WEST FORK CROOKED CREEK WATERSHED PLAN

A guide for healthy soil and clean water
in the West Fork Crooked Creek Watershed

Iowa Soybean Association
Environmental Programs & Services

2018

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A guide for healthy soil and clean water in the West Fork Crooked Creek Watershed

Why was the West Fork Crooked Creek Watershed Plan developed?

This watershed plan is intended to provide guidance for land and water improvements in the West Fork Crooked Creek Watershed while simultaneously enhancing agricultural vitality. Environmental improvements are challenging. This plan lays out a phased approach to conservation implementation to facilitate continuous progress towards achieving long-term watershed goals.

Who developed this watershed plan?

The West Fork Crooked Creek Watershed Plan was authored by the Iowa Soybean Association. Guidance and input were provided by farmers and landowners from the watershed along with representatives of local and federal government and other organizations. The watershed planning process was led by the Iowa Soybean Association with assistance from the Washington Soil and Water Conservation District, the Natural Resources Conservation Service.

Who owns this watershed plan?

This plan is for all stakeholders interested in the West Fork Crooked Creek Watershed, including farmers, landowners, residents, nongovernmental organizations and local, state and federal units of government. Ultimately, successful implementation of this plan will rest with these stakeholders. Relationships and partnerships established and strengthened through the watershed planning process will be valuable as the West Fork Crooked Creek watershed plan is implemented.

Not funded by the soybean checkoff

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1. Executive Summary

A watershed is an area of land that drains to a single point (Figure 1.1). The West Fork Crooked Creek Watershed is comprised of nearly 80,500 acres located in Washington and Keokuk counties that are drained by West Fork Crooked Creek from its headwaters downstream to its confluence with East Fork Crooked Creek to the west of Crawfordville, Iowa.

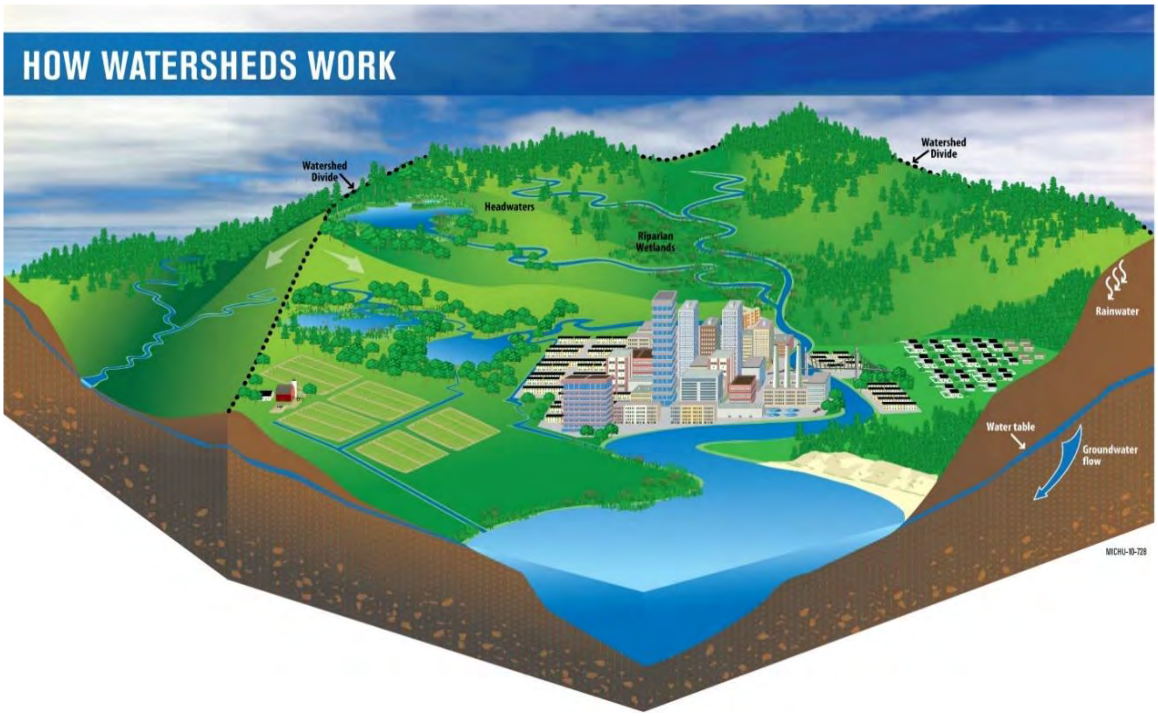

Figure 1.1. A watershed contains the land and water that flow to a common point (**Michigan Sea Grant**).

This watershed plan defines and addresses existing land and water quality conditions, identifies challenges and opportunities and provides a path for improvement. The watershed plan was developed according to the watershed planning process recommended by the Iowa Department of Natural Resources (Figure 1.2) and incorporated input from a variety of public and private stakeholders. The Iowa Soybean Association led development of this watershed plan in conjunction with the Washington Soil and Water Conservation District. Stakeholders including watershed farmers and landowners, conservation professionals and others contributed local knowledge and insights. The West Fork Crooked Creek Watershed Plan integrates existing data, citizen and stakeholder input and conservation practice recommendations to meet the goals established through the watershed planning process.

The West Fork Crooked Creek Watershed was identified for watershed planning due to its high priority location. The watershed is a Water Quality Initiative (WQI) watershed demonstration project led by the Washington Soil and Water Conservation Districts (SWCD) and funded by the Iowa Department of Agriculture and Land Stewardship (IDALS). The WQI project was launched in 2014 to work with farmers and project partners to promote conservation practices that reduce nutrient losses to surface waters. Existing and new relationships between the SWCDs and farmers and landowners have highlighted the importance of water quality and increased local adoption of conservation and water quality improvement practices. Community participation proved important during the watershed planning phase. Such local engagement and leadership will be essential as the plan is implemented now and in the future.

Figure 1.2. The watershed planning process.

The West Fork Crooked Creek watershed is a subwatershed of the larger Skunk River basin, which is one of nine priority watersheds identified in the **Iowa Nutrient Reduction Strategy** (INRS). The INRS identifies a broad strategy to reduce nutrient loads in Iowa water bodies and downstream waters that incorporates regulatory guidelines for point sources of nutrients and a non-regulatory approach for nonpoint nutrient sources. This watershed plan was developed within the flexible nonpoint source framework to identify a locally appropriate strategy to address INRS water quality improvement goals.

Goals for the West Fork Crooked Creek Watershed have been identified to achieve the vision of all stakeholders. This document guides stakeholders according to a continuous improvement approach to watershed management. It is important both to adopt a long-term perspective and to realize that many small improvements must be made to cause large, lasting changes for the entire watershed. The top long-term goals of the West Fork Crooked Creek Watershed Plan are to:

1. Maintain and increase agricultural productivity and profitability
2. Reduce soil erosion
3. Reduce in-stream nonpoint source nitrogen loads by 41 percent
4. Reduce in-stream nonpoint source phosphorus loads by 29 percent
5. Increase soil organic matter
6. Develop financial incentives for new practice users

Public involvement was a key component of the watershed planning process. Watershed planners encouraged participation throughout the planning process and sought to incorporate diverse stakeholder input from farmers, landowners, residents, health officials, conservation professionals and other local stakeholders to guide the development of this watershed plan.

Improving land and water resources in the West Fork Crooked Creek Watershed is a complex challenge and will require substantial, long-term collaboration and partnerships. The implementation schedule in this watershed plan was developed to balance currently available resources and awareness with the need and desire to improve land and water quality. A 20-year phased implementation schedule has been designed to allow for continuous improvements that can be periodically evaluated to determine if progress is being made toward achieving the stated goals by the year 2038. The total investment necessary to accomplish the watershed plan goals is estimated to be approximately $12,410,000 for initial infrastructure costs associated with structural practices, $400,000 for annual costs associated with management practices and an additional $100,000 per year to fund technical assistance, outreach, monitoring and equipment necessary to promote and implement conservation in the watershed.

Expenditures for watershed improvement in the West Fork Crooked Creek Watershed should be viewed as long-term investments in agricultural vitality and water quality. With this perspective in mind, the cost efficiency of any purchased investments (i.e., conservation practices) should be considered along with their potential internal and external benefits and risks. This approach allows for water quality investors (i.e., public or private funding sources) to select conservation practices that align with investment preferences and goals. Table 1.1 contains estimates of annualized nitrogen and phosphorus load reduction cost efficiency for practices that are included in the West Fork Crooked Creek watershed plan. Many of these practices have additional on- and off-farm economic and ecosystem benefits that could also be considered as specific conservation practices are funded.

Table 1.1. Estimated annual nutrient reduction cost efficiency of conservation practices from the West Fork Crooked Creek Watershed conceptual plan. Nitrogen and phosphorus load reduction costs were annualized to 15 years to reflect the typical lifespan of a bioreactor, a key practice included in the watershed plan.

						Expected watershed load reductions		15-year annualized reduction costs		
	Practice	**Watershed plan goal**	**Unit**	**Cost per unit**	**Total cost**	**Nitrogen (lb N/yr)**	**Phosphorus (lb P/yr)**	**Nitrogen ($/lb N/yr)**	**Phosphorus ($/lb P/yr)**	**Assumed Life Span (years)**
Annual costs	Cover crops	20,000	acres	$20	$400,000	124,000	28272	$3.23	$14.15	1
Initial costs	Drainage water management	5,960	acres	$1,000	$5,960,000	39,600	0	$3.76	-	40
	Bioreactors	150	structures	$10,000	$1,500,000	44,645	0	$2.24	-	15
	Saturated buffers	150	structures	$3,000	$450,000	25,956	0	$1.16	-	15
	Ponds/Nitrate Removal Wetlands	60	sites	$75,000	$4,500,000	269,946	38760	$0.33	$2.32	50

Ultimately any land and water quality improvements made in the watershed will be driven by local desire, education and participation. The conceptual, monitoring, goal-based outreach and evaluation components of this watershed plan should provide a framework to guide efforts and focus resources in order to achieve the vision of the West Fork Crooked Creek Watershed.

2. Watershed Characteristics

2.1. General Information

The West Fork Crooked Creek Watershed encompasses 80,449 acres used primarily for agricultural production. Row crop agriculture occupies 71 percent of the watershed. Terrain in the watershed is predominately rolling topography with flat uplands and many small streams. The primary stream in the West Fork Crooked Creek Watershed is West Fork Crooked Creek, which flows generally from west to east to its confluence with East Fork Crooked Creek in southeast Washington County. The segment of West Fork Crooked Creek has been designated by the Iowa Department of Natural Resources (IDNR) as a waterbody that should support recreation and aquatic life. Portions of West Fork Crooked Creek are channelized ditches that receives flow from subsurface drainage infrastructure, particularly in the upper reaches of the watershed, but the majority of West Fork Crooked Creek is a natural stream channel. West Chester and portions of Washington and Keota are the incorporated communities within the watershed. The majority of the watershed is privately owned. Public land in the watershed includes Statler Woods, Clemmons Creek Wildlife and Recreation Area, Hayes Timber and Fern Cliff County park. Table 2.1.1 lists general information for West Fork Crooked Creek stream segments and the 12-digit Hydrologic Unit Code (HUC) watershed.

Table 2.1.1. Watershed and stream information for the West Fork Crooked Creek.

Location	Washington and Keokuk Counties
Waterbody ID (WBID)	IA 03-SKU-921
Segment classes	A1, B(WW-2)
Designated uses	Primary contact recreation, Aquatic life
WBID segment length	28.8 miles
Total length of all streams	173.1 miles
Watershed area	80,449 acres
Dominant land use	Row crop agriculture
Incorporated communities	West Chester, Keota, And Washington
HUC8 watershed	Skunk
HUC8 ID	07080107
HUC10 watershed	West Fork Crooked Creek
HUC10 ID	0708010705
HUC12 watersheds	Upper West Fork Crooked Creek Middle West Fork Crooked Creek Lower West Fork Crooked Creek
HUC12 ID	070801070101 070801070102 070801070103

2.2. Water and Wetlands

Surface water in the West Fork Crooked Creek Watershed includes West Fork Crooked Creek and unnamed tributary streams. West Fork Crooked Creek is primarily natural stream channels within the watershed, but portions of the steam area channelized ditches. Figure 2.2.1 shows the identified streams within the watershed. Figure 2.2.2 displays the wetlands in West Fork Crooked Creek Watershed as identified by the National Wetlands Inventory (NWI), which are also summarized in Table 2.2.1. The NWI dataset was developed beginning in the 1970s by the US Fish and Wildlife Service via aerial photo interpretation.

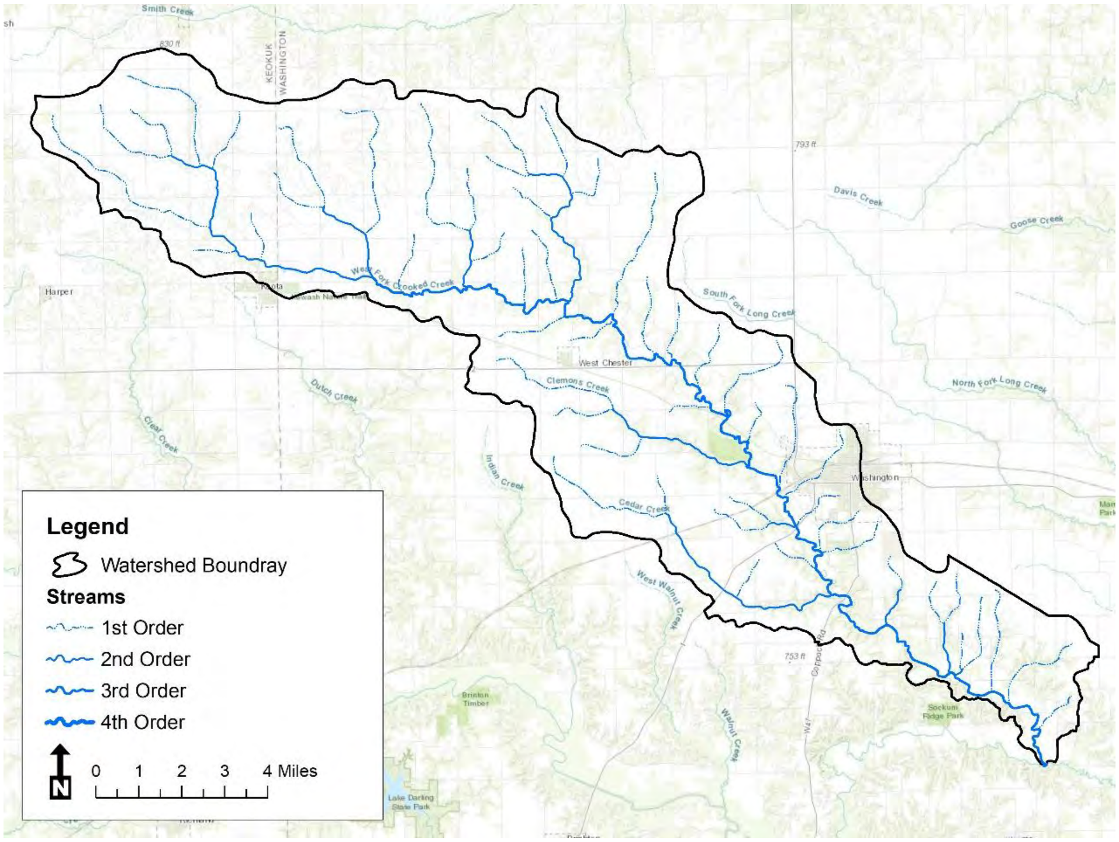

Figure 2.2.1. Streams identified in the West Fork Crooked Creek Watershed.

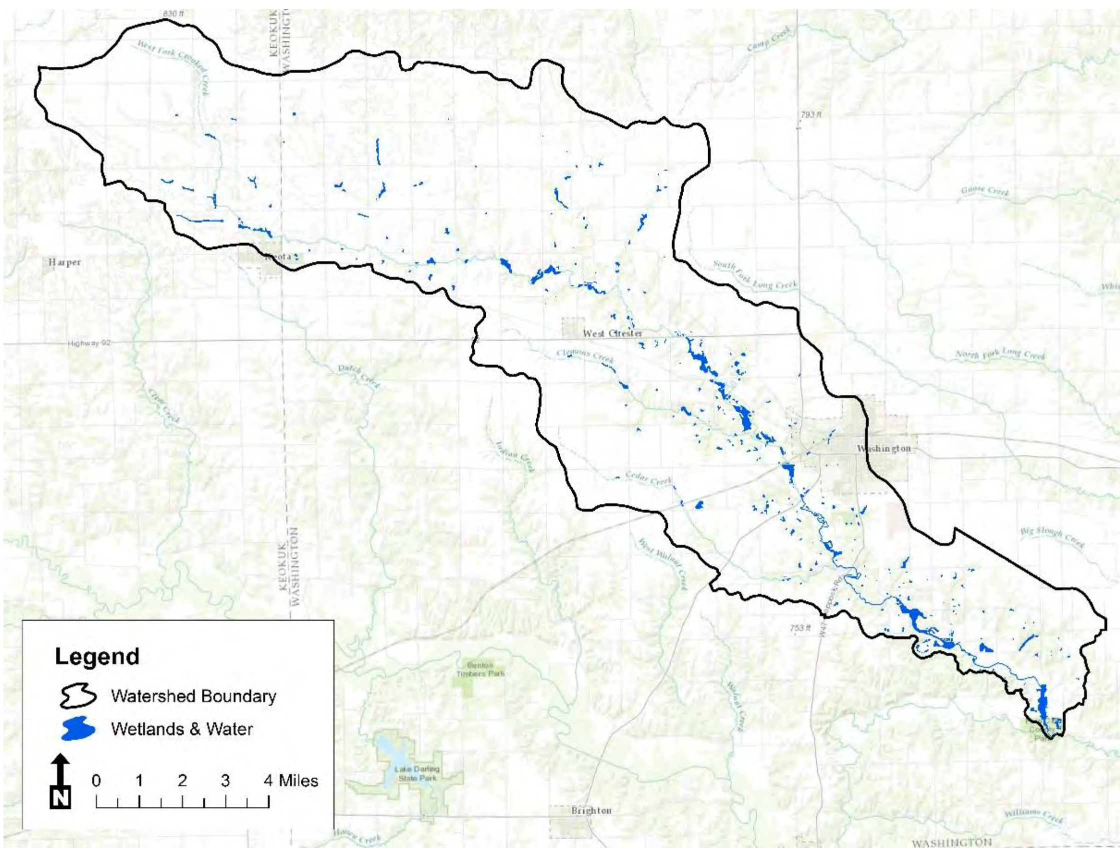

Figure 2.2.2. Wetlands in the West Fork Crooked Creek Watershed mapped in the NWI.

Table 2.2.1. Classification of wetlands in the West Fork Crooked Creek Watershed according to the NWI.

Type	Acres
Artificially Flooded	2
Intermittently Exposed	282
Intermittently Flooded	5
Permanently Flooded	2
Seasonally Flooded	118
Semipermanently Flooded	91
Temporarily Flooded	645
Other	18
Total	**1162**

2.3. Climate

Precipitation data obtained from the **Iowa Environmental Mesonet** for the West Fork Crooked Creek Watershed show annual total precipitation averaged 38.83 inches per year between 2001 and 2016, but a range of 23.56 to 57.79 inches per year for that 16-year period reveals large annual variability. Annual precipitation trends are shown in Figure 2.3.1. Precipitation is seasonal in the watershed, with May through August having the highest average monthly rainfall during the most recent 16 years. Monthly precipitation averages are displayed in Figure 2.3.2.

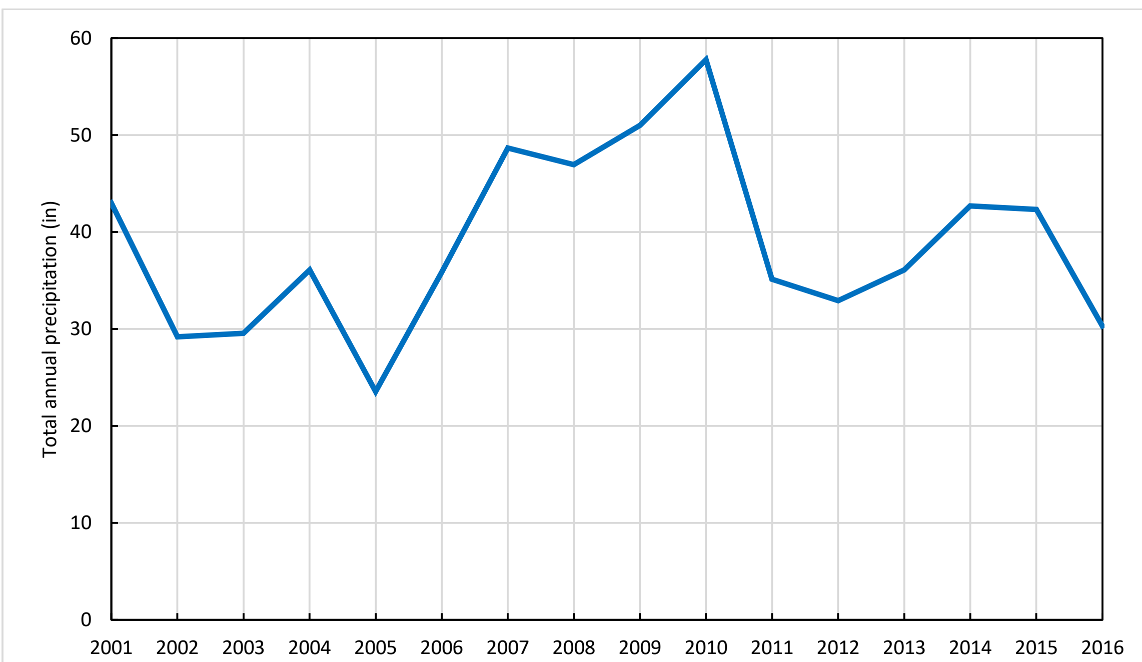

Figure 2.3.1. Total annual precipitation for the West Fork Crooked Creek Watershed from 2001 through 2016.

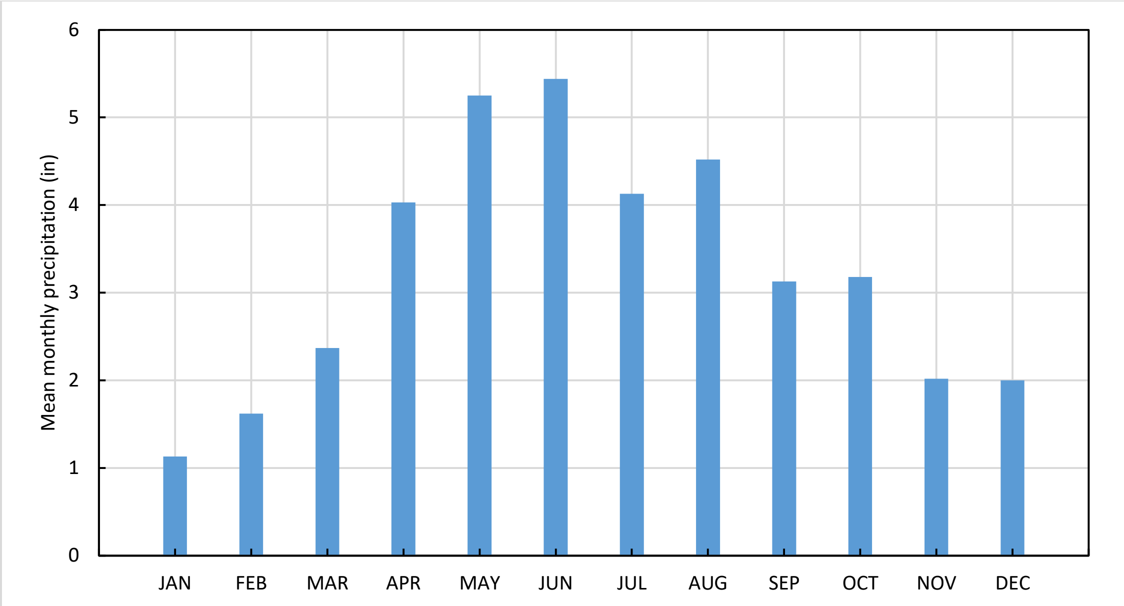

Figure 2.3.2. 2001 to 2016 average precipitation by month for the West Fork Crooked Creek Watershed.

2.4. Geology and Terrain

The West Fork Crooked Creek Watershed is located within the Southern Iowa Drift Plain landform region. The Southern Iowa Drift Plain was glaciated during the Pre-Illinosian glaciers. This older land form is expressed with well defined drainage systems and mature stream channels that have had time to erode and develop. This region is dissected with many drainage ways and small streams and many convex ridgetops and upper side slopes with moderate local relief. The Southern Iowa Drift Plain is characterized by ridges and valleys. Due to the mature geologic age, erosion has slowly dissected the landscape leaving the predominant subsurface parent material loess. Land surface elevation in the watershed ranges from 627 to 838 feet above sea level. Figure 2.4.1 shows elevations derived from Light Detection and Ranging (LiDAR) data. Figure 2.4.2 displays the spatial distribution of slope classes within the watershed, which are also listed in Table 2.4.1. Approximately 86 percent of the watershed has slopes of less than 5 percent.

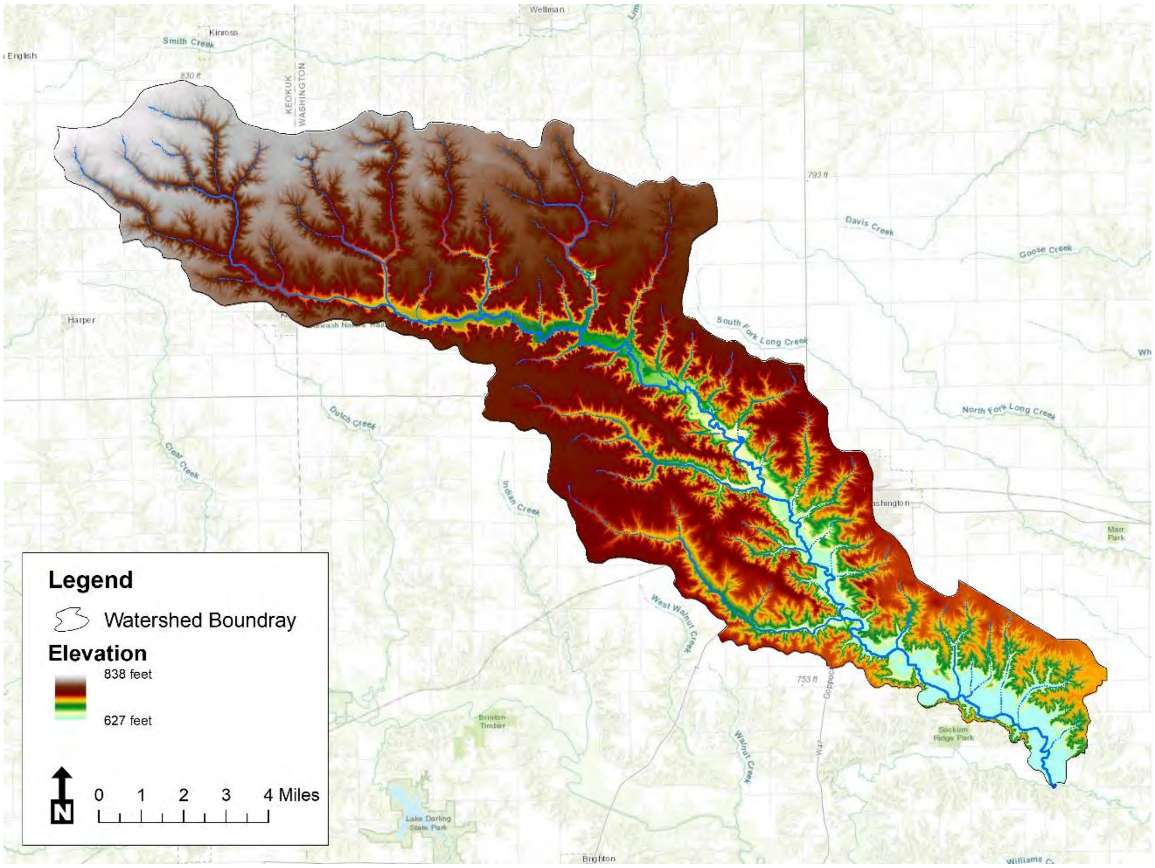

Figure 2.4.1. LiDAR-derived elevations within the West Fork Crooked Creek Watershed.

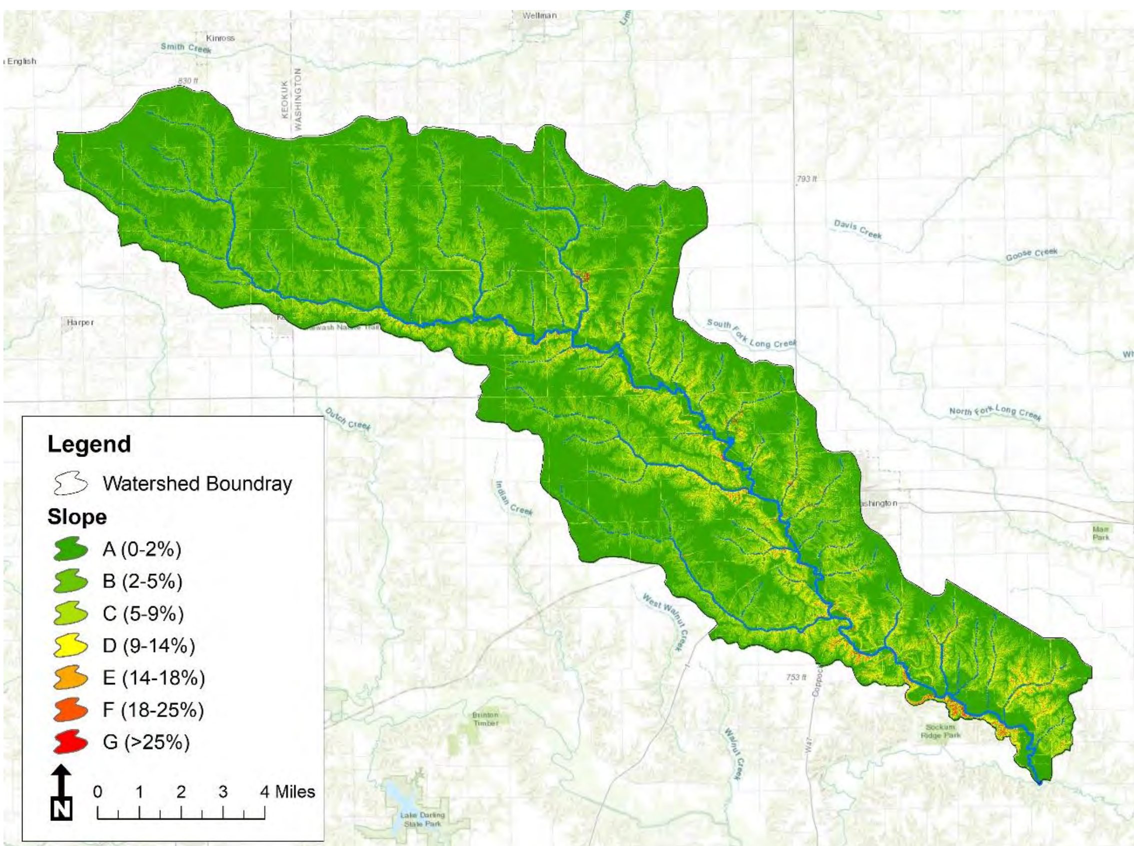

Figure 2.4.2. West Fork Crooked Creek Watershed slope classifications derived from elevation data.

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

Slope Class	Range	Percent of Watershed Area
A	0-2%	54.7
B	2-5%	31.9
C	5-9%	9.5
D	9-14%	2.5
E	14-18%	0.7
F	18-25%	0.5
G	> 25%	0.2

2.5. Soils

The most common soil association in the West Fork Crooked Creek Watershed is the Otley soil association. Parent materials include primarily glacial till and Loess Ridges. Native vegetation for these soils was tall grass prairie. Overall these soils are fairly well drained with side slopes being dissected with many drainage ways and small streams with few large rivers present. The five most prevalent soil series in the watershed are Mahaska, Otley, Taintor, Nira and Ladoga, which together comprise over 60 percent of the watershed. Figure 2.5.1 is a map of the most common soils within the watershed according to the Soil Survey Geographic Database (SSURGO) coverage developed by the National Cooperative Soil Survey and the USDA-Natural Resources Conservation Service (NRCS). Descriptions of the soil Mahaska, Otley, Taintor, Nira and Ladoga series are given in Table 2.5.1.

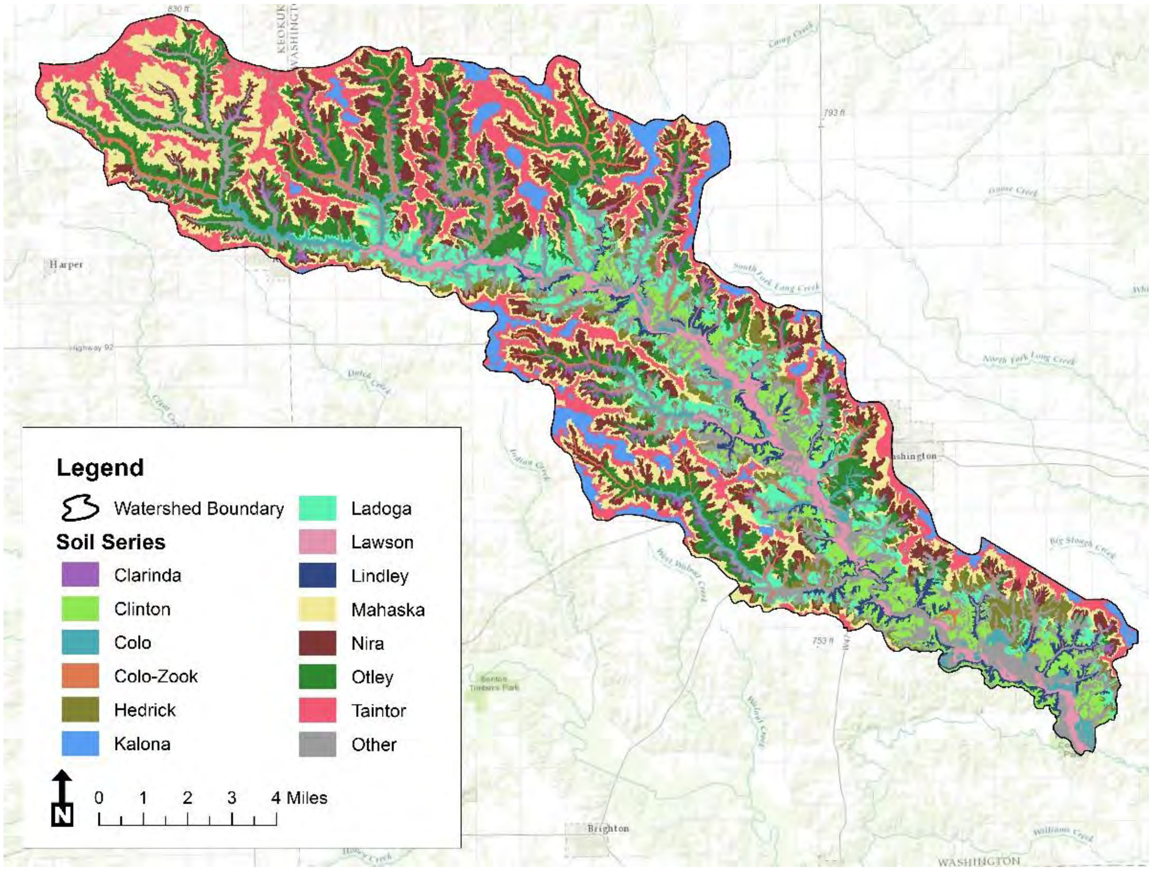

Figure 2.5.1. West Fork Crooked Creek Watershed soil map derived from SSURGO data.80

Table 2.5.1. Official NRCS soil series descriptions.

Soil Series	Description
Mahaska	very deep, somewhat poorly drained soils formed in loess. These soils are on summits of interfluves on dissected till plains and on treads and risers on stream terraces. Slopes range from 0 to 5 percent.
Otley	very deep, moderately well drained soils formed in loess. These soils are on interfluves and side slopes on dissected till plains and on treads and risers on loess covered stream terraces. Slope ranges from 2 to 18 percent.
Taintor	very deep, poorly drained soils formed in loess. These soils are on crests of interfluves on dissected till plains and treads on stream terraces in river valleys. Slope ranges from 0 to 2 percent.
Nira	very deep, moderately well drained soils formed in loess. These soils are on short, convex to linear side slopes on interfluves on dissected till plains and on risers on loess-covered stream terraces in river valleys. Slope ranges from 2 to 18 percent.
Ladoga	very deep, moderately well drained soils formed in loess. These soils are on convex summits of interfluves, side slopes, and nose slopes on dissected till plains and treads and risers on stream terraces. Slope ranges from 0 to 30 percent.

Soil drainage properties affect surface and subsurface water movement within the watershed. These characteristics are summarized in Table 2.5.2. Approximately 62 percent of the soils in the West Fork Crooked Creek Watershed are classified as all hydric or partially hydric, which means they are saturated, flooded or ponded during the growing season for sufficient duration to develop anaerobic conditions in the upper portion of the soil profile. Hydric classification is independent of soil drainage status, so tiled soils may be hydric. Hydric soils within the watershed are mapped in Figure 2.5.2.

Table 2.5.2. Drainage properties and general productivity (rated by Corn Suitability Rating , CSR) of major soils in the West Fork Crooked Creek Watershed.

Soil Series	Acres	Percent	CSR (Range)	Drainage Class	Hydrologic Group	Hydric Class
Mahaska	13,273	16.5	94 (90-95)	Somewhat Poorly drained	B	Partially hydric
Otley	11,572	14.4	80 (55-90)	Moderately well drained	B	Partially hydric
Taintor	11,079	13.8	88 (88)	Poorly drained	C/D	All hydric
Nira	8,396	10.4	77 (62-87)	Moderately well drained	B	Partially hydric
Ladoga	4,778	5.9	73 (50-85)	Moderately well drained	B	Not hydric

As in many other watersheds in the low relief regions in Iowa, much land within the West Fork Crooked Creek Watershed is likely to be artificially drained in order to make agriculture possible and productive. Public records of subsurface drainage infrastructure are nonexistent or sparse, but the USDA-Agricultural Research Service (ARS) has developed a geographic coverage of soils in Iowa that are likely to be drained. Figure 2.5.3 uses this coverage to show where tile drainage may be necessary to maximize agricultural productivity but may not reflect all areas that currently have drainage tile.

