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Elkhart River and Christiana Creek Dams

Section 506 Great Lakes Fishery & Ecosystem Restoration / Great Lakes Restoration Initiative

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City of Elkhart Dams
Feasibility Report & Integrated Environmental Assessment

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EXECUTIVE SUMMARY

The non-Federal sponsor, the City of Elkhart, has requested that the Chicago District, USACE (U.S. Army Corps of Engineers) initiate a study under Section 506 Fishery and Ecosystem Restoration to ascertain the feasibility of restoration features of critical aquatic and riparian habitat. This study evaluates the feasibility and environmental effects of removing completely two dams from the Elkhart River and Christiana Creek in an effort to primarily restore riverine hydraulics and fish passage. This Detailed Project Report (DPR) and Integrated Environmental Assessment (EA) 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.

The study area is part of the St. Joseph River system and is located in north central Indiana in Elkhart County. Overall, the St. Joseph River extends a total of 210-miles through portions of southern Michigan and northern Indiana. Approximately 65-miles downstream from Elkhart, the St. Joseph River flows into Lake Michigan. The proposed riverine restoration for the Elkhart River is located northeast of Elkhart Avenue and Waterfall Drive in the City of Elkhart, Indiana and the proposed riverine restoration for Christiana Creek is located northeast of East Crawford and Cassopolis Street (High Dive Park) in the City of Elkhart, Indiana**.** The project sites are located in the City of Elkhart. Elkhart is located on the St. Joseph River in north central Indiana just south of the Michigan border.

The predominant loss of natural habitat within the Great Lakes, and the confluent rivers in particular, is attributed to the damming and channelizing of river and stream channels, and the clearing of native vegetation from the riparian zones. Most of the habitat destruction and decline within the Elkhart River and Christiana Creek is attributed to the two dams located in the City of Elkhart. The impacts of these structures have created barriers to fish migration and genetic exchange, especially of state listed species such as the greater redhorse. Other impairments caused by the dams include unnatural sediment transport (silt, sand, gravel, cobble), loss of riverine hydraulics and degraded water quality. The loss of riverine habitat connectivity has caused native fish, mussel and invertebrate species richness and abundance to decrease.

This study evaluates the feasibility and environmental effects of dam removal and fish passage. The scope of this study addresses the issues of altered hydrology and hydraulics, altered fluvial geomorphology and associated processes, riverine habitat degradation, habitat fragmentation and fish passage, native riverine species richness, and rare and endangered species. This DPR 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 benefits that would be realized by the removal or modification of these dams.

Opportunity exists in terms of restoring fluvial parameters to restore and maintain stream habitat and providing passage for all species of native fishes. This project also affords the opportunity to create safe passage for Elkhart River paddlers as well.

Four measures (4), including the No Action measure, were input into the USACE planning software in terms of costs and benefits. Based on inputs and criteria, the planning software generated six (6) alternative combinations for ecosystem restoration. 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. Of these, four (4) cost effective combinations were identified, which is inclusive of the three (3) best buy plans also identified under the same analysis. The No Action plan is always deemed cost effective and a best buy plan. Two (2) alternative combinations were screened out as non-cost effective. An incremental cost analysis was performed on the best buy alternatives. 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. This incremental cost analysis sorted and ranked the three (3) best buy plans for ecological restoration that would be considered as best buys, including the no action plan.

Alternative 3 is recommended, which consists of full removal of the Elkhart River and Christiana Creek dams. The recommended plan has a total project cost of approximately $_____ (2013 price levels). This plan provides 115.8 net average annual habitat units over 29.3-acres of riverine habitat. All costs associated with the restoration and preservation of the Elkhart River and Christiana Creek ecosystems have been considered.

The estimated Federal cost share of the project is approximately $_____ and the non-Federal share is approximately $_____. 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. Prior to initiation of the design phase, the Federal government and the non-Federal sponsor will execute a PPA (Project Partnership Agreement).

CHAPTER 1 – INTRODUCTION

1.1 – Report Organization

This Detailed Project Report (DPR) presents the results of the Elkhart River and Christiana Creek Dams Ecosystem Restoration study. This report consists of a main report and seven appendices with figures and tables:

- Appendix A – Hydrology & Hydraulics Analysis
- Appendix B – Geotechnical Analysis
- Appendix C – Civil Design
- Appendix D – Hazardous, Toxic, and Radioactive Waste (HTRW) Report
- Appendix E – Cost Engineering (Intentionally Not Included)
- Appendix F – 404(b)1 Analysis, Draft FONSI and Agency Coordination
- Appendix G – Monitoring Plan
- Appendix H – Real Estate (Intentionally Not Included)

1.2 – Study Authority

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

(a) 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 themeaning 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 St. Joseph River Watershed, located in the southwest portion of lower Michigan and northwestern Indiana is the third largest river basin in Michigan. Beginning in Michigan's Hillsdale County at Baw Beese Lake, it spans the Michigan-Indiana border and empties into Lake Michigan at St. Joseph, Michigan. Like most of the major watersheds in the Great Lakes basin, the St. Joseph River watershed is fragmented by dams. Seven large river dams are present along the mainstem of the St. Joseph River. Natural hydrologic and hydraulic functions have been compromised for nearly a century due to large and small dams. A cluster of these dams is present in downtown Elkhart, Indiana, which includes a

hydropower facility on the St. Joseph River and a small low-head dam on each of two tributaries, the Elkhart River and Christiana Creek. The Elkhart River dam has one dam upstream near Waterford Mills, IN (Goshen Pond Dam) and two low-head dams above the confluence with Christiana Creek. The local sponsor received a grant in 2012 to remove both of the low-head dams upstream of the project site. Native fish and macroinvertebrate communities have been displaced from historical migration routes on these tributaries for many decades. Water quality, streambank erosion, and sediment transport mechanisms have also been adversely affected above and below these dams.

The City of Elkhart, Indiana requested that the Chicago District, U.S. Army Corps of Engineers (USACE) initiate a study under Section 506 Fishery and Ecosystem Restoration to ascertain the feasibility of restoration features to increase ecological integrity and hydraulic regime of Christiana Creek and the lower section of the Elkhart River. This study evaluates the feasibility and environmental effects of dam removal and fish passage. The scope of this study addresses the issues of altered hydrology and hydraulics, altered fluvial geomorphology and associated processes, riverine habitat degradation, habitat fragmentation and fish passage, native riverine species richness, and rare and endangered species. This DPR 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 benefits that would be realized by the removal or modification of these dams.

1.4 – Study Area

The study area is part of the St. Joseph River system and is located in north central Indiana in Elkhart County (**Figure 1**). Overall, the St. Joseph River extends a total of 210-miles through portions of southern Michigan and northern Indiana. Approximately 65-miles downstream from Elkhart, the St. Joseph River flows into Lake Michigan, but is impounded by several dams. The proposed riverine restoration for the Elkhart River is located northeast of Elkhart Avenue and Waterfall Drive in the City of Elkhart, Indiana and the proposed riverine restoration for Christiana Creek is located northeast of East Crawford and Cassopolis Street (High Dive Park) in the City of Elkhart, Indiana (**Figure 2**)**.** The removal of Elkhart and Christiana Creek dams would open up passage to approximately 327 and 83 surface acres of river, respectively. For this study, the study area encompasses the project sites located in the City of Elkhart to the next impoundment upstream of each dam. Elkhart is located on the St. Joseph River in north central Indiana just south of the Michigan border, therefore allowing fishes within the St. Joseph River access to significantly longer reach of river.

Figure 1 – Study area map depicting the dams located within the watershed and within the City of Elkhart.

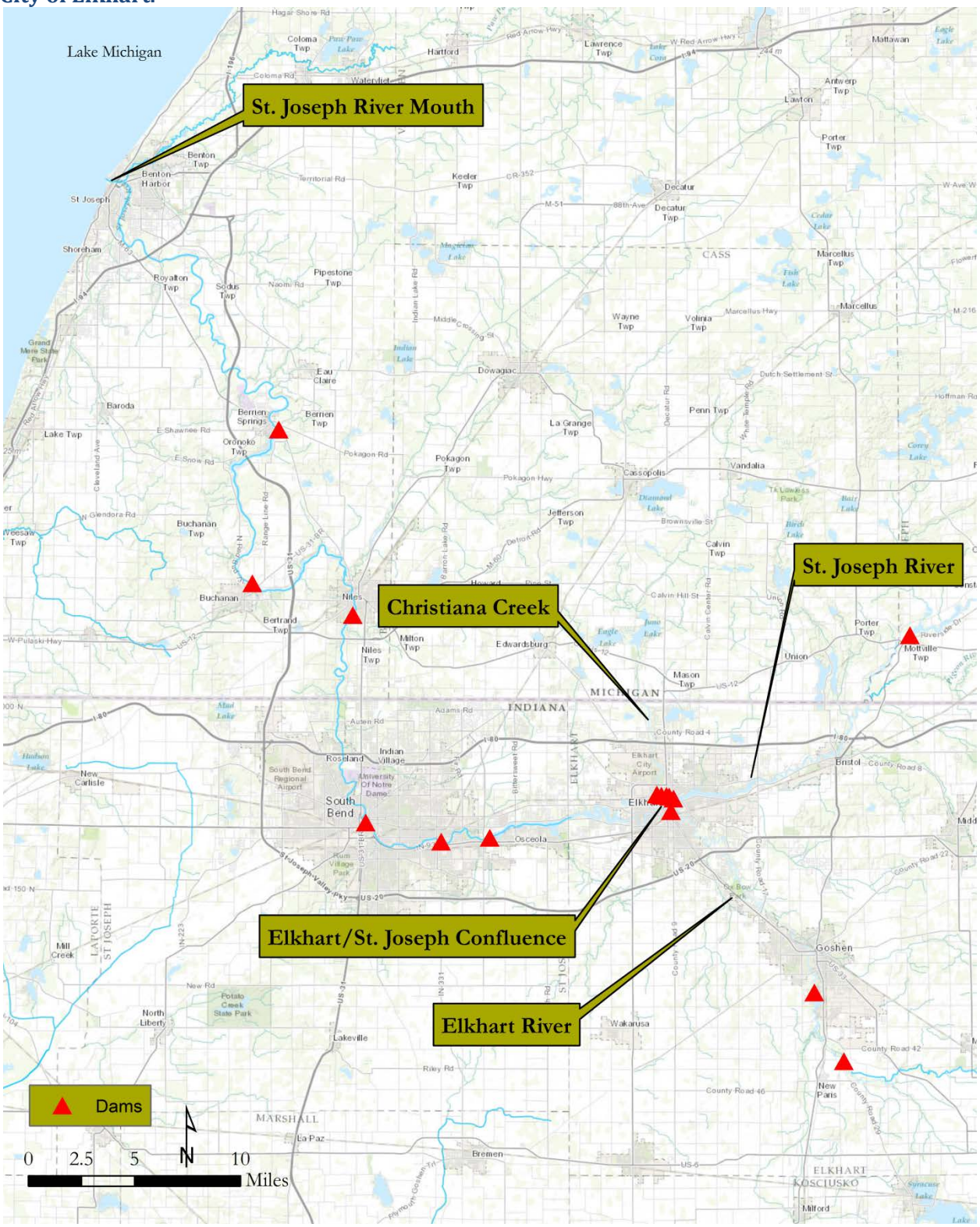


Figure 2 – Aerial View of the City of Elkhart Dams

1.5 – Pertinent Reports, Studies & Projects

- φ <u>1997. A Biological Survey of Christiana Creek, Cass County</u> – A study of the fish and macroinvertebrate community structure, habitat availability and water quality of the Michigan portion of the Christiana Creek Watershed.

- φ <u>1999. St. Joseph River Assessment</u> – A study by the State of Michigan Department of Natural Resources (MDNR). This report describes the characteristics of the St. Joseph River and its biological communities. River assessments are prepared to provide a comprehensive reference for citizens and agency personnel who desire information about a particular aquatic resource. These assessments will provide an approach to identifying opportunities and solving problems. The river assessment was intended to increase public awareness of the St. Joseph River and its challenges and serve to promote a sense of public stewardship and advocacy for the resources

of this watershed. The ultimate goal was to increase public involvement in the decision making process to benefit the river and its resources.

- φ 2005. St. Joseph River Watershed Management Plan – A comprehensive study of the entire St. Joseph River watershed. The plan identifies problems and opportunities within the watershed. It is a way for stakeholders to unite for a common goal.

- φ 2007. Sediment and Groundwater Sampling Results: Former Elkhart Foundry – August Mack completed groundwater and sediment sampling activities at the former Elkhart Foundry Site in Elkhart, Indiana, which is adjacent to the Elkhart Dam

- φ 2008. Elkhart River Watershed Management Plan (WMP) – The Elkhart River WMP is intended as a guide for the protection and enhancement of the environment and quality of the Elkhart River Watershed while balancing the different uses and demands of the community on this natural resource. These goals address items such as: education and outreach; reducing the amount of pollution and sediment entering the aquatic systems; increasing preservation, restoration, and protection of this vital system; increasing cooperation, coordination, and collaboration among all stakeholders in the watershed; and building and maintaining a solid organization to look to the welfare of this important natural resource.

- φ 2009. Combined Sewer Overflow Long Term Control Plan (LTCP) – The LTCP is a comprehensive plan that the city of Elkhart, under the Clean Water Act, will use to reduce sewage overflows to Christiana Creek, the Elkhart River and the St. Joseph River. Elkhart's plan would build new sewers and storage tanks to capture and treat more overflows.

- φ 2010. Elkhart-Mishawaka-Southbend Aquatic Community Monitoring - An annual detailed riverine survey of water quality, fishes, fish tissue, benthic invertebrates and riverine habitat.

- φ 2011. Elkhart-Southbend Aquatic Community Monitoring - An annual detailed riverine survey of water quality, fishes, fish tissue, benthic invertebrates and riverine habitat.

- φ 2011. St. Joseph River Watershed Fish Migration Barrier Inventory – The completion of the accurate mapping and field verification allows a strategic approach to fish passage barrier removals or modifications. This report is intended to provide baseline information necessary for conservation organizations, local, state, federal and tribal governments and other project partners to identify and organize fish passage improvement projects (http://www.fotsjr.org/). It is recommended that this report and associated project data is housed and distributed by Potawatomi Resource Conservation and Development, or a group such as Friends of the St. Joe River Association, which is not restricted by political boundaries and has the capacity to manage and lead watershed-wide improvement efforts.

  This project has already resulted in the funding of implementation work on two Berrien County streams, thanks to efforts of the Southwest Michigan Planning Commission, Michigan Department of Transportation (MDOT), the Berrien County Road Commission, MDNR, and their project partners. MDNR- Fisheries Division and MDNR-Parks and Recreation Division personnel removed the Jonesville Dam on the upper St. Joseph River during January 2011. Also in 2011, the Watervliet Dam on the Paw Paw River was removed with funding from National Oceanic and

Atmospheric Administration(NOAA), U.S. Fish and Wildlife (USFWS), MDNR and Berrien County. This immediate success should serve as an impetus for similar projects. Owners of high priority dams should be contacted to determine interest in dam removal or modification and county road commissions should be contacted to identify projects for collaboration. Project partners can then begin estimating costs for needed work and identifying possible funding opportunities.

An intensive effort was put forth to prioritize field inventory work and to visit as many sites as possible. Despite this effort, work remains to ensure a complete inventory exists for the St. Joseph River Watershed. Specifically, an attempt should be made with local organizations to confirm that the dams assumed to be removed or that could not be found, do not actually still exist, and the remainder of the dams on the list of 85 that have not been visited in the field, while lower in priority, should be field inspected to determine possibility of removal.

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 City of Elkhart Dams project was undertaken from a watershed perspective (not a watershed study), especially since the dams greatly affect the fish community upstream. The following chapter outlines the past, present and future without-project conditions of the lower Elkhart River and Christiana Creek watersheds and biological and human environment.

2.1 – Study Area Conditions

2.1.1 – *Physical Resources

Climate

The Elkhart River and Christiana Creek watersheds are characterized by a humid continental climate, which is somewhat moderated by the Lake Michigan. This modification or "lake effect" can manifest itself by a moderation of temperature and increased precipitation. This is due to winds blowing over the lake and being influenced by water temperature in the lake and evaporation from the lake. This can have a cooling effect in these areas in the summer compared to other parts of the country, and can result in warmer temperatures in the winter months. Precipitation within the watersheds is well distributed throughout the year and is adequate for most crops.

