Headwaters South Skunk River Watershed Management Plan

Headwaters South Skunk River WMA

December 2022

JEO CONSULTING GROUP INC

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Headwaters of the South Skunk River WMA

Watershed Management Plan

Prepared: December 2022

Acknowledgements: Preparation of this plan was made possible by funding assistance provided by the United States Environmental Protection Agency and the Iowa Department of Natural Resources Watershed Management Section (Clean Water Act Section 319 Program).

IOWA DEPARTMENT OF NATURAL RESOURCES

EPA United States Environmental Protection Agency

Prepared for: Headwaters of the South Skunk River WMA

Fiscal Agent: Story County

Prepared by: JEO Consulting Group, Inc.

JEO Project Number: 210289.00

This water quality management plan was prepared to guide the Headwaters of the South Skunk River Watershed Management Authority (WMA) in developing and implementing future projects to improve water quality, habitat, and recreation; reduce flooding; and increase related education and partnership efforts across the watershed. The plan may also serve as a basis for seeking financial support for those projects. It has been written with guidance published in EPA's "Handbook for Developing Watershed Plans to Restore and Protect Our Waters," updated March 2008, including EPA's Nine-Elements of a Successful Watershed Plan. The planning process utilized a Community Based Approach and incorporated several Iowa Smart Planning Principles.

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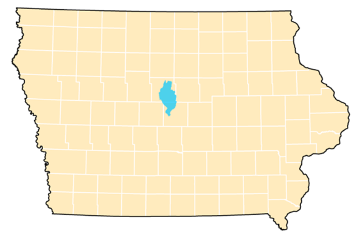
ACPF	Agricultural Conservation Planning Framework
ACS	American Community Survey
AFO	Animal Feeding Operation
APSIM	Agricultural Production Systems Simulator
AQuIA	Iowa Water Quality Database
ASL	Above Sea Level
BDA	Beaver Dam Analogue
BFE	Base Flood Elevation
BMIBI	Benthic Macroinvertebrate Index of Biotic Integrity
BMP	Best Management Practice
BRIC	Building Resilient Infrastructure and Communities
CAFO	Concentrated Animal Feeding Operation
CCB	County Conservation Board
CFS	Cubic feet per second
CIG	Conservation Innovation Grants
CREP	Conservation Reserve Enhancement Program
CRP	Conservation Reserve Program
CRS	Community Rating System
CSA	Critical Source Area
CSP	Conservation Stewardship Program
CTIC	Conservation Technology Information Center
DEP	Daily Erosion Project
DNR	Department of Natural Resources
DU	Ducks Unlimited
EPA	Environmental Protection Agency
EQIP	Environmental Quality Incentives Program
FEMA	Federal Emergency Management Agency
FFA	Future Farmers of America
FIBI	Fish Index of Biotic Integrity
FIRM	Flood Insurance Rate Map
FIS	Flood Insurance Study
FMA	Flood Mitigation Assistance
ft^3/s	Cubic feet per second
GFHI	General Fish Habitat Index
GHOST	Generic Hydrologic Overland-Subsurface flow Toolkit
GIS	Geographic Information System
GLO	General Land Office
HMA	Hazard Mitigation Assistance
HMGP	Hazard Mitigation Grant Program
HMP	Hazard Mitigation Plan
HSEMD	Homeland Security & Emergency Management
HSG	Hydrologic Soil Groups
HUC	Hydrologic Unit Code
HWSSR	Headwaters of the South Skunk River
HWSSRW	Headwaters of the South Skunk River Watershed
HWSSRWMA	Headwaters of the South Skunk River Watershed Management Authority

IBI	Index of Biotic Integrity
IDALS	Iowa Department of Agriculture and Land Stewardship
IDNR	Iowa Department of Natural Resources
IEDA	Iowa Economic Development Authority
IFC	Iowa Flood Center
IFIP	Iowa Financial Incentives Program
IFIS	Iowa Flood Information System
IHSEMD	Iowa Homeland Security Emergency Management Division
ILF	In-Lieu Fee
IR	Integrated Report
ISA	Iowa Soybean Association
ISU	Iowa State University
ISWEP	Iowa Stormwater Education Partnership
KDHE	Kansas Department of Health and Environment
LICA	Land Improvement Contractors Association
LOST	Local Option Sales Tax
MCL	Maximum Contaminant Level
Mg/L	Milligrams per liter
MS4	Municipal Separate Storm Sewer Systems
NASS	National Agricultural Statistics Service Information
NCEI	National Centers for Environmental Information
NFIP	National Flood Insurance Program
NPDES	National Pollutant Discharge Elimination System
NRCS	Natural Resources Conservation Service
NRE	Nutrient Reduction Exchange
NRS	Nutrient Reduction Strategy
NWI	National Wetland Inventory
NWS	National Weather Service
NWTF	National Wild Turkey Federation
OpTIS	Operation Tillage Information System
OWTS	Onsite Wastewater Treatment System
PALS	Post-Assisted Log Structures
PF	Pheasants Forever
PFS	Pay-for-Success
PPJV	Prairie Pothole Joint Venture
PPR	Prairie Pothole Region
PRC	Pollutant Reduction Calculator
PRI	Prairie Rivers of Iowa
RCPP	Regional Conservation Partnership Program
REAP	Resource Enhancement and Protection
RHA	Rapid Habitat Assessment
SGCN	Species of Greatest Conservation Need
SHP	Soil Health Partnership
SIPES	Social Indicator Planning and Evaluation System
SOM	Soil Organic Matter
SPARROW	SPAtially Referenced Regression on Watershed attributes
SRF	State Revolving Fund
STRIPS	Science-based Trials of Rowcrops Integrated with Prairie Strips

SWAT	Soil & Water Assessment Tool
SWCD	Soil and Water Conservation District
T&E	Threatened and Endangered
TIF	Tax Increment Financing
TMDL	Total Maximum Daily Load
TNC	The Nature Conservancy
TSS	Total Suspended Solids
USACE	US Army Corps of Engineers
USDA	United States Department of Agriculture
USFWS	United States Fish and Wildlife Service
USGS	United States Geological Survey
VTS	Vegetative Treatment System
WASCOB	Water and Sediment Control Basin
WBD	Watershed Boundary Dataset
WFPO	Watershed and Flood Prevention Operations
WMA	Watershed Management Authority
WMD	Wetland Management District
WQI	Water Quality Initiative
WQS	Water Quality Standards
WWTF	Wastewater Treatment Facility

Headwaters of the South Skunk River Watershed Management Plan
Executive Summary



A watershed management plan was prepared for the Headwaters of the South Skunk River Watershed located in north central Iowa (shown in blue on map at right). This plan was sponsored by Headwaters of the South Skunk River Management Authority (WMA), a voluntary coalition of local counties, cities, and soil and water conservation districts (SWCDs) within the watershed.

The plan identifies and prioritizes projects and activities to address water quality issues such as high nitrogen, phosphorus, and bacteria levels; stream bank erosion; and flooding concerns across the watershed. Implementation of the plan is based on voluntary cooperation between WMA members, landowners, and other stakeholders. It will be updated every 5 years to maintain eligibility for funding assistance with implementation efforts.

Implementation of the plan relies on the voluntary adoption and use of Best Management Practices (BMPs), a broad set of conservation practices such as terraces, reduced tillage, grassed waterways, in-field and edge-of-field conservation practices, and actions that help conserve soil and water resources. The plan helps to target BMPs for the most needed areas while also ensuring they can be adopted to fit the unique needs, lands, and budget of each farmer, landowner, and city.

The plan contains a long-term implementation strategy (20-years), short-term action plan (5-years), and an education plan.

VISION FOR THE WMA
The Headwaters of South Skunk River WMA will bring together farmers, landowners, residents, soil and water conservation districts, cities, counties, and other stakeholders through an "all in it together" approach towards watershed management. Education, outreach, and voluntary efforts will be used to improve water quality, increase flood resiliency, and enhance soil health across the watershed.

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

View the full plan at www.jeo.com/headwaters-south-skunk-wma

Funding provided by Iowa DNR/EPA Section 319 Watershed Improvement Program and the Environmental Protection Agency (EPA)
Plan developed by JEO Consulting Group

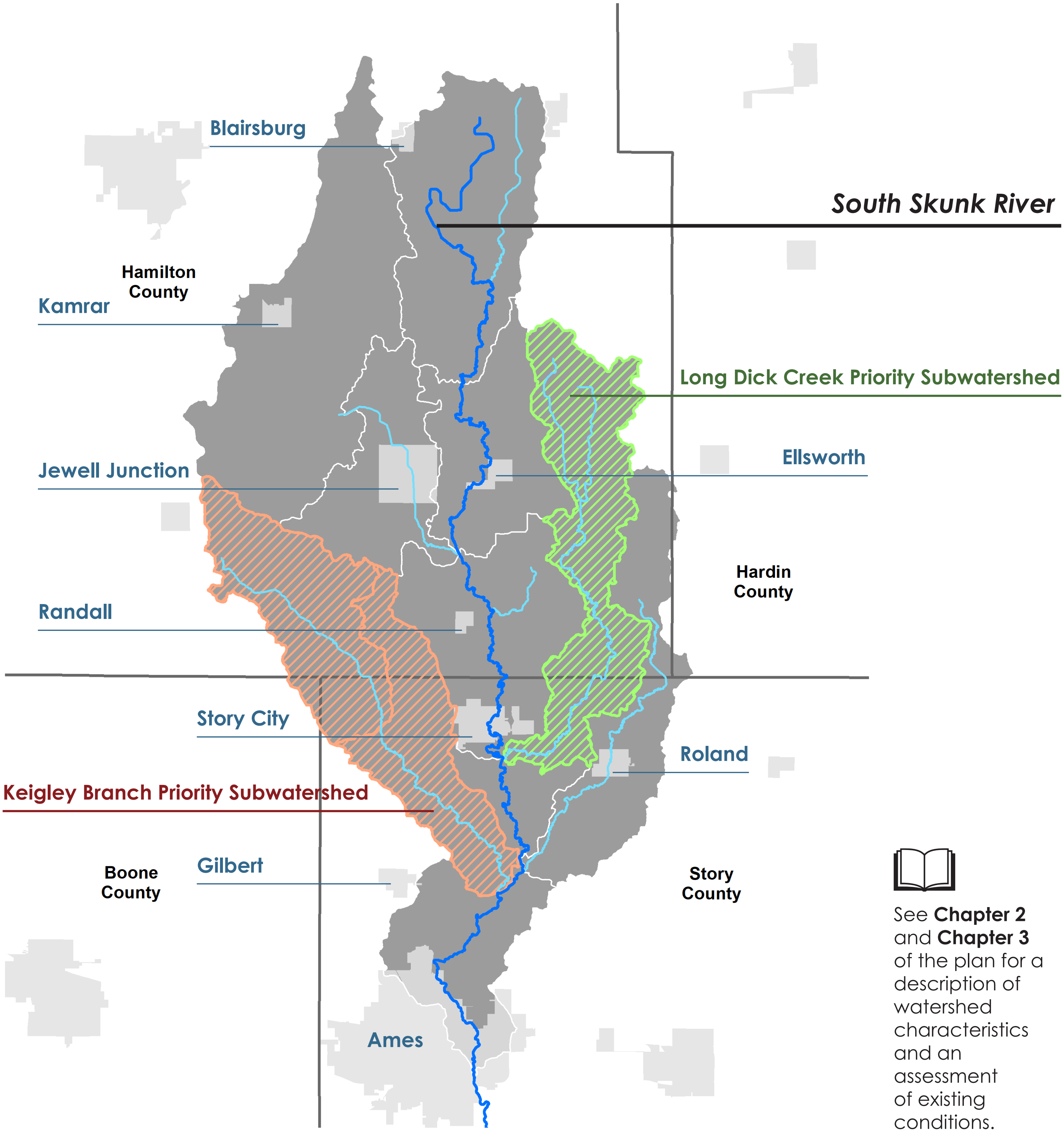
Building on Iowa's legacy of conservation

Cutting edge research on riparian buffers was completed on Bear Creek, through the establishment of a nationally recognized demonstration site.

Interest in **conservation tillage (strip till or no till) and cover crops** is increasing.

Roland and Ames are actively **implementing urban stormwater conservation projects.**

2.8 million feet of **grassed waterways** | More than 9,000 acres of **cover crops planted**



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

More than a plan. A path forward.

The watershed plan includes goals and objectives that are SMART: Specific, Measurable, Attainable, Relevant, and Time-bound.

GOALS

1. Generate and maintain full political, technical, and public support across all participating political subdivisions and other stakeholders to ensure plan sustainability.
2. Improve water quality to enhance quality of life, environmental integrity, and recreational opportunities, within the watershed.
3. More widely and deeply affect water quality improvements in the watershed by increasing individual and community commitment to water quality.

Goals and objectives are identified in **Chapter 4.** While **Chapter 5** outlines a long-term implementation strategy, **Chapter 6** provides a plan to involve and educate stakeholders throughout the watershed, and **Chapter 7** is a short-term action plan to provide initial focus.

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

EDUCATION
Outreach, education, or technical assistance aimed at various target audiences that helps to increase awareness of the WMA, the watershed plan, or assists in the increased adoption of BMPs.

PROJECTS & STUDIES
A standalone or specific effort meant to produce a product, tool, report, or achieve a tangible result.

PARTNERSHIPS & POLICY
Collaboration between WMA members or other partners and the resulting actions, guidelines, or protocols set forth to achieve a specific outcome.

MONITORING & PLAN EVALUATION
Efforts to collect, manage, and utilize data over time to track progress of meeting watershed plan goals.

Monitoring and assessing progress towards improved water quality and increased flood resiliency will be completed through long-term and short-term metrics.

Measurable Indicators of Desirable Change

INPUTS
- People
- Funding
- Public resources
- Private resources

HUMAN
- Partner organizations
- Partner agribusinesses
- Farmer knowledge and attitude
- Communities and management knowledge attitude

LAND
- Land use changes
- BMP adoption
- Flood resiliency indicators

WATER
- Edge of field monitoring
- Stream monitoring
- Modeled pollutant load reductions
- Flood loss avoidance study

Adopted from the Iowa Nutrient Reduction Strategy's (IDALS, 2017) logic model for measurable indicators of desirable change

JOIN YOUR NEIGHBORS

Together we can continue to improve the watershed!

WATERSHED MANAGEMENT AUTHORITY

- Act as the lead facilitator and coordinator for projects throughout the watershed
- Help identify and connect funding opportunities with local project sponsors
- Serve as a regional source for information
- Recruit additional members and build partnerships

CITY & COUNTY GOVERNMENTS

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

LANDOWNERS & RESIDENTS

Voluntarily adopt BMPs, using cost-share opportunities, such as:

- Cover crops
- Drainage management
- Soil health
- Saturated buffers
- Rain barrels
- Nutrient management
- Farm ponds
- Rain gardens
- Bioreactors
- Wetlands
- No-till/strip-till
- Prairie strips

SOIL & WATER CONSERVATION DISTRICTS

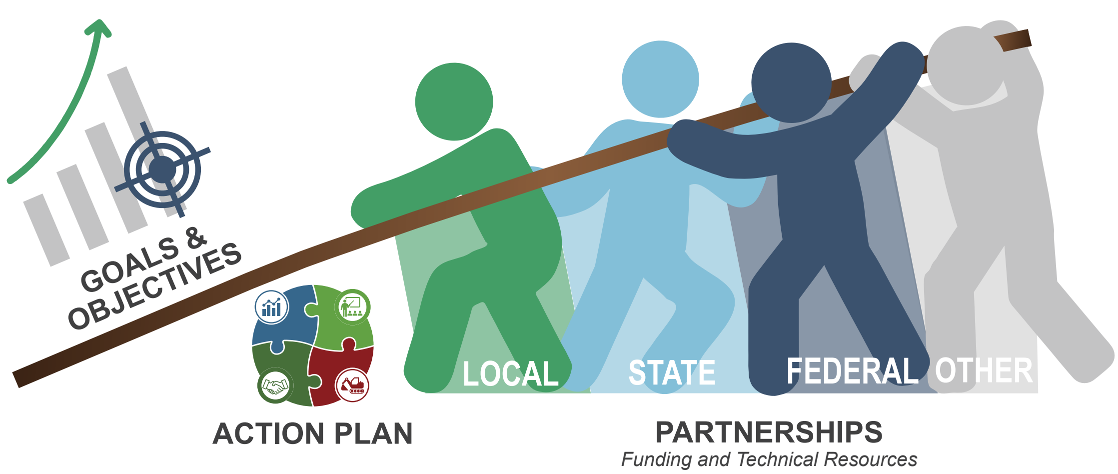
- Provide technical and financial support for BMPs

WE CAN DO MORE TOGETHER

Chapter 8 identifies funding and technical resources that can be used to help with plan implementation.

LEVERAGING THE POWER OF PARTNERSHIPS

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



GETTING STARTED

Within this plan are many ideas for improving the Headwaters of the South Skunk River Watershed and ensuring the longevity of the HWSSRWMA. This page is a place to start. The following first steps should be completed within the first year, after the plan is adopted.

1. After plan adoption, **present the plan to each jurisdiction** in the watershed (including both current and potential WMA members). Presenting on the WMA's goals, specific action items, and asking for involvement in a specific way may yield the best outcomes.

2. Host a **joint meeting with the Ioway Creek WMA** to review the plan and find opportunities to collaborate.

3. Create **an implementation committee** to lead the actions outlined in this plan.

4. **Hold a board member retreat to discuss and develop a strategy to utilize a watershed coordinator,** whom will perform on-the-ground activities to help obtain funding opportunities, provide a catalyst for action items, and give the WMA a more stable presence in the community. Coordination and cooperation between partners is critical, to avoid overlap or duplication of efforts with existing watershed coordinators in the area. See Chapter 7 for more details.

5. Identify long-term strategy to expand **water quality monitoring in Hamilton County.** This should include a way to fund these efforts and identification of entities that will be responsible for completing the work. See Chapter 2 for more details.

6. **Host a funding workshop** for WMA Board Members or **include funding ideas as a standing WMA meeting agenda item** in order to develop a more stable funding base. Chapter 8 identifies possible entities or funding sources to invite and/or request funding information from. **Appendix D contains the *Project Funding Roadmap*** which outlines possible grants that could help with BMPs and education and outreach efforts, as well as ideas to develop local funds.

7. Work with WMA members to develop a strategy to **leverage funding from member entities** as available. This could be in the form of existing (in-kind) programs and staff, or a voluntary per-capita funding formula for cash contributions. See Chapter 8 for more details.

8. **Create an onboarding document** that would help new members get up to speed on the WMA, goals, and other updates.

9. **Identify and recruit "champion farmers" and other influential stakeholders,** which could be early adopters of practices, provide BMP demonstration sites, enhance "farmer-to-farmer" outreach, or simply provide input and credibility on other WMA activities.

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CHAPTER 1. INTRODUCTION AND BACKGROUND

1.01 PLAN PURPOSE

The purpose of the Headwaters of the South Skunk River Watershed Management Plan is to serve as a comprehensive plan to assist partners in implementation actions and ongoing assessment measures. The focus is on recommendations that address water quality; however, additional resource concerns identified by stakeholders include: enhanced recreation opportunities, flood mitigation, nutrient loss reduction, restoration and protection of natural resources and habitat, sediment loss reduction, and waterway buffers. The planning area for the watershed plan is based upon a portion of the headwaters of the South Skunk River HUC 8 (07080105).

The planning process followed the U.S. Environmental Protection Agency's (EPA) nine elements for watershed planning while incorporating Iowa smart planning principles, when applicable. This plan focuses on community-identified priorities and seeks to guide improvements over the next twenty years, with a focus on shorter term goals and actions. The successful implementation of this plan is based entirely on the voluntary actions of communities, landowners, and citizens of the Headwaters of the South Skunk River Watershed. This plan will help guide partners in their conservation efforts and give direction to the conservation steps that need to be taken to meet mutual watershed goals.

1.02 PLANNING AREA AND PARTNERS

WATERSHED OVERVIEW

As shown in Figure 1, the planning area follows the upper portion of the South Skunk River Watershed Hydrologic Unit Code (HUC) 8 boundaries and is comprised of ten (10) HUC 12 subwatersheds. A hydrologic unit code (HUC) is a sequence of numbers or letters that identifies a specific watershed whose. The boundaries are defined by the United States Geological Survey's (USGS) Watershed Boundary Dataset (WBD), and are based on topographic, hydrologic, and other relevant landscape characteristics without regard for administrative, political, or jurisdictional boundaries (USGS, 2018). The planning area ends at the confluence of the South Skunk River and Ioway Creek, near SE 16th Street in Ames.

The Headwaters of the South Skunk River Watershed encompasses approximately 210,698 acres and contains the 47 miles of the almost 175-mile South Skunk River along with other tributary streams. Located entirely in the Des Moines Lobe landform, the watershed covers an area of poorly drained soils that corresponds to the southernmost extent of the last glacial advance in the Upper Midwest. The Headwaters of the South Skunk River Watershed covers portions of four counties in Iowa, including Hamilton, Hardin, Boone, and Story. Approximately 83% of land in the watershed is utilized as cropland for agricultural production, including corn and soybean production.

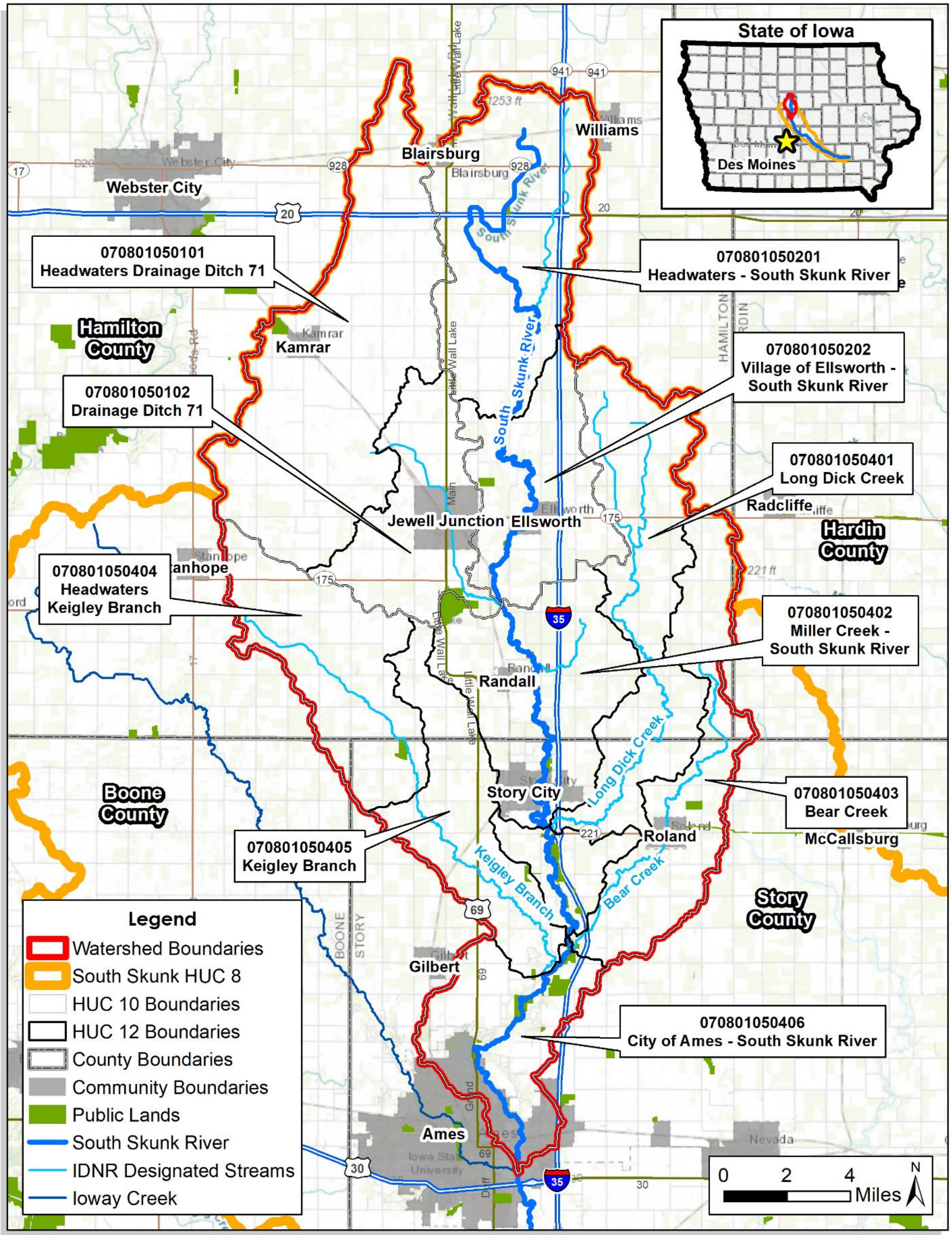


Figure 1: South Skunk River Watershed Planning Area

Notable tributaries within the watershed are Long Dick Creek, Bear Creek, and Keigley Branch. The South Skunk River begins in the northern area of the watershed and flows southward toward Ames as it combines with tributaries and eventually reaches its confluence with the North Skunk River to form the Skunk River in Keokuk County, in Southeastern Iowa. The Story County portion of the South Skunk River is designated as a water trail, with opportunities for water recreation such as kayaking and canoeing. A summary of the Headwaters of the South Skunk River Watershed's characteristics is provided in Table 1. A full watershed inventory can be found in Chapter 2.

This portion of the South Skunk River has many notable positive attributes. One segment is used for its similarity to initial conditions as a reference for the ecoregion by the IDNR. At least 5 mussel species are present, including two species listed as threatened in the state of Iowa, and another considered a species of greatest conservation need. The South Skunk River corridor is also used as a site for breeding birds, including Bald Eagles and Great Blue Herons. The South Skunk River Greenbelt is another notable asset of this stretch of the river, providing protected riparian area as the historic result of an unrealized proposed reservoir project upstream of Ames (Wagner and others, 2016).

Table 1: Plan Area Characteristics

Plan Area Component	Component Details
EPA Region	VII
HUC-8	Portion of South Skunk River Watershed (#07080105)
Counties	Portions of Hamilton, Hardin, Boone, and Story Counties
Cities	Ames*, Blairsburg*, Ellsworth, Jewell Junction, Kamrar, Randall, Roland, Story City, Williams*, (*partially within boundaries)
Tribes	None
Estimated Population (2010)	19,456
Planning Area Boundary Size	210,698 acres
Major River Watershed	Skunk River
Major Streams	South Skunk River, Long Dick Creek, Keigley Branch, Bear Creek, Drainage Ditch 71, Drainage Ditch 64
Major Economic Activity	Agriculture
Major Crop(s)	Corn, Soybean
Major Livestock(s)	Hogs and pigs, Turkeys
Applicable TMDLs	No applicable TMDLs exist within the watershed.
Water Quality Impairments	Portions of the South Skunk River are impaired due to *E. Coli* bacteria and low fish and aquatic macroinvertebrate IBI scores.

	Several tributaries have been listed as impaired due to previously recorded fish kill events and/or low biotic index.
Other Pollutants of Concern	Nutrients (Nitrogen and Phosphorus) and Sediment
Lake Designated Uses (Number of applicable lakes)	A1 – Primary Contact Recreation (3 lakes) BLW – Lakes and Wetlands (3 lakes) BWW1 – Warm Water, Type 1 (1 lake) HH – Human Health (3 lakes)
Stream Designated Uses (Number of applicable stream segments)	A1 – Primary Contact Recreation (6 stream segments) A2 – Secondary Contact Recreation (3 stream segments) A3 – Children's Contact Recreation (2 stream segments) BWW1 – Warm Water, Type 1 (3 stream segments) BWW2 – Warm Water, Type 2 (7 stream segments) HH – Human Health (3 stream segments)

Note: Additional details and data sources for this summary are found in Chapter 2.

WATERSHED MANAGEMENT AUTHORITY

In 2010, Iowa lawmakers passed legislation authorizing the creation of watershed management authorities (WMAs) as a mechanism for cities, counties, and soil and water conservation districts (SWCDs) to cooperatively engage in watershed planning and management. A WMA is formed through a Chapter 28E Agreement between two or more eligible political subdivisions within a specific HUC 8 watershed (IDNR, 2021c). WMAs are voluntary based agreements between participating entities; however, formation of a WMA does not confer any special or new regulatory power to the WMA or the participating jurisdictions. There are multiple benefits to cooperating with other jurisdictions within a watershed including, but not limited to:

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

The Headwaters of the South Skunk River (HWSSR) WMA was formerly established in fall 2018. Multiple cities, counties, and SWCDs are currently members of the WMA (Table 2). Efforts are ongoing to enlist the remaining entities as official members. The formation of the HWSSR WMA is in many ways the formal recognition of the decades of partnerships and conservation work that has already taken place within the watershed by communities, counties, state, federal, and entities. These partners have been working with landowners and farmers to accomplish conservation and agricultural goals. Many of these efforts have continued throughout the planning process, and many of these partners important stakeholders in this watershed planning effort.

Table 2: HWSSR WMA Membership Status of Eligible Entities

Entity	Member of WMA?
Cities	
Ames	Yes
Blairsburg	No
Ellsworth	No
Jewell	Yes
Kamrar	No
Randall	Yes
Roland	Yes
Story City	Yes
Williams	No
Counties	
Boone	No
Hamilton	Yes
Hardin	No
Story	Yes
Soil and Water Conservation Districts (SWCD)	
Boone	No
Hamilton	Yes
Hardin	No
Story	Yes

Through the HWSSR WMA, these parties can "cooperate with one another to successfully encourage, plan for, and implement watershed activities within the South Skunk River watershed" (Agreement 28E, 2018). Iowa Code Section 466B.22 enables the South Skunk River WMA to:

1. Assess the flood risks in the watershed.
2. Assess the water quality in the watershed.
3. Assess options for reducing flood risk and improving water quality in the watershed
4. Monitor federal flood risk planning and activities
5. Educate residents of the watershed regarding flood risks and water quality.
6. Seek and allocate monies made available to the Authority for purposes of water quality and flood mitigation
7. Make and enter into contracts and agreements and execute all instruments necessary or incidental to the performance of the duties of the Authority. The Authority shall not have the power to acquire property by eminent domain. All interests in lands shall be held in the name of the Party wherein said lands are located.

The HWSSR WMA has no taxing or eminent domain authority. This plan was developed for and under the direction of the HWSSR WMA.

1.03 EXISTING DATA AND PROJECTS

Watershed planning requires a careful balance of scientific, regulatory, social, and economic factors. As such, this plan was developed with input and guidance from a variety of organizations, programs, and resources. The following section provides an overview of some of the most influential existing plans, projects, and data sources heavily utilized to develop this watershed plan. However, the following is not an exhaustive list of information available or utilized. Data that was specifically utilized in the plan to define watershed conditions and to inform implementation strategies is further detailed in Chapter 2 and Chapter 3.

WATER QUALITY MONITORING

The Watershed has a variety of water quality data that has been collected by multiple partners. Data collected by each partner has unique spatial variability and covers various periods of record. Chapter 3 of this plan provides additional analysis and information on existing water quality conditions. The following partners and sources of monitoring were available for the planning effort:

- From 1999-2014, IDNR monitored water quality in the South Skunk River upstream of Ames.
- The non-profit Prairie Rivers of Iowa (PRI) began monitoring water quality of the South Skunk River and tributaries in April 2020 and have multiple sites that receive monthly monitoring.
- The U.S. Geological Survey (USGS) has been monitoring stream flows at three sites on the South Skunk River and two tributaries with varying periods of record. Some of these sites have limited water quality data available.

WATERSHED ASSESSMENTS

Several watershed assessments have been completed which cover portions of the HWSSR watershed. It is important to note that each assessment was completed on different dates, covers different spatial scales, and uses different data sources and assessment methodologies. The following assessments were utilized in the development of this plan:

- South Skunk River Watershed Rapid Watershed Assessment (NRCS, 2008)
- County Wide Watersheds Assessment, Story County (EOR, 2018)
- Keigley Branch Watershed Assessment (PRI, 2018)

While each of these presents limits in how they can be applied to this comprehensive watershed plan, they do provide background data that can be used as a starting point. Generally, each assessment provides different levels of information on water resources, identification of impairments, a review of ordinances and roles in resource management, a prioritization of subwatersheds for future management work, and recommendations for water monitoring and urban and agricultural best management practices

IOWA NUTRIENT REDUCTION STRATEGY

The Iowa NRS is a science and technology-based framework to assess and reduce nutrients–particularly nitrogen and phosphorus–delivered to Iowa waters and the Gulf of Mexico (ISU, 2022). It is part of a larger nutrient reduction strategy set forth by the Mississippi River/Gulf of Mexico Watershed Nutrient Force established in 1997 and seeks to reduce the size, severity, and duration of hypoxia in the Gulf of Mexico (ISU, 2018). Iowa is one of 12 states along the Mississippi River that was tasked with developing and implementing a state-level nutrient reduction strategy.

Initiated in 2013, the NRS was developed by the Iowa Department of Agriculture and Land Stewardship, the IDNR, and ISU. The strategy is designed to reduce nutrients in surface water from both point and nonpoint sources in a scientific, reasonable, and cost-effective manner (ISU, 2018). It was the first effort in Iowa to utilize an integrated approach involving both point sources and nonpoint sources. Nonpoint source load reductions goals for nitrogen and phosphorus were established at 41% and 29%, respectively.

For more information, visit http://www.nutrientstrategy.iastate.edu.

The NRS identified the South Skunk River Watershed as a high priority area for implementing best management practices to reduce nitrogen and phosphorous loads. As such, the NRS was particularly relevant in the assessment of existing conditions within the watershed and helped to guide the implementation strategies for improving water quality in the South Skunk River Watershed.

The Story County portion of the South Skunk River Watershed was part of a Water Quality Initiative (WQI) though a partnership between Iowa State University Extension and Outreach and the Iowa Department of Agriculture and Land Stewardship (IDALS). The goal was to implement best management practices (BMPs), including cover crops, strip and no-till, nitrogen inhibitors, bioreactors, drainage water management, CREP wetlands, and oxbow restoration. The project ran from 2018 to 2021; however, no BMPs were ultimately implemented as a result of the initiative (Personal Correspondence with Jaimie Benning, ISU Extension, 11/17/2021).

For more information, visit:

- https://www.cleanwateriowa.org/south-skunk-river-watershed-project
- https://naturalresources.extension.iastate.edu/waterquality/southskunkwqi

LOCAL HAZARD MITIGATION PLANS

The Federal Emergency Management Agency (FEMA) provides financial assistance for a variety of hazard mitigation projects, including flood risk mitigation, through its Hazard Mitigation Assistance (HMA) grant programs. However, to be eligible for HMA funds, a project must be included in a FEMA-approved and locally adopted hazard mitigation plan (HMP). All four counties within the HWSSR Watershed have local HMPs:

- Story County, Iowa Multi-Jurisdictional HMP (2018)
- Hamilton County, Iowa Multi-Jurisdictional HMP (2019-2024)
- Boone County Multi-Jurisdictional HMP (2021)
- Hardin County, Iowa HMP (2011-2016)

This watershed plan is not intended to supersede or replace existing local HMPs. This plan may augment the existing HMPs by providing a watershed approach to flood risk reduction and through pairing (where appropriate) water quality and flood mitigation projects together to provide multiple benefits, to provide access to additional funding mechanisms, and to develop more robust project partnerships.

The existing local HMPs were reviewed flood mitigation projects, and those have been summarized in Chapter 5 of this plan. It is also recommended that new flood mitigation projects identified through the development of this plan be amended into the local HMPs. This will allow those projects to become eligible for HMA funding.

1.04 PLANNING PROCESS AND REQUIREMENTS

COMMUNITY-BASED PLANNING PROCESS

Community-based planning is a participatory process that uses local knowledge to influence and guide an action plan. This type of planning process is central to the development of an effective and implementable watershed management plan, which transcends typical political boundaries. The success of a plan like this is dependent on the commitment and voluntary involvement of community members-–making it imperative that community members be engaged in the planning efforts. Community-based planning techniques used in this plan include the regular involvement of local stakeholders and an open house style public meeting.

TECHNICAL ADVISORY TEAM

One of the stakeholder groups relied upon during the planning process was a local technical advisory team (TAT). Members of the TAT (Table 3) assisted in compiling all existing data/resources, provided input, reviewed plan materials, and supported public meetings or other outreach efforts.

Table 3: Technical Advisory Team

Name	Title/Role	Entity /Agency
Brian Lammers	Director	Hamilton County Conservation
Wes Weise	Director	Hardin County Conservation
Alisha Bowers	District Commissioner / Operations Director	Story County SWCD / Practical Farmers of Iowa
Neil Weiss	Assistant Director	City of Ames, Dept. of Water & Pollution Control
Dr. Thomas Isenhart	Faculty	Iowa State University
Kate Hansen	Policy Associate	Center for Rural Affairs
Erik Christian	Agronomist	Story City
Michael Cox	Director	Story County Conservation
Sara Carmichael	Watershed Coordinator	Story County Conservation
Catherine DeLong	Water Quality Program Manager	ISU Extension
Kimberly Grandinetti	Director	Story County Environmental Health
Megan Volkens	Coordinator for South Skunk River Watershed	Iowa Department of Agriculture and Land Stewardship
Ben Gleason	Sr. Manger of Sustainable Programs	Iowa Corn Growers Association

Note: This table represents TAT members that participated during the development of this plan, these members may change from time to time moving forward.

STAKEHOLDER MEETINGS

Stakeholder meetings were held in conjunction with regular WMA meetings (Figure 2). At each WMA meetings, which are open to the public included: WMA members, TAT members, and other stakeholders or interested entities These groups provided input during the planning process, helped to develop watershed goals and objectives, reviewed the draft watershed plan, and will be instrumental in the implementation of this plan. A short summary of each meeting during the planning process is provided below. More information about the stakeholder meetings, including attendance and meeting minutes, can be found in Appendix A.

- **August 23, 2021** – The first stakeholder meeting was held in Story City, Iowa. The meeting began with a project background presentation and a brief overview of the anticipated planning process. Drafts of the public involvement plan and vision statement were presented for initial input and consideration by stakeholders. A facilitated discussion was held with stakeholders to identify and discuss issues and needs regarding water quality and other resource concerns in the watershed.

- **October 7, 2021** – This second stakeholder meeting was also held in Story City, Iowa. At this meeting stakeholders were updated on the planning process to date. An updated vision statement and goals was presented for additional feedback. Discussion included potential case studies and the stakeholder involvement plan.
- **November 18, 2021** – The third stakeholder meeting was held in Roland, Iowa. At this meeting, the final vision statement and goals were presented and adopted by the WMA (Chapter 4). Additionally, case studies for the plan were discussed and selected, the updated stakeholder plan was presented, and updates on the general project and schedule were given.
- **January 24, 2022** – This fourth stakeholder meeting was held in Roland, Iowa. A general project update was given, including a presentation on the watershed resource inventory, and an assessment of water quality data. Priority area identification and BMP targets were discussed.
- **March 30, 2022** – The fifth stakeholder meeting was held in Roland, Iowa. A general project update was given. Draft chapter 1, 2, and 3 were reviewed in detail with the attendees, and the drafts were also sent out to all stakeholders for review. Long Dick Creek and Keigley Branch were recommended for prioritization of BMP implementation efforts, due to high levels of nitrogen and *E. coli* bacteria. A working session was held to review possible items to include in the action plan (Chapter 7).

Figure 2: Stakeholder Meeting on March 30, 2022

- **May 25, 2022** – The sixth stakeholder meeting was held in Roland, Iowa. A general project update was given. Initial planning for the public open house style meeting began. A review of the new ACPF modeling data was provided, and priority areas were finalized. Feedback from the draft action plan was reviewed. A working session was held to review the draft Education Plan (Chapter 6).

- **July 20, 2022** – The seventh stakeholder meeting was held in Roland, Iowa. A general project update was given. The primary agenda items included a review of the long-term implementation plan (Chapter 5), and an overview of fieldwork that was completed in the priority subwatersheds. Additional planning was completed for the public open house meetings.
- **August 31, 2022** – The eighth and final stakeholder meeting of the planning process was held in Roland, Iowa. A general project update was given. Final planning and a review of draft materials for the public open house meeting were completed. The last remaining draft components of the watershed plan were reviewed: executive summary poster and getting started page.

PUBLIC OPEN HOUSE MEETINGS

The community-based planning process culminated in two open house style public meetings. A total of 28 people attended the meetings, which were held in Story City over the lunch hour and Jewell Junction in the evening on November 10, 2022. The variation in time and location aimed to make the meetings accessible to the multiple audiences. The public meeting provided an opportunity for the broader community to learn about the project, provide input on the stakeholder-informed goals and objectives, and review the draft watershed management plan. The public meeting also offered an opportunity to connect watershed residents and business with existing resources to implement best management practices.

Figure 3: Open House Style Public Meeting on November 10, 2022

IOWA SMART PLANNING PRINCIPLES

The planning process has incorporated Iowa Smart Planning Principles, as described in the Iowa Smart Planning Act, found in Iowa Code Chapter 18B. The Smart Planning Act identifies ten principles which must be considered and may be applied when local governments and state agencies deliberate all appropriate planning, zoning, development, and resource management decisions. Additionally, the act outlines 13 elements that may be included in a city or county comprehensive plan. While this watershed plan is not equivalent to a city or county comprehensive plans, it may inform the development of these local documents.

This plan addresses the following (to varying degrees) the following Iowa Smart Planning Principles:

- Collaboration
- Efficiency, Transparency, and Consistency
- Natural Resources and Agricultural Production
- Sustainable Design

NINE-ELEMENTS OF WATERSHED PLANNING

This watershed plan addresses the EPA's Nine-Elements, as defined in their Handbook for Developing Watershed Plans to Restore and Protect our Waters (USEPA, 2008). Throughout this plan, items that directly address one of the nine-elements are marked with a nine-element graphic like what is displayed to the left. The EPA requires that watershed projects receiving Section 319 funds be supported by either a watershed plan that addresses the Nine-Elements or an equivalent plan. Table 4 also provides an index for the location(s) of each element.

Table 4: Location of EPA's Nine Elements within the Plan

Element		Page Number(s)
a.	Identify causes and sources of pollution	71, 91, 94
b.	Estimate existing pollutant loads and expected reductions	158, 107, 124
c.	Described BMPs needed and targeted critical areas	129, 141, 143
d.	Technical and financial resources; and authorities needed	191
e.	Develop an information/education component	8, 161
f.	Develop a project schedule	148
g.	Describe the interim, measurable milestones	148
h.	Identify indicators to measure progress	126
i.	Develop a monitoring component	151

CHAPTER 2. WATERSHED INVENTORY

2.01 INTRODUCTION

This chapter identifies components of the Headwaters of the South Skunk River Watershed (watershed) and provides an inventory of the watershed's characteristics. Information about watershed boundaries, demographics, physical environment, water resources, hydrology, protected areas, wildlife and habitat, and existing policy and regulations within the watershed is reported and explored in this chapter.

2.02 WATERSHED BOUNDARIES

The Headwaters of the South Skunk River Watershed spans approximately 210,698 acres in central Iowa (*Figure 4*). Boundaries for the watershed are defined by the United States Geological Survey's (USGS) Watershed Boundary Dataset (WBD) (USGS, 2018). The WBD consists of multi-level watershed boundaries, each of which is assigned a hierarchical hydrologic unit code (HUC). The watershed boundaries consist of a combination of three HUC 10 boundaries (#0708010502, #0708010504, and #0708010501) within the larger HUC 8 level South Skunk River Subbasin (#07080105). Smaller subwatersheds discussed throughout the plan are defined at the HUC 12 level. The most up to date WBD for Iowa was downloaded from the Natural Resources Conservation Service (NRCS) Geospatial Data Gateway to accurately identify and map the watershed boundaries for this plan.

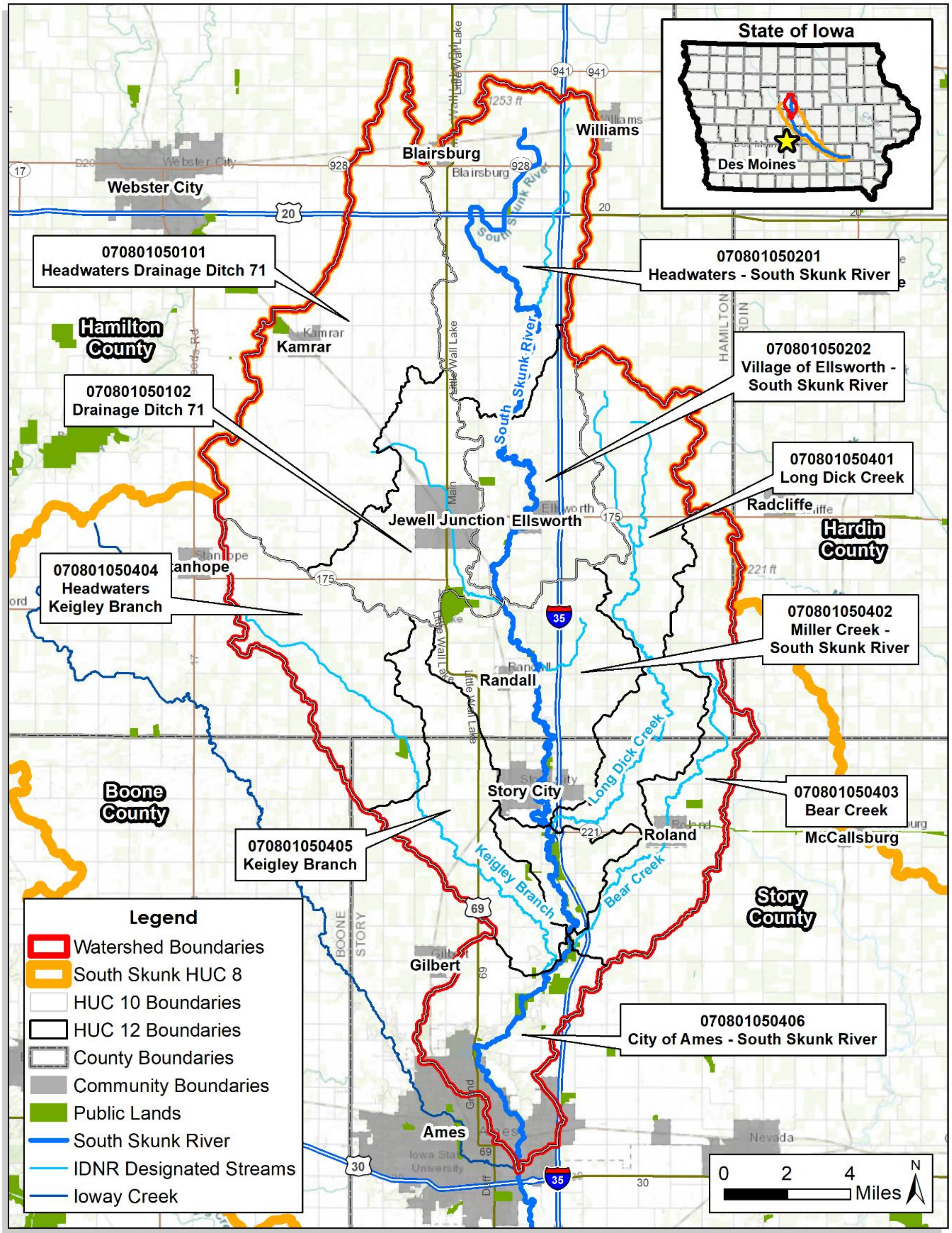


Figure 4: Watershed Location Map

2.03 DEMOGRAPHIC SUMMARY

Understanding demographic data, especially farmer, and landowner statistics, can help in the development of outreach and education programs that are more targeted to the needs of the watershed. These recommendations are provided in Chapter 6.

POPULATION

The watershed encompasses portions of four counties: Story and Hamilton Counties make up the vast majority of the area, with Boone and Hardin Counties each having a small sliver of the watershed. Because the watershed does not fall along political boundaries, only estimates are available for demographic data. The watershed completely contains six incorporated communities, and partially contains another four incorporated communities. Of the communities that fall completely within the HWSSRWMA, none have a population greater than 3,500 people. The largest metropolitan area is Ames, which falls partially within the southernmost end of the watershed. Population estimates are compiled by city and unincorporated county area based on the 2010 census (U.S. Census Bureau, 2010). The total population of the watershed is approximately 19,457 with the majority (80.6%) residing in communities (Table 5, Table 6, and Figure 5).

Table 5: Estimated Population of Communities

Community	Population
Ames*	8,676
Blairsburg*	137
Ellsworth	531
Jewell Junction	1,215
Kamrar	199
Randall	173
Roland	1,284
Story City	3,431
Williams*	32

Source: U.S. Census Bureau, 2010

** Partially within the watershed*

Table 6: Population Type Distribution

Population Type	Population	Percent
Communities	15,678	80.6%
Boone County Unincorporated	5	0.02%
Hamilton County Unincorporated	1,703	8.7%
Hardin County Unincorporated	7	0.03%
Story County Unincorporated	2,063	10.6%
Total	**19,456**	**100.0%**

Source: U.S. Census Bureau, 2010

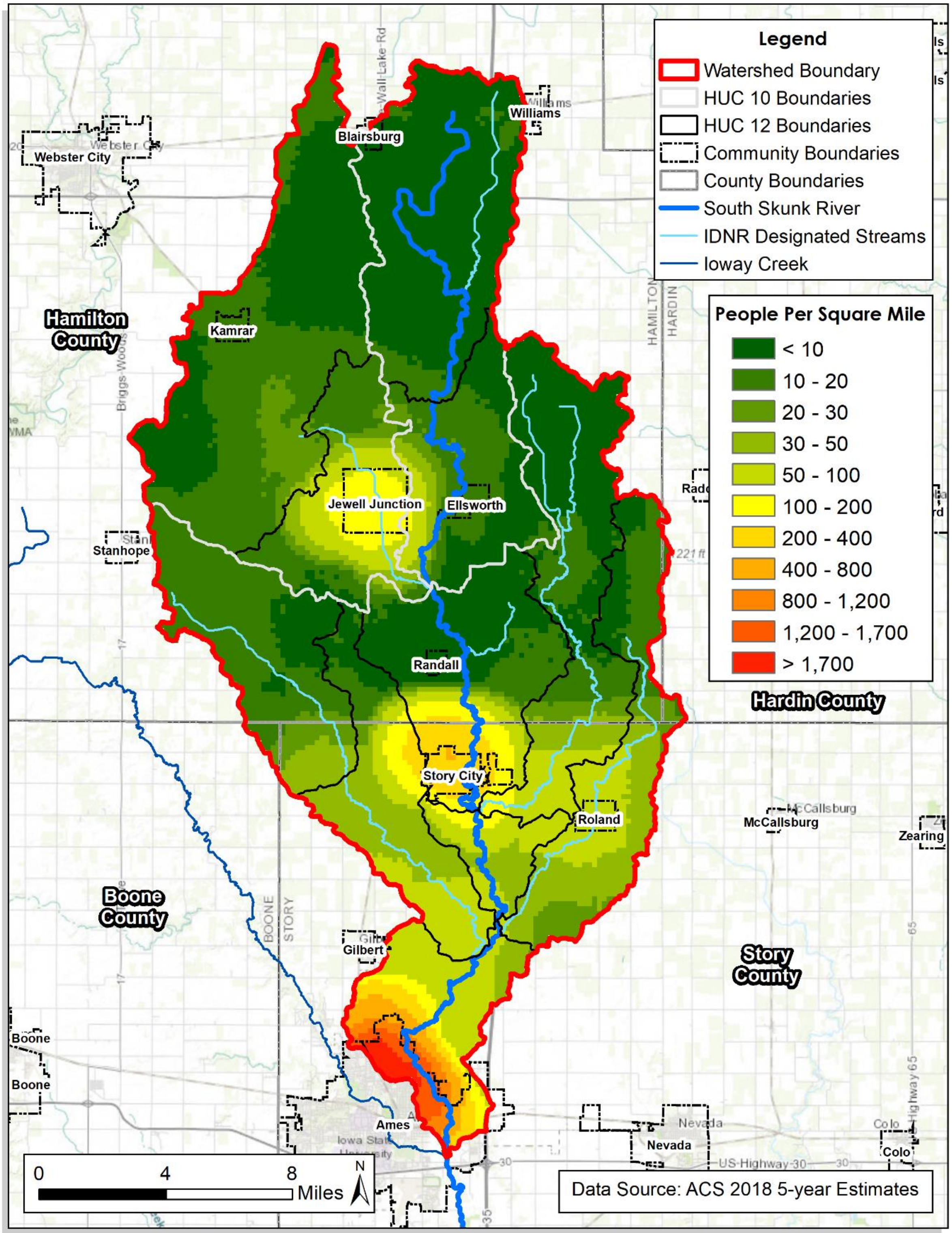


Figure 5: Population Density

AGRICULTURAL ACTIVITIES

Agricultural activities dominate the land use and economy of the watershed. Understanding agricultural activities is important to understanding the potential for certain types of pollutant sources throughout the watershed. Additional assessment of pollutants is provided in Chapter 3.

The United States Department of Agriculture (USDA) Census of Agriculture (Ag Census) provides the most robust statistically valid data for this subject and is published every five years. Select data from the two most recently available years (2012 and 2017) was analyzed to understand both existing conditions and recent trends within the watershed (USDA, 2012, 2019). To estimate values within the watershed boundaries, a percent area was applied to the county-wide data for Hamilton and Story County, which contain most of the watershed (*Table 7*). The primary crops grown in the watershed include corn and soybeans; and turkeys and hogs are the primary livestock produced. The average farm size in the watershed is 228 acres, which is considerably smaller than the statewide average of 360 acres.

Table 7: Changes in Agricultural Activities from 2012 to 2017

Item	2012	2017	Percent Change
Land			
Number of Farms	464	450	-2.96%
Land in Farms (acres)	182,576	177,407	-2.83%
Average Size of Farms (acres)	227	228	+0.25%
Livestock Inventory			
Cattle and Calves	6,853	3,596	-47.53%
Beef Cows	(D)	627*	N/A
Dairy Cows	(D)	74*	N/A
Equine	314	230	-26.84%
Sheep and Lambs	901	1,049	+16.35%
Goats	202	415	+105.16%
Hogs and Pigs	280,602	429,359	+53.01%
Broilers and other Meat Chickens	328	93	-71.71%
Chickens - Layers	523*	866	+65.66%
Turkeys	406,680	406,400	-0.07%
Crops (acres)			
Corn for grain	106,743	95,582	-10.46%
Corn for silage	421	*168	-60.14%
Soybeans	53,624	61,704	+15.07%
Forage (Hay/Haylage)	1,434	1,597	+11.35%

Source: USDA 2012, 2019

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

** Denotes value determined by data from only one county due to withheld data.*

AGRICULTURAL PRODUCERS (FARMERS)

Select demographic statistics for farmers in the watershed were identified from the 2017 Ag Census (Table 8). Like the previous section, to estimate values within the watershed, a percent area was applied to the county-wide data for Hamilton and Story County, which contain most of the watershed. These statistics are also presented with statewide data, to help add context. Across Iowa, farmers are predominantly male (65%), white (98%), and older than 55 (62%). Additionally, only 45% list farming as their primary occupation – which indicates they may also spend a considerable amount of time working an off-farm job. Similar trends were noted in the watershed.

Table 8: Select Statistics on Farmers in the Watershed

Item	Watershed Estimate	Iowa
Total Producers (Farmers)	765	N/A
Percent Male	66%	65%
Percent Female	34%	35%
Average Age	57.8	57.4
Percent of Farms that are Family Farms	93%	95%
Percent of Producers (Farmers) whose Primary Occupation is Farming	42%	39%

Source: USDA, 2019

FARMLAND OWNERSHIP

Across the Midwest a large portion of land in farms is rented to tenant farmers. In Iowa, 53% of farmland is rented. While the exact percentage of rented farmland varies throughout the Midwest, most of Iowa's neighboring states have a similar amount (USDA, 2019; Bawa and Callahan, 2021). Of the owners who rent out their land to be farmed, 57% do not currently farm themselves and 34% have no farming experience (USDA, 2019). Ag Census records showed that between 40-49% of farmland is rented or leased within the watershed (USDA, 2019) (*Figure 6*). These facts indicate that soil and water conservation decisions made by farmers must also take into account the relationship or agreement with landowners. The recommendations found in later chapters of this plan have also been developed to take these factors into account.

Additional data on farmland ownership and farmer tenants at the watershed level was unavailable, however, the *Iowa Farm and Rural Life Poll* (Farm Poll) does offer information at the state level, which is useful for informing the strategies within this plan.

Additional information on the Farm Poll can be accessed here:
https://ext.soc.iastate.edu/programs/iowa-farm-and-rural-life-poll/

The Farm Poll is a survey of Iowa farmers and has been conducted annually since 1982. While the survey topics vary each year, the 2018 poll focused on several dimensions of landlord-tenant relationships. It is important to note that the Farm Poll survey is a longitudinal panel survey and not a true random sample survey, thus the results are not precise measures, but rather may be indicative of trends. Several questions have been asked at 5-year intervals since 2008, so where applicable, the 2018 poll compared results across years. Several key findings from the 2018 poll are included below (Arbuckle, 2019):

- Most farmers who rent land rent it from multiple landowners.
- 50% of the primary landlords were relatives, and 24% characterized their landlord as a friend of the family.
- About 60% indicated their landlord lived in the county and 10% lived in an adjacent county Most primary landlords lived relatively close to their land, and more than 80% within Iowa.
- Short length of tenure and tenure insecurity are often cited as impediments to tenant investment in soil fertility and soil and water conservation practices. However, most farmers had rented from their primary landlords for more than 10 years, and the length of tenure appears to be increasing.
- Communication between farmers and landlords regarding conservation was less frequent (about half as often) as communication regarding farming practices.
- Results indicated that farmer tenants perceive an increase in their responsibility for conservation actions and decline in the landlord's responsibility. This was most apparent, through the following responses:
    - There was a mixture of responsibility for addressing conservation assigned between farmers and landlords. 26% of farmers indicated they were primarily responsible, but very few farmers reported that their landlord was solely responsible. In fact, 72% of farmers agreed or strongly agreed with the following statement "if conservation practices are needed on the land I rent, it is my responsibility to address the need".
    - 32% of farmers agreed with the following statement: "my landlord requires me to minimize impacts on soil and water quality", as it related to contractual obligations. This was a lower response than in a previous poll in 2008 (46%)
    - Similarly, agreement with the item, "my landlord has established adequate conservation measures on his/her land," declined from 73% in 2008 to 58% in 2018.

One other important source of demographic data was reviewed: *Iowa Farmland Ownership and Tenure Survey, 1982-2017: A Thirty-Five Year Perspective* (Zhang, 2018). This survey started in the 1940s, and since 1989 it has been conducted every five years as mandated by Iowa Code. Many of the findings support data presented from the AgCensus and Farm Poll. The results of this report are statistically representative for all farmland and all landowners in Iowa. While there are some differences with respect to landownership across Iowa the major statewide trends are still maintained at the more regional level. Several key findings from the 2017 survey, which are relevant to the development of strategies presented in this watershed plan, are presented below:

- 60% of farmland is owned by people over 65 years of age, and 35% of farmland is owned by people 75 or older.
- 47% of farmland is owned by women.
- 29% of Iowa farmland is primarily owned for family or sentimental reasons.
- 80% of land is owned by full-time Iowa residents, 7% by part-time residents, and 13% is owned by those who do not live in the state.
- Education has been gradually increasing among farmland owners, currently 39% of farmland is owned by someone with a bachelor's or graduate degree. The level increased to 64% when including any post high school education.
- The highest percentage of owned farmland by active farmers are for those who reported farming a total of less than 400 acres: 53% of full-time farmers and 78% of part-time farmers.
- 86% of leased acres in Iowa belong to landowners who currently do not farm.
- Other relevant trends in Iowa farmland include the continuation of aging farmland owners, increase amount of land that is cash rented (verses crop share), and an increasing percentage of land held debt free and an associated tightening of the land market.