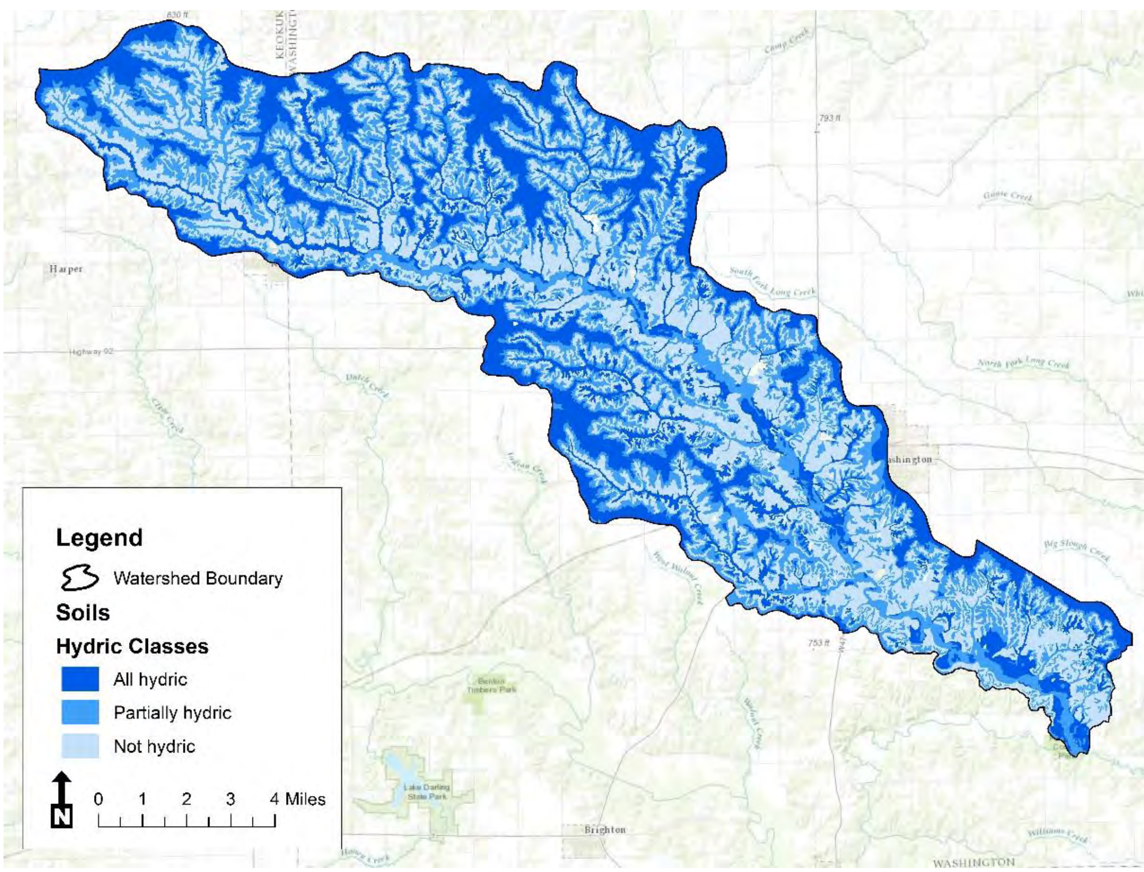

Figure 2.5.2. Soil map units in the West Fork Crooked Creek watershed that are classified as hydric.

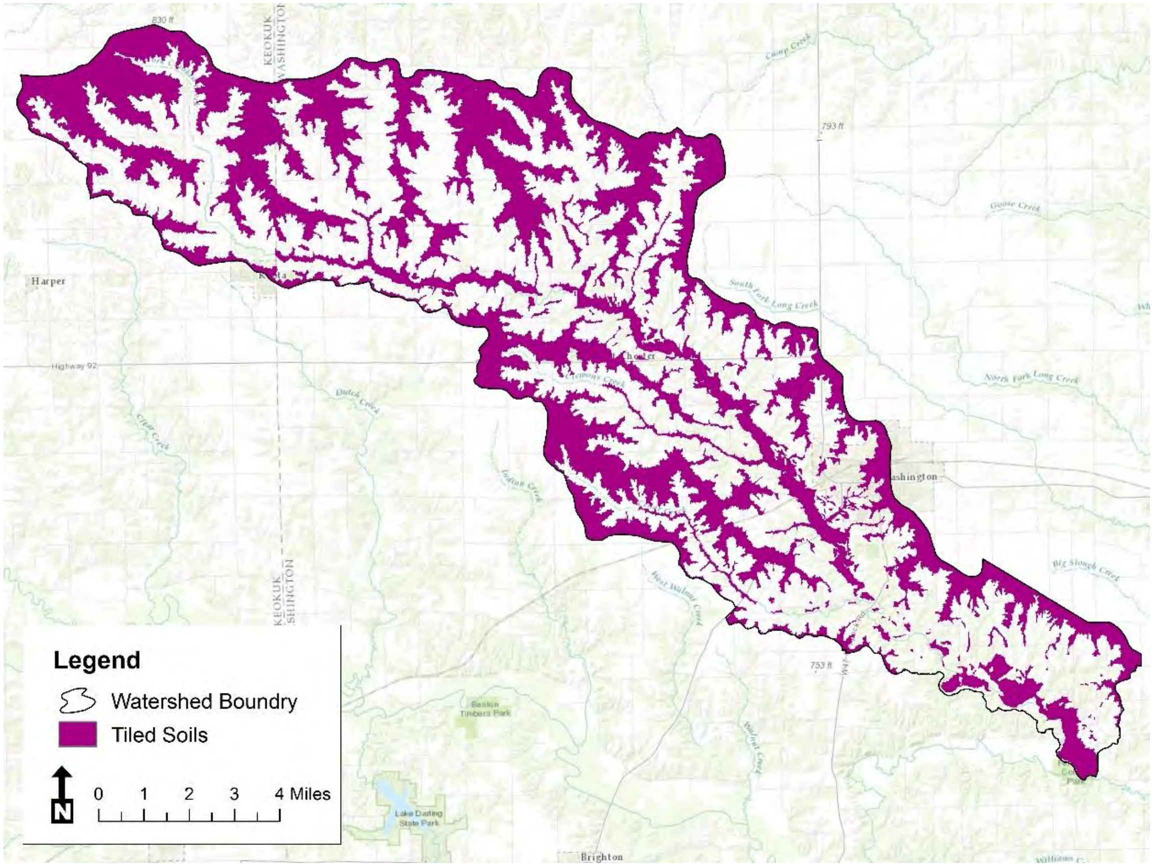

Figure 2.5.3. Areas in the West Fork Crooked Creek Watershed requiring tile drainage to optimize agricultural production.

Soil map units in Iowa are assigned Corn Suitability Rating (CSR) values, which are listed for the major soil series within the watershed in Table 2.5.2. Figure 2.5.4 displays the CSR values for land within the West Fork Crooked Creek Watershed. This map was generated by matching spatial SSURGO data to the Iowa Soil Properties and Interpretations Database (ISPAID) version 8.1. The CSR is an index that provides a relative ranking of soils mapped in Iowa based on their potential to be utilized for intensive row crop production and thus are sometimes used to compare yield potential. CSR scores range from 5 (severely limited soils) to 100 (soils with no physical limitations, no or low slope and can be continuously farmed). The rating system assumes adequate management, natural precipitation, artificial drainage where necessary, no negative effects from flooding and no land leveling or terracing.

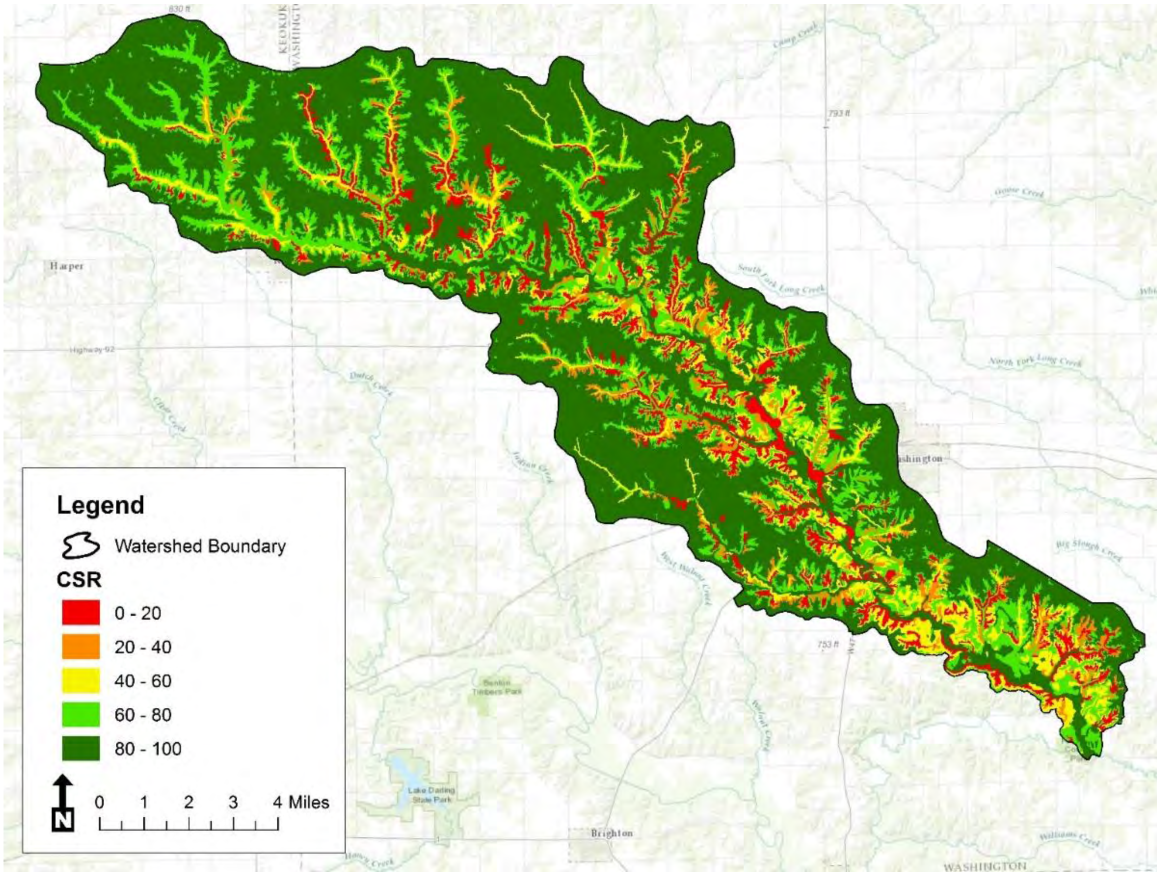

Figure 2.5.4. Corn Suitability Rating (CSR) values for land in the West Fork Crooked Creek Watershed.

2.6. Land Use and Management

Land in the West Fork Crooked Creek Watershed is used primarily for row crop agriculture, which is a major change from its natural state. The General Land Office (GLO) first surveyed the land in Iowa between 1832 and 1859. Surveyors recorded descriptive notes and maps of the landscape and natural resources such as vegetation, water, soil and landform. The collection of historic GLO maps and survey notes is one of few sources of information about native vegetation before much of Iowa's landscape was converted to production agriculture. The GLO surveyors classified land within the West Fork Crooked Creek Watershed as 83 percent prairie and 5 percent water or wetlands. Figure 2.6.1 shows current streams connect and likely drain many of the historically wet portions of the watershed.

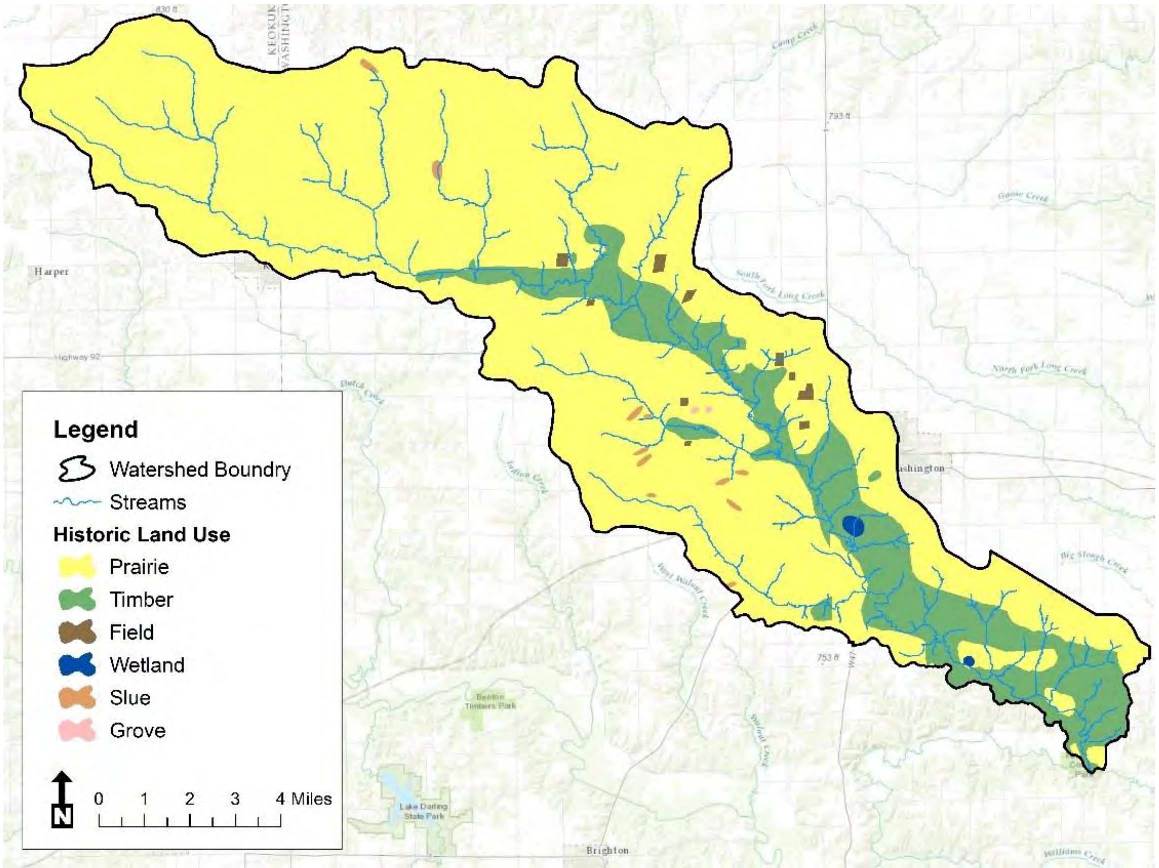

Figure 2.6.1. Pre-settlement land cover in the West Fork Crooked Creek Watershed according to the GLO survey in the mid-1800s (present day streams).

Recent and current land use practices were assessed using the USDA-National Agricultural Statistics Service (NASS) Cropland Data Layer (CDL) 2003 through 2015 information and high-resolution IDNR data from 2009. Land use trends based on CDL data are shown in Figure 2.6.2. The IDNR land use information was developed from aerial imagery and LiDAR elevation data. A summary of the high-resolution IDNR land use data is presented in Table 2.6.1 and Figure 2.6.3. On average since 2009, approximately 71 percent of the watershed has been used for corn and soybean production.

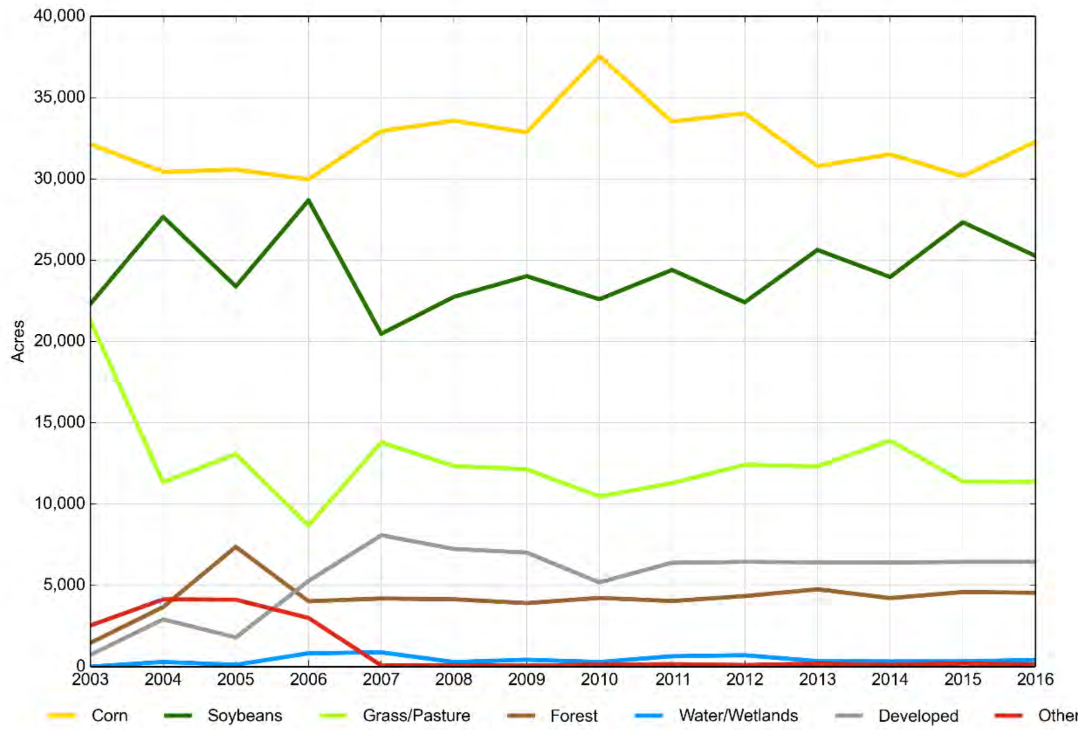

Figure 2.6.2. West Fork Crooked Creek Watershed 2003 through 2015 land use according to CDL data.

Table 2.6.1 West Fork Crooked Creek Watershed 2009 high-resolution land use according to IDNR data.

Land Use	Acres	Percent
Water	368	0.5
Wetland	330	0.4
Coniferous Forest	163	0.2
Deciduous Short	1,546	2
Deciduous Medium	2,160	2.7
Deciduous Tall	1,772	2.2
Grass 1	10,771	13.4
Grass 2	2,950	3.7
Cut Hay	742	.9
Corn	28,300	35.2
Soybeans	28,838	35.8
Barren / Fallow	113	0.1
Structures	284	0.4
Roads / Impervious	1,974	2.5
Shadow / No Data	139	0.2
Total	**80,449**	**100**

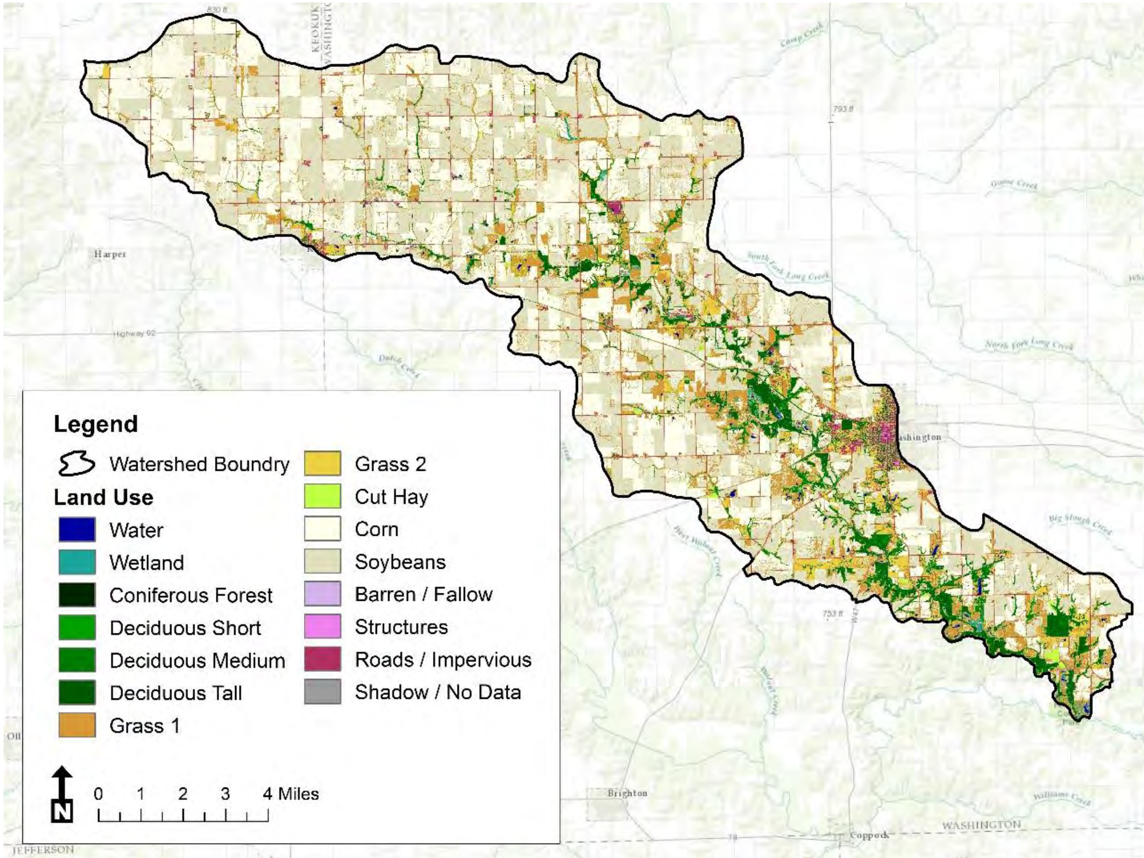

Figure 2.6.3. High-resolution 2009 land use map of the West Fork Crooked Creek Watershed.

2.7. Population

West Chester and portions of Keota and Washington Iowa are the incorporated communities within the watershed. According to US Census Bureau data in 2016, Washington had a population of 7,424, West Chester had population of 148 and Keota had population of 966. 7,824 people lived in census tracts in the West Fork Crooked Creek Watershed, which equates to an average population density of 62.2 people per square mile. There are an estimated 3,458 housing units in the watershed.

2.8. Existing Conservation Practices

Cataloging existing conservation infrastructure provides an important assessment of current conditions and is a useful exercise for determining the need for future conservation practice placement. Current conservation practices were assessed and catalogued using aerial photography, watershed surveys and stakeholder knowledge. Many conservation practices were identified within the watershed, but determining levels of in-field management practices (e.g., nutrient management, reduced tillage, cover crops) can be difficult, so it is possible that this inventory does not capture all conservation within the watershed. Table 2.8.1 lists all practices and known existing implementation levels within the watershed.

Table 2.8.1. Inventory of West Fork Crooked Creek Watershed existing conservation practices as of 2017.

Practice	Quantity	Data Source
No-till/Strip-till	Unknown	NA
Cover crops	8,764 acres	Spring 2017 aerial imagery and cost share information from SWCD
Nutrient management	Unknown	NA
Extended rotation	Unknown	NA
Buffers within 100' of streams	80% in land uses other than row crop	2009 high resolution land use data and 100' buffer of 2^{nd} order or greater streams
Terraces	52 miles	Statewide BMP inventory
Grassed Waterways	1,299 acres	Statewide BMP inventory
Water & Sediment Control Basins	97.5 miles	Statewide BMP inventory
Ponds	186 no.	Statewide BMP inventory
Bioreactors	2 no.	Watershed coordinator
Drainage Water Management	40 acres	Watershed coordinator
Saturated Buffers	2 no.	Watershed coordinator
Perennial Cover (Grass & Trees)	19,362 acres	2009 high resolution land cover

2.9. Soil Erosion Assessment

Soil erosion in West Fork Crooked Creek Watershed was estimated using factors from the Revised Universal Soil Loss Equation (RUSLE) for the various combinations of soils and land use within the watershed. RUSLE2 is a computer model used to evaluate the impact of different tillage and cropping systems on sheet and rill erosion. The major RUSLE model factors incorporate climate, soils, topography and land management. The interactions between these factors drive the model results, but land use, crop rotation and tillage system have the largest impacts on soil loss estimates. Conventional tillage (i.e., minimal crop residue cover) was assumed for all cropland to provide a conservatively large soil erosion estimate, so agricultural fields with conservation practices like reduced or no tillage and cover crops are likely to erode less. Based on the RUSLE analysis, sheet and rill erosion in the West Fork Crooked Creek Watershed average 3.9 tons per acre per year. The total estimated sheet and rill erosion from cropland in the watershed is estimated to be 233,000 tons per year. The distribution of soil erosion rates across the watershed is shown in Figure 2.9.1. To put this estimate into context, most soils are assigned a maximum tolerable soil loss rate of 5 tons per acre per year by the NRCS. It is important to note that RUSLE estimates do not include any soil loss due to concentrated runoff such as ephemeral or classical gully erosion.

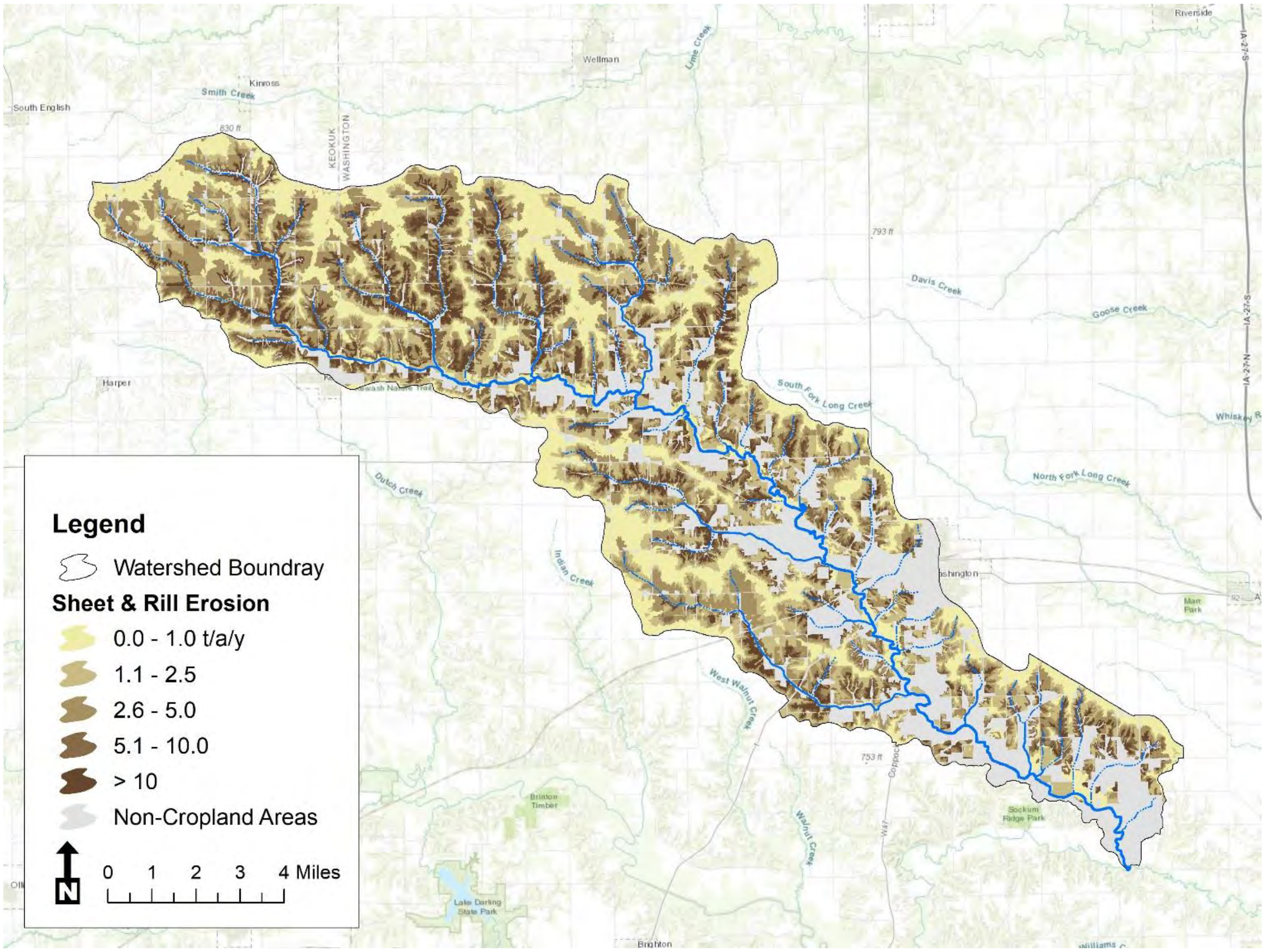

Figure 2.9.1. Estimated sheet and rill erosion rates based on soil types and land use in the West Fork Crooked Creek Watershed.

Not all sediment that moves small distances due to sheet and rill erosion ultimately leaves the watershed. Total sediment yield from the watershed is influenced by upland soil erosion rates, streambank erosion and the sediment delivery ratio (SDR), which reflects the proportion of sediment that is likely to be transported through and out of the watershed. The SDR depends on watershed size and shape, stream network density and conditions and topography. The SDR for the West Fork Crooked Creek Watershed is estimated to be 3.3 percent.

3. Water Quality and Conditions

3.1. Raccoon River Water Quality Impairments

The West Fork Crooked Creek Watershed is a subwatershed of the Skunk River Watershed (Figure 3.1.1). Downstream of Crooked Creek the Skunk River is impaired by bacteria. The Iowa 2014 Integrated Report 305(b) does not identify any impaired stream segments within the West Fork Crooked Creek watershed.

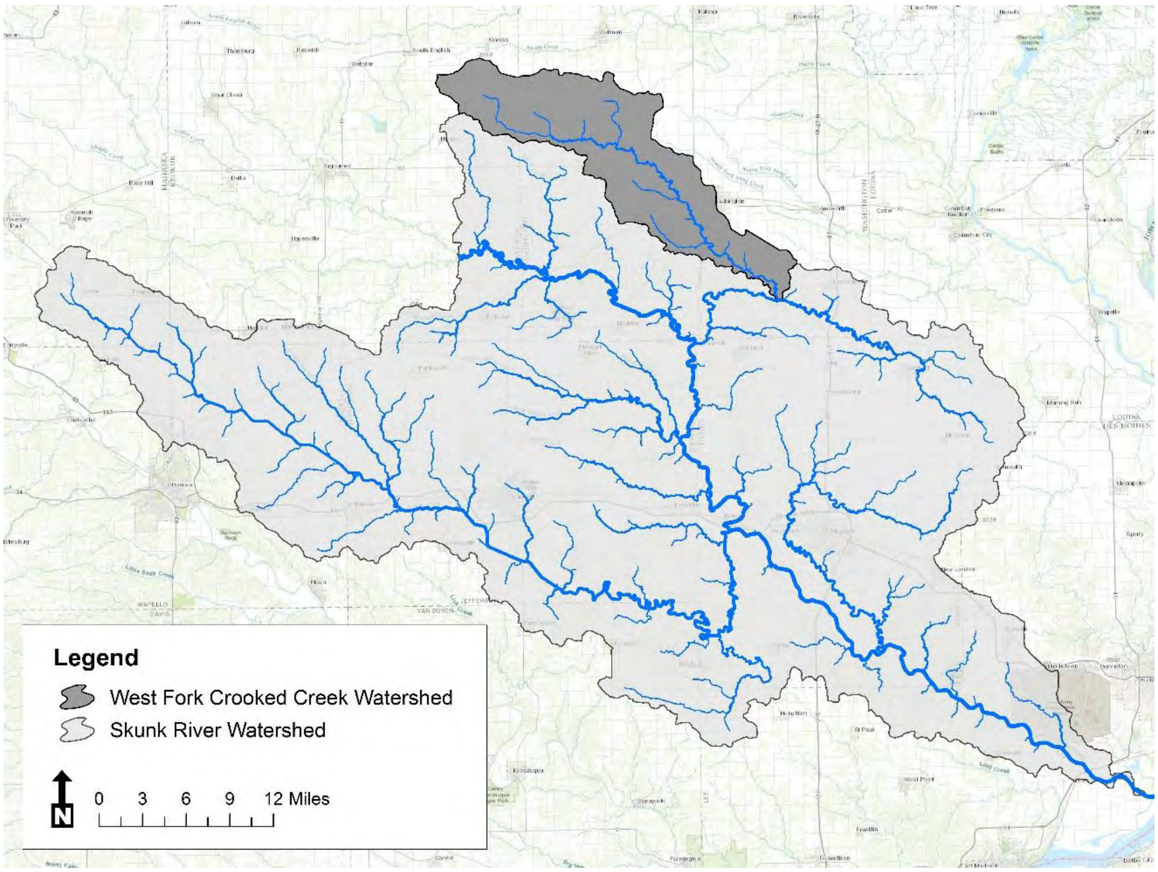

Figure 3.1.1. Location of the West Fork Crooked Creek Watershed within the Raccoon River Watershed.

3.2. West Fork Crooked Creek Water Quality

Water quality from the West Fork Crooked Creek is limited to periodic grab sampling conducted at three locations in the watershed. The stream nitrate concentration in the West Fork Crooked Creek is shown in figures 3.2.1 and 3.2.2. The samples are collected from bridge crossings every two to three weeks during the primary growing season, April through September. The stream results from each year have been averaged and the resulting concentrations are shown in figure 3.2.1. Averages from 2015 through 2016 show a declining trend, however additional factors may play into the results and require further analysis to determine if a trend is occurring. Figure 3.2.2 shows the average stream nitrate concentrations by month. This pattern of high concentrations in April, May and June is typical for Iowa streams. This reinforces the importance of selecting conservation practices that preform during the months of highest concentrations and loading.

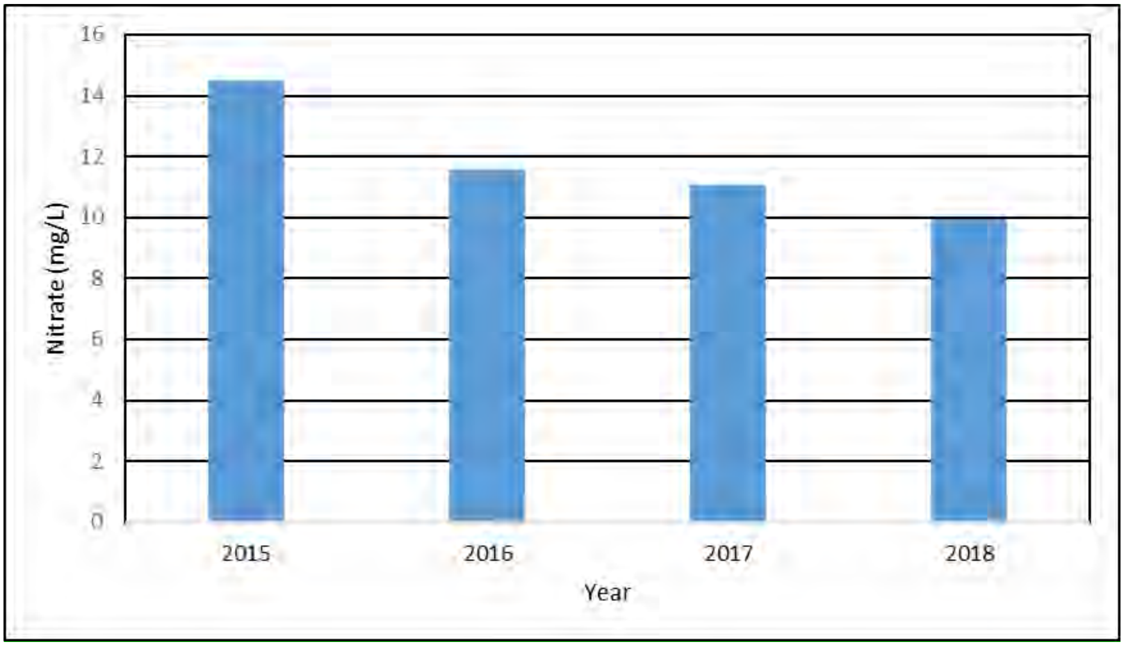

Figure 3.2.1. Average annual nitrate concentration in West Fork Crooked Creek 2015 through 2018 at three stream monitoring sites.

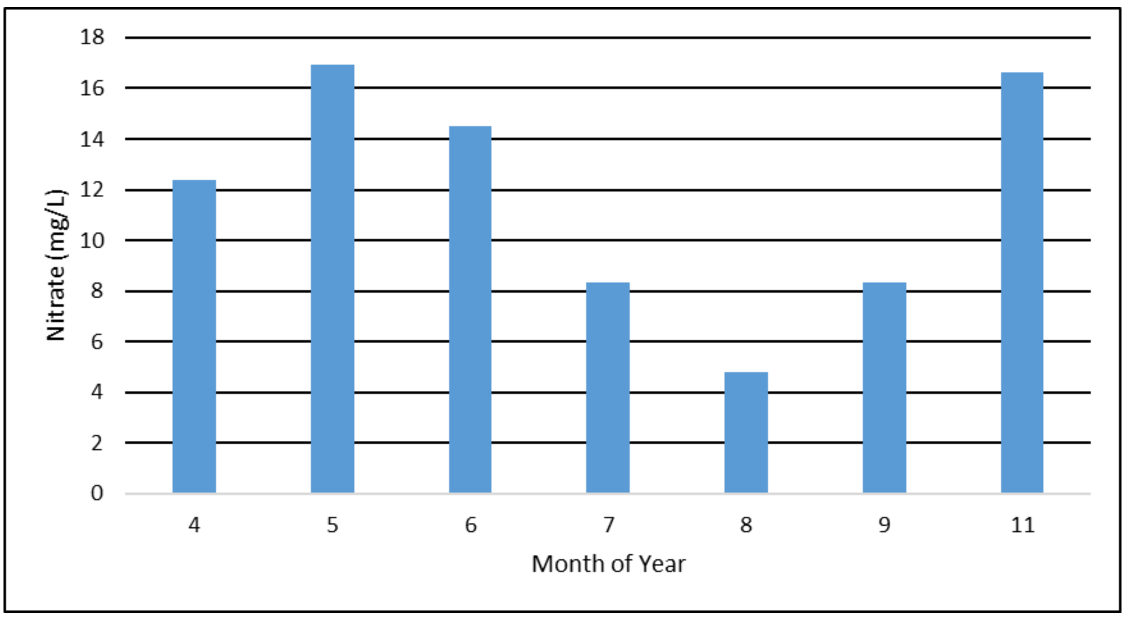

Figure 3.2.2. West Fork Crooked Creek 2015 to 2018 average nitrate concentration by month at three stream monitoring sites.

3.3. West Fork Crooked Creek Watershed Point Sources

The INRS incorporates both point and nonpoint sources. The City of Washington has a wastewater treatment facility, and is identified in the INRS as a priority point source for nutrient load reduction. This watershed plan addresses only nonpoint nutrient sources and prioritizes agricultural conservation practices as the best methods to improve water quality in the West Fork Crooked Creek Watershed. Additional studies may be necessary to understand the contributions of point sources within the watershed.

4. Goals and Objectives

This watershed management plan is a guiding document. Water and soil quality will only improve if watershed conservation activities and best management practices (BMPs) are implemented. This will require active engagement of diverse local stakeholders; collaboration of local, state and federal agricultural and conservation agencies; and funding. In addition to BMP implementation, water monitoring should also be increased. Monitoring is a crucial activity to assess the status of water quality goals, standards and designated uses; to determine if water quality is improving, degrading or remaining unchanged; and to assess the effectiveness of implementation activities and the possible need for additional or alternative BMPs.

