West Nishnabotna River Watershed Management and Flood Resiliency Plan

June 2019

West Nishnabotna Watershed Management Coalition
in partnership with the Iowa Watershed Approach

East & West Nishnabotna Watershed Coalition

WEST NISHNABOTNA WATERSHED COALITION MEMBERS

Counties

- Audubon County
- Carroll County
- Fremont County
- Montgomery County
- Page County
- Pottawattamie County
- Shelby County
- Mills County

Cities

- Emerson
- Hancock
- Henderson
- Imogene
- Manning
- Malvern
- Oakland
- Walnut

Soil and Water Conservation Districts

- Carroll County
- East Pottawattamie County
- Fremont County
- Montgomery County
- Page County
- Shelby County
- Mills County
- West Pottawattamie County

ACKNOWLEDGMENTS

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Watershed Coordinator
Cara Marker-Morgan, Golden Hills RC&D
cmorgan@goldenhillsrcd.org | (712) 482-3029
www.goldenhillsrcd.org/wma.html

In addition to the members of each Coalition and the IWA partners, valuable input was received from stakeholders throughout the watershed. These included landowners, business owners, scientific professionals, citizens, and nonprofit representatives.

DOCUMENT PREPARED BY

This document was prepared by JEO Consulting Group with assistance from Wright Water Engineers, Stantec, and LakeTech Consulting.

Project Contact
JEO Consulting Group
Adam Rupe, Natural Resource Specialist
arupe@jeo.com | (712) 792-9711
www.jeo.com

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CONTENTS

List of Tables

List of Figures

List of Abbreviations and Acronyms

ACEP	Agriculture Conservation Easement Program
ACPF	Agricultural Conservation Planning Framework
ACS	American Community Survey
ASL	Above Sea Level
BFE	Base Flood Elevation
BMIBI	Benthic Macroinvertebrate Index of Biotic Integrity
BMP	Best Management Practice
CDBG	Community Development Block Grant
CFS	Cubic feet per second
CFU	Colony Forming Units
CIG	Conservation Innovation Grants
CREP	Conservation Reserve Enhancement Program
CRP	Conservation Reserve Program
CRS	Community Rating System
CSA	Critical Source Area
CSP	Conservation Stewardship Program
DC	District Conservationist
DEP	Daily Erosion Project
DU	Ducks Unlimited
ENRW	East Nishnabotna River Watershed
ENWMC	East Nishnabotna Watershed Management Coalition
EPA	US Environmental Protection Agency
EQIP	Environmental Quality Incentives Program
FEMA	Federal Emergency Management Agency
FFA	Future Farmers of America
FIBI	Fish Index of Biotic Integrity
FIRM	Flood Insurance Rate Map
FIS	Flood Insurance Study
FMA	Flood Mitigation Assistance
ft^3/s	cubic feet per second
GFHI	General Fish Habitat Index
GIS	Geographic Information System
GLO	General Land Office
HCA	Hungry Canyons Alliance
HMA	Hazard Mitigation Assistance
HMGP	Hazard Mitigation Grant Program
HSG	Hydrologic Soil Groups
HSEM	US Homeland Security and Emergency Management
HUC	Hydrologic Unit Code
HUD	US Department of Housing and Urban Development
IBI	Index of Biotic Integrity
IDALS	Iowa Department of Agriculture and Land Stewardship
IDNR	Iowa Department of Natural Resources
IEDA	Iowa Economic Development Authority
IFC	Iowa Flood Center
IFIS	Iowa Flood Information System

IHSEM	Iowa Homeland Security and Emergency Management
ILF	In-Lieu Fee
IR	Integrated Report
ISU	Iowa State University
ISWEP	Iowa Stormwater Education Partnership
IWA	Iowa Watershed Approach
IWC	Iowa Water Center
IWQIS	Iowa Water Quality Information System
LICA	Land Improvement Contractors Association
LMI	Low to Moderate Income
LOST	Local Option Sales Tax
MCL	Maximum Contaminant Level
MDEQ	Michigan Department of Environmental Quality
mg/L	Milligrams per liter
MID-URN	Most Impacted and Distressed and Unmet Recovery Needs
MS4	Municipal Separate Storm Sewer System
NCEI	National Centers for Environmental Information
NFIP	National Flood Insurance Program
NOAA	National Oceanic and Atmospheric Administration
NPDES	National Pollutant Discharge Elimination System
NRCS	Natural Resources Conservation Service
NRS	Nutrient Reduction Strategy
NWTF	National Wild Turkey Federation
OWTS	Onsite Wastewater Treatment System
PDM	Pre-Disaster Mitigation
PF	Pheasants Forever
PFS	Pay-for-Success
ppm	parts per million
PRC	Pollutant Reduction Calculator
RC&D	Resource Conservation and Development
RCPP	Regional Conservation Partnership Program
REAP	Resource Enhancement and Protection Program
RHA	Rapid Habitat Assessment
SGCN	Species of Greatest Conservation Need
SIPES	Social Indicator Planning and Evaluation System
SRF	State Revolving Fund
SVI	Social Vulnerability Index
SWCD	Soil and Water Conservation Districts
SWP	Source Water Protection
T&E	Threatened and Endangered
TIF	Tax Increment Financing
TIGER	Topological Integrated Geographic Encoding and Referencing
TMDL	Total Maximum Daily Load
TNC	The Nature Conservancy
UI	University of Iowa
USACE	U.S. Army Corps of Engineers
USDA	U.S. Department of Agriculture
USFWS	United States Fish and Wildlife Service

USGS	United States Geological Survey
VTS	Vegetative Treatment Systems
WASCOB	Water and Sediment Control Basin
WBD	Watershed Boundary Dataset
WFPO	Watershed and Flood Prevention Operations
WMA	Watershed Management Authority
WNRW	West Nishnabotna River Watershed
WNWMC	West Nishnabotna Watershed Management Coalition
WQI	Water Quality Initiative
WQS	Water Quality Standards
WWTF	Wastewater Treatment Facility

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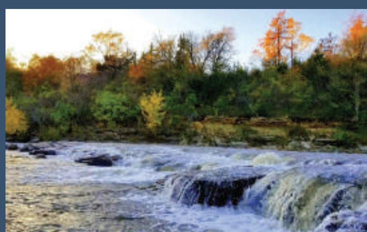
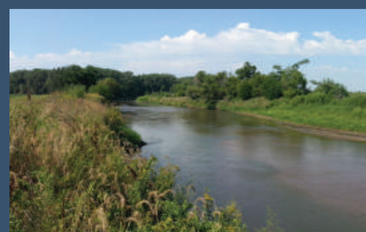
East and West Nishnabotna River Watershed Management and Flood Resiliency Plans

Executive Summary





A watershed management and flood resiliency plan was prepared for both the East and West Nishnabotna River Watersheds located in southwest Iowa. These plans were sponsored by East and West River Nishnabotna Watershed Coalitions (Joint Coalition) and developed as part of the Iowa Watershed Approach.

Approved in 2019, the plans identify and prioritize projects and activities to address flooding and water quality concerns in the two watersheds. The plans are completely voluntary in nature, however, they will need updated every 5 years to maintain eligibility for funding assistance with implementation efforts.

The plans are organized around three concepts: **Assessment**, **Action**, and **Implementation**.

VISION

The East and West Nishnabotna River Watershed Coalitions will work in a collaborative effort to coordinate to reduce flood risks to life and property and improve the water quality within the Nishnabotna Watershed for future generations.

"My takeaway can be summarized with six Cs: These issues are Complex; they are Challenging; it's going to take Coalitions, Coordination, and Conversation among everyone; and Cooperation across the watershed."

- Watershed Stakeholder attending public meeting

Chapter 1 of each plan provides a brief overview of the plan and history of the watershed.

View the full plans at www.goldenhillsrcd.org

Funding provided by The Iowa Watershed Approach
Watershed coordination by Golden Hills RC&D | Plan developed by JEO Consulting Group

East & West Nishnabotna Watershed Coalition

IOWA WATERSHED APPROACH

The East and West Nishnabotna River Watersheds face similar issues.

Flooding

caused by increased runoff due to land use changes

High nitrogen and phosphorus levels

caused by erosion (in fields and streams) and by fertilizer runoff

High levels of bacteria

caused by waste from livestock, humans, and wildlife

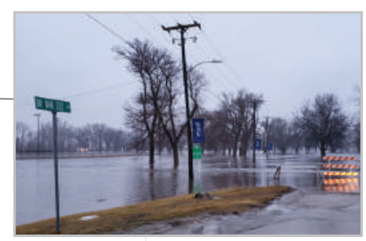
Stream bank erosion

caused by stream channelization and higher runoff rates

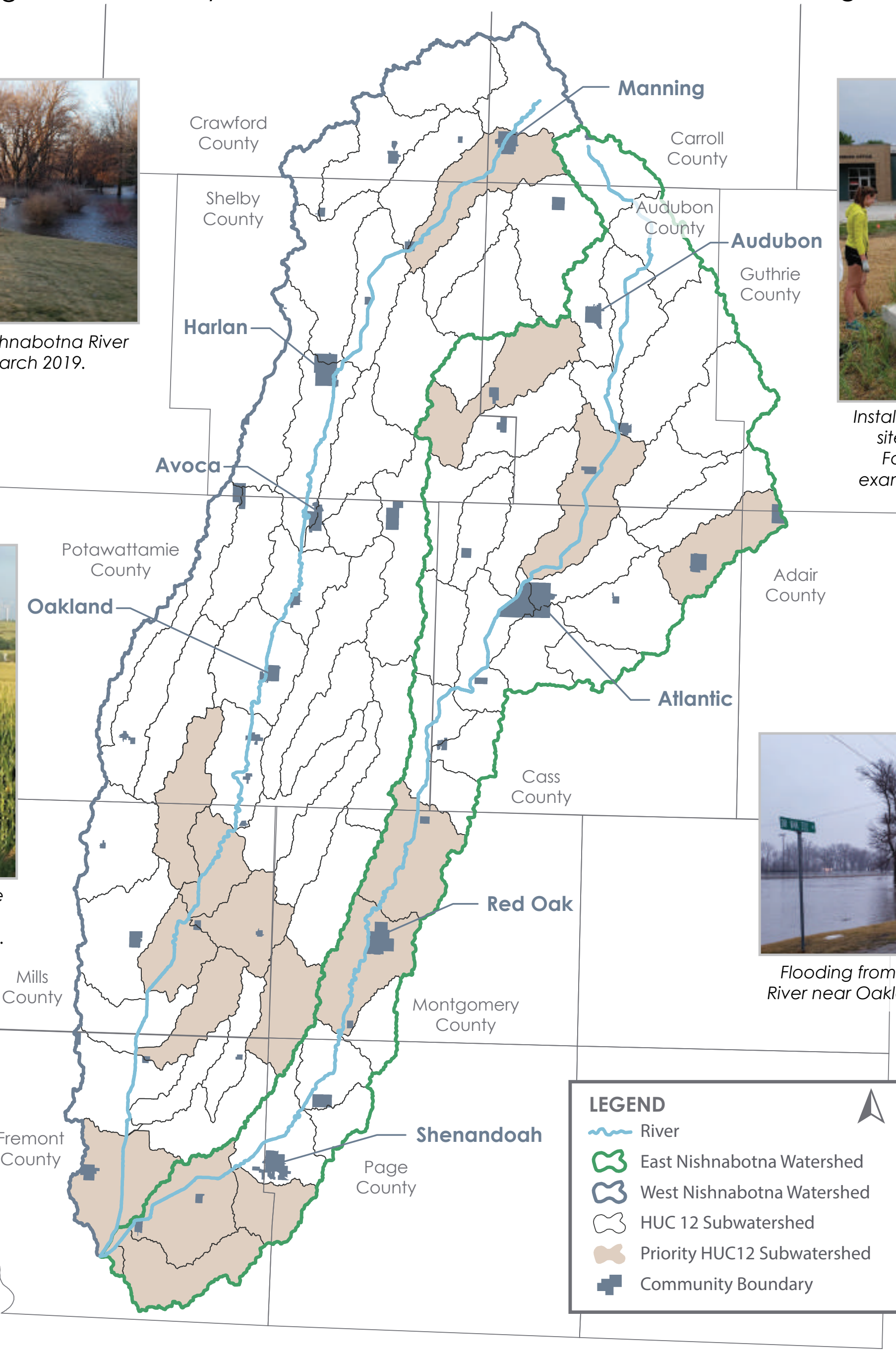
Flooding from the West Nishnabotna River near Avoca, during March 2019.

Installation of a bioretention site at the Mills County Fairgrounds. This is an example of an urban BMP.

Agriculture is a driver of the local economy and land use within each watershed.



Flooding from the West Nishnabotna River near Oakland, during March 2019.



See **Chapter 2** and **Chapter 3** of each plan for a description of watershed characteristics and an assessment of existing conditions.

More than a plan. A path forward.

Supporting a unified vision statement, the two plans share the same goals, objectives, and action items.

GOALS

1. Work in a collaborative effort with a diverse group of stakeholders
2. Reduce flood risks to life and property
3. Increase flood resiliency through community, county, and regional partnerships to mitigate, prepare for, respond to, and recover from floods
4. Maintain and improve water quality to meet state water quality standards
5. Increase public awareness and education on flood risks, flood resiliency, and water quality management

In each plan, **Chapter 4** includes an action plan that outlines steps to achieve the plan's vision, goals, and objectives, while **Chapter 5** identifies strategies to create awareness and activity around implementation.

The action plan identifies priority activities that each city, county, and SWCD, along with the Joint Coalition should take over the next 5 years.

ACTION PLAN FRAMEWORK

EDUCATION
Community outreach efforts aimed at increasing awareness of and participation in flood resiliency and water quality improvement activities.

PROJECTS
Individual improvements made to a specific area to achieve an outcome.

POLICY
Guidelines or protocols set forth by a governing authority to achieve a specific outcome.

MONITORING
Collecting and evaluating data over time to track progress.

PRACTICES
Long-term implementation of site-specific BMPs to achieve an outcome.

Enhanced flood resiliency and improved water quality is a long-term (decades) goal monitored through short-term (years) changes in other resources.

INPUTS
- People
- Funding
- Public resources
- Private resources

HUMAN
- Partner organizations
- Partner agribusinesses
- Farmer knowledge and attitude
- Point source communities and management knowledge attitude

LAND
- Land use changes
- Practice adoption
- Point source implementation

WATER
- Calculated load reduction
- Measured loads in priority watersheds
- Organized watersheds reported load changes
- Measured loads at existing monitoring stations

Adopted from the Iowa Nutrient Reduction Strategy's logic model for measurable indicators of desirable change

EVERYONE HAS A ROLE TO PLAY
in mitigating flooding and improving water quality

JOINT WATERSHED COALITION
- Act as the lead facilitator and coordinator for projects throughout the watersheds
- Help identify and connect funding opportunities with local project sponsors
- Serve as a regional source for information

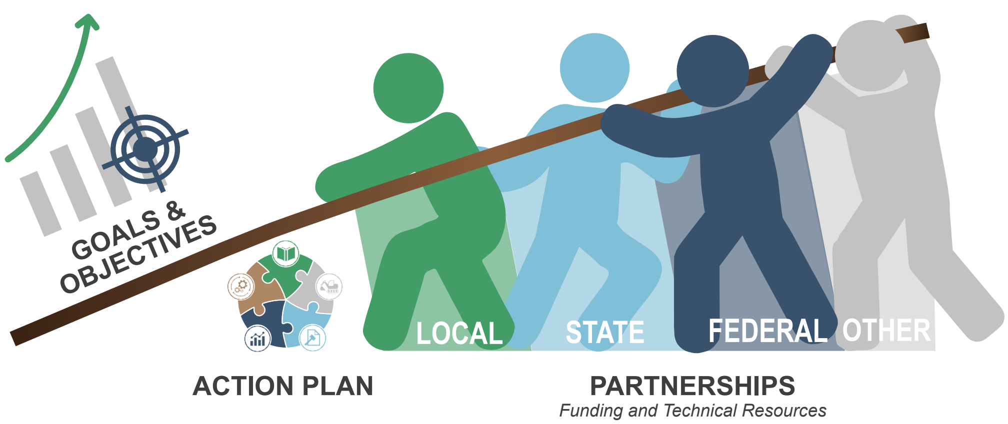
CITY & COUNTY GOVERNMENTS
- Serve as local sponsors for implementing projects
- Leverage local funds against other grant programs
- Adopt policies that reduce runoff or protect floodplains
- Identify and implement urban storm water BMPs, like:
  - » Stormwater management
  - » Infiltration basins
  - » Dams and levees
  - » Channel improvements
  - » Bridge improvements
  - » Non-structural strategies (zoning, acquisitions, floodplain remapping, etc.)
  - » Join the Community Rating System program

LANDOWNERS & RESIDENTS
Using cost-share opportunities, voluntarily implement BMPs, like:
- Cover crops
- Terraces
- Oxbow restoration
- Saturated buffers
- Buffer strips
- Perennial cover
- Farm ponds
- Floodplain restoration
- Bioreactors
- Wetlands
- Channel bank stabilization
- Prairie STRIPS

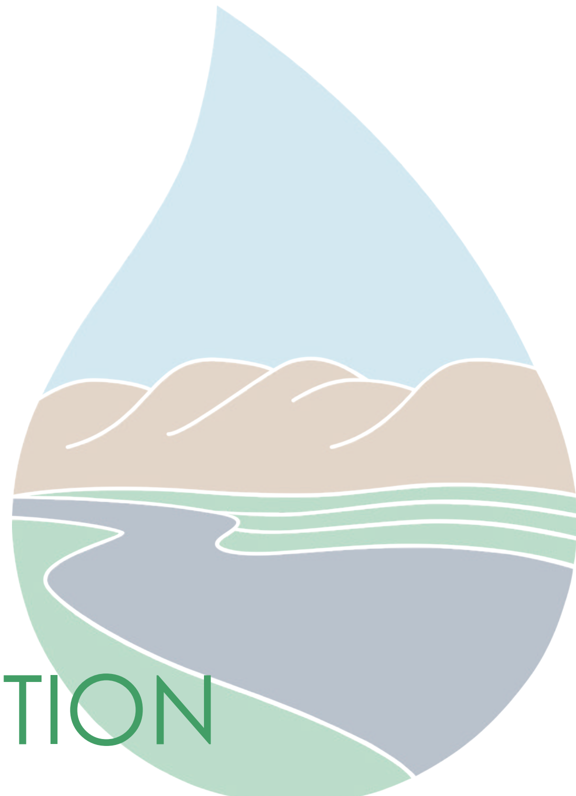
SOIL AND WATER CONSERVATION DISTRICTS
- Provide technical and financial support for BMPs

WE CAN DO MORE TOGETHER

LEVERAGING THE POWER OF PARTNERSHIPS
Local project sponsors use the action plan to direct resources toward meeting goals and objectives. When a local champion can assemble partnerships to contribute towards a project, even more can be achieved.



Chapter 6, 7, and 8 of each plan summarizes recommended projects for implementation, strategies to evaluate implementation efforts, and serves as a collection of helpful resources.



CHAPTER 1

INTRODUCTION

1 INTRODUCTION

1.1 PLAN PURPOSE

The purpose of the West Nishnabotna River Watershed Management and Flood Resiliency Plan is to provide a comprehensive plan for the West Nishnabotna River Watershed (WNRW), HUC-8 #10240002, that addresses flood mitigation and resilience, water quality improvement, and other resource concerns identified by local stakeholders.

> A hydrologic unit code (HUC) is a sequence of numbers or letters that identifies a specific watershed. HUC-8 refers to a subbasin of approximately 700 square miles, while a HUC-12 refers to a subwatershed of approximately 40 square miles.
>
> Source: U.S. Geological Survey and U.S. Department of Agriculture, Natural Resources Conservation Service (2013)

This plan addresses watershed management and flood resilience at three levels: HUC 8, HUC 12, and sub-HUC 12 watersheds. Chapters 1 through9 of this plan address the HUC 8 level. Appendix F provides eight HUC 12 plans. Appendix F provides four case studies, which are on a sub-HUC 12 scale.

Collectively, this plan identifies and focuses on community-identified priorities and seeks to guide flood mitigation and resiliency-building efforts, along with water quality improvements, over the next five to fifteen years. The implementation of this plan is based entirely on the voluntary actions of communities, landowners, and citizens of the WNRW.

1.2 PLANNING AREA LOCATION

As shown in **Figure 1**, the planning area follows the boundaries of the WNRW, which are defined by the United States Geological Survey's (USGS) Watershed Boundary Dataset (WBD). Hydrologic unit boundaries in the WBD are determined based on topographic, hydrologic, and other relevant landscape characteristics without regard for administrative, political, or jurisdictional boundaries (USGS, 2018).

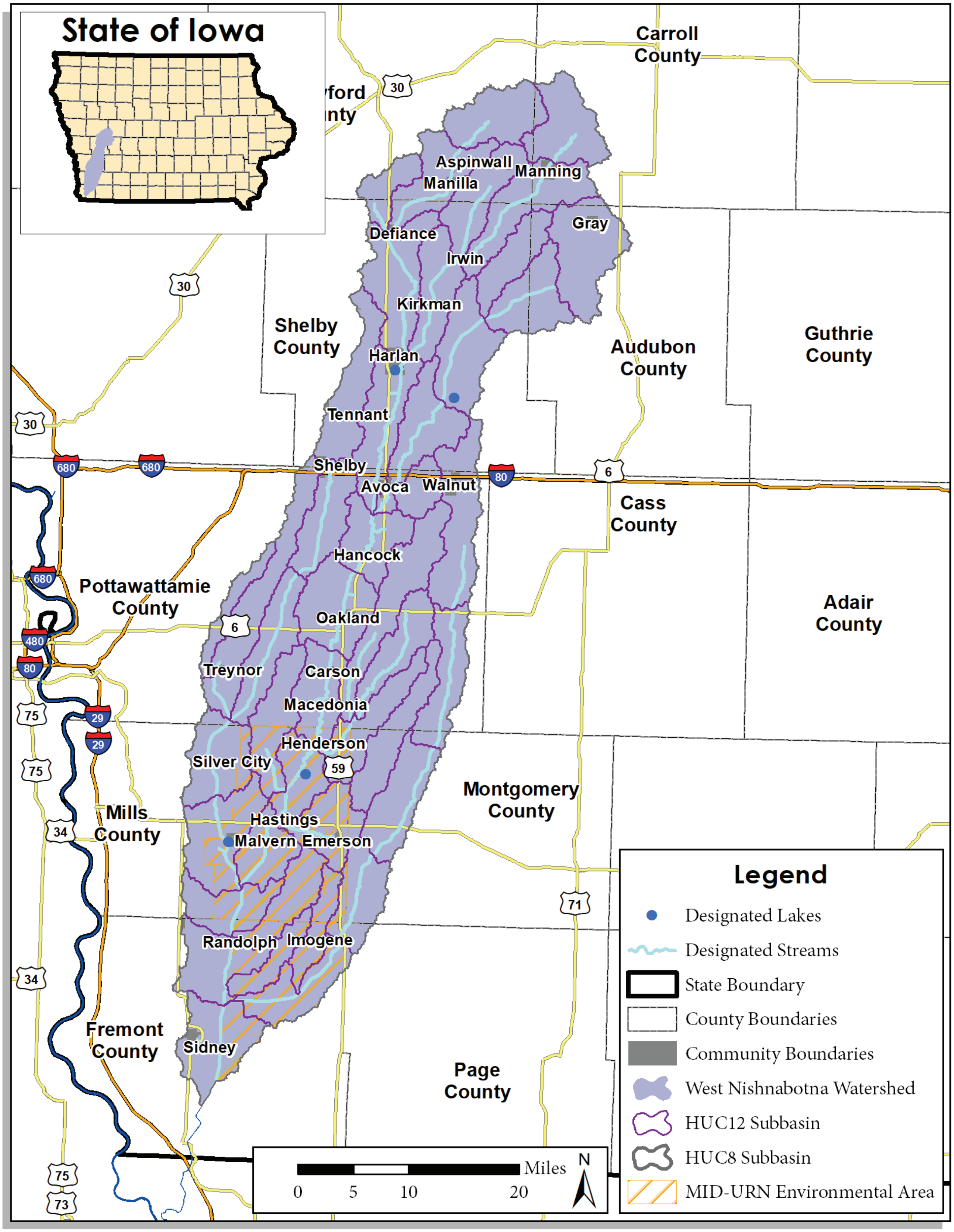


Figure 1: West Nishnbotna River Watershed planning area

The WNRW is a subbasin of the Nishnabotna River basin. It is located in southwest Iowa, encompasses 489,500 acres, and contains the 120-mile West Nishnabotna River. The WNRW includes all or portions of nine counties and 27 cities and stretches south-southwesterly from Manilla (Crawford County) and Manning (Carroll County) to Sidney (Fremont County). The entirety of the WNRW is located in the Southern Iowa Drift Plain landform, which is characterized by broad rolling uplands and deep valleys.

9a The West Nishnabotna River has two major upstream branches: the West Fork of the West Nishnabotna River and the East Branch of the West Nishnabotna River. The confluence of these two branches occurs in Pottawattamie County just south of Avoca, IA. At the southernmost tip of the WNRW, the West Nishnabotna River joins the East Nishnabotna River to form the Nishnabotna River. The Nishnabotna River, which is not addressed in this plan, is approximately 16 miles long and drains to the Missouri River near the community of Hamburg, IA. A summary of the WNRW's characteristics is provided in **Table 1**.

Table 1: Plan Area Characteristics

Plan Area Component	Component Details
EPA Region	VII
HUC-8	West Nishnabotna River Watershed (#10240002)
Counties	Portions of Audubon, Carroll, Crawford, Fremont, Mills, Montgomery, Page, Pottawattamie, Shelby
Cities	Aspinwall, Avoca, Carson, Defiance, Emerson, Gray, Hancock, Harlan, Hastings, Henderson, Imogene, Irwin, Kirkman, Macedonia, Malvern, Manilla, Manning, Oakland, Randolph, Shelby, Sidney, Silver City, Tabor, Tennant, Treynor, Walnut, Westphalia
Tribes	None
Estimated Population (Year)	47,858 (2016)
Planning Area Boundary Size	1,056,983 acres
Major River Watershed	Missouri River
Major Streams	West Nishnabotna River, West Fork of the West Nishnabotna River, East Branch of the West Nishnabotna River, Silver Creek, Walnut Creek
Major Economic Activity	Total Crop Sales (2012): $1,602,855,000 Total Livestock Sales (2012): $859,863,000
Major Crop(s)	Corn, soybean
Major Livestock(s)	Cattle and calves, hogs and pigs, chickens
TMDL Pollutants	None
Other Pollutants of Concern	*E. coli* bacteria, Sediment, and Nutrients (Phosphorus and Nitrogen)
Lake Designated Uses (Number of applicable lakes)	A1 – Primary Contact Recreation (1 Lake)
Stream Designated Uses (Number of applicable stream segments, not including Missouri River)	A1 – Primary Contact Recreation (1 Stream Segment) B(WW-2) – Warm water – Type 2 (5 Stream Segments)

1.3 HISTORY OF THE WATERSHED

The entire West Nishnabotna River Watershed lies in the Deep Loess Region of western Iowa, meaning it is covered by a thick mantle (between 200 and 20 feet; average of 25-30 feet) of highly erosive loess soil covering buried glacial deposits, which are underlain by bedrock.

The WNRW has changed much over the last 160 years. With the arrival of settlers in western Iowa in the 1850's, much of the land was plowed up for agriculture. By the 1890's, so much soil had been eroded from the surrounding farm fields that rivers and streams filled up with the eroded sediment, causing them to meander and flood more often. Wanting to reduce flooding while farming as much ground as possible, especially the fertile "bottom ground," government agencies and landowners partnered together to dredge and straighten the streams in the watershed between 1900 and 1950. Straightening caused the rivers and streams to become steeper and flow faster with more erosive power. Coupled with highly erodible loess soils, the streams eroded downward quickly. Once the streams eroded down to a new stable slope, they began to erode the exposed streambanks, causing the streams to widen. Tributaries that were once 5 feet deep and 40 feet wide are now more than 20 feet deep and 160 feet wide.

In the upper parts of the WNRW, downcutting is still occurring on the tributaries, sending sediment downstream, but the stream channels are so deep, flooding is not a concern. Starting approximately north of Harlan West Nishnabotna River, the sediment from upstream is being deposited along the river faster than the river can remove it. This process has slowly lowered the stream slope and raised the channel bed elevation. This causes more sediment deposition, especially in shallow areas of the channel, such as on point bars, forcing flow to the outside and eroding the opposite bank. Over time, this has led to the river starting to re-meander. In the lowest portions of the river, approximately south of Randolph, the influx of sediment is so great that it has swung the pendulum of channel instability completely the other way, with deposition slowly filling the channel and decreasing flood storage.

In 2010, the Iowa Department of Natural Resources (IDNR) designated a portion of the West Nishnabotna River in Pottawattamie County as a state water trail. Water trails are recreational corridors and routes on rivers and lakes that provide a unique experience for canoeists and kayakers access to riverside campgrounds and other amenities like shelters and restrooms in city, county, or state parks (IDNR, 2010). Iowa water trails are developed to produce "low or no impact on the stream and riparian, or stream-edge, ecosystems" (IDNR, 2010). The state-designated water trail portion of the West Nishnabotna River is 27 miles in length, beginning in Avoca and ending near Macedonia (IDNR, 2016b). It "is the most physically altered stream that is designated a state water trail in Iowa," with 15-foot high banks and no riparian zone (IDNR, 2016b; IWA, 2018). The water trail is used for canoeing, kayaking, small fishing boats, and tubers (IDNR, 2016b). There are five access points along the trail, including the Botna Bend Park access point in Hancock, IA, which has the sole livery (boathouse) from which large plastics tanks can be rented for use (INDR, 2016c).

PREVIOUSLY DEVELOPED RELATED PLANS AND REPORTS

This plan is the first comprehensive watershed plan to be developed for the WNRW. However, portions of the watershed appear in a variety of previously completed studies and reports, including:

- An Inventory of Water Resources and Water Problems: Nishnabotna River Basin, Iowa (Iowa Natural Resources Council, 1955)
- Report on the Flood of July 1958 in the Nishnabotna River Basin, Iowa (US Army Corps of Engineers Omaha District, 1959)
- Inventory and Evaluation: Soil and Water Resources (U.S. Department of Agriculture Soil Conservation Service, 1974)

- Southern Iowa Basin: Iowa Water Quality Management Plan (Iowa Department of Environmental Quality, 1976)
- Potential Water-Supply Impoundment Sites in Southwest Iowa (Iowa Geological Survey, 1984)
- Floods in the Nishnabotna River Basin, Iowa (USGS Open-File Report 91-171, 1991)
- Flood of June 15-17,1998, Nishnabotna and East Nishnabotna Rivers, Southwest Iowa (USGS Open-File Report 99-70, 1999)
- Mills Countywide Multi-Jurisdictional Pre-Disaster Mitigation Plan (2013)
- Pottawattamie County, Iowa Countywide Multi-Jurisdictional Pre-Disaster Mitigation Plan (2013)
- Audubon County Multi-Jurisdictional Hazard Mitigation Plan (2014)
- Carroll County Multi-Jurisdictional Hazard Mitigation Plan (2014)
- Crawford County Multi-Jurisdictional Hazard Mitigation Plan (2014)
- West Nishnabotna Water Trail Plan (IDNR, 2016b)
- Iowa Nutrient Reduction Strategy: A science and technology-based framework to assess and reduce nutrients to Iowa waters and the Gulf of Mexico (2013, 2017)
- Section 22 Planning Assistance to States and Tribes Project Report, Lower Nishnabotna River Basin (US Army Corps of Engineers Omaha District, 2017)
- Various watershed plans through the NRCS's Watershed and Flood Prevention Operations (WFPO) Program, also known as PL-566 Program

1.4 ISSUES FACING THE WATERSHED

FLOOD EVENTS

The WNRW has experienced several significant flood events over the years. Brief summaries of the most notable flood events follow.

Flood of 1947

Severe flooding in June 1947 affected a significant portion of Iowa, including the WNRW. With soils already saturated from frequent rains in late May, four intense thunderstorm systems in June caused four distinct flood peaks in the Nishnabotna River basin (Eash & Heinitz, 1991). The 1991 report summaries these floods:

- The first flood occurred in the East Nishnabotna River Watershed (ENRW) and was caused by rainfall over the eastern tributaries of the East Nishnabotna River on June 1-2.
- The second flood was a result of rainfall in the lower part of the Nishnabotna River basin on June 3-5. Flooding occurred primarily south of the Cass and Pottawattamie county lines on the West and East Nishnabotna Rivers and other tributaries.
- The third flood was caused by a widespread thunderstorm system. Flooding occurred throughout the entire Nishnabotna River basin, on main streams, and the entire length of most tributaries. Two deaths were reported in Red Oak (located in the ENRW) as a result of this flood.
- The fourth flood was a result of "antecedent moisture conditions" and another thunderstorm system on June 21-22. This flood set a new record for maximum discharge on the Nishnabotna River above Hamburg, which is located in Fremont County, downstream of the WNRW. At 55,500 ft3/s (cubic feet per second), the discharge on June 24 was 1.3 times larger than the 100-year recurrence interval discharge.
- The U.S. Department of Commerce and Iowa Department of Agriculture estimated total damages in Fremont and Montgomery counties from the June floods at $2.4 million.

Flood of 1958

During the night of July 1, 1958, an intense thunderstorm centered above the headwaters of the ENRW which produced severe flooding from July 1-3 (Eash & Heinitz, 1991). While the ENRW sustained significant damages, including the loss of 19 lives, the U.S. Army Corps of Engineers (USACE) stated that "no significant urban damages were incurred along the West Nishnabotna River, except at Avoca on the East Branch" and in Oakland (USACE, 1959). In Avoca, one to four feet of flood water caused $11,000 in business and residential damages, while two feet of flood water flowed through residential and park areas in Oakland, causing $1,000 in damages (USACE, 1959).

Flood of 1972

An intense thunderstorm system over the upper part of the Nishnabotna River basin on September 10-12, 1972 caused severe flooding from September 10-15 (Eash & Heinitz, 1991). According to the 1991 report:

- Near Harlan in Shelby County, 12.49 inches of rainfall was recorded on September 11 and the 3-day rainfall total was 20 inches.
- The USACE reported that total damages from the flood were $11.4 million. Washed-out bridges near Brayton, in the ENRW, also resulted in two deaths.
- The flooding occurred in the latter part of the growing season, resulting in excessive crop losses. The USACE reported crop damage estimates of $5.3 million for the 108,000 acres affected by the flooding.
- Peak discharges from the West Nishnabotna River at a Hancock streamflow gaging station was the maximum discharge for the period of record.

Flood of 1982

Indian Creek, which runs through Mills and Montgomery counties in the WNRW, experienced a flood in the early morning hours of June 16, 1982. An unofficial report stated rainfall of up to 8 inches occurred at the headwaters of Indian Creek. A crest-flow gage station (06807470) on Indian Creek at the U.S. Highway 34 bridge recorded a peak flood discharge of 15,800 ft3/s, which is about twice the discharge of a 100-year flood. It was also reported that floodwaters overtopped the road and bridge with no damage to the structures (Heinitz, 1985).

In addition to the flooding of Indian Creek, there were unofficial reports of rainfall of up to 11 inches in the headwaters of both the East and West Nishnabotna rivers (Eash & Heinitz, 1991). A 20-year flood was reported on the West Nishnabotna River, and the National Oceanic and Atmospheric Administration (NOAA) reported that soil erosion from the storm exceeded 20 tons per acre in five southwestern Iowa counties (Heinitz, 1985; Eash & Heinitz, 1991). There was also one death reported in the WNRW as a result of an Amtrak passenger train derailing at a washout near Emerson (Eash & Heinitz, 1991).

Flood of 1987

After up to 10 inches of rain fell between 2 a.m. and nightfall on May 26, 1987, flooding occurred in the Nishnabotna River basin, primarily in the lower portion of the WNRW (Eash & Heinitz, 1991). The May 26 discharge at Randolph (06808500) on the West Nishnabotna River was the maximum discharge for the period of record (Eash & Heinitz, 1991).

Flooding that occurred from May 26-28 caused an estimated $5.5 million in damages, severe soil erosion, and damages to farm terraces and levees throughout the Nishnabotna River basin (Each & Heinitz, 1991). As a result of the flooding, Fremont, Mills, Montgomery, and Page counties were declared federal and state disaster areas (Eash & Heinitz, 1991).

Flood of 1993

"The Great Flood of 1993" extended far beyond the boundaries of the WNRW and is one of the single greatest natural disasters in Iowa history. This flood caused more than $2.7 billion in damage statewide, resulting in each of Iowa's 99 counties being declared a federal disaster area. While the severity of the flooding peaked in summer 1993, the factors that predisposed the state to such flooding began in 1992. There was limited soil moisture loss during the 1992 growing season, followed by a wet fall and a cold, snowy 1992-1993 winter that resulted in one of the greatest snow packs in state history in March 1993. The spring of 1993 was wet, cloudy, and cool. All of these conditions led to record flooding across the state (Zogg, 2014).

In March 1993, the Missouri River was elevated into flood stage, "which caused backwater up the Nishnabotna River" (USACE, 2017). A 1994 (USACE) report describes that the flooding on the upper West Nishnabotna [River] was severe following a July 8-9, 1993 storm, during which 11 inches of rain fell in Crawford and Carroll counties. Record flooding occurred at Hancock, with a peak stage of 24.76 feet, exceeding the previous record by 2.66 feet. Widespread flooding also occurred in Harlan, Avoca, and Oakland as a result of an estimated discharge of 27,000 ft3/s . Interstate 80 was closed near Avoca, and the water treatment plan at Harlan was flooded and closed (USACE, 1994).

In addition to the severe flooding in the upper WNRW, most of the significant flooding within the Nishnabotna River basin occurred downstream of the WNRW at Hamburg—and the flooding that occurred was not from the Nishnabotna River, but from the Ditch 6 tributary. "The ditch, which is plagued with flooding problems, was not able to flow to the Nishnabotna River because of the high stages on the river, largely as a result of Missouri River backwater" (USACE, 2017).

Flood of 1998

Severe thunderstorm activity from June 15-17, 1998, caused major flooding along the Nishnabotna and East Nishnabotna Rivers. The peak discharge of streamflow-gages from throughout the Nishnabotna River basin indicate that flooding occurred mostly in the ENRW and downstream of the WNRW near Hamburg (Fischer, 1999). The Hamburg gage, which measures the combined discharge of the East and West Nishnabotna rivers, recorded a discharge of 65,100 ft3/s, which was a new maximum peak discharge record (Fischer, 1999; USACE, 2017). A 2017 report details that many levees in the lower portions of the Nishnabotna River basin failed and road overflow occurred in numerous places, resulting in the closure of many roads including Interstate 29 for two days (USACE, 2017).

Flood of 2007

Several waves of precipitation moved across the Nishnabotna River basin from May 3-7, 2007. On May 3, one to two inches of rain fell in the lower portions of the ENRW and WNRW, with the heaviest rainfall occurring between Shenandoah and Hamburg. Over the next two days, an additional four to five inches fell in all but the upper quarter of the Nishnabotna River basin. The volume of rainfall and runoff caused flooding along both the East and West Nishnabotna rivers. This flooding resulted in about two-thirds of the bridges being closed in the lower Nishnabotna River basin, from Red Oak in the ENRW and Randolph in the WNRW to the Missouri River. The area around Hamburg was most significantly affected by the flooding. Additionally, in the WNRW, the West Nishnabotna River breached and eventually overtopped a non-federal levee south of road J46, filling 750 acres of farmland behind the levee with water (USACE, 2017).

Flood of 2008

In late May and early June 2008, southwest Iowa experienced several waves of rainfall, usually nighttime storms. More than five inches of rain fell across the Nishnabotna River basin on May 30, sending all the streamflow gages into flood stage. Over the next few days, the rivers in the basin would stabilize, but then more rain would fall, sending the rivers back into flood stage. Each rainfall brought two or more inches of rain, with a June 11 rainfall dropping four inches in the basin. As soils became increasingly saturated, each rainfall caused more runoff than the previous rainfall. The 2008 flood was smaller in magnitude than the 2007 flood, but it still resulted in the closure of the Shenandoah airport due to water on the runway and some of the same bridge closures (USACE, 2017).

Flood of 2011

The 2011 record-breaking flooding of the Missouri River caused flooding in surrounding areas along tributaries of the Missouri River. Most of the flooding experienced the Nishnabotna River basin was a result of backwater from the Missouri River (USACE, 2017). In the WNRW, a wet fall in 2010 followed by heavy winter snowfall exacerbated the heavy spring rains and impacted the Missouri River flooding (Kick off meeting, 2016).

An Iowa Farm Bureau study analyzed the direct and indirect economic impacts from crop losses due to flooded fields and found that Fremont County suffered the highest loss in Iowa. The losses in Fremont County were estimated at $52.2 million, "with $43.9 million in direct crop income loss and $8.3 million indirect losses from the damaged fields" while Pottawattamie County was estimated at $31.2 million in direct and indirect losses (Boshard, 2011). These figures do not factor in losses to personal property or public infrastructure. The Iowa Department of Transportation estimated transportation infrastructure repairs at $63.5 million (Kick off meeting, 2016). The effects of the 2011 flood are still being felt by communities and property owners throughout the WNRW.

The Hamburg area, downstream of the WNRW, was also drastically devastated by the 2011 flooding after a levee along the Missouri River failed and inundated low-laying farmland with floodwater (Avok, 2011).

WATER QUALITY

The 2016 Impaired Waters List and Integrated Report (IR) prepared by the Iowa Department of Natural Resources (IDNR) provided the current impairment status of streams and lakes (IDNR, 2016a). Currently there are five impaired waterbodies in the WNRW: Jordan Creek, Mud Creek, Prairie Rose Lake, Silver Creek, and the West Nishnabotna River. Table 2 shows the impairment causes and categories for the impaired waterbodies. Note that a single waterbody can be impaired for multiple reasons, and in the case of streams, at multiple locations or stream segments. Impairments related to bacteria and algal growth can be caused in part by excess nutrients in runoff entering the waterbody. As the strategies identified in this plan are implemented, the overall nutrients and other pollutants present in runoff may become less frequent and less intense.
The Iowa Nutrient Reduction Strategy was developed in 2013 to improve water quality in Iowa by reducing nutrient concentrations in runoff. Runoff from Iowa makes its way into the Missouri and Mississippi river systems, which eventually deposits into the Gulf of Mexico. The primary nutrients of concern are nitrogen and phosphorus, both of which are major contributors to hypoxia in the Gulf. These nutrients can enter the water system in a variety of ways including soil erosion, vegetation decay, groundwater seepage, and fertilizer application. In November 2017, 88% of land in Iowa drained to a location with a water quality sensor installed (Iowa State University [ISU], 2017). Some of this sensor data is used throughout this plan. In the future, this data will also help estimate the nutrient runoff throughout the entire state and help quantify the effectiveness of nutrient reduction management strategies.

Additionally, the West Nishnabotna River channel is deeply incised into the adjacent floodplain with average vertical streambank heights of 15 ft north of Hancock in Pottawattamie County. Steep streambank slopes and low gradient channels transport large amounts of sediment, clogging launch surfaces and making recreational access points difficult to develop and maintain.

Table 2: Impaired Waterbodies in the West Nishnabotna River Watershed

Name	Type	Legacy Code	ADB Code	Category	Impairment
Jordan Creek	Stream	IA 05-NSH-0133	05-NSH-1459	4c	Biological: low fish Index of Biotic Integrity (IBI)
Mud Creek	Stream	IA 05-NSH-0128	05-NSH-1457	5b-t	Biological: low fish IBI
Prairie Rose Lake	Lake	IA 05-NSH-01440-L	05-NSH-1462	5a	Bacteria: Indicator Bacteria, *E. coli*. Algal Growth: Chlorophyll a. Turbidity.
Silver Creek	Stream	IA 05-NSH-0120	05-NSH-1454	5b-t	Biological: low fish IBI
West Nishnabotna River	Stream	IA 05-NSH-0080	05-NSH-1441	5a	Bacteria: Indicator Bacteria, *E. coli*
West Nishnabotna River	Stream	IA 05-NSH-0090	05-NSH-1446	5b-t	Biological: low fish & invert. IBIs, cause unknown
West Nishnabotna River	Stream	IA 05-NSH-0090	05-NSH-1447	5b	Fish Kill: Caused by Animal Waste

Source: IDNR, 2016a

1.5 PLANNING CONDITIONS AND REQUIREMENTS

Watershed planning requires a careful balance of scientific, regulatory, social, and economic factors. As such, this plan was developed with input and guidance from a variety of organizations, programs, and resources.

WATERSHED MANAGEMENT AUTHORITIES IN IOWA

In 2010, Iowa lawmakers passed legislation authorizing the creation of watershed management authorities (WMAs) as a mechanism for cities, counties, soil and water conservation districts (SWCDs), and stakeholders to cooperatively engage in watershed planning and management. A WMA is formed through a Chapter 28E Agreement between two or more eligible political subdivisions within a specific HUC 8 watershed (IDNR, 2018f). WMAs are voluntary based agreements between participating entities; however, formation of a WMA does not confer any special or new regulatory power to the WMA or the participating jurisdictions. There are multiple benefits to cooperating with other jurisdictions within a watershed including, but not limited to:

- Conduct planning on a watershed scale, which has greater benefits for flood risk reduction and water quality improvement;
- Foster multi-jurisdictional partnership and cooperation;
- Leverage resources, such as funding and technical expertise; and
- Facilitate stakeholder involvement in watershed management.

As of May 2019, there are 25 active WMAs in Iowa, including the West Nishnabotna Watershed Management Coalition (WNWMC) (**Figure 2**)

With the assistance of the Iowa Watershed Approach, the WNWMC was established in spring 2017 through an agreement between the following political subdivisions:

- Counties: Audubon, Carroll, Fremont, Mills, Montgomery, Page, Pottawattamie, Shelby
- Cities: Emerson, Hancock, Henderson, Imogene, Manning, Malvern, Oakland, Walnut
- Soil and Water Conservation Districts: Carroll, East Pottawattamie, Fremont, Mills, Montgomery, Page, Shelby, West Pottawattamie

Through the WNWMC, these parties can "cooperate with one another to successfully plan for and implement watershed improvements within the West Nishnabotna River Watershed" (WNWMC, 2017). Iowa Code Section 466B.23 enables the WNWMC to:

1. Assess the flood risks in the watershed.
2. Assess the water quality in the watershed.
3. Assess options for reducing flood risk and improving water quality in the watershed.
4. Monitor federal flood risk planning and activities.
5. Educate residents of the watershed area regarding water quality and flood risks.
6. Allocate moneys made available to the authority (coalition) for purposes of water quality and flood mitigation.
7. Make and enter into contracts and agreements and execute all instruments necessary or incidental to the performance of the duties of the coalition.

The WNWMC has not taxing authority and it shall not acquire property by eminent domain.

This plan was developed for and under the direction of the WNWMC, which is coordinated by the Golden Hill Research and Conservation District.

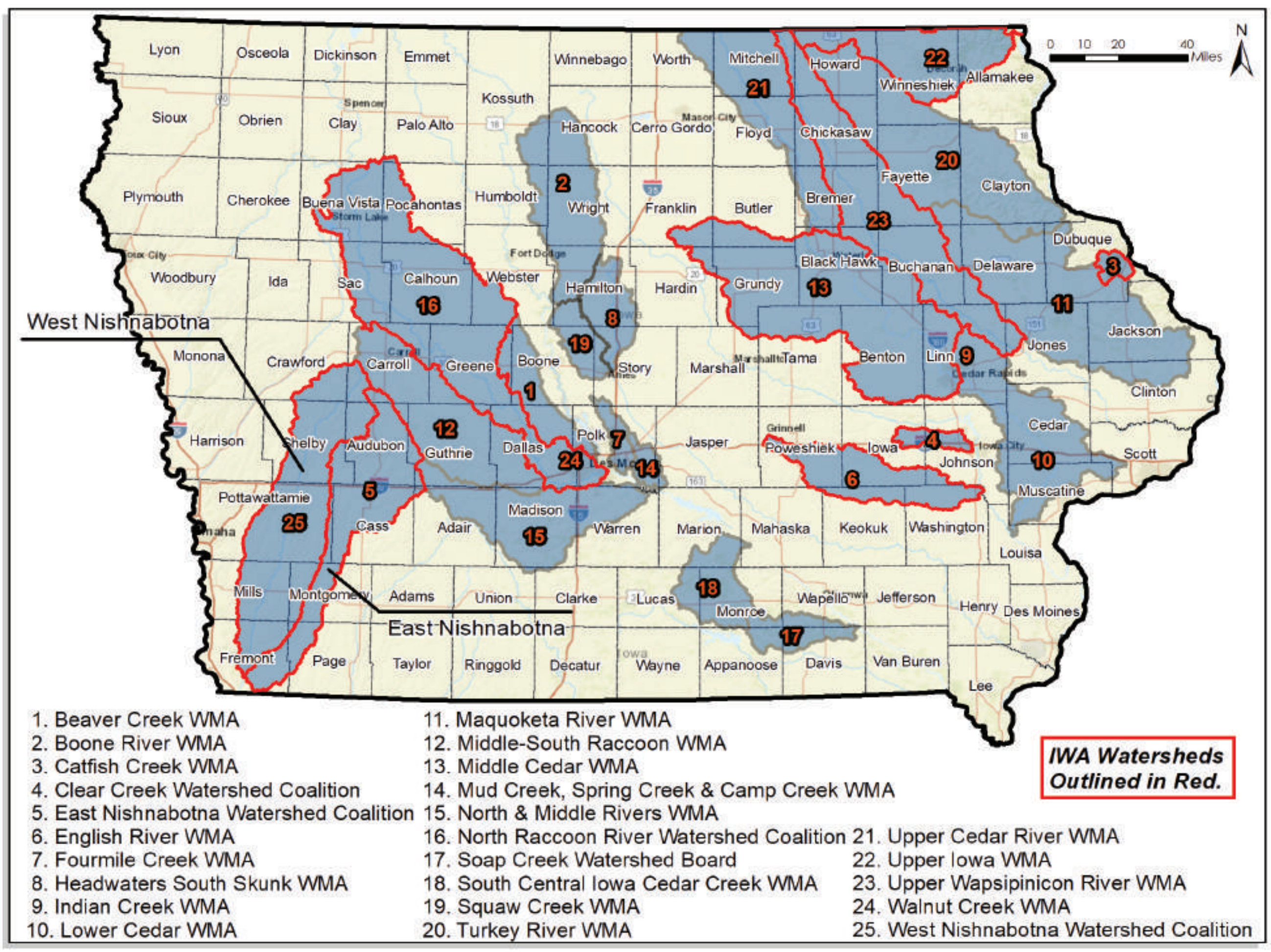


Figure 2: Active Watershed Management Authorities in Iowa

IOWA WATERSHED APPROACH

The Iowa Watershed Approach (IWA) is a program that voluntarily engages stakeholders throughout individual watersheds to achieve common goals, while moving toward a more resilient state. The goals of the IWA include:

- Reduction of flood risk;
- Improvement in water quality;
- Increased resilience;
- Engagement of stakeholders through collaboration, outreach, and education;
- Improved quality of life and health for Iowans; and
- Development of a replicable program.

Nine watersheds across Iowa, most of which were impacted by 2011-2013 flooding, serve as project sites for the IWA (see Figure 2). The WNRW is one of these project sites and has the IWA's guidance and assistance in establishing a WMA (completed spring 2017), developing this watershed management and flood resiliency plan, and implementing projects that reduce the magnitude of downstream flooding and improve water quality during and after flood events.

The IWA is a statewide, five-year project funded by a $96.6 million U.S. Department of Housing and Urban Development grant. For more information about this endeavor or funding, visit http://www.iowawatershedapproach.org/.

COMMUNITY DEVELOPMENT BLOCK GRANT REQUIREMENTS

The IWA received Community Development Block Grant (CDBG) funds through the Iowa Economic Development Authority (IEDA) to help support these planning efforts. As a result, the IEDA's Watershed Management Planning CDBG program requirements were given careful consideration throughout the development of this plan. The CDGB program requirements primarily influenced public involvement and outreach efforts.

IOWA NUTRIENT REDUCTION STRATEGY

The Iowa Nutrient Reduction Strategy (IDALS, 2017b) is a science and technology-based framework to assess and reduce nutrients—particularly nitrogen and phosphorus—delivered to Iowa waters and the Gulf of Mexico. It is part of a larger nutrient reduction strategy set forth by the Mississippi River/Gulf of Mexico Watershed Nutrient Force established in 1997 and seeks to reduce the size, severity, and duration of hypoxia in the Gulf of Mexico (ISU, 2018b). Iowa is one of 12 states along the Mississippi River that was tasked with developing and implementing a state-level nutrient reduction strategy.

Initiated in 2013, the Iowa Nutrient Reduction Strategy was developed by the Iowa Department of Agriculture and Land Stewardship, IDNR, and the Iowa State University College of Agriculture and Life Sciences. The strategy, last revised in December 2017, is designed to reduce nutrients in surface water from both point and nonpoint sources in a scientific, reasonable, and cost-effective manner. It was the first effort in Iowa to utilize an integrated approach involving both point sources and nonpoint sources (ISU, 2018b). For more information, visit **http://www.nutrientstrategy.iastate.edu/**.

In 2013, the Iowa Nutrient Reduction Strategy identified the WNRW as a high priority area for implementing best management practices to reduce nitrogen and phosphorous loads. This prioritization will be reviewed and adjusted every five years. As such, the Iowa Nutrient Reduction Strategy was particularly relevant in the assessment of existing conditions within the watershed and helped to guide the implementation strategies for improving water quality in the WNRW.

FEDERAL EMERGENCY MANAGEMENT AGENCY

The Federal Emergency Management Agency (FEMA) provides financial assistance for a variety of hazard mitigation projects, including flood risk mitigation, through its Hazard Mitigation Assistance (HMA) grant programs. However, to be eligible for HMA funds, a project must be included in a FEMA-approved and locally-adopted hazard mitigation plan. This plan does not meet the criteria of a local mitigation plan, but consideration was still given to FEMA requirements in the event that specific projects identified in the IMPLEMENTATION section of this plan could be incorporated into existing hazard mitigation plans within the watershed and become eligible for such funding.

ENVIRONMENTAL PROTECTION AGENCY

In its Handbook for Developing Watershed Plans to Restore and Protect Our Waters, the U.S. Environmental Protection Agency (EPA, 2008) outlines nine minimum elements of a successful watershed plan. While it is not mandatory that these nine elements be addressed in every watershed plan, the EPA does require that a project receiving Section 319 funds be supported by a watershed plan that addresses the nine elements.

This watershed plan does address each of the EPA's nine elements. Throughout this plan, items that directly address one of the nine elements are marked with a nine-element graphic similar to what is displayed to the right. **Table 3** also provides an index for the location(s) of each element.

Table 3: Location of EPA's Nine Elements Within the Plan*

Identifier	Element	Page Number(s)
a	Identification of Causes & Sources of Impairment	4, 70, 71
b	Expected Load Reductions	131
c	Proposed Management Measures	88, 115, 116
d	Technical & Financial Assistance Needs	133, 148
e	Information and Education	14, 104
f	Implementation Schedule	134, 136
g	Measurable Milestones and Project Outcomes	96, 124, 140
h	Load Reduction Evaluation	56, 92, 145
i	Monitoring	73, 140

**The HUC 12 plans also address the nine elements, but are not included in this table.*

NATURAL RESOURCES CONSERVATION SERVICE

The U.S. Department of Agriculture's (USDA) Natural Resources Conservation Service (NRCS) provides technical and financial assistance to states, local government, tribes, and project sponsors to plan and implement projects that prevent erosion, floodwater and sediment damage; further the conservation, development, use, and disposal of water; and further the conservation and proper use of land (NRCS, 2018). The NRCS program most relevant to this plan is the Watershed and Flood Prevention Operations (WFPO) Program, also known as the PL-566 Program. The WFPO program works with local sponsors to develop a plan to protect and restore watersheds up to 250,000 acres. While the WNRW exceeds this size criteria, significant consideration was given to the WFPO program during the development of the **ASSESSMENT** and **IMPLEMENTATION** sections of this plan. It is intended that this plan could be used to support a future WFPO Program application, to develop a future WFPO watershed plan, or a combination of these efforts.

1.6 COMMUNITY-BASED PLANNING PROCESS

Community-based planning is a participatory process that uses local knowledge to influence and guide an action plan. This type of planning process is central to the development of an effective and implementable watershed management and flood resiliency plan, which more often than not, transcends typical political boundaries. The success of a plan like this, which touches nine counties and 26 cities, is dependent on the commitment and voluntary involvement of community members—making it imperative that community members be engaged in the planning efforts.

