1/6/2010

Dispersal Barrier Efficacy Study

INTERIM I – Dispersal Barrier Bypass Risk Reduction Study & Integrated Environmental Assessment

January 2010

FINAL REPORT

US Army Corps
of Engineers®
Chicago District

Executive Summary

The fish electrical dispersal barrier system (Barriers I, IIA, & IIB) is a unique project that significantly reduce the risk of an inter-basin transfer of Aquatic Nuisance Species (ANS) fish between the Mississippi River and Great Lakes basins via the Chicago Sanitary and Ship Canal (CSSC). The project authority was clarified and expanded in WRDA 2007, Section 3061 (b)(1)(D) and directed the US Army Corps of Engineers (USACE) to conduct a study of a range of options and technologies for reducing impacts of hazards that may reduce the efficacy of the barriers. USACE divided the focus of investigations into four major areas: ANS Barrier Bypasses, Optimal Operating Parameters of the Barriers, ANS Human Transfer and ANS Abundance Reduction.

In the summer of 2009, USACE began employing a new monitoring method, Environmental-DNA (eDNA), which identified potential locations of Asian carps much further upstream in the CSSC than previously thought. In response to eDNA testing results that indicate Asian carps may potentially be one mile south of the barrier system within the CSSC and located in both the Des Plaines River and Illinois & Michigan (I&M) Canal, Congress included a new authority within the Section 126 of the Energy and Water Development Appropriations Act of 2010, P.L. 111-85. This new authority directs the Secretary of the Army to implement measures recommended in the efficacy study, or provided in interim reports, authorized under section 3061 of the Water Resources Development Act of 2007 (121 Stat. 1121), with such modifications or emergency measures as the Secretary of the Army determines to be appropriate, to prevent aquatic nuisance species from bypassing the Chicago Sanitary and Ship Canal Dispersal Barrier Project referred to in that section and to prevent aquatic nuisance species from dispersing into the Great Lakes.

Interim I study investigates emergency measures (various structures and no action) that reduces risk of the Asian carps bypassing the Dispersal Barrier vis-à-vis overland flow from the Des Plaines River to the CSSC and flow through culverts in the I&M Canal to the CSSC. The emergency measures would need to be implemented as soon as possible, but no later than 28 October 2010, based on the project authorization. In addition, preliminary discussions are included on the possibilities of transfer via ballast water of navigational vessels that traverse through the dispersal barrier and Asian carps abundance reduction. These additional areas of study will be further expanded upon in subsequent Interim Reports. These discussions are located in Appendix E.

An Interim report will document investigations into optimal parameters for operating the electric field of the Dispersal Barriers and will recommend the best settings to deter both adult and juvenile Asian carps. The District will implement the recommended operating parameter as part of the Barrier Project's operation and maintenance in the near term.

Another Interim Report will include a recommendation for a permanent solution to Dispersal Barrier bypass. The implementation of additional dispersal barriers or other physical features to further reduce the risk associated with physical bypass will be a focus of this efficacy study, which will require Congressional authorization and appropriations for implementation. This report will provide a summary of all interim reports completed to date and recommend a long-term, multi-agency comprehensive strategy for improving the efficacy of the dispersal barriers and reducing the population effects of Asian carps within the Illinois River system. The long-

term strategy will be coordinated with other agencies and concerned stakeholders that can contribute to efforts related to the reduction of Asian carps in the Illinois River System and CSSC. Additional studies may be undertaken in the future as technologies to address ANS species evolve, to ensure that the Barriers project continues to function to keep ANS fish species from entering the Great Lakes basin.

Interim Risk Reduction Emergency Measures Considered

A USACE Project Delivery Team (PDT) evaluated risk reduction measures that could serve as a physical barrier to the passage of ANS fish, specifically Asian carps from the Des Plaines River overland to the Chicago Sanitary and Ship Canal. Due to the high levels of concern of fish bypass during wet weather the team considered measures traditionally employed for advance flood-fighting, as well as non-traditional measures that would serve as an effective barrier to minimize the risk of carp movement via the Des Plaines bypass. The measures considered, are as follows:

1. No Action – Maintains the status quo and would most likely allow for the Asian carps to bypass the barrier system.

2. Gabion Baskets – Stacked Gabion baskets made of galvanized wire mesh and filled with stone could be utilized. Typical dimensions of a single basket are 3'x3'x6' with 3"x3" openings in the wire mesh. They can be constructed at the project site and stacked as necessary to the desired height. The current estimate assumes the gabion baskets would be filled with rip rap. The topsoil will be stripped and a 6" layer of compacted gravel will be placed prior to placement. This option likely has the longest installation time of the all the barrier options. The gabion baskets would become impermeable over time as they filled with silt, debris and vegetation.

3. Concrete Barricades – Precast concrete barricades are an impermeable barrier. Typical dimensions are 2'-3" tall x 12'-6" long with a 1'-7 5/8" base width and 8" top width. Concrete barricades will be precast and delivered to the site. Barricades are available with male-female ends so that they can be fitted together to minimize flow between the barricades. The topsoil will be stripped and a 6" layer of compacted gravel will be placed prior to placement. Installation time is minimal, although lead time may be required. Placement of compacted gravel and fitted ends will minimize need for sandbags and plastic sheeting.

4. Rapid Deployment Flood Walls (RDFW's) – A RDFW is a modular, collapsible plastic grid that serves as a direct replacement for sandbag walls, which forms an impermeable barrier. Typical dimensions are 8" tall x 3'-6" long x 3'-6" wide. They are assembled in place to the desired height and then filled with sand. It can be assembled with minimal labor and filled with a loader. The topsoil will be stripped and a 6" layer of compacted gravel will be placed prior to placement. Although this feature is typically dismantled after the flood risk is gone, in this application, the RDFW would remain in place until a permanent solution to fish bypass is implemented.

5. Concrete Blocks – Concrete blocks are an impermeable barrier. Typical dimensions vary depending on the height. Concrete blocks will be precast and delivered to the site. The topsoil will be stripped and a 6" layer of compacted gravel will be placed prior to placement. Installation time is minimal, although lead time may be required.

6. Chain Link Fencing – Chain link fence is a permeable barrier. Typical dimensions of a section of fence are 6' long by either 4', 6' or 8' tall. It would consist of 6 gauge galvanized wire steel mesh with 1/4" openings. Fence posts will be four inches in diameter galvanized steel and will be set four feet into the ground into a twelve inch diameter concrete post hole. The posts will be spaced six feet on center. In areas where bedrock exists at the surface, the bedrock will be drilled to accommodate the post holes. The 6' & 8' tall fence will have three rails (top, middle, bottom) horizontally between the fence posts and the 4' tall fence will only have two (top & bottom). Rails will be 1 5/8" diameter galvanized steel pipe. This is not a tried and true method for excluding fish, but theoretically it can stop the dispersal of Asian carps as long as the structural integrity of the fence is maintained. An angled non-barbed wire extension will be placed atop of the fence to thwart leaping silver carp. Issues that may arise from using the fence include vandalism and breakage, clogging with riverine debris and scouring at the base. Continual maintenance would need to be performed to remove clogs and to ensure that if fence cutting occurs, it is quickly mended. Installation time is long and lead time will be necessary because the current robust design of the fence requires materials in massive quantities that will not be found in stock. Riprap will be placed along the bottom fence rail in areas where scour could be an issue during a major flood event.

7. Culvert Blocking – The recommended near term solution for the I&M Canal potential bypass, after preliminary H&H analysis, is to block off the I&M Canal at Cico Road and slip line (reduce the roughness of the pipe by inserting a PVC pipe in the existing culvert) and add inlet transitions to the International-Matex Tank Terminals (IMTT) culverts. The hydrologic flow divide is located just east of Cico Road, so placing a barrier here would not affect stormwater flows or induce flooding. Inclusion of additional freeboard will be evaluated during detailed design and floodway permit process.

8. Chain Link Fence & Concrete Barricade Combo / Block I&M Canal – Optimized combination of concrete barricade and chain link fence with ¼" openings for the Des Plaines bypass, and culvert blocking to address the I&M Canal bypass.

Preferred Risk Reduction Measure

It is the Interim I Report's recommendation to implement the optimized interim risk reduction measure as a temporary and emergency solution. The preferred risk reduction measure is to place 34,600-feet of Concrete Barricades and 33,400-feet of Chain Link Fence with ¼" openings. The total project cost of this IRRM is currently estimated to be $13,174,000. The implementation of this measure would protect 68,000-feet (~13-miles) of flood prone area along the CSSC upstream of the Dispersal Barriers. Also, the two culverts under Cico Road in the I&M Canal will be disabled and the flow capacity increased at the IMTT culverts.

Dispersal Barrier Efficacy Study
INTERIM I – Dispersal Barrier Bypass Risk Reduction Study

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CHAPTER 1 – Introduction

1.1 – Dispersal Barrier Efficacy Study

The fish dispersal barrier project represents a unique, but temporary solution to an imminent threat: the risk of an inter-basin transfer of fish between the Mississippi River and Great Lakes basins. The dispersal barriers were designed and constructed to reduce this risk of inter-basin transfer of fish via the Chicago Sanitary and Ship Canal (CSSC).

Although the dispersal barriers were designed to prevent the movement of any Aquatic Nuisance Species (ANS) fish species in either direction through the canal, the current species of concern are the Asian carp (Cypriniformes: Cyprinidae). Asian carp have the potential to damage the Great Lakes and confluent large riverine ecosystems by disrupting the complex food web of the system and causing damage to the $8 billion/year sport fishing industry. Two species of Asian carp, bighead carp (*Hypophthalmichthys nobilis*) and silver carp (*H. molitrix)*, have become well established in the Mississippi and Illinois River systems exhibiting exponential population growth in recent years. Certain life history traits have enabled bighead and silver carp to achieve massive population numbers soon after establishing. Currently, the Illinois River is estimated to have the largest population of bighead and silver carp in the world. The prevention of an inter-basin transfer of bighead and silver carp from the Illinois River to Lake Michigan is paramount in avoiding ecologic and economic disaster.

This Interim Report (Interim I- Dispersal Barrier Bypass Risk Reduction Study & Integrated Environmental Assessment) investigates emergency measures (various structures and no action) that reduces risk of the Asian carps bypassing the Dispersal Barrier vis-à-vis overland flow from the Des Plaines River to the CSSC and flow through culverts in the Illinois and Michigan (I&M) Canal to the CSSC. The emergency measures would need to be implemented as soon as possible, but no later than 28 October 2010, based on the project authorization. In addition, preliminary discussions are included on the possibilities of transfer via ballast water of navigational vessels that traverse through the dispersal barrier and Asian carps abundance reduction. These additional areas of study will be further expanded upon in subsequent Interim Reports. These discussions are located in Appendix E.

An additional Interim report will document investigations into optimal parameters for operating the electric field of the Dispersal Barriers and will recommend the best settings to deter both adult and juvenile Asian carps. The District will implement recommended operating parameters as part of the Barrier Projects operation and maintenance in the near term.

The last Interim Report planned for completion in 2010 will include a recommendation for a permanent solution to Dispersal Barrier bypass. The implementation of additional dispersal barriers or other physical features to further reduce the risk associated with physical bypass will be a focus of this efficacy study, which will require Congressional authorization and appropriations for implementation. This report will provide a summary of all interim reports completed to date and recommend a long-term, multi-agency comprehensive strategy for improving the efficacy of the dispersal barriers and reducing the population effects of Asian carps within the Illinois River system. The long-term strategy will be coordinated with other agencies and concerned stakeholders that can contribute to efforts related to the reduction of Asian carps in the Illinois River System and CSSC. Additional studies may be undertaken in the future as technologies to address ANS species evolve, to ensure that the Barriers project continues to function to keep ANS fish species from entering the Great Lakes basin.

This report presents the results of the Interim I Study for improving the Efficacy of the Fish Dispersal Barrier project and Ballast Water Transfer. This report consists of 7 parts including a main report and six appendices with figures and tables. The report is structured as follows:

- Main Report
- Appendix A – Hydrology & Hydraulics Analysis
- Appendix B – Geotechnical Analysis
- Appendix C – Civil Design / Cost Engineering
- Appendix D – Hazardous, Toxic, and Radioactive Waste (HTRW) Report
- Appendix E – Planning Information
- Appendix F – Real Estate

1.2 – Study & Implementation Authorities

There are 2 authorities being used for this Interim I Efficacy Report. The first authority is Section 3061(b)(1)(D) of the Water Resources Development Act of 2007 (P.L. 110-114) which is a study authority only. This authority does not authorize implementation of any study recommendations. The second authority is from Section 126 of the Energy and Water Appropriations Act of 2010 (P.L. 111-85) which provides authority to implement recommendations from the Interim I Efficacy Report. This report is only carrying out the first Interim study authorized by subparagraph (b)(1)(D) of Section 3061 and not any other section of the authority. The two authorities are quoted below.

WRDA 2007 SEC. 3061. CHICAGO SANITARY AND SHIP CANAL DISPERSAL BARRIERS PROJECT, ILLINOIS.

> (a) TREATMENT AS SINGLE PROJECT.—The Chicago Sanitary and Ship Canal Dispersal Barrier Project (in this section referred to as ''Barrier I''), as in existence on the date of enactment of this Act and constructed as a demonstration project under section 1202(i)(3) of the Nonindigenous Aquatic Nuisance Prevention and Control Act of 1990 (16 U.S.C. 4722(i)(3)), and the project relating to the Chicago Sanitary and Ship Canal Dispersal Barrier, authorized by section 345 of the District of Columbia Appropriations Act, 2005 (Public Law 108–335; 118 Stat. 1352) (in this section referred to as ''Barrier II'') shall be considered to constitute a single project.
> (b) AUTHORIZATION.—
> (1) IN GENERAL.—The Secretary, at Federal expense, shall—
>> (A) upgrade and make permanent Barrier I;
>> (B) construct Barrier II, notwithstanding the project cooperation agreement with the State of Illinois dated June14, 2005;
>> (C) operate and maintain Barrier I and Barrier II as a system to optimize effectiveness;
>> (D) conduct, in consultation with appropriate Federal, State, local, and nongovernmental entities, a study of a range of options and technologies for reducing impacts of hazards that may reduce the efficacy of the Barriers; and
>> (E) provide to each State a credit in an amount equal to the amount of funds contributed by the State toward Barrier II.

Energy and Water Development and Related Agencies Appropriation Act 2010. SEC. 126

> During the 1-year period beginning on the date of enactment of this Act, the Secretary of the Army shall implement measures recommended in the efficacy study, or provided in interim reports, authorized under section 3061 of the Water Resources Development Act of 2007 [121 Stat. 1121] with such modifications or emergency measures as the Secretary of the Army determines to be appropriate, to prevent aquatic nuisance species from bypassing the Chicago Sanitary and Ship Canal Dispersal Barrier Project referred to in that section and to prevent aquatic nuisance species from dispersing into the Great Lakes.

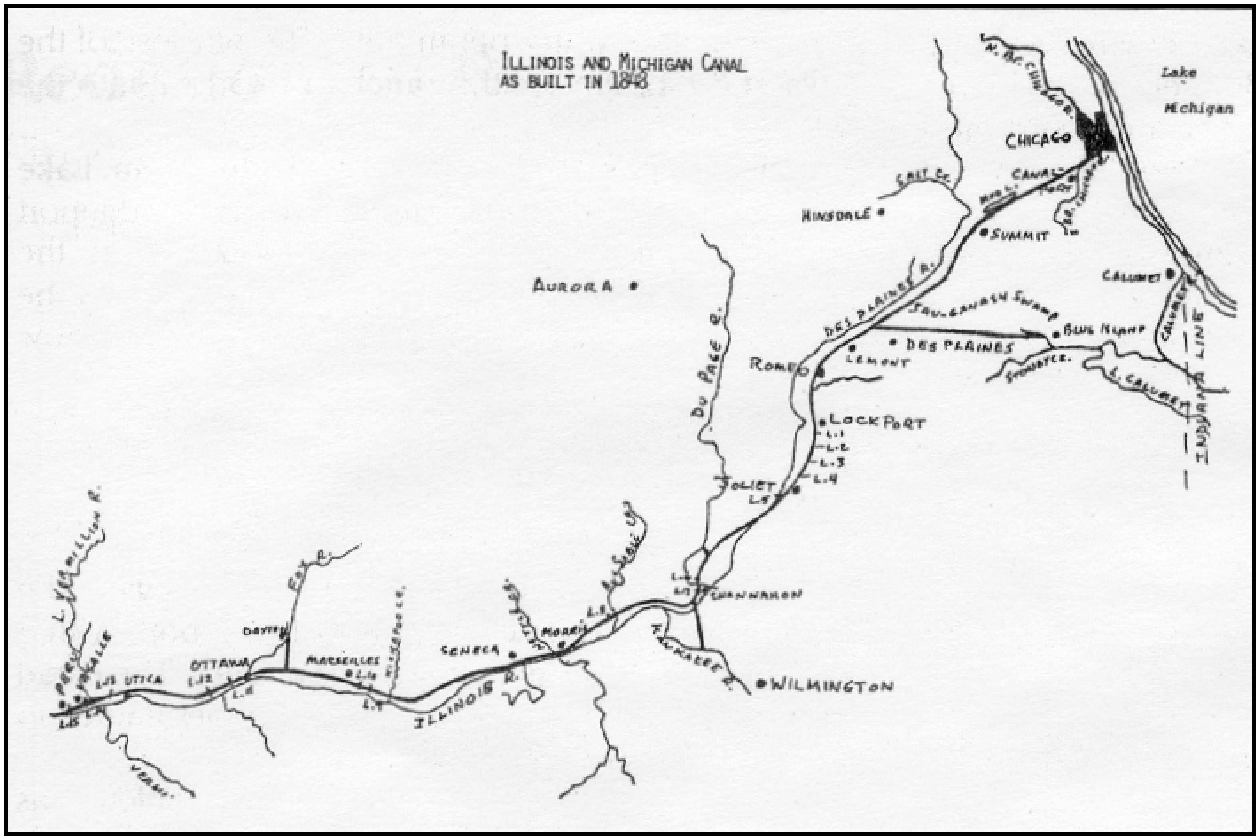
1.3 – Study Background

Prior to anthropogenic intervention, the Chicago and Calumet Rivers were essentially wetland complexes that sluggishly flowed east into Lake Michigan. The Des Plaines River naturally flowed west into the Mississippi River drainage. There were periods of high flow when the Des Plaines River changed its course and flowed into the Chicago and Calumet Rivers. Two critical locations existed, referred to as hydraulic divides, and known as Mud Lake and Saganashkee Slough. Sporadically, during spring floods, Mud Lake and the Saganashkee Slough would overflow into the West Fork of the South Branch of the Chicago River near Kedzie Avenue and the Little Calumet River near Blue Island. This flow reversal provided a temporary connection between the respective drainage basins.

