West Buttrick Creek Watershed Plan

A roadmap to sustain and improve agricultural productivity, Water quality, habitat, and soil health in the West Buttrick Creek Watershed

Prepared by:

IOWA SOYBEAN Association

August 2020

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A guide for water quality and soil health in the West Buttrick Creek Watershed

Developed by

Funded by

Planning partners

Watershed farmers, landowners and residents
Greene County Soil and Water Conservation District
USDA-Natural Resources Conservation Service
Iowa Soybean Association

This material is based upon work supported by the Natural Resources Conservation Service, U.S. Department of Agriculture, under number NR186114XXXXC004.

This document not funded by the soybean checkoff. Project matching funds partially funded by the soybean checkoff.

Contents

1. Summary

The West Buttrick Creek Watershed encompasses 26,097 acres in central Iowa (Figure 1.1). The watershed is a sub-watershed of the North Raccoon Watershed and includes the area of land that drains to and through the lower portion of West Buttrick Creek upstream of its confluence with East Buttrick Creek. As a North Raccoon sub-watershed, the West Buttrick Creek Watershed is supported by the North Raccoon River Watershed Management Coalition.

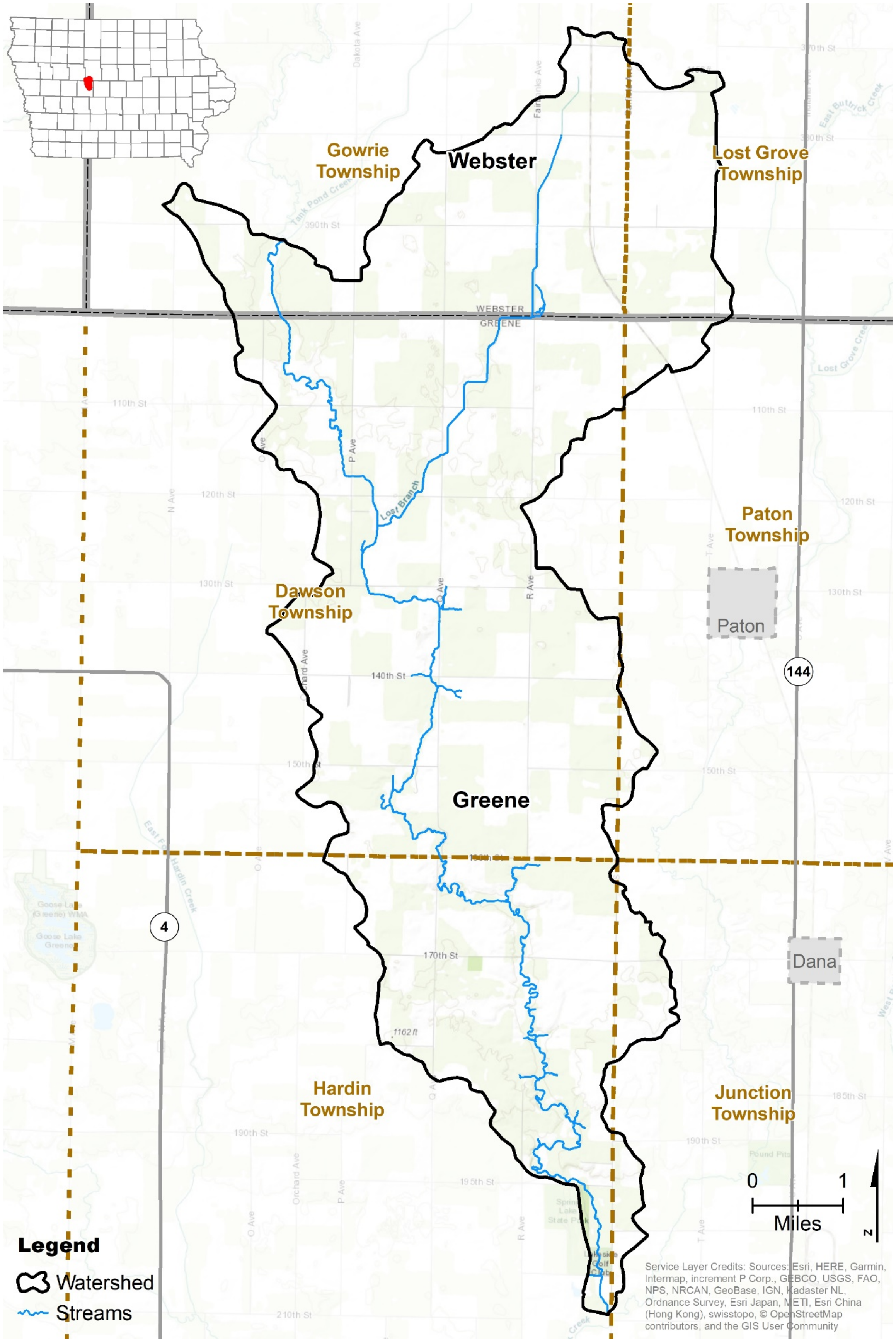

Figure 1.1. The West Buttrick Creek Watershed is located in Greene and Webster counties in central Iowa.

The West Buttrick Creek Watershed Plan was developed to support local stakeholders to establish goals, develop partnerships, and identify an action plan. The watershed plan is intended to provide guidance for land and water improvements while simultaneously enhancing agricultural sustainability and vitality. This document integrates existing datasets, assessment and mapping, and stakeholder input. The plan is designed to incorporate and address input from the watershed community. The community-based planning process integrated with data analysis and research synthesis was used to develop goals, objectives, and action steps for stakeholders and partners in the West Buttrick Creek Watershed. The goals established by watershed stakeholders are to:

1. Improve water quality.
2. Increase resilience of water management.
3. Build soil health.
4. Inform farmers and public of conservation practices and initiatives.

The primary natural resource concerns in the West Buttrick Creek Watershed are water quality and soil health, which include loss of nutrients and sediment to and through West Buttrick Creek. Priority conservation practices identified by stakeholders include nutrient management, no-till, cover crops, crop diversification, wetlands, saturated buffers, bioreactors, and grassed waterways. A combination of these conservation actions will be needed to fully meet local and statewide water quality goals.

The total investment needed to attain necessary levels of conservation adoption is estimated to be $1,585,000 for practice construction plus up to $586,500 per year. If fully implemented, it is anticipated that farmers and landowners would not only locally attain Iowa Nutrient Reduction Strategy goals but also would further reduce soil erosion, build soil health, and reduce flooding.

2. Watershed Characteristics

2.1. General Information

The West Buttrick Creek Watershed is a 26,097-acre (41-square mile) area of land located in Webster and Greene counties. There are no incorporated communities in the watershed. The population as of the 2010 census is estimated to be 159. General watershed information is listed in Table 2.1.1. The West Buttrick Creek Watershed is a 12-digit hydrologic unit code (HUC-12) watershed within the larger Buttrick Creek Watershed. Buttrick Creek flows into the North Raccoon River (Figure 2.1.1).

Table 2.1.1. General information about the West Buttrick Creek Watershed.

Location	Greene and Webster counties, Iowa
Population	159
Watershed Area	26,097 acres
Predominant Land Use	Agriculture
HUC-12 Watershed	West Buttrick Creek
HUC-12 ID	071000061203
HUC-10 Watershed	Buttrick Creek
HUC-10 ID	0710000612
HUC-8 Watershed	North Raccoon
HUC-8 ID	07100006

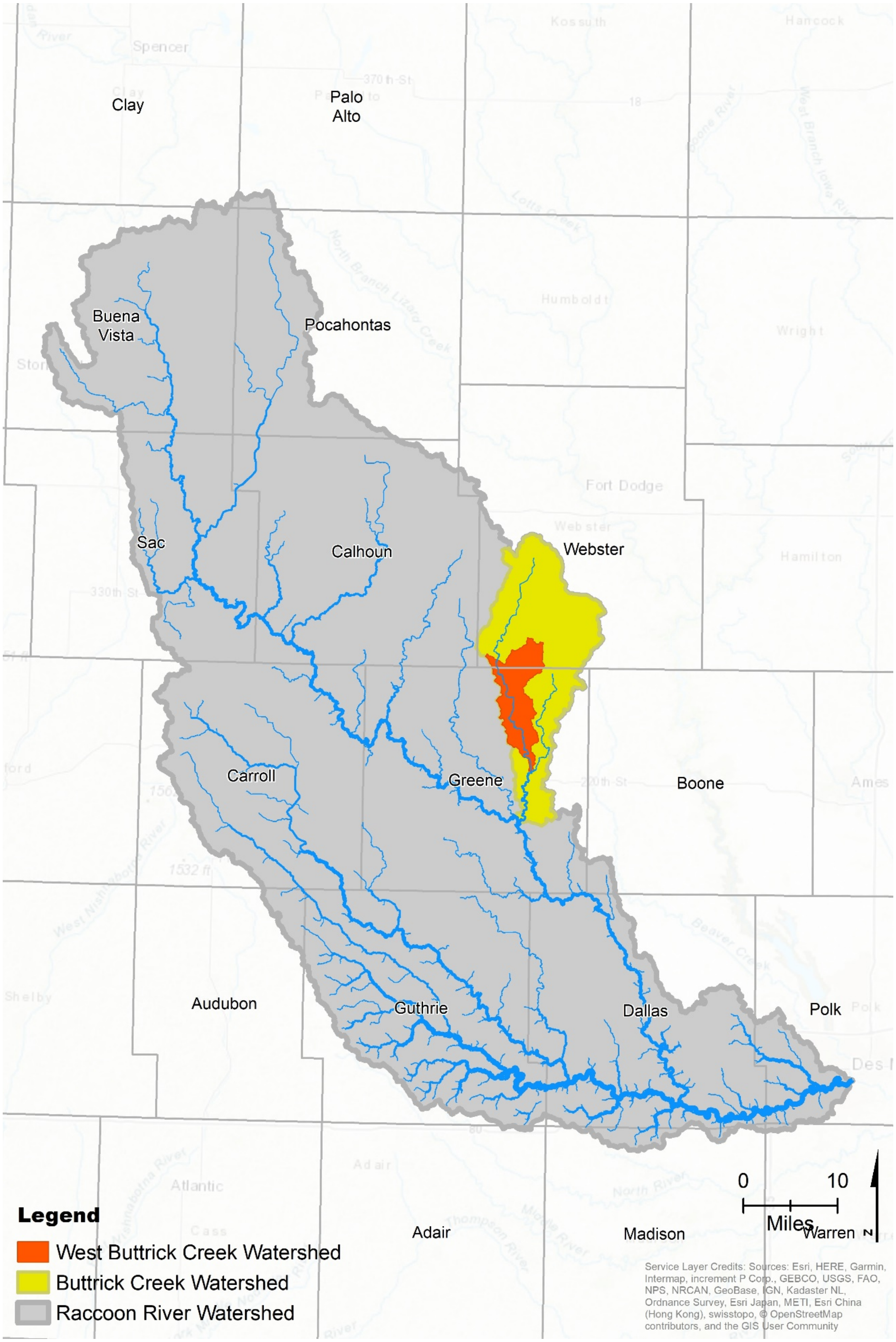

Figure 2.1.1. The West Buttrick Creek Watershed is nested within the Buttrick Creek and Raccoon River watersheds.

Agriculture is the primary land use. According to public records, there are 237 landowners of agricultural land in the watershed. Of that agricultural land, 61 percent is owned by landowners living in or near the watershed, 24 percent is owned by other Iowa residents, and 14 percent is owned by out-of-state landowners.

2.2. Water Resources

Surface water in the watershed includes West Buttrick Creek and Lost Branch (Table 2.2.1). West Buttrick Creek has use designations including primary contact recreation and warm aquatic life. Lost Branch does not have designated uses, and therefore does not have completed assessments. According to the National Wetlands inventory, there are 1,059 acres of wetlands in the watershed, which includes 1,055 acres that are flooded or exposed intermittently, temporarily or seasonally.

Table 2.2.1. Streams and assessment information for the West Buttrick Creek Watershed (source: Iowa Department of Natural Resources).

Waterbody	West Branch Buttrick Creek
ADB Code	IA 04-RAC-1151
Legacy Code	IA 04-RAC-0080_0
Segment Length	24.2 miles
Use Designations	A1 (recreation), B(WW-2) (warm water aquatic life)
Impairments	none
Tributaries	Lost Branch
Total Streams Length	31 miles

2.3. Climate and Hydrology

Precipitation data show that for the most recent 30 years of record, total precipitation at Jefferson, Iowa, averaged 35.6 inches per year for water years 1990 through 2019, with a range of 20.2 to 49.3 inches per year (Figure 2.3.1). Monthly precipitation in the watershed tends to peak during the months of May through August, with each of these months averaging at least 4 inches of precipitation from 1990 through 2019 (Figure 2.3.2).