The average daily maximum temperature in July is 84.5ºF, and the average daily minimum in January is 17.0ºF. Typical relative humidity is ~ 55% - 65% in the mid-afternoon. Humidity is higher in the evening and averages from 80% - 100% at dawn. Using climate data from Goshen, Indiana, the average temperature in winter between 1971 and 2000 was ~25.9ºF, with the average daily minimum being approximately 18.5ºF. The lowest temperature on record was -24ºF occurring on January 25, 1950 and again on February 11, 1999. In summer, the average temperature is ~ 71ºF with the average daily maximum temperature ~82ºF. Winds are most often from the southwest, although in winter the dominant direction is from the northwest. Average velocities range from 8-mph in August to 12-mph in March and April.

Precipitation is generally well distributed throughout the year but is slightly lower in mid to late winter. Rainfall is moderate and averages 36.59-inches annually. The record rainfall based on data between 1915 and 2001 occurred on July 26, 1981, and totaled 5.7-inches. Average annual snowfall is 39.3-inches. The record snowfall occurred on January 26, 1978, and totaled 14.0-inches.

Land Use

Before European settlement, the watershed consisted of tall, mostly deciduous forests dominated by maple, ash, oak, elm, walnut, and beech species. Pockets of white, red, and jack pine were also present. These large tracts of forest were interspersed with streams, lakes, wetlands, savannas and prairies, which were often grazed by elk, deer, moose, and bison. Some of the expansive prairie/savanna areas

were the first lands to be significantly altered by human activity; first Native Americans and then European settlers. As the use of fire by the Native Americans ceased, the prairies were replaced with wetland and forest. The vast majority of original forests were logged by 1900 to be used in construction or, in the case of many native hardwoods, the manufacture of fine furniture. Dams were constructed along the St. Joseph River and its tributaries to supply power for saw and grain mills and later to generate electric power for industry and the public.

Today, the watershed is still predominantly agricultural with about 70% of the land in row crop and animal production, while 23% remains in forest and wetland. The remaining 7% of the watershed is residential and commercial use, particularly along the Elkhart River. The watershed also has an abundance of inland lakes, which are becoming increasingly degraded through. Agriculture has the most significant impact on surface waters in the basin; however, residential and commercial uses adversely affect water inputs along the Elkhart River.

Geology

The bedrock geology of Indiana formed during the Paleozoic Era. The principal bedrock formations in the Elkhart River and Christiana Creek watersheds are associated mainly with rocks of Silurian to middle Mississippian age, and consist primarily of layered Paleozoic limestone, dolomite, sandstone, siltstone and shale, indicative of the ancient inland sea that once covered the Great Lakes region.

The present topography within the Elkhart River and Christiana Creek watersheds has been a result of glacio-fluvial and post glacial fluvial activity rather than the topography of the underlying bedrock. This geology represents a complex glacial history consisting of the results of older glaciations along with several Wisconsinan Age glacial events. The bedrock is covered by a thick layer of glacial outwash.

Hydrology, Hydraulics & Fluvial geomorphology

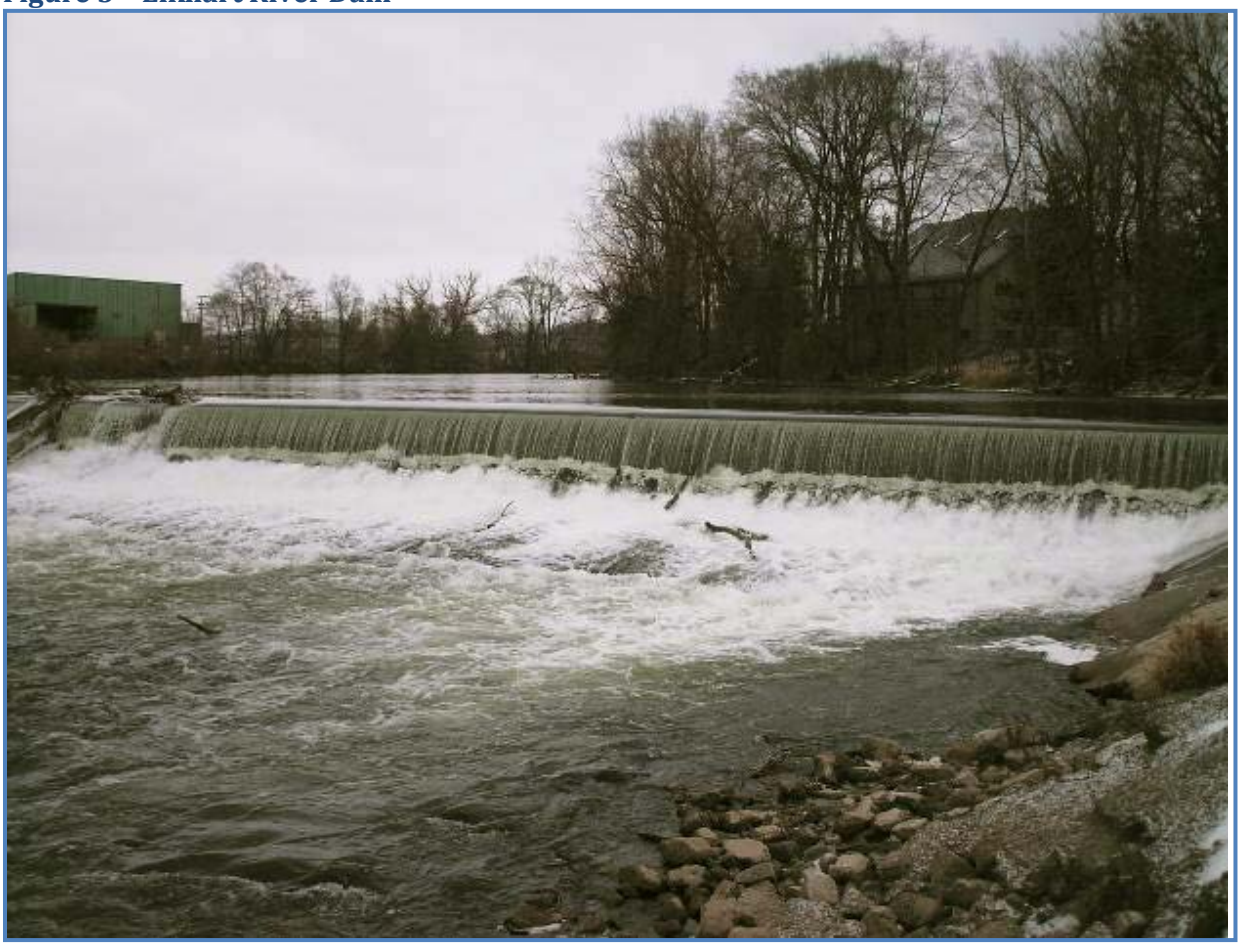
The hydrology of the Elkhart River and Christiana Creek watersheds is impaired from its natural state. About 70% of watershed lands are in agricultural production, which means stream channelization, ditches and drain tile networks work together to drain away surface and subsurface water quickly. These modifications on the natural hydrology have implications for increased flooding beyond natural floodplains and lack of water during drought periods. Christiana Creek receives a moderate amount of groundwater, surface water from warm and coldwater tributaries and from several flowage lakes, all of which buffer the adverse affects of an agriculturally induced hydrology.

Stream hydraulics of the Elkhart River are more impaired than Christiana Creeks due to more urban like activities and the presence of two dams, the Elkhart and Goshen Dams. The dam on Christiana Creek is not significant enough to adversely affect channel geomorphology, sediment transport and fluvial processes, as do the two dams on the Elkhart River.

The first dam on the Elkhart River was constructed in 1832 and permanently rebuilt in 1875. The original use of the dam was to accommodate flour and saw mills upstream of the dam. This dam (**Figure 3**) is about 10-feet high and 147-feet long and currently serves no functional purpose. The dam itself is constructed of river cobbles that were piled up and capped with concrete (**see Appendix B**). Its backwater effects extend for about 2,000-feet upstream, forming a degraded reservoir system due to a lack of fluvial hydraulics. This dam impedes the critical transport of large grain material, primarily sand, gravel and cobble, which has induced significant channel incision below the dam; this has caused the

City's river walk to fall into the channel at various points. Measures taken to stabilize banks were unsuccessful because it was the channel bed that was subsiding, not the banks eroding. The ability for course-grain material to move downstream will prevent stream incision and minimize the current erosion problems. Also, these course-grained substrates are important to provide critical spawning material for several rare fish species, such as the greater redhorse (*Moxostoma valenciennesi*). Small pockets of fine sediment accumulate behind the dam, but are typically washed over the dam during larger flood events.

Figure 3 – Elkhart River Dam



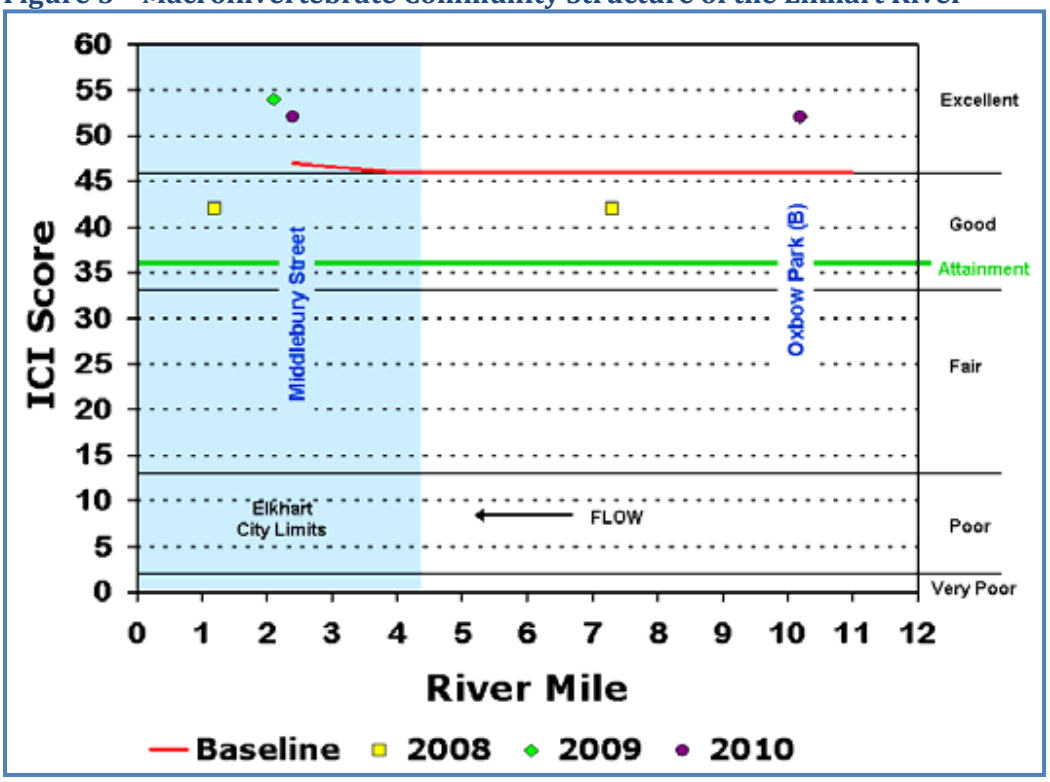
The Christiana Creek Dam is about 60-years old and currently serves no purpose. This dam (**Figure 4**) is about 3-feet high, 50-feet long and is constructed of concrete and steel sheet pile. Its backwater effects on stream hydraulics and geomorphology are quite negligible. The main issue with this dam is that it impedes small fish migration, such as the rare and unique greenside darter (*Etheostoma blennioides*). Although it is evident from field visits that sand and gravel are being shoaled behind the dam, flood waters carry these particles over the dam as evidenced by the lack of channel incision and sand and gravel deposits downstream.

Figure 4 – Christiana Creek Dam

Water Quality

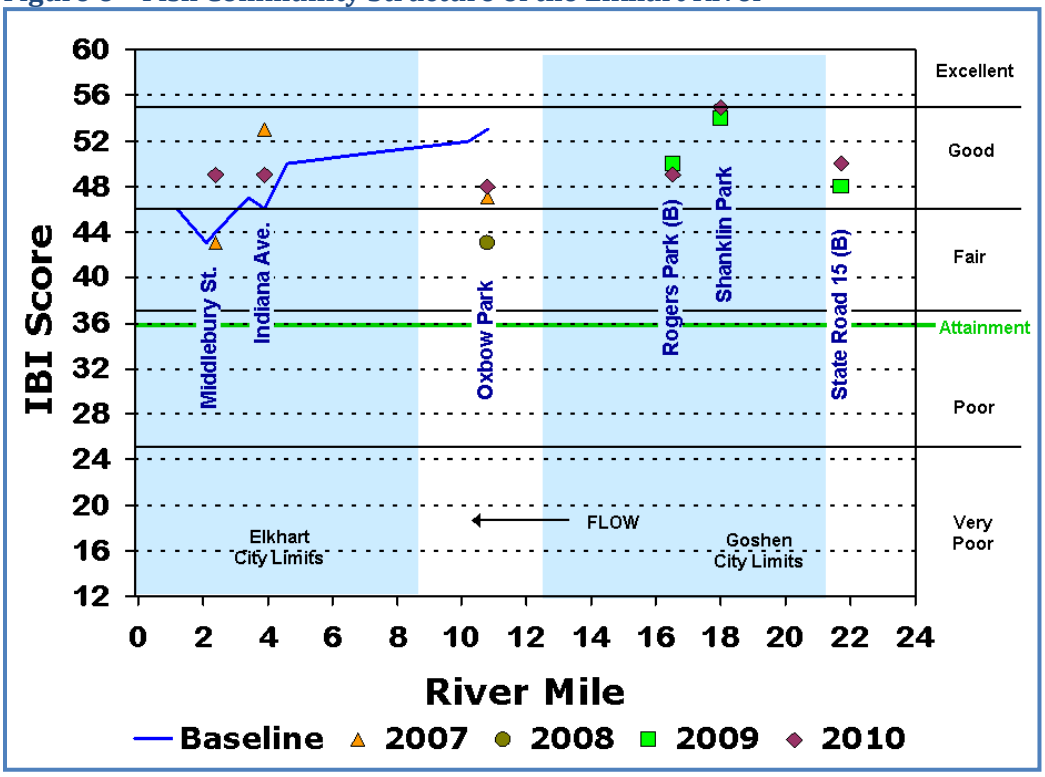
The non-Federal sponsor monitors fish and macroinvertebrate community structure to confirm that water quality in the Elkhart River and Christiana Creek watersheds are acceptable to support aquatic life. Chemical water quality testing has taken place weekly for many years on the Elkhart River to assess the City's influence on overall water quality. Overall, the city of Elkhart causes temporary impacts to the rivers water quality via combined sewer overflows (CSOs). Currently the city has 33 permitted outfalls for CSOs, but initiated a plan to prevent them in 2009. The Long-Term Control Plan outlines a plan to increase retention and minimize CSO events. Despite these short-term impacts from CSOs , indices of biological integrity (IBI) indicate that the Elkhart River has water quality sufficient to support a diverse and healthy aquatic community (**Figures 5 & 6**). Christiana Creek is one of the highest quality streams in the St. Joseph River watershed. This south flowing tributary annually has high rankings for fish and macroinvertebrate communities, habitat quality and chemical water quality. The macroinvertebrate community in Christiana Creek is stable throughout the stream. **Figures 7** and **8** show that good water quality are validated by supporting a strong macroinvertebrate and fish community.

