Lower Cedar Watershed Management Plan

August 2022

Lower Cedar Watershed Management Authority

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Executive Summary

Persistent flooding and water quality concerns have led the governmental entities within the Lower Cedar River watershed to embrace a cooperative, multi-jurisdictional planning approach. The resulting Lower Cedar Watershed Management Plan (Plan) details strategies and recommendations for watershed management and water quality protection.

Watershed Characteristics (Chapter 2)

The watershed characterization chapter includes a description of the Lower Cedar HUC-8 Watershed in terms of area, population, land use/land cover, public lands, flood hazards, climate, topography, geology, and soils. The watershed has urban stormwater and flooding issues around Cedar Rapids and communities such as West Branch and rural/agricultural related flood and water quality challenges throughout. The watershed is home to some of Iowa's most biodiverse landscapes and a variety of reptile and amphibious species that are designated by the State as having the greatest conservation need. Much of the habitat for these sensitive species are in the low-lying portions of the landscape. Upland practices to improve water quality and near-stream opportunities to preserve the riparian corridor are key to protecting these species and their habitats. There are also several recreational areas throughout the watershed that would be enhanced by water quality improvement and have lower maintenance issues from reduced flooding. The number of advocacy groups and coalitions formed since the early 2000s suggests that watershed residents are increasingly aware of and dedicated to conservation, which creates an opportunity for positive change.

Assessment of Current Conditions (Chapter 3)

The Lower Cedar has 13 stream segments that are considered impaired, of which 10 are impaired for more than one use. Not all stream segments are monitored, nor do all monitored segments have an acceptable amount of data for assessment. Nitrogen, phosphorous, and *E.coli*, which are mainly due to a combination of highly productive/fertile soils and agricultural activities, are the primary pollutants of concern in the Lower Cedar. Water quality analysis and other watershed characteristics reveal that a comprehensive suite of best management practices is needed to improve water quality, reduce flooding, and improve ecology and habitat. These include in-field management, edge-of-field practices, and protection/enhancement of the floodplain, riparian corridor, and streams.

Goals & Objectives (Chapter 4)

The overarching goal of the plan is to establish the Lower Cedar Watershed Management Authority as a leader and advocate for local, collaborative solutions. The plan outlines strategies to protect floodplains and reduce peak flows, improve surface and ground water quality, and ensure that the watershed supports a healthy ecosystem for public health, wildlife, and recreation.

Social Assessment (Chapter 5)

The plan was created with extensive input from a variety of stakeholders, including landowners/operators, city and county staff, and the public. The main concern among farmers in this watershed was erosion and city residents were primarily concerned about flooding/stormwater and water quality. Since urban pressures are upstream of farmers in the Lower Cedar, farmers perceived city runoff and wastewater as a challenge and held that cities should bear some of the burden in improvements. A survey found that nitrogen and bacteria pollution were the main contaminants of concern amongst respondents, whereas the top three overall issues of concern were water quality, flooding, and erosion.

Implementation Strategies (Chapter 6)

A variety of implementation strategies are described in Chapter 6 for urban and rural settings. No single project will make measurable, long-term improvements. Instead, a collection of conservation projects and

practices across the watershed will be needed to achieve water quality and flood reduction goals. Strategies cities can implement include green infrastructure practices and permeable pavements. Strategies rural areas can implement include sediment control practices, nutrient management changes, less intense tillage, cover crops, and pasture/land retirement. Different practices have different conservation efficacies and costs, which are the main factors contributing to selection.

Funding Opportunities & Needs (Chapter 7)

Funding conservation practices can be challenging. A proposed schedule of financial contributions from each WMA member for staff support based on population size and area is presented. Staff would include an administrator and coordinator to pursue grants and encourage cost share practices. There are a variety of funding and technical assistance resources from state and federal agencies including the Iowa Department of Agriculture, Iowa State NRCS, Iowa DNR, State Revolving Fund, US Fish and Wildlife Service, Iowa Economic Development Authority, and FEMA.

Education & Outreach (Chapter 8)

Education and public awareness are essential to effective watershed management. Public involvement raises awareness of conservation issues and galvanizes support for watershed planning and projects. This makes projects more appealing to funders. Outreach and involvement programs such as publishing materials through a variety of methods and hosting different events are discussed. Different messages such as everyone having an impact and the watershed being an interconnected community are also presented.

Monitoring & Plan Evaluation (Chapter 9)

Monitoring watersheds matters because it provides the information needed to make sound decisions. Challenges include finding those with the needed technical knowledge and funding. Partners that monitor the Lower Cedar include its watershed coordinator, the United States Geographic Survey, and the University of Iowa (IIHR and Iowa Flood Center). Monitoring encompasses collecting data about flows, pollutant concentrations, *E.coli*, and wildlife/biological conditions. The data collected from expanded monitoring efforts will be needed to evaluate progress towards the plan's goals. It also will help guide plan updates at Year 7 and Year 14. True progress towards implementation and improvement will be demonstrated through increased agency participation and collaboration, public awareness, comprehensive data collection, and BMP adoption and construction.

Summary

Due to the size of the watershed and the scale of the challenges at hand, water quality and flood risk reductions are most likely to be accomplished by incremental focus on a small subset of priority HUC-12 watersheds. As such, this plan includes more detailed watershed plans for three high priorities identified in the planning process: Pike Run, Middle Mud, and West Branch Wapsipinicon. Plans for each priority watershed include pollutant source and load assessments and 20-year implementation plans. The detailed plans identify BMP adoption rates, costs, and potential funding sources needed to facilitate implementation and progress towards goals. Once these plans are underway, future efforts can focus on other priority HUC-12 watersheds. This makes water quality, flood reduction, and habitat improvements in the Lower Cedar a generational effort that will require focus, patience, and education and outreach to both current and future, landowners, producers, residents, and conservationists.

Chapter One
Introduction

ASSESSMENT ■ ENGAGEMENT ■ ACTION

1.1 Lower Cedar Watershed

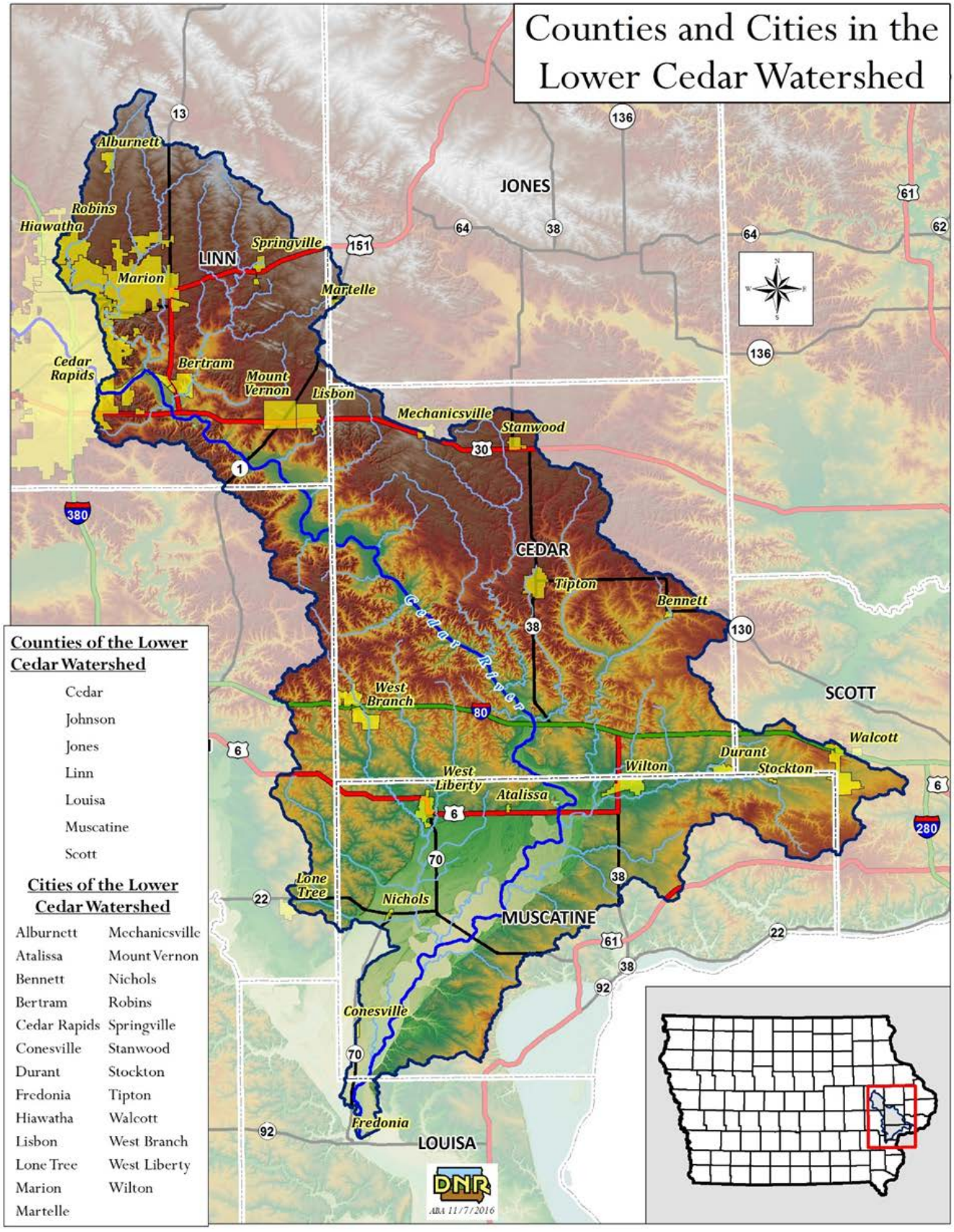
The United States is divided and sub-divided into successively smaller hydrologic units delineating the extent of surface water drainage each with an assigned hydrologic unit code (HUC). The Lower Cedar watershed is classified as a HUC with an 8-digit identification number (07080206) which is the subbasin level, analogous to medium-sized river basins (about 2,200 nationwide). The Lower Cedar watershed spans 7 counties, primarily Linn, Cedar, and Muscatine Counties with smaller portions in Johnson, Scott, Jones, and Louisa Counties. The watershed is thought to include the most biologically diverse landscape in Iowa. The main branch of Cedar River is fed by Indian Creek, Big Creek, Pleasant Run, Spring Creek, Clear Creek, Mill Creek, Coon Creek, Gower Creek, Baldwin Mason Creek, Nicholson Creek, Rock Run Creek, Rock Creek, Crooked Creek, Pike Creek, Sugar Creek, Little Mosquito Creek, Mosquito Creek, Chicken Creek, Pike Run, Wapsinonoc Creek, Crane Creek, and Pike Creek. The Cedar River ultimately drains to the Iowa River near the intersection of Highway 70 and Highway 92 in northern Louisa County. Some notable characteristics in the watershed include:

- The watershed is 703,060 acres in size and has an estimated population of 122,390
- The Lower Cedar Watershed is comprised of 33 HUC12 watersheds
- Historical and current cover data shows the primary land cover was cropland
- FEMA's 100-year floodplain covers 101,284-acres or 14.4% of the watershed
- The Environmental Protection Agency's 303d list of impaired waters of Iowa shows that Indian Creek, Dry Creek, Pike Run, Sugar Creek, West Branch Wapsinonoc Creek, Hoover Creek, Cedar River, and Mud Creek from the Lower Cedar Watershed are impaired due to Bacteria, Biological, and Fish Kill impairments
- The Lower Cedar floodplain is home to two extremely rare ecological communities: floodplain oak savannas and channel fens.
- The Lower Cedar is the most biologically diverse landscape in Iowa and is home to nearly 85% of all amphibian and reptile species in Iowa.

The Cedar River is a 338-mile-long (544 km) river in Minnesota and Iowa. It is a tributary of the Iowa River, which flows to the Mississippi River. The Cedar River takes its name from the red cedar trees growing along its banks and was originally called the Red Cedar River by the Meskwaki. The first Mississippi steamboat reached Cedar Rapids, Iowa in 1844, and during the next decade, the Red Cedar (as it was still called) was an important commercial waterway. The surrounding region is known officially as the Cedar River Valley, though it is more commonly referred to simply as the Cedar Valley. The stream is young geologically, and only in places where the glacial material has been removed is the underlying bedrock exposed.

Boat landing & picnic area at Palisades State Park near Mt. Vernon

Figure 1-1. Lower Cedar Watershed



Source: Iowa Department of Natural Resources

1.2 Lower Cedar Watershed Management Authority

In 2010 Iowa lawmakers passed legislation authorizing the creation of Watershed Management Authorities (Iowa Code Chapter 466B). A Watershed Management Authority (WMA) is a mechanism for cities, counties, Soil & Water Conservation Districts (SWCDs), and stakeholders to cooperatively engage in watershed planning and management. Generally, the purpose of WMAs is to:

- Assess and reduce flood risk
- Assess and improve water quality
- Monitor federal flood risk planning and activities
- Educate residents of the watershed regarding flood risks and water quality
- Allocate money made available to the Authority for water quality and flood mitigation projects

The Iowa Code specifies WMAs do not have taxing authority or the right to acquire property through eminent domain.

In January 2018, the Lower Cedar Watershed Management Authority (LCWMA) was officially formed. Membership in the LCWMA is based on the hydrologic boundary of the Lower Cedar River watershed which is shown in Figure 2-1.

The eligible members within the Lower Cedar watershed include the cities of Alburnett, Atalissa, Bennett, Bertram, Cedar Rapids, Conesville, Durant, Fredonia, Hiawatha, Lisbon, Lone Tree, Marion, Martelle, Mechanicsville, Mount Vernon, Nichols, Robins, Springville, Stanwood, Stockton, Tipton, Walcott, West Branch, West Liberty, and Wilton; the counties of Cedar, Johnson, Jones, Linn, Louisa, Muscatine, and Scott and their Soil and Water Conservation Districts (SWCD). Of the 39 eligible entities, 30 are members.

A Board of Directors representing the participating political subdivisions guides efforts to improve the watershed. The LCWMA Board is responsible for the content of this comprehensive Lower Cedar Watershed Management Plan (Plan) and its implementation and maintenance.

In 2019, the Lower Cedar WMA was funded by Iowa's Nonpoint Source Pollution program through the DNR, also known as Section 319 planning grants, to complete a watershed management plan.

1.3 Plan Development

Purpose of the Watershed Management Plan

The goal of this project is to develop a comprehensive watershed management plan for the Lower Cedar Watershed, which will address stakeholder concerns with water quality, flooding, and degrading habitat quality. Persistent flooding and water quality concerns have led the governmental entities within the Lower Cedar watershed to embrace a cooperative, multi-jurisdictional planning approach. The resulting Lower Cedar Watershed Management Plan details strategies and recommendations for watershed and stormwater management, water quality improvement, and habitat protection. It includes specific implementation strategies and milestones for implementing these recommendations for local governments as well as regional and state agencies. The Lower Cedar Watershed Management Plan enables policy makers to:

- prioritize resources to protect water quality
- mitigate flood impacts that have plagued area residents
- address resource concerns identified by the LCWMA Board and local stakeholders

Resource Concerns

The LCWMA Board identified the primary resource concerns for establishing the LCWMA and completing the Lower Cedar Watershed Management Plan. These resource concerns guided the entire planning process:

- water quality
- erosion
- flooding
- degrading habitat quality

These resource concerns are also shared by the public, as confirmed in a series of workshops, focus groups and an online survey conducted early in the planning process.

Watershed Management Planning Process

The LCWMA utilized a collaborative, adaptive management approach for the Plan, which incorporates and links knowledge and credible science with the experience and values of stakeholders for more effective management decision-making. The resulting Plan is at the watershed scale, aligned with Iowa's Smart Planning Principles, and builds consensus for long-term watershed management solutions.

A watershed approach involves coordination with both public and private sectors focusing efforts to identify and address the highest priority challenges. The Lower Cedar Watershed Management Plan is the result of a collaborative effort between the LCWMA's local jurisdictions and numerous stakeholders.

Planning Partners

The Lower Cedar Watershed Management Plan was completed by FYRA Engineering, the LCWMA Board of Directors, and planning staff from the East Central Iowa Council of Governments (ECICOG), with help from a Technical Advisory Team and technical consulting firms/institutions.

Lower Cedar Watershed Management Authority (LCWMA): The LCWMA played a lead role in engaging the public, assisting with data collection, and overseeing the watershed planning process. The LCWMA member entities supported the effort by participating in specific workshops, providing input to the planning process,

and recruiting participation from their peers. Specific roles included: project reporting, consultant procurement, project oversight, assistance with field data collection, coordinating education events, and public outreach.

FYRA Engineering: FYRA engineering is the planning consultant and responsible for facilitating the watershed planning process to ensure the LCWMA and its partners' goals and objectives are met. FYRA is also the technical lead for several watershed assessment components, including subwatershed prioritization, ACPF analysis, pollutant source estimation, and development of the implementation plan.

East Central Iowa Council of Governments (ECICOG): ECICOG led the stakeholder outreach and engagement tasks and assisted FYRA Engineering in the development of the plan document.

Soil & Water Conservation Districts (SWCD): As integral members of the Lower Cedar WMA, the SWCDs were actively engaged in plan development. Muscatine County SWCD worked in partnership with The Nature Conservancy on the Iowa NRCS Partners in Conservation grant to support the Lower Cedar Watershed Coordinator's position.

Iowa Soybean Association (ISA): ISA has been a partner within the Lower Cedar WMA through the development of the Mill Creek Watershed Plan. The plan will lead to implementing best management practices to reduce nutrient loading in local waters within Mill Creek watershed.

Emergency Management Agencies (EMA): Lower Cedar WMA collaborated with the EMA coordinators of the member entities to fully integrate hazard mitigation and community resilience planning into the watershed plan. As evidenced by the HUD-funded Iowa Watershed Approach project, building community resilience is key to mitigating flood risk. A specific role of the EMA coordinators will be to aid in identifying opportunities to protect infrastructure from flooding.

Technical Advisory Team

Charles Ikenberry
FYRA – consultant

Jennifer Fencl
ECICOG – consultant

Josh Balk
DNR - Basin Coordinator

James Martin
IDALS - Water Resources Regional Coordinator

Josh Spies
The Nature Conservancy

Jodi Freet
County Emergency Management Administrator

Mary Beth Stevenson
WMA Board at Large & Cedar Rapids

Mike Tertinger
WMA Board at large & Linn Co Planner

Holly Howard
WMA Board & NRCS – agriculture

Iowa Department of Natural Resources (IDNR): IDNR is a direct resource to watersheds for formation of watershed management authorities and capacity building. Iowa DNR's Eastern Iowa Basin Coordinator provided technical support to the effort by serving on the Technical Advisory Committee. The basin coordinator also helped connect the Lower Cedar WMA with DNR resources for the source water protection workshop. Iowa DNR provided a $100,000 grant to the LCWMA to support the development of the Lower Cedar Watershed Management plan.

United States Geological Survey (USGS): Provided water quality and quantity data for the entire Cedar River basin.

The Nature Conservancy (TNC): TNC helped facilitate the WMA's formation bringing together both urban and rural stakeholders from across the region to address watershed resource concerns. TNC supported the project by serving on the technical advisory committee and collaborating on outreach events.

Iowa Homeland Security and Emergency Management (HSEMD): HSEMD assisted in the integration of hazard mitigation plans with the Lower Cedar Watershed management plan. They supported the LCWMA planning effort by providing technical assistance for identifying mitigation actions and funding opportunities.

The Great Rivers Alliance of Southeast Iowa (Alliance): The Alliance is a collaboration between area USDA Natural Resources Conservation Service, US Fish and Wildlife Service, Iowa Department of Natural Resources, Iowa Department of Agriculture and Land Stewardship, Johnson County Conservation Board, Louisa County Conservation Board, Muscatine County Conservation Board, Muscatine County Soil & Water Conservation District, Trees Forever, Bur Oak Land Trust, and The Nature Conservancy in Iowa. The mission of the Alliance is to improve the ability of people to care for the lands and waters in the Great Rivers Region of Southeast Iowa (the lower sections of the Cedar and Iowa Rivers as well as the confluence with the Mississippi River). It was formed in 2008. The Great Rivers Alliance supported the Lower Cedar WMA plan development by helping identify conservation priorities.

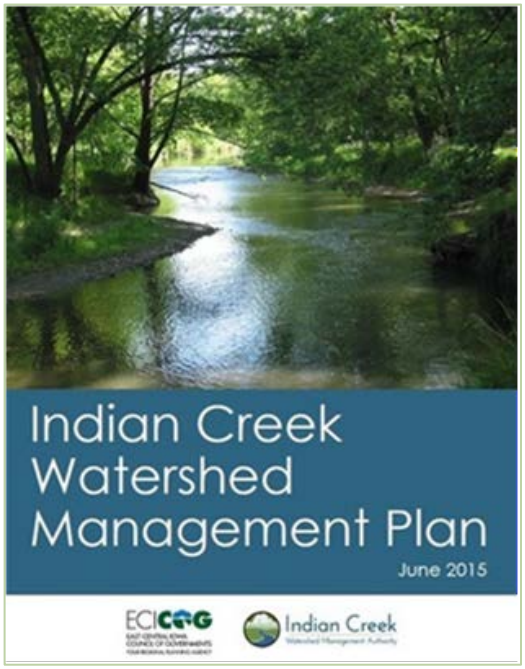
Community Input & Plan Outreach

A variety of methods were used during the planning process to engage the watershed community and stakeholders. These efforts included:

- Establishment of the LCWMA website (https://lowercedarwma.com).
- Social Pinpoint project website (https://fyra.mysocialpinpoint.com/lower-cedar-wma-plan), which housed multiple surveys and an interactive project map that allowed for community member engagement and input.
- ECICOG hosted three virtual focus groups with 12 agricultural producers to gauge the level of concern for watershed issues and how they might fit into the solutions.
- ECICOG partnered with the Indian Creek Soil Health Partnership to host a Women Caring for the Land virtual workshop in March and April 2021 with 22 participants.
- The Indian Creek Soil Health Partnership hosted a Field Day in April 2021 to promote perennial cover and saturated buffers. 50 attended and toured a saturated buffer on Curt Zingula's farm.
- The Lower Cedar WMA hosted Community Source Water virtual workshop to discuss drinking water concerns and possible solutions and funding sources with 13 participants.
- The Lower Cedar WMA hosted a virtual workshop for 14 Emergency Management Administrators in the watershed to connect the watershed plan to Hazard Mitigation Plans.
- Direct inquiries to cities, floodplain managers, and county conservation boards about current and future projects to improve water quality and/or flood mitigation.

1.4 Prior Studies & Reports

Various studies and reports have been completed describing and analyzing conditions within the Lower Cedar River Watershed. The Lower Cedar Watershed Management Plan used existing data to analyze and summarize work that has been completed by others as well as integrating new data and information. A list of known studies and reports is linked and summarized below.



Indian Creek Watershed Management Plan

Mill Creek Watershed Plan

Assessment of Flooding Issues and Possible Mitigation Strategies for the City of Fredonia

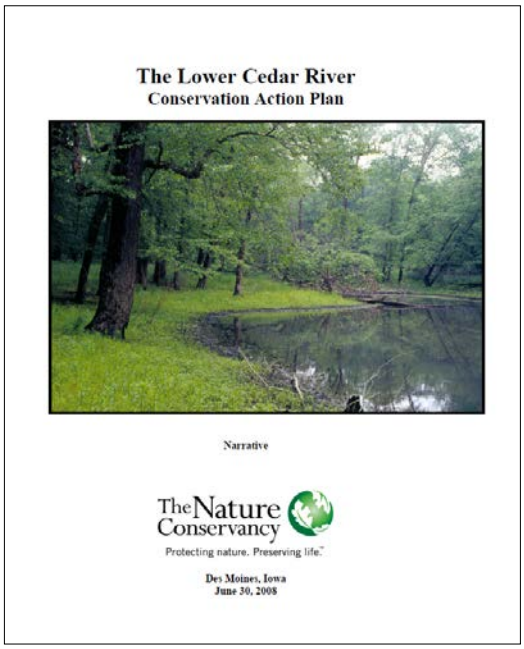
The Nature Conservancy Conservation Action Plan

Hazard Mitigation Plans

- Cedar County
- Johnson County
- Linn County
- Muscatine County
- Scott County
- Louisa County

Iowa Non-Point Source Water Plan

Nutrient Reduction Strategy



Chapter Two
Watershed Characteristics

ASSESSMENT ■ ENGAGEMENT ■ ACTION

2.1 Watershed Location and Overview

The boundaries of the Lower Cedar watershed and its thirty-three subwatersheds are based on United States Geological Survey (USGS) defined boundaries called Hydrologic Unit Codes (HUC). The Lower Cedar watershed (HUC-8 07080206) covers 703,060 acres across 7 counties including Linn, Jones, Johnson, Cedar, Scott, Muscatine, and Louisa, as shown in Figure 2-1. Table 2-1 shows the acres and percentage of each county in the watershed. There are eight HUC-10 watersheds as shown in Figure 2-2. The thirty-three HUC-12 sub-watersheds are depicted in Figure 2-3 and the stream lengths and area are shown in Table 2-2.

Table 2-1. Acres and Percentage of Each County in the Watershed

County	Total Watershed	
	Acres	Percent of Watershed
Cedar	279,806	40%
Johnson	46,829	7%
Jones	2,018	0%
Linn	168,937	24%
Louisa	3,577	1%
Muscatine	184,265	26%
Scott	17,628	3%
Total	703,060	100%

Source: Iowa Department of Natural Resources

Many of the Lower Cedar communities, both large and small, face significant water quality issues such as source water protection, a need for updated stormwater infrastructure, flood mitigation, and wastewater treatment plant upgrades mandated by the State of Iowa. At the same time, the WMA members place a high value on the Cedar River, its tributaries, and the recreational opportunities and ecosystem services the watershed provides. The Lower Cedar members acknowledge that adopting a watershed approach could help alleviate some of their concerns with water quality and flooding by enhancing ecosystem services and promoting cooperation.

Figure 2-1. Map of the Lower Cedar River Watershed (HUC-8)

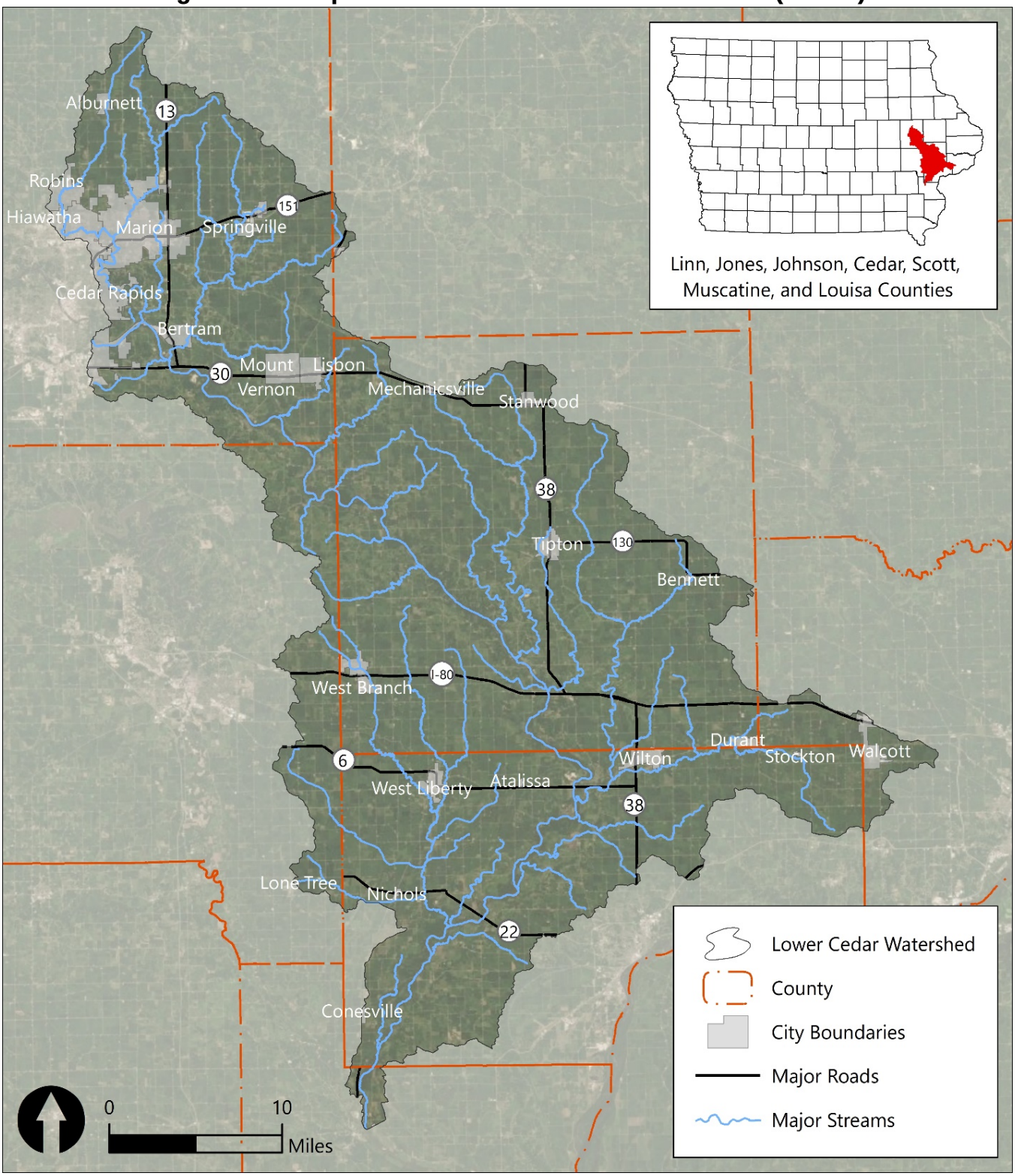


Figure 2-2. Map of HUC-10 Sub-watersheds in the Lower Cedar

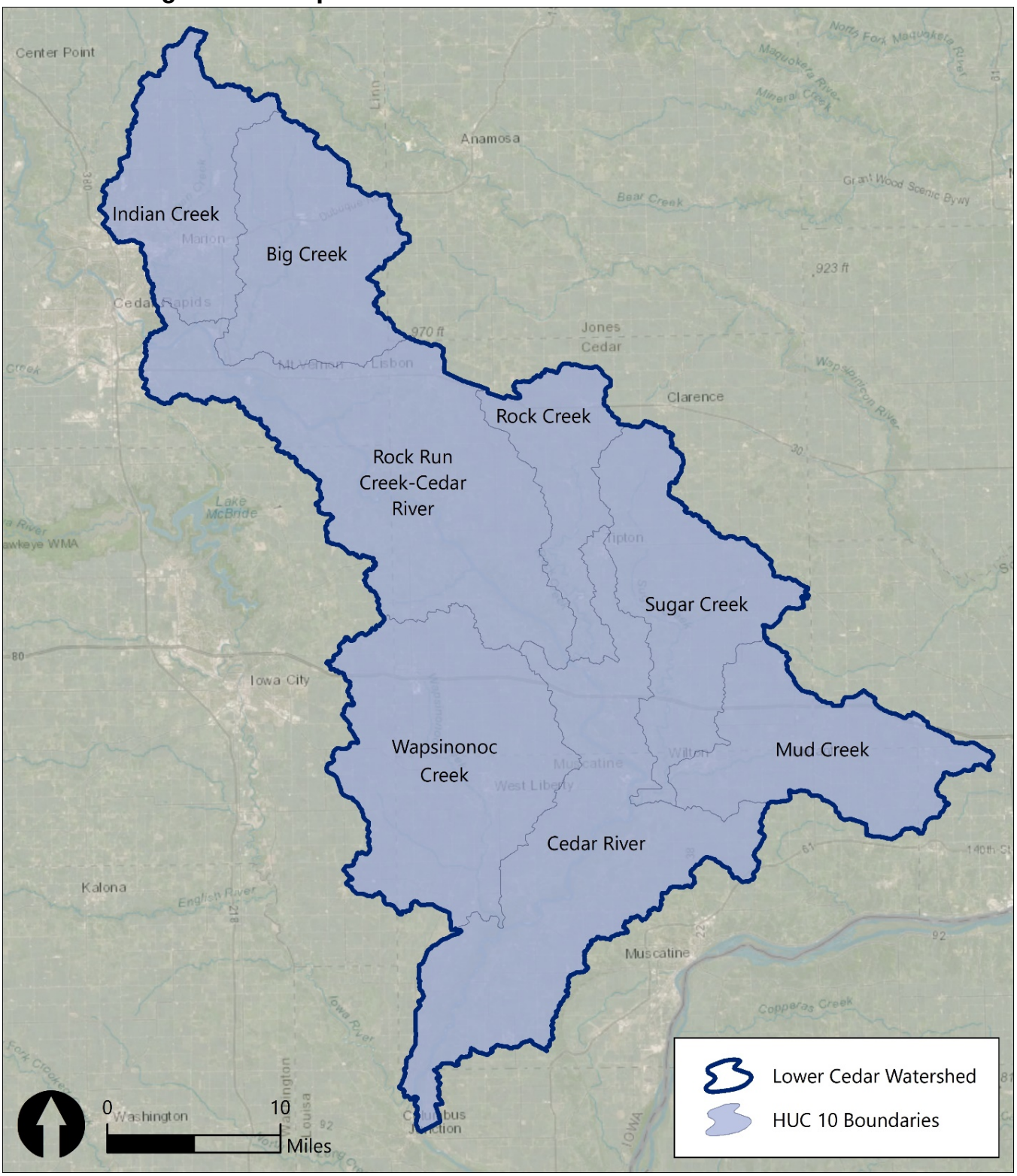


Figure 2-3. Map of HUC-12 Sub-watersheds in the Lower Cedar

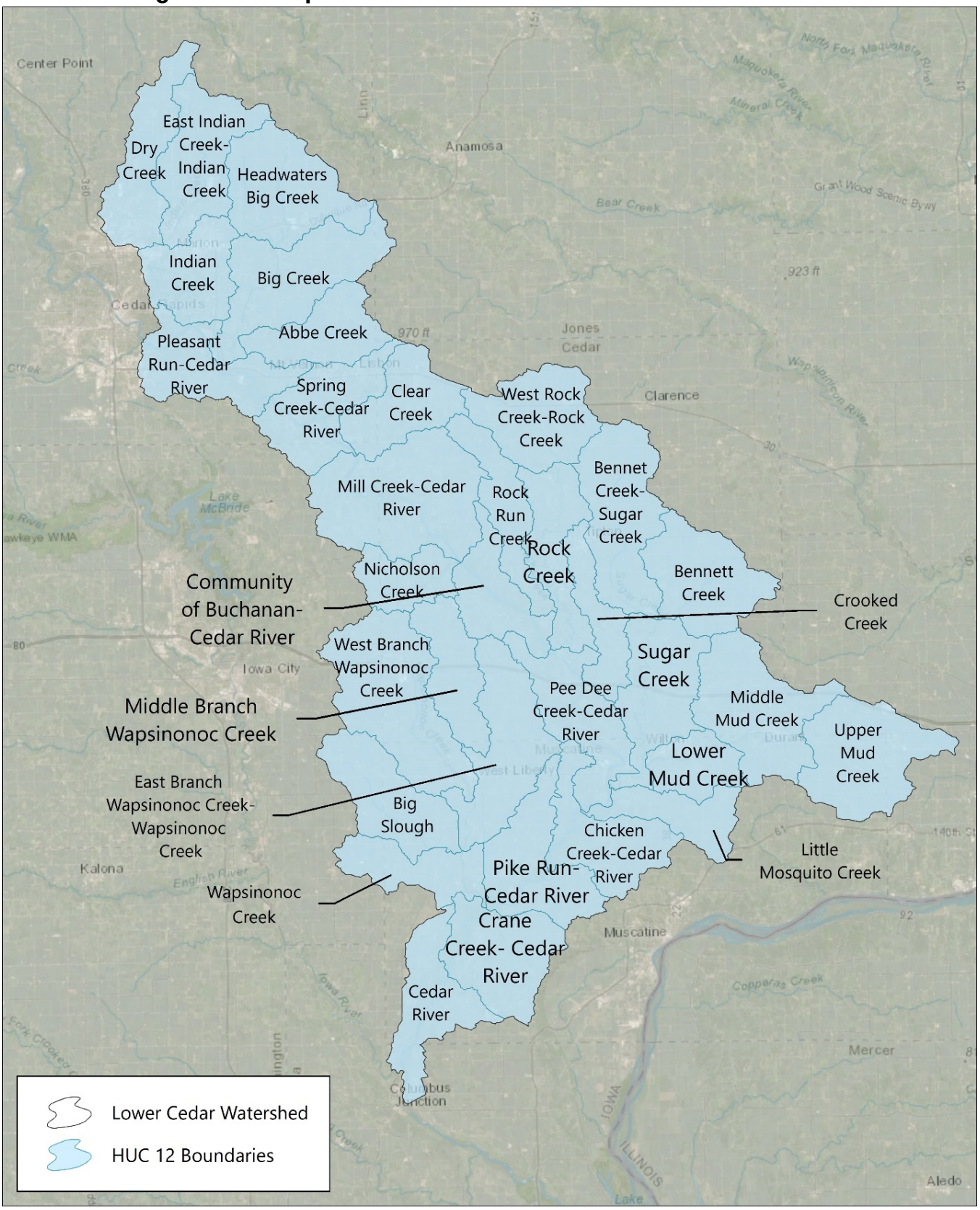


Table 2-2. Stream Lengths and Area in the Lower Cedar Watershed

HUC-12 ID	Watershed (HUC12)	Stream Length (mi)	Watershed Area (acres)
70802060202	Abbe Creek	14	16,210
70802060601	Bennett Creek	10	23,414
70802060703	Big Slough	13	21,329
70802060804	Chicken Creek-Cedar River	24	20,736
70802060806	Crane Creek-Cedar River	14	22,987
70802060405	Mill Creek-Cedar River	41	39,189
70802060803	Pee Dee Creek-Cedar River	23	22,002
70802060807	Cedar River	17	19,511
70802060805	Pike Run-Cedar River	15	23,070
70802060401	Pleasant Run-Cedar River	18	21,118
70802060407	Community of Buchanan-Cedar River	8	15,760
70802060403	Spring Creek-Cedar River	17	20,312
70802060402	Clear Creek	13	17,812
70802060801	Crooked Creek	16	12,121
70802060101	Dry Creek	22	20,158
70802060102	East Indian Creek-Indian Creek	28	23,168
70802060103	Indian Creek	23	16,877
70802060802	Little Mosquito Creek	12	13,053
70802060203	Big Creek	36	28,592
70802060705	Wapsinonoc Creek	16	14,739
70802060701	Middle Branch Wapsinonoc Creek	14	15,709
70802060502	Middle Mud Creek	21	28,977
70802060503	Lower Mud Creek	7	11,277
70802060501	Upper Mud Creek	8	27,885
70802060404	Nicholson Creek	11	11,508
70802060302	Rock Creek	24	17,906
70802060301	West Rock Creek-Rock Creek	20	22,091
70802060406	Rock Run Creek	21	15,096
70802060602	Bennet Creek-Sugar Creek	18	28,244
70802060603	Sugar Creek	29	22,977
70802060201	Headwaters Big Creek	24	26,423
70802060704	East Branch Wapsinonoc Creek	29	26,783
70802060702	West Branch Wapsinonoc Creek	24	36,026
	TOTAL		703,060

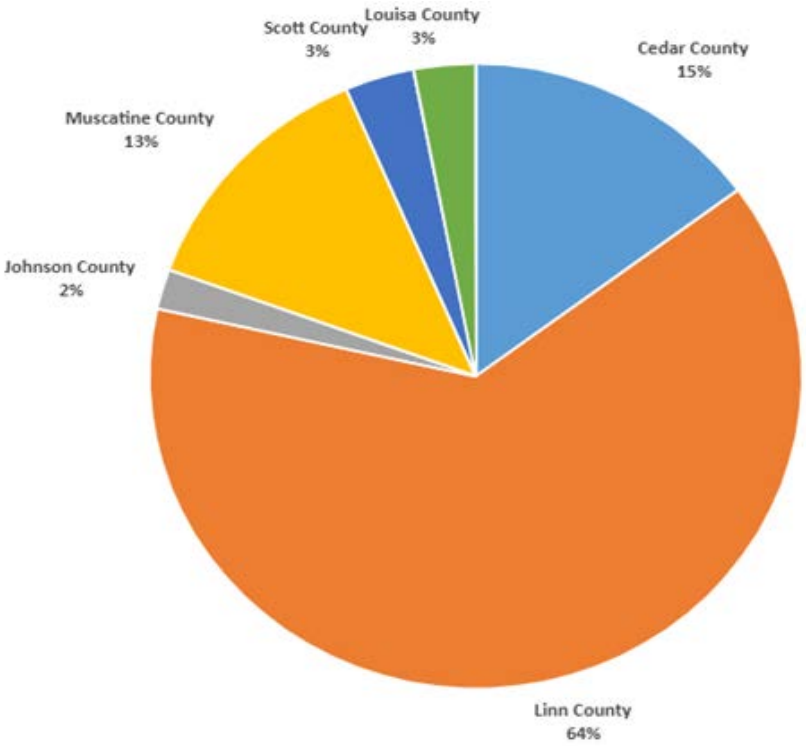
Source: Iowa Department of Natural Resources

2.2 Political Jurisdictions and Populations

The Lower Cedar Watershed lies in 7 counties, including Linn, Jones, Johnson, Cedar, Scott, Muscatine, and Louisa Counties which are located in eastern Iowa. Linn County is the second most populous county in Iowa with a total population of 227,854 in 2020. The population of each county in the watershed is 122,390 in 2020. Figure 2-4 shows the watershed population breakdown by county.

About 11% of the counties' population is a racial or ethnic minority, which is consistent with the State of Iowa's overall racial or ethnic minority population of 10%. While more than 50% of the population lives within and around the urban areas of Cedar Rapids and Marion, there are numerous small communities downstream with limited resources with which to address flooding and water quality issues.

Figure 2-4. Population by County



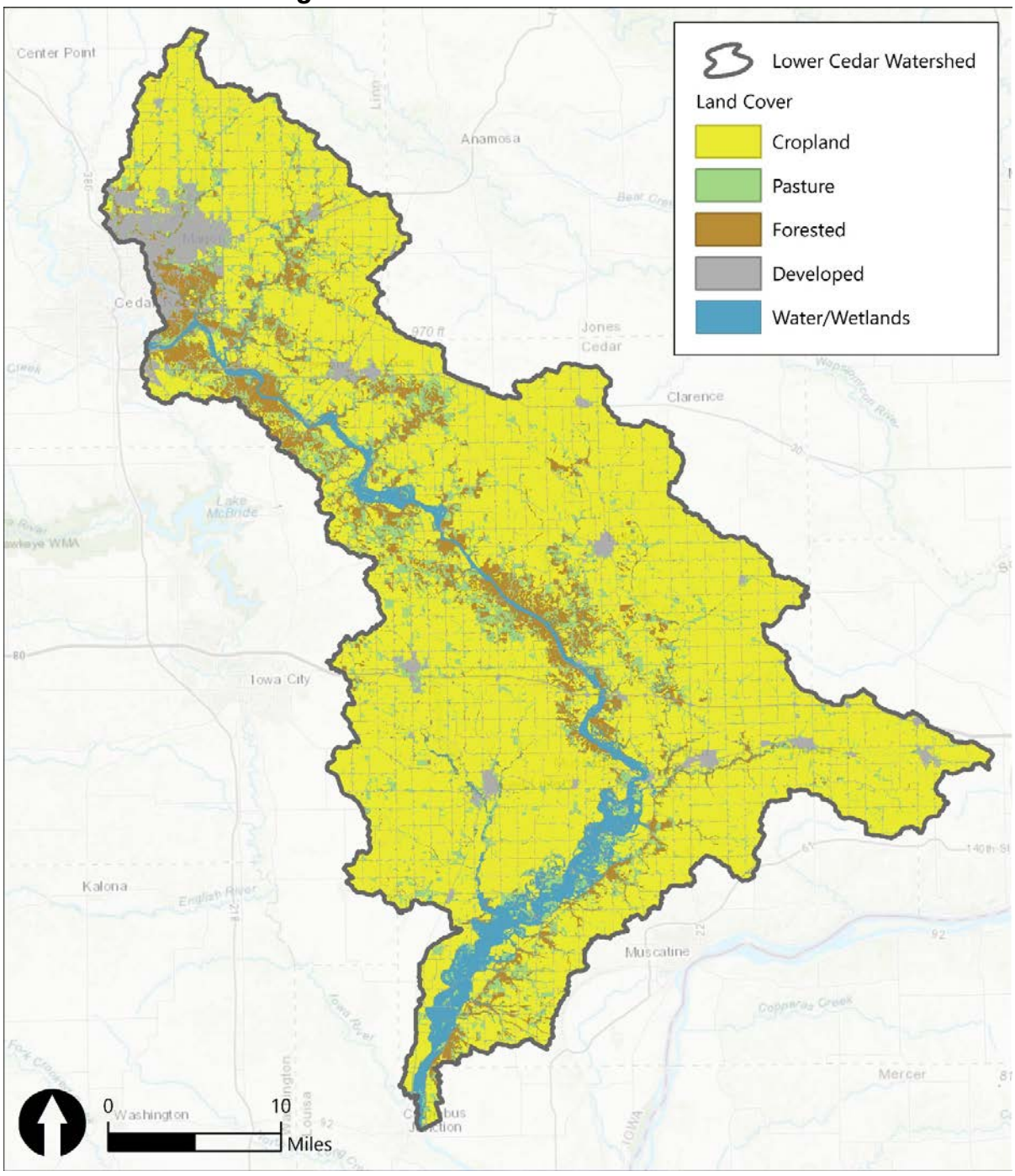
Source: 2010 U.S. Census

Downtown Cedar Rapids looking east into the Lower Cedar Watershed

2.3 Land Use

Agriculture has historically played an important role in the land use and economy of the Lower Cedar Watershed. In 2020, despite the significant growth of urban land uses, most of the watershed area (68%) is still cultivated for agricultural land uses (corn, soybeans, and alfalfa/hay). With pasture included, total agricultural land use comprises 79% of the watershed. Another 9% of the watershed is woodland/natural areas, and 7% is urban. The remaining 5% of the watershed is water/wetland or other land uses. Figure 2-5 depicts the land uses of the watershed.

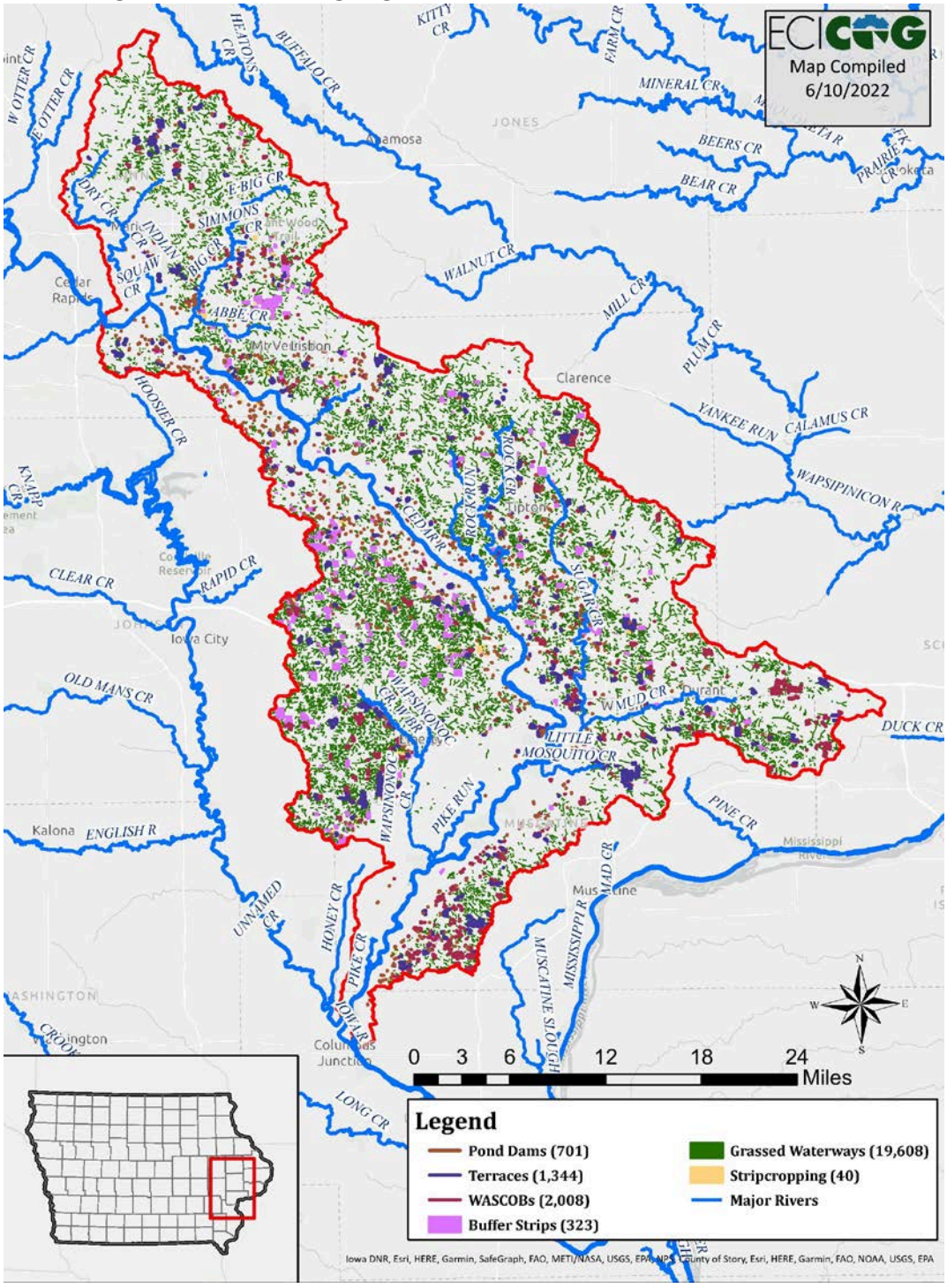
Figure 2-5. Lower Cedar Landcover



Existing Agricultural Best Management Practices

In 2016, Iowa State University undertook the Iowa BMP (Best Management Practices) Mapping Project that set out to provide a complete baseline of BMPs dating from the 2007-2010 timeframe for use in watershed modeling, historic occurrence, and future practice tracking. The BMPs being mapped for the project are terraces, water and sediment control basins (WASCOB), grassed waterways, pond dams/farm ponds, strip cropping and contour buffer strips. For the Lower Cedar watershed planning process, ECICOG compiled the existing BMPs identified by the Iowa BMP Mapping Project presented in Figure 2-6. It is important to note that mapped practices may not meet NRCS standards or are the indicated practice since no ground truthing is being performed. The data does, however, provide a general baseline to begin tracking improvements.

Figure 2-6. Existing Agricultural BMPs in the Lower Cedar



Source: Iowa DNR BMP Mapping Project

Areas of Ecological Importance

The Lower Cedar is situated at the bottom of the Cedar River Watershed, and as a result the watershed issues typical of the Upper Mississippi Basin are prevalent. These watershed issues affect both people and nature. The Lower Cedar floodplain is home to two extremely rare ecological communities: floodplain oak savannas and channel fens. The lower segment of the Cedar River, along with its associated alluvial tributary streams and riparian wetlands, also provides habitat for rare aquatic species from large-river fish like shovelnose sturgeon and paddlefish to smaller backwater fish like grass pickerel and pirate perch as well as mussels like yellow sandshell and pistol grip.

These communities are threatened by unnatural flooding and poor water quality. On a larger scale, this region of southeast Iowa contains the confluences of 3 large river systems: the Cedar River, the Iowa River, and the Mississippi River. Conservation organizations in Iowa generally agree this is the most biologically diverse landscape in Iowa. It is home to nearly 85% of all amphibian and reptile species in Iowa, including many Species of Greatest Conservation Need identified in the Iowa Wildlife Action Plan, leading this region to be designated as the very first Amphibian & Reptile Conservation Area in the nation. Within this 300,000-acre floodplain landscape, more than 50,000 acres have been voluntarily protected and remain in a combination of private and public ownership. This is the greatest concentration of protected land in Iowa creating a relatively intact corridor of habitat. A group of private, federal, state, and local conservation organizations are collaborating as the Great Rivers Alliance of Southeast Iowa. The Alliance meets regularly to identify new conservation targets, threats, and opportunities and works to improve the ability of people to care for the lands and waters in this important place.

Public Areas and Recreation

There are 35,037 acres of important protected areas and recreation resources within the Lower Cedar watershed. The recreational opportunities are varied and provide people of all ages the chance to enjoy the outdoors. The Cedar River Watershed contains many recreation areas, primarily managed by County Conservation Boards and Iowa DNR. These areas include boat accesses, fishing spots, and hiking trails. The Cedar River is one of the most popular fishing rivers in the state of Iowa and a popular kayaking area. Each of the County Conservation Boards in the Lower Cedar manages high quality natural areas that feature fishing, boating, hiking, and wildlife preserve areas. Ecological restoration is a high priority for the counties, and many areas have been restored to native prairie, savannah, or wetland. This demonstrates the partners' commitment to rebuilding the land's capacity to fulfill its natural ecosystem service functions that greatly benefit water quality and reduce flood risks.

The Nature Conservancy

The Nature Conservancy (TNC) acquired several properties in the Lower Cedar as gifts in the 1980s and began more active management activities in the area in the 1990s. The Nature Conservancy properties include the Greiner Family Nature Preserve (32 acres acquired in 1986 to which 86 acres were added in 1988), Swamp White Oak (372 acres), and Red Cedar Woodland (32 acres donated by Nellie Reis in 1985). The Nature Conservancy's work in the area 2003-2005, funded by Monsanto, focused primarily on watershed outreach and monitoring at Pike Run as well as management and tree removal at Swamp White Oak and other partner properties in the region. These areas are the most biologically significant areas within the river valley. Many rare herpetofauna and plants are present and most importantly, two G1 (5 or fewer known occurrences globally) plant communities can be found here, including the Swamp White Oak Savanna and the Central Tallgrass Fen. The Nature Conservancy has helped conserve and restore these communities on their Land of the Swamp White Oak Preserve totaling nearly 4,000 acres. Within the Swamp White Oak Preserve, The Nature Conservancy has documented 399 plant species, of which 70% are native.

Linn County Conservation Board

In 2021, Linn County Conservation completed several wetland projects and a pond in Wanatee Park that captures and stores storm water before entering Wanatee Creek. Another project includes a tributary to Wanatee Creek that will be restored using constructed grade adjustments using all natural materials such as downed logs, branches, soil and rock. This project will let the tributary "heal" naturally and reduce sediment loss and flow into Wanatee Creek. The Dows Maniti Trail is a new trail corridor under route study. When completed, it will create an accessible trail from Mt. Vernon Road at the Dows Farms Argi-Community though Wanatee Park into Marion connecting with the Grant Wood Trail. There is a massive effort underway to restore close to 300 acres of woodlands in Wanatee Park lost to the 2020 derecho. This has included logging, cleanup, and replanting. Hundreds of trees will be planted in 2021 and volunteers will plant acorns and walnuts to supplement the tree planting improving the water quality of Wanatee Creek. The 17 acres of farmland in Wanatee Park are in a long-term lease with Feed Iowa First that will convert the current land that has been row cropped to a mosaic of organic vegetable plots with buffering through native prairie plantings.

Indian Creek Nature Center

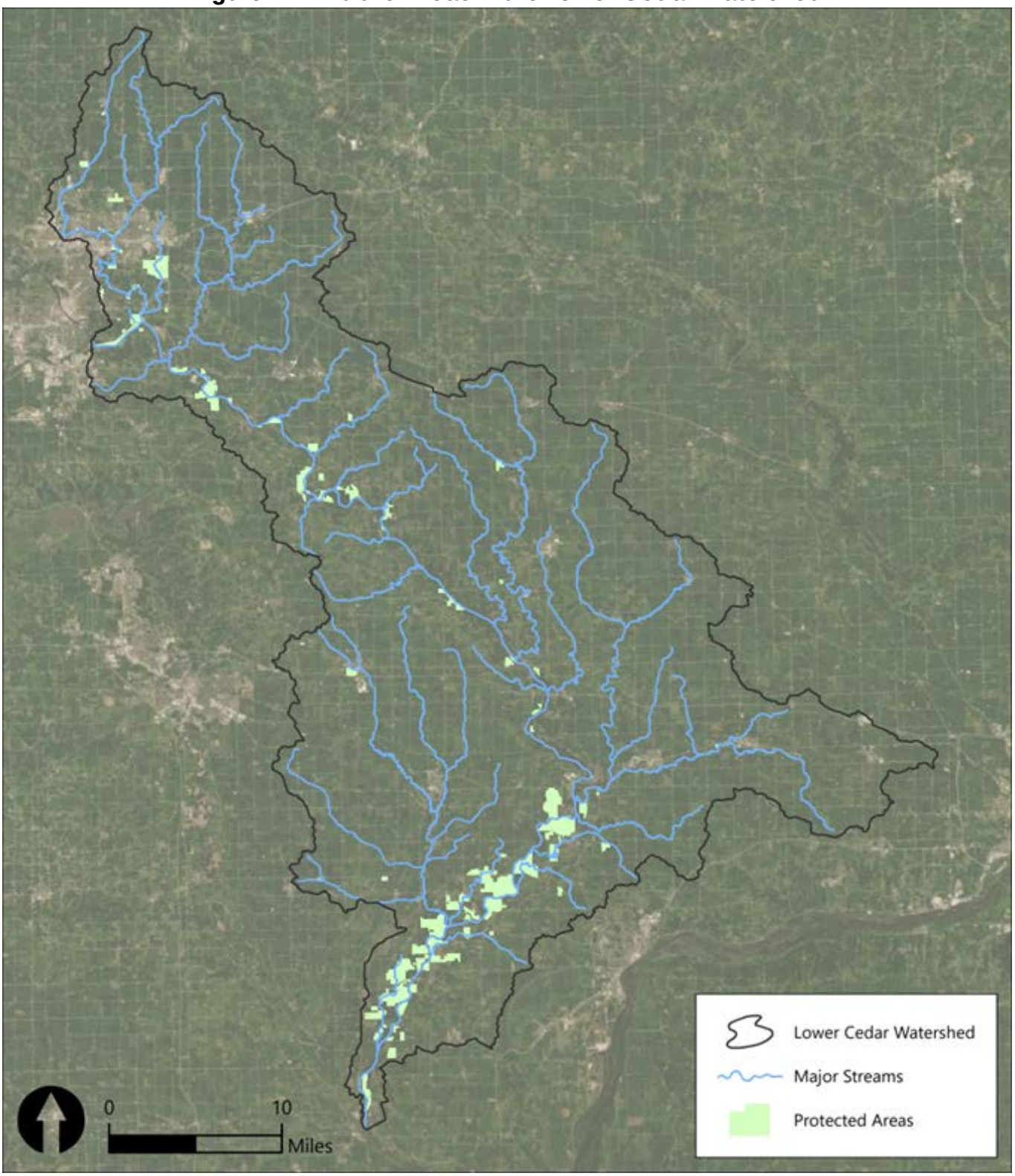
Indian Creek Nature Center cares for 200 acres of wetlands, riparian forests, maple sugarbush, tallgrass prairies and oak savannas around the Nature Center and nearby Věčný Woods has an additional 55 acres of massive hardwood trees. The Nature Center is expanding its 7-mile trail system along the Cedar River to provide more opportunities among a variety of terrains (prairie, hills, woodlands) for people to get outside. The trails connect to the broader Cedar Rapids metro area trail system.

Indian Creek Nature Center is planning several habitat restoration projects including the conversion of an old farm field to prairie habitat, the restoration of woodlands following a significant derecho in 2020, and the addition of specific habitat piles in the woodlands to provide increased shelter for wildlife.

Indian Creek Nature Center

Indian Creek Nature Center

Figure 2-7. Public Areas in the Lower Cedar Watershed



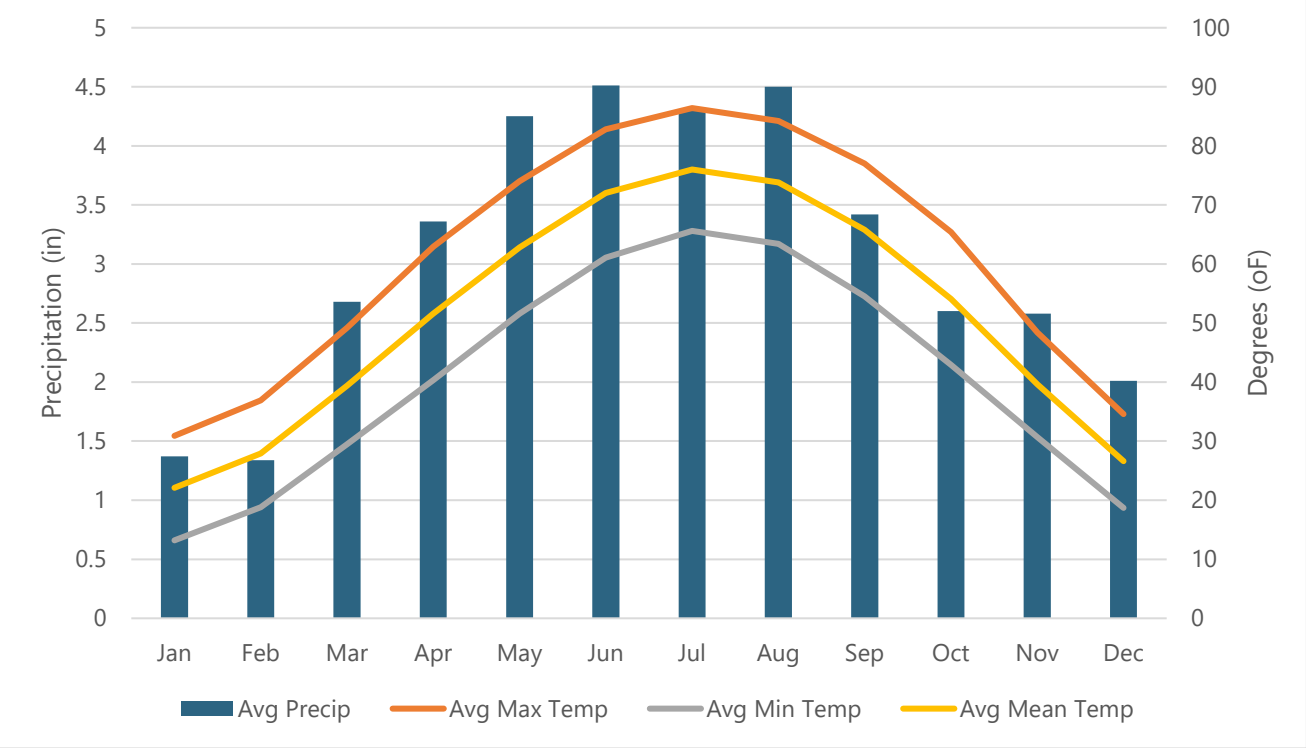
2.4 Climate

Temperature & Rainfall

The Lower Cedar watershed has a continental climate with hot, humid summers and cold, dry winters; but conditions can vary widely from year to year. The average crop growing season is on the order of 180 to 190 days from mid-April to mid-October.

The winter months are cold, averaging highs around 36°F while winter lows are around 13°F. Summers are warm with average highs around 85°F and summer lows around 61°F. The highest recorded temperature was 111°F in July 1936 while the lowest temperature was -31°F in January 2019. Most of the annual precipitation falls in the warm months in the form of rain showers or thunderstorms. Winter often brings snowstorms, ice storms, and occasional blizzards. Total precipitation amounts during winter months are lower on average than in other seasons. Fairly typical for the Midwest, the current climate of the Indian Creek watershed consists of an average rainfall of 36.92 inches and snowfall around 26.5 inches. Normal monthly temperatures and precipitation are summarized in Figure 2-8.

Figure 2-8. Historical Monthly Precipitation at Muscatine, Iowa



Source: NWS Coop weather station IA at Muscatine, Iowa (1971-2000).

Climate Change

In Iowa the average annual temperature, total precipitation, and number of days per year with precipitation have been increasing from the early 20th to the early 21st century. Signs include more days of rain and higher rainfall and warmer temperatures in the winter and hotter nights. Climate models suggest future impacts will be more extreme precipitation events and increased potential for both flooding and drought. The high temperatures will be higher, and the low temperatures will be lower. In general, it is predicted there will be more extreme and unpredictable temperatures, storms, and precipitation.