The economic opportunity provided by this natural occurrence was seized in 1848 when completion of the Illinois and Michigan (I&M) Canal reversed the flow of the Chicago River for the most part (Figure 1). The dimensions of the original I&M Canal were 60-feet wide at the surface, 36-foot wide at the base, and 6-feet deep. Immediately after, in the spring of 1849, the Little Calumet River was connected to the Illinois and Michigan Canal via a 40-foot wide and 4-foot deep Calumet Feeder Canal, which ditched through the Saganashkee Slough. The I&M Canal gave way to a much larger Sanitary and Ship Canal started in 1892 that connected Lake Michigan with the Illinois Waterway. The permanent connection between the Lake Michigan and the Mississippi drainage was finalized with the completion of the Sanitary and Ship Canal in 1900. On the Calumet River, the Corps of Engineers removed sandbars and built piers at the mouth during 1870-1882; between 1888-1896 the river between Lake Michigan and Lake Calumet was straightened; between 1899 and 1916 the Calumet River was dredged to a depth of 16 feet; between 1911-1922 the Calumet Feeder Canal was obliterated by the construction of the Cal-Sag Channel, which was incised through a vast and unique dolomite prairie, formerly the Saganashkee marshland. With the completion of joining the Cal-Sag Channel with the Calumet River, the Calumet Region's drainage was chiefly reversed; and in 1965 the Calumet River was completely reversed by the construction of the O'Brien lock and dam near the original confluence with Lake Michigan. The I&M Canal is no longer in operation.

Since the creation of the canal system, poorly treated wastewater, low dissolved oxygen concentrations, high ammonia concentrations and other contaminants formed an effective "barrier" not only to colonization of the canal by native pioneer species, but to introduced species as well. Significant improvements in water quality over the last two decades have allowed the aquatic conditions in the canal to become accommodating for native and introduced species of the tolerant sort, which both share pioneering attributes.

Figure 1 - Map showing early configuration of the Chicago Waterway System as built in 1848.



There was inter-basin transfer of aquatic species between the Mississippi River and the Great Lakes naturally in the past after various glaciation events, which naturally drives speciation and biogeography; however the permanent man-made connection in conjunction with non-native species introduction (both accidentally and purposefully) poses a great threat to these processes. This was first realized for fish in the early 1990s when the introduced eastern European *Neogobius melanostomus* round goby and the Atlantic slope *Morone americana* white perch were found in southern Lake Michigan. In an effort to contain their range expansion, the Nonindigenous Aquatic Nuisance Prevention and Control Act of 1990 as amended by the National Invasive Species Act of 1996, authorized the Assistant Secretary of the U.S. Army Corps of Engineers (USACE) to examine potential methods to create an aquatic nuisance species dispersal barrier in the CSSC. In November 1997, Congress appropriated $500,000 to begin work on the project. In April 2002, the switch for an electrical barrier was turned on to attempt to prevent fishes from dispersing to and from the Great Lakes and Mississippi River basins after nearly 140 years of unnatural nexus. This dispersal barrier complex located at river mile 296.25 in the CSSC was to be the first stop gap measure to prevent the spread of ANS species. Unfortunately the round goby and white perch dispersed faster than anticipated and were well past the dispersal barrier site by the time construction was able to commence. The decision to construct the barriers was prudent since a new threat was imminent from the Mississippi River system – the Asian carps *Hypophthalmichthys molitrix* silver carp and *H. nobilis* bighead carp.

1.4 – Study Purpose

The Corps of Engineers was directed in WRDA 2007, Section 3061 (b)(1)(D) to conduct a study of a range of options and technologies for reducing impacts of hazards that may reduce the efficacy of the barriers. The Barriers Project Development Team (PDT) initially considered four general areas of evaluation that met the intent of the Congressional authorization. The four areas of study are: Optimal Operating Parameters, ANS Barrier Bypasses, ANS Human Transfer and ANS Abundance Reduction. This report will summarize the evaluation process for each of the four areas of interest identified by the PDT. Additional studies may be undertaken in the future as technologies to address ANS species evolve, to ensure that the Barriers project continues to function to keep ANS fish species from entering the Great Lakes basin.

The failure of the barriers to prevent the spread of the Asian carps to the Great Lakes could be catastrophic to its ecosystem and the planktonic-fisheries interactions. The rapid implementation of measures to ensure the Efficacy of the Dispersal Barrier project is critical. The design analyses contained in this report address the potential for bypass of the Barriers via: 1) overland flow from the Des Plaines River to the CSSC, 2) bypass through culverts via the I&M canal, and 3) ballast water transfer. The potential Des Plaines River and I&M Canal bypasses are located upstream of the Barriers. The intent of this report is consistent with the national plan for managing and controlling Asian carps, which was developed by the Asian Carp Working Group, Aquatic Nuisance Species Task Force. Strategy 3.2.2.1 of the National Plan states: (To) Develop and implement redundant barrier systems within the CSSC to limit the unrestricted access of Asian carp to Lake Michigan.

1.5 – General Study Area

The regional study area of fish dispersal includes the Mississippi River and Great Lakes basins, and the unnatural nexus created by man, which is known as the Chicago Waterway System (CWS) (Figure 2a). The general vicinity of the study area includes reaches of CSSC, Des Plaines River and I&M Canal that is centered at river mile 296.25, roughly 0.2 miles or 1300-feet upstream of the 135th Street Bridge in Romeoville, IL (Figure 2b & Plate 1). The site lies in the southeast ¼ of the southwest ¼ of section 35, T37N R10E, Lockport Township, in Will County. Adjacent property along this reach is owned by the Metropolitan Water Reclamation District of Greater Chicago (MWRDGC) and is leased to various governmental and industrial entities. The proposed site reach is industrialized and is heavily utilized by cargo barges.

Figure 2a – Regional Location of the Dispersal Barriers & Potential Bypass Sites.

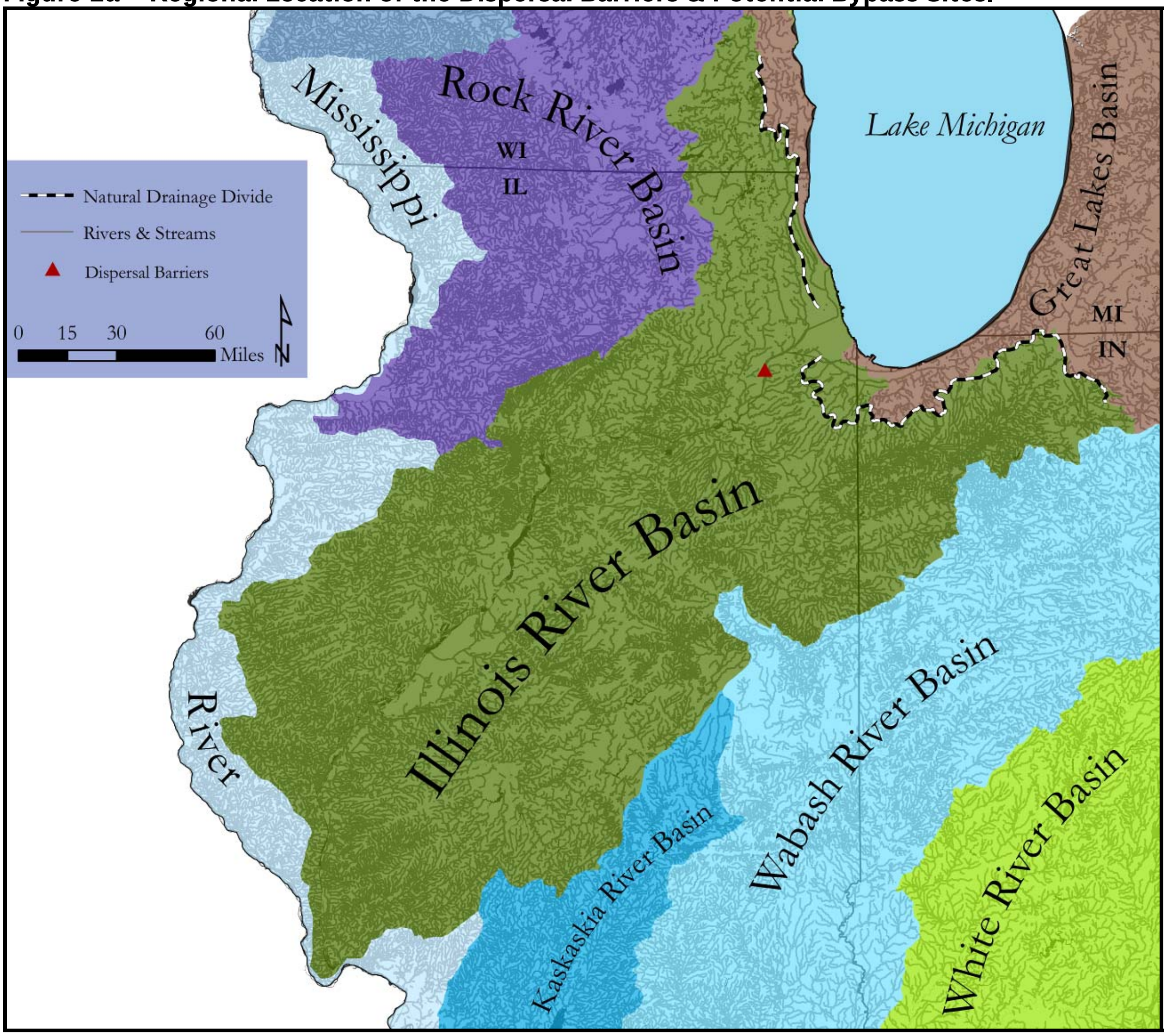
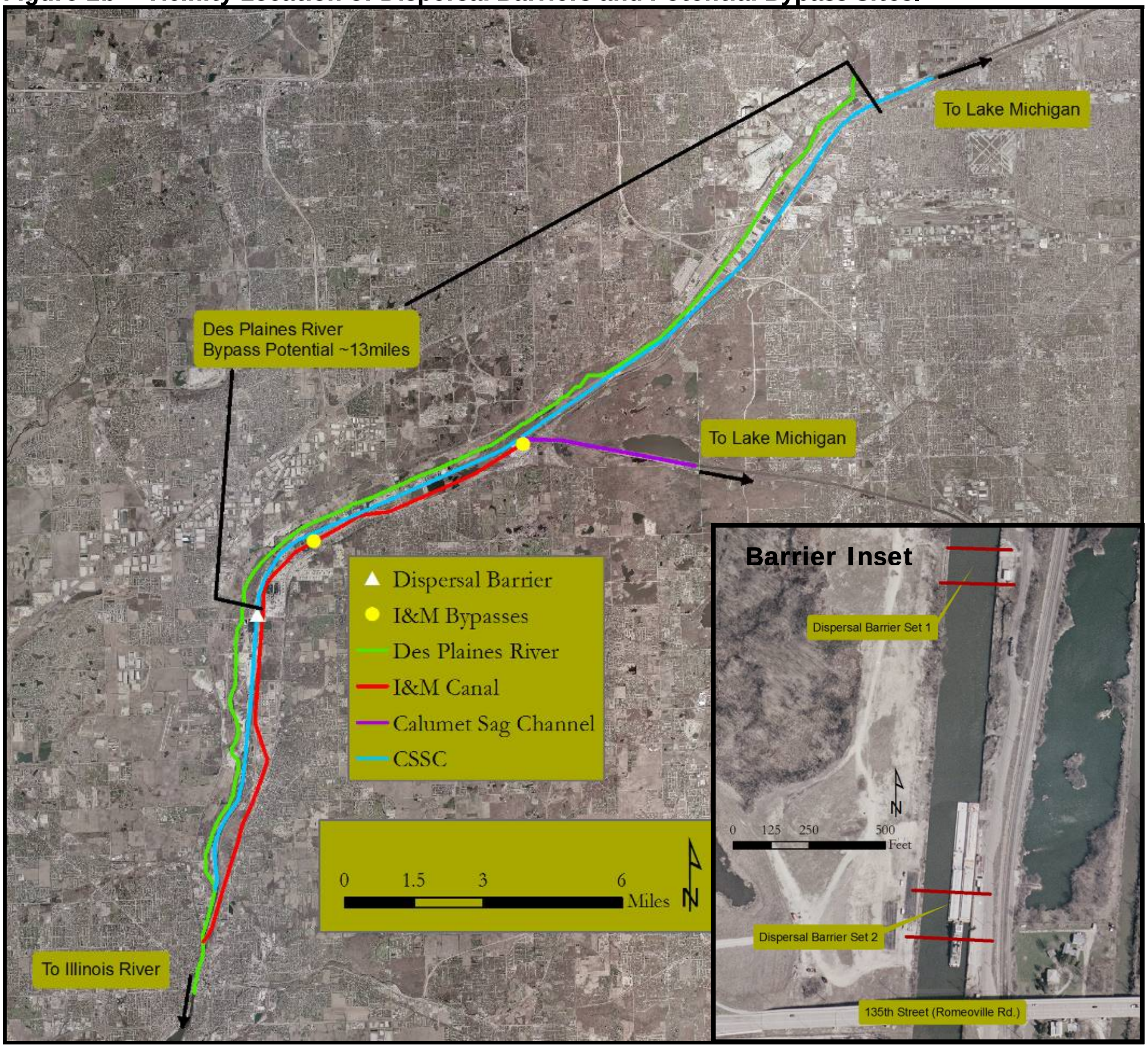


Figure 2b – Vicinity Location of Dispersal Barriers and Potential Bypass Sites.



1.6 – Prior Studies and Reports

Lockport Prairie Section 206 – The Lockport Prairie Nature Preserve (LPNP) is in the immediate area and floodplain of the Des Plaines River overflow areas and Dispersal Barriers location. This USACE project could be affected by decisions made in this report in terms of flooding critical habitat for the Hine's Emerald Dragonfly (*Somatochlora hineana*). Any option to place an impermeable Asian carps barrier along the six overflow points on the Des Plaines River could flood the prairie and smother critical habitat.

1.7 – Existing Projects

Illinois Waterway

The Illinois Waterway Navigation System is a connecting link between Lake Michigan and the Mississippi River. Since this connection was not a natural situation, a combination of engineering works was required to bring it about. These included channel construction, lock and dam construction, and operation and maintenance activities. Presently, navigation is affected by maintenance of sufficient water levels in pools behind the dams, operation of locks to pass boat and barge traffic at dam sites, dredging in certain areas to maintain channel depth, and clearing and snagging to keep the channel clean. The formal authorization for the US Army Corps of Engineers to perform operation and maintenance activities on the Illinois Waterway was given in the Rivers and Harbors Act of 1927, 1930, and 1935.

This waterway is one of the nation's busiest routes for commercial barge transportation. The Waterway includes the Chicago, Des Plaines, and Illinois Rivers, plus numerous canals, in particular the Calumet-Sag Channel and the navigable portions of the Little Calumet and Calumet Rivers. The completion of the I&M Canal linking Lake Michigan to the Illinois River was completed in 1848. In 1900, the upper end of the I&M Canal was replaced as far south as Lockport by the CSSC which, in addition to providing sanitation, was available for navigation. In 1922, the MWRDGC completed the construction of the Calumet-Sag Channel for the purpose of preventing pollution of Lake Michigan by reversing the flow of the Calumet River. Today the Waterway is completely navigable with a minimum depth of nine feet over its stretch of 327-miles. The physical components of the navigation system are the seven sets of locks and dam structures and the 223.2 miles of navigation channel.

