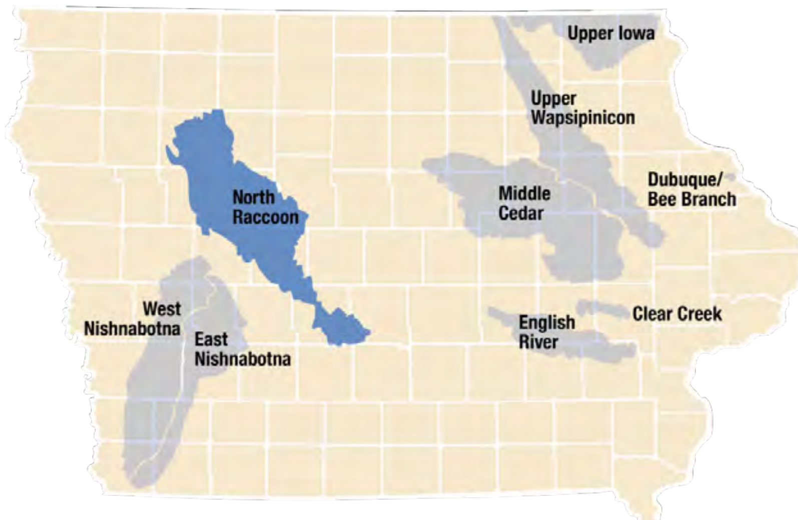
NORTH RACCOON RIVER WATERSHED PLAN

OCTOBER 2020

PREAMBLE

FIGURE 0-1 IOWA WATERSHED APPROACH WATERSHEDS (IWA 2019)



BACKGROUND

The North Raccoon River Watershed, stretches from northwest Iowa to the state's capital city, Des Moines. This watershed is one of nine distinct watersheds involved in the Iowa Watershed Approach for Urban and Rural Resilience program (Figure 0-1).
From 2011–13, Iowa suffered eight Presidential Disaster Declarations due to flooding. The damages from these disasters affected 73 counties which cover more than 70% of the state's land area (Iowa Flood Center and IIHR 2019). In January 2016, the State of Iowa was awarded $97 million from the U.S. Department of Housing and Urban Development (HUD) for the Iowa Watershed Approach (IWA). The goals of the IWA program include the following:

1. Reduction of flood risk
2. Improvement in water quality
3. Increased resilience
4. Engagement of stakeholders through collaboration, outreach and education
5. Improved quality of life and health for Iowans, especially for susceptible populations
6. Development of a replicable program

The IWA program takes a holistic approach to address flooding at the watershed scale, recognizing that upstream and downstream communities need to voluntarily work together to increase community flood resilience. According to the IWA, "community flood resilience is the ability of people living in a common watershed to plan and act collectively, using local capacities to mitigate, prepare for, respond to and recover from a flood" (2020). Each of the nine watersheds has been tasked to form a Watershed Management Authority (WMA), develop a hydrologic assessment and watershed plan (this document), implement projects in the watershed to reduce the magnitude of downstream flooding and improve water quality during and after flood events.

In 2017, the North Raccoon River Watershed Management Coalition (NRRWMC) formed under a Chapter 28E cooperative agreement. This agreement was signed by 11 counties, 12 Soil and Water Conservation Districts (SWCDs) and 18 cities as of 2019, demonstrating their commitment to work together to build a healthier and more resilient watershed. This agreement enables these entities to work together in watershed planning and management within a Hydrologic Unit Code (HUC)-8 watershed boundary, illustrated in Figure 0-2. The area included within this boundary includes those areas which drain to the North Raccoon River, as well as areas that drain to the Raccoon River downstream of the confluence with the South Raccoon River near Van Meter (see Chapter 1 for more information).

The intended role of a WMA is to be an "authority" or expert on the issues and needs in the watershed specific to flood risk and water quality. However, these authorities actually have no ability to issue taxes or regulations. To avoid confusion, the North Raccoon organization elected to refer to themselves as a Watershed Management "Coalition" during its initial planning stages. As a coalition, the NRRWMC's intended primary purpose is to provide guidance, education and assistance to all watershed residents, organizations and businesses, and to build the capacity of these watershed stakeholders to tackle the challenges facing the future of this watershed.

This coalition will need to grow and strengthen itself as a respected organization to work with landowners, producers, residents and other stakeholders across the watershed. To reach the goals and objectives of this watershed plan, the NRRWMC will need to rely on coordination between members and partner organizations. The collective knowledge within the members and partner organizations is one of the NRRWMC's greatest strengths.

FIGURE 0-2 THE NORTH RACCOON RIVER HUC-8 WATERSHED

The North Raccoon River HUC-8 Watershed is represented by the blue area, including the area downstream of the confluence with the South Raccoon River (green watershed) near Van Meter.

PLAN PROCESS

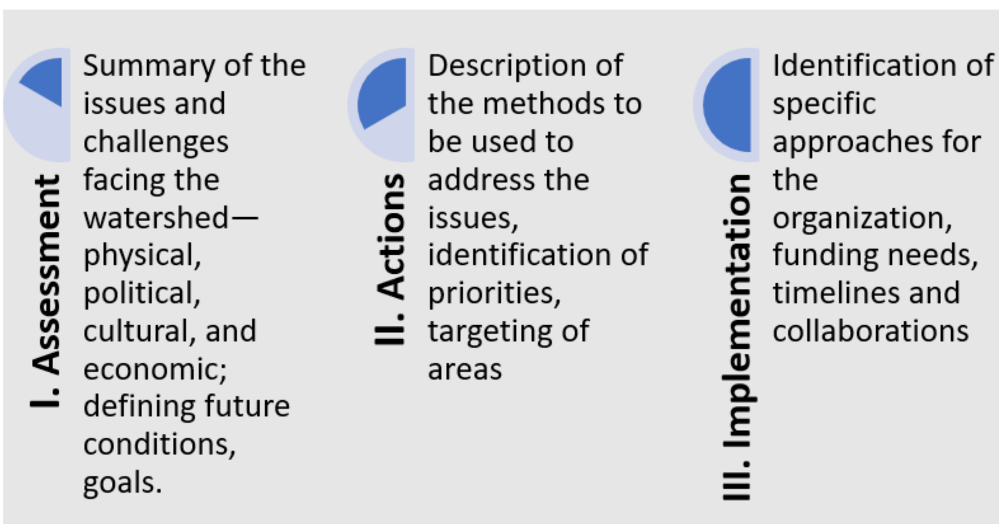
This plan outlines the goals and implementation strategies selected by the NRRWMC based on the priorities and preferences of members, partners and stakeholders within the North Raccoon River Watershed. This plan is intended to act as a guidebook for the next 20 years of implementation.

The plan follows three steps: the watershed assessment, the identification of actions and the creation of implementation strategies (Figure 0-3).

Throughout the planning process, a series of stakeholder meetings and workshops were facilitated by the planning team. These resulted in the identification of issues, goals and strategies that participants wanted the plan to include. Small-group meetings were conducted in various locations throughout the watershed. Finally, prioritization and goal setting workshops took place with the NRRWMC board to discuss how the findings from the Watershed Assessment (Emmons and Olivier Resources, Inc. 2020) and how the plan should address the identified issues. During this process, surveys were used to gain input on strategies for flooding, water quality, funding and organization. Survey results were then reviewed and discussed by stakeholders at various workshops.

Stakeholder input sessions used to develop this plan included:

FIGURE 0-3 ILLUSTRATION OF THE PLANNING PROCESS



- **Strengths, Weaknesses, Opportunities and Threats (SWOT) Analysis**
- **World Café Water Conversation**
- **Resource Assessment Review and Prioritization**
- **Success Measurement Dashboard Exercise**
- **Flood Strategies Workshop**
- **Water Quality Workshop**
- **Funding and Policy Workshop**
- **Implementation Workshop: Flooding and Water Quality**
- **Implementation Workshop: Watershed Management Strategies**
- **Implementation/Prioritization Final Workshop**

Summaries of the discussion from each of the stakeholder workshops and survey results can be found in Appendix A of this plan.

In addition to stakeholder engagement, the planning team reviewed documents, datasets and studies produced from previous planning efforts in the watershed to:

1. Catalog the state of the resources within the watershed
2. Identify issues and priorities that were already established in previous efforts

The documents, datasets and studies reviewed include (but are not limited to):

- **The Raccoon River Total Maximum Daily Load (TMDL) report**
- **The Raccoon River Water Quality Master Plan**
- **Local subwatershed plans**
- **Local stormwater management plans**
- **The Iowa Nutrient Reduction Strategy (NRS)**
- **The Daily Erosion Project**
- **Other statewide reports and datasets**

IWA PARTNER CONTRIBUTIONS

In coordination with this plan, Iowa Watershed Approach partners developed assessments of the watershed to provide technical background information to be used in development of the watershed plan.

- **The Iowa Flood Center and the University of Iowa (IIHR) produced a Hydrologic Assessment for the North Raccoon River Watershed with support from several state and local agencies including the Iowa Department of Natural Resources (DNR), the Natural Resources Conservation Service (NRCS), members of the NRRWMC, Buena Vista County and others (Iowa Flood Center and IIHR 2019).**
  - The Hydrologic Assessment report describes the current watershed hydrology in the watershed and evaluates the impacts of changes in land use and climate change on watershed hydrology.
  - The Hydrologic Assessment also includes a review of two user-friendly, interactive, web-based information systems that provide real-time environmental monitoring data including flooding information and water-quality data. These systems include:
    - *Iowa Flood Information System (IFIS)*
    - *Iowa Water-Quality Information System (IWQIS).*
- **The Iowa Flood Center, in partnership with the Iowa Homeland Security and Emergency Management Department (HSMED), provided a Flood Mitigation Planning Report for the North Raccoon River Watershed. The report outlines the flood mitigation elements from the Federal Emergency Management Agency (FEMA) Local Mitigation Plan Regulation Checklist that are important for flood mitigation planning. Each of these elements is described in detail as they relate to the watershed. (Appendix F).**
- **Iowa State University (ISU) Extension and Outreach developed an Education Plan intended to guide the NRRWMC**

and watershed coordinator in engaging stakeholders and promoting flood reduction and water quality improvement projects in the watershed. The recommendations outlined in the education plan include key messages, strategies and information to be used by municipal governments, county agencies and organized citizens to continue the important work of educating the public about vital waterbodies and how to protect and enhance them for future generations. This document is included as Appendix C to this plan.

WHERE TO FIND EPA'S MINIMUM ELEMENTS FOR WATERSHED PLANS

The Environmental Protection Agency (EPA) has identified nine key elements that must be addressed in watershed plans funded with Clean Water Act section 319 funds. EPA strongly recommends that they be included in all other watershed plans intended to address water quality impairments. This requirement has been adopted for plans developed in the Iowa Watershed Approach project.

Adapted from "Handbook for Developing Watershed Plans to Restore and Protect Our Waters," USEPA Office of Water – Nonpoint Source Control Branch, March 2008.

Within this watershed plan, these elements can be found in the following locations:

Element #1–Identification of causes of impairment and pollutant sources or groups of similar sources that need to be controlled to achieve needed load reductions and any goals identified

in the watershed plan. Sources that need to be controlled should be identified at the significant subcategory level along with estimates of the extent to which they are present in the watershed.

Summarized in watershed plan in:

- **Chapter 2 – Purpose of the Plan**
- **Chapter 3 – Watershed Summary**
- **Chapter 4 – Past Studies**
- **Chapter 6 – Effort Prioritization**

More detailed information can also be found in:

- **Watershed Assessment document – Chapter 1**
  - Factors related to hydrology
  - Potential pollution sources such as terrain, soils and land uses
  - Details regarding stream and lake characteristics
- **Watershed Assessment document – Chapter 2**
  - Current and historic climate data
  - Analysis of historic streamflow patterns and flood risk
- **Watershed Assessment document – Chapter 3**
  - A review of known impairments of designated uses
  - Identification of key pollutants of concern and their impacts
  - Review of existing monitoring data
  - Pollutant loads and sources by subwatershed and land use
  - A review of TMDL studies that influence this plan

Element #2–An estimate of the load reductions expected from management measures.

Summarized in the watershed plan in Appendix D: Conservation Action Plan

- **For each of the Priority HUC-12 subwatersheds the projected load reduction achieved by meeting the nutrient reduction goals of the plan is identified.**

More information is provided in Appendix B (Technical Approach)

- **The rates of implementation for conservation practices and the reductions to be achieved by all subwatersheds meeting the nutrient reduction goal can be found in Appendix B.**

Element #3–A description of the non-point source management measures that will need to be implemented to achieve load reductions and a description of the critical areas in which those measures will be needed to implement this plan.

Summarized in the watershed plan in:

- **Chapter 5 – Implementation Approaches**
- **Chapter 6 – Effort Prioritization**
- **Chapter 7 – Implementation Program**
  - The general types of conservation practices needed to meet the projected load reduction targets are reviewed in Chapter 5.
  - Critical areas for implementation are noted in Chapter 6.
  - Specific application of various practices is described in Chapter 7. The specific suite of conservation practices needed to meet nutrient reduction goals for each of the Priority HUC-12 subwatersheds is identified in Appendix D.
- **Chapter 9 – Policy Recommendations**
  - Proposed policy changes are non-structural management measures. The rural and urban and policies outlined in this plan are those that are recommended for adoption to achieve the goals of this plan.

More information is provided in Appendix B (Technical Approach)

- **Existing and target adoption rates of each conservation practice to meet water quality goals are included here. Further description of each practice is provided.**

Element #4–Estimate of the amounts of technical and financial assistance needed, associated costs and/or the sources and authorities that will be relied upon to implement this plan.

Summarized in the watershed plan in Chapter 16 – Resource Requirements

- **Evaluates the cost of flood mitigation strategies and water quality improvement practices for each of the Priority subwatersheds.**
- **Summarizes costs for watershed monitoring.**

Element #5–An information and education component used to enhance public understanding of the project and encourage their early and continued participation in selecting, designing and implementing the non-point source management measures that will be implemented.

Summarized in the watershed plan in Chapter 13 – Education and Outreach

More information is provided in Appendix C – Education and Outreach Plan

Element #6–Schedule for implementing the non-point source management measures identified in this plan that is reasonably expeditious.

Summarized in the watershed plan in:

- **Chapter 6 – Effort Prioritization**
- **Chapter 14 – Measures and Milestones**
- **Chapter 16 – Resource Requirements**

Element #7–A description of interim measurable milestones for determining whether non-point source management measures or other control actions are being implemented.

Summarized in the watershed plan in Chapter 14 – Measures and Milestones

Element #8–A set of criteria that can be used to determine whether loading reductions are being achieved over time and substantial progress is being made toward attaining water quality standards.

Summarized in the watershed plan in Chapter 14 – Measures and Milestones

Element #9–A monitoring component to evaluate the effectiveness of the implementation efforts over time, measured against the criteria established under item #8.

Summarized in the watershed plan in:

- **Chapter 15 – Monitoring**

REFERENCES:

Emmons and Olivier Resources, Inc. 2020. North Raccoon River Watershed Assessment. NRRWMC.

Iowa Flood Center, IIHR. 2019. Hydrologic Assessment of the North Raccoon River Watershed. Iowa City: University of Iowa IIHR-Hydroscience & Engineering Report No.: 532.

IWA. 2019. North Raccoon River – Iowa Watershed Approach. [accessed 2019 Nov 8]. *www.iowawatershedapproach.org/resources/ghost/north-raccoon-river*

IWA. 2020. Flood Resilience Program. Iowa Watershed Approach. [accessed 2020 Mar 5]. *www.iowawatershedapproach.org/programs/resilience*

NORTH RACCOON RIVER WATERSHED PLAN

PART 1
PURPOSE AND BACKGROUND

OCTOBER 2020

CONTENTS

PART
01

PURPOSE AND BACKGROUND

WATERSHED BASICS

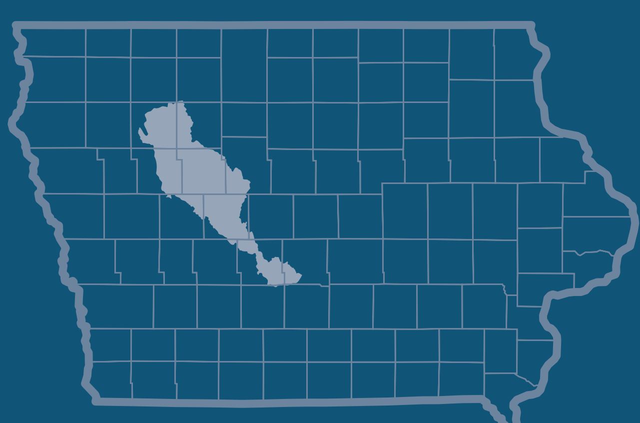
what is a watershed?

an area of land that drains to a common point, into a particular stream or river

Watershed Area

2,470

square miles



4.3%

of the entire state

01

WATERSHED BASICS

This chapter includes basic information about:

- What is a watershed?
- What area does this plan cover?
- How are watersheds classified?
- What factors influence water flow and flooding?

This chapter is intended to inform the reader about basic principles that will be expanded upon throughout this plan. It is mainly intended for a reader that is not experienced with watershed planning or water-related issues.

Readers with a greater understanding of these issues may wish to proceed to the next chapter.

WATERSHEDS

WHAT IS A WATERSHED?

A watershed is an area of land that drains to a common point, or into a particular stream or river. In the United States, watersheds can be as large as the Mississippi River basin. They can also be subdivided into smaller areas of various size, depending on the purpose to study an area.

Watersheds are typically identified using topographic map information. These types of maps show what direction the ground surface is sloping. By reviewing these, the limits of the surface area draining to a given point or stream can be determined. (adapted from RDG 2019)

WHERE IS THE NORTH RACCOON RIVER WATERSHED?

The North Raccoon River Watershed is located in Central and West Central Iowa. The most upstream area of the watershed (headwaters) are in extreme southern Clay and Palo Alto Counties, located just north of the communities of Marathon and Laurens. Storm Lake is also located along the northwestern edge of the watershed. The stream and river network generally flows from northwest to southeast, reaching the confluence (joins) with the South Raccoon River near Van Meter. From there, the Raccoon River flows easterly towards Des Moines, where it merges with the Des Moines River, which is the downstream end of this watershed planning area. When the Raccoon River reaches this location, its watershed is 2,470 square miles in area.

Ultimately, water that flows into the Des Moines River passes through Lake Red Rock before reaching the Mississippi River, which flows to the Gulf of Mexico.

FIGURE 1-1 NORTH RACCOON RIVER WATERSHED

HOW CAN WATERSHEDS BE ORGANIZED?

The United States Geological Survey (USGS) created a numeric system to identify watersheds and subwatersheds of various sizes. Each area is assigned a unique HUC number (Figure 1-2). The number is up to twelve digits long, representing watersheds or subwatersheds measured at six different scales. The first two digits of the code refer to the largest level (for the area covered by this plan, this is the Mississippi River). Each set of two digits after that represents a smaller portion of the larger watershed.

Terms like HUC-8, HUC-10 and HUC-12 are used within this watershed plan. These terms are based on the length of the HUC number used to define a certain study area. The longer the number, the smaller the area defined by that code. A HUC-8 area is identified by an 8-digit code and is known as a sub-basin. A HUC-12 area is given a 12-digit code and is termed a subwatershed.

The area covered by this plan is the North Raccoon River HUC-8 "Sub-basin." This area includes 17 HUC-10 "watersheds" and 75 HUC-12 "subwatersheds" (see Figure 1-3 and Table 1-1). To simplify this language, when the word "watershed" is used throughout this plan, it typically refers to the entirety of the North Raccoon River (HUC-8) sub-basin. The word "subwatershed" is typically used to describe the various HUC-12-scale drainage areas throughout the larger North Raccoon River sub-basin.

FIGURE 1-2 EXAMPLE OF A HUC-12 SUBWATERSHED CODE IN THE NORTH RACCOON RIVER SUB-BASIN

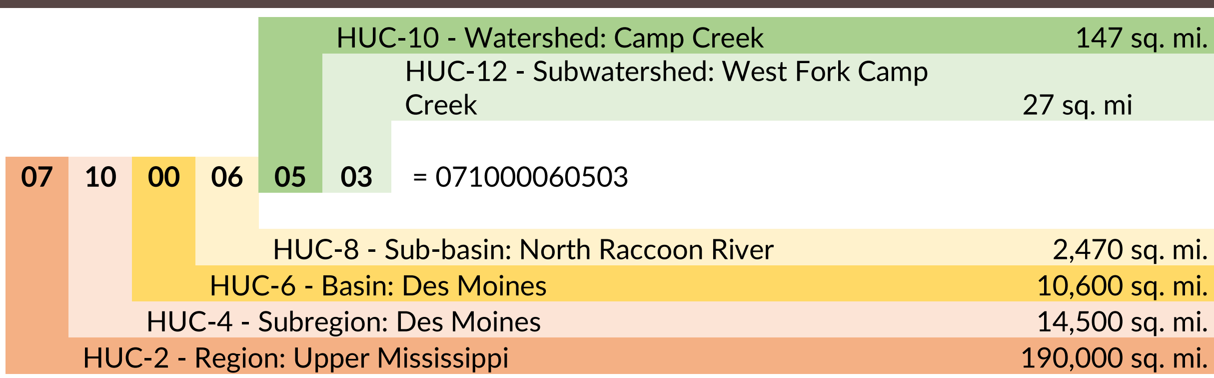


FIGURE 1-3 HUC-12S IN THE NORTH RACCOON RIVER SUB-BASIN

EOR water ecology community

TABLE 1-1 HUC-12 SUBWATERSHEDS WITHIN THE NORTH RACCOON RIVER SUB-BASIN

HUC-12	HUC-12 NAME	# KEY
71000060301	Headwaters North Raccoon River	1
71000060202	Headwaters Cedar Creek	2
71000060303	Lateral 6—North Raccoon River	3
71000060304	Lateral 2	4
71000060102	Headwaters Little Cedar Creek	5
71000060201	Drainage Ditch 21—Cedar Creek	6
71000060302	Lateral 4	7
71000060306	Lateral 3—North Raccoon River	8
71000060101	Drainage Ditch 67	9
71000060305	Poor Farm Creek	10
71000060308	Drainage Ditch 101—North Raccoon River	11
71000060103	Little Cedar Creek	12
71000060204	Drainage Ditch 74—Cedar Creek	13
71000060307	Outlet Creek	14
71000060203	Drainage Ditch 29	15
71000060205	Prairie Creek	16
71000060601	Upper Drainage Ditch No 9	17
71000060309	Buck Run	18
71000060206	Drainage Ditch 37—Cedar Creek	19
71000060501	Drainage Ditch 1	20
71000060207	Drainage Ditch 81	21
71000060602	Lower Drainage Ditch 9 & 13	22
71000060310	Sac City—North Raccoon River	23
71000060502	Headwaters West Fork Camp Creek	24
71000060208	Drainage Ditch 20—Cedar Creek	25
71000060603	Drainage Ditch 13—Lake Creek	26
71000060504	Headwaters Camp Creek	27
71000060903	East Cedar Creek	28
71000060901	Welshs Slough	29
71000060503	West Fork Camp Creek	30
71000060902	West Cedar Creek	31
71000060403	Indian Creek—North Raccoon River	32
71000060801	Drainage Ditch 73—North Raccoon River	33
71000060701	Headwaters Purgatory Creek	34
71000060604	Drainage Ditch 10—Lake Creek	35
71000060505	Camp Creek	36
71000061001	Headwaters Hardin Creek	37
71000060803	Prairie Creek	38

71000061202	Headwaters West Buttrick Creek	39
71000060802	Drainage Ditch 25—North Raccoon River	40
71000060605	Lake Creek	41
71000060402	Drainage Ditch 57	42
71000061201	Tank Pond	43
71000061101	Headwaters East Buttrick Creek	44
71000060401	Wall Lake Inlet	45
71000060805	Rainbow Bend County Park—North Raccoon River	46
71000060702	Purgatory Creek	47
71000061002	Happy Run—Hardin Creek	48
71000060904	Cedar Creek	49
71000060804	Elk Run—North Raccoon River	50
71000060806	Marrowbone Creek—North Raccoon River	51
71000061203	West Buttrick Creek	52
71000061102	East Buttrick Creek	53
71000061003	East Fork Hardin Creek	54
71000061402	Doe Brook—North Raccoon River	55
71000061403	Short Creek	56
71000061004	Village of Farlin—Hardin Creek	57
71000061404	McMahon State Wildlife Management Area—North Raccoon River	58

71000061401	Otter Creek	59
71000061005	Hardin Creek	60
71000061204	Buttrick Creek	61
71000061405	Drainage Ditch 171—North Raccoon River	62
71000061301	Headwaters Greenbrier Creek	63
71000061406	Squirrel Hollow County Park—North Raccoon River	64
71000061501	Fannys Branch—North Raccoon River	65
71000061302	Greenbrier Creek	66
71000061503	Frog Creek—North Raccoon River	67
71000061502	Swan Lake Branch	68
71000061504	Village of Minburn—North Raccoon River	69
71000061601	Little Walnut Creek—Walnut Creek	70
71000061505	Hickory Creek—North Raccoon River	71
71000061602	Walnut Creek	72
71000061701	Sugar Creek	73
71000061703	Jordan Creek—Raccoon River	74
71000061702	Johnson Creek—Raccoon River	75

WHAT GROUP IS LEADING THIS EFFORT?

The State of Iowa passed legislation creating Watershed Management Authorities (WMAs). These "authorities" allow eligible members (counties, cities, Soil and Water Conservation Districts) to enter into partnership agreements to address issues such as flooding and water quality at the HUC-8 watershed scale. In reality, these groups do not have much "authority," as they do not have the direct ability to tax, legislate or acquire land. They are merely alliances formed for mutual cooperation.

The North Raccoon River HUC-8 sub-basin includes areas that drain to the North Raccoon River. It also includes areas that drain to the Raccoon River, downstream of Van Meter. So, the WMA formed for this area can include eligible members for areas that drain to the North Raccoon River and those areas that drain to the Raccoon River below the confluence of the North and South Raccoon Rivers. Areas that drain to the South (and Middle) Raccoon Rivers are in a different HUC-8 sub-basin and are not included within the area covered by this plan.

Enough eligible members within the North Raccoon River sub-basin agreed to become members, deciding to call themselves the NRRWMC. They felt the term "coalition" better represented the purposes of their organization. Table 1-2 lists the jurisdictions that were eligible to join the NRRWMC; those who have actually become members (as of October 2019) are highlighted. Beyond this list, there are a number of active partners and stakeholders who are essential to the implementation of this plan, but the state laws creating WMAs did not grant these groups the ability to become voting members of the group.

TABLE 1-2 ELIGIBLE MEMBER JURISDICTIONS WITHIN THE NORTH RACCOON RIVER SUB-BASIN

Boone County	Guthrie SWCD	City of Glidden	City of Norwalk
Buena Vista County	Madison SWCD	City of Gowrie	City of Paton
Calhoun County	Palo Alto SWCD	City of Grimes	City of Perry
Carroll County	Pocahontas SWCD	City of Harcourt	City of Pomeroy
Clay County	Polk SWCD	City of Jamaica	City of Ralston
Dallas County	Sac SWCD	City of Jefferson	City of Rembrandt
Greene County	Warren SWCD	City of Johnston	City of Rinard
Guthrie County	Webster SWCD	City of Jolley	City of Rippey
Madison County	City of Adel	City of Knierim	City of Rockwell City
Palo Alto County	City of Albert City	City of Lake City	City of Sac City
Pocahontas County	City of Alta	City of Lake View	City of Scranton
Polk County	City of Auburn	City of Lakeside	City of Somers
Sac County	City of Breda	City of Lanesboro	City of Storm Lake
Warren County	City of Callender	City of Laurens	City of Truesdale
Webster County	City of Churdan	City of Lidderdale	City of Urbandale
Boone SWCD	City of Clive	City of Lohrville	City of Van Meter
Buena Vista SWCD	City of Dallas Center	City of Lytton	City of Varina
Calhoun SWCD	City of Dana	City of Manson	City of Waukee
Carroll SWCD	City of Dawson	City of Marathon	City of West Des Moines
Clay SWCD	City of Des Moines	City of Minburn	City of Windsor Heights
Dallas SWCD	City of Farnhamville	City of Nemaha	City of Yetter
Greene SWCD	City of Fonda	City of Newell	

WATER MOVEMENT

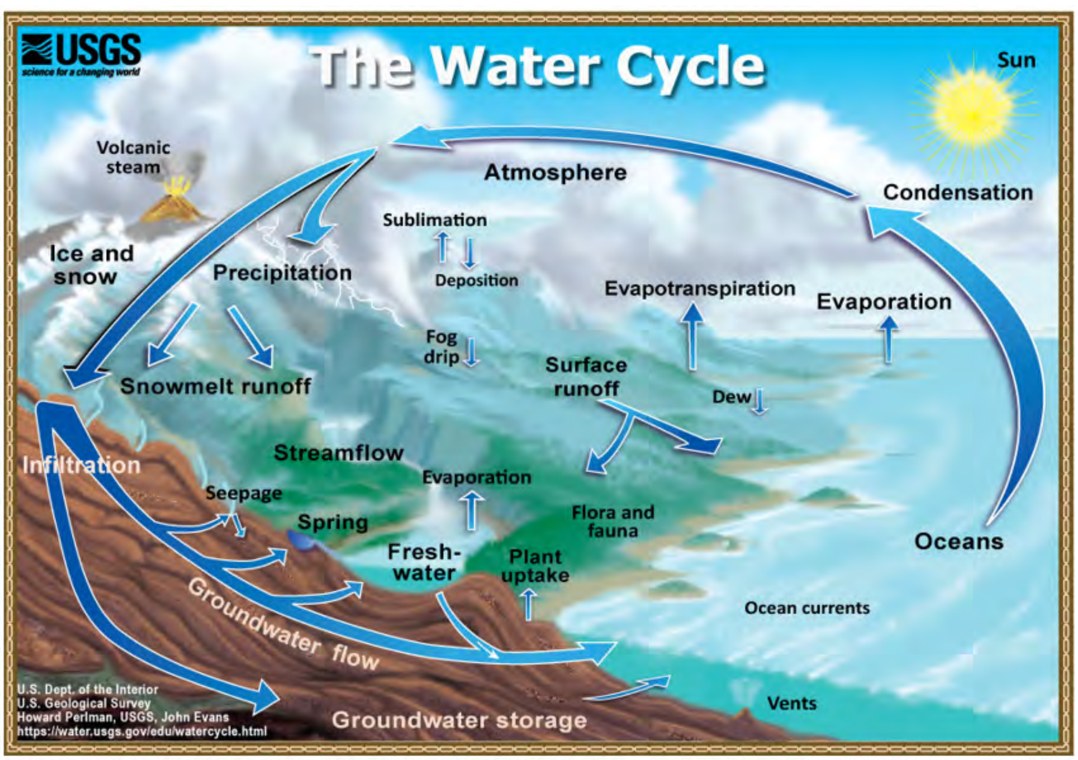
WHAT IS HYDROLOGY?

Hydrology is the study of the movement of water across the earth. This involves understanding the water cycle, starting with precipitation (rainfall, ice or snow), movement (runoff or groundwater), use by plants (transpiration) and return to the atmosphere (evaporation). This cycle is illustrated in Figure 1-4.

A couple of key concepts are important to understand when studying the movement of water in watershed planning:

- **Flow volume: After precipitation, this is the amount of water that either moves across the surface (runoff) or flows below the surface (groundwater). This is typically measured in cubic feet (CF) or acre-feet (43,560 CF) of water.**
- **Flow rate: This is the amount of water that passes by a specific point, over a set period of time. This is typically measured in cubic feet per second (CFS).**
- **Losses: This is the amount of precipitation that does not become flow. It includes evaporation and transpiration (as defined above).**

FIGURE 1-4 ILLUSTRATION OF THE WATER CYCLE



WHAT INFLUENCES FLOW VOLUME?

Flow volume can be raised by several factors:

- **Rainfall patterns (increased precipitation)**
- **Changes in land use**
  - Removal of natural vegetation (prairies, wooded areas)
  - Conversion of natural areas or pastures to row crops
  - Installation of impervious surfaces (roads, parking lots, buildings)
- **Soil conditions**
  - Increases in clay content
  - Soil compaction
  - Reduction in soil organic matter (carbon)
- **Draining of storage features (depressions, ponds, wetlands)**

WHAT INFLUENCES FLOW RATE?

Flow rates are generally increased by anything that increases volume. However, these increases can be magnified when flow is allowed to move more quickly downstream. This results in a greater amount of flow arriving a given point at the same time, which creates the increase in flow rate.

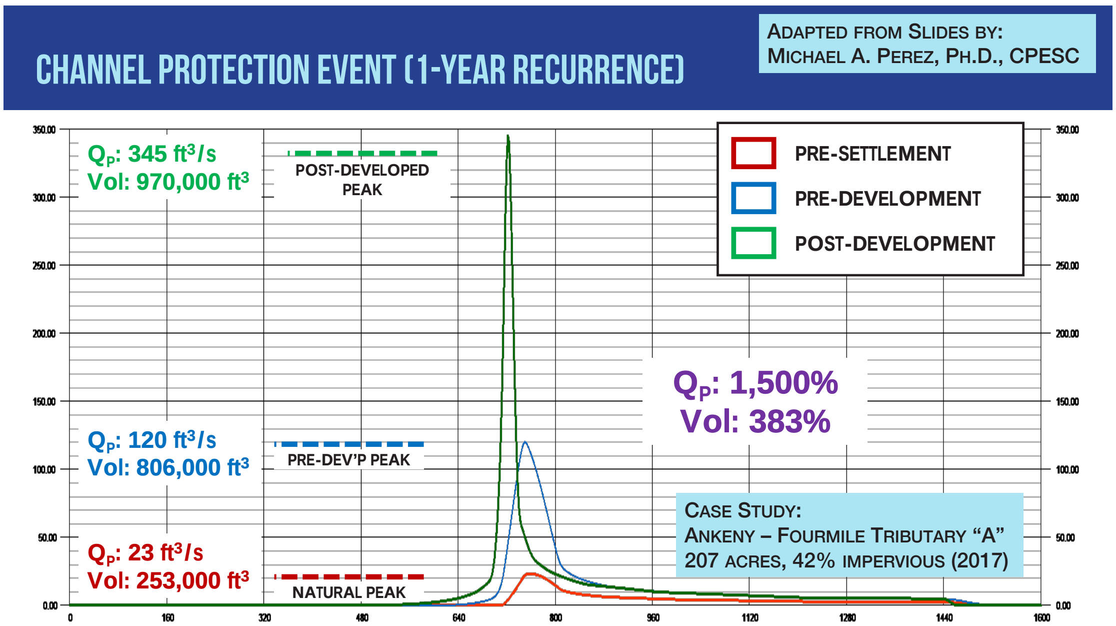
Flow rate increases are magnified by:

- **Installation of pipes or engineered channels**
- **Reducing flow path length**
- **Increasing surface slope**
- **Flow over smoother surfaces (e.g., pavement, bare surfaces, shorter grasses)**

WHAT IS A HYDROGRAPH?

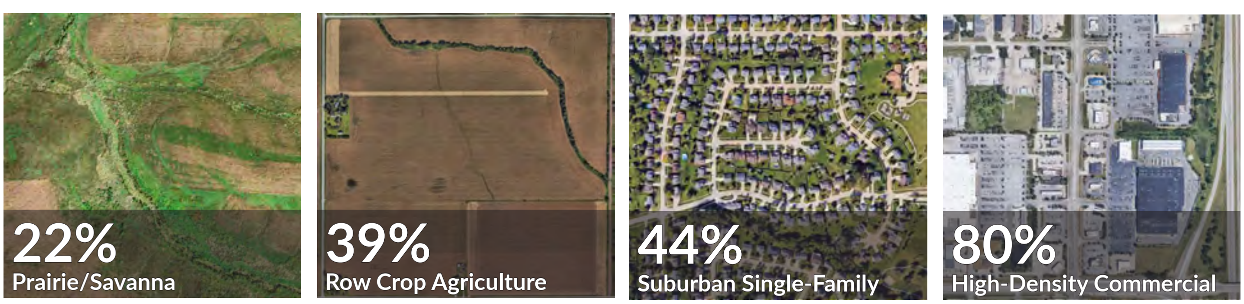
A hydrograph is a chart that shows runoff flow rate levels over time. These are used to evaluate how changes in the landscape affect flow conditions. After storms, these graphs tend to follow a curve that rises quickly then declines more slowly. The rate of flow is typically shown along the left y-axis of the graph, with higher levels shown upwards. Time is shown along the bottom x-axis, in increments of time (minutes, hours, days). The volume of runoff can be determined by calculating the total area beneath the curve that represents flow rates. Figure 1-5 shows an example of how changes in land use and flow patterns can increase flow volumes and rates as land uses are changed from natural to row crop and then to suburban. As land uses change, the volume of runoff increases. As flow velocity increases, the peak flow increases much more than volume increases. Figure 1-6 illustrates changes in runoff volumes by land use.

FIGURE 1-5 EXAMPLE OF CHANGES IN FLOW VOLUMES AND RATES



Parameters: 2.7" rainfall in 24-hours, Type II rainfall distribution
Source: adapted from slides prepared by Michael A. Perez, Ph.D, Iowa State University, 2018

FIGURE 1-6 EXAMPLES OF CHANGES IN RUNOFF VOLUMES BY LAND USE



Parameters: 2.7" rainfall, 24 hour Type II rainfall distribution, Hydrologic Soil Group C soils
Source: RDG 2019

STORMS AND FLOODS

HOW ARE "EVENTS" CLASSIFIED?

When this plan talks about flood "events" it is important to understand what certain terms mean. Terms like "100-year storm" and "1% annual chance flood" are used frequently but are often misunderstood.

Imagine having a deck of 100 unique cards. If you draw a card and reshuffle the deck, it is unlikely (but possible) to draw the same card twice in a row, or even several times out of 10. It is also possible to not draw that same card again for several hundred draws.

However, if you repeated this exercise millions of times, you should draw any card about once out of every 100 draws, on average. (For example, you would expect to draw that unique card around 100 out of 10,000 times.)

Storm and flood event probability is described similarly. A storm or flood event that is expected to happen once in 100 years (averaged over a long period) is often called a "100-year storm" (although, as noted, this event can happen more or less frequently than that). To better describe the risk of various events, FEMA and other agencies now prefer using the term "1% annual recurrence (AR) chance event" for this type of event. This is because there is expected to be a 1% chance of such an event happening in any given calendar year.

Other more-or-less intense events may be described in the same manner. Table 1-3 shows the comparison of these terms for different frequencies of events. It also lists the true mathematical probability that such an event would happen over different periods of time.

TABLE 1-3 EVENT PROBABILITY

		TIME PERIOD (YEARS)							
RETURN PERIOD (YEARS)	**ANNUAL RECURRENCE CHANCE**	**1**	**2**	**5**	**10**	**25**	**50**	**100**	**500**
1		63%	86%	99%	100%	100%	100%	100%	100%
2	**50%**	39%	63%	92%	99%	100%	100%	100%	100%
5	**20%**	18%	33%	63%	86%	99%	100%	100%	100%
10	**10%**	10%	18%	39%	63%	92%	99%	100%	100%
25	**4%**	4%	8%	18%	33%	63%	86%	98%	100%
50	**2%**	2%	4%	10%	18%	39%	63%	86%	100%
100	**1%**	1%	2%	5%	10%	22%	39%	63%	99%
500	**0.2%**	0.2%	0.4%	1%	2%	5%	10%	18%	63%

Example highlighted in gray: What is the chance of seeing a 10-year storm (10% AR event) at least once during a given 5-year period? Starting at the left, within the 10-year return period row, drawing right to the 5-year time period column: table indicates that there is a 39% chance of that scenario happening.

Source: adapted from Iowa DNR 2009

It is also important to understand that event projections are also limited to available rainfall and streamflow data. In most areas, data has only been accurately collected for a few decades; some locations have collected a century of data. This short period of record, along with constantly changing land uses and climate patterns, can make it difficult to accurately predict these levels of risk.

WHAT ARE FLOODPLAINS?

Floodplains are the areas surrounding streams, rivers and lakes that may be inundated by high flows. After heavy rainfalls or snowmelt, streams can receive runoff at high rates, causing the stream to flow up and over banks and onto the adjacent floodplains. In natural settings, this serves the function of allowing larger flows to pass downstream more slowly, reducing velocity and dissipating energy. Sediment and movement of materials during floods in these settings plays a role in healthy stream function and creation of habitat.

However, flooding issues are often related to human impacts on the landscape. Sometimes structures or crops are placed in areas that will frequently flood. Construction of levees and engineered channels can “disconnect” the stream from the adjacent floodplain, forcing water to move through a smaller area, which increases velocities and moves the peak of the flood wave downstream more quickly.

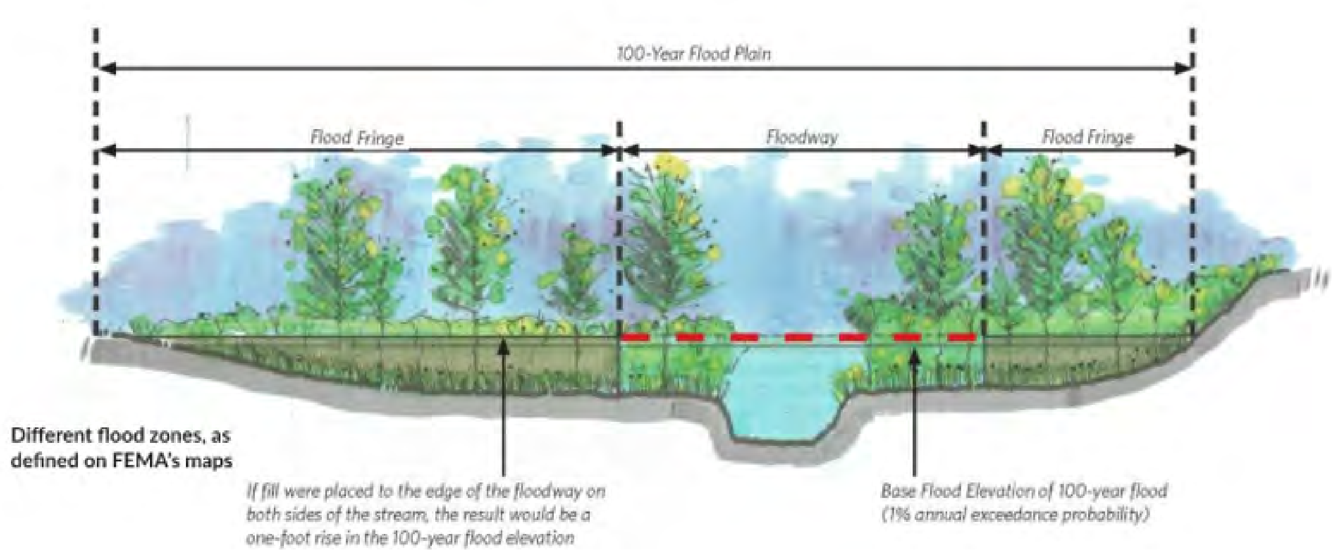
Regulatory issues

FEMA creates Flood Insurance Rate Maps (FIRMs) that illustrate where flooding is expected to be caused by large flood events along major streams. These maps typically show the area expected to have a greater than 1% chance of being flooded in any given year. In some cases, areas expected to have a greater than 0.2% chance of flooding are mapped.

These maps do not show all flood risks. Typically, risks are shown for streams that drain around a square mile of land (640 acres). In some agricultural areas, there could be locations where there is no stream, but the total area drained by a tile system is larger than a square mile. Such areas often do not have a risk shown on FEMA maps, even though they could be frequently flooded. Also, FEMA maps do not show local flash flooding issues which could be caused by insufficient storm drain or culvert capacity, or drainage patterns that drive overland surface flow toward structures. When assessing flood risk, it is important to understand these limitations.

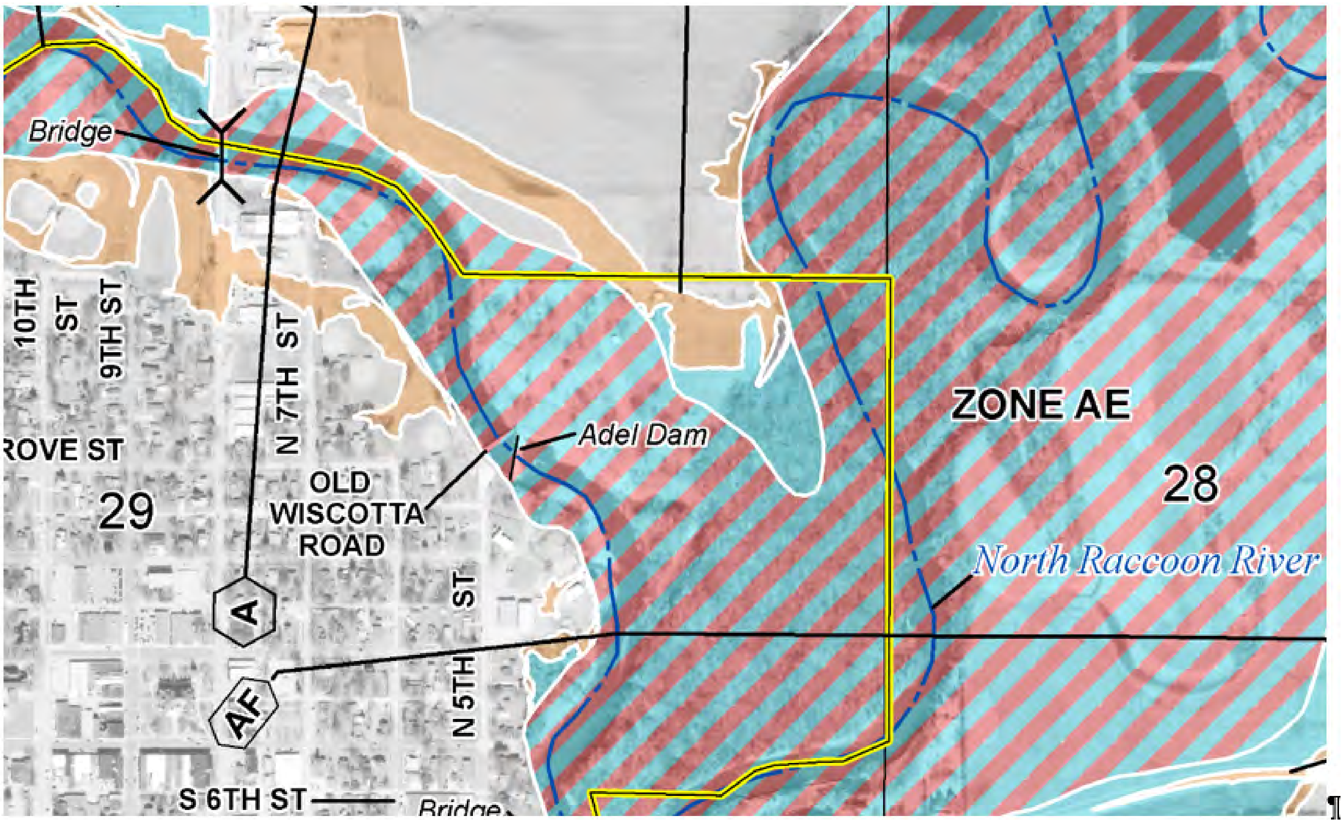
Along some streams, especially in urban areas, flood risk may be mapped in greater detail. The maps may show expected high-water elevations during the 1% annual chance flood event (Base Flood Elevations) and may designate a “floodway” where placement of obstructions or fill material is more restricted. Figure 1-7 illustrates this arrangement within a FEMA-regulated floodplain.

FIGURE 1-7 FIRM FLOODPLAIN ELEMENTS



Adapted from RDG et al. 2016

FIGURE 1-8 SAMPLE OF A FEMA FLOOD INSURANCE RATE MAP

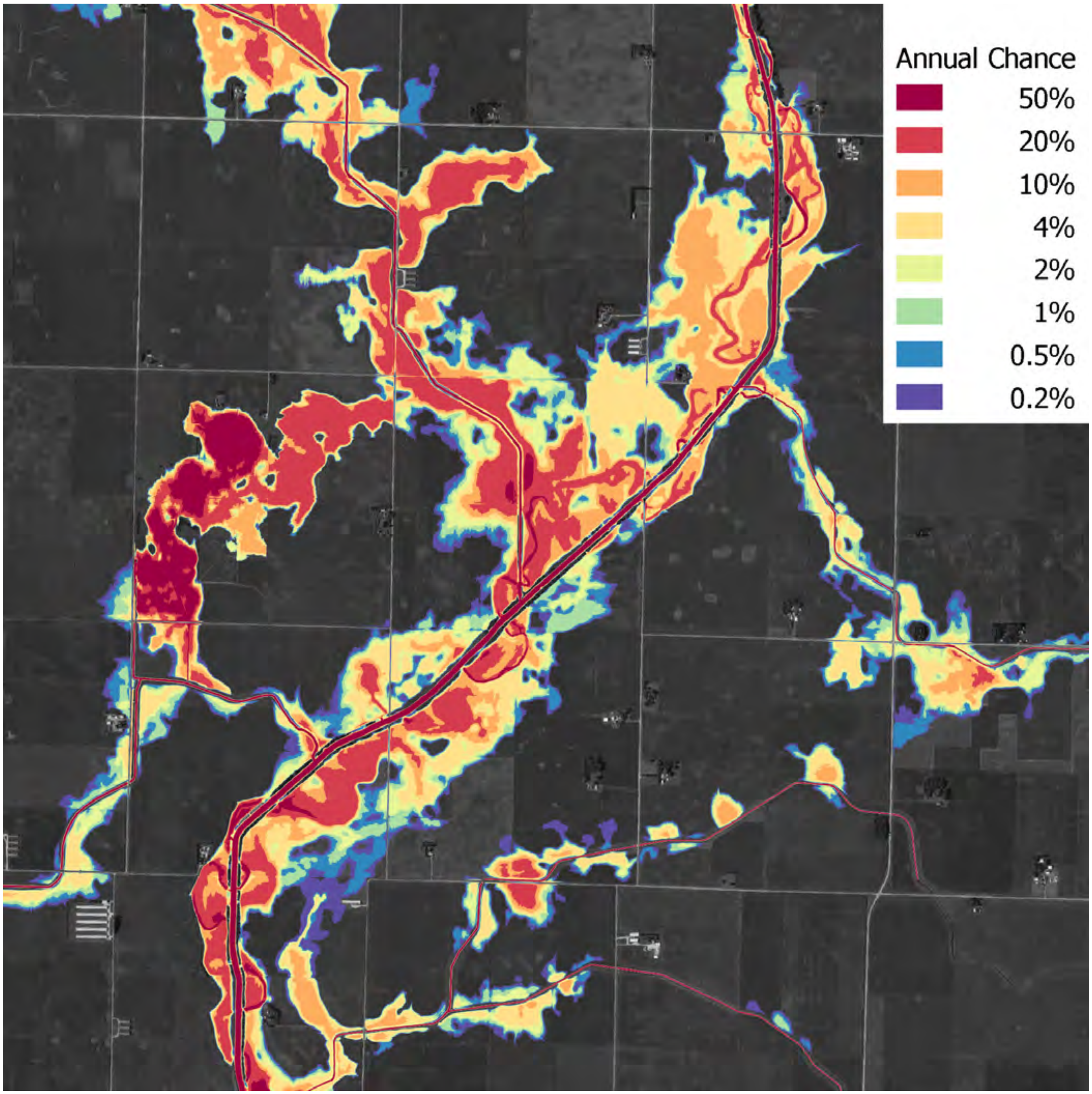


Source: Map Number 19049C0310F, Adel and Dallas Counties, Iowa – map revised Dec. 7, 2018
Figure 1-8 shows a sample from a FIRM map of Adel.
Orange-shaded area = 0.2% or greater chance of flooding
Blue-shaded area = 1% or greater chance of flooding
Blue/red-striped area = Floodway

Level of Risk

Even though areas may be mapped as having a 1% or greater chance of being flooded, that does not mean all areas have the same risk. As noted previously, some areas that are not mapped may also have high risks. Figure 1-9 shows various levels of flood risk in a subwatershed in the upper part of the North Raccoon River sub-basin. This map shows that some areas may be flooded very frequently, perhaps every other year, on average. Other areas may be in the same "floodplain" but may be flooded much less frequently. In addition, frequently flooded areas may be flooded at greater depth than those areas along the edge of the floodplain. It is important to understand these varying levels of risk. Buildings, structures or crops that are most frequently impacted by floods should be addressed with higher priority than those that are impacted much less frequently.

FIGURE 1-9 FLOOD INUNDATION RISKS ALONG CEDAR CREEK



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RDG, Des Moines Area MPO, Snyder & Associates, Polk County SWCD. 2016. Walnut Creek Watershed Master Plan. [accessed 2019 Apr 26]. *https://www.walnutcreekwatershed.org/plan_page.*

PURPOSE OF THE PLAN

Vision:

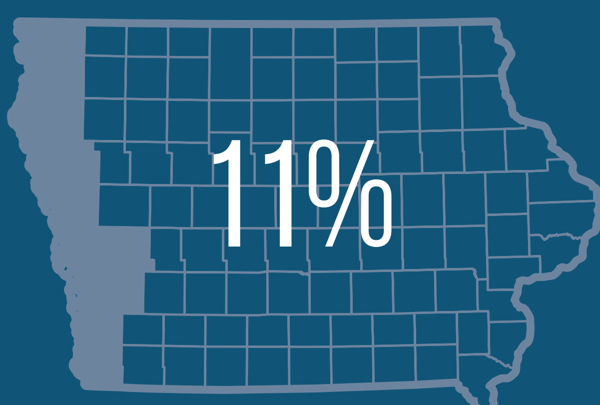
one watershed, one community charting its own destiny through shared responsibility and common goals

Mission:

Working together for reduced flooding, improved water quality and soil health, enhanced education, and strengthened community

Hypoxia Zones

Nutrient pollution* in the Gulf of Mexico equals



of the state of Iowa

*6,000 sq.mi. since 2014

300

private wells tested with elevated levels of nitrate and/or bacteria levels

80% of all wells in this watershed are highly susceptible

02

PURPOSE OF THE PLAN

This chapter reviews the “big picture” issues that the plan is intended to address.

- Flooding
- Water quality
- Drinking water risks
- Recreation and resource threats
- Sedimentation
- Hypoxic zones

This chapter is intended to provide the reader with a summary of basic information about these issues and their scale. Later chapters discuss the causes of these issues and how they should be addressed in greater detail.

Readers that already have an awareness of the nature of these issues may wish to proceed to the next chapter.

INTRODUCTION

The issues, concerns and challenges that this plan addresses are summarized in this chapter. The focus here is a basic understanding of the issues facing this watershed. The sources of these issues and the actions needed to address them are explored in greater detail later in this document.

The first part of this chapter outlines the vision and mission of the NRRWMC.

The second part explores key concerns:

- **Flooding**
- **Water Quality**
- **Drinking water risks**
- **Recreation and Resource threats**
- **Sediment**
- **Hypoxic Zones**

The last part outlines the goals and objectives of this watershed plan to address these issues.

VISION AND MISSION

Vision: One watershed, one community charting its own destiny through shared responsibility and common goals.

Mission: Working together for reduced flooding, improved water quality and soil health, enhanced education and strengthened community.

IDENTIFIED ISSUES

FLOODING

As noted in Chapter 1, floods are part of the natural function of streams and rivers. Floods become hazardous to people and property when they inundate an area where development has occurred, causing losses. Mild flood losses may have little impact on people or property, such as damage to landscaping or the generation of unwanted debris. Severe flooding can destroy buildings, ruin crops and even cause critical injuries or death. Figure 2-1 illustrates the areas of mapped flood risk within the North Raccoon River Watershed.

This planning effort was pursued in response to recent destructive flood events across the state (see the Preamble of this plan). ***According to the Iowa Flood Center, Iowa has seen 18 billion dollars in flood damage over the last 30 years*** (Arenas Amado et al. 2018). The floods of 2008 in Iowa resulted in the sixth-largest FEMA disaster declaration ever (to date), based on estimated public financial assistance (City of Cedar Rapids 2020). Such flooding events are becoming more frequent in the state.

Low-income, marginalized and socially vulnerable populations are only as resilient as the social resources available in the community, yet a community's flood resilience is only as strong as its most vulnerable populations. Flooding impacts both the well-being of communities in the watershed as well as the economic capacity of vulnerable communities to protect their residents.

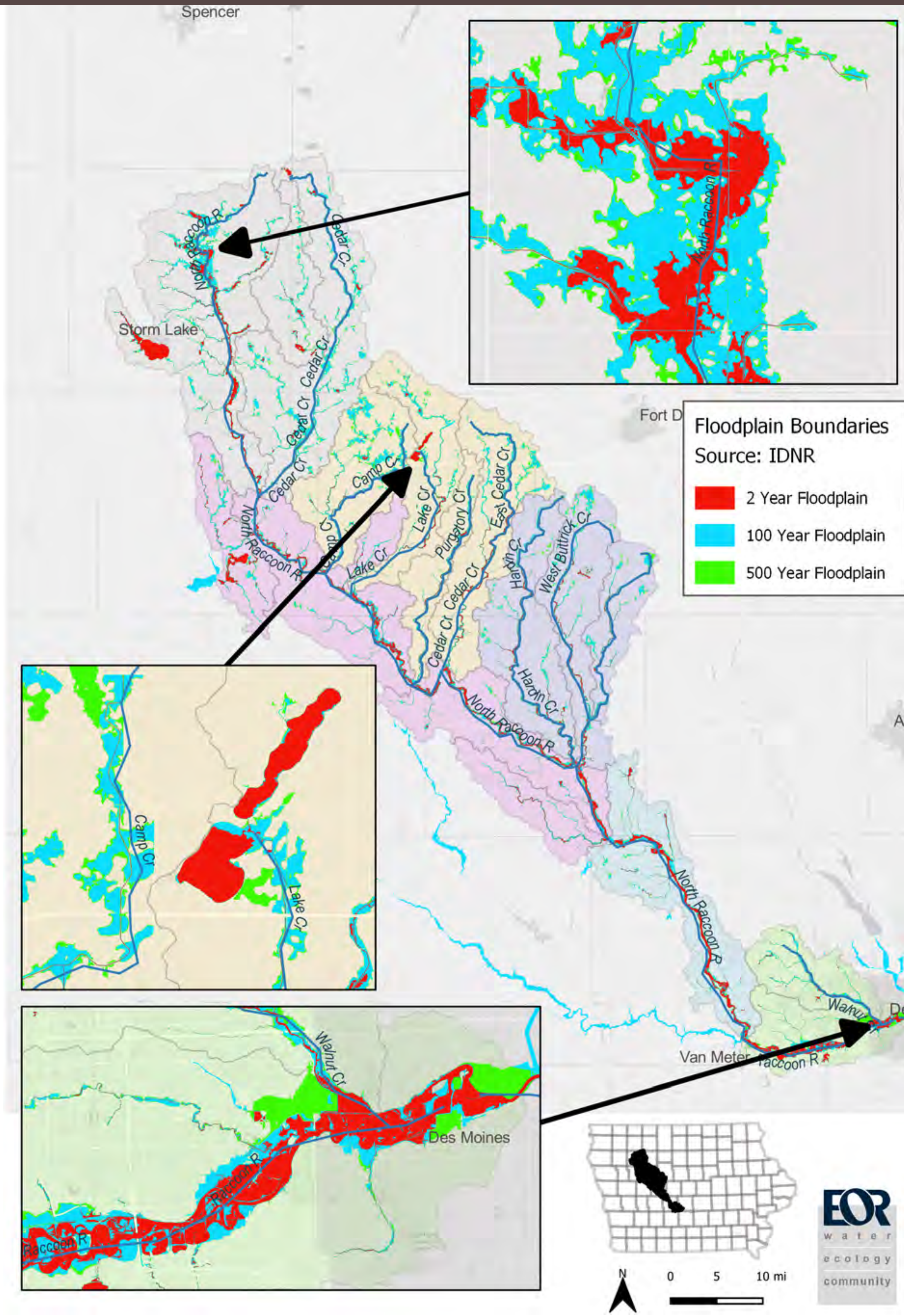
As flooding is a normal function of streams and is expected to continue, a goal of this plan should be to reduce risk and improve resiliency before, during and after flood events. A member jurisdiction in a resilient watershed can better prepare for, mitigate, respond to and recover from floods.

In response to these challenges, the nature of flooding and the risk to various land uses must be understood. Some of the impacts of flooding are described in more detail in Chapter 3 of this plan. Specific strategies to increase resiliency are outlined in Chapter 5, with their prioritization and application outlined in Chapters 6 and 7.

In the Watershed Assessment document (Emmons and Olivier Resources, Inc. 2020) the primary concerns with flood damages in the North Raccoon River Watershed were identified:

- **Projected damages to structures**
  - Areas with greater than a 0.2% chance of flooding any given year
- **Areas of row crops in frequently flooded areas**
  - Areas with greater than a 20% chance of being flooded in any given year
- **Repeated damages to roads and other public infrastructure**
  - Locations expected to have greater than a 4% chance of being inundated in any given year

FIGURE 2-1 AREAS OF MAPPED FLOOD RISK WITHIN THE NORTH RACCOON RIVER WATERSHED



Source: Iowa HSEMD

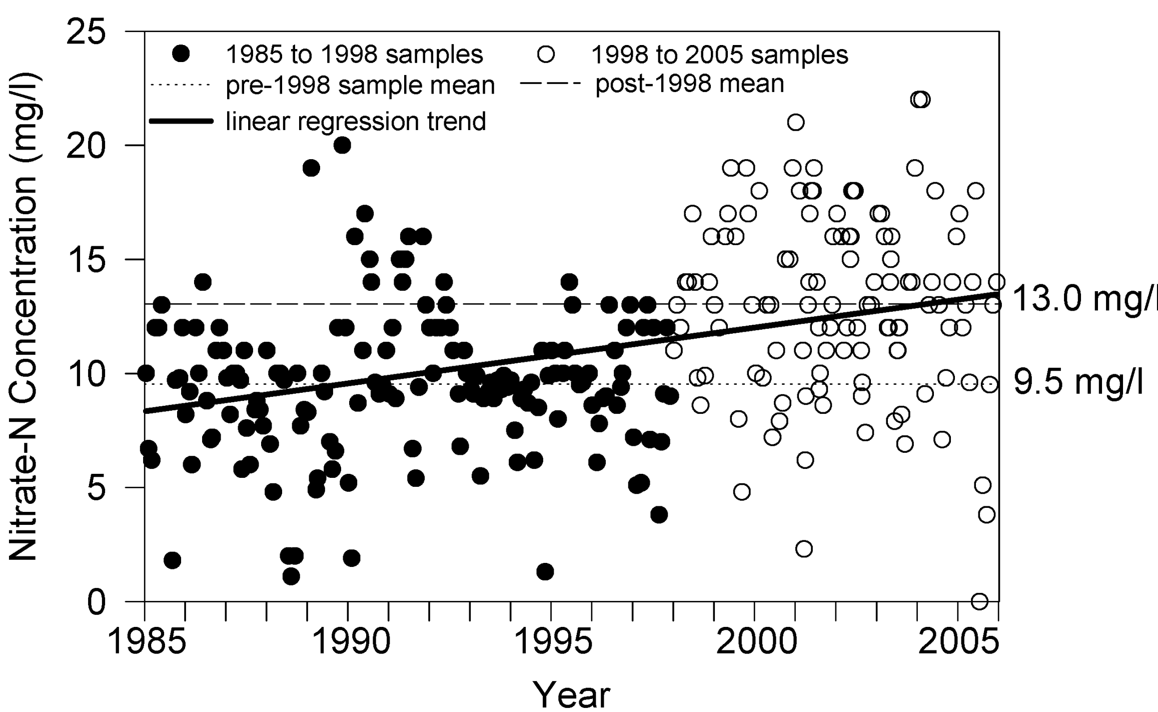
WATER QUALITY

Drinking Water Risks

High nitrate levels and pathogen levels in surface and groundwater supplies poses potential risks to local drinking water supplies. Impacts to Des Moines Water Works operations have been well publicized and are explored in greater detail in Chapters 3 and 12. However, two other communities, Dawson and Lake View, have had impacts due to high nitrate levels. Nearly 80% of the wells throughout the watershed have been identified as highly susceptible. In addition, bacteria contamination has been noted in numerous private wells. In total, over 300 private wells across the watershed have found elevated levels of nitrate or bacteria.

