FLOWING FORWARD: PLANNING IOWA'S WATER QUALITY FUTURE

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Flowing Forward: Planning Iowa's Water Quality Future

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The Nutrient Reduction Strategy aims to reduce the amount of nitrogren and phosphorous in Iowa's waterways. Improvements on the land have made a positive impact, but water quality continues to decline.

I. INTRODUCTION

Iowa holds a rare landscape lush in high yielding, rainfed agriculture, but the bounty comes at a price. The state's water quality threatens public health and outdoor recreation with excessive nitrate, phosphorus, bacteria, sediment, and other pollutants in surface waters. The modern agriculture landscape has altered the movement of water within the state's watershed and reduced the land's natural resiliency.[1] Over the five years since Iowa created the Nutrient Reduction Strategy and began its Water Quality Initiative, improvements on the landscape have made a positive impact, but water quality continues to decline.[2]

The Nutrient Reduction Strategy aims to reduce the amount of nitrogen and phosphorus in Iowa's waterways by 45 percent, and at the current rate of progress, will be achieved long after the target date of 2035.[3] Critics and advocates say progress is hampered by a lack of funding and a lack of accountability to measurable standards. Estimates for cleaning Iowa's water range from $4.8 billion to $9.6 billion based on the assumption that $3 million is needed in each of 1600 HUC[4]-12 watersheds to address both water quality and flood mitigation.[5] Many water quality improvement practices do double duty in addressing both. The Nutrient Reduction Strategy also notes an additional $1.5 billion will be needed in infrastructure updates if municipal discharge permit requirements are expanded for nutrient removal.[6]

Funding for water quality in Iowa comes from multiple sources, but mainly through the federal and state government. Since 2012, the state government has invested approximately $541 million in improving water quality.[7] Since 1997, the federal government has paid Iowa farmers more than $2.76 billion to put in on-farm conservation practices that positively impact water quality.[8] Yet, Iowa continues to lead other states in its role in growing hypoxia in

1 "The Iowa Watershed Approach for Urban and Rural Resilience." Housing and Urban Development National Disaster Resilience Competition: Phase II Application, State of Iowa, 2015.

2 Jones, Christopher S., et al. "Iowa stream nitrate and the Gulf of Mexico." PLoS ONE 13(4): e0195930, April 18, 2018, doi.org/10.1371/journal.pone.0195930. Accessed January 2019.

3 "Iowa Nutrient Reduction Strategy Annual Progress Report 2016-2017." Iowa Department of Agriculture and Land Stewardship, Iowa Department of Natural Resources, Iowa State University College of Agriculture and Life Sciences, December 2017, nutrientstrategy.iastate.edu/sites/default/files/documents/20171211_INRS_2017AnnualReport_PartOne_Final.pdf. Accessed January 2019.

4 HUC stands for Hydrologic Unit Code, a series of numbers that identify a hydrologic feature such as a river or lake and its watershed drainage basin. The number listed is an indication of the size of the watershed and represents the number of digits in the numeric code. For example, a HUC-12 watershed is smaller than a HUC-8 watershed. The Mississippi River Basin, one of the largest watersheds in the world, is classified as a HUC-2.

5 Weber, Larry, Iowa Flood Center, personal communication.

6 "Iowa nutrient reduction strategy: A science and technology-based framework to assess and reduce nutrients to Iowa waters and the Gulf of Mexico." Iowa Department of Agriculture and Land Stewardship, Iowa Department of Natural Resources, Iowa State University College of Agriculture and Life Sciences, May 2013, nutrientstrategy.iastate.edu/sites/default/files/documents/NRSfull-130529.pdf. Accessed January 2019.

7 "Strategy Documents." Iowa State University, Iowa Nutrient Reduction Strategy, 2019, nutrientstrategy.iastate.edu/documents. Accessed January 2019.

8 Cox, Craig, et al. "Losing Ground." Environmental Working Group, April 2011, static.ewg.org/reports/2010/losingground/pdf/losingground_report.pdf. Accessed January 2019.

the Gulf of Mexico. Iowa disproportionately contributes nitrate pollution into the Gulf of Mexico compared to other states in the Mississippi River Basin. This is in part due to increases in intense, frequent rainfall and an uptick in nitrates flowing into streams, mostly as nonpoint source pollution. Iowa ranks fourth nationally in flood-related Federal Emergency Management Agency disaster declarations from 1988 to 2016 with 951 county declarations.[9] Every county in Iowa has had at least four disaster declarations in the last 30 years. Data from the Des Moines Water Works on the Raccoon River shows that nitrate concentrations and loads to streams have disproportionately increased more than precipitation. In comparing 1974 to 1995 (22 years) to 1996 to 2017 (22 years), increases are shown in:

- Precipitation: +2.6 percent
- Nitrogen-nitrate concentration (in parts per million [ppm]): +11 percent
- Nitrogen-nitrate load (in metric tons): +34 percent
- Nitrate yield into streams through precipitation (yield/millimeter [mm][10]): +30 percent.

Of the load increase, 74 percent has occurred in May and June which coincides with the planting season—a time when nitrate is available in the soil and before row crops are established.[11] These trends and patterns indicate the surge in nitrate pollution is influenced by the lack of ground cover in early spring, the timing and application of nitrogen to the landscape, intensifying precipitation, and subsequent increases to surface water runoff. Climate change plays a role by expanding the amount of heavy rainfall events across the state by 37 percent, resulting in more nutrient loss and soil erosion.[12] The timing of nitrogen fertilizer applications compounded by more intense and frequent rains and a lack of live root systems year round creates problems with nitrates and sediment flowing from Iowa.

Victories in the fight to improve Iowa's water have been found in strong, local efforts led by volunteer watershed groups. Farmers banded together to form the Soap Creek Watershed Board in 1986 after seeing crops, roads, and bridges destroyed with 4- to 5-inch rains.[13] Working with Natural Resources Conservation Service staff, they drafted a plan to add 150 farm ponds in the watershed, of which 130 remain in place today. In 2006, the Clear Creek Watershed Project formed locally to pursue targeted efforts to clean up their waterways. By following a clear plan of action and working with state agencies to secure funding, local leaders were successful enough to have Clear Creek removed from the state's list of impaired waterways by 2010.[14]

Farmers in the Miller Creek watershed, an impaired subwatershed within the Middle Cedar River watershed, have banded together to increase on-farm conservation practices through their Soil and Water Conservation Districts and watershed coordinator. Together, cover crop acreage has increased to 16 percent of farmland in the watershed. In 2017, their efforts drained available cost-share funds and a grassroots fundraising campaign began.[15]

Some local efforts have been long-standing volunteer commitments. Others were born following state legislation passed in 2010 as part of a response to

9 "Data Visualization: Disaster Declarations for States and Counties." U.S. Department of Homeland Security: Federal Emergency Management Agency, fema.gov/data-visualization-disaster-declarations-states-and-counties. Accessed November 2018.

10 Yield of nitrogen (or load per unit area, in this case kilograms per hectare, which is similar to pounds per acre) is per millimeter (mm) of precipitation. In other words, how much nitrate is delivered to streams from each hectare of land by each mm of rain that land receives.

11 Jones, Chris. "Tale of Two Raccoons." University of Iowa, Water Quality Monitoring & Research, July 9, 2018, iihr.uiowa.edu/cjones/tale-of-two-raccoons/?doing_wp_cron=1546539849.7665550708770751953125. Accessed January 2019.

12 Walsh, J., et al. "Climate Change Impacts in the United States: The Third National Climate Assessment." Ch. 2: Our Changing Climate, 2014, pp.19-67. U.S. Global Change Research Program, doi:10.7930/J0KW5CXT. Accessed January 2019.

13 Mulugeta, Mikael. "The Soap Creek Tour." University of Iowa, The Iowa Flood Center, Sept. 27, 2017, iowafloodcenter.org/2017/09/27/soap-creek-tour/. Accessed January 2019.

14 Glaza, Rachel. "Nonpoint Source Program Success Story." Sect. 319, U.S. Environmental Protection Agency, September 2012, epa.gov/sites/production/files/2015-10/documents/ia_clear.pdf. Accessed January 2019.

15 "Miller Creek Challenge." Iowa Agriculture Water Alliance, iowaagwateralliance.com/miller-creek-challenge. Accessed January 2019.

record flooding in Cedar Rapids, such as the creation of Watershed Management Authorities.[16] Watershed Management Authorities are formed through an intergovernmental agreement to allow cities, counties, Soil and Water Conservation Districts, and other stakeholders to collaborate on watershed management and planning. Iowa, as of 2018, has 23 Watershed Management Authorities.[17] Each of these efforts combine available funds from local farmers, landowners, volunteers, localized planning, and state agency support to form an on-the-ground strategy at a watershed level.

Iowa's water quality issues have not grown from a lack of trying. This track record of local victories and identified need for future investment shows the state knows how to fix its water quality problem, but lacks the capacity to effectively plan and implement the Nutrient Reduction Strategy statewide. The capacity lacks at both an administrative level within state agencies and at the local level in individual counties and watershed organizations. In this report, the Center for Rural Affairs explores the current policy framework for addressing water quality, what Iowa can learn from other states with nutrient reduction strategies, and how Iowa can prepare to scale up its water quality efforts.

II. USING A WATERSHED APPROACH

Since the beginning of the Nutrient Reduction Strategy, Iowa has grown its commitment to a watershed approach to water quality. More than 30 percent of the state is now covered by watershed organizations. This framework presents an opportunity to meet the goals of the Nutrient Reduction Strategy. Iowa needs a clear strategy and the administrative and leadership capacity to follow before scaling up practices and obtaining more funding. In this section, strategies past, present, and future are examined.

A. HISTORY

Iowa's history in water resource planning begins in 1936 and has long recognized the "paramount importance [of water resources] to the welfare and prosperity of the people of the state."[18] A timeline of events can be found in Appendix I on Page 25.[19] Today's efforts to integrate Iowa's approach toward water quality began in earnest after the Iowa Legislature passed measures to create and fund a Watershed Protection Program in 1999. This bill was the result of a yearlong process initiated by the Iowa Environmental Council to meet with key stakeholders and draft the Iowa Water Quality Action Plan in 1998. The first two years of this program mandated the creation of an Iowa Watershed Task Force and nearly $4 million in watershed protection grants to local communities. After two years of working groups, steering committees, and rotating meetings statewide with a broad group of stakeholders, the Task Force published its results in a 2001 report.[20] Final goals included:

- Developing a framework for enhanced cooperation and coordination;
- Increasing state support for watershed protection;
- Building local capacity for watershed initiatives;
- Emphasizing the role of watershed efforts in flood hazard mitigation; and
- Encouraging citizen involvement.

Almost 20 years later, these goals can be seen in the current structure of the plan taking shape within the Iowa Department of Natural Resources' Watershed Approach and the Iowa Department of Agriculture and Land Stewardship's Water Quality Initiative.

16 "Watershed Management Authorities in Iowa." Iowa Department of Natural Resources, iowadnr.gov/Environmental-Protection/Water-Quality/Watershed-Management-Authorities. Accessed January 2019.

17 "Status of Iowa's Watershed Management Authorities." Map of Water Management Authorities in Iowa, Iowa Department of Natural Resources, Jan. 22, 2018, iowadnr.gov/Environmental-Protection/Water-Quality/Watershed-Management-Authorities. Accessed January 2019.

18 Riessen, Jack. "Iowa's Water Planning History." Iowa Department of Natural Resources, 2009, publications.iowa.gov/20876/1/Iowa%27s_Water_Planning_History.pdf. Accessed January 2019.

19 Ibid.

20 "Iowa Watershed Task Force Report." Iowa Department of Agriculture and Land Stewardship, 2001, iowaagriculture.gov/soil/pdf/IWTFReport.pdf. Accessed January 2019.

Iowa's history in water resource planning dates back to 1936, when the Water Resources Committee of the Iowa State Planning Board published reports on water use and conservation in six major drainage basins.

Former Iowa Gov. Tom Vilsack used his Condition of the State address in 2003 to call for a summit focused on addressing Iowa's water quality issues and set the goal of having no waterways on the Environmental Protection Agency's impaired list by 2010.[21] The Iowa Water Summit was held in November 2003 after a series of public hearings. The following month, farm, business, and environmental groups gathered to discuss and compile a set of recommendations. Subsequent legislation did not pass in 2004.

At the time, Iowa had identified 188 impaired lakes, rivers, and streams, and the Environmental Protection Agency was quickly adding to the list. The recommendations included developing a plan to build local capacity for watershed councils as guided in the 2001 Iowa Watershed Task Force Report, and the first mention of using 28E Agreements, as defined in existing Iowa Code, to leverage resources at a local level toward watershed improvement. The summit also gave explicit authority to the governor to "insist [through executive order] on coordination and cooperation between all state agencies. Once ordered, the governor, with input from a stakeholder group, will initiate, oversee, and implement a needs assessment and a clean water action plan."[22] The summit also recommended leveraging the conservation title of the farm bill as a funding tool for state projects.