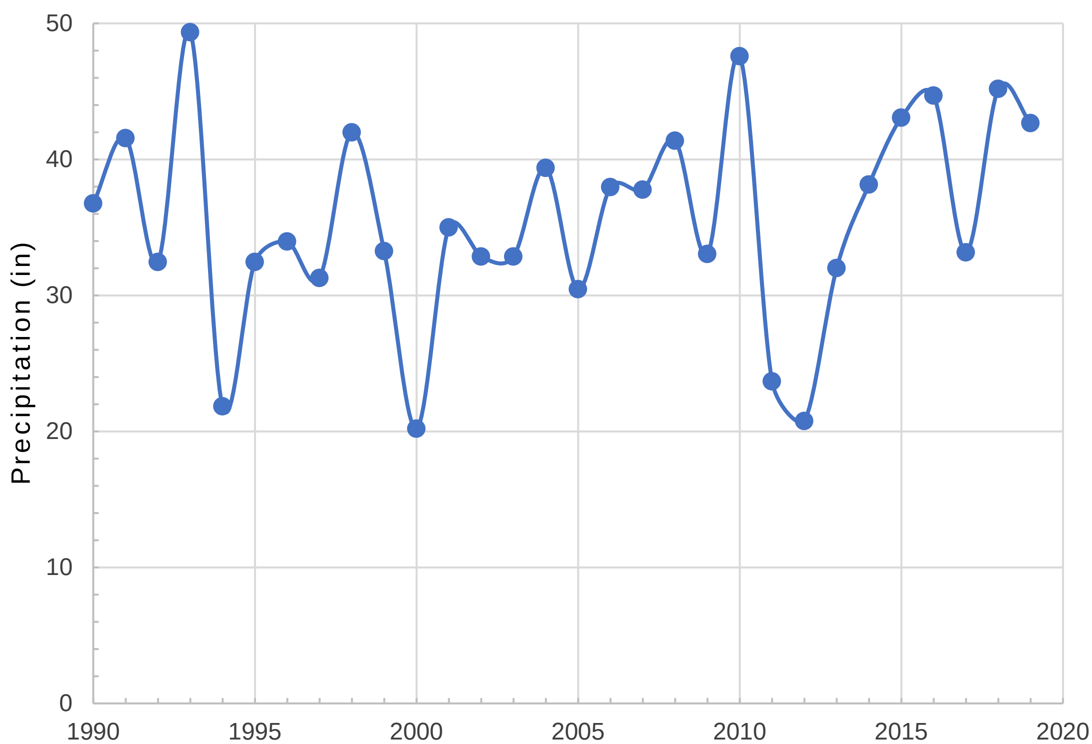

Figure 2.3.1. Precipitation at Jefferson, Iowa, averaged 35.6 inches per year for water years 1990 through 2019 (source: Iowa Environmental Mesonet). A water year extends from October 1 of the previous calendar year through September 30.

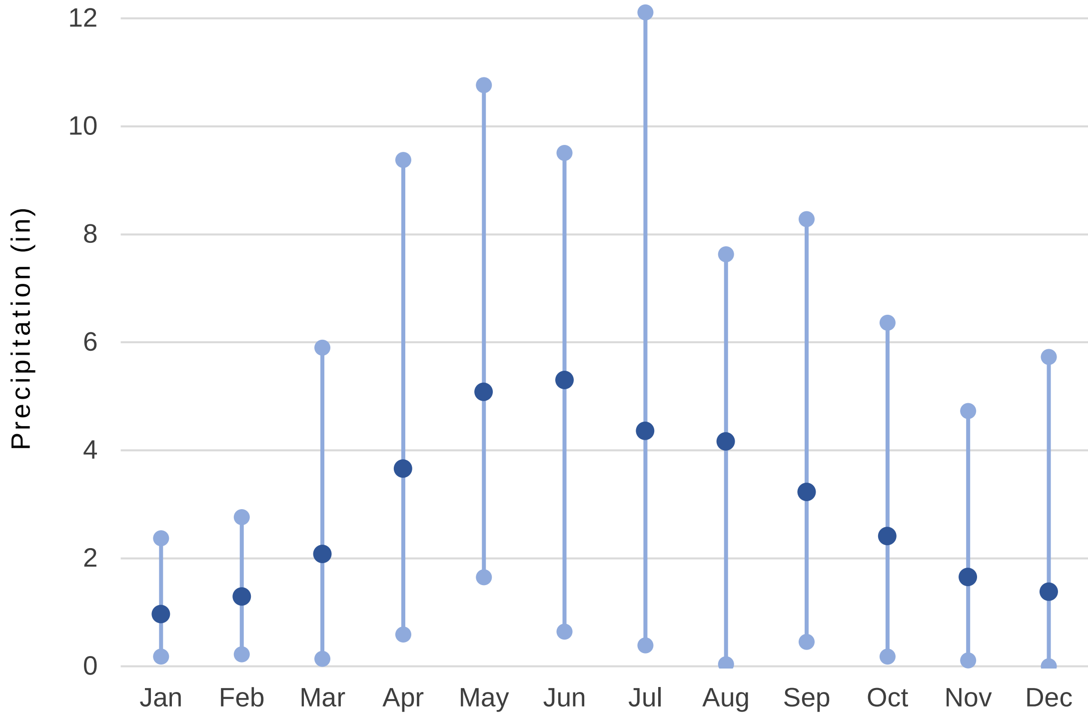

Figure 2.3.2. Monthly average precipitation at Jefferson, Iowa, from water years 1990 through 2019. Bold circles indicate mean, and lower and upper bounds denote 30-year minimum and maximum, respectively (source: Iowa Environmental Mesonet).

2.4. Landscape

The West Buttrick Creek Watershed is located in Major Land Resource Area (MLRA) 103 Central Iowa and Minnesota Till Prairies. The watershed also is located in ecoregion 47b Des Moines Lobe, which also is the name of the Iowa landform region. The landscape contains flat to gentle slopes with a moderately well developed surface drainage network. The landscape is characterized by prairie pothole depressions. Glacial till is the primary geologic parent material. Approximately 9 percent of the watershed contains alluvial deposits.

Land surface elevation in the West Buttrick Watershed ranges from 1,002 to 1,164 feet above sea level (Figure 2.4.1). Slopes are quite gentle throughout the watershed, with 89 percent of the watershed having a slope of 5 percent or less (Table 2.4.1 and Figure 2.4.2).

Table 2.4.1. Extent of each slope class within the West Buttrick Creek Watershed.

Slope Class	Range	Acres	Percent
A	0-2%	14,211	54.5%
B	2-5%	9,061	34.7%
C	5-9%	1,790	6.9%
D	9-14%	510	2.0%
E	14-18%	179	0.7%
F	18-25%	176	0.7%
G	> 25%	171	0.7%

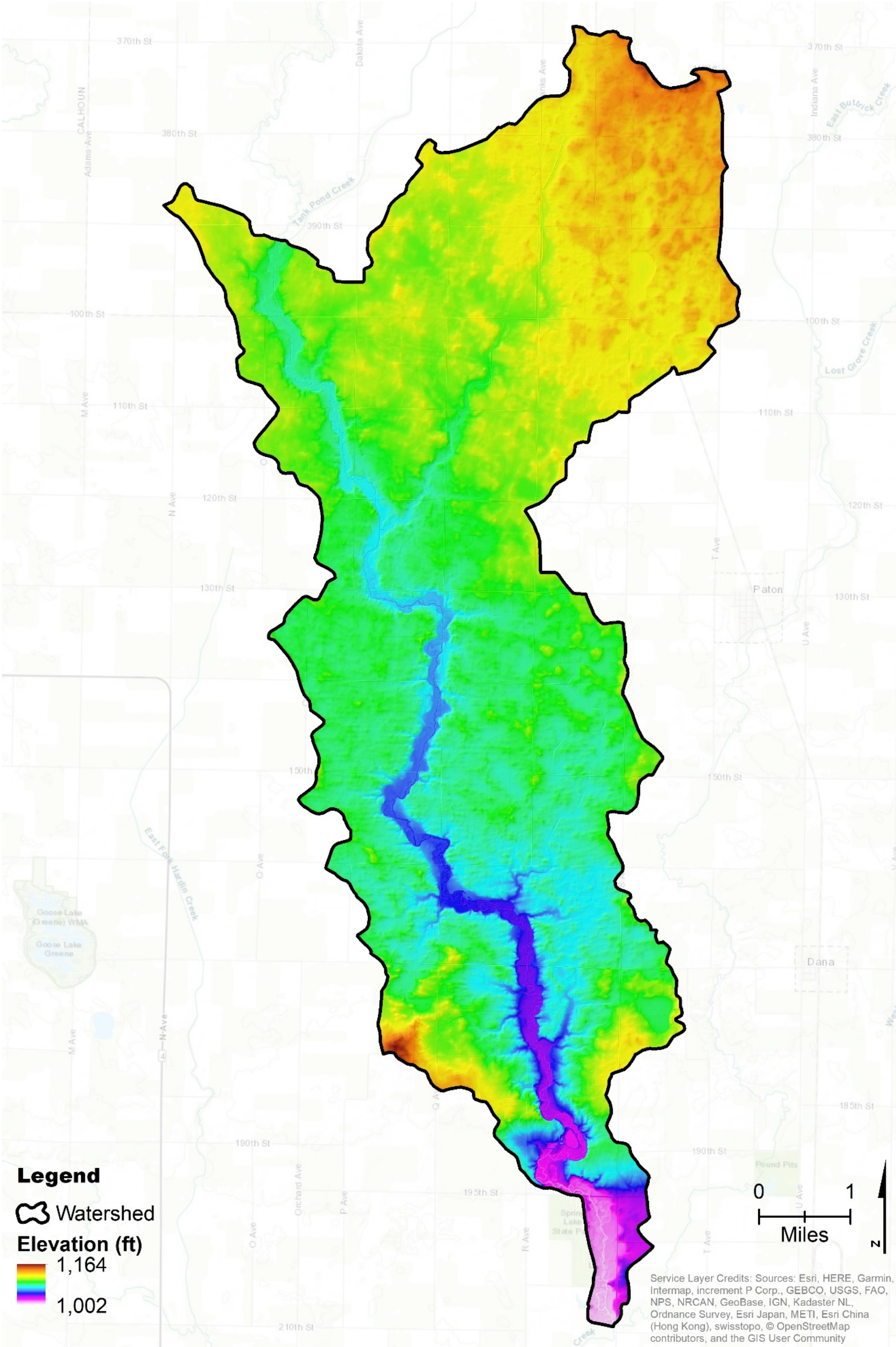

Figure 2.4.1. Elevation in the West Buttrick Creek Watershed derived from a high-resolution digital elevation model.