Figure 5 – Macroinvertebrate Community Structure of the Elkhart River



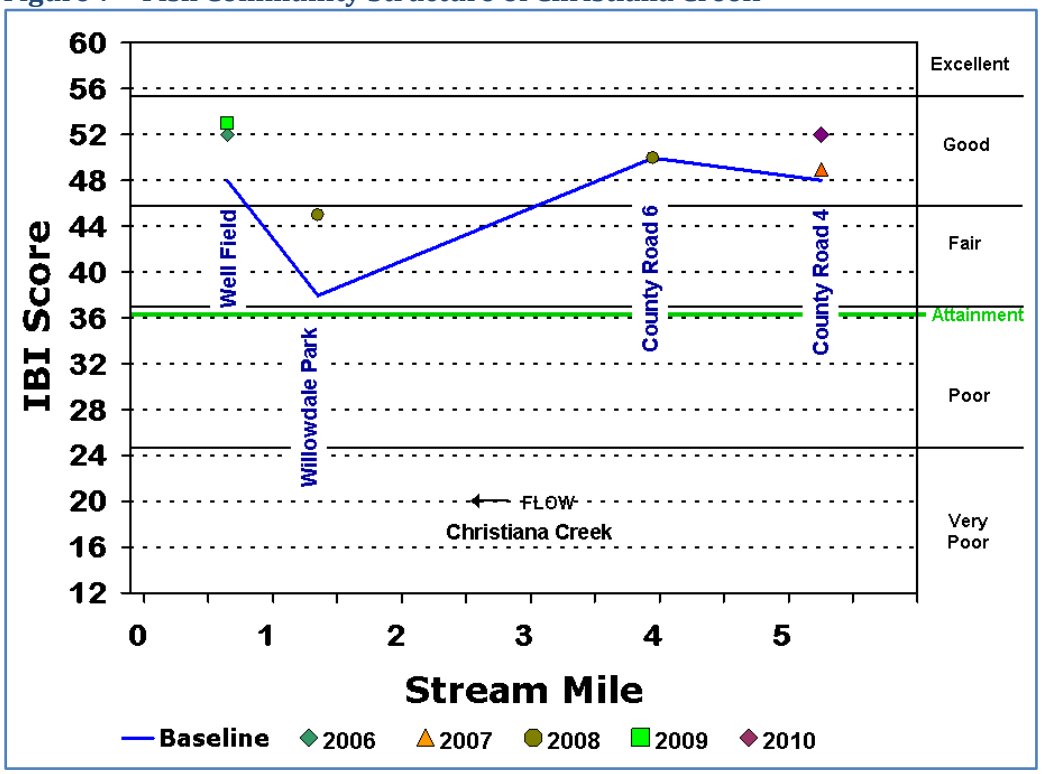
*The Elkhart River Dam is at approximately River Mile 0.5

Figure 6 – Fish Community Structure of the Elkhart River



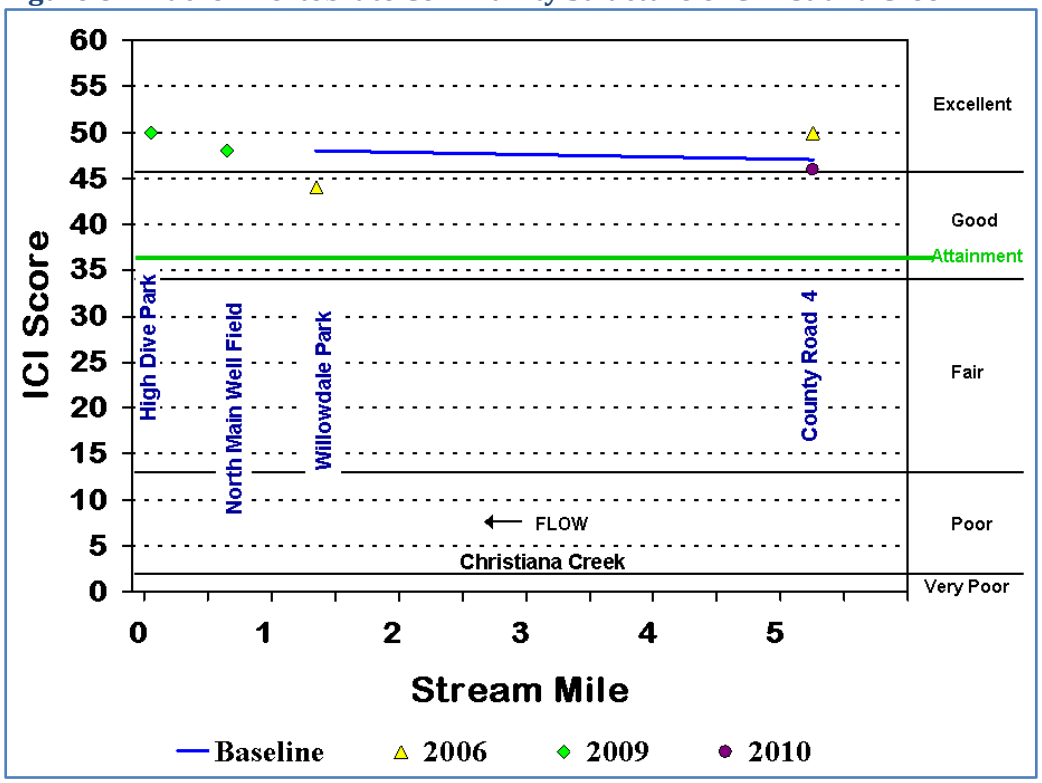
*The Elkhart River Dam is at approximately River Mile 0.5

Figure 7 – Fish Community Structure of Christiana Creek



*The Christiana Creek Dam is located at stream mile 0.15

Figure 8 – Macroinvertebrate Community Structure of Christiana Creek



*The Christiana Creek Dam is located at stream mile 0.15.

Sediment Quality

Approximately 400 feet upstream of the Elkhart River Dam on the north bank is the former Elkhart Foundry. This site is in the process of being remediated; numerous Environmental Site Assessments have been completed to address concerns with the former foundry site. In 2009 a supplemental study to investigate data along the river bank and in the river sediment along the bank was completed. Details of this study can be found in the 2013 HTRW Report (**Appendix D**).

A 2009 supplemental study for the foundry shows that all the bank soil samples exceeded the Indiana Department of Environmental Management (IDEM) Industrial Default Closure Level (IDCL) or the IDEM Residential Default Closure Level (RDCL) for multiple parameters. However, the levels found in the sediment samples in the river were much lower than those on top of the bank. The results along the foundry property below water level were fairly consistent with levels measured either upstream or downstream. All of the samples taken in the upland bank areas within the former foundry site had results above the US EPA Region 5 Ecological Screening Levels (ESLs); only a few results adjacent to the site were above the Probable Effects Concentrations (PECs). These exceedances were not found in the three samples taken in 2009 15 feet from the shoreline. Currently, the banks in the vicinity of the former foundry north of the Elkhart Dam are stabilized with cobble throughout the remediation site. Based on hydraulic analysis of the Elkhart River, further stabilization should not be needed in this reach after dam removal. However, newly exposed banks from dam removal in other reaches of either Elkhart River or Christiana Creek should be stabilized in place to prevent erosion and the release of suspended solids.

Sampling was conducted on the sediment directly behind the Elkhart River Dam in June 2011, and the results are presented in the HTRW Report (**Appendix D**). Sampling occurred upstream of the two dams, Elkhart River Dam and Christiana Creek Dam. Samples from Elkhart River and Christiana Creek were tested for VOCs, pesticides, PCBs, SVOCs, and metals. Sediment sample results are compared to Risk Integrated System of Closure (RISC) Residential Soil Default Closure Levels (DCL). An analysis of the samples showed that for all sediment sampling in both Elkhart River and Christiana Creek only one constituent, arsenic results exceed RISC Residential Soil DCL for some samples. However, the analysis has considered that Indiana background (naturally-occurring) levels of some inorganics such as arsenic can be found at concentrations exceeding the standard. Given that there are no other metals with elevated levels that would indicate anthropogenic sources. Therefore, it is likely that the elevated levels are arsenic can be attributed to naturally occurring arsenic.

2.1.2 – *Ecological Resources

Riparian Vegetation

A majority of the study area's riparian zone consists of narrow strips of weedy vegetation, industrial and commercial areas, cemeteries, residential areas, and parks. Common tree species present in these areas are sycamore (*Platanus occidentalis*), cottonwood (*Populus deltoides*), silver maple (*Acer saccharinum*), red maple (*Acer rubrum*) and black willow (*Salix nigra*). A large portion of the riparian area near either dam consists of concrete or sheet pile seawalls, with concrete walking paths or streets nearby. This limits the amount and native diversity of vegetation. Native plant species that are found in the few wet floodplain areas include arrowhead (*Sagittaria* spp.), pickerel weed (*Pontederia cordata*), cardinal flower (*Lobelia cardinalis*) and lizard tail (*Saururus cernuus*). The invasive purple loosestrife (*Lythrum salicaria*),

garlic mustard (*Alliaria petiolata*) and reed canary grass (*Phalaris arundinacea*) are also present within the wet floodplain areas.

Riparian Wildlife

With both dams being in the heart of downtown Elkhart, there is limited wildlife habitat in the proximity of the immediate project area. Mammal species common in the area include, gray squirrel (*Sciurus carolinensis*), fox squirrel (*Sciurus niger*), raccoon (*Procyon lotor*), eastern chipmunk (*Tamias striatus*), eastern cottontail rabbit (*Sylvilagus floridanus*) and Virginia opossum (*Didelphis virginiana*). Even with the limited amount of forested habitat, there is still a large population of resident and migratory bird species including neo-tropical migrants. Typical bird species include American robin (*Turdus migratorius*), common grackle (*Quiscalus quiscula*), blue jay (*Cyanocitta cristata*), Northern cardinal (*Cardinalis cardinalis*) as well as other common species.

Riverine Communities

The fish community composition in the Elkhart River is reflective of the adverse effects of the dam. **Figure 6** shows longitudinal trends in fish community composition along the entire stretch of the Elkhart River that would be affected by the project. Overall, the fish community structure is strong and falls into the good range based on the Indiana Department of Environmental Management (IDEM) standards. However, as can be seen on the graph the trend in fish community quality goes down as the data collected approaches the dam site.

The aquatic macroinvertebrate community in the Elkhart River does not show quite the same longitudinal trend as the fish community. Macroinvertebrate community status seems to be fairly consistent, at least along the lower 12 miles of the Elkhart River. **Figure 7** shows that the macroinvertebrate communities are strong. It is important to note that macroinvertebrate community structure can fluctuate more dramatically than fish community structure as noted over the three years in the graph below. Macroinvertebrates are usually far less mobile than fish and may be more affected by localized water quality issues.

Loss of aquatic species diversity is mainly associated with the loss of riverine hydraulics, homogenization in channel geomorphology, habitat fragmentation, a reduction in water quality, and impeded migration and recolonization of riverine species all due to the dams. Several fish species including greater redhorse (*Moxostoma valenciennesi*), shorthead redhorse (*Moxostoma macrolepidotum*), silver redhorse (*Moxostoma anisurum*), walleye (*Sander vitreus*), greenside darter (*Etheostoma blennioides*), and rosyface shiner (*Notropis rubellus*) are intolerant of the present hydraulic and geomorphic conditions above the dams. Most of these species do occur in the free-flowing conditions below Elkhart River and the Christiana Creek dams where the streams remain unimpeded to their individual confluences with the St. Joseph River.

In 2009, the City of Elkhart, along with the Chicago District, USACE surveyed both streams in April and June to determine species composition immediately above and below both dams. Species collected upstream and downstream of the dams are presented in **Tables 1** and **2**. Seventeen fish species in total were collected above the Christiana Creek dam while 28 species were collected below the dam. Eighteen fish species in total were collected above the Elkhart River dam while 34 species were collected below the dam. The low species diversity, abundance and absence of intolerant species above both dams indicate that the riverine habitats are degraded and that no source of recolonization exists.

Species highlighted in red could recolonize upstream reaches if the dams were removed. Species in green would benefit from hydraulic and geomorphic restoration that would result from dam removal. Species in blue would benefit from dam removal, but have stable populations above and below the dams.

Table 1 – Christiana Creek Native Fish Species Richness & Abundance

		Above Dam		Below Dam	
Species	**Common Name**	**Apr-09**	**Jun-09**	**Apr-09**	**Jun-09**
Ambloplites rupestris	rock bass		2	4	7
Amia calva	bowfin				2
Catostomus commersonii	white sucker	1	9	5	1
Cyprinella spiloptera	spotfin shiner	57	8	4	9
Esox americanus	grass pickerel		1		2
Etheostoma blennioides	greenside darter			11	27
Etheostoma caeruleum	rainbow darter	1	2	46	17
Hypentelium nigricans	northern hog sucker	6	5	1	6
Ichthyomyzon castaneus	chestnut lamprey			1	1
Ictalurus punctatus	channel catfish				3
Lampetra appendix	American brook lamprey		2	1	
Lepisosteus osseus	longnose gar				1
Lepomis cyanellus	green sunfish				3
Lepomis macrochirus	bluegill				15
Lepomis megalotis	longear sunfish				3
Luxilus cornutus	common shiner	32	5	48	1
Micropterus dolomieu	smallmouth bass	1	4	3	13
Micropterus salmoides	largemouth bass		2		1
Minytrem melanops	spotted sucker			1	
Moxostoma erythrurum	golden redhorse	1	2		3
Moxostoma macrolepidotum	shorthead redhorse		1		18
Nocomis biguttatus	hornyhead chub			3	1
Nocomis micropogon	river chub			1	
Notropis volucellus	mimic shiner		11	3	26
Noturus flavus	stonecat		1		
Percina caprodes	logperch		10	12	87
Percina maculata	blackside darter		1	4	5
Pimephales notatus	bluntnose minnow	2	2	3	5
Semotilus atromaculatus	creek chub			1	
	Total Abundance	**101**	**68**	**152**	**257**
	Species Richness	**8**	**17**	**18**	**24**

Table 2 – Elkhart Dam Native Fish Species Richness & Abundance

		Above Dam			Below Dam	
Species	**Common Name**	**Apr-09**	**Jun-09**		**Apr-09**	**Jun-09**
Ambloplites rupestris	rock bass	17	42		21	35
Amia calva	bowfin				5	
Amieurus natalis	yellow bullhead	1				1
Amieurus nebulosus	brown bullhead					2
Carpiodes cyprinus	quillback					1
Catostomus commersonii	white sucker	20	25		53	10
Cyprinella spiloptera	spotfin shiner		2		3	13
Dorosoma cepedianum	gizzard shad					8
Esox lucius	northern pike				4	3
Esox masquinongy	muskellunge				1	
Hypentelium nigricans	northern hog sucker		4		3	1
Ichthyomyzon castaneus	chestnut lamprey	5	2		11	1
Labidesthes sicculus	brook silverside	1				
Lepisosteus oculatus	spotted gar					1
Lepisosteus osseus	longnose gar					1
Lepomis cyanellus	green sunfish				2	13
Lepomis macrochirus	bluegill	6	19		7	11
Lepomis megalotis	longear sunfish	12	78		5	11
Luxilus cornutus	common shiner	65	65		147	70
Micropterus dolomieu	smallmouth bass	13	32		12	71
Micropterus salmoides	largemouth bass		8		5	3
Minytrem melanops	spotted sucker				24	
Moxostoma anisurum	silver redhorse				2	5
Moxostoma carinatum	river redhorse	1			5	5
Moxostoma erythrurum	golden redhorse	25	78		19	2
Moxostoma macrolepidotum	shorthead redhorse				15	21
Moxostoma valencienessi	greater redhorse				2	1
Nocomis biguttatus	hornyhead chub	1	2			8
Notropis rubellus	roseyface shiner				45	29
Notropis volucellus	mimic shiner				2	164
Percina caprodes	logperch				1	2
Percina maculata	blackside darter					1
Pomoxis nigromaculatus	black crappie		1		3	
Pimephales notatus	bluntnose minnow				2	5
Sander vitreus	walleye				1	2
	Total Abundance	**167**	**358**		**400**	**501**
	Species Richness	**12**	**13**		**26**	**30**

The riverine habitats within the study area also provide habitat for a variety of other organisms such as wading birds, shorebirds, waterfowl, reptiles, amphibians, and aquatic mammals. Aquatic bird species common in the area include great blue herons (*Ardea herodias*), green herons (*Butorides striatus*), belted kingfishers (*Megaceryle alcyon*), mallards (*Anas platyrhynchos*), and wood ducks (*Aix sponsa*). Alteration of the riverine hydraulics and structure caused by the dams has likely affected the composition of species from these groups as well. Several of these species rely on fish and aquatic invertebrates for food. A reduced abundance of prey species and increased water depths above the dams make these portions of the river less suitable for wading birds and waterfowl to find and capture prey. Common aquatic mammal species in the project area are beavers (*Castor canadensis*), and muskrats (*Ondatra zibethicus*).The common species of amphibian and reptile that are present include soft shell turtle (*Apalone spinifera*), common snapping turtle (*Chelydra serpentina*), common map turtle (*Graptemys* geographica), painted turtle (*Chrysemys picta*), American toad (*Bufo americanus*), bull frog

(*Rana catesbeiana*), leopard frog (*Rana pipiens*),tiger salamander (*Ambystoma tigrinum*), garter snake (*Thamnophis radix*), and northern water snake (*Nerodia sipedon*).

Threatened & Endangered Species

The federally endangered Indiana bat (*Myotis sodalis*) and Federal candidate Eastern massasauga (*Sisturus catenatus*) are listed by the U.S. Fish and Wildlife Service (USFWS) to occur in Elkhart County, IN. The proposed project area currently does not provide critical habitat for Federal or state listed species or are Federal or state listed species present at the site. A memorandum determining "no effects" was provided to the Region 3 USFWS per USFWS Section 7 protocol (**Appendix F**).