State legislation in 2006 called for establishing a watershed quality planning task force to provide recommendations for a "voluntary statewide water quality program."[23] Goals outlined included improving water quality and optimizing the costs of voluntarily achieving and maintaining water quality standards. The 2007 Watershed Quality Planning Task Force's report contained six broad recommendations:

1. Creation of a Water Resource Coordinating Council;
2. Development of a water quality research and marketing campaign;
3. Conduct larger (regional) watershed assessment, planning, and prioritization;
4. Smaller (community-based) watershed assessment, planning, prioritization, and implementation;
5. Support for smaller (community-based) watershed monitoring and measurement; and
6. Develop wastewater and stormwater treatment infrastructure.

Several of these recommendations were incorporated into 2008 legislation including formation of the Water Resources Coordinating Council chaired by the governor, and the conducting of larger watershed-based assessments.

While great minds had been convening for more than a decade to discuss Iowa's water resources, few legislative milestones were produced in that time. That changed quickly after record flooding

21 Dorman, Todd. "Vilsack Plans Water Summit." Waterloo-Cedar Falls Courier, July 29, 2003, wcfcourier.com/news/top_news/vilsack-plans-water-summit article_993f00cf-50d1-564d-afcf-ac868bfca1ad.html. Accessed January 2019.

22 "Subcommittee of Water Resources Coordinating Council." Iowa Department of Agriculture and Land Stewardship, Nov. 6, 1999, iowaagriculture.gov/WRCC/wrcc_final.pdf. Accessed August 2018.

23 Riessen, Jack. "Iowa's Water Planning History." Iowa Department of Natural Resources, 2009, publications.iowa.gov/20876/1/Iowa%27s_Water_Planning_History.pdf. Accessed January 2019.

in eastern Iowa in June 2008. A record crest of the Cedar River in downtown Cedar Rapids was recorded at 31.12 feet, shattering the previous record of 20 feet.[24] More than 10,000 people were displaced, and over $3 billion in economic losses were incurred due to flooding.[25] Across Iowa, floods and tornadoes in 2008 caused more than $848 million in damage.[26]

The subsequent 2009 legislative session was a milestone for advancing water quality as lawmakers responded to these natural disasters by adding to Chapter 466B of the natural resources title. A number of long-standing recommendations were formalized and defined, including adding flood mitigation to the purview of the Water Resources Coordinating Council. Support for a marketing campaign was included, which became Clean Water Iowa.[27] The Iowa Flood Center was created and funded, $56 million in disaster assistance was passed, along with flood insurance for cities and counties.[28,29,30] Funding for a floodplain management team within the Iowa Department of Natural Resources was approved along with recommendations for floodplain management.[31,32] The water quality debate in Iowa expanded to include flood mitigation.

In the next year, the Iowa Legislature added to Chapter 466B,[33] and the Watershed Quality Planning Task Force formally became the Watershed Planning Advisory Council. Watershed Management Authorities were created and their board of directors defined. State agencies were directed to seek funding for watershed demonstration projects, which became the Water Quality Initiative. A few months later, the Iowa Department of Agriculture and Land Stewardship and the Iowa Department of Natural Resources cut a number of full-time staff positions due to a 12 percent budget shortfall.[34] As a result, the Conservation Districts of Iowa, a nonprofit supporting the work of Soil and Water Conservation Districts, contracted with the Iowa Department of Natural Resources to employ key personnel at district offices. Today, Conservation Districts of Iowa continues to collaborate, fund, and support the work of Soil and Water Conservation Districts with 11 personnel working as wildlife specialists, water quality specialists, wetland easement specialists, and source water community facilitators.[35]

In 2010, Hurricane Sandy devastated the eastern U.S. seaboard, and the Iowa Watershed Approach program began within the Iowa Department of Natural Resources. As part of the federal relief package from Hurricane Sandy, Iowa was awarded a $97 million grant from the U.S. Department of Housing and Urban Development to implement a strategic approach to flood mitigation. The grant proposal scaled up lessons learned in addressing the 2008 floods in Cedar Rapids and Iowa City, and allowed for further implementation upon the administrative framework from legislation passed in 2009. The initial scaffolding of recommendations of the 2001 Task Force created a framework for Watershed Management Authorities and the creation of the Watershed Protection Advisory Council. The U.S. Department of Housing and Urban Development grant allowed for projects to finally be implemented in line with this decade-old vision.

In March 2011, the Environmental Protection Agency issued a memo urging states to make greater progress in addressing nutrient pollution.[36] The memo included the agency's "Recommended

24 "Flood of 2008 Facts & Statistics." City of Cedar Rapids, cedar-rapids.org/discover_cedar_rapids/flood_of_2008/2008_flood_facts.php. Accessed September 2018.

25 "Other social effects report: City of Cedar Rapids, Iowa—Flood of 2008." City of Cedar Rapids, 2010.

26 "Flood of 2008 Facts & Statistics." City of Cedar Rapids, cedar-rapids.org/discover_cedar_rapids/flood_of_2008/2008_flood_facts.php. Accessed September 2018.

27 "Clean Water Iowa." Clean Water Iowa, cleanwateriowa.org/. Accessed September 2018.

28 House File 64, 2009, Iowa Legislature.

29 House File 759, 2009, Iowa Legislature.

30 House File 822, 2009, Iowa Legislature.

31 House File 756, 2009, Iowa Legislature.

32 House File 822, 2009, Iowa Legislature.

33 "2010 Watershed Legislation Guide." State of Iowa, Rebuild Iowa Office, May 2010. rio.urban.uiowa.edu/sites/rio/files/2010_Watershed_Legislation_Guide.pdf. Accessed January 2019.

34 Van De Hoef, Dustin. "Northey announces first step to balance the Iowa Department of Agriculture and Land Stewardship's 2010 Budget." Iowa Department of Agriculture and Land Stewardship, July 14, 2009. iowaagriculture.gov/press/2009Press/press071409.asp. Accessed January 2019.

35 "About CDI." Conservations Districts of Iowa, 2018, cdiowa.org/conservation-districts-of-iowa/aboutcdi. Accessed January 2019.

36 Stoner, Mary. "Memorandum: Working in Partnership with States to Address Phosphorus and Nitrogen Pollution through Use of a Framework for State Nutrient Reductions." U.S. Environmental Protection Agency, March 16, 2011.

Elements of a State Nutrients Framework" and emphasized strong support of numeric standards and watershed-level planning. In response, Iowa convened a team of leaders across the state to write the Nutrient Reduction Strategy, which was released in 2012. The Nutrient Reduction Strategy set the numeric goal of reducing nitrogen and phosphorus pollution by 45 percent statewide and determined Iowa's "voluntary but not optional" approach to water quality.

Soil and Water Conservation Districts hold a key role in Iowa's administrative framework to address water quality. Established in 1937 following the Dust Bowl, by Hugh Hammond Bennett and President Franklin D. Roosevelt, Soil and Water Conservation Districts are built to provide local level conservation planning through a democratically-elected board.[37] There are now more than 3,000 districts across the country working with Natural Resources Conservation Services staff to protect our soils. The presence of Soil and Water Conservation Districts in every county in Iowa provides a local, grassroots presence on water quality issues and ensures resources are spent fairly.

Water quality, including irrigation runoff, is important for farmers and their crops. Soil and Water Conservation Districts are present in every county in Iowa providing a local, grassroots presence on water quality issues and ensuring resources are spent fairly.

B. EXISTING POLICY

Understanding past efforts on water quality is essential to propose a path forward. Though current public attention has mainly focused on a lack of funding for water quality, an administrative framework has emerged and strengthened in Iowa over the last two decades. A watershed approach in Iowa relies on two key state agencies, the Department of Natural Resources and the Department of Agriculture and Land Stewardship, and three types of local jurisdictions, Water Management Authorities, Soil and Water Conservation Districts, and drainage districts. Water Management Authorities are a cooperative effort formed along the biological boundaries of a watershed with elected and appointed leaders across cities, counties, and Soil and Water Conservation Districts. Soil and Water Conservation Districts have an elected team of commissioners in every county in Iowa. Soil and Water Conservation Districts are connected in a national network of districts (coordinated through the National Association of Conservation Districts) with strong ties to the U.S. Department of Agriculture. Drainage districts are typically represented through the county board of supervisors, and oversee coordinated networks of regulated drainage within a county. Generally, the Iowa Department of Natural Resources administers the work of Water Management Authorities, and the Iowa Department of Agriculture and Land Stewardship oversees the work of Soil and Water Conservation Districts. Each of these jurisdictions has functions and powers defined by Iowa law.

Iowa Code gives Soil and Water Conservation Districts the power to develop comprehensive plans for conserving soil and water resources for both the near and long term. Districts are not required to develop such plans, but are positioned well to leverage resources from state and federal agencies for technical expertise and funding when they do.
Soil and Water Conservation Districts have the ability to fundraise, hire personnel, enter agreements, write grants, own property, sue, and be sued. Through these powers, they can be innovative in meeting the goals of the Nutrient Reduction Strategy. Soil and Water Conservation Districts can form subdistricts, even across county boundaries, with taxing and bond authority with the approval of landowners in the subdistrict.[38]

37 "More Than 80 Years Helping People Help the Land: A Brief History of Natural Resources Conservation Service." Natural Resources Conservation Service, U.S. Department of Agriculture, nrcs.usda.gov/wps/portal/nrcs/detail/national/about/history/?cid=nrcs143_021392. Accessed September 2018.

38 Iowa Code 2019, Chapter 161A (30, 3), 2018, Iowa Legislature.

One example of this arrangement is Badger Creek Lake where a subdistrict was created in 1961 that includes parts of Madison, Dallas, and Warren counties.[39] The Soil and Water Conservation District holds permanent easements on installed structures to control flooding. Natural Resources Conservation Service PL-566 funding (which targets locally led efforts to solve natural resource problems in watersheds smaller than 250,000 acres) was used to plan and construct 43 flood control structures within the watershed. The subdistrict is responsible for operating and maintaining the structures and working with local landowners on required setbacks. Operation and maintenance for those flood control structures is funded by a tax levy on property within the watershed (collected from all three counties) which goes into a fund administered by the Madison County Soil and Water Conservation District. A project coordinator for the watershed leading into Badger Creek Lake is staffed through the Madison County Soil and Water Conservation District with funding made available from Environmental Protection Agency 319 funds, which specifically target nonpoint source pollution, obtained once the lake was added to the impaired water list.

Currently, in Iowa, few counties have Soil and Water Conservation District-level staff. They work closely with government staff of all levels and are often funded through state agency and local government initiatives. Most Soil and Water Conservation District employees dual report to the funders of their position and the board of Soil and Water Conservation District commissioners. Elected commissioners are volunteers and vacancies are prevalent around the state.

How to start a Watershed Management Authority

Any city, county, or Soil and Water Conservation District can initiate the process to form a Watershed Management Authority. An invitation should be sent to all eligible entities within the watershed boundaries. If any two or more entities agree to form the Watershed Management Authority, each party then begins preparing and adopting a 28E Agreement and bylaws. One best practice is to ensure both upstream and downstream entities are members and fairly represented. All required paperwork must be filed with the Iowa Secretary of State.

Watershed Management Authorities create a quasi-governmental body along the natural boundaries of a watershed rather than political boundaries. Watershed Management Authorities consist of a board with members of city, county, Soil and Water Conservation Districts, and other officials (for example, from a recreational lake) from within the watershed boundary. Any two or more political subdivisions can create a Watershed Management Authority through a chapter 28E Agreement, a reference to a chapter of Iowa Code which allows for government entities to cooperate in a number of ways.[40] Though Watershed Management Authorities are titled with the word "authority," they do not have taxing or bonding authority and are prohibited from using eminent domain. From the initial list of eight targeted watersheds in the U.S. Department of Housing and Urban Development grant, Iowa has grown to 23 Watershed Management Authorities covering one-third of the state as of 2018.[41]

Iowa has more than 3,700 drainage districts for the management and oversight of tile drainage and levees. More than 9 million acres of land in Iowa are drained, making Iowa one of the most engineered landscapes in the U.S.[42] A drainage district is formed when two or more contiguous landowners petition their county supervisors to create a district. Private drainage by a single landowner may not fall under its jurisdiction. Drainage is supported in the Iowa Constitution through a provision added in 1908. Drainage law is covered extensively in Chapter 468 of Iowa Code, giving districts the power to use eminent domain and taxing authority.