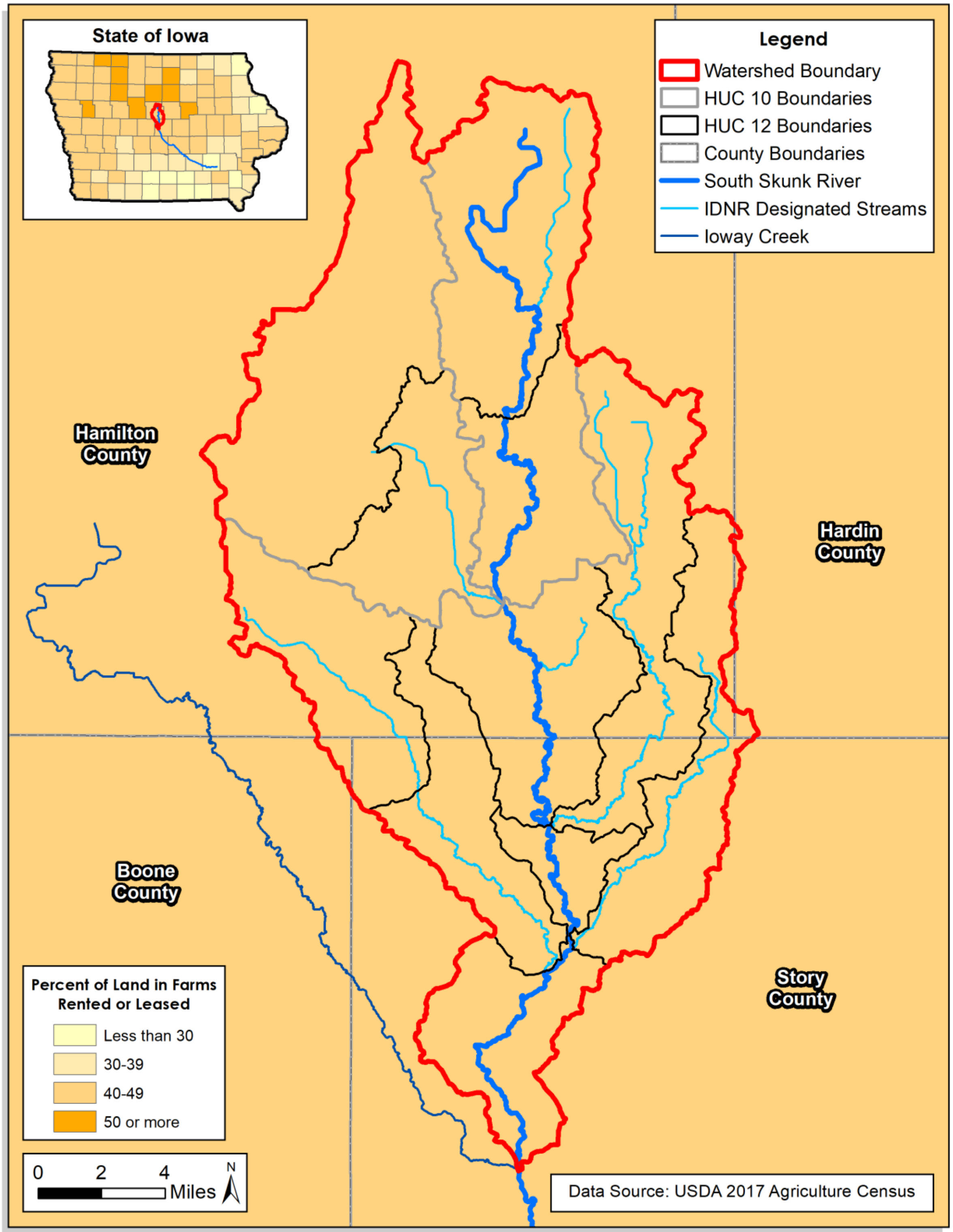


Figure 6: Percentage of Land in Farms Rented or Leased by County

2.04 PHYSICAL ENVIRONMENT

CLIMATE

The climate of the watershed is considered "Humid Continental" on the Köppen-Geiger Climate Classification System (Kottek, 2006). This climate is characterized by large seasonal temperature differences with hot, humid summers and cold winters. Annual precipitation is distributed across the year and varies slightly across the watershed (*Figure 8*), though the majority of the watershed receives, on average, between 35 and 37 inches of precipitation per year. Weather data from the National Centers for Environmental Information (NCEI) is summarized in Figure 7, and below:

- Monthly precipitation averages range from 5.4 inches in June to 0.9 inches in January.
- Average high temperatures range from 84°F during the summer to 29°F during winter.
- Average low temperatures range from 63°F during the summer to 11°F during winter.

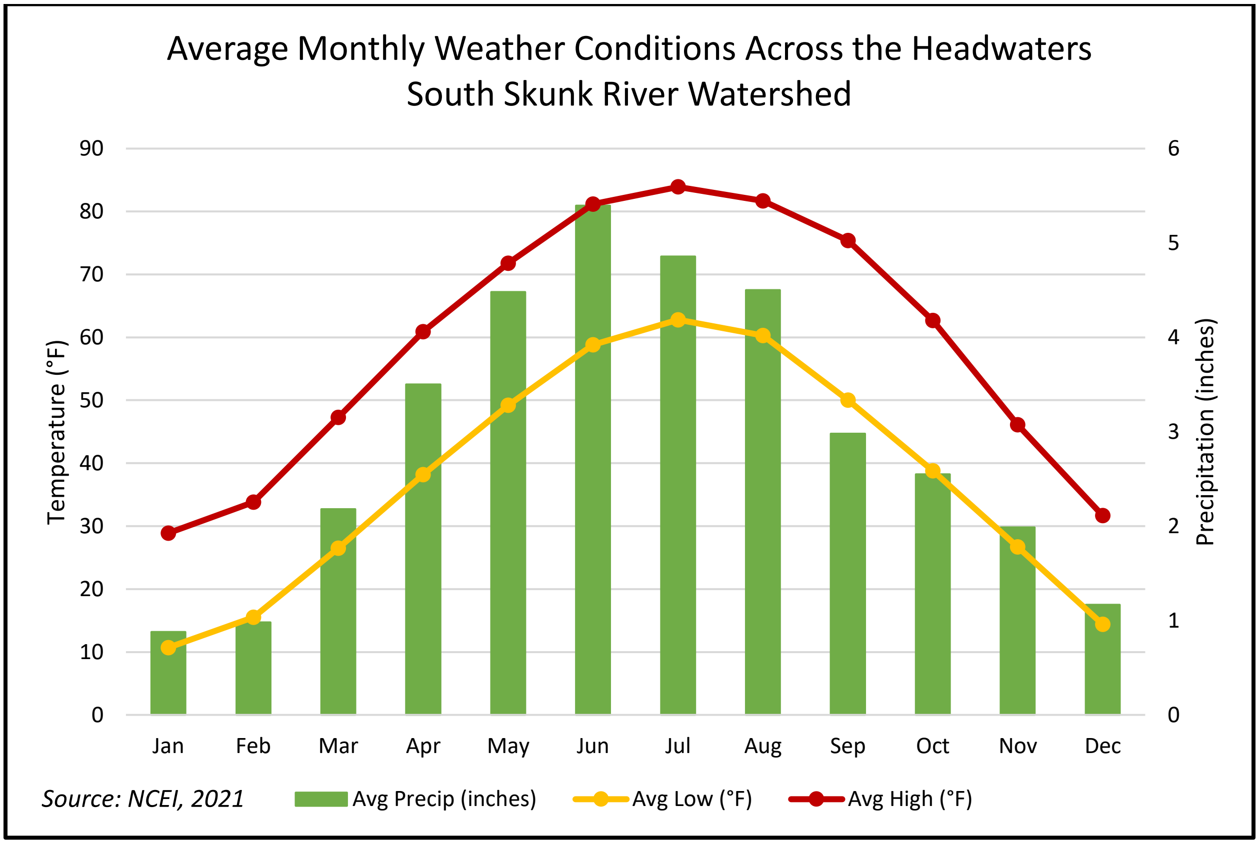


Figure 7: Average Monthly Temperature and Precipitation using data from Jewell and Ames Municipal Airport, IA (1981-2010)

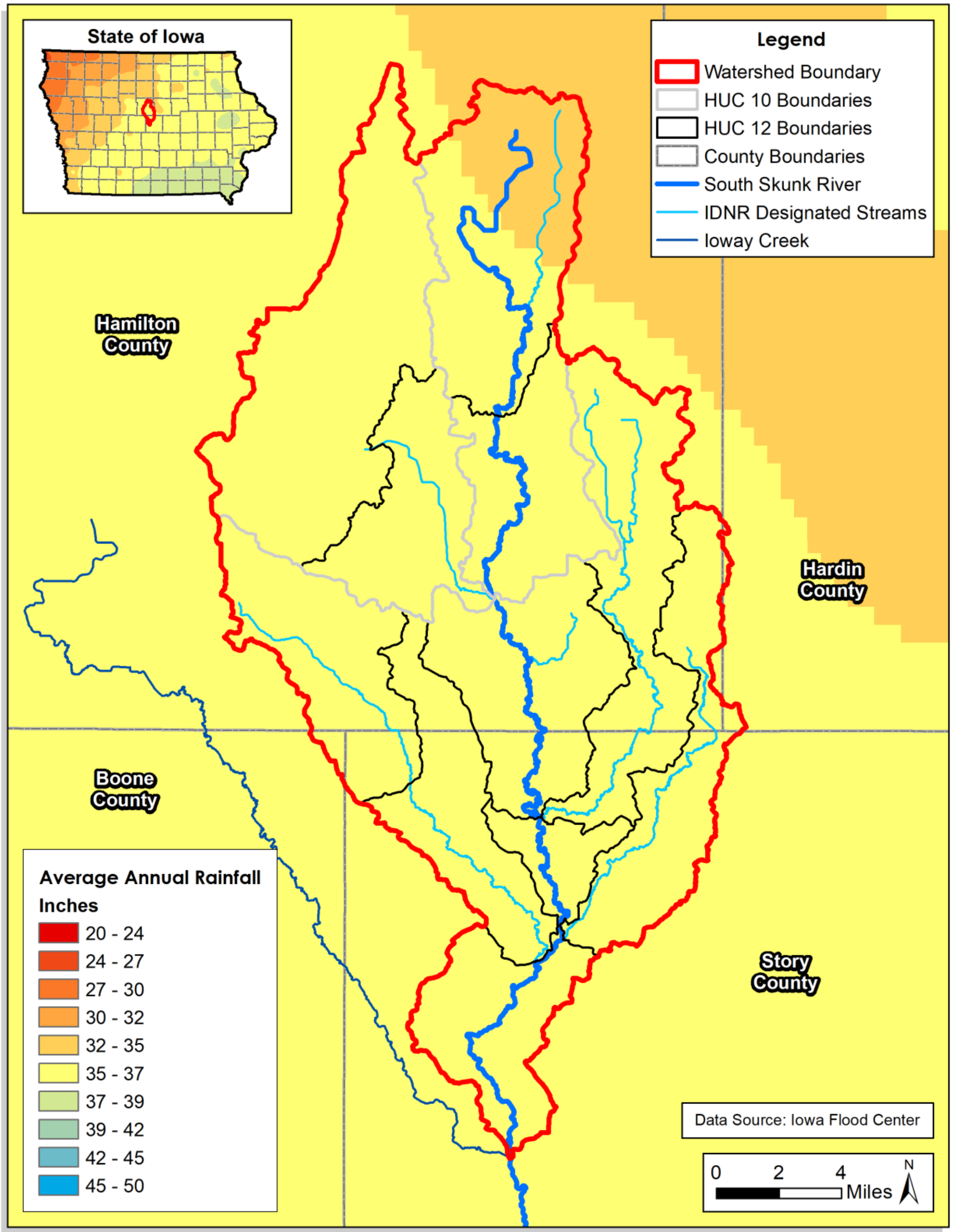


Figure 8: Average Annual Precipitation Map

LANDFORMS AND GEOLOGY

Iowa has been subdivided into ten distinct landform regions (Prior, 1991). In each region a unique geologic history has shaped the landscape and natural resources. Each unique landform influences the distribution of plant and animal communities and helps determine an area's vulnerability to water quality or flooding problems. The entirety of the watershed is located within the "Des Moines Lobe" landform region (Figure 9).

The Des Moines Lobe was the last area in Iowa with glaciers, making it geologically one of the youngest and flattest regions in the state. In general, the land is level to gently rolling with some areas of the moraines having the most relief. The morainal ridges and hummocky knob and kettle topography contrast with the flat plains of ground moraines, former glacial lakes, and outwash deposits. A distinguishing characteristic from other areas in Iowa is the lack of loess over the glacial drift. The stream network is poorly developed and widely spaced. What major rivers do exist have carved valleys that are relatively deep and steep-sided. Almost all of the natural lakes of Iowa are found in the northern part of this region. Most of the region has been converted from wet prairie to agricultural use through substantial subsurface water drainage. Only a small fraction of the wetlands remains, and many natural lakes have been drained as a result of agricultural drainage projects. (IDNR, 2021a)

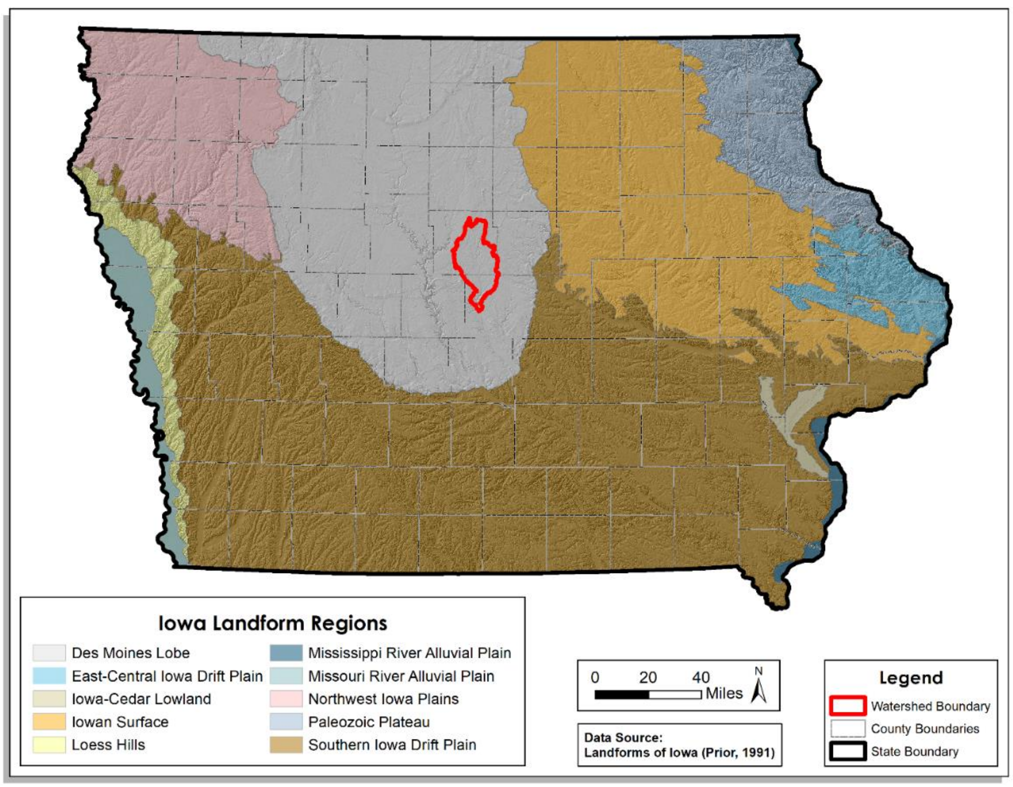
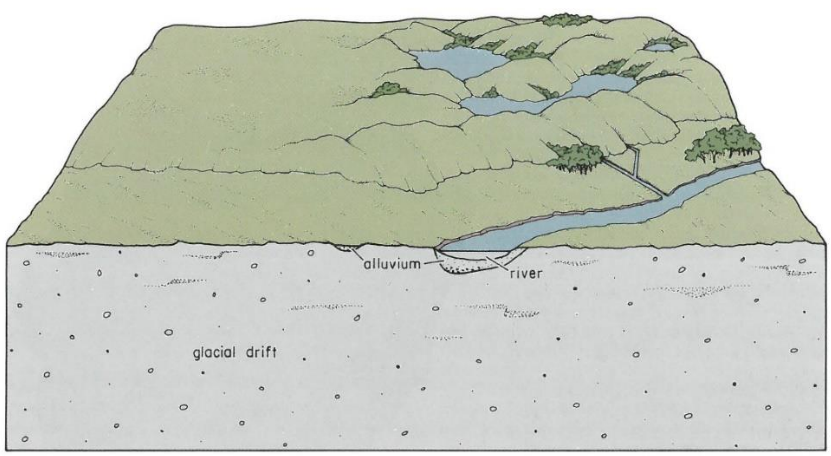


Figure 9: Landforms Within and Near the Watershed

The geology of the Des Moines Lobe has been clearly described in *Landforms of Iowa* (Prior, 1991) and summarized below:

> *The geology of this region is composed primarily of drift, or materials left behind by glaciers. However, due to their age these glacial drift deposits are less eroded than those in other areas of Iowa, such as the Southern Iowa Drift Plan. Following the glacial ice retreat, an inefficient drainage network was established in the Des Moines Lobe region of Iowa. Because of this post-glacial landscape, natural lakes, ponds, sloughs, and bogs formed in the hilly area. In fact, nearly all the naturally occurring lakes in Iowa are located in the Des Moines Lobe. River routes in this area were caused by glacier meltwater floods and overflowing channels from rapid ice melt across the landscape (Figure 10).*
>
> *As the Des Moines Lobe evolved, morainal ridges became prominent across the interior portion of the Lobe, stretching to the east and west. The ridges, standing up to 120 feet in height, formed along the central axis of the glacier, the most mobile portion of the glacier characterized by consistent freezing and thawing of ice.*
>
> *Other irregular landforms and deposits are also found throughout the area such as kames, eskers, and kettles. Water-transported deposits of sand and gravel that gathered in large crevices formed isolated hills called kames. Eskers are ridges that came from alluvial build-up in river channels that flowed beneath glacial ice. They are identified by their narrow form and winding topography. Kettles are characterized as being the opposite of kames and eskers and are bowl-shaped depressions found sporadically throughout the region. They developed when large, isolated glacial blocks were buried by small amounts of soil and rubble and slowly melted into the ground.*



Source: Landforms of Iowa, 1991

Figure 10: Typical Geologic and Terrain Cross Section of the Des Moines Lobe

TOPOGRAPHY

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

The topography of the watershed reflects its geologic past. While the watershed is generally considered a flat landscape, there are areas of diverse topography and varying slopes, especially along the South Skunk River (*Figure 11*). Elevation tends to decrease from north to south, as one travels down the watershed. Elevations range from a low of 837.205 feet above sea level (ASL) in Story County, to a high of 1,256.76 feet (ASL) in Hamilton County. Slopes across the watershed tend to be very flat (0-2%); however, some of the downstream areas are dominated by very steep slopes (greater than 10%), especially in Story County along the South Skunk River. Other pockets throughout the watershed have moderately steep slopes and are seen sporadically throughout all four counties.

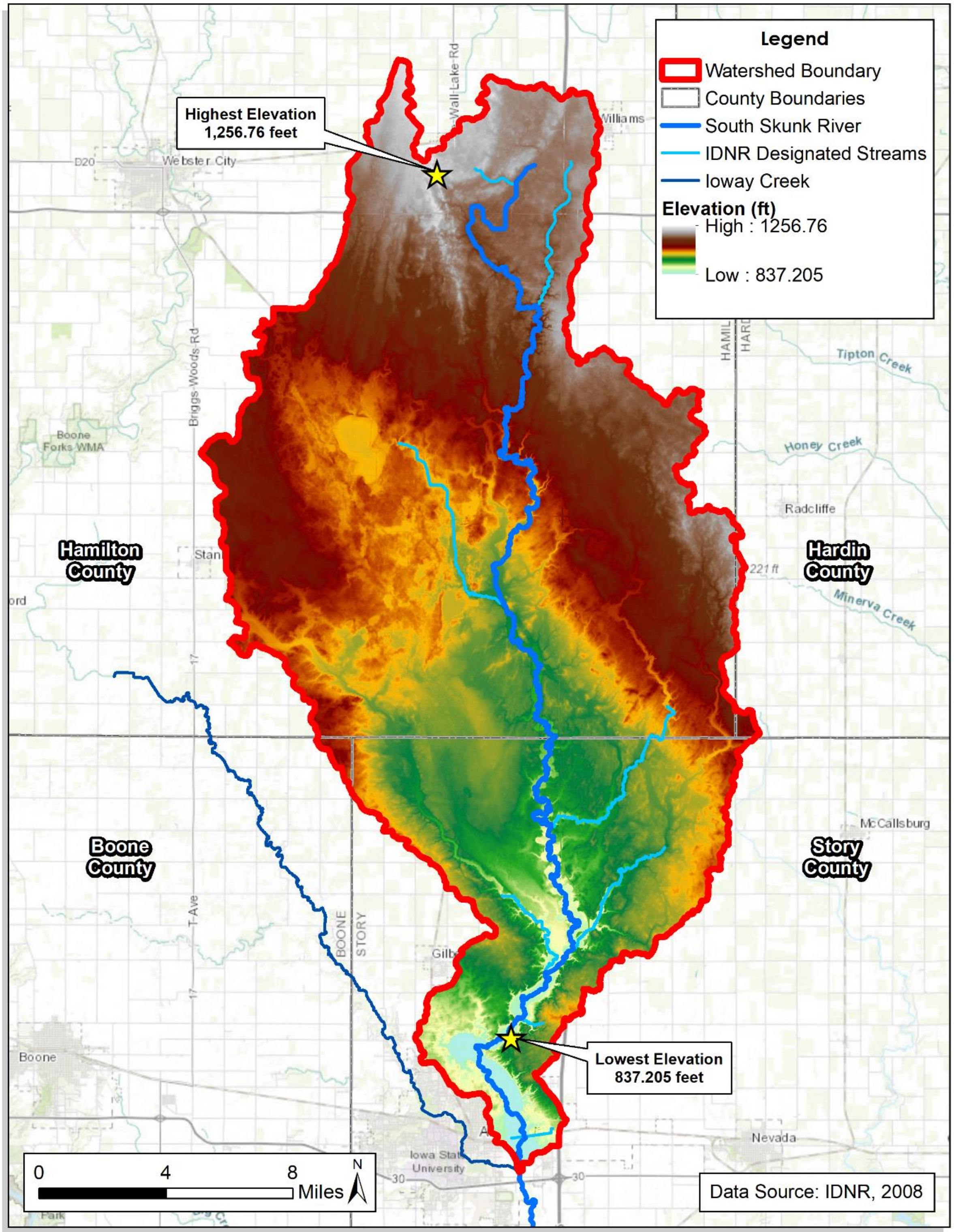


Figure 11: Topographic Relief Map

2.05 SOILS

Soil characteristics such as texture and infiltration rate directly influence the amount of runoff from the landscape and the potential for erosion. NRCS-USDA soils data was downloaded from the NRCS Web Soil Survey and analyzed specific to the watershed with the results provided in the following sections. Please note that information on soil erosion is provided in Chapter 3.

TEXTURE

Soil texture is given in the standard terms used by the USDA. These terms are defined according to the percentages of sand, silt, and clay in a soil sample that is less than 2mm in diameter. If the content of particles courser than sand (greater than 2mm in diameter) is greater than 15%, an appropriate modifier is added. The clear majority of soils (more than 98%) found in the watershed are comprised of some sort of loam soil (Table 9). The western half of the watershed is generally higher in silt than the eastern half. Figure 12 displays the soils based upon texture throughout the watershed.

Table 9: Soil Surface Texture Classes in the Watershed

Soil Surface Texture	Percentage
Clay Loam	49%
Loam	27%
Silty Clay Loam	18%
Various	6%
Total	**100%**

Source: NRCS 2022

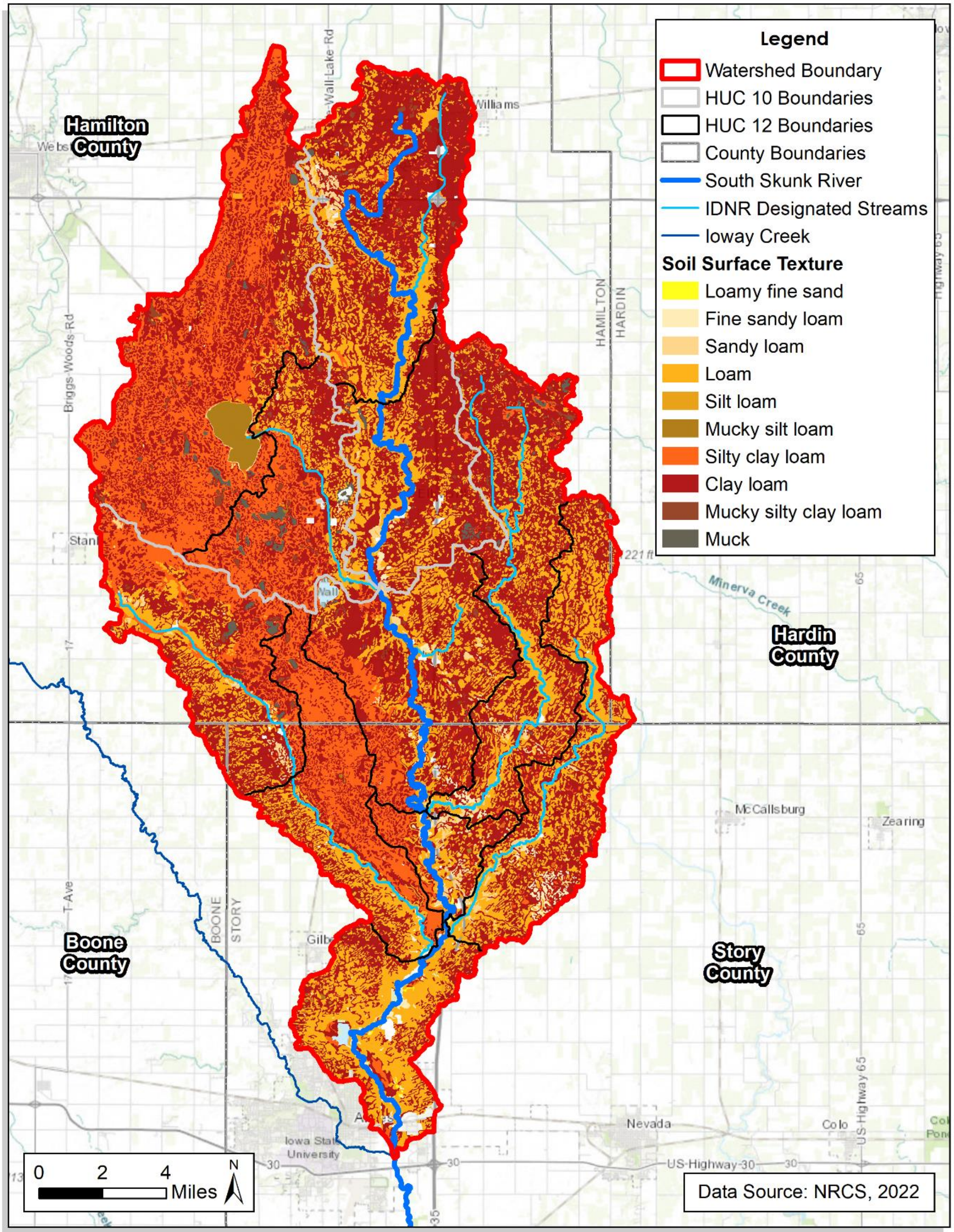


Figure 12: Soil Texture Map

INFILTRATION

The NRCS classification system divides soils into four major hydrologic soil groups (HSG): A, B, C, and D; and three dual classes: A/D, B/D, and C/D. Table 10 provides a description of the role soils plays in runoff generation. Soils within each hydrologic group have comparable runoff potential under similar storm and vegetative conditions. The soils in the watershed consist mostly (more than 85%) of C or C/D soil groups, which contribute to higher runoff rates. Figure 13 illustrates the geographic distribution of HSG types. The HSGs are consistent with the soil textures describe above.

Table 10: Breakdown of Hydrologic Soils Groups

Soil Group	Description	Percentage in the Watershed
A	Soils in this group have low runoff potential when thoroughly wet. Group A soils typically have less than 10 percent clay and more than 90 percent sand or gravel and have gravel or sand textures. Water is transmitted freely through the soil.	2.06%
A/D*	Dual Group, See description below table*	0.00%
B	Soils in this group have moderate infiltration and transmission rate when thoroughly wetted. Group B soils consist chiefly of moderately well- to well-drained soils with moderately fine to moderately course textures. Water movement through these soils is moderately rapid.	10.23%
B/D	Dual Group, See description below table*	2.26%
C	Soils in this group have moderately high runoff potential when thoroughly wet. Group C soils typically have loam, silt loam, sandy clay loam, clay loam, and silty clay loam textures. Water transmission through the soil is somewhat restricted.	19.43%
C/D	Dual Group, See description below table*	66.02%
D	Soils in this group have high runoff potential when thoroughly wet. Group D soils typically have clayey textures. Soils with a depth to a water impermeable layer less than 20 inches, and all soils with a water table within 24 inches of the surface are placed in this group. Water movement through the soil is restricted or very restricted.	0.00%

** Soils are assigned to dual groups if the depth to a permanent water table is the sole criteria for assigning a soil to hydrologic group D. If these soils can be adequately drained, then they are assigned to dual groups. The first letter applies to the drained condition and the second to the undrained condition.*
Source: NRCS, 2022

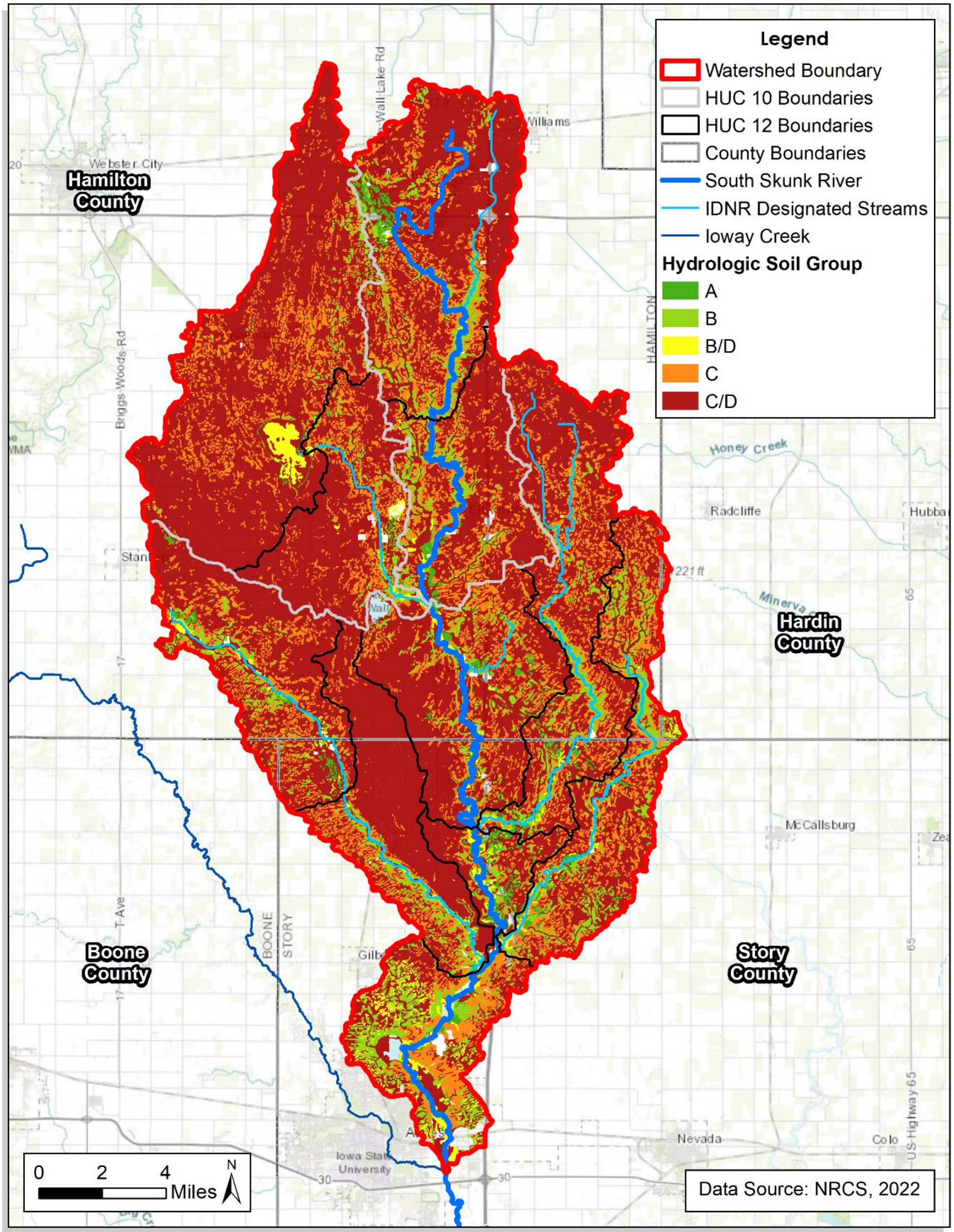


Figure 13: Hydrologic Soil Group Map

SOIL ORGANIC MATTER

Soil organic matter (SOM) is measured as a percentage by weight of soil material that is smaller than 2 mm across. Historically, soils in the Great Plains had high levels of SOM due to the deep roots of prairie grasses. However, intensive agricultural cultivation and erosion has led to reductions in SOM in some areas. SOM has implications for many aspects of soil health, and increased SOM can mean better protection against erosion, reduced leaching of contaminants due to an increase in cation exchange capacity, and better water holding capacity. SOM is greatly impacted by management strategies. Cover crops, conservation tillage, and application of organic matter-rich amendments such as compost, manure, or biochar can all result in increased SOM. The soils in the watershed have relatively high SOM in most areas (Table 11). Low SOM is mostly seen in areas along the South Skunk River and tributaries where slopes are higher and erosion is more likely to occur (Figure 14).

Table 11: Soil Organic Matter Within the Watershed

Soil Organic Matter (% by weight)	Percentage of Watershed
< 2%	3.06%
2 – 3%	10.84%
3 – 5%	26.27%
5 – 15%	58.37%
>15%	1.45%

Source: NRCS, 2022

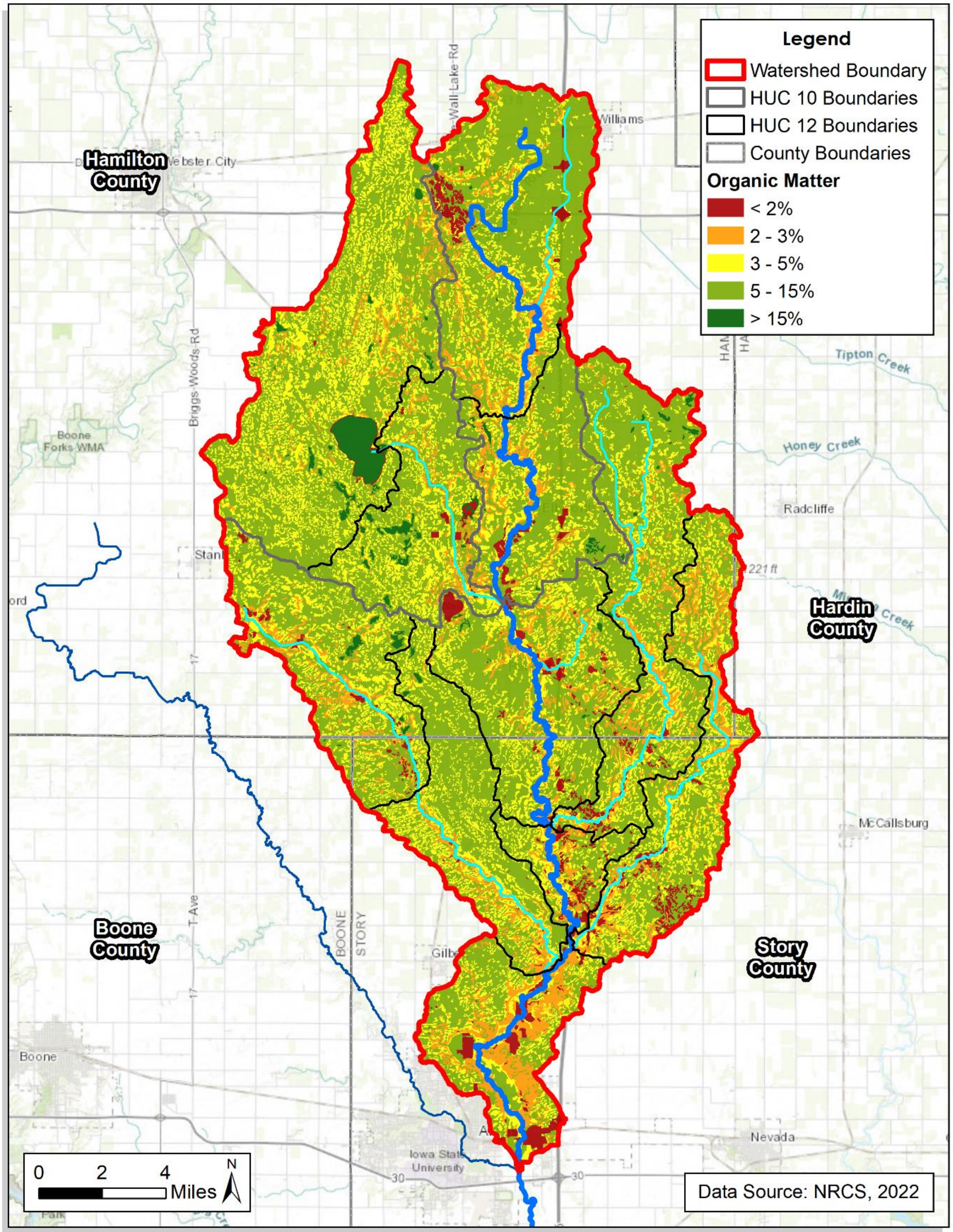


Figure 14: Soil Organic Matter Map

2.06 LAND USE

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

HISTORICAL LAND USE

Surveys conducted by the General Land Office (GLO) and developed by Iowa State University (ISU) Geographic Map Server were used to develop a map of the historical land use in the watershed between 1832 and 1859, prior to major European settlement (ISU, 2018). The vast majority of the watershed, like most of Iowa, was covered by prairie. Small areas of forest and wetlands could also be found across the watershed, as can be seen in Figure 15.

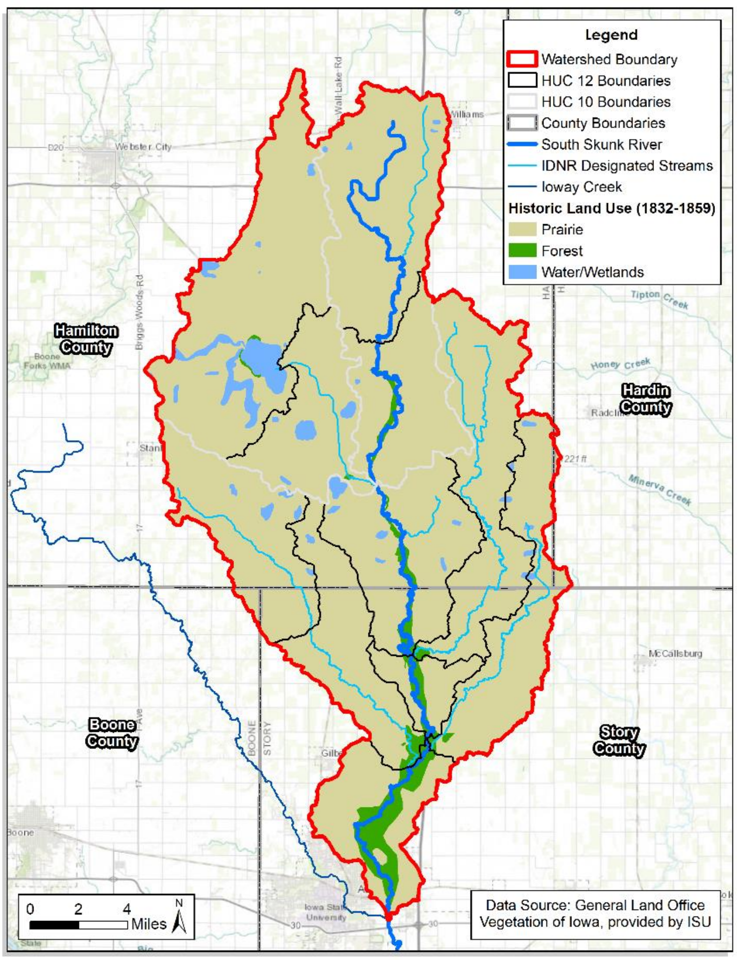


Figure 15: Historic Land Use Map (1832 – 1859)

PRESENT DAY LAND USE

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

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

Present day land use in the watershed was determined by GIS analysis of the 2020 USDA-NASS's Cropland Data Layer (Table 12). As seen in *Figure 16*, agriculture now dominates the watershed with 83% used for crop ground and 6% for pasture (a small amount of this is likely prairie). Small amounts of the watershed are covered with open water or wetlands (2%) and forested areas (2%) are most prominent in the downstream portion of the watershed.

Cropland can be a major contributor to nutrient pollution in surface water. Cropland can also be subject to high erosion rates and become a source of sediment in surface water, as more disturbed soil is more vulnerable to erosion. However, there are in-field and edge-of-field practices that can help nutrient and sediment pollution that originated from cropland. Some of these BMPs include conservation tillage, cover crops, and others, and are discussed more in Chapter 5.

Table 12: Existing Land use in the Watershed

Land Use	Percentage
Crop	83%
Developed (Urban)	7%
Pasture/Grass	6%
Open Water/Wetlands	2%
Forest	2%
Total	**100%**

Source: USDA-NASS Cropland Data Layer (2020)

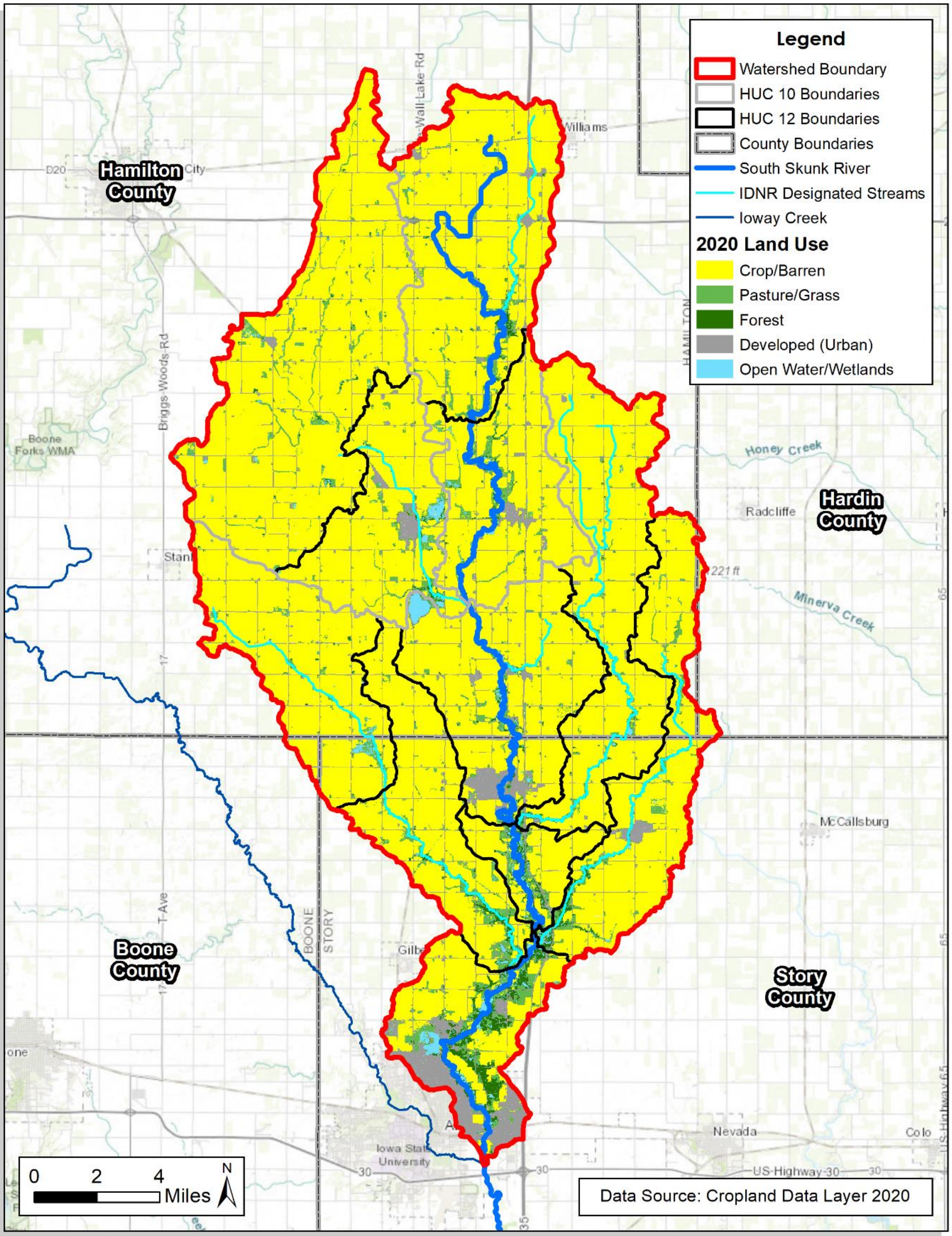


Figure 16: Present Day Land Use Map

2.07 WATER RESOURCES

STREAMS AND RIVERS

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

The watershed is composed of several designated stream segments covering approximately 147 stream miles (Figure 17), two of which are drainage ditches. There are three additional named tributaries contributing approximately 63 miles of the 147 stream miles: Bear Creek, Keigley Branch, and Long Dick Creek (Table 13). The watershed exhibits a dendritic drainage pattern, with many of the perennial tributaries flowing in a north-to-south direction.

Table 13: Designated Streams in the Watershed

Stream Name	Stream Length (miles)	Stream Name	Stream Length (miles)
South Skunk River (5 segments)	58	Drainage Ditch 71	8
Long Dick Creek (2 segments)	25	Drainage Ditch 64	7
Keigley Branch (2 segments)	21	Unnamed Tributary to Long Dick Creek	5
Bear Creek (2 segments)	17	Unnamed Tributary to South Skunk River	3
Total Miles	**147**		

Notes: Totals may not sum due to rounding

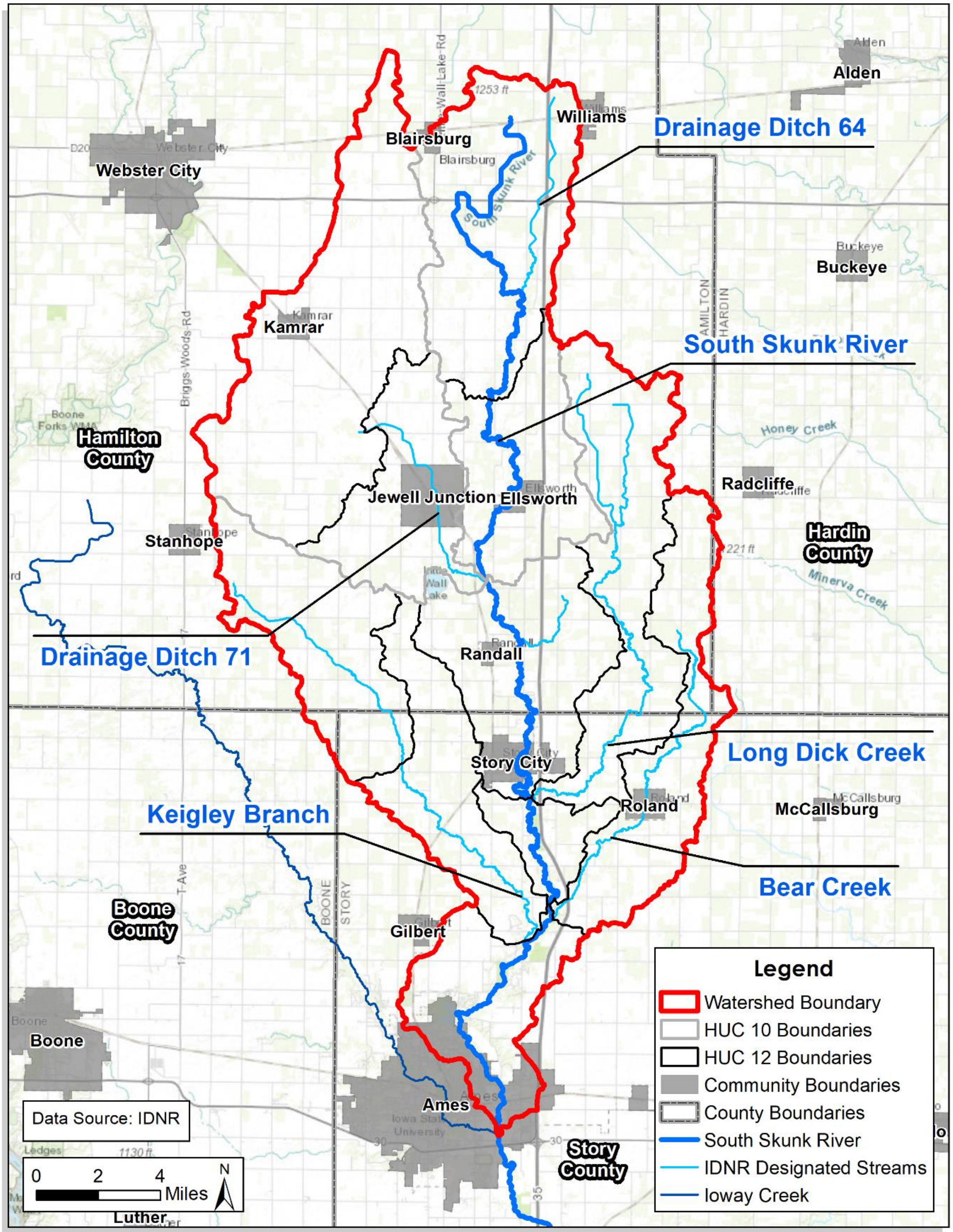


Figure 17: Map of Designated Streams

LAKES AND RESERVOIRS

Like designated streams, IDNR also maintains a GIS database for lakes, each of which has a unique identification number (lake code). There are four designated lakes in the watershed, plus one other notable lake that doesn't appear in the IDNR database: Peterson Park West Lake (*Table 14*, *Figure 18*). Little Wall Lake is the largest, covering 249 surface acres of permanent pool and is located between the communities of Jewell Junction and Randall along Drainage Ditch 71 in the middle of the watershed. Other designated lakes in the watershed range from 6.5 acres to over 130 surface acres and include Ada Hayden Heritage Park Lake, Pyle Marsh, and McFarland's Pond. The lakes in the watershed offer recreational facilities for activities such as fishing, hiking, picnicking, and camping.

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

Table 14: Lakes in the Watershed

Lake Code	Lake Name	Surface Area (acres)
03-SSK-941	Little Wall Lake	249
03-SSK-3104	Ada Hayden Heritage Park Lake	137
N/A	Peterson Park West Lake	31
03-SSK-1787	Pyle Marsh*	20
03-SSK-939	McFarland's Pond	6.5
Total		**413.5**

Source: IDNR, 2022b

**Considered a wetland but designated for primary contact recreation use*

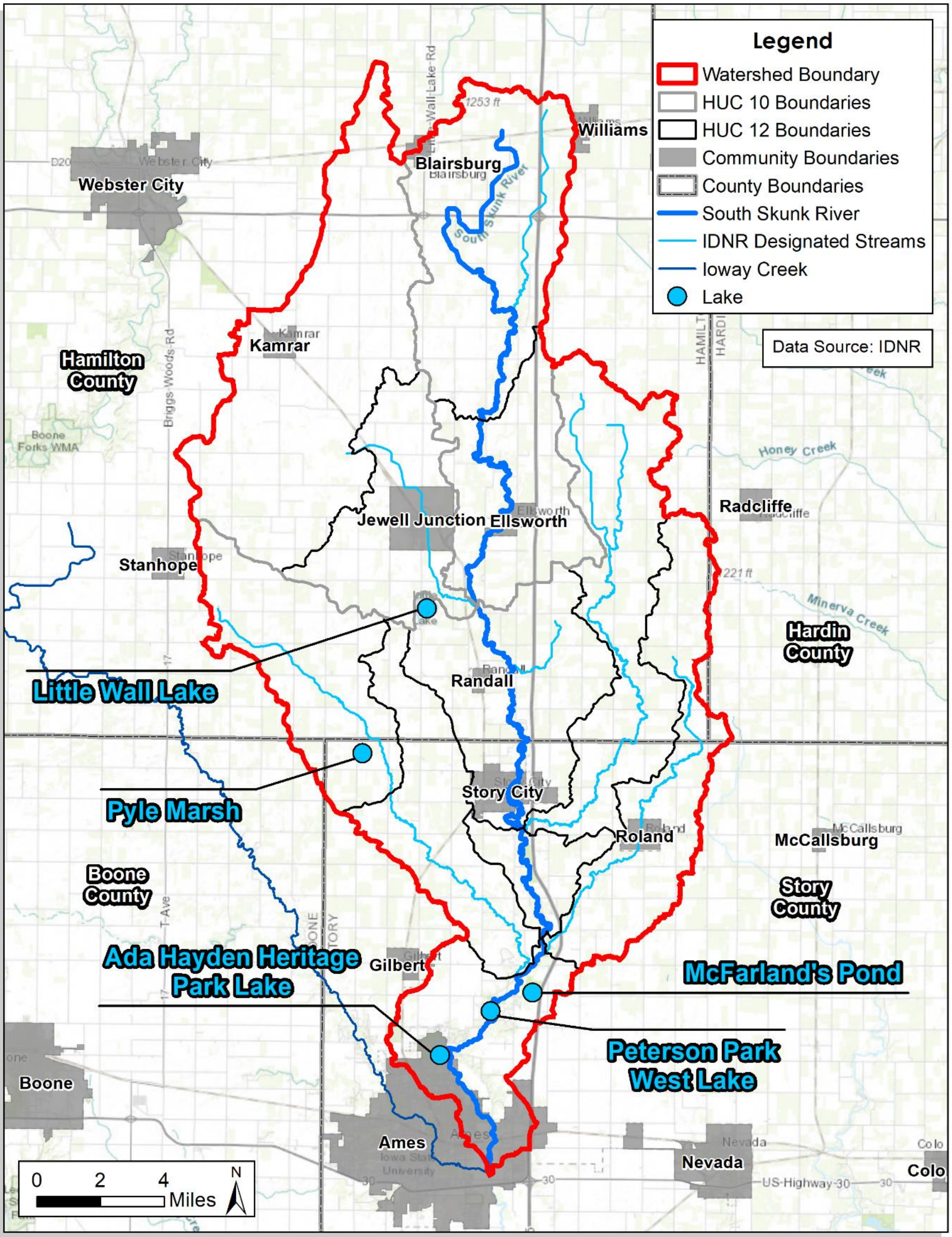


Figure 18: Map of Lakes in the Watershed

WETLANDS

Overview

Wetlands are places where plants and animals live amid standing water or saturated soils. The term 'wetland' is often used interchangeably with other terms such as swamps, sloughs, potholes, marshes, bogs, fens, seeps, oxbows, shallow ponds, or wet meadows. In addition to being essential wildlife habitat, there are socio-economic values related to wetlands. In addition to the money generated from recreation (e.g. fishing, hunting, canoeing, and bird watching), wetlands are economically valuable in flood protection, regulating watershed hydrology, protecting water quality (sediment trapping and nutrient removal), and erosion control.

Originally wetland basins once covered 4 to 6 million acres of Iowa. That represented approximately 11% of Iowa's land surface based upon historical surveys and maps of the landscape prior to European settlement. Wetlands remain part of every watershed in Iowa, but 90-95% of the original wetlands were drained and are no longer fully functional (IDNR, 2016b). Historically, Iowa's wetlands were viewed as a hindrance to land development. In less than 150 years, these rich resources were drained, filled, or otherwise altered, drastically changing the face of Iowa's land.

Many types of wetlands exist in Iowa: prairie-pothole marshes (emergent wetlands), swamps (forested wetlands), sloughs, bogs (emergent wetlands), wet meadows (emergent wetlands), fens (emergent and scrub-shrub wetlands), and shallow ponds are examples of palustrine wetlands. The lacustrine System includes large oxbows, natural lakes, and reservoirs. The Riverine System includes streams and rivers (Association of State Wetland Managers, 2015).

Information on Iowa's wetlands, including those found in the Des Moines Lobe, are primarily documented in the following publications:

- IDNR's *2016 Wetland Program Plan for Iowa* (IDNR, 2016b)
- IDNR's *2010 Wetland Action Plan for Iowa* (Evelsizer and Johnson, 2010)
- US Fish and Wildlife Service's (USFWS) *Iowa Wetland Management District Comprehensive Conservation Plan* (USFWS, 2014)

Additional information on Iowa's wetlands and the organizations that help to manage them can be found at the following websites:

- https://www.fws.gov/refuge/iowa_wmd/
- https://www.iowadnr.gov/environmental-protection/water-quality/water-monitoring/wetlands
- http://ppjv.org/

National Wetland Inventory

The USFWS has established the National Wetland Inventory (NWI) to provide biologists, managers, and others with a centralized inventory of wetlands in the United States. This was developed using remote sensing and aerial photography analysis, which is useful for a widescale inventory, however the NWI also has a tendency to miss smaller wetlands. Additionally, farmed wetlands are likely not well represented. Therefore, while useful, the NWI should not be considered a complete inventory of all wetlands and should not be used as substitute for on-the-ground surveys.

Analysis of NWI data indicates that there are approximately 2,300 acres of mapped wetlands in the watershed (Figure 19). These are all freshwater wetlands. The following is a breakdown of approximate acreages of NWI wetlands (by type) in the watershed:

- Emergent: 566 acres
- Forested/shrub: 415 acres
- Riverine: 543 acres
- Pond: 312 acres
- Lake: 465 acres

Many of the wetlands within the watershed are associated with the Prairie Pothole Region (PPR). The PPR is a naturally poorly drained region across North America (see Figure 19) containing thousands of shallow wetlands known as potholes, which are the result of glacier activity (as previously discussed in the landform section of this chapter). Iowa's Des Moines Lobe forms the southernmost extent of the PPR of central North America. There are also many riverine wetlands that are closely associated with the corridor of the South Skunk River and its tributaries. These mainly consist of those in the floodplain, along the river’s edge, and old oxbows or backwaters.

