# Executive Summary

## ES.1 Important Considerations for Authorization, Appropriation, and Implementation of Recommended Plan

This Draft Final Feasibility Report establishes the Federal interest in preventing the upstream transfer of aquatic nuisance species (ANS) from the Mississippi River Basin (MRB) to the Great Lakes Basin (GLB) through the Chicago Area Waterway System (CAWS) in the vicinity of the Brandon Road Lock and Dam (BRLD). The Recommended Plan is the Technology Alternative – Acoustic Fish Deterrent with Electric Barrier, which includes the following measures: (1) nonstructural measures, (2) acoustic fish deterrent, (3) air bubble curtain, (4) engineered channel, (5) electric barrier, (6) flushing lock, and (7) boat launches.

The Recommended Plan embodies multiple national priorities, including but not limited to safeguarding the Nation's investments in the Inland Waterway System and protecting the Great Lakes and the more than 5,000 tributaries that represent numerous ecosystems and support commercial industries and recreational opportunities. In its entirety, the Recommended Plan would capitalize on a strategic opportunity to protect the environmental, economic, and social systems of the United States.

To maximize the return on investment for the Recommended Plan, it is necessary to recognize the significance of the proposed implementation strategy. Upon completion of the feasibility report in February 2019, the Report of the Chief of Engineers would also be submitted to Congress for authorization. If Congress makes funds available, Preconstruction Engineering and Design (PED) would begin in 2019. Maintenance work is also scheduled on the Illinois Waterway (IWW) within the Inland Waterway System during the same period of time. This scheduled maintenance will require the closure of numerous locks on the waterway, including Brandon Road Lock. The report proposes two implementation strategies: (1) expedited and (2) incremental. These strategies accomplish two key objectives: (1) maximize project efficacy given timely implementation of the Recommended Plan, and (2) minimize impacts on navigation by conducting much of the Recommended Plan's in-water construction activities during planned maintenance closures of nearby locks on the IWW.

The first part of each implementation strategy would have the same schedule:

- February 2019 – Report of the Chief of Engineers submitted to Congress
- February 2019 – Funding appropriated to initiate PED
- October 2019 – Project authorization and provision of capability funding
- July 2020 – Contract for in-water construction activities
- Spring 2021 – Nonstructural field work begins

The implementation of nonstructural measures would minimize the ANS population below the Brandon Road control point and increase the effectiveness of the Recommended Plan. In the spirit of shared responsibility, the Department of the Interior would implement these important measures. The authorization should require the Department of the Interior to implement the nonstructural measures identified in the Recommended Plan.

For the expedited implementation schedule, nonstructural measures would be implemented upon authorization and appropriation of funds, and all constructed measures included in the Recommended Plan would be implemented in an expedited manner:

- March 2027 – Construction complete

The second implementation strategy is an incremental implementation. The initial risk reduction would consist of nonstructural measures. After this, implementation of the project would proceed in three risk-reduction increments:

- Increment 1: Construction starts calendar year 2020. Estimated duration is 5 years.
- Increment 2: Construction starts calendar year 2022. Estimated duration is 3 years.
- Increment 3: Construction starts calendar year 2023. Estimated duration is 1 year

A parametric cost estimate based on the expedited implementation schedule was completed to provide an approximate estimate for each of the increments. A complete resourced cost estimate to include a construction schedule will be developed and certified prior to completion of the study.

The Recommended Plan utilizes best practices for invasive species management including the development of both structural and nonstructural measures that address the transport mechanisms of various life stages of ANS (floating and swimming). Project efficacy is maximized by implementing the ANS control measures efficiently and effectively. Two ANS of concern, Silver Carp and Bighead Carp, are currently about 4 miles below BRLD. The proposed implementation strategy allows nonstructural measures to commence immediately following project authorization. Many of the nonstructural activities included in the Recommended Plan are currently being implemented to a lesser extent, and therefore can be readily increased to the necessary level of effort with additional funding. The Department of the Interior would implement the majority of nonstructural measures, which are estimated to cost $11,822,000 per year. The Department of the Interior would need to increase its relevant ANS management efforts through its own authorities and appropriations. The implementation of the nonstructural elements of the Recommended Plan would ensure the existing population in the lower pools would be aggressively managed, thereby reducing risk of ANS movement through BRLD during the construction period. In addition, the timely appropriations of funding for PED and construction activities would maximize project efficacy by ensuring the array of ANS control measures would be operational under either implementation strategy as soon as possible.

An equally important objective of the implementation strategy is to minimize impacts on navigation during project construction. This would be achieved by limiting the duration of construction and capitalizing on opportunities to conduct in-water construction activities during planned IWW lock maintenance closures.

The availability and reliability of the IWW waterway is necessary for efficient waterborne transportation of cargo and the industries that rely on the timely shipment and receipt of cargo through this transportation corridor. To bolster the long-term reliability of the waterway, a series of maintenance activities are planned for several locks on IWW and have been coordinated extensively with lock users. The IWW lock maintenance projections are relevant to the users of BRLD. On average, over 10 million tons of commercial cargo transited BRLD each year from 2012 to 2016. The vast majority of these movements also transit nearby locks. About 93% of tonnage that transited BRLD from 2012 to 2016 also transited Dresden Island Lock, while about 87% of the tonnage that transited both BRLD also transited Marseilles Lock (Waterborne Commerce Statistics). As such, the closures at nearby locks provide an opportunity to conduct concurrent construction activities at BRLD effectively limiting the impact on the majority of its users. Specifically, the proposed implementation schedule maximizes construction activities during the 90- to 120-day lock maintenance closure in 2020 at the LaGrange, Peoria, Starved Rock, and Marseilles Locks, and the 90-day lock maintenance closure in 2023 at the Dresden Island and Brandon Road Locks.

As such, the effective and efficient implementation of the Recommended Plan is contingent upon the timeliness of project authorization, and the provision of capability funding for PED and construction activities.

## ES.2 Purpose and Need

The U.S. Army Corps of Engineers (USACE) is preparing a Feasibility Report and an integrated Environmental Impact Statement to evaluate alternatives for controlling upstream transfer of ANS from the MRB into the GLB through the CAWS, and the impacts of those alternatives on waterway uses and users. The purpose of this study is to evaluate structural and nonstructural options and technologies near the BRLD site to prevent the upstream transfer of ANS from the MRB into the GLB, while minimizing impacts on existing waterway uses and users. For this study, "prevent" means the reduction of risk to the maximum extent possible, because it may not be technologically feasible to achieve an absolute solution.[1] The need for this study is to address the problem of the interbasin transfer of ANS between the GLB and MRB through the CAWS. Refer to Chapter 1, Introduction, of the main report for a complete discussion of the study purpose and need.

## ES.3 Background and Study Scope

*The Great Lakes and Mississippi River Interbasin Study – Brandon Road (GLMRIS-BR) Draft Integrated Feasibility Study and Environmental Impact Statement* builds on *The Great Lakes and Mississippi River Interbasin Study (GLMRIS) Report* released in 2014 (USACE 2014a). The Assistant Secretary of the Army (Civil Works) concluded that an appropriate next step is a formal evaluation of potential alternative control options and technologies near the BRLD in Will County, Illinois, to prevent upstream movement of ANS from the MRB to the GLB. BRLD was chosen for the following reasons:

- The physical configuration of Brandon Road Dam prevents the upstream transfer of MRB ANS. There is a 24-foot (7.3-meter) difference in water elevation from the downstream side of the dam to the upstream side of the dam, for a flood that has a 1 in 500 chance of occurring in a given year, commonly known as a "500-year flood" (i.e., 0.002 annual chance of exceedance [ACE]); this effectively limits upstream transfer. Therefore, operation of the Brandon Road Lock currently provides the only known continuous aquatic pathway that allows MRB ANS to transfer into the GLB at this location.
- The approach channel and lock provide a unique opportunity to control ANS transfer in a relatively small section of the river where flow is controlled by lock operations.
- Establishing a control point at BRLD for MRB ANS species does not adversely impact flood risk or water quality of the system.
- A control point at BRLD would provide near-term risk reduction for certain ANS by providing additional defense in depth for Asian carp, when combined with the current Chicago Sanitary and Ship Canal (CSSC) Electric Dispersal Barrier System in Romeoville, Illinois (CSSC-EB).

[1] Defining the term "prevent" to mean reducing the risk to the maximum extent possible is entirely reasonable. *Michigan v. U.S. Army Corps of Engineers*, 911 F. Supp. 2d 739, 766 (N.D. Ill. 2012), aff'd, 758 F.3d 892 (7th Cir. 2014).

In addition, establishing a one-way control point for ANS of concern could lead to new long-term solutions to prevent two-way species transfer. This study evaluates alternatives to prevent the upstream transfer of ANS from the MRB into the GLB near the BRLD, incorporating input from Federal, state, and local agencies and nongovernmental stakeholders.

The scope of this study is to evaluate options and technologies near BRLD, with the goal of preventing upstream transfer of ANS from the MRB into the GLB through the CAWS (Figure ES-1). This study does not examine downstream aquatic transfer of ANS from the GLB to the MRB, nor does it examine aquatic transfer of ANS along the remaining basin divide or ANS transfer through nonaquatic pathways.

The CAWS is the primary continuous aquatic pathway connecting the MRB and GLB. At Lemont, Illinois, upstream of the CSSC-EB, the 9-year average flow rate of the CSSC is 2,755 cubic feet per second (78.01 cubic meters per second). The remaining aquatic pathways along the interbasin divide are episodic, meaning they occur during flood events. Section 2.2.1 of the main report discusses the assessment of the aquatic pathways outside of the CAWS and the work completed to reduce the risk of ANS transfer along the pathways assessed as posing the greatest chance of ANS transfer.

The GLMRIS-BR alternatives were purposely formulated to prevent the interbasin movement of ANS that swim (i.e., fish), float (i.e., fish eggs or larvae and plant fragments), or foul/hitchhike on vessel hulls (i.e., hull fouling crustaceans or plants attached to vessels). Three species were identified that are representative of the aforementioned modes of transport: Bighead Carp (*Hypophthalmichthys nobilis*), Silver Carp (*H. molitrix*), and *A. lacustre*. Although the GLMRIS-BR alternative evaluation was conducted specifically for these three species, the alternatives formulated are adaptable for future ANS that use these transport mechanisms.

Refer to Chapter 1 (Introduction) and Chapter 2 (Background, Existing Projects, and Prior Reports) of the main report for a complete discussion of the study background and scope.