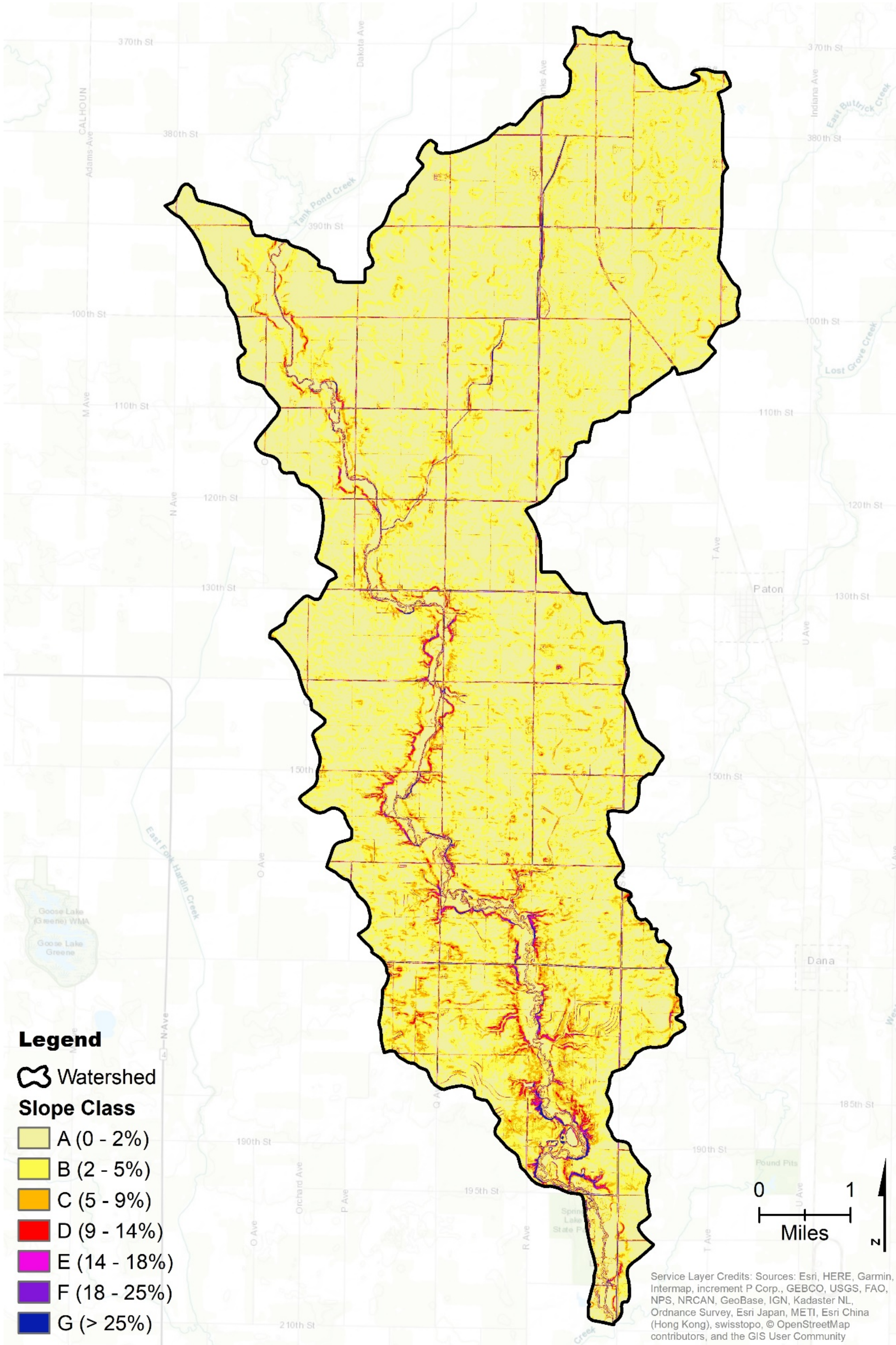

Figure 2.4.2. Slope classifications in the West Buttrick Creek Watershed derived from elevation data.

2.5. Soils

The predominant soil association in the watershed is Clarion-Nicollet-Webster. These soils formed in glacial till. Native vegetation was prairie grass. Soils in the watershed are generally poorly drained. Common soils in the West Buttrick Creek Watershed are shown in Figure 2.5.1. The most abundant soil series mapped in the watershed include Webster, Clarion, Canisteo, and Nicollet, which together comprise 71 percent of the watershed (Table 2.5.1).

Table 2.5.1. Descriptions of common soils in the West Buttrick Creek Watershed (source: quoted directly from USDA-NRCS Official Soil Series Descriptions).

Series	Description
Webster	Very deep, poorly drained, moderately permeable soils formed in glacial till or local alluvium derived from till on uplands. Slope ranges from 0 to 3 percent.
Clarion	Very deep, moderately well drained soils on uplands. These soils formed in glacial till. Slopes range from 1 to 9 percent.
Canisteo	Very deep, poorly and very poorly drained soils that formed in calcareous, loamy till or in a thin mantle of loamy or silty sediments and the underlying calcareous, loamy till. These soils are on rims of depressions, depressions and flats on moraines or till plains. Slope ranges from 0 to 2 percent.
Nicollet	Very deep, somewhat poorly drained soils that formed in calcareous loamy glacial till on till plains and moraines. Slopes range from 0 to 5 percent.

Soil drainage properties affect surface and subsurface water movement in the watershed. Approximately 75 percent of the soils in the watershed are classified as hydric (Figure 2.5.2). While public records of subsurface tile drainage are sparse, it is likely that tile drainage is common throughout the watershed (Figure 2.5.3). Regardless of drainage status, most soils in the watershed are very productive (Figure 2.5.4).

Some soil map units in the watershed are designated as highly erodible land (Figure 2.5.5). According to Daily Erosion Project data, hillslope soil loss as a result of sheet and rill erosion averaged 0.45 tons per acre per year from 2009 through 2018. Soil erodibility factors and digital elevation model-derived topographic factors for the Revised Universal Soil Loss Equation were used to map locations of relative soil erosion risk (Figure 2.5.6). The sediment delivery ratio for the West Buttrick Creek Watershed is 35 percent, which represents the fraction of eroded upland sediment delivered to the watershed outlet.

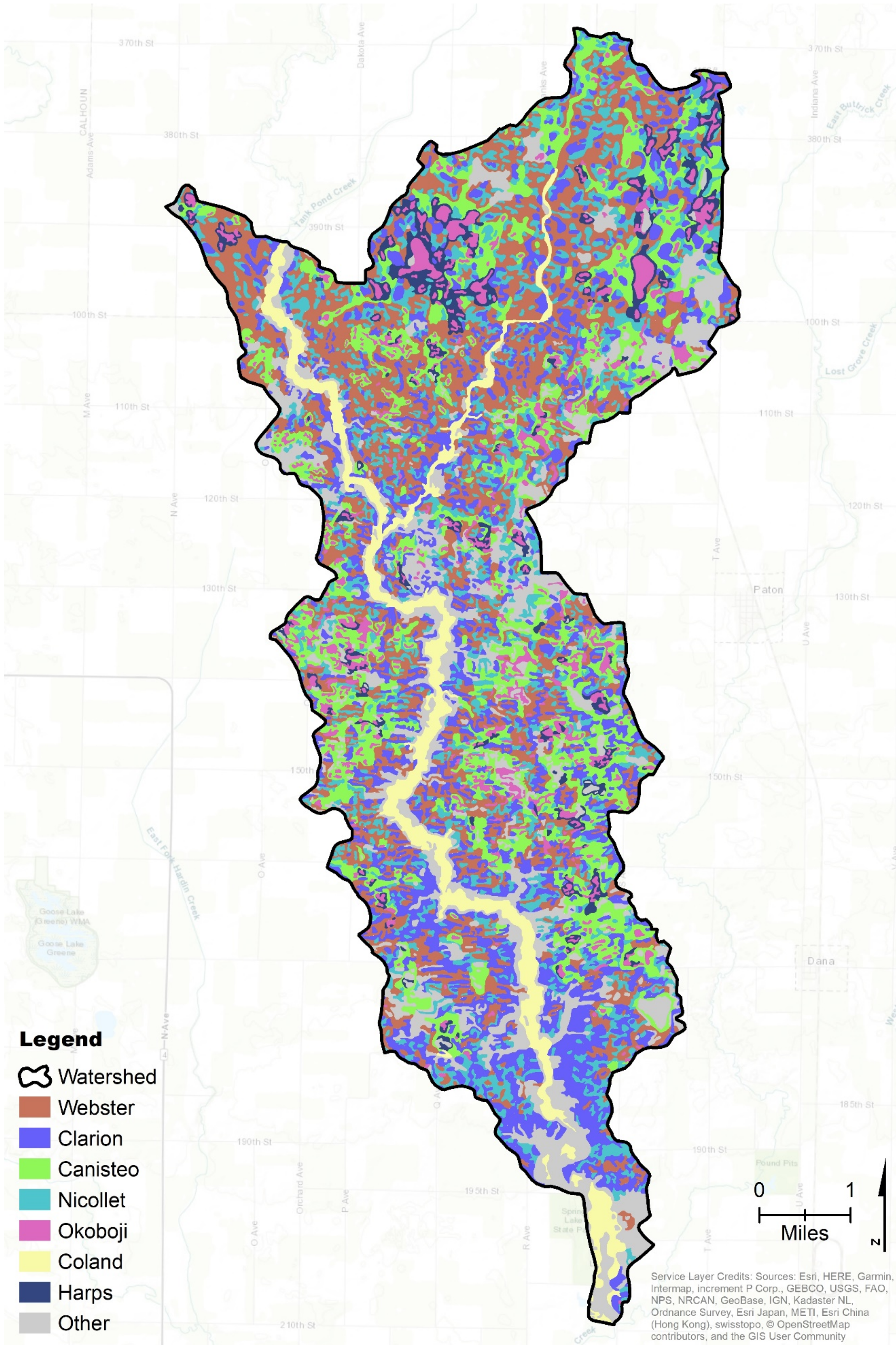

Figure 2.5.1. West Buttrick Creek Watershed soil map (source: Soil Survey Geographic Database).

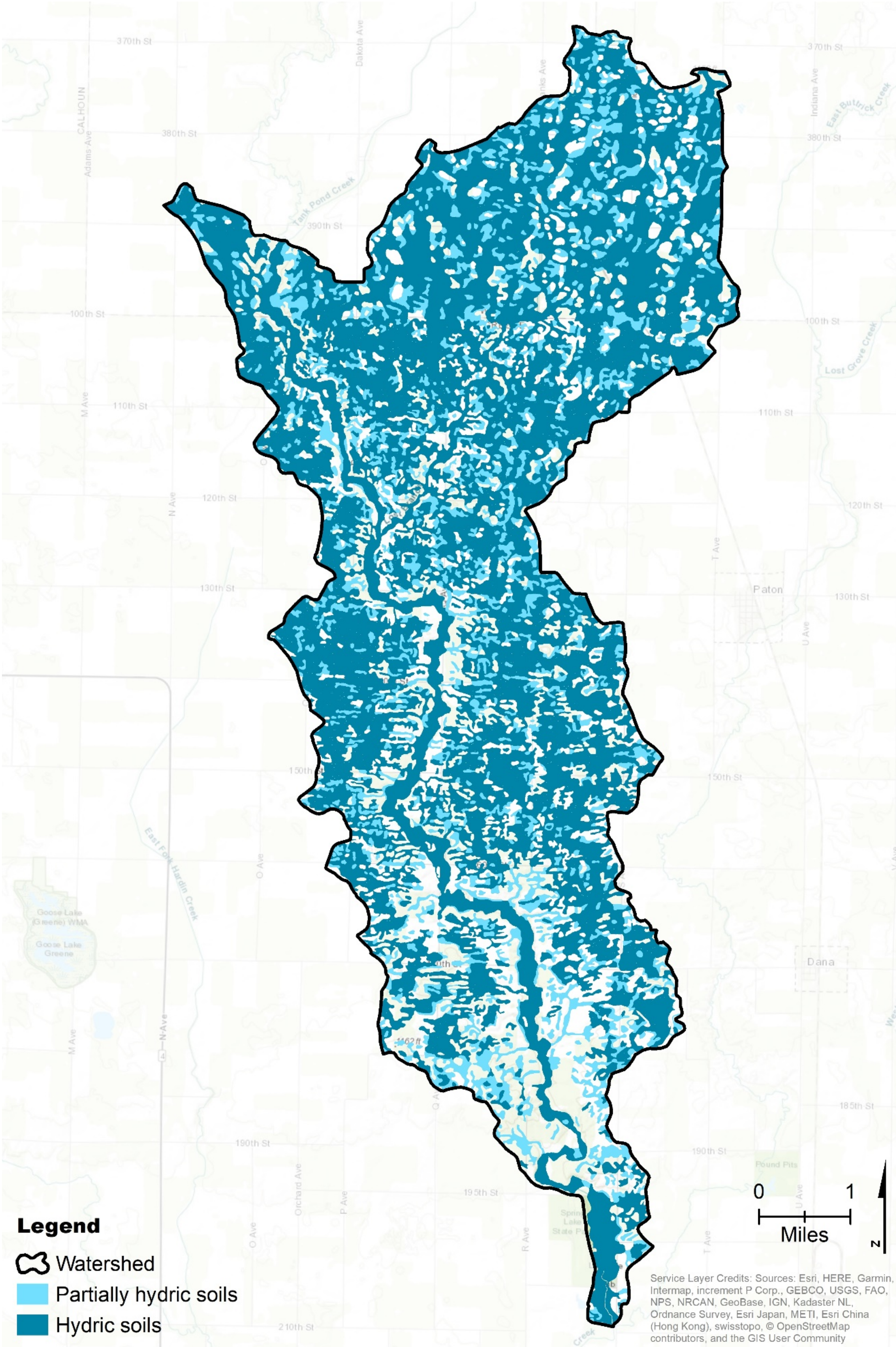

Figure 2.5.2. Hydric soils of the West Buttrick Creek Watershed.