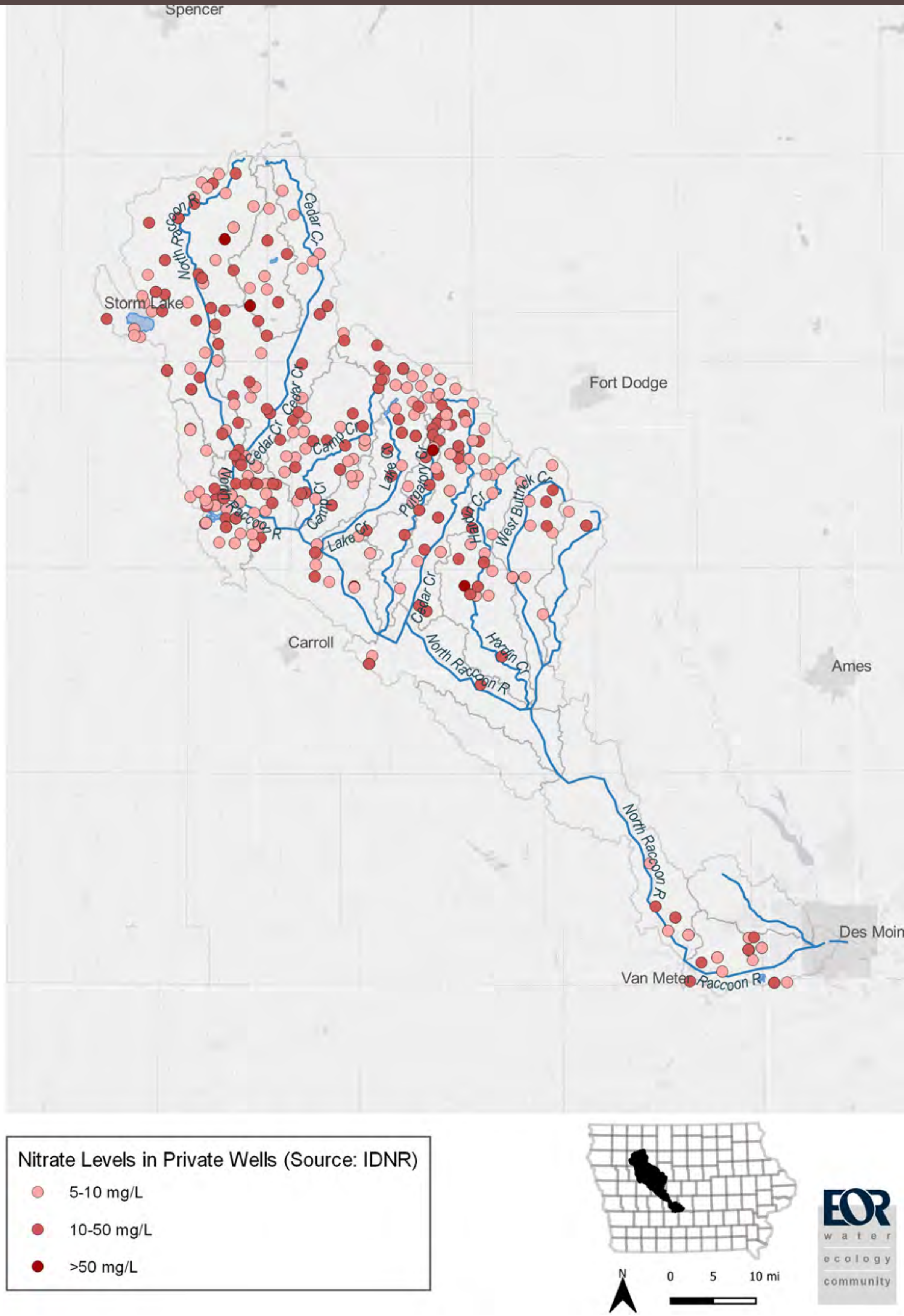
Figure 2-2 shows the trendlines for nitrate levels in the North Raccoon River, measured at Sac City, from 1985 through 2005. Figures 2-3, 2-4 and 2-5 show locations of impacted private wells and highly susceptible public water supply wells throughout the watershed. More detail about these issues can be found in Chapter 3 of this plan and the Watershed Assessment document.

FIGURE 2-2 MONTHLY NITRATE CONCENTRATIONS MEASURED AT SAC CITY FROM 1985 TO 2005



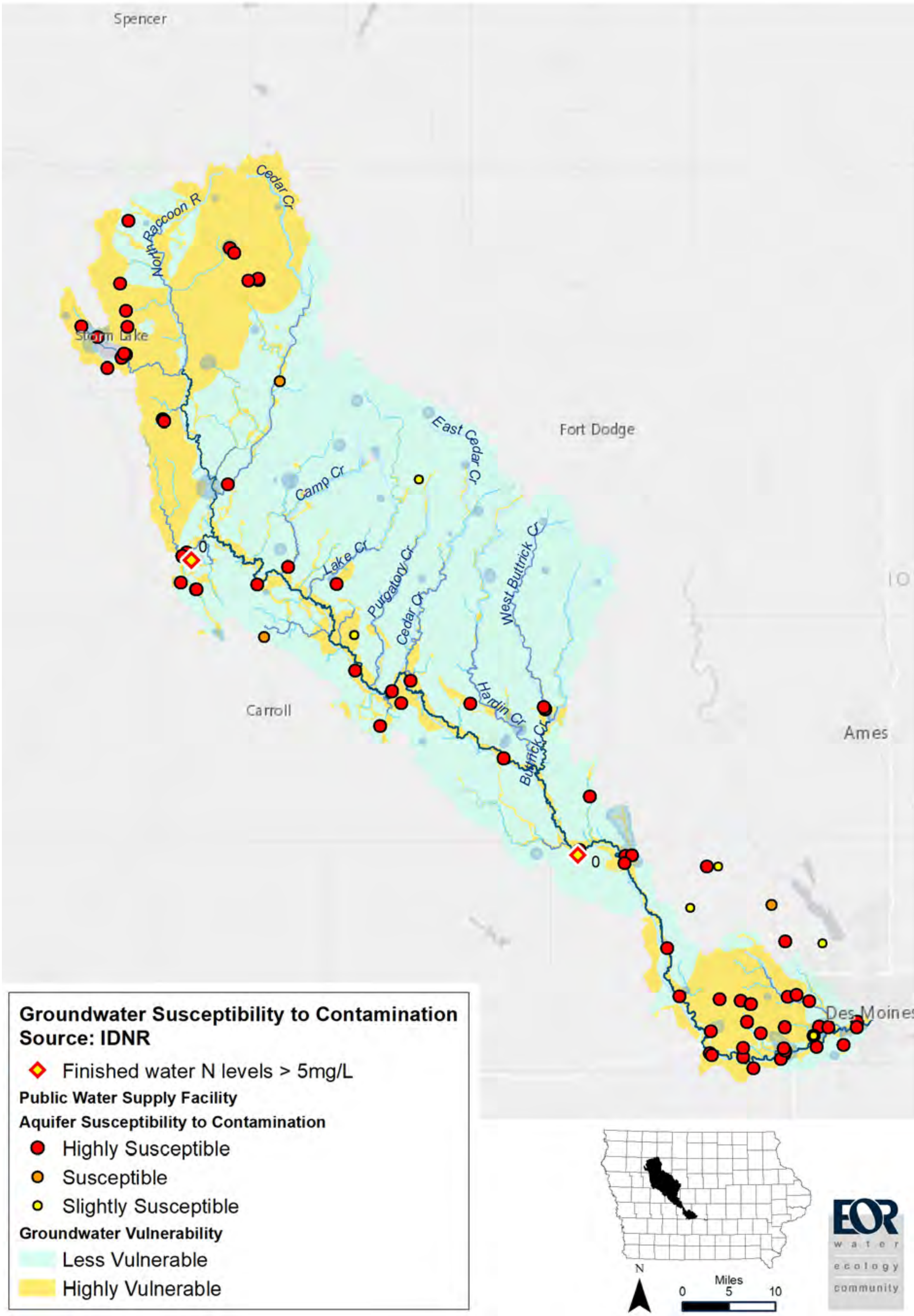
Linear trend is associated with entire data set, whereas sample mean lines are associated with 1985–1998 and 1998–2005 time periods
Source: Schilling and Wolter 2008; ACWA 2018

FIGURE 2-3 PRIVATE WELLS WITH HIGH NITRATE LEVELS (2008–2019)



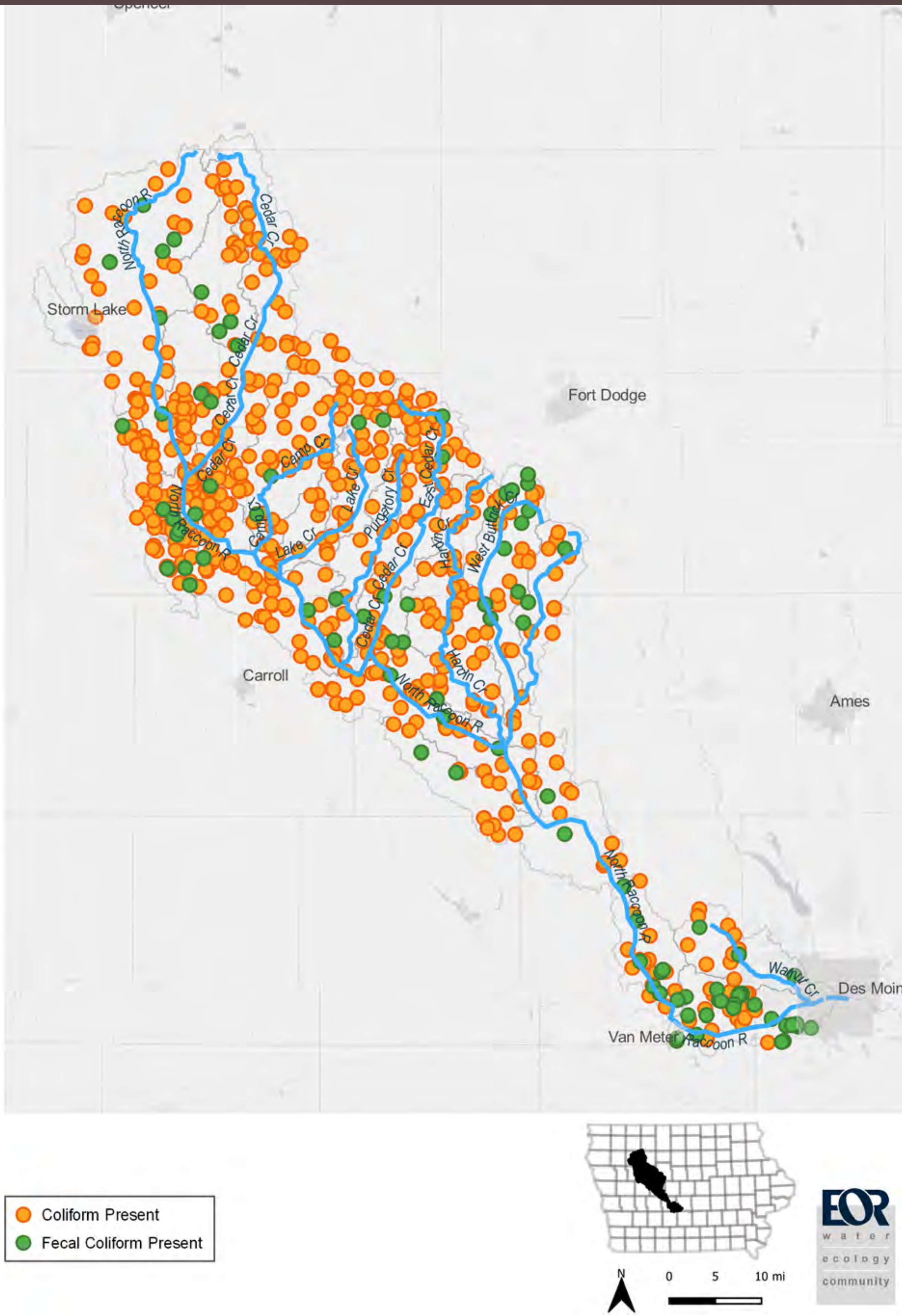
Source: Iowa DNR

FIGURE 2-4 HIGHLY SUSCEPTIBLE WELLS AND GROUNDWATER VULNERABILITY



Source: Iowa DNR

FIGURE 2-5 PRIVATE WELLS WITH BACTERIA PRESENT (2008–2019)



Source: Iowa DNR

Recreation and Resource Impairments

Recreational opportunities can be impaired by a variety of factors:

- **Exotic or invasive species**
- **High nutrient levels**
- **Sedimentation and siltation**
- **Algal growth (influenced by nutrients)**
- **Turbidity**
- **Fish kills due to fuel spills, pesticides and animal waste**
- **Low dissolved oxygen levels (hypoxia)**
- **Other unidentified causes**

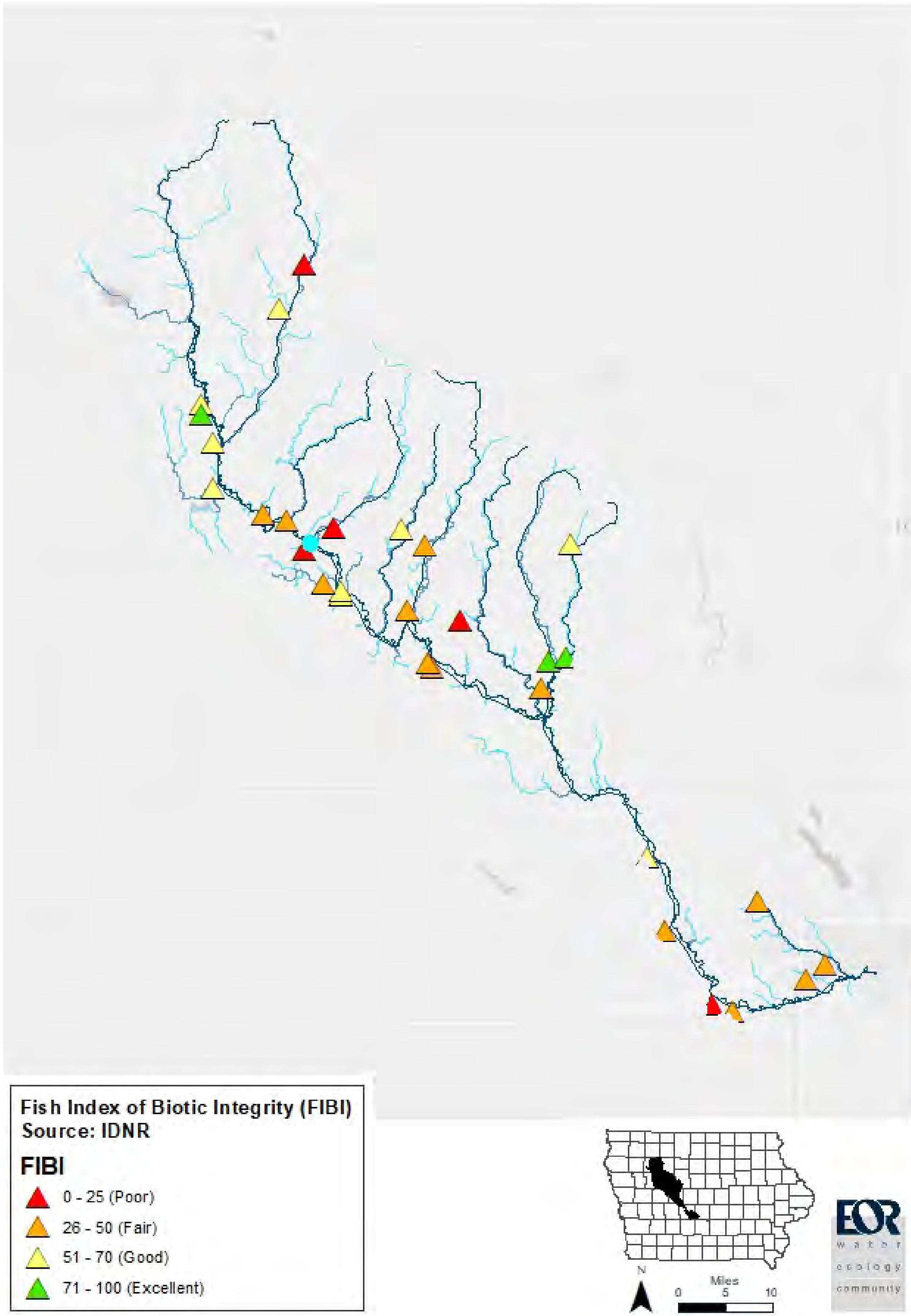
These factors can all impact the ability of lakes and rivers to support recreational opportunities. In the North Raccoon River Watershed:

- **There are 12 waterbodies where primary-contact recreational uses are impaired due to elevated bacteria levels.**
- **There are 10 waterbodies where conditions to support aquatic life are impaired due to a variety of factors: turbidity, algal growth and biological.**

These conditions can prevent public use of existing resources for recreation. They can also impact the desire to expand the network of other recreational opportunities (such as the Central Iowa Water Trails network). Figure 2-6 shows the Fish Index of Biological Integrity (FIBI) which is one commonly used measure to evaluate the ecological health of a stream.

These issues are discussed in greater detail in Chapter 3 of this plan and the Watershed Assessment document.

FIGURE 2-6 WATERSHED FISH INDEX OF BIOTIC INTEGRITY (FIBI) SCORES



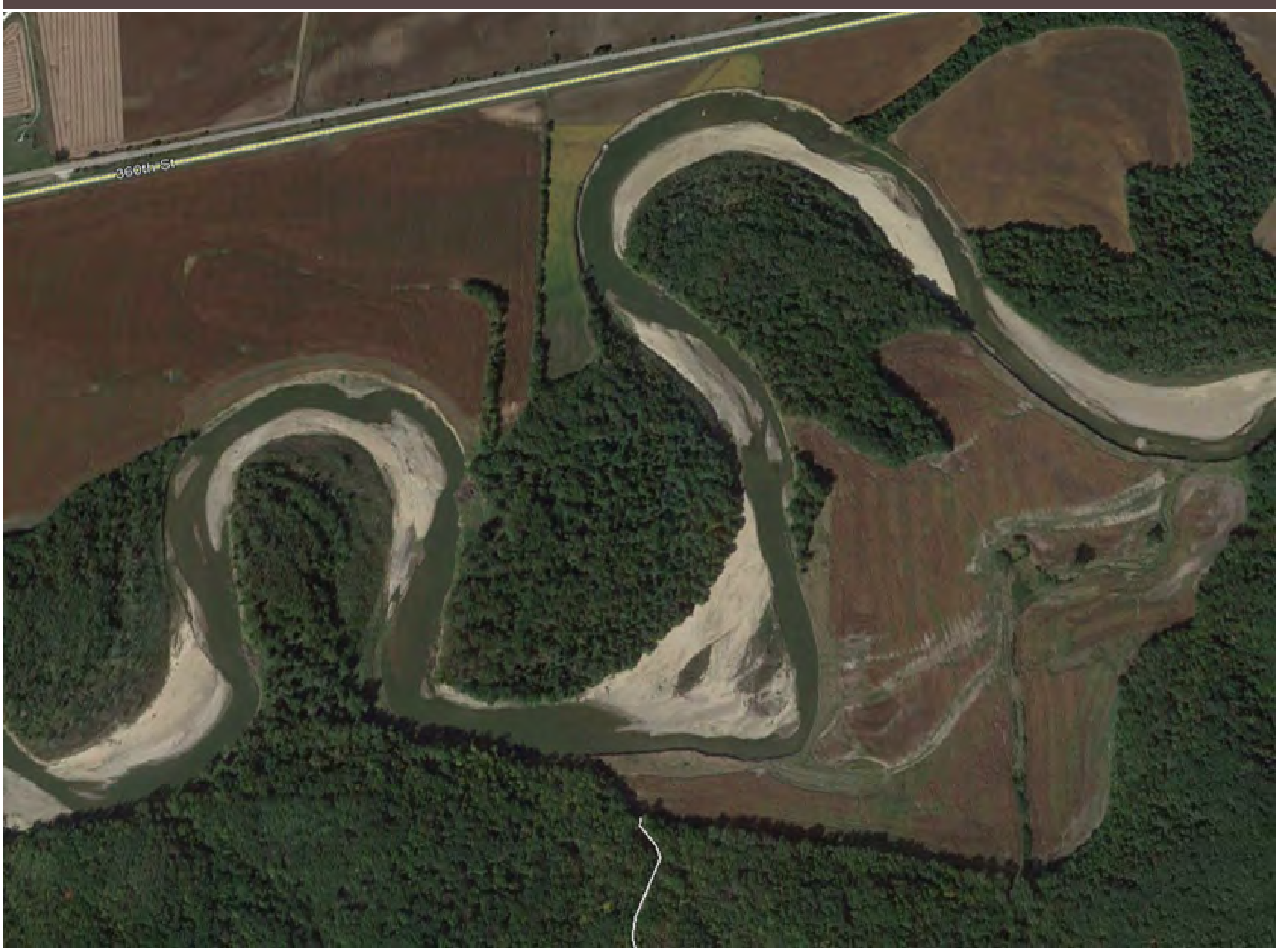
Source: Iowa DNR

Sediment

In addition to recreational impacts caused by sediment noted previously, high levels of sediment runoff can reduce storage volumes in lakes, wetlands, ponds and other stormwater storage practices. This can lead to costly dredging or soil-removal operations.

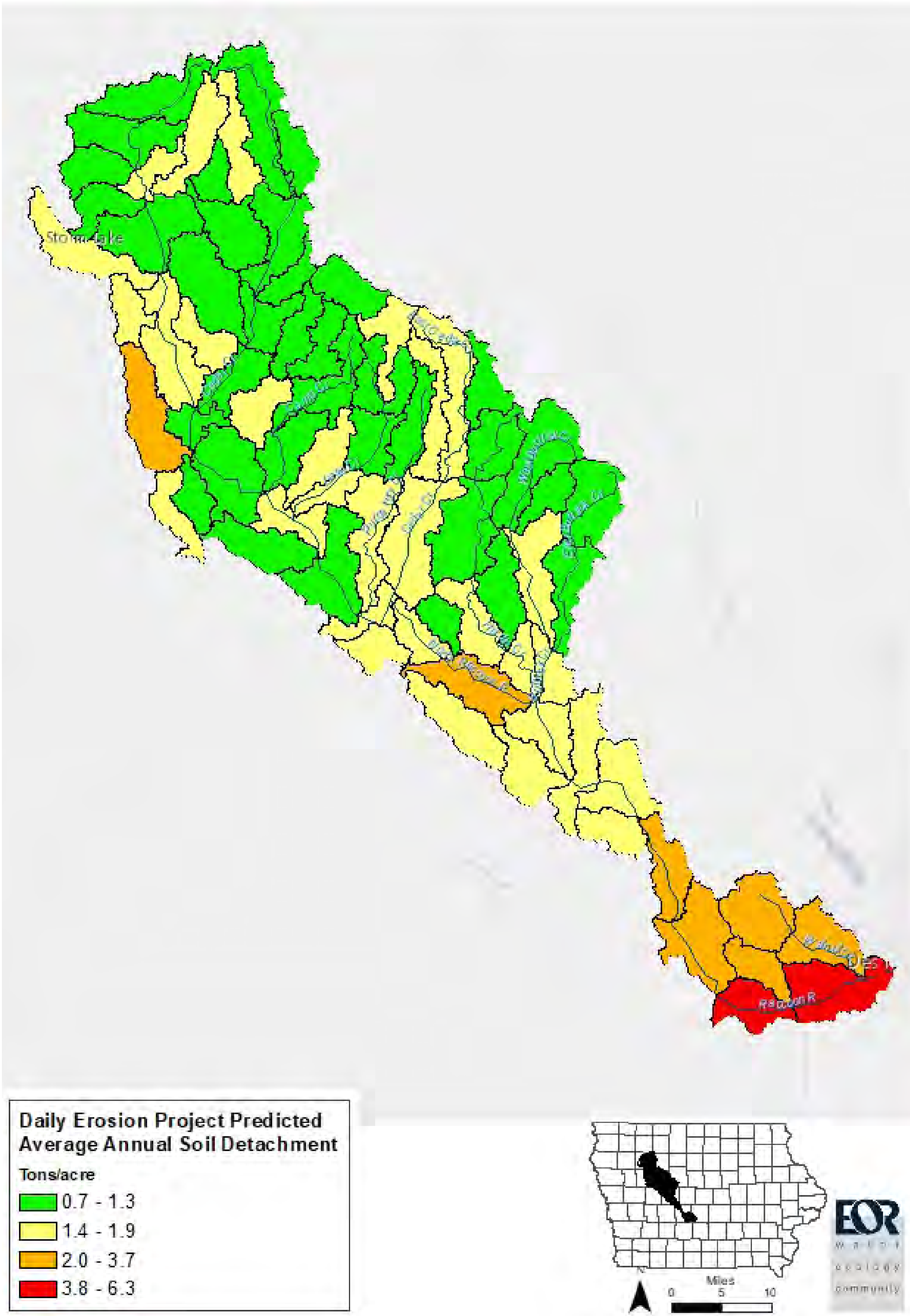
High levels of sediment can also cover rock and cobble areas which may be used as habitat for fish and invertebrates. Deposition in channels along inside bends can also accelerate stream migration, an erosive process which itself generates sediment. Figure 2-7 shows an example of deposition along inner bends of the Raccoon River just east of Booneville. Deposition can accelerate the movement of outer bends in an outward (and generally downstream) direction. Figure 2-8 illustrates potential source areas for sediment from across the watershed.

FIGURE 2-7 DEPOSITION ALONG INNER BENDS OF RACCOON RIVER NEAR BOONEVILLE, IOWA



Source: Google Earth, 9/30/2013

FIGURE 2-8 AVERAGE ANNUAL SOIL DETACHMENT



Source: Iowa State University, 2019

HYPOXIC ZONES

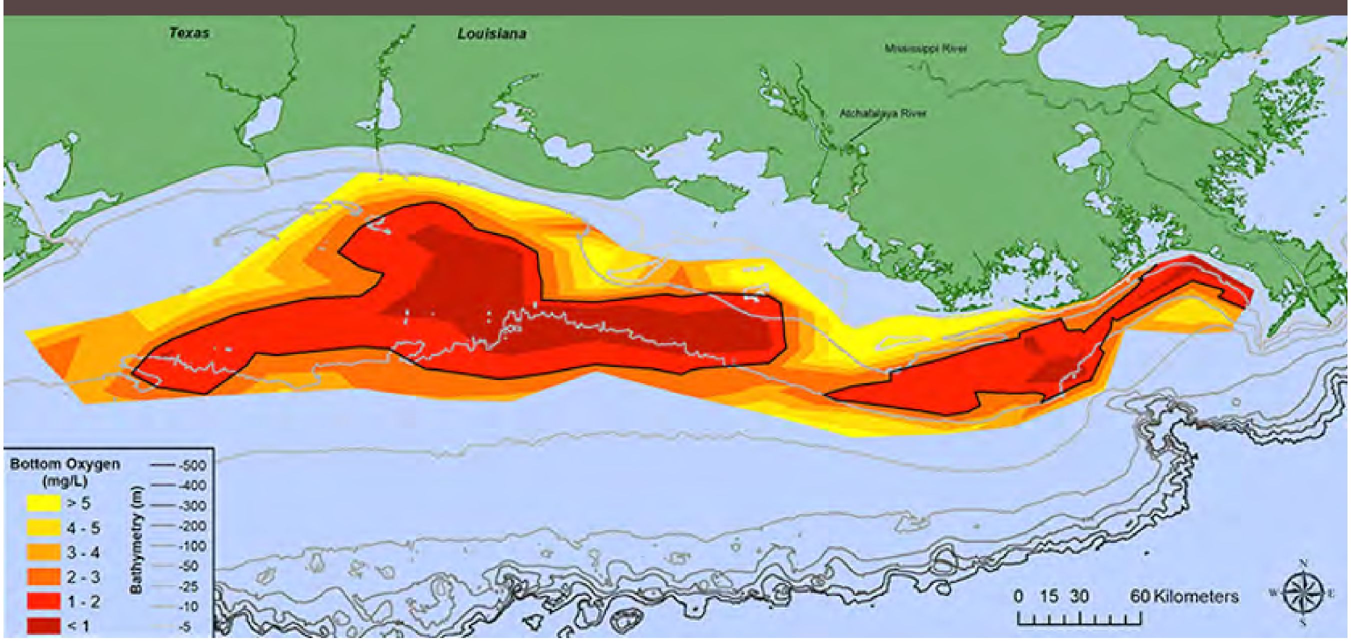
High nutrient levels can lead to the growth of algae and other organisms that can reduce oxygen levels in waterbodies. When populations of these organisms die off, the process of decay consumes oxygen. If levels fall too low, aquatic life in those areas can be fatally impacted. Some species may be able to swim to areas with better oxygen levels. Slow-moving aquatic life may not be able to move fast enough to survive (NOAA 2020).

These conditions can sometimes be present in Iowa streams and lakes. However, a large hypoxic "dead zone" has formed in the Gulf of Mexico, where dissolved oxygen levels are less than 2 mg/L. This area is now the second-largest "dead zone" in the world (Figure 2-10). This has led to a national effort to reduce the size of the dead zone to 5,000 square kilometers (1,930 square miles; Figure 2-9). The size of the dead zone varies from year to year due to weather conditions. Over the last five years of measurements (2014–2019) the zone has measured between 7,000 and 22,700 square kilometers (2,700 to 8,800 square miles).

Those national efforts led to the formation of Iowa's NRS to address nitrogen and phosphorus pollution (U.S. EPA 2015).

FIGURE 2-9 VARIATION OF HYPOXIC ZONE SIZE, GULF OF MEXICO

FIGURE 2-10 MAP OF HYPOXIC ZONE IN GULF OF MEXICO (2019)



GOALS AND OBJECTIVES

Table 2-1 lists the goals and objectives developed by the NRRWMC. These were created through a series of stakeholder workshops, small-group discussion exercises and surveys.

- **December 12, 2018: Included an assessment of the watershed resources available at that time, a facilitated discussion about the parameters in the watershed that would define success to stakeholders and the measures and indicators that could be used to assess progress.**
- **July 19, 2019: Additional information was used to refine specific objectives for flooding, water quality and organizational funding.**
- **Surveys: Three online surveys were sent to members and partners who provided additional input.**

The NRRWMC decided to make flooding and water quality the primary issues for this plan to address. Strategies to address these goals include quantifying practices and estimating cost to achieve a set benchmark. After considerable discussion, the NRRWMC decided to adopt the nitrate reduction determined by the Raccoon River TMDL (48.1% reduction from point and non-point sources) and the phosphorus-reduction target established in the Iowa NRS for non-point source pollution (45% reduction total, 29% assumed for non-point sources).

The NRRWMC chose to consider pathogens—represented by Escherichia coli (*E. coli*) bacteria—and sediments as secondary issues for this plan to address. However, no numeric reduction objectives would be established for these issues, due in part to the complex nature to fully implement practices and monitor performance to address these pollutants.

DID YOU KNOW?

It has been estimated that meeting the Iowa Nutrient Reduction Strategy targets for nitrates and phosphorous will increase recreation benefits from Iowa's lakes by about $30 million per year.
(Tang et al. 2018)

Source: Iowa DNR

TABLE 2-1 GOALS AND OBJECTIVES OF THE NORTH RACCOON RIVER WATERSHED MANAGEMENT PLAN

ISSUE/GOAL	OBJ #	OBJECTIVE	REFERENCE
Improve soil health on agricultural land in the watershed	SH1	Increase soil organic matter by 1%	–
Flooding Reduce flood-related impacts to property while increasing flood resiliency within the watershed	Fld1	Reduce flood impacts to property and crops	Assessments: Ch 3, 4 Strategies: Ch 5, 9 Local hazard mitigation: Ch 11 Milestones and Resource Needs: Ch 14, 16
	Fld2	Increase flood resiliency in the watershed	
Water Quality Improve water quality in surface and groundwater resources	WQ1	Reduce nitrate loads in the watershed by 48.1% (see discussion starting on page 62) and achieve a reduction in phosphorus loading of 45% (29% target reduction from non-point sources).	Assessments: Ch 3, 4 Strategies: Ch 5, 9 Milestones and Resource Needs: Ch 14, 16
	WQ2	Reduce nutrient, bacteria and other surface water pollutants into surface water and groundwater within the watershed	
Recreation Enhance water-based recreational opportunities with an emphasis on habitat restoration	Rec1	Reduce bacteria loads in the watershed	Assessments: Ch 3, 4 Strategies: Ch 5, 9 Milestones and Resource Needs: Ch 14, 16
	Rec2	Increase habitat acres for endangered and protected species	
Education Provide watershed education with an emphasis on flood management and water quality	EO1	Improve awareness of water quality and quantity issues and conservation practices among all watershed residents	Strategies: Ch 13 Milestones and Resource Needs: Ch 14, 16
	EO2	Focus outreach and education efforts to operators and landowners on flood mitigation strategies and nutrient and drainage management strategies	

ISSUE/GOAL	OBJ #	OBJECTIVE	REFERENCE
Organization & Funding Develop a watershed community based on common goals, respect, and an understanding of upstream and downstream issues	Org1	Develop a stable funding mechanism to fund a watershed coordinator and baseline NRRWMC operations	Strategies: Ch 10 Overcoming Barriers: Ch 12 Milestones and Resource Needs: Ch 14, 16
	Org2	Strengthen the NRRWMC to be a more cohesive and productive organization	
	Org3	Build the NRRWMC's reputation as a respected authority on watershed management issues among residents and stakeholders	
Partnerships Develop collaborative relationships with public and private partners to achieve mutual goals	Part1	Leverage existing conservation initiatives and partners in the watershed	Strategies: Ch 10 Milestones and Resource Needs: Ch 14, 16
	Part2	Explore opportunities to collaborate with public and private entities on achieving mutual goals	
Policy Improve public policy across watershed jurisdictions to achieve goals and reduce future impacts	Pol1	Advocate at the state and federal level for policies that assist watershed organizations within Iowa in achieving mutual goals	Strategies: Ch 9 Milestones and Resource Needs: Ch 14, 16
	Pol2	Ensure that the existing ordinances within the watershed align with the goals of the Watershed Management Plan	

STAKEHOLDER INPUT

Preliminary engagement with stakeholders indicated general concerns about water quality. Additionally, they expressed general concerns regarding flooding and its ability to cause significant damage to property, public infrastructure, crop yield and recreational areas (i.e., portage areas and parks).

Initial consultation with stakeholders provided a summary of the many concerns, attitudes and expectations that exist within the watershed. Specific concerns from stakeholders regarding natural resources included the geographical makeup of the board and the types of projects being pursued, a limited knowledge of where tile is and the fact that some drainage areas are not within drainage districts.

Later in the planning process, stakeholders identified some key areas that need to be addressed regarding this topic (natural resources).

These include:

- **Flooding, which causes the most damage to property, crop yield and recreational areas**
- **Improving water quality and protecting finite resources that need to last for generations**
- **Field runoff, which causes road closures and displaces the ability of people to get to work, home, etc.**
- **Protection of recreational areas which should last for generations**
- **Maintaining/expanding the North Raccoon River water trail**

TABLE 2-2 NITRATE REDUCTION TARGETS IN IOWA

SOURCE	REDUCTION TARGET
Des Moines River at Des Moines	TMDL: 34.4%
Cedar River at Cedar Rapids	TMDL: 35.0%
Raccoon River at Des Moines	TMDL: 48.1%
Iowa NRS	45.0%

NITRATE REDUCTION GOAL

Many factors were considered when establishing a goal for the reduction of nitrate loading to be addressed by this plan.

As discussed in more detail in Chapter 2, nutrient pollution from the Mississippi River basin has created an area within the Gulf of Mexico where dissolved oxygen levels in the water are greatly reduced. This creates a “dead zone” where many species of sea life cannot survive. In the response, the EPA organized the states within the Mississippi River Watershed, including Iowa, into the Gulf Hypoxia Task Force. The group asked each state to develop its own specific strategy to reduce nutrient pollution (primarily nitrogen and phosphorus). The Iowa NRS was adopted in 2013 and established a 45% nitrate load reduction target for water leaving the state. The target nitrate reduction was divided among point sources (4%), such as wastewater treatment plants and non-point sources (41%), which includes surface runoff from rural and urban landscapes. The strategy calls for mandatory reductions from point sources and voluntary efforts to meet the reduction goals for non-point sources.

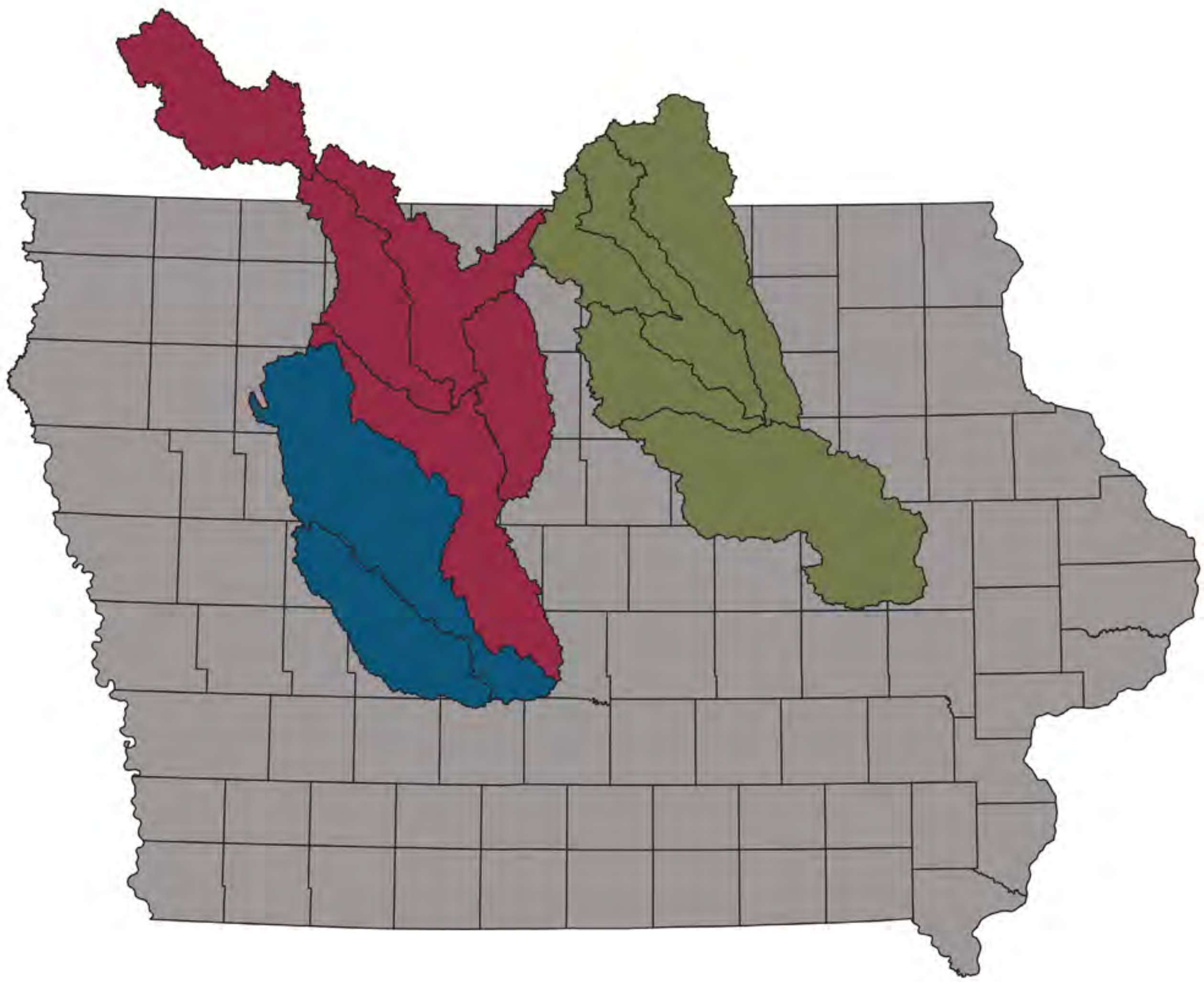
Within Iowa, a process to address local water quality impairments has been in place since the late 1980s. Under authority of the Clean Water Act, the EPA directed states to assess their waterbodies to determine whether or not they were meeting designated uses (the designated uses within this watershed are discussed in Chapter 3). Three rivers within Iowa, which serve as drinking water sources, were found to have nitrate concentrations that exceeded water quality standards (the Raccoon, Des Moines and Cedar Rivers). As a result, these rivers are not seen as meeting their designated use as a water supply source (see Table 2-2 and Figure 2-11).

In the case of the Raccoon River, the impaired stream reaches are located downstream of the confluence of the North and South Raccoon Rivers. In response, as required under the Clean Water Act, the Iowa DNR developed a TMDL limit for the watersheds draining to the impaired segments of the Raccoon River. The TMDL study determined that a total 48.1% reduction in nitrate loading from all sources was needed for the river to achieve the drinking water quality standard under all flow conditions. This plan projected that loading from point sources would be held steady, which would require all reductions to be come from non-point source reductions. This target reduction applies to all areas that contribute runoff to the impaired segments of the river, which includes the entire North Raccoon River Watershed as well as the Middle and South Raccoon River Watersheds.

To summarize the differences in these standards, the TMDL calls for a maximum loading reduction of 48.1%, which is assumed to come entirely from non-point sources. The NRS sets the target at 45%, which it splits between point (4%) and non-point sources (41%). In the case of the NRS target, if required improvements to local wastewater treatment plants are seen as too costly to reach desired point source reductions, the removal rates for non-point sources would need to be increased to meet the total target load reduction of 45%. Conversely, in the case of the TMDL target, if improvements from wastewater treatment plants are planned, then the 48.1% assigned to non-point sources in the TMDL study could be reduced by an equal amount. In any case, the overall difference in the target loading reduction is 3.1%. These past studies and initiatives were considered during discussions at several NRRWMC and stakeholder meetings. Potential impacts to grant funding eligibility were key concerns that were debated around this issue. Should the plan not endorse a goal that meets or exceeds the TMDL standard, it could disqualify projects from grant funding support from certain sources, such as Section 319 implementation funds. To broaden the potential sources of project funding, the TMDL standard would need to be referenced as a goal. Based on those discussions, a majority of the NRRWMC board decided the plan should use the TMDL standard of a total nitrate load reduction of 48.1%, as opposed to the Iowa NRS target of 45%.

It should be understood that meeting either of these goals within this watershed will require decades of work. This will involve installing multiple conservation practices and infrastructure projects, initially focused in key priority subwatersheds and being more broadly distributed over time.

FIGURE 2-11 NITRATE REDUCTION TARGETS IN IOWA



Des Moines River at Des Moines TMDL: 34.4%

Cedar River at Cedar Rapids TMDL: 35.0%

Raccoon River at Des Moines TMDL: 48.1%

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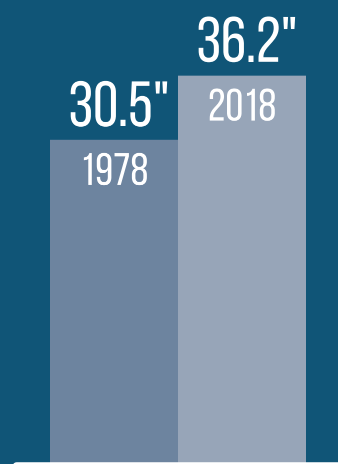
WATERSHED SUMMARY

78% row crop | 3% urban | 19% other

0.8% within 2-year floodplain

$18M

average each year in building and property flood damage within watershed area



19%

rainfall increase in Des Moines

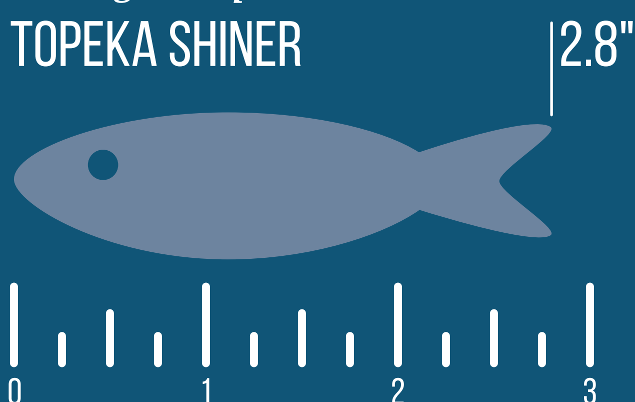
! **38** ***impairments of designated issues***

WATER QUALITY ISSUES:

- ***Nutrients***
- ***Pathogens***
- ***Sediment***

Endangered Species:

TOPEKA SHINER



38%

higher riverflow volume at Van Meter since 1984

03

WATERSHED SUMMARY

This chapter goes into greater detail about the watershed conditions that influence the issues, which are described more broadly in Chapter 2.

Read this chapter to learn about:

- Land uses and natural resources across the watershed
- Watershed climate and streamflow patterns
  - Flooding impacts
  - Identified water quality issues
- Designated uses of streams and lakes
  - How those uses have been impaired

INTRODUCTION

This chapter outlines various conditions within this watershed which can directly influence the issues discussed in Chapter 2 that this plan is seeking to address. These include:

- **Watershed geography (land uses and natural resources)**
- **Hydrology (climate, streamflow) and impacts (flooding, water quality)**
- **Designated uses of waterbodies within the watershed and impairments of those uses**

To study these properties, the North Raccoon River Watershed has been divided into six distinct "watershed settings" which are used to group areas that share similar properties or challenges. These settings are based on groupings of smaller watersheds (HUC-10) defined by primary tributaries to the North Raccoon River. These watershed settings will also be referred to in other chapters of the plan. These watershed settings, described in more detail in the Watershed Assessment document (Emmons and Olivier Resources, Inc. 2020), include:

- **Headwaters North Raccoon**
- **North Central Tributaries**
- **Eastern Tributaries**
- **Upper North Raccoon River Mainstem**
- **Lower North Raccoon River Mainstem**
- **Raccoon River (located below the confluence with the South Raccoon River near Van Meter)**

See Figure 3-1 for locations of these watershed settings.

WATERSHED CHARACTERISTICS

Flooding and water quality issues have posed significant challenges in the North Raccoon River Watershed. These include adverse impacts on property, crops, infrastructure, public health, safety, habitat and recreational spaces. Various factors influence the behavior and health of water resources in the watershed (including hydrologic conditions and land use practices), which help identify potential causes of these issues.

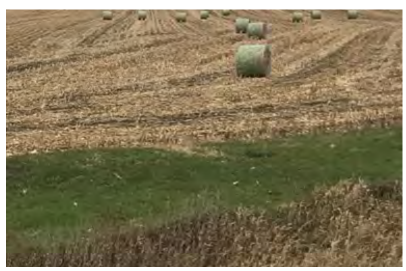
LAND USES

The North Raccoon River Watershed has been altered from its natural state. Currently, 77.7% of the watershed area is row crop agriculture and 3.2% is urban development. Other land uses are as noted in Figure 3-2. Characteristics associated with an altered watershed versus a natural watershed are shown below. These altered watershed characteristics typically result in increased rates and volumes of flow, potentially carrying chemical and biological pollutants to local streams and waterbodies. This results in a watershed that is increasingly prone to flooding, channel erosion and degradation in water quality.

FIGURE 3-1 EFFECTS OF LAND USE CHANGES

NATURAL WATERSHED
PRAIRIE/SAVANNA

- **Little runoff**
- **High infiltration**
- **Stable soils**
- **High soil organic matter**
- **Consistent evapotranspiration**
- **High depressional storage**
- **Deep-rooted systems**
- **Limited erosion**



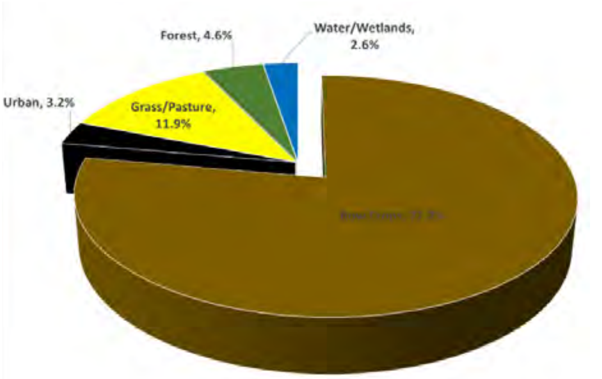
ALTERED WATERSHED
AGRICULTURE

- **Increased runoff**
- **Reduced infiltration**
- **Erodible/bare soils at times**
- **Low soil organic matter**
- **Evapotranspiration out of sync**
- **Depressions drained**
- **Subsurface drainage**
- **Added nutrients**

ALTERED WATERSHED
URBAN

- **Increased intense runoff**
- **Reduced infiltration**
- **Compacted, unhealthy soils**
- **Increased volumes of runoff**
- **Reduced evapotranspiration**
- **Depressions filled**
- **Added nutrients**

FIGURE 3-2 PRIMARY LAND USES IN THE NORTH RACCOON RIVER WATERSHED



Source: NLCD 2016

Rural Areas

INTENSIVE AGRICULTURE

Following the intensification of agricultural production starting in the 1950s, most North American cropland saw a sharp increase in inputs, including both organic and synthetic fertilizers. Fertilizers may be applied in excess of what is taken up by the crops and, therefore, nutrients from these fertilizers can be carried in the form of runoff into navigable waters and permeate through the ground into groundwater resources. Hatfield et al. (2009) found that observed increases in NO3-N concentrations in the Raccoon River basin since 1970 are highly correlated with a decrease in the amount of land in the watershed devoted to growing small grains and hay—nearly all of which has been converted to corn and soybeans. They also found that these changes in cropping patterns were far more influential on increases in NO3-N concentrations during this period than other factors, such as changes to fertilizer application or increases in precipitation.

TILE DRAINAGE

Installation of drainage tiles is a farming practice that has been used for more than a century and continues to be a common practice today. Tile drains transport water from poorly drained soils, some of which may have originally been wetlands, for farmers to plant crops. ***Modifications to the drainage of Iowa's landscape began in the late 1800s, which eventually altered an estimated 99 percent of Iowa's original wetlands, marshes and small streams*** (Koch and Asell 2000). The North Raccoon River Watershed is heavily tiled, particularly in the northern and central regions of the watershed (Emmons and Olivier Resources, Inc. 2020). While tile systems are important networks to support row crop production, they have the potential to deliver nutrients and water to streams more quickly.

MANURE FERTILIZATION

The fertilization of crops with manure is a common practice across the watershed, due in part to the need of confined animal feeding operations (CAFOs) to dispose of manure. CAFO operators develop manure management plans that stipulate the areas of land where they will apply manure based on the quantity of animal units in their operation. By implementing these plans, farmers can use the manure as fertilizer to ultimately reduce the cost of commercial fertilization. During watershed planning workshops, participants expressed concerns that the nitrogen content of manure may be underestimated by farmers, leading them to over-apply commercial fertilizer.

Manure is a significant contributor to bacterial pollution in the watershed. A past watershed study projected that manure from hogs and cattle comprise a significant portion (98%) of the total bacteria population in the Raccoon River Watershed (Schilling and Wolter 2008). When precipitation is elevated, runoff contains a high concentration of bacteria, causing beach closures and other restrictions to recreation.

Urban Areas

As areas are developed for homes, businesses and related transportation networks, a greater portion of the landscape is covered by surfaces that are impenetrable for rainfall. These impervious surfaces prevent rainfall from naturally soaking into the ground. During rain events, runoff is quickly collected and directed into receiving waters through storm drain intakes and pipe networks. ***This can lead to large increases in the rates and volumes of water being discharged to lakes, streams and rivers.*** (Refer to Chapter 1 for more information.)

Stormwater pollution in urban settings results from fertilized grasses and from the many man-made contaminants that are deposited onto impervious surfaces (oils, metals, chemicals, pet waste, etc.). Three primary pollutants of concern in urban areas are phosphorus, sediment and pathogens.

Since urban land uses make up a small part of the North Raccoon River Watershed, their influence on flooding and water quality issues on the majority of the mainstem of the river may be limited. However, there may be significant impacts along smaller tributaries, whose watersheds have a higher percentage of urban development. These streams may see dramatic increases in flashy high flows, channel erosion and pollutant loadings. There are also scenarios where flow volume at the Raccoon River in Des Moines is dominated by flow from some of these urban tributaries. One such scenario is where an intense storm event occurs in Central Iowa, which was preceded by a dry weather period. In the hours immediately following such an event, the majority of flow in the Raccoon River could come from areas draining to Walnut, Jordan and/or Sugar Creeks, which drain the western part of the Des Moines metro. Flow in the river could continue to be dominated by flows from these areas until flows from rural areas much further upstream have a chance to reach those reaches of the river.

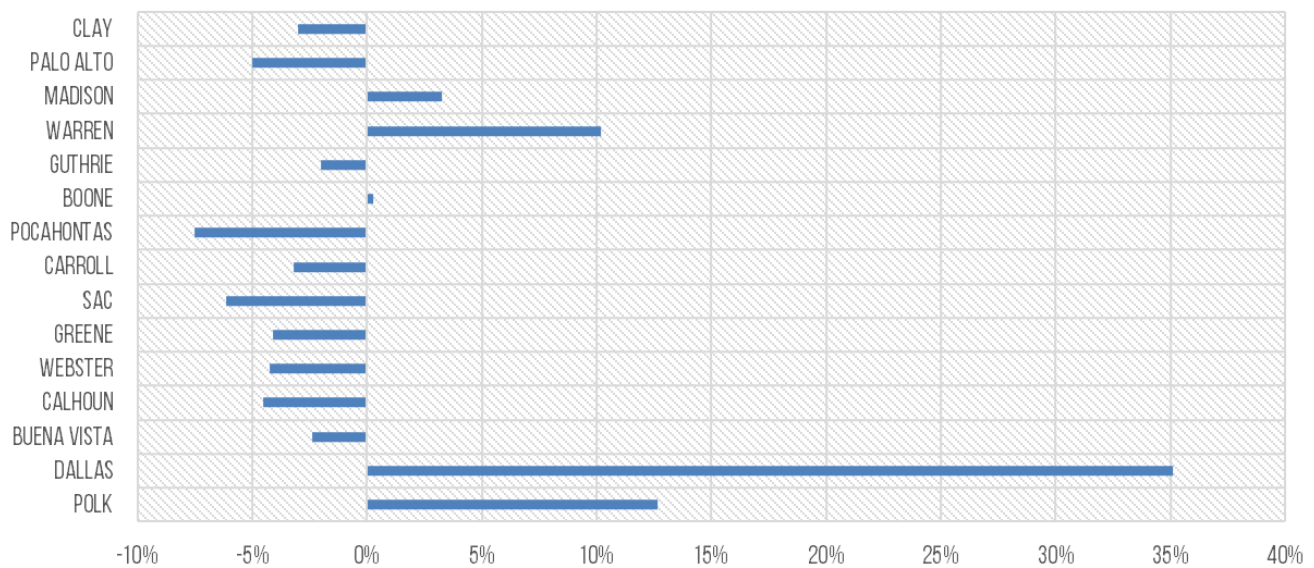
Table 3-1 and Figure 3-3 illustrate how human population and urban growth have been concentrated in Dallas, Madison, Polk and Warren Counties, which are located near the Des Moines metro area in the lowest part of the watershed. Most other counties in the watershed have seen declines in population since 2010.

TABLE 3-1 CENSUS POPULATION BY COUNTY IN THE WATERSHED

COUNTY	2018 CENSUS ESTIMATED POPULATION	PERCENT OF COUNTY IN WATERSHED	ESTIMATED 2018 POPULATION WITHIN WATERSHED
Polk	487,204	12.2%	59,640
Dallas	90,180	42.5%	38,292
Buena Vista	19,874	62.7%	12,452
Calhoun	9,699	98.3%	9,531
Webster	36,277	21.8%	7,891
Greene	8,981	77.6%	6,970
Sac	9,719	49.2%	4,781
Carroll	20,154	18.0%	3,634
Pocahontas	6,740	34.5%	2,326
Boone	26,346	1.7%	458
Guthrie	10,720	2.0%	215
Warren	51,056	0.3%	176
Madison	16,249	0.7%	116
Palo Alto	8,929	0.9%	80
Clay	16,134	0.3%	48

Source: U.S. Census Bureau

FIGURE 3-3 POPULATION CHANGES IN THE NORTH RACCOON RIVER WATERSHED—2010 TO 2018



DID YOU KNOW?

According to the U.S. Census Bureau, between July 2010 and July 2018, Dallas County was the fastest-growing county in Iowa with a 35% growth in population. This rapid urban growth has a larger impact on tributaries feeding into the Raccoon River in the lower part of the watershed.

NATURAL RESOURCES

This watershed has recreational areas and amenities, many of which are located along the river and its tributaries, but there could be opportunities to expand upon these existing resources. There are also ecological and habitat challenges that this plan must consider.

Also, the vast majority of natural pothole depressions and wetlands that were originally in the watershed have been drained for agricultural and urban development, leaving limited habitat for wildlife.

Key Recreational Areas

One outcome of this plan should be to improve conditions that will support existing and new recreational opportunities across the watershed. Some of these key features include:

RACCOON RIVER VALLEY TRAIL

In 1987, conservation boards from Dallas and Guthrie Counties approved the development of a multi-use trail, which led to the first section of the Raccoon River Valley Trail, located in parts of the North Raccoon River Watershed. This 34-mile route was completed in 1990 and has now extended to a nearly 90-mile trail from Jefferson to Clive. Along this trail users can see prairie remnants, wildlife, farm animals and historical developments such as the "French Castle" (Dallas County Courthouse) or the 162-foot-tall Mahanay Memorial Carillon Tower on the Greene County Courthouse square. The trail is used for a number of activities including cycling, jogging, walking, skating, cross-country skiing and snowmobiling. Some of these uses depend on which portions of the trail are open to those specified activities. More information about this trail can be found at the Raccoon River Valley Trail website.

NORTH RACCOON RIVER WATER TRAIL

Along the river is the North Raccoon River Water Trail with over 150 miles of routes starting north of Sac City and winding through Jefferson, Dawson, Adel and Van Meter. Calhoun, Sac, Carroll, Greene, and Dallas Counties have designated "Water Trail" routes with camping amenities along the way. These trails include a 17.8-mile stretch from Vogel Access to Sac City Park Access which goes through the McDonald Greenbelt and provides views of a variety of landscapes and wildlife; a 7.3-mile stretch in Greene County from Richey Access to Wright Access to Hyde Park Access and rock dam, which cuts through tall glacial bluffs and provides views of a wide variety of birds and other wildlife; and a 13.7-mile stretch in Dallas County from Perry Ramp Access to Spring Valley to Snyder to Highway 44 Access, a heavily wooded stream reach with many places to picnic and look for turtles and mussels. These trails and many more can be found in brochures on the Iowa DNR's website.

CENTRAL IOWA WATER TRAILS

This project aims to improve conditions along reaches of several streams in Central Iowa, including Walnut Creek and the Raccoon River.

RECREATIONAL LAKES

Storm Lake in Buena Vista County is the fourth-largest glacial lake in the state of Iowa and brings many tourists to the city looking for water recreation opportunities, including boating and fishing. Black Hawk Lake, near the City of Lake View is a popular fishing destination and is home to Black Hawk Lake State Park. North and South Twin Lakes, located in Calhoun County, are home to a state park, a county park, a swim beach and a camp. Other major water bodies within the watershed include Little Clear Lake, Spring Lake, Arrowhead Lake, Pickerel Lake and the Dale Maffit Reservoir.

OTHER SPACES

The North Raccoon River Watershed contains 16 beaches located primarily in Buena Vista County, but also in Greene, Sac, Polk and Calhoun Counties. There are around 52 boat docks and ramps, many of which are located along the North Raccoon River. Additionally, 12 documented fishing access points, 10 documented paddling access points, and 14 documented picnic areas can be found in the watershed. Almost 130 city parks, 43 county parks and 28 state parks, preserves and wildlife management areas are located in the North Raccoon River Watershed, providing many opportunities for hunting, fishing and general outdoor recreation. The majority of City parks are located in Des Moines, West Des Moines, Urbandale and Clive.

Endangered Species

The Topeka Shiner is an endangered species that lives in small- to mid-size prairie streams, often found in oxbows and off-channel pools, and has had a 70% population decline across the Midwest over the past 50 years (Iowa DOT 2017). A 2009 toxicity study along Buttrick Creek determined the water quality conditions for nitrate, nitrite and ammonia in the North Raccoon River Watershed could sustain the minnow species. However, there were hazards identified for several select reaches (Coffey et al. 2009). Possible causes of the Topeka Shiner decline in Iowa include habitat loss and fragmentation due to channelization and draining of oxbows, increased sedimentation, impaired water quality and the introduction of predator fish not native to the habitat. The protection of the Topeka Shiner was identified as a priority for the Raccoon River Watershed Master Plan (Agren, Inc. 2011).

DID YOU KNOW?

According to the Iowa Wildlife Action Plan, the North Raccoon River Watershed is one of the few places in the state of Iowa that has potential critical habitat for conservation of the Topeka Shiner (Notropis topeka). (Iowa DNR 2015)

Stream Buffers

Riparian buffers in the watershed remain, to a large extent, natural areas. Based on an analysis performed using Iowa's High-Resolution Land Cover data from 2011, on average, the near-stream riparian corridors are approximately 75% vegetated with trees, grasses or other natural vegetation, with the remaining 25% consisting primarily of row crops. Natural vegetation is more common and consistent in the riparian areas of the North Raccoon River and the Raccoon River and the larger tributaries, while along many of the smaller tributaries and agricultural ditches it is more common to see encroachment of row crop agriculture in close proximity to waterways. It should be noted, however, that the presence of natural vegetation does not necessarily indicate that the optimal type of vegetation is present at a given location, and it is currently unclear to what extent riparian areas are providing the most benefit to the streams and rivers.

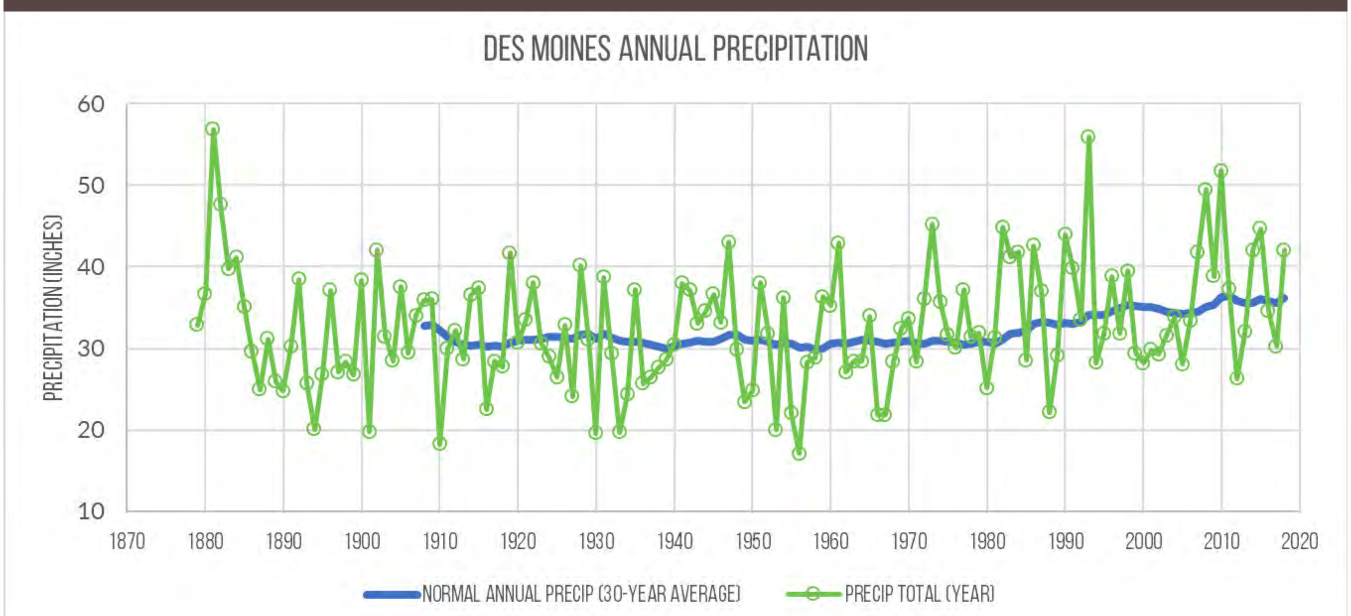
WATERSHED HYDROLOGY

Hydrology refers to how water interacts with the earth and moves across the landscape. Understanding hydrology provides insight into the causes and potential solutions for flooding in the watershed.

LOCAL CLIMATE

According to the North Raccoon River Watershed Hydrologic Assessment Report prepared by the Iowa Flood Center/IIHR—Hydroscience & Engineering, 2019 (Hydrologic Assessment), average annual precipitation in Iowa ranges from 26–40 inches, with the lowest precipitation in the northwest corner of the state and the highest in the southeast corner. The average annual precipitation ranges from roughly 33–36 inches in the North Raccoon River Watershed (PRISM,1981–2010). About 75% of the annual precipitation falls as rain during the months of April through September. During this period, thunderstorms capable of producing torrential rains are possible, with the peak frequency of such storms occurring in June. Central Iowa has experienced increased variability in annual precipitation since 1975, along with a general increase in the amount of spring rainfall (USDA and ISU 2011). Figure 3-4 demonstrates how normal annual precipitation at the Des Moines Airport has increased from 30.5" to 36.2" between 1978 to 2018 (a 19% increase).

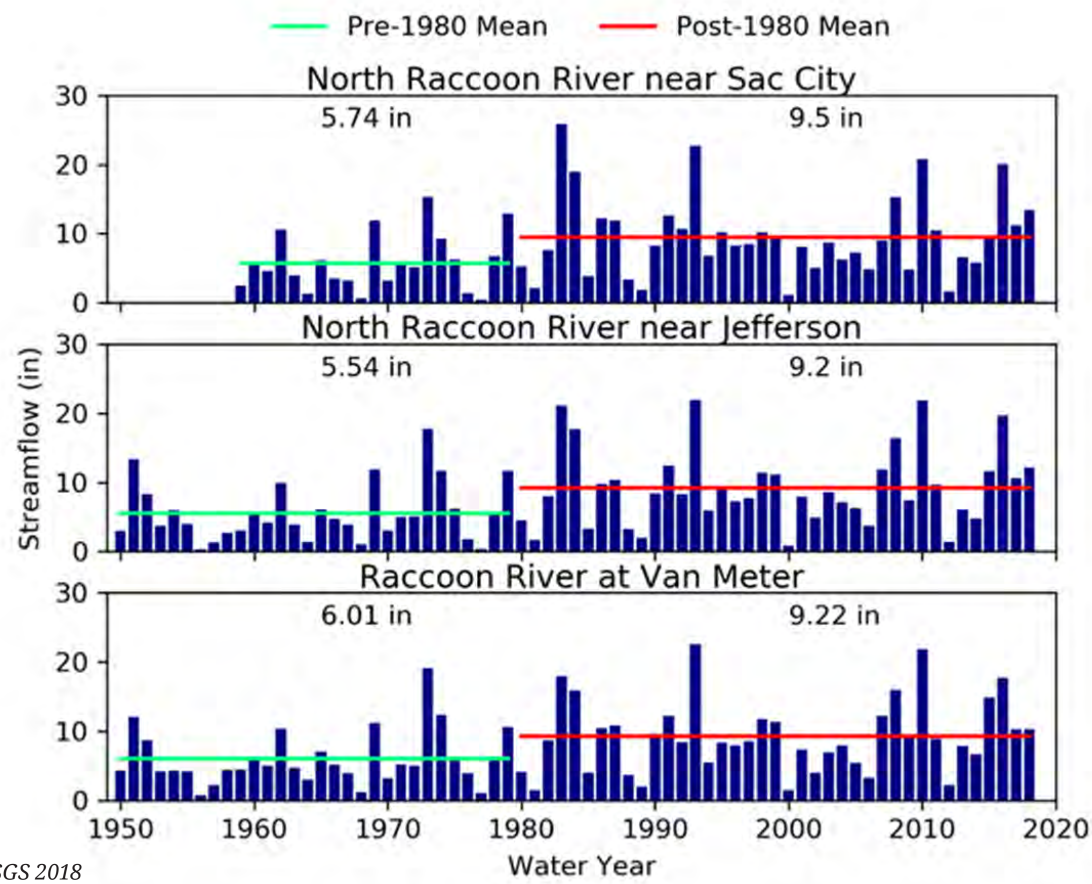
FIGURE 3-4 DATA FROM DES MOINES AIRPORT WEATHER STATION



STREAMFLOW

According to Eash et al. (2015), the average annual streamflow for North Raccoon River at Van Meter was approximately 38% higher during the 30-year period from 1984 to 2013 as compared to the period from 1916 to 2013. To demonstrate this, Figure 3-5 shows the annual streamflow depth in inches for Sac City, Jefferson and Van Meter USGS gauges (USGS 2018). The average annual streamflow depth for all stations is around 5.8 inches between 1950 and 1979. This number then increases to an average annual streamflow depth for all stations of 9.3 inches between 1980 and 2018. This increase is about 3.5 inches, but for streamflow it is more than a 60% increase from the previous 30-year period to the current 30-year period. This increase is much greater than the increase in average annual precipitation of 9%.

