

2015

Saganashkee Slough- McMahon Woods Ecosystem Restoration

Section 506 Great Lakes Fishery & Ecosystem Restoration (GLFER)

Palos Hills, Forest Preserves of Cook County, Cook County, IL
Feasibility Study and Integrated Environmental Assessment



Saganashkee Slough - McMahon Woods Ecosystem Restoration Feasibility Study and Integrated Environmental Assessment

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EXECUTIVE SUMMARY

This report presents the results of an ecosystem restoration feasibility study for Saganashkee Slough - McMahon Woods, referred to as McMahon Woods, located near Palos Hills, Cook County, Illinois. This Feasibility Report presents the assessment of ecological conditions and potential plans to restore important fish and wildlife habitat within critical habitat for the federally listed Hine's Emerald Dragonfly. This report gathered historic and current site conditions, and forecasts future without and future with project conditions for McMahon Woods.

The Forest Preserve District of Cook County (FPDCC) owns and manages around 68,000-acres within Cook County that contain various nature preserves and remnant natural areas that exemplify the historical conditions within the Chicago Region before settlement. The Forest Preserves of Cook County has in turn requested that the Chicago District, US Army Corps of Engineers (USACE) initiate a study under the Section 506 Great Lakes Fishery and Ecosystem Restoration (GLFER) authority to determine the feasibility of restoring important critical wetland and wildlife habitat within Saganashkee Slough - McMahon Woods. Preliminary evaluation of the project site resulted in the removal of the Saganashkee Slough portion of the study area because of the high cost to implement measures to address fish habitat problems and concerns from the FPDCC. This report has evaluated the feasibility and environmental effects of restoring geomorphic features, hydrology, marsh and wooded riparian plant communities within McMahon Woods. The scope of this study addresses the issues of altered geomorphology, absence of native plant communities, invasive species, fire suppression, rare wetland/fen communities, degradation of critical habitat for a federally listed species and poor quality native plant communities.

The McMahon Woods forest preserve is located within the Palos Preserves Division of the Forest Preserves of Cook County that encompasses a large natural area of about 6,000-acres. The study area is within the historic boundary of the Great Lakes basin and borders the Calumet-Saganashkee (Calumet-Sag) Channel near Palos Hills, Illinois in Cook County. These two areas were key biogeographic areas in terms of re-colonizing the Great Lakes with fishes after the last glaciations eliminated them. The Calumet-Sag Channel is connected to Lake Michigan through T.J. O'Brien Lock and Dam, which is located on the Calumet River in Chicago, Illinois, north of the confluence with the Cal-Sag Channel. The Cal-Sal Channel flows west towards its confluence with the Chicago Sanitary and Ship Canal; however, during large storm events, backflows to Lake Michigan from the Cal-Sag and Calumet Rivers through the T.J. O'Brien Lock and Dam can occur.

The study area is located to the east of Saganashkee Slough and to the north of the Calumet-Sag Channel. The total study area is approximately 410.6-acres of publicly protected lands within the Palos Preserves area of the FPDCC. About 300-acres of the study area is designated critical habitat for the Great Lakes subpopulation of federally endangered Hine's Emerald Dragonfly (*Somatochlora hineana*). McMahon Woods is located along the Lake Michigan Flyway, which a part of the greater Mississippi Flyway. The Lake Michigan Flyway is notable as one of America's most important migration routes for songbirds. Songbirds and other groups of birds (e.g., shorebirds, raptors, etc.) migrate from South America to breed in portions of the Upper Midwest all the way to Canada and Alaska. It is critically important to migratory birds that use the Lake Michigan flyway to have optimal stopover habitat and food resources to successfully complete their migration. The shoreline of Lake Michigan and its surrounds, which includes northeast Illinois and McMahon Woods, provides vital natural areas that offer rest and foraging opportunities for tired and hungry migrants.

Problems within the study area are alteration of hydrology, geomorphology and loss of coverage of native plants. The result of these problems is the alteration of ecosystem function (e.g. light availability, soil nutrient cycling, overflow floodwaters, etc.) and structure (e.g., low coverage and diversity of conservative fire adapted plant species) that has impacted the area's ability to provide sufficient function and habitat for regional and migratory species. The effects of altered ecosystem function and structure is

the overall degradation of the native plant community, decreased suitability of wildlife habitat and a lack of suitable habitat for state endangered and threatened plant species to expand their range within the project area. Most notable is the continued degradation of a federally endangered species habitat for the Hine's Emerald Dragonfly.

This project affords the opportunity not only to address issues associated with the above stated problems, but it also continues the movement to establish coastal and inland refuges within the southern Lake Michigan basin. This project can provide a vital piece to the large-scale Great Lakes restoration area by providing a significant quantity of valuable habitat for federally listed species, locally rare species, and a significant number of migratory and resident bird species. Wetland function is constantly being lost in the southern Lake Michigan basin. Enhancing, restoring and protecting these essential habitats is at the heart of the GLFER program. The following are resource problems that could be addressed through this project:

- Degradation of aquatic migratory bird habitat
- Altered hydrologic regime
- Invasive species dominance
- Degradation of groundwater feed (rivulets) wetlands
- Loss of periodic fire
- Lack of native herbaceous and shrub species (food bearing plants)

To address the noted ecosystem problems at McMahon Woods, six (6) measures, including the No Action measure, were input into the IWR-Planning Suite in terms of costs and benefits. Removal of invasive species would be addressed for the marsh (AA), Oak savanna (AB), and wet mesic woodland (AC) within the study area. In order to address altered hydrologic regime and degradation of groundwater feed (rivulets) wetlands (BC-wet mesic woodland) measures were developed that included enlarging the culvert under 107th Street, installation of a small earthen berm along the Crooked Creek riparian area to reduce overflow events into the marsh/rivulets and placement of glacial cobble and stones in the upper reaches of the rivulets to stabilize banks. Other measures included installation and establishment of native plant material, along with prescription burns, in the marsh (BA), Oak savanna (BB) and wet mesic woodland (BC) that would address the lack of native herbaceous and shrub (food bearing plants) species for migratory birds. Based on these inputs and criteria, the IWR-Planning software generated twenty-six (26) alternative combinations for ecosystem restoration. These alternative combinations were analyzed with the IWR Planning Suite Cost Effective & Incremental Cost Analysis.

The cost effectiveness analysis was used to ensure that certain options would be screened out if they produced the same amount or less output at a greater cost than other options with a lesser cost. Twenty-six (26) alternative combinations were analyzed for cost effectiveness. Of these, eighteen (18) cost effective combinations were identified, which is inclusive of the four (4) Best Buy Plans. The No Action plan is always deemed cost effective and a Best Buy Plan.

An incremental cost analysis was performed on the four (4) Best Buy Plans, including no action, identified from the cost effectiveness analysis:

Alternative 1: No Action Plan – No GLFER restoration project.

Alternative Plan 2: This plan includes the restoration of the wet mesic woodland in McMahon Woods. This plan partially addresses reduce/repair of bare soil areas within the marsh/rivulet complex and Crooked Creek riparian area. This plan would only install native plant material within the wet mesic woodland (Objective #3) and not in the marsh, or upper reaches of Hine's Emerald Dragonfly rivulets, or the globally imperiled Oak savanna. It would only remove invasive species in the wet mesic woodland

(#1) and not in the Oak savanna or marsh. This plan would reduce the overflow events from Crooked Creek through the installation of an earthen berm and a bigger culvert under 107th Street, reducing the overflow events would help to repair the hydrology of the rivulets and help to reduce areas of bare soil within the rivulets (#2). This plan would result in a net gain of 88.36 AAHU for an AA cost of \$205,882.

Alternative Plan 3: This plan would also address many, but not all, of the problems within McMahan Woods. This plan would address native plant richness (Objective #3), removal and control of invasive species (#1) and reduce/repair bare soil areas within the marsh/rivulet complex and Crooked Creek riparian area (#2). This plan includes installation of native plant material in not only the wet mesic woodland, but in the marsh as well, helping to establish a diverse native plant community and help to increase the suitability of the rivulets for the Hine's Emerald Dragonfly. It would also address invasive species wet mesic woodland and the marsh. Additionally, the reduction of overflow from Crooked Creek through the earthen berm and bigger culvert would repair the hydrology and reduce bare soil areas in the rivulets. However, it would not address lack of native plant species richness and invasive species in the globally imperiled Oak savanna. This plan would result in a net gain of 96.19 AAHU for an AA cost of \$227,552.

Alternative Plan 4: This plan would fully address all problems, such as native plant richness in all community types (Objective #3), removal of invasive species in all community types (#1) and reduction of overflow events from Crooked Creek and repair of bare soil areas within the rivulets (#2) within McMahan Woods. This plan addresses all problems within all community types including the important Oak Savanna. This plan would result in a net gain of 97.42 AAHU for an AA cost of \$231,357.

The objective of the incremental cost analysis is to assist in determining whether the additional output provided by each successive plan is worth the additional cost. The alternative plan(s) that qualified for further consideration were further assessed in order to identify whether the benefits are worth the Federal investment. The effects include a measure of how well the plan(s) achieve the planning objectives, benefits and costs. The supportive facts include the reality of the ecosystem outputs; significance of the ecosystem outputs; completeness, acceptability, effectiveness and efficiency of the potential plan, and any associated risks or uncertainties that may affect or result from the potential plan.

The plan that reasonably maximizes net National Ecosystem Restoration benefits and is consistent with the Federal objective, authorities and policies, is identified as the Preferred Plan/NER. The Preferred Plan/NER was determined to be Alternative 4. When selecting a single alternative plan for recommendation from those that have been considered, the criteria used to select the NER plan include all the evaluation criteria discussed above. Selecting the NER plan requires careful consideration of the plan that meets planning objectives and constraints and reasonably maximizes environmental benefits while passing tests of cost effectiveness and incremental cost analyses, significance of outputs, acceptability, completeness, efficiency, and effectiveness.

An Environmental Assessment was completed for the proposed habitat restoration at McMahan Woods Palos, Illinois. The Environmental Assessment has found that there would be no adverse affects, resulting from implementation of the NER/Preferred Plan. A 30-day Public Review period was held from November 10 2015 to _____ 2015. Agency and public review comments will be addressed as they are received with pertinent comments incorporated into the document.

All significant aspects of the problems and opportunities as they relate to the McMahan Woods study area's resource problems have been considered. Those aspects include environmental, social, cultural, and economic effects, as well as engineering feasibility. The National Ecosystem Restoration (NER) Plan is Alternative 4, which consists of restoring native plant and fauna communities within McMahan Woods'

project area. The NER plan has a Fully Funded Cost of approximately [REDACTED] (2015 price levels). This plan provides 97.42 net average annual habitat units over 410-acres of the project area.

CHAPTER 1 – INTRODUCTION

1.1 – Report Organization

This reports presents the results of the Saganashkee Slough - McMahan Woods Ecosystem Restoration feasibility study and integrated environmental assessment, referred to as McMahan Woods. This report consists of seven (7) parts including a main report and eight appendices with figures and tables. The report is structured as follows:

Chapter 1 – Introduction: introduces the project and provides a description of the study area and a summary of relevant studies and projects completed

Chapter 2 – Inventory of Study Area and Forecasting: contains an inventory or description of the study area which includes an assessment of pertinent historic, current and future without project conditions

Chapter 3 – Problems and Opportunities: discusses the problems within the study area, potential opportunities to remedy them, a study goal, restoration objectives and limiting constraints

Chapter 4 – Plan Formulation and Evaluation: discusses how plans have been formulated, presents the cost effectiveness and ecological benefits of each alternative, and discusses the evaluation process used to identify the National Ecosystem Restoration (NER) plan and select a recommended plan

Chapter 5 – Environmental Assessment: provides a description of potential impacts, both negative and positive, to cultural, ecological and physical resources within the surrounding environment and their significance.

Chapter 6 – Plan Implementation: discusses construction sequencing, monitoring and adaptive management, project costs and cost sharing responsibilities

Chapter 7 – Recommendation: provides the District Commander’s recommendation for implementation of an ecosystem restoration plan

Appendix A – Hydraulics and Hydrology

Appendix B – Civil Design Sheets

Appendix C – Cost Engineering

Appendix D – Geotechnical Analysis

Appendix E – Hazardous, Toxic, and Radioactive Waste (HTRW) Report

Appendix F – Real Estate Plan

Appendix G – Compliance, Permit & Coordination Information

Appendix H – Monitoring Plan

Appendix I – Current Conditions Biological Inventory

Appendix J – Habitat Assessment Results

1.2 – Study Authority

42U.S.C. § 1962d-22. GREAT LAKES FISHERY AND ECOSYSTEM RESTORATION (WRDA 2000 as amended)

Findings - Congress finds that—

- (1) the Great Lakes comprise a nationally and internationally significant fishery and ecosystem;
 - (2) the Great Lakes fishery and ecosystem should be developed and enhanced in a coordinated manner;
- and

- (3) the Great Lakes fishery and ecosystem provides a diversity of opportunities, experiences, and beneficial uses.
- (b) Definitions - In this section, the following definitions apply:
- (1) Great Lake
 - (A) In general- The term "Great Lake" means Lake Superior, Lake Michigan, Lake Huron (including Lake St. Clair), Lake Erie, and Lake Ontario (including the St. Lawrence River to the 45th parallel of latitude).
 - (B) Inclusions- The term "Great Lake" includes any connecting channel, historically connected tributary, and basin of a lake specified in subparagraph (A).
 - (2) Great Lakes Commission- The term "Great Lakes Commission" means the Great Lakes Commission established by the Great Lakes Basin Compact (82 Stat. 414).
 - (3) Great Lakes Fishery Commission- The term "Great Lakes Fishery Commission" has the meaning given the term "Commission" in section 931 of Title 16.
 - (4) Great Lakes State- The term "Great Lakes State" means each of the States of Illinois, Indiana, Michigan, Minnesota, Ohio, Pennsylvania, New York, and Wisconsin.
- (c) Great Lakes fishery and ecosystem restoration
- (1) Support plan
 - (A) In general- Not later than 1 year after December 11, 2000, the Secretary shall develop a plan for activities of the Corps of Engineers that support the management of Great Lakes fisheries.
 - (B) Use of existing documents- To the maximum extent practicable, the plan shall make use of and incorporate documents that relate to the Great Lakes and are in existence on December 11, 2000, such as lakewide management plans and remedial action plans.
 - (C) Cooperation- The Secretary shall develop the plan in cooperation with—
 - (i) the signatories to the Joint Strategic Plan for Management of the Great Lakes Fisheries; and
 - (ii) other affected interests.
 - (2) Reconnaissance studies- Before planning, designing, or constructing a project under paragraph (3), the Secretary shall carry out a reconnaissance study—
 - (A) to identify methods of restoring the fishery, ecosystem, and beneficial uses of the Great Lakes; and
 - (B) to determine whether planning of a project under paragraph (3) should proceed.
 - (3) Projects- The Secretary shall plan, design, and construct projects to support the restoration of the fishery, ecosystem, and beneficial uses of the Great Lakes.
 - (4) Evaluation program
 - (A) In general- The Secretary shall develop a program to evaluate the success of the projects carried out under paragraph (3) in meeting fishery and ecosystem restoration goals.
 - (B) Studies- Evaluations under subparagraph (A) shall be conducted in consultation with the Great Lakes Fishery Commission and appropriate Federal, State, and local agencies.
- (d) Cooperative agreements- In carrying out this section, the Secretary may enter into a cooperative agreement with the Great Lakes Commission or any other agency established to facilitate active State participation in management of the Great Lakes.
- (e) Relationship to other Great Lakes activities- No activity under this section shall affect the date of completion of any other activity relating to the Great Lakes that is authorized under other law.
- (f) Cost sharing
- (1) Development of plan- The Federal share of the cost of development of the plan under subsection (c)(1) of this section shall be 65 percent.
 - (2) Project planning, design, construction, and evaluation- Except for reconnaissance studies, the Federal share of the cost of planning, design, construction, and evaluation of a project under paragraph (3) or (4) of subsection (c) of this section shall be 65 percent.
 - (3) Non-Federal share
 - (A) Credit for land, easements, and rights-of-way- The Secretary shall credit the non-Federal interest for the value of any land, easement, right-of-way, dredged material disposal area, or relocation provided for carrying out a project under subsection (c)(3) of this section.
 - (B) Form- The non-Federal interest may provide up to 100 percent of the non-Federal share required under paragraphs (1) and (2) in the form of services, materials, supplies, or other in-kind contributions.
 - (4) Operation and maintenance- The operation, maintenance, repair, rehabilitation, and replacement of projects carried out under this section shall be a non-Federal responsibility.
 - (5) Non-Federal interests- In accordance with section 1962d-5b of this title, for any project carried out under this section, a non-Federal interest may include a private interest and a nonprofit entity.

(g) Authorization of appropriations

- (1) Development of plan- There is authorized to be appropriated for development of the plan under subsection (c)(1) of this section \$300,000. Other activities- There is authorized to be appropriated to carry out paragraphs (2) and (3) of subsection (c) of this section \$100,000,000.

1.3 – Study Purpose & Background

The non-Federal sponsor, the Forest Preserve District of Cook County (FPDCC), has requested that the Chicago District, USACE initiate a study under Section 506 Great Lakes Fishery and Ecosystem Restoration Program to determine the feasibility to restore the ecological integrity of McMahon Woods. This study evaluates the feasibility and environmental effects of restoring the wetland and riparian habitat. The scope of this study addresses the issues of altered geomorphology, hydrology, degraded native plant community, federally endangered species critical habitat, invasive species, connectivity, rare wetland communities, and native species richness. This Feasibility Report and Integrated Environmental Assessment will assess and identify problems and opportunities, identify and evaluate measures, and recommend and design the most cost effective and feasible solution to the ecological problems currently existing within the area of study.

1.4 – Study Area

The McMahon Woods is a portion of a greater natural area, called Palos Preserves (~6,000-ac), primarily owned and managed by the FPDCC located (Figure 1). The study area is within the historic boundary of the Great Lakes basin and borders the Calumet-Saganashkee (Calumet-Sag) Channel near Palos, Illinois in Cook County. Figure 2 shows arrows indicating that flow would go either way depending on where precipitation would fall. These two areas were key biogeographic areas in terms of re-colonizing the Great Lakes with fishes after the last glaciations eliminated them. These two areas were key biogeographic areas in terms of re-colonizing the Great Lakes with fishes after the last glaciations eliminated them. The Calumet-Sag Channel is connected to Lake Michigan through T.J. O'Brien Lock and Dam, which is located on the Calumet River in Chicago, Illinois, north of the confluence with the Cal-Sag Channel. The Cal-Sal Channel flows west towards its confluence with the Chicago Sanitary and Ship Canal; however, during large storm events, backflows to Lake Michigan from the Cal-Sag and Calumet Rivers through the T.J. O'Brien Lock and Dam can occur. The Saganashkee Slough is located just to the west of the study area and, along with the Calumet-Sag Channel, represents an important and significant natural feature within the greater Palos Preserves.

The total McMahon Woods study area is approximately 410.6-acres of publicly protected lands within the Palos Preserves area of the Cook County Forest Preserve District (Figures 2 and 3). About 300-acres of the study area is designated critical habitat for the Great Lakes subpopulation of Federally Endangered Hine's Emerald Dragonfly (*Somatochlora hineana*).



Figure 1- McMahon Woods Location within the Chicago Area.

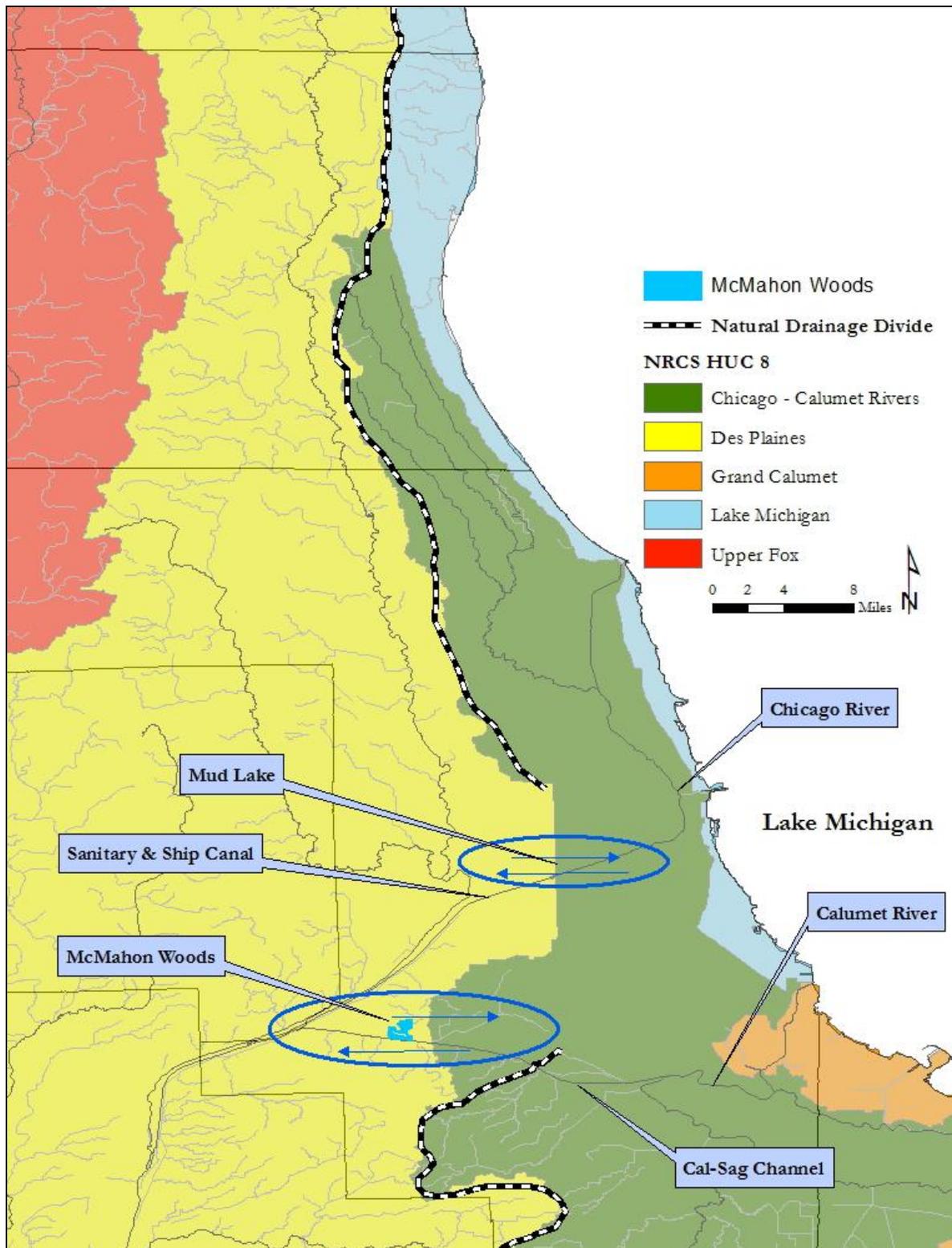


Figure 2 - Project aerial and vicinity map.

1.5 – Pertinent Reports, Studies & Projects

Reports & Studies

- Saganashkee Slough and Fen Restoration, Preliminary Restoration Plan (AKA Federal Interest Determination), Great Lakes and Ecosystem Restoration Section 506 (2011)

The Preliminary Restoration Plan roughly indicates environmental problems associated with Saganashkee Slough and McMahon Woods Fen. Additionally, the plan includes potential restoration actions that would address environmental degradation within the project area. This plan includes the area of Saganashkee Slough, which has been removed from further consideration because of the high cost to implement measures to address fish habitat problems and concerns from the FPDCC over long term operation and maintenance of restored fish habitat that may conflict with future recreational activities within the Slough.

- Great Lakes and Mississippi River Interbasin Study (GLMRIS)

This study investigates aquatic nuisance species controls throughout the Great Lakes and Mississippi River basins. The United States Army Corps of Engineers is conducting the study with cooperation from several federal and state agencies, Native American tribes, local governments, and non-governmental organizations. For more detailed information please see: <http://glmr.is.anl.gov/aboutstudy/index.cfm>. Dispersal of aquatic nuisance species is not expected to result from any project implemented from this study and therefore should not affect the GLMRIS study. This project focuses on removing invasive plants and non-native plant species. Based on current GLMRIS conceptual measures and techniques, this project is not expected to interfere with any potential projects implemented by GLMRIS.

- Tampier Lake/Saganashkee Slough Watersheds Stage One TMDL Draft Report (2008)

This report by the Illinois Environmental Protection Agency discusses the Saganashkee Slough watershed, which includes McMahon Woods, and its associated water quality. Goals and objectives to restore water quality and meet water quality standards are discussed.

- Secondary Source Investigation for McMahon Woods (2007)

This report was prepared by Graef, Anhalt, Schloemer & Associates, Inc, for CorLands. This report discusses the Crooked Creek watershed and its relationship to the fen within McMahon Woods. This fen is critical habitat for the federally endangered Hine's Emerald Dragonfly. Problems within the Crooked Creek watershed that influence water quality, hydrology and erosion of the fen are discussed.

- McMahon Woods Hydrologic Investigations Final Report (2008)

This report was prepared by Graef, Anhalt, Schloemer & Associates, Inc, for CorLands. This report discusses the possible interactions of the ground water system supplying the McMahon Woods Fen and Crooked Creek. As a part of determining the hydrology of the fen and seep communities and its surrounding area, ground water level data were collected throughout the growing season and ground water samples were collected and tested for chloride. Based on an evaluation of the local topography, observations of the site steward and on field observations of oriented woody debris, the conclusion was reached that overbank flows from Crooked Creek are flowing through a topographic saddle and into the rivulets that has caused increased erosion within the rivulets and has impacted the habitat of the Hine's

Emerald Dragonfly. Recommendations of the study included removal of invasive vegetation and installation of a berm in the saddle area.

- Proposal for Dedication of McMahon Woods and Fen as an Illinois Nature Preserve in Cook County, Illinois (2008)

This report was prepared by Illinois Nature Preserves Commission and Illinois Department of Natural Resources, for Cook County Forest Preserve District and Illinois Nature Preserves Commission. This report presents a proposal to dedicate McMahon Woods and Fen as a protected Nature Preserve (totaling 510-acres). The actual graminoid fen (12.10-acres) that is delineated for nature preserve protection is outside of the project footprint, however, the wooded riparian area of Crooked Creek and the wooded fen habitat within the boundaries of McMahon Woods is within the project footprint. This fen is critical habitat for the federally endangered Hine's Emerald Dragonfly. There are only 277.8-acres of graminoid fen habitat left in NE Illinois. Additionally, there are three Illinois State-listed plant species that occur within the degraded wooded areas of the project area, they include the endangered Queen-of-the-prairie (*Filipendula rubra*) and the State-threatened white lady's slipper (*Cypripedium candidum*) and blazing star (*Liatris scariosa nieuwlandii*). In addition, seeds of the State-endangered and federally threatened eastern prairie fringed orchid (*Platanthera leucophaea*) were introduced into the proposed nature preserve in 1994 as part of this species' recovery plan. However, no known plants have been found since the introduction of seeds and it is unknown if a population will appear. This report also states that there is an urgent need to restore the area surrounding the graminoid fen.

- 2009 Vegetation Monitoring Report (2009)

This report was prepared by Graef, Anhalt, Schloemer & Associates, Inc, for CorLands. This report discusses the results of vegetation monitoring and mapping that occurred within portions of McMahon Woods. The report indicates that highest priority for management is the fen and Hine's Emerald Dragonfly breeding habitat, of which the wooded fen is part of the proposed project footprint. Their results indicate that areas before management, within the graminoid fen, ranged from 2.5 to 3.2 Mean Conservatism (please reference section 2.5 for further information about Floristic Quality Assessment). This indicates that areas within McMahon Woods are degraded, but have a high likelihood of responding very well to restoration actions.

- Hydrological Investigation of McMahon Fen (2014)

This report was prepared by U. S. Geological Survey, Illinois Water Science Center, for USACE. This report discusses the results of an in-depth monitoring of surface and groundwater condition within the McMahon Woods graminoid fen and wooded fen area. The report indicates that the groundwater discharging into the fen area is correlated to rain events that fall within the riparian area of Crooked Creek and the fen area itself. Overflow from Crooked Creek impacts water levels within the fen during extreme rain fall events. Erosion within middle and upper reaches of the rivulets (e.g., streamlets) is causing erosion of the bottom substrate and causing down cutting of the channel, which has started to erode adjacent banks as well. Some rivulets were more effected by erosion than others. This indicates that the fen areas within McMahon Woods are undergoing degradation and that this area contains critical habitat of the Hine's Emerald Dragonfly.

- Management and Monitoring Plan for Dan McMahon Woods and Fen (2009)

This report was prepared by Graef, Anhalt, Schloemer & Associates, Inc, for CorLands, Forest Preserve District of Cook County and USACE. This report discusses summary guidelines and recommendations

for enhancement activities throughout McMahan Woods. The report indicates that highest priority for management is the fen and Hine's Emerald Dragonfly breeding habitat, of which the wooded fen is part of the proposed project footprint. This report was also focused on the graminoid fen that was the subject of a mitigation project managed by CorLands. The mitigation area is located within a narrow linear corridor that runs from the northwest corner of 104th Ave traveling southeast more than half way to 95th Ave. This area is not a part of the project footprint. The USACE has been in close contact with CorLands coordinating proposed restoration actions to compliment actions taken in the mitigation area. Mitigation actions were the removal of invasive trees and shrubs and herbaceous plant species, regular prescribed burns and establishment of native plant species with seed installation.