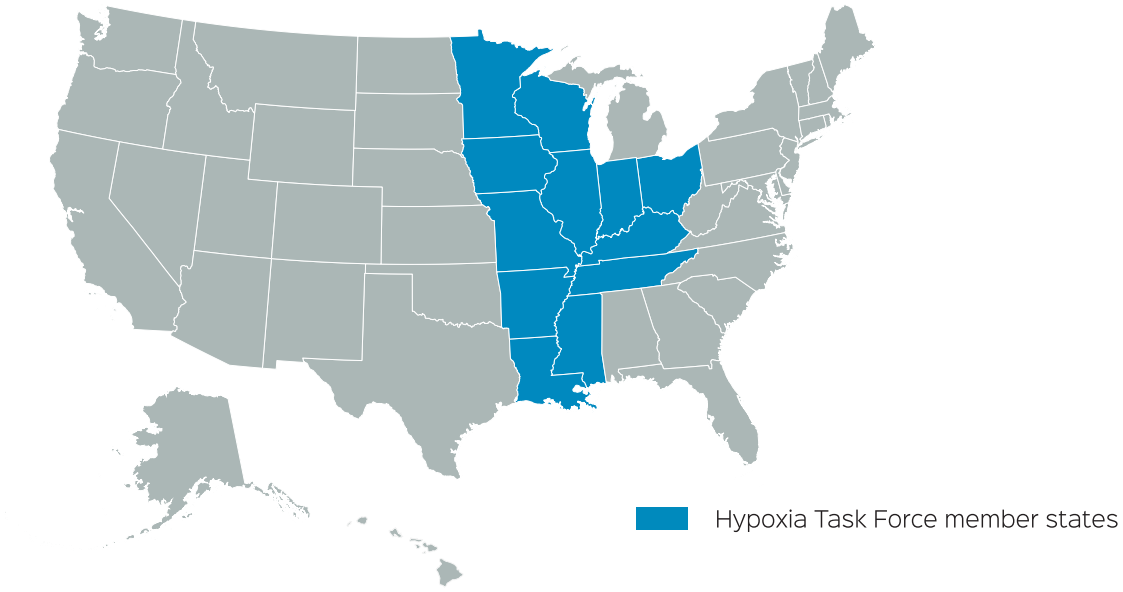
39 "Badger Creek Watershed." Madison County Soil & Water Conservation District, Madison County, Iowa, madison-swcd.org/badger_creek_watershed.html. Accessed January 2019.

40 A 28E Agreement is a joint exercise of governmental powers. Such agreements are most often used between county sheriffs and local deputies to provide law enforcement in rural areas.

41 "Current Iowa Watershed Management Authorities." Iowa Department of Natural Resources, iowadnr.gov/Environmental-Protection/Water-Quality/Watershed-Management-Authorities/Current-Iowa-WMAs. Accessed January 2019.

42 "Iowa Drainage District Association." Iowa Drainage District Association, iowadrainage.org/. Accessed January 2019.

FIGURE 1. HYPOXIA TASK FORCE MEMBER STATES



The Water Resources Coordinating Council, created with 2008 legislation, focuses more broadly on policy and funding recommendations that promote "a watershed management approach to reduce the adverse impact of future flooding on this state's residents, businesses, communities, and soil and water quality."

The Watershed Planning Advisory Council, created in 2009,[43] was established to assemble a diverse group of stakeholders to make recommendations to state and federal agencies to protect water resources with a focus on watershed planning.[44] Voting members of a Watershed Planning Advisory Council consist of representatives of designated non-governmental organizations and representatives appointed by the Iowa Department of Agriculture and Land Stewardship and the Iowa Department of Natural Resources. Two members each from the Iowa Senate and House of Representatives hold non-voting roles. They are required to meet at least once a year, can appoint a task force, and submit an annual report to the governor, general assembly, state agencies, and the Water Resources Coordinating Council.

Both the Iowa Department of Agriculture and Land Stewardship and the Iowa Department of Natural Resources take the challenge of Iowa's water quality seriously. Iowa Department of Agriculture and Land Stewardship focuses its strategy more on meeting the goals of the Nutrient Reduction Strategy while the Iowa Department of Natural Resources focuses on flood mitigation, wastewater treatment, public safety, and maintaining a sustainable supply of safe drinking water. These goals are not mutually exclusive, nor are the jurisdictions in which the agencies primarily work (Soil and Water Conservation Districts and Watershed Management Authorities). The work of the Watershed Planning Advisory Council and the Water Resources Coordinating Council present opportunities to coordinate work across agencies and with key stakeholders.

The Environmental Protection Agency is closely following the actions of the 12 states, including Iowa, composing the Hypoxia Task Force since requiring them to write state nutrient reduction strategies.[45] See Figure 1. Each state is tasked with creating its own strategy, which must contain essential components to achieve the goals. Flexibility is granted to allow each state to tailor their strategy over time.

43 House File 2459, 2010, Iowa Legislature.

44 "Watershed Planning Advisory Council: 2017 Annual Report." Iowa Department of Agriculture and Land Stewardship, 2017, iowaagriculture.gov/WPAC/pdf/2017/WPAC%202017%20Annual%20Report.pdf. Accessed January 2019.

45 The states in the Environmental Protection Agency's Hypoxia Task Force include Arkansas, Illinois, Indiana, Iowa, Kentucky, Louisiana, Minnesota, Mississippi, Missouri, Ohio, Tennessee, and Wisconsin. Tribes are represented through the National Tribal Water Council.

The Gulf Hypoxia Task Force

Hypo- (under, defective, inadequate) + oxygen + -ia

Excessive nutrient pollution in oceans and rivers can cause a dense growth of plant and algae that, in turn, depletes oxygen in the water needed for animals and aquatic life to survive. The technical term for this is eutrophication resulting in hypoxia. This condition creates the Dead Zone where the Mississippi River meets the Gulf of Mexico.

In fall 1997, the Environmental Protection Agency convened a Mississippi River/Gulf of Mexico Watershed Nutrient Task Force that included the 12 states in the watershed: Arkansas, Illinois, Indiana, Iowa, Kentucky, Louisiana, Minnesota, Mississippi, Missouri, Ohio, Tennessee, and Wisconsin. The task force had three goals in mind: (1) understand the causes and effects of eutrophication, or the Dead Zone, in the Gulf of Mexico; (2) coordinate activities to reduce the size, severity, and duration; and (3) lessen the effects of hypoxia. After a four-year scientific assessment, the task force released a 2001 Action Plan.[46] Within that plan, Action Item 11 stated "By December 2005, and every five years thereafter, the Task Force will assess the nutrient load reductions achieved and the response of the hypoxic zone, water quality throughout the Basin, and economic and social effects." A revisit of this Action Plan in 2008 resulted in a call for state strategies and efforts to reduce nutrients flowing into the Gulf of Mexico. Iowa's statewide Nutrient Reduction Strategy was born from this call to action. Each of the 12 states in this task force has similar statewide strategies on file with the Environmental Protection Agency.[47]

The Environmental Protection Agency in their memo requires focus on targeted watersheds. The Iowa Department of Agriculture and Land Stewardship has identified eight through the Water Quality Initiative concentrated on the Nutrient Reduction Strategy, and the Iowa Department of Natural Resources has nine priority watersheds determined through the Iowa Watershed Approach which primarily focuses on reducing the risk of flooding. Only 4 of the 13 total watersheds overlap for both initiatives (East Nishnabotna River, Middle Cedar River, North Raccoon River, and West Nishnabotna River). See Table 1 on page 10. No state level criteria is given publicly on why those watersheds were chosen.

This is largely due to the timing of available funding for both initiatives. Both initiatives are mostly funded through federal grants and have similar but separate goals. Since 2011, the U.S. Department of Agriculture has had a National Water Quality Initiative—largely to fund nutrient reduction strategies in several states.[48,49] Funding for the Iowa Watershed Approach, as mentioned before, was through a 2010 U.S. Department of Housing and Urban Development grant in response to natural disasters, and aims to reduce the risk of flooding. Common threads exist across agencies in their efforts such as weather and water quality monitoring, watershed management plans, and work on special projects. One great example is the three-year effort to create a baseline map of existing conservation practices across the state using Light Detection and Ranging, or LiDAR.[50]

But, for the general public, these overlapping efforts can have many faces. Local communications and outreach to farmers arrives in the form of mailers, press, field days, and promotional events from state agencies, local Soil and Water Conservation Districts, Iowa State University Extension and Outreach, and a long list of partnering organizations and sponsoring companies. The myriad of messages and events tied to water quality all aim to impact the culture around new practices, markets, incentives, and on-farm conservation.

46 "Action Plan for Reducing, Mitigating, and Controlling Hypoxia in the Northern Gulf of Mexico." Mississippi River/Gulf of Mexico Watershed Nutrient Task Force, U.S. Environmental Protection Agency, January 2001, epa.gov/ms-htf/hypoxia-task-force-2001-action-plan. Accessed January 2019.

47 "Hypoxia Task Force Nutrient Reduction Strategies." Mississippi River/Gulf of Mexico Watershed Nutrient Task Force, U.S. Environmental Protection Agency, January 2001, epa.gov/ms-htf/hypoxia-task-force-nutrient-reduction-strategies. Accessed September 2018.

48 Rock, Katie. "USDA Extends Water Quality Initiatives Through 2023." Center for Rural Affairs, Aug. 14, 2018, Lyons, Nebraska, cfra.org/news/180814/usda-extends-water-quality-initiatives-through-2023. Accessed January 2019.

49 "National Water Quality Initiative." U.S. Department of Agriculture, Natural Resources Conservation Service, nrcs.usda.gov/wps/portal/nrcs/detail/national/water/?cid=stelprdb1047761. Accessed January 2019.

50 "Iowa BMP Mapping Project." Iowa State University, Geographic Information Systems, fall 2017, gis.iastate.edu/gisf/projects/conservation-practices. Accessed September 2018.

TABLE 1. ENVIRONMENTAL PROTECTION AGENCY TARGETED WATERSHEDS

Priority watershed	Iowa Watershed Approach (Iowa Department of Natural Resources)	Iowa Water Quality Initiative (Iowa Department of Agriculture and Land Stewardship)
Boone River		X
Clear Creek	X	
Bee Branch Creek	X	
East Nishnabotna River	X	X
English River	X	
Floyd River		X
Middle Cedar River	X	X
North Raccoon River	X	X
Skunk River		X
Turkey River		X
Upper Iowa River	X	
Upper Wapsipinicon River	X	
West Nishnabotna River	X	X

C. THE ROLE OF WATERSHED PLANNING

A watershed plan is a road map to achieving improved water quality within a watershed. It considers the specific characteristics of a local watershed to create goals to reduce the risk of flooding and water pollutants by determining where on the ground practices should be placed. The goals of an effective watershed plan are defined by regulatory standards at both the state and federal levels. A good watershed plan is a community effort, written with the involvement of a broad list of stakeholders, partners, local leaders, farmers, and landowners. A watershed plan is where the rubber meets the road in addressing water quality within a local, biologically-defined area. Where water quality issues exist, a good watershed management plan defines how to solve them.

1. STANDARDS

Current standards in Iowa for watershed management plans are shaped by federal policy. The state has not written its own standards; however, the Iowa Department of Natural Resources provides a guidebook for creating a watershed management plan.[51] This guidebook is driven by Environmental Protection Agency requirements as written in the Clean Water Act where the Total Maximum Daily Load is the key standard for pollutants. These requirements create plans that are in compliance with federally funded projects, such as the Environmental Protection Agency's 319 Program that addresses nonpoint

51 "Watershed Management Action Plan: DNR Guidebook." Iowa Department of Natural Resources Watershed Improvement, July 2009, iowadnr.gov/portals/idnr/uploads/water/watershed/files/wmp_guide.pdf. Accessed August 2018.

source pollution.[52] The Environmental Protection Agency holds nine minimum elements of successful watershed plans:

1. Identify causes and sources of pollution;
2. Estimate load reductions expected;
3. Describe management measures and targeted critical areas;
4. Estimate technical and financial assistance needed;
5. Develop an information and education component;
6. Develop a project schedule;
7. Describe interim, measurable milestones;
8. Identify indicators to measure progress; and
9. Develop a monitoring component.

Beyond Environmental Protection Agency requirements, there are Public Law 566 and Public Law 534 program requirements within the Natural Resources Conservation Service which set technical standards for small watershed programs. These two programs have existed since 1954 to prevent erosion, floodwater, and sediment damage. They have similar objectives and generally parallel requirements with Public Law 566 for watershed projects 250,000 acres or less, and Public Law 534 for specific, smaller subwatersheds. Both programs require a watershed plan to be drafted to leverage federal cost-share for land treatment measures, easements, construction activities, and technical assistance with the Natural Resources Conservation Service.[53] Federal cost-share can cover 50 to 99 percent of a project's costs. Drafted with local input, these plans outline soil and water management problems in subwatersheds, proposals to alleviate these problems, the estimated benefits and costs, cost-sharing, and operation and maintenance arrangements.[54]

Definitions

Nonpoint source pollution: pollution resulting from many diffuse sources, in direct contrast to point source pollution which results from a single source. This type of water pollution, which includes farmland, is largely unregulated.