2.1.3 –* Cultural Resources

Archaeological & Historical Properties

Located within the City of Elkhart are ten properties on the National Register of Historic Properties, as well as three Historic Districts. Listed properties include the Albert Beardsley House (listed 1978), the Havilah Beardsley House (listed 2000), the Bickel House (listed 1979), the Buekler Theater (listed 1986), Buescher Building (listed 1996), Green Block Building (listed 1980), the Learner Theater (listed 1980), The Monleith House (listed 1985), the Puterbaugh-Haines House (listed 1995) and the Elkhart Y.W.C.A. (listed 1991). The 3 Historic Districts are the Elkhart Downtown Commercial Historic District (1997), the Elkhart River Run industrial District (2005), and the State Street Downtown Historic District (1999). None of these properties are within the project area.

Land Use History

In 1829, the Village of Pulaski was established, consisting of a Post Office, mill and a few houses on the north side of the St. Joseph River. Two years later a rival town named Elkhart was established just to the south on the Elkhart River. The two towns merged in 1839 and the Pulaski Post Office was officially changed to Elkhart. The areas' economy was centered on farming until the building of the Michigan Southern and Northern Indiana Railroad in 1851. Efficient railroad transportation combined with cheap hydroelectric power generated the first Elkhart Dam in 1867 and led to a shift away from farming toward an industrial based economy. By the late 1800's numerous light industries were established in Elkhart, many focused on musical instruments and medical equipment. After 1934 a number of trailer manufacturers had moved to Elkhart and by 1949 it was labeled "Trailer Capital of the World". The post 1970's industrial decline of manufacturing has had a strong negative impact on Elkhart. The city now serves as a bedroom community for the South Bend metropolitan area. Surrounding communities include Mishawaka, Goshen and Bristol.

Social Properties

The project area is within the City of Elkhart, Elkhart County, Indiana. Covering 22.3 square miles, Elkhart has a racially and ethnically diverse population of approximately 51,740 persons (2000) with a medium household income of $34,863 (2000) and a medium house value of $88,200 (2010).

Recreational Activities

The City of Elkhart has a system of public parks providing soccer and baseball fields, tennis courts, playgrounds, fishing, hiking trails, nature and picnic areas. The city has 35 different facilities including parks, pavilions, a water park, two skate parks, golf courses, greenways and the downtown river walk, which now features an ice-skating/roller-blade path (depending on the time of year). The Christiana Creek dam is located within High Dive Park, which is primarily a passive recreational park focused around the creek and an artificial duck pond.

*Hazardous, Toxic & Radioactive Waste (HTRW) Analysis

An HTRW investigation was performed to determine if the selected measures for Elkhart River Dam and Christiana Creek Dam will have an impact on any Recognized Environmental Conditions (RECs) that may exist in the surrounding areas, and if RECs will have an impact on the implementation of the project. According to ER 1165-2-132, non-HTRW issues that do not comply with federal, state, and local regulations should be discussed in the evaluation along with HTRW issues.

During the investigation, existing environmental data were examined in order to determine risks associated with the project site. According to the historical aerials and topographic maps, the area surrounding the project sites has been heavily developed with both industrial and residential uses. Over time some areas were converted to parkland, while others remained developed. No new sites were identified that would likely impact the project areas. Similarly the Sanborn maps did not indicate any additional sites likely to pose REC concerns to the project.

Data presented in the Environmental Database Resources, Inc. (EDR) Database Report did not indicate any past or current surrounding sites that are likely to pose concerns to the project beyond already existing information. Sediment in Elkhart River was recommended for sampling based on existing information reviewed for the former Elkhart Foundry site.

Previous bank soil and below water line bank sediment sampling had been conducted along the former Elkhart Foundry site. Due to the results of that sampling, it is recommended that excess bank material generated from project measures such as bank shaping be used onsite or that bank material be stabilized in place. Sampling behind both dams was conducted in June 2011. No significant sediment contamination was found, and the sediment is suitable for stabilization in place.

The Sediment Sampling and Analysis – Elkhart, Indiana April 2013 report provides recommendations for each dam based on the sampling conducted in June 2011. In general, the report indicates that bank sediment should be stabilized and that the sediment behind the dams is not contaminated and consists of very little fines. However, the north banks are currently stabilized near the remediation site and do not need to be stabilized further.

Based on this information, the HTRW investigation concluded that the work proposed for the project site has little potential for encountering a Recognized Environmental Condition (REC). No investigation can wholly eliminate uncertainty regarding the potential for encountering RECs associated with a project area. Performance of this investigation is intended to reduce, but not eliminate, uncertainty regarding the potential for encountering a REC in connection with a project area.

2.2 – Problems and Opportunities

The overall problem within the study area is the fragmentation of aquatic habitat by dams, thus causing a holistic decrease in biodiversity upstream of the dams. Biodiversity is a term that is used to describe all aspects of biological variety including species richness, ecosystem complexity and genetic variation. Biodiversity is decreased through the loss of hydrogeomorphic function, fluvialgeomorphic function, littoral processes and land use change, which collectively lead to a reduction in ecosystem complexity. These are manifested through a decreased level of natural services such as flood affects moderation, maintenance of adequate water quality, wildlife habitat, etc.

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 organism 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 organism community 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.

The predominant loss of natural habitat within the Great Lakes, and the confluent rivers in particular, is attributed to the damming and channelizing of river and stream channels, and the clearing of native vegetation from the riparian zones. Most of the habitat loss and decline within the Elkhart River and Christiana Creek is attributed to the two dams located in the City of Elkhart. The impacts of these structures have created barriers to fish migration and genetic exchange, especially of state listed species such as the greater redhorse. Other impairments caused by the dams include unnatural sediment transport (silt, sand, gravel, cobble), loss of riverine hydraulics and degraded water quality. The loss of riverine habitat connectivity has caused native fish, mussel and invertebrate species richness and abundance to decrease. The following are resource problems that could be addressed through this project:

- Alters Natural Fluvial Processes
  - Alters natural riverine hydraulics by creating a lake (lentic) condition above the dam
  - Alters sediment transport by trapping bedload (sands, gravels, cobbles)
  - Accelerates bedload transport downstream of the dam causing channel incision
  - Induces unnatural hydrology above the dam that creates unsustainable wetlands
- Riverine Fragmentation
  - Prevents fish passage during low and normal flows
- Water Quality Degradation
  - Impounding affects cause water to warm up and lose dissolved oxygen
  - Impounding affects allow for the further lowering dissolved oxygen through algal blooms due to lentic conditions
- Human Safety
  - Hazardous conditions for portaging or “shooting” the dam during low and normal flow conditions; however, there are no rollers on these two dams

- ϕ Aesthetic degradation of the Elkhart River "river-walk" park

Opportunity exists in terms of restoring fluvial parameters to restore and maintain stream habitat and providing passage to a significant stretch of river for all species of native fishes. Invasive species within or near the Great Lakes Basin that require tributary access (i.e. Asian Carp and Sea Lamprey) will not benefit from the removal of these two dams. Currently, several dams on the St. Joseph River, which connects to Lake Michigan, prevent the spread of these organisms into the Elkhart River watershed. This project also affords the opportunity to create safe passage for Elkhart River paddlers and canoers as well.

2.3 – Habitat Assessment Methodology

Many methods and models are available to measure ecosystem function and structure and to predict their future conditions based on differing scenarios. Habitat models developed for individual species may have limitations when used to assess ecosystem problems and restoration objectives. They do not consider communities of organisms and typically consider habitat in isolation from its ecosystem context. The assessment methodology chosen for this study is community based and governed by how well the technique meets the needs of the study goals, objectives, and level of detail. The assessment methodology, or Habitat Suitability Index (HSI), focuses on riverine physical conditions and native species richness fish communities. This HSI was developed to assess the relative ecological value of the proposed future without-project condition and any proposed management measures for the City of Elkhart Dams study. This index is based on how riverine geomorphology and native fish species would respond to a given condition. This response would be quantified through the use of the Qualitative Habitat Evaluation Index (QHEI) and native species richness (R) as presented below.

Qualitative Habitat Evaluation Index

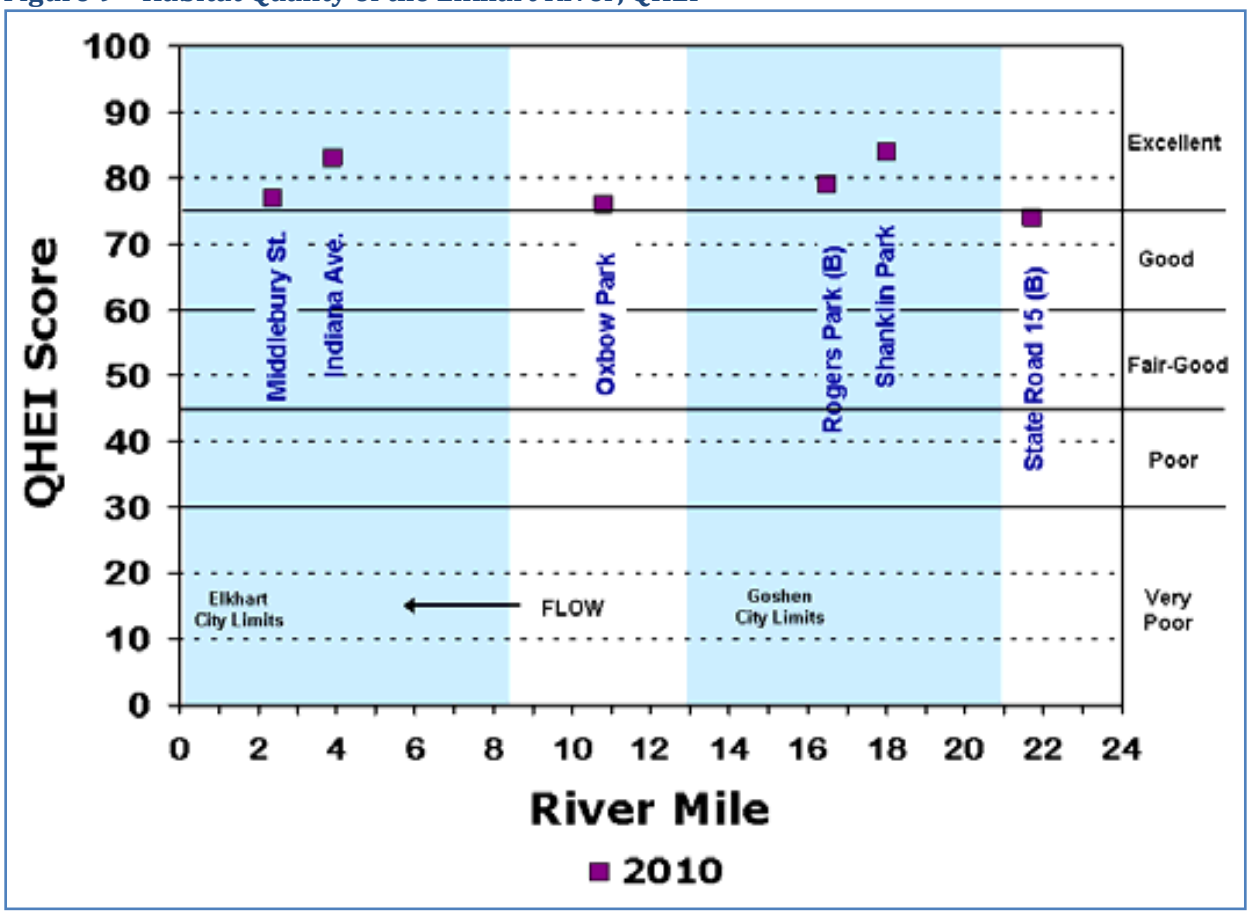
The QHEI developed by the Ohio Environmental Protection Agency (EPA) was employed to assess the physical riverine habitat quality. Riverine habitat would be surveyed in transects. The sites would be assessed from a river right descending perspective. Effects of the dams are clearly reflected in stream morphology and function parameter. The QHEI consists of eight sections with a maximum total of 100 points:

1. Characterization of substrate types and the effects of siltation
2. Characterization of in-stream cover
3. Characterization of channel morphology
4. Characterization of the riparian zone and bank erosion
5. Assessment of the pool / glide & riffle / run
6. Gradient
7. Shade
8. Channel incision

While the habitat immediately above the Elkhart River dam is extremely degraded, habitat improves upstream as the influences from the dam diminish. **Figure 9** shows the longitudinal trend in habitat quality and what would be available to native aquatic species once passage at the dam is established. In this study, QHEI was determined from previous analysis of the Elkhart River and Christiana Creek by the City of Elkhart's Aquatic Biology department. The department sampled across both riverine systems from 1999 to 2010. The QHEI scores for FWOP conditions was determined by taking the score of the

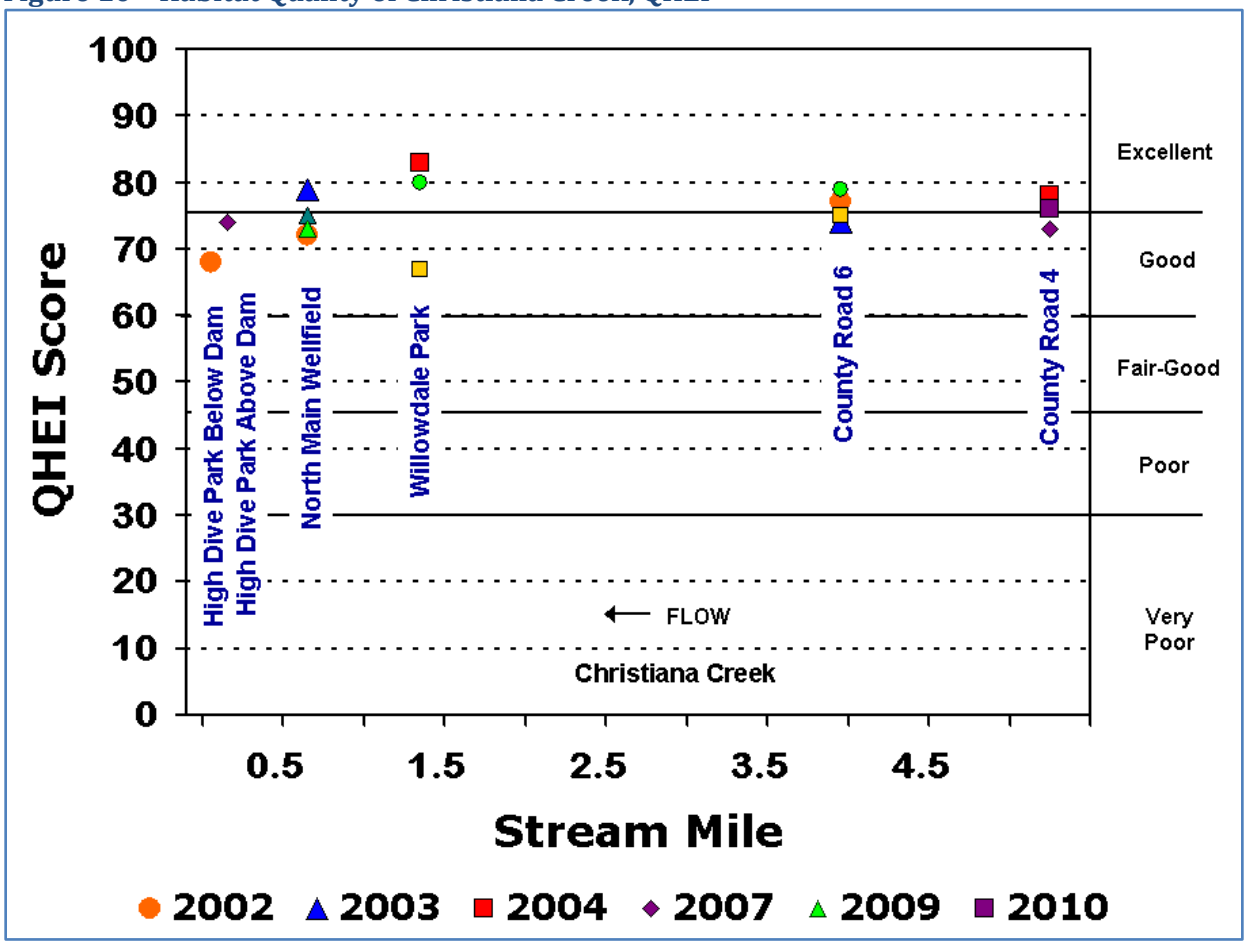
stream or river just above the dam. This score then demonstrates the impacts to QHEI from the impoundment. The FWP conditions QHEI score was then determined by taking the average score across each system. For Elkhart River, 14 sites that were analyzed from 1999-2010 were used to obtain the average QHEI of 77. Similarly, Christiana Creek's QHEI was calculated over four sites from 1999-2010 and equaled 76.