➤ Hine's Emerald Dragonfly (*Somatochlora hineana*), Recovery Plan (2001)

This report was prepared by U.S. Fish and Wildlife Service, Fort Snelling, MN. This report identifies problems within the McMahan Woods Hine's Emerald Dragonfly breeding habitat that include: hydrological problems, cattail density and European buckthorn encroachment. The report recommends additional studies that should be completed in order to identify potential restoration measures to reduce or eliminate habitat degradation for the remaining Hine's Emerald Dragonfly populations.

➤ Hine's Emerald Dragonfly, *Somatochlora hineana* (Odonata: Corduliidae), 5-Year Review: Summary and Evaluation (2013)

This report was prepared by U.S. Fish and Wildlife Service, Midwest Region, Chicago Ecological Services Field Office. This report reviews all the latest population and genetic surveys done on the remaining populations of the Hine's Emerald Dragonfly within North America. The report identifies that there are two breeding areas within the fen within McMahan Woods. It also identifies that habitat destruction is the greatest threat to the Hine's Emerald Dragonfly and that destruction is mainly caused by invasive plants, hydrological alternation (water quality or quantity) and fragmentation (e.g., closed canopy forests). The Hine's Emerald Dragonfly population located in McMahan Woods is part of the Southern Recovery Unit. Although this unit contains discrete populations that are smaller than other recovery units, this unit contains the greatest genetic diversity and is highly valued. The populations in Illinois are considered to be the most vulnerable to extirpation. Continued degradation of Hine's Emerald Dragonfly habitat continues to threaten the long-term viability of this species, and therefore, continues to meet the definition of an endangered species.

➤ Hine's Emerald Dragonfly Population and Genetic Surveys at McMahan Fen, Final Report (2013)

This report was prepared by Dr. D. Soluk, et al., The University of South Dakota for the U.S. Fish and Wildlife Service, Midwest Region, Chicago Ecological Services Field Office. This report reviews the latest population surveys done the within the fen within McMahan Woods. The report concluded that surveys during the summer of 2012 were insufficient to appropriately sample the breeding population at McMahan Woods because of the severe drought conditions of that year. Recommendations were made for future sampling efforts in order to track the response of the Hine's Emerald Dragonfly to future restoration actions.

➤ The Lake Michigan Flyway: Chicagoland's Role in the Miracle of Bird Migration (2001)

Paper was published by the Bird Conservation Network, a prominent non-profit working to educate natural area managers on the importance of migratory birds and to track the response of bird species to

management activities. This paper was prepared to assist natural resource managers better manage for the needs of migratory birds. The paper explains why Lake Michigan and its surrounds are important for migratory birds. The paper also has extensive lists of birds that routinely travel through northeast Illinois and types of plant resources (e.g., fruits, seeds, etc.) these birds are searching for and are attracted to for food or safe rest.

CHAPTER 2 – INVENTORY AND FORECASTING

Consideration of ecosystems within or encompassing a watershed provides a useful organizing tool to approach ecosystem-based restoration planning. Ecosystem restoration projects that are conceived as part of a watershed planning initiative or other regional resources management strategies are likely to more effectively meet ecosystem management goals than those projects and decisions developed independently. Independently developed ecosystem restoration projects, especially those formulated without a system context, partially and temporarily address symptoms of a chronic/systemic problem. The following chapter outlines the past, present and future without-project conditions of the marsh and wooded riparian environments, both ecological and human.

2.1 – Current Conditions

The McMahon Woods study area is diverse, comprised of stream and adjacent wooded riparian areas, marsh, fen & rivulet, and oak savanna. Certain wetland habitats are becoming increasingly rare along with the species that are reliant on them, and in particular fen and rivulet habitat. The spatial extent of native plant communities is still present; however the pressure from anthropogenic sources has led to the deterioration of physical conditions. This degradation in physical habitat structure has caused a marked decline in both species richness and abundance of native animal assemblages, especially the Federally Endangered Hine’s Emerald Dragonfly.

2.2 – Physical Resources*

2.2.1 – Climate

The project is located within a temperate continental climate zone marked by cold winters, warm humid summers, and the lack of a pronounced dry season. From 1971 to 2000 (Midwestern Regional Climate Center, 2011), temperatures ranged from an average maximum of 77°F to an average minimum of 62°F during the summer months (July and August), while an average maximum of 33°F to an average minimum of 17°F temperatures were observed during the winter months (December and January). Total annual precipitation averages approximately 37 inches per year from 1971 to 2000, with the majority of precipitation occurring during the spring (April through mid-June) and summer (July through mid-August) months. Average annual snowfall from 1971 to 2000 was 33 inches, with an average accumulation of 10.2 inches in January. The growing season extends from the last spring frost (typically late April) to the first fall frost (typically mid October) and average 170 days from 1981 to 2000 (Midwestern Regional Climate Center, 2011).

2.2.2 – Geology & Glacial Stratigraphy

Silurian Age Bedrock –

The underlying regional bedrock is Silurian-age dolomite, most likely of the Niagaran Series (Willman 1971). This rock resulted from marine deposition when all of northeastern Illinois and much of the neighboring Great Lakes region was the floor of a tropical sea from about 440 to 410 million years ago. This formation is the foundations for Great Lakes alvars and reefs.

The project site straddles the southern terminus of the Clarendon Moraine, the innermost moraine of the Valparaiso morainic system. The topography here is rough with knobs, ridges, and kettles and is in sharp contrast to the relatively broad, terraced valley that consists of a glacial outwash plain deposited by the Clarendon and Tinley Moraines and glacial river bottom sculpted by torrential melt waters from retreating

Lake Chicago. Willman (1971) referred to the southern portion of the proposed nature preserve as “glacial sluiceway”. Both the Clarendon and Tinley Moraines extend along an axis paralleling Lake Michigan and are members of the Wadsworth Formation (Willman 1971). This formation consists primarily of clayey till and sediment that underwent redeposition along an ice-marginal and/or subaqueous environment during a period between 15,500 and 13,800 years ago (Hansel and Johnson 1996).

2.2.3 – Soils

Till (a mixture of rock and rock debris of all sizes), outwash (sand and gravel literally washed and sorted from the ice by melting water), lacustrine silts (fine textured particles that settled out in and around lakes), limestone bedrock, and windblown silts are the dominant parent materials for the soils in the Lower Des Plaines River watershed (IDNR 2000). Graef, Anhalt, Schloemer, and Associates, Inc. (2007) provide an extensive description of the soils that occur within the McMahan Woods area. Four soil series (Morley silt loam, Blount silt loam, Ashkum silt clay loam, and Thorp loam) are associated with the Clarendon Moraine in the rugged, northern portion of the McMahan Woods. Soils that extend in a broad band across the central portion of the site on fairly level glacial plain outwashes or along the upper portion of the glacial river bottom include Zurich silt loam, Fox silt loam, and the Oakville fine sand (which extends just above the groundwater discharge zone). The Thorp loam, which is associated with the Crooked Creek drainage, extends from along the base of the Clarendon Moraine south across the central region of the area. The graminoid fen/sedge meadow complex consists of Muskego and Houghton mucks. Located below these groundwater discharge zones are Kane silt loam, Kankakee loam, Will silty clay loam, Drummer silty clay, Harpster silty clay soil series (Mapes 1979). The Morley silt loam, which dominates the northern part of the area, occurs on well drained uplands with slopes ranging from 2% to 35% (Mapes 1979).

The surface layer consists of a dark gray to brownish gray silt loam that varies in depth from 2 inches on gentle slopes to as much as 5-7 inches on steep slopes (7 to 15% slopes). The subsoil generally varies from 20 to 22 inches in thickness and contains few pebbles and stones, and movement of air and water through both the surface and subsoil is moderately slow. This soil series’ genesis is silty clay loam glacial till that formed in woodland vegetation (Mapes 1979). The balance of the soils (Blount silt loam, Ashkum silt clay loam, and Thorp loam) are poorly drained soils and occur in shallow depressions or along drainage ways in the northern portion of the area (Mapes 1979). There is a detailed description of the soil series found within Appendix I Current Conditions and the project site (**Figure 4**):

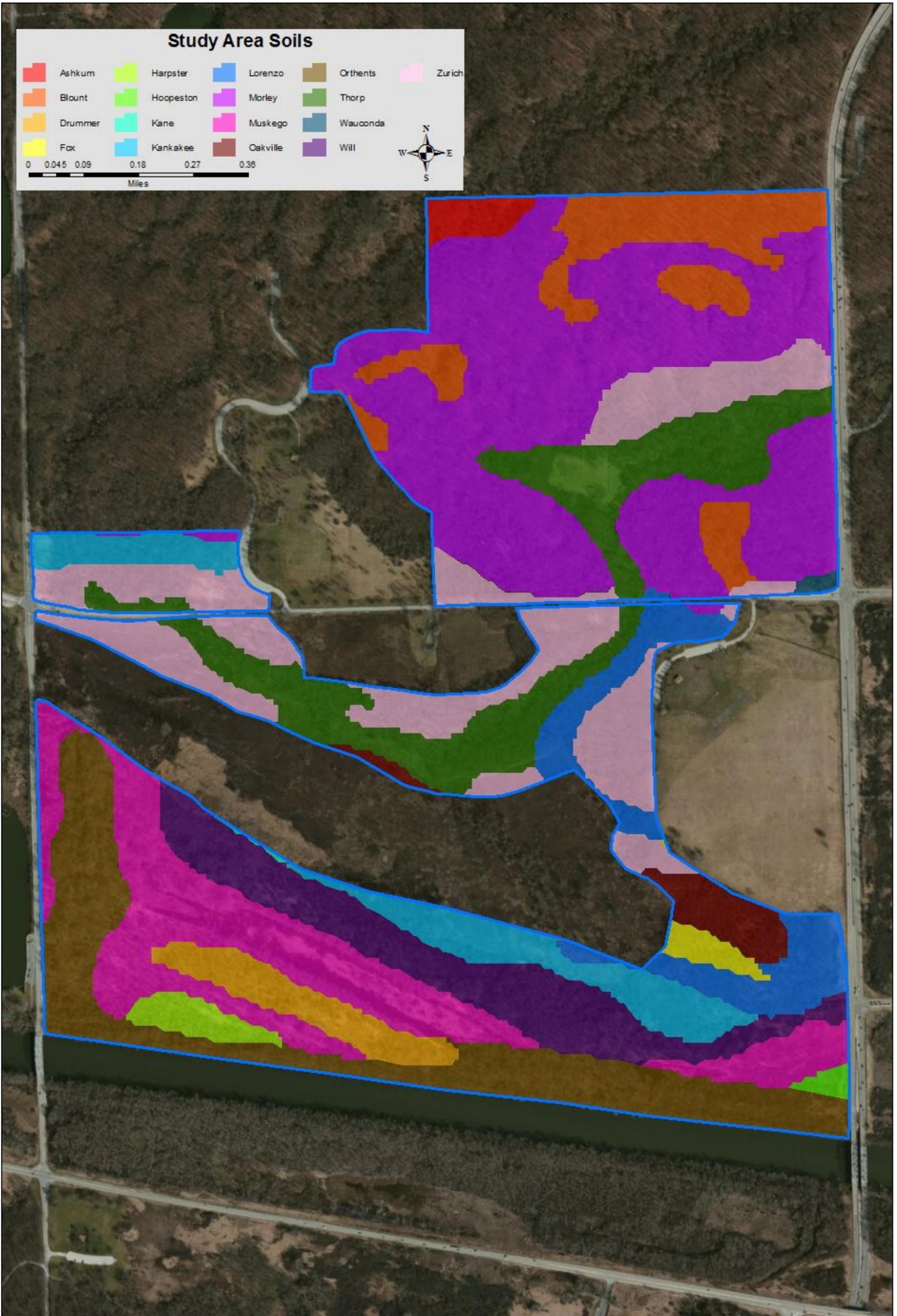


Figure 4 - Project Site Soils.

2.2.4 – Sediment and Sediment Quality

According to the surficial (Quaternary) geology surveyed in 1930 to 1935, riverine sediment comprises approximately most of the McMahon Woods area and is mapped as glacial river bottom. The eastern portion of the area is indicated as outwash plain comprised of sand and gravel with a small northwest/southeast trending remnant sand dune. The southwest portion of the area is peaty muck. The rate of infiltration for each unit is dependent on the *permeability* of the unit (the capacity of the sediment for transmitting a fluid). The infiltration rates from northeast to southwest decrease as the quaternary deposits transition from more permeable glacial outwash plain and sand dune to less permeable riverine sediment to poorly permeable peaty muck. An important connection between the existence of the fen and the permeability of the sediments can be seen when examining the map underlain by the 2005 aerial photograph. Note that the southern edge of the fen noticeably coincides with the southern edge of the riverine sediment and the northern edge of the peaty muck. When the groundwater slows down while moving southwest into the poorly permeable peaty muck, some of the water may pool or even flow upwards into the fen. The upward flow manifests as seeps and rivulets that characterize the fen.

See section 2.2.10 HTRW for results of soil testing within fill area along the western border adjacent to 104th Avenue. Movement of soil and sediment does occur within the rivulet areas and erosion within the head waters of the rivulets is causing problems with the stability of rivulets banks.

2.2.5 – Hydrogeomorphology & Topography

The topography within McMahon Woods ranges from step-like terraces that descend gradually down to the Cal-Sag Channel, to relatively flat fields located on ancient glacial outwash plains and river bottoms, to rugged, rolling topography that is emblematic of the Morainal Section of the Northeastern Morainal Natural Division of Illinois (Schwegman et al. 1973). The most rugged topography with slopes approaching 15 - 25 % is located north of 107th Street near the southern terminus or base of the Clarendon Moraine (Willman et. al. 1975). The majority of the area sits between 570 to 625 feet above sea level, basically an extension of the historic Saganashkee Slough marsh area. The earliest topographic map shows Crooked Creek entering this section from the bluffs and flowing from the northeast corner, meandering in a southerly direction before looping back north to exit the area via the north west corner and then discharging into the flat marshy low land (future Saganashkee Slough). The first fill of this area, located along the future 104th Avenue (also called Willow Springs Road), occurred when the Calumet-Sag Channel was first dug in the 1920s. The fill was mainly limestone bed rock excavated from the channel. By 1953 the original fill had been used for gravel extraction and there formed a large depression. The gravel pit was then filled in with dredge material, most likely during the widening of the Calumet-Sag Channel and the construction of 104th Avenue. This area now sits around 625 feet above sea level, with the remainder of the area still resting between 570 and 625 feet above sea level. According to the hydrological investigation groundwater discharges along one of the lowest ridge lines around 600 feet forming the graminoid fen and rivulets. Groundwater flows in a southwest direction.

2.2.6 – Land Use, Hydrology & Hydraulics

The swampy Saganashkee Slough/McMahon Woods and hilly Palos Hills areas of the Valparaiso Moraine in this area of Southwestern Cook County were ignored by the early settlers for more desirable farming lands. Construction of the Illinois and Michigan Canal from 1836 to 1848 brought large numbers of Irish and German immigrant labor into the area. Their farming settlements of Lemont to the west, and Palos Hills to the east remained on the edges of the Saganashkee-Palos Hills area. Some areas of the

Saganashkee swamp were drained for farming, and the woodlands of the Palos Hills were utilized for timber.

The Illinois Forest Preserves were initiated by a 1913 state statute, with Cook County organizing the first forest preserve district in 1914. No similar preserves existed anywhere in the world at that time. The Saganashkee Slough area was acquired along with portions of the Palos Hills by the Forest Preserve District of Cook County in the 1930's. In 1922 the Calumet-Sag channel, connecting the Calumet River with the Chicago Sanitary and Ship Canal was constructed through the Saganashkee swamp. Review of historical topographic maps and aerial photographs suggests that that material removed to create the channel may have been used to create a berm north of the channel (south of the Saganashkee Slough and McMahon Fen). In addition, an extensive fill pile was created within McMahon Fen, just east and parallel to 104th Avenue (Willow Springs Road) during this period. Saganashkee Slough was created in 1948/1949 by the construction of a dam at the east end of the slough and a levee at the west end (IEPA 2010). In addition, Crooked Creek was a meandering stream that was channelized between 1938 and 1951 and routed to outlet into Saganashkee Slough via McMahon Woods. Agriculture remained the principal occupation of the area until the 1940s. Aerial photographs suggest that some portions of the current slough area were farmed prior to the construction of the outlet weir. Since the 1950's the region has experienced a steady increase in population as the communities surrounding the Saganashkee and the Palos Hills have developed into residential areas for people working in Chicago.

The environmentally delicate area of McMahon Woods' fen (critical habitat of the Hine's Emerald Dragonfly) has been plagued with erosion within the rivulets exacerbated by flood events from Crooked Creek and invasive plant species. There is a low area (referred to as the saddle area) along the south overbank of Crooked Creek, where during flood conditions, significant flows escape Crooked Creek and flow through McMahon Woods fen, causing problematic erosion to environmentally delicate areas of the critical habitat of the Hine's Emerald Dragonfly (fen/rivulets). To evaluate a solution to this overbank flooding problem, the HEC-HMS and HEC-RAS models of Crooked Creek from the Cal-Sag Area Detailed Watershed Plan (DWP) developed by the Metropolitan Water Reclamation District (MWRD) were utilized to analyze the overflow from Crooked Creek into McMahon Woods' fen. The model was modified for the McMahon Woods study to include a lateral weir to model the Crooked Creek overbank overflow condition in the low saddle area. In the DWP HEC-RAS model of Crooked Creek the overflow area was not included in the model and all flood flows were assumed to stay in Crooked Creek. The critical 12 hour precipitation duration was used for the analysis. Results of this H and H analysis are located in the Appendices.

Evidence of the results of erosive activities occurring within the fen areas of McMahon Woods were presented in the USGS (2014) study on the hydrological conditions within McMahon Woods. They measured the cross sections of three rivulets from 2012 to 2013 and found there was a general pattern of down cutting in the upper reaches of the channels (e.g., location of groundwater discharge) and depositing material downstream in the bottom reaches. This erosion is causing the tops of the rivulets to move northward and into the graminoid fen area and start the erosion farther into the fen. Note that most of the graminoid fen area is not located within the project footprint. The graminoid fen is part of a separate mitigation project that is focused on removal of invasive plant species and is not included in the project footprint. This headcutting is also causing the upper reaches to become deeper and devoid of stabilizing graminoid vegetation. The USGS study is confirmation of visual observations made by an area biologist that have become increasingly worried about the long term health of the fen/rivulet complex within McMahon Woods. This information has enabled practitioners to correctly identify problems and will help to formulate appropriate restoration measures.

In addition, Graef, Anhalt, Schloemer, and Associates, Inc. (2007) documented that groundwater within McMahon Woods flows generally from the northeast to southwest along porous sand and gravel layers to

a point where the sand and gravel layers intercept the graminoid fen/rivulet complex. A number of well points for both surface and groundwater have been installed along a transect extending from 104th Avenue east across the graminoid fen/rivulet complex (Graef, Anhalt, Schloemer and Associates, Inc. (2007)). Recent sampling efforts have documented elevated chloride concentrations. **Figure 5** shows the location of the rivulets and locations of crawfish burrows, which indicate possible breeding habitat of the Hine's Emerald Dragonfly. Notice that there is a possible rivulet outlined in the southwest corner that appears to be blocked by the placement of the limestone material from the construction and widening of the Calumet-Sag Channel.

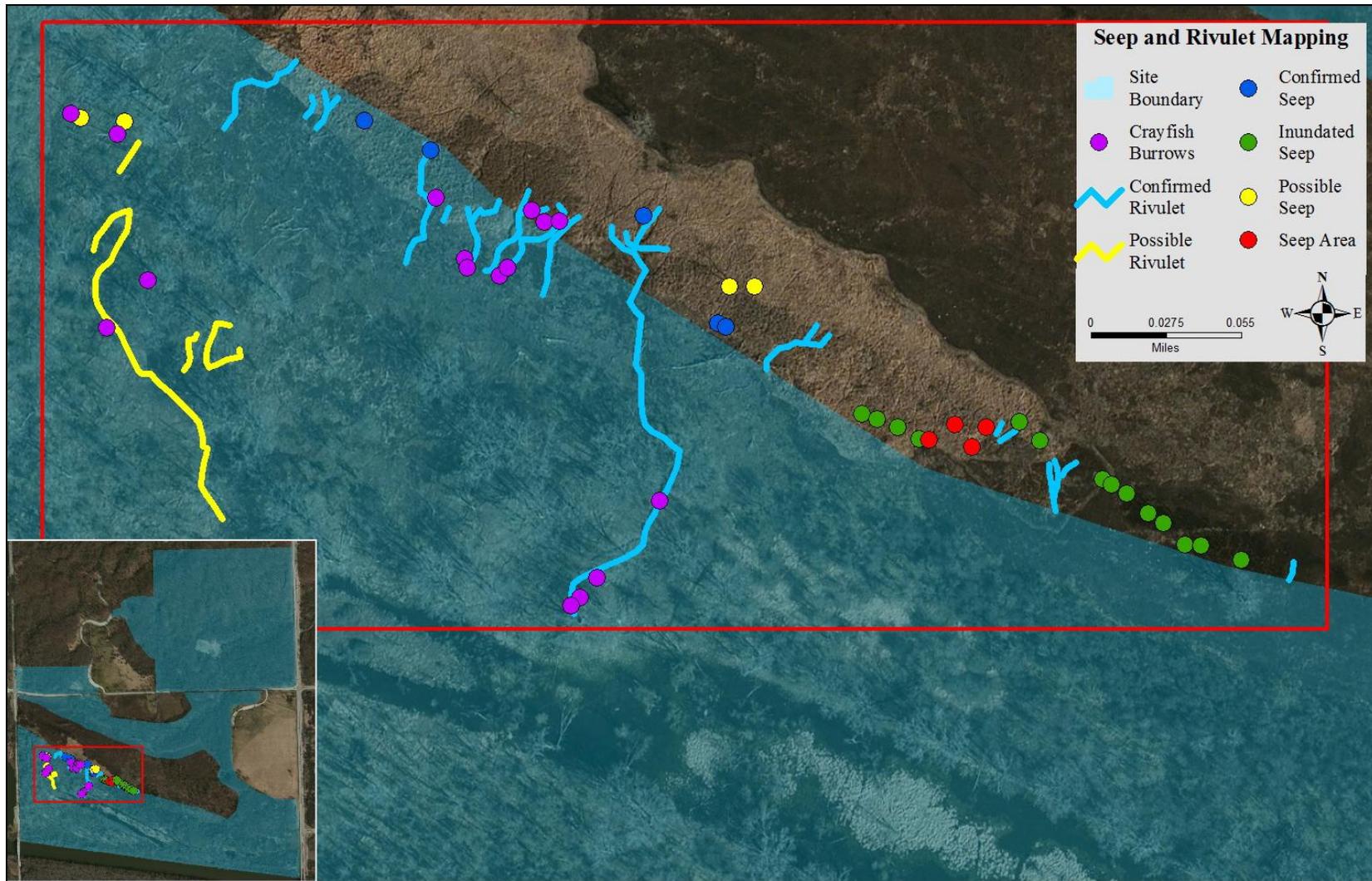


Figure 5 - Map of the Current and Potential Rivulets in McMahon Woods.

The blue shaded areas are inside the project footprint, the un-shaded areas are outside the project footprint (Graef, Anhalt, Schloemer and Associates, Inc. 2007).

2.2.7 – Surface Water Quality

Surface water enters the site from Crooked Creek and precipitation during rain fall events. Although water quality was not measured as part of the hydrologic investigations conducted in the last few years, however, untreated surface runoff from adjacent streets and parking lots located within the Crooked Creek watershed was observed entering Crooked Creek. Based on these observations it is believed that Crooked Creek may carry elevated loads of chloride and petroleum based products after rain fall events.

2.2.8 – Groundwater Quality

Groundwater saturates much of the soil within the graminoid fen located just outside of the project boundaries and daylight into the rivulets as shown in Figure 5. Chloride levels in the groundwater were measured as part of the hydrologic investigations in 2007. Chloride ranged from 74 to 330 mg/L. The highest value was at a well point nearest Crooked Creek. It is believed that chloride has been increasing in the groundwater as a result of untreated runoff from streets and parking lots entering the groundwater recharge within the Crooked Creek watershed.

2.2.9 – Air Quality

The local air quality in the Chicago area including Cook County are considered ‘non-attainment’ under the Clean Air Act for ozone, particulates (PM-10 and PM-2.5), and lead. The project is within the non-attainment zone.

2.2.10– Hazardous, Toxic & Radioactive Waste (HTRW) Analysis

USACE conducted an initial Phase I Environmental Site Assessment (ESA) in accordance with ASTM E-1527-13. According to ER 1165-2-132, non-HTRW environmental issues that do not comply with federal, state, and local regulations should be discussed in the HTRW evaluation along with HTRW issues. The HTRW assessment included in the Appendices was completed using existing information, historical topographic maps and aerial photographs, database research, and a site visit. No recognized environmental conditions (RECs) were identified in the ESA; however, the ESA identified one non-HTRW issue at the project site. Topographic maps suggest that the Cal-Sag Channel was constructed between 1901 and 1928 and material generated from construction of the channel may have been side cast to the north creating a berm in southern portions of McMahan Fen; in addition, an extensive fill pile is also located in the southwest corner of McMahan Fen, just east and parallel to 104th Avenue (Willow Springs Road). The fill areas are included in the limits of the project, though it is unlikely that these areas will be graded, or the fill removed from the site, due to extensive earthwork costs associated. Soil sampling conducted on the McMahan Fen fill pile suggests that, in general, fill materials consist of brown clay, gray and brown silt, and silty sand. Stockpiled soils do not contain VOCs, SVOCs, PCBs, pesticides and herbicides. Arsenic, beryllium, cadmium, chromium, copper lead, nickel, zinc and mercury were detected in most soil samples, but analytical results suggest that concentrations are similar to normal background of metals found in and/or State of Illinois Tiered Approach to Corrective Action Objectives (TACO) residential standards and are therefore not a REC. For more information on HTRW see Appendix E.

2.3 – Ecological Resources*

The following is a description of the ecotypes that occur within the study area of this project. Dominant vegetation and organisms that inhabit the particular ecotype will be presented to paint a contextual picture that relate to the restoration alternatives investigated under this study.

Ecosystem is a term used to describe organisms and their physical and chemical environments and can be described and delineated at various scales. For example, a pond or an ocean can be equally referred to as an ecosystem. Communities are naturally occurring groups of species that live and interact together as a relatively self-contained unit, such as a cobble riffle. Habitat refers to the living space of an organisms or community of interacting organisms, and can be described by its physical or biotic properties, such as substrate, woody debris or depression. Ecosystems may contain many communities and habitat types. These are usually assessed by describing and/or quantifying the physical structure, function, and/or present biological assemblages contained in the area of interest. They may also be assessed at various scales, depending on the level of resolution needed to answer specific questions. To achieve the objectives of the proposed project, the different types of ecosystems or communities contained in the study area were described and delineated based on their respective geomorphic position, dominant species assemblages, and physical structure of respective habitats.

2.3.1 – Macroinvertebrates

According to a survey of butterflies that was conducted by the Butterfly Monitoring Network from 1996-2008, there have been 53 butterfly species sighted within McMahon Woods. Sampling was focused mainly within the graminoid fen area. The graminoid fen area is a part of a mitigation project and is not a part of the project foot of this proposed project, but it is directly north of the wooded fen area and just south of Crooked Creek stream course. The wooded fen habitat and Crooked Creek riparian area (stream course) is within the footprint of the project area. The McMahon Woods site was visited 13 times from 1996-2008 and all species were recorded along with number of individuals per species. Of the 53 species encountered, 7 species are considered to be reliant on remnant habitat and are indicators of high quality habitat (**Table 1**). Remnant in this context means of minimal past human disturbance with intact ecosystem function and structure. This is mainly the result of ceasing agricultural activities back in the 1930s and the lack of drainage tile that would have drained the fen. Also, since the early 1990’s when it was first discovered that Hine’s Emerald Dragonfly had a breeding population at McMahon Woods, the graminoid fen has seen a reduction in woody regrowth via volunteer efforts and a mitigation project. This indicates that McMahon Woods as a whole has a high potential to be restored to a high quality fen/wet mesic oak woodland habitat, which is very scarce within the Chicago Metropolitan Region. The full list of butterfly species is found in Appendix I.

Table 1 - McMahon remnant reliant butterfly species, frequency and average abundance.

Species	Scientific Name	Frequency	Average
Black Dash	<i>Atrytone conspicua</i>	13/13	30
Dion Skipper	<i>Atrytone dion</i>	13/13	7.46
Hobomok Skipper	<i>Poanes hobomok</i>	13/13	7.08
Acadian Hairstreak	<i>Strymon acadica</i>	13/13	11.92
Bronze Copper	<i>Lycaena thoe</i>	13/13	11
Silvery Checkerspot	<i>Melitaea nycteis</i>	13/13	19.92
Eyed Brown	<i>Lethe Eurydice</i>	13/13	112.31

Frequency-is the number of visits this species was sighted

Average-is the average number of individuals each species was recorded for out of the 13 visits

Although Saganashkee Slough is not within the project foot print it is directly adjacent to McMahon Woods and many of the mobile organisms that will be found within Saganashkee Slough can travel to and will use similar habitat types within McMahon Woods. In August of 2012 an insect survey was conducted

of the Saganashkee Slough area and will be used to present the condition of the insect community at McMahan Woods. Two transects were sampled using a combination of sweep nets and visual surveying of flying and other cursorial arthropods (e.g., spiders). One transect was located in the marsh fringe along the eastern bank of the slough and one was located in the wet savanna area along the northern bank of the slough. Because individuals were field identified, none were captured as specimens for further laboratory verification, thus taxonomic resolution was limited. Taxonomic resolution was limited to Order, Family or Genus, very few to Species level. There were 48 taxonomic units identified from the marsh and 61 from the wet oak savanna. Their conclusion is that the diversity was limiting in the marsh because of the dominance of the cattails. Cattails do not offer a diversity of habitat structures for arthropods to utilize. They also concluded that none of the insects reported were unexpected and were fairly general in nature, meaning they can be found in a variety of habitats and conditions. The insects indicate that there is degraded habitat in the marsh areas and somewhat degraded habitat within the wooded areas based on the dominance of aggressive native and invasive non-native plant species. This indicates that restoration measures should have the greatest impact in recovering lost structure and function in an area directly adjacent to a high quality remnant, allowing increased connectivity of quality habitat within the region. For the full results of the insect survey please see Appendix I.