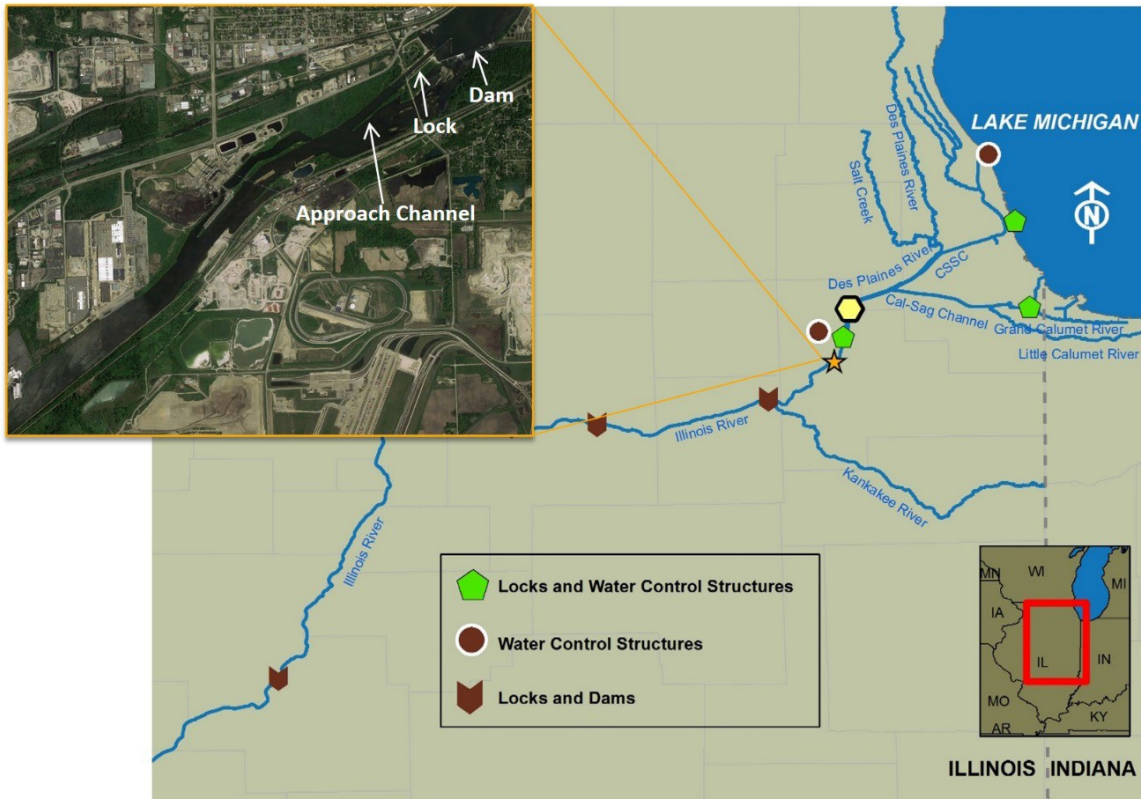


**Figure ES-1 GLMRIS-BR Study Area**

## ES.4 Study Goal, Problems, and Opportunities

The study goal is to prevent the transfer of ANS from the MRB to the GLB while considering the authorized purposes of the IWW with the needs of multiple users and uses of the Upper IWW, and in the spirit of shared responsibility of ANS control consistent with Executive Order 13112.

Study area problems and opportunities were drawn from the GLMRIS Report (USACE 2014a) and from public input and interagency information exchanged during the National Environmental Policy Act public scoping process.

The problems identified were as follows:

- *ANS Cause Impacts*: MRB ANS may transfer through the CAWS and cause significant environmental, economic, and sociopolitical impacts within the GLB.
- *ANS Transfer via Aquatic Pathways*: MRB ANS may transfer to the Great Lakes via aquatic pathways.

The opportunities identified were as follows:

- *Control Point near BRLD*: Establishment of a control point near BRLD could prevent the transfer of MRB ANS to the GLB through the CAWS. Prevention is the most efficient and effective method of combating the environmental, economic, and sociopolitical impacts of invasive species (Figure ES-2).

- *Management Zone*: The CSSC-electric barriers are a control point for swimming ANS (Figure ES-1). Establishing a second control point near BRLD provides an opportunity to create a management zone that augments the CSSC-electric barriers' effectiveness at preventing swimming MRB ANS from transferring to the GLB.
- *Location Minimizes Flood Bypass*: Alternatives that include implementation of a structural control point near the BRLD site would minimize the likelihood of MRB ANS bypassing the CSSC-electric barriers during flood events.
- *Approach Channel and Lock*: The approach channel and lock provide the opportunity to evaluate and optimize the operational characteristics of ANS controls, maximize the efficiency of applied technologies, and minimize the associated costs for implementation and operation.
- *Maintain Existing Uses*: To the extent possible, alternatives should be developed with control measures that allow for navigation and other waterway uses and users while effectively preventing the spread of ANS.
- *Future Adaptability*: Alternatives that include an engineered channel provide a platform for future control technologies near BRLD. Information gathered during the implementation of an alternative could be used to inform future applications of ANS controls in the CAWS and elsewhere.

Refer to Chapter 3, Need for and Objectives of Action, of the main report for a complete discussion of the study goal, problems, and opportunities.

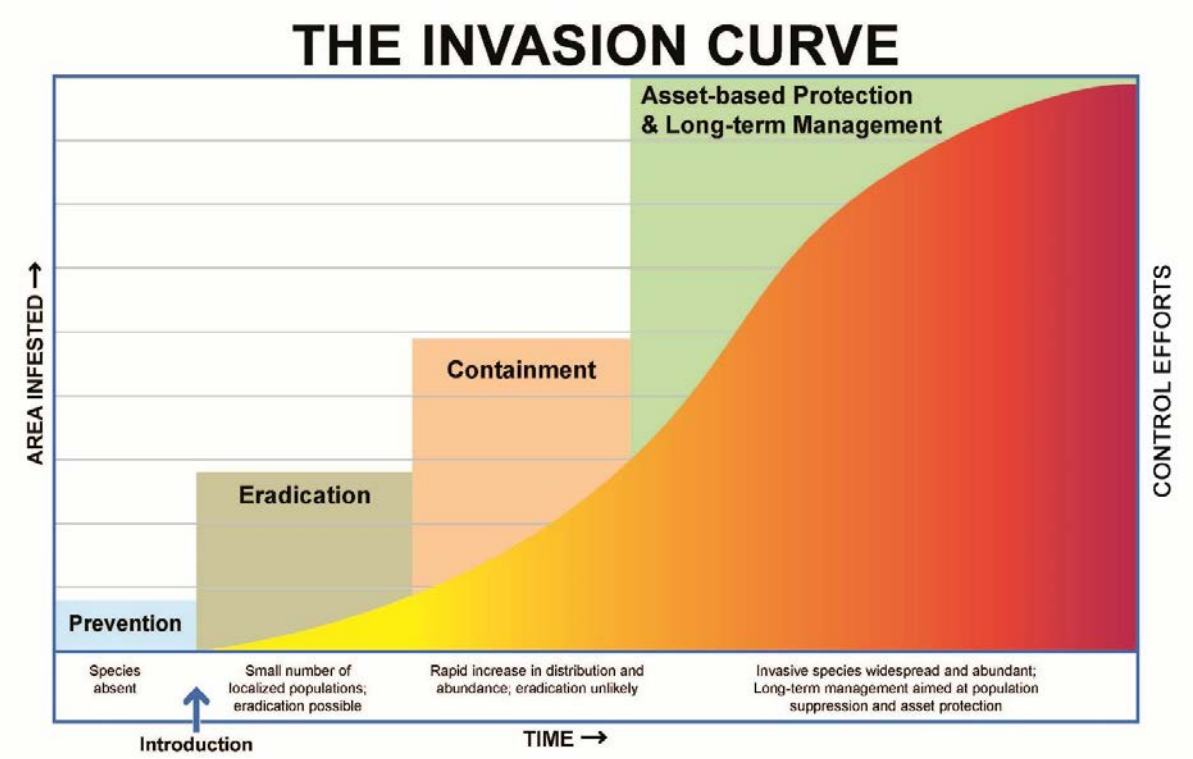


**Figure ES-2 Invasion Curve Describes How Management Changes over Time as an Invasive Species Becomes Established in New Environments (U.S. Department of the Interior 2016)**

## ES.5 Study Objective and Constraints

The study objective is to prevent the upstream transfer of ANS from the MRB to the GLB through the CAWS in the vicinity of the BRLD throughout the planning period of analysis.

Formulation and evaluation of GLMRIS-BR alternatives for the proposed project are constrained by the following factors:

- *Waterway User Impacts*: Each alternative that allows continued use of Brandon Road Lock for navigation will attempt to minimize disruptions to waterway use while maximizing the effectiveness of the alternative.
- *Natural and Human Environment Impacts*: Alternative formulation would attempt to protect the natural and human environment by minimizing impacts on significant natural, cultural, and social resources while maximizing the effectiveness of the alternative.

Refer to Chapter 3, Need for and Objectives of Action, of the main report for a complete discussion of the study objective and constraints.

## ES.6 ANS Populations

Refer to Chapter 4, Affected Environment (Existing Conditions), of the main report for a complete discussion of ANS populations.

### ES.6.1 Current Conditions and Control Efforts Regarding Bighead and Silver Carp

Bighead Carp and Silver Carp are considered established and abundant in the lower IWW. The detectable Bighead and Silver Carp population front (the most upstream pool where detection/presence of adult fish are consistently caught across the pool) is in the Dresden Island Pool, near river mile 280, approximately 6 miles (9.7 kilometers) downstream of BRLD and approximately 47 miles (75.6 kilometers) downstream of Lake Michigan. The U.S. Fish and Wildlife Service maintains the most current information on Asian carp location and abundance at http://asiancarp.us.

The Asian Carp Regional Coordinating Committee's (ACRCC's) Monitoring and Response Working Group (MRWG) currently coordinates planning for Asian carp monitoring and control activities within the IWW and CAWS. Actions are conducted by state and Federal resource management and research agencies, universities, and commercial entities. The MRWG prepares an annual Asian carp Monitoring and Response Plan (MRP) that coordinates activities in the waterway, as well as the implementation of new technologies and methods as they are discovered. The MRP also provides new information on member project plans. The Upper IWW Contingency Response Plan, which describes specific actions members would take in the event a change is detected in the status of Bighead and Silver Carp, is found in the MRP. Additional details regarding the ACRCC's activities can be found at http://asiancarp.us.

The USACE is contributing to this effort through the implementation of a four-pronged strategy, which includes (1) operation of the CSSC-electric barriers, (2) conducting studies to evaluate the effectiveness of the CSSC-electric barriers, (3) participating in extensive monitoring of the IWW for Asian carp, and (4) conducting the GLMRIS-BR. Additional detailed information on USACE efforts against Asian carp can be found at www.lrc.usace.army.mil.

### ES.6.2 Current Conditions and Control Efforts Regarding *Apocorophium lacustre*

*A. lacustre* have established just above the Dresden Island Lock and Dam, less than 20 miles (32.2 kilometers) from BRLD. There are no current efforts to control the spread of *A. lacustre*.

## ES.7 Consequences of Establishment

The potential environmental, economic, and sociopolitical consequences specific to Bighead Carp, Silver Carp, and *A. lacustre* establishment in the GLB were evaluated using best available information. Refer to Chapter 5, Consequences of ANS Establishment in the Great Lakes Basin, of the main report for a complete description of the consequence of establishment for Bighead Carp, Silver Carp, and *A. lacustre*.

