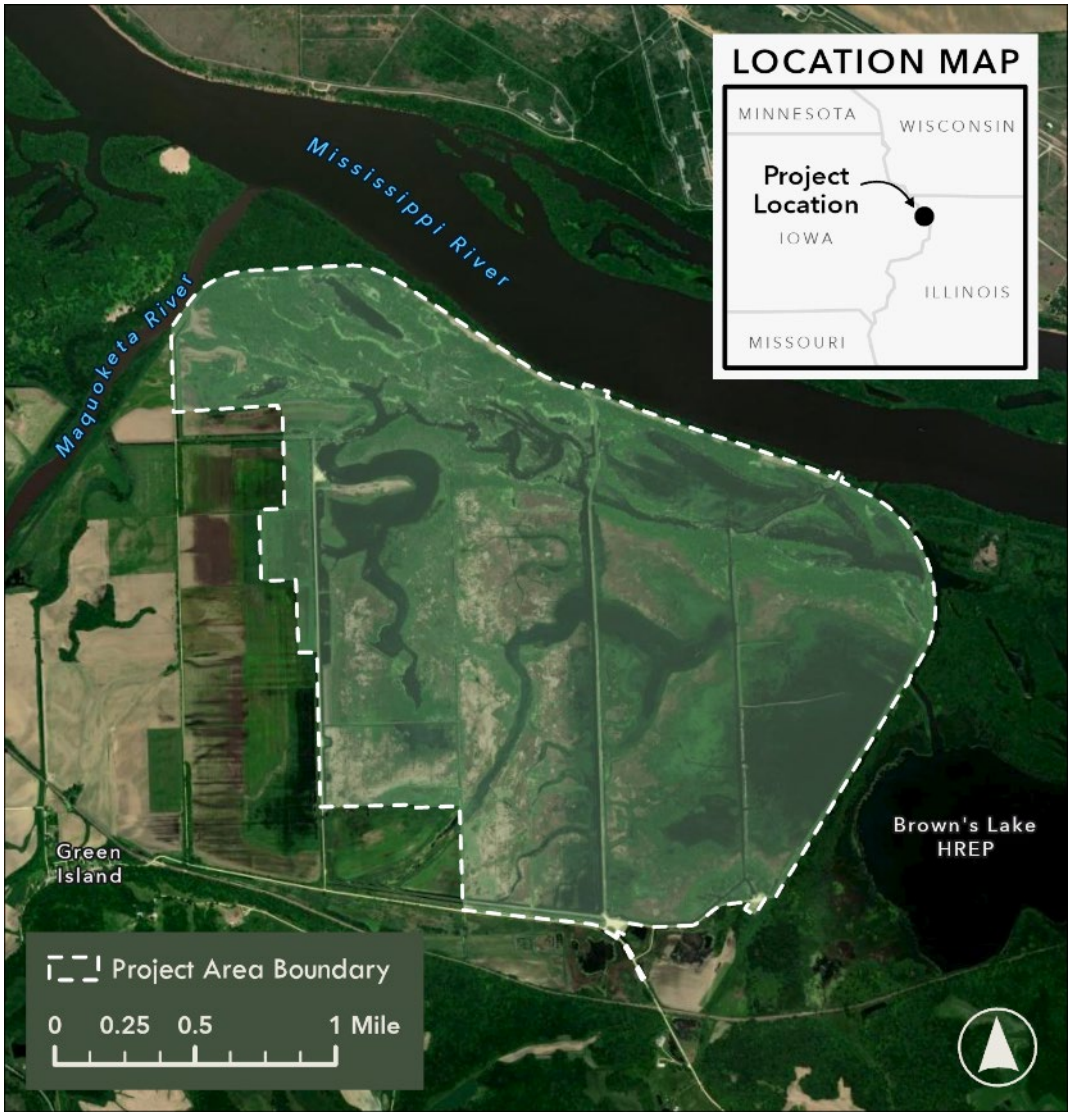
UPPER MISSISSIPPI RIVER RESTORATION FEASIBILITY REPORT WITH INTEGRATED ENVIRONMENTAL ASSESSMENT

GREEN ISLAND HABITAT REHABILITATION AND ENHANCEMENT PROJECT

POOL 13, UPPER MISSISSIPPI RIVER
RIVER MILES 545.9 THROUGH 548.7
JACKSON COUNTY, IOWA



September 2023

US Army Corps of Engineers®
Rock Island District

Upper Mississippi River Restoration
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EXECUTIVE SUMMARY

This Integrated Feasibility Report and Environmental Assessment summarizes the study process utilized for the Green Island Habitat Rehabilitation and Enhancement Project, part of the Upper Mississippi River Restoration Program. During this study, the Project Delivery Team (PDT) evaluated the feasibility of alternative measures to address problems and opportunities within the study area. The study area consists of the Green Island Wildlife Management Area (GIWMA), managed by the Iowa Department of Natural Resources (IA DNR). The GIWMA is on the right descending bank of the Mississippi River from river mile (RM) 545.9-548.7, south of the confluence with the Maquoketa River (Figure ES-1).

Extended periods of high water resulted in the loss and degradation of habitat in the GIWMA. Extensive losses of aquatic vegetation resulted in the degradation of pool habitats for wildlife and fisheries resources. Prolonged inundation also resulted in a decline in the health and extent of existing forestry resources. Combined with the extended inundation durations, the continued accumulation of sediment within the GIWMA reduced the water storage capacity of the system, exacerbating the effects of high-water periods. 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 aquatic, wetland, and floodplain habitats.

The goals of the Project is to maintain, enhance, and restore quality habitat for native and desirable plant, animal, and fish species and functions for a resilient and sustainable ecosystem. The objectives identified to meet these goals for 50 period of analysis are:

- Primary: Restore the historic hydrologic cycle (considering current infrastructure), which would improve the management and sustainability of existing habitat and associated plant and wildlife resources within the GIWMA.

- Improve sediment management across the GIWMA, reduce sedimentation impacts on existing habitat, and reduce the loss of water storage capacity due to sedimentation.

- Restore Green Island aquatic ecosystems for fish and other aquatic organisms by increasing the quality and quantity of aquatic habitat available.

- Restore the quality, quantity, and diversity of vegetation within the GIWMA, including emergent, submerged aquatic, and forest vegetation.

- Restore bathymetric and topographic diversity within the GIWMA.

Habitat and cost benefits were estimated by the PDT for each measure. Habitat benefits were estimated using Habitat Evaluation Procedures. Cost Effective and Incremental Cost Analyses were conducted by the PDT to identify cost-effective plans and reveal changes in cost for increasing levels of environmental output.

The Tentatively Selected Plan (TSP) will restore quality habitat in the Project area. This plan includes constructing a pump station with two multidirectional pumps that can pump water into and out of the area, allowing for a more natural hydrologic cycle. In addition to constructing a pump station, several existing water control structures will be replaced to further increase the ability to manipulate water within the project area. Several areas will be dredged to restore overwintering habitat for fish and other aquatic species. The dredged material will be used to increase the topographic diversity of the area. Dredging will improve connectivity to water bodies within the Project area and berms to help break up wind-driven waves. This will allow water and wildlife to move more freely through the area. A ridge and swale area will be constructed to increase topographic diversity for native plants and animals. Timber stand improvement techniques such as tree thinning, tree and shrub planting, and invasive species treatments will be implemented to restore the wetland forest habitat. Lastly, an in-channel sediment trap will be created to capture and control the sediment coming into Green Island.

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

The Rock Island District's District Engineer reviewed the Project outputs; and the plan costs $30,503,000, with outputs of 1287 net Average Annual Habitat Units (for $929 per Average Annual Habitat Unit) and determined that the implementation of the TSP is in the Federal interest. The TSP is shown in Figure ES-1.

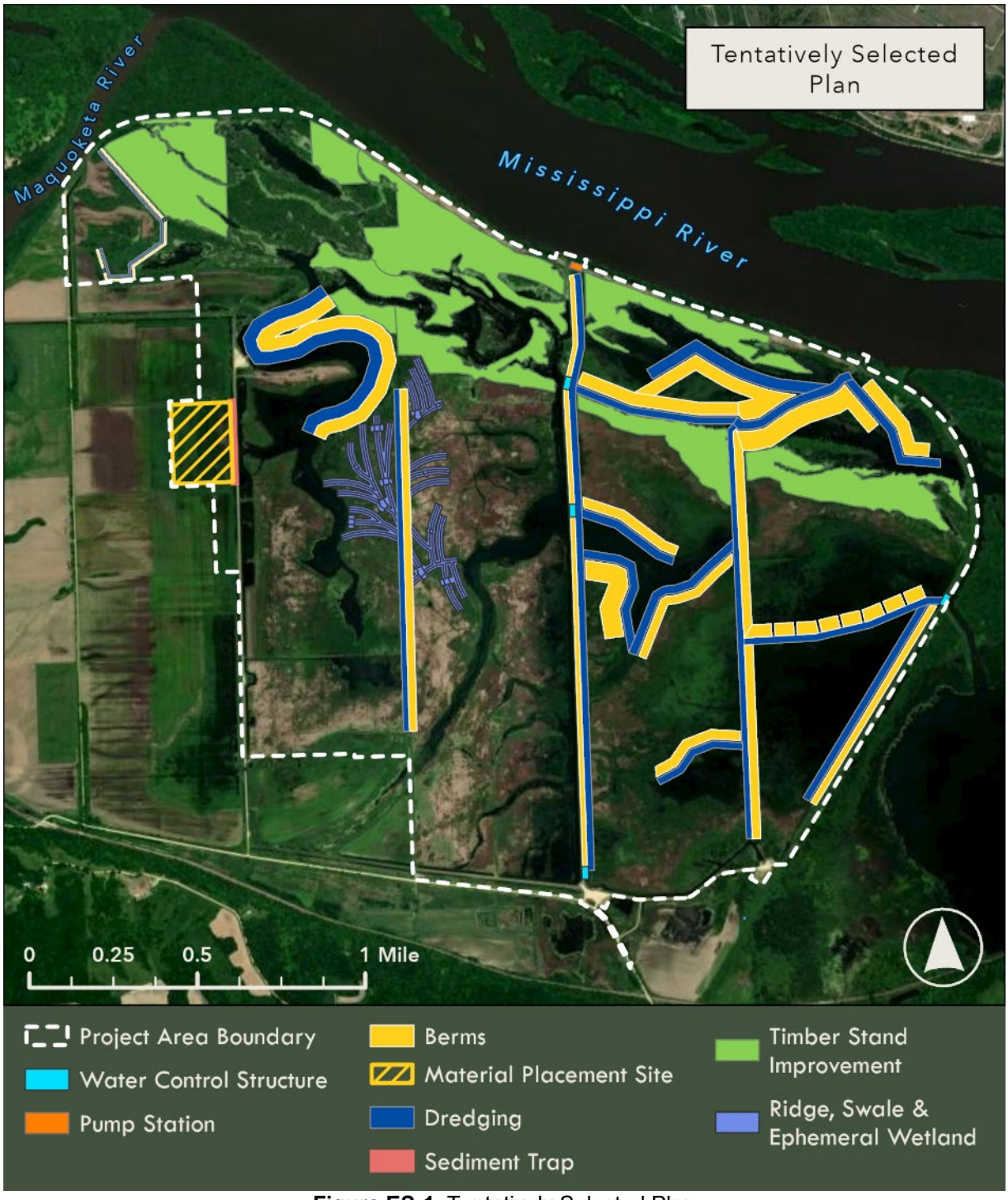

Figure ES-1. Tentatively Selected Plan

ACRONYMS

Average Annual Habitat Unit	**AAHU**	Levee and Drainage District	**L&DD**
Cost Effectiveness & Incremental Cost Analysis	**CE/ICA**	Mean Sea Level	**MSL**
Cubic Yards	**CY**	USACE, Mississippi Valley Division	**MVD**
Rock Island District	**District**	North American Vertical Datum of 1988	**NAVD 88**
Department of Natural Resources	**DNR**	National Environmental Policy Act	**NEPA**
Dissolved Oxygen	**DO**	National Register of Historic Places	**NRHP**
Engineering Circular	**EC**	Planning & Guidance	**P&G**
Essential Habitat Area	**EHA**	Operation and Maintenance	**O&M**
Environmental Protection Agency	**EPA**	Plans & Specifications	**P&S**
Engineer Regulation	**ER**	Project Delivery Team	**PDT**
Engineering Research and Development	**ERDC**	Project Partnership Agreement	**PPA**
Endangered Species Act	**ESA**	River Mile	**RM**
Executive Order	**EO**	River Resources Action Team	**RRAT**
Fish and Wildlife Coordination Act	**FWCA**	River Resources Forum	**RRF**
Fish and Wildlife Interagency Committee	**FWIC**	State Historic Preservation Office	**SHPO**
Fish and Wildlife Work Group	**FWWG**	Timber Stand Improvement	**TSI**
Future With Project	**FWP**	Tentatively Selected Plan	**TSP**
Future Without Project	**FWOP**	Total Suspended Solids	**TSS**
Green Island Wildlife Management Area	**GIWMA**	Upper Mississippi River	**UMR**
Hydrologic Engineering Center-Ecosystem Functions Model	**HEC-EFM**	Upper Mississippi River Restoration	**UMRR**
Habitat Evaluation Procedures	**HEP**	Upper Mississippi River System	**UMRS**
Habitat Needs Assessment-II	**HNA-II**	Upper Mississippi National Wildlife and Fish Refuge	**UMNWFR**
Habitat Rehabilitation and Enhancement Project	**HREP**	U.S. Fish and Wildlife Service	**USFWS**
Hazardous, Toxic, and Radioactive Waste	**HTRW**	Water Level Management	**WLM**
Incremental Cost Analysis	**ICA**	Water Resources Development Act	**WRDA**
Information for Planning and Consultation	**IPaC**		
Institute of Water Resources	**IWR**		

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I. INTRODUCTION

The U.S. Army Corps of Engineers (USACE), Rock Island District (District), prepared this Feasibility Report with Integrated Environmental Assessment (FR/EA) to present a detailed account of the planning, engineering, construction considerations, and environmental considerations that resulted in the Tentatively Selected Plan (TSP) for the Green Island Habitat Rehabilitation and Enhancement Project (HREP) (Project). The FR/EA meets USACE planning guidance and National Environmental Protection Act (NEPA) requirements. The planning and decision process includes:

- Scoping (identifying problems, opportunities, objectives, and constraints)
- Identifying existing conditions and Future Without Project (FWOP) conditions
- Plan formulation (identifying measures, formulating plans, evaluating and comparing plans)
- Plan selection

Evidence gathering, risk management, and stakeholder involvement occur throughout the planning process. This report summarizes the multidisciplinary efforts of the Project Delivery Team (PDT), which includes the District, the Iowa Department of Natural Resources (IA DNR), and the U.S. Fish and Wildlife Service (USFWS). The District developed this report in close coordination with the non-Federal Sponsor (Sponsor), the IA DNR. This report provides planning, engineering, and construction details of the TSP to allow for final design and construction to proceed after document approval.

A. Authority and Project Selection. The Upper Mississippi River Restoration (UMRR) program was authorized by the Water Resources Development Act (WRDA) of 1986 under Section 1103 (33 U.S.C. 2210 et seq.; P.L. 99-662, 1986). The UMRR program comprises 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 Long-Term Resource Monitoring element. The UMMR is a regional program that includes the USACE St. Paul, Rock Island, and St. Louis Districts. Additional information on the program authority can be found at: https://www.mvr.usace.army.mil/Missions/Environmental-Stewardship/Upper-Mississippi-River-Restoration/Key-Documents/.

Interagency groups in each District identify, prioritize, and select the HREPs. Field managers from the interagency groups determine the areas with degraded aquatic, wetland, and bottomland forest habitats and which UMRR-authorized objectives are a priority for the area. After considering resource needs and deficiencies pool by pool, the Fish and Wildlife Interagency Committee (FWIC) and the River Resources Coordinating Team 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 Fact Sheet outlining a general area and need for the project on December 14, 2018.

Participants in the planning of the Project included Rock Island District staff, Regional Planning and Environmental Division North (RPEDN) staff, and the Project Partner (the USFWS). Under Federal regulations governing the implementation of NEPA, the IA DNR is the non-Federal Sponsor. Development of this FR/EA was coordinated with the participants during team meetings, phone conversations, and on-site visits to the Project area.

U.S. Army Corps of Engineers, Rock Island District. The District is responsible for Project management and coordination with the Sponsor, the Project Partner, and other affected agencies. The District will submit the FR/EA, program funds, finalize Plans and Specifications (P&S), complete all NEPA requirements, advertise and award a construction contract, and perform construction contract supervision and administration. Section 906I of WRDA 1986 states that the first cost funding for enhancement measures must be 100% Federal cost because the Project measures will be on federally managed land.

Sponsor. The IA DNR is the non-Federal Sponsor. The IA DNR manages the GIWMA and would ensure the TSP is compatible with the goals and objectives of the management of the GIWMA. Operation and maintenance (O&M), as described in Section VI.F, is the Sponsor's responsibility in accordance with Section 107(b) of WRDA 1992, Pub. L. 102-580, 33 U.S.C. § 652(e)(7)(A). The Sponsor's O&M responsibilities will be addressed in the proposed Project Partnership Agreement for the Project (Appendix D).

Sponsor goals include:

- Promote abundant, diverse, high-quality waterfowl habitat to produce, attract, and harvest waterfowl.
- Create and maintain diverse aquatic vegetation communities for the benefit of diverse aquatic wildlife, maintain diverse and healthy forest communities for the benefit of forest-associated wildlife, and support viable native fish communities.

Partner. The USFWS is a partner and has provided technical and other advisory assistance during all phases of the project and will continue to assist during implementation and monitoring. USFWS will also provide a Coordination Act Report. The USFWS' role is to ensure that TSP is compatible with the goals and objectives of the refuge. A small parcel of the land within the Green Island study area is within the Upper Mississippi River National Wildlife and Fish Refuge (UMR NWFR).

USFWS goals include:

- Management practices will restore or mimic natural ecosystem processes or functions to promote habitat diversity.
- The aesthetics of projects in the context of visual impacts on the landscape should be considered in project design.
- Bottomland forests will be developed consistent with the objectives of the Habitat Management Plan (HMP), including targets for species composition, canopy cover, regeneration, herbaceous cover, and invasive species.

B. Purpose and Need for Federal Action. The Project aims to restore aquatic and floodplain habitats within the GIWMA study area (Figure 1). The need for this restoration effort is based on the broader restoration needs of the Upper Mississippi River System (UMRS) as identified in the Habitat Needs Assessment II (HNA-II; McCain et al., 2018), as well as the study area-specific problems described in Section 2.

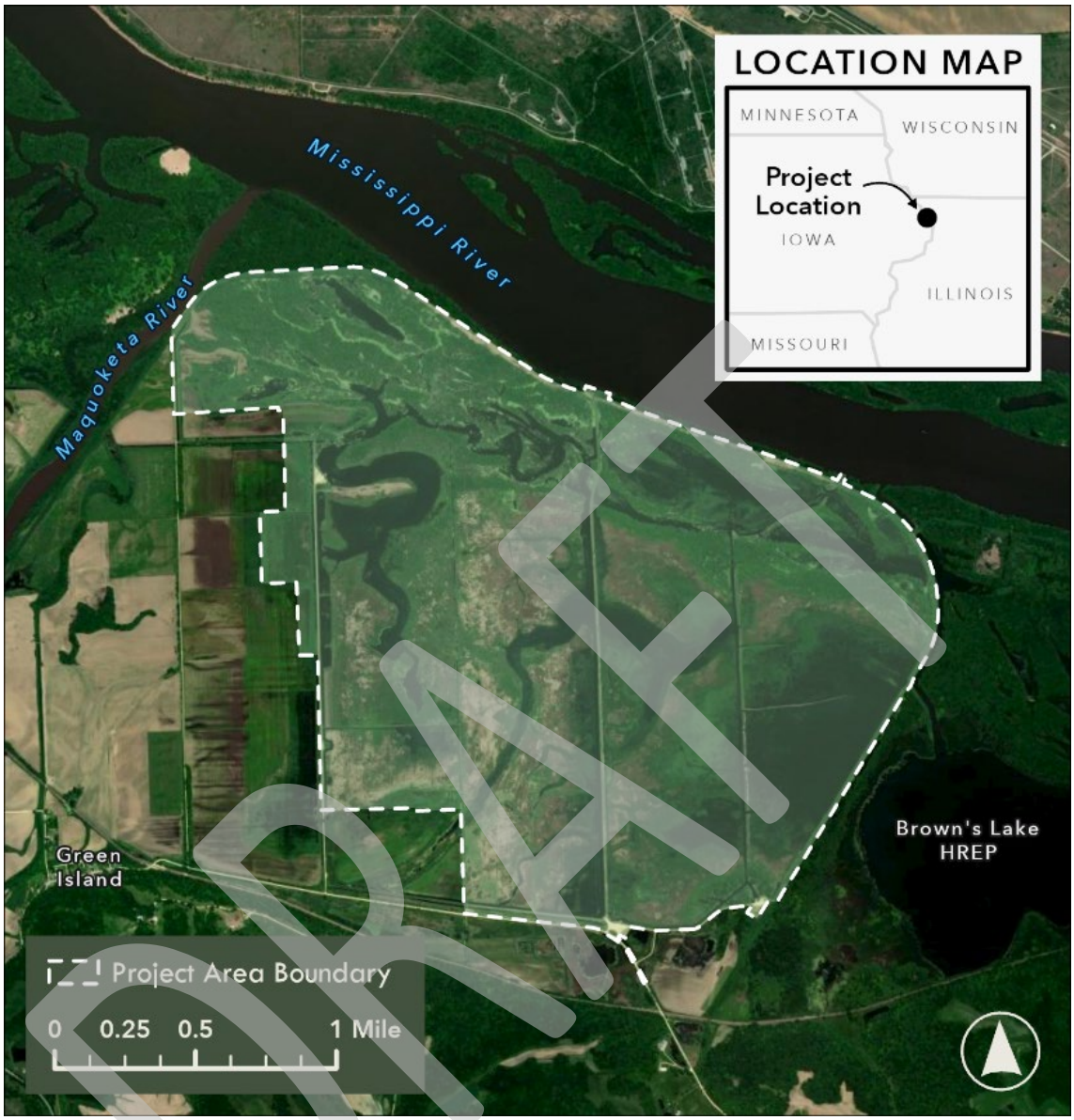

Figure 1. Project Area and Location

Within the Green Island study area, four restoration areas identified by HNA-II need restoration. The proposed Project would improve ecosystem function locally and more broadly within the vision of the UMRR Program.

The District proposes to rehabilitate and enhance the study area by constructing 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. The need for rehabilitation and enhancement of the site is based on the following factors:

- Prolonged high water- Stresses forested wetland communities and loss of emergent and submergent aquatic vegetation.
- Reduction in storage capacity- Resulting in loss of fish habitat.

- Increasingly shallow pools- Resulting in loss of bathymetric diversity and reduced diversity and abundance of plant and animal resources.

The Project is consistent with IA DNR's agency management goals and was planned to benefit of resident and migratory birds, fish, and other aquatic wildlife.

C. Project Area. The Project area is within the GIWMA, which consists of a managed wetland complex, including shallow impounded waters, emergent vegetation and managed moist soil areas, and braided channels surrounded by floodplain timber stands. Recreational use includes hunting (deer, turkey, pheasant, squirrel, waterfowl, and dove), trapping, fishing, recreational paddling, and bird watching. The GIWMA is behind the Green Island Levee system and is part of the Green Island Levee and Drainage District (L&DD). The Green Island L&DD consists of approximately 10.8 miles of levee and protects 4,500 acres of land. Roughly 3,000 acres of this land are contained within the GIWMA, while the remainder consists of private croplands (corn and soybean). The IA DNR maintains approximately 4.8 miles of the existing levee. Water level management (WLM) within the GIWMA is partly controlled by the requirements of the Green Island L&DD, of which IA DNR is the majority land manager. The Green Island L&DD Cooperation Agreement with IA DNR specifies a maximum managed water level of 585.5 feet MSL 1912 (584.82 NAVD88) year-round, except from August 15th to December 15th, when water levels can operate up to 588.9 feet MSL 1912 (588.22 NAVD88). Water levels within GIWMA operate to manage habitat while also meeting the water level requirements of the Green Island L&DD.

The USACE and USFWS federally own the Project area. The USFWS currently manages one parcel within the Project area. The State of Iowa and private landowners (Figure 2) own the adjacent properties. During the construction of the Nine-Foot Channel Navigation Project, the Federal government acquired 2,575 acres of land within the Green Island area. In 1943, this land was made available to the USFWS, who later made the land available to the Iowa State Conservation Commission (now the IA DNR).

