interagency relationships provided the foundation to develop the ecosystem restoration component of the NESP which was authorized in WRDA 2007. Program partners understand the interrelated information needs of multiple navigation and ecosystem restoration programs, so Reach Planning was conducted to identify ecosystem objectives and subareas where they can be achieved in a program-neutral fashion. Reach Planning relied on participants from River Management Team workgroups including the Fish and Wildlife Work Group in the Upper Impounded Reach; the Fish and Wildlife Interagency Committee in the Lower Impounded Reach; the Illinois River Work Group in the Illinois River; and the River Resource Action Team in the Unimpounded Reach (also the Lower Impounded Reach and the Illinois River).

The *Upper Mississippi River System – Ecosystem Restoration Objectives 2009* report is the final product of a planning process initiated in 2008 for the purpose of identifying areas for new restoration projects and identifying knowledge gaps at a system scale. The report serves as a technical basis for investment decisions through 2013 and as a backdrop for the formulation of specific restoration projects and their adaptive management components.

The Reach Planning process led to the identification of high priority areas for restoration of natural river processes (as required by Section 8004 of WRDA 2007). The Reach Planning process also provided context for formulating project measures, defining performance measures, and designing monitoring plans. The Reach Planning framework emphasized system-wide environmental goals, implementation guidance to achieve objectives, considerations of scale and connectivity, and then identified a stepwise process for setting ecosystem restoration objectives that included: identifying unique characteristics, historic, existing, and future conditions, stressors, objectives, performance criteria, and indicators. Goals and objectives for condition of the river ecosystem are central to river management, and are linked to other elements of the framework.

1. **Over-Arching Ecosystem Goal:** ***To conserve, restore, and maintain the ecological structure and function of the UMRS to achieve the vision***

2. **Ecosystem Goals**

    - Manage for a more natural hydrologic regime
    - Manage for functions that shape diverse and dynamic channels and floodplain
    - Manage for natural materials transport and processing functions
    - Manage for a diverse and dynamic pattern of habitats to support native biota

DRAFT

- Manage for viable populations of native species within diverse plant and animal communities

3. Lower Impounded Floodplain Reach. The Steamboat Island Project area is within the Lower Impounded Floodplain reach. Objectives for the reach include:

- A more natural stage hydrograph
- Naturalize the hydrologic regime of tributaries
- Increased water clarity
- Reduced nutrient loading from tributaries to rivers
- Reduced sediment loading and sediment resuspension in backwaters
- Increased storage and conveyance of flood water on the floodplain
- Restored backwater areas
- Restored bathymetric diversity, and flow variability in secondary channels, sand bars, shoals, and mudflats
- Restored habitat connectivity
- Restored riparian habitat
- Restored lower tributary valleys
- Restored floodplain topographic diversity
- Restored diversity and extent of native communities throughout their range in the UMRS
- Diverse and abundant native aquatic vegetation communities
- Reduced adverse effects of invasive species

D. Environmental Pool Plans

The FWIC created Pool Plans in September of 2002 that established common habitat goals and objectives for Pools 11-22 of the UMR. The following resource problems for Pool 14 and proposed actions specific to Steamboat Island are taken directly from the draft report *Environmental Pool Plans, Corps of Engineers, Rock Island District, Mississippi River, Pools 11-22 (*USACE, *2004).*

1. Resource Problems

- Fine sediments are accumulating at accelerated rates within backwaters and other floodplain sites due to high suspended sediment concentrations and the reduced sediment transport capability of the navigation project.
- Habitats critical to migratory birds must be maintained, especially aquatic food resources and woodlands

DRAFT

- Coarse sediments, or bed load sediments, accumulate in side channels where they fill valuable habitats and restrict flows.
- An elevated water table favors moisture tolerant forest species and limits potential for species diversity.
- Watershed discharges into Pool 14 contribute to significant water quality and habitat problems, which impact natural resources. Issues include accelerated sediment deposition, and associated nutrient and contaminate delivery and urban and industrial discharges.
- L&D 13 and 14 restrain fish passage between pools.
- Information is needed to better assess and manage Pool 14 mussels, especially the Higgins eye pearlymussel population.
- The current pool water management regime, especially avoidance of seasonal low water, removes much potential for periodic regeneration of aquatic habitats.

2. Proposed Actions Specific to Steamboat Island HREP

- Increase island elevation with dredged material to introduce and sustain mixed bottomland tree and scrub-shrub species
- Restore and enhance wetland, floodplain, and bottomland forest habitat in order to support a diverse community of resident and migratory wildlife species and provide ecosystem function
- Restore and protect Steamboat Island and other smaller islands to provide resilient and high quality habitat and ecosystem function
- Construct a flow diversity structure to create diverse flows and provide unique aquatic habitat
- Restore fish overwintering areas and other aquatic habitats in the Project area

E. Upper Mississippi River National Wildlife and Fish Refuge Goals

Steamboat Island is part of the UMR NWFR. Broad goals and objectives are provided by legislation that guides management of the National Wildlife Refuge System, including the National Wildlife Refuge System Administration Act of 1966 and the National Wildlife Refuge System Improvement Act of 1997 (16 U.S.C. 668dd to 668ee, Refuge Administration Act). These define the Refuge System and authorizes the Secretary of the Interior to permit any use of refuge provided such use is compatible with the major purposes for which the refuge was established. The landmark Improvement Act, prepared the way for a renewed vision for the future of the refuge system whereby:

- wildlife comes first;
- refuges are cornerstones for biodiversity and ecosystem-level conservations;

- lands and waters of the System are biologically healthy; and
- refuge lands reflect nation and international leadership in habitat management and wildlife conservation.

Important provisions of this legislation and the subsequent policies to carry out its mandates include:

- The establishment of a Broad National Policy for the Refuge System whereby each refuge shall be managed to fulfill the mission and its purposes.
- Directing the Secretary of the Interior to:
  - provide for the conservation of fish, wildlife, and plants within the System;
  - ensure biological integrity, diversity, and environmental health of the System for the benefit of present and future generations;
  - carry out the mission of the System and purposes of each refuge; if conflict exists between these, refuge purposes take priority;
  - ensure coordination with adjacent landowners and the states.
- Providing Compatibility of Uses Standards and Procedures whereby new or existing uses should not be permitted, renewed, or expanded unless compatible with the mission of the System or the purpose(s) of the refuge, and consistent with public safety.
- Planning whereby each unit of the Refuge System shall have a Comprehensive Conservation Plan completed by 2012.
- Compatibility Policy whereby no use for which the Service has authority may be allowed on a unit of Refuge System unless it is determined to be compatible. A compatible use is a use that, in the sound professional judgment of the refuge manager, will not materially interfere with or detract from the fulfillment of the Refuge System mission or the purposes of the national wildlife refuge. Managers must complete a written compatibility determination or each use, or collection of like uses, which is signed by the manager and the Regional Chief of Refuges in the respective Service region.
- Biological Integrity, Diversity, and Environmental Health (BIDEH) Policy whereby the Service is directed in the Refuge Improvement Act to "ensure that the biological integrity, diversity, and environmental health of the Refuge System are maintained for the benefit of present and future generations of Americans…" The biological integrity policy helps define and clarify this directive by providing guidance on what conditions constitute BIDEH; guidelines for maintaining existing levels; guidelines for determining how and when it is appropriate to restore lost elements; and guidelines in dealing with external threats to BIDEH. The policy also provides guidance for the conservation and management of a broad spectrum of fish, wildlife, and habitat resources found on refuges and associated ecosystems.

DRAFT

The specific legislation establishing the UMR NWFR was the UMR Wild Life and Fish Refuge Act of 1924 and the stated purposes of the refuge in that legislation were:

- "…a refuge and breeding place for migratory birds included in the terms of the convention between the United States and the Great Britain for the protection of migratory birds, concluded August 16, 1916, and…

- …to such extent as the Secretary of Agriculture may be regulations prescribe, as a refuge and breeding place for other wild birds, game animals, fur-bearing animals, and for the conservation of wild flowers and aquatic plants, and…

- …to such extent as the Secretary of Commerce may by regulations prescribe as a refuge and breeding place for fish and other aquatic animal life."

The UMR NWFR Comprehensive Conservation Plan (USFWS, 2006) identified several relevant Goals and Objectives, including:

- **Environmental Health Goal:** We will strive to improve the environmental health of the Refuge by working with others.

- **Wildlife and Habitat Goal:** Our habitat management will support diverse and abundant native fish, wildlife, and plants.
  - Management practices will restore or mimic natural ecosystem processes or functions to promote a diversity of habitat and minimize operations and maintenance costs. Mimicking natural process in an altered environment often includes active management and/or structures such as drawdowns, moist soil management, prescribed fire, grazing, water control structures, dikes, etc.
  - Maintenance and operation costs of projects will be weighed carefully because annual budgets are not guaranteed.
  - Terrestrial habitat on constructed islands and other areas needs to best fit the natural processes occurring on the river, which in many cases will allow for natural succession to occur.
  - If project measures in Refuge Closed Areas serve to attract the public during the waterfowl season, spatial and temporal restrictions of uses may be required to reduce human disturbance of wildlife.
  - The aesthetics of projects in context of visual impacts to the landscape should be considered in project design.

Each refuge is required to complete a Habitat Management Plan that includes an identification of Resources of Concern associated with that refuge. Service policy (620 FW 1) defines Resources of Concern as: "All plant and/or animal species, species groups, or communities specifically identified in refuge purpose(s), System mission, or international, national, regional, state, or ecosystem conservation plans or acts. For example, waterfowl and shorebirds are a resource of concerns on a refuge whose purpose is to protect 'migrating waterfowl and shorebirds.' Federal or State threatened and endangered species on that same refuge are also a resource of concern under terms of the respective endangered species acts."

DRAFT

Furthermore, the comprehensive list of Resources of Concern associated with a refuge is refined to a subset known as Priority Resources of Concern. The Priority Resources of Concern have been identified by the UMR NWFR and they serve in part to represent refuge priorities when the refuge engages in the planning and execution of partnership activities such as UMRR HREPs (USFWS, 2019).

Priority Resources of Concern that are relevant to and could benefit from the Project include: Midwestern wooded swamps and floodplains, red-shouldered hawk, prothonotary warbler, cerulean warbler, transient neotropical migrant passerines, tree-roosting bats, and native invertebrate pollinators, dabbling ducks, secretive marsh birds, limnophilic native mussels and fish, fluvial-dependent native mussels, and fluvial-dependent migratory native fish.

F. Habitat Needs Assessment-II

The UMRR Program vision statement is for a healthier and more resilient UMR ecosystem that sustains the river's multiple uses. To address this vision, the UMRR Program developed a suite of 12 indicators that quantify aspects of ecosystem health and resilience (i.e., connectivity, redundancy and diversity, and controlling variables). These indicators reflect the ability of large floodplain river ecosystems to adapt and respond to disturbances and represent ecosystem-based management objectives developed for the UMRS (USACE, 2011). To identify habitat needs for the UMRS, the HNA-II effort used these indicators that quantify the basic structure and function of the river system developed in a previous report (De Jager et al., 2018). Habitat needs were defined by comparing individual indicators to the conditions desired by the management agencies of the UMRR Program. An assessment of current conditions using both quantitative data analysis and qualitative management perspectives was performed at two spatial scales: navigation pool and clusters of navigation pools that shared similar ecological attributes. The UMRR Program can use the information provided in the HNA-II to more effectively achieve the Program's goals.

Pool 14 is part of the Middle Impounded cluster, as identified by the River Teams, and has the following desired future conditions:

- Maintain and enhance aquatic vegetation diversity;
- Restore floodplain topographic diversity and diversify inundation periods;
- Restore function and diversity of aquatic habitat types by improving quality, depth and distribution of lotic and lentic habitats; and
- Restore, maintain and enhance floodplain vegetation diversity, including hard-mast (nut-producing) trees.

G. Project Goals and Objectives

Based on the identified problems affecting the Project's natural resources and considering the management goals of the cooperating agencies, the Project goals are to maintain, enhance and restore quality habitat for native and desirable plant, animal, and fish species and maintain, enhance, restore

and emulate natural river processes, structures and functions for a resilient and sustainable ecosystem. The objectives identified to meet these goals over the period of analysis are to:

1. enhance and restore areal coverage and diversity of forest stands and habitat and increase diversity of bottomland hardwood forest, as measured in forested acres suitable to support hard-mast species and structure, age, and species composition;

2. increase year-round aquatic habitat diversity, as measured by acres and limnophilic native fish use of overwintering habitat, as this habitat is the most limiting of seasonal habitats;

3. restore 50% of island acreage and topography lost since the 1950s and protect from erosion within the Project area, as measured by acres; and

4. protect existing backwater habitat from sediment deposition and enhance backwater and interior wetland areas, as measured by acres of backwater and survivability of scrub-shrub/pollinator habitat.

H. Planning Constraints and Considerations

The following constraints and considerations were included in plan formulation:

- **Navigation.** Ensure measures do not negatively impact the 9-foot navigation channel.

- **Environmental Laws and Regulations.** Construct measures consistent with Federal, state, and local laws. Compliance and coordination under NEPA emphasizes the importance of environmental impacts to be minimized and avoided, as much as possible. Therefore, the following constraints are considered when analyzing alternatives:
  - Minimize floodplain forest impacts;
  - Minimize endangered species impacts;
  - Minimize migratory bird impacts;
  - Maintain hydraulic connectivity to allow for improved water quality for fish; and
  - Avoid cultural resources.

- **Flood Heights.** Restoration measures should not increase flood heights or adversely affect private property or infrastructure.

- **Sponsor Considerations.** Where feasible, restoration measures should address refuge priorities and reduce O&M to address limits of refuge resources.

DRAFT

SECTION IV. POTENTIAL PROJECT MEASURES

This section discusses potential measures that will meet the goals and objectives outlined in Section III, *Problems and Opportunities*. For planning purposes, the period of analysis was established as 50 years. These potential measures were initially screened based on their contribution to the Project goals and objectives, engineering considerations, and local restrictions or constraints. Review of the four formulation criteria suggested by the U.S. Water Resources Council's Principles and Guidelines (P&G) (completeness, effectiveness, efficiency, and acceptability, defined in Section V.D) were used to aide in the screening of potential measures. Several measures were identified in the early planning stages; many of these were partially developed, then were determined not feasible and did not undergo further evaluation. Measures that were evaluated further are described in the following sections. Design criteria and typical photographs are provided in Appendix M, *Engineering Design*.

A. Aquatic Diversity, Topographic Diversity-Forestry, and Topographic Diversity-Scrub-Shrub/Pollinator Habitat

1. Aquatic Diversity Measures. Excavation has been proposed as a potential measure to provide suitable year-round aquatic diversity and habitat for fish, including critical overwintering habitat for centrarchid fish species. Excavation will also provide material needed to increase topographic diversity within the floodplain forest and to increase scrub-shrub and pollinator wetland habitats. Other fish habitat structures, such as stone or log structures, woody debris, or rock piles, may be incorporated into the design. These measures may increase habitat diversity and provide additional fish habitat. Five locations were considered for aquatic diversity measures. Figure IV-1 shows the locations of these measures.

DRAFT

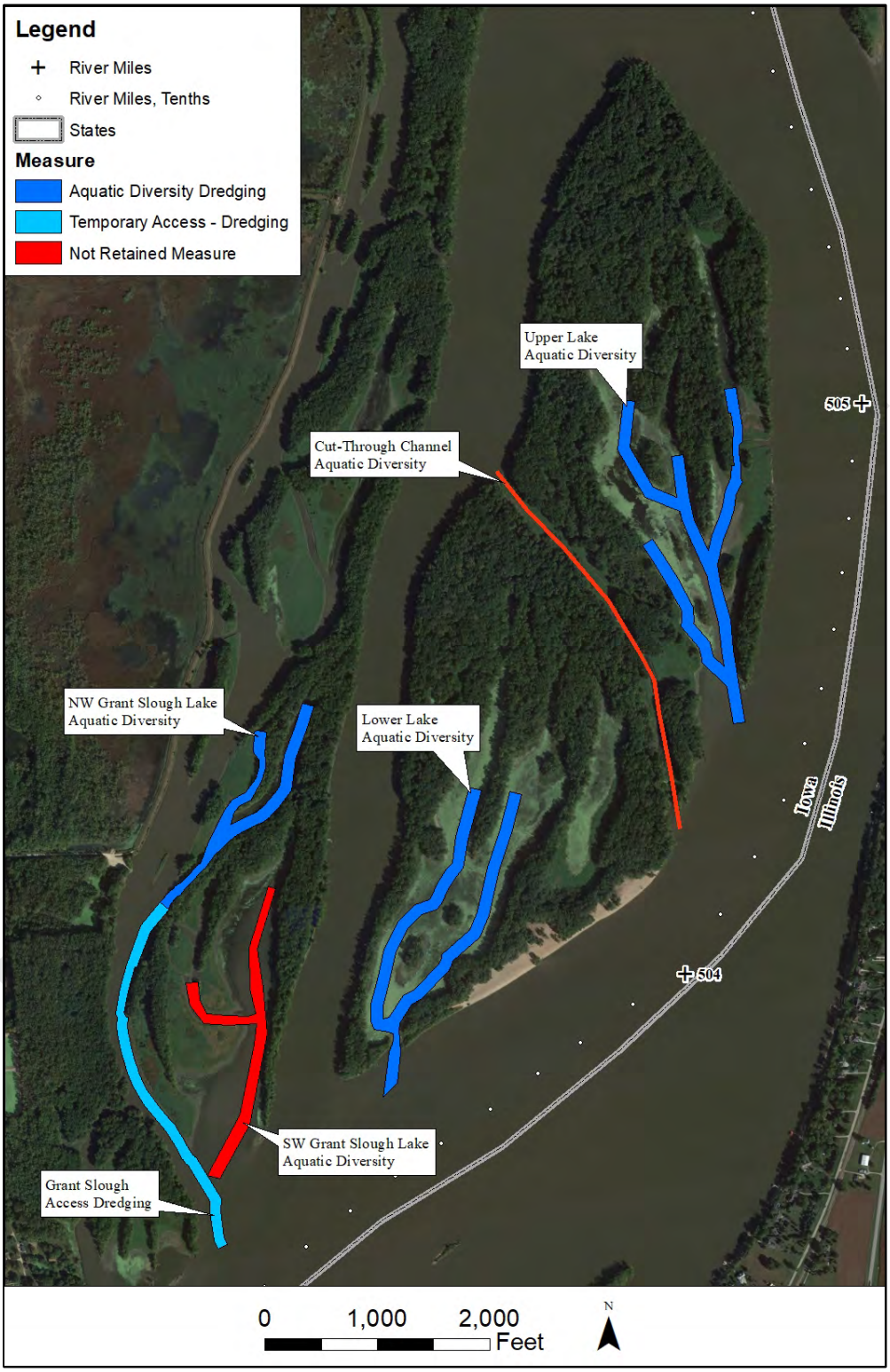


Figure IV-1: Aquatic Diversity Locations

a. Steamboat Island Upper Lake Aquatic Diversity (Upper Lake). Upper Lake is located in the northern portion of Steamboat Island proper. This site was selected as a potential location to enhance suitable year-round aquatic diversity and habitat for fish, including the restoration of critical overwintering habitat for centrarchid fish species, as Upper Lake historically provided overwintering fish habitat. Upper Lake would be excavated to a depth of 8 feet below flat pool to an elevation of 563.2 feet, providing aquatic diversity through dredging and utilizing the dredged material for topographic diversity. The cut was aligned to follow naturally deeper areas and tie into the deeper water of the Mississippi River channel. Following naturally deeper areas minimizes dredging costs and may allow for increased lifespan of the cut. It is assumed that naturally deeper areas are maintaining depth through natural processes, and those natural processes may maintain the dredge cut in those locations as well. The cut is designed to a 60-foot bottom width with 3H:1V side slopes. At bottom depth, the cut encompasses 9.1 acres. The estimated quantity of dredging is 150,570 cubic yards (CY). Upper Lake would be constructed only in combination with addressing the breached natural berm referred to as the Northeast Bank (NE Bank). The NE Bank has eroded, allowing water from the Mississippi River channel to flow into Upper Lake and depositing sediment into the lake. Refer to Section IV.2 and Figure IV-2 for additional information on the NE Bank. It was assumed that material from Upper Lake would be placed at the NE Bank or Steamboat Island Upper Lake Placement 1. See Appendix M, *Engineering Design,* for further details.

This measure was retained for further evaluation.

b. Cut-Through Channel. The Cut-Through Channel bisects Steamboat Island proper into upper and lower Steamboat Island. This site was selected as a potential location to enhance suitable year-round aquatic diversity and habitat for fish, including critical overwintering habitat for centrarchid fish species, as the channel was historically deeper and provided aquatic diversity. Excavation in the Cut-Through Channel was considered to provide aquatic diversity for fish and/or mussel species and provide material for floodplain forest topographic diversity and scrub-shrub/pollinator habitat. During evaluation, it was determined that the Cut-Through Channel, which has been filling in over time due to sediment deposition, would likely continue to fill in if excavated. Additionally, the excavated Cut-Through Channel would have flows through it from Steamboat Slough to the main channel, which is not preferred habitat for overwintering fish species. Lastly, the PDT determined that allowing flows through the Cut-Through Channel would increase vulnerability for sediment-laden water to enter Lower Lake.

This measure was determined to be incomplete and ineffective and was not retained for further evaluation.

c. Steamboat Island Lower Lake Aquatic Diversity (Lower Lake). Lower Lake is located in the southern portion of Steamboat Island proper. This site was selected as a potential location to enhance suitable year-round aquatic diversity and habitat for fish, including the restoration of critical overwintering habitat for centrarchid fish species, as Lower Lake historically provided overwintering fish habitat. Lower Lake would be excavated to a depth of 8 feet below flat pool to an elevation of 563.2 feet, providing aquatic diversity through dredging and utilizing the dredged material for topographic diversity. Similarly to Upper Lake, the cut was aligned to follow naturally deeper areas and tie into the deeper water of the Mississippi River channel. The cut is designed to a 60-foot bottom width with 3H:1V side slopes. At bottom depth, the cut encompasses 7.5 acres. The estimated quantity of dredging is 126,302 CY. It was assumed that material from dredging Lower Lake would

be placed at the scrub-shrub/pollinator placement sites in Lower Lake and the floodplain forest topographic diversity at the West SE Island. See Appendix M, *Engineering Design*, for further details.

This measure was retained for further evaluation.

d. Northwest Grant Slough Lake Aquatic Diversity (NW Grant Slough Lake). NW Grant Slough Lake is located in the southern portion of Grant Slough. This site was selected as a potential location to enhance suitable year-round aquatic diversity and habitat for fish, including the restoration of critical overwintering habitat for centrarchid fish species, as NW Grant Slough Lake historically provided overwintering fish habitat. NW Grant Slough Lake would be excavated to a depth of 8 feet below flat pool to an elevation of 563.2 feet, providing aquatic diversity through dredging and utilizing the dredged material for topographic diversity. The cut was aligned to follow naturally deeper areas and tie into Grant Slough. Grant Slough is generally deep enough to allow for fish passage from NW Grant Slough Lake, through Grant Slough, and into the Mississippi River. The cut is designed to a 60-foot bottom width with 3H:1V side slopes. At bottom depth, the cut encompasses 4.7 acres. The estimated quantity of dredging is 75,082 CY. It was assumed that material from dredging NW Grant Slough Lake would be placed at Grant Slough Placement 2 and the West SE Island. Access dredging will be required to access NW Grant Slough Lake. The access dredge cut would be excavated to a depth of 6 feet below flat pool to an elevation of 565.2 feet. This could provide aquatic diversity, but is not considered a measure when determining habitat benefits. The cut is designed to a 60-foot bottom width with 3H:1V side slopes. At bottom depth, the cut encompasses 4.6 acres. The estimated quantity of dredging is 13,556CY. The material from access dredging into NW Grant Slough Lake will be used for topographic diversity measures. Likely locations for placement of the material include Grant Slough Placement Site 1 (IV.A.3.b) and the West Southeast Island (IV.B.1.b). See Appendix M, *Engineering Design*, for further details.

This measure was retained for further evaluation.

e. Southwest Grant Slough Lake Aquatic Diversity (SW Grant Slough Lake). SW Grant Slough Lake is located in the southern portion of Grant Slough. This site was selected as a potential location to enhance suitable year-round aquatic diversity and habitat for fish, including the restoration of critical overwintering habitat for centrarchid fish species, as NW Grant Slough Lake historically provided overwintering fish habitat. Excavation at SW Grant Slough Lake was considered in order to provide aquatic diversity through dredging and utilizing the dredged material for topographic diversity. A site visit revealed that the proposed SW Grant Slough Lake area is currently functioning well as a wetland complex and is an important resource in its current condition.

Due to the benefits it currently provides and potential environmental impacts that would occur if constructed, this measure was determined unacceptable and not retained for further evaluation.

2. Topographic Diversity Measures – Forestry Habitat. Planting native bottomland forest species on elevated placement areas associated with excavation for aquatic diversity has been proposed as a potential measure to diversify the forested areas in the Project area. Forest diversity sites were selected based on current vegetation quality and the proximity to potential dredge cut locations, as well as accessibility with construction equipment. Sites near aquatic diversity dredge cuts allow for side-cast placement and less handling of dredged material. Although many sites will allow for some side casting of material, material will still need to be spread out and graded at all sites. There

are several locations within the Project area that are characterized by reed canarygrass monocultures. Placement at these sites requires no tree clearing or removal, however, 1.3 acres of tree clearing will be required for access to one site; converting these areas from invasive reed canarygrass to bottomland forest provides for a significant increase in habitat value. Isolated wetlands for herptile habitat will be created by constructing ridge and swale topography, or areas of slightly higher and slightly lower elevation, instead of a plateau of material. Figure IV-2 shows the locations of these measures.

Material excavated from the aquatic diversity dredge cuts will be placed to construct the topographic diversity sites to an optimum elevation for tree survival. Initial design elevations were determined based upon inundation duration tolerance criteria specific to the desired tree species and based upon input from the Project forester and hydraulic engineer. The upper limit of tree planting was identified as elevation 576.2 feet, which is based on the 25% exceedance probability for the minimally tolerant growing season inundation criteria (25-day inundation duration) and the lower limit of tree planting was identified as elevation 574.0 feet, based on the 25% exceedance probability for the moderately tolerant growing season inundation criteria (45-day inundation duration).

Once dredged material has dried sufficiently to work, the site will be graded. Final grade will include gradual and random ridge and swale topography, creating topographical diversity with elevation changes ranging from elevation 576.2 feet to minus 1.5 feet. Ridges would not be uniform in width, length, or position across the placement area. Swales would vary in size and depth and, to allow for water retention, would not extend to either side of the placement area completely. The retention of water in these swales will allow for a slower rate of water migration through subsurface draining, which in turn aides in healthy root development. Refer to Appendix M, *Engineering Design*, for the topographic diversity forestry planting plan.

DRAFT

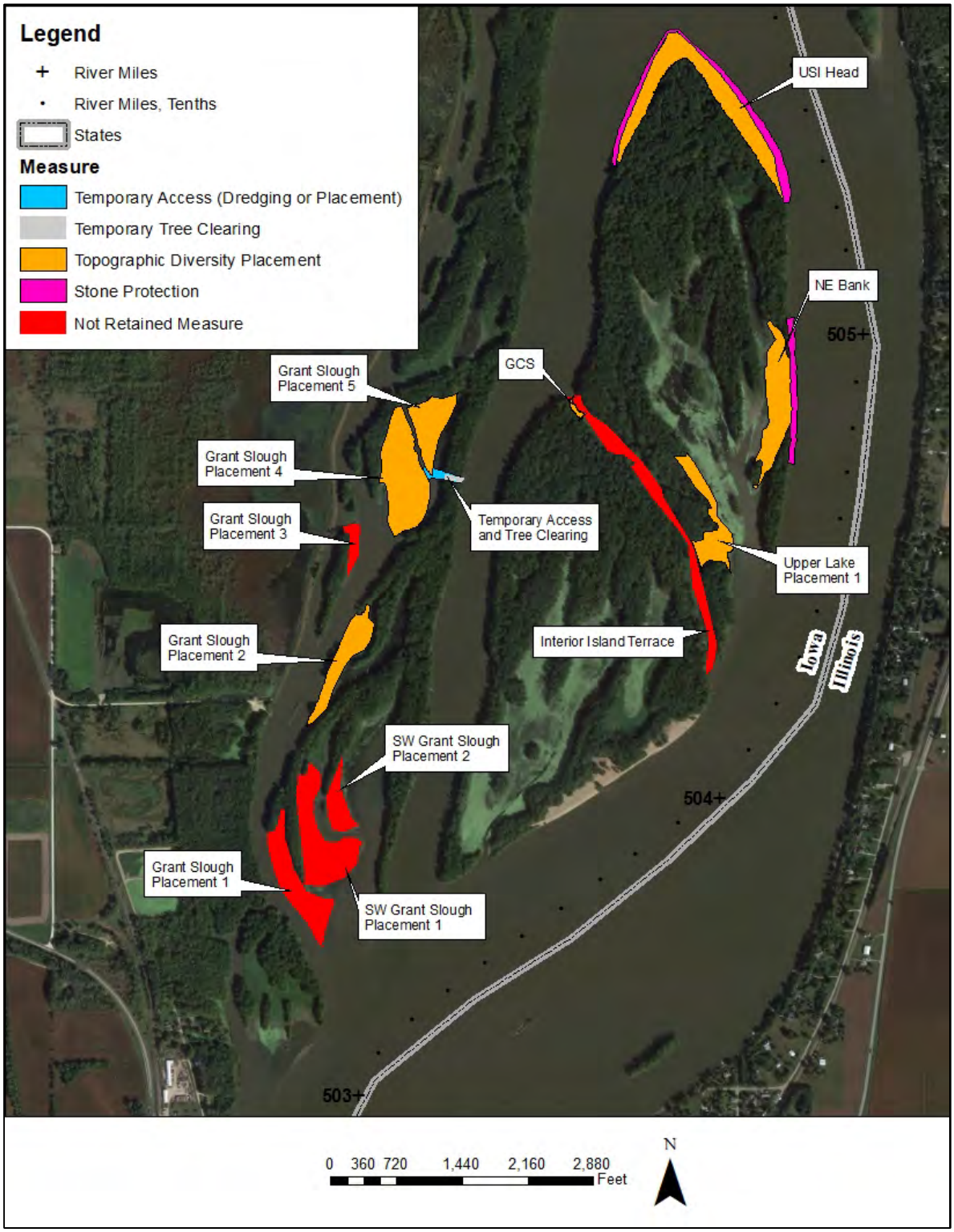


Figure IV-2: Topographic Diversity Locations – Forestry Habitat

a. Upper Steamboat Island Head (USI Head). Restoring the head of Steamboat Island as a topographic diversity site serves several purposes. It meets the objective of creating topographic diversity in an area that has lost forest habitat due to erosion, restores and protects island acreage, and protects Steamboat Island from further erosion. Island protection alone, using stone, was considered to be incomplete and ineffective, due to the lack of island restoration it would accomplish. This measure includes open water placement and 106,800 TN of stone protection to reduce the risk of erosion. Restoring this area to optimum tree survival elevations also provides an increased buffer to Upper Lake from this direction. The trees and other planted vegetation will reduce water velocities during high flows, allowing sediment to drop out before reaching Upper Lake. Due to this site's proximity and placement capacity, dredged material will need to be hauled in by barge from several locations, including Upper Lake Aquatic Diversity dredging, Lower Lake Aquatic Diversity dredging, NW Grant Slough Lake Aquatic Diversity dredging, Grant Slough access dredging, and potentially main channel dredging. This site has a dredged material capacity of 310,491 CY and is 14.2 acres in size. Building a chevron or bullnose dike structure to protect the island from erosive forces and allowing sediment to deposit over time, instead of placing material and protecting it, was considered. It was decided that placing stone protection followed by immediate placement of dredged material and planting with cover crops and then trees was preferred in order to establish floodplain forest species more quickly. Refer to Appendix M, *Engineering Design*, for more details.