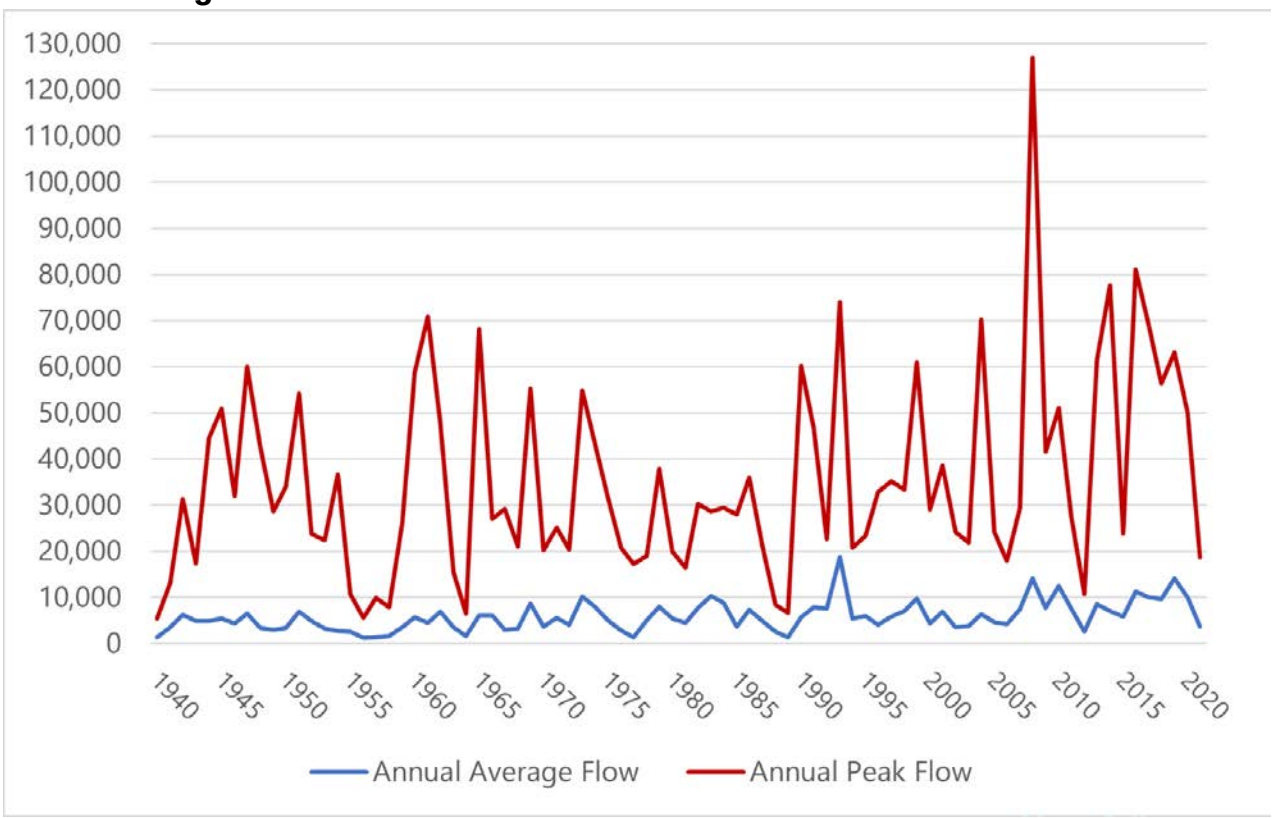
Flooding

In 2008 the Cedar River rose to unprecedented levels and inflicted damage beyond any other local flooding event in recent history. In Cedar Rapids alone 14% of the city was inundated, displacing 18,000 residents, and contributed to the sixth largest FEMA declaration of $848 million. Transportation in the Lower Cedar Watershed was compromised as the ability to cross the Cedar River was removed, all the Cedar River bridges in the Lower Cedar Watershed were closed. This flooding event caused great hardship for stakeholders in the watershed, local economies, and national transportation issues due to closure of Interstate 80.

Damage to U.S. Highway 6 as the Cedar River subsides east of Atalissa in June 2008. Photo by Iowa Department of Transportation.

A review of annual peak flows in the Cedar River near Conesville reveals a more volatile period in the last 25 years.

Figure 2-9. Annual Peak Flows in Cedar River near Conesville



Source: United States Geological Survey

2.5 Flood Hazard Assessment

An objective of the Lower Cedar WMP is to align with each county's multi-jurisdictional hazard mitigation plan (HMP), each of which identifies flooding (riverine and flash flooding) as a high priority for mitigation activities. These plans identify and analyze possible natural hazards including flooding. Flash floods are caused by heavy rainfall and high runoff over a short period of time, whereas river floods occur over a longer period when water rises in an existing channel.

The counties' HMP goals share several common themes including protection of human health and safety, reduction of property losses and impacts to critical infrastructure, enhanced education, and improved intergovernmental communication. Each HMP has also identified key mitigation strategies/actions. Common themes include hydrologic / floodplain studies and monitoring, education of citizens, and construction of mitigation projects to reduce flood risk. Iowa Homeland Security and Emergency Management assisted in facilitating the integration of hazard mitigation plans with the Lower Cedar Watershed Management Plan. They provided technical assistance for identifying mitigation actions and future funding opportunities.

The HMP also identified critical facilities on a community and county level. Critical facilities are those which are essential to keep in operation during and after a hazardous event. Critical facilities are also used to indicate where populations under the greatest risk during a hazard event may be congregated, such as schools or hospitals. Vulnerable populations are typically made up of elderly or very young individuals who might need special assistance or medical care during or after the occurrence of a hazardous event. Detailed locations of critical facilities are not included in this plan. It is recommended that these be mapped in future updates to the HMP or this watershed plan.

Floodplain Management for Resilience

Floodplains are a natural part of a stream corridor and appropriate management is a first step in mitigating flood damage. Historically, river systems had broad, shallow floodplains allowing water to spread out during high flow events. This had an attenuating effect on peak flows, slowing the rate of flow and allowing space for water to soak into the ground. Over the past 40 years, floodplain areas have been significantly narrowed and water is forced to remain within smaller confines of the stream channel. In addition, water is diverted more quickly to the stream channel through the stormwater system in urban areas or tile flow in agricultural areas. Homes and other critical structures built in the floodplain are at greater risk of repeated damage from flooding. Table 2-3 shows the repetitive loss data for cities in the Lower Cedar watershed provided by the Iowa Department of Homeland Security and Emergency Management. Repetitive crop loss impacts agricultural areas when crops are planted in floodplains.

Table 2-3. Repetitive Flood Loss as of June 2022

City	Number of Properties	Total Losses Paid
Atalissa	3	$ 95,005
Cedar Rapids	2	$ 110,654
Marion	1	$ 13,457
Nichols	2	$ 206,901
Durant	1	$ 73,164
West Liberty	1	$ 20,343
Robins	1	$ 51,621
West Branch	3	$ 98,874
Total	**14**	**$ 670,019**

Source: Iowa Homeland Security & Emergency Management repetitive loss data 1984 – June 2022

To better withstand and recover from flood-related disasters in the future, the EPA recommends that communities consider updating, integrating, and revising their plans, policies, and regulations to ensure that they are consistent with their resilience goals and objectives. These are basic steps to help communities get started on their road to resilience:

1. Update and integrate comprehensive plans and Hazard Mitigation Plans
2. Conduct thorough policy and regulatory audits
3. Amend zoning, subdivision, and stormwater policies and regulations to match plans
4. Participate in the National Flood Insurance Program Community Rating System

2.6 Regulations Related to Watershed Management

Amendments made to the Clean Water Act in 1987 required the U.S. Environmental Protection Agency (EPA) to address stormwater runoff in two phases. In 1990, the EPA implemented Phase I of the National Pollutant Discharge Elimination System (NPDES) permit program to control water pollution by regulating the discharge of pollutants into waters of the United States. The NPDES program covers several pollutant sources that are regulated by permits issued by the Iowa Department of Natural Resources (IDNR). There are three general classes of stormwater activities that must be covered by an NPDES permit. These general classes are:

- Construction activity that involves an acre or greater of land disturbance.
- Ten categories of industrial activity.
- Municipal separate storm sewer systems for larger communities or those near larger communities.

NPDES Permit Program

Construction Runoff. Land disturbing activities that involve an acre or greater of land (including smaller sites that are part of a larger common plan of development) are required to obtain coverage under NPDES General Permit No. 2. General Permit No. 2 authorizes discharge of stormwater from construction sites and requires that runoff control measures be implemented and maintained on site for the duration of a project.

Permittees must submit a Notice of Intent (NOI) to the IDNR to obtain coverage under General Permit No. 2. In addition, erosion and sedimentation control plans detailing the runoff control measures to be implemented for the project are required by local authorities, who will review and approve these plans. Inspections and reporting are done by the local authorities to ensure that permittees are following the provisions of the approved plan. General Permit No. 2 coverage must be maintained until construction is completed and a site is fully stabilized.

Industrial Activity. The NPDES permit program requires that stormwater discharges that are associated with industrial activity obtain permit coverage under General Permit No. 1, issued by the IDNR. The EPA lists ten general categories of industrial activity for which permit requirements apply. Publicly owned treatment works, wastewater systems and facilities, sludge and bio-solids handling, and industrial users discharging into a municipal wastewater system are all required to obtain authorization under an NPDES industrial stormwater permit for discharging stormwater. NPDES permits typically establish specific discharge limits, and monitoring and reporting requirements.

Municipal Separate Stormwater Systems (MS4). A municipal separate storm sewer system (MS4) is defined as a conveyance or system of conveyances that are publicly owned, designed for collecting or conveying stormwater, not part of a combined sewer, and not part of a publicly owned treatment works. These conveyances include sewer inlets and pipes, municipal streets, curbs, gutters, drainage ways, and ditches.

MS4s that discharge to surface waters are required to obtain a NPDES Stormwater Permit issued by the IDNR. A NPDES Stormwater Permit authorizes a municipality to operate and discharge from their MS4, in accordance with the provisions of the permit. Permittees are required to develop and implement a stormwater management program that includes six minimum control measures, all aimed at managing stormwater and reducing the quantity of pollutants that get delivered to waterways via the MS4.

NPDES - Six Minimum Control Measures

1. Public Education and Outreach
2. Public Participation/Involvement
3. Illicit Discharge Detection and Elimination
4. Construction Site Runoff Control
5. Post-Construction Runoff Control
6. Pollution Prevention/Good Housekeeping

MS4 Program – Phase I & II. In 1990, the EPA established Phase I rules for the NPDES stormwater program. This phase incorporated cities whose MS4 served populations greater than 100,000, requiring them to implement a stormwater program. Phase II was implemented in 2003 and extended coverage of the program to smaller MS4s as well as MS4s that are in "urbanized areas," as delineated by the Bureau of the Census. The IDNR bases designation of communities required to obtain a permit on a combination of population, proximity to urbanized areas, and receiving streams water quality. Permittees are required to submit an annual report to the IDNR to demonstrate compliance with permit requirements. In addition, permittees are subject to audits by both the IDNR and EPA to ensure that permit provisions are adequately met. Table 2-4 provides a current listing of communities within the Lower Cedar Watershed by permit type.

Table 2-4. NPDES permits within the Lower Cedar Watershed

Permit #	EPA ID	Expire Date	Facility Name	Facility City	Permit Type	Class	Treatment Type
5704001	0024431	1/31/25	Alburnett - STP	Alburnett	Municipal	Minor	Waste Stabilization Lagoon
7009001	0070998	4/18/06	Atalissa - STP	Atalissa	Municipal	Minor	Activated Sludge
1600201	0069043	3/31/16	Pilot Travel Centers #496	Atalissa	Semi-Public	Minor	Waste Stabilization Lagoon
1603001	0021971	7/31/25	Bennett - STP	Bennett	Municipal	Minor	Waste Stabilization Lagoon
5710801	0076732	9/30/25	Four Oaks Group Home - Bertram Campus	Bertram	Semi-Public	Minor	Activated Sludge
5715001	0042641	5/31/22	Cedar Rapids - STP	Cedar Rapids	Municipal	Major	Activated Sludge
5715146	0052651	5/31/22	Cedar Rapids Country Club	Cedar Rapids	Industrial	Minor	No Treatment
5715108	0000540	10/31/21	IPI - Prairie Creek Generating Station	Cedar Rapids	Industrial	Major	Other
5715119	0069523	12/2/24	King's Material, Inc.- Washout Facility	Cedar Rapids	Operation	Minor	No Treatment
7036001	0064891	3/31/27	Durant - STP	Durant	Municipal	Minor	Activated Sludge
5748001	0025909	4/30/25	Lisbon - STP	Lisbon	Municipal	Minor	Activated Sludge
5751002	0078689	8/31/25	Marion - MS4	Marion	Stormwater	Minor	No Treatment
5737001	0062987	12/31/22	Martelle - STP	Martelle	Municipal	Minor	Waste Stabilization Lagoon
5758001	0023710	6/30/25	Mount Vernon - STP	Mount Vernon	Municipal	Major	Activated Sludge
7052001	0036561	3/31/22	Nichols - STP	Nichols	Municipal	Minor	Waste Stabilization Lagoon
5776000	0078816	7/31/25	Robins - MS4	Robins	Stormwater	Minor	No Treatment
5700117	0080934	5/31/25	Wendling Quarries – Robins Quarry	Robins	Industrial	Minor	Other
5700601	0065609	2/28/26	Carlton Mobile Home Court	Springville	Semi-Public	Minor	Waste Stabilization Lagoon
5782002	0064726	4/30/26	Springville - STP	Springville	Municipal	Minor	Waste Stabilization Lagoon
1681001	0033758	9/30/26	Stanwood - STP	Stanwood	Municipal	Minor	Advanced Aerated Lagoon
7063001	0033464	1/31/16	Stockton - STP	Stockton	Municipal	Minor	Waste Stabilization Lagoon
1689001	0032727	5/31/21	Tipton - STP (West)	Tipton	Municipal	Major	Aerated Lagoon
8200202	0076007	2/29/24	Pilot Travel Center #043	Walcott	Industrial	Minor	Other
1694001	0032859	8/31/22	West Branch - STP	West Branch	Municipal	Minor	Aerated Lagoon
1600600	0067946	5/21/14	West Branch Mobile Home	West Branch	Semi-Public	Minor	Waste Stabilization Lagoon
7073001	0031691	1/31/24	West Liberty - STP	West Liberty	Municipal	Major	Activated Sludge
7078101	0061972	5/31/22	Gerdau	Wilton	Industrial	Minor	Other
7078001	0032921	11/30/24	Wilton - STP	Wilton	Municipal	Minor	Activated Sludge

Source: Iowa Department of Natural Resources
(https://www.iowadnr.gov/Environmental-Protection/Water-Quality/NPDES-Wastewater-Permitting/Current-NPDES-Permits)

Wastewater Treatment. Municipal and semi-publicly owned wastewater treatment facilities (WWTFs) are also regulated through the NDPES program and are required to meet NPDES requirements. Permits establish effluent limits that specify allowable pollutant concentrations and loads discharged by a WWTF. Limits are based on either: (1) technology-base limits that establish a minimum level of treatment a facility must provide, and/or (2) a more stringent limit required to comply with WQS when technology-based limits are not sufficient. Common types of WWTFs in the Lower Cedar Watershed include waste stabilization lagoons, activated sludge systems, and aerated lagoons.

Federal Clean Water Act-Total Maximum Daily Loads

The Federal Clean Water Act requires states to develop a 303(d) Threatened and Impaired Waters List. A stream or lake is placed on Iowa's impaired waters list if they do not meet the state's designated water quality standards. Total Maximum Daily Load (TMDL) must then be developed for water bodies that are determined to be impaired. TMDL is the calculation of the maximum pollutant load that can enter a body of water and still result in the water body meeting water quality standards, as well as point and nonpoint-source load allocations from the various sources of the pollutant.

Federal Safe Drinking Water Act

The Federal Safe Drinking Water Act (SDWA) was originally passed by Congress in 1974 to protect public health by regulating the nation's public drinking water supply as a response to outbreaks of waterborne diseases and increasing chemical contamination. The law was amended in 1986 and 1996 and requires many actions to protect drinking water and its sources: rivers, lakes, reservoirs, springs, and ground water wells.

Wellhead protection requirements were included in the 1986 amendments to the SDWA. Wellhead protection areas established around drinking water supply wells are based on the local geology, well depth, and pumping rate, among other factors. These wellhead protection areas help protect wells and springs used as sources of water supply for community public water systems owned by and/or serving municipalities, counties, and authorities from nearby pollution sources.

National Flood Insurance Act

The National Flood Insurance Act of 1968 led to the creation of the National Flood Insurance Program (NFIP) and offered new flood protection to homeowners. Participation in the NFIP is voluntary, based on an agreement between local communities and the federal government which states that if a community will adopt and enforce a floodplain management ordinance to reduce future flood risks to new construction in "special flood hazard areas," the Federal government will make flood insurance available within the community as a financial protection against flood losses.

In 2001, FEMA promulgated hazard mitigation planning regulations pursuant to the Disaster Mitigation Act of 2000. FEMA established the 10-step Community Rating System (CRS) process that identified four essential parts to mitigation planning and created a point-based evaluation system. The CRS rewards communities that undertake floodplain activities beyond the requirements with lower flood insurance premiums. A Class 1 rating requires the most credit points and gives the greatest premium reduction; Class 10 receives no premium reduction. A community that does not apply for the CRS or does not obtain the minimum number of credit points is automatically categorized as a Class 10 community.

Other Regulatory/Reviews for Watershed Projects

In addition to those mentioned above, any projects that involve Federal funding and/or potentially impact Waters of the United States (WOTUS), Threatened and Endangered (T&E) species, cultural resources, and other aspects of the environment and landscape require potential agency review and permitting. These requirements should be identified and accounted for in the scheduling, cost/benefit analysis, and design of alternatives.

2.7 Topography, Geology, and Soils

Glacial Geology

The majority of Iowa's land surface has been covered by glaciers many times in the geologic past. As glaciers advanced and retreated, they left behind distinct landscapes that are characterized by the environment in which they formed. The Lower Cedar watershed lies mostly in the Iowan Surface and Southern Iowa Drift Plain, with a small area of the watershed in the Iowa-Cedar Lowland. The Iowan Surface region acts as a transition between the woodlands to the east and the tallgrass prairie to the west. This region is considered rather flat with long, rolling slopes. The Southern Iowa Drift Plain is the largest of Iowa's landform regions. This area has rolling hills, which mostly slope toward a river or stream. Erosion and windblown loess also contributed to this landscape. The Southern Iowa Drift Plain has ten to hundreds of feet of glacial till covering bedrock.

Table 2-5. Slopes in Watershed

Percent Slope	Acres	Percent of Watershed
0-2%	288,417.88	41%
2-5%	198,325.78	28%
5-9%	122,718.07	17%
9-14%	56,770.58	8%
14-18%	13,619.72	2%
18-25%	18,386.52	3%
>25%	4,821.74	1%

Topography

Topography, the landscape surface features such as shape and slope, is an important consideration of watershed management because it influences patterns of erosion and drainage. It also determines what types of conservation practices are best suited to a particular landscape. In the Lower Cedar River watershed, 69% of the terrain is characterized as nearly level or gently sloping with a slope of less than 5%. Most of the watershed's agricultural activity occurs in these areas. Moderate slopes (5-9%) comprise 17% of the watershed, with steeper slopes (greater than 9%) making up about 14% of the watershed.

Figure 2-10. Slopes in the Lower Cedar Watershed

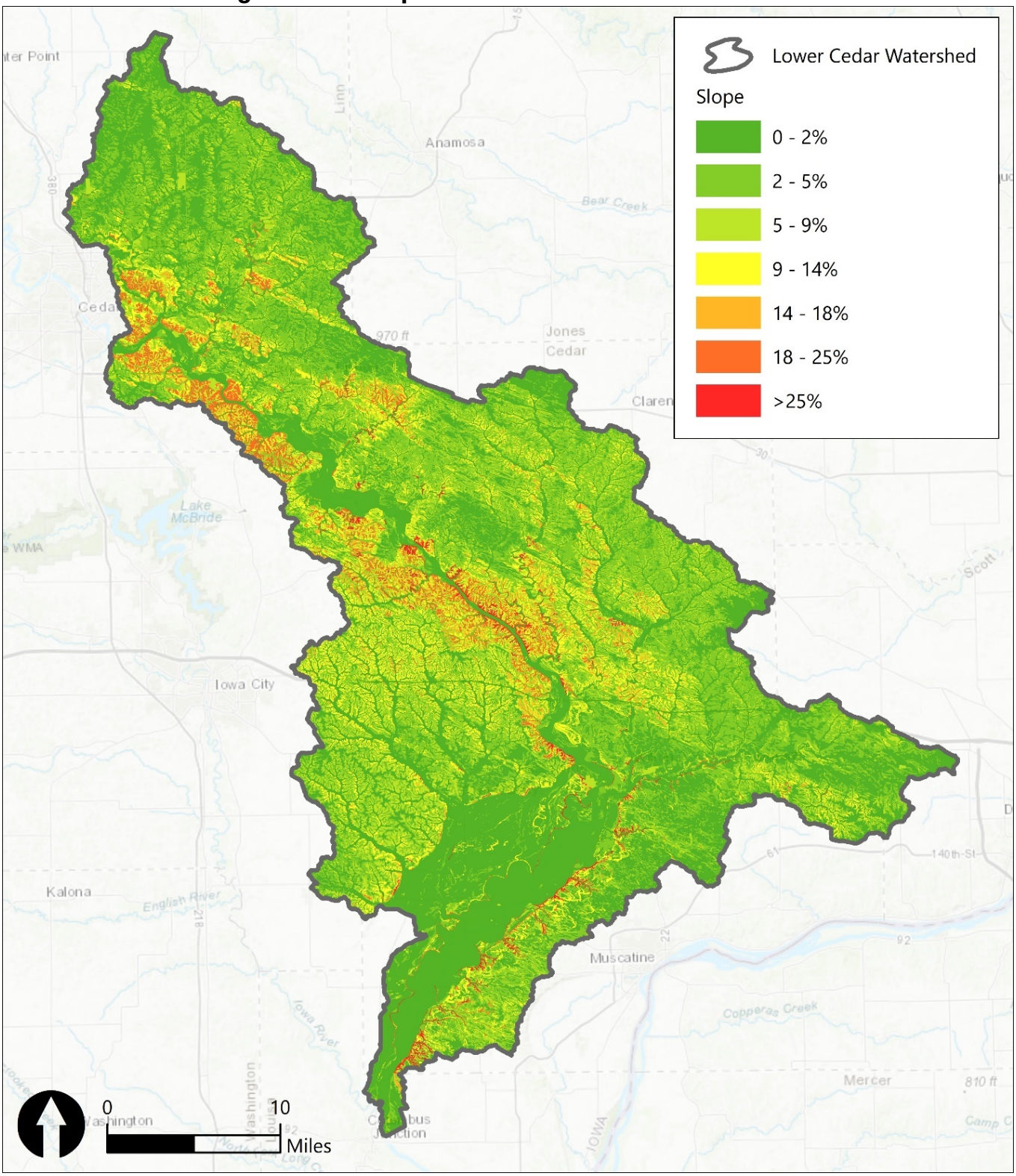
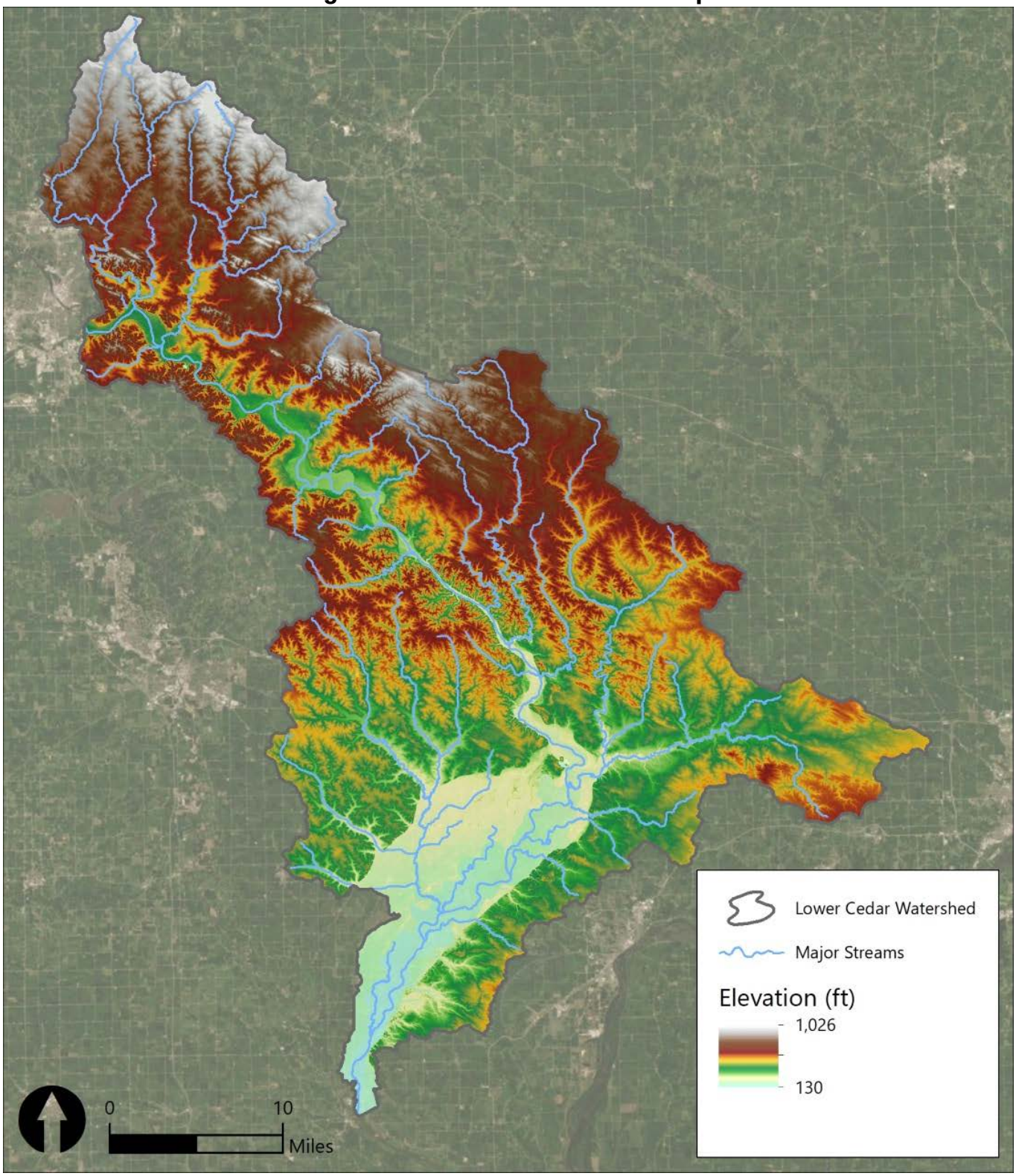


Figure 2-11 shows the topography of the Lower Cedar River watershed. Elevations range from approximately 1,026 feet above sea level in the upstream part of the watershed to 130 feet above sea level in the downstream area.

Figure 2-11. Surface Elevation Map



Soil Types

Soil generation is a complex process that incorporates many factors such as parent material, slope angle, vegetation, moisture content, and the degree to which it has been eroded. Soils are classified using these characteristics and are subdivided into association names, primarily from the sites where each one was initially identified. All the dominant soil associations within the Lower Cedar watershed occur in both the Iowan Surface and Southern Iowa Drift Plain regions. Collectively, the following five soil types comprise 43% of the watershed. All other individual soil types make up less than 5% of the watershed area. A detailed soils summary table is provided in Appendix A.

- Muscatine (13%) - deep, somewhat poorly drained soils nearly flat slopes
- Fayette (9%) - deep, well drained soils with potentially steep slopes
- Tama (8%) - deep, well drained soils with less steep slopes
- Downs (7%) - deep, well drained soils with potentially moderate slopes
- Judson (6%) - deep, well drained soils with gentle slopes

Figure 2-12. Soil Classification in the Lower Cedar

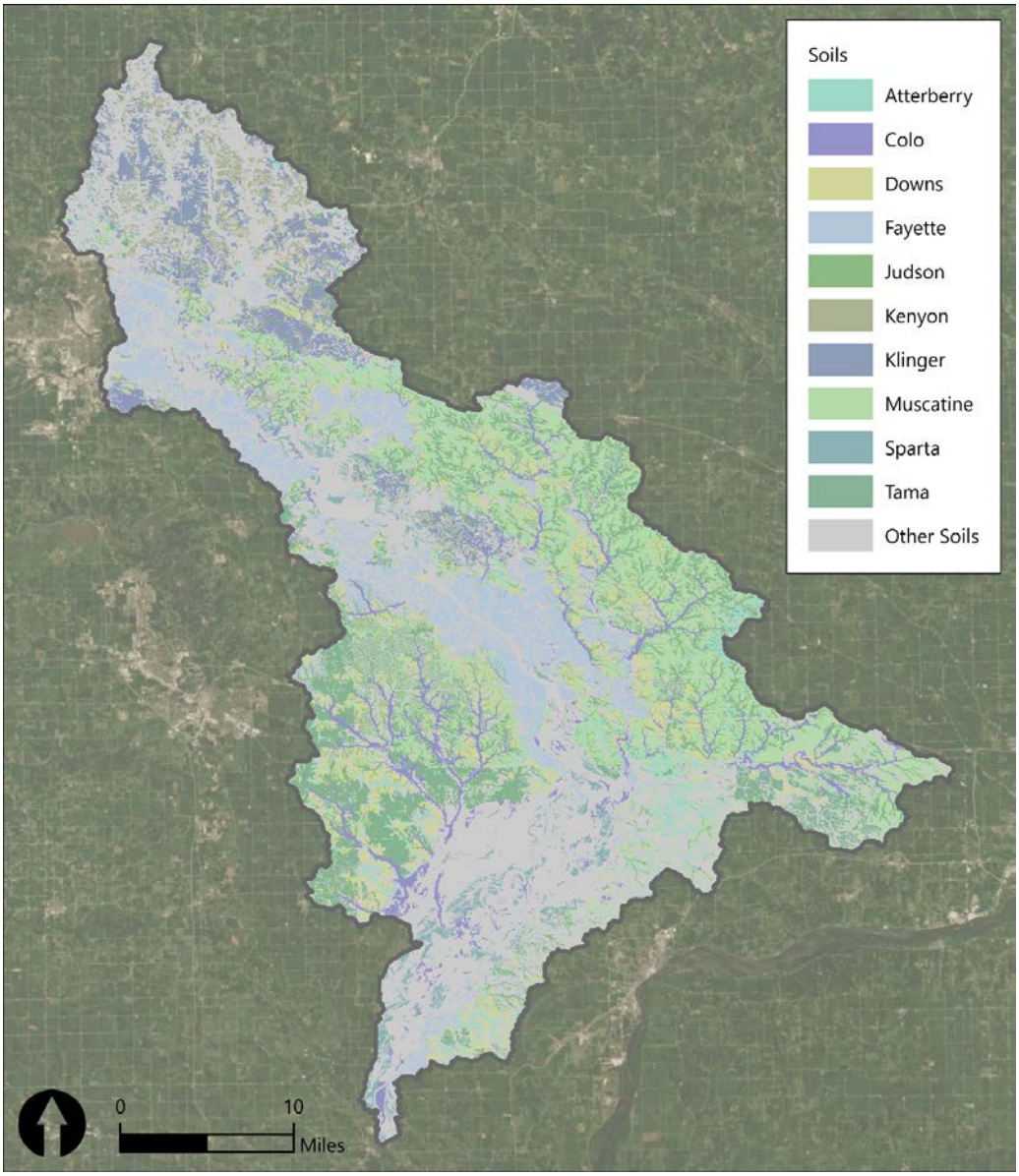
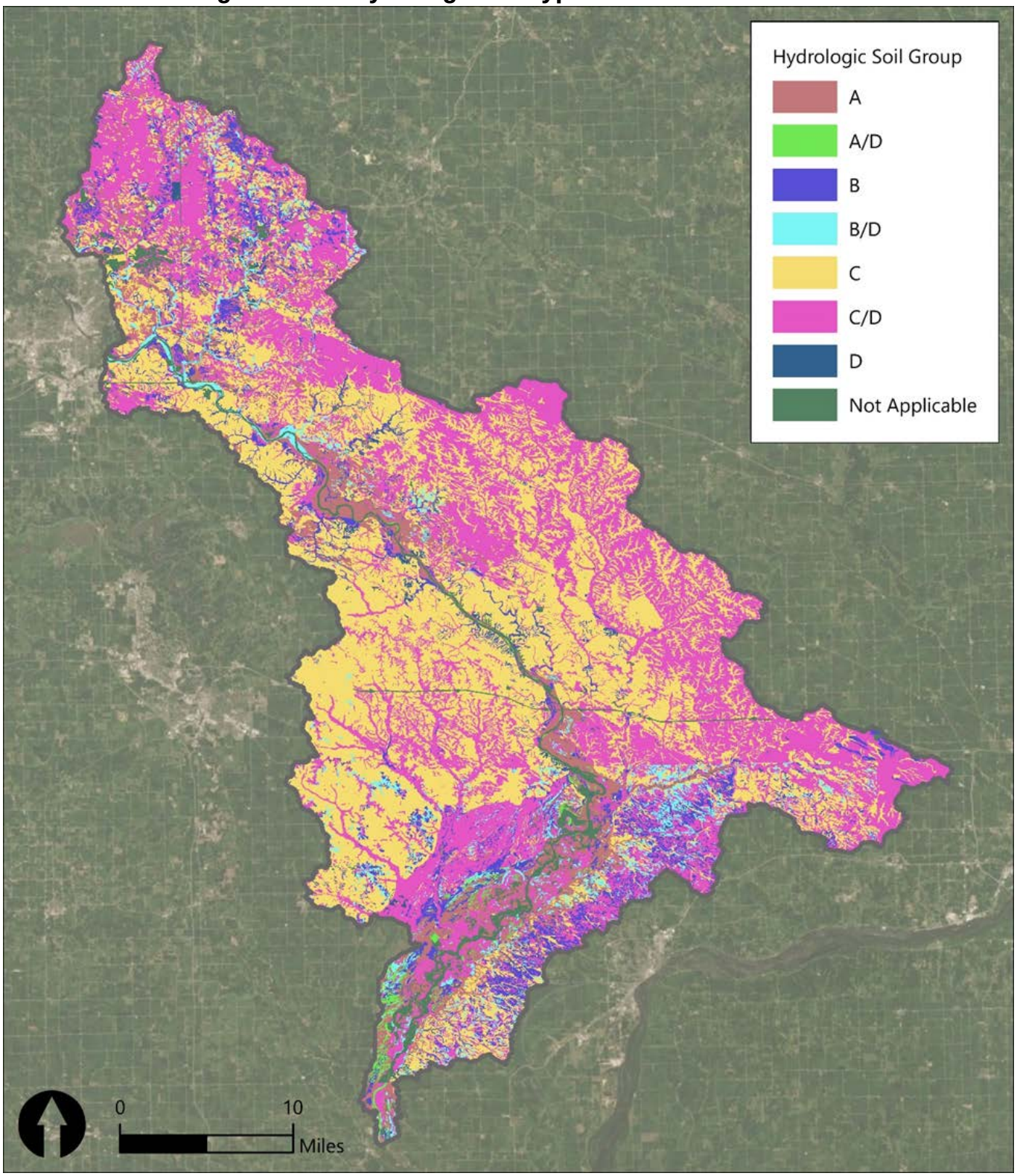


Figure 2-13. Hydrologic Soil Types in the Lower Cedar



2.8 Current & Historical Watershed Efforts

Indian Creek WMA

In 2012 the Indian Creek Watershed Management Authority (ICWMA) was formed, spanning a HUC-10 watershed in the northern reach of the Lower Cedar subbasin. ICWMA is a very active and successful WMA; they completed one of the first WMA comprehensive plans in 2015. The ICWMA watershed plan was an in-depth physical assessment of the Indian Creek Watershed that identified priority projects and was the foundation of engaging the local community to develop local solutions for their watershed and plan for 20 years. ICWMA plan is a valuable tool and will contribute to the baseline information available to inform the Lower Cedar watershed management plan. In 2018, the ICWMA submitted a successful proposal to the Iowa NRCS Iowa Partners for Conservation grant program and was awarded a grant to fund the Indian Creek Soil Health Coordinator position. The coordinator works with farmers and landowners to improve soil health on cropland within the Indian Creek Watershed by promoting best management practice adoption. The Lower Cedar WMA will leverage this farmer engagement to identify conservation leaders who could serve as mentors for producers across the watershed.

Mill Creek

In 2018, the Lower Cedar WMA submitted a request to the Iowa Soybean Association (ISA) to complete an in-depth watershed development project in the Mill Creek-Cedar River HUC 12 watershed. ISA granted the request and initiated a farmer-led watershed planning effort, utilizing the Agricultural Conservation Planning Framework tool, conservation assessment, watershed tillage assessment, and assessing stream conditions across the HUC-12 watershed. The project led to the development of a watershed plan and implementing best management practices to reduce nutrient loading in local waters within the Mill Creek HUC 12 Watershed. The assessments completed as part of the planning process were used to inform the overall Lower Cedar watershed management plan.

Mud Creek

During the years 2002 to 2007, the Muscatine SWCD led a watershed project on Mud Creek to increase riparian buffers, block cattle from having direct access to the stream, and increase the number of rotational grazing operations to improve soil health of pastures along Mud Creek, helping to decrease sedimentation into Mud Creek. This project was funded through a 319 grant and employed a coordinator.

Pike Run Creek

The Pike Run Creek watershed project in western Muscatine County was a 2-year long Muscatine County SWCD project in 2005-2007 that involved extensive water monitoring and outreach events. This project was funded through a 319 grant and employed a coordinator. Outreach events targeted farmers in the Pike Run Creek Watershed and were focused on educating farmers on practices to decrease nutrient loads of Pike Run Creek. In addition, Pike Run Creek is a biological reference stream.

City of West Branch

The City of West Branch has had a long history of engaging in watershed improvement, beginning with the Hoover Creek Watershed Project that wrapped up in 2012. That city has a "Stream Team" that meets periodically to discuss watershed improvements. In 2015, the city began working with USGS to complete a hydrologic study to identify solutions to chronic flooding issues in the downtown area. The study identified several projects that could alleviate flooding concerns.

Chapter Three
Assessment of Current Conditions

ASSESSMENT ▪ ENGAGEMENT ▪ ACTION

3.1 Water Quality & Pollutants of Concern

Impairments and Use Designations

The "impaired" designation is given when water quality monitoring indicates a water body is not capable of supporting its designated use. The designated use and impaired status of each stream segment, per the DNR 303d 2020 Integrated Report, is listed in Table 3-1. It is important to note that not all stream segments in the watershed have been assessed due to lack of sufficient monitoring data.

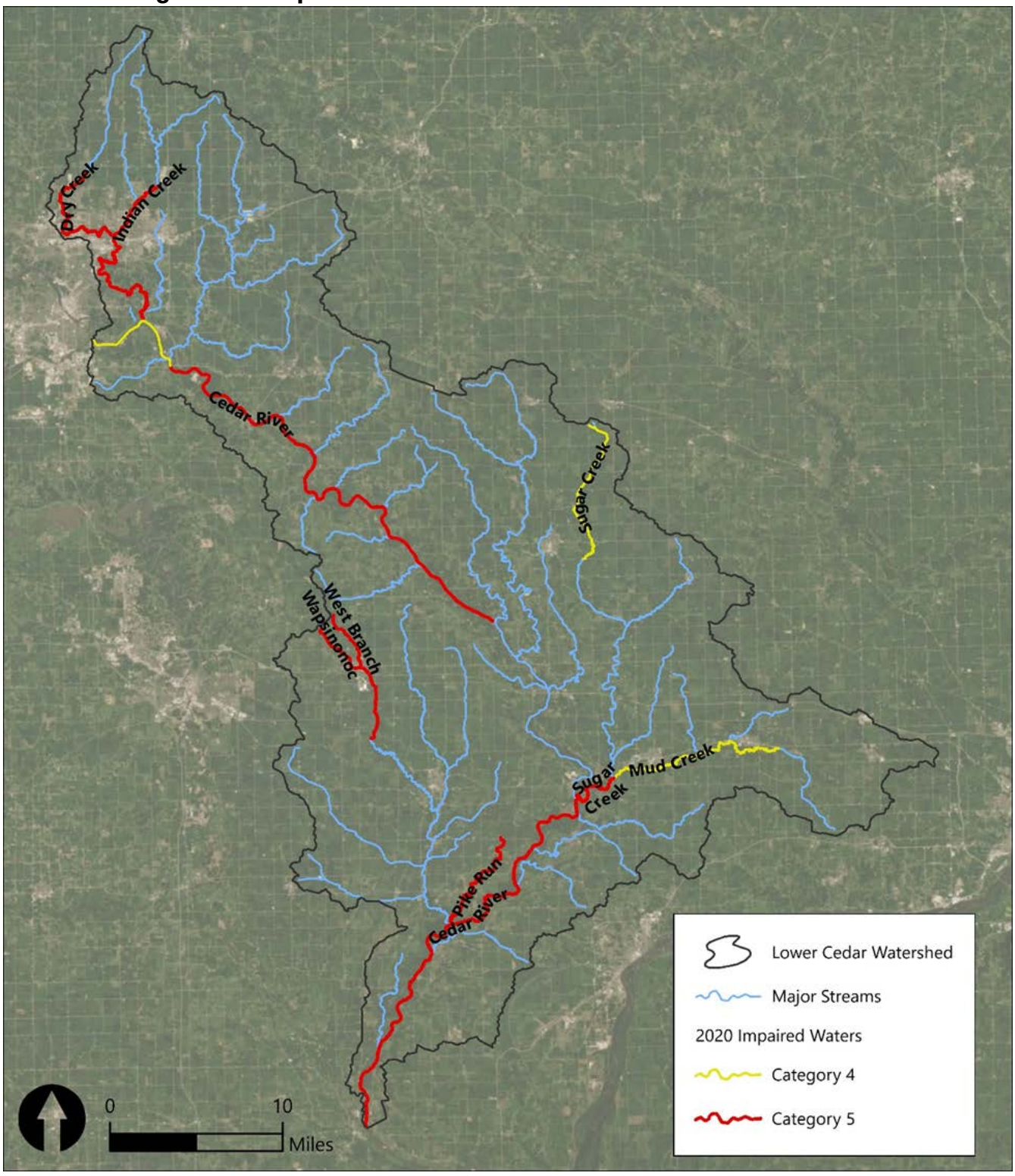
Table 3-1. Impairments and Designated Uses in the Lower Cedar

Waterbody	Segment ID	Designated Uses	Cause of Impairment	Impaired Use(s)	Overall IR Category	TMDL Tier
Indian Creek	504	Primary Contact Recreation (A1); Aquatic Life Support (BWW2)	Bacteria (*E.coli*), Biological	Primary Contact Recreation; Aquatic Life Support	5	III; IV
	505	Primary Contact Recreation (A1); Aquatic Life Support (BWW2)	Bacteria (*E.coli*)	Primary Contact Recreation	5	III
Dry Creek	507	Primary Contact Recreation (A1), Aquatic Life Support (BWW2)	Bacteria (*E.coli*)	Primary Contact Recreation	5	III
Pike Run	485	Primary Contact Recreation (A1), Aquatic Life Support (BWW1)	Biological	Aquatic Life Support	5	IV
	486	Primary Contact Recreation (A1), Aquatic Life Support (BWW2)	Biological	Aquatic Life Support	5	IV
Sugar Creek	489	Primary Contact Recreation (A1), Aquatic Life Support (BWW1), Human Health (HH)	Biological	Aquatic Life Support	5	IV
	492	Primary Contact Recreation (A1), Aquatic Life Support (BWW1)	Biological, Fish Kill	Aquatic Life Support	4	N/A
West Branch Wapsinonoc	6264	Primary Contact Recreation (A1), Aquatic Life Support (BWW1)	Bacteria (*E.coli*)	Primary Contact Recreation	5	III
Hoover Creek	6262	Primary Contact Recreation (A1), Aquatic Life Support (BWW1)	Bacteria (E.coli)	Primary Contact Recreation	5	III
Cedar River	451	Primary Contact Recreation (A1), Aquatic Life Support (BWW1), Human Health (HH)	Bacteria (*E.coli*), Biological	Primary Contact Recreation, Aquatic Life Support	5	IV
	452	Primary Contact Recreation (A1), Aquatic Life Support (BWW1), Human Health (HH)	Bacteria (*E.coli*), Biological	Primary Contact Recreation, Aquatic Life Support	4	III
	449	Primary Contact Recreation (A1), Aquatic Life Support (BWW1), Human Health (HH)	Bacteria (*E.coli*), Biological	Primary Contact Recreation, Aquatic Life Support	5	IV
Mud Creek	488	Primary Contact Recreation (A1), Aquatic Life Support (BWW2)	Biological	Aquatic Life Support	4	N/A

Source: Iowa Department of Natural Resources (https://www.iowadnr.gov/Portals/idnr/uploads/water/watershed/tmdl/files/planschedule.pdf).
Tier numbers (I, II, III, and IV) in Table 3-1 indicate priority level per the 2015 Long-Term Vision for Assessment, Restoration, and Protection under the Clean Water Act Section 303(d) Program, with "I" having highest and "IV" having lowest priority for development and implementation

Figure 3-1 is a map of the impaired streams that distinguishes impairment "category." Category 4 means the waterbody is impaired, but a TMDL is not required; the waterbody is not included on the state's section 303(d) list of impaired waters (Category 5 of the Integrated Report). While Category 5 is the state's Section 303(d) list of impaired waters; the waterbody is impaired, and a total maximum daily load (TMDL) is needed.

Figure 3-1. Impaired Waters in the Lower Cedar River Watershed



LCWMA Board members have expressed significant concerns about water quality conditions in the Lower Cedar. The Lower Cedar has a total of 18 impairments on 13 individual stream segments. Eight impairments are due to elevated bacteria, and nine are due to declining diversity of fish, mussels and/or other aquatic macroinvertebrates. One impairment is due to a fish kill (animal waste). A TMDL was developed in 2003 for a biologic impairment on Mud Creek, due to organic enrichment from wastewater treatment plant effluent and agricultural land uses. The impairments are summarized in Table 3.2

Table 3-2. TMDLs in the Lower Cedar Watershed

Waterbody	Indicator	Segments
Cedar River Watershed, Iowa	Bacteria, *E.coli*	02-CED-0110_3 02-CED-0110_2 02-SHL-0020_1 02_CED-0050-L_0 02-CED-0040_1 02-CED-0030_2 02-CED-0030_1 02-CED-0020_3 02-CED-0020_2
Mud Creek	Organic Enrichment	02-CED-0160-0

Primary Contact Recreation

According to the Iowa DNR, Primary Contact recreational use is defined as the water's recreation uses involve full body immersion with prolonged and direct contact with the water, such as swimming or water skiing. 8 of the 13 impaired streams were impaired for primary contact recreation use.

Aquatic Life Support

There are two different kinds of Aquatic Life Support use designations in the watershed. These are Class B(WW-1) and Class B(WW-2). Class B(WW-1) is defined as typically large interior and border rivers and the lower segments of medium-size tributary streams capable of supporting and maintaining a wide variety of aquatic life, including game fish while Class B(WW-2) is typically smaller, perennially flowing streams capable of supporting and maintaining a resident aquatic community, but lack the flow and habitat necessary to fully support and sustain game fish populations. These uses are defined by the Iowa DNR. 9 of the 13 impaired streams are impaired for the Aquatic Life use designation.

Spring Creek photo by Mary Beth Stevenson

Human Health

The Human Health use designated is defined as waters in which fish are routinely harvested for human consumption or waters both designated as public water supply and routinely harvested for human consumption. None of the waters in the Lower Cedar watershed are impaired for the Human Health use designation.

Source Water Protection

One of the intended outcomes of the watershed planning process is to raise awareness of the importance of source water protection and encourage the development of Phase 2 Source Water Protection Plans in communities with susceptible water supplies. Drinking water reports for communities in Iowa can be found here. A source water protection workshop was held in May 2021 to educate and connect communities with the resources available to assist them in developing source water protection plans. Seven communities have been deemed highly susceptible by Iowa DNR: Lisbon, Hiawatha, Springville, Marion, Muscatine, Cedar Rapids, and Mount Vernon. An additional seven other communities are at risk.

Table 3-3. Source Water Protection

Community	HUC 12	Nearby Streams
Lisbon	Spring Creek - Cedar River	Spring Creek
Hiawatha	Dry Creek	Dry Creek
Springville	Headwaters Big Creek	East Big Creek
Marion	Dry Creek, East Indian Creek - Indian Creek, Indian Creek, and Big Creek	Berry's Run, Dry Creek, Indian Creek, Squaw Creek
Muscatine	NA	NA
Cedar Rapids	Dry Creek, Indian Creek, Pleasant Run - Cedar River	Dry Creek, Indian Creek, Cedar River
Mount Vernon	Spring Creek - Cedar River	NA

3.2 Water Quality Monitoring

The Lower Cedar Watershed Management Authority conducted a water quality sampling and analysis. Samples were collected starting in 2020 by the University of Iowa State Hygienic Laboratory (SHL). Samples were taken monthly from July through November, except for October. A brief description of the 2020 sampling sites is given in Table 3-4. The 2020 sampling sites are represented on the map in Figure 3-2.

Table 3-4. Water Quality Sampling Sites in the Lower Cedar River Watershed

Waterbody	Site Name	Drainage Area (acres)	HUC12
Indian Creek	Indian Creek @ Mount Vernon Road SE	16,884	Indian Creek
Big Creek	Big Creek @ Secrist Road	28,603	Big Creek
West Branch Wapsinonoc	West Branch Wapsinonoc @ Beranek Park	36,037	West Branch Wapsinonoc Creek
Mill Creek	Mill Creek @ 180th Street NE	39,201	Mill Creek-Cedar River
Rock Creek	Rock Creek @ Stone Mill Road	17,910	Rock Creek
Pike Run	Pike Run @ Iron City Ave	23,075	Pike Run-Cedar River
Mud Creek	Mud Creek @ Moscow Ave / X54	22,980	Sugar Creek
Little Mosquito Creek	Little Mosquito Creek @ Moscow Creek	13,054	Little Mosquito Creek
Spring Creek	Spring Creek @ McClelland Road	20,320	Spring Creek-Cedar River
Clear Creek	Clear Creek @ 145th	17,817	Clear Creek

Water Quality Results

In addition to 2020 data, historical stream monitoring data from 2005-2019 was compiled and used to summarize water quality conditions across the watershed. Data sources include

County Snapshot Monitoring

- Cedar County
- Muscatine County
- Scott County

Iowa DNR Ambient Stream Monitoring

- Cedar River downstream of Cedar Rapids at Palisades Kepler Park
- Cedar River near Conesville
- Cedar River at Cedar Bluff

USGS

- Water quality monitoring in the City of West Branch
- Stream gage on Indian Creek in Marion (USGS 05464695, 2012 to Present)
- Numerous river gages

University of Iowa – IIHR

- Continuous stream water quality monitoring device upstream near Conesville
- Numerous bridge water level sensors

Iowa DNR Biologic Monitoring

- Ambient biological sites
- Regional Environmental Monitoring and Assessment Program (REMAP)

Other Monitoring

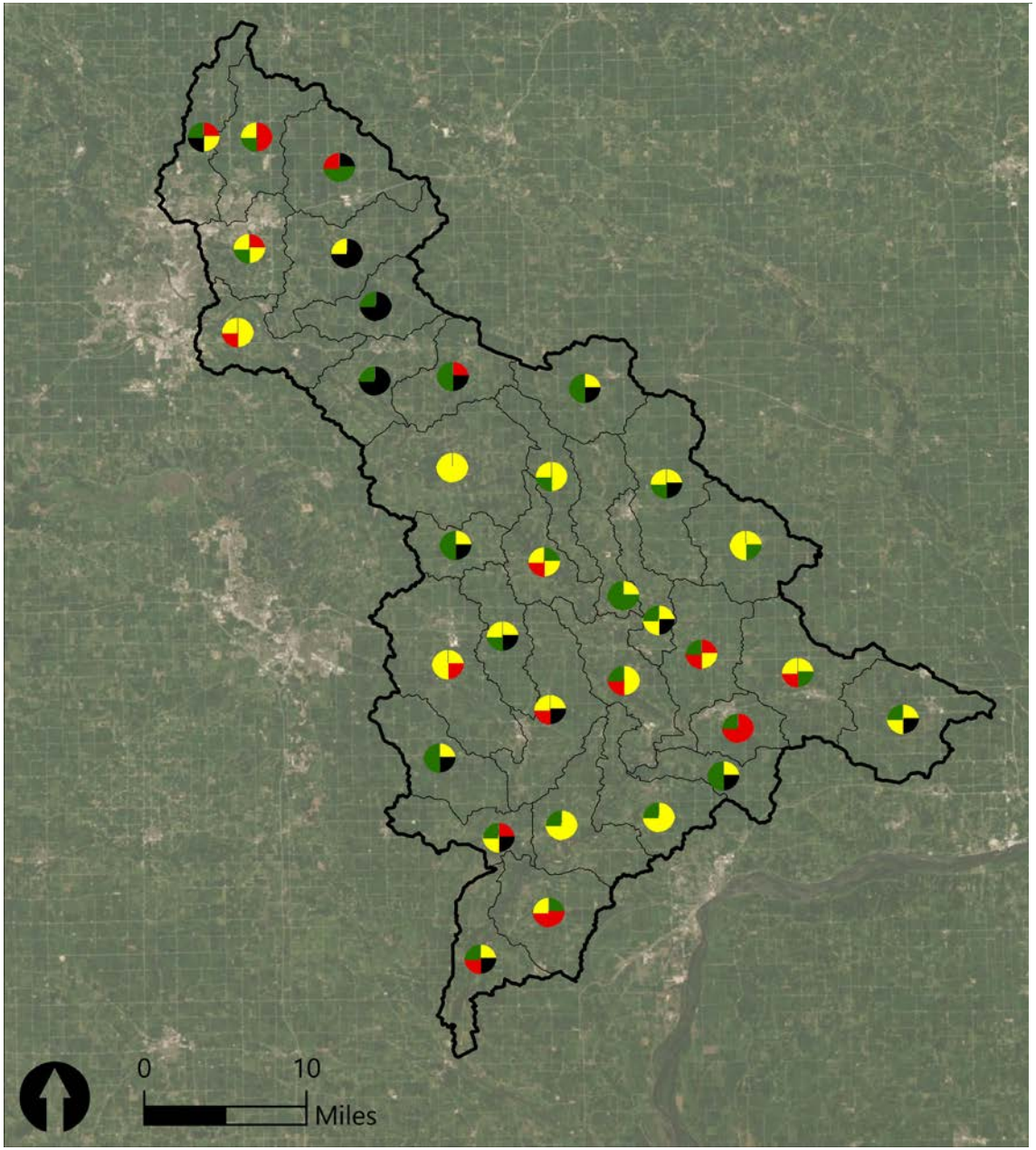
Various TMDL and prior watershed plan monitoring, including Dry creek, Indian Creek, and Hoover Creek

Table 3-5. Summary of 2020 Water Quality Monitoring Results

HUC12	Site	*E.Coli* (cfu/100 mL)	Turbidity (NTU)	TP (mg/L)	TN (mg/L)
070802060103	Indian Creek	1,015	17.1	0.14	2.4
070802060203	Big Creek	3,078	12.5	0.14	4.8
070802060302	Rock Creek	4,559	14.7	0.18	3.4
070802060402	Clear Creek	1,670	32.1	0.21	3.3
070802060403	Spring Creek	5,056	21.5	0.18	2.8
070802060405	Mill Creek	7,262	32.3	0.20	2.5
070802060603	Mud Creek	2,699	33.5	0.22	2.6
070802060702	West Branch Wapsi	1,585	217.0	0.25	2.4
070802060802	Little Mosquito Creek	6,111	37.3	0.20	2.6
070802060805	Pike Run	300	7.1	0.30	0.8

Source: Samples from University of Iowa State Hygienic Lab

Figure 3-2. 2005-2019 Water Quality



2005 - 2019 Nitrate + Nitrite Concentration (mg/L)

- < 5
- 5 - 10
- > 10

2005 - 2019 Total Phosphorus Concentration (mg/L)

- NA
- < 0.18
- 0.18 - 0.26
- > 0.26

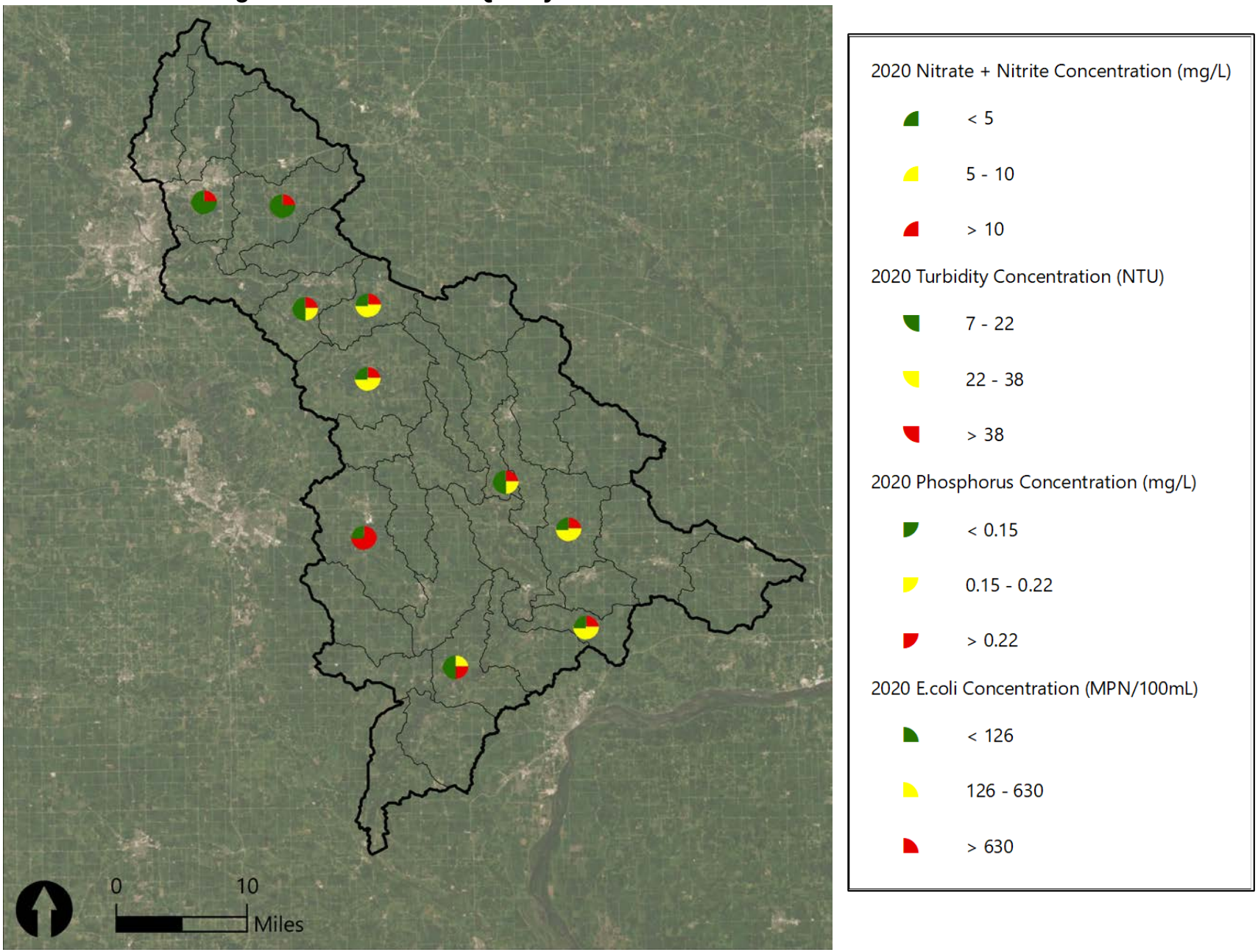
2005 - 2019 Turbidity Concentration (NTU)

- NA
- < 12
- 12 - 28
- > 28

2005 - 2019 E.coli Concentration (cfu/100mL)

- NA
- < 126
- 126 - 630
- > 630

Figure 3-3. 2020 Water Quality Data



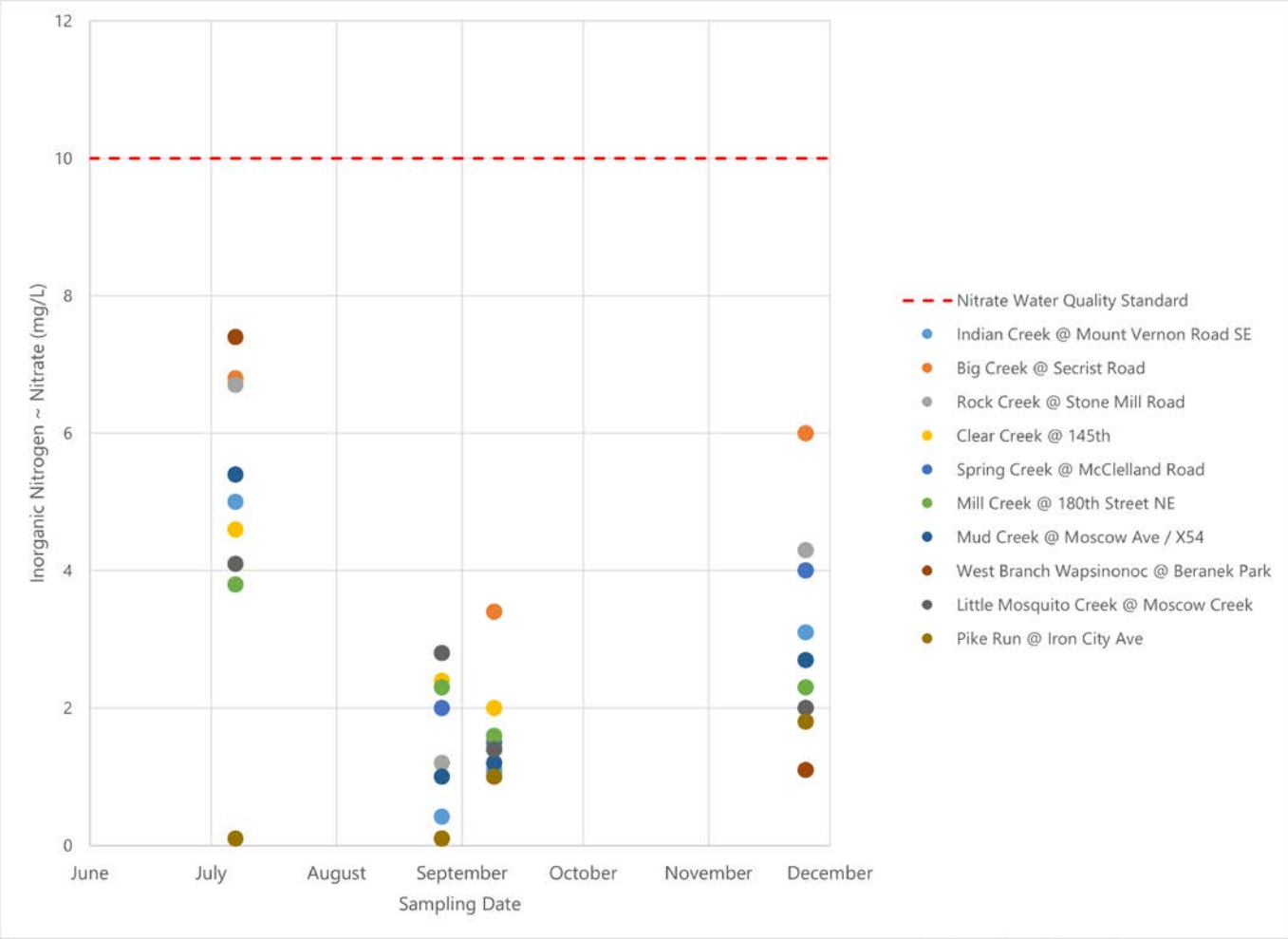
Pollutants of Concern

The pollutants of concern in the Lower Cedar watershed include nitrogen, phosphorus, *E.coli*, and sediment. A description of each pollutant of concern and the sampling results are provided in the following sections.