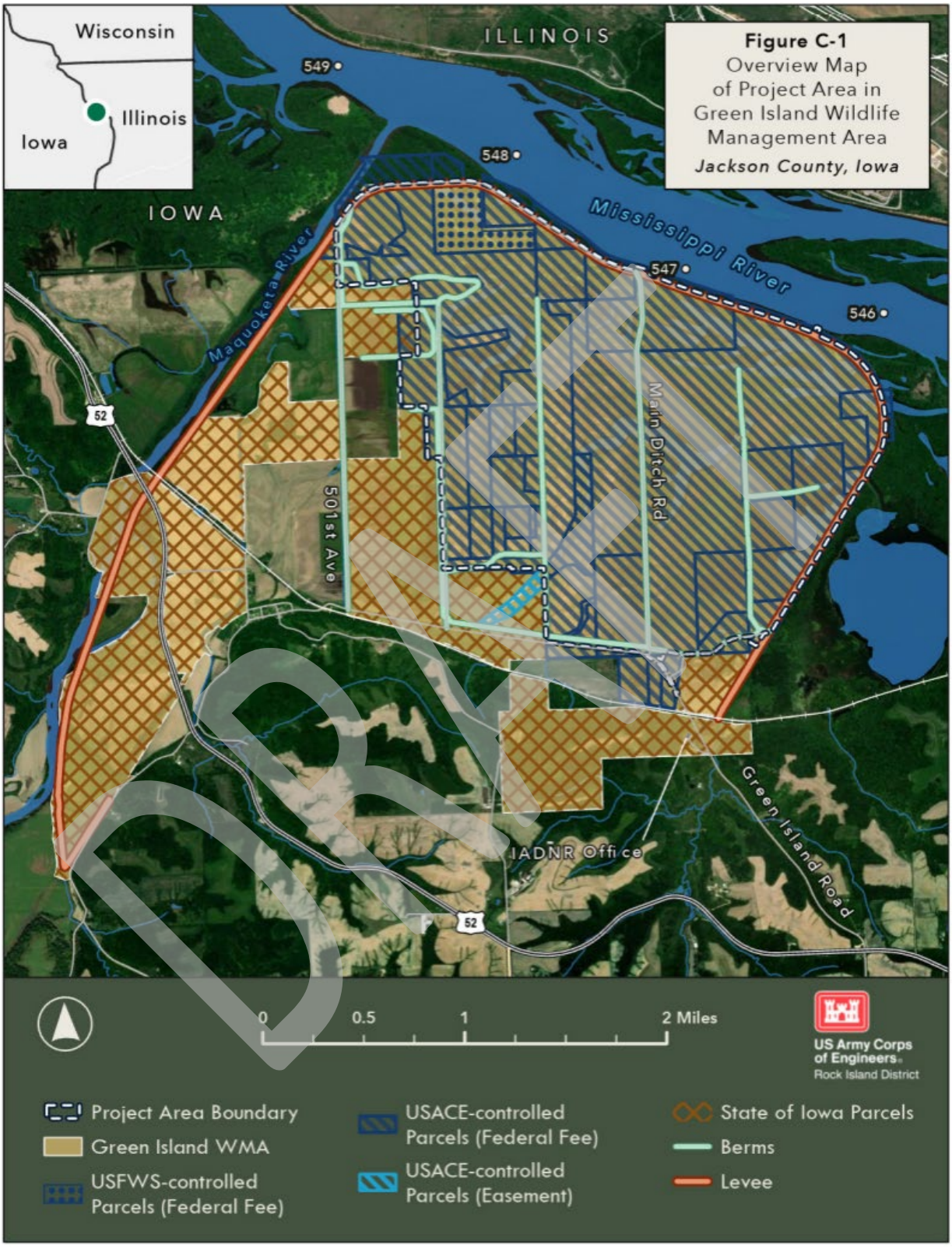

Figure 2. Project Location and Land Ownership Map

D. Prior Reports, Existing Water Projects, and Ongoing Programs. Table 1 summarizes prior reports, existing water projects, and ongoing programs which provided valuable information, experience, or guidance in planning the Project.

Table 1. Prior Reports, Projects, and Programs

Project Year	Study/Report/Environmental Document Title	Project Relevance
1989	Upper Mississippi River System Project Environmental Management Program, Pool 13, Brown's Lake HREP	Adjacent to Project area
1997	Bottomland hardwood forests along the Upper Mississippi River	Used in Floodplain Forest model development
2005	Cooperative Agreement Between Iowa Department of Natural Resources and Jackson County Board of Supervisors	Constraints for water elevation and levee level of protection
2006	UMR National Wildlife and Fish Refuge Comprehensive Conservation Plan, USFWS	Helped in aligning Project goals
2009	Upper Mississippi River System Ecosystem Restoration Objectives, Corps	Basis of helping form objectives
2012	Upper Mississippi River Systemic Forest Stewardship Plan	Basis to forming timber stand improvement objectives
2012	Upper Mississippi River Restoration Environmental Management Program Environmental Design Handbook	Basis for designs and past projects
2018	Habitat Needs Assessment-II	Comparing existing conditions to desired conditions identified by UMRR
2022	Status and Trends of Selected Resources of the Upper Mississippi River System: A Report of the Long-Term Resource Monitoring Program	Development of Adaptive Management Plan
2022	Mississippi River Master Plan	Align Mississippi River Project goals with local Project goals

II. NEED FOR AND OBJECTIVES OF THE ACTION

This section describes the development of Project objectives, including identifying problems and opportunities, assessing the study area's resource significance, considering the goals and recommendations of overarching programs, and identifying constraints and considerations. The analysis period is 50 years for planning purposes, starting in 2028. The period of analysis is the period of time during which an alternative would have significant beneficial effects.

A. Specific Problems and Opportunities

Problems

- Limited ability to mimic historic hydrologic fluctuation range. Water can be pumped into the area, but if the river is, the gravity wells cannot release water from the area.

- Loss of aquatic and terrestrial vegetation. With prolonged periods of inundation, trees' and shrubs' roots are drowned. Aquatic vegetation cannot survive in the deeper water that longer inundation periods provide.

- Loss of topographic and bathymetric diversity. The general shallowing from sedimentation and long periods of inundation, have reduced the diversity within the area.

- Sediment accumulation within the study area reduces storage capacity. Sedimentation increases water levels across the area which increases elevation during high water events. This inundates areas that would have not previously been inundated.

Opportunities

- Mimic historic hydrologic fluctuation range.
- Restore vegetation resources.
- Restore backwater depths and diversity.
- Restore topographic diversity.
- Improve sediment management.

B. Resource Significance. Resource significance is considered from a public, institutional, and technical standpoint, as described in Engineer Regulation (ER) 1105-2-100, *Planning Guidance Notebook (*USACE, 2000). These three categories determine if the ecosystem within the study area is significant enough to warrant Federal investment.

1. Institutional Recognition: Institutional recognition means the importance of an environmental resource acknowledged in the laws, adopted plans, and other policy statements of public agencies, tribes, or private groups. Congress designated the UMRS as a "…nationally significant ecosystem and a nationally significant navigation system…" in Section 1103 of the WRDA 1986. The institutional significance of the UMR is demonstrated in a number of region-specific laws and policies, including the UMR National Wildlife and Fish Refuge Comprehensive Conservation Plan of 2006, the UMR Wildlife and Fish Refuge Act of 1924, and the Migratory Bird Conservation Act of 1929.

The State of Iowa has recognized the quality and diversity of Green Island habitat as an important resource. The IA DNR manages the area as a wildlife area. The IA DNR has several management objectives for the study area.

2. Technical Recognition: Technical recognition means the resource qualifies as significant based on scientific knowledge or judgment of critical resource characteristics. Scarcity, representativeness, status and trends, connectivity, limiting habitat, and biodiversity describe technical significance. Differences across geographical areas and spatial scales may determine whether a resource is significant. The UMRR study area encompasses a globally significant flyway used by more than 326 species of birds and as a home for at least 260 species of fish, 37 species of mussels, 47 species of reptiles and amphibians, and 50 species of mammals, including a number of rare and endangered species. The UMR ecosystem includes 318,750 acres designated as Ramsar Wetlands of International Importance.

The UMR, generally, and the Green Island Project area specifically, support numerous

significant resources. See Section III for more details.

Connectivity. Hundreds of species of migratory birds use the corridor along the Mississippi River. This migratory route is commonly known as the Mississippi Flyway. Numerous Federal and state agencies, as well as non-governmental organizations, have acknowledged the importance of this flyway to regional bird resources. Green Island provides habitat connectivity along this flyway. On a local scale, Green Island sits between the Brown's Lake restoration area to the east and the Upper Mississippi National Wildlife and Fish Refuge (UMNWFR) property to the northwest. Green Island provides important habitat connectivity on the local scale between these ecologically important areas.

Scarcity, Status and Trends. Green Island provides habitat for numerous scarce or declining biological resources. Bald eagles nest and winter within the study area. Green Island supports an important population of grass pickerel, listed as threatened by the State of Iowa, and the state's Wildlife Action Plan lists it as a species of greatest conservation need. Grass pickerel is in only four counties in Iowa. Six declining documented bird species listed by the state as endangered or threatened, including the red-shouldered hawk, northern harrier, king rail, short-eared owl, long-eared owl, and Henslow's sparrow, are at Green Island.

Biodiversity. Over 250 bird species are recorded within the Green Island study area, making it one of the most diverse bird assemblages in the state.

3. Public Significance. Public recognition means some segment of the general public recognizes the importance of an environmental resource, as evidenced by people engaged in activities reflecting an interest or concern for that resource. The public recognizes the UMR as a nationally, regionally, and locally significant resource. 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 2022 and added the Mississippi River as a "special mention" on the 2013 list (https://www.americanrivers.org/media-item/mississippi-river-named-among-americas-most-endangered-rivers-of-2022/). Non-governmental organizations recognize the significance of the resources in the study area due to active engagement in UMRR implementation or serving as non-Federal cost-share sponsors of habitat projects.

The UMR, including Green Island, is a Wetland of International Importance as designated by the Ramsar Convention on Wetlands, and recognized as the most important of all remaining corridors for fish and wildlife in the central U.S. Green Island is designated by the Audubon Society as an Important Bird Area, a global initiative for identifying and conserving the most important places for bird populations.

C. Goals and Recommendations of Overarching Programs

1. Upper Mississippi River System (UMRS) 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 UMRR program was authorized in 1986 and has since gone through several project planning cycles to develop regional ecosystem restoration needs and priorities. Reach planning processes led to identifying high-priority areas for restoration of natural river processes (as required by Section 8004 of WRDA 2007) and provided context for formulating project measures, defining performance measures, and designing monitoring plans. Goals and objectives for the condition of the river ecosystem

are central to river management and linked to other elements of the framework. The overarching UMRS Ecosystem Goal is to conserve, restore, and maintain the ecological structure and function of the UMRS. Objectives for the Upper Impounded Floodplain Reach laid out in the 2012 UMRR EMP Environmental Design Handbook are listed as:

- A more natural stage hydrograph.
- Restore hydraulic connectivity.
- Improve water clarity.
- Reduce nutrient loading.
- Reduce sediment loading from tributaries and sediment resuspension in and loading to backwaters.
- Reduced contaminants loading and remobilization of in-place pollutants.
- Restore rapids.
- Restore a sediment transport regime so that transport, deposition, and erosion rates and geomorphic patterns are within acceptable limits.
- Restore habitat connectivity.
- Restore riparian habitat.
- Restore aquatic off-channel areas.
- Restore terrestrial floodplain areas.
- Restore channel areas.
- Promote diverse and abundant native aquatic vegetation communities.
- Promote diverse and abundant native floodplain forest and prairie communities.
- Promote diverse and abundant native fish communities.
- Promote diverse and abundant mussel communities.
- Promote diverse and abundant native bird communities.

2. Environmental Pool Plans. The FWIC created Pool Plans in September of 2002 that established common habitat goals and objectives for 11-22 of the UMR. The following general resource problems for Pool 13 are taken directly from the draft report *Environmental Pool Plans*, Corps of Engineers, Rock Island District, Mississippi River, Pools 11-22 (USACE, 2004), followed by specific proposed actions for the Project area.

a. Resource Problems

- Fine sediments are accumulating at accelerated rates within backwaters and other floodplain locations 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 at the current level.
- Coarse or bed load sediments, accumulate inside channels that fill valuable habitats and restrict flow.
- Elevated water tables favor moisture-tolerant forest species, limit site potential for species diversity, and promote plant succession to moisture-tolerant grasses.
- Watershed discharge into Pool 13 contributes to significant water quality and habitat problems, which affect natural resources. Issues and examples include

accelerated sedimentation with associated nutrients, increased contaminate delivery, and urban and industrial discharge. More information is needed about discharges into Pool 13 and associated impacts.

- Lock and Dams 12 and 13 restrain fish passage between pools.
- More information is needed to better assess and manage the Pool 13 mussel population.
- The current water management regime, especially avoiding seasonal low water, removes much potential for periodic regeneration of aquatic habitats.

b. Proposed Action Specific to Green Island HREP

- Expand moist soil and shallow aquatic wetland management within the constraints of the Green Island L&DD to provide and ensure critical migratory bird habitats.

3. Habitat Needs Assessment-II. To address the UMRR program's vision statement of a healthier and more resilient UMR ecosystem that sustains the river's multiple uses, the program developed a suite of 12 indicators in the Habitat Needs Assessment-II (HNA-II) that quantify aspects of ecosystem health and resilience, 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 compared individual indicators to the conditions desired by the programs' management agencies. An assessment of current conditions using 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 utilize the information provided in the HNA-II to more effectively achieve the program's goals and individual HREPs (McCain, K.N.S., et. Al., 2018).

Pool 13 is part of the Upper Impounded cluster, as identified by the River Teams, and has the following desired future conditions:

- Improve the function and diversity of aquatic habitat types by improving the quality, depth and distribution of stream, lake, and marshland habitats.
- Maintain and enhance aquatic vegetation diversity.
- Maintain and enhance floodplain vegetation diversity, including hard-mast trees.
- Restore floodplain topographic diversity and diversify inundation periods.

4. IA DNR Management Goals. To promote abundant, diverse, high-quality waterfowl habitat to produce, attract, and harvest waterfowl. Creating and maintaining diverse aquatic vegetation communities for the benefit of diverse aquatic wildlife, maintaining diverse and healthy forest communities for the benefit of forest-associated wildlife, and supporting viable native fish communities.

5. USFWS Management Objectives. The UMNWFR encompasses a portion of the Green Island study area. The goals and objectives for the UMNWFR are defined in the Comprehensive Conservation Plan (CCP; USFWS, 2006), and within the refuge's Habitat Management Plan (HMP; USFWS, 2019). These goals and objectives are not specific to Green

Island but are overarching objectives of the broader UMNWFR. Following is a summary of pertinent objectives from both the CCP and HMP:

- Management practices will restore or mimic natural ecosystem processes or functions to promote habitat diversity.
- The aesthetics of projects in the context of visual impacts on the landscape should be considered in project design.
- Bottomland forests will be developed consistent objectives of the HMP, including targets for species composition, canopy cover, regeneration, herbaceous cover, and invasive species.

D. Project Objectives. Based on the identified problems and opportunities 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:

Primary Objective
- Mimic historic hydrologic fluctuation range.

Secondary Objectives
- Restore the quality, quantity, and diversity of vegetation.
- Improve sediment management across the Green Island study area.
- Increase the quality and quantity of aquatic habitat.
- Restore bathymetric and topographic diversity.

E. Planning Constraints and Considerations. The following constraints and considerations were included in the plan formulation:

1. **Institutional Constraints.** Avoid or minimize impacts to flood stages and navigation.

- Existing waterfowl refuge, eagle nest locations, and potential bat roosting locations may limit construction boundaries and schedules.
- Avoid cultural resource sites. Several known cultural resource sites are present.
- Existing real estate and land ownership boundaries would constrain measures within the study area, particularly regarding potential modifications to the existing levee system.
- There may be access constraints to portions of the Green Island study area, particularly with the unpredictability of future high-water levels and durations.
- Existing level of flood protection constrain construction within the floodplain. The existing levee provides protection up to an 11.8-year event. The Project would have to demonstrate "no-rise" (i.e., <0.009' increase to the 1% event).
- The existing levee district has requirements for the elevation and timing of WLM within the Green Island study area.

- Green Island shall be designed to ensure no detrimental impacts occur to the previously constructed Brown's Lake HREP, adjacent to the study area.
- Flood height restoration measures should not increase flood heights or adversely affect private property or infrastructure.

9. Environmental Constraints. Construct measures consistent with Federal, state, and local laws. Compliance and coordination under NEPA emphasize the importance of environmental impacts being minimized and avoided as much as possible. Therefore, the following constraints are considered when analyzing alternatives.

- **Environmental Laws and Regulations.** Construct measures consistent with Federal, state, and local laws. Therefore, the following elements are considered when analyzing alternatives:
  - Avoid or minimize floodplain forest impacts.
  - Avoid or minimize endangered species impacts.
  - Avoid or minimize migratory bird impacts.
  - Maintain hydraulic connectivity to allow for adequate water quality for fish.
  - Avoid or minimize impacts to cultural resources.
  - Avoid adverse social justice impacts.
  - Avoid wetland loss.

In addition to institutional and environmental constraints, some considerations are deliberated throughout the planning process. Specific considerations used for this study are as follows:

- **Sponsor Constraint.** The IA DNR has a cooperative agreement with the Jackson County Board of Supervisors concerning the area behind the Green Island levee. The agreement states that from August 15th through December 15th, the elevation would not exceed 588.9 feet above mean sea level (MSL) 1912 datum (MSL 1912, 588.22 NAVD88). After this period, the water level would be lowered to 585.5 feet MSL 1912 (584.82 NAVD88) to allow spring field work and planting. The IA DNR is also responsible for maintaining a minimum levee height of 596.5 ft MSL 1912 (595.82 NAVD88).

3. Considerations

- There is currently no electricity to the eastern edge of the Green Island study area, which would be required to support electric pump stations.
- Adjacent railroad ownership must be considered if electricity is brought into the Project area.

III. EXISTING CONDITIONS AND FUTURE WITHOUT PROJECT (FWOP) CONDITIONS

This chapter identifies the existing resources within the Green Island study area and describes FWOP conditions (i.e., No Action Alternative). The FWOP is the forecasted condition of the study area for the next 50 years, assuming no significant action is taken to address the resource problems identified. The FWOP is the basis for calculating the proposed Project features' benefits.

Based on existing conditions in the study area (see Sections III A through III C) and knowledge of IA DNR staff associated with their property management, impoundments in the study area are expected to remain shallow due to sedimentation. Lack of vegetation and increased areas of open expanses of water would contribute to increased wind fetch and wind-wave action, resulting in declining water clarity within the impoundments. Turbidity and erosion of aquatic vegetation beds would continue contributing to a decline in aquatic habitat and wetland vegetation. Continued degradation and decline of aquatic habitat quality are expected to persist in reducing the quality of the native fishery within Green Island.

Extended inundation durations would continue to occur, impacting the sustainability of existing vegetation throughout the study area in aquatic, riparian, and floodplain areas. Extended inundation contributes to the degradation and decline of forestry resources in inundated areas and results in the decline of submerged aquatic and emergent vegetation. A continued decline in quality and abundance of vegetation in the study area would negatively impact various fish and wildlife resources, including bald eagles, bats, Neotropical migrant birds, and waterfowl.

Due to changes in land use, climate, and urbanization, an increased frequency and extended duration of Mississippi River flooding is expected to continue as part of the FWOP. Increased river stages and flooding do not allow the Project area to drain with existing gravity drainage structures properly. The inability to conduct regular drawdowns limits the ability to manage sediment and diverse species of aquatic vegetation. Ultimately, the decline of important terrestrial and aquatic vegetative resources would continue to simplify ecosystem structure and reduce ecosystem function and dynamic processes, impacting important wildlife and fisheries resources within Green Island.

A. Resource History and Current Management of the Study Area The agreement between IA DNR and the Green Island L&DD dictates water level management in the study area. A maximum water surface elevation was originally established in 1965. The water level management (WLM) plan with the Green Island L&DD was modified in 1980 to allow the IA DNR develop habitat management plans that had been written for the area. The new agreement allowed an annual 3-foot rise in water level on the western 1,400 acres of the area (Pool A) from August 15 to December 15. Outside of those dates, water is to be returned to the lower level stated in the plan. Water control dikes and gate structures built during a 1989 Project 91 Resource Enhancement and Protection-funded project contain water in the 1,400-acre Pool A (Figure 3). Water is pumped into Pool A from the Mississippi River by two 20,000-gallon-per-minute (gpm) unidirectional pumps.

Pumping operations typically begin in early mid-September, and water levels are steadily increased in Pool A to crest elevation by approximately November 1. Mooney Hollow Creek watershed runoff drains to the Maquoketa River through the sluice gates or delivers to Pool B through a water conveyance channel that bypasses Pool A and enters Pool B near the 4th Ditch Road (Figure 3). Water may also be delivered via Mooney Hollow Ditch through the Fish Lake stoplog structure into Pool A by gravity flow sourced from the Maquoketa River or Mooney Hollow Creek. Gravity water delivery to Pool A is unusual since the river/ditch sources are normally low during the fall. Smith Creek flows outside of the southeast boundary of the HREP and the Green Island Levee. A gate structure along the levee near Sta. 431+60 allows water to flow through the levee and into a wetland unit outside of the southeast corner of the HREP. A stoplog structure on the HREP perimeter berm allows flow from this wetland unit into Pool B for approximately 15 days each year. Three interior inline water control structures along the 4th Ditch Road allow for flow between Pool A and Pool B. Water can be discharged from Pool B

through the sluice gate structure on the Mississippi River located at RM 546.2. Water control structures and managed pool areas are shown in Figures 3 and 4.

Figure 3. Existing Water Control Structures

Figure 4. Project Area Pools

Water levels in Pool A are drawn down steadily after the close of the duck season (typically mid-December) through gravity drainage into Pool B. Each spring, the goal across the entire area is to draw down water to the desired elevation to promote the growth of desirable aquatic vegetation and maintain diverse forest resources. Spring/summer drawdowns have proven difficult to achieve under the modern hydrologic conditions of the Mississippi River and the surrounding watersheds impacting the GIWMA.

B. Resources Not Evaluated in Detail. The PDT considered relevant environmental resources that would potentially be impacted by the proposed alternatives and eliminated resources that were not in the area of potential effect or would not be impacted by any of the alternatives from further evaluation. These resources include:

- Geology
- Air Quality
- Noise Impacts
- Wild and Scenic Rivers (no designated wild and scenic rivers in or near the study area)
- Mineral and Energy Resources
- Soils (no prime or unique soils in the study area)

- Navigation

The PDT focused on information gathered from the study area and the area of potential effect.

C. Relevant Resources. The PDT evaluated relevant resources in the study area and assessed existing and Future Without Project (FWOP) conditions. Under the National Environmental Policy Act (NEPA), the FWOP (considered the No Action Alternative) is necessary to provide a reference point, enabling a comparison of environmental effects of action alternatives. The PDT focused its evaluation on resources affected by previous HREP Projects of similar size and composition. This section briefly describes the following resources' current conditions.

2. Aesthetics

a. Existing. Aesthetics and visual resources are institutionally important because of the laws and policies affecting visual resources, most notably NEPA and the USACE Engineer Regulation ER 1105-2-100, *Planning Guidance Notebook*. Visual resources are technically important because of the high value of preserving unique geological, botanical, and cultural features. Aesthetic resources are publicly important since environmental organizations and the public support preserving naturally pleasing vistas.

The Study is in the Mississippi River floodplain; however, the complex is disconnected from the river. The complex has mature forests and abundant wildlife. There are no formally designated hiking, biking, or kayaking trails in the Project area; however, the Project area is important for birding, fishing, hunting, and other recreational activities. Several public roadways provide access for viewing existing natural resources, and the study area has few existing buildings or other infrastructure to interrupt or alter the viewshed. The Project is l close to the UMNWFR. These elements contribute to the Pool 13 aesthetic character.

b. No Action (FWOP Conditions). Aesthetics and visual resources would continue to evolve from existing conditions because of land use trends and natural processes over time. Green Island would continue to change naturally, and visual resources would continue to be rich in biodiversity.

3. Aquatic Resources

a. Existing. Green Island is disconnected from the river by a levee system. Water can be brought into the area through a pump station on the Mississippi River and a series of stoplog structures from the Maquoketa River, Mooney Hollow, and Smith's Creek, as shown in Figure 2. The only way to release water is through gravity water control structures that drain into the Mississippi River. Over the past 10 years, Green Island managers have not been able to remove water from the Project area due to high water on the Mississippi River and cannot pump water out of the complex. Due to high river levels, gravity drain capabilities have been difficult to execute, leading to many emergent species of vegetation and bottomland hardwoods being submerged for too long and causing mortality.

The Green Island Project area has abundant native submersed aquatic vegetation (SAV) throughout the area. Native SAV is predominantly coontail (*Ceratophyllum demersum*), with many other SAV species also present, such as waterweeds spp. (*Elodea*), sago pondweed (*Stuckenia pectinate*), northern watermilfoil (*Myriophyllum sibiricum)*, and star duckweed

(*Lemna trisulca*). Despite this, species diversity is declining due to high water during the growing season.

Emergent vegetation is an important food source for migrating ducks on Green Island. Anecdotal evidence suggests that emergent vegetation has been declining throughout the Project area. Emergent vegetation such as buttonbush is desired to provide food and habitat for migrating bird species.

Invasive vegetation is also present in Green Island. Flowering Rush (*Butomus umbellatus*) was identified in 2020. Only a few plants have been found throughout the complex, however, this species is becoming more prevalent throughout Pool 13. Invasive SAV present in the system includes eurasian watermilfoil (*Myriophyllum spicatum*) and curly-leaf pondweed (*Potamogeton crispus*), however, abundance has remained low with minimal impacts.

b. No Action (FWOP Conditions). Without being able to manipulate water levels, desired emergent species and bottomland hardwood species would continue to decline, native SAV species diversity would change over time, and as native species decline, invasive species would have the space to expand.

4. Fish and Wildlife Resources

a. Existing. Many species use the area throughout the year. Green Island is used heavily by migratory birds. Migratory species use the Project area to move through for a resting area and feeding ground. Fish and Wildlife resources have been declining due to WLM challenges. The Project area is not connected to the Mississippi River in a way that would allow fish passage. Therefore, fish located in the area are residents. Fish use the “ditch” system and many small, impounded waters throughout the area for overwintering habitat. Resident fish use the shallow areas for spawning habitat.

The study area forest is made up of 16 different tree species that were recorded during a 2020 forest inventory consisting primarily of silver maple (*Acer saccharinum*), common hackberry (*Celtis occidentalis*), American elm (*Ulmus americana*), green ash (*Fraxinus pennsylvanica*), eastern cottonwood (*Populus deltoids*), bur oak (*Quercus macrocarpa*), river birch (*Betula nigra*), black willow (*Salix nigra*) and pin oak (*Quercus palustris*). Silver maple was the most encountered tree species, ranging from 17 to 147 average trees per acre (TPA). The existing forest consists of even-aged mature silver maple-dominated stand.

b. No Action (FWOP Conditions). Fish and wildlife resources would continue to decline. A general flattening of the area will continue making all the water resources exceeding difficult for wildlife to use. Eventual mortality due to old age can be expected for much of the forest at nearly the same time, resulting in more open canopies with limited understory tree seedlings and saplings available for regeneration. These conditions would likely increase the spread and dominance of non-desirable herbaceous vegetation, such as reed canarygrass (*Phalaris arundinacea*), 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.

5. Threatened/Endangered and Other Species of Concern

a. Existing. According to the USFWS Information for Planning and Consultation (IPaC) website, Green Island has seven species listed in the federally-threatened/endangered species list (Table 2).

