Boone River Watershed Current Conditions Report:

Sediment

Boone River Watershed Management Authority

November 2020

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Boone River

Watershed Management Authority

Current Conditions Report:

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Prepared as part of the Boone River Watershed Management Plan

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INTRODUCTION AND BACKGROUND

REPORT OVERVIEW

The Boone River Watershed Management Authority (WMA) has identified eight primary resource concerns for the Boone River Watershed: Shorelines and Riparian Areas, Plant and Animal Communities, Sediment, Nutrients, Stormwater, Public Access, Flood Resiliency, and Hazard Mitigation. This report focuses on Sediment and is one of eight reports developed for each of these concerns. Information contained in this report will facilitate the identification of resource and implementation priorities that will be used in the development of the Boone River Watershed Management Plan. Additionally, data gaps that are limiting such prioritization have been identified for future consideration.

INTRODUCTION TO RESOURCE

Soil erosion is a natural process that entails the loosening and removal of rock and soil by water, wind, and ice. Rock and soil that is being transported or has been deposited is called sediment. Suspended and deposited sediment can have adverse impacts on terrestrial and aquatic plant and animal communities. In addition to increasing turbidity and degrading habitat, a host of pollutants can be attached to and transported with soil particles. Erosion can also compromise critical infrastructure leading to costly maintenance and repair.

The direct impact of erosion and sedimentation on aquatic resources in the Boone River Watershed has been less documented than for nutrients. While cropland has been identified as contributing most of the sediment to streams and rivers, average erosion rates in the watershed are minimal. Highly erodible land used for row crop production is believed to be yielding most of the sediment from cropland.

Streambank erosion can be a significant contributor of sediment. The watershed drainage network is comprised of approximately 240 miles of river, streams, and drainage ditches. While detailed assessments in the watershed are limited, streambank erosion rates estimated for multiple sites in the Eagle Creek and Eagle Grove drainages indicate highly variable rates throughout both stream networks. While shoreline erosion has not been assessed for lakes in the watershed, only three lakes appear to have a potential for concerns; Lake Cornelia, Briggs Woods Lake, and Big Wall Lake.

Stormwater generated from urbanized areas not only carries a multitude of pollutants but also increases streambank erosion and contributes to flooding. The Iowa Department of Natural Resources (IDNR) issues individual stormwater permits to cities and universities under their MS4 (Municipal Separate Storm Sewer System) program. There are no MS4 communities in the watershed, however, communities within the watershed still contribute stormwater but, the impact of stormwater discharges on local resources is currently unknown.

EXISTING DATA

There is a limited amount of data directly related to erosion and sedimentation in the watershed. Water quality management plans developed for Eagle Creek and Eagle Grove do include streambank erosion assessments. Many of the conservation practices already supported through the Boone River Watershed Project also reduce erosion and sedimentation as nutrients (especially phosphorous) are often transported to waterways when attached to sediment.

Several entities have been involved in ambient water quality monitoring in the watershed including; The Nature Conservancy (TNC), Iowa Soybean Association (ISA), and IDNR. The U.S. Geological Survey and IIHR-Hydroscience and Engineering (University of Iowa) are collecting “real-time” water quality data on the Boone River near Goldfield and Webster City. While not utilized for this report, the ISA also collects data on individual farms to evaluate the effectiveness of specific management practices.

The U.S. Environmental Protection Agency (USEPA) requires all States to submit Water Quality Assessment Reports every two years. These reports include physical, chemical, and biological information for monitored streams, rivers, and lakes. Data and results from completed assessments are provided to the public via the IDNR website. Table 1 contains a compilation of data sources that provide a composite of information on erosion and sediment in the watershed. The list is not exhaustive but serves as a starting point for this subject.

Table 1: Fundamental Source of Data for Sediment and Erosion

Entity	Document/Information
Iowa Department of Natural Resources (IDNR)	Ambient Water Quality Data
Iowa Department of Natural Resources (IDNR)	Fish, Macroinvertebrate, and Habitat Monitoring
Daily Erosion Project (Iowa State University)	Maps and database of estimated sheet and rill erosion across Iowa, updated daily
USDA-Natural Resources Conservation Service	Boone River Watershed Rapid Watershed Assessment
Iowa Soybean Association (ISA)	Eagle Creek Watershed Plan
Iowa Soybean Association (ISA)	Eagle Grove Watershed Plan
Iowa Soybean Association (ISA)	Prairie Creek Watershed Plan

STATE OF THE RESOURCE

CURRENT CONDITIONS

SHEET AND RILL EROSION AND IMPACTS

While current erosion rates were not available, it was estimated that in 1997 erosion from cropland accounted for 65% of the erosion in the Boone River Watershed (USDA-NRCS, 2008). Soil loss in the watershed during 1997 was estimated to be 2.5 tons/acre/year, which is well below the soil loss tolerance "T" of 5 tons/acre/year (USDA-NRCS, 2008). While this average erosion rate indicates the extent of the erosion problems across the watershed may be low, isolated areas of erosion can have significant localized impacts on aquatic life, infrastructure such as bridges and culverts, and lakes or oxbows.

Current soil erosion and runoff rate estimates from hillslopes (sheet and rill erosion) were provided by the Iowa State University (ISU) sponsored Daily Erosion Project (DEP). The DEP uses elevation, soils, land use, precipitation, and other weather data information to realistically estimate erosion on a HUC 12 subwatershed basis (Gelder, 2018). Annual average erosion (2007 – 2020) in the watershed varies by subwatershed, and ranges from 0.35 tons/acre to 0.92 tons/acre (Figure 1).