Community-based planning techniques used in this plan include the involvement of a local stakeholder group, a flood resiliency workshop, and open house public meetings. The plan development also heavily relied upon participation and input from local technical resources, including the IDNR and University of Iowa-based Iowa Flood Center (IFC).

STAKEHOLDER GROUP

Most essential to the community-based planning process was the assembly of a stakeholder group. The WNRW stakeholder group was made up of people from throughout the watershed. They are local landowners, business owners, science professionals, citizens, and nonprofit representatives who all possess first-hand knowledge and experiences with flooding and water quality in the watershed. (See a list of the stakeholder group in Appendix A).

Two facilitated stakeholder meetings were held early in the planning process. The meetings were guided by the following vision statement, which was developed by the WNWMC and accepted by the WNRW stakeholder group:

The East and West Nishnabotna River Watershed Management Coalitions will work in a collaborative effort to coordinate to reduce flood risks to life and property and improve the water quality within the Nishnabotna Watershed for future generations.

The first stakeholder meeting was April 19, 2018, in Glenwood (Figure 3). The meeting began with a project background presentation and a brief overview of the anticipated planning process. After developing the vision statement, stakeholders spent the rest of the meeting identifying and discussing issues and needs regarding water quality and flooding in the WNRW.

The second stakeholder meeting was July 31, 2018 in Malvern. The purpose of this meeting was to review and refine goals and objectives drafted by the project team using the input collected from the first stakeholder meeting. The stakeholders also weighed in on the selection of case study sites and prioritization of potential best management practices to address flooding and water quality in the WNRW.

Figure 3: Stakeholders work to revise draft goals and objectives

More information about the stakeholder meetings, such as meeting minutes, can be found in Appendix A.

FLOOD RESILIENCY WORKSHOPS

The stakeholder group was also invited, along with a variety of other WNRW community representatives, to participate in a flood resiliency workshop (**Figure 4**). A flood resiliency workshop is a scenario-based planning exercise that allows participants to simulate flood mitigation strategies and role-play responses to flood events. Outcomes of the workshop include increased participant awareness of the big-picture of flood mitigation and the identification of locally-supported flood mitigation strategies. The WNRW flood resiliency workshop was held January 8, 2019, in Harlan with 20 community participants.

More information about the resiliency workshop can be found in Appendix A.

PUBLIC MEETINGS

The community-based planning process culminated in three public meetings. Two were held April 23, 2019, in Shenandoah, and one was held April 25, 2019, in Harlan. The public meetings (**Figure 5**) provided an opportunity for the broader community to learn about the project, provide input on the stakeholder-informed goals and objectives, and review the draft watershed management and flood resiliency plan. The public meetings also offered an opportunity to connect watershed residents and business with existing resources to implement best management practices that address water quality and flooding.

Figure 4: Flood resiliency workshop participants discuss possible flood mitigation action items for their community to consider adopting

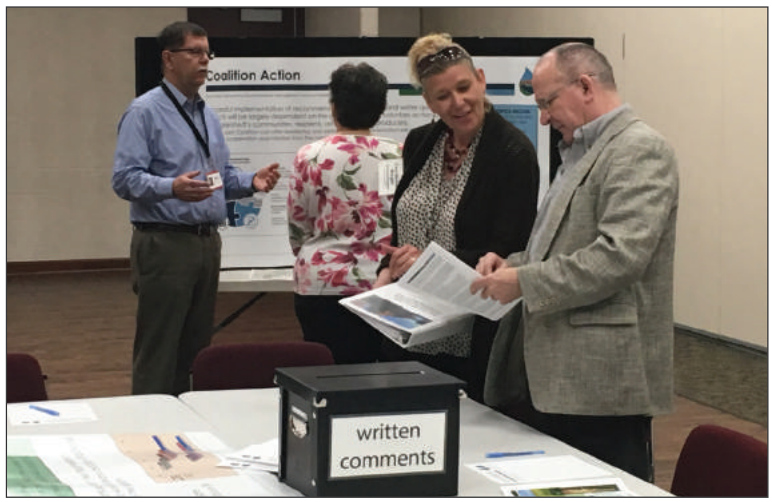


Figure 5: Community members discuss questions and comments with the project team

1.7 DOCUMENT ORGANIZATION AND PLAN UPDATES

The West Nishnabotna River Watershed Management and Flood Resiliency Plan is organized around three main themes: assessment, action, and implementation.

- The **ASSESSMENT** section provides an in-depth review of the history and existing conditions in the WNRW. This section is comprised of three chapters:
  - » **Chapter 1**: Introduction
  - » **Chapter 2**: Watershed Characteristics
  - » **Chapter 3**: Current Conditions
- The **ACTION** section provides on overview of community-driven goals to address water quality and flooding in the WNRW, as well as strategies to inform and involve the community in future implementation projects. This section is comprised of two chapters:
  - » **Chapter 4**: Goals
  - » **Chapter 5**: Public Engagement
- The **IMPLEMENTATION** section provides a summary of recommended and prioritized implementation projects, strategies to evaluate implementation efforts, and a collection of helpful resources. This section is comprised of three chapters:
  - » **Chapter 6**: Implementation Summary
  - » **Chapter 7**: Evaluation
  - » **Chapter 8**: Outside Resources

The plan also includes numerous information-filled appendices that further support the contents found in chapters one through eight. Two of the appendices address watershed management and flood resiliency in specific areas within the WNRW.

- Appendix F provides eight HUC 12 plans:
  - » City of Manning – West Nishnabotna River,
  - » Deer Creek,
  - » Lower Indian Creek,
  - » Lower Walnut Creek,
  - » Mud Creek,
  - » Spring Branch – West Nishnabotna River,
  - » White Cloud – West Nishnabotna River, and
  - » Willow Slough – West Nishnabotna River.
- Appendix I provides four case studies:
  - » Oxbow Restoration
  - » PL-566 Program
  - » Nishnabotna Confluence
  - » Randolph Flood Resiliency

In accordance with EPA requirements, this plan is valid for five years from its official date of publication. After five years, the plan should be reissued, revised, or considered obsolete (EPA, 2001). Taking this into consideration, this plan was developed to be dynamic rather than fixed, allowing for minimal updating effort. Future revisions to this plan may include but are not limited to:

- Revised assessment of water quality data and/or pollutant load estimates;
- Revised hydrologic assessment and/or floodplain maps;
- Determination of whether the current strategy is on track to meet plan goals;
- Revision of goals and objectives;
- Updated Agricultural Conservation Planning Framework or best management practices inventory data maps;
- Updated implementation priority areas; or
- Updates to the resource and budget needs.

CHAPTER 2
WATERSHED CHARACTERISTICS

2 WATERSHED CHARACTERISTICS

2.1 WATERSHED BOUNDARIES

The West Nishnabotna River Watershed (WNRW) spans approximately 1,057,000 acres in the southwestern portion of Iowa (**Figure 6**). Watershed boundaries are defined by the United States Geological Survey's (USGS) Watershed Boundary Dataset (WBD) (USGS, 2018). The WBD consists of multi-level watershed boundaries, each of which is assigned a hierarchical hydrologic unit code (HUC) number. The WNRW boundaries are defined at the HUC 8 level (#10240002), while smaller subwatersheds discussed throughout the plan are defined at the HUC 12 level. The most up-to-date WBD data set for Iowa was downloaded from the Natural Resources Conservation Service (NRCS) Geospatial Data Gateway to accurately identify the planning area boundaries.

2.2 DEMOGRAPHIC SUMMARY

Population

The WNRW encompasses portions of nine counties: Audubon, Carroll, Crawford, Fremont, Mills, Montgomery, Page, Pottawattamie, and Shelby County. The planning area has 27 incorporated communities, with none of those having populations greater than 5,000 (**Table 4**). Because the planning area does not fall along political boundaries, only estimates are available for demographic data. To more closely resemble geographic boundaries of the planning area, demographic information was gathered from the US Census Bureau's American Community Survey (ACS) Topological Integrated Geographic Encoding and Referencing (TIGER) files at the block group level. The total population of the WNRW is approximately 47,858 with the majority (59%) residing in rural areas (refer to **Table 5** and **Figure 7**).

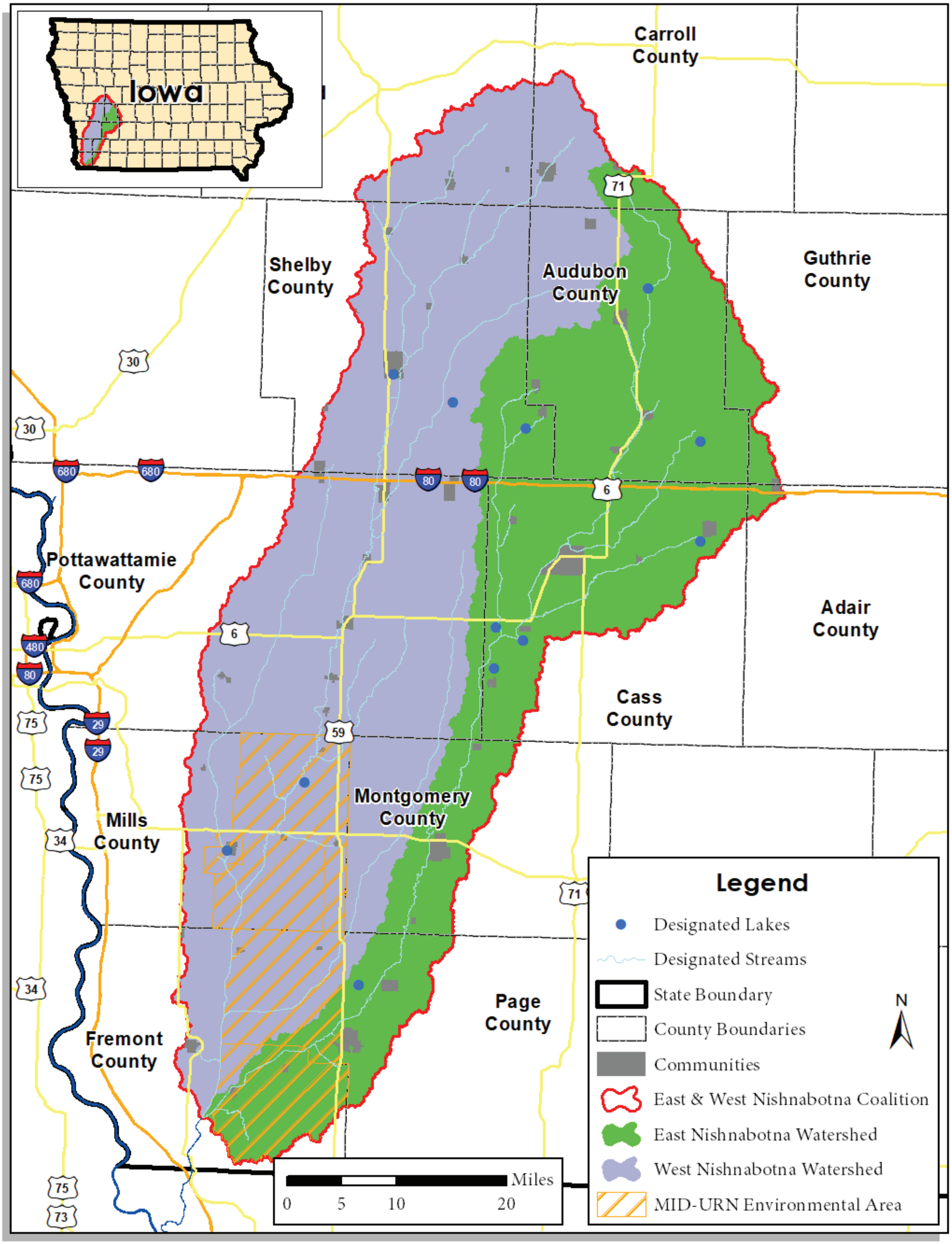


Figure 6: Location Map

Table 4: Population of Communities

Community	Population	Community	Population
Aspinwall	17	Malvern	1,023
Avoca	1,520	Manilla	912
Carson	747	Manning	1,673
Defiance	223	Oakland	1,581
Emerson	476	Randolph	189
Gray	152	Shelby	669
Hancock	173	Sidney	1,032
Harlan	4,944	Silver City	223
Hastings	175	Tabor	1,270
Henderson	193	Tennant	55
Imogene	36	Treynor	898
Irwin	340	Walnut	673
Kirkman	75	Westphalia	126
Macedonia	233		

Source: ACS 2017 5-Year Estimates

Table 5: Urban and Rural Populations

Urban/Rural	Population	Percent
Urban (communities)	19,628	41%
Rural	28,230	59%
Total	**47,858**	**100%**

Source: ACS 2016 5-Year Estimates

AGRICULTURAL CENSUS

Agricultural activities dominate the land use and economy of the watershed. Understanding agricultural activities is important to understanding the potential for certain types of pollutant sources throughout the watershed. Each agricultural activity may contribute differently to types, concentrations, and location of pollutants.

The United States Department of Agriculture (USDA) Census of Agriculture provides the most robust statistically valid data for this subject and is publish every five years. Select data from the two most recently available years at the time of this writing (2007 and 2012) was analyzed to understand both existing conditions and recent trends within the watershed (USDA, 2014). To estimate values within the watershed boundaries, a percent area was applied to the county-wide data (Table 6). The primary crops grown in the WNRW area include corn and soybeans; and cattle and hogs are the primary livestock produced.

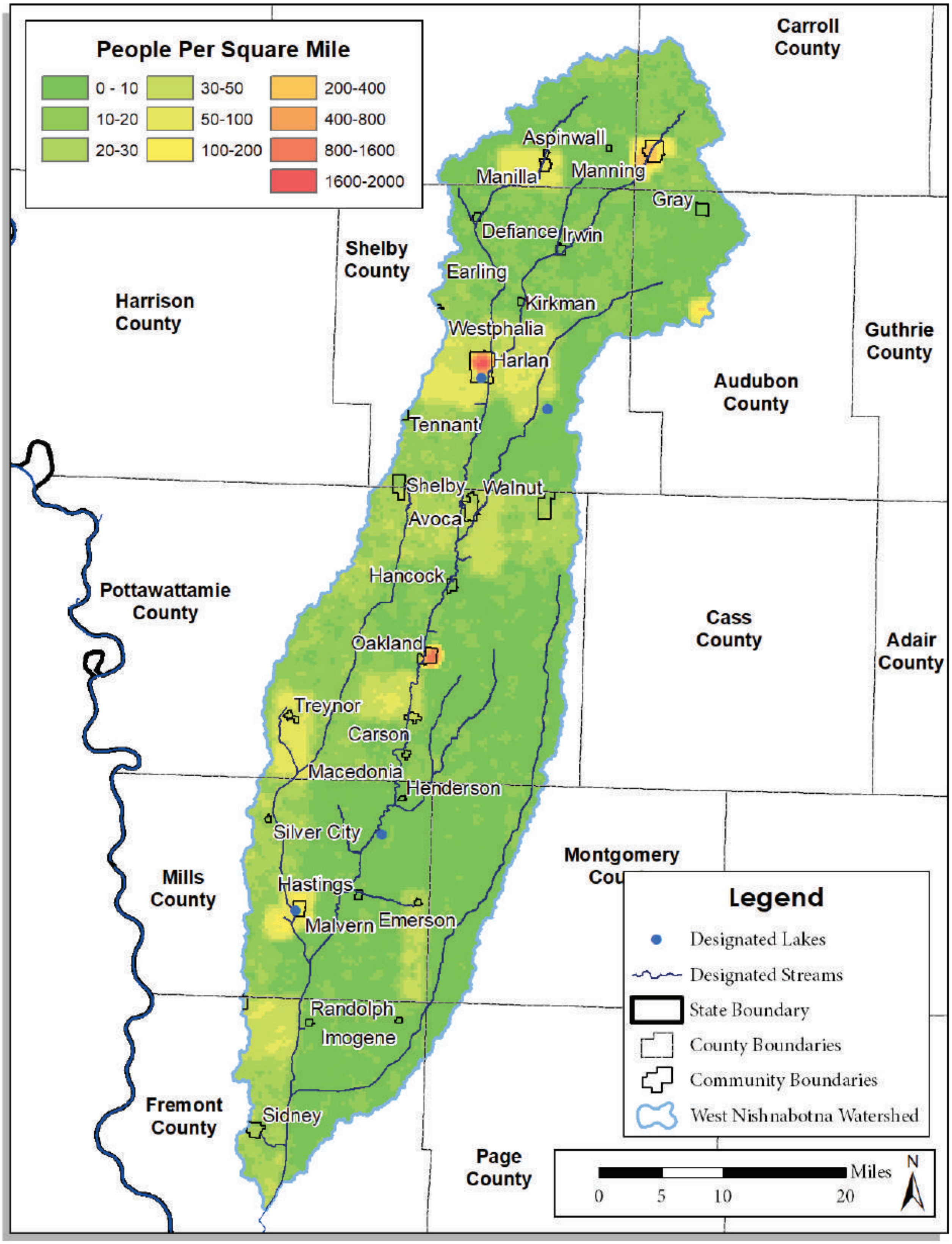


Figure 7: Population Density

Table 6: Changes in Agricultural Activities from 2007 to 2012

Item	2007	2012	Percent Change
Land			
Number Farms	2,159	2,174	1%
Land in Farms (acres)	904,554	967,983	7%
Average Size of Farms (acres)	1,174	1,257	7%
Livestock (Number)			
Cattle and Calves	109,826	96,692	-12%
Beef Cows	D	D	N/A
Dairy Cows	D	D	N/A
Equine	1,447	1,086	-25%
Sheep and Lambs	1,751	1,565	-11%
Goats	679	370	-46%
Hogs and Pigs	274,942	287,487	5%
Broilers and other Meat Chickens	D	D	N/A
Chickens - Layers	D	D	N/A
Crops (acres)			
Corn for grain	404,409	461,590	14%
Corn for silage	4,822	5,683	18%
Soybeans	329,713	352,726	7%
Forage	20,722	15,551	-25%

Source: USDA, 2009; USDA, 2014

D – This data is withheld by USDA to avoid disclosing data for individual operations

ABSENTEE LANDOWNERSHIP

Absentee landowners are defined as those who own agricultural property, but do not live or operate on the land. This includes a diverse cross section of people including: retired farmers/ranchers; those who have inherited or received land through gifts, marriage, divorce, etc.; and those who purchase land for investment or recreational purposes. Contacting absentee landowners or successfully encouraging them to participate in conservation practices can be challenging as these landowners are often distant from the specific conservation needs of the land. Understanding the level of absenteeism in the planning area is important to successfully develop outreach programs or targeted conservation programs.

Land ownership Geographic Information System (GIS) data records for Iowa were utilized to estimate levels of absenteeism within the WNRW area (USDA, 2014). This analysis showed the entirety of the area has greater than 50% absenteeism, with the majority being greater than 60% (**Figure 8**).

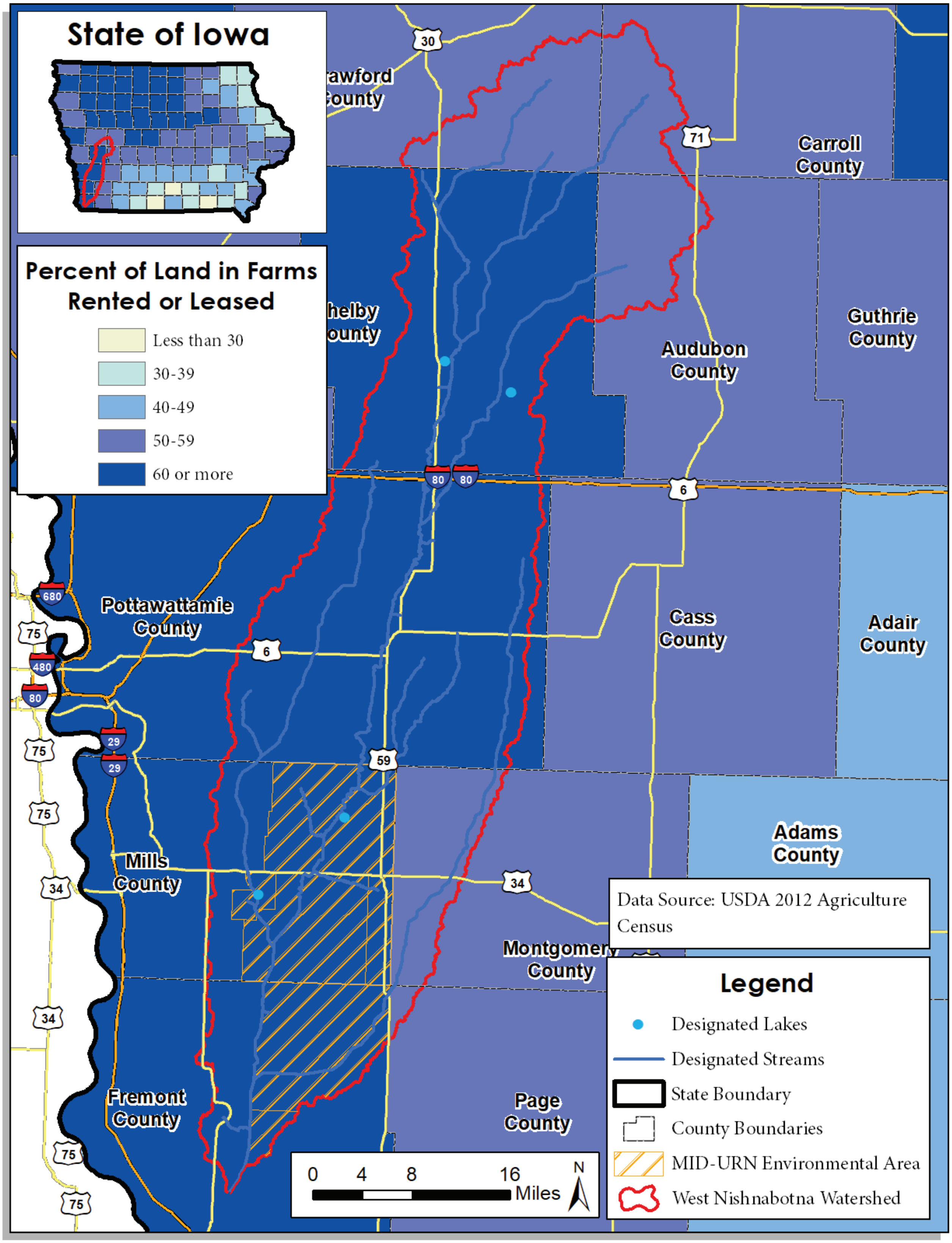


Figure 8: Percentage of Land in Farms Rented or Leased by County

MOST IMPACTED AND DISTRESSED AND UNMET RECOVERY NEEDS (MID-URN) AREAS

The US Department of Housing and Urban Development (HUD) funds the Iowa Watershed Approach (IWA). Some of this funding come from Community Development Block Grant (CDBG) funds which support planning and coordination tasks across the watershed. However, HUD funding for the implementation of best management practices (BMPs) is limited to specific geographic areas known as "Most Impacted and Distressed and Unmet Recovery Needs" (MID-URN) areas. It should be noted that funding from other sources may be eligible to be used in other locations or for other projects.

The MID-URN area was identified during the development of the IWA in areas that: 1) were part of a Presidential Declared Major Disaster in 2011, 2012, or 2013; and 2) have a high percentage of low to moderate income (LMI) populations that could benefit from projects. The MID-URN areas within the East and West Nishnabotna River Watersheds is located within Mills and Fremont County. The cities of Henderson, Hastings, Malvern, Emerson, Randolph, Imogene, Shenandoah, Farragut, Riverton, and the surrounding rural areas are located in the MID-URN areas, as shown in **Figure 9**.

VULNERABLE POPULATIONS

Social vulnerability to hazards is based on the notion that specific characteristics and situations of some population groups result in a disproportionately lower capacity to anticipate, cope with, resist, and recover from the impact of a natural hazard. Social vulnerability can be measured using indicators which serve as proxies for the underlying social, economic, institutional, and political drivers of human vulnerability to hazards (Tate, 2015). By visualizing this data, it is possible to help identify locations or populations in the watershed that could be most benefited from flood resiliency projects.

Flood resiliency is the ability of a community to use local capabilities to mitigate, prepare for, respond to, and recover from a flood event. A key component of a community's resiliency capabilities includes social resources which facilitate collective action, such as trust amongst stakeholders, pre-established partnerships and social networks, and the continual pursuit of collective learning. In communities where these social resources are either lacking or missing, reducing social vulnerability becomes a critical component to improving overall flood resiliency.

The Iowa Flood Center (IFC) Flood Resiliency Team has developed a social vulnerability index using the following indicators:

- Race and ethnicity (including African American and Hispanic);
- English as a second language;
- Renters;
- Employment status;
- Population below the poverty level;
- Number of children;
- Population age;
- Education level;
- Female head of household;
- Disability status; and,
- Those with no vehicle access.

Data from the U.S. Census Bureau's 2016 ACS 5-year estimates was used for each indicator and is based on a percent of the population at the census tract level (US Census Bureau, 2016). Each indicator was then cross referenced with flood risk maps to formulate a final social vulnerability index (SVI) value for each area in the watershed. SVI values were mapped (**Figure 10**) and are also available online at: **http://iwa.iowawis.org/app/**.

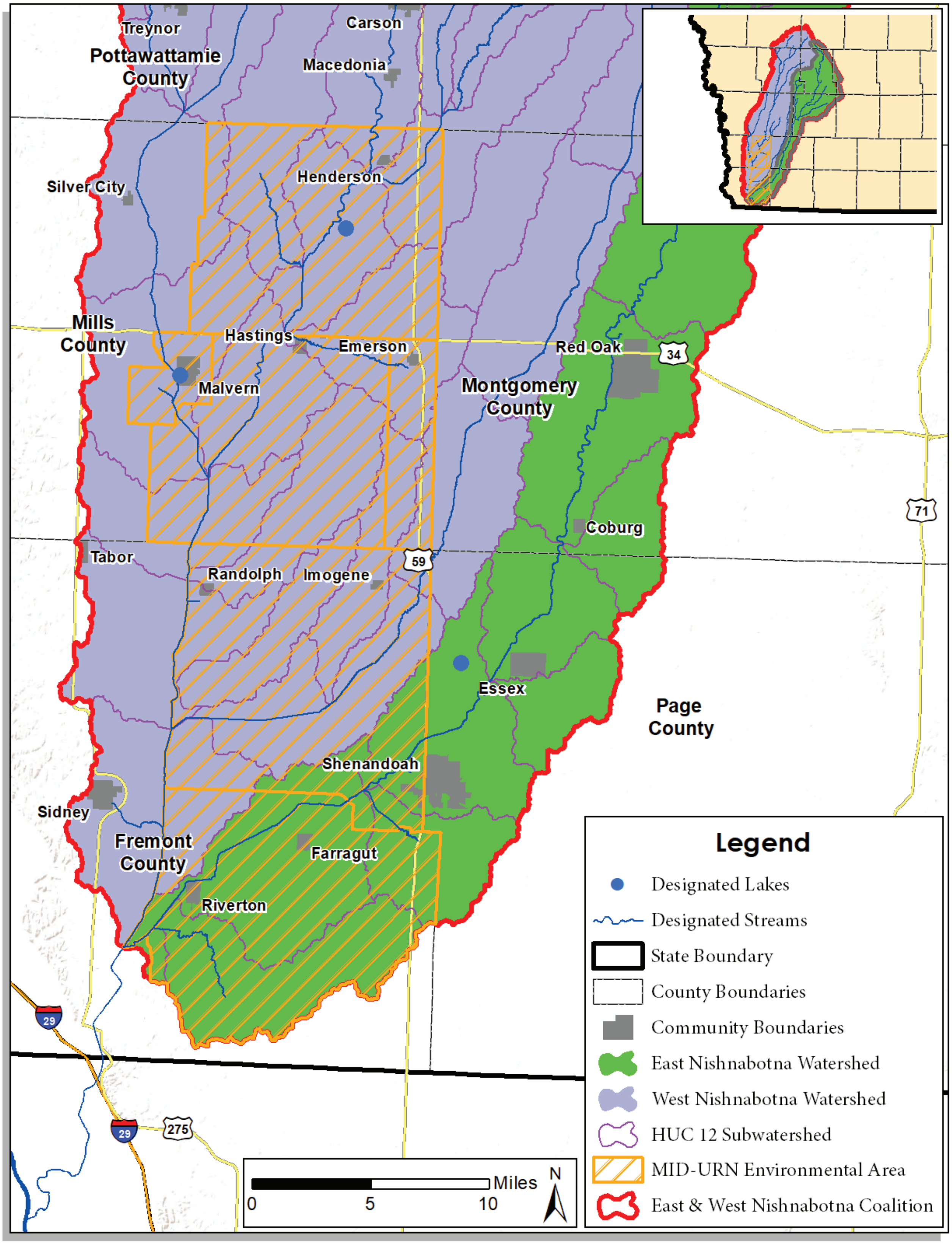


Figure 9: Most Impacted and Distressed and Unmet Recovery Needs Areas

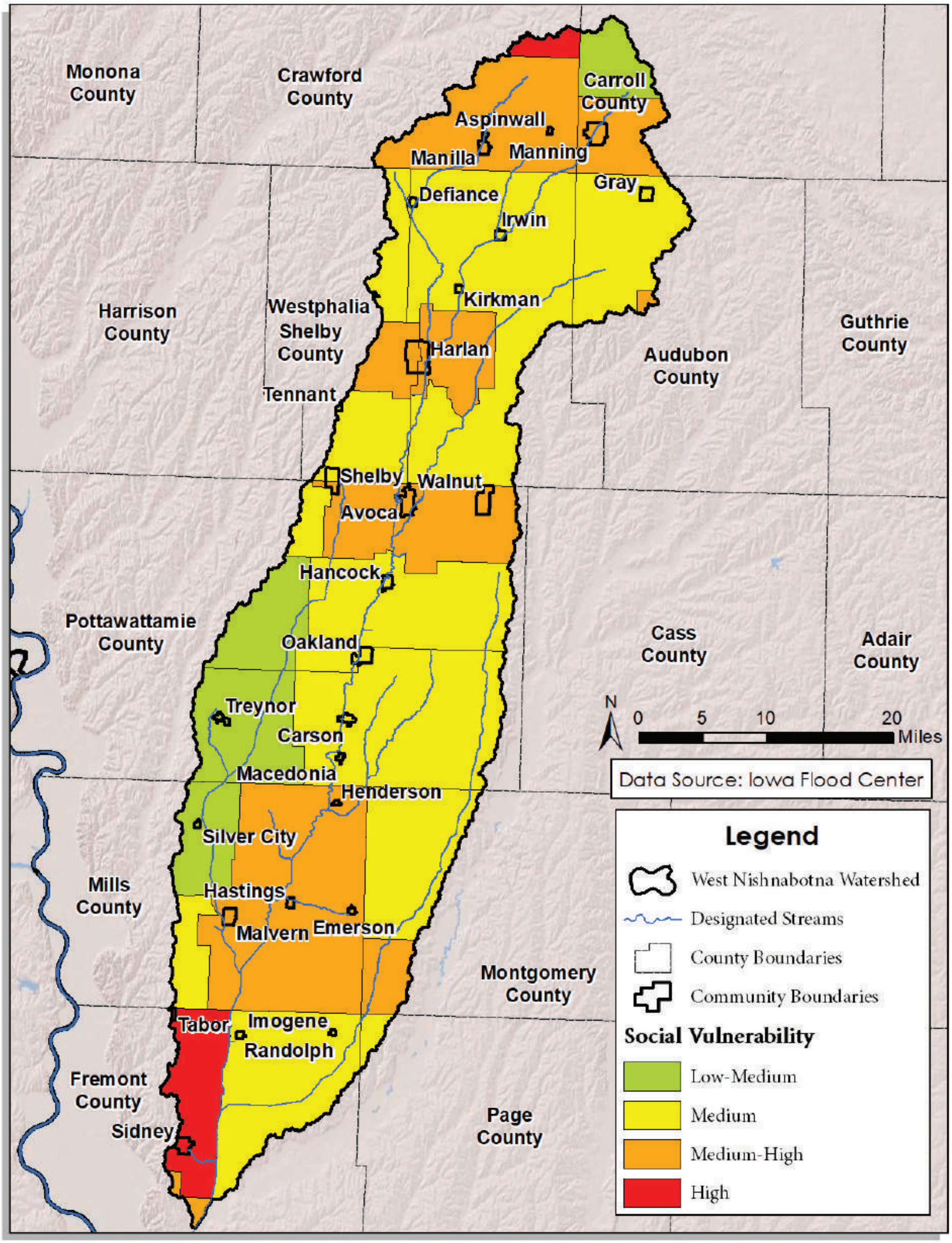


Figure 10: Map of Social Vulnerability Within the Watershed

The majority of the WNRW is low-medium or medium risk on the social vulnerability index. However, areas in the southwestern and far northern reaches of the WNRW stand out with medium-high and high rankings. Top social vulnerability indicators for the area around Sidney include: high percentage of senior citizens, a large population of disabled individuals, and high percentage of rental households. Top indicators for the area in the northern portion of the WNRW include a large population that speaks limited English, and a high percentage of immigrant families.

2.3 PHYSICAL ENVIRONMENT

CLIMATE

The climate of the planning area is considered "Humid Continental" on the Köppen-Geiger Climate Classification System (Kottek, 2006). This climate is characterized by large seasonal temperature differences with hot, humid summers and cold winters. Precipitation is distributed throughout the year. The National Centers for Environmental Information (NCEI) maintains precipitation records from numerous stations within the planning area. Monthly precipitation averages range from a high of 5.9 inches in June to a low of 0.8 inches in January. Average high temperatures range from 89°F during the summer months to 34°F during winter months; average low temperatures range from 60°F during the summer months to 12°F during winter months. Average monthly temperature and precipitation variations are illustrated in Figure 11. Annual precipitation varies slightly across the planning area, though all can be expected to receive between 32 and 37 inches per year on average. Average annual precipitation across the planning area is shown in Figure 12. While the community of Atlantic is not inside the WNRW, its climate is representative of the entire region.

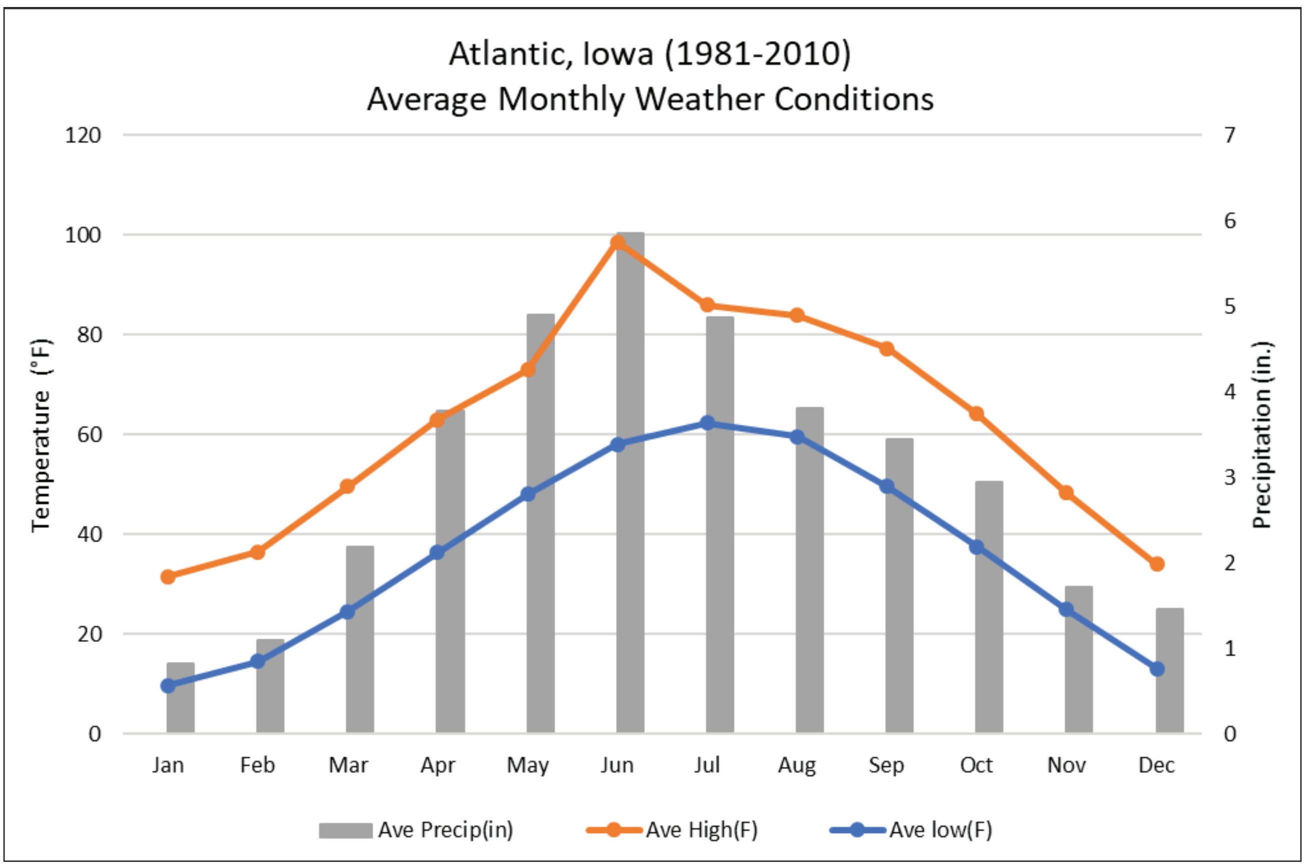


Figure 11: Average Monthly Temperature and Precipitation for Atlantic, IA

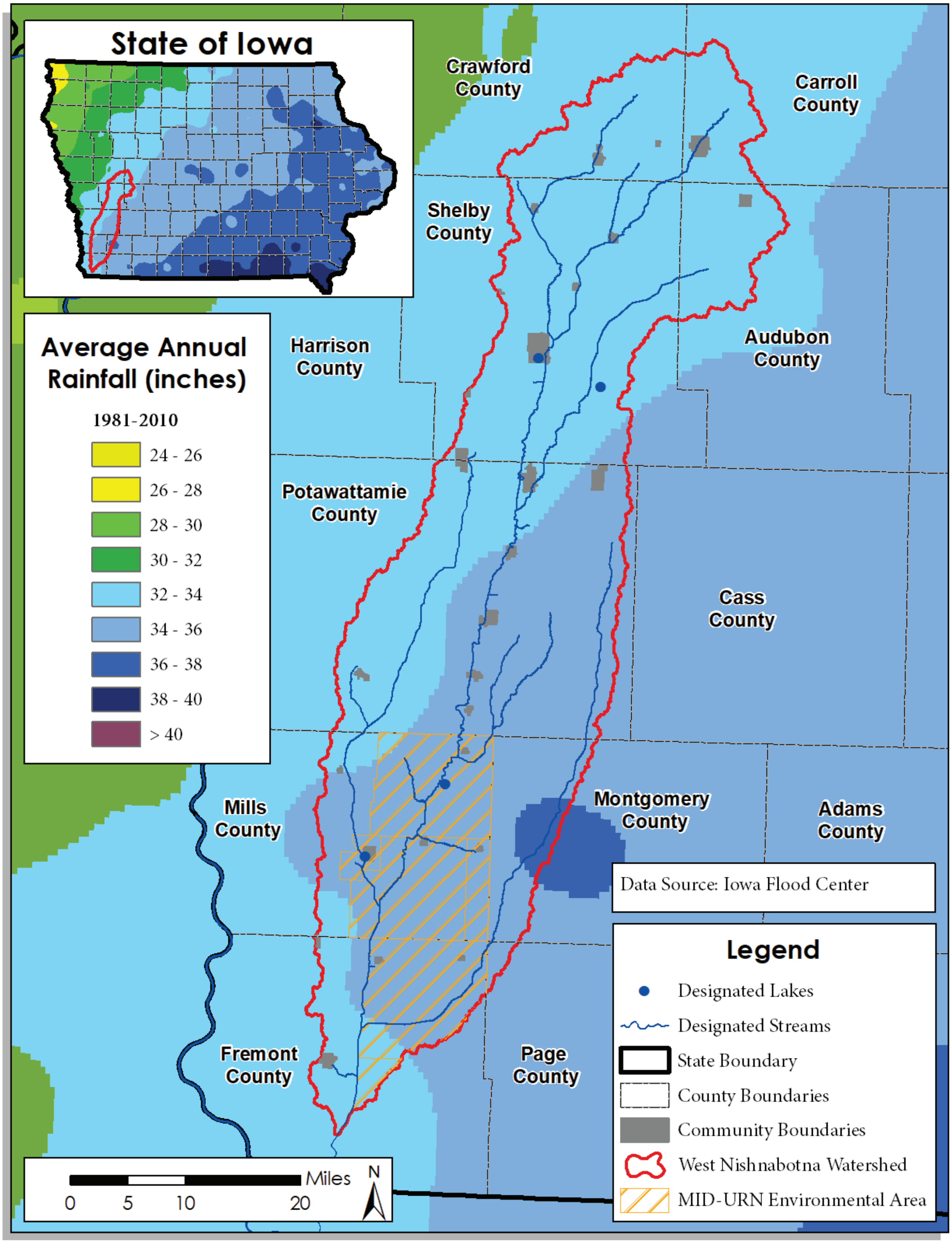


Figure 12: Average Annual Precipitation Map

LANDFORMS AND GEOLOGY

Iowa has a unique and diverse landscape that is the culmination of geologic processes occurring over millennia. Iowa has been subdivided into ten distinct landform regions (Prior, 1991). In each region a unique geologic history has shaped the landscape and natural resources. Each unique landform influences the distribution of plant and animal communities and helps determine an area's vulnerability to flooding problems or water quality.

The entirety of the East and West Nishnabotna River Watersheds are located within the "Southern Iowa Drift Plain," the largest of Iowa's landform region (**Figure 13**). This landform region displays a variety of landscapes, resulting primarily from the deepening network of rivers and streams. Due to long-term erosion activity, the geologic materials exposed along hillsides reveal more of the state's glacial-age history than is seen in any other region.

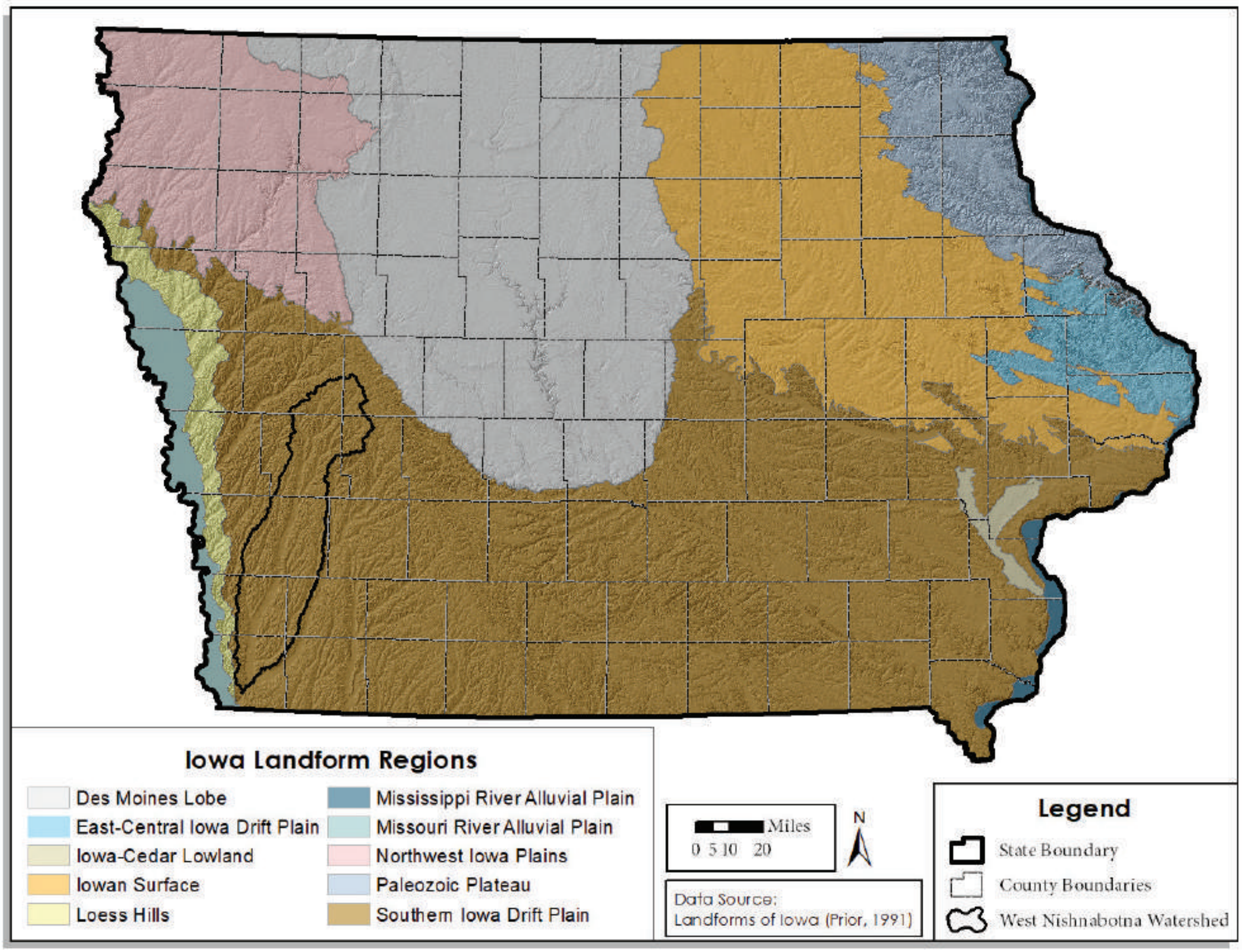


Figure 13: Landforms Within and Near the Planning Area

The geology of this region is composed primarily of drift, or materials left behind by glaciers. However, due to their age these glacial drift deposits are more highly eroded than those in other areas of Iowa, such as the Des Moines Lobe. Following the glacial ice retreat, streams have established well-developed drainage networks and have carved deeply into the land surface. This dendritic drainage network (patterned like the branching veins in a leaf), have eroded away the typical features associated with glaciated landscapes (**Figure 14**).

As this landscape evolved, a windblown mantle of loess was added to the land surface. This silty (and sometimes sandy) deposit can range in thickness between five and 30 feet throughout the region. The bulk of this silt mantle is composed of Peoria Loess. Loess is highly erodible and unstable when wet. Deep, narrow gullies, which can lengthen and widen quickly after rainstorms, are characteristic erosion features across the watershed where terraces, grade-control, no-till, and other BMPs do not exist in the disturbed, agricultural landscape.

The topography of the region is marked by hills that appear to align in long, steep, parallel crests with broad troughs between peaks. The most extensive areas of level terrain occur along valley floors, where much of the area's floodplains have been established. The nearby Loess Hills landform region has similar features, but with thicker loess deposits ranging from 60 feet to over 200 feet.

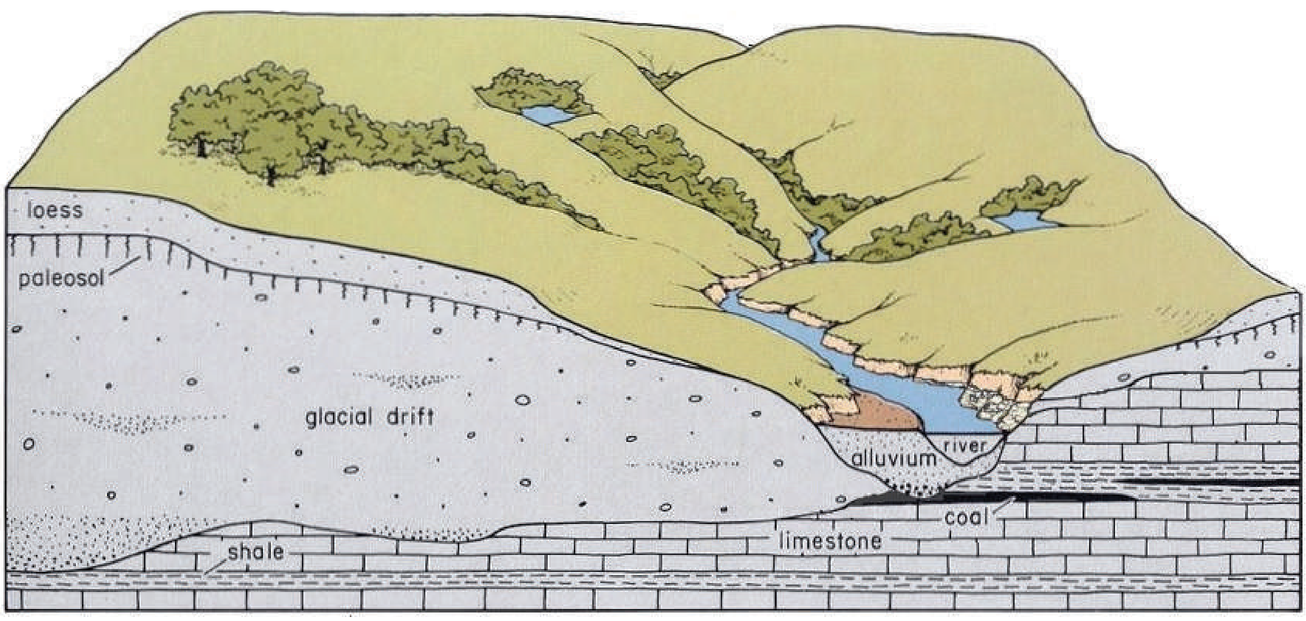


Figure 14: Geologic and Terrain Cross Section

Source: Prior, 1991

TOPOGRAPHY

Topography and slope describe the shape and relief of a landscape. Topography is a measurement of elevation, while slope is the percent change in that elevation over a certain distance. These characteristics are important drivers in drainage and land use patterns within the watershed. Steep slopes lead to higher runoff rates and volumes, which can in turn produce more frequent and more severe flash flooding. High velocity runoff and low infiltration rates severely increase the risks for soil erosion and pollutant runoff.

The WNRW is characterized by diverse topography and slopes due to its geologic history (**Figure 15**). Elevation tends to increase from the southwest to northeast, as one travels up the watershed. Elevations ranges from a low of 906.1 feet above sea level (ASL) in Fremont County, to a high of 1,559.1 ft (ASL) in Carroll County. Slopes across the planning area vary appreciably, with steeper slopes (greater than 10%) primarily in the headwater areas of Audubon, Crawford, and Shelby County. Other pockets throughout the watershed are very steep; however, the downstream areas in general tend to be dominated by moderately steep slopes (5-10%). The West Nishnabotna River floodplain, which widens as it moves downstream, and other valley floors tend to be very flat (0-5% slope) (USDA, 2018b).

SOILS

Soil characteristics such as texture and infiltration rate directly influence the amount of runoff from the landscape and the potential for erosion. NRCS-USDA soils data was downloaded from the NRCS Web Soil Survey and analyzed specific to the planning area with the results provided in the following sections.

Texture

Soil texture is given in the standard terms used by the USDA. These terms are defined according to the percentages of sand, silt, and clay in a soil sample that is less than 2mm in diameter. If the content of particles courser than sand (greater than 2mm in diameter) is greater than 15%, an appropriate modifier is added. Due to loess parent material present across the watershed, the clear majority of soils (99%) found in the planning area are comprised of some sort of loam (**Table 7**). The distribution of these soil textures is generally consistent across the watershed. sand. **Figure 16** displays the soils based upon texture.

Table 7: Percentages of Soil Surface Texture Classes in the Watershed

Soil Surface Texture	Percentage
Silty Clay Loam	71%
Silt Loam	25%
Clay Loam	3%
Various	1%
Total	**100%**

Source: USDA, 2018b

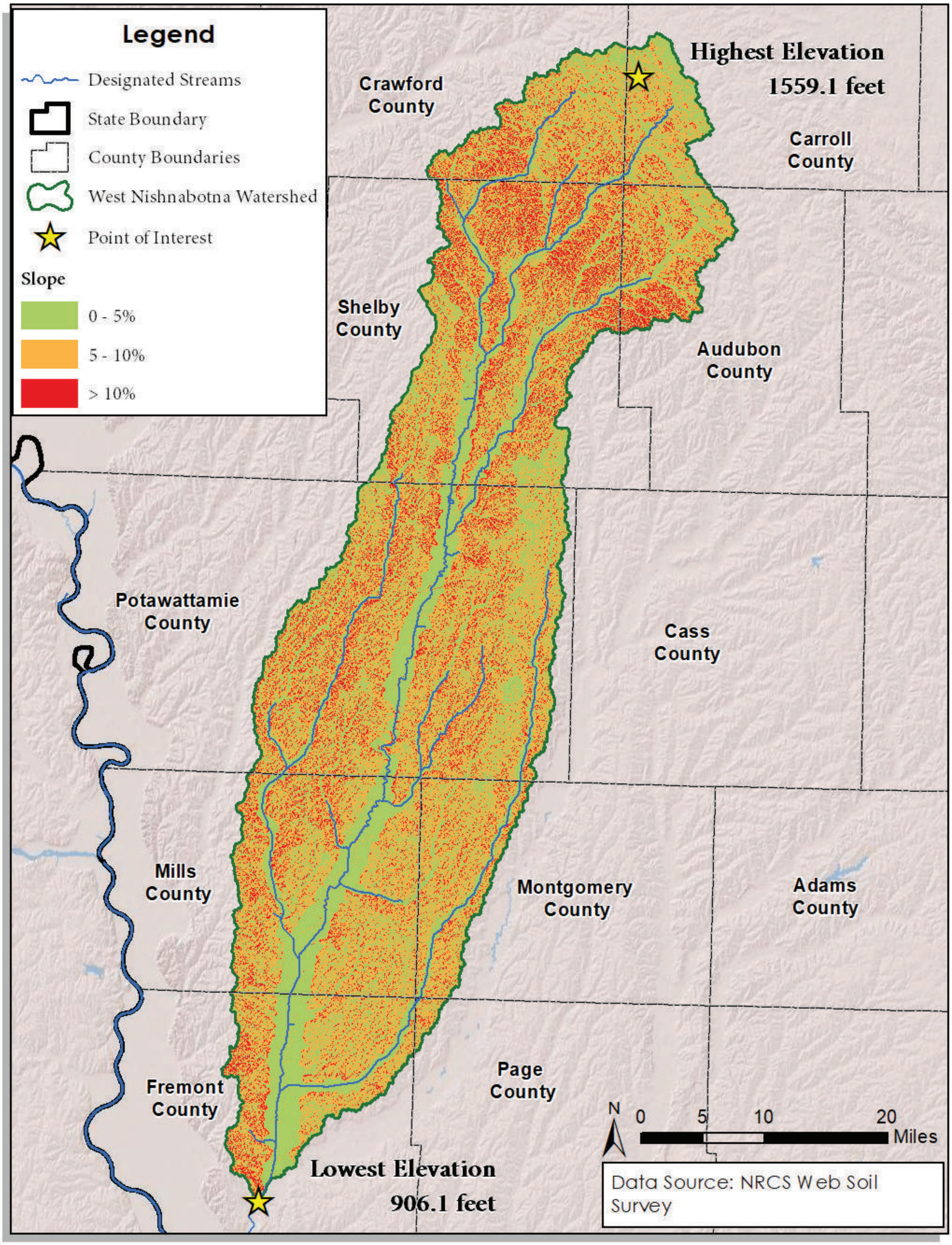


Figure 15: Topographic Relief Map of the Planning Area

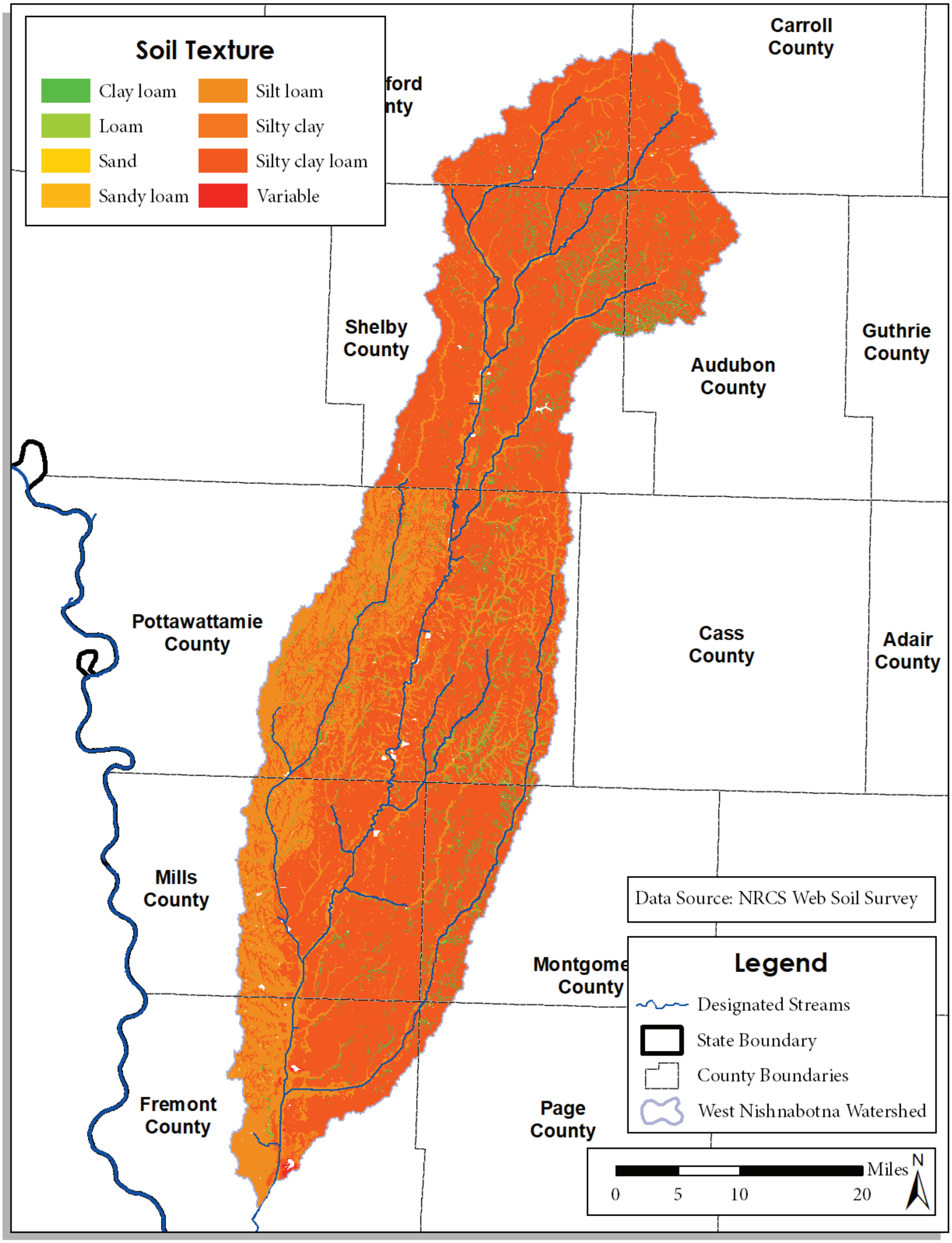


Figure 16: Soil Texture Map

Infiltration

The NRCS classification system divides soils into four major hydrologic soil groups (HSG): A, B, C, and D; and three dual classes: A/D, B/D, and C/D. **Table 8** provides a description of the role soils plays in runoff generation. Soils within each hydrologic group have comparable runoff potential under similar storm and vegetative conditions. The soils in the watershed consist mostly (>96%) of B, C, or C/D soil groups, which contribute to higher runoff rates. **Figure 17** illustrates the geographic distribution of HSG types. These HSGs are consistent with the soil textures described above.

