

Eagle Creek Watershed Plan



A roadmap to sustain and improve agricultural productivity, water quality, habitat and soil health in the Eagle Creek Watershed

Prepared by:



December 2017



Funding to support the development of this watershed plan document and associated watershed planning activities in the Eagle Creek Watershed has been provided by:



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Wright County Soil and Water Conservation District

Natural Resources Conservation Service

The Nature Conservancy

Iowa Department of Agriculture and Land Stewardship

Iowa Department of Natural Resources



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Why was the Eagle Creek Watershed Plan developed?

This watershed plan is intended to provide a roadmap for land and water improvements in the Eagle Creek Watershed while simultaneously maintaining and improving agricultural performance and quality of life. Environmental improvements are a big task, and trying to tackle everything at once can be daunting. This plan lays out a phased approach to implementation to ensure continuous improvements are made towards achieving long-term goals for the watershed.

Who owns this watershed plan?

This plan is for all stakeholders interested in the Eagle Creek Watershed, including landowners, farmers, residents, nongovernmental organizations and local, state and federal units of government. Ultimately, successful implementation of this plan will rest with these stakeholders.

Who developed this watershed plan?

This plan was developed by the Iowa Soybean Association. Guidance and input was provided by representatives of landowners, farmers, residents and county and federal governments. The watershed planning process was led by the Iowa Soybean Association with assistance from the Wright County Soil and Water Conservation District, the Natural Resources Conservation Service, The Nature Conservancy, the Iowa Department of Agriculture and Land Stewardship and the Iowa Department of Natural Resources.

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Note: Links to online resources and information are shown in **bold, blue text** within this document.

1. Executive Summary

A watershed is an area of land that drains to a single point such as a lake or larger stream. The Eagle Creek Watershed (ECW) is located in Iowa and is comprised of nearly 70,000 acres. The ECW is located primarily in Wright County and includes a small portion in Hamilton County. The ECW is drained by Eagle Creek from its headwaters northwest of Belmond to its confluence with the Boone River south of Woolstock. Figure 1.1 shows the location of the ECW and Figure 1.2 illustrates how watersheds function.

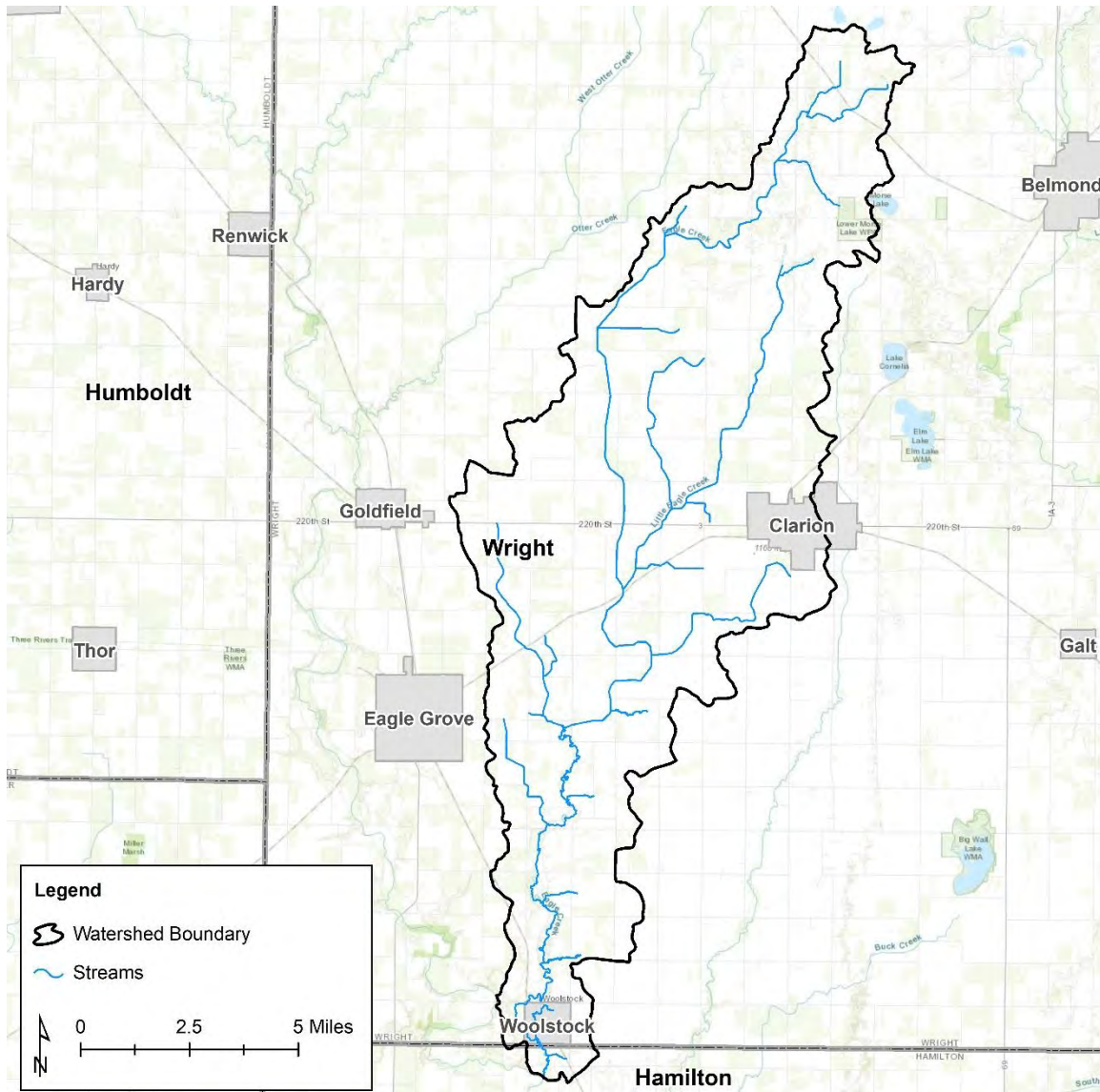


Figure 1.1. Location of the Eagle Creek Watershed in north central Iowa along with nearby cities.

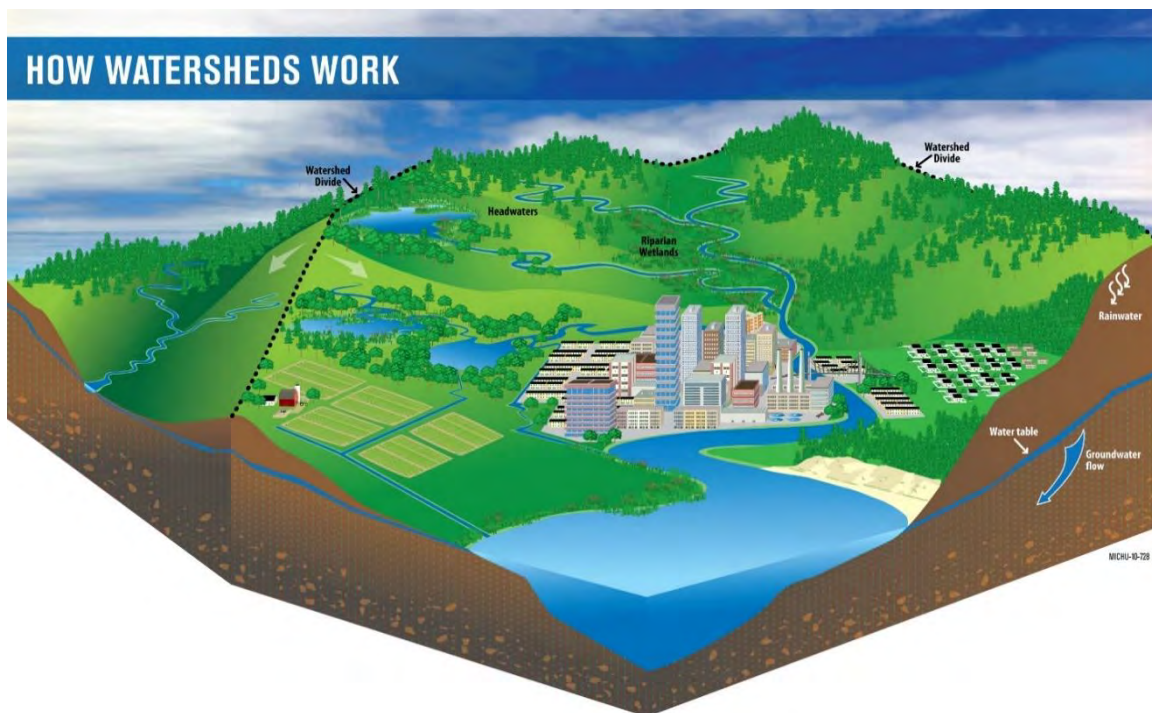


Figure 1.2. A watershed contains the land and water that flow to a common point (Michigan Sea Grant).

The Eagle Creek Watershed Plan defines and addresses existing land and water quality conditions, identifies challenges and opportunities and provides a path for improvement. The plan was developed according to the watershed planning process recommended by the Iowa Department of Natural Resources (IDNR; Figure 1.3) and incorporated input from a variety of public and private stakeholders. The Iowa Soybean Association led development of this watershed plan with funding provided by the Iowa Department of Agriculture and Land Stewardship (IDALS) via the Wright County Soil and Water Conservation District (SWCD). Local ECW stakeholders including watershed farmers, landowners, conservation professionals and others contributed knowledge and insights throughout the watershed planning process. The Eagle 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 ECW is a subwatershed of the larger **Boone River Watershed** and was identified for watershed planning to support ongoing watershed projects. The watershed is one of two focus watersheds (along with the Prairie Creek Watershed in Humboldt and Kossuth counties) located within the **Boone River Watershed Nutrient Management Initiative** project area, which is a Water Quality Initiative (WQI) watershed demonstration project led by the Wright SWCD and funded by IDALS. The Boone River Watershed Nutrient Management Initiative project was launched in 2014 to work with farmers and project partners to demonstrate, implement and evaluate conservation practices identified in the **Iowa Nutrient Reduction Strategy** (INRS). The project is building on previous successes from the Mississippi River Basin Healthy Watersheds Initiative (MRBI), a program led by the USDA-Natural Resources Conservation Service (NRCS). Previous and ongoing efforts in the Boone River Watershed also have been led by **The Nature Conservancy**. Community participation provided important insights throughout the watershed planning process. Local engagement and leadership has been and will continue to be essential as the plan is implemented.



Figure 1.3. The watershed planning process.

The Boone River Watershed is one of nine priority watersheds identified in the 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. The Eagle Creek 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 ECW 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 long-term goals of the Eagle Creek Watershed Plan are to:

1. Increase farmer and urban stakeholder involvement and adoption.
2. Maintain and increase agricultural productivity and/or profitability.
3. Reduce in-stream nonpoint source nutrient loads to Iowa Nutrient Reduction Strategy levels of 41 percent nitrogen reduction and 29 percent phosphorus reduction.
4. Maintain and improve wildlife habitat and biodiversity.
5. Improve soil health and reduce soil erosion.
6. Reduce flood risk.

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, conservation and agricultural professionals and other local stakeholders to guide the development of this watershed plan.

Improving land and water resources in the ECW 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 15-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 2032. The total investment necessary to accomplish the watershed plan goals is estimated to be approximately \$3,960,000 for initial infrastructure costs associated with structural practices, up to \$1,747,200 per year for annual costs associated with management practices and an additional \$120,000 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 ECW 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) can be considered along with their potential internal (local) and external (downstream) 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 nitrate and phosphorus load reduction cost efficiency for practices that are included in the Eagle Creek Watershed Plan. Many of these practices have additional on-farm and off-farm economic and ecosystem benefits that also could be considered as specific conservation practices are funded.

Table 1.1. Estimated annual nutrient load reductions and cost efficiency of conservation practices included in the Eagle Creek Watershed conceptual plan. Initial costs for structural practices were annualized by typical practice lifespans to facilitate comparison to management practices.

| | Practice | Unit | Future needs | Cost per unit | Total cost | Nitrate load reduction (lb N/yr) | Phosphorus load reduction (lb P/yr) | Annualized N reduction cost (\$/lb N/yr) | Annualized P reduction cost (\$/ton P/yr) |
|---------------|----------------------------------|------------|--------------|---------------|-------------|----------------------------------|-------------------------------------|--|---|
| Annual costs | Nutrient management | acres | 30,000 | -\$5 | -\$150,000 | 99,000 | 254 | -\$1.52 | -\$0.30 |
| | No-till/Strip-till | acres | 40,000 | -\$10 | -\$400,000 | 0 | 1,791 | - | -\$0.11 |
| | Cover crops | acres | 45,000 | \$50 | \$2,250,000 | 460,350 | 649 | \$4.89 | \$1.73 |
| | Prairie strips (Perennial cover) | acres | 160 | \$295 | \$47,200 | 44,880 | 60 | \$1.05 | \$0.39 |
| Initial costs | Bioreactors | structures | 43 | \$10,000 | \$430,000 | 21,129 | 0 | \$1.36 | - |
| | Saturated buffers | structures | 50 | \$3,000 | \$150,000 | 28,568 | 0 | \$0.07 | - |
| | Wetlands | sites | 10 | \$325,000 | \$3,250,000 | 130,728 | 337 | \$0.17 | \$4.82 |
| | Oxbow restorations | sites | 13 | \$10,000 | \$130,000 | 6,536 | 0 | \$0.13 | - |

Ultimately, any land and water quality improvements made in the watershed will be driven by local desire, education and participation. The implementation, monitoring, outreach and evaluation components of this watershed plan should provide a framework to guide efforts and focus resources in order to achieve the community vision of the ECW.

2. Watershed Characteristics

2.1. General Information

The Eagle Creek Watershed (ECW) encompasses 69,588 acres (109 square miles) used primarily for agricultural production. Row crop agriculture occupies 84 percent of the watershed. Terrain in the watershed is predominately flat and includes small topographic depressions and wetlands known as prairie potholes. The primary stream in the ECW is Eagle Creek, which flows generally from north to south from its headwaters in north central Wright County to its confluence with the Boone River in north central Hamilton County. Incorporated communities within the watershed include Clarion and Woolstock, along with Holmes, which is unincorporated. The majority of the watershed is privately owned. Rural public land in the watershed includes Morse Lake Wildlife Management Area and the Flowing Well Rest Area managed by the Wright County Conservation Board and the Olaf and Lower Morse Lake Waterfowl Production Areas owned by the U.S. Fish and Wildlife Service and managed by the IDNR. Table 2.1.1 lists general information for the ECW and Figure 2.1.1 displays the Hydrologic Unit Code (HUC)-12 subwatersheds.

Table 2.1.1. Watershed information for the Eagle Creek Watershed.

| | | | |
|------------------------------------|------------------------------|------------------------|--------------|
| Location | Wright and Hamilton Counties | | |
| Watershed area | 69,588 acres | | |
| Total length of all streams | 84.5 miles | | |
| Primary land use | Row crop agriculture | | |
| Incorporated communities | Clarion, Woolstock | | |
| Unincorporated communities | Holmes | | |
| HUC-8 watershed | Boone | | |
| HUC-8 ID | 07100005 | | |
| HUC-10 watershed | Eagle Creek | | |
| HUC-10 ID | 0710000504 | | |
| HUC-12 watershed | Little Eagle Creek | Headwaters Eagle Creek | Eagle Creek |
| HUC-12 ID | 071000050401 | 071000050402 | 071000050403 |

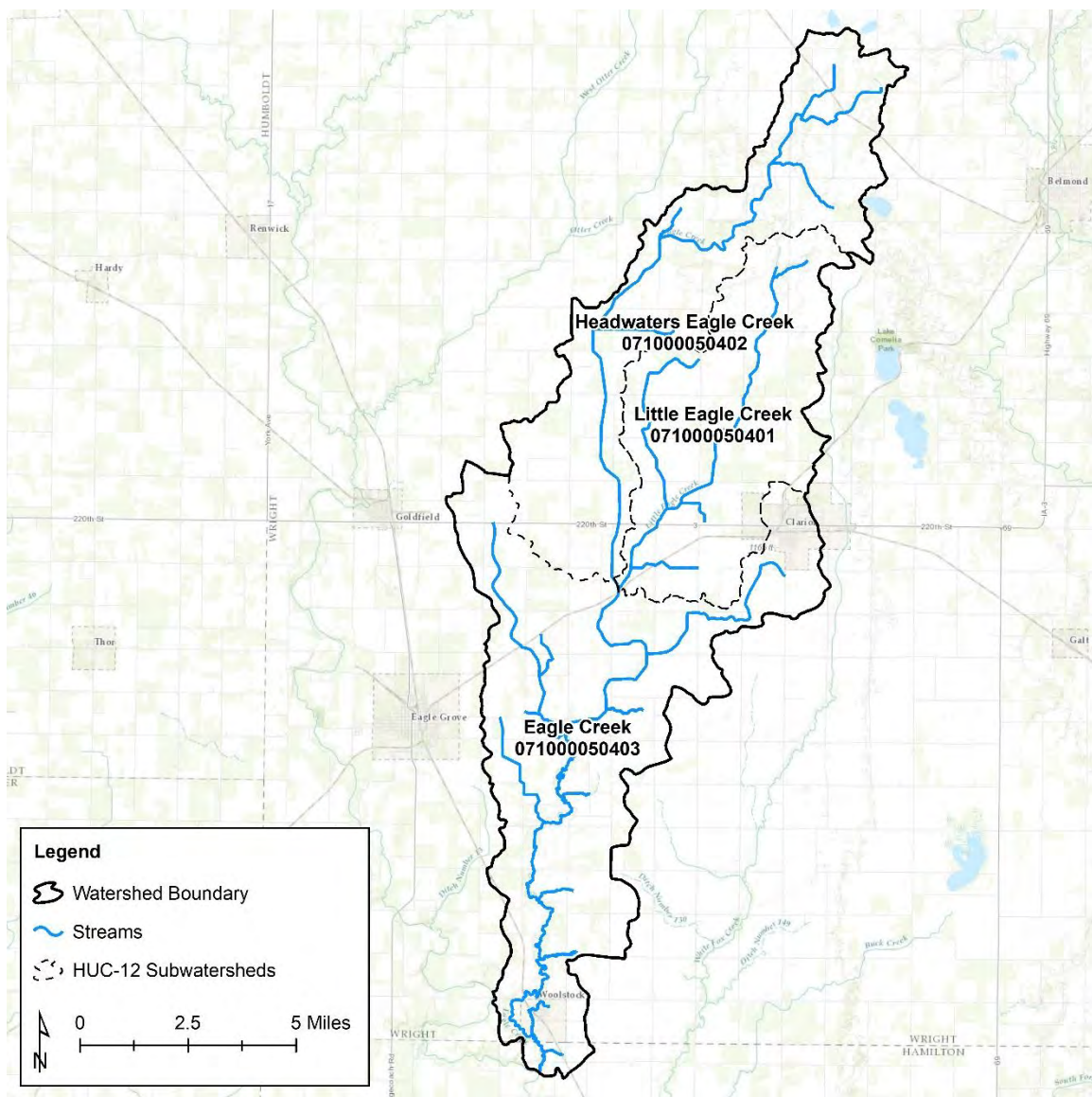


Figure 2.1.1. Eagle Creek Watershed and HUC-12 subwatersheds.

2.2. Water and Wetlands

Eagle Creek has been designated by the IDNR as a waterbody that should support recreation and aquatic life. Much of Eagle Creek is a natural stream channel, but portions of Eagle Creek and its tributaries are channelized drainage ditches that primarily receive flow from subsurface drainage infrastructure. Table 2.2.1 contains information for streams within the ECW. Surface water in the ECW includes Eagle Creek, Little Eagle Creek, unnamed tributary streams and small wetlands. Figure 2.2.1 shows the identified perennial stream network within the watershed. Figure 2.2.2 displays the wetlands in the ECW 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 U.S. Fish and Wildlife Service via aerial photo interpretation.

Table 2.2.1. Information for streams within the Eagle Creek Watershed from the ADBNet water quality database. Designated uses include A1 (primary contact recreation) and B(WW-1)/B(WW-2) (warm water aquatic life).

| Waterbody name | ADBCode | Legacy ADBCCode | Designated uses | Segment length | Most recent assessment |
|---|-------------|-------------------|-----------------|----------------|------------------------|
| Little Eagle Creek | 04-UDM-6256 | IA 04-UDM-02415_0 | A1, B(WW-1) | 9.8 miles | 2016 |
| Unnamed Tributary to Little Eagle Creek | 04-UDM-6257 | IA 04-UDM-02417_0 | A1, B(WW-1) | 0.9 miles | 2016 |
| Eagle Creek | 04-UDM-6258 | IA 04-UDM-0241_0 | A1, B(WW-1) | 18 miles | Not assessed |
| Eagle Creek | 04-UDM-1266 | IA 04-UDM-0240_1 | A1, B(WW-2) | 13.3 miles | Not assessed |
| Eagle Creek | 04-UDM-1267 | IA 04-UDM-0240_2 | A1, B(WW-2) | 5.6 miles | 2016 |
| Ditch Number 9 | 04-UDM-6259 | IA 04-UDM-02413_0 | - | 6.5 miles | - |
| Ditch Number 2 | 04-UDM-6260 | IA 04-UDM-02414_0 | A1, B(WW-1) | 6.3 miles | Not assessed |

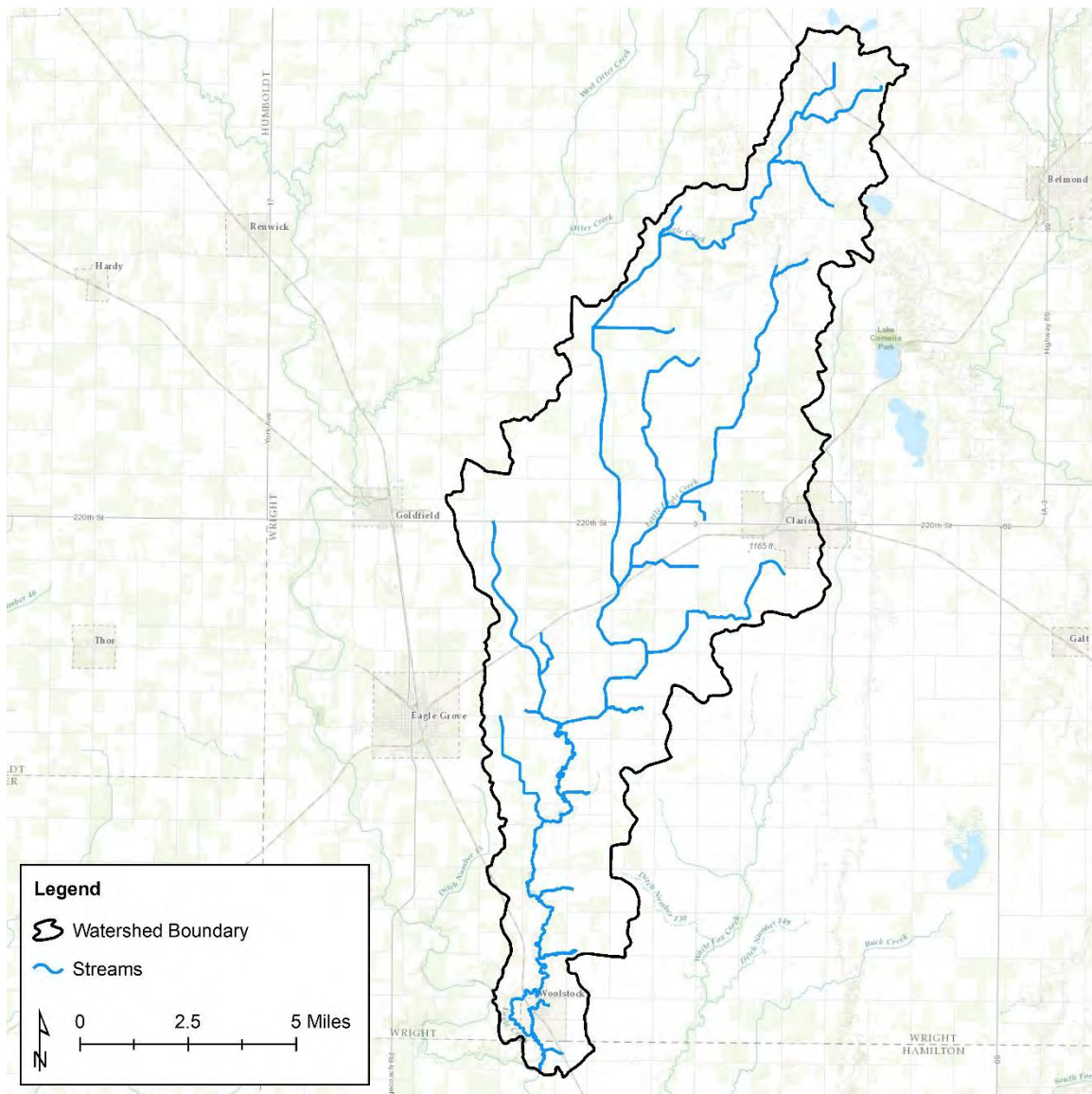


Figure 2.2.1. Streams identified in the Eagle Creek Watershed.