Point source pollution: any single identifiable source of pollution from which pollutants are discharged, such as a pipe, ditch, ship, or factory smokestack. Point source pollution is regulated under the Clean Water Act, which established the National Pollutant Discharge Elimination System. Under the National Pollutant Discharge Elimination System program, factories, sewage treatment plants, and other point sources must obtain a permit from the state and Environmental Protection Agency before they can discharge their waste or effluents into any body of water.

Iowa has a planning element and specific process for its impaired waters list.[55] The water quality monitoring data used to measure an impaired waterway can be leveraged to obtain funding from Environmental Protection Agency's 319 funds targeting nonpoint source pollution.

Another set of watershed planning standards is used by the Iowa Soybean Association. The organization has been a state leader in crafting locally-led watershed plans at the HUC-12 scale. In developing its own watershed planning program, the Iowa Soybean Association has hybridized state and federal requirements into its own standard,[56] and leveraging funding from the Regional Conservation Partnership Program within the Natural Resources Conservation Service. By requiring Natural Resources Conservation Service technical specifications, prescribed projects can be eligible for cost-share where applicable. Also, each plan is written with the goal of meeting the targets defined in the Nutrient Reduction Strategy.

52 "319 Grant Program for States and Territories." U.S. Environmental Protection Agency, epa.gov/nps/319-grant-program-states-and-territories. Accessed September 2018.

53 "Watershed and Flood Prevention Operations: Status of Program." Natural Resources Conservation Service, U.S. Department of Agriculture. nrcs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb1042256.pdf. Accessed September 2018.

54 "A Guide to the Watershed Protection and Flood Prevention Program." Natural Resources Conservation Service, U.S. Department of Agriculture, July 2002, nrcs.usda.gov/wps/PA_NRCSConsumption/download?cid=stelprdb1042259&ext=pdf. Accessed January 2019.

55 "Understanding Iowa's Impaired Waters List." Iowa Department of Natural Resources, iowadnr.gov/Environmental-Protection/Water-Quality/Watershed-Improvement/Impaired-Waters. Accessed September 2018.

56 "Paired Micro-Watershed Studies." Iowa Soybean Association, Environmental Programs, iasoybeans.com/upl/downloads/publications/fact-sheet-watershed-program.pdf. Accessed September 2018.

Willow Creek flows into the Floyd River, in one of eight targeted watersheds identified by the Iowa Department of Agriculture and Land Stewardship through the Iowa Water Quality Initiative. This initiative concentrates on the Nutrient Reduction Strategy.

The Regional Conservation Partnership Program, a farm bill program, has been used to provide technical and financial assistance to on-farm conservation through four existing Natural Resources Conservation Service programs: the Agricultural Conservation Easement Program, Environmental Quality Incentives Program, Conservation Stewardship Program, and Healthy Forests Reserve Program. The Chesapeake Bay area in Maryland obtained earmark funding for its nutrient reduction program through the Regional Conservation Partnership Program. Iowa Soybean Association also emphasizes continuous improvement, short- and long-term goals, and risk management in their planning process.

What matters in watershed planning across these standards are the identified practices, whether they are implemented, and whether there is accountability in setting standards and goals. The standards are only effective if accountability is present and the local community is engaged in the plan. A robust plan written to a high standard cannot be effective if it sits on the shelf and is never implemented. A weak plan with low standards can be effective with a few water retention structures and a high rate of voluntary cover crop adoption by farms in the watershed. Standards also must be tied to solving the problem at hand as stated in the goals of the watershed plan. For example, a small watershed may prioritize flood protection in a written plan even though water quality and drinking water protection is a greater concern to the local community. For these reasons, an equal emphasis on the technical and social components is essential to good watershed planning.

2. GOALS AND ACCOUNTABILITY

Iowa currently has many watershed plans. But, each are written with different goals in mind and to different standards. Are the watershed management plans on file a true road map for meeting the goals of the Nutrient Reduction Strategy?

The Nutrient Reduction Strategy aims for a 45 percent reduction of nitrogen and phosphorus. By volume, this means a 41 percent reduction in nitrogen and 29 percent reduction in phosphorus from agricultural lands.[57] It is a tall order made more difficult by the unpredictability of farm markets and weather. Watershed management plans can offer a blueprint on how to meet this strategy by using robust standards while also leaving some flexibility on potential practices. Based on geography and land use, some watersheds may need more investment than others to meet nutrient reduction goals. Through coordination of watershed plans, targeted practices can be streamlined for the most efficient use of funding to reduce nutrient losses statewide. If the Nutrient Reduction Strategy shows what practices are needed, watershed management plans tell us how and where those practices need to be placed on the landscape.

Technical assistance plays a key role. Sophisticated hydrologic modeling, weather monitoring, and geographic information system technologies allow for precision and confidence in deciding where projects make sense on the landscape. Not all watersheds are equal. Some may have lower nutrient reduction needs than others to meet Nutrient Reduction Strategy goals. A hydrologic assessment can guide those decisions and is typically conducted prior to drafting a plan.

57 "Iowa Nutrient Reduction Strategy Annual Progress Report 2016-2017." Iowa Department of Natural Resources, Iowa Department of Agriculture and Land Stewardship, Iowa State University. Presented to the Water Resources Coordinating Council, Sept. 21, 2017, iowaagriculture.gov/WRCC/pdf/2017/NRS%20Annual%20Report%20presentation%20to%20WRCC.pdf. Accessed January 2019.

Iowa has led the way in researching land management practices that yield the best nutrient reductions. These best management practices can help do the math on what and where methods should be implemented to achieve Nutrient Reduction Strategy goals. The Natural Resources Conservation Service created the Agricultural Conservation Planning Framework toolbox in 2015 to provide farmers with a free tool to assess their land.[58] Many private consulting firms offer similar services.

Iowa has already prioritized 13 HUC-8 watersheds for targeted efforts. Currently, 31 written watershed plans for HUC-12 and larger watersheds are on file through a number of organizations. See Appendix II on page 27. Enough watershed management plans are currently written to offer Iowa some lessons on what works and what does not. The plans represent a significant investment of taxpayer dollars. Since 2009, Iowa has invested approximately $4.1 million in watershed planning using federal funds made available through either U.S. Department of Housing and Urban Development or the Clean Water Act.[59] The state has also offered Watershed Management Authority-specific planning grants since 2013. The prices from existing plans provide a good estimate for projected costs for future planning efforts. State funding for planning grants is not likely to grow in the near future. If new revenue streams become available, a pool of planning funding would be useful.

The Watershed Planning Advisory Council plays a crucial role in guiding work across state agencies. Members' advice and guidance can help shape the direction of the role watershed planning has in driving water quality. The Watershed Planning Advisory Council has emphasized that Iowa is ready to move into a broader implementation phase in their Articles of Agreement drafted in 2016.[60] In addition, the Watershed Planning Advisory Council has stressed a local community connection is needed to drive engagement and a robust measurement component is required to hold plans accountable.

If and when new revenue streams become available, the Watershed Planning Advisory Council should play a larger role in coordinating watershed plans and holding them to the standard of meeting the Nutrient Reduction Strategy.

D. FARM-LEVEL PLANNING

Iowa's "voluntary but not optional" approach allows avenues for farmers to pursue conservation plans through their local Soil and Water Conservation Districts. These entities can help connect farmers with technical and financial assistance through Natural Resources Conservation Service employees. This existing service can play a critical role in guiding farmers toward results, but for implementation in targeted watersheds, more support may be needed.

Other states have had success by targeting farm-level planning for water quality through certificate programs. Minnesota established the Minnesota Agricultural Water Quality Certification Program that provides farmers with regulatory certainty for 10 years if they commit to implement and maintain practices that improve water quality on their land.[61] Certified farms can use the recognition to promote their businesses and receive priority for technical assistance. Vermont is in the pilot stages of a farm certification program focused on soil health. Farms that meet standards for nutrient management, soil erosion, and carbon sequestration earn a five-year certificate. Unlike Minnesota, Vermont offers no regulatory certainty, but research shows that farms with healthier soils are more profitable and productive.[62]

58 "Agricultural Conservation Planning Framework Toolbox." U.S. Department of Agriculture, National Agriculture Library, Dec. 18, 2018, data.nal.usda.gov/dataset/agricultural-conservation-planning-framework-acpf-toolbox. Accessed January 2019.

59 Ament, Kyle. Iowa Department of Natural Resources, personal communication, July 18, 2018.

60 "Watershed Planning Advisory Council, Areas of Agreement." Iowa Department of Agriculture and Land Stewardship, January 2017, iowaagriculture.gov/WPAC/pdf/2017/WPACAreasofAgreement.pdf. Accessed January 2019.

61 "Minnesota Agricultural Water Quality Certification Program." Minnesota Department of Agriculture, mda.state.mn.us/environment-sustainability/minnesota-agricultural-water-quality-certification-program. Accessed September 2018.

62 "Farm Finance and Conservation: How stewardship generates value for farmers, lenders, insurers, and landowners." Environmental Defense Fund and K.Coe Isom AgKnowledge, September 2018, edf.org/sites/default/files/documents/farm-finance-report.pdf. Accessed January 2019.

III. THE ROLE OF WATER QUALITY MONITORING

The only way to ensure progress on water quality is to measure it, but how? This question is a source of debate and criticism for many stakeholders, professionals, advocates, and the public at large. What would a realistic framework for water quality monitoring truly look like?

A good example of interagency collaboration toward the Nutrient Reduction Strategy is contained in a report from 2016 requested by the Water Resources Coordinating Council. The report called for a comprehensive list of existing surface water monitoring sites in Iowa.[63] See Figure 2 on page 15. Water quality data from these individual monitoring sites is reported biennially to the Environmental Protection Agency and to the general public.

Sixteen locations have been monitored on a monthly basis since 1986, thus offering a 30-year continuous record of water quality monitoring at these locations. Until 2000, the majority of the approximately 95 active and discontinued locations represented by the fixed-station network were monitored on a quarterly basis. Since 2000, all fixed stations have been monitored monthly for water quality parameters, including both nitrogen and phosphorus.

Iowa currently collects water quality data from ambient streams monthly at 60 sites mainly within HUC-8 watersheds targeted by the Iowa Department of Natural Resources.[64] Smaller monitoring projects within subwatersheds (HUC-12 or smaller) are also underway by different governmental and nongovernmental research efforts. Some of this data is publicly presented; most is not. The Iowa Institute of Hydraulic Research Center at the University of Iowa operates a continuous water quality monitoring network with remote sensors installed, providing real-time data with measurements reported every 15 minutes. In 2015, sensors were deployed at 30 locations throughout Iowa, expanding to 45 variable sites in 2016. These sensors come at an expense. Most are priced under $20,000 but also include maintenance costs.

This water quality data combined with streamflow data from more than 200 U.S. Geological Survey's National Water Information System[65] gives an assessment of nutrient loads and concentrations in Iowa. Having more in-stream water quality monitors would provide a better picture statewide, especially as money is spent toward the Nutrient Reduction Strategy at a county level and not just at the watershed level. Of greater concern is the lack of a long-term monitoring system in the state.

One of the biggest questions to consider in crafting a water quality monitoring system is whether the data collected is a true measure of cause and effect. A myriad of challenges come with monitoring a natural ecosystem. Understanding the limitations and strengths of a long-term water quality monitoring system is critical before significant investments are made. Nitrogen in the form of nitrate is water soluble and known to come from either surface water runoff or groundwater leaching. Phosphorus can either be dissolved in water, or tied to soil as it erodes into streams and rivers. Being able to measure nitrogen and phosphorus in ambient streams does not indicate the source of these nutrients.