Erosion rates generally increase with an increase in land slope, therefore, the amount of Highly Erodible Land (HEL) in the watershed and land use practices within these areas can indicate the potential for erosion problems. Only 5.3% of the watershed is considered to be HEL or potentially HEL (USDA-NRCS, 2008) (Figure 2). In 2007, there was an estimated 17,800 acres of HEL used for row crop production (USDA-NRCS, 2008). This represents less than 4 percent of the total cropland acres currently in the watershed.

Stormwater generated from urbanized areas carries a multitude of pollutants in addition to increasing streambank erosion and contributing to flooding. As previously described, there are no MS4 communities in the watershed. The impact of stormwater on local resources is currently unknown.

Another source of sediment to streams and rivers that has been less studied nationally is gravel roads. Gravel roads can lose up to 1 inch of material per year, which equates to a higher soil loss rate (tons/acre/yr) than what is "tolerable" for agricultural fields (Moore, 2013). Additionally, studies in two rural sub-watersheds in Vermont indicated gravel roads contributed 17 percent and 31 percent of the annual sediment loads (Wemple, 2013). This is a potential source that may need additional investigation in the Boone River Watershed.

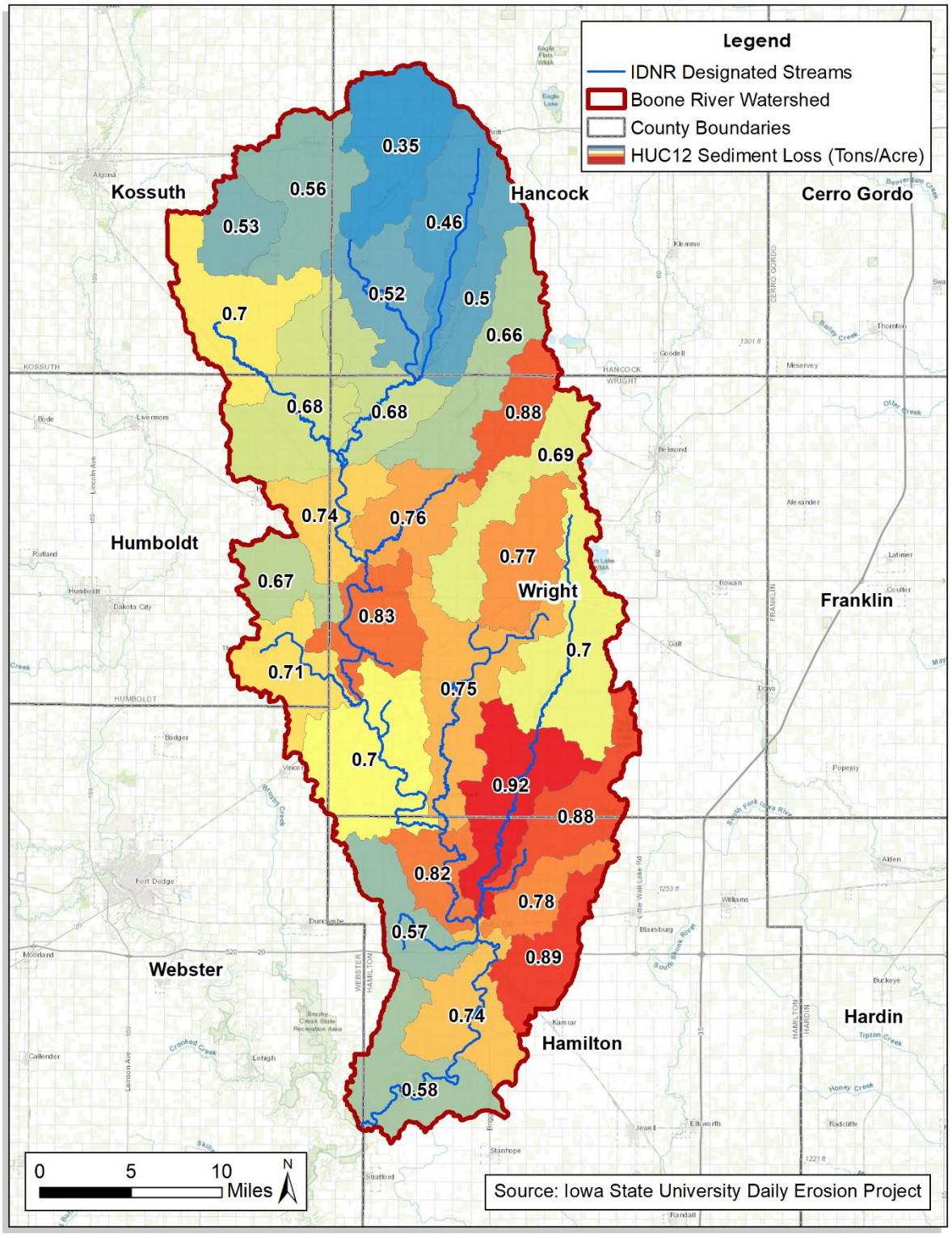

Figure 1: Annual Average Erosion (2007 – 2020) by HUC 12 Subwatershed

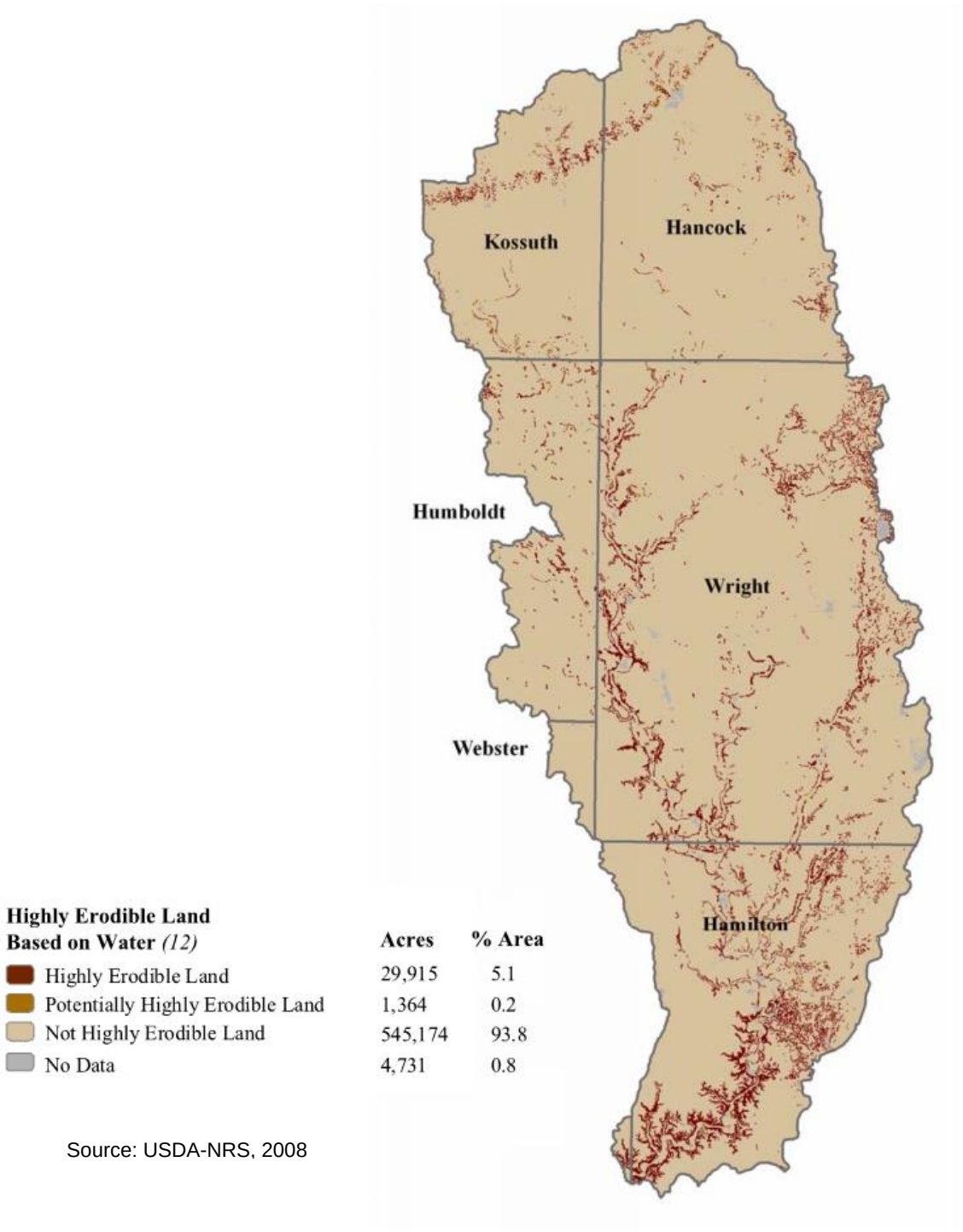

Figure 2: Highly Erodible Land in the Boon River Watershed

IN-STREAM EROSION AND IMPACTS