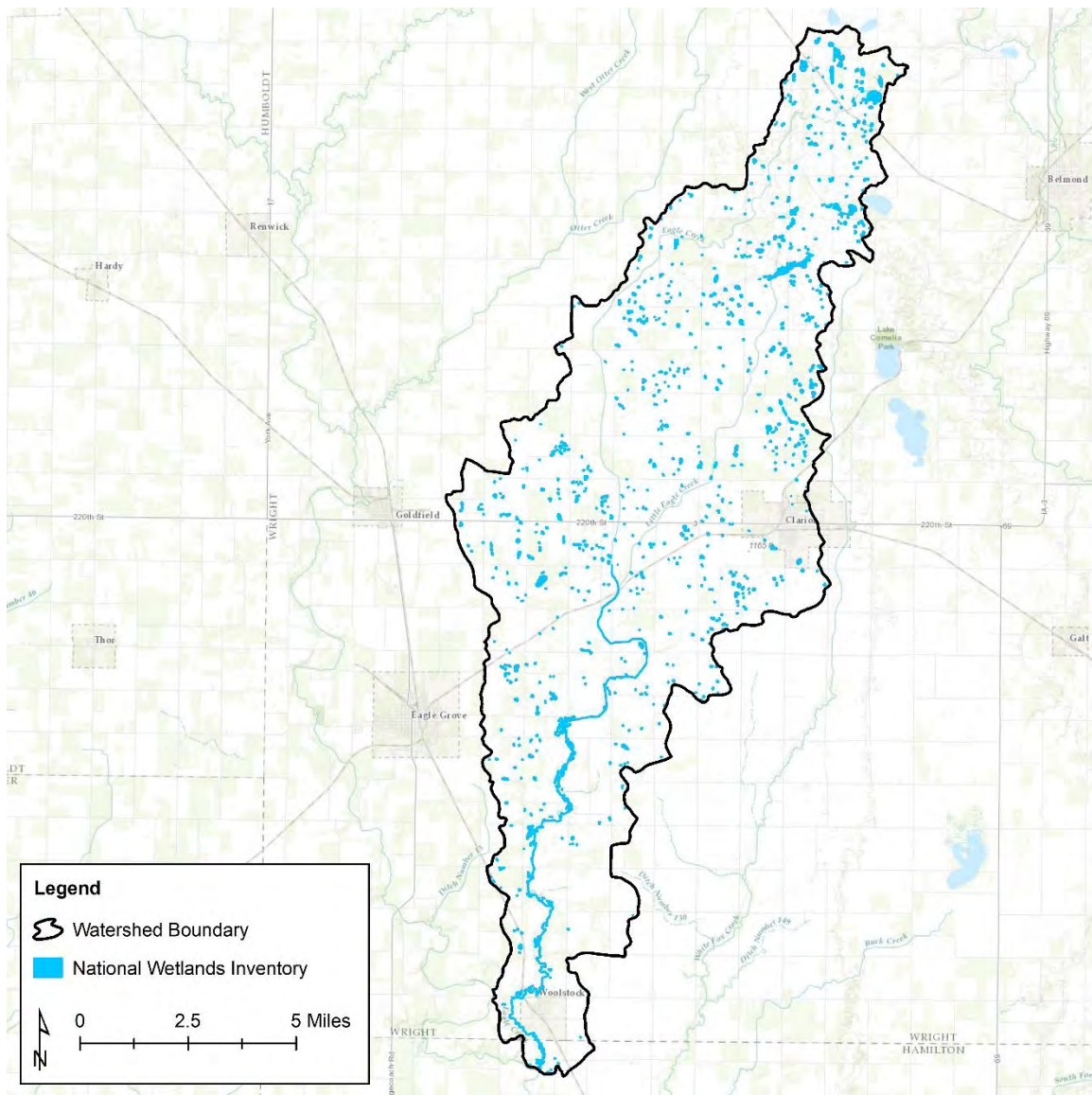


Figure 2.2.2. Wetlands in the Eagle Creek Watershed mapped in the National Wetlands Inventory.

Table 2.2.1. Classification of wetlands in the Eagle Creek Watershed according to the National Wetlands Inventory.

| Type | Acres |
|--------------------------|--------------|
| Artificially Flooded | 21 |
| Intermittently Exposed | 168 |
| Intermittently Flooded | 819 |
| Permanently Flooded | < 1 |
| Seasonally Flooded | 176 |
| Semi-permanently Flooded | 49 |
| Temporarily Flooded | 38 |
| Total | 1,270 |

2.3. Climate

Precipitation data obtained from the [Iowa Environmental Mesonet](#) (IEM) for the ECW show annual total precipitation at Clarion averaged 32.7 inches per year between 1951 and 2016 and 35.6 inches annual from 2000 through 2016, with a range of 26.2 to 50.1 inches per year for the most recent 17-year period, which reveals large variability. Annual precipitation trends are shown in Figure 2.3.1. Precipitation is seasonal in the watershed, with May through July having the highest average monthly rainfall during the 66-year period of record. Monthly precipitation averages are displayed in Figure 2.3.2. Average annual air temperature for the period of record was 46 degrees Fahrenheit.

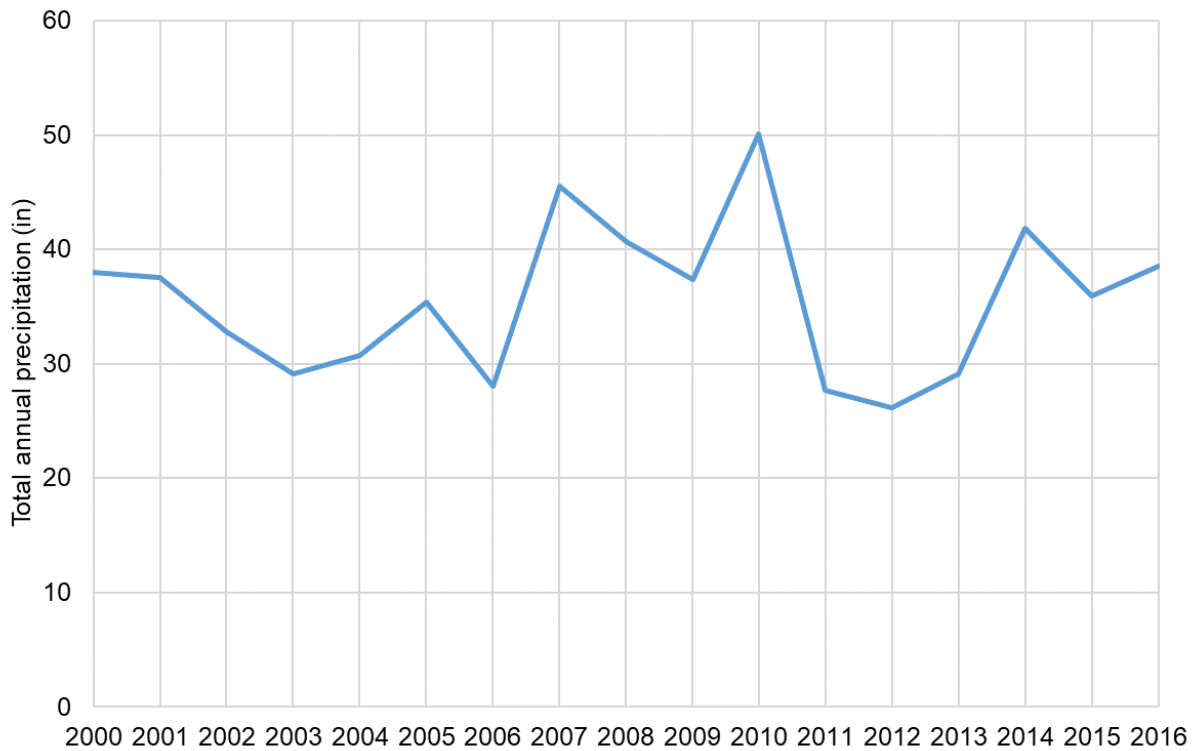


Figure 2.3.1. Total annual precipitation for the Eagle Creek Watershed from 2000 through 2016 (Iowa Environmental Mesonet).

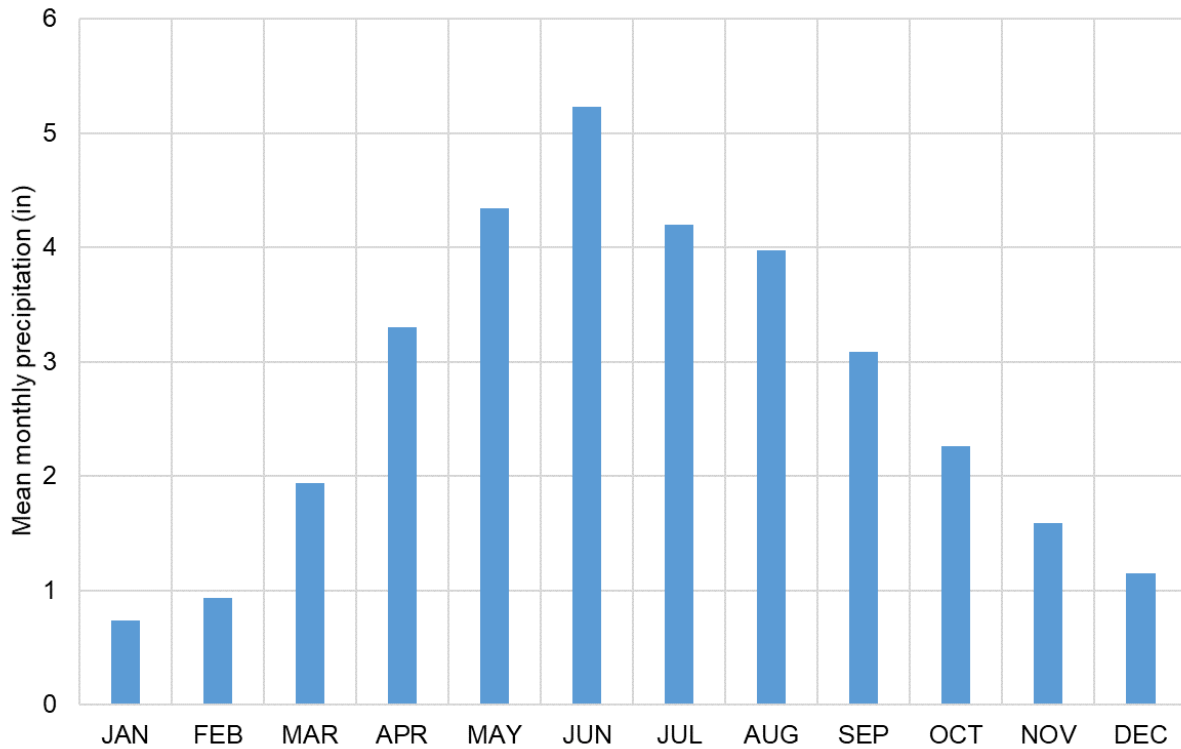


Figure 2.3.2. 1951 to 2016 average precipitation by month for the Eagle Creek Watershed (Iowa Environmental Mesonet).

2.4. Geology and Terrain

The ECW is located within the Des Moines Lobe landform region. The Des Moines Lobe was last glaciated approximately 12,000 years ago during the Wisconsin glaciation. This relatively recent glaciation is expressed on the present-day landscape as poor surface drainage, limited stream network density and flat to gently rolling topography with low local relief. Commonly referred to as the Prairie Pothole region, the Des Moines Lobe is characterized by depressions and ridges. Due to the young geologic age of the region the predominant subsurface parent material is mixed glacial till. Approximately 11 percent of the watershed contains alluvial deposits. The watershed is also located within the Central Iowa and Minnesota Till Prairies Major Land Resource Area (MLRA 103). Land surface elevation in the watershed ranges from 1,039 to 1,285 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. Ninety percent of the watershed has slopes of less than 5 percent.

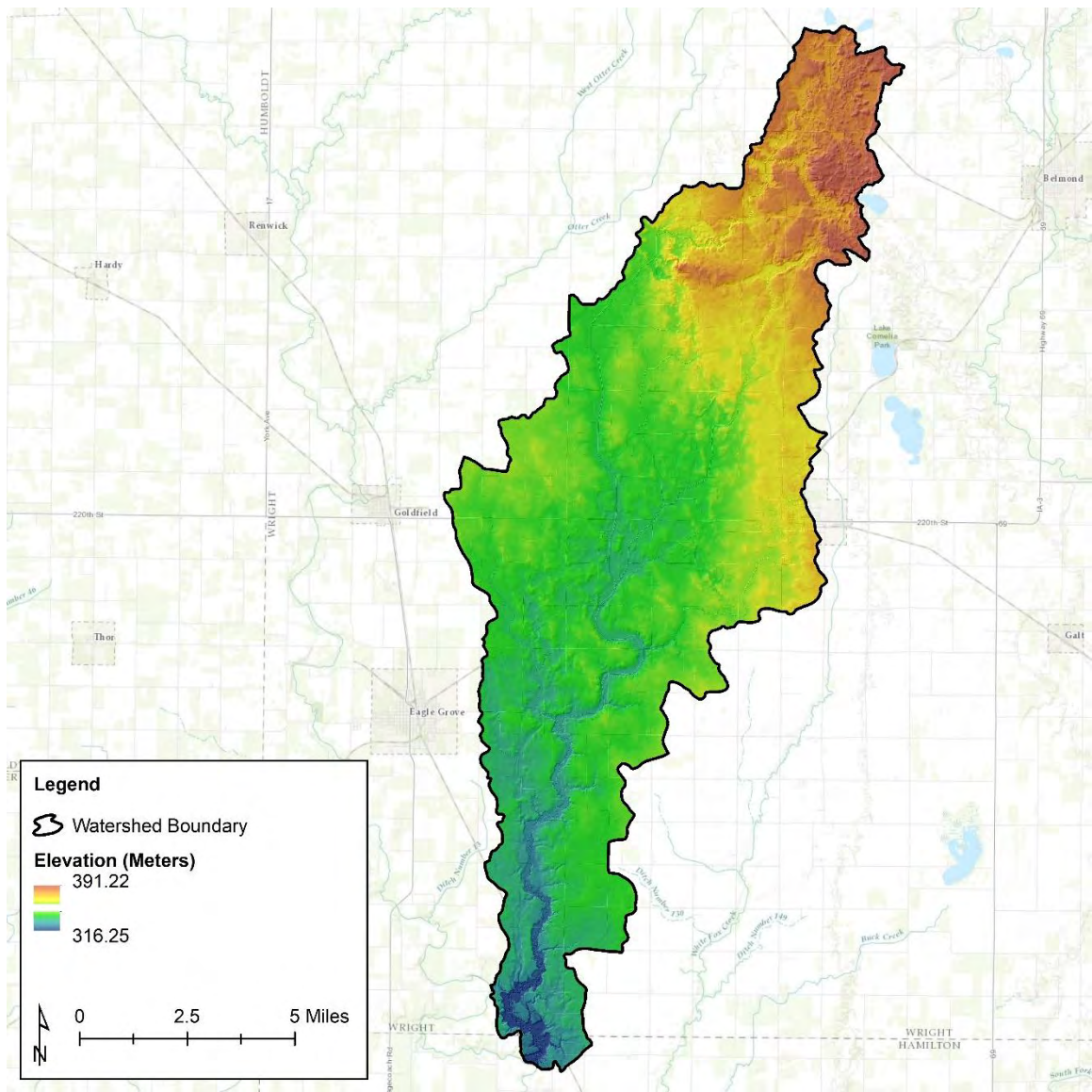


Figure 2.4.1. LiDAR-derived elevations within the Eagle Creek Watershed.

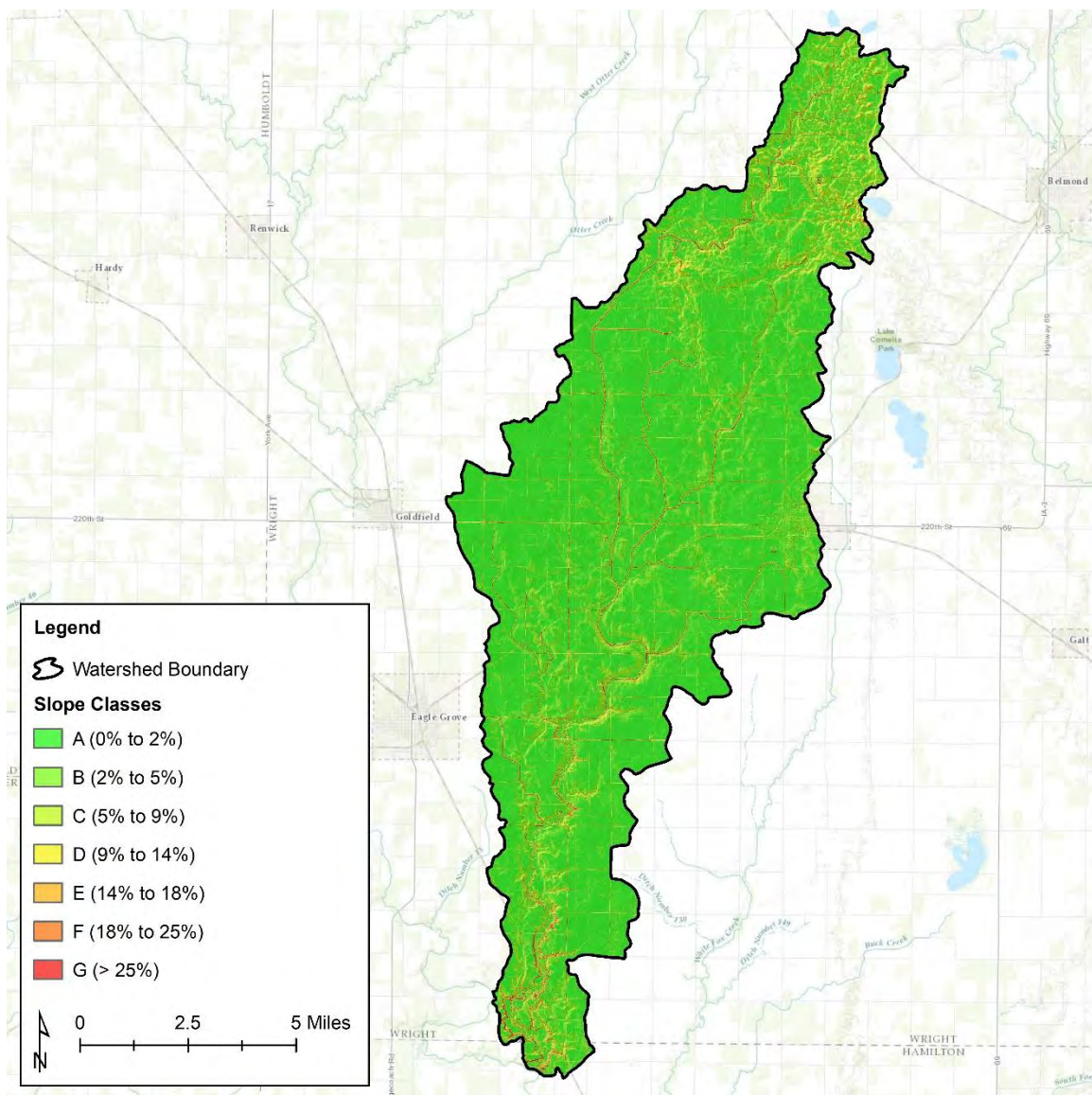


Figure 2.4.2. Eagle Creek Watershed slope classifications derived from elevation data.

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

| Slope Class | Range | Acres | Percent of Watershed |
|-------------|--------|--------|----------------------|
| A | 0-2% | 45,260 | 65.0 |
| B | 2-5% | 17,243 | 24.8 |
| C | 5-9% | 4,288 | 6.2 |
| D | 9-14% | 1,353 | 1.9 |
| E | 14-18% | 436 | 0.6 |
| F | 18-25% | 391 | 0.6 |
| G | > 25% | 617 | 0.9 |

2.5. Soils

The most common soil association in the ECW is the Clarion-Nicollet-Webster soil association. Parent materials include primarily glacial till and outwash along with some alluvium. Native vegetation for these soils was tall and short grass prairie. Overall these soils have poor natural drainage but are highly productive if drained, so tile drainage is common for many soils in this association. The six most prevalent soil series in

the watershed are Canisteo, Nicollet, Webster, Clarion, Kossuth and Ottosen, which together comprise nearly three quarters 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 Canisteo, Nicollet, Webster, Clarion, Kossuth and Ottosen soil series are given in Table 2.5.1.

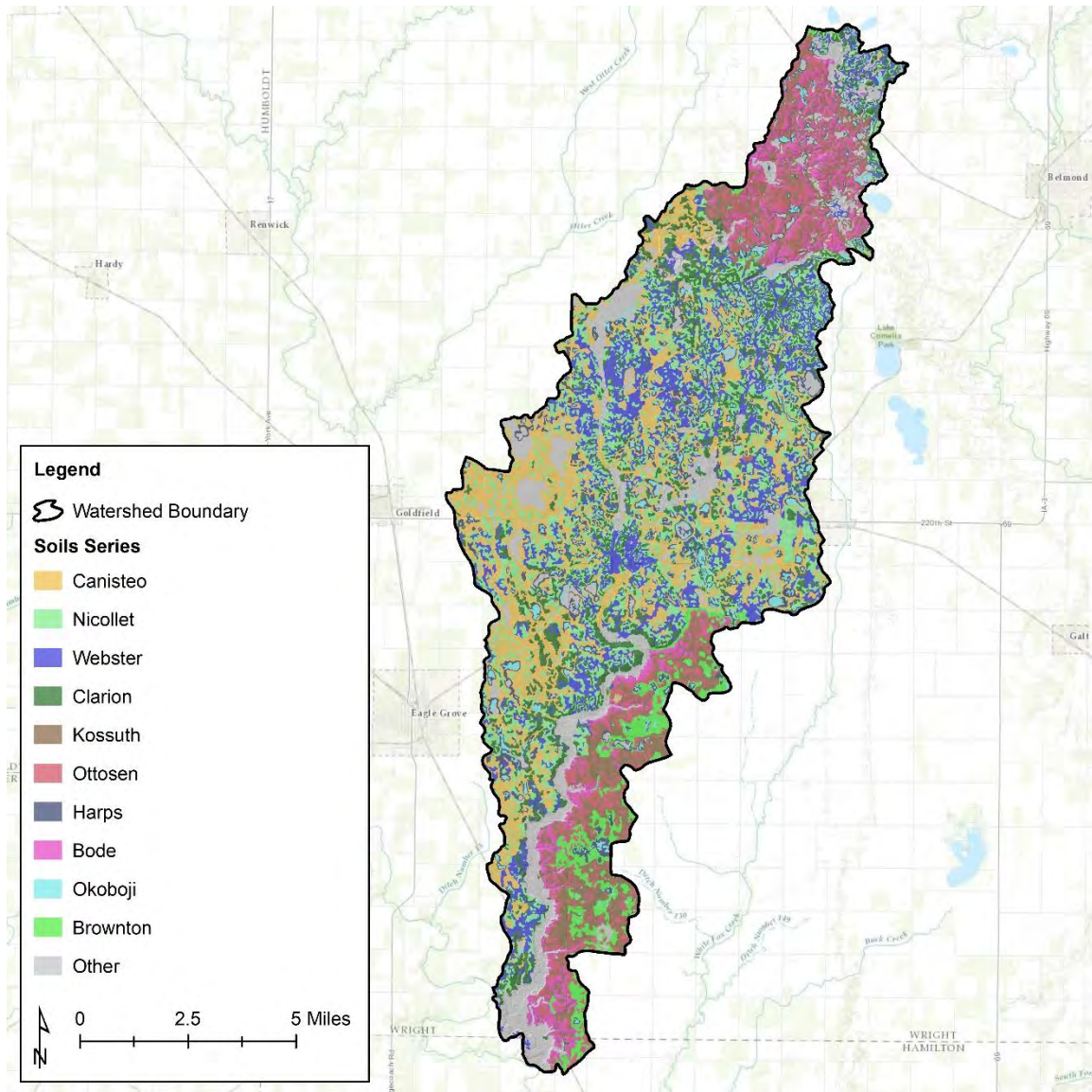


Figure 2.5.1. Eagle Creek Watershed soil map derived from Soil Survey Geographic Database data.

Table 2.5.1. Official NRCS soil series descriptions.

| Soil Series | Description |
|-------------|---|
| Canisteo | Very deep, poorly and very poorly drained soils that formed in calcareous, loamy till or in a thin mantle of loamy or silty sediments and the underlying calcareous, loamy till. These soils are on rims of depressions, depressions and flats on moraines or till plains. Slope ranges from 0 to 2 percent. |
| Nicollet | Very deep, somewhat poorly drained soils that formed in calcareous loamy glacial till on till plains and moraines. Slopes range from 0 to 5 percent. |
| Webster | Very deep, poorly drained, moderately permeable soils formed in glacial till or local alluvium derived from till on uplands. Slope ranges from 0 to 3 percent. |
| Clarion | Very deep, moderately well drained soils on uplands. These soils formed in glacial till. Slopes range from 1 to 9 percent. |
| Kossuth | Deep, poorly drained soils that formed in moderately fine textured glacial or lacustrine sediments and in the underlying medium textured glacial till or sediments on ground moraines. These soils are moderately slowly permeable in the upper part and moderately permeable material. Slope ranges from 0 to 2 percent. |
| Ottosen | Very deep, somewhat poorly drained soils formed in moderately fine textured glacial or lacustrine sediments that overlie medium textured glacial till or sediments. They are on nearly level and gently undulating ground moraines. Slope ranges from 0 to 3 percent. |

Soil drainage properties affect surface and subsurface water movement within the watershed. These characteristics are summarized in Table 2.5.2. Approximately 81 percent of the soils in the ECW are classified as 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 tilled soils may be hydric. Hydric soils within the watershed are mapped in Figure 2.5.2.