Figure 9 – Habitat Quality of the Elkhart River, QHEI



While the habitat immediately above the Christiana Creek dam is extremely degraded, habitat improves upstream as the influences from the dam diminish. **Figure 10** shows the longitudinal trend in habitat quality and what would be available to native aquatic species once passage at the dam is established.

Figure 10 – Habitat Quality of Christiana Creek, QHEI



Fish Species Richness & Abundance

This portion of the assessment uses fish species richness (R), which is the total number of native fish species. An assessment of the fish communities above and below both dams was performed in 2009 in conjunction with the City of Elkhart's Aquatic Biology Department. Sampling took place in April and June to determine species richness and abundance above both dams. Species collected upstream and downstream of the dams are presented in **Tables 1** and **2**. Seventeen fish species in total were collected above the Christiana Creek dam while 28 species were collected below the dam. Eighteen fish species in total were collected above the Elkhart River dam while 34 species were collected below the dam. The low species diversity, abundance and absence of intolerant species above both dams indicate that the riverine habitats are degraded and that no source of recolonization exists. Since the impetus for action is an increase in species above the dam, species richness is a quick, effective, and easy model to measure.

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 site, both ecosystem function and structure were addressed through the two methods mentioned above. These predicted benefits are resultant of the measures described in Section 3.1. The following was used for the HSI:

- HSI = (R/28 + QHEI/100)/2 ; Christiana Creek
- HSI = (R/34 + QHEI/100)/2 ; Elkhart River

where R = species richness and QHEI = Qualitative Habitat Evaluation Index. The sum is divided by 2 so as not to inflate benefits incurred. 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.

In addition, an average annual habitat suitability index (AAHSI) is calculated. The AAHSI takes the average HSI score across the entire study time frame. In the case of this project it is 50 years. The HSI at time zero will be at the current baseline value and will increase after construction and at some point hit a plateau. Similar to how HUs are calculated, the average annual habitat units (AAHUs) are calculated by multiplying the AAHSI by the total number of acres.

2.4 – Future Without-Project Conditions (FWOP)

The future without-project conditions for the proposed project site in general would remain the same or slightly decline in terms of hydrology and hydraulics, geomorphology, non-native vegetation and habitat structure. The riverine habitat would continue to support a significantly lower number of fish species above the dams due to fragmentation. Approximately 40-miles upstream of the Elkhart River and its tributaries and 9.3-miles upstream of Christiana Creek would remain fragmented. Further compounding the issue is a large hydroelectric dam on the St. Joseph River within the City of Elkhart. The dam provides approximately 3.4 MW of hydroelectricity to the City of Elkhart. The location of this dam near the confluence of Christiana Creek and the Elkhart River, acts as an absolute dead end for fish that reside within the 12 miles of un-impounded river downstream. These 12 miles of un-impounded river are ecologically good as they score fish and macroinvertebrate Indices of Biological Integrity (IBI) scores as high as 54 and 48, respectively, on a scale from 0-60. The presence of these dams within the river channel has shown that the riverine communities are being negatively affected, which is evidenced by the decreased species richness and abundance just upstream of the Christiana and Elkhart dams. It has been concluded that leaving the Elkhart and Christiana Dams in-place would continue to suppress the aquatic ecosystem in the foreseeable future unless the fragmentation caused by the dams is removed in full. Due to the presence of the dams, the issues of: riverine habitat and hydraulic regime degradation, fish passage and recolonization, water quality degradation, sediment transport disruption, human safety, and recreational canoe passage will persist well into the future. This will all hold true since there is limited local funding to properly restore this site to a sustainable and stable habitat.

Change in species richness for FWOP conditions was based on species needs and number of individuals collected. It was assumed that if the dams were kept in place for the next 50 years species richness would decrease and the species that would disappear above the dams would be the intolerant species. For Christiana Creek this includes American brook lamprey, blackside darter, logperch, rainbow darter, shorthead redhorse, and stonecat. For the Elkhart River this includes black crappie, hornyhead chub, spotfin shiner, brook silverside, river redhorse and northern hogsucker.

Table 3 – Future-Without Project Conditions per Habitat Type

Code	Description	QHEI	R Above	R Below	HSI	AAHSI	Acres	HU	AAHUs
EA	Elkhart Full Dam Removal	60	17	34	0.46	0.51	327	151	167.4
CA	Christiana Full Dam Removal	73.5	17	28	0.56	0.63	83	46.8	51.9
CB	Christiana Riffle Stair Step	73.5	17	28	0.56	0.63	83	46.8	51.9

2.5 – Goals, Objectives & Constraints

National Ecosystem Restoration (NER) Goal

The goal for this project is to restore riverine connectivity to the Elkhart River and Christiana Creek, while providing riverine species with critical hydraulics and channel geomorphology for all stages of their life cycles.

NER Objectives

Planning objectives are statements that describe the desired results of the planning process by solving the problems and taking advantage of the opportunities identified. The planning objectives must be directly related to the problems and opportunities identified for the study and will be used for the formulation and evaluation of 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.

The Federal Objective

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.

Restoration of the Nation's environment is achieved when damage to the environment is eliminated and important cultural and natural aspects of our nation's heritage are preserved. Various environmental statutes and executive orders assist in ensuring that a water resource planning is consistent with restoration. 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:

- Endangered Species Act of 1973, as amended (16 USC 1531 et seq.)
- Fish and Wildlife Coordination Act, as amended (16 USC 661)
- 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 Safe Drinking Water Act of 1986 as amended (42 USC 201)
- φ National Environmental Policy Act of 1969 (42 U.S.C. 4321 et seq.)
- φ Resource Conservation and Recovery Act of 1976, as amended (42 USC 6901, et seq.)
- φ Protection and Restoration of the Great Lakes (E.O. 13340)
- φ Protection and Enhancement of Environmental Quality (E.O. 11514)
- φ Floodplain Management (E.O. 11988)
- φ Protection of Wetlands (E.O. 11990)
- φ Federal Water Project Recreation Act, as amended (16 USC 460 (L),(12))

Executive Order 13340 Protection and Restoration of the Great Lakes – 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, composed of Secretaries from the Departments of State, Army, Agriculture, Commerce, HUD, Homeland Security, Interior, Transportation, the Administrator of USEPA, and the Chairman of the Council on Environmental Quality. The Task Force worked with the governors of the eight Great Lakes states, mayors, and tribal leaders to establish the Great Lakes Regional Collaboration. This partnership of Federal, state, tribal, and local governments was officially formed in December 2004 in a ceremony in Chicago. The initial goal of the Collaboration was to develop a "strategy for the protection and restoration of the Great Lakes" within 1 year. 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 of which those in bold pertain to this study:

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

Study Objectives

The study non-Federal sponsor, the City of Elkhart, IN, has general goals for ecosystem restoration. These are to improve and increase aquatic habitats and improve ecological functions in the lower Elkhart River and Christiana Creek watersheds to support sustainable populations of diverse and valuable riverine animal species. Specifically, the outcome of this project aims to reestablish and naturally maintain hydrological connectivity and riverine hydraulic and geomorphic characteristics in the lower Elkhart River and Christiana Creek watersheds.

- φ Provide fish passage for all native species
- φ Restore free flowing conditions for an additional combined mileage of ~50-miles
- φ Improve riverine habitat for endangered/threatened fish and mussel species
- φ Naturalize fluvial hydraulics and sediment transport

NER 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. Given that this restoration project is located in an urbanized area, the design must maximize ecological benefits while avoiding high operations and maintenance costs. Constraints include:

- Avoid changes in flood stage profiles both up and downstream of the dams
- Avoid costly sediment management features that would not provide any benefits to the riverine ecosystem

CHAPTER 3 – 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.

Plan formulation for ecosystem restoration (ER) presents a challenge because alternatives have non-monetary benefits. To facilitate the plan formulation process, the methodology outlined in the Corps' Engineering Circular 1105-2-404, "Planning Civil Work Projects under the Environmental Operating Principles," 1 May 2003 was used. The steps in the methodology are summarized below:

1. Identify a primary project purpose. For this portion of the study, ecosystem restoration (ER) is identified as the primary purpose.
2. Formulate management measures to achieve planning objectives and avoid violating planning constraints. Measures are the building blocks of alternative plans.
3. Identify and select those sites most beneficial for ecological restoration.
4. Formulate, evaluate, and compare an array of alternatives to achieve the primary purpose (ER) and identify cost effective plans.
5. Perform an incremental cost assessment on the cost effective plans to determine the NER plan.

3.1 – *Measure Identification

All measures identified and discussed below are displayed on **Plates 1 & 2**. These measures were developed in conjunction with the non-Federal sponsor and lessons learned from the implemented Hofmann Dam Section 206 project, which successfully removed three dams on the Des Plaines River in Riverside, Illinois in 2012. The following measures have been determined to be the most practical alternatives in restoring and maintaining quality riverine habitat.

No Action

The No Action alternative/measure is always considered under the NEPA process. The No Action Alternative would result in the dams remaining in place and becoming degraded over time since there is no entity responsible for maintenance of these structures. As discussed in Section 2.4, the No Action conditions are the same as the Future Without Project conditions. If the dams were to remain in place, the issues of riverine habitat and flow regime degradation, fish passage and recolonization, water quality degradation, sediment transport disruption, human safety, and recreational canoe passage will persist well into the future.

Options Not Under Consideration

The low profile of these run-of-the-river dams, their negligible influence on the surrounding hydrodynamics of the river, and their status of being remnant structures precludes the need to derive engineering solutions to preserve any functions that would be beneficial by having the dams in place. Thusly, fish ladders, rock ramps, bypass channels or stair-step riffles would be much more costly than removing the dams in total. Also, the maintenance associated with these engineered features to mitigate adverse dam effects is costly, and can be a yearly and sometime monthly activity, depending on

how many floods and much debris passes through the system. Recent studies have also shown that anything but dam removal and natural bypass do not effectively pass all fish species within a targeted assemblage (Bunt et al 2012). These reasons alone make anything but full dam removal unjustifiable in terms of economics, ecology and hydrodynamics.

3.1.1 – Christiana Creek Dam

CA – Full Dam Removal

This measure would include the full removal of the Christina Creek Dam. Upstream of the dam is a water control structure that allows water from the creek to fill the pond at High Dive Park. The invert of this structure will need to be lowered after removal of the dam so it still functions and the pond level can be controlled. Also, the existing steel sheet pile retaining wall along the northern creek bank, upstream of the dam, will be removed and the bank will be re-graded. Along with this work, restoration of staging areas where equipment or construction activities have disturbed the ground will be planted with native riparian vegetation. Tasks Include:

- Mobilization & prepare staging area
- Place temporary erosion control BMPs
    - Silt fence, exercising caution
- Remove and dispose of dam materials appropriately
    - Concrete, sheet pile, rebar
- Smooth out ground and bank disturbances after construction activities
    - Replace in-kind; vegetation, sidewalk, parking lot, etc
- Modify the water control structure at High Dive Park
    - Rebuild the structure so that water from the creek can enter the pond after removal of the dam
- Remove steel sheet pile retaining wall along the northern bank of the creek
    - Remove, regrade bank, and plant native vegetation

CB – Riffle Stair-Step

This option would leave the dam in place, but would facilitate fish to bypass the structure. A series of two or three riffles would be constructed downstream of the dam, with the last riffle crest being placed directly on top of the dam's crest. Riffle material would be properly sized and graded to maximum velocities achieved during bank full discharge. Riffles would be comprised of natural fluvial stone, or quarried glacial stone from till or outwash pits with rounded edges. Blasted angular limestone riprap would not be used. Along with installation of these riffles, minor restorative repairs to the banks and staging areas where equipment or construction activities have disturbed the ground would be made. Restored areas would be planted with native riparian vegetation. This measure also includes removing sheet pile along the northern bank and naturalizing the reach with native stream bank plant species. Tasks include:

- Mobilization & prepare staging area
- Place temporary erosion control BMPs
    - Silt fence, exercising caution
- Place stone riffles in a downstream to upstream fashion to specified elevations
    - Natural boulders, cobbles and gravel

- ϕ Smooth out ground and bank disturbances after construction activities
    - Replace in-kind the previous use; vegetation, sidewalk, parking lot, etc

This option would maintain fish passage and current water levels inof the normal low flow conditions. Drawbacks include:

- ϕ No benefits to upstream reaches in terms of increasing riverine habitat
- ϕ Natural riverine sediment and bed load transport not restored
- ϕ Yearly O&M activities and costs to adjust riffles to ensure fish passage
- ϕ Yearly O&M activities and costs to replace lost stone from flooding events on the riffles
- ϕ Monthly O&M activities and costs of debris removal from riffles
- ϕ Potential for people to modify the riffles to the point where they are ineffective at passing fish

3.1.2 – Elkhart River Dam

EA – Full Dam Removal

This measure includes the full removal of the Elkhart River Dam. Along with the removal of this structure, minor restorative repairs to the banks and staging areas where equipment or construction activities have disturbed the ground would be made. Restored areas would be planted with native riparian vegetation. Once the pool is lowered and no more flow occurs over the dam crest the dam could then be systematically removed from the breach back towards the north bank. After the dam is removed, lower river elevations could have the potential to cause scour around the piers of two bridges upstream from the dam. These bridge piers would be monitored, and if necessary, properly sized glacial cobble would be installed around the piers to prevent damage from scour. Tasks include:

- Mobilization & prepare staging areas
- Place temporary erosion control BMPs and boulder field (shoot) for dam breach outlet
    - Large boulders could be used to guide and break the energy of the flow going through the dam breach
- Breach dam at south bank to desired width
- Install work platform after pool has lowered and only flows through breach
    - May use angular riprap for this since it is a consumable
- Remove and dispose of dam materials appropriately
    - Concrete and any fill material that may have been used in the core of the dam
- Smooth out ground and bank disturbances after construction activities
    - Replace in-kind the previous use; vegetation, sidewalk, parking lot, etc
- If necessary, place glacial cobble around upstream bridge piers to prevent scour

A partial removal of the Elkhart Dam was deemed not feasible since the dam is so degraded.

Bank Re-vegetation

After the dam is removed and the bed elevations of the river have stabilized for the most part (a few months), the downstream bank on the south side of the river would be restored using a combination of engineering techniques and natural materials. The concrete and riprap skirt that now covers the bank can be removed since the dam would not force water into this area once removed. The use of boulders,

cobble, sand, soil, woody debris, coconut baskets and matting would be used to then naturalize the bank. Tasks include:

- Mobilization & prepare staging area
- Place temporary erosion control BMPs
    - Exercise caution primarily
- Remove concrete skirt and dispose material
- Grade bank with either removing or adding in soil material
    - Coconut baskets or anchored logs could be used to create terraces if there is not sufficient room to achieve a stable slope
- Protect tow with boulders, cobbles, woody debris
- Plant the bank with native riparian vegetation tolerant to the given conditions
- Smooth out ground and bank disturbances after construction activities
    - Replace in-kind the previous use; vegetation, sidewalk, parking lot, etc

3.2 – Measure Costs & Assumptions

Detailed discussion on planning level feature costs is presented in **Appendix F**. Conceptual, planning level cost estimates were prepared for measures/features that were identified by the study team. 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 (**Appendix E**). Estimates were developed using cost information from previous studies, lump sum and unit prices, and quantities of excavation and placement, and for plant, labor and material methods. Planning level unit costs (**Table 4**) 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. 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 this project is 50 years. Discounting to the base year is the present value method. Costs are compounded or discounted to present value at the base year then amortized over the 50-year period of analysis to give the equivalent annual cost. The discount rate 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 1 -year, 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.

Table 4 – Total & Average Annual Costs per Measure

Code	Description	Total Cost	AA Cost
EA	Elkhart Full Dam Removal	$669,222	$44,895
CA	Christiana Full Dam Removal	$70,451	$5,366
CB	Christiana Riffle Stair Step	$179,209	$13,593

Planning Level OMRR&R Costs – Planning Level Operation, Maintenance, Repair, Rehabilitation, and Replacement Costs (OMRR&R) will vary from project to project depending on the restoration measures described within the recommended alternative. If no annual OMRR&R is recommended then the annual cost is zero. For projects that have recommended alternatives that call for any type of vegetation reestablishment or control, management of native vegetation will be required such as prescribed burns for certain cover types, mowing, invasive species removal/control and reseeding of native plant species. OMRR&R costs are projected to occur after the completion of the construction phase and continue for the period of analysis, 50 years. Costs for any management measures were predicted per year per site (based on area affected and frequency of treatment) and these costs were annualized for the period of analysis. The annualized OMRR&R cost is included in the total project estimate and will not be cost shared.