FIGURE 3-5 STREAMFLOW DATA



Source: USGS 2018

Impacts from Flooding

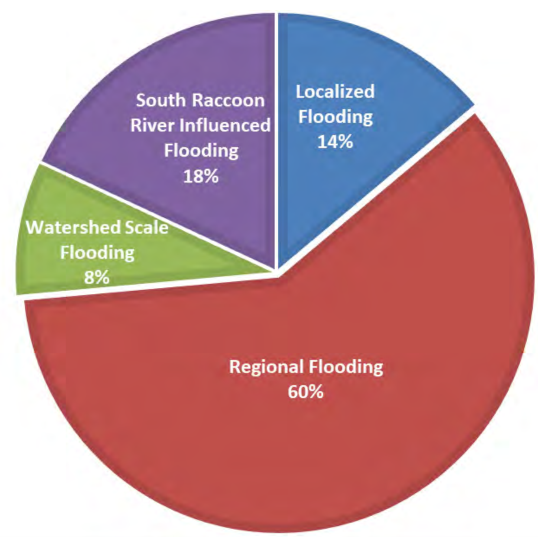
According to data from the HSEMD, which predicts flood damages to buildings using HAZUS, total average annualized losses to buildings in the watershed within the 500-year floodplain are estimated at $18 million. 74% of those costs are expected to occur in the Raccoon River Watershed setting (lowest part of the watershed) and 14% in the Headwaters North Raccoon Watershed setting (most upstream part of the watershed). Additional information on flooding can be found in the Watershed Assessment (Emmons and Olivier Resources, Inc. 2020).

Flood damages in the NRRW are placed into four categories. These include:

1. Localized flooding: confined to a single community or a smaller area. Runoff from local drainage causes the flooding.
2. Regional flooding: spans multiple communities or a large area. Runoff from more than one subwatershed contributes to the flooding.
3. Watershed-scale flooding: occurs along the river's mainstem. Runoff from *many* subwatersheds leads to the flooding.
4. South Raccoon River-influenced flooding: flooding along the mainstem of the Raccoon River downstream of the confluence with the South Raccoon River Watershed.

Of the property damages within the 500-year floodplain, 14% ($2.5 million) are localized flooding, 60% ($10.6 million) are regional flooding, 8% ($1.5 million) are watershed-scale flooding, and 18% ($3.2 million) are in areas where the South Raccoon River contributes to the flooding (see Figure 3-6).

FIGURE 3-6 POTENTIAL PROPERTY DAMAGE IN THE 500-YEAR FLOODPLAIN BY TYPE OF FLOODING



Source: HSEMD

Floodplains

Floodplains are areas on the landscape where water is distributed when runoff exceeds normal conditions that are typically conveyed by ditches, streams and rivers. Floodplains are often described by how frequently an area is covered by floodwaters. For example, the 2-year floodplain refers to areas that have been impacted by flooding about once every two years, on average, over a long period of time. These areas could be impacted several times a single year, or not flooded for several years, but over a long period flood impacts would occur about every two years on average. Such areas are said to be in the 50% annual recurrence chance floodplain, meaning there is a 50% chance of the area flooding in any given year.

The 500-year floodplain are areas expected to be impacted much less frequently. Such a flood would be expected only once every 500 years, on average, or have a 0.2% chance of occurring in any given year. However, as noted, such events can happen more frequently.

Approximately 9.3% of the watershed (146,871 acres) is within the 500-year floodplain. Of this, approximately 75,000 acres are in row crop production (approximately 50% of the 500-year floodplain; Table 3-2).

Approximately 3.5% of the watershed (54,813 acres) is within the 2-year floodplain. Of this, approximately 13,000 acres are in row crop production (approximately 24% of the 2-year floodplain; Table 3-2).

TABLE 3-2 CROPLAND IN FLOODPLAIN

FLOODPLAIN	CROPLAND IN FLOODPLAIN (ACRES)	PERCENT OF CROPLAND IN FLOODPLAIN IN WATERSHED
2-Year	13,169	0.8%
5-Year	25,861	1.6%
10-Year	34,479	2.2%
25-Year	45,702	2.9%
50-Year	52,260	3.3%
100-Year	60,245	3.8%
200-Year	66,952	4.2%
500-Year	74,589	4.7%

WATER QUALITY

When rainfall, snowmelt or irrigation water runs over land or through the ground it picks up various pollutants and deposits them into our waterbodies. This is referred to as ***nonpoint-source pollution*** (NPS). Pollution from an identifiable source is referred to as ***point-source pollution*** and includes discharges such as those from a wastewater treatment plant, industry or even urban runoff through a city storm drain network.

NPS pollution is the major water quality problem in the North Raccoon River Watershed. It has landed several watershed streams and lakes onto Iowa's Section 303(d) Impaired Waters Listing (Emmons and Olivier Resources, Inc. 2020) and has made several community water supplies susceptible to levels of contamination above drinking water standards. NPS pollutants traditionally addressed in watershed management plans include nutrients (nitrogen and phosphorus), pathogens and sediment. Other common pollutants include pesticides, salts, oil and grease.

These pollutants are derived in varying degrees from:

- **Agricultural lands**
- **Urban areas**
- **Construction sites**
- **Roads**
- **Parking lots**
- **Other areas**

Nutrients

Nutrients, especially nitrogen and phosphorus, are major nonpoint pollutants in Iowa. Nutrients naturally occur within soils and plant matter, but excess nutrients can be added to waters from fertilizers, both from agricultural land and lawns in urban areas—however, the impact of urban areas may be limited due to the area they occupy in this watershed). Nutrients are also present in organic sources such as manure and human sewage. While nitrogen and phosphorus pose a similar level of concern for the water resources within the watershed, there are fundamental differences in how they are transported that impact the ability to manage them.

Nitrogen, in its various forms, is soluble in water whereas the major form of phosphorus is often attached to soil particles. Management practices for nitrogen primarily rely on reducing fertilizer inputs, through conversion through anaerobic denitrification, or techniques that maximize the potential for uptake by plants such as fertilizer timing. The most common approach for phosphorus management is to address the particulate form through soil erosion control. More recently, management of phosphorus has focused on the dissolved component which has been tied to algae blooms. The dissolved form of phosphorus can be taken up by plants and can be removed through chemical binding.

Excessive nutrients in water can cause algae blooms in lakes, which reduces water clarity, increases odors and can make boating and fishing difficult. Harmful algae blooms often occur in lakes during calm, hot summer weather.

People and animals can become sick from contact with toxic blue-green algae, by swallowing or skin contact with water, or by breathing in tiny droplets of water in the air. Dogs are particularly vulnerable to toxic algae because they are more likely to wade into lakes with algal scum, which can be fatal (MPCA 2009). In 2019, twenty-one beach advisories were issued in Iowa, including the North Twin Lake East Beach, due to high levels of microcystins, which are toxins produced by some forms of blue-green algae blooms (cyanobacteria) that make the water unsafe for swimming (Iowa Environmental Council 2020).

At concentrations greater than 10 mg/L, nitrate-nitrogen has been linked to health problems like methemoglobinemia ("blue baby syndrome") and some forms of cancer (ATSDR 2015; Temkin et al. 2019).

Pathogens

Disease-producing organisms (pathogens) can cause health problems for people encountering contaminated water. Testing for a wide range of disease-producing organisms is difficult and expensive, so two closely related bacteria groups, fecal coliforms and *E. coli,* are commonly used to indicate the presence of pathogens. For simplicity this pollutant group is then referred to as fecal bacteria. Sources of fecal bacteria to waterbodies are diverse and include livestock, pets, wildlife populations and even human sewage.

Sediments

Excess turbidity can significantly degrade the aesthetic qualities of waterbodies. People are less likely to recreate in waters degraded by excess turbidity. Also, turbidity can make the water more expensive to treat for drinking or food processing uses. Excess turbidity can harm aquatic life, as aquatic organisms may have trouble finding food, gill function may be affected or spawning beds may become buried in sediment.

Summary of Impacts

The North Raccoon River Watershed water quality issues include both surface water and groundwater. In the watershed assessment, five primary concerns with NRRW water quality were identified:

- **Drinking water, recreation and aquatic life impairments in many watershed lakes and streams**
- **Mainstem and tributary water quality monitoring reveals levels of nitrates above safe drinking water standards**
- **Well water and groundwater contamination with bacteria and nitrate-nitrite**
- **Measured bacteria levels in watershed streams and lakes routinely exceed State standards for recreation contact**
- **High Total Suspended Solids (TSS) in streams early in the growing season**
- **High TSS in lakes late in the growing season**

DESIGNATED USES

Designated uses for streams and other waterbodies are the functions that a stream needs to be supported, which are often tied to human activities, such as drinking water sources or recreational uses. They also can be related to habitat or ecological functions. Water quality standards for a given stream, river or lake are based on the designated uses that waterbody is expected to support.

IMPAIRED USES

A waterbody is designated as impaired if conditions are present which limit its ability to support its designated use(s). ***In 2016, the Iowa DNR listed 38 impairments of designated uses for various waterbodies within the North Raccoon River Watershed. These include nine streams and eight lakes and/or wetlands*** (Table 3-3).

TABLE 3-3 TYPES OF WATER QUALITY IMPAIRMENTS IN THE NORTH RACCOON RIVER WATERSHED

TYPE OF IMPAIRMENTS	NUMBER OF LOCATIONS IMPAIRED
Drinking water supply	2
Primary-contact recreation	21
Aquatic life	15

Source: Iowa DNR

DID YOU KNOW?

The State of Iowa lists only three locations as impaired for drinking water sources: the Raccoon River, the Des Moines River and the Cedar River.

Drinking Water Impairments

Surface water drinking impairments (related to high nitrate levels) affect Des Moines Water Works, which uses the Raccoon River as a major supply source to approximately 500,000 people in the Des Moines area. However, Des Moines Water Works is not the only water supply affected by impairments in the North Raccoon River Watershed.

Levels of nitrate exceeding safe drinking water standards have been found in the North Raccoon River and several tributary streams, according to monitoring conducted by Agriculture's Clean Water Alliance (ACWA) (2018). ***There are 78 highly susceptible wells; two priority community wells, Dawson and Lake View, are also impacted.*** Priority community wells are located in highly susceptible aquifers and have had finished water nitrate levels above 5 mg/L. A 2019 report released by the Environmental Working Group (EWG) indicated that between 2002 and 2017 around 12% of wells in Iowa had nitrate averages at or above

10 mg/L, the EPA's limit for nitrates in drinking water (Schechinger 2019). Communities using water from wells with high nitrate concentration can sometimes blend water from the source with other stored water that has lower nitrate levels, to ensure finished water is below the allowable threshold. However, this technique may not be effective if nitrate levels in source waters are very elevated or remain about the allowable standard for an extended period. Water from private wells is less frequently treated to reduce nitrate levels.

Therefore, nitrates are a concern in both groundwater and surface water for this watershed due to their effect on drinking water sources. Additionally, bacteria, sediment and phosphorus are significant contributors to impairments in the watershed. Table 3-4 summarizes drinking water impairments within this watershed.

Recreation-Related Impairments

There are three algal growth, five turbidity and twelve bacteria impairments currently on Iowa's 303(d) list in the North Raccoon River Watershed which do not support or only partially support the designated use of primary-contact recreation. The bacteria impairments are based on monitoring data which show that the geometric mean *E. coli* concentrations exceeded the 126 organisms/100 mL standard. Four lakes are identified as Impairment Category 5a waterbodies. A TMDL is needed to address the bacteria impairments on Black Hawk Lake, Storm Lake and North Twin Lake. A TMDL is also needed to address the algal growth and turbidity impairments on Pickerel Lake. Table 3-5 summarizes primary-contact recreation within this watershed.

TABLE 3-4 DRINKING WATER DESIGNATED-USE IMPAIRMENTS

Concern	Human health impacts including methemoglobinemia ("blue baby syndrome") and some forms of cancer
Pollutant of Interest	Nitrate-nitrogen
Standard	10 mg/L
Areas Impacted	Raccoon River: Des Moines area drinking water City of Dawson public water supply City of Lake View public water supply Public and private drinking water supply facilities

TABLE 3-5 RECREATION DESIGNATED-USE IMPAIRMENTS

CONCERN:	HUMAN HEALTH IMPACTS—GASTRO-INTESTINAL ILLNESS	NUISANCE ALGAL GROWTH	NUISANCE TURBIDITY SILTATION, ALGAL OR NON-ALGAL
Pollutant of Interest	Fecal bacteria / *E. coli*	Phosphorus	Total Suspended Solids (TSS)/ sediment
Standard	126 org/100ml geometric mean of growing season samples	–	–
	235 org/100ml single samples	Narrative standard tied to Trophic State Index	Narrative standard tied to Trophic State Index
Areas Impacted	• Raccoon River (Segment 1116 and 1117: mouth to South Raccoon confluence) • North Raccoon River (Segments 1127, 1131, 1132, and 1139: Buttrick Creek to Short Creek, Camp Creek to Cedar Creek, and above Sac City) • Walnut Creek • Unnamed tributary to Marrowbone Creek • Marrowbone Creek • Black Hawk Lake North Twin Lake • Storm Lake	• Black Hawk Lake • North Twin Lake • Pickerel Lake	• Black Hawk Lake • Spring Lake • Storm Lake • North Twin Lake • Pickerel Lake

Aquatic Life Impairments

There are a total of 15 impairments to aquatic life-designated use. These include biological sources/stressors, algal growth, total suspended solids (TSS), exotic/invasive species, low biological integrity and organic enrichment/low dissolved oxygen, and fish kills due to spills. Table 3-6 summarizes the 11 (out of the 15 total) aquatic life impairments within this watershed that were not because of a fish kill related to a spill.

TABLE 3-6 AQUATIC LIFE DESIGNATED USE IMPAIRMENTS

CONCERN:	ALGAL GROWTH	TURBIDITY SILTATION	BIOLOGICAL	BIOLOGICAL	BIOLOGICAL
Pollutant of Interest	Phosphorus	TSS/sediment	Exotic / invasive species	Low biological integrity	Organic enrichment/low DO
Standard	Narrative standard tied to Trophic State Index	Narrative standard tied to Trophic State Index	NA	Fish & macroinvertebrate presence & abundance index	4.0 mg/l minimum value any time during 24-hour period
Areas Impacted	• Little Clear Lake • South Twin Lake • Pickerel Lake	• Little Clear Lake • South Twin Lake • Pickerel Lake	• Black Hawk Lake Wildlife Area • Little Clear Lake	• North Raccoon River above Sac City—fish and macro • Marrowbone Creek—macro only	• Marrowbone Creek

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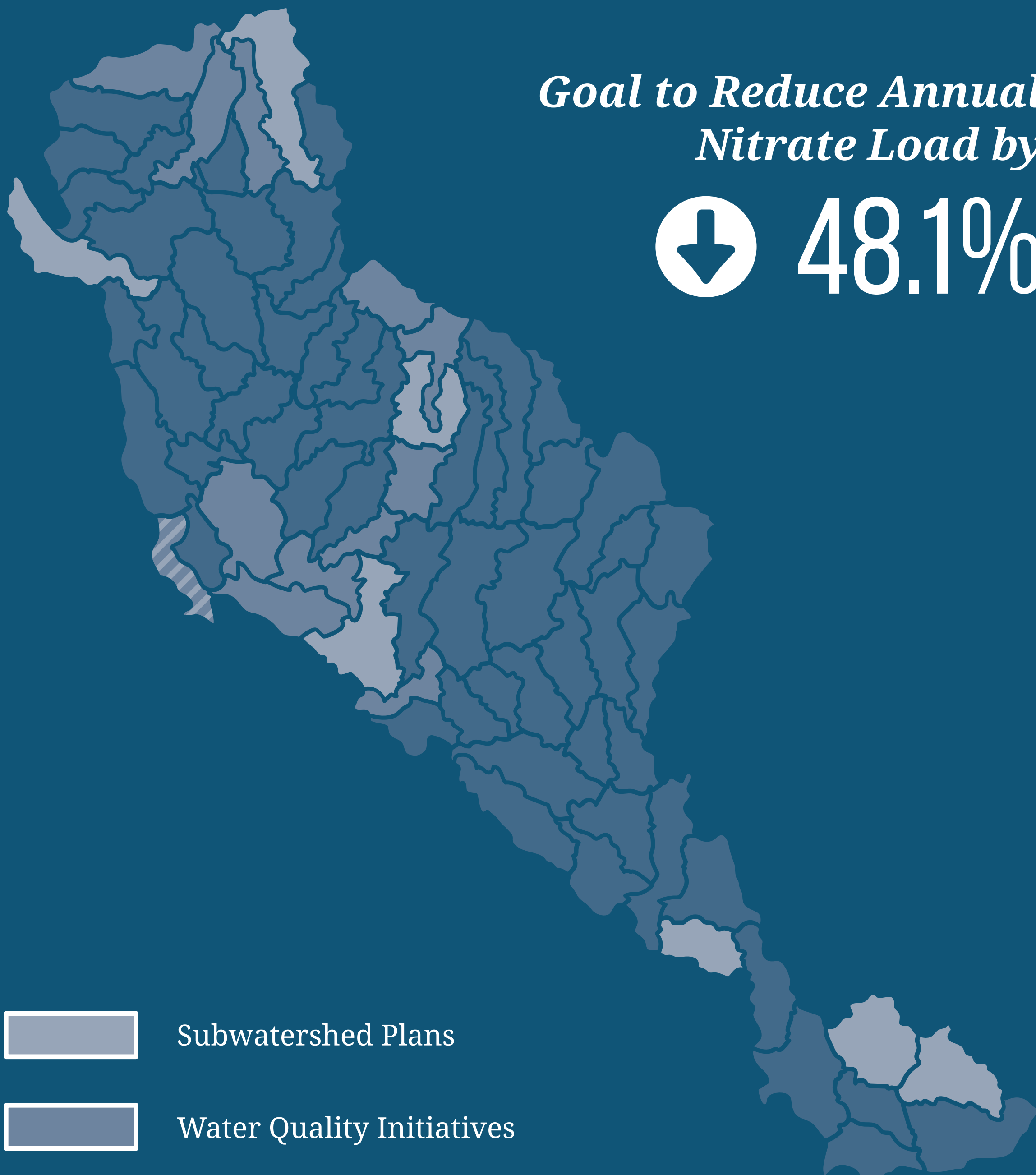
PAST STUDIES

Goal to Reduce Annual Nitrate Load by

48.1%



Subwatershed Plans

Water Quality Initiatives

Both studies

04

PAST STUDIES AND EFFORTS

This chapter reviews past watershed studies and local efforts to address flooding and water quality issues.

This plan is not intended to replace such work, but rather learn from and build upon it.

Active subwatershed efforts can be effective places to start implementation of the overall watershed plan, as relationships formed from such efforts may have already elevated local awareness, leading to greater potential for additional adoption of practices.

WATERSHED-SCALE PLANS

This watershed plan is not the first effort to address impairments or hazards across the entirety of the area which drains to the North Raccoon River. This plan should build upon lessons learned from these past studies and use new information to update and advance their goals.

RACCOON RIVER TMDL

Iowa DNR prepared the "Water Quality Improvement Plan for Raccoon River, Iowa: Total Maximum Daily Load for Nitrate and Escherichia coli" in 2008. The study was developed by Keith E. Schilling and Calvin F. Wolter. The TMDL was developed for three segments (two of which are in the North Raccoon River Watershed) of the Raccoon River that had been identified as impaired by nitrate and five segments that had been identified as impaired by the pathogen indicator *E. coli* bacteria. The TMDL also addresses potential future *E. coli* impairments for all Class A1 streams in the Raccoon River Watershed. Figure 4-1 illustrates the stream segments explicitly included in the Raccoon River TMDL.

Raccoon River Nitrate TMDL Key Findings

- **Nonpoint sources were identified as the main cause of the drinking water impairment**
- **Point sources do not appear to be contributing significantly to the nitrate impairment**
- **Exceedances were more prevalent at high flows than low flows, but exceedances occurred throughout most of the range of flow conditions**
- **Target in-stream concentration of nitrate set at 9.5 mg/L**
- **During the 1996 to 2005 period, nitrate concentrations ranged from 0 to 18.3 mg/L and averaged 6.45 mg/L on the Raccoon River segments**
- **Nitrate concentrations on the Raccoon River segments exceeded 10 mg/L approximately 24.0% of the time from 1996 to 2005.**
- **Nonpoint source nitrate loads for the watershed area contributing to the Raccoon River segments require a reduction of 48.1 % for all daily nitrate loads**

Raccoon River *E. coli* TMDL Key Findings

- **Approximately 39% of the recreation season samples exceeded the single-sample maximum value for *E. coli***
- **The geometric mean of *E. coli* for the recreation season has far exceeded Iowa's Class A water quality criterion of 126 CFU/100 ml during 24 of the 25 years of monitoring**
- ***E. coli* loads exceeded the TMDL target**

of 200 CFUs/100 ml at all flow ranges evaluated

- **Maximum exceedance factor occurred in the 90–80% flow range**
- ***E. coli* loads exceed the TMDL by a factor of more than 100 at flow ranges greater than 30%**
- ***A 99.69% reduction in E. coli loads* is needed in the 90–80% flow range in order for *E. coli* to be below the TMDL target**

North Raccoon River near Sac City *E. coli* TMDL Key Findings

- **During a 20-year monitoring period, the annual geometric mean averaged 340 CFU/100 ml and exceeded the Iowa Class A water quality criterion (126 CFU/100 ml) for 15 of the 20 years.**
- **Data collected from 1986 to 2005 exceeded Iowa's single sample maximum value of 235 CFU/100 ml**
- **Exceedances were more prevalent at high flows than low flows, but exceedances occurred throughout most of the range of flow conditions.**
- **Based on the entire data record, a *maximum E. coli reduction of 99.8%* is required for all measured samples to be less than the TMDL target.**

North Raccoon River near

Jefferson *E. coli* TMDL Key Findings

- **Data collected from 2000 to 2005 exceeded Iowa's single sample maximum value of 235 CFU/100 ml.**
- **Exceedances were more prevalent at high flows than low flows, but exceedances occurred throughout most of the range of flow conditions.**
- **Based on the entire data record, a *maximum E. coli reduction of 99.7%* is required for all measured samples to be less than the TMDL target**

TMDL = WLA + LA + MOS

WHERE:

TMDL = TOTAL MAXIMUM DAILY LOAD

WLA = WASTE LOAD ALLOCATION (POINT SOURCES)

LA = LOAD ALLOCATION (NONPOINT SOURCES)

MOS = MARGIN OF SAFETY

(MAY BE IMPLICIT OR EXPLICIT)

FIGURE 4-1 STREAM SEGMENTS EXPLICITLY INCLUDED IN THE RACCOON RIVER TMDL

RACCOON RIVER WATERSHED WATER QUALITY MASTER PLAN

Prepared for the Missouri & Mississippi Divide Resource Conservation & Development by Agren, Inc., 2011

Iowa DNR awarded a grant to the Missouri & Mississippi Divide Resource Conservation & Development (RC&D), with a subcontract to Agren, Inc., to develop a Water Quality Master Plan for the entire Raccoon River Watershed in January 2010. Funding for the grant agreement was provided through Section 319 of the Clean Water Act, as well as Section 604(b) of the American Recovery and Reinvestment Act of 2009.

The master plan was, by design, broad in scope and intended audience. It was not meant to direct the activities of one specific agency or organization. Rather, it was developed as a tool to inform and guide watershed residents and stakeholders as they seek to improve the environmental conditions of the watershed while maintaining the economic vigor of a region rooted in production agriculture. The plan did not define specific outcome targets for water quality, nor did it prescribe a specific vision of what constitutes an environmentally and economically prosperous Raccoon River basin. Rather, ***the plan focused on common needs that were identified and broadly supported by multi-disciplinary experts and watershed stakeholders.***

The methods for developing the recommendations in this plan used a participatory approach. Four formal expert panel events along with four stakeholder receptions were held to collect information. Additionally, electronic surveys, emails, phone calls and individual small-group meetings were conducted for information. Meeting events are listed below:

- **Agriculture Best Management Practice (BMP) expert panel**
- **Stakeholder Reception—watershed farmers and landowners**
- **Stakeholder Reception—agricultural groups**
- **Stakeholder Reception—environmental groups**
- **Stakeholder Reception—Raccoon River Watershed Association**
- **Non-agriculture BMP expert panel**
- **Expert panel modeling review**
- **Implementation expert panel**

Priorities identified within the master plan were organized into nine recommendations that had been identified by stakeholder and expert contributors as important steps to restore water quality. The nine priorities identified in the Raccoon River Watershed Water Quality Master Plan and how they have been addressed since (or by this Watershed Plan) are described as follows:

Priority #1: Develop a regional planning organization to guide implementation of the Raccoon River Watershed Water Quality Master Plan.

Regional organizations such as the WMAs of Iowa and the Central Iowa Council of WMAs have been formed to share information and collaborate to address water-related issues across watershed boundaries. The NRRWMC was founded using the WMA framework, through agreements between members within this HUC-8 watershed. A 28E Agreement was filed with the State of Iowa on June 22, 2017, which formally established the NRRWMC.

Priority #2: Conduct public education to improve awareness of water quality and instill a personal commitment to water quality improvement among all watershed residents.

An education and outreach plan has been developed by ISU Extension and Outreach for incorporation into this watershed plan (see Chapter 13 and Appendix C). The education and outreach plan includes specific recommendations for conducting public education to improve awareness of water quality and instill a personal commitment to water quality improvement among all watershed residents.

Priority #3: Focus outreach and education efforts to farm operators and agricultural landowners on nutrient and drainage management strategies.

The education and outreach plan referenced in response to Objective #2 focuses efforts to farm operators and agricultural landowners on nutrient and drainage management strategies.

Priority #4: Aggressively pursue opportunities to facilitate private-sector conservation planning services.

Private consultants were employed in the creation of this plan. Commodity groups such as the Iowa Soybean Association and Iowa's ACWA, among others, have worked to implement planning strategies, especially at the subwatershed and individual-property scale. Precision agricultural services have been used to target conservation practices and determine what lands may not be profitable for row crop production. Additional strategies for pursuing private sector conservation planning services are included in Chapters 5, 7 and 14 of this plan.

Priority #5: Take full advantage of emerging technologies and LiDAR elevation data to identify areas of concern, and target practices based on landscape characteristics at the field level.

LiDAR (Light Detection and Ranging) data has been used to more precisely map flow paths and watershed boundaries, which were particularly difficult to discern in the past in the upper watershed due to the flat topography in some areas. The Agricultural Conservation Practices Framework (ACPF) tool, developed by United States Department of Agriculture's Agricultural Research Service (USDA-ARS), was used by the Iowa DNR to map locations for potential conservation practices and infrastructure projects within several of the HUC-12 subwatersheds within the North Raccoon River Watershed.

Priority #6: Target implementation of agricultural BMPs to priority subwatersheds and priority impairments.

The priority subwatersheds that were identified in the Master Plan for nitrates, phosphorus and sediment, pathogens and habitat have been incorporated into this watershed plan. The priority BMPs identified for use in crop production and livestock production that were evaluated and prioritized in the Master Plan have been incorporated into the recommended approaches in the implementation plan (see Chapter 5). Prioritization of work by subwatershed area is described within Chapter 6.

Priority #7: Enhance effectiveness of nutrient control and removal practices by encouraging a "stacked" approach to nutrient management such as reduce, trap and treat.

The recommendations for conservation practices described in Chapter 5 of this plan are based on the "stacked" approach concept of implementing a suite of pollutant control practices that address source reduction, nutrient trapping and nutrient treatment.

Priority #8: Monitor water quality at the subwatershed scale to characterize existing conditions and evaluate effectiveness of watershed projects and conservation practices.

Chapter 15 of this plan includes a monitoring plan that builds upon existing efforts of the ACWA, USGS and the Iowa Flood Center to monitor water quality conditions.

Priority #9: Continue to assess long-term water quality status and trends in the Raccoon River and enhance these efforts as resources allow.

Chapter 15 also includes a series of marker posts that can measure the effectiveness and results of implementation efforts.

SUBWATERSHED MANAGEMENT PLANS

In the years that have followed previous watershed-scale planning efforts, there have been multiple efforts to address issues at a smaller scale (Figure 4-4). The existence of subwatershed management plans, or known activities in specific areas, are considered in prioritization of future work (see Chapter 6). ***Such areas are more likely to have local interest in resource protection or to have producers and landowners with more awareness or interest in adopting conservation practices.***

WALNUT CREEK WATERSHED MANAGEMENT PLAN

Prepared by the Walnut Creek WMA

Consultant team led by RDG Planning & Design (with Snyder and Associates, Polk SWCD)

Completed in 2016
STATUS–ACTIVE

A watershed management plan was completed in 2016 to guide efforts within the Walnut Creek Watershed to improve water quality and reduce flooding in this 53,000-acre (83 mi^2) watershed in Dallas and Polk Counties. The plan was developed from information gathered during stakeholder input sessions, watershed assessments and engineering analyses. It provides detailed watershed information and recommendations for future improvements. Through collaboration and partnership, the Walnut Creek WMA has focused on using this master plan to guide implementation efforts. Its goals are:

1. Reduce flooding through improved stormwater management and soil health
2. Improve water quality, with an emphasis on sediment, nitrate, phosphorous and *E. coli* reductions
3. Enhance recreation and public health through improved water quality, habitat restoration, stream accesses, improved connectivity to parks/trails and cultural opportunities
4. Deliver enriched conservation education and programming with emphasis on water quality/quantity management, wildlife/habitat, urban and agricultural needs within the watershed
5. Support community vitality and maintain economic health through implementing multi-purpose projects producing benefits in public, natural resources and economic health that can be documented
6. Develop ongoing means for collaboration and implementation of effective policies and practices, taking a consistent watershed- and/or regional-scale approach as much as is practical

The Walnut Creek Watershed Management Plan recommended developing case study subwatershed management plans for three distinct settings within the watershed—rural, urban and subwatershed—at the urban/rural interface currently facing development. ***The estimated cost for implementing short-term efforts (10-year) described within the Walnut Creek Watershed Management plan was approximately $30 million for conducting subwatershed case studies, other watershed-level projects and current capital improvement projects.*** An additional expenditure of approximately $762,000 was recommended for a monitoring program.

FIGURE 4-2 EXISTING SUBWATERSHED PLANS

SWAN LAKE BRANCH WATERSHED PLAN

Prepared by the Iowa Soybean Association, 2018

STATUS–ACTIVE

Swan Lake Branch is a 15,775-acre (25 mi^2) watershed located in northwest Dallas County. Swan Lake Branch and Elm Branch meet to form a stream that then meets with the North Raccoon River south of Perry, Iowa. In 2018, this roadmap for land and water improvements was developed by the Iowa Soybean Association Environmental Programs and Services through funding from The Walton Family Foundation and partnerships with watershed planning partners—watershed residents, farmers and landowners, Dallas SWCD and the City of Des Moines. ***This plan was initiated because the City of Des Moines expressed an interest in providing financial support for water quality practices*** to be implemented in the Swan Lake Branch watershed, and it was put together with the help of many local organizations and community members. The plan identified the following five goals:

1. Identify cost-effective solutions
2. Provide for profitable and productive agriculture
3. Create conditions for healthy soils and water
4. Minimize downstream impacts
5. Work with urban and rural stakeholders to implement

These goals are addressed in a phased implementation approach with four-year increments from 2018 to 2037. Each phase indicates which practices and how much of each are to be implemented during that time frame. ***The total investment includes a $2.0 million initial infrastructure cost, an annual cost of $340,000 for management practices and an annual cost of $75,000 to $125,000 for technical assistance, outreach, monitoring and equipment.***

HEADWATERS CEDAR CREEK WATERSHED PLAN

Prepared by the Iowa Soybean Association, 2016

STATUS–ACTIVE

This roadmap was developed by the Iowa Soybean Association Environmental Programs and Services in 2016 for land and water improvements as well as maintaining and improving agricultural performance and quality of life. The Headwaters Cedar Creek Watershed is approximately 35,000 acres (55 mi^2) and located in Pocahontas County and portions of Buena Vista, Clay and Palo Alto Counties. This watershed is drained by the Cedar Creek from the headwaters down to its confluence with Drainage Ditch 21 southeast of Laurens, Iowa. This plan was funded by the NRCS and developed with the help of Iowa Agriculture Water

Alliance (IAWA), Pocahontas and Buena Vista SWCDs, Pocahontas County, Pocahontas County Conservation Board, Pocahontas Community Hospital, and Iowa Department of Agriculture and Land Stewardship (IDALS). The plan integrated existing data, citizen and stakeholder input and conservation practices to develop the following goals:

1. Increase agricultural productivity and profitability
2. Reduce soil erosion
3. Reduce in-stream nonpoint source nitrogen loads by 41%
4. Reduce in-stream nonpoint source phosphorus loads by 29%

These goals are addressed in a phased implementation approach with four-year increments from 2018 to 2037. Each phase indicates which practices and how much of each are to be implemented during that time frame. ***The total investment includes a $4.6 million initial infrastructure cost, an annual cost of $1.0 million for management practices and an annual cost of $100,000 for technical assistance, outreach, monitoring and equipment.***

STORM LAKE WATERSHED MANAGEMENT PLAN

Prepared by the Iowa Lakes RC&D, 2012

STATUS–INACTIVE

In August of 2010, Iowa DNR awarded a Watershed Management Planning Grant to the Iowa Lakes RC&D. The grant was used to develop a watershed management plan for the 18,000-acre watershed of Storm Lake. The lake, located in Buena Vista County in northwest Iowa, is the fourth-largest natural lake in the state and is a regional recreational asset. The Storm Lake Watershed is within the Outlet Creek HUC-12 Subwatershed. In an effort to continue watershed protection and water quality improvement, the watershed management plan was developed to help guide watershed efforts for the 20-year period (2012–2023) and ultimately lead to Storm Lake meeting Iowa's water quality standards.

Due to the high levels of phosphorus and suspended solids in Storm Lake the watershed management plan targets phosphorus and sediment as the pollutants of concern. Watershed and water quality modeling conducted during the development of the watershed management plan revealed the following actions would be necessary to achieve water quality standards for Storm Lake:

1. A 60% reduction in sediment and phosphorus loading from the watershed
2. A 20% reduction in internal loading from within Storm Lake (not explicitly included in the plan)
3. Continued dredging of Storm Lake to an average depth of 9.5 feet (not explicitly included in the plan)

The plan includes an implementation plan to achieve a 60% reduction in sediment and phosphorus loading from the watershed after the estimated 35% reduction achieved by the Little Storm Lake project. ***The estimated cost (in 2012 dollars), to accomplish the additional 25% reduction of sediment and phosphorus delivery into Storm Lake from its watershed was $3.3 million.*** This includes yearly expenses for project coordinator salary, water monitoring and education and outreach. An annual expenditure of $1.0 million is estimated to be needed to continue in-lake dredging.

BLACK HAWK LAKE WATERSHED MANAGEMENT PLAN

Prepared by the Sac County SWCD, 2011

STATUS–ACTIVE

The development of the Black Hawk Lake Watershed Management Plan was largely funded by two grants. The first was a Watershed Development and Planning Grant from IDALS Division of Soil Conservation and administered through the Sac SWCD. The second grant was a Watershed Improvement Planning Grant received from Iowa DNR. It was also administered through the Sac SWCD. Black Hawk Lake is located in Sac County near the City of Lake View. Its watershed is 13,000 acres and is located within the Wall Lake Inlet HUC-12 Subwatershed

Excess phosphorus loading was identified as the primary cause of water quality problems in Black Hawk Lake. Support for water quality improvements was verified from rural and urban landowners and residents and local government agencies.

Goals of the Black Hawk Lake Watershed Management Plan include:

1. Increase public understanding of Black Hawk Lake water quality problems
2. Implement targeted BMPs in Black Hawk Lake and its watershed to improve water quality in Black Hawk Lake. The in-lake water quality target is to have Trophic State Index scores below the impairment trigger for chlorophyll-a and Secchi depth.

The Iowa DNR Lakes Restoration Program established a water quality target for water transparency (i.e., Secchi depth) to be at least 4.5 ft for 50% of the time from April to September.

A 30-year implementation plan to achieve a 50% reduction of the internal phosphorus load and a 77% reduction of the external phosphorus load was developed ***with a total needed investment of approximately $28 million.***

NORTH AND SOUTH TWIN LAKES DIAGNOSTIC AND FEASIBILITY STUDY

Prepared by ISU Limnology Laboratory for Iowa DNR, 2016

STATUS–ACTIVE

North and South Twin Lakes are located in Calhoun County north of Rockwell City. South Twin Lake has a watershed area of 3,314 acres and North Twin Lake has a watershed area of 2,141 acres. North Twin Lake flows into South Twin Lake. The lakes are located within the Drainage Ditch 13-Lake Creek HUC-12 Subwatershed. The lakes are important natural resources that are currently being underutilized due to poor water quality. ***The lakes suffer from high nutrient and sediment loads*** originating in this predominantly agricultural watershed, although development around the lakes also contributes to these problems. High phosphorus loads fuel phytoplankton (algae) growth, which have been dominated by potentially toxic Cyanobacteria (blue-green algae). Combined with algae in the water column, high amounts of inorganic suspended solids derived from the watershed, such as soil particles, reduce water transparency and lead to high sediment accumulation rates. ***High concentrations of bacteria and Cyanobacteria toxins pose health risks to people and animals. Poor water quality plagues the sport fishery, despite ongoing management efforts to improve them.***

Because direct rainfall and dryfall supplies a portion of total phosphorus (TP) to the lakes, it is only possible to achieve maximum TP loading reductions of 80% for North Twin Lake and 70% for South Twin Lake, making it difficult to reach this statewide water quality target. Therefore, an intermediate goal of 2.3 ft was set as a more feasible target for both North and South Twin Lakes, which could be achieved through watershed and in-lake management strategies.

According to this study, a cost-effective, comprehensive restoration strategy for North Twin Lake could involve:

1. Diverse BMPs targeting direct TP runoff from the unconsolidated watershed (i.e., area surrounding the lake)
2. Creating a series of cascading detention ponds near Featherstone Memorial County Park to reduce TP contributions from the western and northwestern portions of the watershed
3. Reducing nutrient loading from tile drain discharge
4. Fisheries renovation to remove rough fish and prevent their reintroduction

The proposed restoration strategy is anticipated to result in a 74.1% reduction to the overall TP budget of North Twin Lake at a cost of $700,000 to $1,000,000.

For South Twin Lake, a comprehensive restoration strategy could involve:

1. Diverse BMPs targeting direct TP runoff from the unconsolidated watershed
2. Creating a diked wetland complex on the north side of the lake to reduce TP contributions from the outfall of North Twin Lake and the northeastern stream
3. Reducing nutrient loading from tile drain discharge
4. Fisheries renovation to remove rough fish and prevent their reintroduction.

Combined with anticipated TP reductions to the outfall of North Twin Lake due to restoration alternatives in the North Twin Lake Watershed, ***the proposed restoration strategy is anticipated to result in a 62.8% reduction to the overall TP budget of South Twin Lake at a cost of $1.3–$1.5 million***.

Table 4-1 summarizes the estimated costs for implementing existing subwatershed management plans in the North Raccoon River Watershed (Figure 4-3).

TABLE 4-1 ESTIMATED COSTS FOR SUBWATERSHED MANAGEMENT PLAN IMPLEMENTATION

SUBWATERSHED MANAGEMENT PLANS	ESTIMATED COST TO IMPLEMENT
Walnut Creek Watershed Management Plan	$31 Million
Swan Lake Branch Watershed Plan	$10.8 Million
Headwaters Cedar Creek Watershed Plan	$27.4 Million
Storm Lake Watershed Management Plan	$23.3 Million
Black Hawk Lake Watershed Management Plan	$28 Million
North and South Twin Lakes	$2 Million to $3 Million

WATER QUALITY INITIATIVES

There are five water quality demonstration watershed projects currently in effect within the North Raccoon River Watershed. These demonstration watershed projects are funded through IDALS with the goal of increasing voluntary adoption of specific water quality conservation practices. The existence of a water quality demonstration project was used as a ranking factor in prioritizing subwatersheds in which to implement water quality improvement practices (see Chapter 6). These subwatersheds are more likely to have local interest in resource protection or to have farmers and landowners interested in adopting conservation practices. Outreach in these subwatersheds will begin at an advantage because of the relationships that were developed during the development of these subwatershed plans.

NORTH RACCOON FARM TO RIVER PARTNERSHIP (ELK RUN CREEK PROJECT)

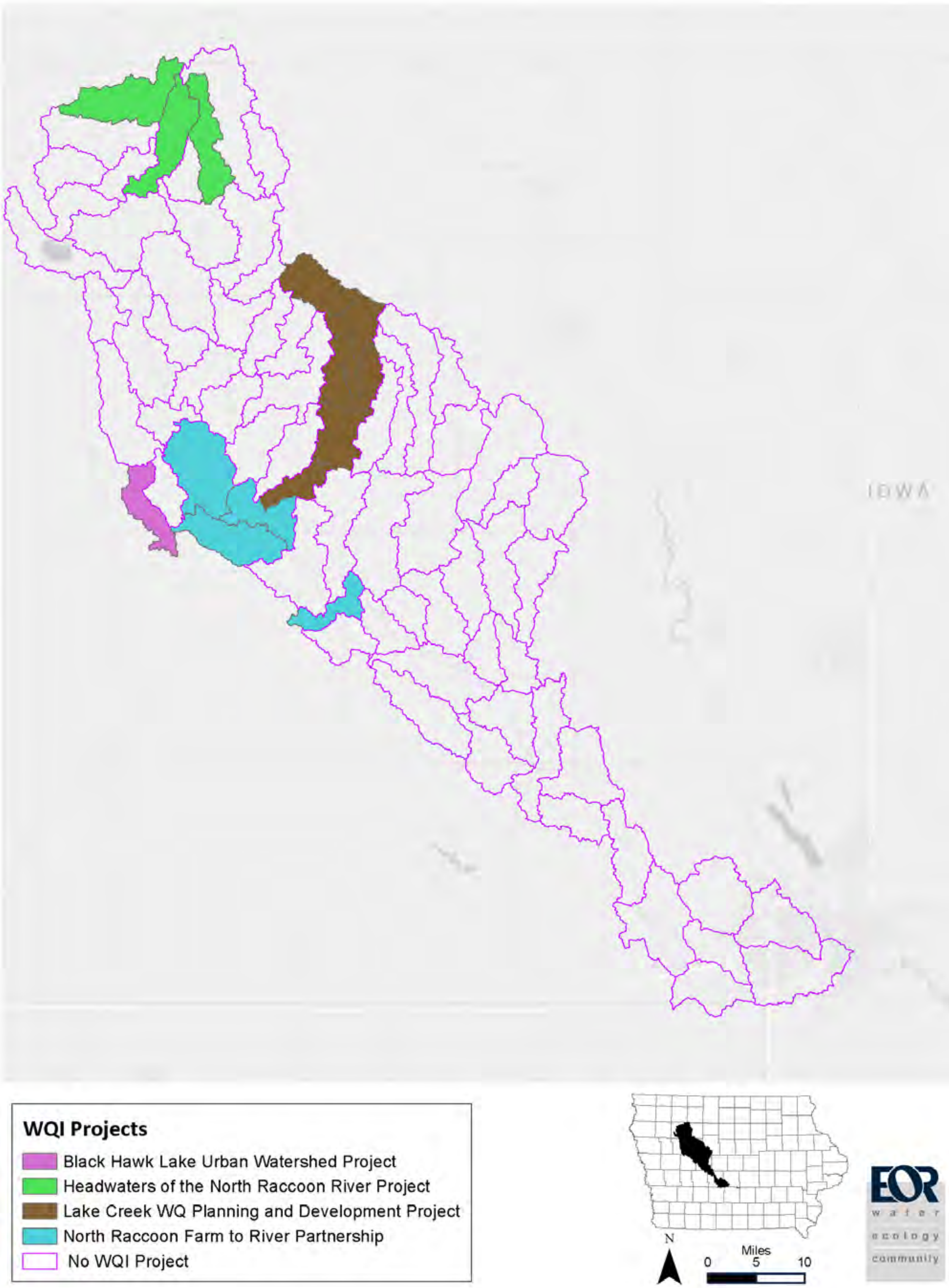
ACWA and partners are leading a demonstration and implementation project in the North Raccoon Watershed to target and showcase both in-field and edge-of-field practices that reduce nutrient loss to surface waters. The North Raccoon Farm to River Partnership project, formerly named the Elk Run Creek project, expanded its coverage area in 2018 to include areas of Sac, Carroll, Greene and Calhoun Counties. ***The $2.6 million-dollar project establishes direct dialogue with producers and landowners in the watershed to discuss opportunities to incorporate and build upon conservation measures on their farms.*** As of the date of this plan (July 2020), farmers in the watershed have implemented a nitrate-removal wetland, three bioreactors, planted 11,5000 acres of cover crops and have implemented livestock waste management, nutrient and tillage management practices. The project is working toward implementing more of these practices and considering others. Future activities will include outreach events to highlight various technologies that significantly reduce loss of nutrients while maintaining the productive capability of cropland in the watershed. Priority conservation practices to be used include bioreactors, cover crops, drainwater management, use of nitrification inhibitor and saturated buffers.

HEADWATERS OF THE NORTH RACCOON RIVER PROJECT

The Headwaters of the North Raccoon River Water Quality Initiative project area is located in the far northern part of the North Raccoon River Watershed. The loss of nutrients to surface and ground water resources is the primary concern to be addressed by this effort. The project works side-by-side with local producers and partners to promote the integration of management, land-use change and edge-of-field practices outlined in the NRS to decrease nutrient loss and improve water quality. A comprehensive list of key trusted agricultural advisers and retailers was assembled to help deliver and promote nutrient stewardship practices in the watershed with a focus on education, demonstration, adoption and evaluation of practices identified in the NRS.

One of the goals of the $2.6 million project is to educate and engage producers and landowners in the adoption and implementation of conservation practices to reduce nutrient loss and improve water quality. The project also aims to encourage experienced conservation farmers to share practical information of first-hand experience with conservation practices to create a can-do attitude toward agriculture and water quality improvement.

FIGURE 4-3 EXISTING WATER QUALITY INITIATIVES



LAKE CREEK WATER QUALITY PLANNING & DEVELOPMENT PROJECT

The Lake Creek Water Quality Planning & Development Project began in 2019 and is being coordinated through the Calhoun County SWCD. The conservation practices used in this project will be modeled after the nearby, successful Headwaters of the North Raccoon WQI project. Funding will help support technical assistance and one-on-one landowner contact to assess the viability of NRS practices. Specific conservation practices of interest include bioreactors and wetlands.

BLACK HAWK LAKE URBAN WATERSHED PROJECT

This project targets stormwater runoff priority areas in two locations in the northern reaches of the Black Hawk Lake Watershed. Practices will include installation of a wetland, bio-swale and rain garden, which were selected to address nutrient and other water quality concerns. This project and associated partnerships will build on existing water quality efforts addressing lake improvement and focus on the importance of Iowa's NRS. The project was funded in 2016 and partners include the City of Lake View, the Black Hawk Lake Project, Black Hawk Lake Protective Association, Iowa DNR, Iowa Soybean Association, Evapco Inc and Sac County SWCD.

SCALING UP CAPACITY TO IMPLEMENT WATER QUALITY WETLANDS

This project is being led by the Iowa Nutrient Research and Education Council with funding from IDALS. The project seeks to develop and demonstrate a model for increasing the technical and landowner services capacity for delivery of water quality wetlands in a manner that is scalable across Iowa. ***The project seeks to tap into the existing capacity of drainage district boards of trustees and their associated drainage engineers and demonstrate their ability to facilitate water quality wetland implementation at a large scale across Iowa with focus on seven counties.*** Included in the project area are the North Raccoon River Watershed counties of Palo Alto, Clay, Pocahontas and Boone.

Table 4-2 summarizes the funding allocations to meet the goals of the current Water Quality Initiatives in the North Raccoon River Watershed.

TABLE 4-2 FUNDING ALLOCATIONS TO MEET THE GOALS OF THE CURRENT WATER QUALITY INITIATIVES	
WATER QUALITY INITIATIVE	FUNDING ALLOCATION TO MEET GOALS OF PROJECT
North Raccoon Farm to River Partnership (Elk Run Creek Project)	$2.6 Million
Headwaters of the North Raccoon River Project	$2.6 Million
Lake Creek Water Quality Planning & Development	$70,000
Black Hawk Lake Urban Watershed Program	$150,000

NORTH RACCOON RIVER WATERSHED PLAN

PART 2
IMPLEMENTATION STEPS

OCTOBER 2020

CONTENTS

PART 02

IMPLEMENTATION STEPS

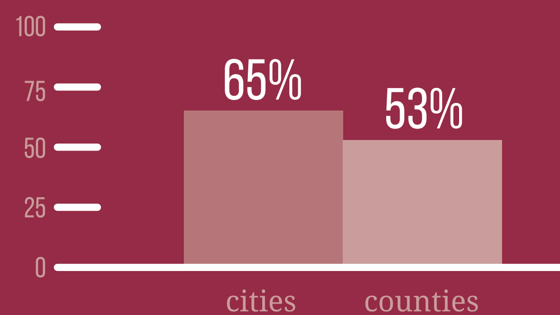
IMPLEMENTATION APPROACHES

Change the Land Use

76 MILES

Current roadways impacted in the 25-year floodplain

Participate in the National Flood Insurance Program



Improve Water Quality in Agricultural Areas

Difficult

RUN-OFF AND POLLUTION REDUCTION

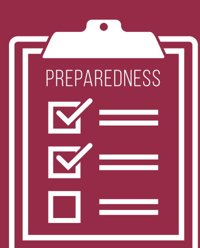
Effective

- Riparian Management
- Edge of Field Practices
- Infield Practices
- Soil Health
- Water

Urban Stormwater Management Practices

- Low Impact Development (LID)
- Stormwater Detention
- Programmable Practices

Make Modifications to Flood Mitigation Strategies



Lessen Flood Impact
- Preparedness Checklists
- Recovery Programs

Alleviate Flooding
- Distribute Water Storage
- Detention Areas

Reduce Flood Damage
- Modify Structures and Construction Sites

05

IMPLEMENTATION APPROACHES

This chapter reviews basic information about approaches to address flooding and water quality issues within the watershed. These include:

- Flooding strategies
- Rural water quality strategies
- Urban water quality strategies

This chapter should be most useful to those who have limited experience with the many Best Management Practices (BMPs), and other tools often used for flood mitigation and water quality improvements.

INTRODUCTION

Many methods are available to address priority flooding and water quality issues of the North Raccoon Watershed, but no single approach reaches all goals and objectives of this plan. This chapter provides an overview of the broad sweep of practices available to help achieve goals. Ultimate choices depend on local knowledge and experience, physical conditions and the specific goal or prFhucject intent. This plan has set flood management and water quality improvement goals for the whole of the North Raccoon River Watershed to inform future HUC-12 subwatershed plans and projects. (See Chapter 8 "The Path to Implementation"). This chapter makes an excellent reference as those subwatershed plans develop.

FLOODING

Flood challenges in the North Raccoon River shift with land uses and whether the floods occur in the upper or lower reaches of the watershed. The NRRWMC's priorities reflect this understanding of the watershed and heed damages to crops and roads as well as buildings and other "vertical structures."

The strategies for flood damage reduction fall into three general categories:

- ***Modify flooding*—these methods include direct flood mitigation, primarily through structures that hold back, channel and/or absorb the water and its energy**
- ***Modify the impact of flooding on individuals and communities*—these methods include education, policy, financial tools, preparation for prevention and aftermath**
- ***Modify susceptibility to flood damage and disruption*—these methods often involve policies to discourage development and re-development in high-risk areas**

There are different types and scales of flooding that occur in the North Raccoon River Watershed, and the effectiveness of any flood damage reduction strategy will vary depending on the type of flooding considered. For instance, due to the sheer volume of water associated with springtime snowmelt flooding events, it is nearly impossible to sufficiently modify flooding at this time of year to protect the highly urbanized downstream reaches of the watershed from flood damage. On the other hand, localized flooding resulting from intense midsummer rainstorms might be all but entirely mitigated through strategic BMP implementation. Therefore, the NRRWMC supports a balance between flood modification and resilience-building. At the watershed scale, flood damages can only be effectively reduced through a combination of conscientious land management, capital improvement projects, and floodplain regulation and restoration. The first half of this chapter focuses on understanding these three types of strategies and how they can work together for maximum positive results.

MODIFY FLOODING

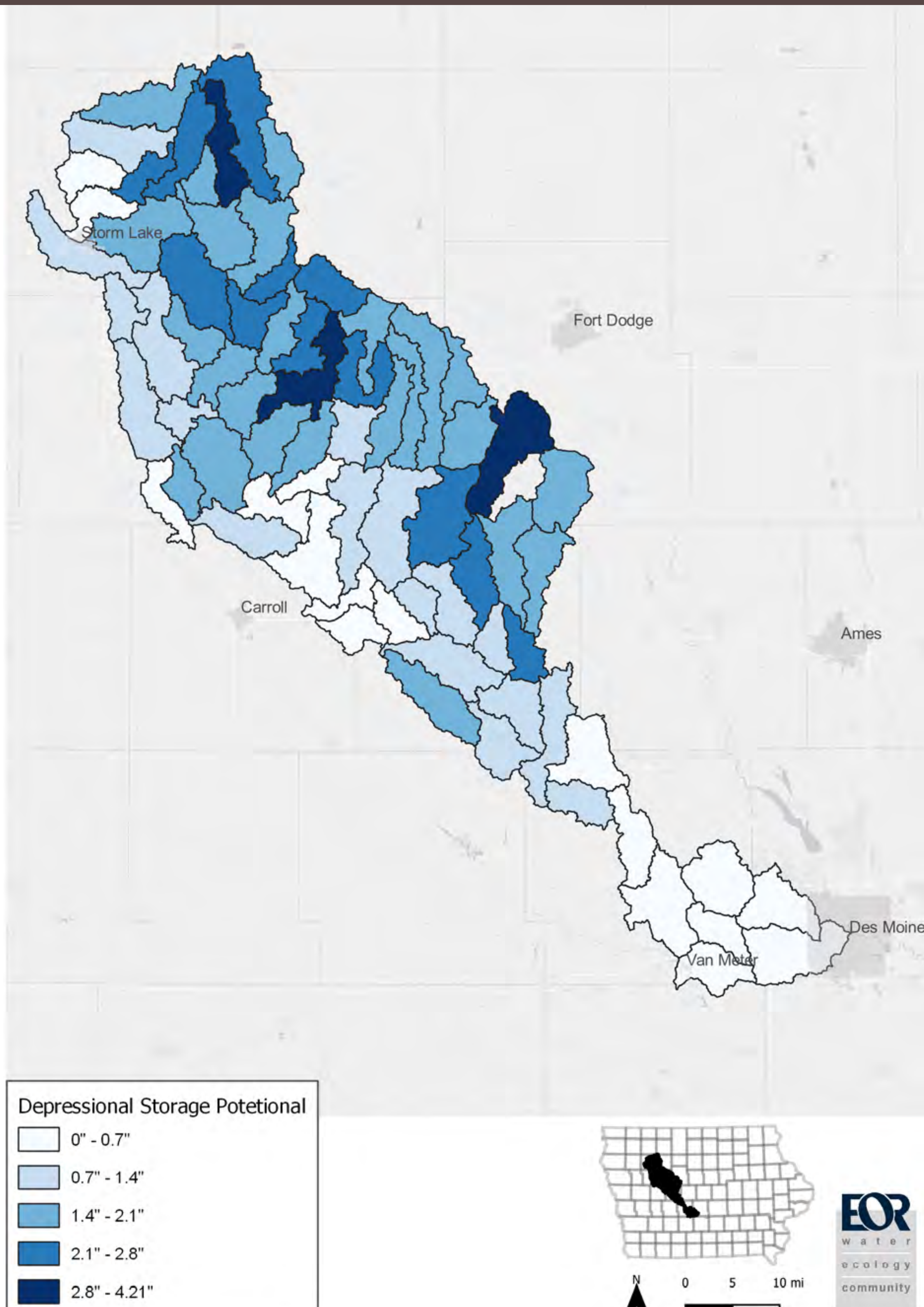
Regional Storage

This approach involves the ***construction of dams and reservoirs*** that capture runoff from large drainage areas. Constructed lakes or reservoirs release runoff at reduced rates and temporarily store some of the runoff volume. This can be referred to as stormwater "detention," as runoff is detained for a period of time, with the rate of release reduced to a desired level (this concept is illustrated in Chapter 9). Constructing these structures can be controversial as large tracts of lands may be flooded in the process or placed under easement. There could be impacts to existing streams, wetlands and habitat for endangered species. The impacts on flood reduction tend to be most noticeable immediately downstream of the structure and for short- to medium-duration flooding events.

Distributed Storage

This strategy involves ***constructing smaller impoundments such as ponds, wetlands and large-scale water and sediment control basins*** (WASCOB) that each drain a few hundred to a few thousand acres, distributed in various locations across a watershed. These practices can be less controversial and more effective than regional storage, especially for smaller storm events. These practices can also reduce runoff volumes, through infiltration (water sinking into soil), evaporation and transpiration (water use or loss through plants). Similar to regional storage, rate control effects may be limited as you move farther downstream into areas where less of the land has detention.

FIGURE 5-1 DEPRESSIONAL STORAGE POTENTIAL ACROSS THE NORTH RACCOON RIVER WATERSHED



Represented in inches of subwatershed runoff.
Source: EOR Analysis of Iowa Statewide LiDAR

Depressional Storage

The prairie pothole topography in the northern part of the watershed (described in the Watershed Assessment) may offer opportunities to store water in depressions which flood frequently, or experience reduced crop yield potential due to high soil moisture conditions. Figure 5-1 shows the greatest potential for depressional storage is in the upper part of the watershed. Restoring drained depressions has the potential to provide flood reduction benefits similar to distributed storage while providing more significant volume reduction, which could result in greater benefit during medium- and long-duration flooding events.

Dikes, Levees and Floodwalls

These approaches protect a portion of the floodplain from flooding, up to a specific design level (e.g., 1% annual probability flood) and can be effective for any type or duration of flooding that does not exceed the design level. Since they effectively reduce the volume of the floodplain, these practices can back water up onto upstream lands or move water more quickly to downstream areas. Additionally, there can be serious consequences if a levee fails or when a flood occurs that is larger than the design level and these structures overtop (Norvell and Cannon 2019). Nevertheless, these strategies are often used in locations where the cost of construction is outweighed by the high cost or low feasibility of flood modification or floodplain restoration.

Channel Alteration and Diversions

This involves ***altering or moving a conveyance channel.*** These projects are often costly and involve significant negative environmental consequences (e.g., reduced stream length, increased slope, higher erosion potential, habitat loss). These alterations can worsen downstream flooding if flow moves more quickly than before the alteration. This is typically a "last resort" method.

Soil Health Practices

Improving soil health increases the landscape's ability to store and retain rainfall. Conservation practices like no-till, cover crops and perennial cover increase soil organic matter, improve soil structure (e.g., reduce soil compaction) and increase surface roughness to slow water down. In contrast to structural practices, the benefits here take years to fully realize, but widespread adoption has effectively and dramatically reduced flooding for a wide range of flood frequencies. They also have many water quality benefits including reducing nitrate and phosphorus leaching and preventing soil erosion. The North Raccoon River Watershed has over 1,228,000 acres of row crop agriculture, which represents nearly 78% of the total watershed area. Therefore, widespread adoption of soil health practices has the potential to produce significant volume reduction and, consequently, flood mitigation benefits throughout the watershed.

Drainage and Stormwater Infrastructure Improvements

When man-made storm systems do not have capacity, they may need a "fix," such as culvert replacement, ditch widening or storm drain upgrades. They can dramatically reduce flooding at the local scale but can also worsen downstream flooding. As an alternative to these traditional "gray" infrastructure fixes, the use of "green" infrastructure has become popular as they provide a wider range of benefits for the community and environment. The Low-Impact Development (LID) practices described in Appendix B are designed to increase resiliency in the landscape, typically by emphasizing infiltrating stormwater runoff. The LID approach to stormwater management can not only help reduce the capacity requirements of downstream stormwater infrastructure but can also help mitigate flooding by reducing overall runoff and discharge volumes.

Community-Scale Stormwater Studies

This approach ***assesses the existing and/or projected flooding in a municipal area*** to determine the various causes and best solutions. More recently, the effects of changing climate (increasing rainfall levels) may increase flood levels above those currently shown on regulatory maps, requiring plans and updates (Iowa Climate Change Impacts Committee 2011). See Chapter 11 for more information on community-scale stormwater plans.

MODIFY THE IMPACT OF FLOODING ON INDIVIDUALS AND THE COMMUNITY

Information and Education

This strategy involves ***developing technical information and performing public outreach*** to inform residents, elected officials and planners about the hazards posed by flooding in the watershed. Often, this involves informing stakeholders about floodplain regulations and dispelling pervasive myths about what "flood frequency" really means (see Chapter 1 of this plan). More information regarding education and outreach strategies can be found in Chapter 13 and Appendix C of this plan.

Flood Insurance

Flood insurance is one mechanism for managing flood impacts, acting to ***discourage development in areas with elevated flood risk and providing a mechanism for widespread risk sharing***. The National Flood Insurance Program (NFIP) enables communities to join an established program of floodplain regulation, which is targeted toward structures located in the floodplain. As of August 2019, there were 37 cities and 8 counties within the watershed participating in the NFIP. For more information about this program visit www.fema.gov/national-flood-insurance-program. For more information on local participation see Chapter 11 and Appendix F.

Tax Adjustments

Tax adjustments at the federal, state or local level can be used both as a ***deterrent against development in the floodplain and to provide relief*** to those impacted by flooding. Amortization provisions can be applied to nonconforming uses within the floodplain, while financial relief following a flood can be provided through provisions for claiming flood losses on federal or state income taxes or through special allowances on real estate taxes that may be enacted by local officials (Wright 2007).

Flood Emergency Measures

These are primarily "last-minute" measures such as ***sandbagging and construction of earthen dikes***, perhaps as part of an emergency evacuation plan. Since ample warning time is required for these measures to be effective, they work best as contingencies in a comprehensive floodplain management plan that attempts, in part, to eliminate the very need for such measures.

Post-Flood Recovery

Recovery plans should be part of a comprehensive floodplain management plan that first attempts to reduce the impacts of and susceptibility to flooding. Post-flood recovery involves ***restoring or reconstructing impacted structures and infrastructure*** in a way that prevents future flood damages.

MODIFY SUSCEPTIBILITY TO FLOOD DAMAGE AND DISRUPTION

Floodplain Regulation and Restoration

This regulatory concept ***strategically discourages development and redevelopment in high-risk areas***. Ideally, this also focuses on restoring natural floodplain functions. Regulation reduces individual risk and improves upstream and downstream community results. Floodplain restoration can involve a number of strategies depending on the context but may include zoning to preclude development and other activities (e.g., planting and grazing) within the floodplain to help restore beneficial floodplain functions. It often involves the removal, relocation or elevation of flood-prone structures.

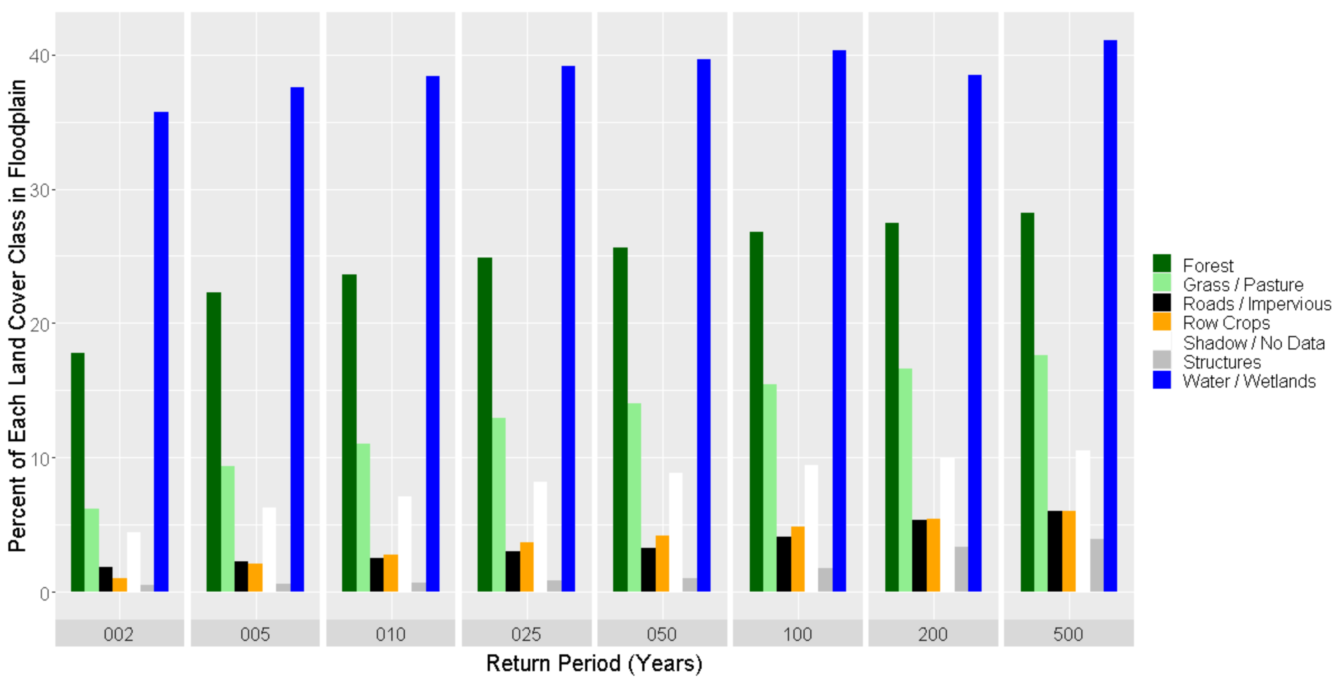
Figure 5-2 shows the percentage of various land-use categories located within various flood stages in the North Raccoon River Watershed. Very small portions of row crops, structures and impervious cover (including roads) are located within areas that flood most frequently (represented by the 2-year flood in this figure). The graph shows that less than 1% of each of these land uses would be inundated by this type of a flood event. But as flood events become larger, more of these land uses are expected to be affected. About 5% of row crop lands and roads/impervious cover see impacts during a 100-year (1% annual chance) event. Decisions can be made to change land uses in areas of increased flood risk.