Table 2. Threatened/Endangered Species and Other Species of Conservation Concern According to IPaC[1]

Common Name	Scientific Name	Class	Designation[2]
Northern Long-eared Bat	*Myotis septentrionalis*	Mammal	Endangered
Tricolored Bat	*Perimyotis subflavus*	Mammal	Endangered
Whooping Crane	*Grus americana*	Bird	Experimental
Higgins Eye (pearlymussel)	*Lampsilis higginsii*	Clam	Endangered
Sheepnose Mussel	*Plethobasus cyphyus*	Clam	Endangered
Monarch Butterfly	*Danaus plexippus*	Insect	Candidate
Eastern Prairie Fringed Orchid	*Platanthera leucophaea*	Flowering Plant	Threatened
American Golden-plover	*Pluvialis dominica*	Migratory Bird	BCC
Bald Eagle	*Haliaeetus leucocephalus*	Migratory Bird	Not BCC; Eagle Act
Black Tern	*Chlidonias niger*	Migratory Bird	BCC
Black-billed Cuckoo	*Coccyzus erythropthalmus*	Migratory Bird	BCC
Bobolink	*Dolichonyx oryzivorus*	Migratory Bird	BCC
Canada Warbler	*Dendroica cerulea*	Migratory Bird	BCC
Chimney Swift	*Chaetura pelagica*	Migratory Bird	BCC
Eastern Whip-poor-will	*Antrostomus vociferus*	Migratory Bird	BCC
Golden Eagle	*Aquila chrysaetos*	Migratory Bird	Not BCC; Eagle Act
Golden-winged Warbler	*Vermivora chrysoptera*	Migratory Bird	BCC
Henslow's Sparrow	*Ammodramus henslowii*	Migratory Bird	BCC
King Rail	*Rallus elegans*	Migratory Bird	BCC
Lesser Yellowlegs	*Tringa flavipes*	Migratory Bird	BCC
Long-eared Owl	*Asio otus*	Migratory Bird	BCC
Marbled Godwit	*Limosa fedoa*	Migratory Bird	BCC
Red-headed Woodpecker	*Melanerpes erythrocephalus*	Migratory Bird	BCC
Ruddy Turnstone	*Arenaria interpres morinella*	Migratory Bird	BCC
Rusty Blackbird	*Euphagus carolinus*	Migratory Bird	BCC
Short-billed Dowitcher	*Limnodromus griseus*	Migratory Bird	BCC
Western Grebe	*Aechmophorus occidentalis*	Migratory Bird	BCC
Wood Thrush	*Hylocichla mustelina*	Migratory Bird	BCC
Yellow Rail	*Coturnicops noveboracensis*	Migratory Bird	BCC

[1] IPaC last accessed 6/13/2023

[2] BCC- Bird of Conservation Concern

The Grass Pickerel (*Esox americanus vermiculatus*) is a state-listed threatened fish species within Green Island. In addition, six declining bird species listed as endangered or threatened by the State of Iowa, including the red-shouldered hawk, northern harrier, king rail, short-eared owl, long-eared owl, and Henslow's sparrow are present at Green Island. A full list of Iowa's threatened and endangered species can be found at https://www.iowadnr.gov/Conservation/Iowas-Wildlife/Threatened-and-Endangered.

b. No Action (FWOP Conditions). Threatened/endangered and other species of concern would likely stay the same or decrease under the No Action Alternative. Dead trees would continue to fall, and bald eagles may be unable to find suitable nesting trees. The two endangered bat species may have an increase in habitat at first, but as the dead trees begin to fall, they would also have difficulty finding suitable habitat.

6. Cultural Resources

a. Existing. As evident through archeological remains, many identified and unidentified Native American groups previously inhabited the study area and its vicinity over the past 10,000 years or more. Gradual and evolving settlement and land use strategies generally characterized the various Native American occupations. Benn et al. (1989 & 1995) offer cultural history summaries relevant to the study area.

Examining the area's mapped Landform Sediment Assemblages (LSA) assists in understanding the archeological potential, as Bettis et al. (1996) discussed. Mapped LSAs within the study area consist of Early-Middle Holocene channel belt (post-ca. 7,000 B.P.), Yazoo Meander Belt, alluvial fans and colluvial slopes, and tributary fan. Less than half of the Project's total area is underwater or seasonally inundated according to modern aerial imagery; however, the earliest cadastral survey plat of the area archived by the Bureau of Land Management's General Land Office Records, dated 1839, show most of the study area as dry land.

Seven prior archeological surveys overlap with small areas along the northern and southwestern boundaries of the study area (R&C# 19861249062, 19871049051, 19880300086, 19930500061, 19941049012, 20000849096, and 20080200004), including the survey reported by Benn et al. (1989) discussed above. These surveys identified two archeological sites and two isolated finds (see Appendix A, Correspondence). The sites identified include a prehistoric lithic scatter of unknown integrity and condition (identified 1987, revisited 1989) and a multi-component site documented through excavation to include a Middle Woodland prehistoric scatter of unknown integrity and condition, an Archaic/Early Woodland/Late Woodland (Lane Farm Phase) open habitation site, and an historic farm/residence on recently tilled cropland, all of unknown integrity (identified 1989, revisited in 2007 with recommendation to avoid). The two prehistoric isolated finds identified consist of one heat-treated lithic flake each and are near the multi-component site discussed above, which is in an abandoned river meander. The multi-component site was the subject of a Phase II survey (Benn, 2007) and was determined to be potentially eligible for listing on the National Register of Historic Places.

b. No Action (FWOP Conditions). Under the No Action Alternative, known historic properties within the Project area would continue to be at risk of degrading integrity due to variable water levels, potential erosion, and lack of protection. Unknown properties would be subjected to continuing risk due to the same factors, with increased potential for inadvertent discoveries in high-probability areas due to their undocumented status.

7. Floodplain

a. Existing. Green Island is within the floodplain of the Mississippi and Maquoketa Rivers. The Green Island L&DD manages flood risk to the Project area from Mississippi and Maquoketa flooding up to approximate elevation 595.5 NAVD88. Incipient overtopping along the Green Island Levee occurs along the downstream tie-back that borders Brown's Lake. The

sequence of overtopping at the Green Island Levee initiates at the downstream end and then generally moves upstream along the mainstem Mississippi River reach, and the Maquoketa River reach. A more detailed description of the Green Island Levee flood risk, flooding history, and hydraulic superiority can be found in Appendix E, Attachment A, *Hydrology and Hydraulics.*

b. No Action (FWOP Conditions). Floodplain conditions would not change in the No Action Alternative.

8. Hazardous, Toxic, & Radioactive Waste

a. Existing. The District conducted a Phase I HTRW analysis in September 2020, in accordance with ER 1165-2-132, *Water Resource Policies and Authorities HTRW Guidance for Civil Works Projects* (see Appendix E, Attachment H, *Hazardous, Toxic, and Radioactive Waste*, for the full report). The Phase I indicated that there were no Recognized Environmental Conditions. Therefore, the Corps does not recommend a Phase II assessment.

b. No Action (FWOP Conditions). There are no known HTRW sites or concerns within or near the study area; therefore, there are no HTRW concerns with the No Action Alternative.

9. Hydrology and Hydraulics

a. Existing. The Green Island L&DD is on the right descending bank of the Mississippi River at the confluence of the Maquoketa and Mississippi Rivers (Figure 3). The Green Island Levee manages flood risk from these two rivers and serves as the HREP perimeter berm along the Mississippi River boundary, the northwestern boundary with the Maquoketa River, and the southeastern boundary with the Brown's Lake backwater area. The berm along the western and southern boundaries of the Project area is not part of the Green Island Levee and thus maintains lower elevations. The Mooney Hollow Creek and Smith Creek watersheds drain into the HREP; however, water control structures manage flows into the HREP from these two creeks. Section III. A. Resources History and Current Management of the Study Area provides a more detailed description of the routing and management of these tributaries.

Mississippi River elevations over the most recent thirty-year period (1993-2022) show an increase relative to the previous 30 - year period (1963-1992). Figure 3 illustrates increases in annual stage duration near the Project between the current 30-year period (1993-2022) and the previous 30-year period (1963-1992) by as much as 1 foot. The current WLM in Pools A and B is shown in Figures 5 and 6, respectively. Drawdown actions are currently achieved through gravity drainage when Mississippi River levels are conducive while filling actions require using an existing ingress diesel pump station with two-20,000-gallons-per-minute pumps. To increase the quantity and diversity of aquatic and floodplain vegetation, periodic, deeper drawdowns are needed; however, Mississippi River levels provide limited opportunity for gravity draining to recreate this desired seasonal, periodic drawdown, as illustrated by Figure 7. The desired periodic drawdown elevation (582.82 feet) for Pools A and B, shown by the solid light green line, is exceeded nearly 100% of the time illustrating the limited opportunity to gravity drain the interior to the desired elevation. Thus, the existing Mississippi River gate structure and one-way ingress pump station do not adequately meet the desired deeper growing season drawdown once every 5 years.

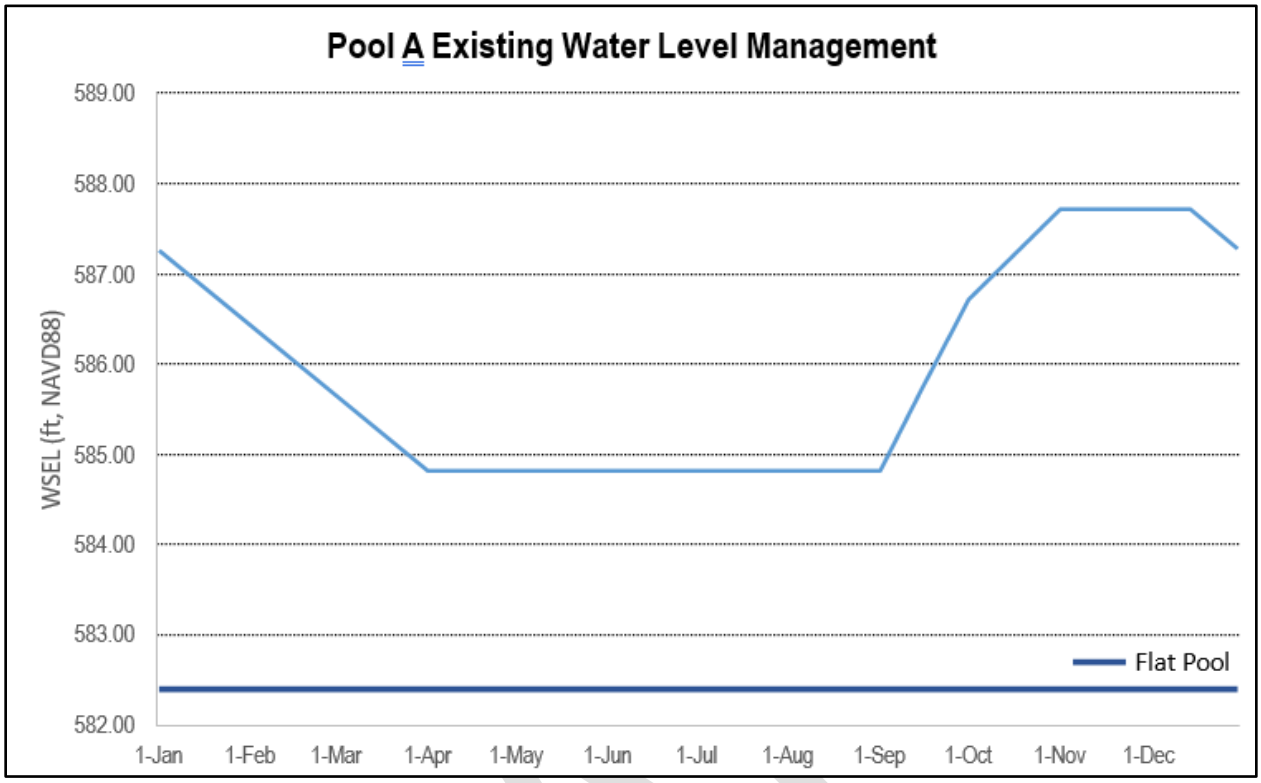

Figure 5. Pool A Existing Water Level Management

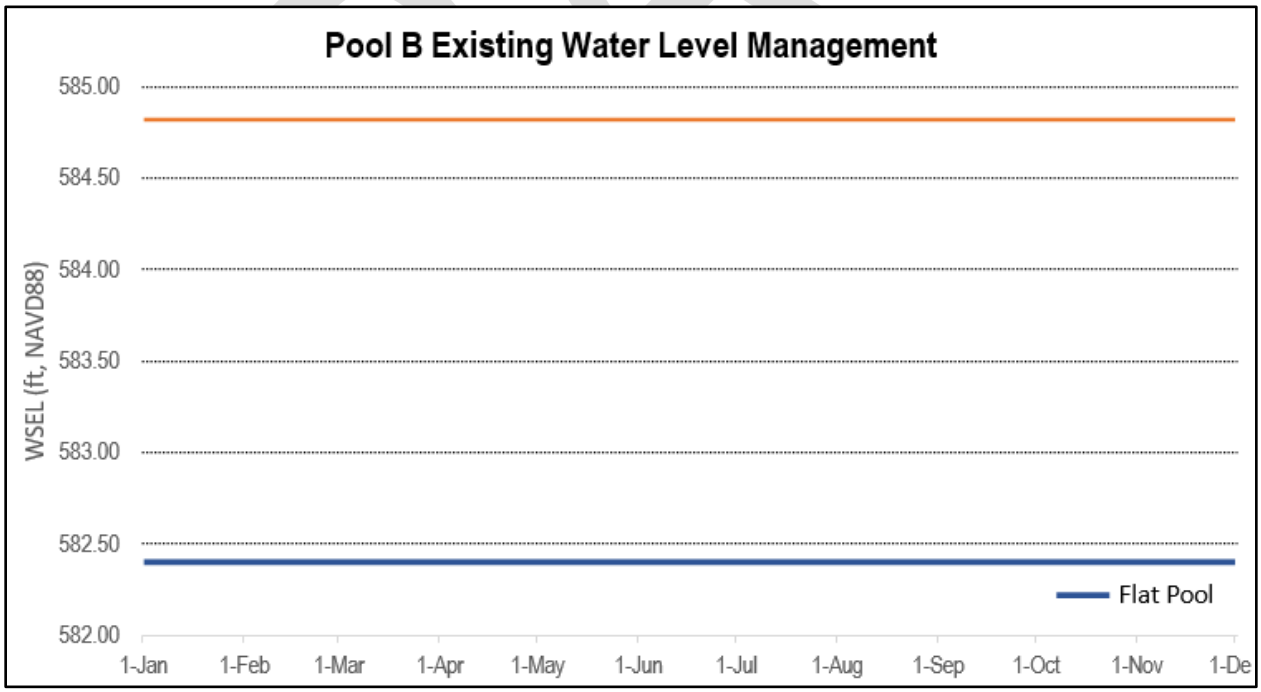

Figure 6. Pool B Existing Water Level Management

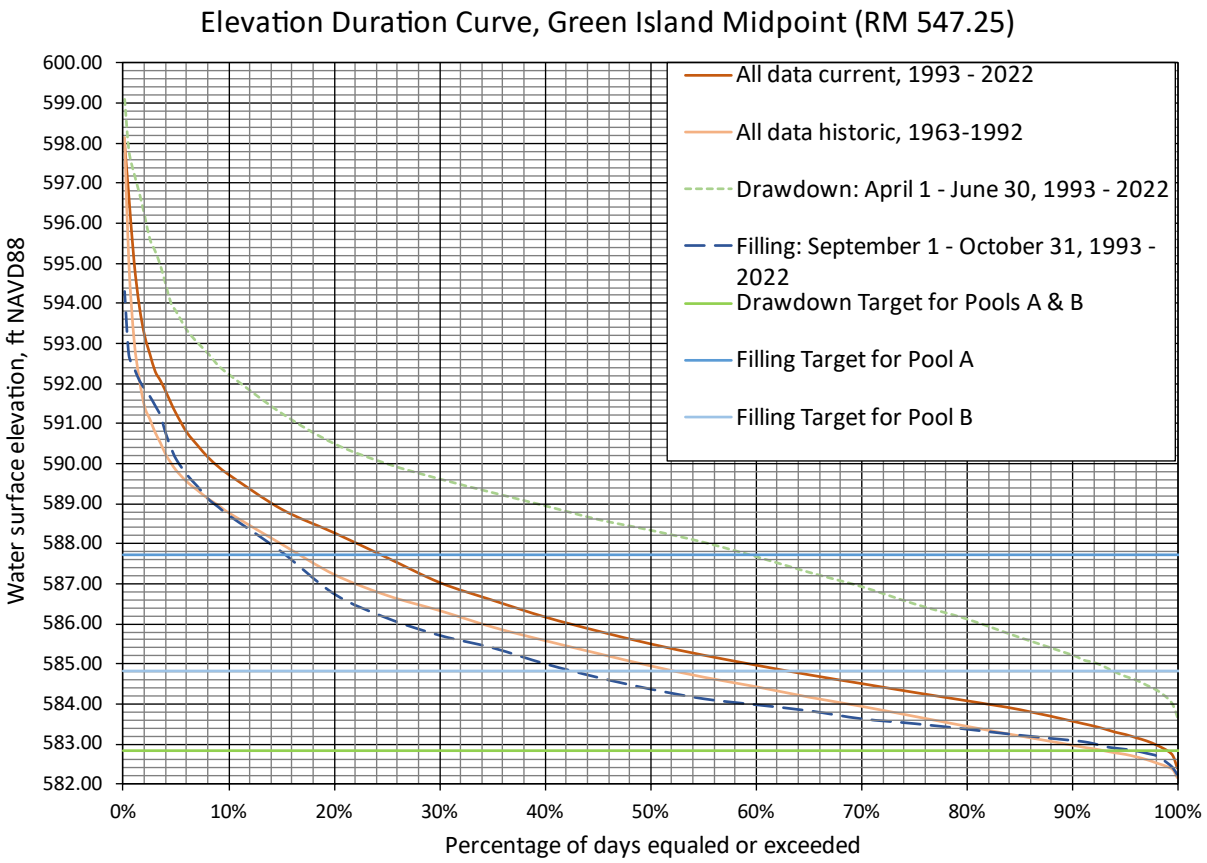

Figure 7. Elevation Duration Curves Approximated for Green Island Midpoint (RM 547.25)

The surrounding Green Island Levee that provides for WLM independent of the Mississippi River has an annual exceedance probability (AEP) of approximately 8.5% (8.5 percent flood) based on an updated Bulletin 17C analysis that includes annual peak flows through 2021. An 8.5 percent flood has one chance in 11.8 of being exceeded in any given year. The likelihood of overtopping or exceedance throughout the 50-year project life is summarized in Table 3, illustrating a greater than 40% chance of overtopping five or more times during the project life.

Table 3. Green Island Levee 50-year Annual Exceedance Probability[1]

Probability of Being Exceeded at Least					
Once	Twice	Three Times	Four Times	Five Times	Six Times
98.71%	92.85%	79.79%	60.79%	40.50%	23.53%

[1] AEP = 8.5%

Flood events on the Mississippi River that cause overtopping or even levee failure prevent the Sponsor from meeting their WLM goals and typically result in a loss of habitat for that year and potentially longer. Existing infrastructure allows gravity drainage through the Mississippi River sluice gates, subject to the rate of fall of the river.

b. No Action (FWOP Conditions). The current Mississippi River hydrology and existing infrastructure limit the Sponsor's ability to conduct periodic, deeper drawdowns necessary to increase the quantity and diversity of aquatic and floodplain vegetation. Climate

projections for the Project's 8-digit Hydraulic Unit Code (HUC) show statistically significant increasing trends for annual streamflow volume, annual maximum streamflow, maximum precipitation, and drought indicators. Increases in maximum precipitation and annual streamflow volume indicate increased flood volume, flood frequency, and flood duration. This suggests an increased potential for levee overtopping and increased flood duration as river levels remain high. These factors would further reduce the Sponsor's ability to manage water levels with the existing infrastructure. Increased flooding could result in decreased water depths, inability to drawdown for annual vegetation recruitment, and increased inundation duration, impacting floodplain forest resources. Nevertheless, increased potential for drought, depending on the intensity, could indicate opportunity for achieving the desired periodic deeper drawdowns.

10. Land Use

a. Existing. The land within the Project area is within the historic floodplain of the UMR. Extensive human activity has manipulated vegetation and land use. The District utilized the National Land Cover Database 2019 to generate land use coverage for this area. Green Island is designated as woody wetlands and emergent herbaceous wetlands. The IA DNR has a master plan under review for Green Island. The area would also fall under two Mississippi River plans: the District's Mississippi River Master Plan March 2022 and the United States Fish and Wildlife Habitat Conservation Plan July 2006.

b. No Action (FWOP Conditions). The land use would not change in the No Action Alternative.

11. Socioeconomics

a. Existing

Population, Income, and Employment. The Project area is in Jackson County, Iowa. According to the 2021 American Community Survey (ACS), the population of Jackson County, Iowa, was 19,499. The number of households was 8,020. Recent trends in population show a decline over time. Between 1980 and 1990, Jackson County saw the biggest decline in population over the last 50 years. Census data from 2021 ACS report that the unemployment rate was 4.3%, and the income per capita was $32,335. The unemployment rate was slightly above the state average, and the income per capita was slightly below the state average. There are no residential or commercial activities within the Project area.

Transportation. No major transportation routes exist within the Project area. Major transportation routes adjacent to the Project include U.S. Highway 52.

Recreation. The Project area provides several recreation opportunities including fishing, birding, and hiking.

Community Cohesion. There are no residential structures within the Project area. The small, incorporated community of Green Island is located adjacent to the Project area.

b. No Action (FWOP) Conditions Socioeconomics would not be impacted by the No Action Alternative.

12. Public Infrastructure

a. Existing. Green Island is relatively remote, with few structures in the area. The largest structure in the area is a pump station, followed by water control structures, including stop log structures and screw gates (Figure 2). These structures are used to manage the complex for migratory birds, fish, and vegetation. The area includes one boat ramp and two parking lots.

b. No Action (FWOP Conditions). Public Infrastructure would not increase with the No Action Alternative. The pump and some water control structures are aging and may require repair or replacement to continue managing the area.

13. Environmental Justice

a. Existing. Executive Order (EO) 12898, *Federal Actions to Address Environmental Justice (EJ) in Minority Populations and Low-Income Populations* (1994), requires Federal agencies to develop strategies to address this issue as part of the NEPA process. Executive Order 12898 requires Federal agencies to identify and address, as appropriate, any disproportionately high and adverse human health or environmental impacts of their programs, policies, and activities on minority and low-income populations.

To determine whether a minority or low-income population was present in the study area, the District economist used the EJScreen web portal (March 29, 2023). The output drawn in EJScreen included a 5-mile buffer to generate study area demographics in Table 4. Since the 5-mile buffer extends into Illinois and Iowa, the state metrics are average.

The EJScreen analysis considers disproportionate impacts with two areas defined to facilitate comparison between the area affected and a larger regional area that serves as a basis for comparison and includes the area affected. The larger regional area is defined as the smallest political unit, including the affected area, and is called the community of comparison. Given the rural nature of the study area and the lack of an encompassing metropolitan community, the analysis covers the two closest cities as communities of comparison: Bellevue, Iowa, and Savanna, Illinois. As summarized in Table 4, low-income and minority populations within the study area are consistent with the communities of comparison and are under 50%. As a result, an EJ population does not exist within the study area. For more information, see Appendix G, Economic and Social Considerations.

Table 4. Low-Income and Minority Populations in the study area, Compared to Local Communities of Comparison and State Level Metrics

Parameter	State Average	Bellevue, IA	Savanna, IL	Study Area
Low-Income Population	30%	25%	41%	32%
Minority Population	38%	4%	13%	5%

b. No Action (FWOP Conditions). EJ will not change in the No Action Alternative.

14. Water Quality

a. Existing. In December 2019, the PDT initiated baseline water quality monitoring in the study area during the summer and winter seasons. Baseline water quality monitoring is

ongoing at three sites. The IA DNR collected water clarity measurements at an additional eight locations after significant rainfall and when operating water control structures. Details of the data collected and sampling site maps are presented in Appendix G, Social and Economic Considerations.

All three sites exhibited lentic characteristics with typical low velocities and good water clarity. The sites in Pool B were generally shallower than the site in Pool A, with site W-M547.7H averaging a depth of 1.74 m over the course of monitoring and sites W-M546.1J and W-M546.8K averaging depths of 1.34 meter (m) and 1.28 m respectively. Summer dissolved oxygen (DO) concentrations at all sites tended to exhibit large diel swings and were prone to prolonged periods of DO below 5 milligrams per liter (mg/L), frequently lasting up to two months at sites W-M546.1J and W-M547.7H. Due to a project-wide drawdown in 2021, low water levels exacerbated these daily swings, with DO concentrations frequently dropping below 5 mg/L at night and rising to nearly 10 mg/L during the day.

Fish overwintering habitat is considered high-quality when DO is over 5 mg/L, velocity is 0 centimeters per second (cm/sec), and the temperature is 4 degrees Celsius (° C) (Palesh and Anderson, 1990). At each site, winter DO concentrations tended to bottom out below 5mg/L, during some seasons dropping to near 0 mg/L for several weeks, until ice cover broke up and allowed air and water interaction. Winter water velocities averaged around 0.5 cm/sec at each site and no site recorded velocities of over 0.28 cm/sec when ice cover was present. Winter temperatures collected by continuous monitoring sondes generally recorded temperatures between 2°C and 4°C.

Water quality sites met UMR criteria for high-quality submerged aquatic vegetation for a majority of the summer sampling season. Light-related criteria necessary to support and sustain SAV during the growing season in the UMRS include a minimum Secchi disk depth of 50 cm, a maximum total suspended solids (TSS) concentration of 25 mg/L, and a maximum turbidity of 20 NTU (UMRCC, 2003). Sites W-M 546.8K and W-M547.7H only met Secchi disk depth criteria in 53% and 48% of samples, respectively; these low Secchi disk depths were usually recorded alongside turbidity and TSS measurements which met UMR criteria. While submerged aquatic vegetation can negatively impact Secchi readings, SAV can provide fish with shade and relief from high summer water temperatures at the surface. Aquatic vegetation was frequently reported at all Green Island water quality sampling sites.