Table 8: Hydrologic Soils Groups and Descriptions

Soil Group	Description	Percentage
A	Soils in this group have low runoff potential when thoroughly wet. Group A soils typically have less than 10 percent clay and more than 90 percent sand or gravel and have gravel or sand textures. Water is transmitted freely through the soil.	0.004%
B	Soils in this group have moderate infiltration and transmission rate when thoroughly wetted. Group B soils consist chiefly of moderately well- to well-drained soils with moderately fine to moderately course textures. Water movement through these soils is moderately rapid.	16.398%
C	Soils in this group have moderately high runoff potential when thoroughly wet. Group C soils typically have loam, silt loam, sandy clay loam, clay loam, and silty clay loam textures. Water transmission through the soil is somewhat restricted.	65.167%
D	Soils in this group have high runoff potential when thoroughly wet. Group D soils typically have clayey textures. Soils with a depth to a water impermeable layer less than 20 inches, and all soils with a water table within 24 inches of the surface are placed in this group. Water movement through the soil is restricted or very restricted.	3.385%
A/D B/D C/D	Soils are assigned to dual groups if the depth to a permanent water table is the sole criteria for assigning a soil to hydrologic group D. If these soils can be adequately drained, then they are assigned to dual groups. The first letter applies to the drained condition and the second to the undrained condition.	15.047%

Source: USDA, 2018b

LAND USE

"Land use" and "land cover" are two separate terms, yet they are often used interchangeably. Land use describes how people utilize the land (i.e. urban or agriculture), while land cover describes the physical material of the earth's surface (i.e., type of vegetation). For the purposes of this plan "land use" will be used as a common term for simplicity and because the term implies intentional management. Understanding land use is at the heart of watershed planning as the activities and uses of the land within a watershed are often the primary drivers in identifying specific sources of pollutants. Understanding how land use affects watershed functions (such as hydrology) requires an understanding of both the historical and present-day land use conditions of the watershed. Streams and other biological communities evolved in the historic setting, and understanding those conditions, as well as the modern-day changes and subsequent impacts to them, is key to finding solutions to current problems.

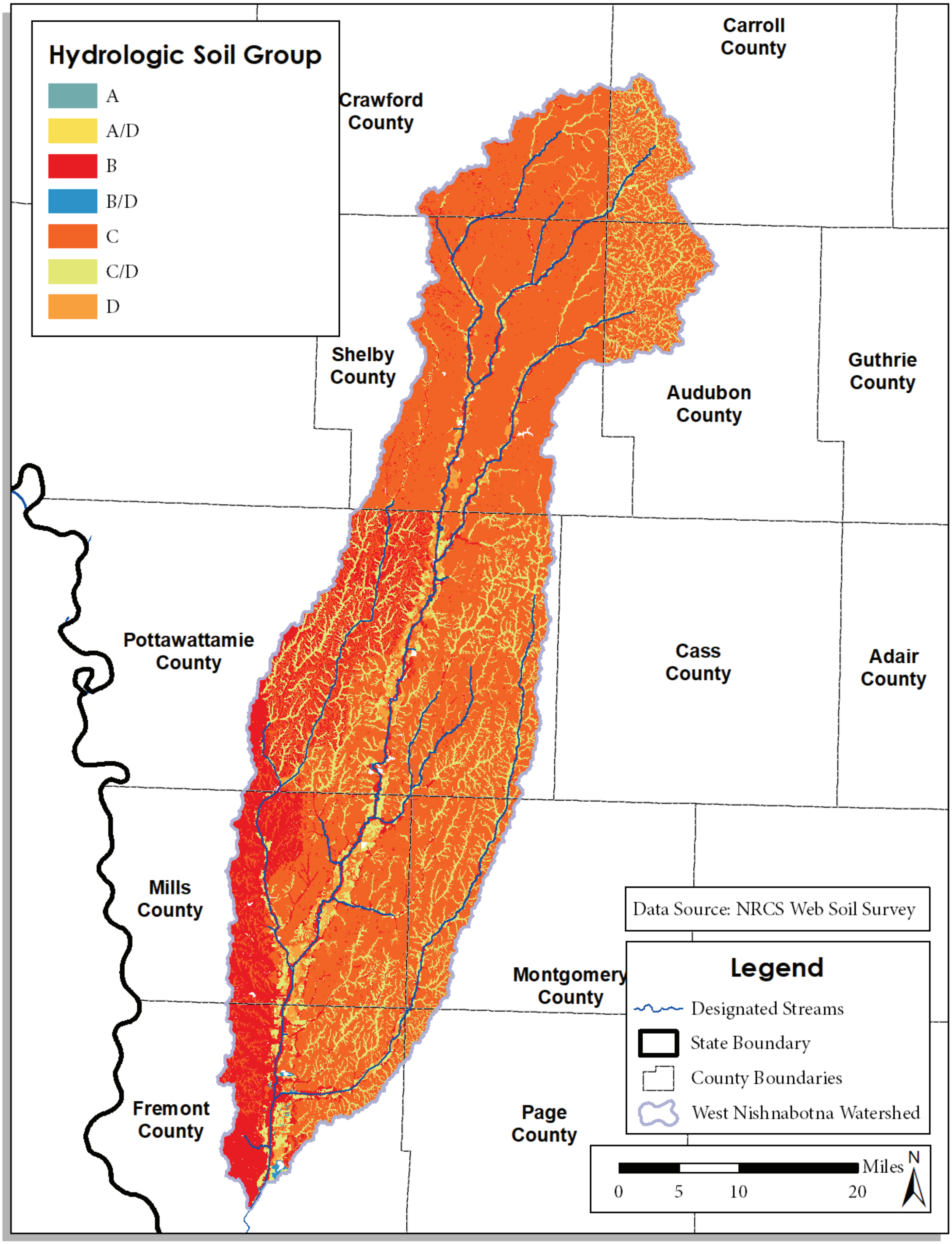


Figure 17: Hydrologic Soil Group Map

NATIVE VEGETATION

Surveys conducted by the General Land Office (GLO) and developed by Iowa State University (ISU) Geographic Map Server were used to develop a map of the historical land cover in the planning area between 1832 and 1859, prior to major European settlement (ISU, 2018c) (**Figure 18**). The vast majority of the watershed, like most of Iowa, was covered by prairie. Small areas of forest and scattered trees could also be found across the watershed.

As European settlement and agriculture came into Iowa, land use began to drastically change. The prairie-forest-wetland mosaic was transformed into small farms, grain fields, and pastures. Changes in the 20th century were even more dramatic with the advent of improved farming technology and government incentive programs. Modern tiling machines allowed wet areas to be drained, farms increased in size and decreased in complexity, and agricultural chemical use became normal. Between 1900 and 2014 row crop acres increased from 9.1 million acres to 23.4 million acres, and hay and small grain acres decreased from 6.8 million acres to 1.2 million acres. The average farm size increased from 100 acres to more than 340 acres. Additionally, larger farms and field sizes have eliminated fencerow, windbreaks, and waterways (Iowa Department of Natural Resources [IDNR], 2015).

PRESENT DAY LAND USE

A century and a half of change to Iowa's landscape has resulted in a shift in the composition of plant communities and wildlife, as well as changes in runoff and water quality. Most of the state is now covered with row crops (corn or soybean), with the remainder primarily grassland and small areas of timber, wetlands, or other land uses. The approximate percentage of Iowa's native vegetation remaining includes 0.2% of Iowa's native prairies, 5% of wetlands, and 37% of its forests (IDNR, 2015a).

Present day land use in the watershed was determined by GIS analysis of the 2017 USDA-NASS's Cropland Data Layer (**Table 9**). As seen in **Figure 19**, agriculture now dominates the watershed with 82% used for crop ground and 10% for pasture (a small amount of this is likely prairie). Small amounts of the watershed have forest (1%) and open water and wetlands (1%) are prominent in the downstream portion of the watershed.

Table 9: Existing Land use in the WNRW

2017 Land Use	Percentage
Crop	82%
Pasture/Grass	10%
Developed (Urban)	6%
Forest	1%
Open Water/Wetlands	1%
Total	**100%**

Source: USDA, 2018a

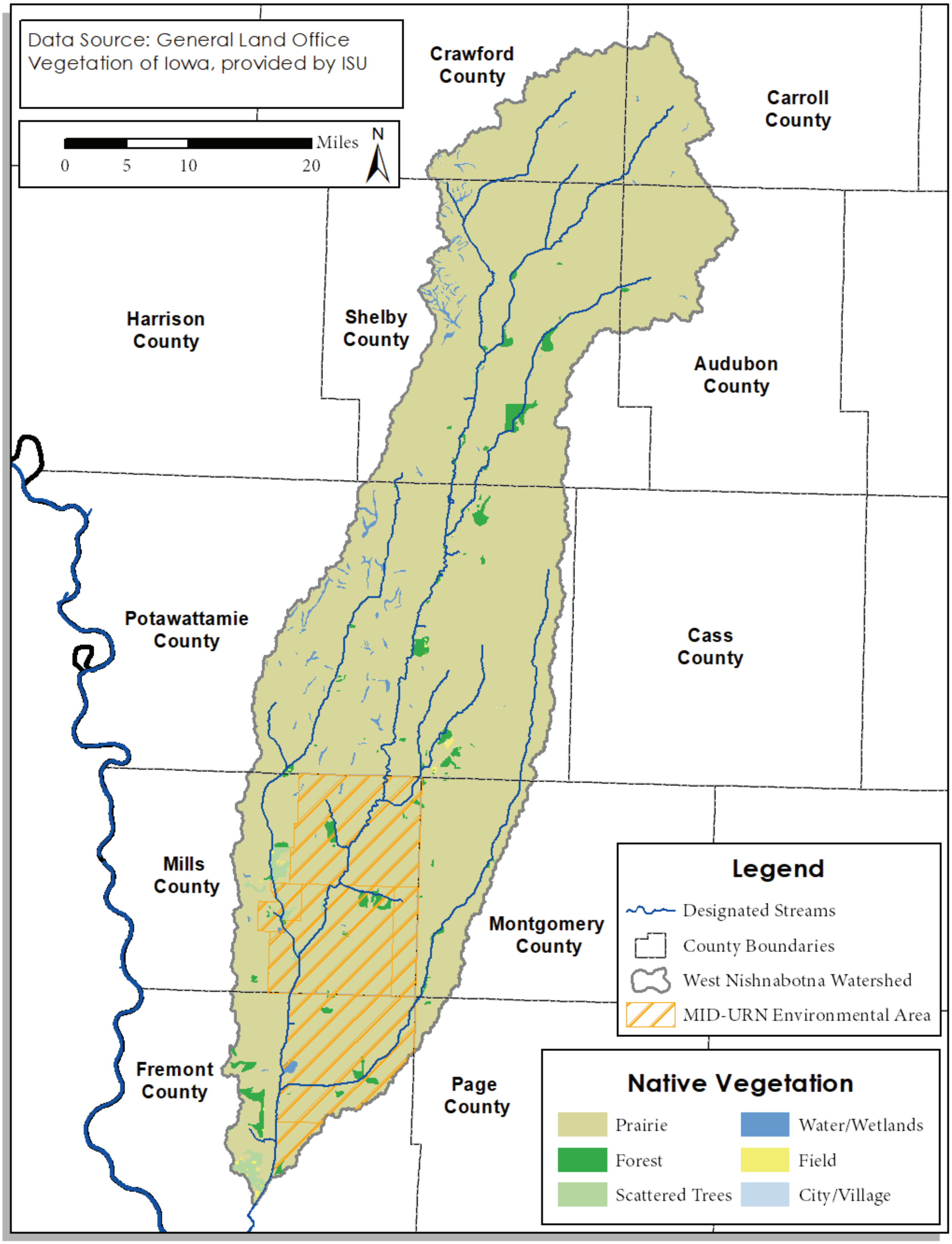


Figure 18: Historic Vegetation of the Planning Area (1832-1859)

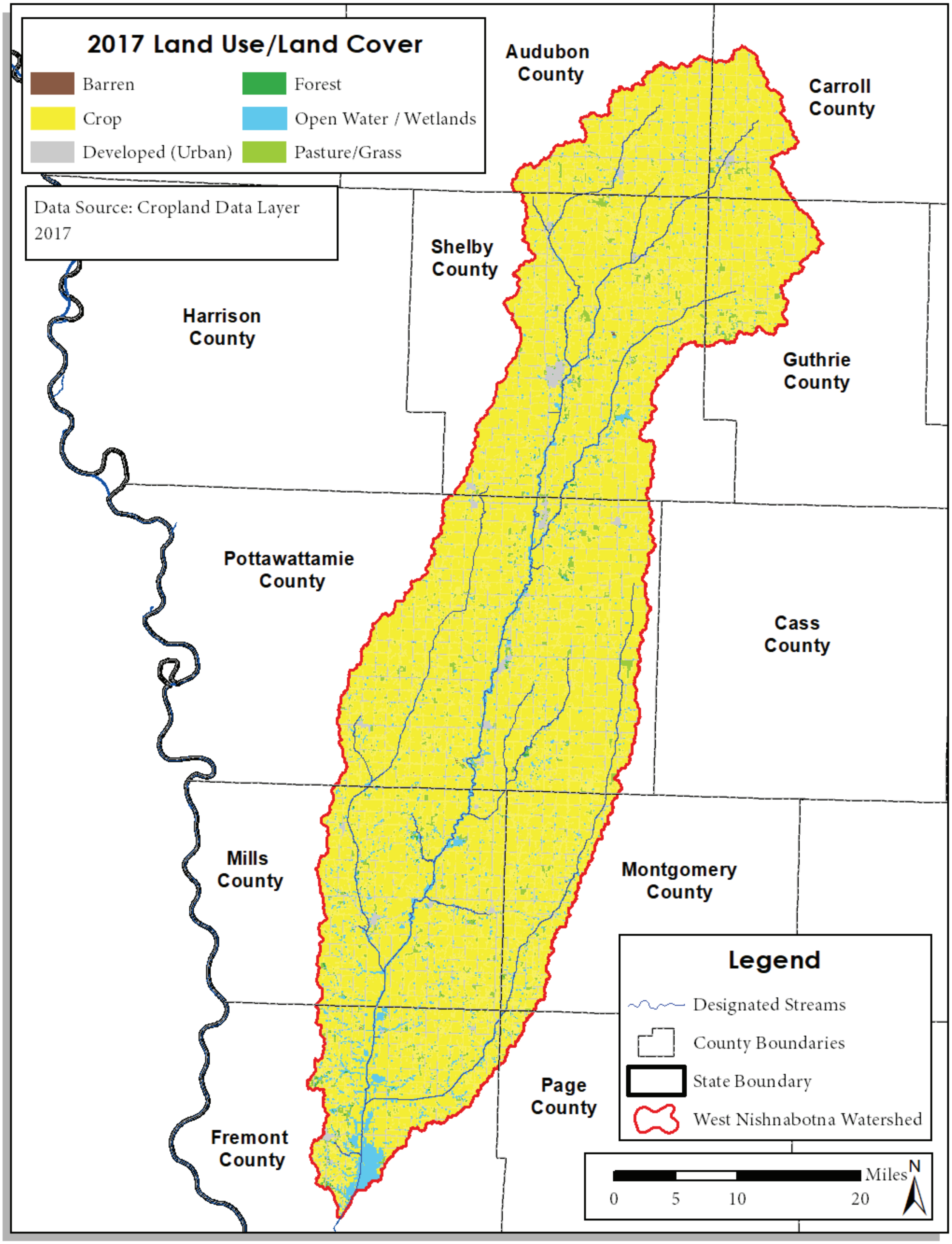


Figure 19: Present Day (2017) Land Use in the Planning Area

2.4 WATER RESOURCES

STREAMS AND RIVERS

The IDNR maintains a GIS database of streams (and stream segments) that have been given designated uses for the purposes of administering the Clean Water Act. Designated uses vary but include swimming, fishing, human health, drinking water supply, and others. These designated use segments are perennially flowing streams or intermittent streams with perennial pools. Each of these designated streams or segments have been assigned an identification number for consistent identification purposes. While this plan focuses on these designated streams, much of the discussion or projects identified in this plan can also apply to or provide benefits to other streams, segments, or waterbodies in the planning area.

The West Nishnabotna River is composed of several designated stream segments covering approximately 115 stream miles (**Figure 20**), one of which is designated for primary contact recreation (swimming). There are 13 additional named tributaries contributing another 224 stream miles to the West Nishnabotna River Watershed: East Branch West Nishnabotna River; West Fork West Nishnabotna River; Elk Creek; Farm Creek; Greybill Creek; Indian Creek; Jim creek; Jordan Creek; Middle Silver Creek; Mud Creek; Silver Creek; Walnut Creek; and Willow Creek (**Table 10**). The West Nishnabotna River Watershed exhibits a dendritic drainage pattern, with many of the perennial tributaries flowing in a northeast-to-southwest direction.

Table 10: Designated Streams in the WNRW

Stream Name	ADB Code(s) for Each Segment	Stream Length (miles)
West Nishnabotna River	05-NSH-1440, 05-NSH-1441, 05-NSH-1442, 05-NSH-1444, 05-NSH-1445, 05-NSH-1446, 05-NSH-1447	115
East Branch West Nishnabotna River	05-NSH-1823, 05-NSH-1824	31
West Fork West Nishnabotna River	05-NSH-1463	30
Elk Creek	05-NSH-1465	8
Farm Creek	05-NSH-1458	6
Greybill Creek	05-NSH-1460	10
Indian Creek	05-NSH-1456	7
Jim Creek	05-NSH-1461	1
Jordan Creek	05-NSH-1459	12
Middle Silver Creek	05-NSH-1455, 05-NSH-3004	6
Mud Creek	05-NSH-1457	6
Silver Creek	05-NSH-1451, 05-NSH-1452, 05-NSH-1454	46
Walnut Creek	05-NSH-1449, 05-NSH-1450	56
Willow Creek	05-NSH-1464	4
Unnamed Creeks		9
	Total	**348**

Source: IDNR, 2018e

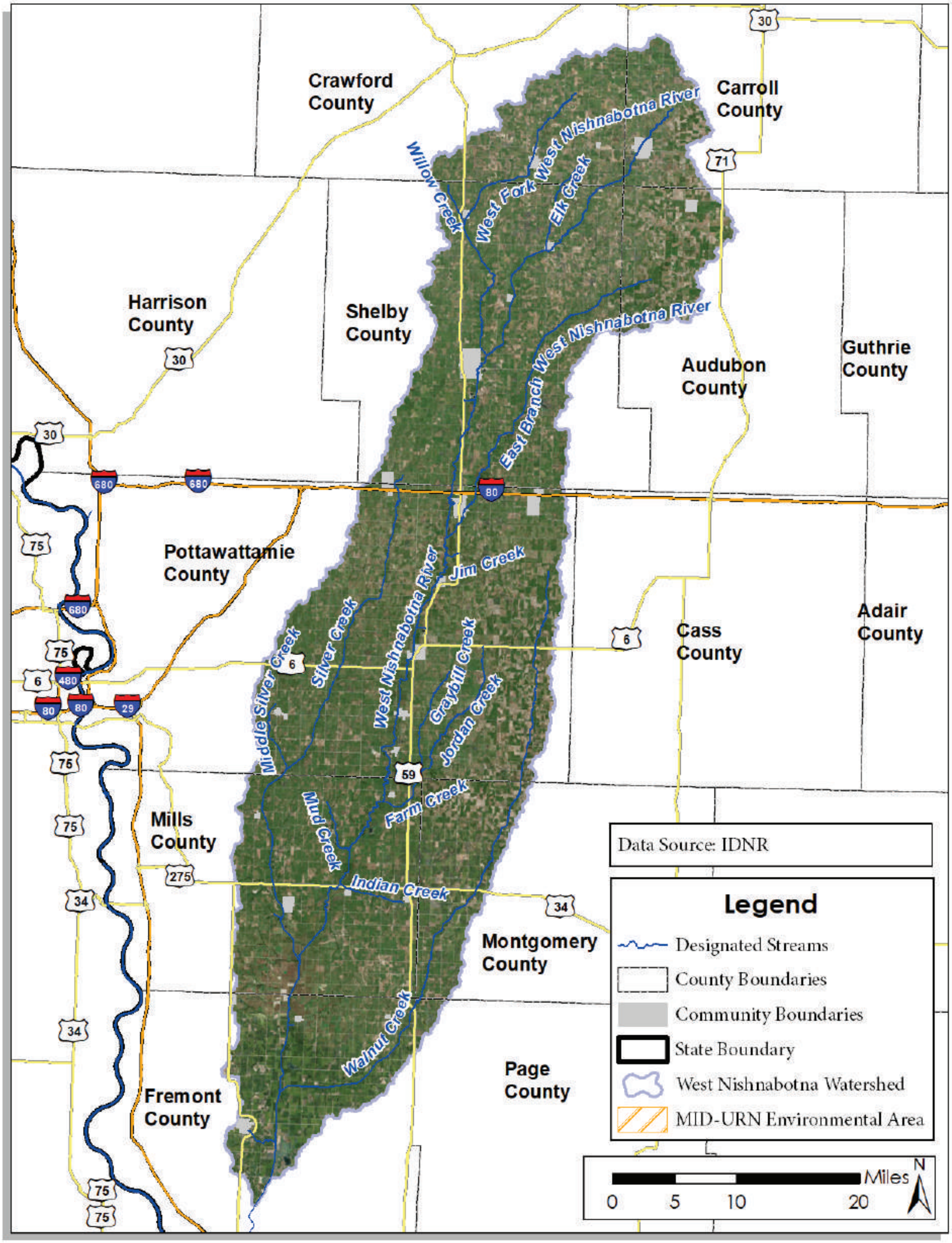


Figure 20: Designated Streams the Planning Area

LAKES AND RESERVOIRS

Similar to designated streams, IDNR also maintains a GIS database for lakes, each of which has a unique identification number (lake code). There are four designated lakes in the planning area (**Table 11**, **Figure 21**). Prairie Rose Lake is the largest, covering 219 surface acres of permanent pool and is located southeast of the City of Harlan. Other designated lakes in the watershed range from two to 150 surface acres and include: Little George Pond, Malvern Pond, and Willow Slough. The many lakes in the planning area offer recreational activities and facilities for fishing, hiking, picnicking, and camping.

It should be noted that this plan focuses on flood resiliency and water quality as they related to the streams in the watershed and thus further discussion on lakes will not be included. However, projects identified within the plan will likely provide benefits to many of these lakes or other waterbodies in the watershed.

Table 11: Designated Lakes in the WNRW

Lake Name	Lake Code	Surface Area (ac)
Little George Pond	LGP83	2
Malvern Pond	MCP65	10
Prairie Rose Lake	PRO83	219
Willow Slough	WIL65	150
	Total Acres	**381**

Source: IDNR, 2018e

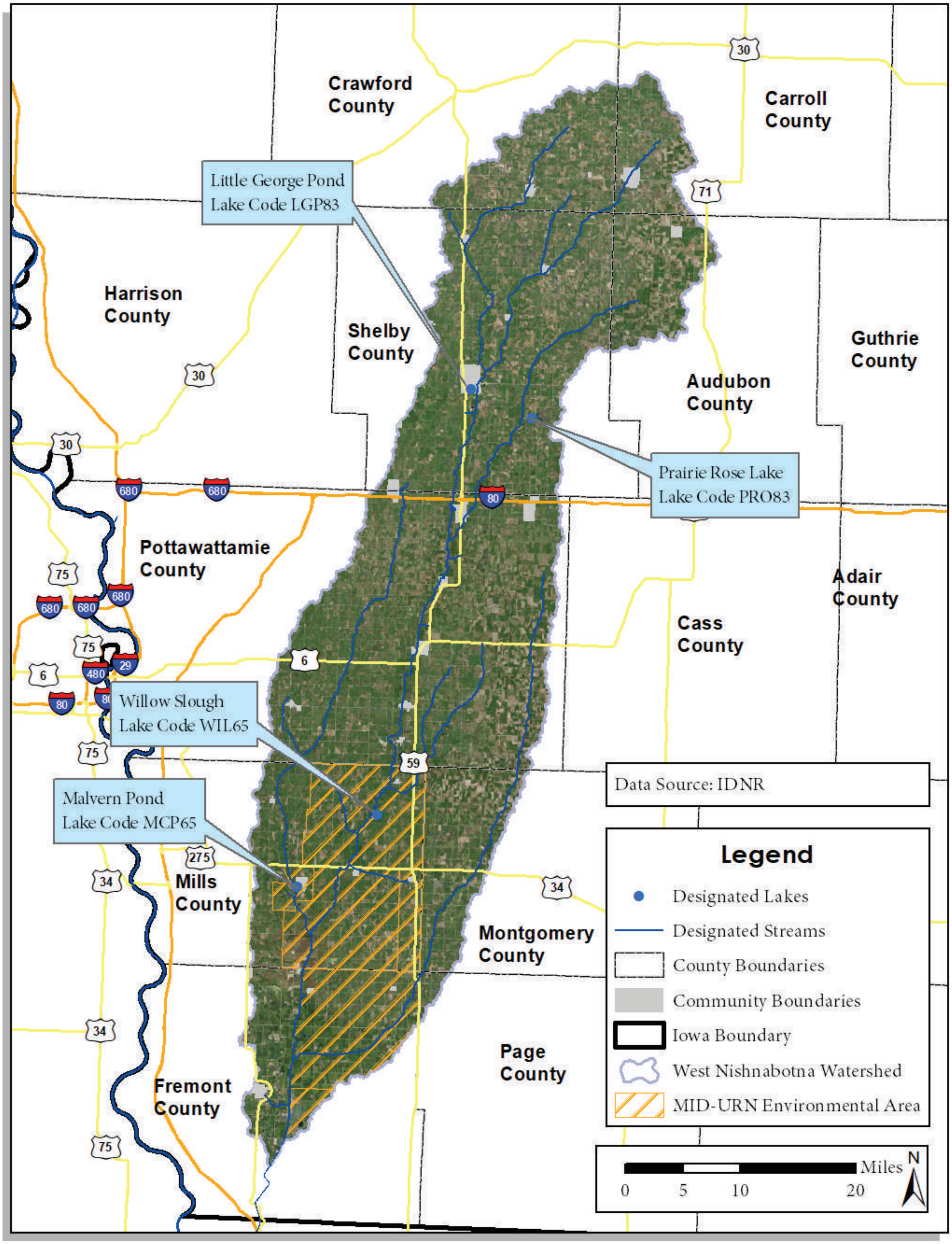


Figure 21: Designated Lakes the Planning Area

2.5 HYDROLOGY

Characterizing the hydrologic regime of a watershed is an important step to understanding its susceptibility to alterations from land and water use practices, which in turn influence flooding and water quality. This understanding is also critical to building appropriate hydrologic models of the watershed. Figure 22 contains a conceptual hydrograph and cutaway which illustrates key hydrologic concepts. When hydrologic alterations occur, the stream system responds with changes in physical, chemical, and biological parameters. Physical changes may lead to increased flooding and reduced streambank stability which may, in turn, impact chemical and physical water quality parameters, and ultimately impact the biological ecosystem or human uses of the stream.

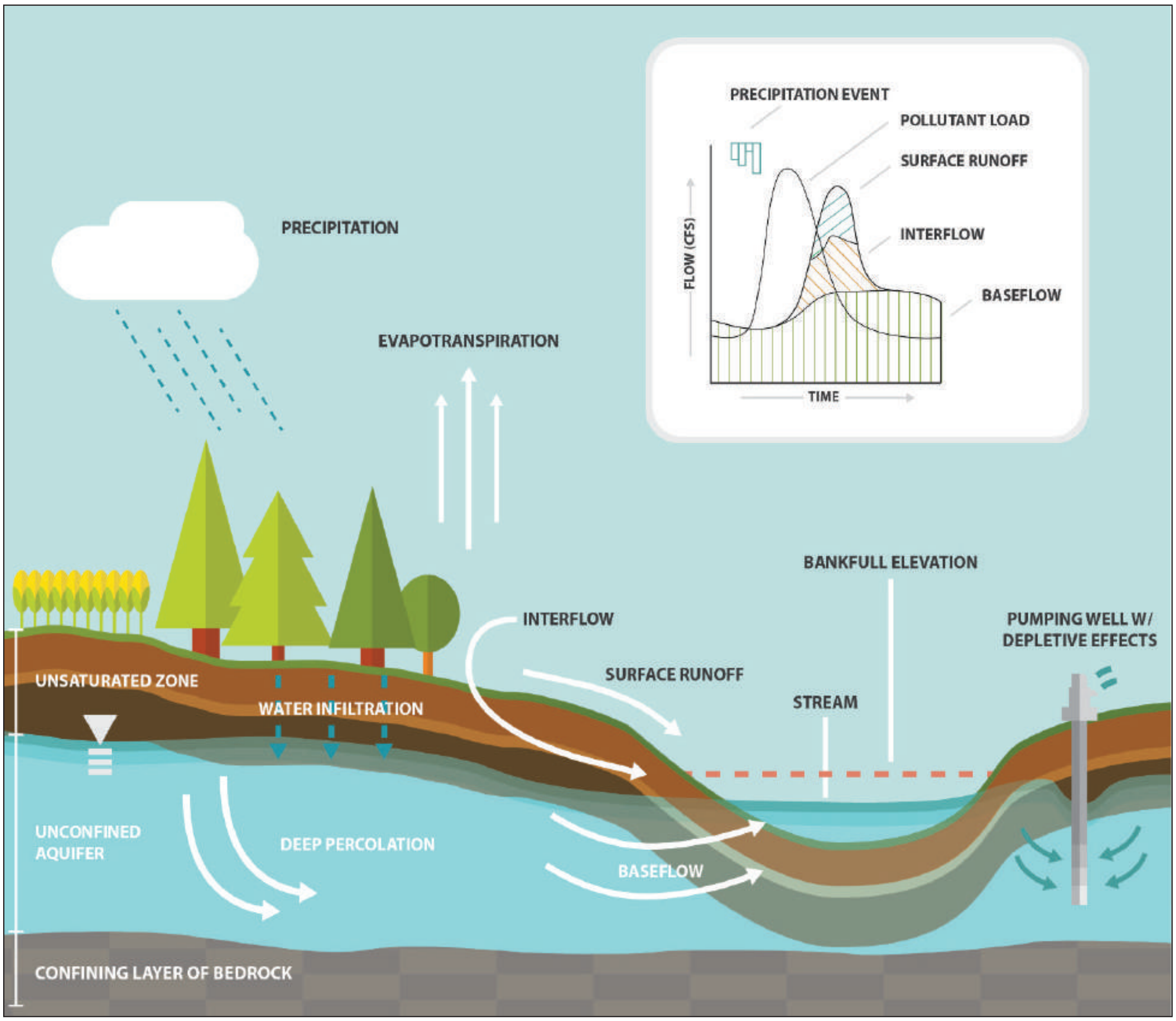


Figure 22: Illustration of a Conceptual Storm Hydrograph and Groundwater Flow System

Source: JEO Consulting Group

Hydrologic processes are complex, involving many interactions that can be difficult to quantify. Additionally, impacts may be seen on both temporal and spatial scales. The location, extent, timing, and type of activities all play a role in alterations. Changes can be seen in the magnitude and timing of peak and low flows, or in year-to-year flow trends. Some activities (roads, seasonal irrigation withdrawals, etc.) cause short-lived alternations, while other activities (dams, urbanization, channelization, groundwater mining, etc.) can cause long-term changes in the hydrology of a watershed (EPA, 2003). As part of the Iowa Watershed Approach, the IFC has developed a hydrologic model for the WNRW and an associated Hydrologic Assessment Report (IFC, 2018). The report provides a review of streamflow components and historic trends, as described here:

- Streamflow, baseflow, and runoff all have slight positive (increasing) trends, with most of the streamflow increase due to baseflow increases over time.
- These changes are likely a result of historic increases in baseflow beginning in the 1980s, with the largest changes occurring the last two decades.
- The reasons for these changes are not completely known, but likely drivers include: improved conservation practices promoting infiltration, greater artificial drainage (tiling), increased row crop production, and channel incision.

Streamflow is largely driven by precipitation. Figure 23 displays the monthly water cycle at Randolph from 1950-2017 using streamflow and precipitation records. Precipitation amounts are lowest during the winter months; however, because this precipitation is likely snowfall, it accumulates before melting in the warmer spring temperatures. A large increase in precipitation occurs in the spring months before peaking in the months of May and June. Precipitation slowly decreases through late summer and early fall (IFC, 2018).

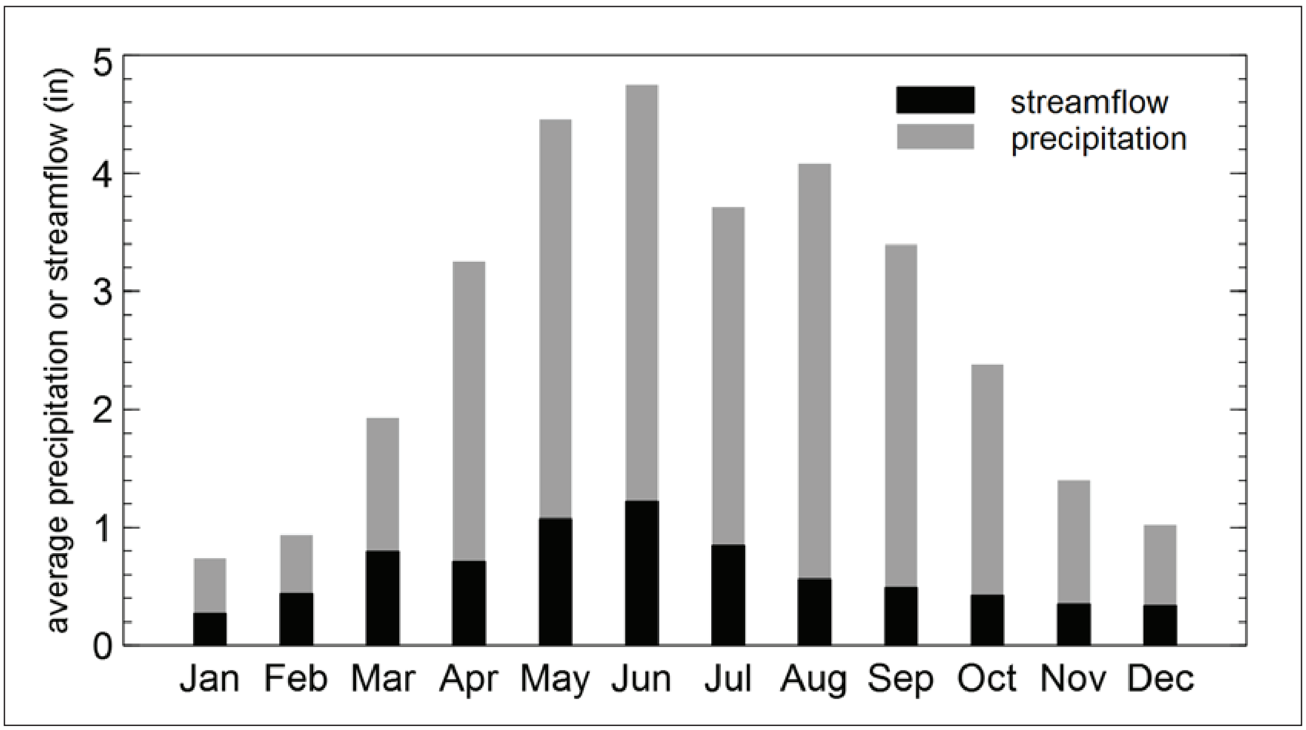


Figure 23: Monthly Water Cycle for the West Nishnabotna Watershed (1950-2017) at Randolph

Source: IFC, 2018

SURFACE RUNOFF

Average annual runoff volumes for each HUC 12 subwatershed were estimated across the planning area. A detailed discussion on methodology is provided in Appendix B. These runoff yield estimates were then utilized to estimate pollutant loadings for individual HUC 12 subwatersheds. Runoff volumes are primarily driven by the interaction of precipitation with soil type, land use practices, and topography (slope). Areas dominated by natural or perennial vegetation generally have the lowest amount of runoff when slope is not a factor; however, increasing slope increases runoff.

Watershed runoff varies across the watershed (**Figure 24**). Most of the lowest runoff estimates were noted along the southwestern edge of the study area nearest to the Missouri River. Land use in this area consists mostly of row crops, primarily corn and soybeans, with soils being predominately silt loam. Moving northeast across the study area, soils transition into silty clay loam and clay loams with increasing slope. These factors result in higher estimated runoff values. **Table 12** provides a runoff summary for the WNRW.

Table 12: Summary of Average Annual Runoff Estimates for HUC 12 Subwatersheds

Average Runoff (in)	6.85
Max Runoff (in)	8.57
Min Runoff (in)	3.85
Highest Contributors	Long Branch
	Willow Creek
	Lower West Fork West Nishnabotna River
Lowest Contributors	Little Silver Creek
	Lower Silver Creek
	City of Treynor-Middle Silver Creek

A similar analysis was completed by the IFC; however, the IFC runoff analysis did not determine average annual runoff. Instead it was conducted to identify the relative amount of runoff during a storm event. Additional discussion can be found in **Chapter 3**, or in the Hydrologic Assessment Report (IFC, 2018).

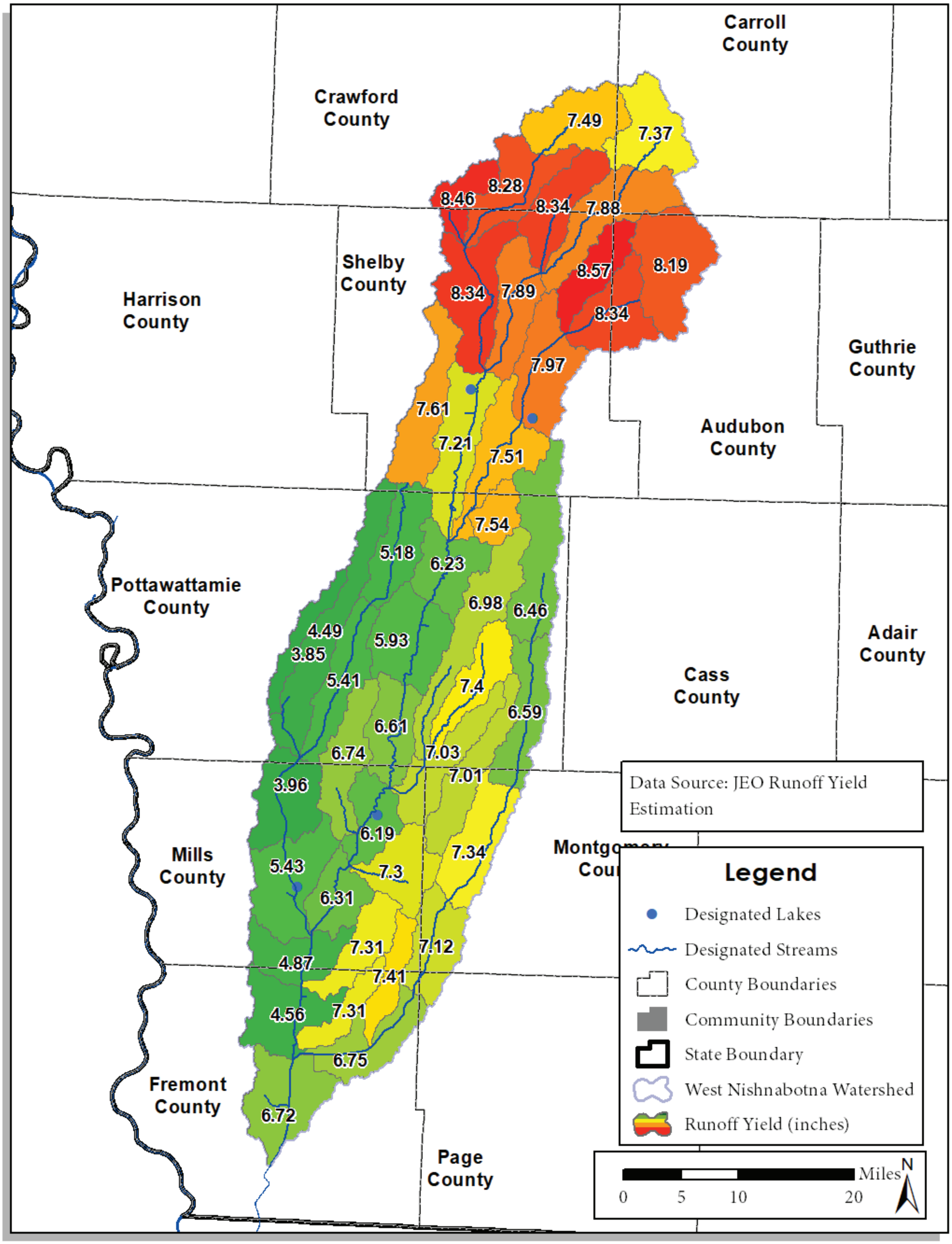


Figure 24: Estimated Average Annual Runoff by HUC12 Subwatershed

STREAMFLOW

Streamflow regimes are composed of seasonally varying environmental flow components including: high flows; base flows; pulses and floods that can be characterized in terms of their magnitude, frequency, duration, timing (predictability), and rate of change (flashiness) of hydrologic conditions (Poff and others, 1997).

To understand the typical hydrologic cycle and streamflow regime of the planning area, a representative stream gage was identified to review streamflow records. The USGS stream gage located on the West Nishnabotna River at Randolph (06808500) was selected as it has a long period of record (1948 – present) and is centrally located in the WNRW. However, while representative of the area and long-term trends, it should be noted that all streams have unique responses to storm events due to variability in precipitation patterns and the effects of terrain, soils, and land use. This creates both local and regional flow patterns. Additionally, many of the area streams are regulated by manmade structures such as flood control reservoirs. A review of the discharge data for the West Nishnabotna River demonstrates a few trends which provide a basic understanding of the dynamic hydrologic cycle in the planning area:

- Streamflow can vary considerably day-to-day, as precipitation is the most significant water supply to the planning area (Figure 25).
- A predictable seasonal pattern can be seen in streamflows. There is an increase in runoff in late winter/early spring caused by snowmelt, leading to increased stream flows. There is also an increase in streamflows during the late spring and early summer storm season (Figure 25).
- The increase in streamflow noted by the Hydrologic Assessment Report (IFC, 2018) is evident in Figure 26.
- There are long-term patterns of wet and dry periods, as seen in the running 5-year average (Figure 26). The highest daily average streamflow recorded was 25,800 cubic feet per second (CFS) in 1998, and the lowest daily average was 10 CFS in 1955. The long-term average flow is 736 CFS.
- Stream flows are seasonally predicable across the planning area, but less predictable during high flow/flood events due to natural and anthropogenic impacts which vary across subwatersheds.

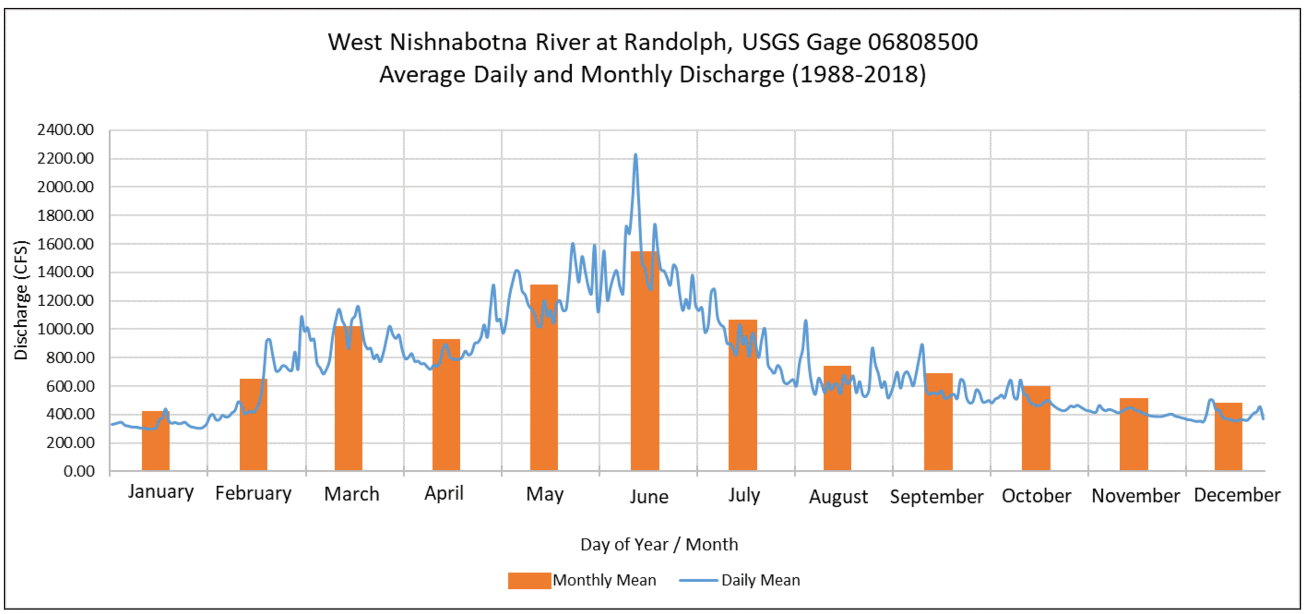


Figure 25: Streamflow Hydrograph of an Average Year for the West Nishnabotna River

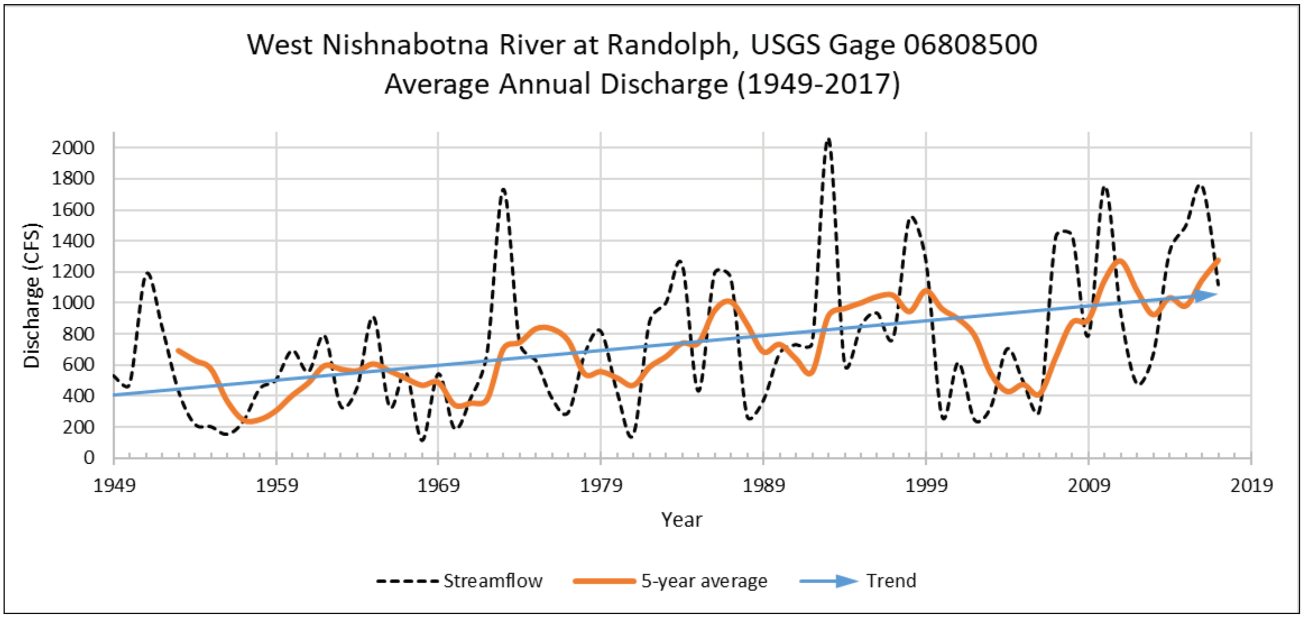


Figure 26: Long Term Streamflow Hydrograph for the West Nishnabotna River

Variations in stream flow levels, including high flow or flooding events, are an important part of the natural ecological function of streams. Many fish and aquatic organisms require habitat that cannot be maintained by minimum or even typical flows over the long term. A range of flows are necessary to scour and revitalize gravel beds, import wood and organic matter from the floodplain, and provide access to riparian wetlands. Additionally, these processes are important in the natural cycling/movement of nutrients and sediments (Poff and others, 1997).

Understanding these hydrological conditions is important to making management decisions regarding watershed planning, especially regarding stream restoration and management practices. However, extremely high flows, which may be considered flooding, can cause damage to infrastructure, homes, businesses or other property, and endanger human life. Balance is needed to manage streams within the planning area. Addressing flooding risks should be done through a multi-pronged risk management approach, which includes: mitigation, preparation, response, and recovery. Additionally, local, state, and federal partners should all be included.

While **Chapter 1** of this plan provides a summary of each major flooding event, the Hydrologic Assessment Report (IFC, 2018) provides a helpful summary of the overall nature of flooding within the planning area:

> Floods are typically related to large amounts of precipitation or snow melt and saturated or frozen soil. In Iowa, historic records show that the great majority (>90%) of floods occur in the spring and summer; the month of June shows the highest number of flood events. Precipitation records show that heavy rains occurred in the fall as well; however, Iowa soils have a larger capacity to infiltrate water late in the year, and therefore fall floods are less common. In Iowa's flood history, the events of 1993 and 2008 are on an entirely different scale than the others. These two events stand out from the rest when looking at the extent of the area impacted, recovery costs, precipitation amounts, and streamflows recorded.

FLOODS OF RECORD

There is a very short period of record at the Randolph USGS gage for water level height; therefore, to provide an understanding of the nature of flooding within the WNRW, discharge data (which has a much longer period of record) was used. The IFC completed a thorough analysis in the Hydrologic Assessment Report (IFC, 2018), and the following sections present a summary of those findings below.

Averaging all annual peak observations provides the mean annual peak discharge which serves as a reasonable threshold for flooding occurrences. Of the 69 annual maximum peak discharges, 31 peaks were greater than the mean annual peak discharge. Further analyses of these annual maximum peak discharges reveal the seasonal flood pattern for the WNRW. Figure 27 shows the number of flood occurrences for each calendar month. Most flooding events occur during the months of May and June. A secondary peak occurs in March, likely caused by snowmelt and spring rains. Late summer and early fall see a similar small increase in the occurrence of flood events.

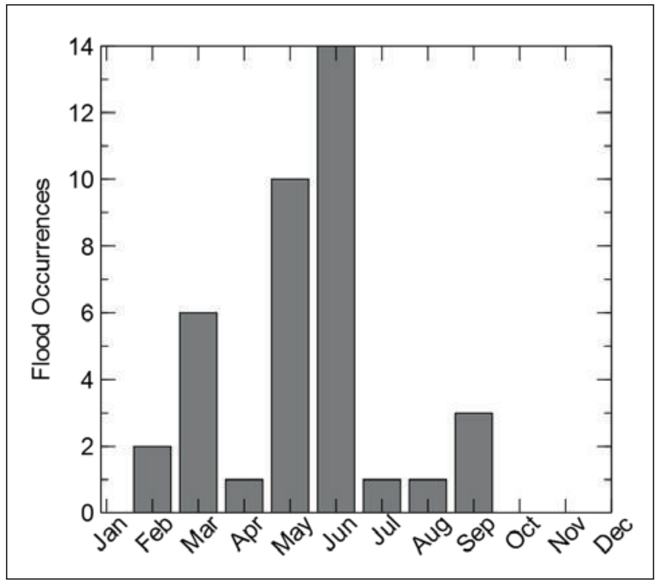


Figure 27: Monthly Flood Occurrence Frequency for the West Nishnabotna River

Source: IFC, 2018

The five largest observed river discharges occurring at Hancock, Randolph, and Riverton USGS gauging stations do not have any events in common. Table 13 shows the dates and discharges associated with each flooding event at the three gauging stations. The Riverton gauging station has a limited period of record relative to the other sites. The absence of dates in common is likely due to the spatial variability of historic storm tracks and rainfall accumulations.

Table 13: Discharges from the five largest flooding events at USGS Gaging Stations in the Watershed

Flood of Record (Ranking)	West Nishnabotna at Hancock (1960 – Present)		West Nishnabotna at Randolph (1947 – Present)		West Nishnabotna at Riverton (2010 – Present)	
	Date	Discharge (cfs)	Date	Discharge (cfs)	Date	Discharge (cfs)
1	7/10/1993	30,100	5/26/1987	40,800	6/4/2014	23,500
2	9/13/1972	26,400	6/21/1967	35,500	6/14/2010	11,800
3	5/6/2007	19,800	7/26/1990	31,300	8/9/2015	10,700
4	3/18/1979	18,300	5/9/1950	29,600	6/27/2011	7,980
5	3/1/1965	18,000	7/3/1951	29,400	4/15/2012	6,990

The flood of record at Hancock occurred on July 10,1993, with a discharge of 30,100 cfs. This event was the result of an unusually wet spring that created saturated soil conditions prior to summer 1993. From late June through late July, an unusual weather pattern stationed over the Midwest brought rainfall amounts that exceeded historical Iowa rainfall records (Galloway, 2010). The largest rainfall totals that produced this discharge record occurred mainly in the northern portion of the WNRW.

The flood of record at Randolph occurred on May 26, 1987, with a discharge of 40,800 cfs. This event was the result of intense rainfall occurring primarily in the lower WNRW (Eash and Heinitz, 1991). The National Oceanic and Atmospheric Administration (NOAA) reported up to ten inches of rainfall on May 26 in parts of Mills and Montgomery counties (NOAA, 2017). Damages estimated at $5.5 million ($12 million adjusted for inflation) to farm terraces and levees, as well as severe soil erosion, were attributed to this event (Eash and Heinitz, 1991). Mills, Montgomery, Fremont, and Page counties were declared Presidential and State disaster areas (Eash and Heinitz, 1991).

