DRAFT
ENVIRONMENTAL ASSESSMENT

LITTLETON DAM REMOVAL AND ROCK RAPIDS CONSTRUCTION ON THE WAPSIPINICON RIVER, IOWA

U.S. Fish and Wildlife Service

La Crosse Fish and Wildlife Conservation Office
555 Lester Avenue
Onalaska, WI 54650

September 2017

Draft Environmental Assessment
Littleton Dam Removal and Rock Rapids Construction on the Wapsipinicon River, Iowa

Executive Summary

The La Crosse Fish and Wildlife Conservation Office of the U.S. Fish and Wildlife Service (USFWS) has prepared this assessment of the environmental effects that may result from the proposed removal of Littleton Dam and construction of a rock arch rapids on the Wapsipinicon River in the town of Littleton, Buchanan County, Iowa. The purpose of the proposed action is to improve river connectivity, upstream and downstream passage of fish and mussels through the river reach and eliminate the public safety hazard associated with the dam. This action involves removal of the dam, installation of an upstream rock rapids ending just upstream of the former dam, reshaping the river banks to a 2:1 slope for stabilization, constructing a rocked pathway for easier river access, and revegetation of disturbed areas. This Environmental Assessment provides information to the USFWS Regional Director on the potential effects of the proposed action for development of a Finding of No Significant Impact (FONSI). The assessment describes the need and purpose for the proposed action, identifies five alternatives, describes the affected environment, examines the environmental consequences for each alternative, and outlines the coordination, consultation, and involvement of the public through the process.

Efforts to comply with Section 106 of the National Historic Preservation Act concluded in January 2015. Littleton Dam was determined to be eligible for the National Historic Register of Places by the Iowa State Historic Preservation Office (SHPO) under criterion A for its association with a historical event. The dam was constructed in 1934 by the Civil Works Administration (CWA) under Roosevelt's New Deal Program that put Americans back to work. Proposed removal of an eligible historic property is an adverse impact of which mitigation is required for the causal of impact. A Memorandum of Agreement (MOA) was developed among the USFWS, Iowa Department of Natural Resources (DNR), U.S. Army Corps of Engineers, and the Iowa SHPO. The FWS and Iowa DNR carried out the mitigation measures outlined in the MOA.

To comply with stipulations of a DNR environmental review to avoid impacts to mussels, mussels were required to be moved from the proposed impact area and relocated to suitable habitat. A mussel relocation effort was conducted down river of the dam in the summer of 2012. Mussels collected were identified to species, measured, aged, and relocated to a suitable area further down river. A second relocation effort may be needed prior to the start of construction due to the time difference between the year mussels were relocated and the actual year of construction.

Removal of the deteriorating dam and construction of a rock rapids upstream of the former concrete structure will lower upstream surface elevations approximately 6 in. under existing conditions. Proposed action will reconnect 56.5 miles of the Wapsipinicon River and 91 miles of tributaries. The proposed project will improve upstream access to needed spawning habitat for adult fish, rearing habitat for larval and juvenile fish and improve the upstream distribution, abundance, and diversity of native mussels including the state listed creeper (*Strophitus undulates)* and ellipse (*Venustaconcha ellipsiformis*) mussels. Completion of the proposed action will eliminate the public safety hazard associated with the dam, provide safer in-stream passage for paddlers and maintain recreational fishing opportunities in the vicinity of former dam.

TABLE OF CONTENTS

1.0 INTRODUCTION 1

1.1 SCOPE OF DOCUMENT 1
1.2 LOCATION 1
1.3 BACKGROUND 2

2.0 PURPOSE AND NEED 2

3.0 ALTERNATIVES 6

3.1 DEVELOPMENT OF ALTERNATIVES 6
3.2 ALTERNATIVE A- NO ACTION 6
3.3 ALTERNATIVE B- DAM REMOVAL 7
3.4 ALTERNATIVE C- DAM MODIFICATION 7
3.5 ALTERNATIVE D- DAM REMOVAL WITH ½ HEIGHT ROCK RAPIDS 8
3.6 ALTERNATIVE E- DAM REMOVAL WITH FULL HEIGHT ROCK RAPIDS 8
3.7 PREFERRED ALTERNATIVE (ALTERNATIVE E) 8

4.0 AFFECTED ENVIRONMENT 14

4.1 AREA DESCRIPTION 14
4.2 SITE DESCRIPTION 15
4.3 NOISE 17
4.4 WATER QUALITY 17
4.5 GROUNDWATER 18
4.6 SEDIMENT 19
4.7 FLOODING 19
4.9 FISH 21
4.10 MUSSELS 24
4.11 WILDLIFE 25
4.12 THREATENED AND ENDANGERED SPECIES 25
4.13 WETLANDS 26
4.14 AQUATIC INVASIVE SPECIES 27
4.15 CULTURAL AND HISTORIC RESOURCES 29
4.16 ENVIRONMENTAL JUSTICE 30
4.17 RECREATION 30
4.18 PUBLIC SAFETY 31

5.0 ENVIRONMENTAL CONSEQUENCES 31

5.1 NOISE 31
5.2 WATER QUALITY 32
5.3 GROUNDWATER 33
5.4 SEDIMENT 33
5.5 FLOODING 34
5.6 FISH 35
5.7 MUSSELS 36
5.8 WILDLIFE 36
5.9 THREATENED AND ENDANGERED SPECIES 37
5.10 WETLANDS 38
5.11 AQUATIC INVASIVE SPECIES 38
5.12 CULTURAL AND HISTORIC RESOURCES 39
5.13 ENVIRONMENTAL JUSTICE/SOCIOECONOMICS 39
5.14 RECREATION 40
5.15 PUBLIC SAFETY 40

6.0 COMPARISON OF ENVIRONMENTAL CONSEQUENCES 42

7.0 CUMULATIVE IMPACTS 44

8.0 COORDINATION, CONSULTATION AND PUBLIC INVOLVEMENT 45

9.0 REFERENCES 48

List of Appendices

Appendix A. Pictures of Littleton Dam, Wapsipinicon River, Iowa
Appendix B. Public questions, comments and concerns

List of Tables

Table 1. Permits and approvals required for the Littleton Dam project 13

Table 2. Design flow rates for the Littleton Dam project. 20

Table 3. List of fish species collected by the Iowa Department of Natural Resources on the 22

Table 4. Mussel species collected in the Littleton reach of the Wapsipinicon River, August 2012 24

Table 5. Summary of elevations modeled at several stations at the 1-yr, bankfull, 2-yr and 100 yr event using flow rate information. 35

List of Figures

Figure 1. Location of the Littleton Dam project on the Wapsipinicon River in Littleton, Iowa. 3

Figure 2. Location of dams within the Upper Wapsipinicon River watershed. 4

Figure 3. Aerial view of Littleton Dam project area located on the Wapsipinicon River, Buchanan County, Iowa. 5

Figure 4. Aerial view of what the Littleton Rapids would look like on the Wapsipinicon River, Iowa 10

Figure 5. Alternative E- Full Height Rock Rapids design at the 3% slope on the Upper Wapsipinicon River at Littleton, IA. 12

Figure 6. Stretch of the Wapsipinicon River designated as a State Water Trail and Water Protection Area 15

Figure 7. Existing condition profile of the Littleton project area on the Wapsipinicon River, Iowa 16

Figure 8. The Silurian Devonian aquifer (lower left panel of the figure) encompasses the Wapsipinicon River in Buchanan County, Iowa. 18

Figure 9. Flood Insurance Map for the Littleton vicinity with Hazard Zone A (1% annual flood) 20

Figure 10. Map depicting wetland categories on the Wapsipinicon River from Littleton up river through the upper impoundment 28

List of Abbreviations and Acronyms

AIS	Aquatic Invasive Species
APE	Area of Potential Effect
AQI	Air Quality Index
BCA	Bird Conservation Area
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
CWA	Clean Water Act
DNR	Department of Natural Resources
DOI	Department of Interior
EIS	Environmental Impact Statement
EPA	Environmental Protection Agency
ERNS	Emergency Response Notification System
FEMA	Federal Emergency Management Authority
FONSI	Finding of No Significant Impact
HEC RAS	Hydrologic Engineering Center River Analysis System
HUC	Hydrologic Unit Code
IACC	Iowa Administrative Code Chapter
IFTMP	Iowa Fish Tissue Monitoring Program
IWWC	Iowa Whitewater Coalition
MOA	Memorandum of Agreement
NAWCA	North American Wetlands Conservation Act
NEPA	National Environmental Policy Act
NHPA	National Historic Preservation Act
NPDES	National Pollutant Discharge Elimination System
NPS	National Park Service
NRCS	National Resource Conservation Service
NREPA	Natural Resources Environmental Protection Act
NRHP	National Register of Historic Places
OSA	Office of the State Archaeologist
RAFT	Regional ambient fish tissue
SGCN	Species of Greatest Conservation Need
SHPO	State Historic Preservation Officer
TRI	Toxic Release Inventory
USACOE	US Army Corps of Engineers
USC	United States Code
USDA	U.S. Department of Agriculture
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
WMA	Wildlefe Management Area
WPA	Water Protected Area

1.0 INTRODUCTION

The U.S. Fish and Wildlife Service (USFWS) has prepared this Environmental Assessment (EA) to evaluate the potential impacts to the human and natural environment of the proposed removal of Littleton Dam and installation of an upstream rock arch rapids on the Wapsipinicon River in Buchanan County, Iowa. The proposed action has received National Fish Passage Program funds from the USFWS and dam safety funds from the Iowa Department of Natural Resources (DNR). Because of the funding sources, this project must comply with the Iowa Administrative Code Chapter (IACC) 13, National Environmental Policy Act (NEPA), (42 United States Code [USC] § 4321-4347), and the National Historic Preservation Act. The IACC 13 refers to lands and waters subject to review of natural resources by the Iowa DNR. The NEPA requires federal agencies to integrate an interdisciplinary environmental review process to evaluate a range of alternatives including the No Action alternative and provide an opportunity for public input as part of its decision-making process. The USFWS is the lead federal agency for the proposed action.

The EA will be used to determine whether to provide a Finding of No Significant Impact (FONSI) or an Environmental Impact Statement (EIS). If the EA demonstrates that there is no significant impact to the human and/or natural environment, a FONSI will be prepared. If the EA indicates that the proposed action is a major federal action that significantly affects the quality of the human and/or natural environment, a notice of intent to prepare a draft EIS will be published in the Federal Register.

1.1 SCOPE OF DOCUMENT

The format of this EA follows the guidelines set forth in the USFWS NEPA Reference Handbook (USFWS 2003). The “Purpose and Need” section provides the reason and justification for the action; the “Alternatives” section provides a description of the No Action alternative, the proposed action, and other alternatives that were under consideration; the “Affected Environment” section outlines existing environmental conditions; the “Environmental Consequences” section reviews the potential effects for each of the alternatives fully considered; the “Cumulative Impact” section examines past, current, and future actions on the Wapsipinicon River for potential positive/negative environmental impacts; and the “Coordination, Consultation and Public Involvement” section describes the collaboration among technical experts and regulatory agencies, and agency engagement with the public to address concerns and obtain feedback to help shape the proposed action.

Public concerns regarding sediment, potential impacts to site fishing, flooding, private wells, expected river conditions after dam removal, and the dam’s historical significance were expressed and addressed in the document. Public questions, comments and responses have been compiled and provided in Appendix B.

1.2 LOCATION

The proposed action would occur at Littleton Dam, located on the Wapsipinicon River in Buchanan County, Iowa (Figure 1). The dam is situated in the town of Littleton at T89N, R10W Section 9 (Lat. 42.530522 Long. -92.027918). County Road D16 crosses the river approximately 1.0 mile upstream of Littleton Dam and the town of Independence is located about 10.6 mainstem miles downstream.

1.3 BACKGROUND

Littleton Dam is one of seven that fragments the mainstem of the Wapsipinicon River in the state of Iowa (Figure 2). The dam partially obstructs upstream movement of walleye (*Sander vitreus*), channel catfish (*Ictalurus punctatus*), smallmouth bass (*Micropterus dolomieu*), suckers and other fish species during the majority of the spring and summer and hampers downstream movement to overwintering habitat in the fall.

The dam has been identified by the Iowa Department of Natural Resources as a high hazard dam, defined as having the potential to threaten life and/or property (Figure 3; Iowa DNR 2010a). Recirculating currents have contributed to nine documented deaths at this dam between 1936 and 1996 (IWWC 2012).

The 83-yr old dam exhibits signs of deterioration. Past floods have contributed to erosion of the concrete abutments on both sides of the dam with notable cracks and other damage to the east side of the dam and fish ladder (Appendix A).

The dam is in private co-ownership. A permanent conservation easement was purchased by the Iowa DNR for one of the properties in 2008. The easement provided the right to use the conservation easement area for approach and access to modify or remove the dam (Iowa DNR 2008). Discussions related to removal/modification of Littleton Dam began shortly thereafter. The second permanent access easement was obtained in the summer of 2017.

2.0 PURPOSE AND NEED

Purpose of the proposed project is to improve river connectivity through the river reach and eliminate the public safety and liability hazards associated with Littleton Dam. Removing the dam and constructing a rock arch rapids upstream will reconnect a 56.5-mile section of river, improving upstream and downstream movement of smallmouth bass, walleye, channel catfish, darters and minnows. It eliminates the dangerous hydraulic undertow formed by the lowhead dam and provides a safer environment for anglers and water enthusiasts such as canoeists and kayakers.

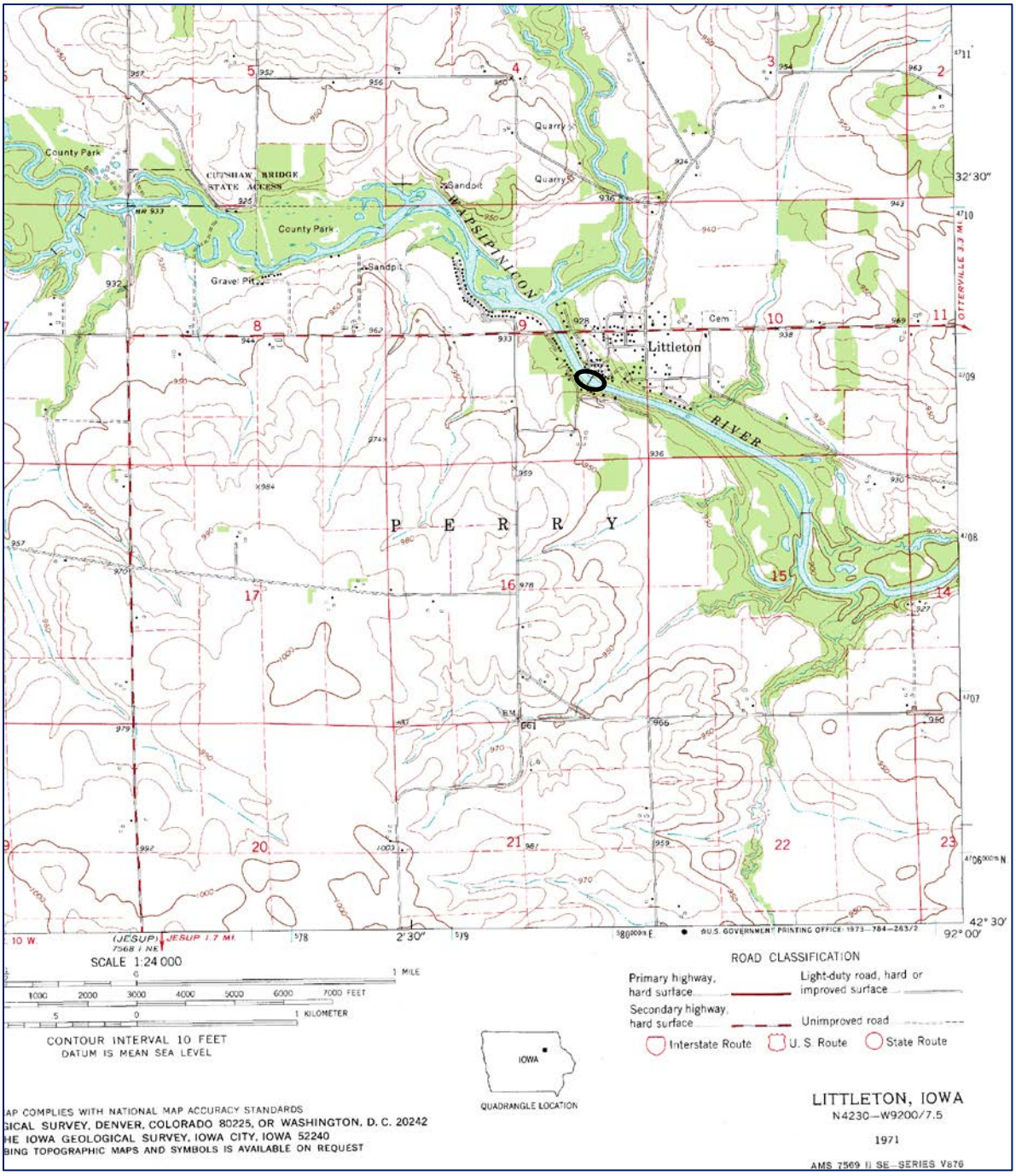

Figure 1. Location of the Littleton Dam project on the Wapsipinicon River in Littleton, Iowa.