Nitrogen

Nitrogen is a nutrient that is critically important for plant growth. Nitrate nitrogen is the dominant dissolved form with typically very small amounts of nitrite nitrogen present. While nitrate is one of the primary forms of nitrogen used by plants for growth, excess amounts in groundwater and streams can cause concerns for human health and aquatic life. Nitrogen is also one of the primary contributors to low oxygen areas resulting from algae blooms, such as the Gulf of Mexico hypoxic zone. Sources of nitrogen to the environment include fertilizer, animal manure, and legumes such as soybeans. Monitoring in the Lower Cedar watershed focused on nitrate nitrogen (NO_3-N) with concentrations that vary seasonally from biological activity and nutrient inputs like fertilizer, wastewater, and urban runoff.

Figure 3-4. 2020 Inorganic Nitrogen Water Quality Sampling

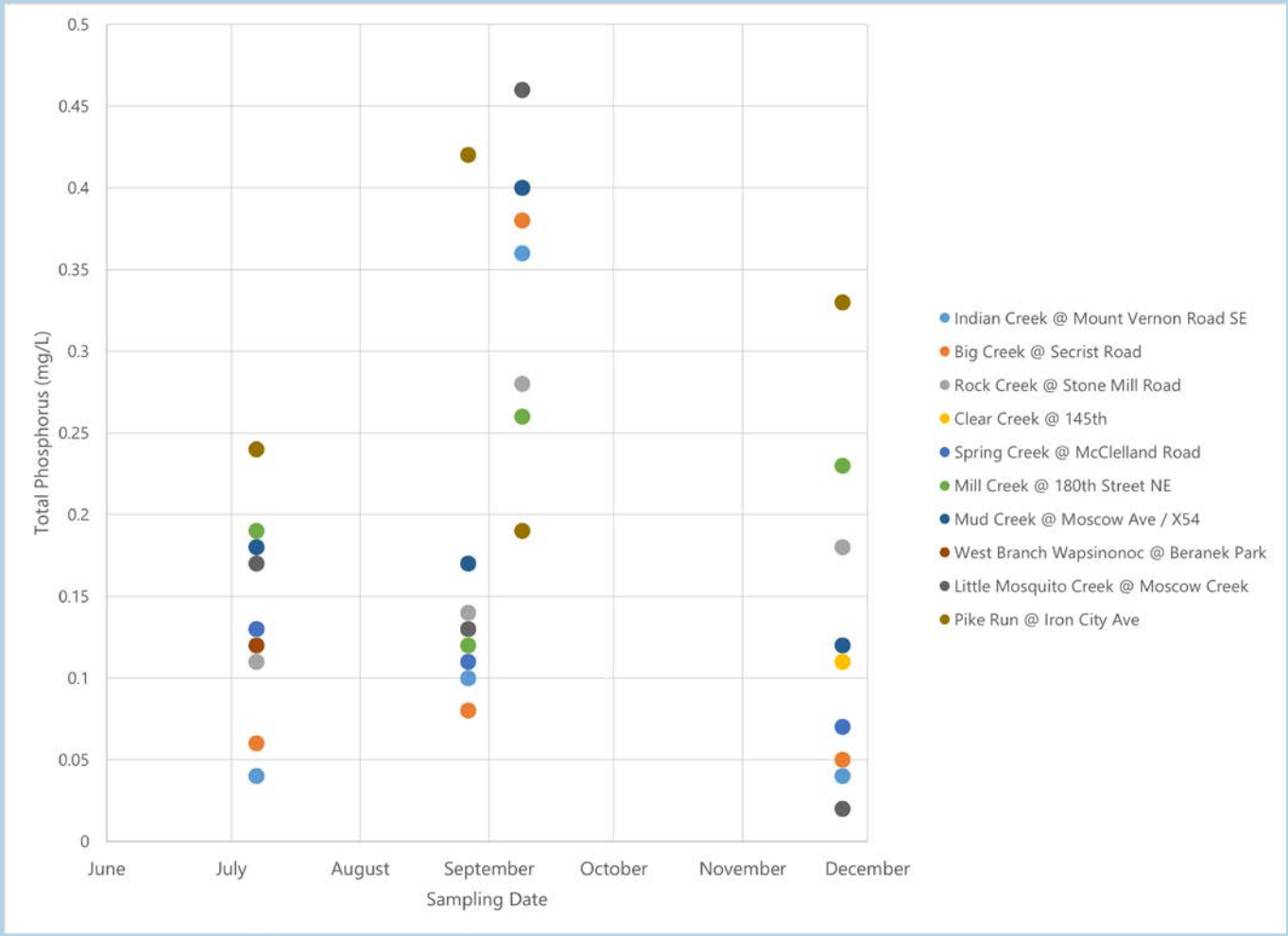


Source: University of Iowa State Hygienic Lab

Phosphorus

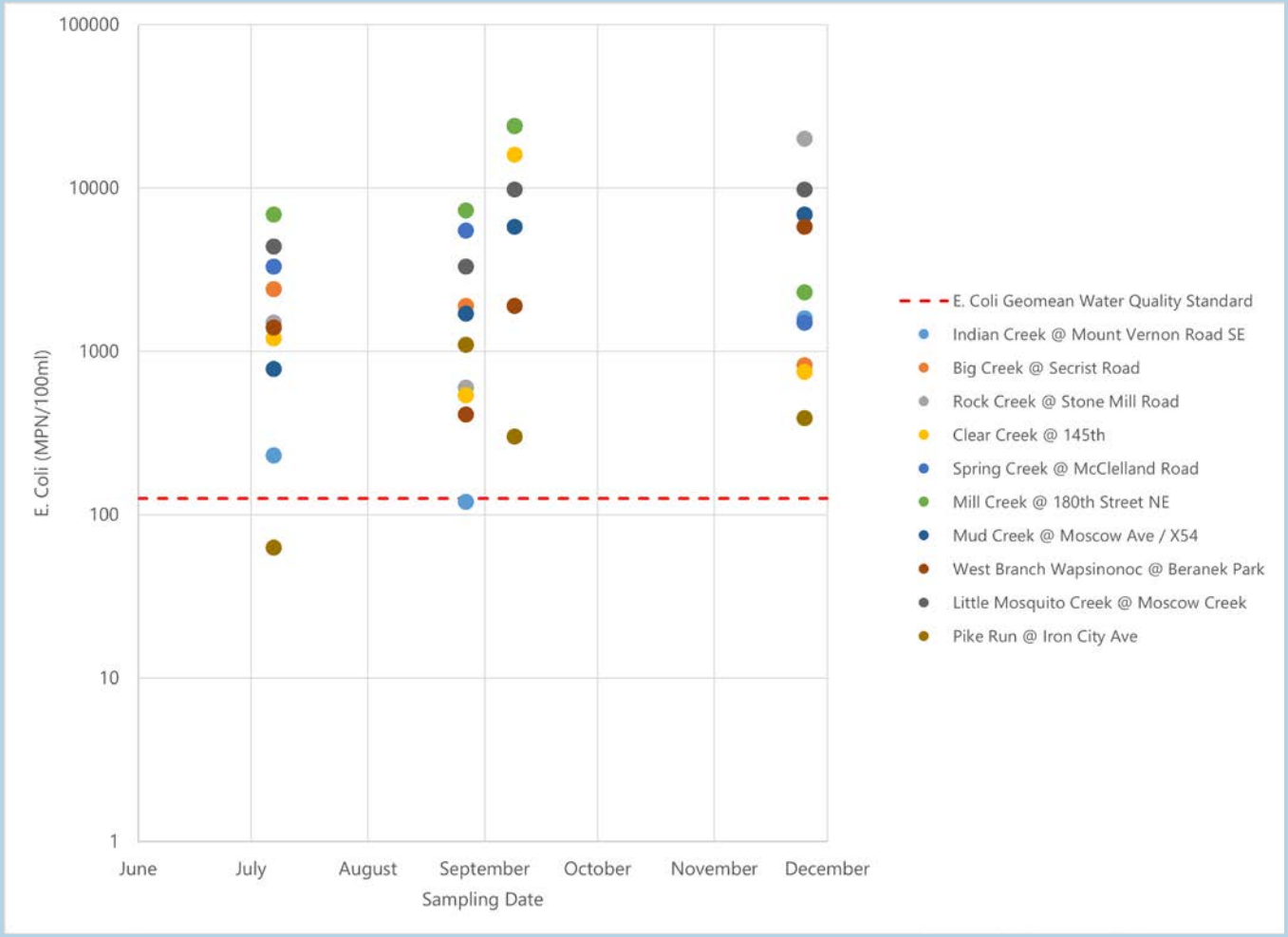
Phosphorus is also a primary nutrient for plant growth on the land and in the water. Reducing phosphorus loading to waterways is a primary focus of watershed management due to the role of this element in creating algae blooms. In severe cases, massive algal mats and scum can be generated by blue-green algae (cyanobacteria) that also can produce toxins such as microcystin that can affect wildlife and drinking water supplies. Phosphorus is typically monitored in two forms: dissolved phosphorus in forms most readily used by crops as well as aquatic plants resulting in increased productivity; and total phosphorus found in both dissolved and particulate forms. The primary sources of excess phosphorus in waterways include sediment from erosion, manure, sewage, and fertilizers.

Figure 3-5. 2020 Total Phosphorus Water Quality Sampling



Source: University of Iowa State Hygienic Lab

Figure 3-6. 2020 *E. Coli* Water Quality Sampling

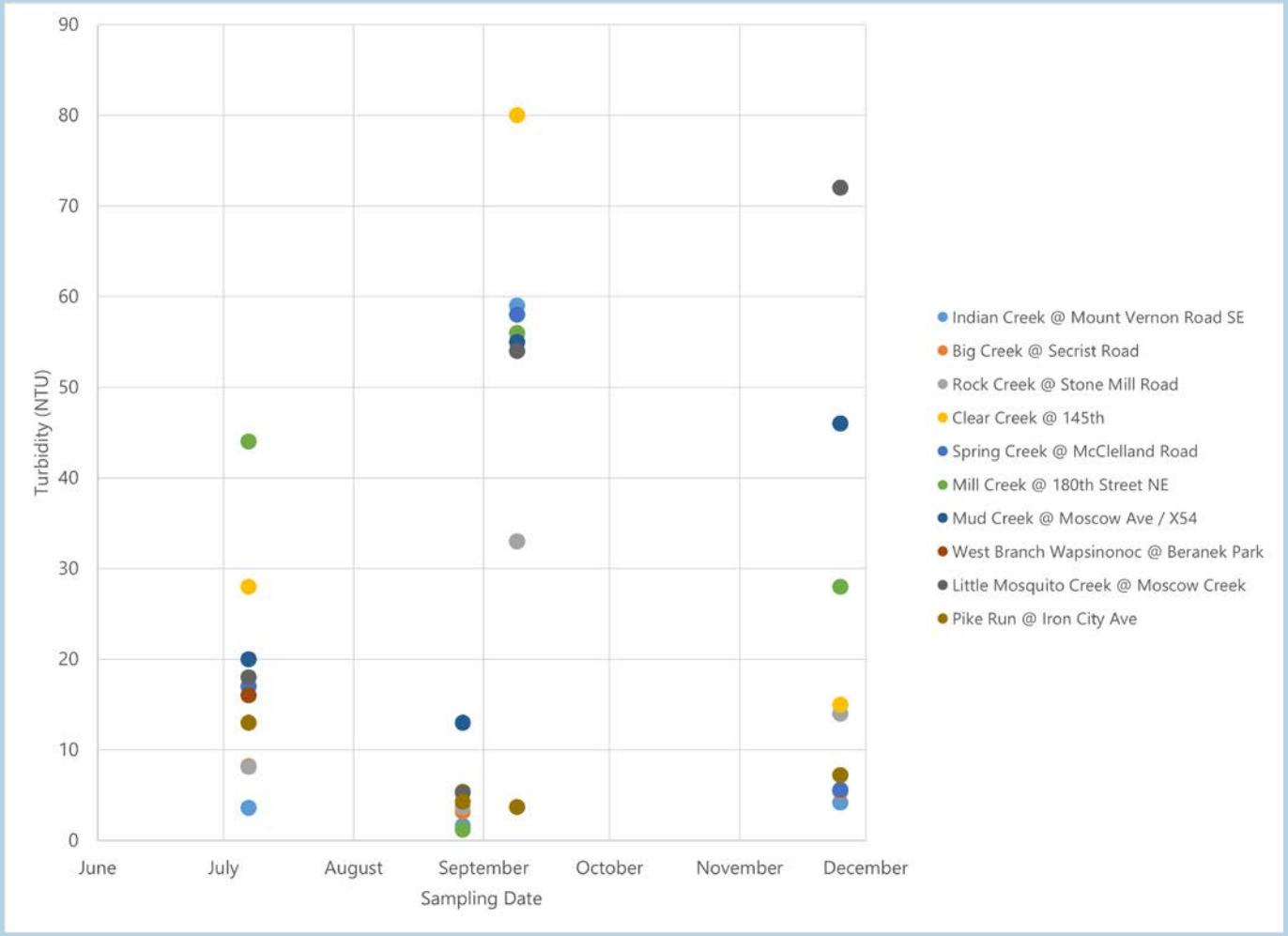


Source: University of Iowa State Hygienic Lab

Sediment

Turbidity is caused by materials suspended in water such as soil, algae, plankton, and microbes. As more sediment is suspended in the water, less light can pass through, making it less transparent. High turbidity is a condition that is rarely toxic to aquatic animals, but it indirectly harms them when solids settle out and clog gills, destroy habitat, and reduce the availability of food. Sediment in streams also magnify solar heat increasing water temperatures and reducing light penetration, which reduces photosynthesis, both of which contribute to lower dissolved oxygen. Sediment can also carry nutrients (phosphorus) attached to the particles, which can have harmful environmental effects. Sources of suspended particles in the Lower Cedar watershed may include soil erosion, sewer/septic discharge, manure, urban runoff, eroding stream banks, and excess algal growth.

Figure 3-7. 2020 Turbidity Water Quality Sampling



Source: University of Iowa State Hygienic Lab

3.3 Subwatershed Prioritization

A key objective of this watershed plan is to capture general conditions, issues, and needs related to water quality, ecology, flood reduction/protection, and other resource concerns across the entire HUC-8 watershed. Another major objective of the plan was to identify a list of high priorities and conduct more detailed assessment and implementation planning in the three highest priority subwatersheds (HUC-12 watersheds). The subwatershed prioritization approach included both quantitative and qualitative considerations from technical (data-driven), socio-political (stakeholder and public interest), and economic (costs, benefits, and available funding) perspectives.

The prioritization utilized the Recover Potential Screening (RPS) Tool developed by the EPA to compare watershed condition and restorability (https://www.epa.gov/rps). This tool uses data compiled by both state and federal agencies to compare watersheds using three sets of indicators: Stressors, Ecological, and Social. The tools are customizable in that watershed-specific data can be added by the user.

Stressor Indicators include watershed characteristics that often stress or have a negative impact on water quality. Examples of stressors include steep slopes, erodible soils, high concentration of nutrient sources. Ecological Indicators are traits that typically provide rich and resilient ecosystems and habitats, such as the percent of the watershed with a perennial grass or forest land cover and measures of desirable/native biological species density and diversity. Social Indicators measure the level of support that exists within subwatershed from stakeholders and potential funding and/or technical partners.

The planning team selected a suite of RPS Tool indicators specific to the three pollutants of concern: phosphorus, nitrogen, and *E. coli*. These are common pollutants of concern in the Lower Cedar and most of Iowa. Iowa's Nutrient Reduction Strategy (NRS) includes phosphorus and nitrogen reduction goals, and many stream impairments in the Lower Cedar stem from high levels of *E. coli* bacteria. Sediment prioritization was not explicitly assessed because most of the indicators that drive phosphorus prioritization apply to erosion and sediment transport as well.

Table 3-6. Summary of Recover Potential Screening Indicators

Pollutant	Stressor	Ecological	Social
Phosphorus	% Cropland on > 10% Slope in WS	% Wetlands in WS	% Protected Land
	Soil Erodibility, Mean in WS	% Rare Ecosystem in WS	USDA Conservation Reserve Program Area in WS
	Livestock Density (AEU) in WS	% Natural Cover in HCZ	% Conservation Easement in WS
	% Corn and Corn/Soy Rotations in WS	Mean Benthic Macroinvert IBI in WS	Nonpoint Control Projects Count
	TP Load from Major Dischargers in WS		Phosphorus Monitoring Density
Nitrogen	% Agriculture on Hydric Soil in WS	% Wetlands in WS	% Protected Land
	% Nonbuffered Agriculture in WS	% Rare Ecosystem in WS	USDA Conservation Reserve Program Area in WS
	Synthetic N Fertilizer Application in WS	% Natural Cover in HCZ	% Conservation Easement in WS
	% Corn and Corn/Soy Rotations in WS		SWP Susceptibility Score
	TN Load from Major Dischargers in WS	Mean Benthic Macroinvert IBI in WS	Nonpoint Control Projects Count
	% Tile Drained Soil in WS		
E.coli	Manure Application in WS	% Wetlands in WS	% Protected Land
	Livestock Density (AEU) in WS	% Rare Ecosystem in WS	USDA Conservation Reserve Program Area in WS
	Septic System Count in WS	% Natural Cover in HCZ	% Conservation Easement in WS
	% Pasture/Hay in RZ	Mean Benthic Macroinvert IBI in WS	SWP Susceptibility Score
			Nonpoint Control Projects Count

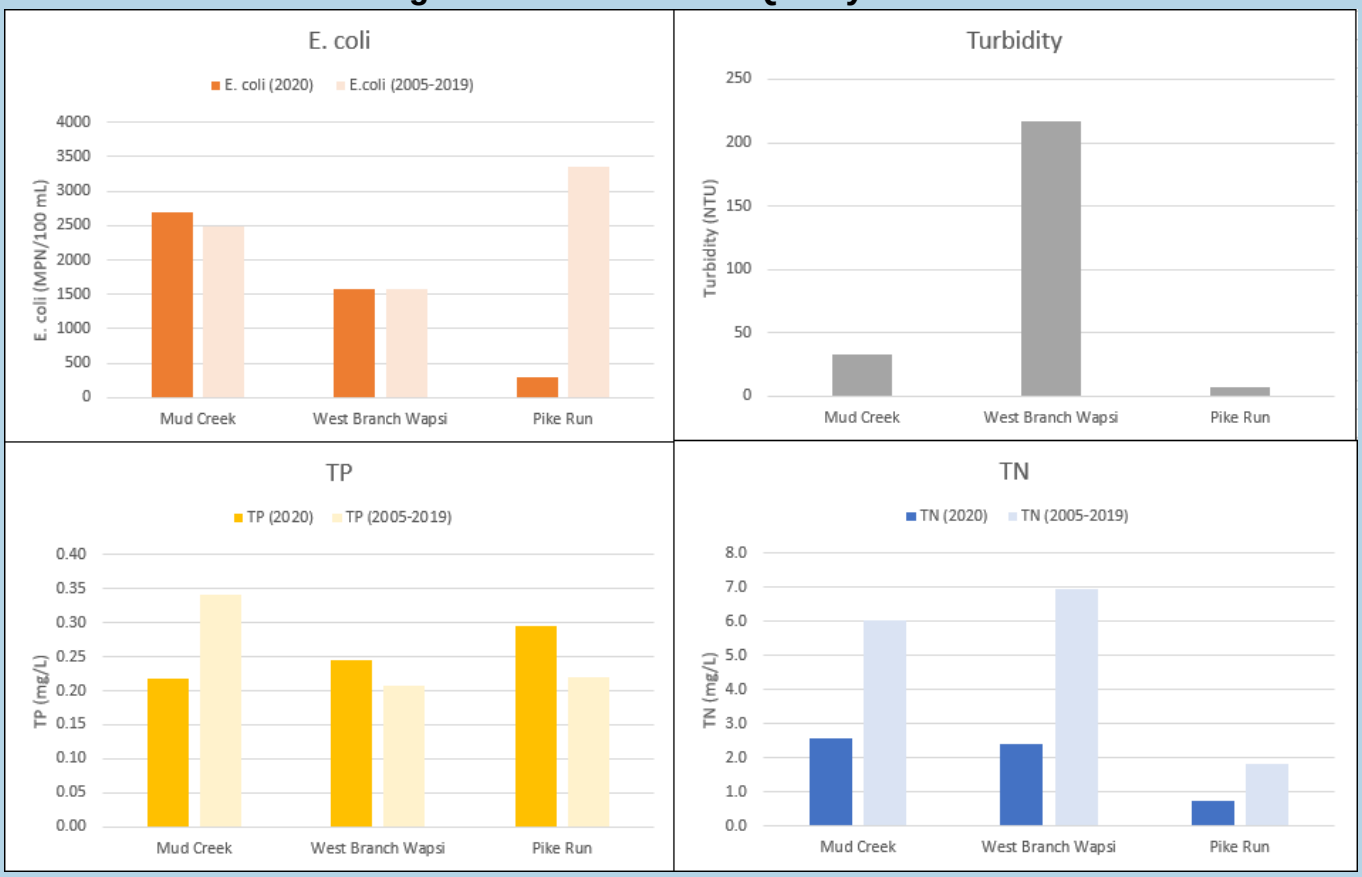
The planning team also considered water quality results (Section 3.2) and stakeholder input and feedback collected through an online outreach and engagement tool called Social Pinpoint. Collectively, WMA members, the TAC, stakeholders, and the water quality and RPS Tool results produced a preliminary list of Priority and High Priority subwatersheds and supporting rationale (Table 3-7).

Table 3-7. Priority Subwatersheds, Supporting Rationale, and Concerns

High Priority Subwatershed	Rationale (Concern)	Priority Waterbody	Rationale
Pike Run	Improvement (nutrients) Protection (aquatic habitat)	Upper Mud Creek	Improvement of water quality and aquatic habitat
West Branch Wapsi	Improvement (flooding) Improvement (bacteria)	East Branch Wapsi	
Middle Mud	Improvement (sediment and phosphorus)	Cedar River – Buchanan	
Wapsinonoc Creek	Improvement (flooding) Improvement (nutrients)	Clear Creek	
Spring Creek	Improvement (bacteria) Protection (natural land cover)	Nicholson Creek	
Crane Creek	Improvement (bacteria) Protection (existing wetlands)	Abbe Creek	Protection of desirable water quality and/ aquatic habitat and ecology)
Dry Creek	Improvement (bacteria)	Headwaters Big Creek	
Pleasant Run	Improvement (phosphorus)	Bennett Creek	
East Indian	Improvement (nitrates) Improvement (bacteria)	Little Mosquito Creek	
Rock Creek	Improvement (nitrogen) Improvement (bacteria)		

Detailed watershed assessments and implementation plans are included as separate appendices for the top three priority watersheds selected from the list in Table 3-7: Middle Mud Creek, West Branch Wapsinonoc, and Pike Run. Mean water quality results from these streams are provided in Figure 3-8.

Figure 3-8. Mean Water Quality Results



Source: 2020 sampling by University of Iowa State Hygienic Lab & IDNR stream monitoring

Chapter Four
Goals & Objectives

ASSESSMENT ■ **ENGAGEMENT** ■ ACTION

4.1 Goals & Objectives

4.1 Goals and Objectives

Goals and objectives for the Lower Cedar Watershed Management Plan were developed through an iterative process involving watershed stakeholders, the LCWMA Board, and the Tech Team. The LCWMA Board provided some context from a local government perspective that helped connect them to local physical and political conditions. The Tech Team reviewed the watershed assessment data and further refined the goals, objectives and implementation strategies based on the assessment and the resource concerns identified at the start of the planning process.

Organizational Goal

To establish the Lower Cedar Watershed Management Authority as a leader and advocate for local solutions to water quality and flooding concerns. This will be accomplished working cooperatively with stakeholders to establish partnerships and shared resources to implement the Lower Cedar Watershed Management Plan.

Flood Risk Management Goal

To protect the floodplain and reduce peak flows observed in the historic record through the following objectives:

1. Recommend that communities reduce stormwater from impervious areas and protect local floodplains by encouraging infiltration practices and undertaking flood mitigation projects to protect critical infrastructure.
2. Encourage communities to participate in the National Flood Insurance Program (NFIP) and its Community Rating System (CRS) and increase their CRS score.
3. Recommend policy changes to protect open space and floodplain for people and wildlife by educating policy makers about flood impacts of various land uses.
4. Encourage the development and adoption of a future development ordinance to limit development in the floodplain.
5. Engage with agricultural landowners by implementing a combination of conservation practices to reduce peak flows.

Water Quality Goal

To protect and improve surface and ground water in the Lower Cedar Watershed through the following objectives:

1. Follow Iowa's Nutrient Reduction Strategy guidance to implement conservation practices that reduce N and P load by 45% in average flow conditions to meet benchmark indicators for aquatic life.
2. Encourage & implement practices that reduce in-stream *E.coli* levels to meet the waterbodies' designated use and protect human health.
3. Encourage & implement practices that treat disproportionally high soil erosion areas delivering sediment to waterbodies.
4. Encourage & implement Stormwater management practices that will infiltrate runoff up to a 2.5-inch rain event (the channel protection volume) as recommended in the Iowa Stormwater Management Manual. Model ordinances are available from the Iowa Stormwater Education Partnership.

Habitat & Recreation Goal

To create healthy watershed function that protects the unique habitat of the Lower Cedar River Watershed and enhances recreation and public health through improved water quality through the following objectives:

1. Increase the quantity and quality of habitat to support an abundance of terrestrial, aquatic, and avian wildlife in the watershed.

2. Encourage the implementation of the recommended actions from the Lower Cedar River Conservation Action Plan produced by The Nature Conservancy in 2008.

3. Promote and improve existing recreational resources such as park amenities, trails, and stream access.

Plain Pocketbook mussel found in Indian Creek
Photo Credit: David Kesler

Black Sand Shell mussels found in Indian Creek
Photo Credit: David Kesler

Lower Cedar River – Photo Credit: Holly Howard

Chapter Five
Social Assessment

ASSESSMENT ▪ **ENGAGEMENT** ▪ ACTION

Completing a social assessment of the Lower Cedar watershed stakeholders was one of the priorities of the planning process. The COVID-19 pandemic changed some of the outreach methods due to social distancing recommendations. Despite that, several methods were modified to reach key stakeholders including farmers and agricultural landowners, WMA Board members, community representatives and local emergency management administrators. This chapter will summarize the methods and stakeholder input.

5.1 Lower Cedar Outreach Methods

FYRA and ECICOG established two websites as outreach tools to use during the planning process to engage the watershed community and stakeholders.

- Lower Cedar Watershed Management Authority website https://lowercedar.weebly.com
- Social Pinpoint project website https://fyra.mysocialpinpoint.com/lower-cedar-wma-plan which housed multiple surveys and an interactive project map that allows for community member engagement and input

5.2 Lower Cedar Stakeholder Events

A series of workshops were held throughout 2021, resulting in the identification of high-priority resource concerns and actions for improving the watershed. Workshop participation was strong, averaging 25 – 30 residents, public officials/staff, non-profit organizations, and academic institution staff interested in watershed improvement projects.

Agriculture Field Day

As part of the Soil Health Partnership in the Indian Creek watershed, a field day at Curt Zingula's farm was held in June 2021 with about 50 in attendance. The event featured presentations by agricultural conservation specialists and the conservation station, which is a trailer with several land cover plots, that demonstrate rainfall impact on soil erosion. The attendees toured a perennial ground cover plot and a saturated buffer in a neighboring field. The photo to the right was taken at the event.

Photo Credit: Emery Davis, Indian Creek Soil Health Coordinator

Women Caring for the Land Workshop

The Indian Creek Soil Health Partnership sponsored a virtual workshop for 22 women landowners in March 2021 through the Women, Food, & Agriculture Network (WFAN) and its Women Caring for the Land program.
A significant percentage of Iowa farmland is owned by women and WFAN research has shown that these landowners have land management concerns but aren't sure what to do about them. This event gives women the opportunity to take in information they need and feel empowered to do something with it.

Invitation Design by Brittany Rempe, ECICOG

Women who own or manage farmland learned how to assess the health of their soils and improve it with cover crops and other conservation best practices. The meeting included presentations by resource professionals and a panel of landowner women discussing their conservation practices and working with tenants.

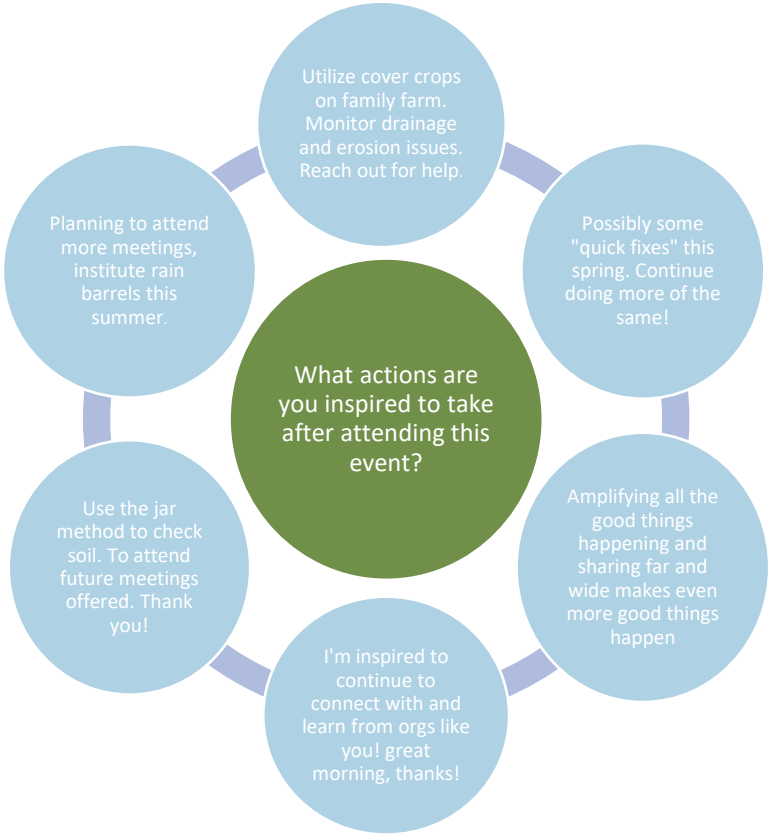
For over a decade, WFAN has organized fun and informative meetings for women landowners to discuss their land management goals and how they can take care of their land.

WFAN conducted before and after surveys and asked for feedback on the workshop. The results are shown in Figure 5-1 and Figure 5-2.

Figure 5-1. Participant Survey Responses

Source: Women, Food and Agriculture Network

Figure 5-2. Participant Survey Responses



Source: Women, Food and Agriculture Network

Agriculture Focus Groups

Focus groups were held virtually due to the COVID-19 pandemic. There were three meetings on March 24th and April 1st with a total of 12 participants representing landowners, farm operators, SWCDs and a local earth moving contractor. The online focus groups were a conversation about where they live or farm in the watershed using an interactive map. Each participant described the conservation they currently do and whether they were interested in other practices.

In general, they observed that conservation practices tended to be in "neighborhoods" where landowners influence each other. There was also agreement that both flooding and erosion have worsened in the watershed over the past 30 years. This is evident in the survey results of the agricultural focus group participants shown in Figure 5-3. In comparison, the results of an email survey of cities in the watershed reveal that flooding and water quality were their top concerns (Figure 5-4). The full responses to the city email survey are included in Appendix A.

Figure 5-3. Ag Issues of Concern

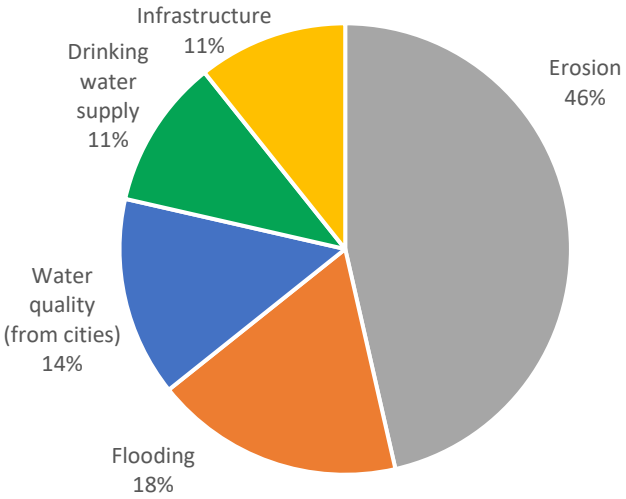
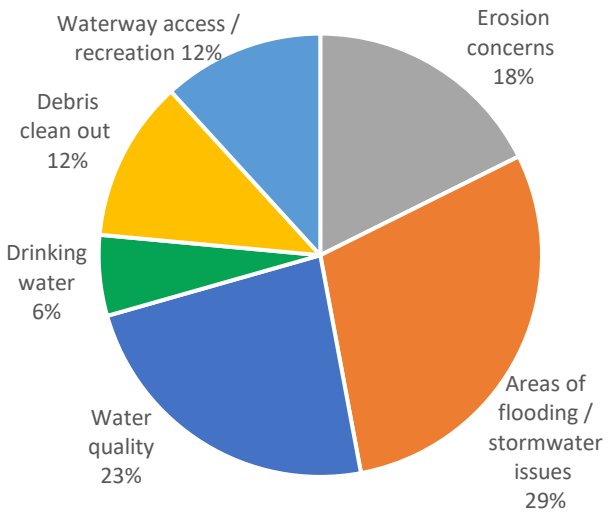
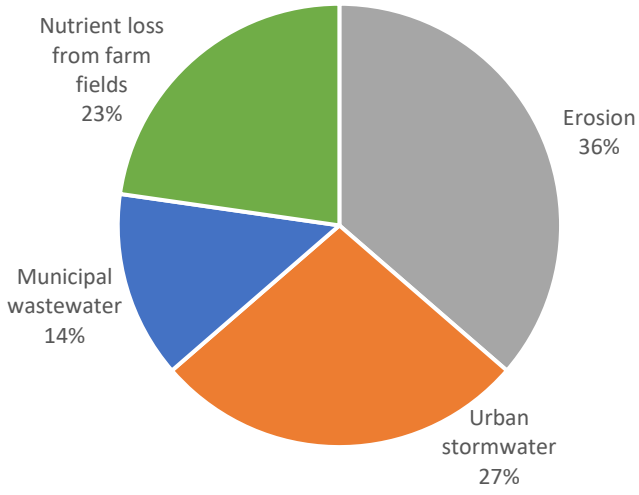


Figure 5-4. City Issues of Concern



The other theme was that the ag focus group participants wanted everyone to be part of the solution to water quality concerns. They perceived runoff and wastewater from cities as significant sources of pollutants and should bear some of the burden to make improvements. Figure 5-5 depicts the sources of pollutants from the point of view of agricultural focus group participants.

Figure 5-5. Ag Sources of Pollutants



Community Source Water Protection Workshop

On May 11, 2021, all the cities in the Lower Cedar watershed were invited to a virtual Source Water Protection Workshop. There were 13 participants to hear staff from the Department of Natural Resources, Iowa Rural Water Association, and the Natural Resources Conservation Service describe how they can assist communities with their source water concerns.

Iowa DNR: Phase 2 Protection Plan

The Iowa DNR Source Water Protection Program is a voluntary program designed to help a community proactively address drinking water quality and quantity concerns.

Iowa Rural Water Association (IRWA) Assistance for Small Communities

IRWA offers assistance to communities to develop and assist in implementation of source water protection plans. Three community examples highlighted the type of assistance available.

Natural Resources Conservation Service Source Water Protection Initiative

As of June 2022, Iowa NRCS is providing 10% of the 2018 Farm Bill program funding for financial assistance for farmers and private landowners to implement water quality practices. The eligible practices include nutrient management, conservation cover, filter strips, cover crops, no-till, denitrifying bioreactors, saturated buffers, and wetlands.

Hazard Mitigation Workshop

A virtual workshop was held on September 30, 2021, with 14 participants including at least one representative from each county emergency management office in attendance. The workshop's goal was to inform County Emergency Management Administrators (EMAs) about the Lower Cedar Watershed Management Plan development and gather input on priority hazard mitigation concerns and project opportunities. Iowa Homeland Security & Emergency Management staff provided an update on funding opportunities. Each County EMA gave an update on their Hazard Mitigation Plan status and watershed related priorities, mitigation strategies, and action items. Those updates are captured below:

Johnson County:

- The Cedar River flooding in 2008 and 2016 caused damage in Sutliff and led to floodproofing and property buyouts
- The Johnson County Conservation Board has done extensive wetland restoration in this area which helps with flooding.
- Flash flooding from new development in Lone Tree is an issue

Linn County:

- Buyouts and other flood mitigation in Cedar Rapids and Marion after flood events
- Smaller cities have some occasional flooding – mostly roadway overtopping

Louisa County:

- Most of the flooding is caused by the Iowa River, but actions on the Cedar River will help
- The levee was decertified – improved the levee to change the flood map back to where it was before discharges were increased
- All potential buyouts have already happened

Cedar County:

- Implemented many buyouts on repetitive loss properties
- West Branch has a lot of repetitive damages and is a priority for mitigation efforts

Muscatine County:

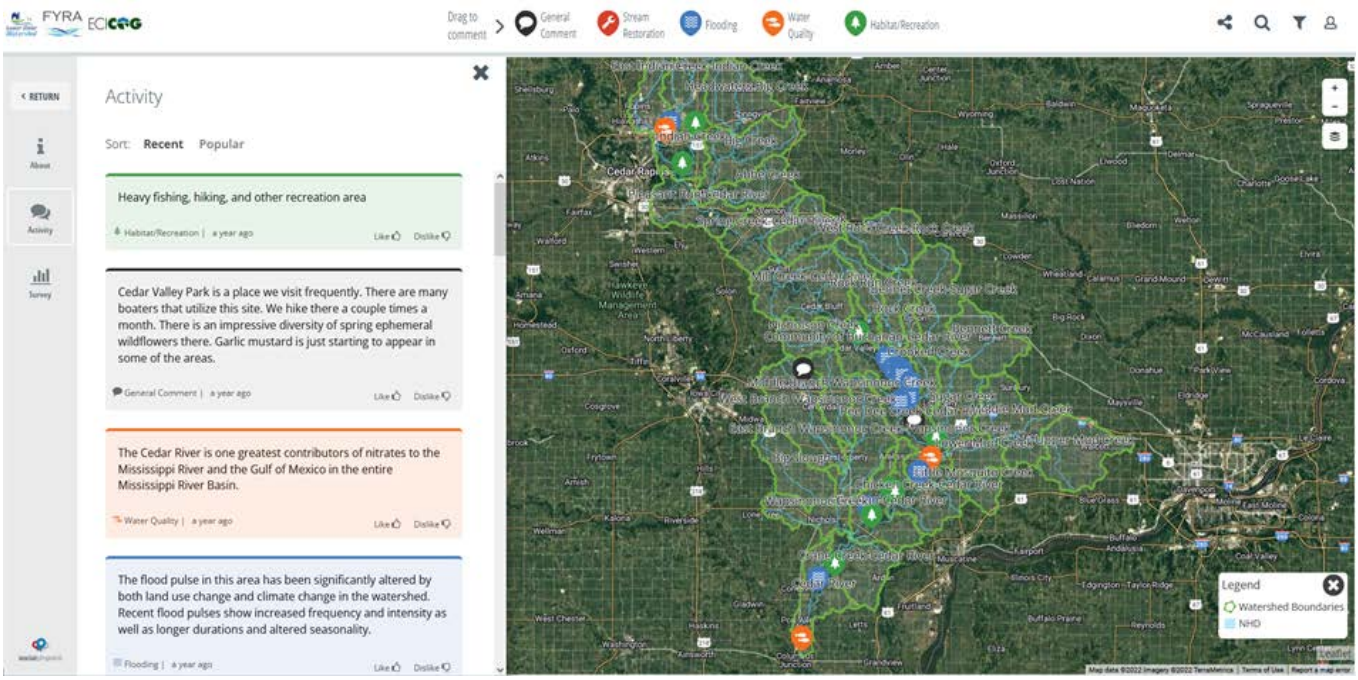
- Looking at buyouts in Pike Run HUC-12 sub-watershed
- Noted a non-certified levee that blew out and was an expensive repair
- Would like to remove the levee, some structures, and buy out some cabins/homes
- A couple of cabin areas on the banks of the Cedar River at the end of a long stretch of county gravel road
- The roads in these areas are in the flood plain and subject to seasonal damage
- One of the areas is served by an old and structurally deficient bridge

5.3 Lower Cedar Surveys

The LCWMA used several methods to capture stakeholder input for the Lower Cedar Watershed Management Plan ranging from broad, on-line surveys to emailed surveys of specific groups. The social interaction website, Social Pinpoint was used to gather input from the 134,500 residents in the watershed. In addition, emailed surveys to cities and county conservation boards asked for recent and upcoming water quality or flood mitigation projects to include in the plan.

Social Pinpoint's map feature provided the opportunity to collect open ended comments for the Lower Cedar Plan. Users could pin a location on the map of the Lower Cedar Watershed and leave a note with their comment or concern about that location. There were 28 responses recorded on the watershed map as seen below.

Figure 5-6. Social Pinpoint Website



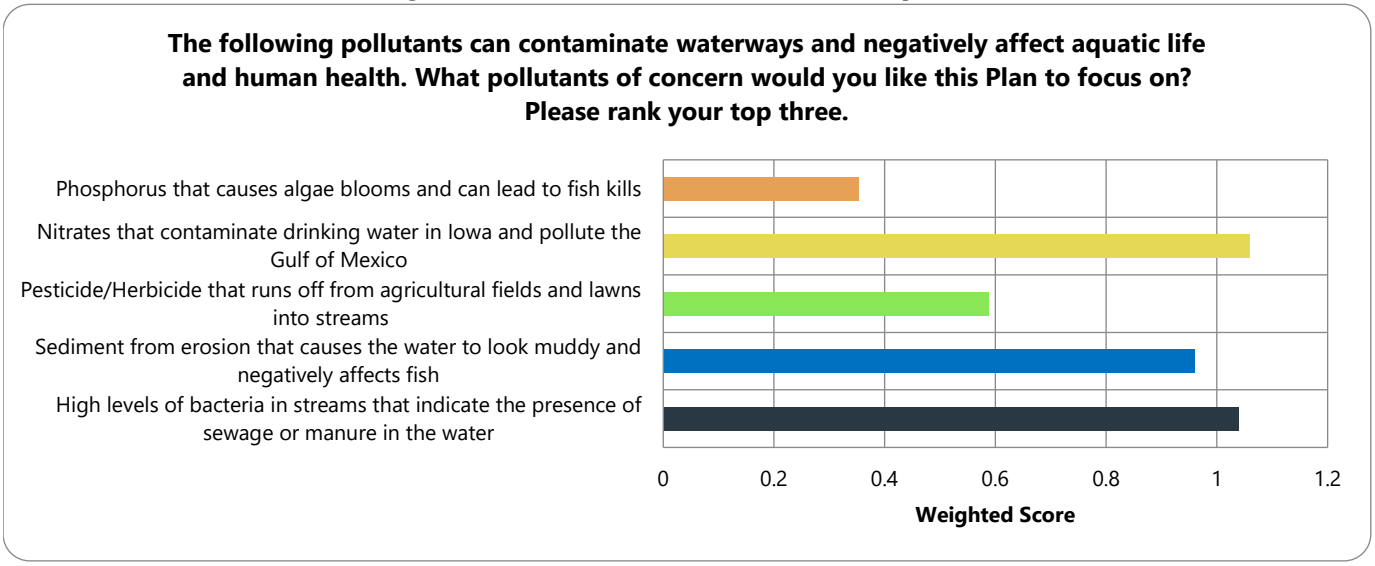
Three different surveys were developed in Social Pinpoint that anyone could access and were promoted through the LCWMA Board and other partners. The three surveys were Issues & Concerns, Watershed Priorities, and Tell Us About Yourself each taking no more than 7 minutes to complete. Surveys were used to measure a variety of factors of key groups including:

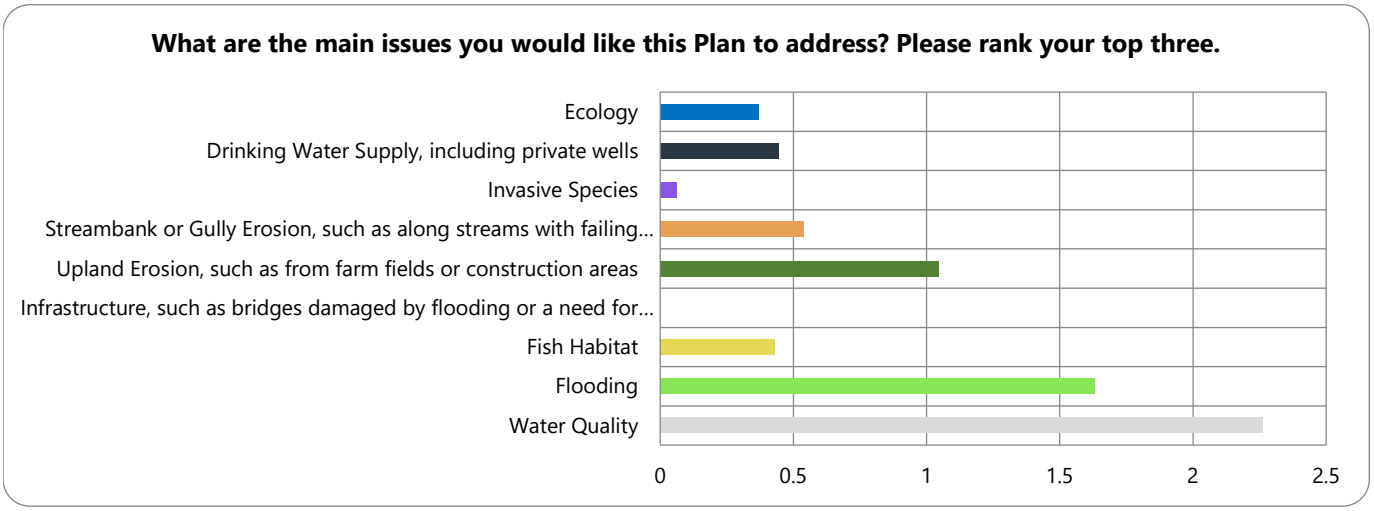
- watershed awareness levels in urban and agricultural areas
- attitudes about the watershed in urban and agricultural areas
- personal sources of information
- interests for the watershed

Issues & Concerns Survey Findings

The survey responses below are from the "Issues & Concerns" survey. In this survey, users were asked about topics such as pollutants of concern, main watershed issues, pollutant sources, and implementation barriers. This survey had 19 responses total.

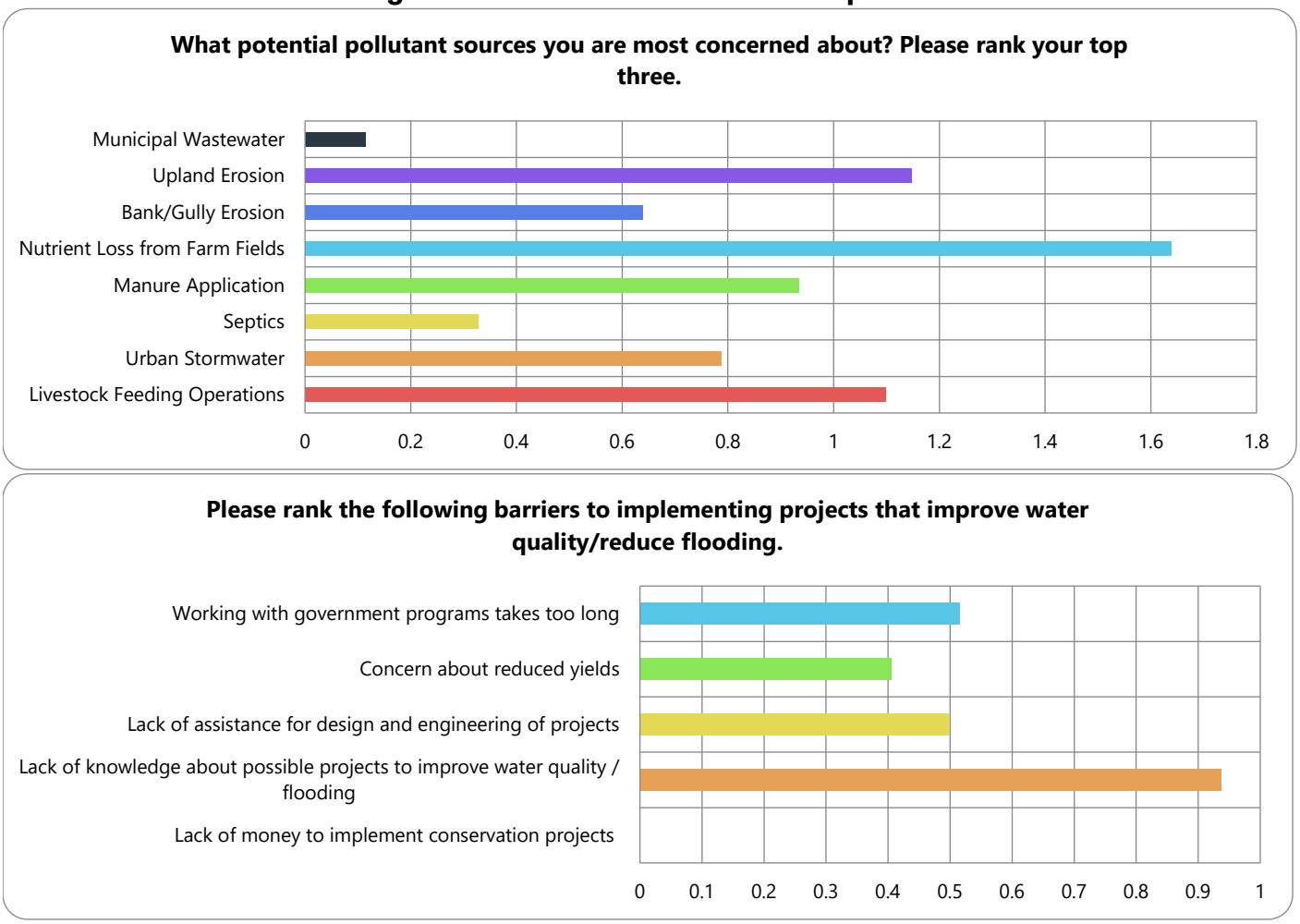
Figure 5-7. Issues & Concerns Responses





Source: FYRA Social Pinpoint survey responses compiled April 2021

Figure 5-8. Issues & Concerns Responses

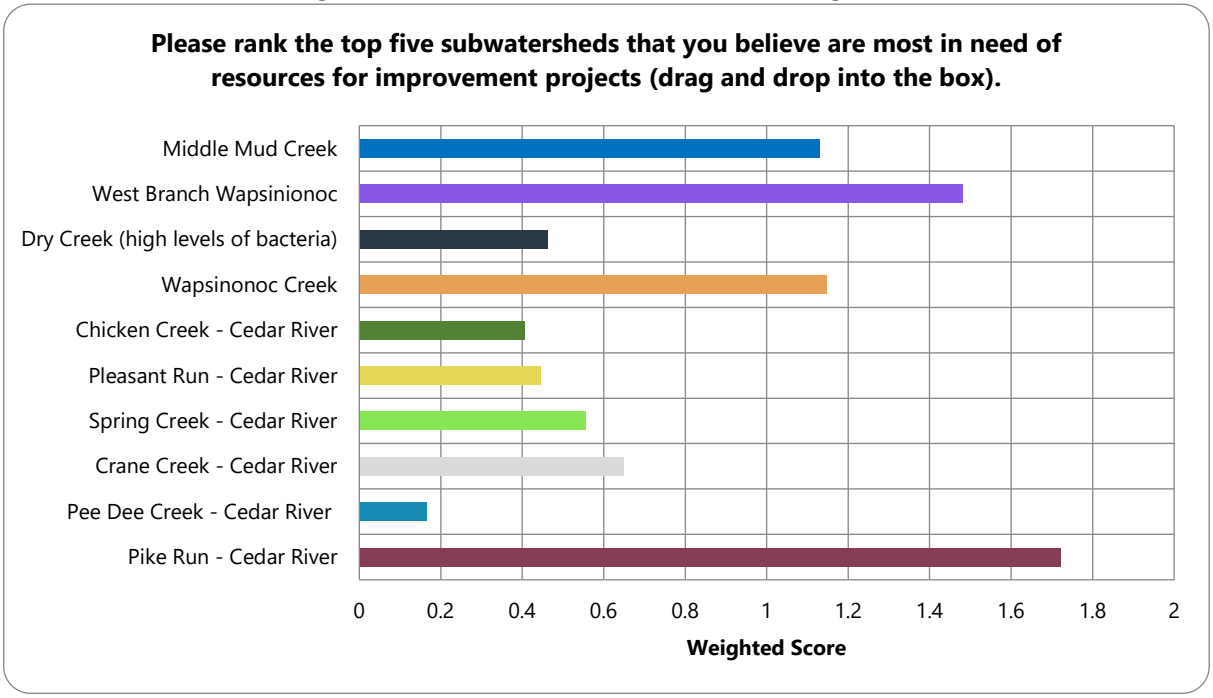


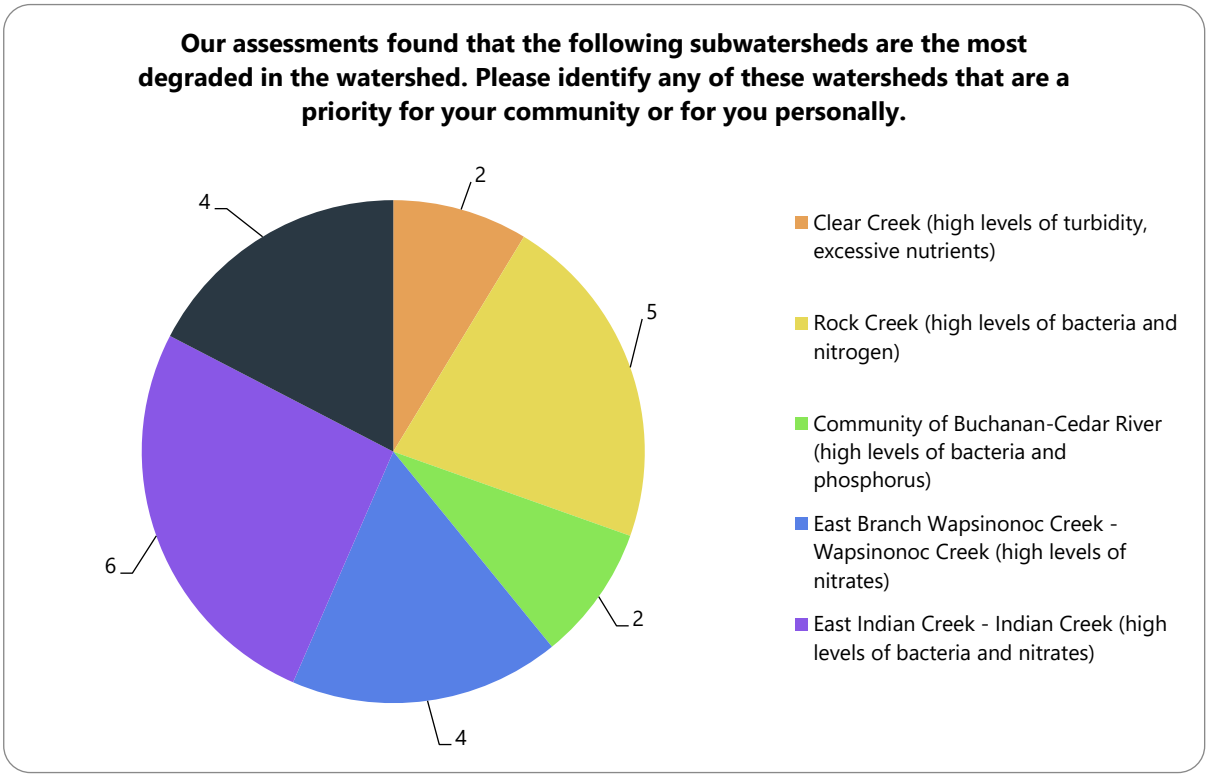
Source: FYRA Social Pinpoint survey responses compiled April 2021

Watershed Priorities Survey Findings

Another survey provided to the watershed community was titled, "Watershed Priorities." This project includes 33 HUC12 watersheds but mainly focuses on three high priority watersheds for the purpose of targeting future funding resources for water quality improvement projects. This survey asked users to rank watersheds by different priorities. This survey recorded 13 responses.

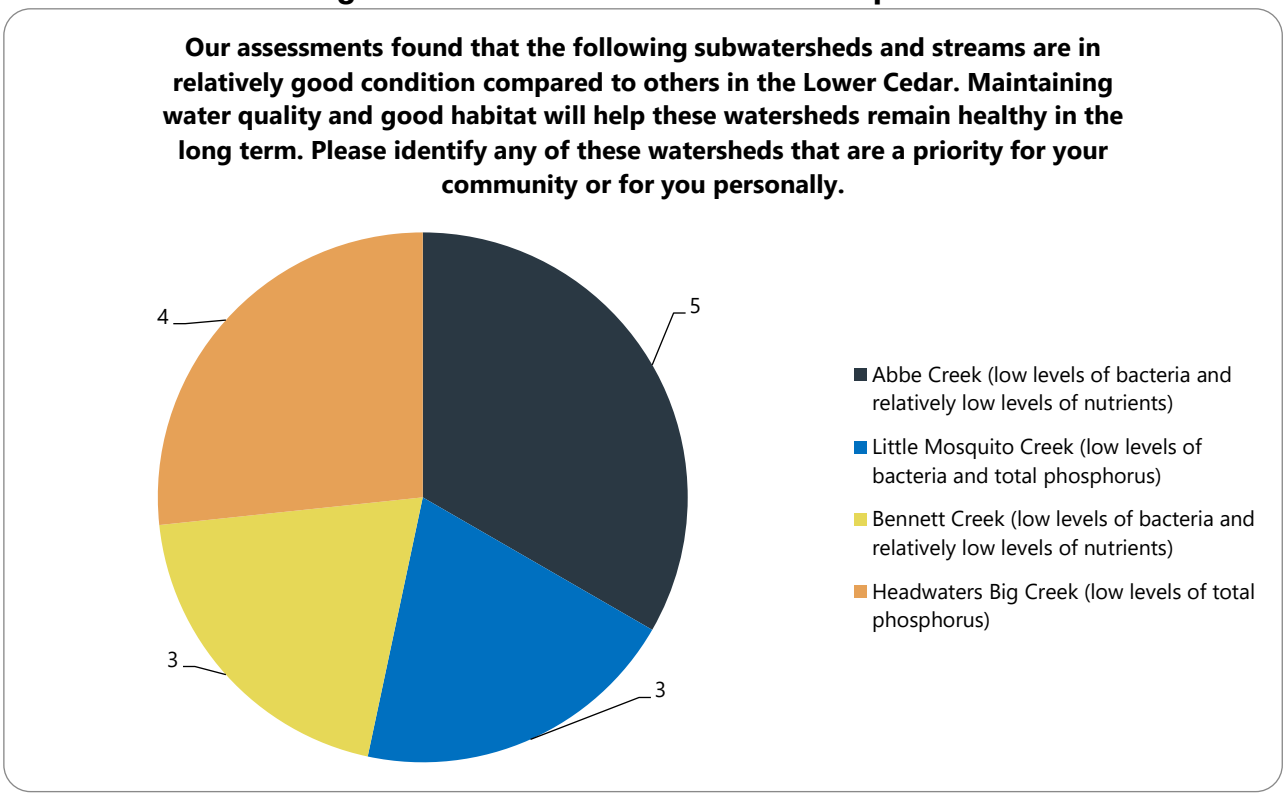
Figure 5-9. Watershed Priorities Responses





Source: FYRA Social Pinpoint survey responses compiled April 2021

Figure 5-10. Watershed Priorities Responses

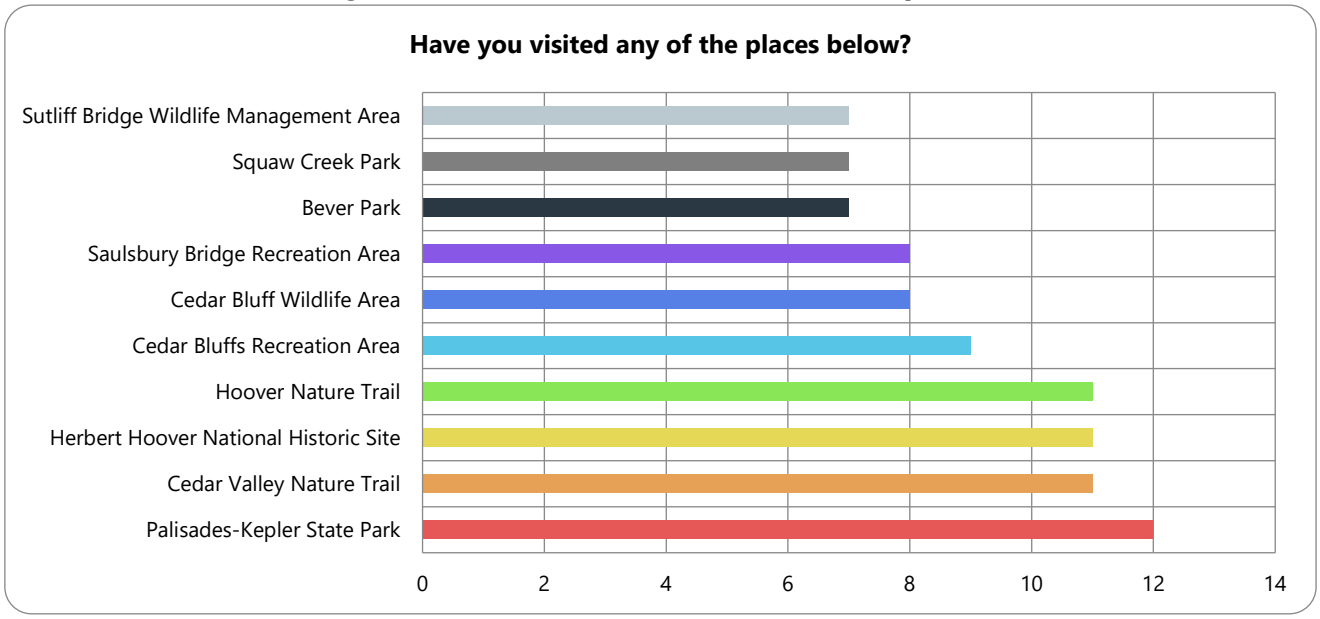


Source: FYRA Social Pinpoint survey responses compiled April 2021

Tell Us About Yourself Survey Findings

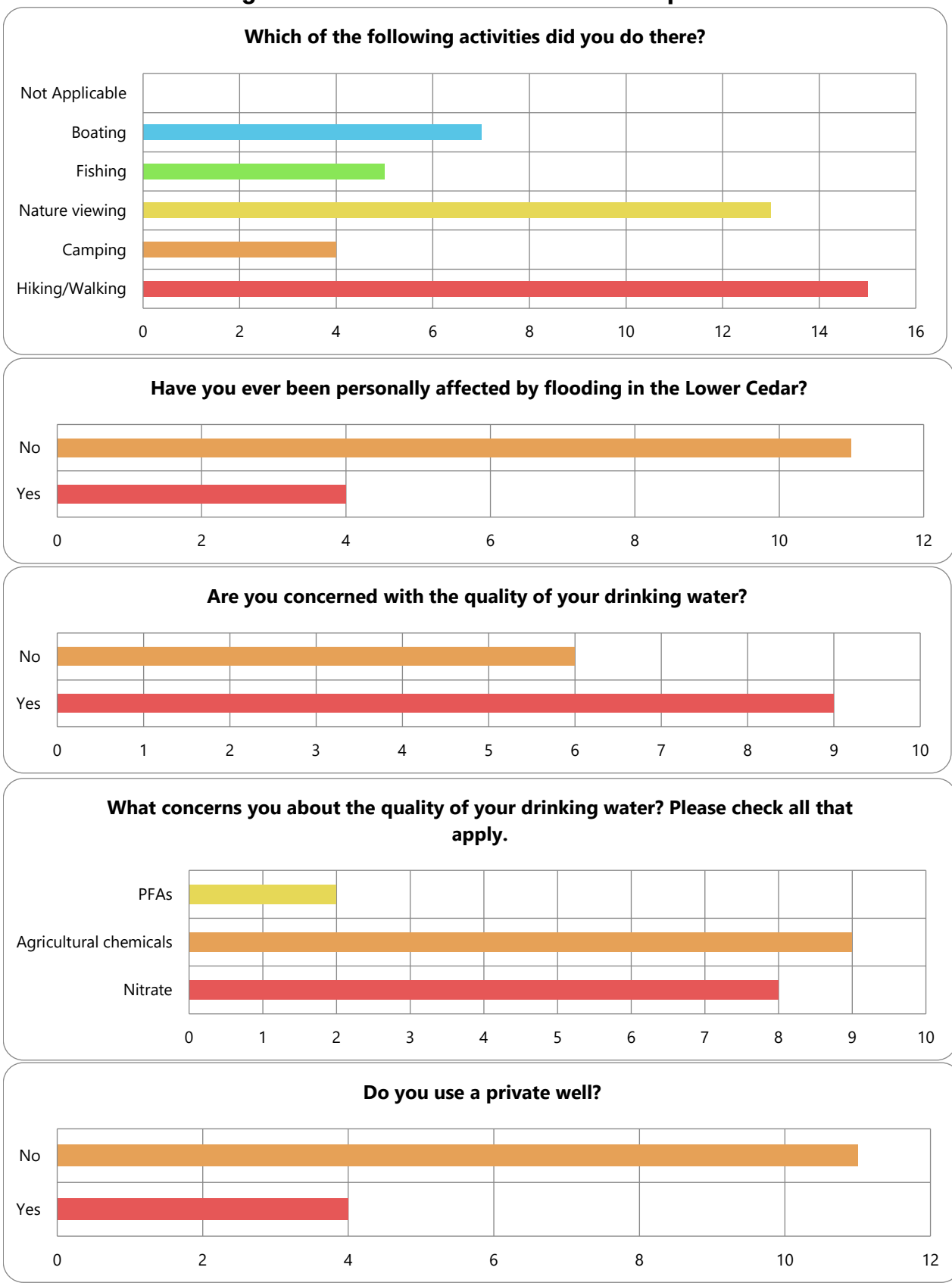
The survey responses below are from the "Tell Us About Yourself" survey. This survey was used to gather more data on the community in the watershed. A total of 15 responses were recorded.