The impact of sedimentation on stream biota has been studied across the country. While deposited sediment degrades fish spawning habitat and reduces benthic diversity, high inorganic turbidity can limit light penetration which reduces primary production, clogs fish gills, and impact habits and movement of sight feeding fish. As described in the Plant and Animal report the Boone River tributaries have characteristics that are supportive of the Topeka Shiner. Efforts to control erosion and sedimentation in these stream reaches are essential to the survival of the Topeka shiner.

Estimates for in-stream erosion rates across the Boone River Watershed were not available. However, in-stream (and gully) erosion generally makes up a large portion of the in-stream sediment load. Many factors affect this but sediment from in-stream erosion can make up approximately 45% of the in-stream sediment load being exported from Iowa, with the remaining coming from upland sheet and rill erosion (Odgaard, 1984). Other estimates sometimes put this number even higher. As more studies are completed across Iowa and within the Boone River Watershed, this estimate can be better understood.

What detailed in-stream erosion estimates exist come from recent water quality projects in four smaller drainages: Eagle Creek, Eagle Grove, Lyons Creek, and Prairie Creek. Planning efforts. These projects included detailed stream assessments, which are needed to estimate in-stream erosion. Specifically, streambank erosion rates were estimated for multiple sites in the in the Eagle Creek and Eagle Grove drainages. Erosion rate estimates varied throughout both stream networks, ranging from 5 tons/year to over 50 tons/year.