<u>Lockport Dam</u> – The dam at Lockport is the powerhouse owned and operated by the MWRDGC. This dam serves the multiple purposes of power generation, flood control, and navigation. The role of the controlling works is primarily to control flooding to large rainfall events. North of Lockport the CSSC lies between high retaining walls backed by earth embankments with the level of the canal being above the level of the surrounding terrain. The dam is a 260 foot long dam, which contains 15 gate opening. Eight of the gate openings have never been used and are sealed with concrete bulkheads. The seven remaining gates are equipped with 30 foot wide by 20 foot high vertical lift sluice gates. The gates are operated with a 3HP electric drive mechanism and counterweight.

<u>Brandon Road Dam</u> – Brandon Road Dam, located on the Des Plaines River just below the city of Joliet, Illinois, is a fixed concrete structure, 1569 feet long. The height of the pool and discharge past the dam are controlled by twenty-one 50-foot tainter-type crest gates which hold the normal pool 27 inches above the crest of the masonry. Six openings through the dam, controlled by sluice gates, are also used for the passage of water. A 320-foot section of head gates which was designed for future addition of a powerhouse. An ice chute, and two sections of earth embankment complete the dam. The major portion of the short pool is the city of Joliet and is in part contained between flood walls varying in height to a maximum of 35 feet.

The remainder of the Illinois Waterway has 4 additional navigation structures know as Dresden Island Lock and Dam (RM 271), Marseilles Dam (RM 246), Starved Rock Dam (RM 230) Peoria Dam (RM 158), and LaGrange Dam (RM 80)

Chicago Sanitary & Ship Canal, Dispersal Barrier I

The CSSC is a man-made waterway in Northeastern Illinois that connects the Chicago River and the Des Plaines River. The CSSC's first dispersal barrier (Barrier I) was carried out as a pilot project under authority granted by the Nonindigenous Aquatic Nuisance Prevention and Control Act of 1990, P.L. 101-636, as amended by Section 2309 of the Emergency Supplemental Appropriations Act for Defense, the Global War on Terrorism and Hurricane Recovery, 2006. The project consists of an array of DC electrodes which were installed on the channel bottom of the CSSC. When power is provided, an electric field is created within the water that repels fish in order to prevent or reduce the dispersal of non-indigenous aquatic species between the Great Lakes and the Mississippi River drainage basins. Barrier I is located at approximately river mile 296.2 about 1000 feet from Barrier II.

Chicago Sanitary & Ship Canal, Dispersal Barrier II

The CSSC's second disposal barrier (Barrier II) initially was carried out by the Corps under the Section 1135 program of the Water Resources Development Act of 1986, as furthered authorized in Section 345 of the District of Columbia Appropriations Act, 2005, P.L. 108-335 and Section 3061(b)(1)(B) of the Water Resources Development Act of 2007 P.L. 110-114.
A second permanent dispersal barrier is needed to provide continued protection against nuisance species. Barrier II is also an electric field barrier, but will include design improvements identified during monitoring and testing of the demonstration barrier. Barrier II is being constructed in two phases, IIA and IIB. The first phase consists of construction of two underwater electrode arrays and one control house. This control house is able to operate one of the two arrays. The second phase consists of construction of a second control house that will allow both arrays to be operated at the same time. Barrier II is located at approximately river mile 296.2, about 1000 feet from Barrier I.

CHAPTER 2 – STUDY TEAM & PARTNERSHIP

2.1 – Efficacy Study Team

USACE Chicago District

Chuck Shea	Project Manager
Scott Kozak	Project Manager
Frank Veraldi	Lead Planner
Susanne Davis	Planner / Planning Chief
Gene Fleming	Planner / Environmental Formulation Chief
Shawna Herleth-King	Aquatic Ecologist
J.D. Ennis	Geospatial Analyst
Zach Langel	Civil Design Lead
Adam Borrelli	Cost Engineer
George Chartouni	Cost Engineer
Daniel Ferris	Geotechnical
Jennifer Raber	Environmental Engineer

USACE Rock Island

Kelly Baerwaldt	Fisheries Biologist
Mark Cornish	Supervisory Fisheries Biologist

USACE Detroit District

Mike Rohde	Real Estate

USACE Engineering Research & Development Center

Jack Kilgore
Jan Hoover
Dave Smith

Non-Federal Sponsors

NA – 100% Federal Project

Other Agencies

US Coast Guard – Ballast Water Study Support (Appendix E)

Private

Smith-Root Inc.

2.2 – Technical Committees & Stakeholders

ANS Barrier Advisory Panel –This advisory panel was originally created to engage experts and stakeholders in the process of identifying an appropriate barrier demonstration project. It has continued to meet regularly as a way to both provide information to the stakeholders and obtain expert advice on project planning and design from them. Participants include other agencies with responsibilities related to the barriers and the movement of invasive species, experts on the physiology and behavior of fish and the likely effectiveness of potential barriers, environmental non-governmental organizations, and representatives of the businesses and other groups that use the waterway system. More than 40 international, Federal, state, regional, municipal, commercial, academic, and environmental groups or agencies have participated, including:

- US Army Corps of Engineers
- US Fish and Wildlife Service
- US Environmental Protection Agency
- US Geological Survey
- US Coast Guard
- International Joint Commission
- Consulate General of Canada
- Great Lakes Fishery Commission
- Great Lakes Sport Fishing Council
- Great Lakes Commission
- Great Lakes Protection Fund
- Lake Michigan Federation
- Illinois Dept. of Natural Resources
- Illinois Natural History Survey
- Illinois Environmental Protection Agency
- Illinois Pollution Control Board
- Minnesota Dept. of Natural Resources
- Michigan Dept. of Natural Resources
- Wisconsin Dept. of Natural Resources
- Mississippi Interstate Conservation
- Illinois International Port Authority
- Metropolitan Water Reclamation District of Greater Chicago
- City of Chicago Dept. of Environment
- DuPage County Forest Preserve
- University of Michigan
- Loyola University
- University of Windsor
- Lewis National University
- University of Illinois
- University of Wisconsin Sea Grant Institute
- Northeast Midwest Institute
- Illinois-Indiana Sea Grant College Program
- Friends of the Chicago River
- Illinois River Carriers Association
- Canal Corridor Association
- Midwest Generation
- Commonwealth Edison
- Material Services Corporation
- Fish Pro/Cochran & Wilken, Inc.

- Habitat Solutions
- Ecological Monitoring and Assessment
- Smith-Root, Inc.
- Garvey International

Monitoring Subcommittee – The monitoring subcommittee functions as a sub-group of the ANSB Advisory Panel. The committee's responsibility is for planning monitoring activities associated with the Barrier project, and will offer recommendations to USACE management and decision makers. Membership is open to all stakeholders. The monitoring studies developed by the subcommittee would be reviewed by an independent review panel consisting of biologists with expertise in Asian carp biology from Federal and state agencies. Decision authority for monitoring activities lies with USACE Chicago District.

Optimal Operating Parameters Subcommittee - provide external review of research plans and results to identify optimal barrier operating parameters (voltage, pulse frequency, pulse duration).

Rapid Response Subcommittee - Planning a multi-agency effort to take rapid response actions against the Asian carp. Most discussion has focused on possible use of rotenone, but recently have also discussed ways to rapidly cut off the potential Des Plaines & I&M barrier bypasses.

2.3 – Agency Technical Review (ATR) / Peer Review Teams

The ATR team will be comprised of USACE staff, other agencies and academics or other subject matter experts in the following disciplines:

- Ecosystem Planning/Environmental Assessment
- NEPA Compliance
- Ichthyology/Fisheries Biology
- Economic Analysis/Risk and Uncertainty
- Hydrology & Hydraulics
- Cost Engineering
- Civil Design Analysis
- Geotechnical Engineering
- Electrical Engineering

Chapter 3 – Current Conditions

3.1 – Site Visit Descriptions

On September 16, 2009, three teams walked along the banks of the CSSC and Des Plaines River to look for areas where flooding might facilitate the dispersal of the Asian carps from the Des Plaines River, over land, and into the CSSC. The purpose of the site visit was to verify the existing LIDAR topography and discover existing structures not accounted for in the available topography. While on site wetland areas were also preliminarily identified and documented. The site visit was broken into the following three segments:

I) West 135th Street to Lemont Road – Group I walked approximately 4.5 miles of the potential alignment from river mile (RM) 23.4 (135th St.) to RM 28.2 (Lemont Rd.) (Photo 1 & Plate 2). The entire length of the segment was paved with an 8' to 10' wide asphalt bike path, which was heavily travelled. The existing bike path elevation is above the Des Plaines River. The segment between Romeoville Rd. and RM 26.5 appeared to have been recently improved. Also, wetland type plants were abundant along both sides of the path along this segment. An existing oil pipe easement crosses the bike path at RM 23.6, which appeared to be a low point in the path. A maintenance crew confirmed that overtopping had previously occurred in this location. There was no other visual evidence of low spots along this segment. The segment from RM 26.5 to Lemont Rd. also has a vehicular access road along the bike path, which provides access to several businesses along this segment. This segment appeared to be significantly higher than both the Des Plaines River and the CSSC. No culverts were identified during the inspection.

Photo 1 – Low Spot in Path Where Maintenance Crew Observed Overflow.

II) Route 83 to Lemont Road – Group II walked approximately 2.25 miles of the alignment from RM 28.2 to 31.7 (Photo 2 & Plate 3). This stretch of the alignment consisted of mostly woods and the existing bike trail. Along the stretch, several significant areas of wetland were found that will be avoided. The wetlands areas had cattail stands, and ranged from approximately one to five acres. There were also two ditch-like low-spots of concern; the first (RM 30-30.2) occurred adjacent to a small levee on the river bank and possibly ran to the Des Plaines River, the other (RM 29.75-29.5) was a large ditch that ran from the bank of the river to a large wetland area. All of the potential bypass areas were located in a densely wooded area, so construction access may be of issue for most spots, though the wetland at RM 28.75 is a quarter-mile from a service road.

Photo 2 – Obvious Overflow Path.

<u>III) Route 83 to La Grange Road</u> – Group III walked approximately 4.5 miles of the alignment from RM 31.7 to 37.2 (Photo 3, Plate 4a & 4b). The entire length of the segment was paved with an 8' to 10' wide asphalt bike path, which was heavily travelled. The existing bike path elevation is above the Des Plaines River and appeared to have been recently improved. Wetland type plants were identified at approximately RM 32, which is also in the location of over topping area Site 1. An existing levee/land bridge was located at RM 33.5, which is about 8' to 10' in height from the surrounding area. The bike path utilized this land bridge which also has existing fencing along the edges. A stockpile area was also located from RM 34.2 to 34.1.

Photo 3 – Obvious Overflow Path.

On October 1, 2009 another site visit to the area was conducted. The purpose of the site visit was to view locations of possible Barrier bypassing from over topping from the Des Plaines River and Barrier bypassing via culverts from the I&M Canal flows and to have on site coordination with landowners, lessees, and Federal, State and County agencies, including USEPA, USFWS, ILDNR, and the Forest Preserve Districts of Cook and DuPage Counties.

I) Possible I&M Canal Flow Divide (E1064047.1, N1819397.1) – This site when visited was at a low flow condition (Photo 4 & Plate 5). The team observed wetland vegetation and trees growing within the canal channel. Per the conversation with the DNR, during high water it may be possible for fish to swim through these areas, but it would be difficult. The group discussed the possible effects of the I&M Canal flooding and the possibility of overtopping into the CSSC. It was concluded that the I&M would need to be hydraulically modeled in order to determine if overtopping was a possibility.

Photo 4 – I&M Canal with wetland vegetation.

II) I&M and CSSC Culvert Connection (E1089388.6, N1829527.4) – Two 48” corrugated metal pipes (CMP) (Photo 5 & Plate 5) and one 24” polyvinyl chloride (PVC) pipe were located. Flow between the two canals was apparent in the two 48” CMPs. The 24” PVC pipe is at a higher elevation and would experience flow in a flood condition. Although hydrological connection is apparent through the two culverts, the high area of land shown in Photo 4 is a low flow block to fish passage.

Photo 5 – Two 48” CMPs

III) 2008 Flood Overflow Location (E1100797.1, N1840699.1) – This area is owned by MWRDGC, but the bike trail is leased by the Forest Preserve District of Cook County (Photo 1 & Plate 5). At this location it was apparent that flooding occurred often in the forest located north of the bike path. The trees in the area had a “permanent” water mark approximately a foot above the ground.

VI) The Lowest Elevation Location (E1078295.8, N1827349.8) – This area is owned by MWRDGC, but is leased by the Du Page County Forest Preserve (Photo 6). The alignment follows an existing embankment that appears to be constructed of broken rock in a wooded area. The forest preserve stated that the plant species are of low quality and it shouldn't be a problem to construct in the area.

Photo 6 – Des Plaines River Lowest Elevation Location.

3.2 – Physical Resources

Climate

The climate of the project area is typical of northeast Illinois and may be classified as humid continental, characterized by warm summers, cold winters, and daily, monthly, and yearly fluctuations in temperature and precipitation. National Weather Service data collected from the area around Chicago report average temperatures of 24.9° F in winter and 71° F in summer. Coldest average monthly temperatures range from daily lows and highs of 14° F and 30° F respectively, in January. July is the warmest month with an average daily low of 63°F and an average high of 84° F. Mean annual precipitation is 36.57 inches with the majority of the precipitation occurring April through October. Accumulated snowfall averages 46.2 inches for the study area. Wind speed averages 11 to 12 miles per hour. Early spring floods may occur when snow accumulations extend into a period of increasing temperature that results in melting. If this occurs when soils are already saturated, and given the amount of impervious surfaces within the study area, runoff increases dramatically. The start of the growing season as defined for agricultural purposes usually occurs from late April to early May, but in natural areas there may be blooming plants in ground water discharge zones as early as the last week in January, although most native organisms start their annual growth after cultivated and non-native species. The first frost typically occurs between late September and mid-October, with the frost free season ranging from 158 to 178 days.

Geology

Bedrock located within the project area is primarily composed of dolomite and limestone with small amounts of shale present. The bedrock is covered by up to 300 feet of an unconsolidated formation comprised of clay, silt, sand, and gravel. Much of the material was directly deposited as glacial till and outwash from melting glaciers. The very young glacial geology of the region plays a significant role in the hydrology that drives the local ecosystems.

The project area lies entirely within the Central Lowland Province. Comprising the Province is the Great Lake Section and the Till Plains Section. The Great Lake Section is composed of the Wheaton Morainal Country and the Chicago Lake Plain. The Wheaton Morainal Country is characterized by broad flat expanses spotted with steeply sloping Wisconsinan-age moraines and till plains that are approximately parallel to the Lake Michigan shoreline. The Chicago Lake Plain is approximately the area that is now metropolitan Chicago. It is relatively flat, glacio-lacustrine deposit formed by the slow moving waters of glacial Lake Chicago. Elevation ranges from 400 to 900 feet above sea level. The Till Plains Section is composed of the Bloomington Ridged Plain, with land surface elevation ranges from 585 to 855 feet above sea level.

Soils

The US Department of Agriculture Soil Surveys of Cook, DuPage, and Will Counties, Illinois describe 28 soil series found on the study area; twelve of the soil classes are hydric. Muskego and Houghton Mucks, which is a group of nearly level depressional areas composed primarily of herbaceous organic material over coprogenous deposits, is the only soil association. The 28 soil series encompass four soil orders: Alfisols, Entisol, Histosol, and Mollisols. Alfisols form in semiarid to humid areas and are typically found under hardwood forest cover. They have a clay-enriched subsoil and relatively high native fertility. The soil series included under Alfisols are Blount, Fox, Ozarkee, and Wanconda. The Entisol soil order is characterized by having no diagnostic soil horizons. Most of the soils within this order are unaltered from their parent material. The only soil series included under the Entisol order is Orthents. Soil comprised primarily of organic materials characterizes the Histosol soil order. For Histosol soils to be present, aquic conditions or artificial drainage must exist. The Muskego and Houghton soils are the only series included under the Histosol soil order. Finally, the largest order is the Mollisols including the Ashkum, Barrington, Channahon, Drummer, Faxon, Grundelein, Harpster, Joliet, Kane, Kankakee, Mundelein, Rockton, Romeo, and Sawmill soil series. The Mollisols form typically under grassland cover in semi-arid to semi-humid areas. These soils are characterized by a deep, high organic matter, nutrient-enriched surface soil. Prime farmlands do not occur along or on the project footprint.

Land Use

Presettlement land cover of the study area was primarily prairie, with pockets of rare dolomitic prairie and wetland depressions. Along the riparian zones of the Des Plaines River and confluent streams, hardwood forest most likely occurred. Currently, the project area land use has been converted from these natural types to industrialized grounds with intermittent pockets of highly disturbed forest and wetland. Most of the land adjacent to the Des Plaines River and canals is owned by the MWRDGC; certain parcels are leased to the Cook County and Du Page Forest Preserves and are used for recreational purposes.