### ES.7.1 Consequence Evaluation for Bighead and Silver Carp Establishment

#### *ES.7.1.1 Environmental Consequences*

Modeling studies and monitoring data from previously invaded systems have documented significant changes in the abundance, health, and composition of resident fish species following Asian carp establishment (Kolar et al. 2005; Cudmore et al. 2012; Ickes 2014; Solomon et al. 2016; Aycock 2016).

These studies, along with modeling studies specific to the Great Lakes (Zhang et al. 2016), also suggest Asian carp have the potential to become a dominant species in portions of the GLB with suitable habitat conditions. The five Great Lakes cover about 302,000 square miles (782,176 square kilometers) and within the GLB there are more than 5,000 tributaries and associated floodplain water bodies. Asian carp are known to occupy a wide range of aquatic habitat; although not all of the GLB would be suitable for these species, this does suggest that if Asian carp were to negatively affect resident species, the effects could be widespread. There is significant uncertainty about the ultimate population size of Asian carp the GLB can support, and therefore there is significant uncertainty about the extent and magnitude of environmental impacts.

Estimates of ecosystem changes were only available for Lake Erie's biomass; these estimates are based upon varied model input, which results in uncertainty in model output. Specifically, changes in biomass due to the introduction of Asian carp were estimated by the National Oceanic and Atmospheric Administration (NOAA) Great Lakes Environmental Research Laboratory using a model of the Lake Erie food web (Zhang et al. 2016). The GLMRIS-BR Project Delivery Team then used the output from this model to estimate how changes in fish biomass would affect recreational fishing, charter fishing, and commercial fishing. NOAA ran the Lake Erie model under multiple scenarios to reflect different assumptions about Asian carp such as their diet, and their eating efficiency, and larvae fish consumption by Asian carp. The biomass output from the model was used to calculate the percent difference in biomass of each species compared to baseline conditions (no Asian carp) and each Asian carp establishment scenario.

### *ES.7.1.2 Economic Consequences*

The Great Lakes and their tributaries are used for numerous economically important commercial and recreational purposes, such as fishing activities, shoreline real estate, boating, beach going, and many others. Estimating the economic consequences of Asian carp establishment on each of these uses requires knowledge of how the ecosystem would change, and in turn affect the use of each water body. Estimates of ecosystem changes were only available for Lake Erie's biomass, and are varied and uncertain. A qualitative economic consequence evaluation was conducted for commercial, recreational and charter fishing in Lake Erie; this evaluation solely considered changes in fish biomass due to Asian carp establishment. Refer to Chapter 5, Consequence of ANS Establishment in the Great Lakes Basin, for more information.

Economic consequences were not estimated for the remaining uses such as, but not limited to, beach going, boating, and real estate values along Lake Erie's shoreline. Economic consequences were not estimated for any uses of the remaining four Great Lakes, or for the more than 5,000 Great Lakes tributaries. However, information regarding these other uses in the GLB highlights activities that could be adversely affected by Asian carp establishment.

### *ES.7.1.3 Social Political Consequences*

Social consequences refer to services the environment provides for human use, regardless of any associated economic consequences. Political consequences refer to potential implementation of new regulations and restrictions to address prevention or control of ANS. The potential social and political consequences of Bighead and Silver Carp establishment in the GLB include the following:

- *Legislative and Regulatory Actions*. The U.S. Fish and Wildlife Service listed Bighead Carp and Silver Carp as injurious wildlife species under the Lacey Act. In response to

this designation, additional and continued state and local regulatory actions to prevent, control, and manage these species are anticipated.

- *International Considerations.* The government of Canada has expressed concern due to the potential effects Bighead and Silver Carp would have on Canadian waters.
- *Tribal Considerations*. Federally recognized Native American tribes co-manage fisheries with Federal and state governments to meet sustainable, target levels of harvest for treaty species (Figure ES-3). If Bighead and Silver Carp establishment in the GLB "substantially frustrates achieving the harvest goals and objectives within the 1836 Treaty waters, [their establishment] could result in reopening the terms of [a 2000 and 2007 Consent] Decree and cause each of the parties to spend considerable resources to renegotiate the terms of the Decree[s]" (USFWS 2018).
- *Safety and Nuisance Concerns*. Due to their jumping behavior, Silver Carp would reduce boater safety and recreational activity in the GLB.
- *Management Expenditures*. The establishment of Bighead and Silver Carp in the GLB would expand the management burden to areas where they are not currently found.

### ES.7.2 Consequence Evaluation for *A. lacustre* Establishment

Environmental consequences may include impacts on native mussels. However, there is uncertainty regarding the potential impact of *A. lacustre* because little research has been done on this species. At this time, no economic or sociopolitical consequences are expected as a result of *A. lacustre* establishment in the GLB.

## ES.8 Alternative Formulation

The alternatives were formulated to prevent the upstream transfer of ANS that swim, float, or hitchhike. Alternative effectiveness was evaluated for Bighead Carp, Silver Carp, and *A. lacustre*. The alternatives were formulated to address future ANS that use similar modes of transport to Bighead Carp, Silver Carp, and *A. lacustre*. The measures used to formulate alternatives included both nonstructural control measures and structural control measures (Figure ES-4). Refer to Chapter 6, Alternative Formulation, of the main report for a complete description of the measures used in formulation of the alternatives.

### ES.8.1 Nonstructural Control Measures

Nonstructural controls do not require the construction of a permanent feature in the waterway. Nonstructural control measures included education and outreach, integrated pest management, manual or mechanical removal, nonstructural monitoring, piscicides, and research and development.

### ES.8.2 Structural Control Measures

Structural controls require the construction of a permanent feature in the waterway. Structural measures consist of an acoustic fish deterrent,[2] an electric dispersal barrier, an engineered channel, a flushing lock, lock closure, and water jets. Boat launches are supporting measures. The fish entrainment technology was

[2] Formerly called "Complex Noise" in the Draft Report, but changed to "Acoustic Fish Deterrent" in order to more accurately describe the technology.

changed from water jets to an air bubble curtain; this change is reflected in the Recommended Plan. See Chapter 9 for details regarding this change.