FLOODPLAINS

In general terms, floodplains are areas adjacent to creeks, streams, and rivers that include the channel and extend to the edges of a valley. These are the areas that both receive floodwaters when stream channels flow out of their banks and provide conveyance of floodwaters during high stream flow events. Other floodplain functions include flood risk reduction, habitat conservation, water quality protection and groundwater recharge. The natural benefits of floodplains and flooding typically outweigh the risks, with the exception of urbanized and built up areas. The Federal Emergency Management Agency (FEMA) has taken steps to define and preserve floodplains to both preserve their natural functions and to reduce flooding risks to human populations.

FEMA has delineated floodplains based upon the anticipated 1% annual chance of flood flows exceeding base flood elevations (BFE). These areas are commonly referred to as the "100-year floodplain" and are illustrated in **Figure 28** for the planning area. In many areas, a regulatory "floodway" has also been established. Floodways are areas that must not be encroached upon to prevent the base flood elevation from increasing by more than one foot. While almost any area in the watershed is at some level of risk for flooding, regulatory floodplains and floodways have been mapped and formally acknowledged by FEMA.

Historically, cities have been developed along waterways for various reasons such as transportation and commerce. As a result, these population centers are at an increased risk to flooding. The same is true in the West Nishnabotna River Watershed as many of its cities are located along the West Nishnabotna River or its tributaries. As previously discussed, this confluence has led to multiple historic flood events across the watershed in recent years. The degree of flood risk for each community varies considerably based on topography, watershed size, flood control structures, land use, or other factors.

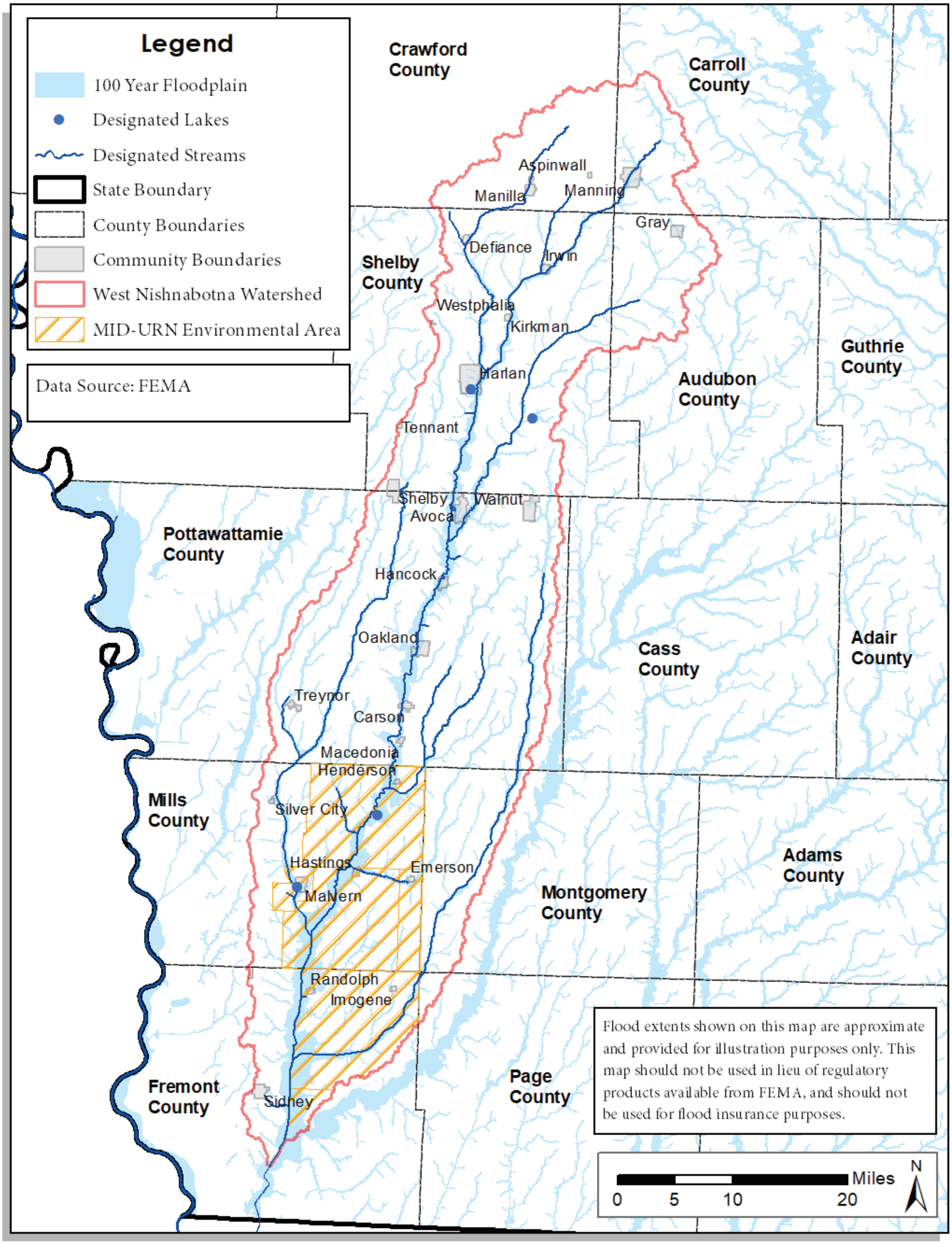


Figure 28: FEMA Regulatory Floodplains in the Planning Area

Source: FEMA, 2018

2.6 SOURCE WATER PROTECTION AREAS

IDNR sponsors a Source Water Protection (SWP) program to protect the quality of drinking water throughout the State of Iowa. SWP areas are located around wellfields and other drinking water sources (**Figure 29**). Of the 27 communities in the WNRW, 18 have started the SWP assessment process and six have developed SWP Plans to ensure their drinking water resources are protected (**Table 14**). It is unknown how many of these plans have been implemented. The SWP Plan development process includes studies to measure nitrate concentrations in drinking water and to determine the contamination susceptibility of an SWP to various pollutants (arsenic, bacteria, etc.). Susceptibility is based on the confining layer thickness of the underlying aquifer, as follows:

- Highly susceptible: less than 25 feet confining layer thickness
- Susceptible: 25 to 50 feet confining layer thickness
- Slightly susceptible: 51 to 100 feet confining layer thickness
- Low susceptibility: more than 100 feet confining layer thickness

Table 14: Summary of Source Water Protection Areas in the WNRW

Community	Assessment Year	Contamination Susceptibility	SWP Plan Status	Nitrate Levels
Aspinwall	N/A	N/A	N/A	N/A
Avoca	N/A	N/A	N/A	N/A
Carson	2014	Highly	Yes	6-year average, <1.3 ppm
Defiance	2012	Highly	Yes	6-year average, <0.0 ppm
Emerson	2014	Susceptible	Yes	6-year average, <5.4 ppm
Gray	N/A	N/A	N/A	N/A
Hancock	N/A	N/A	N/A	N/A
Harlan	2018	Highly	None	10-year average, <1.0 ppm
Hastings	2015	Highly	Yes	6-year average, < 7.5 ppm
Henderson	2017	Highly	None	6-year average, <4.0 ppm
Imogene	N/A	N/A	N/A	N/A
Irwin	N/A	N/A	N/A	N/A
Kirkman	N/A	N/A	N/A	N/A
Macedonia	2017	Highly	None	6-year average, <2.1 ppm
Malvern	2016	Highly	Yes	6-year average, <6.0 ppm
Manilla	2014	Susceptible	None	6-year average, <.0.08 ppm
Manning	2014	Highly	Yes	6-year average, <2.7 ppm
Oakland	2015	Highly	None	6-year average, <1.0 ppm
Randolph	2012	Highly	None	6-year average, <1.46 ppm
Shelby	2016	Highly	None	6-year average, <1.7 ppm
Sidney	2014	Highly	None	6-year average, <6.49 ppm
Silver City	2012	Highly	None	6-year average, <0.02 ppm
Tabor	2018	Highly	None	10-year average, <3.4 ppm
Tennant	N/A	N/A	N/A	N/A
Treynor	2014	Low	None	6-year average, <0.0 ppm
Walnut	2018	Low	None	10-year average, <1.0 ppm
Westphalia	N/A	N/A	N/A	N/A

Source: IDNR, 2018c

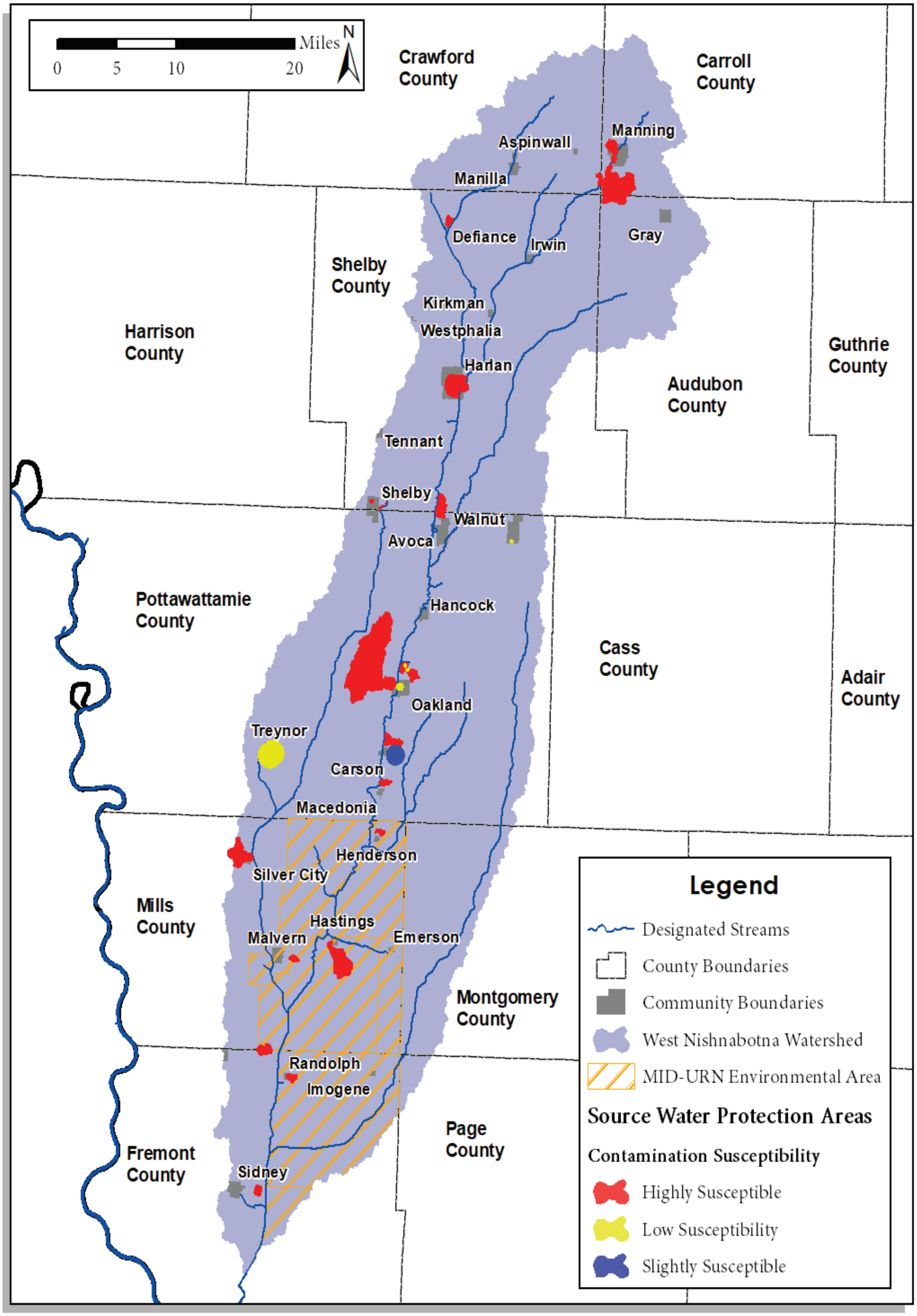


Figure 29: Source Water Protection Areas and Contamination Susceptibility in the WNRW

SWP plan development takes place over three phases. In Phase 1 IDNR provides an initial source water assessment which details the water system's active wells, delineates the SWP area, determines the susceptibility to contamination, and provides all known potential sources of pollutants. Phases 2 and 3 are strictly voluntary and are not commonly pursued by communities. In Phase 2, a local team of officials and volunteers develops the SWP Plan by following a template provided by IDNR and utilizing the information collected during Phase 1. During the final phase, the SWP Plan is implemented to address the specific items that the community will use to protect its drinking water.

Additional information on the IDNR Source Water Protection program can be found here: **https://www.iowadnr.gov/Environmental-Protection/Water-Quality/Source-Water-Protection.**

Complete information for individual SWP areas is available here: **https://programs.iowadnr.gov/sourcewater/**.

2.7 WILDLIFE AND HABITAT

Iowans maintain a strong connection to wildlife and many participate directly in wildlife-associated recreation. In 2013 a non-partisan survey of Iowa's voters found that 97% of respondents agree with the statement "We need to ensure that our children and grandchildren can enjoy Iowa's land, water, wildlife, and the natural beauty the same way we do" (IDNR, 2015a).

Including wildlife and habitat related information in this watershed plan is important. Land protection provides a range of benefits, including increased wildlife habitat, recreational opportunities for humans, and maintaining or restoring ecosystem functions such as water filtration, flood abatement, carbon storage, etc. (IDNR, 2015a). Where opportunities to enhance water quality or flood resilience, as identified in this plan, overlap with opportunities to conserve wildlife and habitat, the likelihood of success is higher. Addressing multiple goals provides opportunities for project partnering and opens additional funding avenues for projects. The West Nishnabotna Watershed Management Coalition (WNWMC) should look for these opportunities and work towards realizing them.

Iowa Wildlife Action Plan

IDNR updated its Iowa Wildlife Action Plan in 2015. This plan was written to guide the conservation of wildlife and natural places across the state and with the intent to outline the steps needed to conserve wildlife, before they are endangered, and habitat, before it become too costly to restore. The plan assesses the health of wildlife and habitat within the state, identifies the problems they face, and outlines the actions that are needed. The plan focuses on Species of Greatest Conservation Need (SGCN).

Habitat availability, quantity, and quality are primary factors influencing the viability of wildlife populations (IDNR, 2015a). While the plan lays out several conservation related visions, strategies, and actions, they are not specific to the WNRW and are not specifically designed to be solely implemented by the IDNR. They are designed to provide a broad framework of actions that can be undertaken by all levels of government, private organizations, and private citizens. They will take a broad array of funding sources, skills, expertise, and partnerships to implement. The plan lays out the following general approaches that should be undertaken:

1. Protect and enhance existing habitats that benefit SGCN;
2. Develop new habitats for SGCN in areas where they do not exist; and,
3. Improving the status of aquatic SGCN will require a more broadly-applied conservation effort.

This third element may be where most opportunities exist for projects and partnerships within the WNRW: Habitat in rivers, streams, lakes, impoundments and wetlands can be improved only if soil erosion, siltation, and all the associated problems are reduced. Targeting areas to protect and restore habitats for terrestrial SGCN will help with this process but will not protect enough land by itself to help all aquatic systems. Vegetative cover must be returned to more of the landscape to hold soil in place. Existing soil-retention programs like terracing, buffer strips, and no-till agriculture need to be expanded and new approaches explored to make soil conservation more widely acceptable and financially attractive to the farming community (IDNR, 2015a).

The plan was developed to be a 25-year strategic plan, thus identifying specific priorities was beyond its scope. The intention was that shorter-term (1-5 year) priorities for implementing actions would be developed by individuals or partnerships of stakeholders. The geographic priorities of the plan were identified as "High Opportunity Areas for Cooperative Conservation," and these should be used to identify the initial areas for partnerships and projects (**Figure 30**). These areas in the WNRW include the Riverton Wildlife Management Area and areas within Shelby County. (IDNR, 2015a).

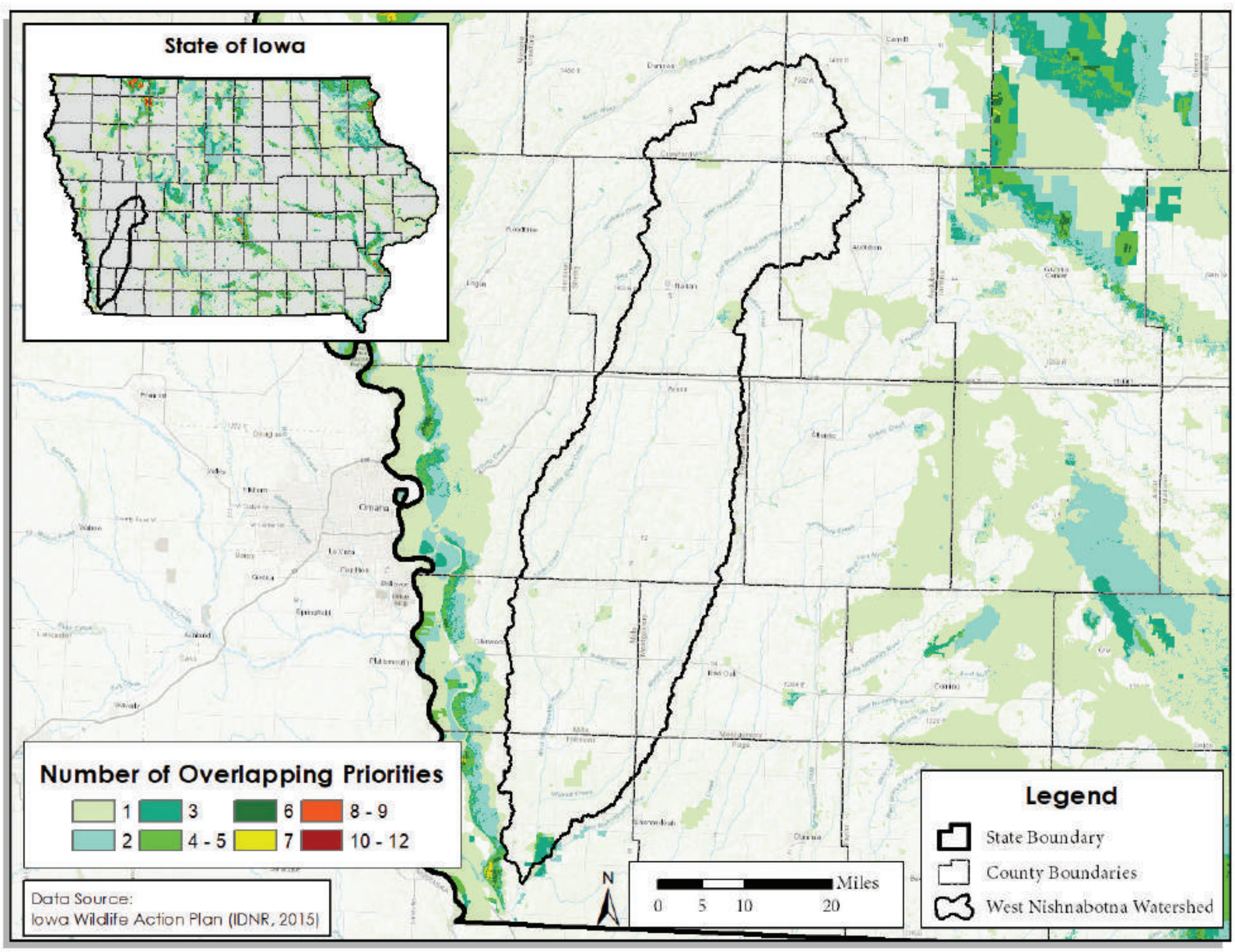


Figure 30: High Opportunity Areas for Cooperative Conservation Actions

THREATENED AND ENDANGERED SPECIES

Identifying specific locations of Threatened and Endangered (T&E) species in the planning area was outside the scope of this planning effort. However, there are both federal and state listed species in the planning area. It is recommended that project sponsors consult with the United States Fish and Wildlife Service (USFWS) and IDNR for specific project sites where threatened or endangered species' habitats may exist. The WNRW encompasses a small portion of designated critical habitat area for the Topeka Shiner (Notropis topeka (=tristis)). This area is located in Carroll County, Iowa. **Table 15** identifies federal T&E species that can be found in the planning area. There 94 state listed T&E species, and a list of those can be found at the Iowa Natural Areas Inventory interactive website: **https://programs.iowadnr.gov/naturalareasinventory/pages/Query.aspx**.

AQUATIC INVASIVE SPECIES

Aquatic invasive species are non-native organisms introduced into rivers, streams, and lakes. They generally have few to no predators or any other natural controls on their population, such as disease or competition, allowing their numbers to grow unchecked. Once established, these species may cause irreparable harm, introduce disease, out-compete native species, change the physical characteristics of waters, damage equipment, clog water delivery systems, and negatively impact local and national economies.

While there is not a complete list of locations where invasive species are found, IDNR maintains information on potential invasive species in Iowa. **Table 16** identifies aquatic invasive species which may be present within the planning area. Prevention is the strongest defense against invasive species. Posting signs or distributing educational information are some methods to prevent the introduction of these species into the watershed. However, if these or other invasive species are found to be in the watershed, future education efforts could be designed to target their reduction and/or elimination.

2.8 EXISTING POLICY AND REGULATIONS

STATE WATER QUALITY STANDARDS

9h

The IDNR manages water quality for all surface waters within Iowa through the implementation of the state's Water Quality Standards (WQS). These standards are found in Chapter 61 of the Iowa Administrative Code. These standards include numerical standards for many potential water quality pollutants based on the waterbody's assigned beneficial use, especially as some uses require higher quality water than others. When multiple uses are assigned to the same waters, the most stringent criteria for the appropriate season applies. This plan has been written to address nonpoint source pollutant loadings from bacteria (*E. coli*), nutrients (phosphorus and nitrogen), and sediment.

Iowa's WQS are in place to protect the quality of surface water for human consumption, wildlife, industry, recreation, and other productive, beneficial uses. Beneficial uses are also protected by permits issued in accordance with both the requirements of these standards and for the applicable level of treatment or control for point and nonpoint sources of pollution. It should be noted that these standards apply to all surface waters of the State, except as noted in Chapter 61, even if they are not specifically assigned a beneficial use in Chapter 61. WQS can be both in numerical or narrative formats. While there are many WQS which apply to both streams and lakes, the only WQS utilized for the development of this plan are identified in **Table 17**. No numerical WQS exist for nutrients or sediment.

Table 15: Federally-Listed Threatened and Endangered Species in the Planning Area

Type	Common Name	Scientific Name	Status
Mammal	Northern Long-eared Bat	Myotis septentrionalis	Threatened
Birds	Least Tern	Sterna antillarum	Endangered
	Piping Plover	Charadrius melodus	Threatened
Fishes	Pallid Sturgeon	Scaphirhynchus albus	Endangered
	Topeka Shiner	Notropis topeka (=tristis)	Endangered
Flowering Plants	Prairie Bush-clover	Lespedeza leptostachya	Threatened
	Western Prairie Fringed Orchid	Platanthera praeclara	Threatened

Source: USFWS, 2018

Table 16: Aquatic Invasive Species That May Be Present Within the Planning Area

Type	Common Name	Scientific Name
Fish	Bighead Carp	Hypophthalmichthys nobilis
	Silver Carp	Hypophthalmichthys molitrix
	Black Carp	Mylopharyngodon piceus
	Round Goby	Neogobius melanostomus
	White Perch	Morone americana
	Ruffe	Gymnocephalus cernuus
	Rudd	Scardinius erythrophthalmus
Plants	Brittle Naiad	Najas minor
	Curlyleaf Pondweed	Potamogeton crispus
	Eurasian Watermilfoil	Myriophyllum spicatum
	Flowering Rush	Butomus umbellatus
	Purple Loosestrife	Lythrum salicaria
	Saltcedar	Tamarix spp.
Invertebrates	Fishhook Waterflea	Cercopagis pengoi
	New Zealand Mudsnail	Potamopyrgus antipodarum
	Quagga Mussel	Dreissena rostriformis bugensis
	Rusty Crayfish	Orconectes rusticus
	Spiny Water Flea	Bythotrephes longimanus
	Zebra Mussel	Dreissena polymorpha

Source: IDNR, 2018b

Table 17: Summary of Water Quality Standards Applicable to This Plan

Parameter	Beneficial Use or Category	Water Quality Standard
Streams		
E. coli Bacteria	Primary Contact Recreation* (Class A1)	Geometric Mean:126 organisms/ 100 ml Individual sample maximum: 235 organisms/ 100 ml

*Standard only applies March 15 – November 15

Source: Iowa Administrative Code, 2019

TOTAL MAXIMUM DAILY LOADS (TMDLS)

A Total Maximum Daily Load (TMDL) is developed by IDNR when a waterbody has been identified as "impaired" for one or more designated beneficial uses and has been identified as a Category 5 waterbody. TMDLs establish the maximum allowable daily load of a pollutant a specific waterbody can receive and still meet WQS. TMDLs are specific to the waterbody they are developed for, and thus can vary. Additional discussion of specific TMDLs in the planning area can be found in **Chapter 3**.

NUTRIENT REDUCTION STRATEGY GOALS

The Iowa Nutrient Reduction Strategy (NRS) has identified statewide goals for reducing nonpoint source pollution. Accounting for the potential reduction from point sources, the target load reductions for nonpoint sources is 41% of the statewide total nitrogen and 29% of the total phosphorus (ISU, 2018b). It should be noted that these goals are based on a reduction of pollutant loads and are not based on the actual concentrations of nutrients or sediment in the water.

SAFE DRINKING WATER ACT

In 1974, the Safe Drinking Water Act directed the EPA to establish national drinking water standards – these are known as Maximum Contaminant Levels (MCLs). These standards set limits on the amounts of various substances allowed in public drinking water. The IDNR is the primary agency responsible for enforcing the federal drinking water regulations in Iowa. The most pervasive drinking water pollutant is nitrate-nitrogen (nitrate). Nitrates are known to cause a disease called methaemoglobinaemia (or "blue baby syndrome") primarily with infants, but it may also impact pregnant women and health-compromised adults. High nitrate levels in drinking water are typically caused by nonpoint source pollution and, thus, are of interest in this planning effort. The MCL for nitrate-nitrogen is 10 milligrams per liter (mg/L) or parts per million (ppm) in drinking water.

STORMWATER AND FLOODPLAIN MANAGEMENT ORDINANCES

Research was conducted throughout September and October 2018 to determine the presence of relevant floodplain, stormwater management, and pet waste management ordinances for cities in the WNRW. The results of this effort were used to estimate existing pollutant sources and identify opportunities for flood mitigation projects and water quality improvement. Community websites were reviewed for online copies of floodplain, stormwater management, and pet waste ordinances. If a community did not have a website, or their ordinances were not available online, efforts were made to contact a community representative via email and follow up phone calls.

Ten of the 27 communities in the WNRW have ordinances related to floodplain management, but none have ordinances related to stormwater management, and 12 have ordinances related to pet waste management. A summary of relevant ordinances is displayed in **Table 18**. Many of the floodplain ordinances are in place to: minimize flood losses by restricting access to the floodplain in times of hazardous events or conditions; protect public facilities that are vulnerable to floods; determine which lands are unsuitable for building in the floodplain; and ensure that the community participates in the National Flood Insurance Program (NFIP). Floodplain ordinances are critical to prevent future losses due to flooding and to reduce flooding risks within a community. It is recommended that all cities adopt ordinances for floodplain management, as well as enroll and actively participate in the NFIP.

Table 18: Summary of Select Ordinance Status for Cities

Community	Ordinance Type			Community	Ordinance Type		
	Floodplain	Storm Water	Pet Waste		Floodplain	Storm Water	Pet Waste
Aspinwall*	-	-	-	Malvern	Yes	No	Yes
Avoca	No	No	Yes	Manilla	No	No	Yes
Carson	Yes	No	Yes	Manning	Yes	No	Yes
Defiance	Yes	No	Yes	Oakland	Yes	No	No
Emerson	Yes	No	No	Randolph	Yes	No	No
Gray*	-	-	-	Shelby	No	No	Yes
Hancock*	-	-	-	Sidney	No	No	No
Harlan	Yes	No	Yes	Silver City*	-	-	-
Hastings*	-	-	-	Tabor	No	No	Yes
Henderson*	-	-	-	Tennant*	-	-	-
Imogene*	-	-	-	Treynor	No	No	Yes
Irwin	No	No	No	Walnut	Yes	No	No
Kirkman	Yes	No	Yes	Westphalia	No	No	No
Macedonia	No	No	Yes				

* denotes community did not respond to inquiry

Stormwater occurs when precipitation falls to the ground and runs off the surface. In cities stormwater often makes its way to a stormwater system, typically consisting of pipes, ditches, culvert, outfalls, etc. before it is eventually discharged to streams. Stormwater does not pass through a wastewater treatment plant before being discharged to a stream. Stormwater discharge from communities has been recognized as contributing to water quality degradation, flooding, and stream erosion. Many cities in Iowa are required to have a permit for their Municipal Separate Storm Sewer Systems (MS4s) through the National Pollutant Discharge Elimination System (NPDES) administered by the IDNR. MS4 permits require cities who meet a specific population threshold to manage their stormwater.

While there are no cities in the watershed that are required to obtain an MS4 permit, there are many benefits of managing stormwater to improve water quality, reduce flooding, and reduce stream erosion. Stormwater ordinances that were found through this effort only addressed the issue of stormwater not being allowed to enter sanitary sewer systems (disconnected downspouts, sump pumps, separate sewers, etc.). No communities were found to have ordinances which address stormwater management, low impact development, post-development runoff, or other related items. It is recommended that each community work to develop local ordinances to better manage stormwater runoff.

Pet waste management ordinances address a pet owner's responsibility to clean up any solid waste left behind by their animal on public property, or the private property of another landowner. Pet waste can contribute bacteria, nutrients, and other contaminants to surface water during precipitation events.

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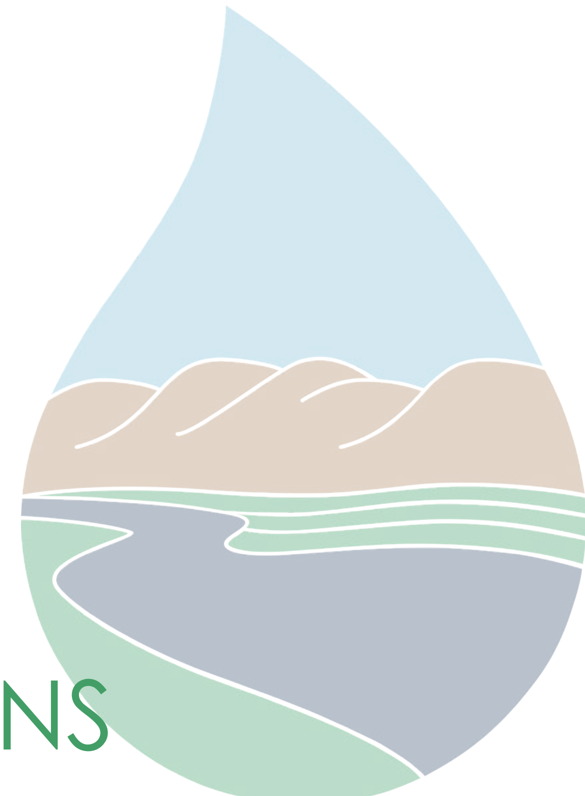


CHAPTER 3

CURRENT CONDITIONS

3 CURRENT CONDITIONS

3.1 FLOOD HAZARD ASSESSMENT

MAPPING AND STREAM GAGING

Flood risks typically originate from three primary sources: mainstem flooding, tributary flooding, and flash flooding. Since 2009, IDNR has been working with the Federal Emergency Management Agency (FEMA) to create and maintain flood hazard data for the State of Iowa. (IDNR, 2018a). The goal of this collaboration is to create Flood Insurance Rate Maps (FIRMs) for every county in the state. Flood hazard maps only account for riverine flooding, which occurs when an existing stream channel, whether it's a tributary or main river branch, overflows its banks. Localized flooding caused by inadequate drainage systems will not be visible on these maps.

The Iowa Flood Information System (IFIS) is an online platform to access flood hazard maps and other flood-related products. IFIS helps communities prepare for and respond to floods before they occur, helping to minimize flood impacts and associated damages. The system includes: real-time stream levels at nearly 250 locations; flood inundation maps showing the extent and depth of predicted flood waters for 24 Iowa communities; weather conditions including current and past rainfall accumulations; and much more. Locations of IFIS stream sensors in the WNRW can be seen in **Figure 31**.

IFIS can be accessed online at: **http://ifis.iowafloodcenter.org/ifis/**

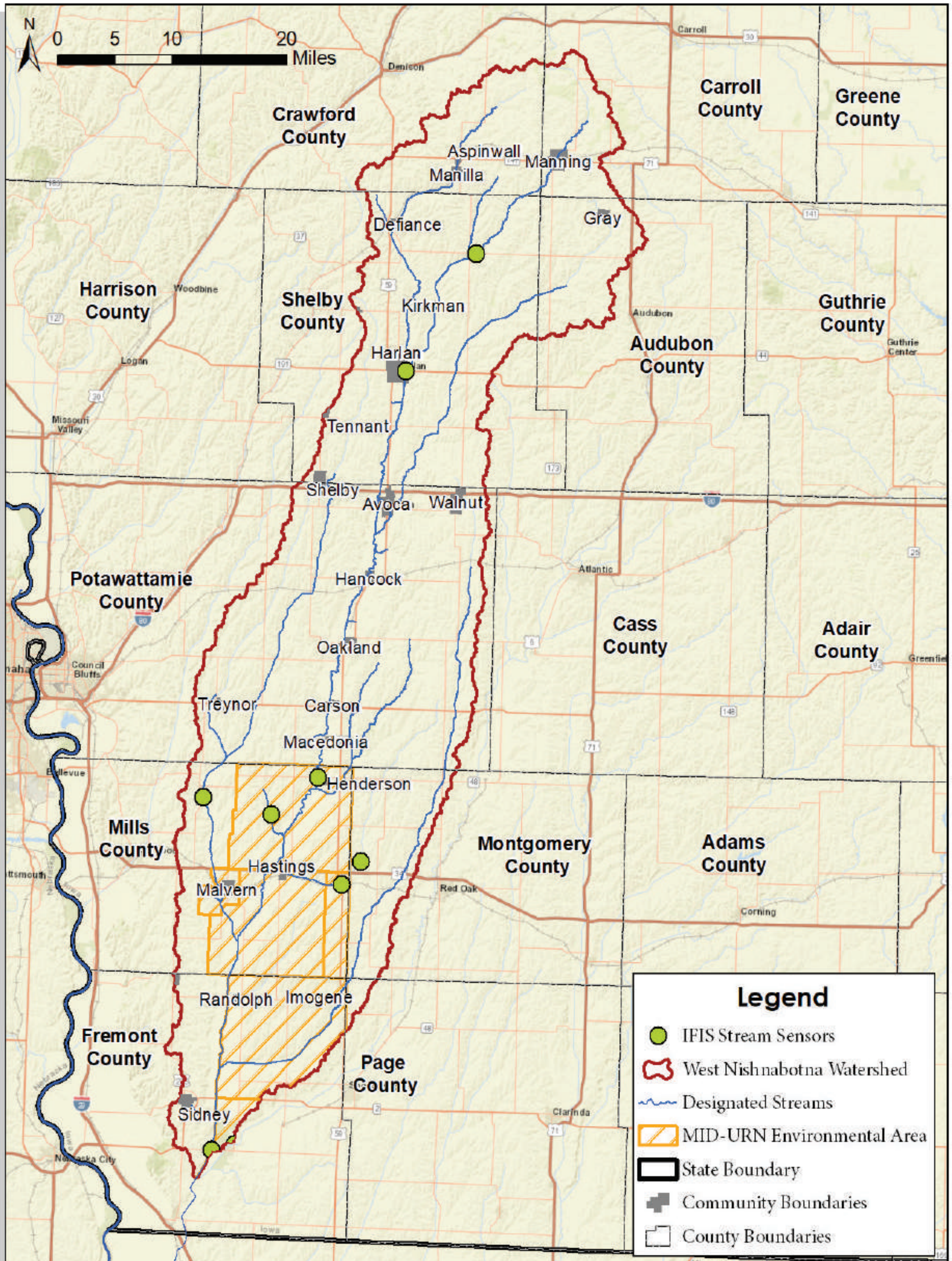


Figure 31: IFIS Stream Sensors in the WNRW

COMMUNITY RISK ASSESSMENT

A flood resiliency assessment was conducted to identify communities in the WNRW with the highest risk for flooding. This information will be used to identify and prioritize potential mitigation alternatives. Prioritized mitigation actions are discussed in more detail in **Chapter 6**. The evaluation focused on reducing and mitigating flood risks that originate from tributaries of both the East and West Nishnabotna Rivers. Flood risks associated with flash flooding and mainstem river flooding were not directly evaluated. By focusing on tributary flooding, local communities will identify projects that can be realistically implemented in the near future. This approach allows local issues to be addressed, while also having positive effects on reducing both flash flooding and mainstem flooding within the larger watershed. A technical memorandum discussing the methodology and full results of the assessment can be found in Appendix B.

The following communities were identified to have moderate to high level of flood risk, as described below and shown in **Figure 32**:

- **Avoca** – the community has an appreciable percentage of the population located within the floodplain and experiences flooding from both the West Nishnabotna River, and the East Branch West Nishnabotna River. The primary potential mitigation measures for Avoca are the construction of upstream dams and levees and channel/bridge improvements.
- **Emerson** – the community is partially located within the floodplain and is flooded by Indian Creek. There appear to be no existing flood control measures in place. The primary potential mitigation measures for Emerson are the construction of upstream dams and levees.
- **Hastings** – the community is partially located within the floodplain and is flooded primarily by Indian Creek. There are no obvious signs of flood control in the community, which is also located in a priority HUC 12. The primary potential mitigation measure for Hastings is the construction of upstream dams.
- **Malvern** - a small portion of Malvern is in the floodplain, but several tributaries (Little Creek, Silver Creek, and Tributary A) flow through the town with no obvious signs of flood control. Numerous flooding events are noted in the FIS, namely in 1947 and 1967. The primary potential mitigation measures for Malvern are the construction of upstream dams and levees.
- **Manning** – a small portion of Manning is located within the floodplain. The community is flooded by both the West Nishnabotna River and an unnamed tributary which flows through the town. The town has a moderate flood risk, and the primary potential mitigation measures are all structural: upstream dams, channel and bridge improvements, and levees.
- **Randolph** – a small portion of Randolph is located within the floodplain of Deer Creek, but there are no apparent signs of flood control structures located in or near town. The town has a moderate flood risk, and the primary potential mitigation measures are all structural: upstream dams, channel and bridge improvements, levees, and urban storm system upgrades. Additional assessment and recommendations can be found in the Randolph Case Study, located in Appendix G.

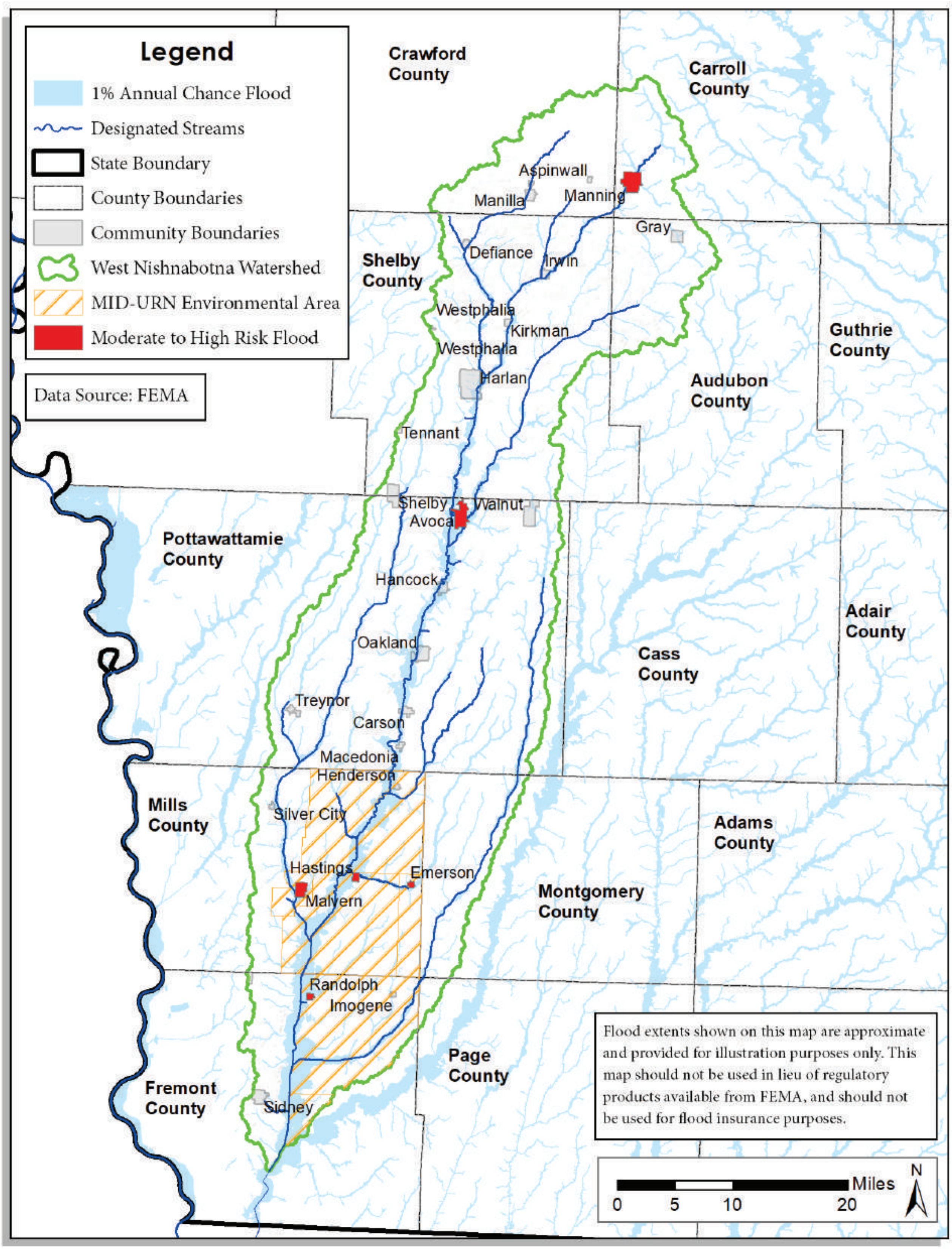


Figure 32: Communities with Moderate to High Risk for Flooding in the WNRW

REPETITIVE LOSS PROPERTIES

As of May 2018, five properties in the WNRW have endured "Repetitive Loss," which means each property has experienced damages of $1,000 or more at least twice in the past ten years. These properties may be classified as single family residential, multiplex residential, or businesses. The sum total of loss to the buildings and their contents is approximately $373,591. See **Table 19** for more information about Repetitive Loss structures in the watershed. This information was also utilized in the community flood hazard risk assessment.

Table 19: Repetitive Loss Properties in the Watershed

City	Total Buildings	Commercial	Residential	Total Damage	Total Losses
Emerson	3	1	2	$ 62,249	6
Harlan	1	1	0	$ 25,643	2
Manning	1	1	0	$ 285,699	2
Total	**5**	**3**	**2**	**$ 373,591**	**10**

Source: Larry Gioffredi, Iowa Homeland Security and Emergency Management, oral communication, January 2019

WATERSHED-WIDE RISK ASSESSMENT

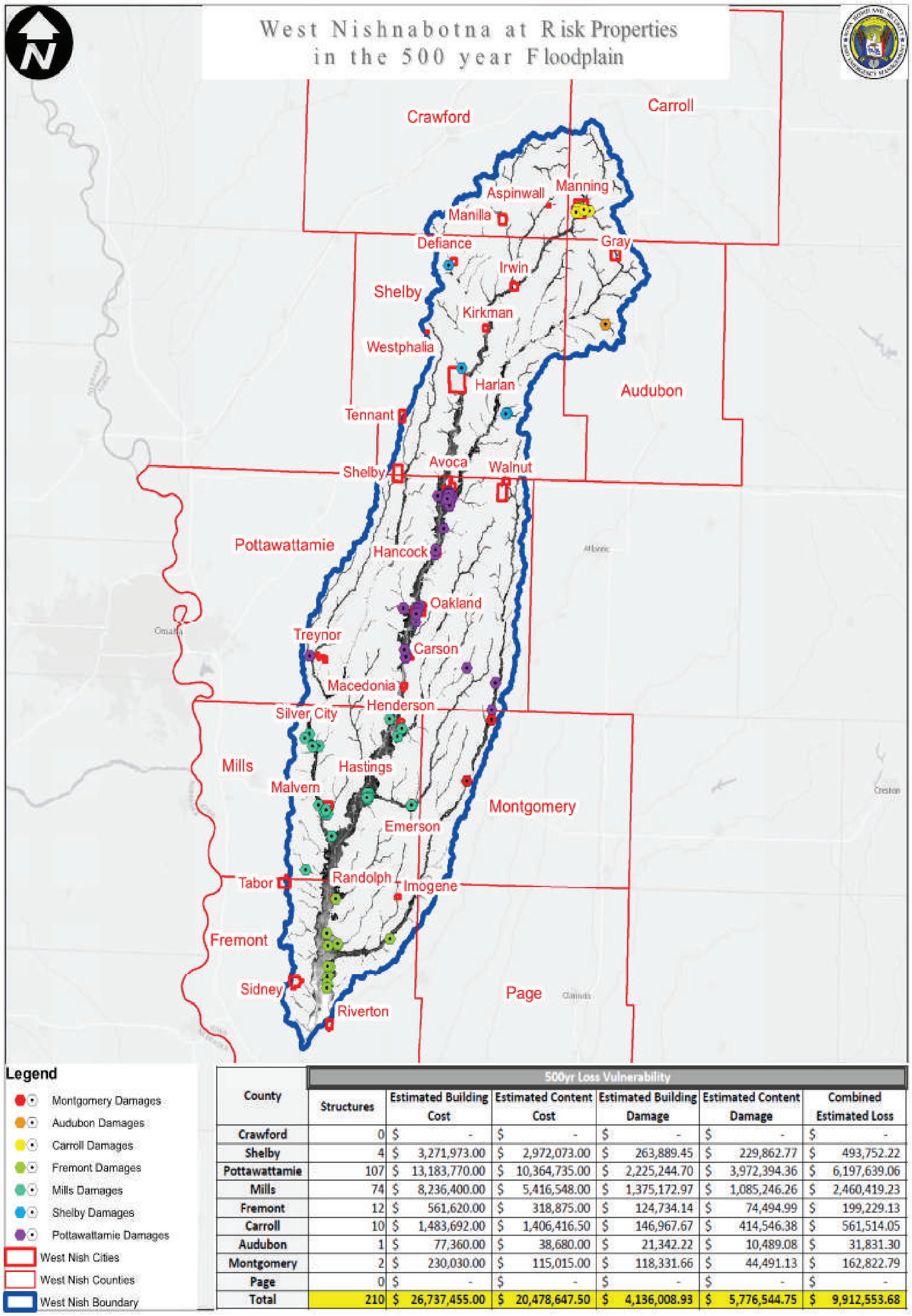
A vulnerability assessment was conducted for at-risk properties in the 0.2 percent annual chance (i.e. 500-year floodplain) flood for the West Nishnabotna River watershed. The assessment utilized Hazards U.S. (HAZUS), a GIS tool that estimates and illustrates potential physical, economic, and social impacts from disasters. For this planning effort, IHSEM incorporated parcel-level data, including assessed property information, into HAZUS to better estimate initial building cost and subsequent damages due to potential flooding. **Figure 33** provides the general location by county where damages could occur in the 0.2 percent annual chance flood. The included table breaks down the number of structures that could be affected during a flood along with the estimated building and content damages. This information is helpful to city and county officials and emergency managers to determine the location of losses and where mitigation alternatives may be most effective to minimize future losses.

3.2 RUNOFF ASSESSMENT

As part of the Iowa Watershed Approach, the Iowa Flood Center has developed a hydrologic model for the WNRW and the associated Hydrologic Assessment Report (IFC, 2018). As a part of that modeling, a runoff assessment was completed. Each HUC 12 Subwatershed in the WNRW was analyzed and assigned a runoff coefficient (Figure 4). The runoff coefficient determines the percentage of precipitation that is likely to be converted into runoff. Regions with higher runoff coefficients are more likely to produce runoff.

The runoff assessment is computed based on a theoretical large storm event: a 6-inch rainfall over a 24-hour period (IFC, 2018). It is important to note that the runoff potentials exceed 50% in all but three HUC 12s (of 44) in the WNRW. This indicates that many areas are contributing to downstream flooding and are also likely contributing to accelerated erosion and degraded surface water quality. Many of the watershed's streams are incised due to straightening, a problem that is accelerated by high runoff amounts which increase the velocity of streams.

This analysis and resulting map (**Figure 34**) are extremely useful in identifying sources of runoff in the watershed contributing to downstream flooding. These are also the areas that should be prioritized for BMPs and flood risk reduction projects, particularly those that retain or detain runoff within the landscape.



County	500yr Loss Vulnerability					
	Structures	Estimated Building Cost	Estimated Content Cost	Estimated Building Damage	Estimated Content Damage	Combined Estimated Loss
Crawford	0	$ -	$ -	$ -	$ -	$ -
Shelby	4	$ 3,271,973.00	$ 2,972,073.00	$ 263,889.45	$ 229,862.77	$ 493,752.22
Pottawattamie	107	$ 13,183,770.00	$ 10,364,735.00	$ 2,225,244.70	$ 3,972,394.36	$ 6,197,639.06
Mills	74	$ 8,236,400.00	$ 5,416,548.00	$ 1,375,172.97	$ 1,085,246.26	$ 2,460,419.23
Fremont	12	$ 561,620.00	$ 318,875.00	$ 124,734.14	$ 74,494.99	$ 199,229.13
Carroll	10	$ 1,483,692.00	$ 1,406,416.50	$ 146,967.67	$ 414,546.38	$ 561,514.05
Audubon	1	$ 77,360.00	$ 38,680.00	$ 21,342.22	$ 10,489.08	$ 31,831.30
Montgomery	2	$ 230,030.00	$ 115,015.00	$ 118,331.66	$ 44,491.13	$ 162,822.79
Page	0	$ -	$ -	$ -	$ -	$ -
Total	210	$ 26,737,455.00	$ 20,478,647.50	$ 4,136,008.93	$ 5,776,544.75	$ 9,912,553.68

Figure 33: Properties At Risk of Flooding in the WNRW

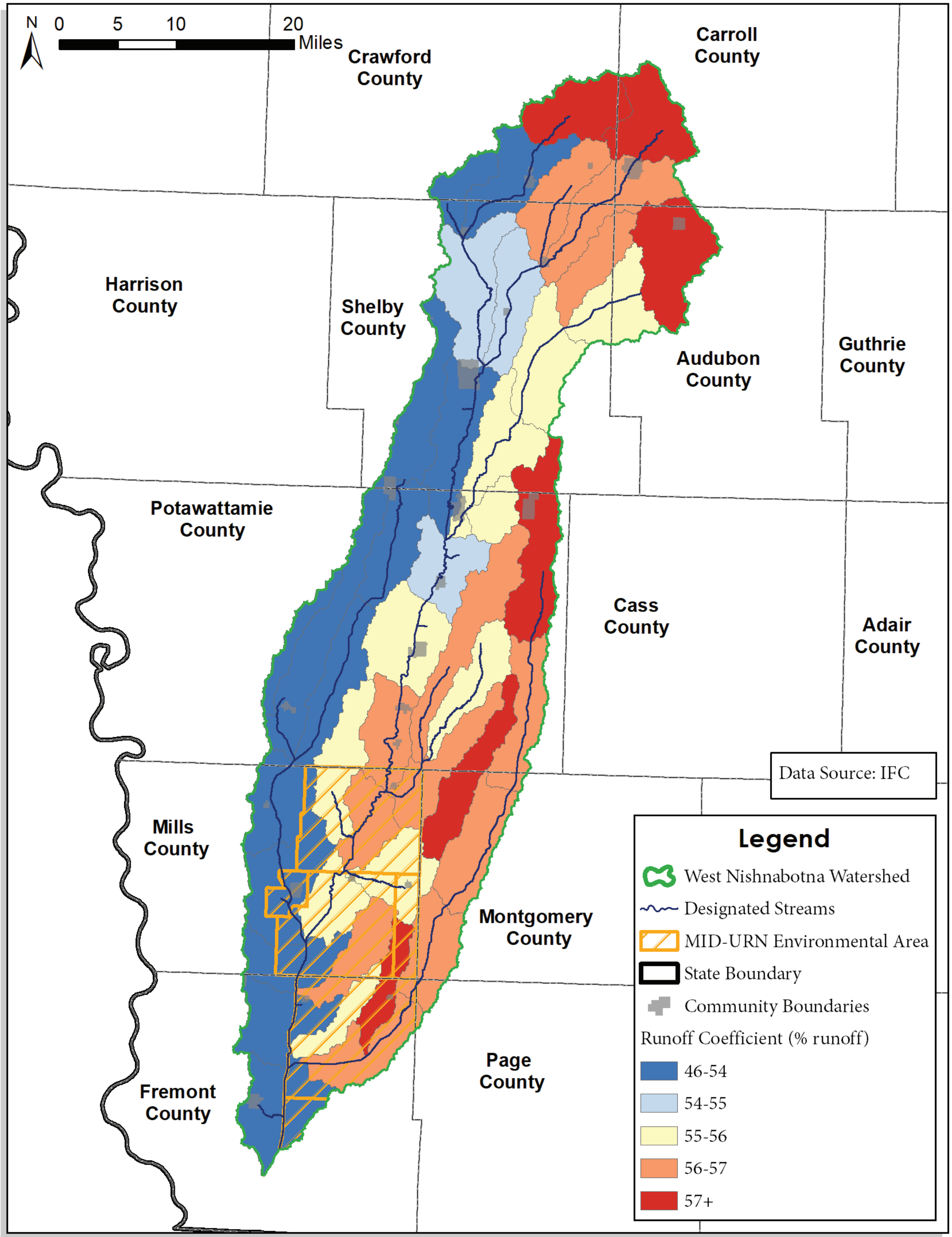


Figure 34: Runoff Potential by HUC 12 Subwatershed in the WNRW

3.3 WATER QUALITY ASSESSMENT

Sources of pollution can be separated into two primary categories: point sources and nonpoint sources. A point source is any discernible, confined, or discrete conveyance from which pollutants can be discharged. Point source pollution can be easily tracked along the pollutant's travel path and identified at the source. Examples include any pipe, ditch, tunnel, conduit, or well that might discharge pollutants. The discharge from some point sources is regulated by the National Pollutant Discharge Elimination System (NPDES) permit program. Many industrial, municipal facilities, and some agricultural operations are required to obtain NPDES permit coverage. However, individual homes connected to a municipal or septic system typically do not need coverage under a NPDES permit.

Identifying permitted facilities is important in developing a water quality management plan. While it's assumed these facilities are meeting all their permit requirements, their pollutant load contributions do need to be accounted for. This allows nonpoint pollution loads to be clearly identified and separated from the total pollutant load. Nonpoint sources of pollution come from facilities, activities, or land uses that do not meet regulatory requirements to be considered point sources. Because these sources are not regulated, are typically smaller, or are otherwise not well defined, they are thus treated as nonpoint sources for management purposes. This is conceptually illustrated below in Figure 35.

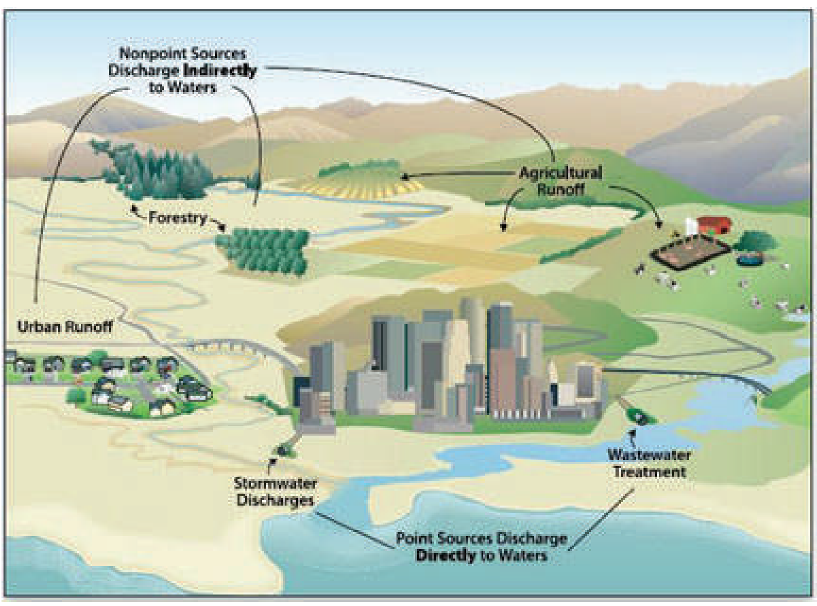


Figure 35: Examples of Point and Nonpoint Sources of Water Pollution

Source: Osterberg, 2014

POLLUTANTS OF CONCERN

The pollutants addressed in this plan are bacteria (*E. coli*), nutrients (phosphorus and nitrogen), and sediment. A summary of pollutants, their sources, and their impacts is shown in Table 20.