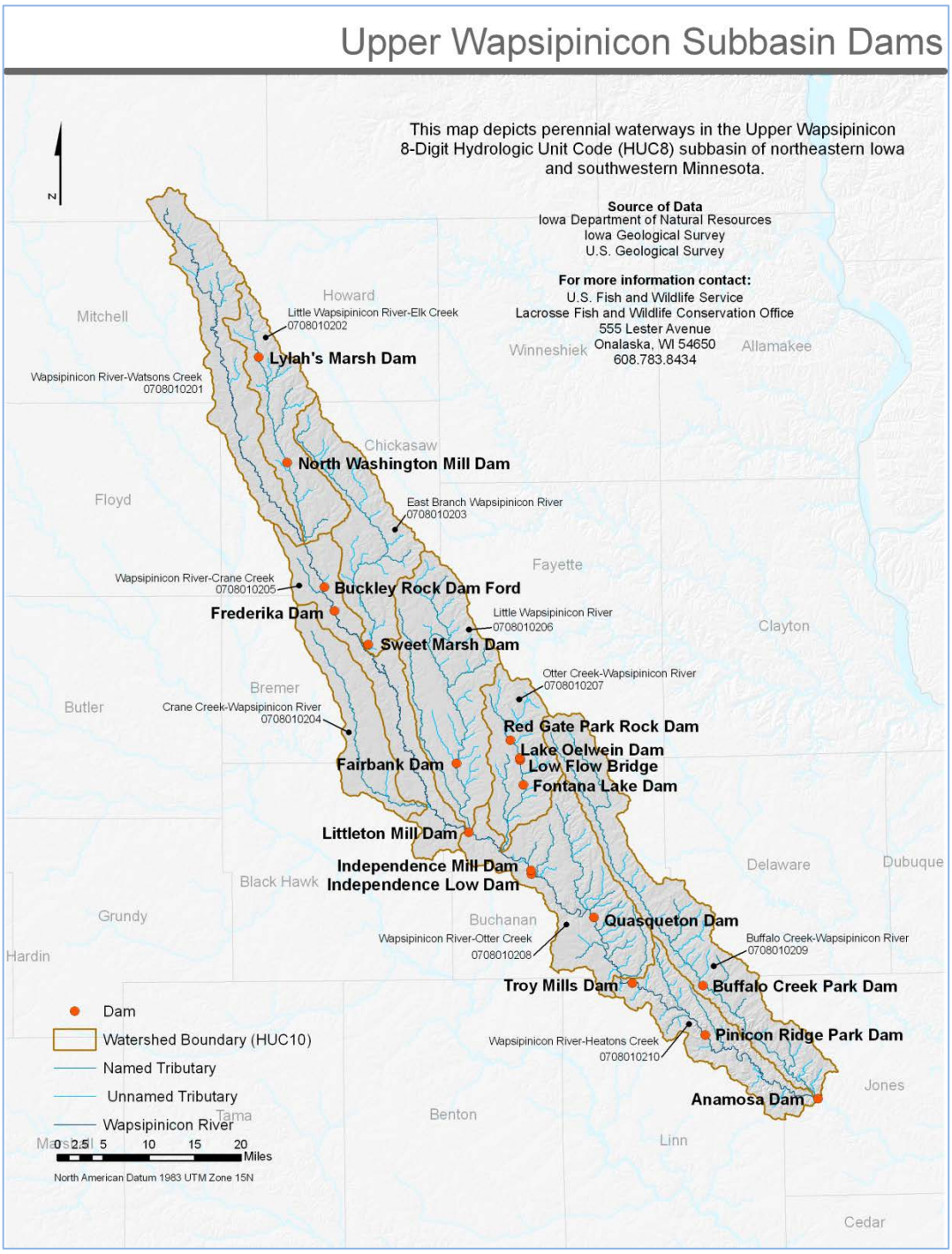

Figure 2. Location of dams within the Upper Wapsipinicon River watershed.

Figure 3. Aerial view of Littleton Dam project area located on the Wapsipinicon River, Buchanan County, Iowa.

3.0 ALTERNATIVES

3.1 DEVELOPMENT OF ALTERNATIVES

This section describes the process used to develop and consider a range of alternatives consistent with the requirements of NEPA. The project technical team considered a range of alternatives that could reasonably meet the stated need and took into account public concerns and feedback which ultimately lead to the preferred alternative. The range of alternatives considered were developed utilizing the following information:

- Objectives associated with the project Purpose and Need:
  (Objectives are not in order of priority)
  - Improve habitat connectivity and upstream/downstream passage for fish, mussels and other aquatic organisms
  - Improve public safety by eliminating the recirculating current formed by the dam
  - Eliminate safety liability and the future structural maintenance responsibility by private dam owners
  - Maintain existing recreational fishing in the vicinity of the dam to include areas immediately downstream of the dam
- Field reconnaissance and surveys to identify and assess fluvial geomorphology of the Wapsipinicon River (longitudinal and cross section channel characteristics, river channel stability, sediment transport and depositional patterns, habitat characteristics, etc.
- Fish and mussel surveys/ecological reviews
- Review of river reach and site specific conditions for each alternative
- Comments/input from the public

Alternatives Considered

Based on the above considerations, five alternatives were proposed, including the "No Action" alterative. Alternatives B and C were not carried out for further analysis because they were not considered feasible, either due to incompatibility with site specific conditions or they did not meet project objectives.

Alternative A-No Action
Alternative B- Dam Removal
Alternative C- Dam Modification- Rock Rapids downstream
Alternative D- Dam Removal with ½ Height Rock Rapids Upstream
Alternative E- Dam Removal with Full Height Rock Rapids Upstream

3.2 ALTERNATIVE A- NO ACTION

Under the No Action alternative, the dam would be left in its present configuration with no alterations to address the existing environmental impacts or safety issues. Leaving Littleton Dam in place would retain existing trends as described in Section 5.0 Environmental Consequences. The No Action alternative provides a basis for understanding positive and negative impacts of the proposed action. The dam would continue to impede upstream movement of fish to mainstem and tributary habitat during normal and low flows. The dam is passable under sustained high flows from snowmelt in spring or rainfall during spring or early summer. The structure would thereby continue to disrupt aquatic species movement, distribution, diversity and abundance in the river reach between Independence and Frederika dams.

The liability of owning a high hazard dam would remain under this alternative. Any future maintenance and repairs to meet state dam safety codes would remain the responsibility of the dam owners.

3.3 ALTERNATIVE B- DAM REMOVAL

This alternative would involve the full removal of the existing dam. The dam would be demolished using a backhoe and/or excavator. Material would be loaded on to dump trucks and hauled to a legal disposal site. This alternative would restore 56.5 miles of free-flowing river in the mainstem. Dam removal provides the greatest potential to restore passage for fish of all sizes and other aquatic species present in the river section under all flows. Removal of the dam would help reestablish natural flows, sediment transport, and restore in-stream habitat within the former impoundment. The public safety hazard would no longer exist because the hydraulic roller would be eliminated from removal of the structure. Dam removal would also provide safe navigation for canoeists and kayakers and safer site conditions for anglers and other water recreationists.

The dam removal alternative was undesirable to some local residents. Removal of Littleton Dam has the most significant impact on water surface profiles in comparison to the other alternatives considered. Under normal flow conditions, full dam removal would lower normal water surface elevations by more than four feet near the dam site. This would impact shallow wells within about a half mile of the dam, from about the upper middle of the impoundment, down river past the boat ramp, located at the dam. The lower water elevations under this alternative may adversely affect streambank stability, also. This could potentially lead to head cutting upstream of the removed dam along both streambanks downstream to the confluence with the Little Wapsipinicon River. Full removal would also have a negative short-term impact to existing wetlands upstream of the dam and would require mitigation if losses exceeded one acre.

3.4 ALTERNATIVE C- DAM MODIFICATION

The dam remains in place and a rock arch rapids would be constructed immediately down river of the dam at a gradual slope to allow fish to pass over the rows of rock weirs. This alternative would be similar to that constructed at Vernon Springs on the Turkey River, the Boone Waterworks Dam on the Middle Des Moines River and Quasqueton Dam on the Wapsipinicon River. This rock rapids design, in many cases, often functions to maintain the upstream water elevation. The rock ramp breaks up the recirculating current eliminating the drowning hazard. This type of design adds structural stability to the dam and requires little maintenance when constructed properly. Hydrologic surveys conducted in the river reach showed that only a small amount of silt had been deposited immediately down river of the dam. Interfluve, the first project environmental engineering consultant, projected that a rock ramp structure installed directly on bedrock down river of the dam would be unstable based on existing conditions. Not enough natural soft substrate of silt was predicted to be present to fill in the voids around the boulder weirs to hold them in place. Also, the construction of a rock rapids down river of the dam would have eliminated the popular fishing site that occurs immediately below the dam structure. Due to the anticipated instability of the structure and potential impact to the fishing site, this option was dropped from further consideration.

3.5 ALTERNATIVE D- DAM REMOVAL WITH ½ HEIGHT ROCK RAPIDS

The ½ height rock rapids would be constructed upstream of the existing dam with subsequent full removal of the dam. Three ½ height riffle design types were considered: a rock riffle constructed at a 1% slope with riffle length of 450 ft., a rock riffle constructed at a 2% slope with a riffle length of 225 ft.; or a rock riffle at 3% slope with a riffle length of 150 ft. This alternative would improve public safety by eliminating the hydraulic roller and provide fish passage under all three design types.

The 3% slope design was more feasible than the other two designs under the ½ riffle option. This design has the lowest drop in water levels at the dam site, upstream through the impounded area. The 150-ft. long structure would result in a 3-ft. drop in surface water elevation near the dam site under normal conditions. With this expected drop in water levels, projections indicated that an unknown number of private wells within a 0.5 mile buffer of the river would be impacted. Due to the potential negative impact to shallow water wells, this option was not selected.

3.6 ALTERNATIVE E- DAM REMOVAL WITH FULL HEIGHT ROCK RAPIDS

The rock rapids would be constructed upstream of the existing dam with subsequent full removal of the dam. Four designs types were considered under the full rock riffle alternative: a rock riffle at a 1% slope with riffle length of 780 ft., 2% slope with riffle length of 390 ft., a 3% slope with riffle length of 194 ft., and a 4% slope with riffle length of 150 ft. The full riffle alternative improves public safety by eliminating the hydraulic roller and improves upstream and downstream passage for fish and other aquatic organisms. The rock riffle structure would provide variable flow through and around the structure to allow fish of various shapes and sizes to navigate the structure, and would require little to no maintenance if constructed properly. The riverbed in the footprint of the rock rapids would change but would potentially provide riffle and pool spawning habitat for fish and microhabitat for various invertebrates and other aquatic organisms at the site. A riffle at the 3% slope would have a projected ½ foot drop under normal water levels alleviating potential impacts to shallow wells in the vicinity of the dam. The first rock weir would be constructed upstream of former dam site with the last weir row ending approximately at the former dam position. The intent is to maintain the conditions immediately below the former dam for anglers.

3.7 PREFERRED ALTERNATIVE (ALTERNATIVE E)

Alternative E is the preferred alternative. The dam would be removed and a rock riffle constructed upstream of the former dam at a 3% slope with a riffle length of 194 ft. Surface elevation at the dam site would be less than a 0.5 ft. drop and the pool elevation through the impounded area would remain the same. A rock rapids constructed at a 3% slope would present the fewest concerns related to the associated drop in water levels impacting private shallow wells and minimize concerns related to angling at the site. Mobilization of construction equipment, labor, removal of dam, purchase of rock, fill and placement of weir boulders, and streambank work near the dam would cost approximately $410,000.

Alternative E was recommended for the following reasons:

- Improves passage for fish and other aquatic organisms on the Wapsipinicon River at Littleton.
- Eliminates known drowning hazard associated with recirculating currents of the dam.
- Maintains channel and stream bank stability reducing occurrence of head cutting.
- Provides safer streambank access to the river for the public.
- Avoids impact to shallow water wells in the area.

- Provides recreational fishing opportunities within the constructed rock weir structure.
- Maintains scour hole below former dam, a popular fishing spot for local anglers.
- Improves navigation within the river reach for paddlers and other water recreationists.
- Eliminates future repair and maintenance costs associated with upkeep of the dam.

Description of dam removal with full height rock rapids construction

Rendering of the Littleton Rock Rapids project is shown in Figure 4. The rock rapids structure will be constructed upstream of the existing dam with the downstream extent of the boulder weirs terminating at the location of the former dam. The current dam has a spillcrest elevation of 913.23 ft. The elevation of the new rock structure will be about 1/2-ft. lower than the former dam with peak weir stone elevation set for 912.66 ft. The rock rapids will contain six weir rows and will be constructed at a design slope of 3%. The rock rapids structure will consist of 3.5 ft. medial diameter boulders. The large, appropriately sized weir boulders add additional resistance to movement if encountered by ice and floating and semi-floating trees moving down river. A 70-ft. wide trough will be constructed down the centerline of the rock rapids. The trough is important during low flow periods to help accommodate fish passage and provides easier navigation through the site for paddlers. The trough will be about ½ ft. lower than the weir boulders. The last weir will end at an elevation of 908.66 ft. The downstream end of the rock rapids will consist of base rock on a 4:1 slope to the bottom of the existing bed.

The flanks of the weirs boulders will be angled towards the centerline. As the rock weir structure rises towards the river banks, it allows for faster, deeper flow down the center of the rock rapids, and slower flow along each bank. Material will be placed across the entire width of the river and for the full extent of the rock rapids. Varied placement of material will provide multiple flow velocities around the rocks and boulders allowing upstream and downstream movement for various fish species. A rock rapids is designed to incorporate naturalistic river features of riffle-pool habitats. The rock rapids may serve as spawning substrate for riffle spawners like walleye which have been observed in Northwest Minnesota.

Dam Removal- Sequencing of how the dam would be removed would be left to the contractor. Water surface elevation at the site during construction will be specified by the DNR and conveyed to the contractor. Keeping surface water elevations close to specified levels avoid disruptions of water usage for wells, fire or other. Portions of the existing Littleton Dam would be removed down to the river bed. Any pilings and other structural features buried in the river bottom would be left. Concrete from the dam structure and the east bank would be used as part of the base for the upstream rock rapids structure. Material used must be clean or free from any rebar. Any non-useable material will be hauled off-site and properly disposed. Clean Class E riprap would be placed over the top of the crushed concrete.

Streambank Work-Trees along the left descending bank will be removed. Cleared trees will be mulched and placed in an area specified in the design plan. Stabilization of the immediate area streambanks will consist of reshaping the banks to a 2:1 slope. Exposed streambank sections would be seeded with grass to protect the bank from erosion. A rocked outcropping path (Figure 5) will be constructed to provide easier public access to the river for fishing and other recreation

Staging Area- Access for construction activity would occur via an existing public gravel access road and boat ramp adjacent to the dam. The parking lot and boat ramp is owned by a private landowner.

The Iowa DNR has a conservation easement for this area which is managed by the Buchanan County Conservation Board**.**

Construction could be completed in a 1-2 month period under good conditions. Low water levels and mild air temperatures during late fall or winter are usually ideal conditions for construction of this type. Construction during this timeframe would have a low impact on river recreation, as well.

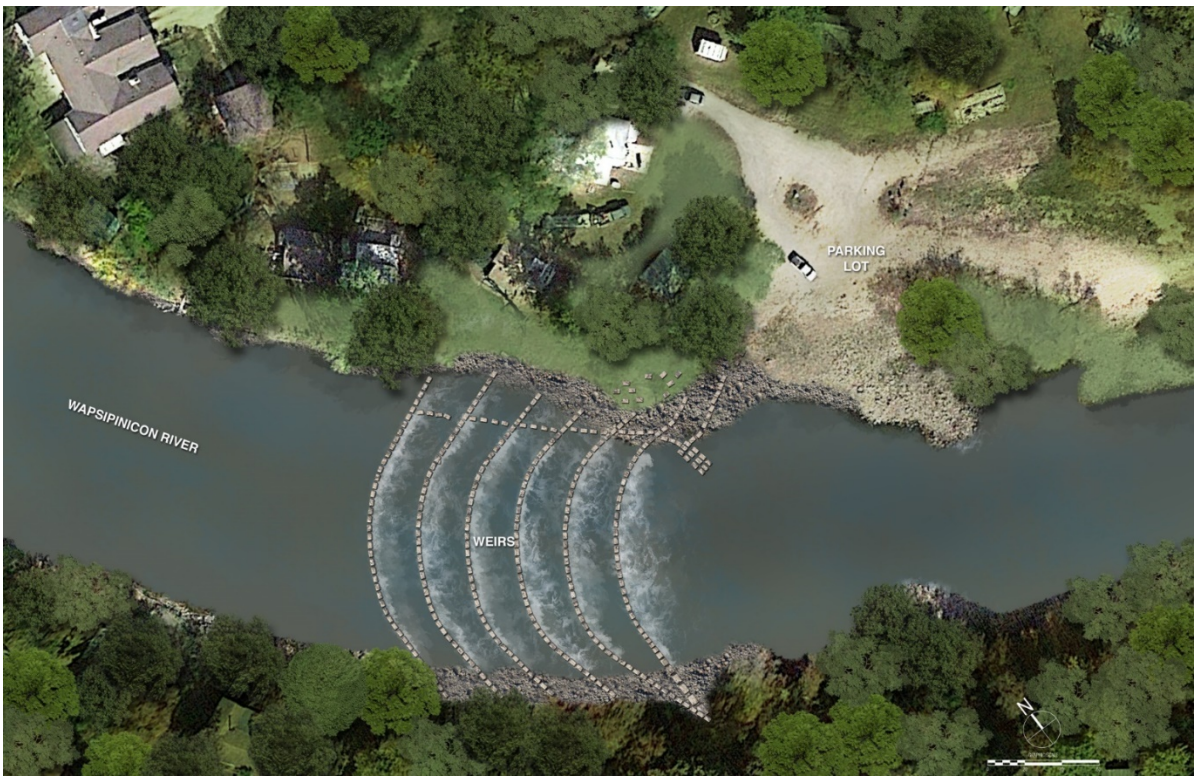

Figure 4. Aerial view of what the Littleton Rapids would look like on the Wapsipinicon River, Buchanan County, Iowa.