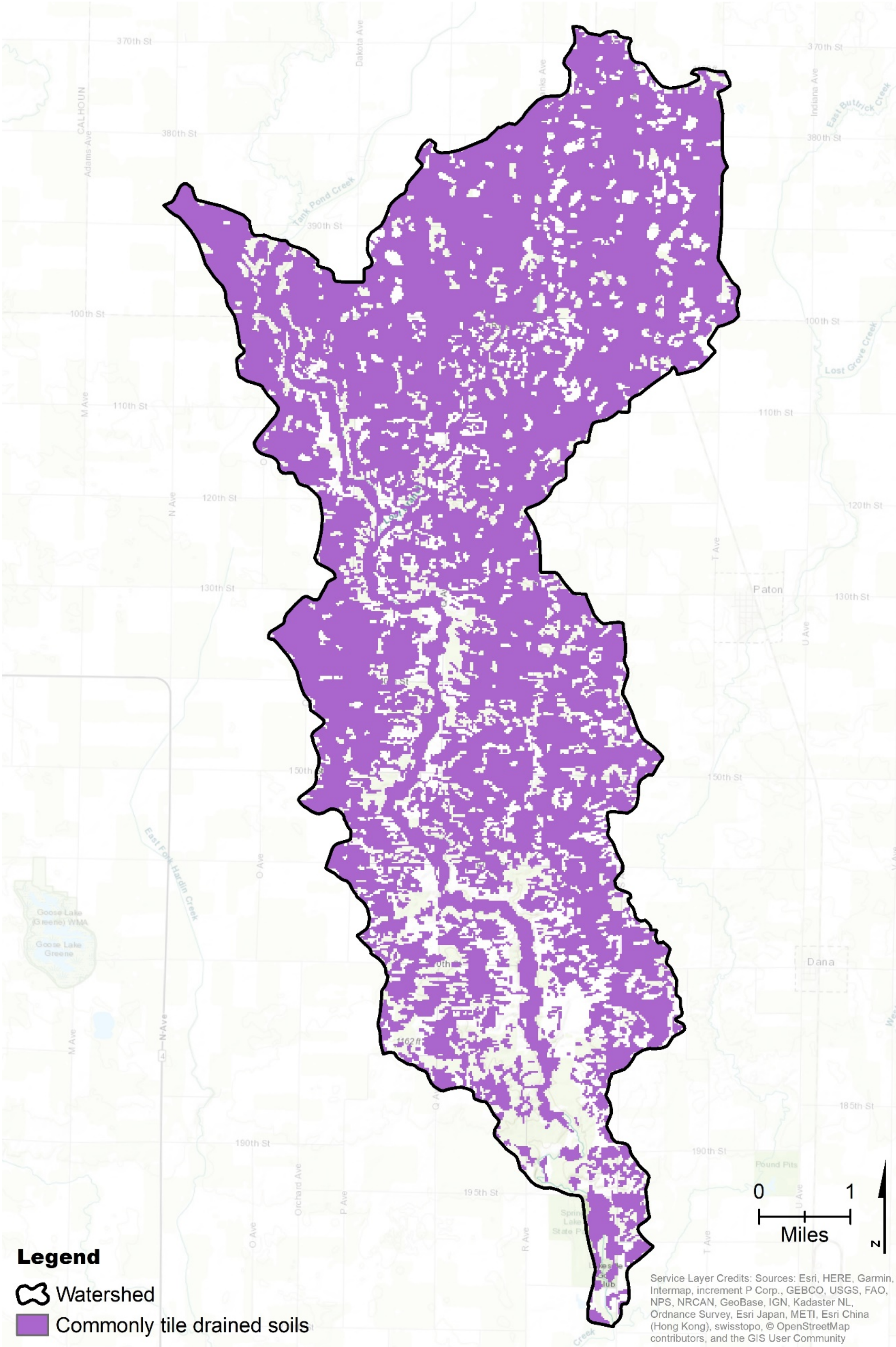

Figure 2.5.3. Soil types in the West Buttrick Creek Watershed that typically are artificially drained.

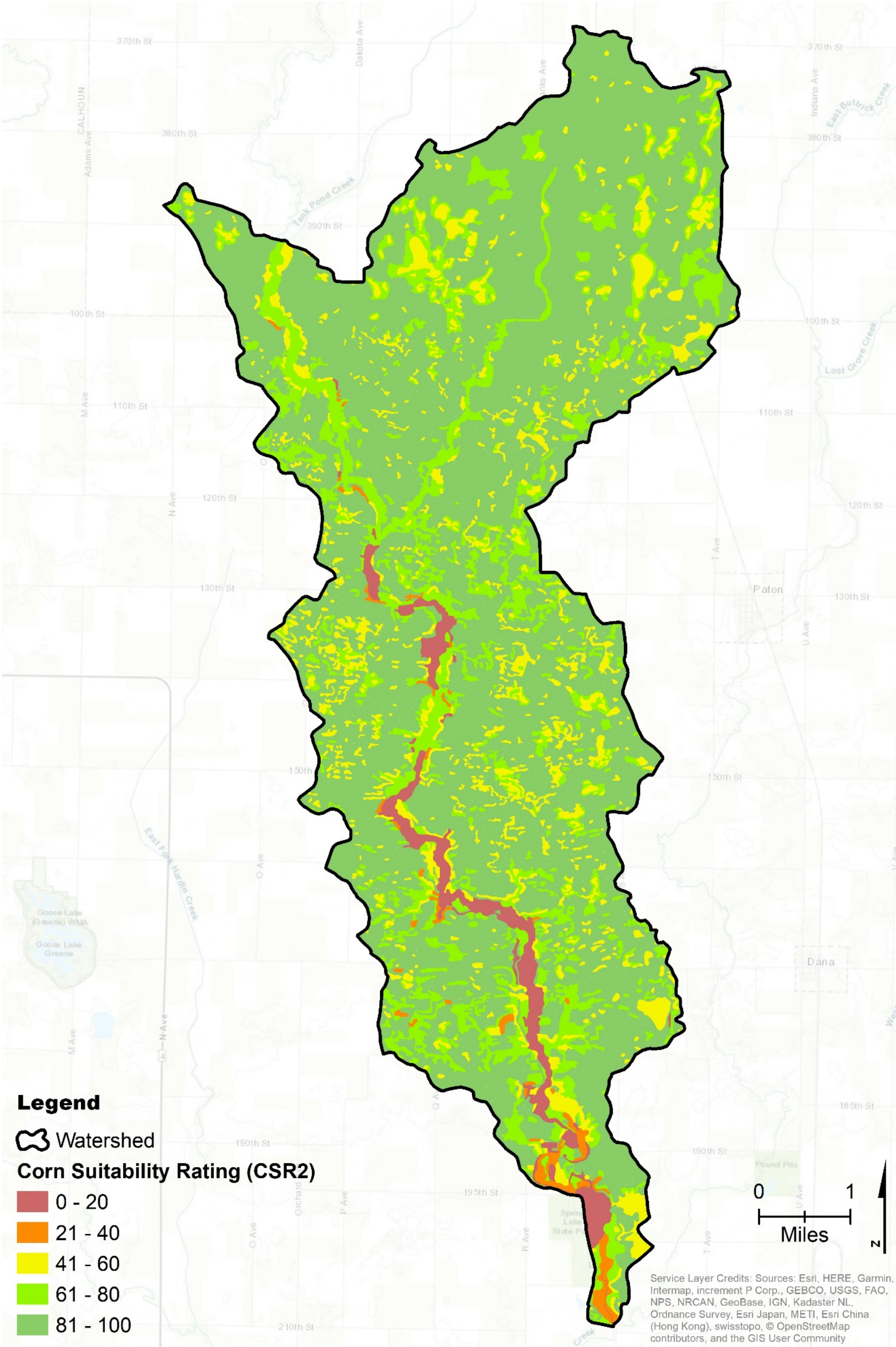

Figure 2.5.4. Corn suitability ratings (CSR2) values are very high for land in the West Buttrick Creek Watershed (source: Iowa Soil Properties and Interpretations Database).

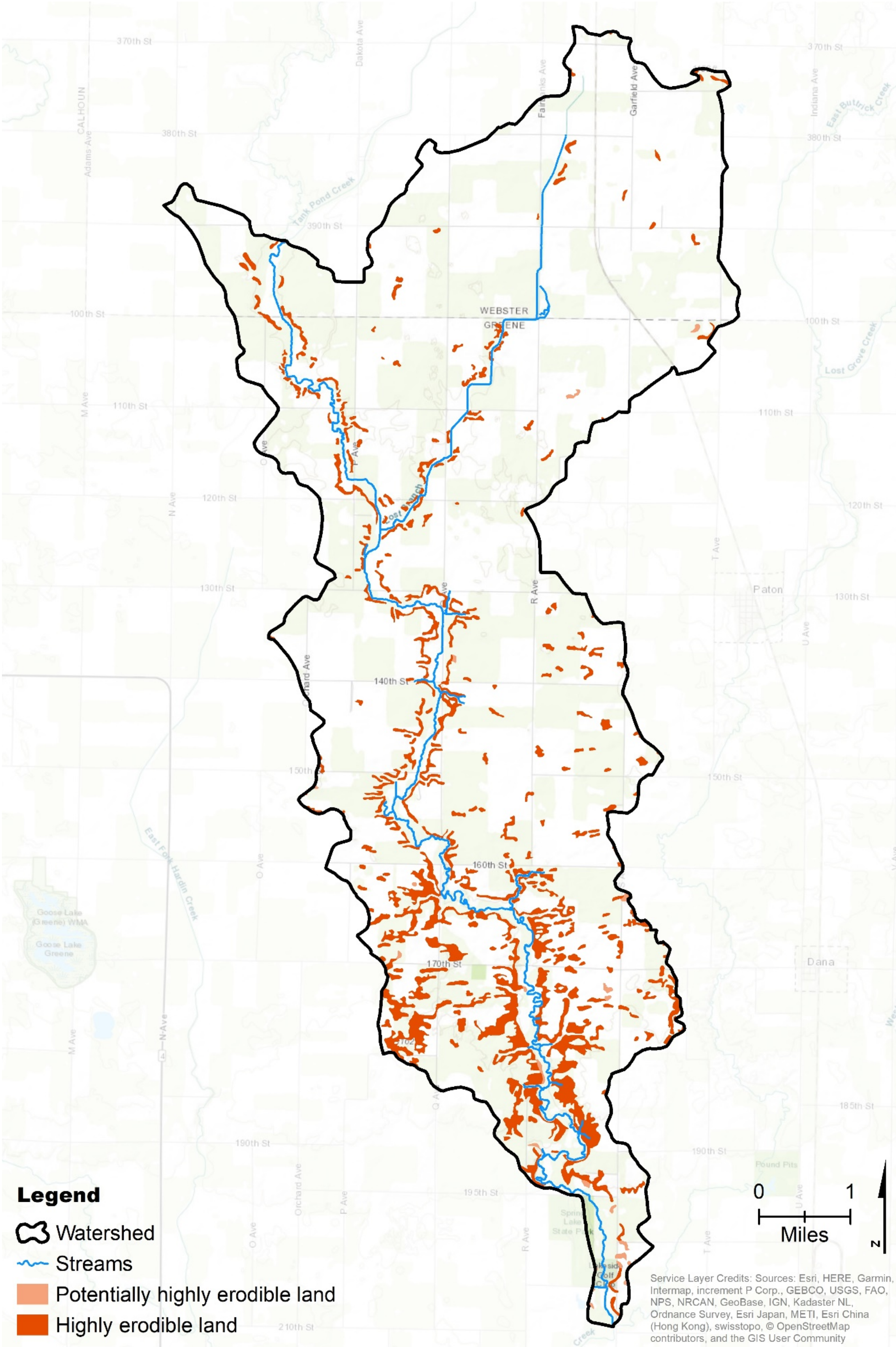

Figure 2.5.5. Highly erodible land in the West Buttrick Creek Watershed.