Figure 5-3 maps where negative impacts are expected too frequently, according to stakeholder feedback received during development of this plan. Stakeholders prioritized the following threshold criteria to identify potential targets for land use change, structure removals or other flood protection measures:

- **Row crop areas within the 2-year flood at their location**
- **Roads impacted by a 25-year flood at their location**
- **Building structures within a 500-year flood at their location**

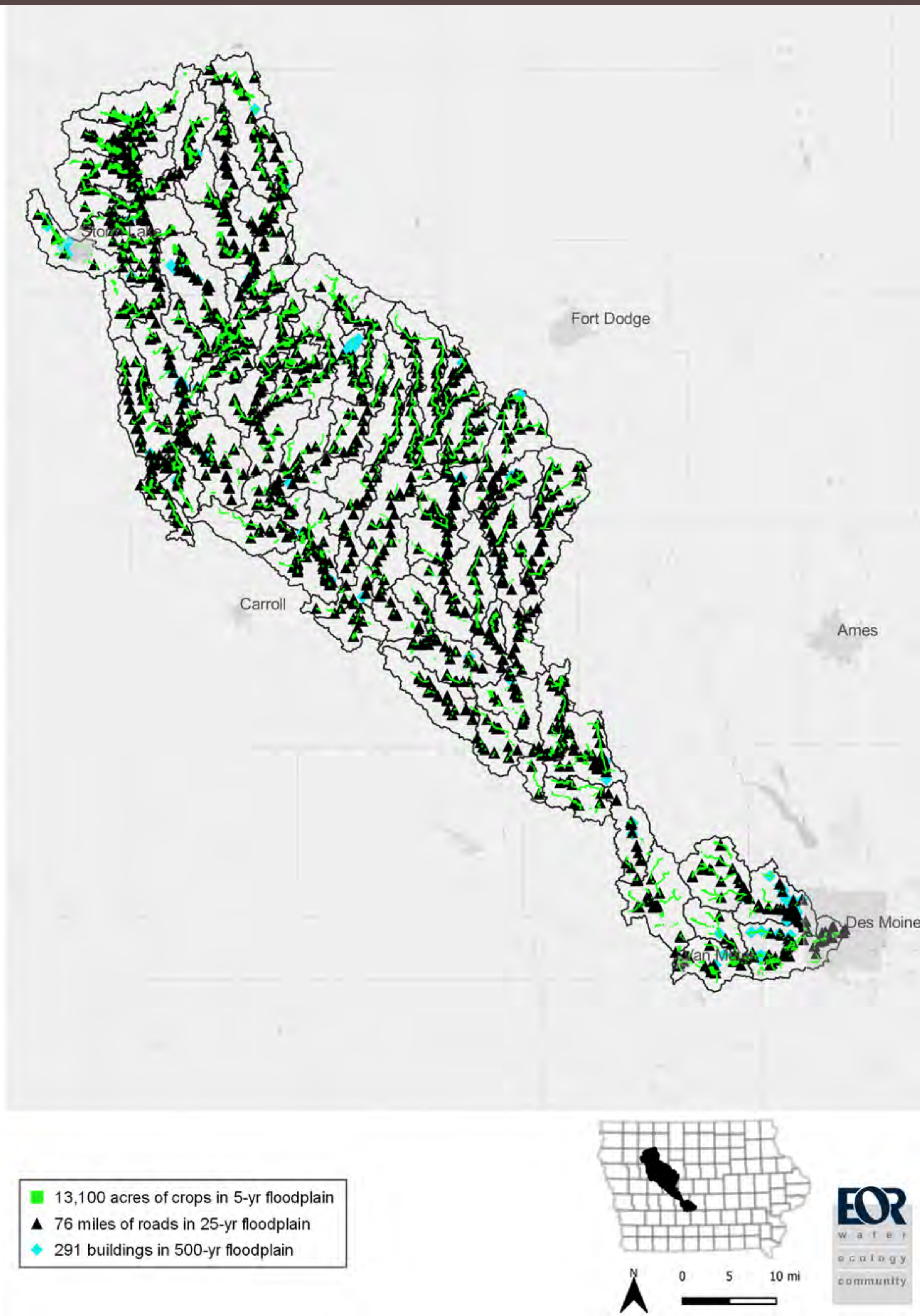
This plan is not advocating for land use changes or other modifications for all these areas. Rather, ***these highlight opportunities which could be investigated,*** with priority given to these features expected to be affected most frequently or severely.

FIGURE 5-2 LAND USES WITHIN VARIOUS FLOODPLAIN STAGES



Data source: Iowa Geodata

FIGURE 5-1 FLOODING ISSUES MEETING STAKEHOLDER PRIORITIZED CRITERIA



Data source: Iowa Geodata, HAZUS

Development and Redevelopment Policies

This strategy overlaps with floodplain regulation, but also includes policy mechanisms that can help reduce the downstream impacts of developments by ***requiring some level of stormwater rate and volume control***. It can also include thoughtful design and location of public services and utilities to passively discourage development in high-risk areas. Additionally, this strategy may include the acquisition or establishment of easements in order to prevent land uses that are incompatible with floodplain management goals. These policies are reviewed in detail in Chapter 9 of this plan.

Disaster Preparedness, Assistance and Recovery

These strategies involve a wide array of tactics ranging from ***post-disaster evaluation to the development of preparedness and recovery programs***. Preparedness involves training and coordination at all levels, including public information campaigns, community readiness evaluations, obtaining flood insurance to supplement post-flood government assistance, and coordinating local, state, and federal disaster preparedness plans and programs. More information on individual and community preparedness can be found at www.fema.gov/individual-and-community-preparedness-division.

Floodproofing

At fema.gov/floodproofing, FEMA defines floodproofing as "any combination of structural and non-structural additions, changes, or adjustments to structures which reduce or eliminate flood damage to real estate or improved real property, water and sanitary facilities, structures and their contents." Furthermore, floodproofing can be either wet or dry. Wet floodproofing, according to FEMA, "includes permanent or contingent measures applied to a structure or its contents that prevent or provide resistance to damage from flooding while allowing floodwaters to enter the structure or area. Generally, this includes properly anchoring the structure, using flood-resistant materials below the Base Flood Elevation (BFE), protection of mechanical and utility equipment and use of openings or breakaway walls." A dry floodproofed structure, according to FEMA, "is made watertight below the level that needs flood protection to prevent floodwaters from entering. Making the structure watertight requires sealing the walls with waterproof coatings, impermeable membranes, or a supplemental layer of masonry or concrete."

For further information, go to:
www.fema.gov/media-library-data/20130726-1608-20490-9182/fema_551_ch_07.pdf

Flood Forecasting and Warning/ Emergency Plans

These strategies typically involve developing systems that predict the magnitude and timing of flooding on major rivers, where flood crests move slowly enough to ***perform analyses and provide advanced warning***. They are typically not feasible on smaller tributaries and in headwater catchments, since the time between a rainfall event and the peak flood may be minutes or hours. A monitoring program which includes improvements to flow level monitoring stations is outlined in Chapter 14 of this plan.

SELECTING STRATEGIES

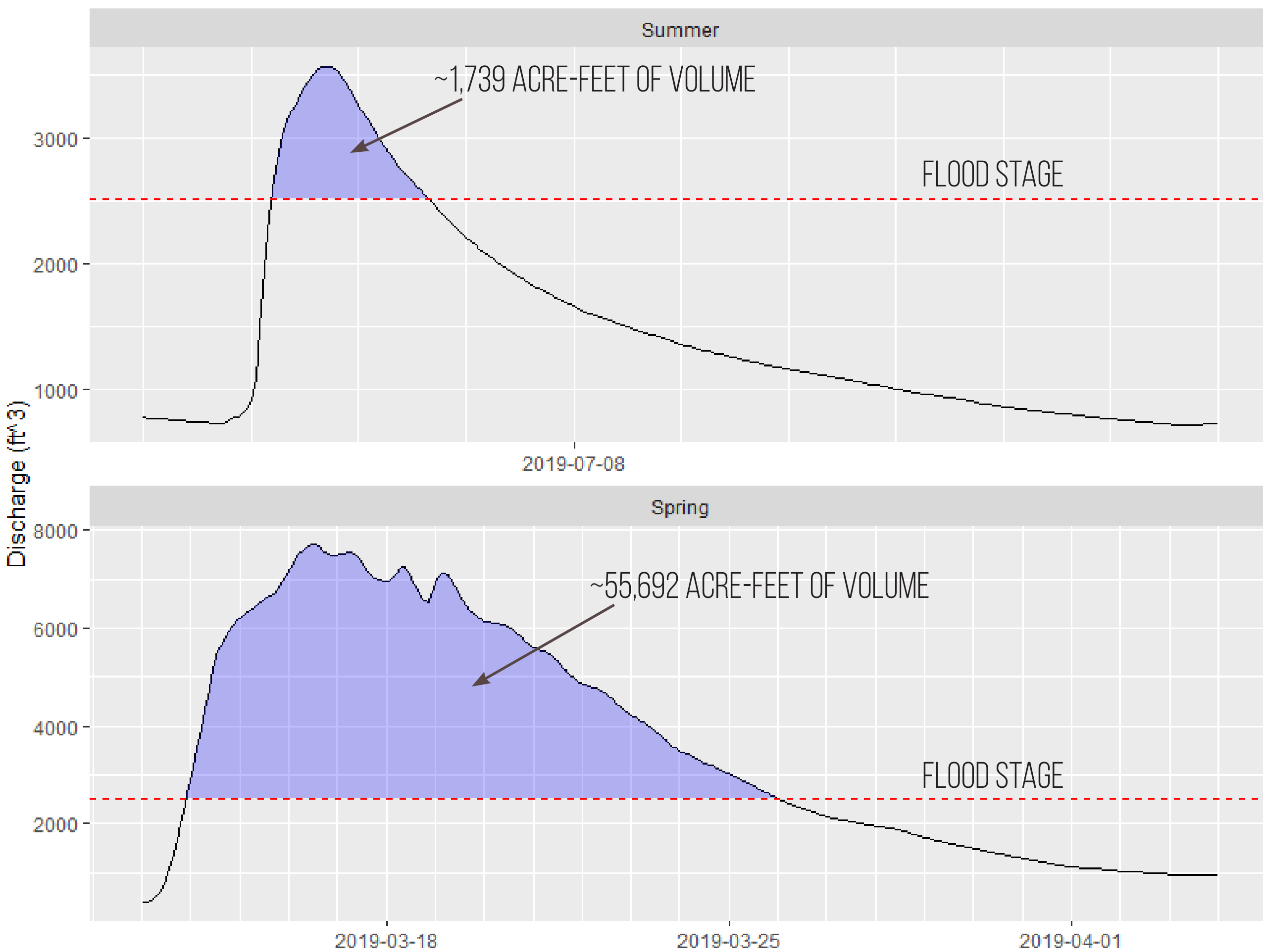
Evaluation of Options

When determining an appropriate flood mitigation strategy, it is critical to identify the target flood event. ***Different types of flooding events have different characteristics, both in terms of the duration of flooding and the geographic extent.*** For example, a midsummer flash flood caused by an intense burst of rainfall on wet soils requires a different approach to flood mitigation than a springtime flood caused by snowmelt. Also, managing risk of flooding along the mainstem of the river is a much different challenge than dealing with similar issues along a smaller tributary stream.

For example, the strategy referred to in this plan as distributed storage is a strategy to modify flooding that consists of constructing basins designed to detain water for a short period of time (typically 24 or 48 hours). ***While a distributed-storage approach to flood mitigation may work well for short-duration flooding in headwater catchments or smaller tributaries, it will provide little if any benefit for some of the river flooding events observed in Iowa in recent years—where rivers are elevated above flood stage for weeks at a time.*** For these long-duration flood events, it will almost certainly be infeasible to use a detention-based approach to modify flooding, as the size of the basins required to hold back thousands of acre-feet of water for days or weeks would certainly be cost-prohibitive and would consume large areas of productive farmland.

To illustrate this point, consider the two flooding events shown in Figure 5-4—both of which occurred in 2019. The amount of excess water (the total volume of water above flood stage) is very different between these two events. The length of time that water was above flood stage is also very different for these two events (about 36 hours for the summer event and about 12 days for the spring event). The flood risk during the summer event could have been improved using a strategy to modify flooding. However, the spring flooding event lasted eight times longer and the volume of water above the flood stage was 32 times that of the summer event. Modifying this flood event would likely go beyond simple detention storage practices, instead requiring a comprehensive suite of strategies including significant changes to land use and management. ***To address this longer event, the landscape would need to absorb nearly 1.5 inches of additional snowmelt and rainfall across the entire drainage area.*** These extended-duration flood events would be prohibitively expensive to address solely with a modify flooding approach—especially one that is focused on construction of detention practices.

FIGURE 5-4 COMPARISON OF SEPARATE 2019 FLOOD EVENTS AT SAC CITY



Source: EOR analysis of USGS stream gauge data

The hydrologic assessment conducted by IIHR (2019) largely confirmed these ideas. The assessment evaluated two scenarios for modifying flooding in the watershed: increased infiltration in the watershed through land cover or land management changes, and increased storage on the landscape through the construction of distributed dry ponds. ***It found that changes to land use (e.g., conversion from agriculture to native prairie) had the most significant impact on runoff. It also noted that using cover crops would decrease runoff volume in a similar manner, while potentially having very little impact on crop production.***

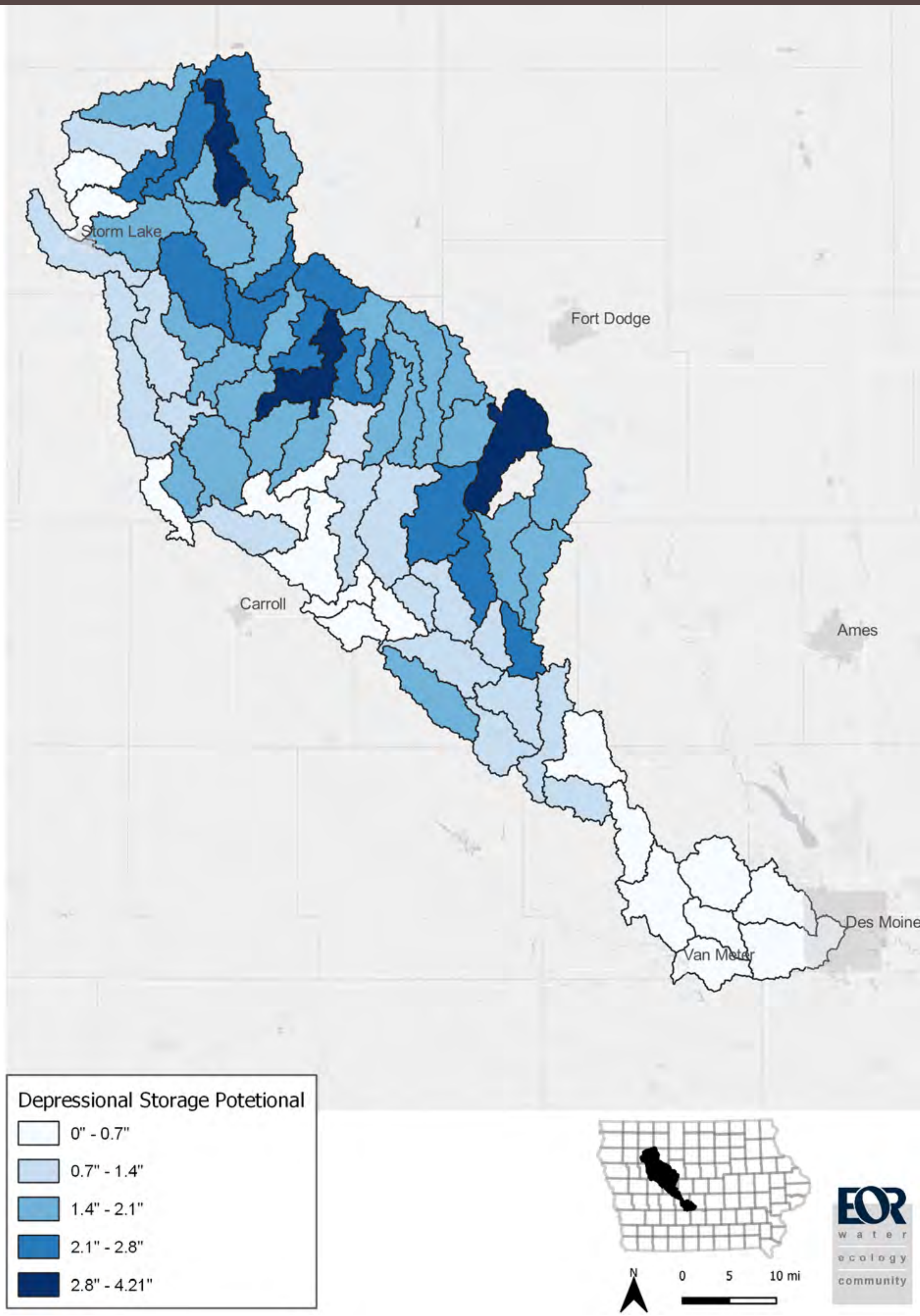
A simulation that included 133 hypothetical wetlands and 151 flood control ponds predicted flow rates immediately downstream of the facilities were reduced by as much as 15%. However, moving further downstream, the peak flow rate reductions were much smaller (as little as 2% along the main stem of the North Raccoon River). The IIHR hydrologic assessment concluded that a combination of cover crops, wetlands and ponds could decrease peak flow rates across the watershed by between 2% and 15%, and on the North Raccoon River by between 2% and 10% during large storm events, depending on the characteristics of the event and the reporting location. This combined approach would not eliminate all flood risk but could reduce the extent of lands or structures negatively impacted by floods. It is important to note that this analysis did not consider the potential impacts of climate change, such as increased flood severity and frequency, so these reductions may be overestimated in the context of future watershed conditions.

Driving Strategy: Flooding

The members of the NRRWMC have indicated that ***modify flooding should be the prioritized strategy within the subwatersheds of the Headwaters North Raccoon River hydrologic setting*** (see information about hydrologic settings in Chapter 3). ***In the remainder of the watershed, strategies that modify impacts and modify susceptibility should be applied.***

This approach aligns with information shown in Figure 5-5. This map shows flood impacts along the smaller tributaries in the headwaters, which could be improved using strategies that modify flooding. Some of the most severe impacts are shown in the lowest parts of the watershed, most of which are near the Des Moines metro area. At this point, the watershed is so large that strategies to modify impacts and modify susceptibility would be most effective.

FIGURE 5-5 ANNUALIZED TOTAL PROSPECTIVE FLOOD DAMAGES IN THE 500-YEAR FLOODPLAIN



Source: Department of Homeland Security Emergency Management Division

RURAL WATER QUALITY

INTRODUCTION

Rural water quality improvements require a mix of approaches to accommodate the needs of rural communities, landowners, farm operators and those downstream. Frequently, water quality initiatives also result in some level of flood mitigation (and vice versa). Here we take a look at common BMPs appropriate for water quality improvements in the North Raccoon. We cannot summarize all of the potential approaches here; at the same time, it must be noted that adoption rates of these practices depend as much on economics and social connections as they do the science of water quality itself. Have the farm operators seen these practices in action? Do they have ample resources for implementation? Are landowners supportive? These are just a few of the questions that must be addressed to succeed in implementing water quality approaches.

What follows is a mix of opportunities to positively impact the land—from reduced application of nitrogen and phosphorus to wetlands to more challenging construction projects. At the same time, outreach, education, planning and program solutions are also part of the mix.

Two general approaches can help implement water quality conservation practices:

Outreach

Watershed coordinators, Soil and Water Conservation Districts (SWCDs), County Conservation staff and individual NRRWMC members have experience conducting outreach. The NRRWMC can also leverage the expertise of partner organizations such as the Natural Resources Conservation Service (NRCS), Iowa DNR, agricultural commodity groups, local co-ops and other local water quality project coordinators. Outreach efforts will be particularly appropriate for implementing conservation practices that involve changes in management and operation.

Cost-Share

Cost-share traditionally comes from federal and state programs, as well as public and private grants. This plan urges these sources to continue or expand. Arrangements can also be made for NRRWMC members or partners to use a cost-share model, providing funds directly to landowners for putting in practices. Meanwhile, support continues to gain ground for downstream members to invest in upstream projects. A cost-share model would likely be the foundation of this kind of investment. The Funding and Organizational chapter of this plan highlights mechanisms for cost-share, including grants, public-private partnerships and possibly NRRWMC member contributions.

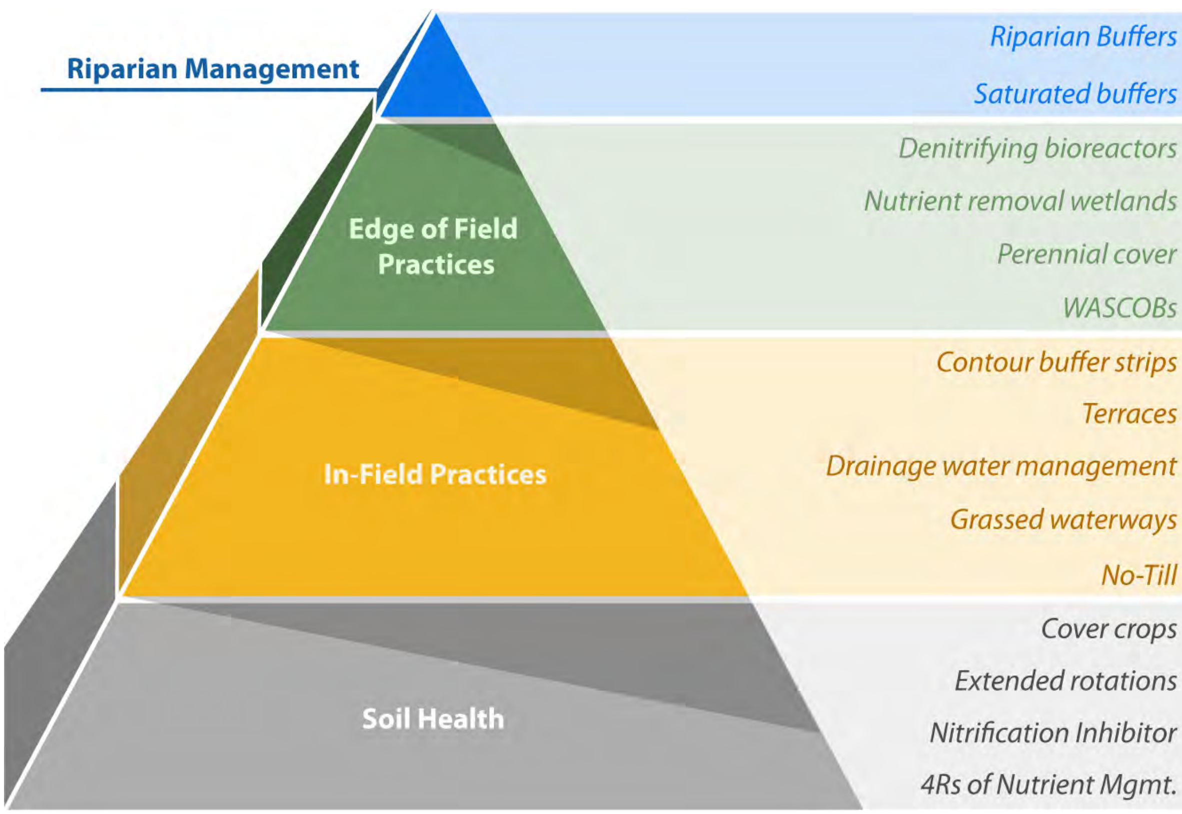
CONSERVATION STRATEGIES

Figure 5-6 shows the "Conservation Pyramid," a suite of conservation strategies for improving water quality in agricultural areas:

- **Soil Health**
- **In-field**
- **Edge-of-field**
- **Riparian Management**

The arrangement of the pyramid illustrates a general principle: it is most effective to deal with water quantity and quality issues as close to the source as possible. As water moves further downstream, it generally becomes more difficult to achieve the same level of runoff or pollution reduction.

FIGURE 5-6 AGRICULTURAL CONSERVATION PYRAMID



Adapted from Tomer et al. 2013

Soil Health

The foundation of this conservation pyramid are practices that either build soil health or focus on the proper application of fertilizers (nutrient sources). These strategies should be the focus of early implementation, as they are some of the most cost-effective and offer benefits beyond water quality. Adjusting the rate and source of nutrient applications can actually result in cost savings. Conservation practices that build soil health do not take land out of production. They can increase crop productivity and decrease costs associated with tillage, thus improving farm profitability. They also increase the amount of rainfall that is stored or infiltrated within each field. Practices include:

- **Cover Crops**
- **Living Mulches**
- **Extended Crop Rotations**
- **No-till/Reduced Tillage**
- **Nitrification Inhibitors**
- **4Rs of Nutrient Management**

In-Field Practices

In-field practices trap nutrients and sediment and are commonly used to address rill and gully erosion in farm fields. These practices typically involve taking small areas out of production. This can sometimes complicate routine farming operations by subdividing fields. Practices include:

- **Contour Buffer Strips**
- **Terraces**
- **Drainage Water Management**
- **Grassed Waterways**
- **Prairie Strips**

Edge-of-Field Practices

These practices typically involve removing some agricultural land from production and converting those areas to conservation practices. They are typically larger, more costly practices but can provide nutrient and sediment removal for large drainage areas. Practices include:

- **Denitrifying Bioreactors**
- **Nutrient Removal Wetlands**
- **Perennial Cover**
- **WASCOBs**
- **Farm Ponds**

Riparian-Area Practices

These can be considered a last defense in keeping nutrients and sediment out of the stream. These include practices along streams or waterbodies which create natural buffers, reconnect floodplains and improve habitat. Riparian buffers provide water and nutrient uptakes and sediment trapping, and can stabilize streambanks. Practices include:

- **Riparian Buffers**
- **Saturated Buffers**
- **Streambank Stabilization**
- **Oxbow Restoration**
- **Two-Stage Channels**
- **Culvert Modifications**

Existing adoption rates for many of these practices can be found in Appendix B of this plan.

More information about various practices can be found in the Technical Approach (Appendix B of this plan).

Programmatic Approaches

Programmatic approaches to nutrient and sediment pollution in an agricultural setting consist of ***policies, regulations and campaigns of local and state government*** designed to address the adverse impacts of agricultural runoff. Local and state governments can adopt policies and regulations to standardize land management activities that contribute to water pollution. They can also provide cost-share assistance programs for practice adoption. Sometimes these programs involve partnerships between state and local governments, and some private entities. Programmatic approaches to agricultural runoff include:

- **Manure management**
- **Pasture management**
- **Easement programs**
- **Cost-share programs**
- **Conservation stewardship programs**
- **Wetland mitigation banking**

PRIORITIZING NUTRIENT REDUCTION PRACTICES

Watershed pollutant reduction methods must suit the unique characteristics of the area. This plan has been created to address flooding and water quality issues at the HUC-8 scale. However, it provides a framework to translate these approaches to more detailed plans at the smaller HUC-12 subwatershed scale. This is discussed further in Chapters 6 through 8 of this plan.

The magnitude of nutrient reductions needed to meet watershed goals requires high adoption rates of conservation practices. No one type of conservation practice can meet pollutant reduction targets. As with flood management, a suite of practices is needed. This plan includes analyses to determine the projected adoption rates of conservation practices needed in key subwatersheds to meet water quality goals. The practices were evaluated based on data included in the Iowa Nutrient Reduction Strategy (IDALS et al. 2017).

The maximum pollutant reduction potential of each type of conservation practice is based on ***practice performance, the area of land treated and practice adoption rate***. These factors vary considerably among conservation practices and local conditions.

Practice performance is typically expressed in terms of percent reduction of a particular pollutant based on the monitoring results of installed practices. The Nutrient Reduction Strategy (NRS) includes a summary of past monitoring research done on various conservation practices in the agricultural setting. The expected nutrient reduction values projected from the NRS for each practice can be found in Appendix B.

The practice performance and the area of land treated are combined to calculate the quantity of a pollutant removed by each individual practice. In some cases, like cover crops, the treated area is synonymous with the area of the individual practice. Other practices, like nutrient removal wetlands, treat runoff from upstream areas. These areas can be much larger than the footprint of the individual wetland.

The final consideration in determining the pollutant removal potential for each conservation practice is its ***adoption rate***. This is the maximum feasible amount of individual practices that can be expected to be implemented on the landscape. Not every site with potential will be implemented. There are social, cultural and economic factors which will typically create barriers for implementing practices. Practice adoption rates are highly variable among subwatersheds and require significant analysis to determine. The adoption rate takes into account the following rates:

- ***Maximum Potential Adoption Rate*****—Physically defined maximum that is possible for the subwatershed**
- ***Maximum Feasible Adoption Rate*****—Reasonable maximum rate based on willingness to adopt**
- ***Optimal Adoption Rate*****—Target adoption rate to meet nutrient reduction goal**
- ***Existing Adoption Rate*****—Current adoption rate within the subwatershed**

Details of how these rates are determined are in Appendix B.

The optimal mix of conservation practices that need to be adopted to meet nutrient reduction goals for the subwatershed constitutes the HUC-12 Conservation Action Plan. Conservation Action Plans for each of the six Priority Subwatersheds are in Appendix D. Optimization of conservation practices is based on several factors including cost-effectiveness, land use/cover and willingness for adoption, all of which vary by HUC-12 Subwatershed.

The performance of the suite of conservation practices is evaluated as a whole to account for effects when several practices are used in series to treat runoff. The effectiveness of conservation practices near the end of the series is limited by the performance of practices higher up in the watershed. In other words, as more nutrient removal is accomplished upstream, the downstream practices have fewer pollutants to remove. As an illustration, a nutrient-removal wetland that treats a drainage area with no upstream conserv ation practices would be responsible for the removal of more pollutants than one which receives runoff from an area with high adoption rates of other practices.

This is not meant to discourage using multiple practices in series. Using multiple practices creates redundancy that can keep removal rates high, even if one practice fails to perform as well as planned. Also, the proper performance of practices may rely on upstream management techniques. For example, grass waterways or wetlands may not perform as well as planned if severe surface erosion in upstream fields clogs these features with high sediment loads. However, this concept needs to be understood, so that removal rates of practices in the downstream end of a series are not overestimated (modeling should not assume they are removing nutrients that other practices upstream have already removed). The parameters of these conceptual models for nutrient removal is shown in Appendix B.

Determining the optimal mix of conservation practices for the HUC-12 Subwatershed Water Quality Strategy is a back-and-forth process that prioritizes the most cost-effective practices. First, the adoption rate for the most cost-effective practices is incrementally increased until the maximum feasible adoption rate is reached. If the model indicates that nutrient reduction goals of the subwatershed are not yet achieved, the next most cost-effective practices will need to be implemented. This process is iterated through the entire suite of conservation practices until either the nutrient reduction goal is achieved, or all practices have been set to their maximum feasible adoption rate.

THREE TIERS OF NUTRIENT REDUCTION CONSERVATION PRACTICES

As implementation proceeds, the conservation practices described previously are grouped into three "tiers" for the purpose of this plan. ***These are organized primarily by the cost and type of effort required for implementing the practices.***

Tier 1 Conservation Practices

The practices categorized as Tier 1 Conservation Practices are management practices that must be implemented annually. Water quality benefits are typically limited to the year in which they are implemented. However, soil health benefits may extend beyond the seasons in which they are implemented.

Many Tier 1 Conservation Practices may be implemented at low cost (compared to other practices), ***or even represent a cost savings to the producer.*** For example, nutrient management strategies may involve the reduction of fertilizer use, which can represent a cost savings. Another example is the conversion of non-profitable row crop areas to the Conservation Reserve Program (CRP) or conservation easements. These could create a source of income to the landowner in areas that might typically operate at a loss.

Implementation of Tier 1 Conservation Practices should be maximized first, as they can result in significant pollutant removal benefits at minimal cost. These practices could be implemented broadly across the North Raccoon River Watershed and do not need to be focused only into priority subwatershed areas (refer to Chapter 6 for subwatershed priorities).

Also included in Tier 1 Conservation Practices are policies in urban areas that would require developers to implement water quality improvement practices at the time a parcel of land becomes developed. These policies are described in further detail in Chapter 9.

TIER 1 CONSERVATION PRACTICES

- **Cover crops**
- **Extended rotations**
- **No-till**
- **Nitrogen management: nitrification inhibitor**
- **Nitrogen management: rate control**
- **Nitrogen management: source control**
- **Nitrogen management: timing control**
- **Phosphorus management: placement control**
- **Phosphorus management: rate control**
- **Phosphorus management: source control**
- **Residential management practices**
- **Municipal management practices**
- **Redevelopment policies**
- **New development policies**

Tier 2 Conservation Practices

The practices categorized as Tier 2 Conservation Practices are in-field, edge-of-field, and stream-side practices that trap and filter agricultural runoff from relatively small contributing areas. ***These practices require an initial investment to construct and each practice has a limited life span, after which they will need to be replaced.*** In some cases, these practices result in a loss of farmable land. They are generally limited to a single landowner.

Included in Tier 2 Conservation Practices are stormwater management retrofit practices in urban areas that are small in scale (limited to one or two residents, either on private property or within the adjacent street right-of-way). Further information on stormwater management practices are in Appendix B.

TIER 2 CONSERVATION PRACTICES

- **Contour buffer strips**
- **Terraces**
- **Drainage water management**
- **Grassed waterways**
- **Denitrifying bioreactors**
- **Perennial cover**
- **WASCOBs**

- **Bioreactors**
- **Riparian buffer: critical zone buffer**
- **Riparian buffer: deep-rooted vegetation buffer**
- **Riparian buffer: multi-species buffer**
- **Riparian buffer: stiff stem grass buffer**
- **Riparian buffer: stream stabilization buffer**
- **Saturated buffers**
- **Right-of-way stormwater retrofits**
- **Residential stormwater retrofits**

Tier 3 Conservation Practices

The practices categorized as Tier 3 Conservation Practices are infrastructure projects designed to treat relatively large areas. ***These practices require a significant initial investment including design, permitting and construction costs.*** Tier 3 Conservation Practices take large areas out of production and typically involve multiple landowners. However, these practices can often be placed within areas that are frequently flooded or are marginally (or not) profitable. Thorough analysis is needed for Tier 3 practices to ensure that there are no adverse impacts to adjacent lands.

Included in Tier 3 Conservation Practices are stormwater management retrofit practices in urban areas that are relatively large, providing benefits to multiple landowners.

TIER 3 CONSERVATION PRACTICES

- **Nutrient removal wetlands**
- **Two-stage channels**
- **Ox-bow restoration/floodplain storage**
- **Commercial stormwater retrofits**
- **Public areas stormwater retrofits**
- **WASCOBs**
- **Detention practices**
- **Floodplain reconnection**
- **Farm ponds**

BACTERIA REDUCTION

As described in the North Raccoon River Watershed Assessment (Emmons and Olivier Resources, Inc. 2020), segments of the North Raccoon River, the Raccoon River, and several smaller streams in the watershed have levels of bacteria exceeding state standards for human contact and recreational use. It can be extremely difficult to implement enough water quality practices to meet these standards during both high- and low-flow conditions. However, practices can reduce the occurrence and length of time when water quality standards are exceeded.

Developing an implementation plan for reducing bacteria concentrations and meeting water quality standards should begin with the most cost-effective and efficient methods. This section describes the steps to identify sources and reduce loading by source control and the implementation of BMPs.

"Bacteria" is a general term used to describe fecal coliform or *E. coli* bacteria. While these bacteria can pose health risks themselves, ***they are also useful as an indicator for the potential presence of other pathogens*** which carry other risks but cannot be effectively evaluated. The presence of indicator bacteria at high levels can indicate that conditions are favorable for other pathogens to also be present at significant levels.

When addressing bacteria sources, priority should be placed on reducing source contributions with human influence, since these sources are more likely to contain pathogens that are harmful to human health.

Priority subwatersheds for control of pathogens (Figure 5-7) were identified using:

- **Very High Priority Bacteria Subwatersheds identified in the Raccoon River Water Quality Master Plan**
- **Subwatersheds with a stream segment or lake that has been deemed impaired due to an elevated level of bacteria**

All other subwatersheds known to have recreational use were categorized as Urgent subwatersheds for control of pathogens.

Remaining subwatersheds are categorized as Action subwatersheds for control of pathogens.

General strategies to address bacteria include:

- **Bacteria concentration, source identification (species) and mapping**
  - Monitoring and detection
- **Ensuring state laws and local ordinances are up to date and enforced**
- **Collection of pet waste**
- **Bans on wildlife feeding**

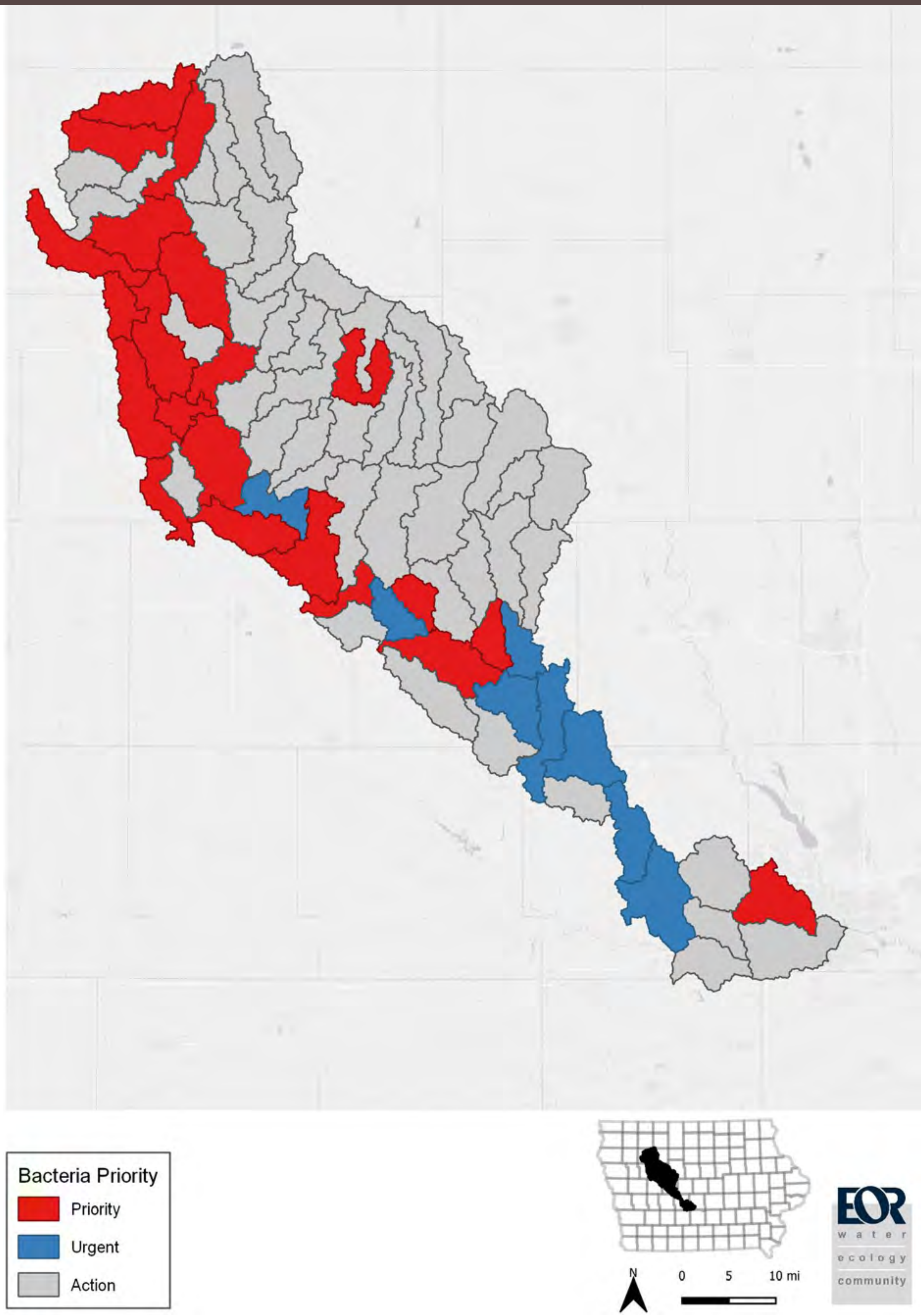
Bacteria Source Control Approaches

The most effective method to reduce loads and meet long-term water quality goals is to address the sources that directly contribute bacteria to waterbodies. Source controls are BMPs that focus on limiting the introduction of bacteria into the landscape where it could be transported to waterbodies. Source control activities that reduce bacteria releases from direct sources include:

- **WWTP upgrades**
- **Improvements to septic systems**
- **Livestock Exclusion from Surface Waterbodies**
- **Manure Management**
- **Pasture Management**
- **Confined Feeding Operations Controls**
- **Routine Maintenance of Onsite Wastewater Treatment System**
- **Pet Waste Collection**
- **Wildlife Feeding Bans**
- **Urban Green Infrastructure Practices**
- **Reduction of Dry-weather Flows in Urban Stormwater Pipes**

More detailed information on each of these practices can be found in the Technical Approach in Appendix B.

FIGURE 5-7 KEY SUBWATERSHEDS FOR CONTROL OF PATHOGENS



Bacteria Treatment Approaches

Source control and the methods mentioned above should be the first step to reduce bacterial loading, as these methods are the most cost-efficient and effective. ***Source control, however, is not always feasible***, which means BMPs that can reduce bacteria levels need to be employed. Based on available data, some conventional stormwater BMPs reduce bacterial loads to receiving waters by:

- **Treating stormwater and removing bacteria from discharged water**
- **Reducing total water discharge along with the associated bacterial load**

In some cases, multiple BMPs, including pre-treatment, may be necessary to achieve significant reductions in bacteria concentrations. Additionally, many BMPs are designed to reduce the loading of several pollutants at the same time.

Before evaluating BMP performance or selecting practices to target bacteria, it is important to understand that estimating the growth or reduction of bacteria is complicated. Bacteria are living organisms. Many factors (temperature, pH, nutrients, etc.) can affect their survivability and rate of reproduction. Therefore, their population change (fate) and ability to move through streams and lakes (transport) is dependent on many factors. In contrast to chemical pollutants, conditions favorable to growth may allow pathogens (such as bacteria) to grow beyond the amounts that are initially washed into waterbodies.

However, properly designed BMPs that reduce the total volume of agricultural or urban runoff (e.g., infiltration BMPs) can often reduce the bacteria load by an amount similar to the reduced volume of runoff. These practices may also reduce the frequency of bacterial discharges to receiving waters if volume reductions are enough to retain runoff from most events.

BMPs that filter runoff (e.g., filtration or other BMPs that do not reduce volumes but do provide treatment) may reduce bacteria concentrations in this runoff and thereby reduce loading to receiving waters. Filtration and similar BMPs should, however, be carefully planned and investigated before implementation as they can cause increased bacteria concentrations in discharges if not property designed or constructed.

Overall, data on BMP effectiveness to address bacteria is limited and, except for properly designed infiltration BMPs, broadly applicable conclusions cannot be drawn. Additional studies are needed for all BMP types to increase the confidence of performance estimates about bacteria.

The measures and BMPs listed below and described in Appendix B are not the only available methods for reducing bacteria but are the actions most recommended and applicable to the North Raccoon River Watershed. As mentioned above, efforts to reduce and eliminate bacteria sources should be conducted first, when possible.

- **Infiltration/bio-infiltration**
- **Filtration/bio-filtration**
- **Filter strips/buffers**
- **Stormwater ponds and constructed wetlands**
- **Feedlot runoff control**

USE OF NATIVE VEGETATION

Native vegetation should be used in all conservation practices where re-vegetation is required. Diverse, deep-rooted native prairie grasses and wildflowers provide durable, perennial cover that protects soil, enhances water quality and mitigates flooding by slowing runoff, increasing infiltration, reducing soil erosion and capturing nutrients. This is also a practice that provides an opportunity for pollinator plants, which may be an avenue for expanding potential partners and funding opportunities. The Tallgrass Prairie Center website (www.tallgrassprairiecenter.org) describes the benefits of native vegetation. The following are examples of conservation practices where native vegetation would be most beneficial:

- **Perennial cover**
- **Contour buffer strips**
- **Terraces**
- **Riparian buffers**
- **Prairie strips**
- **Two-stage ditches**
- **Nutrient-removal wetlands**

RESTORATION OF WILDLIFE HABITAT

The restoration of wildlife habitat can generate a multitude of recreational opportunities including fishing, wildlife viewing, hiking and kayaking. Restoration is an excellent way to repurpose spaces like existing public parks or golf courses without destroying the economic benefits gained from tourism.

- **Oxbow restoration**
- **Woodland restoration**
- **Wetland restoration**
- **Prairie restoration**
- **Channel restoration**

A total of 129 city parks, 43 county parks and 28 state parks, preserves and wildlife management areas are located in the North Raccoon Watershed. These areas may provide opportunities to restore native vegetation and wildlife habitat on public lands.

URBAN WATER QUALITY

Several strategies are available for addressing pollutant loading from urban areas. These strategies, collectively referred to as stormwater management, address pollution generated from urban land uses. Surfaces accumulate pollutants over time which are then washed off to surface waters during rainfalls and spring snowmelt. Pollutants of key concern for this plan that are found in developed areas include pathogens, phosphorus and sediment. Other pollutants such as Volatile Organic Compounds (VOCs), chloride and oil/grease can also create local water quality or environmental issues. ***Urban stormwater management practices can be grouped into low-impact development practices, stormwater storage practices and programmatic approaches.*** Several communities within the watershed (including Storm Lake, Clive and Windsor Heights) have taken an active role in implementing these types of practices.

LOW-IMPACT DEVELOPMENT PRACTICES

The urban conservation practices described in this section adopt the low-impact development (LID) approach to stormwater management. These practices are used to reduce flow volumes, flow rates and pollutant loadings in urban areas. Use of LID practices should be encouraged in new development projects, retrofit projects and public works improvements such as road reconstruction projects. LID practices are an effective means to achieve surface water protection, stormwater volume control and infiltration or groundwater recharge.

Various LID practices, ***listed below and described in Appendix B,*** are preferred over traditional stormwater management techniques because they provide a wider range of benefits for the community and environment. They increase resiliency in the landscape and typically emphasize infiltrating stormwater runoff, which reduces volumes. ***The Iowa Stormwater Management Manual (ISWMM) has been developed and maintained by Iowa DNR and includes more detailed information about each of these management approaches.***

- **Bioretention cells**
- **Bioswales**
- **Box planters**
- **Green roofs**
- **Permeable pavement systems**
- **Naturalized drainage ways**
- **Rainwater/stormwater harvesting for reuse**
- **Rain barrels**
- **Rain gardens**
- **Tree trenches**
- **Soil quality management and restoration**
- **Conversion of turf grass to native prairie**

- **Conversion of impervious surface to native prairie**
- **Enhanced treatment using sand filters**
- **Stormwater storage practices**

Traditionally, the approach for treating urban stormwater has focused on practices that slow the rate of stormwater discharge to reduce destructive velocities and manage flood level. The need for storage and moderating flow rates is necessitated because of the degree of impervious surfaces in urban areas that do not allow for rainfall to soak into the ground and, therefore, lead to an increase in flow rates and volumes. The design of large storage areas that provide runoff control evolved to include water quality elements. Water quality improvement in these practices comes when stormwater ponds for an adequate time to allow for suspended materials to settle out and become trapped within the ponds. Stormwater storage practices include:

- **Dry detention basins**
- **Wet detention ponds**
- **Constructed stormwater wetlands**
- **Underground storage**

When properly designed and maintained, stormwater practice in urban areas can shift stormwater management features from a perceived burden to community amenity.

PROGRAMMATIC APPROACHES TO STORMWATER MANAGEMENT

Programmatic approaches to stormwater management consist of policies, regulations and campaigns of local government designed to address the adverse impacts of urban stormwater. Policies and regulations are typically adopted by local governments for land development activities and, in some cases, for redevelopment. Many of these policies are the result of requirements placed on local government through their own EPA permits under the National Pollutant Discharge Elimination System (NPDES) as regulated point-source dischargers. These policies adopt standards for the performance of stormwater management plans for developments. In addition to policies and regulations, some local governments provide cost-share assistance programs for adoption of small-scale LID practices. Programmatic approaches to stormwater management include those listed below. Potential urban stormwater policies are explained in greater detail in Chapter 9.

- **Pollutant source assessment**
- **Education and outreach campaigns**
- **Better site design and source controls**
- **Construction site erosion control**
- **Construction site sediment control**
- **Residential on-site wastewater systems**
- **Pet waste ordinances**
- **Stormwater utility fees/credits**
- **Retrofit cost-share programs**

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EFFORT PRIORITIZATION

Need-based Water Quality Work Areas

Priority

Urgent

Action

06

EFFORT PRIORITIZATION

The magnitude of flooding and water quality issues means that limited resources will need to be prioritized—to focus work where it will do the most good.

This chapter lists the criteria to decide where most work should be focused.

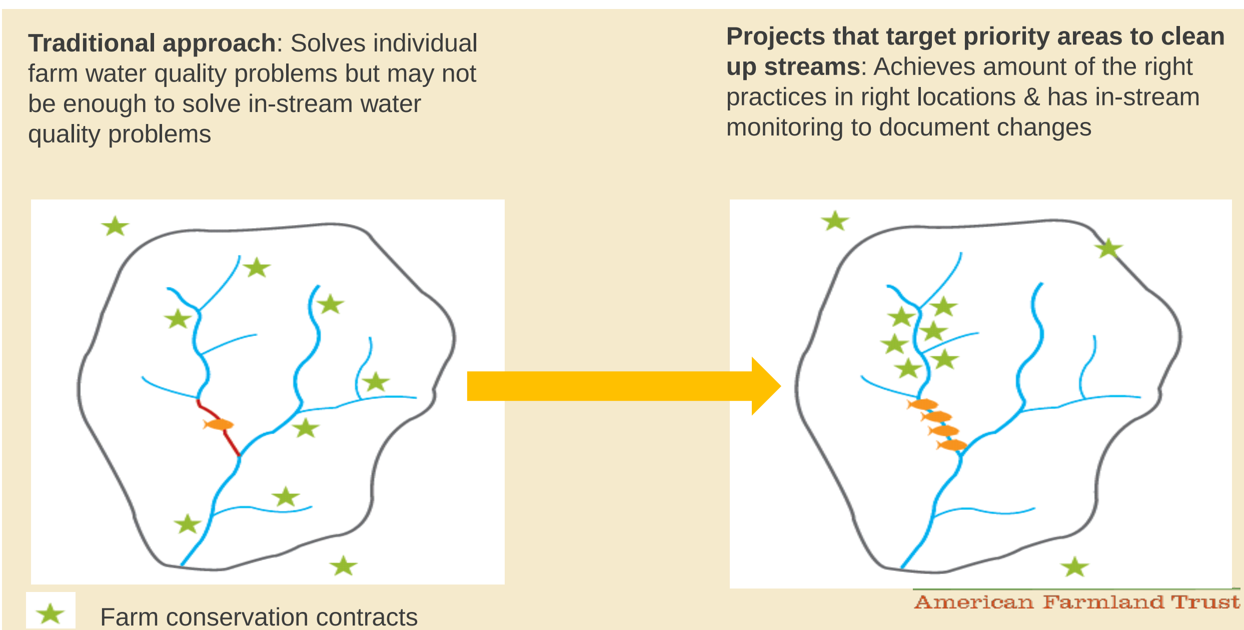
Based on that set of criteria, this plan gives highest priority to implementation in these subwatersheds:

- Headwaters Cedar Creek
- Headwaters North Raccoon River
- Lateral 2
- Outlet Creek
- Headwaters Little Cedar Creek
- Wall Lake Inlet

INTRODUCTION

The magnitude of resource-restoration needs in the North Raccoon River Watershed far exceeds the level of funding that is currently available or would likely be available in the foreseeable future. Faced with this reality, the NRRWMC has opted to focus available resources where flood reduction and water quality improvements can be maximized. This approach is a departure from the past paradigm where landowner interest primarily dictated where conservation efforts were sited. This "random acts of conservation" approach ignored resource needs and failed to recognize that work in certain areas of the watershed provides greater benefits than others. ***By targeting areas that maximize benefits, the NRRWMC has a greater chance to make measurable improvements in watershed flooding and water quality—and do so in the most cost-effective manner.*** The impact of concentrated practices and work in these targeted areas could potentially gain momentum for leveraging funds and policy changes elsewhere in the watershed. Figure 6-1 illustrates this concept.

FIGURE 6-1 TRADITIONAL VS. FOCUSED APPROACH TO CONSERVATION



Source: American Farmland Trust

CRITERIA FOR FLOODING

Flooding affects many areas throughout the watershed, as summarized in the watershed assessment. Property damage, loss of cropland and interruption of transportation have been seen in varying degrees across the watershed. Several criteria have been used to determine where to focus flood damage mitigation efforts in the watershed. ***The primary objective is to maximize benefits by targeting specific HUC-12 subwatersheds.***

NRRWMC members and plan participants used the following evaluation criteria to target HUC-12 subwatersheds for flood mitigation efforts: the hydrologic setting, flood damage type, cost of damages and the flood strategy.

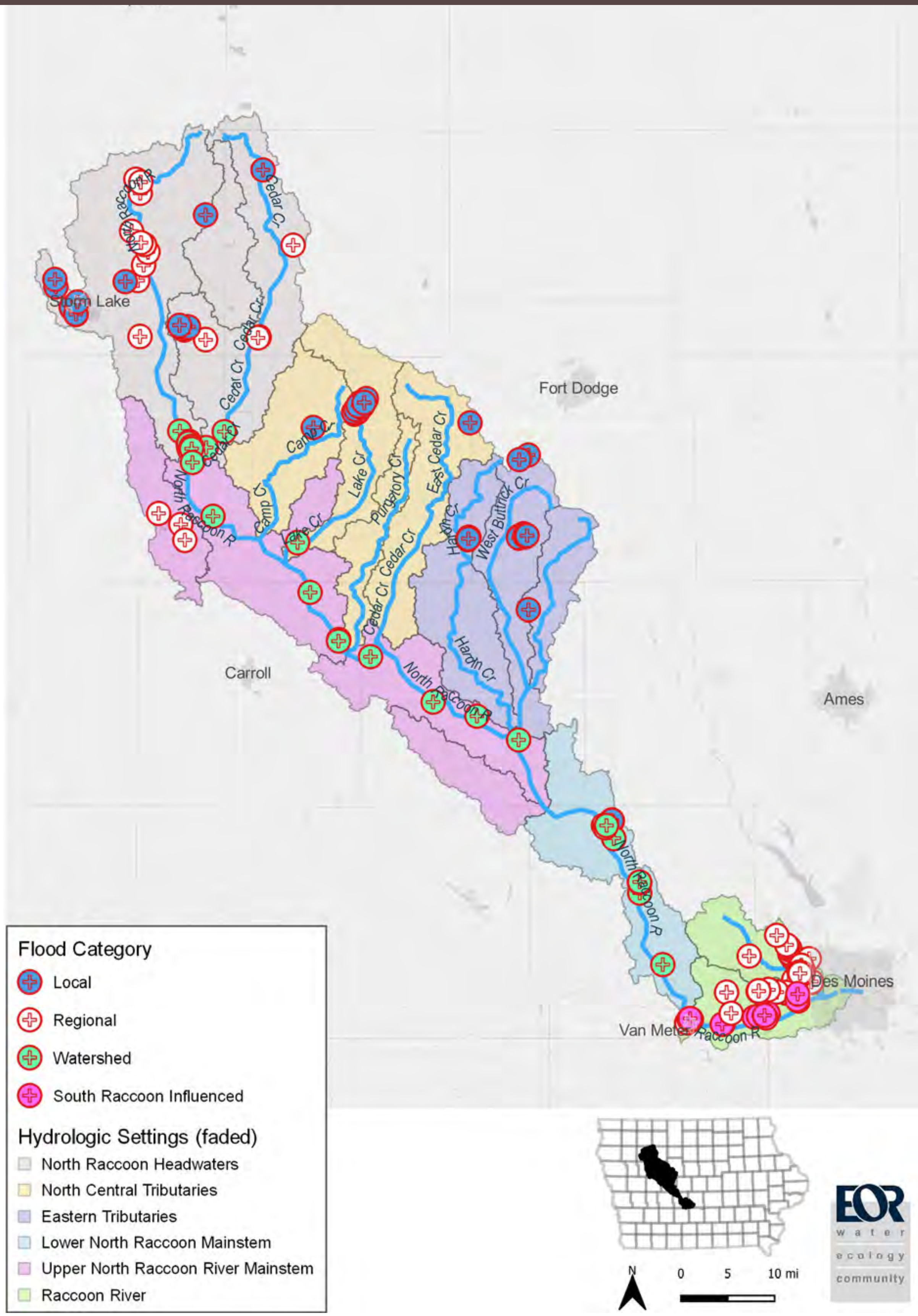
FLOOD DAMAGE TYPE

Each of the projected flood damages in the watershed were placed into four unique categories (refer to Chapter 3):

- **Localized flooding: confined to a single community or a smaller area; runoff from local drainage causes the flooding**
- **Regional flooding: spans multiple communities or a large area; runoff from more than one subwatershed contributes to the flooding**
- **Watershed-scale flooding: occurs along the river's mainstem; runoff from *many* subwatersheds contribute to the flooding**
- **South Raccoon River-influenced flooding: flooding along the mainstem of the Raccoon River downstream of the confluence with the South Raccoon River Watershed**

The type of flooding reflects the scale of work needed to mitigate the damages. For example, local-scale flooding may be addressed by localized efforts in a small community experiencing those damages, while watershed-scale flooding requires a large-scale approach to make a difference. Stakeholders ranked different scales of flooding throughout the six regions of the watershed, focusing priority on local-scale and regional-scale flooding. Figure 6-2 shows potential property and contents damage categories across the watershed.

FIGURE 6-2 FLOOD DAMAGE CATEGORY



Source: FEMA

COST OF DAMAGES

The projected costs of each type of flooding were summarized for each watershed setting. ***These costs are strictly private-property loss projections (buildings and contents); they do not include damage to infrastructure, cropland or other losses.*** Based on this information, financial impacts due to flooding are highest in the Raccoon River hydrologic setting (areas downstream of the confluence with the South Raccoon River), accounting for nearly 75% of the total watershed losses. Urban development in the Des Moines metro area has resulted in a higher density of building structures within flood risk zones in the lowest part of the watershed. Figure 6-3 illustrates private-property damage locations across the watershed.

FLOOD STRATEGY

There are three general strategies for flood mitigation (refer to Chapter 5):

- ***Modifying floods*—direct flood mitigation, primarily through structures that hold back, channel and/or absorb water and its energy**
- ***Modifying the impacts of flooding on individuals and the community*—these methods include education, policy, financial tools and preparation (for prevention and aftermath).**
- ***Modifying the susceptibility to flood damage and disruption*—these methods often involve policies to discourage development and redevelopment in high-risk areas.**

Upon reviewing the locations and financial impacts of flooding in the watershed, the NRRWMC prioritized the Headwaters North Raccoon River and Raccoon River hydrologic settings as areas to prioritize flood management efforts. Storage efforts (modifying floods) were determined to be potentially effective for the Headwaters North Raccoon River setting, whereas resilience efforts (modifying the impacts and susceptibility) were identified as the appropriate approach for the Raccoon River setting. Additionally, the flood categories were ranked within each setting, which is shown in Table 6-1. The ranking of these flood categories is based on a mutual understanding of the role of the NRRWMC and the scale of flooding that should be addressed by a HUC-8-level organization. These priority areas are shown in Figure 6-4 below.

The areas and strategies selected by the NRRWMC were further prioritized and categorized based on a series of information described in Appendix B. In summary, using the one- to 500-year floodplains, subwatersheds were selected based on quantifying specific characteristics in and around the floodplain and assessing their flood mitigation capacity with professional judgment. These characteristics included:

- **Percent of the subwatershed taken up by the floodplain**
- **Expanse of floodplain (based on topography)**
- **Land use (primarily agricultural)**
- **Depressional storage available (overlaid with agricultural land use)**
- **Location within the watershed (upstream/downstream/proximity to mainstem)**
- **Projected financial losses from damage to infrastructure**
- **Stacked benefits (water quality/recreational/habitat opportunities)**

TABLE 6-1 RANKING OF FLOOD SCALE

HYDROLOGIC SETTING	SCALE OF FLOODING	RANK
Headwaters North Raccoon	Localized	Low
	Regional	Medium
	Watershed Scale	High
North Central Tributaries	Localized	Medium
	Watershed Scale	High
Eastern Tributaries	Localized	Low
Upper North Raccoon River Mainstem	Regional	Low
	Watershed Scale	High
Lower North Raccoon Mainstem	Localized Flooding	Low
	Watershed Scale	Medium
Raccoon River	Regional	High
		High

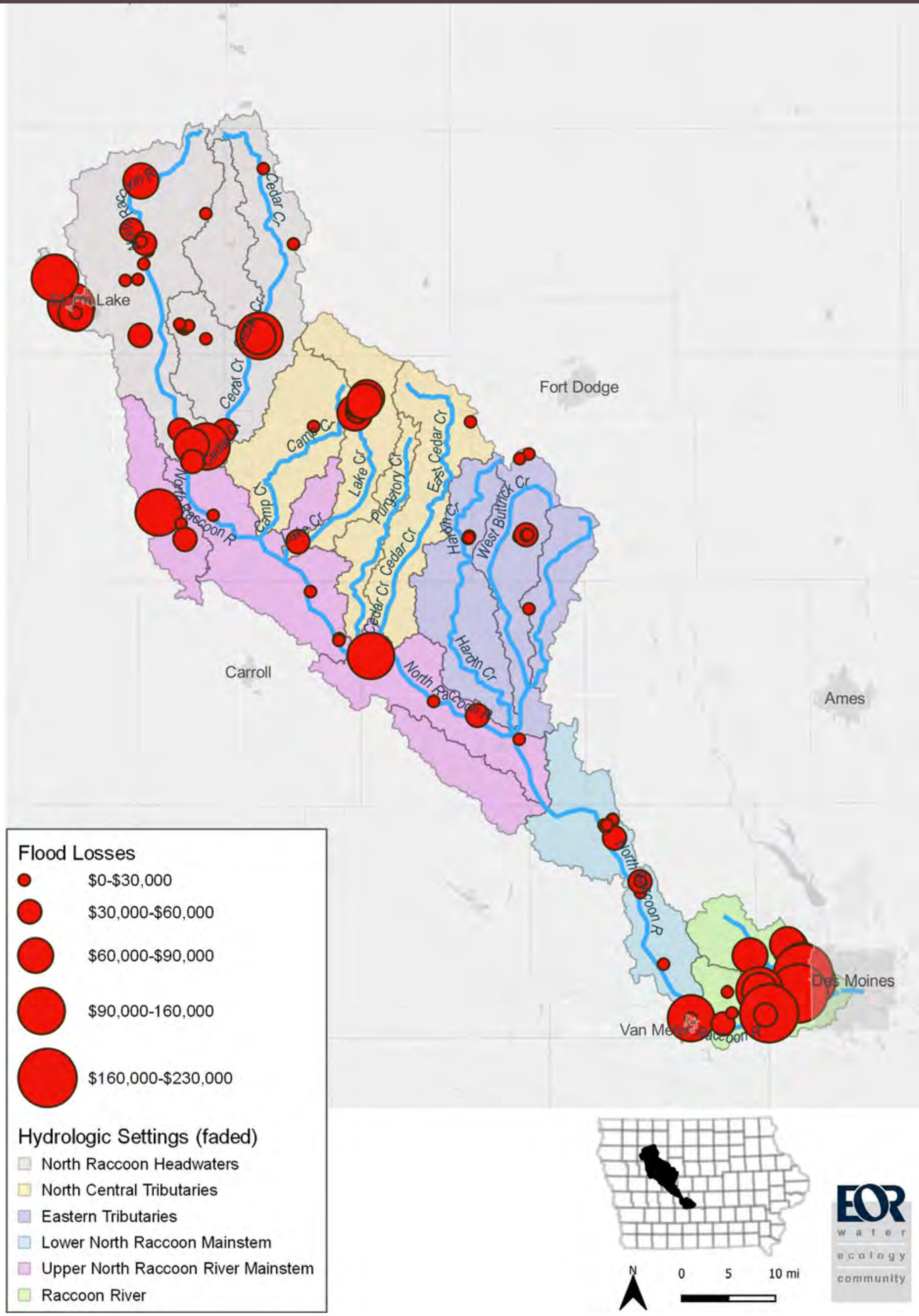
TABLE 6-2 PRIORITIZED SUBWATERSHEDS FOR FLOOD MITIGATION

SUBWATERSHED	FLOOD MITIGATION APPROACH	RANKING FACTORS
Drainage Ditch 101-North Raccoon River	High Priority Storage	• Percent of the subwatershed taken up by the floodplain • Expanse of floodplain (based on topography) • Land use (primarily agricultural)
Headwaters North Raccoon River	High Priority Storage	• Percent of the subwatershed taken up by the floodplain • Expanse of floodplain (based on topography) • Land use (primarily agricultural)
Lateral 3-North Raccoon River	High Priority Storage	• Percent of the subwatershed taken up by the floodplain • Expanse of floodplain (based on topography) • Land use (primarily agricultural)
Lateral 6-North Raccoon River	High Priority Storage	• Percent of the subwatershed taken up by the floodplain • Expanse of floodplain (based on topography) • Land use (primarily agricultural)
Lateral 4	High Priority Storage	• Percent of the subwatershed taken up by the floodplain • Expanse of floodplain (based on topography) • Land use (primarily agricultural)
Outlet Creek	High Priority Storage	• Percent of the subwatershed taken up by the floodplain • Expanse of floodplain (based on topography) • Land use (primarily agricultural)
Poor Farm Creek	High Priority Storage	• Percent of the subwatershed taken up by the floodplain • Expanse of floodplain (based on topography) • Land use (primarily agricultural)
Tank Pond	High Priority Storage	• Depressional storage available (overlaid with agricultural land use) • Location within the watershed (upstream/downstream/proximity to mainstem)

TABLE 6-2 PRIORITIZED SUBWATERSHEDS FOR FLOOD MITIGATION		
SUBWATERSHED	FLOOD MITIGATION APPROACH	RANKING FACTORS
Sac City-North Raccoon River	High Priority Resiliency	• Expanse of floodplain (based on topography) • Land use (primarily agricultural) • Location within the watershed (upstream/downstream/proximity to mainstem)
Marrowbone Creek-North Raccoon River	High Priority Resiliency	• Expanse of floodplain (based on topography) • Land use (primarily agricultural) • Location within the watershed (upstream/downstream/proximity to mainstem)
Drainage Ditch 73-North Raccoon River	High Priority Resiliency	• Expanse of floodplain (based on topography) • Land use (primarily agricultural) • Location within the watershed (upstream/downstream/proximity to mainstem)
Drainage Ditch 20-Cedar Creek	High Priority Resilience	• Projected financial losses from damage to infrastructure
Drainage Ditch 25-North Raccoon River	High Priority Resiliency	• Projected financial losses from damage to infrastructure
Johnson Creek – Raccoon River	High Priority Resiliency	• Projected financial losses from damage to infrastructure
Walnut Creek	High Priority Resiliency	• Projected financial losses from damage to infrastructure
Jordan Creek-Raccoon River	High Priority Resiliency	• Projected financial losses from damage to infrastructure
Sugar Creek		

A included in Appendix B details the scale of flooding, financial loss estimates for a 500-year flood, and the appropriate flood mitigation strategy (refer to Chapter 5 for description of flood mitigation strategies) for each potential flood damage area shown in Figure 6-2.