This plan is designed to be used by local agencies, watershed managers and citizens for decision support and planning purposes. The BMPs listed below represent a suite of tools that will help achieve water quality, soil health, agronomic and socioeconomic goals if appropriately utilized. It is up to all stakeholders to determine exactly how to best implement them. Locally driven efforts have proven to be the most successful in obtaining significant water quality improvements.

Before the watershed plan is implemented the overall goals and objectives must be identified, as they will guide implementation approaches and activities. The goals listed in this plan are not permanent. While the goals and objectives have been developed with input from local stakeholders based on the best information available and the current needs and opportunities for the watershed, changing needs and desires within the watershed, economy or Farm Bill or emerging water and soil quality improvement practices and technologies may mean that these goals and strategies will need to be reevaluated and revised. It is therefore essential to allow for sufficient flexibility to respond to changing needs and conditions while still providing a strong guiding mechanism for future conservation efforts.

The statewide goals of the INRS provided an important starting point for goal development by stakeholders in the West Fork Crooked Creek Watershed. The INRS is a scientific and technological framework for nutrient reduction in Iowa waters and the Gulf of Mexico from both nonpoint and point nutrient sources. The overall goals of the INRS are to reduce nitrogen and phosphorus loads by 45 percent. The INRS states that nonpoint sources need to reduce nitrogen loading by 41 percent and phosphorus loading by 29 percent in order to achieve overall nutrient reduction goals.

The Nonpoint Source Nutrient Reduction Science Assessment component of the INRS was initiated in 2010 to support development of the INRS approach for nonpoint sources by determining the nitrogen and phosphorus reduction effectiveness of specific practices. The agricultural conservation practices identified in the science assessment were broadly classified as nutrient management, land use change and edge-of-field practices. The science assessment illustrated that a combination of practices will be required to achieve nonpoint source nitrogen and phosphorus load reduction goals. The conceptual plan for the West Fork Crooked Creek Watershed identified in Section 5 incorporates many of the nonpoint source practices assessed and included in the INRS.

Through the watershed planning process the following goals addressing agriculture, soil and water have been identified:

1. Maintain and increase agricultural productivity and profitability
2. Reduce soil erosion
3. Reduce in-stream nonpoint source nitrogen loads by 41 percent
4. Reduce in-stream nonpoint source phosphorus loads by 29 percent
5. Increase soil organic matter
6. Develop financial incentives for new practice users

This watershed plan uses the year 2014 as the baseline for conservation practice implementation and determining progress towards reaching goals by 2038 because 2014 conditions reflect the pre-Water Quality Initiative status of the watershed. Watershed models were developed to determine the baseline and future nitrogen, phosphorus and sediment loads plus associated reductions in the West Fork Crooked Creek Watershed. Table 4.1 provides estimates of watershed loading rates for the 2014 baseline and conditions during and after the implementation of practices identified in this watershed plan. Table 4.2 provides estimates of percent load reduction for each phase relative to the 2014 baseline. The phases and associated practices and implementation levels are detailed in Section 6. A practice-based model was used to determine the nitrogen load reductions based on practice nitrate reduction efficiencies from the Iowa Science Assessment of Nonpoint Source Practices to Reduce Nitrogen Transport in the Mississippi River Basin section of the INRS. Soil erosion projections were based on the watershed RUSLE model results. Streambank erosion was estimated to be 4,600 tons per year based on data collected during a stream assessment of West Fork Crooked Creek. Upland sheet and rill erosion, streambank erosion and a Sediment Delivery Model were used to estimate total sediment delivery levels and reductions. A phosphorus enrichment ratio of 1.6 pounds of phosphorus per ton of sediment delivery was used to estimate phosphorus loading.

Table 4.1. Estimated baseline (2014), current (2018) and future nitrogen, phosphorus and sediment export from the West Fork Crooked Creek Watershed for 5-year phases until full watershed plan implementation anticipated by 2038.

	Units	**2014 baseline**	**2018 conditions**	**2023 target**	**2028 target**	**2033 target**	**2038 target**
Nitrogen load	pounds/year	1,213,760	1,213,760	1,115,050	973,236	829,094	710,584
Phosphorus load	pounds/year	86,528	86,528	79,370	63,380	44,805	31,885

Table 4.2. Modeled nutrient and sediment load reductions from the 2014 baseline in the West Fork Crooked Creek Watershed for current 2018 conditions and each 5-year phase of watershed plan implementation.

	Units	**2014 baseline**	**2018 conditions**	**2023 target**	**2028 target**	**2033 target**	**2038 target**
Nitrogen load	% reduction	5%	5%	8%	20%	32%	41%
Phosphorus load	% reduction	12%	12%	20%	36%	55%	68%

5. Conceptual Plan

Best management practices are part of the foundation for achieving water quality, soil health and flood reduction goals. BMPs include practices and programs designed to improve water quality and other natural resource concerns such as changes in land use or management, structural pollutant control and changes in social norms and human behavior pertaining to watershed resources along with their perception and valuation. Efforts are made to encourage long-term BMPs, but this depends upon landscape characteristics, land tenure, commodity prices and other market trends that potentially compete with conservation efforts. With this in mind, it is important to identify all possible BMPs needed to achieve the watershed goals. From an initial list of potential practices, priority practices were identified by narrowing the list to those practices most acceptable to watershed stakeholders. Watershed planning facilitators used an impact versus effort exercise to prioritize BMPs that provide the greatest benefits and are the most acceptable to local stakeholders.

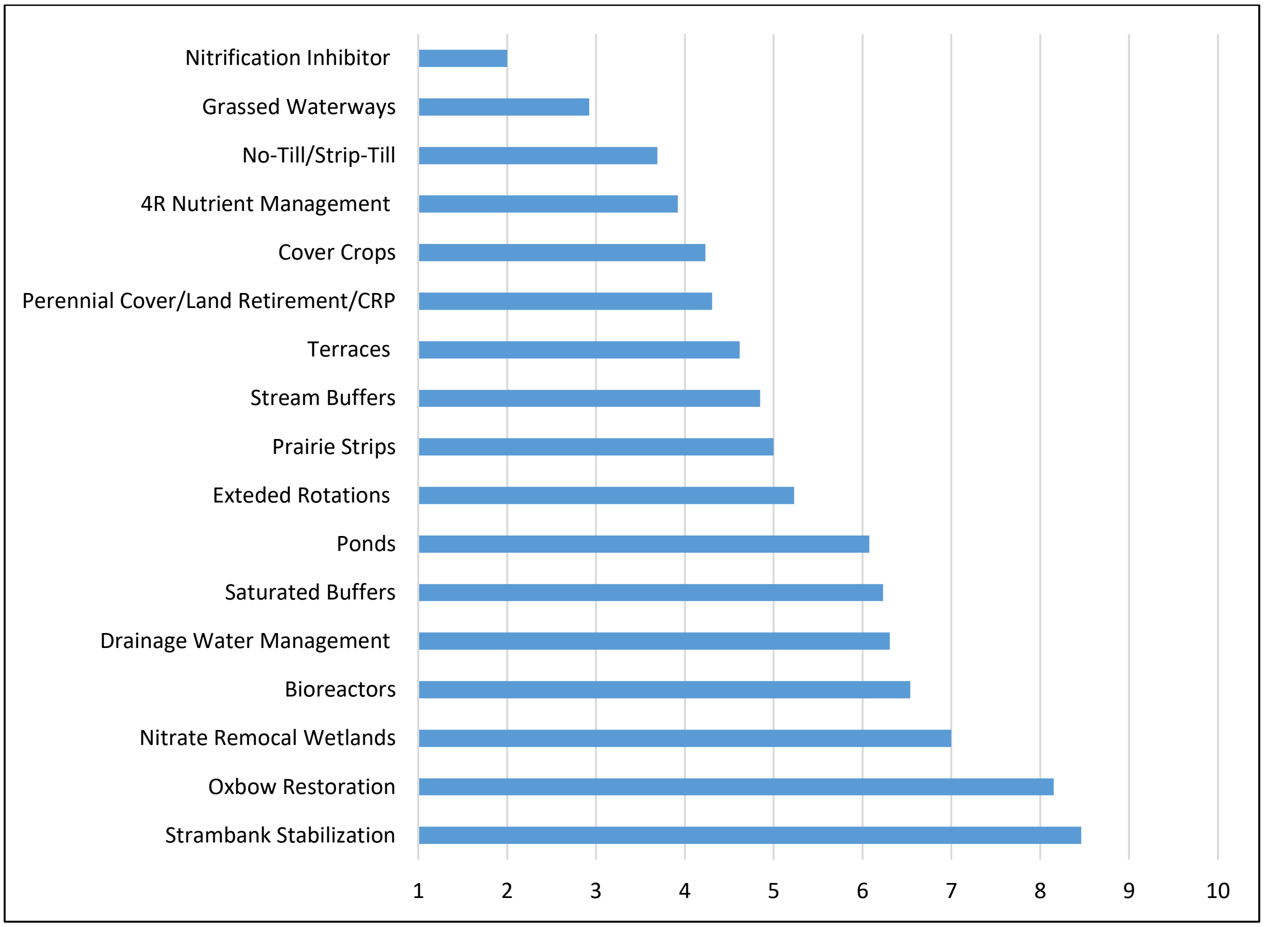

Figure 5.1. Illustration of effort scoring by watershed farmers and stakeholders. Effort of 1 indicates practice is "easy" to implement, a 10 indicates the practice is "difficult" to implement. Effort is thought of as time, money, lost revenue potential and other factors that play in farm decision making.

When selecting and implementing BMPs, it is important to identify if a particular practice is feasible in a given location. Site feature suitability and practice alignment with stakeholder values should be considered. It also is important to determine how effective the practice will be at achieving goals, objectives and targets. Table 5.1 provides a list of BMPs identified by watershed stakeholders and a rating of each practice's efficacy to address identified water and soil goals. While only the practices italicized in Table 5.1 are included in the conceptual plan and nutrient reduction calculations, the other practices will be important to consider when making decisions about water and soil improvement. Figure 5.2 provides a map of a conceptual BMP implementation scenario that sites BMPs in locations intended to achieve maximum benefit (e.g., nitrate removal wetlands placed at strategic locations or bioreactors placed at drainage tile outlets).

Table 5.1. Best management practices and relative impact scores (3 = High impact, 2 = Moderate impact, 1 = Low impact, 0 = No impact). Italicized BMPs are those included in the conceptual plan.

	Practice	**Soil health**	**Nitrogen reduction**	**Phosphorus reduction**
In-field	*4R Nutrient Management*	*1*	*1*	*1*
	Nitrification Inhibitor	*0*	*1*	*0*
	Cover Crops	*3*	*3*	*3*
	Perennial Cover	*3*	*3*	*3*
	Extended Rotations	3	2	2
	No-Till/Strip-Till	*3*	*0*	*3*
	Grassed Waterways	1	0	2
	Drainage Water Management	*0*	*3*	*0*
Edge-of-field	*Bioreactors*	*0*	*3*	*1*
	Saturated Buffers	*0*	*3*	*1*
	Buffers	0	1	3
In-stream	Ponds	0	2	3
	Nitrate Removal Wetlands	*0*	*3*	*1*
	Streambank Stabilization	0	0	2
	Two-Stage Ditch	0	1	0

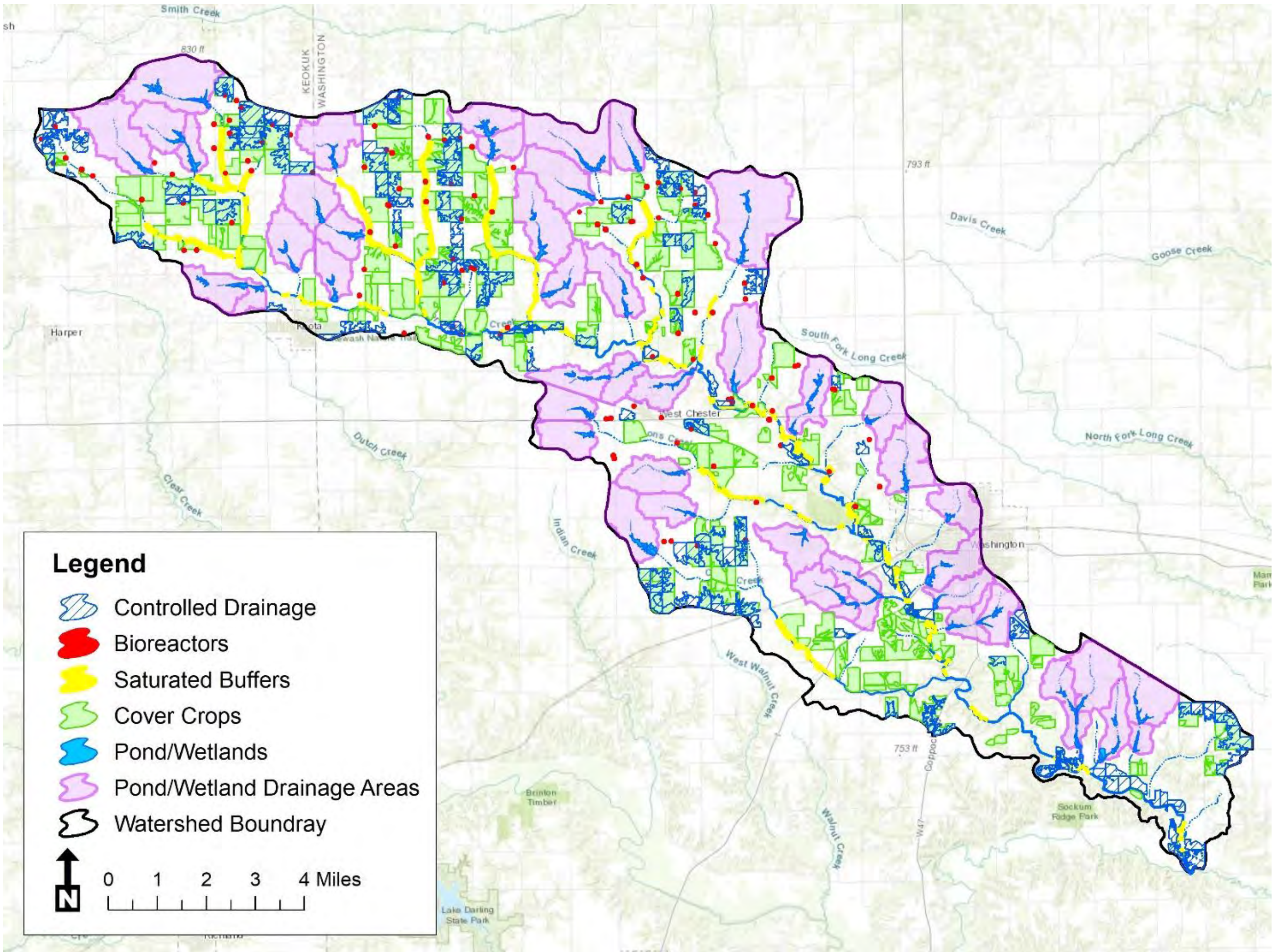

Figure 5.2. Conceptual plan for BMP implementation in the West Fork Crooked Creek Watershed. Appendix A contains detailed, larger maps.

The BMP conceptual plan presented in Figure 5.2 is ambitious, but this level of implementation is needed to achieve the goals identified in this watershed management plan. This scenario is one of a variety of potential combinations of BMPs that would allow for this plan's goals to be reached. Deviations from the proposed implementation plan should be made with the knowledge that additional or alternative practices may then be needed in other locations within the watershed to ensure that goals are met. For example, cover crops grown within a wetland drainage area may not result in the same water quality benefit at the watershed outlet as cover crops grown downstream of a wetland.

A team of USDA-Agricultural Research Service scientists have developed the **Agricultural Conservation Planning Framework** (ACPF) to facilitate the selection and implementation of conservation practices in watersheds with predominately agricultural land use. The ACPF outlines an approach for watershed management and conservation. The framework is conceptually structured as a pyramid (Figure 5.3). This conservation pyramid is built on a foundation of soil health. The priority cover crop zones delineated in Figure 5.2 have been identified for maximum water quality improvement potential at the outlet of the West Fork Crooked Creek Watershed, but such practices that build soil health will result in additional benefits including erosion control, water retention, flood reduction, increased soil organic matter and improved nutrient cycling. Therefore, management practices that improve soil health like cover cropping and reducing tillage should be promoted and implemented on all cropland within the watershed. Following the conservation pyramid concept, structural practices to control and treat water should then be targeted to specific in-field, edge-of-field and in-stream locations where maximum water quality benefits can be realized.

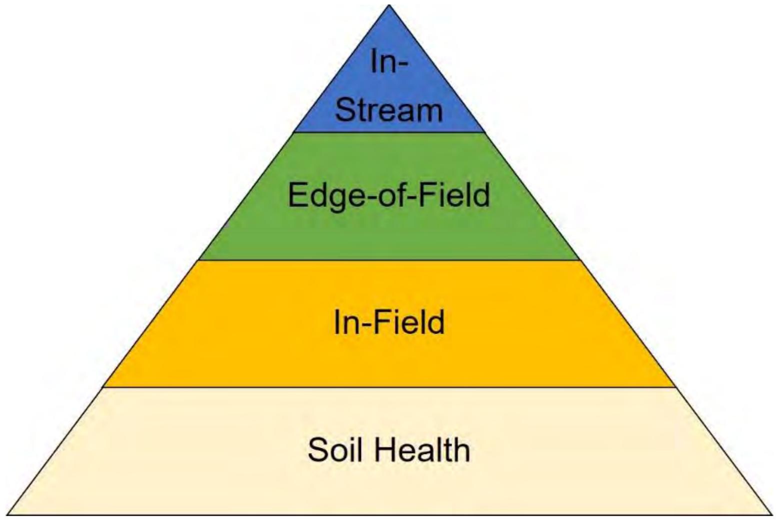

Figure 5.3. The Agricultural Conservation Planning Framework conservation pyramid adapted from the ACPF documentation.

The ACPF includes a mapping toolbox to identify potential locations for conservation practice adoption. Selected results of applying these siting tools to the West Fork Crooked Creek Watershed have been incorporated into this conceptual plan. Appendix B contains detailed ACPF maps for all potential BMPs within the watershed. The ACPF maps contain many practices in more locations than necessary to achieve water quality goals, so along with the conceptual plan displayed in Figure 5.2 serving as the overarching guide, the ACPF results can be used to adapt practice adoption as needed during the implementation phase of the watershed project.

6. Implementation Schedule

Implementation schedules are intended to serve as a reference tool to recognize tasks scheduled for the upcoming year and to identify and focus the necessary resources for the current phase of the project. The implementation schedule should be adaptable and updated on a regular basis due to shifting priorities, unexpected delays and new opportunities.

The 20-year phased implementation schedule was approved by watershed stakeholders and should be used to set yearly objectives and gauge progress. It should be noted that practices included in the implementation schedule only include those identified to reach the watershed plan goals. Other practices such as structural runoff control (e.g., grassed waterways, contour filter strips), extended rotations, stream buffers and streambank stabilization should be promoted wherever appropriate. Existing perennial cover should be maintained to continue provision of diverse water quality, soil health and wildlife and pollinator habitat benefits.

Table 6.1. Watershed plan implementation schedule separated into four 5-year phases for the West Fork Crooked Creek Watershed.

Practice	**Existing level**	**Unit**	**2018-2022 goal**	**2023-2027 goal**	**2028-2032 goal**	**2033-2037 goal**	**Total watershed plan goal**
Cover crops	8,764	acres	12,000	16,000	20,000	20,000	20,000
Drainage water management	40	acres	200	2,000	4,000	5,960	5,960
Bioreactors	60	Acres treated	200	2,000	4,000	5,940	5,940
Saturated buffers	40	Acres treated	200	2,000	2,500	2,960	2,960
Ponds/Wetlands	4,284	Acres treated	2,000	10,000	20,000	30,000	30,000

7. Monitoring Plan

Monitoring is an essential component of watershed plan implementation and provides an opportunity to assess progress. Monitoring can come in many different forms including water monitoring, biological surveys, soil and plant tissue sampling as well as social assessments. This section describes recommendations for future monitoring actions to document improvements resulting from watershed plan implementation.

7.1. Stream Monitoring

Perhaps the most important monitoring activity is stream monitoring due to the watershed plan goals of reducing nitrogen and phosphorus loads. Along with modeled nutrient reductions, water monitoring results will be key indicators of water quality improvement in the West Fork Crooked Creek Watershed. Monitoring data within the watershed is sparse. A small network of stream sites could be established to build a baseline database and track water quality trends as the watershed plan is implemented.

Location information for three potential sites throughout the watershed where stream water samples may be collected is contained in Table 7.1.1. At a minimum, site WFCC21 near the watershed outlet should be sampled throughout the growing season every year as an indicator of overall water quality in the watershed.

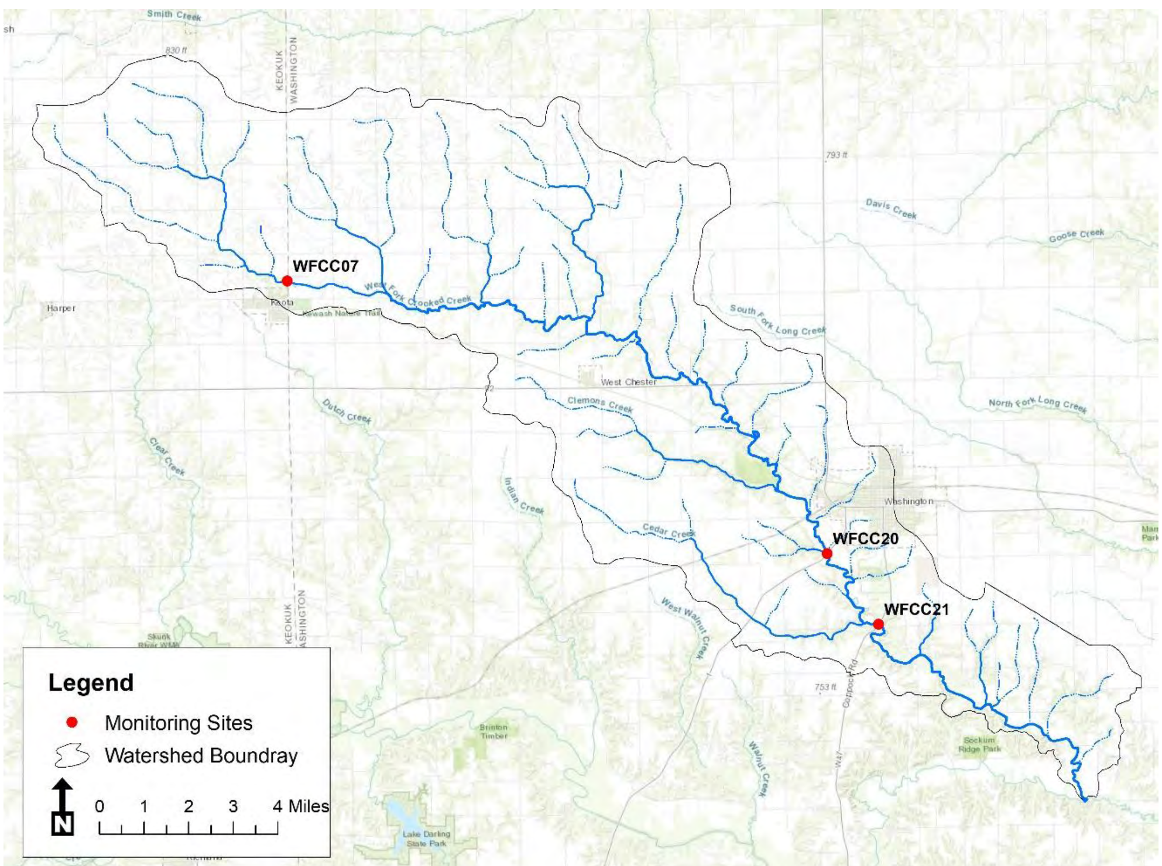

Figure 7.1.1. Potential West Fork Crooked Creek Watershed stream monitoring sites.

Table 7.1.1. Location information for a proposed stream water monitoring network within the West Fork Crooked Creek Watershed.

SiteID	Longitude	Latitude	Site Description
WFCC07	-91.946	41.372	Upper watershed on Washington/Keokuk county line
WFCC20	-91.716	41.281	Highway 1, Upstream of Washington
WFCC21	-91.694	41.258	Downstream of Washington

This monitoring site network would allow for consistent water quality information to be gathered throughout the watershed. Ideally, bi-weekly samples should be collected beginning in April and extending through October. At a minimum, the samples should be analyzed for nitrate, phosphorus and sediment.

In addition to water grab sampling, stream discharge also should be recorded in order to determine nitrogen, phosphorus and sediment loading. One method to capture stream discharge is to measure the stream stage and use a hydrograph to calculate discharge. The US Geological Survey (USGS) **Water Science School** provides an overview of this process.

Other existing water sampling programs offer additional data sources or opportunities to document water quality in the West Fork Crooked Creek Watershed. The Iowa **STORET** database maintained by the IDNR contains water physical, chemical, biological and habitat data. The IDNR's **ADBNet** database documents Iowa's water quality assessments for Clean Water Act section 305(b) reporting. Volunteer water quality monitoring such as **IOWATER** also can be important sources of information, especially to yield a detailed, one-time "snapshot" of water quality. The **Iowa Water Quality Information System** (IWQIS) provides real-time water quality data.

7.2. Biological Monitoring

In addition to chemical and physical indicators of water quality, the biological community of a stream reflects its overall health. Surveys of benthic macroinvertebrate species in streams are excellent biological indicators of water quality. More diverse communities and presence of sensitive species reflect good quality streams. The IOWATER program provides protocols and recommendations for assessing the stream biological community in its **Biological Monitoring Manual**. Existing biological monitoring data are stored in the IDNR **BioNet** database.

7.3. Field Scale Water Monitoring

In addition to monitoring streams in West Fork Crooked Creek Watershed, water quality monitoring at finer scales should be conducted to assess the effectiveness of individual conservation practice installations. Water samples at this scale should be collected from either tile water exiting subsurface drainage systems or surface runoff from a targeted area. Monitoring surface runoff is difficult because runoff events are episodic and often missed via regularly scheduled monitoring programs. Tile water monitoring is easier because tiles tend to flow more consistently. However, monitoring tile water may only provide data on nitrate loss because the majority of phosphorus and sediment loss occurs via surface runoff.

Tile monitoring should be targeted to drainage systems that drain a single field to allow for changes in management practices to be isolated and detectable. Tile outlets that are easily accessible and provide the opportunity to capture sufficient tile flow should be selected for monitoring. Flow volume from tiles can be calculated by measuring the time needed to fill a container of known volume or by using flow sensors such as pressure transducers. Tile flow, nutrient concentration and tile system drainage area can be used to calculate the nutrient loading rate (e.g., pounds of nitrate loss per acre per year) at a tile outlet.

7.4. Soil Sampling

Agricultural soils contain many nutrients, especially where fertilizer or manure have been applied. At a minimum, soil samples should be analyzed for phosphorus, potassium, nitrogen and organic matter, which affects nutrient cycling. Improved soil fertility data will better inform nutrient management, which can result in the multiple benefit scenario of increased profitability and decreased nutrient export due to improved nutrient application. Additionally, collection of soil samples in coordination with field scale water monitoring could improve understanding of the relationship between nutrient management practices, soil fertility, soil health and water quality. Soil samples should be collected for multiple years, particularly if agronomic management practices are altered or in-field conservation practices such as cover crops, are implemented. In-season soil nitrate testing can be used to inform adaptive nutrient management practices with the goals of improving agronomic production and reducing nutrient losses. Tests to measure soil health and biological activity also could be utilized to quantify additional benefits of management practices that build soil health like no-till and cover crops.

7.5. Plant Tissue Sampling

The end-of-season corn stalk nitrate test is a tool used to evaluate the availability of nitrogen to the corn crop. Nitrate concentrations measured from stalk sections for the lower portion of a corn plant taken after the plant reaches maturity are indicative of nitrogen available to the plant. The corn plant will move available nitrogen to the grain first. By measuring the amount of nitrogen left after grain fill, a determination can be made as to how much nitrogen was left in the plant relative to what was needed for optimal grain yield. This is a very basic and easy management evaluation tool. It should be noted the test is a point in time and producers should collect samples over multiple years to account for weather and seasonal variations before modifying operations.

7.6. Social Surveys

Biophysical assessments are useful benchmarks of natural resource quality, but conservation practices only will be adopted and implemented in the West Fork Croked Creek Watershed if local stakeholders recognize and value the necessary alignment of BMPs with both individual farming operations and broader watershed goals. Surveys are one tool that should be used to periodically assess awareness and attitudes regarding the general issue of water quality and the goals of this watershed plan. For example, a detailed survey could be conducted during or after each 5-year phase of the implementation schedule (Table 6.1). Results could be used to modify approaches as needed during the subsequent 5-year implementation phase. Surveys also could be paired with specific educational events like field days to assess the effectiveness of different outreach formats, which could improve information and education strategies as the project proceeds.

8. Information and Education Plan

Behavior patterns of all stakeholders, and especially producers and landowners, must be considered in both BMP design and implementation strategies for water quality projects. To affect changes in behavior, goal-based outreach that addresses the actual and defined needs of key stakeholders is critical. It will also be important to leverage preexisting relationships and previous successes to build a community of support and knowledge around producers and landowners who will actively be adjusting their operations. Many obstacles to the adoption of conservation practices may be overcome by providing adequate education and outreach regarding how land management practices influence nonpoint source pollutant losses to surface water resources. Knowledge increases awareness, which may then motivate changes in behavior.

Local stakeholders identified various information-based challenges: better economic information related to incorporation of conservation practices into farming operations would likely increase the pace of adoption; current understanding of the field-scale nutrient reduction effects of multiple, interacting conservation practices is limited; and an increase in farmer-to-farmer learning sessions would be helpful.

As with any watershed project, a goal-based outreach plan will need to be designed to facilitate the goals set by stakeholders and to support the timeline defined in this watershed plan. With a 20-year implementation schedule, progress can be hindered if expectations are not managed both initially and throughout the project. First, awareness and participation should be raised among farmers, landowners and conservation experts to build community confidence that action is being taken. Next, the broader community should be invited to learn about and participate in the watershed project.

Table 8.1. Components of the information and education plan.

Goal	Increase awareness and adoption of practices to achieve watershed social, land and water goals.
Target audiences	Primary: Producers, landowners and technical experts. Secondary: Residents, educators, students, health experts and others.
Messages	Need to be tailored for farmer engagement, public, decision makers and media. Different audiences respond differently to specific messages, so an outreach plan that incorporates an understanding of what motivates each audience to engage will help the project be successful.

Table 8.2. Outreach strategies and tools.

Logo and other branding	Stream signs	Coffee shop fliers
Website and social media	Conservation practice signs	Conservation icons or graphics
Fact sheets	IOWATER volunteer workshops	Guest speakers at other events
Direct mailings	Youth outdoor learning	
Demonstration field days	Urban/ag learning exchanges	
Watershed boundary signs	Stream cleanup events	

Table 8.3. Potential project partners, contacts and local media.

Potential project partners	Washington and Keokuk Soil and Water Conservation District Commissioners Local ag cooperatives Iowa Agriculture Water Alliance Iowa Department of Natural Resources Iowa Farm Bureau Federation Iowa Pork Producers Association

<table>
<tr><td></td><td>Iowa Soybean Association
Iowa State University Extension
City of Washington
USDA-Agricultural Research Service
USDA-Natural Resources Conservation Service</td></tr>
<tr><td>Other government, agriculture & outdoor groups</td><td>Youth educational groups
Ducks Unlimited
Pheasants Forever
Iowa Natural Heritage Foundation
Iowa Corn Growers Association
Washington & Keokuk County Board of Supervisors
Washington & Keokuk County Conservation Board</td></tr>
<tr><td>Media</td><td>Washington Evening Journal
The Keota Eagle Newspaper
Farm Bureau Spokesman
KCII Washington Iowa 106.1 FM & 1380 AM</td></tr>
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9. Evaluation Plan

Project evaluation and recognition of successes and challenges is a critically important step in implementing any watershed plan. This section lays out a self-evaluation process for project partners to gauge project progress in four categories: project administration, attitudes and awareness, performance and results. These four indicator categories are described in the following sections. A project evaluation worksheet can be found in Appendix C.

9.1. Project Administration

- **Yearly partner review meeting.** Watershed project partners should host an annual review meeting. This will provide an opportunity to evaluate project progress using an evaluation matrix.
- **Quarterly project partner update.** Each quarter, project leadership should ensure project goals and objectives are being accomplished, plan logistics and coordinate field days, events and monitoring.

9.2. Attitudes and Awareness

- **Farmer and landowner surveys.** Periodically a survey should be conducted with a statistically valid sample of farmers and landowners in the watershed. Results of the surveys should be used to determine changes in attitudes and behaviors.
- **Field day attendance.** Field days are an important outreach component of watershed projects. To gauge the impact of the field days, a short survey should be administered at the conclusion of each field day. The goal of the surveys will be to determine if understanding or attitudes were changed or practices have been or will be adopted as a result of the field day events.
- **Regional and statewide media awareness.** Media awareness and promotion of the project should be tracked by collecting and cataloging all articles and stories related to the project.

9.3. Performance

- **Practice adoption.** Locations of implemented practices should be tracked over the life of the project. Practice adoption rates will be aggregated to the watershed scale and reported to partners.
- **Practice retention.** Retention of management practices, such as cover crops, should be emphasized. Yearly follow-up with farmers implementing practices will help gauge practice retention trends.

9.4. Results

- **Practice scale monitoring.** Tile water or edge-of-field monitoring results should be used to gauge water quality improvements at the field scale. Individual results should be provided to farmer participants. All monitoring data should be aggregated to the watershed scale and shared with other famers, landowners and partners. This aggregated data also may be used in a publication to bring broader recognition to local and other Iowa water quality efforts.
- **Stream scale monitoring.** In-stream water monitoring sites should be used to determine if long-term water quality improvements are being realized. Year to year improvements will likely be undetectable but long-term progress on the order of 10 years or more may be measurable if significant practice implementation occurs in the watershed.
- **Soil and agronomic tests.** Scientifically valid methods should be used to determine soil and agronomic impacts of practice adoption. These results will be shared with farmer participants. All soil and agronomic results should be aggregated to the watershed scale and shared with other farmers, landowners and partners.
- **Modeled improvements.** The project should work with appropriate groups or individuals to estimate soil and water improvements resulting from practice implementation.

10. Estimated Resource Needs

An estimate of resource needs is crucial to maintain current financial support and to gain support from potential funding sources. Table 10.1 provides an estimate of the total cost to implement conservation practices identified in this plan. Annual BMP implementation costs are estimated at $400,000 per year and initial structural costs are estimated to be $12,410,000. Some practices, such as nutrient management, reduced tillage and cover crops, may result in long-term cost savings to farmers and landowners. Therefore, cost-share or incentive payment rates may need to be evaluated during the implementation phase of this plan. These cost estimates are in 2018 dollars; so actual water quality investment needs likely will be higher due to inflation.

Table 10.1. Estimated resource needs (in 2018 dollars) to reach the West Fork Crooked Creek Watershed BMP implementation level goals.

	Practice	Watershed plan goal	Unit	Cost per unit	Total cost
Annual costs	Cover crops	20,000	acres	$20	$400,000
Initial costs	Drainage water management	5,960	acres	$1,000	$5,960,000
	Bioreactors	150	structures	$10,000	$1,500,000
	Saturated buffers	150	structures	$3,000	$450,000
	Ponds/Nitrate Removal Wetlands	60	sites	$75,000	$4,500,000

The initial investment needed to construct all proposed structural practices (drainage water management, bioreactors, saturated buffers and ponds/wetlands) is estimated at $12,410,000. Annual investments are necessary to increase and maintain adoption and implementation of management practices (cover crops). The estimated yearly total for these practices fully implemented is $400,000 per year. Cost-share payments may not be permanently available, so alternative funding sources for management practices may need to be pursued or developed or individuals may need to realize the long-term economic and environmental value of such practices to justify costs. For example, cover crop and nitrification inhibitor cost estimates do not account for improved soil health and nutrient use efficiency and associated short- and long-term benefits. The dollars necessary to fund structural and management practices could come from many different sources including farmers and landowners, downstream municipalities, other local or regional stakeholders and conservation organizations.

Additional costs associated with watershed improvement are estimated to begin at approximately $100,000 per year to fund salary, benefits and training for a watershed coordinator; information and education supplies and events; monitoring activities; and office space, computer, phone and vehicle.

11. Funding Opportunities and Approaches

To achieve the goals of this watershed plan, significant resources will be needed. Current funding mechanisms provided by local, state and federal units of government may not be adequate to address all goals outlined in this plan, so creative approaches to secure sustainable funding may be needed. Appendix D provides a listing of current local, state and federal programs and grants that may be able to provide resources for plan implementation. The following list provides ideas to leverage nontraditional resources. Further research is needed to determine feasibility.

- **Locally organized cover crop seeding programs.** Farmers and landowners are often busy with harvest during the prime cover crop seeding time period. To simplify cover crop adoption, cover crop seeding programs could be developed at the SWCD, County Conservation Board or local farm cooperatives. For example, the Mitchell SWCD has developed a "One Stop Cover Crop Shop" program to facilitate and expedite the cover crops cost-share application, planning and planting process for farmers.
- **Local cover crop seed production.** Access to and cost of cover crop seed may become problematic as adoption of cover crops increases in Iowa and the Upper Mississippi River Basin. A solution to this problem is to promote local production of cover crop seed, such as cereal rye. Typical yield of rye is 30 to 50 bushels per acre, so a seeding rate of 1.5 bushels per acre means that every acre of rye grown for seed would allow a rye cover crop to be planted on 20 to 33 acres of row crop land. To avoid taking productive land out of corn and soybean production, rye plantings could be targeted to marginal soils or lands.
- **Conservation addendums to agricultural leases.** More than half of Iowa's farmland is cash rented or crop shared, and an increase in this trend presents issues for ensuring proper conservation measures are in place on Iowa farms. Conservation addendums may be a way to ensure both the landowner and the tenant agree on conservation. Addendums could include any conservation measure, but the practices included in this plan would be of most benefit. A standard conservation addendum could be developed and shared with all absentee landowners in West Fork Crooked Creek Watershed.
- **Conservation easements.** Land easements have proven successful in preservation of conservation and recreation land in Iowa (e.g., Iowa Natural Heritage Foundation, Wetland Reserve Enhancement Program). Some landowners may be interested in protecting sensitive land for extended periods of time or into perpetuity. For these landowners, long-term conservation easements may be a good fit.
- **Nontraditional watershed partners.** Traditional watershed partners (e.g., IDALS, IDNR, SWCD, NRCS) likely will not have the financial resources to fully implement this plan, so local project partners should seek nontraditional partners to assist with project promotion and funding. Involvement could be in the form of cash or in-kind donations.
- **Nutrient offsets with point sources.** Water quality offset and watershed based permitting are solutions that may provide an additional revenue source for nonpoint source practice implementation. The Iowa Nutrient Reduction Exchange establishes the framework for point sources to engage with nonpoint source practices in order to count pollutant reductions towards permit requirements.
- **Recreational leases.** Recreational leases, such as hunting leases, may be promoted as a tool to increase landowner revenue generated from conservation lands, particularly those in perennial cover such as wetlands or grasslands.
- **Equipment rental programs.** Farmers are often hesitant to invest in new conservation technologies that require new equipment or implements. Project partners could invest in conservation equipment, such as a strip-till bar or cover crop drill, and then rent the equipment to interested farmers. In addition to building community support for the watershed project, such cooperation can lower overall practice costs.