Significance of Risk/Unknowns

No significant unknowns are associated with the proposed alternative. Dam removals with installation of a rock arch rapids are commonly constructed in Minnesota and have predictable physical and biological results. Successful dam removal and construction of a rock rapids have occurred at Windom Dam on the West Fork of the West Des Moines River (2012), Montevideo Dam on the Chippewa River (2011), Luverne Dam on the Rock River (2010), Dawson Dam on the Lac Qui Parle River (2009), Breckenridge Lake Dam (2007) and Lyons Park Dam (2003) on the Otter Tail River, Hutchinson Dam on the South Fork Crow River and other sites throughout Minnesota (Aadland 2010).

Significance of Precedent

The proposed action is not precedent setting. Removal of this dam will reconnect 46.0 upstream miles of mainstem aquatic habitat with 10.5 downstream miles while protecting public rights in navigable waters.

Permitting

Several permits have to be obtained and authorizations and compliance reviews completed to implement the proposed action authorized under Iowa Administrative Code 567, chapter 71 (Table 1). A Flood Plains permit application will be co-submitted and will be review by the Iowa DNR Floodplains Division and the Regulatory Division of the U.S. Army Corps of Engineers (USACOE).

Section 404 of the Clean Water Act (CWA), authorizes the USACOE to issue general permits on a state, regional or nationwide basis for categories of activities where such activities will have minimal adverse effects. Section 401 of the CWA requires that before the USACOE can issue a Section 404 permit, the state water quality agency must certify that the proposed activity will not violate state water quality standards. The Iowa DNR has issued its Section 401 water quality certification for Nationwide permits. The proposed project will need to meet the conditions outlined in the Iowa Administrative Code, Environmental Protection 567, Chapter 61 “Water Quality Standards”. Permit application will be submitted and reviewed by the USACOE.

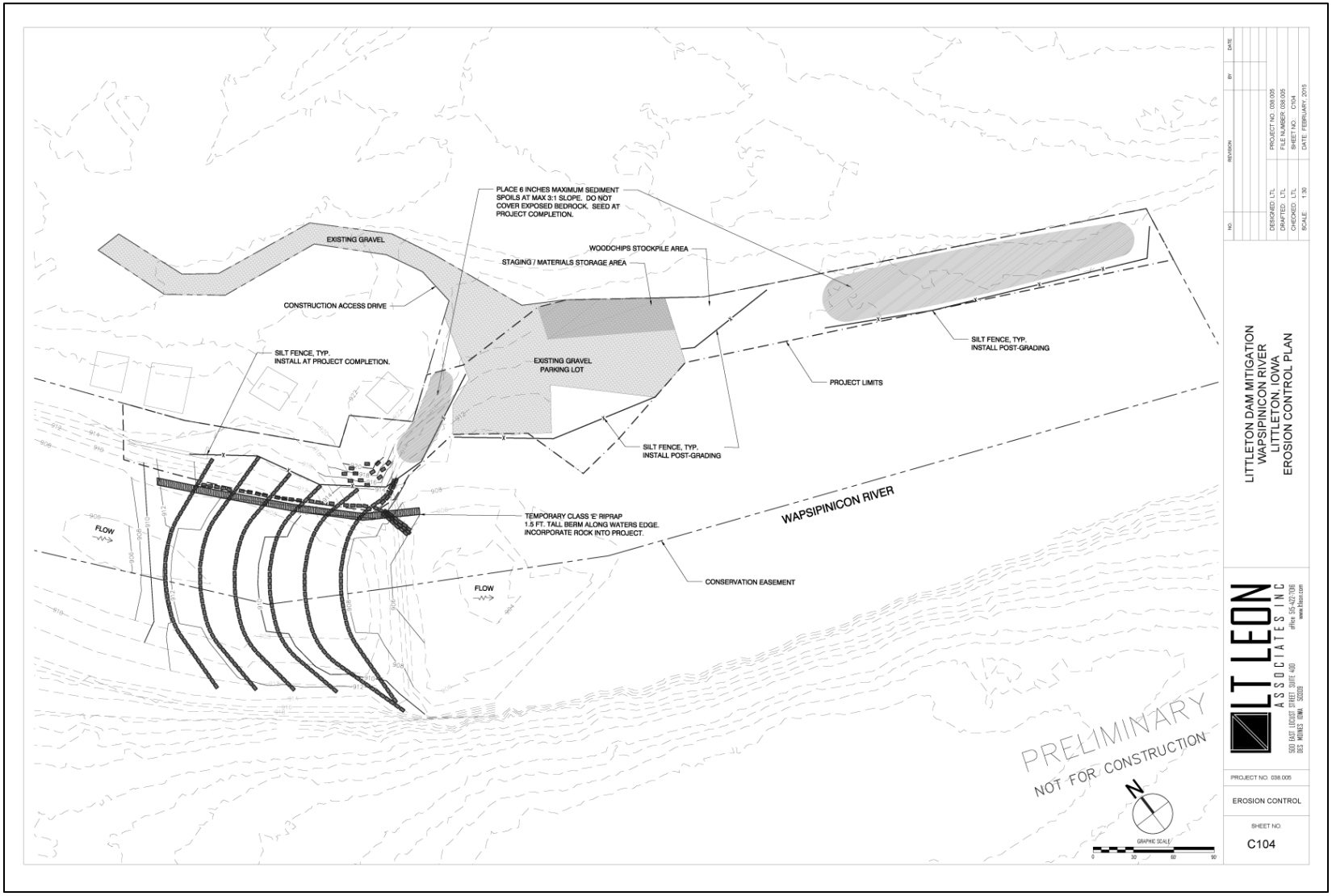

Figure 5. Alternative E- Full Height Rock Rapids design at the 3% slope on the Upper Wapsipinicon River at Littleton, IA.

Table 1. Permits and approvals required for the Littleton Dam project.

Agency	Authority	Requirement	Activity Covered
Iowa DNR	Iowa Administrative Code 567 chapter 71		Warning signage, portage trail construction, and modifications to or removals of low-head dams.
Iowa DNR	571 State of Iowa Administrative Code chapter 13	Flood Plains Permit	Activities in inland lakes and streams, fill placement/stream channel changes.
Iowa DNR	571 State of Iowa Administrative Code chapter 61	Section 401 (CWA) water quality certification	Issued for the 2012 Nationwide permits for projects that meet listed conditions
Iowa DNR		Environmental Review	Review of state threatened and endangered species in project area.
Iowa State Historic Preservation Office	National Historic Preservation Act	Section 106	Consultation and clearance regarding potential effect to historic/cultural properties.
U.S. Army Corps of Engineer	Federal Clean Water Act Under Section 404	Nationwide permit	Activities in streams, wetlands and other waters in the U.S. Issued for projects that have a minimum impact on the aquatic environment.
U.S. Fish and Wildlife Service	Endangered Species Act	Threatened and Endangered species review	Review of federally listed threatened and endangered species in project area.
U.S. Fish and Wildlife Service	National Environmental Policy Act	NEPA compliance	Environmental Assessment with Finding of No Significant Impact determination

4.0 AFFECTED ENVIRONMENT

The following section describes the physical, biological, and human environments that have the potential to be affected by the proposed action.

4.1 AREA DESCRIPTION

Region

The Wapsipinicon River basin (8-Digit Hydrologic Unit Code (HUC)) lies within the Iowan Surface landform of northeast Iowa and was formed during the Wisconsinan period by intense cold-climate weathering and erosion. The landform is characterized by low relief, dendritic drainage systems, stepped hillslopes, and widespread distribution of erratic boulders (Kendall et al. 2012). Rock outcrops and karst topography are common surface characteristics in the northern part of this landform.

The Upper Wapsipinicon River originates in southern Minnesota (Mower County) and flows some 268 miles southeast to the town of Anamosa, Iowa; location of the first dam from the Mississippi River. The watershed is 991,980 acres (1550 mi^2) in size and has an average elevation of 1,060 ft. above mean sea level (Natural Resource Conservation Service (NRCS) 2010). Land use in the watershed is primarily row crops (75.3%) and grass/ pasture/hay (9.8%). Residential and commercial development constitutes 7.5% of the land use in the watershed. Only a small percentage of the watershed is in forest (3.6%) and wetlands (3.4). Land ownership is 98.4% private and 1.1% county-owned (NRCS 2010). The largest population centers in the watershed are the towns of Independence and Anamosa.

Soils in the watershed are highly productive and well suited for agricultural uses. Eighty percent of the county is classified as prime farmland by the US Department of Agriculture (USDA). More specifically, soils in the Wapsipinicon River watershed near the proposed project site are predominantly Basset loam on the southwest riverbank and Finchford sandy loam on the northeast river bank (Kendall et al. 2012).

Hydrology- There are 46.0 mainstem river miles from Littleton Dam upstream to Alcock Park Dam at Frederika with four major tributaries flowing to the Wapsipinicon River between the two dams. The uppermost tributary is the East Fork of the Wapsipinicon entering the Wapsipinicon mainstem from the east. The first dam on East Fork is less than 1.0 mile upstream at Sweet Marsh, a state wildlife management area (WMA). Crane Creek is 33.5 miles in length and flows to the Wapsipinicon River from the west. Further down river, the Little Wapsipinicon flows to the main river just above 175th Street from the east. The first dam on this tributary is at Fairbank, 11.3 miles from the confluence with the Wapsipinicon River. Buck Creek, the 4th major tributary between Littleton and Frederika, is 35 miles in length and joins the Little Wapsipinicon downstream of the dam at Fairbank. There is an additional 21.2 miles of unnamed perennial stream flow to the aforementioned tributaries between Littleton and Frederika dams.

Resource Importance- The Wapsipinicon River is a state-designated water trail, a DNR program design to bring people together to reconnect with and conserve natural resources and promote watershed restoration (Wagner and Hoogeveen 2010). The Wapsipinicon is also a state Protected Waters Area (PWA) nominated because of its scenic, cultural and natural resource significance (Iowa DNR 1990). The boundary for each of the above designations stretches from Sweet Marsh to the Mississippi River (Figure 6).

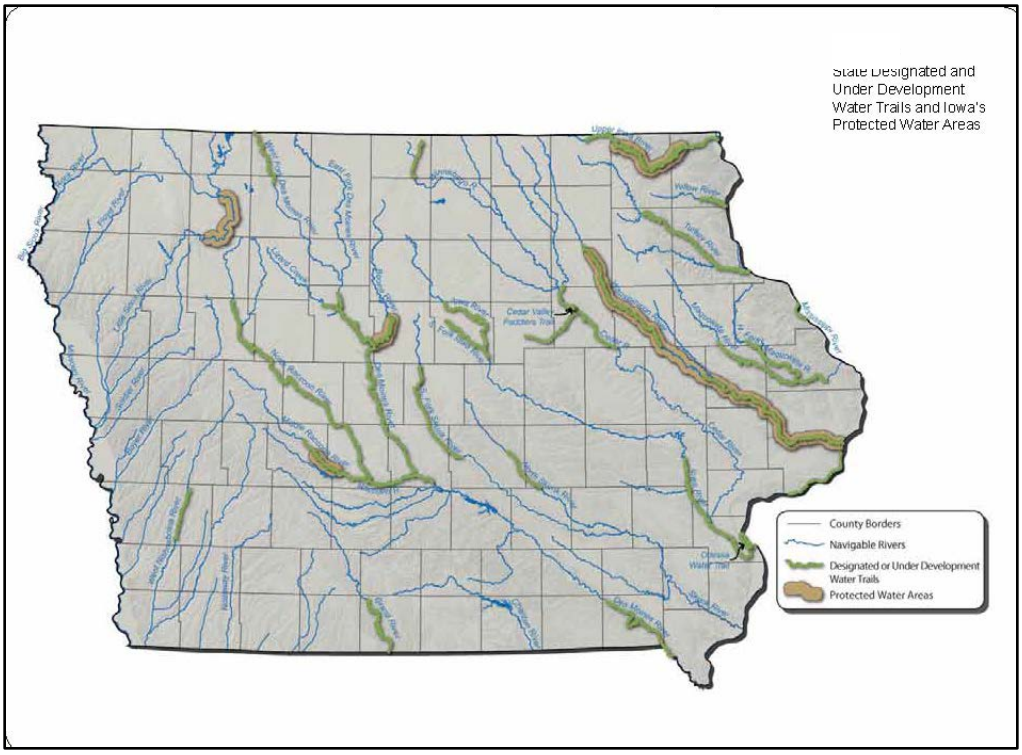

Figure 6. Stretch of the Wapsipinicon River designated as a State Water Trail and Water Protection Area.

4.2 SITE DESCRIPTION

The current day dam was constructed in 1934 by the Civil Works Administration (CWA) for the purpose of recreation. The dam is 270 ft. in width and is approximately 7.8 ft. in height. The elevation at the dam crest is 913.23 ft. A fish ladder was incorporated into the 1934 structure on the east side; however, the design of the stair step style was impassable by fish. The dam is a run-of-the-river structure so it has no control structures or gates to regulate flows. The dam impounds about 1.0 mile upstream and the impoundment is no wider than the average channel width of the river, approximately 150 ft. Substrate upstream of the dam is primarily bedrock with some presence of sand and the substrate immediately downstream of the dam is dominated by bedrock, with a manmade fishing hole on the east side of the river. There is mixture of sand, gravel, and cobble further down river extending through the first inside bend or meander.

Private residences are present on both sides of the river from 175th Street (D16) Bridge down river (Figure 7). A fire line access to the river, via a gravel drive, is located below the 175th Street Bridge on the right descending bank.

River banks in the immediate area of the dam and the proposed rock rapids structure are primarily in grass. Deciduous trees are scattered along both banks with broken concrete present along the east bank adjacent to the dam.

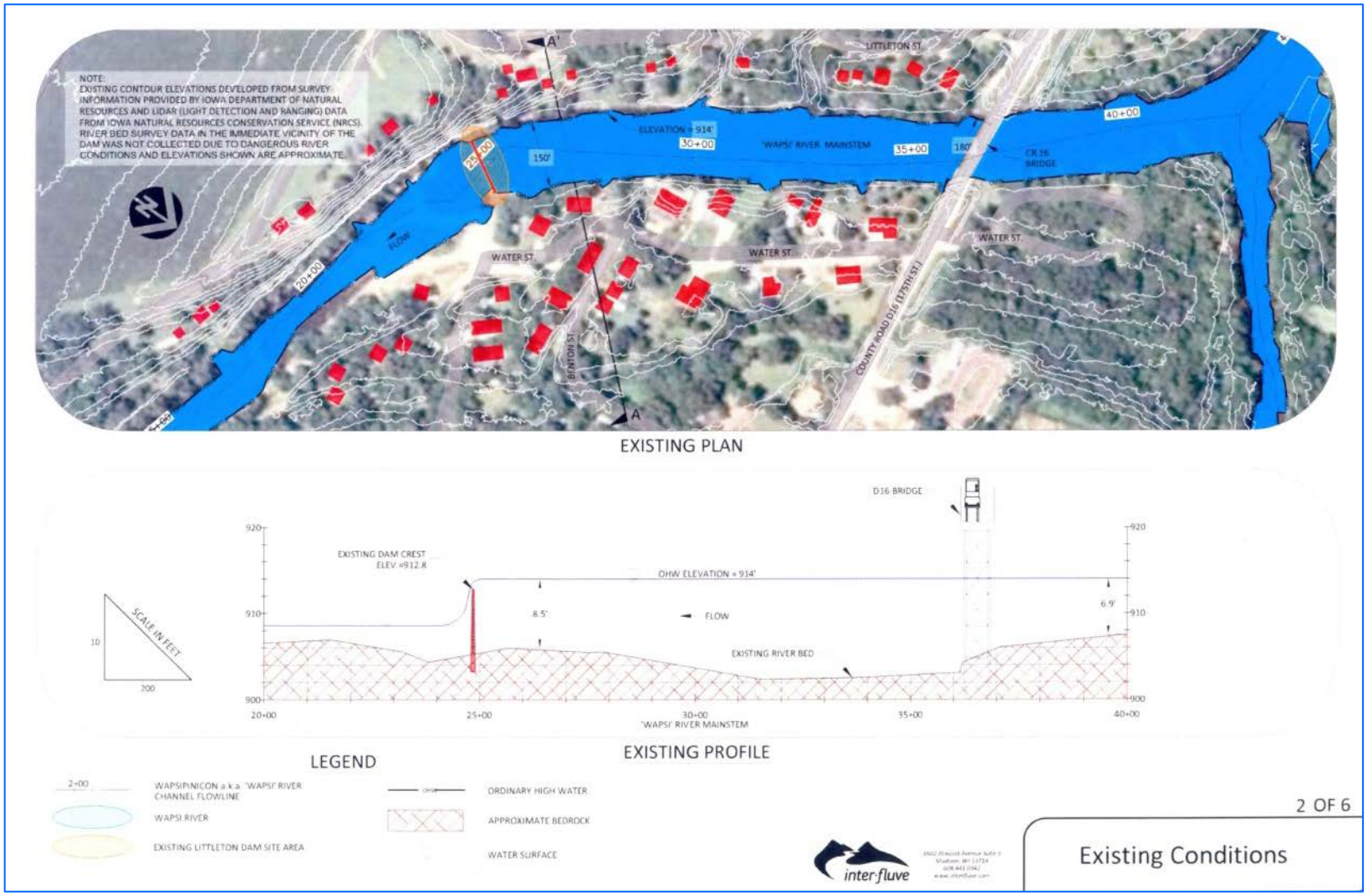

Figure 7. Existing condition profile of the Littleton project area on the Wapsipinicon River, Iowa.