It is known that Hine's Emerald Dragonfly and the crayfish *Cambarus diogenes* occur within the graminoid and wooded fen of McMahan Woods. Hine's Emerald Dragonfly is a federally endangered species that is restricted to wetland habitats characterized by thin soils over dolomite bedrock with marshes, seeps, and sedge meadows. Species life requisites include groundwater feed marsh habitat dominated by graminoid species (e.g., grasses, rushes, sedges) and the burrows of the crayfish *Cambarus Diogenes*. Groundwater discharge forms small thin slow moving intermittent streams referred to as rivulets or streamlets. The species is known to occur within several of the rivulets at McMahan Fen. The crayfish burrowing species is important to the Hine's Emerald Dragonfly, which utilize the crayfish's burrows for overwintering and development, typically from late fall to early spring when water temperatures are cooler. The latest survey was conducted in the summer of 2012 (Soluk et al. 2013). This study was designed to provide essential information on the status of one of the most isolated sites for the Hine's Emerald Dragonfly in Illinois. Hine's Emerald Dragonfly was first identified on the site in 1992 (Cashett et al. 1992). The graminoid fen has been the focus of extensive restoration activities since the last reasonably intensive surveys for larval habitat were conducted in 2008 (Soluk et al. 2009). Limited surveys in 2009 yielded no Hine's Emerald Dragonfly larvae. In 2010, no adults were observed on the site (Soluk et al. 2011) and visual assessments of the site indicated that degradation of the known larval habitat area may have occurred (Daniel Soluk and Emy Monroe pers. obs.).

The McMahan Woods site represents the end of a chain of subpopulations historically connected along the Des Plaines River Valley like a string of pearls. Given that there may be disruptions in the connectedness because of human activities such as urbanization and roadway construction, it is essential to assess the health of these subpopulations to understand and predict potential future trends in the Illinois population as a whole. Those subpopulations at the end of the chain, such as McMahan Fen are often the most likely to experience local extinction because they are the least likely to be colonized from other subpopulations. Alternatively, the presence of a strong local population at McMahan Fen might serve to insure the viability of the subpopulations to its immediate south. In any event, it is of crucial importance to understand what is happening to the Hine's Emerald Dragonfly subpopulation at McMahan Woods. In particular it is critical to identify potential habitat for larval Hine's Emerald Dragonfly and survey their densities within McMahan Woods in order to prevent potential larval mortality caused by restoration efforts aimed at reducing the erosion of rivulets. Some preliminary sampling work was conducted in the rivulets at McMahan in the early fall of 2011 and although most of the rivulets could not be sampled at that time, four larvae were collected from Rivulet System 1 (Soluk et al. 2012). **Figure 5** presents the locations of

the important rivulets within McMahon Woods and **Figure 6** presents the U. S. Fish and Wildlife Service officially designated critical habitat of Hine's Emerald Dragonfly. **Figure 6** was digitized from: <http://www.fws.gov/midwest/endangered/insects/hed/hedch.html> that was published in the federal register, Volume 72, Number 171 on September 5, 2007.

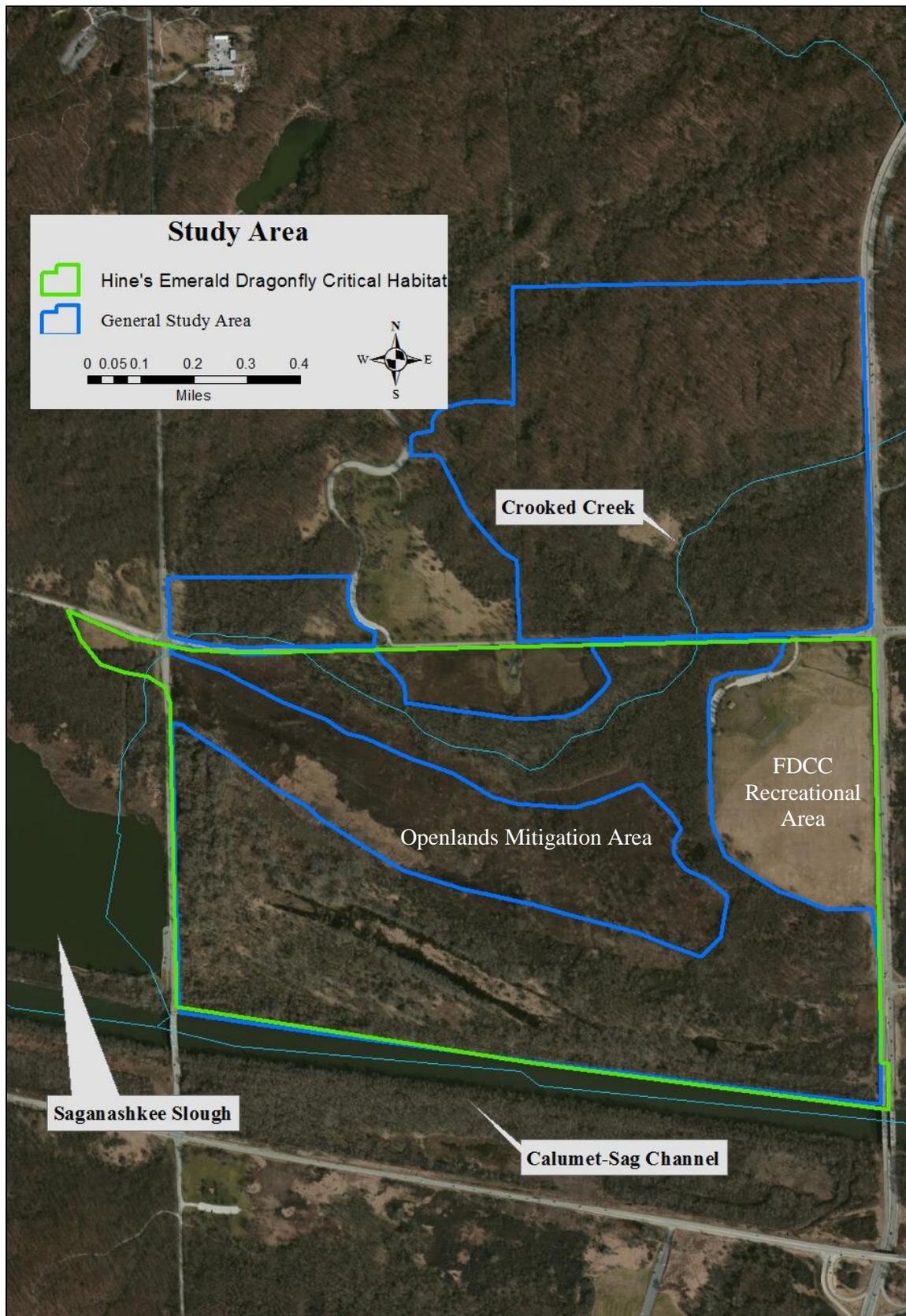


Figure 6 - Hines's Emerald Dragonfly Critical Habitat at McMahon Woods. FWS Unit #6.

2.3.3 – Resident/Migratory Birds

McMahon Woods project site resides within a band of important natural areas and parks that span northeastern Illinois. These natural areas serve as crucial foraging and breeding grounds along the Lake Michigan flyway portion of the Mississippi Flyway (Figure 7), which is an important migration route for many bird species. The flyway provides a visual north-south sight line, the coast of Lake Michigan, which the birds have evolved to follow as they undergo migration. The Bird Conservation Network has named the area that includes the City of Chicago and its suburbs as a globally significant migratory flyway. During the migration periods, March to May and September to mid-October, more than five million song birds are believed to traverse this flyway. Lake Michigan's shoreline is acknowledged as one of the most important flyways for migrant songbirds in the United States by ornithologists and bird watchers worldwide. Many other families of migrating birds - hawks and falcons, owls, waterfowl, gulls, terns and shorebirds - also follow Lake Michigan's shore line or winter just offshore. In all, more than 300 species of birds have been recorded in the Chicagoland area since 1970. Songbirds and other groups of birds migrate from South America to breed in portions of the Upper Midwest all the way to Canada and Alaska. It is critically important to migratory birds that use the Lake Michigan flyway to have optimal stopover habitat and food resources to successfully complete their migration. The shoreline of Lake Michigan and its surrounds, which includes McMahon Woods, provides vital natural areas that offer rest and foraging opportunities for tired and hungry migrants.

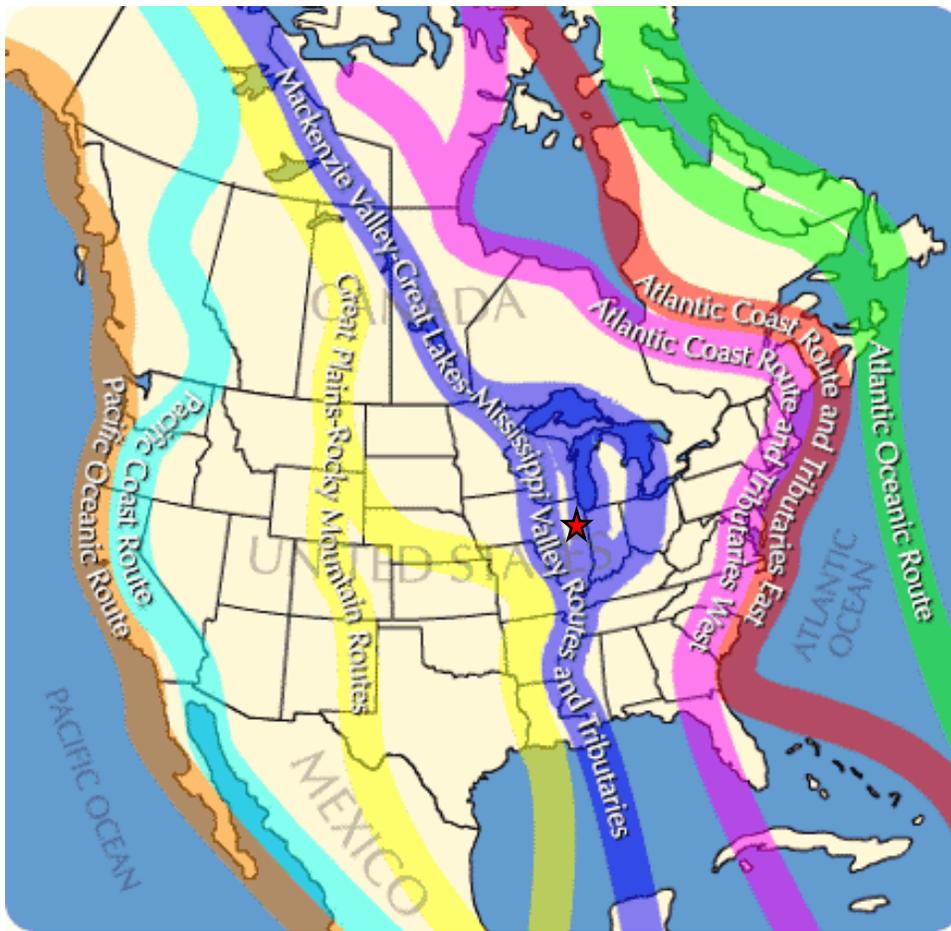


Figure 7 - Location of McMahon Woods and Lake Michigan Flyway. Red star indicates location of project site.

Approximately 285 species of birds may occur within the region throughout the year. Out of these, 105 bird species have been recorded occurring at Saganashkee Slough and McMahon Woods from 1968 through 2008. A number of species are migrating through, specifically large numbers of waterfowl (e.g., Lesser Scaup, Canvasback, etc.) and songbirds (e.g., Chestnut-sided Warbler and Ovenbird), as they make their way north to Canada. A number of species are using the woodlands within McMahon Woods for breeding purposes, such as the Blue-Gray Gnatcatcher. Also notable is the number of species of concern that have been recorded from the project area that would greatly benefit from the proposed restoration measures (**Table 2**).

Table 2 – Recorded Bird Species of Concern (1968-2008).

Common Name	Scientific Name	Historical (1968-1998)	2008	Resident	Migratory	Migratory Breeder	Status
Black-Crowned Night-Heron	<i>Nycticorax nycticorax</i>	X				X	E-IL
Cerulean Warbler	<i>Dendroica cerulea</i>	X			X		*
Forster's Tern	<i>Sterna forsteri</i>	X				X	E-IL
Northern Pintail	<i>Anas acuta</i>	X			X		**
Thayer's Gull	<i>Larus thayeri</i>	X			X		*
Trumpeter Swan	<i>Cygnus buccinator</i>	X	X		X		*

* National Audubon Society Species of Concern

** National Audubon Society Common Declining Bird

E-IL- Illinois State Listed Endangered Species

For a number of interconnected reasons, the available habitat structure and resources available at McMahon Woods are marginal at best. For example, the lack of high quality marsh limits the ability of wetland dependent bird species to use the area. Wetland dependent bird species include: Yellow Rail, King Rail, Virginia Rail, Sora, American Bittern, Least Bittern and Black-Crowned Night-Heron, all of which are of concern to bird conservation groups that have seen their populations decline over time. Additionally, the lack of diverse native wetland plants contribute to the lack of macroinvertebrate diversity, which form the resource base for many of the wetland dependent bird species. Finally, the establishment of invasive shrub species, secondary forest growth and lack of rich herbaceous understory plant species reduce the quality of the McMahon Woods for migrating and breeding passerine bird species. Passerine bird species can be described as neotropic (new world tropical migrating bird species) warblers, flycatchers, and swallows. The invasive shrubs reduce and extirpate native shrub and herbaceous plant species and change nutrient cycling within woodlands that further reduce the suitability of the area for native plant species. Invasive shrubs provide low quality food for fruit eating birds, and the elimination of native plant diversity, reduces the ability of birds to use different resources during the migration and throughout the growing season. Loss of a diversity of resources reduces the ability of birds to survive during migration and successfully reproduce. Overall, the project area provides habitat for many bird species, as depicted by the number of species recorded, but provides a suboptimal habitat and low quality resources.

2.3.4 – Mammals

The McMahon Woods study area provide suitable habitat for common “urban” wildlife species, including whitetail deer (*Odocoileus virginianus*), coyote (*Canis latrans*), raccoon (*Procyon lotor*), possum (*Didelphis marsupialis*), thirteen-lined ground squirrel (*Citellus tridecemlineatus*), gray squirrel (*Sciurus*

carolinensis), cottontail rabbit (*Sylvilagus floridanus*), and striped skunk (*Mephitis mephitis*). No further surveys have been completed for mammal species within the project footprint.

2.3.5 – Fishes

Crooked Creek discharges into Saganashkee Slough. Fish species that occur in Saganashkee Slough are able to travel upstream from the mouth to the upper reaches of Crooked Creek that flows through the project area. However, fish species are usually constrained from moving upstream from Saganashkee Slough during periods of low water, which can occur from mid to late summer through fall. Fish species that have occurred in Crooked Creek, mainly around the mouth, via Saganashkee Slough are listed in Table 3.

Table 3 - Fishes of Crooked Creek

Species	Common Name
<i>Pomoxis nigromaculatus</i>	Black Crappie
<i>Pomoxis annularis</i>	White Crappie
<i>Lepomis macrochirus</i>	Bluegill
<i>Lepomis cyanellus</i>	Green Sunfish
<i>Lepomis hyb.</i>	hybrid sunfish*
<i>Micropterus salmoides</i>	Largemouth Bass
<i>Dorosoma cepedianum</i>	Gizzard Shad
<i>Notemigonus crysoluecas</i>	Golden Shiner
<i>Aplodinotus grunniens</i>	Freshwater Drum
<i>Morone mississippiensis</i>	Yellow Bass
<i>Cyprinus carpio</i>	Common Carp

2.3.6 – Amphibians and Reptiles

Amphibians that have been observed at McMahon Woods include: American Toad (*Anaxyrus americanus*), Western Chorus Frog (*Pseudacris triseiata*) and Northern Leopard Frog (*Lithobates pipens*). These three species are fairly common within the area and can be found in moist woods, riparian areas and wetlands. Although not observed within McMahon Woods, the Blue Spotted Salamander (*Ambystoma laterale*) may occur. McMahon Woods has the right mix of habitat types utilized by the Blue Spotted Salamander, such as riparian areas, slow moving streams and woodlands. Only two reptile species was observed, the Common Gartersnake (*Thamnophis sirtalis*) and Common Slider (*Trachemys scripta*).

2.3.5 – Plant Communities

Plant community structure and function form the base of the food chain and is one of the primary drivers of nutrient cycling in almost all ecosystems. Plant communities influence all other trophic levels within an ecosystem, including arthropods, insects, amphibians, fish, birds and mammals. Plant communities also indicate historical human activities and disturbances within an area. Previous vegetation monitoring in the area was primarily limited to the graminoid fen area within McMahon Woods (2009 Vegetation Monitoring Report). In order to gather more information on the condition of the plant communities within the entire project footprint, a vegetation inventory was conducted by the USACE in the summer of 2012. From this effort distinct plant communities were identified, inventoried and dominant species recorded. The following is the result of the plant community inventory from 2012. Locations of plant community types refer to **Figure 7**. For a full list of plant species see Appendix I:

Marsh

The current distribution of the five (5) marsh plant communities within the project site is limited to a depression area on the north side of McMahon Woods at the intersection of two tributaries to Crooked Creek and an area located just to the south of the graminoid fen (note: graminoid fen is not included in project footprint). Both areas have a typical degraded marsh structure, mostly herbaceous species with some woody species growing intermittently. Both areas are dominated by cattails (*Typha spp.*) that has a conservatism value of 1 (see section 2.5 for more information on Floristic Quality Assessment). Other species include wetland obligate species of moderate conservatism (C of 5), Sneezeweed (*Helenium autumnale*) and Peach-leaved willow (*Salix amygdaloides*), although these are very infrequent species. The Mean Conservatism (C) score for this community is **1.4**. For information about the Mean Conservatism score refer to section 2.5.1 Habitat Assessment Methodology. This is considered to be indicative of a highly degraded community. The causes of this degradation range from the negative impact of aggressive native species (as a result of little to no competition from more conservative native species), non-native invasive species, fire suppression and encroachment of secondary woody growth (as a result of fire suppression). In addition to degradation from invasive species, the marsh area south of the graminoid fen contains the beginnings of the groundwater feed rivulets. This area has experienced increased erosion that seems to have been caused in part from over flow events from Crooked Creek.

Oak Savanna

The Oak savanna is located in two small areas, totaling 4.5-acres, along the western border of the project site and is a globally imperiled habitat type (along with graminoid fen) as recognized by the U.S. Fish and Wildlife Service and The Nature Conservancy. This community typically has an open canopy and supports a diverse herbaceous layer that can tolerate full to semi-sun, but not deep shade. Oak savannas are fire dependent, meaning that the plant species associated with this community are adapted to periodic fire. The current Oak savanna has a mean C of **2.3**. This score is indicative of a degraded system. For example, Pin oak (*Quercus palustris*, C of 8) still retains a presence within the canopy, but the growth of Eastern cottonwood (*Populus deltoides*, C of 2) is threatening to completely close the canopy, thereby constraining the ability of semi-shade tolerant species to remain in the community. Oak savannas function very similarly to prairies in terms of their response to fire. Traditionally, when fire would move through these communities in the dry season (late summer/fall), species such as Eastern cottonwoods would not survive the fire, allowing species that are adapted to fire to dominate the community. Although regular prescribed burns are needed to maintain the community, established European buckthorn (*Rhamnus cathartica*) thickets do not respond to fire and would need to be removed during the early stages of restoration. It appears that buckthorn is just now invading this community, perfect time to start restoration measures. There are still some species that remain that indicate this community would respond favorably to restoration actions such as, Green-head coneflower (*Rudbeckia lacinated*, C of 5) and Tall tickseed (*Coreopsis tripteris*, C of 5).

Wet Mesic Woodland

This is the largest plant community type, at 376-acres, found within the project footprint. It is a mix of low lying groundwater feed land and the riparian area of Crooked Creek. The wet mesic woodland contains the wooded fen that is critical habitat for the Hine's Emerald Dragonfly. The southern portion of McMahon Woods, south of the graminoid fen, holds a mixture of slow moving ground water feed rivulets, slightly higher ridges and low lying depression areas that hold water almost all year round. The northern portion of McMahon Woods, north of the graminoid fen, contains woodlands that directly border Crooked Creek and its tributaries. The wet mesic woodland has a Mean C score of **2.5**. The low Mean C score reflects similar problems identified within the other plant community types such as, fire

suppression, invasion of invasive and non-native aggressive species, canopy closure, and increased rates of erosion within the rivulets.

After agricultural activities ceased in the 1930s this area was colonized by Bur oak (*Q. macrocarpa*) and Pin oak (*Q. palustris*) in the wet areas and White oak (*Q. alba*) and Red oak (*Q. velutina*) in the drier areas from the surrounding bluffs that were not farmed. Only the Pin oaks remain. This woodland had originally a semi-enclosed canopy, similar to a savanna, but supported more shade tolerant species. As fire was suppressed and invasive shrubs moved in, the canopy closed almost entirely resulting in large areas with no herbaceous coverage. Suppression of fire has resulted in the dominance of fire intolerant species such as, Eastern cottonwood (*Populus deltoides*) and American elm (*Ulmus Americana*). And the loss of the herbaceous layer can partly be contributed to the invasion of non-native shrubs such as, European buckthorn (*Rhmanus cathartica*) and Japanese honeysuckle (*Lonicera mackii*). As a result of the loss of the herbaceous layer, the small tributaries that feed into Crook Creek, particularly in the woodland north of 107th st., have begun to incise and are leading to bank failures. This incision and slumping has resulted in increased rates of erosion within the upper reaches of the Crooked Creek watershed.

In general, the plant communities are degraded to highly degraded and that they would greatly benefit from restoration actions. Reasons for this degradation range from fire suppression to dominance by invasive species. For a list of habitat types and indicators of their habitat quality refer to **Table 4**.

Table 4 – Habitat Quality of the Current Plant Communities.

Community Type	Acres	Mean C	HSI	Native	Adventive	Total
Marsh	30.1	1.4	0.14	15	11	26
Oak Savanna	4.5	2.3	0.23	35	9	44
Wet Mesic Woodland	376	2.5	0.25	20	8	28

Mean C – Mean Coefficient of Conservatism

HSI – Habitat Suitability Index

Adventive – Non-native

Total – total of native and non-native plant species

2.3.6 – Threatened & Endangered Species

The County Distribution of Federally-listed Threatened, Endangered, Proposed and Candidate Species was reviewed for Cook County by the Chicago District. The following federally listed species and their critical habitats are identified by the USFWS as occurring within Cook County:

- Piping plover (*Charadrius melodus*) – Endangered – Wide, open, sandy beaches with very little grass or other vegetation
- Eastern massasauga (*Sistrurus catenatus*) – Candidate – Graminoid dominated plant communities (fens, sedge meadows, peat lands, wet prairies, open woodlands, and shrublands)
- Hine’s emerald dragonfly (*Somatochlora hineana*) – Endangered – Spring fed wetlands, wet meadows, and marshes
- Eastern prairie fringed orchid (*Platanthaera leucophaea*) – Threatened – Moderate to high quality wetlands, sedge meadow, marsh, and mesic to wet prairie
- Leafy-prairie clover (*Dalea foliosa*) – Endangered – Prairie remnants on this soil over limestone

- Mead's milkweed (*Asclepias meadii*) – Threatened – Late successional tallgrass prairie, tallgrass prairie converted to hay meadow, and glades or barrens with thin soil
- Prairie bush clover (*Lespedeza leptostachya*) – Threatened – Dry to mesic prairies with gravelly soil

The only Federally endangered species known to inhabit the study area is the Hine's emerald dragonfly (*Somatochlora hineana*). The species was listed as endangered in 1995 with extant populations only occurring in Illinois, Wisconsin, Michigan, and Missouri. Critical habitat for the species includes marshes and sedge meadows fed by calcareous groundwater seepage and underlain by dolomite and bedrock. Threats to Hine's emerald dragonfly include habitat loss, habitat degradation, habitat succession, and disruption of ecological and hydrological processes. Coordination with the USFWS started during the scoping phase of the feasibility study with informal meetings to discuss potential impacts and benefits of the project to federally listed species, namely the Hine's Emerald Dragonfly. Information that was discussed during the meetings centered on the current environmental problems with the Hine's Emerald Dragonfly habitat within McMahon Woods and how this project could reverse the current level of degradation while doing so with minimal temporal impacts to adult and larval stages of the species.

Occurrences of Illinois State listed endangered and threatened species:

- Queen-of-the-prairie (*Filipendula rubra*) – State Endangered – Full or partial sun, moist black soil prairies, moist sand prairies, moist meadows along rivers in woodland areas, shrubby fens, and wet areas in or around seeps and springs
- White lady's slipper (*Cypripedium candidum*) – State Threatened – Graminoid dominated plant communities (fens, sedge meadows, peat lands, wet prairies, open woodlands, and shrublands)
- Savanna blazing star (*Liatris scariosa nieuwlandii*) – State Threatened – Oak savannas and prairies, rocky glades and savannas with pine trees. Savanna Blazing star is found in high quality habitats
- Black-crowned Night-heron (*Nycticorax nycticorax*) – State Endangered – Found near freshwater ponds, lakes, sluggish streams, swamps, marshes, backwaters and shallow. They utilize a wide variety of upland and lowland tree species and where suitable tree species cannot be found they will often nest in marsh vegetation where their nests are concealed
- Foster's Tern (*Sterna forsteri*) – State Endangered – Larger inland lakes with marsh borders for nesting

While all of these species have been recorded within or directly adjacent to the study area, the Black-crowned Night-heron and Foster's Tern have only been sighted infrequently and not within the last 7 years. The Queen-of-the-prairie, White lady's slipper and Blazing star have small populations within the McMahon Woods area. The White lady's slipper occurs within the graminoid fen outside of the project footprint. The Queen-of-the-prairie may occur around the borders of the project footprint near the open areas of the graminoid fen.

2.4 – Cultural Resources*

2.4.1 – Cultural & Social Properties

The Palos Division of the Forest Preserve District of Cook County Forest is an important area for public recreation. Available facilities include the Little Red School House Nature Center as well as designated areas for hiking, cross-country skiing, camping, picnicking, boating, fishing, and horseback riding.

2.4.2 – Archaeological & Historical Properties

McMahon Woods is located about 20 miles north of Chicago in southwestern Cook County, Illinois. Surrounding communities include Palos Hills, Lemont, and Orland Park. McMahon Woods is in the middle of approximately 100 square miles of county forest preserve land.

Numerous properties in southwestern Cook County are listed on the National Register of Historic Places, however none are located near the project area. The Calumet Sag Channel of the Chicago Sanitary and Ship Canal is just to the south of McMahon Woods and runs along the southern edge of it, separated by an earthen berm. Although not listed on the National Register of Historic Places, the Calumet-Sag channel is eligible to be listed.

The project area at McMahon Woods is comprised of the marsh, wooded riparian and adjacent fen areas. Although some of the area woodlands have been cut for timber in the past, most of the project area has never been farmed, although there was an orchard that was located on the north side of the project area that was naturalized when the site ownership changed to the Forest Preserves of Cook County.

The project area may contain intact archaeological material. No construction activities except in previously disturbed areas are planned as part of this project. In the event of the accidental discovery of cultural resources, the Illinois State Historic Preservation Agency will be contacted and consultations will take place.

2.4.3 – Land Use History

The swampy and hilly Palos Hills areas of the Valparaiso Moraine in this area of Southwestern Cook County were ignored by the early settlers for more desirable farming lands. Construction of the Illinois and Michigan Canal from 1836 to 1848 brought large numbers of Irish and German immigrant labor into the area. Their farming settlements of Lemont to the west, and Palos Hills to the east remained on the edges of the Saganashkee-Palos Hills area. Some areas of the swamp were drained for farming, and the woodlands of the Palos Hills were utilized for timber. In 1922 the Calumet-Sag channel, connecting the Calumet River with the Chicago Sanitary and Ship Canal, was constructed through the Saganashkee swamp. One by-product of this construction was the present day Saganashkee Slough. Agriculture remained the principal occupation of the area until the 1940s. Since the 1950's the region has experienced a steady increase in population as the communities surrounding the Saganashkee and the Palos Hills have developed into residential areas for people working in Chicago.

The Illinois Forest Preserves were initiated by a 1913 state statute, with Cook County organizing the first forest preserve district in 1914. No similar preserves existed anywhere in the world at that time. The Saganashkee Slough/McMahon Woods area was acquired along with portions of the Palos Hills by the Forest Preserve District of Cook County in the 1930's.

2.4.4 – Social Properties

South western Cook County has a primarily white upper middle-class population of approximately 240,000 inhabitants. The median home value s \$178,600.00 (2010) and the median household income is \$67,700.00 (2010).