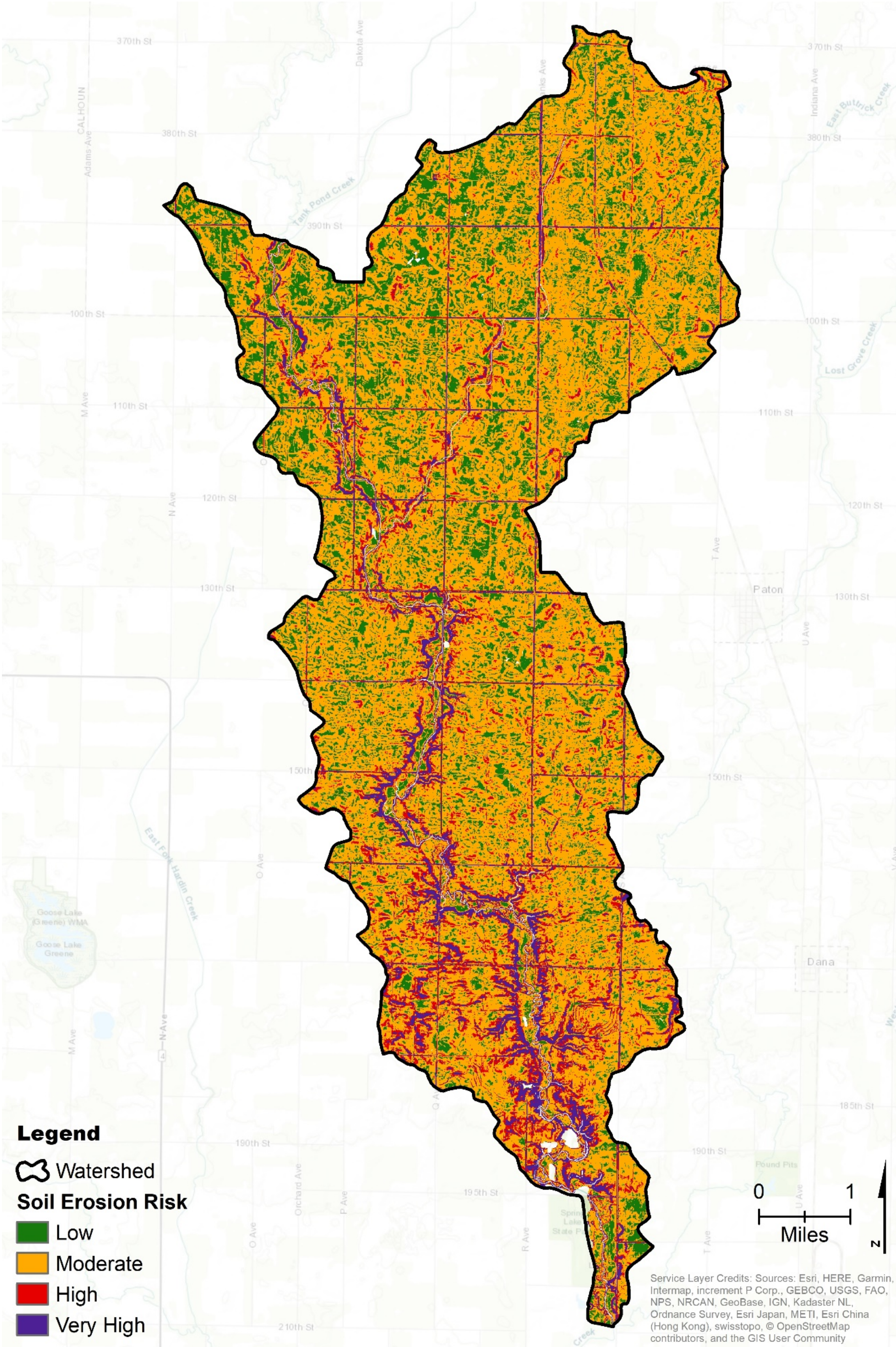

Figure 2.5.6. Soil erosion risk naturally varies throughout the watershed based on topography and soil properties.

2.6. Land Use

Native vegetation the West Buttrick Creek Watershed was primarily prairie (98 percent), along with water and wetlands (2 percent) and some forest (less than 1 percent) (Figure 2.6.1). Presently, land in the watershed is used primarily for agriculture. According to the USDA-National Agricultural Statistics Service, on average 88 percent of land in the watershed was used for corn and soybean production from 2009 through 2018 (Table 2.6.1). High-resolution land use for the West Buttrick Creek Watershed is shown in Figure 2.6.2.

Table 2.6.1. Typical land use in the West Buttrick Creek Watershed based on 2009 through 2018 averages (source: Cropland Data Layer).

Land Use	Acres	Percent
Corn/Soybeans	22,838	88%
Grass/Pasture	1,547	6%
Forest	251	1%
Water/Wetlands	219	1%
Developed	1,198	5%
Other	45	<0.2%
Total	26,097	100%

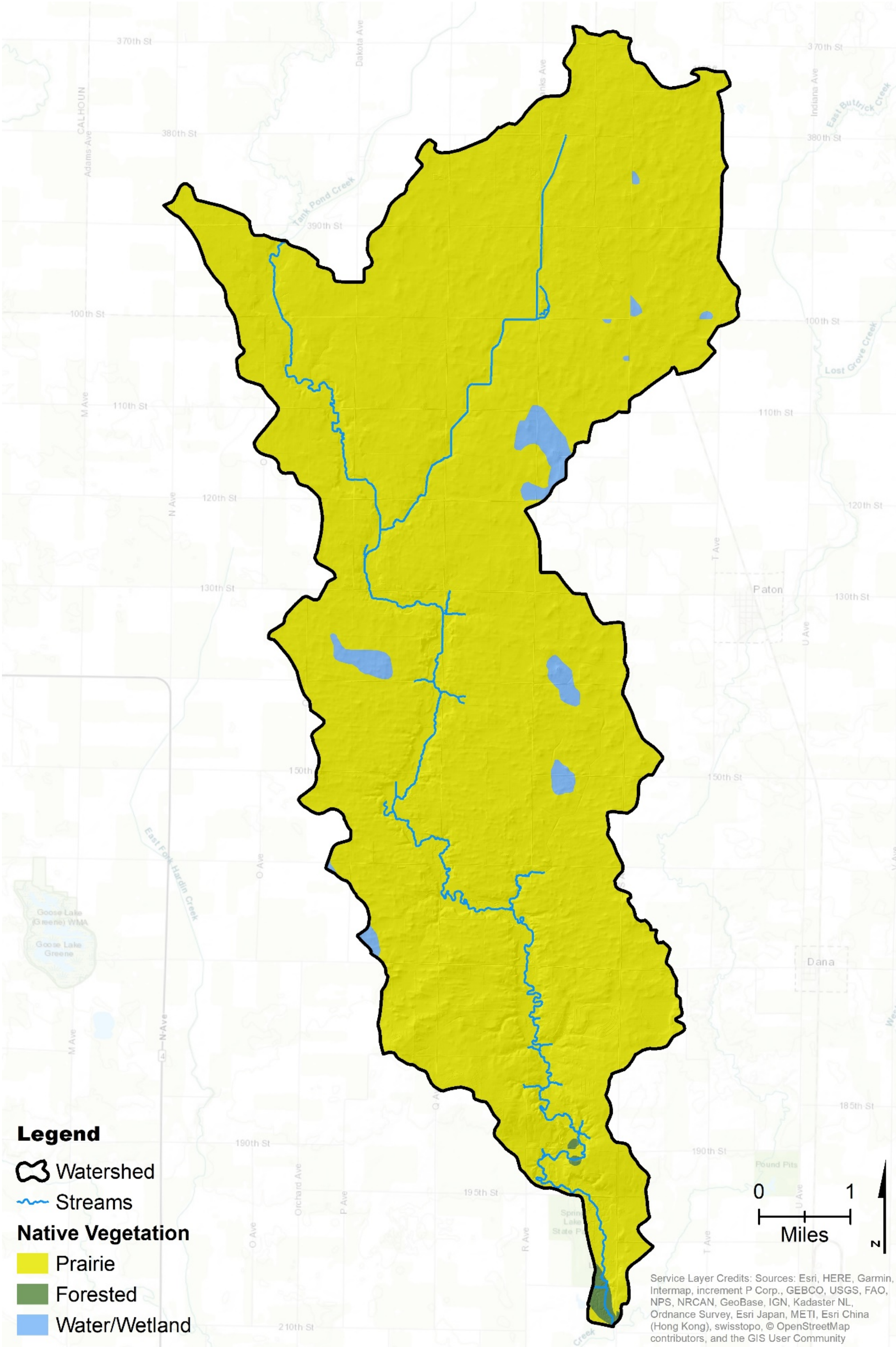

Figure 2.6.1. Native vegetation in the West Buttrick Creek Watershed was primarily prairie.

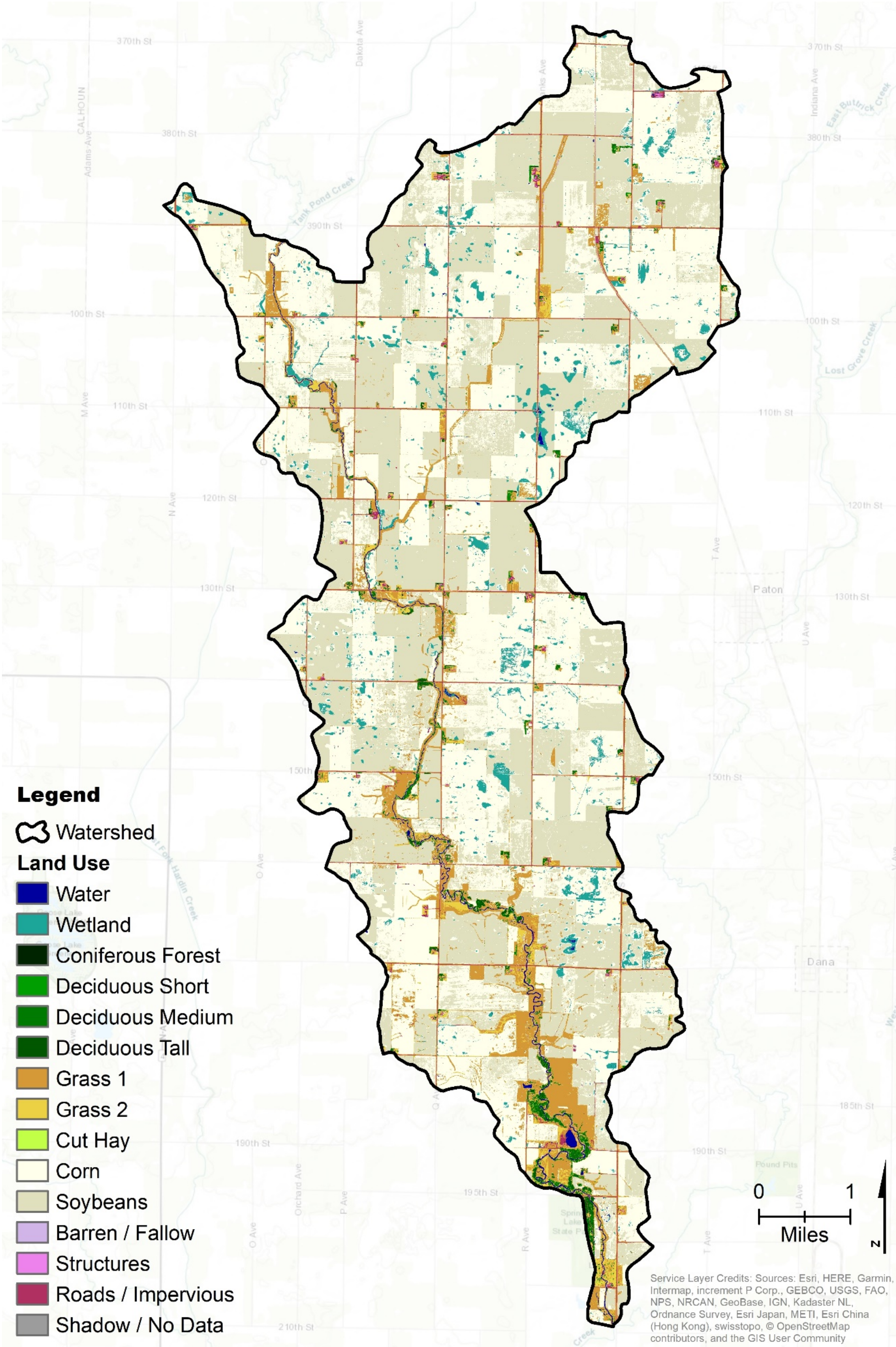

Figure 2.6.2. High-resolution land use in the West Buttrick Creek Watershed. The interpretation year is 2009, as land use classes were mapped based on multi-year aerial imagery and high-resolution digital elevation models (source: Iowa Department of Natural Resources).

2.7. Conservation

Much conservation infrastructure and management already is in place in the West Buttrick Watershed (Figure 2.7.1). An inventory of conservation practices was completed by integrating a 2019 field assessment of in-field practices with locations of constructed practices identified through the Iowa Best Management Practices Mapping Project (Table 2.7.1). While it is difficult to capture all agronomic conservation practices, watershed residents and stakeholders confirmed that these estimated adoption levels are accurate.

Table 2.7.1. Inventory of agronomic and constructed conservation practices in the West Buttrick Creek Watershed (source: Iowa Best Management Practices Mapping Project).