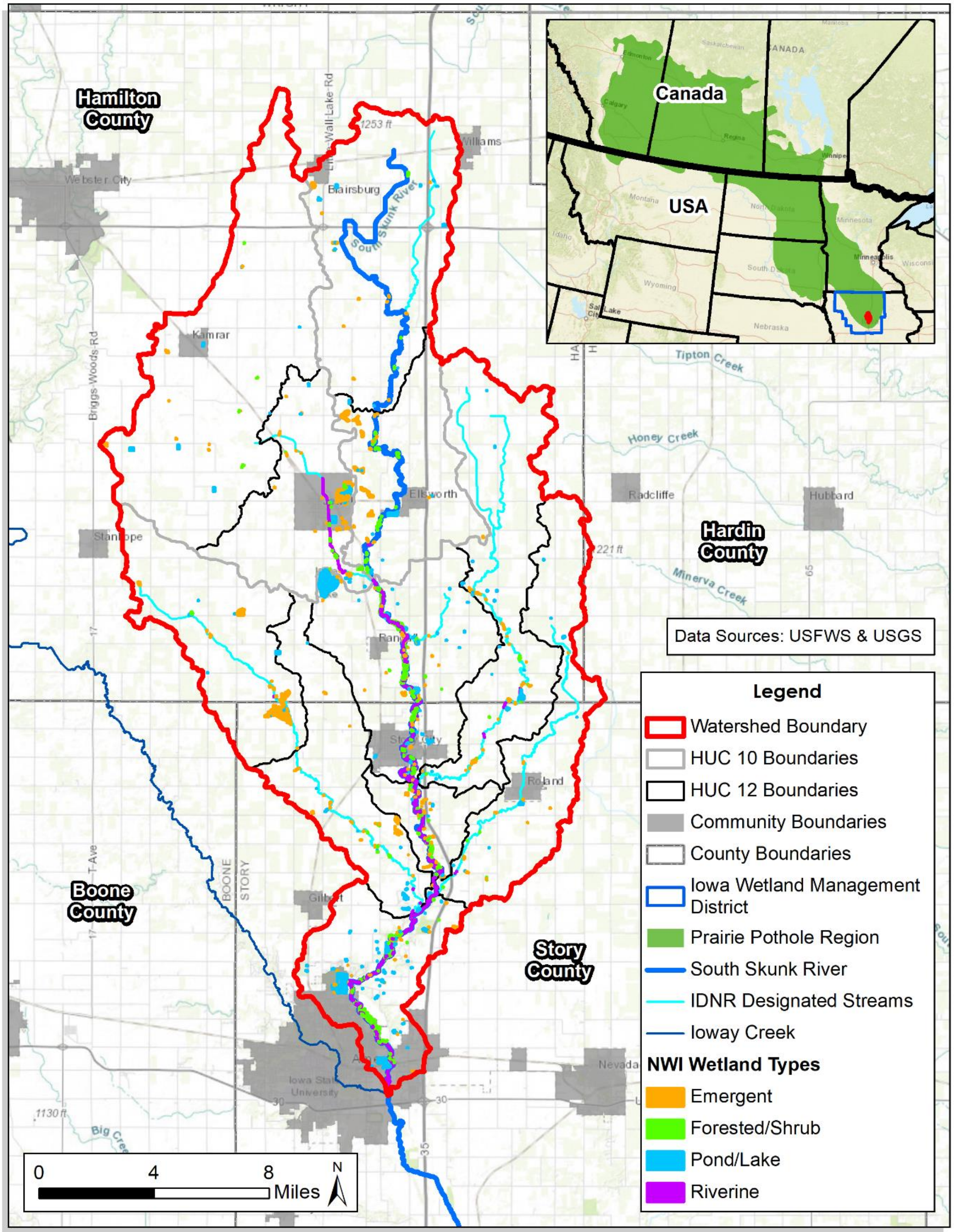


Figure 19: Wetlands Overview Map

Prairie Pothole Region

The watershed is located within the larger Prairie Pothole Region (PPR) (Figure 19). Prior to agricultural drainage, the PPR region contained abundant wetlands, many associated with "prairie potholes" or "kettles” evident from the General Land Office (GLO) surveyors’ maps and notes. The numerous potholes and depressional areas throughout the area historically formed a unique hydrologic system. While subtle features on the ground, the linked depression systems stand out as dark web-like patterns when viewed from the air. Historically, these depressions provided an infiltrative hydrology, allowing surface water to be collected, stored, and gradually released to larger streams and underground aquifers (USFWS, 2014).

Today, the landscape looks much different, dominated by agriculture that consists primarily of corn and soybeans. This alteration has led to an imbalanced hydrological regime. In the upstream or headwater portion of small streams, water moves off the land much faster, allowing greater stream bank and bed erosion, creating increased transport and deposition of sediment, nutrients, and other pollutants, along with more severe flooding downstream. Draining of wetlands has lowered the water table, causing natural underground springs and small streams to stop flowing. Most of these hydrological changes have occurred within a human lifetime (USFWS, 2014).

Through drainage practices, the Des Moines Lobe has been left with 3 to 4 percent of its original wetland area, which was approximately 44 percent of the total land area of the Des Moines Lobe (Arenas, 2020). Based on current land use estimates, that number has been reduced to approximately 3% of the watershed.

This area of Iowa falls within the Iowa Wetland Management District (WMD), as shown in Figure 19. The Iowa WMD consists of scattered tracts of habitat (both wetland and upland grassland) known as Waterfowl Production Areas (WPAs). Currently, there are 75 WPAs in 18 counties in north-central Iowa totaling just over 25,000 acres primarily managed by the IDNR. Even though district acquisition has only occurred in 18 counties to date, a larger 35-county boundary is approved. This boundary follows the historic range of the PPR (USFWS, 2014).

The Iowa WMD, like many other WMDs, was established in 1962 by the USFWS to effectively manage the increasing number of WPAs being acquired with funds from the 1934 Migratory Bird Hunting Stamp Act (also known as the Duck Stamp Act). WMDs were established not only to manage all the WPAs in a multi-county area, but also to work closely with the private landowners, government and nongovernment organizations, businesses, and other federal agencies in their districts to improve wildlife habitat. Uniquely in Iowa, it was decided that while the USFWS would provide federal Duck Stamp funds for land acquisitions, the IDNR would supply the personnel necessary to restore and manage the WPAs (USFWS, 2014).

Management within the Iowa WMD is also coordinated with the Prairie Pothole Joint Venture (PPJV) which was created in 1987 under the North American Waterfowl Management Plan. The PPJV is one of nearly two dozen Joint Ventures dedicated to habitat conservation across North America. Joint Ventures provide a framework for partnerships between various organizations, to work cooperatively on conservation projects, from research and planning through implementation, evaluation, and monitoring.

The PPJV is a voluntary, self-directed partnership that functions as a network of partners at the local, regional, national and international levels. The partnership involves federal and state agencies, non-governmental conservation groups, private landowners, scientists, universities, policy makers, resource managers, corporations interested in conservation, and others interested in prairie habitat conservation. Partners pool their resources and knowledge to accomplish more jointly than they could by working on their own.

ARTIFICIAL DRAINAGE

The Des Moines Lobe is one of the most agriculturally productive areas in the region. This has been made largely possible through artificial drainage of the landscape. Due to the relatively flat landscape of the watershed and lack of natural drainageways, nearly all of the watershed is subject to some form of man-made drainage through a combination of drainage district projects and field tiling. This artificial drainage has allowed countless acres of wetlands and other wet areas to be converted and used for agricultural production. The reclamation process is completed through the removal of surplus groundwater from surface soils to provide optimal conditions for row crop growth.

An overview of this artificial drainage system is important in understanding the overall hydrology of the watershed and how water quality is affected.

Drainage of permanent and seasonal surface water from the landscape in lakes, ponds, wetlands, and potholes generally involves channelization of existing rivers, installation of tile drainage, and construction of drainage ditches to connect depressional areas to natural streams. Shallow groundwater is drained from fields with the uniform placement of field tiles that connect to a main drain. Field tiles can be made from clay, concrete, cement, aluminum, iron, steel, or plastic (Garvin, 2017).

To assist landowners in draining their fields, drainage districts have been created through authority granted by the Iowa Legislature and Constitution. Drainage districts are governed by a board of trustees. Typically, the county board of supervisors (where the district is located) serves as those trustees. The basic purpose of the drainage district is to provide and maintain facilities for draining the excess water in a watershed area. Figure 20 illustrates the estimated extent of drainage districts across the watershed.

While a drainage district is responsible for larger drainage infrastructure, landowners are responsible for the installation and maintenance of tiling infrastructure on their property. The estimated extent of privately tiled fields (estimated based on soil data) is shown in Figure 20. These tile lines are generally buried 3-5 feet below ground level. The tile system is necessary to move excess water from fields to streams or drainage ditches, as illustrated in Figure 21.

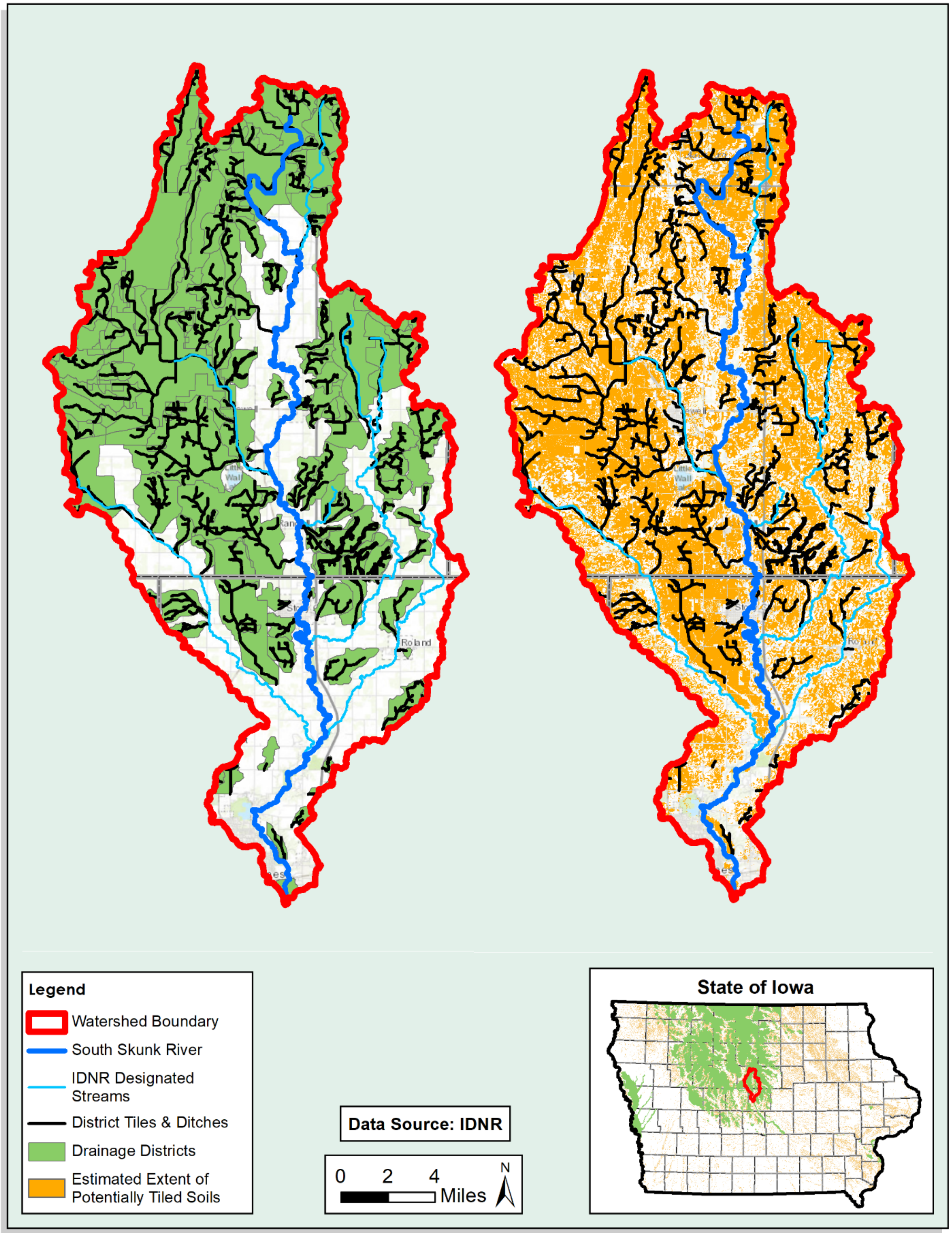
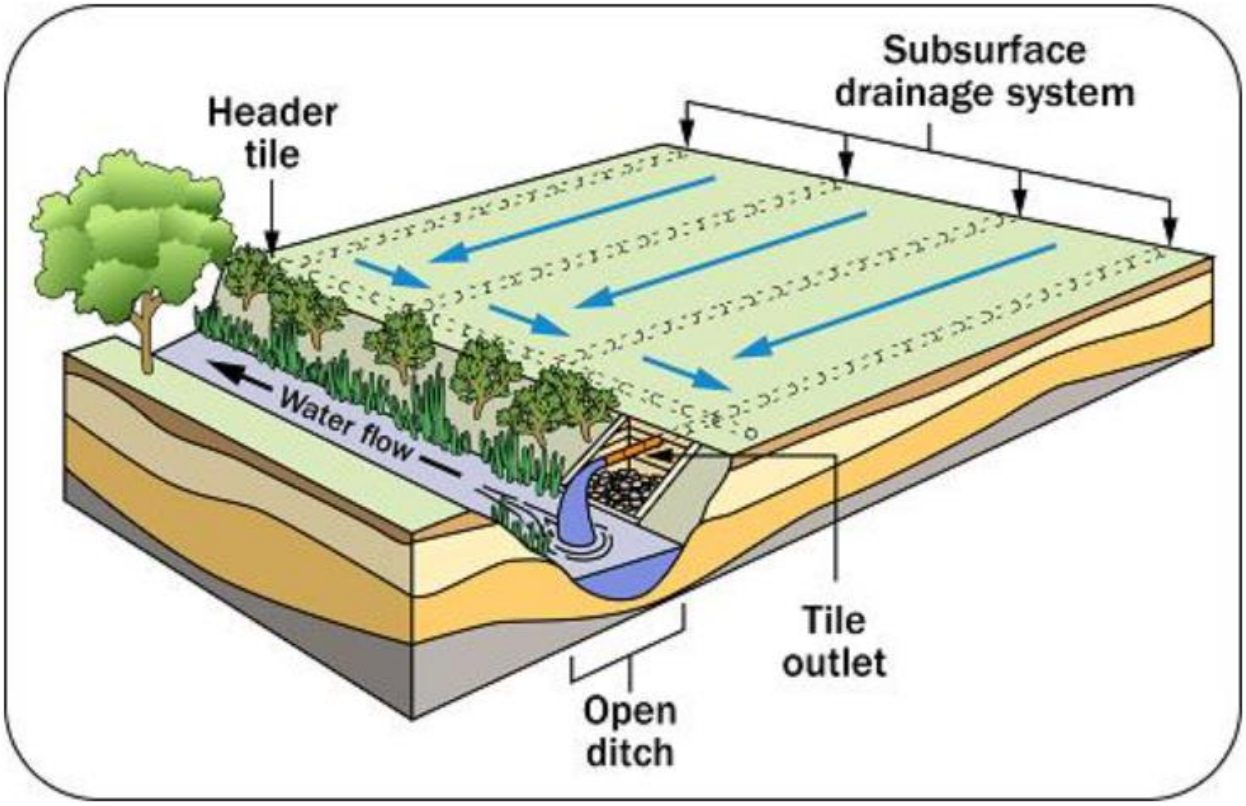


Figure 20: Estimated Extent of Tiled Fields, Drainage Districts, and Ditches

Some documentation of tiling installations, including private locations, is kept by county recorders, NRCS offices, landowners, or contractors. However, the available knowledge of the full extents of both private tiling systems and county drainage district infrastructure and drainage areas is limited due primarily to dated record keeping. The information presented in this plan only provides the reader with a general understanding of this system. For project level planning involving drainage infrastructure and tile lines landowners and county records should be consulted and corroborated with an on-the-ground assessment.



Source: Vander Veen, 2019

Figure 21: Conceptual Illustration of a Tile Drainage System

While there are many agricultural benefits to drainage, the effects on streamflow and water quality can be serious. Field tiling and drainage infrastructure lower water tables and quickly remove water from saturated soil. Water from field tiles flows into ditches and streams much more rapidly than would naturally occur. Increased streamflows can result in increased stream erosion. Additionally, flushing water from fields faster increases the risk of nutrients (especially nitrogen) being carried away and harming downstream water quality. While tile drainage presents unique challenges to watershed management, there are many new and innovative practices that can be implemented to mitigate these effects. These are discussed more in Chapter 5, but include practices such as saturated buffers, drainage water management structures, and bioreactors.

2.08 STREAM MONITORING NETWORK

The stream monitoring network in the Headwaters of the South Skunk River Watershed is composed of multiple streamgages, sensors, and sampling sites. Multiple entities are responsible for maintaining sites, collecting data, and distributing this information to landowners, land managers, and the general public.

The main data sources of the monitoring network identified for this plan consists of the following. A map of these monitoring locations can be found in Figure 22. Streamflow data is discussed later in this chapter, while analysis water quality data is the focus of Chapter 3. It should be noted that the information presented here is not all inclusive and there may be other data sources and studies available, which are not summarized here. The watershed has a rich level of water quality data and sampling efforts should be continued and expanded to further understand the spatial and temporal patterns across the watershed.

IOWA DNR STREAM MONITORING

IDNR maintains a network of "fixed" stations to monitor ambient water quality data across Iowa. Currently, 60 stream sites are sampled year-round on a monthly basis. These sites have been monitored monthly since 1999. No active ambient sites are located within the watershed.

There are two sites on South Skunk River within the watershed that were reviewed for inclusion in this plan. Unfortunately, neither of these sites are currently active but are valuable for historical data.

- "South Skunk River Ames" is located on the South Skunk River in Story County near 170th Street and has a monitoring period of 1995-2017. The monitoring station ID is 12850007. Data at this site can be accessed at the following link: https://programs.iowadnr.gov/aquia//sites/12850007.
- "South Skunk River Upstream of Ames (US1)" is located on the South Skunk River just before Ames and has a monitoring period of 1999-2014. The monitoring station ID is 10850003. Data from this site was selected for use in this plan due to the many more monitoring results over the period of record, and the fact it is located closer to the outlet of the watershed than the other IDNR site. Data at this site can be accessed at the following link: https://programs.iowadnr.gov/aquia//sites/10850003

PRAIRIE RIVERS OF IOWA

Prairie Rivers of Iowa (PRI) is a non-profit organization that has partnered with Story County to complete multiple water quality monitoring efforts across the county and helped to develop the *Story County Water Monitoring & Interpretation Plan* (PRI, 2021).

There are six (6) sampling sites located within the watershed. All sites are monitored monthly and have a period of record from April 2020 to December 2021, and include:

- South Skunk River at Story City
- Long Dick Creek at 567th Street
- Bear Creek at Pleasant Valley Road
- Keigley Branch at 170th Street
- South Skunk River at West Riverside Drive
- South Skunk River at North River Valley Park

More information about PRI water quality monitoring efforts in Story County can be found here: https://www.prrcd.org/story-county-water-monitoring/

US GEOLOGICAL SURVEY (USGS)

The U.S. Geological Survey (USGS) manages 11 continuous water monitoring sensors in Iowa. These are primarily utilized for flow and discharge measurements, with some sites having water quality data. There are three (3) active monitoring sites located within the watershed:

- USGS 05469990 (Keigley Branch near Story City)
    - Period of record: 1966 – present
    - No water quality data available at this site.
- USGS 05469860 (Mud Lake Drainage Ditch 71 at Jewell)
    - Period of record: 1966 – present
    - Water quality data available from June 2019 to May 2021
- USGS 05470000 (South Skunk River near Ames)
    - Period of record: 1901 – present
    - Limited water quality data available from 1972 – 2019

Due to the limited data available at these sites, they are not included in the water quality analysis of this plan. They are shown on Figure 22 for context but are not labeled since their data is not included. Additional information can be found here: https://waterdata.usgs.gov/ia/nwis/rt

CITY OF AMES

The City of Ames conducts water quality sampling at three (3) sites of interest (Figure 22):

- Ada Hayden Park – the multiple sampling points throughout the lake complex do collect water quality parameters that this plan is interested in, but the locations of these sampling points only represent the water quality in the lake and the contributing watershed, not the South Skunk River itself. Therefore, the data collected at Ada Hayden Park will not be used in this plan.
- Water Pollution Control Facility – This site has a long period of record; however, the location of the sampling site is downstream of the South Skunk River's confluence with Ioway Creek. Ioway Creek is a major tributary and brings in its own pollutants from a sizable watershed. Therefore, the samples collected at this site do not inform us as to the water quality in the Skunk River alone and will not be used for this plan.

- North River Valley Park – this site is a good candidate for inclusion in the plan, however, data is only available for the last two years at this site. This overlaps with the period of record provided by Prairie Rivers of Iowa. Therefore, the data collected at this site will not be used.

While the water quality data collected at these sites may be useful for future planning efforts, inclusion of this data does not add to the understanding of the water quality presented in this plan and thus has not been used. Additional information can be found here:

- https://www.cityofames.org/government/departments-divisions-i-z/water-pollution-control/urban-stream-monitoring
- https://www.cityofames.org/government/departments-divisions-i-z/water-pollution-control/ada-hayden-water-quality-monitoring

STORY COUNTY WATER QUALITY MONITORING PROGRAM (SCWQMP)

The SCWQMP is a volunteer water quality monitoring program that began following the development of the *Story County Water Monitoring and Interpretation Plan* (PRI, 2021). The program collects chemical water quality data and monitors aquatic macroinvertebrates, as it follows the Izaak Walton League of America Save Our Streams processes and procedures. Programs such as this are a great way to involve and educate the general public on watershed issues, while collecting useful water quality data. However, this data was not included in this plan due to the short period of record available and because this plan focuses on the larger HWSSR watershed, and adequate data is available at that scale. Additional information can be found here: https://www.storycountyiowa.gov/1536/Water-Quality-Monitoring

IOWA FLOOD CENTER (IFC)

The IFC manages a continuous water monitoring network of 60 high frequency, in-stream real-time monitoring sensors across Iowa. IWQIS allows access to real-time water-quality data and information such as nitrate, pH, and dissolved oxygen concentrations, discharge rates, and temperature. There no monitoring sites located within the watershed. The nearest site is located on Ioway Creek. The nearest site located on South Skunk River is at Bondurant, Iowa.
Data from these sites can be found on the Iowa Water Quality Information System (IWQIS): https://iwqis.iowawis.org/

MONITORING GAPS

Review of existing monitoring data revealed a monitoring gap between the Hamilton and Story County areas of the watershed. Tributary level monitoring is relatively robust in Story County, due to the data provided by PRI – this should be continued to build a long-term record. However, no monitoring network is present in Hamilton County. Filling this data gap will help to better locate and quantify pollutants and prioritize BMP implementation efforts. It is recommended that a monitoring program similar to that in Story County be established in Hamilton County.

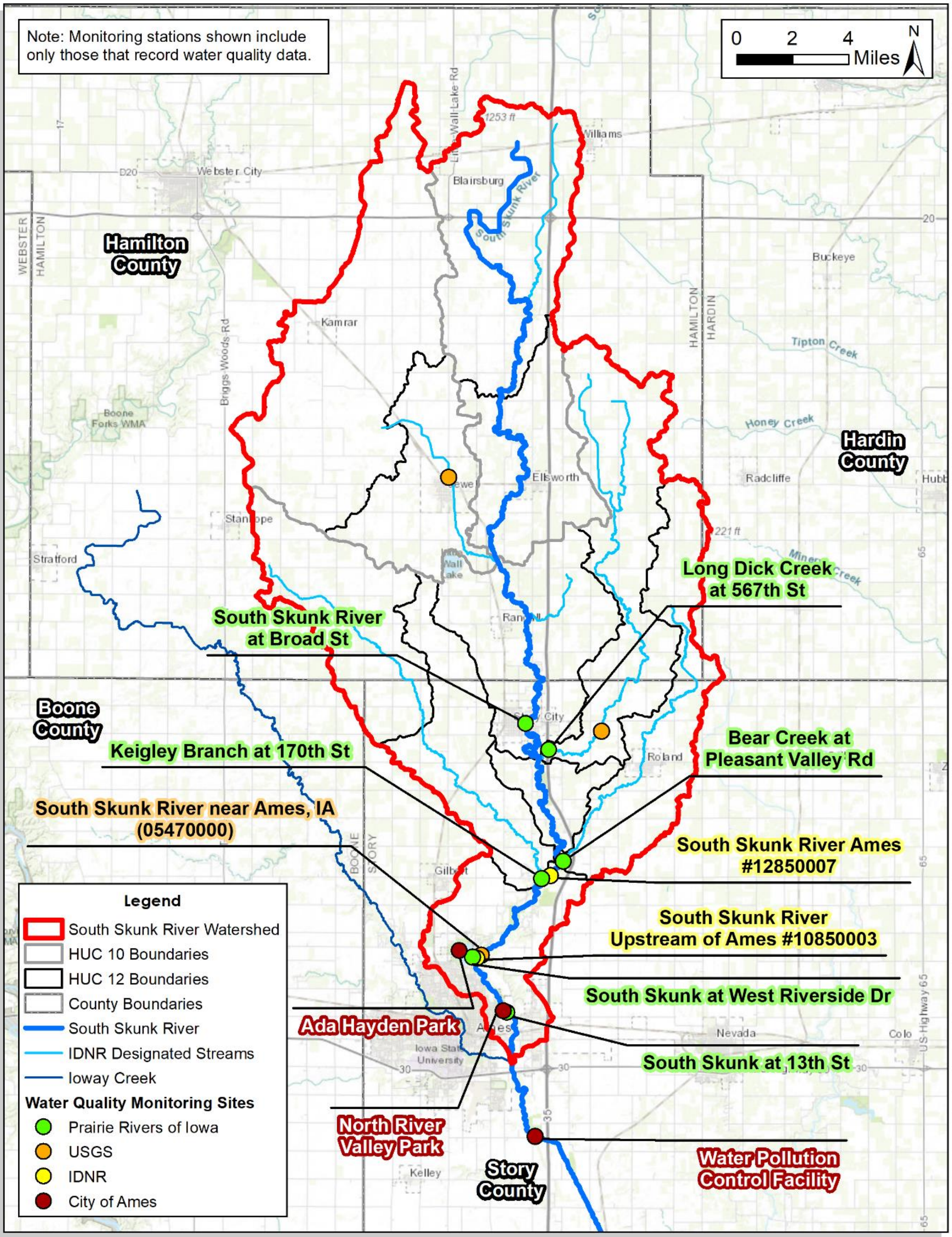


Figure 22: Water Quality Monitoring Sites in the Watershed

2.09 HYDROLOGY

HYDROLOGIC CHARACTERISTICS

Characterizing the hydrologic regime of a watershed is an important step to understanding how land and water use practices influence flooding and water quality. This understanding is also critical to building appropriate hydrologic models of the watershed. *Figure 23* contains a conceptual hydrograph and cutaway which illustrates key hydrologic concepts. When the hydrologic system experiences changes, the stream system responds with changes in physical, chemical, and biological parameters. For example, land use changes may lead to increased runoff or increased flooding and reduced streambank stability which may, in turn, alter chemical and physical water quality parameters, and ultimately degrade the biological ecosystem or human uses of the stream.

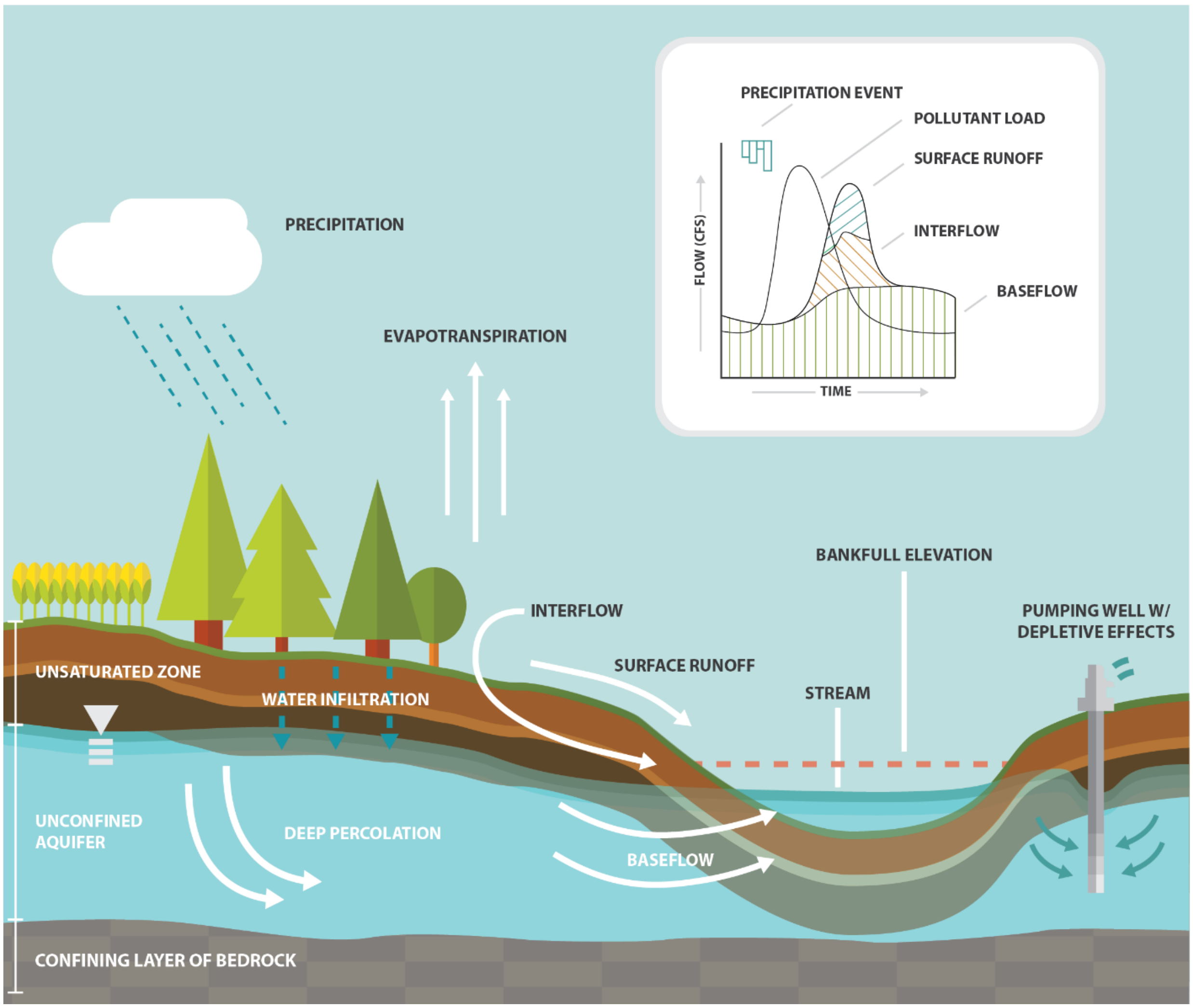


Figure 23: Conceptual Illustration of Key Water Cycle Parameters

Hydrologic processes are complex, involving many interactions that can be difficult to quantify. Additionally, impacts may be seen on both temporal and spatial scales. The location, extent, timing, and type of activities all play a role in alterations. Changes can be seen in the magnitude and timing of peak and low flows, or in year-to-year flow trends. Some activities (roads, seasonal irrigation withdrawals, etc.) cause short-lived alternations, while other activities (dams, urbanization, channelization, groundwater mining, etc.) can cause long-term changes in the hydrology of a watershed (EPA, 2003).

CHANGES IN WATERSHED HYDROLOGY

Several factors have been discussed which have changed the natural watershed hydrology over time, including land use changes (from native prairie to cities and agricultural production) and artificial drainage of wetlands and shallow groundwater. However, the Midwest, including Iowa has begun to experience more volatile and variable weather events and conditions, including increased spring rainfall, more frequent 100-year floods, and more frequent and intense drought conditions (USDA-ISU, 2011). Future watershed management decisions, including design and selection of conservation practices or flood mitigation projects will need to take these changes into account.

A summary of the watershed's hydrology is included below; however it is recommended that a hydrologic study focused on the watershed be completed. This should also include a more detailed review of climate and streamflow data be completed to better understand changing trends and implications on future projects. This study could be similar in scope to a study that was recently completed on the nearby Des Moines River, the *Des Moines River Upstream Mitigation Study.* This new study would be a powerful tool for better understanding and defining the complicated hydrologic system of the watershed, which in turn could help to inform efforts towards water quality modeling, stream restoration, and flood mitigation.

LONG-TERM STREAMFLOW TRENDS

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

To understand a typical hydrologic cycle and streamflow regime within the watershed, a representative streamgage was identified to review streamflow record. The USGS streamgage located on the South Skunk River near Ames (05470000), shown in Figure 23, has a respectable period of record of 1920-present (1920 – present was available for download and analysis, however, there was a notable data gap from 1990 - 2002). This location is downstream to much of the planning area, but it is notably just north of Ames, making it less susceptible to flashier urban runoff trends. However, while representative of the area and long-term trends, it should be noted that all streams have unique responses to storm events due to variability in precipitation patterns and effects of terrain, soils, and land use. This creates both local and regional flow patterns. Additionally, the hydrology of the watershed is affected significantly by artificial drainage.

A review of the discharge data for the South Skunk River demonstrates a few trends which provide a basic understanding of the dynamic hydrologic cycle of the planning area:

- Streamflow can vary considerably day-to-day, as precipitation is the most significant water supply to the planning area (Figure 24).
- A predictable seasonal pattern can be seen in streamflows. There is an increase in runoff in late winter/ early spring caused by snowmelt, leading to increased streamflows. There is also an increase in streamflows during the late spring and early summer storm season.
- A long-term trend of increase in streamflows has been noted across the Midwest (Brown and Caldwell, 2012). The trend at this site follows that pattern and has increased roughly threefold over the course of the observation period.
- There are long-term patterns of wet and dry periods, as seen in the running 5-year average (Figure 25). In the last 20 years, the highest daily average streamflow recorded was 12,400 cubic feet per second (CFS) in August 2010, or a crest of 19.04 feet (well above the major flood stage of 16.5 feet). The lowest daily average was 0.1 CFS in September 2012. The long-term average flow is 194 CFS, or nearly 4 feet in depth.
- Streamflows are seasonally predictable across the planning area, but less predictable during high flow/ flood events due to natural and anthropogenic impacts which vary across subwatersheds.

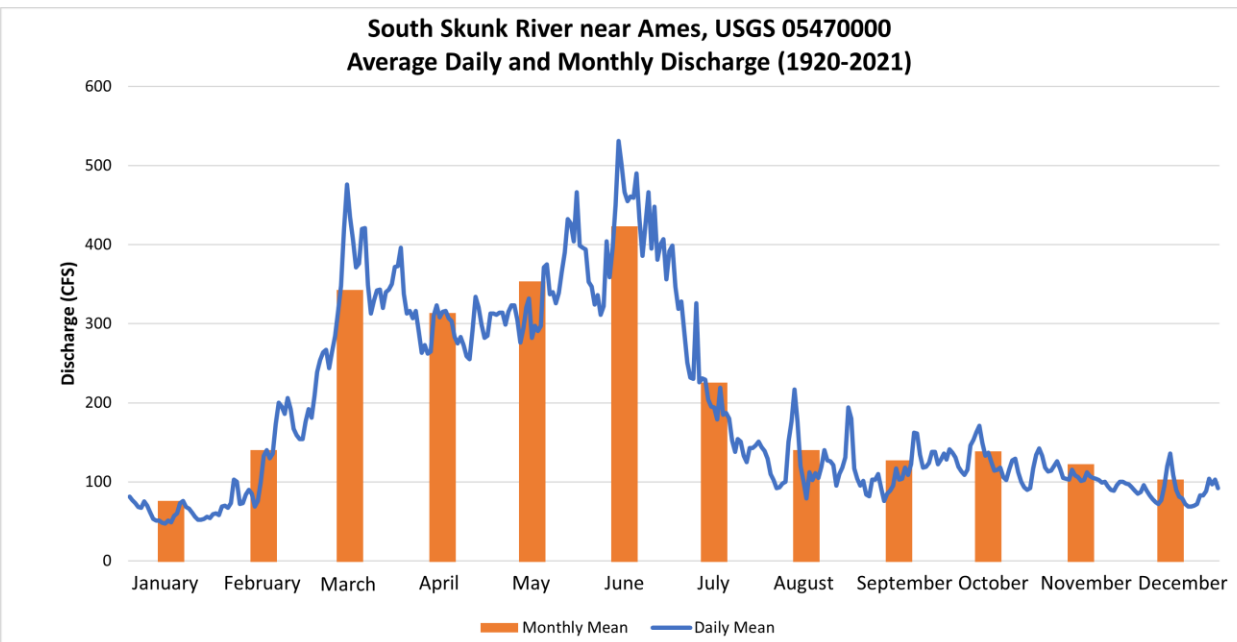


Figure 24: Streamflow Hydrograph of an Average Year for the South Skunk River

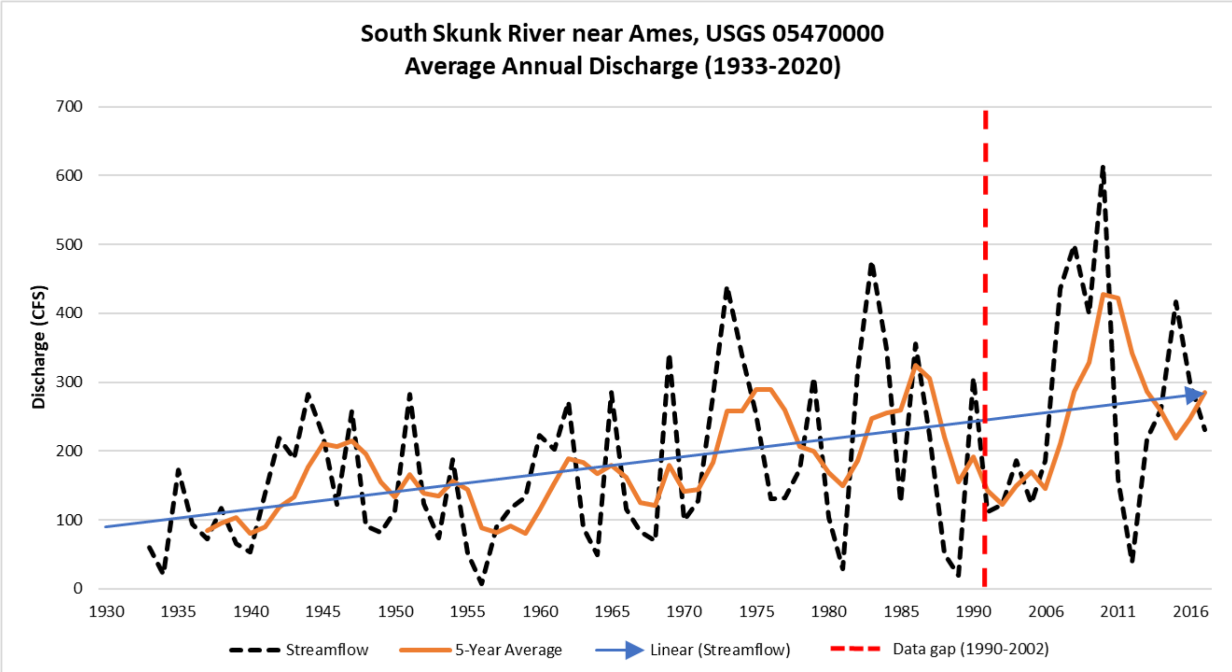


Figure 25: Long Term Streamflow Hydrograph for the South Skunk River

FLOODING

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

Understanding these hydrological conditions is important to making management decisions regarding watershed planning, especially in regard to stream restoration and management practices. However, extremely high flows may cause flooding, which may cause damage to infrastructure, homes, businesses and other property; lead to losses in crops; and endanger human life. Balance is needed in the management of streams.

The *Des Moines River Upstream Mitigation Study* Report provides a helpful summary of the overall nature of flooding within Iowa, and is applicable in this watershed:

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

others. These two events stand out from the rest when looking at the extent of the area impacted, recovery costs, precipitation amounts, and streamflows recorded.

A review of data from the USGS streamgage (05470000) located on the South Skunk River near Ames provides an indication as to the magnitude and frequency of flooding that occurs in the planning area. Gage height data, which indicates the depth of water in the stream channel, was reviewed against the National Weather Service's (NWS) designated "flood stage", which is set at 12.5 feet. Figure 26 shows that since 2007, the gage has recorded the river reaching the NWS flood stage 26 separate times during nine events (2008, 2010, 2013, 2014, 2015, 2019). The stream has been above its average level (3.96 feet) on 14 occasions where it is considered to be at the action stage, between 11 to 12.5 feet.

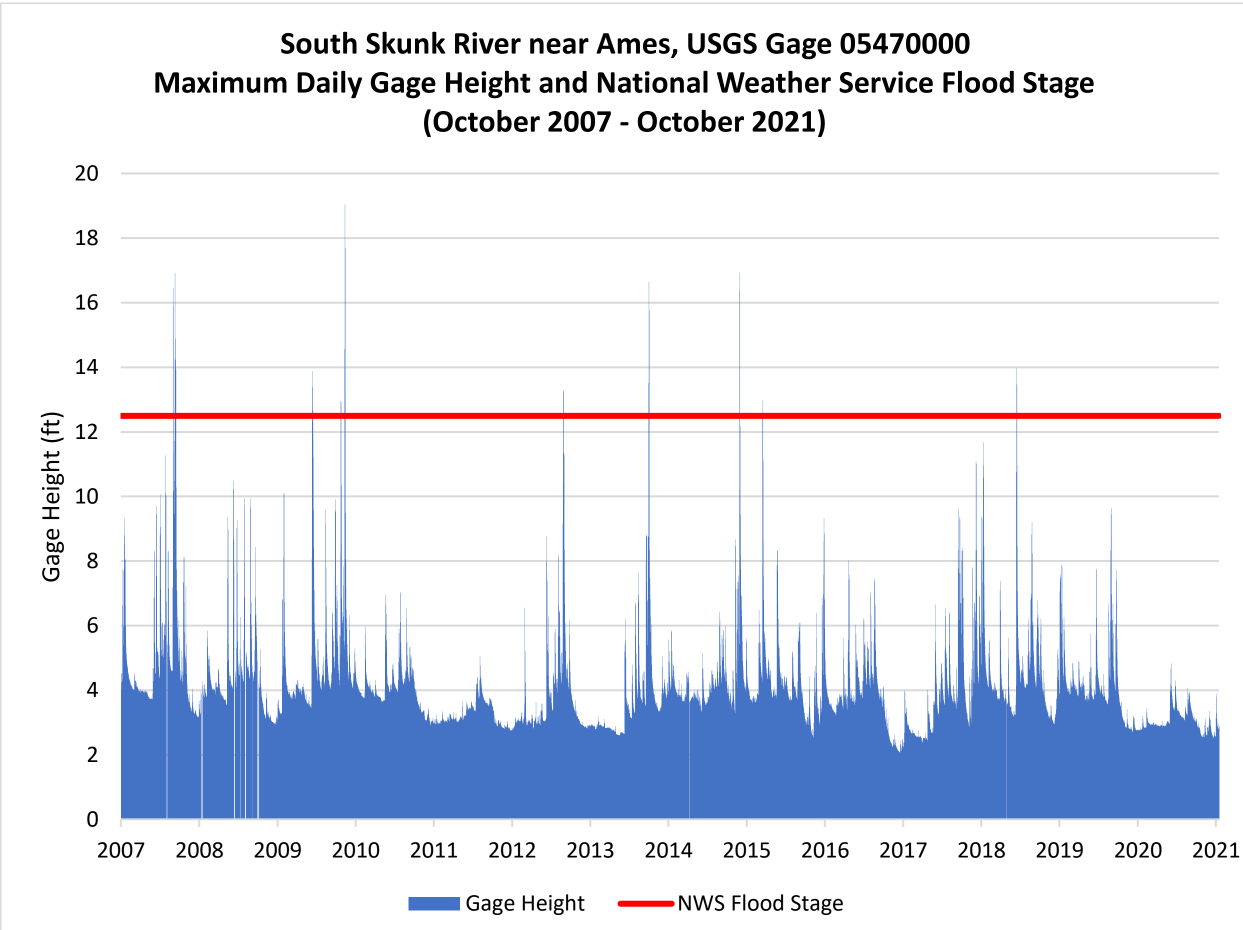


Figure 26: Maximum Daily Gage Height and Flood Stage Records for the South Skunk River

FLOODPLAIN AREA

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

The “100-year floodplain” is illustrated in Figure 27. The “100-year floodplain” is defined by FEMA as the area which has a 1 in 100 (1% probably) of being equaled or exceeded in any given year. FEMA is responsible for delineating this area utilizing hydrologic data and identifying base flood elevations (BFE). Generally, flood insurance and community zoning ordinances are based on a property’s location in relation to the 100-year floodplain. In some areas within the watershed, a regulatory “floodway” has also been established. Floodways are areas that must not be encroached upon to prevent the BFE from increasing by more than one foot. While almost any area in the watershed is at some level of risk for flooding, regulatory floodplains and floodways have been mapped and formally acknowledged by FEMA.

Historically, cities have been developed along waterways for various reasons such as transportation and commerce. As a result, these population centers are at an increased risk to flooding. The same is true in this watershed as many of its cities are located along the South Skunk River or its tributaries. The degree of flood risk for each community varies considerably based on topography, watershed size, flood control structures, land use, or other factors. Chapter 3 presents information on flood risks within the watershed, and Chapter 5 provides flood mitigation recommendations.

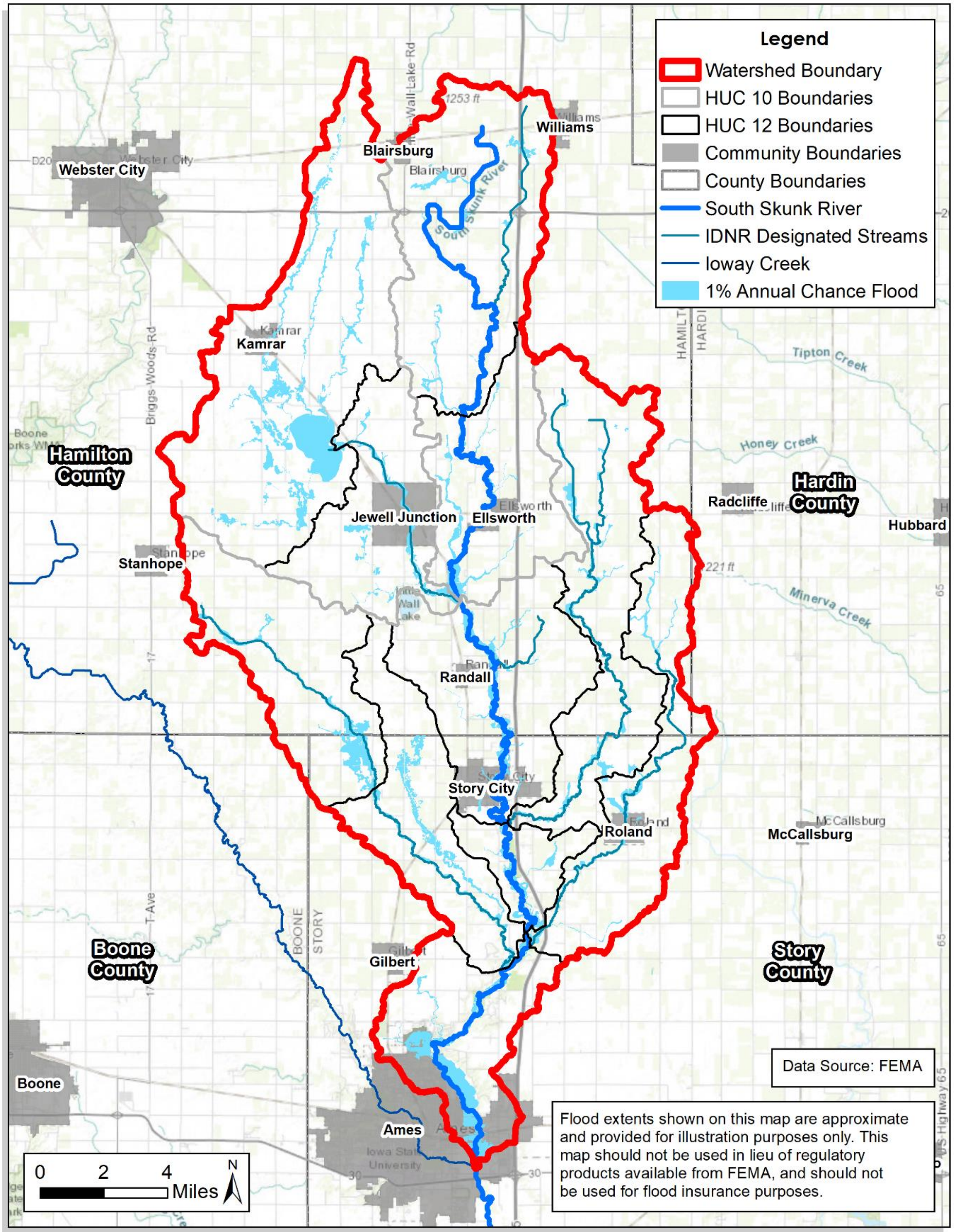


Figure 27: Map of FEMA Delineated Floodplains

2.10 WILDLIFE, HABITAT, AND PUBLIC ACCESS

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

Land protection provides a range of benefits, including increased wildlife habitat, recreational opportunities for humans, and maintaining or restoring ecosystem functions such as water filtration, flood abatement, carbon storage, etc. (Reeder and Clymer, 2015). Where opportunities to enhance water quality or flood resilience, as identified in this plan, overlap with opportunities to conserve wildlife and habitat or expand recreational access, the likelihood of success is higher. Addressing multiple goals provides opportunities for project partnering and opens additional funding avenues for projects. The HWSSR WMA should look for these opportunities and work with partners towards realizing them.

Hamilton and Story County have completed various natural inventory surveys that may provide valuable data for specific project sites. These are referenced below for future use:

- Inventory of Vascular Flora in Hamilton County (Thompson, 2007)
  - A botanical survey of the vascular flora of Hamilton County was performed between 2001 and 2004. The results are important to conservation efforts throughout the county.
- Story County Natural Areas Inventory
  - Phase 1 (completed in 2017) is the identification of potential natural areas using remote sensing (air photos) along with previously collected data
  - Phase 2 (completed in 2022) is the ground survey to visit sites identified in Phase 1 and evaluate the Quality of Naturalness and Biodiversity within these sites

A map of all public lands is shown in Parks and Natural Areas within the Watershed. This includes areas that are owned or managed by various entities. Each may have different requirements for public access and allowed activities. The following websites provided interactive, online mappers where more details for each area can be viewed:

- https://www.fws.gov/refuges/find-a-wildlife-refuge/
- https://www.iowadnr.gov/Hunting/Places-to-Hunt-Shoot
- https://www.mycountyparks.com/

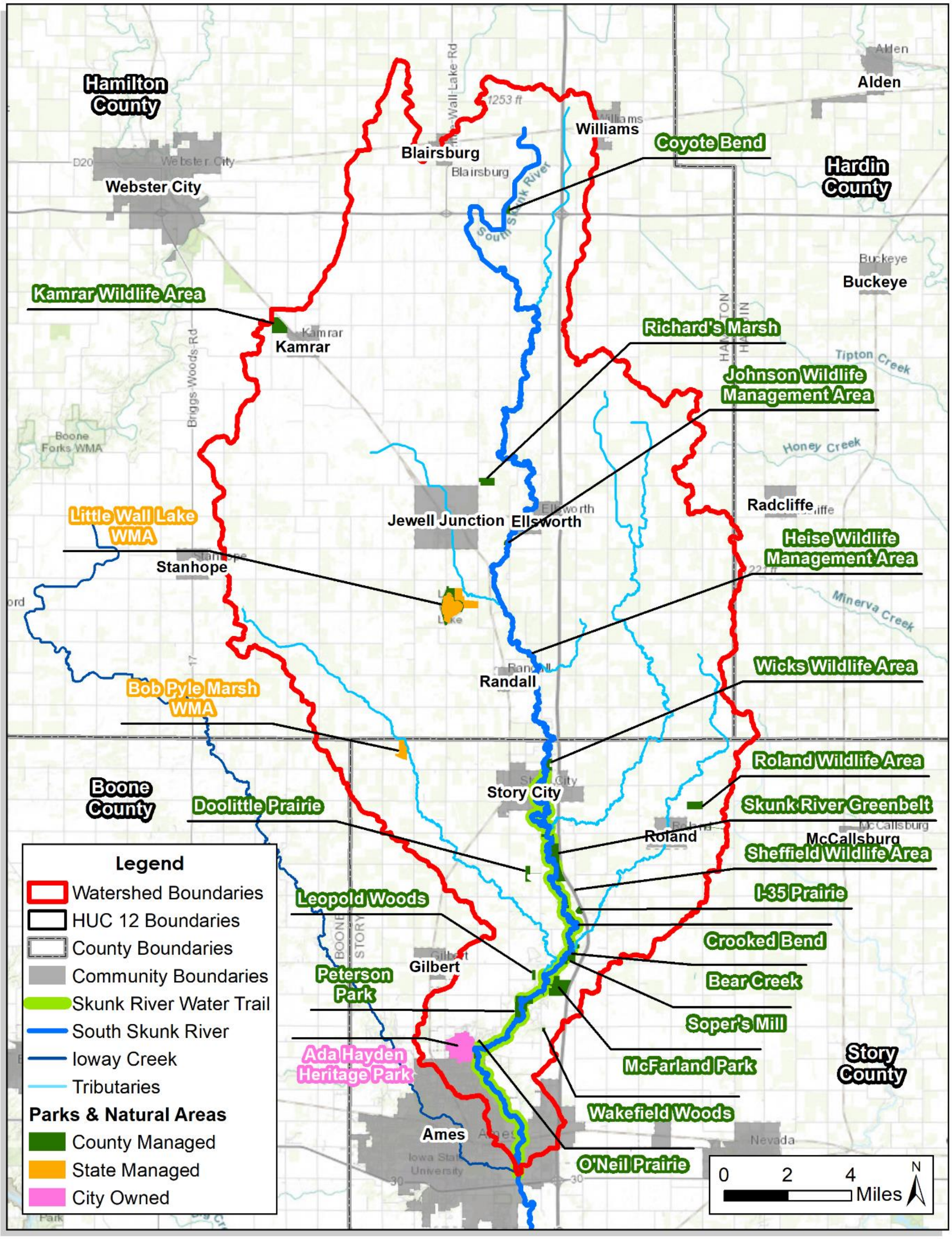


Figure 28: Parks and Natural Areas within the Watershed

SOUTH SKUNK RIVER WATER TRAIL

A portion of the South Skunk River, from Story City to Cambridge (downstream of the HWSSR WMA), is considered a state water trail (Figure 29). Water trails are recreational corridors and routes on rivers and lakes that provide a unique experience for canoeists and kayakers access to riverside campgrounds and other amenities like shelters and restrooms in city, county, or state parks (IDNR, 2010). Iowa water trails are developed to produce "low or no impact on the stream and riparian, or stream-edge, ecosystems" (IDNR, 2010).

Figure 29: Map of the South Skunk River Water Trail

This stretch of the South Skunk River within Story County was designated as a State Water Trail in 2020 to highlight the quality of recreational opportunities along this stretch of the river. In 2009, 313 trips were reported to the segment of the water trail that lies within the HWSSRWMA area. Major activities of these trips included usage of trails (80.5%), relaxing or picnicking (67.1%), wildlife watching (48.6%), and kayaking or canoeing (25.6%), among other activities (Wagner and others, 2016).

IOWA WILDLIFE ACTION PLAN

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

Habitat availability, quantity, and quality are primary factors influencing the viability of wildlife populations (IDNR, 2015). While the plan lays out several conservation related visions, strategies, and actions, they are not specific to the watershed and are not specifically designed to be solely implemented by the IDNR. They are designed to provide a broad framework of actions that can be undertaken by all levels of government, private organizations, and private citizens. They will take a broad array of funding sources, skills, expertise, and partnerships to implement. The plan lays out three general approaches that should be undertaken. The following one is where most opportunities exist for projects and partnerships within the HSSRWMA, particularly in the context of implementing this watershed management plan:

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

THREATENED AND ENDANGERED SPECIES

Identifying specific locations of Threatened and Endangered (T&E) species in the watershed was outside the scope of this planning effort. However, the ranges of both federal and state listed species overlap with the watershed. It is recommended that project sponsors consult with the United States Fish and Wildlife Service (USFWS) and IDNR for specific project sites where threatened or endangered species' habitats may exist. *Table 15* identifies federal T&E species which can be found in the watershed.

Table 15: Federally Listed Threatened and Endangered Species in the Watershed

Type	Common Name	Scientific Name	Status
Mammals	Northern Long-eared Bat	*Myotis septentrionalis*	Threatened
	Indiana Bat	*Myotis sodalist*	Endangered
Fishes	Topeka Shiner	*Notropis topeka (=tristis)*	Endangered
Insects	Monarch Butterfly	*Danaus plexippus*	Candidate
	Rusty Patched Bumble Bee	*Bombus affinis*	Endangered

Flowering Plants	Prairie Bush-clover	*Lespedeza leptostachya*	Threatened
	Western Prairie Fringed Orchid	*Platanthera praeclara*	Threatened

Source: USFWS, 2022

Table 16 lists the state threatened and endangered species for Hamilton and Story Counties, which contain the majority of the watershed. Some of these species overlap with federally listed species. Due to the county-level boundaries, not all of these species are necessarily found within the watershed. Additional species of special concern can be found through the IDNR interactive tool at https://programs.iowadnr.gov/naturalareasinventory/pages/Query.aspx.

Table 16: State Listed Threatened and Endangered Species in the Watershed

Type	Common Name	Scientific Name	Status
Amphibians	Mudpuppy	*Necturus maculosus*	Threatened
Birds	Barn Owl	*Tyto alba*	Endangered
	Northern Harrier	*Circus cyaneus*	Endangered
	Red-shouldered Hawk	*Buteo lineatus*	Endangered
	Short-eared Owl	*Asio flammeus*	Endangered
Fish	Black Redhorse	*Moxostoma duquesnei*	Threatened
	Blacknose Shiner	*Notropis heterolepis*	Threatened
	Topeka Shiner	*Notropis topeka*	Threatened
Freshwater Mussels	Creek Heelsplitter	*Lasmigona compressa*	Threatened
	Creeper	*Strophitus undulatus*	Threatened
	Cylindrical Papershell	*Anodontoides ferussacianus*	Threatened
	Pistolgrip	*Tritogonia verrucose*	Endangered
	Round Pigtoe	*Pleurobema sintoxia*	Endangered
Mammals	Indiana Bat	*Myotis sodalis*	Endangered
	Southern Bog Lemming	*Synaptomys cooperi*	Threatened
	Spotted Skunk	*Spilogale putorius*	Endangered
Plants (Dicots)	Buckbean	*Menyanthes trifoliata*	Threatened
	Canada Plum	*Prunus nigra*	Endangered
	Pink Milkwort	*Polygala incarnata*	Threatened
	Prairie Bush Clover	*Lespedeza leptostachya*	Threatened
	Shining Willow	*Salix lucida*	Threatened
	Silverweed	*Potentilla anserina*	Threatened
Plants (Monocots)	Arrow Grass	*Triglochin maritimum*	Threatened
	Hooker's Orchid	*Platanthera hookeri*	Threatened
	Leafy Northern Green Orchid	*Platanthera hyperborean*	Threatened
	Oval Ladies'-tresses	*Spiranthes ovalis*	Threatened
	Showy Lady's Slipper	*Cypripedium reginae*	Threatened
	Western Prairie Fringed Orchid	*Platanthera praeclara*	Threatened
	Yellow Trout-lily	*Erythronium Americanum*	Threatened
Reptiles	Blanding's Turtle	*Emydoidea blandingii*	Threatened

Source: IDNR, 2022g

AQUATIC INVASIVE SPECIES

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

While there is not a complete list of locations where invasive species are found, IDNR maintains information on potential invasive species in Iowa. *Table 17* identifies aquatic invasive species which may be present within the watershed. Prevention is the strongest defense against invasive species. Posting signs or distributing educational information are some methods to prevent the introduction of these species into the watershed. However, if these or other invasive species are found to be in the watershed, future education efforts could be designed to target their reduction and/or elimination.