Table 2.5.2. Drainage properties and general agricultural productivity (rated by Corn Suitability Rating 2, CSR2) of predominant soils in the Eagle Creek Watershed.

| Soil Series | Acres | Percent of Watershed | CSR2 | Drainage Class | Hydrologic Group | Hydric Class |
|-------------|--------|----------------------|------|-------------------------|------------------|------------------|
| Canisteo | 12,883 | 18.5 | 88 | Poorly drained | B/D | Hydric |
| Nicollet | 11,449 | 16.5 | 89 | Somewhat poorly drained | B | Partially hydric |
| Webster | 8,629 | 12.4 | 88 | Poorly drained | B/D | Hydric |
| Clarion | 7,049 | 10.1 | 87 | Well drained | B | Not hydric |
| Kossuth | 5,300 | 7.6 | 88 | Poorly drained | B/D | Hydric |
| Ottosen | 4,575 | 6.6 | 90 | Somewhat poorly drained | B | Partially hydric |

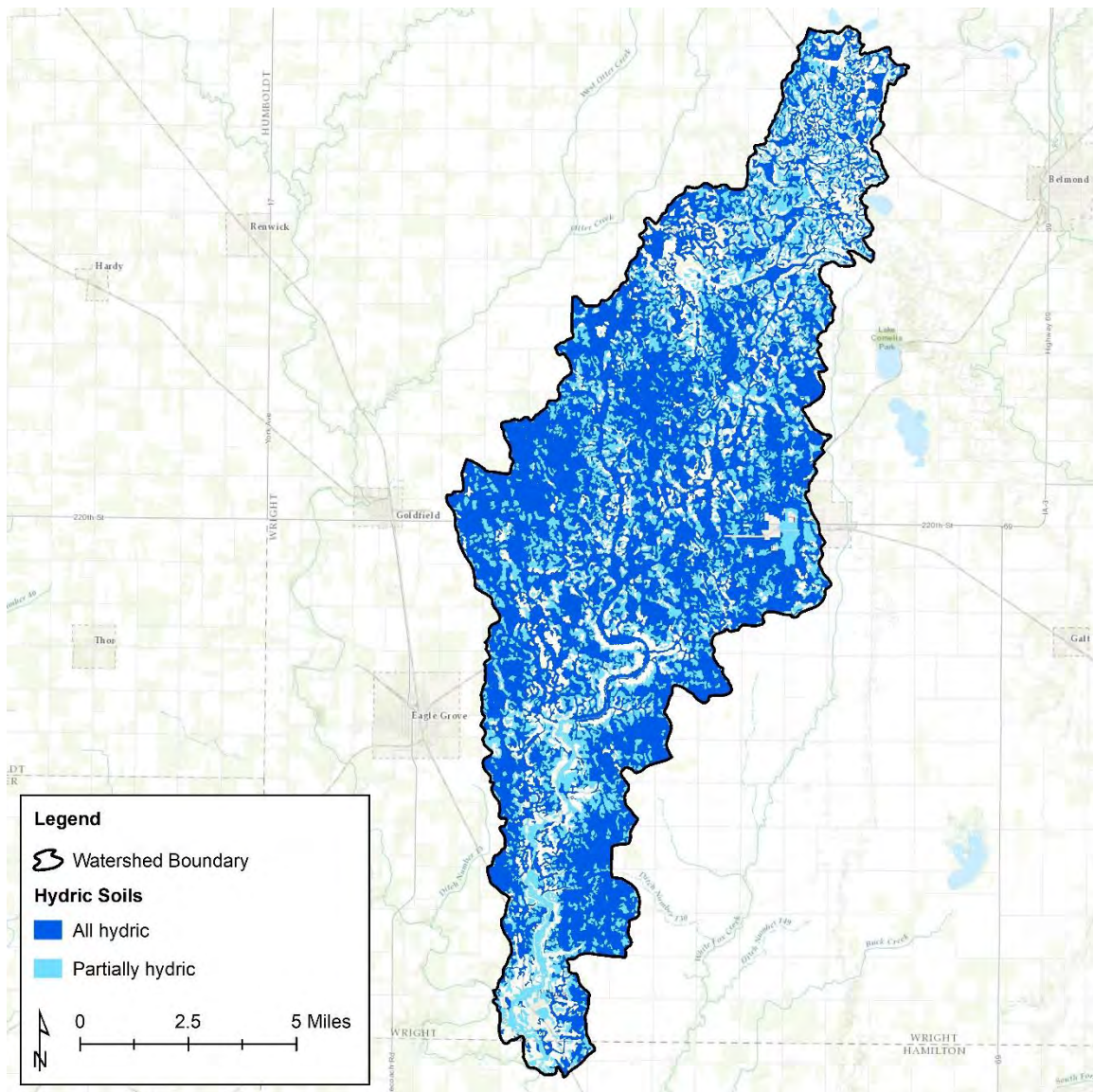


Figure 2.5.2. Soil map units in the Eagle Creek Watershed that are classified as hydric.

Agricultural land within the ECW is likely to be tile drained in order to increase agricultural productivity. Public records of subsurface drainage infrastructure are sparse, but the USDA-Agricultural Research Service (ARS) has developed a geographic coverage of soils in Iowa that are likely to be tile 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.

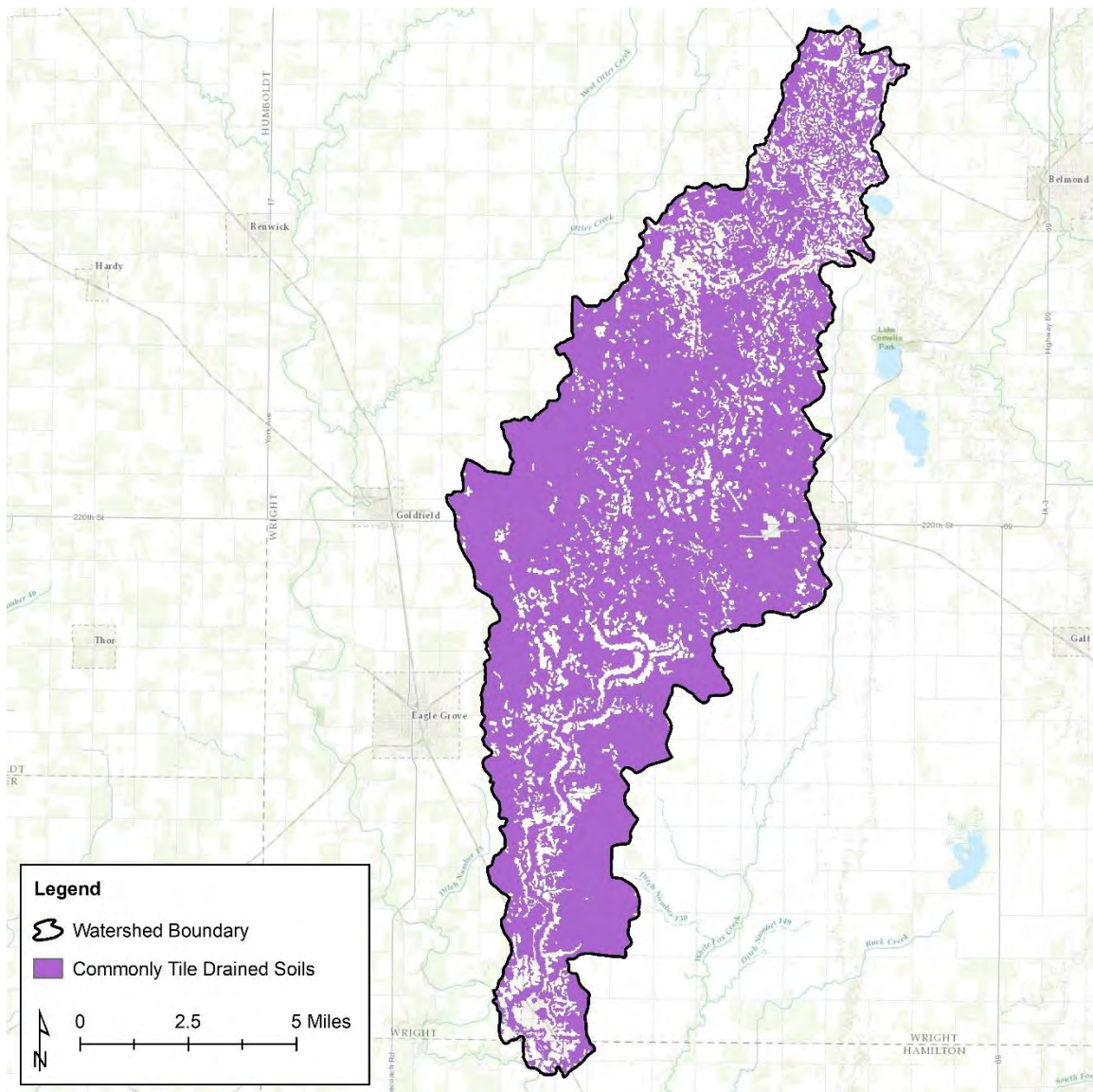


Figure 2.5.3. Areas in the Eagle Creek Watershed requiring tile drainage to optimize agricultural production.

Soil map units in Iowa are assigned **Corn Suitability Rating 2 (CSR2)** values, which are listed for the major soil series within the watershed in Table 2.5.2. Figure 2.5.4 displays the CSR2 values for land within the ECW. This map was generated by matching spatial SSURGO data to the Iowa Soil Properties and Interpretations Database (ISPAID) version 8.1. The Iowa CSR2 is an index that provides a relative ranking of soils mapped in Iowa based on their potential to be utilized for row crop production and thus are sometimes used to compare yield potential. CSR2 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.

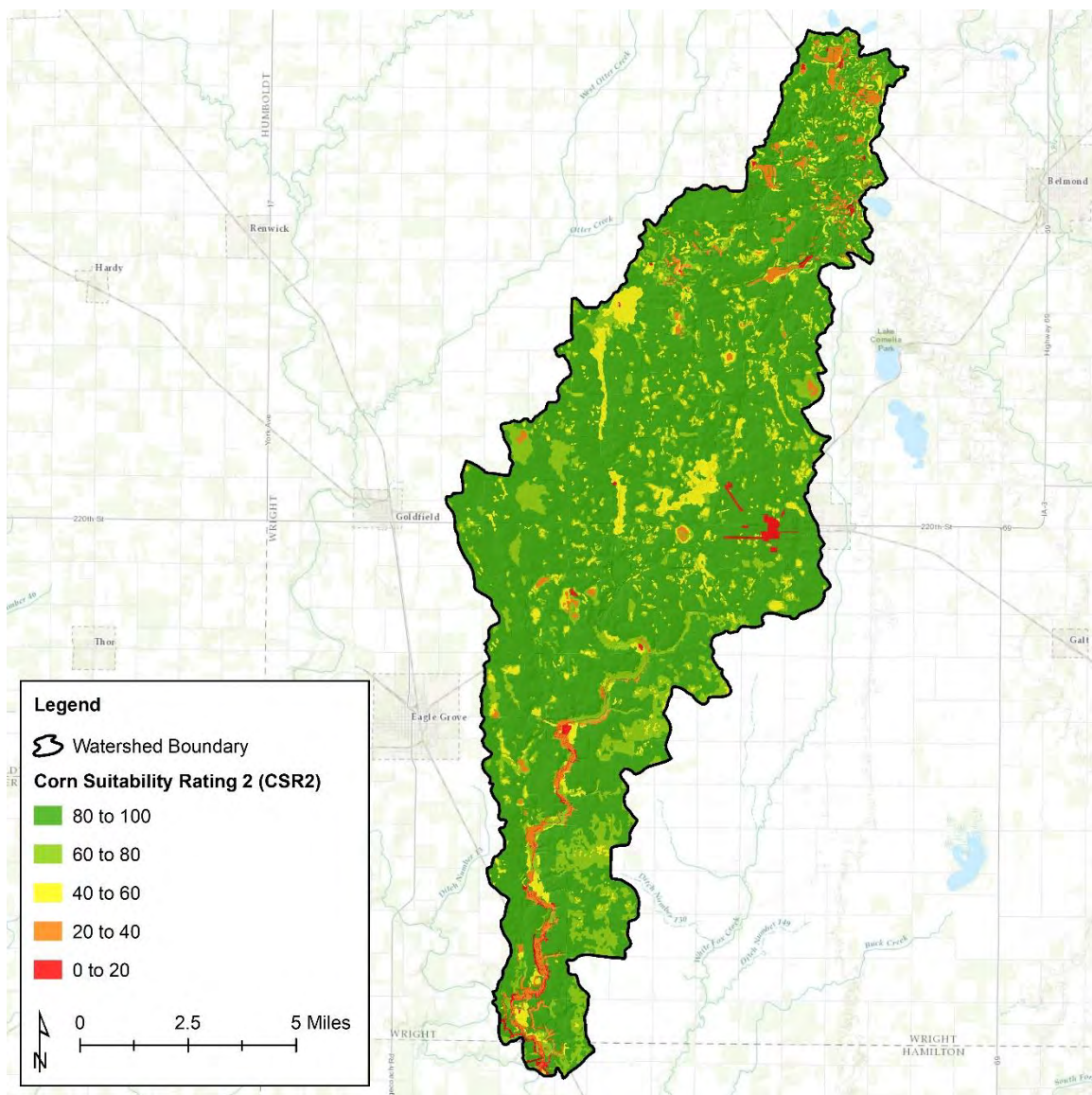


Figure 2.5.4. Corn Suitability Rating 2 (CSR2) values for land in the Eagle Creek Watershed.

2.6. Land Use and Management

Land in the ECW is used primarily for row crop agriculture. 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 the majority of Iowa's landscape was converted to agricultural land uses. The GLO surveyors classified land within the ECW as 95.5 percent prairie, 3.7 percent water or wetlands and less than 1 percent forest and savanna. Figure 2.6.1 shows the distribution of these areas throughout the watershed.

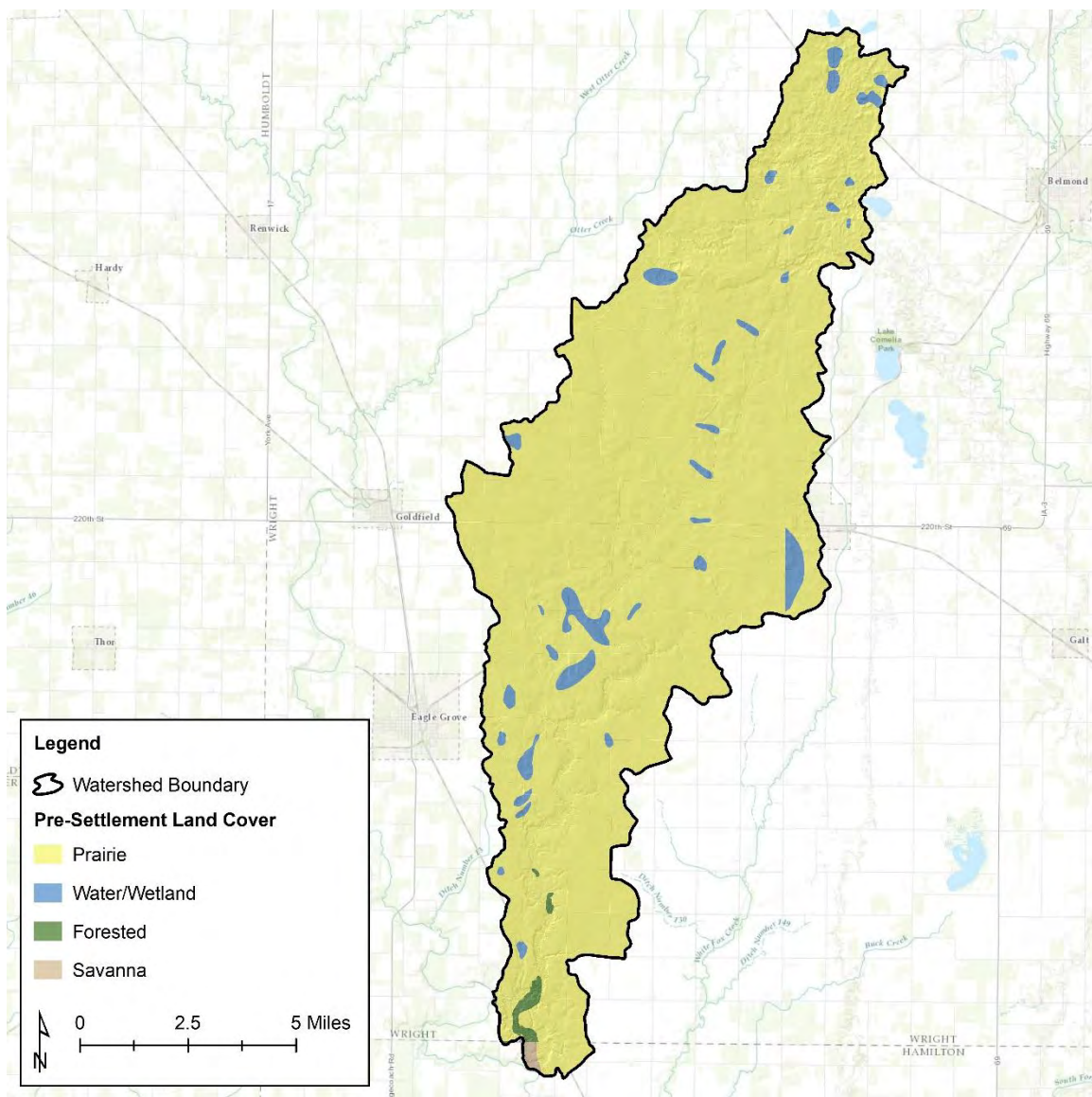


Figure 2.6.1. Pre-settlement land cover in the Eagle Creek Watershed according to the General Land Office survey in the mid-nineteenth century.

Recent and current land use practices were assessed using the USDA-National Agricultural Statistics Service (NASS) Cropland Data Layer (CDL) 2003 through 2016 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 2003, approximately 86 percent of the watershed has been used for corn and soybean production.

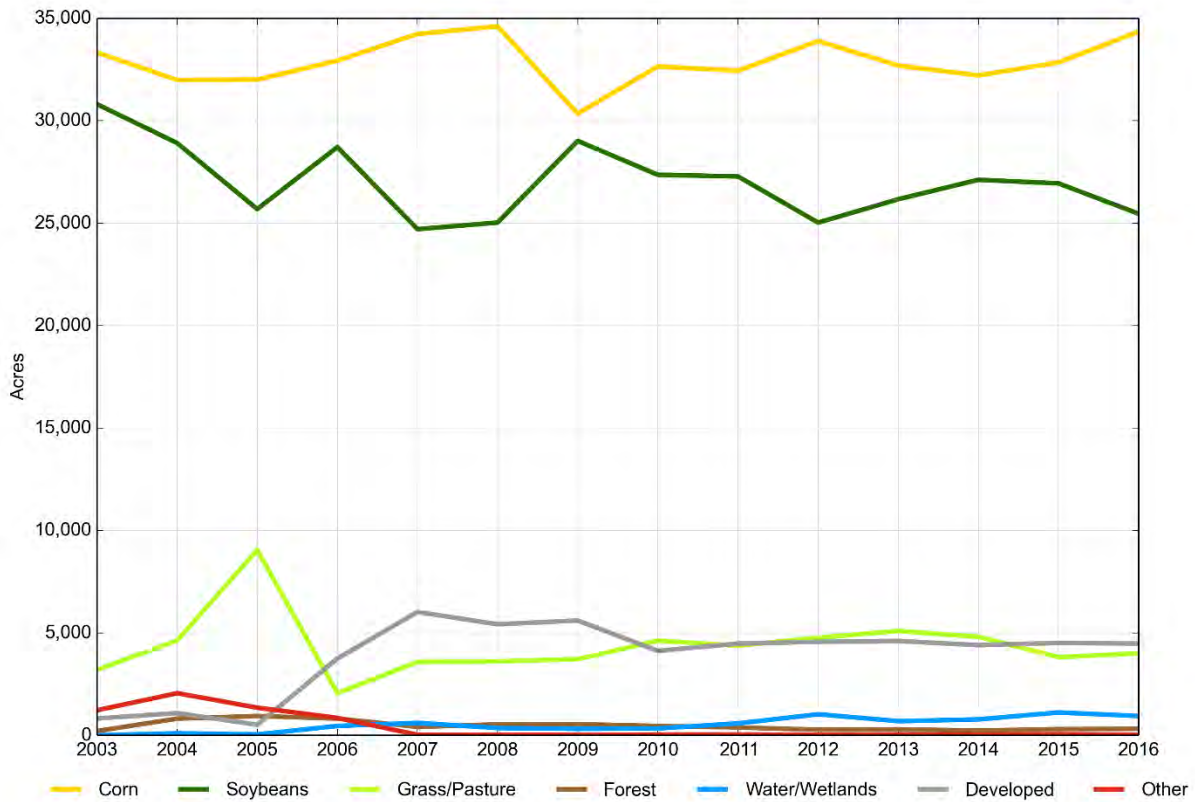


Figure 2.6.2. Eagle Creek Watershed 2003 through 2016 land use according to Cropland Data Layer data.

Table 2.6.1. Eagle Creek Watershed 2009 high-resolution land use according to Iowa Department of Natural Resources data.

| Land Use | Acres | Percent of Watershed |
|--------------------|---------------|----------------------|
| Water | 205 | 0.3 |
| Wetland | 1,572 | 2.3 |
| Coniferous Forest | 76 | 0.1 |
| Deciduous Short | 143 | 0.2 |
| Deciduous Medium | 422 | 0.6 |
| Deciduous Tall | 404 | 0.6 |
| Grass 1 | 4,262 | 6.1 |
| Grass 2 | 2,264 | 3.3 |
| Corn | 35,308 | 50.7 |
| Soybeans | 23,411 | 33.6 |
| Barren / Fallow | 90 | 0.1 |
| Structures | 181 | 0.3 |
| Roads / Impervious | 1,190 | 1.7 |
| Shadow / No Data | 60 | 0.1 |
| Total | 69,588 | 100 |

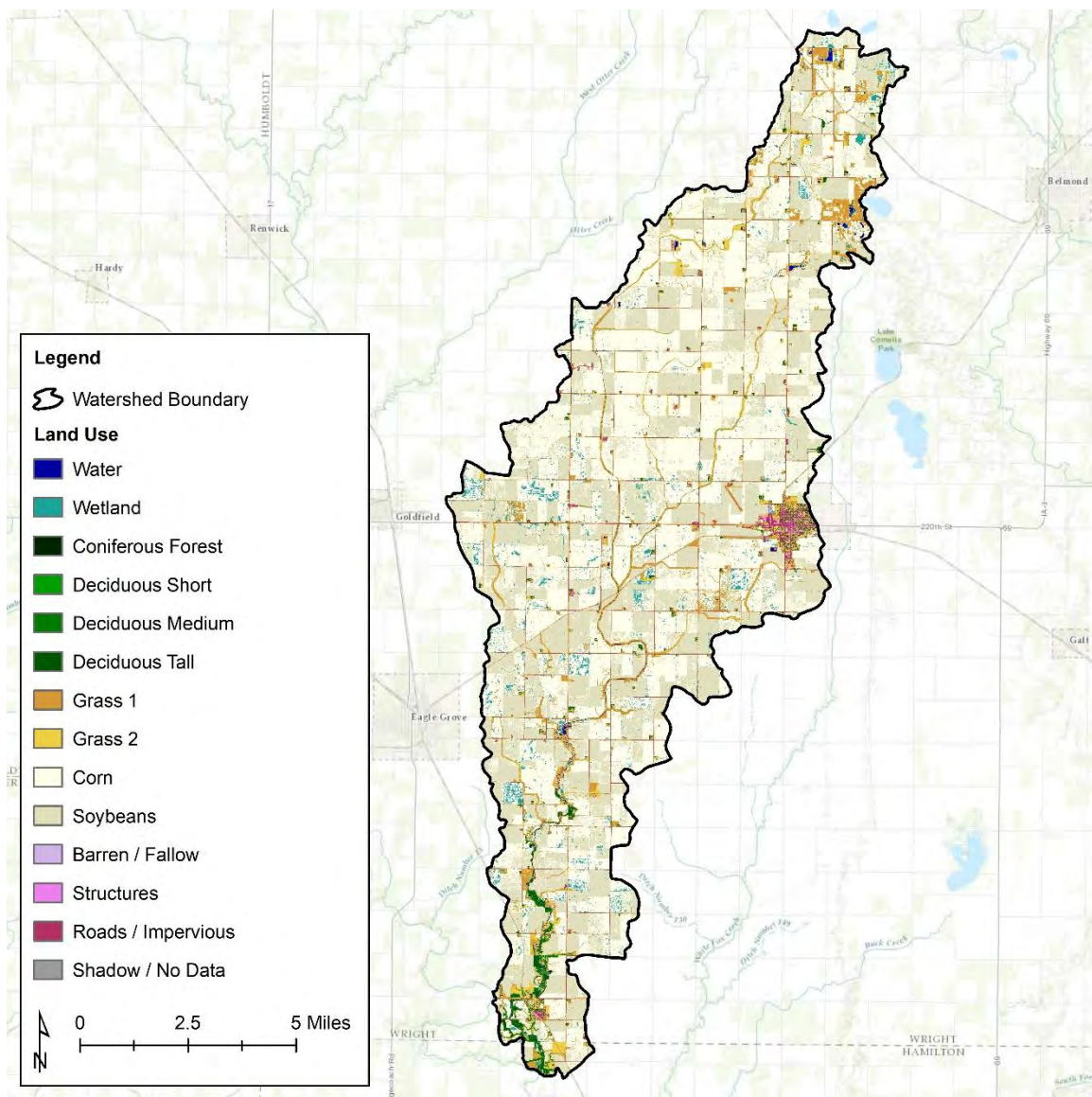


Figure 2.6.3. High-resolution 2009 land use map of the Eagle Creek Watershed derived from Iowa Department of Natural Resources data.