FIGURE 6-3 FLOOD DAMAGE COSTS



Source: FEMA

FIGURE 6-4 FLOOD PRIORITY ACCORDING TO NRRWMC WORKSHOP

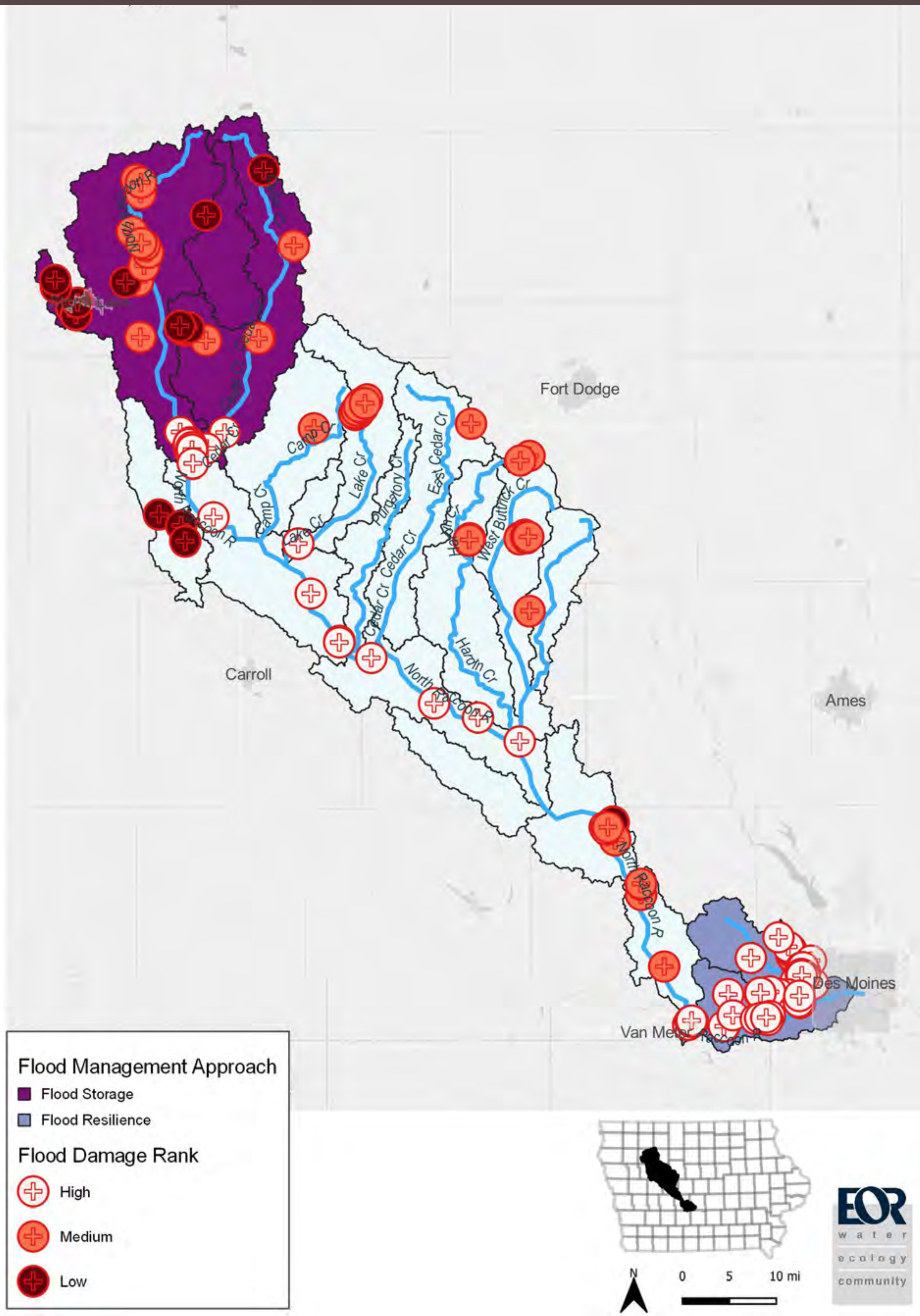
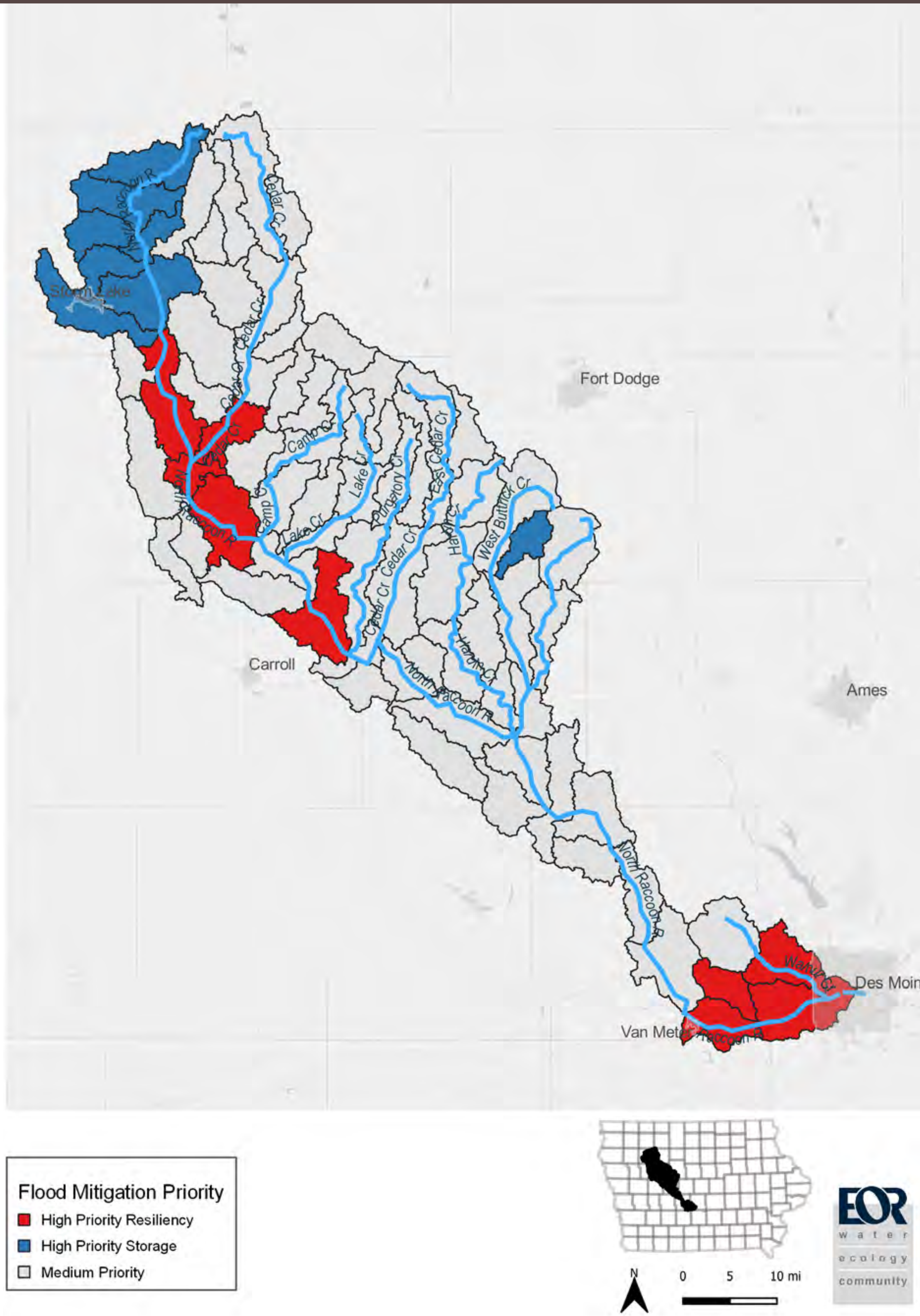


FIGURE 6-5 PRIORITIZED FLOOD MITIGATION SUBWATERSHEDS



TARGETING CRITERIA FOR WATER QUALITY

Several criteria have been used to target areas in which to focus water quality improvement efforts in the watershed. ***The primary objective is to maximize potential benefit by targeting specific HUC-12 subwatersheds.*** The targeting exercise focuses largely on watershed criteria such as pollutant loading rates and impaired resources, but social criteria are considered as well. These criteria, such as involvement in a past planning initiative, may influence the potential for successful implementation with a given subwatershed.

NRRWMC members and plan participants used the following evaluation criteria to target HUC-12 subwatersheds for water quality improvement efforts:

EVALUATION CRITERIA

Pollutant Loading

Loading rates (lbs/acre) for nitrate, phosphorus, sediment and bacteria vary across the watershed based on land use factors. A Surface Water Assessment Tool (SWAT) model was constructed for the Raccoon River TMDL study in 2008 to estimate pollutant loading rates in the North and South Raccoon River Watersheds. The SWAT model identifies subwatersheds where pollutant loading rates are highest. Conservation practices implemented in these subwatersheds have a greater potential to reduce pollutant loading. ***Stakeholders ranked pollutant loading as one of the most important criteria for targeting priority-implementation subwatersheds for water quality.***

Iowa Watershed Approach Grant Eligibility

The Iowa Watershed Approach (IWA) established criteria for selecting eligible subwatersheds for implementing conservation practices using existing IWA grant funds. Eligibility for IWA grant funds is based on past disaster declarations DR-1977 in Pocahontas County and DR-1977 and DR-4126 in Buena Vista County. As a result, three subwatersheds in the northern portion of the watershed were selected for IWA grant funding to mitigate downstream flood damage. Additionally, infrastructure projects in the City of Storm Lake received funds to assist in making the community more flood resilient. ***Stakeholders ranked IWA grant eligibility as one of the most important criteria for targeting priority-implementation subwatersheds for water quality.***

Raccoon River Water Quality Master Plan

This 2011 plan prioritized subwatersheds for implementation through consulting a panel of agricultural BMP experts. The panelists identified the top-priority-implementation subwatersheds for each of the four primary pollutants: nitrate, phosphorus, bacteria/pathogens and sediment. ***Expert panelists***

strongly supported targeting the limited financial resources toward two priority-resource concerns in the Raccoon River Watershed: high nitrates and bacteria/pathogens in subwatersheds where these have been identified as priority impairments (Agren, Inc. 2011).

Groundwater Vulnerability

In addition to surface water impairments, public and private drinking water wells are known to have elevated levels of nitrate and bacteria as a result of surface water contamination. Groundwater vulnerability is influenced primarily by depth, permeability of underlying material and the lack of a geologic confining layer. Subwatersheds where groundwater sources are highly vulnerable to surface water contamination are prioritized for implementation over those areas where there is a lesser threat to drinking water supplies. ***Stakeholders ranked groundwater vulnerability as one of the most important criteria for targeting priority-implementation subwatersheds for water quality.***

Past Plans and Initiatives

Several smaller-scale watershed plans and water quality initiatives have been developed within the North Raccoon River Watershed. Subwatersheds where past water quality efforts have been initiated could be given priority based on the theory that conservation practices are more likely to be adopted in areas where they have been successfully demonstrated. Adjacent subwatersheds could also be given priority based on the "diffusion hub concept," which suggests the willingness to adopt conservation practices spreads into nearby areas. ***Stakeholders ranked the existence of subwatershed plans and initiatives as high importance for targeting priority-implementation subwatersheds for water quality.***

Recreational Use

Water-based recreational opportunities are primarily focused along the Raccoon River, the lower reaches of the North Raccoon River and the handful of lakes within the watershed. ***The North Raccoon River and the Raccoon River are designated water trails and are regularly used for kayaking and canoeing when conditions are favorable.*** Subwatersheds with active recreational use are prioritized for water quality improvement work over subwatersheds where there is little, if any, human contact with water resources. Improvements in these subwatersheds have a more direct link to reduced health threats from contaminated water. ***Stakeholders ranked recreational use as moderate importance for targeting priority-implementation subwatersheds for water quality.***

Habitat Restoration Potential

The Iowa Wildlife Action Plan (Iowa DNR and IDNR 2015) identifies conservation areas across the state that have been prioritized by federal, state and non-profit organizations. The Action Plan developed a restoration potential ranking based on an aggregation of the 14 separate conservation area datasets. ***Subwatersheds with high potential for habitat restorations were given moderate importance for prioritizing water quality improvement efforts.***

Agricultural Conservation Practices Framework (ACPF) Analysis

Subwatersheds where the ACPF analysis has been completed were given priority because of the benefit of having specific conservation practices sited. ***Stakeholders ranked completion of ACPF analysis in a subwatershed as moderate importance for targeting priority-implementation subwatersheds for water quality.*** Note: a complete ACPF analysis is not the same as a completed subwatershed plan. Completed plans earn higher-priority treatment by the NRRWMC.

SELECTED SUBWATERSHEDS

The preceding criteria was coupled with the flooding information and data to prioritize the North Raccoon River's HUC-12 subwatersheds. These subwatersheds were sorted into three categories:

Priority	Subwatersheds where implementation work is expected to have the highest benefit.
Urgent	Subwatersheds where need for implementation work is above the watershed average.
Action	Watershed improvement efforts are needed, but less urgently than the Priority or Urgent subwatersheds. There may be isolated high-importance projects or locations in these areas.

Table 6-3 notes how subwatersheds have been sorted into the Priority and Urgent categories.

TABLE 6-3 PRIORITY AND URGENT SUBWATERSHEDS FOR WATER QUALITY IMPLEMENTATION

PRIORITY-IMPLEMENTATION SUBWATERSHEDS	
Headwaters Cedar Creek	High N, P, TSS Loading Rate, IWA Grant Eligible, ACPF, Groundwater Vulnerability, Recreational Use, Past Plan
Headwaters North Raccoon River	High N, Bacteria Loading Rate, ACPF Groundwater Vulnerability Plan, Ongoing Initiative
Lateral 2	High N, Bacteria Loading Rate ACPF, Groundwater Vulnerability, Ongoing Initiative
Outlet Creek	High Bacteria, P, TSS Loading Rate, Groundwater Vulnerability, IWA Eligible, ACPF Recreational Use, Past Plan
Headwaters Little Cedar Creek	High N, P, TSS Loading Rate, ACPF Groundwater Vulnerability Recreational Use, Past Plan, Ongoing Initiative
Wall Lake Inlet	High P, Bacteria, TSS Loading Rate, Habitat Restoration, Recreational Use, Past Plan

URGENT-IMPLEMENTATION SUBWATERSHEDS	
Drainage Ditch 67	High N Loading Rate, ACPF Groundwater Vulnerability
Drainage Ditch 29	High N Loading Rate, ACPF
Drainage Ditch 74-Cedar Creek	High N Loading Rate, ACPF
Prairie Creek	High N, Bacteria Loading Rate, IWA Eligible, ACPF, Groundwater Vulnerability
Drainage Ditch 37-Cedar Creek	High N Loading Rate, ACPF
Lateral 4	High N Loading Rate, ACPF, Groundwater Vulnerability
Lateral 6-North Raccoon River	High N, Bacteria Loading Rate, ACPF Groundwater Vulnerability
Lateral 3-North Raccoon River	High N Loading Rate, ACPF, Groundwater Vulnerability
Indian Creek-North Raccoon River	High Bacteria Loading Rate, Habitat Restoration, Groundwater Vulnerability
Drainage Ditch 1	High N Loading Rate, ACPF
Headwaters West Fork Camp Creek	High N Loading Rate
Headwaters Camp Creek	High N Loading Rate
Drainage Ditch 13-Lake Creek	High P, Bacteria, TSS Loading Rate, Habitat Restoration, Recreational Use, Past Plan
Prairie Creek	High N Loading Rate
Welsh’s Slough	High N Loading Rate
West Cedar Creek	High N Loading Rate
Johnson Creek-Raccoon River	High P, TSS Loading Rate, Groundwater Vulnerability, Recreational Use
Jordan Creek-Raccoon River	High P, TSS Loading Rate, Groundwater Vulnerability, Recreational Use
Walnut Creek	High Bacteria Loading Rate, Groundwater Vulnerability, Recreational Use, ACPF, Past Plan

Figure 6-6 shows the location of these Priority, Urgent and Action watersheds within the North Raccoon River basin.

Table 6-4 summarizes the priority implementation subwatersheds by county. It is designed to be used by county conservation practitioners in prioritizing their efforts. Focusing conservation spending in these subwatersheds, or locations that are in close proximity, will help focus work where it will be most beneficial.

FIGURE 6-6 WATER QUALITY PRIORITY SUBWATERSHEDS

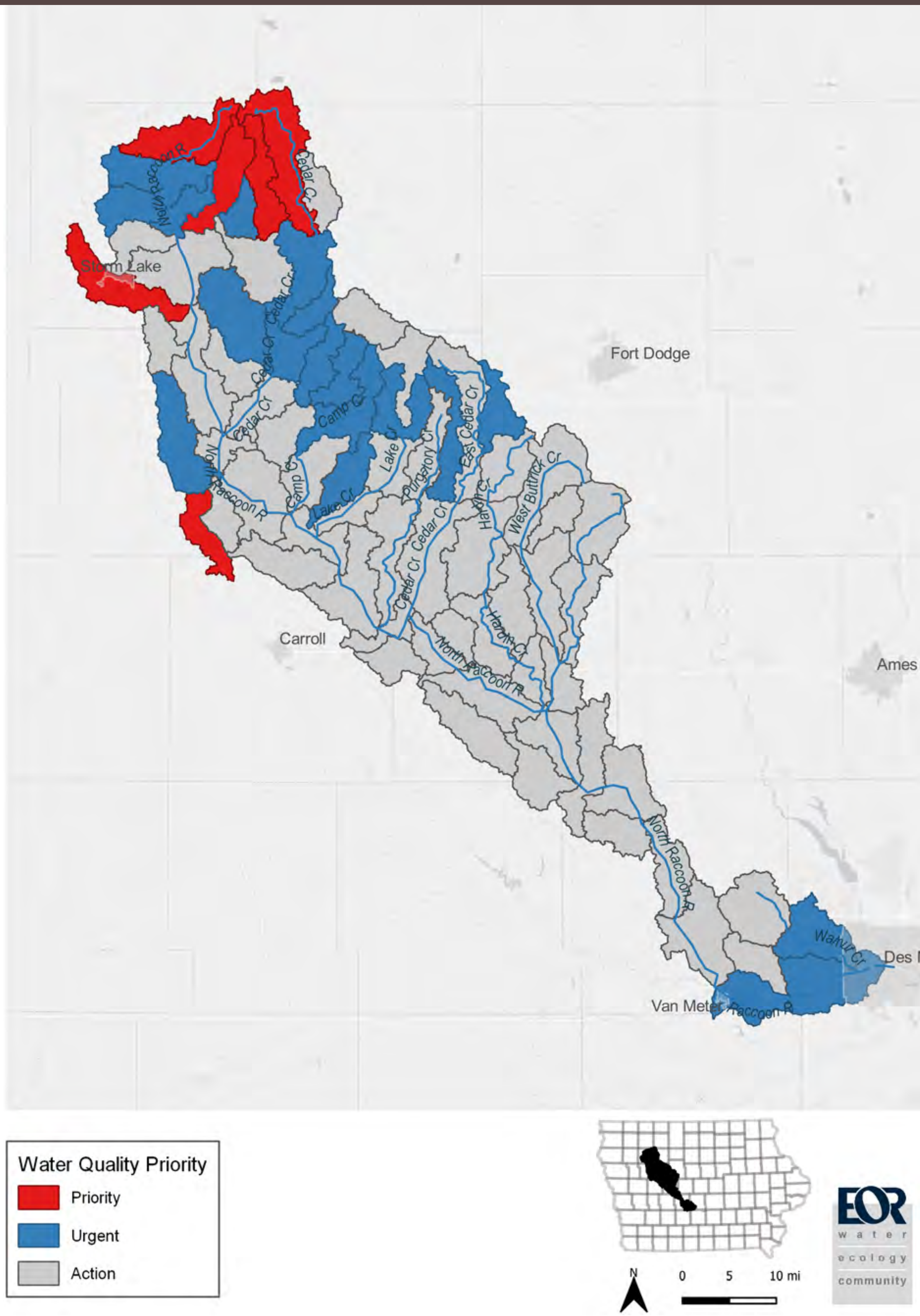


TABLE 6-4 LIST OF PRIORITY AND URGENT WATER QUALITY SUBWATERSHEDS BY COUNTY

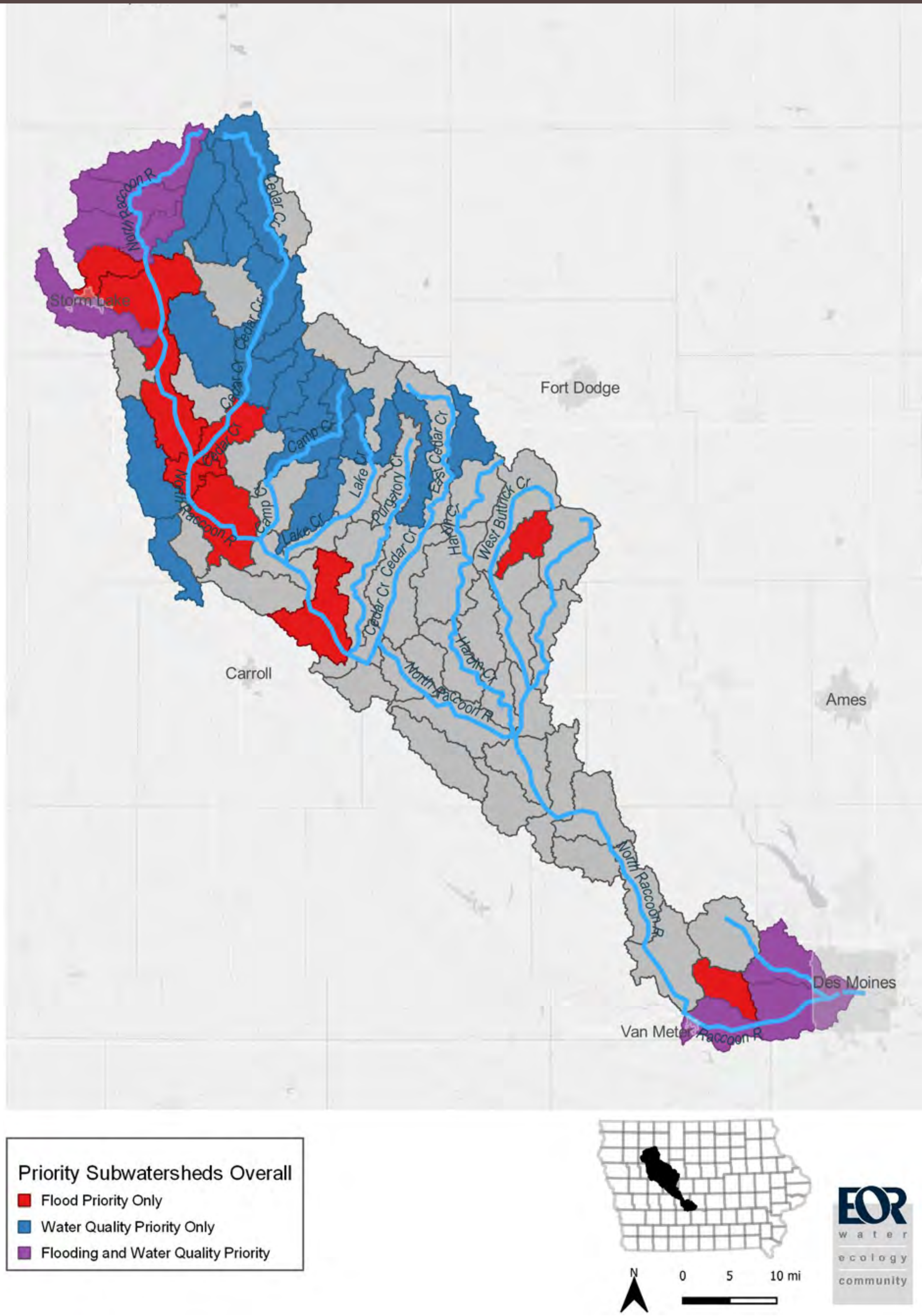
COUNTY	SUBWATERSHED
Polk	Walnut Creek*
	Jordan Creek - Raccoon River*
Warren	Jordan Creek - Raccoon River*
Madison	Johnson Creek - Raccoon River*
Dallas	Walnut Creek*
	Jordan Creek - Raccoon River*
	Johnson Creek - Raccoon River*
Boone	Action subwatersheds only
Guthrie	Action subwatersheds only
Greene	Action subwatersheds only
Carroll	Marrowbone Creek
Webster	Welsh's Slough
Calhoun	Drainage Ditch 37 - Cedar Creek
	Headwaters W. Fork Camp Creek
	Drainage Ditch 1
	Headwaters Camp Creek
	Prairie Creek*
	Drainage Ditch 13 - Lake Creek
	West Cedar Creek

COUNTY	SUBWATERSHED
Pocahontas	Headwaters Cedar Creek*
	Headwaters Little Cedar Creek*
	Drainage Ditch 29
	Drainage Ditch 74 - Cedar Creek
Sac	Prairie Creek*
	Indian Creek - N. Raccoon River
	Wall Lake Inlet
Palo Alto	Headwaters Cedar Creek*
Clay	Headwaters Cedar Creek*
	Headwaters N. Raccoon River*
Buena Vista	Headwaters N. Raccoon River*
	Headwaters Cedar Creek*
	Headwaters Little Cedar Creek
	Lateral 2
	Outlet Creek
	Lateral 6 - North Raccoon River
	Lateral 4
	Lateral 3 - North Raccoon River
	Drainage Ditch 67
	Prairie Creek

Priority Urgent Action

* Subwatersheds that fall in multiple counties

FIGURE 6-7 COMBINED FLOODING AND WATER QUALITY PRIORITY SUBWATERSHEDS



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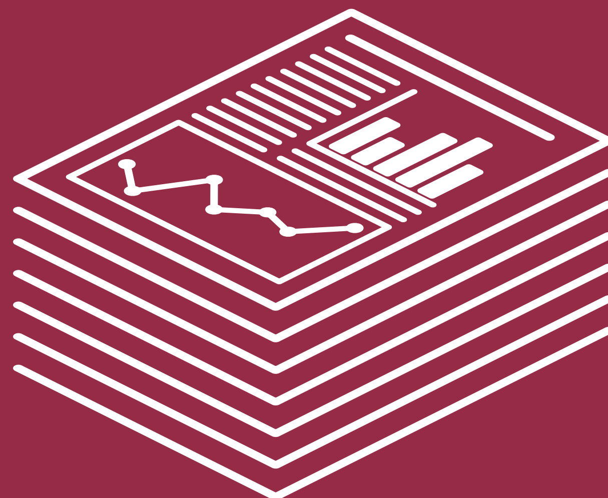
IMPLEMENTATION PROGRAM

Conduct More Detailed Studies



Watershed

- ***Flood Damage Reduction Study***

Subwatershed

- ***Floodplain and Wetland Study***
- ***Distributed Storage Analyses***
- ***Wetland Restoration Study***
- ***Floodplain Storage Feasibility Study***
- ***Hydrologic and Hydraulic Analyses***
- ***Oxbox Restoration Opportunity Analyses***

TIER 1 $

Annual Education Outreach

- ***Promote Soil Health / Nutrient Management Practices***

TIER 2 $$

Farm-scale

- ***Edge of Field Conservation Practices focus on ecology, flood, bacteria and sediment reduction***

TIER 3 $$$

Large-scale

(multiple landowners)

- ***Need to be identified to secure funding***
- ***High-level of analyses, design and permitting***

How to Restore A Floodplain

1. Advocate
2. Prioritize Efforts

   to cost-share between landowners and agricultural producers
3. Introduce Programs

   to help make farmlands profitable

07

IMPLEMENTATION PROGRAM

This chapter outlines the implementation program related to:

- Flooding
- Water quality
- Recreation and resources

It includes approaches and action steps to reach watershed goals and objectives.

INTRODUCTION

This chapter builds on information discussed in previous chapters. Chapter 5 outlines overall watershed goals and objectives and the general approaches that could be applied. Chapter 6 outlines how those approaches could be prioritized in areas of the watershed where they would provide the greatest initial benefit.

This chapter identifies how those strategies are put into implementation. It also highlights specific areas of the watershed where these approaches may be most applicable, beyond the priority subwatersheds discussed in Chapter 6.

Guidance on implementation is divided into the following topics:

- **Flooding**
- **Water Quality**
- **Recreation and Resources**

Within each topic, distinct approaches with action steps are identified.

FLOODING

This section builds on the generic strategies outlined in Chapter 5 and how they are to be prioritized in Chapter 6. Actions to improve flood resiliency start with more detailed studies to understand the nature of flooding impacts and identify specific locations where practices could be most effective. Then implementation of practices includes creating storage through ponds, wetlands and other practices which reduce runoff volumes or rates. Actions will also involve removal of structures or changes in land use to reduce the risk of frequent flooding. This section reviews project-related implementation. Chapter 9 outlines related policy initiatives.

FUTURE WATERSHED-SCALE STUDIES

The NRRWMC is in a unique position to facilitate additional watershed-scale studies as follow-up planning activities to the Watershed Management Plan. These studies would serve primarily to supplement the work done by the technical partners and consultant team during the planning process. At least two such studies have been identified, as discussed below.

Flood Damage Reduction Study

One of the difficulties encountered during the planning process was the lack of readily available information on flood damages in the watershed—specifically, how damages are related to flood stage and peak discharge. The Hydrologic Assessment (Iowa Flood Center and IIHR 2019) evaluated the potential for flood reduction through implementing various BMPs; however, the study looked primarily at the impacts on peak flows rather than how flood stages at various locations relate to flood damages. ***A flood damage reduction study would explore these relationships, which are necessary to evaluate what water level reductions would be needed to reduce risk on various properties.***

Additionally, the Hydrologic Assessment focused on evaluating the impacts of BMP implementation on peak flows following discrete storm events, so there remains uncertainty surrounding the impacts of practices that are known to influence the runoff levels over the long term (such as cover crops and no-till). The flood damage reduction study could improve the understanding of how such practices can impact water levels during the larger, longer-duration flooding events that result from spring snowmelt and extended wet periods.

At its core, a flood damage reduction study for the North Raccoon River Watershed might involve:

- **Revisiting the modeling results from the hydrologic assessment to investigate how reductions in peak flow rates relate to reductions in river stage, and how reductions in river stage relate to reductions in flood damages—particularly at locations where historic flood damages have occurred and where future flood damages are expected (areas of specific interest are listed below)**
- **Investigating how changes in land management, such as the promotion of soil health BMPs, might influence springtime antecedent moisture conditions, surface storage and other factors influencing the volume of runoff that contributes to springtime flooding throughout the North Raccoon River Watershed**
- **Identifying capital improvement projects, such as floodplain storage opportunities, that could be constructed to reduce peak flow rates along the North Raccoon River and its major tributaries**
- **Assessing floodplain management strategies across the North Raccoon River Watershed that could reduce damage flood and disruption in lieu of reducing flooding, such as floodplain restoration, flood protection, and emergency response**
- **Focusing initially on the watershed areas above the following key locations, where there is higher potential flood damage, to discover what kind of flood reduction would be possible**

Priority locations for flood reduction study focus:

- **Upstream of cities identified as having flood damage losses (identified in flood damage mitigation strategy table of Appendix B)**
- **North Raccoon River at Sac City**
- **North Raccoon River at Jefferson**
- **North Raccoon River at Van Meter**

Floodplain and Wetland Restoration Study

A preliminary analysis identified potential opportunities within the watershed for both floodplain restoration and pothole depression wetland restoration. These efforts could be improved and refined by ***performing further analysis at a smaller scale*** (e.g., on a HUC-12 basis), which would identify specific project locations that would offer the greatest benefits. Floodplain and wetland restoration studies would be conducted as an element of a HUC-12 subwatershed management plan.

Recommended Action Steps:

- **Conduct a watershed-scale Flood Damage Reduction Study**
- **Conduct floodplain and restoration studies in conjunction with HUC-12 subwatershed management plans**

DISTRIBUTED STORAGE

The highest potential for peak discharge reduction through the implementation of small-scale, distributed-storage features exists in the Headwaters North Raccoon River setting, according to The Hydrologic Assessment (Iowa Flood Center and IIHR 2019). These features include the WASCOBs, wetlands and ponds identified by the Agricultural Research Service tools (USDA-ARS) for 34 of HUC-12 subwatersheds. Likely additional opportunities for distributed storage were not identified by the desktop-level ACPF analysis.

Initially, supplementary studies should be performed during the subwatershed planning process for the priority water quality subwatersheds (identified in Chapter 6) that would focus on the hydrologic and hydraulic (H & H) analyses necessary to identify the specific flood storage projects. This same analysis should be completed for all subwatersheds in the watershed over time.

Recommended Action Steps:

- **Implement the flood storage practices (WASCOBs, wetlands and ponds) sited by the ACPF tools and soil health practices in priority subwatersheds within the Headwaters North Raccoon River setting (Table 6-1) (specific sites for these practices are identified for the priority subwatersheds and can be found in the Subwatershed Action Plan, Appendix D)**

- **Conduct Distributed Storage Analyses in the priority subwatersheds located within the Headwaters North Raccoon setting to identify potential distributed storage opportunities**
- **Pursue and implement the most beneficial of these practices, following the process for taking these potential sites to construction outlined in Chapter 8**
- **Develop a tool for tracking the construction and maintenance of storage features in the watershed**

POTHOLE DEPRESSION WETLAND RESTORATION

A watershed-wide analysis indicated a large potential for wetland restoration in pothole depressions. Many of these depressions are currently farmed, which require them to be drained by tile and ditch improvements. The preliminary assessment included in Appendix B identified the highest potential in the following HUC-12 subwatersheds:

- **Tank Pond**
- **Headwaters Little Cedar Creek**
- **Headwaters Camp Creek**
- **Headwaters West Buttrick Creek**
- **Upper Drainage Ditch No. 9**

See Figure 1-3 in Chapter 1 for locations of these subwatersheds.

Recommended Action Steps:

- **Conduct a Wetland Restoration Study in the priority subwatersheds and others identified as having high potential, identifying opportunities for pothole depression wetland restoration**
- **Restore wetlands prioritized in the Wetland Restoration Study**

SOIL HEALTH IMPROVEMENTS

Improving soil health increases the landscape's ability to store and retain rainfall by improving soil structure and increasing surface roughness. While these benefits take years to fully realize, widespread adoption has effectively and dramatically reduced flooding for a wide range of flood frequencies. Widespread adoption of the following soil health practices has the potential to produce significant volume reduction and, consequently, flood mitigation benefits throughout the watershed:

- **Cover Crops**
- **Living Mulches**
- **Extended Crop Rotations**
- **No-till/Reduced Tillage**

Recommended Action Steps:

- **Prioritize the implementation of conservation practices identified in the subwatershed action that improve soil health**

FLOODPLAIN RESTORATION

Crops planted within areas that are most frequently flooded are excellent candidates for floodplain restoration. For this discussion, "frequently flooded" is defined as an area expected to have a 20% chance of being flooded at least once in any given calendar year. Even where water levels recede quickly after a flood, high moisture levels can make these lands marginally (or not) profitable. Precision agriculture technologies can be applied to these areas to gauge profitability by studying crop production and cost inputs over multiple years.

Since these areas are frequently inundated and typically close to waterways, they may be a very direct source of nutrients in runoff. These lands can be converted to native vegetation (using the CRP, conservation easements or other methods), which could eliminate the negative impacts of crop production on these areas and potentially offer alternative sources of revenue, through programs or lease agreements. Where streams are present, reserving these spaces may allow for construction of two-stage channels or other approaches that would reconnect the stream with the adjacent flood plain and reduce flow velocities. Several stream reaches in the Headwaters North Raccoon River setting, where storage practices are prioritized, have large expanses of agricultural land that fall within these frequently flooded zones due to their flat, pothole topography. These stream reaches are located within priority subwatersheds for water quality as well. See Appendix B for more information.

Greatest opportunities for floodplain restoration in the following reaches:

- **Lateral 8 (located in Buena Vista County, north of Storm Lake)**
- **Lateral 4 (located in Buena Vista County, north of Storm Lake)**
- **Lateral 6 (located in Buena Vista County, north of Storm Lake)**
- **Lateral 2 (located in Buena Vista County, north of Storm Lake)**
- **North Raccoon River (upstream of Buck Run)**

Recommended Action Steps:

- **Pursue location of conservation practices, creation of buffers and restoration of natural areas within the 2-year floodplain, especially on farmlands which are most frequently flooded or are least profitable**
- **Prioritize restoration efforts in the watersheds noted above and other priority subwatersheds**
- **Direct landowners and producers toward cost-share opportunities or other programs which could offset costs of these conversions or generate income from less profitable farmlands**

FLOODPLAIN STORAGE

There are multiple ways to utilize available storage located within the floodplain. Creating regional-scale storage features in the floodplain may provide significant flood reduction benefits at the regional and watershed scale (although Chapter 5 notes potential challenges for these types of practices). Alternatively, storage features could be placed along the edges of a stream, collecting water from smaller tributaries that are entering a larger stream. This approach may face fewer hurdles related to permitting and owner coordination.

Additionally, a Floodplain Storage Feasibility Study could be conducted in such areas to more precisely locate and analyze potential storage locations. Upon completion of the study, implementation of the recommended projects should follow. From the preliminary analysis included in Appendix B and shown in Figure 7-1, there appear to be a number of suitable locations in the Headwaters North Raccoon River setting for such a project. These reaches are also located within priority water quality subwatersheds.

Another promising use of floodplain storage has emerged from recent research (e.g., Schilling et al. 2017; Schilling et al. 2018) into the restoration of off-channel oxbows for intercepting groundwater discharge and drain tile effluent, which can often be high in nitrates. These practices can provide habitat benefits while providing water quality improvement through the promotion of denitrification. Remote-sensing methods that have already been developed to identify oxbows from LiDAR data (Zambory et al. 2018) could be applied across the North Raccoon River Watershed.

- **Lateral 6 upstream of confluence with North Raccoon River**
- **Lateral 4 upstream of confluence with North Raccoon River**
- **North Raccoon River between Lateral 4 and Lateral 6**
- **North Raccoon River between Buck Run and Outlet Creek**

Recommended Action Steps:

- **Conduct a Floodplain Storage Feasibility Study to identify opportunities in the priority subwatersheds and those listed above**
- **Implement the floodplain storage projects recommended in the Floodplain Storage Feasibility Study**
- **Conduct a siting analysis for Oxbow Restoration Opportunities**

FIGURE 7-1 SUBWATERSHEDS WITH FLOODPLAIN RESTORATION AND STORAGE OPPORTUNITIES

WATER QUALITY

This section builds upon the approaches for improving water quality outlined in Chapter 5 and how they are to be prioritized in Chapter 6. Actions to reduce issues related to nutrients, sediments and pathogens start with more detailed studies of priority subwatersheds. Then the implementation of practices would take place. All recommended BMPs have been grouped into tiers based on levels of investment and planning required. This section reviews project-related implementation. Chapter 9 outlines related policy initiatives.

SUBWATERSHED MANAGEMENT PLANS

As noted in Chapter 6, six HUC-12 subwatersheds have been identified as priority for implementation of water quality practices. Three of these areas already have Subwatershed Management Plans developed. The remaining three need to have planning completed at this scale. Refer to Chapter 8 for description of subwatershed management plans.

Recommended Action Steps:

Develop Subwatershed Management Plans for these priority subwatersheds:

- **Headwaters North Raccoon River**
- **Headwaters Little Cedar Creek**
- **Lateral 2**

See Figure 1-3 in Chapter 1 for locations of these subwatersheds

CONSERVATION PRACTICE IMPLEMENTATION

Chapter 6 details how implementation of conservation practices can be divided into three tiers ranging from practices that are less costly (requiring the least coordination and planning) to those that are larger in size and scale (requiring higher investments and design).

Recommended Action Steps:

Implement the three tiers of water quality practices, with focus on the six priority subwatersheds as outlined in the Subwatershed Conservation Action Plan (refer to Appendix D). Also note the phased implementation of work in these areas as noted in Chapter 6.

TIER 1 IMPLEMENTATION ACTIVITIES

- **Actions to promote adoption of soil health and nutrient management practices**
- **Typically, low-cost to cost-positive practices from a cost-to-reductions standpoint**
- **Often, these techniques are applied annually**
- **Heavy emphasis on education outreach, directing participants to cost-share programs**

TIER 2 IMPLEMENTATION ACTIVITIES

- **Installation of farm-scale/edge-of-field conservation practices**
- **Low cost-to-reduction ratios and low initial cost**
- **Side benefits: ecological, flood reduction, bacteria/sediment reduction**

TIER 3 IMPLEMENTATION ACTIVITIES

- **Construction of larger-scale conservation project**
- **Higher initial cost, but often treat larger areas**
- **Usually will require coordination with multiple landowners**
- **Higher requirements for analysis, design, permitting**
- **Need to identify projects to secure funding sources**

RECREATION AND RESOURCES

Actions to protect recreational areas and natural resources overlap with strategies that address flooding and water quality. Actions described in this section include practices that are expected to particularly influence impairments related to recreational use. This section reviews project-related implementation. Chapter 9 outlines related policy initiatives.

Recommended Action Steps:

- **Ensure that water quality improvement practices implemented by the NRRWMC and partners are constructed in a manner that optimizes their bacteria reduction potential. This is most applicable for the following BMPs:**
  - Wetlands
  - Swales
  - Detention and Retention Ponds
  - Biofiltration/Filtration Practices
  - Vegetated Buffers/Filter Strips
- **Ensure that effective manure management plans (MMPs) are in**

place for animal feeding operations (AFOs) in the watershed and that all requirements are being fully met; the NRRWMC will provide assistance to existing entities as needed

- **Advocate for a state agency-led geographic information system (GIS) mapping and database application to track AFOs and the fields that have been designated for applying manure**
- **Provide technical assistance to farmers to determine the nitrogen content of manure that is applied to fields in order to avoid over-application when commercial fertilizer is applied**
- **Provide cost-share assistance to farmers to determine the nitrogen content of manure that is applied to fields in order to avoid over-application when commercial fertilizer is applied**
- **Work with communities throughout the watershed to ensure illicit-discharge programs are in place and actively implemented; the NRRWMC will provide assistance to existing entities as needed**
- **Work with counties and communities throughout the watershed to identify and eliminate failing septic systems; the NRRWMC will provide assistance to existing entities as needed**
- **Develop a cost-share program to incentivize restricting cattle access to streams by funding fencing or GPS collars and alternative watering systems**
- **Work with cities in the watershed to adopt pet waste ordinances; the NRRWMC will provide assistance to existing entities as needed**
- **Ensure that flood and water quality projects implemented by the NRRWMC and partners include use of native plants to provide pollinator habitat**
- **Ensure that flood and water quality projects implemented by the NRRWMC and partners have elements that improve habitat for Topeka Shiners**
- **Support protection measures for endangered and protected species**
- **Support local and regional efforts to establish and expand water trails and whitewater parks; the NRRWMC will provide assistance to existing entities as needed**
- **Support educational and interpretive elements in watershed water trails**

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THE PATH TO IMPLEMENTATION

1

HUC-8 Watershed Master Planning

- Broad based Stakeholder Engagement
- Watershed Wide Goal Setting
- HUC-12 Prioritization and Targeting
- Partnerships
- Funding Mechanisms
- Policy and Advocacy

2

HUC-12 Subwatershed Planning

- Grass Roots Stakeholder Engagement
- Education and Outreach
- Local Priorities
- Project/Practice Targeting
- Stewardship Focus

3

Implementation

- Landowner engagement
- Design and Analysis
- Permitting and Agency Coordination
- Construction Management

08

THE PATH TO IMPLEMENTATION

This watershed plan offers a high-level vision of the path toward reaching watershed goals.

This vision needs to be translated down into smaller subwatersheds to identify and prioritize specific project sites.

Then, direct interactions with landowners, producers and regulatory agencies will be needed to carry a practice from an idea into reality.

This chapter provides a roadmap through this process.

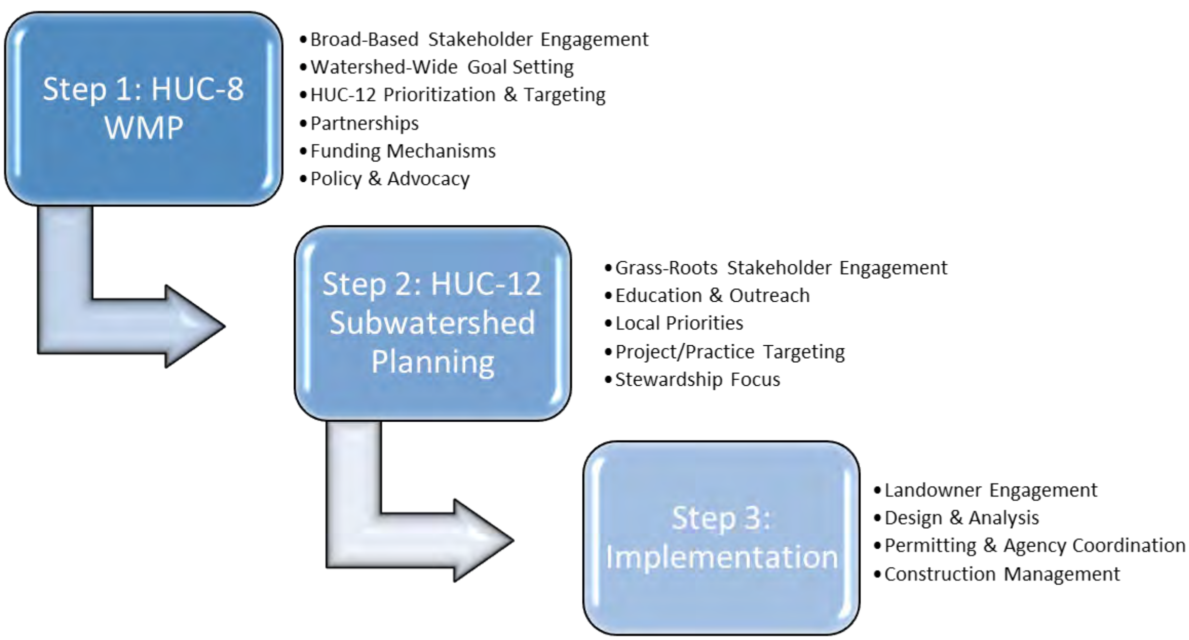
IMPLEMENTATION FRAMEWORK

This watershed plan for the North Raccoon River facilitates large-scale decision-making at the HUC-8 watershed scale. This plan:

- **Evaluates and prioritizes resource issues**
- **Establishes goals**
- **Builds partnerships**
- **Develops policy alternatives**
- **Identifies sources of funding**

When evaluating resource restoration needs, the entire area contributing drainage to that resource must be included. However, given that the North Raccoon River Watershed covers such a large area and variety of land uses, ***it can be challenging to identify and implement specific practices using information generated at the overall watershed scale***. For this reason, this section outlines a three-step path to advance implementation for the NRRWMC. Figure 8-1 illustrates this concept.

FIGURE 8-1 THREE-STEP IMPLEMENTATION PROCESS



STEP 1: DEVELOP A WATERSHED MANAGEMENT PLAN

The Watershed Assessment conducted during this planning effort (Emmons and Olivier Resources, Inc. 2020) identifies the key impairments of watershed resources, identifies the contributing factors to these impairments and quantifies the improvements needed to address those problems.

The HUC-8 watershed can be an effective scale for the NRRWMC to advance a set of unifying goals across all areas in the North Raccoon River basin. The role of the NRRWMC is to set these goals and priorities then coordinate implementation by facilitating partnerships among members, partners and local stakeholders. The NRRWMC should provide guidance for future implementation activities and endorse or support projects that align with the goals established in this plan. ***Creating this watershed-scale management plan is the first step for the NRRWMC in the path to implementation toward desired flood and water quality outcomes.***

STEP 2: WORK WITH PARTNERS TO DEVELOP SUBWATERSHED-SCALE PLANNING

Chapter 6 of this plan outlines how this information can be used to prioritize resources so that a greater share of work is focused within key smaller (HUC-12) subwatersheds. Evaluating implementation at this smaller subwatershed scale allows for the involvement of all parties with a stake in the issues. Local government, farmers and residents from all ends of the subwatershed can have a greater voice in determining where practices and projects are best located. Partnerships formed at this scale based on common goals can direct financial and technical resources into areas of greater need.

Prior to embarking on a specific implementation campaign, more detailed planning is needed at the subwatershed scale. At this level of focus, local landowners, producers and decision-makers have more precise information about their specific area. The HUC-12 subwatershed plans should align with goals established in this watershed plan (HUC-8 scale) but will be tailored to meet local conditions.

The foundation of a HUC-12 subwatershed plan is the determination of the type and quantity of potential conservation practices. This is accomplished using the ACPF analysis tool (North Central Region Water Network 2019). At the subwatershed scale, potential conservation practices should be prioritized based on where they will provide the greatest benefit. The combination of the suite of available conservation practices should then be adjusted to the characteristics of the subwatershed as well as the preferences of local stakeholders. ***Conservation Action Plans, including a series of practice-specific targeting maps for each of the Priority Subwatersheds, are in Appendix D of this plan.*** An example ACPF output map is shown in Figure 8-2. A map of HUC-12 subwatersheds where the ACPF tool has been applied is included in Figure 8-3.

Local landowners and producers share an understanding of the viability of various conservation practices based on experience with past adoption. Using their input throughout the planning process increases conservation practice adoption. ***Recognizing the importance of engaging local stakeholders, the NRRWMC should work with partners to develop subwatershed management plans as the second step in the path to implementation.***

STEP 3: IMPLEMENT LARGER-SCALE PROJECTS AND CONSERVATION PRACTICES

Once a specific project has been identified, additional planning and coordination work is still needed. The final step in the path to implementation entails individual landowner engagement, project design and agency coordination. This should include a specific "go/no-go" decision process where designers, landowners and other stakeholders decide if a project is feasible before it proceeds too far into the design process. Many of the flood reduction and water quality improvement strategies proposed in this plan require in-field changes in farming methods rather than a construction of a specific project or practice. Planning and outreach is needed to increase adoption rates for these conservation practices as well. ***The education and outreach section of this plan (Chapter 13) includes specific recommendations for this type of engagement.***

FIGURE 8-2 EXAMPLE OF ACPF OUTPUT

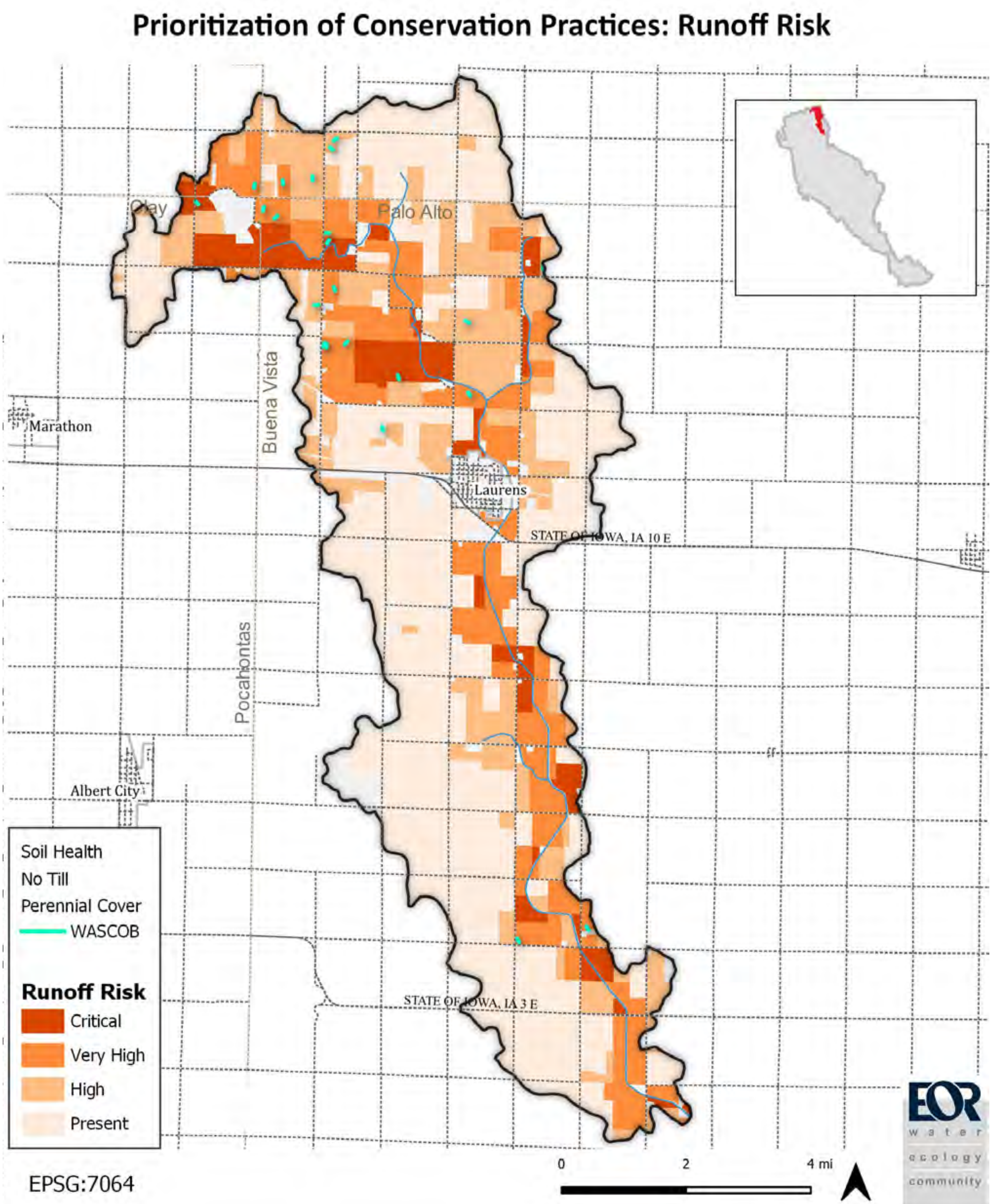
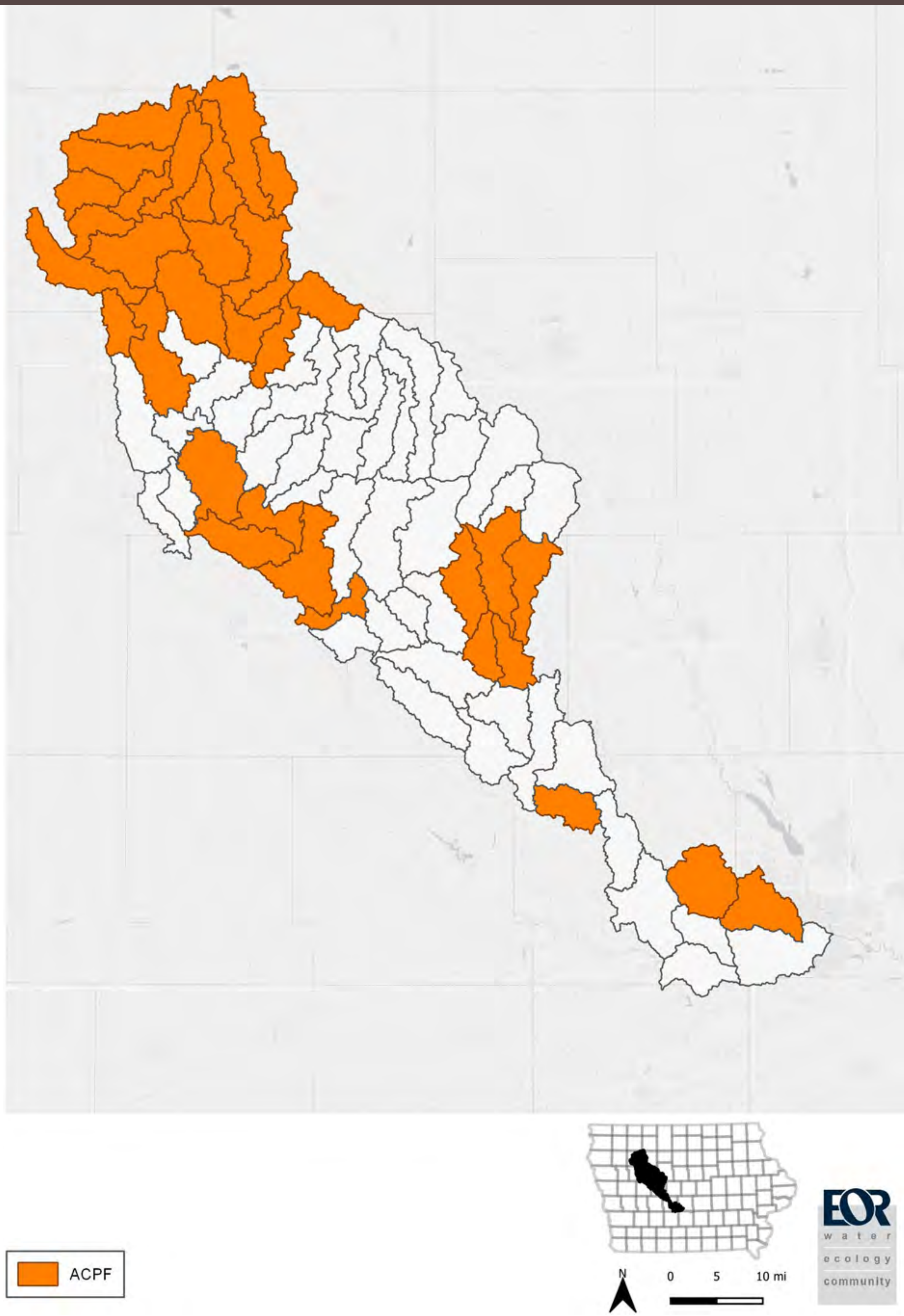


FIGURE 8-3 SUBWATERSHEDS WHERE ACPF ANALYSIS HAS BEEN COMPLETED



.SUBWATERSHED-SCALE PLANNING (STEP 2)

As HUC-12 (or smaller) subwatershed management plans are developed in the watershed, the NRRWMC recommends ***five key elements be included in every plan*** to ensure consistent and comprehensive approaches to implementation throughout the watershed (Table 8-1). When completing these plans, the EPA's Guide to Developing Watershed Plans is also an important reference document, including nine key elements to include in watershed planning (U.S EPA 2013 May). Currently, there are three existing subwatershed management plans in priority subwatersheds (Table 8-2).

TABLE 8-1 FIVE KEY ELEMENTS TO BE INCLUDED IN HUC-12 SUBWATERSHED MANAGEMENT PLANS

KEY ELEMENTS	PRIMARY PLANNING STRATEGIES	ADDITIONAL CONSIDERATIONS
Stakeholder Engagement	Should be producer-/landowner-focused	Build awareness of specific subwatershed resource concerns and watershed-wide NRRWMC goals
Subwatershed Assessment	Highlight 20% and 1% annual recurrence flood events; evaluate current and proposed land uses	Identify nutrient, sediment and pathogen sources at the subwatershed scale for effective response
Conservation Practice Adoption Rate Targets	Base a suite of practices on local preference and knowledge of existing adoption rates. Set a target adoption rate for each practice.	In total, these adoption rates should reach subwatershed reduction goals
Prioritize Subwatersheds With Plans	Currently three subwatersheds have existing plans: Outlet Creek, Headwaters Cedar Creek and Wall Lake Inlet	Allows for prompt implementation
Conservation Practice Targeting Criteria—Priorities	Use Corn Suitability Rating 2 Index (CSR2) and runoff risk (soil type, stream proximity and steepness of slope)	This prioritizes crop production capacity and land topography threat to water quality

TABLE 8-2 EXISTING SUBWATERSHED MANAGEMENT PLANS IN PRIORITY SUBWATERSHEDS

PRIORITY SUBWATERSHED	SUBWATERSHED MANAGEMENT PLAN
Outlet Creek	Storm Lake Watershed Management Plan 2012–2032 (Iowa Lakes RC&D, 2012)
Headwaters Cedar Creek	Headwaters Cedar Creek Watershed Plan (Iowa Soybean Association, 2016)
Wall Lake Inlet	Black Hawk Lake Watershed Management Plan (Sac County SWCD, 2011)

STAKEHOLDER ENGAGEMENT

The stakeholder engagement process used at the subwatershed scale should be ***producer-/landowner-focused*** with a series of meetings where local stakeholders are made aware of the resource concerns within their local subwatersheds and the watershed-wide goals established by the NRRWMC. Their input is critical when setting local goals for conservation practice adoption rates.

PRACTICE-SPECIFIC TARGETING—MORE ABOUT PRIORITIES

The ACPF analysis identifies suitable locations for practices within the subwatershed but an additional step is needed to target priority locations. This analysis was conducted for five of the priority subwatersheds and the results can be found in Appendix D. The following criteria should be used to prioritize specific conservation practices in a HUC-12 subwatershed management plan:

Runoff risk

These practices include soil health practice (cover crops, extended rotations, nitrogen management, phosphorus management), no-till, perennial cover, and WASCOBs. These practices reduce runoff rates, volumes and the pollutant loads in runoff. Land with a relatively higher runoff risk should be prioritized for these practices. Riparian buffers downstream of these areas also offer greater benefit than those in areas with a lower runoff risk.

Relative slope steepness

Place contour buffer strips, prairie strips and terraces on steeper slopes. Both contour buffer strips and terraces reduce sheet and rill erosion, which is a greater concern on steeper slopes.

Stream Power Index

Grassed waterways work where gullies are most likely to form in fields. Moore's Stream Power Index (SPI) helps determine ideal locations for implementation of this practice (Porter et al. 2017).

Estimated land value

Nutrient removal wetlands are sited in ACPF using general ratios of contributing drainage area to wetland size. Larger wetlands generally will provide greater nutrient removal benefits (Porter et al. 2017), but these can be costly. Therefore, the CSR2, a rating to measure soil productivity developed by ISU (Miller and Burras 2015), is used as a surrogate for land value as a way of targeting specific sites to limit impacts to more valuable (or productive) farmland and to identify more cost-effective choices. In many cases, the ACPF analysis will identify wetland sites in a series of two or more. When this is the case, CSR2 can also be used to select the order in which to implement the wetlands that are in a series.

Site-Specific Conditions

Some conservation practices do not have specific criteria within the ACPF framework. These include drainage water management practices, denitrifying bioreactors and saturated buffers. The effectiveness of these practices can be limited by watershed size and surface slopes. ***Specific site evaluations may be necessary to assess the potential costs and benefits***.

IMPLEMENT LARGE-SCALE PROJECTS (STEP 3)

Larger-scale flood and water quality improvement projects typically involve more than one land owner. Public entities using public funds often construct these practices. Once a specific project has been identified, the following process will increase the likelihood of success. These tasks are based on the lessons learned during the planning process for the unsuccessful Swan Lake project described in the Swan Lake Restoration Analysis Post-Project Memorandum (WHKS 2019).

CONCEPTUAL DESIGN AND ANALYSIS

Early in the process, a conceptual design drawing depicting the major construction components should be developed. The conceptual design conveys the intent of the project to landowners and regulatory agencies.