This measure, with immediate placement of dredged material, was retained for further evaluation.

b. NE Bank. The NE Bank measure is located on the northeast bank of Steamboat Island proper, between Upper Lake and the main channel. Restoring the NE Bank as a topographic diversity site serves several purposes. It meets the objective of creating topographic diversity in an area that has lost forest habitat due to erosion and will help protect Upper Lake from sediment-laden flows from the main channel. Restoring this area to optimum tree survival elevations provides an increased buffer to Upper Lake from the main channel. The trees and other planted vegetation will reduce water velocities during high flows, allowing sediment to drop out before reaching Upper Lake. During lower flows, water from the main channel will no longer enter Upper Lake through the breached area. This site includes on-land placement in a reed canarygrass monoculture and open water placement. Material will be placed around the trees with care being taken not to damage the trees located in and around the placement site. This measure requires 8,853 TN of stone protection to keep the material from eroding. It was assumed that material for this site will come from the Upper Lake Aquatic Diversity dredging. Some material will be directly side cast into the placement site, while the remaining material will need to be hauled in, offloaded, and graded. This site has a dredged material capacity of 31,787 CY and is 8.3 acres in size. For this measure, the team also considered placing only stone protection to create a barrier between Upper Lake and the main channel. It was decided that placing dredged material in the breached area and the adjacent locations hosting low value vegetation, then planting with cover crops followed by trees, was preferred in order to restore floodplain forest species in this area. Refer to Appendix M, *Engineering Design*, for more details.

This measure, with dredged material placement, was retained for further evaluation.

c. Steamboat Island Upper Lake Placement 1 (Upper Lake Placement 1). Upper Lake Placement 1 is located in Upper Lake between the proposed Upper Lake Aquatic Diversity measure and the Cut-Through Channel. Upper Lake Placement 1 was chosen because it is a reed canarygrass monoculture within close proximity to the Upper Lake Aquatic Diversity measure. It meets the

objective of creating topographic diversity and provides a large increase in habitat value, as it currently hosts low value vegetation dominated by reed canarygrass. Material will be placed around the trees with care being taken not to damage the trees in and around the placement site. The original design for this location had a smaller footprint and bridged the gap between Upper Lake and the Cut-Through Channel. PDT discussions led to increasing the footprint of this placement site, extending it northwesterly along Upper Lake. This increased footprint provides for an increased buffer to Upper Lake during high water events when water flows through the Cut-Through Channel. The trees and other planted vegetation will reduce water velocities during high flows, allowing sediment to drop out before reaching Upper Lake. It was assumed that material for this site will come from the Upper Lake Aquatic Diversity dredging. Some material will be side cast into the placement site, while the remaining material will need to be hauled in, offloaded, and graded. This site has a dredged material capacity of 13,969 CY and is 5.3 acres in size. Refer to Appendix M, *Engineering Design*, for more details.

This measure was retained for further evaluation.

d. Interior Island Terrace. The Interior Island Terrace is located in the Cut-Through Channel. The design includes filling in the Cut-Through Channel with dredged material and planting floodplain forest species, creating a large tract of topographic diversity, as well as helping protect Lower Lake from sediment-laden water during high flows. Further evaluation of this measure determined the constructability of the measure would be difficult and costly due to the long, thin geometry of the site and increased material hauling and shaping costs. Additionally, the team felt that protecting Lower Lake could be done on a smaller scale by plugging the northwest and southeast ends of the Cut-Through Channel. Upon evaluation of this new measure, the team determined that the intent of the action should not be to block flow, but to help filter water and sediment using the vegetation planted at the topographic diversity site. These evaluations led to the Grade Control Structure (GCS) measure, described below in Section e, *Grade Control Structure*.

The Interior Island Terrace and northwest/southeast plug measures were determined to be incomplete and inefficient and were not retained for further evaluation.

e. Grade Control Structure. The GCS measure is located at the northwest end of the Cut-Through Channel at Steamboat Island proper. The GCS measure is a combination of open-water placement and placement on low-value vegetation and is designed to provide grade control for incoming flows and create topographic diversity. The primary role of the GCS is to filter water and sediment entering the Cut-Through Channel and provide protection to Lower Lake from sediment-laden water. The measure also creates forest habitat. Based on 2017 topobathymetric LiDAR imagery, the primary source of sediment-laden water flowing into Lower Lake is the northwest end of the Cut-Through Channel. Other locations where water or sediment may enter were noted, but this location looked to be the primary concern and an appropriate location for a measure. A site visit during high water supports this hypothesis. See Appendix M, *Engineering Design*, Attachment H, for more details. The measure would be constructed to an elevation of 574.0 feet, which is near the lower limit for moderately tolerant trees. During high flows, the vegetation will reduce water velocities, allowing sediment to drop out before reaching Lower Lake. The structure is designed with 59 TN of stone protection to combat erosive forces during high flows. Due to the measure's location, dredged material will need to be hauled in by barge from one of several locations including Upper Lake Aquatic Diversity dredging, Lower Lake Aquatic Diversity dredging, NW Grant Slough Lake Aquatic

Diversity dredging, or Grant Slough access dredging. This site has a dredged material capacity of 610 CY and is 0.3 acres in size. Refer to Appendix M, *Engineering Design*, for more details.

This measure was retained for further evaluation.

f. Southwest Grant Slough Lake Placement 1 (SW Grant Slough Placement 1). SW Grant Slough Placement 1 is located adjacent to the proposed SW Grant Slough Lake Aquatic Diversity measure. This site was initially chosen because aerial imagery indicated the site was a reed canarygrass monoculture. A site visit revealed the proposed placement area is currently functioning well as a wetland complex with diverse wetland species and is an important resource in its current condition.

Due to the lack of degradation in this area, the benefits it currently provides, and potential environmental impacts that would occur if constructed, this measure was determined unacceptable and not retained for further evaluation.

g. Southwest Grant Slough Lake Placement 2 (SW Grant Slough Placement 2). SW Grant Slough Placement 2 is located adjacent to the proposed SW Grant Slough Lake Aquatic Diversity measure. This site was chosen because aerial imagery indicated the site was a reed canarygrass monoculture. A site visit revealed the proposed placement area is currently functioning well as a wetland complex with diverse wetland species and is an important resource in its current condition.

Due to the lack of degradation in this area, the benefits it currently provides and potential environmental impacts that would occur if constructed, this measure was determined unacceptable and not retained for further evaluation.

h. Grant Slough Placement 1. Grant Slough Placement 1 is located at the southern end of Grant Slough, near the outlet to Steamboat Slough. This site was chosen because it is a reed canarygrass monoculture within close proximity to the proposed aquatic diversity dredging in the SW Grant Slough Lake. Dredging in SW Grant Slough Lake was not retained for further evaluation, but the placement site was retained because it meets the objective of creating topographic diversity and provides a significant increase in habitat value. The site was considered for forestry or scrub-shrub/pollinator planting (see Section III.A.3.b, *Grant Slough Placement 1*). As forestry habitat, the site has a dredged material capacity of 30,732 CY and 7.4 acres in size. As part of TSP refinement, it was ultimately decided that the preferred measure at this site was scrub-shrub/pollinator habitat. It was assumed that material for this site will come from Grant Slough access dredging. Some material will be side cast into the placement site, while the remaining material will need to be hauled in, offloaded, and graded.

The forestry habitat measure was not retained for further evaluation. See additional information in Section III.A.3.b for the scrub-shrub/pollinator planting habitat).

i. Grant Slough Placement 2. Grant Slough Placement 2 is located in Grant Slough between NW Grant Slough Lake and the Grant Slough channel. This site was chosen because it is a reed canarygrass monoculture within close proximity to the proposed aquatic diversity dredging in NW Grant Slough Lake. It would meet the objective of creating topographic diversity and provide a significant increase in habitat value, as it is currently low value vegetation dominated by reed

canarygrass. Restoring this area to optimum tree survival elevations provides an increased buffer to NW Grant Slough Lake, which will reduce water velocities during high flows, allowing sediment to drop out before reaching NW Grant Slough Lake. It was assumed that material for this site will come from NW Grant Slough Lake Aquatic Diversity dredging. Some material will be side cast into the placement site, while the remaining material will need to be hauled in, offloaded, and graded. This 5.4-acre site has a dredged material capacity of 19,468 CY. Refer to Appendix M, *Engineering Design*, for more details.

This measure was retained for further evaluation.

j. Grant Slough Placement 3. Grant Slough Placement 3 is located in Grant Slough, northwest of Grant Slough Placement 2. This site was chosen because it is a reed canarygrass monoculture within close proximity to the proposed aquatic diversity dredging in NW Grant Slough Lake. When this site was considered, it was assumed access dredging would be required in Grant Slough to reach Grant Slough Placement Sites 4 and 5, and that Grant Slough Placement Site 3 would be a good topographic diversity location along this access dredging. When it was determined that accessing Grant Slough Placement Sites 4 and 5 from Steamboat Slough via minor tree clearing was more cost effective than access dredging into Grant Slough, Grant Slough Placement 3 was no longer a viable option for the low amount of topographic diversity obtained.

This measure was determined inefficient and not retained for further evaluation.

k. Grant Slough Placement 4 and 5. Grant Slough Placement 4 and 5 are located in the northern portion of Grant Slough. These sites, both currently reed canarygrass monocultures, are two physically different sites separated by a small channel, but are combined for discussion as it is assumed that they would be constructed together. The placement sites meet the objective of creating topographic diversity and provide a large increase in habitat value, as they are currently low value vegetation dominated by reed canarygrass. Restoring these areas to optimum tree survival elevations provides a large tract of topographic diversity. Due to this measure's proximity and placement capacity, dredged material will need to be hauled in by barge from several locations, including Lower Lake and NW Grant Slough Lake Aquatic Diversity dredging, and Grant Slough access dredging. This site has a dredged material capacity of 60,358 CY and is 16.8 acres in size. Approximately 1.3 acres of tree clearing between the placement sites and Steamboat Slough will be required for access. Access dredging into the sites from Grant Slough was initially evaluated, but assumed to be more costly than 1.3 acres of tree clearing, so it was eliminated from further analysis or quantity calculations. Approximately 4,036 CY of material will need to be placed to build up the access location after tree clearing. Once Grant Slough Placement 4 and 5 are built, the material for the access route will be excavated and likely placed at USI Head. The 1.3 acres of temporary tree clearing will be restored to pre-Project conditions. Refer to Appendix M, *Engineering Design*, for more details.

This measure was retained for further evaluation.

l. Mix Organics with Dredged Material. This method would create suitable material for vegetation planting at the topographic diversity sites. Dredged material that is dominantly sand does not provide sufficient support for vegetation. Mixing the dredged material with organics such as fines, wood chips, and other organics can result in a suitable soil.

DRAFT

This method was further evaluated for topographic diversity, but later eliminated after determining that other more cost-effective methods could be used to obtain similar results. Refer to Section VI, *Tentatively Selected Plan*, for more information.

3. Topographic Diversity Measures - Scrub-Shrub/Pollinator Habitat. Planting native scrub-shrub/pollinator species (SSP) on elevated placement areas associated with aquatic diversity dredging has been proposed as a potential measure to increase scrub-shrub wetlands and pollinator habitat areas in the Project area. SSP sites were determined based on presence of low value vegetation dominated by reed canarygrass and suitability to support SSP, as well as accessibility for construction equipment. Sites near aquatic diversity dredge cuts allow for side cast placement and less handling of dredged material. Although many sites will allow for some side casting of material, material will still need spread out and graded at all sites. There are several locations in the Project area that are mainly reed canarygrass monocultures. Placement at these sites requires no tree clearing. Converting these areas from a monoculture of reed canarygrass to scrub-shrub/pollinator habitat provides a significant increase in habitat value. SSP sites near existing scrub-shrub/pollinator habitats will help protect the existing habitat, while increasing and enhancing the habitat in that area. Figure IV-3 shows the locations of these measures.

Material excavated from the aquatic diversity dredge cuts will be placed to construct the scrub-shrub/pollinator sites to an optimum elevation for scrub-shrub/pollinator survival. Initial design elevations were determined based upon inundation duration tolerance criteria specific to the desired species and input from the Project forester and hydraulic engineer. The upper planting limit for scrub-shrub/pollinator habitat was identified as elevation 573.1 feet; this elevation is based on the 50% exceedance probability for maximum tolerant growing season inundation criteria (55-day inundation duration). Field observations by the Project forester support that existing scrub-shrub/pollinator species are thriving at higher elevations than the calculated upper limit, so these plantings may be incorporated at higher elevations.

Once dredged material has dried sufficiently to work, the site will be graded. Final grade will include gradual and random ridge and swale topography, creating topographical diversity with elevation changes ranging from 573.1 feet to minus 1.5 foot. Ridges would not be uniform in width, length, or position across the placement area. Swales would vary in size and depth and would not completely extend to either side of the placement area to allow for water retention. The retention of water in these swales will allow for a slower rate of water migration through subsurface draining, which in turn aids in healthy root development. Refer to Appendix M, *Engineering Design* for the scrub-shrub/pollinator planting plan.

DRAFT

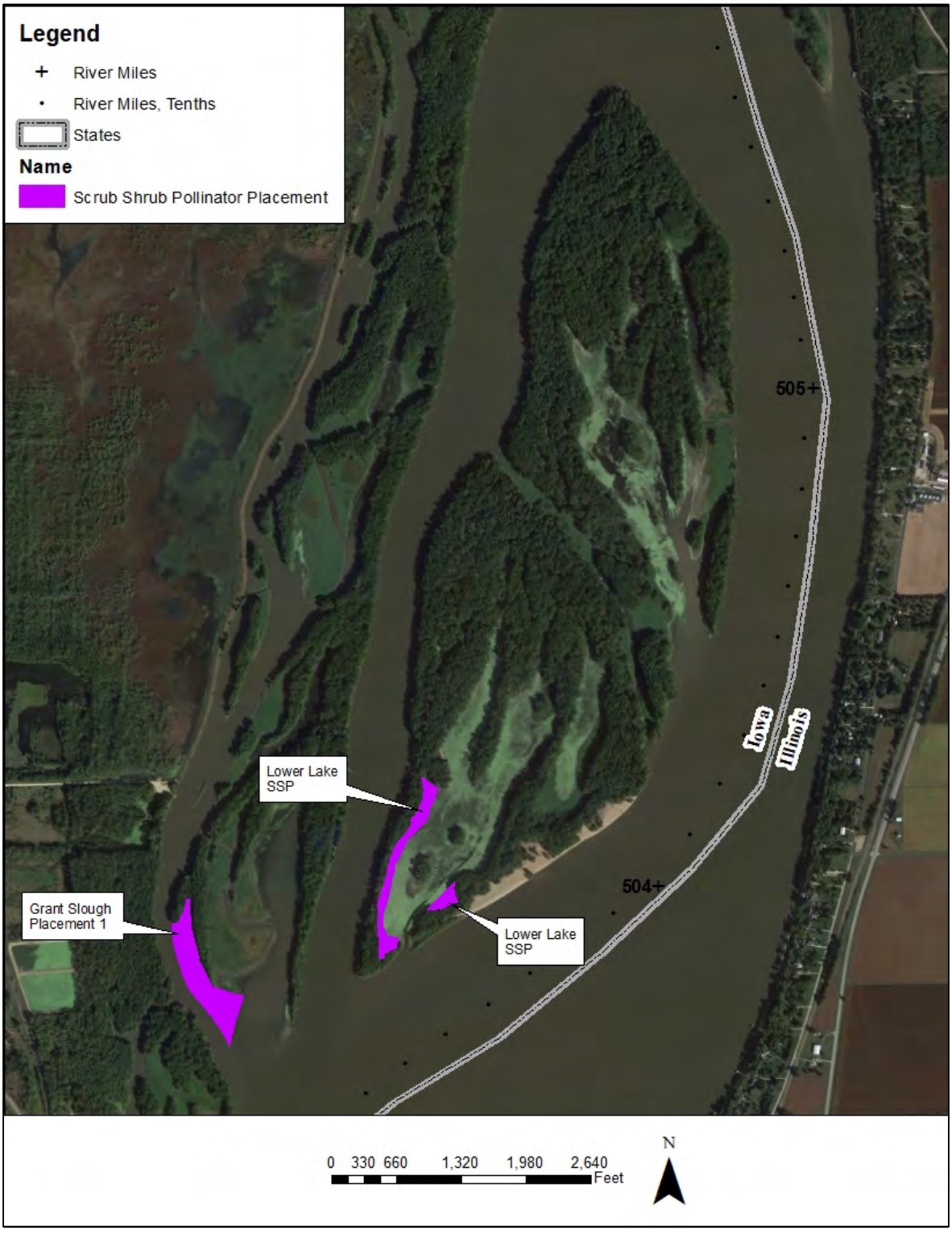


Figure IV-3: Topographic Diversity Locations – Scrub-Shrub/Pollinator Habitat

a. Lower Lake Scrub-Shrub/Pollinator Habitat (Lower Lake SSP). Two sites were identified in Lower Lake for scrub-shrub/pollinator habitat, but are considered one location for evaluation and discussion. Both sites are currently open water. The east site is adjacent to existing stands of button bush and other wetland species. The west site is adjacent to bottomland forest, but will create a transition zone between aquatic and bottomland forest habitats. These sites would be constructed to suitable scrub-shrub/pollinator survival elevations and planted with scrub-shrub/pollinator species. Scrub-shrub/pollinator species can exist over a range of elevations, but elevation 573.1 feet was selected based on the Corps-certified (per EC 1105-2-412) Hydrologic Engineering Center-Ecosystem Functions Model (HEC-EFM) 50% exceedance probability for maximum tolerant growing season inundation criteria (55-day inundation duration). It was assumed that material for this site would come from Lower Lake Aquatic Diversity dredging. Some material will be side cast to the placement site. The rest of the material will need to be hauled in, offloaded, and graded. This site has a dredged material capacity of 3,352 CY and is 5.3 acres in size. Adjacent areas with existing scrub-shrub/pollinator species will be enhanced with Timber Stand Improvement (TSI) methods such as coppicing of button bush. Refer to Appendix M, *Engineering Design,* for more details.

This measure was retained for further evaluation.

b. Grant Slough Placement 1. This site is located at the southern end of Grant Slough, near the outlet to Steamboat Slough. This site was chosen because it is a reed canarygrass monoculture within close proximity to the proposed aquatic diversity dredging in SW Grant Slough Lake. Dredging in SW Grant Slough Lake was not retained for further evaluation, but the placement site was retained because it meets the objective of creating topographic diversity and provides a large increase in habitat value, as it is currently low-value vegetation dominated by reed canarygrass. The site was considered for forestry or scrub-shrub/pollinator planting (see Section III.A.2.h, *Grant Slough Placement 1*). It was decided that the preferred measure at this site was scrub-shrub/pollinator habitat. It was assumed that material for this measure will come from access dredging into Grant Slough. Some material will be side cast to the placement site. The rest of the material will need to be hauled in, offloaded, and graded. As a scrub-shrub/pollinator site, this site has a dredged material capacity of 983 CY and is 7.4 acres in size. Refer to Appendix M, *Engineering Design,* for more details.

This measure was retained for further evaluation.

B. Small Island Restoration and Protection, Small Island Creation, and Flow Diversity

1. Small Island Restoration and Protection Measures. Small islands still exist in the Project area, but have eroded significantly since construction of the locks and dams and associated inundation. Comparison of aerial imagery taken at similar river elevations estimates that islands have been eroding at a rate of 0.05 acres/year to 0.13 acres/year (see Appendix M, *Engineering Design*, for more details on erosion rates). Islands create a variety of habitats including bottomland and/or floodplain forest and scrub-shrub habitat, aquatic zones, and transitional zones. Aquatic zones can include subsurface structure for fish, mussels, and other aquatic species. Transitional zones bridge the gap between these habitats. Islands alter hydraulic connectivity, create flow diversity, and lower wind fetch. Islands may be restored through material placement to desired elevations and footprints. Depending on river velocities, erosion protection may be required. Island protection alone, using stone, was considered as an option. The stone protection would just protect the existing island footprint and not expand or

restore the island footprint. This was considered to be incomplete and ineffective, due to the lack of island restoration it would accomplish. Figure IV-4 shows the locations of these measures.

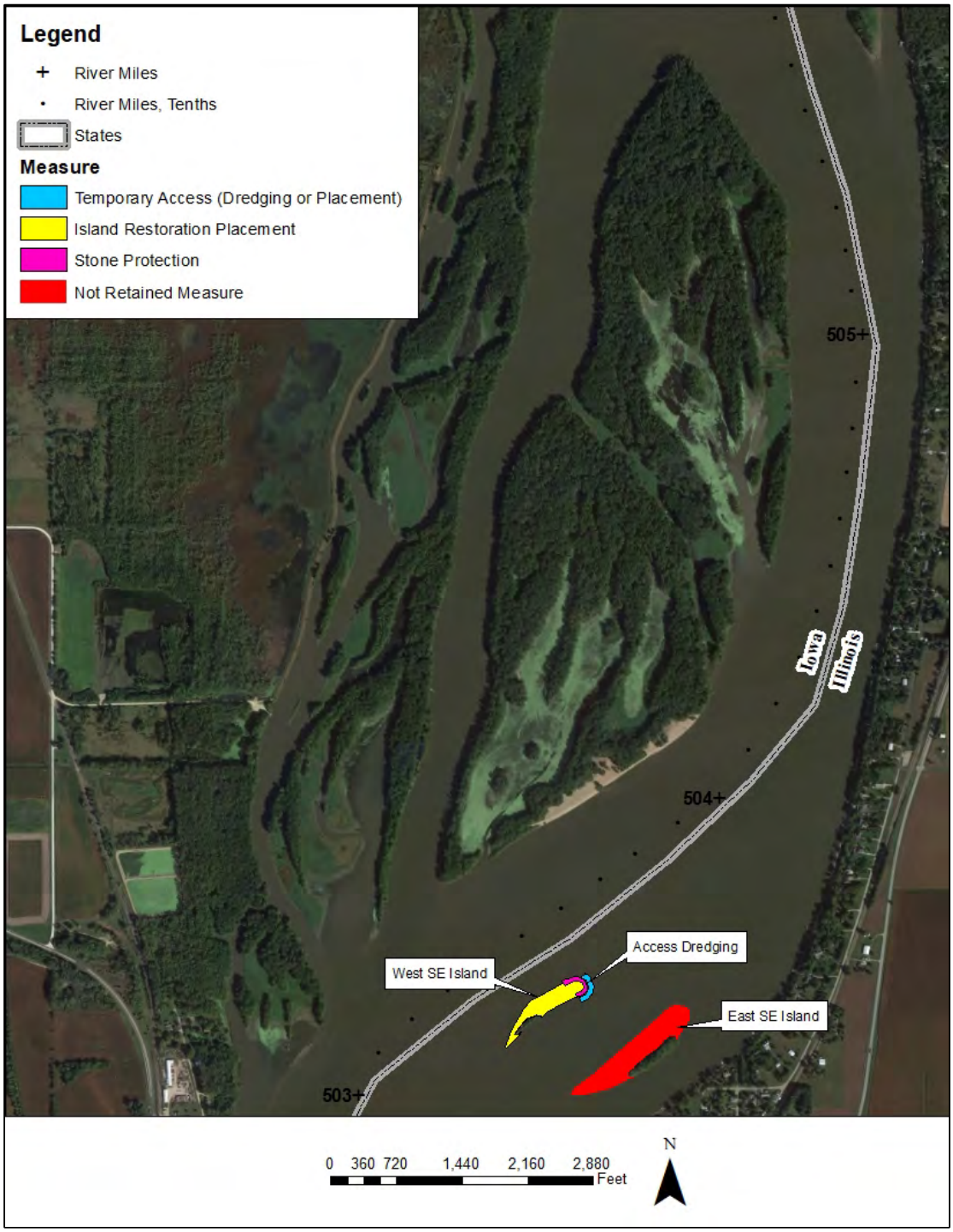


Figure IV-4: Small Island Restoration and Protection Locations

a. East Southeast Island (East SE Island). The East SE Island is a naturally occurring island, but has eroded significantly due to inundation. On average, it has been eroding at a rate of 0.5 acres/year (see Appendix M, *Engineering Design*, Attachment I). The footprint for restoring the East SE Island was based on aerial imagery from 1927 and 1938, which show fairly consistent island geometry, though exact river elevations could not be determined for that imagery as no specific date was provided. Restoring the island to optimum tree survival elevations would allow the island to be planted with trees and other vegetation, reducing the risk of erosion and creating a topographically diverse site. The existing island would not be modified as part of the measure, but the footprint would be expanded to the historic geometry. Stone protection would also be required at the upstream end of the island to combat erosive forces of the main channel. Due to the presence of the Cordova EHA and federally-listed Higgins eye pearlymussel recorded during a 2018 survey, the PDT eliminated the measure in order to avoid take of a listed species, maintain consistency with the UMRR Program goals, and stay consistent with the UMR NWFR priorities and past projects. Should the listing status and/or conditions change, a measure at this location could be considered for a future HREP.

This measure was determined to be unacceptable and was not retained for further evaluation.

b. West Southeast Island (West SE Island). The West SE Island is a naturally occurring island and has also been used as a dredged material placement site, but has undergone significant erosion. On average, is has been eroding at a rate of 0.13 acres/year (see Appendix M, *Engineering Design,* Attachment I). The footprint for restoring the West SE Island is based on aerial imagery from the 1990s, which show fairly consistent island geometry, though exact river elevations could not be determined for that imagery as no specific date was provided. Restoring the island to optimum tree survival elevations allows for the island to be planted with trees and other vegetation, reducing the risk of erosion and creating a topographically diverse site. The existing island would not be modified as part of the measure, but the footprint would be expanded to the historic geometry. Stone protection will also be required at the upstream end of the island to combat erosive forces of the main channel. Refer to Appendix M, *Engineering Design,* for more details.

This measure was retained for further evaluation.

2. Small Island Creation Measures. Small islands used to exist in the Project area, but have eroded significantly and are no longer visible at flat pool conditions. The proposed islands would be created through dredged material placement to desired elevations and footprints. Depending on river velocities, erosion protection may be required. Figure IV-5 shows the locations of these measures.

DRAFT

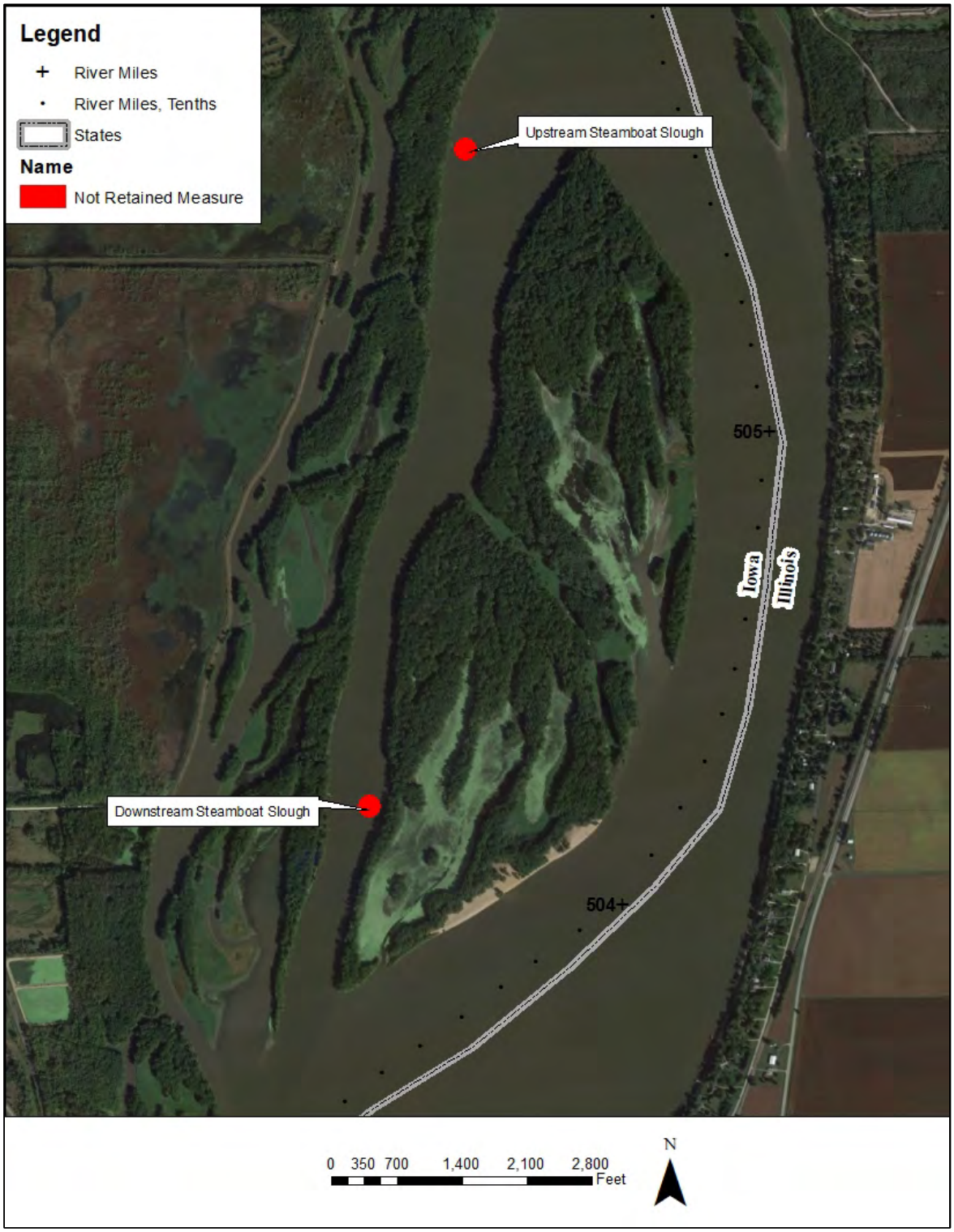


Figure IV-5: Small Island Creation Locations

a. Upstream Steamboat Slough. During the early planning phase, island creation at the upstream end of Steamboat Slough was discussed based on anecdotal information that a small island used to exist. However, no historic information, such as size and location, could be found for this island. Additionally, bathymetry did not show evidence of a recently eroded island and depths are fairly deep in this portion of Steamboat Slough. The depth would make it very costly to build an island to an appropriate elevation at this location and benefits would be minimal.

This measure was determined to be inefficient and was not retained for further evaluation.

b. Downstream Steamboat Slough. Aerial imagery shows a historic island up until 2012 in the downstream portion of Steamboat Slough. Bathymetry supports that there was an island in this location that has recently eroded away, as depths are shallow (2 feet below flat pool). The measure was preliminarily designed to include dredged material placement and stone protection to a historic footprint. Based on preliminary estimates, it was determined that this measure would not be cost effective for the minimal benefit it would provide. Following this, a flow diversity structure, outlined in Section B.3.b, *Flow Diversity Structure*, was formulated for this location.

This measure was determined to be inefficient and was not retained for further evaluation.

3. Flow Diversity. Flow diversity alters the flow in an area and, depending on other conditions, has the added benefit of providing aquatic habitat. An increase in flow by constructing flow diversity structures or installing a pump station may help with sedimentation issues and create more suitable habitat for species that require clearer water. Decreases in flow may allow for slack areas that fish use for overwintering habitat or to ambush prey caught in adjacent turbulent flows. Flow diversity measures may result in creating deep scour holes utilized by some species, as well as create depositional areas and even small islands used by other species. Flow diversity can be created in a variety of ways, such as placing material and structures in the flow path or altering existing structures in the flow path. These may increase or decrease flows, depending on the intent of the measure. Four different measures were considered for flow diversity (locations shown in Figure IV-6).