4.3 NOISE

There is existing ambient or background noise associated with water flowing over the dam. Varying noise levels are dependent upon the volume of water flowing over the structure.

4.4 WATER QUALITY

Water Quality Assessment

Impaired waters-Water quality is managed through the implementation of state of Iowa Water Quality Standards (Iowa Administrative Code 61) and if designated uses of a water body are not fully met the water body is considered impaired and placed on the 303d list (Clean Water Act Section 303d). Designated uses are divided by river and stream segments and include: drinking water, swimming, recreation, aquatic life, etc. The Wapsipinicon River has a Class "A1"state water use designation of *Primary contact recreational use*. The river is also a Class B (WW-1) water in which the river is capable of supporting and maintaining a wide variety of aquatic life including game fish. These waters are assessed regularly for recreation, aquatic life, and game fish conditions. The 2014 and draft 2016 list of 303d impaired waters was checked for river and stream segments within the Wapsipinicon River watershed that do not meet state water quality standards (http://www.iowadnr.gov/Environmental-Protection/Water-Quality/Water-Monitoring/Impaired-Waters). The Wapsipinicon River reach from Harter Creek at Independence upstream to the confluence with the Little Wapsipinicon River near Littleton has been on the state 303d list since 2004 with indicator bacteria, *Escherichia Coli* (*E. coli*), listed as the cause of impairment in the river reach. *E. coli* is typically used to indicate fecal contamination in a waterbody. The microorganisms enter waterways from sources such as sewer discharges, failing septic systems, stormwater runoff, farm animals, wildlife, etc..

Hazardous, Toxic and Radiological Wastes- EPA's envirodatabase (https://iaspub.epa.gov/enviro/em4ef.home) was consulted for industrial, agricultural or other hazardous material that may have been dumped or spilled into the river from Littleton upstream to Tripoli to assess potential for contamination. No EPA Superfund Sites, Toxic Releases (TRI), hazardous waste, or water discharges were uncovered in the August 2017 review. No indications of contamination events or sites were discovered in review of the Emergency Response Notification System (ERNS) and the National Pollution Discharge Elimination System databases (NPDES).

Fish Consumption-Statewide testing of fish tissue in sportfish is used to help identify lakes and rivers where high levels of contaminants could potentially threaten the health of Iowans that consume fish. The program is known as the Iowa Fish Tissue Monitoring Program (IFTMP). Fish tissue is typically tested for mercury, PCBs, and agricultural chemicals such as chlordane and dieldrin from a variety of fish species including sportfish. In review (August 2017) of the IFTMP database, no fish consumption advisories have been issued for waters within the Upper Wapsipinicon River watershed http://www.iowadnr.gov/Environmental-Protection/Water-Quality/Water-Monitoring/Fish-Tissue

No other indications of poor water quality exist such as high temperatures and low oxygen levels during summer or reports of fish kills in the general area in recent years.

4.5 GROUNDWATER

Groundwater within the Littleton area of the Wapsipinicon River watershed is derived from the Devonian aquifer (Figure 8). Principal depths of aquifer usage range from 200-400 ft. (Iowa DNR 2003). According to GeoSam data, most wells that tap into the Silurian-Devonian aquifer range from 22-418 ft. with a mean depth of 167 ft. (C. S. Jones, Univ. Iowa, personal communication, September 7, 2017). Sandpoint wells range from 20-25 ft. Private wells within a 0.5 mile of Littleton Dam range in depth from 0-150 ft.

Wells in the area are generally of two types: drilled or sandpoint. Drilled wells are about 8 in. or less in diameter and draw their water from alluvial basins, inter-till sand and gravel deposits, or deeper bedrock that can hold and transmit water like porous or fractured limestone and sandstone. Drilled wells are normally designed to obtain water from aquifers in geological settings that offer greater protection from surface water and shallow groundwater. Drilled wells are recommended by the Iowa DNR because they are the most dependable and a safe source of drinking water (Iowa DNR 2003).

Driven or sandpoint wells are found in alluvial river basins and adjoining low lying areas near rivers and streams like the Wapsipinicon. These wells are usually 2-inches or less in diameter and are most often less than 50-ft. in depth. A screen allows the groundwater to enter the pipe and be pumped to the surface. The sandpoint wells are usually driven into shallow, unprotected aquifers which have a higher vulnerability to contamination at the land surface (Iowa DNR 2003). About 36 of the 90 wells or about 40% are 50 ft. or less and may have potential for contamination.

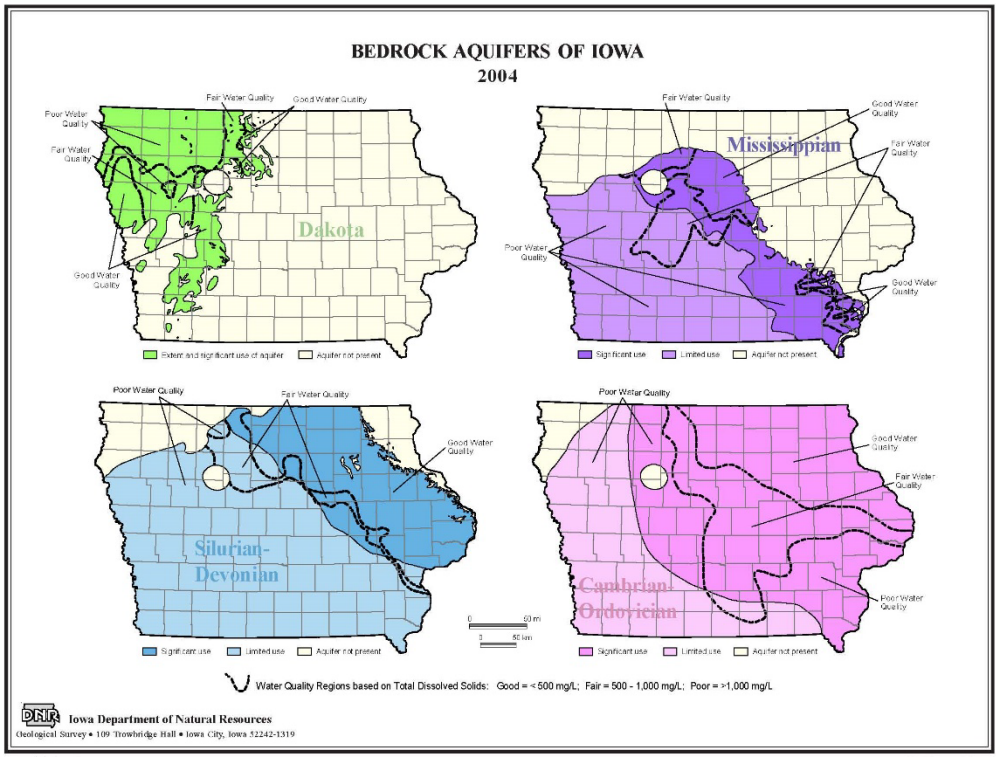

Figure 8. The Silurian Devonian aquifer (lower left panel of the figure) encompasses the Wapsipinicon River in Buchanan County, Iowa.

4.6 SEDIMENT

Sediment is an integral component of a river ecosystem. It contains important nutrients that riverine species require to survive and thrive. Sediment is naturally found on streambanks, riverbeds, and in the water column. As river flows transport and redistribute small and large sediments, gravel, cobble, and boulders, diverse habitats are created for aquatic biota. Dams typically block movement of sediment within a river, allowing sediment to be deposited behind the dam, altering the river's habitat upstream of the dam. The immediate reach down river of a dam is usually sediment starved with unstable, eroding banks.

A depth refusal survey was conducted by the Iowa DNR in the summer of 2011. Probing in multiple locations upstream of the dam showed that a negligible amount of sediment had accumulated upstream of the dam and none immediately downstream of the dam.

The surrounding land area upstream of Littleton is rural. No industrial activities are known to have occurred in this area, historically. Few anthropogenic influences are likely to contaminate sediments entering the Littleton impoundment. Detectable levels would likely be agricultural in nature. The DNR and Interfluve recommended that sediment testing for contaminants was not warranted since there was a negligible amount of sediment collected upstream of the dam. No past records were uncovered about hazardous events in the area and no major water quality concerns were revealed. There are however, elevated bacteria levels in the river reach contributing to the listing of the river section on the 303d list of impaired waters.

4.7 FLOODING

Executive Order 11988 requires Federal agencies to avoid, to the extent possible, the long and short-term adverse impacts associated with the occupancy and modification of floodplains and to avoid direct and indirect support of floodplain development wherever there is a practicable alternative. Federal agencies need to take action to reduce the risk of flood loss, minimize the impact of floods on human safety, health, and welfare, and restore and preserve the natural and beneficial values served by floodplains.

The Wapsipinicon River has a track record for flooding in the upper and middle portions of the watershed with flooding becoming increasingly more frequent. The Littleton area is occasionally overcome by flooding with more recent floods occurring in 2008, 2010, 2013 and 2017. Figure 9 shows the FEMA flood hazard map depicting the 1-percent annual chance flood for the Littleton vicinity. HEC-RAS (Hydrologic Engineering Center River Analysis System) models were developed by the LT Leon Associates Inc. to confirm that construction of the proposed rock rapids would not exacerbate flood flows. Using a USGS water resource planning application (StreamStats), flow rates were reviewed and considered for the 2-yr and 100-yr rain events. Flow rates were based on gage data collected from 1970-2011 by Interfluve and were used for the analysis. The flow rates were used to evaluate existing and proposed conditions. The drainage area used for the model was 577, 922 acres (903 square miles). A bankfull flow rate of 3520 cfs was determined based on proposed model results. This means that the bankfull flow rate of the tailwater fully submerges the slope of the water surface along the proposed rock arch rapids. The low flow condition was based on the flow rate that was exceeded approximately 75% of the time, according to the flow data compiled by Interfluve, Inc. Design flow rates are shown in Table 2.

Table 2. Design flow rates for the Littleton Dam project.

Recurrence Interval	Flow Rate (CFS) Used in Models	Flow Rate (CFS) Per StreamStats Application
Low Flow	140	--
1-Year	1370	--
Bankfull	3520	--
2-Year	9950	9380
100-Year	42810	31200

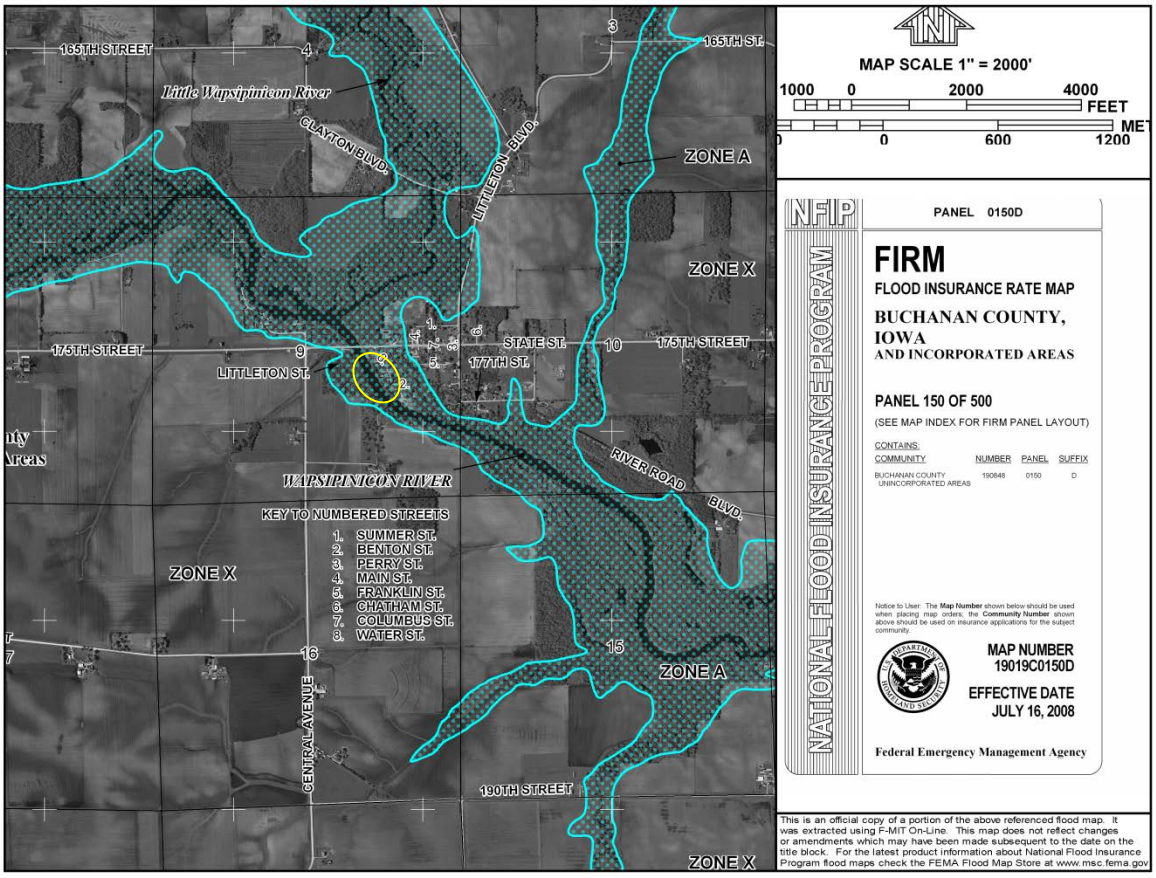

Figure 9. Flood Insurance Map for the Littleton vicinity with Hazard Zone A (1% annual flood) boundary outlined in green along the Wapsipinicon River. Source: http://www.fema.gov

4.9 FISH

The Wapsipinicon River watershed has historically supported a relatively diverse fish community. Since the initial era of dam construction in Iowa in the 1850s, the increased presence of barriers has impacted the number of fish species found throughout the main river and its tributaries. Studies such as Cumming (2004) and Porto (1999) have consistently shown that species richness decreases with upstream presence of dams on rivers and distance from connected large bodies of water including the Mississippi River. Ninety native species have been collected throughout the Wapsipinicon River over time. Sunfish species like bluegill (*Lepomis macrochirus)*, black crappie *(Pomoxis nigromaculatus)*, rock bass (*Ambloplites rupestris)*, green sunfish *(Lepomis cyanellus)*, orangespotted sunfish *(Lepomis humilis)*, and largemouth bass *(Micropterus salmoides*) have largely persisted throughout the river system since construction of dams. Sucker species such as golden *(Moxostoma erythrurum)*, shorthead *(Moxostoma macrolepidotum*) and silver (*Moxostoma anisurum*) redhorses, white sucker *(Catostomus commersonii)*, quillback *(Carpiodes cyprinus)* and river carpsucker *(Carpiodes carpio)* and some darters and minnows like the sand shiner *(Notropis stramineus*) and Johnny darter *(Etheostoma nigrum)* have also been collected throughout the lower and upper portions of the Wapsipinicon River. Game species like channel catfish *(Ictalurus punctatus*) and smallmouth bass *(Micropterus dolomieu)* continue to be present throughout the river, along with northern pike, in lower numbers.

The presence of common carp *(Cyprinus carpio)* and sunfish species such as bluegill, crappie, largemouth bass, green sunfish and orangespotted sunfish suggests that the river reach has more slow-moving flows or lentic habitat that is more favorable for the above species. The slower velocities within the impoundment may reflect the under-representation of darters and minnows which prefer swifter currents with cobble and rocky substrates, particularly in the upper reaches of medium size rivers like the Wapsipinicon.