2.7. Population and Demographics

Clarion and Woolstock are the two incorporated communities within the watershed. According to U.S. Census Bureau data, in 2010 Clarion had a population of 2,850, Woolstock had a population of 168 and a total of 3,186 people lived in census tracts in the ECW, which equates to an average population density of 29.3 people per square mile. There are an estimated 1,535 housing units in the ECW. Approximately 81 percent of the land in the ECW is owned by landowners from Iowa. Table 2.7.1 contains the distribution of local, in-state and out-of-state land ownership. Additionally, the 2012 [Census of Agriculture](#) found that 71 percent of agricultural land in Wright County is rented.

Table 2.7.1. Locations of landowners for the Eagle Creek Watershed.

| Landowner Location | Percent of Watershed |
|----------------------|----------------------|
| Iowa | 80.9 |
| Towns within 5 miles | 60.7 |
| Other Iowa towns | 20.2 |
| Other states | 19.1 |

2.8. Existing Conservation Practices

Inventorying existing conservation infrastructure provides an important assessment of current conditions and is a useful exercise for determining the need for future conservation practice quantity and placement. Current conservation practices were assessed and catalogued using aerial photography, watershed surveys, stakeholder knowledge and structural practice location data provided by IDNR and ISU. Many conservation practices were identified within the watershed, but determining levels of in-field management practices (e.g., nutrient management, no-till/strip-till, cover crops) can be difficult, so it is possible that this inventory does not capture all conservation within the watershed.

The ECW contains one Conservation Reserve Enhancement Program (CREP) wetland. Perennial cover is present throughout the watershed, and there are relatively large concentrations of land enrolled in the Conservation Reserve Program (CRP) and Wetlands Reserve Program (WRP) in the upper reaches of the watershed near Morse Lake and in riparian buffers planted along streams throughout the watershed. The Iowa CREP is a collaborative effort between the Natural Resources Conservation Service (NRCS) and the Iowa Department of Agriculture and Land Stewardship and the CRP and WRP are NRCS programs. Table 2.8.1 lists all practices and known existing implementation levels within the watershed. Figure 2.8.1 provides a map of existing conservation practices as of 2017.

Table 2.8.1. Inventory of Eagle Creek Watershed existing conservation practices as of 2017.

| Practice | Unit | Quantity |
|--------------------------------|-------------------|----------|
| No-till/Strip-till | acres | 2,475 |
| Cover crops | acres | 2,300 |
| Nutrient management | acres | > 3,591 |
| Grassed waterways | feet | 276,293 |
| Terraces | feet | 13,472 |
| Impoundments/Sediment basins | feet | 12,055 |
| Buffers within 100' of streams | % perennial cover | 77% |
| Prairie strips | acres | 3 |
| Drainage water management | acres | 317 |
| CRP/WRP | acres | 2,021 |
| CREP wetlands | sites | 1 |
| Oxbow restorations | sites | 2 |
| Bioreactors | sites | 7 |

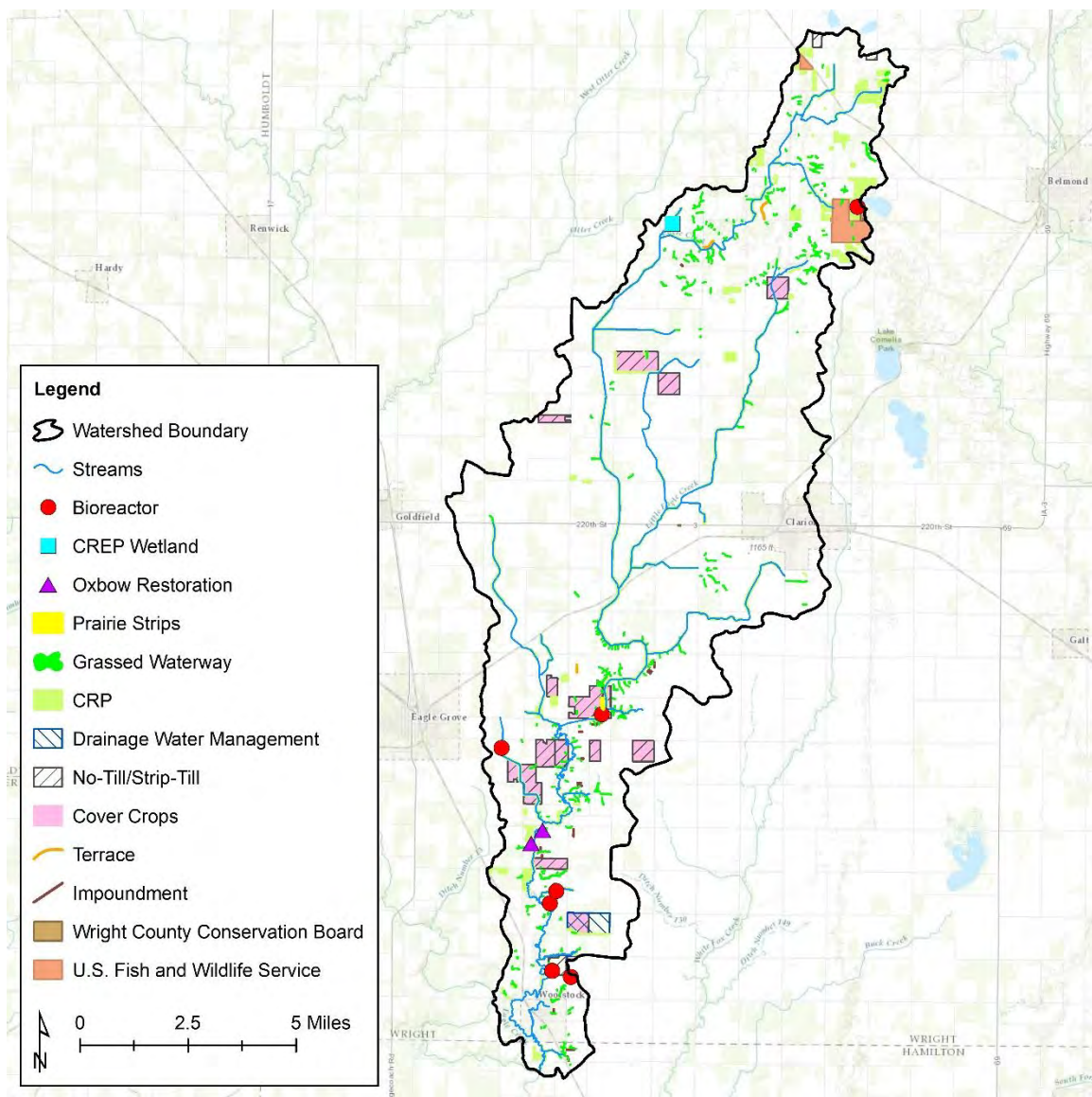


Figure 2.8.1. Conservation practices with known locations in the Eagle Creek Watershed as of 2017.

2.9. Soil and Streambank Erosion Assessment

Soil erosion for agricultural land in the ECW was estimated using factors from the Revised Universal Soil Loss Equation 2 (RUSLE2) for the various combinations of soils and land use within the watershed. RUSLE2 is a computer simulation model used to evaluate the impact of different tillage and cropping systems on soil sheet and rill erosion. The major RUSLE2 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 typically have the largest impacts on soil loss estimates within a watershed. Model inputs for land use were developed by integrating data from watershed surveys, crop rotation information available from the ARS and satellite imagery analysis conducted by ISU. Based on the RUSLE2 analysis, sheet and rill erosion in the ECW averages an estimated 1.26 tons per acre per year. The distribution of soil erosion rates across the watershed is shown in Figure 2.9.1. This estimated sheet and rill erosion rate aligns moderately well with 1.05 tons per acre per year of simulated hillslope soil loss from 2007 through 2013 according to the [Daily Erosion Project](#) (DEP).

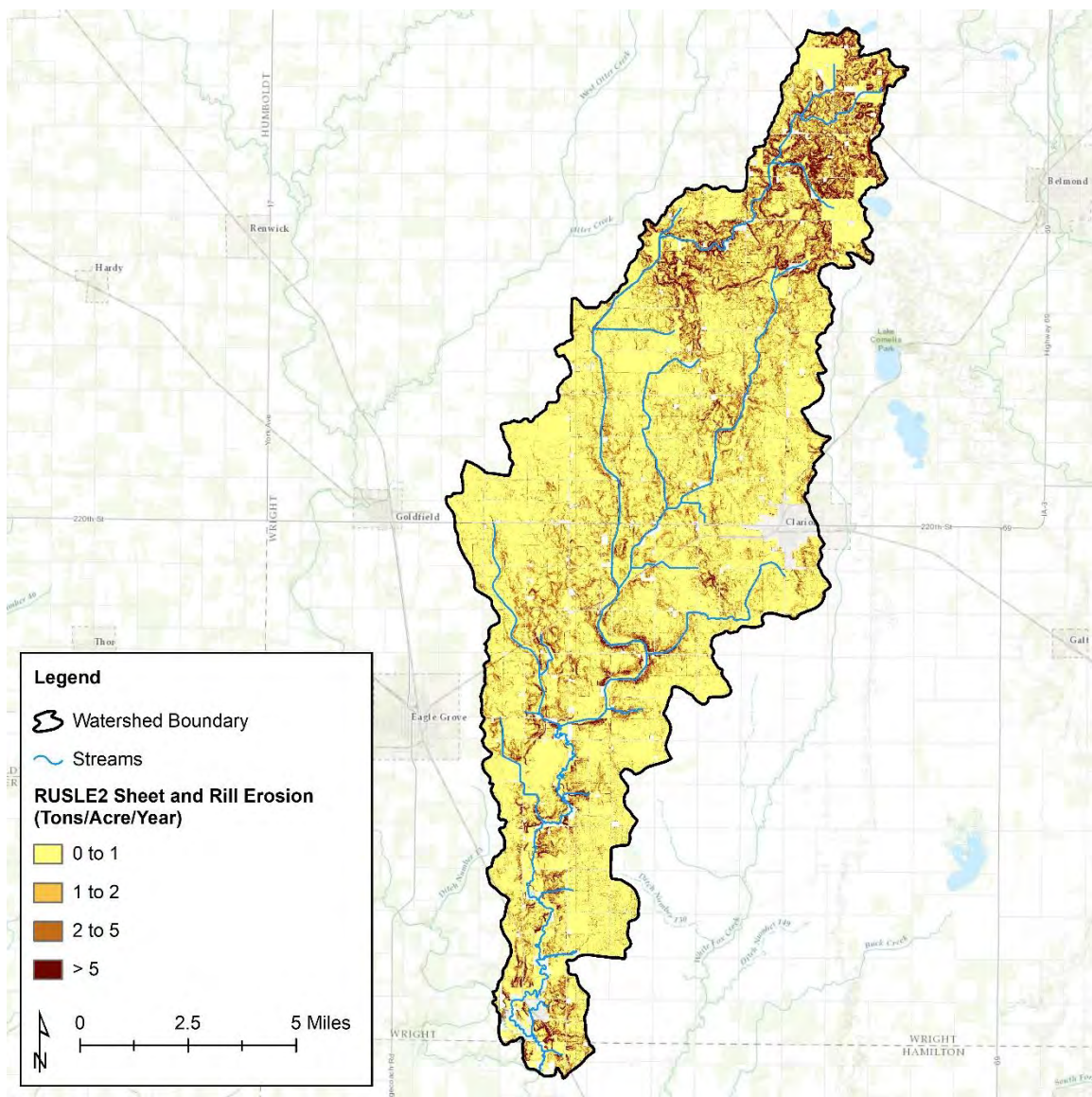


Figure 2.9.1. Estimated sheet and rill erosion rates based on soil types, topography and land use in the Eagle Creek Watershed.

RUSLE2 and DEP estimates do not include any soil loss due to concentrated runoff such as ephemeral or classical gully erosion. Terrain analysis of the watershed was conducted to identify potential locations for gully initiation, which were then cross-referenced with land use data and existing conservation practice locations. The results of this analysis revealed that approximately 38 percent of row crop fields may have elevated potential for ephemeral gully formation relative to other fields in the watershed; these locations are displayed in Figure 2.9.2.

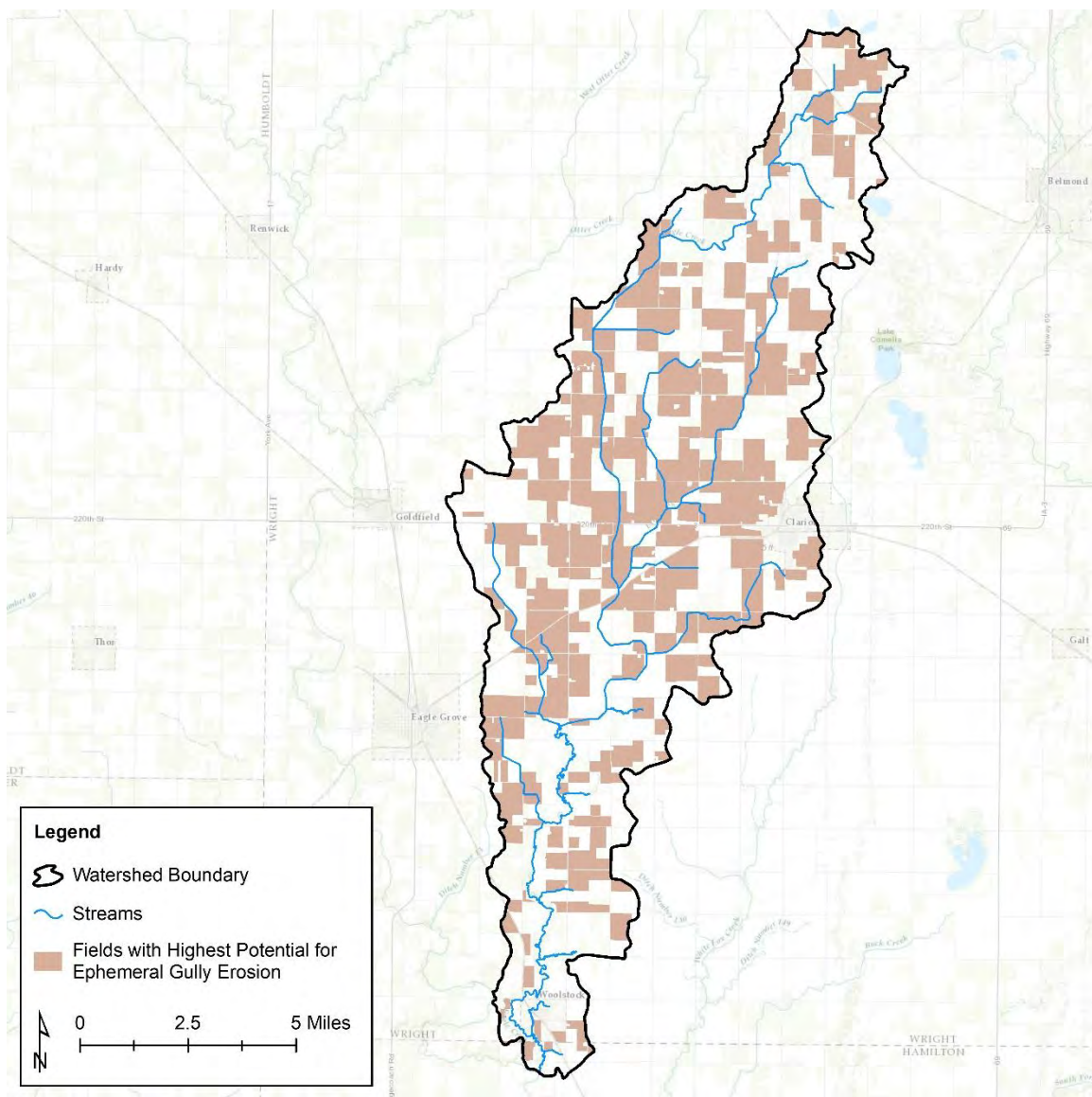


Figure 2.9.2. Locations of potential ephemeral gully erosion within the Eagle Creek Watershed.

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 ECW is estimated to be 2.96 percent.

Streambank erosion was quantified through a visual assessment of the stream channel. Estimated streambank erosion rates are displayed in Figure 2.9.3. Observed streambank erosion in the watershed totaled 4,566 tons. While riparian land cover does impact streambank erosion, hydrologic and hydraulic factors such as sinuosity, local stream discharge and bank morphology are often the primary factors.

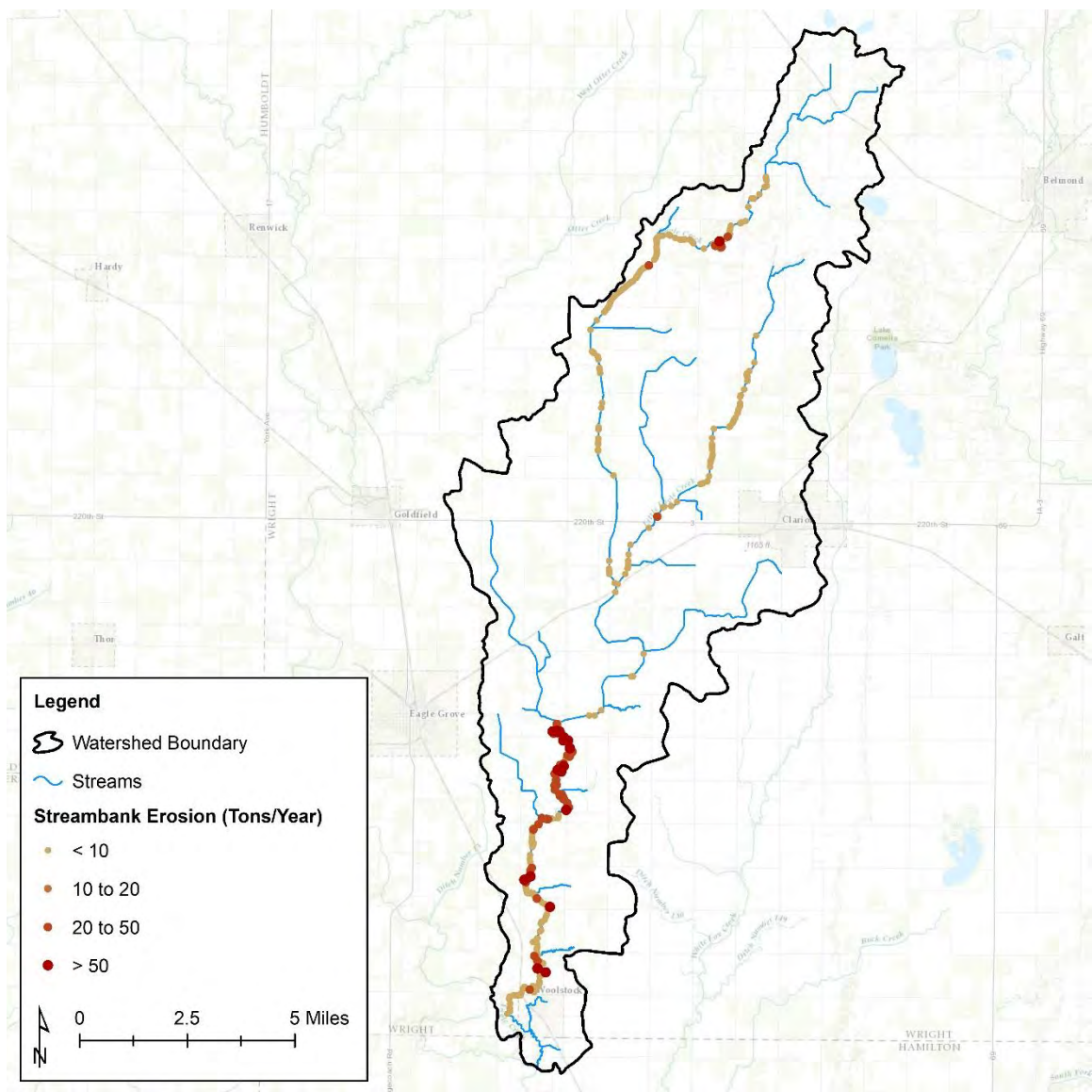


Figure 2.9.3. Estimated streambank erosion rates according to a 2017 Eagle Creek stream corridor assessment.

3. Water Quality and Conditions

3.1. Des Moines River TMDL

The Eagle Creek Watershed (ECW) is a subwatershed of the Boone River Watershed, which comprises a portion of the larger Des Moines River basin (Figure 3.1.1). Downstream of Eagle Creek and the Boone River, the Des Moines River is impaired by nitrate-nitrogen (hereafter "nitrate"). This impacts the drinking water source of the city of Des Moines. Due to the nitrate impairment a Water Quality Improvement Plan (or Total Maximum Daily Load, TMDL) for nitrate was developed by the IDNR and approved by the U.S. Environmental Protection Agency (EPA) in 2009. See Appendix G for additional information about the nitrogen cycle.

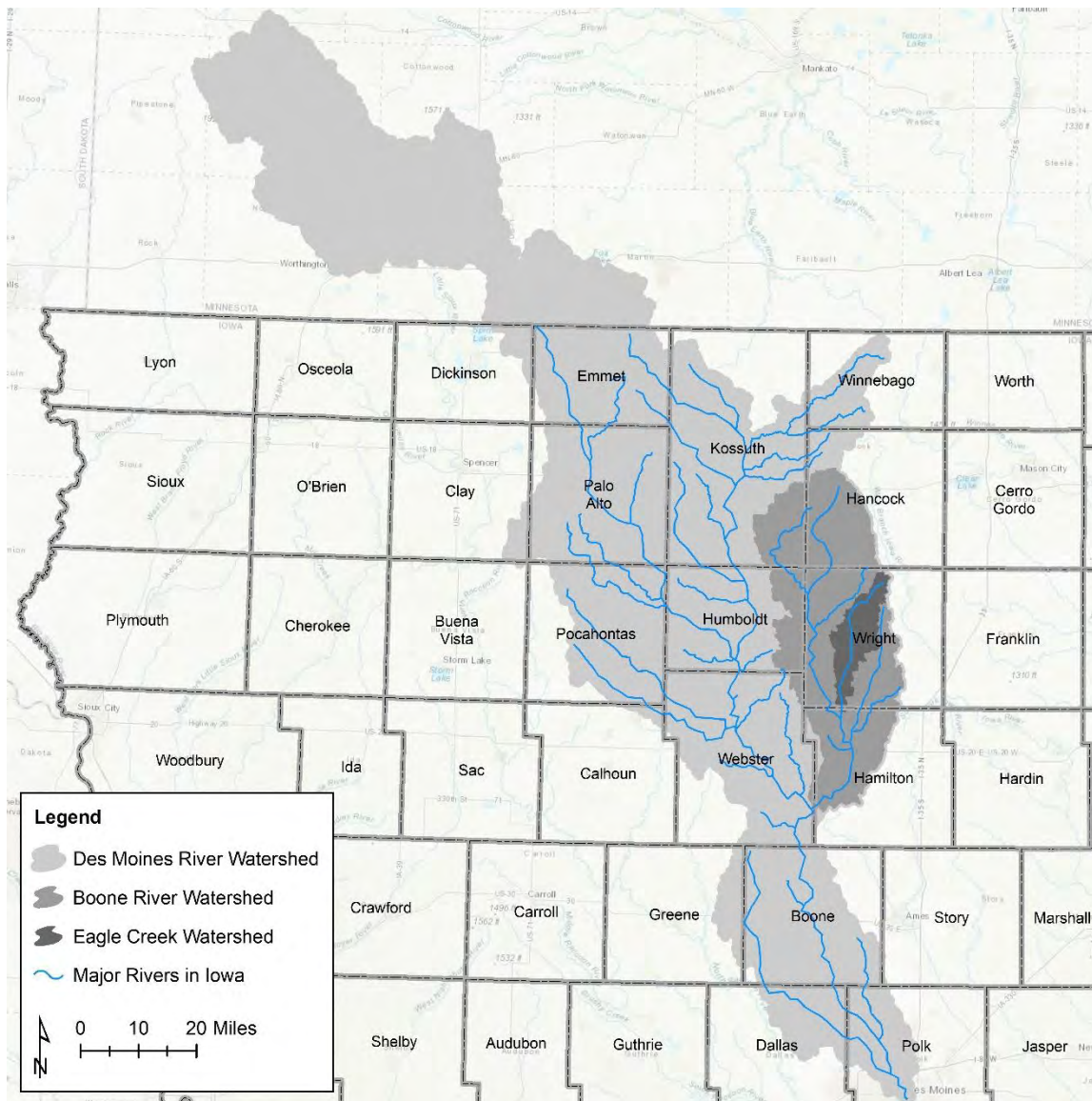


Figure 3.1.1. Extents of the Eagle Creek, Boone River and Upper and Middle Des Moines River watersheds.

The **Des Moines River TMDL** was developed to address the nitrate impairment for a 6.5-mile segment (segment ID **04-UDM-1211**; legacy waterbody ID code: IA 04-UDM-0010_2) of the Des Moines River in the city of Des Moines that was identified within the Iowa 2004 Integrated Report 305(b) assessment. The Class C designated use (drinking water) was determined to be impaired due to nitrate levels exceeding state

water quality standards and the EPA maximum contaminant level (MCL). The current water quality standard for nitrate is 10 milligrams per liter (mg/L). Accounting for a margin of safety (MOS) of 0.5 mg/L and the MCL, the target maximum daily nitrate concentration is 9.5 mg/L.