The Boone River is a 5th order stream that stretches approximately 100 miles (IDNR, 2020a). The river has been targeted for chemical and biological monitoring by governmental entities, conservation groups, and researchers. The IDNR conducts periodic fish, macroinvertebrate, and habitat monitoring on the Boone River to provide direct measure of biological health or condition. Sampling has occurred in the stretch of river located in Mills Park which is a reference site for warmwater streams. Condition indices for the most recent survey (2017) indicate the fish community is in excellent condition while macroinvertebrate and habitat are in good condition (IDNR, 2020b) (Table 2). The potential impact of sediment on the macroinvertebrate and habitat ratings was not indicated by IDNR staff, however, staff did indicate that “species that require silt-free, rock substrate for spawning or feeding are present in low proportion to the total number of fish” (IDNR, 2020b).

Table 2: Conditions in the Boone River based on Biotic Integrity Indices (2017)

Target	Index Value for Boone River	Condition
Fish	73	Excellent
Macroinvertebrates	63	Good
Habitat	64	Good

Data Source: IDNR, 2020a

In 1998 and 1999 sampling was conducted for freshwater mussels at eight locations in the Boone River from its confluence with the Des Moines River upstream past Goldfield (Hoke, 2004). Results of this effort were compared to previous studies conducted in the 1982 and 1984/1985. This comparison "suggest a decline in the abundance of unionids in the Boone River between the mid 1970's and the present, especially below Webster City, and based upon national trends a decline in species diversity seems likely" (Hoke, 2004). Hoke identified certain species of mussels that were once widely distributed but have shown dramatic decreases and in some cases were not found in 1998/1999 (Table 3). While this decline has not been directly linked to sedimentation, it may be reflective of sediment impacts to habitat.

Table 3: Species of mussels that have shown declines in the Boone River

Species	Common Name	Status in 1998/1999	Updated Status
Elliptio dilatata	Spike	Not found	n/a
Quadrula p. pustulosa	Pimpleback	Not found	Found in 2005, 2009, and 2015
Strophitus undulatus	Creeper	Not found	Found in 2009 and 2015
Anodontoides *ferussacianus*	Cylindrical papershell	Dramatic decrease in frequency	Found in 2015
Fusconaia flava	Wabash pigtoe	Dramatic decrease in frequency	Found in 2009 and 2015

Source: Hoke, 2004; Karen Wilke, TNC, personal communication, August 6, 2020

In 2015 a more recent IDNR freshwater mussel survey, found a significant increase in populations in the Boone River over previous surveys, including three species of mussel that are on Iowa's threatened species list. In 2015, 14 sites were sampled as part of the state-wide mussel survey, including those that had been surveyed previously. A total of 16 live species of mussels were found, and several sites had more than 10 species at each site. This would seem to indicate that conservation activities that have been ongoing in the Boone River Watershed are having a positive impact on the freshwater mussel populations and the river itself (Kurth, 2018).

PUBLIC LAKES EROSION AND IMPACTS

Lake Cornelia is the only waterbody in the watershed that has an impairment listing related to sediment (IDNR, 2020b). Lake Cornelia is currently impaired due to high turbidity. This natural lake had a historic maximum depth of "perhaps six feet" (Heathcote A., Filstrup C, & Downing J., 2012). A major dredging project was conducted in the 1940s which researchers "assumed created sediment disturbance and re-suspension that had some impact on the integrity of the chronology, specifically through the redistribution of older

sediments above more recent deposits" (Heathcote et al., 2012). While the anthropogenic contribution to the high turbidity in Lake Cornelia is unknown, efforts to protect developed and natural shorelines from erosion are necessary to maintain or improve current conditions. Current lake sediment accumulation rates are estimated to be 0.101 ± 0.004 g cm^2/yr (Heathcote et al., 2012).

Sedimentation accumulation rates for other lakes in the watershed have not been quantified or are not accessible. Anthropogenic impacts to natural lakes can occur from the degradation or removal of natural shorelines. Shoreline disturbances are generally related to development, excessive foot traffic, or wave action caused by power boats. Lake Cornelia has a partially developed shoreline, accommodates extensive public use, and has fewer boating restrictions than any other public lake in the watershed.

While Briggs Woods Lake lies below approximately 5,700 acres of mainly agricultural land, the design of the lake minimizes sediment and nutrient loading from its watershed. Being located off the main channel reduces the impact many reservoirs see from high flow events. Sediment load estimates for the lake and sediment basin have not been determined or were not available. Since a majority of the drainage above the lake is used for crop production, field runoff is assumed to be the primary sediment source.

Additional information and details on lakes can be found in the Public Access Current Conditions Report.

HISTORICAL CHANGES

"The Western Corn Belt Plains and more specifically, the Des Moines Lobe, was once mostly covered with tallgrass prairie and interspersed depressional wetlands. Currently, over 80 percent of the Western Corn Belt Plains is now used for cropland agriculture and much of the remainder is in forage for livestock. These changes have resulted in higher sedimentation rates, increased nitrogen inputs to the land surface, the loss of natural buffers and filtration, and increased pollutant delivery from the installation of drainage networks" (IDNR, 2015).

Land cover changes in the Boone River Watershed were assessed using data from 2009 and 2018 (Table 4Table 4). Results indicate minimal changes to developed land and the amount of land used for crop production during that period. While there was a 20% decrease in forested land and a 26% decrease in the amount of grass and pasture in the watershed, the acres of water and wetlands increased by 108%. These changes in land cover may have been due, at least in part, to rainfall, weather patterns, and timing of data collection. While there have been large changes to land cover historically, changes in the past 10 years have been minimal.