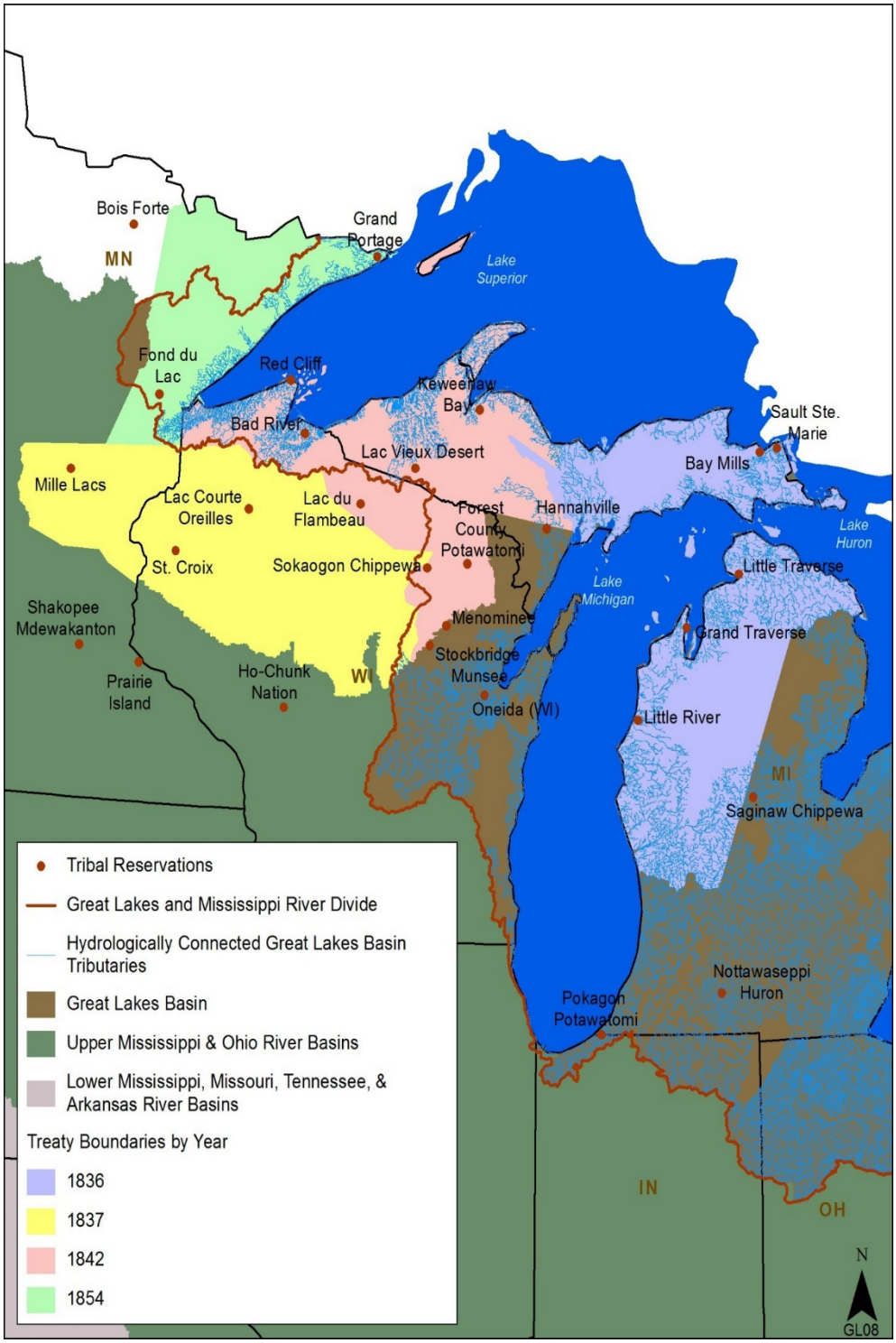


**Figure ES-3 Great Lakes Basin Tributaries Located in Lands That Could Be Accessible by Silver and Bighead Carp**

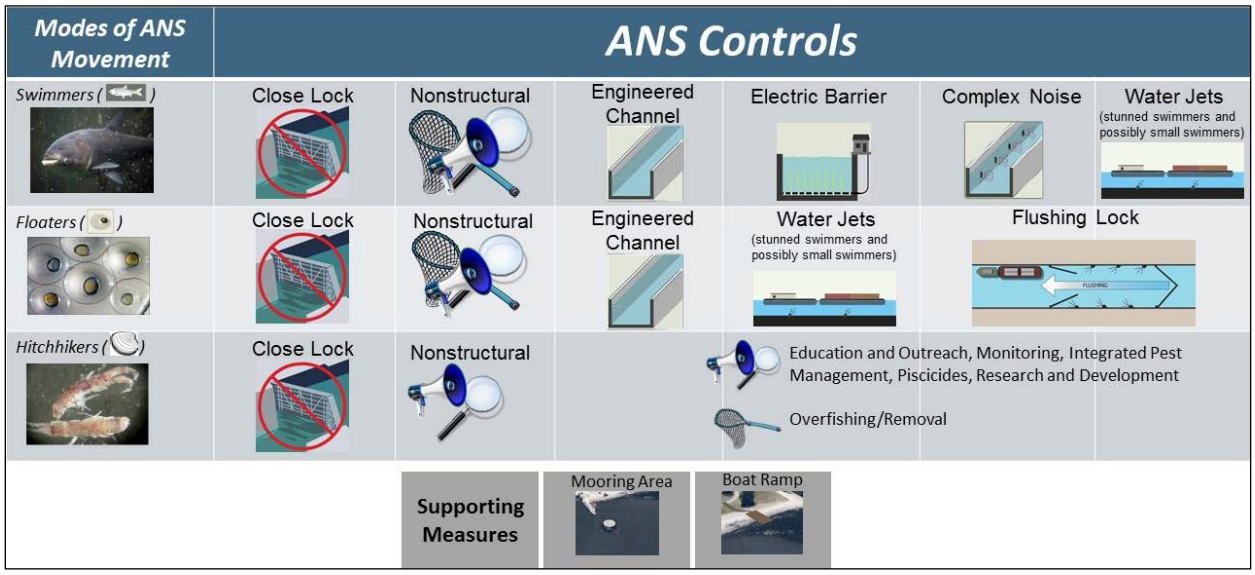


**Figure ES-4 Modes of ANS Movement Addressed by the GLMRIS-BR Control Measures Included in Alternative Plans**[3]

## ES.9 Final Array of Alternative Plans

Refer to Chapter 6, Alternative Formulation, of the main report for a complete description of the alternatives. This section describes the final array of alternative plans. The final array of alternative plans presented in this section and the comparison of the final array of alternative plans also appear in Figures ES-5 and ES-6. Comparisons of the alternative plans are the basis for the selection of the Tentatively Selected Plan (Section ES.10), which is synonymous with the National Ecosystem Restoration Plan.

The Tentatively Selected Plan is further developed into the Recommended Plan (Section ES.11, Recommended Plan) based on public input and additional analyses conducted during the feasibility phase of the project.

The final array of alternatives was developed to a conceptual design level and a corresponding level of cost estimate was developed to inform the selection of the Tentatively Selected Plan (Appendix H, Section H-1, Final Array of Alternative Plans).

## ES.10 Comparison of the Final Array of Alternative Plans

Refer to Chapter 8, Comparison of the Final Array of Alternative Plans, of the main report for a complete discussion on comparison of the alternative plans. The comparison of the final array of alternative plans found in this section are the basis for the selection of the Tentatively Selected Plan (Section ES.10, Tentatively Selected Plan), which is synonymous with the National Ecosystem Restoration Plan.

[3] The fish entrainment technology has changed from water jets to an air bubble curtain; this change is reflected in the Recommended Plan.. Mooring cells were removed from the Recommended Plan due to cost, these measures did not improve project effectiveness. See Chapter 9 for details regarding these changes.

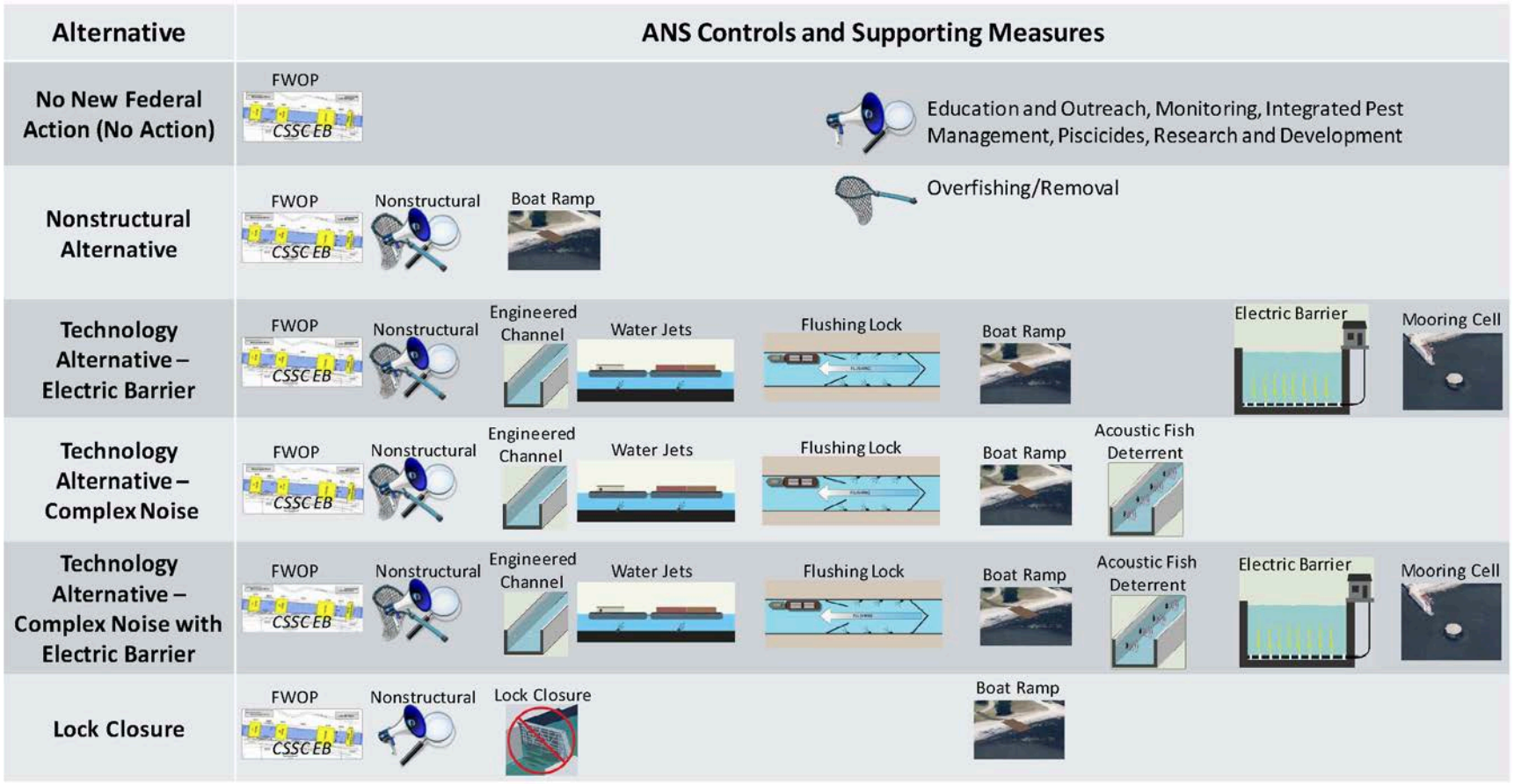


**Figure ES-5 GLMRIS-BR Final Array of Alternative Plans**[4]

[4] The fish entrainment technology was changed from water jets to an air bubble curtain; this change is reflected in the Recommended Plan. Mooring cells were removed from the Recommended Plan due to cost, and these measures did not improve project effectiveness. See Chapter 9 for details regarding these changes.

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NOTE: All costs presented were estimated using the FY 2017 Federal discount rate and price level.

[a] Evaluation criteria descriptions are located on the reverse side of this table.

[b] Composite expert values.

[c] System performance robustness.

[d] Ability to cycle in nonstructural controls:


[e] Ability to cycle in structural controls:


[f] Number of structural control points:

One control point:


Two control points:

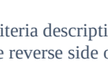

[g] Modes of transport:

Swimmers:



Floaters:

Hitchhikers:



[h] Assumed authorized for construction in FY 2021 and capability funding for planning, engineering design, and construction.

[i] "No Action" means no new Federal or additional action, but current activities could continue.

[j] Permanent closure requires Congressional authorization.

* See Section 6.11.1 for operating assumption

## GLMRIS – Brandon Road Final Array of Alternative Plans Evaluation Criteria[a]

**Objective: Prevent the upstream transfer of aquatic nuisance species (ANS) from the Mississippi River Basin to the Great Lakes Basin through the Chicago Area Waterways in the vicinity of the Brandon Road Lock and Dam through the planning period of analysis.**

| | Alternative | Probability of Establishment for Silver and Bighead Carp in the Great Lakes[b] (Composite Expert Results) | Probability of Establishment for *A. lacustre* in the Great Lakes[b] (Composite Expert Results) | Relative Life Safety Risk | System Performance Robustness[c]: Ability to Cycle in Nonstructural | System Performance Robustness[c]: Ability to Cycle in Structural[e] | System Performance Robustness[c]: Number of Structural Control Points[f] | System Performance Robustness[c]: Modes of Transport[g] | Present Value: Construction Cost (CON) = Construction + PED + Con Mgmt. + Monitoring and Adaptive Management + Mitigation + LERRDS | Average Annual Costs (NED): Construction Cost (CON) | Nonstructural (NS) + OMRR&R | + | Impacts to Navigation (NAV) | = | Total NED Costs (CON + NS + OMRR&R + NAV) | Anticipated Implementation Date[h] |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | No New Federal Action (No Action)[i] | 29% (22–36%) | 61% (36–88%) | LOW | NS | | CP | | N/A | N/A | N/A | | N/A | | N/A | Ongoing |
| | Nonstructural Alternative | 20% (15–26%) | 61% (36–88%) | LOW | NS | | CP | | $600K (Mitigation: $0) | $20K | NS: $11.5M OMRR&R: $20K | | N/A | | $11.5M | 2020: NS 2023: Construction Complete |
| Technology Alternatives | Electric Barrier | 11% (8–14%) | 58% (34–86%) | HIGH | NS | S | CP CP | | $266.8M (Mitigation: $2.2M) | $10.1M | NS Measures: $11.3M OMRR&R: $7.8M | | $31.4M | | $60.6M | 2020: NS 2025: Construction Complete |
| | Assumes Electric Barrier On Continuously | | | | | | | | | | | | | | | |
| | Acoustic Fish Deterrent | 15% (11–19%) | 58% (34–86%) | INTERMEDIATE | NS | S | CP CP | | $113.9M (Mitigation: $2.2M) | $4.4M | NS Measures: $11.3M OMRR&R: $1.4M | | $26.0M | | $43.0M | 2020: NS 2025: Construction Complete |
| | Acoustic Fish Deterrent with Electric Barrier | Tentatively Selected Plan 13% (10–17%) | 58% (34–86%) | HIGH | NS | S | CP CP | | $275.3M (Mitigation: $2.2M) | $10.5M | NS Measures: $11.3M OMRR&R: $8.2M | | $26.2M | | $56.2M | 2020: NS 2025: Construction Complete |
| | Assumes Electric Barrier on Intermittently* | | | | | | | | | | | | | | | |
| | Lock Closure | 2% (1–3%) | 42% (17–78%) | LOW | NS | | CP CP | | $5.9M (Mitigation: $2.3M) | $200K | NS Measures: $9.2M OMRR&R: $20K | | $318.7M | | $328.2M | 2020: NS + Lock Closed[j] 2023: Permanent Lock Closure Construction Complete |

**The final array of alternatives were developed to a conceptual design level and a corresponding level of cost estimate was developed to inform the selection of the Tentatively Selected Plan (Appendix H, Section H-1, Final Array of Alternative Plans). As the study continued, only the design of the Tentatively Selected Plan was further refined and a certified cost estimate of that design was completed (Appendix H, Section H-2, Recommended Plan).**

Figure ES-6 Brandon Road Final Array of Alternative Plans Evaluation Criteria

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*Probability of Establishment for Asian carp in the Great Lakes.* This criterion estimates the probability of establishment for Asian carp within the Great Lakes for each alternative. The probability of establishment range is a composite based on results from the Asian carp expert elicitation. The GLMRIS-BR alternatives can impact probability of arrival (P(arrival)) and probability of passage (P(passage)). The mean value of the composite expert result is shown as well as the low and high ranges in parentheses.