Table 20: Summary of Pollutants and Sources

Pollutant and Sources		Potential Impacts on Waterbodies
Point Sources	**Nonpoint Sources**	
Bacteria (E. coli)		
• WWTFs • Registered AFOs or CAFOs	• Small open feedlots & grazing livestock • Land application of manure • Underperforming septic systems • Wildlife and pets • Land application of wastewater/ sludge	• Human health risks • Recreation impairments
Nutrients (phosphorus and nitrogen)		
• WWTFs • Registered AFOs or CAFOs	• Sheet, rill, and gully erosion • Tile line drainage • Fertilizer application • Land application of manure or wastewater • Small open feedlots & grazing livestock • Stream erosion • Underperforming septic systems • Wildlife and pets	• Aquatic life impairments • Human health risks • Drinking water supply impacts • Recreational impacts
Sediment		
• Stormwater Systems • Construction Sites	• Sheet, rill, and gully erosion • Stream erosion • Urban sources, construction, and roads • Silviculture and timber harvesting (erosion)	• Aquatic habitat • Reduces reservoir capacity • Recreational impacts • Human health risks – fish consumption

Note - WWTF – Wastewater Treatment Facility

AFO – Animal Feeding Operation

CAFO – Confined Animal Feeding Operation

POLLUTANTS NOT ADDRESSED

Point source facilities, including waste water treatment facilities and permitted open feedlots, are not identified for management actions in this plan. For the purpose of this plan, it is assumed point sources are meeting their regulatory requirements and are not contributing beyond the pollutant limits set by NPDES permits. Permitted open feedlots are designed to contain any runoff generated by a storm event weaker in intensity than a 25-year storm event. Therefore, management recommendations and associated load reductions were eliminated from consideration for these point sources. To ensure accurate modeling and accounting for pollutant loads, point sources are accounted for in the water quality modeling. The West Nishnabotna River Watershed (WNRW) contains 108 permitted open feedlots and 53 WWTFs.

Pollutants that originate from naturally occurring sources are not addressed in this plan. Typically, these types of water quality parameters serve as symptoms of impairments, rather than the cause of an impairment. Thus, any pollutant impairments caused by naturally occurring sources are expected to show improvements through implementation of this plan.

Fish tissue contamination was not addressed in this plan due to the global nature of the sources. Mercury is a naturally occurring substance which can enter the environment from human activities such as: atmospheric deposition from air emissions, and the improper disposal of products containing mercury. When mercury from human activities enters rivers and lakes, it can transform into methyl-mercury and can accumulate in fish tissue. Consumption of fish containing mercury is considered a primary path for human exposure. Since the majority of mercury contamination in water bodies is caused by air emissions, which are not contained by watershed boundaries, it is not a pollutant that can be addressed through typical nonpoint source implementation and will be given no further consideration in this plan.

3.4 EXISTING WATER QUALITY

9a

IMPAIRMENTS

Lakes and streams in the State of Iowa are assigned a designated use. **Table 21** shows the designated lakes and streams in the WNRW. If water quality declines to a point that the waterbody can no longer meet that designated use, the waterbody is then considered impaired. The most recent Impaired Waters List and Integrated Report (IR), which are prepared by the Iowa Department of Natural Resources (IDNR), were reviewed to identify the status of water quality conditions for each lake and stream segment in the WNRW (IDNR, 2016a). **Table 22** summarizes the impaired lakes and streams in the WNRW. Note that a single waterbody can be impaired for multiple reasons, and in the case of streams, at multiple locations or stream segments.

A Total Maximum Daily Load (TMDL) is developed when a waterbody has been identified as impaired for one or more designated uses and as a Category 5 waterbody. TMDLs establish the maximum allowable daily load of a pollutant a specific waterbody can receive and still meet water quality standards. There are no impaired waterbodies with TMDLs in the WNRW.

Table 21: Designated Waterbodies in the WNRW

Name	Designated Uses
Prairie Rose Lake	Primary Contact Recreation
East Branch West Nishnabotna River	Primary Contact Recreation
Elk Creek	Primary Contact Recreation
Farm Creek	Primary and Secondary Contact Recreation
Greybill Creek	Primary Contact Recreation
Indian Creek	Primary Contact Recreation
Jim Creek	Primary Contact Recreation
Jordan Creek	Secondary Contact Recreation
Middle Silver Creek	Secondary Contact Recreation
Mud Creek	Primary Contact Recreation
Silver Creek	Primary and Secondary Contact Recreation
Unnamed Creek*	Primary and Secondary Contact Recreation
Walnut Creek	Primary Contact Recreation
West Fork West Nishnabotna River	Primary and Secondary Contact Recreation, and Children's Recreation
West Nishnabotna River	Secondary Contact Recreation
Willow Creek	Primary Contact Recreation

*There are nine streams titled "Unnamed Creek" in the WNRW, they have been grouped together in Table 3.

Source: IDNR, 2015b

Table 22: Impaired Waterbodies in the WNRW

		Impairment Cause				
Waterbody ID	**Name**	**Turbidity**	**Biological**	**Bacteria**	**Algae**	**Fish Kill**
05-NSH-1462	Prairie Rose Lake	X		X	X	
05-NSH-1441	West Nishnabotna River			X		
05-NSH-1446	West Nishnabotna River		X			
05-NSH-1447	West Nishnabotna River					X
05-NSH-1454	Silver Creek		X			
05-NSH-1457	Mud Creek		X			
05-NSH-1459	Jordan Creek		X			

Source: IDNR, 2016a

The WNRW's streams and rivers contain a rich diversity of aquatic life including aquatic insects, fish, amphibians, and mammals. Since aquatic communities are in constant contact with the water, the health of these communities can provide insight on stressors that may not otherwise present themselves through traditional chemical and physical parameter monitoring. The IDNR River and Stream Biological Monitoring Program uses fish and benthic macroinvertebrate communities to assess the biological conditions of Iowa streams.

IDNR (2018d) has evaluated biological conditions at 18 locations on eight streams in the WNRW, six of which are impaired (**Table 23**). A variety of metrics are used to determine impairments in streams. The Fish Index of Biotic Integrity (FIBI) is the primary tool used by IDNR to assess fish health conditions (Wilton, 2015). The FIBI considers 12 metrics to measure fish species richness. The Benthic Macroinvertebrate Index of Biotic Integrity (BMIBI) is a combination of 12 metrics measuring the richness of invertebrate communities. The General Fish Habitat Index (GFHI) includes five habitat metrics that measure the quality of fish habitat. Rapid Habitat Assessments (RHA) give an overview of the habitat conditions based on ten easily observed physical stream traits.

9i

WATER QUALITY MONITORING

Several organizations collect surface water quality information, but the most relevant and complete datasets are collected by IDNR which maintains 138 ambient lake and 60 ambient stream monitoring stations across the state. Ambient lakes are sampled three times annually between May and September, whereas ambient streams are sampled once per month year-round. The WNRW contains one ambient stream monitoring site and one ambient lake monitoring site in the planning area (**Table 24** and **Figure 36**). Note that a single lake can contain more than one monitoring station, as is the case with Prairie Rose Lake. Recent trends of pollutant concentrations sampled at the West Nishnabotna River near Malvern station are displayed below (United States Environmental Protection Agency [EPA], 2018):

- **Figure 37** shows changes in *E. coli* bacteria concentration from January 2003 – June 2018. *E. coli* violations are determined based on a geometric mean of samples taken between March 15th and November 15th of each year. If this geomean exceeds the standard (126 bacteria per 100 milliliters of water) then the waterbody is considered impaired. This segment of the West Nishnabotna River has consistently been above the annual geometric mean water quality standard for *E. coli* (126 colonies/100mL) and has exceeded the individual sample maximum water quality standard (235 colonies/100 mL) 86 times.
- **Figure 38** shows changes in phosphate-phosphorus concentration from November 1998 – June 2018. Note that Iowa does not currently have a numeric standard for phosphorus in streams and rivers.
- **Figure 39** shows changes in total nitrogen concentration from November 1998 – June 2018. The maximum contaminant level (MCL) for the nitrate-nitrogen drinking water standard is 10 mg/L. This segment of the West Nishnabotna River has exceeded the MCL on 27 separate occasions.
- **Figure 40** shows changes in total suspended solids (as a surrogate for sediment) concentration from January 2003 – June 2018. Note that Iowa does not currently have a numeric standard for sediment in streams and rivers.

Table 23: Biological Monitoring Sites in the WNRW

Segment ID	Location Name	FIBI	BMIBI	GFHI	RHA	Impairment
05-NSH-1823	E. Branch W. Nish. River Avoca	Poor	Fair	Fair	Sub-Optimal	N/A
05-NSH-1824	E. Branch W. Nish River Harlan (REMAP #146)	Fair	Fair	N/A	N/A	N/A
05-NSH-1459	Jordan Creek Macedonia	Poor	Good	Poor	Marginal	Low Fish IBI
05-NSH-1457	Mud Creek Hastings (REMAP #158)	Poor	Good	N/A	Marginal	Low Fish IBI
05-NSH-1452	Silver Creek Malvern (REMAP #191)	Poor	Fair	N/A	Marginal	N/A
05-NSH-1454	Silver Creek NE of Treynor (SI001)	Poor	N/A	N/A	N/A	Low Fish IBI
05-NSH-6452	Unnamed Trib. to Silver Creek Shelby (SC3)	Poor	Fair	N/A	Marginal	N/A
05-NSH-1939	Unnamed Trib. To W. Nish. River Irwin (REMAP #149)	Poor	Good	N/A	Marginal	N/A
05-NSH-1446	W. Nish. River Irwin (REMAP #60)	Poor	Fair	Fair	N/A	Low Fish and Invert IBI
05-NSH-1445	W. Nish. River Kirkman	Fair	Good	N/A	N/A	N/A
05-NSH-1441	W. Nish. River Malvern	N/A	Fair	N/A	Marginal	Bacteria
05-NSH-1905	W. Nish. River Manning (REMAP #128)	Poor	Fair	N/A	Marginal	N/A
05-NSH-1442	W. Nish. River Oakland (REMAP #97)	Fair	N/A	N/A	Poor	N/A
05-NSH-1446	W. Nish. River Shelby Co. Upper Nish. Hab Area	Fair	Fair	Fair	Marginal	Low Fish and Invert IBI
05-NSH-1450	Walnut Creek East of Oakland (WA002)	Fair	N/A	N/A	N/A	N/A
05-NSH-1449	Walnut Creek Red Oak – Downstream	Poor	Fair	Good	N/A	N/A
05-NSH-1449	Walnut Creek Red Oak – Upstream	Poor	Fair	Fair	N/A	N/A
05-NSH-1449	Walnut Creek West of Red Oak (WA001)	Fair	N/A	N/A	N/A	N/A

Source: IDNR, 2018d

Table 24: Ambient Monitoring Sites in the WNRW

Name	Monitoring Station ID	Sampling Constituents
West Nishnabotna River near Malvern	10650001	Nitrogen, phosphorus, *E. coli* bacteria, total suspended solids (sediment)
Prairie Rose Lake	21830001 22830002	

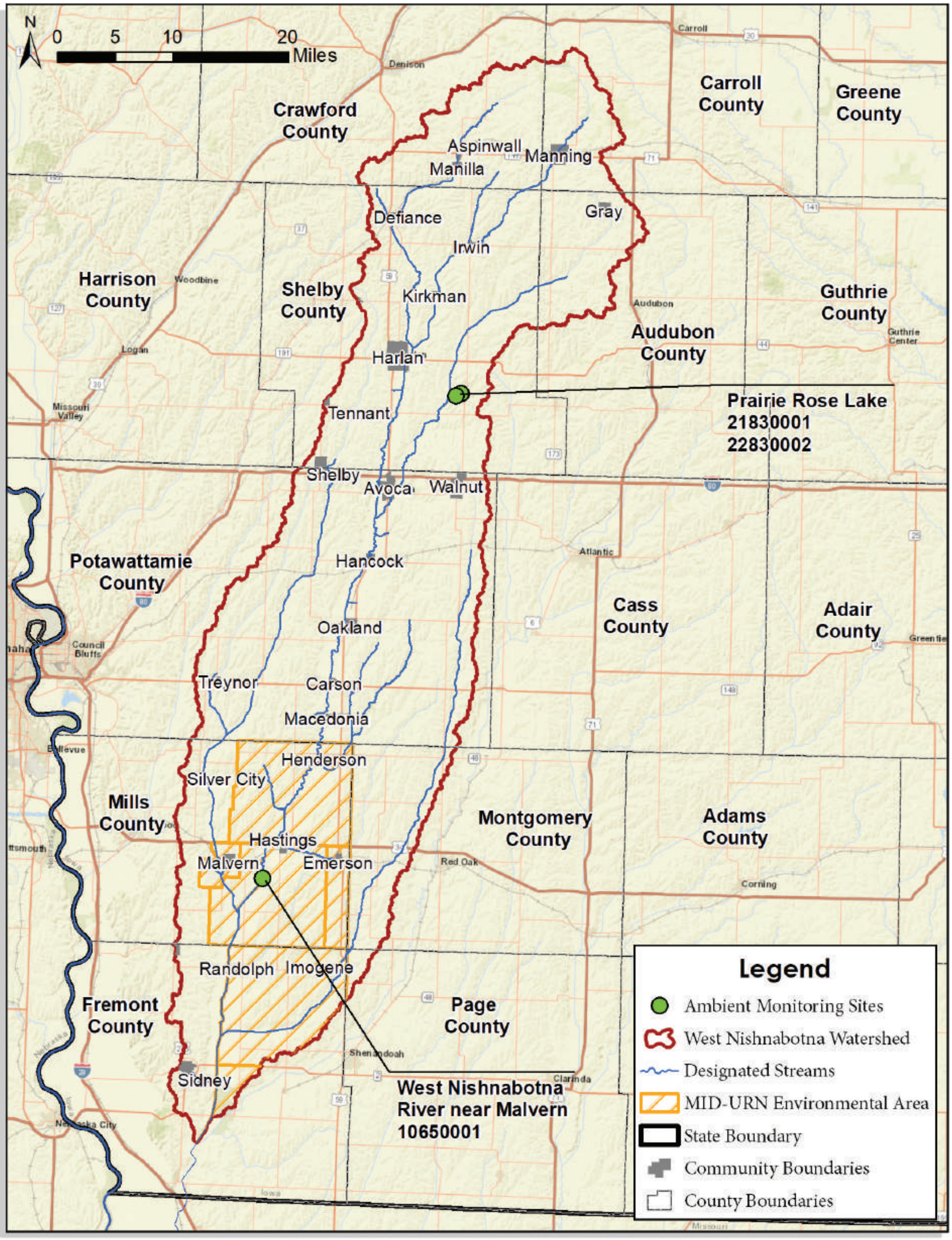


Figure 36: Ambient Monitoring Sites in the WNRW

In addition to ambient surface water quality monitoring stations, IDNR also employs a system of targeted water monitoring to support specific concerns and management needs. This can include nonpoint source pollution evaluation; TMDL development; lake/stream evaluation and restoration; water quality standards development; wastewater discharge permitting; and swimming advisories. Targeted monitoring stations cover a broader spatial area than ambient monitoring stations and are more abundant. However, due to their specialized nature, targeted stations have a shorter period of record generally spanning two to three years. Further water quality information, including periods of record and locations of targeted monitoring stations, is available in Appendix B.

The Iowa Flood Center (IFC) maintains a series of stream sensors which can also collect water quality data through the Iowa Water Quality Information System (IWQIS). One IWQIS water quality sensor is located within the WNRW planning area. Monitoring results and further information about IWQIS can be found here: **https://iwqis.iowawis.org/**.

Figure 37: *E. coli* Concentrations in the West Nishnabotna River Near Malvern

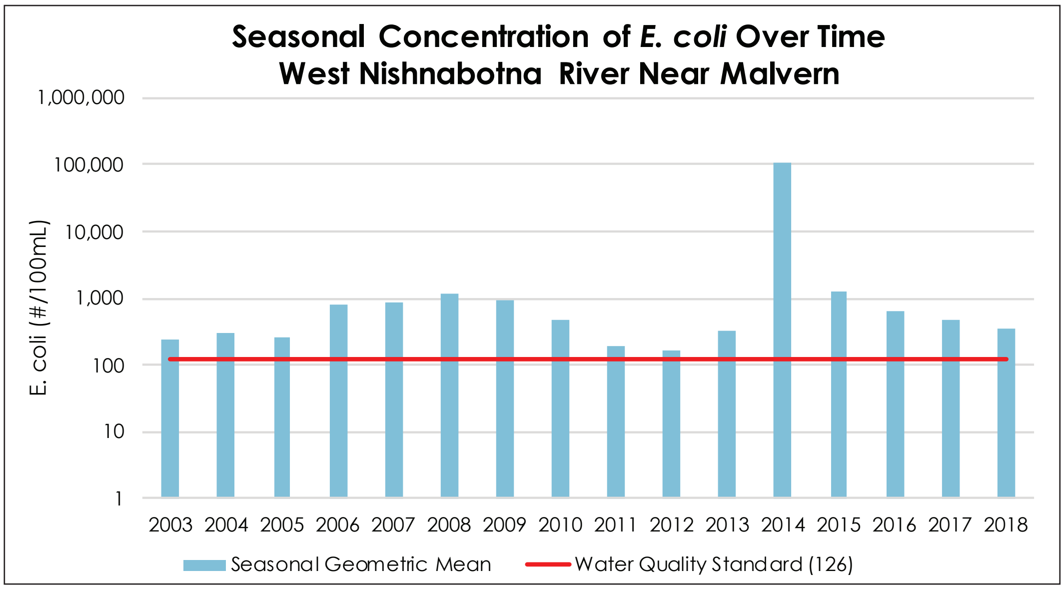
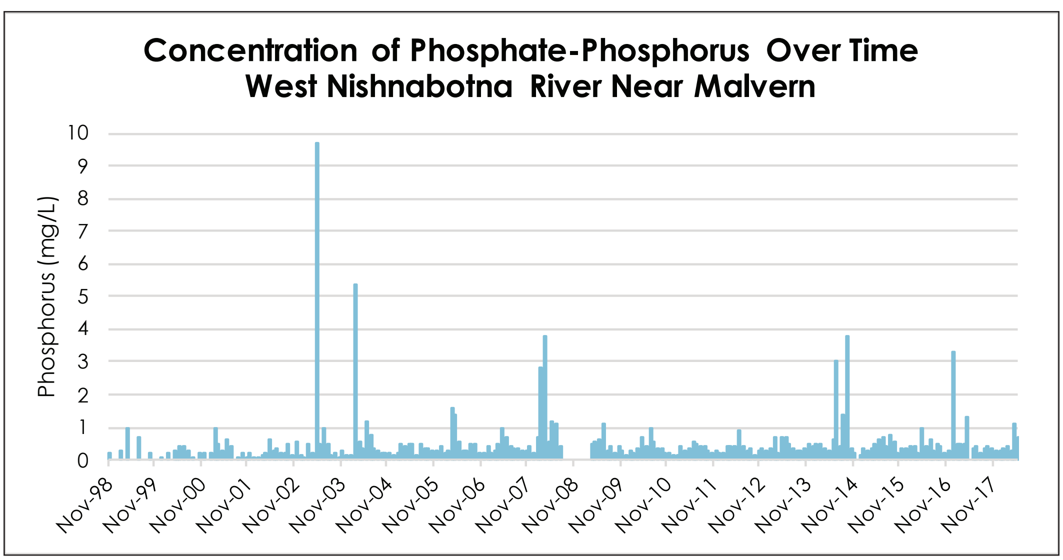


Figure 38: Phosphate-Phosphorus Concentrations in the West Nishnabotna River Near Malvern



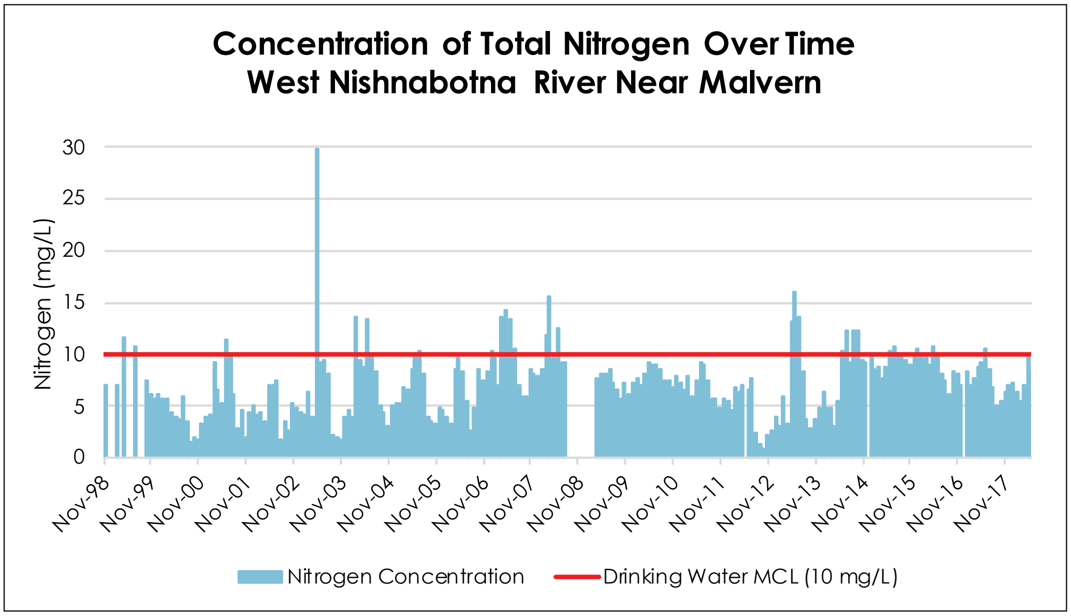


Figure 39: Total Nitrogen Concentrations in the West Nishnabotna River Near Malvern

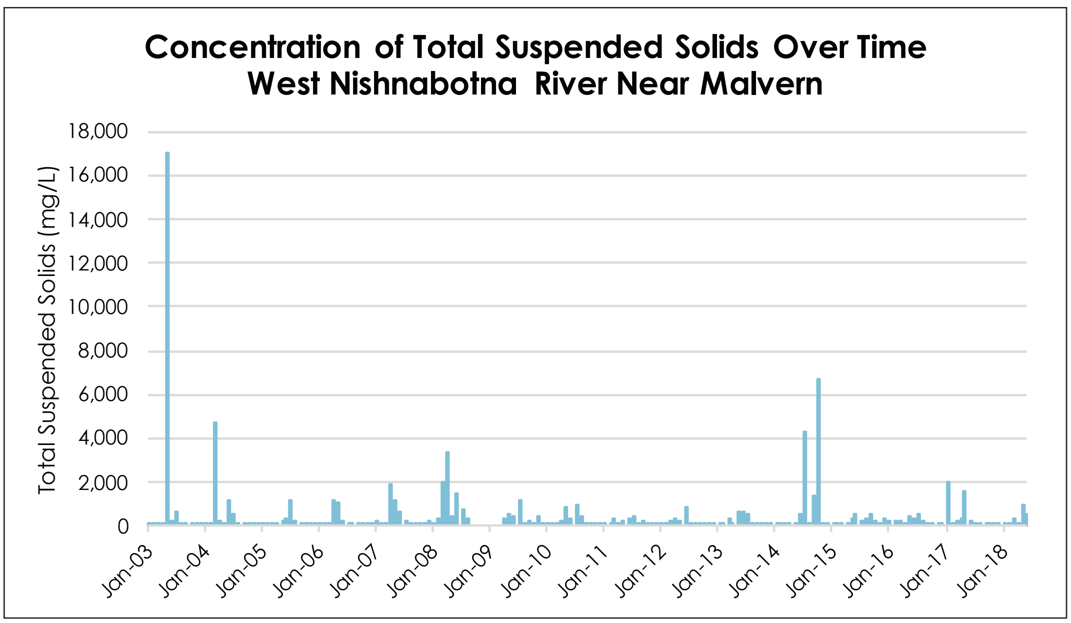


Figure 40: Total Suspended Solids Concentrations in the West Nishnabotna River Near Malvern

DATA GAPS AND NEEDS

Water quality monitoring is largely based upon samples collected near the bottom of drainages. While this information provides a sound basis for estimating overall pollutant loads, it provides minimal insight on potential contributions from individual tributaries, sources, or other areas. Strategically locating monitoring sites in upstream tributaries will allow for pollutant source bracketing, resulting in a better estimate of source contributions and a more effective implementation strategy. Additionally, sampling points located below a single source (e.g., urbanized land, cultivated fields, animal feeding areas, and/or pastures) provides information on pollutant yield by source, an important factor in pollutant load modeling. Future monitoring efforts will require more monitoring sites in addition to the existing ambient stream monitoring system.

3.5 POLLUTANT SOURCES AND LOADS

WATER QUALITY MODELING

A water quality model allows quantitative estimates about existing pollutant loads to be made, as well as quantifies the effects of implementing various BMPs. Water quality modeling allows both natural resource managers to evaluate management strategies and shows incremental progress towards meeting water quality standards or other goals. The resources and information identified in **Chapter 2** and **Chapter 3** of this plan, along with data provided by Iowa Watershed Approach (IWA) partners, were used to develop estimates of pollutant source loads. Detailed documentation on the approach, inputs, and results of water quality modeling can be found in Appendix B.

A simplified modeling approach was developed to meet planning requirements and resource management goals. This approach was necessary due to the limited amount of water quality monitoring data available over a large geographic area. Various hydrologic and water quality variables for all pollutant sources were utilized to reasonably match modeled pollutant loads to existing water quality data. The watershed yield analysis provided an estimate of annual surface runoff volumes for each HUC 12 by land use and all models were populated with the most current information and data.

To model *E. coli* bacteria, a model specific to each HUC 8 watershed was built in a tabular format to identify existing pollutant loads. Modeling results were then provided on a HUC 12 subwatershed basis. Pollutant load reductions, due to BMP implementation, were only modeled for priority subwatersheds. *E. coli* loads from various land use areas were calculated using the Simple Method (Schueler, 1987), which estimates the annual load as a product of the annual runoff volume and associated concentration of *E. coli* in the runoff.

Nutrient and sediment pollutant loads were not modeled. Existing load amounts were provided by the IDNR, Iowa Water Center (IWC), and literature reviews.

Future updates will allow additional water quality data and implementation strategies to be evaluated. Model estimates, in conjunction with plan reviews and monitoring, will be used to show incremental progress towards meeting plan goals.

NITROGEN AND PHOSPHORUS

Nutrients such as nitrogen and phosphorus occur naturally. However, an overabundance of these nutrients may lead to impaired water quality. Nutrient enrichment in Iowa waterbodies can stem from both internal and external sources. Internal sources are those nutrients which originated from an external source but then became trapped in waterbodies and are recycled annually (primarily in lakes and reservoirs). External sources of nutrients are those which enter waterways through contaminated runoff. Excess nutrients in waterbodies produce algae, which often leads to decreased oxygen content that disrupts aquatic life. Contribution of nutrients can come from a variety of sources including fertilizer application, soil erosion, manure application sites, runoff from small open feedlots, grazing livestock, stream erosion, and inadequate or malfunctioning wastewater treatment systems.

Nitrogen and phosphorus loads were not estimated for this planning effort. Modeling efforts were limited in scope to *E. coli* bacteria to meet United States Environmental Protection Agency (EPA) Nine-Element requirements. Additionally, IWA partners did not provide data that could be used to estimate nutrient loads. It is recommended that during future plan updates the West Nishnabotna Watershed Management Coalition invest in a water quality model that includes both nutrients and bacteria. This model would specifically help to determine existing loads and required load reductions for the WNRW.

SEDIMENT

Instream sedimentation and excessive upland soil erosion contribute to impaired water quality. Sediment can increase turbidity and act as a transport mechanism for other pollutants. Excessive sedimentation diminishes the suitability of instream and streamside habitat for fish and wildlife as sediment buries river and reservoir/lake gravel substrate that support spawning and foraging habitat for benthic and other aquatic organisms. The primary sources of sediment are soil erosion from upland areas, and streambed/bank erosion. Every land use type produces sediment through erosion; however, some are greater contributors than others. Farmland has higher sediment loss rates due to the limited perennial vegetation. Developed regions can have high runoff rates due to the lack of natural vegetation and high concentrations of impervious materials.

Sediment loading rates from upland sources were provided by the Iowa State University (ISU) sponsored Daily Erosion Project (DEP). The DEP uses elevation, soils, land use, precipitation, and other weather data information to realistically estimate erosion on a HUC 12 subwatershed basis (Gelder, 2018). **Figure 41** depicts the average sediment loss from 2007-2017 in tons per acre for each HUC 12 in the WNRW. Sediment loss ranges from 5.17 tons per acre in the far south portion of the WNRW, to 21.83 tons per acre in the eastern-central portion of the WNRW. Higher instances of sediment loss are generally seen throughout the central and northern portions of the WNRW. These areas have steep hills that funnel runoff into central stream valleys which transport sediment downstream. The lower reaches of the WNRW are subject to less sediment loss as much of this region is taken up by the wide, flat floodplain surrounding the West Nishnabotna River.

Instream sediment loading rates can be characterized by assessing stream channel stability. Stream channel stability generally refers to the capacity of a stream channel to transport water and sediment without changing dimensions (width, depth, cross-sectional area, and slope). However, there are several complicating factors including, but not limited to:

1. Streambank and bed mobility are natural phenomenon, and stable streams differ from unstable streams primarily in their rate of bank and bed mobility; and
2. Unnaturally high rates of band and bed mobility can have multiple causes, ranging from small-scale, local causes (such as unrestricted livestock access) to large scale, regional causes (such as watershed-wide increase in impervious pavement).

Nature rarely operates on our time scale; thus, it can be difficult to determine exactly when a change in the system reflects either an instability from short term impacts or a dynamic variation within a long-time frame.

A channel is considered stable and in equilibrium when the energy associated with flow and channel slope balances with the sediment load and bed material size. Channels in equilibrium balance these factors over time (**Figure 42**). Erosion is a constant and natural process in stream evolution, but it occurs at a much slower rate under stable conditions. Therefore, the concept of "stability" is better characterized as "dynamic equilibrium."

To regain dynamic equilibrium, destabilized streams generally adjust, or evolve, through a sequence of channel forms. The stream evolution model (Simon, 1989) provides a framework to understand how stream channel morphology changes throughout this evolutionary process and is broken down into six cyclical stages (**Figure 43**). Understanding this framework allows resource managers to evaluate present channel conditions, interpret historical conditions or activities that led to the current state, and predict future channel behavior. Stream assessments are conducted to gather this type of information.

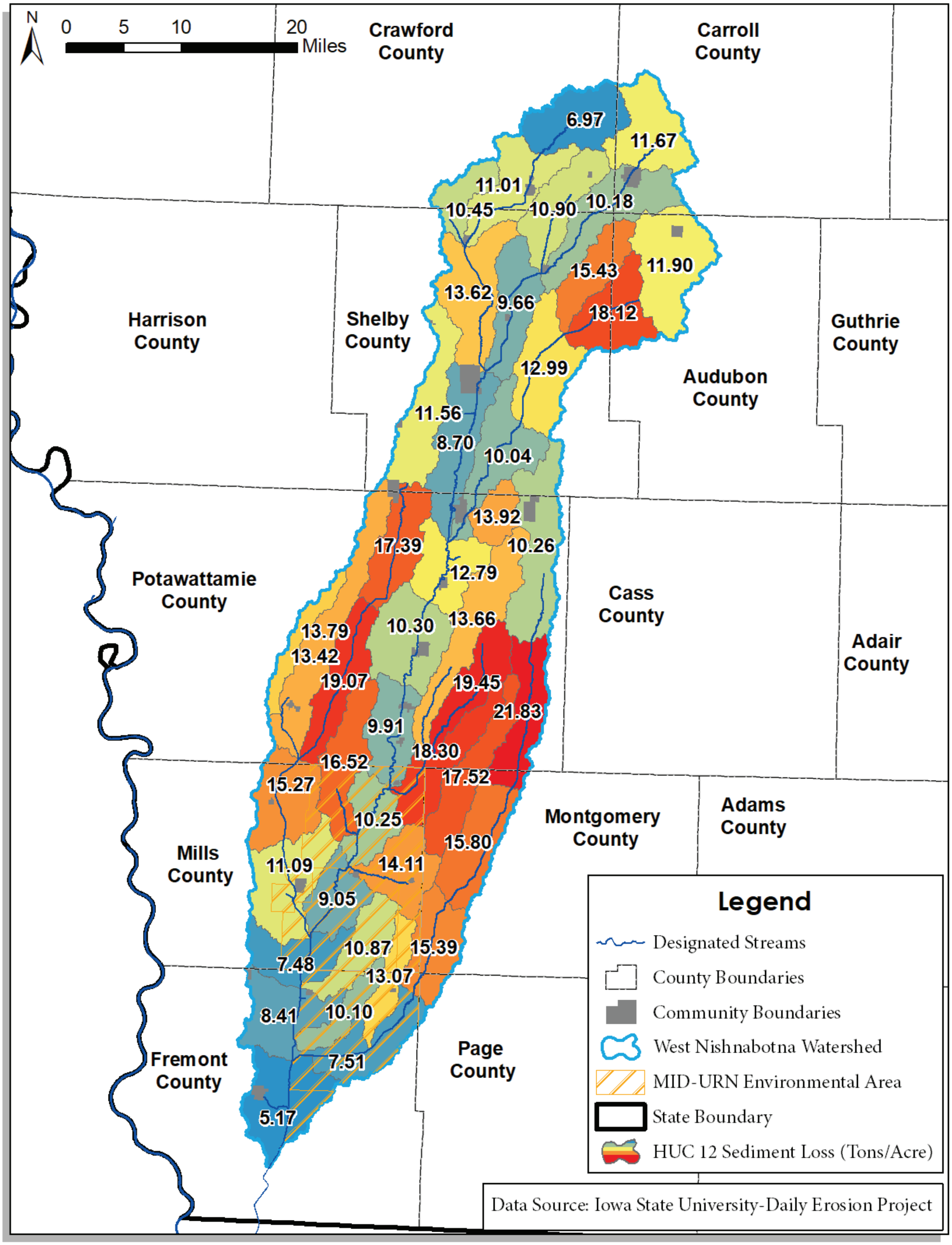


Figure 41: Average Erosion by HUC 12 Subwatershed in the WNRW, 2007-2017

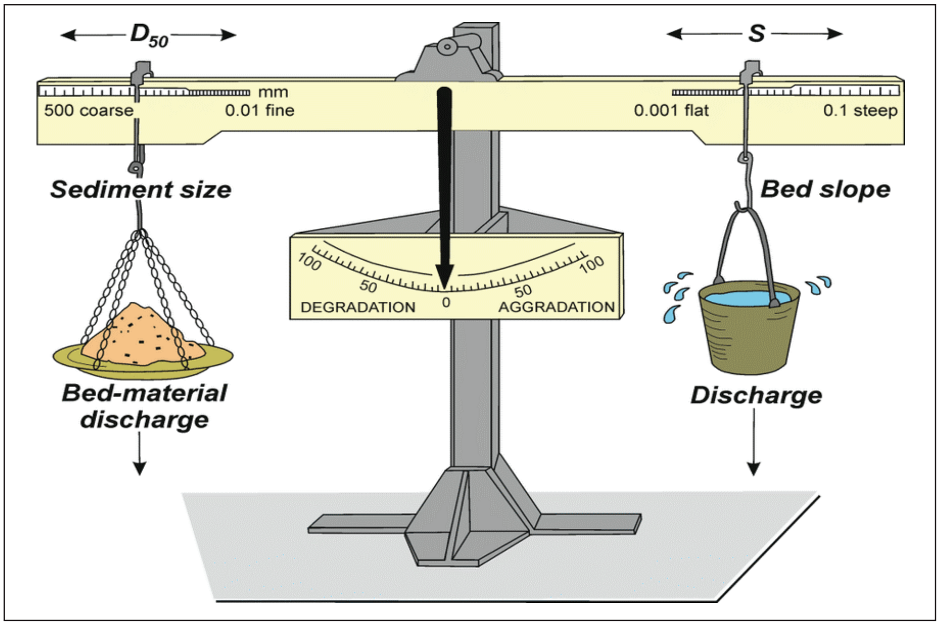


Figure 42: Lane's Balance, a Representation of Stream Stability

Source: Rinaldi, 2015

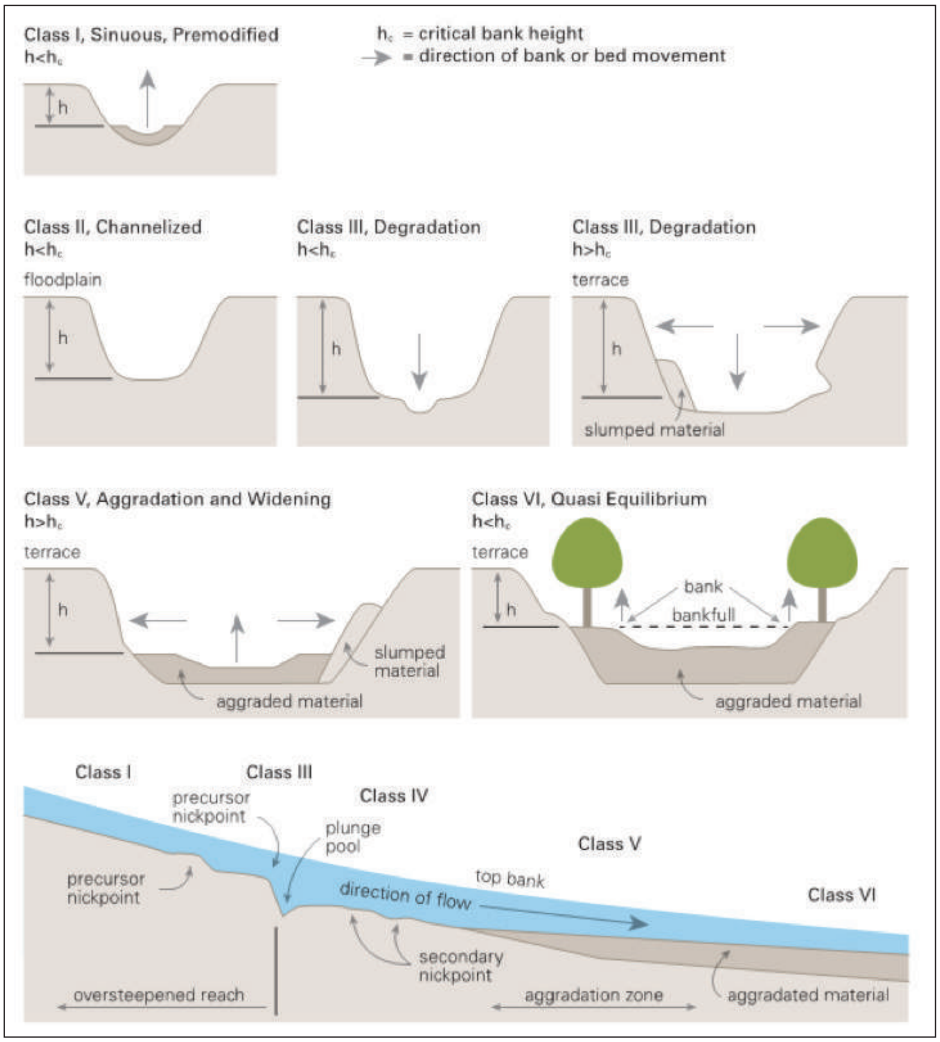


Figure 43: Simon Channel Evolution Model

Source: Harman, 2012

Information on the stability of streams is typically gathered through various types of rapid stream assessments. These evaluations provide a concise, reconnaissance-level overview of stream quality conditions and may also identify potential enhancements to improve stream health. These on-the-ground assessments focus (to varying degrees) on geomorphology, riparian conditions, and in-stream habitat. It can be useful to focus on high priority areas to protect, such as areas near bridges or other infrastructure. Desktop level assessments can either enhance in-field assessments or be used as a standalone to develop an initial, rough level understanding of stream stability. Desktop tools include historic aerial photography, LiDAR, aerial oblique imagery, and stakeholder input.

An extensive stream stability assessment was conducted throughout the WNRW between 2002 - 2003. The results of this assessment, which are based on the channel evolution model, were provided by the Hungry Canyons Alliance (Thomas, 2019). The assessment looked primarily at geomorphology along the streams, in addition to vegetation and other factors, to identify reaches of instability that may be contributing to water quality or biological impairments. Results are available in **Table 25**, and are illustrated in **Figure 44**. Note that the sum of all assessment categories in Table 25 may not equal the total length for a given stream. Some stream segments were not assessed and are not categorized in Table 25 but are still counted in the total stream length. Of the 790.7 miles of streams that were included in the assessment less than 1% are Class I or II, 2.5% are Class III, 15.6% are Class IV, 34.4% are Class V, and 21.9% are Class VI. The remaining percentage of stream miles were not assessed. Streams that were identified as Class III (incising) or Class IV (widening) should be targeted for BMPs to help stabilize those segments. Note that the majority of the West Nishnabotna River was not included in this assessment.

Table 25: Summary of Stream Assessment Results in the WNRW

Assessed Stream	Total Length (miles)	I Stable		II Disturbance		III Incision		IV Widening		V Deposition		VI Recovery	
		Miles	%	Miles	%	Miles	%	Miles	%	Miles	%	Miles	%
Ballard Creek*	5.5	-	-	-	-	-	-	-	-	-	-	-	-
Bedell Creek*	4.9	-	-	-	-	-	-	-	-	-	-	-	-
Brush Creek	4.1	-	-	-	-	-	-	-	-	0.2	4.9%	3.9	95.1%
Camp Creek	4.0	-	-	-	-	-	-	0.4	10.0%	2.6	65.0%	0.9	22.5%
Crabapple Creek	11.1	-	-	-	-	0.1	0.9%	4.3	38.7%	5.6	50.5%	1.1	9.9%
Deer Creek	11.0	-	-	-	-	-	-	1.2	10.9%	6.3	57.3%	3.5	31.8%
Douglas Creek*	6.2	-	-	-	-	-	-	-	-	-	-	-	-
East Branch West Nishnabotna River	39.8	-	-	-	-	-	-	0.6	1.5%	6.9	17.3%	26.7	67.1%
Elk Creek	10.6	-	-	-	-	0.9	8.5%	2.5	23.6%	4.7	44.3%	-	-
Elm Creek	6.8	-	-	-	-	-	-	-	-	1.3	19.1%	0.2	2.9%
Farm Creek	12.7	-	-	-	-	-	-	-	-	4.7	37.0%	8.0	63.0%
Graybill Creek	21.6	-	-	-	-	2.2	10.2%	5.3	24.5%	7.6	35.2%	6.5	30.1%
Honey Creek*	10.3	-	-	-	-	-	-	-	-	-	-	-	-
Hunter Branch	13.6	-	-	-	-	-	-	0.7	5.1%	8.1	59.6%	4.8	35.3%
Indian Creek	29.2	-	-	-	-	0.7	2.4%	13.1	44.9%	14.8	50.7%	0.6	2.1%
Jim Creek	5.0	-	-	-	-	-	-	1.3	26.0%	2.2	44.0%	-	-
Jordan Creek	12.1	-	-	-	-	-	-	2.2	18.2%	3.8	31.4%	6.1	50.4%
Kidds Creek	5.9	-	-	-	-	-	-	-	-	2.7	45.8%	1.1	18.6%
Kilpatric Creek	2.5	-	-	-	-	-	-	-	-	1.6	64.0%	0.9	36.0%
Little Creek	5.7	-	-	-	-	-	-	-	-	2.2	38.6%	3.5	61.4%
Little Indian Creek	5.5	-	-	-	-	0.1	1.8%	0.4	7.3%	4.4	80.0%	0.6	10.9%
Little Silver Creek	19.7	-	-	-	-	-	-	0.2	1.0%	6.2	31.5%	5.4	27.4%
Little Walnut Creek	2.6	0.6	23.1%	-	-	0.1	3.8%	0.9	34.6%	1.0	38.5%	-	-
Lone Willow Creek	2.0	-	-	-	-	-	-	-	-	1.4	70.0%	0.6	30.0%
Long Branch	11.2	-	-	-	-	1.7	15.2%	1.8	16.1%	5.7	50.9%	0.1	0.9%
Lyons Creek	6.5	-	-	-	-	-	-	-	-	4.5	69.2%	-	-
Malony Branch	6.5	-	-	-	-	0.6	9.2%	0.6	9.2%	-	-	-	-
Middle Silver Creek	25.4	-	-	-	-	1.2	4.7%	10.4	40.9%	12.2	48.0%	1.6	6.3%
Minimum Creek	5.1	-	-	-	-			1.1	21.6%	2.2	43.1%	0.5	9.8%
Mud Creek	17.0	-	-	-	-	1.3	7.6%	5.0	29.4%	9.4	55.3%	1.2	7.1%
Mule Creek	6.8	-	-	-	-	-	-	-	-	1.1	16.2%	5.7	83.8%
Osborne Creek	4.4	-	-	-	-	-	-	0.1	2.3%	0.6	13.6%	1.0	22.7%
Perkins Creek	4.3	-	-	-	-	-	-	-	-	2.3	53.5%	2.0	46.5%
Prairie Creek	6.0	-	-	-	-	-	-	-	-	1.3	21.7%	1.1	18.3%
Silver Creek	62.8	-	-	0.3	0.5%	1.8	2.9%	10.8	17.2%	29.2	46.5%	16.4	26.1%
Slocum Creek	6.1	-	-	-	-	0.1	1.6%	0.6	9.8%	5.4	88.5%	-	-
Snake Creek	6.0	-	-	-	-	-	-	-	-	0.6	10.0%	1.3	21.7%
Spring Creek	2.0	-	-	-	-	-	-	-	-	0.9	45.0%	1.1	55.0%
Spring Valley Creek	6.9	-	-	-	-	0.1	1.4%	0.1	1.4%	0.8	11.6%	5.9	85.5%
Walnut Creek	60.2	-	-	-	-	0.7	1.2%	14.4	23.9%	38.2	63.5%	6.9	11.5%
West Fork West Nishnabotna River	36.2	-	-	-	-	2.3	6.4%	5.9	16.3%	6.0	16.6%	18.0	49.7%
West Nishnabotna River	37.4	-	-	-	-	1.4	3.7%	10.7	28.6%	7.7	20.6%	12.7	34.0%
Willow Creek	10.2	-	-	-	-	-	-	-	-	3.2	31.4%	0.4	3.9%
Unnamed Creeks**	217.3	1.1	0.5%	4.3	2.0%	4.2	1.9%	28.9	13.3%	52.5	24.2%	23.2	10.7%
Total	**790.7**	**1.7**	**0.2%**	**4.6**	**0.6%**	**19.5**	**2.5%**	**123.5**	**15.6%**	**272.1**	**34.4%**	**173.5**	**21.9%**

*These stream segments were not assessed but are included for total stream length purposes.
**Multiple Unnamed Creeks were combined under this heading.
Source: Thomas, 2019

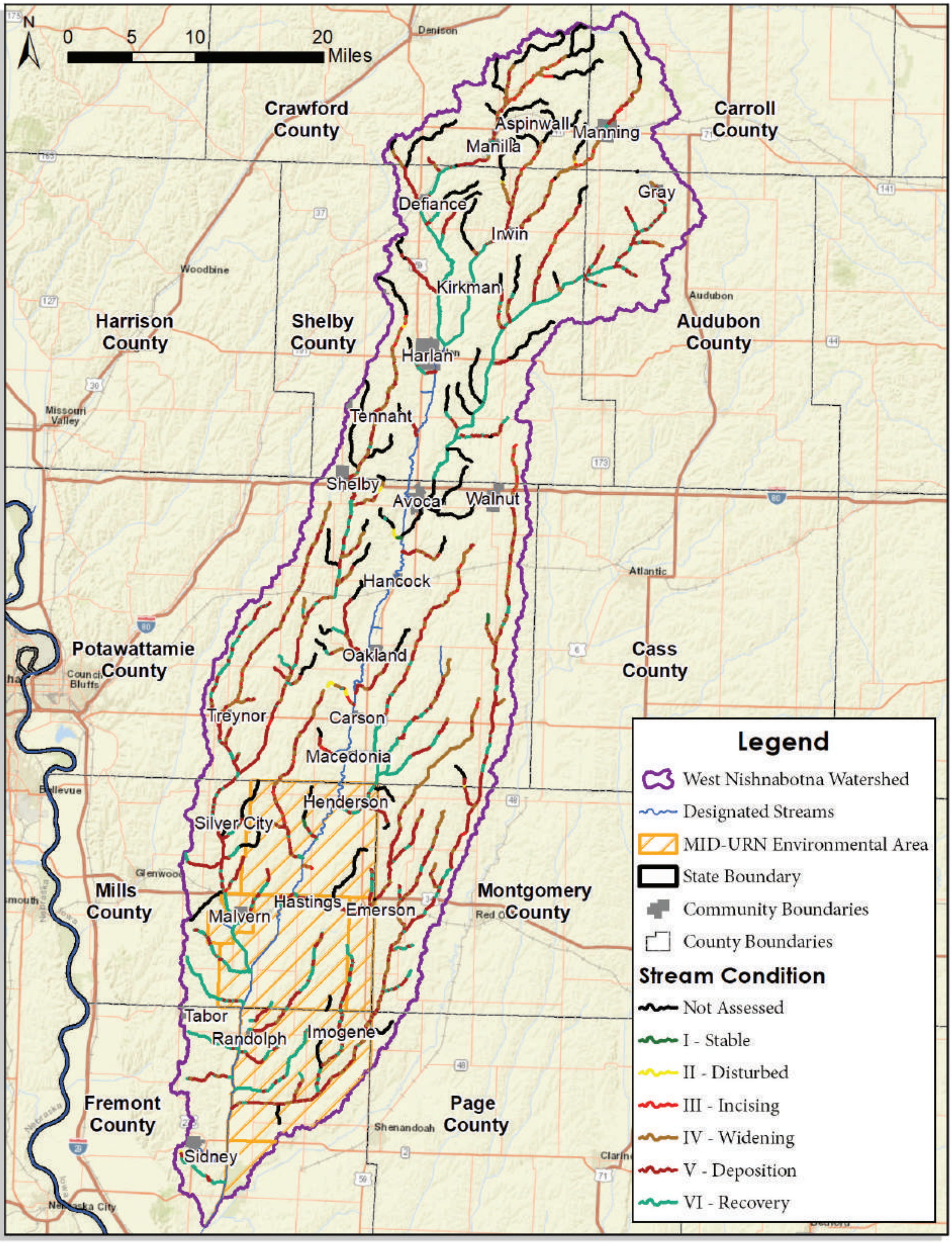


Figure 44: Existing Stream Conditions in the WNRW

E. COLI BACTERIA

E. coli is a species of fecal coliform bacteria that is commonly found in the fecal matter of warm-blooded animals. Most strains of *E. coli* are harmless; however, certain strains (0157:H7) can cause mild to severe gastrointestinal illness. The EPA has recommended that *E. coli* be used as the primary indicator of health risk from recreational waters, therefore identifying the sources of *E. coli* contamination is a priority.

Several nonpoint sources have been identified as contributors of *E. coli* contamination to waterbodies within the watershed. These include: land application of livestock manure and sludge for fertilization; runoff from livestock pastures; small open feedlots; pet waste; underperforming onsite wastewater treatment systems; runoff from urban areas; and natural sources such as wildlife. Runoff from precipitation can cause *E. coli* to be washed into surface waters and it can also potentially enter groundwater through abandoned or poorly constructed wells. Water quality modeling indicated that the largest load of *E. coli* comes from manure applied to farmland, which makes up 50.56% of the total load (**Figure 45**). Grazing livestock are also recognized as a primary source of *E. coli*. The estimated load from wildlife is diffuse as they are found across all land uses throughout the WNRW. The sources and loading rates of bacterial pollution are found across multiple land uses. A selection of the major sources are described in **Table 26**, as well as a natural load for reference. Total annual loads illustrated on a HUC 12 basis are shown in **Figure 46**. Further information is available in the water quality modeling report in Appendix B.

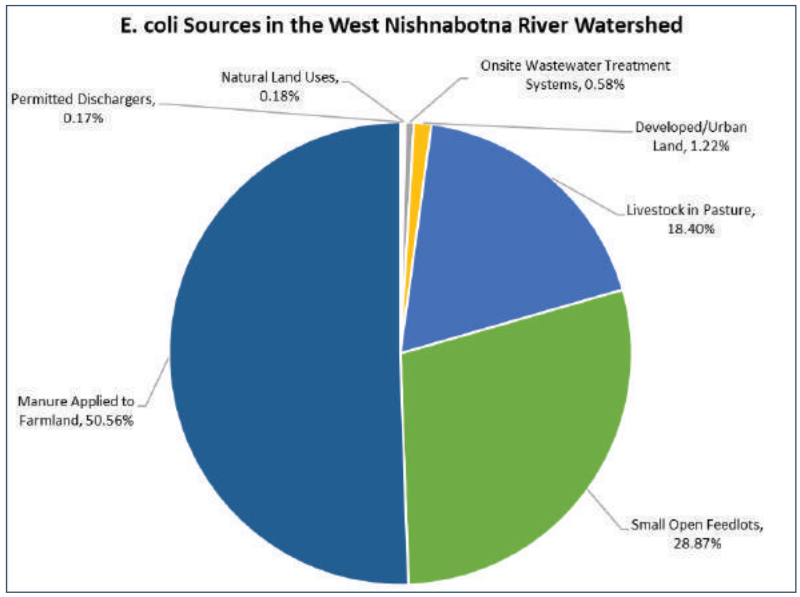


Figure 45: Sources of *E. coli* Bacteria in the WNRW (WWE, 2019)

Bacteria in forests and grasslands is primarily from wildlife or grazing livestock. Open feedlots, where livestock are confined and fed in a limited area for extended periods of time, can also generate bacteria and sediment. Nonpermitted small open feedlots are a potential source of bacteria, nutrients, and sediment. These operations are too small to be regulated by IDNR and are not required to retain any of their waste. There are approximately 1,492 small open feedlots in the WNRW (**Figure 47**). These small open feedlots were identified through an aerial survey using ArcGIS software following a method developed by the Michigan Department of Environmental Quality (MDEQ). Small open feedlots were identified by looking for several key features in aerial photography and then checked against the IDNR database of regulated feedlots to avoid double counting. An average number of livestock for each small open feedlot was calculated using the United States Department of Agriculture agricultural census and reported animal units of IDNR regulated open feedlots. IDNR reported 67,817 livestock in 108 regulated open feedlots in the WNRW. These regulated open feedlots are required to manage their manure and wastewater, unlike small open feedlots, but may still land apply manure and wastewater as fertilizer.