Hydrology & Hydraulics

The Des Plaines River is located in northeast Illinois. It originates in Racine County in southern Wisconsin and flows in a general southerly direction to its confluence with Salt Creek in

Riverside, Illinois. It then flows southwesterly to its confluence with the CSSC near Lockport, Illinois. The present analysis is concerned with a portion of this reach that flows to the southwest because in this area the Des Plaines River flows parallel and adjacent to the CSSC, and the two waterways are separated by a strip of land only a few hundred feet across. The drainage area of the Des Plaines River upstream of Lockport is 705 square miles. The watershed is aligned primarily along a north-south axis with a length of 82 miles and an average width of about 9 miles. Between Lockport and Riverside, the reach of the Des Plaines River modeled in this analysis, the average slope of the river is 1.9 ft/mi (USACE 1999). There are two USGS gages located near the study area: one just downstream of Hoffman Dam in Riverside and the other at Romeoville Road. The gage at Riverside has been operating since 1943 and the gage at Romeoville has been in operation since 2008.

The strip of land between the Des Plaines River and CSSC accommodates industrial plants, navigation facilities and recreational bike trails. It can be accessed through small access roads. There were two large spoil banks, mostly consisting of the debris left from the canal construction, which existed on this strip of land near Romeoville. These spoil banks functioned as a levee that prevented the Des Plaines River water from overflowing to the CSSC. The spoil banks were removed in the 1990s, and overflows into the CSSC have been observed several times since then, most recently in May 2008. The water surface elevation on the CSSC is mainly controlled by the Lockport Lock and Dam. The stage on the Des Plaines River can significantly rise during flood events, but the stage on the CSSC will rise by a much lesser degree due to canal operations. Canal drawdown at the Lockport Lock and Dam and Controlling works allows more flood water to pass through the canal.

Air Quality

The Chicago Metropolitan area, including the study area, is a non-attainment area for both ozone (and ozone precursors) and particulates (with a diameter less than 2.5 microns). Existing air quality data are available for Cook, DuPage, and Will counties from the USEPA Air Data database. Although the trends overall show improvement over the last 10 years, individual measurements and monitoring stations still have measurements that exceed the national standards. The existing air quality should be considered marginal, but improving over time.

Water Quality

<u>Chicago Sanitary & Ship Canal</u> – The CSSC is classified by the Illinois Pollution Control Board as a "Secondary Contact and Indigenous Aquatic Life Use Waterway", which indicates a highly modified waterway, not suited for General Use activities (e.g. swimming, water skiing). Water quality may be capable of supporting indigenous aquatic life, but limited by the physical configuration of the canal, characteristics and origin of the water, and the presence of contaminants in amounts that do not exceed the water quality standards. Illinois Pollution Control Board water quality standards for this category limit dissolved oxygen, temperature, pH, un-ionized ammonia, total dissolved solids, phenols, fats, oils, and greases, cyanide, fluoride, silver, arsenic, barium, cadmium, copper, hexavalent chromium, iron, lead, nickel, manganese, mercury, zinc, selenium, and soluble iron. In 2007, the latest year of available data, standards for all but two parameters were met during routine sampling performed by MWRDGC at two sampling locations on the CSSC within the project study area (Route 83 and Stephen Street). Dissolved Oxygen and Iron standards were each exceeded in one out of eleven sampling events

at the Stephen St. sampling point. Water quality in the I&M Canal is quite similar to the CSSC water quality.

Des Plaines River – The Des Plaines River is classified by the Illinois Pollution Control Board as "General Use Water". General Use waters are protected for aquatic life, wildlife, agricultural use, primary contact (e.g. swimming, water skiing), secondary contact (e.g. boating, fishing), and most industrial uses. Illinois Pollution Control Board water quality standards for general use limit dissolved oxygen, temperature, pH, chloride, ammonium-nitrogen, total dissolved solids, phenols, sulfate, weak acid dissociable cyanide, fluoride, fecal coliform, gross beta radioactivity, BTEX, silver, barium, boron, hexavalent chromium, manganese, selenium, soluble arsenic, cadmium, copper, chromium, iron, lead, nickel, mercury, and zinc. Additionally, two parameters (benzene and total mercury) are subject to IPCB Human Health Standards. In 2007, the latest year of available data, standards for all but four parameters were met during routine sampling performed by MWRDGC at two sampling locations on the Des Plaines River within the project study area (Willow Springs Road and Stephen Street). Chloride and TDS standards were each exceeded in two out of eleven sampling events at Willow Springs Road, and once at Stephen St. The fecal coliform standard was exceeded five times at Willow Springs Rd., and three times at Stephen St. The Human Health Standard for Mercury was exceeded once at Willow Springs Rd., and twice at Stephen St.

3.3 – Biological Resources

Riverine Habitat

CSSC - The CSSC in the study area was incised through the native dolomite limestone. Accordingly, aquatic habitat in the vicinity of the proposed barrier reach is fairly homogeneous, consisting of vertical limestone walls that extend 24 – 26 feet down to the bottom. These nearly perpendicular walls of the canal offer little or no littoral zone for aquatic species. The walls have crumbled down enough at various locations along the reach that may provide limited littoral habitat for present species. The bottom of the canal is essentially flat with virtually no fine substrates; however, rock or flagstone is present on the bottom of the canal where the vertical walls have been gouged away by barge traffic. There are also intermittent areas of woody debris and detritus that may be used as cover for certain benthic organisms.

Des Plaines River - Des Plaines River starts near Union Grove, Racine County, Wisconsin. It then flows south through the center of Kenosha County, Wisconsin, eastern Lake County, the center of Cook County west of Chicago, the very southeast corner of DuPage County, then south-southwest through western Will County before merging with the Kankakee River to form the Illinois River in Grundy County. Habitats in the study area reach are varied. Some reaches are lower gradient and exhibit abundant backwater and side stream wetland habitats (near Channahon). Some reaches are higher gradient where the channel braids and exhibits swift currents over bedrock, thus forming many riffles (near Lockport and Romeoville). The Des Plaines River below Lockport is deeper and wider, a result of modification for commercial navigation.

Riparian Plant Communities

MWRD Culvert 146 – This area is a highly disturbed wet mesic mixture of old field and woodland. The old field is dominated by Late Boneset (*Eupatorium serotinum*) and tall goldenrod (*Solidago altissima*). The woodland tree layer is dominated by White mulberry (*Morus alba*) and the shrub layer is dominated by Elderberry (*Sambucus canadensis*). This area receives periodic floodwater. These species are indicative of a high level of past disturbance that was decimating to the original native plant species.

Romeo to Lemont – The forested area is a mixture of wet floodplain forest and mesic woodland with small areas of emergent marsh. The forested areas are dominated by Cottonwood (*Populus deltoides*), Maple (*Acer* sp.*),* and Ash (*Fraxinus* sp.) with a shrub layer dominated by Japanese bush honeysuckle (*Lonicera* sp.). The dominant vine is Riverbank grape (*Vitis riparia*). The herbaceous layer is represented by mostly Creeping Charlie (*Glechoma hederacea*) and White snakeroot (*Eupatorium rugosum*). The forested area is of low quality, typified by low coverage of herbaceous species and dominance of the invasive shrub species (*Lonicera japonica*). The Emergent Marsh area is dominated by a mix of Cattails (*Typha latifolia*) and Common reed (*Phragmites australis*). Although the cattails are native, their dominance along with the high abundance of Common reed indicates this area is of low quality and is experiencing chronic disturbance.

The riverbank (adjacent floodplain) is wooded with openings dominated by herbaceous species. The herbaceous species are dominated by Reed canary grass (*Phalaris arundinacea*), which is a highly invasive species and is typical of wet/mesic disturbed areas. The wooded areas are low quality as well with some larger trees and a shrub layer dominated by Japanese bush honeysuckle and European buckthorn (*Rhamnus cathartica*), both non-native, highly invasive species.

Route 83 to I-294 – This area is a mixture of old field and degraded floodplain forest. The old field contains mostly Cut-leaved Teasel (*Dipsacus laciniatus*), tall goldenrod, and Queen-Anne's lace (*Daucus carota*). Cottonwood and Ash are well represented in the tree layer of the Forested Floodplain, with very little coverage of shrub and herbaceous species. The low coverage of shrub and herbaceous species indicates this area is inundated/saturated for the majority of the year and contains a dense tree canopy.

Route 83 to Lemont – The wooded areas are very similar to the ones described above, but with unnatural openings obviously maintained for utility right-of-ways. Within the openings the dominant species is Reed canary grass. The riverbank, alongside the canal, contains wetland plant species including: Ash tree seedlings, Cattails, Water plantain (*Alisma subcordatum*) and Common reed. Within the canal, larger areas are dominated by Cattails.

Aquatic Communities

The aquatic communities and riparian zones of the study area have been marginalized by previous impacts of hydrologic and fluvial-geomorphic modification. A total of 49 species of fish (Appendix E Table 1) have been collected from the Des Plaines River, CSSC, and I&M: 43 from the Des Plaines River, 19 from the CSSC, and 21 from the I&M. The majority of fish species that occur in the area are ecologically tolerant, which means they are able to thrive in degraded habitats. Species intolerant to silt and turbid water are found in the Des Plaines River, CSSC, and I&M; however, abundance of these species is most likely low.

Macroinvertebrates play a vital role in aquatic ecosystems by providing a food source and acting as bio-processors of coarse and fine particulate organic matter. In addition, certain macroinvertebrate species may provide insight to the quality of the stream habitat they occupy. Various species of macroinvertebrates (Appendix Table 2) inhabit the Des Plaines River portion of the study area. The river contains portions of braided stream channel, varying depths of riffles and pools, aquatic vegetation, woody debris, and heterogeneous substrates that offer prime habitat to stream macroinvertebrates. Species diversity within the CSSC and I&M is most likely less than in the Des Plaines River due to poor habitat. Fissures in the limestone walls of the canals as well as organic matter inputs provide minimal habitat for invertebrates and other aquatic species. In 1999, the MWRD collected two crayfish species, *Orconectes rusticus* rusty crayfish and *Orconectes virilis* virile crayfish, from the CSSC. The rusty crayfish is introduced from the Ohio River system via bait bucket release.

Other Wildlife

Terrestrial communities on the study area have been degraded due to hydrologic and geomorphic alterations and fragmentation of habitats by industrialization. The majority of the site is covered in anthropogenically induced bottomland forest and ruined industrial parcels. Birds that are associated with these types of habitats and may inhabit the area include marsh birds, nesting and migrant waterfowl and woodland birds (Appendix E Table 3). Muskrat, beaver, mink, otter, and raccoons are mammals often associated with bodies of water because they construct their shelters in or near rivers and streams as well as gather food. Aquatic dependent mammals such as these as well as other species of mammals (Appendix E Table 4) may be found utilizing the study area. In addition, several species of reptiles (Appendix E Table 5) that are semi-aquatic and feed on stream invertebrates and fish may use the area, as well as certain species of amphibians (Appendix E Table 5) that utilize wetlands during reproduction.

Natural Areas

The Black Partridge Woods Forest and Nature Preserve and the Palos Forest Preserve, both located in Cook County, have portions existing within the vicinity of the project area. In Will County, Lockport Prairie Nature Preserve, Waterfall Glen and Romeoville Prairie are located in the heart of the study area. The Lockport Prairie nature preserve is identified as providing critical habitat for the Federally Endangered Hines Emerald Dragon Fly (*Somatochlora hineana*).

Threatened & Endangered Species

Several species of federal and state threatened and endangered species occur within the study area as noted by the USF&WS in a letter dated 19 October 2009. In addition to the vulnerable, yet high quality ecosystem at Lockport Prairie, it supports three Federally-listed species: the Federally-endangered Leafy Prairie Clover and Hine’s Emerald Dragonfly, and the Federally-threatened Lakeside Daisy. In the last 10 years there has been a significant decline in the reproductive output of the Hine’s Emerald Dragonfly there. One concern is the change in the quantity and quality of groundwater discharging into the wetland areas that support the rivulet dependent larvae of the Hine’s Emerald Dragonfly. High quality groundwater discharges from along the bluffs and forms slow flowing seeps, called rivulets. Another result from the change in groundwater discharge has been a decline in the population of Leafy Prairie Clover, another vulnerable hydrophytic species inhabiting the wet and wet-mesic prairie. Other threats to federally protected species include invasive plant species, surface water runoff and development of the watershed.

One state endangered species, *Nycticorax nycticorax* black-crowned night heron has been observed in the study area. It is possible that it is just a single individual from a nearby colony. Currently, no black-crowned night heron colonies are identified within the project area.

Immediate ANS Target Species

There are three Asian carps (Cyprinidae) that are threatening to enter the Great Lakes basin via the CSSC. The following describes the current target species.

Hypophthalmichthys nobilis bighead carp can grow to a length of 130 cm (51") and weigh up to 30 kg (65 lbs.). This carp feeds by filtering plankton from the water column with its large terminal and upturned mouth. This fish requires large river habitat where it reproduces prolifically and may grow rapidly. This fish has been identified as a means to remove excess nutrients and algae from wastewater by consuming algae. Since it can grow to a large size, it has the potential to deplete zooplankton populations; therefore impacting populations of all larval fishes, planktivorous adult fishes, and native mussels (Unionoida). This fish is native to Asia, in Southern and Central China. Bighead carp have been spotted in about 18 states and is established in Illinois within the Mississippi and Ohio Rivers. It also can be found in the Cache, Big Muddy, Kaskaskia, Wabash and Illinois Rivers and in Chain Lake. Currently, bighead carp may be challenging the dispersal barrier.

Hypophthalmichthys molitrix silver carp can grow to a length of 105 cm (41") and weigh up to 50 kg (110 lbs). This freshwater fish is biologically similar to the bighead carp and has also been stocked for phytoplankton control in eutrophic water bodies, wastewater treatment ponds, and used as a food fish. This fish feeds by filtering phytoplankton, zooplankton, bacteria and detritus from the water column. In great numbers, this fish could consume plankton required by larval fish, invertebrates and native mussels. It may also compete with other planktivorous fishes of the Great Lakes such as *Coregonus* sp. whitefish. It is native to Asia and can be found in several major Pacific drainages in eastern Asia from the Amur River of Eastern Russia to the Pearl River in China. In North American it has been documented in Alabama, Arizona, Arkansas, Colorado, Florida, Hawaii, Illinois, Indiana, Kansas, Louisiana, Missouri, Nebraska and Tennessee. In Illinois, it has been found in the Mississippi, Ohio, Cache, and Wabash Rivers, and several of their tributaries. This includes the Big Muddy River, Horseshoe Lake, the Cache River drainage, and the Embarras River below Lake Charleston. Currently, silver carp may be challenging the dispersal barrier.

Mylopharyngodon piceus black carp can grow to a length of 100 cm (39") and weigh up to 32 kg (70 lbs). This carp is a bottom-dwelling molluscivore with a high consumption rate. It has been used to control disease-carrying snails and the yellow grub (*Clinostomum margaritum*) in aquaculture. This fish is a major threat to populations of native mussels and snails, many of which are considered endangered or threatened. Known as "river rabbits" in Australia, these fish breed rapidly and prolifically. It is native to Asia and can be found in most major Pacific drainages of eastern Asia from the Pearl River basin in North China to the Amur River. Its native range may possibly extend from Russia to Vietnam. Escapees from a fish farm in Missouri are the only documented records in North America. Currently, this fish is on the downstream side of the dispersal barrier reach. At least two specimens have been documented from Illinois open waters. The first was captured 26 March 2003 from Horseshoe Lake, Alexander County, in southern part of state. A second specimen was taken June 10, 2004 from the Mississippi River near Lock and Dam 24 near Clarksville Island side channel in Calhoun County. This species has still not been observed in the Illinois River system during silver and bighead carp sampling.

3.4 – Cultural, Archaeological & Social Resources

Archaeological & Historical Properties

The Illinois and Michigan Canal (I&M Canal), listed in 1966, is the only property within the project area that is both on the National Register of Historic Properties and that extends through all three Illinois counties. The Chicago Ship and Sanitary Canal (CSSC) also extends through all three counties, but although it is eligible for the National Register, it is not currently listed. Within this portion of Cook County, two properties in Western Springs are on the National Register of Historic Properties, the Western Springs First Congregational Church (listed 2006) and the Western Springs Water Tower (listed 1981). Three properties within the Village of Lemont are also listed on the National Register. These are the Lemont Central Grade School (listed 1975), the Lemont Methodist Episcopalian Church (listed 1986), and the St. James Catholic Church and Cemetery (listed 1984). With the exception of the I&M Canal, no properties in this area of DuPage County are listed on the National Register of Historic Properties. Properties listed on the National Register within this portion of Will County include the Red Round Barn (listed 1988) in Romeoville, and the five structures and two historic districts listed within Lockport, Illinois to the south of the project area. All of these listed properties will be avoided and none will be within any of the selected sites within the project area. The one exception will be the plugging of a partially filled section of the I&M Canal. This portion of the canal will be filled with dirt and will be completely reversible.

Most prehistoric sites in the Des Plaines River watershed occupy high or well-drained ground, in areas unlikely to be affected by proposed measures; however, the historic occupation of the Des Plaines valley was focused more on water accessibility putting the majority of historic sites within the floodplain.