The TMDL identified nonpoint sources of nitrate as the primary cause of the Class C impairment. Water quality modeling during TMDL development determined that point sources and nonpoint sources contribute 6.4 and 93.6 percent, respectively, to the total nitrate load within the upstream watershed. The TMDL states that up to a 34.4 percent reduction of maximum daily nitrate levels is necessary to attain the target nitrate concentration of 9.5 mg/L.

3.2. Eagle Creek Water Quality

A partnership of 13 agricultural retailers known as **Agriculture's Clean Water Alliance** (ACWA) has monitored water quality in the Raccoon River and Des Moines River watersheds since 1999. Many tributaries to these rivers have been monitored, including three sites within the ECW from 2007 through 2017. These sites are mapped in Figure 3.2.1 and site descriptions and locations are detailed in Table 3.2.1.

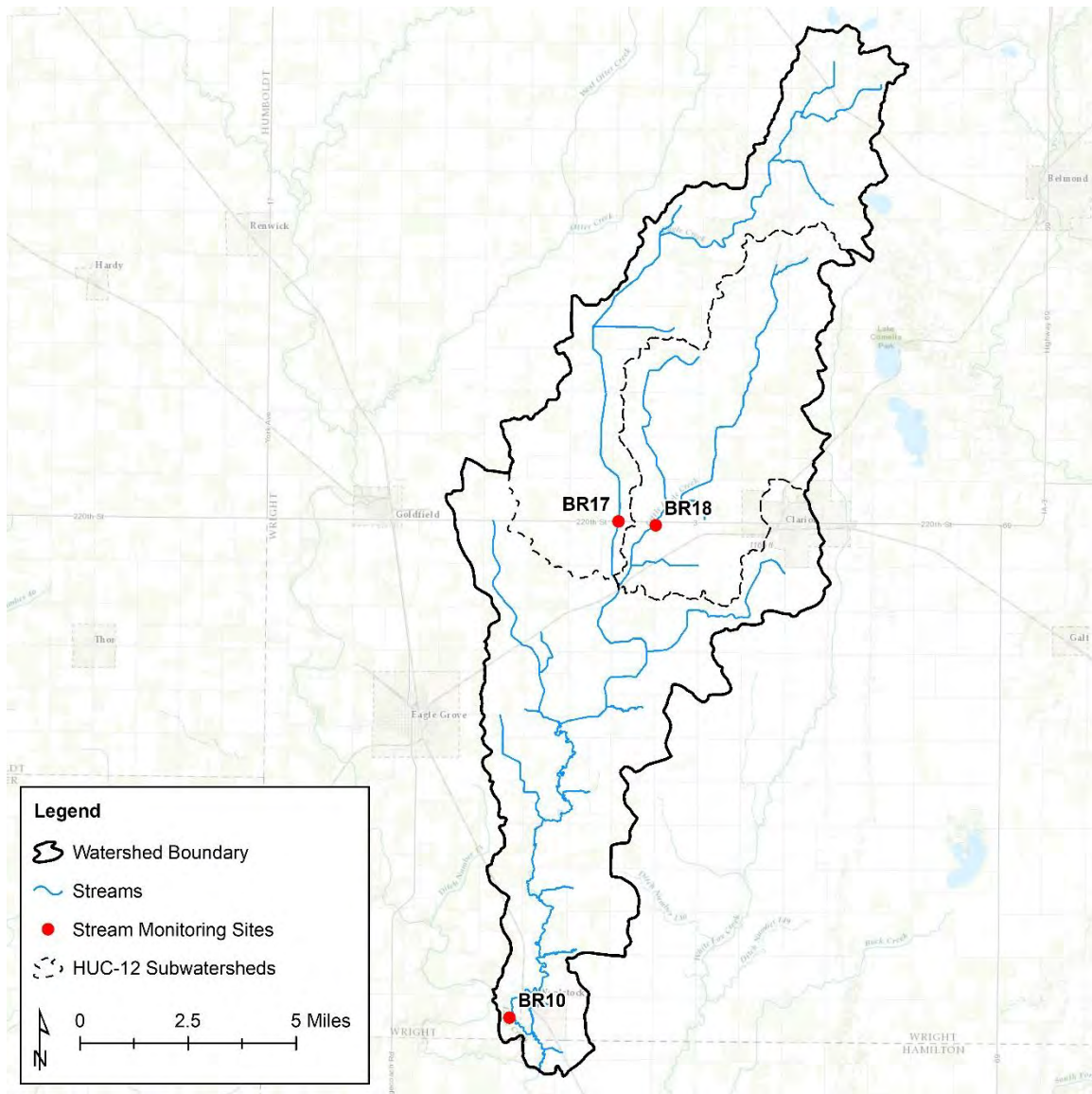


Figure 3.2.1. Agriculture's Clean Water Alliance stream monitoring sites located on Eagle Creek.

Table 3.2.1. Location information for three stream water monitoring sites in the Eagle Creek Watershed monitored by ACWA from 2007 through 2017.

| Site | Subwatershed | Latitude (°N) | Longitude (°W) |
|------|------------------------|---------------|----------------|
| BR10 | Eagle Creek | 42.564918 | 93.858521 |
| BR17 | Headwaters Eagle Creek | 42.731712 | 93.811194 |
| BR18 | Little Eagle Creek | 42.730499 | 93.794215 |

The 2007 to 2017 average nitrate concentration from April through August at each of these monitoring sites is displayed in Figure 3.2.2. This chart shows annual variability, which is often influenced by variable precipitation. Monthly average nitrate concentrations at these sites for 2007 through 2013 (baseline period; see Section 4) are displayed in Figure 3.2.3. This chart reveals monthly trends, which are due to seasonal precipitation and landscape-scale evapotranspiration (i.e., water use by crops and other vegetation) patterns. Data for these stream sites and others are published annually by [ACWA](#).

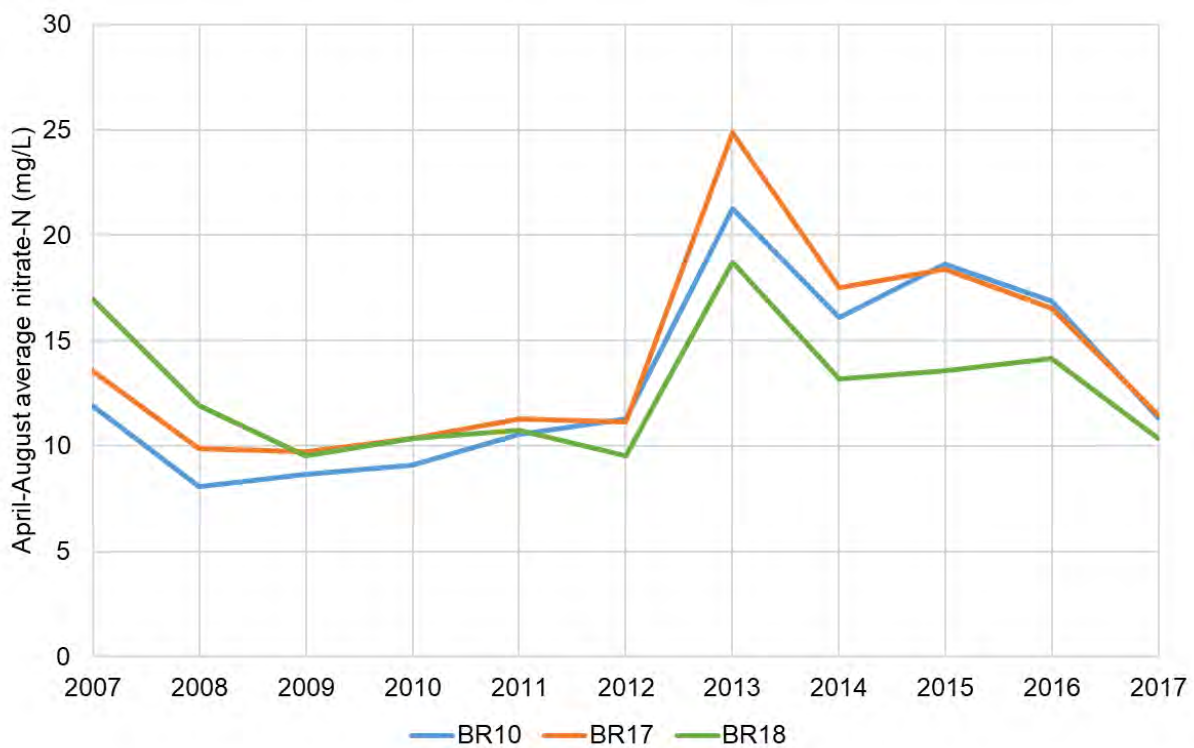


Figure 3.2.2. Average April through August nitrate concentrations for three sites in Eagle Creek from 2007 through 2017.

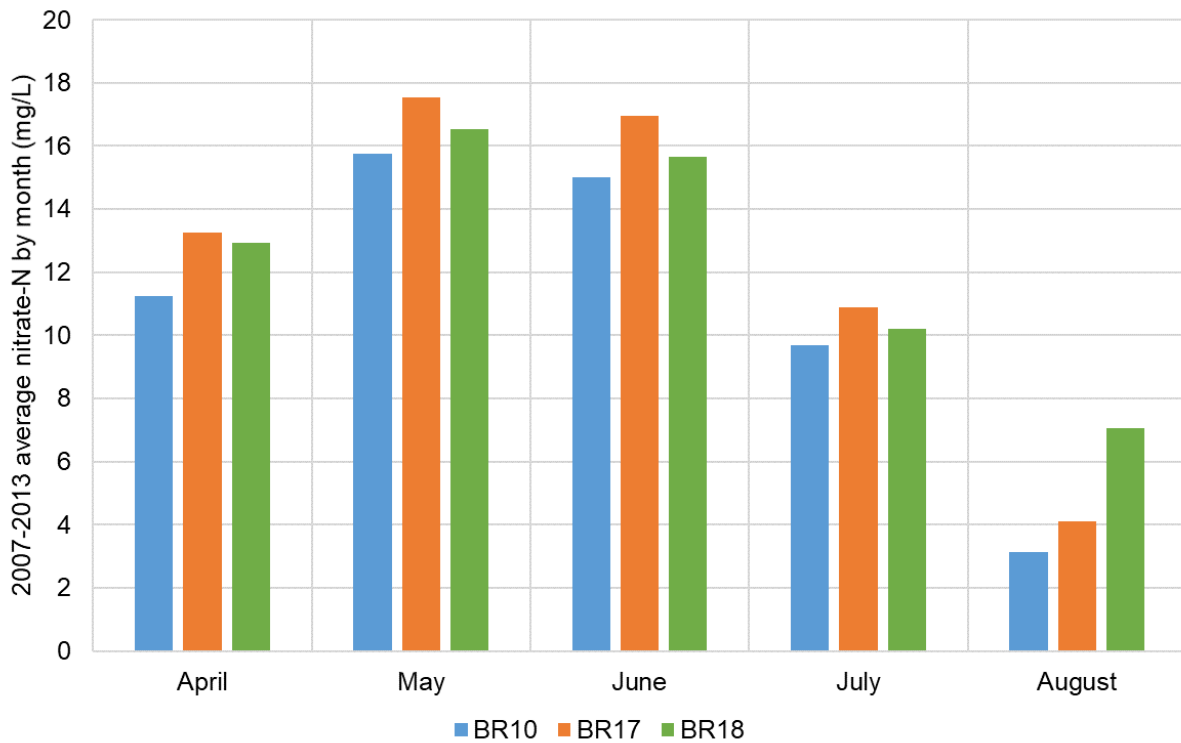


Figure 3.2.3. Monthly average nitrate concentrations at three sites in Eagle Creek based on 2007 to 2013 data.

In the Iowa 2014 305(b) Integrated Report, a 4.2-mile reach of Eagle Creek (portions of three segments: 04-UDM-6256, 04-UDM-6257 and 04-UDM-1267) was listed as partially supporting the Class B(WW-1) aquatic life designated use due to a 2008 fish kill, which was subsequently resolved.

3.3. Source Water Protection

Protection of source water, or local drinking water resources, is important for human health within the ECW. The IDNR Source Water Protection Program maintains an online database of source water protection plans, assessments and other information. Ground water capture zones in **Clarion**, **Woolstock** and **Holmes** are tracked through this system, and the extents of these capture zones are shown in Figure 3.3.1.

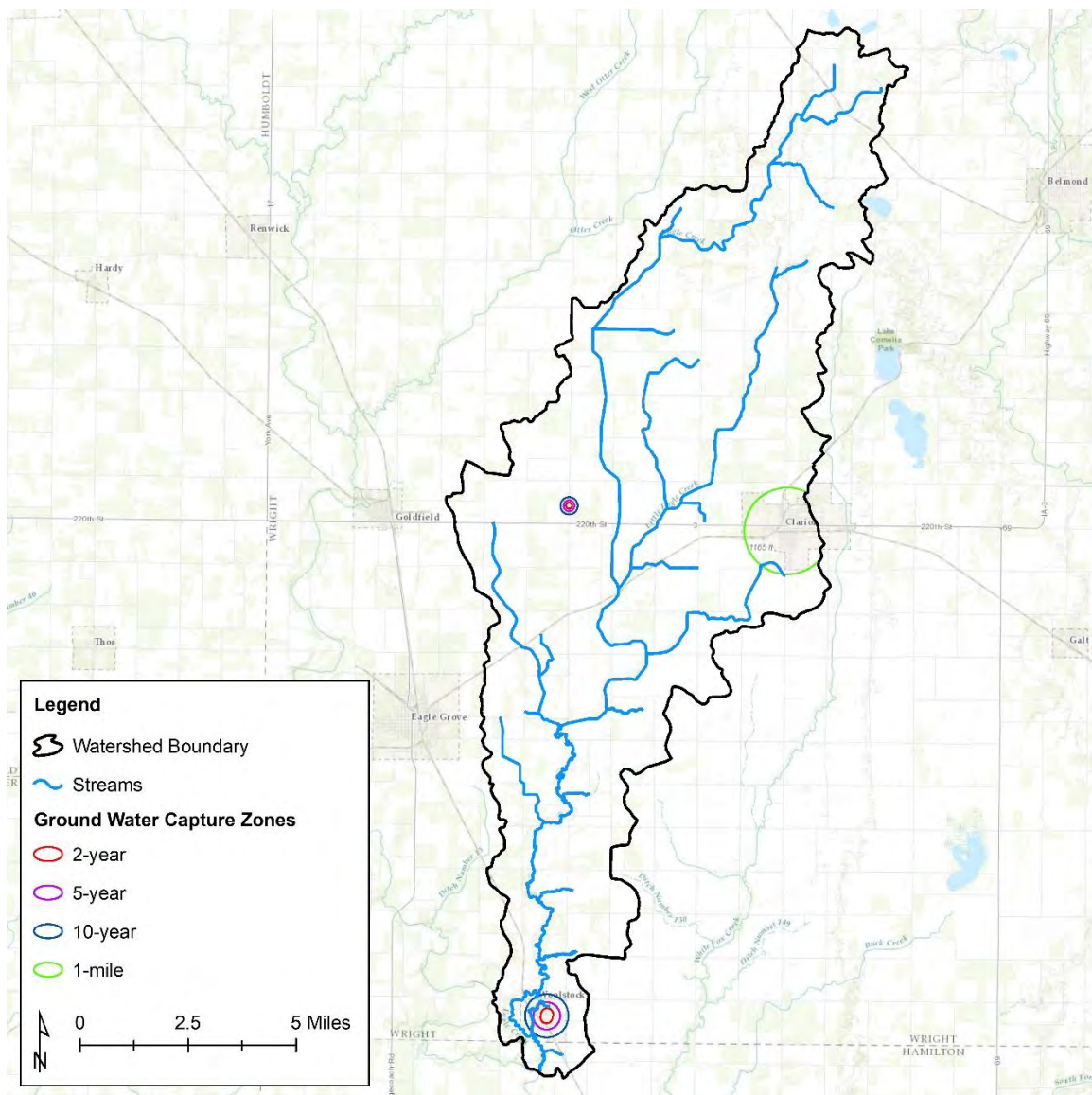


Figure 3.3.1. Priority areas for source water protection in the Eagle Creek Watershed are located near Clarion, Woolstock and Holmes.

3.4. Point and Nonpoint Sources

The INRS incorporates both point and nonpoint sources. The cities of **Clarion** and **Woolstock** each have a wastewater treatment facility with a federal National Pollution Discharge Elimination System (NPDES) permit. The Clarion plant is permitted to discharge a 30-day average of 169.1 pounds of nitrate per day, which equates to up to 2,059 pounds per year. The Woolstock facility is not permitted to discharge nitrate. This point source nitrate loading was included in the water quality modeling results contained in Section 4. Neither facility is permitted to discharge phosphorus. The Clarion and Woolstock wastewater treatment facilities are not identified in the INRS as priority point sources for nutrient load reduction. As these two point source facilities contribute a relatively small amount of nitrate (0.1 percent) compared to the total estimated watershed nonpoint source nitrate load, this watershed plan emphasizes nonpoint nutrient sources and prioritizes agricultural conservation practices as the best methods to improve water quality in the ECW, the Boone River Watershed and downstream.

4. Goals and Objectives

The Eagle Creek Watershed 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 and the continued collaboration of local, state and federal agricultural and conservation agencies, along with sustained funding. In addition to BMP implementation, water monitoring should continue as a crucial activity to assess the status of water quality goals, standards and designated uses. Water monitoring is necessary to determine if water quality is improving, degrading or remaining unchanged and is required 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 the Eagle Creek Watershed (ECW) water quality, soil health, agronomic and ecosystem goals if appropriately utilized. It is up to all ECW stakeholders to determine exactly how to best implement BMPs. Locally driven efforts have proven to be the most successful in obtaining significant water quality improvements.

A key component of the watershed planning process is the identification of the overall goals and objectives, as they will guide implementation approaches and activities. The goals and objectives listed in this plan are not permanent, so this plan should be considered a living document. The goals and objectives that were developed by ECW stakeholders reflect current needs and opportunities for the ECW. Changing social and economic conditions, Farm Bill revisions and new agricultural and conservation technologies may require that ECW stakeholder needs and opportunities periodically be reassessed. It is essential to allow for sufficient flexibility to respond to changing social, political and economic conditions while still providing guidance for future conservation efforts.

The statewide goals of the Iowa Nutrient Reduction Strategy (INRS) provided an important starting point for goal development by stakeholders in the ECW. 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 nitrate 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 portion 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 ECW 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 have been identified for the ECW:

1. **Increase farmer and urban stakeholder involvement and adoption.** Broad awareness and participation in watershed efforts will be essential to achieve the other watershed goals.
2. **Maintain and increase agricultural productivity and/or profitability.** The agricultural identity of the ECW should be embraced and enhanced to preserve local cultural and economic vitality.
3. **Reduce in-stream nonpoint source nutrient loads to Iowa Nutrient Reduction Strategy levels of 41 percent nitrogen reduction and 29 percent phosphorus reduction.** Along with INRS goals

for nitrogen and phosphorus reduction, this goal will also exceed the Des Moines River TMDL target of 34 percent nitrate reduction.

4. **Maintain and improve wildlife habitat and biodiversity.** More abundant and more diverse upland and aquatic life can be an indicator of high quality natural resources and habitat.
5. **Improve soil health and reduce soil erosion.** Healthy, high-functioning soils are the foundation of the ECW. This resource must be protected and valued.
6. **Reduce flood risk.** Decreasing negative impacts of excess water can be beneficial both within the ECW and downstream.

This watershed plan uses the period from 2007 through 2013 as the baseline for conservation practice implementation and determining progress towards reaching goals by 2032. Conditions during this period reflect the status of the watershed prior to release of the INRS and the current Water Quality Initiative project. Watershed stakeholders decided to use water quality monitoring data from 2007 to 2013 to establish a monthly baseline stream nitrate concentration. These levels along with 41 percent reductions are shown in Figure 4.1.

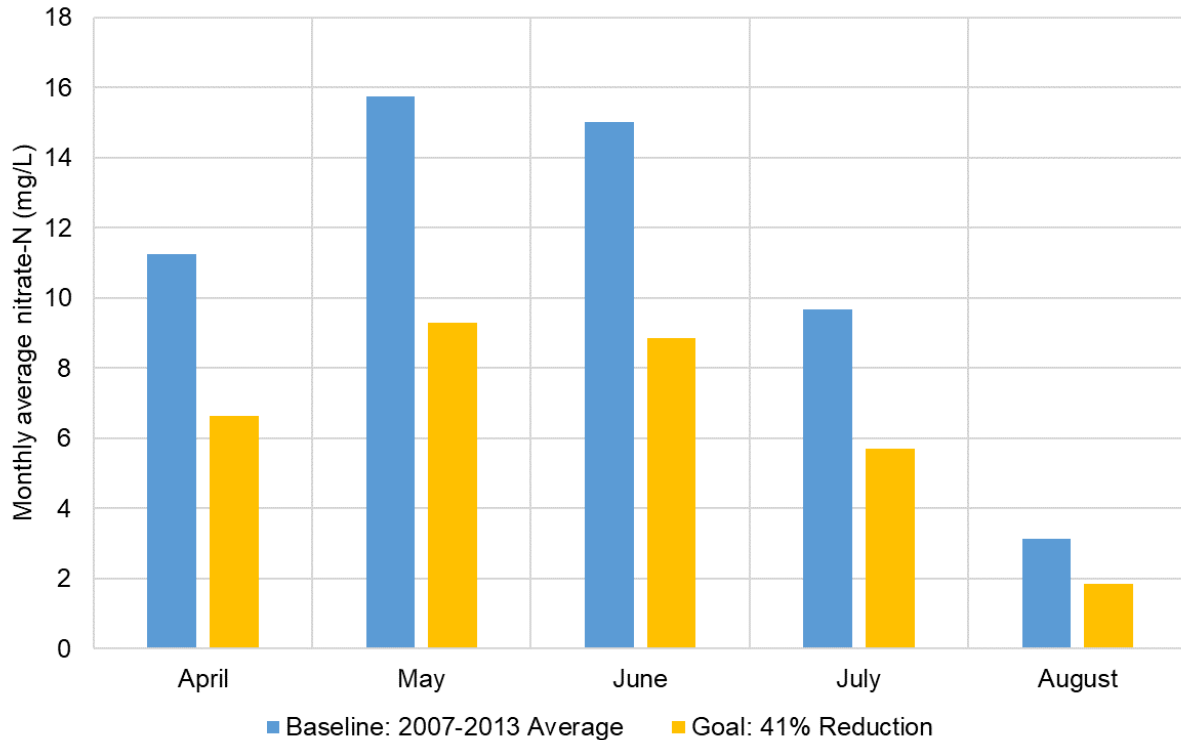


Figure 4.1. Monthly 2007 to 2013 baselines and 2032 targets for Eagle Creek stream nitrate concentrations.

Watershed models were developed to determine baseline, current and future nitrate, phosphorus and sediment loads and associated reductions in the ECW. Table 4.1 provides estimates of watershed nutrient and sediment loading rates for the 2007 to 2013 baseline and conditions during and after the implementation of practices identified in this watershed plan. Table 4.2 provides estimates of percent reductions for each parameter for each five-year phase relative to the baseline. The phases and associated practices and implementation levels are detailed in Section 6. A practice-based model was used to determine the nitrate 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 DEP model results. Streambank

erosion was estimated to be 4,566 tons per year based on data collected during a stream assessment of Eagle Creek. Upland sheet and rill erosion, streambank erosion and a Sediment Delivery Model were used to estimate total sediment delivery levels and reductions. Along with practice phosphorus reduction efficiencies from the Iowa Science Assessment of Nonpoint Source Practices to Reduce Phosphorus Transport in the Mississippi River Basin section of the INRS, phosphorus enrichment ratios (1.6 pounds of phosphorus per ton of upland sediment and 0.6 pounds of phosphorus per ton of streambank sediment) were used to estimate phosphorus loading.

*Table 4.1. Estimated baseline (2007 through 2013), current (2017) and future nitrate, phosphorus and sediment export from the Eagle Creek Watershed for 5-year phases until full watershed plan implementation anticipated by 2032. (*Baseline and 2017 May and June stream nitrate concentration values based on water quality monitoring data.)*

| | Units | 2007-2013 Baseline | 2017 Status | 2022 Target | 2027 Target | 2032 Target |
|--|--------------|-------------------------------|------------------------|------------------------|------------------------|------------------------|
| Nitrate load | pounds/year | 1,978,763 | 1,924,085 | 1,755,501 | 1,378,683 | 1,171,798 |
| Stream nitrate conc. (May-June) | mg/L | 15.4* | 14.3* | 13.7 | 10.7 | 9.1 |
| Phosphorus load | pounds/year | 5,355 | 5,190 | 4,710 | 3,463 | 2,993 |
| Sheet and rill erosion | tons/year | 67,907 | 65,497 | 58,135 | 38,592 | 27,296 |
| Streambank erosion | tons/year | 4,566 | 4,566 | 4,566 | 4,566 | 4,566 |
| Sediment delivery | tons/year | 5,663 | 5,579 | 5,322 | 4,682 | 4,361 |

Table 4.2. Modeled nutrient and sediment load reductions from the 2007 to 2013 baseline in the Eagle Creek Watershed for current 2017 conditions and each 5-year phase of watershed plan implementation.

| | Units | 2007-2013 Baseline | 2017 Status | 2022 Target | 2027 Target | 2032 Target |
|--|--------------|-------------------------------|------------------------|------------------------|------------------------|------------------------|
| Nitrate load | % reduction | - | 3% | 11% | 30% | 41% |
| Stream nitrate conc. (May-June) | % reduction | - | 7% | 11% | 31% | 41% |
| Phosphorus load | % reduction | - | 3% | 12% | 35% | 44% |
| Sheet and rill erosion | % reduction | - | 4% | 14% | 43% | 60% |
| Streambank erosion | % reduction | - | 0% | 0% | 0% | 0% |
| Sediment delivery | % reduction | - | 1% | 6% | 17% | 23% |

In addition to the locally adopted 2032 target to achieve watershed goals, it is important to acknowledge that this timeline aligns with that of the Mississippi River/Gulf of Mexico Watershed Nutrient Task Force (or [Hypoxia Task Force](#), HTF). In a 2017 report, the HTF affirmed a deadline to achieve its Gulf of Mexico hypoxic zone goal of 45 percent reduction by 2035 and added an interim target of 20 percent nutrient load reduction by 2025. If the watershed conceptual plan (Section 5) and implementation schedule (Section 6) are implemented as planned, nitrate and phosphorus loads from the ECW are expected to be reduced by 23 percent and 27 percent, respectively, by 2025, which would exceed the interim milestone recommended by the HTF.