DRAFT

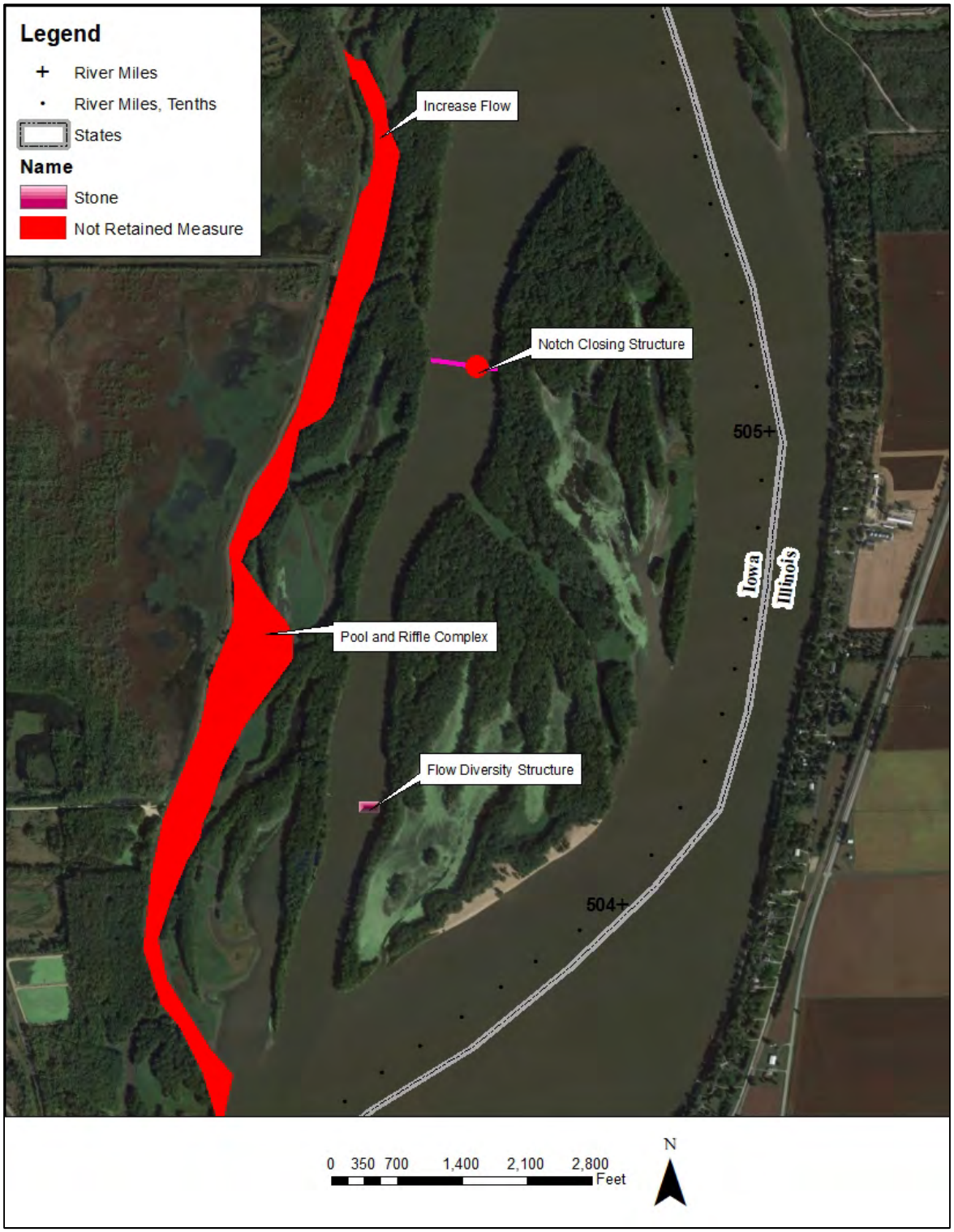


Figure IV-6: Flow Diversity Locations

a. Notch Closing Structure. An existing closing dam located in Steamboat Slough was proposed to be notched to ensure that flow could continue into the backwater habitat and provide flow diversity in Steamboat Slough. Acoustic Doppler Current Profiler measurements showed that there is currently flow diversity within Steamboat Slough and sufficient flows over the closing dam.

This measure was determined to be incomplete and was not retained for further evaluation.

b. Flow Diversity Structure. This measure is located where an island used to exist in Steamboat Slough (see Section B.2.b, *Downstream Steamboat Slough*.). A stone structure was designed for this measure, based on structures used by St. Paul District for seed islands. It is anticipated that the stone structure would create diverse flows in the area, and may also capture sediments, creating an island over time. The flows around stone structures and created islands are diverse because they offer turbid flows around edges, as well as areas of slack water. This further diversifies flow and aquatic habitats, depending on the water level and flow conditions. Refer to Appendix M, *Engineering Design*, for more details.

This measure was retained for further evaluation.

c. Increase Flow. A pump station to increase the flow in Grant Slough and achieve fish habitat was originally proposed as a Project measure. However, it was determined that Grant Slough has sufficient flow for fish habitat. Additionally, a pump station requires continuous operation and maintenance costs, which was not preferred by the Sponsor.

This measure was determined to be incomplete and was not retained for further evaluation.

d. Pool and Riffle Complexes. Pool and riffle structures increase bathymetric diversity, which allow for an increase in aquatic habitat diversity. Pool and riffle structures were proposed in Grant Slough. Grant Slough has sufficient flow for fish habitat, but there is not a sufficient amount of flow to ensure a successful pool and riffle system.

This measure was determined to be incomplete and was not retained for further evaluation.

C. Forest Habitat Measures. Several forest habitat measures were formulated for a broad portion of the Project area. TSI includes a variety of measures that improve forest habitat health, diversity, and resilience for multiple areas, based on current environmental and forest conditions. Traditional methods include tree thinning, girdling, and tree planting. Traditional TSI is included over much of the existing forested areas in the Project boundary (Figure IV-7). Restoring floodplain forest along the southeast shoreline of Steamboat Island proper, Historic Bankline Placement Site RM 503.5-504.1R (locally known as Princeton Beach), and evaluation of sediment around trees were also considered for forest habitat measures and are less typical methods. Refer to Figure IV-8 for these locations.

DRAFT

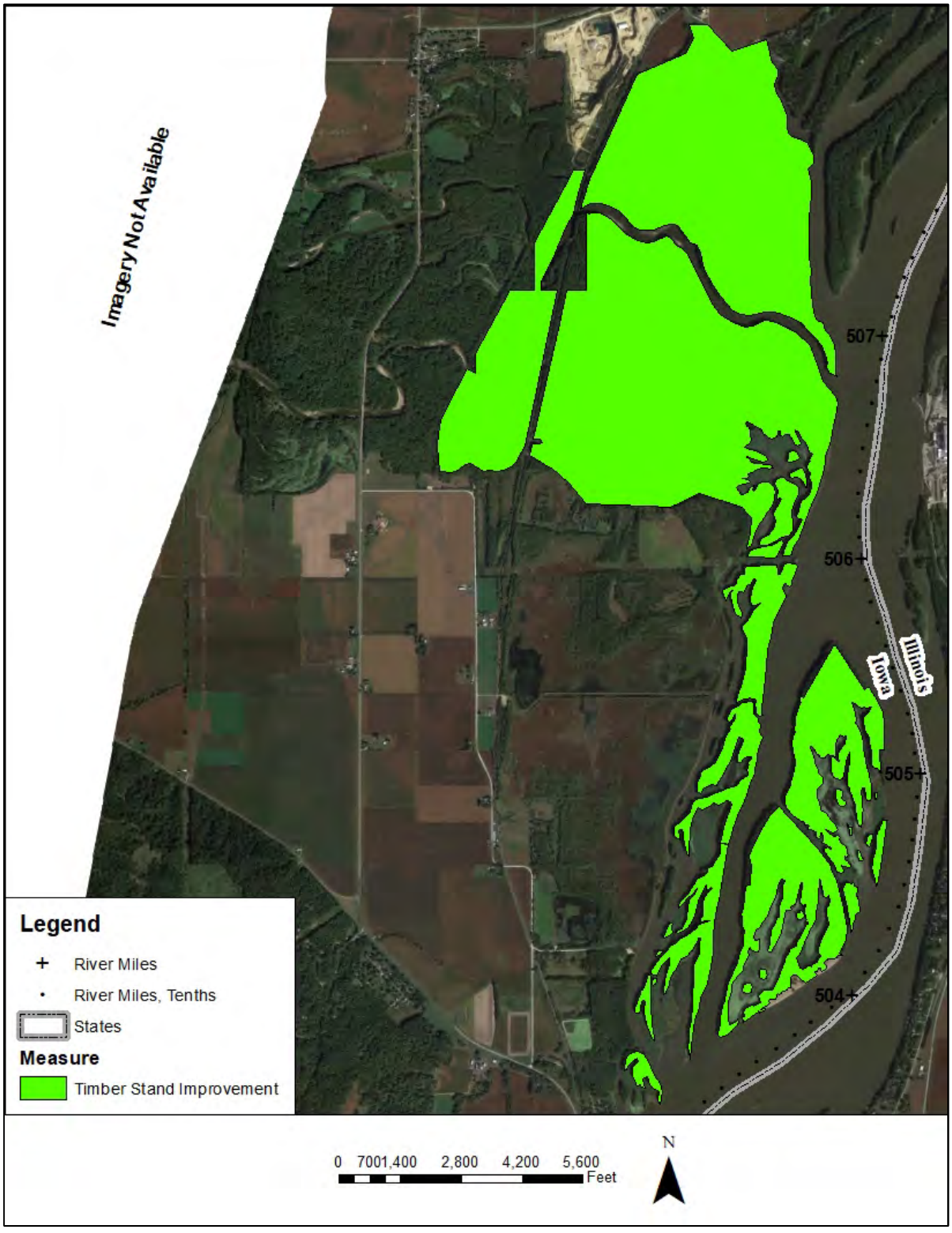


Figure IV-7: Forest Habitat Measures - Timber Stand Improvement Locations.

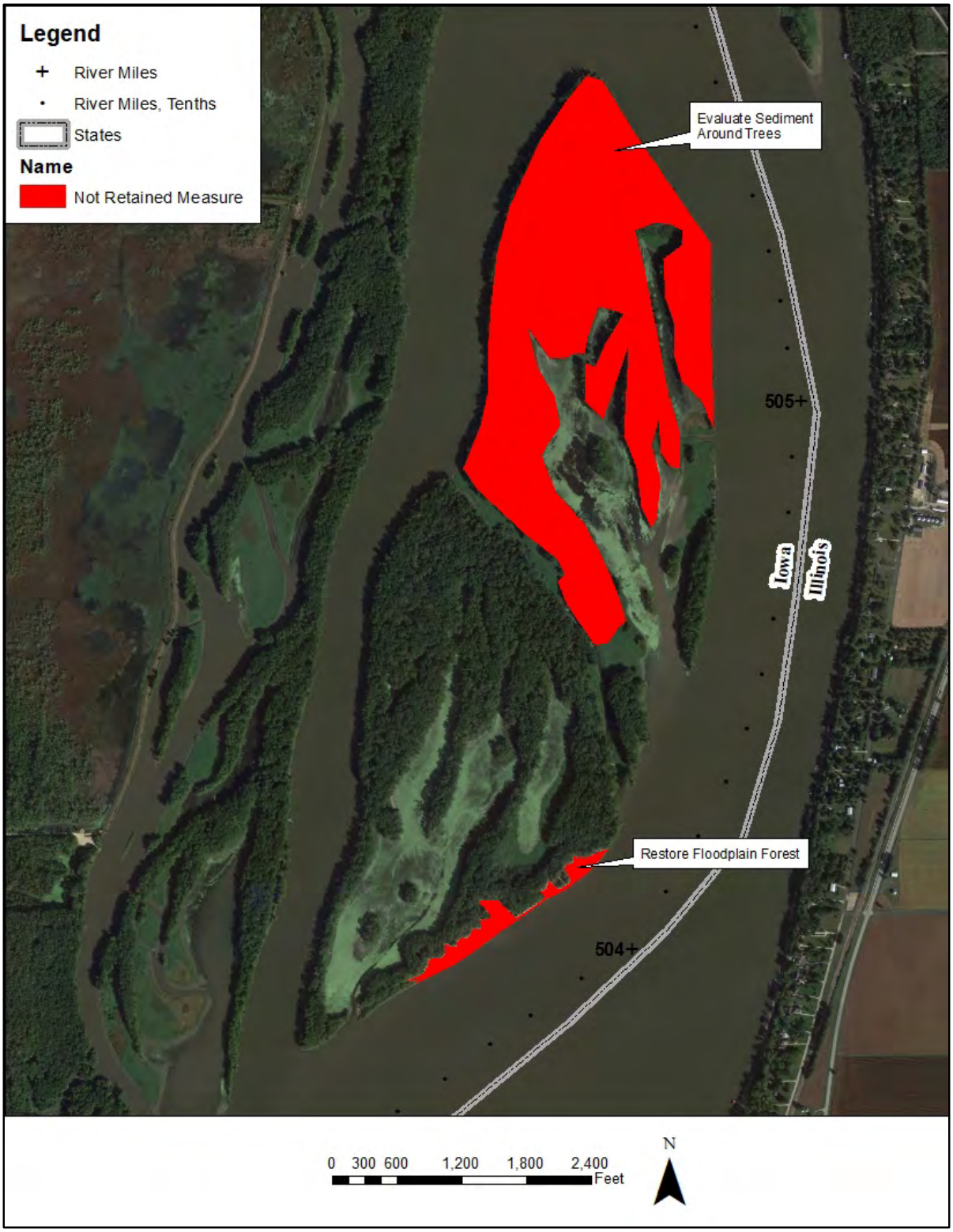


Figure IV-8: Forest Habitat Measures – Sediment Around Trees and Restore Floodplain Forest Locations

1. Timber Stand Improvement. TSI includes a combination of tree thinning treatments, tree planting, and invasive species management over the entire Project area. Tree thinning would open the canopy and benefit desirable understory tree seedlings and saplings by increasing the amount of light available to them. Planting trees increases diversity and improves recruitment of various tree ages**.** Invasive species management would reduce undesirable vegetation and competition for native species. A timber inventory was conducted during the 2018 growing season. TSI historically has resulted in significant benefits for minimal cost.

This measure was retained for the TSP.

2. Restore Floodplain Forest. The dredged material placement site along the southeast shoreline of Steamboat Island proper, Historic Bankline Placement Site RM 503.5-504.1R, consists of dredged sand. This measure would cover the sand with soil to an elevation suitable for vegetation and tree survival, and then planted with various forested wetland trees, understory species, forested wetland shrubs, and buffer species. Implementation of this measure would cause impacts on navigation, due to the loss of a placement site, and public use, due to the loss of a recreation area.

This measure was determined to be unacceptable and was not retained for further evaluation.

3. Evaluate Sediment Around Trees. This measure includes placing dredged material in and around mature trees to various elevations. The intent was to study how different thicknesses of dredged material placed around trees could impact survivorship. That information could be used for future projects. Previous studies have been done by different HREP planning teams and the results were not conclusive. While dead trees may be good bat habitat, it was decided that this measure may cause more adverse impacts than benefits by killing trees and/or allowing invasive species to establish.

This measure was determined to be unacceptable and was not retained for further evaluation.

D. Mussel Habitat Incorporation. This measure includes placing mussel substrate, such as river stone, when constructing other measures, such as stone protection or dredged material placement sites. This would enhance and maintain existing mussel habitat in the area, where analysis shows conditions are favorable. Most healthy beds in large rivers contain a variety of tribes, species, and age classes (Dunn et al, 2016) and are constrained to stable areas of the riverbed, which have physical boundaries generally defined by changes in a combination of substrate, depth, and/or current velocity. The formation of these beds seems to be a function of biotic and abiotic variables. Strayer (2008) proposed the following list of functional characteristics of mussel habitat:

- allows juveniles to settle (shears are not excessive during juvenile settlement)
- provides support (soft enough for burrowing, firm enough for support)
- is stable (stays in place during floods, no sudden scour or fill)
- delivers food (sediment organic matter for juveniles, current provides suspended food to adults
- delivers essential materials (oxygen, calcium, etc.)
- provides favorable temperatures for growth and reproduction
- provides protection from predators (interstitial juveniles)
- contains no toxic materials

These conditions were used as screening criteria to identify potential locations where mussel substrate could be incorporated with other measures. Figure IV-9 shows the locations of these measures.

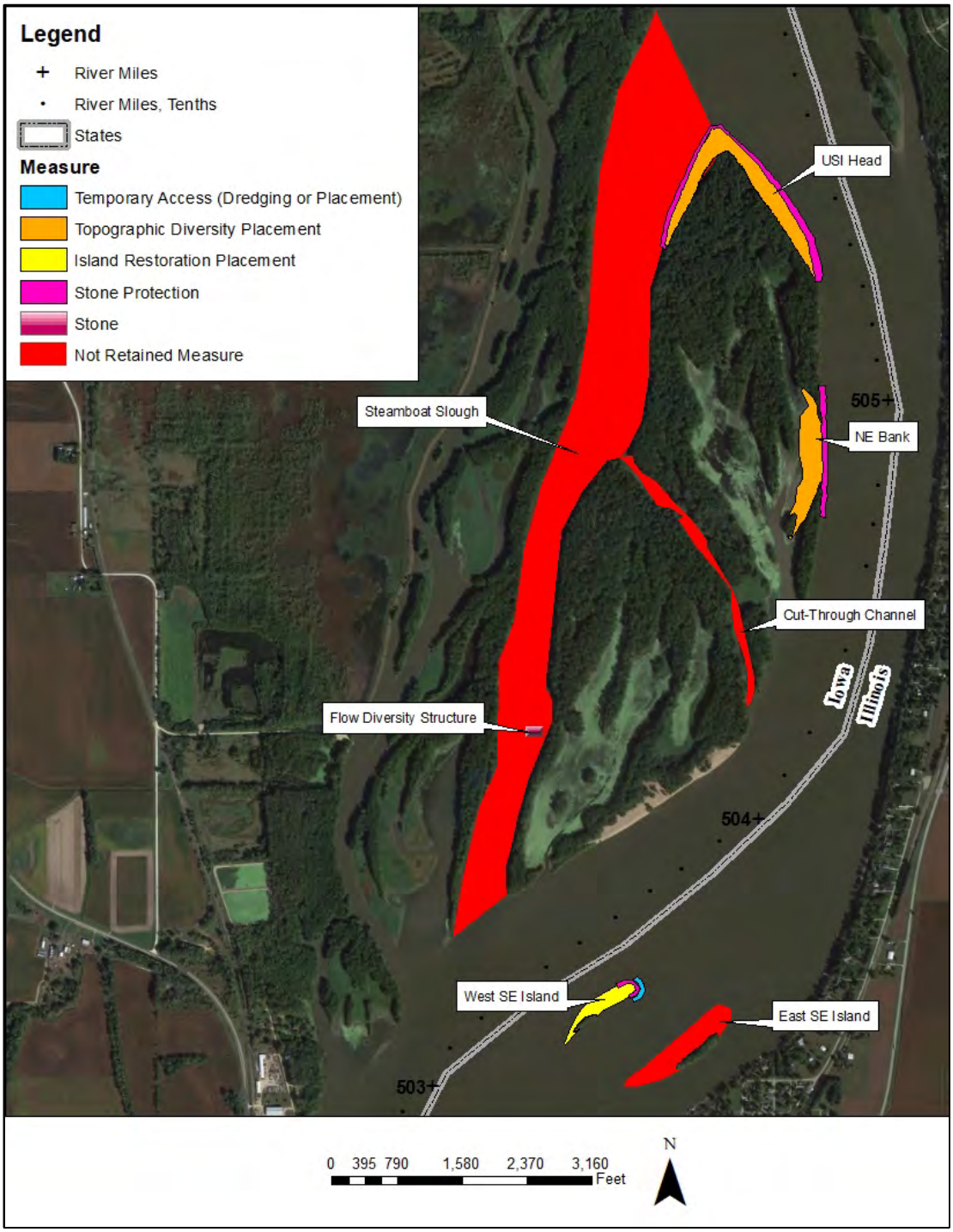


Figure IV-9: Mussel Habitat Incorporation Locations

1. USI Head. Restoring the Head of Steamboat Island was proposed as a topographic diversity measure. This restoration will require stone protection due to high velocities from the main channel. If functional conditions are present, mussel habitat can be incorporated into the stone protection.

This measure was retained for further evaluation.

2. NE Bank. The NE Bank was proposed as a topographic diversity measure. This restoration will require stone protection due to high velocities from the main channel. If functional conditions are present, mussel habitat can be incorporated into the stone protection.

This measure was retained for further evaluation.

3. West SE Island. The East and West SE Islands were proposed as island restoration and topographic diversity measures, however the East SE Island was not retained for further evaluation, so mussel substrate will not be incorporated at this location. The restoration of the West SE Island will require stone protection due to high velocities from the main channel. If functional conditions are present, mussel habitat can be incorporated into the stone protection.

This measure was retained for further evaluation.

4. Cut-Through Channel. An aquatic diversity measure was originally proposed for the Cut-Through Channel, which would have included mussel habitat and could have incorporated mussel substrate. As the Cut-Through Aquatic Diversity measure was eliminated, it was no longer possible to include mussel habitat.

This measure was determined to be incomplete and ineffective and was not retained for further evaluation.

5. Steamboat Slough. Steamboat Slough was considered for mussel habitat along the bank of Steamboat Island near the Cut-Through Channel and throughout Steamboat Slough. When discussing the Interior Island Terrace measure, it was assumed that stone protection would be required along the west bank of Steamboat Island, south of the Cut-Through Channel. If functional conditions were present, mussel habitat could be incorporated into the stone protection. However, since the Interior Island Terrace was not retained for further evaluation, neither was the mussel substrate incorporation.

Mussel habitat enhancement and creation was proposed for Steamboat Slough, to enhance existing habitat and mussel populations. Depths are fairly deep in Steamboat Slough and it was decided that it would be very costly to construct new mussel habitat measures or enhance existing habitat.

This measure was determined to be incomplete and inefficient and was not retained for further evaluation.

6. Flow Diversity Structure. The proposed Flow Diversity Structure would be constructed of riprap. If functional conditions are present, mussel habitat could be incorporated into the riprap.

This measure was retained for further evaluation.

DRAFT

E. Marine Traffic Management through Enforcement and Mooring Cell Creation

1. Enforcement. Stricter enforcement of marine traffic laws and regulations was proposed as a potential non-structural measure to help preserve Steamboat Island. Prop-wash from commercial and recreational boat traffic is a contributor to erosion of Steamboat Island. Likewise, commercial vessels pushing up against the island for fleeting also contribute to erosion of Steamboat Island. Creating no wake zones, no fleeting zones, and enforcement of those laws could cut down on erosion. Figure IV-10 shows the locations of these measures.

DRAFT

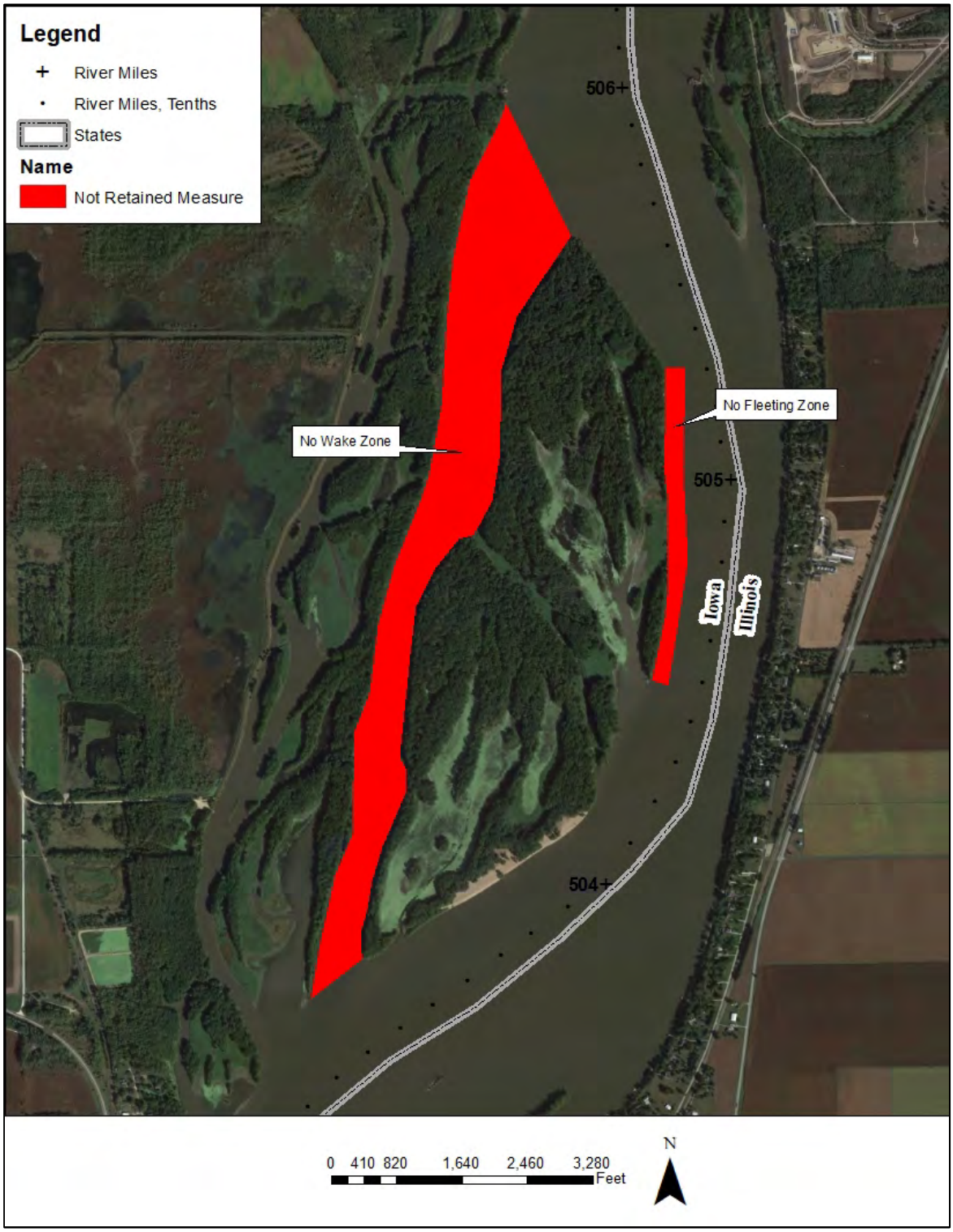


Figure IV-10: Enforcement Locations

a. NE Bank. The NE Bank was proposed as a key location for creating and enforcing a no fleeting zone. Commercial traffic fleeting occurs in this area, and the NE Bank has recently breached, allowing sediment laden water into Upper Lake. It was determined that the fleeting issue could not be corrected under the UMRR Program but other agencies could choose to pursue enforcement through their own programs.

This measure was determined to be incomplete and was not retained for further evaluation.

b. Steamboat Slough. Steamboat Slough was proposed as a key location for creating and enforcing a no wake zone. Recreational boaters cruise at wake-causing speeds in Steamboat Slough, creating prop-wash against Steamboat Island. It was determined that the wake issue could not be corrected under the UMRR Program but other agencies could choose to pursue enforcement through their own programs.

This measure was determined to be incomplete and was not retained for further evaluation.

2. Mooring Cells. Construction of mooring cells for barges to use for fleeting was proposed as a potential measure to help preserve Steamboat Island. Commercial vessels currently push up against Steamboat Island for fleeting. Constructing mooring cells would encourage commercial traffic to fleet against them versus against Steamboat Island. The navigation channel side of Steamboat Island was proposed as a key location for constructing mooring cells (Figure IV-11). It was determined that constructing mooring cells is outside the scope of the UMRR Program.

This measure was determined to be incomplete and was not retained for further evaluation.

F. Sediment Load Management. Sediment load management was proposed for the Project, including the establishment of buffer strips and construction of sediment basins. Figure IV-12 shows the locations of these measures.

DRAFT

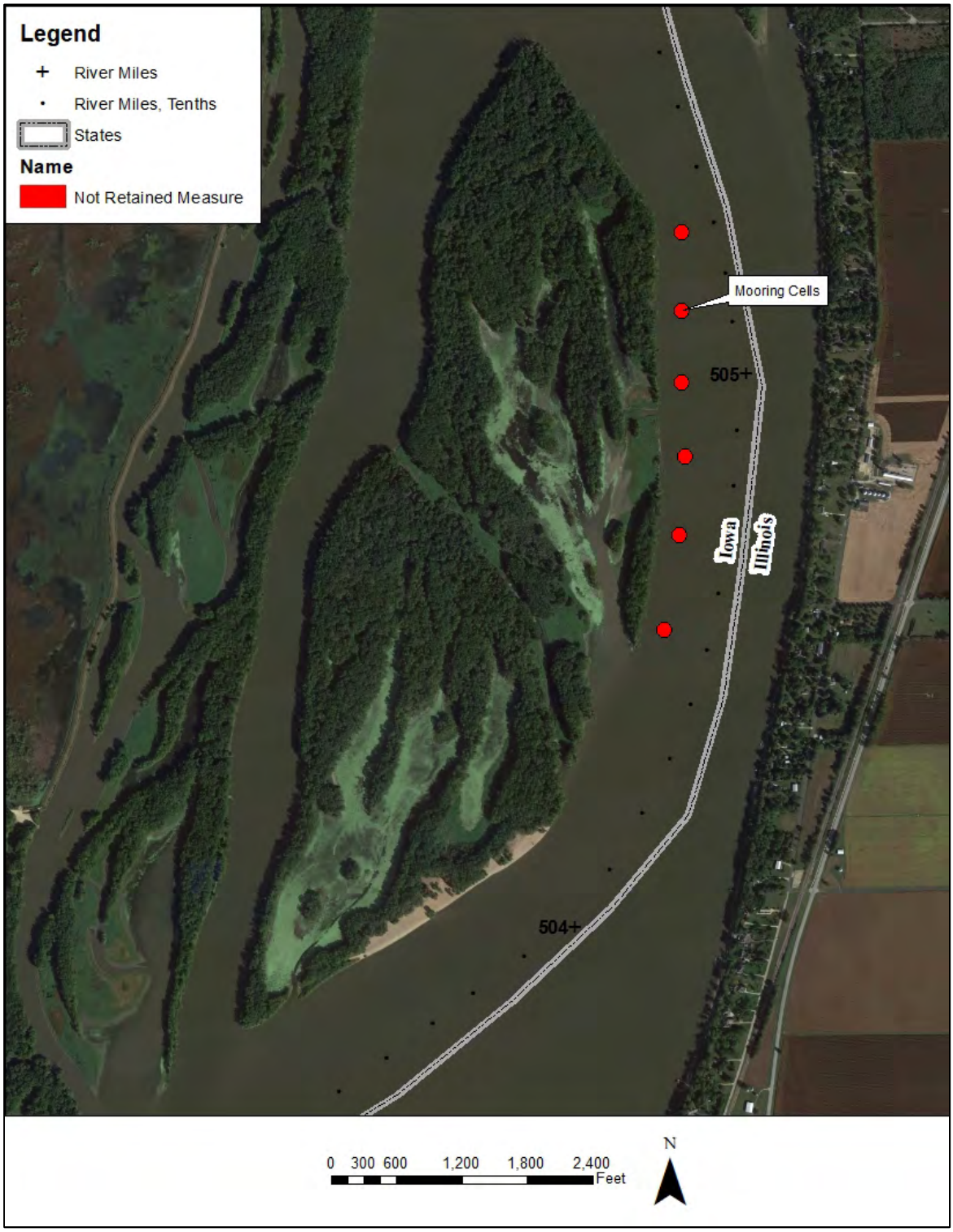


Figure IV-11: Mooring Cells Locations

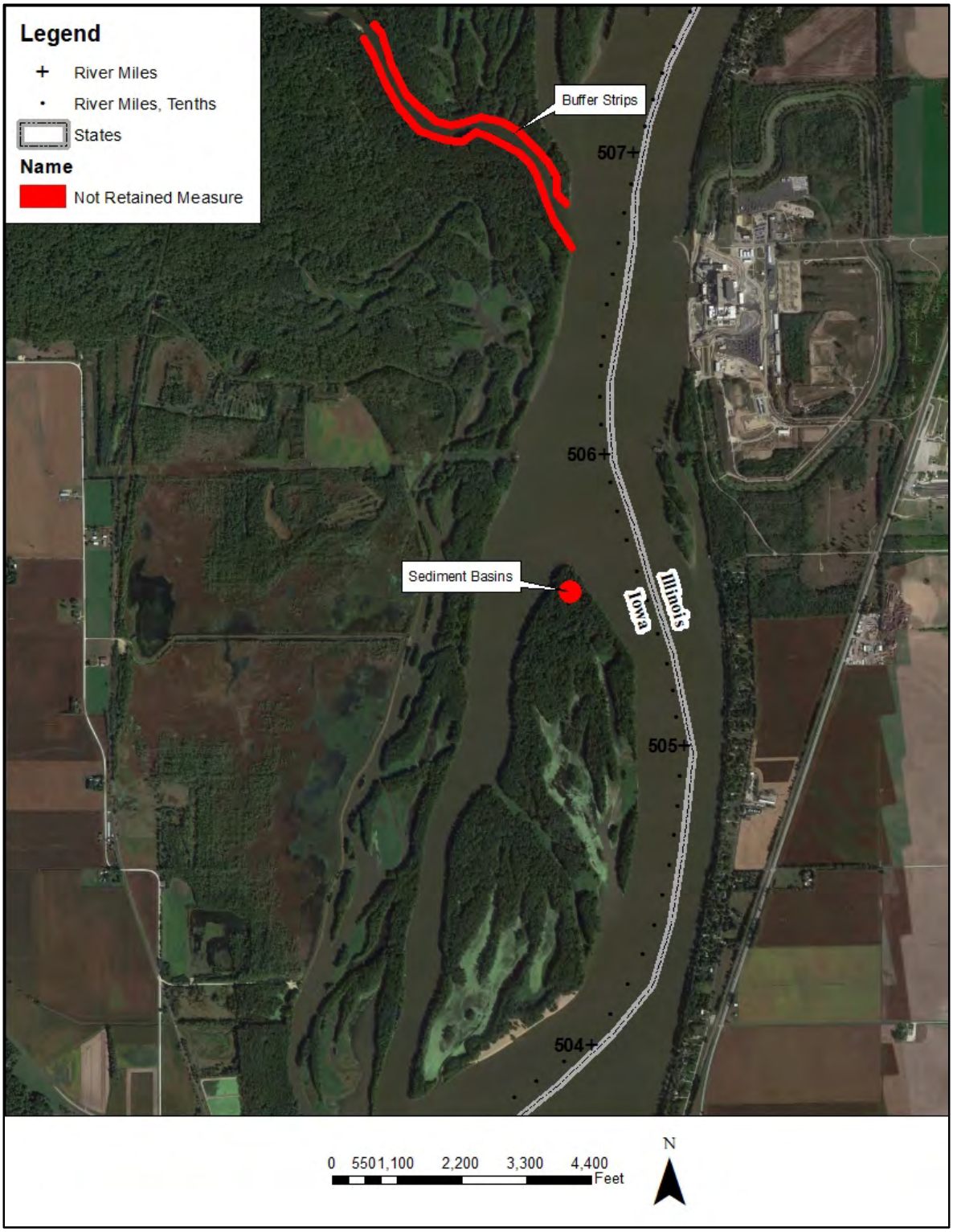


Figure IV-12: Sediment Management Locations

1. Buffer Strips. It is assumed that the Wapsipinicon River produces a higher sediment load during high water events. Planting buffer strips along the Wapsipinicon River may help filter out sediment before the water reaches the Mississippi River at the upstream end of the project area. However, the amount of sediment that buffer strips would filter out would be minimal compared to the amount of sediment contained in the Wapsipinicon River.