*Probability of Establishment for* A. lacustre *in the Great Lakes.* This criterion estimates the probability of establishment for *A. lacustre* within the Great Lakes for each alternative. The probability of establishment range is a composite based on results from the *A. lacustre* expert elicitation. The GLMRIS-BR alternatives can impact P(arrival) and P(passage). The mean value of the composite expert result is shown as well as the low and high ranges in parentheses.

*Relative Life-Safety Risks.* This criterion represents the relative life-safety risk of navigators and facility operators associated with the alternatives. The qualitative risk assigned to each alternative is relative to the remaining alternatives. Low represents a low safety risk as compared to the other alternatives; high represents a high life-safety risk as compared to the other alternatives; and intermediate represents a safety risk between the alternatives ranked as low and high.

*System Performance Robustness*. This criterion has been evaluated as an alternative's ability to accomplish/address the following:

(1) *Ability to Cycle in Nonstructural Measures* – Ability to cycle in nonstructural measures refers to whether the alternative can cycle in new nonstructural measures.
(2) *Ability to Cycle in Structural Measures* – Ability to cycle in structural measures refers to whether the alternative can cycle in new structural measures.
(3) *Number of Structural Control Points* – Number of structural control points refers to the number of structural control points within the GLMRIS-BR Upper IWW. The system currently has one structural control point, the CSSC electric dispersal barriers. If a new structural control point is added at BRLD, then the system would have two structural control points; this is also known as "defense in depth."
(4) *Modes of Transport* – Number of ANS modes of transport that are addressed by the alternative (modes of transport). This shows whether the alternative contains measure(s) that control the transfer of ANS that swim, float, and/or hitchhike. For example, if an alternative prevents swimmers and floaters, then the alternative addresses two modes of transport.

*Present Value – Construction Cost.* This criterion is the total estimated construction costs for an alternative. Construction costs include construction; lands, easements, rights-of-way, relocation, and disposal areas; PED; construction management; performance monitoring and adaptive management; and mitigation. Although they are included in the total construction costs, the mitigation costs are noted in brackets. Mitigation costs are included for adverse effects on the connectivity of the Des Plaines River and the movement of native aquatic species due to the implementation of a technology alternative or Lock Closure. Mitigation costs also include the costs to mitigation for adverse and visual effects from the addition or modifications because of implementation of a Technology Alternative or Lock Closure. These would affect the original fabric of the dam and the new construction within the BRLD Historic District boundaries. Neither the No Action Alternative nor the Nonstructural Alternative would require mitigation.

*Average Annual Cost – Construction Cost.* This criterion is the average annual costs for the construction cost.

*Average Annual Costs – NS and OMRR&R Costs.* This criterion is the average annual costs for nonstructural measures (NS) and OMRR&R.

*Average Annual Cost – Navigation Impacts (NED).* This criterion is the estimated loss in NED benefits for the alternative.

*Average Annual Cost – Total NED Costs (Construction (CON) + Nonstructural Measures (NS) + OMRR&R + Impacts to Navigation (NAV)).* This criterion is total National Economic Development (NED) costs, which are the average annual costs of construction, nonstructural measures, OMRR&R, and navigation impacts.

*Anticipated Implementation Date*. This criterion is the expected calendar year when measures of an alternative would be implemented, assuming the alternative is authorized in FY 2021 and capability funding for pre-construction engineering design and construction.

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The final array of alternative plans evaluation considered the following criteria: reduction in the probability of establishment in the GLB; relative life safety risk; system performance robustness; anticipated implementation date; and costs that include construction and mitigation, nonstructural measures, navigation impacts, and operation, maintenance, repair, rehabilitation, and replace (OMRR&R). The criteria names, including the ways of presenting the costs as either project first costs or average annual costs, correspond to the column names in Figure ES-6. Criteria definitions appear on the second page of Figure ES-6.

## ES.11 Recommended Plan

In the draft report released in August 2017, the Tentatively Selected Plan (TSP) is the Technology Alternative – Acoustic Fish Deterrent with Electric Barrier, which consists of the following measures: nonstructural measures, acoustic fish deterrent, water jets, an engineered channel, an electric barrier, a flushing lock and boat launches (Figure ES-7). Based on input received during the public comment period and additional engineering evaluation, the TSP was ultimately identified as the Recommended Plan. The water jet measure, which was to address fish entrainment, was replaced with an air bubble curtain based on results of a 2017 field demonstration (Chapter 9). Only the design of the Tentatively Selected Plan was further refined and a certified cost estimate of that design was completed. (Appendix H, Section H-1, Recommended Plan)

The Recommended Plan was selected because it meets the project objective by reducing the risk of MRB ANS establishment in the GLB to the maximum extent possible, while minimizing impacts on navigation. Although Lock Closure and the Technology Alternative – Electric Barrier are the most effective alternatives at reducing the risk of MRB ANS establishment in the GLB, both alternatives cause greater impacts to navigation. The Recommended Plan minimizes impacts to navigation while maximizing the effectiveness of preventing MRB ANS from traveling upstream to the GLB through the CAWS. The Recommended Plan addresses two modes of ANS transport, swimming and floating, and creates a second structural control point downstream of the CSSC-EB within the IWW.

The Recommended Plan includes the following measures: (1) nonstructural activities, (2) acoustic fish deterrent, (3) air bubble curtain, (4) engineered channel, (5) electric barrier, (6) flushing lock, and (7) boat launches (Table ES-1 and Figure ES-7).

### Table ES-1 Measures in Technology Alternative – Acoustic Fish Deterrent with Electric Barrier

| Location | Measure | Controlled Modes of ANS Transport |
|---|---|---|
| **GLMRIS-BR IWW Study Area** | Nonstructural | Swimmers |
| **Brandon Road Lock and Approach Channel** | Electric barrier | Swimmers |
| | Acoustic fish deterrent | Swimmers |
| | Engineered channel | Integral to nonstructural swimmer and floater ANS controls |
| | Air bubble curtain | Floaters, small and stunned swimmers |
| | Flushing lock | Floaters |
| | Boat launches | Supporting measure |

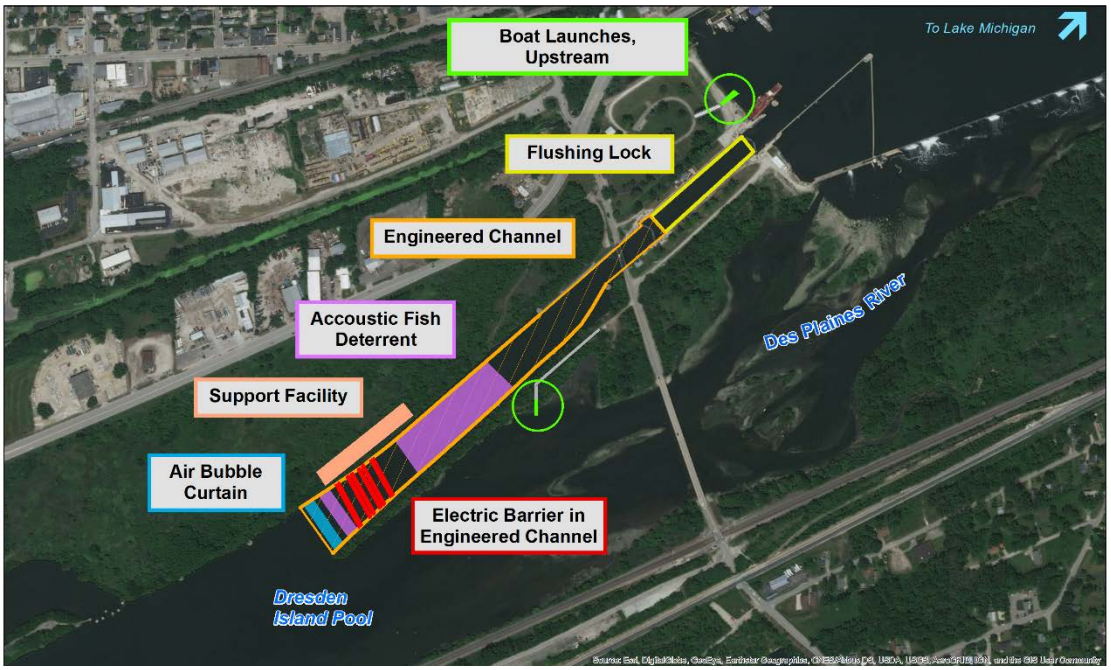


**Figure ES-7 Aerial View of BRLD with Technology Alternative – Acoustic Fish Deterrent with Electric Barrier**

The Recommended Plan includes both structural and nonstructural measures. Nonstructural measures include public education and outreach, monitoring, integrated pest management, piscicides, manual and mechanical removal, and research and development. To support the implementation of nonstructural measures, the National Ecosystem Restoration (NER) plan includes two boat launches. The nonstructural measures would be an important element in keeping population numbers of ANS downstream of Brandon Road low. As the ANS population below the Brandon Road control point increases, the likelihood ANS will transfer through this control point increases. USACE coordinated with the Department of the Interior on the implementation of nonstructural measures that are non-project costs. In the spirit of shared responsibility, the Department of the Interior would implement these important measures, which would increase the effectiveness of the Recommended Plan. The authorization should require the Department of the Interior to implement the nonstructural measures identified in the Recommended Plan.

As for structural measures, the Recommended Plan would be most effective if the electric dispersal barrier operates continuously at optimal parameters to deter fish. Life safety of vessel operators and lock staff and is a primary consideration. In addition to fish deterrence, the Recommended Plan would include life-safety considerations in its design and operation. Testing would be conducted to address site-specific operating considerations that cannot be addressed until after construction. Once the measures have been constructed, USACE and the U.S. Coast Guard (USCG) would conduct an in-water evaluation of the operation of the electric dispersal barrier, acoustic fish deterrent, and air bubble curtain, all within an engineered channel, to assess safe operating parameters for each measure. Lock flushing would also be included in the assessments. The Brandon Road Lock valves would require repairs to allow for flushing operations as described.

The USACE expects it would initially operate the electric dispersal barrier measure only when vessels are not immediately downstream of the engineered channel, are not within the engineered channel, and are not proceeding through the lock. In lieu of operating the electric dispersal barrier during these times, the acoustic fish deterrent would serve to deter fish. Informed by the results of safety testing and continued

coordination with USCG and the navigation community, USACE would work to maximize the effectiveness of the Recommended Plan, which may include increasing the operating duration or continuously operating the electric dispersal barrier, while minimizing impact to life safety.