2.5 – Habitat Quality Forecasting

2.5.1 – Habitat Assessment Methodology

Many methods are available to measure current ecosystem resource conditions and to predict future conditions of those resources. Habitat assessment methods developed for individual species may have limitations when used to assess ecosystem restoration problems and objectives. They do not consider communities of organisms and typically consider habitat in isolation from its ecosystem context. The assessment methodology selected for this study is community based and was chosen by how well the technique meets the needs of the study goals, objectives, and level of detail. The assessment methodology, or Floristic Quality Assessment (FQA), focuses on composition and function of the plant community. This was chosen to assess the ecological value of the proposed future without-project condition and any ecosystem level changes that result from the proposed management measures for Saganashkee Slough. There was no weighting per community type since each part of the ecosystem is just as important as the other. The FQA is a regionally approved model for USACE planning use.

Floristic Quality Assessment

The determination of “quality” with respect to plant assemblages has been the subject of much research and development since the mid 1970’s. Quality, as used in this study, is essentially an assessment of the degree to which native plant species are present within defined plant communities. Plants are exceptional indicators of short and long term disturbance in terms of habitat function and structure. Vegetation influences most aquatic functions such as net annual primary productivity. Plants are the largest primary producers in most systems, which make them the primary vector of energy flow through an ecosystem. In addition, research has shown there to be strong correlations between vegetation and water chemistry.

Most importantly for restoration, vegetation provides resources and habitat for entire suites of species, that than indirectly influence the entire food web of an ecosystem (e.g., insects, fish, birds, mammals, etc.). Out of the approximate 2,500 plant species known to occur in the Chicago Region, around one-third were not present before European colonization. Non-native species did not evolve within the same environmental conditions as the native species, and their persistence indicates a certain degree of functional disablement. Numerically describing the quality of an area using vegetation reflects the level of disturbance to the biological integrity of the site. In the Chicago Region, there is one commonly used approach that attempts to describe plant community quality with a simple numerical metric, which is the FQA (Swink and Wilhelm 1979). This assessment tool was designed to be used as an all inclusive method, not just as a way to identify high quality sites. The FQA was originally developed for the Chicago Region, but has since been developed for regions and states throughout North America. This method has been extensively studied and shows great promise as a quick and easily understood method of assessing the quality of plant communities.

The FQA method specifically excludes the use of “indicator” species, instead assessing the sensitivity of all individual plant species that inhabit an area. Species “conservatism” is used as its basis for assessment; conservatism being defined as a level of tolerance each plant species exhibits to disturbance type, amplitude, and frequency, as well as fidelity to specific habitat types. As an area’s equilibrium is disturbed, the habitat’s capacity to absorb disturbance is weakened and the first plants lost will come from

the high end of the conservatism spectrum. Therefore, what is being measured is the extent to which an area supports conservative native plants.

Based on species inventory, the FQA generates two essential metrics for an area inventoried: the Mean C, which is the average coefficient of conservatism, and the FQI, which is derived by multiplying Mean C by the square root of the number of native species inventoried,

$$FQI = \bar{C}\sqrt{N}$$

where C is the coefficient of conservatism and N is the number of species. The FQI, therefore, is a function of both conservatism (function) and species richness (structure). Typically, larger sites have a greater number of habitat types and likely will have greater species richness. Generally, both Mean C and FQI values are considered in the evaluation of an area or landscape unit. Based on statistical analysis of previous studies, the FQI shows a significant positive relationship to species richness (Ervin et al. 2006) and as such the Mean C value represents the more comparable and accurate metric.

Each native species has been assigned a coefficient of conservatism (C), ranging from 0 to 10. C values were assigned to species within a predefined geographic area by Swink and Wilhelm (1979). A 0 is assigned to species that are highly tolerant to human disturbance and are considered general in their habitat distribution and a 10 is assigned to species with a very low tolerance to human activities which display very specific relationships to certain habitat types. The following descriptions of categories were used to assign coefficients of conservatism to all plant species within the Chicago Region:

- 0-3 Wide range of ecological tolerance and found in a variety of conditions
- 4-6 Mid range of ecological tolerance and a smaller variety of conditions
- 7-8 Low range of ecological tolerance and associated with specific environmental conditions
- 9-10 Very low range of ecological tolerance and a narrow ecological niche

It has been demonstrated that sites with Mean C and Floristic Quality Index (FQI) values less than 2.8 and 20 respectively, as surveyed during the growing season, are degraded or derelict plant communities. Sites with mean C values that approach 3.2 are considered to be moderately disturbed. When site inventories yield mean C values greater than 3.4 or higher, one can be confident that there is sufficient native character present for the area to be at least regionally noteworthy - such landscapes are essentially irreplaceable in terms of their unique composition of remnant biodiversity. Sites with mean C and FQI values greater than 4.0 and 50, respectively, are rare and indicate highly significant natural areas of statewide importance. For the purposes of this study, the Mean C was chosen as the formula to calculate environmental benefits that are predicted from the proposed restoration measures. The formula for the Mean C is as follows:

$$MeanC = \frac{\sum_{i=1} C_i}{I}$$

C – coefficient of conservatism

i – individual species

I – total number of species

With an active land management plan and time, the mean C and FQI values will reflect the extent to which conservative species are being recruited and the floristic quality is improving. In this way, the FQA method can be used to assess restoration management decisions, as well as to document floristic

changes (positive or negative) in the landscape over time. In addition, the FQA has been shown to be highly correlated with other biological assemblages in their response to disturbance and restoration actions. For example, Shuey et al. (2012) found that the FQA predicted the response of moth species to amount of degradation across a gradient of human disturbance within prairie ecosystems. Their results show the same pattern as a variety of other research projects on other insects groups such as Hemiptera and Lepidoptera (Grabas et al. 2012, Panzer and Schwartz 1998, Panzer et al. 2010 and Wallner et al. 2013). Finally, the FQA is also correlated with physical and chemical characteristics of lakes (Radomski and Perlberg 2012), as well as, fish assemblages in lake systems (Garrison et al. 2008). The FQA is a reliable indicator of other aspects of ecosystem function and structure.

Habitat Suitability Index

Habitat outputs for the future without and future with project condition were estimated over the entire 50 year period of analysis. In order to restore the ecosystem within the study area, both ecosystem function and structure were addressed through the FQA method described above. These predicted benefits are projected based on how the plant community will respond per the proposed restoration measures described in Section 3.1. In order to calculate the unit of measure for ecosystem benefits, which is Habitat Units, the Mean C score is divided by 10. This converts to score to a range of 0 to 10. The following formula was used to calculate HSI:

$$HSI = MeanC / 10$$

Total habitat outputs, in terms of habitat units (HUs) were calculated by multiplying the affected area times the habitat suitability index:

$$HUs = A(HSI)$$

where A is the affected habitat area expressed in acres.

2.5.2 – Future Without-Project Conditions (FWOP)

Without restoration of habitat structure and function, the aquatic ecosystem of the McMahan Woods project area is projected to remain in poor condition with a slight reduction in quality as growth of fire intolerant tree species continue to close the canopy and there is an increase in the coverage of invasive shrubs. Legacy effects of past topography alteration from dredging and spoil piling of limestone and silty clay material still exists within the project area. Altered topography will continue to impact the discharge of groundwater within that area. This area is directly adjacent to the rivulets inhabited by the Hine's Emerald Dragonfly. Altered hydrology will continue to impact the stability of the rivulets. It is probable that without addressing these impacts, the marsh, rivulets and wooded habitat will continue to function significantly below its ecological potential. The future without project condition would also negate the possibility of increasing the acres of viable and critical habitat for the federally endangered Hine's Emerald Dragonfly. The effects of climate change are hard to predict because of the uncertainty in the current modeling efforts. The current models predict that the Midwest may experience more frequent periods of drought, colder winters and more frequent periods of intense rainfall. Based on these general trends, it is likely that these conditions will favor species adapted to climatic extremes, namely generalist species. The following predictions for each community type has taken into account the possibility of more frequent weather extremes.

Marsh

The marsh plant community is not expected to change significantly over the next 50 years. This is because of the current low quality of the plant community reflects past events that greatly impacted this community. Past impacts include the invasion of non-native and aggressive native wetland species (e.g., Cattails) that continue to degrade this community. Another possibility is that the rivulets continue to erode at the upper portions and starts to destabilize the slopes of the rivulets resulting in loss of vegetation. The current floristic score is a **Mean C of 1.4**. This is expected to remain stable in the coming years if no restoration actions are taken.

Oak Savanna

The Oak savanna is expected to degrade in the coming years. This is predicted based on the presence of invasive shrubs that have begun to colonize this community and the presence of forest tree species that will eventually form a more light limiting canopy than the current one. The reason forest tree species would be able to succeed in forming a more closed canopy is the lack of prescription burning. Prescription burns allow fire adapted species to dominant areas managed with fire. Species not adapted to fire such as forest tree species (e.g., Ash, Cottonwood, etc.) would not persist. The Oak savanna is a community type that evolved under and is driven by reoccurring fire events. Both of these current problems will continue through time allowing invasive shrubs to change the nutrient cycle of the soil layer, and in conjunction with secondary growth of forest tree species, will change the availability of light to the herbaceous layer. This change in plant structure and system function will cause the loss of shade intolerant and conservative species. The current **Mean C of the Oak savanna is 2.3**, this is expected to **decrease to 0.8**. Again this decrease is the result of the invasion and establishment of non-native shrub species and secondary growth of forest tree species.

Wet Mesic Woodland

This community will also experience persistence degradation from the effects of invasive shrubs and continued down cutting and erosion of the rivulets. The effects of invasive shrubs have been discussed in the above mentioned community types, with the likely result being the loss of conservative species from this community type. In addition, the problems associated with higher than expected rates of erosion within the rivulets and within the small tributaries in the upper reaches of Crooked Creek are expected to continue. This causes down cutting and slumping of the banks and loss of vegetation within these areas. A major cause of this problem within the rivulets is overflow from floodwaters of Crooked Creek, as investigated by the H and H analysis. Problems within the riparian zone of Crooked Creek are contributed to loss of light availability, altered soil nutrient cycling by the invasion of non-native shrubs. This has caused the loss of most of the herbaceous layer and exposed significant areas of bare soil. Without corrective actions, the effects of invasive shrub species and overflows from Crooked Creek will result in a loss of shade intolerant species, conservative species and species that rely on more stable hydrology within and adjacent to the rivulets and tributaries to Crooked Creek. **The Mean C is expected to decrease from 2.5 to 1.9.**

Table 5 - Future Without Project Condition of Plant Communities.

Community Type	Acres	AAMean C	HSI	Native	Adventive	Total	AAHU
Marsh	30.1	1.4	0.14	15	11	26	4.21
Oak Savanna	4.5	1.7	0.17	18	9	27	0.75
Wet Mesic Woodland	376	2.2	0.22	16	7	23	80.84

AAMean C – Average Annual Mean Coefficient of Conservatism

HSI – Habitat Suitability Index

Mean C – Mean Coefficient of Conservatism

Adventive – Non-native
Total – total of native and non-native plant species
AAHU – Average Annual Habitat Units

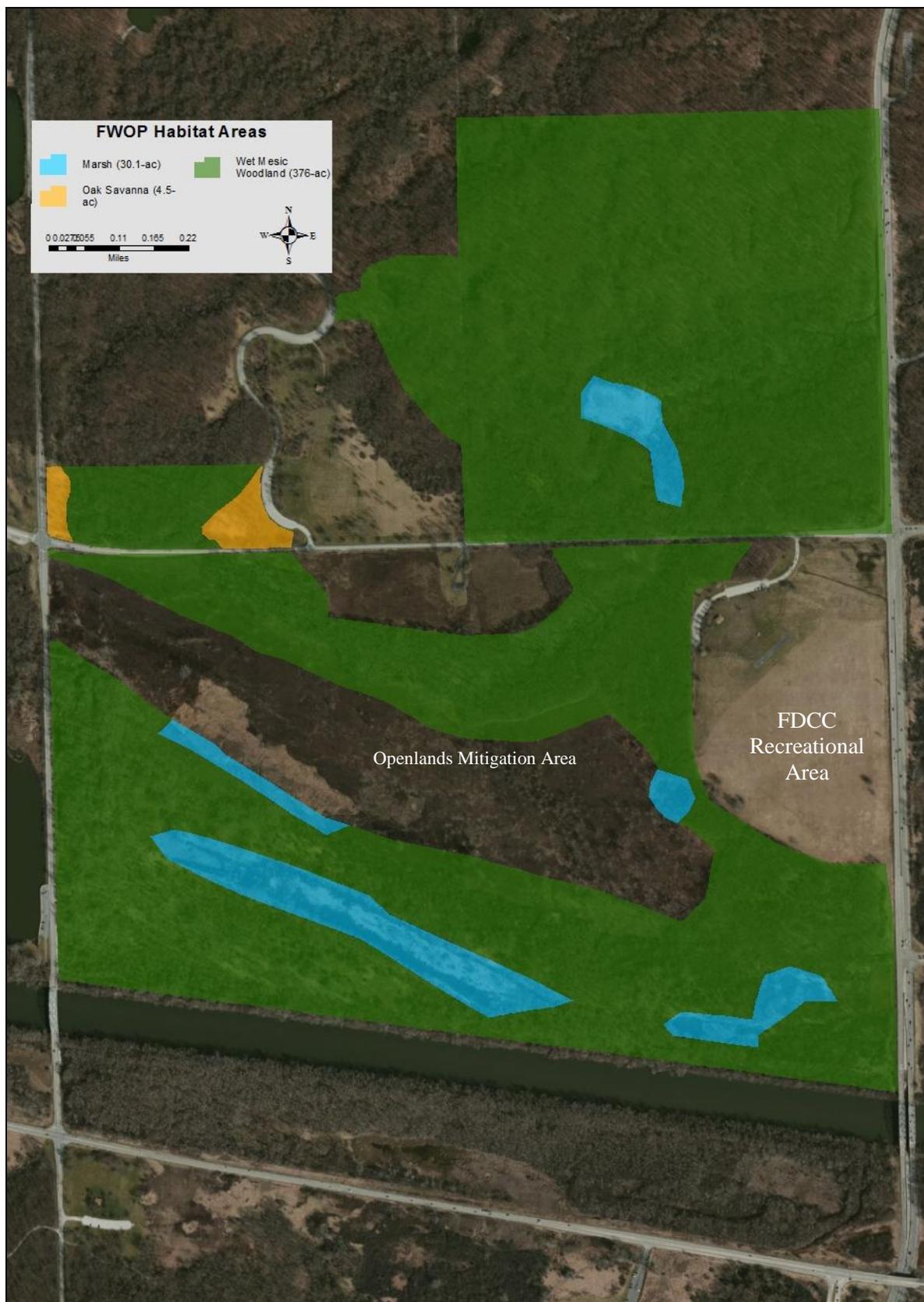


Figure 8 - Current and FWOP Plant Communities at McMahon Woods.

CHAPTER 3 – PROBLEMS & OPPORTUNITIES

This chapter provides a description of identified problems within the study area along with opportunities for improvement. It also outlines the overall project goal along with a list of planning objectives and constraints.

3.1 Problems and Opportunities

The Great Lakes maintain 20% of the world's freshwater and are important for social, economic, and ecological values throughout the region. However, these values can be lost when the integrity of the system begins to decline. The current trend of the Great Lake's ecosystem is that of continuing loss of ecosystem integrity. Anthropogenic modifications to the system have subsequently caused habitat degradation, fragmentation, pollution and invasive species issues, all of which are intertwined. As a result, ecosystem diversity and clean water have become more of a concern. These problematic trends can be lessened and ultimately reversed via physical and institutional efforts. The McMahon Woods study provides an assessment of the opportunities to provide restored acres of wetland, fish and wildlife habitat, important migratory bird habitat and critical habitat for a federally listed species.

3.1.1 Study Area Problems

The overall problem within the study area is the alteration of hydrology, invasive species and loss of coverage of native plants. The result of these problems is the alteration of ecosystem function (e.g. light availability and soil nutrient cycling) and structure (e.g., low coverage and diversity of conservative fire adapted plant species) that has impacted the area's ability to provide sufficient function and habitat for regional and migratory species. The effects of altered ecosystem function and structure is the area's inability to attract and sustain important migratory breeding species (e.g., Black-crowned Night-heron). Also, lack of suitable habitat for state endangered and threatened plant species to expand their range within the project area. Most notable is the continued degradation of a federally endangered species habitat, Hine's Emerald Dragonfly.

This project affords the opportunity not only to address issues associated with the above-stated problems, but it also continues the movement to establish coastal and inland refuges within the southern Lake Michigan basin. This project can provide a piece to the large-scale Great Lakes restoration area by providing a significant quantity of valuable habitat for a multitude of federally listed species, locally rare species, and a significant number of migratory and resident bird species. Wetland function is constantly being lost in the southern Lake Michigan basin. Restoring and protecting these essential habitats is at the heart of the GLFER program. The following are resource problems that could be addressed through this project:

- Degradation of aquatic migratory bird habitat
- Altered hydrologic regime
- Invasive species dominance
- Degradation of groundwater feed (rivulets) wetlands
- Loss of periodic fire
- Lack of native herbaceous and shrub species (food bearing plants)

Although this project is located in an area with a large amount of open space that has been preserved, the vast amount of alteration (e.g., construction of Calumet-Sag Channel) to this area is emblematic of the Chicago Region. The alteration, fragmentation, and finally loss, of natural habitats are the major causes of

the increasingly rapid decline in overall biotic diversity on Earth¹. To solve such problems one must consider not only the dynamics of the target species or process, but also the changes in the biotic and abiotic surroundings². Although ecological processes (e.g., competition, predation, disturbance events, etc.) in cities are the same as in rural areas, some of them, such as invasion by alien species are more prevalent in urban than in rural conditions³. Okinger and others investigated the relative importance of habitat type and connectivity for butterfly species richness in the city of Malmö, Sweden and compared species richness and composition in the urban habitats with that in the surrounding agricultural landscape. This study highlights the importance of the urban landscape composition for species richness in urban habitats, but also demonstrates clearly that urban habitats, especially those characterized by an early-successional stage, can be of relatively high conservation value in regions dominated by intensive human land use⁴.

Fernández-Juricic & Jokimäki reviewed multiple research studies and found that birds in urban landscapes need important habitat islands. Open spaces in metropolitan regions can contain habitat important for numerous species that may be surrounded by unsuitable habitat. Islands of habitat and how they function is based on well-established ecological theory. Understanding how habitat functions within areas of heavy human activities forms the framework for the management and conservation of urban birds. Based on two comprehensive studies conducted at urban parks in Spain (Madrid) and Finland (Oulu and Rovaniemi), several different points related to bird conservation in urban landscapes are presented: open spaces are important biodiversity hotspots in urban landscapes; b) habitat fragmentation has the same deleterious effects as in other fragmented landscapes; and c) size of habitat accounts for species numbers (e.g., the larger the area, the greater the number of species will occur). Because increasing the size of open space is difficult in built environments, enhancement of habitat diversity and resource availability for birds within current open spaces appears to be a straightforward way of increasing bird diversity in urban landscapes⁵.

Donnelly & Marzluff found that larger habitat patches contained richer and less evenly distributed bird communities than smaller habitat patches. It was also found that the as habitat diversity increased so did number of species, some of which were rare. Native forest species were least abundant and synanthropic species (pigeons, house sparrows, rats, common carp) most abundant in urban landscapes. Their abundances were correlated with the presence and abundances of exotic ground and shrub vegetation. Therefore, control of exotic vegetation will likely benefit native songbird populations.

In addition to habitat loss and land alteration, hydrological alteration is also a main driver of loss of quality habitat for native species within the region. As is discussed in the hydrological investigations performed by USACE, Graef, Anhalt, Schloemer and Associates, Inc. (2007) and USGS (2014), changes in hydrology are partially responsible for the degradation of critical habitat for the Hine's Emerald Dragonfly. Changes in hydrology include increased runoff from human land use within the Crooked Creek watershed and redirection of groundwater discharge because of the placement of fill from the construction and widening of the Calumet-Sag Channel. Assessing the problems of overflows from Crooked Creek are important components of this feasibility study (Photo 1).

Finally, the impacts of invasive species are numerous and widely studied. As a summary, invasive species change aspects of ecosystem structure and function in ways that make the invaded habitat unsuitable for a variety of native species and in some cases humans.

¹ Burgess & Sharpe 1981; Harris 1984; Saunders et al. 1987

² Per Angelstam 1992

³ Niemelä 1999

⁴ Okinger et al 2009

⁵ Fernández-Juricic & Jokimäki 2001



Photo 1 - Erosion of rivulet #9 in McMahan Woods, rivulet flows into woodland in background.

Invasive species have become a priority for many agencies (e.g., USDA, BLM, USFWS etc.) and many studies have been and continue to research how to effectively and efficiently control these species. Also, many case studies have documented the ability to return an ecosystem to pre-invasion function and structure after removal of invasive species, making removal of invasive species a priority objective in many restoration projects. Specifically within the project area, invasive shrub species are causing a shift from high/moderate light understory conditions to heavily shaded conditions, changing the entire function of major sections of the project area. Additionally, European buckthorn is known to increase the rate nitrogen is cycled through the soil nutrient cycle, changing the ability of understory plant species to persist under these shrubs (Photo 2). Invasive species can be native in origin, but function in a manner similar to non-native invasive species such as Cattails. Cattails are problematic in the remaining marsh areas (Photo 3-from Saganashkee Slough adjacent to McMahan Woods). Cattails form thick colonies that out competes native marsh vegetation under certain conditions.



Photo 2 - European Buckthorn (*Rhamnus cathartica*) overhanging Crooked Creek.



Photo 3 - Cattails within marsh at Saganashkee Slough adjacent to McMahon Woods.

3.1.2 Opportunities

Humans fragment and alter landscapes to the detriment of native plants and wildlife. Marzluff & Ewing (2001) research suggests that the severity of the effects of landscape alteration is determined by (a) the natural disturbance regime, (b) the similarity of the anthropogenic matrix to the natural matrix, and (c) the persistence of the anthropogenic change. As a result, urbanization is likely to produce greater effects of fragmentation than either agriculture or timber harvest. Marzluff & Ewing (2001) emphasize the importance of maintaining, restoring and monitoring species reproduction, survivorship, and dispersal. They suggest how restoration ecologists can minimize urban impacts:

Restoration ecologists, land managers, and urban planners can help maintain native wildlife species in fragmented landscapes by a combination of short- and long-term actions designed to restore ecological function (not just shape and structure) to fragments, including: (1) maintaining native vegetation, deadwood, and other nesting structures in the fragment, (2) managing the landscape surrounding the fragment (matrix), not just the fragment, (3) making the matrix more like the native habitat fragments, (4) increasing the foliage height diversity within fragments, (5) designing buffers that reduce penetration of undesirable agents from the matrix, (6) recognizing that human activity is not compatible with interior conditions, (7) actively managing mammal populations in fragments, (8) discouraging open lawn on public and private property, (9) providing statutory recognition of the value of complexes of small wetlands, (10) integrating urban parks into the native habitat system, (11) anticipating urbanization and seeking creative ways to increase native habitat and manage it collectively, (12) reducing the growing effects of urbanization on once remote natural areas, (13) realizing that fragments may be best suited to conserve only a few species, (14) developing monitoring programs that measure fitness, and (15) developing a new educational paradigm⁶.

In general, there are numerous opportunities to address significant problems within the McMahan Woods project footprint. Hydrological problems within the rivulets and riparian area of Crooked Creek can be addressed by reducing the frequency of overflow events from Crooked Creek and removal of invasive shrubs. Erosion problems within the rivulets can be further minimized through the installation of glacial cobble to mimic natural substrate and stabilize slopes. Finally, restoring a diverse array of herbaceous plant species will increase the coverage of the herbaceous layer that will further reduce the area of bare soil within the riparian area and streamlets and provide a critical component of vegetation structure for the Hine's Emerald Dragonfly.

3.2 Goals, Objectives and Constraints

3.2.1 Goal

The goal of this Feasibility Study is to determine a cost effective restoration plan, while considering a No Action Plan, which would restore lost or altered ecosystem function and structure within McMahan Woods project footprint.

3.2.2 Objectives

Federal and non-Federal Ecosystem Objectives

⁶Niemelä 1999

The Federal (USACE) and non-Federal sponsors' goals and objectives for water resources implementation studies establish the overall direction for this study. The specific objectives were derived from the identification of the study problems and opportunities and are discussed in the subsequent sections. The Federal objective of water and related land resources planning is to contribute to national economic and/or ecosystem development in accordance with national environmental statutes, applicable executive orders, and other Federal planning requirements and policies. The use of the term "Federal objective" should be distinguished from planning/study objectives, which are more specific in terms of expected or desired outputs whereas the Federal objective is considered more of a National goal. Water and related land resources project plans shall be formulated to alleviate problems and take advantage of opportunities in ways that contribute to study objectives and to the Federal objective. Contributions to national improvements are increases in the net value of the national output of goods, services and ecosystem integrity. Contributions to the Federal objective include increases in the net value of those goods, services and ecosystems that are or are not marketable.

The USACE also has a national objective for ecosystem restoration in response to legislation and administration policy. This objective is to contribute to the nation's ecosystems or National Ecosystem Restoration (NER) by restoring degraded ecosystem structure, function, and dynamic processes to a less degraded, more natural condition. Contributions to NER are increases in ecosystem value and productivity and are measured in non-monetary units such as acres of linear feet of habitat, function, average annual habitat units, or increased species number or diversity. Restoration of the Nation's environment is achieved when damage to the environment is reversed, lessened, eliminated or avoided and important cultural and natural aspects of our nation's heritage are preserved. The objectives and requirements of applicable laws and executive orders are considered throughout the planning process in order to meet the Federal objective. The following laws and executive orders that specifically provided guidance for this study are not limited to, but include:

- φ Endangered Species Act of 1973, as amended (16 USC 1531 et seq.)
- φ Fish and Wildlife Coordination Act, as amended (16 USC 661)
- φ Migratory Bird Treaty Act of 1918, as amended (16 USC 703 et seq.)
- φ Responsibilities of Federal Agencies to Protect Migratory Birds (E.O. 13186)
- φ Clean Water Act of 1977, as amended (33 USC. 1251 et seq.)
- φ National Environmental Policy Act of 1969 (42 U.S.C. 4321 et seq.)
- φ Invasive Species (E.O. 13112)
- φ Nonindigenous Aquatic Nuisance Prevention & Control Act of 1990, as amended (16 U.S.C. 4701 et seq.)
- φ National Invasive Species Act of 1996 (Public Law 104 – 332)
- φ Protection of Wetlands (E.O. 11990)
- φ Protection and Enhancement of Environmental Quality (E.O. 11514)
- φ Protection and Restoration of the Great Lakes (E.O. 13340)
- φ Floodplain Management (E.O. 11988)
- φ Preparing the United States for the Impacts of Climate Change (E.O. 13653)

GLFER Authority Ecosystem Objectives

Based upon the authorizing legislation and the desires of the fishery management and ecosystem restoration communities, the objective of the Great Lakes Fishery and Ecosystem Restoration Program is to provide ecosystem and fishery managers, and others interested in ecosystem restoration, with a planning, design, and construction tool. The following GLFER objectives apply to this project:

- ϕ Control the introduction and/or spread of invasive aquatic species. (Removes non-native plant species from the site).
- ϕ Evaluate the success of projects in order to make future projects better. (Will monitor the restoration to apply lessons learned to future restoration projects).
- ϕ Assure coordination between locally implemented restoration actions and basin wide restoration plans. (Close coordination with the Illinois DNR and FPDCC to ensure plan goals are being met, but not repeated).

Since the proposed alternative is in accord with GLFER 506 objectives, and ecosystem restoration is a high priority mission, there is strong Federal interest providing habitat outputs to the Great Lakes. There is also Federal interest in other related outputs of the potential alternatives, which include increase in diversity and abundance of native species, restoring natural wetland hydrology, and increasing acres of ecotypes in the Lake Michigan basin. There are opportunities within the study area to implement cost effective and environmentally justified projects that would increase the overall acreage of wetlands and natural habitats with the Great Lakes basin.

The study's non-Federal sponsor, FPDCC, has general goals for ecosystem restoration. These are to improve, enhance and increase aquatic and terrestrial quality habitats and improve ecological functions within their land holdings to support sustainable populations of diverse native species populations. Specifically, this study aims to protect, enhance, naturalize, and restore a riparian corridor, wet mesic woodland, marsh and critical habitat of a federally endangered species within southern region of Lake Michigan. The following planning objectives are those that will be directly measured for alternative analysis within this feasibility study:

3.2.3 Planning Objectives

As part of the USACE Civil Works mission, the federal objective of ecosystem restoration projects is to restore the structure, function and dynamic processes of degraded ecosystems to a less degraded, more natural condition. The non-Federal sponsor has an ecosystem restoration objective that partners well with the federal objective stated above. Study objectives are statements that describe the desired results of the planning process by solving the problems associated with the study purpose and need. These objectives were used for the development and evaluation of alternative plans. Objectives must be clearly defined and provide information on the effect desired, the subject of the objective (what will be changed by accomplishing the objective), the location where the expected result will occur, the timing of the effect (when would the effect occur) and the duration of the effect.