Table 4: Land Cover Changes in the Boone River Watershed from 2009 to 2018

Land Cover Type	2009	2018	Change	% Change
Crop Production	487,478	491,689	4,211	1%
Developed	38,830	38,341	-489	-1%
Grassland/Pasture	36,140	26,847	-9,293	-26%
Forest	11,260	9,044	-2,216	-20%
Water & Wetlands	7,004	14,579	7,575	108%
Other	298	511	213	71%

Data Source: USDA, 2020a

Sedimentation rates have increased significantly since European settlement, however, more current trends suggest sedimentation rates are decreasing. In 1982 the Boone River Watershed had a soil loss of approximately 2.7 tons/acre/year, attributed to water erosion, with 85% from cultivated cropland (USDA-NRCS, 2008). In 1997 soil loss decreased slightly to 2.5 tons/acre/year with 68% from cultivated cropland (USDA-NRCS, 2008). Annual average erosion from 2007 – 2020 ranged from 0.35 tons/acre to 0.92 tons/acre (Figure 1).

CURRENT PROJECTS AND PROGRAMS

There are a vast number of local, state, and federal entities that administer programs and projects related to erosion and sediment control or mitigation. The primary federal agencies listed below are those that are currently involved in watershed projects or those that may be applicable to the watershed. While projects and programs that only encompass monitoring, research, and education are also important, they are not included in this section.

PRIMARY FEDERAL AGENCIES AND PROGRAMS

USDA – Natural Resources Conservation Service

In 2009 the USDA-NRCS initiated the Mississippi River Basin Healthy Watersheds Initiative (MRBI) that spans across 13 states. This initiative uses several Farm Bill programs, including the Environmental Quality Incentives Program (EQIP) and the Agricultural Conservation Easement Program (ACEP), to help landowners sustain America's natural resources through voluntary conservation. The overall goals of MRBI are to improve water quality, restore wetlands and enhance wildlife habitat while ensuring economic viability of agricultural lands (USDA, 2020b). The initiative is currently involved in watershed projects in the Prairie Creek and Eagle Creek drainages. These projects involve a multitude of partners consisting of landowners, producers, government agencies, conservation based organizations, and organizations representing agricultural producers. Many of the conservation practices promoted locally through this initiative will reduce erosion rates or provide filtering to reduce sediment delivery to the Boone River and its tributaries.

U.S. Environmental Protection Agency

Nonpoint source (NPS) pollution has been identified as being the most significant source of pollution in the Boone River Watershed. In 1987, Congress added Section 319 to the Clean Water Act and created a federal grant program that provides money to states, tribes, and territories for developing and implementing NPS management programs (USEPA, 2020). Funding provided through Section 319 can be a significant source of funding to implement planning and conservation practices activities in the watershed. The IDNR is responsible for implementing the Section 319 program in Iowa.

U.S. Fish and Wildlife Service

The U.S. Fish and Wildlife Service (Service) is a partner of the Boone River Watershed Project and the Fishers and Farmers Partnership for the Upper Mississippi River Basin. The Service also administers habitat conservation units and programs that implement prairie and wetland restoration practices that reduce erosion and sediment transport. The Service's Iowa Wetland Management District (District) was established in 1979 to provide breeding, nesting, and migratory habitat for waterfowl and other migratory birds. Additional information can be found in the District's Comprehensive Conservation Plan (USFWS, 2014). The District boundary includes 35 counties which encompasses all of the Boone River Watershed (BRW); currently there are 75 waterfowl production areas (WPAs) in 18 counties that provide more than 25,000 total acres of habitat. Most WPAs in the BRW are managed by the Iowa DNR and all are open to the public for certain recreation activities. Through voluntary agreements, the Service's Partners for Fish and Wildlife (PFW) Program provides technical assistance and cost-share incentives directly to private landowners to restore fish and wildlife habitat (e.g., prairie, wetlands, oxbows), in collaboration with many partners, in the Boone River Watershed and beyond.

PRIMARY STATE PROGRAMS & INITIATIVES

Iowa Nutrient Reduction Strategy / Water Quality Initiative

The Iowa Nutrient Reduction Strategy is a science and technology-based framework to assess and reduce nutrients to Iowa waters and the Gulf of Mexico. It is designed to direct efforts to reduce nutrients in surface water from both point and nonpoint sources in a scientific, reasonable and cost-effective manner (IDNR, 2020c). The Iowa strategy outlines a pragmatic approach for reducing nutrient loads discharged from the state's largest wastewater treatment plants, in combination with targeted practices designed to reduce loads from nonpoint sources such as farm fields (IDNR, 2020c). These efforts will also reduce erosion and sedimentation in the watershed.

The Iowa Water Quality Initiative (WQI) is the funding and implementation efforts for the Iowa Nutrient Reduction Strategy. The WQI improves water quality through a collaborative, research-based approach that is evaluated and reported by a team of independent

researchers from multiple institutions, led by Iowa State University. This comprehensive approach allows farmers and cities alike to adopt conservation practices that fit their unique needs, lands, and budgets. Additionally, it should be noted that three practices have been added to the practice list since it was originally developed in 2013: saturated buffers, blind inlet, and multi-purpose oxbow.