Table 17: Aquatic Invasive Species Which May Be Present Within the Watershed

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

Source: IDNR, 2021b

2.11 EXISTING POLICY AND REGULATIONS

STATE WATER QUALITY STANDARDS

The IDNR manages water quality for all surface waters within Iowa through the implementation of the state's Water Quality Standards (WQS). These standards include numerical standards for many potential water quality pollutants based on the waterbody's assigned beneficial use. When multiple uses are assigned to the same waters, the most stringent criterion for the appropriate pollutant or season applies. The WQS are found in Chapter 61 of the Iowa Administrative Code, and available at https://www.iowadnr.gov/Environmental-Protection/Water-Quality/Water-Quality-Standards.

Iowa's WQS are in place to protect the quality of surface water for human consumption, wildlife, industry, recreation, and other productive, beneficial uses. Beneficial uses are also protected by permits issued in accordance with both the requirements of these standards and for the applicable level of treatment or control for point and nonpoint sources of pollution. It should be noted that these standards apply to all surface waters of the State, except as noted in Chapter 61, even if they are not specifically assigned a beneficial use in Chapter 61. WQS can be both in numerical and narrative formats.

While there are many WQS which apply to both streams and lakes, the only WQS utilized for the development of this plan are identified in Table 18. Identification of impaired waterways and analysis of water quality conditions is provided in Chapter 3. This plan has been written to address nonpoint source pollutant loadings of bacteria (*E. coli*), nutrients (phosphorus and nitrogen), and sediment. While there are known point sources of pollution in the watershed, those fall under various regulatory authorities. This plan is based on voluntary actions only and therefore does not address regulated (point sources) pollution sources. It should be noted that no numerical WQS exist for nutrients or sediment, therefore separate benchmarks for these pollutants have been identified (discussed below). Goals for nutrient reductions have been identified through the Iowa Nutrient Reduction Strategy (discussed below), but these are not regulatory WQS.

Table 18: Summary of Water Quality Standards Applicable to this Plan

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

** Standard only applies March 15 – November 15*
Source: Iowa Administrative Code, 2019

OTHER WATER QUALITY BENCHMARKS

As previously stated, there are no numerical WQS in Iowa for nutrients or sediment. Therefore, several “benchmark” water quality criteria were identified (Table 19) in order to help the WMA assess water quality data. The following documents were utilized to provide these benchmarks:

- **Nutrients:** In 2001 EPA published recommendations for nutrient water quality criteria for rivers and streams across the country (EPA, 2000), based on ecoregions. These recommended criteria are not laws or regulations - they are guidance that states and tribes may use as a starting point for establishing criteria for their water quality standards. The watershed is located within Nutrient Ecoregion VI: Corn Belt and Northern Great Plains. The recommendation summarized a large dataset and established the median values of 0.7625 mg/L total phosphorus and 2.18 total nitrogen as the overall guidance values for the area. While this guidance has no regulatory significance in Iowa, it does serve as a useful benchmark to understand water quality conditions of streams.
- **Sediment:** Total Suspended Solids (TSS) is commonly used as a surrogate for sediment. A benchmark was identified through a methodology established by the Kansas Department of Health and Environment, who analyzed a large dataset of TSS data and associated biological monitoring data. A strong threshold relationship exists at 50 mg/L median TSS, above which streams are unlikely to support a rich diversity of aquatic life (KDHE, 2020). While this guidance has no regulatory significance in Iowa, it does serve as a useful benchmark to understand water quality conditions of streams.

Table 19: Summary of Nutrient Water Quality Benchmarks

Parameter	Water Quality Benchmark	Source
Total Nitrogen	2.18 mg/L	EPA, 2001
Total Phosphorus	0.7625 mg/L	EPA, 2001
Total Suspended Solids (TSS)	50 mg/L	KDHE, 2020

TOTAL MAXIMUM DAILY LOADS (TMDLS)

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

The only TMDL developed for a waterbody within the watershed is the 2005 Little Wall Lake TMDL for algae and turbidity. This TMDL was not utilized in the development of this plan because it focuses on a lake, whereas the focus of this watershed plan is on water quality in streams. Additionally, the TMDL was not developed for any of the pollutants of concern that this plan addresses. There are no TMDLs that have been developed for any of the streams within the HWSSR WMA.

Additional information on TMDLs can be found on the IDNR website:

https://www.iowadnr.gov/environmental-protection/water-quality/watershed-improvement/water-improvement-plans

SAFE DRINKING WATER ACT

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

NUTRIENT REDUCTION STRATEGY GOALS

The Iowa NRS has identified statewide goals for reducing nonpoint source pollution. Specifically, for nutrient reduction, the NRS has set statewide reduction targets from nonpoint pollution sources for nitrogen at 41% reduction and phosphorus at 29% reduction. These goals have also been adopted through other local watershed management plans across Iowa, including the watershed plan for neighboring Ioway Creek.

LOCAL ORDINANCES

Research was conducted to determine the presence of relevant floodplain, stormwater management, and pet waste management ordinances for cities and counties in the watershed. The results of this effort may help identify project opportunities for water quality improvements or flood mitigation. These results can be seen in *Table 20*. Government websites were reviewed for online copies of floodplain, stormwater management, and pet waste ordinances. If a community did not have a website, or their ordinances were not available online, efforts were made to contact a community representative via email, phone calls, or during stakeholder meetings.

Table 20: Status of Local Ordinances

Entity	Ordinance Type		
	Floodplain	Stormwater	Pet Waste
Ames	Yes	Yes	Yes
Blairsburg*	-	-	-
Ellsworth*	-	-	-
Jewell	No	Yes	Yes
Kamrar	No	Yes	Yes
Randall	No	No	Yes
Roland	Yes	Yes	Yes
Story City	No	Yes	Yes
Williams	No	No	No
Story County	Yes	Yes	No
Hamilton County	No	No	Yes

** Denotes a community did not respond.*

Floodplain Management

Floodplain ordinances can limit or prohibit development in flood-prone areas to help reduce the number of homes and businesses at risk of flooding. In fact, limiting development of floodplains is one of the most effective ways to lower a community's flood risk and reduce future damages. If local rules and regulations limit or prohibit development in flood-prone areas, there will be fewer buildings at risk of damage when floodwaters rise. It is recommended that all communities adopt a floodplain management ordinance that meets or exceeds the minimum National Flood Insurance Program (NFIP) requirements.

The NFIP is a federal program managed by FEMA that offers flood insurance to households and businesses throughout the United States. The NFIP is a voluntary program in which participating communities adopt and enforce minimum floodplain management regulations that limit development in the FEMA-defined 1% annual chance floodplain. In exchange, the federal government makes flood insurance available to all residents in that community.

Iowa DNR regulates construction in floodplains and floodways in the state and promotes the orderly development and wise use of Iowa's flood plains. Additional information and resources can be found at the following link:

https://www.iowadnr.gov/Environmental-Protection/Land-Quality/Flood-Plain-Management

Stormwater Management

Stormwater occurs when precipitation falls to the ground and runs along the surface until entering a storm drain or directly enters a stream or lake. In cities stormwater often makes its way to a stormwater system, typically consisting of pipes, ditches, culvert, outfalls, etc. before it is eventually discharged to streams. Typically, stormwater does not pass through a wastewater treatment plant before being discharged to a stream. Stormwater discharge from communities has been recognized as contributing to water quality degradation, flooding, and stream erosion.

Many cities in Iowa are required to have a permit for their Municipal Separate Storm Sewer Systems (MS4s) through the National Pollutant Discharge Elimination System (NPDES) administered by the IDNR. MS4 permits require cities who meet a specific population threshold to manage their stormwater. The only city in the watershed required to have an MS4 permit based on population size is the City of Ames. An overview of Ames' MS4 Stormwater Program can be found at the following link:

https://www.cityofames.org/government/departments-divisions-i-z/public-works/stormwater-program

While the other cities in the watershed are not required to have an MS4 permit, it is still recommended that they pass ordinances and develop projects or programs which address stormwater management. Additional information, including model (example) ordinances are available from the Iowa Stormwater Education Partnership, at the following link: https://iowastormwater.org/

Pet Waste Management

Pet waste management ordinances address a pet owner's responsibility to clean up any solid waste left behind by their animal on both public and private property. Pet waste can contribute bacteria, nutrients, and other contaminants to surface water during precipitation events. It is recommended that all communities adopt and enforce ordinances along with educational campaigns for pet waste clean-up.

2.12 SUMMARY AND RECOMMENDATIONS

This chapter provided an inventory of watershed resources and an understanding of the watershed's characteristics. This lays the groundwork for further analysis and exploration of watershed issues and what contributes to those – especially as it relates to opportunities to improve water quality.

While much data is available and summarized here, a few data gaps were identified. The following is a summary of recommendations found within this chapter that should be considered for completion prior to or during future updates of this plan.

- **Expand monitoring priorities into Hamilton County.**
  Current monitoring efforts by Story County SWCD and PRI have been successful in Story County and are valuable both for data collection and public outreach. Expanding these efforts into Hamilton County (or replicating them through a similar effort) would allow for a more holistic view of the watershed when assessing future data.
- **Complete a hydrologic assessment.**
  A focused hydrologic study should be completed. This should also include a more detailed review of climate and streamflow data be completed to better understand changing trends and implications on future projects. This study could be similar in scope to one recently completed on the nearby Des Moines River, the *Des Moines River Upstream Mitigation Study.* This new study would be a powerful tool for better understanding and defining the complicated hydrologic system of the watershed, which in turn could help to inform efforts towards water quality modeling, stream restoration, and flood mitigation.

CHAPTER 3. ASSESSMENT OF CURRENT CONDITIONS

3.01 INTRODUCTION

This section provides an overview of the current data available on water quality and watershed-wide inputs, including pollutants and best management practices intended to mitigate their effect. This data is assembled to form a picture of the watershed as it exists at this point in time. With this perspective, realistic and pertinent goals can be created for the future of the watershed.

For the purposes of this plan, monitoring data has been summarized from select sites to better understand overall watershed and stream conditions, especially as they related to sediment, nutrients (nitrogen and phosphorus), and E*. coli* water quality pollutants. Lake data has not been included in this scope.

3.02 WATER QUALITY ASSESSMENT

IMPAIRED WATERBODIES

Lakes and streams in the State of Iowa are assigned a designated use, which defines how a particular water body is or could be used. Water quality standards are then applied to each waterbody, based on the assigned designated uses. Table 21 shows the designated lakes and streams in the watershed. Note that different designated uses can be applied to each stream segment but have been combined within the table for readability.

On even numbered years the Iowa Department of Natural Resources (IDNR) prepares the *Impaired Waters List and Integrated Report* (IR), which also includes the 303(d) list (IDNR, 2022a). The 303(d) listing is composed of those lakes, wetlands, streams, rivers, and portions of rivers that do not meet all state water quality standards, which are considered "impaired waterbodies".

The most recently prepared IR (2022) was reviewed to identify the status of water quality conditions for each lake and stream segment in the watershed (IDNR, 2022a). Figure 30 summarizes the impaired lakes and streams in the watershed. Note that a single waterbody can be impaired for multiple reasons, and in the case of streams, at multiple locations or stream segments. Of the impaired waterbodies identified in Figure 30, only Little Wall Lake has a TMDL (IDNR, 2005).

Additional information on the 2022 IR can be found here:
https://programs.iowadnr.gov/adbnet/Assessments/Summary/2022

Table 21: Designated Waterbodies and their Uses in the Watershed

Name	Segment ID	Reach Description	Designated Uses
Bear Creek	03-SSK-958	Mouth to north line of S32 T85N R23W Story Co.	Primary contact recreation
	03-SSK-959	From north line of S32 T85N R23W (Story Co.) to confluence with unnamed tributary in NE 1/4 S23 T86N R23W Hamilton Co.	Primary contact recreation
Drainage Ditch 64	03-SSK-6238	From mouth (T88N R24W Sec25 Hamilton Co.) to headwaters (T89N R23W Sec28 Hamilton Co.)	Primary contact recreation
Drainage Ditch 71	03-SSK-963	Mouth (SE1/4 S11 T86N R24W Hamilton Co.) to confluence of Rahto Brach Ditch and Loop Branch Ditch in SE1/4 SE 1/4 S18 T87N R24W Hamilton Co.	Primary contact recreation
Keigley Branch	03-SSK-957	Mouth (S7 T84N R23W Story Co.) to confluence with unnamed tributary (AKA DD 1) in SE 1/4 SE1/4 S36 T85N R24W Story Co. (formerly designated for class B(W) uses).	Primary contact recreation
	03-SSK-1791	From confluence with unnamed tributary (AKA DD 1 SE 1/4 S36 T85N R24W Story Co.) to headwaters in S1/2 S9 T86N R25W Hamilton Co.	Primary contact recreation
Long Dick Creek	03-SSK-960	Mouth (S18 T85N R23W Story Co.) to N. line of S34 T86N R23W Hamilton Co.	Primary contact recreation
	03-SSK-2007	N. Line of S34 (SE1/4) T86N R23W Hamilton Co. to headwaters in NE1/4 S8 T87N R23W Hamilton Co.	Primary contact recreation
Unnamed Tributary to Long Dick Creek	03-SSK-6322	From mouth (SE1/4 S33 T87N R23W Hamilton Co.) to headwaters (T87N R23W Sec16 Hamilton Co.)	Primary contact recreation
South Skunk River	03-SSK-933	From confluence with Squaw [Ioway] Cr. (S12 T83N R24W Story Co.) to the Ames Water Works Dam in River Valley Park at Ames in S36 T84N R24W Story Co.	Primary contact recreation
	03-SSK-934	From the Ames Water Works Dam in River Valley Park at Ames (S36 T84N R24W Story Co.) to the Co. Rd. at north line of S6 T85 R23W	Primary contact recreation, fish routinely harvested for human consumption

Name	Segment ID	Reach Description	Designated Uses
		Story Co. (approximately 1 mile NNE of Story City)	
	03-SSK-935	From the north line of S6 T85 R23W Story Co. (Approximately 1 Mile NNE of Story City) to confluence with Drainage Ditch 71 in SE 1/4 S11 T86N R24W Hamilton Co.	Primary contact recreation
	03-SSK-936	From Drainage Ditch 71 (SE 1/4 S11 T86N R24W Hamilton Co.) to confluence with Drainage Ditch 63 in SE 1/4 S11 T87N R24W Hamilton Co.	Primary contact recreation
	03-SSK-937	From confluence with Drainage Ditch 63 (SE 1/4 S11 T87N R24W Hamilton Co.) to headwaters in S29 T89N R23W Hamilton Co.	Primary contact recreation
Unnamed Tributary to South Skunk River	03-SSK-6236	From mouth (SE1/4 S24 T86N R24W Hamilton Co.) to headwaters in NW1/7 S17 T86N R23W Hamilton Co.	Primary contact recreation

Source: IDNR, 2015

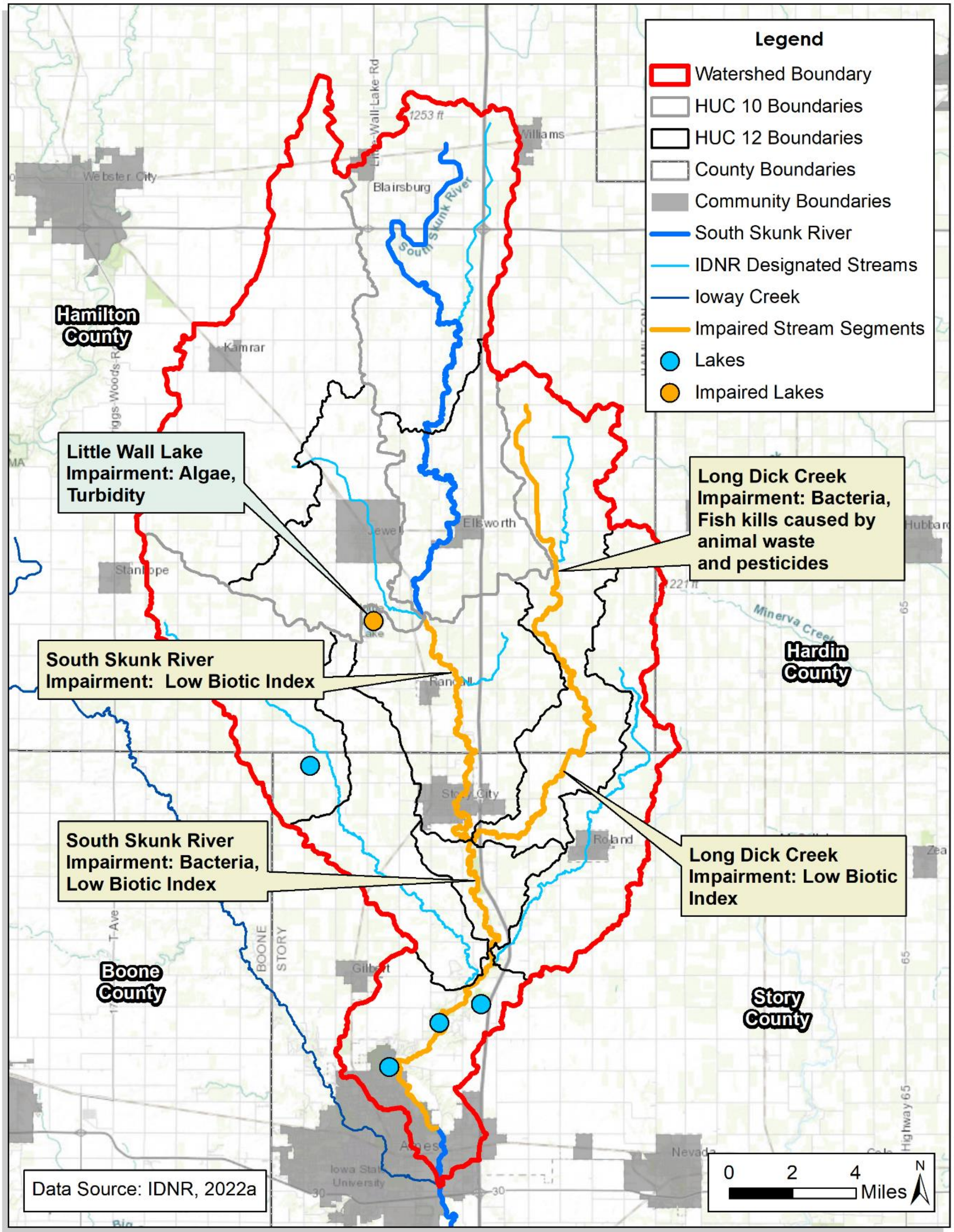


Figure 30: Impaired Waterbodies in the Headwaters of the South Skunk River Watershed

STREAM BIOLOGICAL MONITORING (BIOTIC ASSESSMENT)

Streams and rivers can contain a rich diversity of aquatic life including aquatic insects, fish, amphibians, reptiles, and mammals. Since aquatic communities are in constant contact with the water, the health of these communities can provide insight on stressors that may not otherwise present themselves through traditional chemical and physical parameter monitoring. Since 1994 the IDNR and State Hygienic Laboratory have sampled fish and benthic macroinvertebrate communities to assess the biological conditions of Iowa's streams. Program information and site data can be found at the following locations:

- http://www.shl.uiowa.edu/env/limnology/biologicalmonitoring.xml
- https://programs.iowadnr.gov/bionet/docs/about

IDNR has evaluated biological conditions at 34 locations on 11 stream segments in the watershed, 7 of which are impaired (Table 22). No biological monitoring sites were found on stream segments 03-SSK-937, 03-SSK-1791, 03-SSK-6236, or 03-SSK-6238. A variety of metrics are used to determine impairments in streams. For the sites detailed in Table 22, if multiple sampling dates were available, the most recent date was taken. A wide disparity between sampling dates may contribute to large differences in biological monitoring results between sites on the same stream segment. Sampling methods and the source of data also varied between sites, with some data collected by the IDNR and some by other sources, such as ISU Stream Ecology classes.

Impairments listed, which correspond to those shown in Figure 30, are for the segment as a whole and do not include fish kills that were not considered reason for impairment.

Several metrics are used to assess biological conditions:

- The Fish Index of Biotic Integrity (FIBI) is the primary tool used by IDNR to assess fish health conditions (Wilton, 2015). The FIBI considers 12 metrics to measure fish species richness.
- The Benthic Macroinvertebrate Index of Biotic Integrity (BMIBI) is a combination of 12 metrics measuring the richness of invertebrate communities.
- The General Fish Habitat Index (GFHI) includes five habitat metrics that measure the quality of fish habitat.
- Rapid Habitat Assessments (RHA) give an overview of the habitat conditions based on ten easily observed physical stream traits.

When comparing FIBI and GFHI, if the FIBI is much worse than the GFHI, that suggests that factors other than physical habitat, such as poor water quality, are contributing to a worse biotic index than expected. Likewise, if the FIBI is higher than would be anticipated based on the GFHI, factors such as particularly good water quality may be contributing to the fish biotic index.

Table 22: Biological Monitoring Sites in the Watershed

Segment ID	Location Name	FIBI	BMIBI	GFHI	RHA	Impairment
03-SSK-935	South Skunk River - Randall	Fair	Fair	Fair	-	Low Biotic Index, Pollutant-caused fish kill
03-SSK-933	South Skunk River – Ames – River Valley Park	Good	Excellent	Fair	-	N/A
	South Skunk River – Ames – Squaw [Ioway] Creek Confluence	Good	Good	Fair	-	
	South Skunk River – Ames – Lincolnway Bridge	Fair	Good	Fair	-	
03-SSK-934	South Skunk River – Ames	Good	Good	Good	Sub-Optimal	Indicator bacteria - *E.coli*, low biotic index, animal waste-caused fish kill
	South Skunk River – Story City (US WWTP – DS Storm)	Good	Poor	Fair	-	
	South Skunk River – Story City (DS WWTP)	Fair	Good	Good	-	
	South Skunk River – Story City (US WWTP 200)	Fair	Good	Fair	-	
	South Skunk River – Story City (US Storm)	-	Good	-	-	
	South Skunk River – Hinds Research Farm (ISU1)	Poor/ Fair/ Good *	Good	Fair	-	
	South Skunk River – Ames (US1)	-	Fair	-	Sub-Optimal	
	South Skunk River – Soper Mills – N of Ames (SS002)	Good	-	-	-	
	South Skunk River – Soper Mills (ISU Stream Eco#1)	Poor	Fair	Good	-	
	South Skunk River – Soper Mills (ISU Stream Eco#2)	Good	Fair	Good	-	

Segment ID	Location Name	FIBI	BMIBI	GFHI	RHA	Impairment
	South Skunk River – Soper Mills (ISU Stream Eco#3)	Good	Fair	Good	-	
03-SSK-936	South Skunk River – Ellsworth	Poor	Invalid	Fair	-	Low Biotic Index
	South Skunk River – Ellsworth – Hwy 175 Bridge	-	Good	-	-	
03-SSK-957	Keigley Branch - Gilbert	Fair	Excellent	Fair	-	N/A
03-SSK-958	Bear Creek - Skunk River Greenbelt - Ames	Fair	Good	Fair	Sub-Optimal	N/A
	Bear Creek - ISU Site #1 - Skunk River Greenbelt - Ames	Fair	Invalid	Fair	-	
	Bear Creek - ISU Site #2 - Skunk River Greenbelt - Ames	Fair	Invalid	Fair	-	
	Bear Creek - ISU Site #3 - Skunk River Greenbelt - Ames	Fair	Invalid	Fair	-	
03-SSK-959	Bear Creek - Roland WWTP (DS)	Poor	Fair	-	-	Low Biotic Index
	Bear Creek - Roland WWTP (US)	Fair	Good	-	-	
	Bear Creek - Roland WWTP Mixing	-	Invalid	-	-	
	Bear Creek - Roland (Mixed HWCRS)	Fair	Invalid	-	-	
03-SSK-960	Long Dick Creek - Roland (LDC1)	Fair	Fair	Fair	Marginal	Low Biotic Index
	Long Dick Creek - Roland (Old LDC2)	Fair	Fair	Good	N/A	
03-SSK-963	Drainage Ditch 71 - Jewell	Poor	Fair	Fair	-	Low Biotic Index
03-SSK-2007	Long Dick Creek - Ellsworth (LDC2)	Poor	Good	-	Marginal	Indicator bacteria - *E. coli*, low biotic index,
	Long Dick Creek - Roland (RBP #1)	-	-	-	Marginal	

Segment ID	Location Name	FIBI	BMIBI	GFHI	RHA	Impairment
	Long Dick Creek - Ellsworth (RBP #2)	-	-	-	Marginal	pesticide-caused fish kill, animal waste-caused fish kill
	Long Dick Creek - Ellsworth (RBP #3)	-	-	-	Marginal	
03-SSK-6322	Unnamed Tributary to Long Dick Creek - Ellsworth (RBP #4)	-	-	-	Marginal	N/A

Source: IDNR, 2022c

**Sampling was done on the same day at this location and has not been through QA*

3.03 EXISTING WATER QUALITY

WATERSHED LEVEL WATER QUALITY DATA

The watershed lacks a single monitoring site with a complete period of record; however, it was possible to combine monitoring data from a former IDNR ambient stream monitoring site near Ames, and recent monitoring efforts of the Prairie Rivers of Iowa near Ames into a single dataset. This combined data allows more conclusions to be drawn than if either were used on their own, and the location of the site in the far south of the watershed provides the best representation of overall water quality conditions for the entire watershed. Water quality sampling data from the combined Ames monitoring sites is presented below in comparison to the appliable water quality standards and benchmarks discussed in Chapter 2. Additional water quality data for subwatersheds is discussed later in this chapter.

E. coli Bacteria

E. coli water quality standards do apply to the South Skunk River. Iowa has two sets of water quality standards that apply to *E. coli bacteria* in streams:

- **The chronic water quality standard** is based on a geometric mean of samples taken during the recreation season (between March 15th and November 15th) of each year. If this geometric mean exceeds the standard (126 bacteria per 100 milliliters of water) then the waterbody is considered impaired. Figure 31 shows nine years that the Headwaters of the South Skunk River has not met this standard.
- **The acute water quality standard** is based on individual samples exceeding a one-time maximum quality standard (235 colonies/100 mL). The South Skunk River has exceeded the individual sample maximum water quality standard (235 colonies/100 mL) 43 times during the period of record. Figure 32 displays this long-term trend of exceeding this standard.

Statistics for the year 2021 (most recent year data was available for the plan):

- Number of samples during the season: 8
- Seasonal geometric mean: 97.91 #/100mL
- Number of samples over the single sample maximum: 1
- Maximum value sampled: 830 #/100mL

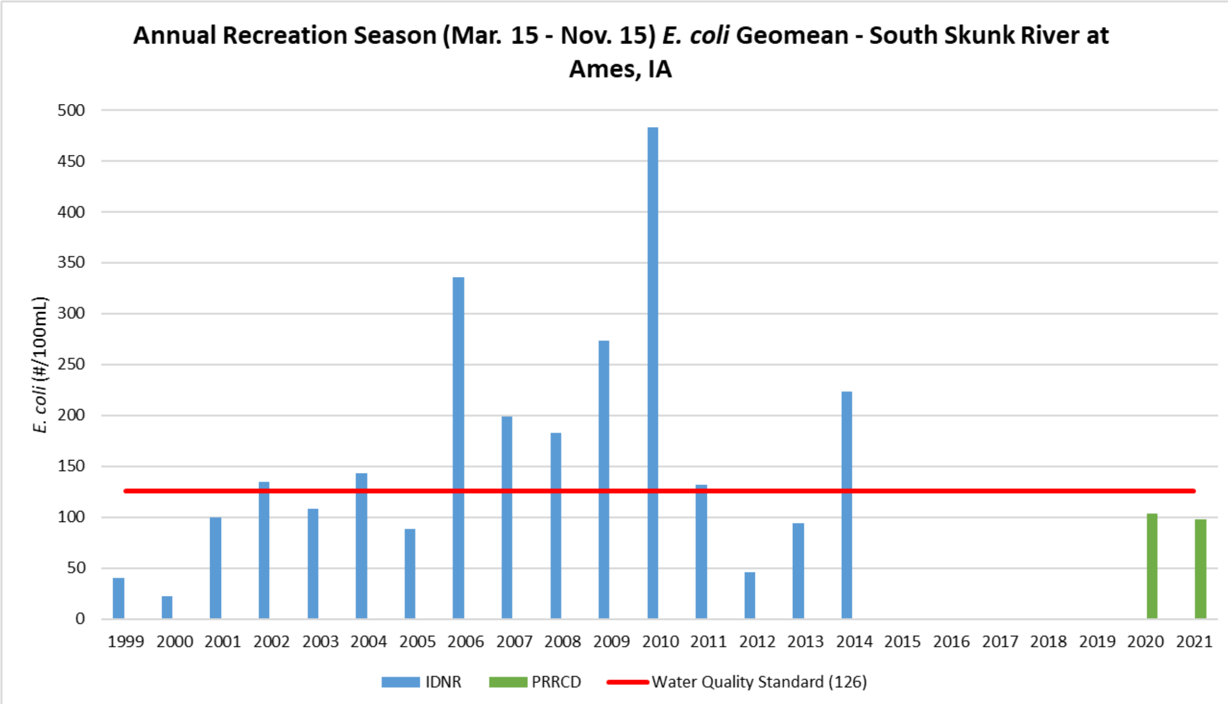


Figure 31: Seasonal *E. coli* Concentrations in the South Skunk River

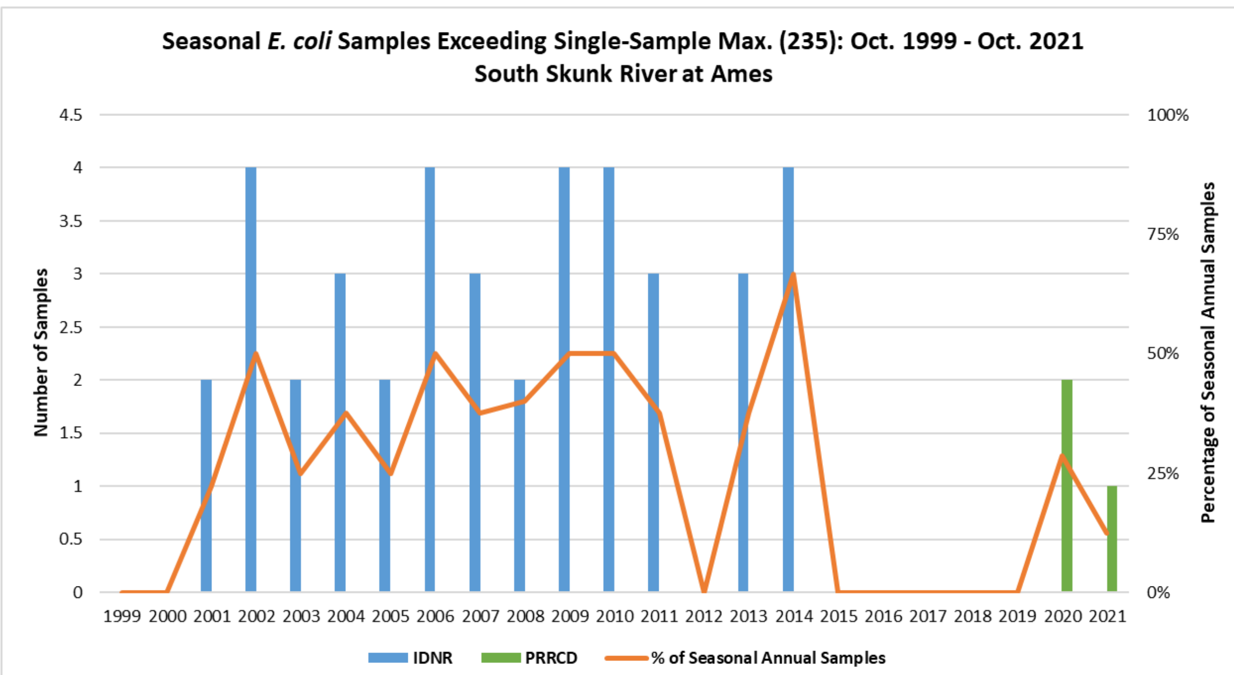


Figure 32: Seasonal *E. coli* Samples Exceeding Single-Sample Maximum Criteria

Nitrogen

Nitrate-nitrogen sampling results are shown in *Figure 33*. The maximum contaminant level (MCL) drinking water standard for nitrate-nitrogen (10 mg/L) is also shown for reference. While the MCL is not directly applicable to the South Skunk River, it is a useful benchmark to use as a reference of water quality. With the exception of 2003, median nitrate levels were above the MCL every year from 2002 to 2007. The EPA water quality benchmark for nitrogen (2.18 mg/L) is also shown for reference on the chart. In most years nitrate levels exceeded this benchmark.

Although levels appear lower in recent years, the data gap and discrepancy between data sources makes it challenging to determine if the trend is valid. Another possible explanation for the lower nitrate concentrations is lower annual rainfall amounts in recent years (especially in 2020 and 2021) which leads to less leaching or runoff of nitrates to streams.

Statistics for the year 2021 (most recent year data was available for the plan):

- Number of samples: 12
- Annual median concentration: 3.55 mg/L
- Number of samples over the MCL: 1

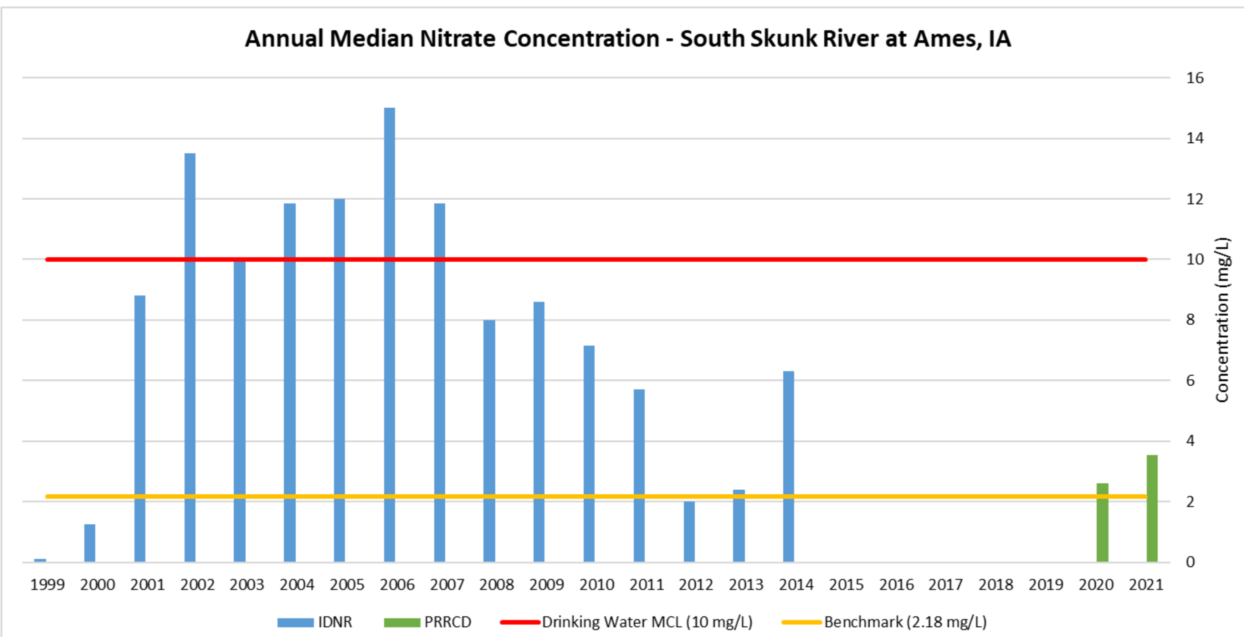


Figure 33: Annual Median Nitrate Concentrations in the South Skunk River

Phosphorus

Phosphate-phosphorus sampling results are shown in Figure 34. The EPA water quality benchmark for phosphorus (0.7625 mg/L) is shown for reference. Note that in the Iowa water quality database (AQuIA), phosphate-phosphorus is equivalent with total phosphorus (IDNR, 2016a). The South Skunk River at Ames has been below the benchmark every year data was assessed. However, care should be taken with interpretation of this data which is based on samples collected monthly and may not characterize these conditions adequately.

Statistics for the year 2021 (most recent year data was available for the plan):

- Number of samples: 12
- Annual median concentration: 0.185 mg/L
- Number of samples over the benchmark: 0

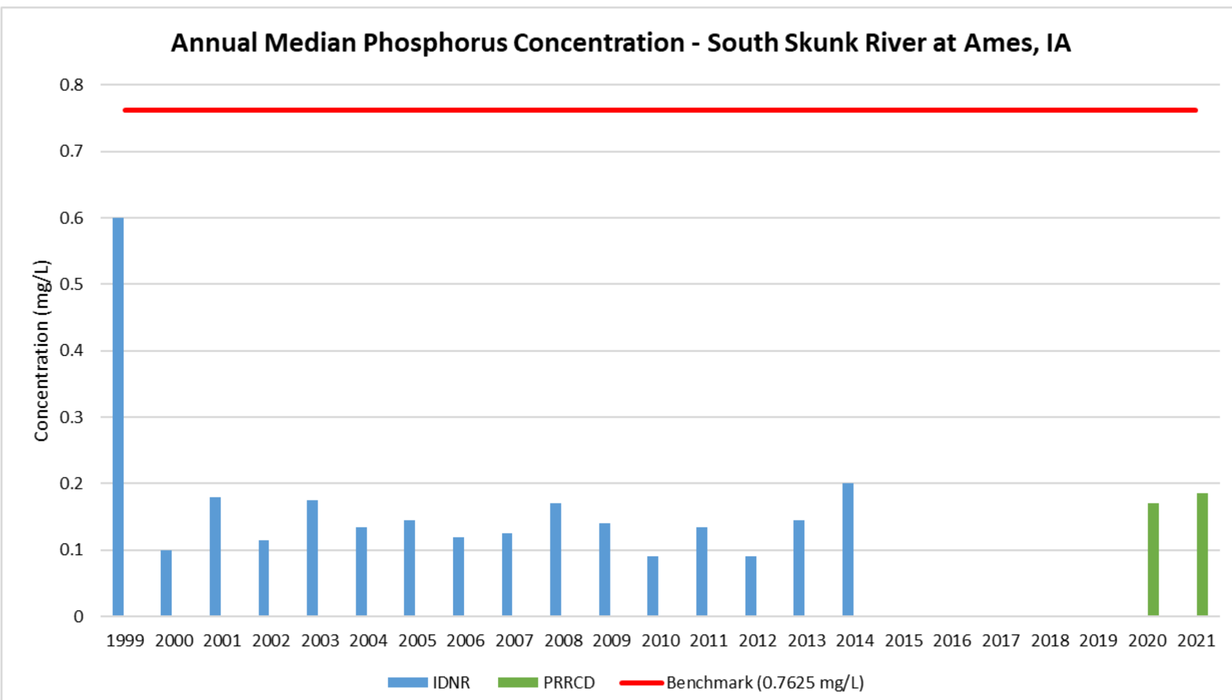


Figure 34: Annual Median Phosphorus Concentrations in the South Skunk River

Sediment

Total suspended solids (TSS) sampling results are shown in Figure 35. TSS is commonly used as a surrogate for sediment, and the KDHE water quality benchmark for TSS (50 mg/L) is shown for reference. The South Skunk River at Ames has been below the benchmark every year data was assessed. However, care should be taken with interpretation of this data which is based on samples collected monthly and may not characterize these conditions adequately.

Statistics for the year 2021 (most recent year data was available for the plan):

- Number of samples: 12
- Annual median concentration: 3.6 mg/L
- Number of samples over the benchmark: 0

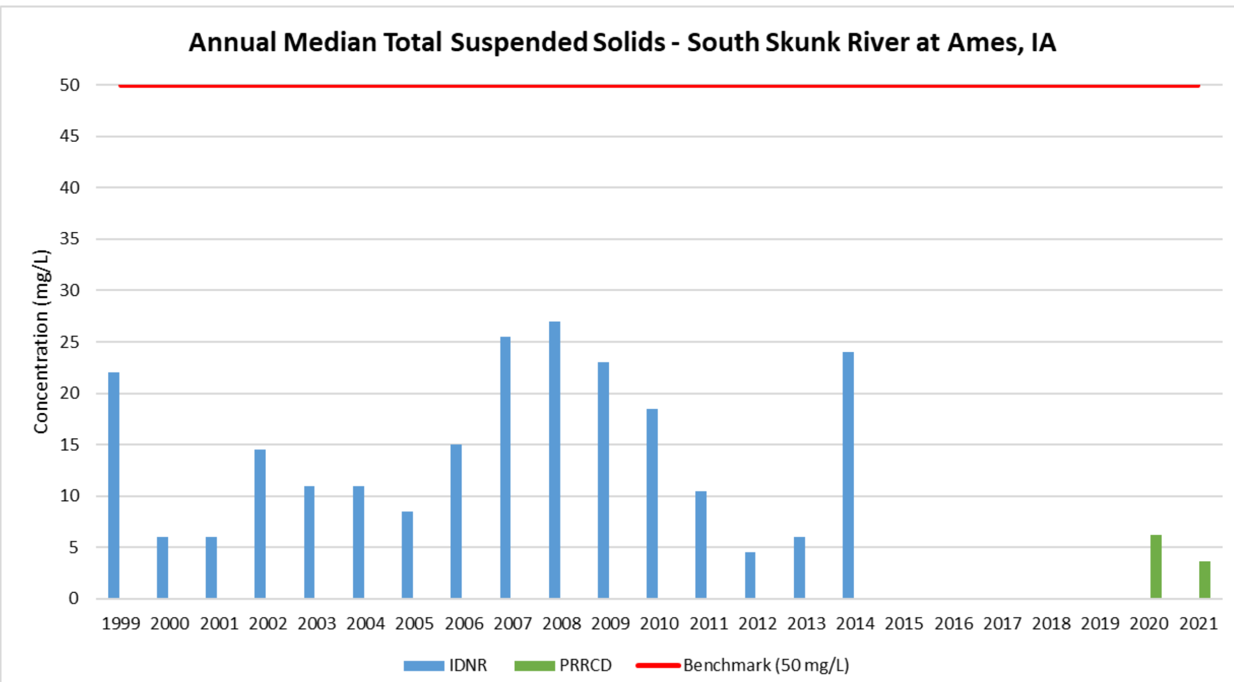


Figure 35: Annual Median Total Suspended Solids Concentrations in the South Skunk River

TRIBUTARY-LEVEL WATER QUALITY DATA

Water quality data was available for several tributaries within the watershed, shown in Figure 36. To provide a better understanding of nitrate, phosphorus, *E. coli*, and total suspended sediment (TSS) pollutant levels in these tributaries (and associated subwatersheds), box plot analysis was completed using water quality data provided by Prairie Rivers of Iowa. Box plot analysis was used instead of bar charts or similar time-series charts due to the limited period of record available.

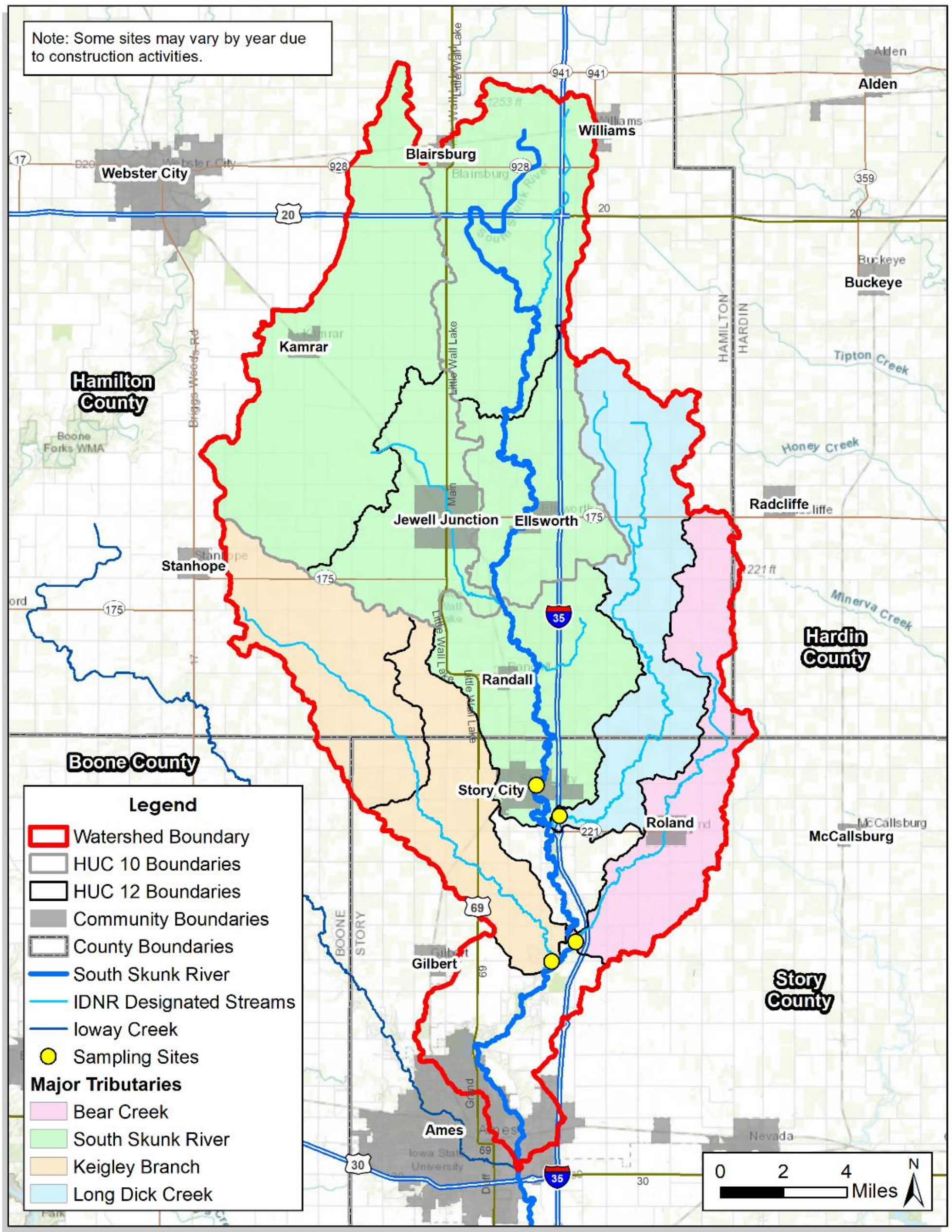


Figure 36: Monitoring Sites with Associated Tributaries and Subwatershed Areas

Bear Creek

Figure 37 shows water quality sampling results for 2020 and 2021 on Bear Creek. Due to construction, three sampling sites were used: West Maple Street in Roland, 590th Street below Roland, and Pleasant Valley Road (main sampling site). This data represents the single HUC 12 that contributes to Bear Creek (Figure 36). Median nitrate levels for both years were slightly above the benchmark of 2.18 mg/L, but below the MCL of 10 mg/L. Phosphorus levels were mostly well below the benchmark in both years. All TSS values were well below the benchmark value. Three *E. coli* samples were above the single-sample max standard of 235/100mL in 2020 (42.9% of samples that season), and 3 above the standard in 2021 (42.9%). The seasonal geometric mean of *E. coli* was 233.7 in 2020 and 159.2 in 2021 – exceeding the standard of 126/100mL.

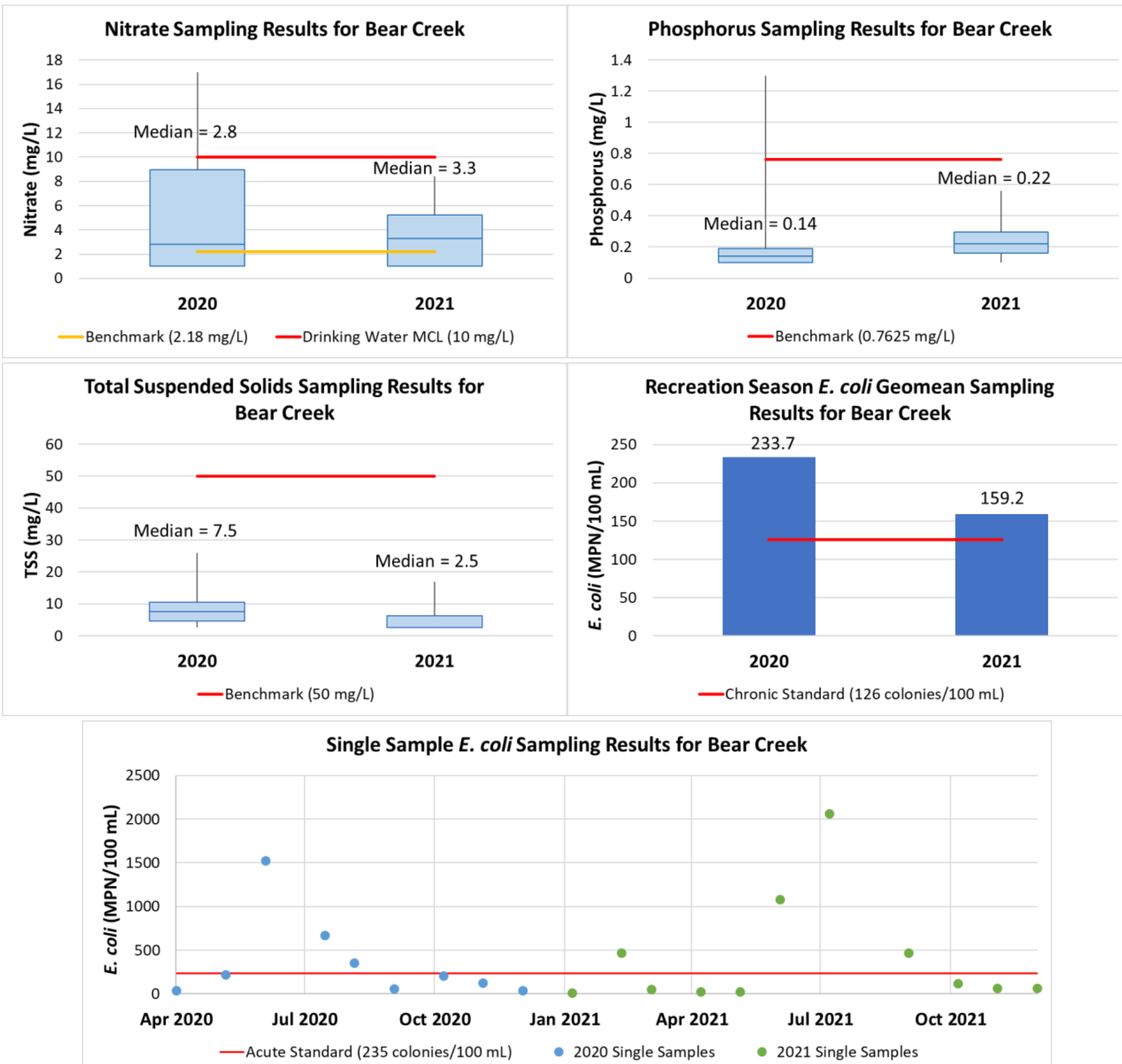


Figure 37: Water Quality Sampling Results for Bear Creek

Keigley Branch

Figure 38 shows water quality sampling results for 2020 and 2021 on Keigley Branch. This data should be considered representative for the two HUC 12 subwatersheds that contribute to Keigley Branch (Figure 36). The median nitrate levels for both years were above the benchmark of 2.18 mg/L, but below the MCL of 10 mg/L. Phosphorus levels were generally well below the benchmark both years. Median TSS values were well below the benchmark value. There were 4 *E. coli* samples above the single-sample max standard of 235/100mL in 2020 (representing 57.1% of samples that season), and 3 above the standard in 2021 (50%). The seasonal geometric mean of *E. coli* was 318.6 in 2020 and 314.4 in 2021 – both exceeding the standard of 126/100mL.

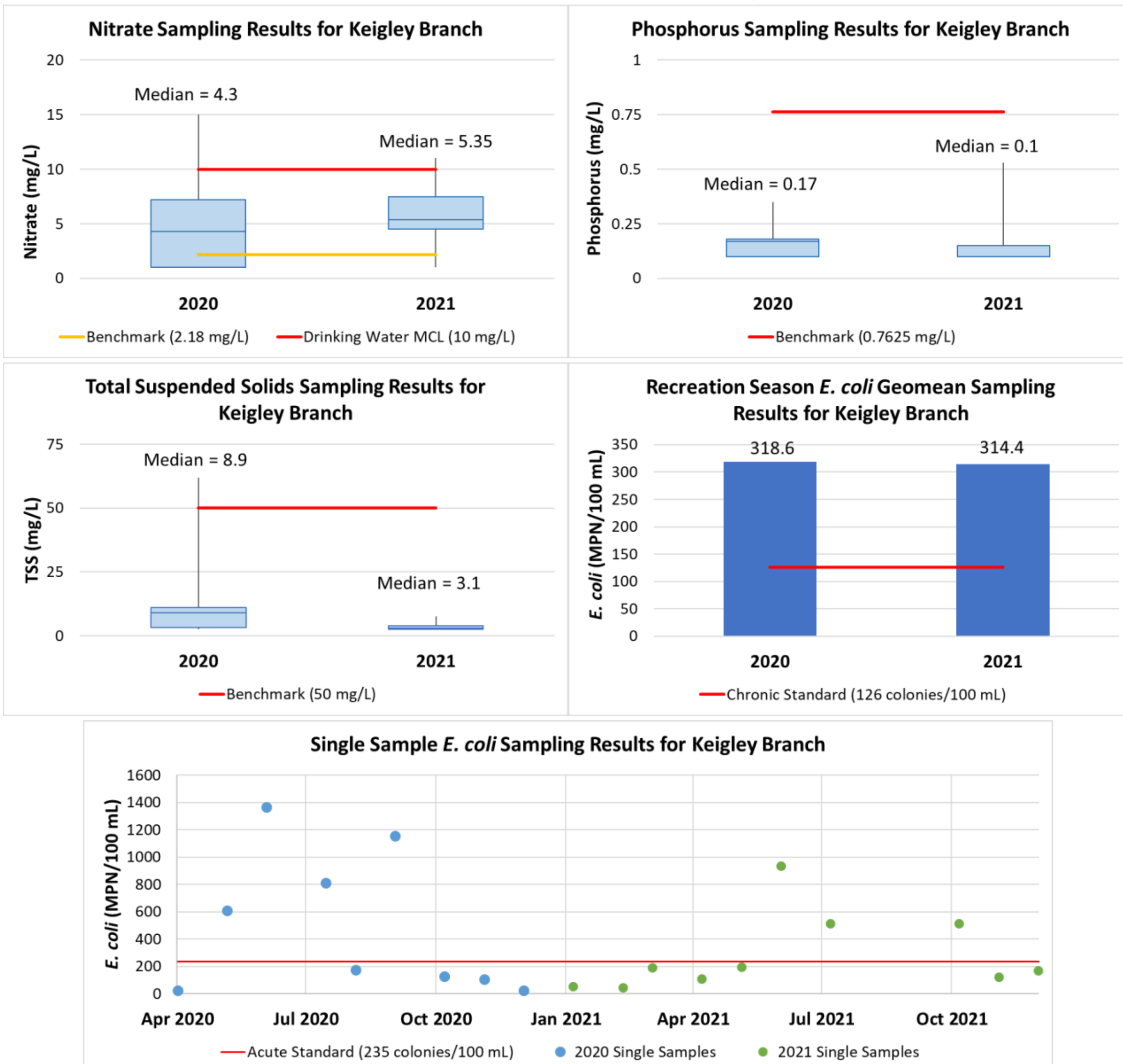


Figure 38: Water Quality Sampling Results for Keigley Branch

Long Dick Creek

Figure 39 shows water quality sampling results for 2020 and 2021 on Long Dick Creek. This data should be considered representative for the single HUC 12 that contributes to Long Dick Creek (Figure 36). The median nitrate levels for 2020 and 2021 were above the benchmark of 2.18 mg/L, but below the MCL of 10 mg/L. Phosphorus levels were all well below the benchmark in both 2020 and 2021. Median TSS values were well below the benchmark value. There were 6 *E. coli* samples above the single-sample max standard of 235/100mL in 2020 (representing 85.7% of samples that season), and 4 above the standard in 2021 (66.7%). The seasonal geometric mean of *E. coli* was 486.6 in 2020 and 391.9 in 2021 – both exceeding the standard of 126/100mL.