Real Estate – An Initial Value Estimate (IVE) of the lands (LERRDs) necessary to implement measures for this ecosystem restoration project was included in the Average Annual costs per measure, which was about $15,800 for Christiana Creek Dam and $21,500 for the Elkhart Dam. The IVE provided by the real estate section determined various preliminary numbers to accomplish plan formulation. Please reference Real Estate Plan(**Appendix E**).

Pre-Construction, Engineering & Design Costs – Standards were used for this cost element to conservatively reflect further work to be completed on the recommended plan. This cost includes any required future sampling, testing and modeling, as well as more typical design analysis activities. The following standard percentages were used:

- Plans & Specifications – 6.5%
- Construction Management – 7.5%
- Engineering & Design During Construction – 3%
- Project Management – 1.5%

3.3 – *Measure Benefits

The evaluation of habitat benefits is a comparison of the with-project and without-project conditions for each measure (**Table 5**). 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 Elkhart River and Christiana Creek ecosystems by providing access to large portions of river and stream habitat to fishes within the St. Joseph River. The measures for this study were evaluated using QHEI and species richness (R) methodology described in Section 2.3.

FWP changes in species richness assumed large predator and sucker species moving upstream immediately after dam removal. Darter, minnow and sunfish species would take longer to move into the area that had been blocked by the dam. This is shown in the AAHU projection. QHEI scores did not change for the calculation.

Table 5 – Total & Net Average Annual Habitat Units per Measure*

Code	Description	QHEI	R Above	R Below	HSI	AAHSI	Acres	HU	AAHUs	Net AAHUs
EA	Elkhart Full Dam Removal	77	34	34	0.89	0.82	327	289.4	276.1	108.7
CA	Christiana Full Dam Removal	76	28	28	0.88	0.83	83	73	70.4	18.5
CB	Christiana Riffle Stair Step	76	28	28	0.88	0.83	83	73	70.4	18.5

*See Table 3 for FWOP AAHUs

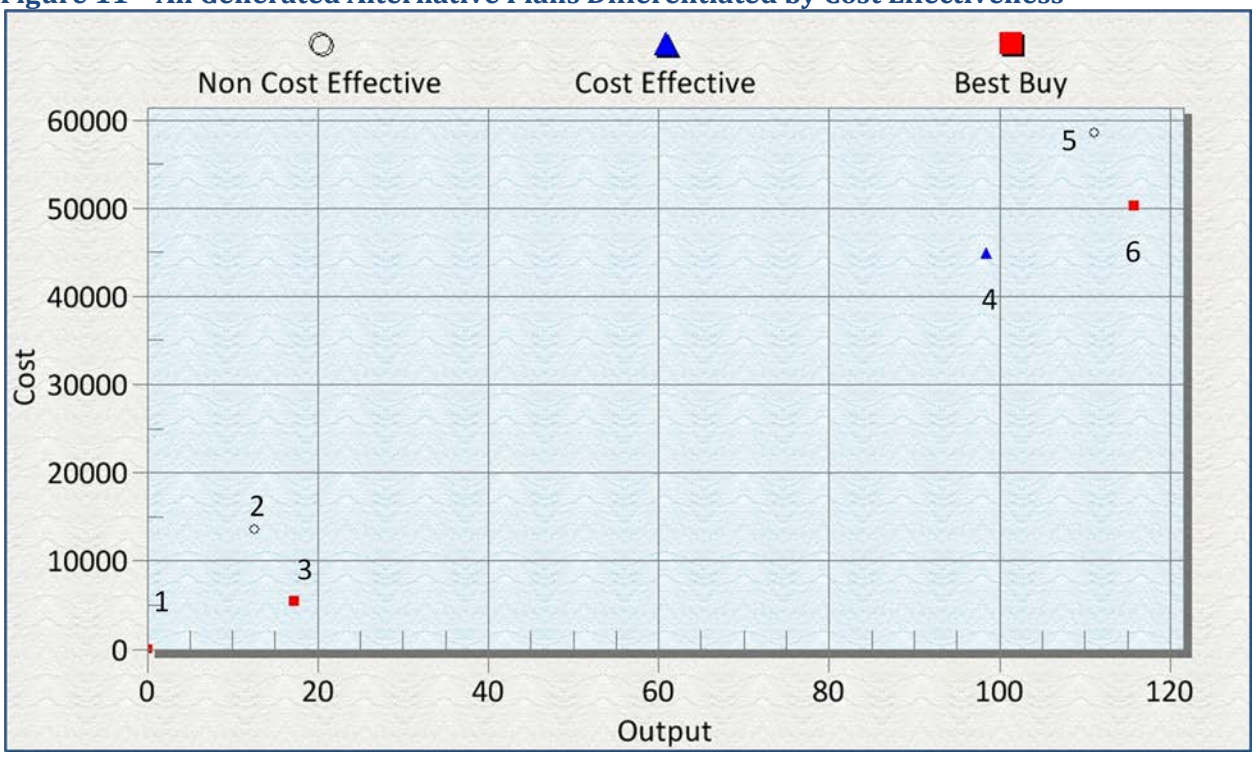
3.4 – Alternative Plan Generation

Four (4) measures, including the No Action measure, were input into the IWR-Planning Suite in terms of costs and benefits shown in **Tables 4** and **5**. All measures were deemed combinable except the two Christiana Dam measures (CA & CB). Based on these inputs and criteria, the IWR-planning software generated 6 alternative combinations (**Table 6**) for ecosystem restoration. These alternative combinations moved forward to the cost effective and incremental cost analysis steps in the following sections.

Table 6 – Generated Plans Analyzed for Cost Effectiveness & Incremental Cost Analysis

Alternative	Net AAHUs	Cost/HU	Total Annualized Cost
No Action	0	$0	-
CB	12.65	$1,075	$13,593
CA	17.29	$310	$5,366
EA	98.48	$456	$44,895
EA, CB	111.13	$526	$58,488
EA,CA	115.77	$434	$50,261

Figure 11 – All Generated Alternative Plans Differentiated by Cost Effectiveness



3.5 – 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. Usually, 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.

The USACE's Institute for Water Resources (IWR) developed procedures and software to assist in conducting CE/ICA. The IWR Report 94-PS-2, *Cost Effectiveness Analysis for Environmental Planning:*

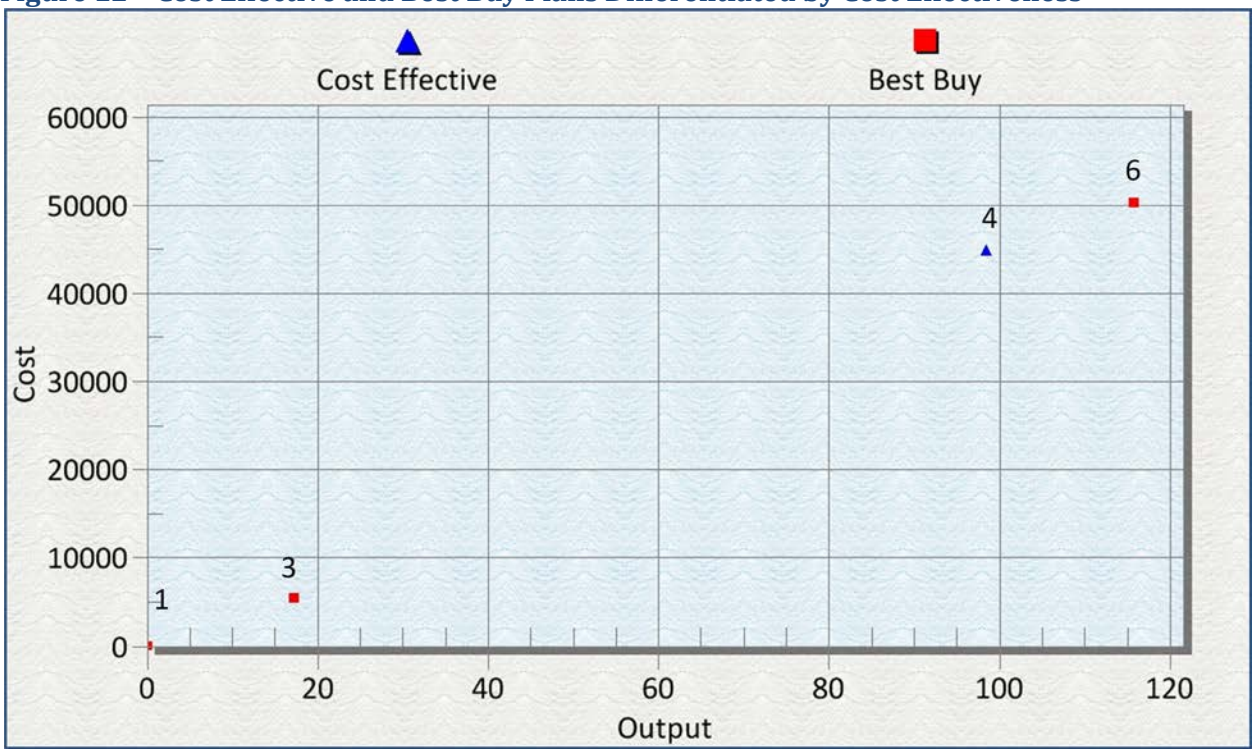
Nine EASY Steps; IWR Report 95-R-1, *Evaluation of Environmental Investments Procedures Manual Interim: Cost Effectiveness and Incremental Cost Analyses*; and IWR Report 98-R-1, *Making More Informed Decisions in Your Watershed When Dollars Aren't Enough* were utilized as guidance for this study. The Windows-based IWR-PLAN Decision Support Software Beta Version was used as the tool for this CE/ICA analyses.

The incremental cost, incremental habitat units, and incremental cost per habitat unit of advancing to each successive cost effective output level was calculated by the IWR-plan. 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. Six (6) alternative combinations were analyzed for cost effectiveness. Of these, four (4) cost effective combinations were identified (**Table 7** and **Figure 12**), which is inclusive of the three (3) "best buy" plans. The No Action plan is always deemed cost effective and a best buy plan. Two (2) alternative combinations were screened out as non-cost effective.

Table 7 – Cost Effective Alternative Analysis

Alternative	Net AAHUs	Cost/HU	Total Annualized Cost
No Action	0	$0	-
CA	17.29	$310	$5,366
EA	98.48	$456	$44,895
EA, CA	115.77	$434	$50,261

Figure 12 – Cost Effective and Best Buy Plans Differentiated by Cost Effectiveness



There are many ways decision makers can use the results of the CE/ICA analyses. The recommended plan is selected as the plan that achieves most of the goals of the project for the least cost. A minimum threshold of outputs is also set to ensure that the recommended plan meets all the objectives. As a part of the process in selecting the recommended plan for implementation, input will be sought from the non-Federal sponsors. It is necessary to ensure the alternative plan identified as cost effective and a "best buy" is reasonable in terms of ability to implement said alternatives.

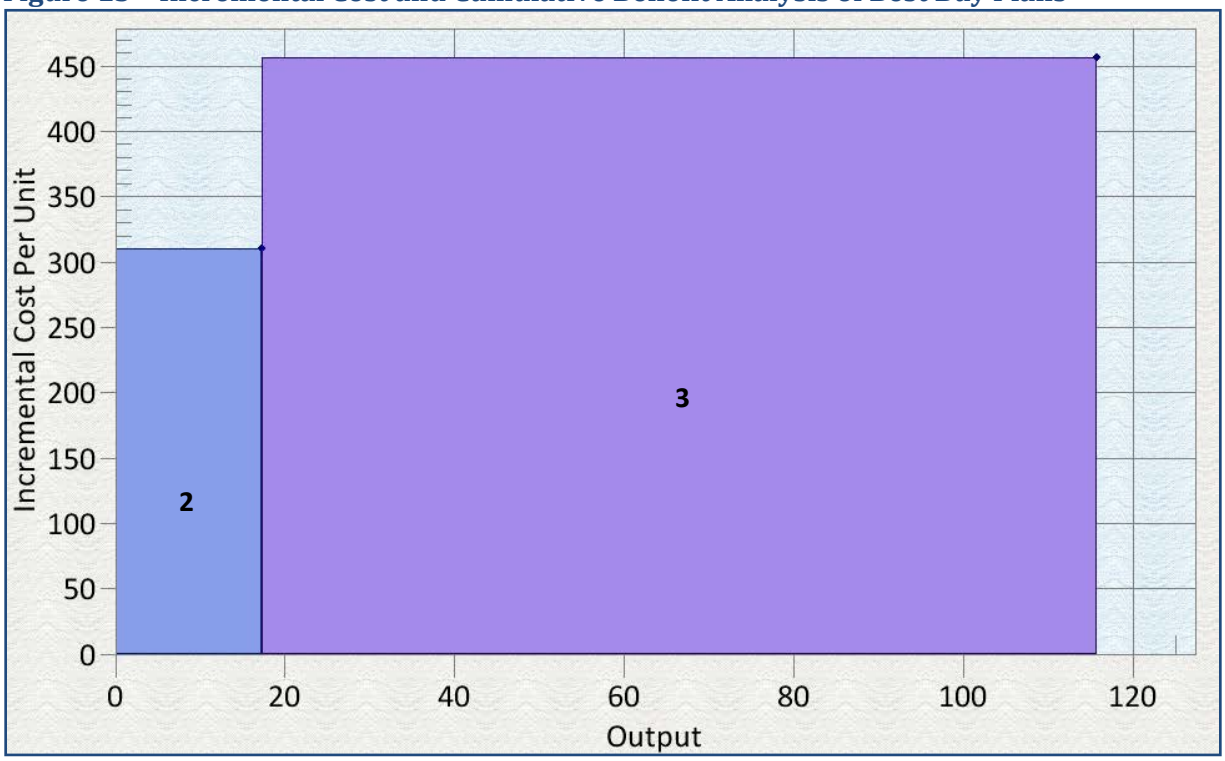
3.6 – Incremental Cost Analysis

An incremental cost analysis was performed on those alternative combinations 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. This incremental cost analysis has identified three (3) alternative combinations for ecological restoration that would be considered as best buys, including the No Action plan. These are presented in **Table 8** and **Figure 13**.

Table 8 – Incremental Cost Analysis of the "Best-Buy" Plans

#	Alternative Plan	HU	AA Cost	AA Cost/HU	Inc. Cost	Inc. HU	Inc. Cost/HU
1	No Action	0	0	-	-	-	-
2	CA	17.29	$5,366	$310	$5,366	17.29	$310
3	EA, CA	115.8	$50,261	$434	$44,895	98.48	$456

Figure 13 – Incremental Cost and Cumulative Benefit Analysis of Best Buy Plans



3.7 – Alternative Plan Trade-Off Analysis

Alternative plans that qualified for further consideration are compared against each other in order to identify the selected sites 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 with respect to 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.

3.7.1 – 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 Elkhart River and Christiana Creek restoration outputs are herein recognized in terms of institutional, public, and/or technical importance.

The three “best buy” alternatives were quantitatively assessed for species richness and qualitatively assessed for habitat (Section 2.3). The following are the three alternative combinations, with Alternative 3 being the most beneficial in terms of restoring a holistic ecological reserve and Alternative 1 not providing any net benefits since it is the No Action plan:

1. No Action
2. Christiana full dam removal
3. Elkhart full dam removal & Christiana full dam removal

Alternative 2 would generally benefit native species; however, it is only Alternative 3 that provides for and fully reconnects the habitats within the Elkhart River and Christiana Creek. Alternative 3 completely addresses impairments caused by the presence of the dams such as unnatural sediment transport, loss of riverine hydraulics, habitat fragmentation and degraded water quality. Implementation of Alternative 3 would rectify these disturbances, which would in turn promote native fish, mussel and invertebrate species richness and abundance to increase.

Institutional Recognition

Significance based on 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.

Clean Water Act – Restore the chemical and biological integrity of the Nation's waters. Removal of these two dams would improve water quality through reestablishing riverine hydraulics, which provides the physical means for biogeochemical processes important in the filtering of stream waters. Removing the dams would increase dissolved oxygen and reduce nutrients by providing water filtering bacteria and algae with proper substrates and hydraulic forces required to perform their functions. Also, the proposed project would remove foreign debris, the dams, from the river.