Fifty-eight species have been collected in the river reach between Littleton and Frederika dams from past collection records. Electrofishing surveys were conducted in 2007 from an area upstream of Littleton, near Cutshall County Park. In 2004, surveys were conducted down river of Littleton near the Otterville Access. There were 30 species collected in the two surveys with golden redhorse, shorthead redhorse and spotfin shiner (*Cyprinella spiloptera)* recorded as the most common species collected.

Species such as the black redhorse *(Moxostoma duquesnei)* were absent in those surveys and have not been collected since 1997. The rainbow darter *(Etheostoma caeruleum)* has not been recorded since 1994 and the blackside *(Percina maculata)* and Iowa darter *(Etheostoma exile*) have not been recorded since 2000.

Iowa DNR annually conducts a fall sportfish survey at Otterville Access (3.5 miles down river of Littleton Dam) with the most recent survey completed during October 2016. Survey data collected from past years will be compared to future post project surveys to evaluate changes in fish community composition and relative abundance of smallmouth bass and walleye *(Sander vitreus)*, and SGCN black redhorse, blackside darter, Iowa darter, slenderhead darter *(Percina phoxocephala)*, and banded darters *(Etheostoma zonale)*. Table 3 shows fish species collected on the Wapsipinicon River from Anamosa to the Cutshall County Park area.

Table 3. List of fish species collected by the Iowa Department of Natural Resources on the Wapsipinicon River.

SPECIES NAME	SCIENTIFIC NAME	Down river of Anamosa Dam September 2008	Wapsipinicon River below Independence August 2002	Down river of Littleton Dam at Otterville July 2004	Upstream of Littleton Dam near Cutshall Park 2007
American brook lamprey	*Lampetra appendix*				
Banded darter	*Etheostoma zonale*	X			
Bigmouth buffalo	*Ictiobus cyprinellus*	X	X		X
Bigmouth shiner	*Notropis dorsalis*				X
Black Buffalo	*Ictiobus niger*	X			
Black crappie	*Pomoxis nigromaculatus*	X	X	X	X
Black bullhead	*Ameiurus melas*				
Blackside darter	*Percina maculata*				
Bluegill	*Lepomis macrochirus*	X	X	X	X
Bluntnose minnow	*Pimephales notatus*		X	X	X
Bullhead minnow	*Pimephales vigilax*	X	X	X	X
Central Mudminnow	*Umbra limi*				X
Central stoneroller	*Campostoma anomalum*				
Channel catfish	*Ictalurus punctatus*	X	X	X	X
Common carp	*Cyprinus carpio*	X	X	X	X
Common shiner	*Luxilus cornutus*		X	X	X
Creek chub	*Semotilus atromaculatus*	X			
Emerald Shiner		X			
Fantail darter	*Etheostoma flabellare*				
Fathead minnow	*Pimephales promelas*	X			
Flathead Catfish	*Pylodictis olivaris*	X			
Freshwater drum	*Aplodinotus grunniens*	X			
Gizzard shad	*Dorosoma cepedianum*	X			
Golden redhorse	*Moxostoma erythrurum*	X	X	X	X
Golden Shiner	Notemigonus crysoleucas	X			X
Green sunfish	*Lepomis cyanellus*	X	X	X	X
Highfin carpsucker	*Carpiodes velifer*	X	X	X	X
Hornyhead chub	*Nocomis biguttatus*			X	X
Johnny darter	*Etheostoma nigrum*		X		X
Largemouth bass	*Micropterus salmoides*	X	X	X	X
Logperch	*Percina caprodes*				

Mississippi Silvery Minnow		X			
Mooneye	*Hiodon tergisus*	X			
Northern hog sucker	*Hypentelium nigricans*		X	X	X
Northern pike	*Esox Lucius*		X	X	X
Orangespotted sunfish	*Lepomis humilis*	X	X		X
Pumpkinseed	*Lepomis gibbosus*	X			
River Carpsucker	*Carpiodes carpio*	X	X		
Quillback carpsucker	*Carpiodes cyprinus*	X	X	X	X
Rock bass	*Ambloplites rupestris*		X		X
Rosyface shiner	*Notropis rubellus*		X	X	X
Sand shiner	*Notropis stramineus*	X	X	X	X
Shorthead redhorse	*Moxostoma macrolepidotum*	X	X	X	X
Shortnose gar		X			
Silver chub	*Hybobsis storeriana*	X			
Silver redhorse	*Moxostoma anisurum*	X	X	X	X
Slenderhead darter	*Percina phoxocephala*		X		
Smallmouth bass	*Micropterus dolomieu*	X	X	X	X
Smallmouth buffalo	*Ictiobus bubalus*	X			
Spotfin shiner	*Cyprinella spiloptera*	X	X	X	X
Stonecat	*Noturus flavus*	X			
Suckermouth minnow	*Phenacobius mirabilis*				
Tadpole madtom	*Noturus gyrinus*				
Walleye	*Sander vitreus*		X	X	X
Western sand darter	*Ammocrypta clara*				
White bass	*Morone chrysops*	X			
White crappie	*Pomoxis annularis*	X	X	X	
White sucker	*Catostomus commersonii*	X		X	X
Yellow bullhead	*Ameiurus natalis*		X		
Yellow perch	*Perca flavescens*				

4.10 MUSSELS

In addition to a diverse fish community in the watershed, the unionid community is also diverse. Common species from Wapsipinicon River surveys include plain pocketbook (*Lampsilis cardium)*, black sandshell (*Ligumia recta)*, pimpleback (*Quadrula pustulosa*) and white heelsplitter (*Lasmigona complanata*) (Iowa DNR 2011). Mussels are good indicators of water and substrate quality, provide substrate for algae and insect larvae to attach to, attract fish to feed, and provide food for wildlife. Their distribution is dependent, in part, upon fish which serve as hosts for a portion of their life cycle. The life cycle of a mussel involves a parasitic larval stage in which the larvae, known as glochidia, attach to the gills of specific species of fish to feed for a short period of time. At the appropriate time of development the juvenile mussel drops off the fish, preferably in suitable habitat where the juvenile mussel grows to an adult. Dams typically inhibit or disrupt dispersal of fish hosts resulting in fragmented mussel populations and declines in species richness and diversity.

A qualitative mussel survey was conducted by the Iowa DNR in the downstream reach of Littleton Dam, August 2011, to determine species of mussels present and their distribution. Sixteen mussels were collected in the August survey representing two species, the plain pocketbook and creeper (*Strophitus undulates)*. In review of the survey information, the Iowa DNR required mussels present in the impact area to be relocated. A relocation effort was conducted in summer 2012. One hundred seventy mussels representing eight species were collected down river of the dam and relocated near Otterville. The Plain pocketbook was the most common mussel species collected down river of the dam.

As a result of the 2011 and 2012 surveys, two state listed threatened species were collected, the ellipse and creeper (Table 4). Other species of concern (SGCN) that were collected from the surveys were the elktoe (*Alasmidonta marginata*) and fluted shell (*Lasmigona costata*).

Table 4. Comparison of mussel species collected in the Littleton reach and Quasqueton reach of the Wapsipinicon River, August 2012.

Species	**Scientific Name**	**Location**	
		Quasqueton Dam downstream area	Littleton Dam downstream area
Black sandshell	*Ligumia recta*	X	
Creeper	*Strophitus undulates*	X	X
Elktoe	*Alasmidonta marginata*	X	X
Ellipse	*Venustaconcha ellipsiformis*		X
Fatmucket	*Lampsilis siliquoidea*	X	X
Fluted-shell	*Lasmigona Costata*		X
Giant floater	*Pyganodon grandis*	X	
Plain pocketbook	*Lampsilis cardium*	X	X

Pimpleback	*Quadrula pustulosa*		X
Wabash pigtoe	*Fusconaia flava*		
White heelsplitter	*Lasmigona complanata*	X	X

Source: Iowa DNR 2012. Mussels identified by Jennifer Kurth, malacologist.

4.11 WILDLIFE

Terrestrial wildlife along the Wapsipinicon River in the Littleton vicinity includes white-tailed deer (*Odocoileus virginianus)*, raccoon (*Procyon lotor)*, eastern gray squirrel *(Sciurus carolinensis)*, coyote (*Canis latrans)*, great blue heron (*Ardea herodias)*, and a variety of songbirds. Common wildlife species found down river in the Cortwright Conservation Area include wood duck (*Aix sponsa)*, Canada geese *(Branta canadensis*), great little brown (*Myotis lucifugus)*, big brown (*Eptesicus fuscus*) and eastern red bats *(Lasiurus borealis*), great horned (*Bubo virginianus)* and eastern screech owls (*Megascops asio)*, and an occasional snowy owl *(Bubo scandiacus*).

The Iowa DNR has designated the Wapsipinicon River in Bremer, Black Hawk and Buchannan counties as a Bird Conservation Area (BCA). Common upland game found in the BCA may include ring-necked pheasants *(Phasianus colchicus)*, bobwhite quail *(Colinus virginianus)*, wild turkey *(Meleagris gallopavo)*, ruffed grouse *(Bonasa umbellus)*, and American woodcock *(Scolopax minor)*.

4.12 THREATENED AND ENDANGERED SPECIES

Federally listed species

The USFWS Threatened and Endangered Species Database System was reviewed to identify the potential presence of listed species in the area of potential effect. Candidate species were also reviewed as they receive the same protections as threatened and endangered species. In the on-line search (https://www.fws.gov/endangered/), two species were listed in Buchanan County, the Eastern massasauga (*Sistrurus catenatus*) and Northern long-eared bat (*Myotis septentrionalis*).

Eastern massasauga–The Eastern massasauga rattlesnake can occupy a variety of habitats including marshes, sedge meadows, swamp forest along rivers and lakes, upland prairies, dry/wet woodlands, and old fields (USFWS 2012). Though the rattlesnake appears to favor aquatic habitats, they usually avoid open water but have been known to swim across water. Radio telemetry studies have shown that massasaugas utilize low, poorly drained habitat in the spring and fall and sparsely vegetated, dry areas during the summer in Illinois (Dave Mauger 1996), Missouri (Reinert and Kodrich 1982; Seigel 1986); New York (Johnson 1995), Ontario (Weatherhead and Prior 1992), and Wisconsin (King 1997). Van De Walle (2005a) found that massasaugas in Iowa used wet prairies and could be found in roadside ditch wetlands. Loss of wetland and prairie habitat in the Midwest has had profound impacts to the species.

The Eastern massasauga was believed to be common along the Wapsipinicon River corridor in the early 1900s (Christiansen and Bailey 1990). Today, they are rarely found (USFWS 1998). One small isolated population is present at the Sweet Marsh DNR Wildlife Management Area on the East Branch of the Wapsipinicon River, 47 river miles upstream from Littleton in Bremer County and the species is also present in the lower portion of the watershed. There are no reported sightings of the Eastern massasauga in the general area, in the proposed Littleton project area, or in

county management areas along the Wapsipinicon River in Buchanan County (Iowa DNR 2014b, Buchanan CCB 2014). Based on review of recovery information, current site conditions and local knowledge, a "*No Effect*" determination is expected for the proposed activities.

Northern long-eared bat-During summer, Northern long-eared bats roost singly or in colonies underneath bark, in cavities, or in crevices of both live and dead trees. They may also roost in cooler places like caves and mines or more uncommonly in barns and sheds. These bats forage for insects, primarily on forested hills and ridges rather than in streamside and floodplain forests (Harvey et. al 1999). Northern long-eared bats mate in early fall and usually give birth to one offspring the following spring. They begin hibernation in fall, after mating. They typically overwinter in large caves or mines with large passages and entrances, constant temperatures and high humidity, with no air currents.

Contact with the Buchanan CCB naturalist yielded no knowledge of the Northern long eared bat in the general area of the Cortwright Wildlife Area or in the dam vicinity (Buchanan CCB 2014a). No caves or mines are present at or in the vicinity of the project site where construction activities would occur. A USFWS determination of "*May Affect but Not Likely to Adversely Affect*" is expected because of no reported indications of presence of the species at the project site or in the general area.

State listed species

The proposed project was also reviewed by the Iowa DNR for impacts to state threatened and endangered plant and animal species. Recent fish and mussel survey data were used to aid in the review.

The Black redhorse is listed as state threatened and has not been collected in recent fishery surveys. The redhorse has a low tolerance for silt and turbidity and usually is found in medium size rivers that are clear with sand, gravel and bedrock substrates.

The creeper, collected in the 2012 unionid survey, is listed as state threatened. The mussel is oval shaped and is usually dark brown or black in older individuals. The creeper inhabits small to medium size rivers like the Wapsipinicon and is found in gravel, mud, or sand substrates (Cedar Valley RC&D 2002). The creeper has a broad range of host fish species that include the fantail darter, sand shiner and walleye.

The ellipse is a small mussel that is oval in shape and yellow-brown in color, with dark green rays. It is found in small to medium size streams with mixed sand and gravel substrates. Darters are known fish hosts for the ellipse.

4.13 WETLANDS

Executive Order 11990 directs federal agencies to avoid, to the extent possible, both short-term and long-term adverse impacts associated with the destruction or modifications of wetlands and to avoid direct or indirect support of new construction in wetlands whenever there is a practical alternative (FR 26961). Wetlands are transitional areas between terrestrial and aquatic systems and are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support under normal circumstances a prevalence of vegetation typically adapted for life in saturated soil conditions (Federal Interagency Committee for Wetland Delineation 1989).

Wetland habitat is critical to many species of waterfowl and is utilized by species such as northern pike for spawning and can serve as rearing habitat for pike, sunfish, walleye, and other species. The site of the proposed rock rapids encompasses the riverbed and riverbanks immediately upstream of the dam. There are no wetlands identified at the proposed project area; however, The upper portion of the impounded area is connected floodplain forest, consisting primarily of silver maple (*Acer saccharinum*), white (*Quercus alba*) and red oak (*Quercus rubra*), American elm (*Ulmus americana*), black walnut (*Juglans nigra*) and willow (*Salix sp.*; Figure 10).

4.14 AQUATIC INVASIVE SPECIES

In a review of the U.S. Geological Survey Nonindigenous Aquatic Species database and the Iowa DNR's fish datasets, no aquatic invasive species of concern were found. The local Iowa DNR area fish manager was also contacted and confirmed that there were no aquatic invasive species to be concerned with in the watershed from Independence to Alcock Park Dam at Frederika. Common carp, rainbow trout (*Oncorhynchus mykiss*), and brown trout (*Salmo trutta*) are already present in the watershed (http://nas.er.usgs.gov/). The non-native rusty crayfish (*Orconectes rusticus*) has been reported as present in the lower watershed from the Mississippi River upstream to approximately Troy Mills area with specimens identified from Linn County. A breach at the Troy Mills Dam, several years ago, may have expanded the upstream distribution of the crayfish. There are currently five dams between the Littleton Dam and the Mississippi River including dams at Independence and Anamosa that may, in part, continue to help prevent and slow the spread of aquatic invasive species.

There are several aquatic invasive plants species that are present in the Upper Wapsipinicon watershed, but there are no known invasive animal species known to occur in the immediate area. Brittle naiad (*Najas minor*), Eurasian watermilfoil (*Myriophyllum spicatum*) and purple loosestrife (*Lythrum salicaria*) have been documented in the Sweet Marsh Wildlife Management Area approximately 30 river miles upstream of Littleton Dam.