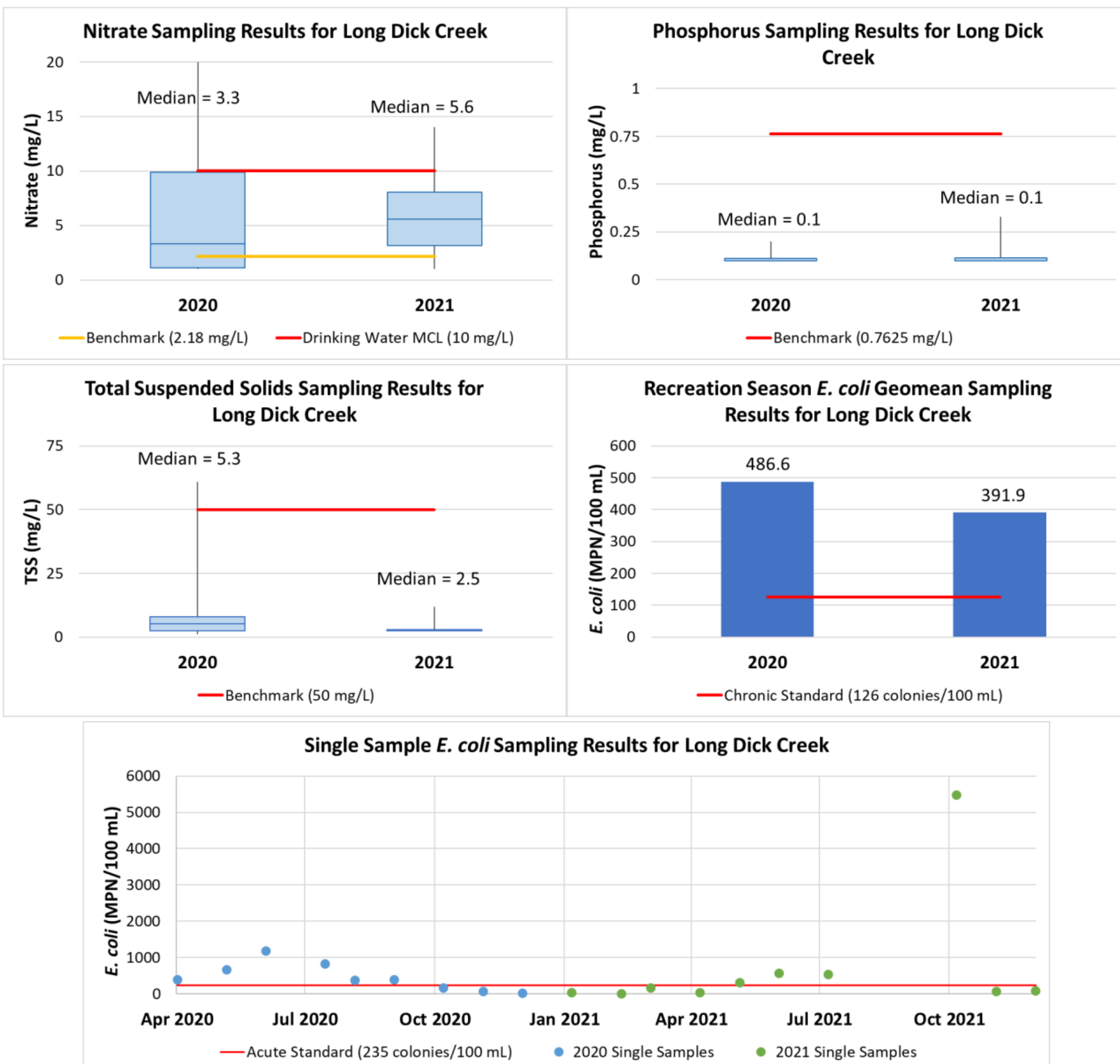


Figure 39: Water Quality Sampling Results for Long Dick Creek

South Skunk River at Story City

Figure 40 shows water quality sampling results for 2020 and 2021 on South Skunk River at Broad Street in Story City. This data should be considered representative for five HUC 12 subwatersheds that contribute to South Skunk River before the sampling site (Figure 36). The median nitrate levels for 2020 and 2021 were above the benchmark of 2.18 mg/L, but below the MCL of 10 mg/L. Phosphorus levels were all well below the benchmark in both 2020 and 2021. Median TSS values were well below the benchmark value. There were 6 *E. coli* samples above the single-sample max standard of 235/100mL in 2020 (representing 85.7% of samples that season), and 3 above the standard in 2021 (37.5%). The seasonal geometric mean of *E. coli* was 425.0 in 2020 and 133.8 in 2021 – both exceeding the standard of 126/100mL.

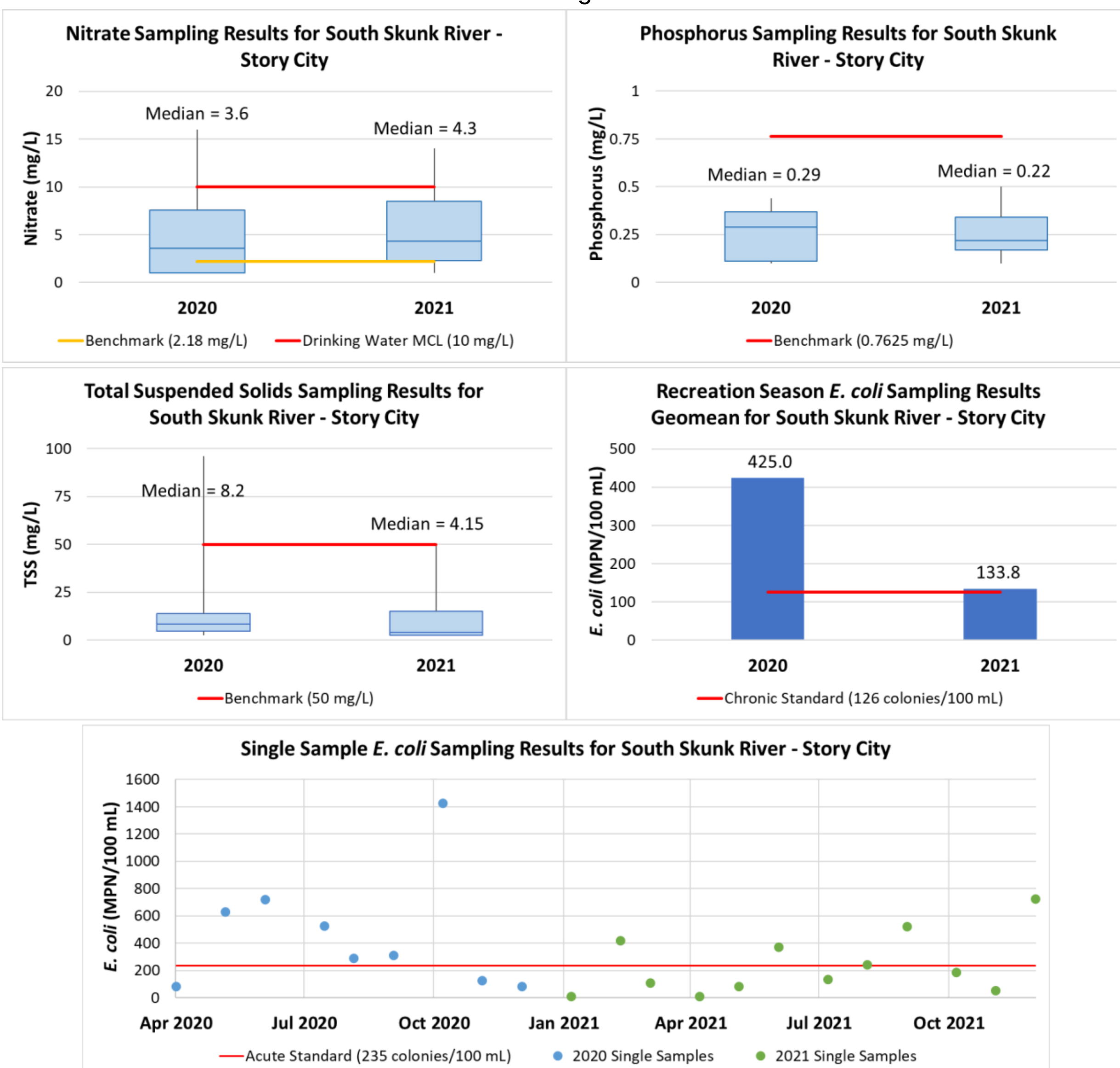


Figure 40: Water Quality Sampling Results for South Skunk River at Story City

3.04 POLLUTANT SOURCES

INTRODUCTION

This section of the chapter provides the reader with an understanding of the sources of the pollutants this plan addresses, including the originating sources of each, transport mechanisms, loads, and the effects of the pollutants. It is important for the reader to keep in mind that many of the pollutant sources are found in the same locations or are transported through similar hydrologic functions. Thus, management of one source often has similar effects on the others.

This watershed plan is based on voluntary implementation of BMPs, therefore limited focus is directed towards pollutant sources that are permitted (i.e., wastewater treatment facilities, MS4 stormwater facilities, and permitted animal feeding operations). It is assumed these sources are meeting their regulatory requirements and are not contributing beyond the pollutant limits set by their permits. However, future water quality modeling efforts should identify these facilities and account for their pollutant load contributions. This allows nonpoint pollution loads to be clearly identified and separated from the total pollutant load.

The City of Ames is the only MS4 regulated municipality within the watershed. Ames complies with these mandated regulations through a state-issued National Pollutant Discharge Elimination System permit for Municipal Separate Storm Sewer System. The permit authorizes the City of Ames to discharge stormwater into the South Skunk River; therefore, for the purposes of this plan, this is considered a permitted source of pollution. The permit requires a mixture of components including inspections, pollutant monitoring, reporting, and educational activities that will complement any voluntary nonpoint source management efforts implemented within the city limits. Any urban stormwater management strategies outlined in this plan are not intended to address the requirements outlined in the City of Ames's MS4 permit, but would be considered supplemental, or above and beyond, any required actions.

POLLUTANT TYPES

Sources of pollution (Figure 41) can be separated into two primary categories: point sources and nonpoint sources:

- **A point source of pollution** is any discernible, confined, or discrete conveyance from which pollutants can be discharged. Point source pollution can be easily tracked along the pollutant's travel path and identified at the source. Examples include any pipe, ditch, tunnel, conduit, or well that might discharge pollutants. The discharge from most point sources is regulated by the National Pollutant Discharge Elimination System (NPDES) permit program. Many industrial, municipal facilities, and some agricultural operations are required to obtain NPDES permit coverage. However, individual homes connected to a municipal or septic system typically do not need coverage under a NPDES permit.
- **Nonpoint sources of pollution** come from facilities, activities, or land uses that do not meet regulatory requirements to be considered point sources. Because these sources are not regulated, are typically smaller, or are otherwise not well defined, they are thus treated as nonpoint sources for management purposes.

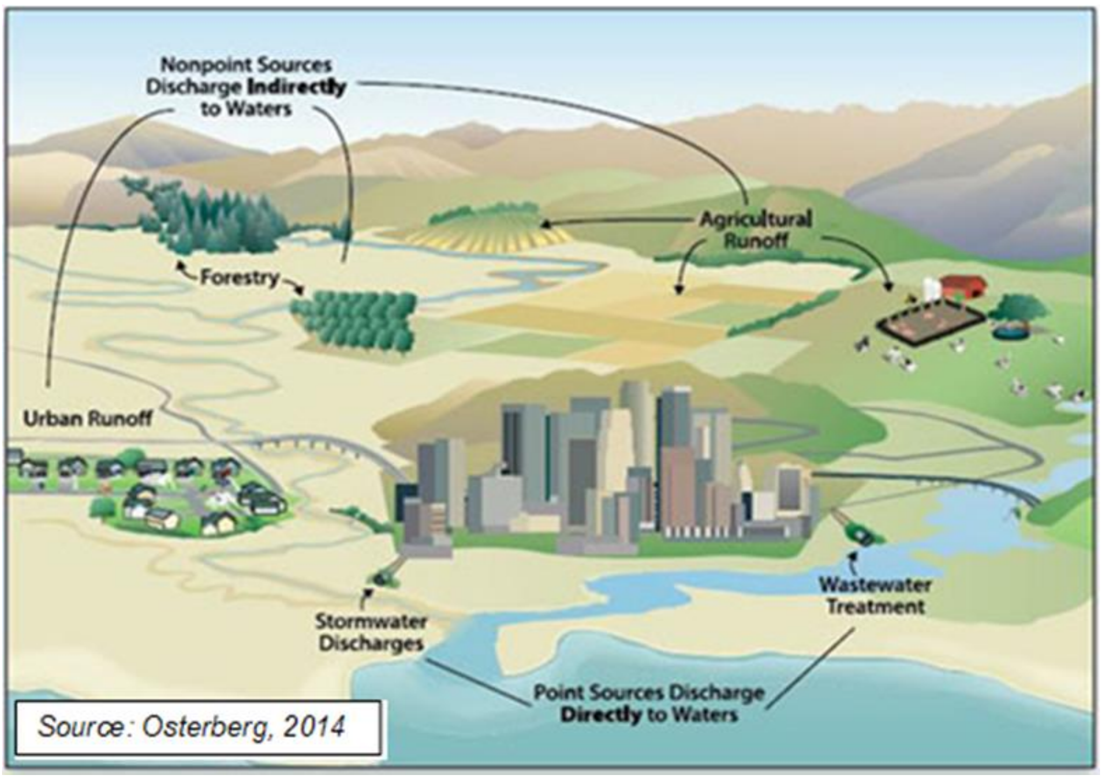


Figure 41: Conceptual Illustration of Point and Nonpoint Sources of Water Pollution

POLLUTANT SOURCES

The pollutants addressed in this plan are bacteria (*E. coli*), nutrients (phosphorus and nitrogen), and sediment. A summary of pollutants, their sources, and their impacts is shown in Table 23.

Table 23: General Summary of Pollutants and Sources

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

Note: WWTF – Wastewater Treatment Facility
AFO – Animal Feeding Operation
CAFO – Confined Animal Feeding Operation

Nitrogen and Phosphorus

Nutrients such as nitrogen and phosphorus occur naturally. However, an overabundance of these nutrients may lead to impaired water quality. Nutrient enrichment in Iowa waterbodies can stem from both internal and external sources. Internal sources are those nutrients which originated from an external source but then became trapped in waterbodies and are recycled annually (primarily in lakes and reservoirs). External sources of nutrients are those which enter waterways through contaminated runoff.

Excess nutrients in waterbodies produce algae (Figure 42). As these large algal blooms die off, the decaying matter utilizes oxygen in the water. Low levels of oxygen can stress and even lead to the death of aquatic life. Sometimes these blooms can be dominated by blue-green algae, which produce toxins that are dangerous to humans, pets, livestock, and other animals.

Contribution of nutrients generally happens during snowmelt or rainfall events when water runs off the landscape and carries pollutants with it. Pollutant sources include fertilizer, soil erosion, manure application sites, small open feedlots, tile line drainage, grazing livestock, stream erosion, and inadequate or malfunctioning wastewater treatment systems. It’s also important to note that nutrient runoff is highly seasonal. A large portion of nutrients runoff or leach from cropland during the spring and early summer months before crops are actively growing and utilizing nutrients in the soil.

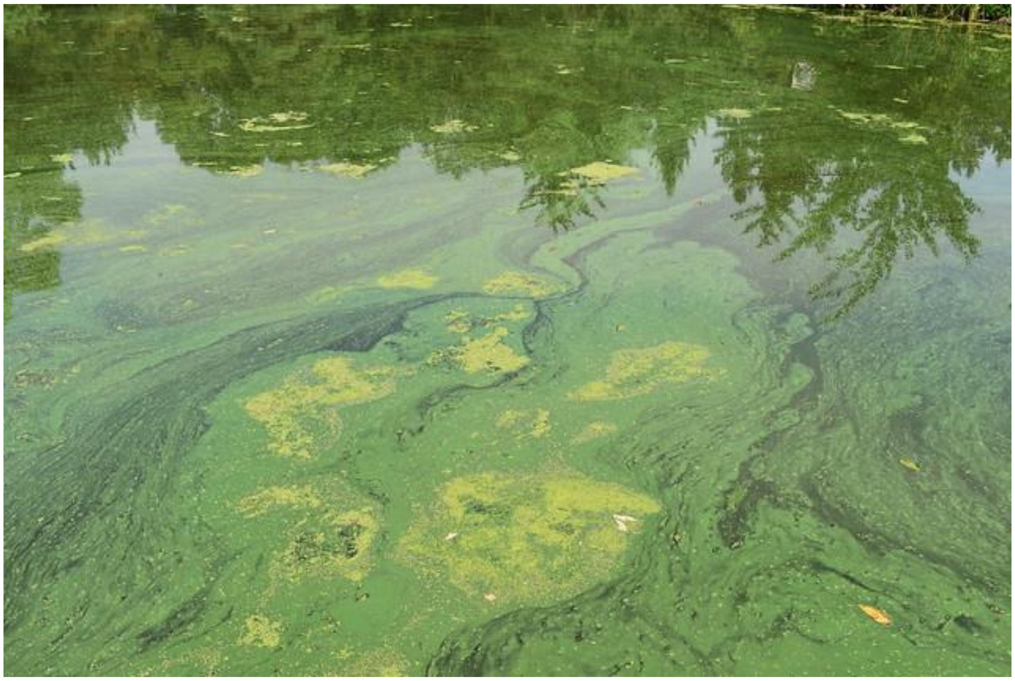


Figure 42: Example of an Algae Bloom Caused by Excessive Nutrients in the Water

Sediment

Sediment originates from stream erosion (streambank and stream bed), gully erosion in fields, and upland erosion (sheet and rill erosion). Sediment can increase turbidity and act as a transport mechanism for other pollutants. Excessive sedimentation diminishes the suitability of instream and streamside habitat for fish and wildlife as sediment buries substrate that support spawning and foraging habitat for benthic and other aquatic organisms. Every land use type produces sediment through erosion; however, some are greater contributors than others. Farmland has higher sediment loss rates due to the lack of perennial vegetation. Developed regions can have high runoff rates due to the lack of natural vegetation and high concentrations of impervious materials.

Estimating total phosphorus and sediment loads with available water quality data is challenging. There are two primary forms of phosphorus that need to be measured to calculate total phosphorus loads: dissolved phosphorus (commonly referred to as ortho-phosphate) and particulate phosphorus, which is attached to sediment and moves primarily by soil erosion.

Most long-term water quality sampling efforts across Iowa, including the HWWSSR watershed are based on monthly grab sampling. However, monthly measurements are not ideal to characterize phosphorus and sediment loading that is dependent upon storm events, which cause erosion and the subsequent loading of sediment and attached phosphorus. This means a particularly large portion of the total phosphorus load is not being accounted for in current data. In fact, sediment and associated phosphorus loads are often dominated by erosion, with total phosphorus loads from streambanks ranging from 3-38% in Iowa (Schilling and others, 2019).

Unfortunately, there are currently no continuous monitoring sensors for total phosphorus available (like there are nitrates). While there are ongoing studies to identify surrogates or methods to estimate total phosphorus from other water quality parameters, no existing studies or data were identified for use in this plan. Therefore, this plan presents two recommendations to help address this data gap:

- Complete stream assessments across the watershed help quantify sediment and phosphorus pollutant loads originating from streams (discussed later in this chapter)
- Expand stream sampling to include samples taken during storm events. Various methods exist such as utilizing flow-paced automated samplers or simpler single-stage samplers. Additional discussion and examples are provided in the *Story County Water Monitoring and Interpretation Plan* (PRI, 2021).

E. Coli Bacteria

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

Several nonpoint sources have been identified as contributors of *E. coli* contamination to waterbodies within the watershed. These include land application of livestock manure and wastewater sludge for fertilization; runoff from livestock pastures; small open feedlots; pet waste; underperforming onsite wastewater treatment systems; runoff from urban areas; and natural sources such as wildlife. Runoff from precipitation can cause *E. coli* to be washed into surface waters and it can also potentially enter groundwater through abandoned or poorly constructed wells.

3.05 POLLUTANT SOURCE MAPPING

Using available data, pollutant sources were overlaid onto several watershed maps. These maps can be very helpful in understanding the watershed, visualizing the location of pollutant sources, and prioritization of implementation efforts. However, care should be taken when interpreting these at the field level. Each property within the watershed has unique physical characteristics and is uniquely managed by the farmer or landowner. The following pollutant sources are presented and discussed below:

- Cropland
- Urban stormwater and pet waste
- In-field Erosion
- Stream Erosion
- Livestock and manure application
- Wastewater treatment

CROPLAND

Cropland dominates the watershed (Figure 43) and is generally equally distributed across the watershed except along the river corridor and where communities are located. This exception is most pronounced at the bottom of the watershed near the City of Ames. Most cropland in the watershed is corn and soybean production, which contributes to nutrient pollution through soil erosion and the runoff of commercial fertilizer. The risk of nitrogen leaching through tile drainage systems is a particular concern given that nearly all cropland in the watershed is in a drainage district or has the potential to be drained. This land use generally has increased erosion due to a lack of perennial vegetation. Bacterial pollution from cropland is primarily associated with manure applied as fertilizer. Due to the relatively homogonous and wide-spread nature of this land use utilization of data from the Agricultural Conservation Planning Framework Toolbox (ACPF) to identify critical source areas at the field level will be important in the prioritization of future implementation efforts (discussed further in Chapter 5).

URBAN STORMWATER AND PET WASTE

Figure 43 also shows the locations of urbanized areas within the watershed. This land use category also includes cities, acreages, farmsteads, etc. Most urban land is “impervious”, that is nearly all precipitation that falls on these surfaces (parking lots, streets, etc.) runs off, doesn’t infiltrate into soil, and increases runoff rates. Developed land contributes to nutrient pollution primarily from the runoff of lawn fertilizer. Soil erosion is typically less in urban areas than farmed areas due to increased impervious surfaces unless construction or land clearing is occurring. Urban wildlife and improper disposal of pet waste are both sources of *E. coli* bacteria and nutrient contamination. While urban areas make up a small portion of the land use, the relative contribution (on a per acre basis) of pollutant loads may be much higher than cropland due to increased runoff rates.

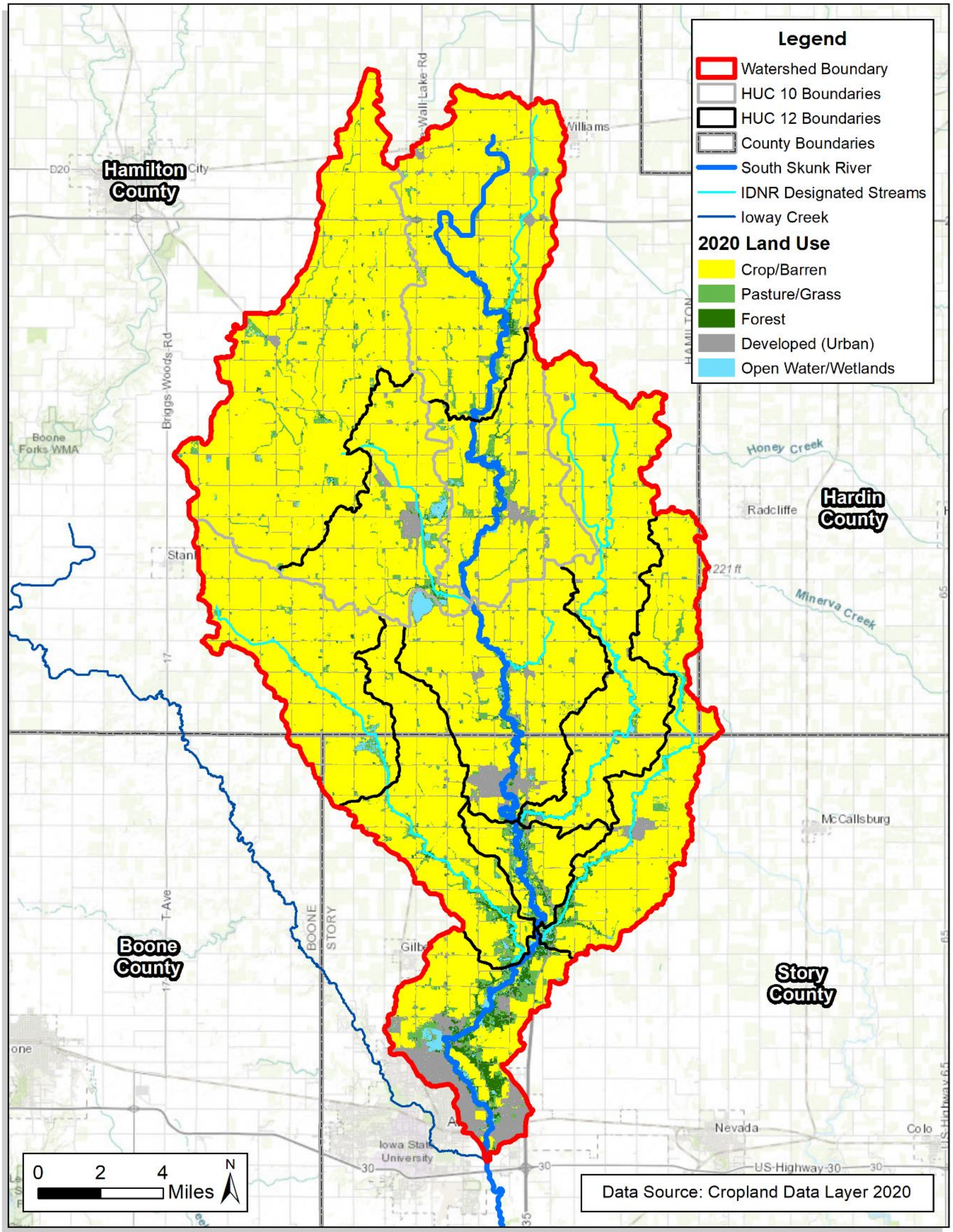


Figure 43: Land Use Distribution Across the Watershed

IN-FIELD EROSION

Average erosion rates from upland sources for each HUC 12 were estimated using the Daily Erosion Project (DEP), produced by Iowa State University. The DEP uses elevation, soils, land use, precipitation, and other weather data information to estimate erosion on a HUC 12 subwatershed basis (Gelder, 2018). Note that DEP only estimates erosion from sheet and rill erosion, but not from gullies or streams due to data limitation. Additionally, these estimates are primarily driven by precipitation and not wind erosion.

These estimates are broken down further into long term averages for each HUC 12 watershed and mapped (*Figure 44*). Table 24 provides the most recent (2020) averages for each HUC 12 for comparison purposes. Sediment loss is relatively uniform across the watershed except for the higher erosion levels seen in the south of the watershed where slopes begin to increase due to the river valley. The low is 0.65 tons/acre/year in the center of the watershed and the high is 2.21 tons/acre/year near Ames.

Additional data and an interactive map of the Daily Erosion Project can be access here: https://www.dailyerosion.org/

Table 24: Recent and Long-Term Average Annual Sediment Loss by HUC 12

Watershed Name	HUC12	Avg Sediment Loss (tons/acre/year) 2007-2021	Avg Sediment Loss (tons/acre) 2021
Rahto Branch Ditch	70801050101	0.79	0.37
Ditch Number 71	70801050102	0.82	0.86
Headwaters South Skunk River	70801050201	0.69	0.22
City of Ellsworth – South Skunk River	70801050202	0.80	0.68
Long Dick Creek	70801050401	0.73	0.53
Miller Creek – South Skunk River	70801050402	0.65	0.61
Bear Creek	70801050403	0.76	0.44
Headwaters Keigley Branch	70801050404	0.79	0.3
Keigley Branch	70801050405	0.71	0.3
City of Ames – South Skunk River	70801050406	2.21	0.61

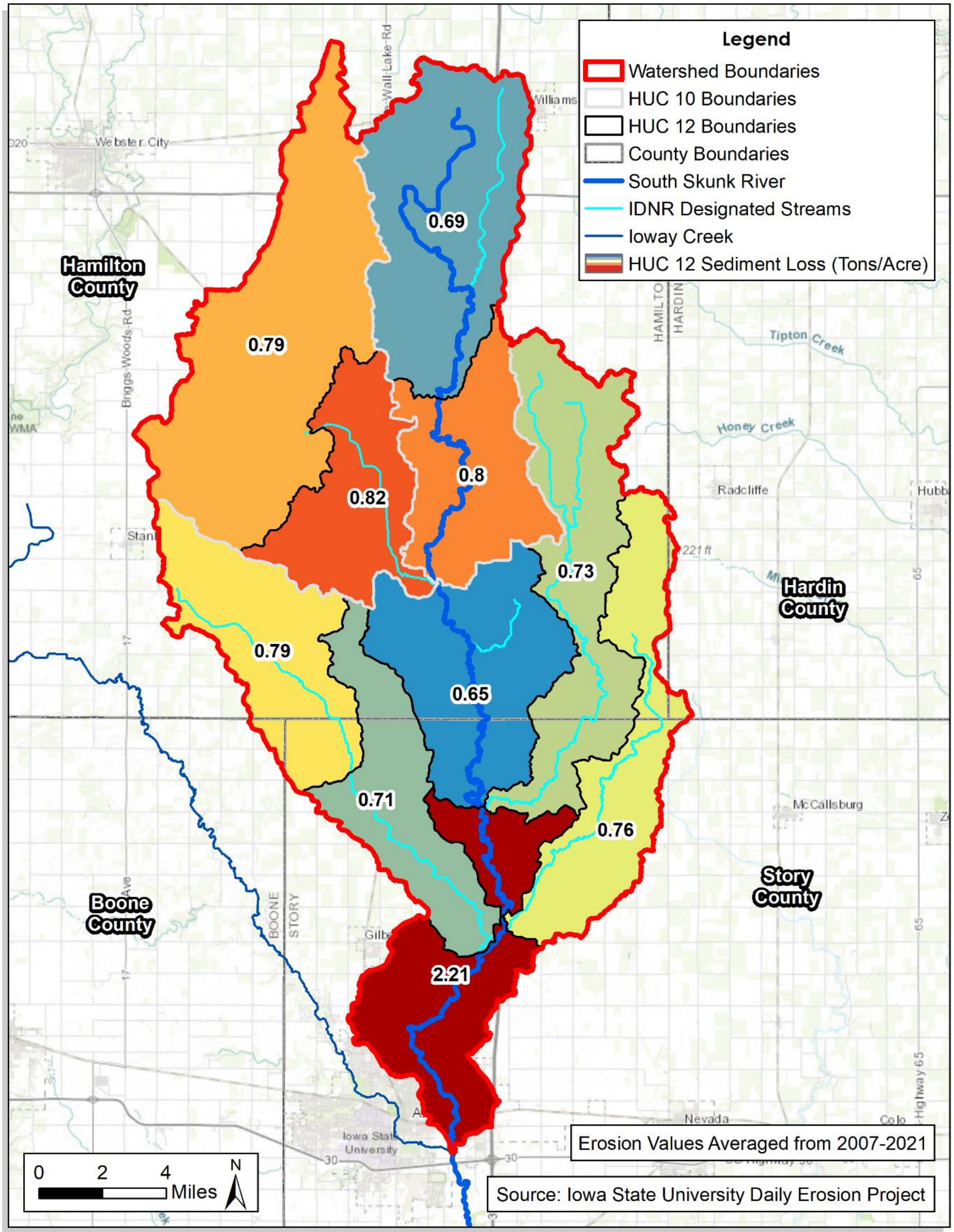


Figure 44: Average Annual Sediment Loss by HUC 12 Subwatersheds (2007-2021)

STREAM EROSION

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

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

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

A channel is considered stable and in equilibrium when the energy associated with flow and channel slope balances with the sediment load and bed material size. Channels in equilibrium balance these factors over time (*Figure 45*). Erosion is a constant and a natural process in stream evolution, but it occurs at a much slower rate under stable conditions. Therefore, the concept of "stability" is better characterized as "dynamic equilibrium".

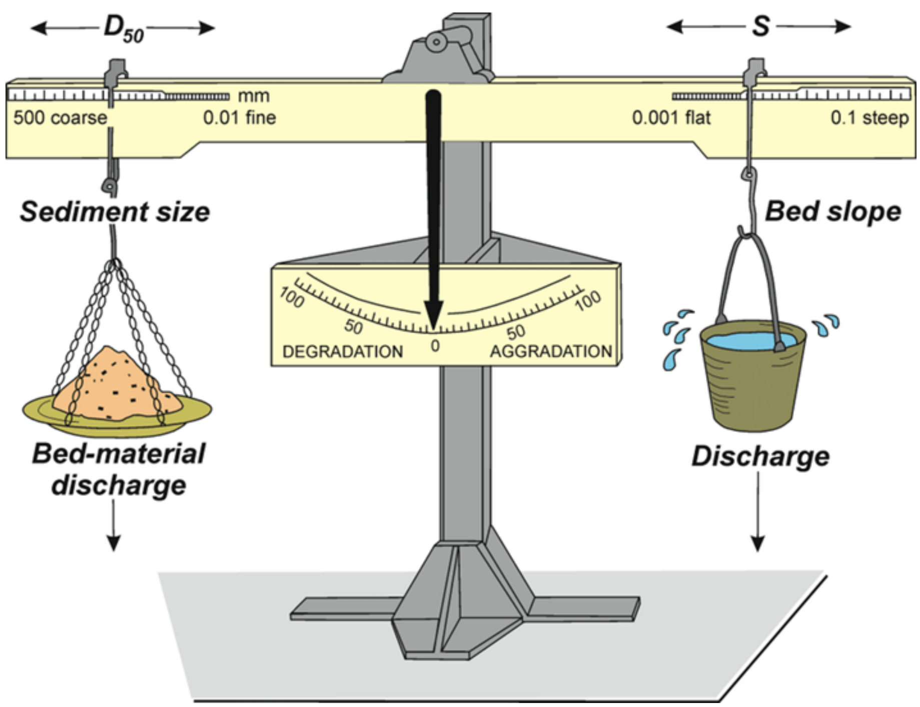


Figure 45: Lane's Balance, a Representation of Stream Stability (Rinaldi and others, 2015)

To regain dynamic equilibrium, destabilized streams generally adjust, or evolve, through a sequence of channel forms. The stream evolution model (Simon, 1989) provides a framework to understand how stream channel morphology changes throughout this evolutionary process and is broken down into six cyclical stages (*Figure 46*). Understanding this framework allows resource managers to evaluate present channel conditions, interpret historical conditions or activities that led to the current state, and predict future channel behavior. Stream assessments are conducted to gather this type of information.

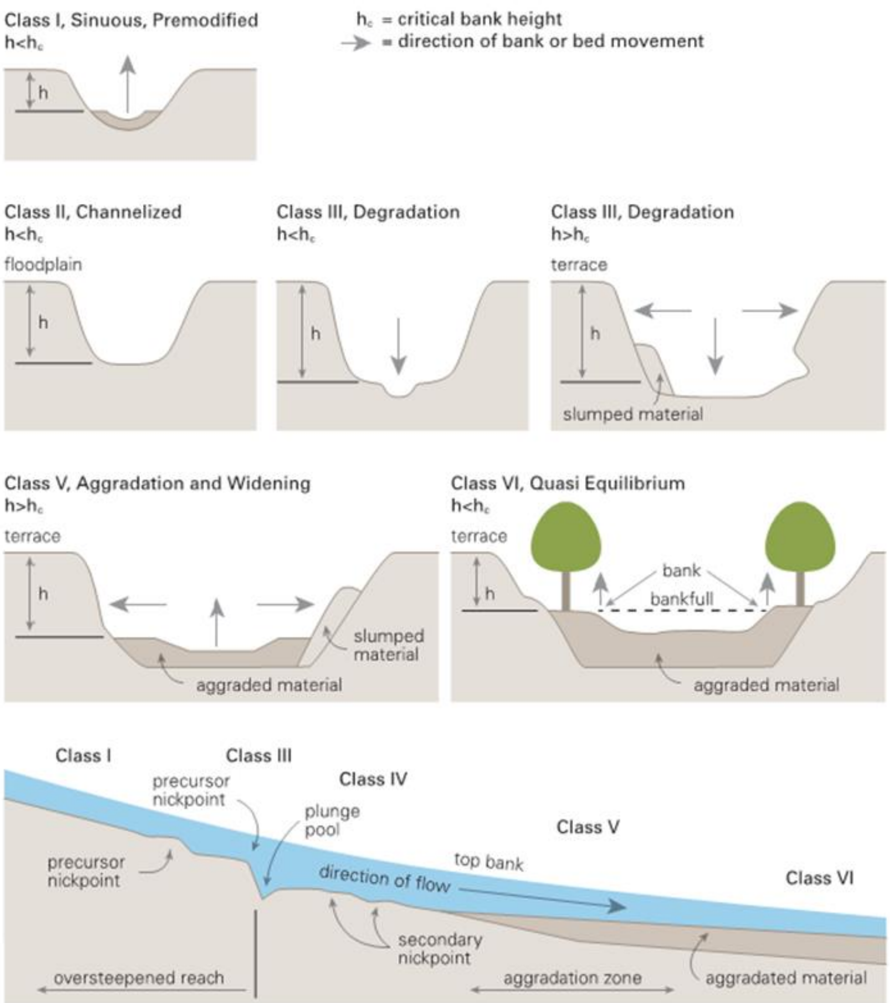


Figure 46: Simon Channel Evolution Model (Harman and others, 2012)

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

IDNR Biological Stream Monitoring data, discussed earlier in this chapter sometimes includes a Rapid Habitat Assessment (RHA) which gives an overview of the habitat conditions based on ten easily observed physical stream traits. This data was reviewed for SSRWMA and was found to not be applicable for quantifying stream erosion due to the limited locations across the watershed and the limited period of record where data was available.

A limited number of on-the-ground stream assessments have been completed within the watershed. Similar efforts across the watershed, or at least in priority subwatersheds, are recommended. As part of these surveys, drainage tile infrastructure should be located and evaluated. Literature review indicates that approximately 15-35% of streams in the northern Iowa region are likely experiencing erosion (Schilling, 2019). Such a high-level of erosion clearly places stream erosion as a major contributor to watershed sediment and phosphorus loads.

The *Countywide Watershed Assessment* prepared for Story County in 2018 identified priority eroded streambank sites using a combination of various GIS tools. Twenty-nine (29) priority sites were identified within the Headwaters South Skunk River Watershed. The following description of streambanks was provided for the following watershed streams within Story County:

- **Bear Creek's** stream banks appear to be in good condition, only 3 high priority streambank instability sites were identified in close proximity to the creek channel.
- **Keigley Branch** – Four high priority streambank sites were identified; overall stream bank health is good
- **Long Dick Creek's** stream banks appear to be in good condition, priority streambank sites were not identified.
- **The South Skunk River's** stream banks are in poor condition, 15 high priority streambank instability sites were identified in close proximity to the river channel.

A similar assessment or data source was not available for the portion of the watershed within Hamilton County.

While stream erosion assessments can be done on small stream reaches with relative ease, quantifying the contribution of streambanks to pollutant loading at the watershed scale is particularly challenging due to the time and resources that would be required for an on-the-ground survey across the watershed. Several efforts are underway in Iowa to develop estimates using GIS and LiDAR based analysis paired with soil sampling. Further development of these technologies will be beneficial to future updates to this plan.

LIVESTOCK AND MANURE APPLICATION

Livestock manure, which is commonly spread on cropland as fertilizer, can be a source of nutrients, sediment, and bacteria when it is carried to streams through runoff. Additionally, cattle can cause erosion to upland areas and streambanks when they have access to those areas for an extended period of time. According to the most recent USDA AgCensus data (see Chapter 2), the primary livestock (and thus manure sources) found within the watershed are hogs (pigs) and turkeys. These types of livestock are found within animal feeding operations, not in open grazing systems. Cattle, which can be found in feedlots or pastures, can also be pollutant source; however, their numbers are relatively low in the watershed compared to hogs and turkeys.

Animal feeding operations (AFO) are facilities that confine livestock in a limited feeding space for an extended period of time. The IDNR recognizes two types of AFOs:

1. A **confinement feeding operation (CAFO)** confines animals to areas that are totally roofed. All confinements, including small animal feeding operations, are required to follow some level of state regulations regarding manure management and land application when building or operating a facility. Figure 47 shows there are 143 CAFOs in the watershed.
2. **Open feedlot AFOs** are facilities where livestock are kept in unroofed or partially roofed areas, where they are fed and maintained in pens for at least 45 days per year. Unlike animals on pasture, manure from the open lot is concentrated and the ground is bare of vegetation. Not all open feedlot AFOs are required to follow permitting standards.
    a. Open feedlot AFOs with 1,000 or more animal units (1,000 beef cattle or 700 mature dairy cattle or 2,500 finishing hogs) are generally required to apply for a NPDES permit to regulate discharge of livestock waste from these operations. Some intermediate size lots may also need an NPDES permit if a stream runs through the lot or there is a man-made conveyance for discharging to a stream. For the purposes of this plan, these permitted facilities are considered zero discharging. Figure 47 shows three (3) permitted open feedlot AFOs in the watershed, two (2) of which overlap with the CAFOs.
    b. Nonpermitted small open feedlots are a potential source of bacteria, nutrients, and sediment. These operations are too small to be regulated by IDNR and are not required to retain any of their waste. However, there is no available mapping data to locate these potential pollutant sources. It is recommended that these small open feedlots be identified during future watershed plan updates through visual review of aerial photography.

For the purpose of this plan, it is assumed CAFOs and permitted open feedlot AFOs are meeting their regulatory requirements and are not contributing beyond the pollutant limits set by NPDES permits. Permitted open feedlots are designed to contain any runoff generated by a storm event weaker in intensity than a 25-year storm event. Therefore, management recommendations are not included in this plan for these facilities.

While regulated CAFOs and open feedlots are required to manage their manure and wastewater at the facility, however, they may still land apply manure and wastewater as fertilizer. Therefore, land application of animal waste / fertilizer should not be considered part of the “zero” discharge assumption placed on these facilities. Land applied manure and wastewater are a potential source of bacteria, nutrients, and sediment. The estimated manure application zone (provided by IDNR) is shown in Figure 47. This mapping is based on an assumption that manure is applied at an agronomic rate of 160 pounds of nitrogen per acre for a two-year crop rotation, from the estimated manure produced from each permitted facility. According to these estimates, approximately 109,209 acres of land receive manure application.

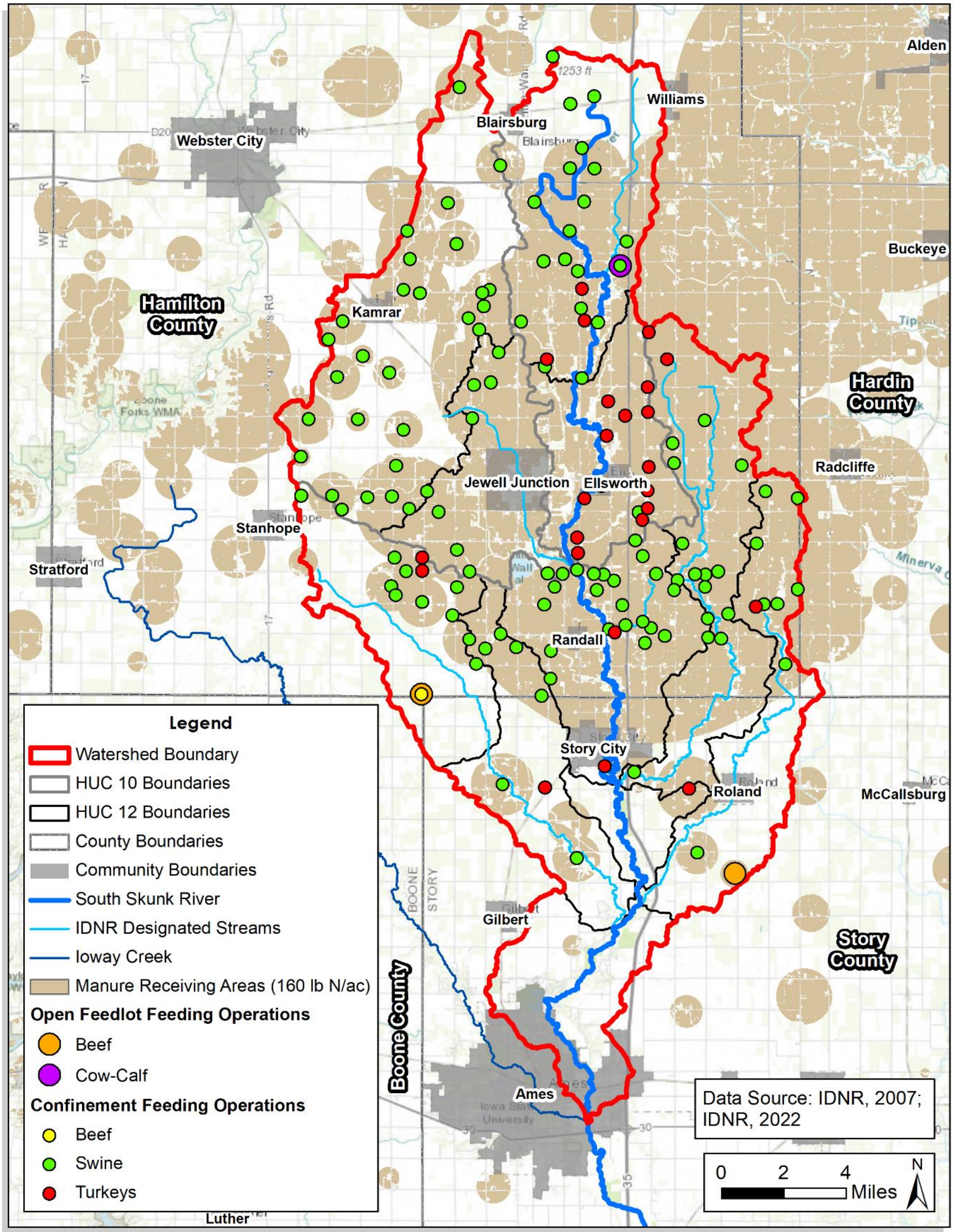


Figure 47: Location of Permitted AFOs and Estimated Manure Application Zones

WASTEWATER TREATMENT

Septic Systems are used to treat wastewater from a home or business and return treated wastewater back into the receiving environment. Septic systems can become a pollutant source for nutrients and bacteria when the systems begin to fail. There is no known estimated failure rate for septic systems in Iowa, but neighboring states (Nebraska and Minnesota) have estimated failure rates of 40-70%, indicating septic systems can be a signific source of pollution (EPA, 2002). It should be noted that Story County has an ordinance which requires septic tanks to be pumped and inspected every 5-years. JEO recommends this practice be encouraged across the watershed, and where underperforming septic systems are found, systems should be repaired or upgraded as needed.

“Unsewered communities” can also be sources of pollutant sources. According to the DNR, an unsewered community doesn't have to be an incorporated city. A "community" has 10 or more residential homes with one or more houses per acre. It's "unsewered" if it lacks a central sewage treatment system or if most of its septic systems don't meet state standards. Several unsewered communities are known to existing in Story County, primarily north of Ames. No unsewered communities were identified for Hamilton County, although they may still exist.

Permitting of small/private septic systems (less than 1,500 gallons per day) in Iowa is regulated at the county level, and therefore a map of individual systems across the watershed was not available. The number of septic systems was estimated using the Spreadsheet Tool for Estimating Pollutant Loads (STEP-L) data server (Tetra Tech, 2013). There are an estimated 1,458 systems in the watershed, and Figure 48 displays estimated counts on a HUC 12 basis. . Approximately half of those are found in Story County, which reported 687 private onsite systems (source: personal correspondence with Kimberly Grandinetti, Story County Environmental Health Director, 12/5/2022.

Additional information on septic systems can be found here:

- EPA Septic Smart Program : https://www.epa.gov/septic
- DNR Private Septic System Program: https://www.iowadnr.gov/Environmental-Protection/Water-Quality/Private-Septic-Systems
- Local County Sanitarian or County Health Department.

Wastewater treatment facilities which discharge to surface waters are required to have an NPDES permit, therefore, IDNR maintains a database of these records. Figure 48 shows 34 WWTFs located within the watershed. However, not all of these are municipal WWTFs, as some industrial facilities are also included in this count. It is recommended that during future updates to this plan pollutant loads be estimated for each WWTF based on a review of their permitted discharge permit. This information will be useful for water quality modeling efforts.

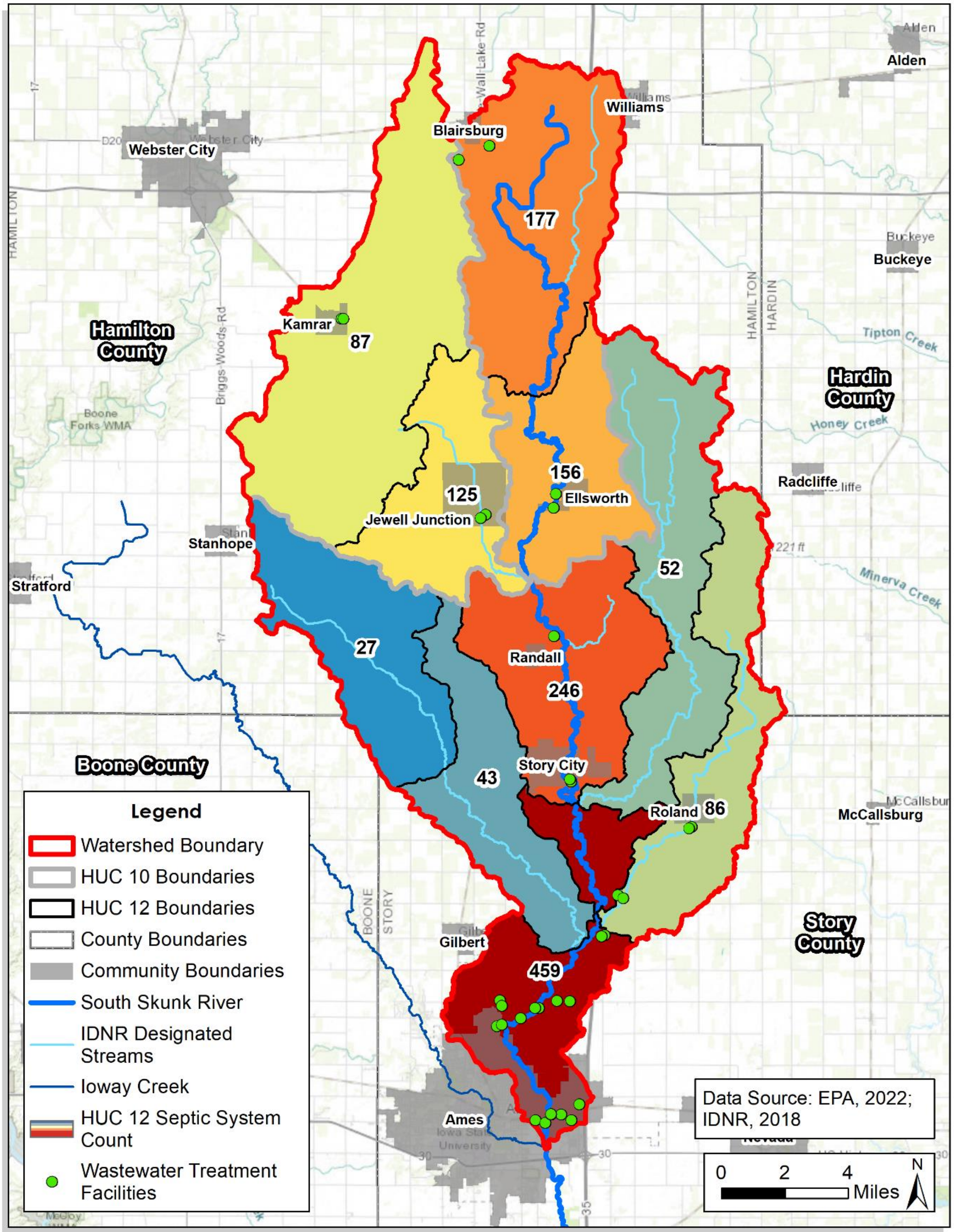


Figure 48: Permitted Wastewater Facilities and Estimated Count of Septic Systems

3.06 POLLUTANT LOADS

NUTRIENT LOADING

Summaries of the literature review conducted for data related to nutrient loading estimates is presented below. While the specific loading numbers in each report are dated or have other limitations; given the lack of a water quality model for the watershed, they do help to provide a reasonable representation of water quality conditions in the watershed. Pollutant load estimates from each study are provided in Table 25.

Table 25: Summary of Nutrient Load Estimates

Data Source	Total Nitrogen Load (lb/acre)	Total Phosphorus Load (lb/acre)
2004 Iowa Nutrient Budget Study	19.4	0.39
2012 USGS SPARROW Modeling**	19.04	1.23

** Based on an average of HUC 12 load estimates*
***Based on delivered accumulated load*
NR = Not Reported

It should be recognized that sediment and associated phosphorus loads are often dominated by erosion, with total phosphorus loads from streambanks ranging from for 3-38% in Iowa (Schilling, 2019). However, estimating total phosphorus loads with available water quality data is challenging. The majority of long-term water quality sampling efforts across Iowa, including the South Skunk River are taken through monthly grab sampling. There are not continuous monitoring sensors available for total phosphorus (like there are for nitrates). This is partially because phosphorus often needs to be measured as two forms: dissolved and total phosphorus. Total phosphorus refers to all forms of phosphorus present, whether attached to sediment being transported by the stream, or dissolved in stream water. The dissolved form is commonly referred to as ortho-phosphate. Typically, the majority of the total phosphorus is attached to sediment with lesser amounts present as ortho-phosphorus. Monthly sampling data likely misses a large amount of phosphorus that is transported during storm events that cause increased erosion. This points to the needs for data from stream erosion assessments.

2004 Iowa Nutrient Budget Study (Libra and others, 2004)

The Iowa Geologic Survey completed a statewide study titled *Nitrogen and Phosphorus Budgets for Iowa and Iowa Watersheds* (Libra and others, 2004). This study, which was supported by the IDNR's Section 319 program, estimated inputs and outputs of nitrogen and phosphorus across Iowa and its major monitored watersheds. Data represented average annual conditions for the period 1997-2002 and stream loading estimates were based on monthly water quality monitoring data across 68 watersheds (80% of the state) from 2000-2002. This report represented the first comprehensive mapping of the distribution of major nutrient sources across the state and presented a reasonable picture of nutrient loading at the time.

Pollutant load estimates for the Headwaters of the South Skunk River, based on water quality data from the IDNR's South Skunk River upstream of Ames site are provided in Table 25. While the specific loading numbers in the report are dated, it provides a full accounting of pollutant sources and offers several insights into relative levels of pollutant loads in watersheds across Iowa:

- Watersheds with a high percentage of row crop also tend to show statistically higher nitrogen concentrations
- High stream nitrogen loads were statistically related to inputs of nitrogen fertilizer
- High ortho-phosphorus loads in streams were statistically related to watersheds with high manure inputs
- There was no statistical correlation of total phosphorus to other factors in the study. This was likely due to the stream monitoring data used, which was based on samples collected monthly and may not characterize total phosphorus concentrations adequately.
- State-wide point sources accounted for about 8% of stream nitrogen, with nonpoint sources accounting for the remaining 92%. For individual watersheds, point source inputs accounted for 1-15%.
    - The Headwaters of the South Skunk River Watershed was below the average, with 5.6% of nitrogen originating from point sources.
- State-wide point sources accounted for about 20% of phosphorus, with nonpoint sources accounting for the remaining 80%. For individual watersheds, point source inputs accounted for 1-52%. Due to inherent issues with quantifying stream loads, as previously discussed, this estimate was less reliable.
    - The Headwaters of the South Skunk River Watershed was above the average, with 27.8% of phosphorus originating from point sources.
- A variety of factors affect the delivery of nitrogen and phosphorus from pollutant sources to streams. These include soil, geologic, climate/weather, land management practices, and the amount of nutrients available. While this study addressed the "amount of nutrients available" factor, strategies and practices to reduce pollutant loading must take all of these factors into account.

2012 USGS SPARROW Modeling

The United States Geological Survey (USGS) has developed the SPAtially Referenced Regression on Watershed attributes (SPARROW) water quality model (Robertson and others, 2019). SPARROW models streamflow, nitrogen, phosphorus, and suspended sediments across five regions in the United States, with Iowa falling into the Midwest Region. The nutrient and suspended sediment models have a base year of 2012, which means they were developed based on source inputs, management practices, and hydrologic conditions similar to those existing during or near 2012, which should be noted was a drought year for much of Iowa and may not represent typical conditions.

Care should be taken in interpreting the outputs from the SPARROW model. The model was developed to cover a very large area of the United States, was not developed to represent watershed specific characteristics of the Headwaters of the South Skunk River Watershed and does not provide load estimates on a HUC 12 basis. Additionally, the specific loading numbers in the report are dated. However, given the lack of a water quality model for the Watershed, it does help to provide a reasonable representation of water quality conditions in the watershed. Pollutant load estimates from the SPARROW model are provided in Table 25.

Additional information on the SPARROW model can be found here:

https://www.usgs.gov/mission-areas/water-resources/science/sparrow-modeling-estimating-nutrient-sediment-and-dissolved

BACTERIA LOADING

No information containing *E. coli* loading estimates specific to the watershed was found through literature review. It is recommended that the existing water quality data from IDNR and PRI could be used in the future to calculate pollutant loads. This should include the development of a load duration curve to help understand the nature of the pollutant loads. A load duration curve is a statistical model that will help answer the question if the bacteria levels are higher during high flow events (likely driven by nonpoint sources) or during low flow events (indicating loading is coming from point sources).

SEDIMENT LOADING

To fully account for sediment loads, data for both upland (in-field) erosion and stream erosion needs to be accounted for. At this time, no data was available for stream erosion estimates However, average erosion rates from upland sources for each HUC 12 were estimated using the Daily Erosion Project. Note that these estimates include erosion from sheet and rill erosion, but not from streams or gullies. The long-term average sediment loss by year (2007-2021) from upland sources across the watershed is displayed in *Figure 49*.

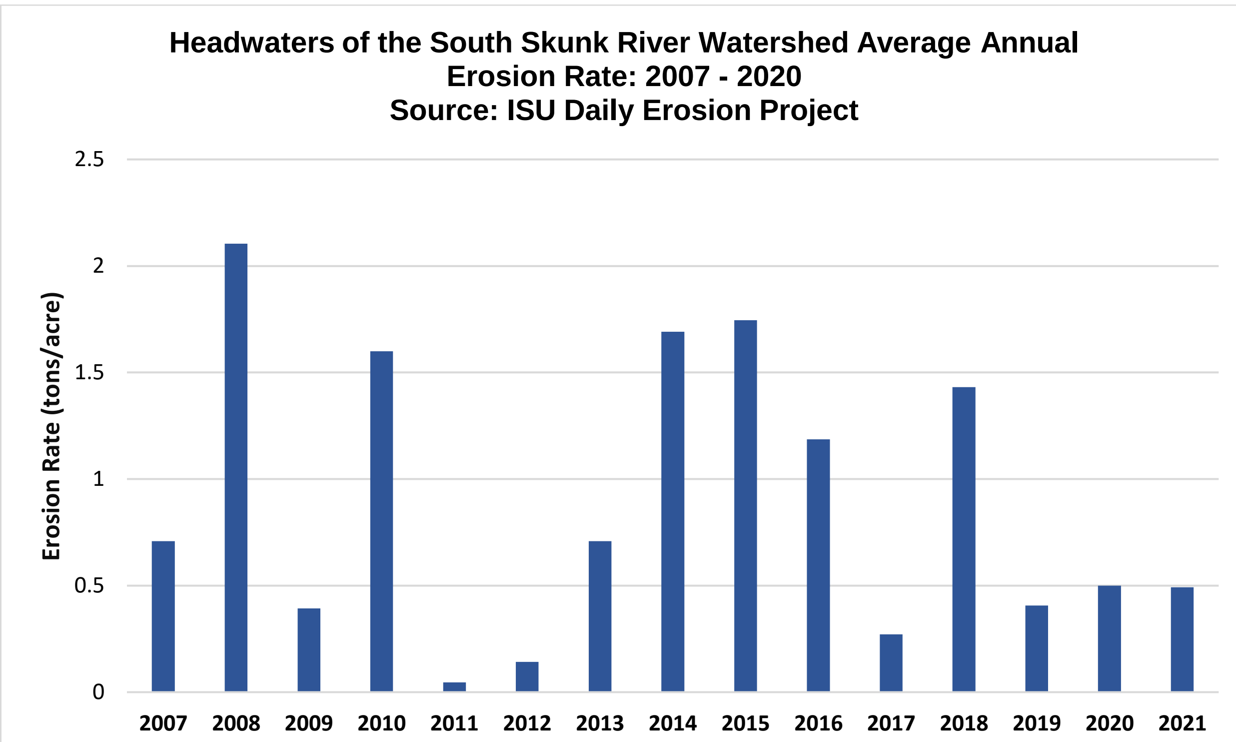


Figure 49: Average Annual Erosion Rate from Upland Sources

3.07 EXISTING BEST MANAGEMENT PRACTICES

Estimating existing BMPs and treated areas is an important step in the planning process. This knowledge helps to prioritize installation of future BMPs and is necessary for calibration of water quality models. These estimates are also used to determine potential pollutant load reductions that additional treatment could have in the watershed. This plan relies upon existing data sources and input from stakeholders to identify current BMPs. Unfortunately, no central listing or full inventory exists for this information. The Natural Resources Conservation Service (NRCS) works with many farmers to install BMPs, however, that information is subject to privacy laws. Additionally, many landowners implement BMPs on their own without government assistance. **Therefore, additional BMPs, not accounted for in this chapter, are likely to exist.**

BMP accounting was broken down into three general types: structural**,** non-structural, and urban stormwater, as discussed below. Suitability for future BMPs was identified using various methodologies, including the ACPF Toolbox, and is included in Chapter 5.