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. Although no Federally endangered species have been identified within the immediate study area, removal of the dams will return the rivers to their natural free flowing condition. In addition, species such as the state endangered greater redhorse (Catostomidae) will benefit greatly by gaining access to 50-miles (410 surface acres) of high quality stream habitat.

Fish and Wildlife Conservation Act of 1980 – All Federal departments and agencies to the extent practicable and consistent with the agencies authorities should conserve and promote conservation of non-game fish and wildlife, and their habitats. Restoring the connectivity of the river and returning instream habitat and associated hydraulics will decrease impediments to native fish migration as well as increase habitat structure and availability. Removal of unnatural habitats would reduce the abundance ratio of exotic to native species. All habitat improvements would benefit plants, invertebrates, fish, birds, amphibians, reptiles and other wildlife within the immediate riparian corridor of the two dams.

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. Removal of the dams from the Elkhart River and Christiana Creek would help to recolonize healthy sections of the river and those areas that are being restored with native fishes and mussels. The removal of dams tends to reduce invasive fish species as well because the altered hydrologic and hydraulic parameters caused by the dams that sustain them would be removed. Dammed waterways typically have increased temperature, nutrients, and productivity that are more suitable for invasive species establishment.

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 would increase species richness and abundance of native riverine communities and fish assemblages, thus providing an increased forage base for piscivorous migratory bird species above the dams.

Executive Order 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. 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
2. **Non-point source pollution**
3. **Coastal health**
4. **Habitat/species**
5. Contaminated sediments/AOCs
6. Indicators/information
7. **Sustainable development**
8. **Invasive species**

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.

The Elkhart River and Christiana Creek watersheds are rich with areas that offer fishing, paddling, boating, and other recreational opportunities. There are numerous city parks in and around the project area including Riverwalk and High Dive Parks that are in the immediate area of the project. The Elkhart Environmental Center is well received within the study area. An ecosystem restoration movement is well established within the watersheds and is rapidly growing. Plenty of groups, including the Friends of the St. Joe and Elkhart River Restoration Association, dedicated to the preservation and restoration of the watersheds, exist and perform such tasks as monitoring native ecosystems and their rare or endangered/threatened flora and fauna, creating volunteer work days to remove invasive species and organizing river clean-ups, conducting guided nature walks and bird watching, and maintaining detailed yearly surveys on populations of rare flora and fauna. The strong public involvement in outdoor recreation within the study area directly relates to the importance of an environmental resource for a growing population involved in protecting their natural areas.

The Elkhart Dam is also recognized for priority removal in the 2012 St. Joseph River Watershed Dam Assessment publication headed up by the Friends of the St. Joseph River and funded by the USFWS http://www.fotsjr.org/Reports.

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.

Long stretches of free-flowing, naturally functioning streams are rare within the project area as well as the St. Joseph River watershed as a whole. There are nearly 200 dams within the St. Joseph River watershed. Removing or modifying the existing dams within the project area would increase free-flowing natural conditions in the watershed.

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.

In 2010, the City of Elkhart's Aquatic Biology Department collected 18,827 fish specimens representing 72 species within the Indiana portion of the St. Joseph River watershed. Of those, 154 specimens represented 5 exotic species. The native fish communities are still intact and thriving. The opportunity for restoring hydrology and natural, fluvial processes and improving water quality will only strengthen and maintain the native fish communities.

Status and Trends of biogeochemical processes are functional within the Elkhart River and Christiana Creek watersheds; however, they have been degraded through alteration of hydrogeomorphic conditions. Function of the riverine systems (erosion, transportation, deposition) has been altered through the construction of dams, channelization, and the rivers' restricted use of their natural floodplains. Removal of these two dams would aid in returning biogeochemical functions that a river should possess.

Connectivity has been impaired due to the construction and presence of the dams within the Elkhart River and Christiana Creek. Aquatic life will benefit greatly through the restoration of connectivity within these two systems and to a greater degree within the St. Joseph River watershed. Removal of the two dams will aid in reducing impediments to fish movement as well as macroinvertebrates. The streams will also be reconnected with portions of their natural floodplain, as previously inundated areas revert back to emergent wetland habitats. This in turn will provide nursery grounds for larval fish species. Finally, with the addition of vertical and horizontal structure within the system, available habitat to niche specific species will improve as well as the overall function of the streams.

Limiting Habitat exists within the Elkhart River and Christiana Creek watersheds. Federally threatened and endangered species that require habitat found here include the Indiana bat and Eastern Massasauga. By removing the dam and restoring local hydrologic function,a plethora of state rare, endangered, and threatened species may benefit from the restoration project. However, the state endangered greater redhorse wil benefit most by having access to longer stretches of river for spawning and foraging purposes.

Budget Guidance

The purpose of the City of Elkhart Dams restoration project is to establish a more natural fluvialgeomorphology to resemble that of its natural structure and function. The USACE has criteria for

selecting projects for implementation with the following criteria and numerical scores being assigned to a project based upon the site meeting the requirements identified in the Corps Budget guidance (EC 11-2-194):

- Habitat Scarcity – Score of 18/25
- Connectivity – Score of 25/25
- Special Status Species – Score of 5/10
- Hydrologic Character – Score of 20/20
- Geomorphic Condition – Score of 20/20
- Plan Recognition – Score of 5/10
- Self Sustaining – Score of 20/20
- Nationally Significant – Yes
- Regionally Significant - Yes

3.7.2 – Acceptability, Completeness, Effectiveness and Efficiency

Acceptability, completeness, effectiveness, and efficiency are the four evaluation criteria specified by USACE to use 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 recommended plan calls for the simplest methods to restore the riverine connectivity and hydraulics that has the least amount of operations and maintenance associated. This plan is most congruent with the desired future conditions of the St. Joseph River watershed, in which local, state and Federal agencies are working together to return free-flowing riverine conditions. The implementation of the recommended plan is acceptable to those local, state and Federal agencies, as well as local groups, that have missions to restore ecosystem integrity to the St. Joseph River watershed.

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.

The recommended plan is the most complete alternative that would naturalize the localized hydraulic regime of the Elkhart River and Christiana Creek. This plan would provide for all riverine organisms and

not just a select few. This plan would also meet objectives for a sustainable fish and macroinvertebrate assemblage.

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 the fragmented and low quality habitats, impaired aquatic communities, poor water quality, and un-natural sediment transport associated with the dams on the Elkhart River and Christiana Creek. The following opportunities for this project are presented:

- The ability to enhance ecological health and biological diversity
- The ability to restore natural fluvial processes
- The opportunity to naturalize and stabilize impaired riparian and floodplain areas
- The opportunity to work in cooperation with others to maximize effective use of funding while achieving ecosystem restoration

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.

Based on the diminutive nature of these two dams, their vestigial functions, and the amount of operations and maintenance associated with other measures to restore connectivity, simply removing the dams is the most efficient use of funding to meet the project goal and objectives (see Section 2.5)

3.7.3 – 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 a dam to restore hydrologic function to a stream since the absence of a manmade structure in a river removes more risk as opposed to adding risk. When identifying the NER 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. Consideration of risk for project alternatives only leads to concern for Measure CB – Riffle Stair-Step because with every flood, there is a chance the riffles would move and sag down, which would return the dams habitat fragmentation problem. This would lead to increased O&M Costs and frequency of maintenance hours.

3.8 – 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 City of Elkhart. Also, as the Section 506 authority intends, the recommended plan would restore and preserve ecosystems in congruence with the Council on Lakes Committee. The Elkhart Dam was also recognized as a priority dam for removal under the 2011 St. Joseph River Watershed Fish Migration Barrier Inventory. This restoration project makes a significant contribution to regional, national, and international programs such as the North American Waterfowl Management Plan as well.

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 reiterated through Executive Order 13340.

Non-monetary values associated with the City of Elkhart Dams restoration project include a variety of ecological benefits such as providing fish passage for all native species, restoring free flowing conditions for an additional combined mileage of approximately 50 miles, improve riverine habitat for endangered/threatened fish and mussel species, and stabilize stream banks and naturalize sediment transport. The restoration of the Elkhart River and Christiana Creek will significantly increase the ecological integrity of the surrounding area and is well worth the investment.

The NER/Preferred 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 3. The NER Plan is considered the Preferred Plan for the direct, indirect and cumulative effects assessment under NEPA in the following Chapter.

CHAPTER 4 – *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.

4.1 – Need & Purpose

The need and purpose is described in detail in Section 1.3 Study Background.

4.2 – Alternatives Considered

Three (3) alternative plans, including the No Action plan, were considered for study implementation. Alternative 3 is the Preferred Plan since it maximizes ecosystem restoration and is holistic in terms of restoring riverine connectivity. See Section 3.1 for measure details, which make up the Alternative Plans below:

1. No Action
2. Christiana full dam removal
3. Elkhart full dam removal & Christiana full dam removal

4.3 – The Affected Environment

The affected environment is described in detail in Chapter 2 – Inventory & Forecasting.

4.4 – Direct & Indirect Effects of the Preferred Plan

In this section, the confluence of the St. Joseph River, including the area above the dams, were considered for direct and indirect effects of the preferred plan.

4.4.1 – Physical Resources

Climate

The minor scale of the preferred plan would not be able to affect the regional climate. The decrease in acreage of open water would decrease evaporation in a minor way, but still not great enough to affect weather patterns or rainfall within the region. No significant adverse effects to the regional climate are expected from implementing the preferred plan.

Land Use

No adverse effects to the land use are expected from implementing the preferred plan since removing two small run-of-the-river dams would not change surrounding land use. All work performed would be in the stream channel and this project is not intended to reconnect the river with former floodplain areas, so flooding would not be induced into riparian lands.

Geology

The preferred plan would have no detrimental effects on local geology upon implementation. The minor construction needed to implement the preferred plan would not disturb any geologic features or deposits. Most of the area in the project area has already been disturbed over the last 150-years and the current project will not alter the geology further. Because implementation of the preferred plan will not disturb significant geologic features or deposits, it is expected that no significant adverse effects to geology would result from implementing the preferred plan.

Hydrology, Hydraulics & Fluvialgeomorphology

Full removal of both dams would produce benefits in terms of riverine hydraulics as the water would be allowed to free flow again. These benefits would be especially important considering the substantial negative effects to the river currently generated by post-settlement agriculture and urban land use in the vicinity of the dams. The small nature of the dams does not lend to local hydrology being affected in any significant means.

Full removal of the Elkhart and Christiana dams would reverse current adverse fluvialgeomorphic trends. Upstream of the dam removal sites, reservoir conditions that developed due to the presence of the dams would return to hydraulically diverse free flowing river. In addition, bedload materials would no longer be sequestered upstream of the dams and would be naturally distributed upstream and downstream, reversing current trends toward extreme channel incision downstream and channel aggradation upstream.

Overall, it is expected that no adverse effects to hydrology, hydraulics or fluvial geomorphology would result from implementing the preferred plan.

Water Quality

There may be temporary increases in turbidity as a result of suspended sediment during construction; however, the benefits of the preferred plan far outweigh any temporary increase in turbidity. It was also shown that any turbidity caused by dam removals is nothing different than the turbidity observed during a normal storm event. Overall water quality, which is currently considered sufficient to support a diverse and healthy aquatic community, would be improved in the vicinity of the dams after removal. It is expected that no significant adverse effects to water quality would result from implementing the preferred plan.

Sediment Quality

It is important to remember that these two dams are run-of-the-river or low-head dams. They function as weirs do by allowing all of the flow to pass over the top sill of the dam. These dams do not function as the large power generating or reservoir dams do by disallowing flows over the top and releasing the water from controlled sluice gates. These large dams then have the ability to trap fine sediment, whereas the low-head dams do not and allow for storm events to carry the wash load over their top sills. Therefore, the concept of “sediment behind the dam” can largely be discounted as sequestering of bedload (sand, gravel, cobble) and not wash load (fine sediments) for run-of-the-river dams.

Full dam removal would not have an adverse effects by releasing bedload material downstream, but contrarily would increase the heterogeneity of habitats through fluvial sorting of substrates both up and downstream. Also, a lesson learned from the Hofmann Dam project is that it is more prudent to let the sediment move on its own with floods rather than trying to remove it out of the way during low flows. It is therefore expected that no significant adverse effects to sediment quality would result from implementing the preferred plan. Sediment transport and sorting would be beneficially affected by the removal of these two dams.

Sediment affecting the ecological integrity of the Christiana Creek due to the dam removal is not a concern. All of the material is fluvial. Movement of this sediment as a result of dam removal is desired in order to restore natural sediment transport and substrate sorting via fluvial processes for the creation of new habitats.

Sediment affecting the ecological integrity of the Elkhart River due to the dam removal is not a concern since all of the material is fluvial. Movement of this sediment as a result of dam removal is desired in order to restore natural sediment transport and substrate sorting via fluvial processes for the creation of new habitats.

4.4.2 – Ecological Resources

The primary objective of any ecosystem restoration project is to return the structure and function of habitat types as close as possible to the original conditions before man had disturbed them. Any ecosystem restoration project that has associated significant adverse effects stemming from implementation is either not a restoration project, or has been incorrectly interpreted for direct and indirect effects. The following ecological community types are the focus of the City of Elkhart Dams restoration project, which is slated to provide beneficial effects to the ecosystem as a whole, but also to the human environment by reducing stream fragmentation, eliminating safety hazards, reducing upstream flooding, addition of open space and aesthetic scenery, education opportunities, etc.

Riparian Vegetation

Overall, full removal of the Elkhart River and Christiana Creek dams would benefit native riparian plan communities by restoring channel geomorphology along bank, toe and bar areas. Dam removal would reduce the elevation of the artificial pool upstream, which would allow for an increasing the abundance of native riparian vegetation, as observed after the Hofmann Dam removal. Dam removal would increase toe and bar vegetation areas downstream as well, due to the refreshed supply of fluvial substrates. No significant adverse effects as a result of implementing the preferred plan are expected.

Riparian Wildlife

The Elkhart River and Christiana Creek dams are both located in the heart of downtown Elkhart where there is limited wildlife habitat available within the immediate vicinity of the project. However, implementation of the preferred plan is expected to benefit riparian wildlife communities. Through removal of the dams, the channel geomorphology would be more conducive to passing organisms other than fish via the return of vegetated bank, toe and bar areas that would be shallow enough for non-swimming organisms to traverse through. This would also in turn provide an increase in quantity and quality of foraging habitat for resident and migratory piscivorous bird species.

Riverine Communities

Implementation of the preferred plan would result in nearly 50-miles of reconnected stream habitat and restored fluvial hydraulics for over 5,000-feet of river. Providing uninhibited access to habitat for native stream species is the impetus for this project. Removing impediments to native species will increase colonization of historical habitat that has been inaccessible for up to 150-years. A restored fluvial system with proper hydraulics and channel morphology would increase spawning, nursery, and feeding areas. Overall biotic integrity is expected to increase due to the implementation of the preferred plan. Since the preferred plan would be implemented in a fashion as to increase quantity and quality of riverine communities, no significant adverse effects resultant from implementing the preferred plan are expected. As an example, as soon as the Hofmann Dam was completely removed, the stream hydraulics upstream resurged, and along with this an additional 12 species were recorded where they were absent before the dam was removed.

There is no long term concern for benthic macroinvertebrates, especially mussels, due to sedimentation and water level changes. The material sequestered behind the dam is primarily coarse grained material of sand and gravel that would not impact mussel beds as it moves through the system. Coordination with the Indiana DNR indicated that during the period of construction when sediment will be let downstream there should be investigation of stranded mussels above the dam due to the water level dropping. This is more of a concern than sediment covering mussels because mussels have the ability to move and due actually burry themselves in winter months beneath the river bed. An environmental specification detailing this need would be added to the contract set should this project move forward for implementation. It would also include a coordination and mussel relocation plan should the need arise.

Threatened & Endangered Species

The Indiana bat and the Eastern massasauga are the only 2 federally listed species in Elkhart County, IN. The project area lies within heavily urbanized areas that offer no critical habitat for these species. The preferred plan would improve habitat access for state endangered species such as the greater redhorse. Since the preferred plan would be implemented in an area that offers no habitat for federally listed species and will improve habitat for state endangered species, no significant adverse effects are expected from implementing the preferred plan.

The USFWS was sent a memorandum determining “no effects” to federally threatened and endangered species (memo dated 17 September 2010).