Refer to Chapter 9, Description of the Recommended Plan, of the main report for a complete discussion on the Recommended Plan.

### ES.11.1 Importance of the Engineered Channel

The engineered channel is the foundation of the integrated ANS control system designed for the Brandon Road Lock downstream approach channel. The engineered channel would protect ANS controls installed within the channel; create an environment that enhances the effectiveness of fish monitoring and clearing increase ANS control effectiveness; and abate impacts from ANS controls, and it is an undesirable habitat for aquatic species. The engineered channel would increase the effectiveness of the ANS control measures installed within it and should reduce the stray current impacts of the electric barrier. This feature provides a platform from which to test new controls and, if appropriate, to install future controls.

#### *Smooth Channel Surface*

An engineered channel would provide a smooth surface environment where underwater monitoring would improve in comparison with current conditions of the Brandon Road downstream approach channel. Fish and other ANS would have fewer places to hide and would be less sheltered from ANS controls in a smooth surface environment. After maintenance or malfunction of ANS controls, a smooth channel and regular channel configuration would allow nets to hug channel sides, improving the effectiveness and efficiency of fish clearing. The current sediment accumulation in the channel is, in part, attributed to the deterioration of bedrock and channel banks. Lining the downstream approach channel is anticipated to reduce sediment accumulation within the channel. It is uncertain whether sediment accumulation would impact ANS control performance; however, these features are currently inset into the channel bottom. To ensure possible future costs are captured, sediment removal is included as an OMRR&R cost (Section 9.9).

#### *Housing and Protection of Engineered Measures*

ANS controls installed within the channel bottom would be protected from debris and passing vessels. Controls would be inset into the channel bottom to minimize damage from debris dragged by vessels, debris that travels through the lock, and propeller projectiles. Power and supply lines would run through pipe chases embedded in the concrete. Engineered channel walls would protect these lines from the impact of vessels traveling along channel walls. By protecting the equipment and the supply lines, the engineered channel provides an environment that ensures the reliability of ANS controls. In turn, this design minimizes shutdowns for maintenance, increasing the reliability of Brandon Road Lock.

#### *Insulated Walls and Floors*

In the vicinity of the electric barrier, the engineered channel walls and floor would include and protect the electrical insulation. The insulation would minimize stray current produced from the electric barrier would lower the risk of safety impacts on lock staff and navigators. By reducing stray current, the insulated walls and floor also reduce the required distance between the electric barrier and other ANS controls to maximize the Recommended Plan’s effectiveness.

### *Channel Design*

The engineered channel design provides for a uniform water depth, which is important for the acoustic and air bubble curtain design and for effective operation. For the electric barrier, the most effective area is the area immediately above the electrodes; however, placing the electrodes in shallow water increases the safety risk to lock staff and navigators.

### *Navigational Improvements*

The engineered channel may also aid navigation by increasing the length of approach guide wall. With a longer approach wall, tows would be able to line up with the lock entrance earlier than the previous guide wall, thereby possibly decreasing the time necessary to enter the chamber safely.

## ES.11.2 Implementation Strategies

Implementation and construction assumptions were based on the best-available information from engineering. The structural measures require further development and design during the PED phase of the project. See Appendix H, Section H.2, Recommended Plan, for more information regarding PED. The approach of the Recommended Plan was to minimize impacts on navigation during construction. This reduced the duration of construction and compressed the overall schedule. Therefore, the schedule includes overtime, shift work, and revised construction sequencing to minimize impacts on navigation and to take advantage of the two scheduled IWW maintenance closures, from July to October of 2020, and from July to September of 2023. As the study continues, the construction schedule would be adjusted to align with progress made during PED and the IWW lock closures to minimize impacts on navigation. Two implementation strategies are presented: an expedited implementation strategy and the incremental implementation strategy.

### *Expedited Implementation Strategy*

Initial risk reduction is the implementation of nonstructural controls upon project authorization and funding. The structural control features would be implemented as soon as possible. The construction schedule takes advantage of maintenance work scheduled to close locks on the IWW, outside of the GLMRIS-BR project – July 2020 to October 2020 and July 2023 to September 2023 – to minimize impacts on navigation. For more information regarding construction sequencing, refer to Section 9.4, where a construction schedule is presented, and to Appendix I, Cost. Construction is estimated to be completed by 2027.

### *Incremental Implementation Strategy*

The second construction strategy is an incremental implementation strategy with three construction increments. Initial risk reduction is the implementation of nonstructural measures upon project authorization and funding. The three construction increments are the following:

- Risk-Reduction Increment 1 includes blasting of the approach channel bottom, constructing the facility support building, air bubble curtain, narrow speaker array, upstream boat launch and associated engineered channel, as well as outfitting the facility support building so the air bubble curtain, and narrow speaker array are functional (Figure ES-8). Construction would start in calendar year 2020.

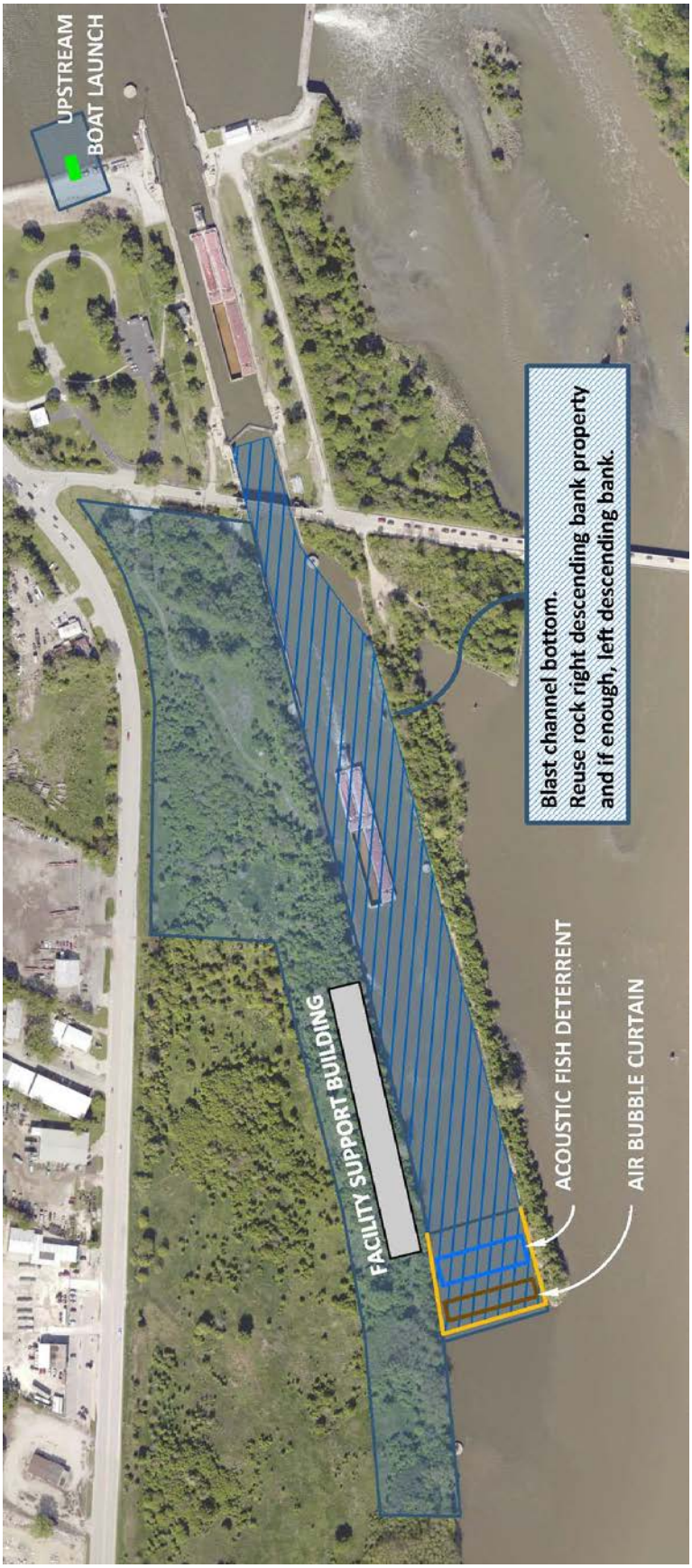


**Figure ES-8 Construction Risk-Reduction Increment 1**

- Risk-Reduction Increment 2 is the construction of the flushing lock, electric barrier, wide speaker array, downstream boat launch and the associated engineered channel, as well as constructing the engineered channel's right descending bank wall so it connects with the lock's long wall along the right descending bank (Figure ES-9). Construction would start in calendar year 2022.

- Risk-Reduction Increment 3 includes completing the engineered channel (Figure ES-10). Construction would start in calendar year 2023.

A parametric estimate based on the expedited implementation schedule was completed to provide an approximate estimate for each increment. A complete resourced estimate that includes a construction schedule would be completed prior to study completion.

## ES.12 Mitigation

A mitigation plan was developed in response to information received after the public review of the draft feasibility report and environmental impact statement. The GLMRIS-BR project (Recommended Plan) would result in loss of longitudinal connectivity between the upper and lower Des Plaines River for native fish and mussel species, and change the original fabric of the BRLD Historic District, which is listed in the *National Register of Historic Places*. In regard to loss of longitudinal connectivity and mitigation for this unavoidable adverse impact, USACE would trap and transport native fish species around the Brandon Road Dam and monitor to ensure that fish are responding as expected after the first year of transfer. For a more detailed discussion on aquatic resource impacts and mitigation, refer to Chapter 7, Impacts of the Final Array of Alternative Plans of the main report; Appendix A, Fish and Wildlife Coordination Act Report (FWCAR); and Appendix N, Mitigation Plan.

## ES.13 Historic Properties Compliance

Due to implementation of the Recommended Plan, there would be changes to the original fabric of the BRLD Historic District. The Illinois State Historic Preservation Office has agreed to a conditional no-adverse effect to structures listed in the *National Register of Historic Places* at BRLD contingent upon the publication of a history of navigation on the IWW. For a more detailed discussion on cultural and archeological resources effects, refer to Chapter 7, Impacts of the Final Array of Alternative Plans, in the main report.

## ES.14 Performance Monitoring and Adaptive Management

Performance monitoring includes two types of monitoring: biological monitoring of the fish populations below BRLD and their response to the Recommended Plan, and monitoring the measures to determine whether the measures are performing as designed (i.e., whether the electric barrier is producing the desired field strength in the water, whether the speakers are producing the desired characteristics of the acoustic fish deterrent in the water column). Adaptive management allows the Recommended Plan to be modified in response to performance monitoring results to maximize the plan's effectiveness and reduce its impact on waterway uses and users. Performance monitoring and adaptive management would occur within 10 years of project implementation. Refer to Chapter 9, Description of the Recommended Plan, of the main report for a complete discussion on performance monitoring and adaptive management.