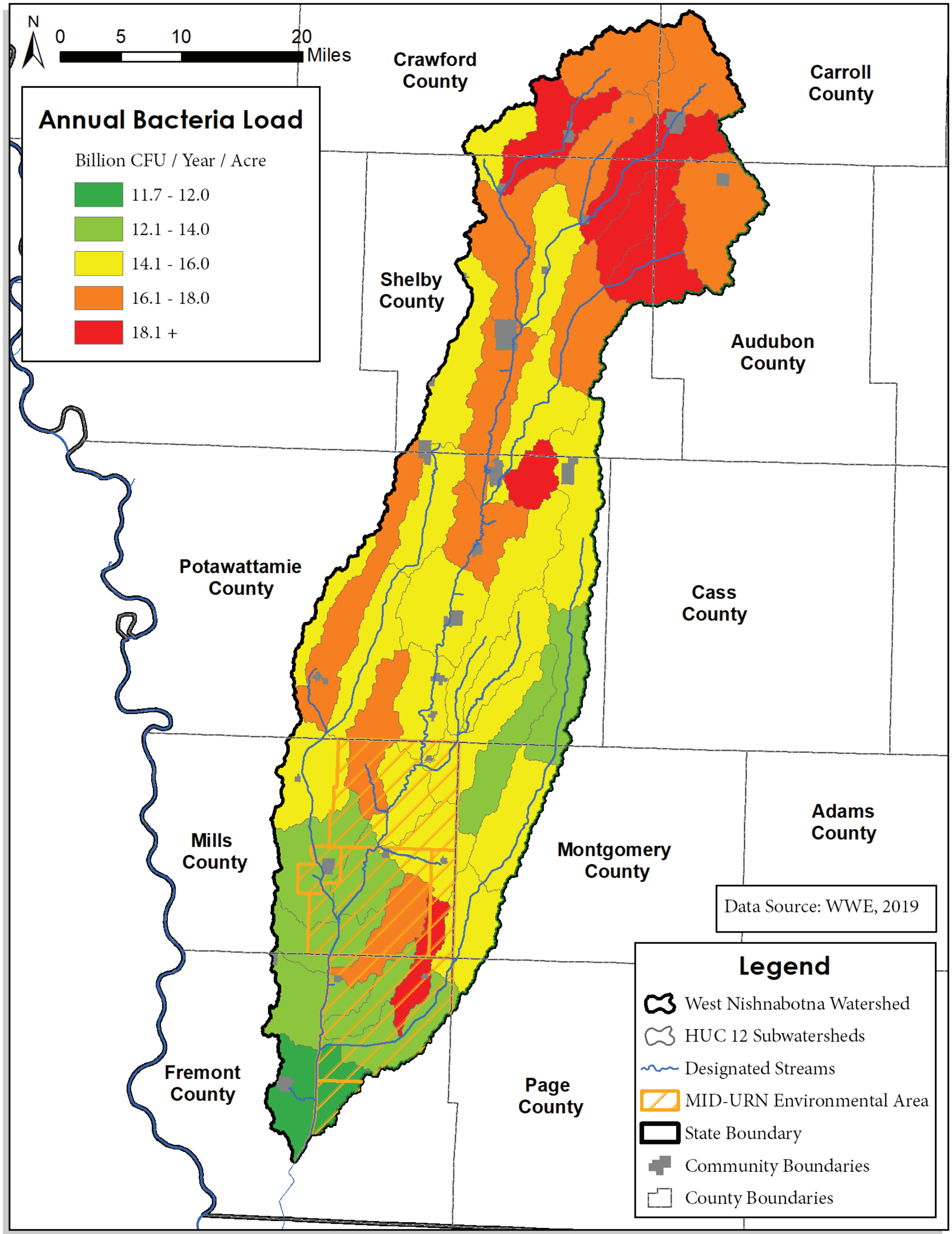


Figure 46: Annual *E. coli* Loads in the West Nishnabotna River Watershed by HUC 12

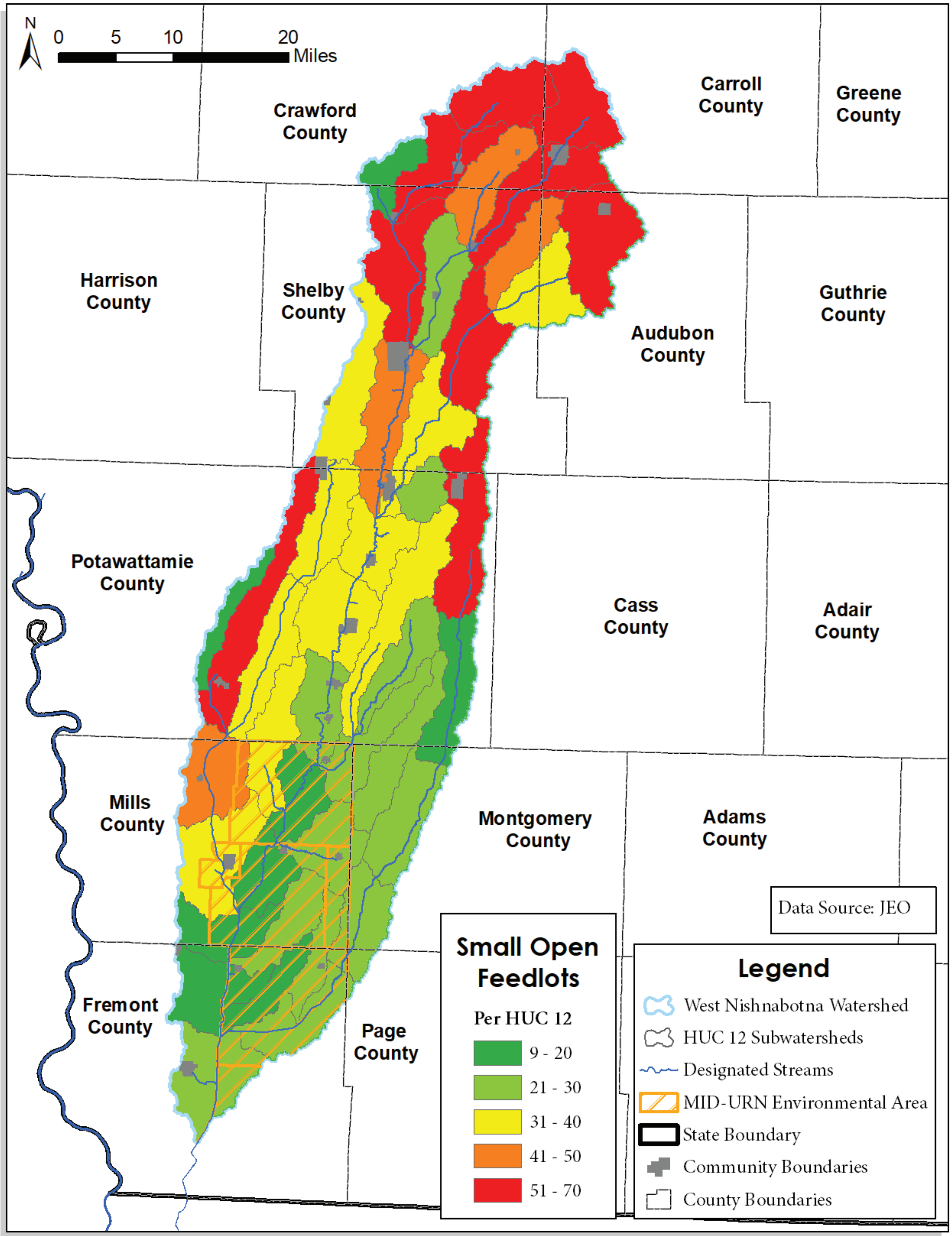


Figure 47: Small Open Feedlots per HUC 12 in the WNRW

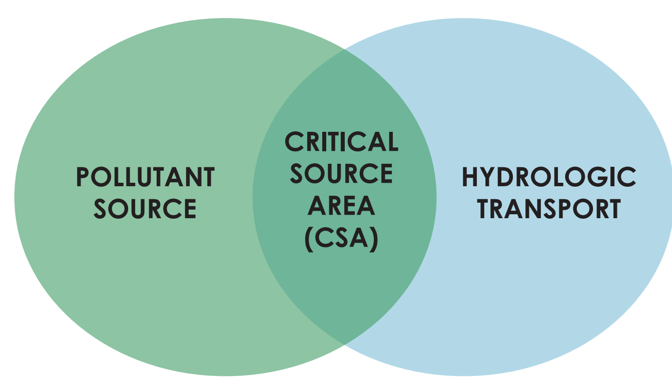
Table 26: Bacteria Sources and Loading Rates

Sources	Loading Rate (billion CFU)	Discussion
Small open feedlots	161.48 / facility	Runoff from grazing and confined livestock is of concern because these operations are not regulated and typically do not have runoff control or treatment measures in place.
Onsite wastewater treatment systems	43.98 / unregistered facility	Inadequate or malfunctioning treatment systems are considered a source of bacteria within the watershed. Estimates show a 40% average failure rate in the Midwest (Mohamed, 2009). Additionally, it was assumed that 30% of registered systems could be underperforming.
Urban areas	4.06 / acre	Urban wildlife and improper disposal of pet waste are sources of bacterial contamination. Urban areas make up only a small portion of the land use in the ENRW but do have increased runoff due to the lack of perennial vegetation. Loading rates vary based on the intensity of development in an urban area, therefore an average value is reported here.
Farmland	9.76 / acre	*E. coli* loads associated with farmland are primarily from wildlife and manure applied as fertilizer. This manure is generated by both swine and cattle. The majority of which comes from permitted facilities, however, the level of effectiveness of manure nutrient plans is unknown, but is likely not high.
Grazing Land Uses	31.02 / acre	*E. coli* loads associated with grazing are primarily from cattle.
Natural Land Uses	0.40 / acre	*E. coli* loads associated with natural land uses are primarily due to wildlife.

Source: WWE, 2019

CRITICAL SOURCE AREAS

Critical Source Areas (CSAs) are a relatively small fraction of a watershed that generates a disproportionate amount of the pollutant load (Meals, 2012). CSAs occur where a pollutant source in the landscape coincides with an active hydrologic transport mechanism (Figure 48). Identifying CSAs can help prioritize areas most in need of Best Management Practices (BMPs), as well as positively impact flood risk reduction. This strategy allows implementation to be more cost-effective. The implementation strategies found in Chapter 6 of this plan include CSAs; however, all producers should be encouraged to develop operation specific conservation plans. These plans incorporate specific tools that can be used to achieve operation and resource goals.



*Adopted from Meals and others, 2012

Figure 48: Illustration of the Concept of Critical Source Areas (CSA)

CSAs are identified using the field runoff risk assessment in the Agricultural Conservation Planning Framework (ACPF) Toolbox. This assessment provides a relative risk rating based on two factors:

- Slope steepness – Steeper fields have a higher risk of generating runoff.
- Distance to stream – The closer a field is to a waterbody, the greater the risk a pollutant will be delivered to that waterbody.

Once the assessment is complete, each field receives a relative classification: A (highest risk – most critical), B (very high), C (high), or other ('present'). Fields classified as A and B are considered critical source areas and should be prioritized for implementation efforts.

One limitation of this tool is that only agriculture land uses (cropland or pasture land) are included in the assessment. Other land uses (typically rural residences and natural areas) are identified as "unknown" in the assessment. "Unknown" areas may still have an elevated runoff risk, especially for pollutants from failing septic systems. A "present" or "unknown" classification does not mean that BMPs would not provide benefits to a given field, but rather indicates that other fields have a greater potential to deliver pollutants to a waterbody via surface runoff. ACPF generated Critical Zones are also considered CSAs. Critical Zones are riparian areas most likely to convey large amounts of runoff into streams. These areas are ideal locations for the installation of pollutant reduction practices as well as buffers for streambank health. Maps of CSAs identified within each priority HUC 12 Subwatershed can be found in Appendix F.

3.6 EXISTING BEST MANAGEMENT PRACTICES

Estimating existing BMPs and treated areas is an important step in the planning process. This knowledge helps to prioritize installation of future BMPs and is necessary for model calibration. These estimates are also used to determine potential pollutant load reductions that additional treatment could have in the WNRW. Unfortunately, no central listing or full inventory exists for this information. The Natural Resources Conservation Service (NRCS) works with many producers to install BMPs, however, that information is subject to privacy laws. Additionally, many landowners implement BMPs on their own without government assistance. To estimate existing BMP levels two types of data were utilized, structural and non-structural, as discussed below. Suitability for future BMPs was identified using various methodologies, including the ACPF tool. Those results, along with prioritized implementation plans, can be found in **Chapter 6**.

STRUCTURAL BMPS

The Iowa BMP Mapping Project, sponsored by ISU, provides a baseline set of existing BMPs spanning from 2007 to 2010. Existing BMPs are identified and digitized through aerial photography, hill-shade and slope grids, and other remote sensing products (ISU, 2018a). ISU focused on identifying structural practices (edge of field) such as ponds, dams, terraces, water and sediment control basins (WASCOBs), contour buffer strips, and grassed waterways. **Table 27** details the numbers of BMPs identified by ISU in the WNRW.

Table 27: Summary of Existing Structural BMPs in the WNRW

BMP Type	Number Identified
Pond or Dam	1,035
Terrace	65,948
WASCOB	5,103
Contour Buffer Strip	487
Grassed Waterway	9,589

Source: ISU, 2018a

NON-STRUCTURAL BMPS

Existing non-structural BMPs (which include in-field and nutrient management BMPs) are more difficult to identify as they cannot be picked out from aerial photography. NRCS District Conservationists (DCs) are local managers in charge of NRCS technical assistance, and have a reasonably informed opinion on local adoption of BMPs.

DCs in the WNRW were surveyed to determine the levels of non-structural BMP adoption by producers. While subjective, this provides an estimation of local BMP adoption. Partial results of this survey are displayed below in Table 28. It is recommended that producer surveys or an on-the-ground inventory of BMPs be performed prior to the update of this plan.

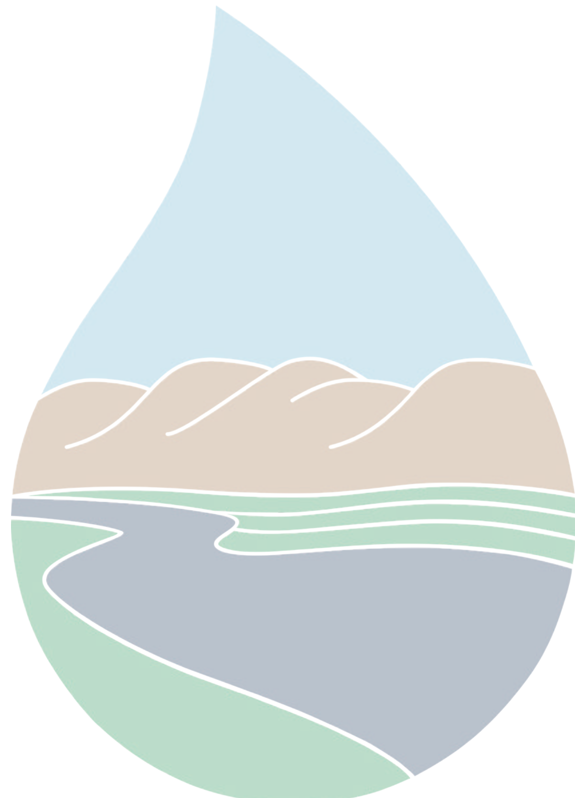
The DCs in Audubon, Carroll, Crawford, Fremont, Mills, Montgomery, and Page counties indicated that many operators implement non-structural or avoidance practices (JEO, 2018). Reduced tillage practices, including no-till, are the most common. Crop production is more popular than livestock grazing in this region, therefore grazing management practices are not heavily used. Cover crops are present but are only used by a small percentage of producers in most counties. Corn and soybeans are the most common crops, with a corn/soybean rotation being heavily used amongst most producers. Complete results of the DC survey are available in Appendix B.

Table 28: Estimated Levels of Non-Structural BMP Adoption in the WNRW

Question	Audubon County	Carroll County	Crawford County	Fremont / Mills / Montgomery / Page County
How many operators utilize non-structural/avoidance practices?	90%	5%	95%	Majority
How many operators utilize reduced tillage practices?	Almost all	80%	95%	Nearly all
How many operators utilize grazing land management?	There is little grazing in this region	5%	N/A	Most grazing operations have BMPs, but they do not meet typical grazing plan requirements
How many operators utilize cover crops?	30%	5%	3%	5%
What are typical crop rotations in this region?	Corn/ soybean	Corn/soybean, Corn/corn, Corn/corn/soybean	Corn/soybean	Corn/ soybean

N/A indicates no answer.

Source: JEO, 2018



CHAPTER 4

GOALS

4 GOALS

4.1 INTRODUCTION

Watershed management and flood resiliency plans at the HUC 8 level encompass a large geographic area and transcend traditional political boundaries, making the success of such plans dependent on the commitment and voluntary involvement of community members. As such, this plan was developed using a community-based planning process, through which community members from throughout the watershed guided the development of the plan's vision, goals, and objectives.

As the East Nishnabotna Watershed Management Coalition (ENWMC) and the West Nishnabotna Watershed Management Coalition (WNWMC) meet and vote in a collaborative effort and are both coordinated by the Golden Hills RC&D, it was agreed upon between the Joint Coalition that one unified vision statement would be used for the two plans. It was also determined that the goals, objectives, and action items of each plan could be consistent between the plans.

4.2 GOAL-SETTING PROCESS

The first step in the goal-setting process was the development of a vision, or an optimal desired future state for the East Nishnabotna River Watershed (ENRW) and the neighboring West Nishnabotna River Watershed (WNRW). To facilitate discussion, three vision statements were presented to the ENWMC and the WNWMC during their March 2018 quarterly meeting. After review and revisions, the Joint Coalition settled on a vision statement that best represents what they would like to accomplish with the watershed plans. The vision statement was shared with and approved by the stakeholder groups of each watershed during the first round of stakeholder meetings.

The next step was to establish goals and objectives for the plans. Stated in unmeasurable terms, goals establish the framework for the vision and are general, long-term guidelines that describe a desired achievement. On the other hand, objectives define strategies or implementation steps to attain the identified goals and provide a way of measuring movement towards the vision.

During the first round of stakeholder meetings, held in April 2018, stakeholders actively participated in an open discussion on issues and solutions, as they related to the vision, across the watersheds. This information was gathered to inform and establish draft goals and objectives. The goals were written in a manner to provide guidance throughout the watersheds, but flexible enough to enable various methods of implementation between the HUC 8 watershed, as well as at the HUC 12 and sub-HUC 12 level.

During the second round of stakeholder meetings, held in July 2018, the draft goals and objectives were presented for review and revision. The stakeholder-revised goals and objectives were then forwarded to the ENWMC and WNWMC for review at their quarterly Joint Coalition meeting in September 2018. With assurance from the Joint Coalitions that the goals and objectives were in alignment with the vision statement, the goals and objectives were considered final.

4.3 GOALS AND OBJECTIVES

Table 29 outlines the vision, goals, and objectives that were collaboratively developed by the ENWMC, WNWMC, and stakeholder groups. It is important to note that vision, goals, and objectives reflect the needs and priorities of watershed communities at the time of this plan's development. These needs and priorities will change over time as resources, policy, and science continues to change; thus, these goals and objectives should be reviewed and adjusted as needed, or at least every five years in accordance with EPA (2001) requirements.

Table 29: Vision, Goals, and Objectives of the Plan

Vision		
The East and West Nishnabotna River Watershed Coalitions will work in a collaborative effort to coordinate to reduce flood risks to life and property and improve the water quality within the Nishnabotna Watershed for future generations.		
Goal 1	**Work in a collaborative effort with a diverse group of stakeholders**	
	Objective 1.1	Continue to schedule quarterly East and West Nishnabotna River Watershed Management Coalition meetings to allow for stakeholder engagement, outreach, and education
	Objective 1.2	Maximize funding opportunities through grant money and other outside sources in conjunction with developing local funding mechanisms to better leverage those grants
	Objective 1.3	Prioritize projects based on greatest risk and benefits to the local or regional area
	Objective 1.4	Encourage self-sustaining financing mechanisms for individual property owners, communities, and counties
	Objective 1.5	Ensure that plan progress is tracked and, at a minimum, formally update the plans every 5 years
Goal 2	**Reduce flood risks to life and property**	
	Objective 2.1	Reduce runoff from cities and agricultural fields using an array of BMPs such as cover crops, detention basin, and others
	Objective 2.2	Reduce flooding impacts using structural measures, such as dams, levees, stream stabilization, elevating structures, and others
	Objective 2.3	Reduce the residual flood risk using non-structural measures such as warning systems, public education, zoning, and others

Goal 3	**Increase flood resiliency through community, county, and regional partnerships to mitigate, prepare for, respond to, and recover from floods**
Objective 3.1	Identify local and regional resources that improve a community's or county's capabilities to prepare, respond, and recover from floods
Objective 3.2	Identify vulnerable populations that may need assistance with flood preparation, response, and recovery
Objective 3.3	Identify gaps in community/county resources and needs so that they may be addressed or provided where possible
Objective 3.4	Integrate hazard mitigation plan resiliency and project information into planning documents
Goal 4	**Maintain and improve water quality to meet state water quality standards**
Objective 4.1	Implement urban and rural BMPs to meet water quality standards and reduce sediment, nutrient, and bacteria pollutant loads from entering waterbodies
Objective 4.2	Implement urban and rural BMPs to protect the quality of drinking water supplies
Objective 4.3	Develop and implement a monitoring and evaluation program to measure results and identify additional pollutants of concern
Goal 5	**Increase public awareness and education on flood risks, flood resiliency, and water quality management**
Objective 5.1	Develop and provide information to residents and landowners about the types of flood risks they are exposed to, where they occur, and the BMPs they may implement to reduce their risk to flooding
Objective 5.2	Develop and provide information to residents and landowners about how to increase flood resiliency so that their communities may adapt and recover more quickly to future flood events
Objective 5.3	Develop and provide information to residents and landowners about water quality and BMPs to improve water quality
Objective 5.4	Share monitoring program results and any newly identified pollutants of concern with residents and landowners

4.4 ACTION PLAN OVERVIEW

The WNWMC has taken the lead on the organizational and planning elements for the West Nishnabotna Watershed. As such, the WNWMC serves as a central hub for communities, counties, SWCDs, and other stakeholders to come together. While the WNWMC has no formal authority or jurisdiction to implement actions, it does provide a mechanism for its members to leverage their authorities and act with a unified voice to accomplish the actions in this plan.

The successful implementation of this plan is dependent on the leadership and guiding assistance that the WNWMC provides. This is most effectively manifested in the employment of a watershed coordinator staff position. Because the WNWMC has no formal authority, it must rely on the commitment and voluntary involvement of community members. Employing a watershed coordinator ensures that there is someone to engage individual communities and residents throughout the watershed, as well as work to bring in outside resources (such as funding and technical assistance). This will allow community members to become educated, encouraged, and enabled to participate in relevant watershed planning efforts.

To help guide the WNWMC and the watershed's community members in the successful implementation of this plan, a detailed action plan is provided in the following section. The action plan is comprised of a series of specific activities that can be completed to collectively achieve the plan's goals and objectives. The activities were identified through evaluation of watershed data, collaboration with project coordinators and partners, and guidance from stakeholders and the general public. Only the action items that were of highest priority and thought to be realistically achievable within five years were included in the following action plan; however, all of the potential action items that were identified have been documented in Appendix B for reference. The action plan framework (**Figure 49**) is based on five types of activity:

- **Education**, which refers to community outreach efforts aimed at increasing awareness of and encouraging participation in flood resiliency and water quality improvement activities. Target audiences should be defined, with communication and informational materials crafted specifically for those audiences. This is measurable in terms of changes in knowledge, attitude, and behavior.
- **Practices**, which refers to the long-term implementation of site-specific BMPs to achieve a specific outcome. It is recommended that practices be concentrated in priority areas to maximize efforts, resources, and impact. This is measured in the number of BMPs implemented and the area treated by the BMPs.
- **Monitoring**, which refers to collecting and evaluating data over time to track progress. Baseline and goal benchmarks may be established to help guide the outcomes of the other four activities. This action is measured by diversity of resources monitored, amount of data collected, and the development of a long period of record.
- **Policy**, which refers to guidelines or protocols set forth by a governing authority to achieve a specific outcome. Whenever possible, policy should promote incentives rather than be punitive. This is measured by tracking the development of formal policies adopted by governing entities.
- **Projects**, which refers to specific improvements being made to a specific area to achieve an outcome. Projects are similar to practices, but projects have distinct starting and completion dates whereas practices are an on-going, long-term effort. This is measured by compiling and summarizing efforts taken by those involved.

EDUCATION
Community outreach efforts aimed at increasing awareness of and participation in flood resiliency and water quality improvement activities.

PROJECTS
Individual improvements made to a specific area to achieve an outcome.

POLICY
Guidelines or protocols set forth by a governing authority to achieve a specific outcome.

MONITORING
Collecting and evaluating data over time to track progress.

PRACTICES
Long-term implementation of site-specific BMPs to achieve an outcome.

Figure 49: Action Plan Framework

4.5 ACTION PLAN

The action plan is organized by the five activity types previously discussed and provides an overview of the activities that could be completed to enhance flood resiliency and improve water quality in the watershed. Each activity in the action plan lists includes the following information:

- Management Activity – a description of the activity or action to be taken.
- Goals Addressed – which goals of this plan the activity seeks to advance.
- Timeline/Milestones – an estimate of when, or at what interval, the activity should be completed.
- Primary Activity Lead – who is responsible for leading or facilitating the activity.
- Potential Partners – a list of agencies or organizations that may directly partner with the activity lead complete the action.
- Primary Technical & Funding Resources – a list of the most likely resources that could aid in completion of the activity.

It is anticipated that the WNWMC will be involved, at some level, in most activities, therefore, it is generally not listed in the action plan. Activities related to education appear in **Table 30**, practices in **Table 31**, monitoring in **Table 32**, policy in **Table 33**, and projects in **Table 34**. The collective list of activities is not meant to be exhaustive and is intended to change over time as goals are achieved, resources change, science progresses, and priorities shift. The activities list should be reviewed annually and updated every five years.

Table 30: Action Plan for Education Activities

EDUCATION

Action #	Management Activity	Goals Addressed					Timeline/ Milestones	Primary Activity Leads	Potential Partners	Primary Technical Funding & Resources
		1	2	3	4	5				
1	Work with officials to review and update, as necessary, flood warning systems, especially in the upper portions of the watersheds	X		X		X	Begin reviewing in 2019	Watershed Coordinator	County EMs, IFC, USGS, National Weather Service	n/a
2	Create and distribute an annual report of WMA activities and finances to members and residents	X				X	First report in 2019 Then annually	Watershed Coordinator	n/a	ISU Extension, MAPA, SWIPCO
3	Host an annual review meeting to provide an opportunity to update the public and partners on activities and evaluate progress; summarize and present the results of annual evaluation metrics/worksheets	X		X		X	First meeting in 2019 Then annually	Watershed Coordinator	n/a	Members of each watershed coalition
4	For each quarterly meeting, arrange for 1-2 guest speakers from major funding or technical programs to present and educate	X		X			Each quarterly meeting beginning June 2019	Watershed Coordinator	IWA	n/a
5	Utilize partnerships to compile and distribute information on BMPs and cost-share programs to targeted audiences within the watershed	X				X	Beginning in 2020, then ongoing	Watershed Coordinator	NRCS, IDALS, ISU	n/a

Table 31: Action Plan for Practices

PRACTICES

Action #	Management Activity	Goals Addressed 1	2	3	4	5	Timeline/ Milestones	Primary Activity Leads	Potential Partners	Primary Technical Funding & Resources
1	Track locations, types, and costs of BMPs implemented. For reporting purposes, aggregate practice adoption rates to the watershed scale to protect personal identifiable information	X	X		X		Ongoing Yearly reporting	ENWMC and WNWMC acting jointly	NRCS, ISU, IDALS, IDNR	IDALS, IDNR
2	Gauge BMP retention levels with randomized yearly follow-ups with operators who implement practices	X			X		Ongoing	Local SWCD Office	NRCS, IDALS, ISU	ISU, SWCD
3	Provide landowners information on multiple funding options and help them navigate the administrative hurdles of programs	X				X	Materials developed by end of 2019 Ongoing	Watershed Coordinator	NRCS, IDALS, IDNR, ISA	ENWMC and WNWMC acting jointly

Table 32: Action Plan for Monitoring Activities

MONITORING										
Action #	**Management Activity**	**Goals Addressed**					**Timeline/ Milestones**	**Primary Activity Leads**	**Potential Partners**	**Primary Technical Funding & Resources**
		1	**2**	**3**	**4**	**5**				
1	Create an initial database of existing urban and agricultural BMPs and current treatment levels	X			X	X	End of 2020	ENWMC and WNWMC acting jointly	NRCS, ISU, IDALS, IDNR	IDALS, IDNR
2	Track existing indicators of flood resiliency monitor these indicators over time to showcase progress and identify areas in need of additional resources	X		X		X	Database developed by end of 2019 Ongoing tracking	ENWMC and WNWMC acting jointly	HSEM, County Engineers, County EMs, IFC, IDNR	n/a
3	Complete a loss avoidance study to identify effectiveness of flood mitigation projects	X		X		X	Complete by 2022	ENWMC and WNWMC acting jointly	HSEM, County Engineers, County EMs, IFC, IDNR	HMGP
4	Identify and install additional stream, tributary, and edge of field monitoring sites for nutrients and bacteria	X			X		End of 2020	ENWMC and WNWMC acting jointly	ISU, IDNR, USGS, IFC, ISA	ISU, IDNR, USGS, IFC, ISA

Table 33: Action Plan for Policy Activities

POLICY										
Action #	Management Activity	Goals Addressed					Timeline/ Milestones	Primary Activity Leads	Potential Partners	Primary Technical Funding & Resources
		1	2	3	4	5				
1	Prior to end of IWA program funding identify and secure funding or a funding arrangement to hire and/or maintain a watershed coordinator	X		X		X	May 2020	Chairpersons of the ENWMC and WNRMC	Golden Hills RC&D	n/a
2	Amend each local hazard mitigation plan with Hazard Mitigation Alternatives identified in this plan (Appendix H)		X	X			Complete by end of 2021	County EMs	IHSEM	n/a
3	Identify and secure both short-term and long-term funding through member contributions, grants, or other means to help fund operations, implement BMPs, or complete projects	X					Apply by mid-2020 Funding in place by end of 2021	Watershed Coordinator working with Chairpersons of the ENWMC and WNRMC	NRCS, IFC, IDNR, Cities, Counties	PL-566, RCPP, IDALS
4	Attend NRCS Local Working Group meetings to guide priorities on NRCS programs and funding locally	X					Yearly	Board Members	NRCS	n/a
5	Review and adjust the plan's goals and objectives every five years	X					Yearly review, formal update in 2024	ENWMC and WNWMC acting jointly	IDNR	IDNR, IDALS

Table 34: Action Plan for Projects

PROJECTS

Action #	Management Activity	Goals Addressed					Timeline/ Milestones	Primary Activity Leads	Potential Partners	Primary Technical Funding & Resources
		1	2	3	4	5				
1	Update and complete PL-566 watershed plans and structures within Turkey Creek, Troublesome Creek, and Davids Creek Watersheds	X	X		X		Apply for planning funding in 2021	ENWMC	County Engineers	NRCS, PL-566
2	Identify and study possible flood risk reduction projects that could be located along the main stem of the East/West Nishnabotna Rivers.		X	X		X	Begin scoping and study in 2022	ENWMC and WNWMC acting jointly	IDNR, USGS, County EMs, Local Cities	IHSEM
3	Complete a project (as identified in the case study) at the East/West Nishnabotna River confluence to alleviate flooding issues near Riverton Road	X	X	X			Apply for funding 2019 Complete project by 2023	Fremont County EM	ENWMC and WNWMC acting jointly, IFC, IHSEM	HMGP
4	Complete a study in high priority areas to identify possible road dams that could be modified or constructed to improve flood control	X	X	X			Complete the study by the end of 2020	County Engineer	Hungry Canyons Alliance	HMGP, IDNR
5	Participate in the IDNR-sponsored Source Water Protection (SWP) program to protect the quality of drinking water	X			X		End of 2020	Local City	IDNR	IDNR, CDI

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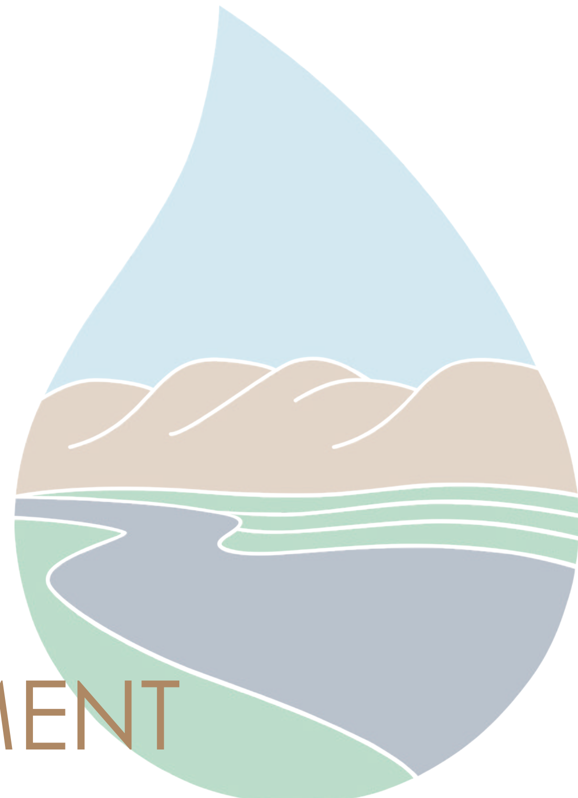

CHAPTER 5

PUBLIC ENGAGEMENT

5 PUBLIC ENGAGEMENT

9e

Education and outreach, as it relates to this plan, refers to the on-going process of informing and involving the watershed's population in the development and implementation of flood resiliency and watershed planning efforts. This process is essential as the success of this plan is dependent on the voluntary efforts of the watershed's communities, landowners, and residents. An informed and involved public is needed for the implementation of the plan, as well as the long-term acceptance, adoption, and maintenance of best management practices (BMPs) within the watershed.

The purpose of this chapter is to provide a framework for education and outreach efforts that will support the implementation of the plan as the West Nishnabotna Watershed Management Coalition (WNWMC) pursues the goals described in **Chapter 4**. This framework is based on stakeholder input; communication and marketing best practices; public participation best practices; and principles outlined in The Social Indicator Planning & Evaluation System (SIPES) for Nonpoint Source Management: A Handbook for Watershed Projects (Genskow and Prokopy, 2011). The SIPES handbook is an excellent resource regarding the identification and monitoring of social indicators, or measures that describe the awareness, values, and behaviors of people and communities, related to water quality improvement.

5.1 TARGET AUDIENCES

While the watershed as a whole can be an audience for education and outreach efforts related to flood resiliency and watershed management, it should not be the only audience. To be most effective, education and outreach should be based on the needs of a target audience. A target audience is a population subset that is the ideal recipient of a message based on shared characteristics or interests. The use of target audiences maximizes the effectiveness of education and outreach efforts because it helps to deliver a relevant message to the individuals who can readily use or act on that information.

Spanning both the West Nishnabotna River Watershed (WNRW) and the East Nishnabotna River Watersheds (ENRW), several target audiences have been identified including, but not limited to:

- Land managers, property owners, and residents throughout the watershed and within each priority area;
- Producers who utilize cover crops, no-till, grassed waterways, and those with the potential to implement similar practices;
- WNWMC Board of Directors and staff;
- County government staff and elected officials;
- Municipal government staff and elected officials;
- Rural homeowners with private wells and septic systems;
- Urban landowners and residents;
- Absentee landowners, both local and distant;
- Crop consultants, agri-chemical dealers, and other agricultural service providers;
- Recreational water users throughout the watershed and within each priority area;
- Civic leaders, such as service organizations and non-profits;
- Youth (Future Farmers of America [FFA], agricultural students, science classes, etc.); and
- Young or beginning producers.

In addition to identification of audience(s) to target, effective education and outreach requires an understanding of how to reach and lead an audience to take action. By developing this understanding, the WNWMC will be better positioned to influence people's awareness, values, and behaviors regarding flood resiliency and watershed improvements. The type of information that would be helpful to have for each target audience includes:

- Preferred delivery method: what format (in-person, mailer, email, website, video etc.) and frequency of communication does the audience prefer?
- Motivators and incentives: what drives the decision-making process of this audience?
- Existing perceptions: what do they currently think about water quality or flood resiliency?
- Barriers and obstacles: what would prevent this audience from engaging?

This type of information can be collected a variety of ways, such as through surveys, in-person interactions, and advisory boards. The initial research of target audiences can also serve as baseline information for on-going monitoring of the awareness, values, and behaviors related to water quality improvements. As described by the previously mentioned SIPES handbook, monitoring social indicators alongside environmental indicators will offer meaningful insight regarding the progress made in achieving the goals and objectives described in this plan. Refer to the SIPES handbook for additional details on how to use social indicators to help plan, implement, and evaluate watershed improvement projects.

5.2 STRATEGIES

Education and outreach strategies are based on one of two things: information or behavior. These strategies will result in different outcomes. An information-based strategy seeks to fulfill information needs, while a behavior-based strategy seeks to motivate change. Typically, an information-based strategy should precede a behavior-based strategy, but that is not always the case. For example, information needs could be sufficiently met for common and readily-understood topics, like household water conservation, using a behavior-based approach. To determine which strategy to use throughout the implementation of this plan, revisit the goals and objectives provided in **Chapter 4** to identify whether the desired outcome is information- or behavior-based.

INFORMATION-BASED STRATEGY

The purpose of an information-based strategy is to increase awareness or understanding of a flood resiliency or water quality topic. When the desired outcome is increased awareness, the goal of the strategy is to make target audiences aware that issues are present, as well as what actions have been or are being taken. When the desired outcome is increased understanding, the goal of the strategy is to broaden or deepen the target audience's understanding of issues and projects. **Table 35** provides an outline of efforts that would support an information-based education and outreach strategy. These information-based outcomes are to be considered a component of the overall education and outreach strategy for this plan. They are to be implemented and evaluated when appropriate but supplementary to, or in support of, the action items outlined in **Chapter 4**.

Table 35: Potential Education and Outreach Efforts for Information-Based Outcomes

Education or Outreach	Outcome
Create logos, taglines, and key messages for the watershed (or specific projects) to create a sense of place and value.	Awareness
Promote the final plan through newsletters, flyers, press releases, websites, and events.	Awareness
Acknowledge, recognize, record, and share previous and existing conservation efforts or other projects completed.	Awareness
Provide updates on plan progress and monitoring through newsletters, flyers, press releases, websites, and events.	Awareness
Identify and partner with other groups within the watershed that are already conducting conservation or flood resiliency efforts.	Understanding
Develop a reporting system to identify successes and failures of projects.	Understanding
Provide educational opportunities (fact sheets, public meetings, field days, classroom activities, etc.) that focus on specific issues, solutions, and funding opportunities.	Understanding
Showcase the relevancy and benefits of this plan's implementation to help audiences understand local impact.	Understanding
Develop and organize demonstration sites, tours, and field days.	Understanding

BEHAVIOR-BASED APPROACH

The purpose of a behavior-based approach is to provide information that leads to changes in values and behaviors. This plan seeks to address change at two levels. At the first level, education and outreach will seek to influence or change existing values and behaviors so as to gain acceptance and adoption of BMPs. At the second level, education and outreach will seek to influence generational change. Generational changes involves shaping the attitudes, values, and behaviors of future land managers, producers, residents, and decisions makers. Generational change will ultimately help enhance the sustainability of implementing BMPs throughout the watershed. Table 36 provides an outline of efforts that would support a behavior-based education and outreach strategy. These behavior-based outcomes are to be considered a component of the overall education and outreach strategy of this plan. They are to be implemented and evaluated when appropriate but supplementary to, or in support of, the action items outlined in Chapter 4.

Table 36: Potential Education and Outreach Efforts for Behavior-Based Outcomes

Education or Outreach	Outcome
Provide information directly to target audiences about the benefits of BMPs, as well as technical and financial programs available to assist in the implementation of BMPs.	Change in existing values and behaviors
Provide information directly to farm consultants, agricultural retailers, and other audiences that have a high degree of influence on landowner and producer decisions.	Change in existing values and behaviors
Hold targeted coffee shop meetings, tailgate sessions, and other informal information exchanges to build relationships and to learn more about the barriers and obstacles audiences perceive regarding implementation of BMPs.	Change in existing values and behaviors
Identify and work with local schools to develop a water quality monitoring program, with information developed for both students and parents.	Change in existing values and behaviors; Generational change
Include school-aged youth in project plans, such as field tours of project sites.	Generational change
Provide information about water quality and other benefits of BMPs to youth-based programs (FFA, agricultural students, science classes, etc.)	Generational change
Provide information targeted for younger generations at regularly used recreation areas (beaches, picnic shelters, canoe trails, etc.) about the importance of watershed management and its relation to water quality and flood resiliency, especially as it related to the location where information is posted.	Generational change

5.3 METHODS OF EDUCATION AND OUTREACH

Education and outreach methods should be tailored to the target audience. This will make efforts more effective and more likely to achieve the desired outcome. A diverse outreach campaign utilizing multiple methods should be used to reach multiple target audiences or the general public regarding watershed-wide initiatives. Table 37 describes a variety of potential education and outreach methods:

Table 37: Education and Outreach Delivery Methods

Method	Description	Recommended Use
One-on-One Contact	On-site meetings to discuss location of projects or to answer questions about programs and projects.	For siting projects within targeted areas.
Direct Mailing	Targeting informational mailer sent to all properties within specified area.	For increasing attendance of public meeting or participation in area event or program.
Mass Media	Newspaper, radio, television news, agriculture-based magazines, outdoor magazines, etc.	For increasing awareness of activities and progress.
Electronic and Social Media	Websites, social media platforms (Listserv emails, Facebook, Twitter, etc.)	For supplementing other outreach methods
Signage	Billboards, cooperator recognition signs, traveling displays, demonstration signs, etc.	For high-traffic areas, such as major intersections, public beaches, entrances to state and local recreation areas, boat ramps, or area events.
Events	Events related to water resources, such as training opportunities, demonstration field days, and recognition picnics.	For use in conjunction with other area events, such as county fairs and nitrogen certification training events.
Field Clinics or Workshops	Outdoor recreation (kayaking, fishing, etc.), equipment calibration, water quality testing, BMP maintenance inspection, etc.	For use in supporting the education or adoption of a specific management activity.
On-site Project Demonstration	Water quality monitoring and BMP installation or maintenance.	For use in supporting the education or adoption of a specific management activity.
Curriculum	Lesson plans and materials for formal and informal education.	For youth-based outreach.
Educators	Assist with the development and delivery of materials.	For youth-based outreach.

Consideration should also be given to the timing which education and outreach materials and efforts are employed. Timing of education and outreach can be based on target audience research, such as avoiding information distribution to producers during the peak of harvest, or timed to occur alongside relevant events, such as county fairs. Regardless of the basis, timing should be deliberate to help ensure target audiences will be receptive to education and outreach efforts.

5.4 EVALUATION

Education and outreach activities should continually be evaluated and conducted for each strategy for several reasons. First, evaluation supports mid-course adjustments and follow-up outreach to ensure the strategy is achieving its desired outcome. Second, evaluation provides an alternative means (i.e. social indicators) to measure the progress of this plan's goals and objectives. And third, evaluation will help the WNWMC refine its education and outreach strategies for future projects and initiatives.

Evaluation methods should be identified during education and outreach strategy development so it can be employed throughout a project or initiative. This early emphasis also prevents evaluation from being overlooked. Evaluation methods that may be used include, but are not limited to:

- Tracking if or how the target audience engaged in the education and outreach;
- Conducting pre-, mid-, and post-surveys;
- Providing and encouraging completion of evaluation forms;
- Offering and assessing the interest in participation incentives;
- Hosting formal or informal focus groups to discuss specific practices; and
- Tracking media coverage.

Evaluation data should be summarized for each project to allows for side-by-side comparison of efforts and outcomes. Evaluation data can also be gathered to measure the collective progress in achieving this plan's goals and objectives.

5.5 ENHANCING EXISTING PROGRAMS

WATERSHED PROJECT COORDINATOR

The WNWMC, in collaboration with the ENWMC, hired a watershed project coordinator to manage the development and implementation of this plan. Given the broad geographic reach and structure of the WNWMC, it will be imperative to either maintain a watershed project coordinator position or assemble a committee specifically to help direct and implement education and outreach efforts. In the spirit of maximizing resources, this coordinator or committee could also readily serve the ENWMC, as many of the target audiences (discussed in Section Error! Reference source not found.) are very similar between the two watersheds.

STRENGTHENING PARTNERSHIPS

Through the Iowa Watershed Approach (IWA), there are established relationships with numerous agencies, universities, non-profits, and other stakeholders that the WNWMC may leverage to complete some of the education and outreach strategies. The watershed project coordinator or committee would assist with facilitating and maintaining those partnerships. As part of its broader education and outreach approach, the WNWMC (or watershed project coordinator) should continue to identify, pursue, and strengthen relationships with credible organizations that have shared interests and goals (e.g. flood resiliency, water quality, etc.) These partnerships may include, but are not limited to:

- Iowa Flood Center (IFC),
- Iowa Department of Agriculture and Land Stewardship (IDALS),
- Iowa Department of Natural Resources (IDNR),
- University of Iowa (UI),
- Iowa State University (ISU) Extension,
- Iowa Homeland Security and Emergency Management (IHSEM),
- Natural Resources Conservation Service (NRCS),
- Soil and Water Conservation Districts (SWCDs),
- County Emergency Managers,
- Golden Hills RC&D, and
- Hungry Canyons Alliance.

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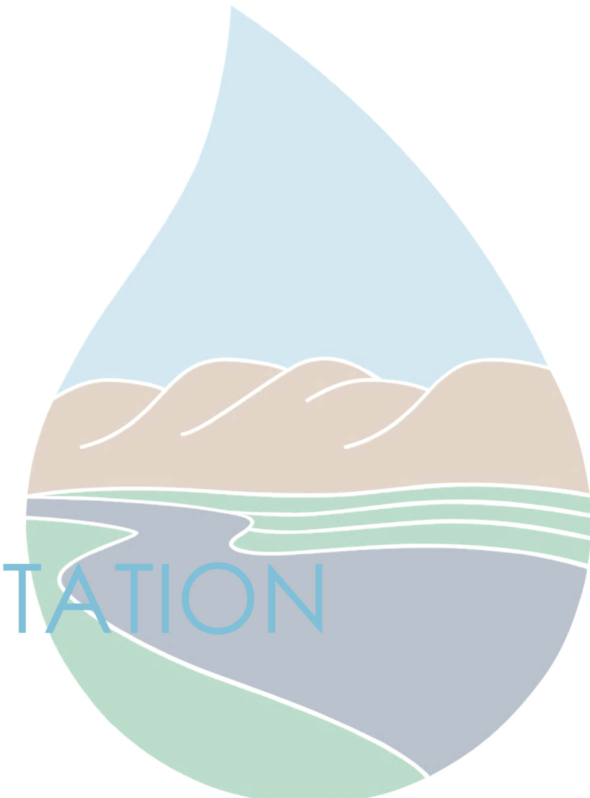

CHAPTER 6

IMPLEMENTATION SUMMARY

6 IMPLEMENTATION SUMMARY

6.1 INTRODUCTION

This chapter focuses on recommended projects and practices identified to reduce flooding and improve water quality within the WNRW. Previous chapters in this plan have laid the groundwork for understanding the resources, concerns, and threats within the WNRW. The following chapters provide information on the resources needed to implement the identified projects and practices - through evaluation and gathering support from technical and financial partners. The main purpose of this chapter is to specifically answer "what is to be done" in the watershed.

6.2 IMPLEMENTATION FRAMEWORK

STRATEGIES

Both watershed-wide and targeted implementation efforts to address flooding and water quality will be accomplished through existing partner programs (EQIP, WQI, HMP, etc.) and newly identified projects. Generally, existing programs provide landowners, producers, and communities, both in and outside of target areas, access to technical and financial assistance. However, to enable targeted implementation, partners will work together to focus these programs (to the greatest extent possible) on the priorities identified in this plan. The following strategies have been identified to guide these activities:

1. Utilize a voluntary approach, rooted in outreach and education;
2. Encourage the development and adoption of policies that reduce runoff and protect the floodplain within communities;
3. Promote soil health, which decreases runoff and loss of soil and nutrients;
4. Promote the adoption of BMPs which store runoff and trap pollutants;
5. Modify and rehabilitate existing structures to provide or improve benefits for flood reduction or water quality improvements; and,
6. Promote improved efficiency in the use of manure and commercial fertilizers

These strategies fall under two larger concepts: "Flood Resiliency" and the "Conservation Pyramid," which are discussed in the following pages.

While these general strategies translate across the planning area, specific practices and actions will need to be tailored to the specific project setting or landowner. A key to getting private landowners or producers to adopt or implement an individual project or practice is to identify barriers to adoption. These barriers may be related to: a lack in understanding or knowledge; logistics; technical staff; costs; or other factors. To successfully address these barriers, it is necessary for partners to work together in developing creative approaches and to involve all available funding sources. Actions centered around outreach and education can help to identify and break down these barriers – see Chapter 5. Actions centered around working together with partners and identifying technical and financial tools to help implement these strategies are discussed in Chapter 8.

FLOOD RESILIENCY

Flood resiliency recognizes that to improve a community's ability to recover from flooding, the risk from flooding must be reduced at both watershed and community levels (Figure 1). It is important to remember that all stakeholders will need to be involved. This approach encourages partners to work together to implement land management policies, structural and nonstructural measures, and to mitigate against remaining risks. An additional benefit of this approach is that the strategies employed both reduce flood risks and lead to improved water quality.

In Figure 50, the bars on the far left indicate the initial, unmitigated risk a community faces and the low amount of resiliency they may have. Taking strategic actions, as indicated in the subsequent bars, reduce the unmitigated risk. Some of these actions are taken at the federal, state, and local community levels; whereas others are taken by the homeowners and businesses at risk. The remaining risk after all actions have been taken is the residual risk (blue bar on the far right), however resiliency is very high at this point. This approach leads to reductions in loss of property, improved safety, and an improved ability to recover from other hazard impacts. Individually each strategy contributes a certain amount of risk reduction; however, when the efforts are combined, a dramatic reduction in risk is achieved.

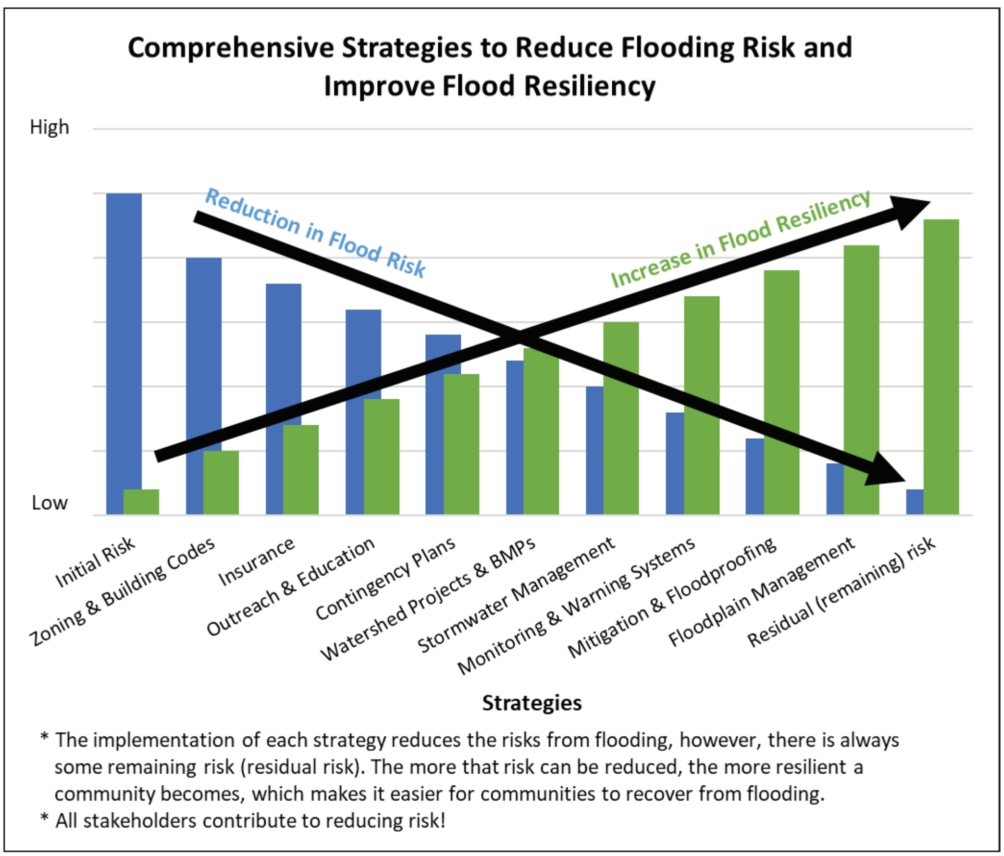

Figure 50: Illustration of How Reducing Flood Risks Leads to Increase in Flood Resiliency

CONSERVATION PYRAMID

The conservation pyramid concept (**Figure 51**) recognizes that to reduce flooding and improve water quality in agricultural watersheds, action must be implemented through a systematic approach of a suite of best management practices (BMPs). This approach reduces peak runoff from extreme rainfall events, protects soils from erosion, reduces nutrient loss, improves water quality of runoff, and improves crop production.

The foundation of the conservation pyramid relies on using BMPs to protect and improve soil health at the field level to increase erosion control, improve water infiltration and retention, increase soil organic matter, and improve nutrient cycling. Structural practices to control and treat runoff should then be targeted to specific in-field, edge-of-field, and riparian locations where maximum water quality benefits can be realized. Examples of BMPs that address soil health and control, or trap, pollutants are provided in the pyramid. However, there are many other actions that should be considered during implementation.

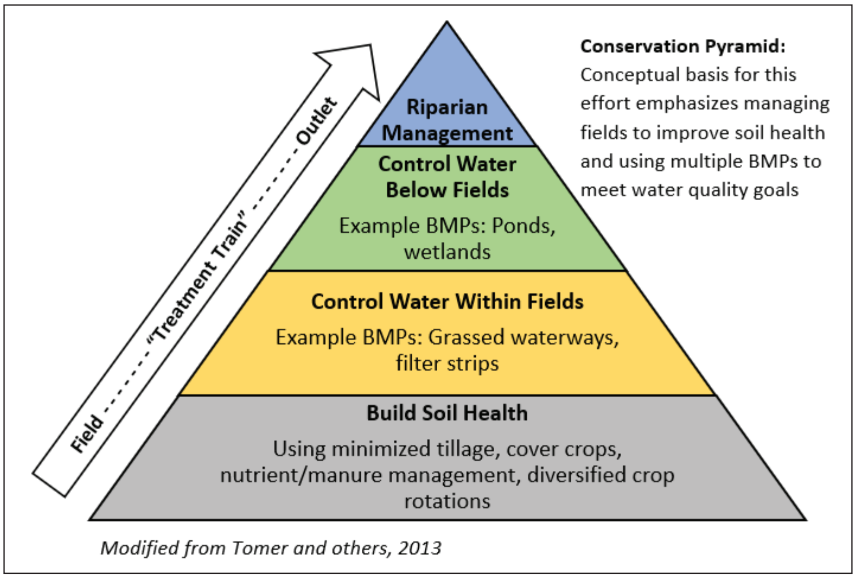

Figure 51: Conservation Pyramid Provides a Framework for Implementing BMPs Across the Watershed

6.3 BEST MANAGEMENT PRACTICES

There are a variety of proven BMPs (strategies, mitigation alternatives, practices, projects, etc.) which can reduce flooding and improve water quality. These BMPs have been previously identified and are discussed in detail by other sources. The BMPs which are most applicable to the WNRW were identified for further evaluation in this plan. Once these BMPs were identified, additional analysis was completed on select items to evaluate feasibility, possible benefits, and costs of each.

IDENTIFICATION OF POTENTIAL BMPS

The following sources provided excellent examples of BMPs that reduce flooding and improve water quality. These resources provide a look inside the "tool box" of BMPs and should be referred to for additional details on each BMP.

- **Mitigation Ideas: A Resource for Reducing Risk to Natural Hazards** (FEMA, 2013) – This publication identifies potential mitigation actions for reducing risk to all types of natural hazards, including flooding. The actions are summarized into four types: 1) local planning and regulation, 2) structures and infrastructure projects, 3) natural systems protection, and 4) education and awareness programs.
- **Iowa Nutrient Reduction Strategy** (IDALS, 2017b) - The Iowa Nutrient Reduction Strategy (NRS) is a science and technology-based framework to assess and reduce nutrients to Iowa waters and the Gulf of Mexico. The NRS has identified and evaluated multiple BMPs for their effectiveness in protecting and improving water quality. It has multiple decision support tools to help managers understand how BMPs operate, how effective they are, and how much they cost. Additional information on BMPs is also provided through Iowa State University Extension's Water Quality Program.

- **Agricultural Conservation Planning Framework** (ACPF) Tool (Porter and others, 2015) - In order to identify potential locations and the quantity of BMPs recommended in this plan, the planning team utilized the ACPF Tool. The ACPF tool utilizes modern, high-resolution geospatial datasets within the ArcGIS environment. This analysis assists in identifying a broad range of opportunities to install BMPs at the field level. Conceptually, the ACPF tool is based on the "Conservation Pyramid."
- **Iowa Stormwater Education Partnership** (ISWEP) – This organization focuses on improving water quality within communities (i.e. the urban environment). ISWEP offers technical and educational resources that include rainscaping and green infrastructure practices.
- **Local Stakeholder and Public Input** – Recommendations and ideas from state and local emergency managers, producers, county engineers, and others were used to help identify other programs or projects that would be beneficial within the WNRW. This input process is documented in Chapter 1 and Appendix B. Additionally, local hazard mitigation plans were reviewed for similar information.