4.4.3 – Cultural Resources

Archaeological & Historical Properties

The preferred plan would have no adverse impacts on archaeological or historic properties (Letter dated 04 December 2012). The project consists of two obsolete dams located within the Elkhart City limits. One dam is located on the Elkhart River and was constructed in 1832. It was permanently rebuilt in 1875. The second dam is located on Christiana Creek and is approximately 60-years old. The two project areas contain no intact archaeological or historical properties.

Social Properties

During construction, increased traffic congestion would be localized and intermittent. Employment could increase slightly during construction, and the region's labor force should provide the necessary workers. Noise levels would be increased during construction from passing trucks. Any aesthetic impacts would be negligible and temporary. The preferred plan would not have any significant adverse impacts on the area's social properties. As a result from construction activities at the Hofmann Dam, groups of observers frequented the site daily. It was noticeable the local restaurants were a bit more crowded than usual.

Recreational Activities

The preferred plan would have no adverse impacts on recreational activities. Short term impediments to recreational activities will occur during the first year of construction as the dams are removed. After all physical restoration features are implemented; the rivers would once again be available for recreational opportunities such as canoeing and boating.

Hazardous, Toxic & Radioactive Waste (HTRW) Analysis

The proposed project would not have any long-term adverse effects stemming from the disturbance of HTRW materials. Investigation of existing environmental data, maps and site conditions determined the risks associated with the project site are negligible. Based on this information, the investigation concluded that the work proposed for the Elkhart and Christiana dam removal site has little potential for encountering a REC.

4.4.4 – 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 – Any of the alternative plans would cause minor and temporary increases in noise levels beyond the current conditions. The minor noise effects would stem from machinery utilized for removing the dams and placing materials. Long term significant effects in terms of noise are not expected.

Displacement of People – None of the alternative plans would displace local residents since this is an isolated public parcel.

Aesthetic Values – None of the alternative plans would reduce the aesthetic values of the Elkhart River or Christiana Creek dam removal sites. Aesthetic values are actually expected to improve with the removal of both dams and the return of more natural free-flowing reaches with less impairment to downstream banks.

Community Cohesion **–** None of the alternative plans would disrupt community cohesion, but instead would provide restored open space for community activities.

Desirable Community Growth **–** None of the alternative plans would adversely affect community growth, but would instead potentially attract people to a more aesthetically pleasing area based on project restoration measures.

Desirable Regional Growth – None of the alternative plans would adversely or beneficially affect regional growth.

Tax Revenues – None of the alternative plans would adversely or beneficially affect tax revenues.

Property Values – None of the alternative plans would have adverse effects on property values, but instead would have the potential to increase surrounding land values since the aesthetics would improve due to project restoration measures.

Public Facilities – None of the alternative plans would adversely affect public facilities of the City of Elkhart.

Public Services – None of the alternative plans would adversely or beneficially affect public services.

Employment – None of the alternative plans would adversely affect employment. Instead implementation of the preferred plan would temporarily increase employment during construction activities.

Business and Industrial Activity – None of the alternative plans would adversely or beneficially affect local commerce.

Displacement of Farms – None of the alternative plans would adversely affect farmland since restoration areas do not occur on agricultural fields.

Man-made Resources – None of the alternative plans would adversely or beneficially affect man-made resources accept for the dams themselves. The dams were originally constructed for flour and saw mills that don't exist within the area and therefore are not needed anymore.

Natural Resources –The No Action alternative allows for the continued degradation of native species, rare communities, and significant habitats. The preferred plan would not adversely affect natural resources, but improve them greatly.

Air – The preferred plan would cause only minor and temporary increases in exhaust emissions from machinery and equipment during construction.

4.5 – 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.

4.5.1 – 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.

Three temporal boundaries were considered:

- Past –1830s because this is the approximate time that the landscape was in its natural state, a vast prairie/wetland/woodland mosaic.
- Present – 2013 when the decision is being made on the most beneficial ecological restoration
- Future – 2062, 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.

4.5.2 – Cumulative Effects on Resources

Physical Resources

For over 150-years, the physical resources of the St. Joseph River watershed, including in the Elkhart River and Christiana Creek, have been altered. Geology, topography, hydrology, water quality and other physical resources have been modified to better accommodate industrial, commercial and other needs deemed necessary by man. Municipalities have developed and incorporated more efficient and effective waste water systems, while at the same time population growth leads to higher traffic volume and pollution. While grass roots organizations organize and facilitate river clean-ups, other factions of the community continue to view neighborhood streams as their own personal dump sites. Local environmental groups are working on other aquatic restoration projects within the St. Joseph River. Many of these projects occur in the Elkhart River and Christiana Creek. These projects include modifying or replacing road crossings, culverts and dams. These projects along with the currently proposed preferred alternative will help to improve the physical resources of the watershed. While the combined projects are minor repairs in terms of the vast array and quantity of adverse effects caused by industrialization and urbanization, they are important in terms of beginning to reverse the damage caused by man on these resources. There are no irrecoverable losses of resources identified in terms of geology, topography, hydrology, water quality and other physical resources due to implementation of the preferred alternative. Cumulative beneficial effects to the Elkhart River and Christiana Creek are anticipated in terms of geology, topography, hydrology, water quality and other physical resources.

Ecological Resources

The ecological diversity of the aquatic communities in the St. Joseph River and its tributaries has been impaired greatly over the last 150-years. Barriers to species in the form of dams and other obstructions have led to the loss or decreased abundance of many native, intolerant fish and macroinvertebrate species. Small dams, such as the ones on the Elkhart River and Christiana Creek have changed the natural scheme of riffle-pool-run patterns with many quality habitat niches to a fragmented system with stagnant pools with impaired water quality and habitat more suitable for tolerant and invasive species. Removal of these barriers will allow for a more natural hydraulics and restoration of habitat suitable to support native species. A movement has begun to remove all barriers in the St. Joseph River watershed to facilitate upstream migration of native fish species and to enhance and preserve critical habitats for all life stages of these species. Considering the past, present and future conditions of the Elkhart River and Christiana Creek watersheds, implementation of the preferred alternative are minor repairs in terms of the vast array and quantity of adverse effects caused by industrialization and urbanization, they are important in terms of beginning to reverse the damage caused by man on these resources. There are no irrecoverable losses of resources identified in terms of aquatic communities and their habitats. Cumulative beneficial effects to the Elkhart River and Christiana Creek are anticipated in terms of aquatic communities and their habitats.

Cultural & Historic Resources

Cumulatively there are no adverse effects expected to the cultural and historic resources on and around the Elkhart River and Christiana Creek dams. The preferred plan will enhance recreational opportunities by restoring the connectivity of the rivers and providing increased habitat for aquatic and wildlife species. The cumulative effects would enhance the landscape and benefit human life by providing a natural habitat mosaic for people to experience.

Aesthetic Values

The current aesthetic value of the reaches where the Elkhart River and Christiana Creek dams are located is reduced. The dams create degraded habitat by disrupting the natural flow of the riverine systems. The preferred plan will restore riverine connectivity which will in turn enhance the aesthetic value of the two systems by restoring riparian and riverine heterogeneity.

Public Facilities

Restoring the connectivity of the Elkhart River and Christiana Creek will provide an enhanced outdoor experience for the surrounding community. The Elkhart Dam is also causing the City's river-walk and downstream banks to collapse due to channel incision caused by the sequestering of bedload materials. The educational potential of the restoration project is exceptional. There are no recreational features proposed under this project. Passive recreational features include canoeing, fishing, and hiking opportunities.

4.5.3 – Cumulative Effects Summary

The overall cumulative effect of the City of Elkhart dam removal projects are considered to be beneficial environmentally, socially and economically. The removal of the dams will greatly benefit the local

environment and increase ecological integrity. River connectivity, hydraulics and fluvial geomorphology would be restored. As a result, local native species of fish, plants, birds, insects, reptiles and amphibians will benefit.

4.6 – Compliance with Environmental Statutes

The plans presented in this integrated Environmental Assessment are 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.

4.6.1 – Environmental Justice EO12898

The preferred plan would not have adverse effect on any low-income populations or minority populations. Any change in area use resulting from the project would not disproportionately affect one group of the local population more than another. Therefore, the residents of the City of Elkhart would not be adversely affected (with regard to health, income, recreational opportunities, or overall quality of life) by the proposed project. A database search of the EPA EJView mapping tool (Accessed 19 September 2012), revealed that within the portion of Elkhart containing the project sites, 20-30% of the population is considered below the poverty line and 20-40% of the population is considered as a minority. Since the overall project and the preferred plan are considered ecosystem restoration and will only benefit the surrounding environment and communities, no adverse effects to any minority population and/or low income populations are expected.

4.6.2 – Clean Air Act

Due to the small scale, short duration and relatively unpolluted nature of the restoration project, it is assumed that the project is below the de minimis level of PM 100 tons per year. As a reference, other USACE projects that are much grander in scale and earthwork have GCA well below the PM 100 tons per year.

4.6.3 – 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 F**. Features addressed by the 404 include full removal of both the Elkhart River and Christiana Creek dams, sediment transport considerations and minor fill activities for removal activities. The conclusion of the 404(b)(1) analysis found no adverse effects from the proposed preferred plan.

Section 401 Water Quality Certification for the dam removals would be applied for once a sufficient set of construction drawings are available. The coordination letter dated 01-Oct-2012 has several comments and concerns were brought up. To help clarify and assist with any concerns, a second pre-permitting meeting was held after the preferred plan was tentatively selected on 19-Mar-2013. These previous concerns were addressed and the stakeholders asked for continued coordination throughout the process. In addition, permitting agencies have indicated that based on the preferred plan; there are concerns over the impacts of sediment on mussel beds and fish downstream of the project area. Modeling suggests that the sediment behind the dam should stay in place and have very little effect

downstream. Further coordination with a mussel biologist from INDNR, Brant Fisher, will continue throughout the project. With continued coordination there is no reason to expect this permit would not be received. This preliminary decision is based on the fact that materials being used are inert and clean, and that dam removals are specifically sought out projects to improve habitat quality.

4.6.4 – USFWS Coordination

Coordination with the USFWS commenced with a project scoping letter dated 17 September 2012 and an additional letter dated 01 October 2012. This environmental assessment identified the preferred ecological restoration plan was determined to have "no effects" on Federally endangered species or their habitats.

4.6.5 – State of Indiana Historic Preservation Act

Pursuant to Section 106 of the National Historic Preservation Act (16 U.S.C. §4701) and 36 C.F.R. Part 800, the staff of the Indiana State Historic Preservation Office (Indiana SHPO) has conducted an analysis and determined that neither Elkhart Dam or Christiana Creek Dam are eligible for the National Register of Historic Places (Letter dated 04 December 2012). While some of the historic properties of the Elkhart dam may exist, the modifications to the dam make it ineligible for listing.

If any archaeological artifacts are uncovered during construction and earth moving activities the Indiana Department of Natural Resources will be contacted within two business days.

4.6.6 – Views of Non-Federal Sponsor and Public Participation

The current views of the non-federal sponsor are positive. The City of Elkhart is committed to restoration within and throughout the watershed. This commitment is evident by the active pursuit of grant money to remove two additional dams just upstream of Christiana Creek.

A summary of public participation will be added after public review.

4.6.7 – Finding of No Significant Impact (FONSI)

An Environmental Assessment was completed for the proposed measures at the City of Elkhart Dams restoration project which found no significant adverse effects to the resources on site. A 30-day Public Review period was held from _____ to _____ for the Environmental Assessment. The proposed project is expected to be in full compliance with the National Environmental Policy Act, the Endangered Species Act, the Fish and Wildlife Coordination Act, the National Historic Preservation Act, the Clean Air Act, Sections 401 and 404 of the Clean Water Act, and the Corps of Engineer's regulations. The FONSI for this project was signed _____.

CHAPTER 5 – *DESCRIPTION OF THE NER PLAN

5.1 – Plan Components

The NER Plan is the recommended plan, which is Alternative 3. This alternative consists of 2 measures: (EA) Elkhart full dam removal and (CA) Christiana full dam removal. Removal of the dams would allow for fish passage and restores both reaches to a free flowing state. The implementation of these measures is generally described as follows and according to the measure descriptions in Section 3.1. The Civil Design Appendix

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 heavy construction. Staging areas and access roads would be demarcated. All surficial infrastructure and ornaments would need to be removed and discarded or stockpiled and saved depending on the City of Elkhart's needs and desires.

Elkhart Dam Removal – The contractor would build a short access road and equipment staging area on the City of Elkhart land on the river. Access to the river would be gained by constructing a ramp from the equipment staging area down to the river bottom. It is of the Chicago District's point of view, based on removing four dams and researching dam removals across the county, that this dam is of such stature that a coffer dam or water diversion structure is not needed. The recommended methodology would be to breach the dam along the south bank to divert flow around the dam. Once the pool is lowered and no more flow occurs over the dam crest, a work platform made of stone or portable slabs would then be installed below the dam from the north bank. Also, since the pool is lowered at this point, upstream silt bars, if necessary, cold be stabilized with vegetation and river cobbles. The concrete cap of the dam would be broken and removed from the river channel, while the natural river cobbles that form the core of the dam would be stockpiled for erosion control or to be consumed back into the river's sediment transport. This work would start from the breach and commence back towards the north bank. In the case that there is a concrete platform or sill that the dam was built on, it would be removed as well so it does not form diminutive dam overtime. The broken concrete would be loaded onto trucks from the equipment staging area and then hauled to a local concrete recycler for final disposal. Any disturbed areas will be restored to current conditions and/or planted with native vegetation.

Christiana Creek Dam Removal - The contractor will build a short access road and equipment staging area on the City of Elkhart land, in High Dive Park on the stream. Access to the stream would be gained by constructing a ramp from the equipment staging area down to the river bottom. Minor coffer dams are suggested for use on this dam since the sheet pile it is constructed of needs to be thoroughly removed below the stream bed as not to impair sediment transport or become a diminutive dam. All sheet pile and concrete removed would be properly disposed of. Any disturbed areas will be restored to current conditions and/or planted with native vegetation.

5.2 – Plans & Specifications

During the design phase, a detailed set of plans and specifications will be fashioned in order to solicit and award a construction contract. Also, prior to finalization of the plans and specifications, assurance will be made that all areas to be prepared by the non-Federal sponsor shall be in compliance with ER 1165-2-132, Federal, State, and local regulations. A schedule, quality control plan, and labor estimate

was fashioned along with the DPR Quality Control Plan (QCP) for the plans and specifications phase; if approval is granted to this project, the QCP would continue to be followed.

5.3 – Monitoring & Adaptive Management 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. Within a period of ten years from completion of construction of an ecosystem restoration project, monitoring shall be a cost-shared project cost. A five year monitoring plan following completion of construction will be implemented for the City of Elkhart Dams restoration project. This plan is detailed in **Appendix G**.

5.4 – Real Estate

The Real Estate Plan for the project site was developed by the Detroit District's Real Estate Division. The Real Estate Plan is included as **Appendix H**, which was reviewed and approved through a formal ATR. The current non-Federal LERRDs credit is estimated at $_____.

5.5 – Operation & Maintenance (O&M)

The O&M costs of the project are estimated to total an annual cost of $500 with a 4.875% interest rate over 50-years. Site maintenance, which will be quite minimal or unnecessary, includes the addition of stone in certain areas that experiences erosion that could potentially cause a problem to City infrastructure. A detailed O&M Manual containing all the duties will be provided to the non-Federal sponsor after construction is closed out.

5.6 – 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 City of Elkhart has agreed to serve as the local cost-sharing sponsor for the Elkhart River Dams removal 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 9** and **10**.

Table 9 – Total Project Cost

Intentionally Not Included

Table 10 – Cost Sharing Breakout

Intentionally Not Included

Responsibilities

Federal – The estimated Federal cost share of the project is approximately $_____. 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 sponsor 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 $_____ and will be covered by a cash value of $_____. 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 $_____. 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 PPA
   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 local 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 of 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 provide 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, easement, 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 6 – *RECOMMENDATION

I have considered all significant aspects of the problems and opportunities as they relate to the project resource problems of the City of Elkhart Dams restoration project. Those aspects include environmental, social, and economic effects, as well as engineering feasibility.

I recommend Alternative 3, which consists of reestablishing riverine connectivity within the Elkhart River and Christiana Creek and to a greater extent the St. Joseph River watershed. The recommended plan has a total project cost of approximately $_____. This plan provides 115.8 net average annual habitat units over 29.3-acres of riverine habitat. All costs associated with the restoration and preservation of the Elkhart River and Christiana Creek ecosystems have been considered.

_____
Frederic A. Drummond Jr.
Colonel, U.S. Army
District Commander

CHAPTER 7 – BIBLIOGRAPHY AND ACRONYMS

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