5. Conceptual Plan

Best management practices (BMPs) 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 Eagle Creek Watershed (ECW) 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. The outcomes of this assessment are charted in Figure 5.1. For the analysis, impact values were related to watershed goals based on practice nutrient reduction efficiencies along with potential impacts on productivity, erosion, flooding and habitat, and effort values were scored by watershed stakeholders.

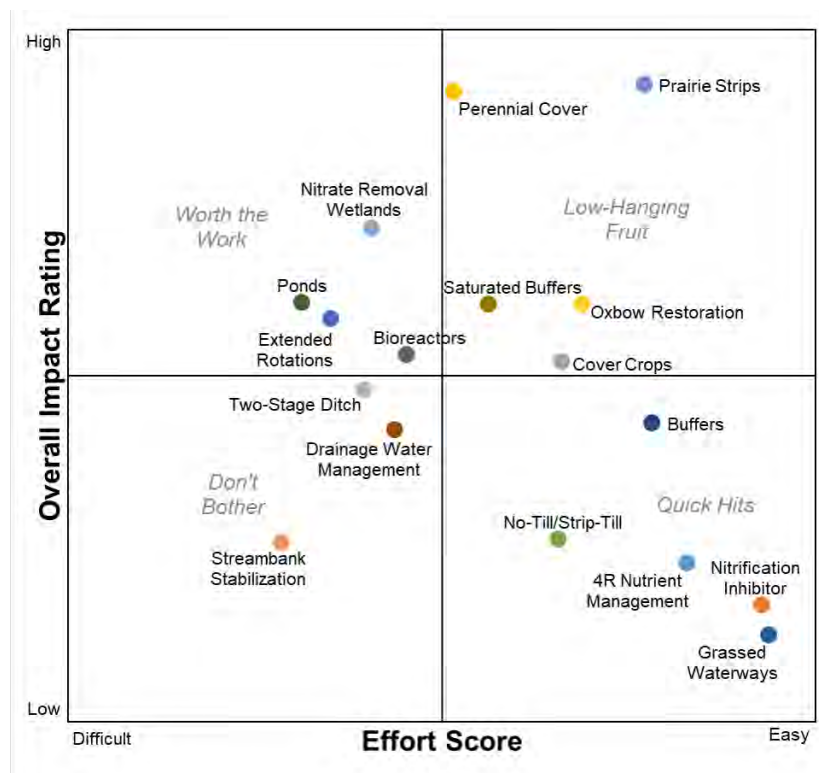


Figure 5.1. Results of impact versus effort best management practice prioritization for the Eagle Creek Watershed.

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., wetlands placed at strategic locations or bioreactors placed at likely drainage tile outlets). See Appendix A for larger conceptual plan maps.

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

| | Practice | Soil Health/Erosion | Nitrogen Reduction | Phosphorus Reduction |
|-----------------------|-------------------------------|----------------------------|---------------------------|-----------------------------|
| In-Field | <i>4R Nutrient Management</i> | 1 | 1 | 1 |
| | Nitrification Inhibitor | 0 | 1 | 0 |
| | <i>Cover Crops</i> | 3 | 3 | 3 |
| | <i>Perennial Cover</i> | 3 | 3 | 3 |
| | Extended Rotations | 3 | 2 | 2 |
| | <i>No-Till/Strip-Till</i> | 3 | 0 | 3 |
| | <i>Grassed Waterways</i> | 1 | 0 | 2 |
| | Drainage Water Management | 0 | 3 | 0 |
| | <i>Prairie Strips</i> | 3 | 3 | 3 |
| Edge-of-Field | <i>Bioreactors</i> | 0 | 3 | 1 |
| | <i>Saturated Buffers</i> | 0 | 3 | 1 |
| | Buffers | 0 | 1 | 3 |
| In/Near-Stream | Ponds | 0 | 1 | 3 |
| | <i>Wetlands</i> | 0 | 3 | 1 |
| | Streambank Stabilization | 0 | 0 | 2 |
| | Two-Stage Ditch | 0 | 1 | 0 |
| | <i>Oxbow Restoration</i> | 1 | 3 | 2 |

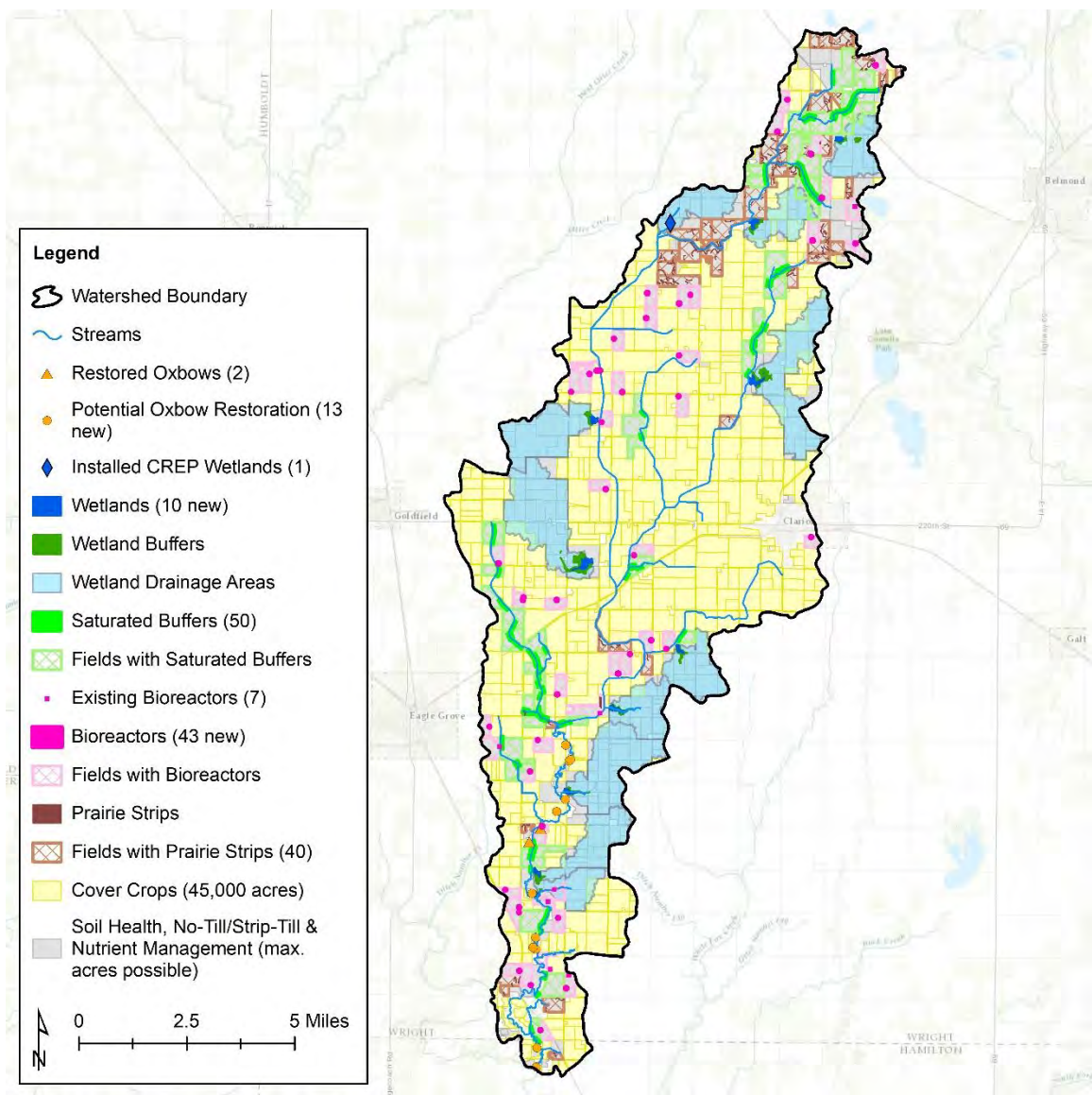


Figure 5.2. Conceptual plan for best management practice implementation in the Eagle Creek Watershed. Appendix A contains detailed, larger maps.

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. Watershed stakeholders also considered alternative scenarios that placed different levels of emphasis on in-field management practices, structural edge-of-field practices and the balance between them. These alternative scenarios are included in Appendix B. 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 and objectives 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 (ARS) scientists have developed the **Agricultural Conservation Planning Framework** (ACPF) to facilitate the selection and implementation of conservation practices in watersheds with predominately agricultural land uses. 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 ECW. Practices that build soil health will support watershed goals due to improved soil function and associated benefits of erosion control, water infiltration and retention, flood reduction, increased soil organic matter and improved nutrient cycling. Management practices that build soil health such as cover crops and no-till/strip-till should be 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.

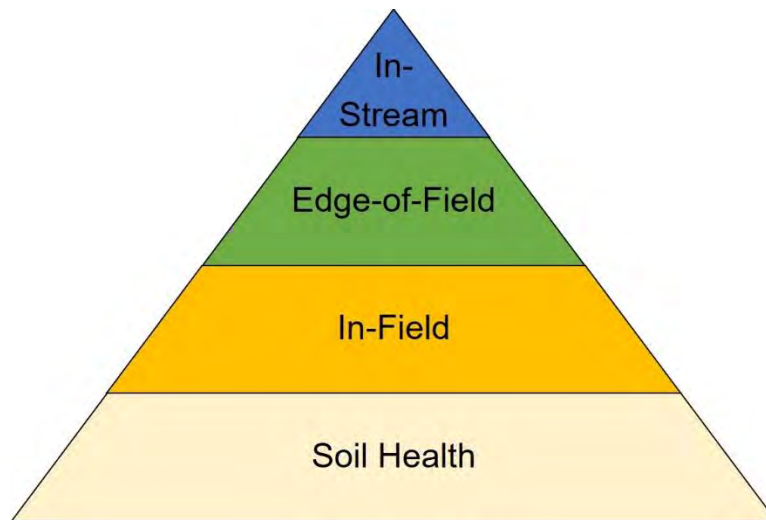


Figure 5.3. The Agricultural Conservation Planning Framework conservation pyramid adapted from the model documentation.

The ACPF includes a mapping toolbox to identify potential locations for conservation practice adoption. Selected results of applying these siting tools to the ECW have been incorporated into this conceptual plan. Appendix C 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 15-year phased implementation schedule in Table 6.1 was approved by watershed stakeholders and should be used to set yearly objectives and gauge progress. The goals listed for each phase are intended to build upon existing levels and previous phases, so practice retention is also important. Practices included in the implementation schedule only include those identified to reach the watershed plan goals. Practices that are not included in the implementation schedule such as drainage water management, extended rotations, stream buffers and streambank stabilization should be promoted and implemented wherever appropriate.

Table 6.1. Watershed plan implementation schedule separated into three 5-year phases for the Eagle Creek Watershed.

| Practice | Unit | Existing | 2018-2022 Goal | 2023-2027 Goal | 2028-2032 Goal | Watershed Plan Goal |
|----------------------------------|-------------|-----------------|--|---------------------------|---------------------------|--------------------------------|
| Nutrient management | acres | 3,591 | 6,409 | 12,000 | 8,000 | 30,000 |
| No-till/Strip-till | acres | 2,475 | <i>Maximum possible cropland acres</i> | | | |
| Cover crops | acres | 2,300 | 7,700 | 20,000 | 15,000 | 45,000 |
| Grassed waterways | feet | 276,293 | <i>As needed for erosion control</i> | | | |
| Prairie strips (Perennial cover) | fields | 1 | 9 | 20 | 10 | 40 |
| Bioreactors | structures | 7 | 13 | 20 | 10 | 50 |
| Saturated buffers | structures | - | 15 | 25 | 10 | 50 |
| Wetlands | sites | 1 | 2 | 6 | 2 | 11 |
| Oxbow restorations | sites | 2 | 3 | 7 | 3 | 15 |

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. In addition to modeled nutrient reductions, water monitoring results will be key indicators of water quality improvement in the Eagle Creek Watershed (ECW). The ECW has a detailed historical water quality monitoring dataset available through Agriculture's Clean Water Alliance (ACWA).

The ACWA stream monitoring sites (see Figure 3.2.1 and Table 3.2.1) within the ECW should be maintained. Future water quality data measured at these locations will allow for water quality evaluation through direct comparison against the 2007 through 2013 baseline. This monitoring site network will continue to allow for consistent water quality information to be gathered throughout the entire watershed. Ideally, bi-weekly samples should be collected beginning in April and extending through August. 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 U.S. Geological Survey (USGS) [Water Science School](#) provides an overview of this process. At a minimum, streamflow should be captured at site BR10 near the watershed outlet.

Other existing water sampling programs offer additional data sources or opportunities to document water quality in the ECW. The Iowa [STORET](#) database maintained by the IDNR contains water physical, chemical, biological and habitat data. The IDNR's [ADNet](#) database documents Iowa's water quality assessments for Clean Water Act section 305(b) reporting. Volunteer water quality monitoring also can be an important source 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 for many streams and rivers in Iowa. The downstream IWQIS sensor closest to the ECW is a USGS gauge in the Boone River near Webster City with station ID 05481000. Data such as stream nitrate concentration, stream discharge and cumulative upstream nitrogen loading are available from 2013 through present.

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 the ECW, water quality monitoring at finer scales should be conducted to assess the effectiveness of individual conservation practice installations. Field-scale water samples 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 irregular and often missed by a regular

monitoring program. Tile water monitoring is reliable due to more consistent flow. 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. Improved soil fertility data will better inform nutrient management, which can result in increased profitability and decreased nutrient loss 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 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 can be utilized to quantify the benefits of management practices that build soil health.

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. Producers should collect samples over multiple years to account for weather and seasonal variations before modifying operations.

7.6. Social Surveys

Surveys are a tool that should periodically be used to assess awareness and attitudes regarding water quality in the ECW and whether the watershed plan goals are on schedule. Detailed surveys 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. Surveys could be conducted online, which also could be a valuable resource to recruit further participation in the project.

8. Information and Education Plan

Behavior patterns of all stakeholders, and especially producers and landowners, must be considered both in designs of best management practices (BMPs) and in implementation strategies for water quality projects. To cause changes in behavior, goal-based outreach that addresses the actual and defined needs of key stakeholders is critical. It is important to leverage preexisting relationships and successes to build a community of support and knowledge around producers and landowners who will be implementing conservation practices. Barriers to conservation implementation may be overcome by providing adequate education and outreach regarding how land management practices influence the ECW and downstream water resources. Knowledge increases awareness, which may then motivate changes in behavior.

During the watershed planning process, local stakeholders identified various information-based challenges. Current needs expressed by farmers include better information on the economics of conservation implementation, improved understanding of the field-scale nutrient reduction effects of multiple conservation practices and more farmer-to-farmer learning sessions.

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 15-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. The following tables summarize an information and education approach, outreach tools and potential partners.

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: Farmers, landowners and technical experts. Secondary: Watershed residents, educators, students and others. |
| Messages | Need to be tailored specifically for farmer engagement, general public, decision makers or 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 hours |
| Website and social media | Conservation practice signs | Conservation icons or graphics |
| Fact sheets | Volunteer workshops | Guest speakers at area events |
| Direct mailings | Youth outdoor learning | Individual on-farm visits |
| Demonstration field days | Urban/ag learning exchanges | Practice-specific outreach |
| Watershed boundary signs | Stream cleanup events | Farmer-led listening sessions |

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

| | |
|---|---|
| <p>Project Partners</p> | <p>Agriculture's Clean Water Alliance Eagle Creek Watershed farmers and landowners Hagie Manufacturing Iowa Department of Agriculture and Land Stewardship Iowa Department of Natural Resources Iowa Soybean Association Iowa State University Extension and Outreach North Central Cooperative The Conservation Fund The Nature Conservancy USDA-Natural Resources Conservation Service Wright County Soil and Water Conservation District</p> |
| <p>Other Government, Agriculture and Outdoor Organizations</p> | <p>City of Clarion Ducks Unlimited Fishers and Farmers Partnership Gold-Eagle Cooperative Iowa Agriculture Water Alliance Iowa Corn Growers Association Iowa Farm Bureau Federation Iowa Geological Survey Iowa Natural Heritage Foundation Iowa Pork Producers Association Landus Cooperative National Fish and Wildlife Foundation NEW Cooperative Pheasants Forever Sand County Foundation U.S. Fish and Wildlife Service U.S. Geological Survey Wright County Board of Supervisors Wright County Conservation Board Youth educational groups</p> |
| <p>Media</p> | <p>Belmond Independent Clarion Wright County Monitor Des Moines Register Eagle Grove Eagle Farm Bureau Spokesman Fort Dodge Messenger Webster City Daily Freeman-Journal KHBT 97.7 FM Humboldt KLGA 92.7 FM Algona KLGZ 1600 AM / 98.5 FM Algona KWMT 540 AM Fort Dodge KZWC 1570 AM / 92.9 FM Webster City WHO 1040 AM Des Moines</p> |

9. Evaluation Plan

Project evaluation and recognition of successes and challenges is a critically important step in implementing the Eagle Creek Watershed Plan. This section lays out a self-evaluation process for project partners to measure project progress in four categories: project administration, attitudes and awareness, performance and results. A project evaluation worksheet can be found in Appendix D.

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 outreach, events and monitoring. If objectives are determined to not be met, amounts or types of activities may need to be adjusted. Input from farmer leaders will be an important source of feedback and ideas for the project to adapt as needed.

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 knowledge, attitudes and behaviors. Surveys should include questions to determine effectiveness of different outreach methods.
- **Field day attendance.** Field days are an important outreach component of watershed projects. To quantify 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 should be aggregated to the watershed scale and reported to partners annually.
- **Practice retention.** Retention of management practices, such as cover crops, should be emphasized. Yearly follow-up with farmers implementing practices will help quantify 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 farmers, landowners and partners. This aggregated data also may be used in a publication to bring broader recognition to local, Iowa and regional water quality efforts such as the Mississippi River Basin Healthy Watersheds Initiative.

- **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 best management 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. Appendix E can be used to estimate watershed nitrate reduction based on practice implementation levels.

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 best management practice (BMP) implementation costs are estimated at up to \$1,747,200 per year and initial structural costs are estimated to be \$3,960,000. A [National Association of Conservation Districts](#) report highlighted that practices such as nutrient management no-till/strip-till and cover crops that build soil health 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 2017 dollars.

Table 10.1. Estimated resource needs (in 2017 dollars) to reach the Eagle Creek Watershed best management practice implementation level goals.

| Practice | Unit | Existing | Watershed Plan Goal | Cost Per Unit | Total Cost |
|----------------------------------|------------|----------|-------------------------|---------------|-------------|
| Nutrient management | acres | 3,591 | 30,000 | -\$5 | -\$150,000 |
| No-till/Strip-till | acres | 2,475 | <i>Maximum possible</i> | -\$10 | -\$400,000 |
| Cover crops | acres | 2,300 | 45,000 | \$50 | \$2,250,000 |
| Grassed waterways | feet | 276,293 | <i>As needed</i> | - | - |
| Prairie strips (Perennial cover) | fields | 1 | 40 | \$295/acre | \$47,200 |
| Bioreactors | structures | 7 | 50 | \$10,000 | \$430,000 |
| Saturated buffers | structures | - | 50 | \$3,000 | \$150,000 |
| Wetlands | sites | 1 | 11 | \$325,000 | \$3,250,000 |
| Oxbow restorations | sites | 2 | 15 | \$10,000 | \$130,000 |

Nutrient management, which includes application of nitrogen at the maximum return to nitrogen (MRTN) rate and phosphorus and potassium application tailored to site specific soil fertility and crop nutrient uptake, can result in decreased nutrient application or improved crop utilization and therefore a net economic benefit (negative cost). Cost savings for no-till/strip-till are expected due to decreased fuel use. Cover crop costs include seed, labor and termination cost estimates from Iowa State University Extension and Outreach Ag Decision Maker and Iowa Learning Farms tools. The perennial cover annual cost is the watershed weighted average Conservation Reserve Program (CRP) soil rental rate multiplied by an estimated 10 percent of agricultural fields converted to prairie strips. Costs for bioreactors, saturated buffers and oxbow restorations are based on typical total installation costs but can vary depending on timing, material availability and contractor experience. Wetland costs were estimated from Iowa Conservation Reserve Enhancement Program (CREP) data and Agricultural Conservation Planning Framework (ACPF) model outputs.

The initial investment needed to construct all proposed edge-of-field structural practices (bioreactors, saturated buffers, wetlands and oxbow restorations) is estimated at \$3,960,000. Annual investments are necessary to increase and maintain adoption and implementation of in-field management practices (nutrient management, no-till/strip-till, cover crops and prairie strips). The estimated yearly total for these practices fully implemented is \$1,747,200 per year. Cost-share payments may not be permanently available, so alternative funding sources for management practices may need to be pursued. The dollars necessary to fund structural and management practices could fully or partially come from many different sources including farmers and landowners, downstream municipalities, other local or regional stakeholders and conservation organizations. Section 11 describes additional potential funding sources.

Additional costs associated with watershed improvement are estimated to begin at approximately \$120,000 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 the Eagle Creek 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 F 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 funding 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 Soil and Water Conservation District (SWCD), County Conservation Board or local farm cooperatives. For example, some SWCDs around Iowa have 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, field edges and fence rows.
- **Conservation addendums to agricultural leases.** More than half of Iowa's farmland is cash rented or crop shared—71 percent in Wright County (see Section 2.7)—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 the Eagle Creek Watershed (ECW).
- **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 in 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 (see Table 8.3). Involvement could be in the form of cash or in-kind donations.
- **Nutrient trading.** Water quality trading programs are market-based programs involving the exchange of pollutant allocations between sources within a watershed. The most common form of trading occurs when trading nutrient credits between point and nonpoint sources. Trading programs could be established to trade nutrient credits. The [Iowa League of Cities](#) is leading a pilot program in Iowa that is testing this nutrient reduction exchange model. Trading within the larger Des Moines River Watershed may be appropriate to increase potential nutrient trading partners.

- **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. The Wright SWCD has invested in a seed drill, which can be rented to interested farmers. In addition to building community support for the watershed project, such cooperation can lower overall practice costs. The availability of this conservation equipment should be promoted.
- **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 ECW may prove to be more successful than existing groups working together without formal organization. (The Boone River Watershed organization may be appropriate for this purpose.) At a minimum, the farmers and landowners involved in the development of this watershed plan should convene regularly to discuss and evaluate project progress, continually develop innovative outreach and implementation strategies and set specific work plans to support steady progress towards the 2032 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 no or negative return on investment.
- **Sponsored projects.** Iowa administrative code authorizes use of the Clean Water **State Revolving Fund** (SRF) to implement water resource restoration sponsored projects, or **sponsored projects**, in order to develop watershed-based approaches to water quality improvement. Wastewater treatment facility upgrades are very expensive, and the SRF provides a source of capital for these infrastructure improvements. In a sponsored project, an overall interest rate reduction on the SRF loan allows the utility to use saved capital to fund nonpoint source water quality improvement practices within the same watershed as the wastewater facility. Use of a sponsored project to fund agricultural/rural practices that improve water quality requires coordination with a wastewater treatment plant upgrade, but can provide two projects for the price of one and establish and strengthen upstream-downstream partnerships within the watershed.

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 Eagle Creek Watershed. An organizational chart is shown in Figure 12.1 to illustrate the relationships between all project stakeholders and partners.

- **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.
- **Wright County 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 State University Extension and Outreach.** Engage farmers and landowners through agronomic and water quality programming, provide outreach opportunities to project and promote relevant university research.
- **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.
- **Wright 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. Agriculture's Clean Water Alliance should continue to fund stream water quality monitoring.
- **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.