Settlement along the Des Plaines River began in the 1820s with large numbers of German immigrants establishing farms in the area in the 1820s and 1830s. Grain and livestock were shipped to the markets in Chicago. The first community along this stretch of the Des Plaines River was Lemont. The town was established in 1836 by land speculators gambling on future development stemming from the planned I&M Canal. The community soon served as the agricultural and commercial hub of the region. This area of Illinois experienced rapid population growth based on construction of the I&M Canal from 1837 to 1848. After 1848 Lemont served as an embarkment point and transit stop for canal traffic. The first railroad was constructed through Lemont in 1854 and the town later developed into a railroad community as canal traffic dwindled. The commercial importance of Lemont faded after 1900 as additional railroads and other transportation links bypassed the town. Lemont's historic buildings and proximity to the I&M Canal National Heritage Corridor have made tourism a major element of the local economy.

Recently the town has also developed into a bedroom community for the growing Chicago metropolitan area. Surrounding towns include Lockport, Bolingbrook, Darien, and Romeoville.

The Illinois and Michigan Canal ran 96 miles (155 km) from the Chicago River at the Bridgeport neighborhood in Chicago and joining the Illinois River at LaSalle-Peru, Illinois. It was finished in 1848 and allowed boat transportation between the Great Lakes to the Mississippi River and the Gulf of Mexico. The canal enabled navigation across the Chicago Portage and helped establish Chicago as the transportation hub of the United States, opening before railroads were laid in the area. It ceased transportation operations in 1933. Portions of the canal have been filled. One segment, including a number of engineering structures, between Lockport and LaSalle-Peru, was designated a National Historic Landmark in 1964. Today much of the canal is a long, thin park with canoeing and a 62.5 mile (100 km) hiking and biking trail (constructed on the alignment of the mule tow paths). It also includes museums and historical canal buildings. It was designated the first National Heritage Corridor by US Congress in 1984.

The CSSC was designed to carry treated sewage away from Chicago by reversing the flow of the Chicago River and directing its flow into the Illinois River drainage. Completed in 1900, the canal was also planned as a replacement for the outdated I&M, thus providing a shipping link between the Great Lakes and the Mississippi Valley. The CSSC is 28-miles long, 202-feet wide, and 24-feet deep. The canal was extended to Joliet by 1907. The Cal-Sag Channel connected the CSSC to the Calumet River in 1922. Construction of the CSSC was the largest earth-moving operation that had been undertaken in North America up to that time, and provided important training to a number of engineers who later worked on the Panama Canal. Although not on the National Register of Historic Properties, The system has been named a Civil Engineering Monument of the Millennium by the American Society of Civil Engineers.

The presence of first the I&M Canal and later the CSSC focused the economy of the project area toward the Des Plaines River valley and the water-based transportation of materials. Industries such as gravel quarries and refineries were developed in the region to take advantage of this transit corridor. Away from the river agriculture dominated the areas' economy until recently. This portion of all three counties remained characterized by farms and widely separated small towns until the explosive development of the 1990s and early 2000s reshaped the area into suburban bedroom communities for Chicago.

Social Setting

The project area extends through portions of three Illinois counties, Cook, DuPage, and Will. Cook County, Illinois has a racially and ethnically diverse population of 5,294,664 (2008) with a medium household income of $73,910.00 (2004) and a medium house value of $290,800. DuPage County has a medium household income of $105,400 and a medium home value of $421,540. For Will County the medium household income is $96,773 and the medium home value is $323,900. The portions of all three counties within our project area are comprised of a number of suburban communities that form a portion of the Chicago metropolitan area with its diverse industrial and commercial base.

Recreation

The Village of Lemont is the community in the closest proximity to the project area. The villages parks provide soccer and baseball facilities. Picnicking is popular along portions of both the Des Plaines and the historic I&M Canal. The undeveloped nature of large portions of the Des Plaines River valley outside of the village of Lemont makes it a popular destination for outdoor sports including bird watching, hunting, fishing and boating. The proposed path of the temporary measures will parallel a multicounty bike path.

Hazardous, Toxic and Radioactive Wastes

A final HTRW report (Appendix D) was generated for the Des Plaines River Bypass portion of the Aquatic Nuisance Dispersal Barrier Efficacy Study, three methods were employed:

Aerial Photography Review: Although some industrial development was seen in the vicinity in the earliest set of photographs available (1938-39), the area closest to the project site, between the Des Plaines River and CSSC, did not see any industry until relatively recently. Barge facilities and other current industrial development in this area were not seen on either the 1938-39 or 1956-61 sets of historical photographs.

Database Review: Review of a corridor database search provided by Environmental Data Resources (EDR) identified many HTRW sites within a mile of the project site. Local Groundwater in the area has been contaminated by several sites. Nevertheless, there is little potential that any of the investigated sites have impacted surface soils at the project site.

Site Visit: Recent site visits revealed an abandoned car on the south side of the existing berm, and several long abandoned barrels and tanks at a greater distance from the project area. The car may require removal upon construction, but the other containers are not anticipated to pose a risk to the project. The Egan Marine facility (which showed unknown CERCLA status in the database search) was visited, and appeared to be of questionable environmental status. Nevertheless, the site should not affect the project, due to the surficial nature of work planned.

Conclusion: No HTRW investigation can wholly eliminate uncertainty regarding the potential for HTRW associated with a project area. Performance of the HTRW investigation is intended to reduce, but not eliminate, uncertainty regarding the potential for HTRW in connection with a project area. As a result of this HTRW analysis it was concluded that there is sufficient information to demonstrate that the work proposed for the Interim I temporary risk reduction measures has little potential for encountering HTRW or non-HTRW contamination.

CHAPTER 4 – INTERIM RISK REDUCTION

The purpose of the Efficacy Interim I report is to quickly determine the best way to keep Asian carps from bypassing the barrier project in the CSSC and dispersing into the Great Lakes. Based upon environmental DNA tests the silver carp are upstream of the dispersal barrier system in the Des Plaines River and the next flood on the Des Plaines could allow silver carp to bypass the barrier. A flood in the Des Plaines River determined to be a 125-year event occurred in September 2008. Another flood could occur at any time but are usually in the spring. If the Asian carps bypass the barrier they could ultimately disperse into the Great Lakes via one or more of the 5 possible points of entry into Lake Michigan, the other Great Lakes and a significant number of the Great Lakes tributaries. The economic impact of Asian carps establishing in the Great Lakes is estimated by others to be between $4 billion and $6 billion annually. Further ecological disruption in the Great Lakes food web would have dire consequences for planktivorous fishes and mussels. The emergency nature of this threat requires expedited development of a USACE project, including an abbreviated planning process, review and approval. The Corps 6 step planning process was used to the extent practicable and modified as necessary without compromising the formulation of the best possible project, considering the engineering feasibility, environmental acceptability and economically optimized project. Rather than performing a traditional Cost Effectiveness /Incremental Cost Analysis, including the development of habitat models to establish habitat units for the natural resources preserved in the Great Lakes, it was recommended the District evaluate risk reduction measures similar to risk reduction measures evaluated for dam safety problems.

This Interim Risk Reduction analysis follows USACE guidance ER 1110-2-1156, Interim Risk Reduction Measures (IRRMs) for Dam Safety. IRRMs are developed, prepared, and implemented to reduce the probability and consequences of catastrophic failure to the maximum extent that is reasonably practicable while long term remedial measures are pursued. This Interim I Report seeks to reduce the catastrophic ecological event of allowing the Asian carps into the Great Lakes, while additional analysis and resources are sought to recommend a long-term solution to the problem.

4.1 – Identified Failure Modes

Dispersal Barrier Bypass 1

In September of 2008, a 125 year magnitude flood made it quite apparent that water from the Des Plaines River discharges overland and into the CSSC (Photo 7). Many points were observed where water was flowing from the Des Plaines River, over the strip of land between, and then cascading down into the CSSC (Plate 6). Currently, there are no barriers to Asian carp dispersal into the Des Plaines River, where they can enter its mouth in the Brandon Lock pool at RM 290. If the Asian carps are to traverse upstream to these overflow areas, which are upstream of the dispersal barrier, and flooding occurs, they could easily gain access to the CSSC and disperse freely to Lake Michigan. Currently, the Asian carps have not been physically collected in the Brandon and Lockport pools or the Des Plaines River despite an intense effort; however, environmental DNA testing suggests that silver carp have been in this area (Appendix E).

Photo 7 – Des Plaines River overflow near RM 300, well upstream of dispersal barriers (9/15/08).

Dispersal Barrier Bypass 2

There is concern that a dispersal route around the barrier array exists via the I&M Canal (Plate 5). Asian carps can enter Deep Run at RM 291, traverse upstream to RM 294 and enter the I&M Canal, where they then can disperse farther and then potentially enter the CSSC above the barrier. It is still unknown as to whether fish can disperse via this path due to all the intermittent marshes and blockages in the I&M Canal.

4.2 – Problems & Consequences

New species have been introduced into the Mississippi River and Great Lakes basins during the last half of the 1900's and continuing through present as a by-product of international trade. At the same time, environmental laws changed the way municipalities and industries disposed of their waste products into rivers and streams, resulting in improved water quality in many lotic environments, which allowed aquatic organisms to disperse over a greater area. This greater dispersal was good when it restored native species to their historic range; however, it has been environmentally, financially and socially disastrous when it allowed non-native species to colonize new areas and displace native species.

The historic headwater confluence of the Des Plaines and Calumet Rivers is a known key zoogeographic nexus that allowed aquatic organisms, primarily fishes, to colonize the Great Lakes region after the glaciers retreated to the north (~7,000 years ago). The geologic processes of the region eventually created modern conditions that separated the Mississippi River and Great Lakes drainage basins for the most part. The natural conditions of the system would have been very difficult for larger fishes to disperse, since the intermittent confluence was a heavily vegetated shallow marsh and inhospitable to most native fish species during most of the year. This zoogeographically isolation would be the primary driver of intra-basin speciation and inter-basin genetic divergence. In the early 1920s, this natural geological barrier was artificially broken by the construction of the CSSC; the two resulting issues are that 1) native speciation in the Great Lakes and Mississippi River basin is being compromised, and 2) a recent threat of introduced aquatic species using the geologic break as a highway has implications for widespread invasion.

The opportunity is to prevent the movement of aquatic nuisance species between the Mississippi River and Great Lakes basins and thereby protecting native species by preventing or delaying the invasion of non-native species between these watersheds. A primary level of protection was achieved when the electrical CSSC Dispersal Barrier was constructed and place in operation in the CSSC which is the main artery of dispersal for invasive fishes from the Mississippi River system to the Great Lakes and vice versa. More in-depth study of the project area and a tell-tale September 2008 flood have revealed that there are secondary intermittent hydraulic connections that could allow invasive species to disperse around the existing electric barrier system. These secondary intermittent hydraulic connections need to be addressed quickly to prevent or slow the invasive Asian carps from entering the Great Lakes basin. The electric barrier system is considered experimental and temporary fix to this problem of aquatic nuisance species dispersal, with fish being the first target. New measures must be implemented to control the movement of other non-native biological organisms such as plants, plankton, and mussels. Additional study is being undertaken to remedy the unnatural connection between basins, but until a permanent solution is recognized and agreed upon, it is anticipated temporary solutions will continue to be implemented and changed as needed.

Without immediate implementation of emergency measures to prevent Asian carp dispersal around the barrier system via the Des Plaines Rive and/or I&M Canal, there is a high level of certainty that Asian carp will gain access to the Great Lakes. The efficacy of the in place electric barriers is quite dependent upon all other routes of dispersal being sealed off. Only adult through juvenile fish are of concern with this issue. Eggs and larvae that get swept over these points would quickly be washed back down stream since they do not have swimming capability. Taking no action would allow Asian carp to disperse to the Great Lakes basin thereby making the placement of an electrical barrier system in the canal useless.

4.3 – Interim Risk Reduction Emergency Measures

The following risk reduction measures were considered to reduce the probability of failure and/or consequences associated with the failure modes identified in Section 4.1. A large range of measures were discussed, and those that were deemed effective at reducing the risk of allowing Asian carps to dispersal around the barrier system were retained. Each of these measures were then looked at independently for engineering feasibility, environmentally acceptable, and cost efficiency with a final step of optimizing, which combined certain measures to achieve cost reductions while still providing maximum risk reduction of Asian carp bypass. The cost engineering section performed this analysis and is detailed in Appendix C.

The alignment for any of the following IRRMs will be along a preexisting recreational trail/road that was built upon formerly used railroad ballast. This road runs parallel to and in between the

Des Plaines River and CSSC (Appendix C and Plates 2-4). The anticipated construction footprint is about 20-feet wide, with a permanent footprint of 2 to 4-feet wide. The highest elevations were chosen to avoid wetlands and reduce the height of the risk reduction measures.

<u>1 No Action</u> – Maintains the status quo and would most likely allow for the Asian carps to bypass the barrier system.

<u>2 Gabion Baskets</u> – Stacked Gabion baskets made of galvanized wire mesh and filled with stone could be utilized. Typical dimensions of a single basket are 3'x3'x6' with 3"x3" openings in the wire mesh. They can be constructed at the project site and stacked as necessary to the desired height. The current estimate assumes the gabion baskets would be filled with rip rap. The topsoil will be stripped and a 6" layer of compacted gravel will be placed prior to placement. This option likely has the longest installation time of the all the barrier options. The gabion baskets would become impermeable over time as they filled with silt, debris and vegetation.

<u>3 Concrete Barricades</u> – Precast concrete barricades are an impermeable barrier. Typical dimensions are 2'-3" tall x 12'-6" long with a 1'-7 5/8" base width and 8" top width. Concrete barricades will be precast and delivered to the site. Barricades are available with male-female ends so that they can be fitted together to minimize flow between the barricades. The topsoil will be stripped and a 6" layer of compacted gravel will be placed prior to placement. Installation time is minimal, although lead time may be required. Placement of compacted gravel and fitted ends will minimize need for sandbags and plastic sheeting.

<u>4 Rapid Deployment Flood Walls (RDFW's)</u> – A RDFW is a modular, collapsible plastic grid that serves as a direct replacement for sandbag walls, which forms an impermeable barrier. Typical dimensions are 8" tall x 3'-6" long x 3'-6" wide. They are assembled in place to the desired height and then filled with sand. It can be assembled with minimal labor and filled with a loader. The topsoil will be stripped and a 6" layer of compacted gravel will be placed prior to placement. Although this feature is typically dismantled after the flood risk is gone, in this application, the RDFW would remain in place until a permanent solution to fish bypass is implemented.

<u>5 Concrete Blocks</u> – Concrete blocks are an impermeable barrier. Typical dimensions vary depending on the height. Concrete blocks will be precast and delivered to the site. The topsoil will be stripped and a 6" layer of compacted gravel will be placed prior to placement. Installation time is minimal, although lead time may be required.

<u>6 Chain Link Fencing</u> – Chain link fence is a permeable barrier. Typical dimensions of a section of fence are 6' long by either 4', 6' or 8' tall. It would consist of 6 gauge galvanized wire steel mesh with 1/4" openings. Fence posts will be four inches in diameter galvanized steel and will be set four feet into the ground into a twelve inch diameter concrete post hole. The posts will be spaced six feet on center. In areas where bedrock exists at the surface, the bedrock will be drilled to accommodate the post holes. The 6' & 8' tall fence will have three rails (top, middle, bottom) horizontally between the fence posts and the 4' tall fence will only have two (top & bottom). Rails will be 1 5/8" diameter galvanized steel pipe. This is not a tried and true method for excluding fish, but theoretically it can stop the dispersal of Asian carps as long as the structural integrity of the fence is maintained. An angled non-barbed wire extension will be placed atop of the fence to thwart leaping silver carp. Issues that may arise from using the

fence include vandalism and breakage, clogging with riverine debris and scouring at the base. Continual maintenance would need to be performed to remove clogs and to ensure that if fence cutting occurs, it is quickly mended. Installation time is long and lead time will be necessary because the current robust design of the fence requires materials in massive quantities that will not be found in stock. Riprap will be placed along the bottom fence rail in areas where scour could be an issue during a major flood event.

7 Culvert Blocking – The recommended near term solution for the I&M potential bypass after preliminary H&H analysis, is to block off the I&M Canal at Cico Road and slip line (reduce the roughness of the pipe by inserting a PVC pipe in the existing culvert) and add inlet transitions to the International-Matex Tank Terminals (IMTT) culverts. The hydrologic flow divide is located just east of Cico Road, so placing a barrier here would not affect stormwater flows or induce flooding Inclusion of additional freeboard will be evaluated during detailed design and floodway permit process.

8 Chain Link Fence & Concrete Barricade Combo / Block I&M Canal – Optimized combination of concrete barricade and chain link fence with ¼” openings for the Des Plaines bypass, and culvert blocking to address the I&M Canal bypass.