- **Reverse auctions.** Reverse auctions, or pay for performance programs, can be a cost-effective way to allocate conservation funding. In some watersheds where reverse auctions have been used, the environmental benefits per dollar spent have been significantly more efficient than traditional cost-share programs such as the USDA-NRCS Environmental Quality Incentives Program (EQIP). In a reverse auction, landowners or farmers compete to provide a service (or conservation practice) to a single buyer (e.g., SWCD). All bids are analyzed for their environmental benefits and the organizer (e.g., SWCD) begins providing funds to the most efficient bids (environmental benefit per dollar) until all available resources have been allocated.
- **Watershed organization.** Often the most successful watershed projects are led by formal watershed organizations. Groups can be formed via a nonprofit organization, 28E intergovernmental agreement, Watershed Management Authority or other agreement or organization. Most watershed projects have significant partner involvement, each with an existing mission or goal. A watershed organization with a dedicated mission to improve land and water quality in the West Fork Crooked Creek Watershed may prove to be more successful than existing groups working together without formal organization. If established, a local watershed organization should convene regularly to evaluate progress, strategize and set specific work plans to ensure progress is made towards the 2036 watershed plan goals.
- **Subfield profit analysis.** Farmers understand some locations within a field produce higher yields and profits, so analyzing the distribution of long-term profitability within fields may be an important selling point for conservation. Technology to analyze profitability within crop fields is available and has been used in Iowa. Incorporating profitability analysis into conservation planning could result in higher profit margins and increased conservation opportunities on land that consistently yields zero or lost revenue.

12. Roles and Responsibilities

Watershed improvement is an ambitious undertaking that requires commitment, collaboration and coordination among multiple entities. Clearly defined roles and duties can facilitate task assignments and improve the efficiency and effectiveness of the watershed project. The following list describes the general responsibilities of various groups in the West Fork Crooked Creek Watershed.

- **Farmers.** Engage with watershed plan implementation; farm, field and subfield evaluation; conservation practice implementation; and knowledge sharing.
- **Landowners.** Engage with tenants on conservation planning, incorporation of conservation addendums to lease agreements and conservation practice implementation.
- **Soil and Water Conservation District commissioners.** Provide project leadership, participate in project meetings and events, hire staff, advocate for project goals and promote project locally and regionally.
- **Natural Resources Conservation Service.** Provide conservation practice design and engineering services, project partnership, house project staff and provide office space, computer, phone and vehicle.
- **Iowa Department of Agriculture and Land Stewardship.** Provide technical support to project, provide the opportunity to receive state funding for soil and water conservation and provide a contact for the Iowa CREP program.
- **Iowa Department of Natural Resources.** Provide technical assistance and advice and water quality monitoring as necessary.
- **Washington County Conservation Board.** Provide project partnership, easement management and public education.
- **County supervisors.** Engage with project to determine and pursue mutual benefits.
- **Agribusinesses.** Engage project partners and promote project goals and opportunities to members and customers.
- **Commodity groups.** Engage project partners, promote project goals and opportunities to members and provide agronomic and environmental services as appropriate.
- **Conservation groups.** Engage project partners, provide planning services and promote practices that have habitat and water quality benefits.
- **Media.** Develop stories related to the watershed project and maintain contact with local sources of information.

Appendix A: Conceptual Plan Maps

Appendix A: Conceptual Plan Maps

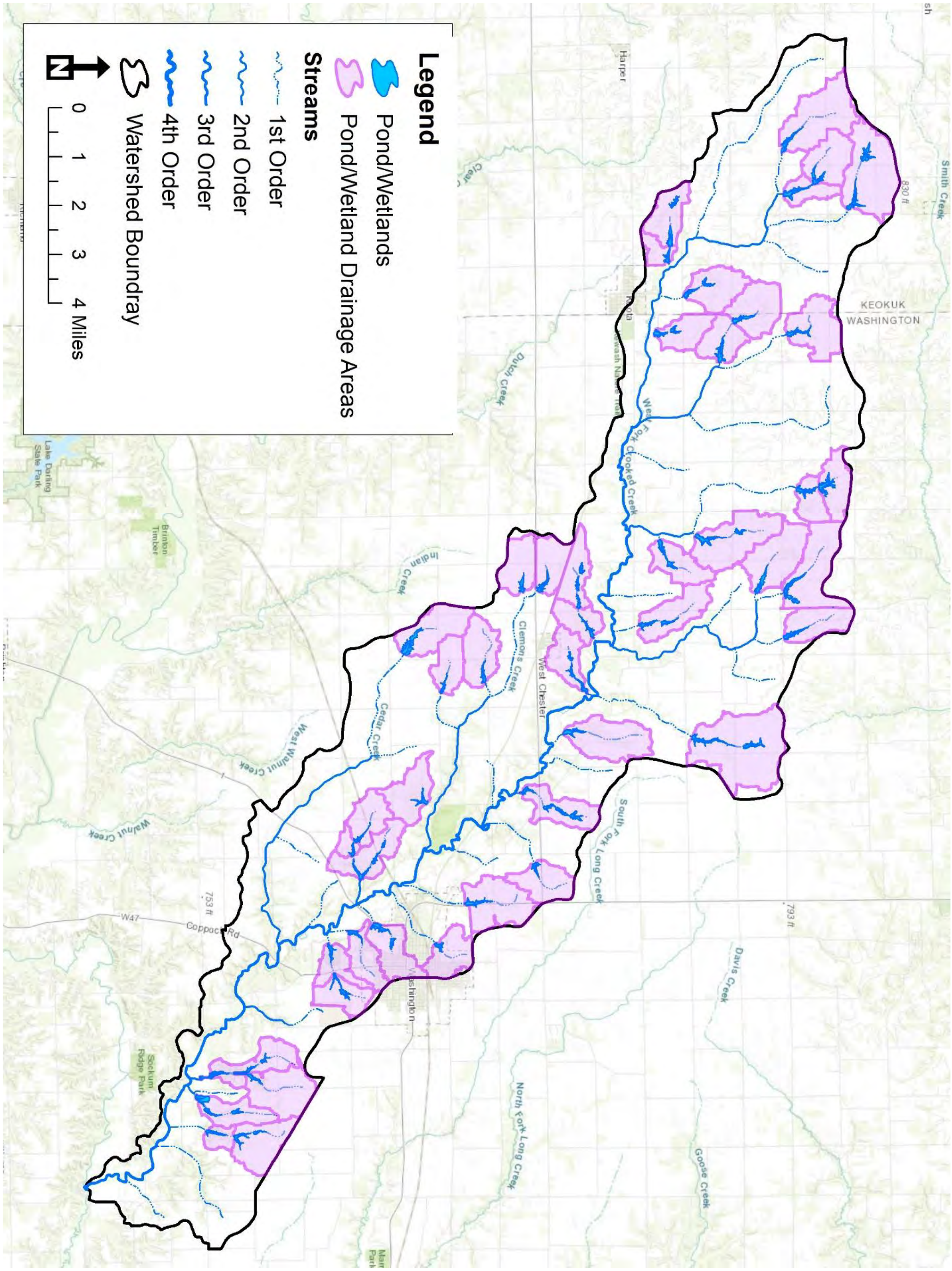


Figure A.1. Priority locations for nitrate removal wetlands.

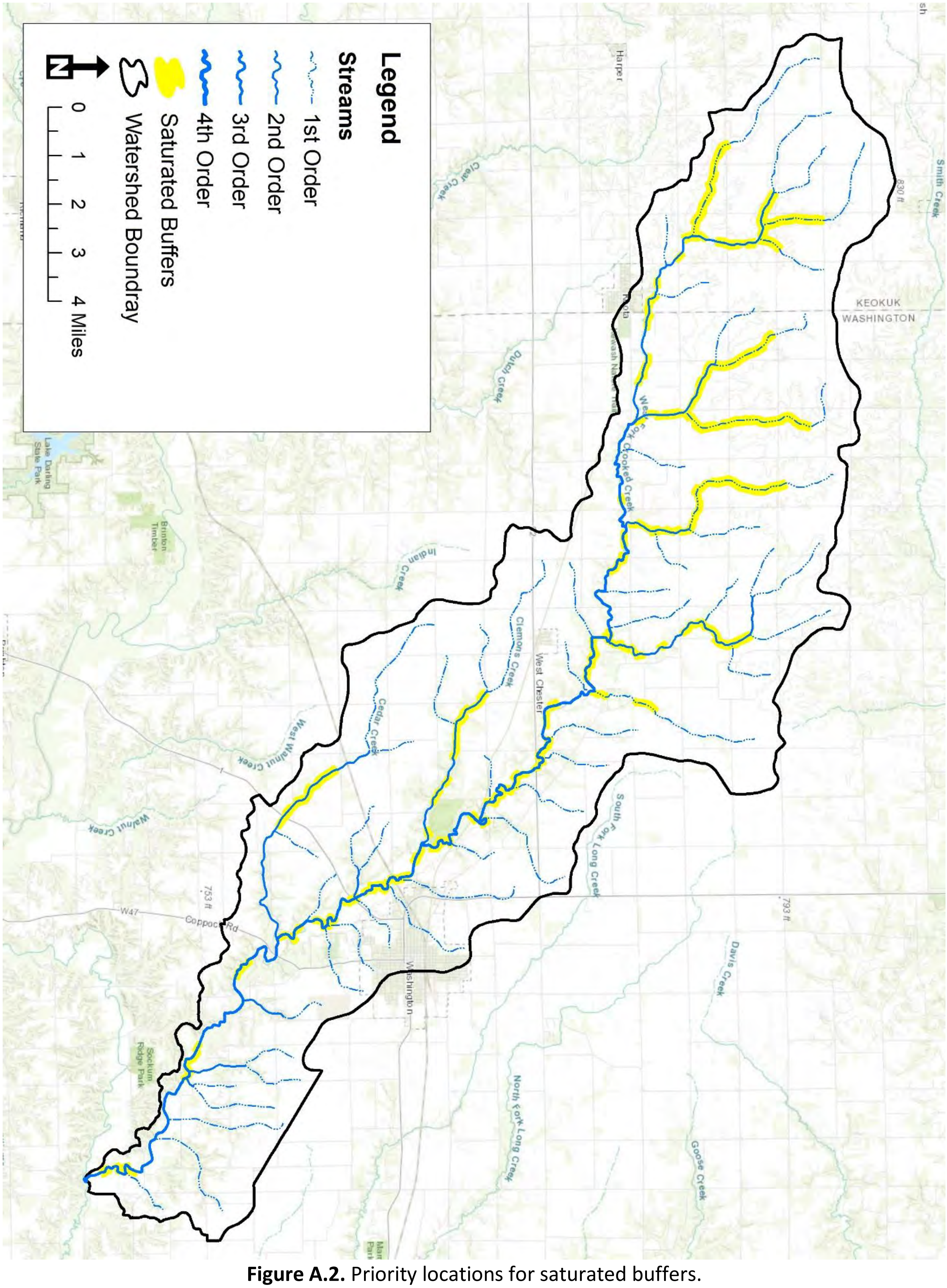


Figure A.2. Priority locations for saturated buffers.

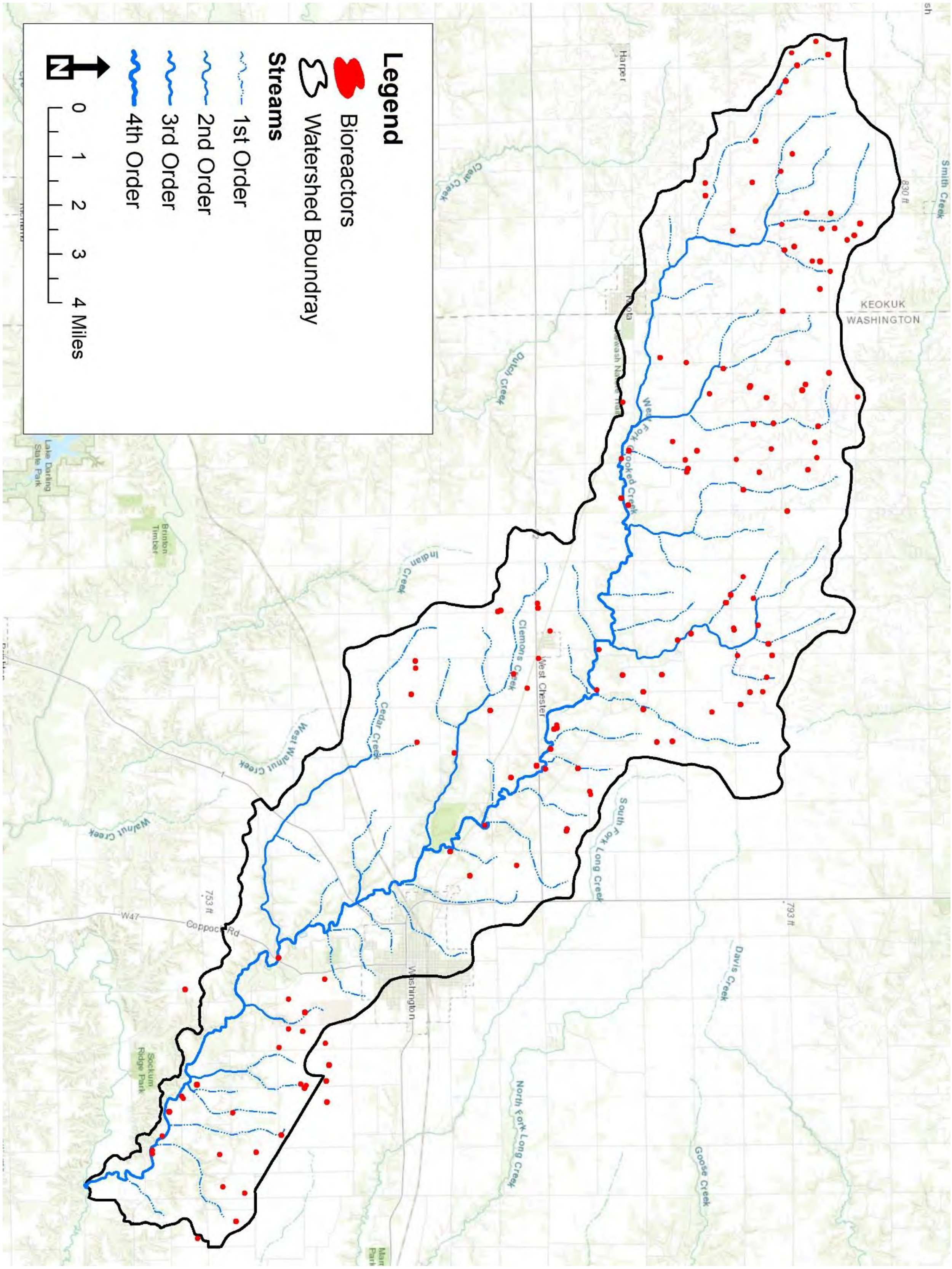


Figure A.3. Priority locations for bioreactors.

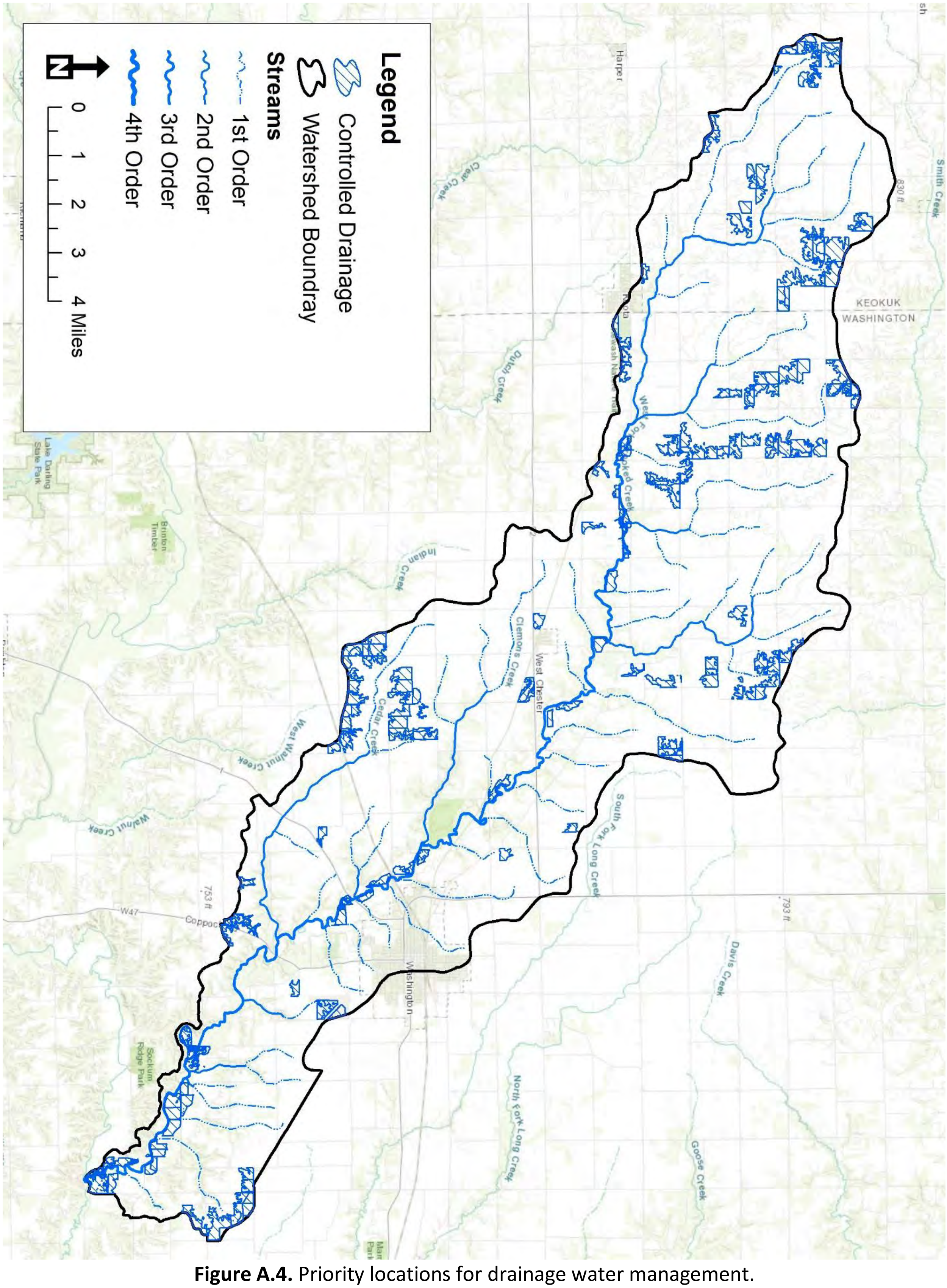


Figure A.4. Priority locations for drainage water management.

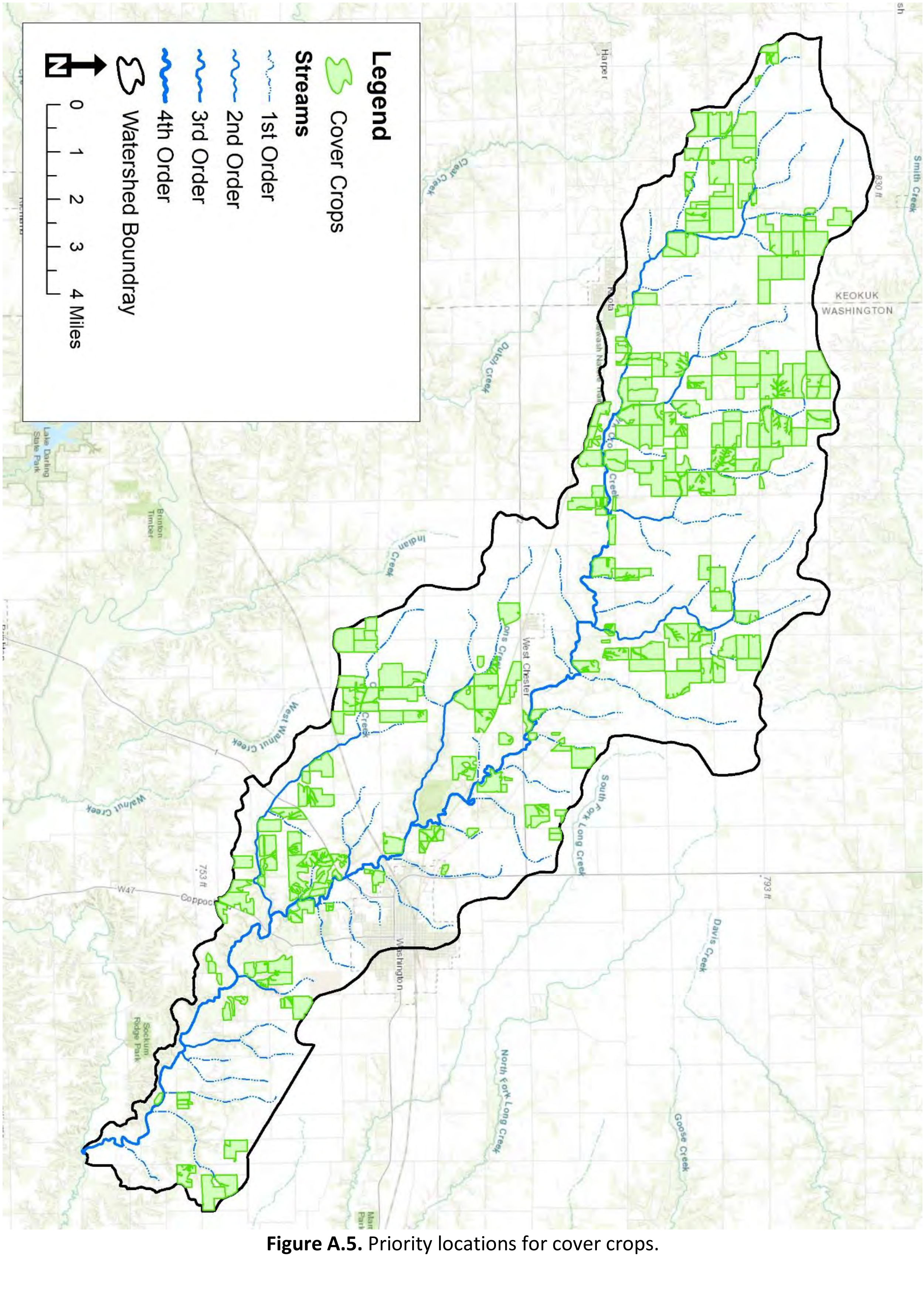


Figure A.5. Priority locations for cover crops.

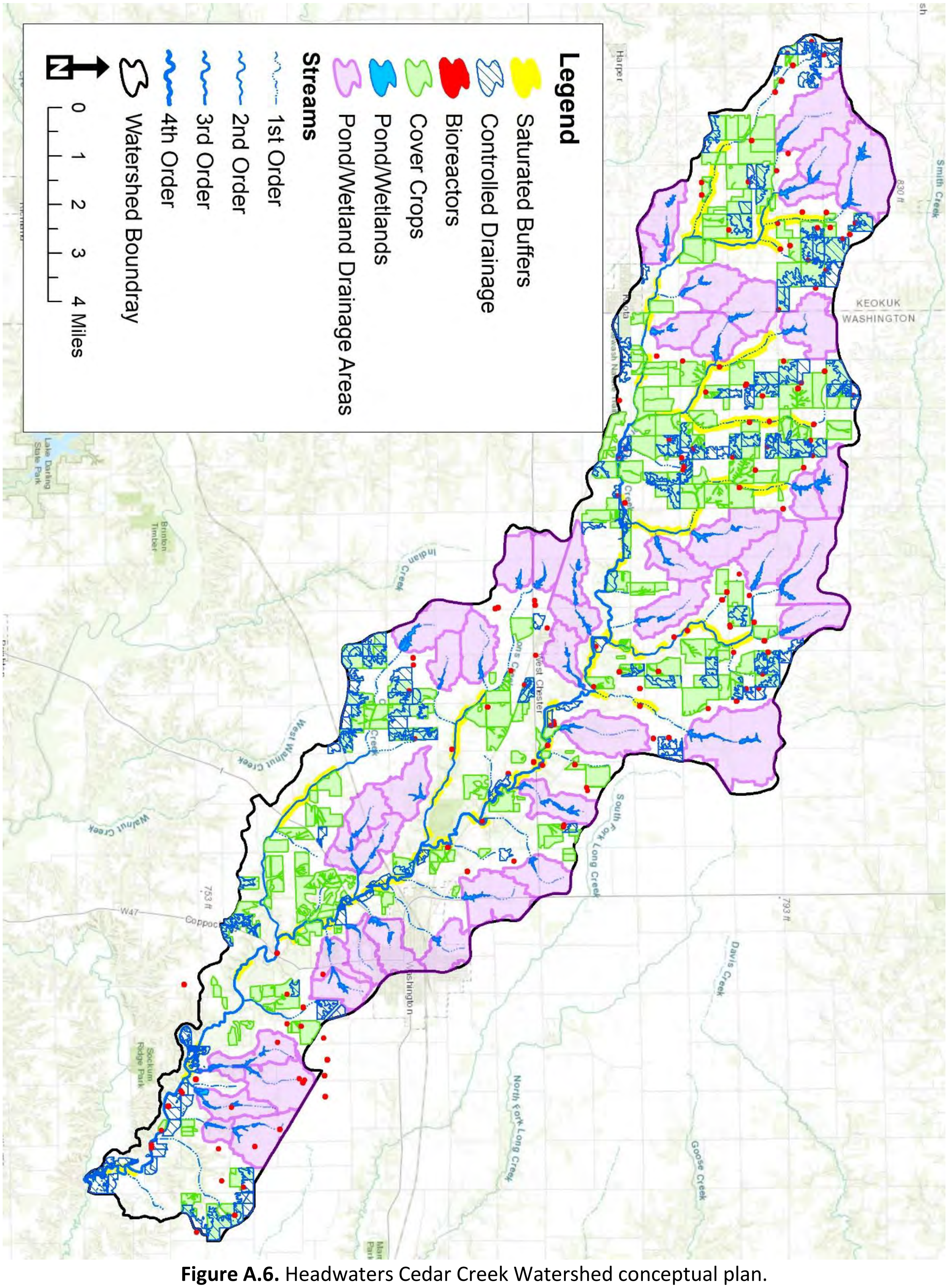


Figure A.6. Headwaters Cedar Creek Watershed conceptual plan.

Appendix B: ACPF Atlas

West Fork Crooked Creek Watershed
Agricultural Conservation Planning Framework Results Atlas

Overview

The Agricultural Conservation Planning Framework (ACPF) provides datasets and mapping tools that can be used to identify suitable locations for agricultural conservation practices. The geographic information system (GIS) tools utilize inputs including elevation, land use, and soils data to characterize watersheds and identify appropriate sites for practices that enhance soil health and water quality by improving drainage, runoff, and riparian management. The ACPF was developed by the USDA-Agricultural Research Service National Laboratory for Agriculture and the Environment.

Results

The results of applying ACPF tools to a watershed provide a suite of potential conservation practice opportunities. Results should be refined based on local and expert input to develop actionable watershed plans that address local conditions and goals. ACPF output is therefore best utilized as scientific data to support decision making and planning in agricultural watersheds. The following atlas of ACPF result maps for this watershed display all conservation practice outputs derived from analysis of the watershed with the GIS toolbox. Practices are mapped based on site suitability and may or may not reflect existing conservation infrastructure.

The following maps include watershed assessments of land use, tile drainage, and runoff risk derived with ACPF tools. The remaining maps are arranged into three sections: drainage practices, runoff practices, and riparian management. For each section, one map displays a watershed overview and the subsequent pages contain detailed maps for each township that contains a portion of the watershed. Conservation drainage practices include bioreactors, saturated buffers, carbon-enhanced saturated buffers, drainage water management, nitrate removal wetlands, and perennial cover or tile intake buffers in topographic depressions. Runoff control practices include contour buffer strips, grassed waterways, and water and sediment control basins. Practices such as nutrient management, no-till/reduced tillage, and cover crops are not explicitly mapped by ACPF tools according to the philosophy that such soil health building practices are appropriate for all agricultural land. The final section of maps includes the results of applying the ACPF riparian function assessment to the stream channels in the watershed. Recommended riparian functions are classified as critical zone (high potential for runoff control and denitrification), multi-species buffer (moderate potential for both runoff control and denitrification), deep-rooted vegetation (denitrification prioritized), stiff stemmed grasses (runoff control prioritized), and streambank stabilization.

Map Index

References

ACPF manual: Porter, S.A., M.D. Tomer, D.E. James, and K.M.B. Boomer. 2015. Agricultural Conservation Planning Framework: ArcGIS®Toolbox User's Manual. USDA Agricultural Research Service, National Laboratory for Agriculture and the Environment, Ames Iowa. http://northcentralwater.org/acpf/

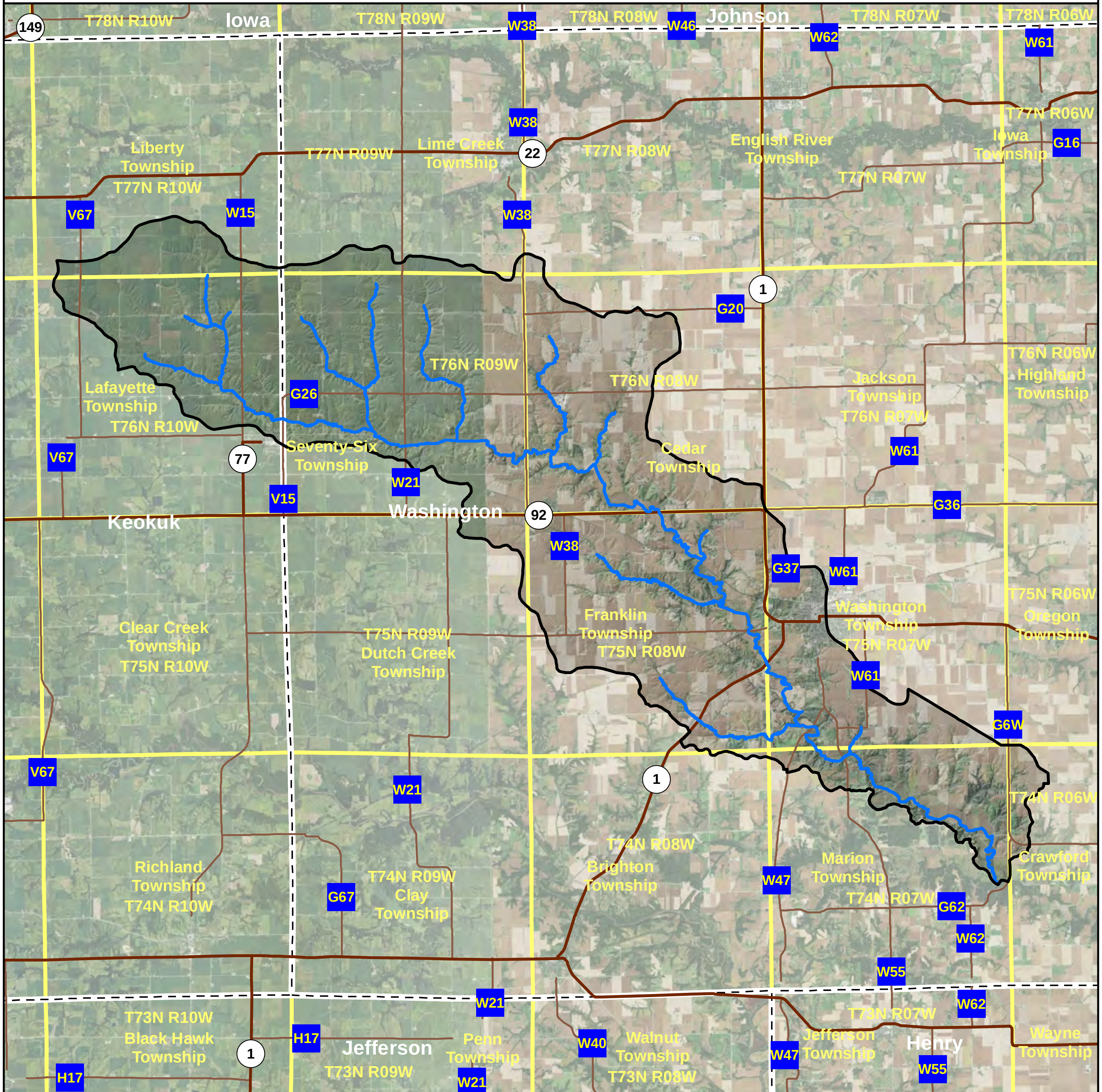
General concepts behind the ACPF: Tomer, M.D., S.A. Porter, D.E. James, K.M.B. Boomer, J.A. Kostel, and E. McLellan. 2013. Combining precision conservation technologies into a flexible framework to facilitate agricultural watershed planning. Journal of Soil and Water Conservation 68:113A-120A. http://www.jswconline.org/content/68/5/113A.full.pdf+html

Development of specific practice siting tools: Tomer, M.D., S.A. Porter, K.M.B. Boomer, D.E. James, J.A. Kostel, M.J. Helmers, T.M. Isenhart, and E. McLellan. 2015. Agricultural Conservation Planning Framework: 1. Developing multi-practice watershed planning scenarios and assessing nutrient reduction potential. J. Environ. Qual. 44(3):754-767. https://dl.sciencesocieties.org/publications/jeq/articles/44/3/754

Development of the riparian classification scheme: Tomer, M.D., K.M.B. Boomer, S.A. Porter, B.K. Gelder, D.E. James, and E. McLellan. 2015. Agricultural Conservation Planning Framework: 2. Classification of riparian buffer design-types with application to assess and map stream corridors. J. Environ. Qual. 44(3):768-779. https://dl.sciencesocieties.org/publications/jeq/articles/44/3/768

Acknowledgements: USDA-NRCS conducted much of this ACPF analysis. Analysis completed and results compiled by Iowa Soybean Association.