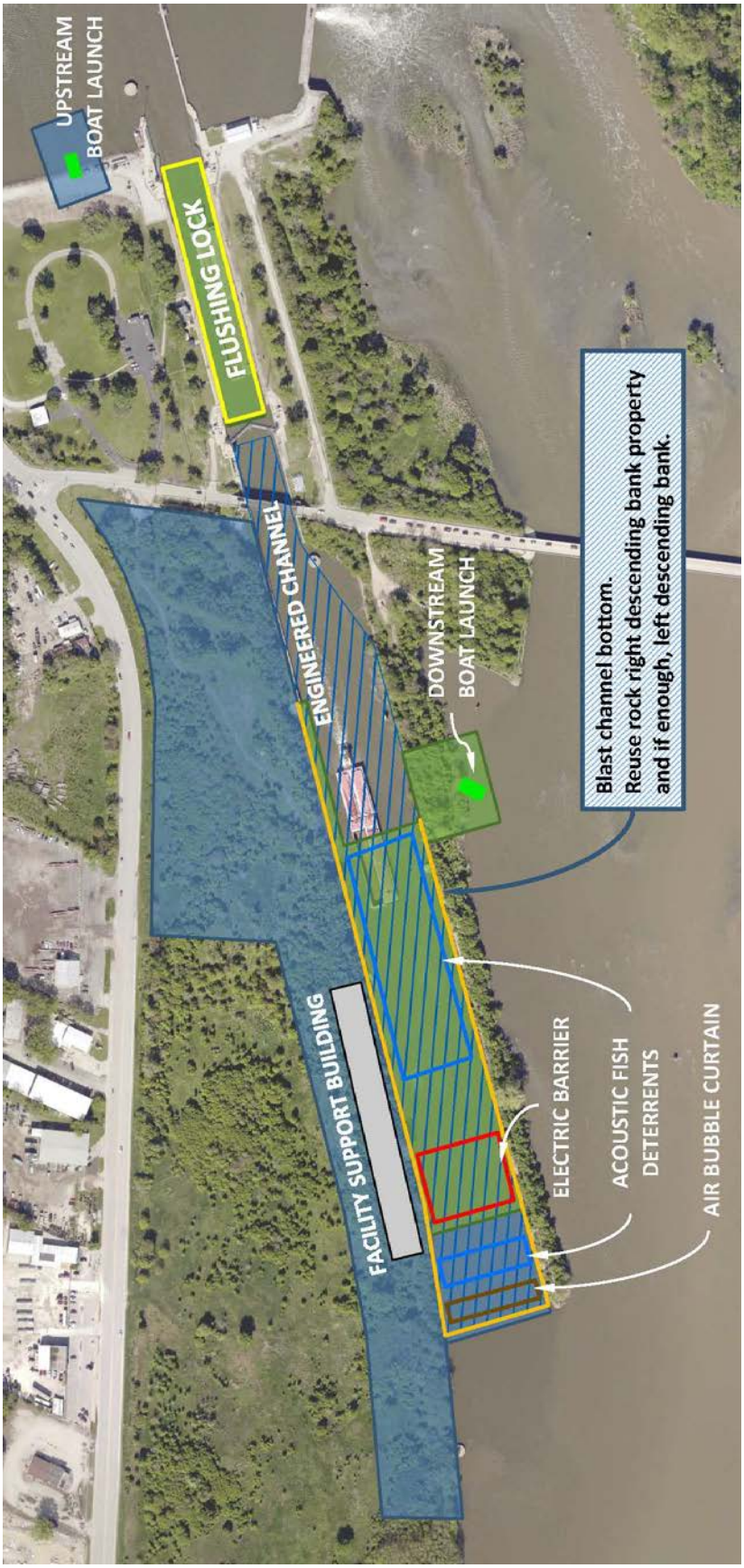


**Figure ES-9 Construction Risk-Reduction Increment 2**

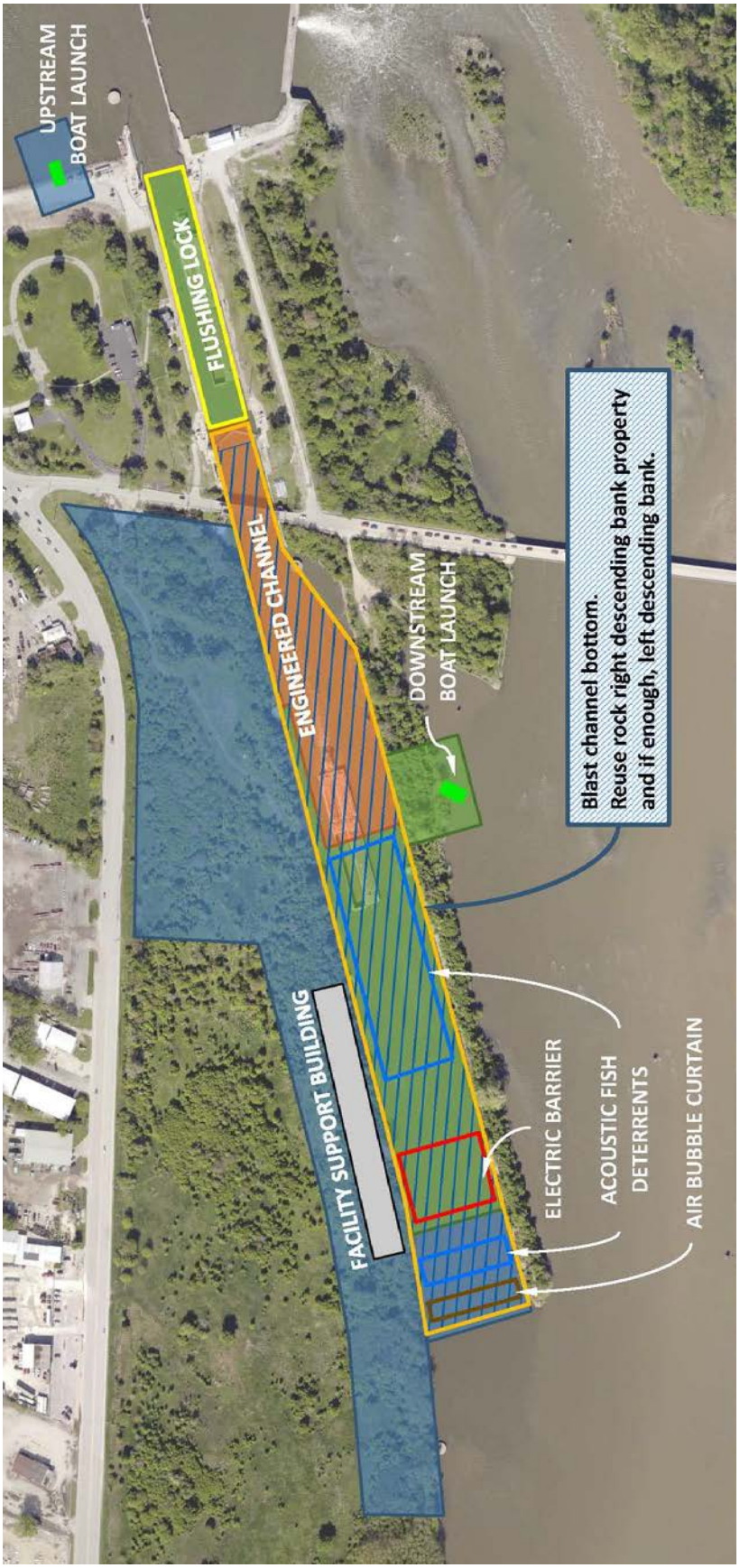


**Figure ES-10 Construction Risk-Reduction Increment 3**

## ES.15 Future Technologies

Much research continues, in particular for swimming ANS. The collaborative research efforts of Federal and state agencies, universities, nongovernmental organizations, and private industry continue the development and testing of new and innovative barrier technologies and monitoring, which has expanded the possibilities for controlling invasive species in the future.

The Recommended Plan includes an engineered channel that provides a platform to field-test future technologies in a navigation channel prior to full-scale deployment, as well as the opportunity to replace or update planned features or add new ANS controls as control technologies become mature or other conditions change. Field-testing or implementation would be subject to required environmental analysis. Proposed modifications to the engineered channel by others, in order to test or add new technologies, would be subject to Section 408 (33 USC §408) analysis. To address the evolving nature of ANS control technologies, USACE recommends, as part of this report, that USACE be authorized to study and implement options and technologies that improve the efficacy of the ANS control measures at BRLD similar to the efficacy study authority associated with the CSSC-EB. Thus, the recommendation includes ongoing study and implementation of options and technologies that improve the efficacy of the ANS control measures at BRLD. This is similar to the CSSC-EB efficacy study (Section 3061(b)(1)(D) of WRDA 2007) and implementation authority in Section 1039(c) of the WRRDA of 2014, P.L. 113-121.

USACE would consider the implementation of new and emerging technologies during PED to ensure that the designed and constructed project includes effective and safe technologies that meet the project goals and objectives. In the future, USACE would work with sponsors, the interagency committee, and other interested parties to evaluate, select, and refine controls that would be further designed and tested for application within the project.

Technologies that may be considered for future implementation include those identified in the *Inventory of Available Controls for Aquatic Nuisance Species of Concern – Chicago Area Waterway System*, April 2012 (see http://glmris.anl.gov/documents/docs/ANS_Control_Paper.pdf), the controls identified through the State of Michigan's Great Lakes Invasive Carp Challenge, and controls implemented in the USFWS's Sea Lamprey Control Program.

## ES.16 Cost Apportionment and OMRR&R

USACE Headquarters directed the GLMRIS-BR team to develop a Federal plan for authorization that implements the structural measures of the Recommended Plan by USACE and the non-Federal sponsor. The non-Federal sponsor for the GLMRIS-BR project is the State of Illinois. The responsibilities for the execution of the nonstructural measures would be shared between USACE and Department of the Interior.

Per Section 210 of the Water Resources Development Act of 1996 (33 USC §2213[c][7]), the non-Federal share of the implementation costs for ecosystem restoration/protection projects is 35% of the project unless project authorization specifies otherwise. The non-Federal share includes PED, implementation, construction management, engineering and design during construction (EDDC), and project management costs (Table ES-2). The non-Federal sponsor shall provide 100% of the lands, easements, rights-of-way, relocations, and disposal areas (LERRDs) and OMRR&R. The value of LERRDs shall be included in the non-Federal 35% share. Refer to Chapter 9, Description of the Recommended Plan, of the main report for a complete discussion on cost apportionment for the Recommended Plan and explanation of project cost increases.

Water Resources Development Act of 2018, H.R. 3021, 115th Cong. § 1142 (2018) clarifies that operation and maintenance of any project authorized under the Chief's Report for the Brandon Road Study is done at an 80/20 Federal/non-Federal cost share and requires consultation with the governor of the state in which a construction project is authorized and built under the report, prior to implementing any additional technologies.