Four (4) planning objectives were identified by the study team, including the non-Federal sponsor and various stakeholders used in the formulation of alternatives:

- Reduce and/or eradicate invasive species
- Reduce/repair bare soil areas within the marsh and rivulet complex and Crooked Creek riparian area
- Increase native conservative plant species richness of marsh, Oak savanna and wet mesic woodland (containing wooded fen) communities

Objective 1 – Increase the native conservative species richness of various aquatic communities

The current conditions of the plant communities within McMahon Woods are very few native and conservative plant species (e.g., Coefficient of Conservatism of 5 or greater). This lack of conservative plant species richness and abundance impacts the structure and function of the system. This objective would address the lack of high quality plant species and thus would facilitate a more species rich and

healthy ecosystem. The effects of increasing the number of conservative plant species found in the plant communities would be reflected in increases in the Mean C measure of floristic quality (FQA). This increase in floristic quality would persist through the life of the project and is projected to be sustainable in perpetuity.

Objective 2 – Reduce and/or Eradicate Invasive Species

Currently, McMahon Woods' habitats are dominated by weedy and invasive plant species. This condition resulted from alteration of the natural hydrogeomorphic regime, disturbance to native soils, and fire suppression. The domination of plant communities by certain species such as European buckthorn and Cattails have changed the function and structure of these areas and as a result they have a low diversity of conservative species. Therefore, the changes to the native plant community desired are those that will reestablish a species composition dominated by conservative native plant species that will enable diverse resources for a variety of wildlife species. These effects would be sustained over the life of the project and in perpetuity. This objective seeks to reestablish native plant community richness and structure to support critical wetland and riparian habitats. Improvement is predicted via the increase in quantity (acres) and increase in quality (Mean C Value of the FQA) of native plant communities.

Objective 3 – Reduce bare soil areas within the wooded fen and Crooked Creek riparian area

This objective seeks to substantially decrease the events of overflow floodwaters from Crooked Creek, thereby reducing events that precipitate erosion within the Hine's Emerald Dragonfly marsh/rivulet complex and the wet mesic woodland. Invasive shrubs would be removed to allow greater light to penetrate the ground layer and allow the reestablishment of a rich herbaceous plant layer. Reestablishment of the herbaceous layer will address multiple problems. A fully functional herbaceous layer would decrease the amount of bare soil, retain and infiltrate more rainwater and provide increased resources for the prey base of the Hine's Emerald Dragonfly. The effects of reducing bare soil areas would be reflected by the increase in the number of conservative plant species that could be supported within the plant communities and as such would be reflected in increases in the Mean C measure of floristic quality (FQA). This increase in floristic quality would persist through the life of the project and is projected to be sustainable in perpetuity.

3.2.4 Planning Constraints

Planning constraints are items of consideration that limit the planning process and are used along with the objectives in the formulation and evaluation of solutions. The establishment of planning constraints is done in concert with the entire study team and in cooperation with stakeholders. A list of planning constraints for the NER purpose follows.

Any measures/alternatives implemented should:

- Avoid adverse effects to adjacent intact remnant ecotypes
- Avoid facilitating the dispersal of aquatic invasive species
- Minimize alteration of state and federal infrastructure
- Avoid adverse impacts to federal and state listed species

CHAPTER 4 – PLAN FORMULATION AND EVALUATION

The formulation, evaluation, and comparison of alternative plans comprise the third, fourth, and fifth steps of the Corps' planning process. These steps are often referred to collectively as plan formulation. Plan formulation is an iterative process that involves cycling through these steps to develop a reasonable range of alternatives, and then narrow those plans down to a final plan, which is feasible for implementation.

4.1 – Project Area and Measure Identification

The project has undergone numerous revisions to its project boundaries during this feasibility phase. The first revision was the understanding that a central part of McMahon Woods that is south of 107th street is currently undergoing mitigation actions and will not be included in this project. The mitigation area is indicated as Openlands Mitigation Area on Figures 3, 6 and 11. The USACE has had many meetings between Openlands (formerly known as CorLands), the FWS and FPDCC since 2013 when the feasibility study first kicked off. It was quickly apparent that all parties were united in a common goal to restore a high quality, high functioning habitat for the endangered Hine's Emerald Dragonfly and other rare and uncommon regional species. In addition, it was clear that both projects (mitigation and USACE restoration) would be using the same restoration techniques, such as invasive plant removal, aggressive tree removal, prescription burns and native plant seed installation. None of the proposed restoration measures would be in conflict with the desired goals of the mitigation project. During this time the FPDCC made known their desire to maintain the recreational opportunities at their open lawn area along 96th Ave (labeled FDPCC Recreational Area on Figures 3, 6, and 11) and that area would be removed from the project boundaries. FDPCC also indicated that they wished to have Saganashkee Slough removed from further consideration as well when it became known that the total cost to restore the slough was more than they wished to cost share and their concerns over possible conflicts between maintaining and operating the restored features and current recreational activities within the slough. Finally, during investigations performed for the mitigation project it was discovered that the riparian corridor of Crooked Creek (McMahon Woods Hydrologic Investigations Final Report (2008)) is important to the functioning of the Hine's Emerald Dragonfly habitat and that its condition had degraded to an extent that is also required restoration actions. Hence the areas to the north of 107th Street were added to the project boundary in order to capture the riparian areas of the mainstem and one major tributary (Figure 3). Although the current boundary configuration is oddly shaped it includes all major areas of influence or importance (wooded fen in the southern half that holds Hine's Emerald Dragonfly rivulets, riparian corridor of Crooked Creek, etc.) and in the most need of restoration actions. This approach enables the USACE to restore at the systems level ensuring a sustainable solution to the variety of environmental problems currently degrading McMahon Woods.

In general, each specified measure takes into account the repair of the physical environment and the subsequent reestablishment of high quality native plant communities. The following measures are based on a collaborative effort between the USACE and the FPDCC. Measures were developed with the intent to restore habitat structure and function in a sustainable fashion. **Table 6** presents the list of proposed measures that will be discussed further and their associated code that will be used in the upcoming IWR Planning Suite for the cost effective/incremental cost analysis.

Table 6 - List of Proposed Restoration Measures and Associated Code.

Code	Measures
AA	Invasive Shrubs-Marsh
AB	Invasive Shrubs-Oak Savanna
AC	Invasive Shrubs-Wet Mesic Woodland
BA	Native Plants-Marsh
BB	Native Plants-Oak Savanna
BC	Native Plants-Wet Mesic Woodland

By dividing the project foot print into units based on habitat types located in McMahan Woods, the plan generation process of the IWR Planning Suite will be robust and increase the ability to more specifically assess and determine the most cost effective and beneficial plan to address environmental problems of the study area. For a full list of proposed plant species to be installed per habitat type please see appendices.

AA. Invasive Shrubs-Marsh

This measure addresses an important problem of the negative impacts of invasive shrub species in the marsh. This measure would provide relief to the marsh area by removing harmful invasive species such as Multiflora rose (*Rosa multiflora*). Removal of invasive shrubs would consist of cutting larger shrubs flush to the ground and applying an herbicide to the cut stumps to prevent resprouting and then a follow up of any newly germinating saplings the next year with a spot application of herbicide. Smaller shrubs that have a similar stature to herbaceous species will be treated with a foliar application of herbicide during the growing season.

AB. Invasive Shrubs-Oak Savanna

Same measures would also be conducted within the Oak savanna to remove the harmful influence of invasive shrub species. Shrubs such as Japanese Honeysuckle (*Lonicera spp.*) will be removed.

AC. Invasive Shrubs-Wet Mesic Woodland

Same measures would also be conducted within the wet mesic woodland to remove the harmful influence of invasive shrub species. Shrubs such as European Buckthorn (*Rhamnus cathartica*) will be removed.

BA. Native Plants-Marsh

Measures to restore the native plant community of the marsh in McMahan Woods include invasive species removal, both herbaceous and woody, aggressive native and non-native tree removal and installation of native plant species with seed and live plug material. Removal of herbaceous invasive species would involve mainly spot application of herbicide by highly skilled individuals. Native plant material would be installed as seed in the fall time frame and live plug material installed primarily within the rivulets to provide a more immediate suitable plant structure for the Hine's Emerald Dragonfly. This measure would also include prescription burning during construction and O and M to ensure long term control of woody species. This measure is not dependant on other measures.

- Native Plants– The installation a mix of mostly seed and some plugs that include: Common rush (*Juncus effusus*), Rice cut grass (*Leersia oryzoides*) and Swamp milkweed (*Asclepias incarnata*).

BB. Native Plants-Oak Savanna

Measures to restore the native plant community of the Oak savanna in McMahon Woods include invasive species removal, both herbaceous and woody, aggressive native and non-native tree removal and installation of native plant species with seed material. Removal of herbaceous invasive species would involve mainly spot application of herbicide by highly skilled individuals. Native plant material would be installed as seed in the fall time frame. This measure would also include prescription burning during construction and O and M to ensure long term control of woody species. This measure is not dependant on other measures.

- Native Plants - The installation a mix of mostly seed and some plugs that include: Little blue stem (*Andropogon scoparius*), Foxglove beardtongue (*Penstomen digitalis*) and Compass plant (*Silphium laciniatum*).

BC. Native Plants-Wet Mesic Woodland

Measures to restore the native plant community of the wet mesic Woodland in McMahon Woods include invasive species removal, both herbaceous and woody, aggressive native and non-native tree removal and installation of native plant species with seed material. Removal of herbaceous invasive species would involve mainly spot application of herbicide by highly skilled individuals. Native plant material would be installed as seed in the fall time frame. This measure would also include prescription burning during construction and O and M to ensure long term control of woody species. Restoration measures will also include installation of small earthen berm, installation of larger culvert under 107th st and reinforcement of rivulets with glacial cobble and stone to restore Hine's Emerald Dragonfly habitat. The hydrology and hydraulic models showed no induced flooding as a result of these potential measures. This measure is not dependant on other measures. The activities listed under this measure are necessary to be able to install and establish native plant species in this community type and as such this is a single independent measure.

- Installation of Berm – This measure would install a small earthen berm within the low lying area just north of the graminoid fen. This will reduce the frequency of overflow events from Crooked Creek. This would address the problems of overflows impacting the streamlets to the south that are critical breeding habitat of the federally endangered Hine's Emerald Dragonfly.
- Installation of a Larger Box Culvert – This measure would remove the current culvert and install a larger box culvert to more effectively allow floodwaters to pass under 107th St. This would decrease the frequency of overflow events from Crooked Creek and lessen the impact of these events on the critical habitat of the Hine's Emerald Dragonfly.
- Reinforcement of Streamlets with Glacial Cobble/Rock – This measure would install a mixture of glacial cobble and rock along areas that are experiencing high rates of erosion. Hydrologic studies have shown there to be issues of erosion in the upper reaches of the streamlets. Reinforcing the bed and sides of the channel will help to reduce higher than expected rates of erosion and to hopefully increase the quality of the reaches in which the Hine's Emerald Dragonfly are breeding.
- Native Planting – Plant species to be planted as a mix of seed and live plug include: Pennsylvania sedge (*Carex pennsylvanica*), Wood betony (*Pedicularis Canadensis*) and Elm-leaved goldenrod (*Solidago ummifolia*).

4.2 – Measure Costs & Assumptions

Detailed discussion on planning level feature costs is presented in Appendix C – Cost Engineering. Conceptual, planning level cost estimates were prepared for measures/features that were identified by the study team in conjunction with the non-Federal sponsors. These cost estimates do not represent complete project construction cost estimates, but rather individual measures of work or components of the entire

project. The measures were used to provide an economic basis for the development of project alternatives. Once the project alternatives have gone through the plan formulation process, and additional design information was developed for the recommended plan, a more detailed and reliable cost estimate was performed (refer to Appendices). Estimates were developed using cost information from previous studies, lump sum and unit prices, and for plant, labor and material methods. A 25% contingency was applied to all measures. Planning level unit costs were placed into a matrix to utilize the different costs for each measure of work.

Cost Annualization: Annualizing costs is a method whereby the project costs are discounted to a base year then amortized over the period of analysis. The base year for this project was determined to be the year in which the first phase of the project is to be completed (calendar year 2017). Costs that occur prior to this year need to be compounded to the base year, while those occurring after the base year need to be discounted to the base year. The period of analysis for the Section 506 project is 50 years. Discounting to the base year is the present value method. Costs are compounded or converted to present value for the base year then amortized over the 50-year period of analysis to give the annual cost. Discount rate of 3.375% was determined by the appropriate Economic Guidance Memorandum 08-01, Federal Interest Rates for Corps of Engineers Projects. The method shown in the above table does this for each measure. The individual measures of the project have the construction period spread out over 3 to 5-years, depending on magnitude or redundancy. Each year of every measure is either compounded or discounted to the base year. Calculation of the measures Average Annual Cost (AA Cost) is completed by multiplying the present value to the 50-year amortization factor. Total Construction and AA Cost per measure is presented in Table 7.

Table 7 - Total Construction Costs and AA Cost per Measure.

Code	Measures	Construction	AA Cost
AA	Invasive-Marsh	██████████	██████████
AB	Invasive-Oak Savanna	██████████	██████████
AC	Invasive-Wet Mesic Woodland	██████████	██████████
BA	Native Plants-Marsh	██████████	██████████
BB	Native Plants-Oak Savanna	██████████	██████████
BC	Native Plants-Wet Mesic Woodland	██████████	██████████

Real Estate: Plan formulation of the lands necessary to implement measures for this ecosystem restoration project was included in the Average Annual costs per measure. The current Real Estate Plan provided by the real estate section determined \$6,500 per acre to accomplish plan formulation. Table 8 presents Real Estate values per measure.

Table 8 - Real Estate Values for Cost Annualization.

Code	Measures	Acres	Real Estate
AA	Invasive-Marsh	30.1	██████████
AB	Invasive-Oak Savanna	4.5	██████████
AC	Invasive-Wet Mesic Woodland	376	██████████
BA	Native Plants-Marsh	30.1	██████████
BB	Native Plants-Oak Savanna	4.5	██████████
BC	Native Plants-Wet Mesic Woodland	376	██████████

4.4 - Alternative Plan Generations

Seven (7) measures, including the No Action measure, were input into the IWR-Planning Suite in terms of costs and benefits. Benefits, the Net Average Annual Habitat Units (NetAAHU), were derived by

taking the difference between Future Without Project AAHUs (section 2.5.2, Table 5, page 35) and Future With Project AAHUs. Table 9 presents the NetAAHU and AA Cost per measure that was used to formulate alternative plans in the IWR Planning Suite. No measures were dependent.

Table 9 - Net Average Annual Habitat Units (NetAAHU) and Average Annual Cost per Measure (AA Cost).

Code	Measures	NetAAHU*	AA Cost
AA	Invasive-Marsh	0.00	\$ 13,315.74
AB	Invasive-Oak Savanna	0.38	\$ 3,582.00
AC	Invasive-Wet Mesic Woodland	28.20	\$ 143,702.54
BA	Native Plants-Marsh	7.83	\$ 21,669.96
BB	Native Plants-Oak Savanna	1.23	\$ 3,805.00
BC	Native Plants-Wet Mesic Woodland	88.36	\$ 205,881.57

*NetAAHUs are calculated by taking the difference between Future Without Project AAHUs and Future With Project AAHUs.

4.3 – Alternative Plan Benefits

The evaluation of habitat benefits is a comparison of the with-project and without-project conditions for each measure. Environmental outputs are the desired or anticipated measurable products or results of restoration measures and plans. The term “outputs” is often used interchangeably with “benefits” or “habitat units (HUs).” Ecosystem restoration proposals may possess multiple output categories, as well as other effects that may need to be considered, but the evaluation must at least address cost and an output category that has been determined to represent reasonable ecosystem restoration benefits. A comparison of the future without-project and future with-project HUs was performed in order to determine if a measure, or group of measures, will actually have beneficial effects to the Saganashkee Slough ecosystem. The measures for this study were evaluated with the HSI methodology described in Section 2.3. Table 10 presents the net average annual HUs per measure.

Table 10 - Average Annual Habitat Units per Measure.

Future With Project Condition - *Invasive Shrub Removal*

Code	Community Type	Acres	AAMean C	HSI	AAHU	NetAAHU
AA	Marsh	30.1	1.40	0.14	4.21	0.00
AB	Oak Savanna	4.5	2.50	0.25	1.13	0.38
AC	Wet Mesic Woodland	376	2.90	0.29	109.04	28.20

Future With Project Condition - *Native Plant Establishment*

	Community Type	Acres	AAMean C	HSI	AAHU	NetAAHU
BA	Marsh	30.1	4.0	0.40	12.04	7.83
BB	Oak Savanna	4.5	4.4	0.44	1.98	1.23
BC	Wet Mesic Woodland	376	4.5	0.45	169.2	88.36

4.5 – Cost Effectiveness / Incremental Cost Analysis

Cost effectiveness and incremental cost analysis (CE/ICA) are two distinct analyses that must be conducted to evaluate the effects of alternative plans according to USACE policy. First, it must be shown through cost effectiveness analysis that a restoration plan’s output cannot be produced more cost effectively by another alternative. *Cost effective* means that, for a given level of non-monetary output, no other plan costs less and no other plan yields more output at a lower cost. Subsequently, through

incremental cost analysis, a variety of alternatives and various-sized alternatives are evaluated to arrive at a “best” level of output within the limits of both the sponsor’s and the USACE’s capabilities.

The subset of cost effective plans are examined sequentially (by increasing scale and increment of output) to ascertain which plans are most efficient in the production of environmental benefits. Those most efficient plans are called “best buys.” As a group of measures, they provide the greatest increase in output for the least increases in cost. They have the lowest incremental costs per unit of output. In most analyses, there will be a series of best buy plans, in which the relationship between the quantity of outputs and the unit cost is evident. As the scale of best buy plans increases (in terms of output produced), average costs per unit of output and incremental costs per unit of output will increase as well. The incremental analysis by itself will not point to the selection of any single plan. The results of the incremental analysis must be synthesized with other decision-making criteria (i.e., significance of outputs, acceptability, completeness, effectiveness, risk and uncertainty, reasonableness of costs) to help the study team select and recommend a particular plan.

Out of the 7 measures input into IWR Planning Suite, 26 plans were generated. **Figure 9** presents the comparison of cost vs. benefit (output) for the entire 26 plans generated.

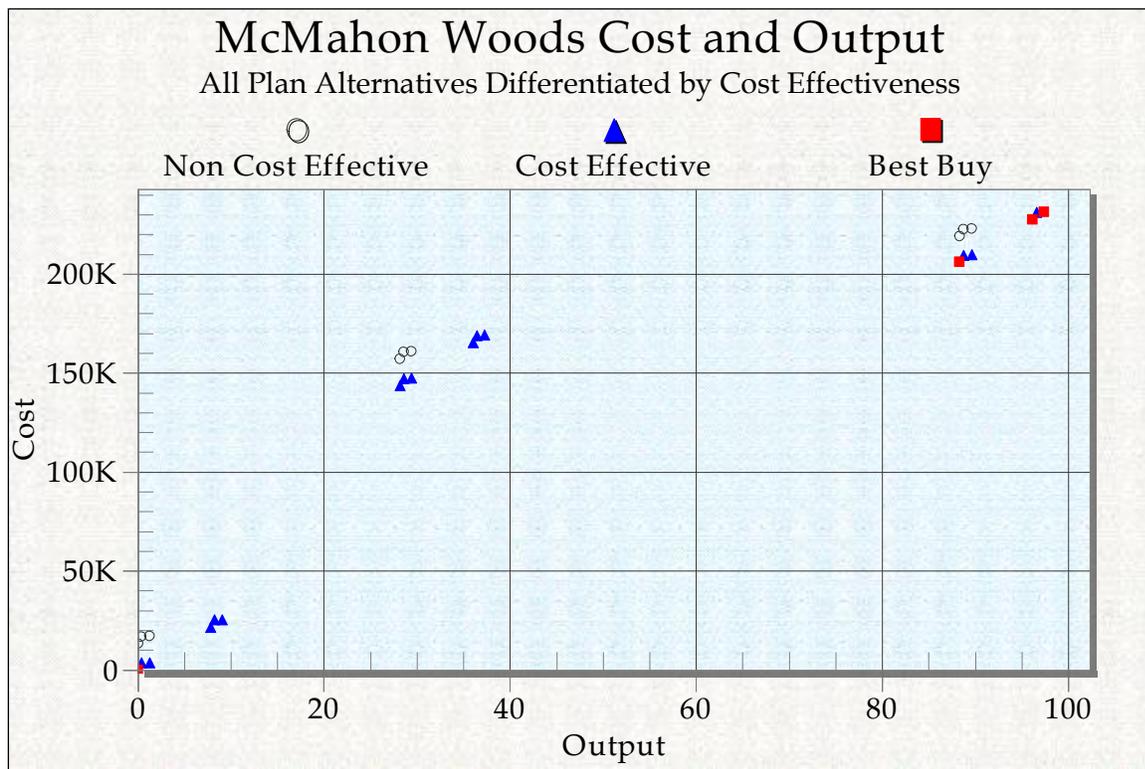


Figure 9 - Cost vs. Output of Alternative Plans.

Cost Effectiveness

The cost effectiveness analysis was used to ensure that certain options would be screened out if they produced the same amount or less output at a greater cost than other options with a lesser cost. Out of 26 plans generated, 18 were cost effective. Benefits ranged from 0.00 – 97.42 AAHUs and average annual costs ranged from \$3,582 - \$231,356.

Incremental Cost Analysis

An incremental cost analysis was performed on those plans deemed cost effective. The objectives of the incremental cost analysis are to provide information to assist in determining whether the additional output provided by each successive cost effective plan is worth the additional cost that must be incurred for implementation; that is, to assist in determining the scale of the recommended plan. Out of the 18 cost effective plans there were 4 best buy plans, including the No Action plan. **Table 11** presents the list of the best buy plans and their associated benefits and costs. **Figure 10** graphically presents the comparison between the best buy plans.

Table 11 - Incremental Cost Analysis of Best Buy Plans.

Plan Alternatives		Output (HU)	Cost (\$1000)	Average Cost (\$1000 / HU)	Incremental Cost (\$1000)	Inc. Output (HU)	Inc. Cost Per Output
1	No Action Plan	0	\$0				
2	BC	88.36	\$205,882	\$2,330	\$205,882	88.37	\$2,330
3	BC, BA	96.19	\$227,552	\$2,366	\$21,670	7.83	\$2,768
4	BC, BA, BB	97.42	\$231,357	\$2,375	\$3,805	1.23	\$3,094

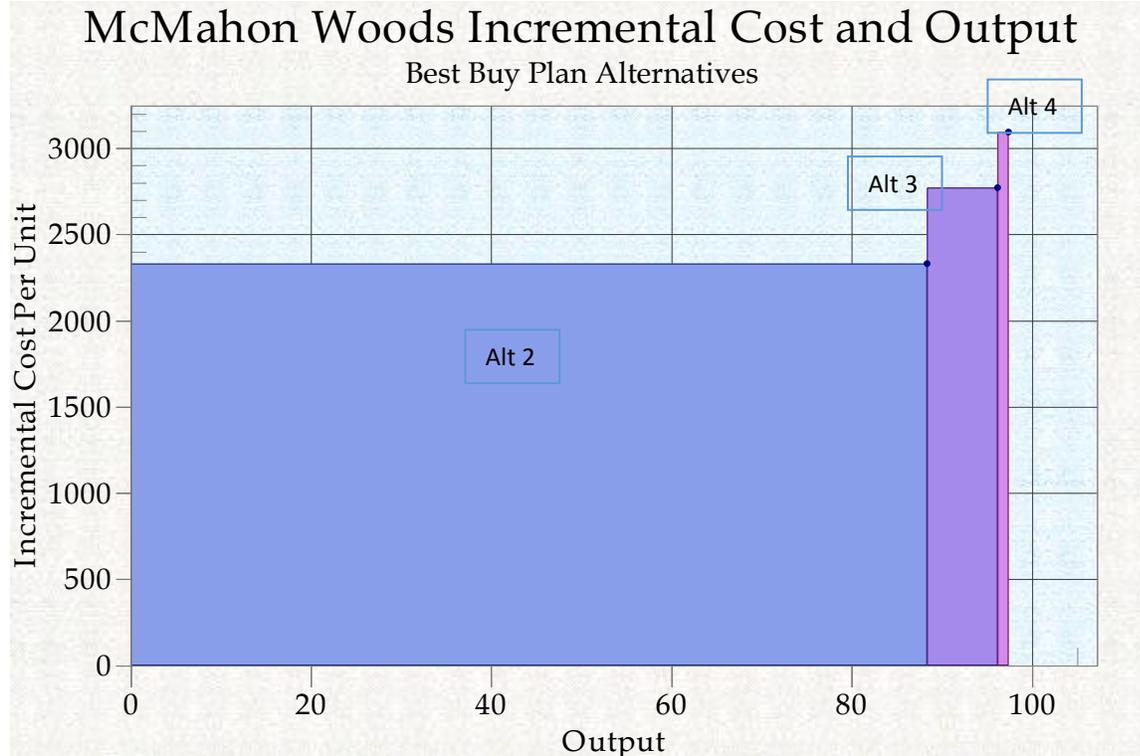


Figure 10 - Incremental Cost Analysis.

4.6 -Alternative Plan Trade-Off Analysis

Alternative plans that qualified for further consideration will be compared against each other in order to identify the selected areas of the project site and their associated alternatives to be recommended for implementation. A comparison of the effects of various plans must be made and tradeoffs among the differences observed and documented to support the final recommendation. The effects include a measure of how well the plans do addressing the planning objectives including NER benefits and costs. Effects

required by law or policy and those important to the stakeholders and public are to be considered. Previously in the evaluation process, the effects of each plan were considered individually and compared to the without-project condition. In this step, plans are compared against each other, with emphasis on the important effects or those that influence the decision-making process. The comparison step concludes with a ranking of plans.

Table 12 - Alternative Plan Comparison.

Plan Alternative		Measures
1	No Action Plan	None
2	BC	BC -Native Plants Establishment-Wet Mesic Woodland
3	BC, BA	BC -Native Plants Establishment-Wet Mesic Woodland; BA -Native Plants Establishment-Marsh
4	BC, BA, BB	BC -Native Plants Establishment-Wet Mesic Woodland; BA -Native Plants Establishment-Marsh; BB -Native Plants Establishment-Oak Savanna

Alternative Plan 1: The No Action plan includes no restoration measures to address problems within McMahon Woods. This plan would not address any of the objectives. This plan would result in no net gain of AAHUs for zero cost.

Alternative Plan 2: This plan includes the restoration of the wet mesic woodland in McMahon Woods. This plan partially addresses reduce/repair of bare soil areas within the marsh/rivulet complex and Crooked Creek riparian area. This plan would only install native plant material within the wet mesic woodland (Objective #3) and not in the marsh, or upper reaches of Hine’s Emerald Dragonfly rivulets, or the globally imperiled Oak savanna. It would only remove invasive species in the wet mesic woodland (#1) and not in the Oak savanna or marsh. This plan would reduce the overflow events from Crooked Creek through the installation of an earthen berm and a bigger culvert under 107th st., thereby reducing the overflow events would help to repair the hydrology of the rivulets and help to reduce areas of bare soil within the rivulets (#2). This plan would result in a net gain of 88.36 AAHU for an AA cost of \$205,882.

Alternative Plan 3: This plan would also address many, but not all, of the problems within McMahon Woods. This plan would address native plant richness (Objective #3), removal and control of invasive species (#1) and reduce/repair bare soil areas within the marsh/rivulet complex and Crooked Creek riparian area (#2). This plan includes installation of native plant material in not only the wet mesic woodland, but in the marsh as well, helping to establish a diverse native plant community and help to increase the suitability of the rivulets for the Hine’s Emerald Dragonfly. It would also address invasive species in the wet mesic woodland and the marsh. Additionally, the reduction of overflow from Crooked Creek via installation of the earthen berm and bigger culvert would repair the hydrology and reduce bare soil areas in the rivulets. However, it would not address lack of native plant species richness and invasive species in the globally imperiled Oak savanna. This plan would result in a net gain of 96.19 AAHU for an AA cost of \$227,552. In comparison to Alternative Plan 2 there is an incremental increase of 7.83 HUs for an additional incremental cost of \$21,670 per HUs.

Alternative Plan 4: This best buy plan would fully addresses all problems, such as native plant richness in all community types (Objective #3), removal of invasive species in all community types (#1) and reduction of overflow events from Crooked Creek and repair of bare soil areas within the rivulets (#2) within McMahon Woods. This plan addresses all problems within all community types including the globally imperiled Oak savanna. The cost to include this community type is worth the investment. The Oak savanna originally covered 100,000’s of acres in the Midwest prior to Euro-American settlement. This community type supports a number of species that is dependent on the unique structure of this

community with its broad open grown trees with a highly diverse herbaceous layer underneath the open canopy. Migratory bird species such as the Orchard Oriole and the Yellow-breasted Chat are associated with the Oak savanna and their population numbers have been steadily declining over the last 30 years. Restorations of Oak savannas in this region are highly beneficial to these bird species and other Oak savanna dependent species. For example, the GLFER section 506 Orland Tract Perimeter restoration project has restored around 250-acres of a mixture of Oak Savanna and Prairie Shrubland and as a result the number of Orchard Orioles that are breeding at the site has increased over the last 3 years. In addition, the Oak savanna habitat is located within the U.S. Fish and Wildlife designated critical habitat for the Hine's Emerald Dragonfly and should be included in any restoration plans of the area. Finally, the inclusion of the Oak savanna provides greater connectivity between the Wet Mesic Woodland within the northwestern portion of the site allowing greater dispersal of native species between habitat types. This plan would result in a net gain of 97.42 AAHU for an AA cost of \$231,357. In comparison to Alternative Plan 3 there is an incremental increase of 1.23 HUs for an additional incremental cost of \$3,805. Although this increase in HUs seems small, the significance of this increase is well worth the additional investment. **This is the recommended NER plan.**

4.6.1 – Significance of Ecosystem Outputs

Because of the challenge of dealing with non-monetized benefits, the concept of output significance plays an important role in ecosystem restoration evaluation. Along with information from cost effectiveness and incremental cost analyses, information on the significance of ecosystem outputs will help determine whether the proposed environmental investment is worth its cost and whether a particular alternative should be recommended. Statements of significance provide qualitative information to help decision makers evaluate whether the value of the resources of any given restoration alternative are worth the costs incurred to produce them. The significance of the McMahan Woods restoration outputs are herein recognized in terms of institutional, public, and/or technical importance.