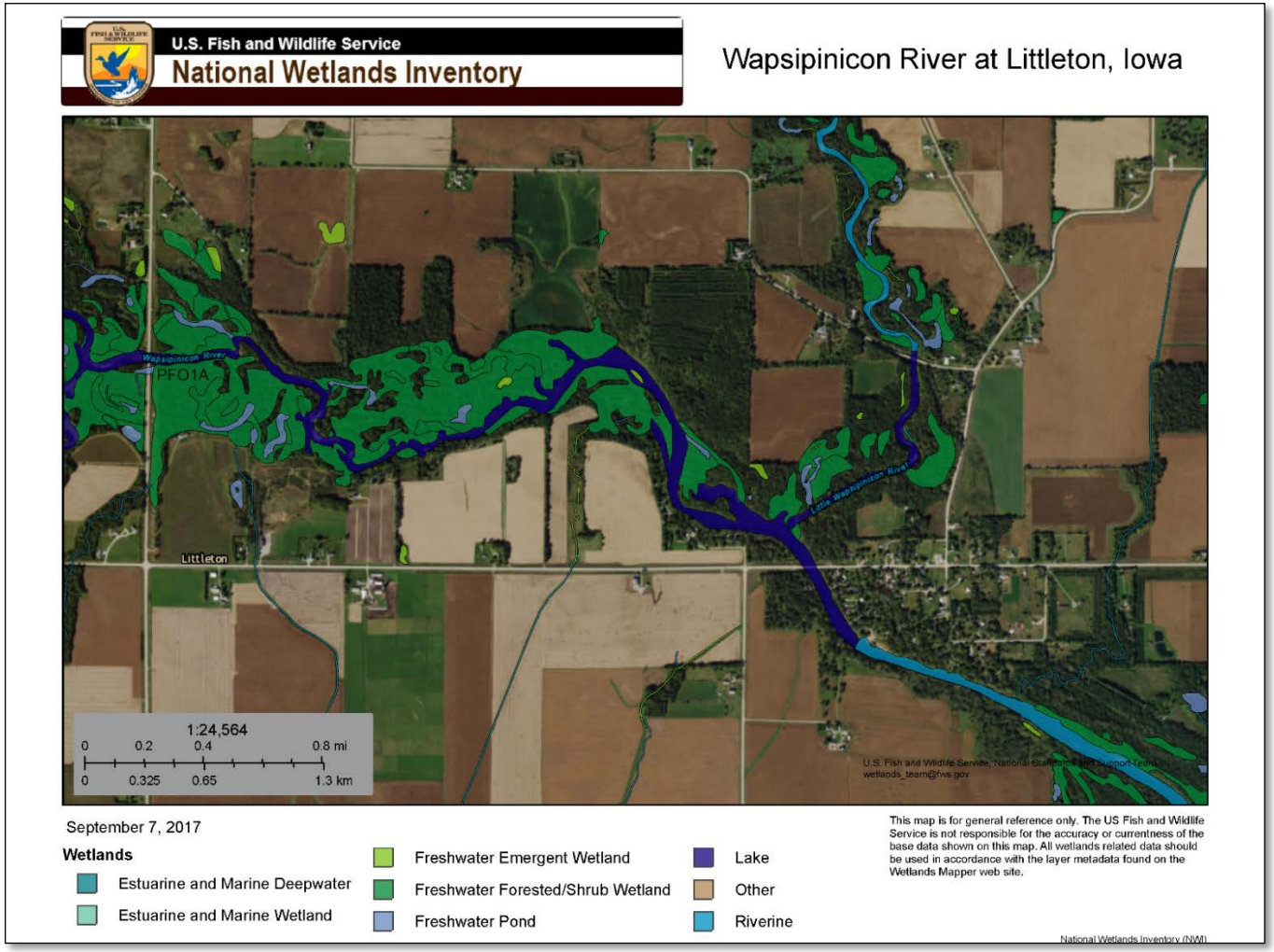

Figure 10. Map depicting wetland categories on the Wapsipinicon River from Littleton upriver through the upper impoundment.

4.15 CULTURAL AND HISTORIC RESOURCES

The USFWS worked to comply with the National Historic Preservation Act (NHPA) of 1966, as amended. Under Section 106 of the NHPA, federal agencies are required to take into account the effect of their proposed undertakings on properties listed in or eligible for inclusion in the National Register of Historic Places (NRHP). A Phase I Intensive Archaeological and Historic architectural investigation was conducted by the Iowa Office of the State Archaeologist (OSA) from Iowa City, IA to identify historic properties that may exist within the project area.

The NRHP is administered by the National Park Service (NPS) under the Secretary of Interior. Criteria used to determine whether a property within the proposed project APE is eligible for the National Register is based on age, physical integrity, and significance (NPS 1995). The structure or site has to be 50 years and older, in good condition, and have quality of significance. The third criteria refers to quality of significance in American history, architecture, archaeology, engineering, and culture that possess integrity of location, design, setting, materials, workmanship, feeling, or association *and* that falls into one or more of the criterion described below:

A. That are associated with events that have made a significant contribution to the broad patterns of our history; or

B. That are associated with the lives of significant persons in our past; or

C. That embody the distinctive characteristics of a type, period, or method of construction, or that represent the work of a master, or that possess high artistic values, or that represent a significant and distinguishable entity whose components may lack individual distinction; or

D. That have yielded or may be likely to yield, information important in history or prehistory.

Findings and recommendations from the Phase I intensive survey were provided in a detailed report. The OSA reported no archaeological concerns for the 0.2 hectares of the APE (Kendall and Carlson 2012). However, the OSA did identify Littleton Dam, site 10-00603, as a historic structure that was potentially eligible for listing on the NRHP (Kendall and Carlson 2012). The recommendation for eligibility was due to the quality of significance in the dam's association with a historical event. The dam was constructed under the Civil Works Administration (CWA), a short-lived, 1-year program under President Theodore Roosevelt's New Deal. The CWA was one of a series of domestic programs enacted by the administration that created temporary jobs for millions of people during the Great Depression.

The USFWS also submitted letters to the Buchanan County Historical Society, Littleton-Chahattan Historical Society, and the Meskwaki tribal preservation office requesting archaeological and historical/cultural information pertinent to the proposed project for potential use in aiding the agency in its findings and determination.

4.16 ENVIRONMENTAL JUSTICE

Civil Rights legislation and Executive Order 12898, *Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations*, direct federal agencies to analyze the proposed alternatives as they relate to ethnic minorities, people with disabilities, and low-income groups. The principles of environmental justice require that populations are allowed to share in the benefits of, are not excluded from, and are not affected in a disproportionately high and adverse manner by, government programs and activities affecting human health or the environment. It requires that "each federal agency identify and address, as appropriate, disproportional high and adverse human health or environmental effects of its programs, policies, and activities on minority populations" (CEQ 1997).

Based on the 2010 census, Buchanan County had a population of 20,958 with 3,252 persons residing in the Perry Township. Perry is 1 of 9 townships in the county. Minority groups constituted less than 2% of the township's population. Median household income from 2010 was $40,647 and low income individuals represented 6 % of the township's population, in comparison to the county's 9.1 percent.

According to the 2015, 5-Year American Community Survey, the population of the county has grown slightly to 20,998 and the median gross income has increased to $56,150 per year (https://affordablehousingonline.com/housing-search/Iowa/Buchanan-County).

4.17 RECREATION

The Wapsipinicon River in the Littleton vicinity is a moderately utilized area for recreational and leisure activities. Common activities include fishing, camping, canoeing, and wildlife watching. A small shelter containing picnic tables is also present on the grassy area adjacent to the dam.

Access- There is access to the river from the east side, immediately downstream of the dam via Greene Street, a gravel drive. Small boats, canoes, and kayaks can launch here and travel down river. Access for streambank fishing is easy and requires walking a short distance from the parking lot to the primary fishing area across relatively flat terrain covered by sand and gravel. The gravel parking lot is adjacent to this river access.

Fishing- Recreational fishing in the surrounding project area is notably important to local citizens. Shoreline fishing access is easy below the dam along the east bank and it is a popular spot to fish. Smallmouth bass, walleye, northern pike (*Esox lucius*), channel catfish (*Ictalurus punctatus*), and suckers (*Catostomus sp.*) are commonly caught with most fishing occurring from shore during the open water season. A formal recreational creel survey has not been completed in this segment of river, but a 2008 study on a comparable section of Wapsipinicon River at Independence found about 50 hours of recreational fishing effort occurred per surface acre of river. Actual effort immediately below the Littleton Dam is likely to be much higher than 50 hours per acre due to concentrated effort in small area, but when considering the reach around Littleton Dam it is likely to be comparable. The 2008 study from the Wapsipinicon at Independence found recreational catch rates were about 50 fish per acre and harvest rates were about 7 fish per acre. About 85% of people using the Wapsipinicon River fishery at Independence traveled less than 25 miles to fish there.

Wildlife Areas- The Cortwright Wildlife Area is located about a 1-mile down river on the left descending bank. The conservation area is 152 acres and provides hiking, hunting, wildlife watching, and fishing in five ponds that are naturally replenished by the river.

4.18 PUBLIC SAFETY

To date, nine deaths have occurred at Littleton Dam (Whitewater Coalition 2012). Deaths occurring at Littleton Dam and other dams are usually attributed to several factors including tubers and kayakers floating over dams from being unaware of their surroundings or just not seeing low seated dams, walking across dams and falling, wading or swimming too close to dams during times of unsafe water levels, getting caught in the recirculating current, and then are drawn underwater with strong current undertows. In some cases, small boats get too close to the dams and are drawn into the recirculating current. Still others, drown while trying to save those in trouble and wind up drowning themselves. In addition to the nine deaths at Littleton, eight or more "near misses" have also been reported and recorded by the Iowa DNR since 1936, with the most recent "near miss" reported during the summer of 2017.

5.0 ENVIRONMENTAL CONSEQUENCES

This section describes the environmental and social effects associated with the No Action, ½ height rock rapids and proposed full rock rapids alternative. Overall, the proposed dam removal replaced with a 3%- full height rock rapids is not expected to result in any long-term adverse environmental impacts for reasons explained in the following section.

5.1 NOISE

Alternative A - No Action

The general public identifies with sounds of water rushing over the dam like a waterfall. Sounds of a waterfall in the vicinity of the dam when water levels are high enough to flow over the structure would remain under the No Action alternative.

Action Alternatives-Dam Removal with ½ Height Rock Rapids or Full Height Rock Rapids

Temporary impacts due to increased construction noise would be experienced by residents on both sides of the river during the removal of the dam and construction of the upstream rock rapids. Construction activities would require the use of heavy construction equipment including backhoes, excavators, loaders, dump trucks, and possibly concrete cutting equipment. Road traffic would temporarily increase on Benton Street and Water Street with dump trucks entering and leaving the project site. No long-term adverse noise impacts would result from the associated construction activities.

The ambient noise of waterflow over the dam would be replaced by the sound of water rushing over and through the boulders and rocks of the constructed rock rapids. In a study conducted at Dillsboro Dam on the Tuckaseigee River in North Carolina, the principal investigator found that the decibel levels of sound did not change significantly with flow, except right at the dam (Hooper 2002). It was determined that sound levels diminished quickly as one moved away from the dam and that rock rapids on the river were louder than the dam under high and low flow conditions. Hooper (2002) also concluded that the rock rapids generated a more constant sound than the dam.

5.2 WATER QUALITY

Alternative A - No Action

No change in water quality is expected to occur as a result of No Action at Littleton Dam.

Alternative D- Dam Removal with ½ Height Rock Rapids

Water clarity may temporarily be reduced during deconstruction of the dam. Given a timeframe of late fall to winter, construction activity impacts to aquatic biota downstream of the site would be minimal. If sediment needs to be excavated, it will be placed on the streambank near the former dam for shaping and seeding. A small quantity of sediment in suspension from construction activities would be flushed downstream and may temporarily elevate turbidity levels.

There are no indications that removal of Littleton Dam would influence *E. coli* levels in a positive or negative manner in the 303d listed stream segment. Based on state and EPA reviews, there are no other issues that indicate water quality would be adversely affected in the Littleton area in the long-term.

Under this alternative, the river channel would be narrower with faster velocities through the impoundment. The narrower river channel and increased velocities may lower river temperatures during the summer benefitting fish and other aquatic organisms.

Alternative E- Dam Removal with Full Height Rock Rapids

Water clarity may temporarily be reduced during deconstruction of the dam. Impacts to aquatic biota downstream of the site are expected to be minimal given the small amount of sediment (sand) present in the lower impoundment and expected low water level conditions during the construction period. If sediment needs to be excavated, it will be placed on the streambanks near the former dam for bank shaping and seeding. A small amount of sediment in suspension from construction activities would be flushed downstream and may temporarily elevate turbidity levels.

There are no indications that *E. coli* levels in the 303d listed stream segment would be positively or negatively affected from removal of Littleton Dam. Also, based on EPA and state record searches for Superfund Sites, toxic releases, hazardous waste, and water discharges there are no indications that water quality from the upstream mainstem and tributary reaches would have an adverse impact to the Littleton area from implementing the proposed action.

Surface water elevation and width of the upstream river channel is expected to be similar to existing conditions; however, velocities are expected increase at the rock rapids site given the change in substrate type over a length of 194 ft.

5.3 GROUNDWATER

Alternative A - No Action

Groundwater and its private well usage would remain unchanged under the No Action alternative.

Alternative D- Dam Removal with ½ Height Rock Rapids

The difference in crest elevation from the dam to the river bottom (904 ft.) is about 9 ft. There would be a 3-ft surface elevation drop under the 3% - ½-height rock rapids design during normal river flows. Though shallow wells are not recommended or permitted for use by the Iowa DNR because of the high potential for contamination, an unknown number of wells less than 50 ft. in depth in the vicinity of the dam could be adversely affected with implementation of this alternative, over the long-term. Low river levels during summer and fall could further expand the number of shallow wells that would be impacted.

Alternative E- Dam Removal with Full Height Rock Rapids

Construction of the rock rapids and removal of the dam would be sequenced such that there would be no significant change in surface water elevation during that time period impacting shallow well usage. It is not expected that shallow wells in the vicinity would be impacted over the long-term with the projected ½ ft. drop or less in surface elevation at normal and low river flows.

5.4 SEDIMENT

Alternative A- No Action

There would be no change in sediment accumulation under the No Action alternative.

Alternative D- Dam Removal with ½ Height Rock Rapids

It is expected that with removal of Littleton Dam channel morphology down river of the dam would not be altered. Removing the dam during low water levels would minimize the release and transport of any silt present during deconstruction activities. Temporary elevation of total suspended solids and turbidity levels, if it occurred, would gradually diminish with distance and would not be discernible from naturally occurring sediment.

After the initial movement of sediment downstream from removal of the dam, sediment transported through the reach would help fill in the crevices within the rock rapids structure to solidify its stability. Sediment not settling in the cracks and crevices would continue to be transported naturally downstream.

There are no indications of contaminated sediment in this reach of river. No long-term impacts are expected from mobilization of the low quantity of sediment. Removal of the dam is expected to improve natural sediment transport.

Alternative E- Dam Removal with Full Height Rock Rapids

Sediment that may be present behind the dam would be excavated and placed on the streambank areas identified on the design plan. There are no concerns regarding contaminated sediment. Suspended sediment that does flow down river is not expected to alter the downstream channel morphology nor harm the ecological and human environment. Total suspended solids levels and turbidity levels would diminish down river with distance. If field conditions during construction

show that that an extensive amount of sediment is present and its disturbance would be a significant degree above natural conditions, a plan would be developed and evaluated to minimize sediment disturbance during construction activities. No significant adverse impacts from sediment disturbance or dispersal are expected.

Appropriate BMPs such as a silt fence will be employed by a contractor to minimize mobilization of sediment from the banks within the construction area as directed in design specifications and USACOE permit.

Transport of sediment downstream in the short-term, would help fill in the crevices within the rock rapids structure to solidify its stability. Particles not settling in the cracks and crevices would continue to be transported downstream.

5.5 FLOODING

Alternative A- No Action

Flood impacts remain unchanged under the No Action alternative during normal flow and flood events.

Alternative D- Dam Removal with ½ Height Rock Rapids

Lower water levels under this alternative would improve upstream river-floodplain connectivity. During flood events under this alternative, water levels would rise more slowly with a wider floodplain reducing the magnitude (height) and intensity of floodwaters.

The river channel is expected to become narrower upstream of the dam through the 1-mile impounded reach. Channel width downstream of the dam is expected to remain similar to existing dimensions.

Hydraulic models run by the Iowa DNR were used to confirm that removal of the dam and construction of full rock rapids would not increase surface water levels at the low flow, 1-yr, bankfull, 2-yr and 100 yr events.

Alternative E- Dam Removal with Full Height Rock Rapids

To address concerns regarding flooding impacts, results from the HEC RAS models indicated that surface water elevations are expected to be slightly lower (<7 inches) than existing conditions upriver of the dam at station 19633.33 during the low flow, 1-yr, bankfull, 2-yr and 100 yr events (Table 5). Surface elevations modeled at the first upstream weir, which serves as the crest of the structure, would be constructed just below (~3 inches) the former dam elevation of 913.23. Projected low flow surface elevations at weir #1 is projected to be slightly lower than existing elevations with the dam in place under flow conditions (Table 5). Projected surface elevations are similar to existing elevations downstream of the dam (station 1087.43) under each of the five flow conditions (Table 5).

Based from the HEC RAS modeled results, it is not expected that the full height rock rapids will exacerbate flood flows, and surface elevations near the former dam area are expected to be slightly less than existing conditions under low flows thereby not impacting shallow wells in the area. Flow conditions downstream of the dam are not expected to change with the installation of the full height rock rapids, based from the modeled flow results.

Table 5. Summary of elevations modeled at several stations at the 1-yr, bankfull, 2-yr and 100 yr event using flow rate information.

Station	Location	Low Flow		1-yr		Bankfull		2-yr		100-yr	
		Exist.	Proj	Exist.	Proj	Exist	Proj	Exist.	Proj	Exist.	Proj
19633.33	U/S of dam	913.78	913.12	914.82	914.15	916.16	915.44	918.81	918.63	929.08	929.10
1430.00	Weir#1	--	912.95	--	913.62	--	914.44	--	917.95	--	928.86
1299.00	Weir #6	--	909.14	--	910.60	--	913.20	--	917.92	--	928.85
1087.43	D/S of dam	909.15	909.14	910.58	910.58	913.20	913.20	917.94	917.94	928.82	928.82

5.6 FISH

Alternative A- No Action

Leaving the dam in place would continue to have a questionable impact to fish populations in the Littleton river reach. The dam would continue to serve as a partial barrier to various fish species migrating upstream during spring at the appropriate time to reach needed spawning habitat, trap (recirculating current) and kill larval fish drifting over the dam and impede movement to overwintering areas upstream or downstream of the dam. A continued lentic-like environment in the impoundment would maintain greater presence of common carp and sunfish.