Water clarity was tested to assess possible sources of sedimentation within the project. Water clarity measurements suggest that Mooney Hollow Creek must consistently contribute significant amounts of sediment to the Project. Both water control intakes—the Pump House Inflow and the Downstream Gate inflow—on the Mississippi River had lower water clarity readings and may introduce sediment in the northern portion of the project. The Smith Creek inflow in the southeastern corner of the project was only operated briefly in the fall, and water clarity readings were drastically different from year to year.

b. No Action (FWOP Conditions). Green Island needs more bathymetric diversity, and with no action, aquatic areas would continue to lose depth due to sedimentation. This would result in a lowered volume of water in the project, causing a lowered capacity to buffer water temperature changes, resulting in overall hotter water temperatures in the summer and lower temperatures in the winter. Water temperatures would likely drop below 4°C in the winter, outside the optimal range for overwintering fish. With the loss of depth and water volume, a smaller DO reservoir would be available to aquatic life once the Project ices over. Smaller DO

volumes can deplete faster, leading to a potential increase in winter fish kills. Additionally, shallower depths would allow the entire water column to heat up more quickly in the summer, exacerbating high biological oxygen demand from aquatic plants and algae and causing more frequent summer low DO events.

15. Climate Change

a. Existing. Hydrometeorologic variables relevant to Green Island include temperature, precipitation, and streamflow, specifically characteristics of magnitude, frequency, duration, and timing. The climate change literature reviewed provides evidence that temperature, precipitation, and streamflow have increased over the observed period of record within the UMR Watershed. Analysis of observed annual mean streamflow at L&D 12 using the USACE Time Series Toolbox indicates a statistically significant increasing trend between water years 1940-2022. Frequent flooding and higher magnitude flows limit the gravity drainage necessary to achieve the desired drawdown under existing conditions. Increased temperatures negatively impact water quality and aquatic habitat.

b. No Action (FWOP Conditions). Evaluated simulated-future hydrometeorologic variables for the Project's 8-digit HUC (Apple-Plum Watershed, HUC07060005), presented in the USACE Climate Hydrology Assessment Tool, show statistically significant increasing trends. This includes trends in annual mean temperature, drought indicator, annual accumulated precipitation, annual maximum 3-day precipitation, annual streamflow volume, annual mean streamflow, and annual maximum of mean monthly streamflow. Increases in maximum precipitation and annual streamflow volume indicate increased flood volume, flood frequency, and flood duration. Under FWOP conditions, these factors will further limit the ability to conduct regular and significant drawdowns, further degrading the aquatic habitat. Increased flooding indicates a greater risk of levee overtopping or failure that would inhibit interior WLM and result in sediment deposition and inundation of floodplain forest resources. Negative impacts to water quality and aquatic habitat are likely with continued increasing temperatures and limited bathymetric diversity. Depending on the intensity, increased potential for drought could indicate opportunity for achieving the desired periodic deeper drawdowns. For more details on the project's climate change vulnerabilities, see Appendix E, Attachment A, *Hydrology and Hydraulics*.

16. Soils and Geology

a. Existing. The Project area is near the confluence of the Mississippi and Maquoketa Rivers in Iowa. It consists of shallow backwaters and is situated on soil regions of loess with bedrock outcrops. The Project area also within the Mississippi Alluvial Plains Section in Jackson County, Iowa. Green Island Levee is in the soil region classified as loess with bedrock outcrops. It has little topographic relief and consists of shallow backwaters, bottomlands, and islands subject to permanent high-water tables and annual flooding.

Subsurface data for the study was gathered from historical project records, available public records, and by completing a limited new boring as described below. The scope of site exploration was limited by project schedule and budget concerns but was considered adequate to provide the preliminary analyses and recommendations included herein. Additional exploration and testing would be necessary to provide design-level recommendations if the project is approved for future work. The location of the most recent borings gathered on Green

Island is shown in Figure 10.

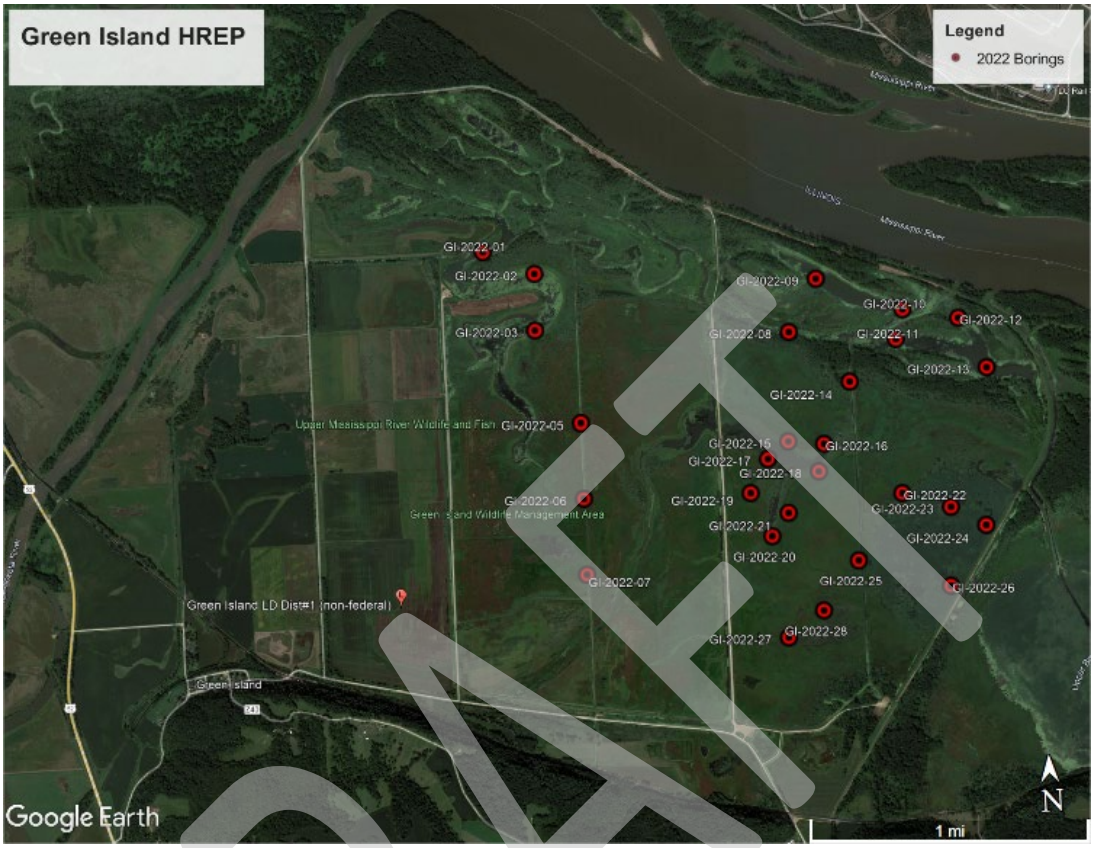

Figure 10. Boring GI-2022-01 to GI-2022-28

Borings GI-2022-01 to GI-2022-07 were gathered on the West side of Green Island near Fish Lake and the GIWMA. Below the ground surface, the top layer of approximately 2.5 to 3 feet was mainly composed of lean clay or fat clay with organics. Two of the borings had organics the entire depth of the boring. Lean clay or fat clay with sand content underlies the upper lean clay or fat clay with an organics layer. Two of the borings transitioned to a poorly graded sand with a clay layer and a clayey sand layer.

Borings GI-2022-08 to GI-2022-13 were gathered on the Northeast section of Green Island. Below the ground surface, the top layer of approximately 1.5 to 5.5 feet was mostly composed of fat clay with organics. GI-2022-11 boring had organics on the entire depth. Mainly clayey sand, poorly graded sand, and poorly graded sand with clay underlie the fat clay with an organics layer. GI-2022-13 boring transitioned from clayey sand to fat clay with a sand content layer.

Borings GI-2022-14 to GI-2022-22 were gathered on Densmore Lake. Below the ground surface, the top layer of approximately 0.5 to 5.5 feet was mostly composed of fat clay or fat clay with organics. Mostly lean clay underlies the fat clay or fat clay with an organics layer.

Borings GI-2022-22 to GI-2022-26 were taken before the Green Island L&DD began experiencing an overtopping breach on April 29, 2023. These borings are the closest to the overtopping breach area. Given that these borings have a top layer of fat clay, it is assumed that

most of the material stayed in place during the overtopping breach. The soil classification conducted after gathering the hand auger borings in this area is still relevant for the preliminary design considerations.

b. No Action (FWOP Conditions). The existing soils and geology will remain consistent with the boring data. Natural processes will continue to unfold in the Project area, with fine sediment accumulating within the backwaters.

17. Sedimentation

a. Existing. Sediment deposition within the study area has resulted in a loss of bathymetric diversity and depth necessary for aquatic habitat. Limited ability to conduct increased drawdowns prevents the consolidation of soft sediments, resulting in increased turbidity and a lack of water clarity and light penetration, limiting aquatic vegetation. Sources of sediment deposition within the Green Island HREP include suspended sediment from external tributaries, including the Maquoketa River, Mooney Hollow Creek, Smith Creek, and the Mississippi River, as well as sediment generated from internal wind-wave erosion of berms.

The Maquoketa River is a significant source of suspended sediment; however, management of the area, as described in Section III. A. *Resource History and Current Management of the Study Area,* provides little opportunity for Maquoketa River flows to enter Pool A. The pump station intake on the Mississippi River, operated to meet the annual fall rise for migratory waterfowl, is located approximately 1.5 miles downstream of the Maquoketa confluence. Due to this proximity, suspended sediment properties of the pumped Mississippi River water are assumed to be influenced by the Maquoketa River. This assumption was considered in estimates of Mississippi River contributions to the HREP existing condition sediment deposition rate. Sediment deposition resulting from Mississippi River overtopping and levee failure was acknowledged but not explicitly estimated. Contributions from inflows from the Mississippi River gate structure were not included due to their rare occurrence. Hillslope soil loss from the Mooney Hollow Creek and Smith Creek watersheds, along with creek flow paths and operation of water control structures into the HREP pools, were considered when estimating sediment contributions from these watershed sources. Wind-wave erosion of interior berms resulting from sustained high water levels and limited ability to conduct significant drawdowns, contributes to internal sediment loading and decreased water clarity and light penetration. Internal sediment loading from wind-wave erosion was qualitatively accounted for in sediment deposition rate estimates. Considering the sources described, the resulting existing condition sediment deposition rate was estimated as 0.72 inches/year. A detailed description of sediment deposition estimates and wind-fetch analysis can be found in Appendix E, Attachment A, *Hydrology and Hydraulics*.

b. No Action (FWOP Conditions). Under FWOP conditions, the inability to conduct significant drawdowns will result in sustained high water levels and a lack of vegetation, enabling continued wind-wave erosion. External sources of sediment deposition are not anticipated to change significantly; thus the without the Project, the sediment deposition estimate remains at 0.72 inches/year or 3 feet over the 50-year Project life.

IV. PLAN FORMULATION

The PDT conducted plan formulation for the Green Island HREP in accordance with the six-step planning process described in *Economic and Environmental Principles and Guidelines for Water*

and Related Land Resources Implementation Studies (P&G; U.S. Water Resources Council, 1983), later incorporated into ER 1105-2-100, *Planning Guidance Notebook* (USACE, 2000). The PDT also adopted a risk-informed planning approach, described in the *Planning Manual Part II* (USACE, 2017). The six steps in the iterative plan formulation process are:

1. Specify the water and related land resources problems and opportunities of the study area;
2. Inventory and overcast existing conditions;
3. Formulate alternative plans;
4. Evaluate alternative plans;
5. Compare alternative plans; and
6. Select a plan.

On December 3, 2019, the USACE hosted a planning charrette for the Green Island HREP (Appendix A). Attendees included diverse representatives from the Corps, the IA DNR, and the USFWS. The purpose of the charrette was to utilize existing knowledge and expertise to refine the study's problems, opportunities, objectives, and constraints through group brainstorming exercises. Throughout the study process, these POCs were periodically revisited and revised by the PDT as new information became available or knowledge of the study area was refined.

The PDT further evaluated existing conditions, focusing on the primary contributing factors to the problems identified within the study area. Historical land use and more recent climatic and hydrologic conditions have influenced existing conditions in the Green Island study area. In recent years, the primary influencing factor in habitat change within the Green Island study area has been long periods of high water. In addition, sediment accumulation within Green Island has reduced storage capacity, increased the effects of inundation, and contributed to the decline in the quality and quantity of lentic habitat. Water levels, inundation duration, and sediment transport have all been significantly altered by the Green Island Levee System and historic land use in the study area, as described in Subsections A and B.

A. Management Measures. Several measures were identified by the PDT in the early planning stages; many were partially developed, deemed unfeasible, and did not undergo further evaluation. Measures that were further evaluated to a point appropriate for planning purposes and will meet the goals and objectives outlined in Section II.D, *Project Objectives*, are described below.

Potential locations for structural or non-structural management measures satisfying the study objectives were identified. The Upper Mississippi River Restoration Environmental Management Program Environmental Design Handbook (Corps, Rock Island District, Rock Island IL, 2012) was also used to develop management measures. Management measures generally fell into six categories:

- sediment management
- vegetation restoration
- wildlife-focused restoration
- water level management
- bathymetric and topographic diversity
- resiliency and sustainability measures

Sediment Management

Sediment Basin or Trap. It consists of an earthen embankment of a combination ridge and channel constructed across the slope and a minor watercourse to form a sediment trap and a water detention basin. Sediment traps can be used to reduce watercourse and gully erosion, trap sediment, reduce and manage onsite and downstream runoff, and improve downstream water quality.

Sediment Collection & Processing Wetland. Wetlands can purify water by removing sediments and other pollutants, including chemicals. Water runs into a wetland where sediment settles out, leaving cleaner water.

Collaborate with watershed partners to reduce sediment inputs. Many sediment inputs come from agricultural fields that do not have any mitigation around the land. Working with adjacent landowners to improve sediment reduction efforts before entering the Project area could reduce sediment load.

Redirect Input Flows. Diverting the flow of waterways coming into the area to adjacent rivers at times of high turbidity would reduce sediment inputs.

Skim Dredging. This would involve removing a thin layer of sediment in inundated areas to reduce nutrient loads. High nutrient loads are not conducive to a diverse aquatic ecosystem. Typically, a large phosphate concentration resides in this thin layer of sediment.

Vegetation Restoration

Timber Stand Improvement (TSI). Includes a variety of techniques such as tree thinning, invasive species management, and mowing and herbicide to improve the forest health.

Routine Water Level Drawdown. Drawdowns allow inundated soils a chance to dry out. If soils remain consistently wet, it promotes fungal and bacterial growth. These pathogens can lead to root rot, ultimately killing terrestrial vegetation.

Replanting Aquatic Species. It involves planting native species to help reduce nutrient loads in wetlands and provide habitat and food for wildlife. Emergent species should typically be planted as deep as a foot below the water surface, while submergent species require at least 16 inches of water.

Wildlife Focused Restoration

Carp removal. This involves removing carp from an area when found by electrofishing. This promotes aquatic vegetation growth without fish eating it.

Close areas to hunting and recreation- This would involve turning areas into wildlife preserves, thus easing the stress placed on the wildlife and the impact on the resource.

Water Level Management

Pump Station. Multidirectional pumps can pump water into and out of the area. The pumps can run off wired electricity or diesel gas.

Water Control Structures. These structures rely on gravity to divert or limit waterflow into an area. Stoplog structures and screw gates are common examples of water control structures. A spillway is a structure at the top of a levee that provides the controlled release of water out of an area. Spillways are typically constructed of concrete or other hard engineering material to armor and protect from erosion. These measures have been used successfully on the UMR.

Seepage Curtain. This measure would help prevent through-seepage on a levee. This is accomplished by placing a barrier in the levee core made of concrete or steel.

Obtain Adjacent Property. Obtaining additional real estate adjacent to the study area would allow greater flexibility in management actions within the project area.

Change Water Level Management Plan in the Drainage District. This would give flexibility to operate outside of the normal water levels within the Project area. This would require the local Green Island L&DD members and county officials to change the current management agreement.

Inflatable Dams. These structures are cylindrical rubber fabrics placed across channels and streams, and act as barriers to raise the upstream water level when inflated. The membrane is a multi-layer fabric made of synthetic fiber and rubberized on one or both sides.

Relief Wells. Relief wells can relieve pressure on a levee and safely divert water on the landward side. This would prevent levee failures or breaches by alleviating pressure on the existing levees.

Wind and Wave Deflection Structures (Berms). These berms would be constructed to slow the wind and wave action, reducing erosion impacts. These are typically constructed with fill material surrounded by an armored shell of riprap.

Topographic Diversity

Dredge Material Topographic Diversity Berms. These would be used to accomplish topographic diversity. The material is placed in appropriate areas for environmentally acceptable improvements. Varying the landscape is important to break up wind wave action. The berms can also be planted with vegetation.

Ridge and Swale. This would involve changing the elevation from higher to lower in short linear distances. The elevation change is typically less than 6 feet and more than 1-foot. This elevation change would promote distinct changes in vegetation communities occurring across the alternating sequence of variability of ridges and swales. Ridge and swale features would be constructed by scraping out terrestrial positioned soil and pushing the excavated soil to various elevations. The higher areas would then be planted with appropriate vegetation.

Thin Layer Placement. This involves depositing sediment on a marsh using either a high-pressure hose to spray sediment or a low-pressure slurry delivered through a pipe suspended above the sediment surface. These techniques are designed to emulate the natural sediment deposition process. This measure would increase the resiliency of the timber stand resources that are currently on site.

Bathymetric Diversity. Bathymetric diversity refers to altering the depths of an area underneath the surface of the water. Sedimentation can cause a general flatting of the area, reducing storage capacity and over-wintering habitat for aquatic species. Water movement through an area can also be slowed by shallowing. Bathymetric diversity can be accomplished through dredging. Hydraulic or mechanical excavation techniques can accomplish dredging.

B. Evaluation and Screening of Measures. The management measures in Section IV.A were initially evaluated using the best professional judgment and screened based on their anticipated efficiency and effectiveness considering risk and uncertainty. Table 5 outlines the array of measures, and notes if they were retained or screened (not retained) and includes justification for their screening.

Table 5. Measures[1]

Measure	Screened or Retained
Sediment Traps or Basins	Retained.
Sediment collection and processing wetland	
Collaborate with watershed parterns to resudce sediment inputs	
Redirect input flows	Screened. Water control structures are already in place within the study area that manage input flows.
Skim dredging	Screened. Phosphates have not been an issue with nutrient loads in the Project waters previously.
Routine Water Level Drawdown	Retained.
Replanting Aquatic species	
Carp Removal	
Close areas to hunting and recreation	
Pump Station	Retained.
Water Control Structures	Retained.
Seepage Curtain	
Obtain adjacent property	
Change water level mangment plan in Green Island L&DD	
Inflatable dams	Screened. This measure is less resilient than replacing the existing water control structures.
Relief Wells	
Wind and wave deflection structures	Retained. To be incorporated into Dredging Material Topographic Diversity Berms
Dredge material topographic diversity berms	Retained.
Ridge and Swale	Retained.
Thin Layer Placement	
Bathemetric Diversity	Retained.

[1] Screened measure are shown in the gray rows.

C. Final Array of Alternatives. Alternative plans developed from the measures are different combinations of various sizes and scales of measures that would contribute to attaining the planning objectives.

The PDT developed an initial array of alternatives using several combinations of measures. Early evaluation of these alternatives led to the understanding that measures to restore a more natural range of hydrologic conditions and water levels in Pools A and B were critical to meeting the planning objectives. Plans without significant WLM measures were screened from consideration. The final array of alternatives was developed to include the critical WLM measures and a variety of other measures to improve both WLM and habitat diversity.

The following section documents the alternatives that survived initial screening and were included in the final array of alternatives.

No Action (Alternative 1). This is the No Action Alternative and does not include any action in the study area.

No Pump/No Brown's Lake (Alternative 5). This smallest action alternative minimally meets Project objectives (Figure 11). Measures included in this alternative include:

- Eight dredge cuts with adjacent dredge placement sites would be completed throughout the project area to improve overwintering fish habitat and improve water conveyance throughout the system. The dredged material would be planted with appropriate trees and vegetation. These dredge cuts and associated placement locations are the minimum needed to achieve each Project objectives.
- An in-channel sediment trap on the Project area's west side would reduce the amount of sediment from entering the system and would preserve the dredge cuts.
- Replacement of all four existing internal water control structures along the central road to get to the pump house (commonly known as Pump House Road). Replacing these structures would allow water to continue moving from Pool A to Pool B and vice versa, allowing water levels to equalize, move out of the system, and provide the existing quantity and quality of habitat. This is critical to fish species that use the pools and the vegetation in the pools. The internal water control structures would need to be replaced before the 50 years of analysis to maintain their function.

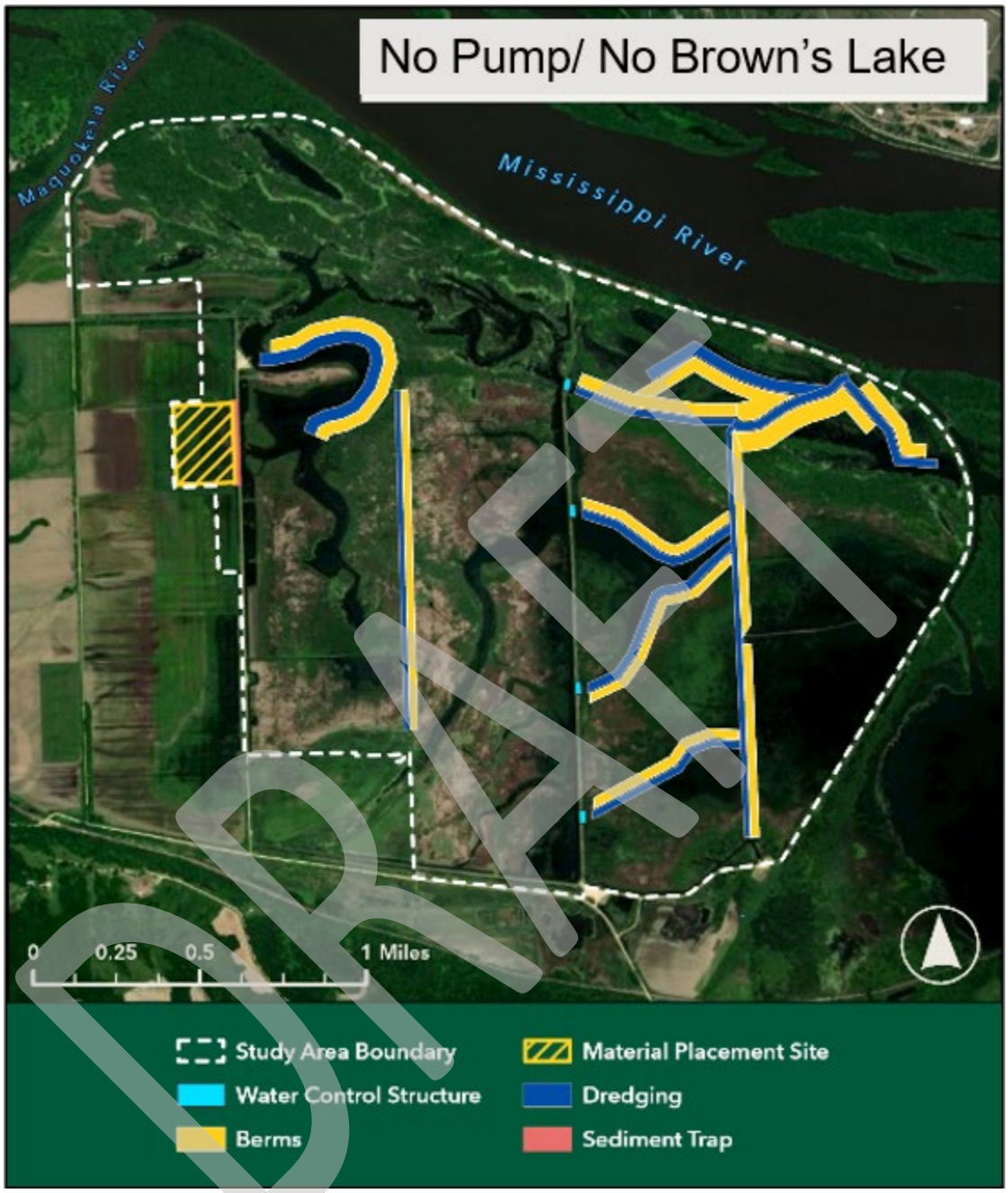

Figure 11. No Pump/No Brown's Lake Alternative

Critical Small Plan (Alternative 3) – Measures in this alternative include (Figure 12):

- Eight dredge cuts with adjacent dredge placement sites would be completed throughout the Project area to improve overwintering fish habitat and improve water conveyance throughout the system. The dredged material would be planted with appropriate trees and vegetation. These dredge cuts and associated placement locations will be the minimum needed to achieve each Project objective.
- Replacement of all four existing internal water control structures along the central road to

get to the pump house (commonly known as Pump House Road). These would continue to allow water to move from Pool A to Pool B and vice versa, allowing water levels to equalize, move out of the system, and continue to provide the quantity and quality of habitat. This is critical to fish species that use the pools and the vegetation in the pools. The internal water control structures would need to be replaced before the 50 years of analysis to maintain their function.

- A spillway from the east side of the project area to Brown's Lake would be constructed to release clear water into Brown's Lake. This would help remove excess water from the Project area during times of high water to put less stress on vegetation and timber resources.
- A pump station located on the northern levee at the end of Pump House Road would be constructed to house two 20,000-gallons-per-minute multidirectional pumps that would be able to pump water into and out of the system to simulate natural hydrologic cycle, reducing the length of inundation period to promote vegetation growth.
- Timber stand improvement is included along the northern half of the Project area. Timber stand improvement measures would be implemented to promote a healthy and diverse wetland forest system.