More research is showing that the increased frequency and intensity of rainfall is driving more "legacy" nutrients into Iowa's waterways. Legacy nutrients refer to nitrogen and phosphorus present in soil and groundwater that is more likely to be delivered to streams during heavy rainfall and flooding. Research estimates that eroding stream banks could deliver between 141 and 375 pounds of nitrogen and 128 pounds of phosphorus per 0.6 miles of stream in Walnut Creek in Jasper County, Iowa.[66] This loss of legacy phosphorus

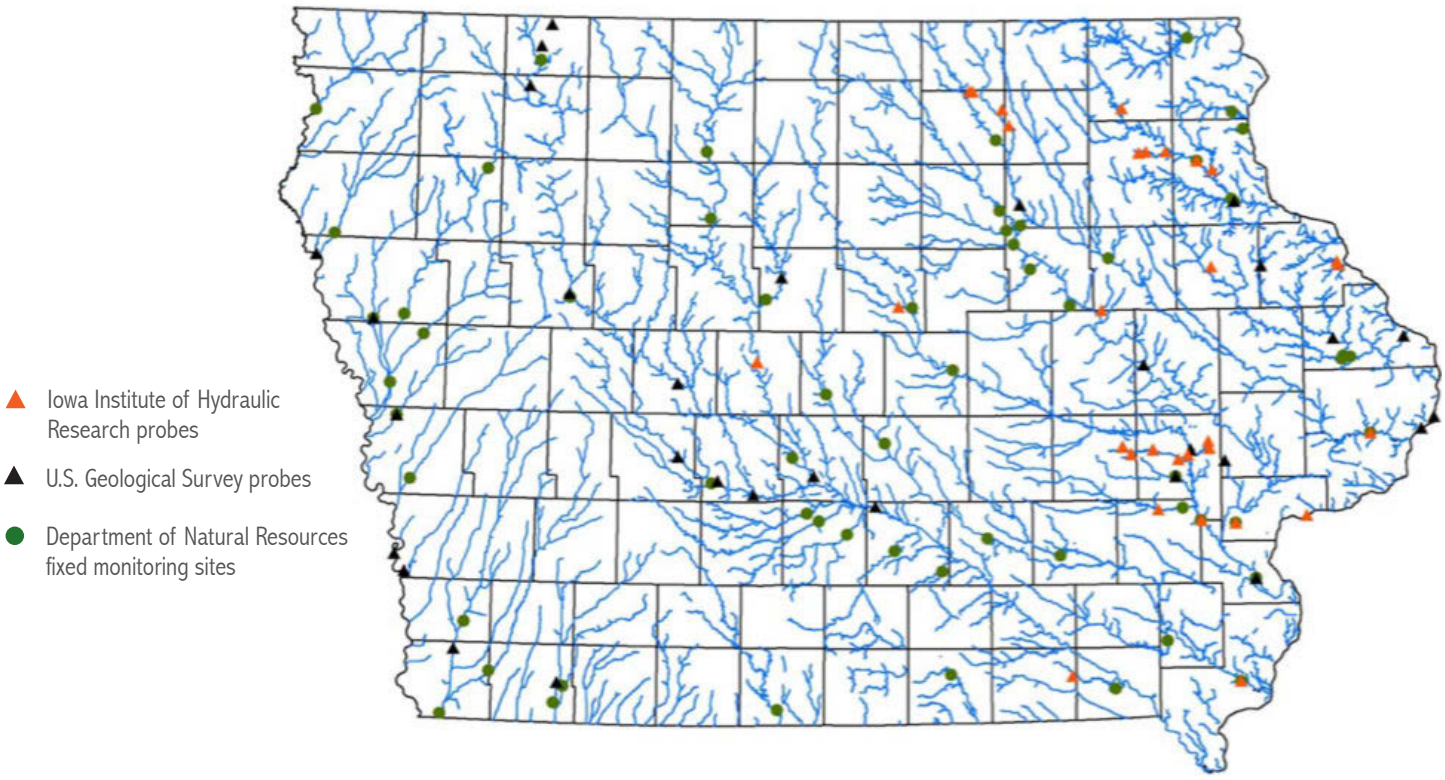
63 "Stream Water Quality Monitoring Conducted in Support of the Iowa Nutrient Reduction Strategy." Iowa Department of Natural Resources, Iowa Department of Agriculture and Land Stewardship, Iowa State University, Iowa Institute of Hydraulic Research Center, Hydroscience and Engineering Center at the University of Iowa, August 2016, nutrientstrategy.iastate.edu/sites/default/files/documents/Water%20Monitoring%20and%20the%20NRS%20_%20Final%208-24-16.pdf. Accessed January 2019.

64 "Ambient Stream Monitoring." Iowa Department of Natural Resources, iowadnr.gov/Environmental-Protection/Water-Quality/Water-Monitoring/Streams. Accessed September 2018.

65 "Current conditions for Iowa: Streamflow." U.S. Geological Survey, National Water Information System, waterdata.usgs.gov/ia/nwis/current/?type=flow. Accessed September 2018.

66 Schilling, Keith E., et al. "Vertical Distribution of Total Carbon, Nitrogen and Phosphorus in Riparian Soils of Walnut Creek, Southern Iowa." Catena, vol. 77, no. 3, 2009, pp. 266–273., doi:10.1016/j.catena.2009.02.006. Accessed January 2019.

FIGURE 2. DEPARTMENT OF NATURAL RESOURCES' STREAM FIXED MONITORING SITES AND NITRATE PROBE LOCATIONS–2015



U.S. Geological Survey probes measure water level and quantity, a crucial role in monitoring floods. The Iowa Institute of Hydraulic Research Center at the University of Iowa probes provide near real-time data which is relayed back to the data center every 15 minutes. These sensors measure nitrate, dissolved oxygen, water temperature, specific conductance, turbidity, and pH. The Iowa Department of Natural Resources' fixed monitoring sites have assessed water quality in the state since the 1970s.

along stream banks can mask the reduction effects of other land management practices, undermining restoration efforts.[67]

Best management practices must be implemented with enough density for water quality to change. Even then, a statistically significant, measurable change may not be detected due to lag time. The main components of lag time include the time required for an installed practice to produce an effect, for the effect to be delivered to the water resource, for the water body to respond to the effect, and for the effectiveness of the monitoring program to measure the response.[68]

The design of a monitoring program must account for the size of the watershed and the implementation of practices, or resulting measurements can be misinterpreted.[69,70] Research has shown significant improvements in water quality may not be measurable at a HUC-12 subwatershed for a decade, and may take more than 20 years to be seen in larger HUC-8 watersheds. The length of lag time can vary by pollutant. Lag time for bacteria may range from months to years, while excessive phosphorus may take decades. Groundwater travel time is also an important factor along with hydrology, soil type, vegetation, and weather patterns.

67 Sharpley, Andrew, et al. "Phosphorus Legacy: Overcoming the Effects of Past Management Practices to Mitigate Future Water Quality Impairment." Journal of Environment Quality, vol. 42, no. 5, 2013, p. 1308., doi:10.2134/jeq2013.03.0098. Accessed January 2019.

68 Meals, Donald W., et al. "Lag Time in Water Quality Response to Best Management Practices: A Review." Journal of Environmental Quality, vol. 39, no. 1, 2010, pp. 85–96, doi:10.2134/jeq2009.0108. Accessed January 2019.

69 House File 2459, 2010, Iowa Legislature.

70 "Watershed Planning Advisory Council: 2017 Annual Report." Iowa Department of Agriculture and Land Stewardship, 2017, iowaagriculture.gov/WPAC/pdf/2017/WPAC%202017%20Annual%20Report.pdf. Accessed January 2019.

The definition of water quality goes beyond the narrow focus of accurately measuring nitrogen and phosphorus. Other threats to public health and aquatic life include harmful algae blooms, microcystins, and toxic bacteria. Efforts in other restoration programs have included measuring to assess the health of water bodies as a natural habitat. The Chesapeake Bay regularly gathers data estimates of turbidity, chlorophyll-a, and dissolved oxygen levels in shallow, nearshore waters.[71] This data yields insight into the presence of plankton and whether the bay can serve as a habitat for aquatic life. As nutrient reduction measures vary year to year, these datasets help to assess the bigger picture based on the assumption that quality water should support life.

IV. EFFORTS IN OTHER STATES

Iowa is not alone in carving a path to improve water quality. The other states in the Hypoxia Task Force offer a learning opportunity through the similarities and differences of their successes and failures.[72] States outside the Upper Mississippi Basin can also offer lessons in how they efficiently address soil and water issues. In this section, brief highlights of successful approaches and lessons learned from other states are presented.

A. HYPOXIA TASK FORCE STATES

1. INDIANA

Cover crop adoption in Indiana has grown dramatically since 2011. Cover crops were planted on just under 200,000 acres in 2011 and now approach 1 million acres annually.[73] Indiana first crossed the 1 million acre mark for cover crop adoption in 2015. The state offers cost-share to farmers through the Environmental Quality Incentives Program administered by the Farm Service Agency with technical guidance from the Natural Resources Conservation Service, but 80 percent of the cost is covered by farmers.

Indiana does not focus heavily on watershed level planning, rather the state focuses on drinking water protection and providing technical assistance and farm level planning through its INfield Advantage program.[74]

2. KENTUCKY

Kentucky crafts water management plans on major river basins or problem areas within watersheds on to a five-year cycle.[75] Water quality monitoring and biological indicators are collected and help refine each round of planning.

3. MINNESOTA

Minnesota's approach to water management heavily emphasizes local planning within a statewide strategy. Minnesota's Board of Soil and Water Resources kicked off a statewide water initiative in 2014 which aligns local water planning on major watershed boundaries with strategies toward prioritized, targeted, and measurable implementation plans. This is known as One Watershed, One Plan.[76] The effort works with counties, watershed districts, and Soil and Water Conservation Districts.

71 "Tidal Water Quality Monitoring." Chesapeake Bay Program, chesapeakebay.net/what/programs/chesapeake_bay_quality_assurance_program/quality_assurance_tidal_water_quality_monitoring. Accessed September 2018.

72 "Progress Report on Coordination for Nonpoint Source Measures in Hypoxia Task Force States." U.S. Environmental Protection Agency, May 2018, epa.gov/sites/production/files/2018-05/documents/nps_measures_progress_report_1-_may_2018.pdf. Accessed January 2019.

73 Harmon, Leah. "Indiana Cover Crops: 2011-2017." Indiana Conservation Partnership, April 6, 2017, in.gov/isda/files/Cover%20Crop%20Trends%202011-2017%20Statewide.pdf. Accessed January 2019.

74 "Indiana's State Nutrient Reduction Strategy." Indiana State Department of Agriculture, Indiana Department of Environmental Management. Version 5, November 2018, in.gov/isda/files/Indiana%20State%20Nutrient%20Reduction%20Strategy_Version%205%20Final.pdf. Accessed February 2019.

75 "Division of Water: Watershed Management Monitoring and Assessment." Kentucky Energy and Environment Cabinet, Department for Environmental Protection, water.ky.gov/watershed/Pages/WMMonitoringandAssessment.aspx. Accessed September 2018.

76 "One Watershed, One Plan." Minnesota Board of Soil and Water Resources, June 2018, bwsr.state.mn.us/planning/1W1P/index.html. Accessed January 2019.

The Minnesota Board of Soil and Water Resources kicked off a statewide water initiative in 2014 known as One Watershed, One Plan. Minnesota also offers farm-level planning through its water quality certification program, which allows farmers to earn certification and regulatory certainty for 10 years by implementing and maintaining approved farm management practices.

Minnesota also offers farm-level planning through its water quality certification program. Farms that implement and maintain approved farm management practices earn certification and obtain regulatory certainty for 10 years.[77] This program was created after Minnesota established its own buffer law requiring perennial vegetation buffers of up to 50 feet along lakes, rivers, and streams, and buffers of 16.5 feet along ditches.[78] With increasing regulations, farmers see the advantage of regulatory certainty.

77 "Minnesota Agricultural Water Quality Certification Program." Minnesota Department of Agriculture, mda.state.mn.us/environment-sustainability/minnesota-agricultural-water-quality-certification-program. Accessed September 2018.

78 "Minnesota Buffer Law." Minnesota Board of Soil and Water Resources, mn.gov/portal/buffer-law/. Accessed September 2018.

4. MISSOURI

Missouri's Watershed Information Network[79] has been cited as a model for Iowa to build a data clearinghouse for watersheds. The Watershed Information Network combines information from state and federal agencies, non-governmental organizations, local government, and other groups into one accessible website for citizens to find information ranging from environmental planning, water quality monitoring, and source water protection. The University of Missouri Extension oversees the partnership to facilitate information tied to Missouri's watersheds.

79 "Missouri Watershed Information Network." MO Space, mospace.umsystem.edu/xmlui/handle/10355/3709. Accessed September 2018.

5. OHIO

Ohio created incentives and standards for watershed organizations based on written action plans. Watershed organizations must submit an "action plan" and have the plan endorsed by the state to be eligible to apply for staffing grants.[80] Earning the endorsement requires a focus on reducing nonpoint source pollution and protecting drinking water sources. Watershed organizations can be affiliated with a nonprofit or any volunteer organization.

In 2018, Gov. John Kasich signed an executive order declaring eight watersheds in Lake Erie's Western Basin as "Watersheds in Distress," initiating aggressive new actions.[81] The designation will require the watersheds to draft nutrient management plans, and will remain in place by the director of the Ohio Department of Agriculture until a sustained recovery is confirmed.