9c

PRACTICES EVALUATED

An important step in finding solutions to reduce flooding and improve water quality is to create a toolbox of BMPs that can be utilized by landowners, producers, communities, resource managers, and others. Due to the large number of BMPs available, detailed reviews or analysis for each was not possible within the scope of this planning effort. Therefore, a focused list of BMPs was selected from a wide variety of potential BMPs, all of which address flooding and water quality to varying degrees. Evaluation and analysis of specific implementation scenarios and BMPs was then completed. Table 38 identifies the BMPs used in each technical assessment completed as a part of this planning effort: Flood Risk Assessment (Appendix B), Hydrologic Assessment (IFC, 2019), and Water Quality Model (Appendix B). It should be noted that this list is not intended to preclude the WNWMC or its partners from implementing other BMPs. Descriptions of each BMP can be found in the previously cited documents and in Appendix C.

Table 38: BMPs Evaluated for Implementation

Flood Risk Assessment	Water Quality Model	
Dams	Information and Education	Wetlands
Channel Widening	Onsite Wastewater Treatment System (OWTS) Upgrade	Farm ponds*
Bridge Improvements	Pet Waste Pick-up	Bioreactors
Levees	Non-structural & Avoidance BMPs	Stream stabilization/ restoration
Infiltration Basins	Small open feedlot BMPs	Terraces
Urban stormwater system upgrades	Drainage water management	Water and sediment control basins (WASCOBs)
Dam rehabilitation / modification	Grazing lands management	Grassed waterways
Non-structural (acquisition, elevation, etc.)	Cover crops*	Land Use Change & Perennial Vegetation*
Floodplain remapping	Riparian buffers	Urban stormwater management
Levee accreditation	Reduced tillage (no-till)	n/a
Join CRS program	Contour buffer strips	n/a

*This BMP was also utilized in the Hydrologic Assessment (IFC, 2019)

POLLUTANT TREATMENT EFFECTIVENESS

9c

An additional component of analysis for water quality BMPs was to identify their effectiveness in reducing pollutant loads, often referred to as treatment efficiency. Treatment efficiencies were identified using scientific peer reviewed literature. The suitability and performance of BMPs can vary significantly based on site conditions, therefore detailed feasibility, design, and analysis may be needed prior to implementing a BMP. In this case a representative efficiency was selected for use in the water quality model. The selected efficiency for BMPs treating *E. coli* bacteria, which is the cause of water quality impairments within the WNRW, is shown in **Table 39**. Additional details on the water quality model, including literature sources, can be found in the modeling report located in Appendix B. Treatment efficiencies for BMPs targeting nutrients were developed by the Iowa Nutrient Reduction Strategy and can also be found in Appendix C.

Table 39: Summary of BMP Treatment Efficiencies for *E. coli* bacteria

Best Management Practice (BMP)	Estimated Treatment Efficiency for *E. coli* bacteria
Watershed Education and Information	10%
Onsite Wastewater Treatment System (OWTS) Upgrade	Change OWTS failure rate from 40% to 5%
Pet Waste Pick-up	20%
Non-structural & Avoidance BMPs	10%
Drainage Water Management	0%
Grazing Lands Management BMPs*	40%
Cover Crops	40%
Riparian Buffers	70%
No-Till Farming	0%
Contour Buffer Strips (Prairie STRIPS, etc.)	70%
Small Open Feedlot BMPs	75%
Wetlands/Farm Ponds/Sediment Basins	78%
Bioreactors	70%
Stream Restoration / Stabilization	35%
Terraces	70%
Water and Sediment Control Basins (WASCOBS)	70%
Grassed Waterways	70%
Land Use Change & Perennial Vegetation	Change in land use type in the model
Urban Stormwater BMPs	37%

*This includes multiple practices such as rotational grazing, fencing, etc.

6.4 IMPLEMENTATION PROJECTS

COMMUNITY FLOOD MITIGATION

In order to identify which communities were most at risk to flooding, a flood risk assessment was performed for each city within the WNRW. The full assessment and methodology can be found in Appendix B. Only communities with moderate to high risk had additional screening to identify potential mitigation alternatives. Mitigation items were identified for the following communities in the WNRW (**Figure 52**): Avoca, Emerson, Hastings, Malvern, Manning, and Randolph. Each mitigation alternative was then reviewed for general feasibility and effectiveness for these communities. These mitigation actions can be found in **Table 40**.

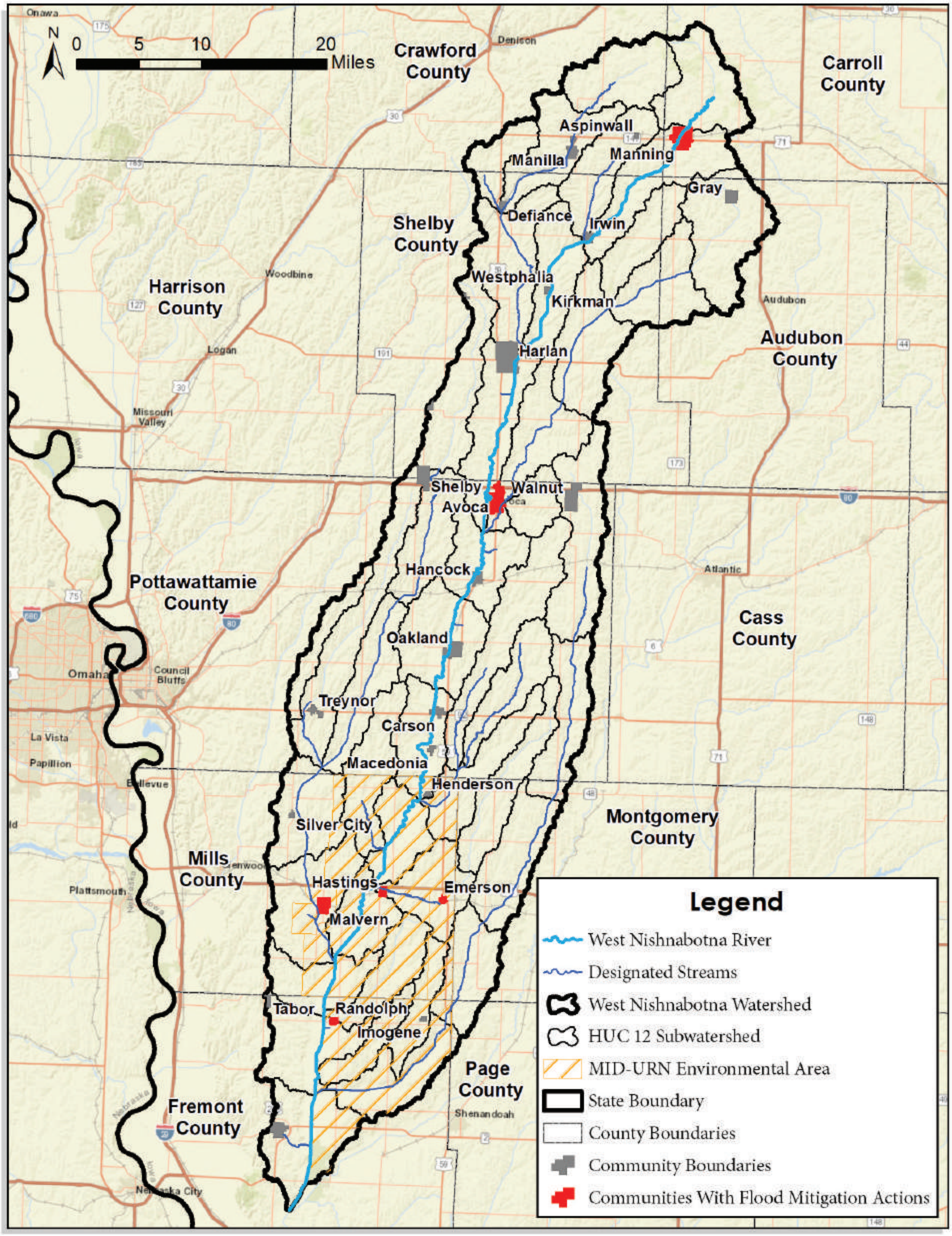

Figure 52: Identified Communities for Flood Mitigation Actions

Table 40: Mitigation Actions for Communities with Moderate- to High-Flooding Risk

Flood Risk Reduction Strategy	Community					
	Avoca	Emerson	Hastings	Malvern	Manning	Randolph
Dams	✖	●	●	●	●	●
Channel Widening/ Bridge Improvements	●	▶	▲	▲	●	●
Levees (excludes Main Stem)	✖	●	▶	●	●	▲
Infiltration Basins	✖	▲	▲	▲	✖	✖
Urban Storm System Upgrades	●	✖	✖	✖	✖	●
Non-Structural (acquisition, elevation, etc.)	●	▲	●	●	▲	▲
Floodplain Remapping	✖	✖	✖	✖	✖	✖
Levee Accreditation (excludes Main Stem)	✖	✖	●	✖	✖	✖
Join CRS Program	▲	▲	▲	●	▲	✖

KEY - Feasibility / Effectiveness Rating	
Highly Effective, Recommended ●	Further Evaluation Needed ▶
Effective ▲	Not Recommended ✖

The flood risk assessment focused on reducing and mitigating flood risks that originate from tributaries of the East and West Nishnabotna Rivers. Flood risks associated with main stem river flooding were not directly evaluated. By focusing on tributary flooding, local communities will be able to identify projects that can more realistically be implemented in the near future. This approach allows local issues to be addressed, while also producing positive effects on reducing both flash and main stem flooding within the larger watershed. It is recommended that these mitigation items, which are described in more detail at the community level in Appendix H, be amended into each respective local hazard mitigation plan. It is also recommended that main stem flood mitigation actions be reviewed as part of future plan updates.

Generally, dams were found to be an effective alternative for all communities evaluated, though site-specific analysis was not performed. Topography, land ownership/land use, and soil conditions all are major factors in dam site feasibility. Modification or rehabilitation of existing dams can provide increased flood attenuation, thereby reducing flood risks downstream. This strategy is only feasible for specific communities with dams in the watershed.

Channel widening and/or bridge improvements also are generally feasible for these communities as the improvements are designed to improve flood water conveyance. Any previous efforts to channelize streams or recent bridge replacements tend to reduce the potential feasibility of utilizing these strategies in the future to further reduce flood risks. New levees and flood walls are commonly utilized in urbanized areas to reduce riverine flood risks. They are not intended to mitigate localized flooding, for which the source is less centralized. Encroachments are also a key consideration in determining feasibility, as land and right-of-way is needed for any levee or floodwall.

Infiltration basins can be an effective method for reducing flood risks with appropriate site conditions. However, the soils within the WNRW are not conducive to infiltration and thus this method was not deemed feasible for the communities evaluated. Where localized flooding is of primary concern, storm system upgrades may be the most effective measures to reduce flooding. In many other cases, available information was insufficient to assess feasibility of storm system upgrades in reducing flood risks.

Non-structural flood mitigation strategies can be effective for short term and long term flood damage reduction, and they can also be very cost effective compared to some structural strategies. A particular advantage of nonstructural measures when compared to structural measures is the ability of nonstructural measures to be sustainable over the long term with minimal costs for operation, maintenance, repair, rehabilitation, and replacement. Non-structural measures include elevating structures, acquisition or relocation of structures out of the flood plain, flood proofing, flood warning systems, planning, and land use regulations.

Floodplain remapping is effective at reducing flood risks as they provide an increased level of awareness of such risks. Residents are less likely to occupy known high-risk areas and are ready to respond when flooding is eminent. Remapping was not recommended for any communities in the WNRW.

Levee accreditation typically involves evaluation and potential improvements, such as raising an existing levee to provide increased flood protection. This was recommended for Emerson as the community has a levee that is currently not accredited by FEMA. Accrediting the levee will not only increase flood protection, but also decrease flood insurance requirements in the areas shown to be protected by the levee.

The National Flood Insurance Program (NFIP) offers reasonably priced flood insurance to all properties in communities that comply with minimum standards for floodplain management. The NFIP's Community Rating System (CRS) credits community efforts beyond those minimum standards by reducing flood insurance premiums for the community's property owners. Participation in the CRS program is recommended for nearly every community.

WATERSHED WIDE FLOOD MITIGATION

The Iowa Flood Center developed a hydrologic model to evaluate potential mitigation scenarios at the watershed scale (IFC, 2019). The model helped to identify areas in the watershed with high runoff potential and ran simulations to help understand the potential impact of alternative flood mitigation strategies. The focus was on two types of implementation scenarios: 1) increasing infiltration in the watershed, and 2) implementing a system of distributed storage projects (ponds) across the landscape. There are many BMP practices that could be used in these scenarios, but due to the scale of the watershed and modeling limitation, the analysis was limited to distributed storage ponds, which are relatively large BMP structures, and broad-scale land use changes. Simulation of other much smaller BMP structures, like terracing or WASCOBS, are still considered an effective part of the overall strategy, but a separate modeling effort would be needed to reliably quantify impacts.

Identifying areas in the watershed with the highest runoff potential is the first step in selecting mitigation project sites. High runoff areas offer the greatest opportunity to retain water from large rainstorms on the landscape and to reduce downstream flood peaks. In the model used, the runoff potential for each subwatershed was determined by its land use and the underlying soils. The fraction of rainfall converted to runoff — also known as the runoff coefficient — is a convenient way to illustrate runoff potential. Areas with higher runoff coefficients have higher runoff potential.

Figure 53 illustrates the runoff coefficient as a percentage (from 0% for no runoff, to 100% when all rainfall is converted to runoff) for each HUC 12 subwatershed. Areas in the WNRW with the highest runoff potential are primarily located in the north or in areas to the east of the central West Nishnabotna River. Runoff coefficients exceed 50% in many areas. From a hydrologic perspective, flood mitigation projects that can reduce runoff from these high runoff areas should be a priority.

To evaluate the watershed-wide flood mitigation scenarios, a "design storm" was defined. Using a design storm allowed the same storm characteristics to be modeled against various changes in the mitigation scenarios. Subjecting each scenario to the same storm allows for direct comparison among them. The design storm chosen represented a rainstorm with a total accumulation of 6.0 inches in 24 hours. This design storm corresponds to approximately the 25-year return interval at the subwatershed scale. Four scenarios, described below, were modeled to gage the potential effectiveness of watershed-wide mitigation actions in reducing flooding.

Increased Infiltration Scenario

Runoff can be reduced from areas with high runoff potential by increasing how much rainfall infiltrates into the ground, as it decreases the volume of water draining off the landscape during and immediately after storms. Two hypothetical land-use changes were modeled in this scenario. Please note, while these are hypothetical examples only, they do provide valuable benchmarks on the limits of flood reduction that are physically possible with broad-scale land use changes.

One hypothetical land use change would be the conversion of row crop agriculture back to native tall-grass prairie. While returning to this pre-settlement condition is unlikely to occur, this scenario is an important benchmark to compare with any watershed improvement project considered. The simulated tall-grass prairie scenario infiltrated 0.9 inches more rainfall into the ground than the current agricultural landscape and most of the watershed experienced a greater than 20% reduction in subbasin peak discharge.

Another possible land use change would be improvements to agricultural conditions resulting from planting cover crops. Cover crops are a farming conservation practice that also enhances infiltration. Cover crops provide a variety of benefits, including improved soil quality and fertility, increased organic matter content, increased infiltration and percolation, reduced soil compaction, and reduced erosion and soil loss. One source suggests that for every one percent increase in soil organic matter (e.g., from 2% to 3%), the soil can retain an additional 17,000–25,000 gallons of water per acre (Archuleta, 2014). On average for the basin, planting cover crops increases infiltration by 0.25 inches for the 6-inch, 24-hour SCS Design Storm. Peak discharge reductions of 7–10% were common at the subbasin scale.

Distributed Storage Scenario

In general, a system providing distributed storage does not change the volume of water that runs off the landscape. Instead, storage ponds hold floodwater temporarily and release it at a slower rate. Therefore, the peak flood discharge downstream of the storage pond is lowered. By adjusting the size and placement of pond outlets, storage ponds can be engineered to efficiently use available storage for large floods. This scenario was based on the flood control concept developed by the Soap Creek Watershed in southern Iowa. In the Soap Creek Watershed, most structures were constructed in the headwater areas of the watershed, which allows for smaller structures rather than large, high-hazard class structures on the main rivers.

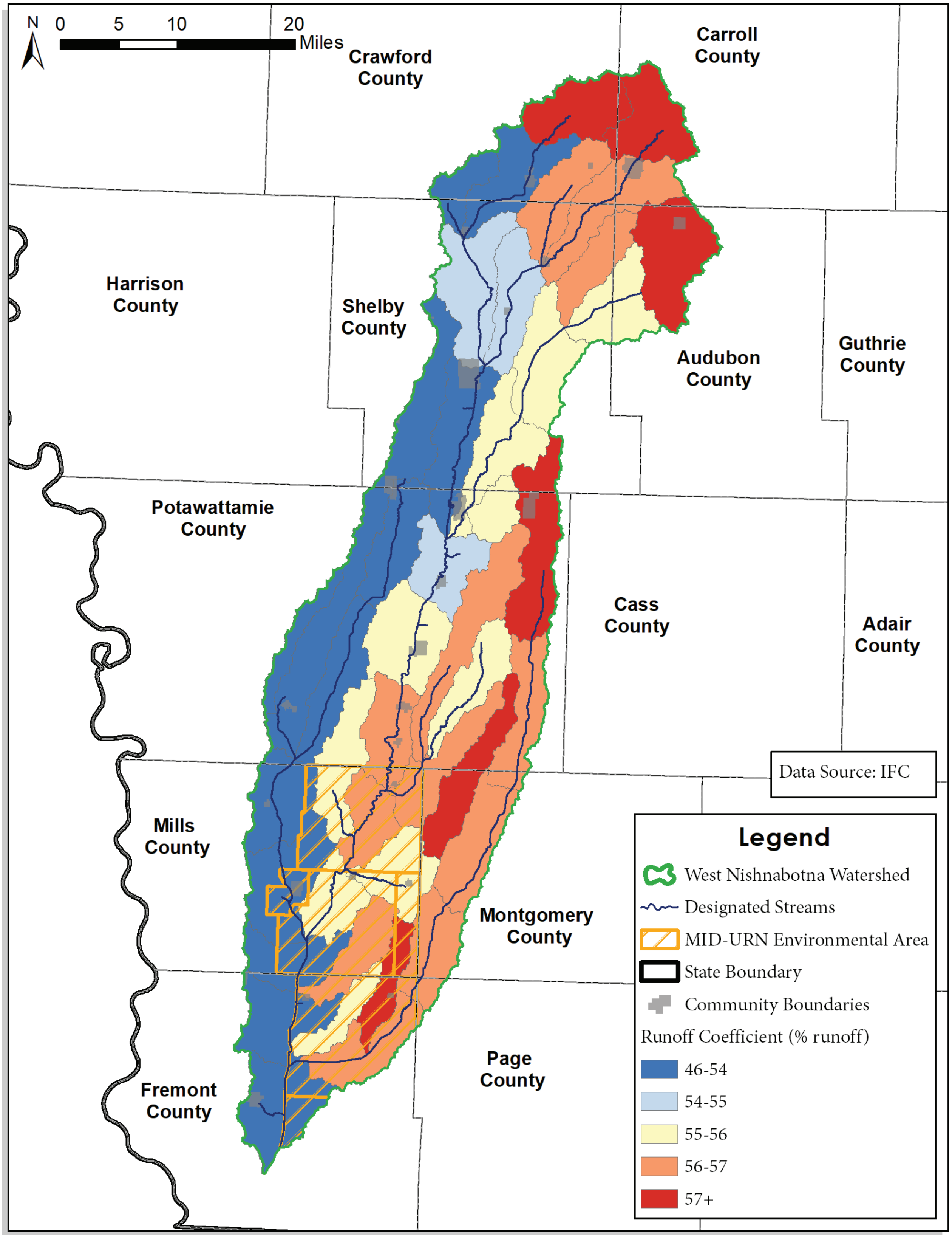

Figure 53: Runoff Potential by HUC 12 Subwatershed in the WNRW

For this scenario, the ACPF Tool was used for the entire WNRW to identify potential locations for nutrient reduction wetlands, which were then modified to be designed as a pond. By controlling water from the drainage area from every identified ACPF site, flood risk reduction was able to be modeled. In general, upland sites with more drainage area intercepted by ponds had the greatest reductions in peak discharge. The northernmost portion of the watershed had the largest peak discharge reductions, approximately 15% or greater.

Ponds can effectively reduce flood peaks immediately downstream of their headwater sites. Floodwaters originating from locations throughout the watershed arrive at junctions further downstream at vastly different times. As a result, the storage effect from ponded areas is spread out over time, instead of being concentrated at the time of highest flows. Hence, for larger drainage areas downstream in the watershed, the flood peak reduction of storage ponds diminishes.

Combined Increased Infiltration and Distributed Storage Scenario

Implementation of actual flood reduction practices in the watershed will likely rely on a mixture of enhanced infiltration and distributed flood storage projects. This scenario is a combination of the previous two. It includes an average implementation of cover crops on 50% of the agricultural land. This is a more realistic expectation for broad implementation of this practice, but it is still extremely ambitious. Implementation of distributed flood storage projects (ponds) remained the same.

Like the simulation of the ponds-only scenario, the largest reductions in peak discharge occur in the northernmost portion of the watershed. This is consistent with the largest concentrations of flood storage available and upstream drainage area intercepted by ponds. However, because of the cover crops, peak discharges across the entire watershed were generally much lower than for either of the scenarios where the practices were used alone.

Recommendation

The results of this modeling indicate that the best approach for flood risk reduction is a combination of various BMPs across the entire watershed. This approach both improves infiltration and detains or delays runoff to prevent or retime peak flows. This also means that a great deal of flood reduction benefits can be realized without large high-hazard class structures on the primary tributaries or mainstem of the West Nishnabotna River. Any larger structures that would still be necessary to protect communities or other at-risk locations would benefit from the reduction in flows achieved through the watershed-wide approach.

PRIORITY SUBWATERSHED IMPLEMENTATION

This plan covers a large geographical area and addresses many interrelated issues. To facilitate and focus implementation efforts in a way that will lead to measurable results, eight HUC 12 subwatersheds were prioritized for detailed planning efforts. Seven of these HUC 12s were identified prior to the planning process kicking off, as part of the Iowa Watershed Approach, and the remaining one was selected through a screening process. This screening process utilized input from the WNWMC members, as well as results from the hydrologic and water quality modeling. Additional details on the process can be found in Appendix B.

Figure 54 displays a map of the priority HUC 12s in the WNRW, these include: 1) City of Manning – West Nishnabotna River, 2) Deer Creek, 3) Lower Indian Creek, 4) Lower Walnut Creek, 5) Mud Creek, 6) Spring Branch – West Nishnabotna River, 7) White Cloud – West Nishnabotna River, and 8) Willow Slough – West Nishnabotna River. The HUC 12s located within the MID-URN area qualify for implementation cost-share opportunities through the IWA. However, this program ends in 2021 and, as implementation moves forward, additional sources of funding will be needed for each of these priority areas. Additional funding should be identified to expand implementation into the remaining HUC 12s.

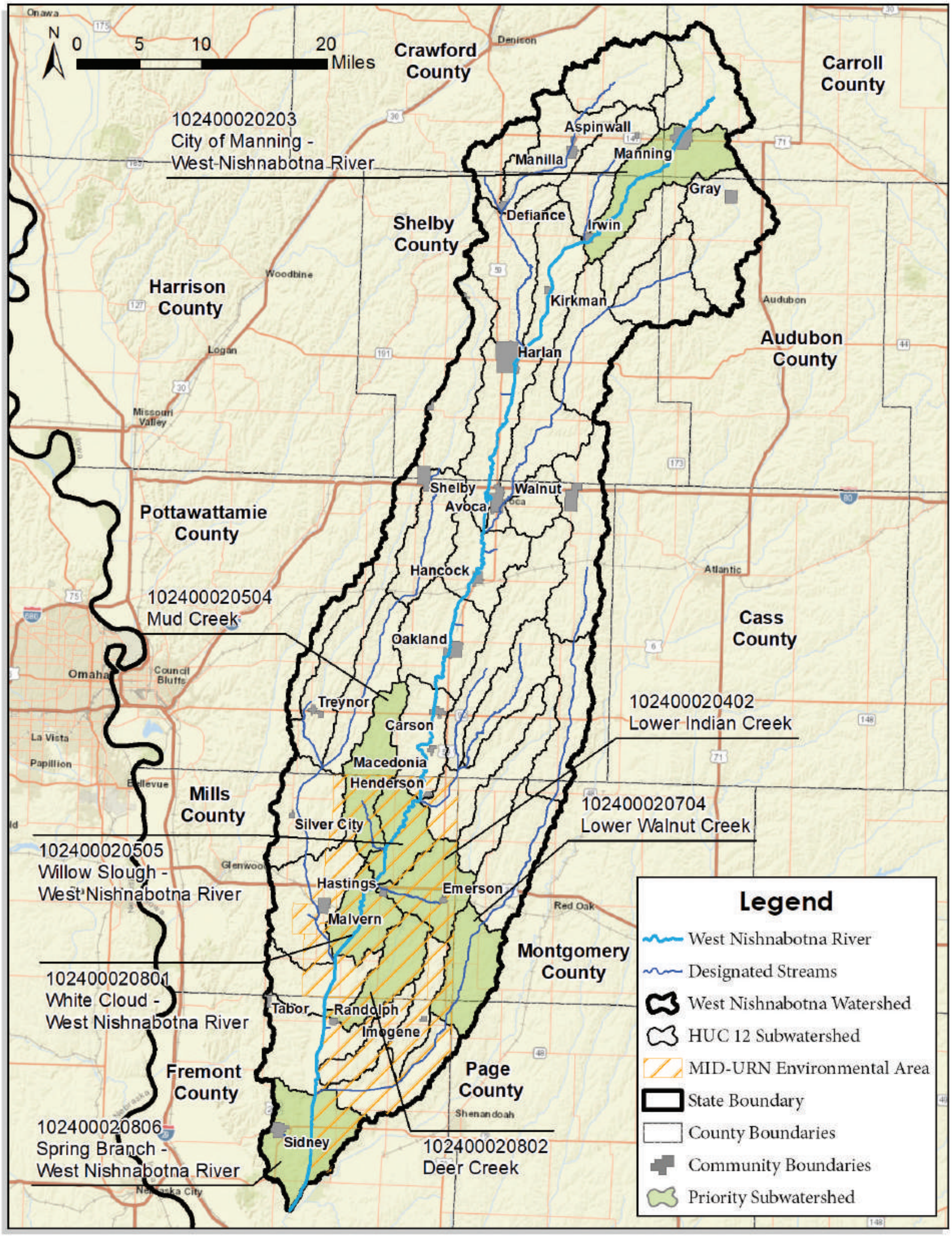

Figure 54: Priority HUC 12 Subwatersheds in the Planning Area

A separate plan for each of these HUC 12s has been prepared and is attached in Appendix F. Each plan provides more specific information on the following for each HUC 12 including:

- Existing conditions
- Pollutants and pollutant loads
- Recommended BMPs
- Pollutant load reductions
- Education and outreach needs
- Schedules and milestones
- Monitoring
- Costs

SPECIAL PRIORITIES

Special priority areas provide flexibility in addressing identified small-scale areas with specific, limited, and timely needs. These include areas which: consist of important resources or pollutant sources that are limited in their geographic footprint; have specific BMP needs; offer unique opportunities to reduce flooding risks or pollutant loads; or are important for public health reasons. These areas were identified through stakeholder input and water quality modeling analysis. It is recommended that projects and BMPs be pursued for these areas even when they lie outside of a priority subwatershed. Projects in these areas are also excellent candidates for partnering opportunities. Additional discussion on each of these is found in the HUC 12 subwatershed plans in Appendix F. The following special priorities have been identified:

Source Water Protection Areas

IDNR sponsors a Source Water Protection (SWP) program to protect the quality of drinking water throughout the State of Iowa. SWP areas are located around wellfields and other drinking water sources. Additional details SWP program and delineated areas are found in **Chapter 2**. This plan recognizes SWP areas as special priorities due to the influence they have on the management needs of source water aquifers and associated public drinking water systems. Completing phase 2 management plans for each SWP area and implementing BMPs which protect water quality, especially from nitrate contamination, are priorities. These BMPs would include, but are not limited to, fertilizer management and cover crops. Communities which do not have plans but are considered highly susceptible to contamination should be prioritized first. This list is found in **Chapter 2**.

On-site Wastewater Treatment Systems

On-site wastewater treatment systems (OWTS) are private systems installed at homes and facilities to treat wastewater when no connection to a municipal wastewater treatment system exists. There is no central database exists to identify the status of OWTS or to ensure that these systems are adequately sized and functioning appropriately. However, many farmsteads and acreages throughout the WNRW likely have these systems. OWTS are considered a special priority because when they fail they become a potential bacteria and nutrient pollution source. OWTS should be targeted for pumping and inspections, with possible replacement of systems that are found to be failing. Homeowners with OWTS that are near streams and lakes should be prioritized.

Low Head Dams

Iowa has many low heads across the state. "Low head" dams span a river and are less than 20 feet high (many are just 2-5 feet high). The dams are often deceptively dangerous as the drop below the dam can be nearly invisible from upstream. These dams are sometimes referred to as "drowning machines," as the powerful recirculating hydraulics below the dam can trap and drown unsuspecting river users. Additionally, dams block the movement of fish and other aquatic life up and down rivers, harm the health and biodiversity of

Iowa's rivers, require costly repairs, and pose major liability concerns. Due to these concerns many low head dams have been prioritized for removal or mitigation projects by IDNR. Depending on the site-specific circumstances, removal is not always an option. Low head dams have been identified as a special priority because they offer unique opportunities for partnerships to address both flood mitigation and water quality improvements. In the WNRW there are 4 known locations of low head dams that should be addressed:

- Railroad, owned by the Mills County Engineer
- 901 Sherman (HHRTS), owned by the Montgomery County Engineer
- 69-6114-2-1(6), owned by the Pottawattamie County Engineer
- 339-22, owned by the Pottawattamie County Engineer

Small Open Feedlots

Almost all livestock operations have the potential to adversely impact water quality; however, those that are exempt by IDNR from regulatory requirements are a special risk. These are known as small open feedlots and are not required to retain any of their waste. They can be a potential source of bacteria, nutrients, and sediment. Additional details on these can be found in **Chapter 3**. Small open feedlots are identified as a special priority in order to provide a proactive approach to livestock waste management while demonstrating appropriate treatment technologies and BMPs. Only operations that are exempted by regulations or are deemed exempt by IDNR are considered. BMPs primarily include the following:

- Animal waste/manure storage systems
- Clean water diversion systems
- Vegetative treatment systems (VTS)
- Terraces
- Containment
- Evaporation ponds
- Open lot runoff management
- Heavy use area protection
- Feed management practices
- Education for manure application and planning

CASE STUDIES

As a part of this planning effort, four case studies were identified for detailed analysis. The intent was to identify possible solutions to specific problems through a more detailed review of community and engineering data. The goal is to provide a high-level overview of potential engineered solutions from which concept level implementation costs can be calculated and potential funding sources identified. The following case studies were identified within the WNRW. The detailed case study reports can be found in Appendix E.

Oxbow Restoration

Oxbows are former meanders which have been cut off from a main stream channel through natural erosion or human intervention. Once cut off the oxbow can form a lake or silt-in naturally to create low-lying wetland areas. Many streams throughout the State of Iowa, including the West Nishnabotna River, were straightened for agricultural purposes in the 20th century. This process led to former oxbows being disconnected from the rivers. However, oxbow lakes or wetlands can be reconnected to streams in order to reduce flooding by storing excess runoff and improve water quality by capturing nutrient laden runoff and tile drain flows.

In this case study the East and West Nishnabotna Rivers were analyzed and screened individually from their northernmost point to their downstream confluence. Potential oxbow restoration sites were identified by analyzing aerial imagery. The potential restoration sites were manually checked for visible oxbows, oxbow lakes, wetlands, or ponds adjacent to the river channels. LiDAR was used to screen potential restoration sites.

An oxbow or oxbow lake which was disconnected from a stream channel during stream straightening can be significantly higher in elevation than the current streambed. To ensure the restoration sites identified represent feasible projects, a maximum elevation difference of six feet between the stream channel and the identified site was imposed. Potential sites with an elevation difference greater than six feet between the adjacent river channel and oxbow are less desirable as the high cost of sediment removal necessary to create a hydrologic connection is prohibitive. This case study identified a total of 28 sites in both the East and West Nishnabotna River Watersheds. Nine of the sites were identified in the WNRW.

PL-566 Program

The NRCS has a long existing program called the Watershed Flood Preventions Operations Program (WFPO), commonly known as the PL-566 program, which has been used extensively in southwest Iowa to construct dams and other structures for flood control and reduction of soil erosion. The structures were targeted for smaller watersheds less than 250,000 acres. All the structures were designed based on calculations of 50-year flood levels. However, there are proposed sites that have not been constructed and, if constructed, could provide additional flood control, trap nutrient laden sediments, and provide habitat and recreation opportunities.

In this case study, NRCS records were reviewed for planned but not constructed PL-566 structures. This review identified 14 watersheds with adopted watershed plans – of those, copies of 11 plans were able to be located for further review. This case study describes the projects identified in these watershed reports, identifies any projects yet to be constructed, and quantifies the potential benefits of both constructed and non-constructed projects within the East and West Nishnabotna River Watersheds. Of the original 237 projects identified, 20 have not been built. These remaining structures are located in the following watershed plans: Turkey Creek, Troublesome Creek, and Davids Creek. Updating these plans, completing final design, and constructing these structures should be considered a priority. Note that even though this study included both the East and West Nishnabotna River watersheds, all unbuilt projects were identified in the East Nishnabotna River Watershed.

Nishnabotna Confluence

Ongoing flooding issues have plagued the Nishnabotna River confluence area, where the East and West Nishnabotna Rivers join, near the City of Riverton. The area of concern extends from the Riverton Wildlife Management Area downstream to the City of Hamburg. Problems include frequent inundation of County Road J-46 (Riverton Road). During times of high flow, floodwaters prevent passage of vehicles to the City of Riverton. Agricultural levees have been constructed that protect farm land, but constrict the floodplain causing problems for conveyance of high river flows.

The purpose of this case study was to identify and analyze potential flood mitigation efforts at Riverton Road and measure the effects of those potential mitigation activities at Hamburg. An unsteady state 2D hydraulic model was created for portions of the East and West Nishnabotna Confluence area. This 2D hydraulic model used in conjunction with flood frequencies ranging up to the 1% annual exceedance probability (100-year) discharge provides a planning level tool that will measure the effects of the engineering alternatives such as off-channel storage, elevating Riverton Road, and removal of agricultural levees. Results indicated that completely eliminating impacts to the road during the 100-year flood event was likely unfeasible due to cost, however, additional study was recommended to identify strategies that could reduce the frequency of flooding during smaller events.

Randolph Flood Resiliency

The Village of Randolph is located in north-central Fremont County, Iowa. Village staff have observed urban drainage issues that have resulted in occasional ponding and some flooding in the southeast portion of the Village. As such, a case study was identified as a way to evaluate methods to improve drainage and reduce flooding. It should be noted that the identified drainage issues are not due to riverine flooding from Deer Creek to the north or from the West Nishnabotna River to the west.

The purpose of the case study was to identify and analyze potential flooding mitigation efforts throughout the city, while also improving water quality and reducing runoff. Four recommendations were identified, some combining multiple projects into one alternative. The study goes on to identify cost ranges as well as potential funding sources.

Case Studies Not Pursued

A preliminary list of possible case studies was identified through public and stakeholder input, however, only a limited number were able to be completed during this planning process. The final selection of which case studies to be completed was decided upon by the WNWMC. The preliminary information gathered on each of these possible case studies has been included in Appendix G to assist future project efforts. The preliminary list of possible case studies relevant to the WNRW are described below in **Table 41**.

Table 41: Case Studies Identified But Not Pursued in the WNRW

Case Study Title	Case Study Description
Avoca Flood Resiliency	Avoca experiences flooding from both the West Nishnabotna River and the East Branch West Nishnabotna River. This case study would assess solutions such as levee construction, flood proofing, and buyout/relocation of flood prone properties.
Greenwood Structures*	Greenwood structures are constructed with a concrete base and wooden sidewalls that form a flume. They are popular for grade control structures. This case study would assess degraded Greenwood structures for renovation and continued usefulness.
Hancock Flood Resiliency	Hancock experiences flooding from the West Nishnabotna River. Flooding primarily occurs on the west side of town, with some additional backwater flooding from an unnamed tributary. This case study would assess solution such as levee construction, flood proofing, and buyout/relocation of flood prone properties.
Harlan Flood Resiliency	Highway 44 has flooded approximately eight times at the bridge crossing the West Nishnabotna River. This cuts off access to Harlan from the east. Westridge Acres mobile home park also flood at the 25-year and higher flood frequency. This case study would asses solutions such as levee construction, flood proofing, and buyout/relocation of flood prone properties.
Levee Set Backs*	Setting back levees provides greater capacity to pass flood flows. This case study would assess existing levees and identify willing landowners to design and construct new levee set backs.
Manning Flood Resiliency	Manning experiences flooding from both the West Nishnabotna River and a tributary. The 1993 flood caused extensive damage. This case study would assess solutions such as levee construction, flood proofing, and buyout/relocation of flood prone properties.
Terraces*	Terraces are highly successful conservation practices installed for both runoff control and water quality improvement. Though this region is already heavily terraced, this case study would assess further limited opportunities for the construction of these BMPs.

*Case study includes both the East and West Nishnabotna River Watersheds

6.5 EXPECTED BENEFITS

Multiple BMPs have been identified within the plan. In order to understand the benefits of implementing a system of BMPs within the WNRW, two primary analyses were conducted: 1) a flood risk reduction analysis was completed by the Iowa Flood Center and documented within the Hydrologic Assessment Report (IFC, 2019); and 2) a water quality model to evaluate *E. coli* bacteria was developed and documented within a report, which is attached in Appendix B. These two documents provide the basis for the following descriptions of BMPs and their benefits within the WNRW. It should be noted that these benefits were evaluated on a watershed or subwatershed basis. Benefits of individual structures or BMPs were not included due to the scale of this plan and the amount of work required to do so. This analysis will take place at the project level.

FLOOD RISK REDUCTION

The Iowa Flood Center developed a hydrologic model to evaluate the three potential BMP implementation scenarios (100% cover crops, storage ponds, blended) at the watershed scale (IFC, 2019). In addition to the design storm event scenarios previously discussed, IFC compared these BMP implementation scenarios to the simulation of several historic storm events. Simulations of these historic events are more relevant to people than a design storm, and many likely remember the consequences of some of these events. The following storm events are documented within the Hydrologic Assessment Report: May 5-7, 2007; June 7-9, 2008; June 29-30, 2014; and June 14, 2018 which was a more recent storm that caused significant flooding in the Ames area. For conciseness, the results of the 2008 event modeling are discussed here as this event was commonly discussed by stakeholders. The results from each storm event can be found in the Hydrologic Assessment Report.

To facilitate the portrayal of flood risk reduction benefits due to BMP implementation, discrete model index points (shown in **Figure 55**) were selected. Index points were selected at headwater locations, along the main stem of the West Nishnabotna River, and the outlets of the Mill Creek and Mud Creek HUC 12 Subwatersheds, which have been selected for implementation.

The largest cumulative rainfall during the June 2008 storm event, totaling more than 4 inches, occurred primarily along the narrow southern portion of the watershed. The follow results were found for each scenario:

- **100% cover crop scenario** - This resulted in an additional 0.25 inches of rainfall infiltration (storage) across the watershed and broadscale reductions in peak discharge. The largest discharge reductions occurred in the northern portion of the watershed. Peak discharge reductions along the main stem of the West Nishnabotna River were approximately 5–20%.
- **Distributed storage pond scenario** - This resulted in peak discharge reductions at model junctions with distributed storage ponds in place. The largest peak discharge reductions of 0–20% occur in the northern portion of the watershed, where pond density is highest, and more storage exists to intercept drainage area and store excess runoff. Like previous simulations, reductions decrease as the drainage area ratio controlled by storage ponds decreases. Flow reductions along the lower reach of the West Nishnabotna River (i.e., Atlantic, Red Oak, and Riverton) were less than 5%. Some junction locations in the area experienced an increase in peak discharges due to timing effects of the ponds.
- **Combined cover crop and storage pond scenario** – This scenario, which is much more realistic for implementation, shows peak discharge reductions at model junctions with 50% use of cover crops and all distributed storage ponds. An additional 0.13 inches of rainfall infiltrated as a result of cover crop use. Broad-scale reductions in peak discharge are the result of cover crop utilization. Peak discharge reductions ranged from 2–20% throughout the entire watershed.

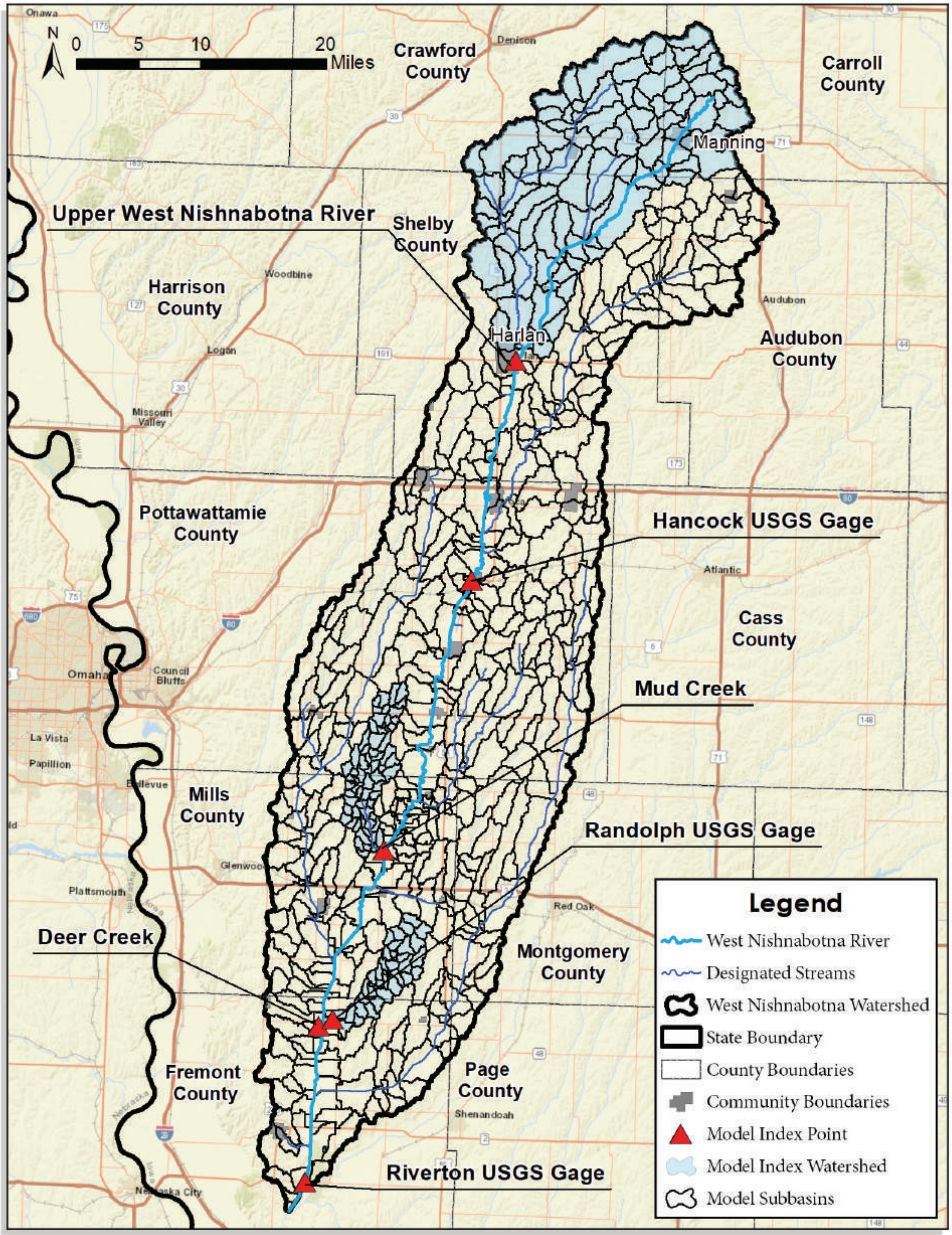

Figure 55: Index Locations from Hydrologic Assessment Report for Flood Risk Reduction Benefits

Figure 56 displays a side-by-side comparison of each implementation scenario at each of the model index points. An approximate reduction in stage, or the height of the water in the river, is shown for each model index point. This is an important attribute to note because a reduction in stage typically corresponds with a reduction in the surface elevation and aerial extent of flood waters. As can be seen the largest reduction in flood risks is due to the effects of infiltration following the implementation of cover crops across the watershed. However, 100% utilization of cover crops is unlikely. Therefore, the blended scenario of 50% cover crops and all storage ponds is likely closer to what BMP implementation effects might look like for the watershed. This scenario resulted in reductions in river stage ranging from 0.13 – 0.78 feet, depending on location within the watershed.

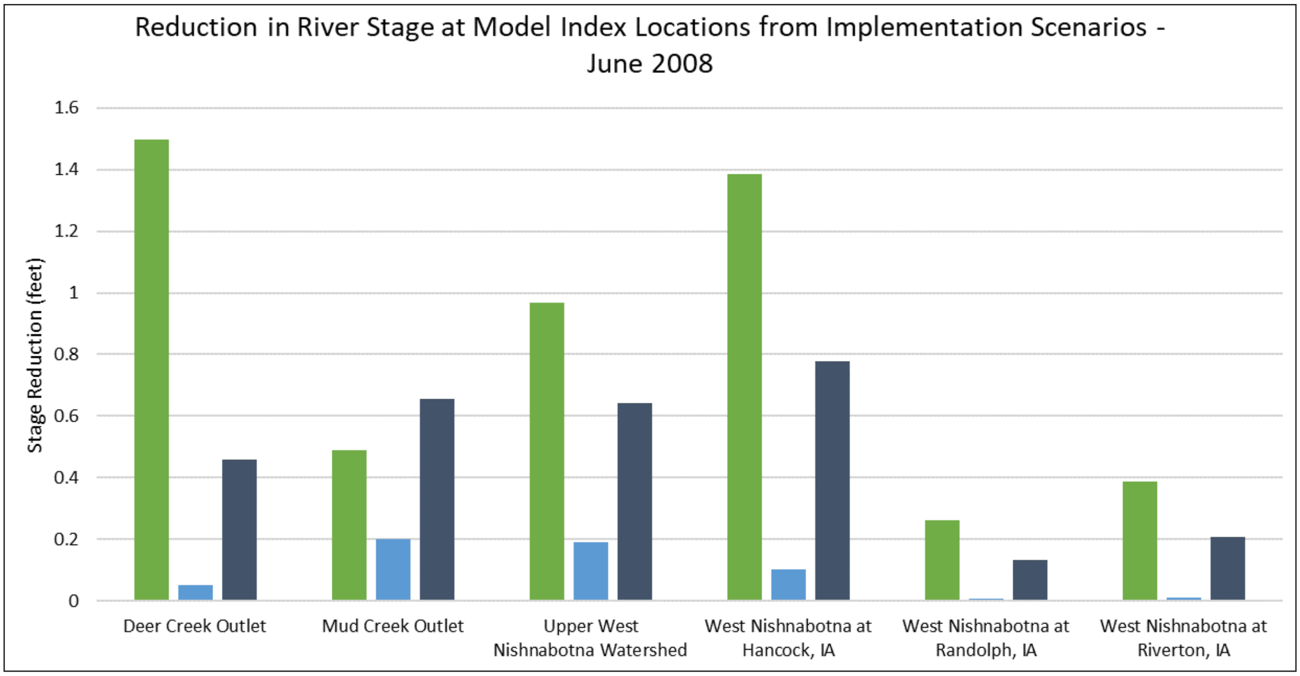

Figure 56: Reduction in stage at model index locations with implementation of BMP scenarios for the June 2008 event

To assist the public in understanding how river flows may change in response to these BMP implementation scenarios, river flows during the June 2008 event were converted into acre-feet (**Figure 57**). An acre-foot is the volume of water necessary to cover one acre of surface area to a depth of one foot, which is equivalent to 325,851 gallons. The 50% cover crop and storage pond scenario resulted in a reduction of 6,923 acre-feet (2,255,558,171 gallons), which is approximately enough water to cover a city the size of Harlan, IA with two and a half feet of water. These reductions are similar in magnitude to those shown in **Figure 56**. Note that the reduction due to implementing only storage ponds is negligible when measured in the West Nishnabotna River near Riverton.

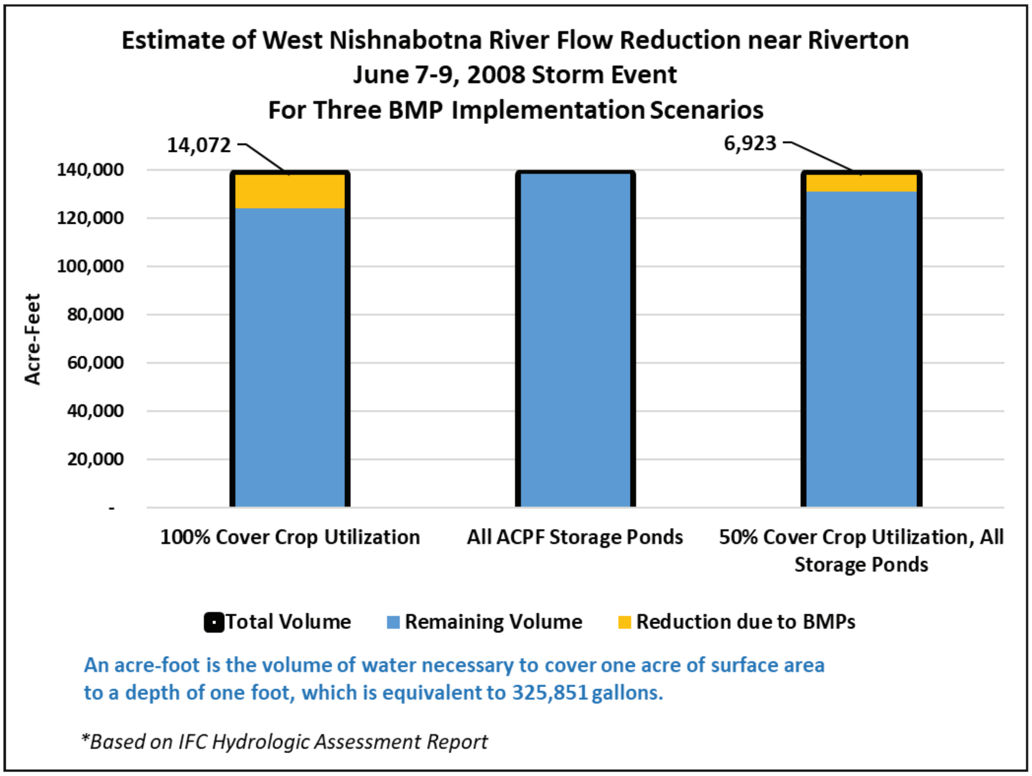

Figure 57: Reduction in River Flow, portrayed in acre-feet, due to BMP implementation

POLLUTANT LOAD REDUCTIONS

A water quality model to evaluate *E. coli* bacteria pollutant loads and reductions due to BMP implementation was developed and documented in a report, which is attached in Appendix B. The primary goal of the model was to reasonably quantify both existing bacteria loads in the watershed and potential load reductions as a result of implementing BMPs within eight priority HUC12 subwatersheds. This modeling analysis was completed at the HUC 12 level and focused on documenting water quality benefits to impaired stream segments. Additional discussion on pollutant loads and reductions, along with other requirements of the EPA's Nine Elements, can be found in the individual HUC 12 subwatershed plans (Appendix F).

E. coli load reductions as a result of implementing BMPs were estimated using one or a combination of the following modeling methods: (1) changing input parameters to reflect the implementation of BMPs, or (2) by reducing the annual pollutant loadings by a single or combined BMP efficiency factor. As more BMPs are implemented within the model the overall calculated efficiency of the BMP system becomes more efficient, providing an estimated cumulative load reduction after each BMP is implemented. The cumulative load reductions as a result of BMP implementation and the estimated physical area or number of structures associated with each BMP can be found in the modeling report in Appendix B. No bacteria fate or transport modeling was performed. Therefore, for the purposes of this plan, the estimated reduction in bacteria load resulting from implementing one or more BMPs is assumed to reduce the instream seasonal geometric mean by the same relative reduction.

Table 42 provides a summary of the estimated bacteria reduction for stream segments in the WNRW with known bacteria impairments. **Figure 58** provides a summary of the estimated reduced *E. coli* loadings for each targeted HUC 12 in the WNRW. Based on the results, bacteria loads within the WNRW can be reduced by using a variety of properly designed, constructed, and maintained BMPs. While this level of BMP implementation does not directly lead to meeting water quality standards for the impaired stream segments (the *E. coli* water quality standard is 126 CFU/100 mL), this effort demonstrates that the goal can be achieved by following the approach of voluntary installation of BMPs within targeted subwatersheds. Given the existing high levels of *E. coli* bacteria in the WNRW, these estimated improvements are very encouraging.

Table 42: Estimated In-stream *E. coli* Reductions

Waterbody Segment ID	Waterbody Segment Name	Estimated Pre-BMP Implementation		Estimated Post-BMP Implementation		
		Existing Average Annual Load (billion CFU)	Existing Average Seasonal Geometric Mean (CFU/100mL)	Average Annual Load (billion CFU)	Percent Reduction	Average Seasonal Geometric Mean
IA 05-NSH-1441	West Nishnabotna River	9,807,000	325	8,707,000	11%	289

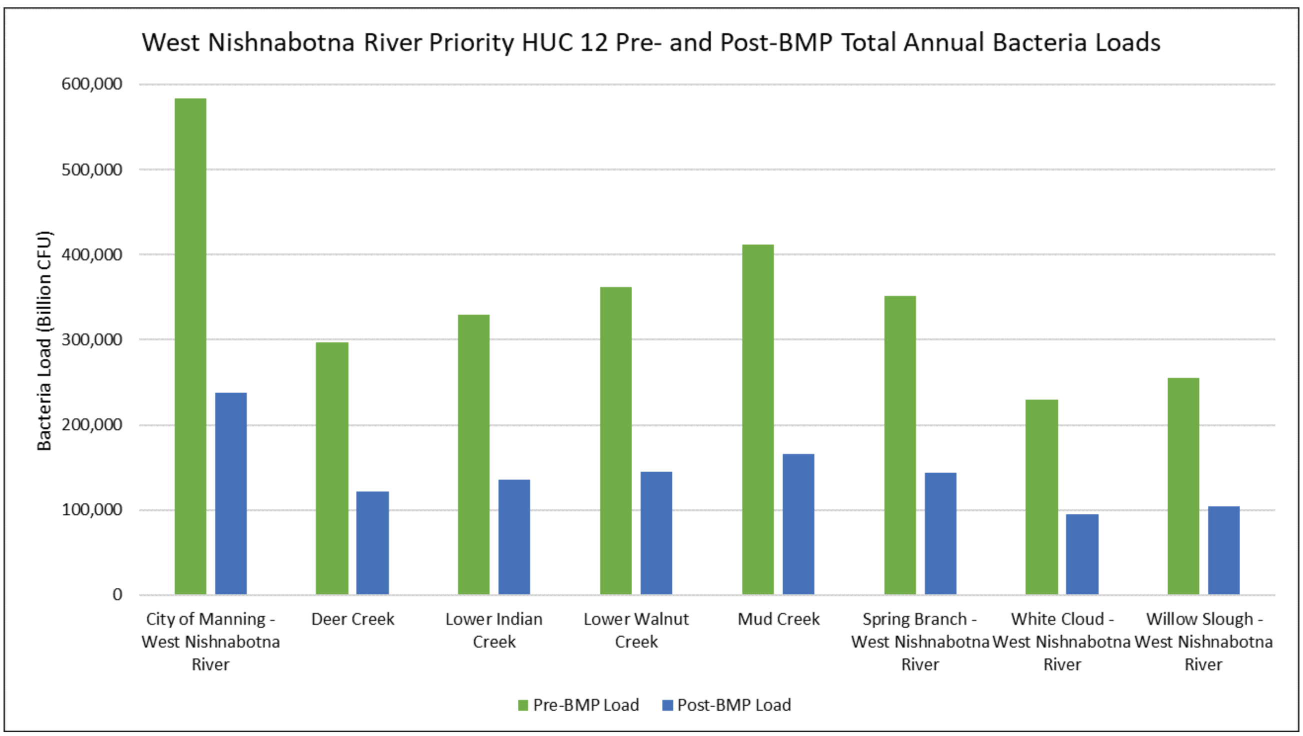

Figure 58: Comparison of existing versus Post-BMP bacteria loads from each HUC 12

6.6 COSTS

The implementation of this plan is expected to be a costly endeavor. **Table 43** provides a high-level cost estimate for the implementation of projects discussed in this chapter. Cost estimates presented here were provided at the most liberal levels (most expensive) to avoid underestimating the necessary funding levels. It should also be noted that some of these costs may overlap or some projects may not be necessary depending upon other projects that are built; therefore, these cost estimates will be updated at a minimum of every five years when the plan is updated. The cost estimates cover the following categories only:

- Community Flood Mitigation – This includes the costs identified to implement flood mitigation projects for each community with a high flood risk, as identified through the flood risk assessment (Appendix B). A summary of projects and their cost ranges can be found in Appendix H. These costs are currently very high-level estimates and may change considerably upon more detailed review.
- Case Studies – These costs were identified in each previously discussed case study. Additional information on these can be found in Appendix G.
- BMP Implementation by HUC 12 Subwatershed – These are the estimated costs of implementing BMPs within each HUC 12 to reduce flooding and improve water quality. More detailed cost estimates for BMP implementation at the HUC 12 subwatershed level can be found in each HUC 12 plan, located in Appendix F.