LANDOWNER ENGAGEMENT

Before proceeding too far beyond the concept design, a series of meetings with landowners should be conducted. These meetings are described in further detail in Table 8-3.

TABLE 8-3 LANDOWNER ENGAGEMENT STRATEGIES	
Introductory Meeting	Discuss basic project concepts and purpose. Encourage questions and help all parties feel comfortable. Can also request property access for data gathering if all goes well.
Meeting Two (if concept is agreeable to landowners)	Present more detail informed by survey. More time for questions, additional analysis request, address concerns.
One-on-One Conversations	Meetings as required to discuss specific impacts of the project, possible land acquisition and/or easement needs.

DESIGN DEVELOPMENT

If landowners are generally in favor of proceeding, detailed evaluations of the concept design using stormwater modeling tools will provide critical information on project performance for flood reduction and water quality improvement. These methods can inform stakeholders about expected high-water levels and outflow rates, and evaluate the impacts. The model should be amended and the project refined throughout the process.

REGULATORY COORDINATION

Regional-scale flood control and water quality improvement projects frequently trigger the need for regulatory coordination. Typically, these projects involve potential impacts to existing streams and wetlands. Regardless of the objective for the project, potential impacts to these resources will need to be evaluated. Two primary agencies—U.S. Army Corps of Engineers (USACE) and Iowa DNR—have regulatory authority for projects that include work in streams and wetlands. They issue a variety of permits. ***Early coordination with these agencies is critical in understanding potential mitigation requirements.***

Also, it should be determined whether the proposed project is located within a local drainage district. Drainage districts address upstream drainage rights and drainage capacity of upstream lands.

OTHER AGENCY COORDINATION

Several non-regulatory agencies and non-profits should be consulted. ***These entities may be able to provide technical assistance or could potentially help fund portions of the proposed project.*** Examples include the NRCS, the Iowa Natural Heritage Foundation, Ducks Unlimited, Pheasants Forever and The Nature Conservancy.

IMPLEMENT CONSERVATION PRACTICES (STEP 4)

The approach for implementing farm-scale conservation practices primarily focuses on education and outreach designed to encourage adoption among landowners. Educational components include demonstrating the need for flood reduction and water quality improvement, promoting the benefits of conservation practices, and dispelling misperceptions related to agronomic impacts. ***Iowa State University Extension and Outreach has developed numerous outreach strategies and specific resources for the North Raccoon River Watershed that are in Appendix C of this plan.***

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POLICY RECOMMENDATIONS

Rural Areas:

1. Sustainable financial support
2. Public / private partnerships
3. Inform and educate about Iowa's Nutrient Reduction Strategy
4. Spread research results
5. Promote practices that improve soil health
6. Protect stream buffers and floodplains

Urban Areas:

1. Application of stormwater management standards
2. Protect floodplains and stream buffers
3. Construction site pollution prevention (generally erosion and sediment control)
4. Preserve and restore healthy topsoil
5. Pursue stormwater retrofits

09

POLICY RECOMMENDATIONS

In some cases, there will need to be updated or new local ordinances or requirements to implement this plan. However, “policies” included in this chapter do not necessarily refer to regulations. It also refers to things that members and partners may need to advocate for financial assistance, or other help from federal or state agencies.

POLICIES FOR RURAL AREAS

- Additional financial support
- Promote public-private partnerships
- Educate, relay research results
- Retain rain on the landscape, improve soil health
- New markets
- Involve drainage districts
- Refine crop insurance programs
- Refine design of pond and wetland outfalls
- Protect source water
- Address feedlots and manure management

POLICIES FOR URBAN AREAS

- Stormwater management (standards and ordinances)
  - Tech support for smaller communities/counties
- LID approaches
- Floodplains and stream buffers
- Restore native vegetation
- Establish or improve stormwater utilities
- Construction site pollution prevention
- Preserve and restore healthy topsoil
- Redevelopment policies

POLICIES FOR RURAL AREAS

GENERAL RECOMMENDATIONS

Over the next decade, it is expected that most water quality improvements will rely on voluntary actions taken by individual farmers and landowners. To support and accelerate the implementation of this plan, a series of policies and action items has been identified. Since the NRRWMC has no authority to enact policies on its own, it will need to rely on ongoing discussions between its members and partners to determine the best approaches to implement these ideas.

1. NRRWMC members and partners should ***advocate for sustained and expanded sources of financial support***, which are needed to support water quality improvements in rural areas. Many practices are known to be effective at reducing pollutant loads and/or runoff volumes, but several of these have costs associated with their installation or the lost potential for agricultural production. There are many economic factors which may make it more difficult for farmers and land owners to commit to investing in these practices (refer to Chapter 12). Federal, state and local resources can bridge this gap and provide water quality and quantity benefits that are important to the entire watershed.
2. The NRRWMC Board and Watershed Coordinator should work to ***develop public-private partnerships*** to develop precision business planning for agricultural areas, targeting those areas which are currently farmed on an annual basis but are routinely not profitable to the producer. These lands could potentially be set aside for water quality practices such as conservation easements, wetlands, buffers, etc.
3. ***Additional educational materials*** are needed that better explain the BMPs that are included in the NRS: what they are, where they are best applied, how they work, their benefits and liabilities, and where interested groups can seek out more information for funding or constructing such practices. The need for such materials extends beyond the boundaries of this watershed, so this could be done in collaboration with other partners such as the Watershed Management Authorities of Iowa, Iowa's Agricultural Clean Water Alliance or ISU Extension offices.
4. ***More information on existing research*** needs to be accessible to explain to producers and landowners what would be considered "natural" levels of nutrient loading and how current agricultural practices have been shown to impact these levels. The Watershed Coordinator could work with ISU Extension or other institutions to collect and share this information. In coordination with the education and outreach strategy for this plan, the NRRWMC and the Coordinator should be educating themselves about up-to-date research practices to share in real time.

5. Partners and members should take collective action to ***promote, install, establish and maintain conservation approaches and practices*** that hold water where it falls. The NRRWMC Board or Watershed Coordinator cannot be expected to drive all implementation. It will take collaboration with other partners (agencies, commodity groups, co-ops, etc.) to drive parallel efforts toward a common goal.

6. ***Practices that improve soil health and address water management*** have benefits beyond water quality and quantity improvements that should be pursued by partners, producers and landowners.

   - Maintaining and improving the structure and organic material within the upper soil profile is key to sustaining agricultural production into the foreseeable future. Practices such as extended crop rotations may cause short-term reductions in profit in the years when fields are used for alfalfa production, but long-term benefits in soil depth and quality are likely to be realized.
   - Methods of subsurface water control may also allow for improved water retention in soil layers during dry period. It has been identified that over the past sixty years, while significant crop losses can be attributed to either excess or insufficient moisture, drought has historically been a larger cause of crop losses than either excess moisture or flooding. In the past, field moisture management has often focused on drying fields out during wet years. The importance of having the ability to retain moisture during drought conditions should not be overlooked.

7. Partners and members should advocate for ***development of state or federal initiatives to develop new markets for cover crops or other products***, which could encourage their production and improve soil health or limit nutrient loss.

8. Many areas within this watershed are served by drainage districts. These districts are administered through individual counties and were originally established to construct and maintain drainage ditches and tile systems that serve multiple property owners. Taxes are collected for areas served by these districts and assessed to landowners.

   - ***Comprehensive maps of these districts should be developed*** and used at the subwatershed scale to ensure tile networks are understood, which could inform where practices would be most effective. One option would be for a state agency to collect this information and make it available for distribution.
   - ***The framework and strategic purpose of drainage districts could be refined*** to implement edge-of-field practices and integrate them into drainage network

elements as needed to accomplish the goals of this plan.

9. ***Federal crop insurance policies should be studied*** to ensure that these programs do not incentivize producers to plant in areas that are frequently flooded, ponded or otherwise not profitable. This study could inform lobbying efforts by NRRWMC members or partners to change policies to reduce crop losses and promote implementation of conservation practices.

10. The NRRWMC members and partners should advocate for state regulators to ***develop methods to track manure management plans and application areas in GIS***, to better understand potential overlaps in coverage areas and better evaluate the potential for over-application.

11. The state should develop an online searchable maps resource with information related to ***high-flood-risk areas*** (flooded by the 50% annual recurrence chance/2-year return period flood event) and ***precision agriculture data*** (information about areas currently farmed that are expected to have limited profitability or even be unprofitable). Such data could delineate areas that could be converted from agricultural uses to conservation practices without significant crop loss.

12. When ponds and wetlands are being planned, ***designers should investigate opportunities to improve control of runoff by integrating multi-stage control structures*** to better control release rates during both small storms (which impact water quality and channel stability) and larger events (to reduce flood risk immediately downstream). See Figure 9-3 for one example of how a multi-stage outlet could be designed.

FOCUSED RECOMMENDATIONS

Source Water Protection

Source water protection (SWP) includes the protection of groundwater (wellhead) and surface water. Communities can join Iowa DNR's SWP program but because the program is not regulatory, it is recommended that communities include the development of source water protection ordinances within their SWP Plans. ***If a community is not developing a SWP Plan, that is a great starting point and should be a priority above other stormwater management ordinances.*** The following are specific policy recommendation areas for SWP:

- **Use Iowa DNR's SWP resources to develop a phase 2 SWP plan**
- **Wellhead protection**
  - Establish and protect buffer zones for specific land uses/activities (e.g., BMP implementation for construction activities)
  - Routine monitoring of water quality

- **Surface water protection**
  - Establish and protect buffer zones on lakes and streams
  - Routine monitoring of water quality
  - Ensure adherence to AFO requirements for surface water setbacks

Feedlots

Regardless of the type or size, Iowa DNR regulates the planning, permitting, siting and operation of AFOs. All AFOs must apply for a permit to establish a new operation, or to expand or modify an existing operation. Permits include conditions on various aspects of AFOs, including setbacks from adjacent residential uses and wells and properly retaining, storing and disposing of manure. The regulations for confinements and open feedlots are slightly different. ***Large confinements are required to develop and submit for approval a Manure Management Plan (MMP)***; small confinements can voluntarily adopt such plans. MMPs contain information on how manure will be stored between applications, and a plan for timing and method of manure application. Open feedlots are subject to similar regulations on siting and construction but must develop and comply with a Nutrient Management Plan.

Legislation in the state of Iowa also prohibits local authorities from either adopting or enforcing any regulations that are not consistent with state law and regulations. Therefore, cities and counties may not develop new policies enforcing AFOs beyond what is already enforced by the state of Iowa. However, feedlots can be prohibited within floodplains and vigorous educational platforms can be developed to raise awareness on water quality issues correlated with AFOs. The following are specific policy recommendation areas for water quality improvements:

- **Use zoning or permit regulations to prohibit AFOs within areas at risk during a 1% annual flood event**
- **Evaluate and improve feedlot inspections to ensure compliance with state law—especially with new or expanding feedlot operations.**
- **Clearly defined resources and required buffers:**
  - Designated areas (sinkhole, abandoned well, cistern, drinking water well, designated wetland, water sources)—200 feet
  - High-quality water resources (defined in Chapter 61 of the Iowa Administrative Code)—800 feet
  - Residence (not owned by farmer), church, school, public areas—750 feet
- **Encourage producers to adopt environmentally sound practices that go beyond minimum requirements.**

- **Focus outreach and education to inform the public of rules and regulations on AFOs**
- **The Watershed Coordinator and partner groups should work with landowners and producers on voluntary initiatives to exclude animals from, or limit their access to, streams and rivers using fences or other exclusion methods.**
- **Regulatory agencies should inspect the on-site implementation of MMPs by producers, particularly in areas near tributaries draining to or into the receiving stream.**

FUTURE CONSIDERATIONS

This plan focuses on voluntary efforts to implement measures to mitigate flooding and improve water quality. A wider establishment of adequate stream buffers and grass waterways is an essential component of this plan. Even if there were a desire to make stream buffer protection a requirement in rural areas, there is not currently a means at the city or county level to execute and enforce such requirements. ***Therefore, it is essential that landowners, farmers and conservation and advocacy organizations work together presently to more broadly adopt these practices.***

POLICIES FOR URBAN AREAS

As introduced in Chapter 5, several policies can be enacted at the local level that will help the NRRWMC meet its flooding and water quality goals. ***These regulations focus on both flood risk reduction and water quality improvements that are the cornerstones of this plan.*** Initially, these policies may be implemented in larger communities in the lower watershed through new or amended ordinances and policies. However, there are benefits to these policies being considered by counties and smaller communities throughout the watershed as well. To do this, ***these jurisdictions may need technical support*** from other communities that already have adopted and enforce such standards, or from consultants who could provide planning, zoning or engineering review assistance. As mentioned previously, the NRRWMC lacks the authority to implement these policies. These recommendations will need to be considered for adoption by individual jurisdictions (counties and communities) across the watershed.

STORMWATER MANAGEMENT (STANDARDS AND ORDINANCES)

In many cases, stormwater detention practices employed in urban areas over the past few decades have shown limited ability to control runoff for the most common small-storm events. Rainfalls of about 2.7" or less make up more than 98% of the precipitation volume in Iowa. As the greatest share of annual runoff volume is generated by these types of storms, most of the pollutant loads carried by stormwater runoff are delivered to streams during these events. In addition, the rapid rise and fall of water level in streams during these types of events is a significant cause of streambank erosion along smaller urban tributaries. Stormwater management policies that address these events are critical.

Therefore, this plan recommends all communities within the watershed consider adoption of the Unified Sizing Criteria, as described within Chapter 3 of Iowa DNR's ISWMM. These standards are most critical in larger communities and those that experience the most growth, but could also be beneficial to smaller communities.

The Unified Sizing Criteria are arranged into these five groups:

Small-Storm Events

1. RECHARGE VOLUME

SQR and other practices are used to ***infiltrate as much of the first 1.0" of rainfall*** as possible.

2. WATER QUALITY VOLUME

Over 90% of all precipitation in Central Iowa can be attributed to rainfall events that are 1.25" or less. BMPs can ***capture and filter runoff from these small events*** to intercept sediments, nutrients and other pollutants.

3. CHANNEL PROTECTION

Over 98% of storm events in Central Iowa are less than about 2.7". The upper range of these smaller storms happen about once a year, on average. Constructed wetlands, ponds and other BMPs can temporarily store and slowly release runoff from these events over a period of between 24 and 48 hours. ***This reduces the occurrence of high peak flows, reducing the potential for channel erosion downstream.***

Large-Storm Events

4. OVERBANK FLOOD PROTECTION

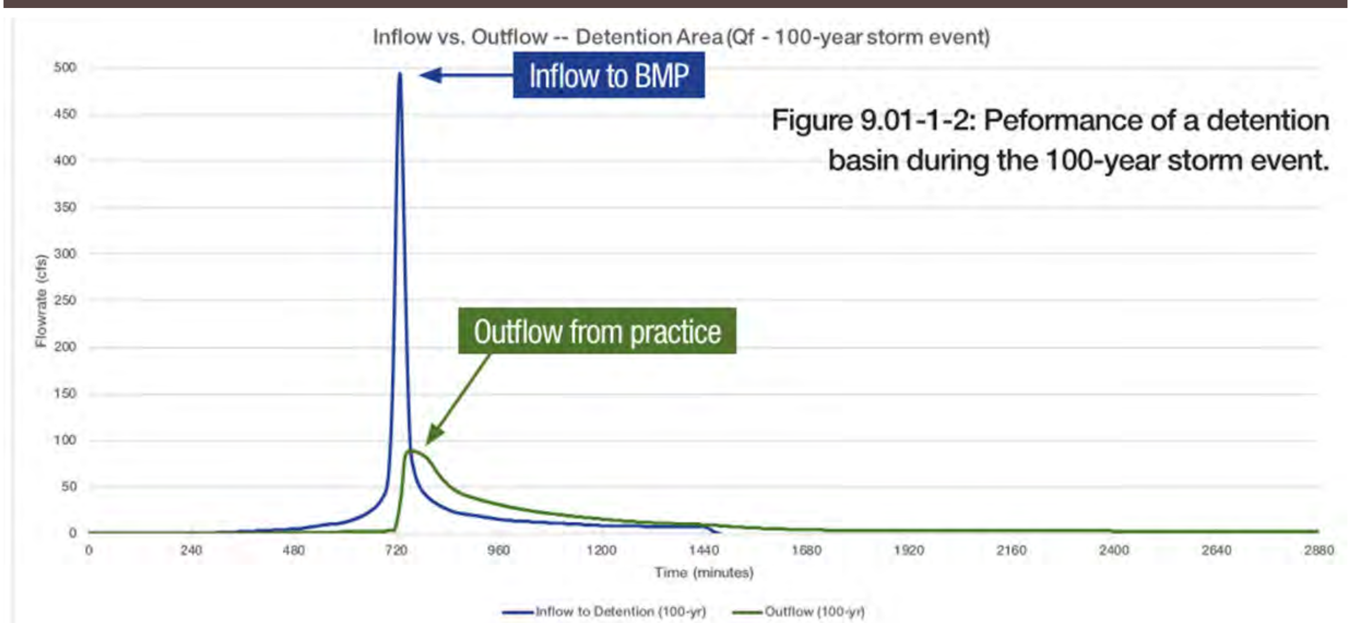
This standard ***reduces the potential for flash flooding*** along small streams and storm drain system surcharge in urban areas. This is accomplished by using stormwater detention practices to limit flow rates for storms that have about a 10–50% chance of happening each year, and help make sure those events replicate more "natural" levels. Natural levels are defined as being similar to a meadow in good condition.

5. EXTREME FLOOD PROTECTION

This standard seeks to ***prevent damage from major flood events*** that happen very infrequently (about 1–10% annual recurrence chance). Flow rates are often limited to the lesser of natural values for the same type of storm event OR the values calculated for the 5-year return period event under existing (agricultural) conditions.

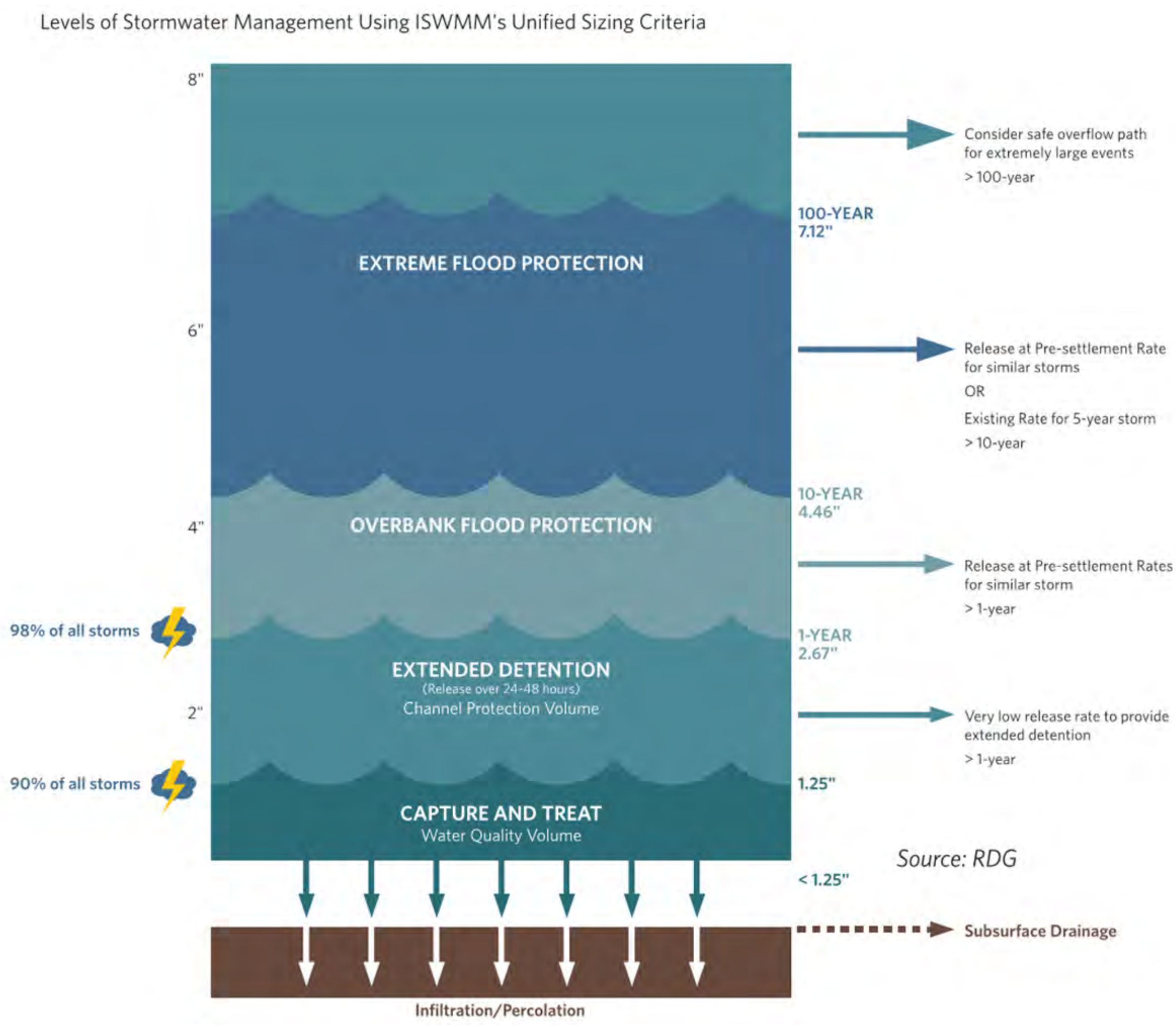
Hydrographs (plots of flowrate versus time) in Figure 9-1 show how stormwater management practices can temporarily store runoff, making the outflow rate from a practice be much lower than the flowrate that enters. Figure 9-2 illustrates the Unified Sizing Criteria.

FIGURE 9-1 EXAMPLE OF OUTFLOW REDUCTIONS PROVIDED BY STORMWATER DETENTION PRACTICES



Source: Iowa Stormwater Management Manual, Section 9.01

FIGURE 9-2 IOWA STORMWATER MANAGEMENT MANUAL'S UNIFIED SIZING CRITERIA (RAINFALL AMOUNTS ARE FOR CENTRAL IOWA REGION)



Source: Walnut Creek Watershed Plan, 2016

Keys to Implementing Stormwater Management Using ISWMM

- ***Plan ahead of development*** **to identify potential opportunities for regional stormwater management and set aside appropriately sized areas for stormwater practices.**
- **Use strategies that go beyond using detention ponds to manage water.** ***Promote a more diverse set of water management practices.***
- ***Use water as an amenity*** **to create ponds, wetlands or other features in parks and open spaces which can provide recreational or aesthetic improvements in addition to achieving stormwater management goals.**

These standards have already been adopted by at least one community within the watershed (Clive). Over the past two years, there has been a facilitated work effort (through Capital Crossroads) to create ordinance language which could be adopted by all Des Moines metro area communities. ***This plan supports that effort and would encourage each community to integrate that language into their city codes. Over time, it is encouraged that counties or smaller communities throughout the watershed consider similar policies, to prevent negative impacts from new developments.***

The intent of such ordinances would be to apply these standards to all new developments. Each community should identify how these standards will be applied to redevelopment sites, such as a minimize project size that would require compliance (the draft language prepared in the Des Moines area includes such provisions). Opportunities to retrofit existing practices or provide new practices in developed areas should also be pursued, where feasible.

To assist counties and communities which may have smaller staff or less experience with development review and zoning enforcement, ***the NRRWMC should investigate a mechanism to cooperatively provide technical assistance to smaller communities***. This could aid in answering planning questions and reviewing site development stormwater management proposals. This could be accomplished through voluntary technical support provided by larger communities that deal with growth issues more frequently. Urban conservationists employed through IDALS could also provide technical support to smaller communities.

Alternatively, the NRRWMC could assemble a list of recommended consultants that could be employed on an as-needed basis to aid in plan or design calculation review. Consulting services could also be provided through the NRRWMC, or in partnership with groups such as the Watershed Management Authorities of Iowa. This could be handled similarly to how IDALS handles review of urban WQI or SRF Sponsored Projects, where there is an annually renewed contract with a consulting firm to help answer engineering questions during the review process at minimal cost.

Expected Impacts of Recommended Stormwater Management Policies

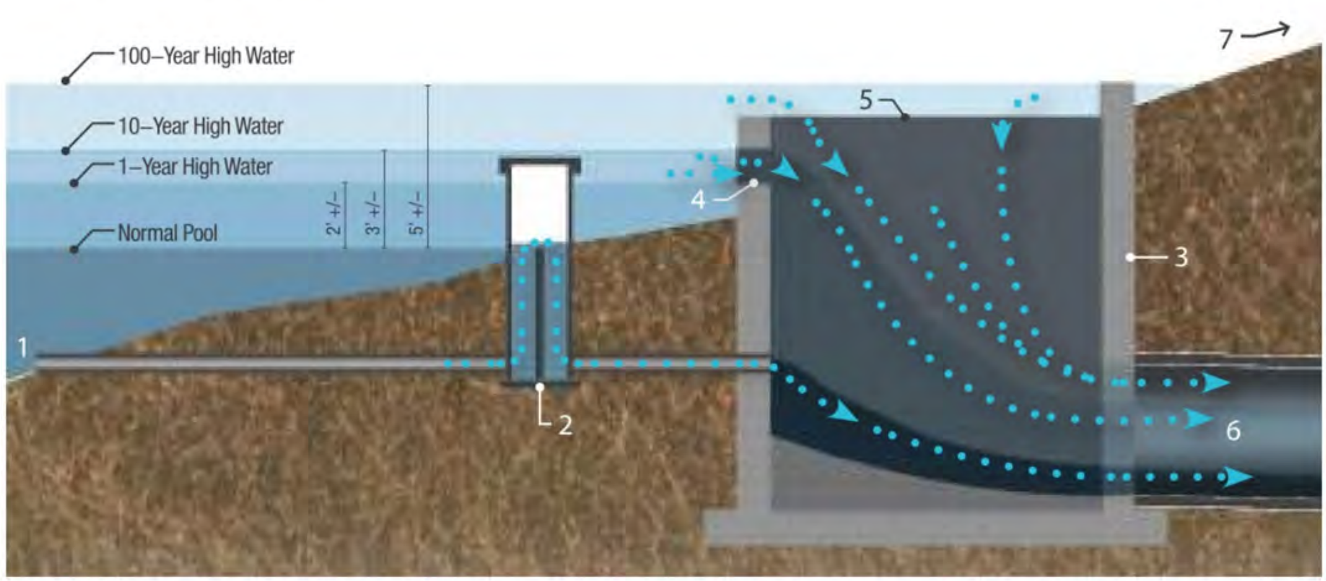
If adopted, these policies could provide the following benefits immediately downstream of a stormwater management feature within a new development:

- **Little or no direct surface runoff during rainfall events up to 1.25" in depth.**
- **Over 95% reduction in peak flow rates for the 1-year return period storm event (less flashy streams).**
- **Approximately 70% reduction in peak flow rates for the 10% annual recurrence storm event.**
- **Approximately 20% reduction in peak flow rates for the 1% annual recurrence storm event.**
- **Control structures for detention areas will often require a multi-stage design to control flow rates during both small and large storm events (see figure 9-3).**
- **Measurable reductions in nutrient, pathogen and sediment pollution are expected.**
- **Streambank and gully erosion rates should be reduced due to lower shear stress in streams (caused by lower stream flow rates and velocities).**
- **Can be implemented regionally or within each individual development. However, regional basins may require less total area dedication and provide for more certain execution of long-term maintenance.**

Sources: Analysis prepared by RDG Planning & Design in support of development of the ISWMM Unified Sizing Criteria Chapter (2019) and Urban Case Study example for Walnut Creek Master Plan (2016).

FIGURE 9-3 ILLUSTRATION OF A MULTI-STAGE OUTLET FOR A WET DETENTION POND OR STORMWATER WETLAND.

Example of a multi-stage outlet



1. 1st Stage: Small Diameter Inlet - Low Flow Control (Below Surface)
2. Water Level Control Structure
3. Main Outlet Structure
4. 2nd Stage: Notch Weir or Medium Size Opening (Controls 2-25 Year Storms)
5. 3rd Stage: Longer Overflow Weir (50-100 Year Storms)
6. Pipe Outlet (Likely Controls 50-100 Year Storms)
7. 4th Stage: Emergency Spillway (For Storms Larger Than 100-Year)

Source: Walnut Creek Watershed Plan, 2016

LOW-IMPACT DEVELOPMENT APPROACHES

A widely recognized—and arguably the most effective—modern stormwater method is LID.

LID is an approach to land development (or re-development) that seeks to manage stormwater as close to its source as possible. LID attempts to mimic a site's natural hydrology as the landscape is developed. It can address stormwater collection, conveyance, infiltration, discharge and reuse; non-point source pollution; and TMDL and other water quality standards.

LID is an ecosystem-focused design approach; it seeks to design the built environment to mimic natural processes that can serve to maintain the hydrologic balance. The LID approach first works to preserve and protect environmentally sensitive sites and natural features, including riparian buffers, wetlands, steep slopes, valuable trees, floodplains, woodlands and highly permeable soils. LID addresses several issues simultaneously:

1. Protecting unique site features and characteristics
2. Maintaining existing drainage patterns
3. Preventing sediment, nutrients and other pollutants from entering stormwater
4. Reducing stormwater discharge velocities and rates
5. Reducing the volume of stormwater generated on site
6. Removing sediment, nutrients and other pollutants from stormwater

LID also includes a comprehensive approach to erosion, sedimentation control and stormwater that is first implemented during initial project planning and design, and carries through other stages of the land development process. To be most effective, LID must address stormwater on two fronts:

1. The design process should incorporate better site design principles
2. Erosion and Sediment Controls (ESC) and stormwater facilities and practices effectively and efficiently capture, retain, infiltrate, evaporate or filter stormwater.

As the new development is built, LID facilities are installed that control stormwater runoff qualities, volumes, rates and velocities in order to meet specific performance standards. These LID facilities and practices are what most people picture when thinking of LID: bioretention facilities, rain gardens, vegetated rooftops, rain barrels, infiltration trenches, permeable pavements and others. However, as stated above, LID is not simply the facilities installed to control stormwater. Rather, it is a paradigm by which to conduct an entire design process—from site design principles, to erosion and sedimentation control at construction sites, to post-construction stormwater facilities. ***By implementing both LID principles and practices, stormwater can be managed in a way that reduces the impact of built areas and promotes the natural movement of water within an ecosystem or watershed.***

DEVELOPMENT ALONG FLOODPLAINS

Throughout this plan, the important functions of floodplains have been highlighted. When structures are built in flood-prone areas, there is potential to raise flood elevations because these obstructions and the structures themselves may be damaged. Local policies and ordinances should be adopted or amended to protect flood plains in the following ways:

- **Reduce structural and property losses during major flood events by** ***preventing construction of new structures within areas expected to be impacted by a 1% annual recurrence (AR, or 100-year return period) flood event*****. This would include all areas shown in Figure 9-4 as being impacted by flood events of having a 1% AR flooding in any given year (colored zones with 1 to 50% risk). In some cases, public facilities (such as park shelters, restrooms, stages, etc.) which are not intended for residential occupancy may be placed in the perimeter of the floodplain. When allowed, such structures should be constructed to be flood resilient to reduce potential damage to the structure and its contents. Such structures should also not be placed within any floodway as designated on FEMA Flood Insurance Rate Maps (FIRMs), which can be viewed and downloaded at FEMAs Map Service Center (www.msc.fema.gov/portal/home). See Chapter 1 for illustrations about FIRMs and flood plain elements.**
- **Maintain flood storage capacity by** ***limiting grading or placement of fill materials within the flood plain*****. If fill is required to be placed within areas expected to be flooded by the 1% annual recurrence (AR) flood, remove 1.5 cubic yards of material for every cubic yard of fill material or other obstructions placed within that zone.**
- **Identify areas of active stream movement and** ***reserve areas as open space where future stream movement or flood plain inundation is expected*****.**
- ***Set protection elevations for new structures at least three feet above the high-water elevations for the 1% AR flood*** **as shown on effective FEMA regulatory flood maps. Many regulatory maps used older rainfall data, which does not account for recent updates to design rainfall values (such as NOAA Atlas 14 data) or continuing upward trends in precipitation patterns.**
- **Collaborate with Iowa DNR and FEMA to update FIRM maps to reflect updated rainfall data sets.**

Application

This plan recommends implementing ordinances and policies to apply these standards to all new developments and where land subdivisions or structures are planned to occur adjacent to streams. Existing structures which fall within these protection zones should be identified. Past known damages to such structures may be reason to pursue opportunities to acquire and remove such structures to avoid recurrent damages and liability.

Expected Impacts

- **Reduced potential for damages to buildings, property and other infrastructure during flood events.**
- **Maximized capacity for storage and conveyance of large flood events.**
- **Reduced risk of higher-velocity flows or reduced travel times being created due to narrowing of the flood plain.**

FIGURE 9-4 FLOOD RISK BOUNDARIES IN THE NORTH RACCOON RIVER WATERSHED

Data Source: Iowa Geodata

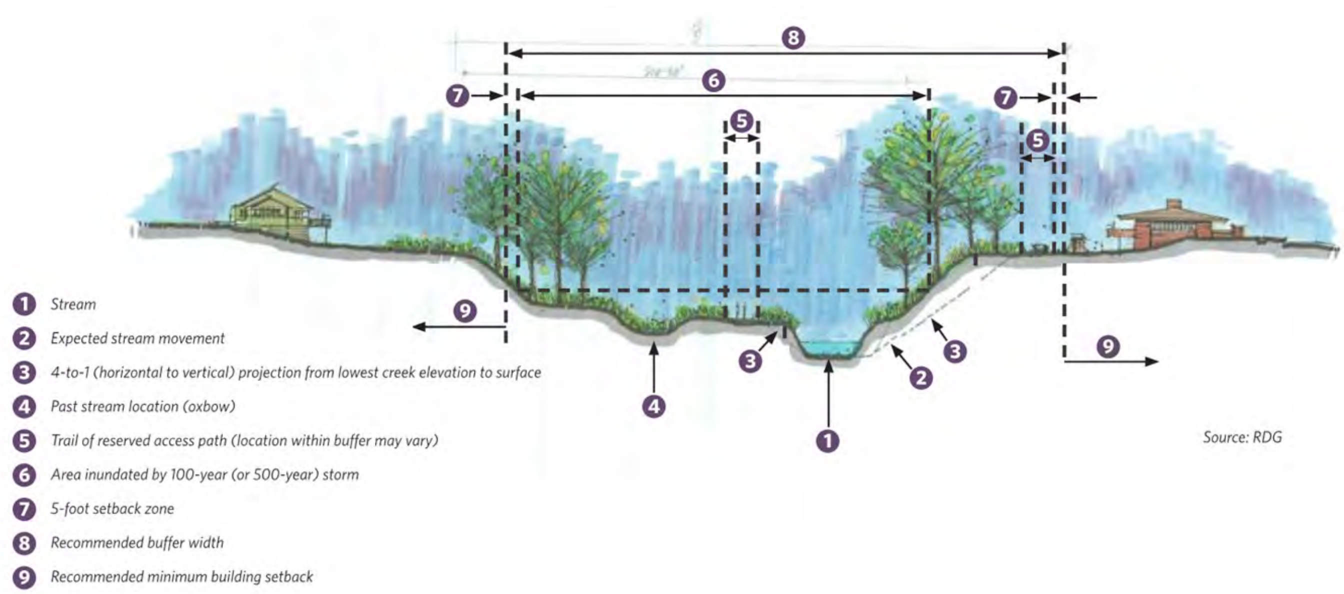
RESERVED STREAM BUFFERS

In urban areas, stream buffers should be established, either by public land acquisition or through reservation as permanent easements as public or private open space. These buffers should be created along all streams that are first order (small, intermittent tributaries) or larger, as well as any existing or created open-drainage course with a drainage area that is larger than 40 acres. ***Local policies and ordinances should be adopted or amended to establish protected stream buffers, which could become a connected series of greenbelt parks or accessible spaces.*** Stream buffers should be wide enough to serve the following functions (see also Figure 9-5):

- ***Include the entirety of the regulatory 1% AR (100-year) flood plain.*** **Where flood plains are not mapped, calculations should be performed to identify the area expected to be flooded by such an event. [In a similar manner, areas impacted by a 0.2% AR (500-year) flood event could also be protected.]**
- ***Allow for expected stream migration*** **based on recent movement patterns or historic stream channel locations.**
- ***Provide enough width for future streambank improvements.*** **This plan recommends setting a line based on the lowest elevation along the existing streambank (toe of bank), or a line that accounts for expected future movement of the streambank. From that line, the buffer should include all land which falls between the stream and a projected slope line from the established toe baseline to the surface of the surrounding area. The slope line should not be steeper than a rate of 4 (horizontal) to 1 (vertical).**
- **Allow width within the stream buffer for a minimum 15' cleared** ***maintenance path*** **on at least one side of the stream, with a cross slope not to exceed 5% (0.5-foot drop for every 10 feet), to allow for access by trucks, tractors and other maintenance equipment. Along streams of first order or higher, these maintenance paths should be provided on both sides of the stream.**
  - These paths may be either undeveloped paths, kept clear of trees and brush by annual mowing, or paths which are surfaced with pavement or gravel.
  - These paths may fall within the flood plain if the slopes along the route are adequate and the path is not threatened by streambank or surface erosion.
  - If the maintenance path is outside the flood plain, provide at least an additional five-foot setback beyond the edge of the maintenance path to the edge of the reserved buffer.

- **In all cases, provide a minimum 50-foot building setback from the existing top of bank for a first-order stream. Provide a minimum 100-foot building setback from the existing top of bank for higher-order streams.**
- **Identify existing structures located within areas expected to be impacted by the 1% AR chance flood. Implement a buyout program, prioritized to** ***target structures that are most frequently flooded or would represent the largest financial or environmental impacts first*****. Integrate this approach into the Hazard Mitigation Program for each county (and city as applicable). Future opportunities to fund buyouts after disaster declarations could be lost if such approaches are not identified in these Hazard Mitigation Plans.**

FIGURE 9-5 ELEMENTS WITHIN A FLOOD PLAIN OR STREAM BUFFER THAT COULD DETERMINE THE WIDTH OF BUFFER TO PROTECT ALONG A STREAM.



Source: adapted from Walnut Creek Watershed Plan, 2016

REESTABLISHING NATIVE VEGETATION

Reserved floodplain buffers are excellent opportunities to restore prairie, savanna and/or wetland vegetation that is native to the State of Iowa. The exact type or species of vegetation will vary based on site moisture and daylight conditions. It is also critical to budget for and execute annual maintenance to reduce the presence of aggressive or invasive species and preserve desired erosion-resistant vegetation.

- **When possible, *create separate "establishment and maintenance contracts"* on projects that will include creation of new native prairie areas, pollinator gardens and wetland vegetation. Identify this approach in any grant applications, so that the cost of this maintenance can be included in the total project cost to be covered by the funding request. These would put installation of permanent seeding and plants under the responsibility of a prime contractor (not a sub to a larger contract associated with site grading, utility work or other site improvements) which also would be responsible for a series of quarterly maintenance trips over an extended period after initial installation (three years recommended). This is beneficial in several ways:**

    i. The selected contractor is more likely to have experience and interest in this type of work, having pursued it as the prime contractor (not just a lowest-cost sub selected by another contractor).

    ii. It makes the contractor responsible for all activities from seeding/planting to full establishment of the desired vegetation using maintenance work such as weeding, spot spraying, removing invasive species and reseeding/replanting as necessary.

    iii. This requires the contractor to turn over maintenance responsibilities to an owner in a condition where weed pressure will be much less and ongoing maintenance will be simpler.

- **It is recommended to use conservation corps or arrange "on-call" contracts with maintenance companies to *reduce the financial cost of maintenance activities* through use of volunteer labor or economies of scale.**

STORMWATER UTILITIES

Several communities have adopted citywide utilities that assess fees to property owners to generate revenue that can be used for administration and project costs related to stormwater management. Typically, these fees are based on the amount of impervious cover on a given property.

For example, the City of Clive charges a $7.83/month fee for all single-family residential properties. Commercial or multi-family properties are assessed a fee based on the amount of impervious cover within any given property, based on the number of Equivalent Residential Units (ERUs) of impervious cover.

Application

Communities that already have such utilities should routinely review the revenues being generated and catalog the financial needs related to stormwater that exist across their jurisdiction. This may require adjustments to the fee collection structure to generate the revenue to address identified needs.

Communities without utilities should consider their use. These funds can create a stable source of funding to address stormwater or flooding issues.

CONSTRUCTION SITE POLLUTION PREVENTION

Construction site runoff is one of the largest sources of sediment loading within urban environments. Construction site runoff can impact downstream properties and clog stream channels, culverts and storm drain systems. Across Iowa, any new development that disturbs more than one acre (43,560 square feet) of land or is part of a larger phased development which would disturb such an area, are subject to state permit requirements to prevent sediments and other pollutants from being washed downstream from construction sites.

Most larger communities near the Des Moines metro area are required by the state to review stormwater pollution prevention plans (SWPPPs) and inspect construction sites for compliance. Counties and smaller communities may not have this responsibility; however, any construction site that disturbs more than the one-acre limit still needs to comply with state and federal permit requirements. Officials in these jurisdictions should understand these requirements and know when to contact Iowa DNR field offices if problems are observed. Refer to the State of Iowa's General Permit No. 2 for additional information.

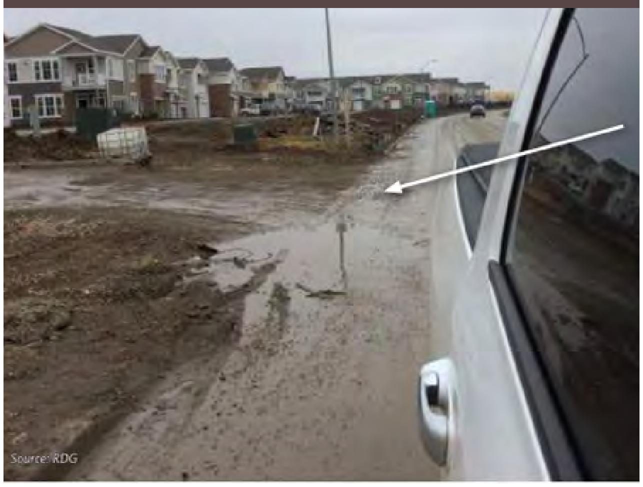
Many strides have been made over the past two decades in the development and implementation of SWPPPs. While most sites are applying for required permits and preparing SWPPPs, there is room for improvement in the installation and maintenance of adequate erosion and sediment BMPs. Refer to Figures 9-6 and 9-7 for examples.

Erosion Control Measures

Erosion control practices protect the surface of the ground from being displaced by the force of falling precipitation or flowing water. The following measures should be used to reduce the potential for soil erosion at construction sites:

- **Designers and developers should *consider stormwater management early in the site design process*. Look for ways to minimize the footprint of disturbed areas and lessen grading volumes.**
- **Construction should be phased to *limit the amount of area that is disturbed* (vegetation removed for construction) at any one time.**
- **Designers should *develop a Soil Management Plan (SMP)*, to be implemented by contractors on the developer's behalf, with the goal of providing healthy soils across all open-space areas on developed landscapes before construction has been completed.**
- **Where upstream areas drain through a construction site, contractors *should stage construction to avoid disturbance to the flow path* or provide stabilized methods to divert stormwater around or through site construction.**
- **Designers and contractors should *increase the use of temporary seeding and mulches*. Use of adequate temporary mulch reduces surface erosion by up to 98% compared to sites with no erosion controls (RUSLE2). State law currently requires that disturbed areas where grading activities cease for a period of longer than 14 days shall have temporary stabilization (such as mulch with seed) applied immediately after the last grading activity in that area. Many sites are currently not providing adequate temporary stabilization measures to comply with this requirement.**
- **On steeper-slope areas or in areas of concentrated flow, there should be *increased use of rolled erosion control products (RECPs) and turf reinforcement mats (TRMs)* where temporary mulch may be insufficient to prevent erosion.**

FIGURE 9-6 TRACKING FROM A CONSTRUCTION SITE ONTO A PAVED ROADWAY



Source: Walnut Creek Watershed Plan, 2016

FIGURE 9-7 WEED GROWTH INDICATES THIS AREA HAS NOT BEEN GRADED RECENTLY; NO STABILIZATION MEASURES APPLIED

Source: Walnut Creek Watershed Plan, 2016

Sediment Control Measures

Sediment control practices collect polluted runoff for a period of time, allowing suspended pollutants to settle out of runoff before it is allowed to leave a construction site. Figures 9-8 to 9-9 show examples of improper placement or maintenance of sediment controls. The following measures should be used to minimize the amount of sediment from being washed downstream from construction sites:

- ***Prior to commencing land-disturbing activities, contractors should install perimeter site controls to prevent sediment from being tracked or washed off-site.*** **These could include silt fences, filter socks, wattles, sediment basins, stabilized construction entrances, trash collection areas and temporary sanitary facilities for site workers.**
- **Contractors should *install interior site controls as soon as allowed* by grading or utility construction.**
- **Contractors should take care not to overload controls. *Make sure controls are adequately sized for the area from which they receive runoff.* Practices should be installed and maintained properly.**
- **State law requires sediment basins to be installed where runoff from more than 10 disturbed acres is routed to**

a common outlet. ***These basins can be very effective at trapping sediment and are underutilized.***

- **All site controls should be checked on a weekly basis and before rainfall is expected to make sure they are in good working order.** ***Controls should be maintained and repaired promptly as needed.***
- **When de-watering excavations, divert discharge to a sediment basin or other collection area on site.** ***Do not directly discharge such water to the storm drain system without treatment.*** **Avoid releasing concentrated flows at the top of steep slopes where gully erosion may be caused.**
- ***All temporary controls such as silt fences, soil logs and inlet protection devices should be removed*** **immediately following establishment of permanent vegetation. Accumulated sediment should be properly disposed of.**

Recommended Improvements to SWPPPs

To allow owners, contractors and inspection personnel to implement effective pollution controls, SWPPPs need to define where practices are to be installed and how they are to be maintained. These SWPPPs also should define the set of "good housekeeping" measures to be applied at each site. The following actions will aid in implementation of SWPPPs:

- ***The SWPPP should be a "living document."*** **The plan should be amended in some fashion so that the site map reflects current site conditions. Inspection records and changes to the sequence of construction events should be made part of the SWPPP document.**
- ***The SWPPP and all site controls are to be maintained as necessary until full establishment of vegetation across all disturbed areas.*** **Site inspections and maintenance of controls should continue until all areas are stabilized with permanent vegetation and the Notice of Discontinuation (NOD) has been filed with Iowa DNR.**

FIGURE 9-8 SEDIMENT CONTROLS HAVE NOT BEEN MAINTAINED TO PREVENT SEDIMENT FROM WASHING INTO THIS INLET

Source: Walnut Creek Watershed Plan, 2016

FIGURE 9-9 SILT FENCES AT THIS SITE HAVE NOT BEEN MAINTAINED, ALLOWING SEDIMENT TO BE TRACKED OR WASHED INTO THE STREET

Source: Walnut Creek Watershed Plan, 2016

Recommendations for Municipal Inspections

Larger communities and those draining to specific resources are required by the state to review SWPPP preparation and implementation. This is the case when the community is designated as a Municipal Separate Storm Sewer System (MS4), requiring a permit through the State of Iowa. In the North Raccoon River watershed, the Des Moines metro area communities and the City of Storm Lake fall under this requirement (Iowa DNR 2019). To improve these inspections, MS4 communities should:

- ***Routinely check sites*** **to ensure that construction sites are following state and local standards. Communities required by the state to review SWPPPs and inspect construction sites should maintain enough staffing to ensure inspections are happening as frequently as needed.**
- ***Respond promptly*** **when polluted site runoff or off-site tracking is observed or citizen complaints are received.**
- ***Use "stop work orders"*** **and other methods, when necessary, to bring sites back into compliance before work on other construction items can proceed.**

Application

The plan recommends ordinances and policies be implemented that would apply these standards to all sites requiring either a local grading permit or authorization under the State of Iowa's NPDES General Permit No.2 (construction sites or common plans of development which will disturb at least one acre). These requirements apply to all sites within the State of Iowa that meet those thresholds, no matter their location. ***Counties and smaller communities may not be required to have such permits or ordinances, but they should be aware of the requirements for construction sites that exceed the threshold of requiring a permit through the State.*** There are frequent training events held through the Iowa Stormwater Education Partnership, offering officials a basic understanding of these requirements. State field offices could also be contacted about these requirements. Iowa DNR Field Offices 3, 4 and 5 each cover parts of this watershed.

Iowa Stormwater Education Partnership:
https://iowastormwater.org/
State Field offices:
https://www.iowadnr.gov/fieldoffice

Expected Impacts

- **Successful implementation of these policies could reduce sediment loading from construction sites by 80%, which is one of the stated goals of the State's NPDES General Permit No. 2.**

SOIL QUALITY MANAGEMENT AND RESTORATION

Recently, requirements within the State of Iowa's NPDES General Permit #2 for construction sites were amended. The permit now requires that topsoil be preserved on site where feasible but does not specify where and how that topsoil is to be placed or preserved. During the discussions leading up to these changes, many concerns were raised by the development and real estate interests about the cost and timing of restoring topsoil, especially on finished lawn spaces within single-family land developments. In some cases, in the past, topsoil was preserved within berms or other confined areas and was not always placed uniformly across the landscape. This means that those ***open spaces often lack the healthy soil material needed to support the growth of lawns and landscaping***. Should this continue to occur, soils in such areas would have limited ability to absorb runoff during rainfall events—runoff volumes may be increased by more than 80% during the most commonly occurring storm events (RDG et al. 2016). Higher levels of watering and fertilization will be necessary to support desired plant materials. All these factors have the potential to increase stormwater runoff volume and pollutant loads.

For this reason, it is recommended that communities implement local ordinances to protect or restore healthy soils in open-space areas. An entire chapter of ISWMM is devoted to the topic of maintaining and restoring healthy soil profiles. Options include limiting the footprint of land disturbance, topsoil stripping/replacing and using soil amendments like compost and sand to rebuild a healthy surface topsoil layer.

To fully realize the benefits of SQR, ***the methods within ISWMM list various ways to maintain or create eight inches of a healthy soil profile across the surface***. Requirements to achieve this standard can be incorporated into other ordinances or implemented as a standalone ordinance.

Such requirements should include the following elements:

- **All construction sites which are subject to local or state permit requirements should *develop and maintain an SMP*. The SMP identifies how topsoil materials are to be stripped, stockpiled, restored or protected during the construction process.**
- **The SMP shall review soils information from county maps, geotechnical studies or other sources to identify where higher-quality soils may exist. When possible, the organic content of on-site topsoil material should be determined by testing.**
- **To the extent possible, site improvements should be oriented to *minimize disturbance of high-quality soils*. Site grading should be planned to avoid compacting, filling or tilling under the**

drip line of trees which are intended to be preserved through construction.

- ***Identify where topsoil will be stripped, stockpiled and replaced.*** **The quantity of stockpiled material should be estimated.**
- **Where grading is necessary, *show the location and type of method of SQR* to be applied (ISWMM lists eight separate options that could be used).**
- **If SQR techniques are not proposed or not applied, *adjustments to stormwater design calculations* should be made to account for the effects of soil compaction and poor establishment of vegetation. ISWMM includes recommendations on how to account for these effects.**

Application

It is recommended that counties and communities consider ordinances and policies that would apply these standards to all sites requiring either a local grading permit or authorization under the State of Iowa's NPDES General Permit No.2.

This concept can also be applied to existing lawns. Polk SWCD is currently promoting cost-share programs in the Des Moines metro area to apply compost over existing lawns to increase soil organic matter. This provides a source of nutrients to lawns which can reduce the need for fertilization and watering and increase the ability of the lawn to absorb rainfall.

Expected Impacts

- **A modeling analysis completed for the Walnut Creek Master Plan found that successful implementation of these policies can reduce runoff volumes from suburban development areas by approximately 45% during a 1-year return period storm event (2.67" in 24-hours for Central Iowa).**
- **The same analysis found that runoff from areas developed using these policies was reduced by approximately 20% compared to sites without SQR during the 1% AR (100-year return period) storm event (7.12" in 24-hours).**
- **Total pollutant loading could be reduced by an amount similar to runoff volume reductions.**
- **Stormwater detention areas and other management practices can be reduced in storage volume and footprint area. Modeling results from the developing case study area within the Walnut Creek Master Plan indicate that stormwater management areas in areas without SQR would need to have 48% more volume and be 40% larger in area to limit runoff rates to desired levels.**

REDEVELOPMENT POLICIES

While many of the policies in urban areas are focused on new areas, it is important to look for opportunities to make improvements within portions of the watershed that are already developed. Cities can require updated stormwater practices to be installed on properties where site improvements or redevelopment is proposed to a level where a new site plan must be approved. Other than these situations, cities usually do not have the ability to force private property owners to make improvements to their sites. For this reason, communities may decide to provide incentives (such as cost-share programs, grants and utility fee reductions) to promote installation of new stormwater practices. Cities may also look to identify critical areas where stormwater retrofits could lessen the potential for flash flooding or streambank erosion along small urban tributaries. Education and outreach efforts can also broaden the use of practices such as rain barrels and rain gardens in residential areas.

The following items could be used as a checklist for the NRRWMC or its Watershed Coordinator to evaluate implementation of urban stormwater policies:

Implementation Plan:

- ✓ **Support the advocacy efforts of the Watershed Management Authorities of Iowa.**
- ✓ **Develop annual priority messages for advocating watershed management policies to local political representatives.**

CAPITAL REGION WATERSHED DISTRICT RAINGARDEN,
SOURCE: EMMONS & OLIVIER RESOURCES

✓ **Conduct an inventory of the standards and ordinances currently in place at the cities and counties within the watershed.**

- Develop a database and keep detailed records of ordinance adoption and continued educational efforts.
- Invite each member entity to provide an overview of their ordinances at each Water Management Authority meeting, as a learning opportunity.
- Identify and assess the need for better enforcement among existing communities/counties on a 5-year cycle.

✓ **Provide a list of resources for technical assistance to communities and counties (elected officials and staff) regarding stormwater/floodplain ordinances and management.**

- Develop a Community Mentoring Program where larger communities in the watershed provide assistance to smaller communities on watershed standards and ordinances.
- Provide resources for watershed communities related to ordinance development, such as those available through the Iowa Stormwater Education Partnership (ISWEP).

REFERENCES

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NORTH RACCOON RIVER WATERSHED PLAN

PART 3
ACTION STEPS

OCTOBER 2020

CONTENTS

PART 03

ACTION STEPS

STRENGTHENING THE COALITION

Team Effort

Executive Committee

Selected from: 57 Cities and Counties, 15 Conservation Districts

Board-Appointed Representatives

Watershed Coordinator

Partners

Elected Officials

Farmers

Landowners

Businesses

Watershed Population

A message you can share in 5 minutes

Hi, my name is __________.

Today I would like to talk about ___________. Followed by:

- Quick (personal) story
- Quick fact (s)
- Big picture/why it matters
- Make the ask

10

STRENGTHENING THE COALITION

The NRRWMC will need to grow in unity and find financial resources to implement this plan. They will need to be organized as a group and seek to expand the list of active partners who will be acting and advocating for additional outside support.

COALITION BUILDING

It takes the whole watershed community to implement a watershed plan. Coalition building is vital to share information and workloads. When building a coalition, develop a working organizational structure and then focus on grassroot efforts throughout the watershed.

ORGANIZATIONAL STRUCTURE

Membership

- **Appointed representatives from cities, counties and SWCDs who have voting authority, as allowed by statutes that established formation of WMAs**
- **These groups must sign 28E Agreements to become official members**

Partners

- **Any individual, group or organization that wishes to attend meetings or participate in plan implementation but have not been given the ability to become official members, by statute.**

Adjustments to By-laws

- **The NRRWMC Board may wish to consider what actions the executive committee may take between Board meetings without a direct vote of authorization by the Board (e.g., issue letters of support for project grant applications, certain level of spending for projects/matching funds, etc.)**
- **The NRRWMC may wish to consider changing requirements for a quorum to be less than 50% plus one vote, if reaching a quorum becomes consistently problematic.**

EXECUTIVE COMMITTEE/BOARD (VOLUNTEERS)

- **Ample representation from throughout the watershed**
- **Term limits (2-year), annual elections, regular meetings**

FULL-TIME WATERSHED COORDINATOR (PAID POSITION)

Refer to the job description included (Chapter 16).

COMMUNITY LIAISONS/ SUBWATERSHED LIAISONS (VOLUNTEERS)

- **Local contact with each community**
- **Interactions with NRRWMC Board members**

Just as everyone in the watershed is connected, everyone involved in the coalition is connected as well. The Board and the Executive Committee provide direction and financial support to the Coordinator. The Coordinator serves as the face of the NRRWMC and works directly with agencies and partners to coordinate work in a strategic way to carry out the plan. They also report to the board, track implementation and establish local liaisons to represent individual communities in a more personal way. The liaisons are the boots on the ground helping with education and outreach that supports and further implements the plan.

This structure is supported by building community throughout the watershed. Education and outreach efforts can be amplified through social media and direct participation and feedback from communities before, during and after projects.

PARTNERSHIPS

To execute this plan and achieve its goals, efforts will go beyond the jurisdictions and organizations that are members of the NRRWMC Board. Partners are individuals, groups and organizations that are vital to the success of this plan but are not allowed by statute to be a member or have not agreed to join.

PARTNERS IN WATERSHED MANAGEMENT:

- **Associations**
  - Iowa Agriculture Water Alliance
  - Iowa Soybean Association
  - Iowa Corn Growers Association
  - Iowa Pork Producers
  - Iowa Cattleman's Association
  - Local Farm Bureau chapters
- **Ag Retailers/Co-ops**
- **NRCS**
  - State and local offices
- **Drainage Districts**
- **County Conservation Boards**
  - Natural Resource Management and county areas
- **ISU Extension**
  - Education and outreach

- **Iowa DNR**
- **Iowa Water Center/WMAs of Iowa**
  - Share resources, ideas and best practices
  - Provide technical assistance
  - Annual Water Conference
- **Local landowners**
- **Iowa Natural Heritage Foundation**
- **Hook and Bullet organizations (state and local chapters)**
  - Ducks Unlimited
  - Pheasants Forever
  - Trout Unlimited
  - Whitetails Unlimited
- **Izaak Walton League of Iowa**
- **The Nature Conservancy**
- **Trees Forever**

Any effort is only as strong as the coalition driving it. Establish it early and connect with it often. ***There is no need to re-invent the wheel when various partner organizations' work aligns with the work of the coalition.*** Find the spaces of overlap and explore where that supports the priorities of this plan.

ADVOCACY

ADVOCACY TO SUPPORT POLICY

The North Raccoon River Watershed is large. ***While that creates challenges in planning, coordination and implementation, it also presents a unique opportunity when it comes to representation.*** Nearly 700 elected officials represent this watershed.

Advocacy is simply educating your decision-makers about issues that matter to you. Advocates need to speak with a loud, united voice. They need to speak up and share their knowledge. They need to inform government decision-makers and the public about the importance of water and how it relates to them, their family, their community and their state.

Rivers, lakes and streams are vital to a healthy environment and a vibrant economy, and provide endless opportunities for swimming, fishing, boating and other recreation. Above all, people need clean, safe drinking water to live. This section will break down *how* to advocate for issues in the North Raccoon River Watershed.

Strength in Numbers

Counties in the North Raccoon River Watershed:

- **Boone**
- **Buena Vista**
- **Calhoun**
- **Carroll**
- **Clay**
- **Dallas**
- **Greene**
- **Guthrie**
- **Madison**
- **Palo Alto**
- **Pocahontas**
- **Polk**
- **Sac**
- **Warren**
- **Webster**

Elected Officials in the North Raccoon River Watershed:

- **City Council Members: over 500**
- **Soil & Water Conservation District Commissioners: 75**
- **County Supervisors: 75**
- **State Representatives: 26**
- **State Senators: 14**
- **U.S. Representatives: 2**
- **U.S. Senators: 2**

Find and Get to Know Local Elected Officials

First Step: Get connected. The best way to get know your leaders is to get involved. Remember, elected officials work for the people. Their work should represent the needs of the communities, natural resources and the families that reside in the watershed.

- **Look them up:** *www.legis.iowa.gov*
- **Join a local neighborhood association**
- **Attend City Council meetings**
- **Get appointed to a local board or commission**
- **Attend County Supervisor meetings**
- **Attend public forums/town halls**

Next Step: Ask them, "What is your Preferred Method of Communication?"

Communication is key. Elected officials should not just hear from you when you need something. In a watershed as big as the North Raccoon, communication and relationship building will help build and strengthen the coalition *and* keep leaders in the loop of progress and challenges. Typical ways to communicate with elected officials include:

- **Emails**
- **Hand-written letters**
- **Phone calls**
- **Texts**
- **Morning coffee**

- **Being invited to an event**
- **Meeting up at the State Capital in Des Moines**
- **Meeting up at their local office**

Get Their Attention!

Elected officials want to hear from *their* constituents. ***By carefully choosing*** *who* ***you want to talk to and*** *how* ***you are going to talk to them, you set yourself up for success.***

Who delivers a message can be as important as the message delivered. Craft a meaningful message and then determine the ideal coalition member to deliver it. Find tips for crafting your message in the next section.

Tips for crafting Your Message:

- **Everyone loves a good story**
  - Make it personal
- **Quick facts are good to have on hand, but** *do not* **lead with them**
- **Be concise**
  - You may have a very limited amount of time to get your point across
  - No fluff
- **What is in it for them (the person you are talking to)?**
  - How does it affect them/their family/their kids/their community/etc.?
- **Hit them in the pocketbook**
  - It often comes down to money.
  - How can you make the case that your idea will *improve* the bottom dollar?
- **Make the ask**
  - Tell them what you want and what you need from them

Sample message Template:

HI, my name is ____________.

Thank you for taking the time to hear from a constituent. Today I would like to talk about ____________. Follow with:

- **Quick (personal) story**
- **Quick fact (s)**
- **Big picture/why it matters**
- **Make the ask**

Total: 5 minutes (or less)

The following are specific activities to be implemented to strengthen the NRRWMC.

- ✓ **Work with member communities to adopt the watershed management plan**
- ✓ **Develop a sustainable funding framework for implementing the watershed management plan using the following recommended methodology**

i. Determine relative distribution of funds from among the source categories needed to support baseline funding levels

ii. Determine the member contribution funding allocation methodology

   » *Develop example scenarios for NRRWMC using different methods*
   » *Leadership group reviews options and suggests top 2–3 methods*
   » *Entire NRRWMC board reviews and selects preferred draft method*

iii. Develop list of the key benefits and accomplishments the NRRWMC will provide over next 5–10 years (i.e., answer why participating organizations should support a sustainable financial model)

iv. Schedule two workshops with each of the cities', SWCD and county member organizations' full boards

   » *Meeting #1—Reacquaint the member organizations with the NRRWMC mission and purpose, and the value the NRRWMC adds to their local community*
      - *Overview of planning process: State laws, regional issues/drivers, NRRWMC formation, startup funding, board representation, issues, goals, analysis, plan implementation*
      - *Articulate answers to key questions:What are the problems/opportunities?Would it be irresponsible of NRRWMC to not address them? Is the approach sound? Is the organization listening and considering all input?*

   » *Meeting #2—Provide summary of benefits that the NRRWMC will accomplish over next 5- to 10-year period (and beyond) and corresponding funding needs*
      - *Review the watershed plan and the need to manage water more effectively*
      - *Discuss the need for stable funding*
      - *Request member organizations to support base-level funding*
      - *Remind them that their representatives sit on the NRRWMC board and they have direct access to know what is happening and that funds are being spent effectively*
      - *Show recommended method for allocating funding and get feedback*

v. Select final funding allocation and levels, based on feedback from member the organizations

   » *NRRWMC Leadership group recommends preferred option*
   » *Full NRRWMC Board approves recommended option*

vi. NRRWMC board members go back to their respective member boards with action request for ratification (if needed)

- ✓ **Annually, apply for grants and other funding sources to fund subwatershed management planning, additional studies, flood mitigation and water quality improvement projects using the resources found in Appendix E**
- ✓ **Foster the creation of partnerships with private entities to fund watershed management efforts**
- ✓ **Conduct an organizational viability assessment using the following questionnaire:**

  i. Is uncontrolled water runoff a problem to be addressed and/or are there opportunities to reap benefits from improved water management?

    - *Is flooding/damage displacing or disrupting residents and businesses?*
    - *Does it put at risk the quality of water supplies and quality of life?*
    - *Can we enhance our community's quality of life and prosperity with cleaner and safer waters?*

  ii. Is the WMA the appropriate organization to undertake water planning and coordination?

    - *Who else is addressing flooding, water quality and erosion issues, and are these issues being effectively resolved already?*
    - *Is a WMA, defined on watershed boundaries, a better format to address water management challenges than other local jurisdictions?*

  iii. Are the initiatives based on good information, sound practices and open/responsive leadership?

  iv. Is the process open and inclusive, such that input from everyone is considered and respected?

- ✓ **Provide Member Highlight presentations at each NRRWMC Quarterly Meeting to share watershed management experiences among members, with topics ranging from past watershed management planning to current projects to upcoming challenges.**
- ✓ **Hold annual watershed tours for coalition members**
- ✓ **Utilize social media platforms to promote the mission, values and activities of the NRRWMC**
- ✓ **Work with Agribusiness Association of Iowa (AAI) on their project, Scaling Up Capacity to Implement Water Quality Wetlands, to identify a drainage district within the watershed that could serve as a collaborative pilot project.**

HARMONIZING THE PLAN

Bringing Plans Together Provides Guidance

- 15 County Hazard Mitigation Plans
- 2+ City Stormwater Management Plans
- Subwatershed Plans
- Local Ordinances and Policies

National Flood Insurance Program

- Incentivize communities to adopt and enforce floodplain management
- Participants receive state and federal financial assistance

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HARMONIZING LOCAL PLANS

Local and watershed planning efforts need to act along parallel tracks so that both may be successful.

Watershed planning can influence local efforts to align with larger watershed goals.

Local efforts can help refine the larger watershed plan by adding to the list of potential projects and updates of local achievements.