6. WISCONSIN

Wisconsin requires local governments to create land use and economic development plans under its comprehensive "Smart Growth" initiative passed in 2009.[82] The state has codified nine elements required in a plan: issues and opportunities; housing; transportation; utilities and community facilities; agricultural, natural, and cultural resources [including water]; economic development; intergovernmental cooperation; land use; and implementation. Without incentives, or state assistance, many local governments did not create a plan. Those that did create a plan often set it aside once complete or did not implement development in relation to the plan. More than $21 million in state planning grants were initially awarded when the effort began. Currently, planning grants are only available at the local level. Multiple efforts to repeal the "Smart Growth" law have failed thus far.

B. OTHER STATES

1. FLORIDA

Florida manages its water sources through five established water management districts.[83] These districts have responsibility for administering water resources at the regional level. The districts hold four core mission areas: water supply, water quality, flood protection and floodplain management, and natural systems.

2. KANSAS

Kansas conducts a Watershed Restoration and Protection Strategy assessment to leverage federal Environmental Protection Agency 319 funds to manage and protect watersheds.[84] The Kansas Department of Health and Environment approves written watershed plans to fund implementation projects and streamline federal, state, and local resources. In this way, watershed planning is treated as a public health issue.

3. MARYLAND

Starting in 2011, Maryland set a goal of reaching the total maximum daily load goal in the Chesapeake Bay by 2025 with three phases of watershed implementation plans.[85] An aggressive cost-share rate of 87.5 percent along with an education and outreach campaign led to broader implementation of cover crops. Farmers and urban land managers were also required to follow a nutrient management plan to protect water quality in the Chesapeake Bay.[86] In 2017, Maryland passed a bill creating a Healthy Soils Program within their Department

80 "Ohio Watershed Coordinator Program." Ohio Nonpoint Source Pollution Management Plan, U.S. Environmental Protection Agency, Aug. 31, 2005, app.epa.ohio.gov/dsw/nps/NPSMP/WAP/Wscoordprogram.html. Accessed January 2019.

81 "Kasich Administration takes aggressive new action to reduce nutrient runoff and improve Lake Erie water quality." Office of the Governor, State of Ohio, July 11, 2018, governor.ohio.gov/Media-Room/Press-Releases/ArticleId/946/kasich-administration-takes-aggressive-new-action-to-reduce-nutrient-runoff-and-improve-lake-erie-water-quality-7-11-18. Accessed January 2019.

82 "Wisconsin's Comprehensive Planning Law." Wisconsin Briefs from the Legislative Reference Bureau, State of Wisconsin, May 2015, docs.legis.wisconsin.gov/misc/lrb/wisconsin_briefs/2015/wb_15_12.pdf. Accessed September 2018.

83 "Water Management Districts." Florida Department of Environmental Protection, floridadep.gov/water-policy/water-policy/content/water-management-districts. Accessed September 2018.

84 "Kansas Watershed Restoration and Protection Strategy." Kansas Wraps, kswraps.org/. Accessed September 2018.

85 "Watershed Implementation Plans." Maryland Department of the Environment, mde.maryland.gov/programs/water/TMDL/TMDLImplementation/Pages/wip.aspx. Accessed September 2018.

86 "About Maryland's Nutrient Management Program." Maryland Department of Agriculture, mda.maryland.gov/resource_conservation/Pages/nutrient_management.aspx. Accessed September 2018.

of Agriculture to reduce soil erosion and research cover crops.[87]

4. NEBRASKA

In Nebraska, natural resource districts along watershed boundaries were created in 1969 when a number of existing authorities responsible for water and soil concerns were combined and realigned.[88] Legislation merged 154 "special purpose entities" into 24 natural resource districts based on Nebraska's major river basins. Each district is governed by a locally elected board to solve flood control, soil erosion, irrigation runoff, and groundwater quantity and quality issues.

5. OKLAHOMA

Similar to Kansas, Oklahoma also has a robust state program emphasizing watershed planning to leverage federal Environmental Protection Agency 319 funds to address nonpoint source pollution.[89] A state working group guides the process that results in local planning and implementation with federal funds.

6. VERMONT

In 2016, the Vermont Environmental Stewardship Program created a certification for farmers who voluntarily commit to a higher level of stewardship.[90] Applicants must meet standards for nutrient management, sediment and erosion control, soil health, greenhouse gas emissions, carbon sequestration, and pasture health. In return, applicants are awarded with a five-year certification, an on-farm sign designating the farm as meeting standards of environmental stewardship, and other recognition-based incentives. If a farmer does not meet the standards designated under the program, he or she can elect to work with technicians on a farm-level conservtion plan to implement best management practices to achieve those standards, and may be eligible for additional funding and technical assistance.

87 "Fiscal and Policy Note: HB 1063, Maryland Healthy Soils Program." Department of Legislative Services, Maryland General Assembly, March 14, 2017, mgaleg.maryland.gov/2017RS/fnotes/bil_0003/hb1063.pdf. Accessed January 2019.

88 "About Natural Resource Districts." Nebraska Association of Resource Districts, 2012, nrdnet.org/nrds/about-nrds. Accessed September 2018.

89 "Water Quality Division: Oklahoma Nonpoint Source Program." Oklahoma Conservation Commission, July 12, 2013, ok.gov/conservation/Agency_Divisions/Water_Quality_Division/WQ_Oklahoma_Nonpoint_Source_Program.html. Accessed January 2019.

90 "Vermont Environmental Stewardship Program (VESP)." State of Vermont, Agency of Agriculture, Food and Markets, agriculture.vermont.gov/vesp. Accessed September 2018.

V. IOWA: READY FOR SCALE

Iowa could be ready for a scale-up of water quality efforts through a clear strategy emphasizing watershed and farm-level planning. By strengthening policies, programs, public-private partnerships, and technical assistance, opportunities for significant investments in water quality can lead to success. In this section, policy recommendations are proposed to help Iowa prepare for the next level of implementation.

A. PATHS TO SUCCESS

Iowa has found some success in emphasizing watershed planning, but standards have been inconsistent and funding has been sparse. Even where funding is available for planning, funding for cost-share and technical assistance to implement projects has been insufficient to make a measurable impact on water quality. Planning can be an extensive and expensive process with hired consultants, or it can be a volunteer grassroots effort that focuses on changing cultural attitudes around farming and conservation.

Consider these recommendations on implementing and writing a good watershed management plan from the 2001 Iowa Watershed Task Force:

1. Encourage and assist development of local watershed councils by providing state support and technical assistance. Local soil and water conservation districts will be the focal point for assistance, providing leadership and a point of contact for local watershed initiatives.
2. Revise current state watershed grant program guidelines to better support local watershed-oriented planning and implementation initiatives. Provide structure while allowing flexibility. Establish an ad hoc committee that includes local watershed project coordinators to review procedures and consider items such as development of standard evaluation format and/or procedures that will provide a "base" set of reporting

requirements to reduce paperwork, improve consistency, and allow more effective quantification of results and comparisons between projects.

3. Increase the emphasis on watershed planning in grant programs. Make resources available to build local capacity in communities or regions for planning-related activities, such as problem assessment, outreach, and group facilitation. Groups may also benefit from legal assistance to utilize opportunities for organizing under existing "subdistrict" legislation that applies to lake and water districts, sanitary districts, and Soil and Water Conservation Districts.

The focus of these recommendations is on building an organizational framework and community connection for resources to be locally implemented. None of these recommendations focuses on the detailed technical aspects of planning, including requirements. While technology has changed drastically since 2001, these elements of good watershed planning remain the same. The state should provide clear standards for watershed management plans and technical guidance to achieve its Nutrient Reduction Strategy goals.

Whether a watershed group is large, like the HUC-8 North Racoon River watershed that supplies drinking water for one-sixth of the state, or a smaller volunteer-led effort, like Soap Creek, each should be challenged to craft a road map to meet the Nutrient Reduction Strategy. The Watershed Planning Advisory Council can help by providing requirements for watershed management plans and by helping watershed organizations connect with resources, both technical and financial. Currently, watershed planning standards are largely dictated by the federal funding source for the planning effort. Grant funds from the U.S. Department of Housing and Urban Development tend to focus on flood mitigation while Environmental Protection Agency grants prioritize water quality. Some general guidelines for statewide hydrologic assessment, planning, and prioritization are included under legislation passed in Chapter 466B of Iowa Code following the 2008 floods. No requirements exist to draft plans to meet the goals of the Nutrient Reduction Strategy.

Strong partnerships can be forged by connecting upstream and downstream communities within a watershed. Many cities in Iowa, small and large, take pride in their riverfronts including the Des Moines metro, Cedar Rapids, Spencer, Adel, Iowa Falls, Charles City, Columbus Junction, and Manchester.

Other major Midwest cities lie where rivers converge and historically acted as trading posts, including St. Louis and Minneapolis-St. Paul. This geography gives urban counties an influential advantage by lying in multiple watershed organizations compared to rural counties that may lie entirely in one watershed. Areas with such a geography have an opportunity to be innovative in providing leadership and obtaining funding for a regional water supply.

Requiring higher standards is only effective if accountability is present and the local community is engaged in the plan. Monitoring water quality and stream flows within a watershed can provide accountability. Relevant monitoring can measure nitrates and phosphorus, but more acute public health contaminants should be assessed with increasing frequency when they are identified. Trends in nitrogen and phosphorus require a long-term strategy. Water quality efforts in the Chesapeake Bay combine water quality monitoring with a quality assurance program.[91] The program checks the veracity of monitored progress, and assesses the overall health of the bay by measuring aquatic life in both submerged plants, clams, oysters, crustaceans, and other relevant species. This assessment allows the entire watershed to see the public health benefit of its efforts and restored biological integrity of the whole system.

The Iowa Soybean Association's approach to watershed planning has been successful in reducing nutrients due to support for both planning and implementation, and by focusing at the smaller HUC-12 watershed scale. Research has shown that a measurable detection in water quality can be reached with roughly $1.5 million in properly planned implementation projects. By working at this scale, the Iowa Soybean Association thinks a tipping point toward water quality could come when Iowa has 100 watershed management plans on hand. Currently, the Iowa Soybean Association has 16 completed HUC-12 plans and more on file, or in progress. Combined with more than 10 watersheds plans on file with the Iowa Department of Natural Resources, the growing number of plans is a reflection of a true effort and investment on mapping Iowa's needs to improve water quality. Identifying the cost to cover the remaining planning gaps would place a cost and timeline to achieve this goal. Where planning funds are not available, free tools and expertise can be used to draft an initial plan and should be encouraged.

91 "Quality Assurance." Chesapeake Bay Program, chesapeakebay.net/what/programs/chesapeake_bay_quality_assurance_program. Accessed September 2018.

The Iowa Department of Natural Resources has offered planning grants each year since 2013 and has leveraged federal funds for larger watersheds to make progress toward their goals. The Iowa Department of Agriculture and Land Stewardship has offered planning grants from time to time through its Water Quality Initiative. Where funding is not available, local Soil and Water Conservation Districts need the staff and administrative capacity to apply and obtain grants. Is it fair to expect taxpayers to carry the cost of planning and implementation? Tools allow any farmer or landowner to draft a conservation plan by working with Natural Resources Conservation Service staff. The Agricultural Conservation Planning Framework tool and the Resource Stewardship Evaluation Tool can guide decisions on where on-farm practices should be placed.[92,93] Other financing mechanisms exist through philanthropic foundations, public-private partnerships, and market-based ideas such as a nutrient reduction exchange, environmental impact bonds, wetland mitigation banking, or carbon pricing and sequestration.

For an agricultural state like Iowa, another way to indirectly assess the overall integrity as progress is made toward the goals of the Nutrient Reduction Strategy is to measure and track soil health. The benefits of healthy soil practices include:

- Increased water retention: 20 to 30 percent more water retention capacity;
- Reduced nutrient pollution: 10 to 30 percent less nutrient pollution of surface and ground waters due to soils better retaining applied fertilizers;
- Reduced soil erosion: 33 percent less soil erosion; and
- Reduced greenhouse gases: one-third to one-half ton of carbon dioxide removed per acre.[94]

In addition, numerous studies have pointed to healthy soil practices increasing farmer profits. For example, one study found a $40 per acre increase in profit on corn acres with healthy soil practices—roughly double the current average.[95] A number of practices have been documented within the Natural Resources Conservation Service for improving soil health, and financial and technical assistance is available.[96]

Credibility and accountability in assessing and incentivizing soil health holds its own concerns. For example, researchers disagree on how to define soil health. Without a common definition, it is hard to agree on what to measure, and evaluate how much soil health can be measured versus modeled. Efforts to advance soil health have emerged in states across the country through state agencies and legislation.[97] Where a regional cap-and-trade system exists for carbon emissions, California, New York, and Hawaii have begun efforts to promote carbon sequestration in soils through agricultural practices. The accumulation of carbon through land management has the potential to offset up to one-third the annual increase in atmospheric carbon dioxide.[98] States outside of these regional cap-and-trade systems, including Oklahoma and Utah, are also looking into the practice. Other states like Vermont, Massachusetts, and Maryland, are focusing on regenerating topsoil lost over centuries of farming and development.