This measure was determined to be incomplete and was not retained for further evaluation.

2. Sediment Basins. A sediment basin consists of an earthen embankment or a ridge and channel combination, constructed across the slope and watercourse to form a sediment trap and water detention basin. Sediment basins upstream of dredge cuts were proposed to capture sediment before entering the Upper and Lower Lakes. However, the amount of sediment that a sediment basin would filter out would be very minimal compared to the amount of sediment coming into Steamboat Island proper.

This measure was determined to be ineffective and was not retained for further evaluation.

G. Complex Connectivity. Modifying the connectivity within the complex was proposed. Some portions of the Project area could benefit from increased connectivity, while other areas could benefit from decreased connectivity. Altering connectivity can provide many benefits, such as changed flow and velocity, as a result of the changed sediment load. Figure IV-13 shows the locations of these measures.

DRAFT

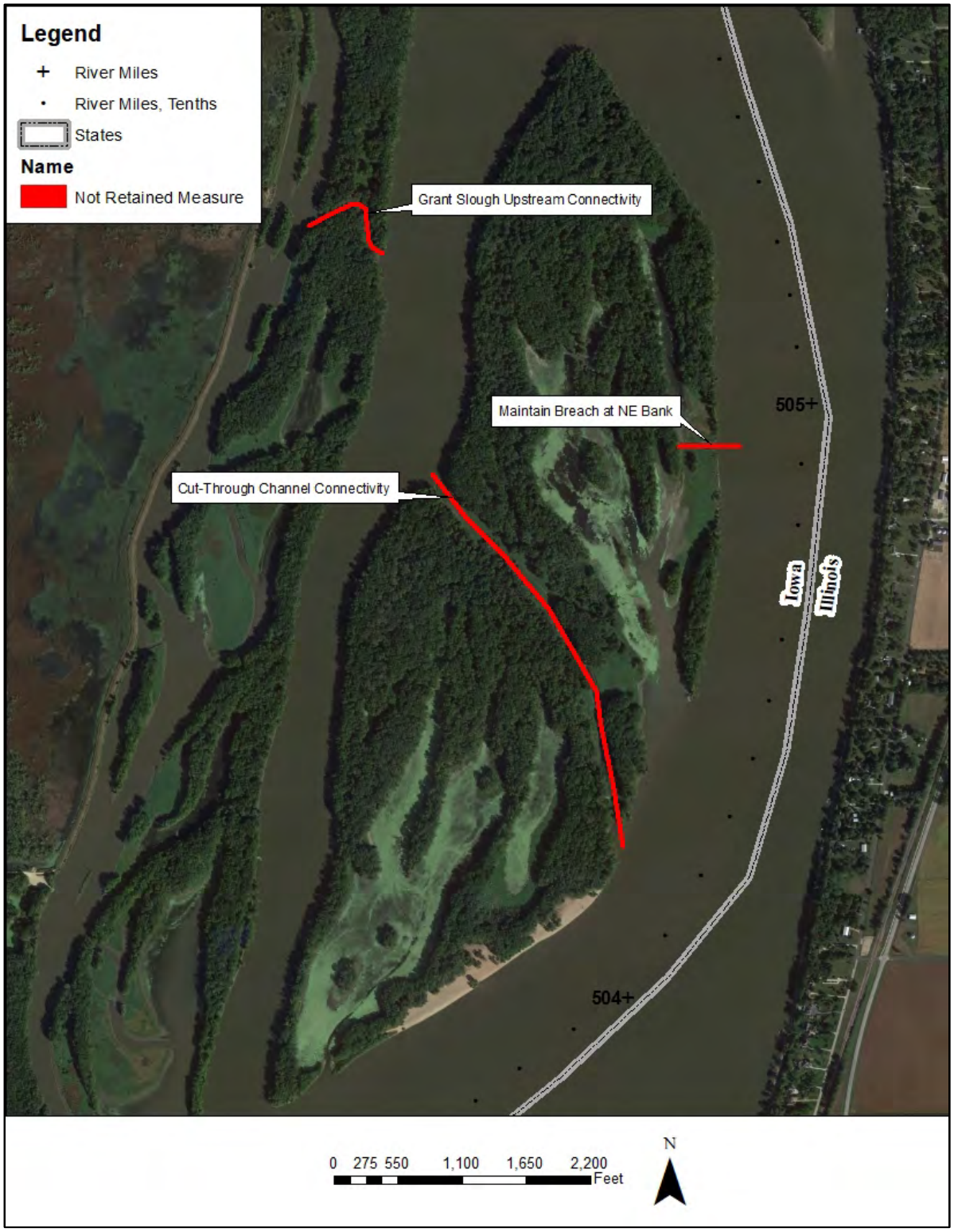


Figure IV-13: Complex Connectivity Locations

1. Maintain Breach at NE Bank. The NE Bank was breached between 2010 and 2011 and, since that time, Upper Lake has been directly connected to the main channel. During initial team meetings, maintaining the flow through the NE Bank was suggested as a potential non-structural measure, but as potential measures were developed and discussed, sustaining connectivity was eliminated, as the PDT felt that restoring and protecting the NE Bank, in conjunction with creating aquatic diversity in Upper Lake, would be of greater benefit to the Project area.

This measure was determined to be ineffective and incomplete and was not retained for further evaluation.

2. Cut-Through Channel Connectivity. Excavation of the Cut-Through Channel was considered to provide connectivity between Steamboat Slough and the main channel. Historically, the watercourse was a flow-through channel, but has been silting in over time. As potential measures were developed and discussed, it was determined the Cut-Through Channel would likely continue to fill in even if excavated and may increase vulnerability for sediment laden water to enter Lower Lake.

This measure was determined to be ineffective and incomplete and was not retained for further evaluation.

3. Grant Slough Upstream Connectivity. Modifying the connectivity between Grant Slough and Steamboat Slough was considered during early planning meetings. The amount and source of sediment entering Grant Slough may come from Steamboat Slough, the Wapsipinicon River, or the main channel. The District has limited water quality data in this area. The PDT decided there wasn't enough information to make informed decisions about the measure, as a Project measure or Adaptive Management measure.

This measure was determined to be incomplete and was not retained for further evaluation.

H. Miscellaneous. Two other proposed Project measures are pool-wide drawdown and acquiring real estate west of Princeton Marsh. Figure IV-14 shows the locations of these measures.

DRAFT

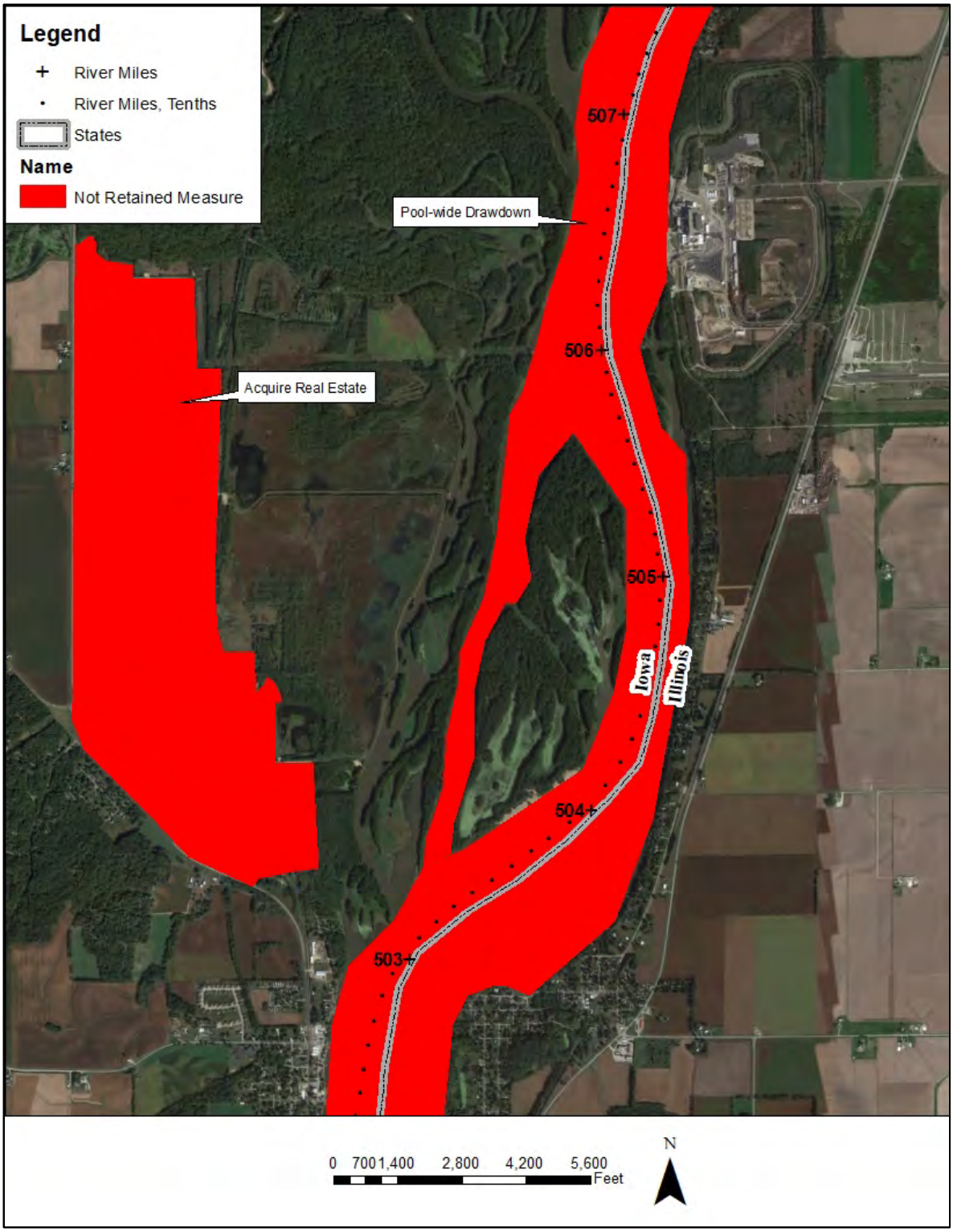


Figure IV-14: Miscellaneous Measure Locations

1. Pool-wide Drawdown. Pool-wide drawdowns have been shown to help restore diversity and abundance of native aquatic vegetation communities through the restoration of a more natural seasonal hydrograph. Water level management is a broad topic that includes maintaining water levels in the channel to support commercial navigation, modifications of the dam operating procedures for environmental benefits, or managing water levels in isolated management areas on the floodplain. Water level management in the main channel is the typical operating procedure that creates and maintains the existing array of habitats. The greatest interest of current stakeholders is to expose sediment to establish emergent perennial and annual wetland plants in shallow aquatic areas. Pool-scale drawdowns can be accomplished while maintaining navigation and are considered non-structural. A pool drawdown is a larger scale measure than what this Project scope entails.

This measure was determined to be incomplete and was not retained for further evaluation.

2. Acquire Real Estate West of Princeton Marsh. Acquisition of agricultural land west of Princeton Marsh, a non-structural measure, could provide benefits to sediment loading, nutrient loading, habitat creation, and more. Land taken out of agriculture production can be converted to buffer strips, timber stands, wetlands, and other habitats. These habitats would provide another buffer to the river system to prevent sediment and nutrients from entering the system. USFWS, IADNR, and the Corps determined they were not able to acquire this property under the UMRR Program.

This measure was determined to be incomplete and was not retained for further evaluation.

I. Summary of Retained Measures

Figure IV-15 shows all retained measures. Figure IV-16 focuses on the measures near Steamboat Island proper, but omits TSI for clarity.

DRAFT

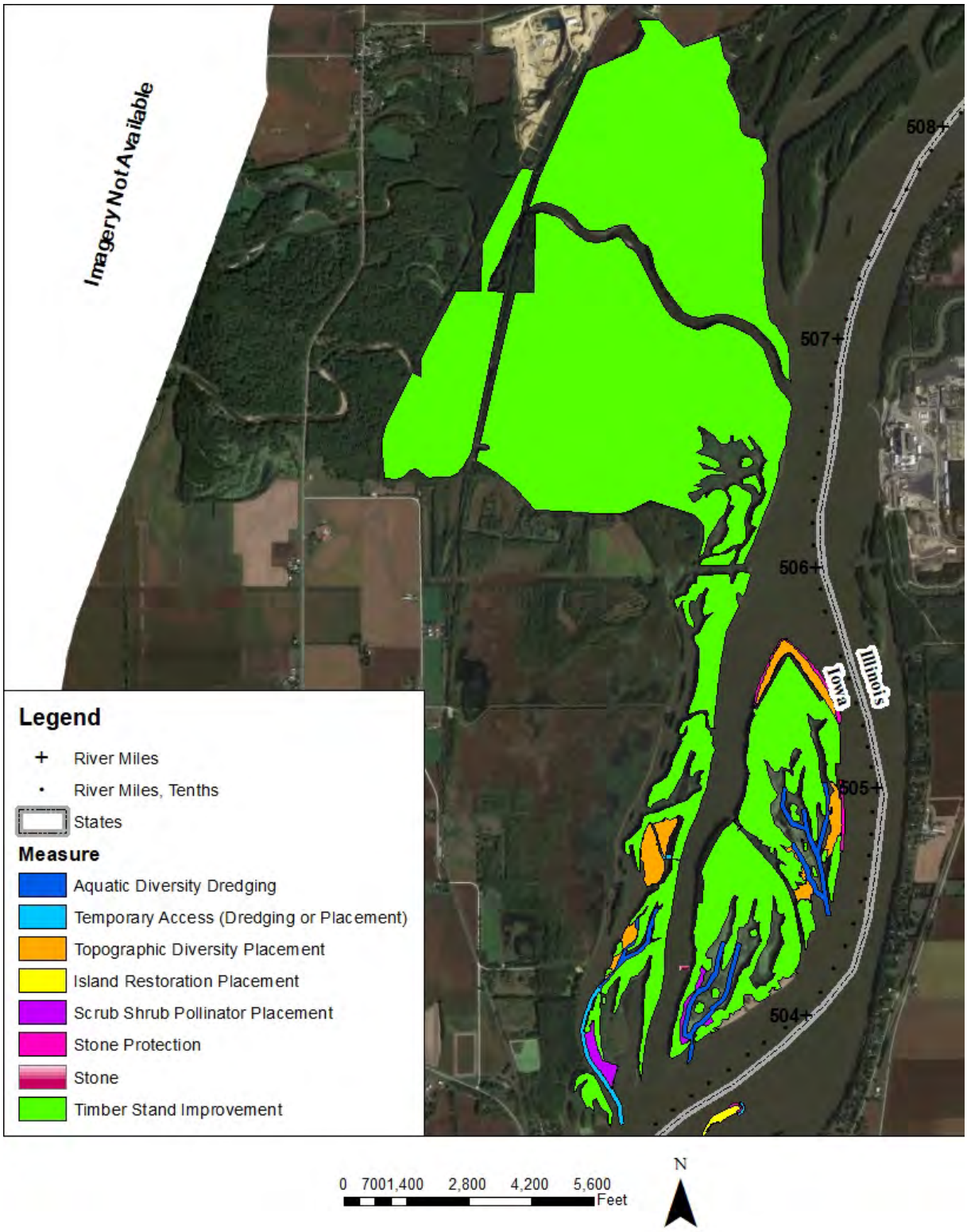


Figure IV-15: All Retained Measures Locations

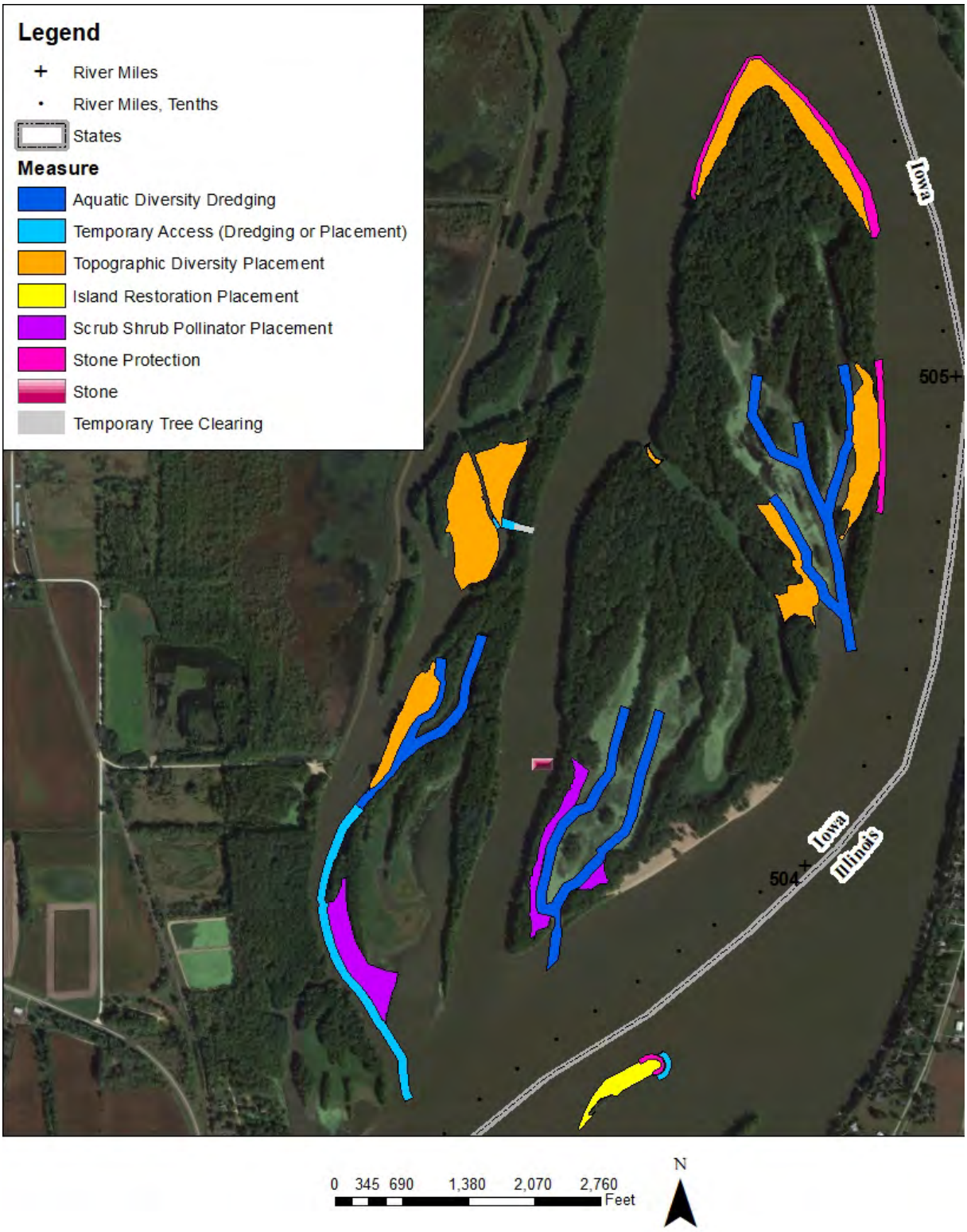


Figure IV-16: Retained Measures Locations, Omitting TSI

J. Quantity Calculations & Measure Layout

Areas, distances, and other measurements for the potential measures were measured using ArcMap. Depths and elevations were obtained from the topobathymetric LiDAR flown over the Steamboat Island Project area December 13, 2017. A TIFF surface was created with the topobathymetric LiDAR elevation information. Measures were laid out in ArcMap and assigned elevations. The Raster Surface Cut/Fill tool in ArcMap was used to calculate quantities of cut (dredging/excavation) and fill (placement sites) by comparing the designs of these potential measures to the TIFF surface (Table IV-1).

The potential measures balance shows 564,490 CY needed for placement and only 366,189 CY of dredging. Additional dredging would be required to construct measures as designed. In analyzing potential measures, it was assumed that additional dredging will come from the main channel, adjacent to measure locations. Updated quantities for the TSP are located in Table VI-1 in Section VI, *Tentatively Selected Plan: Description with Design, Construction, and Operation and Maintenance Considerations*.

Table IV-1: Summary of the Quantities for the Retained Potential Measures

Aquatic Diversity				
Location/Measure	**Acres**	**Dredging (CY)**	**Placement (CY)**	**Stone Protection (TN)**
Upper Lake	9.1	150,570		
Lower Lake	7.5	126,302		
NW Grant Slough Lake	4.7	75,082		
Access to Grant Slough	4.6	13,556		
Access to West SE Island	0.5	679		
Flow Diversity Structure	0.2			2,484
Total	**26.6**	**366,189**		2,484

Topographic Diversity & Scrub-Shrub/Pollinator Habitat				
Location/Measure	**Acres**	**Dredging (CY)**	**Placement (CY)**	**Stone Protection (TN)**
USI Head	14.2		310,491	106,800
NE Bank	8.3		31,787	8,853
West SE Island	3.5		59,079	6,014
Upper Lake Placement 1	5.3		13,969	
Grant Slough Placement 2	5.4		19,468	
Grant Slough Placement 4 & 5	16.8		124,752	
GCS	0.3		610	59
Grant Slough Placement 1 (SSP)	7.4		983	
Lower Lake SSP Placement	5.3		3,352	
Total	**66.5**		**564,491**	**121,726**

DRAFT

SECTION V. DEVELOPMENT AND EVALUATION OF ALTERNATIVES

Retained measures and their dependencies described in Section IV, *Potential Project Measures*, were carried forward for development of alternatives. The PDT, including the Sponsor and Project partners, further evaluated the retained measures to determine necessary refinement, additional dependencies, and ecologically relevant combinations for moving forward with alternative development.

Upper Lake: This measure includes the Upper Lake Aquatic Diversity measure; this measure was determined to be dependent on the restoration and protection of the NE Bank, in order to protect the Aquatic Diversity and dredge cut from sediment-laden water of the main channel. This measure may also incorporate fish and mussel habitat.

Lower Lake: This measure includes the Lower Lake Aquatic Diversity measure. This measure may also incorporate fish habitat.

NW Grant Slough Lake: This measure includes the NW Grant Slough Lake Aquatic Diversity measure. This measure may also incorporate fish habitat.

Topographic Diversity – Forestry Habitat: This measure includes the placement of material and plantings at seven locations over the Project area. Most topographic diversity sites will be located at locations that are currently monocultures of reed canarygrass.

Timber Stand Improvement: This measure includes a combination of tree thinning treatments, tree planting efforts, and invasive species management over portions of the Project area.

Topographic Diversity - Scrub-Shrub/Pollinator Habitat: This measure includes the placement of material and scrub-shrub/pollinator plantings at two locations in the Project area.

Island Restoration and Protection: This measure includes the restoration and protection of USI and the West SE Island, which will also incorporate forestry habitat. This measure may incorporate mussel habitat.

Flow Diversity: This measure includes the construction of a flow diversity stone structure in Steamboat Slough.

As the team progressed toward a final array of alternatives for evaluation, the PDT identified the following additional considerations and rules for combining measures:

- Upper Lake Aquatic Diversity and Lower Lake Aquatic Diversity were combined for purposes of alternative formulation to meet constructability & material balance. They will together increase overwintering habitat that is currently limiting on Steamboat Island proper. TSI will be included in all alternatives.
- Topographic diversity (forestry and scrub-shrub/pollinator habitats) is included in all alternatives.

A. Formulation of Project Alternatives

After all potential measures and their dependencies were identified, the Institute for Water Resources (IWR) Planning Suite software (IWR Planning) was used to facilitate development of alternative combinations of the measures. Input into the software included potential measures only, since the

DRAFT

measures (including dependencies) could be implemented independently. This resulted in 64 possible alternatives, which were further reduced through an iterative process based on completeness and effectiveness. The full plan formulation process is shown in Figure V-1.

Of the 64 possible alternatives, combinations that were single measures or lacked an aquatic diversity element were eliminated from further consideration, as they were ineffective and would not provide a complete ecosystem restoration project. Measures that were determined to be dependent on other measures were eliminated as stand-alone alternatives and integrated as such. Specifically, the PDT determined that the GCS was necessary with the proposed excavation in the Lower Lake Aquatic Diversity measure to aid in the reduction of sediment transfer into that backwater system. This resulted in an initial array of 32 possible alternatives.

Further comparison and analysis of the initial array determined that, in order for the Project area to remain a significant resource for the UMR and contribute to the unique mosaic of habitats, alternatives would need to include aquatic diversity and protection thereof, as well as island restoration and protection to mimic historic conditions and support the dynamic system. Furthermore, the restoration and protection of USI Head and all aquatic diversity measures on Steamboat Island proper were determined to be essential to the restoration of the Project area and highest priority for the Sponsor and Project partners; retaining these measures for all alternatives would meet Project objectives and result in a complete and effective Project. Restoration and protection of USI Head would protect the measures and investment on Steamboat Island proper and prevent sediment transport to other significant habitats downstream, including the Cordova EHA. Over time, continued degradation of USI Head could lead to unplanned changes in the thalweg of the main channel. For all these reasons, all alternatives that did not include USI Head restoration and protection, Upper Lake Aquatic Diversity (and associated NE Bank measure), and Lower Lake Aquatic Diversity were eliminated from further comparison, which resulted in a final array of nine alternatives.

Of the remaining eight action alternatives, a base plan was identified as a stand-alone project with the combination of measures needed to achieve a minimum level of restoration (Table V-1), to include the restoration and protection of the USI Head and aquatic diversity measures on Steamboat Island proper. The PDT then identified the maximum restoration plan that contained the maximum amount of habitat restoration and produced the maximum restoration output (Table V-1). The remaining with-Project alternatives included combinations of Grant Slough Complex, the West SE Island, and Flow Diversity added onto the base plan. This approach resulted in the final array of nine alternatives, including the No Action Alternative (Tables V-2 and V-3).

DRAFT

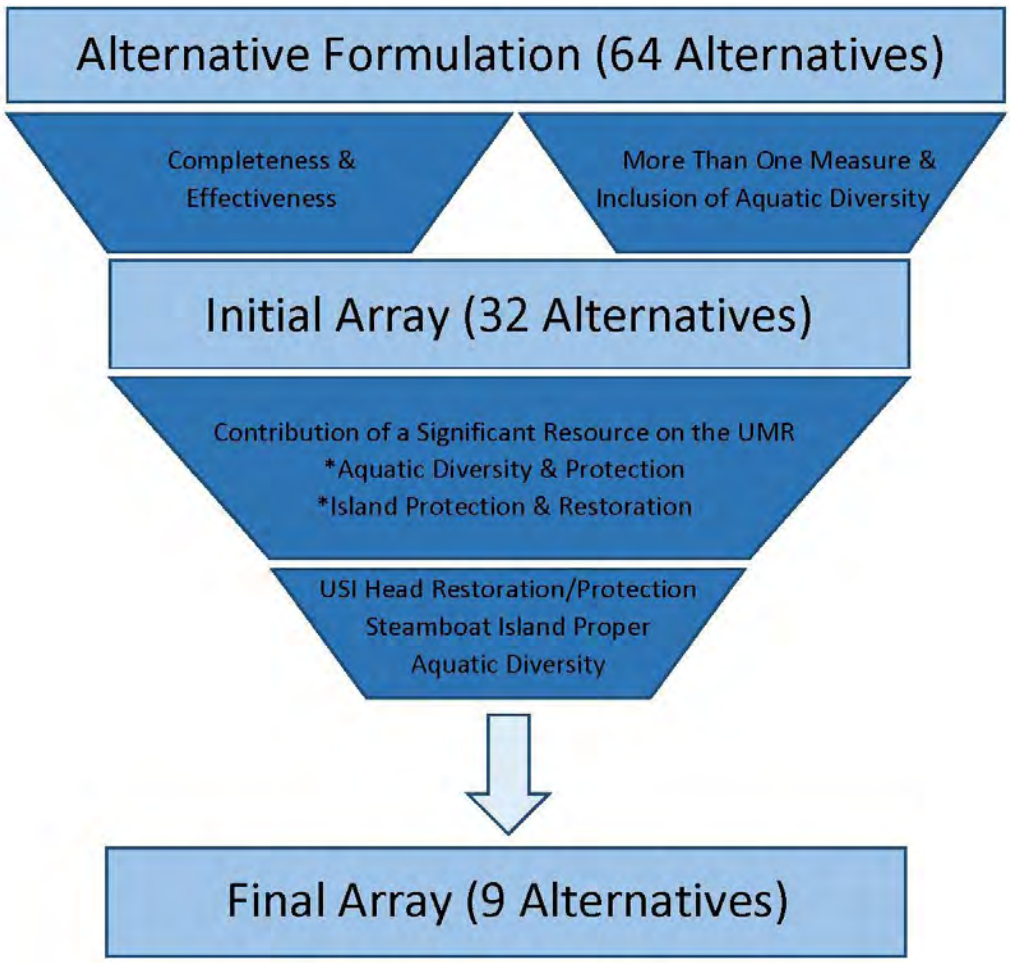


Figure V-1: Alternative Formulation

B. Evaluation of Final Array of Project Alternatives

1. Habitat Benefits. The initial habitat benefit evaluation was further refined and additional detail applied to the final array of alternatives to finalize the environmental benefits. This assessment includes a summary of the existing biological conditions used in the evaluation, as well as a forecast for future conditions under the No Action Alternative and each potential Project measure. The evaluation was conducted by a multi-agency team that included representatives from the USFWS, Project partners, and the Corps. Aquatic and floodplain benefits were quantified through the use of the Habitat Evaluation Procedures (HEP; USFWS 1980a).

a. Habitat Evaluation Procedures. HEP is a habitat-based evaluation methodology used in project planning. The procedure documents the quality and quantity of available habitat for selected wildlife species. The HEP are based on the assumption that habitat for selected wildlife species can be described by a Habitat Suitability Index (HSI). This index value (from 0.0 to 1.0) is multiplied by the area of applicable habitat to obtain Habitat Units (HUs).