West Fork Crooked Creek Watershed (0708010701)
Agricultural Conservation Planning Framework Results Atlas



Watershed Boundary

Streams

Analysis performed by USDA-NRCS
Additional analysis and mapping by

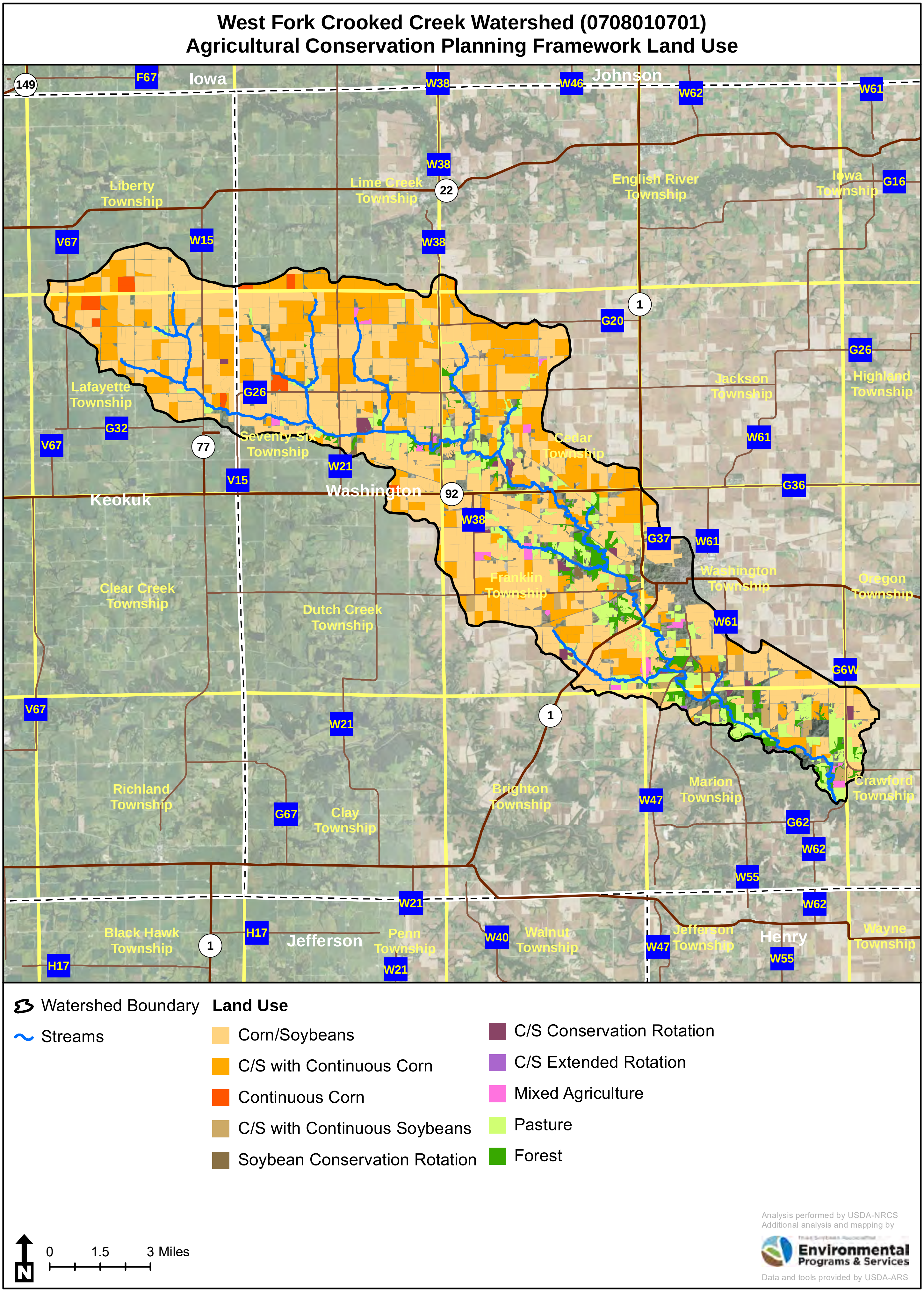
Environmental Programs & Services

Data and tools provided by USDA-ARS

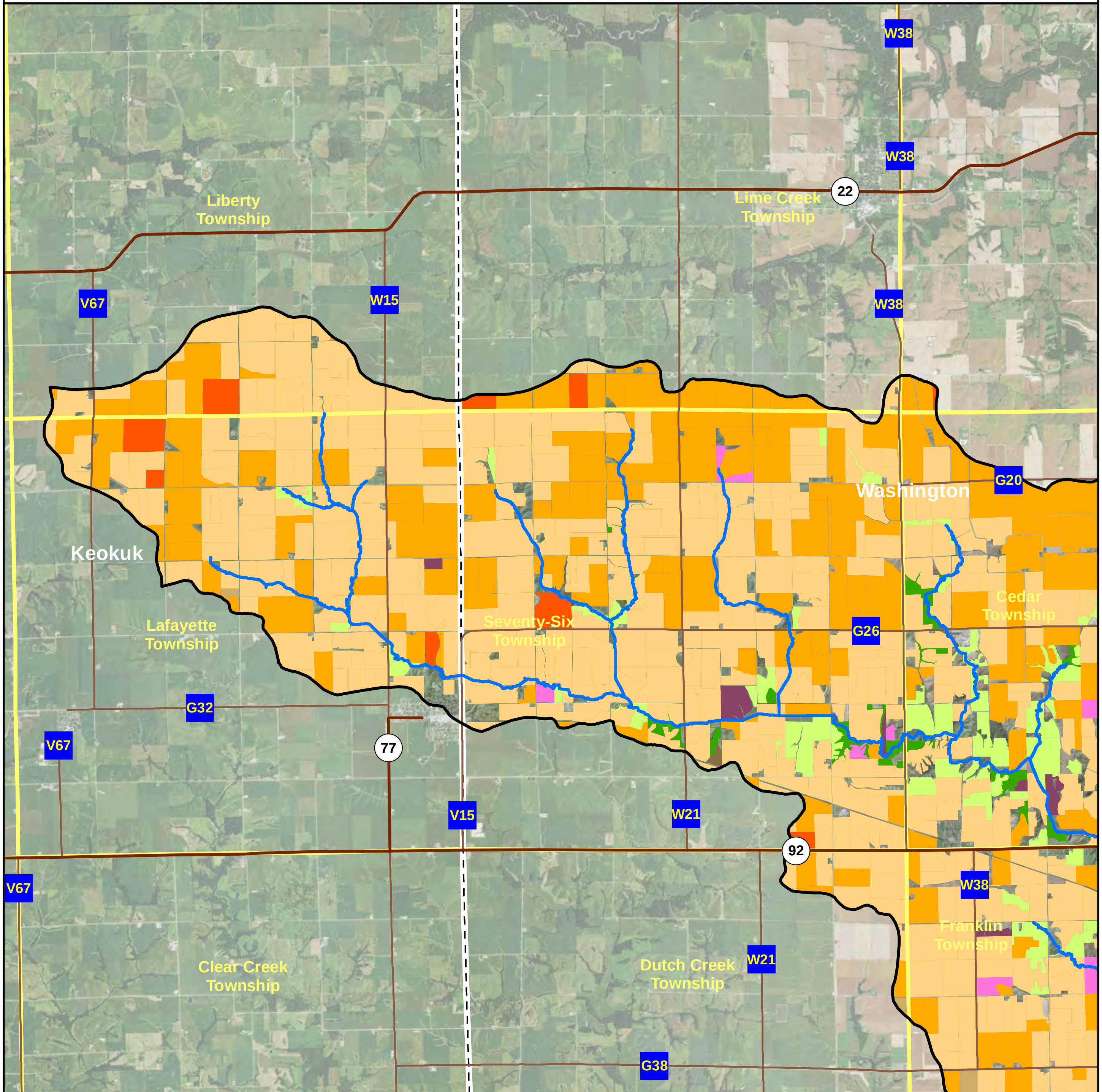
N

0 1.5 3 Miles

West Fork Crooked Creek Watershed (0708010701)
Agricultural Conservation Planning Framework Land Use



Upper West Fork Crooked Creek (070801070101)
Agricultural Conservation Planning Framework Land Use



Watershed Boundary

Streams

Land Use

- Corn/Soybeans
- C/S with Continuous Corn
- Continuous Corn
- C/S with Continuous Soybeans
- Soybean Conservation Rotation
- C/S Conservation Rotation
- C/S Extended Rotation
- Mixed Agriculture
- Pasture
- Forest

N

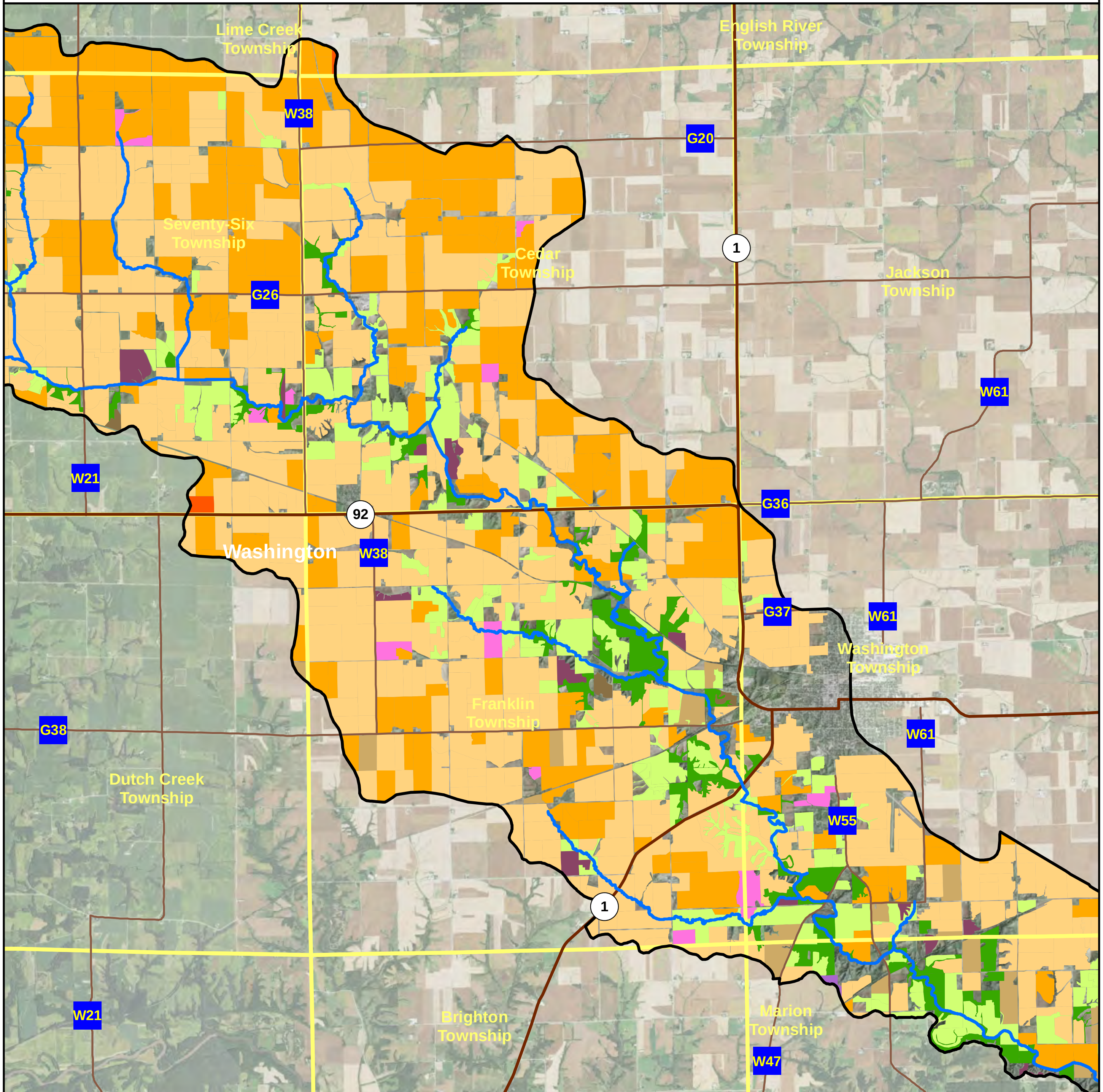
0 1 2 Miles

Analysis performed by USDA-NRCS
Additional analysis and mapping by

Environmental Programs & Services

Data and tools provided by USDA-ARS

Middle West Fork Crooked Creek (070801070102)
Agricultural Conservation Planning Framework Land Use



Watershed Boundary

Streams

Land Use

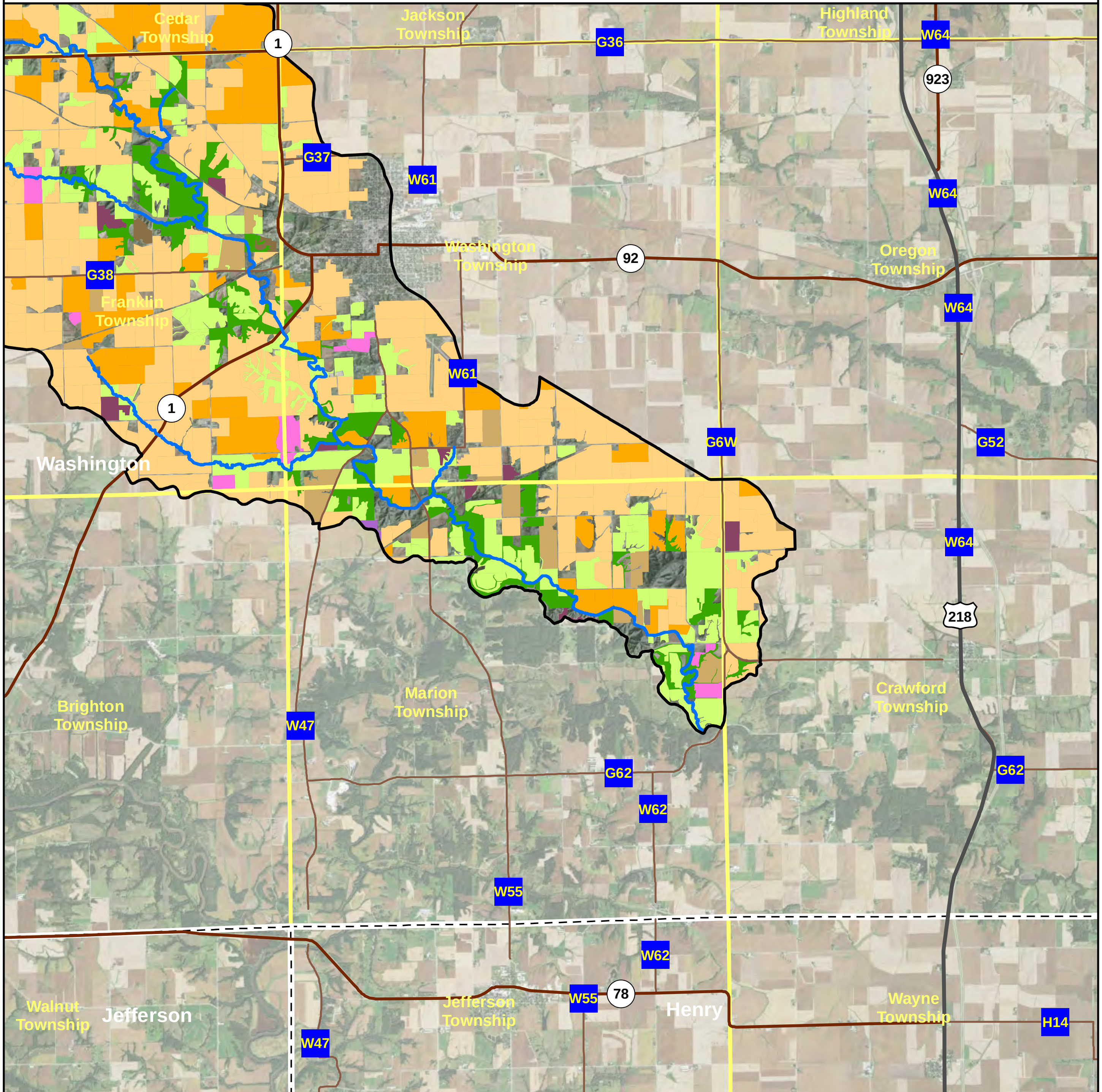
- Corn/Soybeans
- C/S with Continuous Corn
- Continuous Corn
- C/S with Continuous Soybeans
- Soybean Conservation Rotation
- C/S Conservation Rotation
- C/S Extended Rotation
- Mixed Agriculture
- Pasture
- Forest

N

0 1 2 Miles

Analysis performed by USDA-NRCS
Additional analysis and mapping by
Environmental Programs & Services
Data and tools provided by USDA-ARS

Lower West Fork Crooked Creek (070801070103)
Agricultural Conservation Planning Framework Land Use



Watershed Boundary
Streams

Land Use

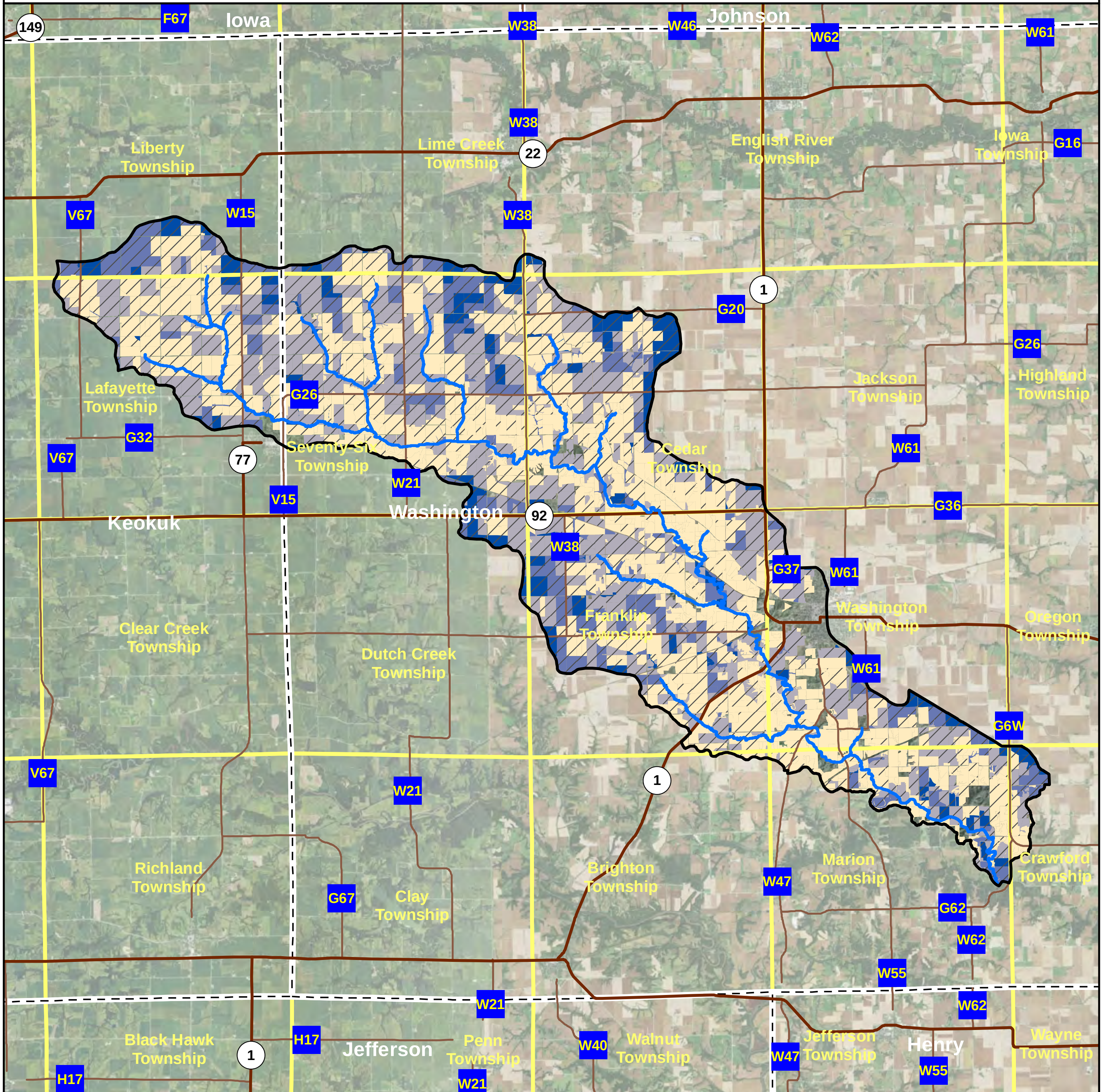
- Corn/Soybeans
- C/S with Continuous Corn
- Continuous Corn
- C/S with Continuous Soybeans
- Soybean Conservation Rotation
- C/S Conservation Rotation
- C/S Extended Rotation
- Mixed Agriculture
- Pasture
- Forest

N

0 1 2 Miles

Analysis performed by USDA-NRCS
Additional analysis and mapping by
Environmental Programs & Services
Data and tools provided by USDA-ARS

West Fork Crooked Creek Watershed (0708010701)
Agricultural Conservation Planning Framework Tile Drainage



Watershed Boundary

Streams

Tile Drainage Likely

Percent Hydric Soils

75 to 100%

50 to 75%

25 to 50%

0 to 25%

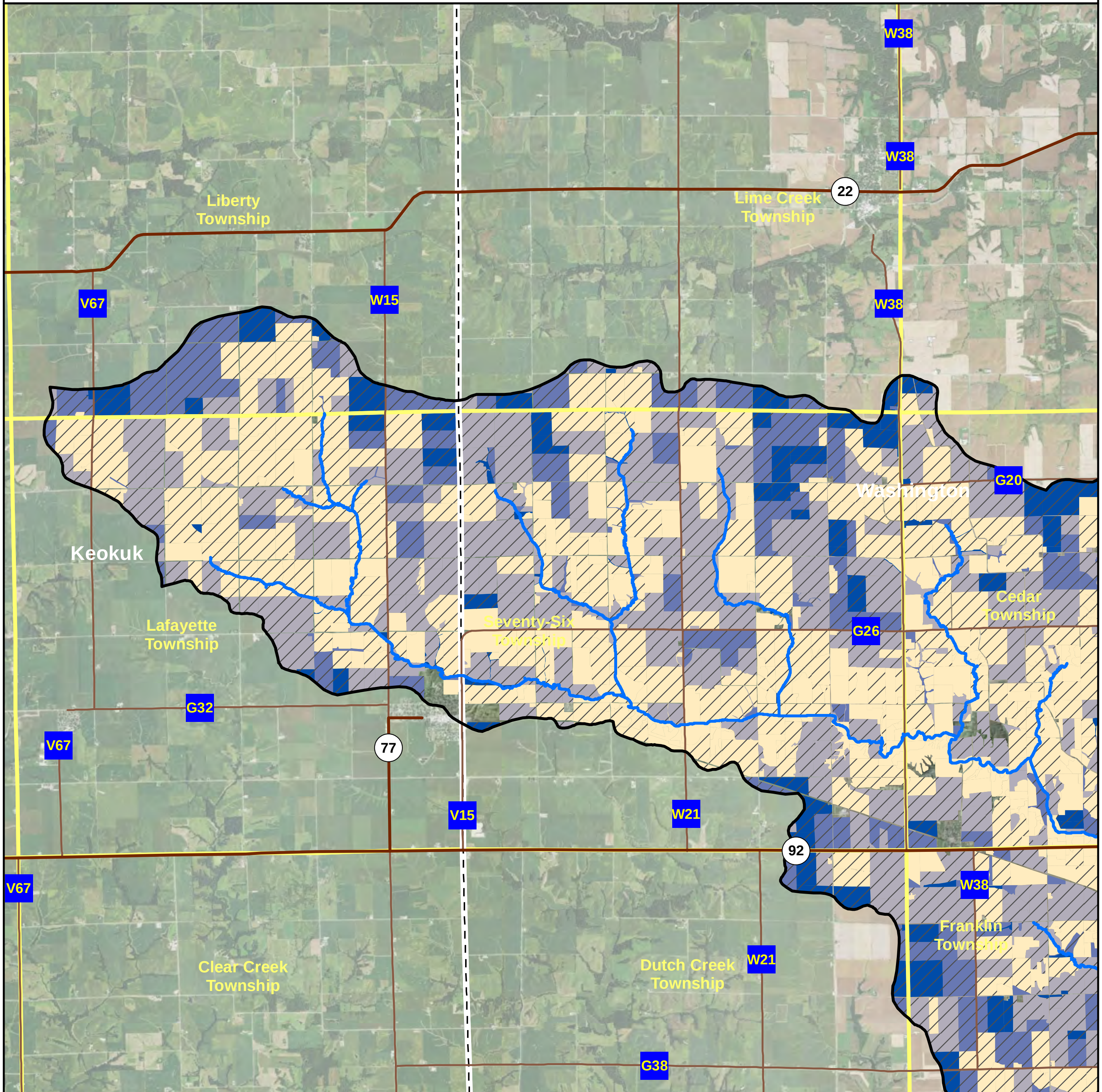
0 1.5 3 Miles

N

Analysis performed by USDA-NRCS
Additional analysis and mapping by Environmental Programs & Services

Data and tools provided by USDA-ARS

Upper West Fork Crooked Creek (070801070101)
Agricultural Conservation Planning Framework Tile Drainage



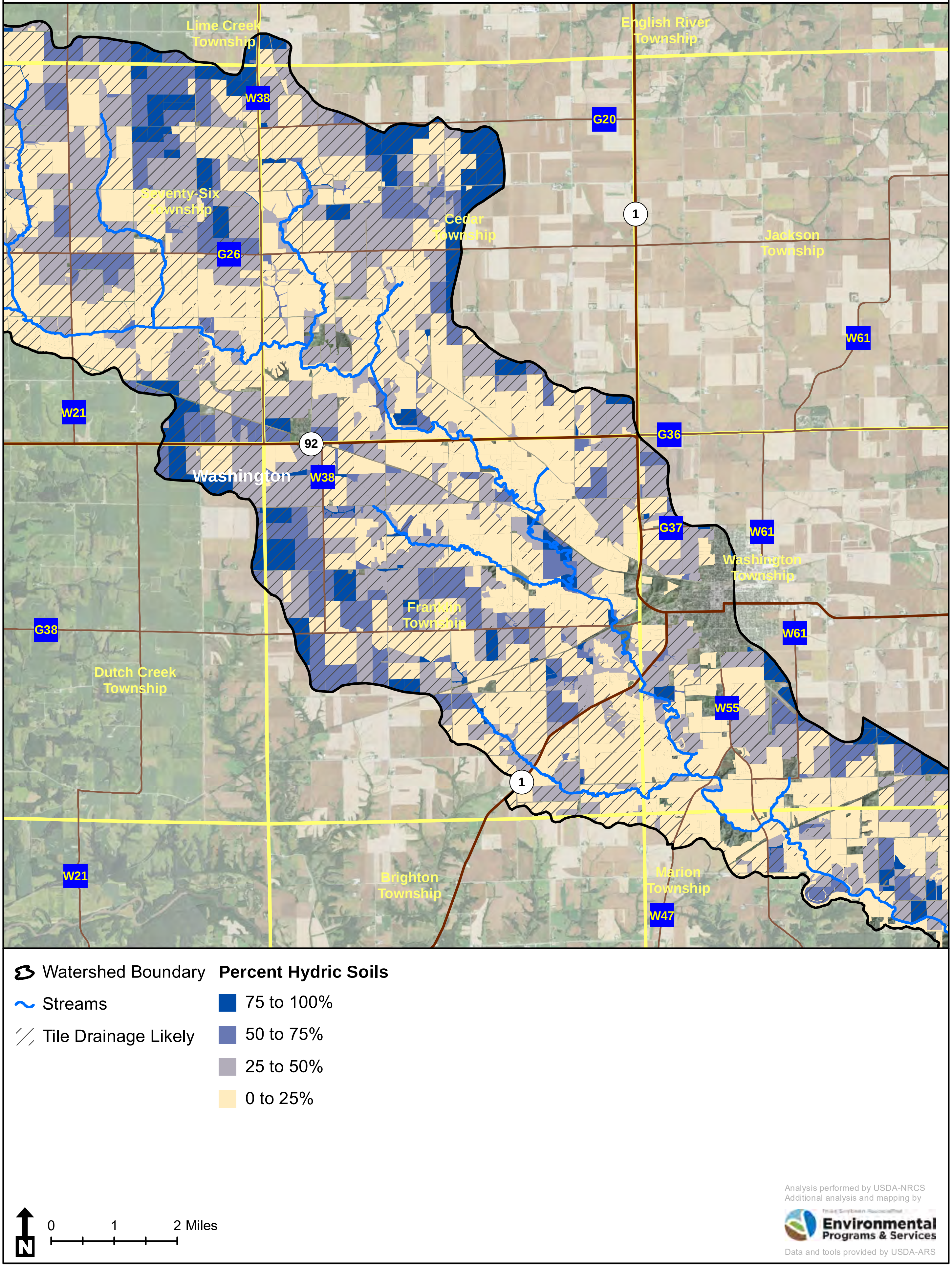
Watershed Boundary
Streams
Tile Drainage Likely

Percent Hydric Soils
75 to 100%
50 to 75%
25 to 50%
0 to 25%

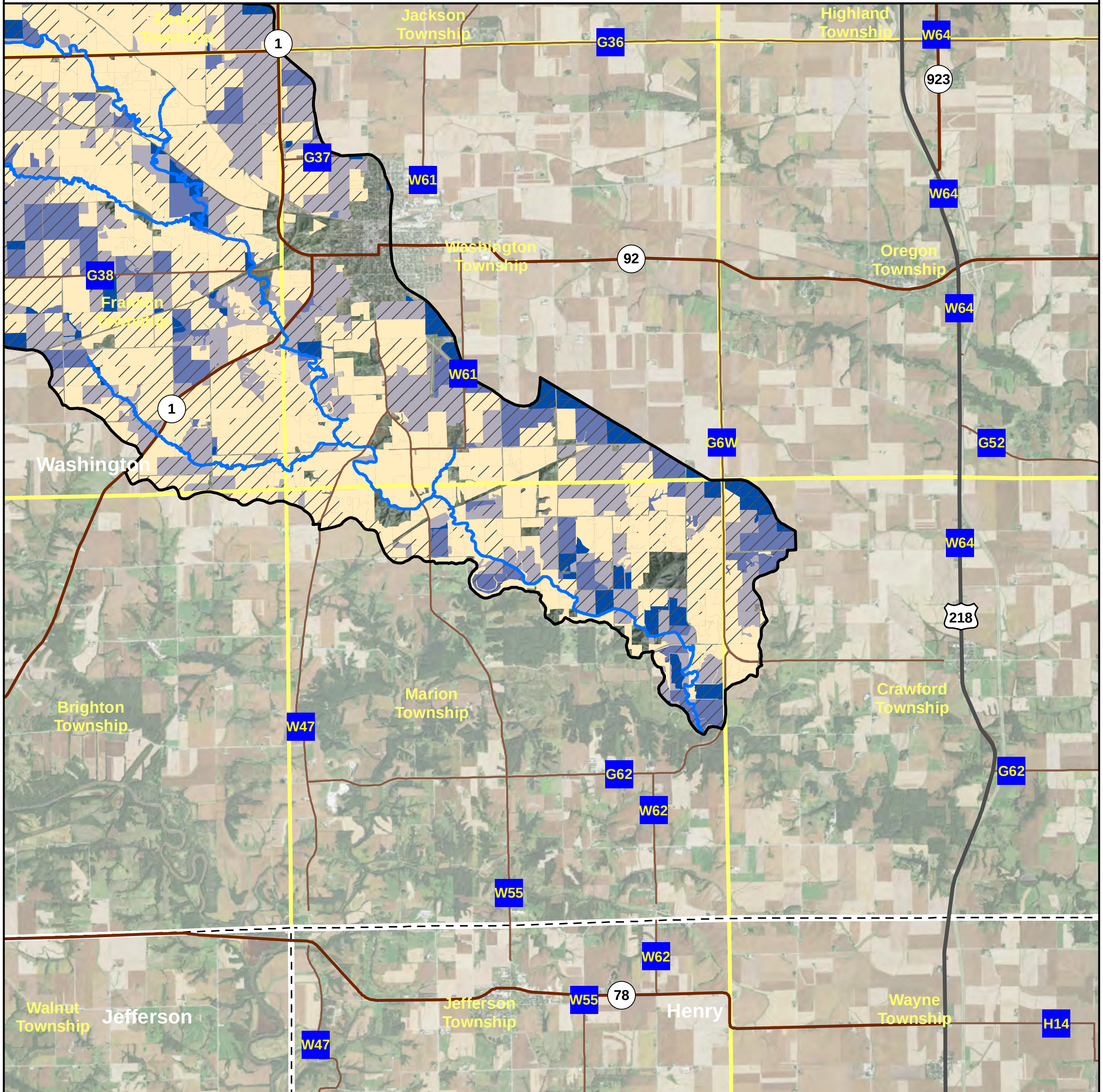
0 1 2 Miles

Analysis performed by USDA-NRCS
Additional analysis and mapping by
Environmental Programs & Services
Data and tools provided by USDA-ARS

Middle West Fork Crooked Creek (070801070102)
Agricultural Conservation Planning Framework Tile Drainage



Lower West Fork Crooked Creek (070801070103)
Agricultural Conservation Planning Framework Tile Drainage



Watershed Boundary

Streams

Tile Drainage Likely

Percent Hydric Soils

75 to 100%

50 to 75%

25 to 50%

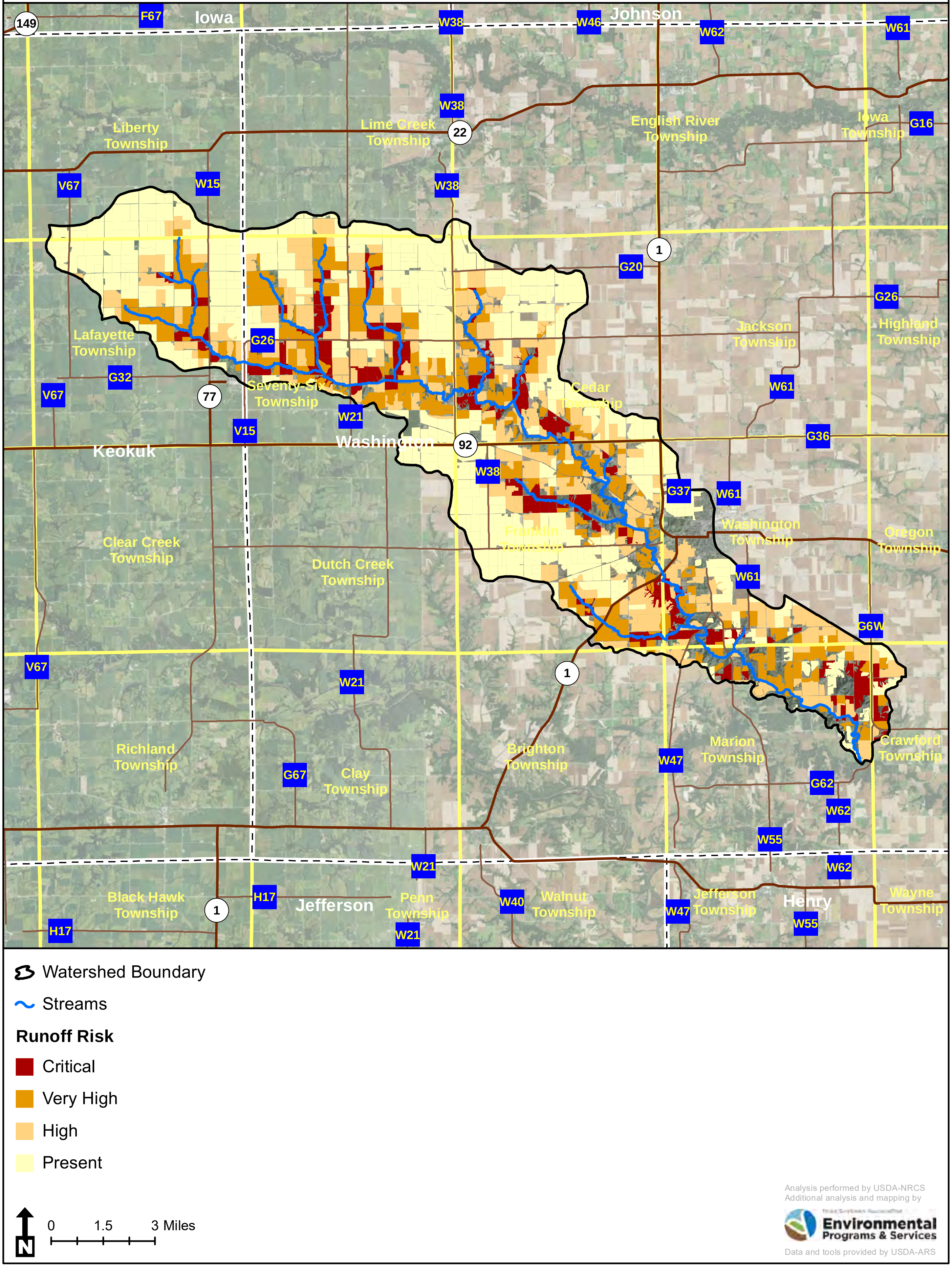
0 to 25%

0 1 2 Miles

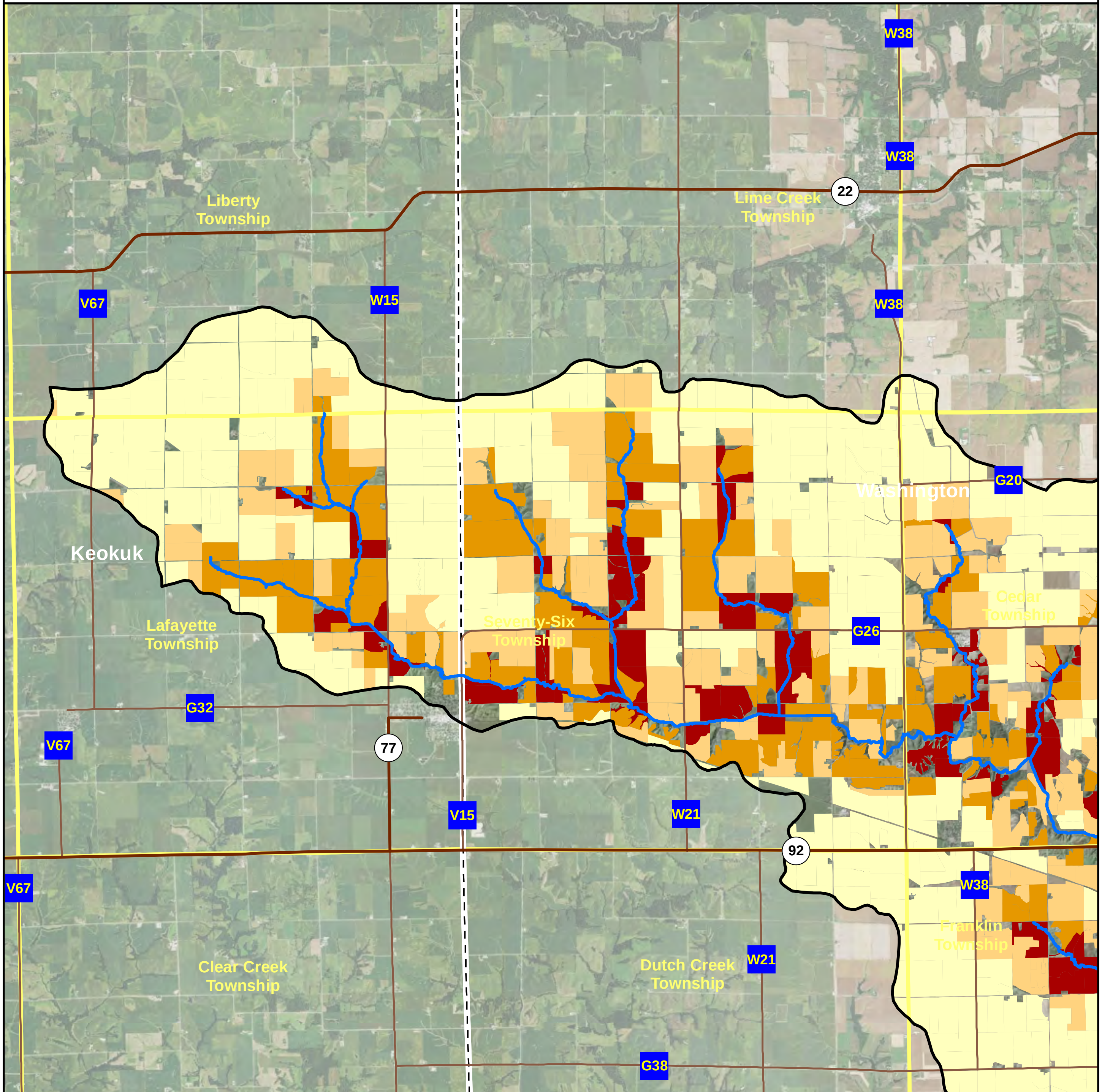
N

Analysis performed by USDA-NRCS
Additional analysis and mapping by
Environmental Programs & Services
Data and tools provided by USDA-ARS

West Fork Crooked Creek Watershed (0708010701)
Agricultural Conservation Planning Framework Runoff Risk



Upper West Fork Crooked Creek (070801070101)
Agricultural Conservation Planning Framework Runoff Risk



Watershed Boundary

Streams

Runoff Risk

- Critical
- Very High
- High
- Present

0 1 2 Miles

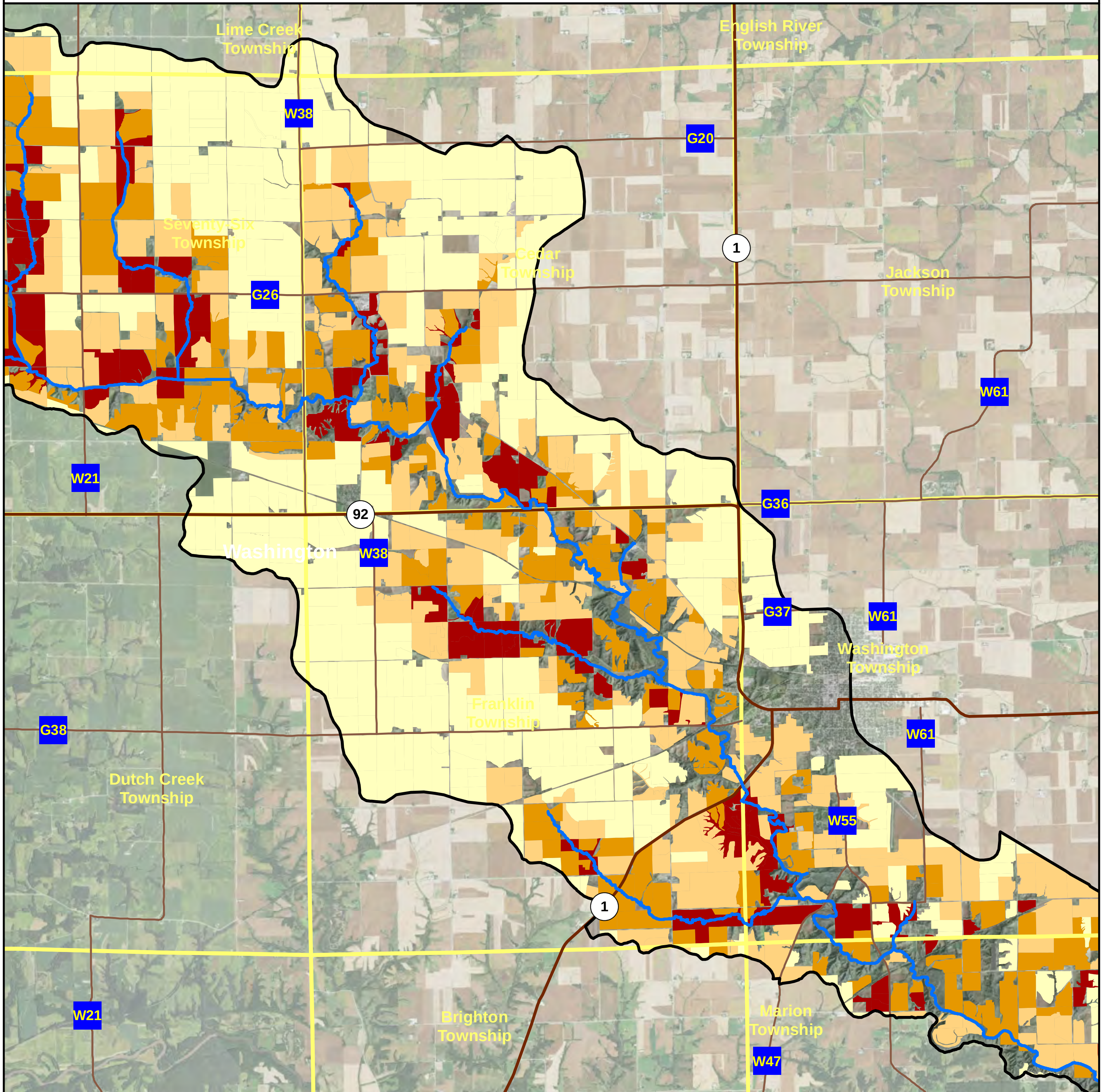
N

Analysis performed by USDA-NRCS
Additional analysis and mapping by

Environmental Programs & Services

Data and tools provided by USDA-ARS

Middle West Fork Crooked Creek (070801070102)
Agricultural Conservation Planning Framework Runoff Risk