Figure 5-11. Tell Us About Yourself Responses



Source: FYRA Social Pinpoint survey responses compiled April 2021

Figure 5-12. Tell Us About Yourself Responses



Source: FYRA Social Pinpoint survey responses compiled April 2021

Chapter Six
Implementation Strategies

ASSESSMENT ■ ENGAGEMENT ■ **ACTION**

6.1 Potential Best Management Practices (BMP)

Point Source Practices

Owners/operators of wastewater treatment facilities (WWTFs) across the state are working to reduce nutrient loads discharged to surface water through the framework established in Iowa's NRS. The NRS calls for total nitrogen effluent concentrations of no greater than 10 mg/L or 66% reduction and total phosphorus concentrations no greater than 1 mg/L or 75% removal. WWTFs are required to conduction a nutrient reduction feasibility study as part of the permit renewal process. As of August 3, 2020, 43 municipal WWTFs statewide had undergone permit amendments to meet NRS goals (https://nrstracking.cals.iastate.edu/tracking-iowa-nutrient-reduction-strategy). Several WWTFs in the Lower Cedar basin have been through permit renewal and some of made significant upgrades to their facility to meet NRS and/or TMDL targets. Permits are being renews and facilities upgraded continuously, therefore current status of point source improvements should be obtained from the Iowa DNR Wastewater Permitting program (https://www.iowadnr.gov/Environmental-Protection/Water-Quality/NPDES-Wastewater-Permitting).

Nonpoint Source Practices

Attaining load reduction targets to meet overall water quality goals, and where applicable, TMDL targets, will require a combination of urban and agricultural best management practices (BMPs). Potential nonpoint source pollutant BMPs can be identified through modeling and outreach/engagement activities as the plan is implemented. This Watershed Management Plan (WMP) prioritizes BMPs and other strategies and lays out a phased and adaptive implementation approach designed using knowledge about landowner interests, priority areas and BMPs, and financial opportunities and constraints. This approach will create momentum through short term adoption of popular and fundable alternatives while spreading out implementation and investments to facilitate adoption of mid-term and long-term alternatives. The WMP has a 20-year horizon comprised of three phases: an initial 7-year phase, and second 7-year phase, and a 6-year phase. Implementation milestones (practices adopted, other achievements, and water quality improvements) will be reviewed annually, documented, and used to guide future implementation. Technical partners will collaborate with landowners and stakeholders proactively in all phases to encourage adoption of suitable BMPs in target locations to optimize phosphorus and sediment load reduction effectiveness and costs.

Realization and documentation of significant water quality benefits may take 10 years or longer, depending on weather patterns, amount of water quality data collected, and the success of selection, location, design, construction, and maintenance of BMPs. Monitoring should continue throughout implementation of BMPs and beyond to document water quality improvement.

No stand-alone BMP will be able to sufficiently reduce nutrient loads to the watershed. Rather, a comprehensive package of BMPs will be required to meet water quality goals. The following sections describe practices for both urban and agricultural settings that will advance water quality and reduce flood impacts.

6.2 Urban BMPs

Low Impact Development or Green Infrastructure promotes infiltration-based practices that can help to mitigate the effect of impervious surface. Prioritizing locations for green infrastructure is important for plan implementation, however, it will depend upon the individual homeowners, business owners, and a community's willingness to make it a reality.

Watershed Scale

Interconnected systems of natural areas and open space. These are large-scale practices that require long-term planning and coordination.

Land Conservation

Land conservation is one way of preserving interconnected systems of open space that sustain healthy communities. Land conservation projects begin by prioritizing areas of land for acquisition. Land or conservation easements can be bought or acquired through donation.

Greenways

Greenways are corridors of protected open space managed for both conservation and recreation. Greenways often follow rivers or other natural features. They link habitats and provide networks of open space for people to explore and enjoy.

Floodplain Restoration

Undisturbed floodplains help keep waterways healthy by storing floodwaters, reducing erosion, filtering water pollution, and providing habitat. Floodplain restoration rebuilds some of these natural functions by reconnecting the floodplain to its waterway.

Wetland Restoration and Protection

Restoring and protecting wetlands can improve water quality and reduce flooding. Healthy wetlands filter, absorb, and slow runoff. Wetlands also sustain healthy ecosystems by recharging groundwater and providing habitat for fish and wildlife.

Stormwater Parks

Stormwater parks are recreational spaces that are designed to flood during extreme events and to withstand flooding. By storing and treating floodwaters, stormwater parks can reduce flooding elsewhere and improve water quality.

Neighborhood Or Site Scale

Distributed stormwater management practices that manage rainwater where it falls. These practices can often be built into a site, corridor, or neighborhood without requiring additional space.

Rain Gardens

A rain garden is a shallow, vegetated basin that collects and absorbs runoff from rooftops, sidewalks, and streets. Rain gardens can be added around homes and businesses to reduce and treat stormwater runoff.

Native Plantings

Native Plantings are low maintenance areas that provide habitat for insects and birds. Their deep root system increases soil organic matter, builds soil quality, and helps retain and infiltrate storm water. A one percent increase in soil organic matter is estimated to retain an additional 17,000- 25,000 gallons of water per acre (Archuleta, 2014).

Vegetated Swales

A vegetated swale is a channel holding plants or mulch that treats and absorbs stormwater as it flows down a slope. Vegetated swales can be placed along streets and in parking lots to soak up and treat their runoff, improving water quality

Green Roofs

A green roof is fitted with a planting medium and vegetation. A green roof reduces runoff by soaking up rainfall. It can also reduce energy costs for cooling the building. Extensive green roofs, which have shallower soil, are more common on residential buildings. Intensive green roofs, which have deeper soil, are more common on commercial buildings.

Rainwater Harvesting

Rainwater harvesting systems collect and store rainfall for later use. They slow runoff and can reduce the demand for potable water. Rainwater systems include rain barrels that store tens of gallons and rainwater cisterns that store hundreds or thousands of gallons.

Permeable Pavement

Permeable pavements allow more rainfall to soak into the ground. Common types include pervious concrete, porous asphalt, and interlocking pavers. Permeable pavements are most used for parking lots and roadway shoulders.

Tree Canopy

Tree canopy can reduce stormwater runoff by catching rainfall on branches and leaves and increasing evapotranspiration. By keeping neighborhoods cooler in the summer, tree canopy can also reduce the "urban heat island effect." Because of trees' many benefits, many cities have set urban tree canopy goals.

Tree Trenches

A stormwater tree trench is a row of trees planted in an underground infiltration structure made to store and filter stormwater. Tree trenches can be added to streets and parking lots with limited space to manage stormwater.

Green Streets

Green streets use a suite of green infrastructure practices to manage stormwater runoff and improve water quality. Adding green infrastructure features to a street corridor can also contribute to a safer and more attractive environment for walking and biking.

Detention Basins Detention basins can be either wet or dry detention basins used to reduce peak discharge and detain runoff for a specified short period of time. A wet detention basin is a constructed stormwater detention basin that detains runoff from each rain event and has a permanent pool of water. Wet ponds are among the most widely used stormwater practices. A dry detention or extended dry detention basin is a surface storage basin or facility designed to provide extended detention of stormwater runoff.

6.3 Agricultural and Upland BMPs

Agricultural conservation encompasses a broad array of strategies and identification of potential practices and viable locations to implement them is an important component of the WMP implementation. This section describes the suite of practices that could be implemented in the areas used for row-crop production identified in the land use assessment more broadly.

As plan implementation rolls out, specific agricultural conservation strategies will be developed by working one-on-one with farm owners or operators to identify the practices that meet their agronomic and conservation goals. The LCWMA and the Lower Cedar Watershed Coordinator will work with partners such as the local SWCDs, NRCS, ISU Extension, and crop consultants/advisors to promote a balanced strategy of managing natural resources while maintaining agricultural productivity.

Land Management (Prevention Strategies)

In-field practices address resource concerns such as soil erosion and nutrient loading at the source. Building soil health and reducing soil bulk density, as well as increasing residue on crop fields, are key elements of in-field conservation management. Nutrient management is another aspect of this, focusing on the 4 Rs of nutrient application: Right Time, Right Place, Right Amount, Right Source.

Many agricultural BMPs are designed to reduce erosion and nutrient loss from the landscape. These in-field BMPs provide the highest level of soil conservation and soil health benefits because they prevent erosion and nutrient loss from occurring. Land management alternatives implemented in row crop areas include conservation practices such as in-field buffers, no-till methods, and cover crops. Removal efficiencies and costs for these practices are quantified in the WMP. Improved manure management (e.g., application methods and timing) also protect water quality and are included in the plan, but potential reductions are not explicitly quantified because the TMDL did not quantify this potential source.

Sediment Control

Vegetated filter strips or buffer strips are shallowly sloped vegetated surfaces that remove suspended sediment and nutrients from water runoff. When installed and functioning properly, the EPA has documented that filter strips can reduce total suspended solids (sediment) by 73%, total phosphorus by 45%, and total nitrogen by 40%.

Grade Stabilization Structure is a dam, embankment or other structure built across a grassed waterway or existing gully control to reduce water flow. The structure drops water from one stabilized grade to another and prevents over-fall gullies from advancing up a slope.

Contour Farming involves tilling and planting on the land contour to create hundreds of small ridges or dams. These ridges or dams slow water flow and increase infiltration which reduces erosion.

Grassed Waterway is a natural drainage way graded and shaped to form a smooth, bowl-shaped channel. This area is seeded to sod-forming grasses. Runoff flows across the grass rather than tearing away soil and forming a gully. An outlet is often installed at the base of the drainage way to stabilize the waterway and prevent any new gullies from forming.

Water and Sediment Control Basins are small earthen embankments built across an area of concentrated flow within a field. They are designed to reduce the amount of runoff and sediment leaving the field.

Nutrient Management Practices

Source: http://www.nutrientstewardship.com/what-are-4rs

Reduce nitrogen application rate to the MRTN Reduce the nitrogen application to the level which maximizes yield vs. fertilizer costs.

Use a nitrification inhibitor to slow the microbial conversion of ammonium-nitrogen to nitrate-nitrogen. The practice specifically uses Nitra pyrin and applies only to fall application of anhydrous ammonia.

Eliminate fall anhydrous nitrogen application involves moving fall anhydrous N fertilizer application to spring pre-plant. It prevents denitrification and leaching during late fall, winter and spring.

Side-dress all spring applied nitrogen during the periods of plant demand (late spring/early summer) rather than the early spring which reduces the risk of loss from early spring rainfall/leaching events.

Reduce phosphorus application rates in fields that have high to very high soil test phosphorus content. This practice minimizes phosphorus fertilizer over-application.

Manure injection/ Phosphorus banding involves injecting liquid manure and banding solid inorganic fertilizers within all no-till acres. Placing phosphorus at the root zone can increase phosphorus availability and allow for reduced application rates.

Other In-Field Management Practices

Conservation Tillage includes a range of practices from permanent no-till to strip-till to reduced tillage. The overall goal is to preserve some degree of crop residue on the soil surface to reduce erosion. A primary benefit of no-till is the resulting increase in soil health. Tillage negatively impacts soil microorganisms and earthworms, reduces the organic matter within the soil, and increases soil bulk density. Healthy soils are spongier, with increased pore spaces, which can help to infiltrate water more quickly. Along with soil conservation benefits, fuel prices can drive a switch to conservation tillage for many farmers. Eliminating tillage passes reduces both fuel and labor expenses.

Cover Crops include any number of plants that are sown following the growing season of corn / beans, such as oats or cereal rye. Cover crops varieties include those that are winter-killed or those that are winter-hardy. Both types have specific benefits for reducing erosion, nutrient uptake, nitrogen-fixation, or adding organic material to the soil. The varieties selected in any situation depend upon the specific agronomic goals and the experience level of the grower.

Increasing organic matter provides both greater water and nutrient retention, preventing leaching, and increasing soil fertility. Currently, the primary practices for building soil organic matter are planting cover crops, reducing tillage and applying manure rather than commercial fertilizer.

Extended Rotation is a rotation of corn, soybean, and at least three years of alfalfa or legume-grass mixtures managed for hay harvest. These crops provide soil cover, reduce soil erosion, and reduce phosphorus loss.

Pasture/Land Retirement removes land from agricultural production and converts it to perennial vegetation to limit soil erosion. This is a long-term Conservation Reserve Program (CRP) of 10-15 years. The established vegetation is a near natural system that has animal habitat and soil improvement benefits.

Terraces break long slopes into shorter ones. They usually follow the contour of the land. As water makes its way down a hill, terraces serve as small dams to intercept water and guide it to an outlet.

Livestock Management

Land use assessments could be used to identify areas in the watershed where livestock management practices could be implemented. Limiting access to streams by livestock can reduce streambank erosion and facilitates growth of riparian vegetation to help stabilize streambanks and filter nutrients and pathogens from animal waste. Livestock management practices include:

Access Control involves either temporary or permanent exclusion of animals or vehicles from streambanks.

Stream Crossings help control streambank erosion by creating stabilized areas for both animal and vehicle traffic to cross streams.

Heavy Use Area Protection involves stabilizing land in areas that are heavily impacted by livestock, such as outdoor paddocks or near feeding troughs, to control erosion and soil disturbance.

Planned (Prescribed) Grazing System divides pasture into two or more paddocks with fencing. Cattle are moved from paddock to paddock on a pre-arranged schedule based on forage availability and livestock nutrition needs.

Structural BMPs (Trap and Treat Strategies)

Edge-of-field practices provide an additional line of defense to trap pollutants and infiltrate runoff before it reaches a waterway. These practices can significantly reduce pollutant loads, especially when used in conjunction with appropriate in-field management practices as part of a whole-farm conservation plan.

Although they do not address the underlying generation of sediment or nutrients, structural BMPs such as sediment control basins, terraces, grass waterways, saturated buffers, riparian buffers, and wetlands can play a valuable role in reduction of sediment and nutrient transport to the Cedar River. These edge-of-field BMPs attempt to mitigate the impacts of soil erosion and nutrient loss by intercepting them before they reach streams, rivers, or lakes. Structural BMPs should be targeted to priority areas to increase their cost effectiveness and maximize pollutant reductions. Landowner willingness and the physical features of potential sites must also be considered when targeting structural practices.

Controlled Drainage (Drainage Water Management) describes the practice of installing water level control structures within the tile system. This practice reduces nitrogen loads by raising the water table during part of the year, thereby reducing overall tile drainage volume and nitrate load. The water table is controlled using gate structures that are adjusted at different times during the year. When field

access is needed for planting, harvest or other operations, the gate can be opened fully to allow unrestricted drainage. When the gate is used to raise the water table level after spring planting, it may allow more plant water uptake during dry periods, which can increase crop yields. Controlled drainage may be used on fields with flat topography, typically one percent or less slope.

Nutrient Removal Wetlands are shallow depressions created in the landscape where aquatic vegetation is typically established. Nutrient removal wetlands can be a cost-effective approach to reducing nitrogen loadings in watersheds dominated by agriculture and tile drainage. Wetlands and surrounding grassland buffers also provide environmental benefits beyond water quality improvement such as increases in wildlife habitat, carbon sequestration, and flood water retention.

Denitrification bioreactors are trenches in the ground packed with carbonaceous material, such as wood chips, that allow colonization of soil bacteria that convert nitrate in drainage water to nitrogen gas. Installed at the outlet of tile drainage systems, bioreactors usually treat 40-60 acres of farmland.

Saturated Buffers are designed to treat tile runoff, which otherwise bypasses riparian vegetation to discharge directly to the ditch or stream. Field tiles are intercepted and routed into a new tile pipe that runs parallel to the ditch or stream. The tile water is allowed to exfiltrate and saturate the buffer area facilitating contact with soil and vegetation resulting in significant denitrification.

6.4 BMP Removal Efficiencies

Potential BMPs and their assumed phosphorus and sediment reduction efficiencies are listed in Table 6-1. Efficiencies were obtained from a variety of sources, including the Iowa Nutrient Reduction Strategy (2013), NRCS, Tyndall and Bowman (2016), and others.

Table 6-1. Best Management Practice Efficiencies

BMP	Removal Efficiency (%)			
	Sediment	Phosphorus	Nitrogen	E.coli
Bioreactors	5%	25%	43%	75%
Contoured Buffer Strips	95%	90%	25%	25%
Grassed Waterways (WW)	75%	75%	25%	50%
Nutrient Reduction Wetlands	25%	20%	45%	70%
Sediment Retention Ponds	90%	80%	30%	70%
Terraces	85%	75%	20%	25%
[1]WASCOBs	90%	80%	42%	70%
No-Till	90%	80%	-	0%
Cover Crops	70%	29%	38%	33%
Extended Rotations	25%	25%	40%	25%
Annual-Perennial Conversion	55%	45%	70%	N/A
Riparian Buffers/Filter Strips	86%	65%	27%	70%
Saturated Buffers	5%	5%	53%	5%
Streambank Stabilization	[2]90%	[2]80%	10%	-
Gully Stabilization	[2]90%	[2]80%	10%	-
[3]Livestock Fencing	N/A	N/A	N/A	N/A

[1]Water and Sediment Control Basins
[2]Removal efficiency based on bank and gully sources only
[3]Livestock Fencing included to protect other BMPs (e.g., wetlands, ponds, buffers, and stabilization).

Up front and annualized costs of potential BMPs (per acre of land treated) were adapted from the Iowa NRS, related supporting documentation, and NRCS Practice Scenarios (Table 6-2). Capital costs include land/easement requirements, construction costs, and other one-time expenses. Annual costs reflect annual maintenance, landowner payments, and other recurring costs. Annual costs are greater for BMPs requiring significant maintenance or those that take large areas of land out of production (which increases costs of required landowner payments).

Table 6-2. Best Management Practice Costs

BMP	Implementation Costs	
	[1]Capital ($/ac)	[2]EAC ($/ac)
Bioreactors	300	15
Contoured Buffer Strips	435	35
Grassed Waterways (WW)	100	6
Nutrient Reduction Wetlands	380	20
Sediment Retention Ponds	550	25
Terraces	1,223	90
[1]WASCOBs	1,700	125
No-Till	-	10
Cover Crops	-	50
Extended Rotations	-	30
Annual-Perennial Conversion	-	192
Riparian Buffers/Filter Strips	300	325
Saturated Buffers	210	360
Streambank Stabilization ($/ft)	[3]200	10
Gully Stabilization ($/ft)	[3]100	5
Fencing ($/ft)	4	-

[1]Up-front costs of land, construction, etc. Adopted from NRCS practice scenarios and/or Iowa NRS documentation.
[2]Equivalent Annual Costs of BMP over lifetime (adopted from the Iowa NRS and supporting documents).
[3]Costs per foot of stabilized streambank or gully

BMP Prioritization and Selection

To obtain the necessary reductions in phosphorus loads to meet water quality targets, land management strategies and upland structural BMPs should be implemented to obtain the largest and most cost-effective water quality benefit. Targeting efforts should consider priority areas with the highest potential phosphorus loads to the lake. Factors affecting phosphorus contribution include land cover, steepness of slopes, proximity to the waterbody, tillage practices, and the method, timing, and amount of manure and commercial fertilizer application.

The Agricultural Conservation Planning Framework (ACPF) was used to identify suitable locations in the landscape for each of the BMPs identified in Table 6-1. ACPF is based on land use, topography, and other landscape-related parameters. ACPF output helps watershed planners ensure that the type and number of practices selected for implementation are feasible given watershed characteristics. ACPF output was used to generate the Watershed Implementation Plan described in the three appendices of this WMP, along with local knowledge and feedback related to landowner interest, conservation economics, and modeling tools used to target BMPs to critical areas with the highest sediment and phosphorus losses.

Goals and milestones for treatment/adoption extents are outlined in the three appendices of this WMP.

Chapter Seven
Funding Opportunities & Needs

ASSESSMENT ▪ ENGAGEMENT ▪ **ACTION**

Watershed improvement requires substantial investment in technical assistance (human resources) and financial assistance (funding to support practice adoption or construction). This section provides opportunities to consider.

7.1 Local Funding

The Lower Cedar Watershed Management Authority (LCWMA) is considering several options for funding watershed improvements. Determining a funding contribution formula based on the area and population in the watershed is one option. The benefit would be a stable funding stream for local technical assistance and potential matching funds for future grant opportunities. The challenge is uncertain local budgets and conveying the longer-term outcomes to justify the investment. Table 7-1 is one possible contribution formula.

Table 7-1. Possible Contribution Formula Supporting the LCWMA

Entity	Population	Range	Flat Fee Admin	Flat Fee Coordinator
Cedar County	7,387	full	$ 7,000	$ 14,000
Johnson County	966	very partial	$ 500	$ 1,000
Linn County	5,224	full	$ 7,000	$ 14,000
Louisa County	3,474	partial	$ 2,500	$ 5,000
Muscatine County	6,961	full	$ 7,000	$ 14,00
Scott County	2,271	partial	$ 2,500	$ 5,000
Atalissa	308	very small	$ 250	$ 500
Bennett	378	very small	$ 250	$ 500
Bertram	278	very small	$ 250	$ 500
Cedar Rapids	26,186	large	$ 5,000	$ 10,000
Durant	1,714	small	$ 500	$ 1,000
Lisbon	2,125	medium	$ 1,500	$ 3,000
Lone Tree	1,381	small	$ 500	$ 1,000
Marion	35,215	large	$ 5,000	$ 10,000
Mechanicsville	1,129	very small	$ 250	$ 500
Mount Vernon	4,501	medium	$ 1,500	$ 3,000
Nichols	362	very small	$ 250	$ 500
Robins	2,918	medium	$ 1,500	$ 3,000
Stanwood	658	very small	$ 250	$ 500
Tipton	3,223	medium	$ 1,500	$ 3,000
Walcott	1,634	small	$ 500	$ 1,000
West Branch	2,385	medium	$ 1,500	$ 3,000
West Liberty	3,766	medium	$ 1,500	$ 3,000
Wilton	2,819	medium	$ 1,500	$ 3,000
Total	117,263		$ 50,000	$ 100,000

Source: East Central Iowa Council of Governments

7.2 Grants, Cost Share & Easement Programs & Loans

This section provides a description of available funding sources and assistance programs for watershed management efforts. There is a website link for each program to access additional information about eligibility and application details. Other groups with funding or assistance programs to benefit watershed improvements include Trees Forever, National Association of Conservation Districts and a variety of foundations. There may be other funding sources not captured here, so potential applicants are encouraged to check with watershed resource personnel at the Iowa Department of Natural Resources or Iowa Department of Agriculture and Land Stewardship for more up-to-date opportunities.

Iowa Department of Agriculture & Land Stewardship (IDALS)

Water Quality Initiative accepts applications on an annual basis for projects focused on improving water quality in urban areas. Preference points are given to projects within nine priority watersheds and the projects selected will be announced in March.

Watershed Development and Planning Grants are issued by the Division of Soil Conservation for Districts and watershed partners to complete projects regarding watershed assessment, problem source identification, partnerships, and landowner support.

Water Protection Fund and/or Watershed Protection Fund offers financial assistance to SWCDs interested in watershed implementation grants and those interested are encouraged to contact IDNR.

Natural Resources Conservation Service (NRCS)

Watershed Flood Prevention Operations Program provides technical and financial assistance to States, local governments and Tribes to plan and implement authorized watershed project plans for the purpose of flood prevention watershed protection.

Iowa Partners for Conservation funding is intended to leverage NRCS and partner resources to build soil health on cropland; improve environmental and economic performance of grasslands, woodlands and wildlife areas; support the Iowa Nutrient Reduction Strategy; and build capacity to better manage and maintain watershed infrastructure.

National Association of Conservation Districts partners with NRCS to offer Technical Assistance Grants to help conservation districts build capacity and enhance their ability to provide conservation planning and technical assistance to customers.

Conservation Innovation Grants (CIG) is a voluntary program intended to stimulate the development and adoption of innovative conservation approaches and technologies while leveraging Federal investment in environmental enhancement and protection, in conjunction with agricultural production.

Environmental Quality Incentive Program (EQIP) is a voluntary conservation program that provides financial assistance to individuals/entities to address soil, water, air, plant, animal and other related natural resource concerns on their land. EQIP offers financial and technical assistance for participants installing or implementing structural and management practices on eligible agricultural land.

Regional Conservation Partnership Program (RCPP) promotes coordination between NRCS and its partners to deliver conservation assistance to producers and landowners. NRCS aids producers through partnership agreements and through program contracts or easement agreements.

Conservation Reserve Program (CRP) is a land conservation program administered by the Farm Service Agency (FSA). In exchange for a yearly rental payment, farmers enrolled in the program agree to remove environmentally sensitive land from agricultural production and plant species such as native prairie grasses that will improve environmental health and quality. Contracts for land enrolled in CRP are 10-15 years in length.

Wetland Reserve Program (WRP) is a voluntary program offering farmers the opportunity to protect, restore, and enhance wetlands on their property. The NRCS provides technical and financial support to help landowners with their wetland restoration efforts. The program offers landowners three options: permanent easements, 30-year easements, and restoration cost-share agreements of a minimum 10-year duration. As a requirement of the program, landowners voluntarily limit future use of the land, yet retain private ownership.

Grassland Reserve Program (GRP) is a voluntary conservation program that emphasizes support for working grazing operations, enhancement of plant and animal biodiversity, and protection of grassland under threat of conversion to other uses. Participating farmers voluntarily limit future development and cropping uses of the land while retaining the right to conduct common grazing practices and operations related to the production of forage and seeding, subject to certain restrictions. A grazing management plan is required for participants.

Agricultural Conservation Easement Program (ACEP) is a voluntary program that provides financial and technical assistance to help conserve agricultural lands and wetlands and their associated benefits through Agricultural Land Easements. Land eligible for agricultural easements includes cropland, rangeland, grassland, pastureland, and nonindustrial private forest land. These programs require agricultural land easement or wetland reserve restoration easement plans to protect the land over the long-term.

Wildlife Habitat Incentive Program (WHIP) is a voluntary program for landowners who want to develop and improve wildlife habitat on private lands. It provides both technical assistance and cost share payments to help native fish and wildlife species, reduce impacts of invasive species, and improve aquatic wildlife habitat. NRCS and the participant enter into a cost-share agreement for wildlife habitat development that lasts from 5 to 10 years.

Iowa Department of Natural Resources (IDNR)

319 Watershed Planning Grant is designed to assist interested groups in developing a Watershed Management Plan, which identifies problems in the watershed and proposes solutions for better water quality. Applicants are encouraged to contact their IDNR Basin Coordinator.

319 Watershed Implementation Grant is designed to assist interested groups in putting their Watershed Management Plan into Action. Applicants are encouraged to contact their IDNR Basin Coordinator.

Land and Water Conservation Fund (LWCF) is a competitive, federally funded grant program that provides match funds of 50% for outdoor recreation area development and acquisition. All Iowa's cities and counties are eligible to participate, and the deadline is in March of each year.

Resource Enhancement and Protection (REAP) funding is appropriated by the Iowa Legislature and signed into law by the Governor. The program is divided into three categories.

City Park & Open Space: Grant amount dependent on city size and is specifically for parkland expansion and multi-purpose recreation development.

County Conservation: Thirty percent of this fund is automatically and equally allocated to all 99 counties to be used for and easements or acquisition, capital improvements, stabilization and protection of resources, repair and upgrading of facilities, environmental education, and equipment. Another thirty percent is allocated based on population and the remaining forty percent is available through competitive grants.

Conservation Education Program (CEP): An annual amount of $350,000 is administered by a five-member board of landowners, naturalists, and educators. Funds are divided according to a standard application and mini grants.

State Revolving Fund

Clean Water State Revolving Fund is jointly administered by the Iowa Finance Authority (IFA) and DNR Clean Water Program and is designed for publicly owned wastewater treatment works and non-point source projects (both public and private entities). A list of priority projects is outlined by the Intended Use Plan on a quarterly basis, which determines the eligibility of a project's application.

Livestock Water Quality Program offers low-interest loans through participating lenders to Iowa livestock producers for projects to prevent, minimize or eliminate non-point source pollution of Iowa's rivers and streams from animal feeding operations.

On-site Wastewater Assistance Program (OSWAP) offers low-interest loans through participating lenders to rural homeowners for the replacement of inadequate or failing septic systems. According to Iowa law, all septic systems, regardless of when they were installed, must have a secondary wastewater treatment system following the septic tank.

Local Water Protection Program (LWPP) offers low-interest loans through participating lenders to Iowa landowners for projects to control the runoff of sediment, nutrients, pesticides or other nonpoint source pollutants from entering Iowa waters.

Storm Water Loan Program provides low-cost loans for projects to address stormwater quality. Funds are available at 3% interest for municipalities that are required to have an MS4 permit.

Water Resource Restoration Sponsored Projects Program reduces the overall interest rates on loans for projects designed to improve water quality where the wastewater treatment facility is located. Applications are approved by the Environmental Protection Commission on an annual basis.

U.S. Fish & Wildlife Service

Visit the U.S Fish & Wildlife website for a listing of the different grant programs funded through the Cooperative Endangered Species Conservation Fund, with the funding levels for this fiscal year. Eligibility criteria and the application process for each grant program are different.

The North American Wetlands Conservation Act (NAWCA) grant programs fund projects in the United States, Canada and Mexico that involve long-term protection, restoration, and/or enhancement of wetlands and associated uplands habitats.

The Urban Conservation Treaty for Migratory Birds (Urban Bird Treaty) is a program working with cities and partners to conserve migratory birds through education, hazard reductions, citizen science, conservation actions, and conservation and habitat improvement strategies in urban/suburban areas. Urban areas can become effective sanctuaries for birds by restoring and conserving greenspace.

Iowa Economic Development Authority (IEDA)

Enhance Iowa - Improving Community Vitality Through Recreational Attractions provides grant funds to assist projects that provide recreational, cultural, entertainment and educational attractions, as well as sports tourism. The funds help communities create transformational projects that enhance the vitality of a region and the state overall.

Community Development Block Grants can be used to fund water and sewer facilities and must comply with the Green Streets criteria. Applications are guided by the CDBG annual application workshop, which is held in conjunction with the Water and Wastewater Infrastructure Funding Summit.

Federal Emergency Management Agency (FEMA)

FEMA administers three programs that provide funding for eligible mitigation planning and projects that reduce disaster losses and protect life and property from future disaster damage.

- Hazard Mitigation Grant Program (HMGP) assists in implementing long-term hazard mitigation planning and projects following a Presidential major disaster declaration
- Building Resilient Infrastructure and Communities (BRIC) program aims to categorically shift the federal focus away from reactive disaster spending and toward research-supported, proactive investment in community resilience.
- Pre-Disaster Mitigation (PDM) provides funds for hazard mitigation planning and projects on an annual basis
- Flood Mitigation Assistance (FMA) provides funds for planning and projects to reduce or eliminate the risk of flood damage to buildings that are insured under the National Flood Insurance Program (NFIP) on an annual basis

FEMA requires state, territorial, tribal, and local governments to develop and adopt hazard mitigation plans as a condition for receiving certain types of non-emergency disaster assistance.

Chapter Eight
Education & Outreach

ASSESSMENT ■ ENGAGEMENT ■ ACTION

Lower Cedar Watershed

8.1 Education & Outreach

Education and public awareness are essential to effective water resources management. Public education will raise awareness about the environmental impacts of daily activities and build support for watershed planning and projects. This Plan includes the framework for a detailed education and awareness program specifically designed to:

- Raise public awareness of water issues and needs to foster support for solutions;
- Educate the public and other identified target groups in order to increase awareness and encourage behavioral changes; and
- Coordinate with other public as well as private entities to maximize the visibility of the Lower Cedar Watershed Management Authority (LCWMA) and its messages.

This section outlines how the education and public awareness program could be organized as both a watershed-wide program managed by the LCWMA and education activities undertaken by member governments or other partners.

An Education & Outreach Subcommittee of the LCWMA will be established to coordinate the education messages, materials, and methods used among LCWMA Members. A variety of resource partners including State agencies and the County Conservation Boards have already created educational tools such as mass media content, brochures/factsheets and presentation materials. Coordinating education and outreach efforts will have many benefits including reducing duplication of effort, improving cost effectiveness by sharing costs, and expanding the size and scale of education efforts.

The LCWMA Education & Outreach Subcommittee will consider the following program framework as a starting point to building a watershed level public awareness and education program.

Program Elements

The watershed level public awareness and education program should include both public education & outreach and public participation & involvement activities defined as:

Education & outreach activities are designed to distribute education materials and messages and perform outreach to inform citizens and target audiences.

Public participation & involvement activities provide opportunities for citizens to participate in programs and become active in implementing watershed protection programs.

Table 8-1. Example Outreach Activities

Education / Outreach Programs	Public Involvement / Participation Programs
Bill inserts or newsletters	Water quality monitoring program
Brochures at local government facilities	Watershed festival
Website with watershed education information	River/Creek clean-up events
Speakers bureau presentations	Storm drain stenciling events
Event displays and/or kiosks	Watershed citizen advisory group
Press releases	Rainscaping workshops
School classroom education	Agriculture stakeholder group

Education & Outreach Workplan

The following education strategies were identified as priorities in the public engagement for the Plan and will guide the efforts of the Education & Outreach Subcommittee in the near term.

- Educate agricultural community about practices to reduce erosion at workshops, tours, field days and other peer to peer events for farmers and other stakeholders.
- Create a program to recognize and share BMPs on the LCWMA Facebook page and other social media accounts to expand the "neighborhoods" of conservation.
- Organize opportunities to take urban residents to rural areas and rural residents to urban areas to observe issues caused by flooding and the solutions implemented to date.
- Educate various audiences about infiltration practices to improve water quality through:
    - Workshops (with CEUs) for developers, builders, engineers, and inspectors about infiltration practices and green infrastructure.
    - Green infrastructure workshops and urban BMP tours for homeowners, policy makers, or other interested stakeholders.
- Build awareness of flood risk and intensifying rain events due to climate change by hosting an annual "flood awareness" meeting and promote ways residents can reduce stormwater run-off.
- Communicate with residents about the relationship between stream health and human health through community engagement events about water quality (outdoor classrooms, watershed tours, paddling outings, creek clean-ups).
- Promote the Nutrient Reduction Strategy and its recommended practices through workshops, tours, field days, or other peer to peer events for farmers and other stakeholders.
- Educate the agricultural community about flood risks and how they can be part of the solution by engaging the agricultural community through small events with ag groups and youth groups such as FFA and 4-H clubs.
- Partner with FFA teachers to incorporate watershed & water quality issues into their classes each year.
- Communicate with households utilizing septic systems about the impact of human waste management on stream health through workshops.

8.2 Watershed Public Education Messages

The LCWMA Education & Outreach Subcommittee will consider incorporating these central messages for the watershed level education and public awareness program.

- Everything we do, where we work, live or play can impact our water resources
- We are all part of the solution to stormwater pollution/We are in this together
- Being a steward of your land includes the water
- Clean water for drinking, recreation, and economic benefits needs to be protected for future generations
- Watershed stewardship: It is the responsibility of everyone to protect our water resources
- We all live downstream

Education Focus for Target Audiences

The LCWMA Education & Outreach Subcommittee will tailor the messages for the target audiences identified in the Goal Setting Sessions as follows.

General Public

Basic concepts of stormwater runoff and non-point source pollution, including how their actions can impact water quality.

Students / Schools

Partner with Iowa Learning Farms to incorporate water resource protection lesson plans into current curriculum.

Homeowners / Urban Agriculture / Golf Courses

Best practices for fertilizer and pesticide use on gardens and landscapes as well as proper disposal of grass clippings and leaves in order to protect nearby water sources. Using low impact development practices to mitigate runoff such as rain gardens, rain barrels, and permeable paving.

Builders / Developers / Design Professionals

Best management practices on proper disposal of construction materials, erosion and sedimentation control, low impact development and buffer protection.

Realtors / Floodplain Residents

Explain long term flood risk to potential home buyers.

Local Government Staff

Educate local government staff such as public works, parks and recreation, code enforcement, planning and zoning, etc. on best management practices that affect water quality.

Local Elected Officials / Governing Boards

Importance of promoting and sufficiently funding the implementation of best management practices in order to protect local water resources.

Farmers / Producers / Landowners

Promote best management practices (BMP) in the Nutrient Reduction Strategy and raise awareness about the various resources available for implementation.

Education Program Delivery Techniques

There are several ways to reach target audiences in a public education effort both at a local and watershed level. Some examples of these delivery methods are outlined below.

Internet

- ✓ **Website** – An internet site can provide an inexpensive way to foster awareness and education of stormwater management and watershed protection issues at the community or regional level. A website also serves as an information clearinghouse for educational materials and provides links to resources for target groups such as the general public, the development community, and various industries.
- ✓ **Social Media** – Promote events and funding opportunities through social media.
- ✓ **Email** – Email newsletters can provide information on upcoming outreach events as well as tips on nonpoint source pollution control for targeted audiences and the general public. Email is often the least expensive way to reach a larger number of individuals and entities.

- ✓ **Streaming media** – Tools such as streaming audio and video, webcasts, online training workshops, and other interactive electronic media tools can provide additional opportunities for reaching target audiences.

Printed Materials

- ✓ **Brochures & Fact Sheets** – Brochures, fact sheets, and other literature can be for general information or provide messages and tips specific to a topic or target group. Printed materials often complement other education and public awareness activities such as public outreach events and workshops.
- ✓ **Bill Inserts** – Printed materials can be designed to accompany utility bills or other correspondence to local citizens and businesses. Inserts can include brochures, newsletters, tips on best management practices and event notices.
- ✓ **Posters** – Wall posters provide a great deal of information quickly to the target audience at a stationary location and can be displayed at locations such as libraries, schools, and other public locations.

Outreach and Involvement

- ✓ **Workshops** – Workshops and seminars are opportunities to provide more detailed information and training to citizens, businesses, and public sector groups.
- ✓ **Speakers Bureau** – A speaker's bureau provides an opportunity for government staff and other professionals to address community organizations, business groups, homeowners' associations, church groups and educational institutions on issues related to stormwater and watershed management.
- ✓ **Events** – Hosting or participation in community events provides an opportunity for the distribution of information and resources directly to target communities. In addition, topic specific events such as agricultural field days, watershed fairs, stream cleanups and storm drain stenciling are an important way to involve citizens directly in watershed management efforts.
- ✓ **Event Display** – An event display provides a way to present information and educational messages at workshops and other events. Exhibits may be permanent or portable and can have static displays, videos, or interactive features. Portable display boards are often effective for use at events or workshops.

Chapter Nine
Monitoring & Plan Evaluation

ASSESSMENT ▪ **ENGAGEMENT** ▪ ACTION

9.1 Water Monitoring Plan

Water monitoring is an important part of establishing a baseline for both water quality and stream flows, and for documenting progress in achieving the goals of the Lower Cedar Watershed Management Plan. Due to the nature of the watershed, the monitoring plan should have both an urban and agricultural monitoring component, in which the parameters being monitored may differ according to the land uses. Currently in the Lower Cedar watershed, there is a lack of consistent water quality monitoring efforts suitable for tracking pollutant trends. Recent monitoring/sampling in the basin is limited to the following:

- The Iowa Water Quality Information System (IWQIS) operations a single sensor in the Lower Cedar (WQS9903 at Conesville), and it measures only temperature and turbidity.
- IWQIS also includes a small number of Citizen Science sites that report nitrate-nitrogen concentrations collected in 2018
- Programmatic ambient stream monitoring and biological monitoring by the Iowa DNR (refer to Section 3.2).

A major recommendation of this planning effort is to initiate a long-term sampling program based on the 2020 monitoring presented in Section 3.1. Building off the 2020 monitoring activities will provide baseline information and track future trends. A HUC-12 scale monitoring framework should also be established to provide higher resolution data in priority watersheds such as Middle Mud Creek, Pike Run, and West Branch Wapsipinicon. Sampling analytes (pollutants) and frequency should mimic the 2020 sampling but include multiple key locations within a HUC-12. This will help better identify hot spots and track pollutant reductions at more appropriate temporal and spatial scales. The long-term monitoring plan should be flexible to accommodate changing priorities. The WMA may wish to consider establishing a rotational monitoring plan where efforts are focused in one or more HUC-12s for a several years than then move to other watersheds around the basin.

Flows

Monitoring flows in the Lower Cedar River over time - how much water flows each day, month and year - is important both for understanding the nature of flooding, as well as for documenting pollutant loads from the Lower Cedar watershed to the Iowa River. Pollutant loads (such as pounds of sediment or phosphorus per year) are calculated by multiplying stream flows by sampled pollutant concentrations, which requires measuring continuous stream flows. This is done by the use of automated flow gauging stations that record the depth of the stream every 15 minutes. The depth of the stream is converted into stream flows based upon mathematical relationships derived from numerous measurements of flows and depths across the stream channel each year. Flow monitoring is currently conducted at the USGS stream gage sites at Cedar Rapids (Station # 05464730), Cedar Bluff (Station # 05464780), and Conesville (Station # 05465000).

Pollutant Concentrations

The LCWMA benefits from the partnership with the State Hygienic Lab in collecting water quality data. It is hoped that this partnership will continue, at a minimum collecting the same basic suite of data: dissolved oxygen, turbidity, temperature, specific conductance, pH, total suspended solids, chloride, nitrate, sulfate, dissolved reactive phosphorus, and *E. coli*. Additional resources should also be sought to allow for enhanced monitoring efforts, as determined by the specific phase of the watershed plan being implemented.

Urban Constituents Monitoring should be conducted in the upper reaches of the watershed to assess the impact of urban land use on the watershed's creeks. The effects of urbanization can vary from increasing the temperature of a receiving water body (thermal loading), the amount of runoff contaminated with urban pollutants such as oil and grease or heavy metals, and the rate/volume of runoff reaching the creeks. Parameters could include oil and grease, heavy metals, chloride, temperature, and TSS.

Tile Outlet Monitoring would be a useful addition to the existing data set. Monitoring the quality of water from agricultural tile outflows is beneficial in understanding field-scale contributions of nitrates and dissolved orthophosphate to the watershed. In addition, tile outlet monitoring has been useful to producers in terms of helping them to understand the patterns of nitrate leaching from their fields, which has a direct economic component. It should be noted that tile outlet monitoring results are never published publicly to protect the privacy of the landowner. However, publishing aggregated tile outlet monitoring data at the watershed scale is acceptable if individual data collection points are not listed.

Storm Event Sampling is useful for characterizing the 'first flush' of contaminants reaching Lower Cedar following a rain event. Automatic flow-paced sampling should be used, which will allow for sampling of each storm event's rising and declining limbs of the storm hydrograph (peak and recession of flows). Rising water levels at the beginning of a storm typically have higher pollutant concentrations that decline with receding water levels. If funding is not available (or until funding becomes available) grab sampling could be done at the USGS stations with recording of instantaneous river gauge height, date and time noted for each sample. Multiple grab samples would need to be taken over the course of a storm event. Monitored pollutants should include; total phosphorus, soluble reactive phosphorus, total suspended solids, nitrate-nitrogen.

Bacteria (*E.coli*) Monitoring

Bacteria monitoring should also be continued in the Lower Cedar watershed, ideally including the USGS Stations to determine bacteria loads. For comparison to standards, sampling should occur at least 5 times per month per site, from April through October, to obtain geometric mean concentrations for comparison to Iowa *E.coli* standards. Standardized sampling protocols have been established for monitoring *E.coli* in streams.

Biological Monitoring

Development and implementation of a long-term biological monitoring and assessment plan is strongly recommended to provide a mechanism for tracking progress in habitat improvements and documenting the stream aquatic community response. The value of stream biological and habitat monitoring data collected at a limited number of fixed locations might be enhanced by careful integration and refinement of rapid visual assessments (such as RASCAL) that can produce a more comprehensive assessment of habitat improvement needs throughout the watershed. Staff with the IDNR stream bio-assessment program have offered to provide technical advice on developing habitat and biological sampling design.

9.2 Compiling the Data and Calculating Loads

The result of the intensive monitoring is the calculation of water flows and nutrient/sediment losses from the land expressed as loads or pounds of phosphorus or sediment per acre per year. Wet years can have larger losses that may need to be adjusted for rainfall for inter-year comparisons (pounds P /acre/inch of precipitation). Very large storms can be expected to produce large amounts of runoff and associated pollutants and hence, the emphasis should be on evaluating average values for more typical years.

In addition to calculating loads based on field measurements, the DNR's Pollutant Load Reduction calculator should be used to document load reductions resulting from the implementation of specific Best Management Practices in the watershed. The IDNR or IDALS Basin Coordinators can assist with setting up an account for the Lower Cedar watershed once the project has reached the stage of BMP implementation.

The data collected through the various programs should be compiled into an annual monitoring report that summarizes the monitoring results in straightforward language, with clear conclusions and recommendations for watershed management. If possible, the monitoring report should be presented to the public (or at minimum, at an LCWMA Board meeting) with responsible agencies providing an overview of their key findings. Keeping the public apprised of water monitoring data is a public outreach tool that can help to build awareness of the need for continued watershed improvement efforts.

9.3 Plan Evaluation

There will need to be an evaluation of the progress towards implementation of the specific actions identified in the Lower Cedar Watershed Management Plan and towards meeting the long-term goal of a healthy watershed. It is recommended that evaluation be completed through bi-annual plan reviews and plan updates that occur every seven years. Reviews and updates are an important component of the adaptive management approach.

Adaptive management is a type of natural resource management in which decisions are made as part of an ongoing science-based process. Adaptive management involves testing, monitoring, and evaluating applied strategies, and incorporating new knowledge into management approaches that are based on scientific findings and the needs of society. Results are used to modify management policy, strategies, and practices. (USGS)

This adaptive management approach recognizes the limitations of current knowledge regarding future situations, and the inevitability of change. This Plan provides a big-picture context for specific actions based on the best available data and will need to be adjusted as better information or new conditions arise. By design, the action steps that happen in the first 7 years are reasonably firm, whereas those beyond 14 years are expected to be refined several times before they are implemented.

Implementation

The LCWMA will begin Plan implementation by establishing subcommittees and advisory groups:

- Agriculture Related Advisory Group to advise on project development and education strategies.
- Infrastructure Subcommittee to incorporate low impact development and best management practices into capital improvement projects.
- Monitoring & Analysis Subcommittee to develop and implement a long-term monitoring and data collection plan.

Bi-annual Reviews

The purpose of the bi-annual plan review is to identify and discuss implementation challenges to determine if there is a need for plan amendments. The evaluation process provides stakeholders an opportunity to discuss concerns about an element of the Lower Cedar Watershed Management Plan. The bi-annual reviews are a reminder that the Plan is adaptable, dynamic, and flexible. Information that will be collected as part of the bi-annual survey and evaluation of progress will include:

Education Activities – Reporting of education and outreach efforts

Watershed Improvement Projects – Track implementation of projects and locations, provide watershed-wide summary with a map

Watershed Conditions Assessment – Update and summarize monitoring program data

As additional metrics for measuring progress are developed by the LCWMA they will be included in the bi-annual survey and progress report.

Plan Updates

Plan updates occur every 7 years and take a more holistic look at changed conditions and implementation actions since the last Plan Update. Evaluations of changed conditions for Plan Updates may include:

- Population and land use forecasts and trends;
- Water quality trends using the 303(d) list and available watershed assessment data;
- Tracking of BMPs; and
- Flood risk modeling for future land use projections.
- Undoubtedly, other issues will emerge that merit in-depth consideration in the future. As with existing efforts, future planning work should be open and inclusive, involving all LCWMA members and stakeholders.

Conclusions

While the performance will be reported bi-annually by the LCWMA members, the final measure of implementation success will be the longer term, demonstrable trends of:

- Watershed planning and greater local coordination on land use and watershed health.
- The progression of communities towards proactive programs.
- Proactive detection of potential pollutant sources and collection of better watershed conditions data.
- Heightened public awareness and community support through an effective public education and awareness program.
- Progress on improving surface water quality and reducing the risk of flood impacts.

Appendix A
Detailed Assessment Data

Table A-1. Soils in the Lower Cedar Watershed

Soil Name	Map Units	Area	Area (%)	Description	Hydrologic Soil Group	Typical Slopes (%)
Muscatine	1119; 119; 119A; 119B; 120; 120A; 120B; T119A	94,076	13%	very deep, somewhat poorly drained soils formed in loess	C/D	0-5
Fayette	293C; 293E; 4163B; 4163C; 4163D; 4293B; 4293C; 4293D; 463B; 463C; 917B; 917C; 917C2; 917D2; M163B; M163C2; M163D; M163D2; M163D3; M163E; M163E2; M163F; P163B; P163C; P163C2; P163D3; P163E3; T163B	60,706	9%	very deep, well drained soils formed in loess	C	0-60
Tama	120B; 120B2; 120C; 120C2; 120C3; 121; 121B; 121C2; 121D2; 420B; 442B; 442C; 442C2; 442D; 442D2; T120A; T120B	53,126	8%	very deep, well drained soils formed in loess	C	0-20
Downs	462B; 462C; 916B; 916C; 916C2; M162B; M162C; M162C2; M162C3; M162D; M162D3; M162E3; P162B; P162C; P162C2; P162D	45,830	7%	very deep, well drained soils formed in loess	C	0-35
Judson	11B; 133B; 8B; 911B	42,002	6%	very deep, well drained soils formed in silty colluvium derived from non-calcareous loess	C	0-12
Klinger	184; 184A; 184B; 377B; 382	31,373	4%	very deep, somewhat poorly drained soils formed in 50 to 102 centimeters of loess and the underlying glacial till	C/D	0-5
Colo	1212; 133; 133+; 1539; 212; 2133; 220; 3133; 430; 484; 54	27,238	4%	very deep, poorly drained soils formed in alluvium	C/D	0-5
Atterberry	1291; 291; 291B; 351A; 916B; 916B2	23,264	3%	very deep, somewhat poorly drained soils formed in loess on uplands	B/D C/D	0-6
Sparta	140; 175B; 393B; 393C; 41; 41A; 41B; 41C; 41D; 41E; 442D2; 8041B; 8041C	15,072	2%	very deep, excessively drained soils formed in sandy outwash that has been reworked by wind	A	0-40
Kenyon	394; 394B; 394C; 4083B; 4083C; 83B	15,052	2%	very deep, moderately well drained soils formed in 30 to 75 centimeters of silty or loamy sediments and the underlying till	C	2-35
Other Soils	Varies	295,321	42%	Varies	Varies	Varies

A-2. Responses to an email survey of cities in the Lower Cedar Watershed

Atalissa
What water quality or quantity concerns does your community have? Check all that apply.
- Waterway access / recreation

List water quality or flood related projects your community has done and/or plans to do.
None at the moment

What projects are you interested in or want more information about? Check all that apply.
None

How can the Lower Cedar WMA assist your community with water quality or flooding concerns?
Nothing right now

Bennett
What water quality or quantity concerns does your community have? Check all that apply.
- Areas of flooding / stormwater issues

List water quality or flood related projects your community has done and/or plans to do.
have not done anything
What projects are you interested in or want more information about? Check all that apply. Other, please specify:
- The creek on the east side of town

How can the Lower Cedar WMA assist your community with water quality or flooding concerns?
don't know if we can do anything about the creek on the east side of Bennett because when it rains 2 or more inches the creek comes up so fast the water can't get away

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Mechanicsville
What water quality or quantity concerns does your community have? Check all that apply.
Debris clean out

List water quality or flood related projects your community has done and/or plans to do.
Clean out storm water catch basins

What projects are you interested in or want more information about? Check all that apply.
n/a
How can the Lower Cedar WMA assist your community with water quality or flooding concerns?
n/a

Bertram
What water quality or quantity concerns does your community have? Check all that apply.
- Water quality concerns
- Areas of flooding / stormwater issues
- Erosion concerns

List water quality or flood related projects your community has done and/or plans to do.
The City of Bertram is just beginning an infrastructure study with the Fehr & Graham group, to see about extending our water service to a couple of additional areas of town. Our current water well and delivery system only has about 30 hookups, and we believe the current well/tank system could deliver to some more homes. We remain interested in a more comprehensive study to ascertain runoff problems that occur during strong rains or storms.

What projects are you interested in or want more information about? Check all that apply.
Permeable paving; Native plantings; Bioswales; Rain gardens; Detention basins

How can the Lower Cedar WMA assist your community with water quality or flooding concerns?
We remain keenly interested in the preliminary study proposal currently under discussion with Federal agencies. Our main waterway is Big Creek, which we understand is an area in discussion for this preliminary study. We also note that our "Big Creek Bridge" on the eastern edge of the city limits has been identified for several years, by county and/or state officials, as a higher priority for repair or replacement. We believe an environmental/hydrological study could help us gain insights into how to best proceed with that project, for the benefit not only of City of Bertram residents, but a wider population in southern Linn County.

Durant
What water quality or quantity concerns does your community have? Check all that apply
Water quality concerns; Areas of flooding / stormwater issues; Erosion concerns

List water quality or flood related projects your community has done and/or plans to do.
We plan to upsize the storm water system from the south side of the tracks to the plant to help alleviate street flooding and backups. We have installed permeable pavers on one street-however after 4 years they are cracking and needing replacing. We do have a bioswale that separates commercial and residential properties that appears to be working as it should.

What projects are you interested in or want more information about? Check all that apply. Other
Storm water funding

How can the Lower Cedar WMA assist your community with water quality or flooding concerns?
Keeping us posted on the projects

Cedar Rapids
What water quality or quantity concerns does your community have? Check all that apply.
Water quality concerns; Areas of flooding / stormwater issues; Erosion concerns; Debris clean out; Waterway access / recreation; drinking water protection

List water quality or flood related projects your community has done and/or plans to do.
Cedar Rapids Flood Control System; Indian Creek berm along Sun Valley; Urban stormwater BMPs (long list); BMPs on City-owned ag land; Cedar Lake restoration

What projects are you interested in or want more information about? Check all that apply.
Permeable paving; Native plantings; Bioswales; Rain gardens; Detention basins

How can the Lower Cedar WMA assist your community with water quality or flooding concerns?
Continued Watershed Planning support & Funds for BMP implementation

---

West Branch
What water quality or quantity concerns does your community have? Check all that apply.

List water quality or flood related projects your community has done and/or plans to do.
West Branch has collected USGS stream gauge data for several years. From this data a model was produced identifying areas to target for flood reduction. Also, water quality data has been taken. Our most urgent and recent plan of action is to implement a stream widening project which is designed to address water quality issues as well as flooding issues. That project is in the design phase now. In addition, West Branch may consider other water quality projects on other targeted streams. Most recently Hoover National Park has just completed a large detention project to help deter flooding in the National Park. Water quality issues were also addressed in that project.

What projects are you interested in or want more information about? Check all that apply.
Native plantings; Bioswales; Detention basins

How can the Lower Cedar WMA assist your community with water quality or flooding concerns?
Primarily, helping West Branch create a comprehensive plan for flood mitigation. Finding sources of funding for future projects would of course be very helpful.

Appendix B
Prioritization of Subwatersheds

A major objective of the plan was to identify a list of high priority subwatersheds (HUC-12 watersheds) for more detailed assessment and implementation planning. The subwatershed prioritization approach included both quantitative and qualitative considerations from technical (data-driven), socio-political (stakeholder and public interest), and economic (costs, benefits, and available funding) perspectives.

The prioritization utilized the Recover Potential Screening (RPS) Tool developed by the EPA to compare watershed condition and restorability (https://www.epa.gov/rps). This tool uses data compiled by both state and federal agencies to compare watersheds using three sets of indicators: Stressors, Ecological, and Social. The tools are customizable in that watershed-specific data can be added by the user.

Stressor Indicators include watershed characteristics that often stress or have a negative impact on water quality. Examples of stressors include steep slopes, erodible soils, high concentration of nutrient sources. Ecological Indicators are traits that typically provide rich and resilient ecosystems and habitats, such as the percent of the watershed with a perennial grass or forest land cover and measures of desirable/native biological species density and diversity. Social Indicators measure the level of support that exists within subwatershed from stakeholders and potential funding and/or technical partners.

The planning team selected a suite of RPS Tool indicators specific to the three pollutants of concern: phosphorus, nitrogen, and *E. coli*. These are common pollutants of concern in the Lower Cedar and most of Iowa. Iowa's Nutrient Reduction Strategy (NRS) includes phosphorus and nitrogen reduction goals, and many stream impairments in the Lower Cedar stem from high levels of *E. coli* bacteria. Sediment prioritization was not explicitly assessed because most of the indicators that drive phosphorus prioritization apply to erosion and sediment transport as well.

The maps that follow illustrate the results of the RPS Tool for nitrate, phosphorus, and E. coli. The bubble plots show all three indicators. The x-axis of each bubble plot indicates the level of stress on waterbodies, the y-axis quantities the quality of the ecological resources within the watershed, and the size of the bubbles indicate the degree/presence of social support, such as prior watershed work, presence of monitoring, and other factors (see Section 3.3 for more detailed description of prioritization parameters).