Cost opinions were calculated based on literature reviews, project team experience, and information provided by stakeholders. Cost opinions include staff time, design costs, materials cost, and implementation costs, as appropriate. Every effort has been made to prepare realistic cost opinions; however, due to the broad scope and long-term implementation time frame of this plan and affiliated actions, actual costs may vary widely. This may be due to, but not limited to, the following factors: inflation, site specific conditions for structural BMPs, varying methodologies for BMP implementation, changes to the plan based on monitoring results, or other unforeseen changes to operational costs. Detailed cost opinions will be prepared for each project. Additionally, these estimates were developed for the priority BMPs, but other practices may also be considered. These estimates also include costs for plan maintenance, updates, or other evaluations necessary to implement projects.

This cost opinion should be used for general planning purposes only, as cost opinions and budgeting techniques can vary widely based on the type of project being planned. In addition, the reader should keep in mind that cost opinions are representative of the total cost of implementation, which may ultimately be shared among various stakeholders and land owners through financial assistance and other funding strategies. Information on possible partners and technical and financial tools to help implement this plan is discussed in **Chapter 8**. Note that no costs are attributed to the Pl-566 Program Case Study, as no missing projects were identified in the WNRW, as discussed above.

Table 43: Estimated Costs for Project Implementation

Category	Cost
Community Flood Mitigation	
Avoca	$1,220,000
Emerson	$2,470,000
Hastings	$1,470,000
Malvern	$2,720,000
Manning	$2,220,000
Randolph	$2,700,000
Subtotal	**$12,800,000**
Case Studies	
Oxbow Restoration	$90,000
PL-566 Program	$0
Nishnabotna River Confluence (additional study recommended only)*	$50,000
Randolph Flood Resiliency	$1,000,000
Subtotal	**$1,140,000**
BMP Implementation by HUC 12 Subwatershed	
City of Manning – West Nishnabotna River	$11,605,490
Deer Creek	$5,732,383
Lower Indian Creek	$7,937,475
Lower Walnut Creek	$7,660,698
Mud Creek	$10,269,525
Spring Branch – West Nishnabotna River	$3,317,449
White Cloud – West Nishnabotna River	$2,473,552
Willow Slough – West Nishnabotna River	$2,361,615
Subtotal	**$51,358,187**
Total	**$64,158,187**

*This case study is located in both East and West Nishnabotna River Watersheds

6.7 SCHEDULE

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The following table (Table 44) provides a watershed-wide summary of major activities and accomplishments expected to be achieved during the first 5-year phase of this plan. This schedule will be updated at a minimum of every five years when the plan is updated. Additional information for each action item can be found in the action plan in Chapter 4. Detailed schedules and milestones for each priority HUC 12 subwatershed can be found in the appropriate plan, attached in Appendix F. It should be noted that not listing a major activity on this schedule does not preclude it from being executed by the WNWMC or one of its partners.

Table 44: Anticipated Schedule of Watershed-wide Activities through 2024

Major Activity	2019	2020	2021	2022	2023	2024
Plan approval / adoption	X					
Develop database for tracking flood resiliency indicators	X					
Review and update flood warning systems	X	X				
Compile BMP cost-share summaries for targeted audiences	X	X				
Provide guidance to landowners on BMP funding assistance programs	X	X				
Apply for HMGP funding to implement the Nishnabotna Confluence Case Study	X	X				
Create an initial database of existing urban and ag BMPs		X				
Identify and install additional monitoring sites for nutrients and bacteria		X				
Secure funding for long term watershed coordinator position		X				
Design and construction of BMPs in IWA priority 2 subwatersheds	X	X	X			
Amend each local hazard mitigation plan with alternatives identified in this plan		X	X			
Create permanent watershed coordinator position		X	X			
Complete a study in high priority areas to identify possible road dams that could be modified or constructed to improve flood control		X	X			
Apply for NRCS funding to complete existing PL-566 projects			X			
Complete a flood loss avoidance study			X	X		
Identify and study flood risk reduction projects on the main stem of the East and West Nishnabotna Rivers				X	X	
Update PL-566 watershed plans				X	X	
Apply for funding to design and construct PL-566 projects					X	
Identify funding and implement BMPs in remaining priority subwatersheds			X	X	X	X
Begin design and construction of remaining PL-566 projects						X
Update watershed plan and goals/objectives						X
Annual or Ongoing Items						
BMP implementation tracking	X	X	X	X	X	X
Hold quarterly Coalition meetings	X	X	X	X	X	X
Attend NRCS Local Working Group meetings	X	X	X	X	X	X
Distribute annual report	X	X	X	X	X	X
Hold annual review meeting	X	X	X	X	X	X

6.8 LONG TERM MAINTENANCE AND COMPLIANCE

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The long-term performance of BMPs hinges on ongoing and proper maintenance. In order for this to occur, detailed maintenance plans are needed that include specific maintenance activities and frequencies for each type of BMP. When BMPs are implemented using financial assistance, there are typically maintenance agreements put in place between the landowner and the paying entity.

Because each maintenance plan or agreement may vary based on BMP type or funding entity, it is not practical to identify all requirements in this plan. However, the following guidance is provided to assist in planning efforts. The following is recommended to be included within BMP maintenance plans or agreements:

- Indicators for assessing when "as needed" maintenance activities are required
- Identify the responsible party for maintenance
- Clearly state the inspection and maintenance requirements
- Comprehensive requirements for documenting and detailing maintenance
- Identify the procedure for maintenance noncompliance
- Recognize that adequate and secure funding is needed for facility inspection and maintenance, and provide for such funding
- Maintenance Schedules - maintenance requirements may vary, but typically BMP owners should perform at least an annual inspection and document any maintenance and repairs performed The agreement should grant permission to a local government (or other project owner) to enter onto property to inspect BMPs
- An important aspect to the recording of the maintenance agreement is that the agreement be recorded into local deed records. This helps ensure that the maintenance agreement is bound to the property in perpetuity.

As BMPs and projects are identified, the specific requirements of each BMP and/or funding source should be carefully reviewed.

6.9 ROLES AND RESPONSIBILITIES

The WNWMC is the sponsor of this plan, which has been developed through a stakeholder-driven process including input from communities, counties, state and local agencies, nonprofit organizations, and producers whom will ultimately lead specific projects identified within the plan. Because the WNWMC does not currently have any statutory powers or permanent funding sources, it will be reliant on others to champion the actions in this plan. Each agency is unique in its capabilities and priorities, and the following list summarizes the responsibilities, roles, and expectations each primary planning partner may play in implementation.

- **West Nishnabotna Watershed Management Coalition** (WNWMC) – The WNWMC will act as the lead facilitator and coordinator for projects throughout the WNRW. It will help to connect funding opportunities with local project sponsors and serve as a regional source of information exchange. The WNWMC will provide a watershed coordinator position to assist with execution of the plan.
- **Counties** – County governments can serve as local sponsors (through the Board of Supervisors, county emergency managers, county engineers, conservation boards, etc.) for leading the implementation of projects that mitigate flooding and improve water quality throughout each county. They can promote or encourage policies to protect floodplains and reduce runoff. They can leverage their local funds against other grant programs.
- **Cities** - City governments can serve as local sponsors for implementing projects that mitigate flooding and improve water quality within or near urban areas. They can promote or encourage policies to protect floodplains and reduce runoff. They can leverage their local funds against other grant programs.

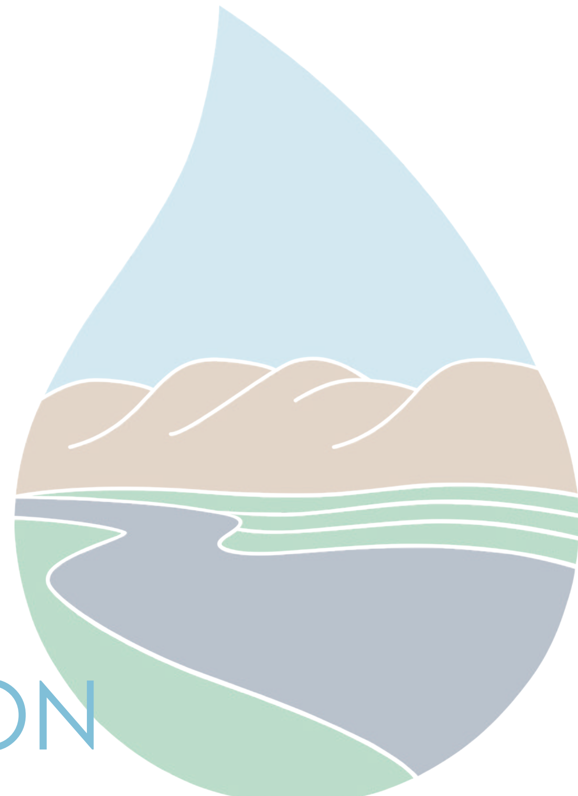
- **Soil and Water Conservation Districts** (SWCD) – Each county's SWCD can provide funding and technical expertise for the implementation of BMPs.
- **Iowa DNR** (IDNR) – Through multiple programs, including the Section 319 program, IDNR can provide technical expertise and funding through education and grant programs to assist with implementation of BMPs. Additionally, IDNR will continue to provide data through the water quality sampling program. IDNR can also provide floodplain management technical expertise.
- **IDALS** – Through the Iowa Water Quality Initiative (WQI), IDALS is working to improve water quality across Iowa. IDALS can provide funding and technical expertise through the WQI or other programs for staffing, monitoring, and implementation of BMPs.
- **NRCS** – The NRCS can be a leader in implementing agricultural BMPs through technical support and targeted EQIP funding. Additionally, the WNWMC may also work with the NRCS to access other funding programs such as the Regional Conservation Partnership Program (RCPP) or the Watershed and Flood Prevention Operations (WFPO or PL-566) program.
- **Iowa Flood Center** (IFC) – IFC will: continue to provide technical assistance and support to the WMA in helping them reach the goals identified in this plan.

6.10 SUMMARY

Reducing flood risk, improving flood resiliency, and improving water quality throughout the WNRW is possible with a long-term commitment by communities, counties, producers, and other entities within the watershed. Long term funding, planning, and dedication to the implementation of this plan will be required. As projects move forward, the following should be kept in mind:

- Selection of various BMPs should consider not only the watershed or field level characteristics, but also management goals and any technical and financial resources available.
- Reducing runoff from agricultural lands should be a priority and would likely have the greatest benefit-to-cost ratio.
- Urban development has the highest (acre for acre) runoff potential, but a relatively small footprint compared to other land uses. Local drainage issues could be improved by more effectively capturing and storing storm water (e.g., storm water detention and low-impact development practices).
- High runoff potential is not the only factor in selecting locations for potential projects. Landowner participation and local stakeholder involvement is essential to identifying projects.
- Ponds were sited using ACPF for maximum nutrient reduction criteria, rather than flood control. If flood control was the siting criteria, additional suitable locations could be identified, particularly in the southern portion of the watershed. This could be the focus of future studies, particularly for the PL-566 program.
- Hydrologic modeling results from the design storm and historical events indicated the use of cover crops would provide much broader benefits than ponds alone, while also further enhancing the ability of ponds to store excess runoff without decreasing agricultural production and providing enhanced rain water infiltration.
- As more water quality data is collected in the watersheds, it is recommended that the water quality modeling be updated with *E. coli* concentrations for each land use
- It should be noted that the estimated flood risk and pollutant load reductions by different BMPs are based on readily available literature. Actual improvements will vary based on the location and unique characteristics of the areas in which they are implemented.
- It is recommended that implementation of BMPs and land management practices be performed using an adaptive management approach, which is informed through monitoring results. Actions centered around the adaptive management process and monitoring can be found in **Chapter 7**.

Finally, because this is a voluntary plan, social and political realities which may affect landowner participation and plan implementation need to be considered. Projects can be implemented much more effectively and successfully when public education is provided and buy-in is garnered through active involvement. Actions centered around outreach and education can help to identify and break down these barriers – as discussed in **Chapter 5**.



CHAPTER 7

PLAN EVALUATION

7 PLAN EVALUATION

7.1 PLAN EVALUATION

ADAPTIVE MANAGEMENT PROCESS

The evaluation process of this plan will follow an adaptive management approach. Adaptive management is a systematic process of "learning by doing," as illustrated in Figure 59. This process is utilized in situations where there is uncertainty in precisely how selected actions will affect the outcome, but management decisions must be made. This process involves executing and evaluating various alternatives, allowing managers to make more well-informed and better decisions in the future. Overall, adaptive management is the process of using the best available science to implement management actions today, learn from those results, and revise actions as required.

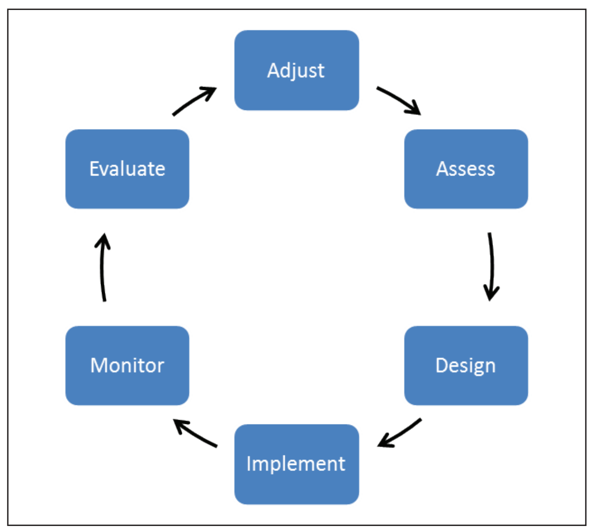


Figure 59: Basic Procedural Steps of Adaptive Management

The West Nishnabotna Watershed Management Coalition (WNWMC) will utilize an adaptive management scheme to evaluate and adjust plan implementation efforts over time. Monitoring assessments will take place continuously, with evaluation and adjustment actions taking place both as necessary and formally at yearly and 5-year increments. All available data may be utilized, but recommended evaluation procedures and metrics are discussed in this chapter.

EVALUATION CATEGORIES

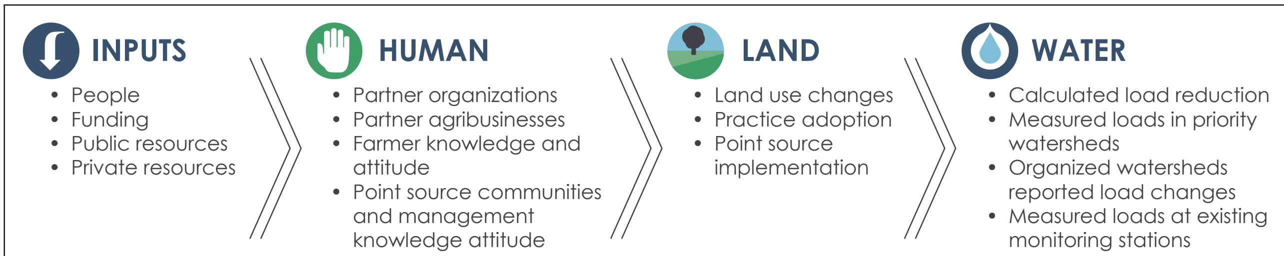
The WNWMC will utilize the Iowa Nutrient Reduction Strategy's (NRS) logic model to measure and evaluate implementation efforts. Ultimately, the goal is to produce changes in flood resiliency and water quality, represented by the 'Water' category in **Figure 60**. However, changes in this category can be slow to develop and are reliant on many factors. There are significant challenges in measuring water quality and flood resiliency changes across a large watershed in the short-term. Changes in monitoring data can take decades to become apparent and be properly evaluated due to weather, climate, development, lag times, and legacy effects.

The NRS's logic model was introduced by the Water Resources Coordinating Council made up of members from Iowa State University (ISU), the Iowa Department of Agriculture and Land Stewardship (IDALS), the Iowa Department of Natural Resources (IDNR), the University of Iowa, the United States Department of Agriculture, and the United States Geological Survey, to assist in identifying short-term, quantifiable indicators of desirable change (IDALS, 2017a). Quantification allows for tracking and evaluation over time. While the NRS Logic Model is focused on water quality changes, flood resiliency concepts can also be incorporated.

In order to affect and measure change in water quality and flood resiliency, there are four categories to the NRS Logic Model (**Figure 60**). These are:

- Inputs - measured as funding, staff, and resources; affect changes in Human category.
- Human - measured as outreach efforts and shifts in attitudes and behaviors; affects changes in Land category.
- Land - measured as land use changes and adoption of best management practices (BMPs) or other mitigation projects; measuring these indicators over time leads to measurable, long-term indicators in the Water category.
- Water - indicators include changes in water quality or flood risk reduction - ultimately measured through both monitoring and modeling.

The measurable indicators that correspond to each category, as outlined in Figure 2, provide specific parameters in which to track annual changes and persistent trends. These factors are used to develop a standardized protocol for evaluating progress. Additionally, mirroring the Iowa NRS Logic Model for reporting will allow reporting standards that can be utilized and replicated across Iowa.



Adopted from the Iowa Nutrient Reduction Strategy's logic model for measurable indicators of desirable change

Figure 60: Logic Model Used to Identify Measurable Indicators of Desirable Change

EVALUATION METRICS

Evaluating success or failure is a critically important step in implementing any watershed plan. This section clarifies the metrics or products that the WNWMC will produce and/or utilize to evaluate the success of this plan's implementation. The metrics discussed below are organized by the four categories of the NRS Logic Model.

Inputs

Inputs are the foundational indicator of change in efforts to improve water quality and flood resiliency within the West Nishnabotna River Watershed (WNRW). Inputs encourage and help realize changes in human behavior and help promote conservation practices and mitigation project adoption. To identify the inputs dedicated to the WNRW, the following metrics should be monitored and recorded:

- Funding
- Grants (both applied for and received)
- Staffing
- Partnerships
- Others as they are identified

Human

In order to implement conservation practices and flood resiliency projects, people's attitudes must first shift in order to change perspectives and behaviors related to these efforts. A variety of metrics can be analyzed in order to measure the progress of this change. It is very important to coordinate with all partner organizations to ensure all metrics are accounted for and are not being needlessly duplicated. The following metrics should be monitored and recorded

- **Events:** The number and type of events conducted each year should be recorded. These could include, but are not limited to: quarterly meetings, partner meetings, stakeholder meetings, resiliency tournaments, emergency exercises, site visits, demonstrations, field days, etc.
- **Attendance at Events:** At a minimum, attendance at all events should be quantified. Additional information could also be gathered, such as: where attendees are from, motivating factors to attend, how they heard about the event, etc. This information can also be used to help better design future events. To gauge the impact of events, a short survey should be administered with the goal to determine if the attendee's understanding or attitudes were changed as a result of the event.
- **Self-reported awareness and attitudes:** These can be tracked over time to identify geographical areas or subject matter areas that should be targeted for additional educational or research opportunities. Additionally, this metric can be an early indicator of changes in the watershed that may lead to additional adoption of BMPs or implementation of projects. It is recommended that a baseline survey be conducted by the WNWMC. This should be updated every five years.
- **Regional and Statewide Media Awareness:** Media awareness and promotion of the WNWMC and affiliated projects should be tracked. All articles and stories related to the watershed should be collected and cataloged.

Land

Tracking the extent of Best Management Practices (BMPs) and implemented projects begins to illustrate the on-the-ground success or failure of the WNWMC. Thus, this metric often receives much interest. Additionally, changes in water quality and flood resiliency takes time to be accurately measured and evaluated. Tracking the existing treatment levels, as well as the rates of new BMP adoption, will provide the following benefits:

- Understand barriers to adoption
- Identify the need for additional BMPs
- Help develop a better watershed model
- Help the WNWMC quantitatively measure the success of this plan over time

Both urban and agricultural BMPs and projects should be included here. Quantifying and tracking the following metrics should be conducted:

- **Existing BMP Levels:** As discussed in Chapter 3, no centralized list or full inventory exists for this information. It is recommended that the WNWMC use the ISU BMP Mapping Project to create an initial database of existing BMPs. The database should be supplemented with information gathered from producer surveys. Developing this local database will ensure both structural and non-structural BMP levels are captured, which can then be updated as landowners and operators implement the new practices recommended in this plan.
- **New BMP Adoption:** Locations, types, and costs of implemented BMPs should be tracked. For reporting purposes, practice adoption rates should be aggregated to the watershed scale in order to protect personal identifiable information.
- **BMP Retention:** Long term success relies on the retention of BMPs. Randomized yearly follow-ups with operators who implement practices will help gauge retention levels.
- **Projects Completed:** Many projects or studies, especially for flood resiliency, are "one off," or do not fall into the category of BMP implementation. These projects and their impacts should also be tracked.
- **Resiliency Indicators:** Existing indicators of flood resiliency can be tracked. As these indicators change over time, they help to showcase progress and identify areas in need of additional resources. These include, but are not limited to: public assistance claims; flood insurance enrollment and claims; properties in the regulatory floodplain; and properties removed from the floodplain. This data will not only be useful throughout the life of this plan but will also be necessary when a loss avoidance study is completed.
- **Land Use Change:** Change in land use, particularly conversion of annual crops to perennial land uses (Conservation Reserve Program, buffers, open space, etc.) is important to track. Perennial land uses typically have lower pollutant loads and can serve as buffers to flooding.

Water

This plan lays out various goals related to water quality and flood resiliency, as well as a strategy for achieving these goals through voluntary efforts. As shown in the NRS Logic Model, these goals will be met through effective changes in human behaviors, land uses, and adoption of projects. Identifying and measuring these changes will require the following metrics:

- **Edge-of-Field Monitoring:** Tile water or edge of field monitoring results should be used to gauge water quality improvements at the field scale. Individual results should be provided only to individuals that are cooperating in the monitoring program. All monitoring data should be aggregated to the watershed scale and then shared with other operators, landowners, and partners. This aggregated data may also be used in publications to broaden recognition to these water quality efforts.
- **Stream Scale Monitoring:** In-stream water monitoring sites should be used to determine if long-term water quality improvements are being realized. Annual improvements will likely be undetectable, but long-term progress may be evident if significant BMP adoption takes place in the WNRW.
- **Modeled Improvements:** The WNWMC should utilize pollutant reduction calculators to estimate soil and water improvements resulting from practice implementation. Additional discussion is provided later in this chapter.
- **Loss Avoidance Study:** A loss avoidance study identifies and quantifies the losses or damages avoided due to the implementation of a flood mitigation measure. The ability to assess the economic performance of mitigation projects is important to evaluate and justify public investments, encourage additional funding, and continue local support of mitigation projects and activities. A loss avoidance study should be completed approximately every five years.

7.2 EVALUATION TIMEFRAMES

The evaluation metrics laid out in this chapter are meant to help guide the WNWMC towards meeting its stated goals and objectives (**Chapter 4**). However, they are also useful to inform the public and partners on the work that is being done and the resources that are needed. The recommended frequency of reporting on these metrics is discussed below and summarized in **Table 45**.

On-Going / Quarterly Project Updates

On-going tracking is recommended for current projects, BMP implementation, public outreach, and partner updates. Quarterly board meetings provide a logical time to provide updates on these topics to board members and the public. By tracking some of these items regularly, yearly updates will be more manageable to accomplish.

Yearly Partner Review Meeting

Watershed project partners should host an annual review meeting to provide an opportunity to update the public on activities and evaluate progress. This may take the place of one quarterly meeting board meeting; however, extra effort should be made to invite the press and stakeholders to this meeting. Annual evaluation worksheets (see Appendix D) should be completed by all staff and board members of the WNWMC prior to this meeting, and the results summarized and presented. An annual report documenting metrics should be prepared by WNWMC and widely distributed. These annual reports can be evaluated to show changes over time and to help identify gaps where additional inputs are needed.

5-year Annual Review

Every five years this plan will be completely reviewed, evaluated, and updated. Preceding annual reports will provide a good basis to begin this review; however, at this time an updated analysis should be done on key subjects such as water quality data, watershed modeling, public surveys, land use changes, loss avoidance studies, goal setting, and identifying priorities. Milestones, goals, and objectives should all be reviewed at this time.

The WNWMC will need to coordinate with many partners and other public agencies on an on-going basis, especially to identify the extent and level of implemented BMPs and public outreach efforts in the watershed. As progress is tracked, the WNWMC will be able to evaluate these records against milestones identified in this plan. Stakeholders and the public will have an opportunity to review yearly reports and will have explicit opportunities to provide input during the 5-year plan update.

Table 45: Summary of the Timeframe Each Evaluation Metric Should be Completed

On-Going / Quarterly	Annually	Every 5 Years
BMP tracking database	Summary of quarterly updates	Summary of annual reports
List of completed projects	Water quality monitoring report	Land use changes
Summary from pollutant reduction calculator tools	Funding report	Inventory of Open Feedlots
Summary of public outreach	Results of public input and comments	Watershed models updated with new inputs
Grants, staffing, and partner updates	Complete annual evaluation worksheet	Formal survey of landowners and producers on knowledge, attitudes, and behaviors
	Hold annual stakeholder meeting to review annual progress	Perform/update loss avoidance study
		Review goals and objectives
		Review milestones
		Complete plan update

Note: This summary is not meant to exclude any possible metrics which are useful towards plan evaluation or beneficial to plan updates

7.3 POLLUTANT REDUCTION CALCULATOR TOOLS

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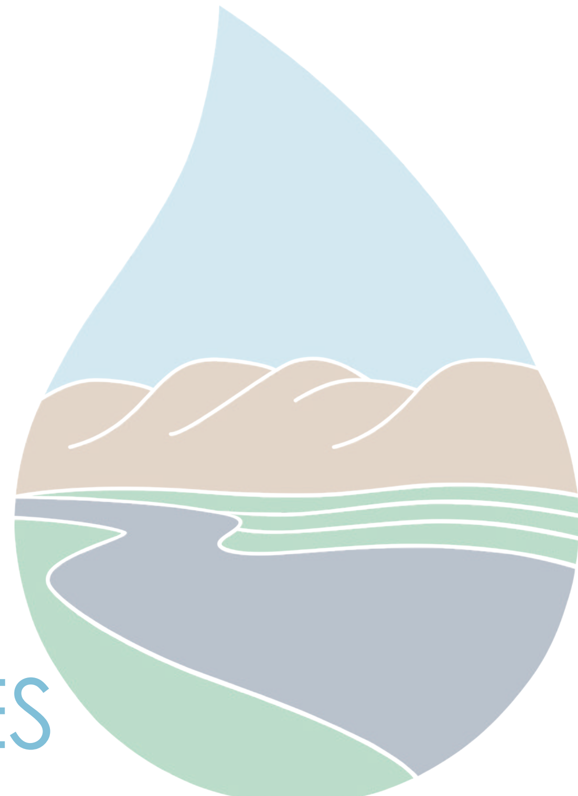
To assist with reporting progress on pollutant load reductions, two tools are recommended and described below. These tools allow simple estimates to be performed without the need to run complex water quality models. This allows the WNWMC to estimate loading reductions achieved through project implementation, which can then be used to evaluate project milestones. Additionally, these tools may be useful when considering the potential benefits of future water quality projects.

The first tool is the IDNR Pollutant Reduction Calculator (PRC). The PRC is a web-based tool developed to determine sediment, phosphorus, and nitrogen delivery reductions from BMP implementation in watersheds smaller than 250 acres (IDNR, 2004). The PRC may also be a useful tool for the WNWMC when planning BMP implementation on a landowner or parcel basis. The PRC can be accessed here: **https://programs.iowadnr.gov/tmdl/PollutantCalculator**.

In addition to the PRC, a supplementary BMP calculator tool was built by Wright Water Engineers to provide estimated *E. coli* bacteria load reductions achieved by BMP implementation. This tool is a Microsoft Excel based tool developed using average results from the water quality model. The tool is provided via an Excel file with the digital files accompanying this plan.

To ensure the water quality model and the *E. coli* tool accurately represent the conditions of the watershed, it is recommended that they be updated as future water quality data becomes available or conditions change.



CHAPTER 8
OUTSIDE RESOURCES

8 OUTSIDE RESOURCES

8.1 POWER OF PARTNERSHIPS

9d

The power to implement this plan lies with each city, county, and Soil and Water Conservation District (SWCD) that is a member of the West Nishnabotna Watershed Management Coalition (WNWMC). A key function of the WNWMC is to champion the plan, coordinate member actions within the watershed, and help to leverage resources and partnerships. These resources include both financial and technical assistance. Individual members of the WNWMC are taxing authorities and may be able to contribute a local match (cash or in-kind funds); however, the WNWMC does not have this authority or any funds of its own. Therefore, it is important to identify a variety of outside funds to leverage against the limited available local sources. The intent of this chapter is to identify resources that may be available to support implementation.

All available monetary and technical resources will need to be explored and leveraged to achieve the plan goals. This includes partnering with Federal, state, local governments; academia; nonprofits; businesses; and other local entities (**Figure 61**). The discussion in this chapter focuses on those programs or agencies that can provide significant or critical funding for projects, BMPs, or other actions items. It should be noted that during the implementation process, other resources or partners may be identified and should be considered at that time

LEVERAGING THE POWER OF PARTNERSHIPS

Local project sponsors use the action plan to direct resources toward meeting goals and objectives. When a local champion can assemble partnerships to contribute towards a project, even more can be achieved.

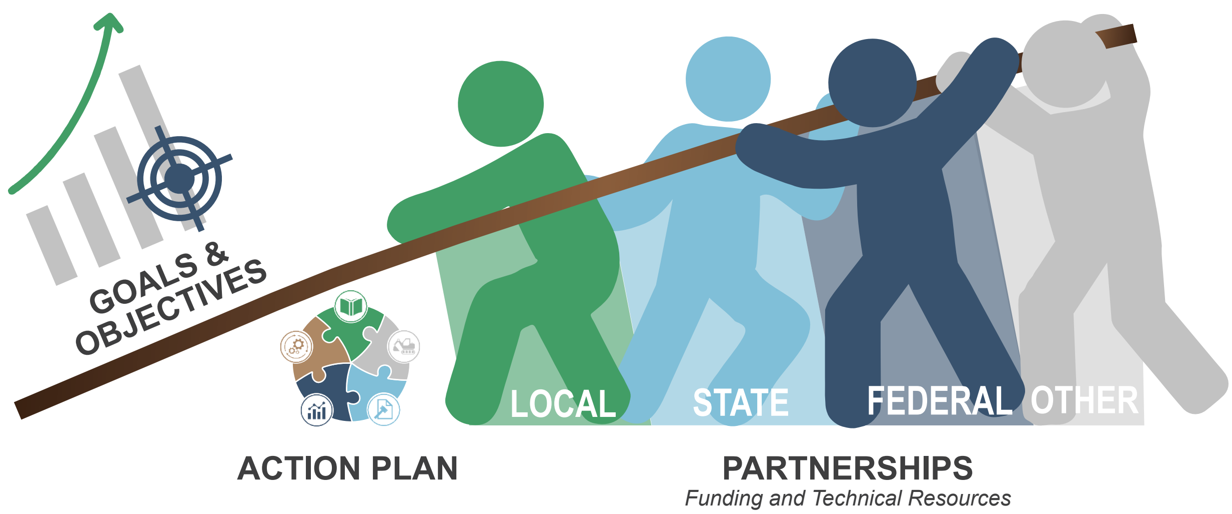


Figure 61: Partners from all levels will be necessary for successful plan implementation

8.2 FLOOD RESILIENCY FUNDING

Improving flood risk reduction, mitigation, or resiliency involves implementing projects, practices, and programmatic changes throughout a community and watershed. There are multiple options to help pay for many of these initiatives; however, the WNWMC should start by looking at the most readily available programs (**Table 46**). Each funding program has their own requirements they must meet prior to accessing the funding, and many programs typically only fund certain activities. However, piecing these programs together is necessary to address the many aspects of flood resiliency. By working with multiple programs, the WNWMC will better leverage local match sources. It should be noted that while the activities identified in Table 1 primarily address flood risk reduction, mitigation, or resiliency, many of them have secondary benefits for water quality.

8.3 WATER QUALITY FUNDING

While there are many options for funding the implementation of water quality BMPs, the WNWMC should start by looking at the most readily available programs (**Table 47**). Each funding program has their own requirements to meet prior to accessing the funding, and many programs typically only fund certain types of practices. However, piecing these programs together for landowners is critical. By providing landowners with multiple funding options and helping them navigate the administrative hurdles, more BMPs will be implemented and a better leveraging of local match sources will be achieved. It should be noted that while the programs and BMPS identified in Table 2 primarily benefit water quality, many of them have secondary benefits for flood risk reduction, mitigation, or resiliency.

Table 46: Matrix of Primary Funding Sources for Flood Resiliency Projects and Programs

	Pre-Disaster Mitigation (PDM)	Flood Mitigation Assistance (FMA)	Hazard Mitigation Grant Program (HMGP)	Public Assistance Section 406	Community Development Block Grants	Water Waste Disposal Loan & Grant Program	Flood Plain Management Program	Watershed and Flood Prevention Operations (WFPO)	Emergency Watershed Protection Program *(Recovery and Floodplain Easements)*	Agricultural Conservation Easement Program	Iowa Watershed Approach
Action Type (examples) / Funding Agency	FEMA / HSEM				HUD	USDA	DNR	NRCS			Partners
Acquisition / Demolition / Relocation	X	X	X						X	X	
Structure Elevation	X	X	X								
Floodproofing Structures	X	X	X								
Local Flood Risk Reduction Projects *bridge/culvert replacement, storm system upgrades, detention cells*	X	X	X	X	X	X		X	X	X	X
Green Infrastructure (Urban Drainage) *green space, rain gardens, infiltration basins, bioswales*			X		X	X			X		
Non-localized Flood Risk Reduction Projects *bridges, dams, levees, detention cells, channel widening, diversion channels*	X		X	X	X	X		X	X		X
Structural Retrofits *dam and detention cell rehabilitation*	X	X	X	X	X	X		X			
Administrative Actions *building code and floodplain management ordinance updates and enforcements*	X		X				X				
Social Vulnerability *flood awareness and education programs, community rating system (CRS), warning systems*		X			X						
Floodplain Mapping *Improved mapping products, Risk MAP*		X	X					X			
Mitigation Planning *Parcel-leve planning, flood mitigation plan, drainage studies, watershed plan, GIS inventory*					X						X

Table 47: Matrix of Primary Funding Sources for Water Quality BMPs

Practice Type (examples) / Funding Agency	DNR		IDALS				FSA	NRCS			Partners		
	Watershed Program (319 Program)	State Revolving Fund (SRF) Sponsored Projects	Iowa Water Quality Initiative (WQI)	Financial Incentives Program	Urban Conservation Program	Conservation Reserve Enhancement Program (CREP)	Conservation Reserve Program (CRP)	Environmental Quality Incentives Program (EQIP)	Agriculture Conservation Easement Program (ACEP)	Conservation Stewardship Program (CSP)	Regional Conservation Partnership Program (RCPP)	Nonprofit Conservation Organizations (PF, DU, NWTF, TNC)	Iowa Watershed Approach
Nutrient Management *Sidedress N, agronomic rate application, 4Rs, etc.*	X		X					X		X	X		
Tillage *No-till, strip till*	X		X	X				X		X	X		
Cover Crops *Rye, oat, clover, radish, etc.*	X		X	X				X		X	X		
Edge-of-Field Erosion Control *Grassed waterways, terraces, WASCOBS, ponds, etc.*	X	X		X				X		X	X		X
Edge-of-Field Practices *Wetlands, saturated buffers, bioreactors, etc.*	X	X	X			*wetlands only*		X		X	X	X	X
Land Use Changes / Alternative Crops *Pasture conversion, buffers, prairie STRIPS, land retirement, rotation, wetlands, etc.*	X	X		X	X		X	X	X	X	X	X	X
Livestock/Small Open Feedlots *Waste systems, clean water diversion, vegetative treatment, open lot runoff management, manure management plans, heavy use area protection, etc.*	X	X						X		X	X		
Grazing Lands Management *Exclusion fencing, alternative water sources, grazing management plans, stream crossings, etc.*	X							X	X	X	X	X	
Riparian Area Management *Buffers, stream stabilization, grade control, floodplain restoration, oxbow restoration, etc.*	X	X			X		X	X			X		X
Urban Stormwater BMPs *Bioretention, bioswales, rain gardens, permeable pavers, soil restoration, septic systems, etc.*	X	X			X								X

8.4 KEY STATE AND FEDERAL RESOURCES

There are several key agencies and programs that will be important to explore, utilize, or partner with for funding and/or technical assistance. Each one of these agencies or programs will bring a unique set of opportunities and individual priorities that must be aligned with those of the WNWMC and/or members. The WNWMC should lead an initial and ongoing dialog with entities and their key programs. The intent is to identify possible partnership opportunities and to be best positioned for when funding becomes available. Below are highlights of primary programs that may be of interest or of use to the WNWMC at this time; however, the Funding Roadmap in Appendix E includes a much longer list of additional programs and agencies that should be reviewed. It should be noted that participation with any of these entities will depend on the alignment of mutually beneficial goals between the WNWMC and applicable agency or outside program.

FEMA

FEDERAL EMERGENCY MANAGEMENT AGENCY (FEMA)

FEMA funding is administered via Iowa Homeland Security & Emergency Management (HSEM). HSEM is a participant in the IWA and is well positioned to begin assisting with plan implementation right away. Local communities should work with FEMA and the Iowa Department of Natural Resources (IDNR) on floodplain management issues. Many flood mitigation-type projects are specifically eligible and of high priority for FEMA under existing funding programs. County emergency managers and their communities should work with HSEM on obtaining project funding through the hazard mitigation assistance (HMA) program under one of the following programs:

- Pre-Disaster Mitigation (PDM)
- Flood Mitigation Assistance (FMA)
- Hazard Mitigation Grant Program (HMGP)

US Army Corps of Engineers®
Omaha District

US ARMY CORPS OF ENGINEERS (USACE)– OMAHA DISTRICT

USACE has multiple programs that can be tapped to obtain assistance for both planning and implementation type projects. USACE has a history of working within the watershed and should be contacted by the WNWMC about the following programs:

- Section 14 – Emergency Streambank and Shoreline Protection
- Section 22 – Planning Assistance to States
- Section 206 – Aquatic Ecosystem Restoration

USDA United States Department of Agriculture

UNITED STATES DEPARTMENT OF AGRICULTURE (USDA)

The USDA has two primary programs that the WNWMC should consider:

- The Water and Waste Disposal Loan & Grant program. This program provides low interest loans or grants to finance drinking water, storm water drainage, and waste disposal systems for rural communities with 10,000 or fewer residents. In 2018, the USDA awarded $256 million to 81 projects in 35 states through this program.
- The Conservation Reserve Program (CRP) is a long-standing conservation program that be used to fund the establishment of permanent vegetation such as crop conversions and buffers.

NATURAL RESOURCES CONSERVATION SERVICE (NRCS)

NRCS has long standing relationships with almost every producer in the WNWMC's planning area. Through both the state and local offices NRCS provides conservation assistance (financial and technical) through various programs, such as the Environmental Quality Incentives Program (EQIP) and the Conservation Stewardship Program (CSP). The WNWMC should promote and utilize these programs in partnership with local NRCS offices to achieve common goals. Additionally, the Regional Conservation Partnership Program (RCPP) and the Watershed and Flood Prevention Operations (WFPO) programs can be utilized to bring in large sums of financial assistance to get conservation on the ground and to provide large benefits towards flood resiliency. Because of the number of NRCS programs they can seem complicated, and thus the WNWMC should work to form a partnership with each local NRCS office to learn the programs. Additionally, implementation of the RCPP or WFPO programs can take time, therefore the WNWMC should begin the process of applying for them as soon as possible.

IOWA DEPARTMENT OF NATURAL RESOURCES (IDNR)

The IDNR has multiple primary programs that the WNWMC should consider:

- The Resource Enhancement and Protection (REAP) Program can provide funding for conservation education as well as on-the-ground BMPs. Counties, cities, and nonprofits can apply for this grant.
- The Private Lands Program provides technical assistance and can help secure funding to private landowners interested in installing BMPs. The WNWMC can work with the local IDNR biologists to identify landowners and to assist in conservation efforts.
- IDNR administers the Flood Plain Management and Dam Safety Programs which can be consulted to assist in various flood mitigation projects and local floodplain ordinance development.
- The Lake and River Restoration Program, as well as the Watershed (Section 319) Program all have funding and technical assistance available to help implement projects and BMPs within priority watersheds or waterbodies.
- The State Revolving Fund (SRF) Sponsored Projects program can fund a wide variety of water quality projects through low-interest loans. For communities already utilizing SRF funding for water infrastructure projects (drinking or waste water), a portion of the interest paid can be redirected towards water quality improvement projects. This lets the overall interest rate to be reduced and allows the community to finance two projects for the cost of one.

IOWA DEPARTMENT OF AGRICULTURE AND LAND STEWARDSHIP (IDALS)

IDALS has numerous programs available that would greatly enhance the WNWMC's efforts towards plan implementation. Many of these are funneled through a local SWCD, which can take the lead in contacting regional coordinators or urban conservationists to assist in accessing these programs. Given the IDALS well established state funding and existing contacts with producers, the WNWMC should establish a strong working relationship with IDALS to achieve common goals utilizing one or more the following programs:

- Conservation Reserve Enhancement Program (CREP)
- Urban Conservation Program
- Water Quality Initiative (WQI)

8.5 LOCAL RESOURCES

PUBLIC FUNDS

While outside funding from grants, loans, or other sources will be needed to fully implement this plan, there is also a need for local match (cash or in-kind). This may be required for matching funds to grants, to leverage against other funds, to pay staff that can coordinate and apply for other funding sources, or to simply pay for projects directly. Each community is unique in its financial resources available and taxing structure, therefore the following options are meant to be flexible and to inspire communities to develop something that fits them best. These options should be used to help generate ideas that work for each community or entity. The WNWMC should consider discussing these options or hosting a guest speaker on each. The following entities may be able to provide additional information:

- Iowa Stormwater Education Partnership
- County Auditor
- Iowa League of Cities
- Iowa State Association of Counties
- Watershed Management Authorities of Iowa
- City or County Attorney
- Other communities that have successfully utilized these options

In-Kind Services

Many grant programs allow all or a portion of the "local match" to be made up of in-kind services instead of a cash match. In-kind contributions typically include the work of local government staff or materials towards a specific project. This might be coordination, landowner outreach, public education, or completing technical work they are qualified to do. Communities need a consistent and defendable way to document, track, and report in-kind services in order for them to count towards match on grant funded projects.

General Fund Dollars

A portion of a community or county's general funds could be budgeted towards the implementation of this plan. This could be for specific projects, programs, or administrative costs of the WNWMC. The WNWMC should consider establishing a general fund to which each member contributes. This fund would support a staff position of a watershed coordinator. By having a paid watershed coordinator, the WNWMC would be able to pursue other grant funds, essentially leveraging local funding to bring outside funding into the community for project implementation.

Capital Improvement Fund

A city may establish a reserve fund for capital improvement projects. This fund is built using tax revenue on a yearly basis, which is levied for the fund to accumulating money for the financing of specified capital improvements or to carry out a specific capital improvement plan. While it does take several years to build up a fund capable of making major improvements, this fund allows a city to save for specific projects without the need for issuing debt (bonds). When the city bonds for a project or to make a larger purchase, the city pays interest on those bonds.

Permits, Fees, and Developer Contributions

Communities can establish new fees, earmark a portion of existing permit and fee structures, and/or establish requirements for developer contributions for new development in flood prone areas or areas that may contribute to water quality problems. The proceeds can be accumulated into a separate fund that is tied to specific projects types. One kind of these fees is known as a stormwater utility fee, which is discussed below.

General Obligation Bonds

General obligation bonds are backed by property taxes and are issued by a city or county for a wide array of community betterment projects. These are typically best suited for infrastructure projects.

Local Option Sales Tax (LOST)

LOST is a special-purpose tax implemented and levied at the city or county level. A local option sales tax is often used as a means of raising funds for specific local area projects. Jurisdictions that don't have already exercise a LOST, or those that already do, could consider targeting LOST funds towards projects identified in this plan.

Special Assessment Districts

Certain improvements can be financed by special assessments. This method of financing is a tax upon a property owner for a portion of the costs incurred by the city for a particular improvement. This could be considered for a variety of projects, especially urban stormwater improvements or flood mitigation projects.

Tax Increment Financing (TIF)

Tax Increment Financing (TIF) is a tool that encourages private development in areas experiencing blight and disinvestments, typically areas in or near downtown. A TIF program provides a method for financing public costs (roads, sewer, infrastructure, etc.) associated with a private development project by using the projected increase in property tax revenue, which would be a result of the new development bringing increased value to the property. This could be considered for a variety of projects, especially urban stormwater improvements or flood mitigation projects.

Stormwater Utility Fee

A stormwater utility is a stand-alone city utility that is used to pay for capital improvements, operations, maintenance, and meeting federal/state permit obligations. Rates are typically based on the quantity of hard surface (or impervious area) on a property. This funding option can be used to help pay for urban stormwater improvements or flood mitigation projects.

Lease Purchase Program

A lease-purchase agreement allows a city to purchase and use an item while making payments on the item. These items include pieces of equipment, such as fire trucks, or real estate, such as land or buildings. These agreements are similar to private "rent-to-own" agreements. It is very important that cities consult with their bond attorney to ensure the agreement is worded in such a manner to benefit the city.

Utility Franchise Fee

In 2009, Iowa authorized cities to charge up to 5 percent in franchise fees on gas and electric bills. All revenues collected must be deposited in a separate account from the city's general fund. These funds can only be used for authorized purposes, which includes the repair, remediation, restoration, cleanup, replacement, and improvement of existing public improvements and other publicly owned property, buildings, and facilities, projects designed to prevent or mitigate future disasters, and the establishment, construction, reconstruction, repair, equipping, remodeling, and extension of public works, public utilities, and public transportation systems. These purposes could all includes projects or portions of a project that could be intended to improve water quality or flood resiliency.

PRIVATE FUNDS

While outside financial assistance is important to help implement BMPs, existing programs rarely cover 100% of all project or BMP costs. It is also important that willing landowners, citizens, farm operators, etc. have a "stake in the game." Many BMPs and practices require long term maintenance or behavior changes. Ensuring individuals are invested in the success of a particular BMP will help ensure they continue the maintenance or behavioral change into the future. These costs will vary by practice type and by the extent of funding received from other sources. Financial assistance through incentives are necessary for many conservation measures, particularly for smaller producers that may not be able to afford to install more costly measures.

PUBLIC-PRIVATE PARTNERSHIPS OR FOUNDATIONS

Successfully implementing this plan will require creative approaches to project funding. A broader range of funding resources will create opportunities for additional implementation options. Alternative funding sources can sometimes be found at the regional or local level through partnerships with private sector businesses, private foundations, and other non-governmental organizations. Creativity is often needed in fitting various funding sources together to ensure project objectives are met, while also meeting the purposes of each funding source.

This may lead to finding project benefits through secondary effects, or piggy backing projects together. For example, a "trail project" may provide an opportunity to improve an area's hydrology, install educational activities, or implement streambank stabilization structures. Another example can be found through the wildlife habitat programs that IDNR or various conservation nonprofits have. Many of these program activities, such has wetland restoration or other habitat improvements, provide secondary benefits to water quality or flood resiliency.

The following options for partnerships (**Table 48**) have been identified due to the possibilities for working together on financial and/or technical resources, and because they have been shown to be successful in other communities. Forming successful partnerships is not as clear-cut as applying for grants. For example, The Hungry Canyons Alliance (HCA) provide cost share directly to both public and private projects, but not in the form of a grant that could be administered through the WNWMC. However, the HCA does provide technical assistance for any type of river restoration project.

Successfully partnerships involve engaging a broad spectrum of stakeholders, each with diverse programs and interests, and employing combinations of resources (both directly and indirectly) towards solving what are formidable issues. The reality is that significant increases in government funding to address flooding or water quality issues are not apparent on the immediate horizon and the WNWMC will need to be creative, cooperative, and proactive to realize implementation on a meaningful level. Table 3 should not be considered all-inclusive, as other options may be identified during the implementation process and should be considered at that time. Additional details on each organization can be found in the funding roadmap, located in Appendix E.

Table 48: Options for Local Partnerships

Nonprofits	
Iowa Land Improvement Contractors Association (LICA)	
Golden Hills RC&D	
Hungry Canyons Alliance	
Iowa Stormwater Education Partnership	
Citizens groups (Rotary, etc.)	
Iowa State University	Leopold Center for Sustainable Agriculture
	Iowa Learning Farms
	Prairie STRIPS
	Extension
Conservation Organizations	Groundwater Foundation
	Pheasants Forever (PF) – both state level and local chapters
	Ducks Unlimited (DU)
	National Wild Turkey Federation (NWTF)
	Iowa Natural Heritage Foundation
Agriculture Associations	Iowa Soybean Association
	Iowa Corn Growers Association
	Iowa Cattlemen's Association
	Iowa Pork Producers Associations
	Soil Health Partnership
	Women, Land, and Legacy Program
Corporate Foundations, Grants, or Giving (types of entities to consider)	
Co-Ops and other agricultural businesses (implement, sales, and equipment dealers)	
Feedlots or other larger farming operations	
Wineries or other similar types of agritourism businesses	
Local businesses	
Corporate businesses (Wal-Mart, John Deere, etc.)	
Fund Raising Campaigns	
Crowdfunding (GoFundMe, Kickstarter, etc.)	
Traditional fund raisers (raffles, sales, etc.)	

8.6 ALTERNATIVE FUNDING OPTIONS

PAY FOR SUCCESS

A Pay-for-Success (PFS) program is a financing structure which leverages private investment to achieve outcomes with a public benefit (**Figure 62**). PFS projects are designed to attract private capital to conservation, broadening the funding base available for programs and infrastructure improvements. This structure benefits communities by getting projects and BMPs on the ground which have direct benefits to their community, while significantly reducing financial risk.

Essentially, the investors and service providers take on the risk of a project (flood project, BMPs, etc.), anticipating that successful outcomes will bring returns that make shouldering the costs worthwhile. These returns can be financial, but they also include social or environmental outcomes (flood risk reduction, water quality, etc.). The local government pays for outcomes, not practices or interventions, lowering risk and ensuring that public funds go towards effective and proven solutions. Conservation Innovation Grants (CIG), a program from the NRCS, may be a great starting point for the WNWMC to begin a pilot PFS program.

WETLAND BANKING INSTRUMENT

A mitigation bank is a wetland, stream, or other aquatic resource area that has been restored, established, enhanced, or preserved for the purpose of providing compensation for unavoidable impacts to aquatic resources as permitted under Section 404 (of the U.S. Clean Water Act) or a similar state or local wetland regulation. A mitigation bank may be created when a government agency, corporation, nonprofit organization, or other entity undertakes these activities under a formal agreement with a regulatory agency.

In a mitigation bank, a government agency or a firm acquires a large tract of land and restores or creates wetlands. Based on the extent and type of wetlands restored, “credits” are earned which can then be sold to those who need them to satisfy their mitigation requirements. If the WNWMC or one of its members were to establish a mitigation bank, not only would the available credits assist in permitting some flood resiliency or water quality projects, but the income generated could be used to help pay for those projects.

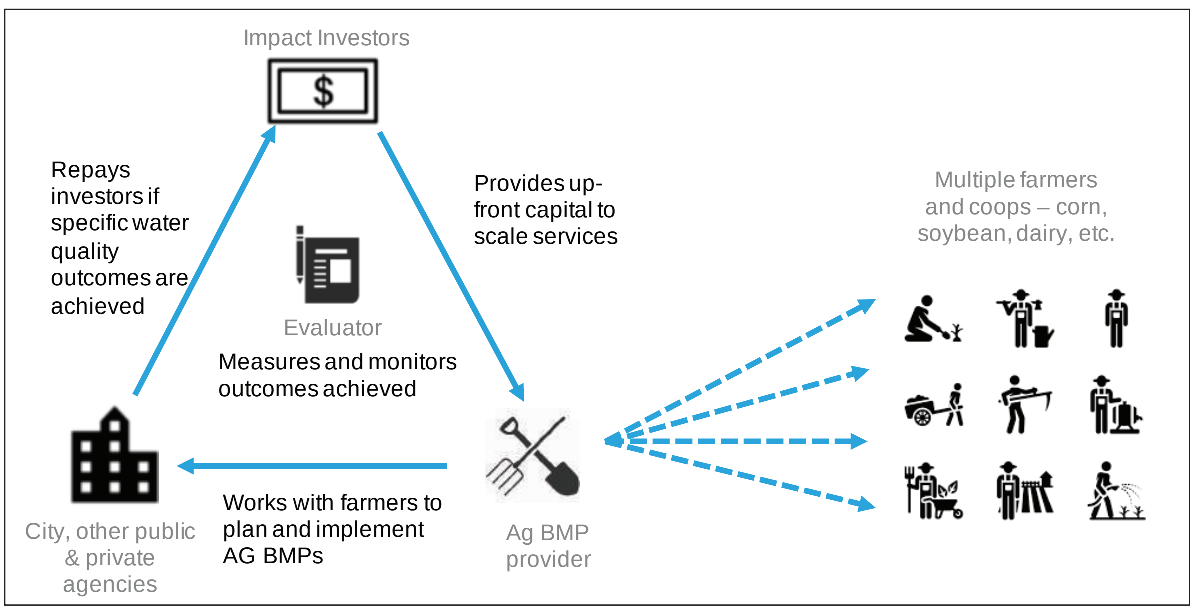


Figure 62: Pay for Success Financing Model

Source: Quantified Ventures

IN-LIEU FEE MITIGATION PROGRAM

An In-Lieu Fee (ILF) is one method of compensatory mitigation for damages to the environment. It is used to compensate for impacts or unavoidable losses to wetlands and streams due to development, road-construction, or other projects. With ILFs, mitigation occurs when a permittee provides funds to an in-lieu-fee sponsor (e.g. a public agency or non-profit organization). In most cases, the sponsor collects funds from multiple permittees to pool the financial resources necessary to plan for, build, and maintain a mitigation site. Like mitigation banking, in-lieu fee mitigation is often "off-site." Unlike mitigation banking, it typically occurs after the permitted impacts.

The Iowa DNR has investigated the feasibility of an in-lieu fee compensatory mitigation program (ILF program) to serve the needs of stream mitigation work for USACE permittees in Iowa. This process was initiated in response to conversations with various constituent groups and complements Iowa DNR's work on other river restoration initiatives, including the Rivers Restoration Best Management Practices Toolbox and Iowa Stream Mitigation Method. Work to date has culminated in the document titled "In-Lieu Fee Market Assessment and Alternatives Analysis," (Bentley and others, 2017). Analysis has shown that an Iowa DNR-sponsored ILF program could be financially sustainable. The WNWMC should continue to monitor the development of the ILF program as it could be a valuable source of project funding in the future.

WATER QUALITY TRADING

Water quality trading programs are used in various places throughout the United States to make water quality permit compliance easier, raise funds for projects, and ultimately improve the water quality of streams and lakes. This type of program focusses on incentives instead of penalties to achieve goals. A trading program can be operated on various scales, but the larger the better.

Currently the Iowa Nutrient Reduction Exchange (NRE) is in early stages of framework development and pilot projects. However, once operational this may be a source of funds for potential projects. The WNWMC should work with state and regional agencies, such as IDNR, other WMAs, the Iowa League of Cities, and others to develop the NRE, which focused on nutrients and flood mitigation.

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