Iowa DNR

The Iowa DNR administers several regulatory and non-regulatory programs that involve erosion and sediment management including: Public Drinking Water Program, National Pollutant Discharge Elimination System (NPDES), Lake and River Restoration, and Nonpoint Source Management (Section 319 Program). The NPDES program regulates a wide array of activities including industrial and municipal discharges, construction site runoff, and stormwater management.

LOCAL/NONPROFIT IMPLEMENTATION EFFORTS

The Nature Conservancy

The Nature Conservancy assists with projects designed to protect land and water. They are currently a partner on the Boone River Watershed Nutrient Management initiative. To date, they have completed 31 oxbow restoration projects within the watershed. Oxbows improve riparian area functions including creating fish and wildlife habit; capturing nutrients and sediments; and provide floodwater storage. TNC and partners have identified more than 400 oxbows that could be restored in the BRW.

Iowa Stormwater Education Partnership

The Iowa Stormwater Education Partnership (ISWEP) is a nonprofit organization that provides support for local stormwater management programs including statewide education and outreach. The ISWEP provides support to MS4 and non-MS4 communities.

Completed Watershed Plan

Watershed Management Plans have been developed for four sub-watersheds in the Boone River drainage; Eagle Creek, Eagle Grove, Prairie Creek, and Lyons Creek (Table 5, Figure 3). These plans are currently being implemented in all the sub-watersheds except for Lyons Creek. The area covered by current plans is 185,313 acres or approximately 32% of the Boone River Watershed. Multiple practices targeted in these plans address erosion and sedimentation.

Table 5: Completed watershed management plans in the Boone River Watershed

Watershed	Planning Area (ac)	% of the Boone River Watershed
Prairie Creek	90,000	15%
Eagle Creek	70,000	12%
Eagle Grove	14,240	3%
Lyons Creek	11,073	2%
Total Planning Area	**185,313**	**32%**

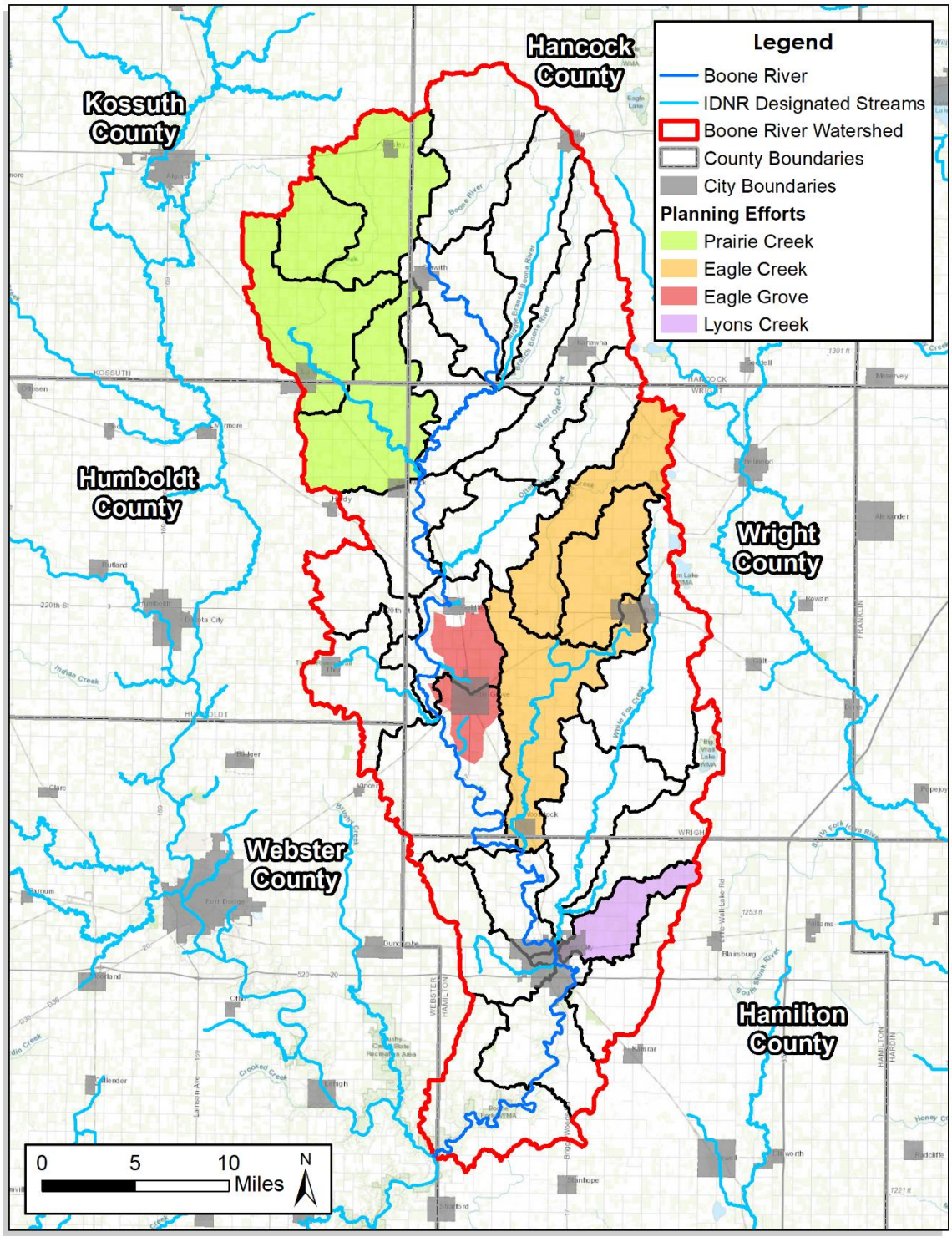

Figure 3: Areas in the Boone River Watershed Addressed by Current Watershed Management Plans