Watershed Boundary

Streams

Runoff Risk

Critical

Very High

High

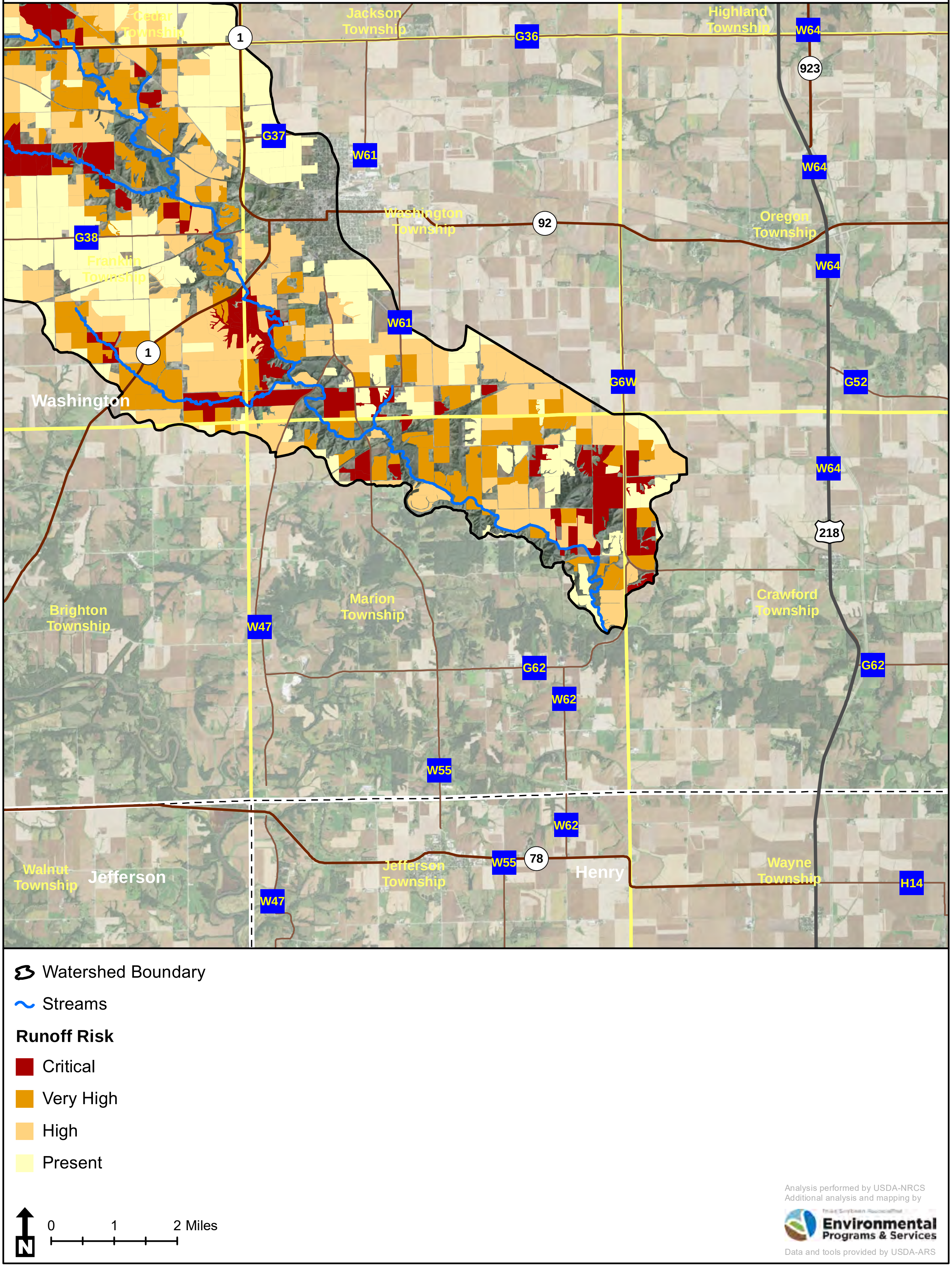
Present

0 1 2 Miles

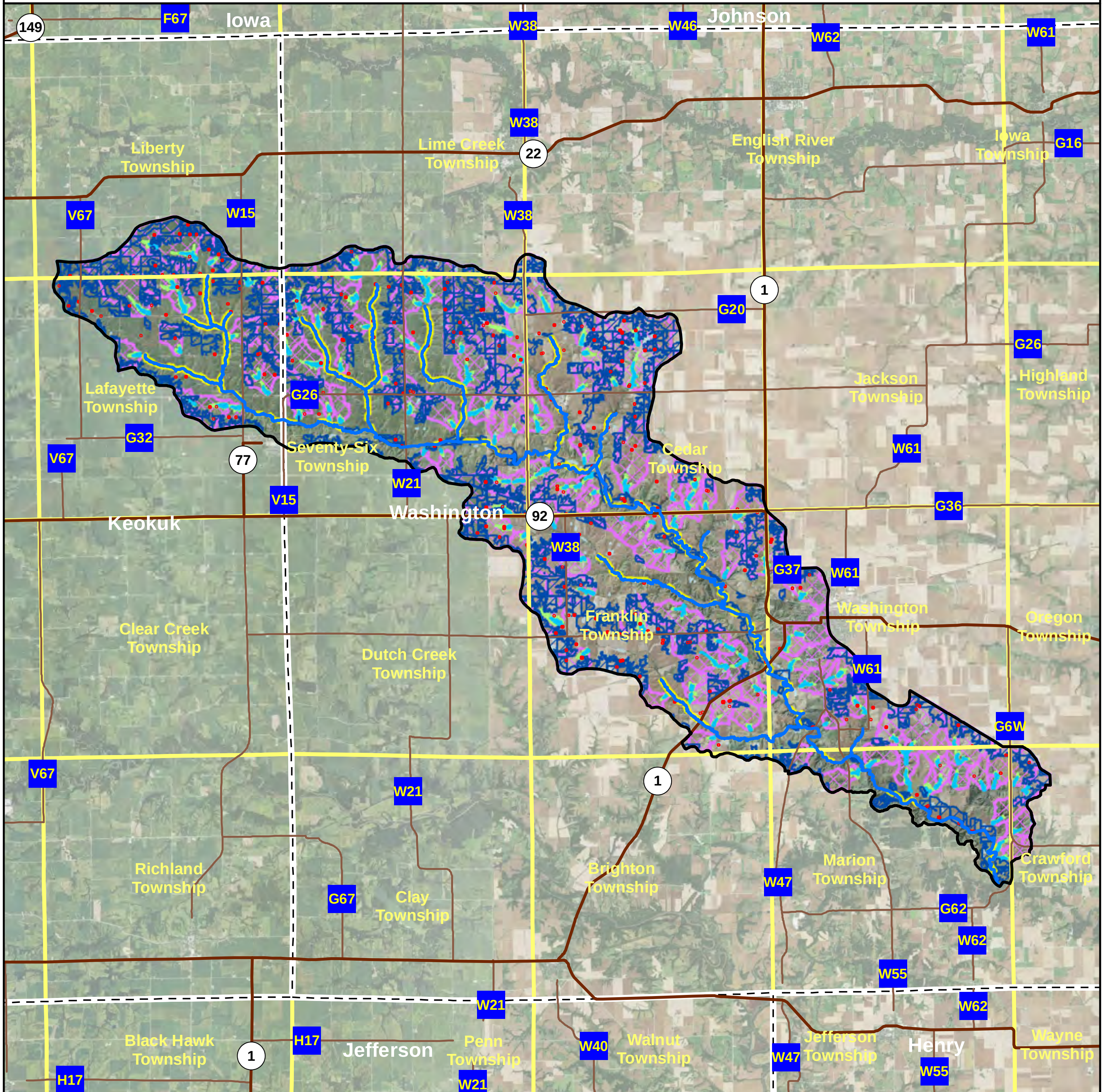
N

Analysis performed by USDA-NRCS
Additional analysis and mapping by
Environmental Programs & Services
Data and tools provided by USDA-ARS

Lower West Fork Crooked Creek (070801070103)
Agricultural Conservation Planning Framework Runoff Risk



West Fork Crooked Creek Watershed (0708010701)
Agricultural Conservation Planning Framework Drainage Treatment Practices



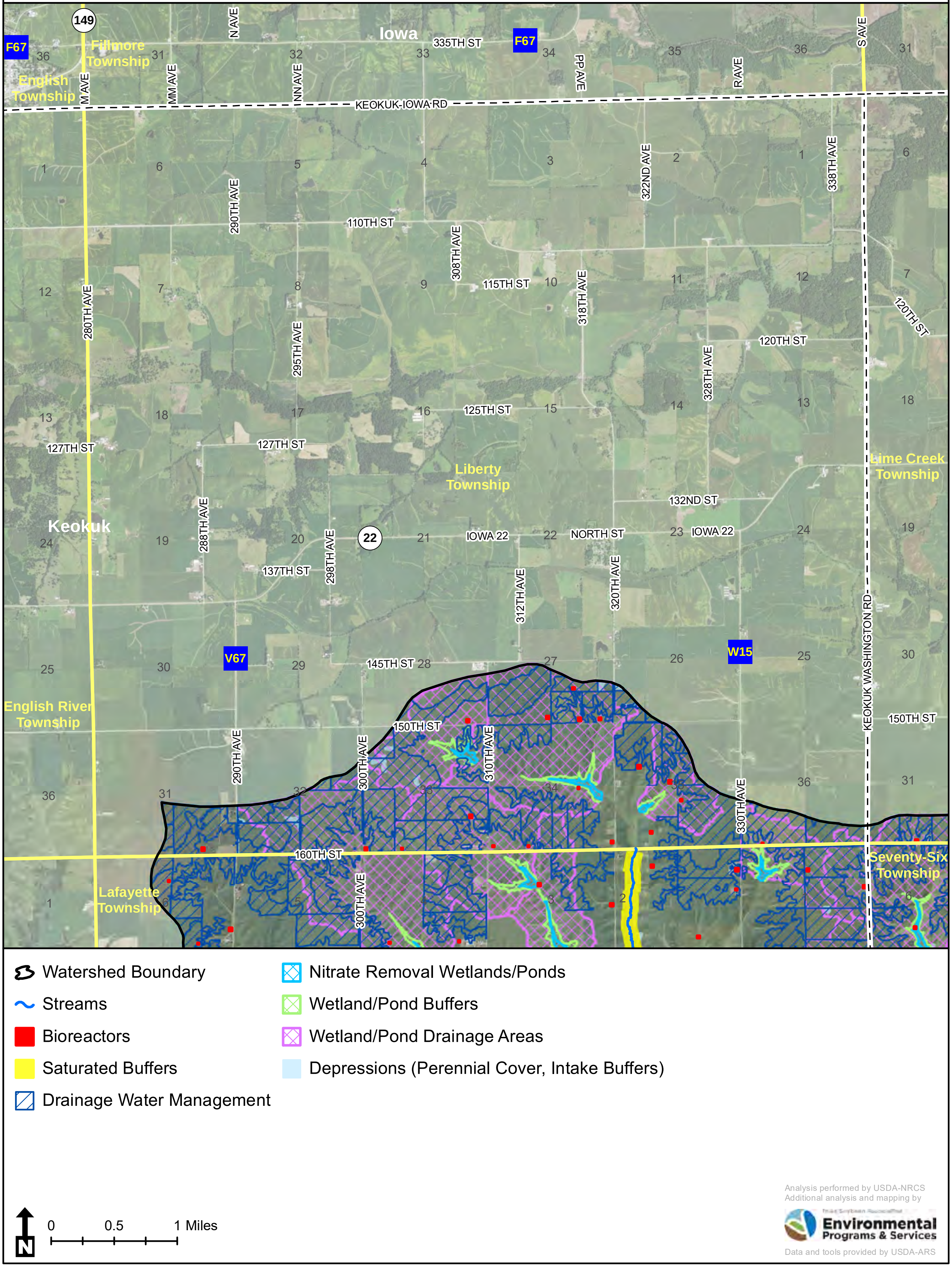
Watershed Boundary
Streams
Bioreactors
Saturated Buffers
Drainage Water Management
Nitrate Removal Wetlands/Ponds
Wetland/Pond Buffers
Wetland/Pond Drainage Areas
Depressions (Perennial Cover, Intake Buffers)

N

0 1.5 3 Miles

Analysis performed by USDA-NRCS
Additional analysis and mapping by
Environmental Programs & Services
Data and tools provided by USDA-ARS

West Fork Crooked Creek Watershed (0708010701) T77N R10W
Agricultural Conservation Planning Framework Drainage Treatment Practices



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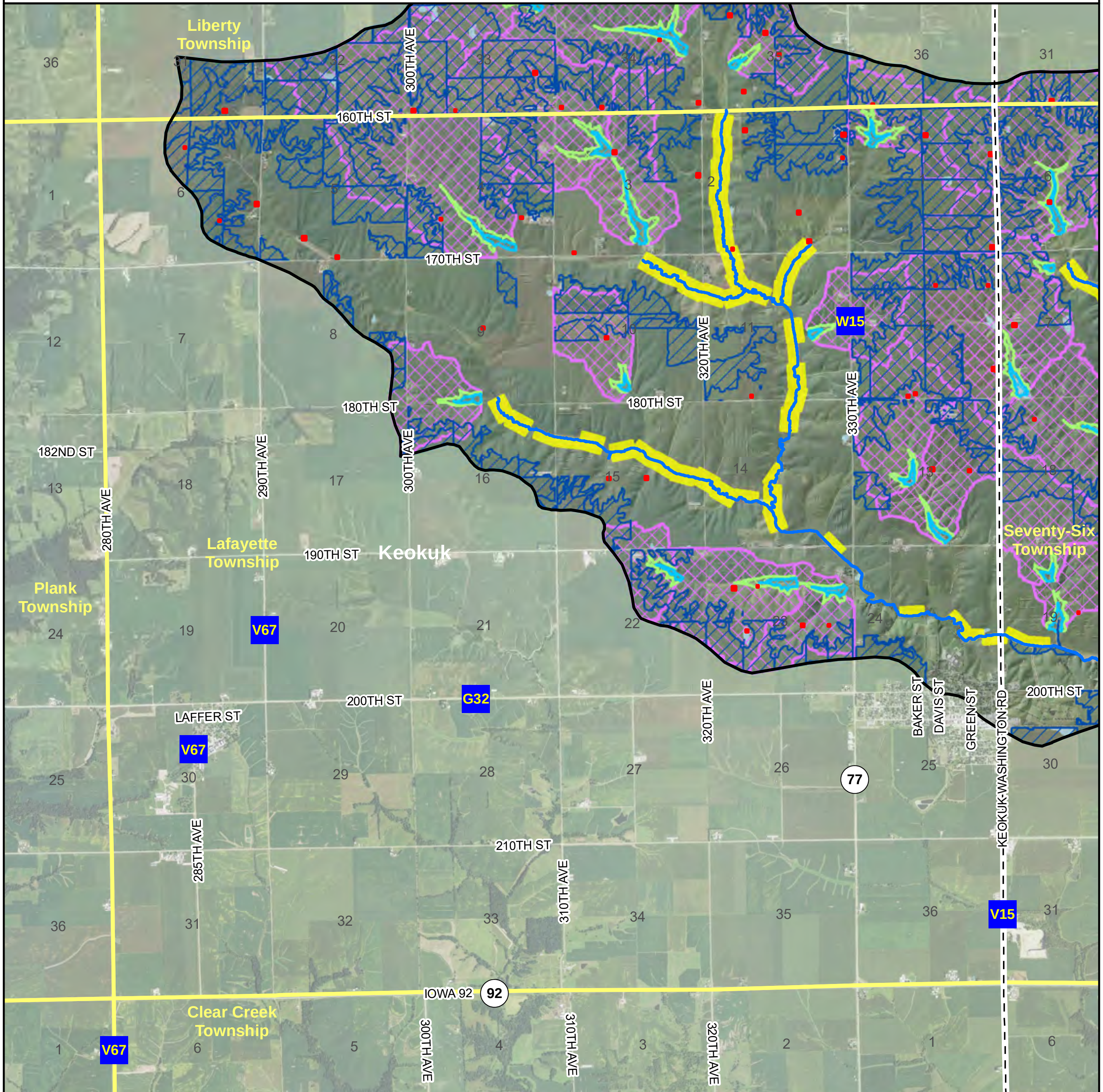
Agricultural Conservation Planning Framework Drainage Treatment Practices



Watershed Boundary

Streams

Bioreactors

Saturated Buffers

Drainage Water Management

Nitrate Removal Wetlands/Ponds

Wetland/Pond Buffers

Wetland/Pond Drainage Areas

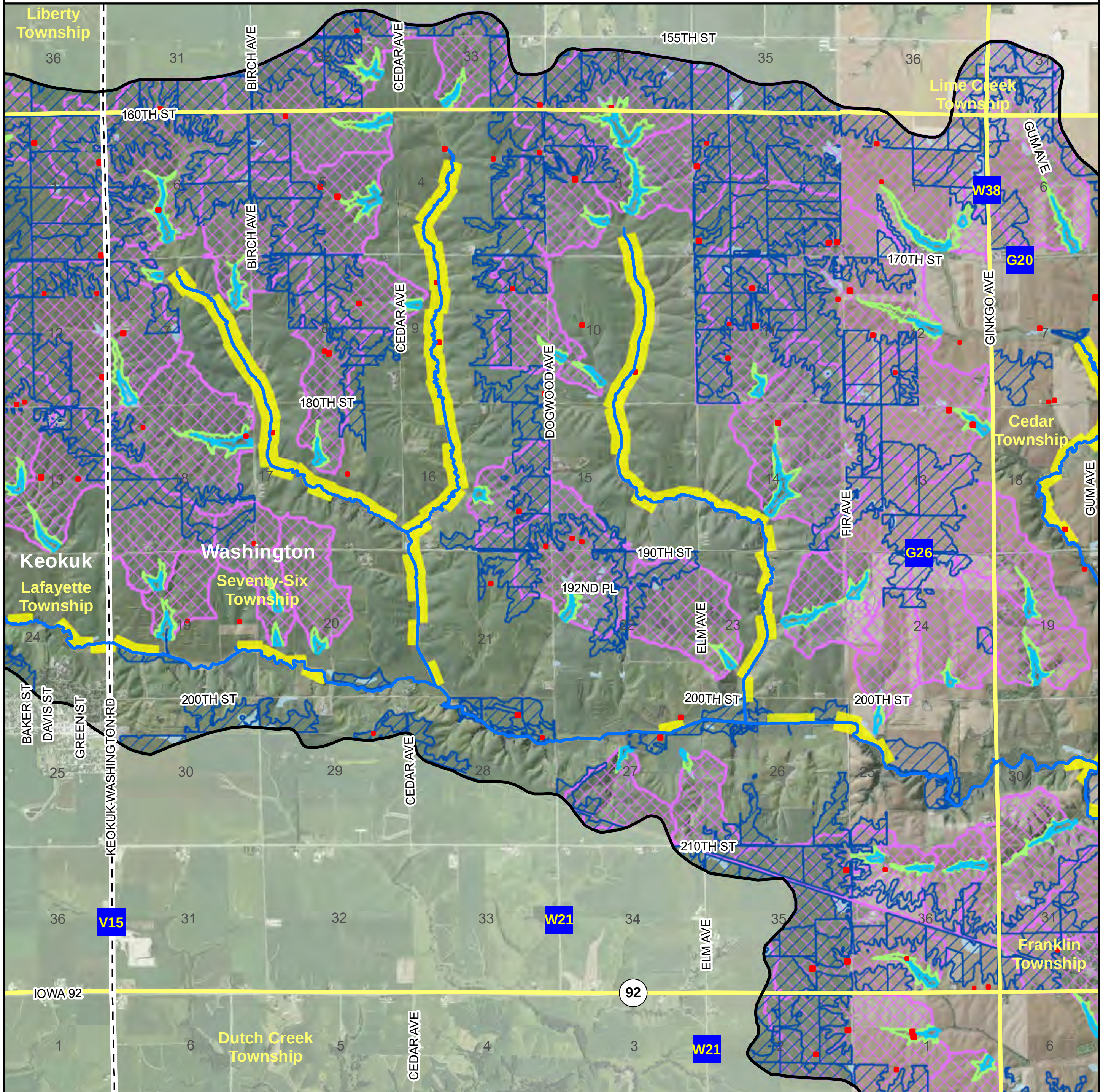
Depressions (Perennial Cover, Intake Buffers)

0 0.5 1 Miles

N

Analysis performed by USDA-NRCS
Additional analysis and mapping by
Environmental Programs & Services
Data and tools provided by USDA-ARS

West Fork Crooked Creek Watershed (0708010701) T76N R09W
Agricultural Conservation Planning Framework Drainage Treatment Practices



Watershed Boundary

Streams

Bioreactors

Saturated Buffers

Drainage Water Management

Nitrate Removal Wetlands/Ponds

Wetland/Pond Buffers

Wetland/Pond Drainage Areas

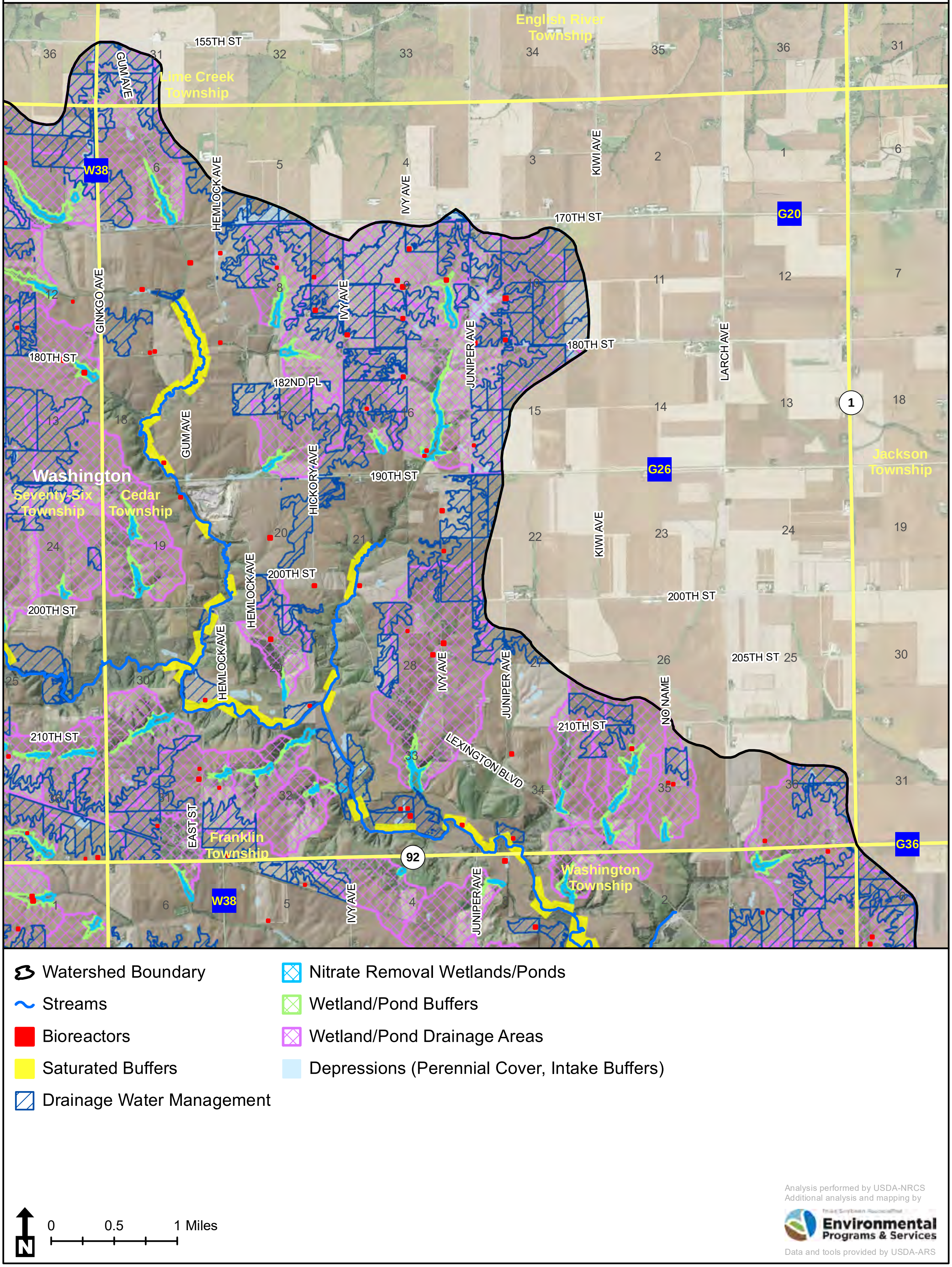
Depressions (Perennial Cover, Intake Buffers)

N

0 0.5 1 Miles

Analysis performed by USDA-NRCS
Additional analysis and mapping by
Environmental Programs & Services
Data and tools provided by USDA-ARS

West Fork Crooked Creek Watershed (0708010701) T76N R08W
Agricultural Conservation Planning Framework Drainage Treatment Practices



Analysis performed by USDA-NRCS
Additional analysis and mapping by
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Data and tools provided by USDA-ARS

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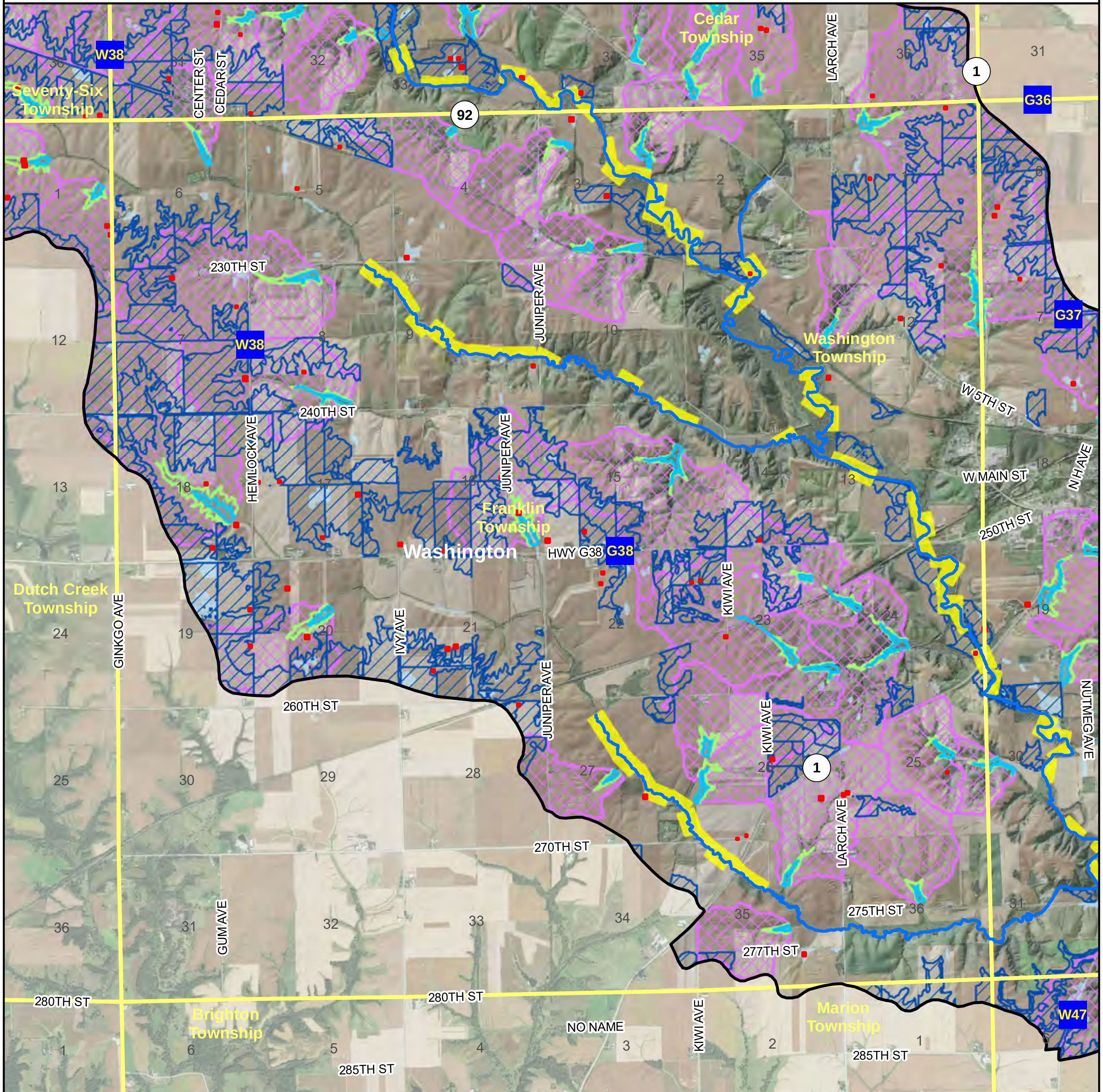


Watershed Boundary

Streams

Bioreactors

Saturated Buffers

Drainage Water Management

Nitrate Removal Wetlands/Ponds

Wetland/Pond Buffers

Wetland/Pond Drainage Areas

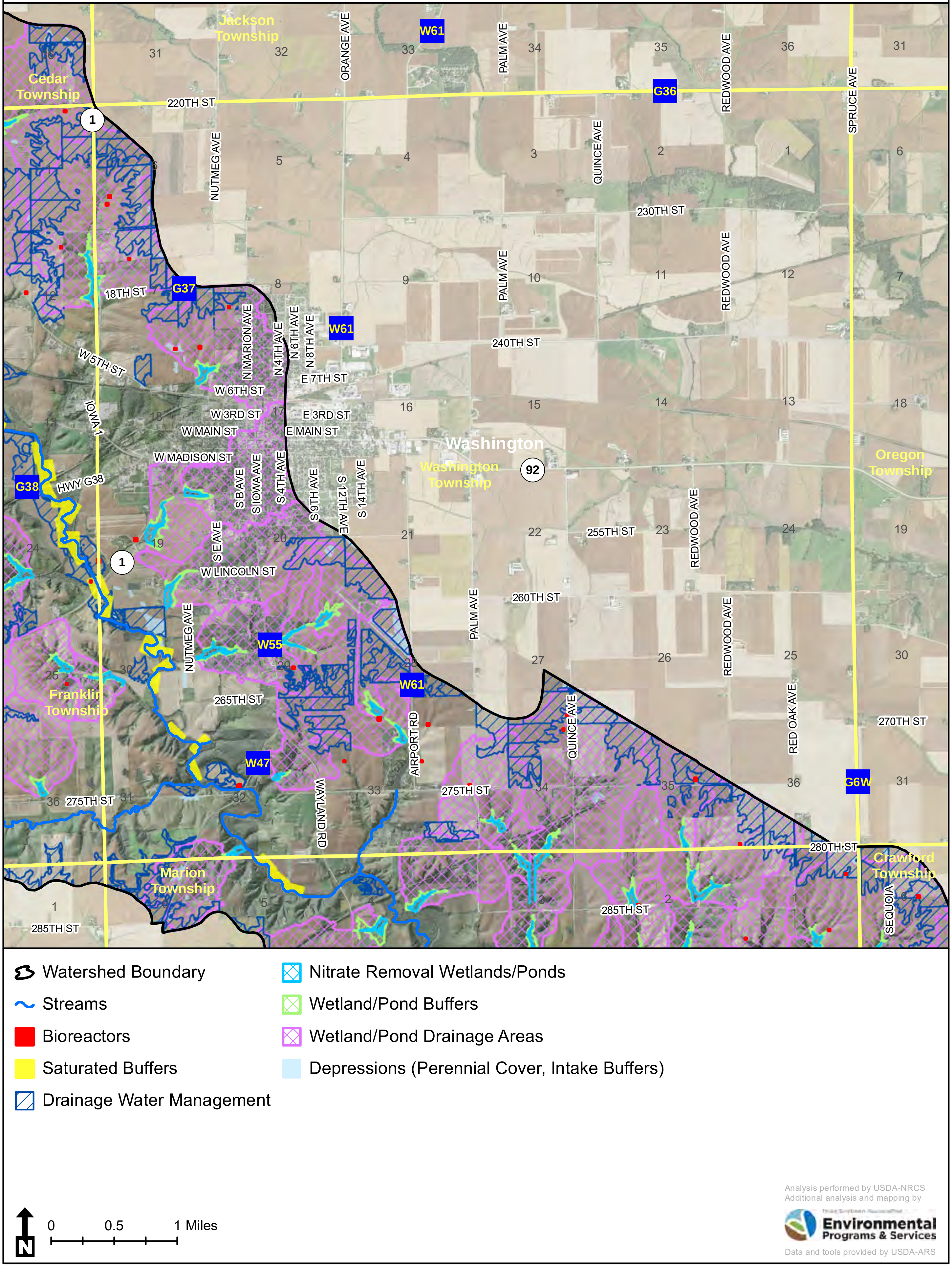
Depressions (Perennial Cover, Intake Buffers)

N

0 0.5 1 Miles

Analysis performed by USDA-NRCS
Additional analysis and mapping by
Environmental Programs & Services
Data and tools provided by USDA-ARS

West Fork Crooked Creek Watershed (0708010701) T75N R07W
Agricultural Conservation Planning Framework Drainage Treatment Practices



Analysis performed by USDA-NRCS
Additional analysis and mapping by
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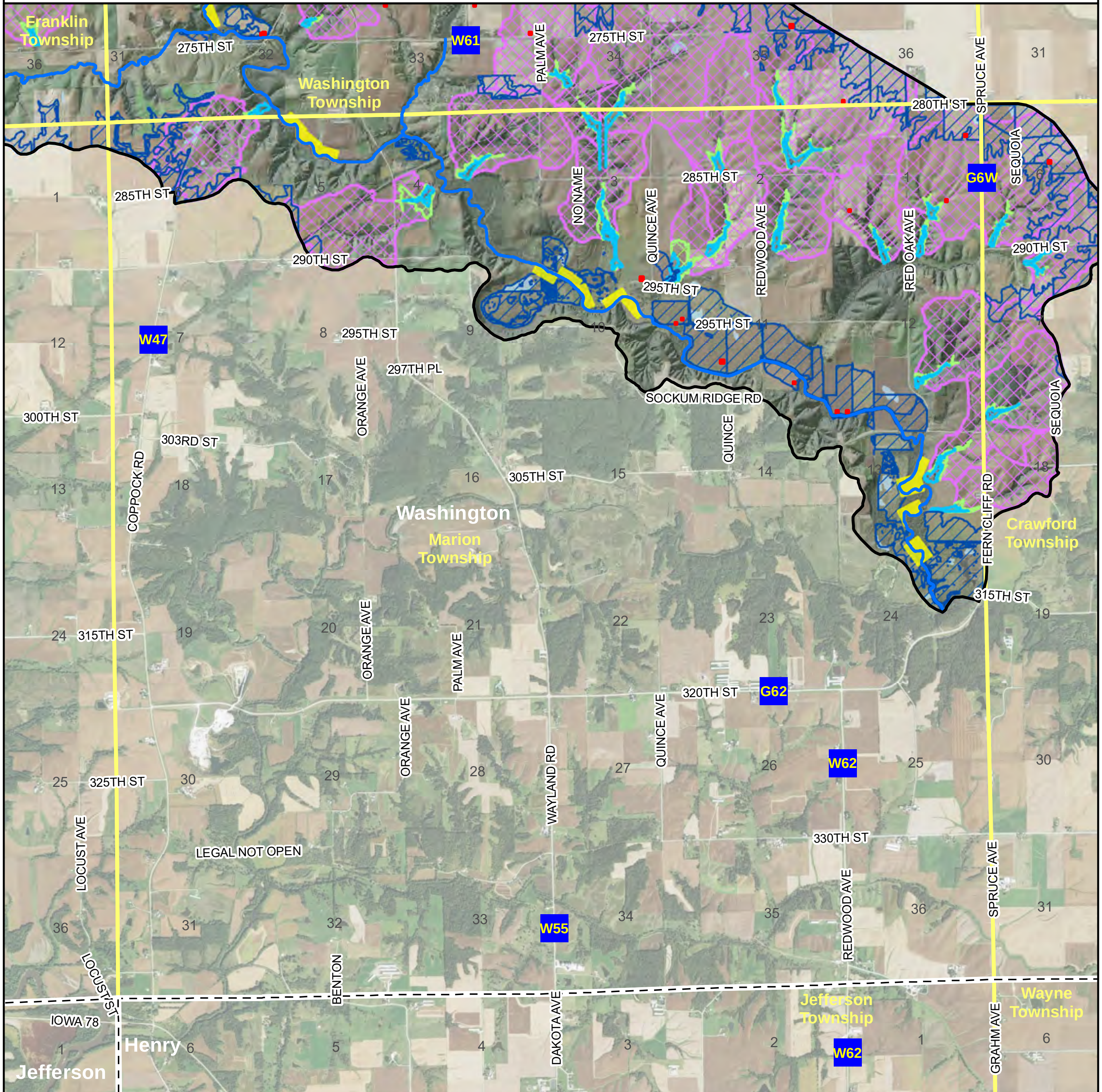
Agricultural Conservation Planning Framework Drainage Treatment Practices