Figure B-1. Recover Potential Ranking for Nitrate

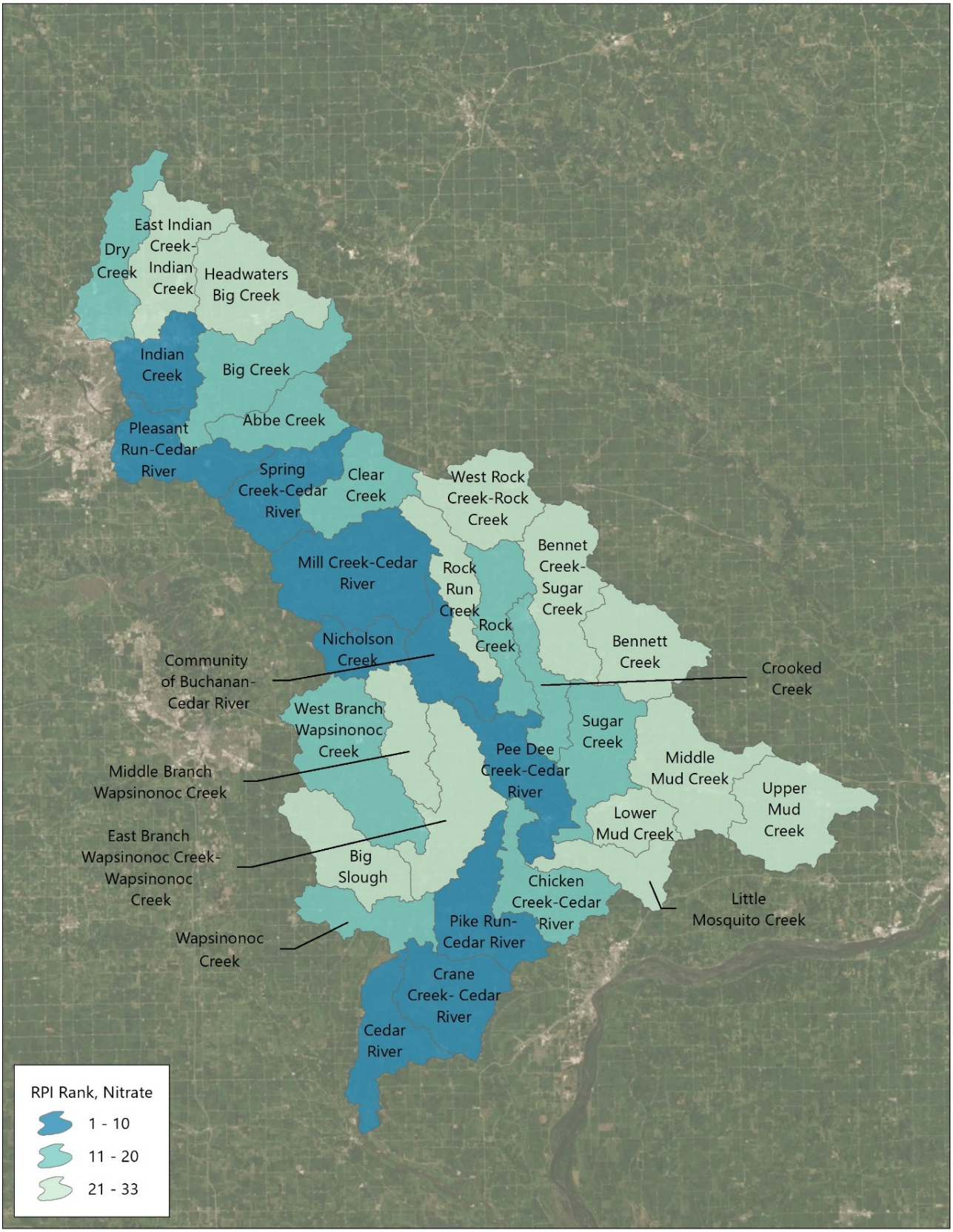
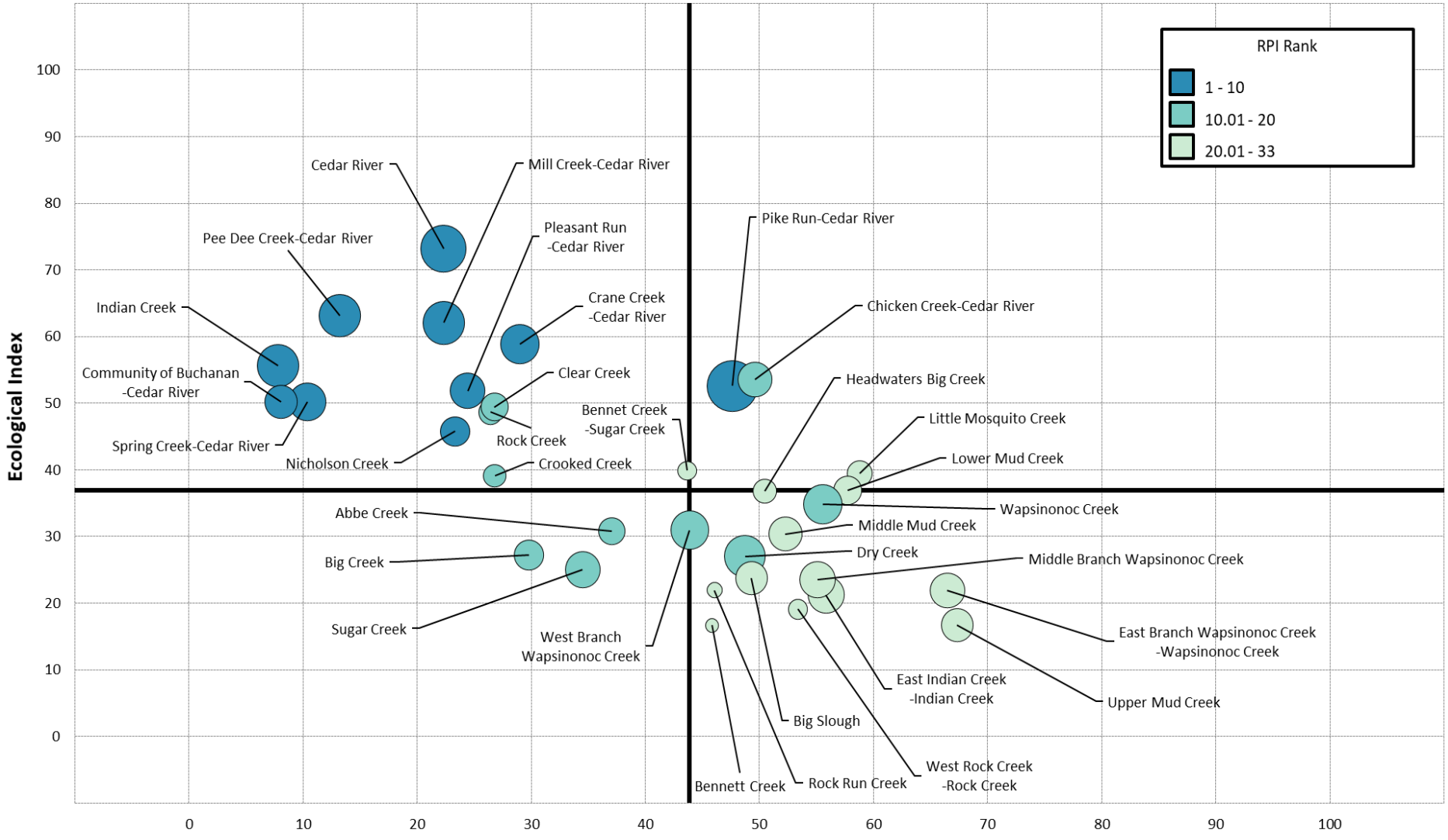


Figure B-2. Stressor, Ecological, and Social Scores for Nitrate



Note: Circle size increases with Social Index score

Figure B-3. Recover Potential Ranking for Phosphorus

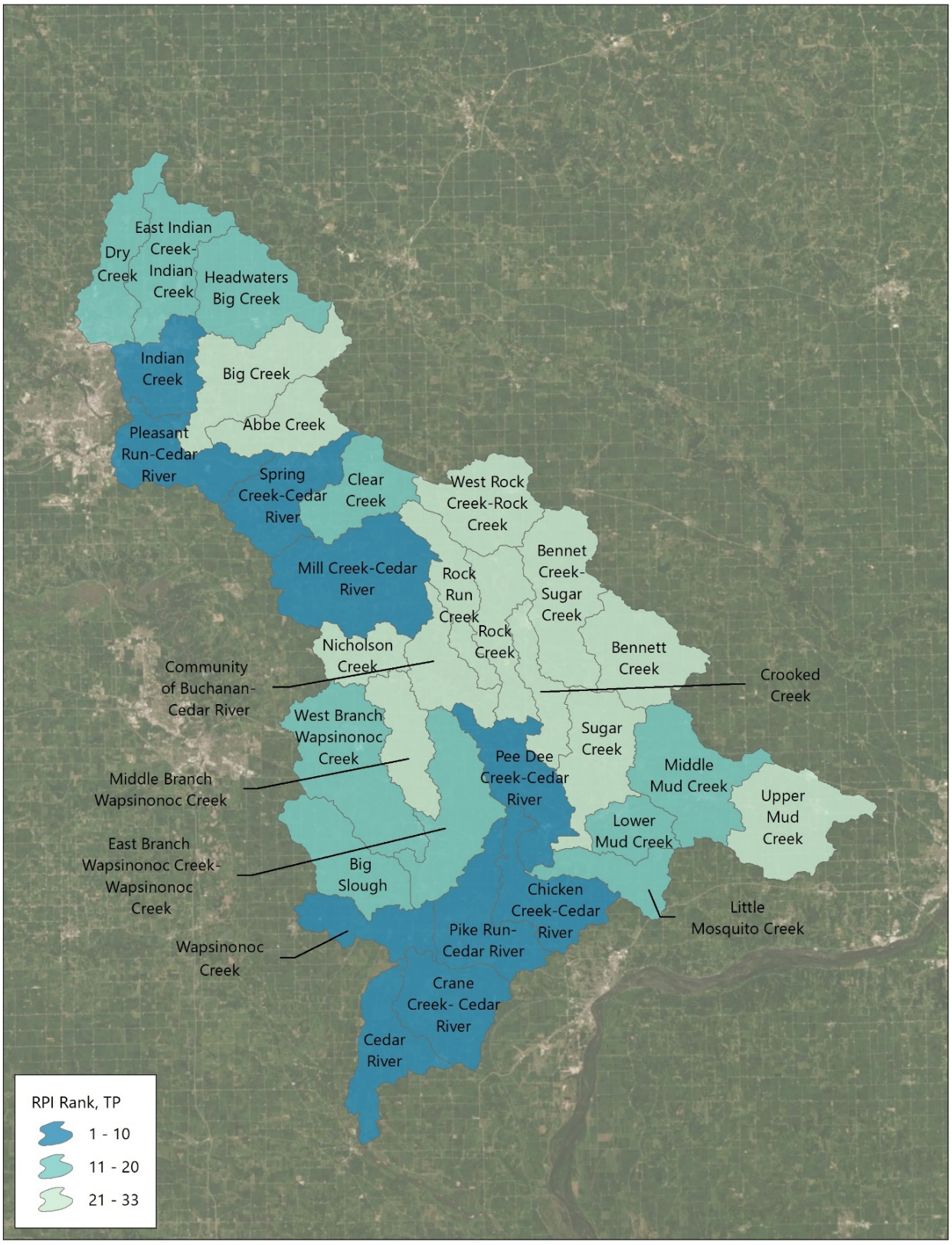
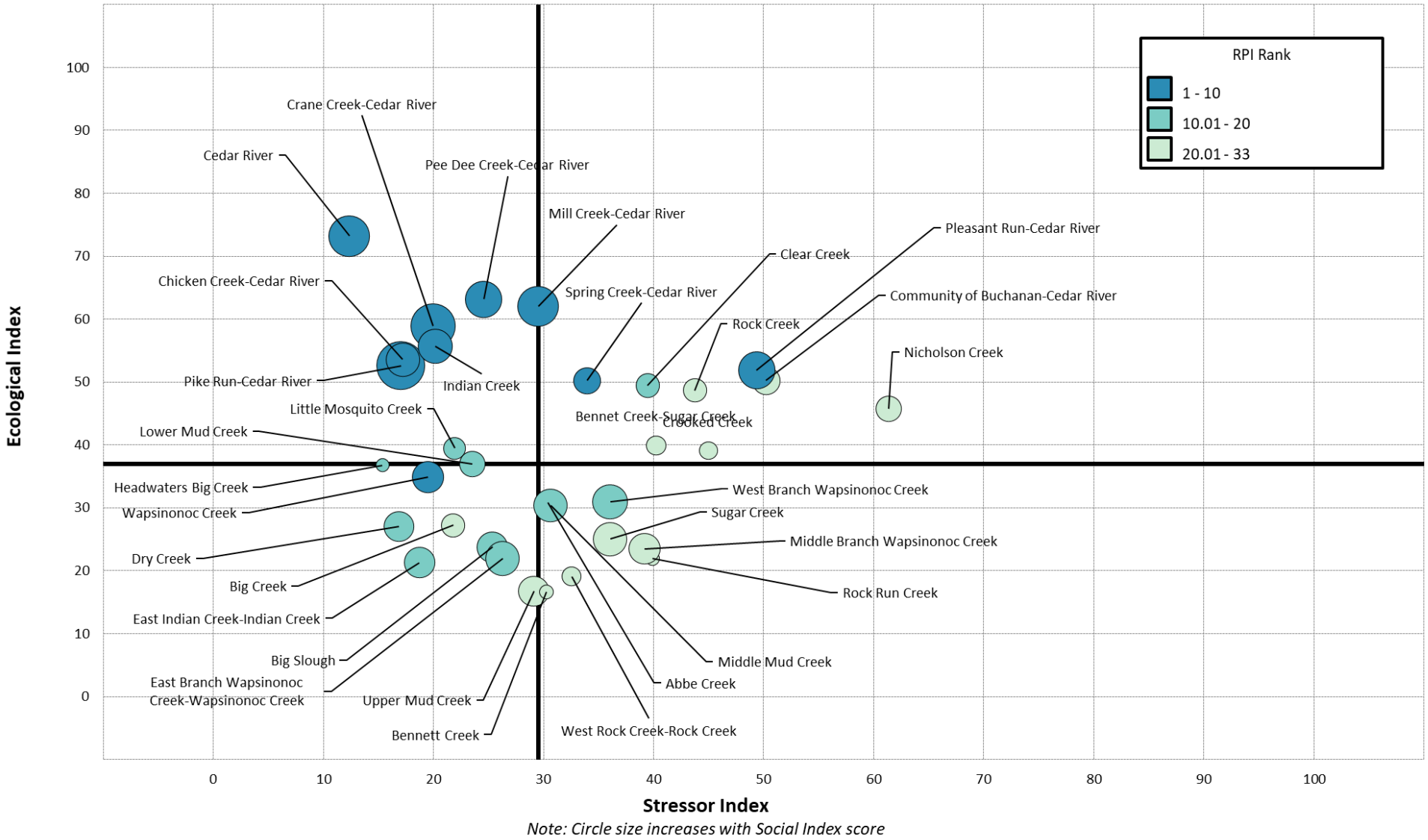


Figure B-4. Stressor, Ecological, and Social Scores for Phosphorus



Note: Circle size increases with Social Index score

Figure B-5. Recover Potential Ranking for E. coli

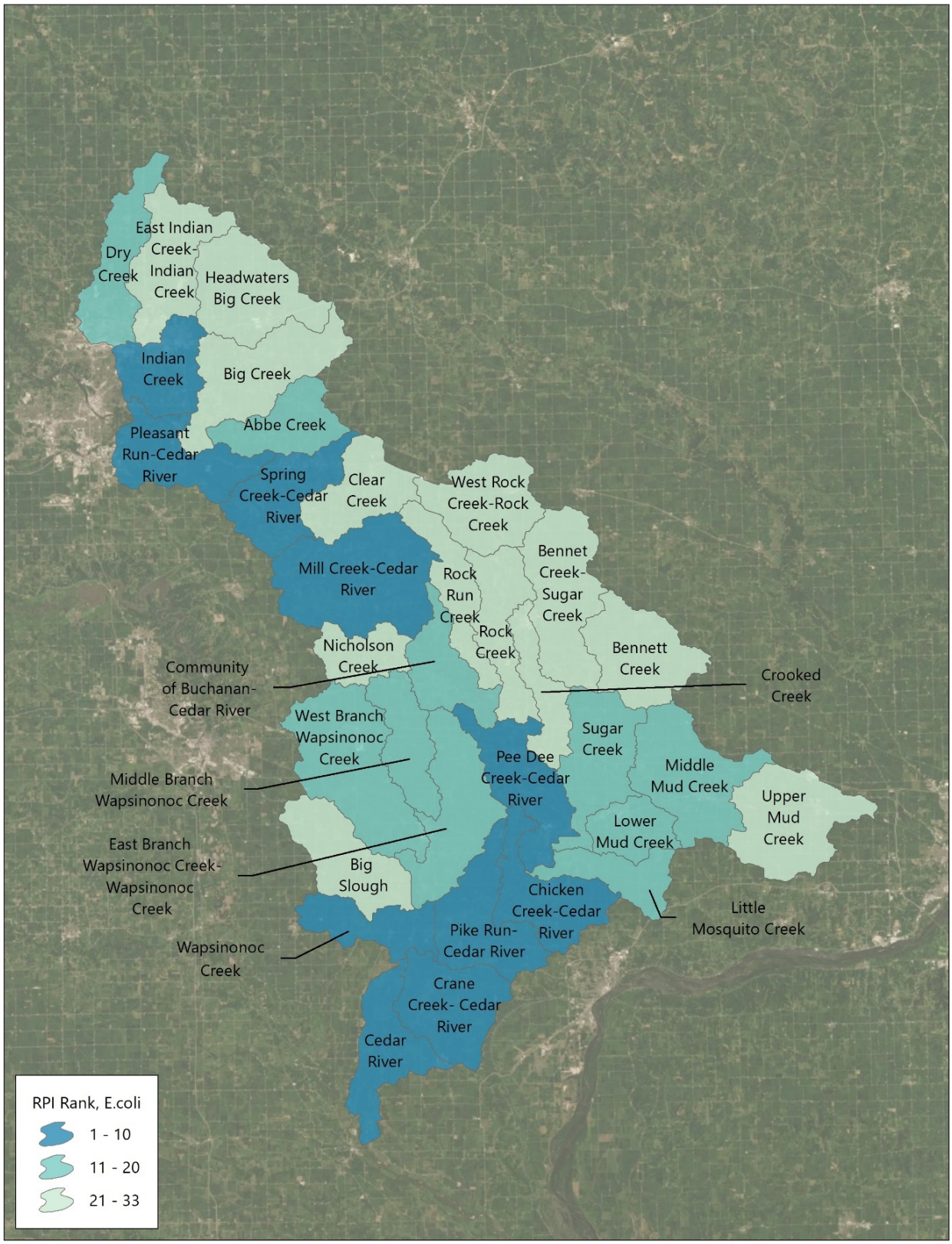
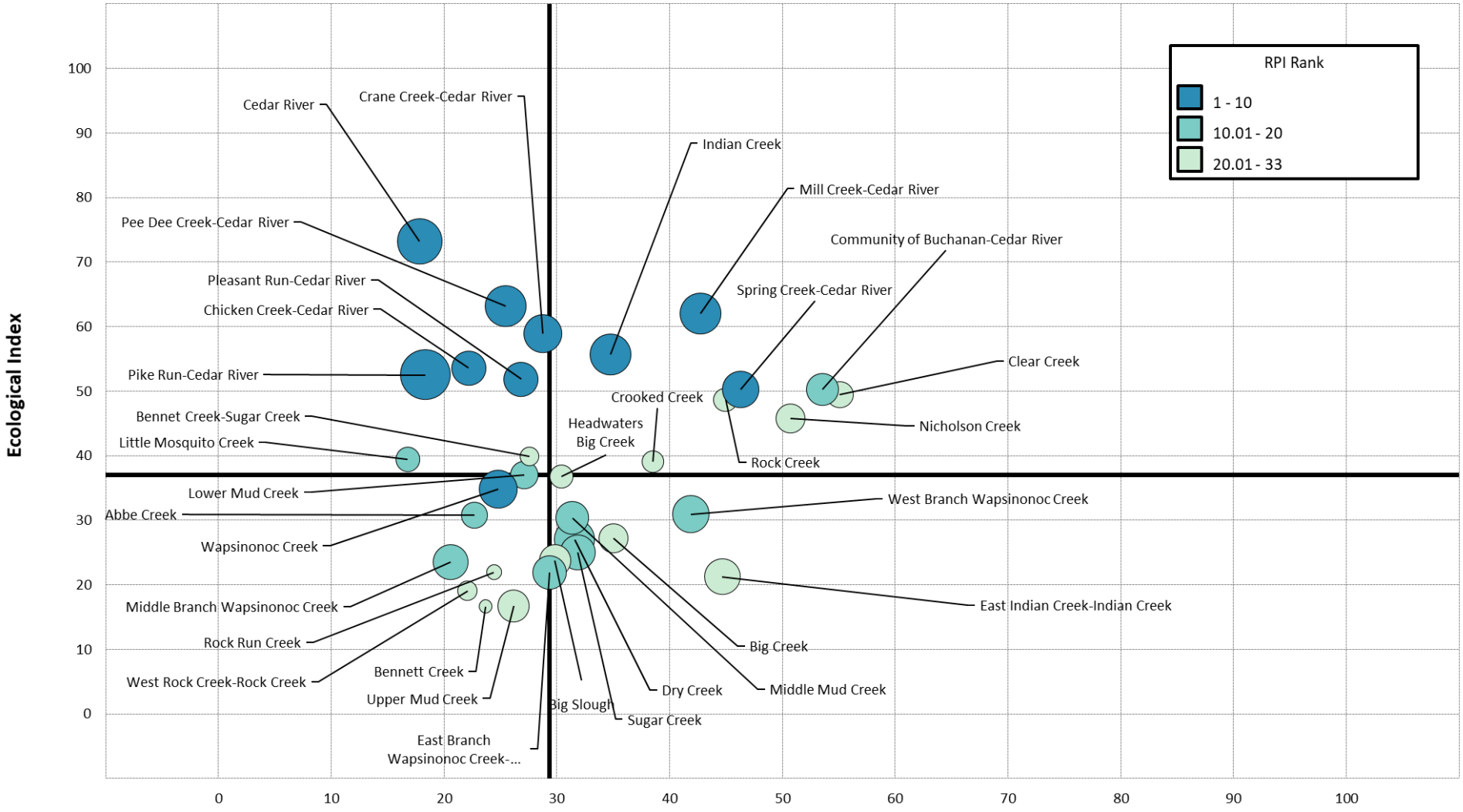


Figure B-6. Stressor, Ecological, and Social Scores for E. coli



Note: Circle size increases with Social Index score

Figure B-7. Composite Recover Potential Ranking

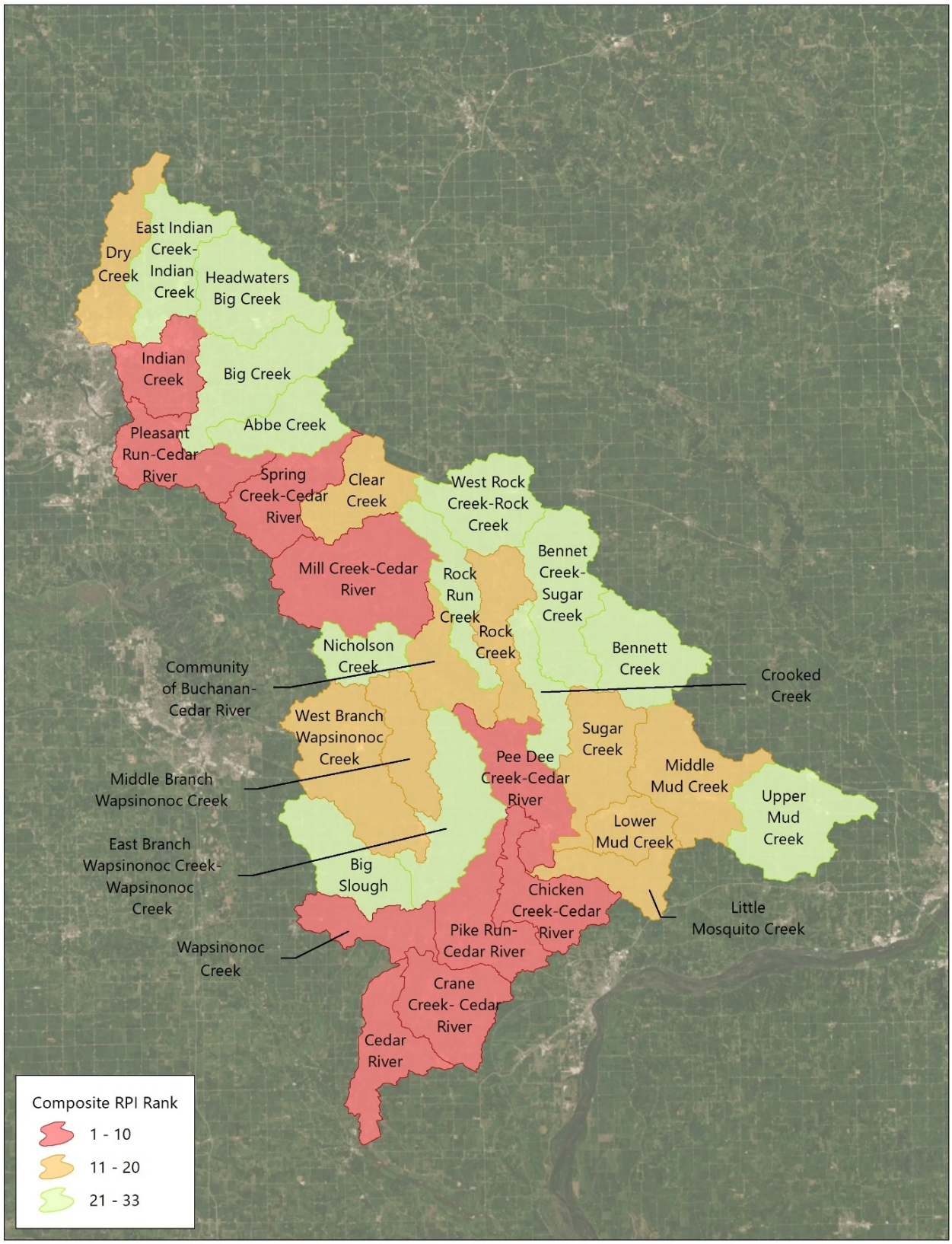


Figure B-8. Priority Rankings by Stressor

Top 10 Priority Watersheds			
Nitrate	**E.coli**	**Total Phosphorus**	**Composite**
Cedar River	Cedar River	Cedar River	Cedar River
Pee Dee Creek-Cedar River	Pike Run-Cedar River	Pike Run-Cedar River	Pike Run-Cedar River
Indian Creek	Pee Dee Creek-Cedar River	Crane Creek-Cedar River	Pee Dee Creek-Cedar River
Mill Creek-Cedar River	Crane Creek-Cedar River	Mill Creek-Cedar River	Crane Creek-Cedar River
Spring Creek-Cedar River	Indian Creek	Pee Dee Creek-Cedar River	Mill Creek-Cedar River
Pike Run-Cedar River	Mill Creek-Cedar River	Indian Creek	Indian Creek
Crane Creek-Cedar River	**Chicken Creek-Cedar River**	**Chicken Creek-Cedar River**	**Spring Creek-Cedar River**
Community of Buchanan-Cedar River	Pleasant Run-Cedar River	**Wapsinonoc Creek**	Pleasant Run-Cedar River
Pleasant Run-Cedar River	**Wapsinonoc Creek**	Pleasant Run-Cedar River	**Chicken Creek-Cedar River**
Nicholson Creek	**Spring Creek-Cedar River**	**Spring Creek-Cedar River**	**Wapsinonoc Creek**

Middle Mud Creek
HUC-12 Watershed Plan

August 2022

Lower Cedar Watershed Management Authority

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Middle Mud Creek

Table of Contents

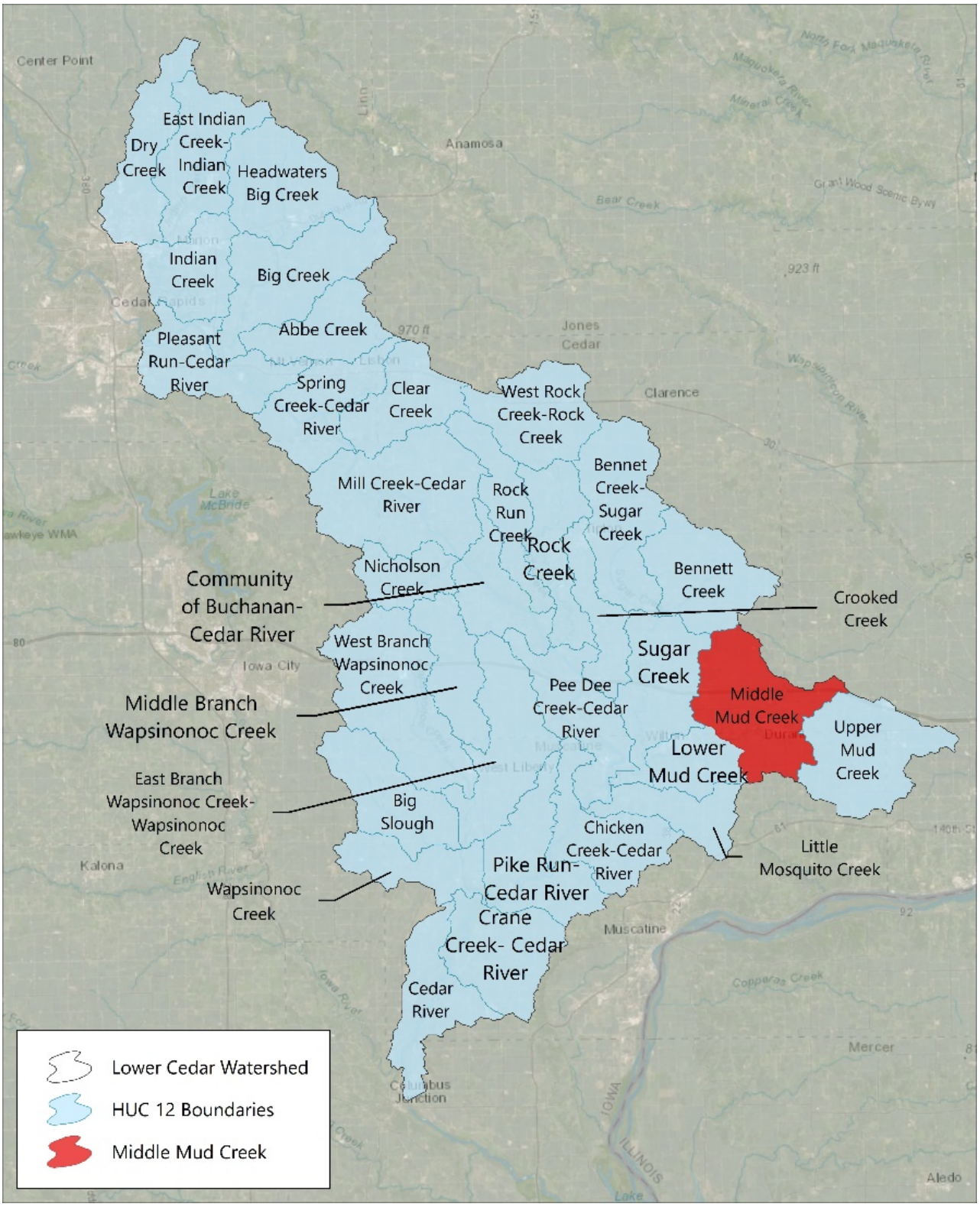
1. Introduction

The boundaries of the Lower Cedar watershed and its thirty-three subwatersheds are based on United States Geological Survey (USGS) defined boundaries called Hydrologic Unit Codes (HUC). The Lower Cedar watershed (HUC-8 07080206) covers 703,060 acres across 7 counties including Linn, Jones, Johnson, Cedar, Scott, Muscatine, and Louisa. The HUC-8 watershed includes 33 smaller, HUC-12 scale subwatersheds (Figure 1-1). The Middle Mud Creek watershed (HUC-12 070802060502) (shaded red in Figure 1-1) was selected as a high priority subwatershed for more detailed analysis and planning. The prioritization analysis utilized a data driven approach based on political, economic, socio-cultural, and technical (PEST) inputs and considerations.

- Political inputs included the presence of organized, local support for watershed improvement initiatives
- Economic inputs included feasibility of funding acquisition from various sources
- Social-cultural inputs were based on stakeholder and public engagement feedback (landowner, producer, community, and resident interest or buy-in)
- Technical inputs include water quality impairments, other habitat and water quality considerations, and historical monitored pollutant concentrations, and watershed characteristics (erodible soils, land use, slope, and others)

The EPA's Recover Potential Screening Tool (RPST) provided a quantitative summary of the technical inputs related to existing ecology and stressors in each HUC-12 watershed and captured several social and political indicators. Other political and social considerations were based on focus group discussions, survey results, and discussions by a group of partner agency staff with expertise related to water and natural resources conservation, flooding, and funding opportunities (called the technical advisory committee, or TAC). The detailed results of the prioritization process for the entire HUC-8 watershed are provided in Appendix B. Middle Mud Creek was classified as a high priority subwatershed because of its high stressor scores for water quality and habitat (due to phosphorus and sediment) and based on elevated stakeholder interest and support for improvement efforts in this subwatershed.

Figure 1-1. HUC-12 Subwatersheds



2. Watershed Characteristics

Political Jurisdictions and Populations

The Middle Mud Creek watershed spans Muscatine, Scott, and Cedar Counties and includes the City of Durant. The total population of the watershed is 2,495 based on 2010 census data and EnviroAtlas – Dasymetric population by 12-digit HUC. The City of Durant's Wastewater Treatment Plant (WWTP) discharges treated wastewater into Middle Mud Creek, and the City of Walcott's WWTP discharges into Upper Mud Creek, which flows through Middle Mud.

Land Use and Land Cover

Agricultural production is the predominate land use of the Middle Mud Creek watershed, with 85% in row crop production (cropland) and 6% in pasture. Another 1.5% of the watershed is woodland/natural areas, and 7% is urban. The remaining 0.5% of the watershed is water/wetland or other land uses. Given that the majority of the Lower Cedar Watershed is devoted to agricultural uses, much of the focus on the watershed plan will be on engaging rural landowners and emphasizing that the burdens of flooding and water quality are not just urban issues.

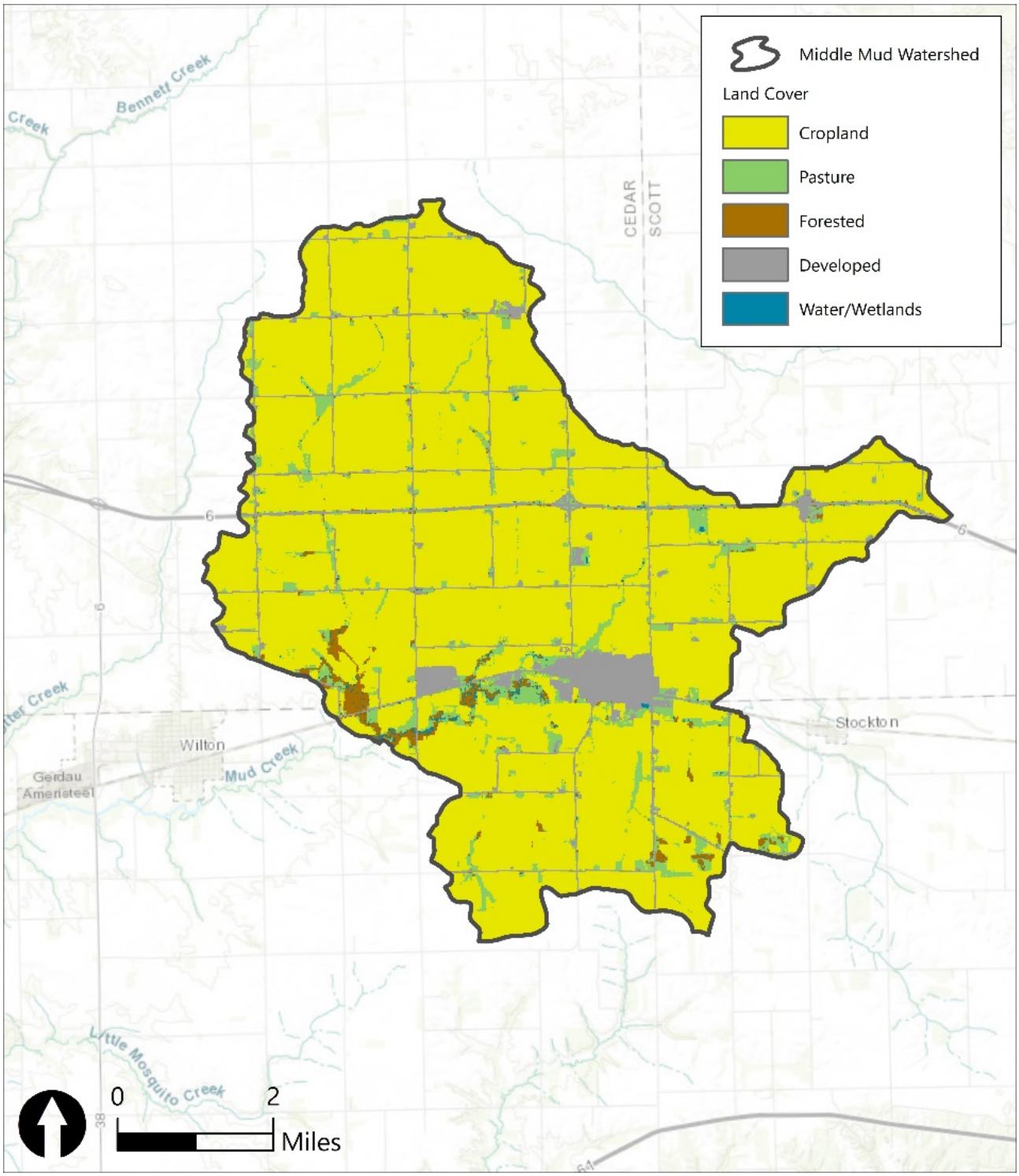
As shown in Table 2-1, the area in row crops has increased the past 20 years due to agricultural production trends and conversion of land that was once in pasture, timber, or other perennial cover. By engaging rural landowners throughout the planning process, the WMA hopes to increase their buy-in to the watershed project, to scale up adoption of critical agricultural conservation practices.

Figure 2-1. Land Cover in the Middle Mud Creek Watershed

Land Cover	Acres in 2001	% of Watershed	Acres in 2020	% of Watershed
Cropland	20,864	72%	24,600	85%
Pasture	6,508	22%	1,723	6%
Forested	1,651	6%	460	1.5%
Developed	N/A	N/A	2,131	7%
Water & Wetlands	N/A	N/A	109	0.5%

Source: Iowa Department of Natural Resources.
N/A = 2001 data that did not specify Developed and Water & Wetlands area.

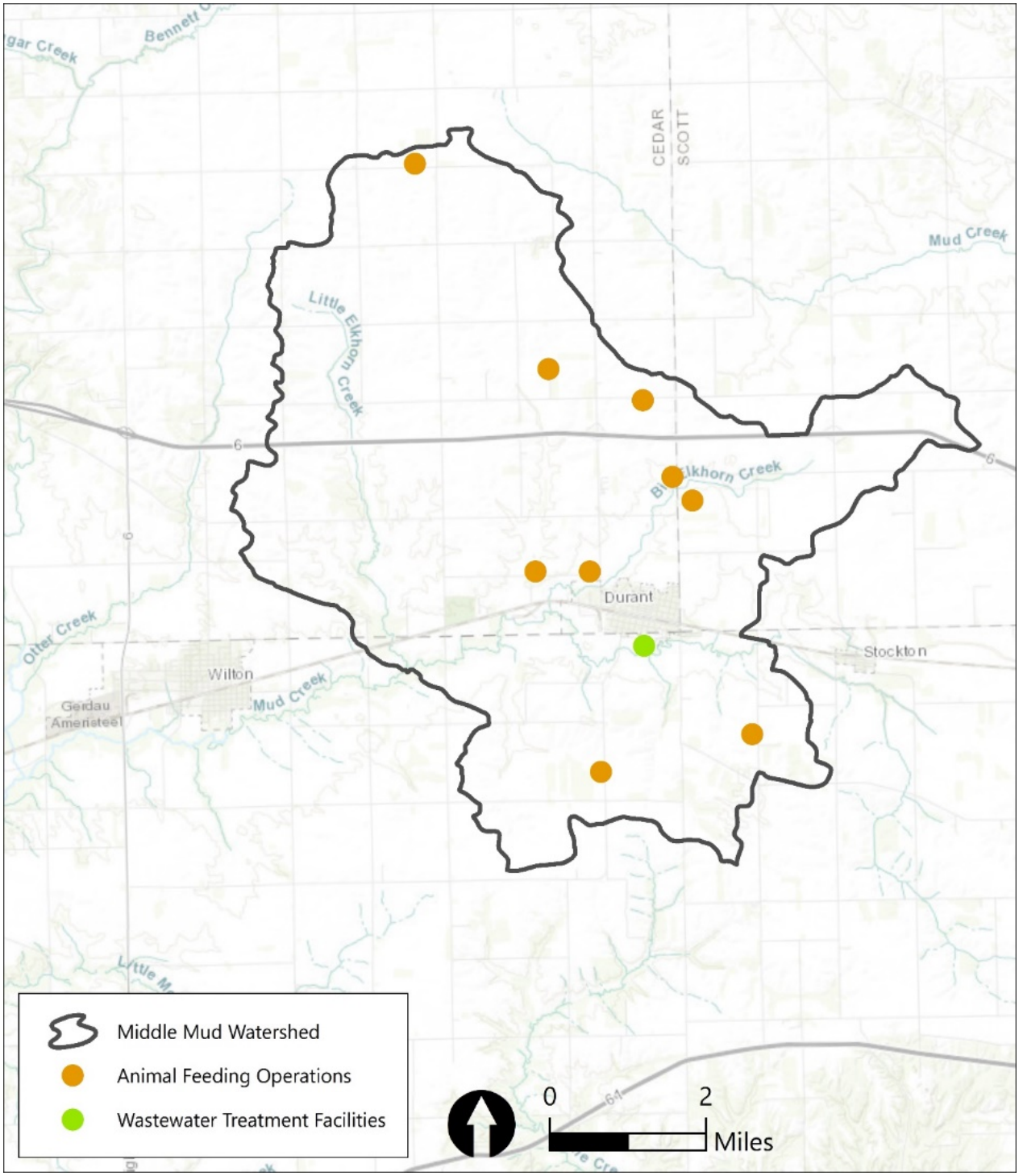
2-1. Middle Mud Creek Watershed Land Cover



Source: Iowa Department of Natural Resources

Livestock is present in the Middle Mud Creek Watershed on pasture and confined in animal feeding operations (Figure 2-2). The location of Durant's WWTP is also shown in Figure 2-2, and although it is not in the same HUC-12, the City of Walcott has a WWTP that discharges to Mud Creek in Upper Mud Creek. These concentrated sources of nutrients and bacteria can cause water quality impacts, particularly if there are spills or accidental discharges to surface water.

Figure 2-2. Permitted Livestock and Human Waste Facilities



Source: Iowa Department of Natural Resources (DNR)

Soils and Topography

Soil generation is a complex process that incorporates many factors such as parent material, slope angle, vegetation, moisture content, and the degree to which it has been eroded. Soils are classified using these characteristics and are subdivided into association names, primarily from the sites where each one was initially identified. All the dominant soil associations within the Lower Cedar watershed occur in both the Iowan Surface and Southern Iowa Drift Plain regions. Collectively, the following five soil types comprise 76% of the watershed. All other individual soil types make up about 24% of the watershed area. A detailed soils summary table is provided in Appendix A.

Muscatine (40%) - deep, somewhat poorly drained soils nearly flat slopes

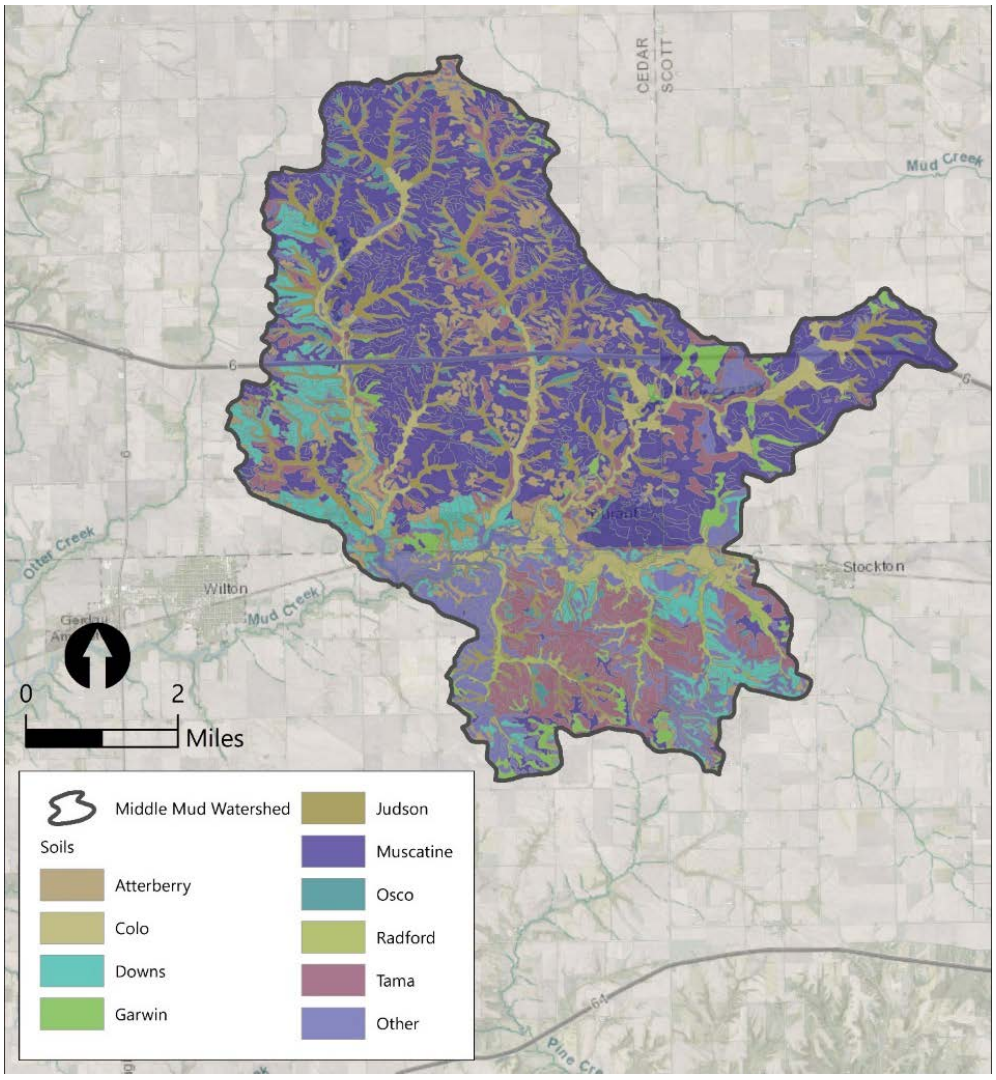
Tama (13%) - deep, well drained soils with less steep slopes

Judson (9%) - deep, well drained soils with gentle slopes

Downs (7%) - deep, well drained soils with potentially moderate slopes

Atterberry (7%) – very deep, somewhat poorly drained soils with gentle slopes

Figure 2-3. Middle Mud Creek Watershed Soils



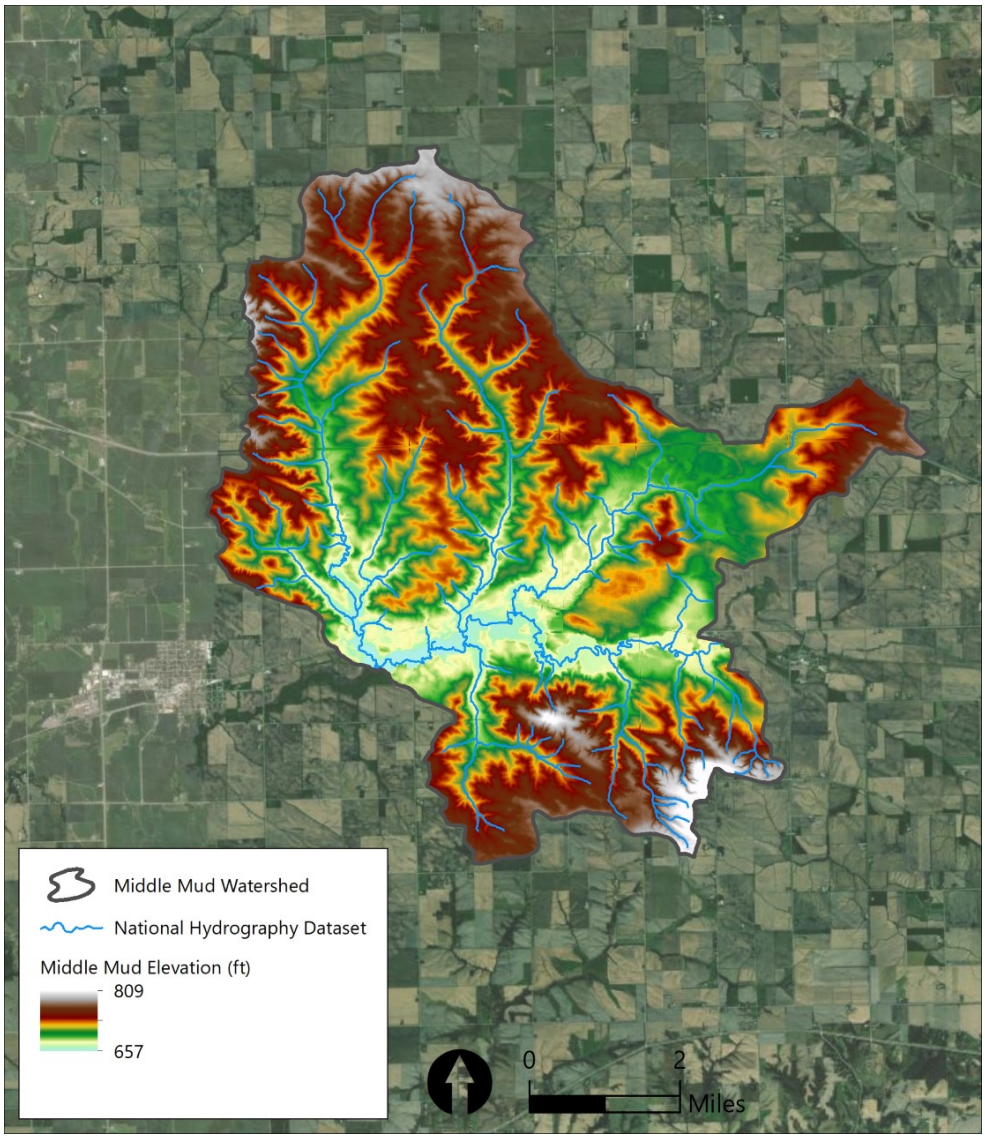
Source: Web Soil Survey, USDA NRCS

Topography, the landscape surface features such as shape and slope, is an important consideration of watershed management because it influences patterns of erosion and drainage. It also determines what types of conservation practices are best suited to a particular landscape. In the Middle Mud Creek watershed, 81% of the terrain is characterized as nearly level or gently sloping with a slope of less than 5%. Most of the watershed's agricultural activity occurs in these areas. Moderate slopes (5-9%) comprise 16% of the watershed, with steeper slopes (greater than 9%) making up about 2% of the watershed.

Table 2-2. Slopes in the Middle Mud Creek Watershed

Percent Slope	Acres	Percent of Watershed
0-2%	7,871	27%
3-5%	15,668	54%
6-9%	4,583	16%
10-14%	496	2%
15-18%	43	0.1%
19-25%	64	0.2%
>25%	14	0%

Figure 2-4. Middle Mud Creek Watershed Elevation



Source: Iowa DNR

Streams and Other Waterbodies

The Middle Mud Creek watershed includes 102 total miles of streams, including Mud Creek, Big Elkhorn, Little Elkhorn, and an unnamed tributary to Mud Creek (Table 2-3). Other waterbodies are limited to isolated, privately-owned ponds and several riparian wetlands along the main stem and larger tributaries. Evaluation of aerial imagery revealed several existing and potential oxbow wetlands along the main stem of Mud Creek south Highway 6 between Verda Avenue (east of Durant) and Thayer Avenue (west of Durant).

Table 2-3. Stream Lengths and Area in the Middle Mud Watershed

Stream Name	Segment ID	Stream Length (mi)	Watershed Area (acres)
Mud Creek	488	8.5	28,977
Big Elkhorn	None	7.3	5,714
Little Elkhorn	none	6.7	10,078
Unnamed Tributary to Mud Creek	6269	7.1	5,640

Source: USGS National Hydrography Dataset (NHD)

Ecological Considerations

As reported in Chapter 2 of the basin-wide plan, the Lower Cedar is home to a variety of unique and valuable ecological communities and many Species of Greatest Conservation Need identified in the Iowa Wildlife Action Plan. Biological sampling a more detailed stream assessment and/or biological surveys in the Middle Mud Creek HUC-12 may reveal more detailed information about specific ecological concerns. As a major tributary to the Lower Cedar; however, it should be assumed that Middle Mud Creek has critical habitat and ecological considerations worth identifying and protecting. The Middle Mud Creek watershed includes a protected tract of floodplain called the Norton Nature Area, located 1.2 miles west of Durant. There are several high potential locations for oxbow wetland creation/restoration along the main stem of Mud Creek near this area.

The watershed includes 5 Stream Biological Monitoring and Assessment Program monitoring sites, with data available through the online BioNet portal (https://programs.iowadnr.gov/bionet/). The Fish Index of Biological Integrity (FIBI) scores at all sites reporting scores indicates poor habitat quality, which is consistent with the high stressor scores developed in the HUC-12 watershed prioritization process (Basin-wide Plan Chapter 3). Several BioNet sites are associated with sampling near the outfall of Durant's WWTP and other sites were sampled for fish kill follow-up assessments.

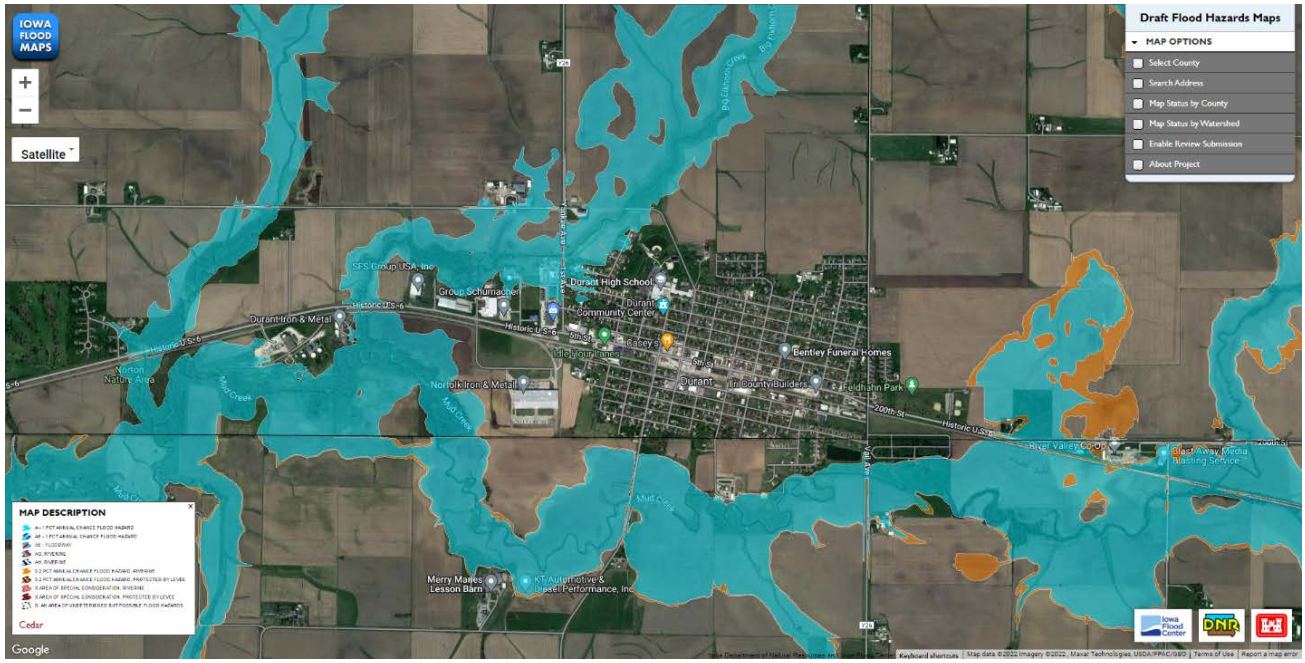
Climate

Climate conditions in the Middle Mud Creek watershed are consistent with those found across the Lower Cedar River Watershed, as described in Chapter 2 of the basin-wide plan.

Flooding

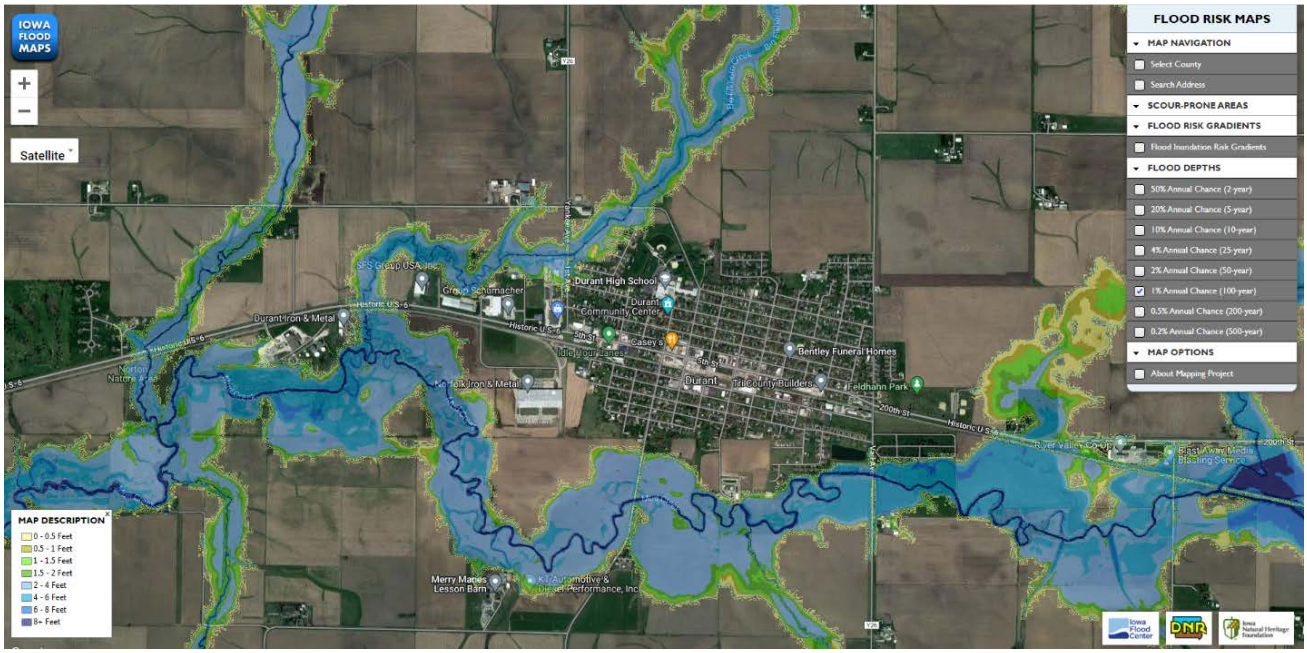
Flood damages in the Middle Mud Creek Watershed are largely on agricultural lands because there are few communities located along Mud Creek and its tributaries. There are a few areas where homes and businesses experience flooding, most of which are in the City of Durant. The maps below show the FEMA 100-year floodplain boundary (Figure 2-5) and the Iowa Flood Center's (IFC) approximation of the 100-year flood depth over the same area.

Figure 2-5. Flood Hazard Zone for the City of Durant



Source: https://ifis.iowafloodcenter.org/ifis/newmaps/hazard/

Figure 2-6. Flood Risk Map for the City of Durant



Source: https://ifis.iowafloodcenter.org/ifis/newmaps/risk/map/

3. Watershed and Water Quality Conditions

Use Designations and Water Quality Impairments

According to application of Iowa's water quality standards, the Mud Creek should support primary contact recreation (Class A1) and warm water (Type 2) aquatic life (Class BWW). These use designations have specific water quality standards associated with them. Water quality criteria most relevant to the current conditions of Mud Creek are reported Table 3-1.

Table 3-1. Water Quality Criteria for the Middle Mud Creek Watershed

Designated Use	Class	Description	Relevant Criteria
Warm water aquatic life (Type 1) Segment 6269 is not assessed	BWW1	Waters in which flow or other physical characteristics can support a resident aquatic community that includes a variety of native nongame fish and invertebrate species. The flow and other physical characteristics limit the maintenance of warm water game fish populations. These waters generally consist of large interior and border rivers and lower segments of medium-size tributary streams.	Biological sampling data: • Benthic macroinvertebrate index of biological integrity (not supported) • Fish index of biological integrity
Warm water aquatic life (Type 2) Segment 488 is impaired (not supporting).	BWW2	Waters in which flow or other physical characteristics can support a resident aquatic community that includes a variety of native nongame fish and invertebrate species. The flow and other physical characteristics limit the maintenance of warm water game fish populations. These waters generally consist of small perennially flowing streams	Biological sampling data: • Benthic macroinvertebrate index of biological integrity • Fish index of biological integrity
Primary contact recreation Segments 488 and 6269 are not assessed	Class A1	Waters in which recreational or other uses may result in prolonged and direct contact with the water, involving considerable risk of ingesting water in quantities sufficient to pose a health hazard. Such activities would include, but not be limited to, swimming, diving, water skiing, and water contact recreational canoeing.	Pollutant of Concern: *E. coli* (March 15 through November 15) • Geometric mean ≤ 126 cfu/100mL • Single sample max ≤ 235 cfu/100 mL

Source: Iowa ADBNet https://programs.iowadnr.gov/adbnet/

Mud Creek was first impaired in the 1998 assessment, based on poor indices of biological health (fish and macroinvertebrate) from sampling conducted in 1996. The 1998 assessment attributed the impairment of biological health to high organic waste loads from Durant's WWTP and from nonpoint source pollution. To address the biological impairment, the Iowa DNR developed a Total Maximum Daily Load (TMDL) for Mud Creek in 2003. Additional sampling conducted to support TMDL development revealed moderately high ammonia-nitrogen concentrations and periods of low dissolved oxygen (DO) concentrations, which can negatively impact aquatic life. The TMDL was developed for "organic enrichment" and targeted ammonia-nitrogen and carbonaceous biochemical oxygen demand (CBOD).

The TMDL attributed the organic enrichment to both point sources and nonpoint sources of pollution. Point sources of pollution are typically easily identifiable sources, such as wastewater treatment plants and industrial facilities that discharge to surface water at known locations in the landscape. Point sources are regulated under the Clean Water Act (CWA) and must meet pollutant discharge limits called wasteload allocations (WLAs). Nonpoint sources are not typically regulated and often rely on voluntary efforts for pollutant reductions. Nonpoint sources include things like sediment and nutrient runoff from agricultural land uses, streambank erosion, and other sources spread out over the entire landscape.

One outcome of the TMDL was that the communities of Walcott (Upper Mud Creek), Durant (Middle Mud Creek), and Wilton (Lower Mud Creek) received waste load allocations for ammonia-nitrogen and CBOD. Nonpoint sources of pollution were assumed to contribute to the impairment by increasing the sediment oxygen demand (SOD) of the stream. Because nonpoint sources are not regulated in the same way as point sources under the Clean Water Act, and because connections between ammonia-nitrogen and CBOD and SOD were not possible using available data, and nonpoint sources were not assigned numeric ammonia-nitrogen or CBOD reduction targets in the TMDL.

Historical Watershed Efforts

The Cities of Walcott, Wilton, and Durant all made improvements to their WWTPs to reduce their contributions to the impairment addressed by the 2003 TMDL for Mud Creek.

- The City of Durant upgraded from a trickling filter to an activated sludge facility to meet ammonia limits set forth in the TMDL. The new facility has limits in place for total suspended solids (TSS), CBOD, ammonia-nitrogen, E. coli, and dissolved oxygen (DO). The cost of the upgrade was $6,250,000.
- The City of Walcott in the Upper Mud Creek watershed upgraded their facility from 2 aerated lagoons to one activated sludge system. The new facility has limits in place for TSS, CBOD, pH ammonia-nitrogen, E. coli, and dissolved oxygen (DO). Cost of the upgrade was $4,700,000.
- The City of Wilton is downstream of the Middle Mud Creek watershed, so WWTP effluent does not directly affect Middle Mud Creek, but it does impact the downstream reach of Mud Creek and larger downstream river systems. Wilton also made significant investments in their WWTP by upgrading from a trickling filter to an activated sludge system. The cost of the Wilton WWTP improvements was $5,878,900.

Historical nonpoint source improvement efforts include watershed project on Mud Creek led by the Muscatine Soil and Water Conservation District (SWCD) from 2002 to 2007. The project consisted of implementing riparian buffers, limiting cattle from having direct access to the stream, and increasing the number of rotational grazing operations to improve soil health of pastures along Mud Creek. The

project helped decrease erosion, sediment, nutrient, and bacteria loads to Mud Creek. This project was funded through a 319 grant and employed a watershed coordinator.

Pollutants of Concern

The primary pollutants of concern in the Middle Mud Creek watershed include phosphorus, sediment, nitrogen, and *E. coli*. A description of each pollutant of concern is laid out in Chapter 3 of the basin-wide plan.

Water Quality Results

The water quality samples collected in 2020 from Mud Creek at Moscow Avenue and County Road X54 provide a reasonable reflect of water quality in Middle Mud Creek, even though the monitoring station is at the lower end of Mud Creek, downstream of the Middle Mud Creek segment. Water quality data from 2005-2019 were averaged across multiple sites within the HUC-12 were averaged and included with data collected in 2020 in Table 3-2. The 2005-2019 data includes results from multiple monitoring efforts, including county-wide snapshots, ambient stream monitoring by Iowa DNR, and monitoring near Durant's WWTP outfall to Middle Mud Creek.

Table 3-2. Summary of Water Quality Monitoring in Mud Creek

Date	*E. Coli* (cfu/100 mL)	Turbidity (NTU)	TP (mg/L)	TN (mg/L)
07/07/2020	780	20	0.18	5.4
08/27/2020	1,700	13	0.17	1
09/09/2020	5,800	55	0.4	1.2
11/25/2020	6,900	46	0.12	2.7
2020 Average	2,699	33.5	0.22	2.6
[1]Historical HUC-12 Averages	≥ 2,492	no data	0.34	6.0
[1]Historical averages from all 2005-2019 monitoring sites across the Middle Mud Creek HUC-12				

Source: Various DNR and partner agency monitoring efforts

4. Pollutant Source Assessment

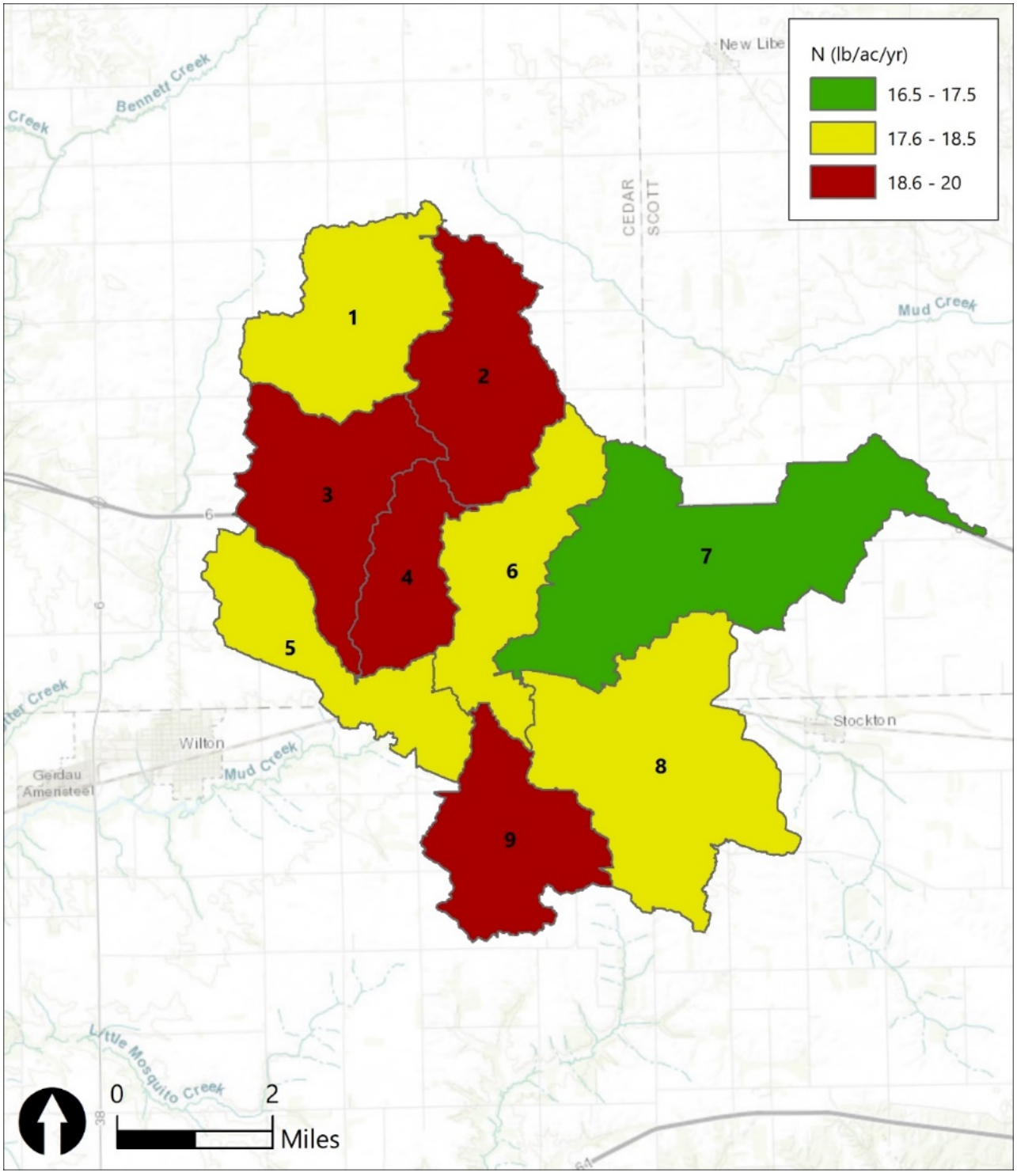
The pollutant source and loading model of the Middle Mud Creek priority HUC-12 watershed utilized a modified version of the Spreadsheet Tool for Estimating Pollutant Load (STEPL) (Tetra Tech, 2011). The model predicts annual average runoff and groundwater/baseflow volumes using a simple annual rainfall runoff equation, soil erosion and transport using the Universal Soil Loss Equation (USLE) approach, and pollutant loads using soil, slope, and land used based pollutant concentrations from a combination of literature values and water quality monitoring results.