Alternative D- Dam Removal with ½ Height Rock Rapids

Removal of the dam and construction of an upstream rock rapids would be less prohibitive to upstream and downstream movement by fish. The proposed action would improve upstream and downstream movements to seasonal mainstem and tributary habitat. The drop in water levels would transform the 1-mile impounded area back to a more lotic environment that benefits stream-dwelling species including smallmouth bass, darters and redhorse. A narrower river channel with swifter flows would result, along with improved sediment transport and more suitable habitat for fish species that prefer low turbidity, cool water temperature, and moderate velocities. Populations of sportfish with known seasonal movements to habitat including channel catfish, smallmouth bass, and walleye are likely to experience benefits in abundance or size structure. For example, larger walleye have a general tendency to move downstream and movements back upstream are blocked by dams.

Alternative E- Dam Removal with Full Height Rock Rapids

Inundation of the impounded area would largely remain similar to its current state with only a slight drop in surface water elevation. Carp and sunfish may continue to persist in the reach. However, fish will be able to maneuver the step-pool structure upstream and downstream to access spawning, rearing and overwintering habitat. The rock rapids structure eliminates the velocity barrier, particularly for small and medium sized fish. In the long term, the proposed action is expected to improve the distribution and abundance of species like black redhorse and slenderhead darter. Channel catfish, smallmouth bass, and walleye are likely to experience benefits in abundance or size structure, similar to the previous alternative. The constructed rock rapids may provide suitable spawning habitat for walleye, as well as spawning habitat and refugia for darters and minnows. The interstitial spaces created by various sized rock could also be favorable for invertebrate production, which in turn, increases the availability of food for some fish species. Similar

There may be a short term disruption in fish presence in which fish avoid the construction area due to noise or increased turbidity levels from construction activities. The impact is expected to be minimal because fish movement should be low when fall/winter construction activities occur.

5.7 MUSSELS

Alternative A- No Action

Low mussel species richness and diversity upstream of the dam would remain unchanged under the No Action alternative. Mussels reproduce at various times during the year depending on the species. If river flows are not high enough to allow fish to move upstream and downstream over the dam at the appropriate time, mussels will not encounter fish hosts to release their glochidia, their main dispersal and survival mechanism.

Action Alternatives- Dam Removal with ½ Height Rock Rapids or Full Height Rock Rapids

Removal of the dam and construction of a rock rapids will bolster fish host encounters with mussel glochidia because the barrier will no longer be present to impede upstream and downstream movement through this river reach.

In the long-term, species richness, diversity, and distribution are expected to increase in the river reach provided that substrate, velocity and depth conditions are suitable. Over time, the distribution of state listed species ellipse and creeper are expected to expand upstream of the former dam site. Mussel surveys in the river reach will be conducted in the future to evaluate changes in the community.

5.8 WILDLIFE

Alternative A-No Action

Under the No Action alternative, there would be no changes to wildlife.

Alternative D- Dam Removal with ½ Height Rock Rapids

Construction activities during late fall/winter are expected to have a minimal impact to amphibians, reptiles and small mammals as their activity levels are expected to slow down with colder air temperatures. Several species would likely be in hibernation. No long-term negative impacts are anticipated. The vegetation community including wetland plants, prairie plants, or tree species in the upper and mid portions of the 1-mile impoundment may slightly shift to a more terrestrial community because of the drop in surface water elevation. Removal of the dam and vegetative improvements within the disturbed areas of the project site would enhance habitat for wildlife.

Alternative E - Dam Removal with Full Height Rock Rapids

Construction activities during late fall/winter are expected to have a minimal impact to amphibians, reptiles, and small mammals because their activity levels are expected to have slowed with colder air temperatures. Bats, amphibians and reptiles are likely to be in hibernation starting late fall. No changes are expected to occur in the wildlife community given that water levels and vegetation are expected to be similar to existing conditions.

5.9 THREATENED AND ENDANGERED SPECIES

Alternative A- No Action

No federally endangered or threatened species would be affected by the No Action alternative.

Action Alternatives- Dam Removal with ½ Height Rock Rapids or Full Height Rock Rapids

Federally listed species

Eastern massasagua- There is no known presence of the Eastern massasauga in the direct construction area or the affected upstream area. Wetland habitat in the upper impoundment would not expected to be impacted, if the species were present. A "No effect" has been determined by the USFWS for the proposed construction of a rock rapids.

Northern long-eared bat- The range of the bat is statewide; however, there is no known presence of the bat near the construction area or within the 1-mile upstream impoundment. Suitable habitat for the bat consists of living trees such as cottonwood, silver maple, American elm, hickory, and ash trees having exfoliating bark. Trees that contain hollow areas may be suitable habitat for the bat and may be present in the project area. Tree removal adjacent to the dam is expected to be minimal. Any tree removal should occur during the hibernation period of the bat in a November-February timeframe before early spring when off-spring start to emerge.

Based on the potential presence of suitable habitat and the removal of several trees adjacent to the dam, the USFWS has determined that the proposed construction of a rock rapids "*May affect but is not likely to adversely affect*" the federally threatened Northern long-eared bat.

State listed species

It is anticipated that with improved connectivity from removal of the barrier there will be an increase in abundance of the black river redhorse upstream of the dam as the species has not been collected in DNR fish surveys above the dam since 1997. The Iowa DNR environmental review was completed in April 2012. The project was approved with the condition that mussels in the area of impact be relocated. To comply with the DNR's stipulation, mussels were collected down river of the dam and relocated to a suitable area identified by a DNR malacologist in 2012. Another survey effort upstream of the dam will be conducted if deemed necessary by the area DNR office before construction activities commence.

Presence and distribution of state listed creeper and ellipse are expected to expand upstream of the former dam, along with other species of mussels with increased frequency of upstream/downstream movement by fish hosts. The low amount of sediment movement down river is expected not to alter in-channel characteristics such as point bars or pools that may already provide suitable habitat for mussels.

5.10 WETLANDS

Alternative A- No Action

Wetlands including floodplain habitat will remain unaffected by the No Action alternative.

Alternative D- Dam Removal with ½ Height Rock Rapids

Removal of the dam and construction of a ½ height rock rapids would improve hydrology and sediment transport in the river between Frederika and Independence. These changes would also impact overall wetland habitat in the upper impoundment. Lower average water levels in the long-term would expand the width of the riparian corridor and river-floodplain connectivity. Increases in lateral (river-floodplain) connectivity under this alternative would slow the rise of floodwaters and reduce the height of flooding. The drop in water levels would establish new vegetative growth to help stabilize banks and prevent bank erosion.

With the predicted narrower river channel through the impoundment from the drop in surface water elevation, natural vegetation is expected to grow in the newly exposed areas throughout the impoundment and in the lower Little Wapsipinicon River during the following growing season. The sediment often contains seeds that, once exposed to sunlight and oxygen, germinate quickly.

Alternative E- Dam Removal with Full Height Rock Rapids

The majority of the construction will occur directly in the river. No wetlands have been identified within the construction area and wetlands in the upper impoundment are expected to be unaffected. The wetland community composition in the lower Little Wapsipinicon River is expected to be similar to existing conditions, as well. Therefore, a no net loss of existing wetland community is expected through the upstream impoundment and the Little Wapsipinicon River.

5.11 AQUATIC INVASIVE SPECIES

Alternative A- No Action

The potential for introduction and the spread of aquatic invasive species would not change under the No Action alternative.

Action Alternatives- Dam Removal with ½ Height Rock Rapids or Full Height Rock Rapids

Common carp are found throughout the upper Wapsipinicon River watershed and the rusty crayfish has been document in the Troy Mills area. Brown trout and rainbow trout are stocked in an a small segment of the Wapsipinicon River in Mitchell County, but the distribution of these salmonids is limited because water temperatures in downstream segments of the Wapsipinicon River are above the thermal tolerance for these species during most summers. Removal of Littleton Dam would have no impact on the spread of the above mentioned species. Modes of introduction and spread are more likely to occur from bait bucket and intentional releases or from transportation by contaminated boats, trailers, live wells, and fishing equipment such as waders and fishing gear.

5.12 CULTURAL AND HISTORIC RESOURCES

Alternative A - No Action

No archaeological or historical properties would be affected under the No Action alternative.

Action Alternatives- Dam Removal with ½ Height Rock Rapids or Full Height Rock Rapids

After reviewing the OSA's archaeological and historic architectural report, the USFWS determined that Littleton Dam was eligible for the NRHP based on its association with an event that shaped the broad patterns of our history (Criterion A). The USFWS submitted a determination letter to the Iowa SHPO for review and comment in August 2012. In response, Iowa SHPO concurred that the dam was eligible for the NHRP under Criterion A.

Following the guidelines of Section 106, alternatives to avoid or minimize the alteration of the characteristic of the eligible historic property were explored. The consulting parties reached and agreed that there was no feasible alternative that could be implemented to avoid or minimize the adverse effects to the dam and still meet project objectives of eliminating the hydraulic roller and improving passage for fish and other aquatic species given site specific conditions. Project parties therefore agreed to mitigate for removal of the eligible historic property. A Memorandum of Agreement (MOA) was developed among the Iowa SHPO, Iowa DNR, USACOE, and USFWS). Stipulations of the mitigation were associated with the criterion that the dam's eligibility was based upon. A publication entitled "Building Jobs in Iowa- New Deal Dams in Wapsipinicon River Watershed" was developed for public availability. The USFWS and Iowa DNR worked with a consultant through completion of this document. The history of the dam, its association with the CWA program and other dam projects completed by the CWA or New Deal programs within Buchanan County and the Wapsipinicon River watershed were summarized. After fulfillment of the terms in the MOA, the Iowa SHPO concurred with project plans. This led to the conclusion of Section 106 in 2015.

5.13 ENVIRONMENTAL JUSTICE/SOCIOECONOMICS

Alternative A- No Action

There would be no impacts to minorities within Perry Township under the No Action alternative.

Action Alternatives- Dam Removal with ½ Height Rock Rapids or Full Height Rock Rapids

No negative impacts are expected with regard to the local population, unemployment, median per capita income, and local industry of the Perry township area. The proposed project is not located in a minority community and would not affect residents of low or moderate income.

The proposed project is not expected to have significant impacts to the socioeconomic environment of the township. The dam and the water it backs up currently does not serve as a major economic purpose. The dam does not provide power, electricity, irrigation water, municipal or industrial water supply, flood control benefits or significant waterfowl benefits. The proposed action is not expected to pose an adverse impact or otherwise on the human environment.

Implementation of the proposed action could have beneficial social and economic effects and could positively affect members of the public. Construction activities could result in a minor short-term infusion of income into area communities from purchase of materials from vendors, lodging, dining or employment of persons from the area, particularly if construction work is awarded to near area

contractors. Potential increases in revenue from lodging, dining, and shopping, fishing equipment/supplies sales and public services may benefit local businesses along the river.

5.14 RECREATION

Alternative A- No Action

Site and area fishing upstream and downstream of the dam would remain. Access to the river upstream and downstream of the dam would remain the same for anglers and paddlers. Paddlers would still have to portage around the structure.

Action Alternatives- Dam Removal with ½ Height Rock Rapids or Full Height Rock Rapids

The gravel parking lot adjacent to the river access from Water Street would temporarily be a construction zone and closure of the lot would be necessary for staging large equipment and material for carrying out construction activities. Winter construction would have a temporary, mild impact on parking lot use for ice fishing and other river activities. Construction activity during this time period also minimizes the impact of elevated turbidity and noise levels that would otherwise affect anglers during the spring or summer. Timing of construction would also minimize the noise that may carry a distance and impact the quality of hiking, wildlife watching, and hunting down river of the dam at the Cortwright Wildlife Area. Once construction activities have ceased, any negative recreational impacts would subside. The proposed project will have no long-term adverse impacts on the recreational environment.

Completion of the proposed project is expected to have long-term recreational benefits. Canoeists and kayakers will have a 56.5-mile long continuous stretch of river to paddle. Paddling trips through the river reach may increase overnight stays at campgrounds, cabins, hotels and spending for food at conveience stores and local restuarants. Sport fishing is anticipated to improve within the river segment. The primary fishing hole will be maintained below the former dam so fishing opportunities and catch rates are expected to be similar to the present. There will be a change in the appearance of the site and the primary fishing area below Littleton Dam; however, the rapids is situated just upstream of the former dam and the river current should keep the fishing pool scoured of sand and sediment. Similar to other constructed rapid sites in Iowa and Minnesota, the Littleton rock rapids design will provide opportunities to fish within, above and below the structure. As such, angler effort would be spread over a larger area at the rock rapids site.

5.15 PUBLIC SAFETY

Alternative A- No Action

If the dam were to remain in place the structure would continue to be a drowning risk to the public.

Action Alternatives- Dam Removal with ½ Height Rock Rapids or Full Height Rock Rapids

Removal of the lowhead dam eliminates safety concerns related to the potential risk of drowning from dangerous recirculating currents. Proposed action also eliminates safely liability associated with the dam.

Dam removal with installation of a rock rapids structure upstream will allow for safe passage of canoeists and kayakers navigating through this river segment and safer and easier access to the river for anglers. Rock rapid sites such as the Boone Water Works rapids on the Middle Des

Moines River and Vernon Springs rapids on the Turkey River were designed to have flatter boulders in the trough to accommodate safe passage for paddlers.

6.0 COMPARISON OF ENVIRONMENTAL CONSEQUENCES

A comparison of environmental consequences for the No Action and proposed action alternatives are found in Table 5.

Table 5. Summary of environmental consequences for each alternative proposed in the Littleton Dam removal and rock rapids construction project.

Affected Environment	No Action	Dam Removal ½ Height Rock Rapids	Dam Removal and Full Height Rock Rapids
Noise	*No Change.*	*Minor and temporary impact* during construction. Noise from heavy equipment leaving and entering construction zone. Long-term change to sounds of water flowing through a rapids.	*Minor and temporary impact* during construction. Noise from heavy equipment leaving and entering construction zone. Long-term change to sounds of water flowing through a rapids.
Water Quality	*No Change.*	*Minor and temporary impact*. Possible increase in short-term turbidity levels during removal and excavation of sediment, if needed.	*Minor and temporary impact*. Possible increase in short-term turbidity levels during removal and excavation of sediment, if needed.
Groundwater	*No Change.*	***Adverse Impact***. Lower water levels may negatively impact an unknown number of shallow sand point wells within a ½ mile of the dam area; and may interfere with fire line access to readily obtain sufficient water in the impoundment.	*No Impact*. Surface elevations in affected area slightly lower than existing conditions at dam area at low flows.
Sediment Transport	*No Change*. Disrupts natural sediment transport.	*Minor and temporary impact*. Limited amount of sediment moving downstream during construction. Long term improvement in the natural process of downstream sediment transport.	*Minor and temporary impact*. Limited amount of sediment moving downstream during construction. Long term improvement in the natural process of downstream sediment transport.
Flooding	*No Change*. Periodic flooding through middle of watershed.	***Beneficial.*** Improves river -floodplain connectivity reducing flood intensity and height.	*No Impact*. Not expected to exacerbate flooding.
Fish	*No Change*. Dam impedes movement majority of year.	***Beneficial.*** Improves upstream and downstream movement and access to seasonal habitats. Improves species diversity and distribution. Rapids provides habitat for some species.	***Beneficial.*** Improves upstream and downstream movement and access to seasonal habitats. Improves species diversity and distribution. Rapids provides habitat for some species.

Mussels	*No Change*. Dam impedes movement of host fish limiting presence and distribution.	***Beneficial***. Improves movement of fish hosts through river reach resulting in increased upstream mussel distribution, diversity, and abundance.	***Beneficial.*** Improves movement of fish hosts through river reach resulting in increased upstream mussel distribution, diversity, and abundance.
Wildlife	*No Change.*	***Beneficial.*** Improves aquatic habitat for invertebrates at rock rapids site. Improves upstream & downstream movement of amphibians and reptiles.	***Beneficial.*** Improves aquatic habitat for invertebrates at rock rapids site. Improves upstream & downstream movement of amphibians and reptiles.
Wetlands	*No Change.*	***Beneficial.*** Expansion of wetland community up river will help slow flood-waters. Increases habitat for fish and wildlife species.	*No Impact*. Similar to existing conditions in upper impoundment and Little Wapsipinicon tributary. Water levels similar to exiting conditions in impoundment.
Threatened and Endangered Species	*No Change.*	***Beneficial.*** Federally-listed species Northern long eared bat- *not likely to be adversely affected with removal of several trees near dam.* State-listed black river redhorse and mussel species expected to increase in upstream distribution.	***Beneficial.*** Federally-listed species Northern long eared bat- *not likely to be adversely affected with removal of several trees near dam.* State-listed black river redhorse and mussel species expected to increase in upstream distribution.
Aquatic Invasive Species	*No Change.* Dam occasionally inundated.	*No Impact.* Removal of dam will not influence the spread of existing or future aquatic invasive species.	*No Impact.* Removal of dam will not influence the spread of existing or future aquatic invasive species.
Historical and Cultural Impacts	*No Change.*	***Adverse Impact*** to eligible NRHP property. Mitigation required. Removal of dam will cause an adverse impact to eligible historic property. Mitigation measures were implemented. Section 106 completed in 2015.	***Adverse Impact*** to eligible NRHP property. Mitigation required. Removal of dam will cause an adverse impact to eligible historic property. Mitigation measures were implemented. Section 106 completed in 2015.
Environmental Justice	*No Change.*	*No Impact*. All individuals equally benefit from proposed action.	*No Impact*. All individuals equally benefit from proposed action.
Recreation	*No Change*. Popular fishing hole immediately below dam. Paddlers continue to portage around dam.	***Beneficial.*** Fishing below, within and above structure. Expected increase in sportfish size structure Low flow channel allows paddlers to navigate rapids.	***Beneficial.*** Maintains popular fishing hole below former dam. Fishing below, within and above structure. Expected boost in sportfish Low flow channel allows paddlers to navigate rapids.
Public Safety	*No Change*. High hazard dam remains; Structural deterioration continues.	***Beneficial.*** Improves human safety by eliminating hydraulic roller of dam. Eliminates addressing deterioration of dam in the future. Provides safer access to river for fishing and other recreation.	***Beneficial.*** Improves human safety by eliminating hydraulic roller of dam. Eliminates addressing deterioration of dam in the future. Provides safer access to river for fishing and other recreation.