Practice	Quantity	Unit
N management	1,300	acres
No-till	3,200	acres
Cover crops	200	acres
Wetlands	1	sites
Bioreactors	1	sites
Grassed waterways	119,400	feet
Terraces/basins	46,700	feet
Ponds	4	sites
CRP	850	acres
Public land	55	acres

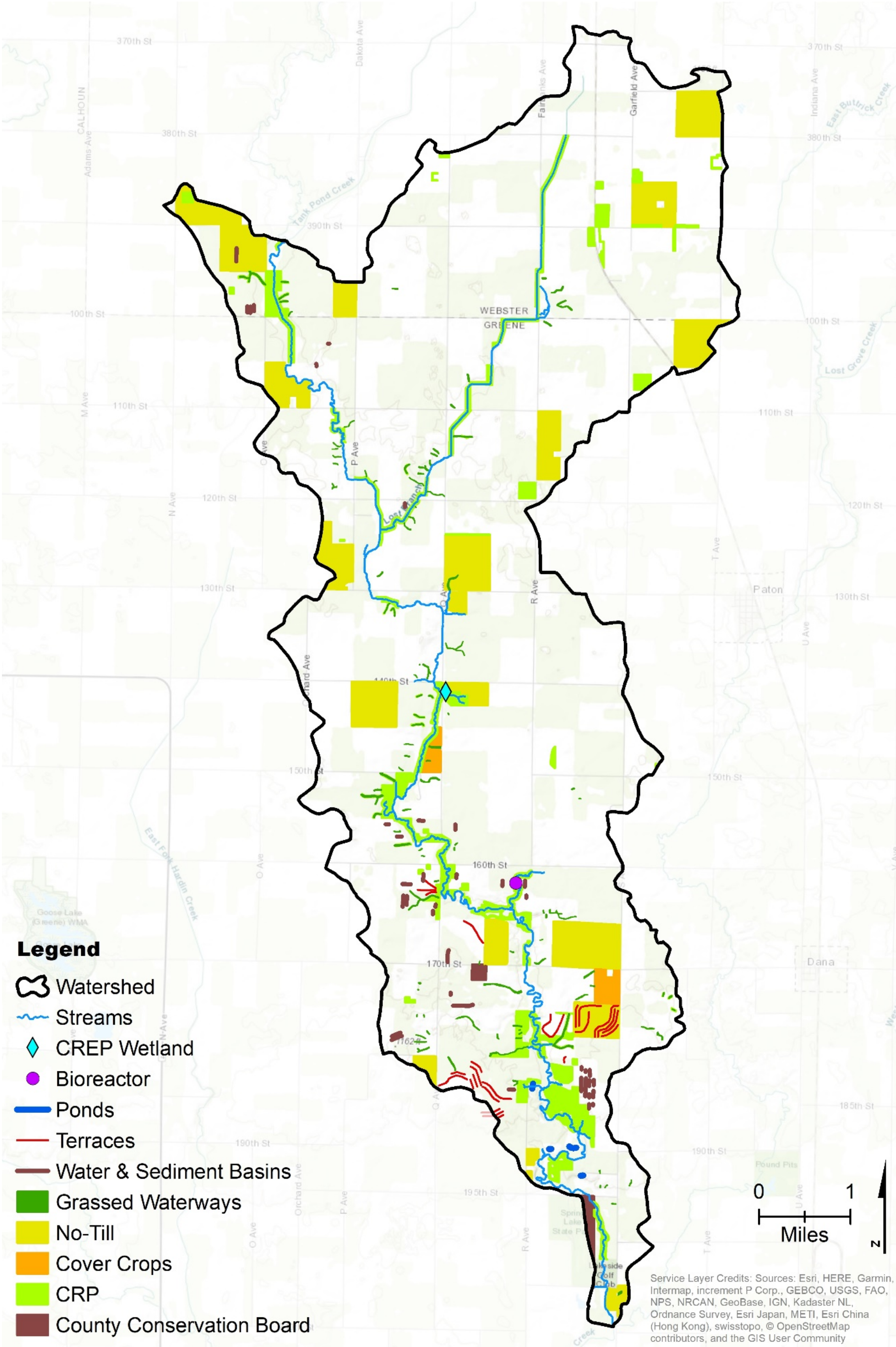

Figure 2.7.1. Conservation practices with known locations in the West Buttrick Watershed (source: Iowa Best Management Practices Mapping Project).

3. Water Quality Conditions

3.1. Resource Concerns

The water quality constituents of interest in the West Buttrick Creek Watershed include sediment, phosphorus, and nitrogen (Table 3.1.1). In addition to soil conservation to enhance agricultural productivity and local surface water quality, nitrogen and phosphorus transport is a high priority due to the Iowa Nutrient Reduction Strategy (INRS). The INRS provides a scientific and technological framework for agriculture, industries, and communities in Iowa to reduce nitrogen and phosphorus loss to Iowa and downstream waters.

Table 3.1.1. Water quality constituents of concern in the West Buttrick Creek Watershed include nitrogen, phosphorus, and sediment.

Constituent	Context
Nitrogen	Local stakeholder goal and Iowa Nutrient Reduction Strategy
Phosphorus	Local stakeholder goal and Iowa Nutrient Reduction Strategy
Sediment	Local stakeholder goals to address water quality and soil health resource concerns

3.2. Water Quality

Water quality monitoring data for the Buttrick Creek Watershed are available from Agriculture's Clean Water Alliance. Samples have been collected from Buttrick Creek since 1999, and are indicative of overall conditions across the Buttrick Creek Watershed, including West Buttrick Creek. The 1999 through 2019 average nitrate concentration was 11.8 mg/L (as nitrogen), and the 2001 through 2019 average orthophosphate concentration was 0.18 mg/L (as phosphorus). Monitoring data, assessment information from the ADBNet and BioNet databases for West Buttrick Creek, and estimated nutrient loss and erosion rates are provided in Table 3.2.1.

Table 3.2.1. Use designations, assessment details, biological and chemical water quality, and watershed-scale nutrient and sediment yields and loads for the West Buttrick Creek Watershed (sources: Agriculture's Clean Water Alliance, Iowa Department of Natural Resources, Daily Erosion Project).

Parameter	Value	Interpretation and Details
Class A1	Not assessed	
Class B(WW-2)	Partially supporting	Potentially impaired and in need of furter investigation
FIBI	77	Excellent (FIBI, fish index of biotic integrity)
BMIBI	51	Fair (BMIBI, benthic macroinvertebrate index of biotic integrity)
NO3-N (mg/L)	11.8	Nitrate as nitrogen (N), 1999 to 2019 average
Ortho-P (mg/L)	0.18	Ortho-phosphorus as phosphorus (P), 2001 to 2019 average
NO3-N yield (lb/ac/yr)	30.1	
P yield (lb/ac/yr)	0.16	Integrates soil erosion, sediment delivery ratio, and P enrichment ratio
Soil loss (t/ac/yr)	0.45	Sheet and rill erosion transported from hillslopes
Nitrate-N load (lb/yr)	686,280	Baseline nitrogen loss
P load (lb/yr)	3,623	Baseline phosphorus loss
Soil erosion (t/yr)	10,351	Baseline sheet and rill erosion

As the majority land use in the watershed, agriculture is the primary source of nitrogen, phosphorus, and sediment loss from uplands in the watershed. Critical source areas have been identified for these priority water resource constituents (Figure 3.2.1). These areas were prioritized through an analysis of soil, topographic, and hydrologic factors.

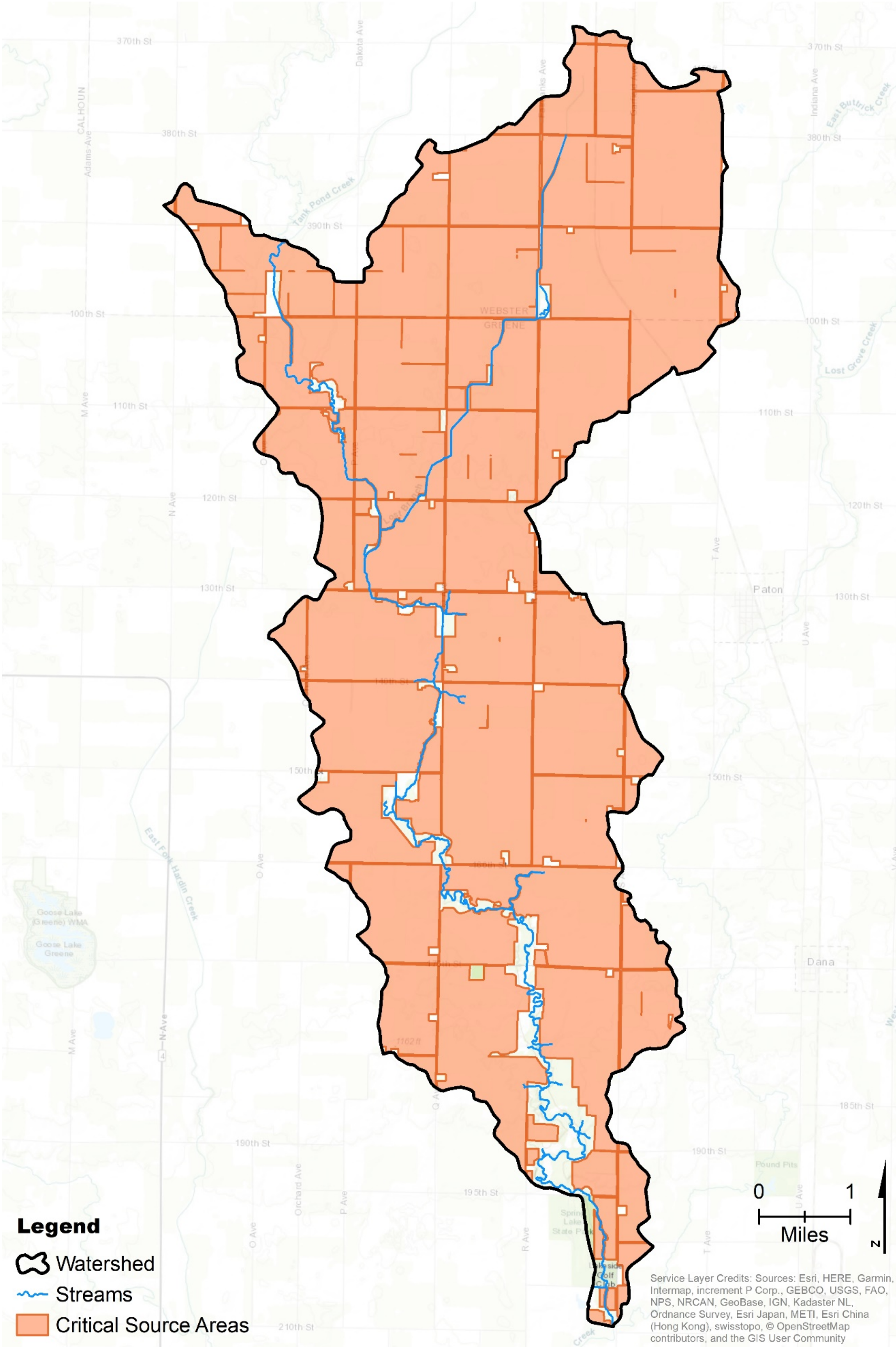

Figure 3.2.1. Critical source areas for nitrogen, phosphorus and sediment loss in the West Buttrick Creek Watershed.

Continued and increased water quality monitoring will be important to evaluate trends and outcomes of the watershed project over time. Stakeholders in the West Buttrick Creek Watershed identified water quality improvement as a top priority.

4. Goals and Objectives

4.1. Goals

Watershed goals were established through a community-based, participatory planning process. Local farmers, landowners, technical experts, and watershed partners engaged in facilitated discussions to identify local conditions, challenges, and opportunities. From these conversations a set of goal statements was developed to serve as guides for watershed improvement. The goals for the West Buttrick Creek Watershed are to:

1. Improve water quality.
2. Increase resilience of water management.
3. Build soil health.
4. Inform farmers and public of conservation practices and initiatives.

4.2. Objectives

Specific objectives have been established for each goal to facilitate implementation and evaluation as watershed improvement actions occur.

Goal 1. Improve water quality.

Objective 1.1. Achieve Iowa Nutrient Reduction Strategy goals of 41 percent nitrogen and 29 percent phosphorus loss reductions relative to baseline conditions.

Objective 1.2. Monitor water quality to assesses trends. Nitrogen, phosphorus, sediment, and bacteria levels each should be quantified regularly.

Goal 2. Increase resilience of water management.

Objective 2.1. Optimize conservation drainage and increase water storage across the watershed by improving soil infiltration and constructing or restoring wetlands to temporarily hold water.

Objective 2.2. Manage poorly drained, flood-prone, and drought-susceptible areas to maximize profitability and resilience.

Goal 3. Build soil health.

Objective 3.1. Minimize soil erosion by meeting or exceeding USDA-Natural Resources Conservation Service soil erosion conservation planning criteria.