Model Setup

- Parameterization of inputs for pollutant loading estimates included land-use (CDL, 2020), livestock and feedlot numbers (IDNR), septic systems (from STEPL Model Input Data Server), soil data (e.g., hydrologic soil group), topographic data, and other watershed characteristics. Initial inputs were obtained from a variety of sources, including the STEPL data server (Tetra Tech, 2013), locally available data, applicable literature/research data, and best professional judgement.
- Prediction of stream bank erosion was estimated for all second order and larger streams and assumed moderate recession rates (0.13 ft/yr) based using a desktop assessment, soils information, and NRCS streambank recession rates.
- Gully erosion was estimated using 1st order stream length and best professional judgement and rules-of-thumb for gully size and progression rate.
- A key modification to the STEPL model is that areas of pastureland cover within 1,000 linear feet of either side of the stream channel were assumed to have cattle with direct access to the streams. This is important for simulation of the impacts of direct deposition of manure on bacteria concentrations. This assumption should be field verified, but it provides information helpful for modeling as well as targeting areas for livestock exclusion BMPs.

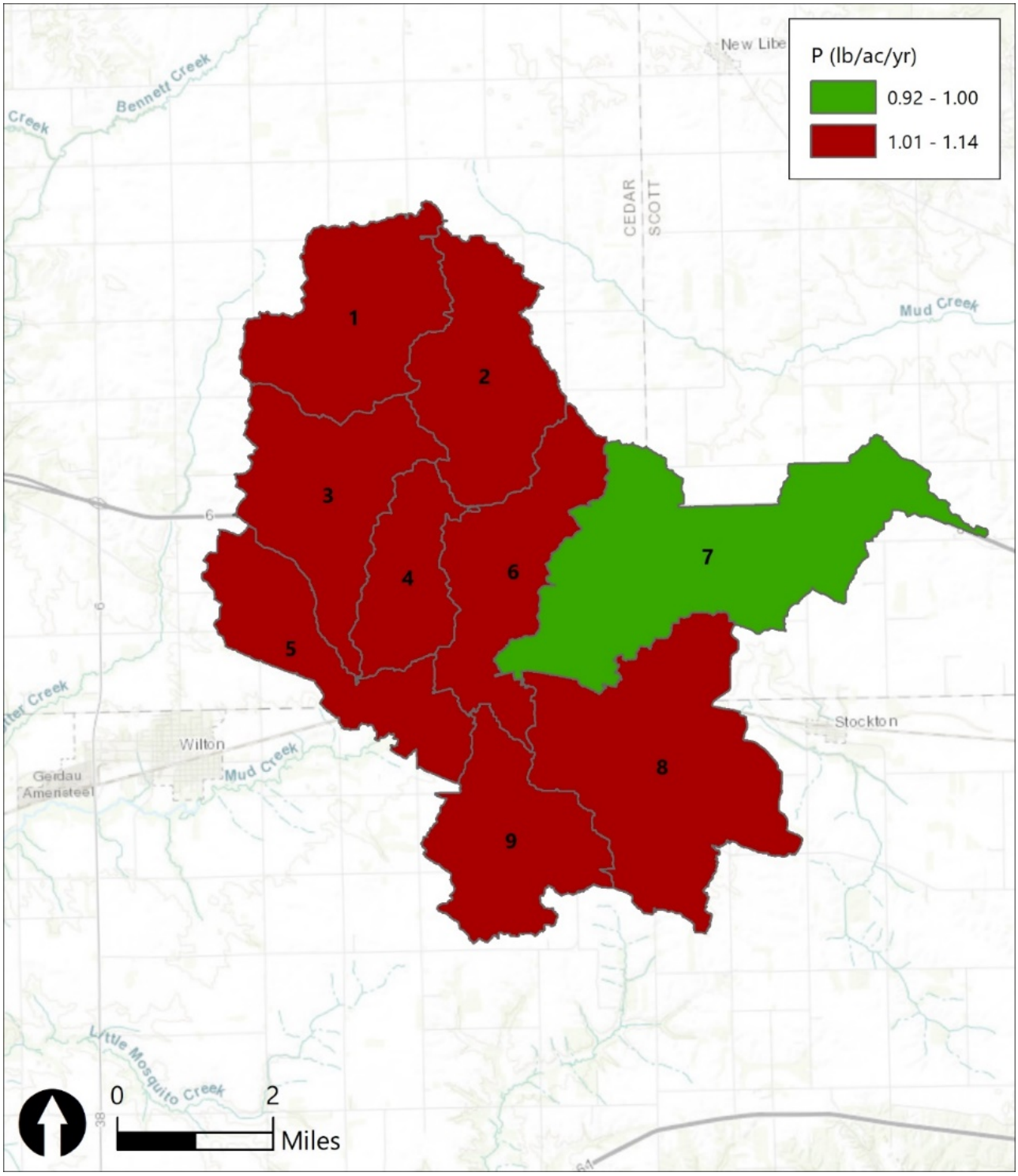
Predicted pollutant loads are summarized for the four main pollutants of concern: sediment, phosphorus, nitrogen, and bacteria (*E. coli*). The STEPL spreadsheet reports loads in total mass and mass per acre and summarizes loads by both subwatershed and pollutant source.

Figure 4-1. STEPL Nitrogen Loads



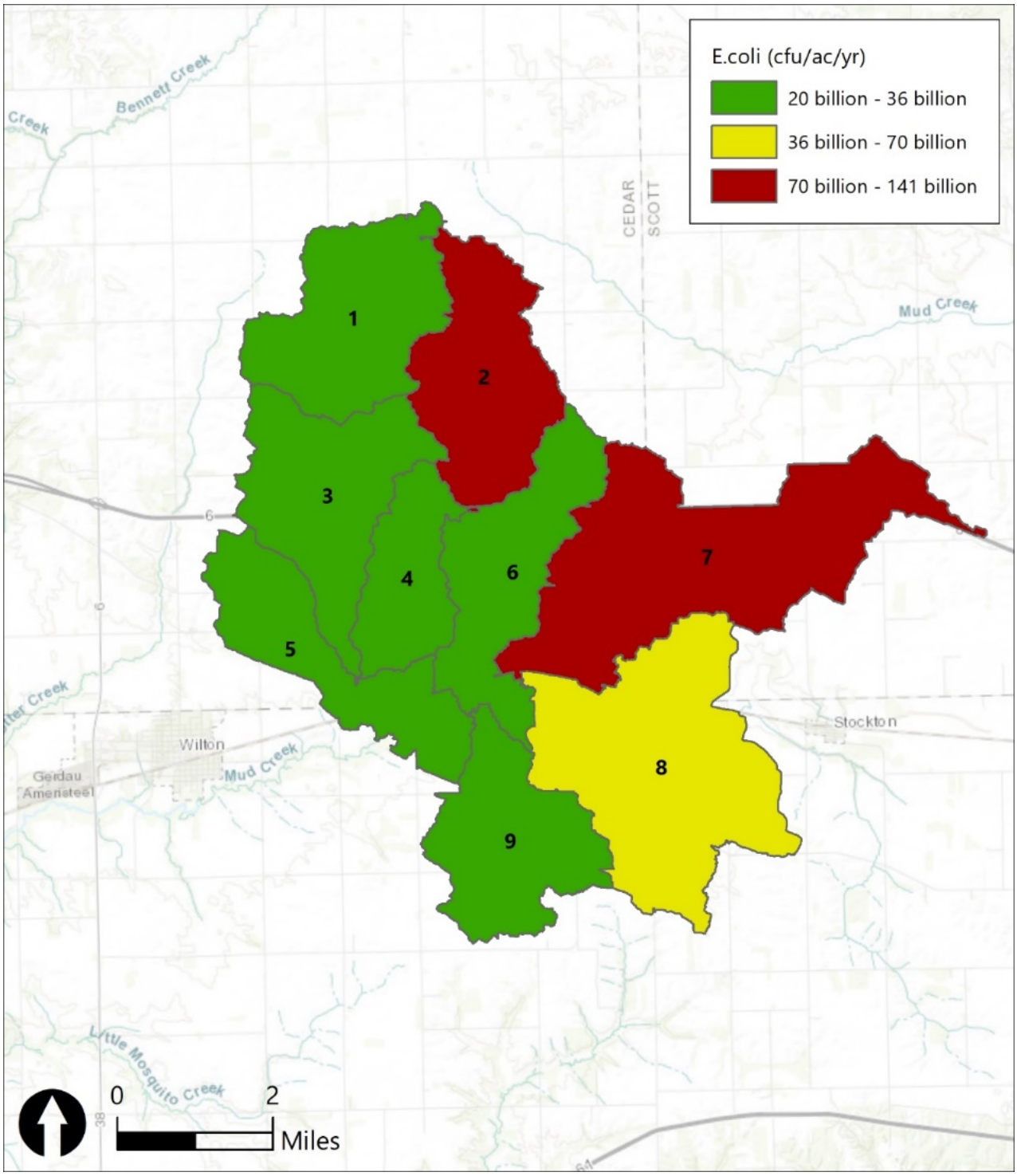
Source: Middle Mud Creek HUC-12 STEPL model

Figure 4-2. STEPL Phosphorus Loads



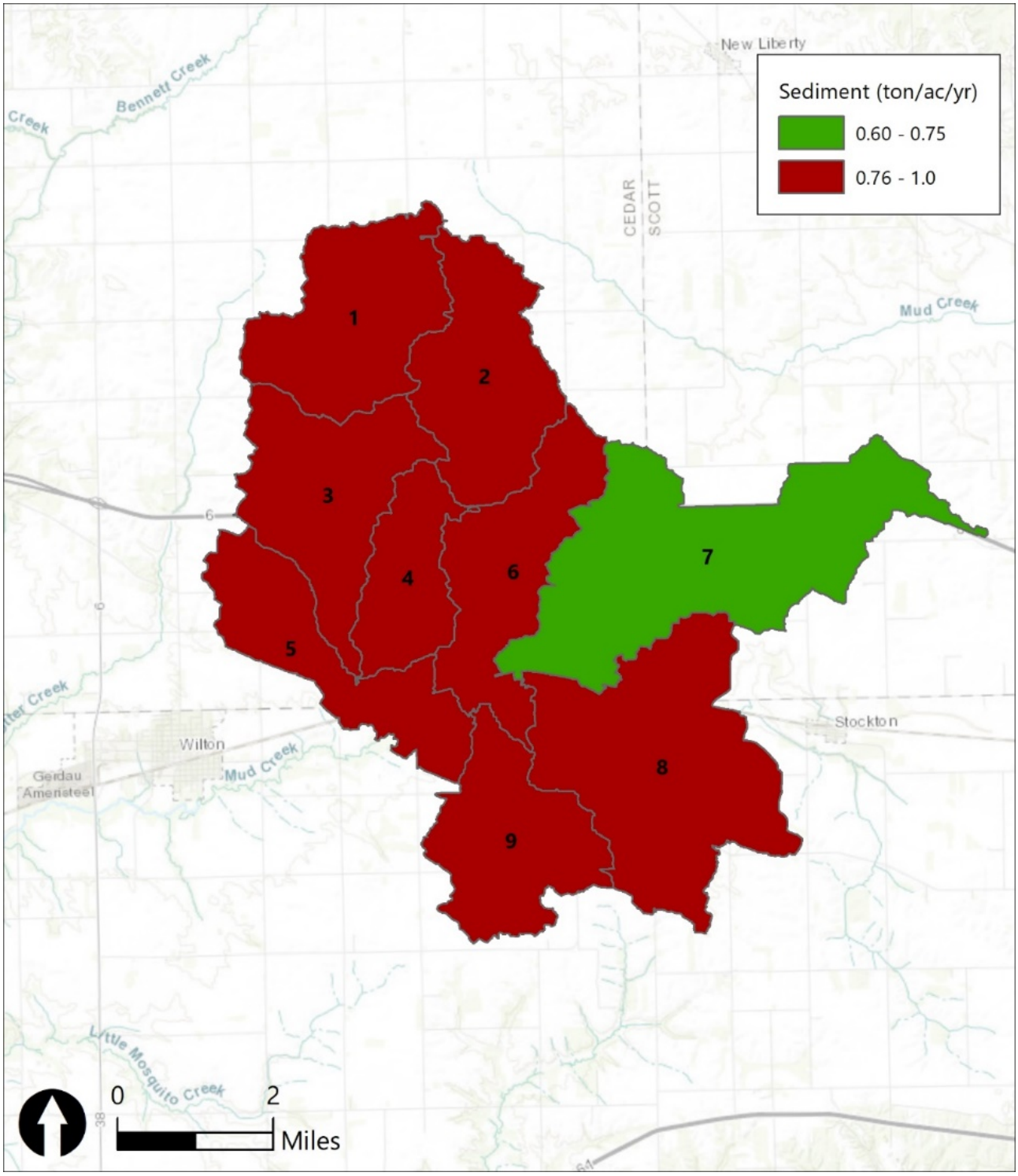
Source: Middle Mud Creek HUC-12 STEPL model

Figure 4-3. STEPL *E. coli* Loads



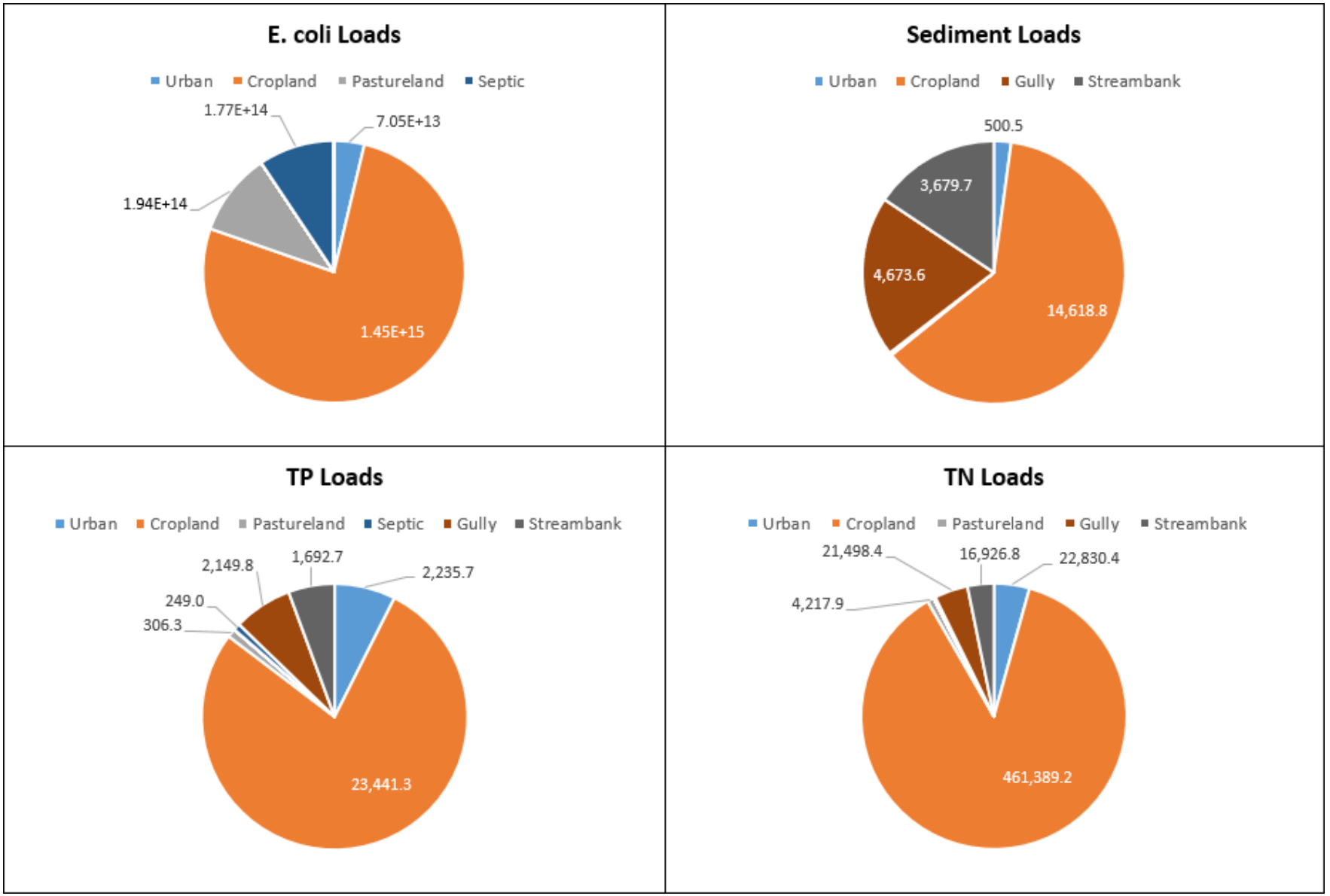
Source: Middle Mud Creek HUC-12 STEPL model

Figure 4-4. STEPL Sediment Loads



Source: Middle Mud Creek HUC-12 STEPL model

Figure 4-5. STEPL Total Loads by Land Use



Source: Middle Mud Creek HUC-12 STEPL model

Table 4-1. STEPL Total Loads by Land Use

Sources	N (lb/yr)	N %	P (lb/yr)	P %	E. coli (cfu/yr)	E.coli %	Sediment (ton/yr)	Sediment %
Urban	22,830	4%	2,236	7%	7.1E+13	4%	501	2%
Cropland	461,389	87%	23,441	78%	1.4E+15	77%	14,619	62%
Pastureland*	4,218	1%	306	1%	1.9E+14	10%	74	0%
Forest	94	0%	16	0%	2.0E+11	0%	5	0%
Feedlots	0	0%	0	0%	0.0E+00	0%	0	0%
User Defined	0	0%	0	0%	0.0E+00	0%	0	0%
Septic	1,245	0%	249	1%	1.8E+14	9%	0	0%
Gully	21,498	4%	2,150	7%	4.4E+11	0%	4,674	20%
Streambank	16,927	3%	1,693	6%	7.7E+10	0%	3,680	16%
Total	**528,202**		**30,090**		**1.9E+15**		**23,552**	

Source: Middle Mud Creek HUC-12 STEPL model

Existing BMPs

Existing BMPs were not explicitly included in the pollutant loading model for Middle Mud Creek, but practices included in the statewide Iowa BMP Mapping Project or watershed-specific Agricultural Conservation Planning Framework (ACPF) analysis were mapped and summarized (Table 4-1). Practices include ponds, dams, terraces, contour buffer strips, strip cropping, grassed waterways, and water and sediment control basins (WASCOBs). Although not simulated in modeling, existing BMPs were incorporated in the implementation model to avoid predicting reductions that aren't available on the ground.

Table 4-1. Middle Mud Existing BMPs

BMP Type	Number of BMPs
Pond or Dam	12
Terraces	31
WASCOBs*	112
Contour Buffer Strips	7
Grassed Waterways	755
Strip Cropping	1
*Water and Sediment Control Basins	

Source: Iowa BMP Mapping Project, https://www.gis.iastate.edu/BMP

Middle Mud Creek ACPF Assessment

The Agricultural Conservation Planning Framework (ACPF), developed by USDA-Agricultural Research Service, was applied to the Middle Mud Creek HUC-12 watershed. ACPF identifies potential locations and the quantity of BMPs suitable for specific areas of the landscape in an ArcGIS platform. ACPF output was used to quantify potential pollutant reductions in this planning effort. ACFP can also be used by the WMA for landowner/operation information and education, and for stakeholder engagement in small or large group settings, both of which facilitate higher rates of conservation and BMP adoption.

Table 4-2. Middle Mud Creek Watershed ACPF Summary

In Field ACPF BMPs	Number Generated	Total Area Treated (acres)
Contour buffer strips	851	3,350
Grassed Waterway	991	13,028
Drainage water management	66	4,581
Edge of Field ACPF BMPs	**Number Generated**	**Total Area Treated (acres)**
Bioreactors	44	2,475
Nutrient reduction wetlands	35	12,639
WASCOBs	191	2,622
Farm Pond	2	33
Riparian Zone ACPF BMPs	**Number Generated**	**Total Area Treated (acres)**
Saturated buffers	273	9,166
Streambank stabilization	294	1,543
Critical Zone	6	2,151
Deep rooted vegetation	49	367
Multi Species Buffer	30	1,946
Stiff Stemmed Grasses	110	11,414

Source: Middle Mud Creek ACPF Output

5. Lower Cedar Social Engagement

FYRA and ECICOG established two websites as outreach tools to use during the planning process to engage the watershed community and stakeholders.

- Lower Cedar Watershed Management Authority website https://lowercedar.weebly.com
- Social Pinpoint project website https://fyra.mysocialpinpoint.com/lower-cedar-wma-plan which houses multiple surveys and an interactive project map that allows for community member engagement and input

Outreach Methods & Stakeholder Events

A series of workshops were held throughout 2021, resulting in the identification of high-priority resource concerns and actions for improving the watershed. Workshop participation was strong, averaging 25 – 30 local residents, public officials/staff, non-profit organizations, and academic institution staff interested in watershed improvement projects. There is more detail about outreach efforts and the public input gathered in Chapter 5 of the basin-wide plan.

- ECICOG hosted three virtual focus groups with 12 agricultural producers to gauge level of concern for watershed issues and how they might fit into the solutions.
- ECICOG partnered with the Indian Creek Soil Health Partnership to host a Women Caring for the Land virtual workshop in March and April 2021 with 22 participants.
- The Indian Creek Soil Health Partnership hosted a Field Day in April 2021 to promote perennial cover and saturated buffers. 50 attended and toured a saturated buffer on Curt Zingula's farm.
- The Lower Cedar WMA hosted Community Source Water virtual workshop to discuss drinking water concerns and possible solutions and funding sources with 13 participants.
- The Lower Cedar WMA hosted a virtual workshop for 14 Emergency Management Administrators in the watershed to connect the watershed plan to Hazard Mitigation Plans.
- Direct inquiries to cities, floodplain managers, and county conservation boards about current and future projects to improve water quality and/or flood mitigation.

6. Goals and Objectives

The overall goal of the Middle Mud Creek Watershed Plan is to inform the LCWMA and its partners with useful and actionable information related to identifying, prioritizing, and implementing solutions to water quality, flooding, and other water and natural resources concerns.

Water Quality Goal

The overall water quality goal is to protect and improve surface and ground water in Middle Mud Creek, with the following specific objectives:

1. Follow Iowa's Nutrient Reduction Strategy (NRS) guidance to implement conservation practices that reduce total N and P load by 45%
2. Reduce nonpoint source loads of nitrogen by 41% and phosphorus by 29%, consistent with NRS targets.
3. Encourage & implement erosion reduction and soil health practices that reduce sediment transported to surface water by 50%.
4. Encourage & implement Stormwater management practices that will infiltrate runoff up to a 2.5-inch rain event (the channel protection volume) as recommended in the Iowa Stormwater Management Manual.
5. Reduce E. coli bacteria in surface water by the maximum extent practical (MEP), working towards a long-term goal of compliance with Iowa water quality standards (geomean concentrations not to exceed 126 cfu/100mL).

Table 6-1. Middle Mud Creek Watershed Water Quality Goals

Parameter	Reduction Goal (%)	Actual Reduction (%)
Phosphorus	45%	53%
Sediment	50%	67%
Nitrogen	45%	34%
E. coli	96%	38%

Secondary Goals

The other goals in the Middle Mud Creek Watershed include flood reduction, both locally and downstream, as well as improvement of habitat and recreational opportunities. Many water quality improvement practices offer ancillary benefits. The LCWMA plan and future implementation will maximize opportunities for multi-benefit projects.

Information & Education Goal

A proactive Information and Education (I&E) plan is an important part of planning and implementing water quality, flooding, and habitat improvements at the watershed scale. The I&E goal for the Middle Mud Creek watershed is to implement the relevant components of the following outreach workplan from the basin-wide plan.

Education & Outreach Workplan

These education strategies were identified as priorities in the public engagement for the WMP and will guide the efforts of the watershed coordinator and the LCWMA Board throughout plan implementation.

- Educate agricultural community about practices to reduce erosion at workshops, tours, field days and other peer to peer events for farmers and other stakeholders
- Create program to recognize and share BMPs on the LCWMA Facebook page and other social media to expand the "neighborhoods" of conservation
- Organize opportunities to take urban residents to rural areas and rural residents to urban areas to observe issues caused by flooding and the solutions implemented to date
- Educate various audiences about infiltration practices to improve water quality through:
    - Workshops (with CEUs) for developers, builders, engineers, and inspectors about infiltration practices and green infrastructure
    - Green infrastructure workshops and urban BMP tours for homeowners, policy makers, or other interested stakeholders
- Build awareness of flood risk and intensifying rain events due to climate change by hosting an annual "flood awareness" meeting and promote ways residents can reduce stormwater run-off
- Communicate with residents about the relationship between stream health and human health through community engagement events about water quality (outdoor classrooms, watershed tours, paddling outings, creek clean-ups)
- Promote the Nutrient Reduction Strategy and its recommended practices through workshops, tours, field days or other peer to peer event for farmers and other stakeholders
- Educate the agricultural community about flood risks and how they can be part of the solution by engaging the agricultural community through small events with ag groups and youth groups such as FFA and 4-H clubs
- Partner with FFA teachers to incorporate watershed & water quality issues into their classes each year
- Communicate with households utilizing septic systems about impacts of human waste management on stream health through workshops

7. Implementation – Action Plan

Implementation Strategies and Practices

A comprehensive menu of potential best management strategies to improve water quality, reduce flood damages, enhance wildlife habitat, and provide recreational opportunities is provided in Chapter 6 of the basin-wide plan. Descriptions, applicability, and pollutant removal of specific BMPs are also provided in Chapter 6. The approach and combination of BMPs suitable for each HUC-12 in the Lower Cedar basin will vary according to soils, topography, land use, and preference and interest of watershed stakeholders including agricultural landowners and operators, residents, municipalities, and others that live, work, and recreate in each HUC-12.

Successful implementation will require efforts driven by specific goals and milestones but must also be dynamic to reflect changes in real world conditions, including changes in policy that affect agricultural practices, regulations, funding, water quality, stakeholder concerns, and many others. The three-phase implementation plan for the Middle Mud Creek watershed was developed to:

- Identify short-term actions to assist a watershed coordinator in Information & Education to establish momentum
- Allow time for increased outreach to promote BMP adoption over time
- Provide the watershed coordinator time to gather additional information and align funding
- Secure engineering and permitting services required for long-term BMP adoption and construction of proposed structural practices

Information and Education Program Elements

The watershed level public awareness and education program should include both public education & outreach and public participation & involvement activities defined as:

Education & outreach activities are designed to distribute education materials and messages and perform outreach to inform citizens and target audiences.

Public participation & involvement activities provide opportunities for citizens to participate in programs and become active in implementing watershed protection programs.

Table 7-1. Example Outreach Activities

Education / Outreach Programs	Public Involvement / Participation Programs
Bill inserts or newsletters	Water quality monitoring program
Brochures at local government facilities	Watershed festival
Website with watershed education information	River/Creek clean-up events
Speakers' bureau presentations	Storm drain stenciling events
Event displays and/or kiosks	Watershed citizen advisory group
Press releases	Rainscaping workshops
School classroom education	Agriculture stakeholder group

Milestones and Outcomes

Plan milestones, costs, and outcomes are presented in Tables 7-2 and 7-3 for the entire 20-year implementation period across 3 phases of implementation. Metrics are based on the pollutant load reduction goals set forth in the prior section.

Table 7-2. Implementation Strategies, Costs, and Timeline for Middle Mud Creek Watershed

	20-Year Plan		Phase 1		Phase 2		Phase 3	
# Years	20		7		7		6	
Practice	Goal (acres)	*Cost	Phase Goal (acres)	*Phase Cost	Phase Goal (acres)	*Phase Cost	Phase Goal (acres)	*Phase Cost
Watershed Coordinator	N/A	$2,084,466	N/A	$552,881	N/A	$727,553	N/A	$804,032
Water Quality Monitoring	N/A	$160,000	N/A	$56,000	N/A	$56,000	N/A	$48,000
Stakeholder Engagement/Outreach	N/A	$7,000	N/A	$2,450	N/A	$2,450	N/A	$2,100
Bioreactors	1,238	$495,001	433	$173,250	433	$173,250	371	$148,500
Contoured Buffer Strips	-	$0	-	$0	-	$0	-	$0
Grassed WW	4,299	$945,828	1,505	$331,040	1,505	$331,040	1,290	$283,748
Wetlands	3,160	$1,832,667	1,106	$641,433	1,106	$641,433	948	$549,800
Sediment Ponds	11	$7,678	4	$2,687	4	$2,687	3	$2,303
Terraces	838	$795,638	293	$278,473	293	$278,473	251	$238,691
WASCOBs	656	$1,245,541	229	$435,939	229	$435,939	197	$373,662
No-Till	5,801	$1,160,176	2,030	$406,062	2,030	$406,062	1,740	$348,053
Cover Crops	8,287	$4,143,487	2,900	$1,450,221	2,900	$1,450,221	2,486	$1,243,046
Extended Rotation	4,520	$3,616,134	1,582	$1,265,647	1,582	$1,265,647	1,356	$1,084,840
Perennial Conversion	2,511	$7,533,613	879	$2,636,765	879	$2,636,765	753	$2,260,084
Riparian Buffers	5,229	$3,660,102	1,830	$1,281,036	1,830	$1,281,036	1,569	$1,098,031
Saturated Buffers	2,292	$5,064,313	802	$1,772,510	802	$1,772,510	687	$1,519,294
Streambank stabilization	5,055	$2,274,570	1,769	$796,100	1,769	$796,100	1,516	$682,371
Gully stabilization	4,946	$989,115	1,731	$346,190	1,731	$346,190	1,484	$296,735
Livestock Exclusion	93	$242,359	32	$84,826	32	$84,826	28	$72,708
Total		$36,257,689		$12,513,509		$12,688,182		$11,055,999

*Up-front capital plus sum of annual costs (e.g. maintenance and land payments) incurred over plan/phase period

Table 7-3. Load Reduction Targets and Milestones for Middle Mud Creek Watershed

	20-Year Plan				Phase 1				Phase 2				Phase 3			
# Years	Reductions				7				7				6			
Practice	P (lbs)	Sediment (tons)	N (lbs)	E.coli (MPN)	P (lbs)	Sediment (tons)	N (lbs)	E.coli (MPN)	P (lbs)	Sediment (tons)	N (lbs)	E.coli (MPN)	P (lbs)	Sediment (tons)	N (lbs)	E.coli (MPN)
Bioreactors	278	32	9,004	5.65E+13	97	11	3,151	1.98E+13	97	11	3,151	1.98E+13	83	10	2,701	1.70E+13
Contoured Buffer Strips	0	0	0	0.00E+00	0	0	0	0.00E+00	0	0	0	0.00E+00	0	0	0	0.00E+00
Grassed WW	2,915	1,712	18,194	1.56E+14	1,020	599	6,368	5.47E+13	1,020	599	6,368	5.47E+13	875	514	5,458	4.69E+13
Wetlands	577	436	23,947	1.28E+14	202	152	8,381	4.50E+13	202	152	8,381	4.50E+13	173	131	7,184	3.85E+13
Sediment Ponds	8	5	54	3.87E+11	3	2	19	1.36E+11	3	2	19	1.36E+11	2	2	16	1.16E+11
Terraces	580	404	2,860	1.58E+13	203	141	1,001	5.53E+12	203	141	1,001	5.53E+12	174	121	858	4.74E+12
WASCOBs	485	336	4,725	2.37E+13	170	117	1,654	8.30E+12	170	117	1,654	8.30E+12	146	101	1,418	7.11E+12
No-Till	4,175	2,736	0	1.69E+14	1,461	958	0	5.91E+13	1,461	958	0	5.91E+13	1252	821	0	5.07E+13
Cover Crops	2,162	3,040	53,102	2.41E+14	757	1,064	18,586	8.44E+13	757	1,064	18,586	8.44E+13	649	912	15,931	7.24E+13
Extended Rotation	1,017	592	30,489	6.58E+13	356	207	10,671	2.30E+13	356	207	10,671	2.30E+13	305	178	9,147	1.97E+13
Perennial Conversion	1,017	724	29,642	3.65E+13	356	253	10,375	1.28E+13	356	253	10,375	1.28E+13	305	217	8,893	1.10E+13
Riparian Buffers	3,041	2,325	23,664	2.20E+14	1,064	814	8,283	7.71E+13	1,064	814	8,283	7.71E+13	912	697	7,099	6.60E+13
Saturated Buffers	103	60	20,611	6.84E+12	36	21	7,214	2.40E+12	36	21	7,214	2.40E+12	31	18	6,183	2.05E+12
Streambank stabilization	68	166	85	2.50E+09	24	58	30	8.74E+08	24	58	30	8.74E+08	20	50	25	7.49E+08
Gully stabilization	86	210	107	1.42E+10	30	74	38	4.96E+09	30	74	38	4.96E+09	26	63	32	4.25E+09
Livestock Exclusion	37	0	165	5.36E+13	13	0	58	1.88E+13	13	0	58	1.88E+13	11	0	50	1.61E+13
Total	16,549	12,779	216,651	1.17E+15	5,792	4,473	75,828	4.11E+14	5,792	4,473	75,828	4.11E+14	4,965	3,834	64,995	3.52E+14

Phase 1 (Years 1-7)

The first phase of work will commence following submittal and approval of this WMP and includes meeting with the TAC to begin aligning funding sources, hire a watershed coordinator, coordinate with stakeholders, and begin landowner/farmer outreach. A water quality monitoring program has been initiated in conjunction with WMP development, but monitoring efforts will intensify in Phase 1 to provide data that reflects pre-implementation (baseline) conditions. Phase 1 objectives accomplished this phase of implementation will include WMP approval, landowner/farmer outreach and education, and aligning a watershed coordinator, TAC members, and key stakeholders to implement projects.

Engagement Activities will continue for the duration of the 20-year plan to keep momentum and ensure maximum adoption of BMPs. Engagement efforts will include:

- Outreach to landowners about the importance of water quality and how they can have an impact on protection and improvement of the Middle Mud Creek Watershed.
- Outreach to homeowners in the watershed to identify ways to increase infiltration and repair and/or replace failing septic systems – a potential source of nutrients to Middle Mud Creek.
- Outreach to farmers to encourage conservation practices that minimize nutrient losses and erosion to surface and groundwater.

Phase 2 (Years 8-14)

Phase 2 will involve implementation of the "low-hanging fruit" BMPs and management strategies. These include working with willing landowners that recognize the need for conservation on their properties, with emphasis on the most popular and easy-to-adopt practices.

The watershed coordinator and the TAC will continue collaboration and work with landowners and producers in the watershed in Phase 3 to adopt BMPs in critical areas, with an emphasis on practices that require more education and active management to implement successfully.

Phase 3 (Years 13-20)

Phase 3 milestones are laid out to meet plan objectives by implementing conservation practices and structures on remaining land requiring additional treatment. Outreach efforts may include contacting landowners and properties where BMPs were not adopted in Phase 1 or Phase 2. It may also involve adding additional BMPs for a "treatment train" approach in areas with willing landowner participation. Additionally, after substantial progress made on watershed goals in Phases 1 & 2 coordination with TAC members and other stakeholders to undertake larger structural practices.

8. Monitoring and Evaluation

There will need to be evaluation of the progress towards implementation of the specific actions identified and towards meeting the long-term goal of a healthy watershed. It is recommended that evaluation be completed through bi-annual plan reviews and plan updates that occur every seven years. Water monitoring is an important part of establishing a baseline for both water quality and stream flows, and for documenting progress in achieving plan goals. Building off the existing monitoring activities will provide more information about conditions in the Middle Mud Creek watershed to inform management decisions. A framework for an on-going monitoring program in the Lower Cedar watershed is provided in Chapter 9 of the basin-wide plan.

Bi-annual Reviews

The purpose of the bi-annual plan review is to identify and discuss implementation challenges to determine if there is a need for plan amendments. The evaluation process provides stakeholders an opportunity to discuss concerns about an element of the Middle Mud Creek Watershed Plan and the basin-wide plan. The bi-annual reviews are a reminder that the Plan is adaptable, dynamic and flexible. Information that will be collected as part of the bi-annual survey and evaluation of progress will include:

Education Activities – Reporting of education and outreach efforts

Watershed Improvement Projects – Track implementation of projects and locations, provide watershed-wide summary with a map

Watershed Conditions Assessment – Update and summarize monitoring program data

As additional metrics for measuring progress are developed by the LCWMA they will be included in the bi-annual survey and progress report.

Plan Updates

Plan updates occur every 7 years and take a more holistic look at changed conditions and implementation actions since the last Plan Update. Evaluations of changed conditions for Plan Updates may include:

- Population and land use forecasts and trends;
- Water quality trends using the 303(d) list and available watershed assessment data;
- Tracking of BMPs; and
- Flood risk modeling for future land use projections.
- Undoubtedly, other issues will emerge that merit in-depth consideration in the future. As with existing efforts, future planning work should be open and inclusive, involving all LCWMA members and stakeholders.

Pike Run
HUC-12 Watershed Plan

August 2022

Lower Cedar Watershed Management Authority

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Pike Run

Table of Contents

1. Introduction

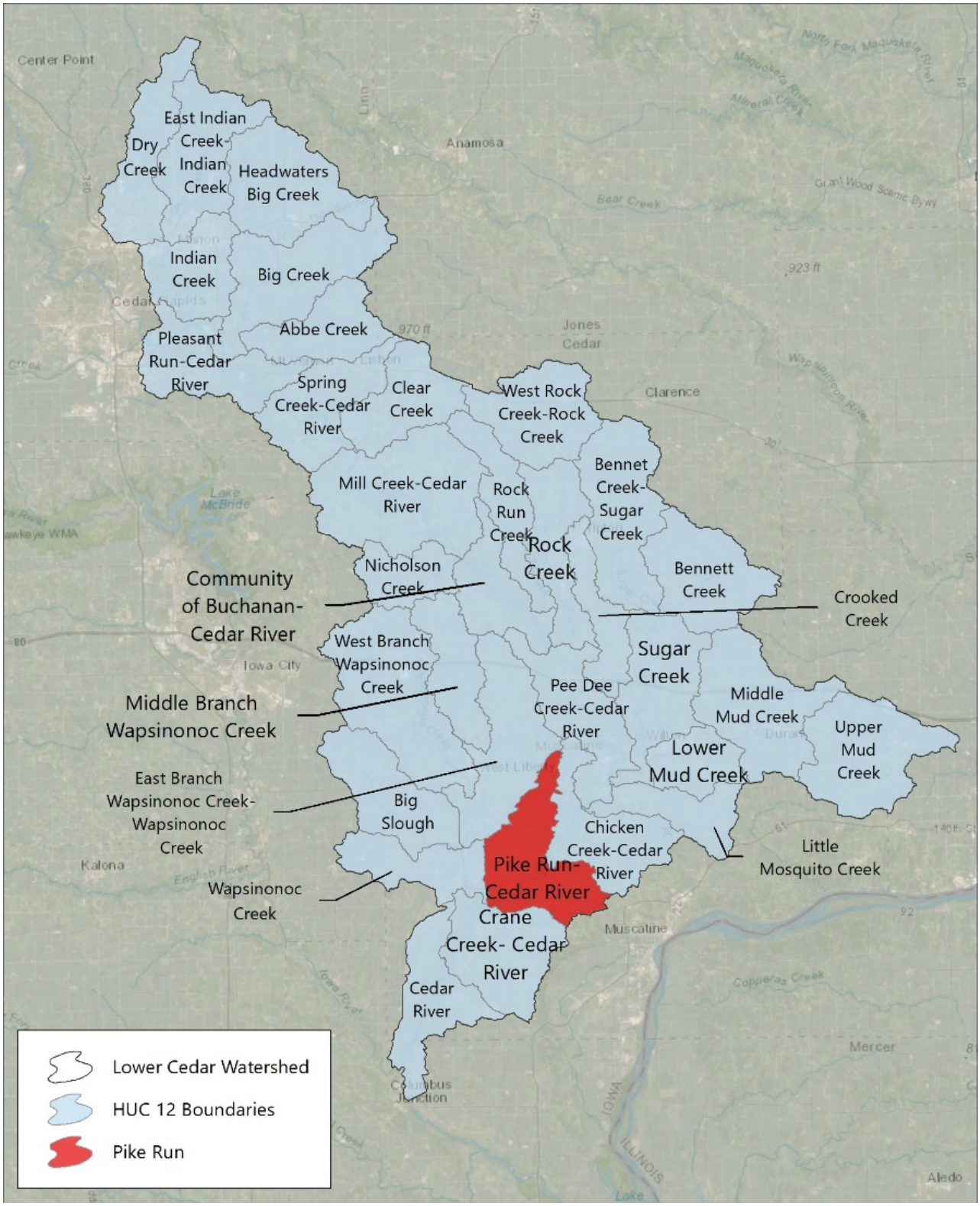
The boundaries of the Lower Cedar watershed and its thirty-three subwatersheds are based on United States Geological Survey (USGS) defined boundaries called Hydrologic Unit Codes (HUC). The Lower Cedar watershed (HUC-8 07080206) covers 703,060 acres across 7 counties including Linn, Jones, Johnson, Cedar, Scott, Muscatine, and Louisa, as shown in Figure 1-1. The HUC-8 watershed includes 33 smaller, HUC-12 scale subwatersheds (Figure 1-1). The Pike Run HUC-12 watershed (070802060805) (shaded red in Figure 1-1) was selected as a high priority subwatershed for more detailed analysis and planning. The prioritization analysis utilized a data driven approach based on political, economic, socio-cultural, and technical (PEST) inputs and considerations.

- Political inputs included the presence of organized, local support for watershed improvement initiatives
- Economic inputs included feasibility of funding acquisition from various sources
- Social-cultural inputs were based on stakeholder and public engagement feedback (landowner, producer, community, and resident interest or buy-in)
- Technical inputs include water quality impairments, other habitat and water quality considerations, and historical monitored pollutant concentrations, and watershed characteristics (erodible soils, land use, slope, and others)

The EPA's Recover Potential Screening Tool (RPST) provided a quantitative summary of the technical inputs related to existing ecology and stressors in each HUC-12 watershed and captured several social and political indicators. Other political and social considerations were based on focus group discussions, survey results, and discussions by a group of partner agency staff with expertise related to water and natural resources conservation, flooding, and funding opportunities (called the technical advisory committee, or TAC). The detailed results of the prioritization process for the entire HUC-8 watershed are provided in Appendix B.

Pike Run was classified as a high priority because of its high stressor scores for water quality and habitat (due to phosphorus and sediment) and based on elevated stakeholder interest and support for improvement efforts in this subwatershed.

Figure 1-1. Lower Cedar HUC-12 Subwatersheds



2. Watershed Conditions

Political Jurisdictions and Populations

The Pike Run watershed is located in Muscatine County. The total population of the watershed is 723 based on 2010 census data and EnviroAtlas – Dasymetric population by 12-digit HUC.

Land Use and Land Cover

Agricultural production is the predominate land use of the Pike Run watershed, with 61% in row crop production (cropland) and 13% in pasture. As shown in Table 2-1, the area in row crops has increased while pasture and timber have decreased. Another 4% of the watershed is woodland/natural areas, and 4% is urban. The remaining 19% of the watershed is water/wetland or other land uses, which indicates the presence of significant riparian areas and habitats. Given that the majority of the Lower Cedar Watershed is devoted to agricultural uses, much of the focus on the watershed plan will be on engaging rural landowners and emphasizing that the burdens of flooding and water quality are not just urban issues.

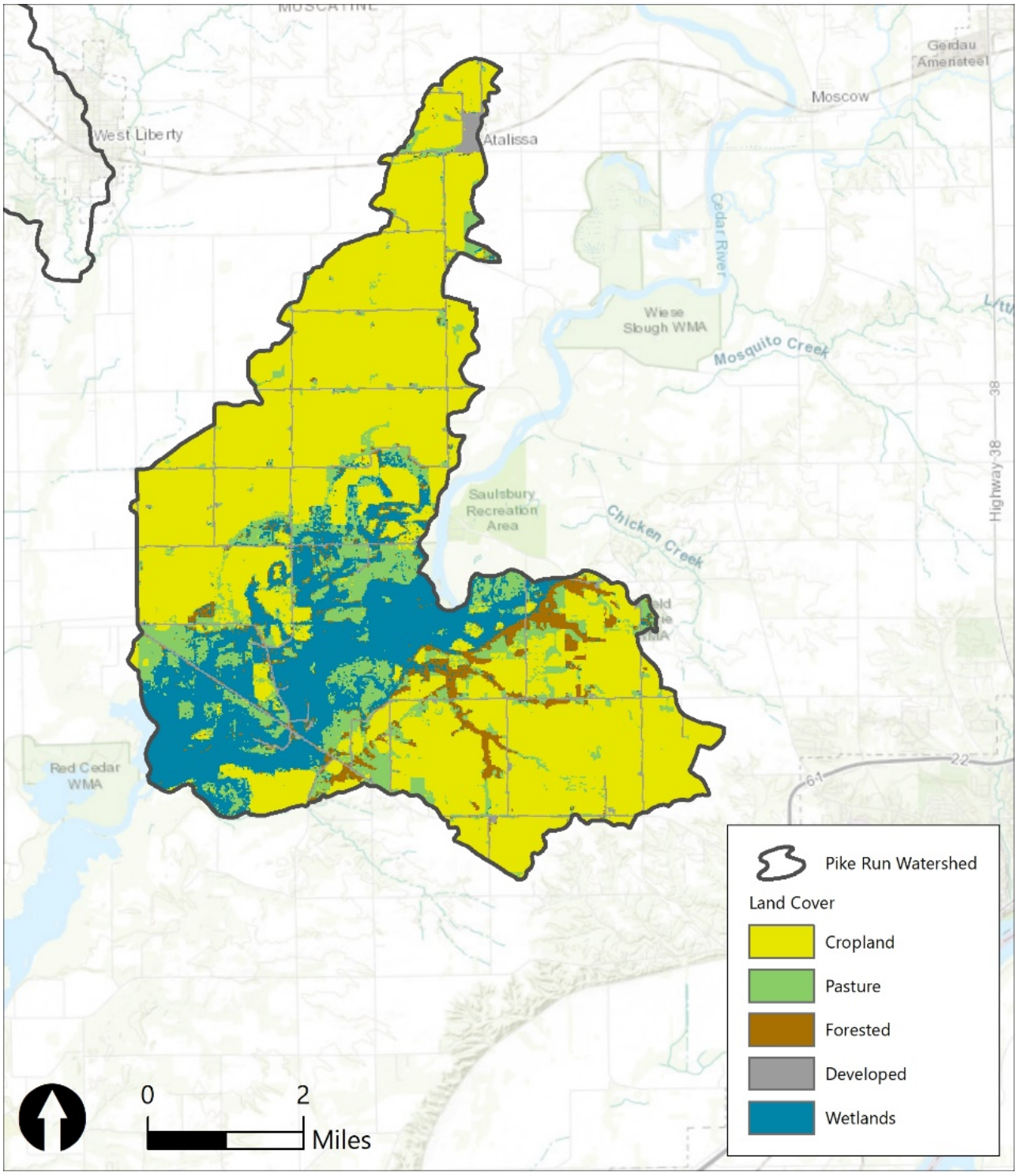
As shown in Table 2-1, the area in row crops has increased the past 20 years due to agricultural production trends and conversion of land that was once in pasture, timber, or other perennial cover. By engaging rural landowners throughout the planning process, the WMA hopes to increase their buy-in to the watershed project, to scale up adoption of critical agricultural conservation practices.

Table 2-1. Land Cover in the Pike Run Watershed

Land Cover	Acres in 2001	% of Watershed	Acres in 2020	% of Watershed
Cropland	11,790	51%	14,012	61%
Pasture	7,934	34%	2,937	13%
Forested	3,347	14%	967	4%
Developed	N/A	N/A	872	4%
Water & Wetlands	73	<1%	4,355	19%

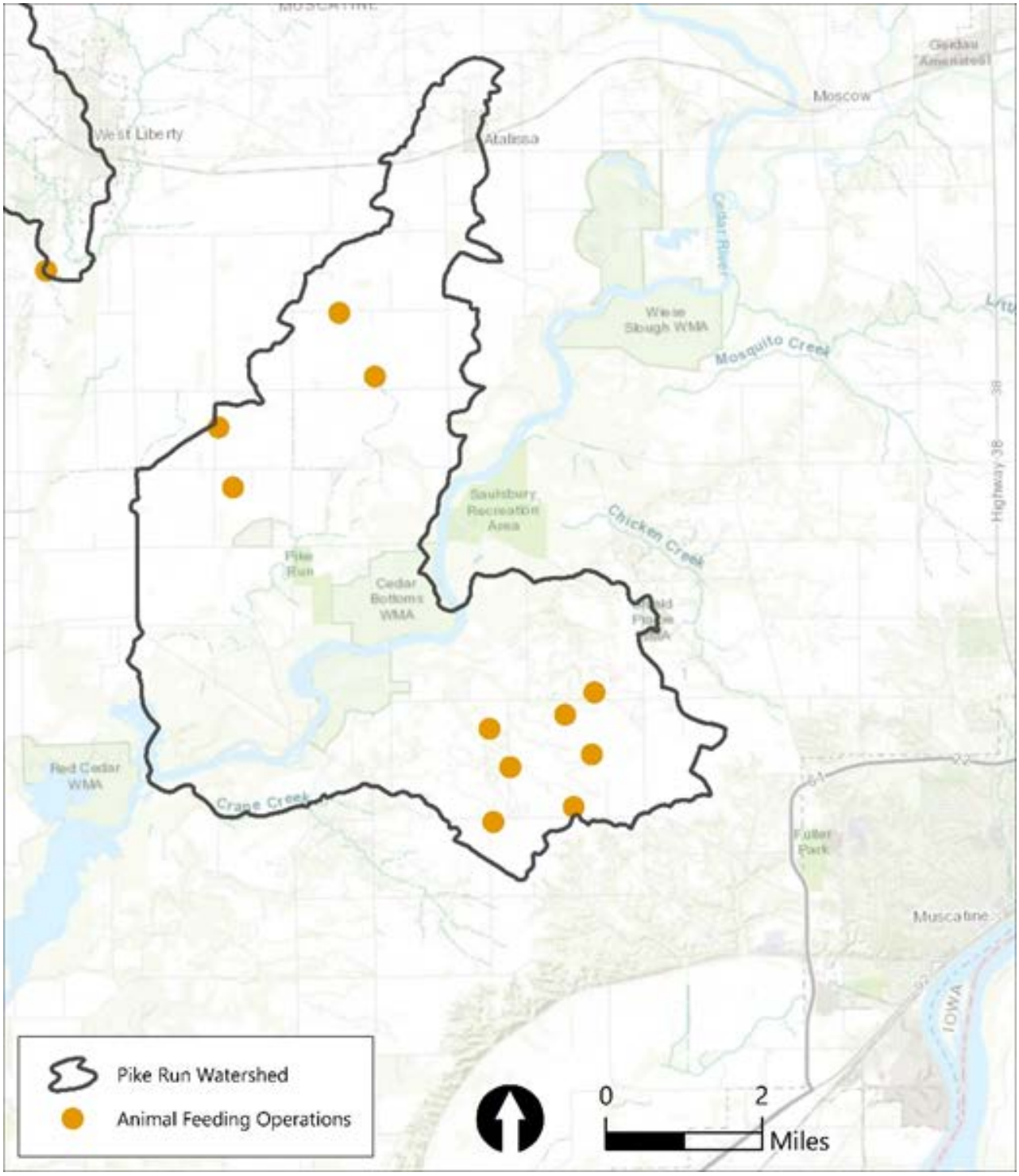
Source: Iowa Department of Natural Resources.
N/A = 2001 data that did not specify Developed and Water & Wetlands area.

Figure 2-1. Land Cover in the Pike Run Watershed



Source: Iowa Department of Natural Resources

Figure 2-2. Permitted Livestock Waste Facilities



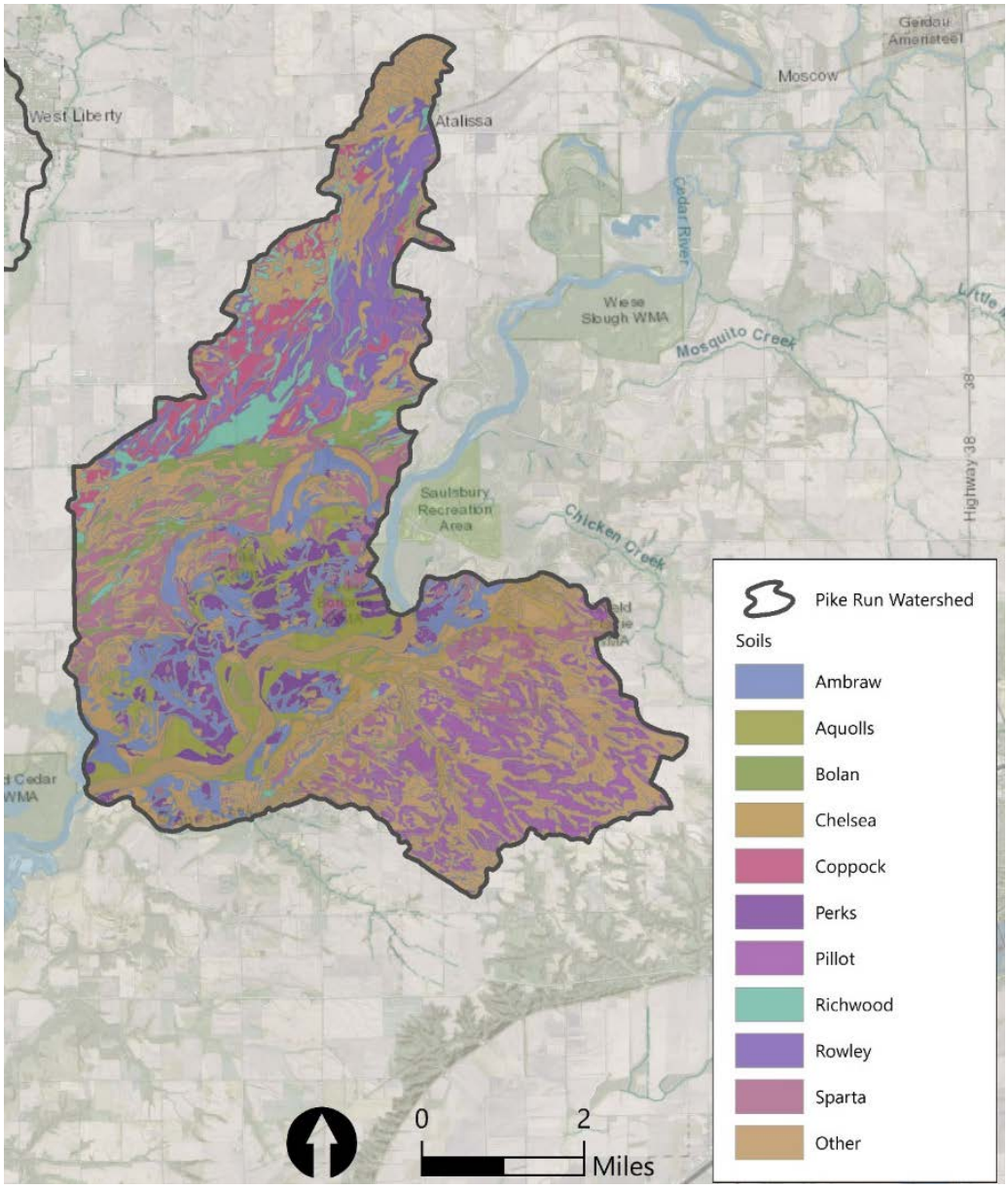
Source: Iowa Department of Natural Resources

Soils and Topography

Soil generation is a complex process that incorporates many factors such as parent material, slope angle, vegetation, moisture content, and the degree to which it has been eroded. Soils are classified using these characteristics and are subdivided into association names, primarily from the sites where each one was initially identified. All the dominant soil associations within the Lower Cedar watershed occur in both the Iowan Surface and Southern Iowa Drift Plain regions. Collectively, the following five soil types comprise 43% of the watershed. All other individual soil types make up about 57% of the watershed area. A detailed soils summary table is provided in Appendix D.

- Pillot (10%) – very deep, well drained soils with slopes ranging from 0-18 percent
- Sparta (10%) – very deep, excessively drained soils with slopes ranging from 0-40 percent
- Ambraw (9%) – very deep, poorly drained, moderately or moderately slow permeable soil with very gentle slopes
- Rowley (8%) – very deep, somewhat poorly drained soils with gentle slopes
- Perks (6%) – deep, excessively drained, rapidly permeable soils with mildly gentle slopes

Figure 2-3. Pike Run Watershed Soils



Source: Web Soil Survey, USDA NRCS

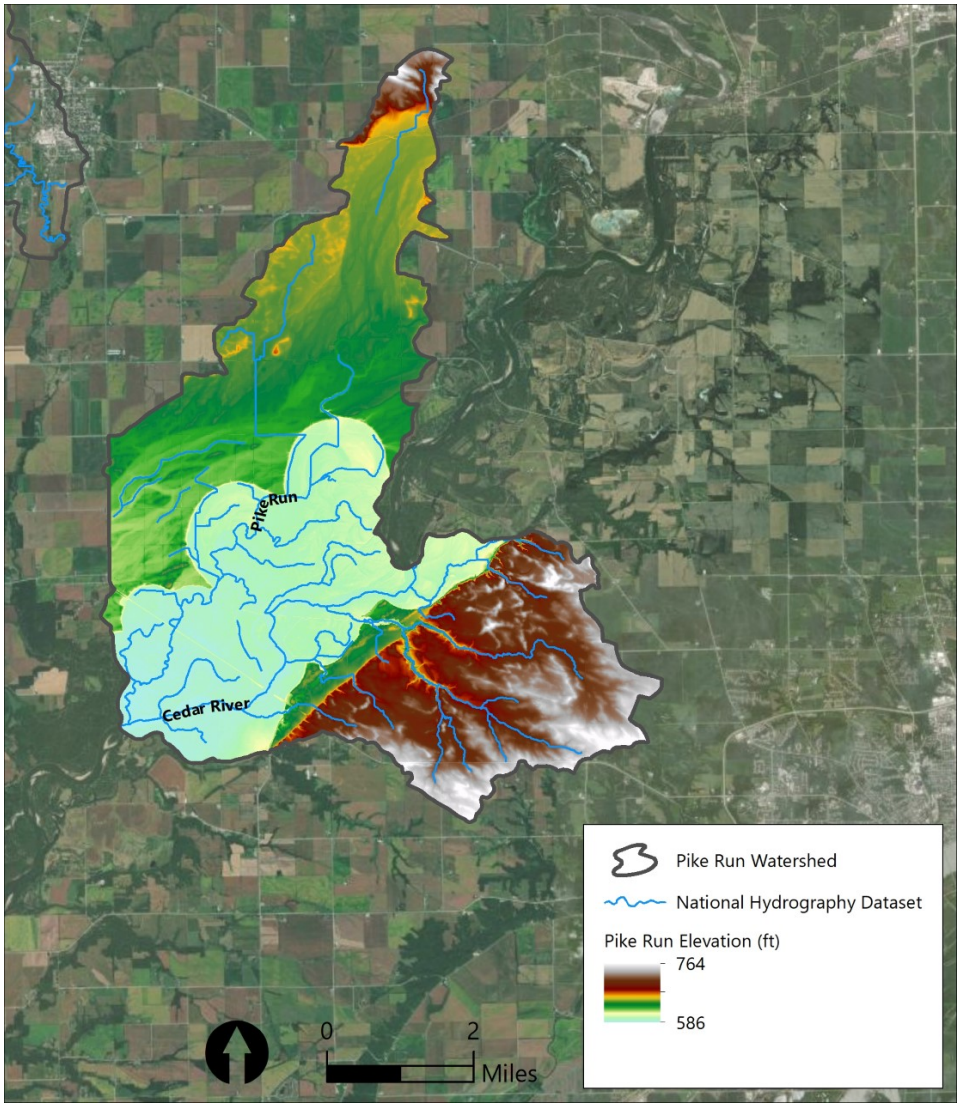
Topography, the landscape surface features such as shape and slope, is an important consideration of watershed management because it influences patterns of erosion and drainage. It also determines what types of conservation practices are best suited to a particular landscape. One of the defining characteristics of the Pike Run watershed is the presence of high elevations and a steep drop down to the Cedar River on the east side of the river, and low-lying, flat areas on the west side. Overall, 81% of the terrain is characterized as nearly level or gently sloping with a slope of less than 5%. Most of the watershed's agricultural activity occurs in these areas. Moderate slopes (5-9%) comprise 6% of the watershed, with steeper slopes (greater than 9%) making up about 7% of the watershed.

Table 2-2. Slopes in the Pike Run Watershed

Percent Slope	Acres	Percent of Watershed
0-2%	15,518	67%
3-5%	3,231	14%
6-9%	1,331	6%
10-14%	1,074	5%
15-18%	7	0%
19-25%	295	1%
>25%	221	1%

Source: Web Soil Survey, USDA NRCS

Figure 2-4. Pike Run Watershed Elevation



Streams and Other Waterbodies

The Pike Run watershed includes 71.4 total miles of streams, including the Cedar River and Pike Run (Table 2-3). Other waterbodies include significant riparian wetlands along the main stem of Pike Run and the Cedar River. There are many existing and potential oxbow wetlands in the floodplain of this watershed.

Table 2-3. Stream Lengths and Area in the Pike Run Watershed

Stream Name	Segment ID	Stream Length (mi)	Watershed Area (acres)
Cedar River	449	5.9	23,070
Pike Run	485, 486	9.0	13,689

Source: USGS National Hydrography Dataset (NHD)

Ecological Considerations

As reported in Chapter 2 of the basin-wide plan, the Lower Cedar is home to a variety of unique and valuable ecological communities and many Species of Greatest Conservation Need identified in the Iowa Wildlife Action Plan. This is especially true of the Pike Run watershed, which contains the Pike Run Wildlife Area, a 182-acre area immediately north of Highway 22 that includes rare and valuable habitats. The area is managed by the Muscatine County Conservation Board and features a native sand prairie, oak timber stands, many riparian wetlands, and Pike Run itself.

Pike Run has stream Biological Monitoring and Assessment Program monitoring sites, with data available through the online BioNet portal (https://programs.iowadnr.gov/bionet/). The Fish Index of Biological Integrity (FIBI) and Benthic Macroinvertebrate Index of Biological Integrity (BMIBI) scores indicate reach with both good and poor habitat quality, illustrating both the potential and concerns with respect to wildlife and habitat issues in Pike Run.

Climate

Climate conditions in the Pike Run watershed are consistent with those found across the Lower Cedar River Watershed, as described in Chapter 2 of the basin-wide plan.

Flooding

The Pike Run watershed has no urban areas within the floodplain and flooding issues are limited to farm fields and a few isolated private properties. A significant opportunity exists, however, to increase floodplain connectivity and flood storage along Pike Run, which would provide potential flooding and flood damage reductions downstream.

3. Watershed and Water Quality Conditions

Use Designations and Water Quality Impairments

According to application of Iowa's water quality standards, Pike Run should support primary contact recreation (Class A1), warm water (Type 1 and Type 2) aquatic life (Class BWW1 and BWW2), and Human Health according to use attainability analysis performed by Iowa DNR and approved by the US EPA. These use designations have specific water quality standards associated with them. Water quality criteria most relevant to the current conditions of Pike Run are reported Table 3-1.