7.0 CUMULATIVE IMPACTS

Cumulative impacts to the environment are the result of the incremental impacts of past actions, the proposed project, and reasonably foreseeable future actions (CEQ 1997). In "Considering Cumulative Effects under the NEPA," the methodology is as follows:

1) Identification of the geographic area in which effects of the project may be felt;
2) Assessment of the impacts that are expected in that area from the project;
3) ID of other actions (past, present, and reasonably foreseeable) that have had or are expected to have impacts in the same geographic area;
4) Assessment of the impacts or expected impacts from these other actions; and
5) Assessment of the overall impact that can be expected if the individual impacts are allowed to accumulate

Geographic Area:

1. Immediate Vicinity of the Littleton Dam. This area contains the proposed action (dam removal and rock arch rapids construction) and is the area of direct effect. The riverbed in the footprint of the rock rapids would change, but would potentially provide riffle and pool spawning habitat for fish and microhabitat for various invertebrates and other aquatic organisms at the site. Sediment that exists behind the impoundment in the project area will be removed by an excavator during deconstruction and placed on the stream banks. A silt fence will be used in project area to minimize erosion and sedimentation in the riparian corridor.

2. Upstream of Littleton Dam. There are 46.0 mainstem river miles from Littleton Dam upstream to Alcock Park Dam at Frederika with four major tributaries flowing to the Wapsipinicon River between the two dams. The dam impounds water approximately 1-mile upstream, which effects water temperature, groundwater or water table level, sediment transport, and aquatic species, such as fish, mussels, and aquatic invertebrates. Due to shallow sand point wells located in the project area, the rock arch rapids was designed to maintain the current upstream water level so the wells would not be impacted.

3. Downstream of Littleton Dam. Impacts from Littleton down river reach to Otterville are expected to be negligible. Measures taken to keep mobilization of sediment and sand to a minimum should be specified in permits, design plan technical notes and contractor meetings; however, suspended sediment or turbidity levels may be temporarily elevated during construction. Mobilization of sediment and sand in the lower impoundment would be minimal because surface water elevations during construction are expected to remain at a level in which the sediment that is present in the area where the Little Wapsipinicon confluences the Wapsipinicon would not be mobilized and transported down river.

Assessment of impacts from the project:

As described in Section 4.0, Affected Environment, projected impacts on noise, water quality, groundwater, sediment, flooding, effects on species and habitat, environmental justice, recreation and public safety, are minimal in comparison to the improvements in human safety, potential increases in species populations, improvements in connectivity, and improved recreational opportunities after project completion.

Because the Littleton Dam was associated with events that have made a contribution to the broad patterns of our history in the town of Littleton, Iowa, the Iowa SHPO concurred with the USFWS that the dam was eligible for the NRHP. Consulting parties reached and agreed that there was no feasible alternative that could be implemented to avoid or minimize the adverse effects to the dam and still meet project objectives. Project parties therefore agreed to mitigate for removal of the eligible historic property through development of a "Building Jobs in Iowa" 2015 publication.

Identification of other actions that have had or are expected to have impacts in the same geographic area:

Dams within the Wapsipinicon River watershed dating back to the mid1800s have significantly disrupted upstream-downstream movement of fish, mussels, and other biota, and have altered natural flow regimes, sediment transport, and floodplain connectivity. Loss, alteration and degraded habitat in the watershed have led to declines in fish and mussel richness and diversity and have contributed to poor natural reproduction and recruitment of walleye and the decline and near extirpation of the eastern massasauga and Higgins eye pearlymussel (*Lampsilis higginsii*) in the watershed. Habitat improvements in the upper and lower portions of the basin have been ongoing. Actions to address flooding, sedimentation, nutrient loading and water quality in the upper part of the watershed through the newly formed Upper Wapsipinicon River Watershed Management Authority should have some positive down river benefits to the Littleton area of the river.

Assessment of the impacts or expected impacts from these other actions:

Cumulative effects with implementation of future habitat improvement actions would be positive in nature for fish and wildlife and would continue to build resiliency to thermal factors. The proposed dam removal and upstream rock rapids construction and future potential riparian and in-river projects in the middle part of the watershed should provide long-term improvements to the environment through improved hydrological connectivity, fish passage, and biological integrity and diversity. The proposed project would also improve long-term safety at the project site eliminating the potential risk of drowning and eliminate dam repair costs or the potential risk of dam failure through continue deterioration of the structure on both the east and west sides of the dam. The proposed project is a positive step towards improving the quality of the human environment.

Assessment of overall impact to be expected if individual impacts allowed to accumulate:

In assessing the five considerations above, the proposed action would not result in significant adverse cumulative impacts. Potential impacts during dam deconstruction will be alleviated as described in detail throughout this document. Some of these include silt fences, sediment removal, water level maintenance by rock arch rapid design. The Littleton Dam removal is significantly important not only to the fish and wildlife that live in the river, but also to the safety and well-being of the human community as outlined in Sections 4.0 and 5.0.

8.0 COORDINATION, CONSULTATION AND PUBLIC INVOLVEMENT

Public involvement has been a component of planning activities associated with the Littleton Dam project. Fiver public meetings have been held to inform local citizens of proposed project designs during which concerns, comments and questions associated with proposed actions have been discussed. The first meeting included exhibits that communicated the project purpose and need, environmental setting and key project features, project alternatives under consideration and public comment forms. Other forms of communication have been made with the Buchanan County

Conservation Board, DNR or USFWS personnel. News media outlets have also provided coverage of the proposed project at Littleton over a period of years.

A final public meeting was held August 29, 2017 to present final dam removal and rock rapids design plans, provide updates on permits, compliance, and answer questions. The Draft EA will be made available for public review and comment for a 30-day period starting September 20, 2017. Hard copies of the EA can be reviewed at the Independence, Jesup and Oelwein public libraries, and the Fontana Park and Interpretive Nature Center. The EA can be retrieved electronically on-line under the Hot Topics tab at http://www.fws.gov/midwest/fisheries.

Entities that participated in the process have included but are not limited to the following:

- Buchanan County Conservation Board
- Interfluve, Inc
- Iowa Department of Natural Resources
- Iowa State Historic Preservation Office
- LT Leon Associates Inc.
- University of Iowa Office of the State Archaeologist
- U.S. Army Corps of Engineers
- U.S. Fish and Wildlife Service

The above parties will continue to work together to obtain necessary permits and satisfy appropriate regulatory requirements. Coordination will continue through project construction activities and monitoring.

Consultants and contributors to the Environmental Assessment:

- Nate Hoogeveen- Iowa DNR- Water Trails Program
- Glenn Harmann-- Iowa DNR- Water Trails Program
- Daryl Howell- Iowa DNR-Conservation and Recreation Division
- Heidi Keuler- US Fish and Wildlife Service
- Dan Kirby-Iowa DNR- Fisheries Division
- Jennifer Kurth- Iowa DNR- Malacologist
- Louise Mauldin-U.S. Fish and Wildlife Service-Fisheries
- James Myster-U.S. Fish and Wildlife Service-Regional Historic Preservation Officer
- Brant Vollman- U.S. Army Corps of Engineers Rock Island District-Archaeologist
- Richard Carlson-University of Iowa Office of the State Archaeologist
- Ralph Christian-Iowa State Historic Preservation Office

Table 6. List of important dates regarding Littleton Dam project.

DATE	**Public meetings, important dates**
July 30, 2008	Public meeting- Hookenliners Club, Littleton, IA 78^+ in attendance
February 10, 2011	Public meeting Fontana Park, Hazelton, IA
May 12, 2011	Public meeting- review of alternatives 57^+ in attendance
2012	USFWS began Section 106
2012	Iowa Environmental Review complete-project approval with stipulation to relocate mussels
November 28, 2012	Public meeting- Independence Falcon Civic Center
2015	USFWS completed Section 106 with the Iowa State Historic Preservation Office
August 29, 2017	Final public meeting Fontana Park and Interpretive Nature Center, Hazeleton ~40 in attendance
September 2017	Draft Environmental Assessment 30-day public comment period
Fall 2017	Submission of DNR floodplain and USACOE nationwide permits
Construction	Dependent upon funding/Anticipation of Winter 2018

9.0 REFERENCES

Aadland, L. 2010. Reconnecting Rivers: Natural Channel Design in Dam Removal and Fish Passage. First edition. Minnesota Department of Natural Resources, Fergus Falls, Minnesota.

American Rivers. 2002. The Ecology of Dam Removal: A Summary of Benefits and Impacts. Washington, D.C.

Bednarek, A. T. 2001. Undamming rivers: A review of the ecological impacts of dam removal. Environmental Management. 27: 803-814.

Buchanan County Conservation Board. 2014. Personal Communication 3/24/2014.

Cedar Valley Resource Conservation & Development. 2002. Freshwater Mussels of Iowa. Cedar Valley Resource Conservation & Development, Inc. Charles City, Iowa.

Christiansen, J. L. and R. M. Bailey. 1990. The Snakes of Iowa. Iowa Dept. of Natural Resources. Des Moines, Iowa.

Council on Environmental Quality. 2013. NEPA and NHPA: A handbook for Integrating NEPA and Section 106.

Council on Environmental Quality. 1997. Environmental Justice: Guidance Under the National Environmental Policy Act.

Cumming, Graeme. 2004. Ecological Applications 14(5):1495-1506. Ecological Society of America

Department of Interior. 2003. National Environmental Compliance Handbook.

Department of Interior. 1984. Department of the Interior National Environmental Policy Act Procedures (516 DM1-7).

Federal Interagency Committee for Wetland Delineation. 1989. Federal manual for identifying and delineating jurisdictional wetlands. Interagency Cooperative Publication. 75 pp+ appendices.

Harvey, M.J, J.S. Altenbach, and TL. Best. 1999. Bats of the United States. Arkansas Game and Fish Commission and US Fish and Wildlife Service.

Hay, R. and D. Kopitzke. 1993. Status Survey for the Massasauga Rattlesnake (*Sistrurus c. catenatus*) in Wisconsin, 1993. Unpubl. Report for the U.S. Fish and Wildlife Service, Twin Cities, Minnesota. 31 pp + appendices.

Hooper, Rose. 2002. How river would look, sound without Dillsboro Dam. The Sylva Herald. Sylva, North Carolina.

Iowa Association of Naturalists. 2001. Iowa Wetlands. Iowa's Biological Communities Series. Guthrie Center, Iowa.

Iowa Department of Natural Resources. 2014. Personal communication 3/30/2014.

Iowa Department of Natural Resources. 2013a. Iowa's 2012 Integrated Report: EPA-approved Section 303d impaired waters. Retrieved from http://www.iowadnr.gov/Environment/WaterQuality/WaterMonitoring/ImpairedWaters.aspx

Iowa Department of Natural Resources. 2013b. Personal communication 10/30/2013.

Iowa Department of Natural Resources. 2010a. Solving Problems: Iowa's 2010 Plan for Dam Mitigation. Des Moines, Iowa.

Iowa Department of Natural Resources. 2010b. Iowa Surface Water Quality Standards Implementation (WLA Procedure). Des Moines, Iowa.

Iowa Department of Natural Resources. 2003. Iowa's Groundwater Basics. Geological Survey Educational Series 6. Iowa City, Iowa.

Iowa Department of Natural Resources. 1990. Wapsipinicon River Water Protection Area Management Plan. Ofice of Trails and Waterways, Parks, Recreation and Preserves Division. Des Moines, Iowa.

Iowa Department of Agriculture and Land Stewardship. 2013. Living on the Edge: Endangered Species in Iowa. Retrieved from http://www.iowaagriculture.gov/livingOnTheEdge/ westernPrairieFringed Orchid.asp

Iowa Department of Natural Resources and Well Contractors Council. 2007. Non-Public Water Wells and Water Systems: A Consumer Information Booklet. Des Moines Iowa. IDNR Publication No. 542-8168.

Iowa Whitewater Coalition. http://www.iowawhitewater.org/lhd/LHDlittleton.html. Accessed May29, 2014.

Johnson, G. 1995. Spatial Ecology, Habitat Preference, and Habitat Management of the Eastern Massasauga, *Sistrurus c. catenatus* in a New York Weakly-Minerotrphic Peatland. Dissertation. State University of New York, College of Environmental Science and Forestry, Syracuse, New York.

Kendall, B. and R. J. Carlson. 2012. Phase I Intensive Archaeological and Historic Architectural Investigation of the Proposed Dam Removal Project, Floyd County, Iowa. Office of the State Archaeologist. University of Iowa. Iowa City, Iowa.

King, R.S. 1997. Preliminary Findings of a Habitat Use and Movement Patterns Study of the Eastern Massasauga Rattlesnake in Wisconsin. Unpublished Report to U.S. Fish and Wildlife Service, Green Bay, WI. 32 pp.

LT Leon Associates Inc. 2015. Littleton Dam Mitigation Wapsipinicon River- Project Summary. Project # 0038.005. Des Moines, Iowa.

Mauger, D. and T.P. Wilson. 1999. Population Characteristics and seasonal activity of … in Will County, Illinois: Implications for Management and Monitoring.

Minnesota Department of Natural Resources. 2010. Reconnecting Rivers: Natural Channel Design in Dam Removals and Fish Passage. Fergus Falls, Minnesota 56537.

National Park Service. 1995. How to Apply the National Register Criteria for Evaluation. National Register Bulletin.

Natural Resource Conservation Service. 2010. Rapid Watershed Assessment Upper Wapsipinicon (MN/IA HUC 07080102).

Porto, L.M., R.L. Mc Laughlin, and D.L. Noakes. 1999. Low-head barrier dams restrict the movements of fishes in two Lake Ontario streams. North American Journal of Fisheries Management 19:1028-1036.

Prior, K.A. 1991. Eastern Massasauga Rattlesnake (*Sistrurus catenatus*) Biology, Status, and Management: A Guide for Recovery. Unpubl. Discussion paper for Canadian Parks Service. 40pp.

Reinert, H.K. and W.R. Kodrich. 1982. Movements and habitat utilization by the massaugua (*Sistrurus catenatus catenatus*). J. Herpetol. 16:162-171.

Seigel, R.A. 1986. Ecology and conservation of an endangered rattlesnake, *Sistrurus catenatus*, in Missouri, USA. Biological Conservation 35:333-346

Smith, P. 1961. The amphibians and reptiles of Illinois. Illinois Natural History Survey Bulletin 28:1-298.

U.S. Census Bureau. 2011. American Community Survey 2007-2011. Retrieved from http://www.census.gov/acs/www/

U.S. Fish and Wildlife Service. 2003. Fish and Wildlife Service NEPA Reference Handbook.

U.S. Fish and Wildlife Service. 1998. Status Assessment for the Eastern Massasauga (*Sistrurus c. catenatus*). Fort Snelling, MN 55111.

U.S. Geological Survey. NAS Nonindigenous Aquatic Species. Retrieved from http://nas.er.usgs.gov/queries/SpeciesList.aspx?HUCNumber=7080202. Accessed February 2014.

Van DeWalle, T. J. (2005). Ecology of the eastern massasauga rattlesnake (*Sistrurus catenatus catenatus*) along the upper Wapsipinicon River in Bremer County, Iowa. Final report submitted to the Iowa Department of Natural Resources.

Wagner, M. and N. Hoogeveen. 2010. Iowa Water Trails: Connecting People with Water and Resources. Iowa State University Department of Landscape Architecture and Iowa Department of Natural Resources. Wallace State Office Building,502 E. Ninth St., Des Moines, Iowa, 50319.

Watters, G.T. 1995. Small Dams as barriers to Freshwater mussels (Bivalvia, Unionoida) and their Hosts. Biological Conservation 75(1996):79-85.

Weatherhead, P.J., K.A. Prior. 1992. Preliminary Observations of Habitat Use and Movements of the Eastern Massasauga. Journal of Herpetology 26(4):447-452.

Wisconsin Department of Natural Resources. 2003. Freshwater Mussels of the Upper Mississippi River.

APPENDIX A.

Pictures of Littleton Dam, Wapsipinicon River, Iowa

APPENDIX B.

Public questions, comments and concerns