Changes in HUs will occur as a habitat matures naturally or is influenced by development. These changes influence the cumulative HUs derived over the period of analysis (50 years). Habitat Units are calculated for select target years and annualized using the IWR Planning Suite II tool annualizer over the period of analysis to derive net Average Annual Habitat Units (AAHUs). Net AAHUs are used as the output measurement to compare alternatives for the proposed Project.

Threshold elevations to model aquatic, SSP, and forestry acres for the Project were developed based on growing season inundation duration and exceedance probability criteria determined by the PDT's best professional judgment. Time series analyses to identify the appropriate elevation threshold for each habitat type was performed using HEC-EFM. Acreages for each habitat type were then calculated based on existing conditions and with-Project terrains and elevation thresholds.

The HEP procedures were used to evaluate the effects of the proposed Project measures on aquatic and floodplain habitat quantity and quality. The PDT used four Corps-approved [per EC 1105-2-412] habitat evaluation methodologies in their analyses:

- The Bluegill HSI model (Stuber et al., 1982; Palesh and Anderson, 1990) was used to assess backwater aquatic habitat because bluegills require backwater habitat for all or most of their life cycle and are often limited in the availability of high quality overwintering habitat.

- The Walleye HSI model (McMahon et al., 1984) was used to assess the riverine components because it is rheophilic or oriented to flow, and captures the benefits from an increase in forage, water clarity, and spawning habitat afforded by the measures. Additionally, walleye is a popular host fish species for numerous freshwater mussels that inhabit the Project area.

- The Yellow Warbler HSI Model (Schroeder, 1982) was used to assess pioneer floodplain forest habitat because yellow warblers prefer hydrophytic scrub-shrub habitat for foraging and nesting and are often limited in the availability of quality wet scrub-shrub habitat.

- The Grey Squirrel HSI Model (Allen, 1987) was used to assess mast tree habitat because grey squirrels require diverse mast-producing tree habitat for forage, cover, and reproduction, and are often limited in the availability of mast-producing trees in the floodplain.

A summary of the habitat analysis is provided in Table V-1. Assessment of existing Project area conditions, projected future conditions without the Project, and expected impacts of proposed Project description of the habitat analysis are provided in Appendix D, *Habitat Evaluation and Benefits Quantification*.

DRAFT

Table V-1: Habitat Types and Areas Evaluated for This Assessment

Habitat Type	Evaluation Area	Area (acres)	Habitat Suitability Index Model
Aquatic	Steamboat Island (Upper and Lower Lakes) – Aquatic Diversity	23	Bluegill
	NW Grant Slough – Aquatic Diversity	6	Bluegill
	Steamboat Slough – Flow Diversity	0.4	Walleye
	West SE Island – Mussel Habitat	1	Walleye
Floodplain[1]	Steamboat Island – Forest Topographic Diversity (3 sites)	14	Yellow Warbler/Gray squirrel
	Steamboat Island – SSP Topographic Diversity (Lower Lake)	5	Yellow Warbler
	USI Head – Forest Topographic Diversity	14	Yellow Warbler/Gray squirrel
	Grant Slough Complex – Forest Topographic Diversity (4 sites)	30	Yellow Warbler/Gray squirrel
	West SE Island – Forest Topographic Diversity	4	Yellow Warbler/Gray squirrel
	TOTAL	**97.4**	

[1]TSI measures were not included in the initial habitat analysis, but were anticipated to help restore the process and function of ~900 acres of floodplain forest in the Project Area.

2. Cost Estimate for Measures. Table V-2 shows the estimated cost of Project alternatives as of completion of the habitat analysis and for use in the comparison of alternatives. Cost estimates for alternative comparison were prepared using January 2019 price levels; annualized costs include construction costs, contingency costs, adaptive management costs and Operation and Maintenance, Repair, Replacement and Rehabilitation costs. Project measures are on Federal lands; consequently, there are no lands and damages or relocation costs. Total Project costs were annualized based on the Fiscal Year 2019 discount rate of 2.875% and a 50-year period of analysis. Interest During Construction (IDC) was calculated using end of year compounding based on a six-year period of construction, using the Fiscal Year 2019 discount rate of 2.875%. A more detailed breakdown of costs based on further design refinement for the TSP is outlined in Section VIII, *Cost Estimates.* The costs in Section VIII will not match the costs used in this habitat analysis.

C. Comparison of Final Array of Project Alternatives

IWR Planning was used to complete a Cost Effective and Incremental Cost Analysis (CEICA) for the nine alternatives (including the No Action Alternative), using the AAHUs and annualized costs included in Table V-2 and described in this section. The CEICA is used when project benefits are not measured in dollars and is used to ensure the least cost alternative is identified for each possible level of environmental output, and the maximum level of output is identified for any level of investment. Cost Effectiveness evaluation is used to identify the least costly solution to achieve a range of Project benefits; the Incremental Cost Analysis identifies the subset of cost-effective plans that are superior financial investments, called "Best Buys," through analysis of the preliminary incremental costs. Best Buys are the plans that are the most efficient at producing the output variable or provide the greatest increase in AAHUs for the least increase in preliminary cost. The first Best Buy is the most efficient plan, producing output at the lowest incremental cost per unit. If a higher level of output is desired than that provided by the first Best Buy, the second Best Buy is the most efficient plan for producing additional output, and so on.

Table V-3 and Figure V-2 show the resulting alternatives differentiated by cost effectiveness. From this list of nine alternatives, four Best Buy Plans were identified (Table V-4 and Figure V-3).

DRAFT

Table V-2: Environmental Output and Costs of Final Array of Alternatives
January 2019 Price Level – 50-year period of analysis using 2.875% discount rate

Alt. Number	Measures	Over-wintering (Net AAHUs)	Floodplain Forest (Net AAHUs)	Island Prot./Mussel Substrate (Net AAHUs)	Total Gross AAHUs	Net AAHUs	Construction Costs w/ Contingency ($)	Annualized Costs ($)	Annualized Operation Costs ($)	Annualized Maintenance Costs ($)	Annualized Adaptive Mgmt Costs ($)	IDC ($)	Total Annualized Costs ($)
0	No Action Plan	0	0	0	.20	0	0	0	0	0	0	0	0
18	USI Head, Steamboat Island aquatic diversity	19.09	24.50	0	43.69	43.59	21,443,000	848,303	0	56,506	905	911,306	907,143
19	USI Head, Steamboat Island aquatic diversity, Grant Slough Complex	25.03	46.50	0	71.63	71.53	28,170,000	1,114,429	0	56,506	905	1,197,197	1,174,112
22	USI Head, Steamboat Island aquatic diversity, Flow Diversity	19.09	24.50	0.10	43.79	43.69	21,665,000	861,927	0	58,009	905	1,048,328	922,270
23	USI Head, Steamboat Island aquatic diversity, Grant Slough Complex, Flow Diversity	25.03	46.50	0.10	71.83	71.63	28,412,000	1,130,352	0	58,009	905	1,374,802	1,191,538
26	USI Head, Steamboat Island aquatic diversity, West SE Island	19.09	27.40	0.64	47.23	47.13	25,546,000	1,010,621	0	61,554	5,516	1,085,680	1,086,210
27	USI Head, Steamboat Island aquatic diversity, SE Island, Grant Slough Complex	25.03	49.40	0.64	75.17	75.07	32,656,000	1,278,853	0	61,554	5,516	1,044,057	1,355,285
30	USI Head, Steamboat Island aquatic diversity, West SE Island, Flow Diversity	19.09	27.40	0.74	47.43	47.23	25,768,000	1,046,974	0	63,057	5,516	1,821,636	1,124,066
31	USI Head, Steamboat Island aquatic diversity, West SE Island, Grant Slough Complex, Flow Diversity	25.03	49.40	0.74	75.37	75.17	33,259,000	1,325,221	0	63,057	5,516	1,662,941	1,403,156

DRAFT

Table V-3: Final Array of Alternatives Differentiated by Cost Effectiveness

Alt. Number	Alternative	Annualized Cost ($)	Output (AAHU)	Average Cost ($)	Cost Effective
0	No Action Plan	0	0	0	Best Buy
18	USI Head, Steamboat Island aquatic diversity	907,143	43.59	20,811	Yes
19	USI Head, Steamboat Island aquatic diversity, Grant Slough Complex	1,174,112	71.53	16,414	Best Buy
22	USI Head, Steamboat Island aquatic diversity, Flow Diversity	922,270	43.69	21,109	Yes
23	USI Head, Steamboat Island aquatic diversity, Grant Slough Complex, Flow Diversity	1,191,538	71.63	16,635	Yes
26	USI Head, Steamboat Island aquatic diversity, West SE Island	1,086,210	47.13	23,047	Yes
27	USI Head, Steamboat Island aquatic diversity, West SE Island, Grant Slough Complex	1,355,285	75.07	18,054	Best Buy
30	USI Head, Steamboat Island aquatic diversity, West SE Island, Flow Diversity	1,124,066	47.23	23,800	Yes
31	USI Head, Steamboat Island aquatic diversity, West SE Island, Grant Slough Complex, Flow Diversity	1,403,156	75.17	18,666	Best Buy

DRAFT

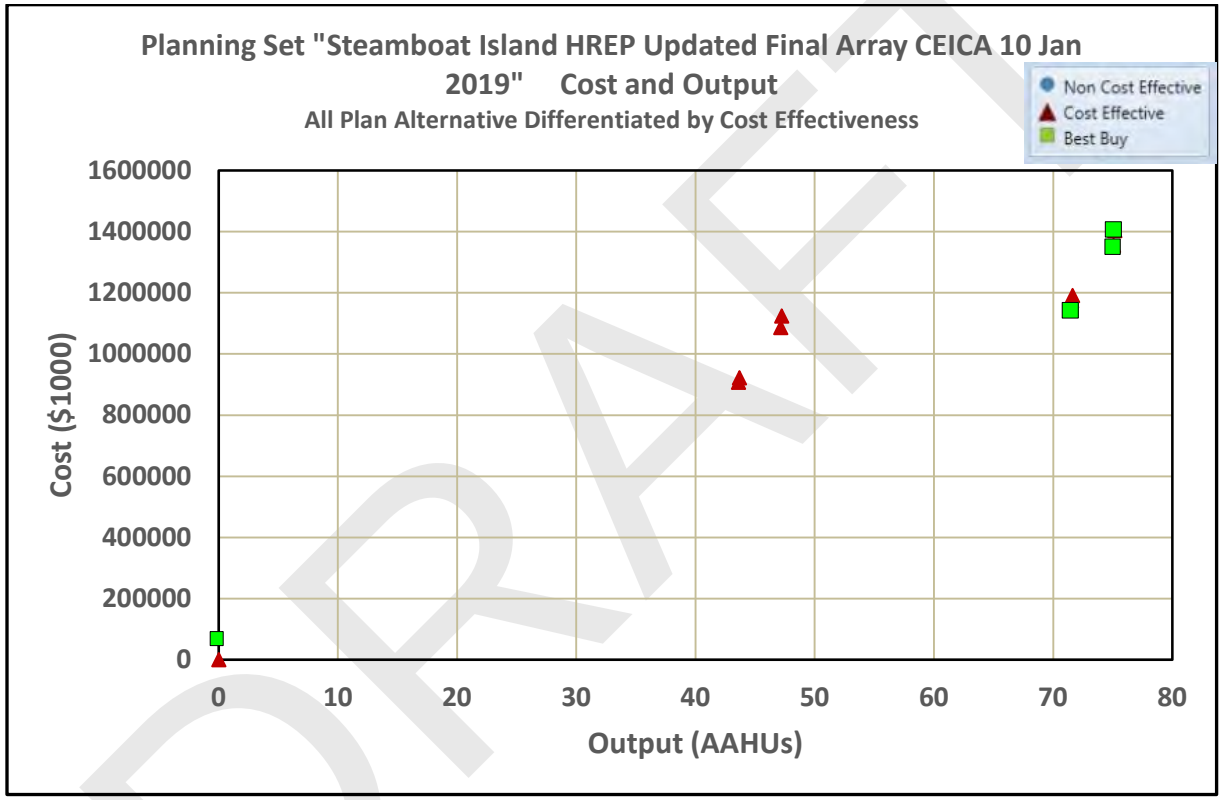


Figure V-2: Final Array of Alternatives Differentiated by Cost Effectiveness

DRAFT

Table V-4: "Best Buy" Combinations

Alt. Number	Alternative	Outputs (HU)	Annualized Cost ($)	Average Cost ($)	Incremental Cost ($)	Incremental Output (HU)	Incremental Cost/Output ($/HU)
0	No Action Plan	0	0	0	0	0	0
19	USI Head, Steamboat Island aquatic diversity, Grant Slough Complex	71.53	1,174,112	16,414	1,174,112	71.53	16,414
27	USI Head, Steamboat Island aquatic diversity, West SE Island, Grant Slough Complex	75.07	1,355,285	18,054	181,173	3.54	51,179
31	USI Head, Steamboat Island aquatic diversity, West SE Island, Grant Slough Complex, Flow Diversity	75.17	1,403,156	18,666	47,871	0.10	478,710

DRAFT

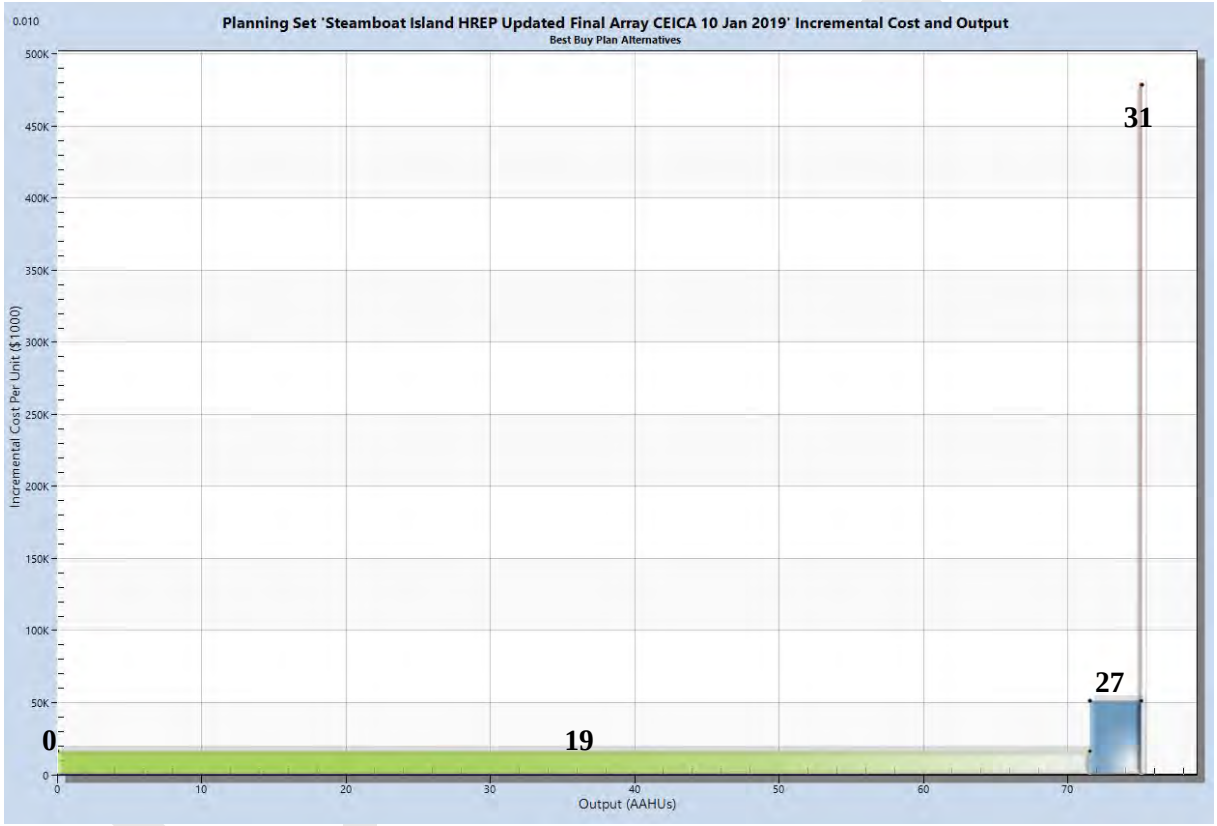


Figure V-3: Steamboat Island "Best Buy" Plans

D. Selection of the Tentatively Selected Plan

Federal planning for water resources development was conducted in accordance with the U.S. Water Resources Council's P&G.

> *"For ecosystem restoration projects, a plan that reasonably maximizes ecosystem restoration benefits compared to costs, consistent with the Federal objective, shall be selected. The selected plan must be shown to be cost effective and justified to achieve the desired level of output. This plan shall be identified as the National Ecosystem Restoration (NER) Plan."*

Review of the four formulation criteria suggested by the P&G (completeness, effectiveness, efficiency, and acceptability, defined below) and resource significance (institutional, public, and technical) were used to aide in the selection of the TSP.

- ***Completeness.*** Completeness is the extent to which an alternative plan provides and accounts for all necessary investments or other actions to ensure the realization of the planned effects. That could require relating the plan to other types of public or private plans if the other plans are crucial to achieving the contributions to the objective. Completeness varies in the plans, depending on the measure that are incorporated.
- ***Effectiveness***. All the plans in the final array provide some contribution to the Project objectives. Effectiveness is defined as a measure of the extent to which a plan achieves its objectives.
- ***Efficiency.*** All the plans in the final array provide net benefits. Efficiency is a measure of the plan's cost-effectiveness expressed in net benefits.
- ***Acceptability.*** All the plans in the final array must be in accordance with Federal law and policy. Acceptability is the extent to which the alternative plans are acceptable in terms of applicable laws, regulations, and public policies. All the plans in the final array provide some level of acceptability for the Sponsor and Project partners.
- ***Institutional Recognition.*** The importance of an environmental resource is acknowledged in the laws, adopted plans, and other policy statements of public agencies, tribes, or private groups.
- ***Public Recognition.*** Some segment of the general public recognizes the importance of an environmental resource, as evidenced by people engaged in activities that reflect an interest or concern for that particular resource.
- ***Technical Recognition.*** The resource qualifies as significant based on its "technical" merits, which are based on scientific knowledge or judgment of critical resource characteristics. Technical significance should be described in terms of one or more of the following criteria or concepts: scarcity, representativeness, status and trends, connectivity, limiting habitat, and biodiversity.

The PDT reviewed the Best Buy Plans (Table V-4 and Figure V-3) and determined that the cost to implement the first iteration of Best Buy Plans above the No Action Plan, Alternative 19, was worth the incremental investment above the No Action Plan because it provides an acceptable level of

DRAFT

restoration for an acceptable cost. Alternative 19 includes the Grant Slough Complex, in addition to the Steamboat Island proper measures. It provides 71.53 habitat units over the No Action Plan at an incremental cost per unit of output ($/HU) of $16,414. This alternative is efficient, effective, complete, and acceptable. Alternative 19 would provide restoration over a majority of the Project area.

The next Best Buy Plan, Alternative 27 (75.07 AAHUs; $51,179 $/HU), differs from Alternative 19 by adding restoration and protection of the West SE Island and an additional 3.54 AAHUs. The PDT determined that this alternative is also efficient, effective, complete, and acceptable, and would be considered further, as it provides additional benefits and contributes to the restoration and protection of the unique and diverse mosaic of habitats within the Project area. However, Alternative 27 would further support a complete and effective Project, without adding adverse impacts. The additional 3.54 AAHUs of the TSP, as compared to Alternative 19, contribute to many aspects of resource significance and provide additional ecosystem output. The additional forest habitat and island acreage of the West SE Island will be used as a refuge, feeding, and breeding ground for migratory birds, fish, and other wildlife. It will support transitional zone habitat at the edge of the island and aquatic diversity just outside of its land mass. The restoration and protection of the West SE Island will provide direct and indirect benefits to the mussel community and their host species. 3.54 AHHUs, while seemingly small, will do a great deal for the institutional and technical importance of the Project area and Pool 14. The West SE Island measure contributes to overall connectivity by supporting the Cordova EHA and providing fish and mussel habitat in the side channel, providing limiting habitat that is essential for the conservation of the Higgins eye pearlymussel, and contributes to the unique mosaic of habitats that are desired for the Project area.

The last Best Buy Plan, Alternative 31 (75.17 AAHUs; $478,710 $/HU), differs from Alternative 27 by adding the construction of the Flow Diversity measure within Steamboat Slough. The PDT determined that although there would be minimal additional benefits, Alternative 31 would not be considered further because the incremental cost was not worth the small amount of benefit the alternative would provide. The additional 0.1 AAHU would provide some aquatic diversity but not contribute to the institutional or technical significance in the Project area or Pool 14.

The other cost-effective alternatives between Best Buy Alternatives 19 and 27 would not fully realize the Project objectives and the Sponsors' needs because the Grant Slough complex is not included in Alternatives 22 and 26 and/or the West SE Island is not included in Alternatives 22 and 23. The Grant Slough complex currently has existing, but low quality, overwintering habitat and is important because its proximity to the main channel would maintain a hydraulic connection, providing adequate DO levels to overwintering fish during severe winters or other low DO events. The restoration and protection of the West SE Island would result in a higher amount of diverse forest habitat, as described previously, and indirectly benefit an existing EHA by providing additional aquatic habitat diversity and act as a buffer from the flow of the main channel. The inclusion of these measures into the TSP provide benefit and habitat to the Project area and Pool 14, where these habitat needs have been diminishing over time and will continue to do so if no action is taken.

As a result of this discussion and review of the formulation criteria, the PDT concluded that Alternative 27 is the TSP and the NER Plan since it reasonably maximizes ecosystem restoration benefits at an acceptable incremental cost. Table V-5 shows how the TSP compares to other plans based on the P&G criteria and Resource Significance of the Outputs.

Table V-5: TSP Justification as Compared With Other Alternatives

Alternative	Efficiency (CEICA)	Acceptability /Sponsor Priority	Completeness	Robustness and Connectivity (# Lakes Excavated)	Limiting Habitat (acres)	Island Restoration/Protection (acres)	Topographic Diversity (acres)	Aquatic Diversity (acres)
No Action	BB	1	0	0	0.0	0	0	0
18	CE	1	1	2	42.0	14	19	23.0
19	BB	3	3	3	78.0	14	49	29.0
22	CE	1	1	2	42.4	14	19	23.4
23	CE	3	3	3	78.4	14	49	29.4
26	CE	3	3	2	47.0	18	23	24.0
27 (TSP)	BB	5	5	3	83.0	18	53	30.0
30	CE	3	3	2	47.4	18	23	24.4
31	BB	5	5	3	83.4	18	53	30.4

Assumptions:
All acres come from HEP
Acceptability: 1 - Low Priority, 3 - Medium Priority, 5 - High Priority
Completeness: 0 - Incomplete, 1 - Minimally Complete, 3 - Moderately Complete, 5 - Maximally Complete
Robustness and Connectivity, measured by the number of lakes excavated (overwintering habitat): More than 2 considered ideal
Limiting Habitat, combined acres overwintering habitat, forestry and SSP habitat: More than 75 acres considered ideal
Topographic and aquatic diversity will not require clearing or placing on existing diverse areas; all topographic diversity will be located in existing reed canary grass fields
Topographic diversity, combined acres forestry and SSP habitat: More than 25 acres considered ideal
Aquatic diversity, combined acres overwintering habitat: Maximization of benefits considered ideal

The TSP is important to the Project area and offers a unique opportunity to restore the unique mosaic of habitats in the landscape, mimic pre-settlement conditions, increase the quality and quantity of bottomland hardwood forest, aquatic habitat, island acreage and topography, backwater and interior wetland habitat, and provide important linkages between similar habitats in Pool 14. The enhancement of Steamboat Island and the whole Project area offered by the TSP is preferred among the other plans, specifically because of the improvements to the recognized significant resources (institutional, public, and technical) and the quality and quantity of island restoration and protection.

The institutional importance of the Steamboat Island HREP and TSP is primarily demonstrated as it meets the goals and objectives of the UMR NWFR, to provide a refuge and breeding ground for migratory birds, fish, other wildlife, and plants. The incorporation of mussel habitat into Project measures and the enhancement of bat habitat by TSI actions provide benefits to species protected under the ESA of 1973, as amended. Additional habitat gains will result for floodplain forest quality through increasing hardwood forest stand species diversity, age, and structure. This will also provide long-term benefits to resident migratory bird and other species relying on hard mast trees as a source of food and shelter, implementing the goals and objects set forth in the MBTA; EO 13186, *Responsibilities of Federal Agencies to Protect Migratory Birds;* the Bald and Golden Eagle Protection Act of 1940; and the FWCA, as amended (16 U.S.C. § 661). The restoration and protection of island acreage and habitat will also contribute to these institutional values.

The public importance of the Steamboat Island HREP and TSP is primarily demonstrated by the multi-agency coordination effort in maintaining a high quality UMR ecosystem while avoiding adverse impacts. Steamboat Island represents one of the largest habitat restoration projects in Pool 14 to restore degraded environmental conditions within the backwater and floodplain forest habitats that will also benefit migratory birds, fish, other wildlife, and plants. This Project addresses the public's and natural resource specialists' needs and preferences in local habitat restoration and recreation.

The technical importance of the Steamboat Island HREP and TSP is primarily demonstrated by improving habitat for a variety of species, thus increasing the representativeness, connectivity, and limiting habitat of the area. Expansion of the aquatic limiting habitat by excavation in Upper Lake, Lower Lake, and NW Grant Slough Lake will increase backwater depths with the resulting improvement in water quality, aquatic diversity, and fish habitat. This should promote and improve seasonal refugia with resulting benefits to the warm-water fisheries communities. Restoration and protection of the NE Bank will protect the overwintering area in Upper Lake, as well as provide an increase in floodplain forest. The GCS will reduce sediment transfer and deposition into overwintering areas, thereby protecting the resulting biodiversity and habitat restoration. Expansion of the forested and SSP limiting habitat will increase island acreage and the topographic diversity in the Project area; the biodiversity of the floodplain forest and SSP species will be increased through plantings, which is important for Pool 14 connectivity and the species which use these habitats. The enhancement of the floodplain forest by these and other TSI actions will improve the scarcity of habitat available for migratory bird and listed bat species in the area by providing foraging, roosting, and breeding areas. In addition, the restoration and protection of USI and the West SE Island will restore many acres of island habitat within Pool 14 that have been lost, which serves important functions for the ecosystem. Incorporation of fish and mussel habitat into Project measures will directly benefit the Project area and enhance the value of the adjacent Cordova EHA. The West SE Island restoration and protection is vital because the adjacent side channel lies within the Cordova EHA established for the recovery of the endangered Higgins eye pearlymussel. If the West SE Island eroded away, the freshwater mussel community inhabiting the EHA may be negatively impacted,

including federally-listed mussels, through direct connection of the adjacent side channel with the main channel. All of these improvements would extend beyond each individual measure and are expected to benefit the entire fish and wildlife communities within adjacent areas, therefore improving connectivity and representativeness.

E. Evaluation of Additional Floodplain Benefits Quantified by the Hydrogeomorphic Approach

TSI measures were not included in the initial habitat analysis, but were anticipated to help restore the process and function of ~900 acres of floodplain forest in the Project area. Since TSI prescriptions were anticipated to be the same for all Final Array Project alternatives, the Hydrogeomorphic Approach was later applied to support the TSP and demonstrate the additional benefits provided by TSI actions relative to the cost of the Project. The results of this analysis determined an additional 318 net AAHUs are gained by TSI implementation, resulting in a total of 393.07 AAHUs. See Appendix D, *Habitat Evaluation and Benefits Quantification*, for further information on the methods and results.

F. Risk and Uncertainty

Areas of risk and uncertainty have been analyzed and were defined so that decisions could be made regarding the reliability of estimated benefits and the costs of alternative plans. Risk is defined as the probability or likelihood for an outcome. Uncertainty refers to the likelihood that an outcome results from a lack of knowledge about critical elements or processes that then contributes to risk or natural variability in the same elements or processes.

The PDT worked to manage risk in developing measures by expanding on and referencing successful similar work completed by previous HREPs and the Design Handbook. The PDT used that experience and information to identify possible risks and decrease uncertainty in plan formulation. No measures in the TSP are believed to be burdened by significant risk or uncertainty regarding the eventual success of the proposed measures. Significant risk would be avoided by proper design, appropriate selection, and correct seasonal timing of applications.

The dynamic and complex nature of riverine environmental processes is a principal source of uncertainty. This source of uncertainty effects the USI and West SE Island restoration and protection measures the most, as erosion will continue to occur during Project planning and design, and high or low water during construction may affect construction. These risks are quantified in Appendix I-B, *Project Cost and Schedule Risk Analysis Report.* Post-construction evaluation, including performance monitoring and long-term performance reporting, and adaptive management measures would be used to address uncertain outcomes in all TSP components.

Success of floodplain forest plantings was identified as having a minor level of risk. Risk to floodplain forest features with topographic diversity due to increased inundation duration was mitigated during design by increasing topographic diversity elevations to account for changing hydrology. Furthermore, risks to floodplain forest plantings due to dredge material, herbivory and predation were reduced using a phased planting and monitoring schedule. The reasoning and probability of mortality and poor establishment is commonly associated with multiple drivers, rather than simply one direct cause. Incorporating a phased planting effort to directly counter the primary drivers that have caused high probability of mortality in the past helps to further buy down risk by building up the organic material in the dredge material (cover crops), planting early successional tree

species one growing season prior to late successional tree species (diversity), and increasing resilience by planting trees in higher densities.

Further detail on phased planting and monitoring schedules can be found in Appendix M, *Engineering Design*. This knowledge of relevant forest ecosystem structure and function is a result of UMRR Forestry Monitoring efforts, having produced monitoring data to understand relationships among project management actions and corresponding outcomes.

It is expected that overwintering and summer habitat in the dredged backwater will not be limited by dissolved oxygen or flow. Furthermore, the Beaver Island HREP is currently in construction and has an adaptive management and monitoring design for aquatic diversity and backwater fish habitat, which can inform the design process for this Project. However, sediment transport and deposition may occur in the aquatic diversity sites, depending on river conditions and function of Project measures. This expectation remains uncertain. If monitoring demonstrates a need for reduced sediment transport, an adaptive management measure to modify the NE Bank and/or GCS will be implemented.

It is expected that implementation of the GCS and NE Bank restoration will not significantly alter hydraulic forces within Steamboat Island and will bring benefit to the Project by reducing the transfer and deposition of sediment into the overwintering areas. Adaptive management measures have been formulated to address risk and uncertainty associated with these structures. For further information, see Appendix K, *Monitoring and Adaptive Management Plan*. Hydraulic modeling of the TSP demonstrated that impacts to flood profiles met the "no-rise" requirements as interpreted by the States of Iowa and Illinois.

Sea level rise is not expected to impact the TSP since the Project is located several hundred feet above mean sea level. However, uncertainty in future hydrology and the associated sediment transport regime introduces risks to Project performance, such as successful floodplain forest restoration and dredge cut longevity. As shown in Figure II-9 and II-12, stage duration has increased over the last sixty years. Consideration of risk due to future hydrology informed the design of the floodplain forest with topographic diversity measures. A description of how observed changes in growing season inundation duration were applied to topographic diversity design and a qualitative assessment of climate change impacts is documented in Appendix H, *Hydrology and Hydraulics*, Table H-21, *Climate Risk Summary*, which shows climate risks for each Project measure.