4.4 – Risk Reduction Action Analysis

The primary risk being reduced is the potential for dispersal of Asian carps into the Great Lakes. As the current electric dispersal barrier project is implemented, Asian carp could bypass via overland flows from the Des Plaines River and a culvert connection in the I&M Canal. Each of the proposed actions also has a much smaller risk of allowing Asian carps to bypass the barrier system when implemented as well. This would occur when flood events exceed the proposed level of risk reduction, or if there is a failure of the temporary system. Potential adverse affects of raising the 100-year flood plain profile by +2-feet are possible with select measures based on hydraulic modeling of the various measures considered (Figure 3 & Table 1) (see also Appendix A). Cost was determined for each action at the 100-year flood elevation and the 100-year flood elevation with 3 levels of free board: 1, 2 and 3-feet (Appendix C). Since the 2008 event exceeded a 100 year event, it was determined that more than one foot of freeboard would be appropriate, so that the proposed line of protection would exceed the last overtopping event. Further, since the cost was not dramatically increased for higher levels of freeboard, it was decided that to ensure the efficacy of the dispersal barriers, the actions would be implemented to the 100-year flood elevation plus 3-feet of freeboard. Additional factors, such as the age of the hydrologic and hydraulic models were also part of the decision making process. The use of three feet of freeboard is consistent with the high level of uncertainty associated with the existing H&H modeling.

Figure 3 – Recommended Plan 100-yr Flood Stages Compared to Flood Insurance Study Model

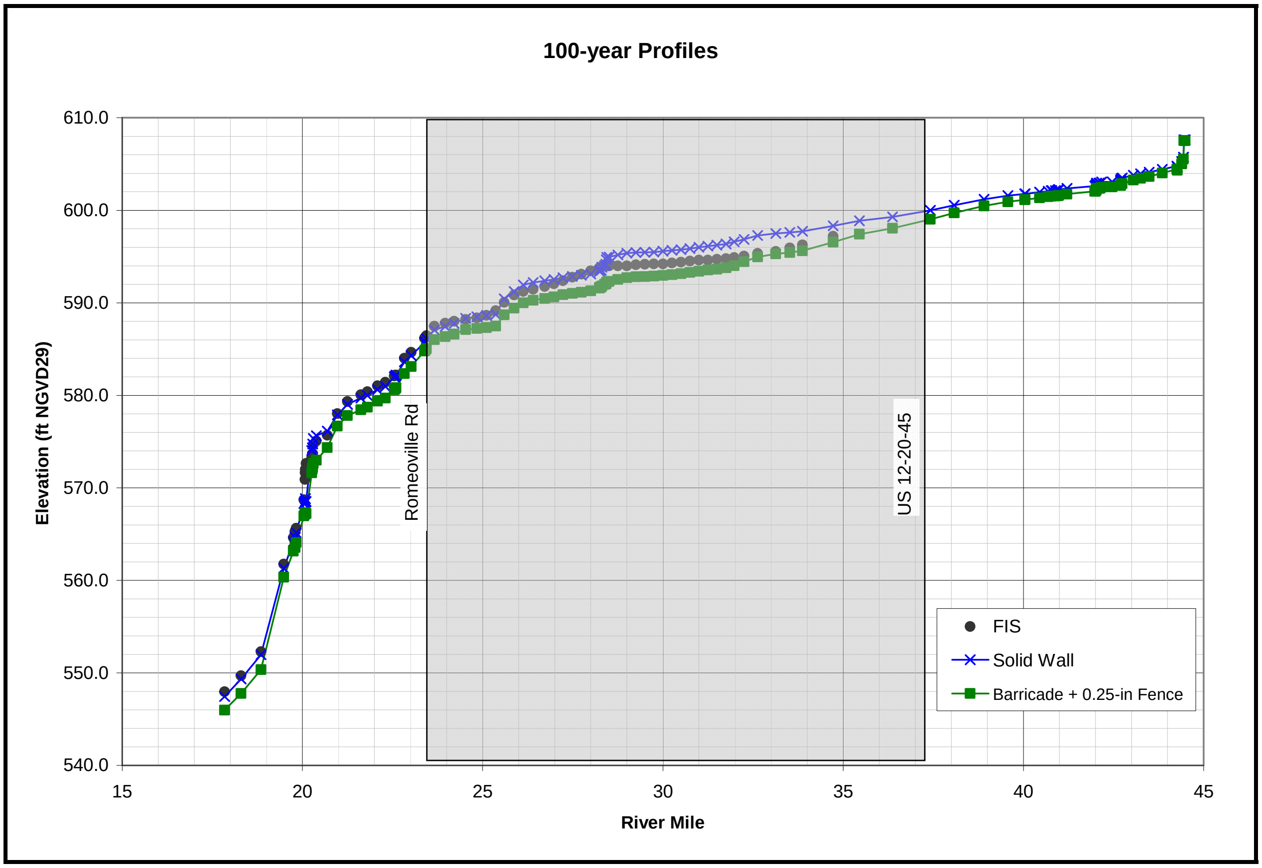


Table 1 – 100-year Profiles and Stage Increases with IRRM Implementation.

		100-year Water Surface Elevation		
Location	**River Mile(s)**	**FIS**	**Solid Wall**	**Barricade + 0.25-in Fence**
Lockport Prairie	18.3	549.7	549.3	547.8
	19.8	564.6	564.7	563.6
Romeoville Rd	23.41	586.3	585.8	584.9
Black Partridge Woods	26.25	591.3	592.0	590.1
	28.25	593.8	593.5	591.7
Lemont Rd	28.25	593.8	593.5	591.7
Waterfall Glen	28.25	593.8	593.5	591.7
	31.75	594.8	596.4	593.8
IL-83 / Kingery Rd	31.75	594.8	596.4	593.8

Figure 3 and Table 1 above displays the 100-year flood profiles of three conditions: the Flood Insurance Study (FIS), which represents existing, without project conditions, a solid wall (representing water impervious barriers), and a fence-barricade combination. Water surface elevations for the three conditions were reported out for critical habitat locations as well as key landmarks within the study area. The analysis for the FIS condition assumed no overflow from the Des Plaines into the CSSC due to the existence of large spoil piles when the model was created in the early '1980s. The spoil piles were removed in the 1990s, after the FIS was completed, but the regulatory model has not been updated by the State of Illinois to reflect current topographic conditions. Existing conditions without the spoil piles were also modeled as part of the H&H analysis, but were not used as a point of comparison to assess regulatory impacts. Because the fence-barricade combination still allows water overflows while blocking fish, the flood stage is lower than both the FIS and solid wall simulations.

As shown in Figure 3, the fence-barricade combination produced lower flood stages than the solid wall or the existing conditions (FIS). The solid wall option would raise the water surface elevation in sensitive areas highlighted in the table. At Lockport Prairie, a solid wall would induce 100-year flood stages 0.1 ft higher than the FIS and over 1 ft higher than the fence-barricade combination. At Black Partridge Woods, the solid wall would induce flood stages up to 0.7 ft higher than the FIS and nearly 2 ft higher than the fence-barricade combination. At Waterfall Glen, a solid wall would induce flood stages 1.6 ft higher than the FIS and 2.6 ft higher than the fence-barricade combination. Impacts to critical habitat, even on an emergency basis could require extensive mitigation as would seriously delay the installation of emergency measures to reduce risks associated with bypass of the barriers via the Des Plaines River.

Table 2 outlines the associated risks, adverse effects and costs per action. Costs associated with each of the measures is based on the length and unit costs for each measure. Table 2 also documents the conclusion of the team's analysis: 1) of all the IRRM's considered, four alternatives provided the greatest benefit in terms of "major reductions in fish passage" and "highest risk reduction to the Great Lakes;" 2) of these four, two were not cost effective (RDFW's and chain link fence only); 3) of the remaining two, the least expensive alternative (concrete blocks) was not acceptable due induced flooding, unlikelihood of obtaining a state permit, T&E impacts, and adverse impacts to wetlands and nature preserves. Based on the analysis, only one alternative (optimized combination chain link fence/concrete barrier) provided the greatest benefits, least adverse effects and second lowest costs.

A detailed project cost analysis, including design, construction oversight and lands is contained in Table 3. A detailed effects analysis is presented in Chapter 5, Environmental Assessment. The analysis was based on several key factors, the reduction in the risk to the Great Lakes provided by the measure, the potential negative effects, i.e. induced flooding and the impacts associated with the induced flooding in the project area.

Table 2 – Risk Reduction Analysis[1,2]

#	Interim Risk Reduction Measure	Level of Protection	Reduction in Risk to Great Lakes Ecosystem	Action Risk	Affects / Effects	Construction Cost
1	No Action	N/A	no reduction, fish could pass	N/A	Significant adverse affects to the Great Lakes ("GL") ecology and economics of the region; no induced flooding; possible use of pesticides in waterway up stream and eventually GL tributaries; no NEPA. Real estate requirements - none;	$ -
2	Gabion Baskets	100-YEAR + 3 FEET OF FREEBOARD	significant reduction in fish passage; will block most swimming life stages of fish; potential for small holes to form in baskets allowing small fish to pass through	scour at toe of structure could impact structure stability; gabion baskets are subject to vandalism that would impact structure integrity	Structure would provide medium risk reduction to Great Lakes, but with appreciable flooding induced up to 2'; not likely to get state permit; labor intensive and time consuming to install; threatened and endangered ("T&E") species impacts at Lockport Prairie; significant impact to wetlands; structure would require some real estate interest for construction and maintenance; impacts to 2 Nature preserves; NEPA = EIS. Real estate requirements - Level 2.	$ 16,640,000
3	Concrete Barricades	10-YEAR	significant reduction in fish passage up to 2.5'; will block all swimming life stages of fish until overtopped in lowest areas	jersey barriers provide only 2.5' of vertical protection; scour at toe of barriers could impact structure stability and integrity;	Modest risk reduction to GL because only 10 year level of protection; easy to implement; significant maintenance required to ensure that flow paths for small fish do not develop; T&E impacts minimal, no impact to wetlands, modest real estate interest required for implementation and maintenance; NEPA = EA. Real estate requirements - Level 2	$ 2,610,000
4	RDFWs	100-YEAR + 3 FEET OF FREEBOARD	major reduction in fish passage; will block all swimming life stages of fish	relatively new flood-fighting technology, potential loss of integrity the longer the RDFW is in place.	Structure would provide the highest risk reduction to GL; appreciable flooding induced up to 2'; not likely to get state permit; expensive, labor intensive and time consuming to install; T&E impacts at Lockport Prairie; adverse impact to wetlands, wide structure. Impacts to 2 Nature Preserves; NEPA = EIS. Real estate requirements - Level 3	$ 34,280,000
5	Concrete Blocks	100-YEAR + 3 FEET OF FREEBOARD	major reduction in fish passage; will block all swimming life stages of fish	scour at toe of structure could impact structure stability;	Structure would provide the highest risk reduction to Great Lakes; appreciable flooding induced up to 2'; not likely to get state permit; labor intensive and time consuming to install; T&E impacts at Lockport Prairie; adverse impact to wetlands, wide structure would require maximum real estate interest for construction and maintenance. Impacts to 2 Nature Preserves; NEPA = EIS. Real estate requirements - Level 1.	$ 9,030,000
6	Chain Link Fence w/ 1/4" openings	100-YEAR + 3 FEET OF FREEBOARD	major reduction in fish passage; will block adult & sub-adult fish	potential for scouring at base of fence; potential blocking from flood debris or vandalism of fence mesh.	Structure would provide the highest risk reduction to Great Lakes by blocking passage of all swimming stages of fish; no appreciable flooding induced; easy to implement; no T&E impacts; no impact to wetlands; NEPA = EA. Real estate requirements - Level 1.	$ 15,230,000
7	I&M Culvert Block	TBD	major reduction in fish passage; will block all swimming life stages of fish	none	No adverse affects; Lowest risk reduction to GL; easy to implement; no T&E impacts; no impacts to wetlands; NEPA = EA. Real estate requirements - Level 1.	$ 350,000
8	Chain Link Fence/ Concrete Barricade Combo / Block I&M Canal - Optimized IRRM	100-YEAR + 3 FEET OF FREEBOARD	major reduction in fish passage; will block all swimming life stages of fish	potential for scouring at base of fence; potential blocking from flood debris or vandalism of fence mesh.	Level 1 adverse affects; Structure would provide the highest risk reduction to the GL by blocking passage of all swimming stages of fish; in select areas concrete barrier affects are same as fence and less expensive and thus optimized; no appreciable flooding induced; easy to implement; no T&E impacts; no impact to wetlands; NEPA = EA. Real estate requirement - Level 1.	$11,570,000

[1] Each of these measures span the entire 13-miles of bypass except for the I&M Culvert Block

[2] RE Requirements & Implementation Time: Level 1- modest real estate requirements; 150 to 180+ days; Level 2 medium real estate requirements; 150 to 180+days; Level 3 greatest real estate requirements; 180 to 270+days

The Desirable End State

The most desirable “end state” would be to have an easily constructed impermeable barrier along the entire area where the Des Plaines River has the potential to overflow into the Des Plaines River. This measure would ensure that all life stages of Asian carps would be prevented from bypassing the barrier along the Des Plaines River up to the top of the level of protection proposed for construction. These risk reduction measures that are impermeable to fish and nekton (non-swimming eggs and larvae) would be impermeable to water as well. These were contemplated, but are not feasible primarily due to hydrologic, hydraulic and environmental adverse affects. The following discussion identifies several adverse issues with an impermeable measure.

Section 7 Endangered Species Act Consultation

Under provisions of the Endangered Species Act a Federal Agency must consult with the USFWS for activities that may impact Federally listed species. A flood profile raise of up to 2-feet for the 100-year event will allow water from the Des Plaines River to overbank into 101 parcels and effect 14 structures, including Lockport Prairie, Waterfall Glen and several other Nature Preserves. Lockport Prairie is an area known to have two Federally listed plant species, the leafy prairie clover and the lakeside daisy, and one animal species, the Hines emerald dragonfly that could be affected by increased water levels. As a result, the Corps would have to initiate consultation with the USFWS. Once the formal consultation process starts the USFWS Biological Opinion on the impacts of the project must be completed within 135 days. If it is determined that the project will have an adverse effect the Corps and USFWS would examine all reasonable and prudent measures to prevent or minimize the impact. If there is no way to avoid or minimize an impact the project is likely to be stopped. The Corps believes there is a strong possibility that a 2-foot raise in the 100 year profile will negatively impact 3 Federally listed species and the possibility to avoid or minimize impacts would be a time consuming process. The ESA time constraints likely involved make a solid barrier not feasible.

Real Estate Implications and Constraints

The building of a solid barrier on an emergency, interim basis that raises the 100-year profile up to 2-feet is estimated to cause flooding on 101 parcels and 14 structures. This impact would require the government to acquire flowage easements on all of the impacted parcels and structures. Assuming all the land owners would not provide the flowage easements willingly, the time required for acquiring flowage easements by condemnation could take in excess of 9 months to a year to get possession. Final legal actions as to value challenges and damages could take 3 years to resolve. The real estate time constraints likely involved in obtaining flowage easements make a solid barrier not feasible at this time given the impending anticipated flood events on the Des Plaines River. See Table 2.

The Preferred Interim Risk Reduction Measure

An optimization analysis was performed by the planning and cost engineering sections in which combinations of actions were applied where they were most appropriate and effective (Appendix C). For instance, along certain reaches of the Des Plaines River overflow alignment, only a 1-foot rise in elevation was needed to achieve the 100-year+3 level of protection;

therefore, the less expensive Concrete Barricades could be used to achieve full protection. The results of this optimization indicate that a combination of Concrete Barricades and Chain Link fence would be the most cost effective options, while maintaining a great degree of risk reduction/fish blockage, while having negligible affect on the 100-year floodplain profile (Figure 3 and Table 1). The concrete barricades can easily be designed to be impermeable to all fish life stages, but utilizing the pervious chain link ¼" mesh would offset any adverse affects from the barricade being water impervious. The ¼" wire mesh of the chain link fence could be easily designed to prevent all fish greater than a ¼" in girth from bypassing. The current threat of Asian carps dispersal is from large adults. Even if eggs and larvae were present in the Des Plaines River, which is highly unlikely, they would be swept downstream to below barrier reaches within hours since they have no swimming capability.

The total cost for this optimized action is about $13,174,000 (Table 3). This optimized measure is the preferred method of a temporary solution to the Asian carp bypass of the CSSC dispersal barrier array. Also, the two culverts under Cico Road in the I&M Canal will be disabled and the flow capacity increased at the IMTT culverts. See Sheet C-07 in Appendix C for Concrete Barrier and Fencing locations. The option could be implemented the most expeditiously out of all of the options as well (Table 4).