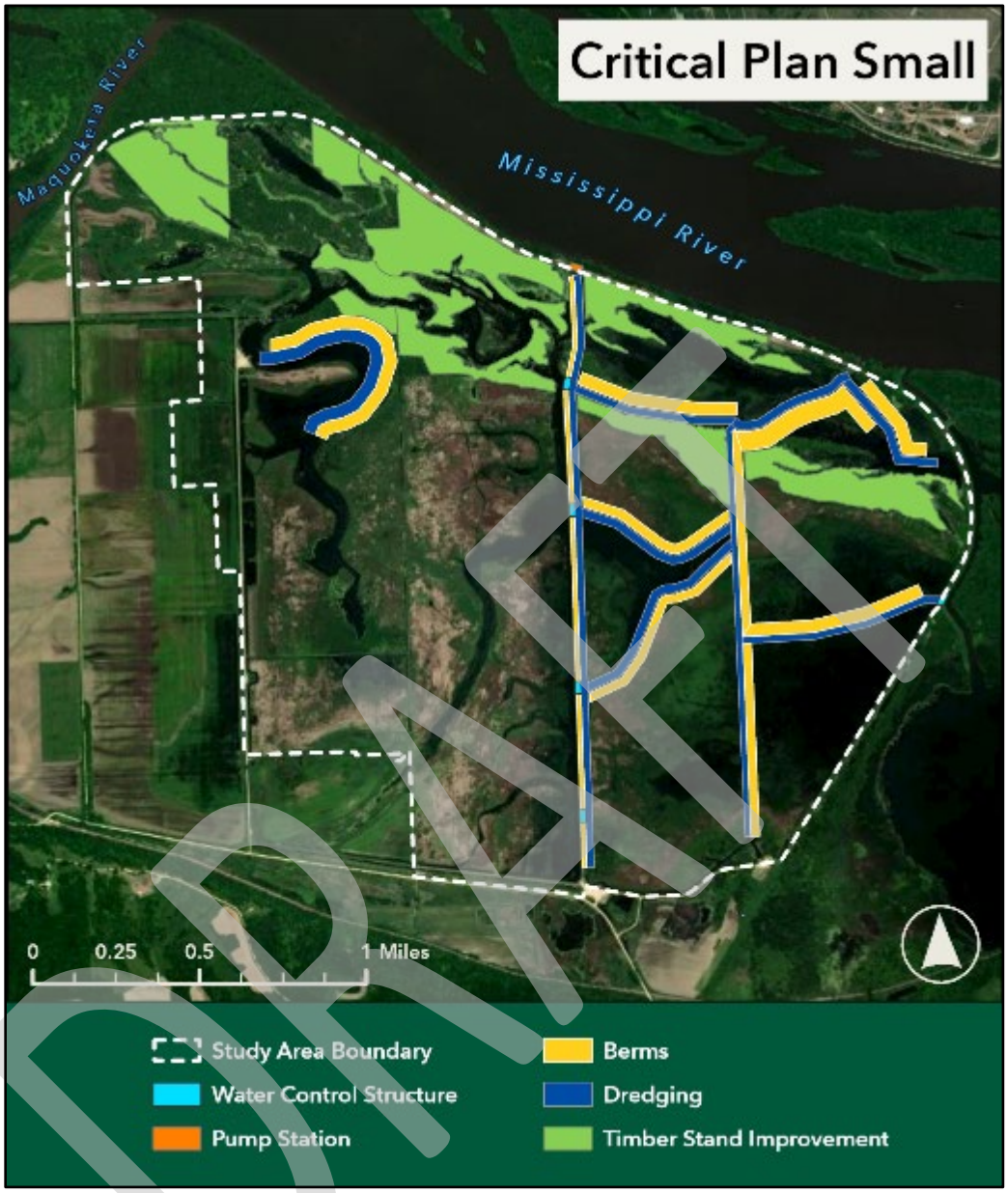

Figure 12. Critical Small Plan Alternative

Balanced Water Level Management Plan (Alternative 6) – Measures of the alternative include (Figure 13):

- Thirteen dredge cuts with adjacent dredge placement sites would be completed throughout the Project area to improve overwintering fish habitat and improve water conveyance throughout the system. The dredged material would be planted with appropriate trees and vegetation.
- An in-channel sediment trap on the west side of the Project area, which would prevent sediment from entering the system and would preserve the dredge cuts that are included in this alternative.
- Replacement of three of the four existing internal water control structures along the

central road to get to the pump house (commonly known as Pump House Road). These would continue to allow water to move from Pool A to Pool B and vice versa, allowing water levels to equalize, move out of the system, and continue to provide the quantity and quality of habitat. This is critical to fish species that use the pools and vegetation in the pools. The internal water control structures would need to be replaced before the 50 years of analysis to maintain their function.

- A spillway from the east side of the project area to Brown's Lake would be constructed to release clear water into Brown's Lake. This would help remove water from the Project area during times of high flows to put less stress on vegetation and timber resources.
- A pump station located on the northern levee at the end of Pump House Road would be constructed to house two 20,000-gallons-per-minute multidirectional pumps that would be able to pump water into and out of the system to simulate the natural hydrologic cycle, reducing the length of inundation period to promote vegetation growth.
- The TSI is also included along the northern half of the Project area. The TSI measures would be implemented to promote a healthy and diverse wetland forest system.
- Ridge and swale would be constructed by manipulating existing on-site material to create ridges and swales. The ridges would be planted with appropriate, desirable hard-mast tree species. The swales would act as low spots supporting a diverse plant community that would be typically found in an ephemeral wetland.

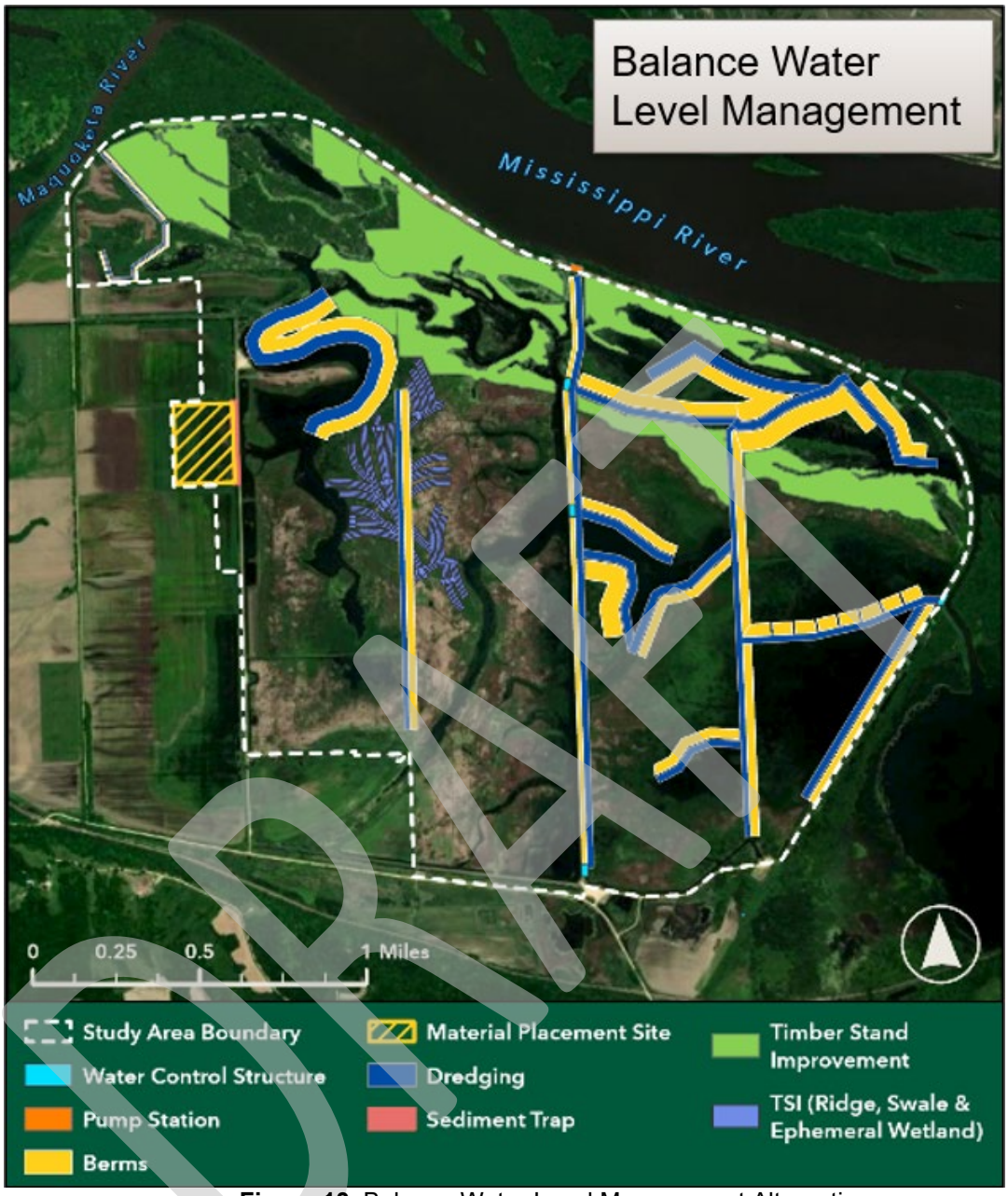

Figure 13. Balance Water Level Management Alternative

Cadillac Plan (Alternative 2) – This is the largest action alternative. Measures of this alternative include (Figure 14):

- Fourteen dredge cuts with adjacent dredge placement sites would be completed throughout the Project area to improve overwintering fish habitat and water conveyance throughout the system. The dredged material would be planted with appropriate trees and vegetation.
- An in-channel sediment trap on the west side of the Project area which would prevent sediment from entering the system and preserve the dredge cuts included in this alternative.

- Replacement of all four of the existing internal water control structures along the central road to get to the pump house (commonly known as Pump House Road) and adding a new internal water control structure. The addition of the new water control structure would be needed to facilitate conveyance to connect the dredge cuts. These would continue to allow water to move from Pool A to Pool B and vice versa, allowing water levels to equalize, move out of the system, and continue to provide the quantity and quality of habitat. This is critical to fish species that use the pools and the vegetation in the pools. The internal water control structures would need to be replaced before the 50 years of analysis to maintain their function.
- A spillway from the east side of the project area to Brown's Lake would be constructed to release clear water into Brown's Lake. This would help remove excess water from the Project area during times of high flow to put less stress on vegetation and timber resources.
- A pump station located on the northern levee at the end of Pump House Road would be constructed to house two 20,000-gallons-per-minute multidirectional pumps that would be able to pump water into and out of the system to simulate the natural hydrologic cycle, reducing the length of inundation period to promote vegetation growth.
- The TSI is also included along the northern half of the Project area. The TSI measures would be implemented to promote a healthy and diverse wetland forest system.
- Ridge and swale would be constructed by manipulating existing on-site material to create ridges and swales. The ridges would be planted with appropriate, desirable hard-mast tree species. The swales would act as low spots supporting a diverse plant community typically found in an ephemeral wetland.

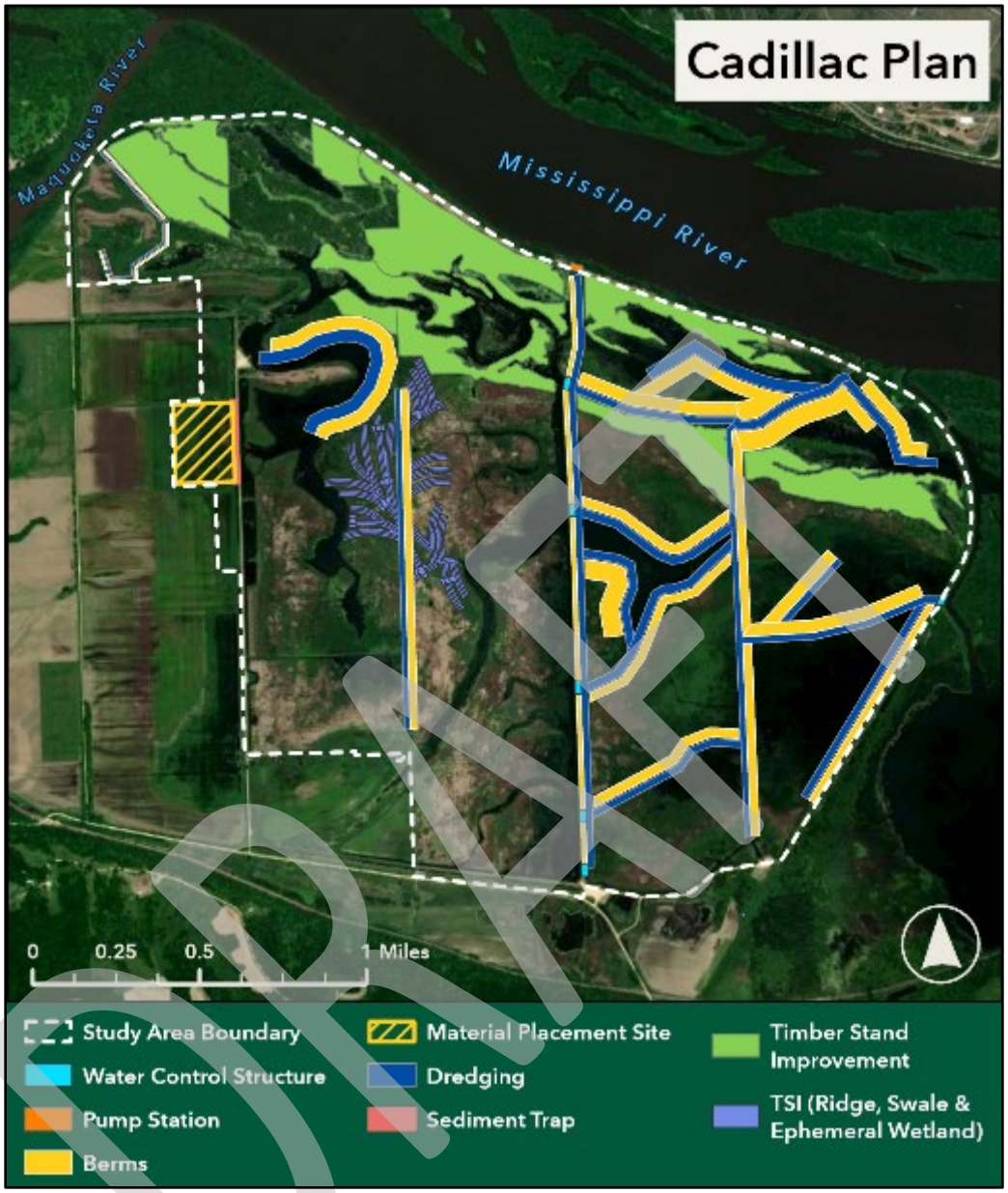

Figure 14. Cadillac Alternative

V. EVALUATION AND COMPARISON OF ALTERNATIVES

A. Evaluation of Alternatives

This section documents the process to determine the habitat benefits and estimated costs for each alternative. The benefits and costs were used in the evaluation and comparison of alternatives.

1. Habitat Benefits. This assessment includes a summary of the existing biological conditions used in the evaluation, and a forecast for future conditions under the No Action Alternative and each potential Project alternative. A multi-agency team conducted the elevation, including representatives from the US Army Corps of Engineers Rock Island District, IA DNR,

and USFWS. Aquatic and floodplain benefits were quantified using the Habitat Evaluation Procedures (HEP; USFWS 1980a), 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 assumes that a Habitat Suitability Index can describe the habitat for selected wildlife species. 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). HUs are calculated for select target years and annualized using the Institute of Water Resources (IWR) Planning Suite II tool to derive a net Average Annual Habitat Unit (AAHU) quantity over the analysis period. By using target years, AAHUs were annualized using a linear interpolation approach, drawing a straight line between target years and then calculating the area under the curve for the resulting planning horizon benefit curve. Resulting net AAHUs are used as the output measurement to compare alternatives for the proposed Project.

The PDT used four USACE-approved (per EC 1105-2-412) habitat evaluation methodologies in their analyses:

- Bluegill model for overwintering fish habitat benefits (Palesh and Anderson, 1990)
- Muskrat model for aquatic habitat benefits (Allen and Hoffman, 1984)
- Dabbling Duck model for migratory birds (Devendorf, 2021)
- Floodplain Forest model to evaluate the expected benefits of forestry-related measures (USACE, 2020)

A summary of the habitat analysis is provided in Table 6. Locations of the applied habitat models are shown in Figure 15. Additional details are provided in Appendix H, *Habitat Evaluation and Quantification*.

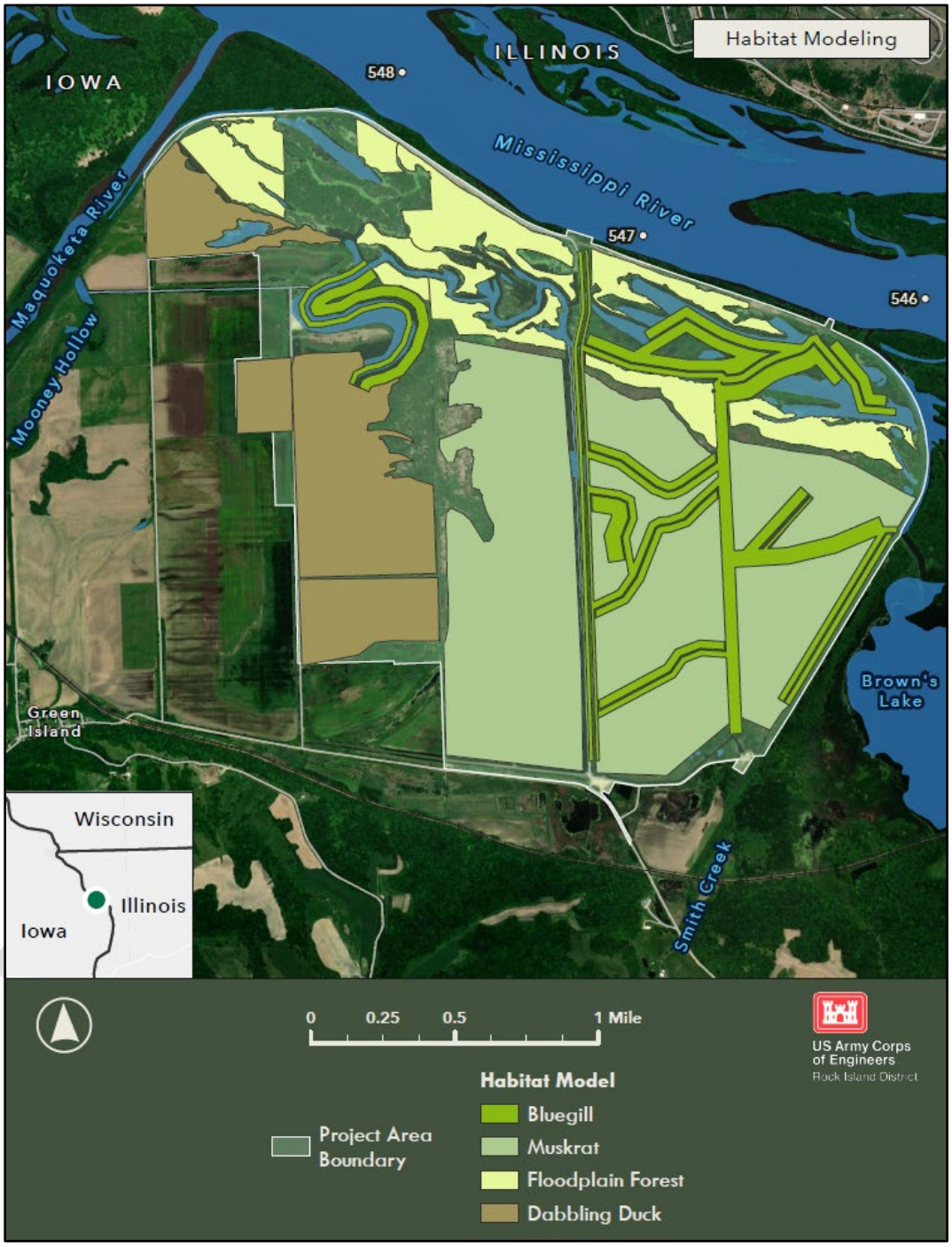

Figure 15. Habitat Modeling

Table 6. Habitat Types and Areas Evaluated for This Assessment

Habitat Type	Evaluation Area	Area (acres)	Habitat Suitability Index Model
Emergent Freshwater Marsh	Blake's Lake	194	Muskrat
	Pool B Middle Pool	278	Muskrat
	Pool A	386	Muskrat
Moist Soil	Cell 2.5	31	Dabbling Duck
	Cell A	77	Dabbling Duck
	Lower Fish Lake	188	Dabbling Duck
	Moist Soil Unit	71	Dabbling Duck
Lentic Aquatic Habitat	Bluegill Overwintering	305	Bluegill Overwintering
Floodplain Forest	Floodplain Forest	348	Floodplain Forest
	TOTAL	**1876**	

2. Cost Estimates. Cost estimates for alternative comparison were prepared using December 2022 price levels; annualized costs include construction and contingency costs. The Project measures are on Federal lands; consequently, there are no land damages or relocation costs. Total Project costs were annualized based on the Fiscal Year 2023 discount rate of 2.5% and 50 years of analysis. Interest During Construction was calculated using middle-of-the-year compounding based on a number-year construction period, using the Fiscal Year 2023 discount rate of 2.5%. Table 7 shows the estimated cost of Project alternatives as of the completion of the habitat analysis and for use in comparing alternatives before selection, refinement, and developing a full cost estimate of a TSP.

Table 7. Project First Cost (Constant Dollar Basis) -FY23

	Alt. 1 (No Action)	Alt. 2 (Cadillac)	Alt. 3 (Critical Small Plan)	Alt. 5 (No Pump/No BL))	Alt. 6 (Balanced WLM)
Construction Costs	$0	$19,225,000	$15,815,000	$5,115,000	$18,240,000
PED (see TPCS)	$0	$2,762,000	$2,353,000	$1,069,000	$2,644,000
CM/S&A (see TPCS)	$0	$2,529,000	$2,086,000	$695,000	$2,401,000
Subtotal	$0	$24,516,000	$20,254,000	$6,879,000	$23,285,000
Contingency (see ARA)	0%	31%	32%	28%	31%
Contingency*	$0	$7,600,000	$6,481,000	$1,926,000	$7,218,000
Total	**$0**	**$32,116,000**	**$26,735,000**	**$8,805,000**	**$30,503,000**

B. Comparison of Alternatives. The IWR Planning Suite II software was used to complete CE/ICA for the four action alternatives and the No Action Alternative using the AAHUs and annualized costs described in this section. The CE/ICA is used when project benefits are not measured in dollars 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 ICA 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.

The CE/ICA analysis evaluated the five alternatives. Figure 16 and Table 8 show the resulting alternatives differentiated by cost-effectiveness. From this list of five alternatives, one cost-effective plan and three Best Buy Plans were identified (Figure 16 and Table 8).

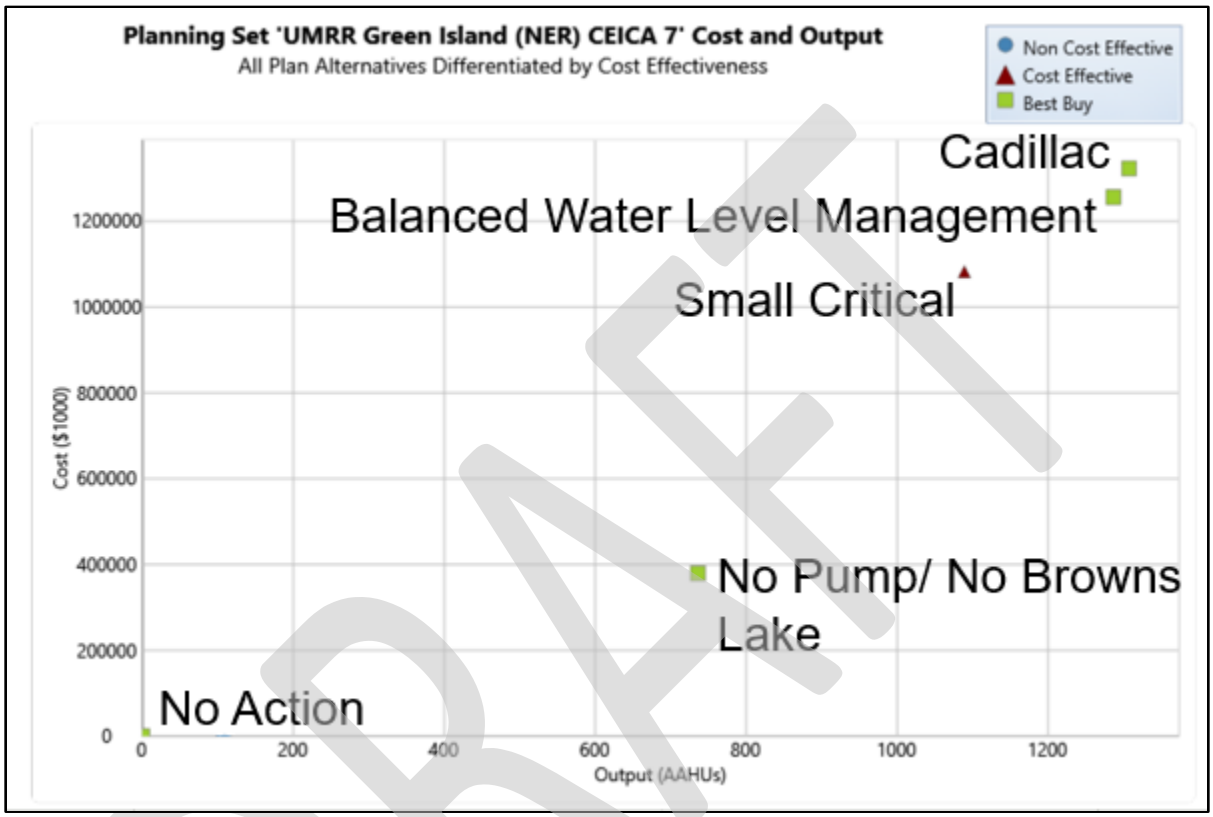

Figure 16. CE/ICA Analysis of Final Array of Alternatives

Table 8. Alternative Comparison Using Cost and AAHUs

Alternative	Net AAHUs	Project First Cost	Annualized Cost	Cost per AAHU	Cost Effectiveness
No Action (Alt 1)	0	0	0	0	Best Buy
No Pump/No Brown's Lake (Alt 5)	736	$8,805,000	$362,000	$492	Best Buy
Critical Small Plan (Alt 3)	1088	$26,735,000	$1,030,000	$947	Cost Effective
Balanced Water Level Management (Alt 6)	1287	$30,503,000	$1,196,000	$929	Best Buy
Cadillac (Alt 2)	1307	$32,116,000	$1,260,000	$964	Best Buy

The cost-effectiveness analysis showed that all of the plans were cost-effective, and Alternative 3 was not a Best Buy. Alternative 3 was screened from further consideration, and only Best Buy alternatives were carried forward for further consideration.