FUTURE TRENDS

As previously mentioned, sedimentation rates in the Boone River Watershed decreased from 1982 to 1997. In 1997 soil loss was estimated to be 2.5 tons/acre/year which is well below “T” (5 tons/acre/year) (USDA-NRCS, 2008). However, soil loss rates below “T” can still degrade stream water quality and aquatic habitat. Isolated areas of erosion related to human and livestock encroachment can result in significant impacts to water quality, habitat, and infrastructure.

RECOMMENDATIONS

The following goals have been developed for initial discussion with the WMA regarding erosion and sediment resource concerns. It is anticipated that these goals may be modified for inclusion in the final Boone River Watershed Management Plan.

GOALS

To ensure watershed goals align with and support state priorities, assistance and coordination should be sought from respective professionals at the IDNR, IDALS, and WMA partners. Sediment management goals for the Boone River Watershed should be developed to protect the physical, chemical, and biological integrity of streams, rivers, wetlands, and lakes.

General goals for the watershed include:

1. Utilize regulatory programs to control and monitor sediment loading from point source discharges, permitted facilities, and urban stormwater.
2. Utilize non-regulatory programs to reduce sediment loading from agricultural and urban nonpoint sources in the watershed.
3. Continue to support and promote funding programs and conservation practices throughout the watershed.
4. Along with partners, continue to initiate targeted projects in priority sub-watersheds that address water quality, soil health, habitat, wildlife, and public access.
5. Support monitoring activities that help define the physical, chemical, and biological integrity of the Boone River and its tributaries.
6. Conduct updated stream and soil erosion studies or modeling throughout the watershed to quantify current erosion rates, including from urban areas

RESOURCE GOALS

There are no established erosion and sedimentation goals for specific resources in the watershed. This may be due, in part, to the relatively low erosion rates in upland areas and a strong agriculturally based economy. Based on the data reviewed, the primary sources of

sediment entering the Boone River and its tributaries are; agricultural crops on highly erodible land, urban stormwater, and streambank erosion.

Briggs Woods Lake, which is man-made, receives water from an agriculturally dominated watershed. Sediment and nutrient loads from the lakes drainage area and to the lake have not been quantified. While structural controls are in place, the current condition and function of these controls are unknown. Based on the information provided above, resource goals are mainly focused on quantifying the extent of the erosion problems in the watershed.

Boone River and Tributaries

- Quantify and evaluate the extent of erosion and sedimentation in the Boone River and its tributaries.
- Maintain and improve the health and function of riparian areas in the watershed.
- On a subwatershed basis, develop sediment loading goals and implementation strategies.
- Quantify and evaluate the impact of sediment loading to the Boone River and its tributaries from municipal stormwater.
- Quantify and evaluate the causative factors, and impact of streambank and bed erosion on the Boone River and its tributaries.
- Evaluate the impact of erosion on major infrastructure in the watershed.
- Restore oxbows and implement conservation practices that reduce streambank erosion to manage sediment transport, improve floodplain function, and restore riparian habitat for species such as Topeka shiner.

Briggs Woods Lake

- Conduct a bathymetric survey to support sedimentation rate assessments
- Develop a sediment control plan for Briggs Woods Lake.
- Estimate maintenance needs for current sediment control measures.
- Evaluate the need for additional sediment control measures.

Lake Cornelia

- Conduct a bathymetric survey to support sedimentation rate assessments
- Conduct a visual evaluation of the lake shoreline to identify areas of erosion.
- Evaluate the need for shoreline erosion controls.

IMPLEMENTATION

STRATEGIES

The overall framework for protecting water quality and beneficial uses from being degraded by sediment includes both regulatory and non-regulatory efforts. The primary regulatory mechanism to address sediment loading from industry, wastewater facilities, construction sites, urban stormwater, and large livestock operations is the NPDES. The NPDES program for Iowa is administered by the IDNR.

Non-regulatory efforts to reduce and control sediment leaving private lands involve the voluntary adoption of management practices. A majority of the management practices promoted through USDA, USFWS, or IDALS programs are beneficial to the environment by improving soil health, increasing fish and wildlife habitat, reducing erosion, and reducing bacteria, nutrient, and chemical runoff.

The voluntary adoption of management practices can be achieved on a targeted or non-targeted basis. Non-targeted implementation of management practices across the Boone River Watershed can be accomplished through existing programs such as EQIP. These programs provide all landowners, both in and outside of priority areas, access to technical and financial assistance.

Targeted implementation of management practices can be accomplished through “projects” focused in a priority area, which is generally a smaller drainage or subwatershed area. This would be a continuation of projects that are currently being implemented in Eagle Creek, Eagle Grove, and Prairie Creek drainages. Targeted projects can bring additional cost-share and more implementation flexibility. In most cases, the decision by a landowner or producer to implement or adopt a “practice” is financially based.