Other state policies include the stream setback rule passed in Minnesota in 2017. This law establishes requirements for perennial vegetation buffers of up to 50 feet along lakes, rivers, and streams, and buffers of 16.5 feet along regulated drainage ditches. In June 2018, Gov. John Kasich, of Ohio, signed an executive order to reduce nutrient pollution in Lake Erie from farm runoff. The order established

92 "Agricultural Conservation Planning Framework (ACPF) Toolbox." U.S. Department of Agriculture, National Agriculture Library, Dec. 18, 2018, data.nal.usda.gov/dataset/agricultural-conservation-planning-framework-acpf-toolbox. Accessed January 2019.

93 "Resource Stewardship." U.S. Department of Agriculture, Natural Resources Conservation Service, 2018, nrcs.usda.gov/wps/portal/nrcs/detail/national/technical/cp/?cid=nrcseprd429509. Accessed January 2019.

94 Six, J. and K. Paustian. "Aggregate-associated soil organic matter as an ecosystem property and a measurement tool." Soil Biology and Biochemistry, Vol. 68, pp. A4-A9, January 2014.

95 Schilling, Keith E., et al. "Vertical Distribution of Total Carbon, Nitrogen and Phosphorus in Riparian Soils of Walnut Creek, Southern Iowa." Catena, vol. 77, no. 3, 2009, pp. 266–273, doi:10.1016/j.catena.2009.02.006. Accessed January 2019.

96 "Soil Health Literature." U.S. Department of Agriculture, Natural Resources Conservation Service, nrcs.usda.gov/wps/portal/nrcs/detailfull/soils/health/mgnt/?cid=stelprdb1257753. Accessed January 2019.

97 "Soil Health Policy Resources." Soil Health Institute, 2019, soilhealthinstitute.org/resources/catalog/. Accessed January 2019.

98 Machmuller, B. M. et al. "Emerging land use practices rapidly increase soil organic matter." Nature Communications, vol. 6, no. 6:6995, April 30, 2015, doi: 10.1038/ncomms7995. Accessed January 2019.

eight targeted "watersheds in distress" which in turn requires higher standards for storing, handling, and applying manure along with nutrient management plans with the Ohio Department of Agriculture. State level enforcement of nutrient management plans for farms has also been a regulatory tool to reduce pollution in the Chesapeake Bay.

VI. POLICY PROPOSALS

Iowa can chart its own path forward in addressing water quality by building on its existing framework of a watershed approach with renewed leadership and a greater emphasis on watershed planning. Other states serve as good examples of successful policy and leadership efforts.

Better coordination between state agencies through robust watershed planning could ensure that tax dollars are spent strategically and efficiently. An example of how the Iowa Department of Agriculture and Land Stewardship and the Iowa Department of Natural Resources could better coordinate their efforts to meet the goals of the Nutrient Reduction Strategy lies in how their two approaches prioritize work in targeted watersheds, and they set standards for watershed planning. The four watersheds that both agencies have selected as priorities for their respective efforts could be used in a streamlined effort for targeted planning and accountability.

Major HUC-8 watersheds with formed watershed management authorities should be required to file a watershed management plan, similar to Minnesota's One Watershed, One Plan approach. Within that plan, specific HUC-12 subwatersheds should be identified and prioritized for implementation of practices. This approach is already underway where funding is available, but extra effort should be made for other watersheds to catch up. To ensure accountability toward these plans, content requirements should be clearly identified and administered through state agencies and the Watershed Planning Advisory Council. The goals should be written to the standard of meeting the Nutrient Reduction Strategy and Environmental Protection Agency using technical guidelines from the Natural Resources Conservation Services. The Watershed Planning Advisory Council can create a task force to draft standards and oversee and implement watershed management plans in conjunction with Iowa Department of Agriculture and Land Stewardship and the Iowa Department of Natural Resources. Additional funding for targeted projects, whether structural, edge-of-field, or in-field, should be tied to having a watershed management plan on file.

Along with planning grants, more outreach and project coordinators need to be hired to engage local stakeholders. These staff people act as a hub for guiding the values of a local community and implementing new practices on farms. State agencies offering technical assistance, guidance, and resources for staff to grow efforts is vital. How these personnel are managed is critical, too. A key element in making local planning efforts successful is building trust between the project coordinator and the community. These relationships take time to build, therefore a lack of turnover in good coordinators is essential.

Iowa can also pursue a path in farm level planning toward better water quality and soil health. A farm certification program would provide an incentive for farms outside of a watershed organization or a prioritized subwatershed to meet the Nutrient Reduction Strategy. Rather than focusing on flood mitigation and water quality, a certification program focused on soil health and preserving topsoil would accomplish both goals. Metrics can include soil carbon, biological activity, organic matter, and soil depth. Together, these would provide an assessment of Iowa's soil health and a chance to pilot practices and crops that offer a range of benefits. How to define soil health and measurement standards is complicated. Investing in research could help clarify common metrics for soil health. Restoring soil carbon is a moving target and quantifying it is not simple. But, enough is known to encourage no-till, cover crops, and extended rotations to demonstrate soil health and water infiltration benefits.

Coupling the certification with exemption from future regulations, like the water quality farm certification program in Minnesota, would offer an incentive for farmer adoption. In Minnesota's program, farmers are guaranteed regulatory certainty for 10 years in return for complying with its voluntary farm certification program. In the Center for Rural Affairs' report "Catching Waves: Farmers Gauge Risk to Advance Water Quality in Iowa," regulatory certainty was cited as a top concern in both a farmer survey and interviews with watershed coordinators.[99] To encourage continuous improvement,

99 Rock, Katie, and Stephanie Enloe. "Catching Waves: Farmers Gauge Risk to Advance Water Quality in Iowa." Center for Rural Affairs, August 2018, Lyons, Nebraska, cfra.org/publications/CatchingWaves. Accessed January 2019.

a shorter certificate term of five to seven years could make sense and lessen the interval between quality checks.

A long-term plan for water quality monitoring will be essential for Iowa going forward. The state leads in some aspects of its approach to its Nutrient Reduction Strategy but lags in this one. One shift that has occurred is moving the bulk of water quality monitoring activities from the Iowa Department of Natural Resources to the Iowa Institute of Hydraulic Research at the University of Iowa. This network would monitor progress toward the Nutrient Reduction Strategy and overall streamflow reduction. Iowa should continue to leverage the expertise of the Iowa Institute of Hydraulic Research to expand and oversee a framework of in-stream sensors and other water quality measurements. The Iowa Department of Natural Resources can augment this network with water quality data from targeted projects. So can municipal water utilities and other public and private partners. However, a long-term framework should be the work of experts at Iowa's regent universities with support from the state.

Water quality monitoring would also benefit from a less narrow focus on nitrogen and phosphorus by including measures of health of aquatic life in Iowa. Recreational opportunities from fishing and water sports benefit from a focus on restoring lakes and wetlands.[100] Metrics like these would resonate better with the public and could drive a cultural change in how we connect and value Iowa's numerous waterways. Different indices of biological integrity exist that describe which macroinvertebrates (such as crayfish, snails, and clams) and fish are susceptible to pollution and poor habitat quality.[101] Another effective change gleaned from other states is to create an interagency group that focuses on quality assurance for monitoring of other co-pollutants such as microcystins, chlorophyll-a, endocrine disruptors and other pharmaceuticals, and indicators of harmful algae blooms.

Other policies and incentives can be incorporated over time to advance water quality. Iowa could match available federal funds for Conservation Reserve Enhancement Program wetlands dollar for dollar, similar to an effort underway in Minnesota.[102] If the state sales tax is raised to fund the Natural Resource and Outdoor Recreation Fund, nearly $180 million would be generated annually to advance water quality. With this dedicated funding source, the personnel capacities of Soil and Water Conservation Districts could be expanded with $12 to $15 million. A former tax credit for cow-calf operations could be reinstated and other incentives tied to grazing of cover crops could help, since few incentives are available within the federal farm bill for working conservation lands to encourage grazing. Incentives could also be offered for watersheds once 80 percent of its agricultural land area incorporates no-till, cover crops, or achieves other benchmarks.

VII. CONCLUSION

Iowa convened its initial draft of its statewide Nutrient Reduction Strategy more than five years ago, and progress has been hard fought and slow. The state knows the technical and agronomic solutions needed to reach the goal of a 45 percent reduction of nitrogen and phosphorus. Obtaining additional funding from both state and federal support and investment through public-private partnerships toward a broader cultural and market-based shift has been more challenging. Iowa has so far rejected the notion of additional regulation on agriculture. Instead, an administrative framework has emerged over 20 years to direct water quality efforts on a watershed level. This approach is key to target priority areas and funding into an overall strategy.

Nearly two decades ago, the best minds on water quality from across Iowa met and identified a watershed approach as the best path forward. Key policy levers for Iowa to accomplish this approach were identified, but only after the disastrous floods of 2008 were these policy recommendations treated with urgency. Legislation was passed to create Watershed Management Authorities. These volunteer-led groups convene local political entities along the biological boundaries of a watershed. By engaging local communities, farmers, and landowners, these groups hold the most

100 Tang, Chuan, et al. "Economic Benefits of Nitrogen Reductions in Iowa." Center for Agricultural and Rural Development, Iowa State University of Science and Technology, February 2018, card.iastate.edu/products/publications/texts/water-quality-report.pdf. Accessed January 2019.

101 Fore, L.S., et al. "Assessing invertebrate responses to human activities: evaluating alternative approaches." Journal of the North American Benthological Society, 15 (2), pp. 212-231.

102 "The Minnesota Conservation Reserve Enhancement Program – A Plan to Improve Water Quality and Enhance Habitat." Minnesota Board of Water and Soil Resources, bwsr.state.mn.us/crep/. Accessed January 2019.

promising path for addressing water quality through an emphasis on community and local planning. Over a third of Iowa's landscape is now included in some type of watershed organization. Major watersheds have been identified as a priority with two focuses—water quality and flood mitigation. Many have drafted technical plans that act as a road map to improving water quality. But, standards underlying these plans vary, and many sit on the shelf with best practices identified but unfunded. As funding becomes available, watersheds that have more than 80 percent conversion from wetland to farmland should be strategically targeted and prioritized. Farmer engagement in planning is key to successfully implementing the plan. Another option is planning at a farm level with steps needed to accomplish the Nutrient Reduction Strategy. This type of planning would include existing requirements for nutrient management plans, but go beyond by adding features like cover crops, grassed waterways, and stream buffers.

How to monitor water quality in Iowa remains an unanswered question. The technical aspects are challenging, but Iowa can learn from approaches taken by other states, particularly Maryland. In efforts to clean the Chesapeake Bay, Maryland focused on the biological health of its waters, relied on public universities to build a monitoring framework, and created a technical team as a check on the monitoring framework. A key argument against water quality monitoring in Iowa is a general distrust that more data will lead to more regulations and a violation of privacy. Good policy and education can address these concerns. These social needs to advance the Nutrient Reduction Strategy are often overlooked.

Lessons can be learned from other states included in the Gulf of Mexico Hypoxia Task Force. Only Minnesota has advanced their state Nutrient Reduction Strategy with a regulatory approach requiring stream setback rules and watershed planning statewide. Ohio is requiring nutrient management plans in critical watersheds to Lake Erie before they can apply for project funding. Consistent across states is an emphasis on organizing at the watershed level and robust planning standards at either the farm or watershed level. Calling attention to these consistencies is important to farms and rural communities looking for regulatory certainty. Often, these policy changes begin through pilot programs where key lessons and barriers are learned before adoption on a wider scale.

Iowa's approach is moving toward a heavy emphasis on public-private partnerships and system change through a market approach. Such an approach may include new businesses and markets in cover crop seed and small grains for extended rotations. Or, innovative environmental financing through a nutrient reduction exchange, wetland mitigation banking, and upstream-downstream projects funded with environmental impact bonds.

These opportunities are promising but still need oversight and coordination to be effective. Iowa's state agencies, including the Department of Agriculture and Land Stewardship, Department of Natural Resources, and Economic Development Authority, need appropriate staffing and support. Interagency coordination through the Watershed Planning Advisory Council and Water Resources Coordinating Council should be robust. Long-term support for staffing watershed project coordinators would provide stability for implementation, especially in targeted watersheds. Funds generated by raising the state sales tax to fund the Natural Resources and Outdoor Recreation Trust Fund would provide a long-term source of funding for key personnel. The current formula agreed for this funding source would cover the cost of administrative needs and provide more watershed planning grants.

Iowa needs to remain proactive and tightly focused on addressing water quality. If history is any indication, the best leaps in progress have happened after a natural disaster. In these moments, people set aside their different opinions to unite and rally behind their community and show the best of themselves. Good lessons abound across the Midwest where Iowa can learn while charting its own course. Iowa should not wait for another disaster before showing the best it can be, and should provide new opportunities for rural communities by addressing water quality.