The cost-effective Alternative 3 would not fully realize the Project objectives and the Sponsor's needs. Fish Lake and Densmore Lake currently have existing but low-quality overwintering habitat that is important because it provides adequate DO levels to overwintering fish during severe winters or other low DO events. Alternative 6 has greater depth restoration and protection of Fish Lake and Densmore Lake, resulting in a higher amount of aquatic habitat and diverse forest habitat from side casting dredge material. Including these measures in the TSP provides benefits and habitat to the Project area and Pool 13, where these habitat needs have been diminishing over time and will continue to do so if no action is taken.

Figure 17 and Table 9 present the Incremental Cost Analysis of the Best Buy plans using IWR Planning Suite II software. Complete documentation of the habitat benefits analysis is provided in Appendix H, Habitat Evaluation.

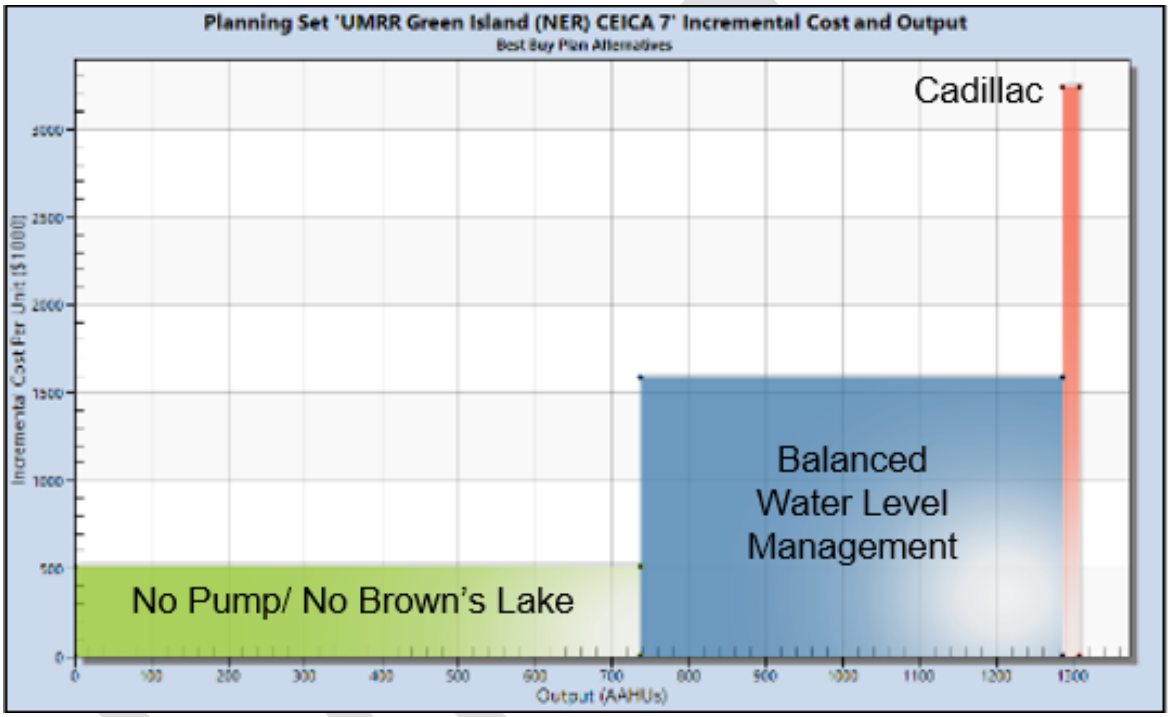

Figure 17. Incremental cost and output of Best Buy plans

Table 9. Best Buy Plans Incremental Cost per Incremental Output

Alternative	Net Annual AAHUs	Project First Cost	$/AAHU	Annualized Cost	Incremental Cost per Incremental Output	Incremental Output
No action	0	0	$0	0	0	0
No Pump/No Brown's Lake	736	$8,805,000	$492	$362,000	$515	736
Balanced Water Level Management	1287	$30,503,000	$929	$1,196,000	$1,592	551
Cadillac	1307	$32,116,000	$964	$1,260,000	$3,238	20

The No Action Alternative would provide 0 habitat benefits and no Federal dollars would be expended.

The No Pump/No Brown's Lake Alternative provides minimal features to restore the historic hydrologic cycle but does not provide sediment management and only minimal vegetation restoration. These alternative yields 736 AAHU at an incremental cost of $492. It provides 736 habitat units over the No Action Plan at an incremental cost per unit of output ($/HU) of $515. This alternative is efficient, marginally effective, marginally complete, and marginally acceptable. Additional alternatives that should be considered to ensure the objectives can be more fully met with additional investment.

The next Best Buy plan, Balanced Water Level Management Alternative, yields 1287 AAHUs and has an incremental cost per AAHU of $976. It differs from the No Pump/No Brown's Lake Alternative by adding a multidirectional pump station, additional topographic and bathymetric diversity, TSI, additional outlet, and ephemeral wetland restoration. It provides an additional 551 AAHU compared to the No Pump/No Brown's Lake Alternative at an incremental cost of $1,592 per AAHU. It was determined that the incremental cost was worth the incremental benefit compared to the No Pump/No Brown's Lake Alternative. This alternative meets the Project objectives for a reasonable cost.

The last Best Buy plan, Cadillac Alternative, yields 1307 AAHUs, with an incremental cost per AAHU of $1,012. It differs from the Balanced Water Level Management Alternative by adding the construction of additional water control structures along the Pump House Road and has additional dredging for conveyance. It provides an additional 20 AAHU compared to the Balanced Water Level Management Alternative at an incremental cost of $3,238 per AAHU. It was determined that the incremental cost was not worth the incremental benefit compared to the Balanced Water Level Management Alternative.

C. Principles and Guidelines. The final array of alternatives was evaluated by the PDT based on the Economic and Environmental Principles and Guidelines (P&G) for Water and Related Land Resources Implementation. The P&G criteria include:

- **Completeness** is the extent to which a given alternative plan provides and accounts for all necessary investments or other actions to realize the planned effects. This may require relating the plan to other types of public or private plans if the other plans are crucial to the realization of the contributions to the objective.
- **Effectiveness** is the extent to which an alternative plan alleviates the specified problems and achieves the specified opportunities.
- **Efficiency** is the extent to which an alternative plan is the most cost-effective means of alleviating the specified problems and realizing the specified opportunities, consistent with protecting the Nation's environment.
- **Acceptability** is the extent to which the alternative plans are acceptable regarding applicable laws, regulations, and public policies. Acceptability can also consider the sponsor's, partners', and public's acceptance of the alternative.

Ratings of high, moderate, and low were used to indicate the degree to which each alternative meets each criterion. High indicates full compliance with the criterion, moderate indicates mostly compliant with the criteria, while low indicates a failure to comply. Results are shown in Table 10.

Table 10. Alternative Comparison Using the Four P&G Criteria

Alternative	Acceptable	Complete	Efficient	Effective
No Action	Low	High	High	Low
No Pump/No Brown's Lake (Alt 5)	Low	High	High	Low
Critical Small Plan (Alt 3)	Moderate	High	Moderate	Moderate
Balanced Water Level Management (Alt 6)	High	High	High	High
Cadillac (Alt 2)	High	High	Moderate	High

Table 11 documents the Best Buy alternatives and whether an alternative met or didn't meet the Project objectives.

Table 11. Ability to Meet Project Objectives

	Project Objective			
Alternative	**Protect, enhance, restore, or create naturally regenerating, resilient, and diverse bottomland forest habitats.**	**Maintain a balance of coverage and relative abundance of native emergent, rooted floating leaved, and submergent aquatic vegetation communities.**	**Protect, enhance, restore, or create flowing channel habitats.**	**Protect, enhance, restore, or create backwater habitats.**
No Action Alternative 1	None	None	None	None
No Pump/No Brown's Alternative 5	Low – would improve ~8 acres of floodplain forest on new islands and 159 acres of forest management.	High – would improve 100+acres of aquatic vegetation throughout the study area.	High – would incorporate shoreline stabilization to minimize erosion and widening of secondary channels.	Low - would improve 141 acres of backwater habitat through closures.
3 Critical Small Plan Alternative 3	Moderate – would improve ~29 acres of floodplain forest on new islands and 159 acres of forest management.	High – would improve 100+acres of aquatic vegetation throughout the study area.	Moderate – would incorporate shoreline stabilization to minimize erosion and widening of secondary channels.	Moderate – would improve 141 acres of backwater habitat through closures and backwater dredging.
Balanced Water Level Management Alternative 6	High – would improve ~29 acres of floodplain forest on new islands, 21 acres through tin layer placement, and 159 acres of forest management.	High – would improve 100+acres of aquatic vegetation throughout the study area.	High – would incorporate shoreline stabilization to minimize erosion and widening of secondary channels.	High – would improve 310 acres of backwater habitat through closures and backwater dredging.
Cadillac Alternative 2	High – would improve ~35 acres of floodplain forest on new islands, 21 acres through tin layer placement and 159 acres of forest management.	High – would improve 100+acres of aquatic vegetation throughout the study area.	Moderate – would incorporate shoreline stabilization to minimize erosion and widening of secondary channels.	High – would improve 310 acres of backwater habitat through closures and backwater dredging.

D. Comprehensive Benefits. In January 2021, the Assistant Secretary of the Army for Civil Works issued a policy memorandum directing PDTs to identify and analyze benefits in total and equally across a full range of benefit categories. The intent of this directive is for teams to comprehensively evaluate benefits, including equal consideration for economic, environmental, and social categories. The Best Buy alternatives were assessed to identify benefits across four categories to meet the intent of this memo: National Economic Development (NED), Environmental Quality (EQ), Regional Economic Development (RED), and Other Social Effects (OSE).

NED: The NED account displays changes in the economic value of the national output of goods and services. All action alternatives would have an economic cost to the nation to achieve the non-monetized environmental output of goods and services provided by improving fish connectivity. The annualized cost for the Best Buy alternatives is as follows:

No Pump/ No Brown's Lake Alt 5	$ 362,000
Balanced Water Level Management Alt 6	$1,996,000
Cadillac Alt 2	$1,260,000

EQ: The EQ account displays non-monetary effects on significant natural and cultural resources. EQ of alternatives is scored based on AAHU output. The AAHU output for the Best Buy alternatives is as follows:

No Pump/ No Brown's Lake Alt 5	736
Balanced Water Level Management Alt 3	1287
Cadillac Alt 2	1307

All action alternatives would provide positive long-term effects for fish and other aquatic species in the study area.

RED: The RED account registers changes in the distribution of regional economic activity. All action alternatives would have a positive impact on the regional economy. The percentage of Federal expenditure to regional benefits are assumed to be similar across the Best Buy action alternatives. Examples of regional economic benefits could include but are not limited to, increasing employment opportunities during the construction and increasing visitation to the region due to monitoring and adaptive management activities. The No Action alternative would not produce any RED benefits since the Federal government would take no action.

Regional Economic System (RECONS) is used to see the economic impact region for 1,500 different impact models. It also provides information about the demographic and economic characteristics of these areas. This added information provides a greater understanding for assessing the economic impact estimates and the economic significance of USACE activities. The RECONS produces Word documents and spreadsheet reports of the results of different analyses, including a comprehensive assortment of tables.

A primary purpose of RECONS is to estimate forward linkages stemming from the effects of USACE business line activities (additional economic activities associated with Navigation, Recreation, etc.,). Estimating the total spending (i.e., amount and distribution of restaurants, gasoline, lodging, etc.) associated with these visits is necessary. Spending varies significantly by the type of trips (e.g., overnight, day). RECONS automatically estimates the amount and type of spending associated with a number of visits that are associated with IMPLAN sectors. See

RECONS results for the Best Buy plans in Table 12.

Table 12. RECONS Results for Best Buy Alternatives

Alternative	Local Capture	Output	Jobs	Labor Income	Value Added
Cadillac Alt 2	$34,000,000	$88,000,000	570	$39,000,000	$54,000,000
No Pump/ No Brown's Lake Alt 5	$9,000,000	$24,000,000	160	$11,000,000	$15,000,000
Balanced Water Level Management Alt 2	$32,00,000	$84,000,000	540	$37,000,000	$51,000,000

OSE: The OSE account registers effects from perspectives relevant to the planning process but needs to be reflected in the other three accounts. The OSE account includes urban and community impacts; life, health, and safety factors; displacement; long-term productivity; and energy requirements and conservation. Other criteria can be added to this category based on feedback from stakeholders.

There is no significant difference in the OSE impacts between the alternatives. All alternatives will provide increased habitat and food to wildlife. As a result, current recreation activities such as hunting, fishing, and bird watching would improve quality and maintain long-term viability. All action alternatives assume positive social impacts since there was an increase in AAHU. The No Action alternative would not produce any OSE benefits since the Federal government would take no action.

E. 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 and the Assistant Secretary of the Army (Civil Works) policy directive for comprehensive documentation of benefits.

> "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."
>
> "All USACE planning study PDTs must evaluate and provide a complete accounting, consideration, and documentation of the total benefits of alternative plans across all benefit categories. Total benefits involve a summation of monetized and/or quantified benefits, along with a complete accounting of qualitative benefits, for project alternatives across nation and regional economic, environmental and social benefit categories."

A review of the four formulation criteria suggested by the P&G (completeness, effectiveness, efficiency, and acceptability, defined above), ability to meet the Project's objectives, and comprehensive benefits were used to aid in selecting the TSP.

The Balanced Water Level Management Alternative is the alternative that best meets the project objectives and reasonably maximizes ecosystem benefits and total benefits compared to cost. The Balanced Water Level Management Alternative is recommended as the National Ecosystem Restoration Plan, the Net Benefits Plan, the Least Environmentally Damaging Practicable Alternative, and the TSP. The IA DNR did not request a Locally Preferred Plan.

VI. TENTATIVELY SELECTED PLAN

A. Description of Plan. The TSP is shown on Figure 18 and Plate C-102 in Appendix K, Plates, and is described as follows:

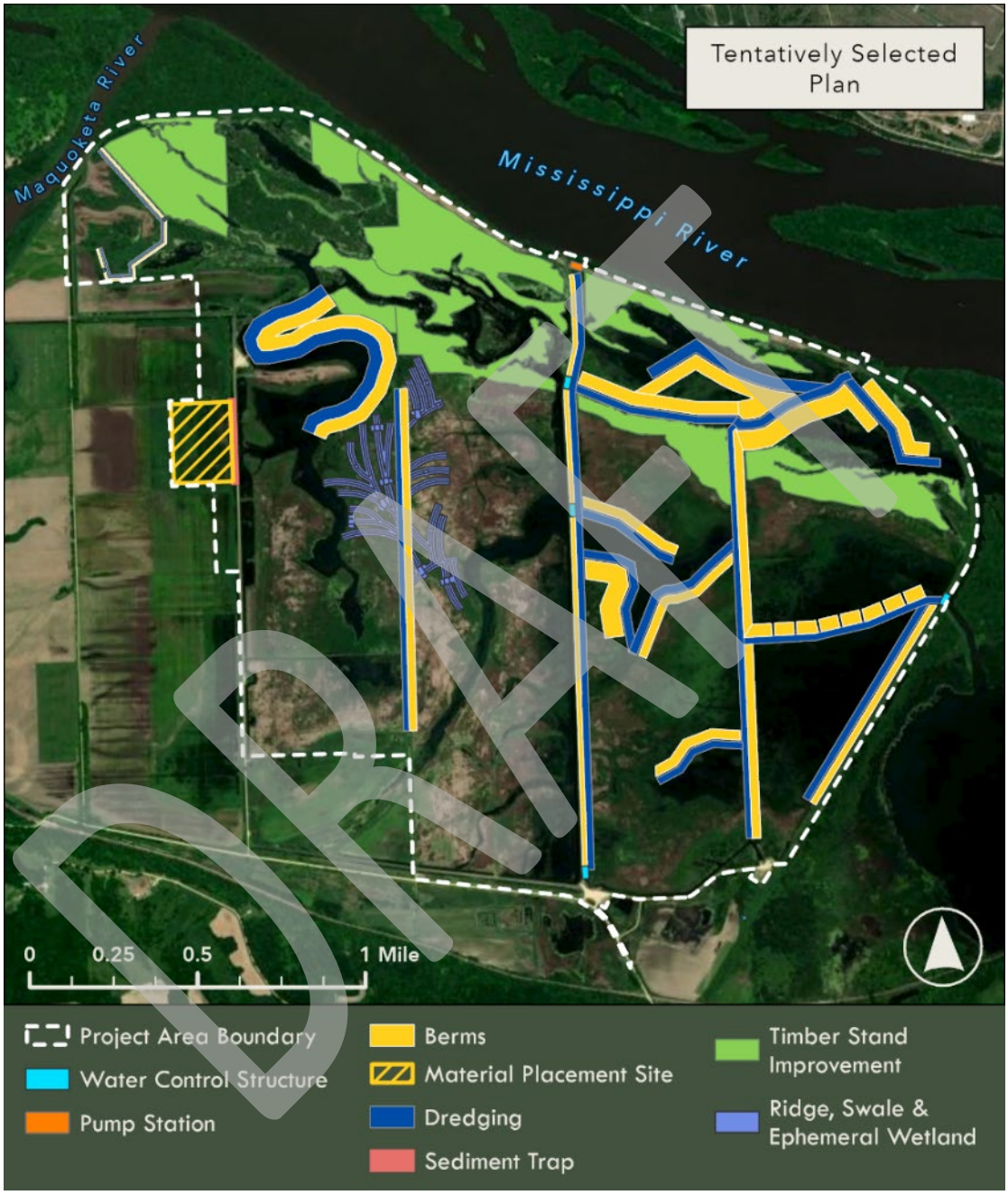

Figure 18. Tentatively Selected Plan

- **Pump Station** - with two multidirectional 20,000-gallons-per-minute electric pumps located on the northern border on the levee. These pumps will be housed inside a structure to protect them from the elements. These will be able to pump water into and out of the Project area. The existing diesel-powered pump station will be left in place and decommissioned.

- **Water Control Structures** - located along the 4th Ditch (Pumphouse Road) leading to the pump station will allow water to pass between pools A and B using screw gate or stop log structures. The water control structure on Project's east side will act as an outlet into the previous Brown's Lake HREP project. The structure in the northwest corner of the Project area will manage water into and out of the area surrounded by the newly constructed berm BRM-A-02, as seen in Figure 19.

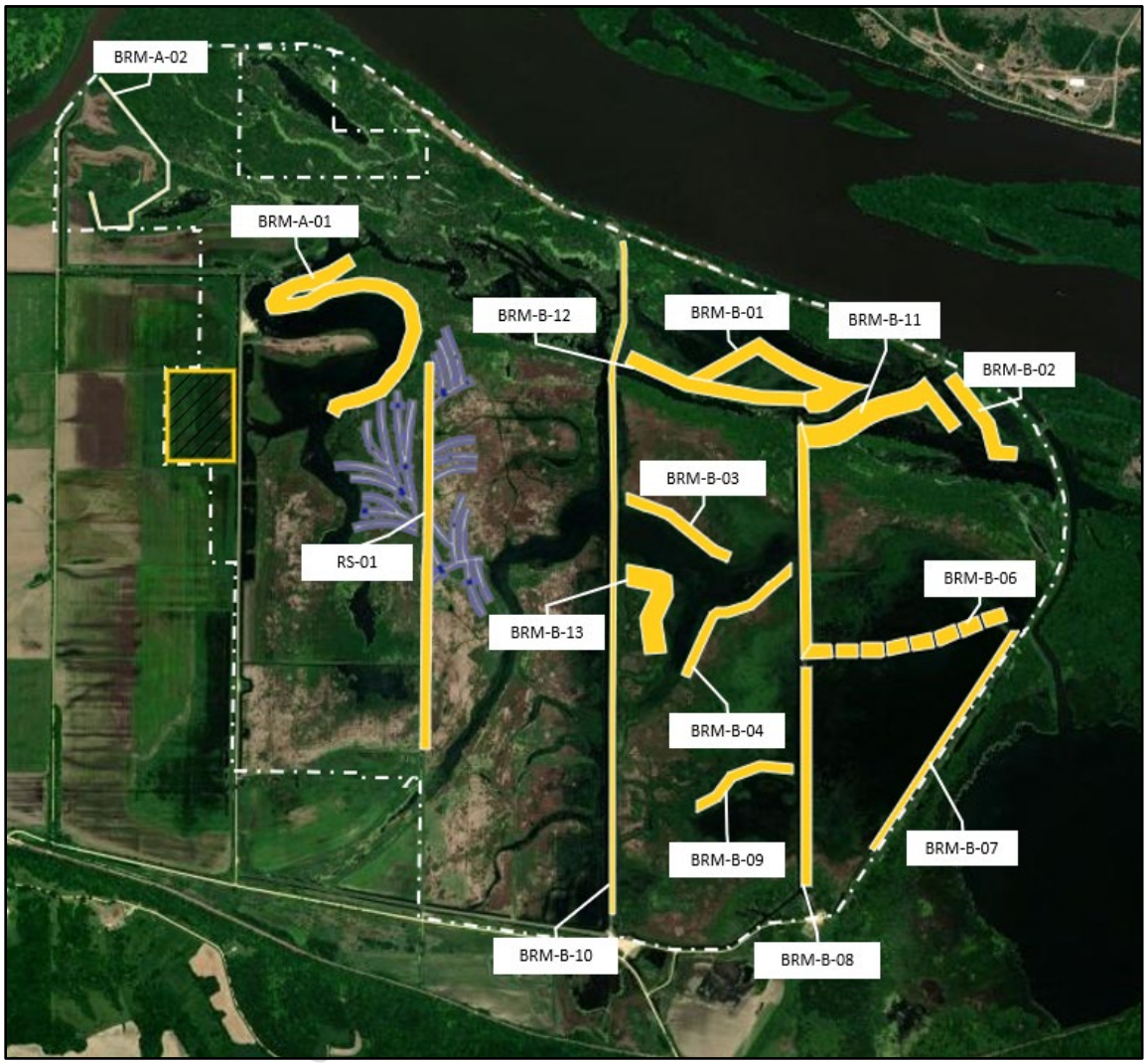

Figure 19. Dredge material Placement Location Map

- **Dredge Material Topographic Diversity Berms** - All proposed placement sites were identified as desirable locations for dredge material placement. Berms were designed to heights for tree planting survivability. Dredge material will be placed to a top elevation of 589.72 in Pool A and 586.82 in Pool B. Dredge channel side slopes were set at 8 horizontal (H):1 vertical (V) for stability and to prevent sloughing. The two main functions of these features are to break up wind-driven waves and to be planted with vegetation. Dredge material quantities can be seen in Table 13.

Table 13. Summary of Dredged Material Placement Site Capacities

Measure Name	Description	Quantities	Units
BRM-A-01	Fish Lake Berm	107,352	CY
BRM-A-02	Murphy's Cell Berm	44,694	CY
BRM-B-01	Sawmill Berm	57,910	CY
BRM-B-02	McGann's Berm	28,596	CY
BRM-B-03	Densmore Lake Upper Berm	32,483	CY
BRM-B-04	Densmore Lake Lower Berm	53,562	CY
BRM-B-06	Blake's Lake to Brown's Berm	45,527	CY
BRM-B-07	Blake's Lake Lower Berm	56,812	CY
BRM-B-08	5th Ditch Berm	123,877	CY
BRM-B-09	Southeast Berm	29,908	CY
BRM-B-10	4th Ditch Berm	252,198	CY
BRM-B-11	McGann's to Miss Berm	40,397	CY
BRM-B-12	Snag Slough	39,760	CY
BRM-B-13	Densmore Horseshoe	43,859	CY
RS01	Ridge & Swale	128,906	CY
	5 Potholes - 60' length	1,701	CY
	10 Potholes - 100' length	8,426	CY
	Total	**1,095,969**	CY

- **Ridge and Swale** - Increases topographic diversity for native plants and animals. It creates approximately 140 acres of ridge and swale consisting of clear-cutting, planting trees, mulching, and excavating ephemeral wetland-like potholes. The ridges will be a 3 H:1V slope. The potholes are of varying depths; typical sections details can be found in Appendix L, 0. Five of the potholes are 54 feet wide by 60 feet long. The other proposed potholes are 86 feet wide by 100 feet long. The ridges will be planted with trees and shrubs.

- **TSI** - Includes tree thinning, tree and shrub planting, mowing, and invasive species treatments. The northern section of the project area targeted areas of stressed or dead trees. The District's Forest management plan planting methods maximize the longevity of the forest and are cost-effective. Hard-mast species planted may include Bur Oak, Swamp White Oak, Pin Oak, Northern Pecan, Shellbark Hickory, and Black Walnut. Other species found in the floodplain include the Kentucky Coffee tree and Hackberry. Other trees with "winged fruit or light-seeded" could invade, creating a diverse forest community.

- **In-channel Sediment Trap** – The trap will capture and control the sedimentation coming from Moon Hollow. An adjacent sediment placement site on the Project's west side allows for easy clean-out of the sediment trap when it becomes clogged.

- **Excavation/Dredging** - to provide suitable year-round habitat for fish, provide conveyance for interior supply and drainage, and provide material to increase topographic diversity within the floodplain forest. Mechanical dredging was the

excavation method used for feasibility design. Several potential areas in the study area were evaluated for channel excavation. Based on the nature of the Ridge and Swale feature being a slightly different construction using a dozer to excavate material, those slopes were set at 3H :1V. Dredge channels will be designed further during PED once further Geotechnical borings and seepage analyses are completed. Slopes may be changed and/or protection of slopes may be required based on further analysis. The potential dredge channel capacities are summarized in Table 12.

Details of quantities and design for the TSP can be found in Appendix E, *Engineering*. A summary of quantities is located in Table 14.