Institutional Recognition

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

Migratory Bird Treaty Act (1918)

The Migratory Bird Treaty Act is the domestic law that implements the United States' commitment to four international conventions for the protection of migratory birds and their habitats. The Act protects species or families of birds that live, reproduce, or migrate within or across international borders at some point during their annual life cycle. The four Migratory Bird Conventions are:

- Convention for the Protection of Migratory Birds with Great Britain on behalf of Canada (1916)
- Convention for the Protection of Migratory Birds and Game Mammals - Mexico (1936)
- Convention for the Protection of Migratory Birds and Their Environment - Japan (1972)
- Convention for the Protection of Migratory Birds and Their Environment - Union of Soviet Socialist Republics (1978)

The Mississippi Flyway

There are 4 principal North American flyways, the Atlantic, Mississippi, Central and Pacific. Except along the coasts, such as Lake Michigan, the flyway boundaries are not always sharply defined. Its eastern boundary runs along western Lake Erie and the western boundary is ambiguous, as the Mississippi Flyway merges unnoticeably into the Central Flyway. The longest migration route in the Western Hemisphere lies in the Mississippi Flyway; from the Arctic coast of Alaska to Patagonia, spring migration of some shorebird species fly this nearly 3,000 mile route twice. Parts of all four flyways merge together over Panama.

The Lake Michigan Flyway, which includes McMahon Woods, is ideal for migratory wetland obligate birds and neotropical migrants (new world tropical species) because it is uninterrupted by mountains, dotted with tens of thousands of lakes, wetlands, ponds, streams and rivers, and is well timbered in certain reaches. Palos Hills, Illinois is located in the Lake Michigan Flyway portion of the Mississippi Flyway and about 200⁺ species of birds pass through this corridor annually. The Chicago Region is also one of America's most important migration routes for songbirds, with more than ~5 million individuals passing through during the migration season. Illinois and Indiana farmland consists of corn and soybean fields, which do not provide the type and variety of food and shelter required by nearly all migrating birds. In comparison, the McMahon Woods natural area provides a variety of plant life and habitat for resting and refueling. The McMahon Woods restoration project has great potential to provide critical migratory bird habitat. Alternative Plans 2 – 4 support the Migratory Bird Treaty Act, however, Alternative Plan 4 most supports the Migratory Bird Treaty Act.

EO 13186 Responsibilities of Federal Agencies to Protect Migratory Birds – Federal agencies shall restore or enhance the habitat of migratory birds and prevent or abate pollution or detrimental alteration of the environment for migratory birds. This project will restore marsh/rivulets, globally imperiled Oak savanna, wet mesic woodland and Crooked Creek riparian area. Restoration will provide forage and shelter for numerous migratory bird species. This project lies within a significant portion of the Mississippi Flyway sandwiched between the Des Plaines River and the coast of Lake Michigan, which particularly favors both ecological and economically valuable waterfowl and wetland obligate species (Section 2.3.3). Alternative Plans 2 – 4 fulfill the USACE's role and responsibilities, however, Alternative Plan 4 most supports USACE's role and responsibilities by utilizing its Ecosystem Restoration Mission, authority and supporting polices to restore diverse habitats for Migratory Birds to the fullest extent.

EO 13547 Stewardship of the Ocean, Our Coasts, and the Great Lakes – This order establishes a national policy to ensure the protection, maintenance, and restoration of the health of ocean, coastal, and Great Lakes ecosystems and resources, enhance the sustainability of ocean and coastal economies, preserve our maritime heritage, support sustainable uses and access, provide for adaptive management to enhance our understanding of and capacity to respond to climate change and ocean acidification, and coordinate with our national security and foreign policy interests. Alternative Plans 2 – 4 supports this order, however Alternative Plan 4 would most fully support the recovery of migratory bird habitat for important Great Lakes species, which supports this EO.

EO 13340 – Identified the Great Lakes as a national treasure and defined a Federal policy to support local and regional efforts to restore and protect the Great Lakes ecosystem through the establishment of regional collaboration. A number of activities have been accomplished by Federal agencies working in partnership with state, tribal and local governments in response to the Executive Order. The USACE has been a major participant in these activities. The Executive Order established the Great Lakes Interagency Task Force. The Task Force worked with the governors of the eight Great Lakes states, mayors, and tribal leaders to establish the Great Lakes Regional Collaboration. The initial goal of the Collaboration was to develop a “strategy for the protection and restoration of the Great Lakes” within 1 year. Alternative Plan 4

would restore physical characteristics of Lake Michigan watershed habitats, which is in full support of this Act. The Collaboration developed the strategy by using teams consisting of 1,500 stakeholders for the following eight priority issues identified by the Great Lakes governors and mayors with items in bold relative to this project:

- | | |
|-------------------------------|--------------------------------|
| 1. Toxic contaminants | 5. Contaminated sediments/AOCs |
| 2. Non-point source pollution | 6. Indicators/information |
| 3. Coastal health | 7. Sustainable development |
| 4. Habitat/species | 8. Invasive species |

Fish and Wildlife Conservation Act of 1980 – all Federal departments and agencies to the extent practicable and consistent with the agency’s authorities should promote the conservation of non-game fish, wildlife, and their habitats. Alternative Plans 2 – 4 supports this act, however, Alternative Plan 4 would restore physical habitat and reintroduce native non-game fish and wildlife, which is in full support of this Act.

EO 11514 Protection and Enhancement of Environmental Quality – the Federal Government shall provide leadership in protecting and enhancing the quality of the Nation’s environment to sustain and enrich human life. Improving both the habitat and aesthetic values of the McMahon Woods would be achieved via Alternative Plans 2 – 4, however, Alternative 4 would most fully achieve enhanced environmental quality. This project would provide leadership by providing an example to other large metropolis and urban areas that highly degraded water bodies can be reclaimed for the public and nature to enhance environmental quality and recreational opportunities.

EO 11990 Protection of Wetlands – each agency shall provide leadership and shall take action to minimize the destruction, loss or degradation of wetlands, and to preserve and enhance the natural and beneficial values of wetlands. Alternative Plans 2 – 4 supports the protection of wetlands, however, Alternative 4 would restore about 30-acres of marsh and groundwater feed rivulets, 376- acres of wet mesic woodland that includes a wooded fen, and 4.5-acres of Oak savanna.

EO 13112 Invasive Species – prevent the introduction of invasive species and provide for their control and to minimize associated economic, ecological, and human health impacts. Implementation of . Alternative Plans 2 – 4 supports the removal of invasive species, however, Alternative Plan 4 would most fully address invasive species needs within the project site by treating and controlling all invasive plant species from the entire 410.6-acres.

Endangered Species Act of 1973 – all Federal departments and agencies shall seek to conserve endangered species and threatened species. The purpose of the act is to provide a means whereby the ecosystems upon which endangered and threatened species depend may be conserved and to provide a program for the conservation of such endangered and threatened species. Alternative Plans 2 – 4 supports Endangered Species, however implementation of Alternative Plan 4 is necessary to conserve and most fully support a Great Lake’s subpopulation of the Hine’s Emerald Dragonfly. The Queen-of-the-prairie, White lady’s slipper and Blazing star have small populations within the McMahon Woods area and would benefit and may potentially spread to restored areas and beyond. The White lady’s slipper occurs within the graminoid fen outside of the project footprint. The Queen-of-the-prairie and Savanna blazing may occur around the borders of the project footprint near the open areas of the graminoid fen.

Hines’s Emerald Dragonfly Recovery Plan (USFWS) - This plan supports the recovery plan for the federally endangered Hine’s Emerald Dragonfly (HED). Many small subpopulations occur in Illinois and Illinois’s subpopulations are known to contain the greatest amount of genetic diversity within the remaining populations world-wide. This makes these smaller somewhat isolated populations critical to

conserve and increase in the number of breeding adults. McMahon Woods's rivulets are considered to be in poor shape and future degradation may wipe out this population entirely, further contributing to the loss of genetic diversity for this species and reducing the chances of a long term recovery. As stated in the recovery plan for this species, removal of invasive species is an important first step in recovery of functional habitat. In addition to removal of invasive species, hydrological impairments and lack of high quality native vegetation can impact the ability of this species to successfully reproduce in their slow moving ground water feed seasonal streams. Alternative Plans 2 – 4 supports recovery of this species, however implementation of Alternative Plan 4 is necessary to conserve and most fully support a Great Lake's subpopulation of the Hine's Emerald Dragonfly. Alternative plan 4 includes measures to remove invasive species, reduce hydrological impairments, restore the geomorphic structure of rivulets and install appropriate native plant species. These measures are expected to increase the suitability of habitat for this species and is hoped to start a full recovery of this subpopulation.

EO 13653 Preparing the United States for the Impacts of Climate Change – The impacts of climate change — including an increase in prolonged periods of excessively high temperatures, more heavy downpours, an increase in wildfires, more severe droughts, permafrost thawing, ocean acidification, and sea-level rise — are already affecting communities, natural resources, ecosystems, economies, and public health across the Nation. These impacts are often most significant for communities that already face economic or health-related challenges, and for species and habitats that are already facing other pressures. Managing these risks requires deliberate preparation, close cooperation, and coordinated planning by the Federal Government, as well as by stakeholders, to facilitate Federal, State, local, tribal, private-sector, and nonprofit-sector efforts to improve climate preparedness and resilience; help safeguard our economy, infrastructure, environment, and natural resources; and provide for the continuity of executive department and agency (agency) operations, services, and programs. The Federal Government must build on recent progress and pursue new strategies to improve the Nation's preparedness and resilience. In doing so, agencies should promote: (1) engaged and strong partnerships and information sharing at all levels of government; (2) risk-informed decision-making and the tools to facilitate it; (3) adaptive learning, in which experiences serve as opportunities to inform and adjust future actions; and (4) preparedness planning.

Alternative Plans 2 – 4 supports this order, however Alternatives 4 support this Executive Order via the sequestration of carbon and carbon dioxide by increasing the acreage and biomass of native plant material above and below ground throughout the project area. Even dead plant material in the form of wood snags and debris, peat, detritus and mucks prevents carbon from entering the atmosphere. Converting homogenous spaces to diverse structures and native plants would ultimately absorb more sunlight rather than reflecting it into the atmosphere and heating up the planet.

Public Recognition

Public recognition means that some segment of the general public recognizes the importance of an environmental resource, as evidenced by people engaged in activities that reflect an interest or concern for that particular resource. Such activities may involve membership in an organization, financial contributions to resource-related efforts, and providing volunteer labor and correspondence regarding the importance of the resource.

Chicago Paddling & Fishing

The Saganashkee Slough/McMahon Woods is identified on the Chicago Paddling & Fishing guide page as great place to seek peace and solitude and to angle for fishes. The potential restoration of the McMahon Woods would enhance the aesthetics and incidentally improve angling experience.

<http://pages.ripco.net/~jwn/sag.html>

Stakeholder Support

Partners in support of the McMahon Woods Ecosystem Restoration Project and Alternative Plan 4 includes, but are not limited to: U. S. Fish and Wildlife Service, Openlands, Audubon Chicago Region, Illinois Nature Preserves Commission, Illinois Department of Natural Resources, Friends of the Forest Preserves and Friends of the Chicago River.

Technical Recognition

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

Scarcity is a measure of a resource’s relative abundance within a specified geographic range. Generally, scientists consider a habitat or ecosystem to be rare if it occupies a narrow geographic range (i.e., limited to a few locations) or occurs in small groupings. Unique resources, unlike any others found within a specified range, may also be considered significant, as well as resources that are threatened by interference from both human and natural causes.

Representation is a measure of a resource’s ability to exemplify the natural habitat or ecosystems within a specified range. The presence of a large number and percentage of native species, and the absence of exotic species, implies representation as does the presence of undisturbed habitat.

Status and Trend measures the relationship between previous, current and future conditions.

Connectivity is the measure of a resource’s connection to other significant natural habitats.

Limiting Habitat is the measure of resources present supporting significant species.

Technical Summary – Wildlife conservation in urban habitats is increasingly important due to current *urbanization trends*⁷. Alternative Plan 4 focuses on restoring diverse habitats within the McMahon Woods natural area, which is *representative* of a *scarce* graminoid fen & groundwater feed streams (rivulet) and Oak savanna habitats. In terms of *connectivity*, this project adds to the increasing patches of habitat within the urbanized reaches of Northeastern Illinois, lessening the distance species have to travel over inhospitable areas of urbanized and agricultural lands. The coastal zone of Lake Michigan in Illinois is trending towards wide spread improvement and connectivity, indicative of projects such as Orland Tract 206, Orland Perimeter 506, Sauk Lake 506 and other large tracts being restored by the FPDCC. Connectivity within the site is important as well, especially between different plant communities. Hydrologic gradients provide the basis for plant community species richness and structure, and because of the gradients, these plant communities seamlessly connect to each other. This makes it critical to restore in-between habitats such as the marsh, which connects the graminoid fen habitat with the wet mesic woodland and Crooked Creek riparian area that then connects to the Oak savanna habitats. Species such as the Eastern Newt require all three habitats in order to survive. Their eggs and larvae would be

⁷ Fernández-Juricic & Jokimäki 2001

incubated within isolated wetland pools, and then as they morph into adults they move into the fringe marsh and pond, finally emerging from the fringe marsh. They then seek out isolated wetland pools within the wet mesic woodland to mate and reproduce again. Many species of water fowl also require fringe marsh for both nesting and rearing of young. Restoring viable habitat within and along the Lake Michigan coastal zone would provide a critical habitat for migratory birds and insects such as Hine's Emerald Dragonfly. The proposed habitat restoration would have great potential to support several state threatened species, such as the Peregrine Falcon. Ultimately, the project would restore and conserve a critically imperiled subpopulation of the Federally Endangered Hine's Emerald Dragonfly within the McMahan Woods natural area.

4.6.2 – Acceptability, Completeness, Effectiveness, and Efficiency

Acceptability, completeness, effectiveness, and efficiency are the four evaluation criteria specified that the USACE uses in the screening of alternative plans. Alternatives considered in any planning study, not just ecosystem restoration studies, should meet minimum subjective standards of these criteria in order to qualify for further consideration and comparison with other plans.

Acceptability

An ecosystem restoration plan should be acceptable to state and Federal resource agencies and local governments. There should be evidence of broad-based public consensus and support for the plan. A recommended plan must be acceptable to the non-Federal cost-sharing partner. However, this does not mean that the recommended plan must be the locally preferred plan.

The McMahan Woods 506 study was developed in a collaborative fashion in which planning and design meetings screened and refined habitat restoration measures. The Federal, State and local groups that participated in these activities are discussed in the previous [section](#). Alternative 1, No Action, provides no ecosystem improvements and does not meet the [Federal Objective](#), the non-Federal sponsor's goals and stakeholder desires. Alternatives 2 and 3 address the majority of the site by fully restoring the wet mesic woodland and the geomorphology and hydrologic regime of the rivulets. However, these two alternatives do not address the problems within the globally imperiled Oak savanna and would leave this important habitat in a degraded state. Alternative 4 is the most acceptable in terms of the Federal Objective and non-Federal sponsor/stakeholder vision for reestablishing a sustainable and viable ecosystem within the McMahan Woods study area. Taking the Federal Objective, study objectives, and non-Federal sponsor/stakeholder needs into consideration, Alternative 4 fully addresses all the problems within the study area and would provide critical restoration of all of the diverse habitat types within McMahan Woods and therefore is the most acceptable.

Completeness

A plan must provide and account for all necessary investments or other actions needed to ensure the realization of the planned restoration outputs. This may require relating the plan to other types of public or private plans if these plans are crucial to the outcome of the restoration objective. Real estate, operations and maintenance, monitoring, and sponsorship factors must be considered. Where there is uncertainty concerning the functioning of certain restoration features and an adaptive management plan has been proposed it must be accounted for in the plan.

All of the factors were considered in the development or post formulation assessment of alternative plan [costs/outputs](#), consistency with other Federal and non-Federal [Plans](#), real estate, O&M, monitoring and non-Federal sponsorship. Alternative 1 does not provide any action to restore degraded habitats and therefore is incomplete in realization of ecosystem improvements. Alternatives 2 thru 3 are incomplete in terms of restoring the entire McMahan Woods system and are inconsistent with State and local [plans](#) for

reestablishing a healthy coastal zone. Alternative 4 is the most complete in that it would address all habitat types identified as experiencing environmental degradation and in need of restorative actions. Hence, Alternative 4 is the NER plan and is most complete for the most efficient investment of federal funds.

Effectiveness

An ecosystem restoration plan must make a significant contribution to addressing the specified restoration problems or opportunities (i.e. restore important ecosystem structure or function to some meaningful degree). The problems identified that may be addressed under this ecosystem restoration authority are impaired hydrology, geomorphology, and wetland plant communities.

Alternative 4 addresses all objectives that include the improvement of hydrgeomorphology, habitat complexity, native plant species richness, removal of invasive species and reduces bare soil areas within critical habitats.

Efficiency

An ecosystem restoration plan must represent a cost-effective means of addressing the restoration problem or opportunity. It must be determined that the plan's restoration outputs cannot be produced more cost effectively by another agency or institution.

Seven (7) measures, including No Action, were refined to seize site specific opportunities, address McMahan Woods' problems and were further honed by targeting the restoration objectives. Using the USACE Institute for Water Resources Planning Suite Software, twenty-nine (29) alternative combinations were generated from the measures. Through the CE/ICA analyses, 18 cost effective combinations were identified, which is inclusive of the four (4) Best Buy Plans. The No Action plan is always deemed cost effective and a Best Buy Plan. Only Best Buy Plans were considered for selection.

4.6.3 – Risk and Uncertainty

When the costs and outputs of alternative restoration plans are uncertain and/or there are substantive risks that outcomes will not be achieved, which may often be the case, the selection of a recommended alternative becomes more complex. It is essential to document the assumptions made and uncertainties encountered during the course of planning analyses. Restoration of some types of ecosystems may have relatively low risk. For example, removal of drainage tiles to restore hydrology to a wetland area. Other activities may have higher associated risks such as restoration of coastal marsh in an area subject to hurricanes. When identifying the NER/recommended plan, the associated risk and uncertainty of achieving the proposed level of outputs must be considered. For example, if two plans have similar outputs but one plan costs slightly more, according to cost effectiveness guidelines, the more expensive plan would be dropped from further consideration. However, it might be possible that, due to uncertainties beyond the control or knowledge of the planning team, the slightly more expensive plan will actually produce greater ecological output than originally estimated, in effect qualifying it as a cost effective plan. But without taking into account the uncertainty inherent in the estimate of outputs, that plan would have been excluded from further consideration.

Native plantings have an associated risk of not establishing due to a variety of unforeseen events. Predation from herbivorous animals and insects is a possibility and can be reasonably estimated based on baseline surveys of the existing flora and fauna. However, weather also plays a large role in the establishment success of new plantings. Periods of drought or early frost may alter the survival percentage of plantings. Although historical records can help to predict the best possible location and timing of new

plantings, single unforeseen events may lead to failure. To mitigate these risks, planting over several years, overplanting and/or adaptive management and monitoring may be incorporated into the overall plan. In addition, climate change in the years to come may play a role in impacting the project outcome. Increased temperatures or rainfall may lead to changes in the ecosystem of the project area; however, Lake Michigan primarily drives the weather in the Chicagoland area and may partly mitigate climate change concerns.

Complete eradication of invasive species always presents a certain level of risk and uncertainty as the chances of reinvasion are likely to occur without proper management, increasingly so when native species have not yet established. Changes in nutrient cycling processes and soil chemistry (due to impaired hydrology and prolonged invasive species establishment) further increases uncertainty with the eradication of invasive species. Measures that prevent further degradation to soils and measures that alleviate impaired hydrology can reduce the invasibility of the ecosystem and should lessen the risk and uncertainty associated with invasive species removal.

The Hine's Emerald Dragonfly inhabits the rivulets of their birth for many years as in a juvenile larval state. There is a risk associated within working within the rivulets within McMahon Woods. Risks include workers walking over areas that contain juveniles and may crush individuals. Additionally, vibrations from machinery near the habitat may make some individuals release their hold on the substrate and drift downstream of in the rivulet. These risks will be mitigated through careful surveying of the rivulets and areas that contain juveniles to keep workers and machinery out of these areas. Also, restoration activities will be limited to certain seasons to limit risk or mortality and stress on juveniles. The USACE and their contractor will work closely with the USFWS to determine best practices to minimize contact and stress to juveniles.

4.7 – Selection of the National Ecosystem Restoration Plan

When selecting a single alternative plan for recommendation from those that have been considered, the criteria used to select the NER plan include all the evaluation criteria discussed above. Selecting the NER plan requires careful consideration of the plan that meets planning objectives and constraints and reasonably maximizes environmental benefits while passing tests of cost effectiveness and incremental cost analyses, significance of outputs, acceptability, completeness, efficiency, and effectiveness. Additional factors to consider include the following items.

Partnership Context

This restoration project was planned in cooperation with the Forest Preserve District of Cook County. Also, as the Section 506 authority intends, the recommended plan would restore and preserve ecosystems in congruence with the Council of Lake Committees, which identified this project as a medium priority. This restoration project makes a significant contribution to regional, national, and international programs that include the North American Waterfowl Management Plan, and Lake-wide Management Plans. This plan included an opportunity for open comment to ensure all stakeholder parties have had equal contribution.

Reasonableness of Costs

All costs associated with a plan were considered and tests of cost effectiveness and incremental cost analysis have been satisfied for the alternatives analyzed. The cost estimates were based on current ecosystem restoration projects of the like that are in construction.

Having established confidence in the estimated implementation costs, the remaining test of reasonableness is to assess the value of the resource to be improved based on the cost to implement the improvement. The importance of the Great Lakes in terms of habitat, and human uses has been documented through numerous sources. The importance of the Great Lakes to the nation was established through Executive Order 13340.

In terms of non-monetary values, the ecosystem of the McMahan Woods and its importance to the region is emphasized by the institutional and technical significance of providing necessary migratory bird habitat within the Lake Michigan portion of the Mississippi Flyway, which is recognized as globally significant by the Audubon Society. Observation of bird and plant ecology in the immediate area classified this site as potential critical habitat for rare and conservative flora as well as resident and migratory birds. In addition, the project provides critical habitat for the Federally endangered Hine's Emerald Dragonfly. These analyses conclude that restoration and preservation measures are well worth the investment.

The NER Plan

The plan that reasonably maximizes net national ecosystem restoration benefits, consistent with the Federal objective, is identified as the NER plan. Thus, the plan that maximizes net NER benefits and has shown great merit in the trade-off analysis is Alternative 4. The NER Plan is considered as the Preferred Plan for direct, indirect, and cumulative effects assessment under NEPA in the following Chapter. The plan would restore 410-acres result in a net increase in 97.42 average annual habitat units at a construction cost of [REDACTED] (includes contingency, construction management and monitoring).



Figure 11 - Alternative 4 National Ecosystem Restoration (NER) Plan.

CHAPTER 5 – ENVIRONMENTAL ASSESSMENT

This chapter involves identification of direct, indirect and cumulative environmental effects to current conditions stemming from any of the proposed alternatives if they were to be implemented. All sections denoted with an asterisk are pertinent to the Environmental Assessment.

5.1 – Need & Purpose

Currently, the McMahon Woods study area habitats (marsh/ rivulets, wet mesic woodland (wooded fen) and Oak savanna) have become compromised to the point where they are unable to maintain structure and support healthy plant and animal communities. The resources lost in physical habitat structure have caused a marked decline in both species richness and abundance of native animal assemblages, especially the federally endangered Hine’s Emerald Dragonfly. Based on site inventory and characterization by the USACE, a set of Problems and Opportunities were developed by the study team, non-Federal Sponsors and supporting stakeholders. These drive the need for action, which is summarized as the historic loss of significant endangered species, and migratory bird, fish and wildlife habitats. The purpose of this feasibility study and integrated environmental assessment is to identify the most environmentally beneficial, cost effective and publicly supported habitat restoration project that would restore resources lost as a result of human activities.

5.2 – Alternatives Considered

Section 4.1 provides discussion on the suite of measures that were developed to address study problems and meeting objectives. These measures that were processed through the IWR Planning Suite program to generate cost effective plans. The cost effective and incremental cost analysis takes implementation and real estate costs and ecosystem outputs into consideration. Ecosystem outputs were measured via the Floristic Quality Index (FQA). Four (4) best buy alternative plans, including the No Action Plan, were deemed best case scenarios for project implementation. Alternative 4 was selected as the National Ecosystem Restoration (NER) Plan, which for the purposes of this Environmental Assessment is termed the Preferred Plan. Rationale for selecting the NER/Preferred Plan is presented in Section 4.6 and 4.7.

- Alternative Plan 1: (No Action Plan) Future Without-Project Conditions (see Section 2.5.2)
- Alternative Plan 2: (BC) Native Plants-wet mesic woodland
- Alternative Plan 3: (BC) Native Plants-wet mesic woodland +(BA) Native Plants-marsh
- Alternative Plan 4: (BC) Native Plants-wet mesic woodland +(BA) Native Plants-marsh +(BB)Native Plants-Oak savanna

5.3 – The Affected Environment

A detailed description of the affected environment can be found in Chapter 2 – Study Area inventory & Forecasting. Based on data collection, analysis, and modeling conducted under this feasibility study and coordination with Federal, State and local governmental agencies and published studies by academia, it was determined that the physical, chemical and biological conditions of the McMahon Woods study area are in a state of severe habitat degradation. As a result, dominant species present at the site are tolerant to habitat loss, anthropogenic disturbance and poor water quality and are lacking conservative native plant species. There is also grave concern for the persistence of the Hine’s Emerald Dragonfly population within the McMahon Woods marsh/rivulet habitat due to past affects from construction of the Calumet Sag Channel (spoil pile along eastern boundary) and flooding from Crooked Creek. Slight improvements in water quality and some vegetation patches (graminoid fen that is adjacent to project foot print) that have occurred are not enough for a robust native plant and animal communities to reestablish, resulting in

missing critical structural habitat components. The No Action Alternative conditions are synonymous with the Future Without-Project Conditions, which are presented in Section 2.6.

5.4 – Direct, Indirect & Cumulative Effects of the Preferred Plan

In addition to the effects discussed in the following sections, a 404(b)(1) analysis is provided in **Appendix A**. This analysis further documents whether or not there are effects to the aquatic environment resulting from construction activities as guided by the Clean Water Act.

5.4.1 – Physical Resources

Climate

The Preferred Plan/NER Plan would have incidental benefits to climate change via the long term sequestration of carbon. This would happen via the reestablishment of native plant communities and stored organic carbon in soils and sediments. Short term affects from petroleum fueled machines used during construction are considered negligible based on the long term benefits of carbon sequestration.

Sediment Quality

Sediment within the adjacent Saganashkee Slough and marsh areas of McMahon Woods consists of organic mucks from past wetland decayed plant matter. These organic mucks would provide an acceptable base to reestablish native wetland obligate plant species. All sediments are deemed clean for onsite reuse and there were no areas identified to have contamination would be disturbed by the Preferred Plan/NER Plan (e.g., rivulets). Implementation of the Preferred Plan/NER Plan would result in beneficial effects to marsh sediments via promotion of aquatic macrophyte root structure and associated fungal symbionts.

Water Quality

The Preferred Plan/NER Plan would have incidental water quality benefits to the groundwater feed fen and rivulets through the installation of a bigger culvert under 107th st., a small earthen berm within the Crook Creek riparian area and establishment of native wetland obligate plants (e.g., *Carex stricta*). Short term affects are expected since the project need necessitates structural and biological change within the rivulets. Long term, adverse effects to water quality stemming from construction activities is not anticipated.

Geology & Glacial Stratigraphy

The McMahon Woods study area was a glacial sluice way for discharge water from a once retreating Lake Chicago, which is now Lake Michigan. Since installation of glacial cobble and stones within the upper reaches of the rivulets would not disturb any geologic features or displace glacial materials present, there would be no adverse effects resulting from implementation of the Preferred Plan/NER Plan. The stabilization of the rivulets, Hine's Emerald Dragonfly critical habitat, resulting from the implementation of the Preferred Plan/NER Plan is considered to be highly beneficial.

Soils

The soils within the McMahon Woods study area are diverse due to the historically intense geologic activity and resulting topography. The footprint of the earthen berm (900-CY) and the bigger culvert

under 107th st. is fairly small and would be considered to be an insignificant disturbance to any natural soils present. Material would be placed during times of the year when there is little risk of compaction of soil along the haul route (e.g., winter -freezing temperatures) coupled with the use of heavy equipment matting if soils are not completely frozen. The placement of glacial material (250-CY) within the upper reaches of the rivulets within the Hine's Emerald Dragonfly critical habitat and the establishment of native plant communities resulting from the implementation of the Preferred Plan/NER Plan are considered to be highly beneficial. Material and placement of material would have no adverse effects resulting from implementation of the Preferred Plan/NER Plan.