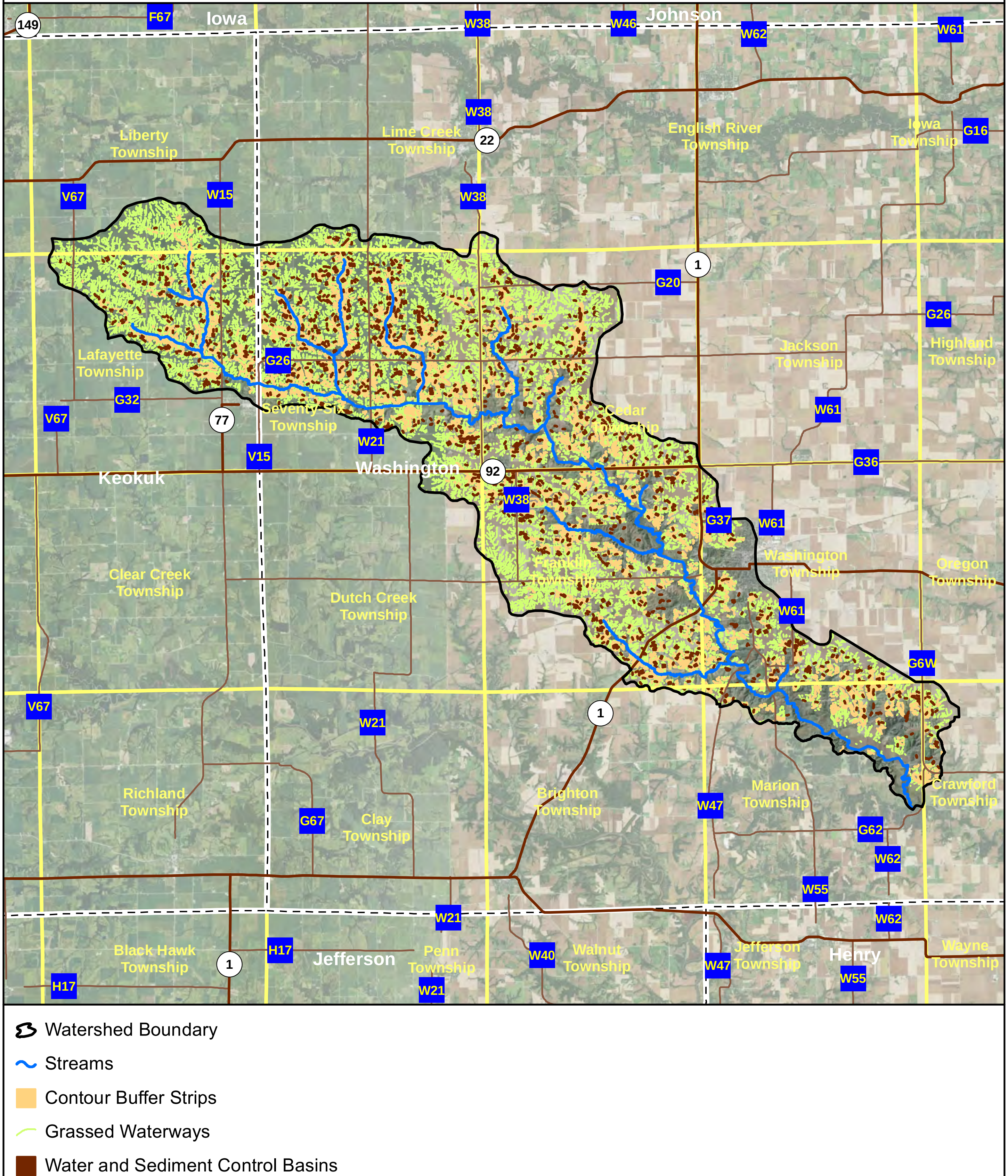
Watershed Boundary
Streams
Bioreactors
Saturated Buffers
Drainage Water Management
Nitrate Removal Wetlands/Ponds
Wetland/Pond Buffers
Wetland/Pond Drainage Areas
Depressions (Perennial Cover, Intake Buffers)

0 0.5 1 Miles

N

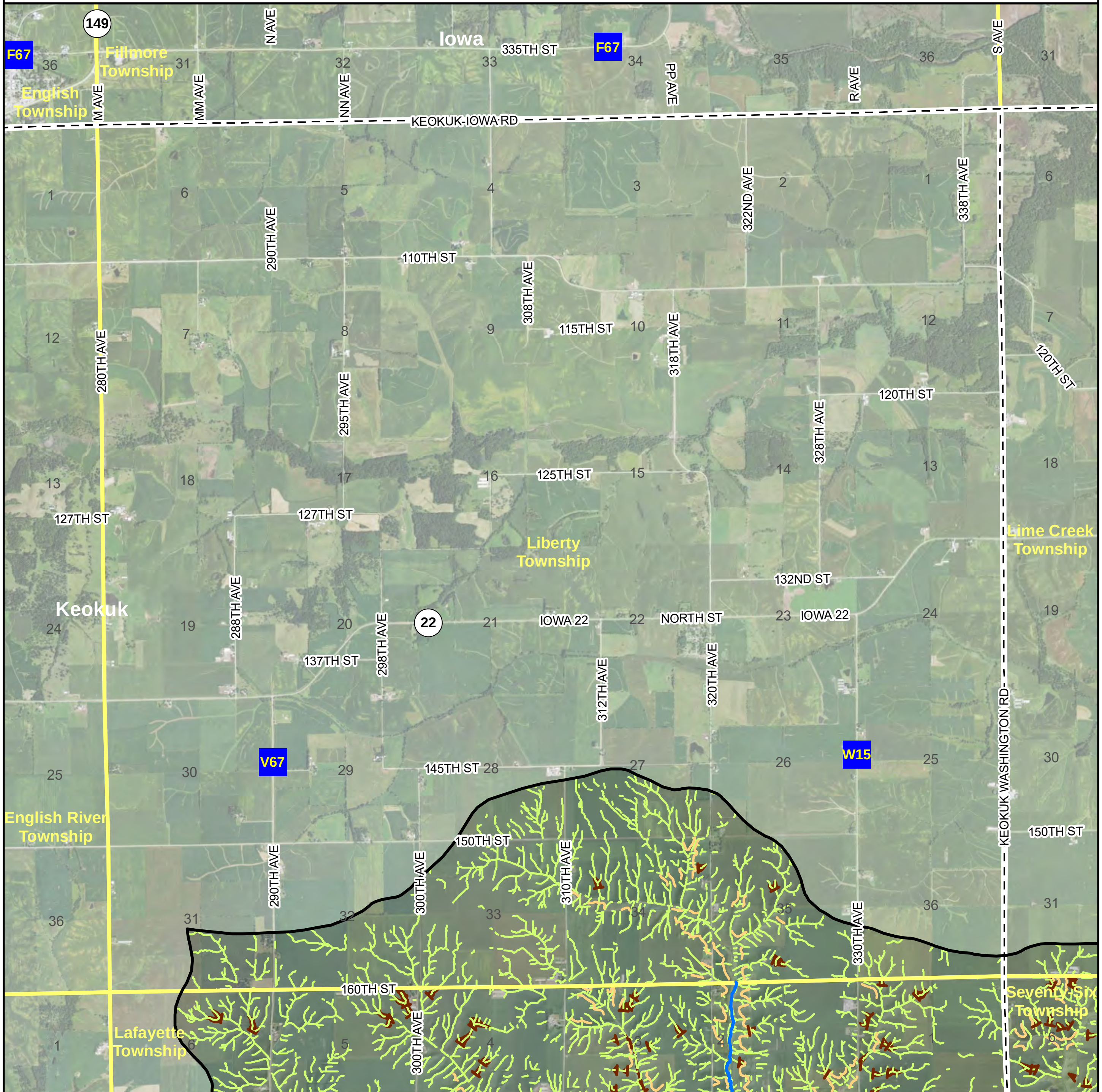
Analysis performed by USDA-NRCS
Additional analysis and mapping by
Environmental Programs & Services
Data and tools provided by USDA-ARS

West Fork Crooked Creek Watershed (0708010701)
Agricultural Conservation Planning Framework Runoff Control Practices



Analysis performed by USDA-NRCS
Additional analysis and mapping by
Environmental Programs & Services
Data and tools provided by USDA-ARS

West Fork Crooked Creek Watershed (0708010701) T77N R10W
Agricultural Conservation Planning Framework Runoff Control Practices



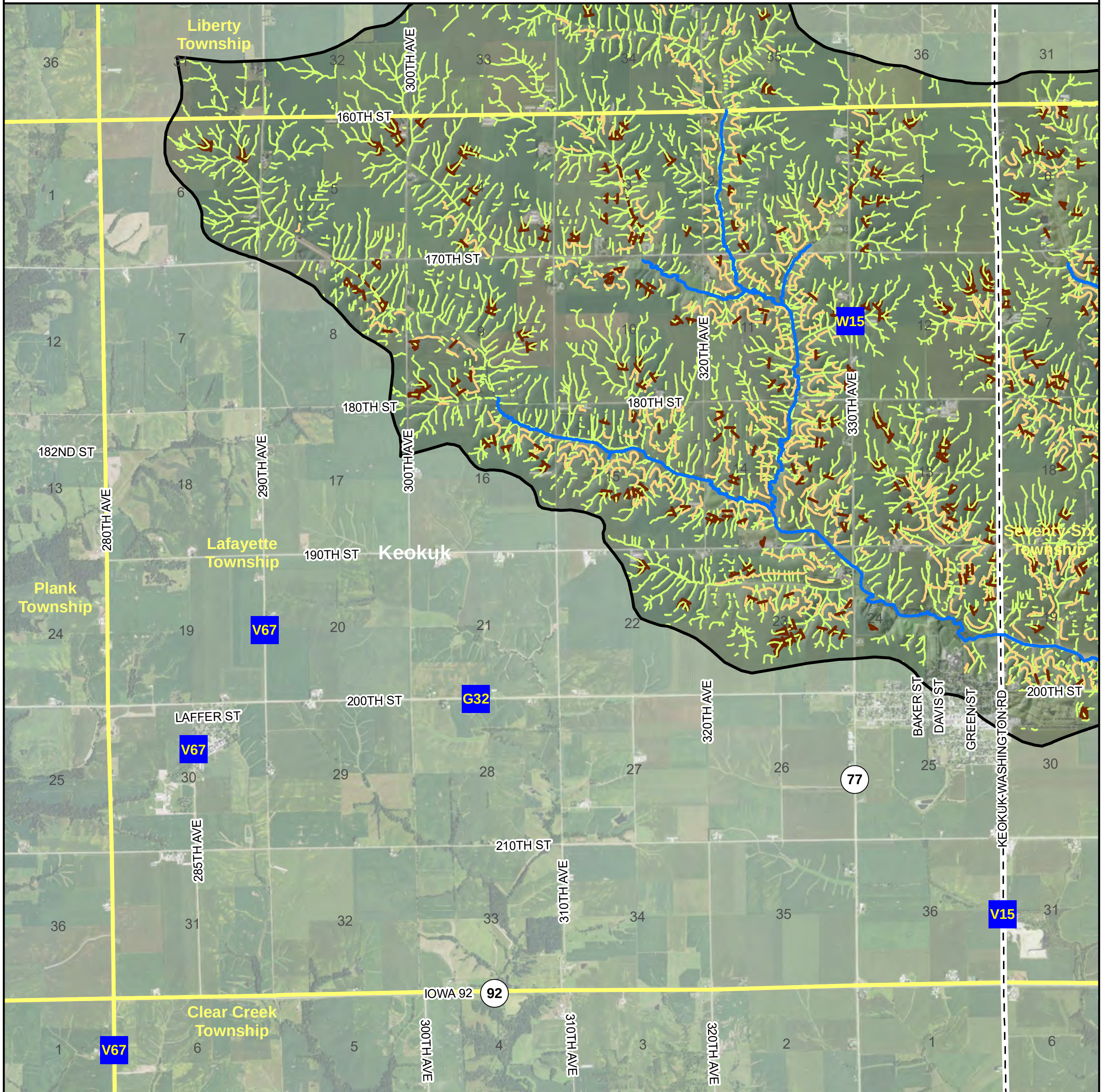
Watershed Boundary
Streams
Contour Buffer Strips
Grassed Waterways
Water and Sediment Control Basins

0 0.5 1 Miles

N

Analysis performed by USDA-NRCS
Additional analysis and mapping by
Environmental Programs & Services
Data and tools provided by USDA-ARS

West Fork Crooked Creek Watershed (0708010701) T76N R10W
Agricultural Conservation Planning Framework Runoff Control Practices



Watershed Boundary

Streams

Contour Buffer Strips

Grassed Waterways

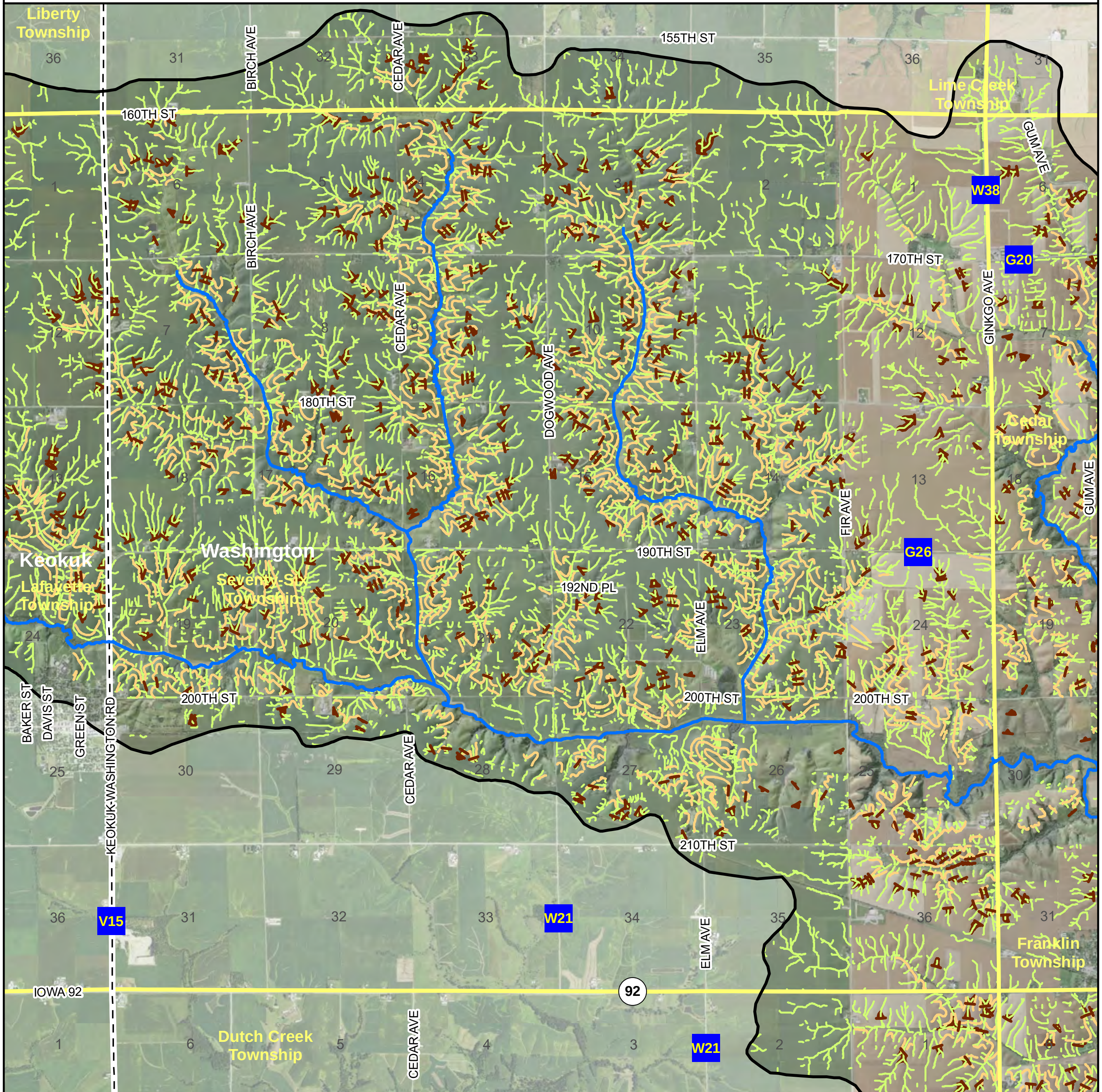
Water and Sediment Control Basins

0 0.5 1 Miles

N

Analysis performed by USDA-NRCS
Additional analysis and mapping by
Environmental Programs & Services
Data and tools provided by USDA-ARS

West Fork Crooked Creek Watershed (0708010701) T76N R09W
Agricultural Conservation Planning Framework Runoff Control Practices



Watershed Boundary

Streams

Contour Buffer Strips

Grassed Waterways

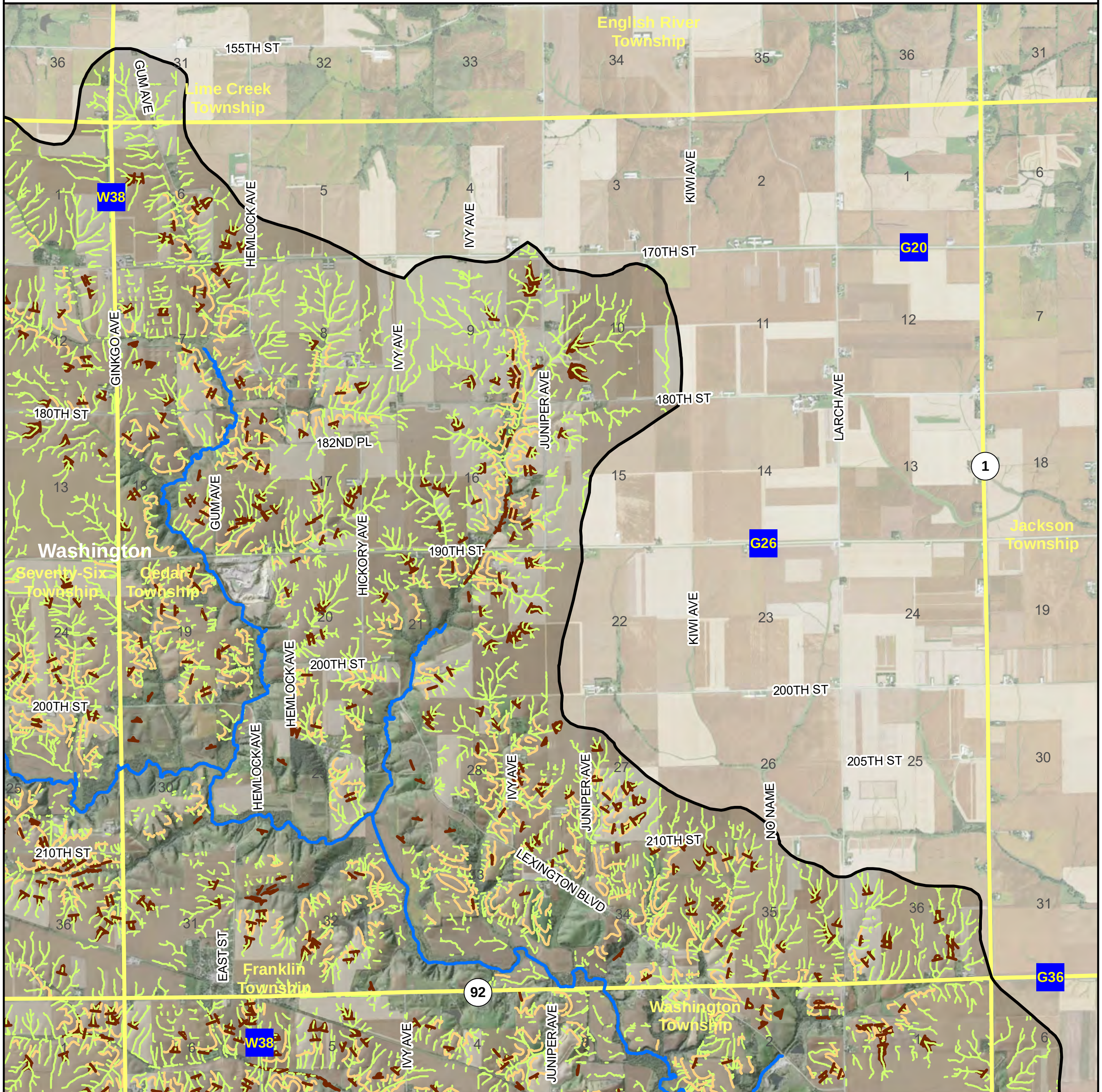
Water and Sediment Control Basins

0 0.5 1 Miles

N

Analysis performed by USDA-NRCS
Additional analysis and mapping by
Environmental Programs & Services
Data and tools provided by USDA-ARS

West Fork Crooked Creek Watershed (0708010701) T76N R08W
Agricultural Conservation Planning Framework Runoff Control Practices



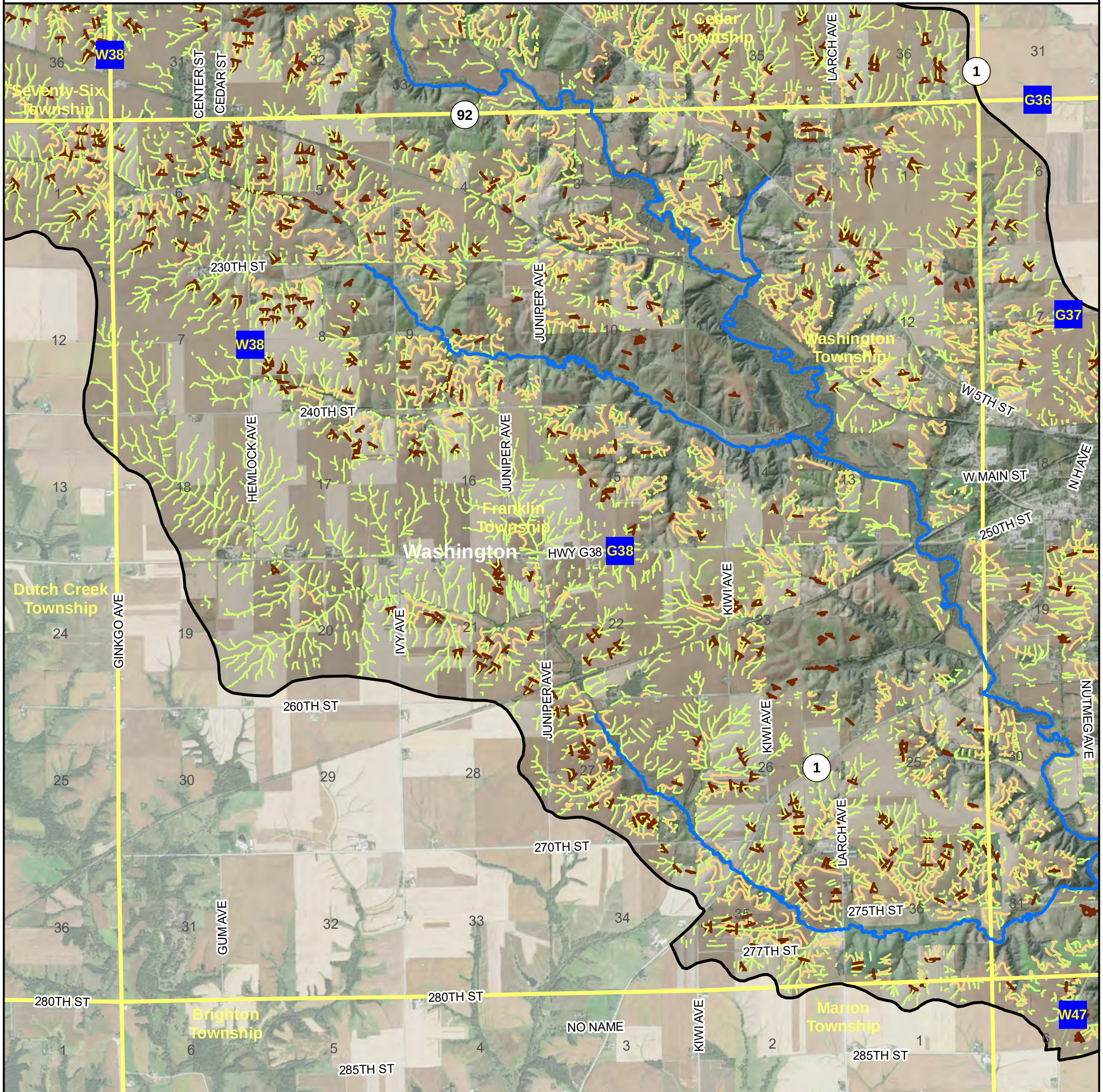
Watershed Boundary
Streams
Contour Buffer Strips
Grassed Waterways
Water and Sediment Control Basins

0 0.5 1 Miles

N

Analysis performed by USDA-NRCS
Additional analysis and mapping by
Environmental Programs & Services
Data and tools provided by USDA-ARS

West Fork Crooked Creek Watershed (0708010701) T75N R08W
Agricultural Conservation Planning Framework Runoff Control Practices



Watershed Boundary

Streams

Contour Buffer Strips

Grassed Waterways

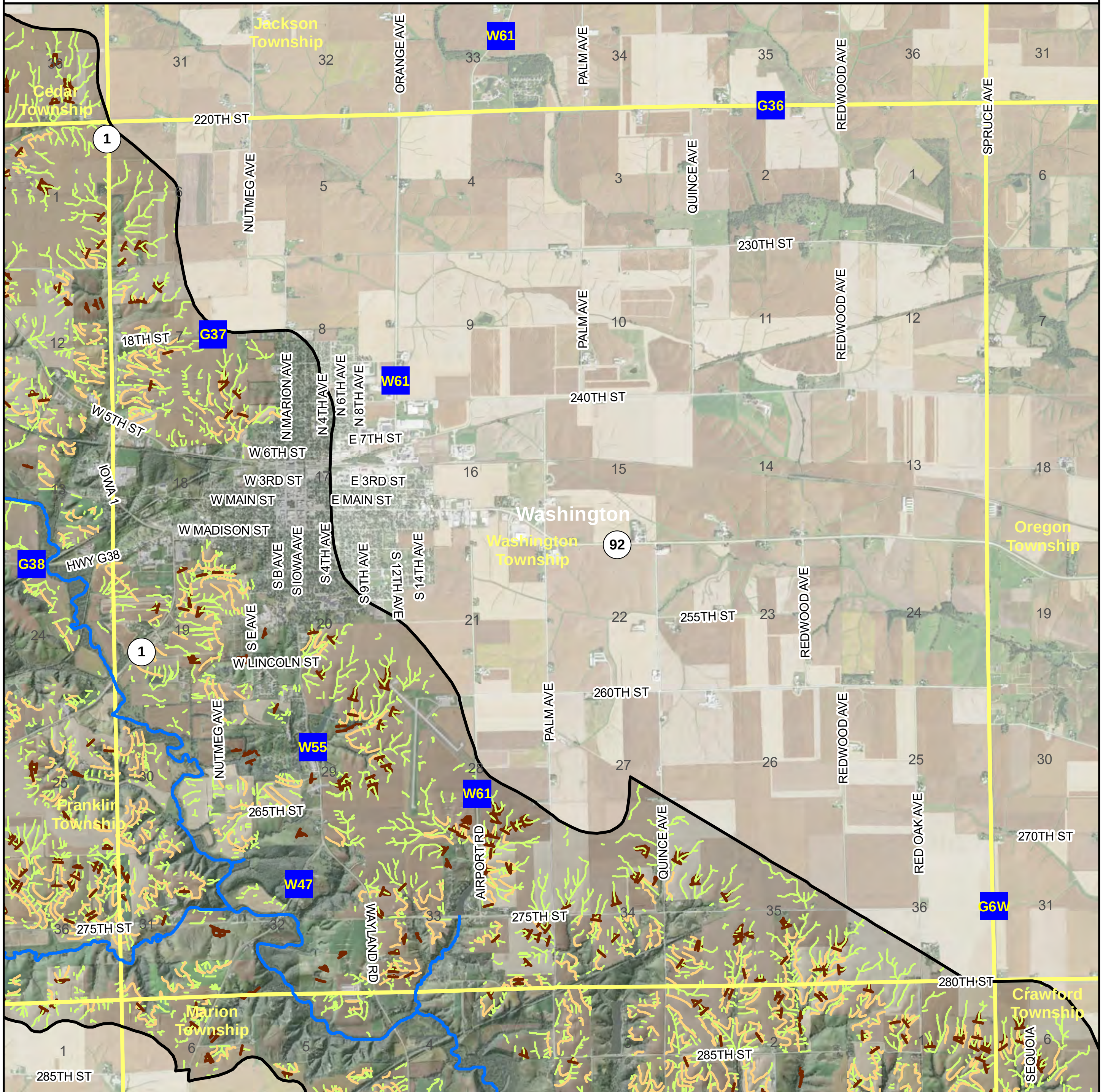
Water and Sediment Control Basins

0 0.5 1 Miles

N

Analysis performed by USDA-NRCS
Additional analysis and mapping by
Environmental Programs & Services
Data and tools provided by USDA-ARS

West Fork Crooked Creek Watershed (0708010701) T75N R07W
Agricultural Conservation Planning Framework Runoff Control Practices



Watershed Boundary

Streams

Contour Buffer Strips

Grassed Waterways

Water and Sediment Control Basins

0 0.5 1 Miles

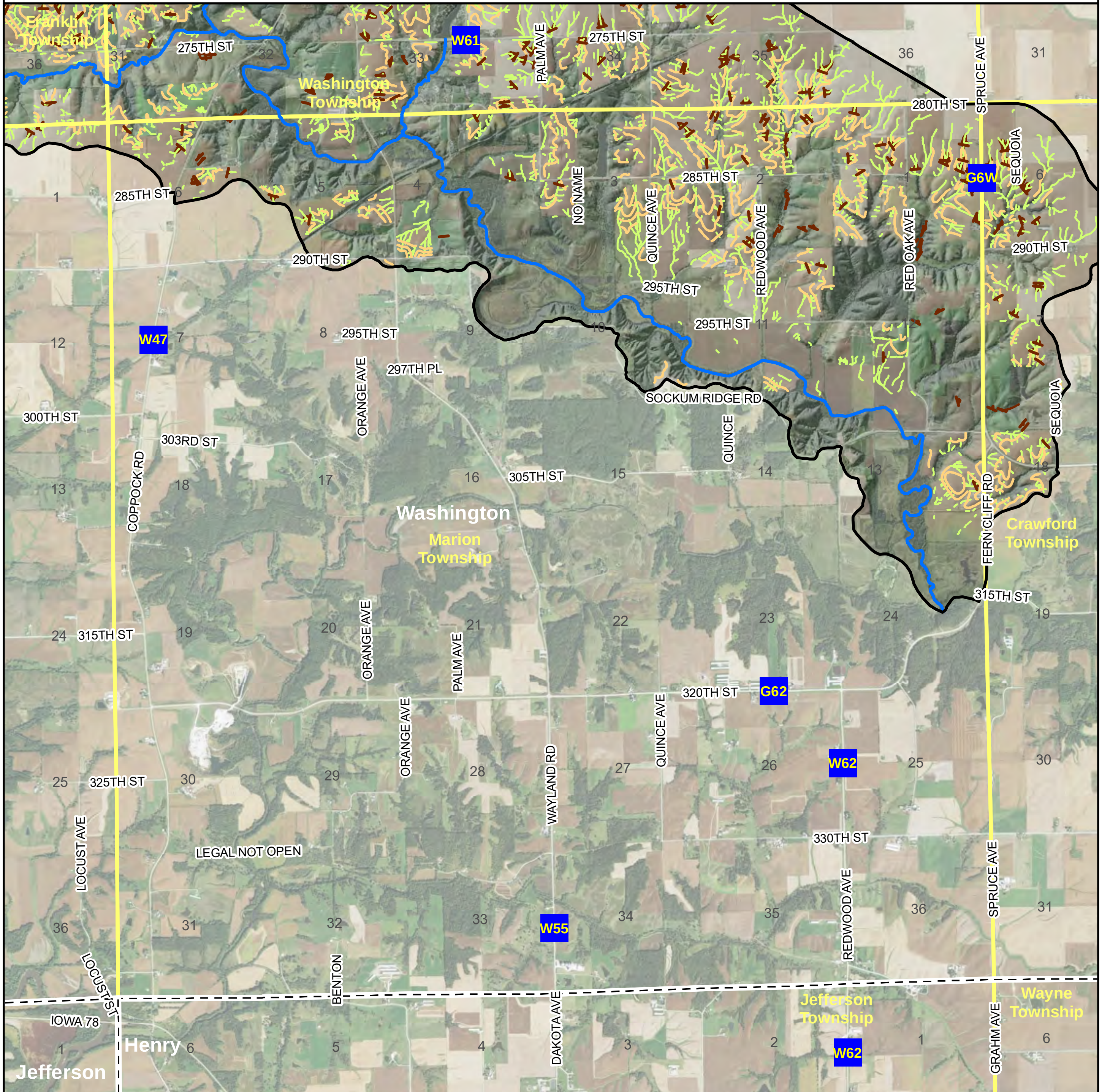
N

Analysis performed by USDA-NRCS
Additional analysis and mapping by

Environmental Programs & Services

Data and tools provided by USDA-ARS

West Fork Crooked Creek Watershed (0708010701) T74N R07W
Agricultural Conservation Planning Framework Runoff Control Practices



Watershed Boundary

Streams

Contour Buffer Strips

Grassed Waterways

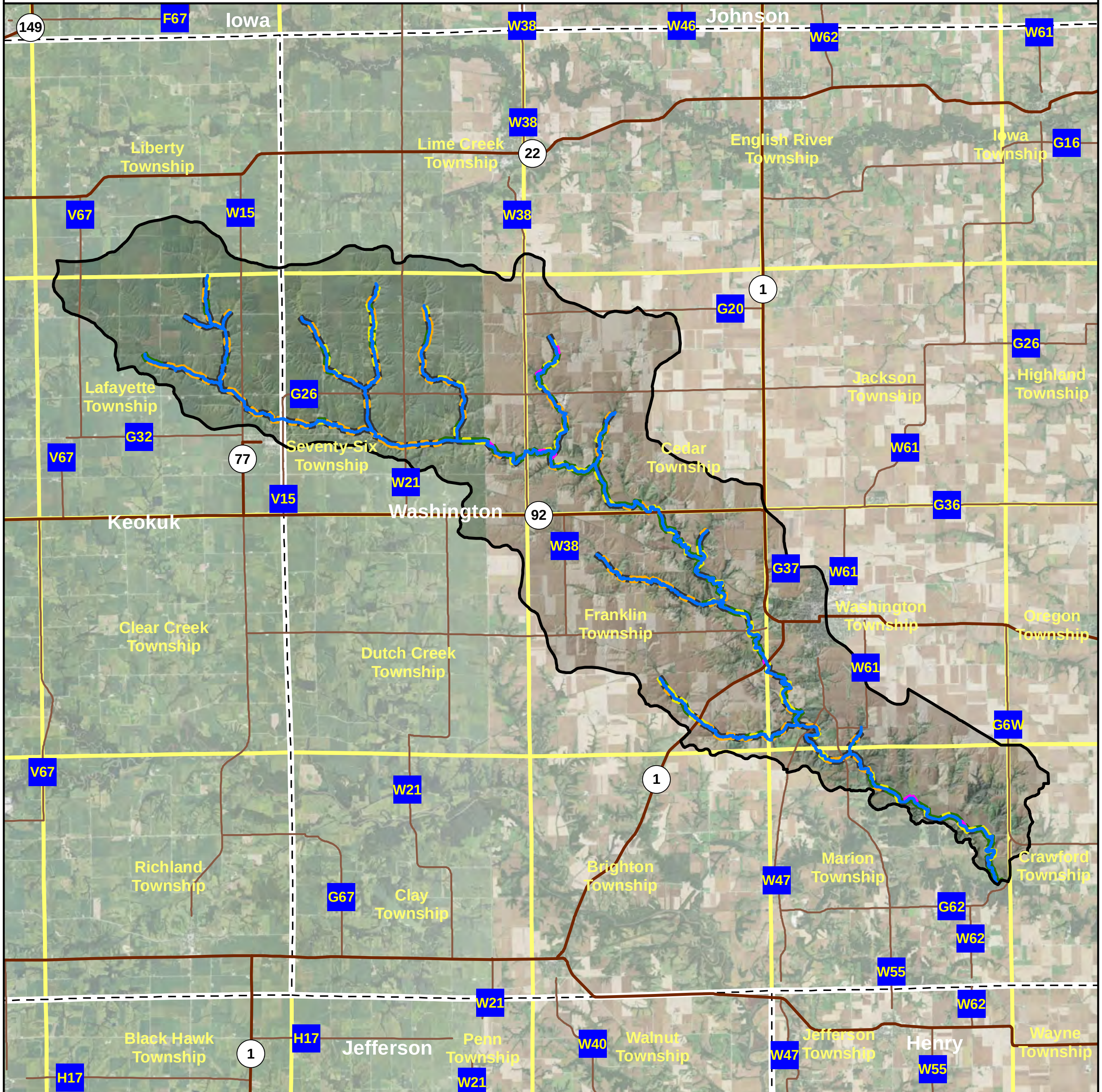
Water and Sediment Control Basins

0 0.5 1 Miles

N

Analysis performed by USDA-NRCS
Additional analysis and mapping by
Environmental Programs & Services
Data and tools provided by USDA-ARS

West Fork Crooked Creek Watershed (0708010701)
Agricultural Conservation Planning Framework Riparian Management Practices