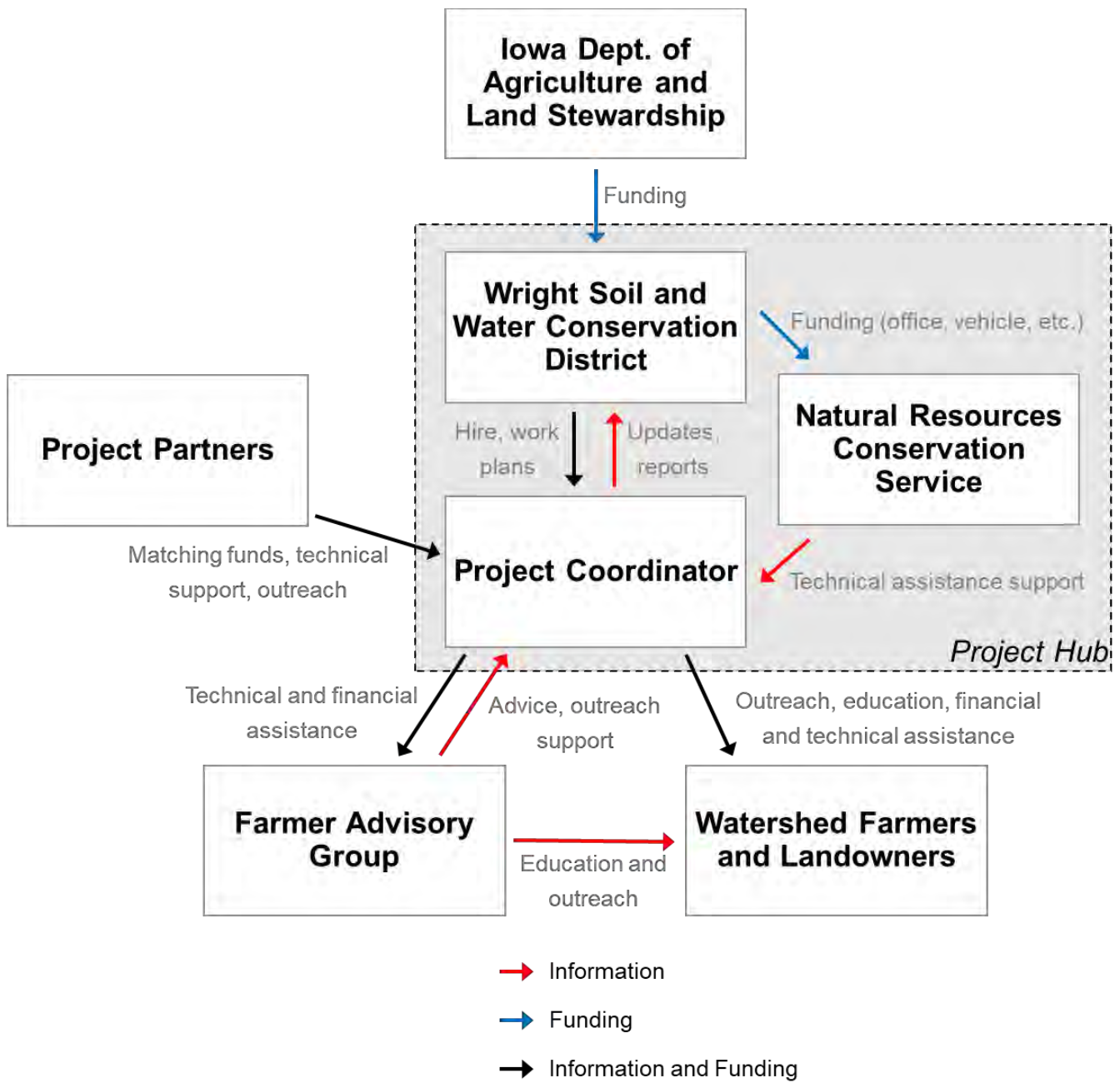


Figure 12.1. Organizational chart for the Eagle Creek Watershed project. Red, blue and black arrows denote flow of information, funds and both, respectively.

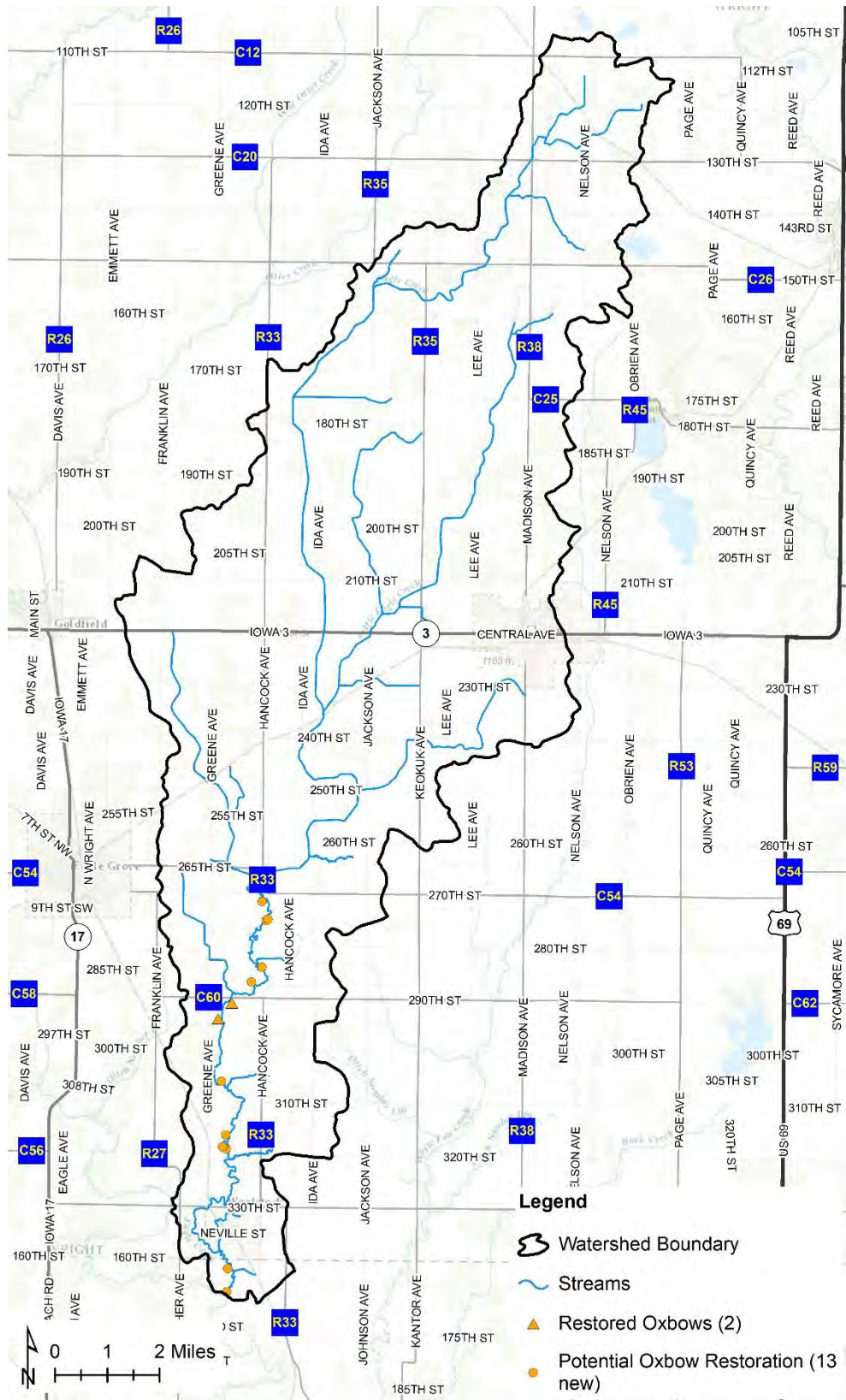


Figure A.3. Priority locations for oxbow restoration.

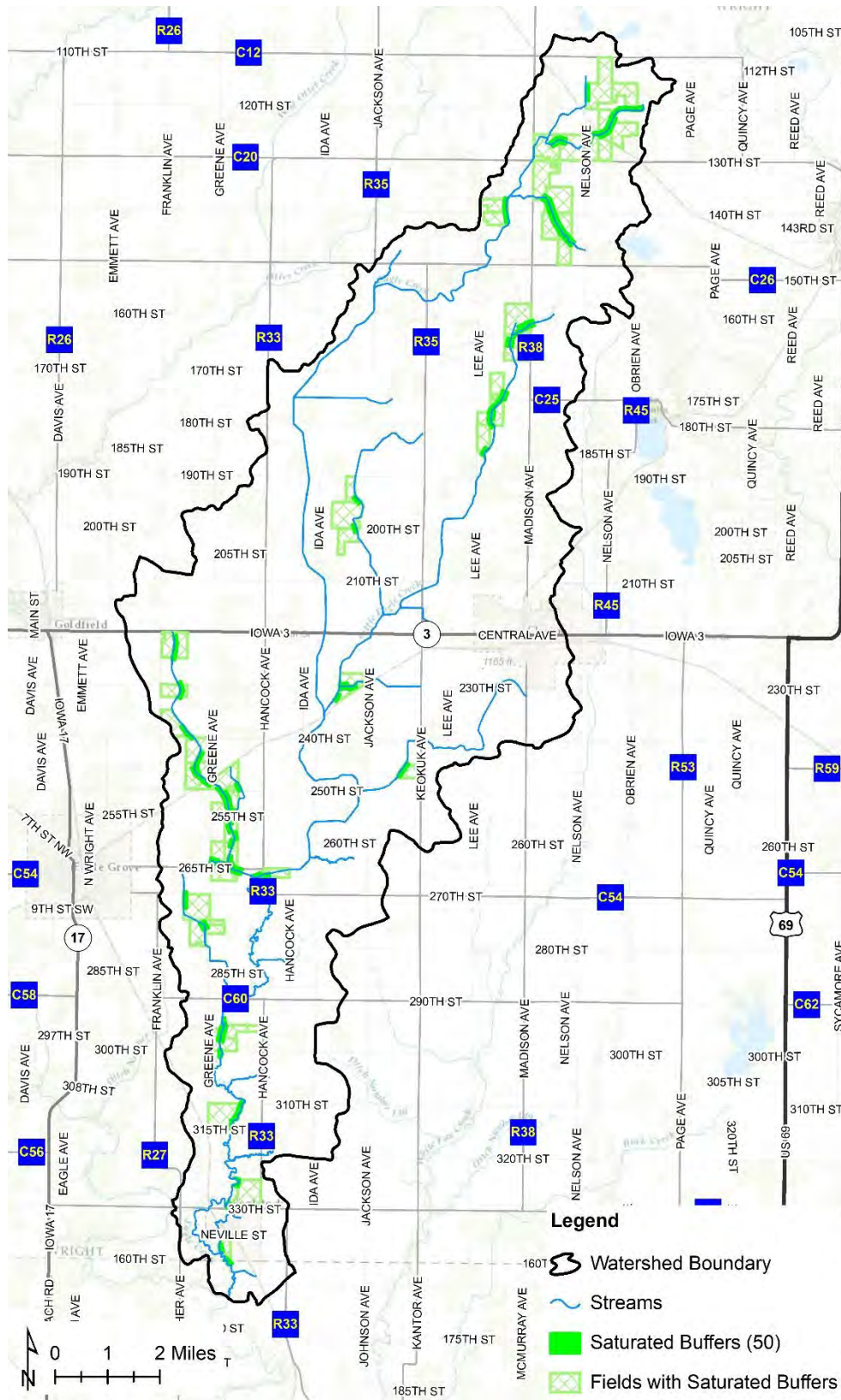


Figure A.4. Priority locations for saturated buffers.

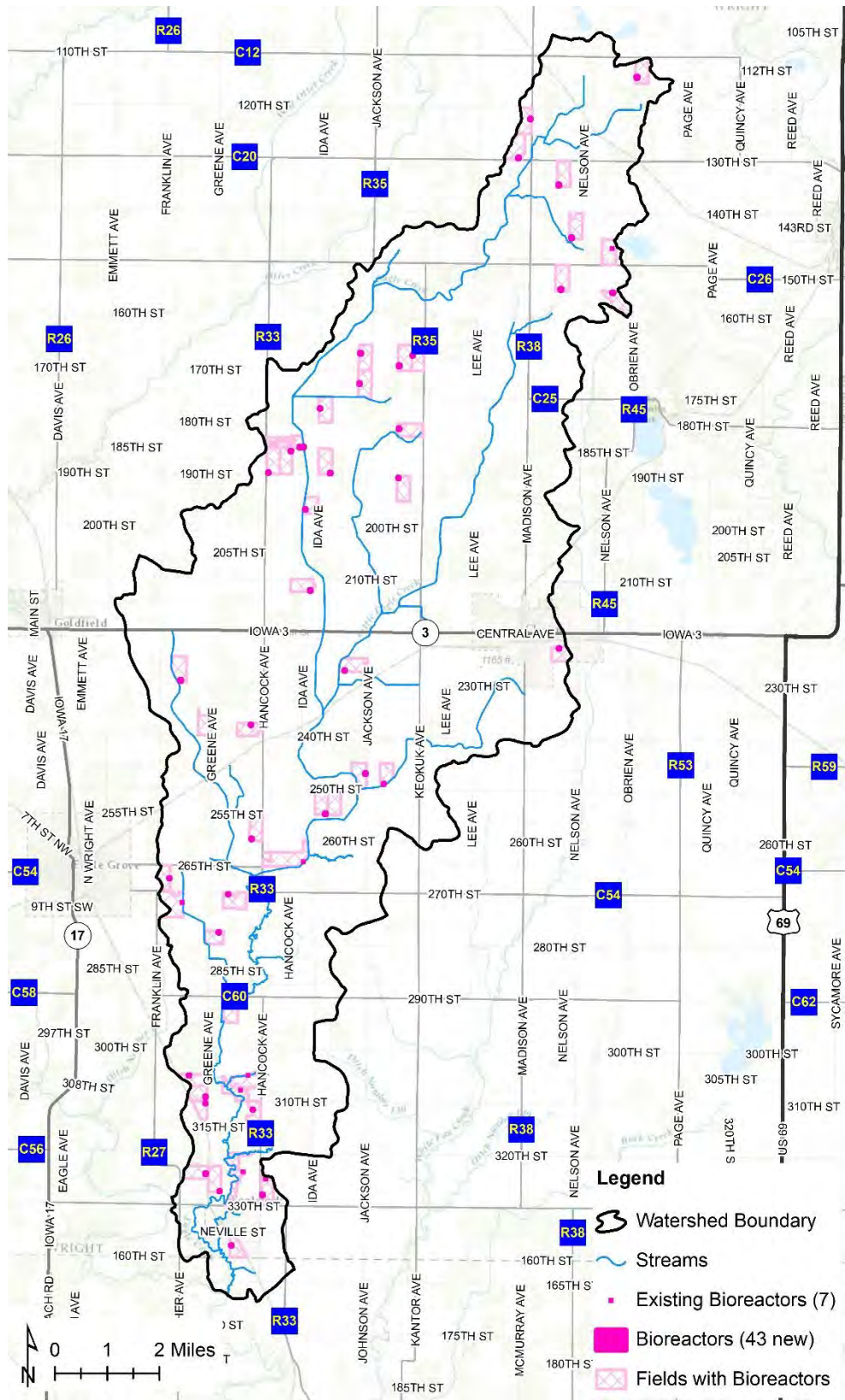


Figure A.5. Priority locations for bioreactors.

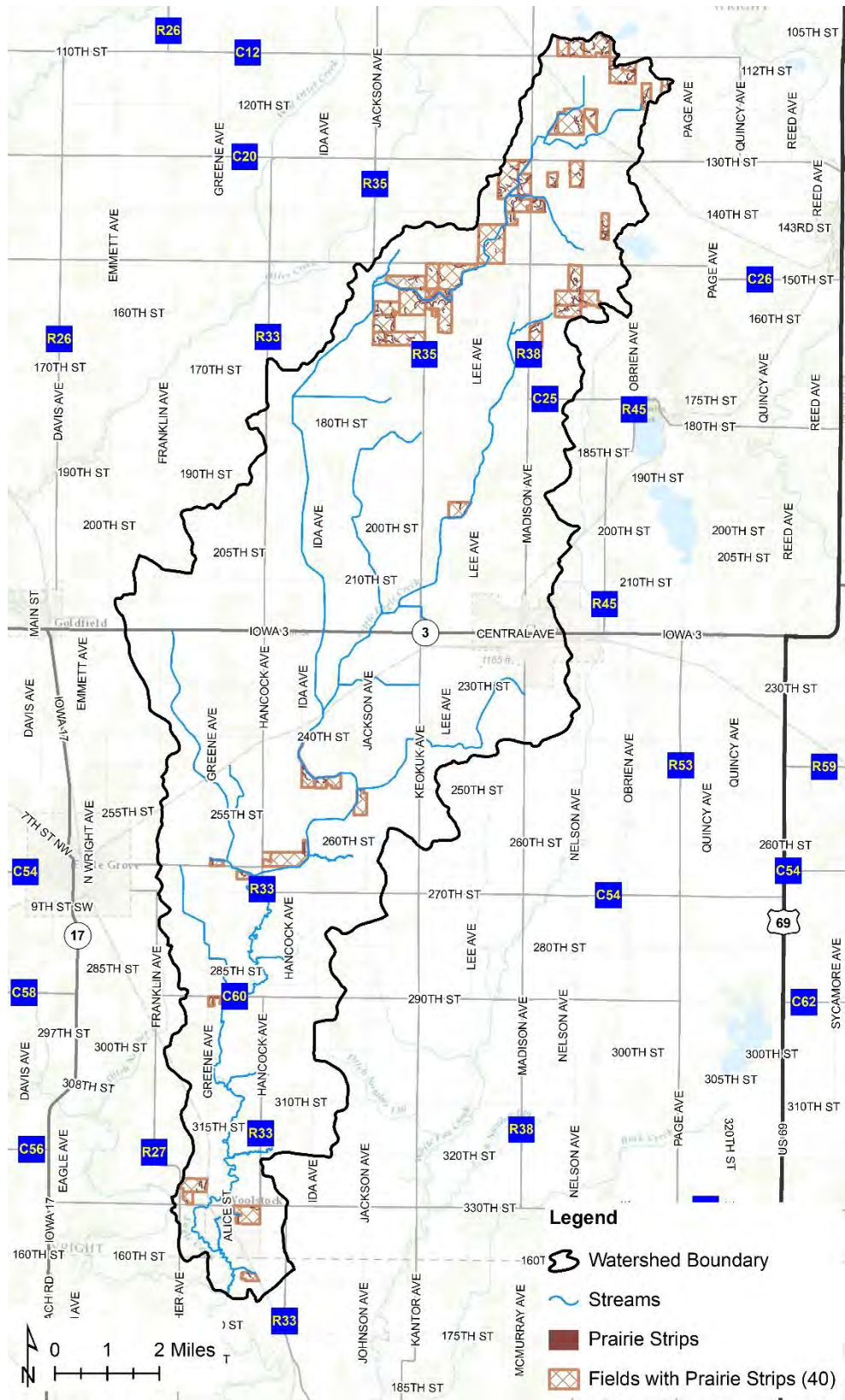


Figure A.6. Priority locations for prairie strips.

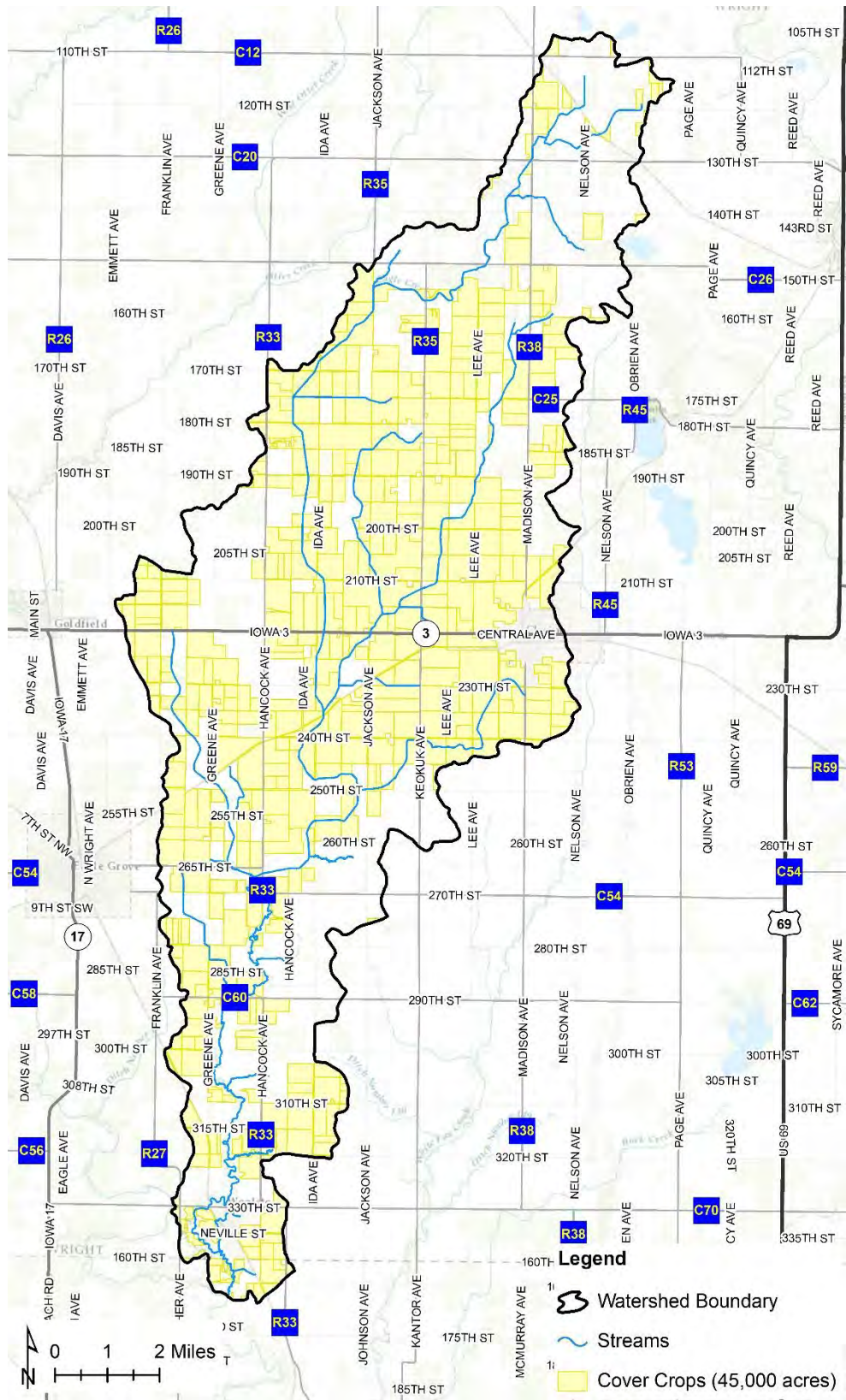


Figure A.7. Priority locations for cover crops.

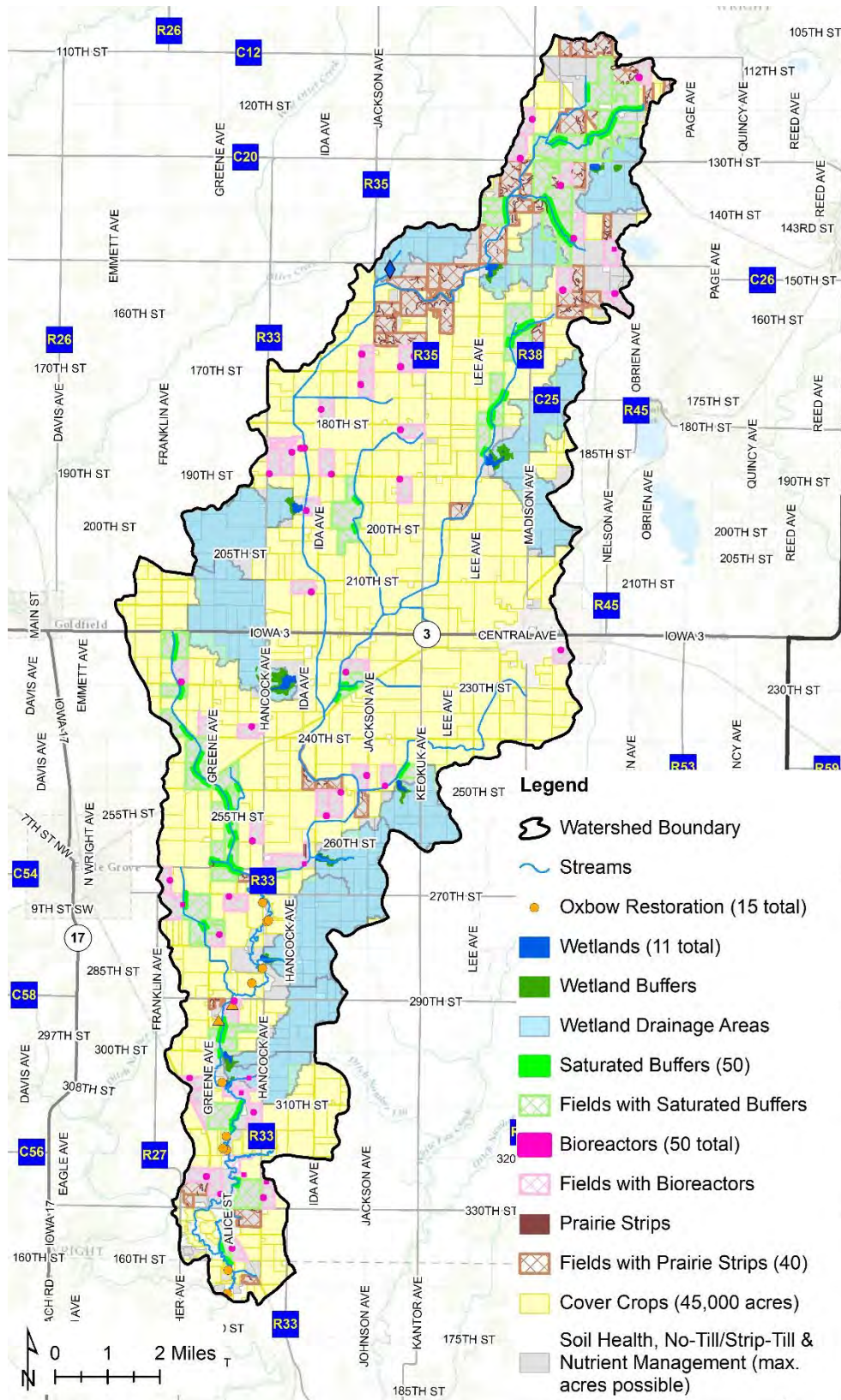


Figure A.8. Eagle Creek Watershed conceptual plan.