DRAFT

SECTION VI. TENTATIVELY SELECTED PLAN: DESCRIPTION WITH DESIGN, CONSTRUCTION, AND OPERATION AND MAINTENANCE CONSIDERATIONS

The TSP, which will meet the Project goals and objectives, was developed following the CEICA and was refined with more design details. All measures described below passed the CEICA. The TSP is shown on Figure ES-1 and Plate 8, C-102, and described as follows:

- Restoring topographic diversity in portions of the Project area by increasing existing elevations and planting trees, shrubs, understory plants, and buffer species, as well as implementing TSI measures, to address the Project objective of enhancing and restoring areal coverage and diversity of forest stands and habitat and increase diversity of bottomland hardwood forest.

- Increasing aquatic diversity in the Project area backwaters, specifically in Steamboat Island Upper Lake, Steamboat Island Lower Lake, and NW Grant Slough Lake, by excavation, which will address the Project objective of increasing year-round aquatic habitat. Where appropriate, additional fish and mussel habitat may be incorporated to bring further benefit to the species that use the Project area. Due to the low cost and risk of these structures, further design will occur during the Plans & Specifications (P&S) stage. Preliminary design information for the fish and mussel habitat can be found in Appendix M, *Engineering Design*.

- Restoring and protecting island acreage on portions of Steamboat Island proper and the whole West SE Island by placing stone protection and dredged material, then planting with trees, to address the Project objective of restoring island acreage and protecting from erosion within the Project area.

- Placing protection measures at the NE Bank and the northwest end of the Cut-Through Channel of Steamboat Island and restoring SSP habitat in the Project area, to address the Project objective of protecting existing backwater habitat from sediment deposition and enhancing backwater and interior wetland areas.

A. Aquatic Diversity, Topographic Diversity – Forestry, and Topographic Diversity – Scrub-Shrub/Pollinator Habitat

The aquatic diversity, topographic diversity-forestry, and topographic diversity-SSP measures are listed as separate measures because they are distinct habitat types. However, these measures are intertwined, as material used from excavation of the aquatic diversity areas will be used for topographic diversity measures.

1. Aquatic Diversity Measures. Excavation has been proposed as a potential measure to provide suitable year-round habitat for fish, including critical overwintering habitat for centrarchid fish species. Excavation will also provide material to increase topographic diversity within the Project area. Mechanical excavation or dredging would be required for these aquatic diversity sites (Plate 24, C-301). Appendix M, *Engineering Design*, lists design constraints or considerations.

Aquatic diversity was considered using a mechanical dredge. Mechanical dredging necessitates adjacent placement or handling excavated material multiple times, but it does not require a large settling basin as would be required for a hydraulic dredging placement site or cause an increase in effluent for water quality as is a risk of hydraulic dredging. The material would be immediately available for use at a topographic diversity site. A floating excavator, barge mounted crane, or barge mounted excavator could be used. For excavation areas with a larger bottom width or a further reach

DRAFT

for placement of dredged material, a barge mounted crane with a bucket of sufficient size would likely dredged material. Other dredged material will need to be hauled by barge to nearby placement sites. Refer to Appendix M, *Engineering Design*, for photographs of various dredges which may be used.

a. Steamboat Island Upper Lake Aquatic Diversity. Steamboat Island Upper Lake is in the northern portion of Steamboat Island proper. The dredge cut would be excavated to provide aquatic diversity through dredging, utilizing the dredged material for topographic diversity. The cut was situated to ensure it will tie into deeper water in the main channel, and placed in deeper water locations. Fishery structures such as woody debris or rock piles may be added to this area to provide a more diverse habitat. Material excavated from this site will be transported to topographic diversity sites near the cut (Steamboat Island Upper Lake Placement Site 1 or the NE Bank) and other sites as required. This measure was revised after formulation. Refer to Appendix M, *Engineering Design,* for quantities and design details and for revisions to the measure.

b. Steamboat Island Lower Lake Aquatic Diversity. Steamboat Island Lower Lake is in the southern portion of Steamboat Island proper. The dredge cut would be excavated to provide aquatic diversity through dredging, utilizing the dredged material for topographic diversity. The cut was situated to ensure it will tie into deeper water in the main channel, and placed in deeper water locations. Fishery structures such as woody debris or rock piles may be added to this area to provide additional diverse habitat. Material excavated from this site will be transported to SSP sites near the cut (Lower Lake SSP measure) and other topographic diversity sites. This measure was minimally revised after formulation. Refer to Appendix M, *Engineering Design*, for quantities and design details.

c. NW Grant Slough Lake Aquatic Diversity. NW Grant Slough Lake is located in southern Grant Slough. The dredge cut would be excavated to provide aquatic diversity through dredging, utilizing the dredged material for topographic diversity. The cut was situated to ensure it will tie into deeper water in Grant Slough and placed in deeper water locations. However, access dredging will likely be required to access the lake. Fishery structures such as woody debris or rock piles may be added to this area to provide a more diverse habitat. Material excavated from this site will be used for topographic diversity sites near the cut (Grant Slough Placement Site 1 and 2) and other topographic diversity sites as required. This measure was minimally revised after formulation. Refer to Appendix M, *Engineering Design*, for quantities and design details.

2. Topographic Diversity Measure - Forestry. Topographic diversity sites were determined based on proximity to proposed aquatic diversity dredge cuts, presence of low-value vegetation dominated by reed canarygrass, and absence of high-value vegetation, including native trees, shrubs and non-woody plants. Preference was given to sites adjacent to the aquatic diversity sites, which allows for side-cast placement and less handling of dredged material. Appendix M, *Engineering Design*, outlines detailed design considerations.

Due to existing conditions of the proposed topographic diversity sites, tree clearing will not be required before placing material to the optimum elevation for tree survival at the topographic diversity sites (refer to Plate 24, C-301 for typical placement method). The exception to this is 1.3 acres of tree clearing required to access Grant Slough Placement Sites 4 and 5. No tree clearing will be conducted during the federally endangered Indiana bat and northern long-eared bat maternity season of April 1 to September 30. Cleared trees shall be removed from the site or utilized as habitat structures on site.

DRAFT

Material will come from excavated channels within the Project area. The sites will either be sloped to drain, or will have +0' to -1.5' elevation changes to create swales across the wider sites. Once placed material is shaped, temporary seeding will be employed prior to permanent seeding and tree planting.

Tree species to be planted are included in Appendix M, *Engineering Design*. Tree wraps or other measures to prevent herbivory will be provided. Forested wetland shrubs will be interplanted with the forested wetland trees. Herbaceous planting efforts will be conducted prior to shrub and tree plantings.

Topographic diversity sites are shown on Plate 8, C-102, *Tentatively Selected Plan*. Each site is further detailed in this section. TSI activities will be implemented on approximately 900 acres of the Project and would incorporate thinning treatments, tree planting, and invasive species management that will promote healthy forest growth. TSI activities will result in positive long-term benefits to federally-listed bat species by providing additional habitat and/or potential roost trees, providing foraging habitat, and increasing solar exposure to occupied roost trees adjacent to clearing areas. TSI activities would provide the following functions:

- reduced density to provide adequate growing space and sunlight;
- increased natural regeneration of native tree species;
- snag creation for the benefit of wildlife use and habitat;
- tree planting to increase tree species diversity and age assemblage;
- increased complexity of forest structure for the benefit of avian species; and
- reduced invasive species dispersal

a. Upper Steamboat Island Head. The USI Head measure will restore and protect island habitat, bringing the footprint back to what is recorded in the 1931 Brown's Map, and provide forest habitat for the Project area. The area has been eroded and is currently open water. Dredged material would be placed and the site constructed to optimum tree survival elevations. The footprint of this site will allow for variations in plantings, and minor variations in elevation height (+/- 1 foot) to provide small swales on top of the placement sites. This area would be planted with various forested wetland trees, understory species, forested wetland shrubs, and buffer species. Stone protection will be required at the upstream most end of placement. This measure was minimally revised after formulation. Refer to Appendix M, *Engineering Design*, for quantities and design details.

b. NE Bank. The NE Bank topographic diversity site, located adjacent to Steamboat Island Upper Lake, will restore the natural barrier between Upper Lake and the Mississippi River, limiting flow and sediment from entering the lake. The site currently consists of a reed canarygrass monoculture and open water, but is adjacent to higher diversity areas. Most of the material at this location will come from the Steamboat Island Upper Lake aquatic diversity cut. After dredged material is placed, the site will be planted with various forested wetland trees, understory species, forested wetland shrubs, and buffer species. The site will require stone protection on the east bank adjacent to the main channel.

DRAFT

This measure was later revised in the TSP to address stone protection quantities and the slope of dredged material placement. Refer to Appendix M, *Engineering Design*, for quantities and design details.

c. Steamboat Island Upper Lake Placement Site 1. Upper Lake Placement Site 1, currently dominated by reed canarygrass, was originally formulated to be a small area between Steamboat Island Upper Lake and the Cut-Through Channel. It was later expanded to include a narrow strip to the northwest to provide a larger buffer between Steamboat Island Upper Lake and the Cut-Through Channel. The northeast portion of the placement site is adjacent to Steamboat Island Upper Lake and will allow for side-cast placement; the remainder of the site will have dredged material transported and placed. The site will be built to optimum elevations for tree survival and planted with various forested wetland trees, understory species, forested wetland shrubs, and buffer species. This measure was minimally revised after formulation. Refer to Appendix M, *Engineering Design,* for quantities and design details.

d. Grade Control Structure. The GCS, located at the northwest end of the Cut-Through Channel, is a combination of open water placement and placement on low-value vegetation and is designed to provide grade control for incoming flows and create topographic diversity. The site will provide protection to Lower Lake and adjacent interior wetlands by reducing water velocities and capturing sediment that enters from Steamboat Slough. The material for placement will most likely come from aquatic diversity dredging in Grant Slough. The measure incorporates stone to protect the site from further erosion. The site would be constructed to optimum tree survival elevations and planted with various forested wetland trees, forested wetland shrubs, and non-woody wetland plants. This measure was minimally revised after formulation. Refer to Appendix M, *Engineering Design*, for quantities and design details.

e. Grant Slough Placement Site 2. Grant Slough Placement Site 2 is located adjacent to NW Grant Slough Lake and is currently a reed canarygrass monoculture. The site would be built to optimum elevations for tree survival, using side-cast material from dredging the NW Grant Slough Lake aquatic diversity cut, then planted with various forested wetland trees, understory species, forested wetland shrubs, and buffer species.

This measure was later revised in the TSP to address the slope of dredged material placement, which decreased placement capacity. Refer to Appendix M, *Engineering Design*, for quantities and design details.

f. Grant Slough Placement Sites 4 and 5. Grant Slough Placement Sites 4 and 5, located north of NW Grant Slough Lake between Grant Slough and Steamboat Slough, are currently comprised of low-value vegetation. The measure is designed to create topographic diversity and forest habitat in an area that has lost forest habitat over the years due to high water events, erosion, and competition from invasive species. Site access will be from Steamboat Slough and result in 1.3 acres of tree clearing. The site would be built to optimum elevations for tree survival and then planted with various forested wetland trees, understory species, forested wetland shrubs, and buffer species. The 1.3 acres of temporary impact would be restored using the same species. This measure was minimally revised after formulation, including an initial quantity error correction. Refer to Appendix M, *Engineering Design,* for quantities and design details.

DRAFT

3. Topographic Diversity Measures - SSP Habitat. The Project area, and portion of Pool 14 in which the Project is located, has very limited SSP habitat. SSP sites were determined based on presence of low value vegetation dominated by reed canarygrass and absence of high-value vegetation, as well as suitability of that site to support SSP vegetation. The SSP sites are expected to be protected from degradation, due to their location within the Project area. Appendix M, *Engineering Design*, outlines detailed design considerations.

Material will come from excavated channels within the Project area. The sites will either be sloped to drain, or will have +0' to -1.5' elevation changes to create swales across the wider sites. Once placed material is shaped, temporary seeding will be employed prior to permanent seeding and SSP habitat planting.

a. Lower Lake SPP. The Lower Lake SSP sites, located in Lower Lake, are open water placement on low value vegetation and designed to create SSP habitat in an area that has lost forest and SSP habitat over the years due to high water events, erosion, and competition from invasive species. The material for placement will most likely come from Lower Lake aquatic diversity dredging. The site currently has no SSP habitat, but is adjacent to higher diversity areas. This site would be constructed to optimum SSP survival elevations and planted with various forested wetland shrubs, non-woody wetland plants, and scrub-shrub/pollinator species. This measure was minimally revised after formulation. Refer to Appendix M, *Engineering Design*, for quantities and design details.

b. Grant Slough Placement Site 1 SSP. Grant Slough Placement Site 1 SSP is located at the downstream-most end of Grant Slough and is currently a reed canarygrass monoculture. The site would be built to optimum elevations for SSP survival, using side-cast material from Grant Slough access dredging, then planted with various forested wetland shrubs, non-woody wetland plants, and scrub-shrub/pollinator species. During formulation, this site was considered for either forestry or SSP plantings. Based on existing site conditions, the team decided to pursue the SSP measure. This measure was minimally revised after formulation. Refer to Appendix M, *Engineering Design*, for quantities and design details.

B. Island Restoration and Protection. Small island restoration sites were selected to expand existing islands and restore lost island footprint. Stone was incorporated to protect the restored island from erosion. Appendix M, *Engineering Design*, outlines detailed design considerations.

1. West SE Island. This island will be restored and protected through a combination of open water placement and bankline placement. It is designed to restore the island footprint and create topographic diversity and forest habitat in an area that has lost forest habitat over the years due to high water events, erosion, and competition from invasive species. The material for placement will most likely come from access dredging for stone placement, dredging in Grant Slough (access or aquatic diversity), or aquatic diversity dredging in Lower Lake. By protecting this restored island with stone, the island will be protected from further erosion. This site would be constructed to optimum tree survival elevations, then planted with various forested wetland trees, forested wetland shrubs, and non-woody wetland plants. This measure was minimally revised after formulation. Refer to Appendix M, *Engineering Design*, for quantities and design details.

Details of quantities and design for the TSP can be found in Appendix M, *Engineering Design*. A summary of quantities is located in Table VI-1.

DRAFT

Table VI-1: Summary of the Quantities for the TSP Measures

Aquatic Diversity				
Location/Measure	**Acres**	**Dredging (CY)**	**Placement (CY)**	**Stone Protection (TN)**
Upper Lake	12.7	194,828		
Lower Lake	11.4	170,158		
NW Grant Slough Lake	5.9	87,704		
Access to Grant Slough	5.0	10,721		
Access to West SE Island	0.6	855		
Total	**35.6**	**464,266**		

Topographic Diversity & Scrub-Shrub/Pollinator Habitat				
Location/Measure	**Acres**	**Dredging (CY)**	**Placement (CY)**	**Stone Protection (TN)**
USI Head	14.4		274,530	102,941
NE Bank	7.6		30,990	22,403
West SE Island	5.4		76,020	6,115
Upper Lake Placement 1	4.1		10,972	
Grant Slough Placement 2	3.6		11,886	
Grant Slough Placement 4 & 5	13.8		47,503	
GCS	0.2		561	162
Grant Slough Placement 1 (SSP)	4.3		3,077	
Lower Lake SSP Placement	5.6		2,988	
Total	**59.0**		**458,527**	**131,621**

C. Forest Habitat (Timber Stand Improvement). TSI includes a variety of measures that improve forest habitat health, diversity, and resilience for tracts of timber. Prescriptions are based on current environmental and forest conditions and focused on areas at higher risk of forest decline. Eleven sites, contained within three units, will be improved through silvicultural prescriptions. Proposed methods include tree thinning treatments, tree planting, and invasive species management. A map of the sites as well as detailed design considerations and design details are outlined in Appendix M, *Engineering Design*.

D. Design Considerations

1. Location. See Section I, *Introduction*, of the Main Report.

2. Survey Data. The project vertical datum is NAVD88 (converted from MSL1912, which is what the river gages report). The project horizontal datum is IL West State Plane NAD 83, US Survey Feet. Survey data has come from Corps hydrosurvey (several events), UMRR LiDAR, and Corps ground survey (Plate 3, V-101). Flat pool at the Project location (RM 504.5) is 571.2 NAVD88. At RM 504.5, to convert elevations in MSL1912 to NAVD88, 0.85 feet must be subtracted.

3. Access. The Project is located on and near an island in the Mississippi River, so all access will be by water. Seven boat ramps, located nearby the Project, are public boat ramps available for use by the contractor (see Appendix M, *Engineering Design*). Some ramps may have limits in terms of size and weight of equipment that may be launched. The Contractor will need to abide by local boat ramp usage regulations.

DRAFT

4. Excavated Material. Excavated material will be required to construct the topographic diversity sites. Geotechnical borings are provided in Appendix P, *Plates*.

5. Historic Properties. Historic properties are addressed in Section II.L and Section IX.G of this report. The layout and design of measures will be conducted to avoid impacts to historic properties. Contract specifications will include requirements to the contractor for what to do in case historic properties are encountered during construction.

6. Hazardous, Toxic, and Radioactive Waste. As required for all earth working projects in the District, it is recommended that the Environmental Protection specification section include requirements for HTRW testing of any material to be brought onto the site or removed from the site to ensure the material is not contaminated. If contaminated material is identified, the Corps would stop work and follow the steps outlined in ER 1165-2-132, *Hazardous, Toxic, and Radioactive Waste Guidance for Civil Works Projects*. A Phase I HTRW ESA was conducted and revealed no evidence of a REC that could potentially affect the Project area (see Section II.N. of the Main Report). If any evidence of a REC is discovered during construction activities, operations will cease until an assessment is performed, at which time the Phase I ESA will be revisited. All construction equipment should be cleaned and free of soil residues, plants, pests, noxious weeds and seeds.

7. Public Access and Security. Safety and security are important parameters which would be detailed during the Plans & Specifications Phase. Of specific concern, will be the coordination of regional hunting seasons with the construction season.

E. Construction Considerations

1. Permits. Laws of the United States and the States of Iowa and Illinois have assigned the Corps, IADNR, ILDNR, and the Illinois EPA with specific and different regulatory roles designed to protect the waters within and on the State boundaries. Protecting Iowa and Illinois waters is a cooperative effort between the applicant and regulatory agencies.

The basis for the Corps regulatory functions over public waterways was formed in 1899 when Congress passed the Rivers and Harbors Act of 1899. Until 1968, the Rivers and Harbors Act of 1899 was administered to protect only navigation and the navigable capacity of this Nation's waters. In 1968, in response to a growing national concern for environmental values, the policy for review of permit applications with respect to Sections 9 and 10 of the Rivers and Harbors Act was revised to include additional concerns (fish and wildlife, conservation, pollution, aesthetics, ecology, and general welfare) besides navigation. This new type of review was identified as a "public interest review." The Corps' regulatory function was expanded when Congress passed the Federal Water Pollution Control Act Amendments of 1972. The purpose of the Federal Water Pollution Control Act was to restore and maintain the chemical, physical, and biological integrity of this Nation's waters. Section 402 of the Act established the National Pollutant Discharge Elimination System (NPDES) to regulate industrial and municipal source discharges of pollutants into the Nation's waters. The NPDES permit program, administered by the IADNR and the Illinois EPA, should not be confused with the Corps' Section 404 permit program. Section 404 of the Federal Water Pollution Control Act (now called the Clean Water Act due to amendments in 1977) established a permit program to be administered by the Corps to regulate the nonpoint source discharges of dredged or fill material into waters of the United States.

DRAFT

The IADNR is the State agency created by consolidating all previous duties of the IADNR of Water, Air, and Waste Management; the Conservation Commission; the Energy Policy Council; and the Iowa Geological Survey. The IADNR administers permit programs for conserving and protecting Iowa's water, recreational and environmental resources, and for the prevention of damage resulting from unwise floodplain development. The IADNR also has jurisdiction over sovereign lands and waters and certain fee title lands of the State (Iowa Code, Chapters 106 and 111). On meandered streams and lakes, sovereign State property is that land below the ordinary high water mark.

The IADNR has authority to regulate construction on all floodplains and floodways in the State. The IADNR's administrative rules explain when a permit must be obtained for various types of floodway/floodplain-development. Examples are channel straightening, levee construction, excavation and stockpiling of overburden and rock materials, building construction, dams, stream crossings, and bank protection work. Anyone planning to perform or allow such floodplain construction must contact the IADNR to determine if a floodplain construction permit is needed.

Section 10/404 Permit. The Project will need to show compliance with Section 10 of the Rivers and Harbors Act and Section 404 of the Clean Water Act. The District anticipates obtaining Nationwide Permit (NWP) #27 (Aquatic Ecosystem Restoration) in order to be compliant with Section 404 of the CWA. Section 401 Water Quality Certification conditions have already been coordinated and documented as a part of the NWP. This Project will abide by all conditions of the NWP and Water Quality Certification permits. This permit will be coordinated using the Joint Application Form.

Sovereign Lands and Floodplain Permits. These permits, issued by the IADNR and ILDNR, were applied for during feasibility report development using the Joint Application Form.

National Pollutant Discharge Elimination System (NPDES). The Contractor is responsible for obtaining the NPDES Storm Water Permit prior to initiating construction. A storm water discharge or NPDES permit for construction activities will be required. Effective March 10, 2003, the NPDES storm water discharge permit is required when a construction activity disturbs more than one acre. The construction contract for the Project will trigger the need for the contractor to apply for this permit. With or without the permit, the Corps requires an environmental protection plan that addresses contaminants as well as erosion control measures. Working near a river requires extra care and erosion control measures. Contract requirements should require the use of an erosion control mat or fence to control erosion and sediment deposition of soil prior to establishing vegetative cover. The contractor would be required to prepare an erosion control plan to ensure that unprotected soil is not allowed to leave the Project site work limits. The contractor would be required to comply with all local codes and permit requirements.

Refuge Special Use Permit. During Plans & Specifications, the District will apply for this permit, issued by the USFWS Refuge Manager.

2. Construction Materials. Only common construction materials are required and can likely be obtained from local sources. Materials used for topographic diversity construction include dredged material. Refer to Appendix P, *Plates*, Plate 4 (B-101, *Boring Plan*) and Plates 5 and 6 (B-601 and B-602, *Boring Logs*) for more information. Stone will be used for the NE Bank restoration and

protection, GCS measure, and island restoration and protection measures. Refer to Appendix G, *Geotechnical Considerations*, for information on gradation sizes. Plants and trees to be planted will be obtained through approved nurseries using native sources.

3. Construction Schedule Constraints. Scheduling of construction contracts would depend on availability of funds, and based on expected funding, it is likely that the Project would be awarded in at least two construction contracts (plantings will likely be a separate contract).

- No clearing of trees shall be allowed between April 1 and September 30 to avoid impacts to bat roosting trees and maternity colonies.
- Construction staging and access points to Project measures will be defined during Plans & Specifications to avoid and minimize potential impacts to aquatic resources and freshwater mussel resources.
- Coordination with USFWS personnel is required prior to working during the seasonal waterfowl and deer hunting seasons. During peak hunting weekends or dates, all construction activities may be required to cease for a short period of time. The NWFR is actively used during the hunting season.
- No clearing of trees where roosting or occupied nests exist shall be allowed when bald eagles or red-shouldered hawks are present in the area. There is an active bald eagle nest within the Project area. Construction activities and other sources of disturbance should be avoided within a 660-foot buffer area from the nest, when active.
- In accordance with Executive Order 13186, take of migratory birds protected under the MBTA should be avoided or minimized, to the extent practicable, to avoid adverse impact on migratory bird resources.
- Placement of dredged materials and final preparation of the topographic diversity sites shall be completed before seeding and planting of vegetation will be allowed.
- Trees and shrubs shall be planted during optimum times for each species. Final planting dates will be coordinated during the P&S phase.

4. Construction Sequence. The probable construction sequence is summarized in Table VI-2; however, no sequence will be required contractually.

F. Operational Considerations

Operation and maintenance of UMRR HREPs is similar to that undertaken by the partner agencies in day-to-day management of parks, boat ramps, wildlife management areas, and other public use areas. The purpose of assigning O&M costs to the Project Sponsor is to ensure commitment and accountability. HREPs are designed and constructed to operate for 50 years with proper maintenance. This Project was designed to reduce overall operation costs. In general, operation is limited to routine inspections to ensure that the measures are performing as designed. Total estimates of annual operation costs are shown in Section VIII, *Cost Estimates*. A complete list of operation needs would be provided in an O&M manual following construction completion and preparation of as-built drawings, and prior to transferring the project to the USFWS.

DRAFT

Table VI-2: Steamboat Island HREP Probable Construction Sequence

Sequence	Construction	Instructions	Purpose
1	TSI (Year 1) and Temporary Access Grant Slough 4 & 5 (tree cutting and clearing)	Tree clearing can occur only between Oct 1 & Mar 31.	Clearing areas in preparation for new seed and/or plantings.
2	GCS, NE Bank, and West SE Island bankline protection	Riprap likely to be handled multiple times.	Constructing this in an earlier construction stage would ensure that USI Head, GCS, NE Bank, and West SE Island
3	Excavate Dredge Cuts for Upper Lake Aquatic Diversity	Two flat barges moving between floating plant and placement sites.	Provide aquatic diversity.
4	Transport Material to various Topographic Diversity Placement Sites	Material likely to be handled multiple times.	Elevate areas for better tree survival.
5	Shape Topographic Diversity Placement Sites	Sufficient drying time of 9 months between placement and shaping will be required.	Match elevations defined by inundation criteria
6	TSI cutting and clearing (Year 2) and TSI tree and shrub planting (Year 1)	Tree clearing can occur only between Oct 1 & Mar 31.	Clearing areas in preparation for new seed and/or plantings. Plantings improve forest diversity.
7	TSI cutting and clearing (Year 3), TSI tree and shrub planting (Year 2, and Cover Crop seeding.	Tree clearing can occur only between Oct 1 & Mar 31. Plantings between Oct 15 & Dec 5. Cover Crop seeding Apr 1 to May 20 & Aug 20 to Sep 20.	Clearing areas in preparation for new seed and/or plantings. Plantings and seeding improve forest diversity.
8	Lower Lake Aquatic Diversity Dredging, Grant Slough Access Dredging, West SE Island Construction, NW Grant Slough Lake Aquatic Diversity Dredging, Grant Slough Sites 4 and 5 Temporary Access (placement).	Two flat barges moving between floating plant and placement sites.	Provide aquatic diversity.
9	Transport Material to various Topographic Diversity Placement Sites	Material likely to be handled multiple times.	Elevate areas for better tree survival.
10	Shape Topographic Diversity Placement Sites	Sufficient drying time of 9 months between placement and shaping will be required.	Match elevations defined by inundation criteria
11	TSI tree and shrub planting (Year 3) and Cover Crop seeding.	Containerized tree and shrub plantings between Oct 15 & Dec 5. Cover Crop seeding Apr 1 to May 20 & Aug 20 to Sep 20.	Plantings and seeding improve forest diversity.
12	Additional Cover Crop Seeding, Native Species Planting, Bare Root Seedling Planting, and Planting	Cover Crop seeding Apr 1 to May 20 & Aug 20 to Sep 20. Native Species Planting, Bare Root Seedling Planting, and	Plantings and seeding improve forest diversity.
13	Containerized tree and shrub planting begins.	Fast-growing containerized tree and shrub plantings between Oct 15 & Dec 5.	Plantings improve forest diversity.
14	Additional Cover Crop seeding, Additional Native Species Planting, Bare Root Seedling Planting, and Planting Forbes/Grasses.	Cover Crop seeding Apr 1 to May 20 and Aug 20 to Sep 20. Native Species Planting, Bare Root Seedling Planting, and Plant Forbes/Grasses plantings between Apr 1 & May 20.	Plantings and seeding improve forest diversity.
15	Containerized tree and shrub planting ends.	Slow and fast-growing containerized tree and shrub plantings between Oct 15 & Dec 5.	Plantings improve forest diversity.

DRAFT

G. Maintenance Considerations

The proposed measures have been designed to ensure low annual maintenance requirements. Maintenance will include replacing rock and removing vegetation and debris from the NE Bank restoration and protection, GCS measure, and island restoration and protection measures. The estimated annual maintenance costs are presented in Section VIII, *Cost Estimates*. Maintenance requirements would be further detailed in the Project's O&M manual published after construction completion and preparation of as-built drawings, and prior to transferring the project to the USFWS.

H. Repair, Rehabilitation and Replacement Considerations

Repair, rehabilitation and replacement considerations may extend outside of the typical 50-year period of analysis, as the USFWS is expected to maintain the HREP as outlined in the Memorandum of Agreement (MOA). Rehabilitation cannot be accurately measured during P&S or construction phases. Rehabilitation is the reconstructive work that significantly exceeds the annual O&M requirements and is needed as a result of major storms or flood events.

I. Value Engineering

A Value Management Plan will be completed during the P&S phase. Numerous Value Engineering (VE) studies have been conducted on previous UMRR HREPs with similar measures (topographic diversity, bathymetric diversity, and overwintering habitat) within the past several years.

DRAFT

SECTION VII. PROJECT IMPLEMENTATION SCHEDULE

Table VII-1 presents the Project Implementation Schedule.

Table VII-1: Project Implementation Schedule

Event	Scheduled Date
District Quality Control Review – Feasibility	January 2020
Major Strategic Command Decision Milestone Meeting	April 2020
Agency Technical Review	May 2020
Public Review of Draft Report	May 2020
Submit Final Feasibility Report to MVD	September 2020
Approved Final Feasibility Report from MVD	December 2020
Execute the Memorandum of Agreement with the USFWS	March 2021
Initiate Design for First Stage	September 2020
Complete All Construction Stages	2028

DRAFT

SECTION VIII. COST ESTIMATES

Table VIII-1 compares costs for the fully funded estimate (FFE) and the current working estimate (CWE) (Appendix I, *Cost Estimate*). The FFE was calculated based on the proposed construction schedule, expected escalation costs, and a contingency factor, and represents the money expected to be spent at the end of construction. The detailed CWE of Project design and construction costs is presented in Table VIII-2. Quantities and costs may vary during final design.

Table VIII-1. Project Design and Construction Cost Estimates (February 2020 Price Level)

Account	Measure	FFE[1]	CWE
01	Lands and Damages	$0	$0
06	Fish and Wildlife Facilities	$19,694,025	$17,471,137
16	Bank Stabilization	$8,968,695	$8,218,628
30	Planning, Engineering and Design	$6,259,284	$4,321,200
31	Construction Management	$3,018,922	$2,628,000
	Project Cost Estimates	**$37,940,926**	**$32,638,965**

[1] Fully funded estimate is marked up to midpoint of construction for each construction stage

A. Performance Monitoring and Adaptive Management. Costs for performance monitoring to determine the degree which the Project is meeting the success criteria and for informing potential adaptive management decisions are summarized in Table VIII-3. See Section X, *Project Performance Monitoring*, and Appendix K, *Monitoring and Adaptive Management Plan*, for a full description of post-construction evaluation, including performance monitoring and long-term performance reporting, and adaptive management activities. Performance monitoring and adaptive management are projected to approximately 10 years.