Table 14. Summary of the Quantities for the Tentatively Selected Plan Measures

Berms	Shaped Material for Topographic Diversity, including ridge features	1,095,969	CY
Channels	Dredging including overwintering, conveyance, swale, and ephemeral wetland features	1,095,969	CY
Sediment Trap	Temporary containment to collect sediment from Mooney Hollow	3,146	CY
TSI	Tree thinning/Tree Planting	319	AC
Pump Station	2-20,000 gallons-per-minute pumps and electric power connection	1	LS
WCS	Water Control Structures	7	EA

(CY) Cubic yards, (AC) Acres, (LS), (EA) Each

B. Cost Estimates

Table 15 presents the TSP's Project first cost. Quantities and costs may vary during the final design. A full description of the cost estimate, including all related elements, can be found in Appendix F, *Cost Engineering*.

Table 15. Project First Cost
(Constant Dollar Basis, FY23 Price Level)

	Construction Costs	$18,240,000
01	Lands and Damages	$0
Subtotal		
30	Planning, Engineering & Design	$2,644,000
31	Construction Management	$2,401,000
Subtotal		**$23,285,000**
	Contingency (31%)	$7,218,000
	Total Project First Cost Total	**$30,503,000**

The annualized costs and AAHUs were used to calculate the total annual cost per average annual habitat unit (Table 16). The total cost per habitat unit is $929. The costs used for analysis include total Project Costs, Interest During Construction, annualized O&M, adaptive management, and monitoring costs.

Table 16. Total Annual Cost per Average Annual Habitat Unit

Analysis Element	Total

Project First Cost	$30,503,000
Interest During Construction	$1,556,000
Total Project Costs	$32,060,000
Annual Construction Cost	$1,130,000
Annual O&M	$66,000
Annual Adaptive Management	$8,000
Annual Monitoring Costs	$24,200
Total Annual Costs	**$1,196,000**
AAHUs	1,287
Total Annual Cost/AAHU ($)	**$929**

Costs for post-construction evaluation, as described in Section VI.J, are provided in Appendix E, *Engineering*. The Project funds' performance monitoring and adaptive management. Monitoring to support Long-Term Performance Reporting starts following the completion of performance monitoring and adaptive management (approximately 10 years), if implemented, except for water quality monitoring. Long-term performance reporting is a UMRR Program cost not included in the Green Island HREP cost estimate. Table 17 lists the frequency of each monitoring component.

Table 17. Estimated Monitoring Costs

Monitoring Component	Frequency	Total Costs
Inspection of All Features	Yearly	$4,000
Water Quality Survey	Yearly	$7,500
Bathymetric Survey	Every 5 Years	$10,000
Performance Evaluation Reporting	Every 5 Years	$3,000
Forestry Survey	Every 10 Years	$1,500

C. Design Considerations

1. Location. See Section I.C.

2. Survey Data. Topographic survey data was not available at the beginning of the feasibility phase. A publicly available State Lidar Survey was utilized for bathymetry. Topographic and Hydrographic Surveys were conducted for feature design. The PDT will determine if further survey data is required during the design phase.

3. Access. The Project is behind a levee along the Mississippi River. All work will be conducted from the landside. Several parking lots in the Project area will be used as staging areas. Because of the geological makeup, most areas will be restricted to low-pressure equipment to conduct work. The contractors will need to abide by all State usage regulations.

4. Excavated Materials. Excavated material will be required to construct topographic diversity features. Material will have to be consistent with USACE quality standards for use in the features. Geotechnical borings are provided in Appendix E, Engineering.

5. Historic Properties. The layout and design of features will be conducted to avoid impacts to known historical properties. There are known sites on the Project area that have been surveyed and several incidental sites. A Phase I archeological survey will be conducted

before construction. Contract specifications will include requirements for the contractor for what to do in case historic properties are encountered during construction.

6. Hazardous, Toxic, and Radioactive Waste. A Phase I HTRW ESA was conducted and revealed no evidence of a recognized environmental condition (REC) that could potentially affect the Project area. 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 being 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 revealed no evidence of a REC that could potentially affect the Project area (see Appendix E, Attachment H).

D. Construction Considerations. The construction of the Project is anticipated to be completed in four stages. The stages and associated work are outlined in Table 18. All stages are draft and subject to change.

Table 18. Green Island Construction Sequence

Stage	Pool	Construction Features	Purpose
I	A/B	Build Pump Station	Construct multidirectional pump station for restoration of the historic hydrologic cycle.
		Water Control Structures	Demolish and replace existing structures and add new structures for WLM to help restore the diversity of vegetation.
II	A	Dredge Channels	Provide aquatic diversity for conveyance and/or overwintering habitat for fish.
		Construct Topographic Diversity Berms	Build features to match elevations defined by inundation criteria and elevate areas to support vegetative communities.
		Construct Ridge and Swale	Create diverse habitat for ephemeral wetlands and connectivity between wetland and upland terrestrial habitat.
		Create Sediment Trap	Capture sediment from Mooney Hollow and improve sediment management across the Project area.
		TSI	Thinning, plantings, and seeding improve forest diversity.
III	B	Dredge Channels	Provide aquatic diversity for conveyance and/or overwintering habitat for fish.
		Construct Topographic Diversity Berms	Build features to match elevations defined by inundation criteria and elevate areas to support vegetative communities.
		TSI	Thinning, plantings, and seeding improve forest diversity.
IV	A/B	TSI	Thinning, plantings, and seeding improve forest diversity.

E. Real Estate Considerations. The Project is located within the GIWMA. Access to the GIWMA is via Highway 52 to Green Island Road, which feeds onto various roadways within the GIWMA, as well as 501st Avenue, which travels along a portion of the northern boundary of the Project area.

The lands within the Project area boundary are owned in Fee by the United States. The Federal

tracts containing the Green Island Levee system are subject to the right of the Green Island L&DD to maintain the levee and is controlled by a 2005 Cooperation Agreement between the IA DNR and the Jackson County Board of Supervisors, which acts as the complete authority for the Green Island L&DD.

The waters the Project intends to manage may continue to inundate lands outside the Project area boundary but remain within the GIWMA on State of Iowa parcels that are managed, operated, and maintained by the IA DNR for conservation purposes. Flowage easements and Flood Protection Levee easements may need to be acquired in two areas where existing berms may extend into the State of Iowa parcels that contain Pool A waters not controlled by the Project features. During the design and construction, the lands would be surveyed to determine if the existing berms that contain the Pool A waters fall outside the Federal Project area boundary. If the State of Iowa requires the acquisition of Flowage easements and Flood Protection Levee easements, no Public Law 91-646 relocations would be necessary given, that the State of Iowa parcels are used for conservation purposes within the GIWMA.

The Project Area Overview Map containing some of the Federal lands within the GIWMA can be found in Appendix C, Real Estate Plan. The Real Estate Plan also includes a Real Estate Map with Project Features, which shows the real estate, including specific easement estates, needed for the Project along with the corresponding quantity of acres needed. The Project Features are also shown on the Real Estate Map, noting the location for activities necessary during construction. In addition, the Real Estate Plan contains a third figure depicting the Federal ownership and the Federal agency management interests within the GIWMA.

F. O&M Considerations. O&M is the responsibility of the Sponsor in accordance with Section 107(b) of WRDA 1992, Public Law 102-580. Upon completion of the construction, as determined by the District Engineer, the Sponsor shall operate and maintain the Project as defined in this FR/EA and in the Project's O&M Manual; the Sponsor would bear 100 percent of all costs associated with the O&M. Operation and maintenance of UMRR HREPs is similar to that undertaken by the partner agencies in the day-to-day management of parks, boat ramps, wildlife management areas, and other public use areas.

This Project was designed to reduce overall operation costs and ensure low annual maintenance requirements. In general, operation is limited to the pump house and water control structures to ensure the measures perform as designed. Maintenance would include periodic dredging on the conveyance channels and routine maintenance of the pumps. Maintenance requirements would be further detailed in the Project's O&M Manual published after construction completion and preparation of as-built drawings and before transferring the Project to the IA DNR.

The IA DNR is expected to maintain the HREP as outlined in the PPA. 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 due to major storms or flood events. Estimated Annual O&M Costs are shown in Table 19.

Table 19. Estimated Annual O&M Costs

	Quantity	Unit	Unit Cost	Total Cost
Operation				
Pump Station	1	LS	-	$14,000
Maintenance				

Pump Station	1	LS	-	$11,800
Water Control Structures	7	EA	$3,480	$24,360
Mowing (Berms)	62	AC	$50	$3,100
Debris Removal (Berms)	90	HR	$50	$4,500
TSI (Once/Yr)	20	AC	$50	$1,000
Sediment Trap	3,100	CY	$1.355	$4,200
Site Inspections (All	80	HR	$50	$4,000
Total Annual O&M Cost				**$66,960**

G. Implementation Schedule. The schedule for the feasibility study is shown in Table 20. After MVD approves the feasibility study, the Project Partnership Agreement (PPA) will need to be executed with the IA DNR. The PDT will initiate plans and specifications once the PPA is signed. Preconstruction Engineering and Design work will be conducted for 18-24 months prior to proposed construction award date. This schedule assumes that funding would be available to prepare plans and specifications and undertake construction. The Project will be broken into four stages. The pump station will be the first contract awarded to include the pumps, pump station, and water control structures along the 4th Ditch Road to the pump house. The remaining features will likely be divided into the remaining three construction contracts based on historic funding availability for the UMRR program. Appendix E, Engineering, provides a more detail schedule broken out by stages.

Table 20. Project Implementation Schedule

Event	Scheduled Date
Public Review of Draft Report	Fall 2023
Submit Final FR/EA to MVD	February 2024
Approved Final FR/EA from MVD	Summer 2024
Execute the PPA with the IA DNR	Summer 2024
Initiate Design	Fall 2024
Complete Design	Fall 2026
Initiate Construction	Summer 2027
Complete All 4 Construction Stages	2035

H. Environmental Effects. Sections 1 through 17 describe the potential environmental effects (both adverse and beneficial) the TSP may have on the resources addressed in Section VI. The effects described in the following sections may be temporary or long-term. Minor effects are typically considered negligible, while moderate adverse effects may be avoided or counteracted by other actions that further enhance or benefit the resource. According to NEPA guidance, the meaning of significant effects varies with the context (where the action occurs) and intensity (how much damage or improvement the action causes). Non-significant effects mean no substantial change to the resource, while significant effects may be beneficial or adverse. The effects of the TSP may furthermore occur immediately because of the action (direct), occur later in time or be removed in the distance in response to the action (indirect), or may be reasonably expected to occur, given similar restoration actions within the UMRR Program (cumulative).

This section does not explicitly discuss the effects of the No Pump/No Brown's and Critical Small Plan Alternatives because the Maximum Alternative contains all the measures included in the No Pump/No Brown's and Critical Small Plan alternatives. It was assumed by the PDT that

effects would be similar for the No Pump/No Brown's and Critical Small Plan alternatives, just in a slightly smaller amount and degree. Therefore, only the effects of the TSP and Cadillac Alternatives are discussed in detail below. Additionally, the Cadillac plan and TSP overlap quite frequently, so relevant resources will be the same for those overlaps. However, relevant resources between the TSP and the Cadillac plan are discussed.

1. **Short-Term Construction Effects.** During construction, many existing conditions at Green Island would temporarily change. Areas may need to be closed to the public. Some areas may need to be drawn down or dewatered entirely for equipment. Water quality in dredged areas would become poor but settle back out after the project is complete. Submersed aquatic vegetation (SAV) would be removed in dredged areas; however, seed banks should allow SAV to return during the growing season.

2. **Aesthetics**

    a. **TSP and Cadillac Plan**

        i. **Direct.** Aesthetic impact on the Project area would include a new pump station built near the old pump station. This construction would be a minimal change to what is already there and out of sight from most of the Project area. Forested areas would directly benefit from the Project and would be able to regenerate, bolstering the forested areas with new growth and eventually a healthy and diverse area.

        ii. **Indirect.** Forested areas would provide habitat and food for the increase in wildlife. Birding, fishing, and hunting would be bolstered as habitat increases and draws new populations into the area. In addition to effects on Green Island, the adjacent Fish and Wildlife Refuge could see positive benefits from Green Island. Increases in forested areas and other habitats in the complex would also allow more migratory species to use the refuge.

        iii. **Cumulative.** No cumulative aesthetic impacts from the project.

        iv. **Environmental Commitments.** No specific environmental commitments would be needed. Any negatively impacted environmental element would be made up for by environmental gains.

3. **Aquatic Resource**

    a. **TSP and Cadillac Plan**

        i. **Direct.** The Future With Project (FWP) would allow for better WLM. This capability would allow IA DNR to dry out bottomland hardwood forests and emergent vegetation areas. Decreased water levels during the growing season would let the trees, scrub-shrub, emergent, and SAV grow and better establish for the future.

        ii. **Indirect.** Providing the area with various depths across the Project would allow for a more diverse SAV community. Diversity can provide more food

for animals and better habitat for fish.

iii. **Cumulative.** Increases in Native Aquatic Vegetation (NAV) would deter the expansion of aquatic invasive species by using up resources that invasive species require to establish.

iv. **Environmental Commitments.** Environmental commitments include material placement on the 4th ditch berm to allow underground electric lines to reach the pump station. Without the pump, features wouldn't be able to function as designed. The benefits of the Project would make up for any negative impacts from the material placement on the berm.

4. Fish and Wildlife Resources

a. TSP

i. **Direct.** Under the FWP, fish and wildlife habitats would increase throughout the Project. Forested areas would be bolstered by plantings in established forested areas and the ridge and swale feature. Dredged channels would create better overwintering habitat for fish throughout the Project area, and deeper water would allow for a more diverse SAV community.

ii. **Indirect.** Increases in habitat would increase other fish and wildlife, including reptiles, amphibians, and other non-game species.

iii. **Cumulative.** There are no known cumulative effects on fish and wildlife in the Project.

iv. **Environmental Commitments.** Many features would contribute to this resource. Many parts of the Project area including ridge and swale, dredged channels, tree plantings, and WLM from water control structures would need environmental commitments.

b. Cadillac Plan

i. **Direct.** This alternative would be similar to the TSP. However, with more dredging, this alternative would add more fish overwintering habitat.

ii. **Indirect.** Increases in habitat would increase other fish and wildlife, including reptiles, amphibians, and other non-game species. With more dredge cuts, this habitat would expand even further.

iii. **Cumulative.** There are no known cumulative effects on fish and wildlife in the Project.

iv. **Environmental Commitments.** Many features would contribute to this resource. Many parts of the Project area including ridge and swale, dredging, tree plantings, and WLM from water control structures would need environmental commitments.

5. **Threatened/Endangered Species and Other Species of Concern.** A coordination letter was sent to USFWS on July 25, 2023, requesting concurrence on the District's ESA determinations (Table 21). Given the habitat requirements, the District determined there would be no effect on eastern prairie fringed orchid, monarch butterfly, sheepnose mussel, higgins eye, and whooping crane. However, due to the removal of dead trees while dredging and creating features, the District made a May Affect but Not Likely to Adversely Affect. In a letter dated September 5, 2023, the USFWS concurred with the District's determinations.

Table 21. Species Determination for Threatened/Endangered Species

Common Name	Scientific Name	Designation	Determination
Northern Long-eared Bat	*Myotis septentrionalis*	Endangered	Not Likely to Adversely Affect
Tricolored Bat	*Perimyotis subflavus*	Endangered	Not Likely to Adversely Affect
Whooping Crane	*Grus americana*	Experimental Population	No Effect
Higgins Eye (pearlymussel)	*Lampsilis higginsii*	Endangered	No Effect
Sheepnose Mussel	*Plethobasus cyphyus*	Endangered	No Effect
Monarch Butterfly	*Danaus plexippus*	Candidate	No Effect
Eastern Prairie Fringed Orchid	*Platanthera leucophaea*	Threatened	No Effect

a. TSP and Cadillac Plan

i. Direct. Under the FWP, this Project would directly impact threatened/endangered species and other species of concern. Dead and dying trees would be removed in areas where features are located thus negatively impacting species that would use those trees; however, all other dead or dying trees would be left providing habitat for bats and suitable trees for bald and golden eagle nesting. In addition, trees would be planted, bolstering the forested areas of the project and positively increasing bottomland hardwood regeneration.

By dredging, the Project area, would directly benefit the state-threatened Grass Pickerel and provide deeper water for overwintering.

ii. Indirect. The FWP would increase water quality throughout the Project area, specifically DO. Increases in DO and fewer DO swings would positively impact state-threatened fish species.

iii. Cumulatively. The FWP conditions would increase the number of bottomland hardwoods in the area, which would shade the water, cooling the water temperature in the summer and allowing the water to hold more DO. With more DO, state-threatened fish species would be able to survive in more locations throughout the Project.

iv. **Environmental Commitments.** To see the benefits described above,

tree plantings on the ridge and swale feature, tree planting in the already forested areas, and dredging would need to be completed. These are all a part of the Project features. Any negative impacts from removing trees would be more than offset by the environmental benefits gained by these features.

6. Cultural Resources

a. TSP and Cadillac Plan

i. The FWP would facilitate the identification and evaluation of currently unknown historic properties within the Project area and the protection and/or avoidance of any cultural resources eligible for listing on the National Register of Historic Places (NRHP). The ongoing risk of degrading integrity for NRHP eligibility would be reduced due to variable water levels, potential erosion, and lack of protection. The risk of inadvertent discoveries in high-probability areas during future use and maintenance would be reduced due to systematic surveys and documentation.

ii. Environmental Commitments. No environmental commitments would be needed.

7. Floodplains. Green Island is leveed off from the river, and the Project does not propose to change its connectivity to the floodplain. All effects discussed in this section are within Green Island.

a. TSP and Cadillac Plan

i. Direct. Water level management would directly impact on how water would be used within the Project. Water levels would be manipulated to mimic the hydrologic cycle, allowing managers to provide the complex with the best-growing conditions and provide the area with increases in trees, emergent vegetation, and SAV diversity.

ii. Indirect. As stated above, increases in vegetation would provide more habitat and food for resident and migratory species within Green Island.

iii. Cumulative. No floodplain cumulative resources.

iv. Environmental Commitments. No environmental commitments would be needed.

8. Hazardous, Toxic, & Radioactive Waste.

a. TSP and Cadillac Plan

i. The Project would not directly, indirectly, or cumulatively change any HTRW. Refer to Appendix E, Engineering, for more information. All material coming onto the site would be tested to avoid impacts.

ii. **Environmental Commitments.** No environmental commitments would be needed.

9. Hydrology and Hydraulics.

a. TSP and Cadillac Plan

The Project will manage for periodic, increased drawdowns to expose more acreage for emergent vegetation recruitment, support sediment consolidation, improve water clarity, allow for more light penetration into deeper areas, and increase species richness. The FWP drawdown WLM Plans include periodic drawdowns in Pools A and B to elevation 582.82 feet NAVD88 during the growing season (approximately April 1-June 30) and an annual fall rise to elevation 587.72 feet in Pool A for fall waterfowl migration (approximately September 1-October 31) (Figures 20 and 21). Pool B fall rise would go to elevation 584.82' NAVD88. These drawdown WLM Plans would be implemented approximately one out of every 5 years. The Typical WLM, similar to the existing WLM illustrated in Figures X8a and X8b, will be implemented in the other four years. The TSP and Cadillac plans include a bidirectional pump station, conveyance channels, and wind-fetch reduction berms, providing increased capability for managing water levels and reducing sediment resuspension and wave-driven erosion. Bi-directional pumping affords the Sponsor the operational flexibility necessary to meet WLM objectives under a changing and uncertain hydrologic regime.

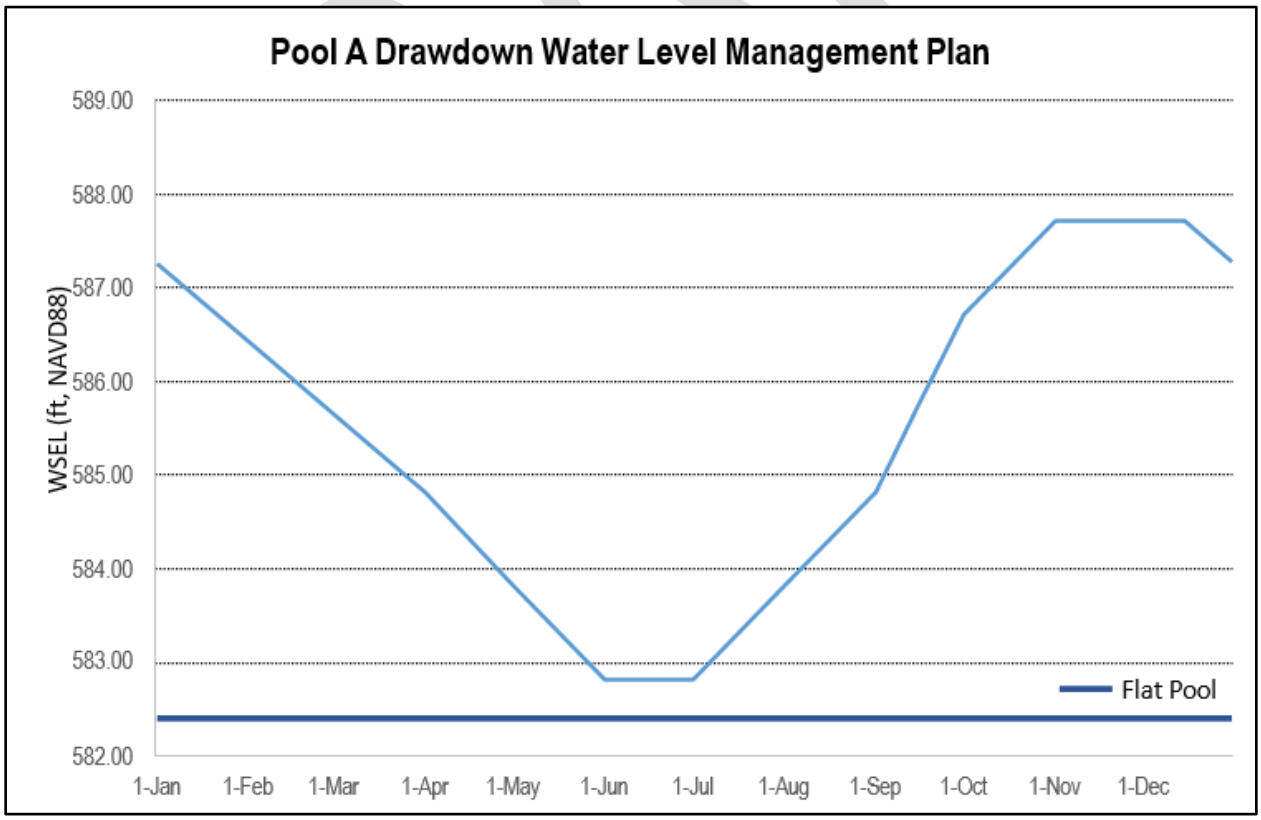

Figure 20. Pool A Drawdown WLM Plans

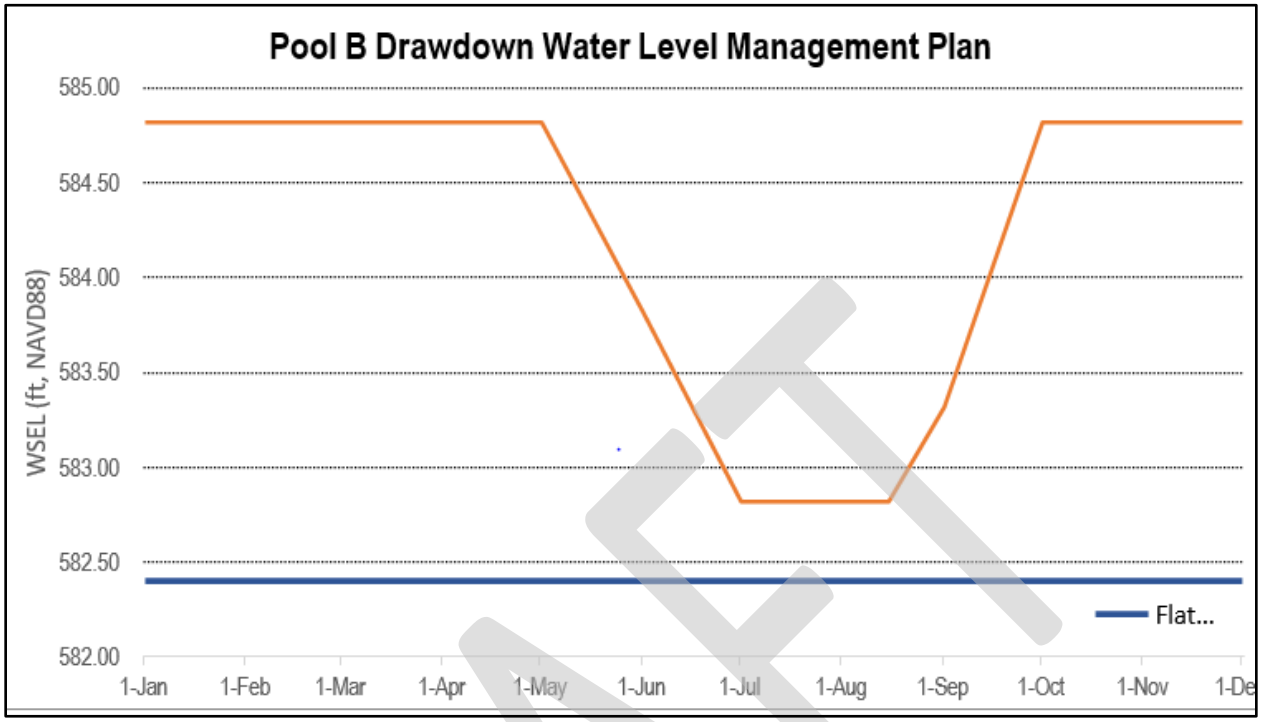

Figure 21. Pool B Drawdown WLM Plans

b. Environmental Commitments. No environmental commitments would be needed.

10. Land Use

a. The FWP would not directly, indirectly, or cumulatively change the land use for Green Island. However, the FWP will work closely with the IA DNR operating plan to allow managers to remove water from the area and manage lands as needed. Mississippi River Plan land use will remain the same from this Project.

b. Environmental Commitments. No environmental commitments would be needed.

11. Socioeconomics

i. Direct. In the FWP condition, there would be short-term increases in employment and income during the Project's construction. A minor short-term increase in traffic and debris during construction of the Project; no direct impacts to population, housing, recreation, or community cohesion.

ii. Indirect. In the FWP condition, recreational opportunities in the Project area would have positive long-term impacts. There would be no indirect impacts on population, housing, employment, income, transportation, or community cohesion.

iii. Cumulative. In the FWP condition, there would be no cumulative effects to socioeconomics.