This Chapter references key aspects of local planning:

- Hazard mitigation plans
- Flood insurance programs
- Stormwater plans
- Policies and ordinances
- Comprehensive or strategic plans

HAZARD MITIGATION

ALIGNMENT WITH LOCAL HAZARD MITIGATION PLANS

This plan is being developed through the IWA, supporting development of a watershed plan that identifies goals and actions to reduce flooding, improve soil health and water quality and increase flood resilience. ***The boundaries of the North Raccoon River Watershed include parts of fifteen counties, each of which has a local hazard mitigation plan.*** As of the date of this plan (2020), Webster and Palo Alto counties are working on updates for their mitigation plans. As these county mitigation plans are updated in the future, the goals, objectives and implementation programs outlined in this plan should be reviewed, and the local plans should be amended, as necessary, to align with the watershed plan. Specific actions identified at the local level should be integrated into updates of the watershed plan, through the annual evaluation and amendment process (see Chapter 16). ***Aligning local- and watershed-scale hazard mitigation efforts should enhance the competitiveness of watershed communities for Hazard Mitigation Assistance (HMA) and other potential funding sources.***

The NRRWMC will provide technical assistance to communities implementing the flood mitigation activities identified in their local hazard mitigation plans. These projects are identified in Appendix F.

ALIGNMENT WITH FEMA NFIP AND CRS PROGRAMS

The FEMA National Flood Insurance Program (NFIP) provides subsidized insurance to property owners, renters and businesses in flood hazard areas. ***This program incentivizes participating communities to adopt and enforce floodplain management regulations in flood hazard areas.*** In order to receive most state and federal financial assistance, communities must participate in NFIP. The Community Rating System (CRS) is a preventive and incentivizing action program for NFIP communities to reduce flood risks by implementing local mitigation, floodplain management and outreach activities that exceed the minimum NFIP requirements.

There are nine class levels in the CRS program, with Class 1 being the highest amount of credits and incentives possible. ***For CRS-participating communities, flood insurance premium rates (charged to cover local residences and businesses) are discounted.*** These reductions can range from 0–45% for special flood hazard areas (SFHA) and 0–10% for non-special flood hazard areas (NSFHA), depending which class level is achieved; discounts are given in 5% increments. More information can be found in the CRS Coordinator's Manual (FEMA 2017).

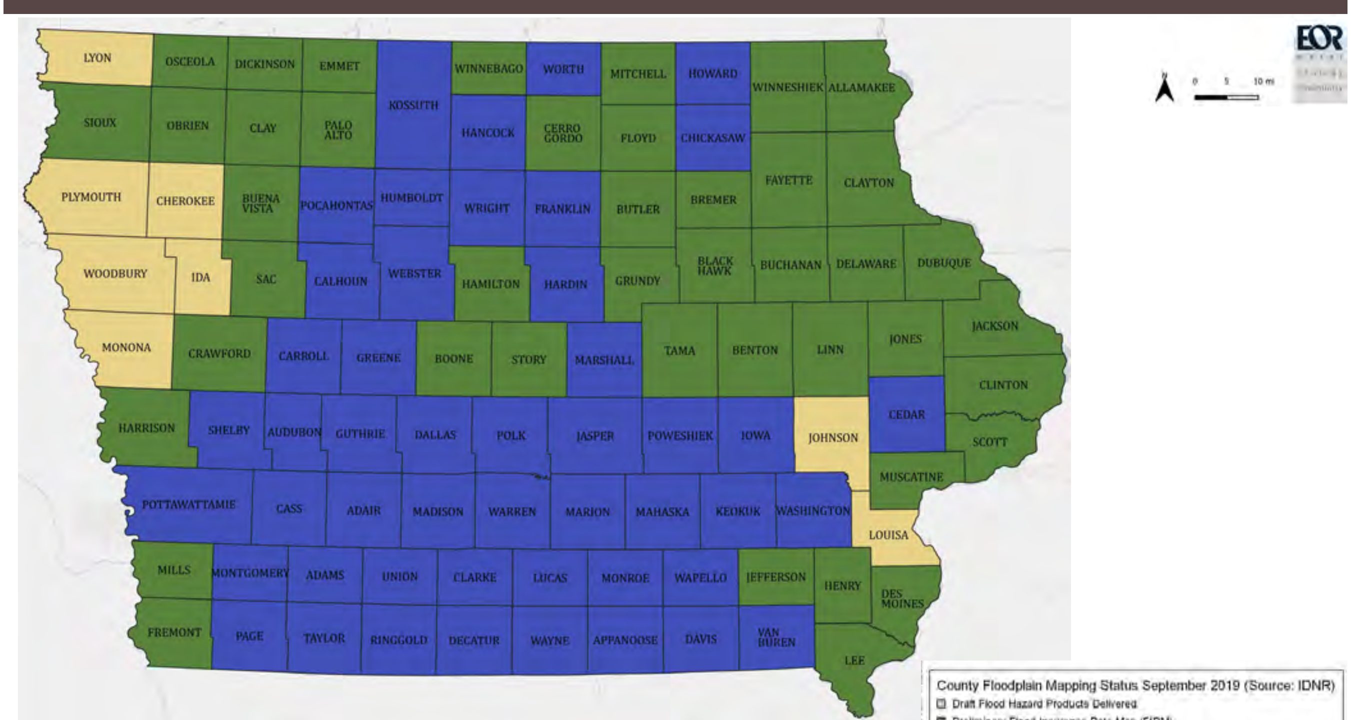
Communities that participate in NFIP must keep their floodplain ordinances current or update them when new FEMA Flood Insurance Rate Maps (FIRMs) become available. Communities must also enforce compliance with the ordinances during development projects, which is intended to limit the potential for new structures being constructed in areas with elevated flood risk. Most of the counties in the watershed have had recent map updates and the remaining counties have updates in progress (see FEMA FIRM update information shown in Table 11-1 and Figure 11-1).

Additional information on coordinating local flood mitigation efforts is described in the document Flood Mitigation Planning for the North Raccoon River Watershed (see Appendix G). North Raccoon River Watershed communities can use the information in this flood mitigation planning section to identify action items to reduce flooding, improve soil health and water quality and increase flood resilience.

TABLE 11-1 NORTH RACCOON RIVER WATERSHED COUNTY FIRM UPDATE STATUS (2019)

STATUS	NUMBER OF COUNTIES
New FIRMs in Effect	10
Preliminary FIRMs issued (under review)	3
Draft Hazard Products Delivered	2

FIGURE 11-1 IOWA FIRM UPDATE STATUS MAP (2019)



Source: Iowa DNR website

All communities in the North Raccoon River Watershed which are actively participating in the NFIP participation status are compliant with the ordinance requirement. ***Some communities are not participating***; perhaps because they do not have enough resources to maintain program participation, they may not perceive significant risk of flood damage to their communities, or simply have not been interested.

It is recommended that all communities participate in the NFIP and complete a CRS Community Self-Assessment. Communities should attempt to maximize their class status within the CRS, which would not only reduce local flood insurance premiums, but also would require actions which would reduce flood risk. To see which communities are participating in the NFIP or the CRS as of May 2019, see Appendix F.

By ensuring that all communities remain compliant with or become participants in the NFIP—and by encouraging and assisting communities to perform a CRS Community Self-Assessment—the NRRWMC can help improve the level of flood preparedness and resiliency across the watershed while simultaneously increasing the incentives for which participatory communities are eligible through the CRS.

OTHER LOCAL PLANNING

COUNTY OR CITY STORMWATER PLANNING

Local Stormwater Management Plans

Some communities in the Des Moines metropolitan area and smaller communities such as Storm Lake and Lake City have chosen to create stormwater management plans that address issues at the community scale. ***In the past, these local stormwater management plans have traditionally focused on flooding or storm drain capacity issues*** (water quantity issues), with the primary objective being to evaluate needs to improve city infrastructure. These often include detailed studies to determine flooding cause and impacts, and to identify critical bottlenecks in storm drain pipe capacity. Flood risks are not limited to areas shown on FIRM maps. Flash flood risks can occur in urban areas away from streams and along waterways having too small of a drainage area to have a mapped risk shown on FIRM maps, typically under one square mile (640 acres).

More recently, these types of plans have been expanded to consider water quality issues, or to evaluate possible methods to use water more effectively as a local resource. Some of these plans have included conceptual locations for stormwater management features which would serve entire neighborhoods or evaluate needs for stream stabilization or restoration.

Information within this watershed management plan can help guide the development of city stormwater management plans. When developing new or updated plans, the following recommendations should be considered:

- **Define the primary goals and objectives of the planning effort. What is the plan most critically needing to address:**
  - Riverine flood risk reduction
  - Local flooding caused by storm drain capacity limitations
  - Stream erosion
  - Planning for future growth
  - Water quality issues
  - Source water protection
- **Look at the past, present and future**
  - Review past land use changes
  - Changes in stream widths
  - Changes along floodplain, surface vegetation
  - Review local streamflow and climate data, as available
- **Define ways to address key issues**
  - Reserve floodplains and buffers through changes to zoning, comprehensive plans
  - Develop local stormwater management requirements
  - Refine local construction site pollution control measures
- **Develop a Capital Improvement Program to make improvements**
  - Projects
    - » *Stream stabilization*
    - » *Storm drain improvements*
    - » *Bridge, culvert replacements*
    - » *Protection of key infrastructure*
    - » *Stormwater management practices for flood control, water quality*
    - » *Integration of stormwater management into parks, open spaces*
  - Funding
    - » *General Funds*
    - » *Bonds*
    - » *Grants*
    - » *Create or adjust Stormwater Utility Fund*

Since community-scale plans are often focused on smaller geographic areas, a more detailed resource assessment can be performed. This watershed management plan can be used as a reference to understand how the smaller local subwatersheds within a community fit into the context of the larger watershed of a stream or river that passes through or near a community. ***The community plan should address how local efforts can advance the goals and objectives of this plan.***

Local Ordinances and Policies

As the NRRWMC does not have the ability to directly raise revenues, enforce regulations or commission projects, it must rely on members and partners to enact the plan. Counties and communities can advance the plan in several ways, the first of which is the review of local ordinances and policies. Local codes (zoning, subdivision, site plan) and ordinances (floodplain, resource buffer, stormwater management) can prevent new structures from being constructed in areas of flood risk; reserve and protect floodplain and natural areas; and mitigate the effects of increased runoff from developing areas. Other policies can also encourage removal of existing structures from areas of flood risk or inclusion of streams and natural areas into local park systems. Refer to Chapter 9 for policy frameworks.

Comprehensive or Strategic Plans

Many communities create and update comprehensive or strategic plans which identify community needs for growth. Often these plans project future land uses to advise landowners, residents and potential developers on the vision for local growth over the next couple decades. ***These plans can consider stormwater by adjusting future land use patterns to preserve flood plains, reduce impacts to stream alignments and protect natural resources*** (wetlands, quality woodlands, prairie remnants, etc.). These plans can also project concepts for redevelopments which can be used to reduce existing risks.

TECHNICAL SUPPORT

The challenges counties and smaller communities may have implementing some of these approaches have been previously noted. Many of these entities may have limited staff or rely on volunteer efforts to operate local government. ***The NRRWMC can play a role in developing a network of technical support to guide communities through these issues.*** Chapter 9 of this plan discusses these issues in greater detail.

CONCLUSIONS

This chapter has listed various county and community planning efforts that can reduce flood risk and improve water quality. ***Local and watershed planning should not be viewed as in conflict or superseding one or the other. Rather, these should be opportunities for each to inform the other.*** First, this watershed plan can help influence local efforts align with larger watershed goals. Then, the local efforts can be used to amend the larger watershed plan by including lists of potential projects (to pursue funding) and updating local advancements toward watershed goals.

BARRIERS TO IMPLEMENTATION

Political

Cultural

Social

Economic

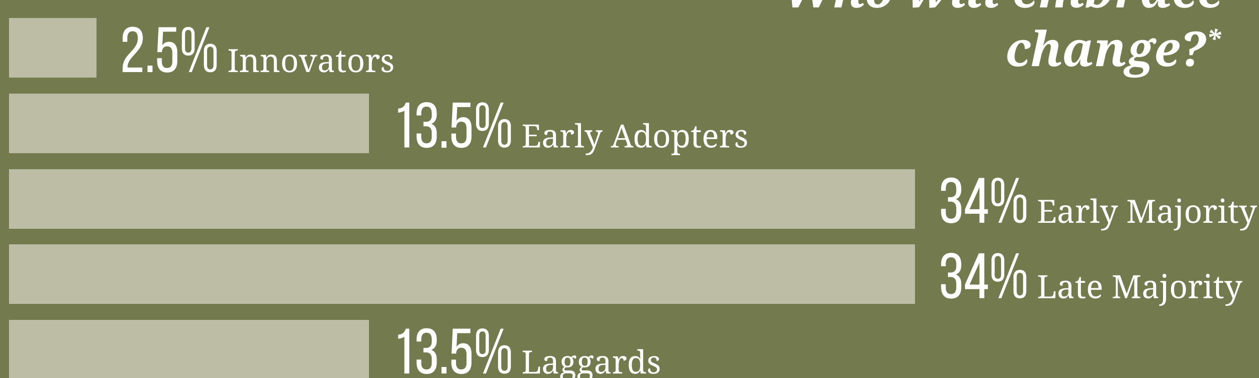
What is a deadzone?

Little to no oxygen means fish and marine life die.

†33 year Average

Who will embrace change?*

QUICK TO ADOPT • YOUNGER • HIGHER SOCIAL/FINANCIAL STATUS • RISK TAKER



SLOW TO ADOPT • ELDERLY • LOWER SOCIAL/FINANCIAL STATUS • SKEPTICAL

*Study: Rogers

Rural and Urban Divide

Insufficient Funding

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BARRIERS TO IMPLEMENTATION

There are political, cultural, social and economic challenges which are barriers to implementation.

These should not be excuses to not try; rather, they need to be understood in order to be addressed and overcome.

POLITICAL LANDSCAPE

Several past studies and recent events have brought concerns surrounding watershed management in the North Raccoon River Watershed to the forefront. These events have the potential to bring members, partners and stakeholders together to address these issues. Working together is vital to ensuring that these issues do not become wedges that disrupt cooperation. Problem-solving will be a full-scale collaboration effort. In order to move forward with the problem-solving outlined in this plan, it is important to understand some history.

GULF HYPOXIA TASK FORCE AND IOWA NUTRIENT REDUCTION STRATEGY

As noted in Chapter 2, high concentrations of nutrients in runoff from the Mississippi River watershed (which stretches the entire length of the contiguous United States) have contributed to an area with low oxygen levels in the northern Gulf of Mexico. Hypoxia can cause fish to leave the area and can cause stress or death to bottom-dwelling organisms that cannot move out of the hypoxic zone. This led to creation of the Hypoxia Task Force which developed an action plan to address this issue. In response, the Iowa NRS was developed. The Iowa NRS is a science- and technology-based framework to assess and reduce nutrients to Iowa waters and the Gulf of Mexico. It is designed to direct efforts to reduce nutrients in surface water from both point and nonpoint sources in a scientific, reasonable and cost-effective manner.

In 2013, the Hypoxia Task Force revised its goal in response to a lack of overall progress being made in reducing the Gulf of Mexico hypoxic zone. ***The Task Force established an interim target of a 20% reduction in nitrogen and phosphorus loading by 2025. This required greatly accelerated implementation and also eliminated the reference to "voluntary actions"*** (Hypoxia Task Force 2013). Biennial reports to Congress containing information about the progress made toward the goals of the 2008 Action Plan began in 2015 and can be found on the Environmental Protection Agency's (EPA) website. This revision to the goal generates a foreboding that the Hypoxia Task Force could take legal action if the goals it has set are not pursued aggressively. Therefore, the effort and performance of the NRRWMC in implementing this plan may be under greater scrutiny and could also determine the extent of future oversight from regulatory entities.

DES MOINES WATER WORKS LAWSUIT

In 2015, the Des Moines Board of Water Works (DMWW) Trustees filed a lawsuit against 10 drainage districts and their trustees, all located in Buena Vista, Sac, and Calhoun Counties in Northwest Iowa. (Bd. of Water Works Trs. of Des Moines v. Sac Cnty. Bd. of Supervisors of Drainage Districts 32, 42, 65, 79, 81, 83, No. C15-4020-LTS

(N.D. Iowa Mar. 17, 2017)). This was a federal Clean Water Act (CWA) lawsuit claiming that under the CWA, these districts were a "point source" for nitrates and should therefore be subject to regulations under the National Pollutant Discharge Elimination System (NPDES) permit program. The DMWW was seeking monetary compensation for the costs associated with negligence and property damage from these pollutants, which were claimed to have derived from the 10 drainage districts in question. (Tidgren 2017). As noted in Chapter 2, high nitrate concentrations in the river require DMWW to operate a nitrate removal system (the largest nitrate removal system in the world) which is expensive to operate. The case can be found at the Casetext website.

The Iowa Supreme Court ruled in favor of the drainage districts on March 17, 2017, stating that they were not responsible for the monetary damages associated with the DMWW nitrate treatment needs. The premise of this ruling was that the drainage districts did not have the authority or power to influence the behaviors of their constituents because they can only pursue changes to restore or increase water flow and are not required to have an NPDES permit for drainage systems. Therefore, it was regarded that they should not be held responsible for the nitrate pollution. There were many additional complications included in this lawsuit, such as the claim that drainage districts deprived the DMWW of property rights, and the claim that the DMWW was denied due process. However, the primary point of importance here is that an attempt was made to hold another entity responsible for the contamination of drinking water sources for the City of Des Moines. A huge portion of this argument centered on which entities are subject to regulation under EPA's NPDES permit program. This lawsuit is an example of the push for increased oversight on unregulated parties that are contributing to water pollution.

The aftermath of the Iowa Supreme Court ruling permeated the state and the Midwest. Most watershed planning processes now reference the case to explain some of the history that has affected watershed work to date. What is often confused for an urban vs. rural divide in Iowa can be pivoted to discussions about commonality. What happens upstream affects those downstream and we all have a part to play.

RACCOON RIVER LAWSUIT

On March 27, 2019, a lawsuit was filed by Iowa Citizens for Community Improvement and Food & Water Watch against the State of Iowa regarding Iowa's violation of the Public Trust Doctrine in its failure to protect the Raccoon River for the use and benefit of all Iowans (Rakestraw et al. 2019). In this "petition for injunctive and declaratory relief," the groups petitioned the State of Iowa to put mandatory controls on the construction and operation of new and/or expanding Animal Feeding Operations in the watershed (Conlin et al. 2019). The Public Trust Doctrine states that select natural resources must be held in a "trust" for current and future generations. The government must not alienate those resources or permit their destruction, as the government has a duty to protect those resources, long-term, for the benefit of the public (Frank 2012). This lawsuit reflects the growing tensions around the State's approach to water quality and again highlights the importance of the NRRWMC and the implementation of this plan.

MANAGEMENT AND ORGANIZATIONAL LEADERSHIP

Watersheds cross multiple jurisdictions, making it challenging for existing local entities, like cities and counties, to act independently to address problems. The North Raccoon River Watershed spans about 2,500 square miles, thus the scale of the watershed is particularly challenging. There are many governmental entities throughout the watershed that have little or no history of collaborating on water issues, including cities, counties, SWCDs and County Conservation Boards. There is also a large and diverse group of partners in this watershed working to enhance many aspects of the watershed independently. The scale and size of this watershed is a challenge but also represents the importance of the establishment of the NRRWMC. While this is a coalition of cities, counties and SWCDs, the NRRWMC provides a means for more intentional collaboration among government entities, state agencies, non-profits and other organizations to work toward the goals of this plan.

Therefore, the NRRWMC needs to have a lasting organizational structure, accountable to the public, along with some form of stable funding. Iowa Code Chapter 466B Subchapter II provides for the creation of WMAs on an as-needed basis following the completion of a 28E agreement. There is no taxation authority granted to WMAs. Creating a voluntary system among members to create a sustainable source of funding may be a significant leap for the NRRWMC and will take some time to evaluate.

STAKEHOLDER INPUT ON THE POLITICAL LANDSCAPE

Initial consultation with stakeholders provided a summary of the many concerns, attitudes and expectations that exist within the watershed. Specific concerns from stakeholders regarding the political landscape include political movements against WMAs, the difficulty in obtaining research and following requirements of federal agencies.

CULTURAL AND SOCIAL CHALLENGES

All too often, conservation efforts are viewed solely as technical and educational challenges. ("If we develop a technology and disseminate it, people will use it and the problem will be solved!") In reality, adopting practices is far more complex than this and often faces barriers that those on the conservation side do not anticipate. As Nowak (1992) observed, there are many reasons why farmers may be unwilling or unable to adopt a particular practice. Some of these challenges are economic or technical, while others have to do with tradition or farmer perceptions. ***Understanding the social barriers to practice adoption is as important as understanding the technical issues.***

Innovation adoption is often understood through the Rogers Diffusion of Innovations theory (Rogers 1962). This theory suggests that within a population there will be a range of reactions to an innovative practice or technology, which fit a 5-part typology ranging from Innovators who are actively seeking to try new things, to Laggards, who may never adopt a practice. Rogers ties these categories to social, educational and economic status within a community. Understanding these categories can help communicators target their messages to those people who are most receptive.

ATTITUDES ABOUT WATER AMONG RESIDENTS

Landowners often have strong connections to the water resources on their lands, but not all understand the ways in which their activities impact waters on and downstream of their property. Water flows downstream, and the by-products of activities from upstream residents become the burden of downstream residents. Unfortunately, because the activities that alter hydrology and diminish water quality are not full-circle and do not directly impact the residents taking part in those activities, there is a limited awareness of the impact upstream land use has on downstream residents. When stakeholder groups in upstream communities are asked to contribute funds and efforts toward flood and water quality mitigation activities, there can be strong hesitation or resistance. This resistance may stem from a range of factors, including limited awareness of the downstream problems or a feeling that blame or accountability is being placed unfairly in the watershed. Because the coalition is very large and contains members from both upstream and downstream communities in the North Raccoon River Watershed, these attitudes need to be addressed head-on so members of the coalition can proceed with civility, free of underlying resentment.

WILLINGNESS TO ADOPT NEW LAND-USE PRACTICES

Throughout the planning process, stakeholders identified the unwillingness of farmers to adopt conservation practices as an important and pressing concern for the NRRWMC's future progress. This unwillingness can be explained from both a cultural and economic standpoint. No matter how high the cost-share or how obvious it may seem that a practice should be adopted, a lack of willingness of a farmer and/or landowner to adopt the practice can completely halt progress.

Inwood (2013) suggested that the distinction between a multigenerational farmer and first-generation farmers can be valuable in identifying the reasoning behind resistance to adopting conservation practices. The study found that multigenerational farmers tend to have highly specialized farming systems in place, informed by generations of knowledge and experience. The assets maintained and owned by these farmers represent long-term investments from generations before them. Therefore, these farmers are much less likely to adapt to a new system of land management because the losses would include the loss of investments from previous generations. First-generation farmers, however, are more likely to adopt conservation practices and tolerate the risks because they are not restricted by previous investments or assets. ***Therefore, first-generation farmers may be more likely than multigenerational farmers to be early adopters of soil health conservation practices such as no-till farming and extended rotations.***

Farmers can be concerned with their social status among their peers and will often evaluate a practice based on how they expect it will be viewed by peers and neighbors. The desired social position will vary between farmers, of course—some will welcome being seen as innovators, but others will want to be seen as responsible and conservative.

Changes in land tenure represent another emerging barrier to conservation practice adoption. ***More than 50% of farmland in Iowa is rented, creating a barrier to long-term investments in soil health for tenant farmers, as there is no guarantee that they will reap the rewards of those investments*** (Love 2017).

STAKEHOLDER INPUT ON CULTURAL AND SOCIAL CHALLENGES

Initial consultation with stakeholders provided a summary of the many concerns, attitudes and expectations that exist within the watershed. Specific concerns from stakeholders regarding cultural and social challenges included the presence of negative media attention, the resistance of landowners and renters to adopt cover-cropping, the reluctance of farmers to be transparent with internal knowledge, the diverse interests between urban and rural stakeholders, the large number of entities involved in the coalition and the strong cultural barriers that exist regarding the adoption of conservation practices. Later in the planning process, stakeholders identified some key areas that must be addressed surrounding this topic. These included:

- **A lack of common goals and support among upstream and downstream communities**
- **Limited representation of agricultural groups in the organizational structure of the NRRWMC (can be partners, but not members)**
- **Insufficient communication among landowners, urban communities and rural communities**
- **An absence of accountability among members of the watershed regarding water quality and hydrology**

ECONOMIC SETTING

Farming is, first and foremost, a business, and increasingly one in which farmers compete against other producers from around the world. Commodity prices are established in global marketplaces where farmers have little negotiating power and prices fluctuate wildly and unpredictably. Farmers need to make major economic investments early in the year when neither the price of their commodity nor the conditions for its production are known. One wrong investment can lead to bankruptcy. This dramatic uncertainty is baked into the nature of farming and causes farmers to think in terms of risk when making economic decisions. This uncertainty leads farmers to shy away from practices perceived as opening them up to increased risk.

These realities make clear the importance of understanding the economic landscape within which farmers make production decisions. ***Expecting most farmers to invest in conservation practices that increase their costs or require a significant realignment of their production systems is not realistic without a concurrent risk mitigation strategy.***

Financial resources to address flooding and water quality from government entities are limited, while the commitments needed to address these problems are increasing. Because the high cost of adopting conservation practices in urban and agricultural settings is already a deterrent to landowners and local communities, the limited funding available from external sources only perpetuates the challenge to increasing adoption rates. ***Additionally, farmers tend to focus their efforts on increasing production (yield), but increased production does not always correlate with increased profits.***

AGRICULTURAL PROFITABILITY

Nearly all the growth seen in the agricultural sector since the advent of the Green Revolution in the 1950s and 1960s has come from increases in per-acre farm productivity, which rose 170% between 1948 and 2015 (Wang et al. 2018). At the same time, commodity prices have dropped dramatically. This has been a positive development for food security; however, continued productivity growth cannot be sustained forever.

Agriculture is a notoriously volatile market sector, and there are few other businesses where individual business operators are so exposed to market risks. Farmers face not only unpredictable weather, but unpredictable market forces and labor availability. Between 2013 and 2017, U.S. farm income fell from more than \$120 billion to \$63 billion (USDA ERS 2019). According to an article from the Des Moines Register (Eller 2019), the state of Iowa had the highest agricultural debt in the U.S. in 2018, totaling \$18.5 billion. The article reports that because of the challenges farmers face, in some cases, they are selling off small parcels of land to generate the means necessary to continue operating.

Loss of topsoil is the result of soil erosion, which can be accelerated by various land use choices and changing climactic conditions (e.g., increased wind speeds, increased precipitation). Soil organic matter can also be lost to erosion and through soil disturbance. According to estimates from the Daily Erosion Project (DEP) conducted by ISU, soil detachment in the North Raccoon River Watershed is as high as 6.3 and as low as 0.7 tons/acre/year (see NRR-Watershed Assessment for more information).

While soil health has always been a priority for farmers, the advent of chemical fertilizers and pesticides has led to a reduced focus on developing long-term soil health in favor of chemical amendments. In recent years there has been growing interest in reversing this trend; however, there are many factors that limit farmers' ability to implement practices that offer long-term benefits. For example, as soon as new pesticides are developed, pests begin to evolve resistance to those pesticides, which in turn forces farmers to intensify their pest management practices. These activities not only harm pests, but also the microorganisms necessary to help plants fight against them. Because of this, long-term soil health has been moved to the back burner, resulting in a landscape more vulnerable to pest problems and more dependent on novel chemical inputs. This ultimately makes farmers dependent on the use of pesticides. According to an article published by the EPA (Atwood and Paisley-Jones 2017), agricultural pesticide expenditures in the U.S. grew from \$6.6B to \$9.0B between 2005 and 2012, and from 4.2% to 5% of total farm expenditures between 2007 and 2012. ***In Iowa alone, spending on pesticides increased from \$720M in 2010 to 1.12B in 2017, an increase of over 50% in***

7 years. Practices such as Integrated Pest Management provide opportunities to improve agro-ecosystems, reduce chemical inputs and decrease farm expenses, but these systems are complex and require a great deal of expertise and experience to implement effectively.

Overall, agricultural practices in farming are generally focused on the capacity of the land, paired with technology advances, to produce the largest yield possible. ***However, because of the economics surrounding agriculture, profits are not entirely correlated with yield.*** Shifting the focus from production to profit is a challenging endeavor but it may be a necessary step to address the economic challenges facing farming communities in the watershed.

Farmers face difficult decisions every year, balancing short-term profitability and production capacity with long-term sustainability and risk management. Decisions that maximize yield in one year may decrease future productivity though soil loss or damage, but may be perceived as necessary to maintain the viability of the farm in the short term. In an era of changing consumer preferences, increasing international competition and accelerating consolidation in the agriculture industry, farms are going out of business at a record pace (WPR 2018) so concerns about competitiveness are not unfounded.

According to a recent publication (Lane et al. 2019), farmers consider themselves "risk reducers," and many of their decisions are geared toward reducing their exposure to risk. The risks farmers face, however, are varied and not all intersect well with conservation goals. Regulatory, market and labor risks are all highly salient to modern farmers. Moreover, known problems will be weighted highly against unknowns—for instance, transitioning a cow barn to LED lighting from fluorescents may offer an attractive return on investment on paper, but farmers express concern that if the cows' production is reduced even slightly, that large financial investment may never pay back.

Conservation efforts must therefore be undertaken with an eye toward establishing economic and risk management co-benefits for farmers. This can happen through selecting conservation practices that come with an inherent risk-reduction co-benefit (e.g., cover-cropping), or by bundling an unrelated risk reduction with a conservation practice through programs like the USDA's Conservation Reserve Program.

If year-on-year risk can be mitigated, farmers will be more open to practices that provide longer-term risk reduction. Framing conservation practices as risk management strategies will provide opportunities for improved environmental management in a manner that intersects with farmers' existing decision-making processes.

Increasing profits without increasing production requires either an increase in the value of goods sold, or a decrease in production expenses. Most farmers are at the mercy of international market forces when it comes to the value of their products, so reducing expenses (fertilizer, pesticides, energy) is one of the key ways farmers can increase their profitability. A recent study looking at the economic incentives for farmers to reduce fertilizer inputs on their land identified three important factors that actually do the opposite of incentivizing reduced inputs and rather incentivize increased inputs: Crop insurance, the 2014 Farm Bill's Agricultural Risk Coverage (ARC) and Price Loss Coverage (PLC) (Plastina 2019). All three of these programs provide long-term incentives to increase nitrogen fertilizer by providing higher returns for additional bushels in actual production history (APH).

CONSERVATION PRACTICE COSTS

Addressing nonpoint source nutrient pollution in agricultural areas involves considerable effort and cost. In addition to establishing nitrogen and phosphorus load reduction goals, The Iowa NRS (IDALS et al. 2017) included an assessment of the conservation practices that can be used to reduce nutrient loads from agricultural areas. The assessment documented the nitrogen and phosphorus reduction effectiveness of various conservation practices, as well as the range of costs associated with implementing each of the practices. The NRS developed three example scenarios for meeting the state goals of 41% reduction in nitrogen and 29% reduction in phosphorus using a suite of conservation practices. The example scenarios represent three distinct approaches for meeting the nutrient reduction goals statewide. ***Initial investment costs of the three scenarios range from $1.2 billion to $4 billion. Additionally, annual costs, including initial investment and operating cost, range from $77 million per year to $1.2 billion per year.*** It should be noted that the scenario with the lowest annual cost has the highest initial investment cost.

These costs were then scaled to the North Raccoon River Watershed based on acreage of agricultural land and then to divided into its 77 HUC-12 subwatersheds. Costs are shown in Table 12-1.

TABLE 12-1 COSTS OF IMPLEMENTING THE IOWA NUTRIENT REDUCTION STRATEGY (41% N REDUCTION & 29% P REDUCTION)

	STATEWIDE INRS	NORTH RACCOON RIVER WATERSHED	HUC-12 SUBWATERSHED SCALE
Initial Investment	$1.2 B to $4.0 B	$72 M to $237 M	$956K to $3.2 M
Annual Cost	$77 M to $1.2 B	$4.1 M to $71 M	$60K to 950K
20-Year Cost	$5.6 B to $25.5 B	$327 M to $1.5 B	$4.4 M to $14.4 M

AVAILABILITY OF FUNDING

Currently, the NRRWMC operates on a $3.8-million IWA grant from the Department of Housing and Urban Development (HUD). Moneys from this grant are to be used for flood reduction and water quality projects and must be spent by the December 2021. These funds do not extend to the longer-term efforts to achieve watershed goals that are outlined in this plan. Grant funding is a popular option for conservation practices, but many grants only last 2–3 years and the funds available do not amount to the necessary annual spending that will be required to achieve the goals of the NRRWMC. Sustainable funding sources are challenging to come by, and as stated earlier in this chapter, the NRRWMC does not have taxation authority which makes finding a source of funding an even greater challenge. ***In order to fund the implementation actions of this plan, finding sustainable sources of funding that are endorsed by the board is critical, but will require significant time commitments.***

Funding for water quality in Iowa peaked in 2009 at $45 million but has since gone down and recently rose to $43 million last year. ***This level of funding is insufficient for funding practices and programs that meet the water quality needs in Iowa.*** It also indicates a lack of dedication to achieving meaningful progress toward the Iowa NRS goals.

According to data provided by the USDA-NRCS Resource Economic and Analysis Division, between 2004 and 2018 financial commitments from the NRCS for conservation practices in the North Raccoon River Watershed have totaled $1,156,124. This is an annual average of about $82,500 and is, again, insufficient for funding the implementation of this plan.

STAKEHOLDER INPUT ON THE ECONOMIC SETTING

Initial consultation with stakeholders provided a summary of the many concerns, attitudes and expectations that exist within the watershed. Specific concerns from stakeholders regarding the economic setting included the residents' lack of willingness to pay, money does not go to flat ground but instead to rolling topography, banks and loan providers not valuing soil health, competing funding sources and a limited budget. Later in the planning process, stakeholders identified some key areas that need to be addressed surrounding this topic, including:

- **Funding that is fair and equitable across the entire watershed**
- **Using funding strategically, wisely, cost-effectively and in priority areas**
- **Taxpayer money to be directed as recovery money, whether crops or infrastructure**
- **More government and private funding to be incorporated into watershed efforts**

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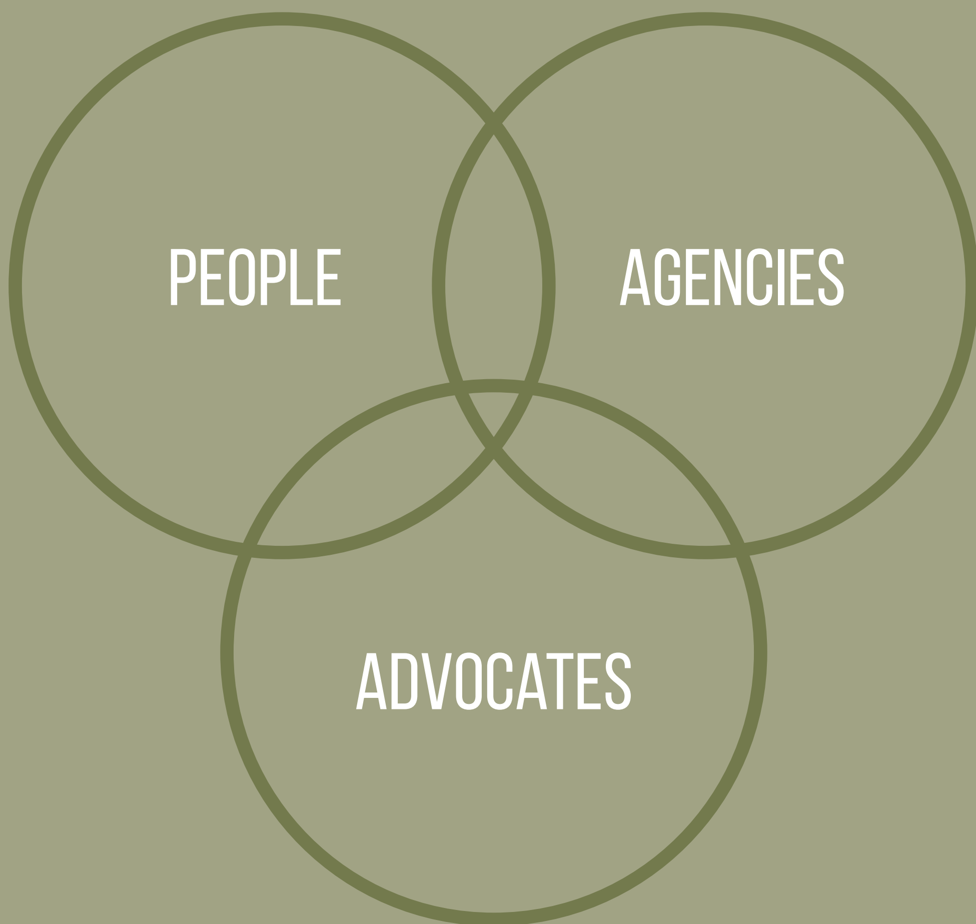
EDUCATION PLAN

Get the message out by connecting these groups:



13

EDUCATION PLAN

An Education and Outreach Plan has been developed for use by the NRRWMC. This chapter summarizes the educational and outreach tools that are included within that plan.

EDUCATION AND OUTREACH

An education and outreach plan for the North Raccoon River Watershed was developed by ISU Extension and Outreach. That plan has been included as Appendix C to this watershed plan. ***This chapter offers a summary of the main points of emphasis of the education and outreach approach.***

SUMMARY OF PLAN CONTENTS

The key objectives of this education plan focus on communication, awareness and the major issues affecting watershed water quality and quantity, and what can be done about each. ***The plan is flexible and should be used as a toolbox that can be added to and utilized readily throughout implementation of the plan.*** This plan will be strengthened through partnerships. ISU Extension and Outreach will be a vital partner, but others are listed as well, and that list should be added to as the coalition grows and strengthens. Statewide partners will be crucial to connect the communities and individuals throughout this large watershed.

The objectives should serve as a guide and the actions will get the process going, but relationship-building should be the guiding force of implementation. A Watershed Coordinator cannot accomplish this in isolation. The very nature of the coalition model is meant to bring people together, find common ground and take steps towards implementation, progress and a brighter future.

Below, you will find Objectives and Actions to guide the Education and Outreach strategy.

Objective 1: Improve awareness of water quality and quantity issues and conservation practices among all North Raccoon River Watershed residents

INCREASE OUTREACH TO AGRICULTURAL STAKEHOLDERS (OPERATORS AND LANDOWNERS)

ACTION 1:

- **Host field days during or after the construction of water quality practices in the watershed. Aim to host at least two field days per calendar year during construction of practices and two field days per calendar year after construction, which can highlight maintenance, benefits (measured results, farmer/landowner observations, etc.) and lessons learned during planning, construction and maintenance of the practices.**
- **Field days can be organized with partner organizations, such as Iowa Learning Farms.**
  https://www.iowalearningfarms.org
  Iowa Learning Farms (ILF) utilizes

strong partners—farmers, non-farmers, urban residents, educators, agencies and conservationists—as spokespersons around the state. These people are opinion leaders and positive role models who practice, understand and promote a renewed commitment to a culture of conservation. ILF has developed a Field Day Toolkit to support one of the most effective means of communicating with farmers (because of their preference to learn about new land management practices through on-on-one conversations with experts and other farmers).

ACTION 2:

- **The WMA should strive to develop a consistent, recognizable brand in order to create awareness of the entity and eventually credibility for delivering information within the watershed.**
- **A campaign to increase awareness of both water quality issues within the watershed and conservation practices to help mitigate the issues should be delivered over an extended period. It should be delivered through various media, such as direct mail, local newspapers, radio stations and social media. Field days will also be a part of this ongoing campaign.**
- **The theme of strong communication echoes throughout this report and will need to infuse the work of the NRRWC. Getting to know folks in this large watershed will help determine preferred and effective methods of communication.**
- **Likely, a mix of different media will be required to reach different audiences. Continued communication and keeping people engaged will be the challenge.**

INCREASE OUTREACH TO NON-AGRICULTURAL WATERSHED RESIDENTS

ACTION 3:

- **Host events that allow watershed residents who are not involved in agriculture the opportunity to learn about the agricultural and urban conservation practices that have been or are being implemented in the watershed.**
- **Farm tours, field days and urban practice-focused tours can be held to increase awareness of the practices in the watershed and what urban homeowners and residents can do on their own properties to contribute to the mitigation of water quality issues.**

ACTION 4:

- **Increase awareness by targeting youth outreach.**
- **Invite Water Rocks! to classrooms within the watershed—target a different school district in the watershed each semester throughout a three-year timeframe. The WMA can sponsor events such as a Water Rocks! assembly within the watershed, or can work with a local school to request a free Water Rocks! classroom visit or Conservation Station visit to a local event.** *www.waterrocks.org*
- **Youth environmental education is crucial to long-term, sustainable plans that require behavior changes. Young minds are more likely than older community members to adopt new habits and accept new ways of thinking. Engaging and robust environmental education can expose kids and families to natural resources and food systems and pave the way for future environmental stewardship.**

Objective 2: Focus nutrient and drainage management strategies outreach and education efforts on operators and landowners

EMBRACE A "NEW KIND OF CONSERVATION OUTREACH" THAT IS CUSTOMIZED TO LANDOWNERS AND OPERATORS

ACTION 1:

The marketing plan mentioned above (Objective 1) is a key part of this because it will initiate a public awareness campaign. Campaigns related to conservation practice adoption must be designed "to bring the audience from a level of awareness, through interest, desire and finally to action (practice implementation)."

ACTION 2:

Develop specific and unique campaigns that can be delivered to the farm operators and absentee landowners. Due to the growing number of absentee landowners in the watershed, it is essential to the success of water quality projects that they become aware of water quality in the watershed and understand their role in supporting their operator to improve nutrient and drainage management.

ACTION 3:

Develop a communication strategy to educate landowners about the possibility of including conservation practices in their lease agreements.

- **This would need to first ensure that landowners understand conservation practices—from terminology (absentee landowners may not have an agricultural background) to implementation costs and long- and short-term benefits.**
- **Then, specific information about how to include conservation practices in lease agreements can be shared. This is an opportunity to partner with local NRCS staff or the Drake University Agricultural Law Center, who may be familiar with these conservation addendums and will be able to provide information about what a landlord and tenant may want to include. The Drake University Agricultural Law Center has a host of additional resources including legal guides, a video library, presentations and decision-making tools, all available to the public.** *www.aglawcenter.wp.drake.edu*

Appendix C includes an in-depth description of suggested implementation methods, media kits and additional resources. The Coordinator should have a thorough understanding of the full strategy in order to recruit the necessary partners to fulfill the goals for implementation.

The following are specific education and outreach activities to be implemented by the NRRWMC.

COMMUNICATION PLANNING, PRODUCTS AND CAMPAIGNS

- ✓ **Develop and implement a communications plan using all forms of media**
- ✓ **Develop specific and unique campaigns that can be delivered to the farm operators and absentee landowners**
- ✓ **Develop a communication strategy to educate landowners about the possibility of including conservation practices in their lease agreements**
- ✓ **Promote the goal of ground cover 12 months a year and the "Don't Farm Naked" informational campaign in collaboration with Practical Farmers of Iowa**
- ✓ **Promote the benefits of cover crops as forage/grazing of animals to incentivize adoption**
- ✓ **Distribute educational information on the economic viability and secondary benefits of cover crops**
- ✓ **Distribute No-till November branding materials to local farmers using outreach resources described in Appendix C**
- ✓ **Make subwatershed-scale maps that show priority fields for no-till/reduced tillage practices available at outlets described in Appendix C**

OUTREACH EVENTS

- ✓ **Host field days for farmers that feature agricultural water quality improvement practices implemented in the watershed**
- ✓ **Host events that allow watershed residents who are not involved in agriculture the opportunity to learn about the agricultural and urban conservation practices that have been or are being implemented in the watershed**
- ✓ **Utilize the Water Rocks! program to increase awareness among youth in the watershed**

RECOGNITION AND MENTORSHIP PROGRAMS

- ✓ **Develop a Conservation Certification Program that would recognize farmers who meet an established conservation performance standard**
- ✓ **Recognize farmers for their conservation efforts through establishment of a Conservation Champion Award**
- ✓ **Develop a Farmer Mentorship Program to incentivize dissemination of information related to implementation of conservation practices**

IN-FIELD NUTRIENT AND SOIL MANAGEMENT

- ✓ **Promote and encourage practices that improve soil health; use soil health outreach as a pilot project**
- ✓ **Promote and encourage the 4Rs of Nutrient Management using 4R Plus Educational Materials in collaboration with the 4R Plus program**
- ✓ **Work with local agronomic advisors, co-ops and other resources identified in the Education Outreach Resources Appendix to distribute information on the need to determine the nitrogen content of manure that is applied to fields in order to avoid the potential for over-application when commercial fertilizer is applied**
- ✓ **Work with local agronomic advisors, co-ops and other resources identified in Education Outreach Resources Appendix to distribute information on the benefits of using nutrient management Nitrification Inhibitors**

EDGE-OF-FIELD PRACTICES (USING THE EDUCATIONAL MATERIALS DEVELOPED BY IOWA STATE UNIVERSITY EXTENSION AND OUTREACH FOUND IN APPENDIX C)

- ✓ **Promote and encourage the installation of contour buffer strips, terraces and grassed waterways**
- ✓ **Promote the benefits of identifying bioreactors and drainage water management practices**
- ✓ **Promote and encourage the protection and restoration of riparian buffer areas along watershed streams**
- ✓ **Promote and encourage the installation of saturated buffer areas along watershed streams**

URBAN WATER MANAGEMENT

- ✓ **Promote and encourage adoption of residential and municipal management practices in developed areas throughout the watershed using resources developed by the Iowa Stormwater Education Program**

MEASURES AND MILESTONES

How can success be achieved?

Urban Policy Adoption

Number of Practices

Water Quality Monitoring

Flow Monitoring Stations

(including real-time data collection)

14

MEASURES AND MILESTONES

This chapter details how progress toward watershed goals related to the following items can be measured

- Organizational leadership
- Flooding
- Water quality
- Recreation

It is intended to provide a checklist for measuring progress, which can be used to prepare annual progress updates to members, partners and stakeholders.

ORGANIZATIONAL LEADERSHIP

Chapter 10 reviews ways that the NRRWMC should organize itself to become stronger and support the efforts of members, partners and other stakeholders in implementing this plan. This will need to continue over a long period of time. For this reason, this section lists specific milestones that can help ensure the NRRWMC remains organized and effective in its leadership in collaborations to achieve the goals and objectives of this plan.

LIFTOFF

This introductory period would run through the first full calendar year after this plan has been approved by the NRRWMC Board. These tasks will help the initial transition of efforts from planning into implementation.

Before the end of 2021, the following actions should be completed by the NRRWMC:

Organization

Organization items are related to plan adoption and the organization of the NRRWMC and its supporting staff.

1. Members jurisdictions should ***adopt the watershed management plan*** (no later than one year after approval by NRRWMC Board).
2. The NRRWMC Board should ***find or establish sustainable funding sources*** to continue staffing of the Watershed Coordinator position.
3. The NRRWMC Board should begin to ***invite "Member Highlight" presentations*** at each quarterly NRRWMC Board meeting to discuss success stories, share lessons learned or discuss barriers that need to be overcome.
4. The Watershed Coordinator should ***loop back to existing subwatershed improvement efforts***, coordinating with local watershed partners to amend existing plans and implementation efforts as needed to work in parallel with the efforts described within this plan.
5. The Watershed Coordinator should ***begin working with partner organizations*** (Iowa Flood Center, ACWA, etc.) ***to establish the recommended monitoring network*** described in the monitoring plan (including additional monitoring stations, equipment and analysis). Refer to Chapter 15.
6. Work with members and partners to confirm existing practice adoption rates for flooding and water quality practices, which will be used as a baseline to evaluate future improvements. ***Complete these evaluations for the six priority subwatersheds.***

Outreach

Outreach items are related to education and outreach efforts, as generally described in Chapter 13.

1. ***Conduct a field day or watershed tour*** of past projects or those constructed through the IWA/HUD Grant. This could be organized by the NRRWMC itself or a member or partner organization.
2. The Watershed Coordinator should work with the NRRWMC Board to ***develop a framework to support implementation of the Education and Outreach Plan.***
3. ***At least quarterly***, the Board or Coordinator should ***provide updates of key activities*** through emails, newsletters and social media posts.

Community Support

Community support includes activities through which the NRRWMC Board or Watershed Coordinator can offer guidance or assistance to member jurisdictions to improve adoption of suggested approaches.

1. ***Connect cities with assistance, as needed, to perform the CRS Community Self-Assessment*** and increase their ranking in the Community Rating System.
2. The Watershed Coordinator should work with members and partners to ***develop a list of mentors from larger communities*** within the watershed who are willing to answer questions from review staff from counties or smaller communities related to zoning enforcement, development review and stormwater management. Create a list of consultants who can be contacted to provide additional technical or review assistance.
3. The NRRWMC Board should ***coordinate with member jurisdictions that have been identified as needing local stormwater management planning*** to address flooding issues, including those activities identified in local Hazard Mitigation Plans (see Appendix F). Work to find funding sources to support completion of such a plan.
4. The NRRWMC Board should ***distribute a policy and ordinance survey*** which would evaluate all local jurisdictions' adoption of ordinances and polices as described within this plan, completion of any community- or large-scale stormwater studies (describe scope and date) and evaluate local participation in the NFIP.

Advocacy

Advocacy items are activities through which members and partners can collaborate with other stakeholders to promote policies or changes that are beyond the control of member jurisdictions.

1. Members and partners should work with the WMAs of Iowa and other partner organizations to ***advocate for sustainable funding streams to fund projects***. This may include legislation at the state level, particularly for increased funding for grant programs like CREP, REAP, SRF, WQI, etc.
2. Members and partners should encourage location of conservation practices, creation of buffers and restoration of natural landscapes on lands located within the 2-year floodplain. Such efforts should be prioritized to focus on the most frequently flooded or least profitable lands first.

GROW

Before the end of 2025, the following actions should be completed by the NRRWMC:

Organization

Organization items here are related to sustaining the organization of the NRRWMC and its supporting staff and making progress on more detailed planning studies.

1. The NRRWMC Board should ***develop a sustainable funding strategy for general operations*** described in Chapter 10.
2. The NRRWMC Board should work with partner organizations to ***begin implementation of the monitoring network***. Refer to Chapter 15 for more information.
3. Work with members and partners to confirm existing practice adoption rates for flooding and water quality practices, which will be used as a baseline to evaluate future improvements. ***Complete these evaluations for all HUC-12 subwatersheds.***
4. The Watershed Coordinator should take action to work with partners or consultants to ***develop HUC-12 Subwatershed Management Plans for priority subwatersheds*** without plans, as described in Table 14-1. Refer to Chapter 6 for additional information.
5. Complete more robust evaluations of plan and make amendments as necessary in 2025.

TABLE 14-1 SUBWATERSHED PLAN DEVELOPMENT SCHEDULE

SUBWATERSHED	HUC-12 PLAN COMPLETION DATE
Headwaters North Raccoon River	2022
Headwaters Little Cedar Creek	2022
Lateral 2	2022

Outreach

Outreach items here are related to short-term education and outreach efforts, as generally described in Chapter 13.

1. ***At least once annually, conduct a field day or watershed tour*** of implementation projects led by the NRRWMC or a member or partner organization.
2. The Watershed Coordinator should guide implementation of the Education and Outreach Plan (Chapter 13, Appendix C). ***Develop and implement a communications plan*** using all forms of media (see the Education Resources Appendix).
3. The NRRWMC Board should create recognition and mentorship programs.

   i. ***Develop a Conservation Certification Program*** that would recognize landowners and producers that meet an established conservation performance standard.

   ii. ***Use the Conservation Certification Program*** to develop a network of landowners and producers that can mentor others to accelerate acceptance and adoption of conservation practices.

   iii. ***Create a Conservation Champion Award*** presented at the NRRWMC annual meeting to recognize a landowner, producer, member or partner whose actions best exemplify the goals of this plan.

Community Support

Community support are activities through which the NRRWMC Board or Watershed Coordinator can offer guidance or assistance to member jurisdictions to improve adoption of suggested approaches.

1. The Watershed Coordinator should work with individual communities or counties to approve ordinance changes related to floodplain/ stream buffer protection and/or stormwater management as described within Chapter 9 of this plan. ***Foster adoption of ordinances in at least four jurisdictions within this time period.***
2. The Watershed Coordinator should continue to support enforcement efforts within counties and smaller communities through mentorship or consultant support.
3. The NRRWMC Board should ***coordinate with at least two of the member jurisdictions identified as needing local stormwater management plans.***
4. The NRRWMC Board should work with member jurisdictions that do not currently participate in the NFIP. ***Enroll 50% of those that currently do not participate in the NFIP***. Refer to Chapter 11 for more information.
5. The NRRWMC Board should lead member jurisdictions toward wider participation in the NFIP CRS. ***Achieve 10% participation in the CRS by member jurisdictions.*** Refer to Chapter 11 for more information.

Advocacy

Advocacy items are activities through which members and partners can collaborate with other stakeholders to promote policies or changes that are beyond the control of member jurisdictions.

1. Members and partners should work with the WMAs of Iowa and other partner organizations to advocate for sustainable funding streams that can be used to fund projects. This may include legislation at the state level particularly for increased funding for grant programs like CREP, REAP, SRF, WQI, etc.
2. Advocate for crop insurance reforms that offer adequate protection but do not encourage planting row crops within areas expected to have a 20% annual chance of being impacted by flooding.

SUSTAIN

Through the end of 2040, the following actions should continue:

Organization

Organization items here are related to sustaining the organization of the NRRWMC and its supporting staff, and making progress on more detailed planning studies.

1. The NRRWMC Board should ***maintain a sustainable funding strategy for general operations*** described in Chapter 10.
2. The NRRWMC Board should work with partner organizations to ***fully develop the monitoring program*** (see Chapter 15).
3. The Watershed Coordinator should take action to work with partners or consultants to ***develop HUC-12 Subwatershed Management Plans for other priority and urgent subwatersheds*** without plans. Refer to Chapter 6.
4. Complete more robust evaluations of this plan and make amendments as necessary in 2025.
5. Complete a comprehensive plan update in 2030 and 2040.

Outreach

Outreach items here are related to longer-term education and outreach efforts, as generally described in Chapter 13.

1. ***Continue annual field days or watershed tours*** of implementation projects led by the NRRWMC or a member or partner organization.
2. The Watershed Coordinator should ***continue to guide implementation of the Education and Outreach Plan*** (Chapter 13, Appendix C).
3. ***Adapt and update outreach approaches*** to reflect changes in technology and new ways to share information.

Community Support

Community support are activities through which the NRRWMC Board or Watershed Coordinator can offer guidance or assistance to member jurisdictions to improve adoption of suggested approaches.

1. The Watershed Coordinator should work with individual communities or counties to ***approve ordinance changes*** related to floodplain/ stream buffer protection and/or stormwater management as described within Chapter 9 of this plan ***in at least 75% of member jurisdictions***.
2. The NRRWMC Board should ***coordinate with at least 75% of the member jurisdictions identified as needing local stormwater management plans to complete such plans***.
3. The Watershed Coordinator should continue to support enforcement efforts within counties and smaller communities through mentorship or consultant support.
4. The NRRWMC Board should coordinate with the remaining member jurisdictions identified as needing local stormwater management plans.
5. The NRRWMC Board should work with member jurisdictions that do not currently participate in the NFIP. ***Enroll 100% of those that currently do not participate in the NFIP.*** Refer to Chapter 11 for more information.
6. The NRRWMC Board should lead member jurisdictions toward wider participation in the CRS. ***Achieve 75% participation in the CRS by member jurisdictions.*** Refer to Chapter 11 for more information.

Advocacy

Advocacy items are activities through which members and partners can collaborate with other stakeholders to promote policies or changes that are beyond the control of member jurisdictions.

1. Members and partners should seek to sustain federal and state funding for programs that can aid in implementation of conservation practices, infrastructure and hazard mitigation.

FLOODING

Part 2 of this plan outlines the practices and policies that should be implemented to increase flood resiliency. The NRRWMC should track implementation toward the goals and objectives of this plan in the following ways:

MEASURES AND MILESTONES

- **Track the percentage of the row crop agriculture at risk to be inundated by a 20% annual recurrence chance flood, which is converted to natural vegetation or used for conservation practices**
  - By 2025, convert 1% of all such land (approximately 260 acres or 0.40 square miles)
  - By 2030, convert 10% of all such land (approximately 2,600 acres or 4 square miles)
  - By 2040, convert 50% of all such land (approximately 13,000 acres or 20 square miles)
- **Track the quantity of new storage practices created**
  - By 2025, create five new storage practices
  - By 2030, create 25 new storage practices
  - By 2040, create 100 new storage practices
- **Track adoption rates of conservation practices that improve soil health**
  - By 2025, achieve target adoption rates for soil health practices in Priority Subwatersheds with existing subwatershed management plans
  - By 2028, achieve target adoption rates for soil health practices in Priority Subwatersheds without subwatershed management plans currently in place
- **Track quantity of pothole depression wetlands restored**
  - By 2025, restore one pothole depression wetland
  - By 2030, restore five pothole depression wetlands
  - By 2040, restore 20 pothole depression wetlands

The milestones for completing implementation activities to address flooding are summarized in Table 14-2.

TABLE 14-2 FLOODING MILESTONES

YEAR	MILESTONE
2021	Database for tracking construction of storage features is developed
2022	Complete a Distributed Storage Analysis for the Headwaters Cedar Creek and Outlet Creek subwatersheds
2025	Complete a Distributed Storage Analysis for the Headwaters North Raccoon River, Headwaters Little Cedar Creek and Lateral 2 subwatersheds
2025	Complete a Wetland Restoration Study in the subwatersheds identified as having high restoration potential
2025	Cost-share program for floodplain restoration in high-priority reaches is completed
2030	Complete Floodplain Storage Feasibility Study for priority subwatersheds
2032	Feasibility study to identify floodplain restoration opportunities is funded
2033	Complete Feasibility Study to identify floodplain restoration opportunities
2035	Complete Floodplain Storage Feasibility Study for all subwatersheds

WATER QUALITY

Part 2 of this plan outlines the practices and policies that should be implemented to improve water quality. The NRRWMC should track implementation toward the goals and objectives of this plan in the following ways:

MEASURES AND MILESTONES

- **Track projects implemented and identify percentage of conservation practices implemented. Detailed conservation practice adoption rate targets, by year, for each of the priority subwatersheds can be found in Appendix D. The process to be used in measuring progress toward achieving these annual adoption rate targets includes:**
  - Refer to initial adoption rate baselines by subwatershed
  - Annually, complete a report card for each priority subwatershed using water quality BMP analysis tools provided to the NRRWMC.
- **Track pollutant reductions from conservation practices using water quality BMP analysis tools and water quality monitoring data.**
  - Refer to monitoring program in Chapter 15 for details on monitoring data and analysis to be used in tracking long-term water quality trends.
  - In absence of enough monitoring data to establish trends, modeling tools may be used
  - Annually, complete a report card for each priority subwatershed using water quality BMP analysis tools provided to the NRRWMC and using information provided in Appendix D.

The milestones for completing implementation activities to address water quality are summarized in Table 14-3.

TABLE 14-3 WATER QUALITY MILESTONES	
YEAR	MILESTONE
2020	Begin BMP Implementation for 3 priority HUC12 subwatersheds with already-completed plans
2022	HUC12 subwatershed plans for 3 additional priority HUC12 subwatersheds
2023	Begin BMP Implementation for 3 additional priority HUC12 subwatersheds
2024	Complete analysis of potential oxbow restoration (watershed-wide)
2025	Achieve Target Adoption Rates for Tier One Implementation Activities in initial 3 high-priority HUC12 subwatersheds
2028	Achieve Target Adoption Rates for Tier One Implementation Activities in additional 3 high-priority HUC12 subwatersheds
2030	Evaluation of water quality monitoring results and BMP implementation progress
2040	Evaluation of water quality monitoring results and BMP implementation progress

RECREATION

Part 1 of this plan summarizes the process to identify and prioritize issues to be addressed by the plan. Plan participants identified recreational use of watershed resources as an important issue to be addressed but acknowledged that the NRRWMC role should be focused on improving water quality for recreational use and improving the ecological health of the watershed. Part 2 of this plan outlines the practices and policies that should be implemented to improve recreational opportunities. Some of these include implementation of water quality practices that specifically relate to addressing pathogens, which can have a direct impact on recreational uses. The NRRWMC should track implementation toward the goals and objectives of this plan in the following ways:

MEASURES AND MILESTONES

- **Track water quality measures and milestones as noted in the "Water Quality" section**
- **Track number of pastures where cattle access to streams is restricted**
  - By 2021, identify all points of cattle access to streams in priority subwatersheds
  - By 2025, identify all points of cattle access to streams in all subwatersheds draining to lakes and streams with bacteria impairments
  - By 2030, identify all points of cattle access to streams in all subwatersheds
  - By 2030, reduce the number of cattle accesses to streams in priority subwatersheds by 20%
  - By 2035, reduce the number of cattle accesses to streams in subwatersheds draining to impaired lakes and streams by 20%
  - By 2035, reduce the number of cattle accesses to streams in priority subwatersheds by 50%
  - By 2040, reduce the number of cattle accesses to streams in all subwatersheds by 20%
  - By 2040, reduce the number of cattle accesses to streams in subwatersheds draining to impaired lakes and streams by 50%
  - By 2040, reduce the number of cattle accesses to streams in priority subwatersheds by 75%
- **Monitor bacteria concentrations in watershed streams collected through the monitoring plan**
- **Track native habitat creation through conservation practice implementation tracking**

- **Track community adoption of:**
  - Illicit discharge elimination programs
    - » *20% of all jurisdictions by 2030*
    - » *50% of all jurisdictions by 2040*
  - Pet waste programs or ordinances
    - » *20% of all jurisdictions by 2030*
    - » *50% of all jurisdictions by 2040*

The milestones associated with completing implementation activities to address recreational use of watershed resources are summarized in Table 14-4.

TABLE 14-4 RECREATION MILESTONES

YEAR	MILESTONE
2030	Evaluation of bacteria concentration from monitoring
2040	Evaluation of bacteria concentration from monitoring

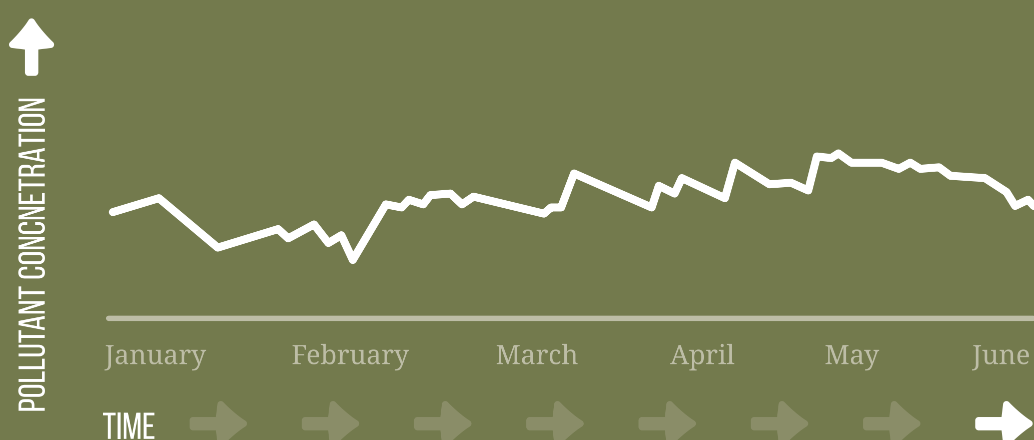
MONITORING

Why is Monitoring the Quality of Water So Important?

- Results help pinpoint changes or trends that appear in water bodies.
- Data can identify where practices should be implemented and once they have, water quality testing can reveal their effectiveness.

Monitoring is a great opportunity to engage with community members and do some citizen science. !

Water Quality Gauge



15

MONITORING

This chapter includes recommendations for a monitoring program to expand sources of data to evaluate flooding and water quality conditions and evaluate trends through various weather conditions over long periods of time.

Monitoring initiatives include:

- Sentinel site monitoring
- Snapshot monitoring
- Flood preparedness monitoring
- Lake monitoring

MONITORING

Stream and lake monitoring provides valuable information to help detect trends over time and support future resource management decisions. These decisions may be based on a comparison of monitored conditions to standards, changes detected from completed restoration and protection measures, or changing climate and land uses. The ability of future monitoring efforts to detect such changes and the reliability of comparisons depends on the nature and design of the recommended monitoring program.

EXISTING MONITORING EFFORTS

Automated Stream Stage and Discharge

Water levels of the North Raccoon River and its tributaries are monitored at automated stations at numerous locations. These stations collect data very frequently (daily, hourly or in some cases every 15 minutes). These sites are funded and maintained by a variety of state and federal organizations including:

- **United States Geological Service (USGS)**
- **National Oceanic & Atmospheric Administration (NOAA)**
- **National Weather Service (NWS)**
- **Iowa DNR**
- **City of Des Moines**
- **Des Moines Water Works**
- **Army Corps of Engineers Rock Island District**
- **Iowa Department of Transportation**
- **Iowa Geological and Water Survey**
- **Iowa Flood Center (IFC)**

Stream stage data collected at some of these locations is uploaded in real-time to publicly available websites including the Iowa Flood Information System
http://ifis.iowafloodcenter.org/ifis/
and the National Water Information System Web Interface
https://waterdata.usgs.gov/nwis/rt
hosted by the USGS.

Real-time Water Quality Sensors

There are currently five real-time water quality sensors deployed in the watershed. Three of the sensors are operated by USGS and are located on the North Raccoon River at Sac City and Jefferson, and on the Raccoon River at Van Meter. Two additional water quality sensors are operated by IIHR—Hydroscience and Engineering on Cedar Creek and Powell Creek above Storm Lake. Data collected by the water quality sensors include the following parameters, depending upon the specific configuration of the station:

- **Nitrate (NO3-N)**
- **Nitrite (NO2-N)**
- **Chlorophyll-A**

- **Dissolved oxygen**
- **pH**
- **Specific conductance**
- **Temperature**
- **Turbidity**

Water quality data is available at these sites at the Iowa Water Quality Information System webstite *http://iwqis.iowawis.org/*.