Table 3-1. Water Quality Criteria for the Pike Run Watershed

Designated Use	Class	Description	Relevant Criteria
Warm water aquatic life (Type 1) Segment 449 is in need of further investigation. Segment 485 is impaired (not supporting).	BWW1	Waters in which temperature, flow, and other habitat characteristics are suitable to maintain warmwater game fish populations along with a resident aquatic community that includes a variety of native nongame fish and invertebrate species.	Biological sampling data: • Benthic macroinvertebrate index of biological integrity • Fish index of biological integrity
Warm water aquatic life (Type 2) Segment 486 is impaired (not supporting)	BWW2	Waters in which flow or other physical characteristics are capable of supporting a resident aquatic community that includes a variety of native nongame fish and invertebrate species. The flow and other physical characteristics limit the maintenance of warm water game fish populations. These waters generally consist of large interior and border rivers and lower segments of medium-size tributary streams.	Biological sampling data: • Benthic macroinvertebrate index of biological integrity • Fish index of biological integrity
Primary contact recreation Segments 485 and 486 are not assessed. Segment 449 is impaired (not supporting).	Class A1	Waters in which recreational or other uses may result in prolonged and direct contact with the water, involving considerable risk of ingesting water in quantities sufficient to pose a health hazard. Such activities would include, but not be limited to, swimming, diving, water skiing, and water contact recreational canoeing.	Pollutant of Concern: E.coli (March 15 through November 15) • Geometric mean ≤ 126 cfu/100mL • Single sample max ≤ 235 cfu/100 mL
Human Health Segments 449 and 485 are not assessed.	NA	Waters in which fish are routinely harvested for human consumption.	NA

Source: Iowa ADBNet https://programs.iowadnr.gov/adbnet/

Pike Run (Segments 485 and 486) is classified as an Overall IR Category 5 (TMDL needed) due the aquatic life impairments. Further investigations are needed on the Cedar River (Segment 449) to determine impairment status of the aquatic life use. This segment of the Cedar is impaired for primary contact recreation, which places the segment in Category 5 and an E. coli TMDL is needed.

Historical Watershed Efforts

No watershed-scale historical efforts are known to have occurred in the Pike Run watershed. The watershed is a priority for several conservation agencies and partners, and there is broad interest in watershed implementation based on feedback obtained as part of the information and education and stakeholder engagement conducted in this planning effort.

Pollutants of Concern

The primary pollutants of concern in the Pike Run watershed include phosphorus, sediment, nitrogen, and *E.coli*. A description of each pollutant of concern is laid out in Chapter 3 of the basin-wide plan.

Water Quality Results

The water quality samples collected in 2020 from Pike Run at Iron City Ave provide a reasonable reflect of water quality in Pike Run. Water quality data from 2005-2019 were averaged across multiple sites within the HUC-12 were averaged and included with data collected in 2020 in Table 3-2. The 2005-2019 data includes results from multiple monitoring efforts, including county-wide snapshots, and ambient stream monitoring by Iowa DNR.

Table 3-2. Summary of 2020 Water Quality Monitoring in Pike Run

Date	*E. Coli* (cfu/100 mL)	Turbidity (NTU)	TP (mg/L)	TN (mg/L)
07/07/2020	63	13	0.24	<0.10
08/27/2020	1100	4.3	0.42	<0.10
09/09/2020	300	3.7	0.19	1
11/25/2020	390	7.2	0.33	1.8
2020 Average (GeoMean for *E. coli*)	300.1	7.1	0.30	0.8
[1]Historical HUC-12 Averages	3,363	no data	0.22	1.8
[1]Historical averages obtained from 2005-2019 monitoring sites across the Pike Run HUC-12				

Source: Various DNR and partner agency monitoring efforts

4. Pollutant Source Assessment

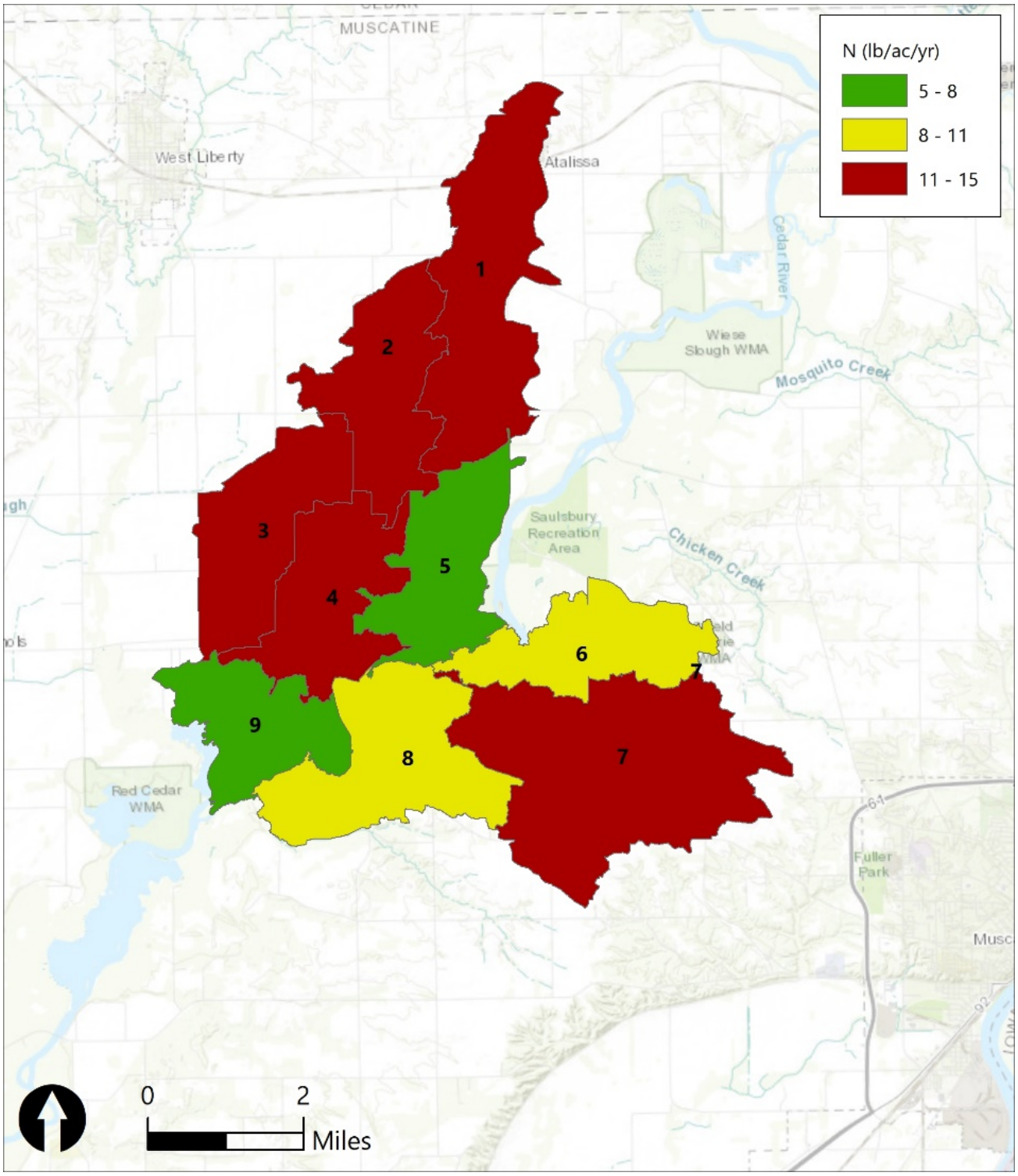
The pollutant source and loading model of the Pike Run priority HUC-12 watershed utilized a modified version of the Spreadsheet Tool for Estimating Pollutant Load (STEPL) (Tetra Tech, 2011). The model predicts annual average runoff and groundwater/baseflow volumes using a simple annual rainfall runoff equation, soil erosion and transport using the Universal Soil Loss Equation (USLE) approach, and pollutant loads using soil, slope, and land used based pollutant concentrations from a combination of literature values and water quality monitoring results.

Model Setup

- Parameterization of inputs for pollutant loading estimates included land-use (CDL, 2020), livestock and feedlot numbers (IDNR), septic systems (from STEPL Model Input Data Server), soil data (e.g., hydrologic soil group), topographic data, and other watershed characteristics. Initial inputs were obtained from a variety of sources, including the STEPL data server (Tetra Tech, 2013), locally available data, applicable literature/research data, and best professional judgement.
- Prediction of stream bank erosion was estimated for all second order and larger streams and assumed moderate recession rates (0.13 ft/yr) based using a desktop assessment, soils information, and NRCS streambank recession rates.
- Gully erosion was estimated using 1st order stream length and best professional judgement and rules-of-thumb for gully size and progression rate.
- A key modification to the STEPL model is that areas of pastureland cover within 1,000 linear feet of either side of the stream channel were assumed to have cattle with direct access to the streams. This is important for simulation of the impacts of direct deposition of manure on bacteria concentrations. This assumption should be field verified, but it provides information helpful for modeling as well as targeting areas for livestock exclusion BMPs.

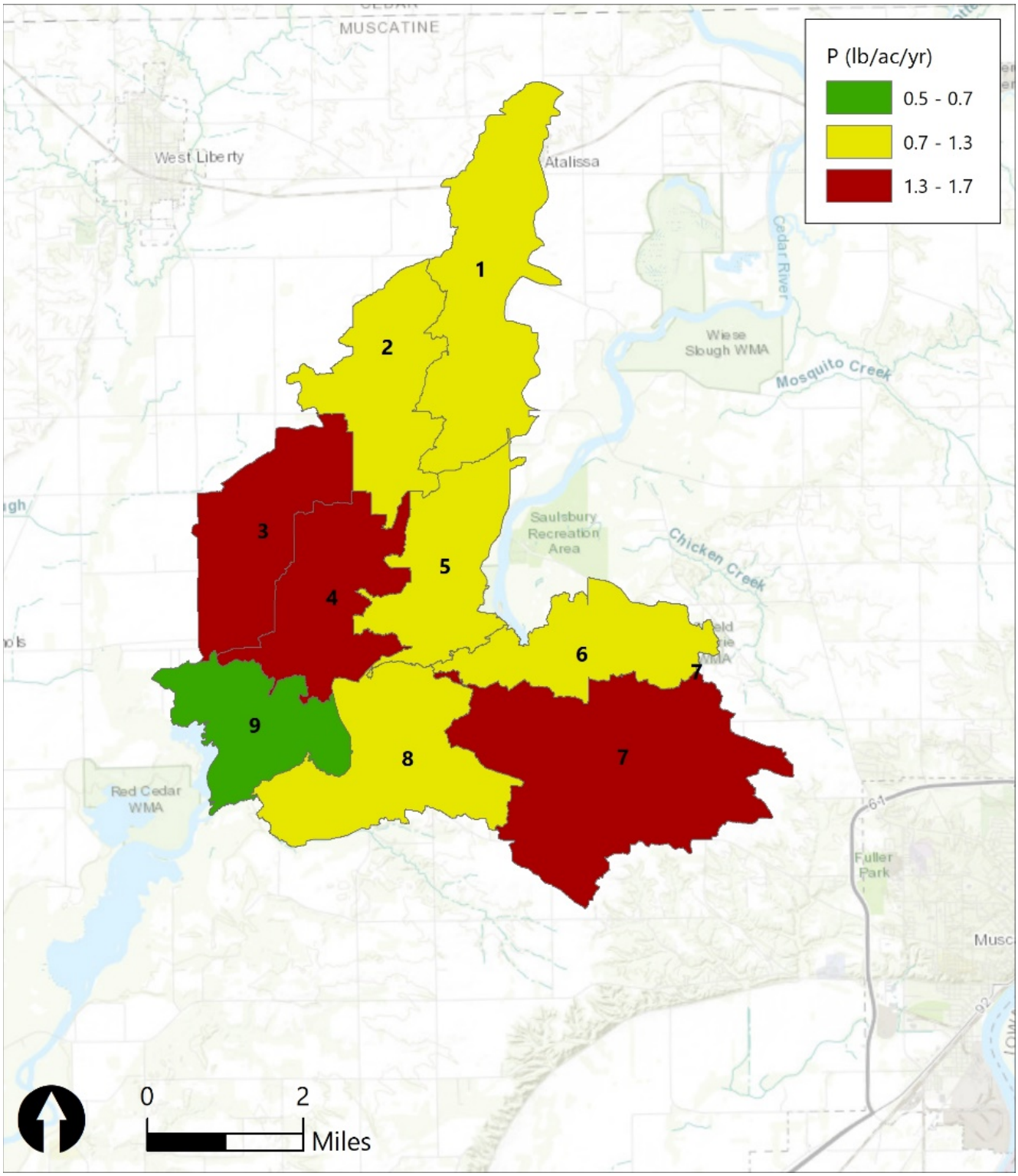
Predicted pollutant loads are summarized for the four main pollutants of concern: sediment, phosphorus, nitrogen, and bacteria (E. coli). The STEPL spreadsheet reports loads in total mass and mass per acre and summarizes loads by both subwatershed and pollutant source.

Figure 4-1. STEPL Nitrate Loads



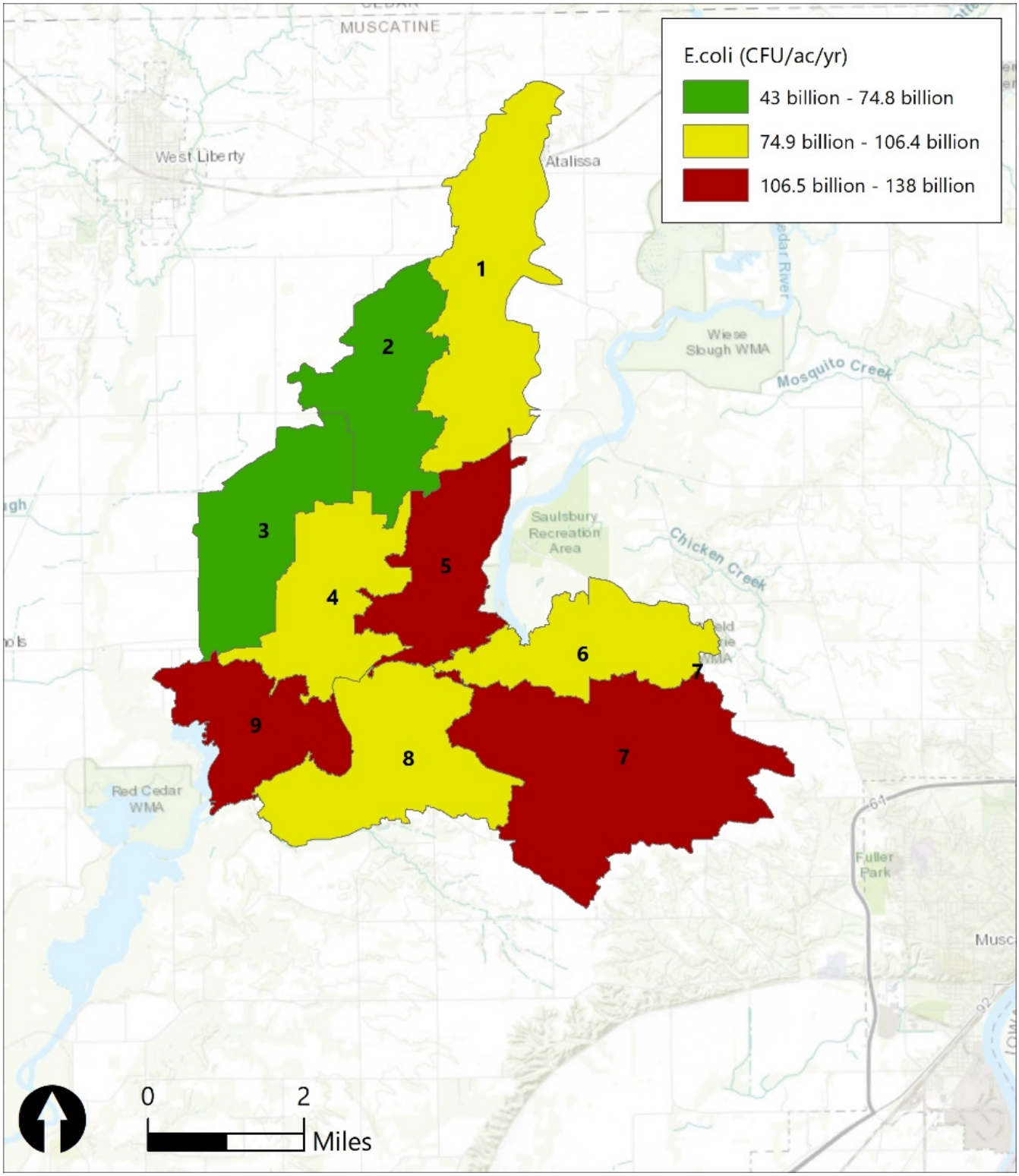
Source: Pike Run HUC-12 STEPL model

Figure 4-2. STEPL Phosphorus Loads



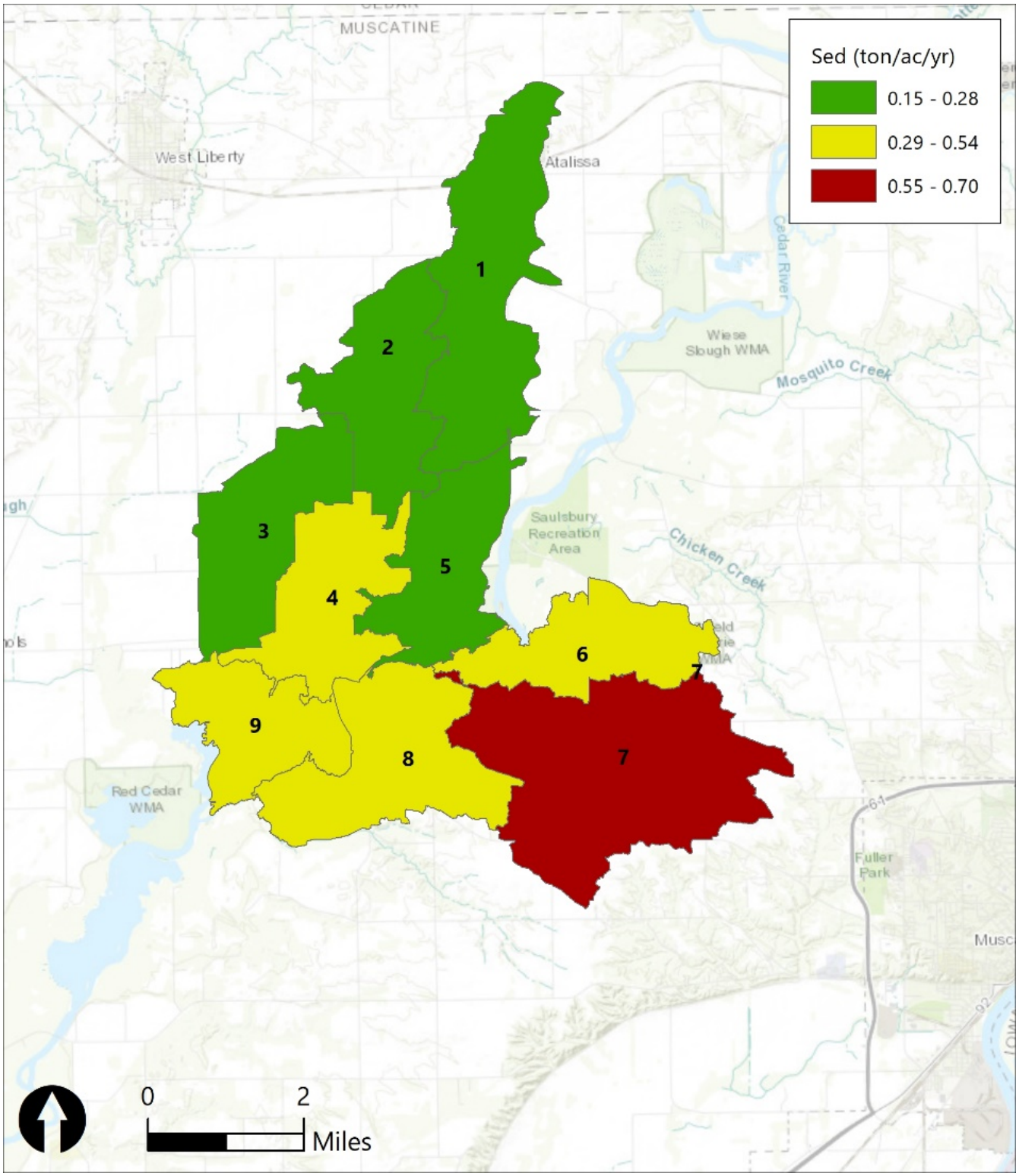
Source: Pike Run HUC-12 STEPL model

Figure 4-3. STEPL *E. coli* Loads



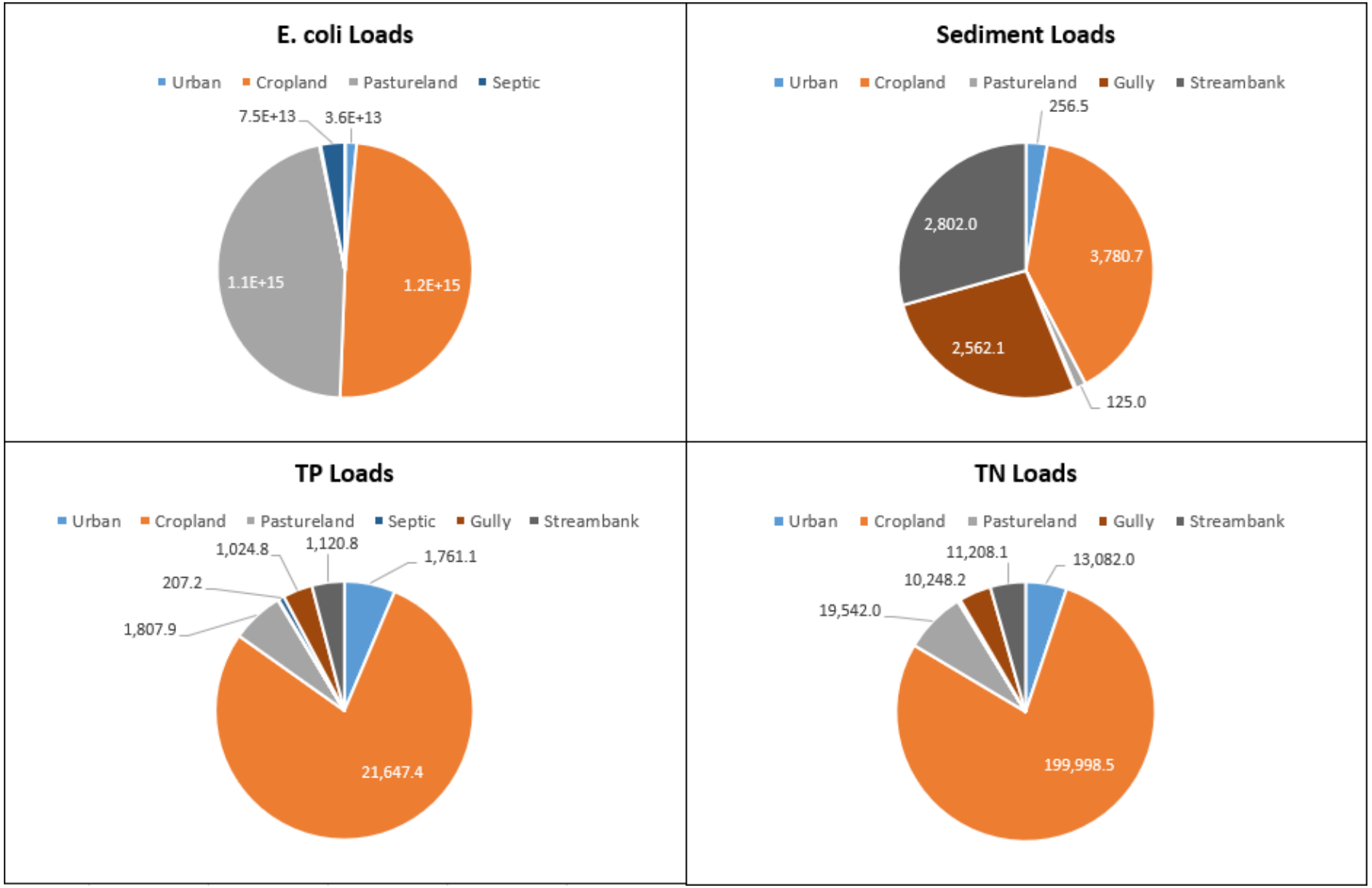
Source: Pike Run HUC-12 STEPL model

Figure 4-4. STEPL Sediment Loads



Source: Pike Run HUC-12 STEPL model

Figure 4-5. STEPL Total Loads by Land Use



Source: Pike Run HUC-12 STEPL model

Table 4-1. STEPL Total Loads by Land Use

Sources	N (lb/yr)	N %	P (lb/yr)	P %	E. coli (cfu/yr)	E.coli %	Sediment (ton/yr)	Sediment %
Urban	13,082	5%	1,761	6%	3.6E+13	1%	257	3%
Cropland	199,998	78%	21,647	78%	1.2E+15	49%	3,781	40%
Pastureland*	19,542	8%	1,808	7%	1.1E+15	46%	125	1%
Forest	275	0%	32	0%	4.1E+12	0%	20	0%
Feedlots	0	0%	0	0%	0.0E+00	0%	0	0%
User Defined	0	0%	0	0%	0.0E+00	0%	0	0%
Septic	658	0%	207	1%	7.5E+13	3%	0	0%
Gully	10,248	4%	1,025	4%	2.9E+11	0%	2,562	27%
Streambank	11,208	4%	1,121	4%	6.9E+10	0%	2,802	29%
Total	**255,012**		**27,601**		**2.5E+15**		**9,547**	

Existing BMPs

Existing BMPs were not explicitly included in the pollutant loading model for Pike Run, but practices included in the statewide Iowa BMP Mapping Project or watershed-specific Agricultural Conservation Planning Framework (ACPF) analysis were mapped and summarized (Table 4-1). Practices include ponds, dams, terraces, contour buffer strips, strip cropping, grassed waterways, and water and sediment control basins (WASCOBs). Although not simulated in modeling, existing BMPs were incorporated in the implementation model to avoid predicting reductions that are not available on the ground.

Table 4-1. Pike Run Existing BMPs

BMP Type	Number of BMPs
Pond or Dam	5
Terraces	11
WASCOBs*	48
Contour Buffer Strips	1
Grassed Waterways	154
Strip Cropping	0
*Water and Sediment Control Basins	

Source: Iowa BMP Mapping Project, https://www.gis.iastate.edu/BMP

Pike Run ACPF Assessment

The Agricultural Conservation Planning Framework (ACPF), developed by USDA-Agricultural Research Service, was applied to the Pike Run HUC-12 watershed. ACPF identifies potential locations and the quantity of BMPs suitable for specific areas of the landscape in an ArcGIS platform. ACPF output was used to quantify potential pollutant reductions in this planning effort. ACPF can also be used by the WMA for landowner/operation information and education, and for stakeholder engagement in small or large group settings, both of which facilitate higher rates of conservation and BMP adoption.

Table 4-2. Pike Run ACPF Summary

In Field ACPF BMPs	Number Generated	Total Area Treated (acres)
Contour buffer strips	201	766
Grassed Waterway	301	2,529
Drainage water management	123	7,140
Edge of Field ACPF BMPs	**Number Generated**	**Total Area Treated (acres)**
Bioreactors	29	1,378
Nutrient reduction wetlands	10	3,640
WASCOBs	40	424
Farm Pond	6	212
Riparian Zone ACPF BMPs	**Number Generated**	**Total Area Treated (acres)**
Saturated buffers	35	2,307
Streambank stabilization	99	246
Deep rooted vegetation	202	428
Multi Species Buffer	46	2,715
Stiff Stemmed Grasses	21	4,112

Source: Pike Run ACPF Output

5. Lower Cedar Social Engagement

FYRA and ECICOG established two websites as outreach tools to use during the planning process to engage the watershed community and stakeholders.

Lower Cedar Watershed Management Authority website https://lowercedar.weebly.com

Social Pinpoint project website https://fyra.mysocialpinpoint.com/lower-cedar-wma-plan which houses multiple surveys and an interactive project map that allows for community member engagement and input

Outreach Methods & Stakeholder Events

A series of workshops were held throughout 2021, resulting in the identification of high-priority resource concerns and actions for improving the watershed. Workshop participation was strong, averaging 25 – 30 local residents, public officials/staff, non-profit organizations, and academic institution staff interested in watershed improvement projects. There is more detail about outreach efforts and the public input gathered in Chapter 5 of the basin-wide plan.

- ECICOG hosted three virtual focus groups with 12 agricultural producers to gauge level of concern for watershed issues and how they might fit into the solutions.
- ECICOG partnered with the Indian Creek Soil Health Partnership to host a Women Caring for the Land virtual workshop in March and April 2021 with 22 participants.
- The Indian Creek Soil Health Partnership hosted a Field Day in April 2021 to promote perennial cover and saturated buffers. 50 attended and toured a saturated buffer on Curt Zingula's farm.
- The Lower Cedar WMA hosted Community Source Water virtual workshop to discuss drinking water concerns and possible solutions and funding sources with 13 participants.
- The Lower Cedar WMA hosted a virtual workshop for 14 Emergency Management Administrators in the watershed to connect the watershed plan to Hazard Mitigation Plans.
- Direct inquiries to cities, floodplain managers, and county conservation boards about current and future projects to improve water quality and/or flood mitigation.

6. Goals and Objectives

The overall goal of the Pike Run Watershed Plan is to inform the LCWMA and its partners with useful and actional information related to identifying, prioritizing, and implementing solutions to water quality, flooding, and other water and natural resources concerns.

Water Quality Goal

The overall water quality goal is to protect and improve surface and ground water in Pike Run, with the following specific objectives:

1. Follow Iowa's Nutrient Reduction Strategy (NRS) guidance to implement conservation practices that reduce total N and P load by 45%
2. Reduce nonpoint source loads of nitrogen by 41% and phosphorus by 29%, consistent with NRS targets.
3. Encourage & implement erosion reduction and soil health practices that reduce sediment transported to surface water by 50%.
4. Encourage & implement Stormwater management practices that will infiltrate runoff up to a 2.5-inch rain event (the channel protection volume) as recommended in the Iowa Stormwater Management Manual.
5. Reduce E. coli bacteria in surface water by the maximum extent practical, working towards a long-term goal of compliance with Iowa water quality standards (geomean concentrations not to exceed 126 cfu/100mL).

Table 6-1. Pike Run Watershed Water Quality Goals

Parameter	Reduction Goal (%)	Actual Reduction (%)
Phosphorus	45%	30%
Sediment	50%	59%
Nitrogen	45%	18%
E. coli	97%	16%

Secondary Goals

The other goals in the Pike Run Watershed include flood reduction, both locally and downstream, as well as improvement of habitat and recreational opportunities. Many water quality improvement practices offer the ancillary benefits. The LCWMA plan and future implementation will maximize opportunities for multi-benefit projects.

Information & Education Goal

A proactive Information and Education (I&E) plan is an important part of planning and implementing water quality, flooding, and habitat improvements at the watershed scale. The I&E goal for the Pike Run watershed is to implement the relevant components of the following outreach workplan from the basin-wide plan.

Education & Outreach Workplan

These education strategies were identified as priorities in the public engagement for the WMP and will guide the efforts of the watershed coordinator and the LCWMA Board throughout plan implementation.

- Educate agricultural community about practices to reduce erosion at workshops, tours, field days and other peer to peer events for farmers and other stakeholders
- Create program to recognize and share BMPs on the LCWMA Facebook page and other social media to expand the "neighborhoods" of conservation
- Organize opportunities to take urban residents to rural areas and rural residents to urban areas to observe issues caused by flooding and the solutions implemented to date
- Educate various audiences about infiltration practices to improve water quality through:
    - Workshops (with CEUs) for developers, builders, engineers, and inspectors about infiltration practices and green infrastructure
    - Green infrastructure workshops and urban BMP tours for homeowners, policy makers, or other interested stakeholders
- Build awareness of flood risk and intensifying rain events due to climate change by hosting an annual "flood awareness" meeting and promote ways residents can reduce stormwater run-off
- Communicate with residents about the relationship between stream health and human health through community engagement events about water quality (outdoor classrooms, watershed tours, paddling outings, creek clean-ups)
- Promote the Nutrient Reduction Strategy and its recommended practices through workshops, tours, field days or other peer to peer event for farmers and other stakeholders
- Educate the agricultural community about flood risks and how they can be part of the solution by engaging the agricultural community through small events with ag groups and youth groups such as FFA and 4-H clubs
- Partner with FFA teachers to incorporate watershed & water quality issues into their classes each year
- Communicate with households utilizing septic systems about impacts of human waste management on stream health through workshops

7. Implementation – Action Plan

Implementation Strategies and Practices

A comprehensive menu of potential best management strategies to improve water quality, reduce flood damages, enhance wildlife habitat, and provide recreational opportunities is provided in Chapter 6 of the basin-wide plan. Descriptions, applicability, and pollutant removal of specific BMPs are also provided in Chapter 6. The approach and combination of BMPs suitable for each HUC-12 in the Lower Cedar basin will vary according to soils, topography, land use, and preference and interest of watershed stakeholders including agricultural landowners and operators, residents, municipalities, and others that live, work, and recreate in each HUC-12.

Successful implementation will require efforts driven by specific goals and milestones but must also be dynamic to reflect changes in real world conditions, including changes in policy that affect agricultural practices, regulations, funding, water quality, stakeholder concerns, and many others. The three-phase implementation plan for the Pike Run watershed was developed to:

- Identify short-term actions to assist a watershed coordinator in Information & Education to establish momentum
- Allow time for increased outreach to promote BMP adoption over time
- Provide the watershed coordinator time to gather additional information and align funding
- Secure engineering and permitting services required for long-term BMP adoption and construction of proposed structural practices

Information and Education Program Elements

The watershed level public awareness and education program should include both public education & outreach and public participation & involvement activities defined as:

Education & outreach activities are designed to distribute education materials and messages and perform outreach to inform citizens and target audiences.

Public participation & involvement activities provide opportunities for citizens to participate in programs and become active in implementing watershed protection programs.

Table 7-1. Example Outreach Activities

Education / Outreach Programs	Public Involvement / Participation Programs
Bill inserts or newsletters	Water quality monitoring program
Brochures at local government facilities	Watershed festival
Website with watershed education information	River/Creek clean-up events
Speakers' bureau presentations	Storm drain stenciling events
Event displays and/or kiosks	Watershed citizen advisory group
Press releases	Rainscaping workshops
School classroom education	Agriculture stakeholder group

Milestones and Outcomes

Plan milestones, costs, and outcomes are presented in Tables 7-2 and 7-3 for the entire 20-year implementation period across 3 phases of implementation. Metrics are based on the pollutant load reduction goals set forth in the prior section.

Table 7-2. Implementation Strategies, Costs, and Timeline for Pike Run

	20-Year Plan		Phase 2		Phase 3		Phase 4	
# Years	20		7		7		6	
Practice	Goal (acres)	*Cost	Phase Goal (acres)	*Phase Cost	Phase Goal (acres)	*Phase Cost	Phase Goal (acres)	*Phase Cost
Watershed Coordinator	N/A	$2,084,466	N/A	$552,881	N/A	$727,553	N/A	$804,032
Water Quality Monitoring	N/A	$0	N/A	$0	N/A	$0	N/A	$0
Stakeholder Engagement/Outreach	N/A	$7,000	N/A	$2,450	N/A	$2,450	N/A	$2,100
Bioreactors	758	$303,114	265	$106,090	265	$106,090	227	$90,934
Contoured Buffer Strips	-	$0	-	$0	-	$0	-	$0
Grassed WW	835	$183,614	292	$64,265	292	$64,265	250	$55,084
Wetlands	2,184	$1,266,856	764	$443,400	764	$443,400	655	$380,057
Sediment Ponds	70	$49,078	25	$17,177	25	$17,177	21	$14,723
Terraces	192	$181,936	67	$63,678	67	$63,678	57	$54,581
WASCOBs	106	$201,443	37	$70,505	37	$70,505	32	$60,433
No-Till	3,347	$669,467	1,172	$234,313	1,172	$234,313	1,004	$200,840
Cover Crops	7,245	$3,622,655	2,536	$1,267,929	2,536	$1,267,929	2,174	$1,086,797
Extended Rotation	3,260	$2,608,312	1,141	$912,909	1,141	$912,909	978	$782,494
Perennial Conversion	2,174	$6,520,780	761	$2,282,273	761	$2,282,273	652	$1,956,234
Riparian Buffers	3,852	$2,696,421	1,348	$943,747	1,348	$943,747	1,156	$808,926
Saturated Buffers	1,500	$3,314,284	525	$1,159,999	525	$1,159,999	450	$994,285
Streambank stabilization	3,849	$1,732,028	1,347	$606,210	1,347	$606,210	1,155	$519,608
Gully stabilization	4,232	$846,498	1,481	$296,274	1,481	$296,274	1,270	$253,949
Livestock Exclusion	561	$1,466,465	196	$513,263	196	$513,263	168	$439,939
Total		**$27,754,416**		**$9,537,363**		**$9,712,036**		**$8,505,017**

Table 7-3. Load Reduction Targets and Milestones for Pike Run

	20-Year Plan				Phase 1				Phase 2				Phase 3			
# Years	Reductions				7				7				6			
Practice	P (lbs)	Sediment (tons)	N (lbs)	E.coli (MPN)	P (lbs)	Sediment (tons)	N (lbs)	E.coli (MPN)	P (lbs)	Sediment (tons)	N (lbs)	E.coli (MPN)	P (lbs)	Sediment (tons)	N (lbs)	E.coli (MPN)
Bioreactors	235	7	3,826	3.74E+13	82	2	1,339	1.31E+13	82	2	1,339	1.31E+13	70	2	1148	1.12E+13
Contoured Buffer Strips	0	0	0	0.00E+00	0	0	0	0.00E+00	0	0	0	0.00E+00	0	0	0	0.00E+00
Grassed WW	809	169	2,551	5.41E+13	283	59	893	1.89E+13	283	59	893	1.89E+13	243	51	765	1.62E+13
Wetlands	529	146	10,569	1.39E+14	185	51	3,699	4.87E+13	185	51	3,699	4.87E+13	159	44	3171	4.17E+13
Sediment Ponds	46	9	152	1.77E+12	16	3	53	6.19E+11	16	3	53	6.19E+11	14	3	46	5.31E+11
Terraces	180	45	434	7.46E+12	63	16	152	2.61E+12	63	16	152	2.61E+12	54	13	130	2.24E+12
WASCOBs	103	24	506	6.74E+12	36	8	177	2.36E+12	36	8	177	2.36E+12	31	7	152	2.02E+12
No-Till	3,281	658	0	1.29E+14	1,148	230	0	4.51E+13	1,148	230	0	4.51E+13	984	197	0	3.87E+13
Cover Crops	2,575	1,108	31,861	2.79E+14	901	388	11,151	9.77E+13	901	388	11,151	9.77E+13	772	332	9558	8.37E+13
Extended Rotation	999	178	15,092	6.28E+13	350	62	5,282	2.20E+13	350	62	5,282	2.20E+13	300	53	4528	1.88E+13
Perennial Conversion	1,199	261	17,607	4.19E+13	419	91	6,163	1.47E+13	419	91	6,163	1.47E+13	360	78	5282	1.26E+13
Riparian Buffers	2,843	690	11,091	1.76E+14	995	241	3,882	6.16E+13	995	241	3,882	6.16E+13	853	207	3327	5.28E+13
Saturated Buffers	89	16	9,888	4.20E+12	31	5	3,461	1.47E+12	31	5	3,461	1.47E+12	27	5	2966	1.26E+12
Streambank stabilization	45	126	56	2.24E+09	16	44	20	7.85E+08	16	44	20	7.85E+08	13	38	17	6.73E+08
Gully stabilization	41	115	51	9.33E+09	14	40	18	3.27E+09	14	40	18	3.27E+09	12	35	15	2.80E+09
Livestock Exclusion	225	0	998	3.24E+14	79	0	349	1.14E+14	79	0	349	1.14E+14	67	0	300	9.73E+13
Total	13,198	3,553	104,684	1.26E+15	4,619	1,244	36,640	4.42E+14	4,619	1,244	36,640	4.42E+14	3,959	1,066	31,405	3.79E+14

Phase 1 (Years 1-7)

The first phase of work will commence following submittal and approval of this WMP and includes meeting with the TAC to begin aligning funding sources, hire a watershed coordinator, coordinate with stakeholders, and begin landowner/farmer outreach. A water quality monitoring program has been initiated in conjunction with WMP development, but monitoring efforts will intensify in Phase 1 to provide data that reflects pre-implementation (baseline) conditions. Phase 1 objectives accomplished this phase of implementation will include WMP approval, landowner/farmer outreach and education, and aligning a watershed coordinator, TAC members, and key stakeholders to implement projects.

Engagement Activities will continue for the duration of the 20-year plan to keep momentum and ensure maximum adoption of BMPs. Engagement efforts will include:

Outreach to landowners about the importance of water quality and how they can have an impact on protection and improvement of the Middle Mud Creek Watershed.

Outreach to homeowners in the watershed to identify ways to increase infiltration and repair and/or replace failing septic systems – a potential source of nutrients to Middle Mud Creek.

Outreach to farmers to encourage conservation practices that minimize nutrient losses and erosion to surface and groundwater.

Phase 2 (Years 8-14)

Phase 2 will involve implementation of the "low-hanging fruit" BMPs and management strategies. These include working with willing landowners that recognize the need for conservation on their properties, with emphasis on the most popular and easy-to-adopt practices.

The watershed coordinator and the TAC will continue collaboration and work with landowners and producers in the watershed in Phase 3 to adopt BMPs in critical areas, with an emphasis on practices that require more education and active management to implement successfully.

Phase 3 (Years 13-20)

Phase 3 milestones are laid out to meet plan objectives by implementing conservation practices and structures on remaining land requiring additional treatment. Outreach efforts may include contacting landowners and properties where BMPs were not adopted in Phase 1 or Phase 2. It may also involve adding additional BMPs for a "treatment train" approach in areas with willing landowner participation. Additionally, after substantial progress made on watershed goals in Phases 1 & 2 coordination with TAC members and other stakeholders to undertake larger structural practices in and/or near the lake on park property. These may include

8. Monitoring and Evaluation

There will need to be evaluation of the progress towards implementation of the specific actions identified and towards meeting the long-term goal of a healthy watershed. It is recommended that evaluation be completed through bi-annual plan reviews and plan updates that occur every seven years. Water monitoring is an important part of establishing a baseline for both water quality and stream flows, and for documenting progress in achieving plan goals. Building off the existing monitoring activities will provide more information about conditions in the Pike Run watershed to inform management decisions. A framework for an on-going monitoring program in the Lower Cedar watershed is provided in Chapter 9 of the basin-wide plan.

Bi-annual Reviews

The purpose of the bi-annual plan review is to identify and discuss implementation challenges to determine if there is a need for plan amendments. The evaluation process provides stakeholders an opportunity to discuss concerns about an element of the Pike Run Watershed Plan and the basin-wide plan. The bi-annual reviews are a reminder that the Plan is adaptable, dynamic and flexible. Information that will be collected as part of the bi-annual survey and evaluation of progress will include:

Education Activities – Reporting of education and outreach efforts

Watershed Improvement Projects – Track implementation of projects and locations, provide watershed-wide summary with a map

Watershed Conditions Assessment – Update and summarize monitoring program data

As additional metrics for measuring progress are developed by the LCWMA they will be included in the bi-annual survey and progress report.

Plan Updates

Plan updates occur every 7 years and take a more holistic look at changed conditions and implementation actions since the last Plan Update. Evaluations of changed conditions for Plan Updates may include:

- Population and land use forecasts and trends;
- Water quality trends using the 303(d) list and available watershed assessment data;
- Tracking of BMPs; and
- Flood risk modeling for future land use projections.
- Undoubtedly, other issues will emerge that merit in-depth consideration in the future. As with existing efforts, future planning work should be open and inclusive, involving all LCWMA members and stakeholders.

West Branch Wapsinonoc HUC-12 Watershed Plan

August 2022

Lower Cedar Watershed Management Authority

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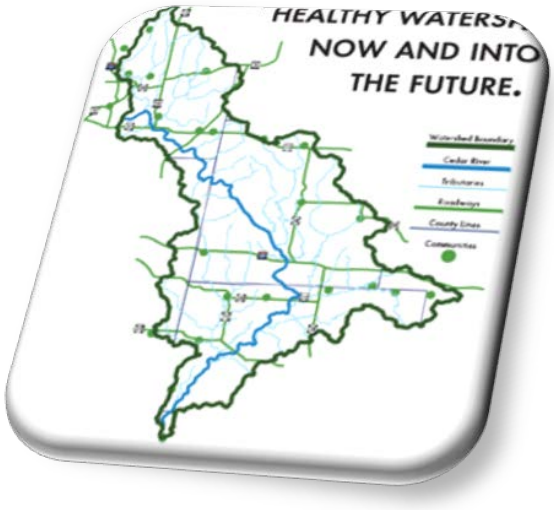
West Branch Wapsinonoc Creek



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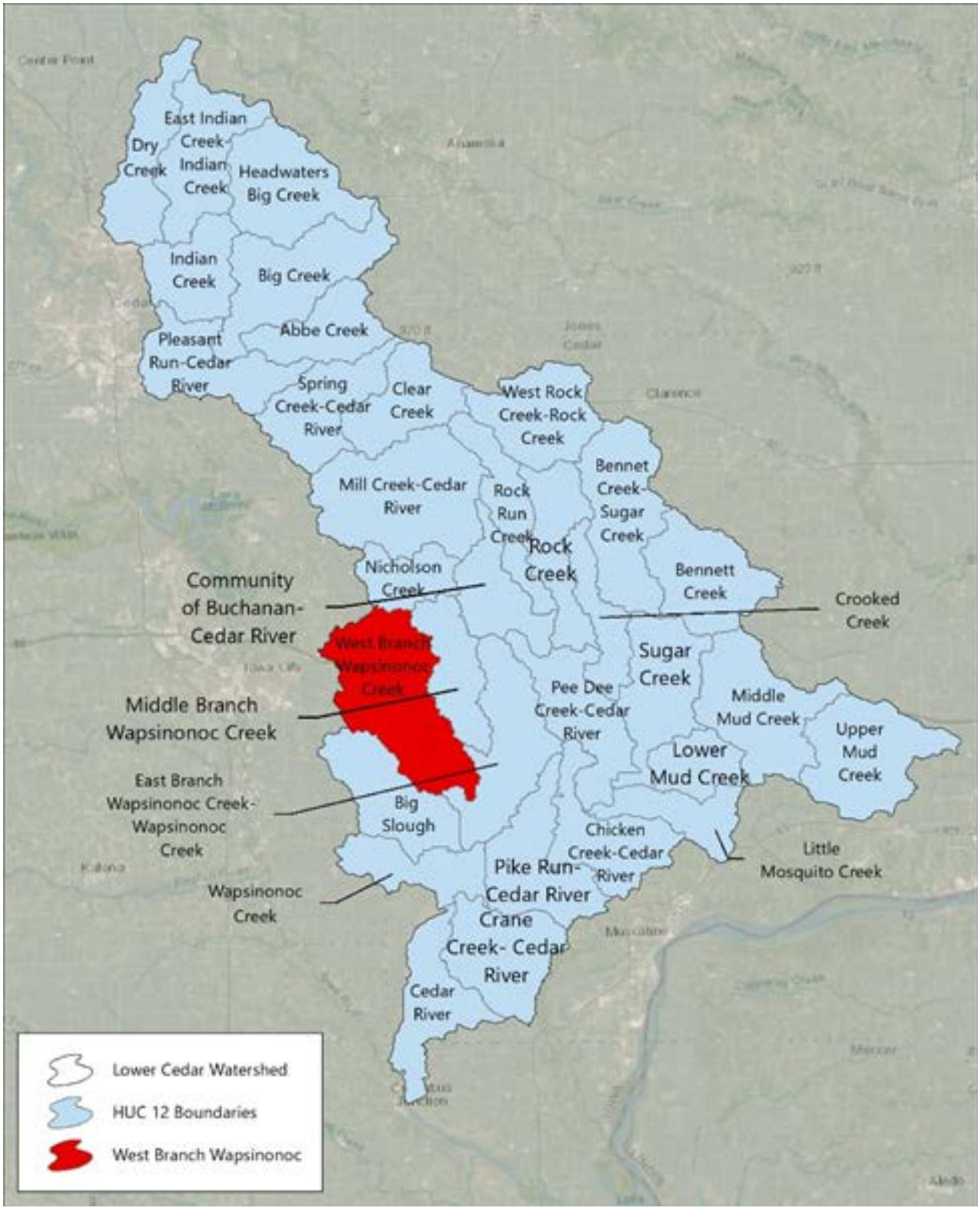
1. Introduction

The boundaries of the Lower Cedar watershed and its thirty-three subwatersheds are based on United States Geological Survey (USGS) defined boundaries called Hydrologic Unit Codes (HUC). The Lower Cedar watershed (HUC-8 07080206) covers 703,060 acres across 7 counties including Linn, Jones, Johnson, Cedar, Scott, Muscatine, and Louisa, as shown in Figure 1-1. The HUC-8 watershed includes 33 smaller, HUC-12 scale subwatersheds (Figure 1-1). The West Branch Wapsinonoc Creek watershed (HUC-12 070802060702) (shaded red in Figure 1-1) was selected as a high priority subwatershed for more detailed analysis and planning. The prioritization analysis utilized a data driven approach based on political, economic, socio-cultural, and technical (PEST) inputs and considerations.

- Political input included the presence of organized, local support for watershed improvement initiatives
- Economic inputs included feasibility of funding acquisition from various sources
- Social-cultural inputs were based on stakeholder and public engagement feedback (landowner, producer, community, and resident interest or buy-in)
- Technical inputs include water quality impairments, other habitat and water quality considerations, and historical monitored pollutant concentrations, and watershed characteristics (erodible soils, land use, slope, and others)

The EPA's Recover Potential Screening Tool (RPST) provided a quantitative summary of the technical inputs related to existing ecology and stressors in each HUC-12 watershed and captured several social and political indicators. Other political and social considerations were based on focus group discussions, survey results, and discussions by a group of partner agency staff with expertise related to water and natural resources conservation, flooding, and funding opportunities (called the technical advisory committee, or TAC). The detailed results of the prioritization process for the entire HUC-8 watershed are provided in Appendix B. West Branch Wapsinonoc Creek was classified as a high priority because of its high stressor scores for water quality (specifically phosphorus and *E. coli*) and habitat and based on elevated stakeholder interest and support for improvement efforts in this subwatershed.

Figure 1-1. HUC-12 Subwatersheds



2. Watershed Conditions

Political Jurisdictions and Populations

The West Branch Wapsinonoc Creek watershed spans Johnson, Cedar, and Muscatine Counties and includes the City of West Branch. The total population of the watershed is 5,318 based on 2010 census data and EnviroAtlas – Dasymetric population by 12-digit HUC. The city of West Branch's Wastewater Treatment Plant (WWTP) and a mobile home park (West Branch Village) discharge treated wastewater into West Branch Wapsinonoc Creek.

Land Use and Land Cover

Agricultural production is the predominate land use of the West Branch Wapsinonoc Creek watershed, with 79% in row crop production (cropland) and 9% in pasture. Another 3% of the watershed is woodland/natural areas, and 9% is urban. The remaining 1% of the watershed is water/wetland or other land uses. Given that the majority of the Lower Cedar Watershed is devoted to agricultural uses, much of the focus on the watershed plan will be on engaging rural landowners and emphasizing that the burdens of flooding and water quality are not just urban issues.

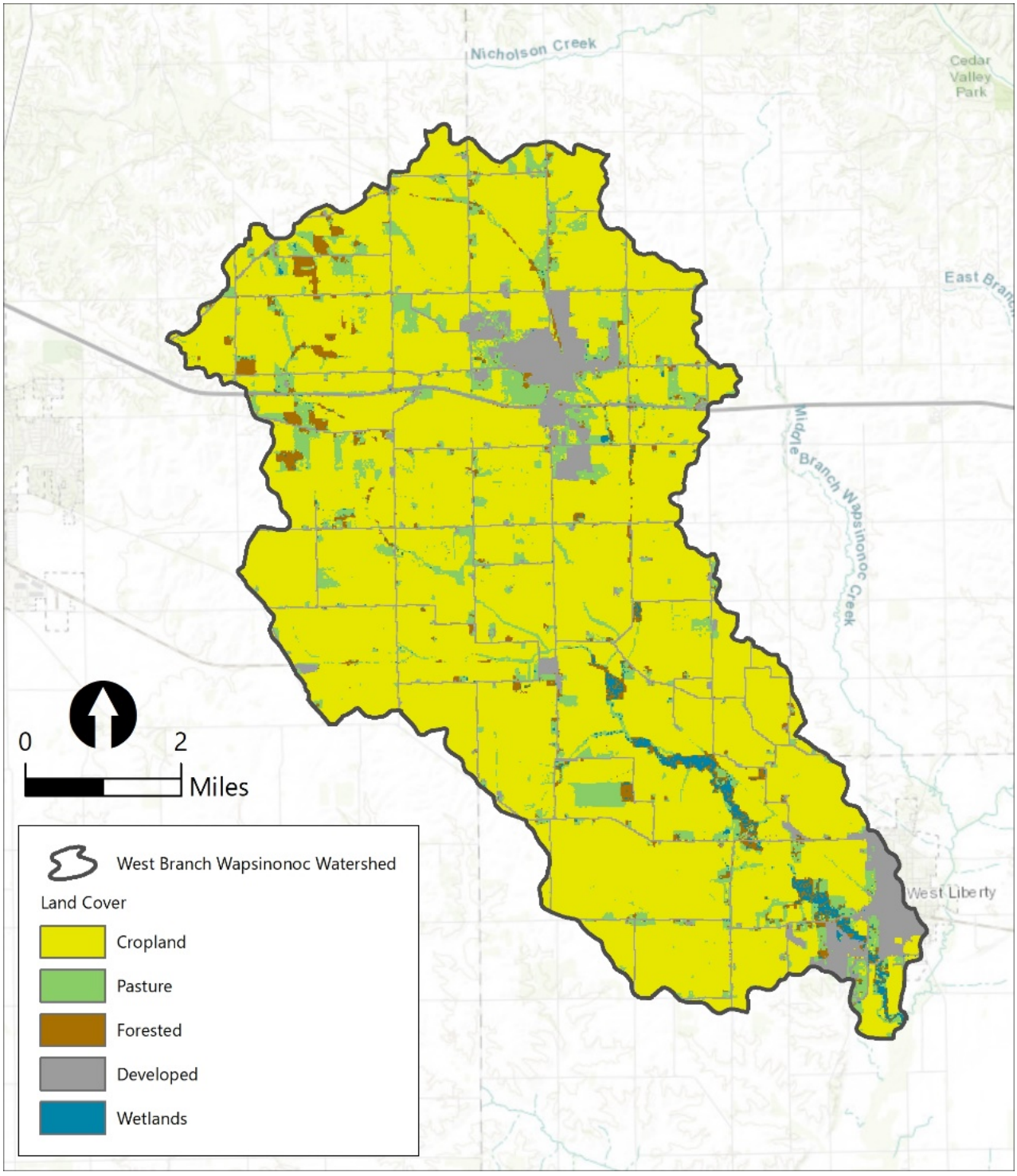
As shown in Table 2-1, the area in row crops has increased the past 20 years due to agricultural production trends and conversion of land that was once in pasture, timber, or other perennial cover. By engaging rural landowners throughout the planning process, the WMA hopes to increase their buy-in to the watershed project, to scale up adoption of critical agricultural conservation practices.

Table 2-1. Land Cover in the West Branch Wapsinonoc Watershed

Land Cover	Acres in 2001	% of Watershed	Acres in 2020	% of Watershed
Cropland	24,660	68%	28,356	79%
Pasture	9,815	27%	3,198	9%
Forested	1,606	4%	952	3%
Developed	N/A	N/A	3,192	9%
Water & Wetlands	N/A	N/A	384	1%

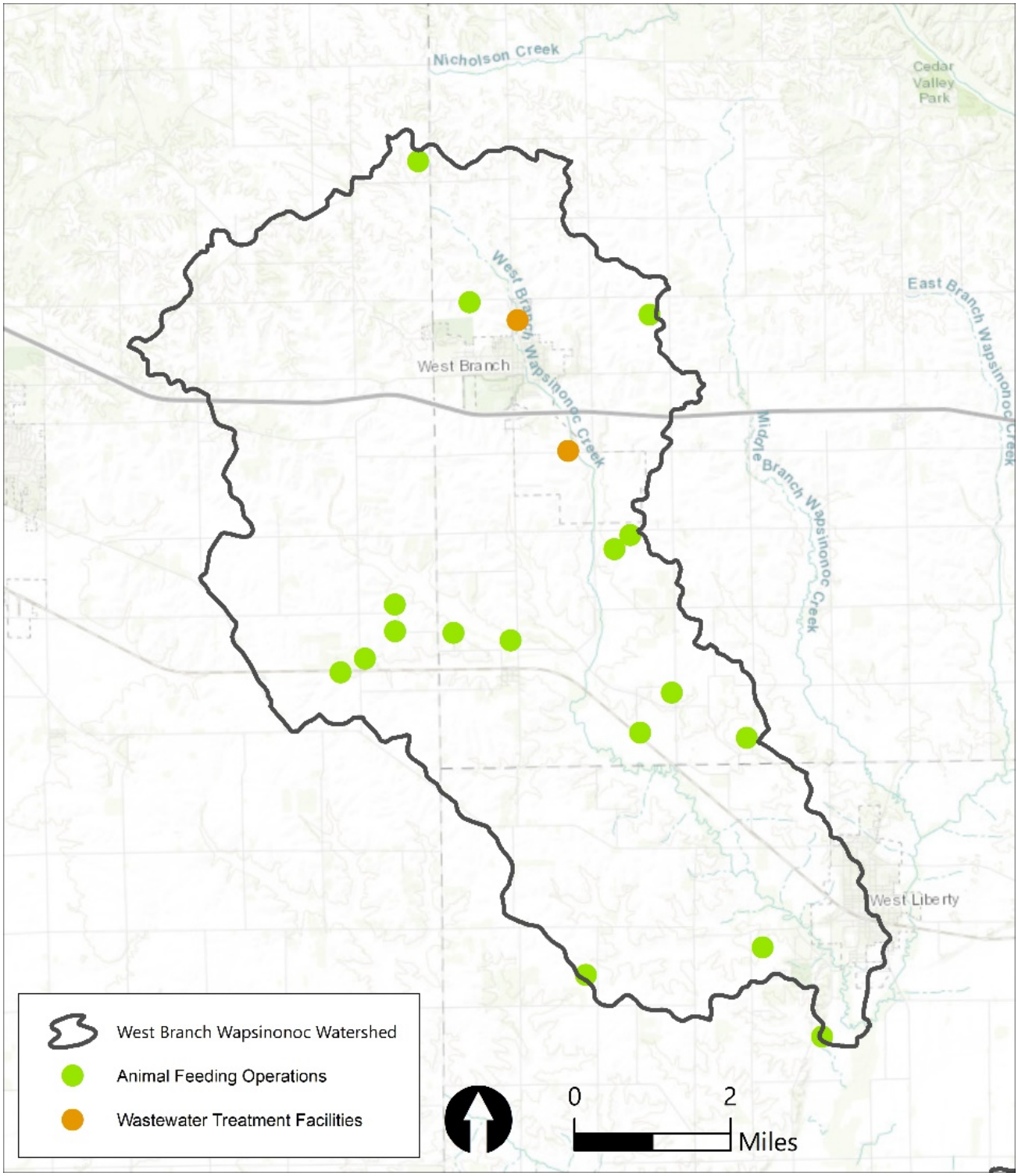
Source: Iowa Department of Natural Resources.
N/A = 2001 data that did not specify Developed and Water & Wetlands area.

Figure 2-1. Land Cover in the West Branch Wapsinonoc Watershed



Source: Iowa Department of Natural Resources

Figure 2-2. Permitted Livestock and Human Waste Facilities



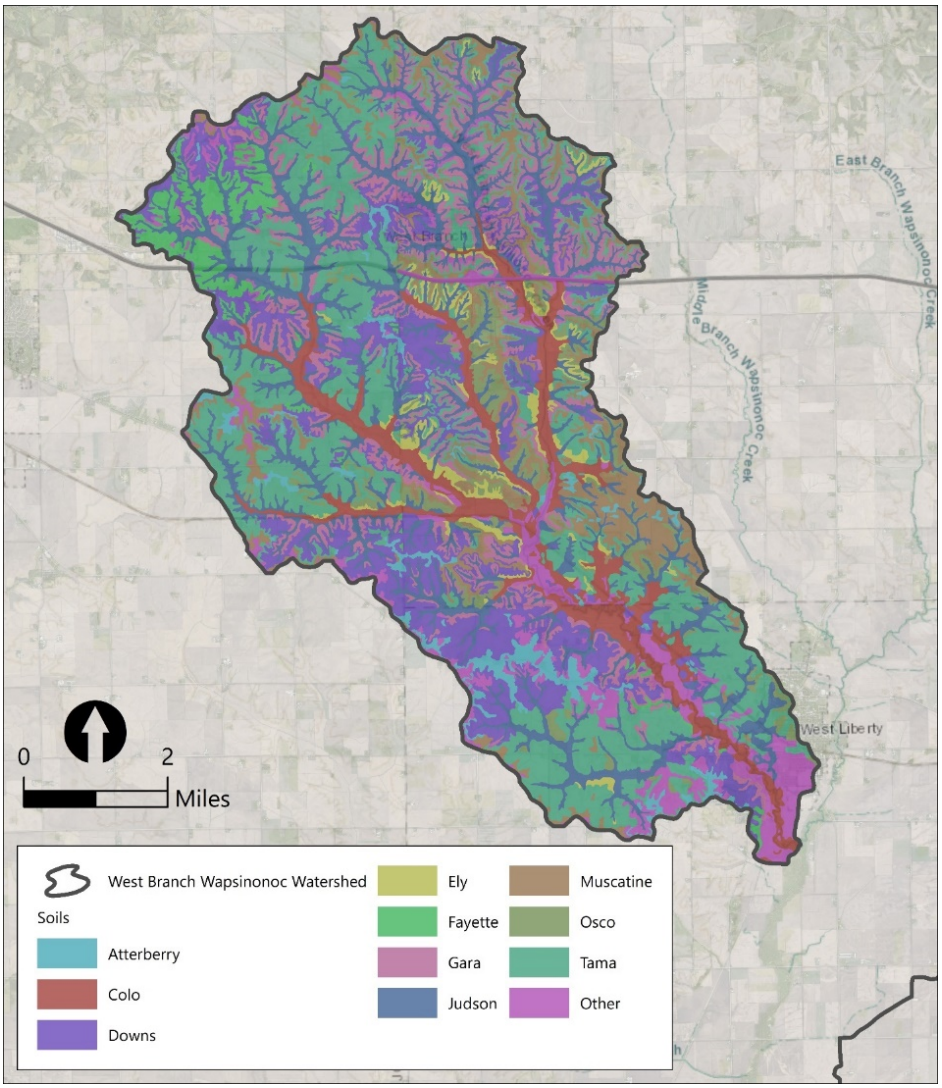
Source: Iowa Department of Natural Resources (DNR)

Soils and Topography

Soil generation is a complex process that incorporates many factors such as parent material, slope angle, vegetation, moisture content, and the degree to which it has been eroded. Soils are classified using these characteristics and are subdivided into association names, primarily from the sites where each one was initially identified. All the dominant soil associations within the Lower Cedar watershed occur in both the Iowan Surface and Southern Iowa Drift Plain regions. Collectively, the following five soil types comprise 72% of the watershed. All other individual soil types make up about 28% of the watershed area. A detailed soils summary table is provided in Appendix D.