STRUCTURAL BMPS

The Iowa BMP Mapping Project, sponsored by ISU, provides a baseline set of existing BMPs spanning from 2007 to 2010. Existing BMPs are identified and digitized through aerial photography, hill-shade and slope grids, and other remote sensing products (ISU, 2018). ISU focused on identifying structural practices (edge of field) such as ponds, dams, terraces, water, and sediment control basins (WASCOBs), contour buffer strips, and grassed waterways. Additional information can be found here: https://www.gis.iastate.edu/BMPs

Personal correspondence with IDALS employees also aided in identifying wetlands restored through the Iowa Conservation Reserve Enhancement program (CREP). No tile-zone wetlands were identified in the watershed. Additional program information, including water quality monitoring and effectiveness data can be found here: https://www.iowacrep.org/

Figure 50 identifies the existing locations of structural BMPs in the watershed, where data was available. Table 26 details the numbers of those structural BMPs identified in the watershed.

Table 26: Summary of Existing Structural BMPs in the Watershed

BMP Type	Count Identified
Contour Buffer Strips*	7 structures
Grassed Waterways*	2,853,948 feet
Ponds*	32 structures
Terraces*	32,823 feet
WASCOBs*	221 structures
Nutrient Reduction Wetland / CREP Wetland**	3 sites

**Source: ISU, 2018*

***Source: written communication. with Jerry Neppel, January 27, 2022*

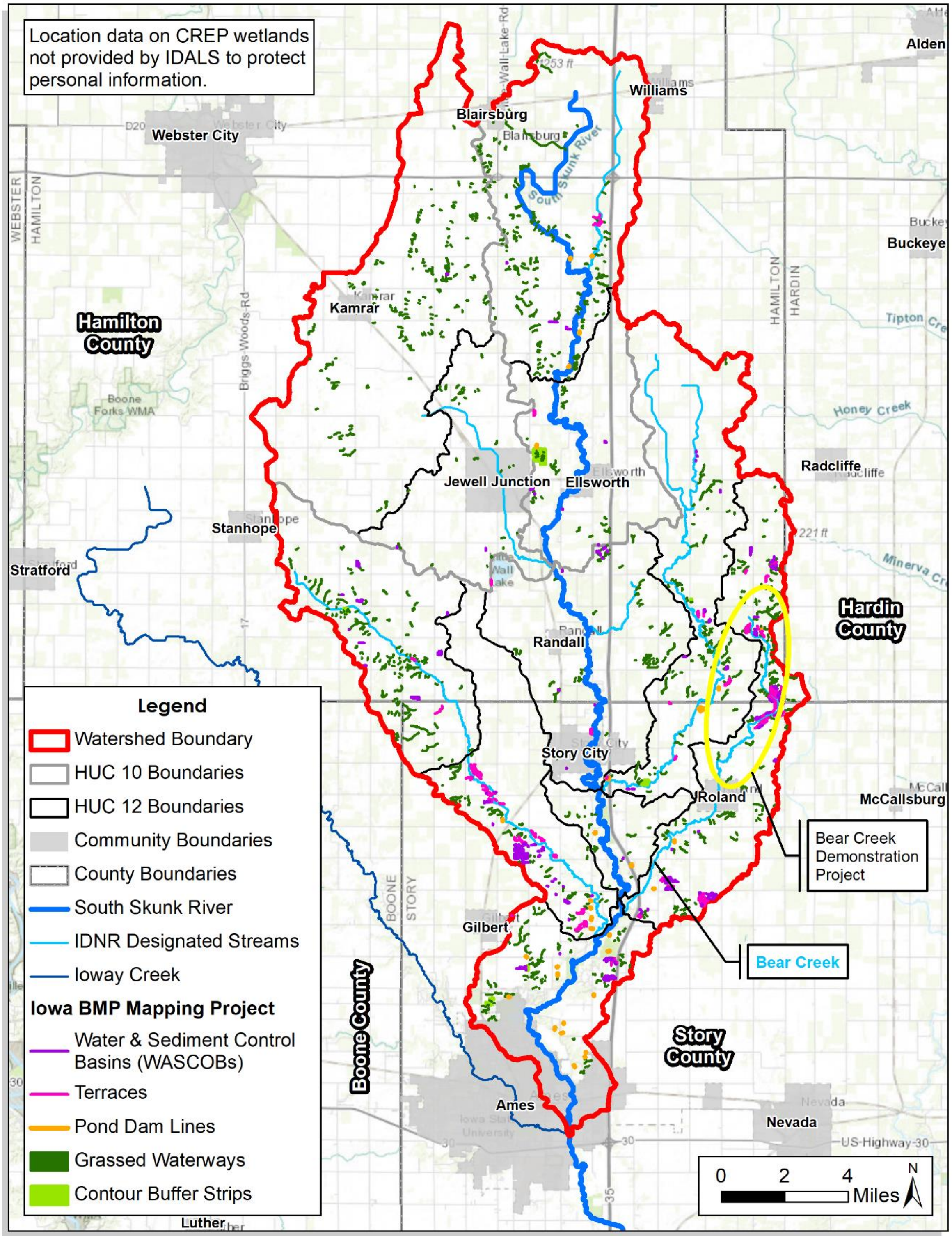


Figure 50: Map of Structural BMPs in the Watershed

BEAR CREEK RIPARIAN BUFFER PROJECT

This nationally recognized project involves research and demonstration of a large scale, “real world” application of riparian buffer BMPs. It is located within the watershed on Bear Creek, just north of Roland (Figure 50). Iowa State University, through the Leopold Center, operated it from 1990 to 2002, and research still continues. The project re-established various types of riparian buffers on row cropped land, including trees, shrubs, and native grasses. This project continues to demonstrate the benefits of buffers: improved water quality, reduced soil erosion, improved wildlife habitat, and reduced input costs for farmers.

NON-STRUCTURAL BMPS

Existing non-structural BMPs (which include in-field and nutrient management BMPs) are more difficult to identify as they cannot be easily identified in aerial photography. Non-structural BMPs are also not permanent like structural BMPs. The adoption or implementation levels for non-structural BMPs can vary year-to-year based on landowner or farmer management practices. It is recommended that farmer surveys or an on-the-ground inventory of BMPs be performed prior to the update of this plan.

To gain a better understanding of adoption levels of non-structural BMPs across the entire watershed, Operation Tillage Information Center (OpTIS) data, provided by the Conservation Technology Information System (CTIC), was also reviewed (CTIC, 2022). According to the data, from 2014-2018, 69% (580,617 acres) of the HUC 8 South Skunk watershed as a whole used some form of conservation tillage for at least one year, while the adoption rate in all of Iowa was found to be 85%. 15.8% of the South Skunk HUC 8 watershed was found to use conservation tillage for all 5 years, compared to 17.1% of Iowa as a whole. Conservation tillage is broadly defined as a practice including strip-till, ridge-till, and mulch till systems. Occasionally, vertical tillage is also included in the definition.

Also, from OpTIS, the data shows that from 2014-2018 for the South Skunk HUC 8 watershed, 5.3% of the row crop area used winter cover crops for at least one year, and less than 0.05% used cover crops all five years. These low rates of cover crop usage are similar to the state acres in cover crops for at least one year (5.3%) and for all five years (less than 0.05%). Complete findings and figures depicting the reviewed OpTIS data, as well as other information on existing BMPs is available in Appendix B.

Table 27: Conservation Practices in South Skunk HUC 8 Compared to Iowa (2014 – 2018)

Conservation Practice	South Skunk HUC 8 Watershed Adoption Rate	Iowa Adoption Rate
Conservation tillage at least 1 year	69%	85%
Conservation tillage all 5 years	15.8%	17.1%
Cover crops at least 1 year	5.3%	5.3%
Cover crops all 5 years	<0.05%	<0.05%

URBAN STORMWATER BMPS

Identifying and summarizing existing urban BMPs was limited to input from watershed partners.

- **The City of Ames** has implemented many urban stormwater BMPs:
  - Reconstructing the City Hall parking lot with permeable pavers
  - Implementing a stormwater erosion control project along South Skunk River from Carr Park to Homewood Golf Course
  - Developing bioretention cells on 24th Street with the Street Rehabilitation Project
  - Construction of riffle pools and streambank stabilization with Ioway Creek Water Main Stabilization at Lincoln Way
  - The city also regularly uses phosphorus-free fertilizer in parks and water quality treatment of stormwater runoff through the city's current post-construction ordinance.
- **The City of Roland** implemented a bioswale project in Britson Park (Figure 51). Bioswales channels convey stormwater runoff while also removing debris and pollution using infiltration and vegetation which often consists of native grasses and flowers.

Figure 51: Bioswale Project in Roland Designed to Treat Urban Stormwater Runoff

3.08 EXISTING ACPF MAPPING DATA

The Agricultural Conservation Planning Framework (ACPF) is a GIS-based toolbox that produces a standard set of outputs that can be used to better understand a watershed at the HUC 12 level. Geospatial outputs include the creation of a stream reach and catchments, suggested locations for BMPs, and other pertinent data about the watershed. Prior to this project, the southernmost six HUC 12s had undergone ACPF modeling (completed by PRI), shown in Figure 52. Data from PRI's mapping can be viewed online here: https://arcg.is/0e1Wjm0 As part of the planning process, the remaining four HUC 12s were modeled by JEO, and the data provided to the HWSSRWMA.

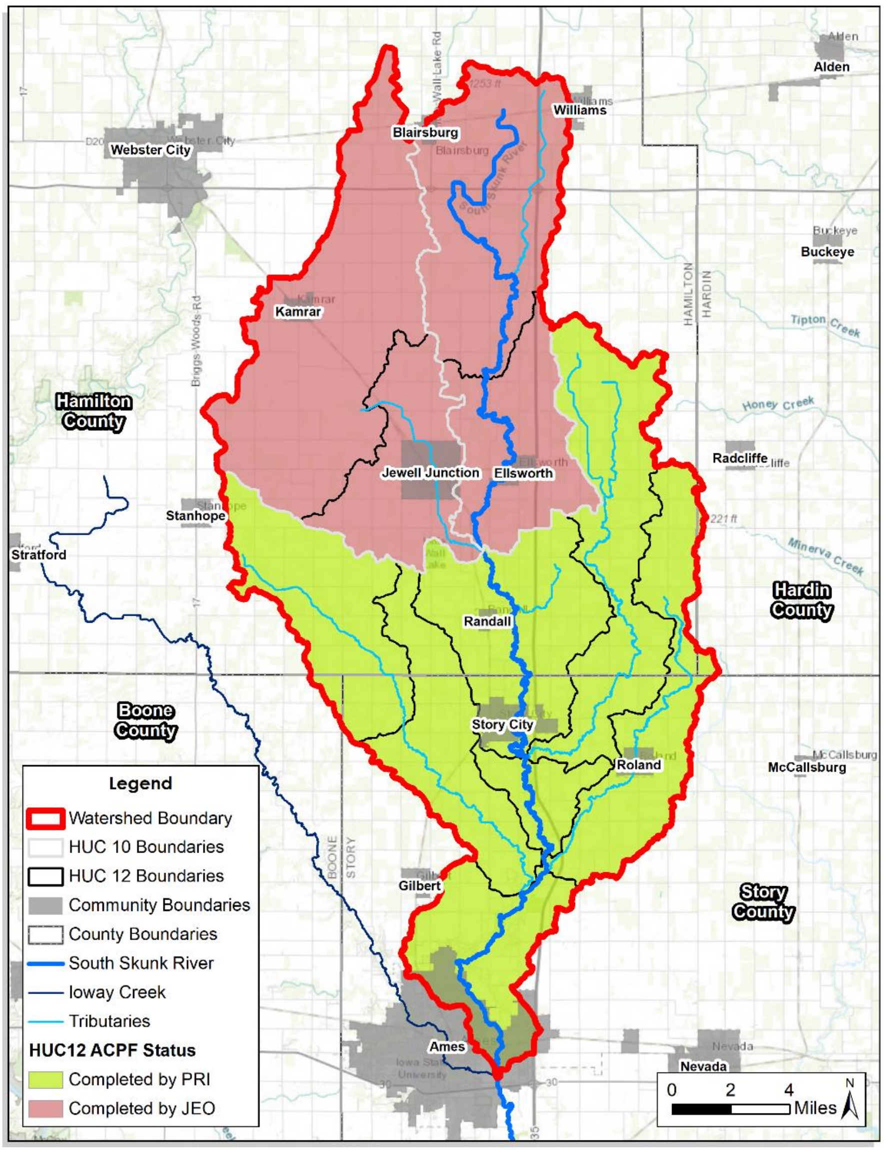


Figure 52: Status of ACPF Mapping in the Watershed

3.09 SOURCE WATER PROTECTION ASSESSMENT

The IDNR Source Water Protection (SWP) Program is a voluntary program that public water systems can choose to participate in to protect the source of their drinking water. In Iowa, this water is generally sourced from groundwater. The program has three phases: Phase 1 includes an initial source water assessment, provided by DNR for all public water supplies; Phase 2 is voluntary and includes the development of a SWP plan with a local team effort; Phase 3 includes the implementation of the SWP plan.

Communities within the watershed that have developed a source water protection plan are shown in Table 28. Although the majority of communities within the watershed have developed a SWP plan at one time, a community is encouraged to update their plan to keep it relevant to current conditions. The Conservation Districts of Iowa and the Iowa Rural Water Association can provide planning assistance to interested communities free of charge. More information can be found at https://www.iowadnr.gov/Environmental-Protection/Water-Quality/Source-Water-Protection.

Table 28: Source Water Protection Plan Status for Cities within the Watershed

Community	Most Recent Phase I Assessment	SWP Plan?	SWP Plan Date Approved
Ames	2014	No	-
Blairsburg	2022	No	-
Ellsworth	2019	Yes	2006
Gilbert	2018	Yes	2004
Jewell	2012	Yes	Unknown
Kamrar*	2003	No	-
Randall	2012	Yes	2004
Roland	2016	Yes	2004
Story City	2014	Yes	2003
Williams	2018	Yes	2004

Source: IDNR, 2022e

** Source water assessment for the Community Church of Kamrar only*

3.10 FLOOD RISK ASSESSMENT

Flood risks typically originate from three primary sources: mainstem flooding, tributary flooding, and flash flooding. Since 2009, the Iowa Department of Natural Resources (IDNR) has been working with the Federal Emergency Management Agency (FEMA) to create and maintain flood hazard data for the State of Iowa. (IDNR, 2022d). The goal of this collaboration is to create Flood Insurance Rate Maps (FIRMs) for every county in the state. Flood hazard maps only account for riverine flooding, which occurs when an existing stream channel, whether it is a tributary or main river branch, overflows its banks. Localized flooding caused by inadequate drainage systems will not be visible on these maps. Chapter 2 provides an overview and maps floodplains within the watershed.

A flood risk assessment is a key step towards creating both communities and a watershed that is flood resilient. A flood risk assessment is conducted to identify communities with the highest risk for flooding. This information can then be used to identify and prioritize potential mitigation alternatives. A watershed approach towards flood risk reduction allows local issues to be addressed, while also having positive effects on reducing flooding within the larger watershed. Additional discussion on flood mitigation recommendations can be found in Chapter 5.

A flood risk assessment at the watershed level was not available to be included in this watershed planning effort; however, it is recommended that this be done in the future. Therefore, to understand flooding risks across the watershed, the following countywide hazard mitigation plans were reviewed:

- *Story County, Iowa Multi-Jurisdictional Hazard Mitigation Plan* (Story County, 2019)
- *Hamilton County, Iowa Multi-Jurisdictional Hazard Mitigation Plan* (Weinzetl, 2019)

Each plan profiles multiple hazards related to flooding, including dam/levee failure, flash flood, and river flood. A thorough review of each of these hazards is presented in the plans, including past and projected damages and a hazard assessment by jurisdiction. For the river flood profile, floodplain maps and damage estimates are provided for each jurisdiction as part of the assessment. Each plan provides a hazard assessment score for jurisdictions within each county (except Blairsburg), based public input, records of historical events, and risk factors such as: probability, vulnerability, severity of impact, and speed of onset. A summary of the flood hazard assessments is provided in Table 29.

Table 29: Flooding Hazard Assessment for Cities Within the Watershed

City	Vulnerability	
	Flash Flood	Riverine Flooding
Story County		
Ames	High	High
Gilbert	High	Moderate
Roland	High	High
Story City	High	High
Hamilton County*		
Blairsburg	N/A	N/A
Ellsworth	10	7
Jewell	11	5
Kamrar	12	5
Randall	11	Not evaluated
Williams	11	5

**Hazards were assessed scores out of a total of 20 possible points, the higher the score the more vulnerable a jurisdiction.*

If communities, especially those most vulnerable, are interested in a more detailed flood risk assessment, it is recommended that this be completed as a future study. A detailed flood risk assessment would include developing detailed hydraulic and hydrologic models, helping to identify risks to various types or sizes of flooding events. The assessment should be completed with a model that has variable time step series, which allows one to visualize the source and direction that flood waters originate from, as well as the speed at which they can impact a community. This modeling is key to developing and prioritizing sound mitigation actions, especially at the watershed scale. The approach allows local issues to be addressed, while also having positive effects on reducing flooding within the larger watershed.

In lieu of a detailed flood risk analysis, communities can review online flood maps to supplement the information in the hazard mitigation plans and further understand their risk. This can be done through the Iowa Flood Information System (IFIS), which is an online platform to access flood hazard maps and other flood-related products (IFC, 2022). IFIS helps communities prepare for and respond to floods before they occur, helping to minimize flood impacts and associated damages. The system includes real-time stream levels at nearly 250 locations; flood inundation maps showing the extent and depth of predicted flood waters for 24 Iowa communities; weather conditions including current and past rainfall accumulations; and much more.

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

3.11 SUMMARY AND RECOMMENDATIONS

SUMMARY OF WATER QUALITY ANALYSIS

Overall, water quality conditions in the watershed are “mixed” in as much that some indices are relatively good (phosphorus and TSS), others are concerning (*E. coli*), and others show a clear sign of a problem (nitrogen).

Unfortunately, identification of “hot spots” across the watershed was not possible with the data available. “Hot spots” are locations with an above average density of pollutant sources. Identification these areas can help to focus implementation efforts where they will have the most impact. Development of a water quality model would help to identify these areas and is recommended. However, there were clearly identify subwatersheds with higher concentrations of pollutants, as indicated through water quality data. These areas (discussed below) may be good candidates for focusing implementation efforts.

After a review of water quality data for the full watershed and tributaries, several summary observations can be made:

- Water quality for phosphorus and sediment (TSS) is generally good. However, care should be taken with this conclusion as the current monitoring data available was based on samples collected monthly and may not characterize these conditions adequately. Results from event-based sampling, which may show elevated pollutant loads, should be evaluated in future updates to this plan (see recommendations).

- *E. coli* bacteria and nitrates appear to be the primary pollutants plaguing the watershed and each tributary.
- Impairments due to *E. coli* bacteria have been identified by IDNR on the South Skunk River and Long Dick Creek, both of which are supported by the water quality data.
- *E. coli* levels on all tributaries is well above state water quality standard for the seasonal geometric mean (Figure 53). Loads from each tributary are likely contributing to the high levels found near the mouth of the watershed, on the South Skunk River.
- While recent (2020 and 2021) *E. coli* sampling data on the South Skunk River at Ames appears to be below the state water quality standard, there is a long-term history of the standard being exceeded (Figure 31) and is still cause for concern.
- Targeting BMPs to directly address sources of *E. coli* and nitrogen or reducing runoff or tile drainage from cropland will also lead to reductions in phosphorus and sediment.

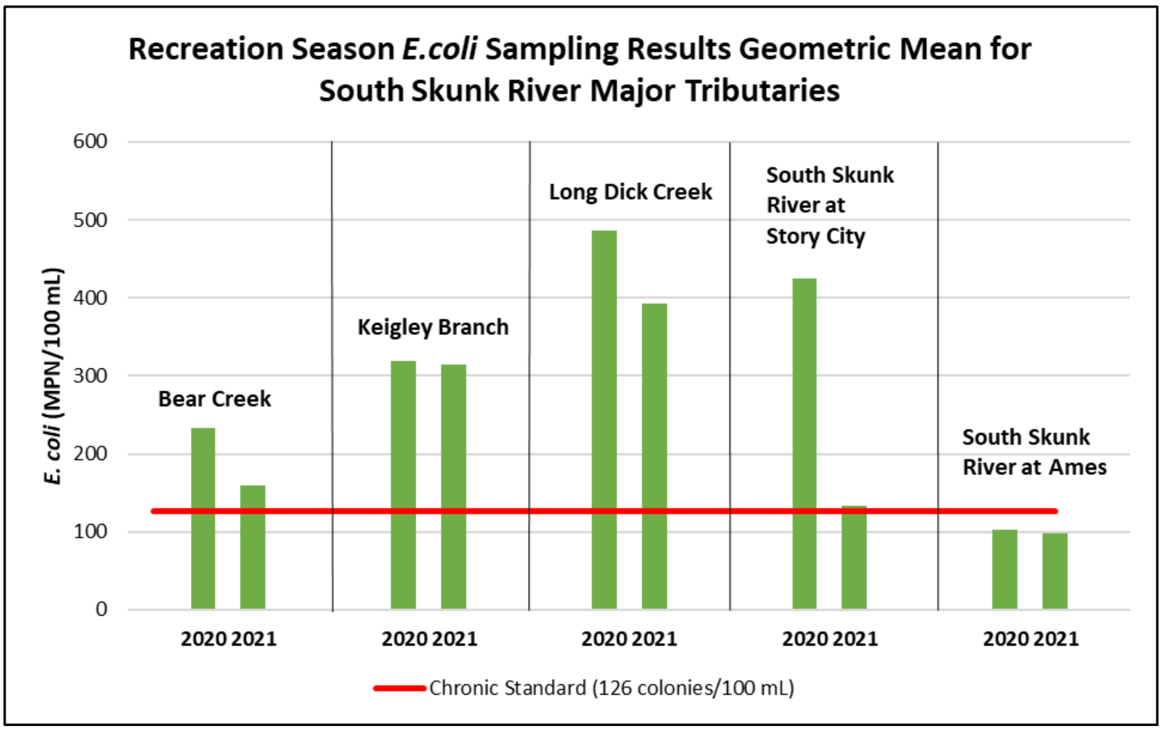


Figure 53: Comparison of Seasonal *E. coli* Concentrations in Tributaries

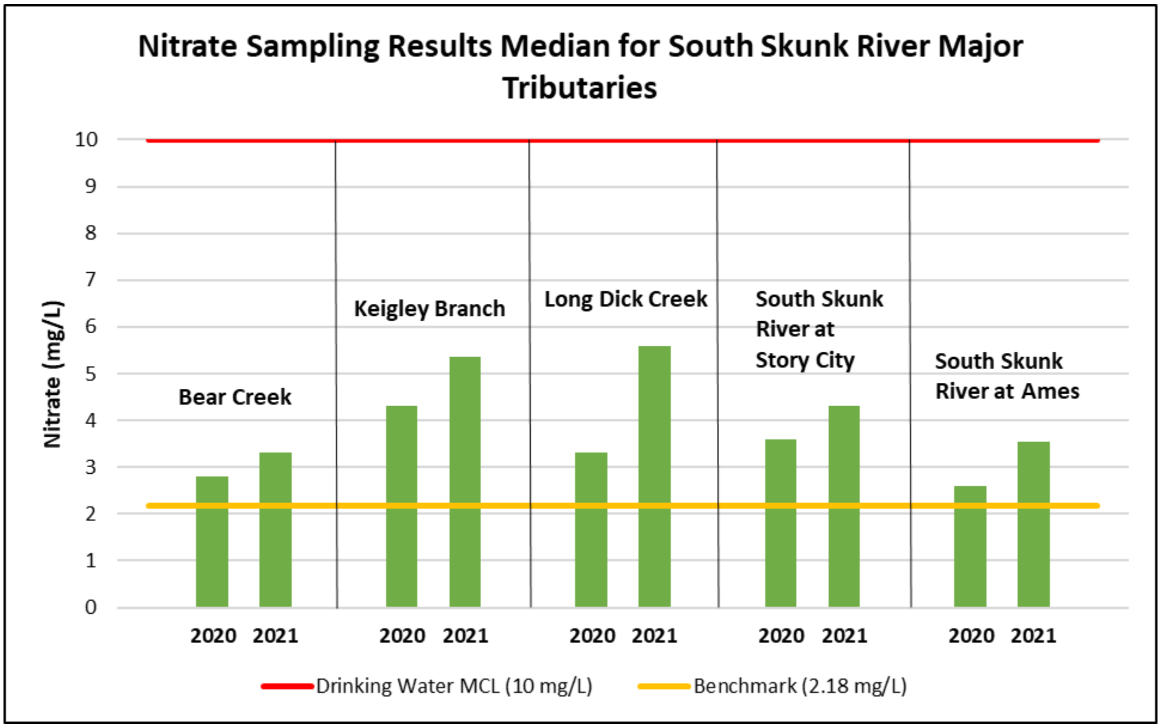


Figure 54: Comparison of Nitrate Concentrations in Tributaries

RECOMMENDATIONS

While a rich supply of information has been reviewed and presented in this chapter, there are further questions and data gaps. The following is a summary of recommendations found within this chapter that should be considered for completion prior to or during future updates to this plan.

- **Expand stream sampling to include samples taken during storm events.**
  Water quality data for phosphorus and sediment are currently based on monthly sampling, however this likely underrepresents loading from storm events when erosion occurs. Sampling of storm event could help to fill in this data gap. Various methods exist such as flow-paced automated samplers or simpler single-stage samplers. Additional examples are provided in the *Story County Water Monitoring and Interpretation Plan* (PRI, 2021).
- **Additional pollutant source identification.**
  Locations of small open feedlots, which can be a significant source of pollutants, especially bacteria, are not known. These should be identified during future watershed plan updates through visual review of aerial photography. Pollutant loads should be estimated for each WWTF facility based on a review of their permitted discharge permit. This work could be completed with the development of a watershed model and will vastly improve the understanding of pollutant sources and loads in the watershed.

- **Complete stream assessments.**
  On-the-ground stream assessments should be completed across the watershed, or at least in priority subwatersheds. As part of these surveys, drainage tile infrastructure should be located and evaluated.
- **Survey farmers on adoption levels of non-structural BMPs.**
  Existing non-structural BMPs (which include in-field and nutrient management BMPs) are difficult to identify through existing databases or review of aerial photography. It is recommended that farmer surveys and/or an on-the-ground inventory of BMPs be performed prior to the update of this plan. It would also be beneficial to include structure BMPs in this survey effort. This will enhance efforts for prioritizing BMP implementation efforts and in calibration of water quality models.
- **Perform a detailed flood risk assessment for communities.**
  A more detailed flood risk assessment should be developed for the communities within the watershed that are most at risk to flooding. This could be performed as a standalone study, or during future updates to the county hazard mitigation plans.
- **Perform a statistical analysis of water quality data.**
  A statistical analysis should be completed for the water quality pollutants of interest (nitrogen, phosphorus, TSS, and *E. coli*). Additionally, development of a load duration curve for bacteria will help understand if spikes in the bacteria level sampling data are during high flow events (likely driven by nonpoint sources) or during low flow events (indicating loading is coming from point sources). This work could be accomplished alongside or separately from the development of a water quality model.
- **Develop a water quality model.**
  A water quality model was unavailable for use during the development of this plan. It is recommended that future planning or evaluation steps include the development of a water quality model. A water quality model allows quantitative estimates about existing pollutant loads to be made, as well as quantifies the effects of implementing various Best Management Practices (BMPs) (Figure 55). It can function as a tool to evaluate management strategies, demonstrate incremental progress towards meeting water quality standards or goals, and evaluate future water quality data. Modeling should be completed at the HUC 12 subwatershed level to assist with BMP targeting and evaluation efforts. Additionally, the pollutant loads should be broken down by source, not just a total aggregate load.

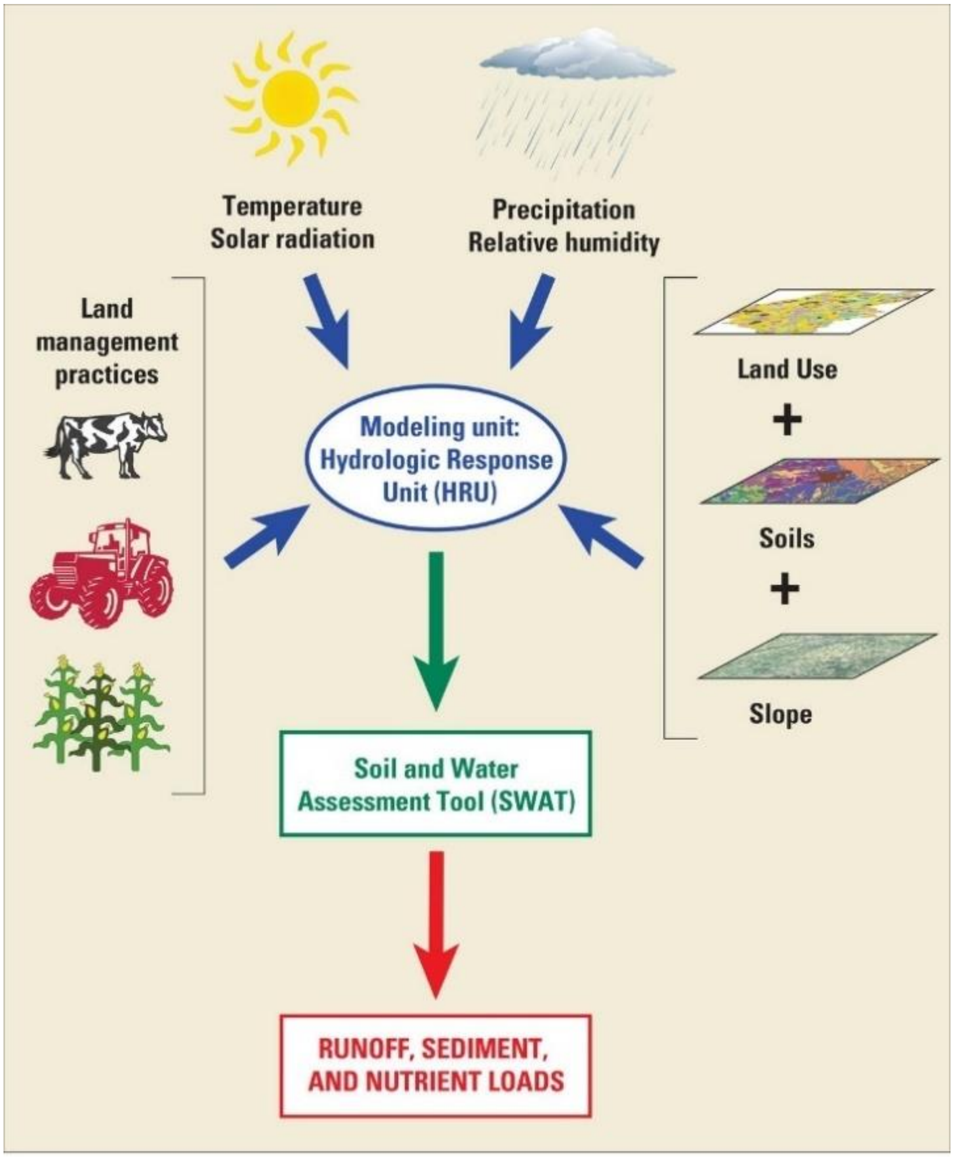


Figure 55: Example Illustration of a Water Quality Model

CHAPTER 4. GOALS

4.01 INTRODUCTION

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

The overarching goal of the Headwaters South Skunk River Watershed Management Authority (HSSRWMA), and this watershed plan, is to improve the water quality of the Headwaters of the South Skunk River. Each of the goals and objectives are written to address this overarching goal either directly or indirectly through mutually supporting efforts and interests.

ACHIEVING THE GOALS AND OBJECTIVES

To help guide the HWSSRWMA towards the achievement of these goals and objectives, the watershed plan includes a **Long-term Implementation Strategy in Chapter 5**, and a **Short-term Action Plan in Chapter 7**. Because the watershed management authority WMA has no formal authority, it must rely on the commitment and voluntary involvement of community members. Therefore, education and outreach will be the cornerstone of most activities undertaken to implement this plan, thus there is an **Education Plan in Chapter 6.**

4.02 GOAL-SETTING PROCESS

The final vision, goals, and objectives that were collaboratively developed by the HSSRWMA members and stakeholders are found in Figure 30. It is important to note that the vision, goals, and objectives reflect the needs and priorities of watershed communities at the time of this plan's development. These needs and priorities may change over time as resources, policy, and science continues to change; thus, these goals and objectives should be reviewed and adjusted as needed, and at a minimum of every five years during plan updates in accordance with the EPA's nine elements (EPA, 2008).

STAKEHOLDER INPUT

The first step in the goal-setting process was the development of a vision, or an optimal desired future state for the watershed. To facilitate discussion, an initial discussion was held at the August 23, 2021 WMA meeting. At the next WMA meeting (October 7, 2021) a draft version of the vision statement was provided. After discussion and multiple rounds of revision, the WMA adopted a vision statement that best represents what they would like to accomplish with the plan. The final vision statement (Table 30) was adopted by the WMA at the November 18, 2021 meeting.

Concurrently, the WMA also worked to establish goals and objectives for the plan. While the vision statement helps to set the stage within which efforts to implement the watershed plan will be bounded, goal and objectives help to identify key outcomes that can be used to measure progress. Additionally, goals help to clearly communicate to stakeholders what the WMA hopes to achieve. Goals are written to be long-term outcomes of watershed plan implementation. Objectives define strategies or implementation steps to attain the identified goals and provide a way of measuring movement towards each goal and the overall vision. The final goals (Table 30) were also adopted by the WMA at the November 18, 2021 meeting.

WATER QUALITY BASELINES AND TARGETS

Goals and objectives are more likely to be achieved when they are written to be specific, measurable, and time-bound. This is level of detail is particularly important to Goal #2, which is focused specifically on water quality. To develop this level of detail, the following attributes were developed for each:

- **Water quality baseline measurements** are based on the stream sampling data for each pollutant from 2001-2014 taken at “South Skunk River Upstream of Ames” site provided by DNR, as presented in Chapter 3. This baseline data was selected as it represents the most representative long-term sampling record for the watershed. This excludes the most recently collected data from 2020 and 2021 that is potentially skewed by years with below average precipitation. Additionally, data from 1999 and 2000 were omitted as there were very few samples collected that year. These years are likely not a good representation of the true historical/long-term or current water quality conditions in the watershed. It is recommended that these baselines be reevaluated in future updates to this plan as additional sampling data becomes available, and as additional analysis such as flow weighting, water quality modeling, etc. can be completed.
- **Pollutant reduction targets** for nitrogen and phosphorus are based on those set by the Iowa Nutrient Reduction Strategy, reduction targets for *E. coli* bacteria are based on state water quality criteria, and reduction targets for sediment/ total suspended solids (TSS) are based on partner input. Each of these are discussed in more detail in Chapter 2.
- **Target dates** for achieving these goals were set to be consistent with the Iowa Nutrient Reduction Strategy and/or the stakeholder identified 20-year window for plan completion.

These water quality baselines and targets are based on water quality data that is “representative” of the full HWSSR Watershed, as measured near Ames. However, as illustrated in Chapter 3, each tributary differs in pollutant concentrations; therefore, individual goals, objectives, baselines, and reduction targets should be identified for each subwatershed as Best Management Practice (BMP) implementation projects are developed. Additional discussion on this level of planning is provided in Chapters 5 and 7.

Table 30: Vision, Goals, and Objectives of the Plan

Vision	The Headwaters of South Skunk River WMA will bring together farmers, landowners, residents, soil and water conservation districts, cities, counties, and other stakeholders through an "all in it together" approach towards watershed management. Education, outreach, and voluntary efforts will be used to improve water quality, increase flood resiliency, and enhance soil health across the watershed.
Goal 1	**Generate and maintain full political, technical, and public support across all participating political subdivisions and other stakeholders to ensure plan sustainability.**
Objective 1.1	Expand WMA membership to all eligible cities, counties, and SWCDs by the end of 2024.
Objective 1.2	Increase the number of individuals, businesses, nonprofits, government entities, and others that participate in WMA meetings or watershed projects by 10% each year.
Goal 2	**Improve water quality to enhance quality of life, environmental integrity, and recreational opportunities, within the watershed.**
Objective 1.1	Reduce annual median nitrate levels by 41%, from 8.8 mg/L to 5.2 mg/L, by 2035, based on the Iowa Nutrient Reduction Strategy.
Objective 1.2	Reduce annual median total phosphorus levels by 29%, from 0.14 mg/L to 0.01 mg/L, by 2035, based on the Iowa Nutrient Reduction Strategy.
Objective 1.3	Reduce current annual levels of sediment loading* to streams by 10% from 11.5 mg/L to 10.4 mg/L, through reducing in-field erosion and/or stream erosion. **Sediment loading rates currently measured by TSS sampling*
Objective 1.4	Maintain *E. coli* bacteria levels to ensure no samples exceed 235 organisms/100mL and that the seasonal geometric mean is maintained below 126 organisms/100mL.
Goal 3	**More widely and deeply affect water quality improvements in the watershed by increasing individual and community commitment to water quality.**
Objective 3.1	Form an education and outreach committee as part of the WMA by the end of 2023. This committee will work with partners to implement the education plan and action items.
Objective 3.2	Set up HWSSRWMA webpages or links on partner websites by 2024.
Objective 3.3	By the end of 2025 hold a minimum of two outreach and education event in the watershed per year (one in Story County, one in Hamilton County).
Objective 3.4	By the end of 2023, expand regular stream monitoring efforts into Hamilton County.

4.03 MONITORING INDICATORS FOR EACH GOAL

Several metrics (indicators) were identified for each goal. Indicators are what is measured or monitored to determine whether progress is being made toward goals and objectives. Some have the capability to be measured nearly continuously, others at less frequent intervals; however, it will be important for the WMA to review these metrics on at least an annual basis. Monitoring and evaluating these metrics will allow the WMA to evaluate the effectiveness of implementation efforts. Additional discussion on monitoring and plan evaluation can be found in Chapter 5.

Due to the long time frame it may take to achieve many of these goals, indicators which can be measured and assessed at different intervals (long, medium, and short-term) have been identified. Additional indicators may be identified as implementation and updates to this plan are carried out. It is important to recognize that different indicators are suitable to document different types of outcomes. For instance, water quality parameters may take many years to change, so in the interim, it may be useful to document social or administrative indicators as a surrogate for water quality changes that are slowly happening. Additional discussion on indicators related to education and outreach can be found in Chapter 6.

1. Goals 1 and 3:
   - 1.1. Maintain a roster of WMA membership and entities participating in meetings or projects.
   - 1.2. Utilize surveys that measure the knowledge and attitudes of target audiences.
2. Goal 2
   - 2.1. Stream monitoring at "South Skunk River Upstream of Ames" site, provided by PRI.
   - 2.2. Tributary-level (subwatershed) monitoring sites provided by PRI.
   - 2.3. Estimates of hillslope (in-field) erosion, through visual assessments or the Daily Erosion Project.
   - 2.4. Visual stream assessments results.

4.04 RECOMMENDATIONS

The following is a summary of recommendations found within this chapter that should be considered for completion prior to or during future updates to this plan.

- **Develop a water quality model for the watershed.** This will allow for incremental monitoring of progress towards goals and BMP implementation to be better paired. This would also allow the objectives to be updated to be based on pollutant loads rather than pollutant concentrations.
- **Reevaluate water quality baselines:** It is recommended that the baselines utilized within the objectives be reevaluated in future updates to this plan as additional sampling data becomes available, and as additional analysis such as flow weighting, water quality modeling, etc. can be completed.

CHAPTER 5. LONG-TERM IMPLEMENTATION STRATEGY

INTRODUCTION

This chapter presents a long-term roadmap (20 years) for how the Headwaters of the South Skunk River Watershed Management Authority (HWSSRWMA), in partnership with federal, state, private, and nonprofit partners, will achieve the goals identified in Chapter 4. Included is an estimate of financial and technical resources the WMA and partners will need to implement the plan. Due to the long-term schedule and large geographic extent of the watershed this strategy is broken down into multiple phases and priorities. This will allow interim progress to be measured and will require the plan to be updated at least every 5 years.

The long-term implementation strategy was developed from stakeholder input, technical analysis, and existing data available during the planning process. Previous chapters in this plan have laid the groundwork for understanding the resources, concerns, and threats within the HWSSRW. This chapter provides the guidance on “what is to be done” in the watershed. Chapter 6 provides an education plan, the use of which should accompany any implementation effort. Action items for the first 5-year phase, including the prioritized subwatershed areas for BMP implementation, are provided in Chapter 7.

WILL THIS PLAN WORK?

While this plan is ambitious, many of the strategies presented have been successfully implemented through other watershed efforts across Iowa. Using a mixture of BMPs, it has been shown that goals can be met without sacrificing the agricultural backbone of the watershed. To achieve these results, it will take education and buy-in of landowners, farmers, and communities; plus, grants and other funds to help make this plan a reality.

As discussed in Chapter 3, a water quality model was unavailable for use during the development of this plan. It is recommended that future planning or evaluation steps include the development of a water quality model. A water quality model will allow better BMP targeting and enhanced prioritization of watersheds. Furthermore, a water quality model will assist in evaluating project successes and better predicting future success.

5.01 OVERARCHING STRATEGIES

Both watershed-wide and targeted implementation efforts to improve water quality and flood resiliency will primarily be accomplished through both existing partner programs and projects and newly identified projects. Existing programs provide landowners, farmers, and communities access to technical and financial assistance. However, to enable targeted implementation, partners will need to work together to focus these programs on the priorities identified in this plan. The following strategies have been identified to guide these activities:

1. **Voluntary** - Adoption of BMPs, projects, or other programs is through voluntary involvement for landowners, farmers, and all partners.
2. **Compatible with Agriculture –** Agriculture is the primary economic engine and land use within the watershed. Therefore, implementation should work within this existing system and minimize land taken out of production.
3. **Data Driven –** Understanding both problems and opportunities; and prioritizing efforts will rely heavily on a robust network of stream monitoring sites.
4. **Prioritized –** Full implementation will require a long-term campaign, and thus these efforts will be prioritized and phased to focus energy and resources, allowing results to be seen and measured more readily and for progress to be evaluated and strategies adjusted.
5. **Whole Farm Conservation** – Each farmer and landowner has unique goals and production constraints; therefore, conservation decisions are also personal. A full menu of practices will be utilized including land use changes, soil health practices, and BMPs located in-field, at the edge-of-field, below fields, and within the riparian area of each farm.
6. **Sustainable Communities** - Encourage the development and adoption of local policies that reduce runoff and protect the floodplain within communities.
7. **Flood Resiliency –** A watershed approach to flood resiliency benefits the entire watershed, which is accomplished through distributed storage, mitigation at key infrastructure, and improvements to watershed drainage and hydrology. This approach provides additional benefits of improved water quality, enhanced wildlife habitat, and recreation.

While these strategies translate across the planning area, specific practices and actions will need to be tailored to the specific project area, farmer, or landowner. A key to getting private landowners or farmers to voluntarily implement BMPs is to identify and address barriers to adoption. These barriers may be related to a lack of understanding or knowledge; logistics; technical assistance; costs; or other factors. To successfully identify and break down these barriers, an integrated outreach and education approach is needed – see Chapter 6. Information regarding technical and financial resources are discussed in Chapter 8.

5.02 BEST MANAGEMENT PRACTICES

TOOLBOX OF PRACTICES

Implementation of the plan relies on the voluntary adoption and use of **Best Management Practices (BMPs), which are defined as a broad set of conservation practices that help to conserve soil and water resources.** These BMPs have been previously identified and discussed in detail by many other sources. Sometimes these BMPs are referred to as strategies, mitigation alternatives, practices, projects, etc. depending on the agency or scale of effort. The following resources provide background and technical information on the "toolbox" of BMPs included as part of this plan.

- **Iowa Nutrient Reduction (NRS) -** The NRS has identified multiple BMPs to reduce nutrients. Available at: http://www.nutrientstrategy.iastate.edu/
- **Clean Water Iowa -** Clean Water Iowa provides information on BMPs applicable to rural (agricultural), urban, and industrial areas. Available at: https://www.cleanwateriowa.org/
- **ACPF Toolbox Manual -** The ACPF Toolbox is used to cite various structural BMPs according to NRCS practice standards. Available at: https://acpf4watersheds.org/
- **Iowa Stormwater Education Partnership (ISWEP) -** ISWEP has developed multiple information sheets for stormwater BMPs. Available at: https://iowastormwater.org/
- **Iowa Watershed Approach -** Multiple BMP informational sheets were developed by Iowa State University Extension. Available at: https://iowawatershedapproach.org/
- **Prairie STRIPS –** A strategic planting of native-tall grass prairie within farm fields that is more versatile and offers more benefits than traditional contoured buffer strips. More information at: https://www.nrem.iastate.edu/research/STRIPS/
- **Oxbow Restoration Toolkit -** Provides step-by-step guidance and cross-agency standards to restore oxbow wetlands. Available at: https://www.nature.org/en-us/about-us/where-we-work/united-states/iowa/stories-in-iowa/what-is-an-oxbow/
- **BMPs for Livestock, Manure, and Animal Facilities (multiple guides) -**
    - *Small Open Beef Feedlots in Iowa – A Producer Guide:* https://store.extension.iastate.edu/product/13744
    - *Small Open Lot Dairies in Iowa – A Producer Guide:* https://store.extension.iastate.edu/product/13760
    - *Best Environmental Management Practices for Open Feedlots -- Solutions for Open Feedlot Operators:* https://store.extension.iastate.edu/product/5538
    - *Iowa Manure Management Action Group:* https://www.extension.iastate.edu/immag/
- **Iowa DNR River Restoration Toolbox -** A series of proven BMPs for stream stabilization and restoration in Iowa with emphasis on incorporating natural materials. Available at: https://www.iowadnr.gov/environmental-protection/water-quality/river-restoration
- **Low-Tech Process Based Restoration of Riverscapes Design Manual -** Provides guidelines for implementing post-assisted log structures (PALS) and beaver dam analogues (BDAs)—for stream restoration. Available at: http://lowtechpbr.restoration.usu.edu/manual/.

- **Mitigation Ideas: A Resource for Reducing Risk to Natural Hazards** (FEMA, 2013) – This publication identifies potential mitigation actions for reducing risk to all types of natural hazards, including flooding. The actions are summarized into four types: 1) local planning and regulation, 2) structures and infrastructure projects, 3) natural systems protection, and 4) education and awareness programs.

THE CONSERVATION PYRAMID

The conservation pyramid concept, which can be seen in Figure 56, recognizes that to be effective, implementation within agricultural watersheds must be taken through a systematic approach of a suite of BMPs. The foundation of the conservation pyramid relies on using BMPs to protect and improve soil health at the field level to improve erosion control, improve water infiltration and retention, increase soil organic matter, and improve nutrient cycling. Structural practices to control and treat runoff should then be targeted to specific in-field, edge-of-field, and riparian locations where maximum water quality benefits can be realized. Examples of BMPs that address soil health and control, or trap, pollutants are provided in the pyramid. However, there are many other actions that should be considered during implementation.

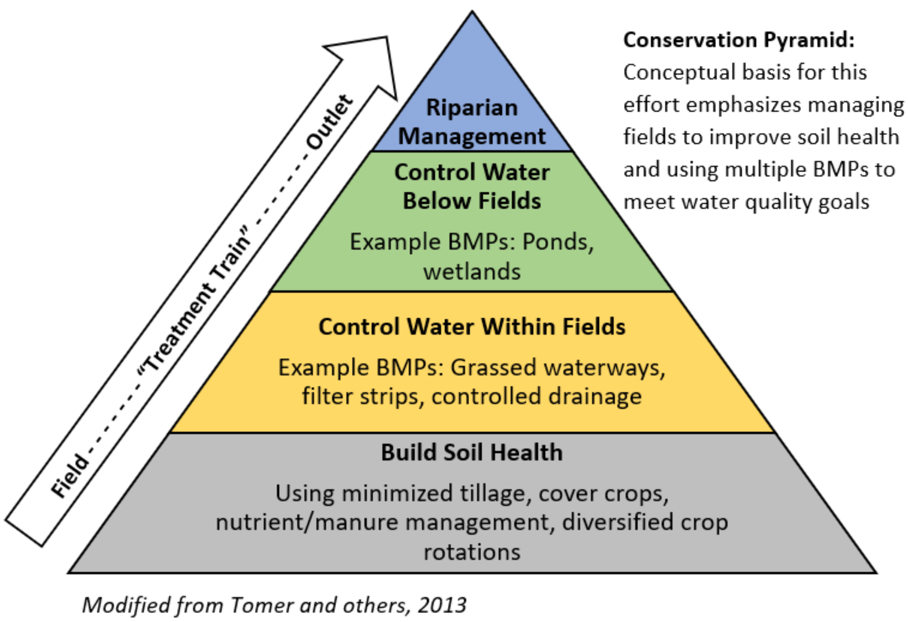
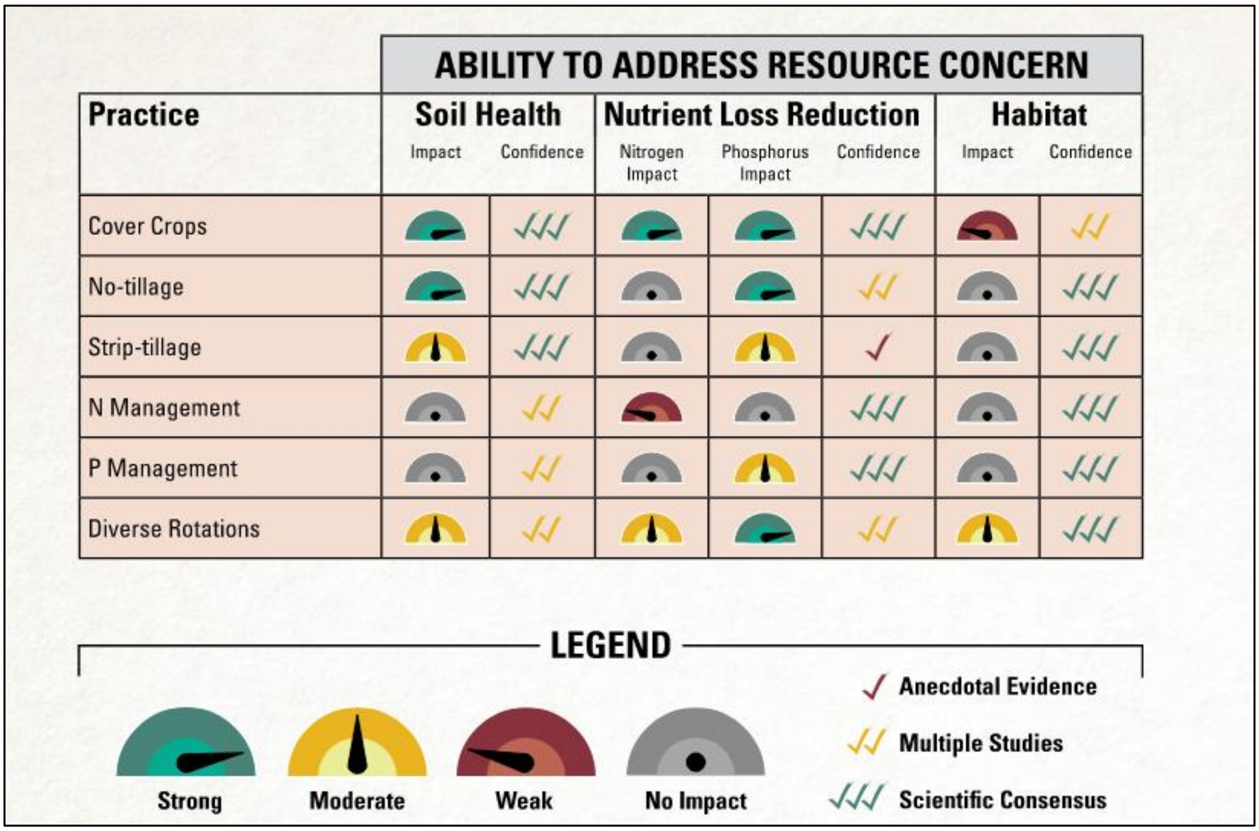


Figure 56: The Conservation Pyramid Provides a Framework for BMP Implementation

The conservation pyramid approach means that BMPs are ideally implemented in a series or a "treatment train" with each other throughout the watershed, so their effects are multiplied as implementation is scaled up. This leads to multiple practices on each farm within the watershed as implementation advances. This approach requires that the full suite of BMPs be made available for implementation, so that the correct practice can be selected based on individual site characteristics and landowner or farmer preferences.

LAND USE AND IN-FIELD BMPS

Figure 57 is an excerpt from the *Whole Farm Conservation Best Practices Manual, 2nd Edition* (ISU, 2022) and features an overview of nonstructural BMPs that are based on in-field nutrient management practices, soil health concepts, and land use/cropping changes. These practices can be very effective at preventing or reducing nutrient and sediment losses before they occur and in building soil health. Drawbacks are that the practices can easily be discontinued, as they generally rely upon a change in a farmer's management style. However, this relative ease of operations change also means that the practices can be adopted at a larger scale or faster pace than structural practices that require engineering or construction. Additionally, these practices require little, if any, land to be taken out of production.

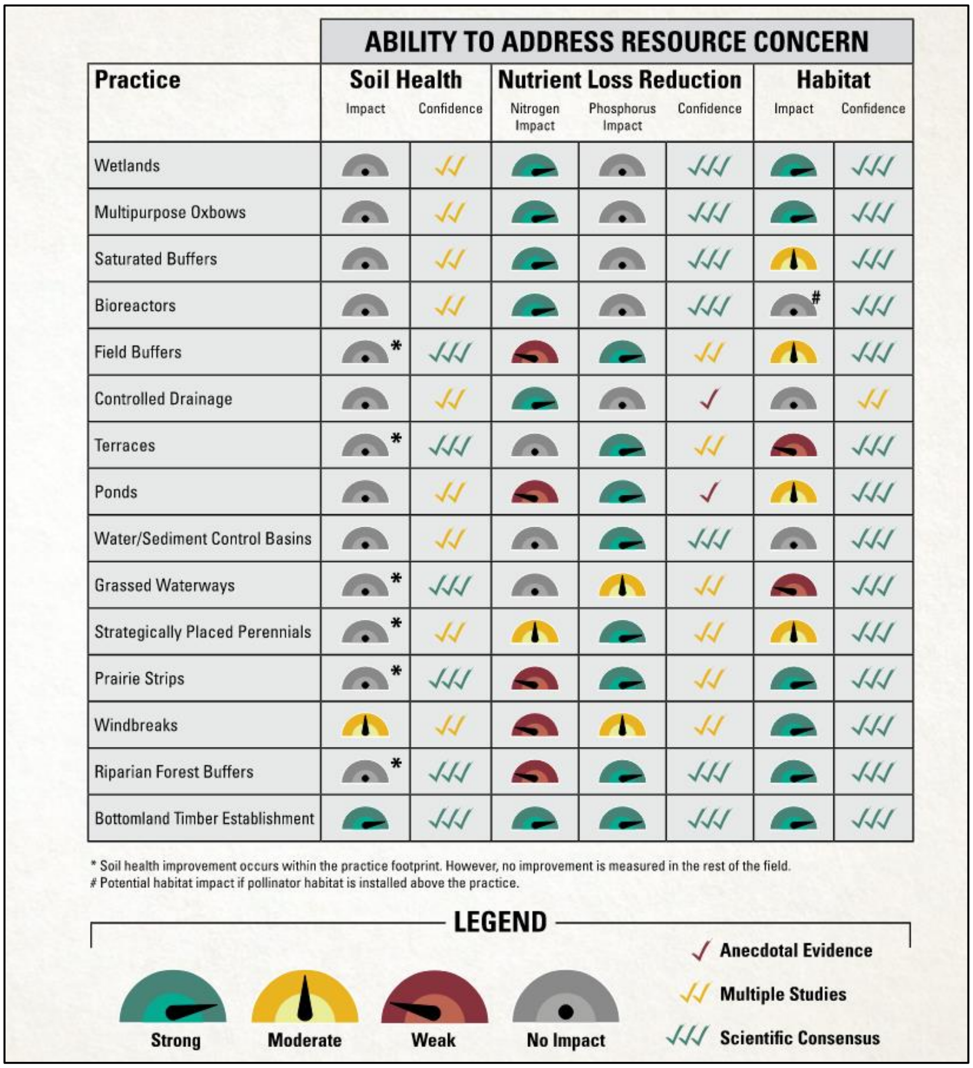


Source: (ISU, 2022)

Figure 57: Priority Land Use and In-Field BMPs for Agricultural Areas

EDGE-OF-FIELD BMPS

Figure 58 is an excerpt from the *Whole Farm Conservation Best Practices Manual, 2nd Edition* (ISU, 2022) and features an overview of BMPs suitable for placement below, or at the edge-of-field. These practices can be very effective at trapping nutrients and sediments before they enter waterways, however their benefits to soil health are generally limited. Drawbacks are that many of them require some land to be taken out of crop production, although it is generally land that requires more inputs or is less productive, and they require a higher upfront investment due to the engineering or construction requirements. A positive feature of these practices is that most have a long lifespan or are harder to discontinue and therefore will reliably provide benefits over a long period of time. Another benefit is that they require less active management from landowners than nonstructural BMPs (although they are not maintenance free).



Source: ISU, 2022

Figure 58: Priority Edge-of-Field BMPs for Agricultural Areas

RIPARIAN MANAGEMENT BMPS

Riparian management is often one of the most overlooked opportunities for adoption or installation of BMPs. Management of the riparian zone is critical for reducing erosion, filtering sediment, and trapping nutrients before they enter downstream waterbodies – they are the last line of defense in water quality management. Additionally, due to the highly modified land use and hydrologic regime of the watershed, establishment of riparian buffers and BMPs is necessary to ensure that habitat exists for both terrestrial and aquatic ecosystems. Buffers and stream stabilization can also provide benefits by mitigating damages from flooding. Riparian BMPs can be applied to both urban and agricultural settings and are generally categorized as riparian buffers and stream stabilization (Figure 59), but there are various types of approaches or designs to each practice. Other BMPs can also be integrated with these BMPs, such as: bioreactors, saturated buffers, grade stabilization, channel stabilization, and floodplain restoration.