About the Center for Rural Affairs

Established in 1973, the Center for Rural Affairs is a private, nonprofit organization with a mission to establish strong rural communities, social and economic justice, environmental stewardship, and genuine opportunity for all while engaging people in decisions that affect the quality of their lives and the future of their communities.

APPENDIX I

TABLE A1. IOWA WATER QUALITY HISTORY

Date	Event/milestone
1936	Water Resources Committee of the Iowa State Planning Board published reports on "water use and conservation" in six major drainage basins.
1949	Iowa Natural Resources Council was created to establish a comprehensive statewide program for surface water and groundwater resources.
1956 to 1959	Iowa Natural Resources Council published reports on water resources in eight major basins looking at water supply, use, and flood and sediment problems.
1957	Iowa Natural Resources Council was given authority from the Legislature to regulate water withdrawal, use, and floodplain development based on a comprehensive plan.
1965 to 1978	Iowa Geological Survey published a series of Water Atlases for ground and surface water availability versus demand.
1970	Six Conservancy Districts were created with boundaries formed along major drainage basin divides. Later renamed Water Resource Districts, they were given broad powers for watershed planning and construction. These sunsetted in 1988. The lack of taxation powers and resistance from Soil and Water Conservation Districts were cited as leading to their demise.
1972	Publication of the Upper Mississippi Comprehensive Basin Studies authorized by the 1965 Water Resources Planning Act.
1975 to 1978	A "Water Plan '78 Framework Study" was developed providing recommendations for further planning work. A follow-up report due in 1980 was never prepared.
1983	Iowa Natural Resources Council merged with the Department of Environment Quality to form the Department of Water, Air, and Waste Management. The 1982 legislation called for an emphasis of water needs and floodplain mapping for the next 20 years.
1985	A 1985 State Water Plan was published focusing on water availability as required from 1982 legislation.
1985	Legislation created the Department of Natural Resources by combining the Department of Water, Air, and Waste Management, Iowa Geological Survey, Energy Policy Council and Conservation Commission, and established a groundwater protection strategy.
1986	Floodplain Mapping Plan as required from 1982 legislation was developed.
1987	The Iowa Groundwater Protection Strategy was published, of which many recommendations were incorporated into the 1987 Groundwater Protection Act.
1996	The 1996 Iowa State Water Plan was published by Iowa State University identifying options for water problems in rural areas.
1998	Iowa Environmental Council publishes its Water Quality Action Plan after a year of stakeholder outreach.
Spring 1999	Iowa Legislature creates Watershed Protection Program.
December 2001	Iowa Watershed Task Force publishes its final report after two years of meetings with stakeholders.

APPENDIX I CONTINUED

TABLE A1. IOWA WATER QUALITY HISTORY CONTINUED

Date	Event/milestone
January 2003	Gov. Tom Vilsack declares intention in Condition of the State address to hold a summit on water quality.
November 2003	Iowa Water Summit held and a list of recommendations written prior to legislative session.
Spring 2006	Iowa Legislature calls for creation of Watershed Quality Planning Task Force.
November 2007	Watershed Quality Planning Task Force creates recommendations to Iowa Legislature calling for the creation of the Water Resources Coordinating Council.
2008	Iowa Department of Natural Resources develops recommended nutrient criteria for Iowa's recreational lakes.
June 2008	Record flooding in Cedar Rapids and tornadoes across the state cause $848 million in damages.
Spring 2009	Iowa Legislature follows recommendations of Watershed Quality Planning Task Force and creates the Water Resources Coordinating Council.
November 2009	Water Resources Coordinating Council publishes a Final Recommendations Report for the Iowa Legislature.
Spring 2010	Watershed Planning Advisory Council and Watershed Management Authorities established through Iowa Legislature.
March 2011	Environmental Protection Agency publishes memo urging Hypoxia Task Force states to make greater efforts in their nutrient reduction strategies.
2012	Iowa drafts the Nutrient Reduction Strategy asking for public comment.
2013	Iowa Environmental Council files a petition for rulemaking with the Iowa Department of Natural Resources to establish numeric nutrient criteria for recreational lakes.
January 2013	Iowa releases its Nutrient Reduction Strategy for the first time.
2015	Survey of Iowa farmers conducted by Iowa State University finds more than 92 percent have knowledge of the Nutrient Reduction Strategy.
September 2017	Iowa, with help from Iowa State University, releases its baseline assessments of nonpoint nitrogen and phosphorus loads from 1980 to 1996.
January 2018	Iowa celebrates the five-year anniversary of the Nutrient Reduction Strategy with release of a progress report.
Spring 2018	The Iowa Legislature passes Senate File 512 which will increase funding for water quality by $282 million over 12 years.
November 2018	Iowa Environmental Council and Environmental Law and Policy Center again petition the Iowa Department of Natural Resources for rulemaking to establish numeric nutrient criteria for Iowa's recreational lakes.

APPENDIX II

The growth of Watershed Management Authorities in Iowa has been remarkable since legislation was passed in 2010. Watershed Management Authorities now encompass more than 17 million acres, which is just under half of the state's land area. See Table A2 on Page 29. These entities are the beginning of local planning efforts. Many already have watershed management plans developed or in development. From our analysis, more than 9 million acres of Iowa are covered by formal Watershed Management Authorities with watershed plans on file. Another 7.9 million acres are covered by a Watershed Management Authority but do not yet have plans on file. See Table A3 on Page 28.

In Figure A1, overlaying this map of Watershed Management Authorities are robust plans developed by the Iowa Soybean Association. The Iowa Soybean Association follows consistent criteria in drafting its plans, including focusing at the HUC-12 scale which may include subwatersheds of existing Watershed Management Authorities. Just more than 1.7 million acres of Iowa are covered through this approach.

Not shown are additional subwatersheds where the Iowa Department of Agriculture and Land Stewardship has done some planning through the Agricultural Conservation Planning Framework. A map of this work is typically provided in the annual progress report of the Iowa Nutrient Reduction Strategy.

TABLE A2. IOWA WATERSHED ACRES

	Total acres
Iowa Soybean Association watersheds with plans	1,700,176
Total Watershed Management Authorities	**17,189,402**
Watershed Management Authorities with plans	9,230,330
Watershed Management Authorities without plans	7,959,072

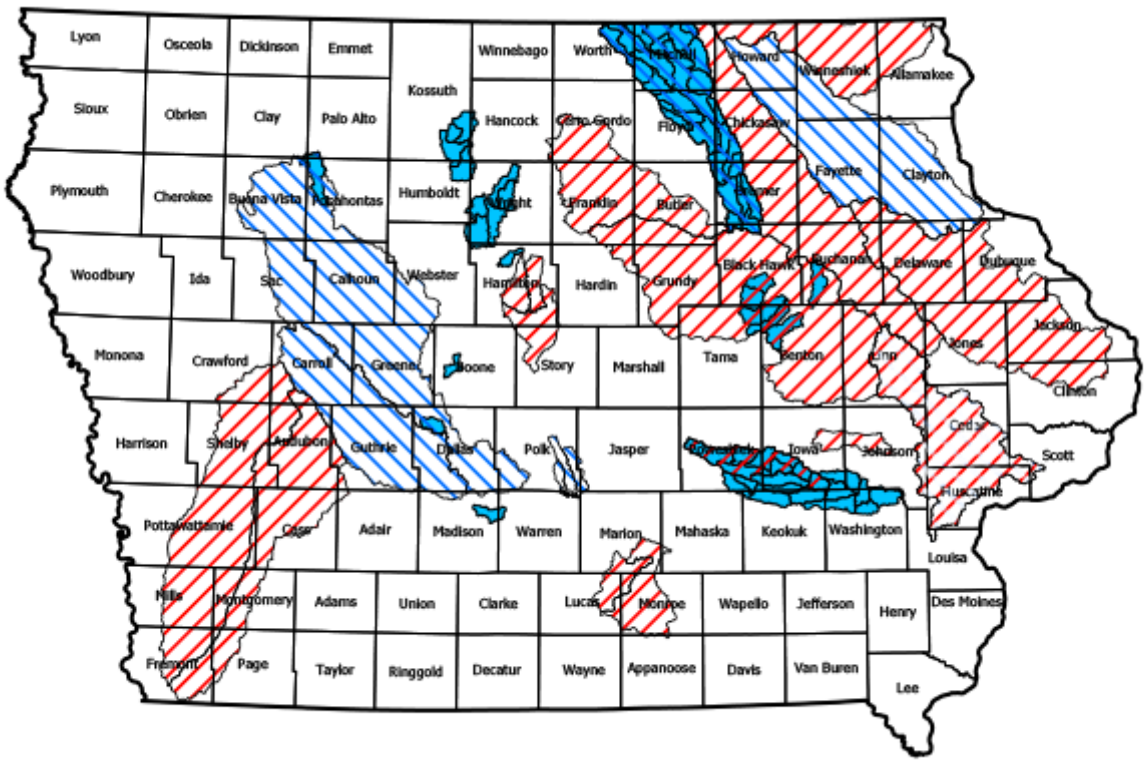
APPENDIX II CONTINUED

TABLE A3. IOWA WATERSHED ACRES BREAKDOWN

Watershed	Entity	Year	Acres	Plan on file
Badger Creek Lake	Iowa Soybean Association	2012	11,356	Yes
Beaver Creek	Iowa Soybean Association	2015	11,081	Yes
Benton-Tama	Iowa Soybean Association	2015	92,219	Yes
Charles City Sponsored Project	Iowa Soybean Association	2017	33,324	Yes
Des Moines Sponsored Project	Iowa Soybean Association	2017	15,766	Yes
Don Williams Lake	Iowa Soybean Association	2012	21,340	Yes
Eagle Creek	Iowa Soybean Association	2017	69,588	Yes
Eagle Grove Sponsored Project	Iowa Soybean Association	2017	14,240	Yes
English River	Iowa Soybean Association	2015	409,236	Yes
Headwaters Cedar Creek	Iowa Soybean Association	2016	34,925	Yes
Holland Creek	Iowa Soybean Association	2018	14,075	Yes
Howard Creek	Iowa Soybean Association	2018	19,937	Yes
Lime Creek	Iowa Soybean Association	2016	26,774	Yes
Lyons Creek	Iowa Soybean Association	2012	10,377	Yes
Miller Creek	Iowa Soybean Association	2015	42,431	Yes
Prairie Creek	Iowa Soybean Association	2017	92,752	Yes
Rock Creek	Iowa Soybean Association	2014	44,788	Yes
Upper Cedar	Iowa Soybean Association	2015	624,829	Yes
Upper Crane Creek	Iowa Soybean Association	2018	30,689	Yes
West Fork Crooked Creek	Iowa Soybean Association	2017	80,449	Yes
Beaver Creek	Watershed Management Authority	2016	703,238	No
Clear Creek River	Watershed Management Authority	2015	66,101	No
East Nishnabotna River	Watershed Management Authority	2017	735,169	No
Headwaters of South Skunk River	Watershed Management Authority	2018	42,599	No
Maquoketa River	Watershed Management Authority	2017	1,196,960	No
Middle Cedar River	Watershed Management Authority	2016	1,546,745	No
North-Middle Rivers	Watershed Management Authority	2017	536,768	No
Soap Creek	Watershed Management Authority	2015	162,000	No
South Central Iowa Cedar Creek	Watershed Management Authority	2015	269,512	No
Upper Iowa River	Watershed Management Authority	2015	639,664	No
Upper Wapsipinicon River	Watershed Management Authority	2015	1,003,356	No
West Nishnabotna River	Watershed Management Authority	2017	1,056,960	No
Bee Branch Creek	Watershed Management Authority	2013	4,160	Yes
Catfish Creek	Watershed Management Authority	2012	1,084,086	Yes
Fourmile Creek	Watershed Management Authority	2012	727,581	Yes
Indian Creek	Watershed Management Authority	2012	43,240	Yes
Lower Cedar	Watershed Management Authority	2017	703,238	Yes
Middle-South Raccoon River	Watershed Management Authority	2012	727,581	Yes
Mud-Camp-Spring Creek	Watershed Management Authority	2014	64,511	Yes
North Raccoon River	Watershed Management Authority	2017	1,581,325	Yes
Squaw Creek	Watershed Management Authority	2012	1,078,091	Yes
Turkey River	Watershed Management Authority	2012	1,084,086	Yes
Upper Cedar River	Watershed Management Authority	2012	551,106	Yes
Walnut Creek	Watershed Management Authority	2014	1,581,325	Yes
TOTAL			18,889,578	

APPENDIX II CONTINUED

FIGURE A1. IOWA WATERSHED PLAN MAP



Watershed Management Authority watersheds with no plans on file

Watershed Management Authority watersheds with plans on file

Iowa Soybean Association watersheds with plans on file