USACE coordinated with the Department of the Interior on the implementation of nonstructural measures that are non-project costs. In the spirit of shared responsibility, the Department of the Interior would implement these important measures, which would increase the effectiveness of the Recommended Plan. The authorization should require the Department of the Interior to implement the nonstructural measures identified in the Recommended Plan.

**Table ES-2 Cost Apportionment of the Recommended Plan**

| Contributor | Estimated Project First Costs[a] |
|---|---|
| **Recommended Plan** | |
| **USACE (65%)** | **$505,593,000** |
| **Non-Federal (35%)** | **$272,243,000** |
| **Total Federal Contribution** | **$505,593,000** |
| **Total Non-Federal Contribution** | **$272,243,000** |
| **Cash** | **$268,931,000** |
| **LERRDs** | **$3,312,000** |
| **Total Project First Costs** | **$777,836,000** |
| | |
| **Nonstructural Measures (Equivalent Aver. Annual Cost)[b]** | |
| **Project** | |
| **USACE** | **$325,000** |
| **Non-Federal Sponsor** | **$175,000** |
| **Not Project Costs** | **$11,822,000** |
| **Department of the Interior** | |
| **Total Nonstructural Measures[b]** | **$12,322,000** |
| | |
| **OMRR&R (Equivalent Ave. Annual Cost) [c]** | |
| **OMRR&R** | |
| **USACE** | **$6,176,000** |
| **Non-Federal** | **$1,537,000** |
| **Total OMRR&R [c]** | **$7,713,000** |

[a] Costs are presented at FY19 price level and rounded to nearest thousand. Equivalent average annual costs were estimated using base yr of FY21 and 50-yr period of analysis.

[b] Nonstructural measures commence in 2021. USACE's portion pertains to monitoring of the control point. The annual estimate will be cost-shared 65% fed and 35% non fed. Equivalent average annual costs were estimated using a base yr of FY21, 50-yr period of analysis, and the FY19 fed discount of 2.875%.

[c] OMRR&R activities assumed to commence in FY28. Pursuant to Water Resources Development Act of 2018, H.R. 3021, 115th Cong. § 1142 (2018), these costs are 100% fed for flushing lock, and 80% fed and 20% non-fed for the remaining features. Equivalent average annual costs were estimated using a base yr of FY21, 50-yr period of analysis, and FY19 fed discount of 2.875%.

**Table ES-3 Parametric Cost Estimate of Incremental Implementation**

| Increment | Parametric Cost Estimate |
|---|---|
| **1** | **$221,881,00** |
| **2** | **$490,509,000** |
| **3** | **$119,881,000** |
| **Total** | **$832,271,000** |
| **Nonstructural Measures (Equivalent Average Annual Cost)[b]** | |
| **Project**<br>**USACE**<br>**Non-Federal sponsor** | <br>**$325,000**<br>**$175,000** |
| **Not Project Costs**<br>**Department of the Interior** | **$11,822,000** |
| **Total Nonstructural Measures[b]** | **$12,322,000** |
| **OMRR&R (Equivalent Average Annual Cost) [c]** | |
| **USACE**<br>**Non-Federal** | **$6,176,000**<br>**$1,537,000** |
| **Total OMRR&R** | **$7,713,000** |

[a] All costs are presented at the FY19 price level and rounded to the nearest thousand. Equivalent average annual costs were estimated using a base yr of 2021 and a 50-yr period of analysis.

[b] Nonstructural measures commence in 2021. USACE's portion pertains to monitoring of the control point. That yearly estimate will be cost-shared 65% fed and 35% non-fed. Equivalent average annual costs were estimated using a base yr of FY21, 50-yr period of analysis, and the FY19 fed discount of 2.875%.

[c] OMRR&R activities assumed to commence in FY28. Pursuant to Water Resources Development Act of 2018, H.R. 3021, 115th Cong. § 1142 (2018)OMRR&R costs are 100% fed for the flushing lock, and 80% fed and 20% non-fed for the remaining features. Equivalent average annual costs were estimated using a base yr of FY21, 50-yr period of analysis, and FY19 fed discount of 2.875%.. See Table ES-2 for breakdown.

## ES.17 Milestone Schedule and Procedures

The current schedule for completing the feasibility report is as follows:

- State and Agency Review begin November 2018
- Chief's Report Milestone February 2019

Upon completion, the Report of the Chief of Engineers would also be submitted to Congress for authorization. If Congress makes funds available, PED can begin. The report would also be reviewed by the Office of the Assistant Secretary of the Army (Civil Works) and the Office of Management and Budget for potential inclusion in future administration budget requests. Refer to Chapter 9, Description of the Recommended Plan, of the main report for a complete discussion on milestone schedule and procedures.

## ES.18 Unresolved Issues and Areas of Controversy

Refer to Appendix P, Comment Response Document, for a complete discussion on unresolved issues and areas of controversy that were received during the Draft Report NEPA public comment period. The USACE received over 1,400 comment submittals, both written and oral, on the Draft Report, representing about 1,730 individuals and organizations. Comments were received that supported action being taken; however, there were also comments received expressing concerns about the project and its features. Key

issues included in the public comments are desire for phased implementation of project features, safety concerns, project impacts on the natural environment, impacts of MRB ANS on the GLB, economic impacts of the project on navigation during construction and operation, project's failure to address two-way transfer, desire for replacing the existing 600-ft lock BRLD with a 1,200-ft lock and for adding more or different controls, desire to eliminate all structural control measures, lengthy project schedule, and high project costs. The USACE summarized the public comments that were received and developed responses (refer to Appendix P, Comment Summary Report). No significant comments were received during the public review period of the Draft Report that significantly changed the report or the Recommended Plan.

Implementation of the Recommended Plan would require the construction of upland support facilities on an adjacent parcel of land. The parcel, which appears to be an ideal construction site, has an uncertain use history and may be subject to regulatory action or remediation. Testing would be required to fully characterize the site and any constraints on site usage for the project.

### ES.18.1 Environmental Conditions of Real Estate

The current plan sites certain project features on the right descending bank of the channel. If future investigation indicates historic uses preclude use of the property, then siting of the project on the left descending bank would be reevaluated.

### ES.18.2 Mitigation Requirements

USACE identified the least-cost mitigation plan that provides full mitigation of losses specified in mitigation planning objective as required in policy (USACE 2000). The mitigation objective for this project is 115 habitat units. The selected mitigation alternative offsets the loss of these 115 habitat units with the restoration of 123 net average annual habitat units at an average annual cost of $133,000. The cost of mitigation ($6,635,000) is greater than what was presented in the draft report ($2,200,000) after USACE factored in the impacts identified in the FWCAR (Appendix A). The USFWS weighed the pros, cons, and uncertainties relative to fish and wildlife losses of the USACE mitigation approach with the draft USFWS recommended mitigation measures presented in the FWCAR (Appendix A). USACE was unable to use USFWS' draft mitigation recommendations because they were not compliant with USACE policy.

### ES.18.5 Optimization of Flushing Lock Operation

A three-dimensional numerical model of the flushing lock was developed during the feasibility study; results determined that a flushing lock at BRLD is implementable. During PED, a physical model of the flushing lock would further aid in the determination of whether valves need to be replaced or redesigned, flushing duration, and inform estimates of potential navigation impacts. In addition, the physical model would determine whether it would be safe to flush the lock chamber with vessels tied off inside the chamber and would determine the impacts of flushing with various tow configurations and recreational vessels. USACE regulations require physical models for lock designs that do not follow the design criteria directly (Engineering Manuals 1110-2-1604 and 1110-2-2602).

### ES.18.6 Minimizing Impacts on Navigation during Construction of Recommended Plan

To better inform the construction schedule and associated navigation restrictions, additional engineering and economic analysis, safety testing, and coordination with navigation stakeholders and the USCG would be completed as the study continues and during the PED phase. If possible, construction activities would be scheduled to coincide with other scheduled waterway maintenance in order to minimize impacts on navigation.

The USACE Rock Island District is planning for a series of lock maintenance events that are to commence in year 2020. The projected lock maintenance schedule is summarized as follows:

- In 2020, the LaGrange, Peoria, Starved Rock, and Marseilles Locks will be closed for 90 days (or up to 120 days) to facilitate maintenance construction activities.

- Starting on July 1, 2020, Dresden Island and Brandon Road Locks will have channel width restrictions to facilitate construction; this will be followed by a 2-week lock closure.

- In 2023, Dresden Island and Brandon Road Locks will be closed for 90 days to facilitate construction activities.

IWW lock maintenance projections are relevant to the waterway users of Brandon Road Lock. The vast majority of the movements transiting Brandon Road Lock also transit Lockport and LaGrange locks. The tonnage transiting both Brandon Road and Lockport Locks in years 2012 to 2016 was about 96%, while the tonnage transiting both Brandon Road and La Grange Locks in years 2012 to 2016 was about 80% (Waterborne Commerce Statistics). See Appendix D, Economic Analyses, for more information. See Figure 9-6 for the IWW maintenance closures, estimated GLMRIS-BR construction schedule, and impacts on navigation.

## ES.18.7 Additional Navigation Considerations

The navigation community has expressed four main concerns. USACE has identified a plan to further address these concerns during PED:

1. *Navigation Impact Estimates.* The navigation community has expressed concern about whether USACE adequately estimated the economic impact on navigation to inform an evaluation of alternatives and selection of the Recommended Plan.

   USACE used the best available engineering and economic information to estimate economic impacts of the alternative. Information was incorporated from the following sources: USACE navigation databases (e.g., Waterborne Commerce Statistics Center; Lock Performance Management System), Agency-certified economic models, responses to shipper and carrier surveys administered for both GLMRIS and GLMRIS-BR studies, information gathered from the USCG and navigation stakeholders during the GLMRIS-BR safety workshop, and other informative data sources. During PED, USACE would continue to coordinate with navigation stakeholders to identify opportunities to maximize effectiveness of the recommended plan while minimizing impacts on navigation. The estimated impacts on navigation due to the Recommended Plan estimates would also be updated during PED to reflect more detailed engineering analysis.

2. *Safety Implications of Operating the Recommended Plan, in Particular the Electric Barrier.* The navigation community has expressed concern over the safety impacts of adding ANS control features to the downstream approach channel, in particular an electric barrier.

USACE in coordination with USCG would conduct an evaluation of the ANS control measures included in the Recommended Plan. The evaluation results and input gained through coordination with the navigation community would inform operating parameters and safety protocols for the control measures.

3. *Impacts the Recommended Plan May Have on the BRLD Infrastructure*. The navigation community has expressed concern over whether the operation of the Recommended Plan could affect the current infrastructure of the BRLD, which may decrease its reliability.

   During the feasibility study, USACE performed an engineering assessment of the potential corrosion impacts the electric barrier could have on the BRLD. The assessment identified that with increased monitoring, potential impacts could be mitigated. The design of the Recommended Plan provides for insulation in the engineered channel to limit stray current impacts on the lock. See Appendix H, Engineering, for more information.

USACE would continue to coordinate with navigation stakeholders during PED to identify opportunities to maximize effectiveness of the Recommended Plan while minimizing impacts on navigation.