Table 3 – Budget for Preferred Plan

Item	Estimate	Contingency	Total
Construction	$ 8,898,000	$ 2,669,000	$ 11,567,000
Land	$ 475,000	$ 119,000	$ 594,000
Preconstruction, Eng & Design	$ 454,000	$ 78,000	$ 532,000
Eng & Design During Construction	$ 110,000	$ 33,000	$ 143,000
Construction Management	$ 250,000	$ 75,000	$ 325,000
Project Close Out	$ 10,000	$ 3,000	$ 13,000
Total Project Costs	**$ 10,197,000**	**$ 2,977,000**	**$ 13,174,000**
Annual O&M Costs	**$ 813,000**	**$ 81,000**	**$ 894,000**

Table 4 – Implementation Schedule for Preferred Plan

Start Date	Phase	Activity
7-Dec-09	PED	Plans and Specifications
2-Jan-10	PED	ATR Review
15-Jan-10	PED	Design Complete
30-Jan-10	PED	BCOE Signoff/RTA
10-Feb-10	PED	Real Estate Available
10-Feb-10	Construction	Advertise
16-Feb-10	Construction	Purchase Order Fence Mesh & Barricades
15-Mar-10	Construction	Contract(s) Award
31-Oct-10	Construction	Construction Complete

CHAPTER 5 – ENVIRONMENTAL ASSESSMENT

5.1 – Coordination and Compliance

The recommend plan (IRRMs) presented in this Integrated Environmental Assessment is in compliance with appropriate statutes, executive orders including the Natural Historic Preservation Act of 1966, the Endangered Species Act of 1973, the Fish and Wildlife Coordination Act, Executive Order 12898 (environmental justice), Executive Order 11990 (protection of wetlands), Executive Order 11988 (floodplain management), the Rivers and Harbors Act of 1899, the Clean Air Act, the Clean Water Act, and the National Environmental Policy Act of 1969.

Federal Statues and Regulation Compliance

This feasibility study complies with applicable environmental laws, regulations, and Executive Orders for the current stage of the study. Table 5 provides a summary of the compliance status for the primary environmental requirements associated with the study.

Table 5 - Compliance with Environmental Statutes and Regulations

Reference	Environmental Regulation	Compliance Status*
16 USC 1531, et seq.	Endangered Species Act, as amended	Compliance Expected
16 USC 460 (L),(12)	Federal Water Project Recreation Act, as amended	Compliance Expected
16 USC 4601-4, et seq.	Land and Water Conservation Fund Act, as amended	Compliance Expected
16 USC 470a, et seq.	National Historic Preservation Act (NHPA), as amended	Compliance Expected
16 USC 661	Fish and Wildlife Coordination Act, as amended	Compliance Expected
16 USC 703 et seq.	Migratory Bird Treaty Act of 1918,as amended	Compliance Expected
16 USC469, et seq.	Archaeological and Historical Preservation Act as amended	Compliance Expected
25 USC 3001, et seq.	Native American Graves Protection and Repatriation Act	Compliance Expected
33 USC. 1251 et seq.	Clean Water Act, of 1977, as amended	Compliance Expected
42 USC 1962	Water Resources Planning Act of 1965	Compliance Expected
42 USC 1996	American Indian Religious Freedom Act of 1978	Compliance Expected
42 USC 201	Safe Drinking Water Act of 1986 as amended	Compliance Expected
42 USC 4321, et seq.	National Environmental Policy Act (NEPA), as amended	Compliance Expected
42 USC 4901, et seq.	Quiet Communities Act of 1978	Compliance Expected
42 USC 6901, et seq.	Resource Conservation and Recovery Act of 1976, as amended	Compliance Expected
42 USC 7401	Clean Air Act (CAA) of 1970 as amended	Compliance Expected
42 USC 9601	CERCLA of 1980	Compliance Expected
7 USC 4201, et seq.	Farmland Protection Policy Act	Compliance Expected
CEQ Memo Aug 11,1980	Prime or Unique Agricultural Lands NEPA	Compliance Expected
E.O. 11514	Protection and Enhancement of Environmental Quality	Compliance Expected
E.O. 11593	Protection and Enhancement of the Cultural Environment	Compliance Expected
E.O. 11988 (1977)	Floodplain Management	Compliance Expected
E.O. 11990 (1977)	Protection of Wetlands	Compliance Expected
E.O. 12088 (1978)	Federal Compliance with Pollution Control Standards	Compliance Expected
E.O. 12898 (1994)	Federal Actions to Address EJ in Minority and Low-Income Populations	Compliance Expected
E.O. 13007 (1996)	Indian Sacred Sites	Compliance Expected
E.O. 13045 (1997)	Protection of Children from Environmental Health Risks and Safety Risks	Compliance Expected
E.O. 13186	Responsibilities of Federal Agencies to Protect Migratory Birds	Compliance Expected
E.O. 13340	Great Lakes Designation of National Significance to Promote Protection	Compliance Expected
PL 79-525, 60 Stat 634	Rivers and Harbors Act of 1946	Compliance Expected

*pending agency and public review

<u>EO12898 – Environmental Justice</u> – To the greatest extent practicable and permitted by law, and consistent with the principles set forth in the report on the National Performance Review, each Federal agency shall make achieving environmental justice part of its mission by

identifying and addressing, as appropriate, disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority populations and low-income populations in the United States and its territories and possessions, the District of Columbia, the Commonwealth of Puerto Rico, and the Commonwealth of the Mariana Islands. The project area is primarily a checker board of industrial lands and low quality forest. The recommended IRRMs do not have any adverse impacts to any minority or low income populations.

Clean Air Act – Due to the small scale, short duration and existing quality of the immediate project area, the project is considered below the de minimis level of particulate matter of 100 tons per year. As a reference, other Chicago District projects that are much grander in scale and earthwork have readings well below the particulate matter of 100 tons per year.

Section 404(b)(1) of the Clean Water Act – Wetlands or waters of the United States would not be filled or impacted. The alignment of the IRRMs would be such that all wetlands would be avoided. The alignment would be placed along the recreational road and on preexisting railroad ballast. The I&M Canal culvert blocking would have no affect on navigation, the environment or wetlands.

Section 401 Compliance – This project would have no effect on water quality or wetlands. 401 Water Quality Certification is not required. Coordination with IEPA is in progress and they are expected to concur.

USF&WS Coordination – Preliminary consultation with the USFWS under Section 7 of the Endangered Species Acts was initiated and documented in a letter 19 October 2009. A biological assessment was provided to the USFWS on 18 December 2009. The Biological Assessment concluded no adverse affect under Section 7 of the Endangered Species Act. The USFWS is expected to complete their Biological Opinion by 8 January 2010 and concur with the Corps' assessment.

SHPO Coordination – There is no significant affects to cultural, historical or archaeological resources associated with the preferred risk reduction measures. The Illinois Historic Preservation officer has concurred with this determination in a letter dated 27 October 2009.

The National Environmental Policy Act (40 CFR 1501.6) allows the action agency to establish a cooperating agency relationship with other Federal agencies that have jurisdiction by law or special expertise relevant to the project. The USACE established a relationship with the USFWS and USEPA, in which they are serving significant roles in the management and monitoring of the CSSC Dispersal Barrier project.

5.2 – Need & Purpose of Proposed Action

Without immediate implementation of temporary Interim Risk Reduction Measures (IRRMs) to prevent Asian carps dispersal around the barrier system via the Des Plaines River and/or I&M Canal, that Asian carp will gain access to the Great Lakes. The efficacy of the in place electric barriers is quite dependent upon all other routes of dispersal being sealed off. Only adult through juvenile fish are of concern with this issue. Eggs and larvae that get swept over these points would quickly be washed back down stream since they do not have swimming capability.

Taking no action would allow Asian carp to disperse to the Great Lakes basin thus making the placement of an electrical barrier system in the canal useless.

5.3 – Alternatives (IRRMs) Considered

A large range of measures were discussed, and those that were deemed effective at reducing the risk of allowing Asian carps to dispersal around the barrier system were retained. The following IRRMs, which are temporary, were considered to reduce the probability of failure and/or consequences associated with the failure modes identified in Section 4.1:

1. No Action
2. Gabion Baskets
3. Concrete Barricades
4. Rapid Deployment Flood Walls (RDFW's)
5. Concrete Blocks
6. Chain Link Fencing
7. Culvert Blocking
8. Chain Link Fence/ Concrete Barricade Combo / Block I&M Canal (Optimization)

The Interim Risk Reduction Measures, or as NEPA would term them Alternatives, are detailed in Section 4.3 – Interim Risk Reduction Measures. Table 2 identifies levels of protection, associated risks, environmental effects and costs. The No Action alternative was considered as well.

The Preferred Alternative (IRRM)

The preferred alternative, from here on termed, Interim Risk Reduction Measures (IRRMs), is optimized IRRM 8. This includes placing 34,600-feet of Concrete Barricades and 33,400-feet of Chain Link Fence with ¼" openings to prevent the potential bypass of adult and juvenile Asian carps. The implementation of this measure would protect 68,000-feet (~13-miles) of flood prone area along the CSSC upstream of the Dispersal Barriers. Also, the two culverts under Cico Road in the I&M Canal will be disabled, along with modifications to the IMTT culverts and inlets.

5.4 – The Affected Environment

The affected environment is described in detail in Chapter 3 – Current Conditions, with comprehensive species lists located in Appendix E. The alignment of the measures will be along a preexisting recreational trail/road that was built upon formerly used railroad ballast. This road runs parallel to and in between the Des Plaines River and CSSC (Appendix C and Plates 2-4). The anticipated construction footprint is about 20-feet wide, with a permanent footprint of 2 to 4-feet wide. The highest elevations were chosen to avoid wetlands and to reduce the height the features would have to be. The affected area of the I&M Canal proposed blockage is a highly degraded ditch that has since filled in with sediment. This area is of little to no habitat value for native aquatic organisms.

5.5 – Direct & Indirect Effects

Climate

The preferred IRRM would not directly or indirectly affect the regional climate.

Other IRRMs considered also would not directly or indirectly affect the regional climate.

The rationale behind no affects is that all of the considered IRRMs are temporary and surficial in character. There would be no pollutants or chemicals or activities that could possibly affect climate involved.

Geology

The preferred IRRM would not directly or indirectly affect regional geology, unique geologic features or geological processes. Minor holes would be bored in some areas to secure fence posts.

Other IRRMs considered would not directly or indirectly affect the geology or unique geologic features of the study area.

The rationale behind no affects is that all of the considered IRRMs are temporary and surficial in character. There would be no excavation or disturbance of bedrock or fluvial geomorphic processes.

Soils

The preferred IRRM would not directly or indirectly affect the natural soils series of the study area. The rationale behind the no affect determination is that hydraulic and hydrologic profiles would remain in the current condition; therefore flood waters would not intrude in areas where natural soil series occur.

Other IRRMs considered that would increase the 100-year floodplain by 2-feet could have long term affects on the soils in natural areas. The new flooding regime would deposit silt, sediments and nutrients overtime, thusly creating a different kind of soil.

Land Use

The preferred IRRM would not directly or indirectly affect the current land uses of the study area. The rationale behind the no affect determination is that hydraulic and hydrologic profiles would remain in the current condition; therefore land use and their associated activities would be of the same status as the current conditions.

Other IRRMs considered that would increase the 100-year floodplain by 2-feet could have short term affects during a flood event by disallowing normal activities to commence due to flood water inundation.

Hydrology & Hydraulics

The preferred IRRM would not appreciably affect the current hydrology and hydraulics of the study area. The hydrologic modeling (Appendix A) shows only a .08 raise in the 100-year flood profile. The preferred project is not located in the regulatory floodway and so is not subject to state regulations.

Other IRRMs considered that would increase the 100-year floodplain by 2-feet would have adverse affects to the timing, duration and extent of study area hydrology. Raising the 100-year floodplain profile by 2-feet would flood out certain businesses along the waterway and would have adverse affects on the Lockport Prairie Nature Preserve and Romeoville Prairie. It is unlikely the required state permits could be obtained for measures that increase the 100-year floodplain profile by 2-feet.

Air Quality

The preferred IRRM, as well as other IRRMs considered, would cause localized, temporary increases in exhaust emissions from equipment and vehicles during construction, and may cause localized, temporary increases in particulate emissions from dust related to construction activities. These impacts would be limited through emissions controls and dust controls during construction, in compliance with USACE, USEPA, Illinois EPA, and local laws and regulations. The construction specifications will include language providing protection for the local environment. The project as proposed is compliant with the Clean Air Act, and will not result in significant or long-term adverse impacts to air quality.

Water Quality

The preferred IRRM would not directly or indirectly affect the regional or local water quality.

Other IRRMs considered also would not directly or indirectly affect the regional or local water quality.

The rationale behind no affects is that all of the considered IRRMs are temporary and surficial in character. There would be no excavation or disturbance of soils or contaminated areas that could have affects on water quality during a flood event.

Riverine Habitat

The preferred IRRM would not directly or indirectly affect the riverine habitat of the Des Plaines River.

Other IRRMs considered also would not directly or indirectly affect the riverine habitat of the Des Plaines River.

The rationale behind no affects is that The Des Plaines River, in the study area, already has particle sizes of large boulder and in most places is scoured to the bedrock. Temporary increases in flood elevations and hydraulic forces would not alter this type of instream habitat.

Technically, large channel forming events are critical in maintaining the dynamic nature of rivers and are need to provide habitat diversity.

Riparian Plant Communities

The preferred IRRM would not directly or indirectly affect the immediate riparian plant communities of the study area.

Other IRRMs considered that would increase the 100-year floodplain by 2-feet would not change the immediate riparian plant community composition and structure, since this is typically dictated by more frequent events of 2 to 5-year frequencies. The predominant vegetation of the area is tolerant and weedy species that are able to handle much disturbance from hydrology alterations and physical land use alterations.

Aquatic Communities

The preferred IRRM would not directly or indirectly affect the aquatic communities of the Des Plaines River; however, this IRRM would protect the aquatic communities of the Great Lakes, as they currently stand, from Asian carps invasion. The addition of an additional planktivorous fish species to the Great Lakes could be detrimental for the remaining planktivores, such as ciscoes and whitefish (*Coregonus* sp.)

Other IRRMs considered also would not directly or indirectly affect the aquatic communities of the Des Plaines River, but would also protect the Great Lakes in the same manner.

Other Wildlife

The preferred IRRM would have minor and temporary affects on local wildlife migration. Although this area is typically degraded habitat for wildlife, tolerant species still utilize the area. These include whitetail deer and raccoon. The areas of fencing would impede local migration of these species, but they would eventually be able to bypass the barrier once they found the concrete barricade locations, which could easily be crossed by deer and other mammals. Birds could easily fly over and turtles primarily use the Des Plaines River and waterways as their migration pathways.

Other IRRMs considered would have the same affects on wildlife as the preferred IRRM.

Natural Areas

The preferred IRRM would not directly or indirectly affect the natural areas located within the study area. The rationale behind no affects is based on no increase in the 100-year floodplain. The H&H modeling shows a 1% decrease in flood elevations with preferred alternative implemented. This 1% reduction in the 100-year flood profile is insignificant to ecologic functions of these natural areas. The Illinois Department of Natural Resources and USFWS are expected to concur. Mitigation is not expected.

The preferred IRRM would not directly or indirectly affect the natural areas located within the project area. The rationale behind the assessment of no-affects in the reduction in the regulatory profile for with versus without project conditions. The H&H modeling indicates a decrease in the 1% event water surface profile for the preferred IRRM conditions. A small decrease or increase in water levels associated with an infrequent event, such as the 1% event, is very unlikely to impact water regimes at natural areas that are typically driven by more frequency events such as the 50% event (2-year) or 99% event (1-year). Further, the critical factor for these natural areas is minimizing overflow from the Des Plaines River, which could include the deposition of silt as well as an inflow of degraded water quality in areas that currently support sensitive native species.

Those measures that could increase the 100-year floodplain by 2-feet would adversely affect the Black Partridge Woods Forest and Nature Preserve, the Palos Forest Preserve, Lockport Prairie Nature Preserve, Santa Fe Prairie, and Romeoville Prairie. Portions of these natural areas that do not current experience inundation are free from the adverse affects of poor water quality of the Des Plaines River. If these portions were inundated several times or perhaps once, they would receive silt, nutrients and other pollutants that could alter and degrade the current plant community composition and structure.

Threatened & Endangered Species

The preferred IRRM would not directly affect threatened and endangered species or their critical habitats within the immediate project area; however, it would protect many threatened and endangered planktivorous species in the Great Lakes basin such as the listed ciscoes and whitefish (*Coregonus* sp.). As noted in the discussion on Natural Areas above, no affects are anticipated because the preferred IRRM would not result in a significant change in water levels for the 1% event.

Those measures that could increase the floodplain by 2-feet would adversely affect those species living in close proximity to the boundary of the 100-year floodplain. If critical habitats were inundated several times or perhaps even once, they would receive excess water, silt and nutrients that would alter and degrade them.

T&E species identified in a letter by the Illinois Department of Natural Resources dated 14 October 2009 include the Federally Listed Hine's Emerald Dragonfly, leafy prairie clover, white lady's slipper, and State Listed buffalo clover, slender sandwort, car-leafed foxglove, Blanding's turtle, spotted turtle, eastern massasauga and Henslow's sparrow. These species are typically found in the natural areas along the Des Plaines River including the Black Partridge Woods Forest and Nature Preserve, the Palos Forest Preserve, Lockport Prairie Nature Preserve, Santa Fe Prairie, and Romeoville Prairie.

The District is engaged in ongoing coordination under Section 7 of the Endangered Species Act with the USFWS. As noted in the FWS letter dated 19 October 2009, the District is preparing a Biological Assessment for the T&E species that might be impacted by the preferred IRRM.

Archaeological & Historical Properties

None of the IRRMs considered, including the preferred IRRM, would directly or indirectly affect archaeological or historical properties of the study area, since there are no features of significance located within the area.