Air Quality

Any of the alternative plans would not adversely affect long term air quality since machinery for construction activities would be limited to several months of total time. The local air quality in the Chicago area including Cook County are considered 'non-attainment' under the Clean Air Act for ozone, particulates (PM-10 and PM-2.5), and lead. The project is within the non-attainment zone. Once implemented, the project itself will be neutral in terms of air quality, with no features that either emit or sequester air pollutants to a large degree. During the project construction, heavy equipment would cause minor, temporary air quality impacts, however all equipment will be in compliance with current air quality control requirements for diesel exhaust, fuels, and similar requirements. These activities would be unnoticeable compared to current barge and shipping traffic within the Calumet-Sag Channel and surrounding trucking routes within the immediate project area. Short term affects from petroleum fueled machines used during construction are considered negligible. It has been determined that the direct/indirect emissions resulting from the project are below *de minis* levels and, therefore, a conformity determination is not required. The Preferred Plan/NER Plan would have short term temporary, although insignificant, impacts to air quality. The Preferred Plan/NER Plan would have no long term impacts to air quality as heavy construction activities would limited to few months total.

Hydrogeomorphology & Topography

The topography and resulting hydrogeomorphology (e.g., fen and rivulets) within the McMahan Woods study area are diverse due to the historically intense geologic activity. Installation of the the earthen berm, large culvert under 107th st. and glacial material within the upper reaches of the rivulets is considered to be beneficial and not a disturbance to any natural topography or groundwater functions currently present, there would be no adverse effects resulting from implementation of the Preferred Plan/NER Plan. The implementation of the Preferred Plan/NER Plan is considered to be hydrogeomorphic restoration.

Land Use, Hydrology & Hydraulics

The hydrology within the McMahan Woods study area is quite intricate due to the historically intense geologic activity. Land use within the study area would not be adversely affected via the implementation of the Preferred Plan/NER Plan since there would be no change. Hydrologic modifications to the system to achieve ecosystem restoration include an earthen berm along Crooked Creek, larger culvert under 107th Street and establishing a diverse native wetland plant community reestablishing a more natural hydrologic regime within McMahan Woods. These actions are both necessary and beneficial to both the Hine's Emerald Dragonfly and the marsh plant community by naturalizing the hydrologic regime. There would be no adverse effects to study area hydrology resulting from the implementation of the Preferred Plan/NER Plan. Stream hydraulics within the small rivulets would be restored by preventing urban induced floodwaters from entering them. This will allow for the groundwater source to drive stream hydraulics, which is the natural condition that the Hine's Emerald Dragonfly is adapted to. The earthen berm would have negligible affects on Crook Creek's hydraulics since the volume of urban induced

floodwaters is already the dominating condition during storm events. Ultimately, there would be no adverse effects to study area land use, Calumet-Sag Channel operations, hydrology and hydraulics resulting from the implementation of the Preferred Plan/NER Plan.

Hazardous, Toxic & Radioactive Waste (HTRW) Analysis

The Preferred Plan/NER Plan would not affect or be effected by HTRW materials since there are none present within or around the McMahan Woods study area.

5.4.2 – Ecological Resources

Macroinvertebrates

Currently, significant species richness and abundance of macroinvertebrates are concentrated in the McMahan marsh/rivulet areas, which are expected due to the status of the remnant graminoid plant community. The Hine’s Emerald Dragonfly is expected to benefit from the proposed restoration measures and any potential temporary impacts from construction activities will be minimized through continuing coordination with the USFWS. Surveys within the adjacent Saganashkee Slough marsh and other degraded habitats corresponded with low diversity and held no species of concern. Since only the degraded plant communities would be actively restored, and the remnant patches (e.g., graminoid fen) avoided, there would be no adverse effects to study area macroinvertebrates resulting from the implementation of the Preferred Plan/NER Plan.

The most important of all macroinvertebrates for this study is the Hines Emerald Dragonfly, which only occurs in the rivulets discharging from the fen. The activities planned to restore these rivulets is imperative to conserve the Hines Emerald Dragonfly population in McMahan Woods. The first activity would be to prevent urban induced waters from Crooked Creek to flood over the natural embankment and cascade down into the rivulets. This has caused severe channel incision (headcutting) within the rivulets and is physically destroying Hines Emerald Dragonfly habitat. Once the overflows are prevented, then the rivulets themselves can be restored to their original geomorphic configuration by backfilling the incised areas with glacial material that is replicated from the remaining high quality reaches of the rivulets. Prior to restoration of the rivulets, preventative measures would be exercised to conserve remaining Hines Emerald Dragonfly /crayfish burrows. Coordination and consultation with the USFWS would continue through completion of the restoration project.

Resident/Migratory Birds

The McMahan Woods study area is located within the Lake Michigan portion of the Mississippi Flyway, which is recognized as a globally significant route for many migratory and resident birds. The Preferred Plan/NER Plan recommends the removal of invasive plant species and the establishment of native plants, which provide habitat for organisms and plants that support migratory birds and in particular, water birds (herons, ducks, shorebirds, etc) and woodland birds (e.g., Blue-gray Gnatcatcher, Chestnut-sided Warbler, etc.) and savanna birds (e.g., Yellow-breasted Chat and Orchard Oriole, etc.). Also, about 410-acres of marsh, Oak Savanna and wet mesic woodland habitat would be added to the flyway’s habitat via the restoration of McMahan Woods. Activities during the first year of construction that would make the area unusable for birds will be restricted to times of the year when bird use is low, such as winter months. Based on this, there would be no adverse effects to migratory and residential birds within McMahan Woods area or the surrounding area resulting from implementation of the Preferred Plan/NER Plan. Bird species effects resulting from the implementation of the Preferred Plan/NER Plan are considered to be beneficial.

McMahon Woods project site resides within a band of important natural areas and parks that span northeastern Illinois. These natural areas serve as crucial foraging and breeding grounds along the Lake Michigan flyway portion of the Mississippi Flyway (Figure 7, page 20), which is an important migration route for many bird species. The flyway provides a visual north-south sight line, the coast of Lake Michigan, which the birds have evolved to follow as they undergo migration. The Bird Conservation Network has named the area that includes the City of Chicago and its suburbs as a globally significant migratory flyway. During the migration periods, March to May and September to mid-October, more than five million song birds are believed to traverse this flyway. Lake Michigan's shoreline is acknowledged as one of the most important flyways for migrant songbirds in the United States by ornithologists and bird watchers worldwide. Many other families of migrating birds - hawks and falcons, owls, waterfowl, gulls, terns and shorebirds - also follow Lake Michigan's shore line or winter just offshore. In all, more than 300 species of birds have been recorded in the Chicagoland area since 1970. Songbirds and other groups of birds migrate from South America to breed in portions of the Upper Midwest all the way to Canada and Alaska. It is critically important to migratory birds that use the Lake Michigan flyway to have optimal stopover habitat and food resources to successfully complete their migration. The shoreline of Lake Michigan and its surrounds, which includes McMahon Woods, provides vital natural areas that offer rest and foraging opportunities for tired and hungry migrants.

Approximately 285 species of birds may occur within the region throughout the year. Out of these, 105 bird species have been recorded occurring at Saganashkee Slough and McMahon Woods from 1968 through 2008. A number of species are using the woodlands within McMahon Woods for breeding purposes, such as the Blue-Gray Gnatcatcher. Also notable is the number of species of concern that have been recorded from the project area that would greatly benefit from the proposed restoration measures (Table 2, page 21).

Mammals

Currently, only those mammal species indicative of urban life are present within the McMahon Woods study area. Based on this, and the activities of restoring native plant communities, there would be no adverse effects to small or large mammals within the study area resulting from implementation of the Preferred Plan/NER Plan. Mammal species effects resulting from the implementation of the Preferred Plan/NER Plan are considered to be beneficial, but minor.

Plant Communities

Plant species identified from current plant communities are generally comprised of a mix of native, non-native, and Eurasian species. The Preferred Plan/NER Plan recommends the removal of invasive, nonnative plants and Eurasian species and the reestablishment of diverse native plant communities. While invasive and non native trees will be removed, remnant patches of high quality plant community would be preserved and avoided. Based on this, there would be no adverse effects to plant communities within the study area or the surrounding areas resulting from implementation of the Preferred Plan/NER Plan. Plant community effects resulting from the implementation of the Preferred Plan/NER Plan are considered to be beneficial.

Threatened & Endangered Species

Federal – The only Federally endangered species known to inhabit the study area is the Hine's Emerald Dragonfly (*Somatochlora hineana*). Threats to Hine's Emerald Dragonfly include habitat loss, habitat degradation, habitat succession, and disruption of ecological and hydrological processes. The proposed

project would restore dragonfly habitat within the study area and would greatly benefit this important population of the species. For these reasons, we conclude the resulting from implementation of the Preferred Plan/NER Plan will have no effect on listed species or proposed or designated critical habitat (Figure 4).

State – The following species are listed as threatened or endangered in Illinois that have been observed at or near the McMahon Woods: Queen-of-the-prairie (*Filipendula rubra*), White lady’s slipper (*Cypripedium candidum*), Savanna blazing star (*Liatris scariosa nieuwlandii*), Black-crowned Night-heron (*Nycticorax nycticorax*), Foster’s Tern (*Sterna forsteri*). The Black-crowned Night-heron and Foster’s Tern have only been sighted infrequently and not within the last 7 years. The Queen-of-the-prairie, White lady’s slipper and Blazing star have small populations within the McMahon Woods area. The White lady’s slipper occurs within the graminoid fen outside of the project footprint. The Queen-of-the-prairie and Savanna blazing may occur around the borders of the project footprint near the open areas of the graminoid fen. Based on the location of these species and the type of activities that would occur should the Preferred Plan/NER Plan be implemented, there would be no adverse effects to state threatened and endangered species within the McMahon Woods study area.

5.4.3 – Cultural Resources

Cultural & Social Properties

The Palos Division of the FPDCC is an important area for public recreation. Available facilities include the Little Red School House Nature Center as well as designated areas for hiking, cross-country skiing, camping, picnicking, boating, fishing, and horseback riding. Also, the adjacent Saganashkee Slough is a popular fishing destination. There are no adverse impacts expected to cultural or social properties through the implementation of the Preferred Plan/NER.

Archaeological & Historical Properties

The Preferred Plan/NER Plan would have no adverse impacts on archaeological or historic properties that occur within the study area. No construction activities except in previously disturbed areas are planned as part of this project. In the event of the accidental discovery of cultural resources, the Illinois State Historic Preservation Agency will be contacted and consultations will take place.

Land Use History

The Preferred Plan/NER Plan will not have any adverse impacts on the area’s historical land uses since land use change is not part of the plan.

Social Properties

The Preferred Plan/NER Plan will not have any adverse impacts on the area’s social properties. Aesthetic and open space improvements resulting from implementation of the Preferred Plan/NER Plan may have positive effects on adjacent parks and neighborhoods.

5.4.4 – 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). Effects to these points are discussed as follows:

Noise: Under any of the alternative plans there would be elevated, but intermittent, levels of noise from construction machinery during the first 1 to 2 years of the restoration project. This is a temporary and intermittent affect that would cease as soon as culvert, berm and glacial material placement was complete.

Displacement of People: Any of the alternative plans would not displace local residents within the township of the study area since only open space parcels are proposed for restoration.

Aesthetic Values: Any of the alternative plans would not reduce the aesthetic values of the study area, but greatly enhance aesthetics resulting from shifting low quality plant communities into diverse healthy native plant communities.

Community Cohesion: Any of the alternative plans would not disrupt community cohesion, but provide restored open space for community activities.

Desirable Community Growth: Any of the alternative plans would not adversely affect community growth based on project restoration measures.

Desirable Regional Growth: Any of the alternative plans would not adversely or beneficially affect regional growth.

Tax Revenues: Any of the alternative plans would not adversely or beneficially affect tax revenues.

Property Values: Any of the alternative plans would not have adverse affects on property values, but has the potential to increase surrounding land values since the aesthetics would improve to do project restoration measures.

Public Facilities: Any of the alternative plans would not adversely affect public facilities, but would provide a more natural and healthy open space.

Public Services: Any of the alternative plans would not adversely or beneficially affect public services.

Employment: Any of the alternative plans would not adversely affect employment and would temporarily increase employment during construction activities.

Business and Industrial Activity: Any of the alternative plans would not adversely or beneficially affect local commerce.

Displacement of Farms: Any of the alternative plans would not adversely affect farmland since restoration areas do not occur on agricultural fields.

Man-made Resources: Any of the alternative plans would not adversely affect man-made resources. However, the man-made function of the culvert under 107th would benefit from being replaced with a higher capacity culvert and would reduce any impacts from water backing up during flood events.

Natural Resources: The No Action Alternative allows for the continued degradation of native species, rare communities, and significant habitats. The proposed project would not adversely affect natural resources, but improve them greatly.

Air: Any of the alternative plans would not adversely affect long term air quality since machinery for construction activities would be limited to several months of total time. These activities would be

unnoticeable compared to current barge and shipping traffic within the Calumet-Sag Channel and surrounding trucking routes within the immediate project area.

Water: Any of the alternative plans would not adversely affect water quality, but incidentally improve it in the rivulets for the Hine's Emerald Dragonfly.

5.5 – Cumulative Effects

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 impacts 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 restoration project were assessed in accordance with guidance provided by the Council on Environmental Quality (CEQ) and U.S. Environmental Protection Agency (USEPA 315-R-99-002). This guidance provides an eleven-step process for identifying and evaluating cumulative effects in NEPA analyses.

5.5.1 – Scope of Cumulative Effects Analysis

Through this environmental assessment, the cumulative effects 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 McMahan Woods. The spatial boundary being considered is normally in the general area of the proposed ecological restoration; however, this area may be expanded on a case-by-case basis if some particular resource condition necessitates broadening the boundary.

Three temporal boundaries were considered:

- Past –1830s because this is the approximate time that the landscape was in its natural state, which included open water (slough), stream, marsh, fen & rivulet, wet prairie, savanna, and woodland.
- Present – 2015 when the decision is being made on the most beneficial ecological restoration
- Future – 2065, the year used for determining project life end, although the ecological restoration should last until a geologic event disturbs the area.

Projecting the reasonably foreseeable future actions is difficult. The proposed action (ecosystem restoration) 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. Reasonable foreseeable includes the following:

- Stable growth in both population and water consumption near the study area
- Sowing of native plants to return plant communities across the landscape

- Continued increase in tourism/recreation in the open spaces of the region
- Continued, but slowed urban development near the study area
- Continued application of environmental requirements such as those under the Clean Water Act
- Implementation of various programs and projects to deal with runoff and waste water pollution and to restore degraded environments
- Community will increasingly value not only the open space but the biodiversity as well
- Improvement to nearby natural areas surrounding the McMahan Woods study area
- Continued operation of the Calumet-Sag Channel as a navigation and wastewater canal
- Continued pressures and threats to the Hine's Emerald Dragonfly

5.5.2 – Cumulative Effects on Resources

Physical Resources

The past has brought alteration to the physical resources of the McMahan Woods study area. Portions of the site's geology, soils, topography, hydrology, hydrogeomorphology, and hydraulics have all been modified to suit man's needs via the construction of the Calumet-Sag Channel. Also, natural processes that drive diverse native ecosystems such as fire have ceased within the study area. Even though there is low development within the watershed, minor alterations within a system such as the McMahan Woods study area has experienced negative changes in storm water flows. Other past physical alterations include seasonal activities such as road salting and infrastructure such as roads and parking lots. It is reasonably foreseeable that small projects within the study area for ecological restoration purposes would occur. Best management practices and water reclamation systems are important but not numerous and big enough to remove impacts to streams such as Crooked Creek, but could possibly occur in the future as technology advances. Given the past, current and future condition of the study area physical resources, the implementation of this ecosystem restoration coupled with potential future infrastructure projects would have important positive effects, but are not considered cumulatively significant. There are no irrecoverable loss of resources identified in terms of geology, soils, substrates, topography, hydrology, water quality and fluvial geomorphology due to implementation of the Preferred Plan/NER Plan in the context of study past and future activities. Cumulative beneficial effects to the McMahan Woods' physical resources are anticipated in terms of geologic features and deposits, soils, substrates, hydrology, hydrogeomorphology, hydraulics, and water quality.

Biological Resources

The ecology within the McMahan Woods has had significant impacts as a result of previous physical and biological resource alterations. The area was intensely geological active, which drove an immensely diverse ecosystem complex. This complex was inclusive of now rare and interesting habits such as the Fen & Rivulet, which provides critical life requisites for the Federally Endangered Hine's Emerald Dragonfly. All of the resulting plant communities have since been degraded via the physical alterations noted above compounded by physical removal of native vegetation and the infestation by non-native weeds. The geomorphic and hydrologic alterations to the area via the construction of the Calumet-Sag Channel caused a major shift from the natural historic condition of a marsh/meadow/fen complex into dry degraded secondary forest regrowth. It is reasonably foreseeable that small projects within the study area for ecological restoration purposes would occur. Small patches of non-native species would be typically removed and replanted with natives, but the larger surrounding areas would maintain as a high potential for reinvasion and degradation of restored sites without large management investments. Considering these past, current and future conditions of the study area, the implementation of the Preferred Plan/NER Plan is minor in terms of the vast array and quantity of significant effects caused by past industry and urbanization; however, it is instrumental in beginning to address the human induced problems the area

suffers, helps to recover lost globally significant migratory bird habitat and to save a critically endangered species population. Therefore, there are no irrecoverable losses of resources identified in terms of plant, insect, fish, amphibian, reptile, bird, and mammal taxa or to their habitats they occupy due to implementation of the Preferred Plan/NER Plan. Cumulative beneficial effects to the McMahan Woods' biological resources are anticipated in terms of fish and wildlife and their preferred habitats.

Cultural Resources

The study area has a few cultural and historic significant places or structures, and the Preferred Plan/NER is not expected to affect any of these directly or indirectly. Therefore, there are no irrecoverable losses of resources identified in terms of cultural, archaeological, or social aspects due to implementation of the Preferred Plan/NER. Cumulative effects to area cultural resources are considered to be neutral.

5.5.3 – Cumulative Effects Summary

The overall cumulative effects of the McMahan Woods habitat restoration project are considered to be beneficial environmentally, socially and economically. The irreversible and irretrievable commitment of resources was not identified to be resultant from implementation of the proposed action; NEPA 1502.16 (102(2)(C)(v)). Relationships between local short-term uses of man's environment and maintenance and enhancement of long term productivity would be swayed towards ecological recovery of McMahan Woods; NEPA 1502.16 (102(2)(C)(iv)). No adverse environmental effects which cannot be avoided were identified should the proposal be implemented; NEPA 1502.16 (102(2)(C)(ii)).

5.6 – Unavoidable Adverse Impacts

Unavoidable impacts resulting from this ecosystem restoration project include displacement of existing vegetation and wildlife species and removal or disturbance of previously unidentified cultural resources (in coordination with appropriate agencies). Construction activities would create short-term obstruction or temporary disruption to local roads. There would be no long-term impacts to transportation.

5.7 – Relationship between Short-term Uses and Long-term Productivity

Management of the Forest Preserves of Cook County land is primarily for the long-term productivity of sensitive plant and animal species and for the enhancement of recreation opportunities. Construction-related impacts of the Preferred Plan/NER would result in the short-term loss of access to some recreational opportunities and increases in localized noise, dust, traffic, and vehicular emissions. Short-term use of the labor force for construction activities would result in long-term productivity of the economic environment, including employment, personal income, and tax revenue. Long-term employment would relate to the addition of recreational and economic development opportunities realized under implementation of the Preferred Plan/NER.

5.8 – Irreversible and Irretrievable Commitments of Resources

A commitment of resources is irreversible when its primary or secondary impacts limit the future option for a resource. An irretrievable commitment refers to the use or consumption of resources that is neither renewable nor recoverable for later use by future generations. The commitment of resources refers primarily to the use of nonrenewable resources such as fossil fuels, water, labor, and electricity. Construction activities would require the use of fossil fuels for electricity and for the operation of vehicles and equipment. Use of raw building materials for construction would be an irretrievable commitment of resources from which these materials are produced. Development of lands would also require labor that

would otherwise be available for other projects. Commitment of labor and fiscal resources to develop the land is considered irretrievable.

5.9 – Relationship of the Proposed Project to Land-use Plans

Implementation of the Preferred Plan/NER would be consistent with all known land use plans including:

- Hine's Emerald Dragonfly (*Somatochlora hineana*), Recovery Plan
- Forest Preserve District of Cook County Recreation Master Plan
- Forest Preserves of Cook County Natural and Cultural Resources Master Plan
- 2012-2016 Capital Improvement Plan Forest Preserves of Cook County

5.10 – Compliance with Environmental Statutes

The Preferred Plan/NER presented in this integrated Environmental Assessment are in compliance with appropriate statutes, executive orders and USACE regulations 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); and the Rivers and Harbors Act of 1899. The potential project is in compliance with the Clean Air Act; the Clean Water Act, and the National Environmental Policy Act of 1969. There were no adverse environmental effects identified which cannot be avoided should the proposal be implemented [1502.16 (102(2)(C)(ii))]. This proposal reverses some of the adverse affects of man's local and short-term uses of the environment. There have been no irreversible and irretrievable commitments of resources identified resulting from the proposed action should it be implemented [1502.16 (102(2)(C)(v))]. The proposed project supports land-use plans identified in the Hine's Emerald Dragonfly (*Somatochlora hineana*), Recovery Plan, Forest Preserve District of Cook County Recreation Master Plan, Forest Preserves of Cook County Natural and Cultural Resources Master Plan, and the 2012-2016 Capital Improvement Plan Forest Preserves of Cook County in terms of natural area restoration [NEPA 1502.16].

Environmental Justice EO12898

The Preferred Plan would not cause adverse human health effects or adverse environmental effects on minority populations or low-income populations. Executive Order 12898 (environmental justice) requires that, 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 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.

A database search of the EPA EJView mapping tool (Accessed 02 May 2014), revealed that within the greater Palos Hills, Illinois area in which the study area occurs, there are not Environmental Justice issues to be concerned with. Since the overall project is considered ecosystem restoration and will only benefit the surrounding environment and communities, no adverse effects to any low income populations and/or minority populations are expected.

Clean Air Act

The local air quality in the Chicago area including Cook County are considered ‘non-attainment’ under the Clean Air Act for ozone, particulates (PM-10 and PM-2.5), and lead. The project is within the non-attainment zone. Once implemented, the project itself will be neutral in terms of air quality, with no features that either emit or sequester air pollutants to a large degree. During the project construction, heavy equipment would cause minor, temporary air quality impacts, however all equipment will be in compliance with current air quality control requirements for diesel exhaust, fuels, and similar requirements. It has been determined that the direct/indirect emissions resulting from the project are below *de minis* levels and, therefore, a conformity determination is not required due to the short and temporary nature of any air quality impacts.

Section 401 & 404 of the Clean Water Act

A Section 404(b)(1) analysis was completed for the preferred plan and is located in **Appendix G**. Features addressed by the analysis include the replacement of the culvert under 107th Street, the placement of the earthen berm and repair and physical alterations to the Hine’s Emerald Dragonfly rivulets. No long-term, adverse effects were determined. Since project activities under the jurisdiction of Section 401 are minimal, an individual permit for Section 401 Water Certification would not be sought.

USFWS Coordination

The USACE have been in coordination regarding this project since 2012 and supports this project as stated in their coordination letter dated June 8, 2015. The following is an excerpt of the letter, the entire letter has been placed in the Appendix G under agency coordination:

“We strongly support the removal of invasive plant species and creation of important wetland areas within McMahon Woods and Fen Nature Preserve (MWFNP). We encourage the consideration of the above mentioned recommendations. If changes or modifications to the plan occur during design, these should be provided to our office for review and comment.

We support the proposed ecological restoration of the MWFNP including the above measures to identify and protect the eastern fringed prairie orchid and the Hine’s Emerald Dragonfly (HED). In general, we support the concept of ecological restoration at both sites.”

The Chicago District of the USACE is committed to continue to work closely with the USFWS staff during design, construction and monitoring of this project. The past and current level of coordination has been very helpful and we have built a solid working relationship between our offices.

State of Illinois Historic Preservation Act

Coordination with the Illinois Historic Preservation Agency (IHPA) commenced with a project scoping letter dated 01 May 2012. In a letter 04 June 2012, the IHPA informed USACE that if any cultural or archaeological material is discovered during earthwork in already disturbed area, activities should cease and the SHPO would be notified. If any cultural or archaeological material is discovered in other areas any ongoing activities will cease and SHPO notified.

Tribal Coordination

Tribal coordination was conducted during the scoping phase of the feasibility study with letters sent on May 1, 2012 to eleven (11) tribal organizations and associations. The Nottawaseppi Huron Band of the

Potawatomi responded on May 7, 2012, with a letter of support for the project – “*On behalf of the Tribe I earnestly support the project and anticipate the benefits to wildlife it will provide*”.

Impacts of Climate Change EO 13653

This Executive Order seeks to increase the nation’s level of preparedness and resilience to changing climatic conditions that pose a risk to infrastructure, public health and the natural environment (species, communities, ecosystems, etc.) by (1) engaged and strong partnerships and information sharing at all levels of government; (2) risk-informed decisionmaking and the tools to facilitate it; (3) adaptive learning, in which experiences serve as opportunities to inform and adjust future actions; and (4) preparedness planning. Methods proposed to increase resilience of the project and mitigate risks of climate change include installing native plant material over multiple growing seasons to reduce risk of impacts from severe weather during one year, high species richness to ensure redundancy in species functional roles, increased genetic diversity by requiring contractors to source plant material from different source populations and adaptive management and monitoring will be incorporated into the overall plan.

5.11 - Finding of No Significant Impact (FONSI)

McMahon Woods Ecosystem Restoration

Background

The non-Federal sponsor, the Forest Preserves Cook County, has requested that the Chicago District, USACE initiate a study under Section 506 Fisheries and Ecosystem Restoration to ascertain the feasibility of restoration features to restore the ecological integrity of the McMahon Woods project area. This study evaluates the feasibility and environmental effects of restoring marsh, Oak savanna and wet mesic woodland areas. The scope of this study addresses the issues of altered hydrology, native plant community preservation, invasive species, connectivity, rare wetland communities, native species richness and encourages public education. This Feasibility Report and Integrated Environmental Assessment will assess and identify problems and opportunities, identify and evaluate measures, and recommend and design the most cost effective and feasible solution to the ecological problems currently existing within the area of study

One crucial component that is important to ecosystem integrity and integrates both aquatic and riparian or buffer habitat, is wetlands. Historically, northeastern Illinois was lush with vast expanses of wetlands. Restoring wetlands and other aquatic habitat will provide critical habitat for a number of organisms. These wetlands and buffering plant communities would serve as an important refuge for migrant and resident bird species, as well as a variety of aquatic organisms (fish, amphibians, aquatic insects, etc.). The main problems at McMahon Woods are as follows:

- Degradation of aquatic migratory bird habitat
- Altered hydrologic regime
- Invasive species dominance
- Degradation of groundwater feed (rivulets) wetlands
- Loss of periodic fire
- Lack of native herbaceous and shrub species (food bearing plants)

Brief Summary of Findings

Six (6) measures, including the No Action measure, were input into the IWR-Planning Suite in terms of costs and benefits. These measures that were processed through the IWR Planning Suite program to generate cost effective plans. The cost effective and incremental cost analysis takes implementation and real estate costs and ecosystem outputs into consideration. Ecosystem outputs were measured via the Floristic Quality Index (FQA). Four (4) alternative plans, including the No Action Plan, were deemed best case scenarios for project implementation. Alternative 4 was selected as the National Ecosystem Restoration (NER) Plan, which for the purposes of this Environmental Assessment is termed the Preferred Plan. Rationale for selecting the Preferred Plan/NER is presented in Section 4.6 and 4.7.

- Alternative Plan 1: (No Action Plan Future) Without-Project Conditions (see Section 2.5.2)
- Alternative Plan 2: (BC) Native Plants-wet mesic woodland
- Alternative Plan 3: (BC) Native Plants-wet mesic woodland +(BA) Native Plants-marsh
- Alternative Plan 4: (BC) Native Plants-wet mesic woodland +(BA) Native Plants-marsh +(BB)Native Plants-Oak savanna

The NER/Preferred Plan

The plan that reasonably maximizes net National Ecosystem Restoration benefits and is consistent with the Federal objective, authorities and policies, is identified as the NER plan. This NER Plan is considered as the Preferred Plan for direct, indirect and cumulative effects assessment under NEPA in the following Chapter. The NER/Preferred Plan was determined to be Alternative 4. Alternative 4 would restore over 400 acres of habitat within McMahon Woods project area which includes hydrogeomorphic and native plant community restoration.

The Preferred Plan/NER presented in this integrated Environmental Assessment is in compliance with appropriate statutes, executive orders and memoranda 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); and the Rivers and Harbors Act of 1899. The potential project is in compliance with the Clean Air Act; the Clean Water Act, and the National Environmental Policy Act of 1969.

Major Compliance Items

Environmental Justice

The Preferred Plan/NER would not cause adverse human health effects or adverse environmental effects on minority populations or low-income populations. Executive Order 12898 (environmental justice) requires that, 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 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.

A database search of the EPA EJView mapping tool (Accessed 02 May 2014), revealed that within the greater Palos, Illinois area in which the McMahon Woods study area occurs, there are not Environmental

Justice issues to be concerned with. Since the overall project is considered ecosystem restoration and will only benefit the surrounding environment and communities, no adverse effects to any low income populations and/or minority populations are expected.

Clean Air Act

The local air quality in Chicago and Cook County are considered ‘non-attainment’ under the Clean Air Act for ozone, particulates (PM-10 and PM-2.5), and lead. The project is within the non-attainment zone. Once implemented, the project itself will be neutral in terms of air quality, with no features that either emit or sequester air pollutants to a large degree. During the project construction, heavy equipment would cause minor, temporary air quality impacts, however all equipment will be in compliance with current air quality control requirements for diesel exhaust, fuels, and similar requirements. A general conformity analysis was not conducted due to the short and temporary nature of any air quality impacts.