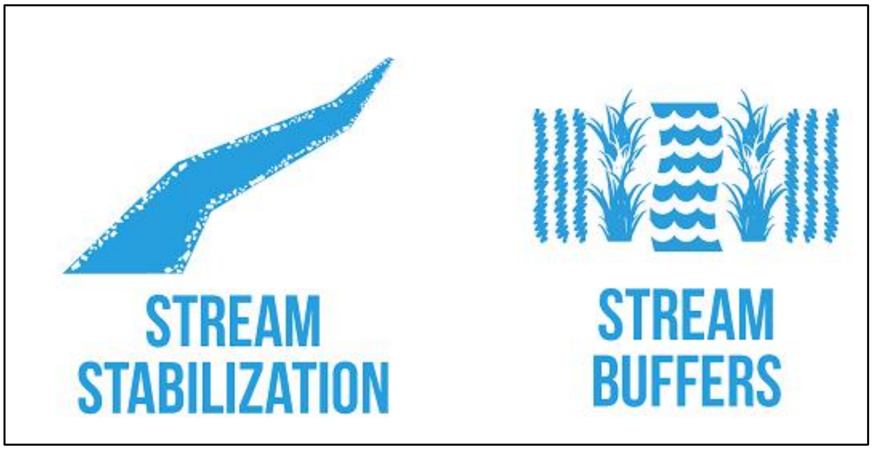


Figure 59: Priority Riparian Management BMPs

Many factors influence buffer performance including buffer width, vegetation type and age, and depth to the water table. Citing of these practices is oftentimes proceeded by the completion of a stream assessment. Additional guidance on the placement, selection, or design of individual practices can be found in the following resources:

- ACPF Toolbox
- Low-Tech Process Based Restoration of Riverscapes Design Manual
- Iowa DNR River Restoration Toolbox

LIVESTOCK, MANURE, AND ANIMAL FACILITY BMPS

While the NRS identifies the best BMPs to reduce nitrogen and phosphorus runoff from agricultural lands, it does not fully address livestock, manure, and animal facilities (especially grazing lands and small open feedlots). These can be some of the largest sources of *E. coli* bacteria runoff, which has impaired the water quality of the South Skunk River. Priority BMPs for these sources are identified in Figure 60.

Figure 60: Priority BMPs for Livestock, Manure, and Animal Facilities

URBAN STORMWATER MANAGEMENT

Residential and urban landscapes generate runoff with almost every rainfall event. Conservation measures capture and infiltrate stormwater and reduce a property's contribution to water quality degradation, flashy stream flows, and flooding. The practices identified in Figure 61 are the best practices for preventing runoff and promoting infiltration within urbanized areas. Communities implement these conservation practices through installing new systems and retrofitting existing infrastructure.

It should be noted that that urban BMP practices presented in this plan are meant to be voluntary for communities, and not to replace any regulatory programs, such as those identified through NPDES, MS4, or other local requirements.

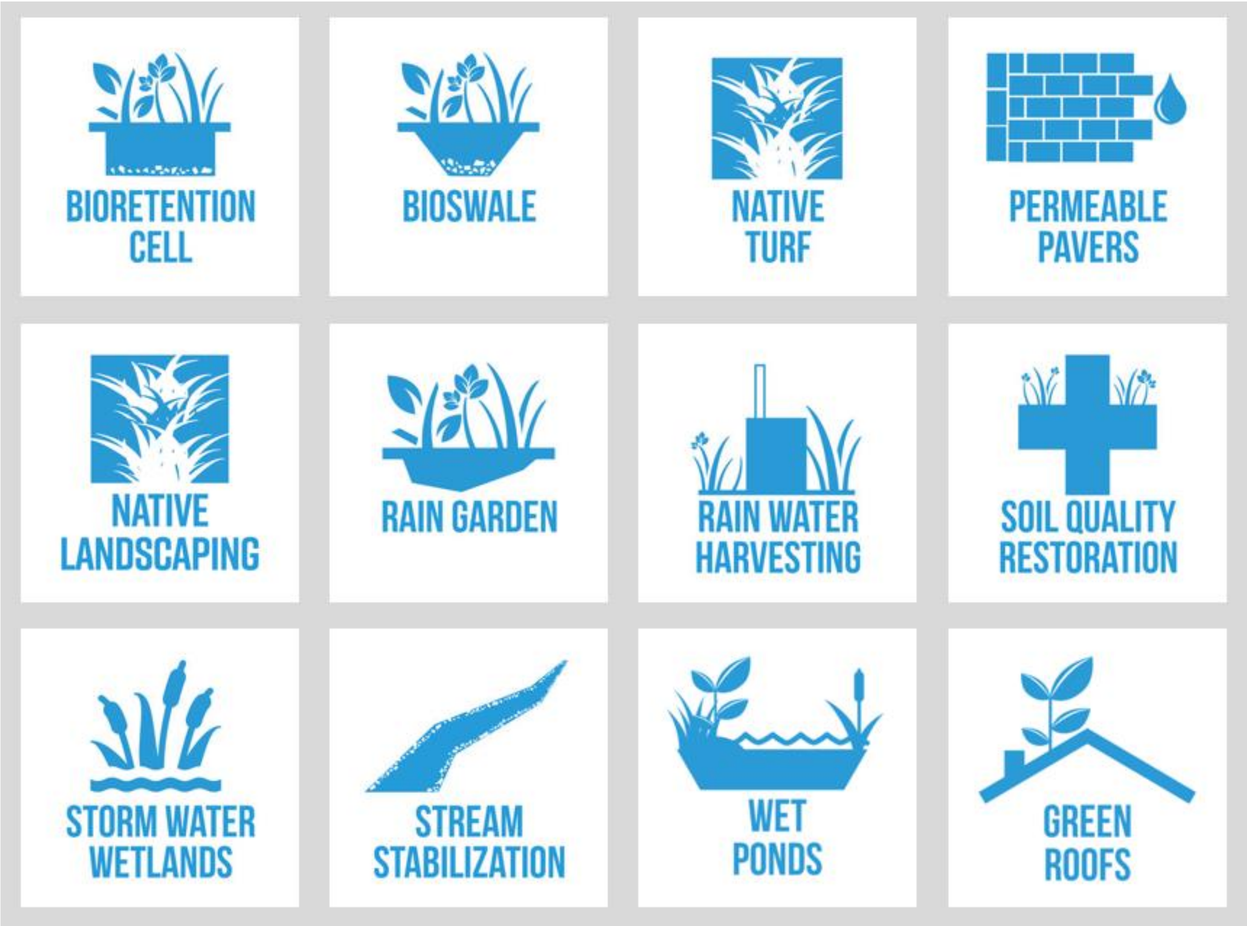


Image Credit: Clean Water Iowa, 2021

Figure 61: Priority Urban Stormwater BMPs

POLLUTANT TREATEMENT EFFECTIVENESS

It is important to understand the effectiveness that BMPs have in reducing pollutant loads, often referred to as treatment efficiency. The suitability and performance of BMPs can vary significantly based on site conditions, therefore detailed feasibility, design, and analysis may be needed prior to implementing a BMP.

Treatment efficiencies for nitrogen and phosphorus were identified in the Iowa Nutrient Reduction Strategy and summarized in the ISU Extension publication titled *Reducing Nutrient Loss: Science Shows What Works* (Summary sheet SP435A) (Lawrence and Benning, 2019). Excerpts from this are provided in Figure 62 and Figure 63. The full resource can be downloaded here: https://store.extension.iastate.edu/product/13960

Treatment efficiencies for *E. coli* were identified through an analysis of scientific peer reviewed literature and are summarized in Table 31. A representative efficiency was selected for display in the table.

Table 31: Summary of BMP Treatment Efficiencies for E. coli bacteria

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

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

Iowa Strategy to Reduce Nutrient Loss: Nitrogen Practices

This table lists practices with the largest potential impact on nitrate-N concentration reduction (except where noted). Corn yield impacts associated with each practice also are shown as some practices may be detrimental to corn production. If using a combination of practices, the reductions are not additive. Reductions are field level results that may be expected where practice is applicable and implemented.

	Practice	Comments	% Nitrate-N Reduction*	% Corn Yield Change**
			Average (SD†)	Average (SD†)
Nitrogen Management‡	Timing	Moving from fall to spring pre-plant application	6 (25)	4 (16)
		Spring pre-plant/sidedress 40-60 split Compared to fall-applied	5 (28)	10 (7)
		Sidedress – Compared to pre-plant application	7 (37)	0 (3)
		Sidedress – Soil test based compared to pre-plant	4 (20)	13 (22)††
	Source	Liquid swine manure compared to spring-applied fertilizer	4 (11)	0 (13)
		Poultry manure compared to spring-applied fertilizer	-3 (20)	-2 (14)
	Nitrogen Application Rate	Nitrogen rate at the MRTN (0.10 N:corn price ratio) compared to current estimated application rate. (ISU Corn Nitrogen Rate Calculator – **http://cnrc.agron.iastate.edu** can be used to estimate MRTN but this would change Nitrate-N concentration reduction)	10	-1
	Nitrification Inhibitor	Nitrapyrin in fall – Compared to fall-applied without Nitrapyrin	9 (19)	6 (22)
	Cover Crops	Rye	31 (29)	-6 (7)
		Oat	28 (2)	-5 (1)
	Living Mulches	e.g. Kura clover – Nitrate-N reduction from one site	41 (16)	-9 (32)
Land Use	Perennial	Energy Crops – Compared to spring-applied fertilizer	72 (23)	
		Land Retirement (CRP) – Compared to spring-applied fertilizer	85 (9)	
	Extended Rotations	At least 2 years of alfalfa in a 4 or 5 year rotation	42 (12)	7 (7)
	Grazed Pastures	No pertinent information from Iowa – assume similar to CRP	85	
Edge-of-Field	Drainage Water Mgmt.	No impact on concentration	33 (32)	
	Shallow Drainage	No impact on concentration	32 (15)	
	Wetlands	Targeted water quality	52	
	Bioreactors		43 (21)	
	Buffers	Only for water that interacts with the active zone below the buffer. This would only be a fraction of all water that makes it to a stream.	91 (20)	
	Saturated Buffers	Divert fraction of tile drainage into riparian buffer to remove Nitrate-N by denitrification.	50 (13)	
	Multi-purpose Oxbow	Targeted water quality	42 (6)	

* A positive number is nitrate concentration or load reduction and a negative number is an increase.

** A positive corn yield change is increased yield and a negative number is decreased yield. Practices are not expected to affect soybean yield.

† SD = standard deviation. Large SD relative to the average indicates highly variable results.

†† This increase in crop yield should be viewed with caution as the sidedress treatment from one of the main studies had 95 pounds-N/acre for the pre-plant treatment but 110 pounds-N/acre to 200 pounds-N/acre for the sidedress with soil test treatment so the corn yield impact may be due to nitrogen application rate differences.

Source: *Reducing Nutrient Loss: Science Shows What Works (Lawrence and Benning, 2019)*

Figure 62: Summary of BMP Treatment Efficiencies for Nitrogen

‡ See Standard Practices (blue box) on page 2 of this publication.

Iowa Strategy to Reduce Nutrient Loss: Phosphorus Practices

Practices below have the largest potential impact on phosphorus load reduction. Corn yield impacts associated with each practice also are shown, since some practices may increase or decrease corn production. If using a combination of practices, the reductions are not additive. Reductions are field level results that may be expected where practice is applicable and implemented.

	Practice	Comments	% P Load Reduction[a]	% Corn Yield Change[b]
			Average (SD[c])	Average (SD[c])
Phosphorus Management‡	Phosphorus Application	Applying P based on crop removal – Assuming optimal STP level and P incorporation	0.6[d]	0
		Soil-Test P – No P applied until STP drops to optimum or, when manure is applied, to levels indicated by the P Index[f]	17[e]	0
	Source of Phosphorus	Liquid swine, dairy, and poultry manure compared to commercial fertilizer – Runoff shortly after application‡	46 (45)	-1 (13)
		Beef manure compared to commercial fertilizer – Runoff shortly after application‡	46 (96)	
	Placement of Phosphorus	Broadcast incorporated within 1 week compared to no incorporation, same tillage	36 (27)	0
		With seed or knifed bands compared to surface application, no incorporation	24 (46)	0
	Cover Crops	Winter rye	29 (37)	-6 (7)
	Tillage	Conservation till – chisel plowing compared to moldboard plowing	33 (49)	0 (6)
		No till compared to chisel plowing	90 (17)	-6 (8)
Land Use Change	Perennial Vegetation	Energy Crops	34 (34)	
		Land Retirement (CRP)	75	
		Grazed pastures	59 (42)	
Erosion Control and Edge-of-Field	Terraces		77 (19)	
	Buffers		58 (32)	
	Control	Sedimentation basins or ponds	85	
	Blind Inlet	Sediment control	50	

[a] A positive number is P load reduction and a negative number is increased P load.
[b] A positive corn yield change is increased yield and a negative number is decreased yield. Practices are not expected to affect soybean yield.
[c] SD = standard deviation. Large SD relative to the average indicates highly variable results.
[d] Maximum and average estimated by comparing application of 200 and 125 kilogram P_2O_5/hectare, respectively, to 58 kilogram P_2O_5/hectare (corn-soybean rotation requirements) (Mallarino et al., 2002).
[e] Maximum and average estimates based on reducing the average STP (Bray-1) of the two highest counties in Iowa and the statewide average STP (Mallarino et al., 2011a), respectively, to an optimum level of 20 ppm (Mallarino et al., 2002). Minimum value assumes soil is at the optimum level.
[f] ISU Extension and Outreach publication (PM 1688).
‡ See Standard Practices (blue box) on page 2 of this publication.

Source: *Reducing Nutrient Loss: Science Shows What Works (Lawrence and Benning, 2019)*

Figure 63: Summary of BMP Treatment Efficiencies for Phosphorus

FLOOD RESILIENCY PRACTICES

Flood resiliency recognizes that to improve a community's ability to recover from flooding, the risk from flooding must be reduced at both watershed and community levels. It will be important for the WMA to help all partners work together to implement these practices. This will involve implementing land management policies, structural and nonstructural measures, and mitigation against remaining risks. An additional benefit of flood resiliency practices is that many of them lead to improved water quality and wildlife habitat.

In Figure 64, the blue bars on the far left indicate the initial, high, unmitigated risk a community faces and the low amount of resiliency (green bars) they may have. Taking strategic actions, as indicated in the subsequent bars, reduces the flood risk. Some of these actions are taken at the federal, state, and local city/county levels, whereas others are taken by the homeowners and businesses at risk. The remaining risk after all actions have been taken is the residual risk (blue bar on the far right); however, resiliency is very high at this point. This approach leads to reductions in loss of property, improved safety, and an improved ability to recover from other natural disasters. Individually each strategy only contributes small amount of risk reduction; however, when the efforts are combined, a dramatic reduction in risk is achieved.

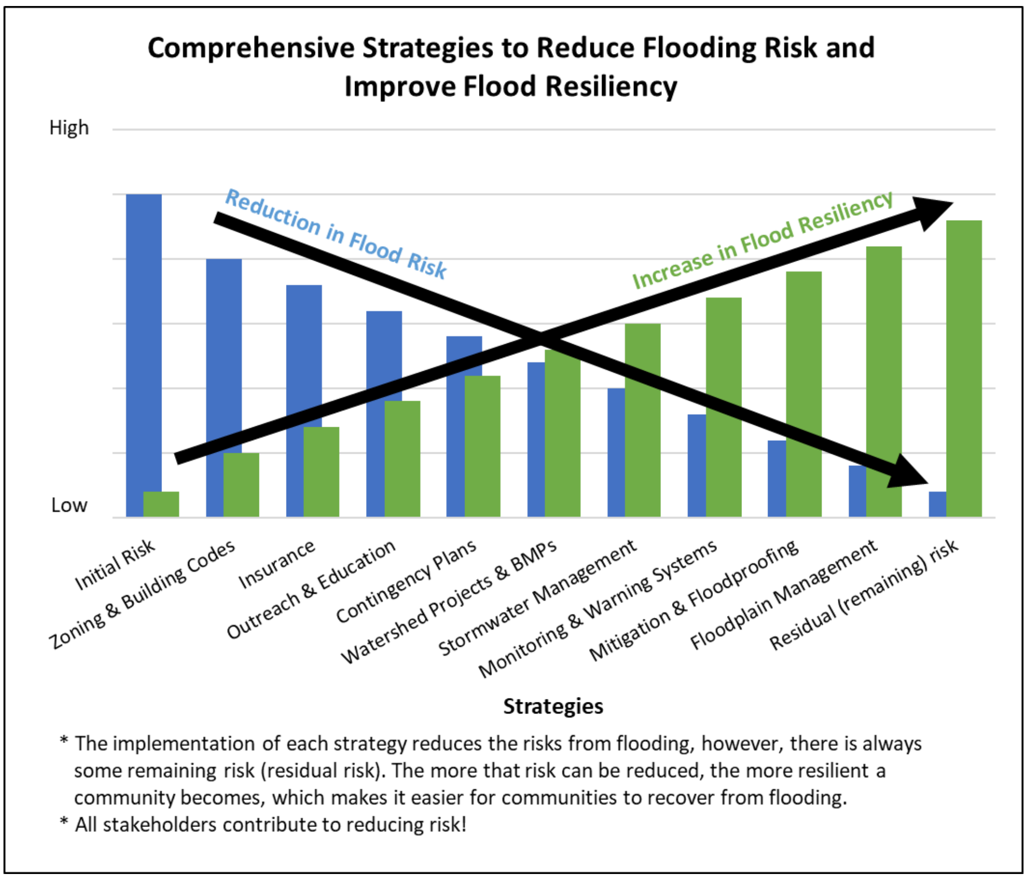


Figure 64: Illustration of How Reducing Flood Risks Leads to Increased Flood Resiliency

Strategies and projects related to watershed flood resiliency were identified through a review of local county hazard mitigation plans (HMP) and are summarized in Table 32. It is recommended to further integrate the Headwaters of the South Skunk River Watershed Plan with each county's local HMP by recognizing or amending this plan into each HMP. Chapter 3 presents a summary of flood risk assessments completed across the watershed. For the most vulnerable communities it is recommended that a more detailed flood risk assessment and evaluation of mitigation actions be completed.

Table 32: Flood Mitigation Actions Identified in Local Hazard Mitigation Plans

Mitigation Action	Jurisdiction
Continue promotion, participation in, or consideration of the National Flood Insurance Program (NFIP) and Community Rating System (CRS)	Story County, Ames, Ellsworth, Webster City, Boone County
Review the Floodplain Management Ordinance, annually or as needed	Gilbert, Story City, Webster City, Boone County
Expand or otherwise improve storm and/or sanitary sewer infrastructure	Ames, ISU, Ellsworth, Jewell, Kamrar, Williams
Protect properties and structures from river and flash flooding through the construction of water storage areas, building of flood protection structures, removal of flood-prone properties, implementation of policies, and other measures to reduce the risk of property damage and threats to resident safety.	Ames, ISU
Identify and plan flood control projects. Budget and complete improvements as needed.	Roland
Work with Story County Conservation Board which makes specialized equipment available for rent to assist in planting native grasses, trees, and shrubs for erosion control and water quality improvements.	Roland
Create a water conservation public awareness and educational campaign, including educational materials on water conservation measures to implement during drought periods.	Story City
Construct a farmable drainage ditch for the north end of town	Ellsworth
Upgrade the size of the water mains	Ellsworth
Purchase portable pumps	Ellsworth
Purchase a trash pump	Kamrar
Continue regular inspections on the lagoon	Kamrar
Fix sinkholes and perform maintenance on drainage tiles in town	Williams
Communicate with the drainage district to improve tiles near Williams	Williams
Create retention ponds or other drainage systems to guide rainwater away	Williams
Look into alternatives for protecting repetitive flood loss properties	Hamilton County
Construct a new water tower	Ellsworth, Williams

5.03 PRIORITIZATION AND TARGETING

PRIORITY SUBWATERSHEDS

This plan covers a large geographical area and addresses many interrelated issues. To facilitate and focus BMP implementation efforts in a way that will lead to measurable results, priority areas, based on HUC 12 subwatershed boundaries, will be utilized. The identification and selection process of these areas utilized water quality data and input from stakeholders. After a lengthy review and selection process, the WMA's final selection consisted of two (2) areas, identified in Table 33 and shown in Figure 65.

Table 33: Priority Subwatersheds for BMP Implementation

Name	Acres	Notes
Keigley Branch	33,384	Contains 2 HUC 12s
Long Dick Creek	23,581	
Total	**56,966**	Approximately 27% of HWSSRWMA

These areas were prioritized due to high levels of nitrates and *E. coli* bacteria (water quality monitoring data provided in chapter 2), and the fact that the geographic dispersion within the watershed encourages multiple WMA members to partner together. These areas represent approximately 27% of the entire HWSSRWMA.

Following adoption of this plan, the HWSSRWMA and/or its partners will need to select an area to pursue BMP implementation efforts. This will consist of obtaining funding that will be used for BMP cost-share for landowners/farmers, education and outreach efforts, and other supporting activities. **Additional data and planning steps for these priority subwatershed is presented in Chapter 7.**

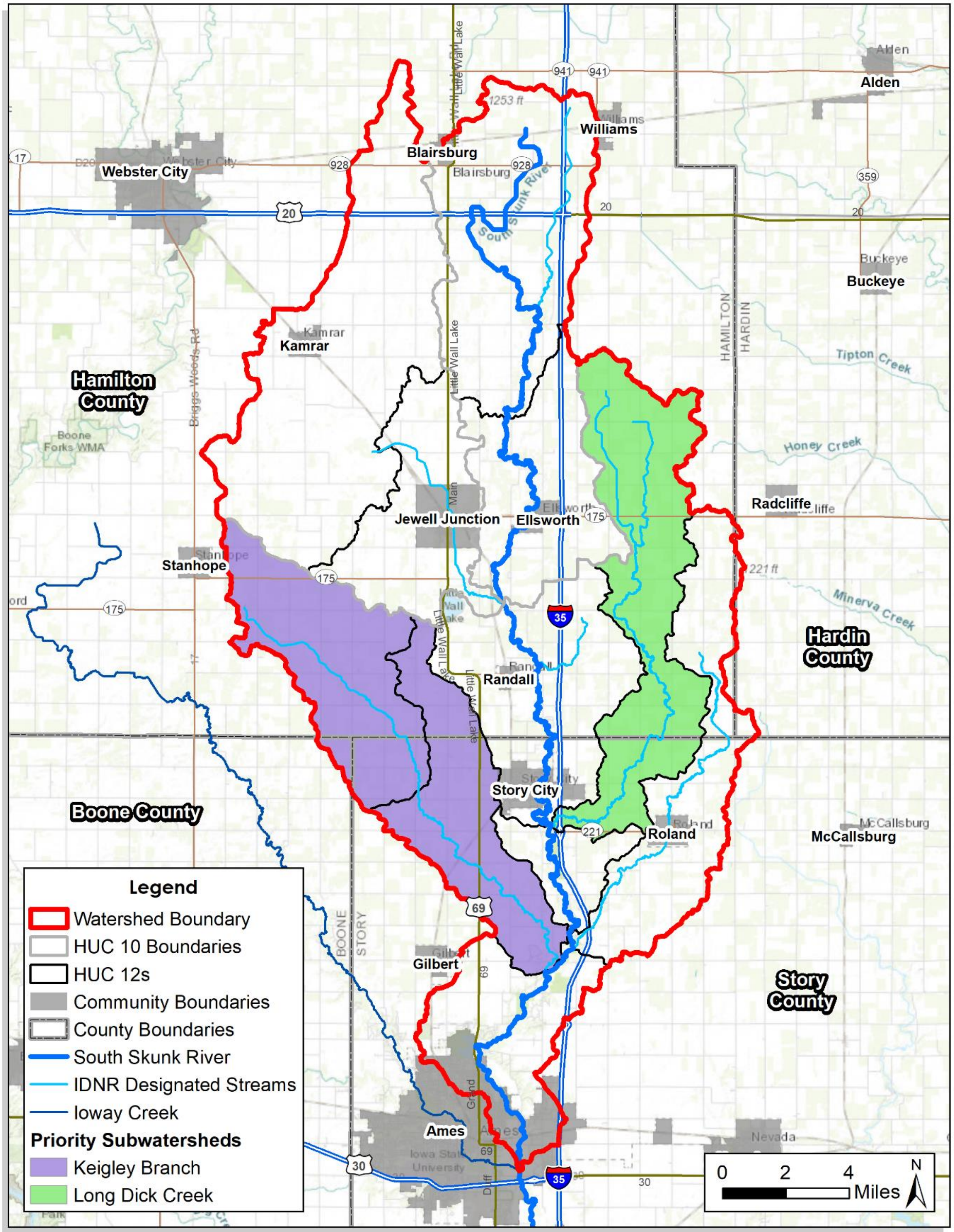


Figure 65: Priority Subwatersheds for BMP Implementation

FARM LEVEL BMP PRIORITIZATION

Within each subwatershed, further prioritization of BMPs can be completed, following the concepts highlighted by the conservation pyramid, presented earlier in this chapter This should take place at the farm or field scale. Two primary strategies exist for this, both of which rely on the ACPF Toolbox:

- Critical Source Areas
- Cost Effectiveness

The appropriate time to complete additional prioritization is during planning for future implementation projects within the priority subwatersheds.

Critical Source Areas

Critical Source Areas (CSAs) are areas that make up a relatively small fraction of a watershed but generate a disproportionate amount of the pollutant load (Meals and others, 2012). CSAs occur where a pollutant source in the landscape coincides with an active hydrologic transport mechanism such as a waterway or groundwater recharge area (Figure 66). Identifying CSAs can help prioritize areas most in need of BMPs, as well as positively impact flood risk reduction. This strategy allows implementation to be more cost-effective.

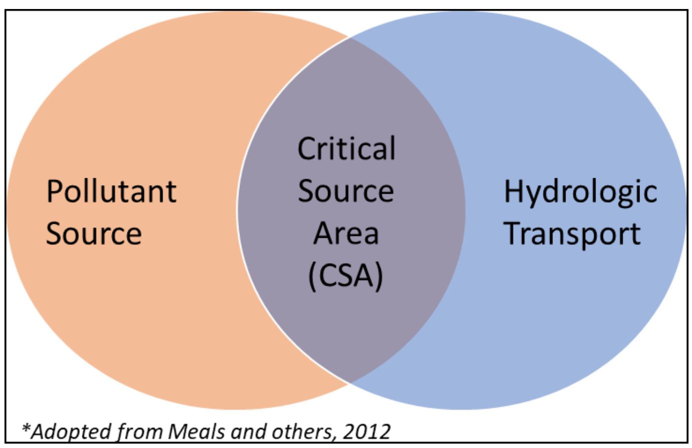


Figure 66: Illustration of the Concept of Critical Source Areas (CSA)

ACPF can be used to find CSAs in two ways: 1) Critical Zones, which are riparian areas most likely to convey disproportionally high amounts of runoff into streams, and 2) the Field Runoff Risk Assessment, which ranks agricultural fields according to potential for pollutant delivery. The field runoff risk assessment in ACPF provides a relative risk rating based on two factors:

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

Once the assessment is complete, in ACPF version 4.0, each field receives a relative classification: A (very high risk), B (high), C (moderate), or D (low). In older versions of ACPF the rankings are slightly different. Fields classified as A and B are considered critical source areas and should be prioritized for implementation efforts.

Cost Effectiveness

The ACPF Financial and Nutrient Reduction Tool (ACPF FiNRT) is a recently developed ACPF-compatible tool that provides information about estimated costs and nitrate reduction outcomes from ACPF-generated BMP scenarios.

This new tool provides context for broader watershed analysis regarding farmer and landowner preferences, trade-offs, ecosystem services beyond water quality, and available technical and financial support. Information about potential outcomes from various BMP scenarios is provided at multiple scales: BMP, field, and watershed.

The tool uses financial and expected field-scale nitrate loss to estimate the total long-term cost and cost effectiveness of BMP implementation using the following inputs:

- Costs of BMPs are calculated long-term to include both installation and maintenance
- Opportunity costs of removing land from row-crop production for BMP installation
- Based on BMP placement, nitrate reduction efficiencies for each BMP are applied to estimate nitrate reduction at multiple scales.

The outputs from the tool include:

- Area treated by BMPs
- Nitrate load and load reduction potential from BMPs
- Nitrate load reduction at field and watershed levels
- Total costs (direct costs + opportunity costs)
- Cost efficiency (cost per lbs. of N reduced per individual conservation practice and scenario).

At the time this plan was developed, the ACPF FiNRT tool was released in beta version for Iowa. As implementation of the plan proceeds, or during future plan updates, it is recommended that the ACPF FiNRT tool be utilized to further refine implementation strategies and prioritize BMPs in a way that will be most effective for the HWSSRWMA.

BMP TARGET LEVELS

Target levels for BMP implementation were developed to aid the WMA and partners in estimating technical and financial resources needed to implement this plan. These targets have been identified for select BMPs only – those most likely to be the focus of implementation efforts and those most likely to be adopted. Targets were estimated from partner input, available ACPF Toolbox mapping data, and through a review of existing BMP levels. The rationale, or reason behind how the target level for each BMP was identified is summarized in Table 34. Cost estimates for implementation are found in later sections of this chapter.

Table 34: BMP Target Level Rationales

BMP	Target Level Rationale
Bioreactors	ACPF Output
Conservation Tillage	Currently estimated that 69% of cropland already utilizes this BMP. Target level is set at achieving 100% adoption rate.
Cover Crops	Currently estimated that 5% of cropland already utilizes this BMP. Target level is set at achieving 100% adoption rate.
Drainage Water Management	ACPF Output
Grassed Waterways	ACPF Output
Nutrient Management	Assumed 50% of watershed utilizes some form of this BMP. Target level is set at achieving 100% adoption rate.
Nutrient Reduction Wetland / CREP Wetland /Ponds	ACPF Output
Oxbow Restoration	No target level set. Additional study needed.
Prairie STRIPs / Contour Buffer Strips	ACPF Output
Row Crop Conversion to Perennial Cover / Wildlife Habitat	Target level is set at doubling the existing acres, based on the goals set in Chapter 4.
Saturated Buffer	ACPF Output
Riparian Buffers	ACPF Output
Urban BMPs	Currently, two communities are known to have completed projects. Target level is set completing at least one project in each remaining community within the watershed.

It should be noted that some of these potential BMPs identified may overlap with existing BMPs (due to data limitations), and thus, the targets provided should be considered an estimate only. As implementation begins, a detailed review of LiDAR, aerial photography, and in-field surveys should be completed to further estimate BMP needs. This review should be completed prior to landowner consultation for BMP siting.

5.04 COSTS

The implementation of this plan is expected to be a costly endeavor. Cost opinions presented here are based upon the BMP targets levels, but other practices may also be considered. Cost opinions are provided at the most conservative levels (most expensive) to avoid underestimating the necessary funding levels. However, it is likely that costs will rise over time, and these estimates may no longer be valid. It should also be noted that some of these costs may overlap, or some projects may not be necessary, depending upon other projects that are built; therefore, these cost estimates should be updated at a minimum of every five years when the plan is updated.

Cost opinions were calculated based on literature reviews, professional experience, and information provided by stakeholders. Cost opinions include anticipated staff time, design costs, materials cost, and implementation costs, where available. Every effort has been made to prepare realistic cost opinions; however, due to the broad scope and long-term implementation time frame of this plan and affiliated actions, actual costs may vary widely. This may be due to, but not limited to, the following factors: inflation, site specific conditions for BMPs, varying methodologies for BMP implementation, changes to the plan based on monitoring results, or other unforeseen changes to operational costs.

Please note that the direct and indirect costs of any BMP can vary from site to site and are contingent on initial conditions, hydrology, soils, cropping system, practice design, management characteristics, and highly variable opportunity costs (such as removing acres from crop production). The costs presented here are simply baseline numbers and are meant to be informative rather than prescriptive. Detailed cost estimates should be prepared for each BMP or implementation project prior to starting.

Table 35 provides a summary of the cost opinions for BMP implementation within priority subwatersheds (additional details can be found in Chapter 7). Table 36 provides a cost opinion for full scale BMP implementation across the watershed. It is not expected that this will be accomplished in the short-term, however, it does provide the order of magnitude that full scale BMP implementation will cost. Not included are costs for monitoring, plan maintenance/updates, or other evaluations/studies that have been recommended. It is recommended that individual cost estimates be prepared for those efforts based upon the scope desired by the HWSSRWMA, and at the time services are needed.

These cost opinions should be used for general planning purposes only, as cost opinions and budgeting techniques can vary widely based on the type of project being planned. In addition, the reader should keep in mind that cost opinions are representative of the total cost of implementation, which may be shared among various stakeholders and landowners through financial assistance and other funding strategies. Information on partners and technical and financial tools to help implement this plan is discussed in Chapter 8.

Table 35: Summary of Cost Opinions for BMP Implementation within Priority Subwatersheds

Priority Subwatershed	Total Cost for BMP Implementation
Long Dick Creek (33,384 acres, 16% of total watershed)	$4,796,753
Keigley Branch (23,581 acres, 11% of total watershed)	$7,400,827
Total	**$12,197,580**

Table 36: Estimated BMPs Needed and Cost Opinions for BMP Implementation across the Entire HWSSR Watershed

BMP Practice	Target Number for Cost Estimate	Unit for Cost Estimate	Unit Cost	Total Cost
Bioreactors	559	Site	$10,150	$5,673,850
Conservation Tillage	28,444	Acres	$30	$853,320
Cover Crops	163,278	Acres	$44	$7,184,232
Drainage Water Management	26,081	Acres	$88	$2,295,128
Grassed Waterway	573	Acres	$5,277	$3,023,721
Nutrient Management	86,906	Acres	$75	$6,517,950
Nutrient Reduction / CREP Wetlands	212	Site	$25,055	$5,311,660
Oxbow Restoration	*	Site	$7,500	*
Prairie STRIPs / Contour Buffer Strips	444	Acres	$298	$132,312
Row Crop Conversion to Perennial Cover / Wildlife Habitat	21,437	Acres	$330	$7,074,210
Saturated Buffer	252	Acres	$360	$90,720
Riparian Buffer**	5,227	Acres	$308	$1,609,916
Urban BMPs	7	Community	$275,000	$1,925,000
Total				**$41,692,019**

**Study needed to determine site locations*

***Includes vegetative buffer only, not locations where engineering measures are needed to stabilize the streambank or channel*

5.05 SCHEDULE AND MILESTONES

SCHEDULE

The schedule for implementation is based on a phased approach. The plan is required to be updated every five years; therefore, each phase will be in increments of five years. Table 37 provides a watershed-wide summary of major activities expected to be achieved during the first 5-year phase of this plan. Activities are subject to approval by the HWSSRWMA, or other project sponsors, and may change as the plan is implemented. This schedule will be updated at a minimum of every five years when the plan is updated. It should be noted that not listing a major activity on this schedule does not preclude it from being executed by the HWSSRWMA or one of its partners. Additional information for action items can be found in the Action Plan in Chapter 7.

The total schedule length is based on a 20-year timeframe; however, it is possible that the level of BMPs needed across the HWSSRW will take much longer to implement. Phase I activities will include the initiation of watershed BMPs, and each following phase will include a plan revision and will build upon implementation achieved to date. A summary of progress achieved during each will be included in future plan revisions. Guidance and resources on yearly evaluation of progress, and evaluation of BMP effectiveness can be found later in this chapter.

MILESTONES

While the purpose of this plan is improved water quality and flood resiliency, it is unlikely that these improvements will be seen overnight, during a project term, or even within one phase of plan implementation. To evaluate short-term successes, indicators are used to see whether the plan is meeting its milestones. Monitoring indicators are identified for each goal within Chapter 4.

Milestones are checkpoints or special events that mark developments during or at the end of projects. In this way, they can be used to gauge progress towards meeting the project schedule and goals. To gauge implementation of this plan, it was determined that BMP implementation was the most relevant way to gauge success. Table 38 identifies milestones to be met during each five-year phase of implementation.

The BMP targets used to develop these milestones were estimated from partner input, ACPF mapping data, and through a review of existing BMP levels (discussed in Chapter 3). It is assumed that achieving these BMP targets will take place through a phased and prioritized approach across each subwatershed. Due to the scale of estimates, existing BMP levels were removed (accounted for) in reaching the total target levels.

Milestones should be reviewed on a yearly basis and adjusted accordingly for changes to the schedule during 5-year updates.

Table 37: Schedule for Watershed Implementation

Major Activity	Phase 1					Phases 2 - 4
	2022	2023	2024	2025	2026	2027-2041
Plan approval and adoption	X					
Water Quality Monitoring (ongoing)						
Select Priority Subwatershed for BMP Implementation	X					
Apply for BMP project funding	X	X				
Implement BMPs using cost-share & education plan						
Project evaluation and report (varies by funding source)					X	
Complete at least one activity identified in the Action Plan	X	X	X	X	X	
Full evaluation and update of watershed plan					X	
Continue implementation as identified						X
Annual or Ongoing Administrative Activities						
BMP implementation tracking	X	X	X	X	X	X
Quarterly WMA meetings	X	X	X	X	X	X
Hold annual review meeting and distribute report	X	X	X	X	X	X

Table 38: Phased Milestones for BMP Implementation Across the Watershed

BMP	Existing Level	Unit	Phase 1: 2022 – 2026	Phase 2: 2027 – 2031	Phase 3: 2032 – 2036	Phase 4: 2037 – 2041	Total New BMPs to Implement	Watershed Target (Existing + New)
Bioreactors*	-	Sites	140	140	140	140	559	559
Conservation Tillage	145,368	Acres	43,453	43,453	43,453	43,453	28,444	173,812
Cover Crops	10,534	Acres	43,453	43,453	43,453	43,453	163,278	173,812
Drainage Water Management*	-	Acres	6,520	6,520	6,520	6,520	26,081	26,081
Grassed Waterways	2,853,948	Feet	1,025,249	1,025,249	1,025,249	1,025,249	1,247,046	4,100,994
Nutrient Management*	-	Acres	21,727	21,727	21,727	21,727	86,906	86,906
Nutrient Reduction Wetlands / CREP Wetlands / Ponds	35	Sites	62	62	62	62	212	247
Oxbow Restoration*	-	Sites	**	**	**	**	**	**
Prairie STRIPs / Contour Buffer Strips	7	Sites	479	479	479	479	1,910	1,917
Row Crop Conversion to Perennial Cover / Wildlife Habitat	21,437	Acres	10,719	10,719	10,719	10,719	21,437	42,874
Saturated Buffer*	-	Sites	265	265	265	265	1,059	1,059
Riparian Buffer***	-	Acres	1,307	1,307	1,307	1,307	5,227	5,227
Urban BMPs	2	Communities	2	2	2	2	7	9

**No known existing sites (or data unavailable) for these BMPs*

***Study needed to determine possible site locations*

***Includes vegetative buffer only, not locations where engineering measures are needed to stabilize the streambank or channel*

5.06 MONITORING AND EVALUATING PROGRESS

EVALUATION MODEL

The HWSSRWMA will utilize the Iowa Nutrient Reduction Strategy's (NRS) logic model to measure and evaluate implementation efforts. Using the NRS logic model provides the WMA access to a standardized state-wide reporting system and process.

In 2021, the process of reporting NRS efforts transitioned to publishing data and findings in a set of web-based dashboards. This revised reporting structure aims to increase the timeliness, frequency, and transparency of updates. The dashboards can be accessed here:

https://nrstracking.cals.iastate.edu/tracking-iowa-nutrient-reduction-strategy

Ultimately, the goal is to produce measurable changes in water quality or flood resiliency factors which are represented by the 'Water' category in Figure 67. However, changes in this category can be slow to develop and are reliant on many factors. There are significant challenges in measuring water quality and flood resiliency changes across a large watershed in the short-term. Statistically significant trends in water data can take decades to become apparent or be properly validated due to variability in weather or climate, watershed land use changes, and legacy pollutant sources.

The NRS's logic model (Figure 67) was developed to assist in identifying short-term, quantifiable indicators of desirable change (IDALS and others, 2017a). Quantification allows for tracking and evaluation over time. While the original NRS Logic Model is focused on water quality changes, flood resiliency concepts can also be incorporated.

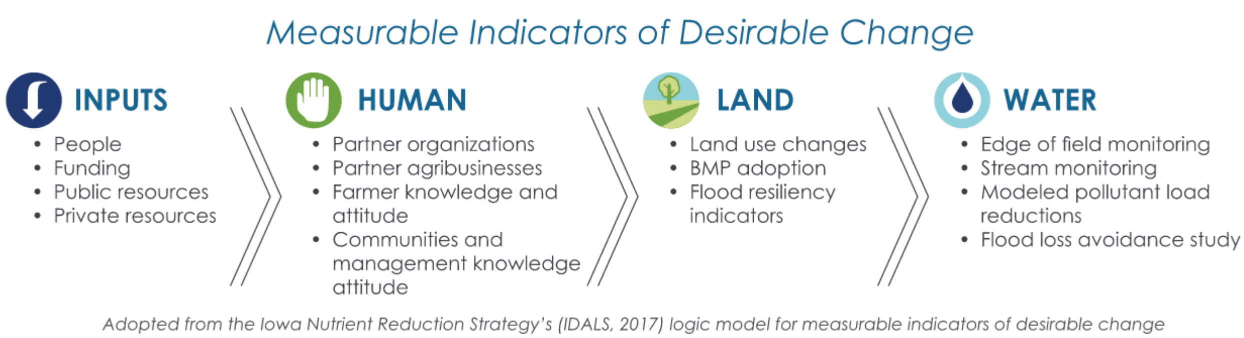


Figure 67: Logic Model Used to Identify Measurable Indicators of Desirable Change

EVALUATION CATEGORIES

To affect and measure change in water quality and flood resiliency, there are four categories to the NRS Logic Model (Figure 67). These are:

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

The measurable indicators that correspond to each category, as outlined in Figure 67, provide specific parameters in which to track annual changes and persistent trends. These factors are used to develop a standardized protocol for evaluating progress. Monitoring indicators are identified for each goal within Chapter 4.

EVALUATION METRICS

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

Inputs

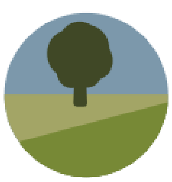
Inputs are the foundational indicator of change in efforts to improve water quality and flood resiliency within the watershed. Inputs encourage and help realize changes in human behavior and help promote conservation practices and mitigation project adoption. To identify the inputs dedicated to the HWSSRW,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

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

Human

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

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



Land

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

- Understand barriers to adoption
- Identify the need for additional BMPs
- Help to develop or refine watershed models
- Help the HWSSRWMA quantitatively measure the success of this plan over time

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

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

Water

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

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

EVALUATION TIMEFRAME

The evaluation process of this plan will follow an adaptive management approach. Adaptive management is a systematic process of "learning by doing," as illustrated in Figure 68. This process is utilized in situations where there is uncertainty in precisely how selected actions will affect the outcome, but management decisions must be made. This process involves executing and evaluating various alternatives, allowing managers to make more well-informed and better decisions in the future. Overall, adaptive management is the process of using the best available science to implement management actions today, learn from those results, and revise actions as required.

The HWSSRWMA will utilize an adaptive management scheme to evaluate and adjust plan implementation efforts over time. Monitoring assessments will take place continuously, with evaluation and adjustment actions taking place both as necessary and formally at yearly and 5-year increments.

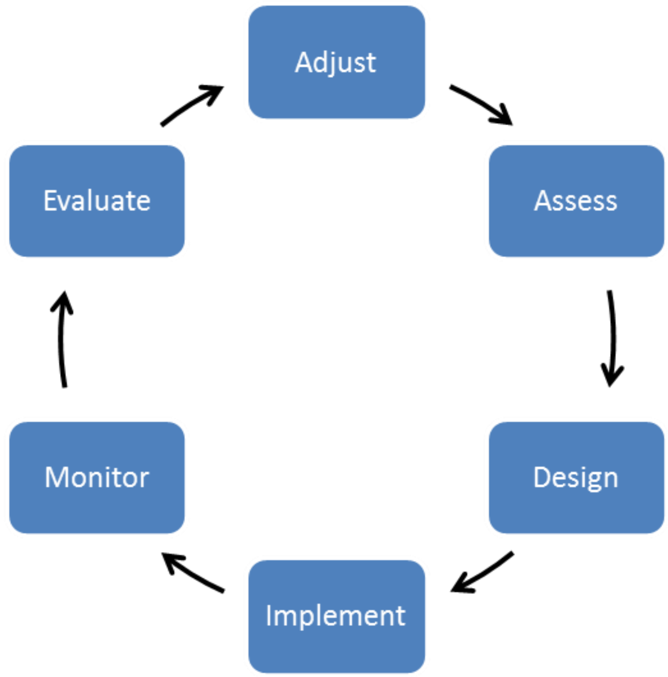


Figure 68: Basic Procedural Steps of Adaptive Management

The evaluation metrics laid out in this chapter are meant to help guide the HWSSRWMA towards meeting its stated goals and objectives (Chapter 4). However, they are also useful to inform the public and partners on the work that is being done and the resources that are needed. The recommended frequency of reporting on these metrics is discussed below and summarized in Table 39.

- **On-Going / Quarterly Project Updates**
  On-going tracking is recommended for current projects, BMP implementation, public outreach, and partner updates. Quarterly board meetings provide a logical time to provide updates on these topics to board members and the public. By tracking these items regularly, yearly updates will be more manageable to accomplish.
- **Yearly Partner Review Meeting**
  Watershed project partners should host an annual review meeting to provide an opportunity to update the public on activities and evaluate progress. This may take the place of one quarterly meeting board meeting; however, extra effort should be made to invite the press and stakeholders to this meeting. Annual evaluation worksheets (see Appendix C) should be completed by all partners and board members of the HWSSRWMA prior to this meeting, and the results summarized and presented. An annual report documenting metrics should be prepared by the HWSSRWMA and widely

distributed. These annual reports can be evaluated to show changes over time and to help identify gaps where additional inputs are needed.

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

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

Table 39: Summary of the Timeframe Each Evaluation Metric Should be Completed

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

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

POLLUTANT REDUCTION CALCULATOR TOOLS

A BMP or pollutant load reduction calculator should be used to estimate loading reductions achieved through project implementation. This estimate can then be used to evaluate project milestones. Additionally, these tools may be useful when considering the potential benefits of future water quality projects.

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

There is currently no tool to estimate *E. coli* bacteria load reductions achieved by BMP implementation.

As discussed in Chapter 3, a water quality model was unavailable for use during the development of this plan. It is recommended that future planning or evaluation steps include the development of a water quality model. A water quality model will allow better subwatershed and BMP prioritization. Furthermore, a water quality model will assist in evaluating project successes and better predicting future success. The water quality model should address sediment, nutrients, and *E. coli*.

5.07 SUMMARY AND RECOMMENDATIONS

Improving water quality and flood resiliency throughout the HWSSRW is possible with a long-term commitment by communities, counties, farmers, and other entities within the watershed. Long-term funding, planning, and dedication to the implementation of this plan will be required.

While a long-term and comprehensive implementation plan has been presented in this chapter, there are several recommendations that should be completed as initial steps or during future plan updates – some of these have been included in the Action Plan within Chapter 7. Recommendations from this chapter have been summarized below for easy reference.

- **Select Priority Area for BMP Implementation:** Following adoption of this plan, the HWSSRWMA and/or its partners will need to select an area to pursue BMP implementation efforts. This will consist of obtaining funding that will be used for BMP cost-share for landowners, education and outreach efforts, and other supporting activities. A detailed project plan will be developed, specific to the priority area selected, and will include the following:
    - Project sponsor and partners
    - Project description
    - Goals and objectives
    - Proposed BMPs
    - Pollutant source and load reductions
    - Education and outreach activities
    - Monitoring and evaluation procedures
    - Schedules and milestones
    - Budget
- **BMP and ACPF Mapping and Updates:**
    - A detailed review of LiDAR, aerial photography, and in-field surveys should be completed to compare ACPF estimated needs with actual BMP levels. This should be completed prior to landowner consultation for BMP siting.
    - During BMP implementation projects, the HWSSRWMA should identify and prioritize CSAs using the ACPF Toolbox and complete ACPF FiNERT analysis within priority subwatersheds to further refine implementation strategies and prioritize BMPs.
    - It is recommended that the HWSSRWMA use the ISU BMP Mapping Project to create an initial database of existing BMPs. The database should be supplemented with information gathered from farmer surveys. This would be used as baseline for implementation monitoring and future plan evaluation.
    - It is recommended that that a separate study be completed to identify potential locations for oxbow restoration within the watershed, this can be used to help estimate future costs.
- **Do not Ignore Other Project Priorities:**
    - Not included are costs for monitoring, plan maintenance/updates, or other evaluations/studies that have been recommended. It is recommended that

    individual cost estimates be prepared for those efforts based upon the scope desired by the HWSSRWMA, and at the time services are needed.
  - It is recommended that a baseline survey of awareness and attitudes be conducted by the HWSSRWMA. This would be used to help inform implementation planning and as baseline for future plan evaluation.
- **Watershed Hydrologic and Water Quality Modeling:**
  - During plan updates a watershed model should be developed to estimate benefits at a minimum of the subwatershed (HUC 12) scale. Ideally, benefits of individual structures or BMPs could also be included, however, that could be difficult due to the scale and complexity of data required. This will help inform the watershed plan implementation strategy and may provide a way to evaluate progress during plan updates.
  - There is currently no tool to estimate *E. coli* bacteria load reductions achieved by BMP implementation. It is recommended that when a water quality model is developed for the HWSSRW, a tool be developed for this purpose.
- **Complete a Flood Risk Assessment:**
  - It is recommended that a more detailed flood risk assessment and recommendations be developed, either as a standalone study or during future updates to the county hazard mitigation plans. This would allow flood mitigation benefits to be identified at the community level.
  - It is recommended that a study to identify current flood resiliency should be completed, which would be used as baseline for plan evaluation.
- **Integrate the Watershed Plan with County Hazard Mitigation plans:** Each county's local HMP should be amended to recognize the watershed plan, recommendations, and other actions. Additionally, when a flood risk assessment is completed, this should also be included in the amendment of the HMPs. This will open additional partnership and funding opportunities for implementation.

CHAPTER 6. EDUCATION PLAN

6.01 INTRODUCTION

This chapter serves as an education plan, which provides a diverse framework for outreach, information, and education (I&E) efforts that will support the implementation of this watershed plan. This includes strategies and methods to engage watershed residents, landowners, farmers, and other stakeholders. Additionally, this plan includes recommendations for evaluating I&E activities and sharing lessons learned, success stories, and other outcomes with stakeholders.

Education, information, and outreach (I&E) refers to the on-going process of informing and involving watershed stakeholders in the development and implementation of the watershed plan. This process is essential as the success of the watershed plan is dependent on the voluntary participation in plan implementation. An informed and involved public is needed not just for the initial implementation efforts, but the long-term adoption and maintenance of best management practices (BMPs) within the watershed.

This education plan provides a framework that future efforts can be built on. Those efforts can take place at both the full watershed scale and within prioritized subwatersheds through BMP implementation projects. Two primary takeaways from this education plan include:

1. This chapter should be used as a guide to develop unique education plans for each BMP implementation project, based on the unique target audiences and project goals in the priority areas identified in Chapter 7.
2. The highest priority educational activities for the watershed are identified in the Action Plan in Chapter 7.

In addition to the stakeholder input received during the watershed planning process, this education plan is based on communication and marketing best practices; public participation best practices; and principles outlined in *The Social Indicator Planning & Evaluation System (SIPES) for Nonpoint Source Management: A Handbook for Watershed Projects* (Genskow and Prokopy, 2011). The SIPES handbook is an excellent resource regarding the identification and monitoring of social indicators, or measures that describe the awareness, values, and behaviors of people and communities, related to water quality improvement.

Additionally, recommendations and key findings from the *Lyons Creek Watershed Project: Lessons Learned from Partner & Participant Reflections* (Losch and others, 2016) were reviewed and considered for inclusion in this education plan. This report provided lessons learned from the recently completed 319 Watershed Improvement Project in the Lyon's Creek Subwatershed – which is nearby the HWSSR Watershed. Therefore, this report provides very valuable insights for this plan. A copy of the Lyon's Creek report can be found at:

https://www.iowadnr.gov/Environmental-Protection/Water-Quality/Watershed-Improvement

6.02 TARGET AUDIENCES

While the watershed as a whole can be an audience for I&E efforts, it should not be the only audience. To be most effective, I&E should be based on the needs of a target audience. A target audience is a population subset that is the ideal recipient of a message based on shared characteristics or interests. The use of target audiences maximizes the effectiveness of I&E efforts because it helps to deliver a relevant message to the individuals who can most readily benefit from or act on that information. Specific target audiences should be identified for each BMP implementation project, based on the goals identified for the priority area.

Across the HWSSRWMA, several potential target audiences have been identified including, but not limited to:

- Land managers, property owners, and residents throughout the watershed and within each priority area;
    - Row crop farmers
    - Animal agricultural / livestock farmers
    - CAFO managers/owners
- Farmers who implement specific BMPs, and those with the potential to implement similar practices;
- WMA Board of Directors and/or member representatives;
- Schools
- County government staff and elected officials;
- Municipal government staff and elected officials;
- State government staff and elected officials;
- Federal government staff and elected officials;
- Rural homeowners with private wells and/or septic systems;
- Urban landowners and residents;
- Absentee landowners, both local and distant;
- Crop consultants, agri-chemical dealers, Co-op's, and other agricultural service providers;
- Outdoor recreational users or groups (water trail users, etc.)- both within and external to the watershed;
- Civic leaders, such as service organizations and non-profits;
- Youth (Future Farmers of America [FFA], agricultural students, science classes, etc.);
- Young or beginning farmers;
- Ag-based non-profits (ISA, Iowa Corn Growers Association, etc.);
- Environmental service non-profits and consultants;
- Lawn care providers;
- Civil engineers.

In addition to identification of audience(s) to target, effective I&E requires an understanding of how to reach and lead an audience to take action. By developing this understanding, the WMA will be better positioned to influence people's awareness, values, and behaviors regarding watershed improvements. The type of information that should be developed for each target audience include:

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

This type of information can be collected a variety of ways, such as through surveys, in-person interactions, and advisory boards. This information for target audiences should be identified and gathered at the outset of each BMP implementation project, based on the unique target audiences and needs in the priority area. The initial research of target audiences can also serve as baseline information for on-going monitoring of the awareness, values, and behaviors related to water quality improvements. Monitoring social indicators alongside environmental indicators will offer meaningful insight regarding the progress made in achieving the goals and objectives described in this plan. Refer to the SIPES handbook for additional details on how to use social indicators to help plan, implement, and evaluate watershed improvement projects.

RURAL (AG) VS URBAN AUDIENCES

The HWSSRWMA includes both rural and urban areas. While these are two distinct target audiences, each meriting tailored outreach materials and activities, care should be taken that even defining rural and urban can vary. While there are differences between rural and urban audiences, they are all residents of the same watershed and will still share many similarities. Table 40 outlines some general strategies to consider when tailoring outreach materials and activities to both audiences.

Table 40: Generalized Outreach Considerations for Rural and Urban Audiences

Rural	Urban
• Generally, more homogenous population and may be more skeptical of change. • Sparser population, and more geographically spread, than urban audiences • Information shared through word of mouth and community centers (gas stations, coffee shops, etc.) • Media tends to be the weekly paper, but increased use of local social media groups/sites is becoming more common. • Conduct one-on-one or small group meetings. Door-to-door contact can be very effective, sometimes you have to meet people where they are. • Tone down your approach; it's critical a program does not project a slick, "big city" image. • Utilize a local liaison; a known, friendly face. • Take it slow and easy; don't barge right in.	• Generally, more diverse interests and more people to contact. • Messages compete with many others • Attention spans may be shorter • Focus on concise, clear messaging. Avoid the complicated or layered messaging. • Use the Internet, e-mail and direct mail in tandem. • Identify and include neighborhood councils, homeowners associations, or other local organizations as appropriate.
Both Audiences	
• Listen, listen, listen • Adapt your message to the local context • Build a team that reflects the composition of your audience • Be clear with objectives and timeframe. • Build in extra time to your schedule. Meaningful outreach takes time. • Be appreciative of the time and participation audiences are willing to give. Everyone is balancing various responsibilities. • Identify and engage community influencers and opinion leaders (hint: they aren't just elected officials). • Remember that effective outreach is based on mutual trust. • Avoid stereotyping, or assuming what each audience knows, understands, or values • Don't be judgmental and leave your ego at home. • Both audiences can be technologically savvy, yet may still prefer in-person engagement • Remember, there is lots of overlap between rural and urban populations, especially when considering the high levels of absentee landowners across the watershed.	

6.03 STRATEGIES

Each I&E strategy is based on one of two types of outcome change: information or behavior.

An information-based strategy seeks to fulfill information needs, while a behavior-based strategy seeks to motivate change. Typically, an information-based strategy should precede a behavior-based strategy, but that is not always the case. For example, information needs could be sufficiently met for commonly understood topics using a behavior-based approach, such as household water conservation.

These two basic types of strategies and associated activities are to be considered a component of the overall I&E strategy of this plan. They should be implemented when appropriate but will work best when they inform or supplement the action items outlined in Chapter 7. A determination of which strategy to use should be made at the outset of a BMP implementation project based on the goals and objectives identified for that priority area.

INFORMATION-BASED STRATEGY

The purpose of an information-based strategy is to increase awareness or understanding of a specific topic:

- When the desired outcome is increased awareness, the goal of the strategy is to make target audiences aware that issues are present, as well as what actions have been or are being taken.
- When the desired outcome is increased understanding, the goal of the strategy is to broaden or deepen the target audience's understanding of issues and projects.

Table 41 provides an outline of efforts that could be used to support an information-based I&E strategy. These activities are a key a component of the overall I&E strategy for this plan, and can also be adopted for use in more detailed implementation plans for priorities watershed areas.

Table 41: Potential Activities for Information-Based Outcomes

Activity	Outcome
Create logos, taglines, and key messages for the watershed (or specific projects) to create a sense of place and value.	Awareness
Promote the watershed plan through newsletters, flyers, press releases, websites, and events.	Awareness
Acknowledge, recognize, record, and share previous and existing conservation efforts or other projects completed.	Awareness
Provide updates on plan progress and monitoring through newsletters, flyers, press releases, websites, and events.	Awareness
Install watershed and stream name signage at all major road crossings	Awareness

Identify and partner with other groups within the watershed that are already conducting conservation or flood resiliency efforts.	Understanding
Develop a reporting system to identify successes and failures of projects.	Understanding
Provide educational opportunities (fact sheets, public meetings, field days, classroom activities, etc.) that focus on specific issues, solutions, and funding opportunities.	Understanding
Showcase the relevancy and benefits of this plan's implementation to help audiences understand local impact.	Understanding
Develop and organize demonstration sites, tours, and field days.	Understanding

BEHAVIOR-BASED APPROACH

The purpose of a behavior-based approach is to provide information that leads to changes in values and behaviors. This plan seeks to address change at two levels:

- At the first level, I&E will seek to influence or change existing values and behaviors so as to gain acceptance and adoption of BMPs.
- At the second level, I&E will seek to influence generational change. Generational changes involve shaping the attitudes, values, and behaviors of future land managers, farmers, residents, and decisions makers. Generational change will ultimately help enhance the sustainability of implementing BMPs throughout the watershed.

Table 42 provides an outline of efforts that would support a behavior-based I&E strategy. These activities are a key a component of the overall I&E strategy for this plan, and can also be adopted for use in more detailed implementation plans for priorities watershed areas.