Social Setting

The preferred IRRMs, would not directly or indirectly affect the social setting of the study area since flooding would not be induced into residential or commercial areas.

Other IRRMs considered that would increase the 100-year floodplain by 2-feet could have adverse affects to the social setting. Raising the 100-year floodplain profile by 2-feet would flood out certain businesses and potentially a few residences along the waterway. This could greatly disrupt the normal way of life during certain flood events.

Recreation

Any of the IRRMs considered, including the preferred IRRM, would have short-term affects on local recreation during construction. Once construction of the temporary IRRM would be completed, the recreation trail would be open again for hiking and biking.

Hazardous, Toxic and Radioactive Wastes

None of the IRRMs considered, including the preferred IRRM, would directly or indirectly disturb or uncover hazardous, toxic or radioactive wastes, as identified by the HTRW report in Appendix D.

Prime Farmlands

None of the IRRMs considered, including the preferred IRRM would directly or indirectly affect farmland or prime farmlands, since none occur in the affected area.

17 Points of Environmental Quality

The 17 points are defined by Section 122 of Rivers, Harbors & Flood Control Act of 1970 (P.L. 91-611) from (ER 1105-2-240 of 13 July 1978). The 17 points include noise, displacement of people, aesthetic values, community cohesion, desirable community growth, tax revenues, property values, public facilities, public services, desirable regional growth, employment, business and industrial activity, displacement of farms, man-made resources, natural resources, air and water. Impacts to these identified points are not expected. Additional discussion on some of these points is as follows:

Noise –None of the IRRMs considered, including the preferred IRRM, would have significant increases in noise levels.

Displacement of People – The preferred IRRM would not displace any local residents within the township of the study area. Certain IRRMs identified in Table 1 have the potential to increase the 100-year floodplain and in consequence would temporarily impact people during a flood event of this magnitude.

Aesthetic Values – Any of the IRRMs considered, including the preferred IRRM, have the potential to reduce the aesthetic values of the Forest Preserve land they are being placed on except for the I&M Canal culvert disablement.

Community Cohesion –None of the IRRMs considered, including the preferred IRRM, would disrupt community cohesion. The project site is primarily a patch work of industrial lands and low quality forest.

Desirable Community Growth – None of the IRRMs considered, including the preferred IRRM, would adversely affect community growth.

Desirable Regional Growth – None of the IRRMs considered, including the preferred IRRM, would adversely affect regional growth.

Tax Revenues – None of the IRRMs considered, including the preferred IRRM, would affect tax revenues.

Property Values – The preferred IRRM would not affect property values. Any of the IRRMs considered that would raise the 100-year floodplain may affect nearby property values if the land classification changes to floodplain.

Public Facilities –None of the IRRMs considered, including the preferred IRRM, would adversely affect public facilities.

Public Services – None of the IRRMs considered, including the preferred IRRM, would adversely affect public services.

Employment – None of the IRRMs considered, including the preferred IRRM, would adversely affect employment. Short term employment gains would be realized with implementing the measures.

Business and Industrial Activity – The preferred IRRM would not adverse affect local business or industrial activity. Those measures that would raise the 100-year floodplain up to 2-feet may affect local commerce by halting day to day activity during an event. The No Action choice could adversely affect the commercial and recreational fishing industry in the Great Lakes.

Displacement of Farms – None of the IRRMs considered, including the preferred IRRM, would adversely affect farmland. There are no farms in the project area.

Man-made Resources – None of the IRRMs considered, including the preferred IRRM, would adversely affect man-made resources.

Natural Resources – The no action choice would greatly affect the Great Lakes basin by allowing the dispersal of Asian carps. Any of the IRRMs considered, including the preferred IRRM, would protect the Great Lakes basin from the invading Asian carps.

5.6 – Cumulative Effects Assessment

Consideration of cumulative effects requires a broader perspective than examining just the direct and indirect effects of a proposed action. It requires that reasonably foreseeable future effects be assessed in the context of past and present effects to important resources. Often it requires consideration of a larger geographic area than just the immediate "project" area. One of the most important aspects of cumulative effects assessment is that it requires consideration of how actions by others (including those actions completely unrelated to the proposed action) have and will affect the same resources. In assessing cumulative effects, the key determinant of importance or significance is whether the incremental effect of the proposed action will alter the sustainability of resources when added to other present and reasonably foreseeable future actions.

Cumulative environmental effects for the proposed ecosystem protection project were assessed in accordance with guidance provided by the President's Council on Environmental Quality (USEPA, EPA 315-R-99-002, May 1999). This guidance provides an eleven-step process for identifying and evaluating cumulative effects in NEPA analyses.

The overall cumulative effect of implementing the preferred risk reduction measure is considered to be beneficial environmentally, socially and economically. The protection of the Great Lakes and its thousands of miles of confluent tributaries is the ultimate goal of this Interim I determination. The most significant cumulative effect is preventing the dispersal of an aggressive invasive species to one of the largest freshwater ecosystems on the planet.

Scope

In this environmental assessment, cumulative effect issues and assessment goals are established, the spatial and temporal boundaries are determined, and the reasonably foreseeable future actions are identified. Cumulative effects are assessed to determine if the sustainability of any of the resources is adversely affected with the goal of determining the incremental impact to key resources that would occur should the proposal be permitted.

The spatial boundary for the assessment has been broadened to consider effects beyond the footprint of the dispersal barrier area and to include far reaching influence this action would have on the Great Lakes ecosystem.

The temporal boundaries considered are:

- Past –1920s because this is the approximate time that the modification of the Illinois Waterway System was complete providing an unimpeded dispersal route to and from the Great Lakes and Mississippi River basins.
- Present – 2009 when the decision is being made on an emergency risk reduction measure that would prevent Asian carps from entering the Great Lakes/Barrier II construction

- Future – 2010 -2020, the time frame used for implementing a final plan to ecologically separate the Mississippi and Great Lakes basins.

Projecting the reasonably foreseeable future actions is difficult at best. Clearly, the proposed action is reasonably foreseeable; however, the actions by others that may affect the same resources are not as clear. Projections of those actions must rely on judgment as to what are reasonable based on existing trends and where available, projections from qualified sources. Reasonably foreseeable does not include unfounded or speculative projections. In this case, reasonably foreseeable future actions include:

- Continued navigation in the Illinois Waterway, CSSC and Calumet Sag Channel
- Continued increase in floodplain profiles due to development and land use change
- Continued introduction of non-native species
- Continued application of environmental requirements such as those under the Clean Water Act and water quality improvement
- Implementation of various programs and projects to deal with runoff and waste water pollution and to restore degraded environments

Cumulative Effects on Physical Resources

The physical resources of the immediate spatial boundary (geology, soils, topography, land cover, hydrology) were altered from their natural condition. The creation of the Illinois and Chicago Waterway systems significantly altered what the retreating glaciers had created. The implementation of the preferred IRRM would not restore physical resources or alter them in the study area or the conjoined Great Lakes and Mississippi basins. Cumulative, adverse physical effects are not anticipated.

Cumulative Effects on Ecological Resources

The ecological resources of the spatial boundary (plants, fish, birds, prairies, streams, wetlands, etc) were altered from their natural condition. There are remnant patches left, however, that merit protection. The extensive change in hydrology, geology and land cover significantly impacted rare plant communities such as the dolomite prairie and valley seeps that etched the lower Des Plaines River valley. The degradation of natural and native communities has allowed for invasive species to easily take over by filling in niches that were once occupied by native species. The implementation of the preferred risk reduction measure will not restore ecological resources or degrade them, but would protect what is left in the Great Lakes aquatic ecosystem. Thus, implementing the preferred IRRM has a negligible incremental effect on the status of ecological integrity within the immediate study area. Cumulative, adverse ecological effects are not anticipated. Through implementing the preferred IRRM, an incremental benefit to the Great Lakes ecology would be achieved by disallowing a non-native planktivorous fish from colonizing. In terms of the Great Lakes ecology, this aids in the effort to restore the Great Lakes, and cumulatively will be a good action.

Cumulative Effects on Archaeological & Cultural Resources

The implementation of the preferred measure has no affect upon archaeological or cultural resources, either pre-European or post. Significant cultural or archaeological resources are not present in the affected area. Cumulative, adverse archaeological or cultural effects are not anticipated.

Cumulative Effects on Aesthetic Values

Aesthetics are typically a matter of conjecture. Many agree that Asian carps overrunning the Mississippi and Illinois Rivers as a grand nuisance, and it can be assumed this would be the same case if these fish were to disperse into the Great Lakes and the confluent tributaries. The choice is a 13 mile fence in a highly industrialized area, or jumping silver carp in the Great Lakes basin. Cumulative, adverse aesthetical effects are not anticipated.

Cumulative Effects Summary

Table 6 – Cumulative Effects Summary.

	1920 - Present (Past Actions)	No Action	Preferred Risk Reduction Measure
Air Quality	Significantly Adverse	No Effect	No Effect
Noise	Significantly Adverse	No Effect	No Effect
Geology and Soils	Significantly Adverse	No Effect	No Effect
Hydrology & Hydraulics	Significantly Adverse	No Effect	Minor Adverse
Land Use	Significantly Adverse	No Effect	Minor Adverse
T & E Species	Significantly Adverse	Significantly Adverse	Beneficial
Wetlands	Significantly Adverse	No Effect	No Effect
Aquatic Resources	Significantly Adverse	Significantly Adverse	Beneficial
Terrestrial Resources	Significantly Adverse	No Effect	No Effect
Recreation & Aesthetic Values	Significantly Adverse	Minor Adverse	Beneficial
Pre-1830 Cultural Resources	Significantly Adverse	No Effect	No Effect
Post-1830 Cultural Resources	Significantly Beneficial	No Effect	No Effect
Economic Resources	Significantly Beneficial	Adverse	Beneficial
Total Impacts	Significantly Adverse	Significantly Adverse*	Beneficial**

* The adverse effects are tied to Asian carps impacting Great Lakes resources
** The adverse effects are to the immediate area of the Barriers and the beneficial effects are to the Great Lakes by preventing Asian carps dispersal.

Along with direct and indirect effects, cumulative effects of the preferred risk reduction measures were assessed following the guidance provided by the President's Council on Environmental Quality. There have been numerous effects to resources from past and present actions, and reasonably foreseeable future actions can also be expected to produce both beneficial and adverse affects. In this context, the increments of effects from the proposed risk reduction measures are relatively minor in terms of adverse effects, but very important in terms of the long term viability of the Great Lakes ecosystem. Assessment of cumulative effects indicates that long-term sustainability of Great Lakes as a resource is dependent on the preferred risk reduction measure. Based on the expectation of continued sustainability of all resources, cumulative effects are not considered significantly adverse.

CHAPTER 6 – INTERIM I RECOMMENDATION

I have considered all significant aspects of the problems and opportunities as they relate to the high risk of Asian carps bypassing the Dispersal Barriers in the Chicago Sanitary & Ship Canal in the overall public interest. Those aspects include environmental, social, and economic effects, as well as engineering feasibility.

I recommend the approval and implementation of the optimized risk reduction measure as a temporary and emergency solution. The preferred risk reduction measure is to place 34,600-feet of Concrete Barricades and 33,400-feet of Chain Link Fence with ¼" openings. The cost for implementation of this IRRM is currently estimated to be $13,174,000. The implementation of this measure would protect 68,000-feet (~13-miles) of flood prone area along the CSSC upstream of the Dispersal Barriers. Also, the two culverts under Cico Road in the I&M Canal will be disabled and the capacity of the IMTT culverts would be increased.

Vincent V. Quarles

Vincent V. Quarles
Colonel, U.S. Army
District Commander

CHAPTER 7 – SUBSEQUENT INTERIM REPORTS

This study, Interim I investigates emergency measures that reduces the risk of the Asian carps bypassing the Dispersal Barrier from overland flow from the Des Plaines River to the CSSC and flow through culverts in the I&M Canal to the CSSC. The emergency measures need to be implemented as soon as possible, but no later than 28 October 2010 because the authority expires. However, there are additional areas of study that will be further expanded upon in subsequent Interim Reports. The final number of and subject matter of subsequent Interim Reports has not been finally decided at this time in deference to the emergency nature of this report. Some of the subsequent interim report recommendations may require additional Congressional authorization and appropriations for implementation. The subsequent Interim Reports could include any number of the following issues.

1. <u>Optimal Operating Procedures</u> - Optimal operating parameters is also an important issue since it is uncertain that the current operating voltage (1-2V/in) is the level that would stop all sizes of Asian carp. Research needs to be conducted to operate the barrier at the optimal level, which is assumed to be somewhere in the range of 1V/in to 4V/in. It is imperative that this voltage level immobilize juvenile bighead and silver carp as well as sub-adult and adult life stages of both species.

2. <u>Permanent Bypass Solution</u> - After addressing the need for short term emergency measures to prevent bypassing the barriers a major threat to the effectiveness of the dispersal barriers is for a permanent solution to the Dispersal Barrier bypass problem. The implementation of additional dispersal barriers or other physical features may be recommended for a more permanent solution.

3. <u>Breaching the Barrier</u> - Another major threat is an ANS breaching the barrier and permitting individuals to navigate through the existing barrier. In the case of Asian carps, the specific concern is the upstream dispersal of individuals through the barrier system. There are several factors that could possibly result in a barrier breach, such as power outages or any force that would compromise the integrity of the system, or possibly cause longer term damage (storms, navigation accidents, etc).

4. <u>ANS Human Transfer</u> - The Asian Carp Working Group and Aquatic Nuisance Species Task Force identified 22 separate pathways for accidental or deliberate unauthorized introductions of Asian carps in the 2007 report *Management and control plan for bighead, black, grass, and silver carps in the United States.* Although no physical barriers can prevent these from occurring, they still can defeat the purpose of having a physical barrier in place. These are:

Proposed Highest Risk Pathways

- Accidental and deliberate unauthorized releases by individuals
- Activities related to wild-caught baitfish
- Domestic live transport and distribution of wild-caught fish
- Illegal distribution and sales of diploid grass carp as triploid fish
- Importation into the United States
- Poorly sited aquaculture facilities with Asian carps
- Stocking of diploid Asian carps into non-aquaculture waters
- Unintentional live transport “in ballast water” by commercial vessels and recreational watercraft

- Unintentional live transport and distribution by natural resources management agencies

Proposed Moderate Risk Pathways

- Aquarium/hobby industry
- Commercial, domestic transport of live farm-raised Asian carps
- Incidental inclusion of Asian carps in aquaculture shipments of other farm-raised species to non-aquaculture waters
- Research and educational facilities and projects
- Unintentional shipment of black carp in diploid or untested triploid grass carp stockings

Proposed Lowest Risk Pathways

- Incidental inclusion and potential release of Asian carps in farm raised baitfish
- Incidental inclusion of Asian carps in domestic shipments of catfish to fish farms
- Incidental inclusion of Asian carps in domestic shipments of food fishes
- Incidental inclusion of Asian carps in international imports of other fishes
- Intentional release of live, “adult-size” (non-baitfish) Asian carps by boaters, anglers, and bow fishers
- Properly sited aquaculture facilities
- Stocking of triploid

5. ANS Abundance Reduction - Currently, the Illinois River has the highest abundance/biomass of Asian carp in the world. The pressure to find suitable habitat on a species increases as the population becomes larger. This may be one of the factors causing Asian carp to expand their range into waters that were thought by some to be unsuitable for this species. There are many methods to effectively cull a fish species to a lower abundance where they may not feel the need to expand their range.

6. New Studies **-** Additional studies may be undertaken in the future as technologies to address ANS species evolve, to ensure that the Barriers project continues to function to keep ANS fish species from entering the Great Lakes basin.

CHAPTER 8 – GLOSSARY OF TERMS

ACRONYMS AND ABBREVIATIONS

ANS	Aquatic Nuisance Species
ATR	Agency Technical Review
CEQ	Council on Environmental Quality
CE/ICA	cost effectiveness and incremental cost analysis
CSO	combined sewer overflow(s).
CSSC	Chicago Sanitary and Ship Canal
CWS	Chicago Waterway System
EA	Environmental Assessment
eDNA	Environmental DNA
EO	Executive Order
ft^3/s	cubic feet per second
GIS	Geographic Information System
HTRW	hazardous, toxic and radioactive wastes
H&H	Hydrology and Hydraulics
IEPA	Illinois Environmental Protection Agency
IDNR	Illinois Department of Natural Resources
I&M Canal	Illinois and Michigan Canal
IRRM	Interim Risk Reduction Measure
IWR	Institute for Water Resources
LPNP	Lockport Prairie Nature Preserve
MWRDGC	Metropolitan Water Reclamation District of Greater Chicago
NAISA	National Aquatic Invasive Species Act 1996
NEPA	National Environmental Policy Act
NER	National Ecosystem Restoration Plan
NGVD	National Geodetic Vertical Datum
OMRR&R	operations, maintenance, repair, rehabilitation and replacement
PDT	Project Delivery Team
USACE	U.S. Army Corps of Engineers
U.S.C.	United States Code
USEPA	U.S. Environmental Protection Agency
USFWS	U.S. Fish and Wildlife Service
WRDA	Water Resources Development Act