Water Quality Grab Sample Monitoring Stations

In the North Raccoon River Watershed, stream nitrate monitoring data has been collected annually during the growing season (May through August) since 1999 by ACWA. These grab samples are collected less frequently than automated stations can accomplish (every two weeks or monthly). Additionally, the USGS and Iowa DNR have conducted water quality sampling for nitrates, phosphorus, total suspended solids and *E. coli* at monitoring stations located primarily on the mainstem of the North Raccoon River as well as lakes in the watershed. Polk County Conservation has recently started a grab sample monitoring program for watersheds within the Des Moines metropolitan area, which includes locations along Walnut Creek draining to the Raccoon River.

National Water Quality Initiative (NWQI) Monitoring in the Black Hawk Lake Watershed

The purpose of this NWQI project was to collect, analyze and evaluate water quantity and quality monitoring data in the Black Hawk Lake watershed to compare nutrient and sediment concentrations and loads at subwatersheds with different levels and types of BMPs (Law 2019). The findings of this study can be used by the NRRWMC to evaluate the return on investment in terms of costs for nutrient reductions.

PROPOSED MONITORING STRUCTURE

Future monitoring in the watershed will fully incorporate and augment existing monitoring efforts already in progress. The following paragraphs outline four tiers of watershed monitoring, including description of data collection procedures and type of monitoring equipment to be used. References to existing monitoring efforts are indicated throughout.

Sentinel Site Monitoring

Sentinel sites have been selected within the North Raccoon Watershed to detect trends in streamflow and water quality. These sites are detailed in Figure 15-1 and Table 15-1. In most cases, these sites have been selected because of their history of monitoring. Many have existing USGS stream gages and have had consistent water quality measurements historically. These sites will be useful in detecting long-term trends. Other sites, specifically Sentinel Site 6 Cedar Creek and Sentinel Site 7 Outlet Creek, should be established as stations to be used in evaluating the effectiveness of NRRWMC water quality efforts. These stations are located at the outlet of HUC12 subwatersheds that were selected as priority-implementation subwatersheds.

Monitoring at sentinel sites should consist of automated flow/stage measurements using either year-round USGS or IIHR/IFC stream gages. Stream stage and flow measurements at sentinel sites should be used to detect long-term changes in streamflow and provide a valuable tool for flood preparedness. Stream flow data will also be coupled with water quality measurements to allow for the measurement of pollutant loading.

Sentinel sites will also be equipped with water quality sensors provided by either the USGS or IIHR. Data collected by the water quality sensors include the following parameters, depending on the specific configuration of the station:

- **Nitrate (NO3-N)**
- **Nitrite (NO2-N)**
- **Chlorophyll-A**
- **Dissolved oxygen**
- **pH**
- **Specific conductance**
- **Temperature**
- **Turbidity**

The sensors are typically deployed in the spring and removed from the stream in the fall to prevent damage from ice. Data from the water quality sensors deployed at sentinel sites will be used to detect long-term trends and seasonal variability, provide nitrate drinking water standard exceedance alerts and develop pollutant load calculations.

In addition to the use of water quality sensors, bi-monthly water quality grab sampling will be conducted throughout the growing season at sentinel sites for temporal and spatial trend detection, and for comparison to standards and benchmarks. The additional phosphorus monitoring will also allow for determination of the ratio between total and dissolved forms. The following parameters will be included:

- **Nitrate**
- **Total phosphorus**
- **Dissolved phosphorus**
- **Turbidity or TSS**
- ***E. coli* bacteria**

FIGURE 15-1 SENTINEL MONITORING SITE LOCATIONS

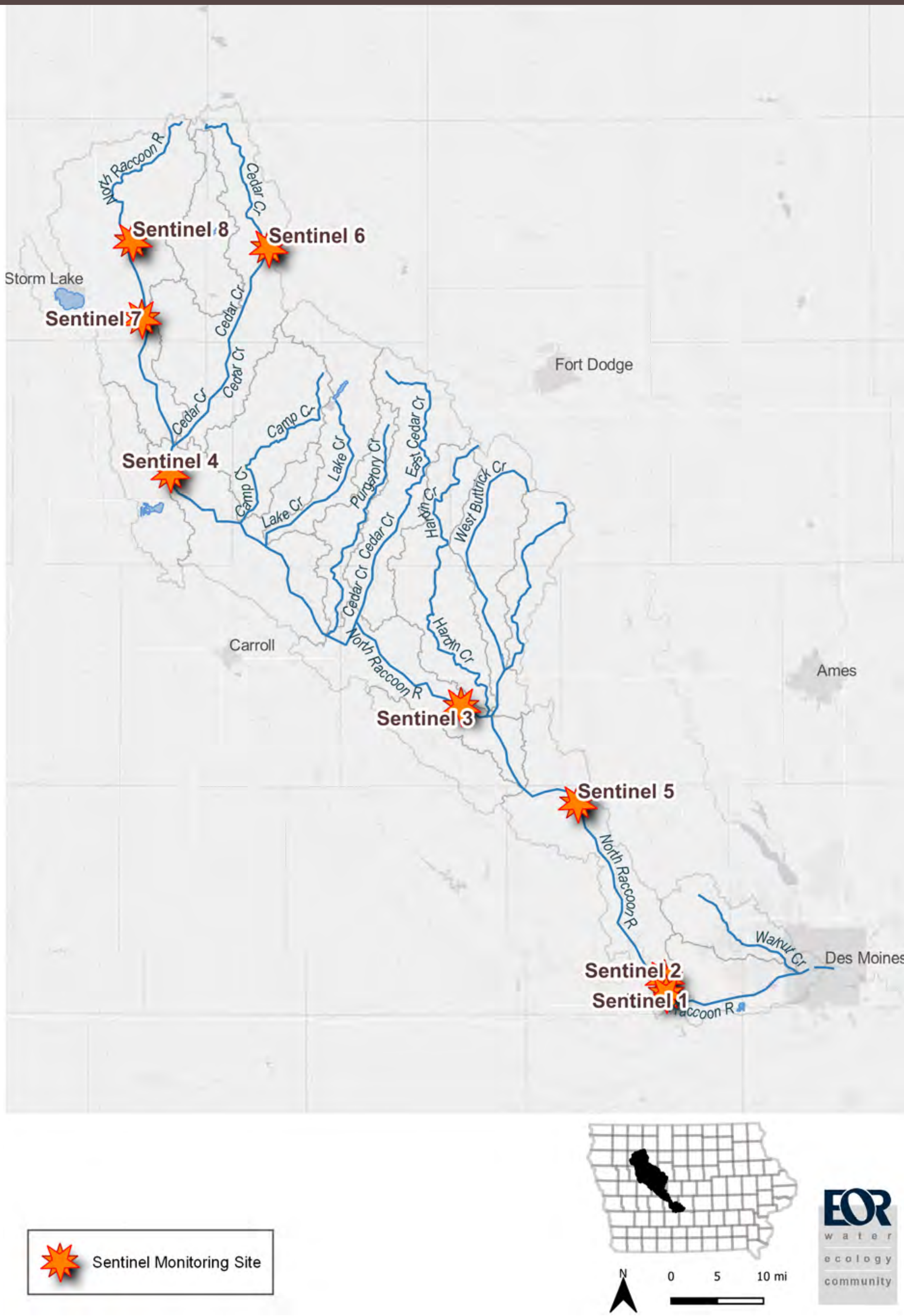


TABLE 15-1 SENTINEL MONITORING SITE LOCATIONS

MONITORING SITE	EXISTING STREAM GAGE	EXISTING WATER QUALITY MONITORING
Sentinel Site 1 Raccoon River: Van Meter Raccoon River at Van Meter long-term monitoring station	USGS Gage	USGS WQ Sensor 05484500 DNR Ambient WQ Station ACWA Snapshot Monitoring Station ID38
Sentinel Site 2 North Raccoon River: Van Meter North Raccoon River - Van Meter above confluence with the South Raccoon River	NA	ACWA Snapshot Monitoring Station ID A
Sentinel Site 3 North Raccoon River: Jefferson North Raccoon River at Jefferson long-term monitoring station	USGS Gage	USGS WQ Sensor 05482500 DNR Ambient WQ Station ACWA Snapshot Monitoring Station ID21
Sentinel Site 4 North Raccoon River: Sac City North Raccoon River below Sac City long-term monitoring station	USGS Gage	USGS WQ Sensor 05482300 DNR Ambient WQ Station
Sentinel Site 5 North Raccoon River: Perry North Raccoon River at Perry (141st St) long-term monitoring station	USGS Gage	ACWA Snapshot Monitoring Station ID45
Sentinel Site 6 Cedar Creek Cedar Creek below WMP Implementation HUC12 Subwatershed: Headwaters Cedar Creek	NA	IIHR WQ Sensor WQS0074
Sentinel Site 7 Outlet Creek Outlet Creek below WMP Implementation HUC12 Subwatershed: Outlet Creek	NA	ACWA Snapshot Monitoring Station ID4
Sentinel Site 8 Lateral 2 Lateral 2 WMP Implementation HUC12 Subwatershed	NA	ACWA Snapshot Monitoring Station ID1

Additional monitoring above those listed in Table 15-1:

- **New IFC Level Gages at:**
  - Sentinel Site 2 North Raccoon River: Van Meter
  - Sentinel Site 6 Cedar Creek
  - Sentinel Site 7 Outlet Creek
  - Sentinel Site 8 Lateral 2
- **New IIHR Water Quality Sensors at:**
  - Sentinel Site 2 North Raccoon River: Van Meter
  - Sentinel Site 5 North Raccoon River: Perry
  - Sentinel Site 7 Outlet Creek
  - Sentinel Site 8 Lateral 2
- **New Water Quality Grab Sampling at:**
  - Sentinel Site 5 North Raccoon River: Perry
  - Sentinel Site 6 Cedar Creek
  - Sentinel Site 7 Outlet Creek
  - Sentinel Site 8 Lateral 2
- **Expanded Water Quality Sampling:**
  - Additional parameters (TP, DP, TSS, and *E. coli*)
  - Additional Sampling Events (bi-monthly through growing season)

Snapshot Water Quality Monitoring

The second tier of monitoring that should be conducted in the watershed is intended to build upon the snapshot monitoring that is currently being conducted by the ACWA (should that continue). Proposed locations are illustrated in Figure 15-2 and Table 15-2. The sampling consists of monthly nitrate measurements from April through August. The snapshot monitoring allows for comparisons among tributaries to the North Raccoon River, identifies potential problem areas and provides a tool for resource management decisions.

Additional monitoring beyond existing efforts and those listed in Table 15-2:

- **New snapshot monitoring station at the outlet of Marrowbone Creek**
- **Stream stage measurement at all 23 existing ACWA water quality snapshot stations (IFC stream level gages to be added as possible)**

FIGURE 15-2 SNAPSHOT MONITORING SITE LOCATIONS

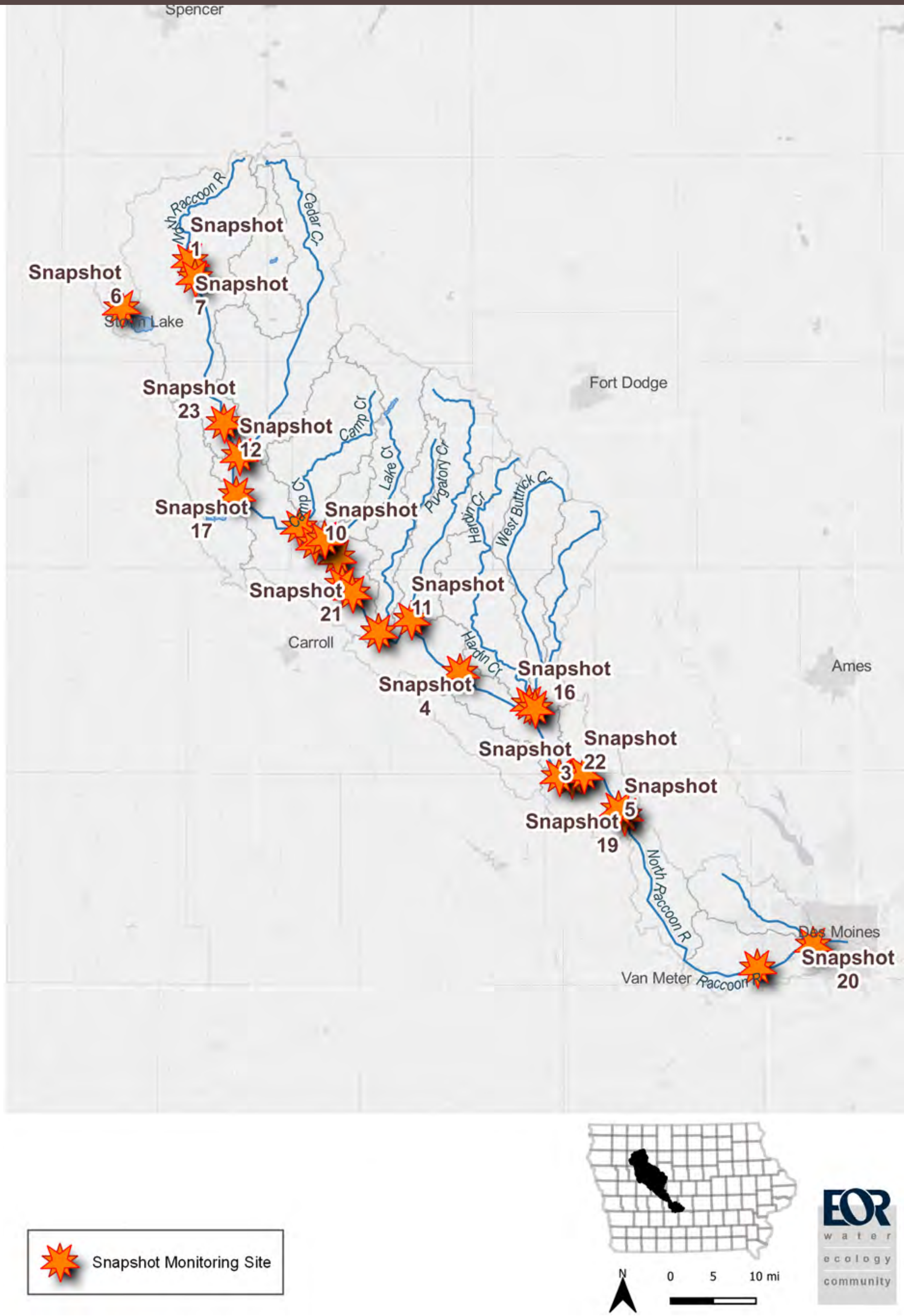


TABLE 15-2 SNAPSHOT MONITORING SITE LOCATIONS

MONITORING SITE	EXISTING STREAM GAGE	EXISTING ACWA SNAPSHOT MONITORING
Snapshot Site 1 North Raccoon River Storm Lake		Station ID 02
Snapshot Site 2 North Raccoon River Lake City		Station ID 13
Snapshot Site 3 North Raccoon River Dawson	IFC Gage	Station ID 100
Snapshot Site 4 North Raccoon River US Hwy 30		Station ID 21A
Snapshot Site 5 North Raccoon River Perry		Station ID 46
Snapshot Site 6 Powell Creek		IIHR WQ Sensor WQS0073
Snapshot Site 7 Poor Farm Creek		Station ID 3
Snapshot Site 8 Prairie Creek		Station ID 11
Snapshot Site 9 Purgatory Creek		Station ID 19
Snapshot Site 10 Lake Creek Lake City	IFC Gage	Station ID 12
Snapshot Site 11 Cedar Creek A		Station ID 17
Snapshot Site 12 Cedar Creek B		Station ID 8
Snapshot Site 13 Camp Creek		Station ID 10
Snapshot Site 14 Buttrick Creek		Station ID 23
Snapshot Site 15 Greenbriar Creek		Station ID 24
Snapshot Site 16 Hardin Creek		Station ID 22
Snapshot Site 17 Indian Creek		Station ID 9
Snapshot Site 18 Sugar Creek		Station ID 39
Snapshot Site 19 Swan Lake Branch		Station ID 60
Snapshot Site 20 Walnut Creek		Station ID 40
Snapshot Site 21 Elk Run		Station ID 14
Snapshot Site 22 Snake Creek		Station ID 48
Snapshot Site 23 North Raccoon River above Sac City	IFC Gage	Station ID 07
Snapshot Site 24 Marrowbone Creek		

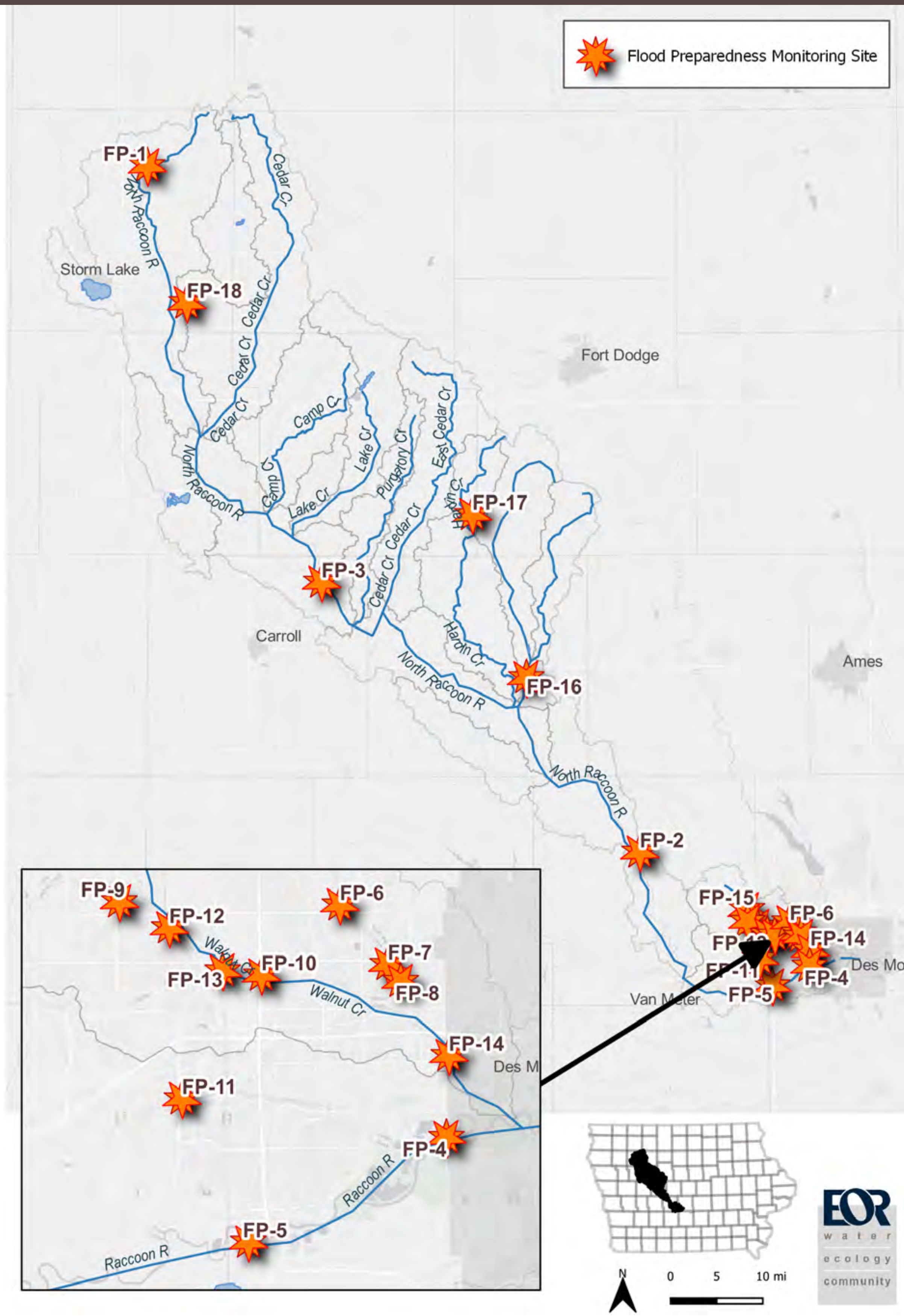
Flood Preparedness Monitoring

Flood preparedness monitoring consists of water quantity (flooding) evaluation sites near communities or other infrastructure (e.g., roads) that currently do not have a flood gage, but which have experienced recent flooding events. Table 15-3 and Figure 15-3 contain proposed stream sensor locations based on input from partners with localized flood experience and knowledge of information gaps, who are actively engaged in their area flood response. The IFC has expressed interest in obtaining this information from local communities to demonstrate the need and show support for expansion of the statewide stream sensor network. If funding becomes available, the IFC may be able to provide financial assistance or assist with the installation of the stream sensors.

TABLE 15-3 FLOOD PREPAREDNESS MONITORING SITE LOCATIONS

MONITORING SITE	EXISTING MONITORING
Flood Preparedness 1 Headwaters North Raccoon Flood Site	
Flood Preparedness 2 North Raccoon River at Minburn	Existing IFC Gage
Flood Preparedness 3 North Raccoon River near Lanesboro, IA	Existing USGS Gage
Flood Preparedness 4 Raccoon River at 63rd Street	Existing USGS Gage
Flood Preparedness 5 Raccoon River West Des Moines	Existing USGS Gage
Flood Preparedness 6 North Walnut Creek at 92nd	Existing IFC Gage
Flood Preparedness 7 North Walnut Creek at Urbandale	Existing IFC Gage
Flood Preparedness 8 North Walnut Creek at Windsor Heights	Existing IFC Gage
Flood Preparedness 9 Little Walnut Creek at Clive	Existing IFC Gage
Flood Preparedness 10 Walnut Creek at I-80/35	Existing IFC Gage
Flood Preparedness 11 Jordan Creek at West Des Moines	Existing IFC Gage
Flood Preparedness 12 Walnut Creek at Urbandale 142nd St	Existing IFC Gage
Flood Preparedness 13 Walnut Creek at Clive	Existing IFC Gage
Flood Preparedness 14 Walnut Creek at Des Moines	Existing USGS Gage
Flood Preparedness 15 Walnut Creek at Waukee 156Th St	Existing NWS Gage
Flood Preparedness 16 Buttrick Creek at Grand Junction	Existing NWS Gage
Flood Preparedness 17 Farnhamville City Flood Site	
Flood Preparedness 18 Newell City Flood Site	

FIGURE 15-3 FLOOD PREPAREDNESS MONITORING SITE LOCATIONS



Additional monitoring above existing efforts and those listed in Table 15-3:

- **New IFC Level Gages at:**
  - Flood Site 1 Headwaters North Raccoon Flood Site
  - Flood Site 17 Farrhamville City Flood Site
  - Flood Site 18 Newell City Flood Site

Lake Monitoring

The following lakes are being monitored as part of Iowa DNR's Ambient Lake Monitoring Program. The lakes are sampled three times per year between May and September—once in early summer, once in mid-summer, and once in late summer/early fall. Data collected by the program includes:

- **Total Phosphorus and Orthophosphorus**
- **Nitrogen – Nitrate + Nitrite as N, Ammonium Nitrogen, and Total Kjeldahl Nitrogen**
- **Suspended Solids – Total, Fixed, and Volatile Solids**
- **Secchi Depth**
- **Chlorophyll a**
- **Phytoplankton and Zooplankton**

It is assumed that this monitoring will continue. No additional lake monitoring will be conducted by the NRRWMC. Lake monitoring sites are illustrated in Figure 15-4.

- **Black Hawk Lake at Lake View, IA 1**
- **Black Hawk Lake at Lake View, IA 2**
- **North Twin Lake**
- **Spring Lake**
- **Storm Lake**

REPORTING

Data collected through monitoring efforts should be publicly available, in real time to the greatest extent possible, using existing web interfaces such as the Iowa Flood Information System.
http://ifis.iowafloodcenter.org/ifis/
Partnerships with the IFC and/or USGS could use existing platforms to host and distribute data.

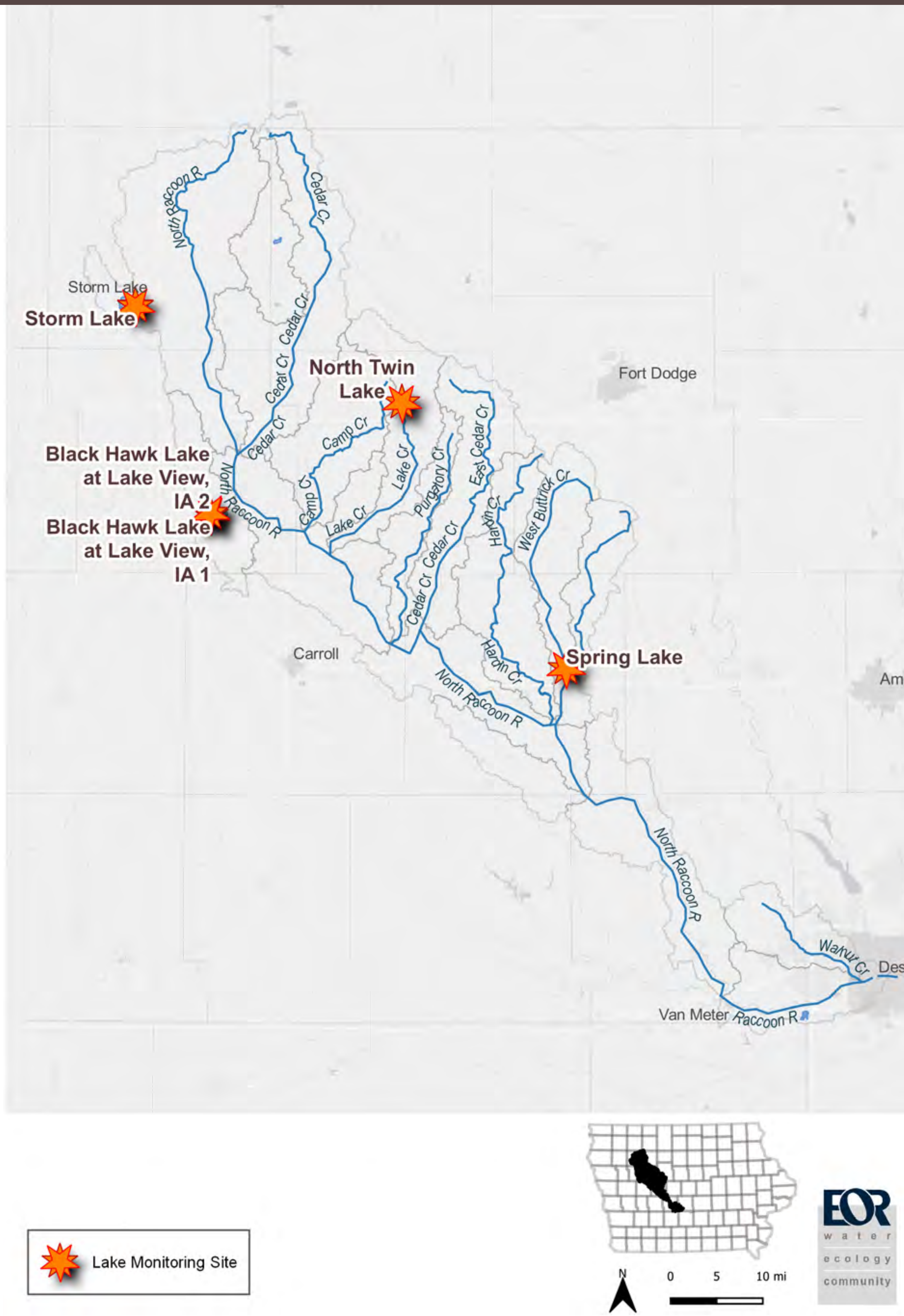
The Watershed Coordinator should prepare summary reports of data collected to evaluate trends over time. It may require many years of data before any trends related to implementation at a subwatershed (HUC-12) or watershed scale (HUC-8) can be observed. Reports should be made at the second quarterly meeting of the NRRWMC Board each year to evaluate the previous calendar year's data. Work with partners to establish the recommended monitoring network described in the monitoring plan (including additional monitoring stations, equipment and analysis).

- **Annual reports should include summaries of water quality and flow data collected. At sites where both water quality and flow data are collected, annual loadings may be projected. The summary should focus on the previous year's data but also highlight a cumulative review of past data collected to evaluate trends.**
- **Every five years (2025, 2030, 2035, etc.) the annual report should include a more robust review of trends from past data collection to evaluate any improvements in water quality at either the subwatershed or watershed scale. The primary focus should be reviewing improvements observed in the priority subwatersheds or other subwatersheds where watershed restoration work becomes more active.**

REFERENCES

Law JY. 2019. National Water Quality Initiative (NWQI) Monitoring in the Black Hawk Lake Watershed. Iowa State University.

FIGURE 15-4 LAKE MONITORING SITE LOCATIONS



RESOURCE REQUIREMENTS

Financial Support

Provided from
- ***Federal, State and Local Government***
- ***Private Resources***

$184 Million over 20 years

To accomplish the goals of this plan

Paid Staff

Implementation to be supported by a watershed coordinator

16

RESOURCE REQUIREMENTS

This chapter includes the public and private financial resources that will be needed to carry out the first 20 years of implementation (2020–2039). In total, it is projected that $184 million (2020 dollars) will be needed to carry out implementation during this period.

This chapter outlines the costs for:

- Operational framework
- Flood planning
- Water quality conservation practices
- Flood and water quality monitoring

Members and partners will have additional costs related to flood repairs and risk-reduction efforts.

OPERATIONAL FRAMEWORK

Parts 2 and 3 of this watershed plan detail the implementation efforts and activities that will be required to achieve the goals and objectives outlined in Chapter 2. Funding will need to come from a variety of sources to execute this plan.

To fully implement projects and conservation practices, ***a long-term, sustainable funding plan is crucial to execute a plan of this size and scope.*** The following recommended Funding Source Categories would ideally each make up a reasonable share of the annual budget (with room for flexibility and adjustment).

GENERAL OPERATIONS

A base level of funding is needed to assist the members of the NRRWMC with daily operations and organization (Table 16-1). This includes ongoing employment of a Watershed Coordinator, who will work directly with the Board and its Executive Committee. The NRRWMC already has such a position, which has been funded by the current HUD grant (which also funded development of this plan). Due to the scale of the watershed, it should not be expected that this one person can drive implementation of the plan. For this reason, the duties of the coordinator should be refocused. The following section describes the role of a watershed coordinator. In the event that a coordinator is not employed, these tasks would need to be conducted by individual NRRWMC members.

Watershed Coordinator Job Description

- **Coordinate with the Executive Committee to set NRRWMC Board meeting dates and agendas**
- **Prepare quarterly and annual updates of plan progress to the Board**
- **Keep the coalition strong and engaged with regular communication and opportunities to come together, share information and visit active practices on the landscape**
- **Coordinate with local partners who are connecting with landowners and producers and encouraging them to implement conservation practices and infrastructure projects (NRCS offices, Farm Service Agencies, Iowa Soybean Association, SWCDs, ISU Extension Services and local non-profit organizations)**
  - Most direct interaction with landowners and producers would originate with these partner organizations
  - The Coordinator should work with these groups to make sure they are following parallel tracks that support the approach included in the plan
  - As needed, the Coordinator could have more direct interactions with landowners and producers to support partner

outreach efforts

- **Identify potential funding sources**
  - Keep an updated list of potential funding sources (federal, state and local) to share with members and partners
  - As applicable, assist members or partners with applications for grants, cost-share programs, etc.
- **Oversee implementation of the Education and Outreach Plan (Chapter 13, Appendix C)**
  - Assist with assembly and distribution of educational materials
  - Activate local partners to help with education and outreach throughout the watershed; environmental education can be supported by ISU Extension, county conservation boards, Parks and Rec departments and science teachers

Beyond salaries and benefits, there may be other costs associated with the Coordinator position that should be budgeted for, such as travel and fees to attend conferences. Ideally the Coordinator could work from an existing county or agency office (such as a local NRCS office); however, there could be costs for office space.

Other Needs

Each year, there will be additional organizational costs beyond support for the Coordinator position. Educational materials may need to be printed and distributed. Meeting spaces may need to be reserved. Promotional events may need to be funded. In some cases, consultant services may be needed for planning and design of practices. The NRRWMC could also choose to establish an annual fund. Revenue generated for this fund could be used as match money in grant applications, help jump-start project construction or provide seed money for joint ventures. Considering these factors, ***an annual budget of $300,000 could support the Watershed Coordinator position and some of these other efforts***.

TABLE 16-1 POTENTIAL NRRWMC ANNUAL OPERATING SUPPORT

NEED	ANNUAL COST (2020 DOLLARS)
Watershed Coordinator (salary, benefit, other support)	$150,000
Matching Funds for Grants	$75,000
Consulting Services	$50,000
Support for Education and Outreach	$25,000
Total	***$300,000***

IMPLEMENTATION

Financial resources for implementation of conservation practices, infrastructure projects and other activities will need to come from a variety of sources beyond the NRRWMC organization itself. In some cases, member organizations will fund efforts directly, sometimes supplemented by grants or other funding sources. In other cases, property owners may pay some or all the cost of conservation practices, supported by a variety of assistance programs. Some of the methods and mechanisms for these elements of funding are explained across the rest of this chapter.

FUNDING SOURCE CATEGORIES

To carry out the vision of this plan, funding will need to come from a variety of sources. Successful organizations must value diversified funding strategies in order to stay viable over a long period of time. The NRRWMC may choose to pursue any or all the strategies listed in this chapter or develop additional strategies as new opportunities come into view.

Member Contributions

Member contributions and sponsorships provide reliable annual budget lines that can be supplemented and enhanced by grants and localized fundraising efforts. The members of the NRRWMC may determine that there are significant benefits to be achieved through the mission of the NRRWMC and agree to provide funding to the organization to support part or all of the general operations noted previously. This kind of financial support would provide the NRRWMC with support to assist them in meeting their own flooding and water quality objectives in a more efficient manner. Downstream areas would have a mechanism for investing in upstream improvements with multiple benefits. Not every member will be able to contribute equally. There are several methods that can be used to determine relative and appropriate contributions among members, as presented in the next section.

Producers and Landowners

Private-property owners or producers will often need to contribute to improvements and conservation practices that need to happen on their own property. This may involve paying the full cost of implementation or providing matching funds for cost-share or grant programs.

Cities and Counties

Infrastructure or improvement projects will be proposed by local jurisdictions. ***These projects will often be fully or partially funded by local Capital Improvement Programs.*** Grants and other cost-share programs may be pursued in some cases to offset at least a share of the costs for such projects.

Grants and Cost-Share Programs

These programs can be from state, federal or private sources and should be pursued to supplement any funding from local landowners and partners. However, ***there is often competition for these limited sources of funding***, so there is no guarantee that these sources will always be obtained when pursued.

Public and Private Partnerships

Private companies or business within the watershed could provide ***sponsorships for local watershed projects***. Signage at project sites would recognize those that contribute to such improvements. Commodity groups can also provide education and outreach to their members as well as leverage their resources in pursuing grant opportunities to fund multiple projects across the watershed.

Foundation or "Friends of the Watershed" Organization

A non-profit 501(c)3 organization could be formed to ***fundraise to support general operations and pursue grant opportunities*** to fund projects being pursued across the watershed.

FUNDING MECHANISMS

Member Contribution

The concept of a funding structure based on contributions from member jurisdictions had limited support during NRRWMC stakeholder meetings. However, this concept is explained here, in case the NRRWMC wishes to revisit this idea at a later date.

A formula can be developed wherein member jurisdictions enter into an agreement to each contribute a set amount of funds on an annual or quarterly basis. This formula could be based on factors such as population or land area within the watershed. ***To limit the annual burden on NRRWMC members, this funding mechanism would most likely be used only to fund the most basic needs of the organization.*** These could include employment of the Watershed Coordinator, education and outreach efforts and potentially a small pot of matching funds for grants.

At least three methods are commonly used for member contribution determination by watershed management organizations:

- **Land area**
- **Population**
- **Property value**

A combination of the above methods can also be used. In a watershed that has a large mix of urban and agricultural areas, such as the NRRWMC, the method chosen can influence which areas are paying a greater proportion. By choosing a mix of methods, it can help reflect the goals and realities of the organization. Using just one method rather than a mix is not recommended in the NRRWMC. For the NRRWMC, a mix is suggested because drivers of flooding and water quality problems originate in both rural and urban areas, and the impacts of those problems are also being experienced in both areas. The emphasis on funding of each method is shown in Table 16-2.

Ease of calculating fees and collection are factors that should be considered when choosing a funding method—there is a reason local governments use certain methods more frequently. Table 16-2 summarizes those factors.

TABLE 16-2 COLLECTION METHOD LOGISTICS CONSIDERATIONS

COLLECTION METHOD	FUNDING EMPHASIS	DATA SOURCE
Land Area	Greater proportion on the ***rural*** areas	GIS (land area of each contributing member within watershed)
Population	Greater proportion on the ***urban*** areas	Census block data (may not match exact watershed boundaries)
Property Value	Mix of urban and rural areas	County assessor data (would need to be collected for properties within watershed boundary)

OUTSIDE FUNDING SOURCES

Below is a list of possible funding sources to help implement parts of this plan. This list is not exhaustive and will need to be updated and verified annually.

Municipal Funding Sources

- **Local Stormwater Utility**
- **Self-Supported Municipal Improvement District**
- **Local Option Sales Tax**
- **Hotel/Motel Tax (recreational opportunities)**

State Sources

- **IDALS Development & Planning Assistance**
- **IDALS Water Quality Initiative Projects**
- **IDALS Water Protection Fund/ Watershed Protection Fund**

- **Enhance Iowa—River Enhancement Community Attraction and Tourism**
- **Community Development Block Grants**
- **All DNR Grants**
- **319 Watershed Planning Grant**
- **319 Watershed Implementation Grant**
- **Land and Water Conservation Fund**
- **City Park & Open Space**
- **County Conservation**
- **Conservation Education Program**
- **Soil & Water Enhancement**
- **Clean Water State Revolving Fund**
- **Clean Water Program**
- **Storm Water Loan Program**
- **Sponsored Projects Program**
- **Research and Demonstration Grant Program**

Federal Funding Sources

- **Environmental Protection Agency (EPA)**
- **Natural Resources Conservation Service (NRCS)**
- **Department of Agriculture**
- **Department of Homeland Security**
- **Federal Emergency Management Agency (FEMA)**

Non-Profits and Private Foundation Funding

- **Ducks Unlimited**
- **Keep Iowa Beautiful—Community Beautification Grants**
- **Pheasants Forever**
- **Trees Forever—Working Watersheds Buffers & Beyond**

- **Community Foundation**
- **Coca-Cola Foundation**
- **McKnight Foundation**
- **Walton Foundation**

Payment for Ecosystems Services/ Conservation Finance

- **Nori Carbon Removal Marketplace**
- **Soil and Water Outcomes Fund**
- **Indigo Ag**
- **Ecosystem Services Market Consortium**

FLOOD MITIGATION

Table 16-3 includes the resources required to begin implementation of flood risk-reduction activities. The costs for implementing specific, yet-to-be determined projects are listed as TBD to indicate that the level of effort in implementing these projects will be determined by the NRRWMC in the future. The NRRWMC will make this determination based on technical recommendations developed at that time, along with financial considerations. Activities that will be accomplished by either the Watershed Coordinator or by members of the NRRWMC are listed as having a nominal (Nom) cost. This HUC-8 planning effort is too broad to include all costs for improvements at specific sites or risk-reduction projects. Individual

TABLE 16-3 PROJECTED TOTAL COSTS FOR FLOOD MITIGATION ACTIVITIES (2020-2039)

PROJECT ID	PROJECT DESCRIPTION	COST	TIMELINE FOR IMPLEMENTATION
Flood 1.0	Implement the flood storage practices (WASCOBs and ponds) sited by the ACPF tools, and soil health practices in the priority subwatersheds within the North Raccoon River Setting identified in Chapter 6 (Overlaps with WQ Implementation)	Refer to water quality implementation activities	Ongoing
Flood 1.1	Develop a database for tracking implementation of storage features	$5,000	2020–2021
Flood 1.2	Conduct distributed storage analyses in the Headwaters Cedar Creek and Outlet Creek subwatersheds to identify additional storage opportunities	$30,000	2020–2021
Flood 1.3	Conduct distributed storage analyses in Headwaters North Raccoon River, Lateral 2, and Headwaters Little Cedar Creek subwatersheds to identify additional storage opportunities	$45,000	2022–2025
Flood 1.4	Implement the distributed storage projects recommended by the outcomes of Flood 1.2, 1.3 and 1.4	TBD	2025–2039
Flood 2.0	Conduct a wetland restoration study in the subwatersheds identified as having high potential, to identify opportunities for pothole depression wetland restoration	$10,000	2022–2025
Flood 2.1	Restore wetlands prioritized in the wetland restoration study for priority subwatersheds identified in Chapter 7	TBD	2025–2039
Flood 3.0	Pursue opportunities across the entire watershed to locate site-appropriate conservation practices or establish buffers within the 2-year floodplain. Prioritize such efforts on least profitable farmlands.	TBD	2025–2039

TABLE 16-3 PROJECTED TOTAL COSTS FOR FLOOD MITIGATION ACTIVITIES (2020-2039)

PROJECT ID	PROJECT DESCRIPTION	COST	TIMELINE FOR IMPLEMENTATION
Flood 3.1	Develop a cost-share program to incentivize practices and restoration efforts within the 2-year floodplain along the high priority stream reaches—Lateral 8, Lateral 4, Lateral 6, Lateral 2 and the North Raccoon River upstream of Buck Run	TBD	2022–2025
Flood 4.0	Conduct a floodplain restoration feasibility study to identify opportunities along Lateral 8, Lateral 4, Lateral 6, Lateral 2 and the North Raccoon River upstream of Buck Run	TBD	2022–2025
Flood 4.1	Implement the recommended floodplain restoration opportunities recommended by the outcomes of Flood 4.0	$25,000	2022–2025
Flood 5.0	Assist cities in performing the Community Rating System community self-assessment and increasing their rankings in the CRS	TBD	2025–2039
Flood 5.1	Assist communities to develop stormwater management plans	Nom	On-going
Flood 5.2	Support coordination among NRRWMC members, including technical assistance in facilitating implementation of projects identified in local Hazard Mitigation Plans	Nom	On-going
Flood 5.3	Develop a system to track the age of floodplain management and/or stormwater management plans for all cities in the watershed	Nom	On-going
Flood 6.0	Conduct a watershed-scale flood damage reduction study	$5,000	2021–2022
Flood 6.1	Conduct watershed-scale floodplain and wetland restoration study	$100,000	2030–2031
Costs listed in this Table are 2020 dollars (without inflation)			

jurisdictions should add identified projects and activities to this plan as an appendix by routinely updating the Watershed Coordinator or the NRRWMC Board of their planned actions.

These may include:

- **Flood damage repairs (spend funds toward reducing future risk)**
- **City/County flood risk-reduction projects**
  - Bridge/culvert improvements
  - Two-stage ditches
  - Flood plain reconnections
- **Property buyouts/acquisitions**

WATER QUALITY

The HUC-12 subwatersheds included within this plan have been divided into Priority, Urgent and Action levels as noted in Chapter 6. Implementation efforts can begin anywhere within the North Raccoon River watershed; however, it is recommended that initial efforts focus on the priority subwatersheds, then build out into areas categorized as urgent, then spreading to the adjacent action subwatersheds.

Water quality improvements will be accomplished using the suite of conservation practices described in Chapters 5 and 7. Further details on these approaches can be found in the Conservation Action Plan for each of the priority subwatersheds, which can be found in Appendix D of this plan. These levels of investment are needed to meet the nitrate and phosphorus reduction goals established in Chapter 2. ***These costs include the total investment by all parties (public and private) beyond the current levels of adoption of conservation practices.*** These projections consider both the costs and savings expected to be created (listed separately for Tier 1 practices), using information from the Iowa NRS as a basis (IDALS et al. 2017). It should be noted that the costs listed in this plan represent only those for addressing non-point source nutrient reductions (chosen as the primary goal of this plan). Reducing levels of sediments and pathogens was chosen as a secondary goal of this plan, but direct costs for addressing those pollutants has not been quantified. Tier 1, 2 and 3 practices are defined in Chapter 5.

GETTING STARTED IN PRIORITY SUBWATERSHEDS

Priority Subwatersheds with Existing Plans

Full implementation of conservation practices will not happen immediately. It will take time for partners to work with producers and landowners to gradually raise adoption rates to target levels. The target rates of adoption are those needed to meet the non-point source nitrate and phosphorus reduction goals. Tables 16-4, 16-5 and 16-6 summarize the projected expenditures for three priority subwatersheds where subwatershed management plans are already in place (***Headwaters Cedar Creek, Outlet Creek, and Wall Lake Inlet;*** refer to Chapter 6 for the location of the priority subwatersheds.)

TABLE 16-4 HEADWATERS CEDAR CREEK SUBWATERSHED IMPLEMENTATION SCHEDULE AND COSTS

TIER	2020	2021	2022	2023	ANNUAL COST AFTER 2023
Tier 1 Conservation Practices	$59,950	$299,750	$599,500	$899,250	$1,199,000
Tier 1 Ramp-Up (% of total)	5%	25%	50%	75%	100%
Tier 2 Conservation Practices	$1,529,000	$1,529,000	$1,529,000	$1,529,000	$1,529,000
Tier 3 Conservation Practices	$80,000	$80,000	$80,000	$80,000	$80,000
Headwaters Cedar Creek Totals	***$1,668,950***	***$1,908,750***	***$2,208,500***	***$2,508,250***	***$2,808,000***

Costs listed in this Table are 2020 dollars (without inflation). Annual costs after 2023 are the average investments expected each year.

TABLE 16-5 OUTLET CREEK SUBWATERSHED IMPLEMENTATION SCHEDULE AND COSTS

TIER	2020	2021	2022	2023	ANNUAL COST AFTER 2023
Tier 1 Conservation Practices	$51,900	$259,500	$519,000	$778,500	$1,038,000
Tier 1 Ramp-Up (% of total)	5%	25%	50%	75%	100%
Tier 2 Conservation Practices	$446,000	$446,000	$446,000	$446,000	$446,000
Tier 3 Conservation Practices	$48,000	$48,000	$48,000	$48,000	$48,000
Outlet Creek Totals	***$545,900***	***$753,500***	***$1,013,000***	***$1,272,500***	***$1,532,000***

Costs listed in this Table are 2020 dollars (without inflation). Annual costs after 2023 are the average investments expected each year.

TABLE 16-6 WALL LAKE INLET SUBWATERSHED IMPLEMENTATION SCHEDULE AND COSTS

TIER	2020	2021	2022	2023	ANNUAL COST AFTER 2023
Tier 1 Conservation Practices	$21,400	$107,000	$214,000	$321,000	$428,000
Tier 1 Ramp-Up (% of total)	5%	25%	50%	75%	100%
Tier 2 Conservation Practices	$359,000	$1,529,000	$1,529,000	$1,529,000	$1,529,000
Tier 3 Conservation Practices	$94,000	$80,000	$80,000	$80,000	$80,000
Wall Lake Inlet Totals	***$474,400***	***$1,716,000***	***$1,823,000***	***$1,930,000***	***$2,037,000***

Costs listed in this Table are 2020 dollars (without inflation). Annual costs after 2023 are the average investments expected each year.

It is projected that implementation of the conservation practices will have to ramp up over the next few years of watershed plan implementation. In this scenario, it is assumed that adoption will gradually increase between 2020 and 2023, reaching target rates of adoption for the first time in 2024. From 2024 and beyond, this level of spending will need to be sustained to continue to meet nutrient removal goals. For Tier 2 and Tier 3 conservation practices, the average annual investment expected over the next 20 years is listed. There may be a higher initial cost to implement these types of practices, with fewer ongoing costs for maintenance. For the purpose of this analysis, life-cycle costs have been calculated for each of these practices. These costs have been converted to uniform level of investment over the forecast period (2020–2039).

Priority Subwatersheds without Existing Plans

Three of the priority subwatersheds identified in Chapter 6 do not yet have subwatershed management plans ***(Headwaters North Raccoon River, Headwaters Little Cedar Creek and Lateral 2)***. It is recommended that subwatershed management plans be developed for each of these subwatersheds in 2022 with significant implementation of conservation practices starting the ramp-up period in 2024.

TABLE 16-7 HEADWATERS NORTH RACCOON RIVER SUBWATERSHED IMPLEMENTATION SCHEDULE AND COSTS								
TIER	2020–2021	2022	2023	2024	2025	2026	2027	ANNUAL COST AFTER 2027
Subwatershed Management Plan	-	$20,000	-	-	-	-	-	-
Tier 1 Conservation Practices	-	-	-	$46,800	$234,000	$468,000	$702,000	$936,000
Tier 1 Ramp-Up (% of total)	-	-	-	5%	25%	50%	75%	100%
Tier 2 Conservation Practices	-	-	-	$1,099,000	$1,099,000	$1,099,000	$1,099,000	$1,099,000
Tier 3 Conservation Practices	-	-	-	$73,000	$73,000	$73,000	$73,000	$73,000
Headwaters North Raccoon River Totals	***-***	***$20,000***	***-***	***$1,218,800***	***$1,406,000***	***$1,640,000***	***$1,874,000***	***$2,108,000***
Costs listed in this Table are 2020 dollars (without inflation). Annual costs after 2027 are the average investments expected each year.								

TABLE 16-8 HEADWATERS LITTLE CEDAR CREEK SUBWATERSHED IMPLEMENTATION SCHEDULE AND COSTS								
TIER	2020–2021	2022	2023	2024	2025	2026	2027	ANNUAL COST AFTER 2027
Subwatershed Management Plan	-	$20,000	-	-	-	-	-	-
Tier 1 Conservation Practices	-	-	-	$32,950	$164,750	$329,500	$494,250	$659,000
Tier 1 Ramp-Up (% of total)	-	-	-	5%	25%	50%	75%	100%
Tier 2 Conservation Practices	-	-	-	$703,000	$703,000	$703,000	$703,000	$703,000
Tier 3 Conservation Practices	-	-	-	$5,000	$5,000	$5,000	$5,000	$5,000
Headwaters Little Cedar Creek Totals	***-***	***$20,000***	***-***	***$740,950***	***$872,750***	***$1,037,500***	***$1,202,250***	***$1,367,000***
Costs listed in this Table are 2020 dollars (without inflation). Annual costs after 2027 are the average investments expected each year.								

TABLE 16-9 LATERAL 2 SUBWATERSHED IMPLEMENTATION SCHEDULE AND COSTS								
TIER	2020–2021	2022	2023	2024	2025	2026	2027	ANNUAL COST AFTER 2027
Subwatershed Management Plan	-	$20,000	-	-	-	-	-	-
Tier 1 Conservation Practices	-	-	-	$38,650	$193,250	$386,500	$579,750	$773,000
Tier 1 Ramp-Up (% of total)	-	-	-	5%	25%	50%	75%	100%
Tier 2 Conservation Practices	-	-	-	$1,051,000	$1,051,000	$1,051,000	$1,051,000	$1,051,000
Tier 3 Conservation Practices	-	-	-	$40,000	$40,000	$40,000	$40,000	$40,000
Lateral 2 Totals	***-***	***$20,000***	***-***	***$1,129,650***	***$1,284,250***	***$1,477,500***	***$1,670,750***	***$1,864,000***
Costs listed in this Table are 2020 dollars (without inflation). Annual costs after 2027 are the average investments expected each year.								

Tables 16-7, Table 16-8 and Table 16-9 summarize the projected expenditures for these three priority subwatersheds.

ONGOING COSTS

After the initial ramp-up period, the average annual level of investment should level off (without consideration of inflation). The ongoing

TABLE 16-10 ANNUAL COSTS FOR THE NUTRIENT WATER QUALITY IMPLEMENTATION IN PRIORITY SUBWATERSHEDS

	HEADWATERS CEDAR CREEK	OUTLET CREEK	WALL LAKE INLET	HEADWATERS NORTH RACCOON RIVER	HEADWATERS LITTLE CEDAR CREEK	LATERAL 2
Annual Investment Tier 1 Practices	$1,199,000	$1,038,000	$428,000	$936,000	$659,000	$773,000
Farmer Savings from Tier 1 Practices	-$669,000	-$714,000	-$353,000	-$539,000	-$392,000	-$460,000
Annual Investment Tier 2 Practices	$1,529,000	$446,000	$359,000	$1,099,000	$703,000	$1,051,000
Annual Investment Tier 3 Practices	$80,000	$48,000	$94,000	$73,000	$5,000	$40,000
Total Annual Investment to meet Water Quality Goals	***$2,808,000***	***$1,532,000***	***$881,000***	***$2,108,000***	***$1,367,000***	***$1,864,000***

Costs listed in this Table are 2020 dollars (without inflation).

TABLE 16-11 ANNUAL COSTS FOR ALL WATER QUALITY IMPLEMENTATION PROJECTS (2020-2039)

YEAR	ANNUAL COST	CUMULATIVE COST
2020	2,688,000	2,688,000
2021	3,221,000	5,909,000
2022	3,948,000	9,857,000
2023	4,554,000	14,411,000
2024	8,310,000	22,721,000
2025	8,783,000	31,504,000
2026	9,375,000	40,879,000
2027	9,967,000	50,846,000
Total	*$10,559,000*	*$177,554,000*

annual implementation costs for the six priority subwatersheds are shown in Table 16-10 and the total annual costs for all water quality implementation activities, by year, is shown in Table 16-11.

WATERSHED-WIDE IMPLEMENTATION COST ESTIMATE

An analysis was performed to determine the total cost to meet the nitrogen and phosphorus reduction targets established in the plan for all subwatersheds within the watershed. The total annual investment needed to meet the nitrogen and phosphorus reduction targets is approximately $124 million/year. Conservation practices that reduce inputs would result in an annual

TABLE 16-12 WATER QUALITY ACTION ITEMS	
PROJECT ID	PROJECT DESCRIPTION
WQ 1.0	Develop Subwatershed Management Plans for Headwaters North Raccoon River, Headwaters Little Cedar Creek and Lateral 2 subwatersheds. Refer to Chapter 8 for description of subwatershed management plans.
WQ 2.0	Implement Tier 1 Conservation Practices in Priority Subwatersheds with existing plans
WQ 2.1	Implement Tier 1 Conservation Practices in Priority Subwatersheds without existing plans
WQ 2.2	Begin Implementation of Tier 1 Conservation Practices in Urgent and Action Subwatersheds (not included in Tables 15-2 to 15-9)
WQ 3.0	Implement Tier 2 Conservation Practices in Priority Subwatersheds with existing plans
WQ 3.1	Implement Tier 2 Conservation Practices in Priority Subwatersheds without existing plans
WQ 4.0	Implement Tier 3 Conservation Practices in Priority Subwatersheds with existing plans
WQ 4.1	Implement Tier 3 Conservation Practices in Priority Subwatersheds without existing plans
WQ 5.0	Develop and implement a traditional cost-share program to provide financial assistance for conservation practice adoption
WQ 5.1	Develop and implement an alternative cost-share program that would incentivize conservation practice adoption by providing funding to top performing farmers
WQ 5.2	Develop and implement alternative cost-share program using a pay-for-performance methodology
WQ 5.3	Develop and implement a cost-share program for farmer recordkeeping (software, time, etc)
WQ 6.0	Conduct a siting analysis for oxbow restoration opportunities

savings for farmers of approximately $42 million/year.

The information previously listed related to Tables 16-4 to 16-11 address the following actions (Table 16-12) from Chapter 7.

TABLE 16-13 PATHOGEN ACTION ITEMS			
PROJECT ID	**PROJECT DESCRIPTION**	**COST**	**SCHEDULE**
Rec 1.0	Develop a GIS mapping and database application to track animal feeding operations and the fields that have been designated for application of manure	$5,000 initial setup. On-going coordinator time	Ongoing
Rec 2.0	Cost-share program to incentivize restricting cattle access to streams by funding fencing, GIS collars and alternative watering systems	TBD	Ongoing
Costs listed in this Table are 2020 dollars (without inflation).			

PATHOGENS

As noted previously, specific practices to address pathogen levels have not been separately quantified by this plan. However, there are some related actions which could require dedicated resources (Table 16-13).

TABLE 16-14 UNIT COSTS FOR INSTALLATION AND ANNUAL MONITORING COSTS			
MONITORING TYPE	MONITORING COMPONENT	INSTALLATION COST	ANNUAL COST
Sentinel	Real-time water quality monitoring station (Nitrate, Turbidity, pH, Temperature, DO, Conductivity)	$33,000	$1,000
	Real-Time Stream Gauge	$5,300	$200
	Water quality samples (Phosphorus, Nitrate, Suspended Solids, *E. coli*) Bi-monthly during growing season	-	$1,750
Snapshot	Grab-Sampling monthly N during growing season	-	$250
Flood Preparedness	Real-Time Stream Gauge	$5,300	$200
Lake	DNR Lake Sampling	**	**
Costs listed in this Table are 2020 dollars (without inflation).	***No additional cost; covered by existing IDNR monitoring program*		

MONITORING

A detailed monitoring program is defined in Chapter 15. Total costs for the various types of monitoring were developed based on the unit costs shown in Table 16-14.

Table 16-15 shows costs associated with the monitoring activities defined in the Monitoring Plan within Chapter 15 which are beyond any current monitoring activities. This plan does not assume that these costs are to be incurred directly by the NRRWMC. ***Watershed partners currently conducting monitoring efforts*** (Iowa Flood Center, Agricultural Clean Water Alliance) may be able to expand existing programs to include these efforts. Coordination with these groups will be the first step toward implementing the monitoring plan and will occur during 2020. If additional funding to conduct the monitoring plan is still needed following discussions with project partners, the NRRWMC will need to investigate alternative public or private funding sources.

The monitoring costs are summarized (Table 16-15) by monitoring site and a description of

TABLE 16-15 MONITORING PROGRAM SCHEDULE AND COSTS							
MONITORING SITE	MONITORING DESCRIPTION	2021	2022	2023	2024	2025	2026–2039
Sentinel Site 1 Raccoon River: Van Meter	Water Quality Sampling All Years	$1,750	$1,750	$1,750	$1,750	$1,750	$1,750/year
Sentinel Site 2 North Raccoon River: Van Meter	Install WQ & Flow Station 2022 Annual WQ Sensor Maintenance & Annual Flow Sensor Maintenance: 2023–2040 Water Quality Sampling All Years	$1,750	$40,050	$2,950	$2,950	$2,950	$2,950/year
Sentinel Site 3 North Raccoon River: Jefferson	Water Quality Sampling All Years	$1,750	$1,750	$1,750	$1,750	$1,750	$1,750/year
Sentinel Site 4 North Raccoon River: Sac City	Water Quality Sampling All Years	$1,750	$1,750	$1,750	$1,750	$1,750	$1,750/year
Sentinel Site 5 North Raccoon River: Perry	Install WQ 2025 Annual WQ Sensor Maintenance 2026–2040 Water Quality Sampling All Years	$1,750	$1,750	$1,750	$1,750	$34,750	$2,750/year
Sentinel Site 6 Cedar Creek	Install Flow Station 2021 Flow Sensor Maintenance 2022–2040 Water Quality Sampling All Years	$7,050	$1,950	$1,950	$1,950	$1,950	$1,950/year
Sentinel Site 7 Outlet Creek	Install WQ & Flow Station 2023 Annual WQ Sensor Maintenance & Annual Flow Sensor Maintenance: 2024–2040 Water Quality Sampling All Years	$1,750	$1,750	$40,050	$2,950	$2,950	$2,950/year
Sentinel Site 8 Lateral 2	Install WQ & Flow Station 2024 Annual WQ Sensor Maintenance & Annual Flow Sensor Maintenance: 2025–2040 Water Quality Sampling All Years	$1,750	$1,750	$1,750	$40,050	$2,950	$2,950/year
Snapshot Site 24 Marrowbone Creek	Grab Sampling All years	$250	$250	$250	$250	$250	$250/year
Flood Preparedness 1 Headwaters North Raccoon Flood Site	Install Flow Sensor 2021 Annual Flow Sensor Maintenance 2022–2040	$5,300	$200	$200	$200	$200	$200/year
Flood Preparedness 17 Farnhamville City Flood Site	Install Flow Sensor 2021 Annual Flow Sensor Maintenance 2022–2040	$5,300	$200	$200	$200	$200	$200/year
Flood Preparedness 18 Newell City Flood Site	Install Flow Sensor 2021 Annual Flow Sensor Maintenance 2022–2040	$5,300	$200	$200	$200	$200	$200/year
	Total Cost	***$35,450***	***$53,350***	***$54,550***	***$55,750***	***$51,650***	***$19,650/year***

the additional monitoring that is needed over what is currently being conducted. In the case of new monitoring equipment installations, the year of installation is indicated by a weighted outline. All new equipment installation is proposed within the first five years (beginning in 2021). The total cost for additional monitoring over the 20-year plan period is approximately $530,000.

OTHER COSTS

EDUCATION AND OUTREACH

Costs for education and outreach implementation activities are included in the operational budget proposed in Table 16-1).

ORGANIZATION, FUNDING AND PARTNERSHIPS

Costs for organization, funding and partnership implementation activities are assumed to be included in the operational budget proposed in Table 16-1. These activities will be the role of the Watershed Coordinator or will involve time and effort by NRRWMC members.

EVALUATIONS : AMENDMENTS

Implemented through 2040, this document will be a living plan.

In addition to providing annual reports to the Executive Committee and Boards, robust adjustments to the plan will be considered on 5- and 10-year cycles.

2025	✓
2030	✓
2035	✓
2040	✓

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EVALUATION AND AMENDMENTS

This chapter summarizes annual processes to evaluate progress and make amendments to this plan. This plan should be considered a "living document," changing direction as needed to include new research and results, applied toward the ultimate project goals.

EVALUATION

This chapter offers recommendations on how the NRRWMC should continue to operate into the future with respect to this plan. ***This plan is intended to be a "living document," which needs to change based on the progress and setbacks encountered during implementation.*** Lessons learned should be applied to change approaches and direction as needed to continue progress toward subwatershed and watershed goals. Progress should be evaluated at least annually, with deeper evaluations after every fifth calendar year.

After each ten-year period, the entire plan should be re-evaluated. As that benchmark approaches, the NRRWMC should decide if significant changes are necessary, which might require pursuing grants or other funding sources to acquire outside assistance with plan updates.

EVALUATION FRAMEWORK

Regular review periods are required to determine whether the watershed conditions are progressing toward the goals along the timeline set forth in the implementation plan. As the monitoring network is established, collected data can be reviewed and assessed to develop a baseline for measurement.

Initial Annual Reports

Starting after year one of implementation (2021), the Watershed Coordinator (or other person designated by the NRRWMC Board) should ***complete a report or scorecard each year*** which evaluates progress on the milestone measurements described in Chapter 14 for the previous calendar year. This should be presented to the Board for discussion at its second quarterly meeting.

The report should:

- **Itemize completed improvements projects related to flooding and water quality. Report project-related information such as cost, maintenance requirements and lessons learned. Collecting and sharing quality photos will help illustrate the information and provide a library for the NRRWMC to use for marketing efforts.**
- **Update adoption rate of conservation practices (at the subwatershed and watershed scale, as applicable and as data is available).**
- **Include a brief summary of that year's monitoring results including average, minimum and maximum pollutant concentrations. When possible, use available flow data to project total annual load of measured pollutants. Compare results to previously collected data.**

Initial plan evaluations should focus primarily on the rate of adoption of conservation practices and implementation of infrastructure projects. Data from research projects and outside studies should be used to adjust implementation approaches and inform design and application.

Annual Reports After Year Five (2025)

Beginning in year five of implementation (2025), the annual report should include a more detailed review of monitoring results to begin to evaluate averages and trends for data collected over longer periods of time. Initially, this will be used to set initial baselines from which target reduction rates would be measured. Because of variability in weather patterns, stream flow rates and other environmental factors, it is expected that water quality data will also be variable. ***Several years of data collection may be required before any decreases in pollutant concentration or loading can be discerned.***

Patterns and trends may first be noticed in smaller watersheds, or if monitoring is being conducted upstream or downstream of a specific practice. In those cases, as conservation practices are employed and associated vegetation becomes better established, improvements in concentration and/or loading may start to become measurable. During this period, monitoring at practices and small watersheds may be most useful in evaluating the effectiveness of different practice types and using that information to adjust implementation.

In larger drainage areas, or at the river watershed scale, it may be well past year 10 of monitoring (2030) before enough practices in the upstream area are constructed and established to begin to see improvements in collected data. ***After this point, monitoring information may first be used to refine source identification—determining which subwatersheds are expected to generate the highest pollutant loads.*** This data could be used to evaluate original source projects and reevaluate the prioritization of subwatersheds for implementation.

Over time, trends in pollutant reductions may begin to be observed. The annual report should use all collected data to evaluate progress toward watershed goals and to reprioritize work on a regular basis (at least every 5 years).

AMENDMENTS

At any time, the Board may choose to alter or amend this plan to better reflect new information regarding adoption rates, local interest in implementation, new research, monitoring data or for any other reason as needed to expedite the path to achieving desired objectives.

ANNUAL REPORTS

Annual reports should be collected and added as amendments to the plan. If any specific changes to implementation approaches are warranted, they should be ***attached to the end of the plan document as an appendix titled "Plan Adjustments."*** This document could simply be a PDF document attached to the end of the original report.

5-YEAR AMENDMENTS

At least every five years, the entirety of the plan should be evaluated more thoroughly. ***A chapter-by-chapter listing of any required updates or amendments to information in the plan*** should be added to the "Plan Adjustment" appendix. Changes in prioritization and updates on implementation should also be considered for inclusion.

10-YEAR AMENDMENTS

At least every ten years, the entire plan document should be evaluated for necessary amendments. Smaller changes could be included as a chapter-by-chapter listing of any required updates or amendments to the plan, and should be added to the "Plan Adjustment" appendix. Larger changes may require a more robust update of the plan document itself, to incorporate new data and/or refocus plan implementation. Such an amendment may be beyond the scope of the Watershed Coordinator position and may require outside assistance to complete.