Table 42: Potential Activities for Behavior-Based Outcomes

Activities	Outcome
Provide information directly to target audiences about the benefits of BMPs, as well as technical and financial programs available to assist in the implementation of BMPs.	Change in existing values and behaviors
Provide information directly to farm consultants, agricultural retailers, engineers, and other audiences that have a high degree of influence on landowner and farmer decisions.	Change in existing values and behaviors
Hold targeted coffee shop meetings, tailgate sessions, and other informal information exchanges to build relationships and to learn more about the barriers and obstacles audiences perceive regarding implementation of BMPs.	Change in existing values and behaviors
Identify and work with target audiences to develop a water quality monitoring program.	Change in existing values and behaviors; Generation change

Include school-aged youth in project plans, such as field tours of project sites, and water quality monitoring sites.	Generational change
Provide information about water quality and other benefits of BMPs to youth-based programs (FFA, 4-H, agricultural students, science classes, etc.)	Generational change
Provide information targeted for younger generations at regularly used recreation areas (beaches, picnic shelters, water trails, etc.) about the importance of watershed management and its relation to water quality and flood resiliency, especially as it related to the location where information is posted.	Generational change

HWSSR WATERSHED TARGETED STRATEGIES

The following strategies were identified by stakeholders and through literature review specifically for use during the implementation of this plan:

- **Use of Focus Groups**
  - Work with focus groups or other interested individuals to help develop or refine education and outreach materials. These might include farmer focus groups; individuals that have completed various educational programs such as Master Conservationists, Master River Stewards, or Iowa Land Stewardship Leadership Academy; or other groups as they are identified.
- **Utilize messaging from the "Whole Farm Conservation Manual".**
  - The *Whole Farm Conservation Best Practices Manual, 2nd edition* (ISU, 2022) was developed by ISU Extension and seeks to summarize the existing scientific consensus of BMPs and streamline the BMP recommendation process for landowners, farmers, and natural resource professionals. The manual complements the NRCS's conservation planning process and integrates BMPs from the Iowa Nutrient Reduction Strategy.
  - This is recommended reading for every WMA member, partner, landowner, and farmer within the watershed.
  - The manual can be obtained from ISU Extension: https://store.extension.iastate.edu/product/15823
- **Provide farmers with information on the economics of conservation.**
  - It is important for farmers to understand the economic consequences of adopting BMPs. Providing this information will be important to the success of this plan. It is recommended that outreach and education efforts targeted to farmers emphasizes this subject area, and where possible use real world data from within the watershed.
  - The Soil Health Partnership (SHP), a farmer-led organization, released a report in 2021 titled *Conservation's Impact on the Farm Bottom Line* (SHP, 2021). It summarized the evaluation of the financial impact of conservation tillage and cover crop usage among Midwest corn and soybean farmers, including those in Iowa.

The report showed that while conservation practices do not pay for themselves in all situations, there is a business case to be made for increased adoption.

- The following three key financial impacts of implementing conservation practices were identified in the SHP report, and could serve as standard messaging:
  - Conservation tillage reduces operating costs
  - Cover crops can be part of a profitable system, especially as experience grows
  - Success with conservation practices is optimized with a targeted, stepwise, tailored approach
- The report is available online, along with additional supporting economic evidence that can be used in outreach and education materials: https://www.soilhealthpartnership.org/farmfinance/achieving-profitability-with-on-farm-conservation/

- **Implement lessons learned from the Lyon's Creek Watershed Improvement Project.** The WMA should become more familiar with this project and the key lessons learned, which are documented within the previously mentioned Lyon's Creek Report (Losch and others, 2016). These include, but are not limited to:
  - Create a sense of shared understanding, project goals, and criteria for success
  - Employ a full-time watershed coordinator
  - Find common ground between landowners and cash-rent operators
  - Simplify access to the multitude of adjacent, concurrent, and /or overlapping BMP cost-share programs from various partners
  - Utilize active-recruitment strategies for outreach/education to target audiences
  - Provide data from local sources and or local demonstrations as much as possible
  - Plan for a long-term timeframe of implementation. It will take a long-term "campaign" to gain trust and recognition from farmers.
  - Provide clear, consistent, and science backed information on pollutants, sources, impacts, and attributes of BMPs (costs, benefits, limitations, etc.)
  - Casting blame decreases farmers interest in participation or willingness to adopt BMPs.
  - Identifying and highlighting local "champion farmers" to help deliver messaging increases credibility and visibility
- **Utilize water trails to create a sense of place and leverage opportunities for educational outlets.**
  - By highlighting, the existing South Skunk River Water Trail, the WMA could help to create local concern and ownership for improving the watershed. This would focus the conversation on protecting local resources instead of more ambiguous goals set by outside entities.
  - Water trail access points could also serve as natural places for educational signs, events, and for people to connect with the river. This would help the public see and experience firsthand the resources this plan seeks to protect in a much more intimate way.

- **Utilize ACPF mapping to prioritize outreach to critical source areas.**
    - Within each priority subwatershed, outreach efforts should be prioritized and emphasized around getting farmers and landowners in critical source areas to adopt conservation practices. Critical source areas, discussed in Chapter 5, produce a disproportionately high level of pollution compared to others within the watershed. Treating these areas with BMPs will therefore produce the largest impact on water quality per dollar spent on practices. ACPF can be used to identify these areas and site specific BMPs, which can then be reviewed with landowners.
- **Leverage virtual technology to expand outreach efforts.**
    - The HWSSR Watershed spans across four counties and nine cities, and nearly 50% of the land is owned by absentee landowners (many of them residing outside the watershed) – this is a huge geographic area to focus outreach and education on. While this plan does include targeted outreach within priority subwatersheds, virtual technologies can be used to expand the impact of all efforts relatively cheaply.
    - It is recommended that all, or at least some key events, have a virtual option for attendance and that some events include planning and coordination to increase attendance and interaction with virtual participants. This will also allow these events to be shared across social media and delivered to absentee landowners and other stakeholders that are unable to be reached locally.
    - Work with the Iowa State Farm Management Team to host targeted farmland leasing workshops within Story and Hamilton County that target absentee landowners. Additional contact information is here: https://www.extension.iastate.edu/ag/farm-management

6.04 DELIVERY METHODS AND MATERIALS

I&E methods should be tailored to the target audience. This will make efforts more effective and more likely to achieve the desired outcome. Each outreach campaign should consider the utilization of a diverse set of methods to reach targeted audiences. *Table 43* describes a variety of potential I&E methods.

Table 43: I&E Delivery Methods

Method	Description	Recommended Use
One-on-One Contact	On-site meetings to discuss location of projects or to answer questions about programs and projects.	For siting projects within targeted areas.
Direct Mailing	Targeting informational mailer sent to all properties within specified area.	For increasing attendance of public meeting or participation in area event or program.

Media	Newspaper, radio, television news, agriculture-based magazines, outdoor magazines, etc.	For increasing awareness of activities and progress.
Electronic and Social Media	Websites, social media platforms (Listserv emails, Facebook, Twitter, etc.)	For supplementing other outreach methods
Signage	Billboards, cooperator recognition signs, traveling displays, demonstration signs, etc. When possible, should include interpretive information.	For high-traffic areas, such as major intersections, public beaches, entrances to recreation areas, boat ramps, water trails, or area events.
Events	Events related to water resources, such as training opportunities, demonstration field days, and recognition picnics.	For use in conjunction with other area events, such as county fairs or other partner events.
Field Days or Workshops	Hands-on and site-specific event, such as a site tour, outdoor recreation clinic, training, equipment calibration, water quality testing, etc.	For use in supporting the education or adoption of a specific management activity.
On-site Project Demonstration	Water quality monitoring and BMP installation or maintenance.	For use in supporting the education or adoption of a specific management activity.
Curriculum	Lesson plans and materials for formal and informal education.	For youth-based outreach.
Educators	Assist with the development and delivery of materials.	For youth-based outreach.
Water Quality Test Kits	Simple water quality test kits that show instant sample results and provide a hands-on involvement and learning opportunity.	Provide to volunteers, youth groups, civic groups, or volunteer farmers.

USE OF MEDIA

Selection of media type should be considered based on the target audience and type of strategy being used. While each type of media outlet may have a different cost for publication, their effectiveness also varies based on its use by target audience. Media use by farmers (a key target audience for this watershed plan) was recently measured in the *2021 Iowa Farm and Rural Life Poll* (Arbuckle, 2021), as summarized below and in Figure 69:

> Local or state TV news was the most frequently used source, with 77% of farmers reporting use or several times daily. National TV news and local or state radio news and talk were essentially tied for second, with 62% reporting viewing either daily or several times weekly. Twitter and podcasts were the least frequently used, with

just six percent of farmers reporting use of these either daily or several times weekly. It is important to note that although farm magazines were not among the most frequently used, 87% of farmers indicated using farm magazines at least monthly, second only to local or state TV news.

	Never	Less than Monthly	Monthly	Weekly	Several Times Weekly	Daily
Local or state TV news	6%	3%	3%	12%	17%	60%
National TV news	14%	7%	4%	13%	21%	41%
Local or state radio news and talk	11%	8%	5%	14%	22%	39%
Cable/Satellite TV	34%	2%	2%	5%	8%	50%
Facebook	47%	5%	3%	8%	12%	25%
Farm magazines (paper or online)	6%	7%	28%	28%	21%	9%
Local newspaper (online or paper)	12%	9%	7%	42%	11%	19%
Streaming video service (Netflix, Amazon Prime Video, Disney+, Hulu, HBO Max, etc.)	49%	9%	7%	11%	12%	11%
National newspaper (online or paper)	48%	14%	5%	13%	9%	12%
Iowa Public Radio	44%	17%	9%	13%	9%	8%
YouTube	44%	16%	11%	13%	10%	6%
Podcasts	68%	14%	7%	6%	4%	3%
Twitter	88%	4%	2%	1%	2%	4%

Figure 69: Use of Various Media Types by Farmers

TIMING

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

6.05 EVALUATION

Each I&E activity should undergo at least some level of evaluation for several reasons:

1. Evaluation supports mid-course adjustments and follow-up outreach to ensure the strategy is achieving its desired outcome.
2. Evaluation provides an alternative means (i.e. social indicators) to measure the progress of this plan's goals and objectives.
3. Evaluation will help the WMA refine its I&E strategies for future projects and initiatives.

Evaluation methods should be selected during I&E strategy development so they can be employed throughout a project or initiative. This early emphasis also prevents evaluation from being overlooked. Evaluation methods include, but are not limited to:

- Tracking if or how the target audience engaged in each activity or method;

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

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

As the implementation efforts are just getting started, there may be limited data regarding existing attitudes, behaviors, values, or beliefs of target audiences. Until this data can be collected, as discussed above, it will be useful to refer to the following data sources, which may serve as an interim baseline until local data can be collected.

- Lyons Creek Watershed Project: Lessons Learned from Partner & Participant Reflections (Losch and others, 2016).
- Public Perceptions of Water Quality in Iowa: A Statewide Survey (Wittrock and others, 2015)
- Informing the Cooperative Conservation Framework for Improving Watershed Health: Operator and Landowner Survey Results (Arbuckle, 2010)

6.06 SUMMARY AND RECOMMENDATIONS

This education plan provides a framework that project level efforts will be built on. Given the importance of outreach and education to the success of this watershed plan, the WMA should begin implementing these activities right away. The following is a summary of initial recommendations for this process:

- **Begin implementing the strategies identified in the Action Plan in Chapter 7.** These were prioritized by watershed stakeholders and can be executed outside of project-level BMP implementation projects within subwatershed, and parallel to education efforts that other watershed partners are already pursuing.
- **Work with partners.** Partners have been working in or near the watershed to accomplish conservation with many of the same target audiences identified in this plan. It will be important to learn from, strengthen, and build on these previous experiences and existing partnerships. Additionally, the WMA should continue to identify, pursue, and strengthen new relationships with credible organizations that have shared interests and goals. These partnerships may include, but are not limited to:
    - The Nature Conservancy (TNC)
    - US Fish and Wildlife Service (USFWS)
    - Iowa Soybean Association (ISA)
    - Iowa Department of Agriculture and Land Stewardship (IDALS)

  - Iowa State University (ISU) Extension
  - Iowa Department of Natural Resources (IDNR)
  - Natural Resources Conservation Service (NRCS)
  - County Emergency Managers, Engineers, and Drainage Districts
  - Prairie Rivers of Iowa
  - Practical Farmers of Iowa
  - Iowa Stormwater Education Partnership
  - National Fish and Wildlife Association
  - Center for Rural Affairs
- **Utilize Watershed Coordinators.** Employing a watershed coordinator ensures that there is someone to do the day-to-day work of engaging communities, farmers, and other project partners; as well as work to bring in outside resources (such as funding and technical assistance). Because there are existing watershed coordinators within the watershed, a next step for the WMA would be to evaluate where the service areas and capabilities of these coordinators overlap or where there are gaps. Then, the WMA should discuss and develop a strategy to better utilize existing watershed coordinators and/or fill the gaps between existing coordinators.
- **Survey farmers and landowners.** Completing a baseline survey of awareness and attitudes will help identify of barriers to adoption of BMPs, inform implementation planning, and provide a baseline for future plan evaluation. This could be paired with farmer surveys to identify current adoption levels of nonstructural BMPs.
- **Learn from the Lyon's Creek Watershed Improvement Project.** In addition to each member reviewing the summary report discussed in this plan, the WMA should host speakers during regular WMA meetings whom either prepared the report or worked on the project, to share their lessons learned.
- **Collect additional data on farm economics.** Adoption of BMPs is often driven by economic decisions and situations that are specific to each farm- such as soil type, geography, and crop rotation. It is therefore important to provide more and increasingly refined financial information about conservation practices to farmers from local geographies, farm sizes, and crop productions. It is recommended to integrate financial data gathering as part the implementation of this plan. This should be used to help farmers inform their conservation solutions and to support farmers in establishing profitable conservation systems

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CHAPTER 7. SHORT-TERM ACTION PLAN

7.01 INTRODUCTION

To help guide the Headwaters of the South Skunk River WMA and other stakeholders in the successful implementation of this plan, a detailed action plan has been developed. This action plan is focused on specific actions that can be implemented over the short-term (less than five years). This action plan covers the two following types of activities:

1. **Priority Areas for BMP Implementation** – These areas were identified for initial efforts of focused implementation of Best Management Practices (BMPs) within the larger HWSSR Watershed. Focusing and concentrating the implementation of BMPs within priority areas allows the HWSSRWMA to maximize efforts, resources, and impacts. Supporting information for these areas are included as part of the long-term implementation plan in chapter 5.
2. **Supporting Action Items –** These action items are focused on activities that both support BMP implementation in priority areas, build capacity for WMA activities, and establish a more robust foundation for future watershed management decisions.

The action plan is comprised of groups of specific and independent activities that can be completed to work towards achieving the plan's goals and objectives. The activities were identified through evaluation of watershed data and input from WMA members and stakeholders. Additional consideration was given to ensure that action items were identified for each of the draft goals. Only the action items that were of highest priority and thought to be realistically achievable within five years were included in the action plan; however, all potential action items that were identified have been documented in Appendix B for reference.

The action plan was developed concurrently with the plan's goals and objectives over the course multiple WMA meetings. Key meetings and discussion took place at the following meetings:

- August 21, 2021: Participants identified and discussed the issues and potential solutions that were important to both themselves and the broader watershed.
- October 7, 2021: Participants discussed recently completed projects and potential future projects that could be completed to help kick off implementation of the plan.
- January 24, 2022: Participants began reviewing existing watershed data and assessment of conditions, to help identified future implementation needs and priorities.
- March 30, 2022: A working session on a draft list of action items was held to help identify all potential actions and begin to prioritize them for inclusion in the action plan. Additionally, draft priority areas were presented for discussion. Following the meeting, an updated and prioritized list of action items was emailed to the WMA for additional feedback.
- May 25, 2022: The fully drafted action plan was presented to the WMA and reviewed line-by-line with participants. Both the priority areas and action plan were finalized.

7.02 PRIORITY AREAS FOR BMP IMPLEMENTATION

WATERSHED ASSESSMENT

Initial BMP implementation efforts from this plan will be focused within priority subwatersheds. As identified in Chapter 5, these include Long Dick Creek Subwatershed and Keigley Branch Subwatershed (Figure 65). To begin planning and evaluation for these efforts, IDNR completed a watershed assessment of both areas. This work consisted of an in-field, windshield level, analysis of each watershed in June 2022. Detailed results and maps of this assessment are provided in Appendix B. The following information was collected:

- Observed land use
- Estimated sheet and rill erosion, and sediment delivery rates
- Identification of existing structural BMPs
- Inventory of cover crops
- Inventory of tillage practices
- Inventory of animal feeding operations (does not distinguish between types of facilities, size, or permitting status)

PROJECT DEVELOPMENT

Following the adoption of this plan, the HWSSRWMA will need to select one of these subwatersheds for implementation. This will consist of obtaining funding that will be used for BMP cost-share for landowners/farmers, education and outreach efforts, and other supporting activities. A detailed project plan will be developed, based on the information in this watershed plan, and will include the following:

- Lead project sponsor, fiscal agent, and contributing partners
- Project description and scope
- Goals and objectives (tied to this plan, but specific to the project are)
- Proposed BMPs (BMP targets are provided below)
- Pollutant source and load reductions (based on information in Chapter 5)
- Education and outreach activities (based on information in Chapter 6)
- Monitoring and evaluation procedures
- Schedules and milestones
- Budget (Initial cost opinions provided below)

Additionally, the following data collection and analysis is recommended at the project level:

- Identification of critical source areas (CSAs) using ACPF
- Identification of the most cost-effect BMPs, using ACPF FiNRT
- Complete a stream assessment to estimate erosion, identify critical areas, and map drainage tile infrastructure

- Identify and map nonpermitted open feedlot AFOs
- Identify and map possible oxbow restoration locations
- Refine existing BMP estimates using ground truthing and stakeholder input

STREAM BUFFER INITIATIVE

The HWSSRWMA should consider focusing on, or at least including, stream buffers (and associated practices) as part of plan implementation. As previously discussed, and as demonstrated on Bear Creek, buffers offer many benefits to water quality, habitat, and flooding. If fact, the NRS Science Assessment (ISU, 2022) found that implementation of a 35-foot buffer on either side of all agricultural stream across Iowa would reduce phosphorus loads by 18% or nearly 2/3 of the way towards the NRS goal of 29% reduction in phosphorus loads.

A recent analysis (Rundquist and Mason, 2015) assessed the potential of implementing buffers across five Iowa counties, which represented each of Iowa's major landscape regions. The study reviewed existing stream buffers using aerial photography to see how many landowners would be affected and how many acres would be needed for widespread adoption. The study looked at three different potential buffers widths (from stream side to cropland): 35, 50, and 75 feet. Hamilton County was included in this study, which provides valuable findings for this plan:

- Hamilton County had the greatest concentration of cropland yet had the second highest concentration of stream buffers of the five counties studied. The county had 81% of streamside buffers necessary to meet a 35-foot width standard, 76% for a 50-foot standard, and 72% for a 75-foot standard.
- While this is a positive finding, the study found large discrepancies between adjacent fields. Indicating that while some stretches of stream may be well buffered, others may have no protection at all.
- Across all counties, the number of acres that would need to be converted from crop production to stream buffer (grass, trees, and other perennial vegetation) is extremely small. Hamilton County would need only 81, 164, or 457 acres to meet the 35, 50, or 75-foot standards, respectively.
- Implementation of buffers would only affect a small percentage of landowners – those that own cropland adjacent to streams. Of that small group of landowners in Hamilton County, only 27–46% of them would be affected the implementation of any of the buffer standards.
- Even more striking, a fully 85% of all affected landowners across all five counties would need to convert only an acre or less of cropland to meet the 35-foot standard, which was the buffer size evaluated within the Iowa NRS Science Assessment.

Strategically targeting and focusing implementation on stream buffers would be a simple but very effective way to make significant progress towards meeting the goals of this plan. Recommendations on buffer widths and design can be found in the IDNR River Restoration Toolbox Practice Guide #3.

COSTS AND BMP TARGETS

Table 44 provides a summary of the cost opinions for BMP implementation within priority subwatersheds. Detailed cost estimates for each priority subwatershed are found in

Table 45 and Table 46. Target levels for BMP implementation in each priority area have been developed based on the same rationale as provided in Chapter 5. These cost opinions presented are based upon the BMP targets levels, but other practices may also be considered. Additionally, costs for education, monitoring, or other special studies are not included here, and should be identified on a project-by-project case.

The assumptions and exclusions that these cost opinions are based on are provided in Chapter 5. These cost opinions are based on the full cost of each BMP, not just on the cost-share rates which can vary However, costs are subject to change based on final design needs, inflation, bidding climate at the time of construction, and project size and complexity.

This plan assumes that multiple funding sources will be utilized for implementation. Information on possible technical and financial resources to assist with plan implementation can be found in Chapter 8. Note that the costs given below are based on complete BMP implementation; however, those efforts may be spread over multiple years depending on funding availability or BMP adoption rates.

Table 44: Summary of Cost Opinions for BMP Implementation within Priority Subwatersheds

Priority Subwatershed	Total Cost for BMP Implementation
Long Dick Creek (33,384 acres, 16% of total watershed)	$4,796,753
Keigley Branch (23,581 acres, 11% of total watershed)	$7,400,827
Total	**$12,197,580**

Table 45: Estimated BMP Needs for the Long Dick Creek Priority Area

BMP Practice	Target Number for Cost Estimate	Unit for Cost Estimate	Unit Cost	Total Cost
Bioreactors	57	Site	$10,150	$578,550
Conservation Tillage	6,548	Acres	$30	$196,444
Cover Crops	20,067	Acres	$44	$882,941
Drainage Water Management	2,590	Acres	$88	$227,920
Grassed Waterway	108	Acres	$5,277	$569,916
Nutrient Management	10,562	Acres	$75	$792,113
Nutrient Reduction / CREP Wetlands	21	Site	$25,055	$526,155
Oxbow Restoration	*	Site	$7,500	*
Prairie STRIPs / Contour Buffer Strips	42	Acres	$298	$12,516
Row Crop Conversion to Perennial Cover / Wildlife Habitat	1,345	Acres	$330	$443,850
Saturated Buffer	58	Acres	$360	$20,880
Riparian Buffer**	1,771	Acres	$308	$545,468
Urban BMPs	0	Community	$275,000	$0
Total				**$4,796,753**

**Study needed to determine site locations*

***Includes vegetative buffer only, not locations where engineering measures are needed to stabilize the streambank or channel*

Table 46: Estimated BMPs Needed and Cost Opinions for Keigley Branch Subwatershed

BMP Practice	Target Number for Cost Estimate	Unit for Cost Estimate	Unit Cost	Total Cost
Bioreactors	87	Site	$10,150	$883,050
Conservation Tillage	8,971	Acres	$30	$269,142
Cover Crops	27,493	Acres	$44	$1,209,692
Drainage Water Management	6,154	Acres	$88	$541,552
Grassed Waterway	147	Acres	$5,277	$775,719
Nutrient Management	14,470	Acres	$75	$1,085,250
Nutrient Reduction / CREP Wetlands	46	Site	$25,055	$1,152,530
Oxbow Restoration	*	Site	$7,500	*
Prairie STRIPs / Contour Buffer Strips	47	Acres	$298	$14,006
Row Crop Conversion to Perennial Cover / Wildlife Habitat	2,905	Acres	$330	$958,650
Saturated Buffer	11	Acres	$360	$3,960
Riparian Buffer**	1,647	Acres	$308	$507,276
Urban BMPs	0	Community	$275,000	$0
Total				**$7,400,827**

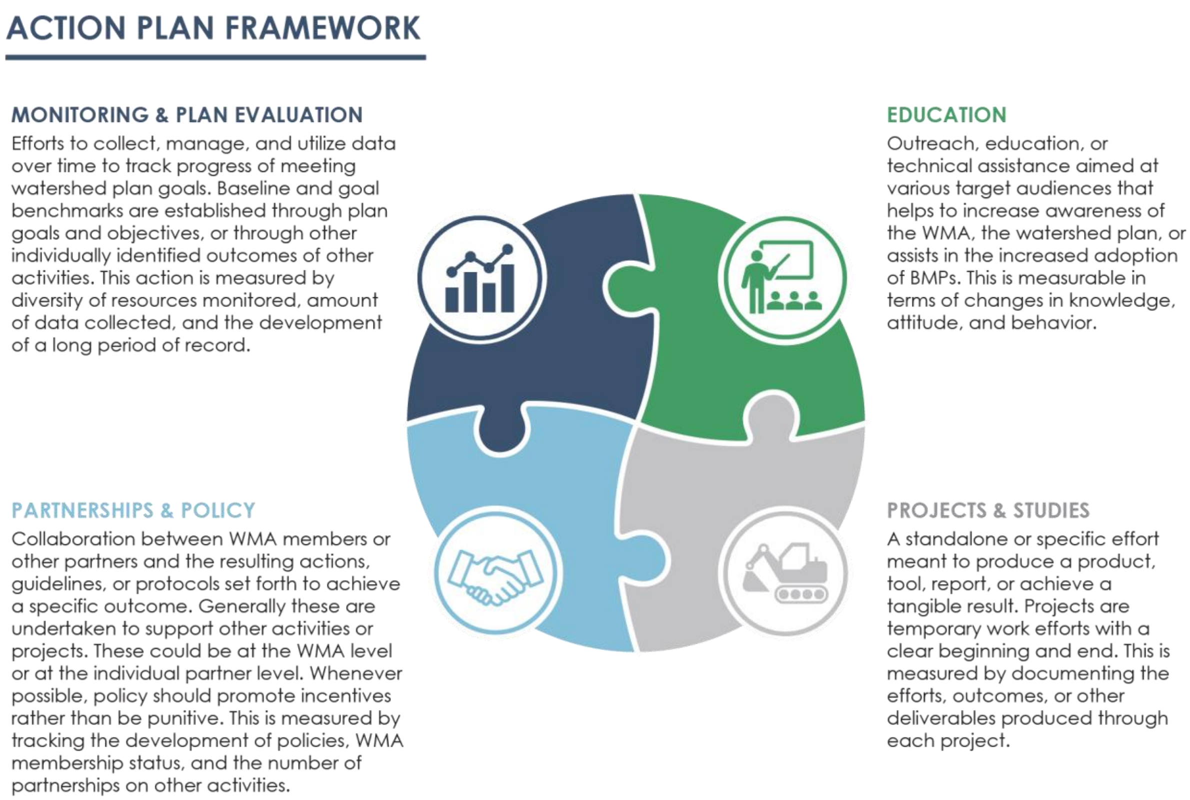
**Study needed to determine site locations*

***Includes vegetative buffer only, not locations where engineering measures are needed to stabilize the streambank or channel*

7.03 ACTION PLAN FRAMEWORK

Action items which support the implementation BMPs and other priorities within this plan have been developed around a framework of four categories of activities (Figure 70), which include Education, Projects and Studies, Partnerships and Policy, and Monitoring and Plan Evaluation.

Figure 70: Action Plan Framework



Additionally, each activity in the action plan lists includes the following information:

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

It is important to note that the action plan has been developed to help realize the goals and objectives identified within this plan. Should those change, the action items should also be reevaluated. At a minimum, they should be reviewed annually and updated every five years during plan updates in accordance with the EPA's nine elements (EPA, 2008).

7.04 PARTNER ROLES

While the Headwaters of the South Skunk River WMA is the sponsor of this plan, it has no authority to implement actions or other recommendations on its own. The success of this plan is reliant on the voluntary coordination and cooperation of numerous private and public stakeholders at all levels. Individual WMA members and stakeholders will ultimately be needed to lead implementation.

Each stakeholder or agency is unique in its capabilities and priorities, and the following list summarizes the responsibilities, roles, and expectations each primary planning partner may play in implementation. It should be noted that this list is not exhaustive, and it is a goal of the plan to expand the number and diversity of partners working to implement this plan.

- **Headwaters of the South Skunk River Watershed Management Authority (HSSRWMA)**
  - The WMA will act as the lead facilitator and coordinator for projects throughout the watershed. It will help to connect funding opportunities with local project sponsors and serve as a regional source of information exchange.
  - A key role of the WMA is to facilitate the identification of partnerships, projects, public meetings/outreach events, and other opportunities that members can participate in and partner with to streamline and enhance watershed management efforts.
  - Develop a working relationship with Ioway Creek WMA, which shares many of the same members as HWSSRWMA. This may include joint meetings, shared learning opportunities, project resources, or other areas of mutual benefit.
  - Ensure that the entire watershed is adequately served by one or more watershed coordinators
- **Counties –** County governments can serve as local sponsors (through the Board of Supervisors, county emergency managers, county engineers, drainage districts, conservation boards, etc.) for leading the implementation of projects. They can promote or encourage policies to protect floodplains and reduce runoff. They can leverage their local funds against other grant programs.
- **Cities -** City governments can serve as local sponsors for implementing projects within or near their communities. They can promote or encourage policies to protect floodplains and reduce runoff. They can leverage their local funds against other grant programs.
- **Soil and Water Conservation Districts (SWCD)** – Each county's SWCD can provide funding and technical expertise for the implementation of BMPs. SWCDs can also lead

the recruitment of, or provide initial information/names, for farmers to join the technical advisory team.

- **Iowa DNR** (IDNR) – Through multiple programs, including the Section 319 program, IDNR can provide technical expertise and funding through education and grant programs to assist with implementation of BMPs. Additionally, IDNR will continue to provide data through the water quality sampling program and can provide assistance in evaluation of the data. IDNR can also provide expertise towards river restoration, floodplain management, and water trails.
- **NRCS**
    - Local NRCS can be a leader in implementing agricultural BMPs through technical support and targeted funding. Additionally, the HSSRWMA may also work with Iowa NRCS to access other funding programs such as the Regional Conservation Partnership Program (RCPP) or the Watershed and Flood Prevention Operations (WFPO or PL-566) program.
    - Local NRCS offices should notify HWSSRWMA members when local working group meetings are held. Local working groups are subcommittees to the State Technical Committee and meet at least once each year. Local working groups provide recommendations on local natural resource priorities and criteria for NRCS conservation activities and programs.
- **Iowa State University (ISU) Extension** – ISU Extension will continue to serve in a technical advisory capacity in support of the WMA. Extension can provide leadership for outreach and education efforts, especially those directed at farmers and landowners, to help boost adoption of BMPs.
- **Technical advisory team and other partners** – It will be incumbent upon the HWSSRWM to initiate, foster relationships, and utilize the expertise and special resources that the technical advisory team and other partners (nonprofits, farmer groups, etc.) can contribute. This should lead to additional buy-in by partners and eventually greater conservation success.

7.05 CATALYST FOR ACTION

The Headwaters of the South Skunk River WMA has taken the lead on the organizational and planning elements for the Headwaters South Skunk River Watershed. As such, the WMA serves as a central hub for communities, counties, SWCDs, and other stakeholders to come together. While the WMA has no formal authority or jurisdiction to implement actions, it does provide a mechanism for its members to leverage their existing authorities or capabilities and act in a unified direction.

This leadership and coordination role would be most effectively manifested if there was a watershed coordinator to assist in the day-to-day operations of the WMA and implementation of this plan. Generally, a watershed coordinator is an employee that does the day-to-day work of engaging communities, farmers, and other project partners; helping get conservation practices installed, coordinates efforts between watershed partners, and works to bring in outside resources (such as funding and technical assistance). A watershed coordinator serves as a catalyst for action.

Because there are existing watershed coordinators within the watershed, a next step for the WMA would be to evaluate where the service areas and capabilities of these coordinators overlap or where there are gaps. Then, the WMA should discuss and develop a strategy to better utilize existing watershed coordinators and/or fill the gaps between existing coordinators.

7.06 ACTION PLAN

The action plan consists of *Table 47* through *Table 50*

Table 47: Action Plan for Education Activities Practices

EDUCATION

#	Action Item and Description	Goals Addressed			Timeline/ Milestones	Primary Activity Lead(s)	Potential Partner(s)	Other Technical or Funding Resources
		1	2	3				
1	Identify “influencer” or “champion” farmers for direct outreach efforts and get their input on outreach and education efforts.			X	Initial “push” in 2023, then ongoing	SWCDs	County conservation, NRCS	n/a
2	Work with existing partners on updating their websites to include or link to information on HWSSRWMA, such as meeting minutes, maps, outreach materials, watershed plan, education materials, monitoring data, etc.			X	Begin once a watershed coordinator is hired	TBD	n/a	n/a
3	Partner with the NRCS coordinator currently working on the South Skunk River Watershed project, to provide or utilize joint educational activities, events, or resources.	X		X	Beginning 2023, then ongoing	County conservation	SWCDs, Extension, IDALS	IDNR, IDALS
4	Install outreach signage that highlights BMP practices landowners or farmers are utilizing. (Could start with champion farmers)			X	2023 and 2024	SWCDs	Counties, IDALS, Ames	IDNR
5	Enlist local Co-Op’s and crop advisors to provide education and resources to farmers regarding water quality and benefits of BMP adoption.	X		X	Beginning 2024, then ongoing	TBD, possibly find an a consultant	IDALS, County conservation, Ames, Extension, ISA	n/a
6	Provide landowners information on multiple BMP funding options and help them navigate the administrative hurdles of programs in order to increase BMP sign-up/adoption rates.		X	X	Begin once a watershed coordinator is hired	TBD	Extension, IDALS, NRCS, SWCDs	n/a

Table 48: Action Plan for Projects and Studies

PROJECTS & STUDIES								
#	Action Item and Description	Goals Addressed			Timeline/ Milestones	Primary Activity Lead(s)	Potential Partner(s)	Other Technical or Funding Resources
		1	2	3				
1	Work with each drainage district to identify potential projects and partnerships that bring mutual benefits to the district operations and watershed improvements.	X	X		Beginning 2023 then ongoing	Counties	CCBs	IDDA, Ames
2	Identify and map existing BMP demonstration sites within each county, which can be used for education activities. This could start with champion farmers. Where sites do not exist, create a strategy to develop new sites or expand existing ones. Include those owned by the county or other public entities but prioritize highly visible sites and those on private property (cooperating landowners) or working farms.		X	X	Beginning 2023	CCBs	SWCDs, Extension	IDALS, DNR, Ames
3	Complete a manure management study, that looks at locations and types of AFOs, levels and locations of manure application, manure management plans, reviews existing requirements, and recommends future management opportunities to reduce risk of manure runoff		X		2024	Counties	IDALS, DNR	Manure application companies, Extension, CAFO owners
4	Identify and prioritize possible locations for oxbow restoration.		X		2025	CCBs	DNR, USFWS	The Nature Conservancy, Ames
5	Complete stream assessments across the watershed to help estimate the current conditions, sediment loads, and prioritize BMP efforts. This could be paired with related assessments such as fish passage studies, tile outlet identification, and biotic assessments.		X		2026	CCBs	DNR	USFWS, Drainage Districts

Table 49: Action Plan for Partnerships and Policy Activities

PARTNERSHIPS & POLICY								
#	Action Item and Description	Goals Addressed			Timeline/ Milestones	Primary Activity Lead(s)	Potential Partner(s)	Other Technical or Funding Resources
		1	2	3				
1	Add local farmers to the technical advisory team to enhance “farmer-to-farmer” outreach and provide input to WMA members and proposed activities. This could start with champion farmers.	X			Begin in 2022, and continue	SWCD	CCB, Cities, Extension	CO-OPs and other agri-businesses
2	Work with local NRCS offices to identify, refine, or develop a workflow of BMP cost -share application and funding processes. Identify gaps or opportunities to enhance the process.	X			2023-2024	SWCD	DNR, IDALS, Cities	n/a
3	Identify the overlap or gaps in resources, technical knowledge, or service areas of existing watershed coordinators. Develop a strategy to ensure the full watershed is adequately served by a watershed coordinator.		X	X	Begin process in 2022, after plan adoption	WMA	WMA Members	WMA Members
4	Work with County Emergency Managers and Iowa Homeland Security and Emergency Management (IHSEMD) officials to integrate the watershed plan with local county hazard mitigation plans by amending a list of watershed projects to each county HMP.	X			2023	Counties	IHSEMD	

PARTNERSHIPS & POLICY

#	Action Item and Description	Goals Addressed			Timeline/ Milestones	Primary Activity Lead(s)	Potential Partner(s)	Other Technical or Funding Resources
		1	2	3				
5	Attend NRCS Local Working Group meetings to guide priorities on NRCS programs and funding locally.	X	X		Begin in 2023, then annually	WMA	CCBs, NRCS, SWCD	

Table 50: Action Plan for Monitoring and Plan Evaluation Activities

MONITORING & PLAN EVALUATION

#	Action Item and Description	Goals Addressed			Timeline/ Milestones	Primary Activity Lead(s)	Potential Partner(s)	Other Technical or Funding Resources
		1	2	3				
1	Coordinate and partner with entities operating existing water quality sampling efforts. Support and expand existing efforts where data gaps exist (Hamilton County).	X			Begin process in 2022, start monitoring in 2023	CCBs	DNR	Counties, Cities
2	Partner with entities that are currently tracking BMP implementation in order to coordinate uniform data collection on locations, types, and costs of BMPs implemented. For reporting purposes, aggregate practice adoption rates to the watershed scale to protect personal identifiable information.	X	X		Begin in 2024	SWCDs	DNR, NRCS, IDALS, ISU	CCBs
3	Host an annual watershed review meeting to provide an opportunity to update the public and partners on activities and evaluate progress; summarize and present the results of annual evaluation metrics.	X		X	Beginning 2023	WMA	DNR, IDALS, Extension	ISA, Corn Growers, Cattlemen's Association, other non-profits

MONITORING & PLAN EVALUATION

#	Action Item and Description	Goals Addressed			Timeline/ Milestones	Primary Activity Lead(s)	Potential Partner(s)	Other Technical or Funding Resources
		1	2	3				
4	Gauge BMP retention levels with randomized yearly follow-ups with operators who implement practices. This should include survey of knowledge, understanding, and attitudes of target audiences		X	X	2026, after BMP database is fully developed	TBD	Extension, SWCD	DNR, IDALS

CHAPTER 8. FUNDING AND TECHNICAL RESOURCES

8.01 INTRODUCTION

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

All available monetary and technical resources will need to be explored and leveraged to achieve the plan goals. This includes partnering with Federal, state, and local governments; academia; nonprofits; businesses; and other local entities (*Figure 71*). The discussion in this chapter focuses on those programs or agencies that can provide significant or critical funding for projects, BMPs, or other actions items. However, a full listing of organizations and the primary type of assistance they can provide is found in the *Project Funding Roadmap* in Appendix D. This summary specifies the primary type of assistance (financial and/or technical), along with the primary activities each address (as correlated to the action plan) for each agency or program. It should be noted that during the implementation process, other resources or partners may be identified and should be considered at that time.

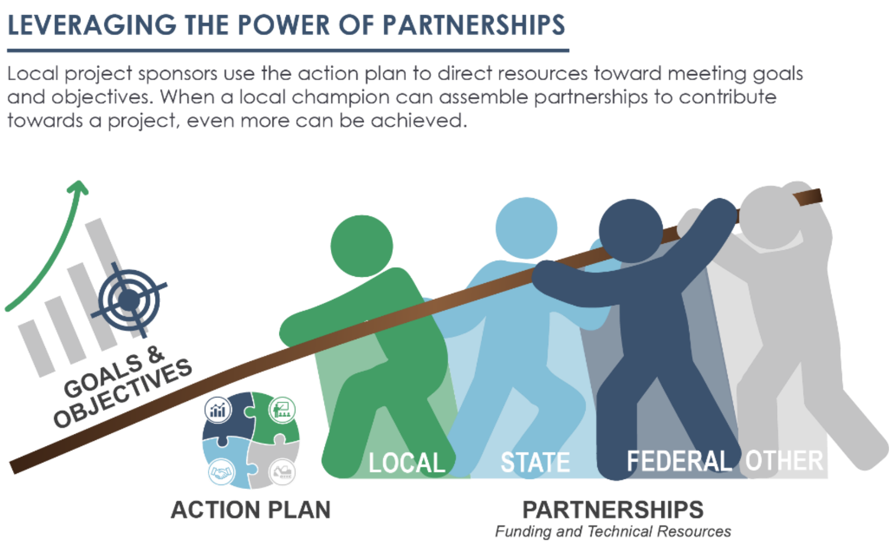


Figure 71: Partners from all levels will be necessary for successful plan implementation.

8.02 FUNDING WORKSHOP AND EDUCATION

There are many grant programs and local funding options presented in this chapter. It is recommended that the WMA hold a "funding workshop" and/or feature regular guest speakers during "learning moments" at regular WMA meetings. These events will help WMA members understand various funding models and programs – and identify those that would fit with the goals of this plan and the resources needed for the watershed.

The following entities should be invited to participate, as they can provide more detailed information on the programs or funding options identified within this chapter.

- Center for Rural Affairs
- Iowa Stormwater Education Partnership
- County Auditor
- Iowa League of Cities
- Iowa State Association of Counties
- Watershed Management Authorities of Iowa
- City or County Attorney
- Other communities that have successfully utilized these options
- Drainage District Attorney or Auditor
- Iowa Drainage District Association
- Iowa Nutrient Research and Educations Council
- Others, as identified

8.03 LOCAL FUNDING FORMULA

Various forms of a local funding formula are a relatively new model that has begun to be explored and utilized by WMAs across Iowa. The strategy is based on a voluntary, per-capita funding formula and involves WMA members contributing funding on a per capita basis, with the formula established upon factors such as population size, acres within the watershed area, and total available budget. For example, the Maquoketa River WMA was able to raise over $50,000 in one year through this strategy. More information can be found in Appendix D, or online: https://www.cfra.org/publications/leveraging-local-funds-watershed-improvement.

8.04 WATER QUALITY FUNDING

While there are many options for funding the implementation of water quality BMPs, the WMA should start by looking at the most readily available programs (Table 51). Each funding program has their own requirements that must be met prior to accessing the funding, and many programs typically only fund certain types of practices. However, piecing these programs together for landowners is critical. By providing landowners with multiple funding options and helping them navigate the administrative hurdles, more BMPs will be implemented, and a better leveraging of local match sources will be achieved. It should be noted that while the programs and BMPs identified in Table 51 primarily benefit water quality, many of them have secondary benefits for flood risk reduction and wildlife habitat.

8.05 FLOOD RESILIENCY FUNDING

Improving flood risk reduction, mitigation, or resiliency involves implementing projects, practices, and programmatic changes throughout a community and watershed. There are multiple options to help pay for many of these initiatives; however, the WMA should start by looking at the most readily available programs (Table 52). Each funding program has their own requirements they must meet prior to accessing the funding, and many programs typically only fund certain activities. However, piecing these programs together is necessary to address the many aspects of flood resiliency. By working with multiple programs, the WMA will better leverage local match sources. It should be noted that while the activities identified in Table 52 primarily address flood risk reduction, mitigation, or resiliency, many of them have secondary benefits for water quality.

Table 51: Water Quality BMP Funding Sources

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

Table 52: Funding Sources for Flood Resiliency Projects

	Building Resilient Infrastructure and Communities (BRIC)	Flood Mitigation Assistance (FMA)	Hazard Mitigation Grant Program (HMGP)	Public Assistance Section 406	Community Development Block Grants	Water Waste Disposal Loan & Grant Program	Flood Plain Management Program	Watershed and Flood Prevention Operations (WFPO or PL-566)	Emergency Watershed Protection Program (Recovery and Floodplain Easements)	Agricultural Conservation Easement Program
Action Type (examples) / Funding Agency	**FEMA / HSEMD**				**HUD**	**USDA**	**DNR**	**NRCS**		
Acquisition / Demolition / Relocation	X	X	X						X	X
Structure Elevation	X	X	X							
Floodproofing Structures	X	X	X							
Local Flood Risk Reduction Projects bridge/culvert replacement, storm system upgrades, detention cells	X	X	X	X	X	X		X	X	X
Green Infrastructure (Urban Drainage) green space, rain gardens, infiltration basins, bioswales			X		X	X			X	
Non-localized Flood Risk Reduction Projects bridges, dams, levees, detention cells, channel widening, diversion channels	X		X	X	X	X		X	X	
Structural Retrofits dam and detention cell rehabilitation	X	X	X	X	X	X		X		
Administrative Actions building code and floodplain management ordinance updates and enforcements	X		X				X			
Social Vulnerability flood awareness and education programs, community rating system (CRS), warning systems		X			X					
Floodplain Mapping Improved mapping products, Risk MAP		X	X					X		
Mitigation Planning Parcel-leve planning, flood mitigation plan, drainage studies, watershed plan, GIS inventory, flood risk assessment			X		X					

8.06 KEY STATE AND FEDERAL RESOURCES

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

FEDERAL EMERGENCY MANAGEMENT AGENCY (FEMA)

FEMA funding is administered via Iowa Homeland Security & Emergency Management (HSEMD). Local communities should work with FEMA and the Iowa Department of Natural Resources (IDNR) on floodplain management issues. Many flood mitigation-type projects are specifically eligible and of high priority for FEMA under existing funding programs. County emergency managers and their communities should work with HSEMD on obtaining project funding through the hazard mitigation assistance (HMA) program under one of the following programs:

- **Hazard Mitigation Grant Program (HMGP): https://www.fema.gov/grants/mitigation/hazard-mitigation**
- **Building Resilient Infrastructure and Communities (BRIC) Program: https://www.fema.gov/grants/mitigation/building-resilient-infrastructure-communities**
- **Flood Mitigation Assistance (FMA): https://www.fema.gov/grants/mitigation/floods**

US ARMY CORPS OF ENGINEERS (USACE) – ROCK ISLAND DISTRICT

USACE has multiple programs that can be tapped to obtain assistance for both planning and implementation type projects. USACE should be contacted by the WMA about the following programs:

- **Section 14 – Emergency Streambank and Shoreline Protection: https://www.saj.usace.army.mil/Sect14EmergencyStreambankProtection/**
- **Section 22 – Planning Assistance to States: https://www.nae.usace.army.mil/missions/public-services/planning-assistance-to-states/**
- **Section 206 – Aquatic Ecosystem Restoration: https://www.saj.usace.army.mil/Sect206AquaticEcosystemRestoration/**

UNITED STATES DEPARTMENT OF AGRICULTURE (USDA)

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

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

US FISH AND WILDLIFE SERVICE (USFWS)

The USFWS currently can help implement projects through the Partners for Fish and Wildlife Program, which provides technical assistance and cost-share incentives directly to private landowners to restore fish and wildlife habitat. The WMA should explore a possible working relationship with the USFWS to enhance these efforts.
https://www.fws.gov/program/partners-fish-and-wildlife

NATURAL RESOURCES CONSERVATION SERVICE (NRCS)

NRCS has long standing relationships with many farmers in the WMA. Through both the state and local offices NRCS provides conservation assistance (financial and technical) through various programs. There are many NRCS programs, and thus the WMA should work to form a partnership with each local NRCS office to learn about each program, and how they can be promoted and utilized to achieve common goals between the NRCS and the WMA. Programs include:

- Environmental Quality Incentives Program (EQIP): https://www.nrcs.usda.gov/wps/portal/nrcs/main/national/programs/financial/eqip/
- Conservation Stewardship Program (CSP): https://www.nrcs.usda.gov/wps/portal/nrcs/main/national/programs/financial/csp/
- Regional Conservation Partnership Program (RCPP): https://www.nrcs.usda.gov/wps/portal/nrcs/main/national/programs/financial/rcpp/
- Watershed and Flood Prevention Operations (WFPO or PL-566): https://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/programs/landscape/wfpo/

IOWA DEPARTMENT OF NATURAL RESOURCES (IDNR)

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

- The **Resource Enhancement and Protection (REAP) Program** can provide funding for conservation education as well as on-the-ground BMPs. Counties, cities, and nonprofits can apply for this grant. https://www.iowadnr.gov/Conservation/REAP
- The **Private Lands Program** provides technical assistance and can help secure funding to private landowners interested in installing BMPs. The WMA can work with the local IDNR biologists to identify landowners and to assist in conservation efforts. https://www.iowadnr.gov/conservation/wildlife-landowner-assistance
- IDNR administers the **Flood Plain Management and Dam Safety Programs** which can be consulted to assist in various flood mitigation projects and local floodplain ordinance development. https://www.iowadnr.gov/Environmental-Protection/Land-Quality/Flood-Plain-Management
- The **Lake and River Restoration Program**, as well as the **Watershed (Section 319) Program** all have funding and technical assistance available to help implement projects and BMPs within priority watersheds or waterbodies. https://www.iowadnr.gov/Environmental-Protection/Water-Quality
- The **IDNR Water Trails Program** provides technical assistance and grant funding to study, create, and develop water trails across Iowa. https://www.iowadnr.gov/things-to-do/canoeing-kayaking/water-trail-development
- The **State Revolving Fund (SRF) Sponsored Projects** program can fund a wide variety of water quality projects through low-interest loans. For communities already utilizing SRF funding for water infrastructure projects (drinking or wastewater), a portion of the interest paid can be redirected towards water quality improvement projects. This lets the overall interest rate to be reduced and allows the community to finance two projects for the cost of one. https://www.iowasrf.com/index.cfm
- The **Water Quality Financing Program** is a relatively new low interest rate program established through SF512 in 2018. The program is administered by the Iowa Finance Authority in partnership with the IDNR and IDALS. It is focused on helping project sponsors implement BMPs from the Iowa Nutrient Reduction Strategy.
- Funding from the **Grants to Counties Water Well Program** is made available to local county health departments to provide financial assistance to their residents for private water well services. The program is administered through the Iowa Department of public Health, through close coordination with IDNR. Additional information: https://idph.iowa.gov/Environmental-Health-Services/Grants-to-Counties-Water-Well-Program

IOWA DEPARTMENT OF AGRICULTURE AND LAND STEWARDSHIP (IDALS)

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

- Conservation Reserve Enhancement Program (CREP)
- Iowa Financial Incentives Program (IFIP)
- Urban Conservation Program
- Water Quality Initiative (WQI)
- Low interest loan available for drainage district improvements
- District Buffer Initiative

IDALS is available online at https://iowaagriculture.gov/.

8.07 LOCAL FUNDING OPTIONS

PUBLIC FUNDS

While outside funding from grants, loans, or other sources will be needed to fully implement this plan, there is also a need for local match (cash or in-kind). This may be required for matching funds to grants, to leverage against other funds, to pay staff that can coordinate and apply for other funding sources, or to simply pay for projects directly. Each WMA member and stakeholder is unique in its financial resources available and taxing structure; therefore, the following options are meant to be flexible and to inspire the WMA members to develop something that fits them best.

STORY COUNTY EDGE OF FIELD PROJECT FUNDING

Story County is currently participating in a program to scale up implementation of edge of field BMPs, such as saturated buffers and bioreactors. The program creates a new framework to streamline and scale up adoption by simplifying the financing and construction processes for landowners. Traditional cost-share programs require landowners to navigate government programs, enroll, hire and pay contractors, and apply for reimbursement – all on their own. This new project utilizes a fiscal agent model that allows Story County to manage the process, complete engineering designs, and hire contractors. This simplified and streamlined process is installing practices more efficiently through a batch and build model, while making it easier for landowners to participate. Primary project partners include IDALS, NRCS, Story County SWCD, Polk County, Story County, and Heartland Co-op. The program has been successful and should be replicated where possible.

IN-KIND SERVICES

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

GENERAL FUND DOLLARS

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

CAPTIAL IMPROVEMENT FUND

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

PERMIT, FEES, AND DEVELOPER CONTRIBUTIONS

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

STORMWATER UTILITY FEE

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

GENERAL OBLIGATION BONDS

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

LOCAL OPTION SALES TAX (LOST)

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

SPECIAL ASSESSMENT DISTRICTS

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

TAX INCREMENT FINANCING (TIF)

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

LEASE PURCHASE PROGRAM

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

UTILITY FRANCHISE FEE

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

8.08 PRIVATE FUNDS

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

8.09 NONPROFITS AND PRIVATE FOUNDATIONS

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

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

The following options for partnerships (Table 53) have been identified due to the possibilities for working together on financial and/or technical resources, and because they have been shown to be successful in other communities. Forming successful partnerships is not as clear-cut as applying for grants.

Successful partnerships involve engaging a broad spectrum of stakeholders, each with diverse programs and interests, and employing combinations of resources (both directly and indirectly) towards solving what are formidable issues. The reality is that significant increases in government funding to address flooding or water quality issues are not apparent on the immediate horizon and the WMA will need to be creative, cooperative, and proactive to realize implementation on a meaningful level. Table 53 should not be considered all-inclusive, as other options may be identified during the implementation process and should be considered at that time.

Table 53: Options for Local Partnerships

<table>
<tr><th colspan="2">Nonprofits</th></tr>
<tr><td colspan="2">Iowa Land Improvement Contractors Association (LICA)</td></tr>
<tr><td colspan="2">Iowa Stormwater Education Partnership</td></tr>
<tr><td colspan="2">Citizens groups (Rotary, etc.)</td></tr>
<tr><td rowspan="4">Iowa State University</td><td>Leopold Center for Sustainable Agriculture</td></tr>
<tr><td>Iowa Learning Farms</td></tr>
<tr><td>Prairie STRIPS</td></tr>
<tr><td>Extension</td></tr>
<tr><td rowspan="8">Conservation Organizations</td><td>Groundwater Foundation</td></tr>
<tr><td>The Nature Conservancy (TNC)</td></tr>
<tr><td>Izaak Walton League</td></tr>
<tr><td>Pheasants Forever (PF) – both state level and local chapters</td></tr>
<tr><td>Ducks Unlimited (DU)</td></tr>
<tr><td>National Wild Turkey Federation (NWTF)</td></tr>
<tr><td>Iowa Natural Heritage Foundation</td></tr>
<tr><td>Center for Rural Affairs</td></tr>
<tr><td rowspan="8">Agriculture Associations</td><td>Iowa Soybean Association (ISA)</td></tr>
<tr><td>Iowa Corn Growers Association</td></tr>
<tr><td>Iowa Cattlemen’s Association</td></tr>
<tr><td>Iowa Pork Producers Associations</td></tr>
<tr><td>Soil Health Partnership</td></tr>
<tr><td>Women, Land, and Legacy Program</td></tr>
<tr><td>Practical Farmers of Iowa</td></tr>
<tr><td>Women Food and Agricultural Network</td></tr>
<tr><th colspan="2">Corporate Foundations, Grants, or Giving (types of entities to consider)</th></tr>
<tr><td colspan="2">Co-Ops and other agricultural businesses (implement, sales, and equipment dealers)</td></tr>
<tr><td colspan="2">Feedlots or other larger farming operations</td></tr>
<tr><td colspan="2">Wineries or other similar types of agritourism businesses</td></tr>
<tr><td colspan="2">Local businesses</td></tr>
<tr><td colspan="2">Corporate businesses (Wal-Mart, John Deere, etc.)</td></tr>
<tr><th colspan="2">Fund Raising Campaigns</th></tr>
<tr><td colspan="2">Crowdfunding (GoFundMe, Kickstarter, etc.)</td></tr>
<tr><td colspan="2">Traditional fund raisers (raffles, sales, etc.)</td></tr>
</table>

8.10 ALTERNATIVE FUNDING OPTIONS

PAY FOR SUCCESS

A Pay-for-Success (PFS) program is a financing structure which leverages private investment to achieve outcomes with a public benefit (Figure 72). PFS projects are designed to attract private capital to conservation, broadening the funding base available for programs and infrastructure improvements. This structure benefits communities by getting projects and BMPs on the ground which have direct benefits to their community, while significantly reducing financial risk.

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

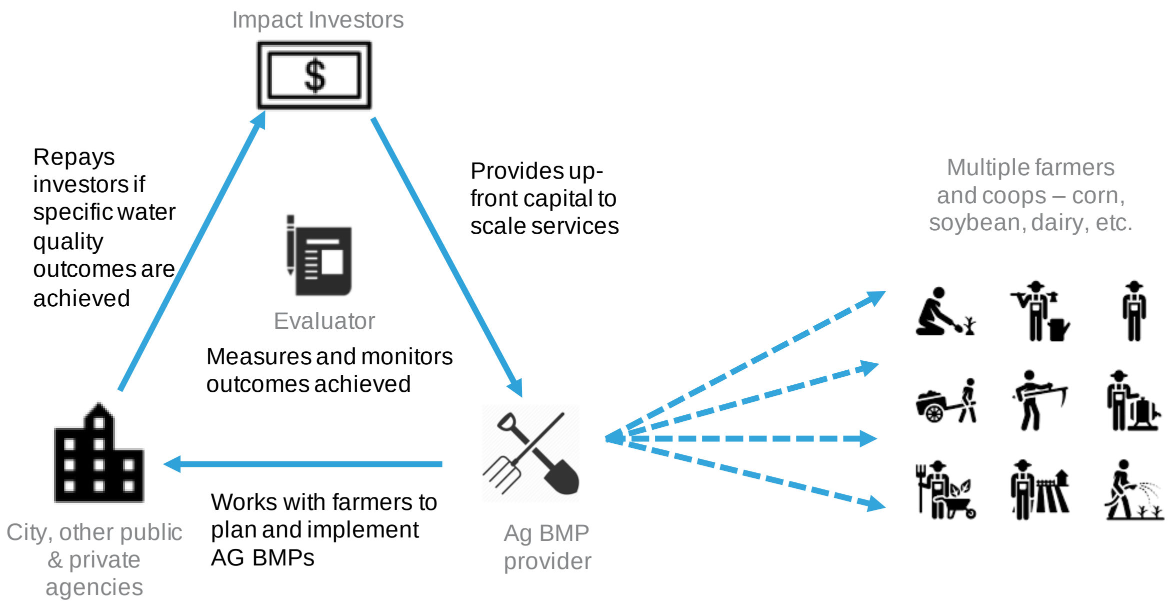


Figure 72: Pay for Success Financing Model

WETLAND BANKING INSTRUMENT

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

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

IN-LIEU FEE MITIGATION PROGRAM

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

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

WATER QUALITY TRADING

Water quality trading programs are used in various places throughout the United States to make water quality permit compliance easier, raise funds for projects, and ultimately improve the water quality of streams and lakes. This type of program focusses on incentives instead of penalties to achieve goals. A trading program can be operated on various scales, but the larger the better. The Iowa Nutrient Reduction Exchange (NRE) is in early stages of framework development, and currently four communities are participating: Dubuque, Cedar Rapids, Storm Lake, and Ames.

Currently, the City of Ames is working with the Iowa League of Cities, other large utilities, and IDNR to utilize this program. The city is setting aside $200,000 per year that can be invested in structural practices such as wetlands, saturated buffers, and bioreactors and annual conservation practices such as cover crops within the South Skunk River Watershed. These funds are currently being directed into the following projects:

- Soil and Water Outcomes Fund
- Moore Memorial West
- Story County Edge-of-Field Project
- Dotson Wetland

8.11 SUMMARY AND RECOMMENDATIONS

Ultimately, funding will be needed to improve water quality and flood resiliency throughout the HWSSRW. This chapter has presented many options and ideas for funding the implementation of this plan; however, it will be up to the WMA to pursue these sources. Therefore, there is only one recommendation found in this chapter:

- **Hold a Funding Workshop or Devote Regular WMA Meeting Agenda to Funding**
    - The WMA should hold a "funding workshop" and/or feature regular guest speakers during "learning moments" at regular WMA meetings. These events will help WMA members understand various funding models and programs – and identify those that would fit with the goals of this plan and the resources needed for the watershed.
    - The following entities should be invited to participate, as they can provide more detailed information on the programs or funding options identified within this chapter.
        - Center for Rural Affairs
        - Iowa Stormwater Education Partnership
        - County Auditor
        - Iowa League of Cities
        - Iowa State Association of Counties
        - Watershed Management Authorities of Iowa
        - City or County Attorney
        - Other communities that have successfully utilized these options
        - Drainage District Attorney or Auditor
        - Iowa Drainage District Association
        - Iowa Nutrient Research and Educations Council
        - Others, as identified

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