Objective 3.2. Increase soil organic matter as indicated by positive trends in the Soil Conditioning Index.

Goal 4. Inform farmers and public of conservation practices and initiatives.

Objective 4.1. Develop and distribute outreach materials regularly to watershed residents, farmers, landowners, and partners. Emphasize farmer-to-farmer learning.

Objective 4.2. Partner with individuals and organizations that can implement and support conservation in the watershed.

Objective 4.3. Identify relevant and timely public, private, and innovative sources of funding to provide and increase technical and financial assistance in the watershed.

Objective 4.4. Track investment in the watershed, quantify benefits provided, and report outcomes to funding partners and stakeholders.

4.3. Timeline

Watershed stakeholders established 2035 as the target date to achieve full-scale implementation of the watershed plan. A 15-year planning horizon balances the needs for immediate adoption with long-term transitions in conservation cropping systems. Additionally, 2035 aligns with the goal of the Mississippi River/Gulf of Mexico Hypoxia Task Force. To facilitate adaptive management and evaluation of interim milestones, three 5-year phases for project implementation are recommended: 2021 through 2025, 2026 through 2030, and 2031 through 2035. A detailed implementation schedule for each phase is provided in Section 5.3.

4.4. Outcomes

Fully implemented, the conservation practices in this watershed plan are anticipated to contribute to significant environmental outcomes. Annually, these outcomes would include 279,877 pounds of nitrogen loss reduction, 2,708 pounds of phosphorus loss reduction, 6,748 tons of soil conserved from erosion, and net greenhouse gas reductions equivalent to 8,830 tons of carbon dioxide.

5. Implementation Plan

5.1. Priority Conservation Practices

Priority conservation practices were identified through stakeholder input and applied analysis. To determine a set of high priority practices, watershed farmers and technical experts weighed the relative impact and adoption likeliness of many conservation practices. These two characteristics were compared (Figure 5.1.1).

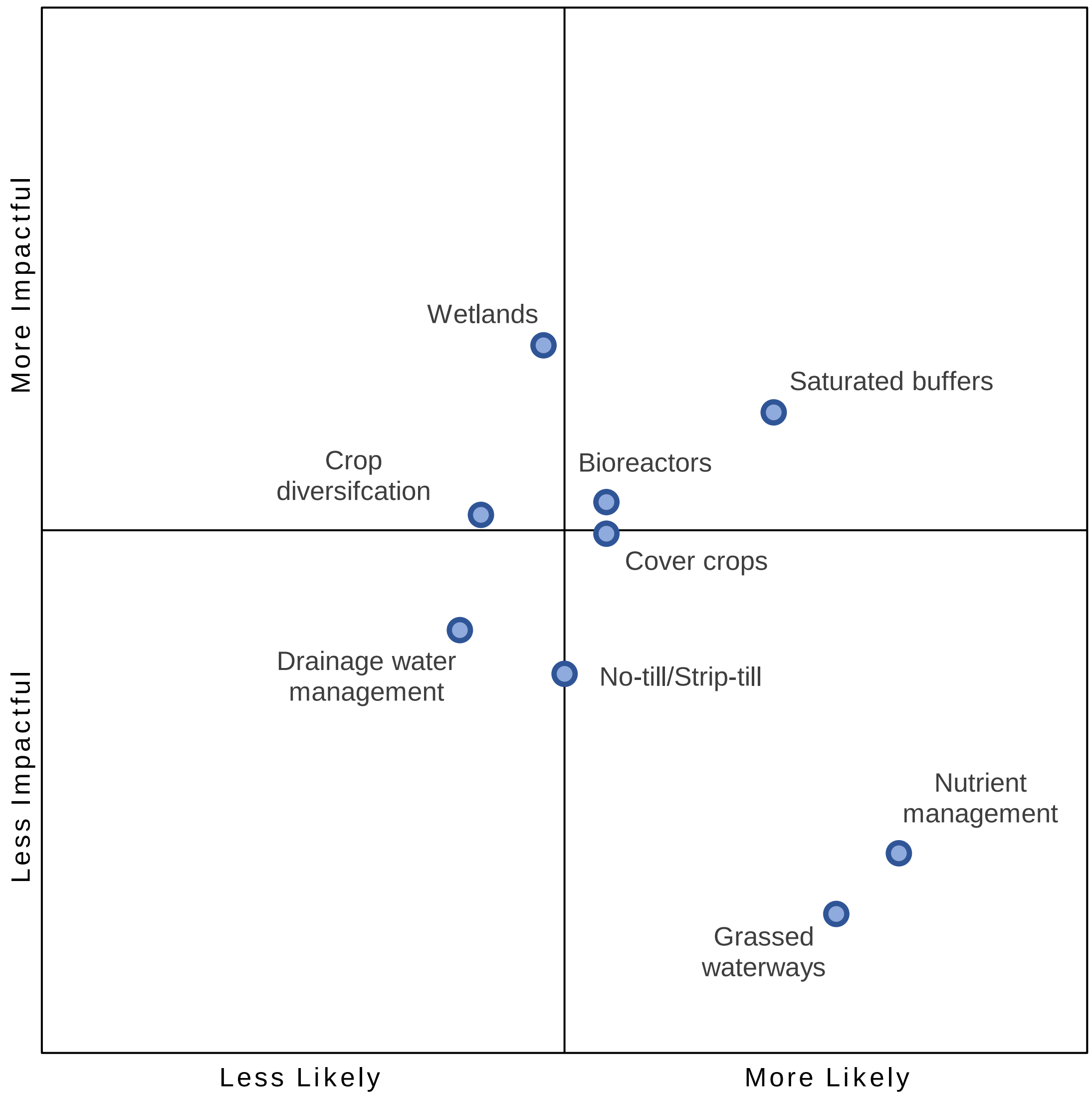

Figure 5.1.1. Relative impact and adoption likeliness for conservation practices according to watershed stakeholders. In general, higher priority practices are those that have greater potential to impact watershed goals and that are more likely to be broadly adopted.

The needed levels of each of these priority conservation practices were determined using simple water quality models based on the Iowa Nutrient Reduction Strategy. Potential locations for conservation practices throughout the watershed were identified with the Agricultural Conservation Planning Framework (ACPF) mapping software. The ACPF tools provided insights into landscape capacity for various types of practices. These locations are mapped in an atlas included as an appendix to this plan.

5.2. Conceptual Plan

Priority conservation practices along with their needed quantities are listed in Table 5.2.1, and potential locations for adoption are shown in Figure 5.2.1. While conceptual, this combination of practices and geographic distribution illustrates the level of effort that will be needed to meet watershed goals.

Table 5.2.1. Priority conservation practices and adoption level goals.

Practice	Unit	Goal	Note
N management	ac/yr	13,300	Corn
No-till	ac/yr	9,500	Soybeans
Cover crops	ac/yr	16,200	Soybeans + 50% of corn
Crop diversification	ac/yr	As needed	for soil health & profitability
Wetlands	sites	6	5 additional CREP sites
Saturated buffers & bioreactors	sites	90	
Grassed waterways	feet	As needed	for erosion control

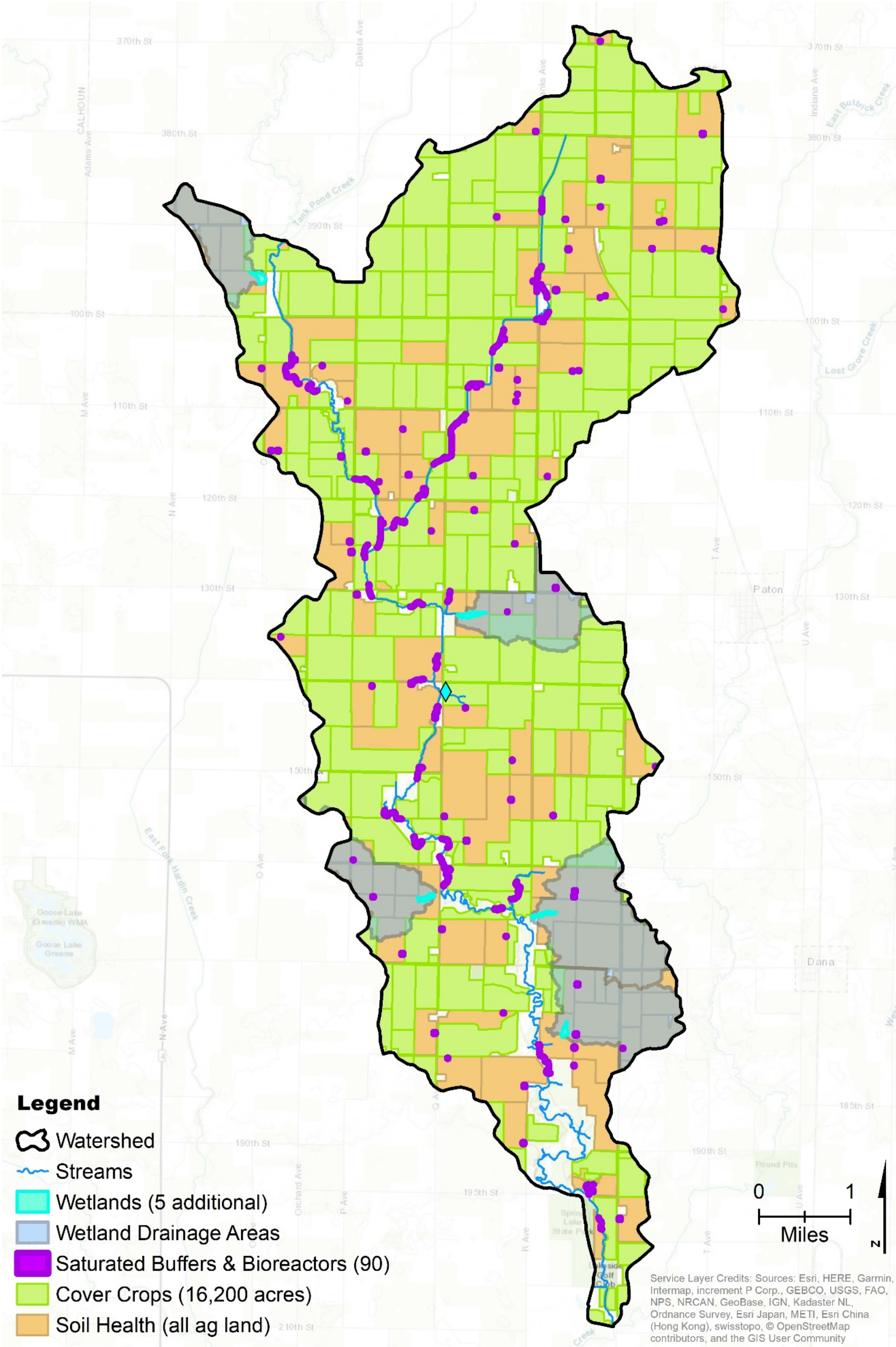

Figure 5.2.1. Conceptual plan for conservation practice implementation.

5.3. Implementation Schedule

An implementation schedule was developed to facilitate evaluation of interim project milestones before the 2035 target date for full plan implementation. Three project phases are recommended: 2021 through 2025, 2026 through 2030, and 2031 through 2035. Existing, phased, and cumulative implementation goals are provided in Table 5.3.1.

Table 5.3.1. Implementation schedule for the West Buttrick Creek Watershed.

Priority Conservation Practice	Unit	Current Level	Phase 1: 2021-2025	Phase 2: 2026-2030	Phase 3: 2031-2035	Cumulative Goal
N management	ac/yr	1,300	2,000	4,000	6,000	13,300
No-till	ac/yr	3,200	3,300	2,000	1,000	9,500
Cover crops	ac/yr	200	3,000	5,000	8,000	16,200
Crop diversification	ac/yr	-	*As needed for soil health and profitability*			
Wetlands	sites	1	1	1	3	6
Saturated buffers & bioreactors	sites	1	14	25	50	90
Grassed waterways	feet	119,400	*As needed for erosion control*			

6. Roles and Responsibilities

Watershed management requires commitment, collaboration, and coordination among multiple entities. Much of the responsibility for implementing the watershed plan ultimately will be assumed by farmers and landowners, so it is critical to continue to involve them in leadership roles. The following list identifies current and potential project partners along with their key functions.