Watershed Boundary
Streams

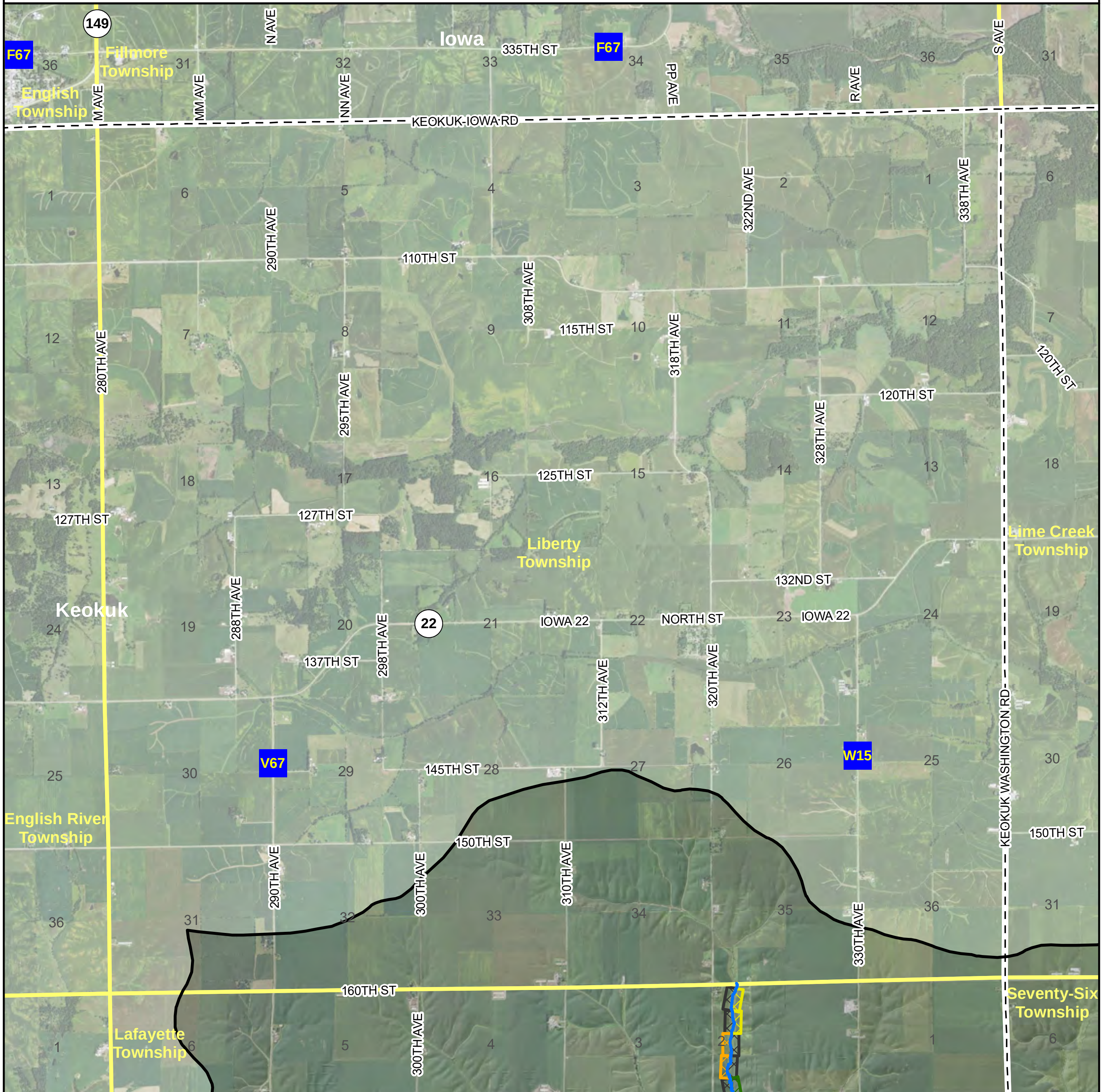
Riparian Function
- Critical Zone
- Multi Species Buffer
- Deep Rooted Vegetation
- Stiff Stemmed Grasses
- Stream Bank Stabilization

N

0 1.5 3 Miles

Analysis performed by USDA-NRCS
Additional analysis and mapping by
Environmental Programs & Services
Data and tools provided by USDA-ARS

West Fork Crooked Creek Watershed (0708010701) T77N R10W
Agricultural Conservation Planning Framework Riparian Management Practices



Watershed Boundary

Streams

Riparian Function

- Critical Zone
- Multi Species Buffer
- Deep Rooted Vegetation
- Stiff Stemmed Grasses
- Stream Bank Stabilization

N

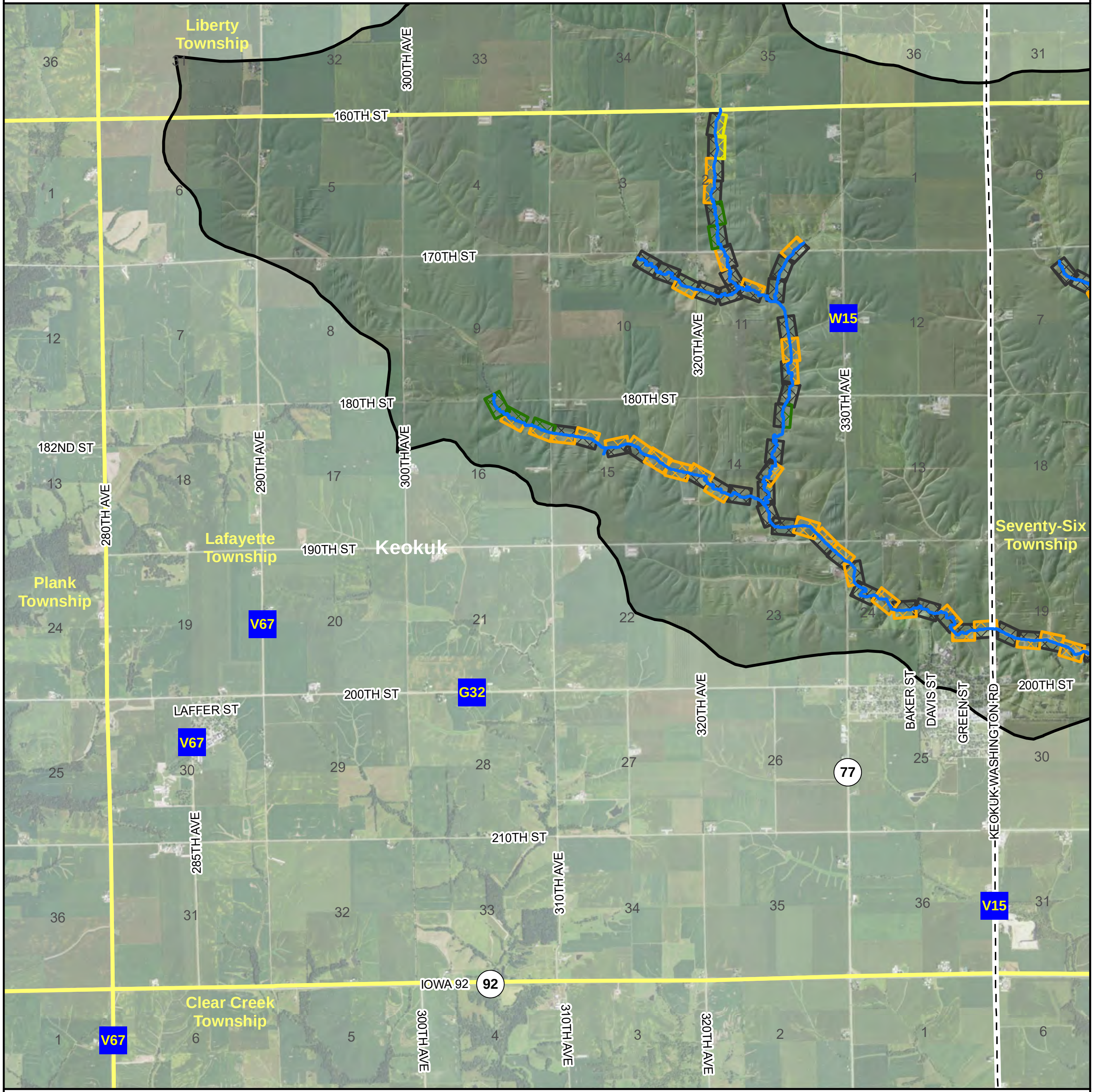
0 0.5 1 Miles

Analysis performed by USDA-NRCS
Additional analysis and mapping by

Environmental Programs & Services

Data and tools provided by USDA-ARS

West Fork Crooked Creek Watershed (0708010701) T76N R10W
Agricultural Conservation Planning Framework Riparian Management Practices



Watershed Boundary

Streams

Riparian Function

Critical Zone

Multi Species Buffer

Deep Rooted Vegetation

Stiff Stemmed Grasses

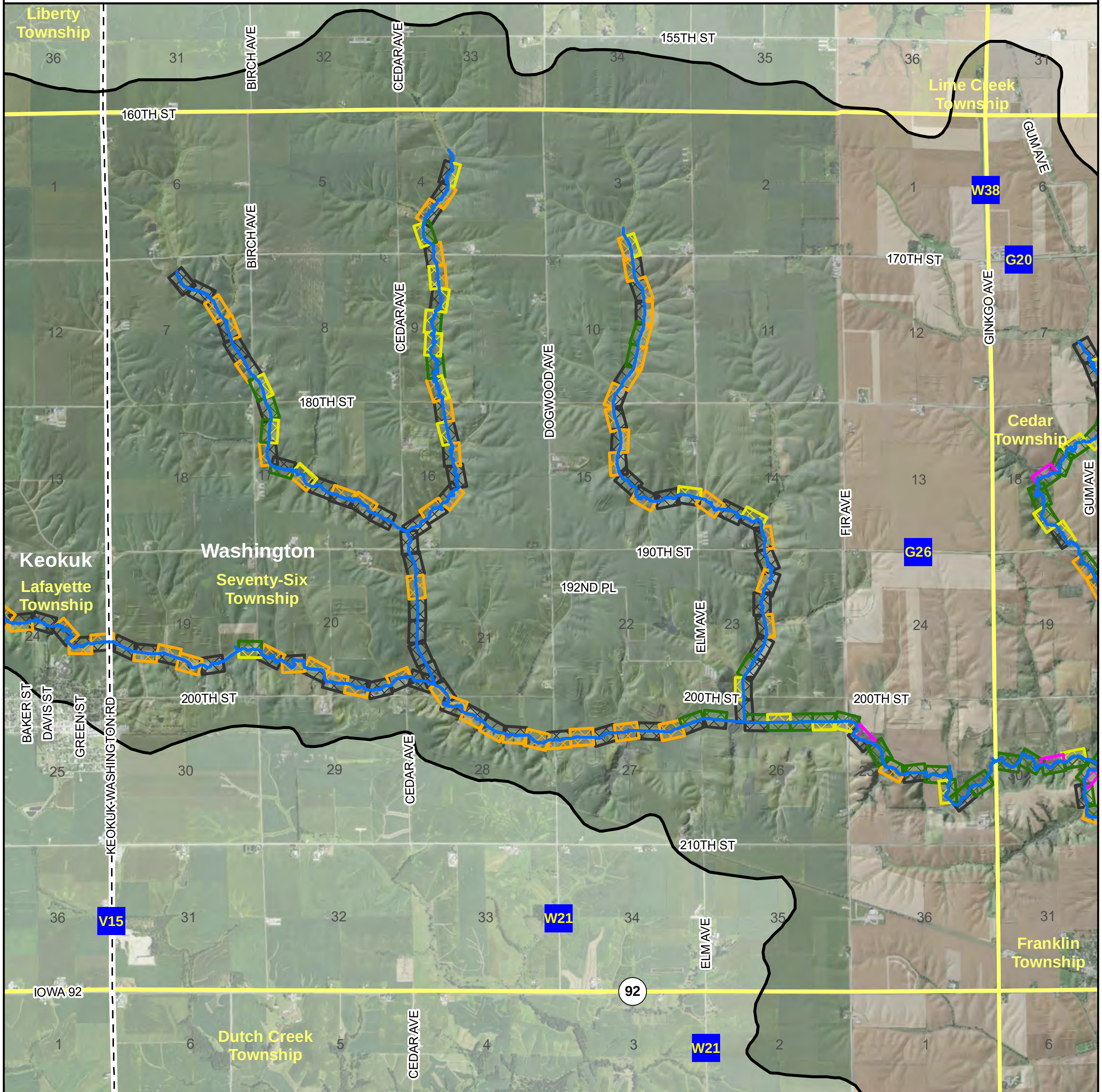
Stream Bank Stabilization

N

0 0.5 1 Miles

Analysis performed by USDA-NRCS
Additional analysis and mapping by
Environmental Programs & Services
Data and tools provided by USDA-ARS

West Fork Crooked Creek Watershed (0708010701) T76N R09W
Agricultural Conservation Planning Framework Riparian Management Practices



Watershed Boundary

Streams

Riparian Function

Critical Zone

Multi Species Buffer

Deep Rooted Vegetation

Stiff Stemmed Grasses

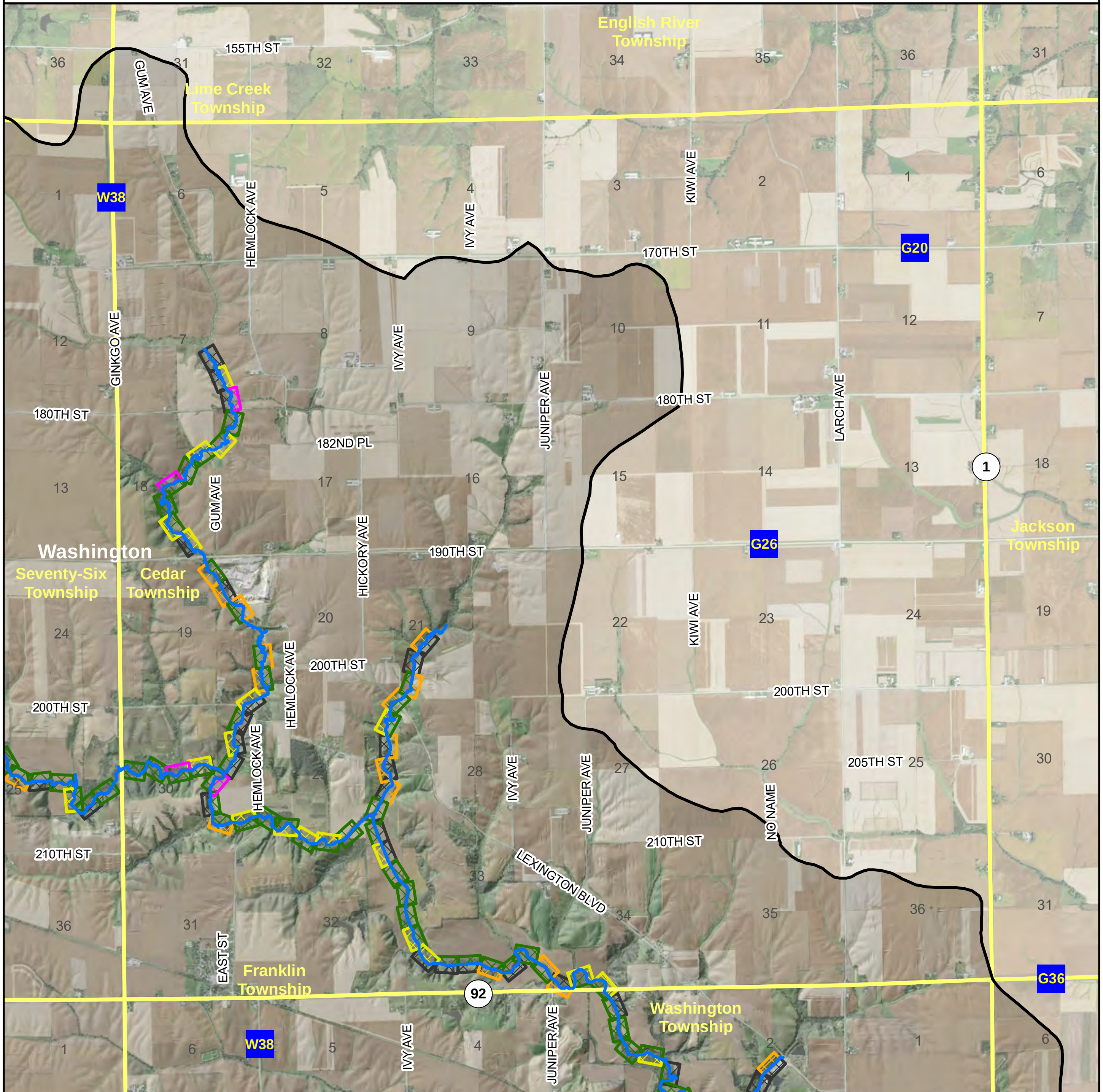
Stream Bank Stabilization

N

0 0.5 1 Miles

Analysis performed by USDA-NRCS
Additional analysis and mapping by
Environmental Programs & Services
Data and tools provided by USDA-ARS

West Fork Crooked Creek Watershed (0708010701) T76N R08W
Agricultural Conservation Planning Framework Riparian Management Practices



Watershed Boundary
Streams

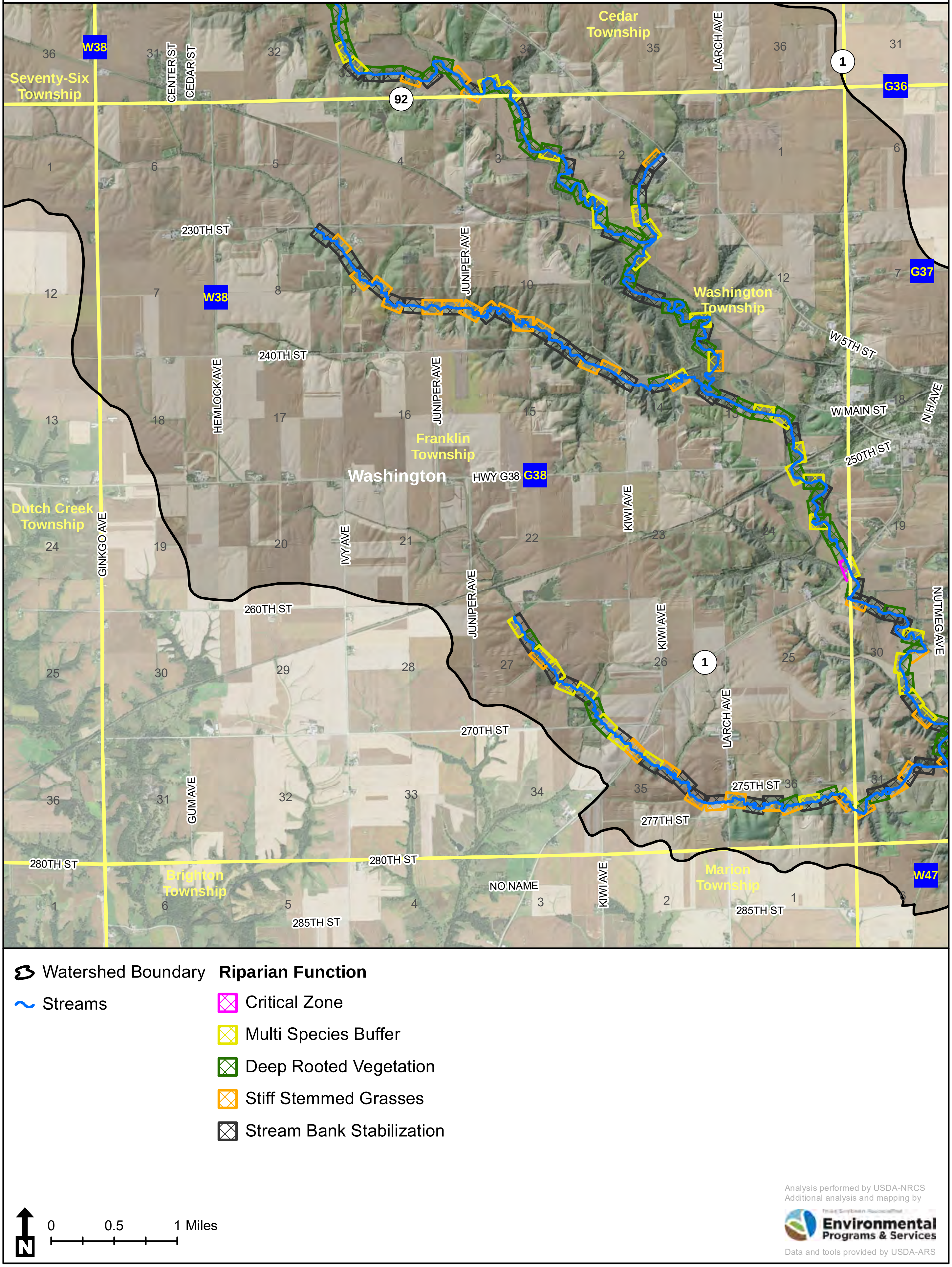
Riparian Function
- Critical Zone
- Multi Species Buffer
- Deep Rooted Vegetation
- Stiff Stemmed Grasses
- Stream Bank Stabilization

N

0 0.5 1 Miles

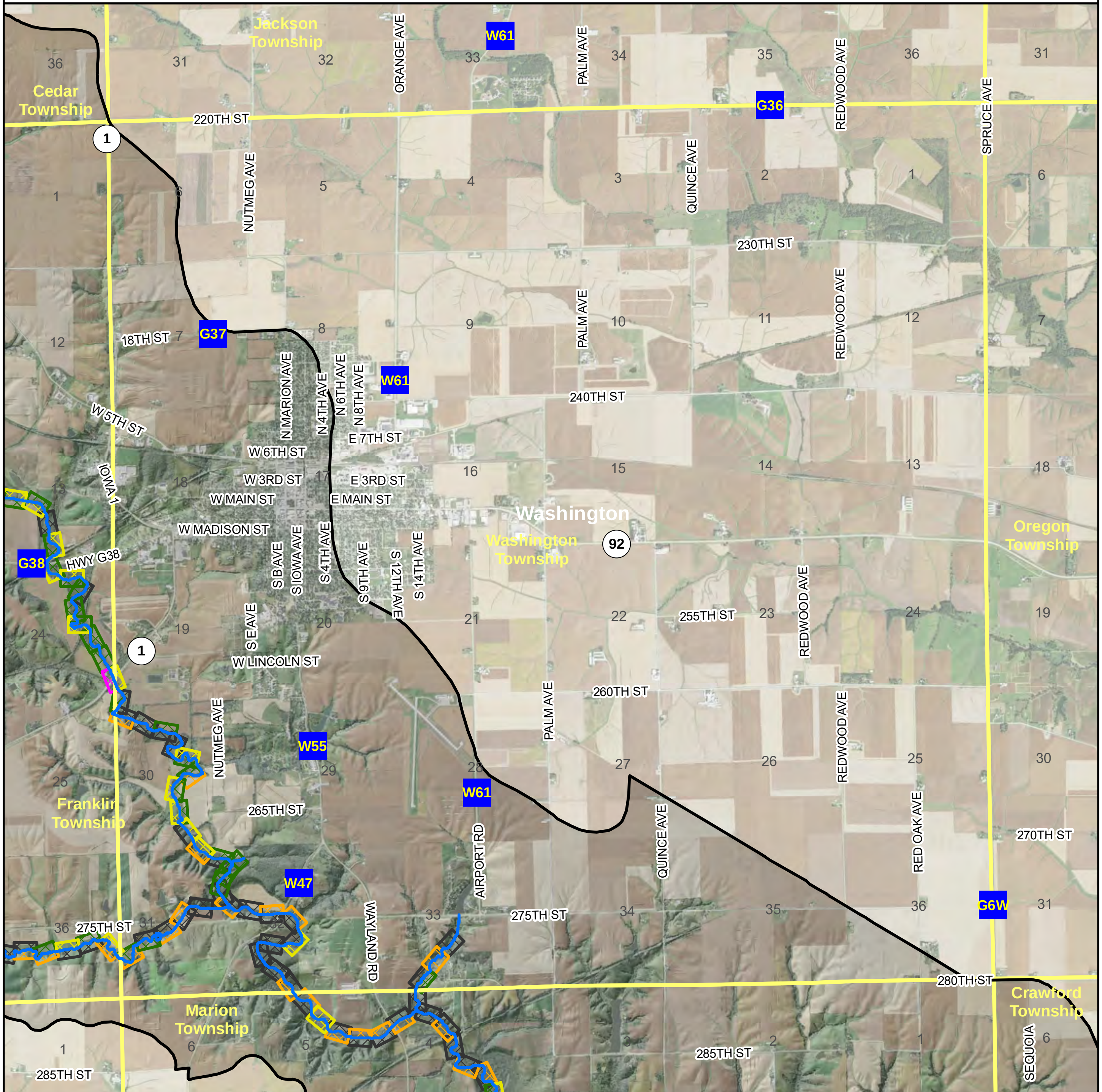
Analysis performed by USDA-NRCS
Additional analysis and mapping by
Environmental Programs & Services
Data and tools provided by USDA-ARS

West Fork Crooked Creek Watershed (0708010701) T75N R08W
Agricultural Conservation Planning Framework Riparian Management Practices



Analysis performed by USDA-NRCS
Additional analysis and mapping by
Environmental Programs & Services
Data and tools provided by USDA-ARS

West Fork Crooked Creek Watershed (0708010701) T75N R07W
Agricultural Conservation Planning Framework Riparian Management Practices



Watershed Boundary

Streams

Riparian Function

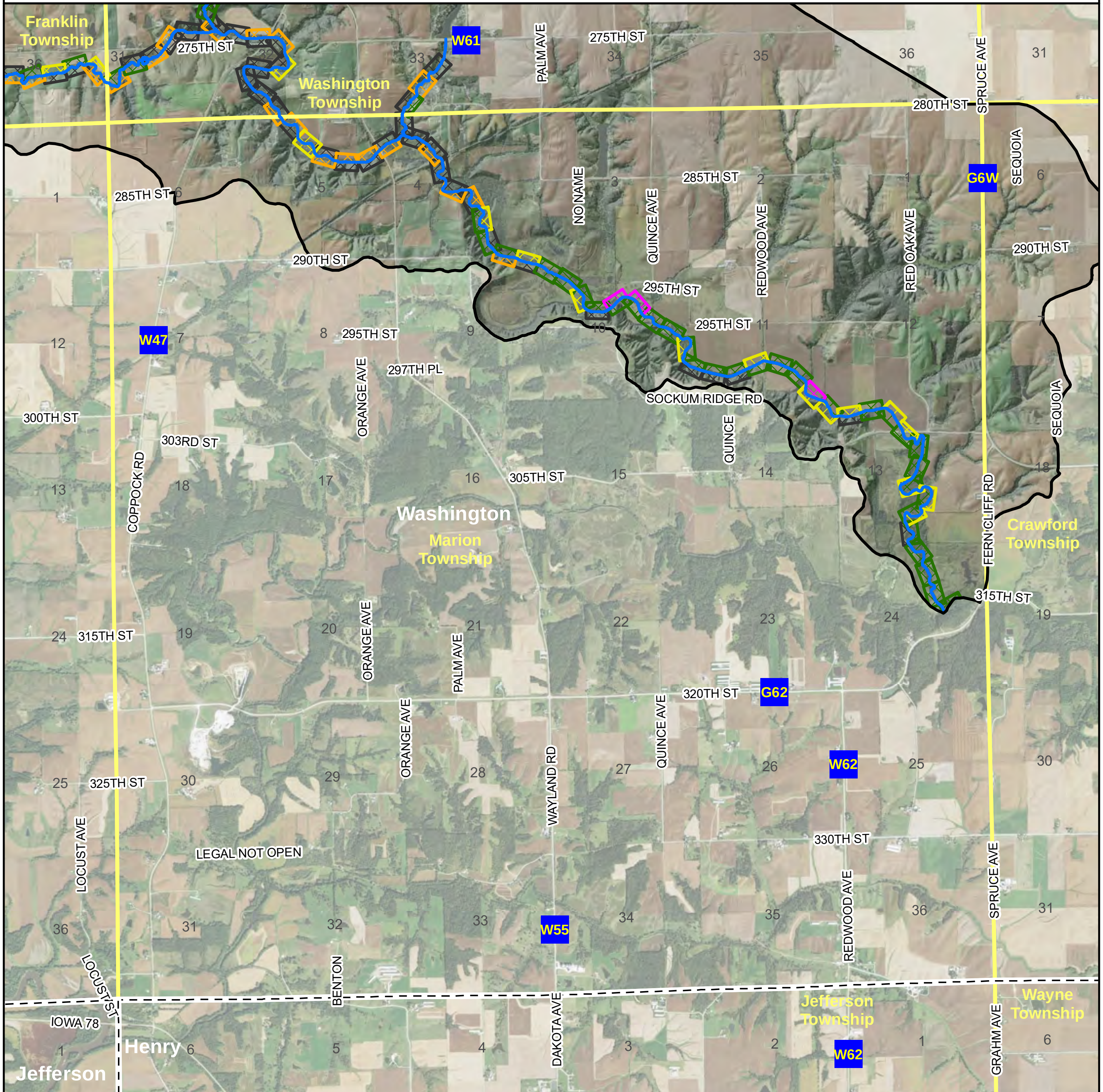
- Critical Zone
- Multi Species Buffer
- Deep Rooted Vegetation
- Stiff Stemmed Grasses
- Stream Bank Stabilization

N

0 0.5 1 Miles

Analysis performed by USDA-NRCS
Additional analysis and mapping by
Environmental Programs & Services
Data and tools provided by USDA-ARS

West Fork Crooked Creek Watershed (0708010701) T74N R07W
Agricultural Conservation Planning Framework Riparian Management Practices



Watershed Boundary
Streams

Riparian Function

- Critical Zone
- Multi Species Buffer
- Deep Rooted Vegetation
- Stiff Stemmed Grasses
- Stream Bank Stabilization

N

0 0.5 1 Miles

Analysis performed by USDA-NRCS
Additional analysis and mapping by
Environmental Programs & Services
Data and tools provided by USDA-ARS

Appendix C: Watershed Project Self-Evaluation Worksheet

Appendix C: Watershed Project Self-Evaluation Worksheet

Purpose

This self-evaluation worksheet is a means to assess annual watershed project progress and to identify areas of strength and weakness. The evaluation worksheet should be completed annually by project leaders and partners. Results should be compiled and shared with all project partners.

Evaluation Watershed Project: ______________________________

Evaluator Name: _________________

Evaluation Date: _________________

Evaluation Time Period: _________________ to _________________

Project Administration	**Exceeds**	**Meets**	**Partially Meets**	**Does Not Meet**	**NA**
Project annual review meeting held.					
Watershed partners represent a broad and diverse membership and most interests in the watershed.					
Watershed partners understand their responsibilities and roles.					
Watershed partners share a common vision and purpose.					
Watershed partners are aware of and involved in project activities.					
Watershed partners understand decision making processes.					
Watershed meetings are well-organized and productive.					
Watershed partners advocate for the mission.					

Attitudes and Awareness	**Exceeds**	**Meets**	**Partially Meets**	**Does Not Meet**	**NA**
Positive changes in attitudes, beliefs and practices have occurred in the watershed.					
Field days and other events have been held in the watershed.					
Watershed project has received publicity via local and regional media outlets.					

Performance	Exceeds	Meets	Partially Meets	Does Not Meet	NA
Yearly ______________ (insert conservation practice) implementation goals have been met.					
Yearly ______________ (insert conservation practice) implementation goals have been met.					
Yearly ______________ (insert conservation practice) implementation goals have been met.					
Yearly ______________ (insert conservation practice) implementation goals have been met.					
Yearly ______________ (insert conservation practice) implementation goals have been met.					
Yearly ______________ (insert conservation practice) implementation goals have been met.					
Yearly ______________ (insert conservation practice) implementation goals have been met.					
Yearly ______________ (insert conservation practice) implementation goals have been met.					
The majority of implemented conservation practices have been retained after cost-share payments ended.					

Results	Exceeds	Meets	Partially Meets	Does Not Meet	NA
Monitoring of __________ (insert variable) has shown progress towards reaching plan goals.					
Monitoring of __________ (insert variable) has shown progress towards reaching plan goals.					
Monitoring of __________ (insert variable) has shown progress towards reaching plan goals.					
Impact (financial or other) to farmers and landowners has been positive or minimal.					
Modeled impacts on _____________ (insert variable) have shown progress towards reaching plan goals.					
Modeled impacts on _____________ (insert variable) have shown progress towards reaching plan goals.					
Modeled impacts on _____________ (insert variable) have shown progress towards reaching plan goals.					

Strengths, Weaknesses, Opportunities and Threats Analysis

Thinking about the goals of the watershed plan, brainstorm the strengths, weaknesses, opportunities and threats (SWOTs) relevant to the project. Identification of SWOTs is important as they help shape successful watershed plan implementation.

Strengths	Opportunities
Weaknesses	**Threats**

Appendix D: Potential Funding Sources

Appendix D: Potential Funding Sources

Public Funding Sources

Program	Description	Agency/Organization
Iowa Financial Incentives Program	50 percent cost-share available to landowners through 100 SWCDs for permanent soil conservation practices.	IDALS-DSCWQ
No-Interest Loans	State administered loans to landowners for permanent soil conservation practices.	IDALS-DSCWQ
District Buffer Initiatives	Funds for SWCDs to initiate, stimulate, and incentivize signup of USDA programs, specifically buffers.	IDALS-DSCWQ
Iowa Watershed Protection Program	Funds for SWCDs to provide water quality protection, flood control, and soil erosion protection in priority watersheds; 50-75 percent cost-share.	IDALS-DSCWQ
Conservation Reserve Enhancement Program	Leveraging USDA funds to establish nitrate removal wetlands in north central Iowa with no cost to landowner.	IDALS-DSCWQ
Soil and Water Enhancement Account - REAP Water Quality Improvement Projects	REAP funds for water quality improvement projects (sediment, nutrient and livestock waste) and wildlife habitat and forestry practices; 50-75 percent cost-share. Used as state match for EPA 319 funding. Tree planting, native grasses, forestry, buffers, streambank stabilization, traditional erosion control practices, livestock waste management, ag drainage well closure and urban storm water.	IDALS-DSCWQ
State Revolving Loans	Low interest loans provided by SWCDs to landowners for permanent water quality improvement practices; subset of DNR program.	IDALS-DSCWQ
Watershed Improvement Fund	Local watershed improvement grants to enhance water quality for beneficial uses, including economic development.	IDALS-DSCWQ
General Conservation Reserve Program	Encourages farmers to convert highly erodible land or other environmentally sensitive land to vegetative cover; farmers receive annual rental payments.	USDA-FSA
Continuous Conservation Reserve Program	Encourages farmers to convert highly erodible land or other environmentally sensitive land to vegetative cover, filter strips or riparian buffers; farmers receive annual rental payments.	USDA-FSA
Farmable Wetland Program	Voluntary program to restore farmable wetlands and associated buffers by improving hydrology and vegetation.	USDA-FSA
Grassland Reserve Program	Provides funds to grassland owners to maintain, improve and establish grass. Contracts of easements up to 30 years.	USDA-FSA
Environmental Quality Incentives Program	Provides technical and financial assistance for natural resource conservation in environmentally beneficial and cost-effective manner; program is generally 50 percent cost-share.	USDA-NRCS
Wetland Reserve Program	Provides restoration of wetlands through permanent and 30 year easements and 10 year restoration agreements.	USDA-NRCS
Emergency Watershed Protection Program	Flood plain easements acquired via USDA designated disasters due to flooding.	USDA-NRCS
Wildlife Habitat Incentives Program	Cost-share contracts to develop wildlife habitat.	USDA-NRCS
Farm and Ranchland Protection Program	Purchase of easements to limit conversion of ag land to non-ag uses. Requires 50 percent match.	USDA-NRCS
Cooperative Conservation Partnership Programs	Conservation partnerships that focus technical and financial resources on conservation priorities in watersheds and airsheds of special significance.	USDA-NRCS
Conservation Security Program	Green payment approach for maintaining and increasing conservation practices.	USDA-NRCS
Conservation Innovation Grants	National and state grants for innovative solutions to a variety of environmental challenges.	USDA-NRCS

Regional Conservation Partnership Program	Grants from national, state or Critical Conservation Area funding pools to promote formation of partnerships to facilitate conservation practice implementation. Each partner within a project must make a significant cash or in-kind contribution.	USDA-NRCS
Conservation Stewardship Program	Encourages farmers to begin or continue conservation through five-year contracts to install and maintain conservation practices and adopt conservation crop rotations.	USDA-NRCS
Aquatic Ecosystem Restoration — Section 206	Restoration projects in aquatic ecosystems such as rivers, lakes and wetlands.	US Army Corps
Habitat Restoration of Fish and Wildlife Resources	Must involve modification of the structures or operations of a project constructed by the Corps of Engineers.	US Army Corps
Section 319 Clean Water Act	Grants to implement NPS pollution control programs and projects in watersheds with EPA approved watershed management plans.	EPA/DNR
Iowa Water Quality Loan Fund	Source of low-cost financing for farmers and landowners, livestock producers, community groups, developers, watershed organizations and others.	DNR
Sponsored Projects	Wastewater utilities can finance and pay for projects, within or outside the corporate limits, that cover best management practices to keep sediment, nutrients, chemicals and other pollutants out of streams and lakes.	DNR/Iowa Finance Authority
Resource Enhancement and Protection Program	Provides funding for enhancement and protection of State's natural and cultural resources.	DNR
Streambank Stabilization and Habitat Improvement	Penalties from fish kills used for environmental improvement on streams impacted by the kill.	DNR/IDALS-DSCWQ
State Revolving Fund	Provides low interest loans to municipalities for waste water and water supply; expanding to private septics, livestock, storm water and NPS pollutants.	DNR
Watershed Improvement Review Board	Comprised of representatives from agriculture, water utilities, environmental organizations, agribusiness, the conservation community and state legislators and provides grants to watershed and water quality projects.	WIRB
Iowa Water Quality Initiative	Initiated by IDALS-DSCWQ as a demonstration and implementation program for the Nutrient Reduction Strategy. Funds are targeted to 9 priority HUC-8 watersheds.	IDALS-DSCWQ
Fishers and Farmers Partnership	Fishers & Farmers Partnership for the Upper Mississippi River Basin is a self-directed group of nongovernmental agricultural and conservation organizations, tribal organizations and state and federal agencies working to achieve the partnership's mission "… to support locally-led projects that add value to farms while restoring aquatic habitat and native fish populations."	US Fish and Wildlife Service and others

Private Funding Sources

Program	Description	Website
Field to Market® Alliance	Field To Market® is a diverse alliance working to create opportunities across the agricultural supply chain for continuous improvements in productivity, environmental quality and human well-being. The group provides collaborative leadership that is engaged in industry-wide dialogue, grounded in science and open to the full range of technology choices.	https://www.fieldtomarket.org/members/
International Plant Nutrition Institute (IPNI)	The IPNI is a not-for-profit, science-based organization dedicated to the responsible management of plant nutrition for the benefit of the human family.	http://www.ipni.net
Iowa Community Foundations	Iowa Community Foundations are nonprofit organizations established to meet the current and future needs of our local communities.	http://www.iowacommunityfoundations.org/
Iowa Natural Heritage Foundation	Private nonprofit conservation organization working to ensure Iowans will always have beautiful natural areas — to bike, hike and paddle; to recharge, relax and refresh; and to keep Iowa healthy and vibrant.	http://www.inhf.org
McKnight Foundation — Mississippi River Program	Program goal is to restore the water quality and resiliency of the Mississippi River.	www.mcknight.org/grant-programs/mississippi-river
National Fish and Wildlife Foundation (NFWF)	NFWF provides funding on a competitive basis to projects that sustain, restore and enhance our nation's fish, wildlife and plants and their habitats.	www.nfwf.org
National Wildlife Foundation	Works to protect and restore resources and the beneficial functions they offer.	www.nwf.org
The Fertilizer Institute (TFI)	TFI is the leading voice in the fertilizer industry, representing the public policy, communication and statistical needs of producers, manufacturers, retailers and transporters of fertilizer. Issues of interest to TFI members include security, international trade, energy, transportation, the environment, worker health and safety, farm bill and conservation programs to promote the use of enhanced efficiency fertilizer.	http://www.tfi.org
The Nature Conservancy (TNC)	TNC is the largest freshwater conservation organization in the world — operating in 35 countries with more than 300 freshwater scientists and 500 freshwater conservation sites globally. TNC works with businesses, governments, partners and communities to change how water is managed around the world.	http://www.nature.org
Trees Forever — Working Watersheds Program	Annually work with 10-15 projects in Iowa that emphasize water quality through our Working Watersheds: Buffers and Beyond program.	www.treesforever.org/
Walton Family Foundation — Environmental Program	Work to achieve lasting change by creating new and unexpected partnerships among conservation, business and community interests to build durable solutions to big problems.	www.waltonfamilyfoundation.org/environment