DRAFT

Table VIII-2. Detailed Cost Estimate of Current Working Estimate with Contingency

Account Code	Item	Quantity	Unit	Amount	Contingency (%)	Escalation	Total Cost with Contingency CWE
CONSTRUCTION COSTS							
06	Adaptive Management	1	LS	$212,484	20.0	0	$254,980
32	Mobilization and Demobilization	1	LS	$1,140,670	20.0	0	$1,368,804
06	Dredging, Placement, and Shaping	1	LS	$9,421,514	20.0	0	$11,305,817
06	Topographic Diversity (Forestry Planting)	1	LS	$515,246	20.0	0	$618,295
06	Topographic Diversity (SSP Planting)	1	LS	$123,871	20.0	0	$148,645
06	Island Restoration & Protection (SE) Island)	1	LS	$1,241,550	20.0	0	$1,489,860
06	Timber Stand Improvement (TSI)	1	LS	$1,761,692	20.0	0	$2,114,030
16	Bank Stabilization (Stone Protection)	1	LS	$6,374,830	20.0	0	$7,649,796
	Survey and Quality Control	1	LS	$616,281	20.0	0	$739,538
TOTAL CONSTRUCTION COSTS		**$21,408,138**				**$25, 689,765**	
PLANNING, ENGINEERING, & DESIGN (PED) COSTS							
30	P&S, EDC	1	LS	$3,601,000	20.0	0	$4,321,200
						TOTAL PED COSTS	**$4,321,200**
CONSTRUCTION MANAGEMENT COSTS							
31	Construction Management	1	LS	$2,190,000	20.0	0	$2,628,000
						TOTAL CONSTRUCTION MANAGEMENT COSTS	**$2,628,000**

TOTAL PROJECT COSTS $32,638,965

DRAFT

Table VIII-3: Estimated Performance Monitoring and Adaptive Management Costs ($) (February 2020 Price Level)

				Post-Construction Years									
Objective	**Work Category**	**Activity**	**PED**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**9**	**10**	**Total**
Floodplain Forest Diversity	Monitoring, Analysis, Reporting	Forest Plot Survey Monitoring [2]	-	$6,000	$6,000	$8,000	$8,000	$12,000	-	$12,000	$12,000		$64,000
													Floodplain Forest Diversity Subtotal: $64,000
Aquatic Diversity	Monitoring, Analysis, Reporting	Backwater Bathymetry[1]	-	-	-	-	-	$30,000	-	-	-	$30,000	$60,000
		Water Quality/ Data Analysis	-	$4,000	$4,000	$4,000	$4,000	$6,500	-	-	-	-	$22,500
	AM: NE Bank/GCS modification								$255,000				$255,000
													Aquatic Diversity Subtotal: $337,500
Island Restoration/Protection	Monitoring, Analysis, Reporting	Topographic, LiDAR, or Remote Sensing surveys [2]	-	-	-	$30,000	-	$30,000	-	-	-	$60,000	$120,000
													Island Restoration and Restoration Subtotal: $120,000
Backwater/ Interior Wetlands Protection	Monitoring, Analysis, Reporting	Topographic or LiDAR surveys [2]	-	-	-	$30,000	-	$30,000	-	$60,000	-	-	$120,000
		Backwater Bathymetry	-	-	-	-	-	$30,000	-	-	-	$30,000	$60,000
		Water Quality/Data Analysis	-	$4,000	$4,000	$4,000	$4,000	$6,500	-	-	-	-	$22,500
		Scrub-Shrub/Pollinator Habitat Monitoring [3]	-	-	-	-	-	-	-	-	-	-	(footnote 3)
	AM: NE Bank modification								$191,000				(footnote 4)
													Backwater/Interior Wetlands Protection Subtotal: $202,500
													TOTAL $724,000

[1] Fish surveys completed by the IADNR will aid in determining success of the aquatic habitat component.

[2] Topographic, LiDAR, or Remote Sensing surveys will be conducted for the whole Project concurrently, the cost of which is $60,000. This survey will assess Island Protection/Restoration and Backwater/Interior Wetlands Protection objectives; distribution of costs between objectives is reflected in the Table.

[3] Forestry monitoring cost estimates include SSP monitoring costs, as surveys are conducted concurrently.

[4] Backwater/Interior Wetlands Protection Adaptive Management (NE Bank Modification) costs are accounted for in Aquatic Diversity Adaptive Management

DRAFT

B. Long-Term Performance Reporting. Costs for collection of basic site-inspection data to report long-term Project performance are summarized in Table VIII-4. These costs include preparation of Performance Evaluation Reports that summarizes the Project's long-term ability to meet Project success criteria, inform O&M adjustments, and provide basic data for planning purposes. This monitoring starts following completion of performance monitoring and adaptive management (approximately 10 years), if implemented, with the exception of water quality monitoring. Long-term performance reporting is a UMRR Program cost and not included in the Steamboat Island HREP cost estimate.

Table VIII-4. Estimated Long-Term Annual Monitoring Costs ($)

Site Inspections	Unit Cost	Frequency	Year Start	Quantity	Total Cost
Water Quality	$11,000	Every Year	6	20	$220,000
Bathymetric Survey	$60,000	Every 5 Years	11	8	$480,000
Forestry Survey	$20,000	Every 10 Years	15	4	$80,000
Reporting	$15,000	Every 5 Years	11	8	$120,000
				Subtotal	**$900,000**
				Contingencies (20%)	**$180,000**
				TOTAL	***$1,080,000***

C. Operation and Maintenance Considerations. The proposed Project measures have been designed to ensure low annual O&M requirements (Table VIII-5). O&M may include performing inspections and debris removal from rock structures. The estimated total annual O&M cost is $7,200. These quantities and costs may change during final design. Significant changes in O&M will be coordinated with the Sponsor. A complete list of O&M needs will be provided in an O&M manual following construction completion and preparation of as-built drawings, and prior to transferring the project to the USFWS.

Table VIII-5. Estimated Annual Operation and Maintenance Costs (February 2020 Price Level**)**

	Quantity	Unit	Unit Price ($)	Total Cost ($)
Operation				0
Maintenance				
Site Inspections (all measures)	40	Hours	50	2,000
Debris Removal (rock structures)	80	Hours	50	4,000
			Subtotal	**$6,000**
			Contingencies (20%)	**$1,200**
			TOTAL	***$7,200***

D. Repair, Rehabilitation, and Replacement Considerations. For analysis purposes, the costs presented for O&M used the 50-year period of analysis. The USFWS is expected to operate and maintain the Project per the agreed-to terms in the Memorandum of Agreement (Appendix C) and should expect to incur costs associated with this responsibility outside of the 50-year period of analysis. Table VIII-6 lists the major Project components and their associated frequencies of repair, rehabilitation, and replacement. Estimates of these costs will be included in the O&M manual.

DRAFT

Table VIII-6. Repair, Rehabilitation, and Replacement Considerations

Component	Frequency
Replace Rock Structures	Every 75 Years
Rehab Aquatic Diversity Areas	Every 60 Years

E. Annual Habitat Unit Cost. The costs used for analysis purposes include total Project costs, IDC, and annualized O&M, adaptive management, and monitoring costs. The annualized costs and AAHUs were used to calculate a total annual cost per annual habitat unit (Table VIII-7). The total cost per habitat unit is $4,110.

DRAFT

Table VIII-7. Total Annual Cost per Annual Habitat Unit ($000)

Construction Cost	IDC	Total Project Costs	Annual Construction Cost	Annual O&M	Annual Adaptive Management	Annual Monitoring Costs	Total Annual Costs	AAHUs	Total Annual Cost/AAHU
$35,262	$7,524	$42,786	$1,585	$7	$8	$15	$1,615	393.07	$4.11

DRAFT

SECTION IX. ENVIRONMENTAL EFFECTS OF THE TENTATIVELY SELECTED PLAN

The following sections describe the potential environmental effects (both adverse and beneficial) the TSP may have on the resources addressed in Section II, *Affected Environment*. The discussion is organized by potential direct, indirect, and cumulative effects on the identified resources. The No Action, or Future Without Project (FWOP), Alternative is discussed in Section II.O.

A. Short-Term Construction Effects

The proposed Project construction would take place within Steamboat Island proper, Grant Slough, and the West SE Island. No measurable change in floodplain storage would occur as a result of the Project, and the Project would not directly induce additional development within the floodplain. More detailed information is available in Section IX.B., *Floodplain Resources*, and Appendix H, *Hydrology and Hydraulics*.

There are several publicly-owned and managed options for staging and access within the Project area and Pool 14. All public access locations are currently developed and would not result in environmental impacts or impacts to recreation. Minor short-term impacts in the form of dust, noise, and temporary disruption of traffic may result, at times, from increased travel to the staging and construction area.

Construction of the Project measures would require approximately 1.3 acres (currently identified) for tree clearing and access to enable topographic diversity site construction. Temporary disruptions to wildlife are likely to occur. This includes Indiana and northern long-eared bats, which likely use a part of the area for feeding and roosting. The area designated for clearing is not anticipated to negatively affect primary roost trees, primary feeding corridors, and areas of high bat activity. No clearing of trees shall be allowed between April 1 and September 30 to avoid the bat maternity roosting season. There is an active bald eagle nest located at the northern end of Steamboat Island. Any tree thinning would be minimal near this area to avoid disturbance. Seasonal limitations will be in compliance with USFWS regulations and adhere to buffer restrictions (660 feet) during periods when the nest is active. The Corps, in consultation with the USFWS (see Appendix A, *Correspondence*), anticipates no long-term adverse effects to wildlife, Indiana bats, northern long-eared bats, or bald eagles as a result of this Project.

Disruption of the habitat during tree planting would be minimal. Post-planting and periodic operation and maintenance procedures, such as undesirable vegetation control through hand pulling or herbicide treatments, would have little impacts on the environment. Any required herbicide treatments would be applied by a licensed applicator using state and Federal standards, thus minimizing potential localized impacts.

Construction activity would temporarily increase turbidity immediately downstream of the proposed dredge cuts and in-water construction. Material will be mechanically excavated and placed in the floodplain. Although macroinvertebrate density and diversity is relatively low, temporary disruption and minor loss is expected to occur through dredging and rock placement. A 2019 mussel survey was conducted in Grant Slough and the West SE Island. The West SE Island area revealed very few live mussels, most of which were common, tolerant species (refer to Section II.D.3 for previous mussel survey results in the Project area). There were no federally-listed endangered species encountered during this survey and only one Illinois-state listed species (black sandshell) that occurred was well outside the design footprint of the West SE Island. Project survey efforts identified a species-rich

DRAFT

assemblage of mussels within Grant Slough, with pockets of higher density areas. The surveys will be used to inform the alignment of the access channel dredging within Grant Slough to avoid and minimize impacts to areas of higher mussel densities. These areas should be recolonized shortly following construction.

B. Floodplain Resources

The measures of the proposed plan will improve the ecological structure and function for approximately 950 acres of bottomland forested wetland habitat through an increase in floodplain elevation, hard mast tree plantings, and implementation of TSI strategies. This is highly important as floodplains are important elements of regional landscapes, controlling ecosystem processes (e.g., sediment deposition, nutrient cycling, and community succession), ecosystem properties (e.g., soil texture, fertility, and plant species composition,), and ecosystem services (e.g., denitrification and biodiversity), making them biodiversity hotspots in the landscape. Of these floodplain characteristics, the proposed plan would directly or indirectly benefit all of them.

Section II, *Affected Environment*, explained roughly 51% of the island is at an elevation (>574 feet) assumed suitable for hard mast-producing trees. The areas with hard mast trees present were, on average, over 88 years-old (ranges 1874 to 1964) and contained little production in the understory. This lack of production is directly related to increased water inundation and duration. Current topography shows a significant portion of the Project area is low in elevation and below the threshold for producing a sustainable nut producing tree population. It is highly unlikely hard mast-producing trees will regenerate without intervention in the next 50 years. The proposed plan effectively works to stop and reverse this trend, which should increase habitat availability and quality for migratory birds (i.e., neotropical, waterfowl, bald eagle, heron), endangered species (i.e., Indiana bat, northern long-eared bats), general wildlife, reptiles and amphibians, etc.

The following structural and functional elements contribute to the overall habitat value and benefits of the Project.

1. **Increase Topographic Diversity**. A critical element to floodplain forest diversity is water inundation duration. Lower elevations flood more often and for longer periods of time than higher elevations, which influences nutrient cycling, germination, and growth of native tree species (De Jager et al., 2012). Benefits from the proposed measures result from the increased elevation of the Project in relation to the pre-dam reference condition. The increased elevation promotes tree survival, establishment, production, and sustainability, and an increase in habitat complexity and diversity. Although at a small scale, nutrient uptake and cycling at the Project site could reduce nutrient delivery downstream.

2. **Increase Hard Mast Tree Species**. Currently 18 species of native trees are present. In addition to increases in elevation and habitat quality, benefits are accrued from an increase in tree species (Appendix M, *Engineering Design*, Attachment F). An increase in hard mast species provides habitat diversity, which increases cover, food, and reproduction habitat for a wide variety of floodplain species. This is especially important for the federally-endangered Indiana bat and northern long-eared bat, and numerous species covered under the MBTA (e.g., foraging and reproductive habitat for diving and dabbling duck, herons, shorebirds, bald eagles, etc.) that will benefit from increased foraging and roosting opportunities.

DRAFT

3. Increase Mast Tree Sustainability. Over 3,000 containerized trees from 7 hard mast-tree species will be planted above the 2-year flood elevation, which has been shown to be the critical threshold for hard mast tree survival (De Jager et al., 2012). An increase in survival increases seed production and dispersal. As such, regeneration and recruitment opportunities will increase, which creates additional reproduction, foraging, and cover habitat for all floodplain species, including the local avian community.

4. Increase Pollinator Habitat. Protection and establishment of wild flowers and prairie grasses that produce attractants are vital to pollinator conservation. The Project area has limited wildflower production due to reed canarygrass domination; areas that have the potential to establish flower producing shrubs/vegetation are overtaken by this invasive species. Over ten acres of SSP habitat will be restored to provide benefits to essential pollinators in the surrounding area.

5. Reduction in Forest Fragmentation. Well-connected floodplain forest communities are critical for wildlife dispersion, migration, survival, habitat quality, and a buffer against undesirable species. Without intervention, the area would convert to a mix of silver maple forest, moist soil species, and reed canarygrass, which has less habitat value than a diverse floodplain. This conversion would also impact migratory birds and listed bat species that rely on well-connected diverse forest habitat for migration, nesting, and foraging purposes. The strategic locations of the constructed placement sites and associated planting of desirable species would buffer against fragmentation and provide a mosaic of interconnected habitat throughout the Project.

6. Limit Invasive Species Distribution. Over time, the over-mature silver maple stand will experience significant mortality. As a result, canopy openings could increase reed canarygrass establishment. This has already been documented within the UMRS and is expected to continue. An increase in elevation increases hard mast tree production, and the operation and maintenance of the Project will limit opportunities for invasive species establishment.

7. Backwater Habitat Protection. Topographic diversity sites, the NE Bank, and the GCS will serve as protection for the excavated backwater lakes during high water events. The sites would function as flow breaks, resulting in reduced sediment deposition within the backwaters, decreased turbidity, increased water clarity, and decreased flow.

C. Aquatic Resources

Additional discussion of aquatic and water quality impacts is contained in Appendix B, *Clean Water Act, Section 404(b)(1) Assessment: NWP 27 Justification.* The proposed plan would benefit 614 acres of aquatic habitat, both directly and indirectly, through an increase in backwater and riverine habitat structure and function. Specifically, backwater habitat is improved through increased depths and improved water quality for aquatic organisms. Riverine habitat geomorphic processes are improved through a reduction of island erosion and restoration of side channel structure and function. This not only improves habitat for all types of riverine fish species, but it also prevents degradation of an existing freshwater mussel community containing at least one federally-listed Higgins eye pearlymussel.

DRAFT

Of the available backwater habitat in the Project area, only about 0.14 acres are suitable depth for overwintering, mainly located in Upper Steamboat Lake (see Section II, *Affected Environment*). Overwintering habitat is a limiting habitat type due to the shallow nature of the backwater, ice cover, and flows into the Project. The following structural and functional elements contribute to the overall habitat value and benefits.

1. Increased Backwater Depths. Nearly 614 acres of aquatic habitat will be improved as a result of this Project. Of the 127 acres classified as lentic habitat, approximately 29 acres (with depths > 4 feet) will be immediately improved for the purposes of overwintering fish habitat, with the remainder contributing significantly to the year-round habitat required by fish in the UMRS. This represents an increase from 0.11% to nearly 22% in overwintering habitat. Currently, overwintering habitat is limited in Pool 14 and is mainly attributed to reduced depths in backwaters, which will be addressed by this Project. Increased depths provide areas where higher water temperatures and DO can persist in the winter. Year-round habitat is improved by increasing lateral and longitudinal connectivity for overwintering, spawning, and rearing habitat connectivity, and access to movement corridors.

2. Reduced Island Erosion and Restoration of Side Channel Function. Island habitat in the UMRS is highly valuable for habitat diversity, and has been steadily declining in Pool 14. Installation of rock protection at the restored USI Head will reduce erosive forces, restore valuable off-channel fish habitat, and facilitate the restoration of geomorphic processes and habitat function. Implementation of rock protection at the restored West SE Island would facilitate sediment deposition at the tail-end of the island, resulting in an increase in island acreage, wildlife habitat diversity, and potential tree production. The tail-end of the island will also serve as shallow, low flow sandbar habitat desired by shorebirds, turtles, and riverine species (e.g., shovelnose sturgeon, catfish, and walleye). The flow refuge afforded by the island will be critical low-flow foraging and nursery habitat for both backwater and riverine fish species. Finally, the rock protection is critical to limit the continued deterioration of the West SE Island because without the island, the side channel ceases to exist, converting this area to main channel habitat. This particular side channel lies within the Cordova EHA established for the recovery of the endangered Higgins eye pearlymussel. Without this side channel, the freshwater mussel community, including federally-listed mussels, inhabiting the EHA and adjacent side channel may be negatively impacted.

3. Fish and Mussel Substrate Improvements. As part of the Project, fish habitat (e.g., rock substrate, large woody debris) and mussel habitat (e.g., mixture of various sizes of river rock suitable as substrate for multiple mussel species) may be installed at the island protection sites and within aquatic diversity sites. This has immediate direct benefits to the fish and mussels that inhabit the area in the form of increased habitat structure and function.

D. Invasive Species

The effect of the Project on invasive species distribution and abundance were considered throughout the planning process. State and Federal natural resources agencies have weighed the benefits that this Project will have on invasive species, as well as to the native communities that it is intended to help sustain, and fully support this Project.

The proposed plan would buffer against reed canary grass population growth by managing canopy openings and promoting tree growth which would shade this invasive grass species. The increased

elevation and diversity of planted scrub-shrub species and tree species should work to out-complete reed canary grass growth.

Invasive aquatic plants such as Eurasian watermilfoil may colonize the bathymetric diversity components of this Project as sedimentation reduces depths of dredged areas to the point where light can penetrate to the bottom and rooted aquatic plants can become established. This successional process occurs in most backwaters within the UMR as they fill with sediment over time and is unavoidable.

The proposed Project includes measures that will increase off-channel habitat, which may potentially be used by juvenile and adult Asian carp in future years, as they have currently migrated as north as Pool 16 (Kolar et al., 2005). However, if these species do migrate into the Project area, this additional habitat is unlikely to have a major effect on the abundance of these species because it comprises only a small component of the overall habitat available in Pool 14. The TSP is consistent with Strategy 3.2.3 identified in the Asian Carp Working Group's *Management and Control Plan for Bighead, Black, Grass, and Silver Carps in the United States* (Conover et al., 2007), which recommends that natural resources managers minimize the potential range expansion of Asian carp in conjunction with actions that enhance the aquatic environment to sustain native biological communities. The PDT recognizes the risk of this Project being used by Asian carp due to the dynamic nature of dispersal and inter-specific competition, however, the known positive benefits of these rehabilitated habitats for native species are well known. Healthy native fish populations and their habitats is one of the major priorities of management agencies for slowing the spread of non-native organisms.

Natural resources managers recognize that there will always be some degree of risk that a project will unintentionally enhance the spread of invasive species because of the dynamic nature of dispersal and inter-specific competition that cannot be fully understood until after a nuisance species becomes prolific.

E. Endangered and Threatened Species

The Higgins eye pearlymussel, sheepnose mussel, spectaclecase mussel, Indiana bat, and Iowa Pleistocene snail are federally-endangered species listed in the Project area, while the prairie bush clover, Western and Eastern prairie fringed orchid, Eastern massasauga, and northern long-eared bat are listed as federally-threatened species. The TSP was revised to avoid and minimize impacts to federally-listed mussel species and a follow-up survey in 2019 yielded no federally-listed mussel species within the TSP footprint. In coordination with the USFWS, the 2019 survey results precluded the need for a Biological Assessment and the District determined the proposed Project *May Affect,* but is *Not Likely to Adversely Affect* the Higgins eye pearlymussel, due to the potential impacts from in-water rock and dredged material placement, as well as necessary access dredging (approximately 5.6 acres). The determination for listed bats included the seasonal limitations on tree clearing and conservation measures that will be in place to avoid important maternity colonies during construction. The USFWS replied to the District's informal consultation letter with a concurrence letter dated February 21, 2020 (Appendix A, *Correspondence*).

Table IX-1: Determination of Effects from Proposed Modifications for Federally-listed Species

Species	Scientific Name	Status	Determination of Impacts
Indiana Bat	*Myotis sodalis*	Endangered	Not Likely to Adversely Affect
Northern Long-Eared Bat	*Myotis septentrionalis*	Threatened	Not Likely to Adversely Affect
Higgins Eye Pearlymussel	*Lampsilis higginsii*	Endangered	Not Likely to Adversely Affect
Sheepnose Mussel	*Plethobasus cyphyus*	Endangered	No Effect
Spectaclecase Mussel	*Cumberlandia monodonta*	Endangered	No Effect
Eastern Massasauga	*Sistrurus catenatus*	Threatened	No Effect
Prairie Bush Clover	*Lespedeza leptostachya*	Threatened	No Effect
Western Prairie Fringed Orchid	*Platanthera praeclara*	Threatened	No Effect
Eastern Prairie Fringed Orchid	*Platanthera leucophaea*	Threatened	No Effect
Iowa Pleistocene Snail	*Discus macclintocki*	Endangered	No Effect

1. Direct Effects

a. Indiana Bat and Northern Long-Eared Bat. The Project includes approximately 1.3 acres of tree clearing for access to topographic diversity sites. The overall forested habitat that exists on Steamboat Island proper is approximately 1,674 acres. When compared to the number of acres potentially affected by the Project, the District determined it to be about 0.07% of the total. This limited amount of tree removal will not result in fragmentation of bat roosting or foraging habitat and cleared areas will be replanted following the completion of construction. Further, tree clearing will be completed outside of the bat active period; therefore, removal of unidentified maternity roost trees is unlikely to result in the incidental take of Indiana or northern long-eared bats.

b. Higgins Eye Pearlymussel. The proposed excavation, including access dredging, of the backwaters in the Project area should have no direct impacts to the Higgins eye pearlymussel because the backwaters do not appear to contain suitable habitat.

As part of the restoration of the head of Steamboat Island and the West SE Island, the Project proposes to install bank stabilization to reduce island erosion. The construction of the bank stabilization would potentially affect approximately 4,130 linear feet of substrate through rock placement at the head of Steamboat Island and 380 linear feet of substrate at the West SE Island. Shifting sand and/or flocculent silt conditions within this footprint are generally not considered to be ideal for Higgins eye. Furthermore, they were not collected within this immediate area during extensive mussel surveys. Collectively, there is a low likelihood of presence.

Higgins eye pearlymussel has been found to occur within the Project area with six individuals found during a 2018 survey at the East SE Island. As a result, the East SE Island was removed from further consideration. The West SE Island was retained and the District conducted an effects analysis to determine the extent to which placement of rock would influence the hydraulics of the channel, thus potentially impacting the structure and function of the existing mussel bed. This approach inductively derives a spatially explicit model of mussel habitat suitability directly from study area data (i.e., mussel occurrences, site-scale modeled hydraulic conditions).

Building upon a previous CART model developed by Zigler et al. (2008), machine-learning models (Phillips et al., 2006;), mussel community health metrics (Dunn et al., 2016), and best professional judgment (Kelner, pers comm., April, 2019), the District used a two-dimensional hydraulic model to

assess the degree to which the presence or absence of mussels might be impacted by the Project measures. Refer to Appendix M, *Engineering Design*, Attachment C, for more detailed information on the HREP Mussel Model. When comparing existing conditions to future with-project conditions at the West SE Island, the District found changes in velocity, shear stress, substrate composition, and channel slope may increase habitat suitability for mussels in this area. Furthermore, Figure IX-1 demonstrates how the derived mussel habitat suitability model estimated a higher probability of suitable mussel habitat (red indicates areas of higher mussel habitat suitability) in the with-Project condition, suggesting conditions are not likely to change significantly and may improve with-Project implementation (Figure IX-1).

DRAFT

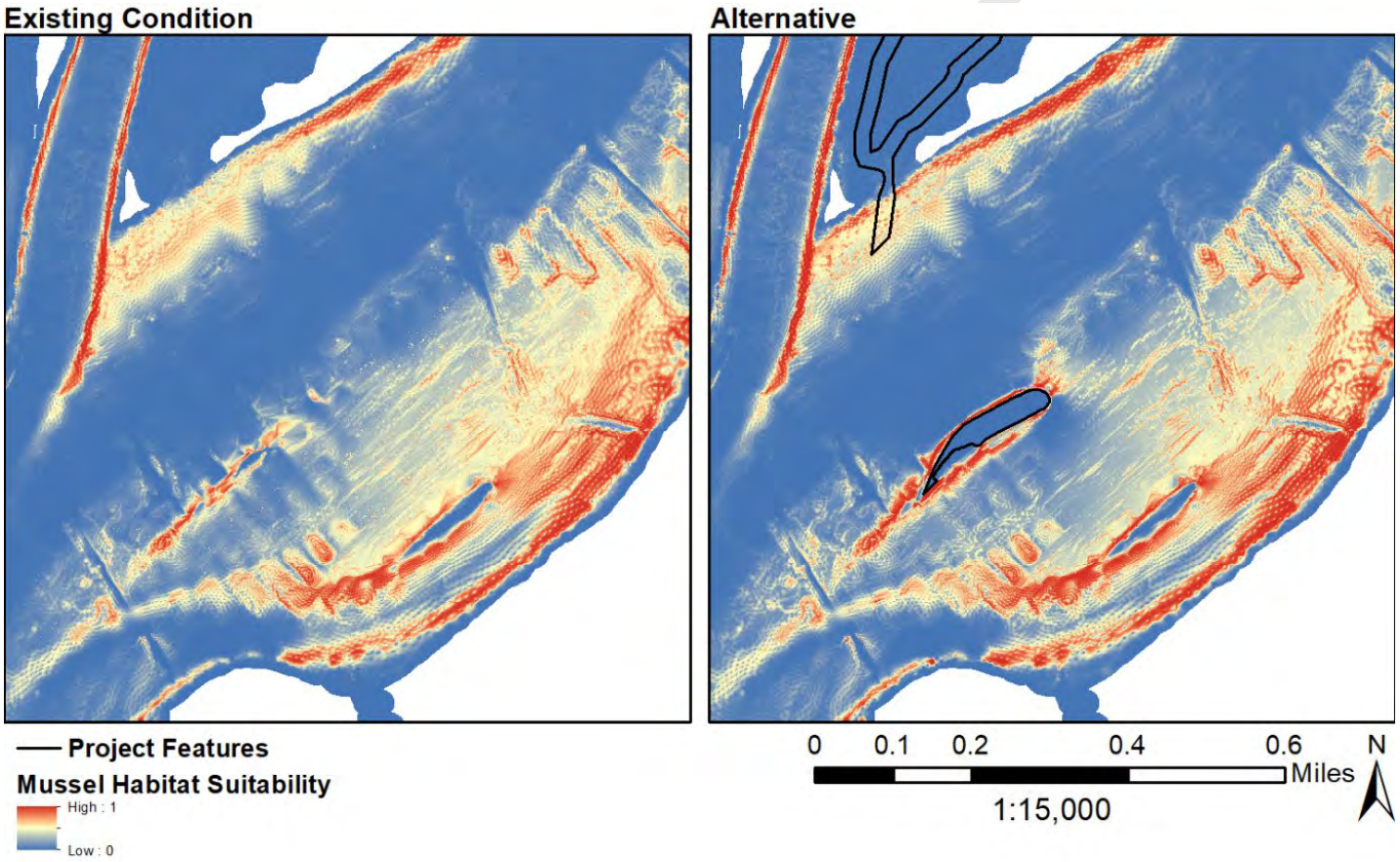


Figure IX-1: Spatially-explicit HREP Mussel Model of Existing and Future With-Project Implementation of the West SE Island

2. Indirect Effects. The TSP for the Steamboat Island HREP includes planting over 4,000 containerized trees from 15 species, 7 of which are native hard mast tree species. In addition, approximately 10 acres of a mix of several species of forested wetland shrub/scrub plants will be planted. Long-term, these plantings should provide the bat community with habitat complexity and diversity through increased forage opportunities and potential roost tree production. TSI throughout the island increases the habitat quality and value to all species, including the Indiana bat and northern long-eared bat.

Mussel habitat improvements, particularly near the southeast islands, provide increased opportunities for mussel colonization, growth, and reproduction in a pool that contains a designated EHA.

3. Cumulative Effects. Corps Foresters will continue to implement forest management measures after construction of this Project. Measures such as large-scale clearing of non-desirable trees, large scale tree plantings, and continued implementation of TSI strategies will contribute to the overall health and continued success of the forest community in the Project area.

Although this Project will avoid the clearing of identified primary roost trees and directly facilitate the creation of future tree snags, cumulative tree clearing activities potentially impacts the structure and function of the island habitat for feeding, resting, and reproduction activities.

F. Hazardous, Toxic, and Radioactive Waste

A Phase I ESA for the Steamboat Island HREP was conducted. The Phase I ESA revealed no evidence of a REC that could potentially affect the Project area. Based on the Phase I ESA, no further HTRW assessment is recommended. No HTRW impacts to the Project area or surrounding environment are anticipated (see Appendix E, *HTRW Documentation Report*).

G. Historic and Cultural Resources

The geomorphological and cultural evaluation of the Area of Potential Effect (APE) have been delayed due to excessive and prolonged high water and flooding of the Project area. Therefore, a full assessment of effects to cultural resources for the Project activities cannot be determined at this time. Initial project coordination letters were sent to consulting parties on December 20, 2019 (Appendix A, *Correspondence*). A Programmatic Agreement (PA) detailing cultural work to be conducted and coordinated with appropriate parties was drafted (Appendix O, *Draft Programmatic Agreement for Cultural Resources*). The draft PA was subsequently disseminated for review and comment on January 31, 2020. Coordination for this project and the associated PA are ongoing. Determinations of effect will be made upon execution of the PA.

While the Corps is assured that no historic properties would be affected by the TSP, if any undocumented cultural resources are identified or encountered during the undertaking, the Corps will discontinue Project activities and resume coordination with the consulting parties to identify the significance of the historic property and determine any potential effects.

DRAFT

H. Hydrology and Hydraulics

1. Discharge and Velocity. Velocities throughout the Steamboat Island proper will be reduced by the NE Bank and GCS, thereby providing conditions suitable for overwintering. The NE Bank will reduce the velocities in Upper Lake, and the GCS will reduce velocities in Lower Lake. The mussel habitat suitability model (Appendix M, *Engineering Design*, Attachment C*)* indicated minimal changes to the existing suitable mussel habitat distribution within the Project area and therefore no negative impacts to the existing mussel bed are expected as a result of the measures.

2. Inundation Duration. The topographic diversity enhancement measures will afford greater survivability to hard mast trees by increasing the elevation in order to reduce the frequency of long duration root inundation which results in mortality.

3. Sediment Deposition. The NE Bank and GCS are intended to help reduce sediment deposition throughout Upper Lake and Lower Lake by reducing input from a primary sediment source.

I. Socioeconomic Resources

1. Community and Regional Growth. No short-term or long-term impacts to the growth of the neighboring community or region are anticipated as a result of the Project. Recreational opportunities will be improved in the Project area, increasing the attractiveness of the area for wildlife observation, waterfowl hunting, sport fishing, boating, photography, and commercial fishing.

2. Community Cohesion. The proposed habitat restoration Project has positive impacts on community cohesion by attracting visitors and recreationists from other communities. Overall, the Project would have no adverse impacts to the quality of the human environment.

3. Displacement of People. There are no residential properties that would will be displaced.

4. Property Values and Tax Revenues. The Project area is federally-owned land managed by the USFWS. No change in property values or tax revenues would occur.

5. Public Facilities and Services. Temporary use of the local public boat ramps during construction will potentially limit availability for boat ramp usage. However, the proposed Project would positively impact public facilities and services by increasing habitat diversity, resulting in additional opportunities for recreational use of the area following construction.

6. Life, Health, and Safety. The Project poses no threats to the life, health, or safety of recreationists in the area.

7. Business and Industrial Activity. No substantial changes in business and industrial activities will occur during construction. Long-term impacts to business and industrial development would be related to tourism and recreational activities.

8. Employment and Labor Force. Short-term employment opportunities in the area may increase slightly during construction. The Project would not directly affect employment of the labor force in nearby Illinois and Iowa counties.

9. Farm Displacement. No farms or farmsteads would be displaced as a result of the proposed

Project. No prime and unique farmland would be impacted.