12. Public Infrastructure

a. TSP and Cadillac Plan

i. Direct. The FWP would affect the public infrastructure of Green Island substantially. The existing pump station would be replaced with a new one, and existing water control structures would be replaced with new structures. These new structures would allow for IA DNR to manage the area better in the future. Staging would take place in the parking lot areas, which would then be restored to preconstruction conditions.

ii. Indirect. No indirect public infrastructure effects.

iii. Cumulative. No cumulative public infrastructure effects

iv. Environmental Commitments. The proposed pump location is in a gravel parking lot next to the existing pump station. Water control structures would be constructed in a similar location to where existing structures are located.

13. Environmental Justice

a. TSP and Cadillac Plan

i. The Project would not displace or have any adverse impacts related to EJ as the action would not disproportionally impact any individuals of a particular social or economic status. Under the FWP, there are no concerns with EJ.

ii. Environmental Commitments. No environmental commitments would be needed.

14. Water Quality.

a. TSP

i. Direct. Under the FWP, water clarity would increase, and DO would improve. The depth of dredged areas would provide sections in each pool with diverse SAV stands. Changes in SAV in areas would inhibit large DO swings from day to night through respiration. Clarity would increase in the area due to islands and a decrease in wind fetch.

ii. Indirect. Under the FWP, water temperature would change in areas where bottomland hardwoods would be planted. The ridge and swale feature would provide shading of the water, decreasing the temperature of the water within the complex.

iii. Cumulative. Overall, the implemented features of the Project would improve water quality within Green Island. Decreases in water temperature in the summer help alleviate strain on fish that use the area, and cooler water can hold DO more efficiently. Increased depth would allow more water to hold DO for fish overwintering.

iv. Environmental Commitments. Any environmental commitments that may negatively impact water quality would be temporary.

b. Cadillac Plan

i. This alternative would provide more dredged areas than the TSP, increasing the potential area of benefits.

15. Climate Change

a. TSP and Cadillac Plan

i. The FWP provides flexibility in terms of the Sponsor's ability to manage water levels under uncertain future hydrology with a likelihood for more frequent, longer duration flooding and increased drought intensity.

ii. Environmental Commitments. No environmental commitments would be needed.

16. **Reasonably Foreseeable Environmental Effects of the Proposed Agency Action.** The loss of some benthic organisms currently inhabiting the footprint areas for feature construction, dredging, and excavation is a likely effect of the proposed action. Following construction, benthic organisms should rapidly recolonize the excavated area.

17. **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 from construction. Long-term productivity would be enhanced through increased reliability of nut-bearing tree production, establishment of submerged, emergent, and wetland vegetation, and providing more dependable reproduction, foraging, and resting areas for migratory and resident wildlife. Overall, habitat diversity would increase, and both game and non-game wildlife species would benefit. 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.

18. **Irreversible or Irretrievable Resource Commitments.** The purchase of materials and the commitment of man-hours, fuel, and machinery are irretrievable. Other than the aforementioned, none of the proposed actions are considered irreversible.

I. Compliance with Environmental Statutes. This document is an integrated environmental assessment with a Clean Water Act analysis. Table 17 highlights District compliance with major environmental laws and regulations.

Bald and Golden Eagle Protection Act. The Bald and Golden Eagle Protection Act prohibits anyone from taking, possessing, or transporting an eagle or such birds' parts, nests, or eggs without prior authorization. Disturbing an eagle to the degree that causes or is likely to cause injury to an eagle, decrease productivity, or cause nest abandonment each counts as a form of take. Activities that directly or indirectly lead to take require a permit. Coordination with USFWS through the Fish and Wildlife coordination document will ensure we comply with this act.

Clean Water Act. The Clean Water Act (CWA, 33 USC §1251 et seq.) establishes the basic structure for regulating discharges of pollutants into the waters of the United States and for regulating quality standards for surface waters.

Nationwide Permit 27 would be used for this project and provides the project with all necessary water quality certifications (WQC) under Section 404 of the CWA. More information can be found in Appendix A, *Environmenta*l.

Actions that may result in a discharge of a pollutant into waters of the United States require Section 401 WQC. This action ensures that anticipated discharge complies with applicable water quality standards. See Appendix B, *Clean Water Act*, for the Section 401 WQC waiver issued by the IA DNR.

Endangered Species Act. Seven federally listed species may potentially occur in the study area (see Section IV.G.5). Coordination with USFWS through the Fish and Wildlife coordination document will ensure we comply with this Act.

Fish and Wildlife Coordination Act. In partial compliance with the Fish and Wildlife Coordination Act (FWCA), the District coordinated project plans with the USFWS and IA DNR. The FWCA directs the USFWS to investigate and report on proposed Federal actions that affect any stream or other body of water and to provide recommendations to minimize impacts on fish and wildlife resources. The USFWS is working on the FWCA document and will provide it to the District when completed. Coordination with USFWS through the Fish and Wildlife coordination document will ensure we comply with this Act.

National Historic Preservation Act. Section 106 of the National Historic Preservation Act (NHPA) of 1966, as amended, and its implementing regulations at 36 CFR Part 800: "Protection of Historic Properties," establish the primary policy and authority for preservation activities and compliance procedures (Public Law 89-665; 16 U.S.C. 470 et seq.). The NHPA ensures early consideration of historic property preservation in Federal undertakings and the integration of these values into each agency's mission. The Act declares Federal policy to protect historic sites and values in cooperation with other nations, states, and local governments.

Early coordination of this Project (April 15, 2022) before the TSP milestone was initiated with the Advisory Council on Historic Preservation (ACHP), the Iowa State Historic Preservation Office (IA SHPO), the Iowa Office of the State Archaeologist (OSA), the USFWS, and 23 federally recognized Native American tribes with ancestral interest in the proposed Project area. The District communicated that due to the size of the Area of Potential Effect (APE) and the complex scope of the Project, the undertaking consists of multiple activities whose potential to adversely affect historical properties cannot be determined before the TSP milestone. As per 36 CFR§Part 800, the District invited the parties named above to consult on developing a program alternative for Section 106 compliance. Development of an agreement document that sets out the measures the District will implement to avoid and resolve any unavoidable adverse effects is ongoing. This agreement will be executed prior to completion of the Finding of No Significant Impact (FONSI) to ensure adherence to the requirements of the NHPA as implemented by 36 CFR Part 800 and codified in 54 U.S.C. § 306108. While the development of this program alternative is ongoing, phased identification of historic properties within the Area of Potential Effect will also occur, facilitating the avoidance of potential adverse effects to historic properties wherever possible.

National Environmental Policy Act. This FR-EA has integrated the content required of a NEPA environmental compliance document. The District provided a range of alternatives and evaluated the significance of the proposed project's impacts. The District will distribute the FR-EA to agencies, the public, and other interested parties and gather any comments or concerns. If USACE finds no substantial effects on the environment during the comment period or moving forward with the project design, the Rock Island District Commander will sign the FONSI. See Table 22 for results.

Table 22. Relationship of Plans to Environmental Protection Statutes and Other Environmental Requirements

Federal Environmental Protection Statutes and Requirements	Applicability/ Compliance[1/2/3]
Archaeological and Historic Preservation Act, 16 U.S.C. 469, et seq.	Partial Compliance
Clean Air Act, as amended, 42 U.S.C. 1857h-7, et seq.	Fully Compliant
Clean Water Act, Sections 404 and 401	Fully Compliant
USACE Planning Guidance Notebook (ER 1105-2-100)	Fully Compliant
Endangered Species Act of 1973, as amended, 16 S.C. 1531, et seq.	Fully Compliant
Environmental Justice (EOs 12898, 13985, 13990, 14008)	Fully Compliant
Executive Order 11988 Project Floodplain Management	Fully Compliant
Executive Order 11990 - Protection of Wetlands	Fully Compliant
Executive Order 12898 Project Environmental Justice	Fully Compliant
Executive Order 13112 - Invasive Species	Fully Compliant
Farmland Protection Policy Act. 7 U.S.C. 4201, et seq.	Fully Compliant
Federal Water Protection Recreation Act, 16 U.S.C. 460-(12), et seq.	Fully Compliant
Fish and Wildlife Coordination Act, 16 U.S.C. 601, et seq.	Partial Compliance
Green House Gases, CEQ Memorandum 18, Feb 2010	Fully Compliant
Land and Water Conservation Fund Act, 16 U.S.C. 460/-460/-11, et seq.	Fully Compliant
National Environmental Policy Act, 42 U.S.C. 321, et seq.	Partial Compliance
National Historic Preservation Act, 16 U.S.C. 470a, et seq.	Partial Compliance
Rivers and Harbors Act, 33 U.S.C. 403, et seq.	Fully Compliant
Watershed Protection and Flood Prevention Act, 16 U.S.C. 1001, et seq.	Fully Compliant
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
[2] Partial Compliance = having met some requirements of the statute for the current stage of planning or anticipate full compliance at completion of planning (additional information below)
[3] Not Applicable = no requirements for the statute, or Project does not contain resources applicable to the law

J. Post-Construction Evaluation. Per Section 2039 of WRDA 2007, monitoring for ecosystem restoration studies would 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 post-construction evaluation plan, which includes performance monitoring, adaptive management, and long-term performance reporting, as described in Table 23. A full description of post-construction evaluation can be found in Appendix I, *Monitoring and Adaptive Management Plan*, and long-term performance reporting.

Table 24 presents the overall types, purposes, and monitoring and data collection responsibilities. Table 25 presents specific monitoring types and data parameters grouped by Project phase and data collection intervals. Table 26 presents the post-construction evaluation plan, which displays several specific parameters and the enhancement levels that the Project would achieve. Other factors may be considered to evaluate Project performance and success.

Table 23. Post-Construction Evaluation 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 24. 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.	Sponsor	Sponsor	Sponsor
	Baseline Monitoring	Establish baselines for performance evaluation.	USACE	Field Station or Sponsor through Cooperative Agreements or USACE	HREP/Sponsor
Design	Data Collection for Design	Include quantification of Project objectives, design of Project, and development of Performance Evaluation Reports.	USACE	USACE	HREP
Construction	Construction Monitoring	Assess construction impacts; assure permit conditions are met.	USACE	USACE	HREP
Post-Construction	Performance Evaluation Monitoring	Determine success of Project as related to objectives.	USACE (quantitative) Sponsor (field observations)	Field Station or Sponsor through Cooperative Agreement, Sponsor thru O&M, or USACE	HREP/Sponsor
	Biological Response Monitoring	Use performance monitoring and Adaptive Management and Monitoring results to evaluate predictions and assumptions of the habitat benefit evaluation.	USACE	USACE	HREP

Table 25: Resource Monitoring and Data Collection Summary [1]

	WATER QUALITY DATA						ENGINEERING DATA			NATURAL RESOURCE DATA				
	Pre-Project Phase		Design		Post-Const. Phase		Pre-Project Phase	Design	Post-Const. Phase	Pre-Project Phase	Design	Const. Phase	Post-Const. Phase	
Type Measurement	**Jun-Sep**	**Dec-Mar**	**Jun-Sep**	**Dec-Mar**	**Jun-Sep**	**Dec-Mar**								Agency
Water Quality Stations [2]	2W	6W	2W	6W	2W	6W								Corps
Boring Stations [3]														
Geotechnical Borings							1	1						Corps
Habitat Surveys														
Tree Planting Survey[4]													10Y	Corps
Aquatic Vegetation Surveys[5]										1Y			1Y	DNR
Emergent Vegetation[6]										1			5Y	Corps
Fish Overwinter Response[7]										Y			2Y	DNR
Survey														
Bathymetry (sediment)							1	1	5Y& 10Y					Corps
Land Survey							1	1	5Y & 10Y					Corps

Legend

W = Weekly nW = Every "n" week
M = Monthly nY = Every "n" year
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 0-102 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 and Post-Construction water quality stations are shown in Appendix B, *Water Quality and on Plate O-101:* W-M546.1J, W-M546.8k, and W-M547.7H. Water quality data will be collected during approximately 50% of the long-term monitoring period.

[3] Boring Plan will be developed, and geotechnical borings obtained during PED. Initial borings were collected, see Appendix K, Plates, B-101, B-601 and B-602.

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

[5] Vegetation: Regular LTRM SRS sampling is already conducted in the project area and will continue through the life of the project.

[6] Drone Survey will be used for emergent vegetation sampling.

[7] Electrofishing surveys in the Spring.

Table 26. 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
Aquatic Diversity/ Overwintering Habitat	Acres of Aquatic Habitat (deep water >4 ft, low velocity <I cm/sec, high DO concentrations >5.0 mg/L, increased water temperature >1.0°C)	Dredged areas	.72	43 acres (100% of dredged area)	Sedimentation 0.48 inches per year			Water Quality Stations (depth, velocity, DO, temperature), Bathymetry,	Water quality parameters
Topographic Diversity - Forestry	Percent survivability	All Tree Planting Sites	0%	≥90% survival of planted species; ≥90 trees/acre after planting	≥60% survival of planted species; ≥60 trees/acre after planting	≥60% survival of planted species; ≥60 trees/acre after planting	≥40% survival of planted species; ≥40 trees/acre after planting	Tree Survey	Visual Observations by Corps
Water Level Management	Success rate of meeting water level management targets	Entire Complex	0%	80%	80%	80%	80%	Gage Reading	Gage Reading by IA DNR
Submersed Aquatic Vegetation Response	Species Diversity of Submersed Aquatic Vegetation	Entire Complex/ LTRM SRS Sites	No Change	6 or more SAV species	6 or more SAV species	6 or more SAV species	6 or more SAV species	Submersed Aquatic Vegetation Survey	Vegetation Rake Diversity and Abundance by IA DNR
Emergent Vegetation Response	Species Diversity and Quantity	Entire Complex	No Change	50% of desired vegetation in suitable Habitat	65% of desired vegetation in suitable Habitat	75% of desired vegetation in suitable Habitat	75% of desired vegetation in suitable Habitat	Drone Survey	IA DNR anecdotal visual observations while managing the area; Vegetation in Drone survey

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
Aquatic Diversity/ Overwintering Habitat	Acres of Aquatic Habitat (deep water >4 ft, low velocity <I cm/sec, high DO concentrations >5.0 mg/L, increased water temperature >1.0°C)	Dredged areas	.72	43 acres (100% of dredged area)	Sedimentation 0.48 inches per year			Water Quality Stations (depth, velocity, DO, temperature), Bathymetry,	Water quality parameters
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 by Corps

K. Environmental Operating Principles. The EOPs outline the USACE's role and responsibility to sustainably use and restore our natural resources in a complex and changing world. 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 District has proposed a Project that supports economical and environmentally sustainable solutions.

L. Risk and Uncertainty. Areas of risk and uncertainty were analyzed and defined to make decisions regarding the reliability of estimated benefits and the costs of alternative plans. Risk is defined as the probability or likelihood of an outcome. Uncertainty refers to the likelihood that an outcome results from a lack of knowledge about critical elements or processes, contributing to risk or natural variability in the same elements or processes.

During the initial measure and alternative development processes, the PDT identified several areas of uncertainty. Some of the preliminary uncertainty identified helped scope surveys to gather additional information before detailed formulation. The PDT collected water quality data, bathymetry, and elevation data to reduce areas of uncertainty. In September 2020, the PDT identified uncertainties and associated risks (Table 27). In addition, the PDT used tools and techniques that could address the uncertainty, in turn reducing the associated risk. The focus of this effort was to identify key areas of uncertainty and risk that had the potential to have a significant effect on decisions.

Table 27. Identification of Uncertainties and Risks [1]

Uncertainty	Risk	Resolution
Future water levels are difficult to predict and highly variable.	Appropriate scale of designs for WLM or elevation of features are difficult to determine and could impact both costs and benefits.	Taking a conservative approach to designed features. Pump sizing is larger to account for moving larger volumes of water. Berm are designed to heights and grades to withstand longer periods of inundation.
Lack of water quality information	Formulating measures to improve aquatic habitat conditions relies, in part, on an understanding of water quality. Without this information, design parameters may not be appropriate, and benefits outputs may be inaccurate.	Water quality has been monitored by non-Federal Sponsor and by the PDT from the beginning of feasibility. Water quality will be monitored into the future as part of the adaptive management plan.
Lack of geotechnical data	Feature design, location, and construction methodology rely on an understanding of geotechnical data. This may influence both costs and benefits. Geotech information would help inform WLM (i.e. seepage).	Geotech obtained approximately 16 borings overall on the site for the feasibility study. This information allowed them to make some design recommendations. The remaining borings will be obtained during the design phase to finalize the feature design and locations.
Lack of field survey data (i.e. topography and bathymetry)	Water level management requires a solid understanding of water volume in the study area to design project features. Feature design (dredging, berm creation) would rely on an understanding of bathymetry.	Survey obtained topographic and hydrographic survey during the feasibility design to assist in feature design. Any remaining needed survey data will be acquired during the design phase.
Lack of knowledge on sediment inputs	Project features may not appropriately address sedimentation, or function as intended, without knowledge of sediment sources.	Resistivity data was acquired during feasibility along the levee to assist Geotech in an under-seepage analysis to be completed during the design phase to aide in sedimentation source input.
There may be potential access issues for portions of the study area for construction, particularly during high water periods	Increase in construction costs or delays to construction schedule.	Care will be taken during construction so that only one Pool is closed at a time, leaving access to the site and parking lots available for use. During high water events there will be a high-water action plan in place to address work during those times.

[1] Gray rows indicate preliminary uncertainties identified during surveys as discussed in paragraph K above.

The PDT managed 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. All measures in the TSP are not considered 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.

VII. PUBLIC INVOLVEMENT, COORDINATION, AND CONSULTATION

Coordination has been made throughout the planning process with the IA DNR, USFWS, the Iowa OSA, the ACHP, and federally recognized Native American tribes with ancestral ties to the Project area.

A. Coordination Meetings. Numerous coordination meetings were held with the Project Sponsor and partners to discuss the Project (see Appendix A, Correspondence). Subsections B through D relate to ongoing coordination:

B. Coordination by Correspondence. Consulting parties under Section 106 were identified, provided with a project summary, informed that the potential to adversely affect historic properties could not be determined before the TSP milestone, and invited to consult on developing a program alternative for Section 106 compliance on April 15, 2022. This alternative was proposed to be implemented via a project-level Programmatic Agreement based on a recently executed Agreement among several of the same parties for a similar project under the same authority. Responses from the ACHP, OSA, IA SHPO, USFWS, the Forest Country Potawatomi Community, the Miami Tribe of Oklahoma, the Iowa Tribe of Kansas and Nebraska, and the Kickapoo Tribe of Oklahoma were received through May 26, 2022, concurring with the planned development. While the SHPO accepted the invitation to enter into the Agreement as a signatory and OSA accepted the invitation to participate as a concurring party, ACHP and USFWS declined to participate in the development of the Agreement or to participate as signatories. All tribes invited as consulting parties were retained following this correspondence, as none communicated that they wished to be removed from consultation for the Project.

Subsequent correspondence containing the first draft of a Programmatic Agreement document was submitted to the consulting parties on May 31, 2022. Comments were received in response to this draft from the IA SHPO (June 23, 2022) and OSA (June 6, 2022). The SHPO replied with an additional comment on June 7, 2022, requesting that the District evaluate the number of similar Agreements that had been developed in recent years and were expected to be developed for future projects and to consider developing a program-level Agreement for the UMRR-HREP. While this program-level Agreement is also currently being developed, the timeline for this effort would not facilitate Section 106 compliance for the Green Island Project. District cultural resources and environmental planning staff met at L&D 12, Bellevue, Iowa, on the Mississippi River on February 15, 2023, to discuss this topic. At that time, the SHPO agreed to resume the initiation of a project-level Agreement for the Green Island Project while awaiting execution of the program-level Agreement at a later date.

On May 31, 2023, a second draft incorporating comments previously provided by the IA SHPO, with revision made by the assigned District Archeologist, was submitted to all consulting parties for review. As per email correspondence received from the IA SHPO on July 10, 2023, their office expected to complete review by July 21, 2023, and then forward the draft with comments to the Iowa Attorney General's office for state-level legal review. Additionally, the Ponca Tribe of

Oklahoma and the Upper Sioux Community of Minnesota accessed the draft for review but as of DATE OF FINAL REPORT, had not yet submitted any comment regarding the project or the draft Agreement.

C. Public Views and Comments. A virtual open house was posted to the MVR Corps website from November 2, 2020 to December 2, 2020.

D. Views of the IA DNR. The IA DNR is in full support of the TSP; a letter of support can be found in Appendix A, *Correspondence*.

VIII. RECOMMENDATION

Full realization of the potential habitat value in the Green Island HREP area has been hindered by increased water levels, sedimentation, and erosive forces from wind-driven wave action, which has led to loss of topographic diversity, aquatic habitat adversely altered by water regime and loss of native wetland habitat. Establishing reliable aquatic and floodplain areas that support the survival and regeneration of hard-mast producing trees would allow the Project area to realize the highest benefit of desirable plant, animal, and fish species.

The TSP is Alternative 6, Balanced Water Level Management. Restoration measures for the Project (dredging for fish overwintering habitat and conveyance, dredge material placement for topographic diversity, water control structures, timber stand improvement, ridge and swale, and an in-channel sediment trap) are designed to meet the Project's objectives (see Section II, Need for and Objectives of the Action).

The estimated Project first cost of the TSP is $30,503,000 (FY23 price level), which includes monitoring costs of $242,000 and adaptive management costs of $80,000. Upon completion, the Sponsor is responsible for O&M at an estimated cost of $66,000 annually.

The expected outputs of the TSP include restoration of 1,877 acres of habitat. The TSP would contribute 1,287 average annual habitat units for three habitat types over the 50 years of analysis.

Having weighed the outputs obtained from the full implementation of the Green Island HREP against its estimated cost, and considering the various alternatives proposed, impacts identified, and overall scope, I recommend the Green Island Project be implemented as generally described in this Report.

The recommendations herein reflect the information available at the time and current Department of the Army policies governing the formulation of individual projects. They do not reflect programming and budgeting priorities inherent in formulating the national Civil Works construction program, nor the perspective of higher review levels within the Executive Branch. Consequently, the recommendations may be modified before they are approved for implementation funding. However, before approval, the State of Iowa, Federal agencies, and other parties would be advised of any modifications and afforded the opportunity to comment.

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Jesse T. Curry
Colonel, US Army
Commander & District Engineer

IX. REFERENCES

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FINDING OF NO SIGNIFICANT IMPACT

UPPER MISSISSIPPI RIVER RESTORATION
FEASIBILITY REPORT
WITH INTEGRATED ENVIRONMENTAL ASSESSMENT

GREEN ISLAND
HABITAT REHABILITATION AND ENHANCEMENT PROJECT

POOL 13, UPPER MISSISSIPPI RIVER MILES 545.9-548.7
JACKSON COUNTY, IOWA

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. The final Integrated Feasibility Report and Environmental Assessment (FR/EA) dated DATE OF FR/EA, for the Green Island HREP addresses the restoration of aquatic and floodplain habitat, opportunities, and feasibility within the GIWMA study area, Jackson County, Iowa.

The Final FR/EA, incorporated herein by reference, evaluated various alternatives that would restore and enhance the environment in the study area. The Tentatively Selected Plan (TSP) is the National Ecosystem Restoration Plan and includes:

- Backwater dredging and bathometric diversity (305 acres of overwintering)
- Dredged channels for conveyance and wetland restoration (857 acres)
- Bidirectional pump station (1 structure)
- Moist soil unit habitat (367 acres)
- Timber Stand Improvement (348 acres)

In addition to a “No Action” plan, four alternatives were evaluated. The alternatives included distinct combinations of backwater dredging/aquatic diversity, island protection, topographic diversity, timber stand improvement, grade control structure, and flow diversity. Nonstructural 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.

For all alternatives, the potential effects were evaluated, as appropriate. A summary of the potential effects of the TSP are listed in Table 1.

Table 1: Summary of Potential Effects of the TSP

	Insignificant effects	Insignificant effects as a result of mitigation*	Resource unaffected by action	Positive effects
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 and Hydraulics	☐	☐	☐	☐
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 TSP. Best management practices as detailed in the FR/EA would be implemented, if appropriate, to minimize impacts.

No compensatory mitigation is required as part of the TSP.

Public review of the draft FR/EA and FONSI was completed on **DATE DRAFT EA AND FONSI REVIEW PERIOD ENDED**. All comments submitted during the public review period were responded to in the Final FR/EA and FONSI. **DATE SAR PERIOD ENDED PICK OPTION BASED ON RESULTS OF STATE AND AGENCY REVIEW**

Pursuant to section 7 of the Endangered Species Act of 1973, as amended, the U.S. Army Corps of Engineers determined that the TSP may affect but is not likely to adversely affect the following federally-listed species or their designated critical habitat: Northern Long-eared Bat and Tricolored Bat. The U.S. Fish and Wildlife Service (FWS) concurred with the Corps' determination on **5 September 2023**

Pursuant to section 106 of the National Historic Preservation Act of 1966, as amended, the U.S. Army Corps of Engineers determined that historic properties would not be adversely affected by the TSP. The Iowa SHPO concurred with the determination on **DATE OF CONCURRENCE LETTER.**

Pursuant to Section 106 of the National Historic Preservation Act of 1966, as amended, the U.S. Army Corps of Engineers determined that the TSP has no potential to cause adverse effects on historic properties.

Pursuant to the Clean Water Act of 1972, as amended, the discharge of dredged or fill material associated with the TSP has been found to be compliant with Nationwide Permit 27 which includes section 404(b)(1) Guidelines (40 CFR 230). The Clean Water Act compliance is found in in the Appendix B, *Clean Water Act*, of the FR/EA.

The proposed project would meet the conditions of Nationwide Permit 27 for Aquatic Habitat Rehabilitation and Enhancement Project. A separate water quality certification, pursuant to section 401 of the Clean Water Act, was not required because this Nationwide permit has already received Section 401 WQC from the State of Iowa. All conditions of the water quality certification shall be implemented in order to minimize adverse impacts to water quality.

Technical, environmental, economic, 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 TSP would not cause significant adverse effects on the quality of the human environment; therefore, preparation of an Environmental Impact Statement is not required.

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Date

_____
Jesse T. Curry
Colonel, US Army
Commander & District Engineer