The primary sources of sediment to the Boone River and its tributaries are assumed to be; crops grown on highly erodible land, urban stormwater, and streambanks. The primary delivery mechanisms are overland runoff, drainage ditches, tile/surface inlets, and stormwater outfalls. In order to most effectively reduce erosion, control efforts should be focused on these sources and delivery mechanisms. While there has been a wealth of nutrient information collected in the watershed, erosion and sedimentation have been less studied. In order to develop effective control strategies, primary sources need to be identified and their loads or contributions need to be quantified. Additionally, the delivery mechanisms need to be evaluated to determine their role in either causing erosion or delivering sediment. Once an understanding of sources and delivery is gained, targeted and non-targeted approaches described above can be used to address the problems.

As mentioned, a targeted approach may involve targeting priority subwatersheds or primary sediment sources. For example, a majority of the cropland erosion occurs on highly erodible land allowing resource managers to target specific fields for specific practices. In

most cases these practices will involve the establishment of cover crops, buffers, and/or re-establishment of riparian habitat.

The impact of gravel roads on sediment loads to the Boone River and its tributaries is unknown. However, it has been shown that the application of best management practices, including vegetated ditches, turnouts, and energy dissipating measures (rip rap, check dams) were associated with lower frequency and magnitude of erosion on roads (Wemple, 2013). The incorporation of these management practices into future road projects will improve sediment management in the Boone River and its tributaries.

Of the public lakes in the watershed, sediment management will be the most challenging at Briggs Woods Lake. Sediment management in reservoirs is a complex and expensive undertaking no matter which techniques are used. A perfectly sustainable solution for every situation does not exist, but efforts can be optimized for the particulars of each reservoir. Sediment management strategies for reservoirs should include:

- Watershed Erosion Control
- In-reservoir Water Quality Basins
- Reservoir Shoreline Stabilization
- Removal of Deposited Sediment
- Regular bathymetric surveys (5-10 year schedule) to monitoring lake capacity and sedimentation rates

Based on the information reviewed, it appears the sediment basin above Briggs Woods Lake is providing benefits to lake water quality. However, sediment loads and current storage in the lake and basin are unknown. This information would aid in developing sediment control and remediation strategies specific for this lake.

ACTION STEPS

Several action steps have been identified that should be taken on a sub-watershed scale to achieve overall goals for the watershed. These actions will facilitate planning and the development of implementation strategies for subwatersheds that do not have completed management plans. Priorities should be given to subwatersheds that contain critical habitat for the Topeka shiner. Additional actions have been developed to facilitate sediment management planning and implementation on Briggs Woods and Cornelia lakes.

Boone River Subwatersheds

- Estimate annual sediment loads to the Boone River
- Identify and quantify loads from major sediment sources
- Evaluate the current condition and function of sediment delivery mechanisms including drainage ditches and stormwater outfalls
- Evaluate in a quantifiable manner, the current condition of riparian areas along the Boone River and its tributaries

- Work with county engineers to incorporate sediment control measures into future road projects.

Briggs Woods Lake

- Identify major sediment sources in the watershed
- Quantify annual sediment yield from the lakes watershed
- Quantify annual sediment deposition in the lake
- Quantify the current volume and annual volume loss rates in the existing sediment basin.
- Estimate maintenance needs for current sediment control measures
- Evaluate the need for additional sediment control measures

Lake Cornelia

- Conduct a visual inspection of the lake shoreline to identify any erosion concerns

PROJECT OPPORTUNITIES

Watershed management plans have been completed in four sub-watersheds; Eagle Creek, Eagle Grove, Prairie Creek, and Lyons Creek. These four sub-watersheds total 185,313 acres or 31% of the Boone River Watershed. Projected needs for management measures in the four sub-watersheds mentioned above were used to estimate future needs in the remaining portion of the drainage or approximately 395,873 acres (Table 6). It should be noted that costs associated with reduced tillage were “negative” in all the watershed plans. Additionally, costs associated with nutrient management were “negative” in three of the four plans. Additional practices and updated cost estimates could be provided in the Boone River Watershed Management Plan, if necessary.

Table 6: Estimated need for management practices in the Boone River Watershed

Practice	Units	Estimated Watershed Practice Needs	Expected Cost
Cover crops	Acres	239,120	$18,812,766
No-till/Strip-till	Acres	213,500	-$2,135,000
Nutrient management	Acres	80,169	$60,127
Prairie strips	Acres	3,544	$1,049,054
Drainage Water Management	Acres	2,135	$2,135,000
Buffers & Filter Strips	Acres	854	$1,131,550
Conversion of Cropland	Acres	427	$128,100
Pasture Management	Acres	320	$94,154
Bioreactors	Structures	265	$2,614,308
Saturated Buffers	Structures	203	$608,475
Wetlands	Sites	53	$20,794,006
Oxbow restorations	Sites	90	$717,360
Total Cost	**-**	**-**	**$46,009,899**

EDUCATION STRATEGIES

It is imperative that all resource managers, decision makers, and general public understand the value of plant and animal communities, related issues, management tools, and costs associated with the protection and restoration resources. This can only be achieved through continuous communication, education, information transfer, and monitoring and assessment. Specific education strategies should be considered within the context of the overall goals and recommendations in the Boone River Watershed Management Plan. Therefore, the development of education strategies should be completed after watershed goals have been finalized.

Targeted projects in sub-watershed should be developed with input from landowners, producers, and residents along with resource professionals. The process of developing targeted plans can serve as an opportunity to educate the public. Education strategies developed for current projects should be used as a starting point for new projects.

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