Section 401 of the Clean Water Act

A Section 404(b)(1) analysis was completed for the preferred plan and is located in **Appendix G**. Features addressed by the 404 include the repair the devastating physical alterations to the Hine’s Emerald Dragonfly rivulets. No long-term, adverse effects were determined. Since project activities under the jurisdiction of Section 401 are minimal, an individual permit for Section 401 Water Certification will not be sought.

USFWS Coordination

The USACE have been in coordination regarding this project since 2012 and supports this project as stated in their coordination letter dated June 8, 2015. The following is an excerpt of the letter, the entire letter has been placed in the Appendix G under agency coordination:

“We strongly support the removal of invasive plant species and creation of important wetland areas within McMahon Woods and Fen Nature Preserve (MWFNP). We encourage the consideration of the above mentioned recommendations. If changes or modifications to the plan occur during design, these should be provided to our office for review and comment.

We support the proposed ecological restoration of the MWFNP including the above measures to identify and protect the eastern fringed prairie orchid and the Hine’s Emerald Dragonfly (HED). In general, we support the concept of ecological restoration at both sites.”

The Chicago District of the USACE is committed to continue to work closely with the USFWS staff during design, construction and monitoring of this project. The past and current level of coordination has been very helpful and we have built a solid working relationship between our offices.

State of Illinois Historic Preservation Act

Coordination with the Illinois Historic Preservation Agency (IHPA) commenced with a project scoping letter dated 01 May 2012. In a letter 04 June 2012, the IHPA informed USACE that if any cultural or

archaeological material is discovered during earthwork in already disturbed area, activities should cease and the SHPO would be notified.

Public Interest

An Environmental Assessment (EA) was prepared for the project and sent to Federal, State and local agencies along with the general public for review. A 30-day Public Review period will be held for the Environmental Assessment. Significant comments from the Federal, State or local agencies or the public were addressed and are attached to this FONSI. All comments and correspondence are attached to this FONSI.

Conclusion

The draft Finding of No Significant Impact (FONSI) maybe found in Appendix G. An Environmental Assessment was completed for the proposed habitat restoration within the McMahon Woods study area near Palos, Illinois. The Environmental Assessment has found that there would be no adverse affects resulting from implementation of the Preferred Plan/NER Plan. A 30-day Public Review period will be held from November 10, 2015 to __ ____ 2015, and any comments received would be incorporated document if necessary. The NEPA document and supporting appendices were placed on the Chicago District’s Civil Works webpage for maximum distribution.

Christopher T. Drew. Date: _____
Colonel, U.S. Army
District Commander

CHAPTER 6 – PLAN IMPLEMENTATION

This chapter outlines details for implementing the Preferred Plan/NER Plan. Plan implementation details include sequencing, environmental assessment findings, mitigation requirements, permit requirements, agency and stakeholder views, project schedule, total project costs and cost sharing requirements.

6.1 – Plan Authorization

Study and implementation authorization by Congress is provided by the Great Lakes Fishery & Ecosystem Restoration (Section 506 WRDA 2000, as amended). Following completion and approval of this feasibility study, USACE implementing guidance allows the Chicago District to enter into a Project Partnership Agreement for completion of design, plans and specifications, construction and subsequent monitoring.

6.2 – Implementation & Sequencing

Alternative four (4) is the National Ecosystem Restoration (NER) Plan and is the recommended plan. This alternative consists of 3 measures: Native Plants-marsh (BA), Native Plants-Oak Savanna (BB) and Native Plants-wet mesic woodland (BC). The implementation of all of these measures would restore habitat complexity and integrity to marsh/rivulets, globally imperiled Oak Savanna and riparian communities within McMahan Woods (wet mesic woodland). The implementation of these features is generally described as follows and according to the measures descriptions in [Section 4.1](#). Much more detail would be added to the plan should this project commence to the PED/P&S Phases, for example, specifying spatial distribution of native plugs within a given zone and species clumping, planting centers, temporary predator controls, and establishment activities. General construction activities and sequencing would include:

1) Site Preparation – The first task would be to install safety fencing, signage and other safety features in order to keep the public out of the site during times with machinery (e.g., placement of earthen berm). Staging areas and access roads would be demarcated.

2) Invasive Species Eradication – All invasive plant species would be physically and chemically eradicated from the planting zones within each habitat to be restored. All woody invasive species removed would be chipped into small pieces and removed from site.

3) Geomorphic Repair – Repair of rivulets will be the strategic placement of glacial cobble and stones within the upper reaches of the rivulets to mimic natural substrate and stabilize banks. Placement activities would happen after further surveys of the rivulets to determine exact locations of Hine’s Emerald Dragonfly juvenile larvae in order to avoid areas or to temporarily remove these individuals and place them in undisturbed areas. Placement would be by some sort of tracked vehicle in order to minimize the compaction of the surrounding mucky marsh soils. Tracked vehicles distribute the weight of vehicles over a larger surface and are considered to lessen the risk of soil compaction. Placement would also occur during winter months when the ground should be dry and solid, again minimizing risk of soil compaction.

4) Hydrologic Repair – This work would be completed before native plants could be installed. Special care, consideration and coordination would occur before these measures could be attempted. Measures include the installation of a small earthen berm and larger culvert under 107th St.

5) Native Plant Community Establishment – Next would be to establish native plant communities of marsh, wet oak savanna and wet mesic woodland over the remainder of the construction period. Planting

lists are presented in Appendix J. Zones would be seeded and planted with seed and live plugs. Live plug areas will require predatory control, primarily stringing and caging to prevent Canada Goose and Deer predation. Again, the duration of the construction contract would primarily be for spot herbicide application and additional planting; most activities similar to home gardening activities.

6) BMPs – Soil erosion and sediment control measures will be designed during design phase and will comply with local and federal environmental requirements. The minimum measures required at the project site include:

- Hydroseeding, seeding, and mulching to stabilize disturbed areas
- Installation of silt fences around graded slopes and stockpile areas
- Stabilizing construction entrances to limit soil disturbance at the ingress/egress from the site
- Installing erosion blanket over unprotected finished grades (earthen berm) that are to be unplanted for at least two weeks

6.3 – Real Estate

This Real Estate Plan Appendix F was prepared in support of the AFB-level feasibility study of the McMahon ecosystem restoration study. The Real Estate Plan identifies and describes the area proposed for construction, operation and maintenance of the Project, in addition to the real estate requirements and procedures for implementation of a recommended Plan.

Non-Federal Sponsor Lands – The non-federal sponsor currently owns in simple fee all areas that will be utilized for this project. Total acreage of non-federal sponsor property needed for this project is 410.1-acres, which is inclusive of lands needed for ecosystem restoration, staging during construction, and operation and maintenance of restored habitats after construction is complete.

Non-Standard Estates – There are none for this study area.

LERRDs Crediting – Currently crediting amount is estimated to be \$ [REDACTED].

6.4 – Operation and Maintenance

The O&M costs of the project are estimated to an average annual cost of [REDACTED] with a 3.75% interest rate over 50 years. A detailed O&M Manual containing all the duties will be provided to the non-Federal sponsor after construction is closed out. The O&M for Chicago District ecosystem projects are practical and minimal due to initial project design efforts and design targets for sustainability. Mostly if not all of the O&M activities are no different than the specific activities that take place during construction. O&M costs are detailed in Table 13.

Invasive Plant Species Control – The invasive plant control maintenance activity is probably the most important to conduct. Preventing the establishment of invasive species and weedy vegetation prevents the need for large scale herbicide or physical eradication and replanting efforts. An annual maintenance plan will be drafted in conjunction with input from the Forest Preserve District of Cook County taking into account the types of invasive and non-native species to be treated and the acreage of the treatment area. Problematic areas will include the bank transition and emergent marsh zones. Species such as white and yellow sweet clover, cut-leaved teasel, reed canary grass, common reed, buckthorn, honeysuckle, are known invasive species which will need to be kept at bay.

Precautions should be taken to ensure that any long term herbicide application is appropriately dispensed to remove non-native plants and invasive species while avoiding native plant communities.

Native Plant Community Maintenance – It will be required to maintain the species richness, abundance and structure of the restored plant communities within McMahan Woods. Aside from minor re-plantings, it will be important to continue to protect plant communities from external changes by man’s daily activities, whether single incidents or chronic stressors. These can cause native plant communities to experience significant species richness declines even to the point of becoming monotypic stands. The best operational measure to quickly identify and rectify external stressors is vigilance. Routine inspections by the non-Federal sponsor’s qualified stewards are imperative to notice adverse change quickly. The long term monitoring plan provided above will not catch quick change as would routine inspection by site stewards.

Precautions should be taken to ensure Forest Preserve District of Cook County staff understands the limits of native plant communities and how those areas should be maintained. Buffers around aquatic resources and native plants which border mowed turf grass areas should be avoided when routine mowing occurs.

Table 13 - Detailed Costs of Average Annual O&M

Ecosystem Management	Total AA Cost
Burning	
Mowing	
Invasive Control (herbaceous)	
Invasive Control (Woody)	
Seeding	
TOTAL	

6.5 – Monitoring Plan

Section 2039 of WRDA 2007 directs the Secretary to ensure that when conducting a feasibility study for a project (or a component of a project) for ecosystem restoration that the recommended project includes a plan for monitoring the success of the ecosystem restoration. Additionally, Implementation Guidance for the WRDA of 2007 – Section 5011, Great Lakes Fishery and Ecosystem Restoration Program states that the term "monitoring" means the activities performed, including the collection and analysis of data that are necessary to determine if predicted outputs of the project are being achieved. Monitoring plans for Section 506 projects will not be complex but the scope and duration will address the minimum monitoring actions necessary to evaluate project success. Within a period of up to ten years from completion of construction of an ecosystem restoration project, monitoring shall be a cost-shared project cost.

(a) In General - In conducting a feasibility study for a project (or a component of a project) for ecosystem restoration, the Secretary shall ensure that the recommended project includes, as an integral part of the project, a plan for monitoring the success of the ecosystem restoration.

(b) Monitoring Plan - The monitoring plan shall--

(1) include a description of the monitoring activities to be carried out, the criteria for ecosystem restoration success, and the estimated cost and duration of the monitoring; and

(2) specify that the monitoring shall continue until such time as the Secretary determines that the criteria for ecosystem restoration success will be met.

(c) Cost Share - For a period of up to 10 years from completion of construction of a project (or a component of a project) for ecosystem restoration, the Secretary shall consider the cost of carrying out the

monitoring as a project cost. If the monitoring plan under subsection (b) requires monitoring beyond the 10-year period, the cost of monitoring shall be a non-Federal responsibility.

Component 1 – Structural Sustainability

This component covers the structural sustainability of the implemented features. It is a qualitative assessment of whether each feature is retaining its physical character and project purpose. The most important information derived from this component would be to determine if adaptive management measures are needed or not. This monitoring would take place once every other year for 10-years. Assessments would be conducted by walking through the project and visually assessing each of the components or project features that are listed below. This is intended to be fairly quick and to notice problems before they become issues that require complete overhauls and may adversely impact other project features. Structural components are currently broken down into the following:

- 1) Earthen Berm
- 2) Culvert under 107th St.
- 3) Hine’s Emerald Dragonfly rivulets
- 4) Plant community reestablishment
 - a) Marsh
 - b) Oak Savanna
 - c) Wet Mesic Woodland

The following is a list (living list) of parameters that would be assessed:

1. Earth Berm
 - a. Presence/absence of erosion
 - b. Hydrological indicators
 - c. Invasive species % coverage
2. Culvert under 107th St
 - a. Presence/absence of erosion
 - b. Structural integrity
3. Plant Community Zones
 - a. Spatial coverage
 - b. Invasive species % coverage
 - c. Predator induced damages
 - d. Hydraulic induced damages
4. Human Interference & Damages
 - a. Physical damage
 - b. Removal
 - c. Rubbish and foreign debris

Visual observations during site visits will be used to determine if structural integrity and sustainability exist within the project. Based on said site visits, adaptive management protocols may be initiated. Success of structural components, and any adaptive management triggered by observations, will be determined by the absence of structural problems at the end of 10 years.

Component 2 – Biological Response

These monitoring events would occur every other year during the monitoring period.

Plant Communities

Evaluation of plant community zones would be accomplished using the Floristic Quality Assessment Index (FQA) and native plant richness, as described in the 2.3.5 Plant Communities. In short, the FQA is a measure of overall environmental quality based the presence or absence of certain plant species. Plant species that are assigned a coefficient of conservatism of 5 to 10 are considered to be indicative of less human mediated disturbance and a higher level of functionality. As the area stabilizes after restoration measures are complete, the number of higher conservative plant species that become established should increase. Communities that have an average mean coefficient of conservatism of between 3 to 5 are considered to be fair quality. This is a good estimate of the future quality of the area based on the current plant community restorations and ongoing monitoring. Success will be determined by comparing FQA results with those predicted from the Future With Project Conditions (Table 13). Adaptive management measures will be taken if there is a decreasing trend of floristic quality over a period of three consecutive years. Adaptive management measures may include installation of native plant seed in areas of downward trend, more frequent fires or more intensive efforts to remove invasive species. Results from monitoring will be reported per year of monitoring efforts and project success determined and report in the final report to be completed in the final year of monitoring.

Avian Community

The monitoring for this community will be implemented; however, at this point in the study/project, it is unknown if the USACE, Forest Preserve District of Cook County or Audubon Chicago Region would take on this role. The metric for avian communities will be a species count during spring migration and species abundance point counts during the breeding season. The goal will be to document habitat specific species within each vegetation community. For instance, in a grassland community we would expect to see at least three grassland species utilizing the habitat. The use of the habitat via community specific species is a great indicator that the habitat is functioning appropriately. Failure to meet these criteria will result in the implementation of adaptive management processes. Adaptive management measures include more frequent prescription burns or installation of suitable native plant species to increase the suitability of the habitat for the target bird species. Results of monitoring will be reported each year of monitoring and will be reported in a final report to be completed in the final year of monitoring.

Bird species that are important to monitor are the wetland dependent birds that will be using the marsh and wooded fen within the wet mesic woodland. Also, Oak savanna bird species will be important to monitor as these species have seen population numbers decrease over the past 30 years. During the spring migration it will be important to keep monitor the number of migratory birds coming through this area that are traveling along the globally significant Lake Michigan flyway, which McMahan Woods is located within.

Hine's Emerald Dragonfly

The monitoring of this species would be most likely carried out by U.S. Fish and Wildlife Service and University of South Dakota (Dr. Soluk) or a nationally recognized expert. These organizations have the expertise necessary to appropriately monitor this species in both adult and larval forms without negatively impacting the sensitive population at McMahan Woods. Success will be determined by recording an upward trend in population numbers over the course of the 10 year monitoring period. If a downward trend is detected over 3 consecutive years adaptive management measures would be conducted to reverse negative trend. Adaptive management measures may include additional removal of non-native vegetation and installation of appropriate native vegetation and/or introduction of more prairie crayfish to increase the number of burrows Hine's Emerald Dragonfly use to forage and overwinter. Any adaptive management would be closely coordinated with the USFWS and Forest Preserves of Cook County.

Monitoring data will be reported each year of monitoring effort and a final report completed on the final year of the monitoring period.

Other Communities

Ancillary data will be collected on other assemblages as well. During fish monitoring, effort would be spent observing wildlife utilizing the habitats, including terrestrial insects, amphibians, reptiles and mammals.

Component 3 – Planning Goal & Objectives

The goal of this proposed project is to restore native wetlands and create a more complex ecosystem to benefit plants, insects, amphibians, reptiles, mammals, and migratory birds. Planning objectives for this study are as follows:

- Increase native conservative plant species richness of marsh, Oak savanna and wet mesic woodland (containing wooded fen) communities
- Reduce and/or eradicate invasive species
- Reduce/repair bare soil areas within the marsh and rivulet complex and Crooked Creek riparian area

These objectives would be assessed the same way as the FWOP and FWP project benefits were modeled as described in the Main Report of the feasibility report, Section 2.5 – Habitat Quality Forecasting. The modeling would be completed as described in Section 2.3.5 – Plant Communities Assessment and Monitoring Component 2, Biological Response, Plant Communities. If the following specific targets are not achieved, the non-Federal sponsor would need to implement necessary measures to bring the quality of these plant communities up to the functional levels expected from restoration activities:

Table 14 - Targets for Monitoring the Response of Plant Communities.

Community Type	Acres	AAMean C	HSI	AAHU	NetAAHU
Marsh	30.1	4	0.4	12.04	7.83
Oak Savanna	4.5	4.4	0.44	1.98	1.23
Wet Mesic Woodland	376	4.5	0.45	169.2	88.36

AAMeanC – Average annual Mean Coefficient of Conservatism
 HSI – Habitat Suitability Index
 AAHU – Average annual habitat units
 NetAAHU – Net (=FWP minus FWOP) Average annual habitat units

Monitoring Responsibilities

The USACE, USFWS and University of South Dakota are currently responsible for implementing all three Monitoring Components as described above. Coordination with partner agencies and organizations to discuss future monitoring responsibilities is planned.

Monitoring Costs & Funding Schedule

Year 1 of Monitoring starts the following growing season after construction is complete.

Table 15 - Monitoring Costs per Year.

Tasks	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Total
Component 1	■	■	■	■	■	■	■	■	■	■	■
Component 2	■	■	■	■	■	■	■	■	■	■	■
Component 3	■	■	■	■	■	■	■	■	■	■	■
Final Report	■	■	■	■	■	■	■	■	■	■	■
Total	■	■	■	■	■	■	■	■	■	■	■

Reporting Results

A yearly monitoring summary report will be drafted by the USACE that briefly summarizes the data collected and determines if adaptive management is needed. A final monitoring report will be drafted that details the outcomes of the restoration project.

6.6 – Implementation of Environmental Operating Principles

In assessing the environmental effects, USACE implemented the following Environmental Operating Principles (EOPs)⁸ as part of this Feasibility Study.

Foster sustainability as a way of life throughout the organization.

Plans to restore native plant and fauna communities to McMahon Woods will be easily sustainable because of the adaptability of the proposed communities to the conditions of McMahon Woods. With minimal monitoring and maintenance to the newly introduced communities, outlined within the Preferred Plan/ NER, should result in lasting success. This design creates sustainability by avoiding the use any mechanical features which would require intensive operations and maintenance over time. Additionally, the proposed work is taking place within the Forest Preserves of Cook County lands, which are cared for and maintained in perpetuity.

Proactively consider environmental consequences of all Corps activities and act accordingly.

The study team considered environmental consequences of proposed restoration features and construction activities. A cumulative effects assessment was completed to ensure all things were considered. Participation from Federal, state and local agencies and stakeholders were also held to ensure the most environmentally beneficial project. The study team does not anticipate negative impacts to the McMahon Woods study area based on the restorative nature of the project, which would reestablish healthy native plant communities.

Create mutually supporting economic and environmentally sustainable solutions.

The study team formulated potential restoration plans to determine what the most cost-effective solution for ecosystem restoration is; however, appropriate engineering studies and biological assessments were performed to ensure that an implemented plan would be sustainable. Chicago District ecosystem designs avoided more operationally costly features such as pumps, weirs, and other fabricated structures. These types of features require continual monitoring, maintenance and funding to ensure they are providing required parameters for the ecosystem to be sustained. Designs for the McMahon Woods restoration project rely on the parameters provided by the everyday system and predicted future changes.

⁸ USACE. Environmental Operating Principles. <https://eko.usace.army.mil/usacecop/environmental/eop/>

Continue to meet our corporate responsibility and accountability under the law for activities undertaken by the Corps which may impact human and natural environments.

This project is exemplary for meeting USACE corporate responsibility and accountability. The hydrology of the area was changed because of the construction and widening of the Cal-Sag channel and placement of material along the western border adjacent to 104th Avenue. The fill material has altered the direction of Hine's Emerald Dragonfly rivulets within that area. The Preferred Plan/NER plan would help to restore and conserve the remaining rivulets on the project site. The HTRW analyses were completed and reviewed to ensure construction activities would not result in an unlawful release of contamination (Appendix E). The Laws, Compliance Statutes and Executive Orders support the Preferred Plan/NER plan, which are discussed in the Federal Objective, Institutional Significance of the Preferred Plan/NER Plan and Compliance.

Consider the environment in employing a risk management and systems approach throughout life cycles of projects and programs.

Risks associated with ecosystem restoration projects are typically low, for example, if certain portions of the project were to fail, other portions could be successful just as well; so it is not an all or nothing scenario. There is typically no chance for the loss of or causing discomfort to human life as well. In the case of McMahon Woods, restoring native plant and fauna communities within the study area would only have beneficial affects to people and the environment. Risk considerations for this project primarily deal with the cost obligated to restore the environment and ultimately gain no benefits in return. The study team has not only incorporated very detailed engineering models to ensure the physical resilience of the habitat features, but have also weighed the biological conditions against other natural areas and similar restoration projects to ensure the plan will function as expected. The study has also presented this question to review teams within and outside of the USACE to ensure a high level of quality assurance.

Leverage scientific, economic, and social knowledge to understand the environmental context and effects of Corps actions in a collaborative manner.

This Feasibility Study was conducted in a manner that leveraged scientific knowledge from the USEPA, University of South Dakota, Openlands, USFWS and previously constructed Chicago District ecosystem restoration projects. The study team will also meet with governmental agencies, local industry, and environmental interest groups to gather scientific, economic and social information that pertains to the McMahon Woods study area.

Employ an open, transparent process that respects views of individuals and groups interested in Corps activities.

This study process and subsequent Feasibility Report was drafted in a manner that has reduced redundancies, excessive and inconsequential information, and confusing engineering and policy discussions. Presentation of this study was done in a clear sequential order to show what the natural condition of McMahon Woods was historically, what the existing conditions are now, what they would be if left alone, what could be done, and what should be done based on considerations of ecosystem improvement and associated costs.

6.6 – Division of Responsibilities

As established in PL99-662, as amended, project costs are shared with the non-Federal sponsor in accordance with project outputs. The Forest Preserve District of Cook County has agreed to serve as the local cost-sharing sponsor for the McMahon Woods 506 Great Lakes Fishery & Ecosystem Restoration project. The cost-sharing requirements and provisions will be formalized with the signing of the Project Partnership Agreement (PPA) between the local sponsor and USACE prior to initiation of contract award activities. In this agreement, the local sponsor will agree to pay 35 percent of the total project costs. Based

on the cost sharing requirements, the total project cost and pertinent cost-sharing information for the restoration project are summarized in **Tables 16-17**.

Table 16 - Total Cost.

Item	Cost
Feasibility Cost**	██████████
P&S	██████████
Construction	██████████
Construction Management	██████████
Monitoring	██████████
LERRDs Credit	██████████
Total Project Cost*	██████████
Average Annual O&M	██████████
Cost Sharing	██████████
35% non-Federal	██████████
65% Federal	██████████
Total	██████████

** First \$100,000 Federal

Table 17 - Cost Sharing Breakout .

	FY15	FY16	FY17	FY18	FY19	FY20	FY21-31	Cost Shared Total
Feasibility Phase								
Detailed Project Report**	██████	██	██	██	██	██	██	██████
Design & Implementation								
100% P&S	██████	██	██	██	██	██	██	██████
Construction & Management	██	██████	██████	██████	██████	██████	██	██████
Monitoring	██	██	██	██	██	██	██████	██████
LERRDs	██	██████	██	██	██	██	██	██████
Total Shared Project Cost	██	██	██	██	██	██	██	██████
Fed / non-Fed Breakdown								
FED share	██	██	██	██	██	██	██	██████
non-FED	██	██	██	██	██	██	██	██████
non-FED cash	██	██	██	██	██	██	██	██
non-FED WIK	██	██	██	██	██	██	██	██
non-FED LERRD	██	██████	██	██	██	██	██	██████

** First \$100,000 Federal

Responsibilities

Federal - The estimated Federal cost share of the project is about \$ [REDACTED]. The USACE would accomplish the plans and specifications phase, which includes additional design studies and plans and specifications, contract for construction, overall supervision during construction, prepare an operation and maintenance manual, and participate in a portion of the post construction monitoring.

Non-Federal Responsibilities - Prior to initiation of the design phase, the Federal Government and the non-Federal sponsors will execute a PPA. The LERRDs and OMRR&R of the project will be the responsibility of the non-Federal sponsors for the proposed project. The estimated non-Federal share of the total first cost of the project is about \$ [REDACTED] and will be covered by LERRDs credit of \$ [REDACTED]. In addition to the total first cost, the feasibility level operations and maintenance costs of the project are estimated to total an annual cost of \$ [REDACTED]. The non-Federal sponsors shall, prior to implementation, agree to perform the following items of local cooperation:

1. Provide 35 percent of the separable project costs allocated to environmental restoration as further specified below
 - a) Provide the non-Federal share of all complete planning and design work upon execution of the PCA
 - b) Provide all lands, easements, and rights-of-way, including suitable borrow and dredged or excavated material disposal areas, and perform or ensure the performance of all relocations determined by the government to be necessary for the construction and O&M of the project
 - c) Provide or pay to the government the cost of providing all features required for the construction of the project
 - d) Provide, during construction, any additional costs as necessary to make its total contribution equal to 35 percent of the separable project costs allocated to environmental restoration
2. Contribute all project costs in excess of the USACE implementation guidance limitation of \$10,000,000
3. For so long as the project remains authorized, operate, maintain, repair, replace, and rehabilitate the completed project or the functional portion of the project at no cost to the government in accordance with applicable federal and state laws and any specific directions prescribed by the government
4. Give the government a right to enter, at reasonable times and in a reasonable manner, upon land that the local sponsor owns or controls for access to the project for the purpose of inspection and, if necessary, for the purpose of completing, operating, maintaining, repairing, replacing, or rehabilitating the project
5. Assume responsibility for operation, maintenance, repair, replacement, and rehabilitation (OMRR&R) of the project or completed functional portions of the project, including mitigation features, without cost to the government in a manner compatible with the project's authorized purpose and in accordance with applicable federal and state laws and specific directions prescribed by the government in the OMRR&R manual and any subsequent amendments thereto
6. Comply with Section 221 of Public Law (P.L.) 91-611, Flood Control Act of 1970, as amended, and Section 103 of the WRDA of 1986, as amended, which provides that the Secretary of the Army shall not commence the construction of any water resource project or separable element thereof until the nonfederal sponsor has entered into a written agreement to furnish its required cooperation for the project or separable element
7. Hold and save the United States free from damages due to construction of or subsequent maintenance of the project except those damages due to the fault or negligence of the United States or its contractors
8. Keep and maintain books, records, documents, and other evidence pertaining to costs and expenses incurred pursuant to the project to the extent and in such detail as will properly reflect total project costs
9. Perform or cause to be performed such investigations for hazardous substances that are determined necessary to identify the existence and extent of any hazardous substances regulated under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), 42 U.S. Code 9601 through 9675, that may exist in, on, or under lands, easements, or rights-of-way necessary for the construction, and O&M of the project, except that the nonfederal sponsor shall not perform investigations of lands, easements, or rights-of-way that the government determines to be subject to navigation servitude without prior written direction by the government

10. Assume complete financial responsibility for all necessary cleanup and response costs for CERCLA-regulated material located in, on, or under lands, easements, or rights-of-way that the government determines necessary for the construction and O&M of the project
11. To the maximum extent practicable, conduct OMRR&R of the project in a manner that will not cause liability to arise under CERCLA
12. Prevent future encroachment or modifications that might interfere with proper functioning of the project
13. Comply with the applicable provisions of the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970, P.L. 91-646, as amended in Title IV of the Surface Transportation and Uniform Relocation Assistance Act of 1987, P.L. 100-17, and the uniform regulation contained in Part 24 of Title 49, *Code of Federal Regulations* (CFR), in acquiring lands, easements, and rights-of-way for construction and subsequent O&M of the project, and inform all affected persons of applicable benefits, policies, and procedures in connection with said acts
14. Comply with all applicable federal and state laws and regulations, including Section 601 of Title VI of the Civil Rights Act of 1964, P.L. 88-352, and Department of Defense Directive 5500.11 issued pursuant thereto and published in 32 CFR, Part 300, as well as Army Regulation 600-7 entitled "Non-Discrimination on the Basis of Handicap in Programs and Activities Assisted or Conducted by the Department of the Army"
15. Provide 35 percent of that portion of the total cultural resource preservation, mitigation, and data recovery costs attributable to environmental restoration that are in excess of 1 percent of the total amount authorized to be appropriated for environmental restoration
16. Do not use federal funds to meet the nonfederal sponsor's share of total project costs unless the federal granting agency verifies in writing that the expenditure of such funds is expressly authorized by statute

Financial Capability of Sponsor

In accordance with regulation ER1105-2-100, Appendix D, where the non-Federal sponsor's capability is clear, as in the instances where the sponsor has sufficient funds currently available or has a large revenue base and a good bond rating, the statement of financial capability need only provide evidence of such. The non-Federal sponsor is committed to its specific cost share of the Design & Implementation (D&I) Phase, and expresses willingness to share in the costs of construction to the extent that can be funded.

CHAPTER 7 – RECOMMENDATION

I have considered all significant aspects of the problems and opportunities as they relate to the project resource problems of the McMahon Woods and its associated habitats. Those aspects include environmental, social, and economic effects, as well as engineering feasibility.

I recommend Alternative 4.

Christopher T. Drew.
Colonel, U.S. Army
District Commander

CHAPTER 7 – BIBLIOGRAPHY

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