- Tama (24%) – deep, well drained soils with less steep slopes
- Judson (16%) – deep, well drained soils with gentle slopes
- Downs (14%) – deep, well drained soils with potentially moderate slopes
- Gara (10%) – very deep, well drained soils with slopes of 5-40%
- Muscatine (8%) – deep, somewhat poorly drained soils nearly flat slopes

Figure 2-3. West Branch Wapsinonoc Watershed Soils



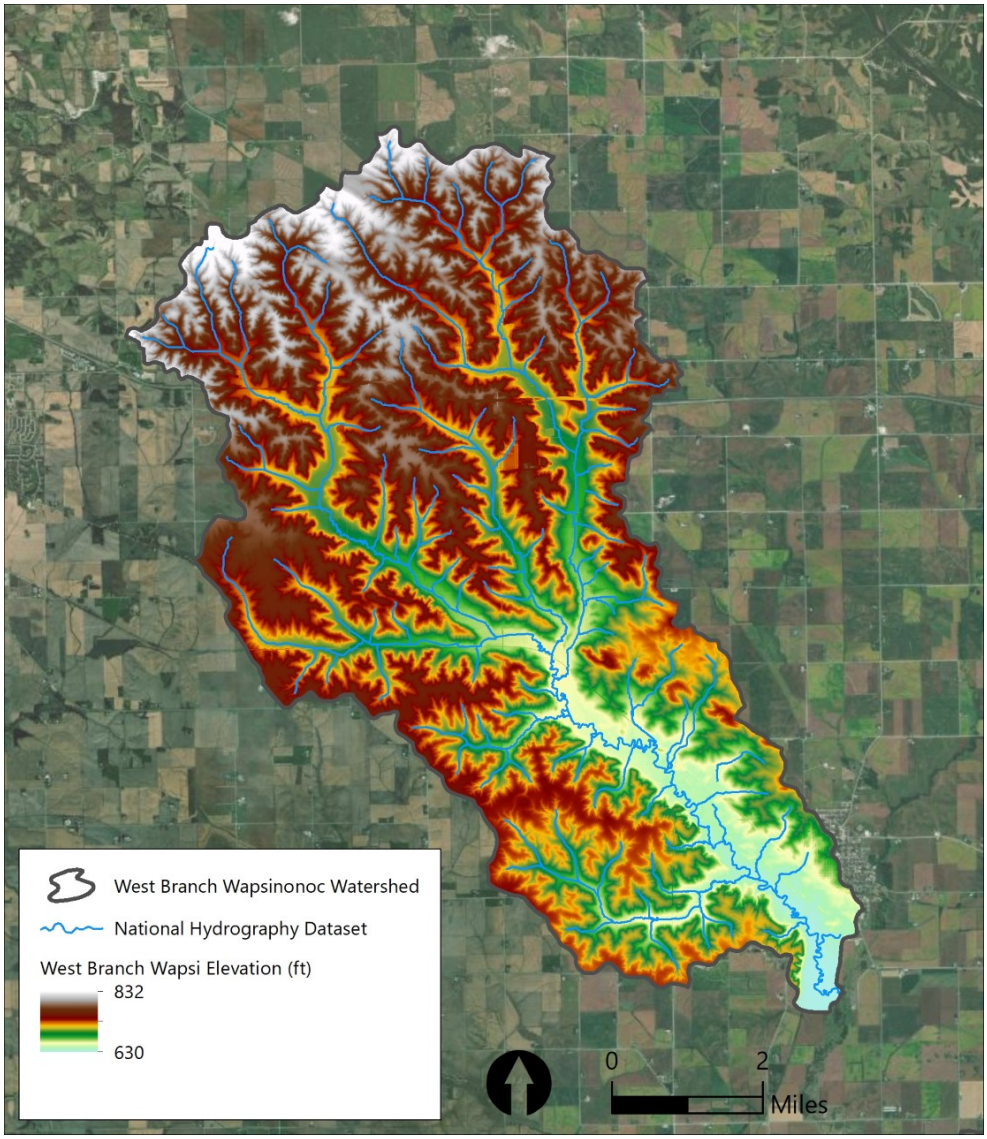
Source: Web Soil Survey, USDA NRCS

Topography, landscape surface features such as shape and slope, is an important consideration of watershed management because it influences patterns of erosion and drainage. It also determines what types of conservation practices are best suited to a particular landscape. In the West Branch Wapsinonoc watershed, 54% of the terrain is characterized as nearly level or gently sloping with a slope of less than 5%. Most of the watershed's agricultural activity occurs in these areas. Moderate slopes (5-9%) comprise 28% of the watershed, with steeper slopes (greater than 9%) making up about 18% of the watershed.

Table 2-2. Slopes in the West Branch Wapsinonoc Watershed

Percent Slope	Acres	Percent of Watershed
0-2%	11,948	33%
3-5%	7,466	21%
6-9%	10,025	28%
10-14%	6,043	17%
15-18%	532	1%
19-25%	3	0%
>25%	8	0%

Figure 2-4. West Branch Wapsinonoc Watershed Elevation

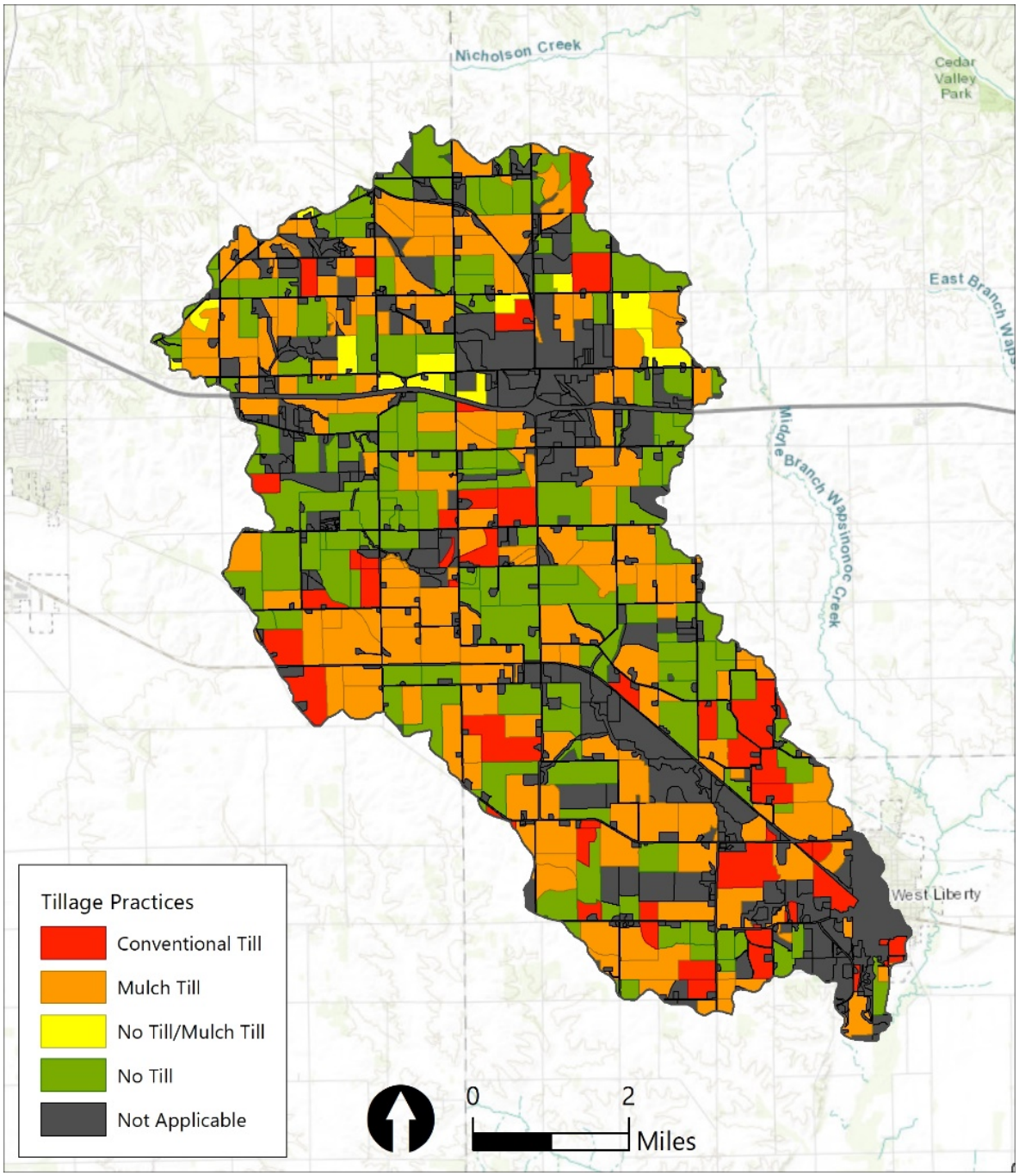


Source: Iowa DNR

Existing Tillage Practices

A windshield assessment was conducted in 2020 to evaluate tillage practices in the watershed. The study revealed agricultural producers are using conservation tillage techniques such as mulch till and no till, and that only 12% of cropland in the watershed is in conventional tillage as seen in Figure 2-5. Future implementation efforts should include outreach to producers still using conventional tillage methods to learn about the perceived challenges they face with conservation tillage and what kinds of incentives producers might be effective. It is likely that this relatively small area of production is contributing a large share of sediment and phosphorus losses to surface water.

Figure 2-5. Tillage Practices in the West Branch Wapsinonoc Creek Watershed



Streams and Other Waterbodies

The West Branch Wapsinonoc watershed includes 129 total miles of streams, including West Branch Wapsinonoc, Hoover Creek, and an unnamed tributary to West Branch Wapsinonoc (Table 2-3). Other waterbodies are limited to several isolated riparian wetlands and a few small ponds.

Table 2-3. Stream Lengths and Area in the West Branch Wapsinonoc Creek Watershed

Stream Name (Segment ID)	Segment ID	Stream Length (mi)	Watershed Area (acres)
West Branch Wapsinonoc Creek	484, 6264	20.0	36,026
Hoover Creek	6262	3.8	5,367
Unnamed Tributaries to West Branch Wapsinonoc	1863, 1864, 1865	6.7	14,370

Source: USGS National Hydrography Dataset (NHD)

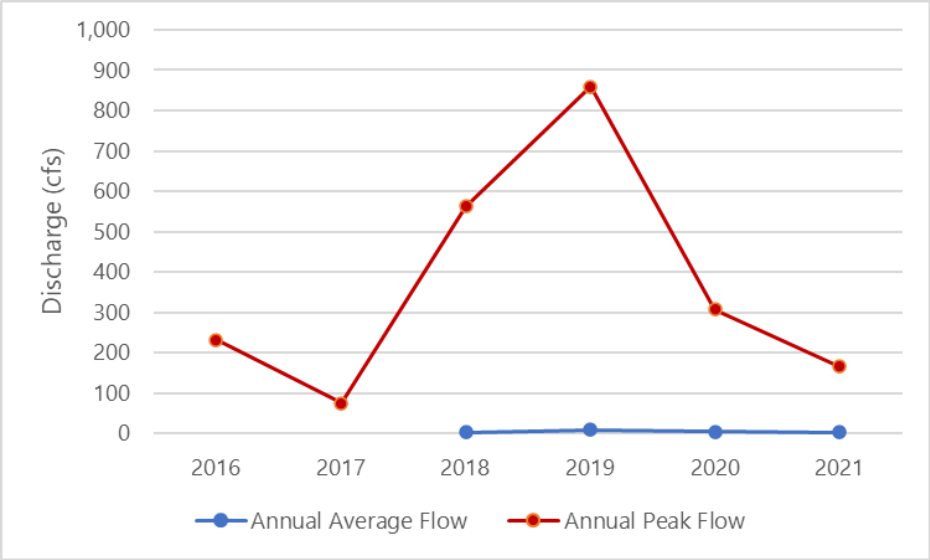
Ecological Considerations

As reported in Chapter 2 of the basin-wide plan, the Lower Cedar is home to a variety of unique and valuable ecological communities and many Species of Greatest Conservation Need identified in the Iowa Wildlife Action Plan. As a major tributary to the Lower Cedar; however, it should be assumed that the West Branch Wapsinonoc has critical habitat and ecological considerations worth identifying and protecting.

Climate

Climate conditions in the West Branch Wapsinonoc watershed are consistent with those found across the Lower Cedar River Watershed, as described in Chapter 2 of the basin-wide plan.

Figure 2-6. West Branch Wapsinonoc Annual Discharge



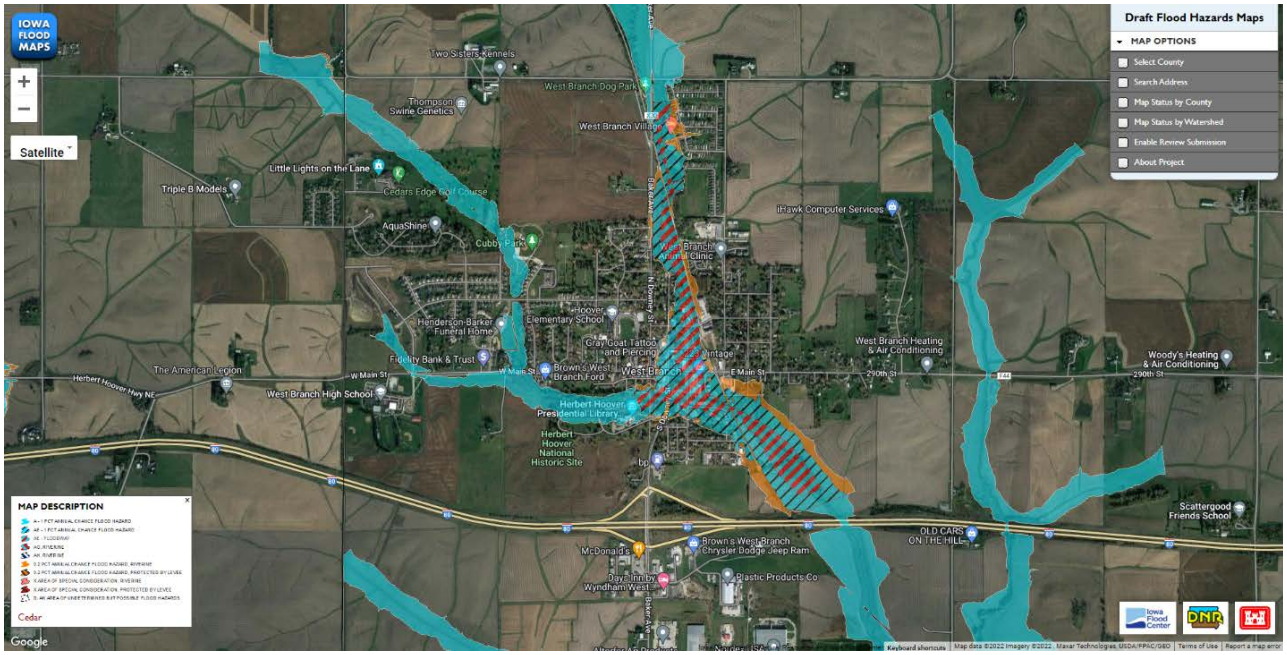
Source: USGS 0546494170 WB Wapsinonoc Cr at College St at West Branch, IA

Flooding

The stream exhibits flashy behavior and has experienced overbank flooding multiple times in the past 10 years. The United States Geological Survey (USGS) performed a hydrologic and hydraulic study (USGS, 2018) that evaluated the potential for damage reductions resulting from detention storage and channel conveyance improvements. The City of West Branch has invested in both detention and conveyance projects, but flood risk remains high in this community.

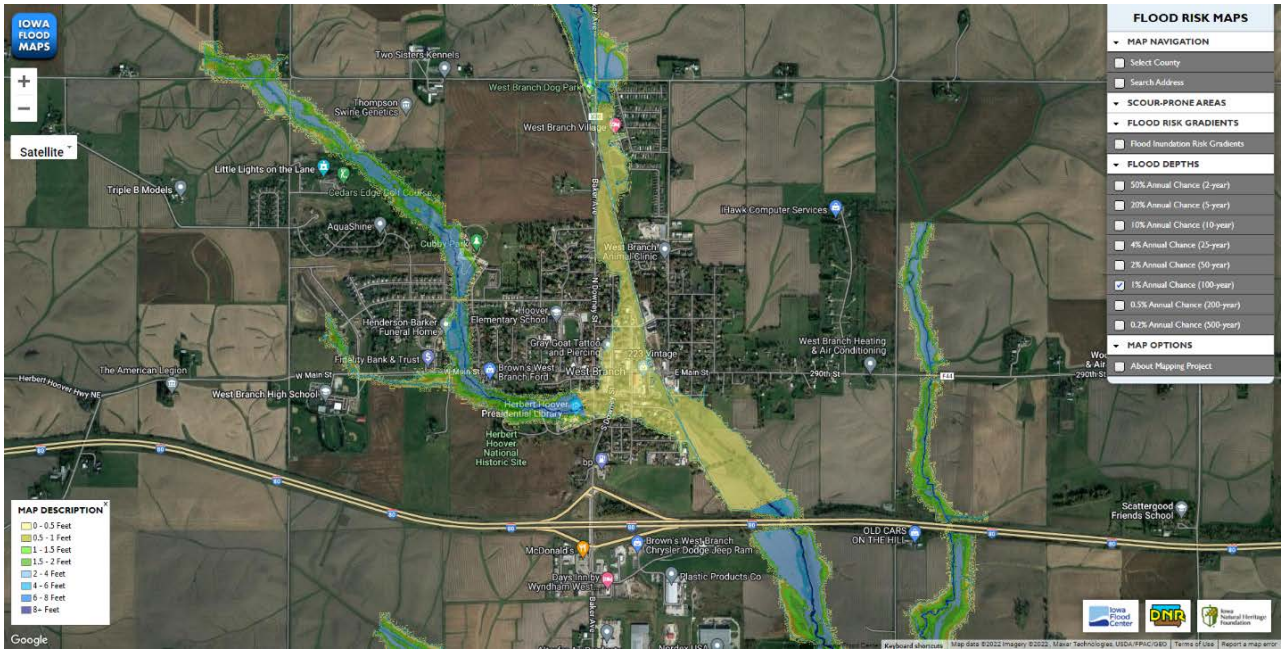
Flooding has caused significant damage along the West Branch of the Wapsinonoc and its primary tributary, Hoover Creek. The maps below show the FEMA 100-year floodplain boundary (Figure 2-7) and the Iowa Flood Center's (IFC) approximation of the 100-year flood depth over the same area (Figure 2-8).

Figure 2-7. Flood Hazard Map for the City of West Branch



Source: https://ifis.iowafloodcenter.org/ifis/newmaps/hazard/

Figure 2-8. Flood Risk Map for the City of West Branch



Source: https://ifis.iowafloodcenter.org/ifis/newmaps/risk/map/

3. Watershed and Water Quality Conditions

Use Designations and Water Quality Impairments

According to application of Iowa's water quality standards, streams in the West Branch Wapsinonoc should support primary contact recreation (Class A1) and warm water aquatic life. Aquatic life use is either Type 1 (Class BWW1) or Type 2 (Class BWW2), depending on stream reach. The upper reach of West Branch Wapsinonoc (Segment 6264), Hoover Creek (Segment 6262), and an unnamed tributary (Segments 1863, 1864, and 1865) to West Branch Wapsinonoc should support BWW1. The lower reach of West Branch Wapsinonoc Creek (Segment 484) should support BWW2. These use designations have specific water quality standards associated with them. Water quality criteria most relevant to the current conditions of West Branch Wapsinonoc are reported Table 3-1.

Table 3-1. Water Quality Criteria for the West Branch Wapsinonoc Creek Watershed

Designated Use & Impairment Status	Class	Description	Relevant Criteria
Warm water aquatic life (Type 1) Segments 6262 and 6264 are fully supporting. Segments 1863, 1864, and 1865 are not assessed	BWW1	Waters in which temperature, flow, and other habitat characteristics are suitable to maintain warmwater game fish populations along with a resident aquatic community that includes a variety of native nongame fish and invertebrate species.	Biological sampling data: • Benthic macroinvertebrate index of biological integrity • Fish index of biological integrity
Warm water aquatic life (Type 2) Segment 484 is not assessed	BWW2	Waters in which flow or other physical characteristics are capable of supporting a resident aquatic community that includes a variety of native nongame fish and invertebrate species. The flow and other physical characteristics limit the maintenance of warm water game fish populations. These waters generally consist of small perennially flowing streams	Biological sampling data: • Benthic macroinvertebrate index of biological integrity • Fish index of biological integrity
Primary contact recreation Segments 6262 and 6264 are impaired (not supporting). *Segments 484, 1863, 1864, and 1865 are not assessed*	Class A1	Waters in which recreational or other uses may result in prolonged and direct contact with the water, involving considerable risk of ingesting water in quantities sufficient to pose a health hazard. Such activities would include, but not be limited to, swimming, diving, water skiing, and water contact recreational canoeing.	Pollutant of Concern: E.coli (March 15 through November 15) • Geometric mean ≤ 126 cfu/100mL • Single sample max ≤ 235 cfu/100 mL

Source: Iowa ADBNet https://programs.iowadnr.gov/adbnet/

West Branch Wapsinonoc Creek (Segment 484) is classified as an Overall IR Category 3, which means insufficient data exists to determine whether any designated uses are met. The assessment was conducted in accordance with Iowa's 2022 IR methodology. The West Branch Wapsinonoc Creek has been classified as an IR Category 3 for every assessment since 2006. In 2004, the creek was assessed as Category 4d, meaning water is impaired due to a pollutant-caused fish kill and enforcement action was taken to address the source, therefore a TMDL is not needed. Prior to 2004, West Branch Wapsinonoc was not evaluated.

Historical Watershed Efforts

The City of West Branch has planned improvements to their WWTP to enhance reliability, increase capacity, and to replace obsolete systems to operate the system for the next 20 years. The projected completion date is June 2023. Improvements include construction of a new aerated lagoon cell, earthen berm/pit area for SAGR system, an aeration system, filling with gravel, and topping with mulch. A new lagoon aeration system with blowers, a masonry building, control building, underground piping, granular resurfacing, and UV disinfection will also be included as well as all connections and appurtenances. Additionally, the City is utilizing the State Revolving Fund (SRF) Sponsored Project Program to fund nonpoint source pollution improvements.

Pollutants of Concern

The primary pollutants of concern in the West Branch Wapsinonoc watershed include phosphorus, sediment, nitrogen, and *E.coli*. A description of each pollutant of concern is laid out in Chapter 3 of the basin-wide plan. As noted previously, there are two E. coli impairments in the watershed.

Water Quality Results

Water quality data from 2005-2019 were averaged across multiple sites within the HUC-12 were averaged and included with data collected in 2020 in Table 3-2. The 2005-2019 data includes results from multiple monitoring efforts, including county-wide snapshots, and ambient stream monitoring by Iowa DNR.

Table 3-2. Summary of 2020 Water Quality Monitoring in West Branch Wapsinonoc

Date	E. Coli (cfu/100 mL)	Turbidity (NTU)	TP (mg/L)	TN (mg/L)
07/07/2020	1,400	16	0.12	7.4
08/27/2020	410	5.9	0.4	<0.10
09/09/2020	1,900	86	0.28	1
11/25/2020	5,800	760	0.18	1.1
2020 Average (GeoMean for E.coli)	1,585.9	217.0	0.25	2.4
[1]Historical HUC-12 Averages	1,567.4	NA	0.21	7.0
[1]Historical averages from 2005-2019 monitoring sites across the West Branch Wapsinonoc HUC-12				

Source: Various DNR and partner agency monitoring efforts

4. Pollutant Source Assessment

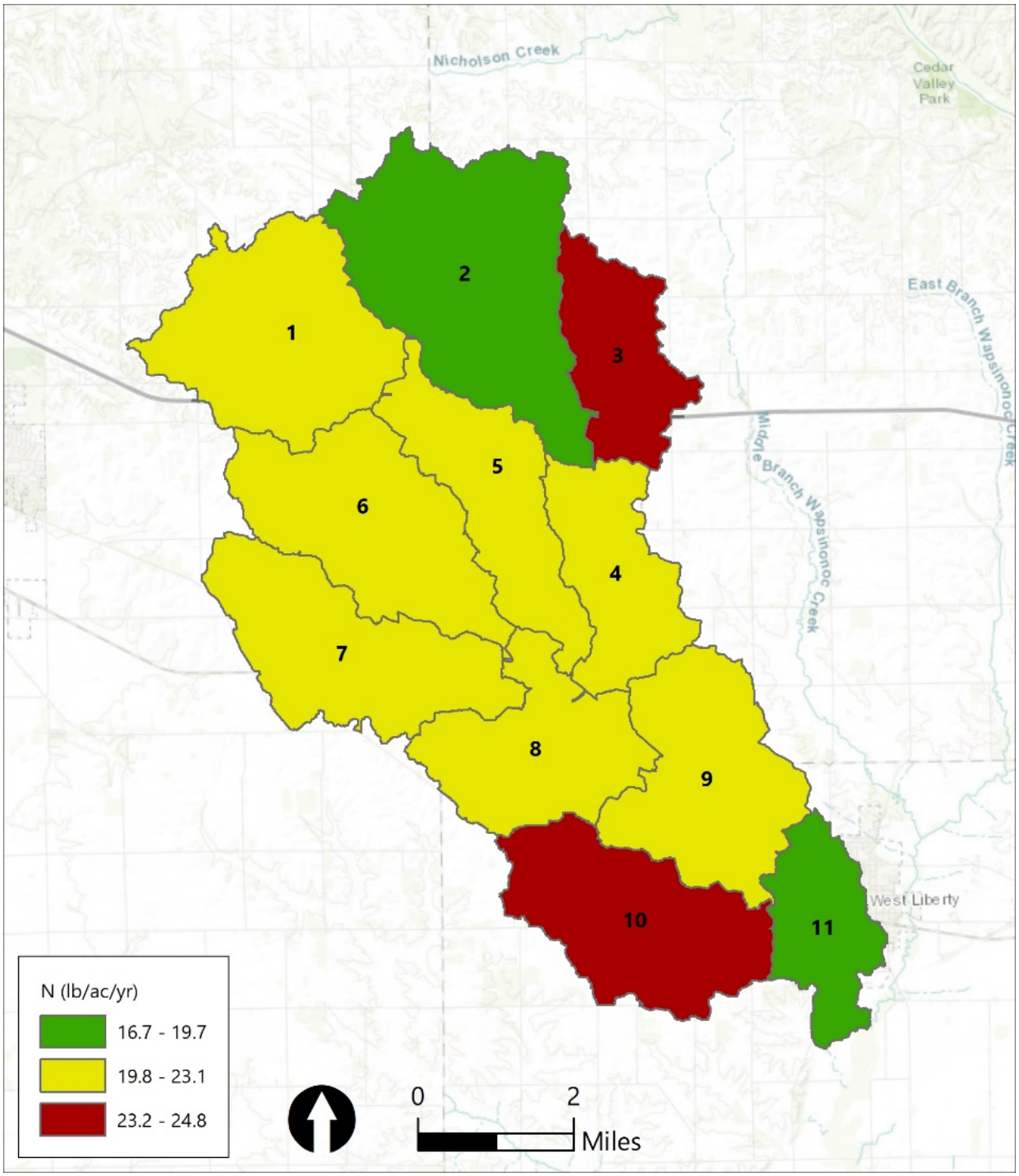
The pollutant source and loading model of the West Branch Wapsinonoc Creek priority HUC-12 watershed utilized a modified version of the Spreadsheet Tool for Estimating Pollutant Load (STEPL) (Tetra Tech, 2011). The model predicts annual average runoff and groundwater/baseflow volumes using a simple annual rainfall runoff equation, soil erosion and transport using the Universal Soil Loss Equation (USLE) approach, and pollutant loads using soil, slope, and land used based pollutant concentrations from a combination of literature values and water quality monitoring results.

Model Setup

- Parameterization of inputs for pollutant loading estimates included land-use (CDL, 2020), livestock and feedlot numbers (IDNR), septic systems (from STEPL Model Input Data Server), soil data (e.g., hydrologic soil group), topographic data, and other watershed characteristics. Initial inputs were obtained from a variety of sources, including the STEPL data server (Tetra Tech, 2013), locally available data, applicable literature/research data, and best professional judgement.
- Prediction of stream bank erosion was estimated for all second order and larger streams and assumed moderate recession rates (0.13 ft/yr.) based using a desktop assessment, soils information, and NRCS streambank recession rates.
- Gully erosion was estimated using 1st order stream length and best professional judgement and rules-of-thumb for gully size and progression rate.
- A key modification to the STEPL model is that areas of pastureland cover within 1,000 linear feet of either side of the stream channel were assumed to have cattle with direct access to the streams. This is important for simulation of the impacts of direct deposition of manure on bacteria concentrations. This assumption should be field verified, but it provides information helpful for modeling as well as targeting areas for livestock exclusion BMPs.

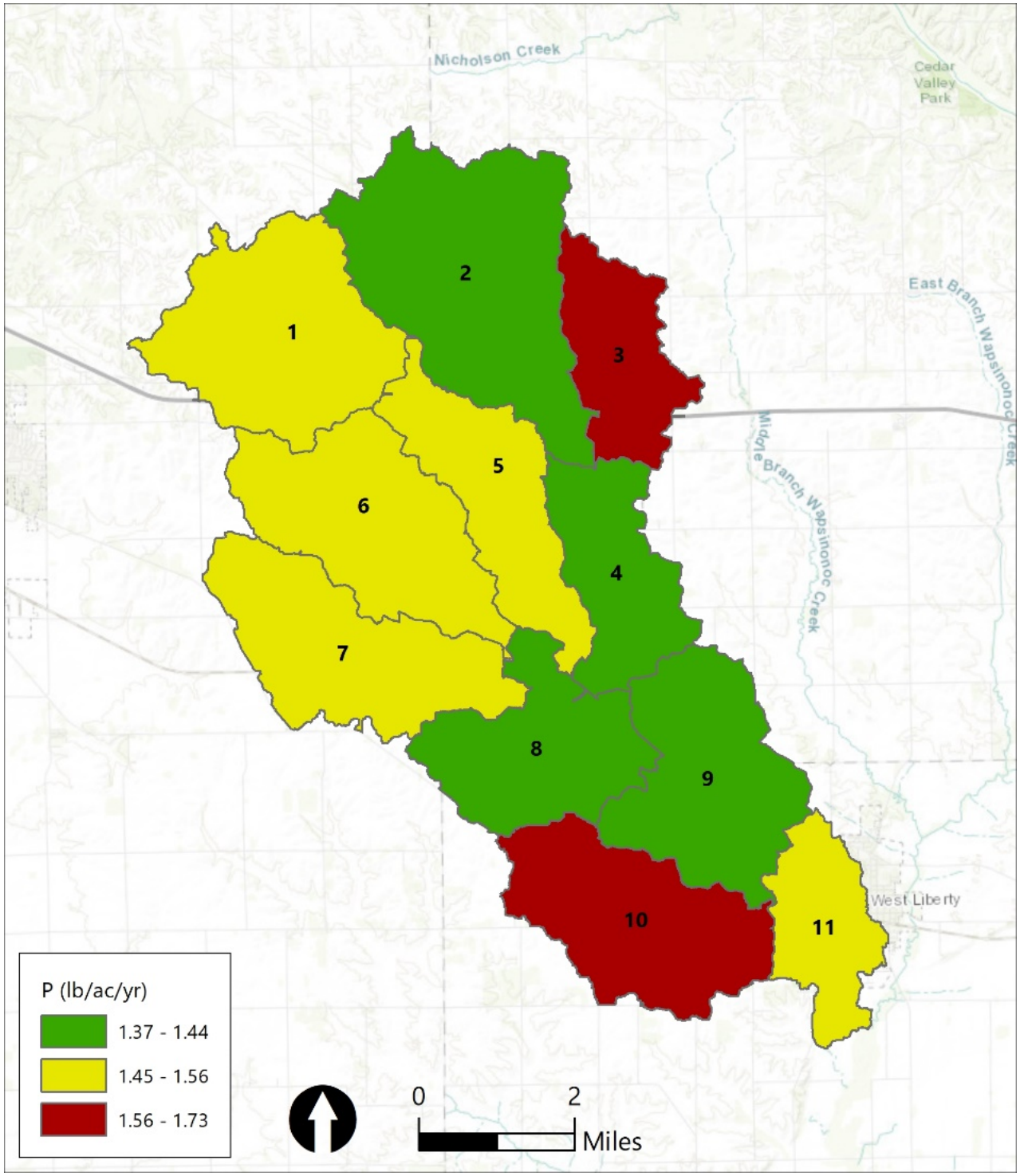
Predicted pollutant loads are summarized for the four main pollutants of concern: sediment, phosphorus, nitrogen, and bacteria (*E. coli*). The STEPL spreadsheet reports loads in total mass and mass per acre and summarizes loads by both subwatershed and pollutant source.

Figure 4-1. STEPL Nitrate Loads



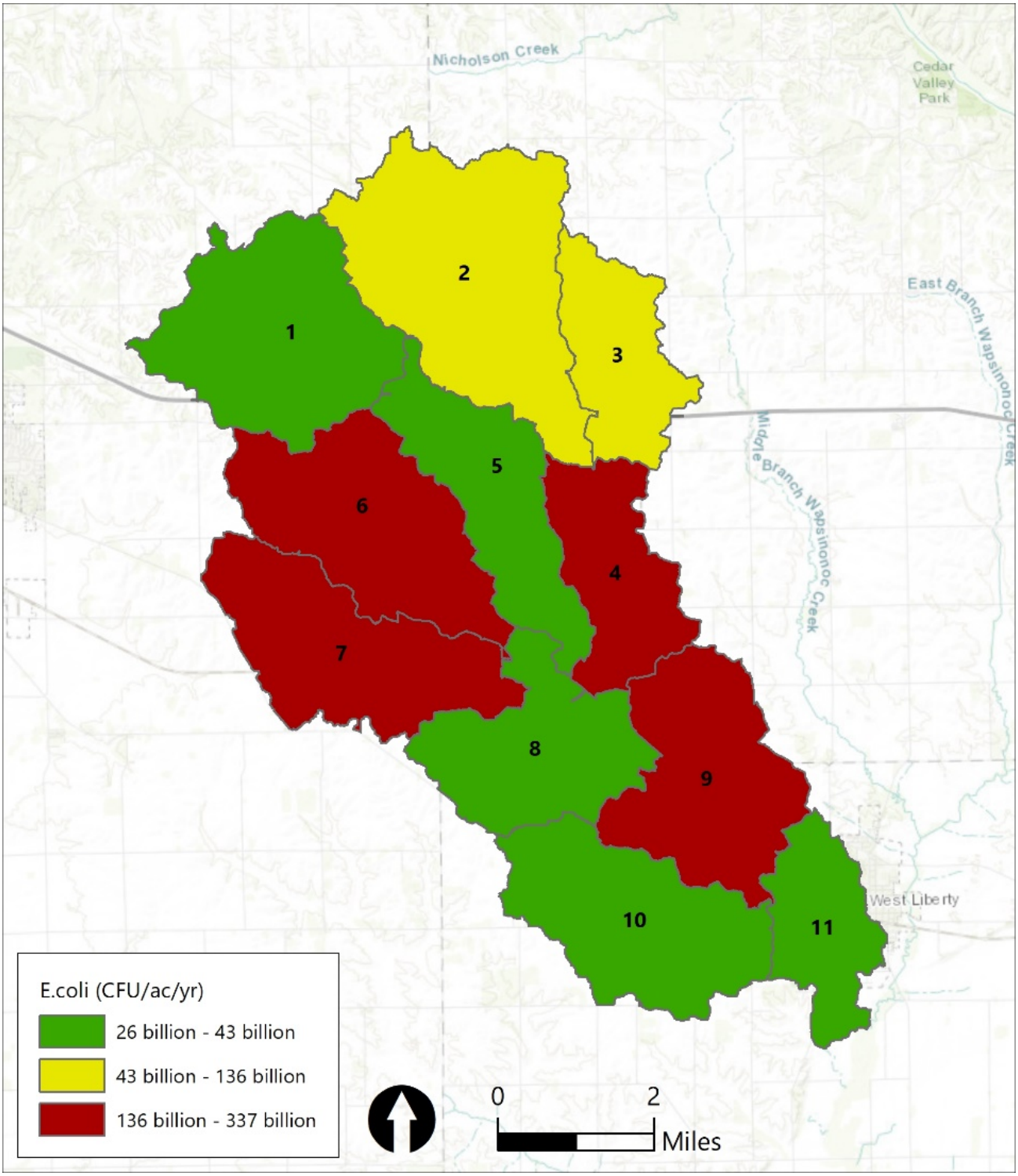
Source: West Branch Wapsinonoc Creek HUC-12 STEPL model

Figure 4-2. STEPL Phosphorus Loads



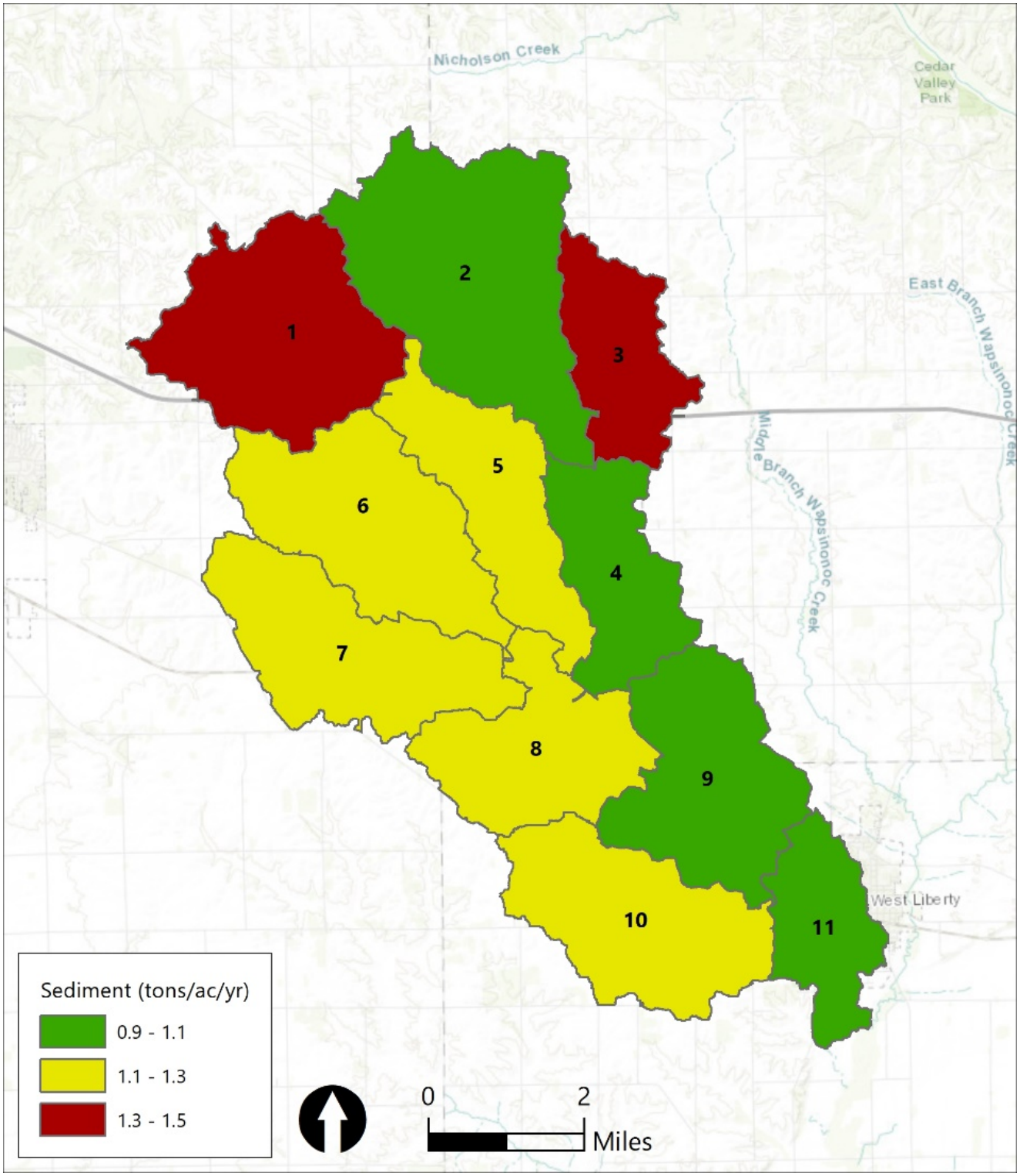
Source: West Branch Wapsinonoc Creek HUC-12 STEPL model

Figure 4-3. STEPL *E. coli* Loads



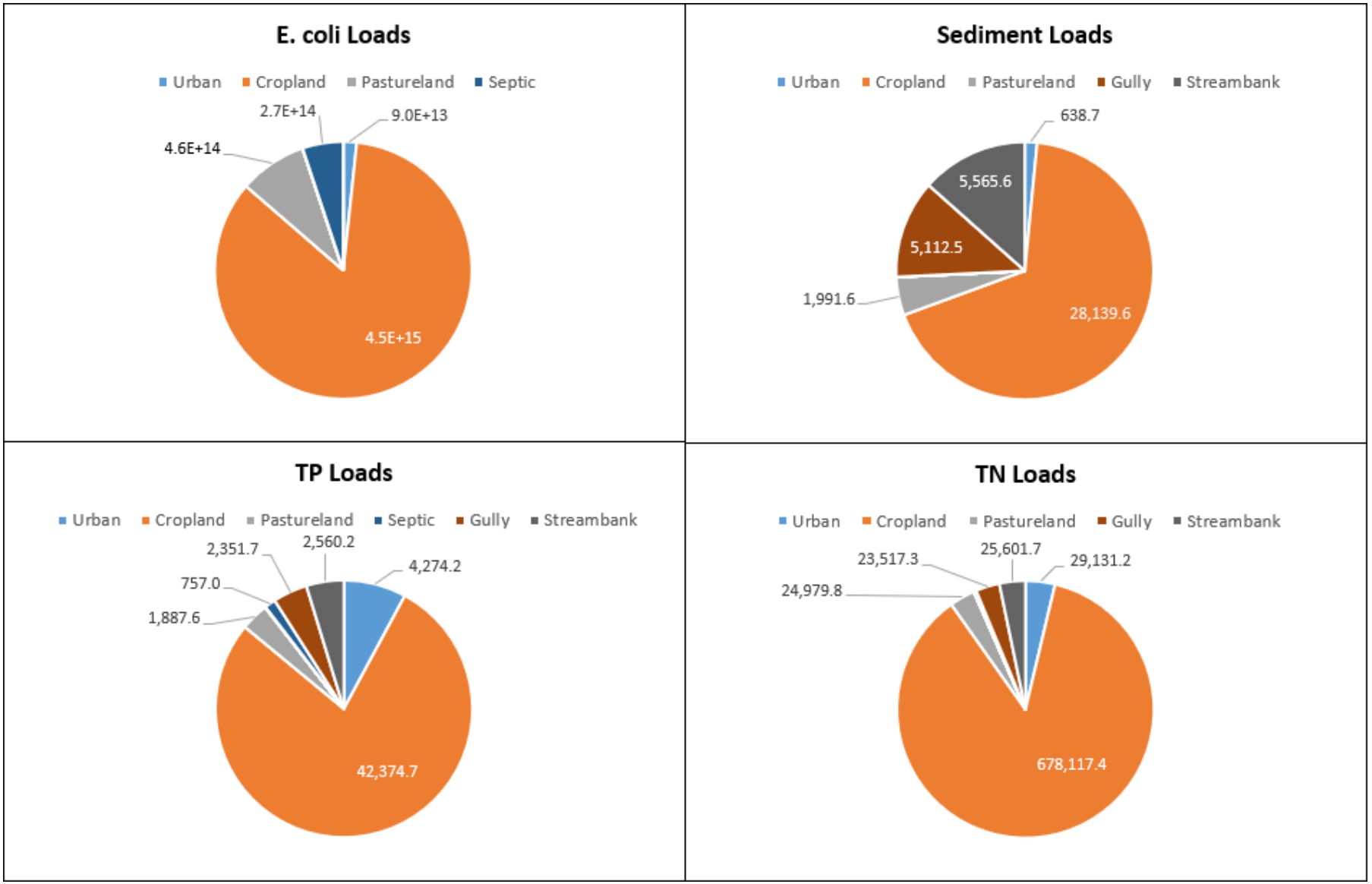
Source: West Branch Wapsinonoc Creek HUC-12 STEPL model

Figure 4-4. STEPL Sediment Loads



Source: West Branch Wapsinonoc Creek HUC-12 STEPL model

Figure 4-5. STEPL Total Loads by Land Use



Source: West Branch Wapsinonoc Creek HUC-12 STEPL model

Table 4-1. STEPL Total Loads by Land Use

Sources	N (lb/yr)	N %	P (lb/yr)	P %	E. coli (cfu/yr)	E.coli %	Sediment (ton/yr)	Sediment %
Urban	29,131	4%	4,274	8%	9.0E+13	2%	639	2%
Cropland	678,117	87%	42,375	78%	4.5E+15	87%	28,140	68%
Pastureland*	24,980	3%	1,888	3%	4.6E+14	9%	1,992	5%
Forest	254	0%	45	0%	1.1E+12	0%	8	0%
Feedlots	0	0%	0	0%	0.0E+00	0%	0	0%
User Defined	0	0%	0	0%	0.0E+00	0%	0	0%
Septic	1,441	0%	564	1%	1.4E+14	3%	0	0%
Gully	23,517	3%	2,352	4%	4.6E+11	0%	5,112	12%
Streambank	25,602	3%	2,560	5%	7.6E+11	0%	5,566	13%
Total	**783,042**		**54,058**		**5.2E+15**		**41,456**	

Source: West Branch Wapsinonoc Creek HUC-12 STEPL model

Existing BMPs

Existing BMPs were not explicitly included in the pollutant loading model for West Branch Wapsinonoc Creek, but practices included in the statewide Iowa BMP Mapping Project or watershed-specific Agricultural Conservation Planning Framework (ACPF) analysis were mapped and summarized in Table 4-2. Practices include ponds, dams, terraces, contour buffer strips, strip cropping, grassed waterways, and water and sediment control basins (WASCOBs). Although not simulated in modeling, existing BMPs were incorporated in the implementation model to avoid predicting reductions that aren't available on the ground.

Table 4-2. West Branch Wapsinonoc Existing BMPs

BMP Type	Number of BMPs
Pond or Dam	32
Terraces	101
WASCOBs*	152
Contour Buffer Strips	59
Grassed Waterways	2,472
Strip Cropping	1
*Water and Sediment Control Basins	

Source: Iowa BMP Mapping Project, https://www.gis.iastate.edu/BMP

West Branch Wapsinonoc ACPF Assessment

The Agricultural Conservation Planning Framework (ACPF), developed by USDA-Agricultural Research Service, was applied to the West Branch Wapsinonoc Creek HUC-12 watershed. ACPF identifies potential locations and the quantity of BMPs suitable for specific areas of the landscape in an ArcGIS platform. ACPF output was used to quantify potential pollutant reductions in this planning effort. ACPF can also be used by the WMA for landowner/ operation information and education, and for stakeholder engagement in small or large group settings, both of which facilitate higher rates of conservation and BMP adoption.

Table 4-3. West Branch Wapsinonoc Creek Watershed ACPF Summary

In Field ACPF BMPs	Number Generated	Total Area Treated (acres)
Contour buffer strips	2,497	11,158
Grassed Waterway	1,813	12,741
Drainage water management	22	789
Edge of Field ACPF BMPs	**Number Generated**	**Total Area Treated (acres)**
Bioreactors	75	4,110
Nutrient reduction wetlands	22	7,875
WASCOBs	486	5,648
Farm Pond	2	147
Riparian Zone ACPF BMPs	**Number Generated**	**Total Area Treated (acres)**
Saturated buffers	315	7,204
Streambank stabilization	405	2,038
Critical Zone	9	2,249
Deep rooted vegetation	104	655
Multi Species Buffer	35	2,466
Stiff Stemmed Grasses	149	11,339

Source: West Branch Wapsinonoc Creek ACPF Output

5. Lower Cedar Social Engagement

FYRA and ECICOG established two websites as outreach tools to use during the planning process to engage the watershed community and stakeholders.

Lower Cedar Watershed Management Authority website https://lowercedar.weebly.com

Social Pinpoint project website https://fyra.mysocialpinpoint.com/lower-cedar-wma-plan which houses multiple surveys and an interactive project map that allows for community member engagement and input

Outreach Methods & Stakeholder Events

A series of workshops were held throughout 2021, resulting in the identification of high-priority resource concerns and actions for improving the watershed. Workshop participation was strong, averaging 25 – 30 local residents, public officials/staff, non-profit organizations, and academic institution staff interested in watershed improvement projects. There is more detail about outreach efforts and the public input gathered in Chapter 5 of the basin-wide plan.

- ECICOG hosted three virtual focus groups with 12 agricultural producers to gauge the level of concern for watershed issues and how they might fit into the solutions.
- ECICOG partnered with the Indian Creek Soil Health Partnership to host a Women Caring for the Land virtual workshop in March and April 2021 with 22 participants.
- The Indian Creek Soil Health Partnership hosted a Field Day in April 2021 to promote perennial cover and saturated buffers. 50 attended and toured a saturated buffer on Curt Zingula's farm.
- The Lower Cedar WMA hosted Community Source Water virtual workshop to discuss drinking water concerns and possible solutions and funding sources with 13 participants.
- The Lower Cedar WMA hosted a virtual workshop for 14 Emergency Management Administrators in the watershed to connect the watershed plan to Hazard Mitigation Plans.
- Direct inquiries to cities, floodplain managers, and county conservation boards about current and future projects to improve water quality and/or flood mitigation.

6. Goals and Objectives

The overall goal of the West Branch Wapsinonoc Creek Watershed Plan is to inform the LCWMA and its partners with useful and actional information related to identifying, prioritizing, and implementing solutions to water quality, flooding, and other water and natural resources concerns.

Water Quality Goal

The overall water quality goal is to protect and improve surface and ground water in West Branch Wapsinonoc Creek, with the following specific objectives:

1. Follow Iowa's Nutrient Reduction Strategy (NRS) guidance to implement conservation practices that reduce total N and P load by 45%
2. Reduce nonpoint source loads of nitrogen by 41% and phosphorus by 29%, consistent with NRS targets.
3. Encourage & implement erosion reduction and soil health practices that reduce sediment transported to surface water by 50%.
4. Encourage & implement Stormwater management practices that will infiltrate runoff up to a 2.5-inch rain event (the channel protection volume) as recommended in the Iowa Stormwater Management Manual.
5. Reduce E. coli bacteria in surface water by the maximum extent practical, working towards a long-term goal of compliance with Iowa water quality standards (geomean concentrations not to exceed 126 cfu/100mL).

Table 6-1. West Branch Wapsinonoc Creek Watershed Water Quality Goals

Parameter	Reduction Goal (%)	Actual Reduction (%)
Phosphorus	45%	49%
Sediment	50%	55%
Nitrogen	45%	39%
E.coli	98%	64%

Secondary Goals

The other goals in the West Branch Wapsinonoc Watershed include flood reduction, both locally and downstream, as well as improvement of habitat and recreational opportunities. Many water quality improvement practices offer ancillary benefits, and the LCWMA plan and future implementation seek to maximize opportunities for multi-benefit projects.

Information & Education Goal

A proactive Information and Education (I&E) plan is an important part of planning and implementing water quality, flooding, and habitat improvements at the watershed scale. The I&E goal for the West Branch Wapsinonoc Watershed is to implement the relevant components of the following outreach workplan from the basin-wide plan.

Education & Outreach Workplan

These education strategies were identified as priorities in the public engagement for the WMP and will guide the efforts of the watershed coordinator and the LCWMA Board throughout plan implementation.

- Educate agricultural community about practices to reduce erosion at workshops, tours, field days and other peer to peer events for farmers and other stakeholders
- Create a program to recognize and share BMPs on the LCWMA Facebook page and other social media to expand the "neighborhoods" of conservation
- Organize opportunities to take urban residents to rural areas and rural residents to urban areas to observe issues caused by flooding and the solutions implemented to date
- Educate various audiences about infiltration practices to improve water quality through:
    - Workshops (with CEUs) for developers, builders, engineers, and inspectors about infiltration practices and green infrastructure
    - Green infrastructure workshops and urban BMP tours for homeowners, policy makers, or other interested stakeholders
- Build awareness of flood risk and intensifying rain events due to climate change by hosting an annual "flood awareness" meeting and promote ways residents can reduce stormwater run-off
- Communicate with residents about the relationship between stream health and human health through community engagement events about water quality (outdoor classrooms, watershed tours, paddling outings, creek clean-ups)
- Promote the Nutrient Reduction Strategy and its recommended practices through workshops, tours, field days or other peer to peer events for farmers and other stakeholders
- Educate the agricultural community about flood risks and how they can be part of the solution by engaging the agricultural community through small events with ag groups and youth groups such as FFA and 4-H clubs
- Partner with FFA teachers to incorporate watershed & water quality issues into their classes each year
- Communicate with households utilizing septic systems about the impact of human waste management on stream health through workshops

7. Implementation – Action Plan

Implementation Strategies and Practices

A comprehensive menu of potential best management strategies to improve water quality, reduce flood damage, enhance wildlife habitat, and provide recreational opportunities is provided in Chapter 6 of the basin-wide plan. Descriptions, applicability, and pollutant removal of specific BMPs are also provided in Chapter 6. The approach and combination of BMPs suitable for each HUC-12 in the Lower Cedar basin will vary according to soils, topography, land use, and preference and interest of watershed stakeholders including agricultural landowners and operators, residents, municipalities, and others that live, work, and recreate in each HUC-12.

Successful implementation will require efforts driven by specific goals and milestones but must also be dynamic to reflect changes in real world conditions, including changes in policy that affect agricultural practices, regulations, funding, water quality, stakeholder concerns, and many others. The three-phase implementation plan for the West Branch Wapsinonoc watershed was developed to:

- Identify short-term actions to assist a watershed coordinator in Information & Education to establish momentum
- Allow time for increased outreach to promote BMP adoption over time
- Provide the watershed coordinator with time to gather additional information and align funding
- Secure engineering and permitting services required for long-term BMP adoption and construction of proposed structural practices

Information and Education Program Elements

The watershed level public awareness and education program should include both public education & outreach and public participation & involvement activities defined as:

Education & outreach activities are designed to distribute education materials and messages and perform outreach to inform citizens and target audiences.

Public participation & involvement activities provide opportunities for citizens to participate in programs and become active in implementing watershed protection programs.

Table 7-1. Example Outreach Activities

Education / Outreach Programs	Public Involvement / Participation Programs
Bill inserts or newsletters	Water quality monitoring program
Brochures at local government facilities	Watershed festival
Website with watershed education information	River/Creek clean-up events
Speakers' bureau presentations	Storm drain stenciling events
Event displays and/or kiosks	Watershed citizen advisory group
Press releases	Rainscaping workshops
School classroom education	Agriculture stakeholder group

Milestones and Outcomes

Plan milestones, costs, and outcomes are presented in Tables 7-2 and 7-3 for the entire 20-year implementation period across 3 phases of implementation. Metrics are based on the pollutant load reduction goals set forth in the prior section.

Table 7-2. Implementation Strategies, Costs, and Timeline for West Branch Wapsinonoc Creek Watershed

	20-Year Plan		Phase 1		Phase 2		Phase 3	
# Years	20		7		7		6	
Practice	Goal (acres)	*Cost	Phase Goal (acres)	*Phase Cost	Phase Goal (acres)	*Phase Cost	Phase Goal (acres)	*Phase Cost
Watershed Coordinator	N/A	$2,084,466	N/A	$552,881	N/A	$727,553	N/A	$804,032
Water Quality Monitoring	N/A	$0	N/A	$0	N/A	$0	N/A	$0
Stakeholder Engagement/Outreach	N/A	$7,000	N/A	$2,450	N/A	$2,450	N/A	$2,100
Bioreactors	2,260	$904,180	791	$316,463	791	$316,463	678	$271,254
Contoured Buffer Strips	-	$0	-	$0	-	$0	-	$0
Grassed WW	3,185	$700,780	1,115	$245,273	1,115	$245,273	956	$210,234
Wetlands	4,331	$2,511,981	1,516	$879,193	1,516	$879,193	1,299	$753,594
Sediment Ponds	29	$20,648	10	$7,227	10	$7,227	9	$6,194
Terraces	2,232	$2,120,028	781	$742,010	781	$742,010	669	$636,008
WASCOBs	1,130	$2,146,299	395	$751,205	395	$751,205	339	$643,890
No-Till	5,038	$1,007,693	1,763	$352,693	1,763	$352,693	1,512	$302,308
Cover Crops	11516	$5,758,246	4,031	$2,015,386	4,031	$2,015,386	3,455	$1,727,474
Extended Rotation	2,591	$2,072,969	907	$725,539	907	$725,539	777	$621,891
Perennial Conversion	1,440	$4,318,685	504	$1,511,540	504	$1,511,540	432	$1,295,605
Riparian Buffers	6,187	$4,330,714	2,165	$1,515,750	2,165	$1,515,750	1,856	$1,299,214
Saturated Buffers	3,962	$8,756,230	1,387	$3,064,680	1,387	$3,064,680	1,189	$2,626,869
Streambank stabilization	8,737	$3,931,740	3,058	$1,376,109	3,058	$1,376,109	2,621	$1,179,522
Gully stabilization	5,410	$1,082,002	1,894	$378,701	1,894	$378,701	1,623	$324,601
Livestock/Manure Management	88	$230,598	31	$80,709	31	$80,709	26	$69,179
Total		$41,984,260		$14,517,809		$14,692,481		$12,773,970

*Up-front capital plus sum of annualized costs incurred over plan/phase period.

Table 7-3. Load Reduction Targets and Milestones for West Branch Wapsinonoc Creek Watershed

	20-Year Plan				Phase 1				Phase 2				Phase 3			
# Years	Reductions				7				7				6			
Practice	P (lbs.)	Sediment (tons)	N (lbs.)	E. coli (MPN)	P (lbs.)	Sediment (tons)	N (lbs.)	E. coli (MPN)	P (lbs.)	Sediment (tons)	N (lbs.)	E. coli (MPN)	P (lbs.)	Sediment (tons)	N (lbs.)	E. coli (MPN)
Bioreactors	767	97	19,972	2.99E+14	268	34	6,990	1.05E+14	268	34	6,990	1.05E+14	230	29	5,992	8.96E+13
Contoured Buffer Strips	0	0	0	0.00E+00	0	0	0	0.00E+00	0	0	0	0.00E+00	0	0	0	0.00E+00
Grassed WW	3,306	2,088	16,620	3.22E+14	1,157	731	5,817	1.13E+14	1,157	731	5,817	1.13E+14	992	626	4,986	9.65E+13
Wetlands	1,225	944	41,196	4.19E+14	429	330	14,419	1.47E+14	429	330	14,419	1.47E+14	367	283	12,359	1.26E+14
Sediment Ponds	33	27	183	7.24E+11	12	10	64	2.53E+11	12	10	64	2.53E+11	10	8	55	2.17E+11
Terraces	2,316	1,676	9,284	1.29E+14	810	586	3,249	4.53E+13	810	586	3,249	4.53E+13	695	503	2,785	3.88E+13
WASCOBs	1,250	905	9,847	1.15E+14	438	317	3,446	4.01E+13	438	317	3,446	4.01E+13	375	271	2,954	3.44E+13
No-Till	5,543	3,921	0	3.83E+14	1,940	1,372	0	1.34E+14	1,940	1,372	0	1.34E+14	1,663	1,176	0	1.15E+14
Cover Crops	4,593	6,971	90,487	8.76E+14	1,608	2,440	31,670	3.06E+14	1,608	2,440	31,670	3.06E+14	1,378	2,091	27,146	2.63E+14
Extended Rotation	891	560	21,431	9.85E+13	312	196	7,501	3.45E+13	312	196	7,501	3.45E+13	267	168	6,429	2.95E+13
Perennial Conversion	891	685	20,836	5.47E+13	312	240	7,293	1.92E+13	312	240	7,293	1.92E+13	267	205	6,251	1.64E+13
Riparian Buffers	5,483	4,557	34,259	6.28E+14	1,919	1,595	11,991	2.20E+14	1,919	1,595	11,991	2.20E+14	1,645	1,367	10,278	1.88E+14
Saturated Buffers	270	171	42,694	2.41E+13	94	60	14,943	8.44E+12	94	60	14,943	8.44E+12	81	51	12,808	7.24E+12
Streambank stabilization	102	250	128	2.46E+10	36	88	45	8.62E+09	36	88	45	8.62E+09	31	75	38	7.39E+09
Gully stabilization	94	230	118	1.50E+10	33	81	41	5.25E+09	33	81	41	5.25E+09	28	69	35	4.50E+09
Livestock Exclusion	35	0	157	5.10E+13	12	0	55	1.79E+13	12	0	55	1.79E+13	11	0	47	1.53E+13
Total	26,799	23,081	307,211	3.40E+15	9,380	8,078	107,524	1.19E+15	9,380	8,078	107,524	1.19E+15	8,040	6,924	92,163	1.02E+15

Phase 1 (Years 1-7)

The first phase of work will commence following submittal and approval of this WMP and includes meeting with the TAC to begin aligning funding sources, hire a watershed coordinator, coordinate with stakeholders, and begin landowner/farmer outreach. A water quality monitoring program has been initiated in conjunction with WMP development, but monitoring efforts will intensify in Phase 1 to provide data that reflects pre-implementation (baseline) conditions. Phase 1 objectives accomplished this phase of implementation will include WMP approval, landowner/farmer outreach and education, and aligning a watershed coordinator, TAC members, and key stakeholders to implement projects.

Engagement Activities will continue for the duration of the 20-year plan to keep momentum and ensure maximum adoption of BMPs. Engagement efforts will include:

- Outreach to landowners about the importance of water quality and how they can have an impact on protection and improvement of the West Branch Wapsinonoc Watershed.
- Outreach to homeowners in the watershed to identify ways to increase infiltration and repair and/or replace failing septic systems – a potential source of nutrients to West Branch Wapsinonoc Creek.
- Outreach to farmers to encourage conservation practices that minimize nutrient losses and erosion to surface and groundwater.

Phase 2 (Years 8-14)

Phase 2 will involve implementation of the "low-hanging fruit" BMPs and management strategies. These include working with willing landowners that recognize the need for conservation on their properties, with emphasis on the most popular and easy-to-adopt practices.

The watershed coordinator and the TAC will continue collaboration and work with landowners and producers in the watershed in Phase 3 to adopt BMPs in critical areas, with an emphasis on practices that require more education and active management to implement successfully.

Phase 3 (Years 13-20)

Phase 3 milestones are laid out to meet plan objectives by implementing conservation practices and structures on remaining land requiring additional treatment. Outreach efforts may include contacting landowners and properties where BMPs were not adopted in Phase 1 or Phase 2. It may also involve adding additional BMPs for a "treatment train" approach in areas with willing landowner participation. Additionally, after substantial progress made on watershed goals in Phases 1 & 2 coordination with TAC members and other stakeholders to undertake larger structural practices.

8. Monitoring and Evaluation

There will need to be an evaluation of the progress towards implementation of the specific actions identified and towards meeting the long-term goal of a healthy watershed. It is recommended that evaluation be completed through bi-annual plan reviews and plan updates that occur every seven years. Water monitoring is an important part of establishing a baseline for both water quality and stream flows, and for documenting progress in achieving plan goals. Building off the existing monitoring activities will provide more information about conditions in the West Branch Wapsinonoc Creek watershed to inform management decisions. A framework for an on-going monitoring program in the Lower Cedar watershed is provided in Chapter 9 of the basin-wide plan.

Bi-annual Reviews

The purpose of the bi-annual plan review is to identify and discuss implementation challenges to determine if there is a need for plan amendments. The evaluation process provides stakeholders an opportunity to discuss concerns about an element of the West Branch Wapsinonoc Creek Watershed Plan and the basin-wide plan. The bi-annual reviews are a reminder that the Plan is adaptable, dynamic and flexible. Information that will be collected as part of the bi-annual survey and evaluation of progress will include:

Education Activities – Reporting of education and outreach efforts

Watershed Improvement Projects – Track implementation of projects and locations, provide watershed-wide summary with a map

Watershed Conditions Assessment – Update and summarize monitoring program data
As additional metrics for measuring progress are developed by the LCWMA they will be included in the bi-annual survey and progress report.

Plan Updates

Plan updates occur every 7 years and take a more holistic look at changed conditions and implementation actions since the last Plan Update. Evaluations of changed conditions for Plan Updates may include:

- Population and land use forecasts and trends;
- Water quality trends using the 303(d) list and available watershed assessment data;
- Tracking of BMPs; and
- Flood risk modeling for future land use projections.
- Undoubtedly, other issues will emerge that merit in-depth consideration in the future. As with existing efforts, future planning work should be open and inclusive, involving all LCWMA members and stakeholders.