10. Aesthetic Values. Clearing of some woody vegetation would occur because of construction activities. Following construction, the area would be reseeded and planted with hard mast trees. No permanent adverse impacts to area aesthetics are anticipated. The enhancement of habitat areas would make the wildlife area more aesthetically pleasing to visitors.

11. Noise Levels. Heavy machinery will generate temporary noise during construction, disturbing wildlife and recreationists in the area. The Project area is rural with no significant, long-term impacts.

12. Air Quality. Minor, temporary increases to air quality due to construction activity may occur as a result of construction and transportation of materials.

J. Man-Made Resources

The proposed Project should not impact flood reduction levees in Iowa or Illinois. The Project would not result in any significant change in floodplain storage. Navigation training structures will not be impacted by this Project. Impacts to the navigation channel will not occur as a result of Project implementation.

K. Probable Adverse Impacts Which Cannot Be Avoided

An unavoidable adverse impact would be the clearing of vegetation for construction. In an effort to minimize tree clearing, the placement sites dominated by reed canarygrass were selected. The only area that will need to be cleared is located near Grant Slough to reduce the need for extensive access dredging for topographic diversity measures. This will require approximately 1.3 acres of clearing to accommodate the measures footprints, grading and shaping, and access. Clearing of existing vegetation, particularly over-mature silver maple stands, would be kept to the minimum required for construction activities and post-construction maintenance, and will adhere to seasonal restrictions recommended by the USFWS for protection of threatened and endangered species.

The loss of some benthic organisms currently inhabiting the footprint areas for bank stabilization and dredging is a likely effect of the proposed action. Following construction, benthic organisms should rapidly recolonize the excavated areas, especially due to the added habitat diversity created with stone placement and increased backwater depth.

L. Short-Term Versus Long-Term Productivity

Construction activities would temporarily disrupt wildlife and human use of the Project area. Long-term productivity for natural resource management would benefit considerably by the construction of this Project. Long-term productivity would be enhanced through increased reliability of hard mast-producing tree production, enhancement of existing submerged, emergent and wetland vegetation, and providing more dependable reproduction, foraging, and resting areas for migratory birds, resident wildlife, and aquatic species. Overall habitat diversity would increase, and both game and nongame wildlife species would benefit from the proposed Project. In turn, both consumptive and non-consumptive users would realize heightened opportunities for recreational use. Negative long-term impacts are expected to be minimal on all ecosystems associated with the Project.

DRAFT

M. Irreversible or Irretrievable Resource Commitments

The purchase of materials and the commitment of man-hours, fuel, and machinery to perform construction are irretrievable. Other than the aforementioned, none of the proposed actions are considered irreversible.

N. Relationship of the Proposed Project to Land-Use Plans

The proposed Project would not change the use of any floodplain or aquatic resources. If implemented, the Corps does not expect the proposed action to alter or conflict with other authorized Corps projects.

O. Cumulative Impacts

Cumulative effects occur when a relationship exists between a proposed action and other actions which have occurred, are occurring, or are expected to occur in a similar location. The primary area considered in the cumulative effects analysis is limited to Pool 14.

1. Past Actions. The most significant navigation action in Pool 14 was the authorization, construction, and operation and maintenance of the 9-foot Navigation Channel Project. Construction of L&D 14 raised water levels by as much as 7 feet. Floodplains are now inundated more often and for longer durations. Temporarily inundated wetlands were converted to permanently inundated lakes and sloughs. Several fluvial processes were disrupted, which includes sediment transport and hydrologic fluctuations. The effects from the construction can still be seen today with decreased topographic diversity, floodplain vegetation diversity, lack of regeneration, and shallow backwaters.

Portions of Pool 14 are periodically excavated to maintain the navigation channel by the District. As a result, several wingdams and closure structures have been constructed in the pool. While these areas provide some level of habitat for aquatic species, they also work to direct flows to the main channel and reduce flows in the secondary and tertiary channels. While construction of wingdams is not very likely in the near future, dredging and O&M of existing structures will continue.

Construction of the Princeton Refuge HREP (RM 504.0–506.4) was completed in 1998. The HREP was developed to reduce forest fragmentation, increase bottomland hardwood diversity, and enhance migratory waterfowl habitat.

2. Present and Foreseeable Actions. The Corps will continue to operate and maintain the 9-foot Navigation Channel Project. This includes continuation of dredging, placement of material, and construction, operation, and maintenance of river regulating structures (i.e., chevrons, closing structures, and wingdams).

Corps Foresters will continue to implement TSI measures at locations within the Project area. These measures include tree thinning, hard mast tree plantings, and non-desirable vegetation maintenance. These efforts will continue in the future on the island

Cumulative impacts of the proposed action are not expected to be significant. The proposed Project should have positive long-term benefits to the fish, wildlife, and other natural resources inhabiting the

DRAFT

area. This Project, in concert with Princeton Refuge HREP, Beaver Island HREP, and ongoing forestry management strategies, should counter some of the past, current, and foreseeable actions described earlier. In total, 56 HREPs have been completed, benefiting nearly 106,000 acres on the UMRS. Twenty-two projects are in various stages of planning, engineering, or design, which will benefit another 65,000 acres of habitat when implemented.

3. Compliance with Environmental Statutes. See Table IX-2.

Table IX-2: Relationship of Plans to Environmental Protection Statutes and Other Environmental Requirements

Federal Environmental Protection Statutes and Requirements	**Applicability/ Compliance[1]**
Analysis of Impacts on Prime and Unique Farmland (CEQ Memorandum, 11 Aug 80)	Not Applicable
Archaeological and Historic Preservation Act, 16 U.S.C. 469, et seq.	Pending[2]
Clean Air Act, as amended, 42 U.S.C. 1857h-7, et seq.	Full Compliance
Clean Water Act, Sections 404 and 401	Full Compliance
Corps of Engineers Planning Guidance Handbook (ER 1105-2-100)	Full Compliance
Endangered Species Act of 1973, as amended, 16 S.C. 1531, et seq.	Full Compliance
Executive Order 11988 – Floodplain Management	Full Compliance
Executive Order 11990 - Protection of Wetlands	Full Compliance
Executive Order 12898 – Environmental Justice	Full Compliance
Executive Order 13112 - Invasive Species	Full Compliance
Farmland Protection Policy Act. 7 U.S.C. 4201, et seq.	Not Applicable
Federal Water Protection Recreation Act, 16 U.S.C. 460-(12), et seq.	Full Compliance
Fish and Wildlife Coordination Act, 16 U.S.C. 601, et seq.	Full Compliance
Green House Gases, CEQ Memorandum 18, Feb 2010	Full Compliance
Land and Water Conservation Fund Act, 16 U.S.C. 460/-460/-11, et seq.	Not applicable
National Environmental Policy Act, 42 U.S.C. 321, et seq.	Pending[3]
National Historic Preservation Act, 16 U.S.C. 470a, et seq.	Pending[2]
Rivers and Harbors Act, 33 U.S.C. 403, et seq.	Full Compliance
Watershed Protection and Flood Prevention Act, 16 U.S.C. 1001, et seq.	Not Applicable
Wild and Scenic Rivers Act, 16 U.S.C. 1271, et seq.	Not Applicable

[1] Full Compliance = having met all requirements of the statute for the current stage of planning, Not Applicable = no requirements for the statute required.
[2] Pending execution of the Cultural Programmatic Agreement
[3] The Project will be in full compliance with NEPA once the Finding of No Significant Impacts is signed.

The Environmental Operating Principles (EOPs) outline the Corps' role and responsibility to sustainably use and restore our natural resources in a world that is complex and changing. The TSP meets the intent of the EOPs. The PDT proactively considered the environmental consequences of the proposed Project, as well as the benefits of the TSP. The Project would be constructed in compliance with all applicable environmental laws and regulations. In accordance with the EOPs, the Corps has proposed a Project that supports economic and environmentally sustainable solutions.

SECTION X. PROJECT PERFORMANCE MONITORING

Per Section 2039 of WRDA 2007, monitoring for ecosystem restoration studies will be conducted to determine Project success. "Monitoring includes the systematic collection and analysis of data that provides information useful for assessment of Project performance, determining whether ecological success has been achieved, or whether adaptive management may be needed to attain Project benefits." This section summarizes the resource monitoring, data collection, and post-construction evaluation plan. Table X-1 describes the activities involved in post-construction evaluation. Performance monitoring will occur for 10 years post construction and be used to determine the degree to which the Project is meeting the success criteria and for informing potential adaptive management decisions. Long-term performance reporting will commence following the 10-year performance monitoring and adaptive management stage. Long-term performance reporting demonstrates the ability to meet Project success criteria through the period of analysis, inform O&M adjustments, and provide basic data for planning purposes. Further details on performance monitoring and adaptive management are provided in Appendix K, *Monitoring and Adaptive Management Plan*.

Table X-1: Post Construction Monitoring Description

	Monitoring Stage	Length of Time	Description	Funding Source
Post-Construction Evaluation	Performance Monitoring	10 years	For entire Project, determine the degree to which the Project is meeting the success criteria and for informing potential adaptive management decisions	Project Cost
	Adaptive Management	10 years	Provides a process for making decisions in the face of uncertainty and learning from outcomes of management actions; may improve the performance of a designed construction measure that is not meeting performance criteria	Project Cost
	Long-Term Performance Reporting	50 years	For entire Project, demonstrates the ability to meet Project success criteria through the period of analysis, inform O&M, and provide basic data for planning and UMRR Program purposes	UMRR Program Cost

Table X-2 presents overall types, purposes, and responsibilities for monitoring and data collection. Table X-3 presents actual monitoring and data parameters grouped by Project phase, as well as data collection intervals. Table X-4 presents the post-construction evaluation plan, which displays several specific parameters and the levels of enhancement that the Project hopes to achieve. Other factors may be considered to evaluate Project performance.

DRAFT

Table X-2: Overall Types, Purposes, and Responsibilities of Monitoring and Data Collection

Project Phase	Type of Activity	Purpose	Responsible Agency	Implementing Agency	Funding Source
Pre-Project	Pre-Project Monitoring	Identify and define problems at HREP. Establish need of proposed Project measures.	Project Partners	Project Partners	Project Partners
	Baseline Monitoring	Establish baselines for performance evaluation.	Corps	Corps	HREP
Design	Data Collection for Design	Include quantification of Project objectives, design of Project, and development of Performance Evaluation Reports.	Corps	Corps	HREP
Construction	Construction Monitoring	Assess construction impacts; assure permit conditions are met.	Corps	Corps	HREP
Post-Construction	Performance Evaluation Monitoring	Determine success of Project as related to objectives and success criteria.	Corps (quantitative) IADNR (field observations)	Project Partners through Cooperative Agreement, USFWS thru O&M, or Corps	HREP/ IADNR

DRAFT

Table X-3: Resource Monitoring and Data Collection Summary [1]

	WATER QUALITY DATA						ENGINEERING DATA			NATURAL RESOURCE DATA					
	Pre-Project Phase		P&S		Post-Const. Phase[3]		Pre-Project Phase	P&S	Post-Const. Phase	Pre-Project Phase	P&S	Const. Phase	Post-Const. Phase		
Type Measurement	**Jun-Sep**	**Dec-Mar**	**Jun-Sep**	**Dec-Mar**	**Jun-Sep**	**Dec-Mar**								**Agency**	**Remarks**
Point Measurements															
Water Quality Stations[2]														Corps	
Air Temperature	2W	6W	2W	6W	2W	6W									
Wind Direction	2W	6W	2W	6W	2W	6W									
Wind Velocity	2W	6W	2W	6W	2W	6W									
Percent Cloud Cover	2W	6W	2W	6W	2W	6W									
Wave Height	2W	6W	2W	6W	2W	6W									
Water Depth	2W	6W	2W	6W	2W	6W									
Velocity	2W	6W	2W	6W	2W	6W									
DO	2W	6W	2W	6W	2W	6W									
Water Temperature	2W	6W	2W	6W	2W	6W									
pH	2W	6W	2W	6W	2W	6W									
Specific Conductance	2W	6W	2W	6W	2W	6W									
Total Alkalinity	2W	6W	2W	6W	2W	6W									
Secchi Disk Depth	2W	6W	2W	6W	2W	6W									
Turbidity	2W	6W	2W	6W	2W	6W									
Suspended Solids	2W		2W		2W										
Chlorophyll	2W		2W		2W										
Ice Thickness		6W		6W		6W									
Snow Depth		6W		6W		6W									
Mussel Survey										2				Corps	June 2018; June 2019
Boring Stations[4]															
Geotechnical Borings							1	1						Corps	
Fish Stations															
Electrofishing[5]										Q			Q	IADNR	June-Dec
Vegetation Surveys															
Hard Mast Tree Survey[6]													10Y	Corps	
Forest Transects												Y (4)	7		
Scrub-Shrub Survey												Y (2)	7	Corps	
Sediment (Bathymetry)									5Y					Corps	
Mapping[7]							1		3					Corps	

DRAFT

Legend

W = Weekly	nW = Every "n" weeks
M = Monthly	nY = Every "n" years
Y = Yearly	1,2,3 = Number of times data is collected within designated Project phase
Q = Quarterly	Y(n) = Annually for "n" Years

[1] See Plate 28, O-102 for post construction phase monitoring. Note that the information presented in this table includes data obtained to develop the Project (Pre-Project Phase), during Project design, and Post-Construction phase. Post-construction work refers to monitoring and data collection used in the Performance Evaluation Reports

[2] Pre-Project water quality stations are shown on Plate 27, O-101: W-M505.7C, W-M505.0B, W-M 504.9P, W-M504.7S, and W-M504.1E. Post-Construction water quality stations are shown on Plate 28, O-102: W-M 504.9P, W-M504.7S, W-M503.6L, and W-M504.1E.

[3] Water quality data will be collected during approximately 50% of the long-term monitoring period.

[4] See Plate 4, B-101 for geotechnical boring locations and Plates 5 and 6, B-601 and B-602 for boring logs and dates.

[5] Fish sampling by the IADNR will occur annually during 4 events from summer through late fall; once in each of the three LTRM periods, then once in late fall (overwintering), or until ice cover occurs. The IADNR's sampling data will be used to evaluate Project effectiveness.

[6] Hard mast tree (forestry) surveys will be conducted twice as best determined by Corps foresters approximately 10 years apart following completion of Performance Monitoring activities to determine tree planting effectiveness.

[7] Depending on river conditions and Program budget, the following methods could be utilized: topographical survey, LiDAR survey, and remote sensing or aerial imagery comparison.

DRAFT

Table X-4: Post-Construction Evaluation Plan

Enhancement Measures	Measurement	Location	Year 0 w/o Alt	Year 1 w/ Alt	Year 10 w/ Alt	Year 25 w/ Alt	Year 50 w/ Alt	Method	Field Observations by Sponsor
Aquatic Diversity/ Overwintering Habitat (Lower Lake, Upper Lake, NW Grant Slough)	Acres of Aquatic Habitat (deep water ≥4 ft, low velocity ≤1 cm/sec, high dissolved oxygen concentrations ≥5.0 mg/L, increased water temperature ≥1.0°C)	Lower Lake	0 acres	10.4 acres	10.2 acres	9.8 acres	9.2 acres	Water Quality Stations (depth, velocity, dissolved oxygen, temperature), and Bathymetry	Presence of fish during overwintering season
		Upper Lake	0.14 acres	12.5 acres	12.2 acres	11.8 acres	11.2 acres		
		NW Grant Slough	0 acres	6.0 acres	5.9 acres	5.8 acres	5.5 acres		
		All locations (constructed dredge cuts)	0.14 acres	29 acres	28 acres	27 acres	26 acres		
Topographic Diversity Sites - Forestry	Percent survivability; trees/acre	All topographic diversity sites	0%	≥90% survival (of planted species); >800 trees/acre after planting	≥60% survival; 800 trees/acre	≥60% survival; 350-500 trees/acre	≥40% survival; 150-250 trees/acre	Tree Survey	Visual Observations
Topographic Diversity Sites – SSP (Lower Lake, Grant Slough Site 1)	Percent survivability of SSP species	All SSP sites	0%	≥80% survival	≥60% survival	≥45% survival	≥30% survival	Shrub Survey	Visual Observations
TSI	Forest Metrics – timber inventory stand summary	All TSI Areas	0%	>90% Silvicultural Treatment Target Threshold	>90% Silvicultural Treatment Target Threshold	>60% Silvicultural Treatment Target Threshold	>40% Silvicultural Treatment Target Threshold	Standard Timber Inventory Protocol	Visual Observations
Island Restoration and Protection	Acres of island (constructed)	USI Head	0	14.2 acres	14.2 acres	14.2 acres	14.2 acres	Topographic Survey and Aerial Imagery	Visual Observations
		NE Bank	0	8.3 acres	8.3 acres	8.3 acres	8.3 acres		
		West SE Island	0	3.5 acres	3.5 acres	3.5 acres	3.5 acres		
		All locations (constructed islands)	0	26	26	26	26		

DRAFT

The PDT relied on several assumptions to determine enhancement measures and develop target thresholds as outlined in Table X-3. The following explanation should assist managers in evaluating performance for the extended life of the Project.

Aquatic Diversity/Overwintering Habitat. The water quality and depth metrics for overwintering habitat in Table X-3 were revised based on a proposed update to the Bluegill Overwintering HSI Model, which occurred during a 2019 UMRR partnership workshop. Performance evaluations of Aquatic Diversity/Overwintering Habitat will compare pre-project overwintering acres that meet all of the water quality and depth metrics with targets at Years 1, 10, 25, and 50. Target acreages were calculated by measuring the areas of designed dredge cuts with depth greater than or equal to 4 feet below flat pool, which corresponds to a bottom elevation of 567.2 feet. The reduction in target acreages over time reflects the uniform 1 cm/year sediment deposition rate referenced in Section II of this report. Refer to Appendix K, *Monitoring and Adaptive Management Plan* for further details regarding locations and monitoring methodology.

Topographic Diversity Sites – Forestry. Performance of this enhancement measure will be documented by percent survivability of planted tree species and density (TPA), as there are currently no trees occupying the proposed topographic diversity sites. Trees planted will be the baseline for monitoring performance into the future. Performance evaluations of these targets will be conducted by Corps' foresters to assess topographic diversity sites at Years 1, 10, 25, and 50. Performance targets are based on lessons learned from other HREPs with tree plantings on placement sites. Refer to Appendix K, *Monitoring and Adaptive Management Plan*, for further details regarding planting locations and monitoring methodology and Appendix M, *Engineering Design*, for forestry data, planting plans, and prescriptions.

Topographic Diversity Sites – Scrub-Shrub/Pollinator Habitat. Performance of this enhancement measure will be documented by percent survivability of planted SSP species, as there are currently no SSP species occupying the proposed topographic diversity sites. SSP species planted will be the baseline for monitoring performance into the future. Performance evaluations of these targets will be conducted by Corps' foresters to assess topographic diversity sites at Years 1, 10, 25, and 50. Performance targets are based on lessons learned from other HREPs with scrub-shrub plantings on placement sites. Refer to Appendix K, *Monitoring and Adaptive Management Plan*, for further details regarding locations and monitoring methodology and Appendix M, *Engineering Design*, for forestry data, planting plans, and prescriptions.

Timber Stand Improvement. TSI includes thinning treatments, tree planting, and invasive species management to meet desirable forest health, diversity, and resilience based on current environmental and forest conditions. Silvicultural treatment prescriptions were devised based on the 2018 forest inventory and a forest stand reconnaissance conducted in 2019, which provides a baseline for monitoring performance into the future. Additionally, forest age, structure, and function will be assessed during forest surveys scheduled in Table X-2 and compared to the 2018 baseline survey. Performance evaluations of these targets will be conducted by Corps' foresters to assess TSI sites at Years 1, 10, 25, and 50. Refer to Appendix M, *Engineering Design*, for forestry data, planting plans, and prescriptions.

Island Restoration and Protection. Performance of this enhancement measure is based on as-built acreage of islands following construction to have a baseline for monitoring performance into the

DRAFT

future. It is assumed that implementation of the island protection measures will not significantly alter hydraulic forces within the Project area, will continue to provide stabilization, and may even help islands accrete over time. Refer to Appendix K, *Monitoring and Adaptive Management Plan,* for further details regarding locations and monitoring methodology and Appendix M, *Engineering Design*.

DRAFT

SECTION XI. REAL ESTATE REQUIREMENTS

The Steamboat Island HREP is a part of the UMRR Program authorized by Section 1103 of the WRDA of 1986, Public Law 99-662, as amended. Project location and description can be found in Sections I and II of this Report.

All lands necessary for the Project are owned by the United States. The acquisition of Project lands was administered by the Corps and the USFWS, Savanna District, as part of the UMR NWFR.

For this Project, the USFWS is acting as the Federal Sponsor. The Project would be 100% Federal cost. A map showing the Project area is included on Plate 7, (C-101, *Site Plan*) in Appendix P, *Plates*.

There are no proposed Public Law 91-646 relocations, as there are no acquisitions required.

All placement materials would be excavated from within navigational servitude and Project waters and from existing top soil within the Project area.

All access to the Project will be by water. Boat ramps in the Project vicinity are public boat ramps, which the contractor may use. The Contractor will need to abide by local boat ramp usage regulations. See Appendix M, *Engineering Design*, for additional details.

There are no known hazardous, toxic, or radioactive sites within the Project area.

A draft Memorandum of Agreement between the USFWS and the Corps is included as Appendix C and a Real Estate Plan is included as Appendix J. Estimated O&M costs can be found in Section VIII, *Cost Estimates*¸ Table VIII-5.

DRAFT

SECTION XII. COORDINATION, PUBLIC VIEWS, AND COMMENTS

Coordination has been made throughout the planning process with the following State and Federal agencies and local entities:

U.S. Fish and Wildlife Service

Iowa Department of Natural Resources

Illinois Department of Natural Resources

Illinois State Historic Preservation Office

Iowa State Historic Preservation Office

Exelon Power Plant, Cordova, Illinois

The USFWS, IADNR, and ILDNR have been cooperating agencies in the preparation of this EA and have been integral in the decision making process for the Feasibility Report, including informal reviews of the Report throughout its development. Review comments included need for clarification in roles and responsibilities, TSP design, and potential environmental impacts. Letters of support provided by the Project Sponsor and partners are provided in Appendix A, *Correspondence*.

A. Coordination Meetings

Numerous coordination meetings were held with Project Sponsor and partners to discuss the Project. The following meetings demonstrate ongoing coordination:

- April 26-27, 2017. Kick-off meeting, including a site visit and planning charette, to consult and collaborate on the initial study scope.
- May 24, 2017, and June 14, 2017. General scoping meetings to discuss study scope and general Project elements.
- July 6, 2017. Conceptual model workshop to develop a conceptual model for the Project.
- July 20, 2017, and August 31, 2017. PDT meetings to discuss an expanded Project scope and define Project problems, opportunities, goals, and objectives.
- October 18, 2017, and November 28, 2017-May 18, 2018. Measures workshop and subsequent PDT meetings to consult and collaborate on potential Project measures, in relation to the Project goals & objectives, conceptual ecological model, constraints & considerations, and known existing conditions.
- June 5, 2018 to September 6, 2018. PDT Meetings and Alternative Workshop to consult and collaborate on Project alternatives, comprised of potential Project measures.
- December 17, 2018 to January 17, 2019: CEICA Workshop and subsequent PDT meeting to decide on a TSP.
- February 7, 2019 to September 16, 2019: PDT meetings to refine the TSP and associated measures, as well as performance monitoring and adaptive management of the TSP.

DRAFT

B. Coordination by Correspondence

Refer to Appendix A, *Correspondence*, for specific coordination efforts to date.

C. Public Views and Comments

An open house was held on March 26, 2014, in Clinton, Iowa, to discuss the initiation of the Feasibility Study and proposed Project with interested members of the public and to gather public input (Appendix N, *Distribution List*). Representatives from the Corps, USFWS, and IADNR were present to talk one-on-one with attendees. Information packets and "Subject Matter Expert" tables included information about the UMRR program, preliminary Project elements, potential Project measures, bathymetric data, general design information, current imagery of Steamboat Island, and information about the IADNR and the UMR NWFR. Seventy five members of the public attended the evening session and another 19 people watched the live feed streamed by the District's Corporate Communications Office. Three comment sheets were returned. Respondents indicated they used the area for recreation, fishing, boating, and water sports. Generally, the most common concern from the open house was the lack of deep water, overwintering habitat and fishing/boating opportunities due to the backwater channels and sloughs being significantly silted in. Respondents indicated that they would like to see dredging and channel restoration occur in the Project area, for both fisheries and recreation benefits.

DRAFT

SECTION XIII. CONCLUSIONS

Full realization of the potential habitat value in the Steamboat Island HREP area has been hindered by increased water levels, sedimentation, and erosive forces from the implementation of the UMRS 9-Foot Navigation Channel Project, which has led to lack of floodplain connectivity, habitat fragmentation, loss of floodplain topographic diversity and aquatic habitat, altered water regime, and loss of native wetland habitats. Establishing off-channel areas containing reliable aquatic/SSP habitat and establishing floodplain areas that would support survival and regeneration of hard mast-producing trees would allow the Project area to realize the highest benefit to desirable plant, animal, and fish, species.

The TSP restoration measures for the Project (backwater dredging and aquatic diversity, topographic diversity, island restoration and protection, grade control) are designed to meet the Project's objectives (see Section III, *Problems and Opportunities*).

Assessment of the future with-Project scenario shows definite increases in total habitat units over the 50-year period of analysis, benefitting target species and a majority of other aquatic and bottomland hardwood forest dwelling species. These increases represent quantification of the projected outputs: improved habitat quality and increased preferred habitat quantity.

DRAFT

UPPER MISSISSIPPI RIVER RESTORATION
FEASIBILITY REPORT
WITH INTEGRATED ENVIRONMENTAL ASSESSMENT

STEAMBOAT ISLAND
HABITAT REHABILITATION AND ENHANCEMENT PROJECT

POOL 14, UPPER MISSISSIPPI RIVER MILES 502.5-508.0
CLINTON & SCOTT COUNTIES, IOWA,
AND ROCK ISLAND COUNTY, ILLINOIS

RECOMMENDATIONS

I have weighed the outputs to be obtained from the full implementation of the Steamboat Island HREP against its estimated cost and have considered the various alternatives proposed, impacts identified, and overall scope. In my judgment, this Project, as proposed, justifies expenditure of Federal funds. I recommend that the Division Engineer approve the proposed Project to include excavating backwaters, constructing topographic and aquatic diversity, restoring and protecting islands, and implementing grade control measures.

The total Federal estimated Project cost, including general design and construction management, is approximately $32,639,000.

At this time, I further recommend that funds in the amount of $1,229,000 be allocated for the Project's Planning, Engineering, and Design.

_____ _____

Date

Steven M. Sattinger, P.E.
Colonel, US Army
Commander & District Engineer

DRAFT

FINDING OF NO SIGNIFICANT IMPACT

UPPER MISSISSIPPI RIVER RESTORATION
FEASIBILITY REPORT WITH INTEGRATED ENVIRONMENTAL ASSESSMENT

STEAMBOAT ISLAND
HABITAT REHABILITATION AND ENHANCEMENT PROJECT

POOL 14, UPPER MISSISSIPPI RIVER MILES 502.5-508.0
CLINTON & SCOTT COUNTIES, IOWA,
AND ROCK ISLAND COUNTY, ILLINOIS

DRAFT

The U.S. Army Corps of Engineers, **Rock Island** District (Corps) has conducted an environmental analysis in accordance with the National Environmental Policy Act of 1969, as amended. This IFR/EA dated **31 January 2020**, for the **Steamboat Island Habitat Rehabilitation and Enhancement Project** addresses **ecosystem restoration** opportunities and feasibility in the **Pool 14, Upper Mississippi River (UMR) river miles (RM) 502.5-508.0**. The final recommendation is dated **31 January 2020**.

The Final IFR/EA, incorporated herein by reference, evaluated various alternatives that would **1) maintain, enhance, and restore quality habitat for desirable native plant, animal, and fish species and 2) maintain, enhance, restore, and emulate natural river processes, structures, and functions for a resilient and sustainable ecosystem** in the study area. The Recommended Plan is the **National Ecosystem Restoration (NER) Plan** and includes:

- **backwater dredging and aquatic diversity (30 acres of overwintering habitat)**
- **grade control structure (1 structure)**
- **island restoration/protection (26 acres)**
- **topographic diversity – forest or scrub-shrub/pollinator habitat (66 acres)**
- **timber stand improvement (900 acres)**
- **mussel and fish habitat incorporation (to be determined in plans & specifications)**

In addition to a "no action" plan, **eight** alternatives were evaluated. The alternatives included **distinct combinations of backwater dredging/aquatic diversity, island restoration and protection, topographic diversity, timber stand improvement, grade control structure, and flow diversity. Non-structural measures were considered but not selected for alternative formulation because they were found to be incomplete, ineffective, or not within the scope of the authorized project.**

SUMMARY OF POTENTIAL EFFECTS

For all alternatives, the potential effects were evaluated, as appropriate. Table 1 is a summary assessment of the potential effects of the Recommended Plan:

Table 1: Summary of Potential Effects of the Recommended Plan

	Insignificant Effects	Insignificant Effects as a Result of Mitigation	Resource Unaffected By Action
Aesthetics	☐	☐	☒
Air Quality	☐	☐	☒
Aquatic Resources/Wetlands	☒	☐	☐
Invasive Species	☒	☐	☐
Fish and Wildlife Habitat	☐	☐	☒
Threatened/Endangered Species/Critical Habitat	☒	☐	☐
Historic Properties	☐	☐	☒
Other Cultural Resources	☐	☐	☒
Floodplains	☒	☐	☐
Hazardous, Toxic & Radioactive Waste	☐	☐	☒
Hydrology	☒	☐	☐
Land Use	☐	☐	☒
Navigation	☐	☐	☒
Noise Levels	☐	☐	☒
Public Infrastructure	☐	☐	☒
Socio-Economics	☐	☐	☒
Environmental Justice	☐	☐	☒
Soils	☐	☐	☒
Tribal Trust Resources	☐	☐	☒
Water Quality	☐	☐	☒
Climate Change	☐	☐	☒

All practicable and appropriate means to avoid or minimize adverse environmental effects were analyzed and incorporated into the Recommended Plan. Best Management Practices as detailed in the IFR/EA will be implemented, if appropriate, to minimize impacts.

No compensatory mitigation is required as part of the Recommended Plan.

Public review of the draft IFR/EA and FONSI will be completed **in June 2020.**

ENDANGERED SPECIES ACT: Pursuant to the Endangered Species Act of 1973, as amended, Section 7 consultation requirements have been met for the Recommended Plan. Informal consultation was concluded with a USFWS concurrence letter, dated 21 February 2020.

NATIONAL HISTORIC PRESERVATION ACT: PENDING

CLEAN WATER ACT SECTION 404(B)(1) COMPLIANCE: Pursuant to the Clean Water Act of 1972, as amended, the discharge of dredged or fill material associated with the Recommended Plan has been found to be compliant with section 404(b)(1) Guidelines (40 CFR 230). The Clean Water Act Section 404(b)(1) Guidelines evaluation is found in **Appendix B, Clean Water Act Section 404(b)(1) Assessment** of the IFR/EA.

DRAFT

401 WQC PENDING: A water quality certification pursuant to section 401 of the Clean Water Act will obtained from the **issuance of Nationwide Permit NO. 27** prior to construction.

OTHER SIGNIFICANT ENVIRONMENTAL COMPLIANCE

All applicable environmental laws have been considered and coordination with appropriate agencies and officials has been completed.

FINDING

Technical, environmental, and cost effectiveness criteria used in the formulation of alternative plans were those specified in the Water Resources Council's 1983 *Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies*. All applicable laws, executive orders, regulations, and local government plans were considered in evaluation of alternatives. Based on this report, the reviews by other Federal, State and local agencies, Tribes, input of the public, and the review by my staff, it is my determination that the Recommended Plan would not cause significant adverse effects on the quality of the human environment; therefore, preparation of an Environmental Impact Statement is not required.

_____ _____

Date

Steven M. Sattinger, P.E.
Colonel, US Army
Commander & District Engineer

DRAFT