Stakeholder Group	Roles
Farmers and landowners	Implement conservation practices, evaluate on-farm performance, share knowledge and experience with others, and partner with relevant operator or owner on conservation practice adoption.
North Raccoon River Watershed Management Coalition	Coordinate watershed activities with other watershed management authority member entities across the broader North Raccoon Watershed.
Greene and Webster Soil and Water Conservation Districts	Hire watershed project staff, pursue and obtain grants and other funding, evaluate implementation progress, and develop partnerships.
USDA-Natural Resources Conservation Service	Provide technical and financial assistance, provide conservation practice design and engineering, house project staff as needed, and provide associated office space, computer, phone, and vehicle as available. In addition to assistance provided through the local USDA service center, the NRCS is well positioned to support watershed goals by providing access to federal funding programs for working lands conservation.
Iowa Department of Agriculture and Land Stewardship	Provide technical support for the watershed project and provide opportunities for state funding for soil and water conservation practices.
Iowa Department of Natural Resources	Conduct water quality monitoring and water resources assessments.
Greene and Webster Counties	Coordinate with county emergency managers as needed, maintain county conservation board properties and provide public educational opportunities, and coordinate on infrastructure projects with an emphasis on natural resource resilience.
Conservation and farm organizations	Engage members, provide environmental and/or agronomic services as appropriate, and support mutual goals.
Educational institutions	Local schools can provide educational programming. Universities such as Iowa State University and the University of Iowa can provide opportunities for research, extension, and flood-focused programs.

7. Funding Needs and Opportunities

7.1. Resource Needs

Watershed management requires substantial investment in technical assistance (human resources) and financial assistance (funding to support practice adoption or construction). Table 7.1.1. provides estimated implementation costs by conservation practice.

Table 7.1.1. Estimated annual or initial costs of priority conservation practices.

Practice	Unit	Goal	Unit Cost	Total Cost
N management	ac/yr	13,300	-$5	-$66,500
No-till	ac/yr	9,500	-$10	-$95,000
Cover crops	ac/yr	16,200	$40	$648,000
Wetlands	sites	6	$150,000	$750,000
Saturated buffers	sites	50	$5,000	$250,000
Bioreactors	sites	40	$15,000	$585,000

The total cost to fully implement the West Buttrick Creek Watershed Plan is estimated to be $1,585,000 in up-front capital plus an additional $585,500 per year in annual operating expenses. This annual operating budget includes $486,500 per year in conservation financial assistance plus approximately $100,000 per year to fund watershed management and technical assistance, which includes salary and benefits for a watershed coordinator, supplies for outreach materials and events, water monitoring, and overhead costs such as office space, computer, phone, and vehicle.

Short- and long-term cost savings to farmers and landowners are anticipated from adoption of no-till and optimized nutrient management. These financial gains could offset near-term adoption costs associated with other practices such as cover crops. Investment in soil and water conservation should be balanced between one-time, up-front construction and annual, in-field practices to efficiently achieve watershed goals. The costs and benefits (both economic and environmental) should be aligned with needs and goals of individual farmers and landowners that will implement each conservation practice.

For context, these implementation costs were compared to annual revenue and asset value of cropland in the watershed. Based on 10-year averages of corn and soybean acreages, yields, and prices, the gross annual revenue from corn and soybean production in the watershed is $15,842,000, or $695 per acre. The annual plan implementation cost of $586,500 per year represents 3.7 percent of annual gross revenue. Based on 2019 data, agricultural land in Greene County, Iowa averaged $8,008 per acre, for a total asset value of $182,582,000. The initial capital investment cost of $1,585,000 represents 0.9 percent of the total value of watershed cropland.

7.2. Funding Sources

Funding opportunities include state and federal grants and cost-share, which typically are obtained and administered by a soil and water conservation district. State programs include the Iowa Water Quality Initiative and the Iowa Financial Incentive Program. Federal programs include Environmental Quality Incentives Program, Conservation Stewardship, Conservation Reserve Program, and Regional Conservation Partnership Program.

Nontraditional, innovative approaches will be necessary to secure long-term sustainable funding for watershed improvement. To supplement cost-share from state and federal sources, watershed stakeholders could pursue finance-based funding models that provide payments for environmental outcomes generated by conservation practices. Opportunities to measure, research, manage, and optimize farm enterprise-scale profitability also could be pursued to ensure that farmers maintain and build their financial strength over time in addition to their natural resource capital.

8. Outreach and Engagement Plan

Outreach and education will be needed on an ongoing basis to provide information to watershed stakeholders. Outreach initiatives and materials should be designed to accomplish specific goals. Messaging and formats should be tailored to specific audiences. Local and regional media should be engaged as appropriate to build awareness and understanding of the watershed project.

Communications and coordination should be conducted by a watershed leadership team. The North Raccoon River Watershed Management Coalition board of directors may be able to support this role. Ideally, the West Buttrick Creek Watershed group also should include farmers and landowners, USDA-Natural Resources Conservation Service, soil and water conservation district commissioners and staff, Iowa Department of Agriculture and Land Stewardship, and other local partner organizations.

In addition to sharing information, outreach should drive engagement and participation. Public events such as field days and meetings are important venues to share information, yet these events present important opportunities to foster community ties within and around the watershed. Watershed improvement is highly collaborative, so such community bonds and cooperation will be essential for sustained, long-term success. For example, cooperative learning opportunities that facilitate farmer-to-farmer knowledge sharing will allow more producers to adopt best practices and adaptive management as they refine their operations with new or additional conservation practices.

9. Monitoring and Evaluation Plan

9.1. Monitoring

Multiple indicators should be monitored to track progress and measure success. Water quality monitoring will be a key indicator of overall conditions within the watershed. Stakeholders should continue to work with Agriculture's Clean Water Alliance to monitor stream water quality and assess trends. At a minimum, water quality parameters to measure include inorganic nitrogen, dissolved phosphorus, and turbidity or total suspended solids. Locations along West Buttrick Creek and tributary streams could be monitored to evaluate water quality conditions throughout the watershed (Figure 9.1.1).

Field-scale water monitoring also can be used to evaluate the effectiveness of individual conservation practices. Additional field-scale monitoring could include tile water monitoring, soil health testing, nutrient management trials, or crop tissue sampling. Such agronomic studies can be important sources of data to inform decision making by individual farmers and landowners. Environmental outcomes of conservation practice implementation can be measured using USDA-Natural Resources Conservation Service conservation planning tools and criteria (e.g., Revised Universal Soil Loss Equation 2, Soil Conditioning Index), other public agroecosystem models (e.g., Nutrient Tracking Tool, COMET-Farm), or private sustainability and stewardship technology platforms.

Watershed project evaluation also should include tracking of social indicators such as surveys of attitudes and awareness, event attendance, and media reach. Additional success indicators such as practice adoption and retention, new project participants, and new project partners should be documented and reported.

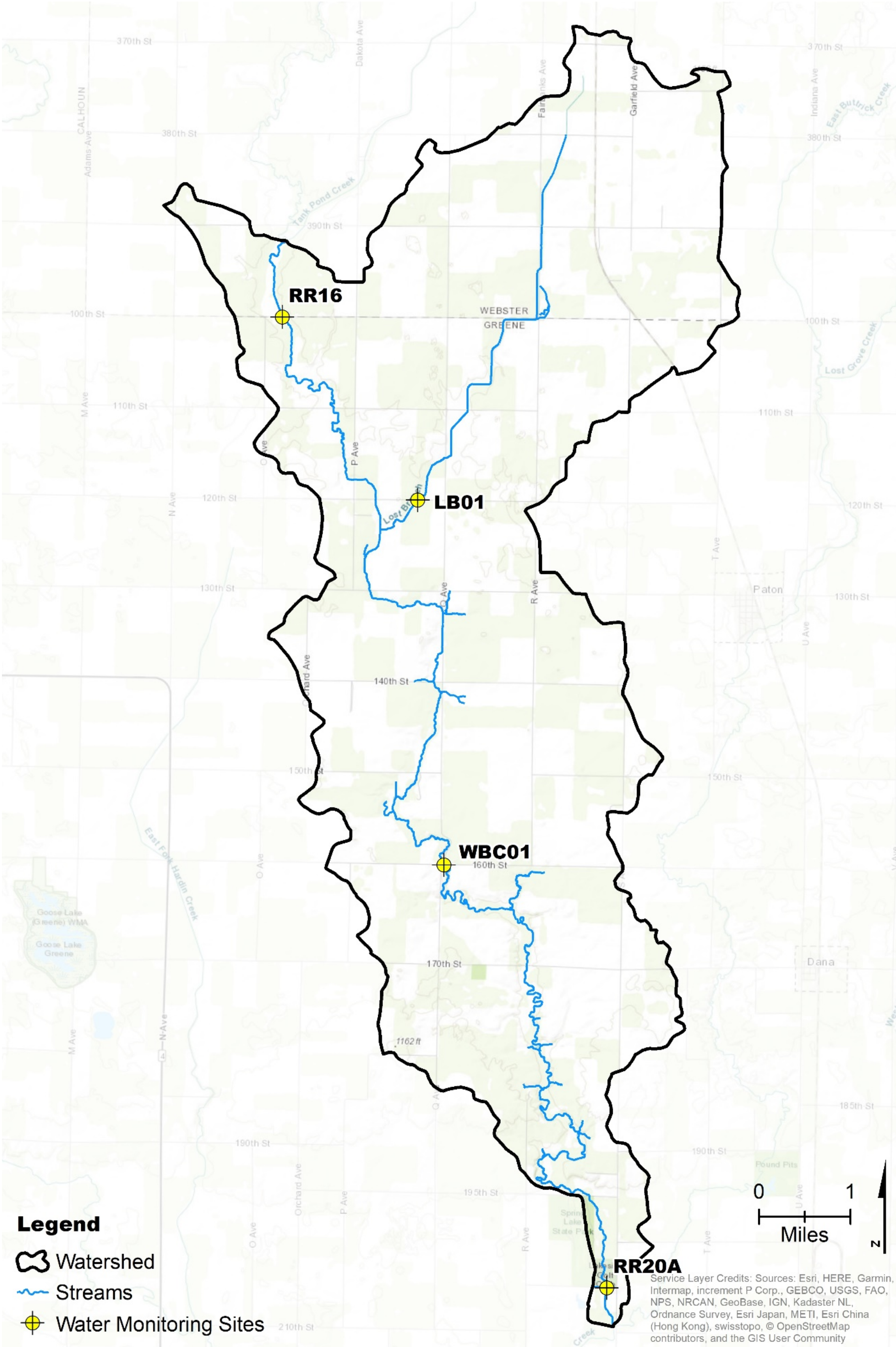

Figure 9.1.1. Locations to monitor surface water quality of West Buttrick Creek and its tributaries.

9.2. Evaluation

Watershed project actions and progress should be tracked in four categories: administration, engagement, implementation, and outcomes. The following chart provides details on what, when, and how to measure within each of these categories.

Metric	Frequency	Details
Administration		
Formal project review	Annually	An annual project review meeting should be conducted with project partners, funding entities, and supporting agencies. The review should capture the following metrics and provide a platform both to celebrate accomplishments from the past year and to plan for the next year.
Project advisory meetings	Quarterly	Project leaders—including farmers—should meet regularly, ideally quarterly, depending on timing of agriculture field work. These gatherings should be used to ensure project goals and objectives are being accomplished. Upcoming outreach, events, and monitoring activities also should be coordinated.
Engagement		
Awareness and attitudes	Periodically	Awareness of the project and watershed goals should be assessed. This qualitative data will provide a measure of trends in stakeholder knowledge, opinions, and actions.
Event engagement	Event-based	Evaluations can be tied to specific events in order to provide direct feedback to increase participation and learning outcomes from future events.
Project participation	Annually	The number of watershed farmers and landowners that implement and maintain conservation practices should be tracked annually. Other types of participation such as leadership and event attendance also could be tracked.
Implementation		
Practice adoption	Annually	Locations of newly implemented conservation practices should be tracked throughout the project, and total adoption levels and acres treated should be reported annually.
Practice retention	Annually	In addition to constructed practices that will function over multiple years, retention of in-field management practices should be emphasized. Locations of these conservation practices can be identified through field assessments, and will become increasingly easy to track with remote sensing technology.
Outcomes		
Water quality monitoring	Monthly	Surface water quality parameters should be measured monthly or semi-monthly during the growing season. Stream water monitoring data will be essential to determine if long-term water quality improvements are attained.
Agronomic testing	Seasonally	Agronomic and profitability outcomes should be evaluated to determine and understand the impacts and benefits of individual or integrated conservation practices. Research results can be aggregated and shared with all farmers across the watershed to support learning, practice adoption, adaptive management, and continuous improvement.
Outcomes modeling	Annually	Conservation outcomes should be quantified, especially nutrient loss reduction, soil conservation, and greenhouse gas reductions. While it likely will not be feasible to perform field measurements for all implemented conservation practices, agroecosystem models, tools, and technologies should be used to estimate the environmental benefits of all conservation practices adopted across the watershed.