Appendix B: Additional Watershed Conceptual Scenarios

In addition to the conceptual plan (Figure 5.2) and implementation schedule (Table 6.1) included in the final watershed plan, watershed stakeholders also considered alternative future scenarios. Alternatives were developed using priority conservation practices, Agricultural Conservation Planning Framework mapping results (see Appendix C) and water quality models.

Three alternatives were developed and presented to watershed stakeholders. Alternatives were designed to meet Iowa Nutrient Reduction Strategy goals and verified with water quality models. Each alternative included both in-field management practices and structural edge-of-field practices, but the balance between these two categories was varied for each scenario. Watershed stakeholders selected a watershed conceptual scenario with a blended emphasis on both in-field and edge-of-field conservation practices. The other scenarios considered are presented below.

Alternative 1: Emphasize Structural Edge-of-Field Practices

Table B.1. Estimated annual management costs of up to \$1,670,000 and initial construction costs of \$15,320,000.

| Practice | Unit | Existing | Implementation Goal | Cost Per Unit | Total Cost |
|----------------------------------|------------|----------|---------------------|---------------|--------------|
| Nutrient management | acres | 3,591 | 4,000 | -\$5 | -\$20,000 |
| No-till/Strip-till | acres | 2,475 | Maximum possible | -\$10 | -\$400,000 |
| Cover crops | acres | 2,300 | 30,000 | \$50 | \$1,500,000 |
| Grassed waterways | feet | 276,293 | As needed | - | - |
| Prairie strips (Perennial cover) | fields | 1 | 50 | \$295 | \$590,000 |
| Drainage water management | fields | 4 | 50 | \$1,000 | \$4,000,000 |
| Bioreactors | structures | 7 | 80 | \$10,000 | \$730,000 |
| Saturated buffers | structures | - | 80 | \$3,000 | \$240,000 |
| Wetlands | sites | 1 | 20 | \$530,000 | \$10,070,000 |
| Oxbow restorations | sites | 2 | 30 | \$10,000 | \$280,000 |

Alternative 2: Emphasize In-Field Management Practices

Table B.2. Estimated annual management costs of up to \$2,037,000 and initial construction costs of \$3,190,000.

| Practice | Unit | Existing | Implementation Goal | Cost Per Unit | Total Cost |
|----------------------------------|------------|----------|---------------------|---------------|-------------|
| Nutrient management | acres | 3,591 | 59,800 | -\$5 | -\$299,000 |
| No-till/Strip-till | acres | 2,475 | Maximum possible | -\$10 | -\$400,000 |
| Cover crops | acres | 2,300 | 50,000 | \$50 | \$2,500,000 |
| Grassed waterways | feet | 276,293 | As needed | - | - |
| Prairie strips (Perennial cover) | fields | 1 | 20 | \$295 | \$236,000 |
| Drainage water management | fields | 4 | - | \$1,000 | - |
| Bioreactors | structures | 7 | 20 | \$10,000 | \$130,000 |
| Saturated buffers | structures | - | 20 | \$3,000 | \$60,000 |
| Wetlands | sites | 1 | 4 | \$990,000 | \$2,970,000 |
| Oxbow restorations | sites | 2 | 5 | \$10,000 | \$30,000 |

Appendix C: 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

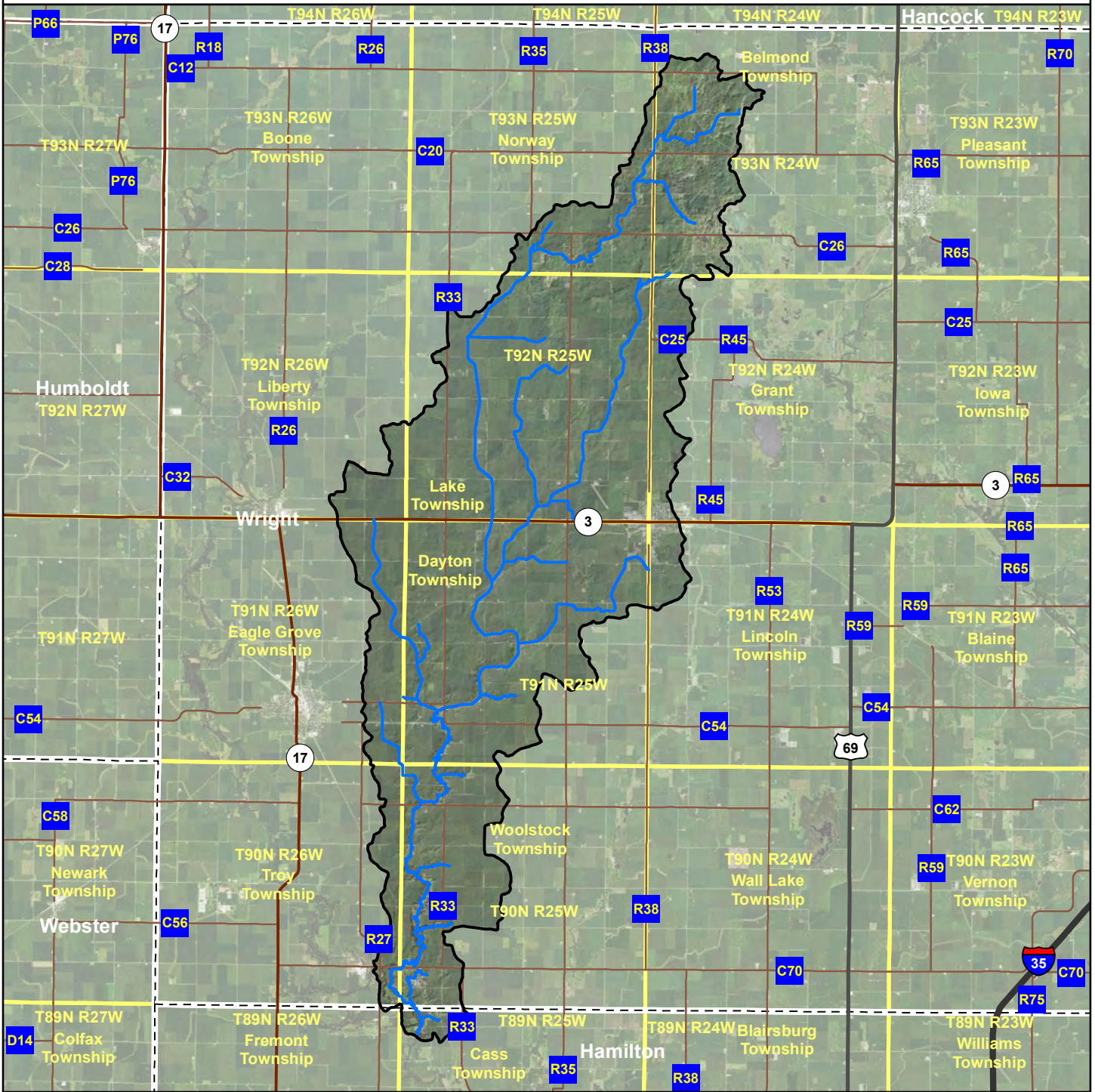
1. Watershed Overview
2. Land Use: Watershed & HUC-12 Subwatersheds
3. Tile Drainage: Watershed & HUC-12 Subwatersheds
4. Runoff Risk: Watershed & HUC-12 Subwatersheds
5. Drainage Treatment Practices: Entire Watershed & Individual Townships
6. Runoff Control Practices: Entire Watershed & Individual Townships
7. Riparian Management Practices: Entire Watershed & Individual Townships

References

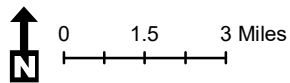
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Eagle Creek Watershed (0710000504)

Agricultural Conservation Planning Framework Results Atlas



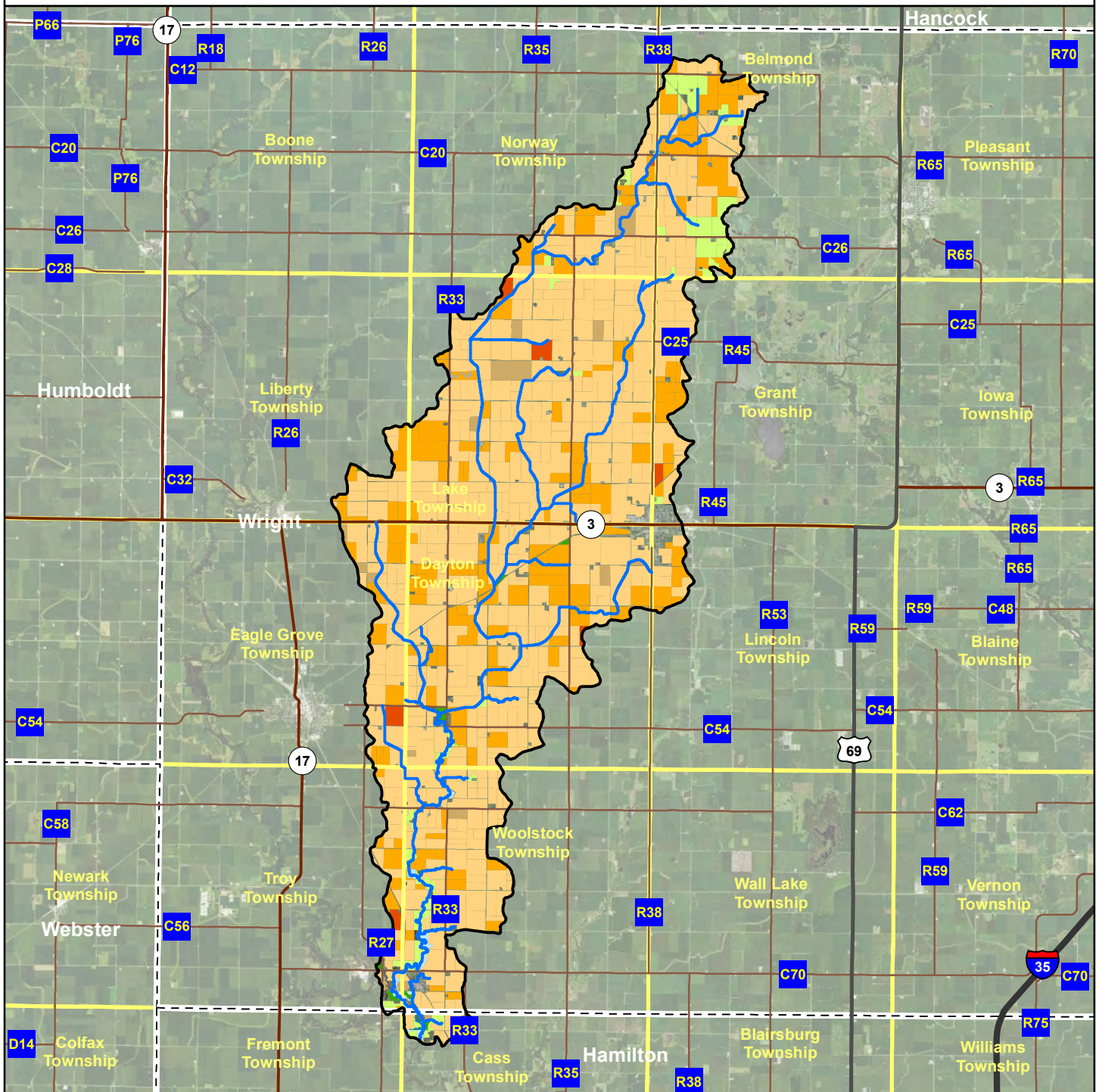
- Watershed Boundary
- Streams



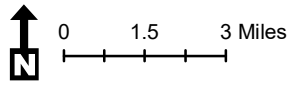
Analysis performed by
Environmental Programs & Services
 Data and tools provided by USDA-ARS

Eagle Creek Watershed (0710000504)

Agricultural Conservation Planning Framework Land Use

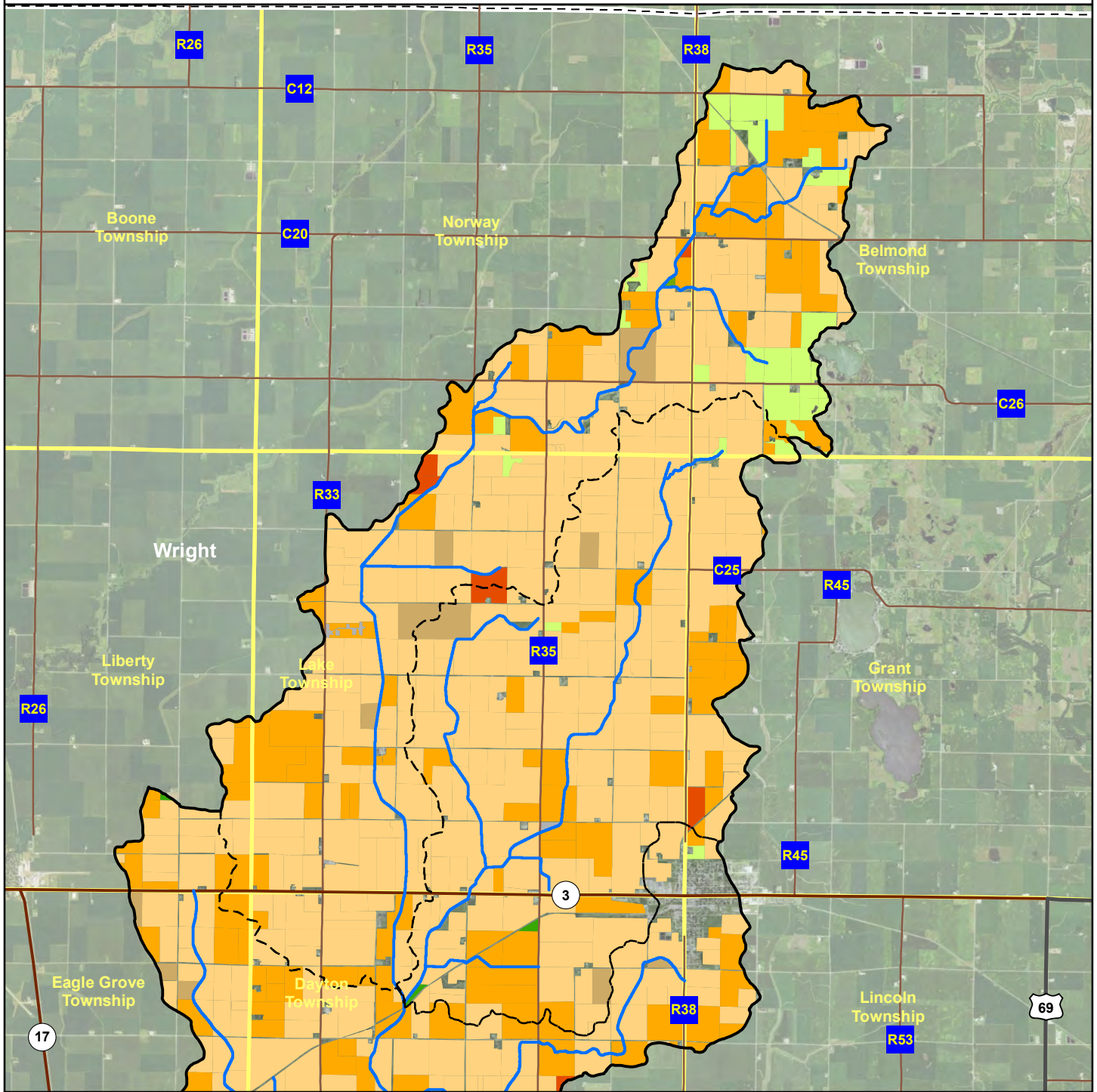














- | | | |
|--------------------|------------------------------|-------------------------|
| Watershed Boundary | Land Use | Corn/Perennial Rotation |
| Streams | Corn/Soybeans | Flood-prone Cropland |
| | C/S with Continuous Corn | Water/wetland |
| | Continuous Corn | Pasture |
| | C/S with Continuous Soybeans | Urban |
| | C/S/Perennial Rotation | |

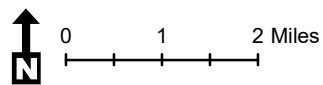



Analysis performed by
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Little Eagle Creek & Headwaters Eagle Creek (071000050401 & 071000050402) Agricultural Conservation Planning Framework Land Use

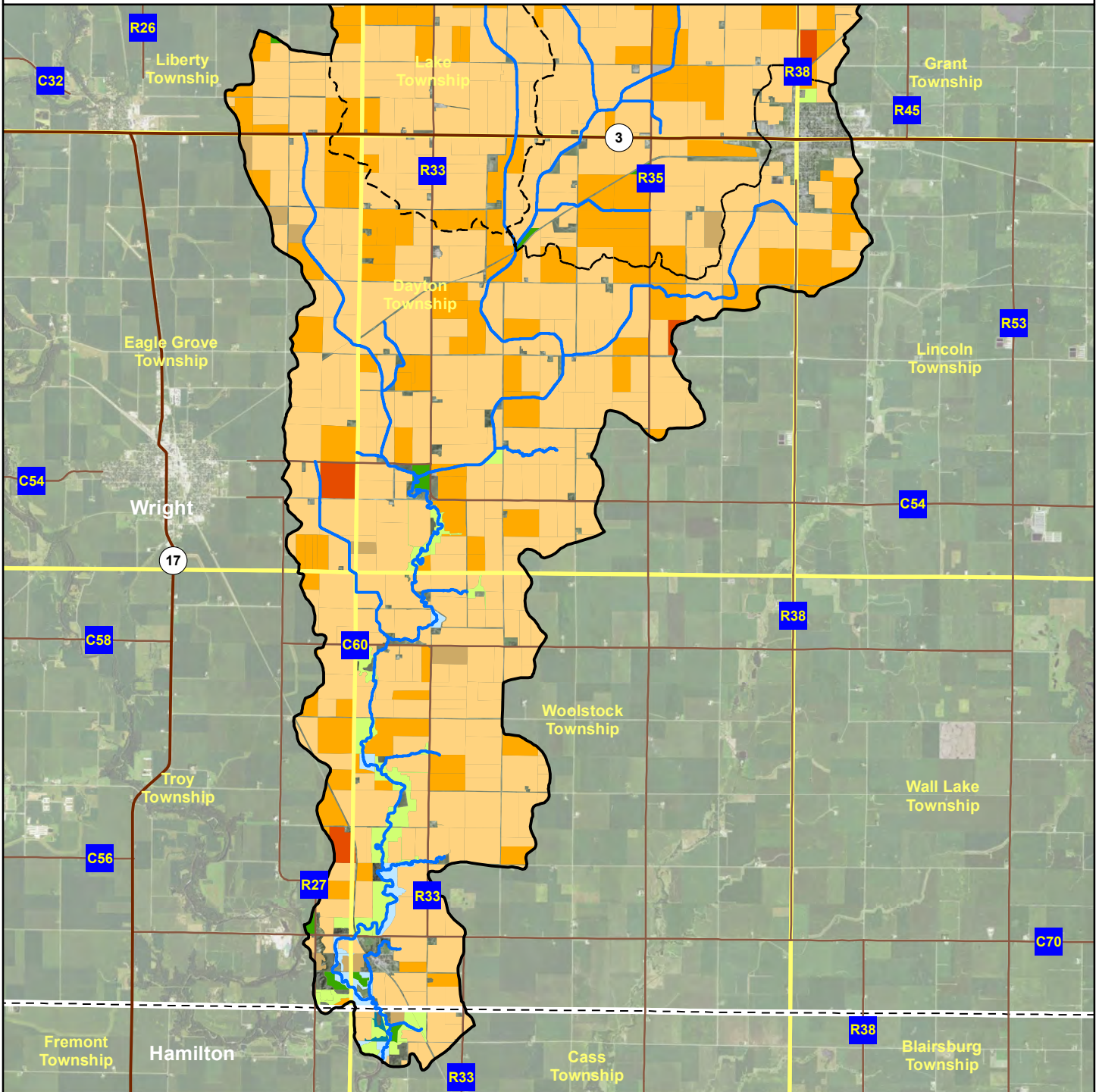


| | | |
|--|--|---|
|  Watershed Boundary | Land Use |  Corn/Perennial Rotation |
|  Streams |  Corn/Soybeans |  Flood-prone Cropland |
| |  C/S with Continuous Corn |  Water/wetland |
| |  Continuous Corn |  Pasture |
| |  C/S with Continuous Soybeans |  Urban |
| |  C/S/Perennial Rotation | |

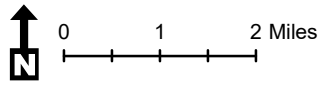


Analysis performed by
 **Environmental Programs & Services**
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Eagle Creek (071000050403) Agricultural Conservation Planning Framework Land Use



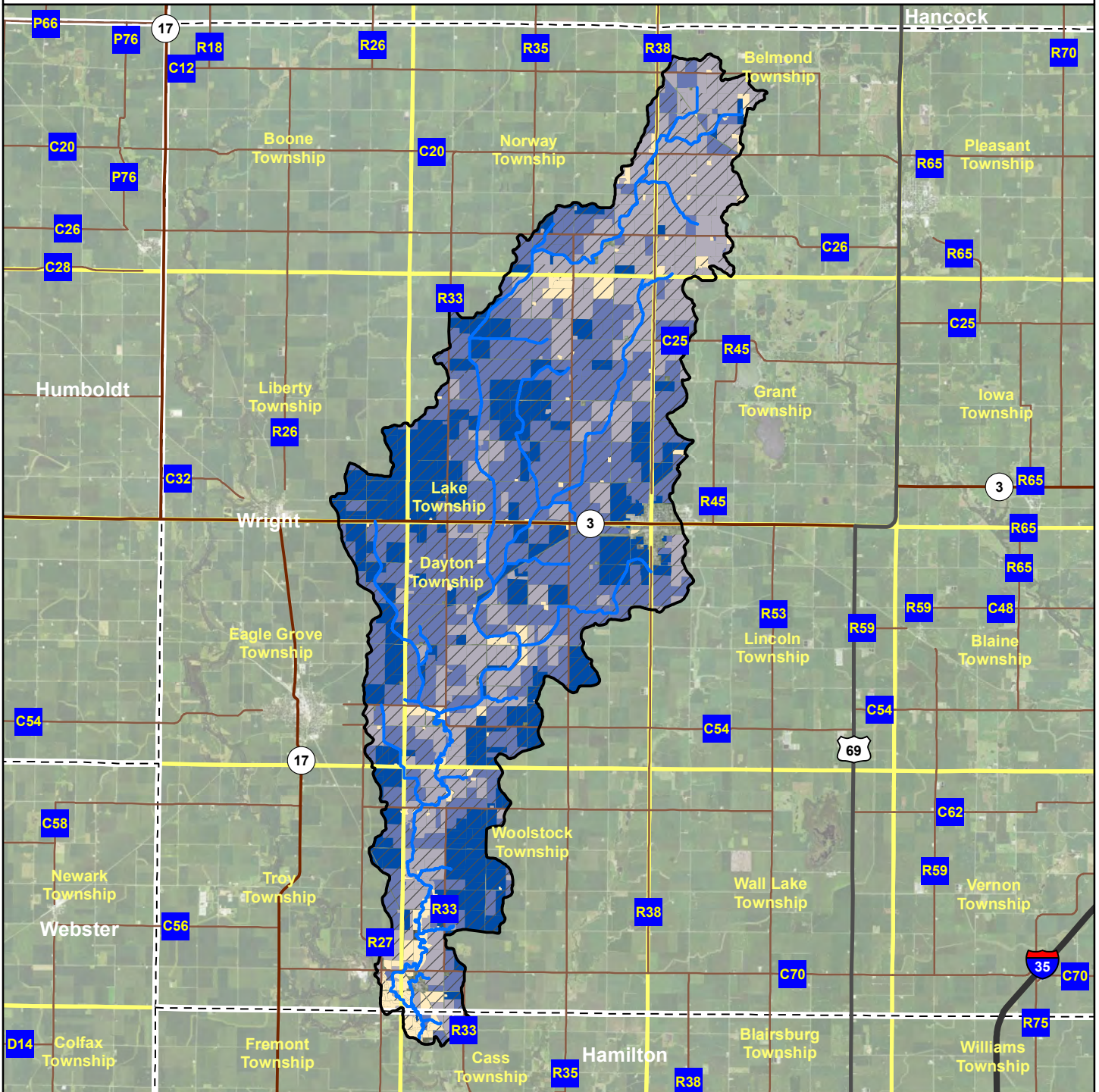
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|--------------------|------------------------------|-------------------------|
| Watershed Boundary | Land Use | Corn/Perennial Rotation |
| Streams | Corn/Soybeans | Flood-prone Cropland |
| | C/S with Continuous Corn | Water/wetland |
| | Continuous Corn | Pasture |
| | C/S with Continuous Soybeans | Urban |
| | C/S/Perennial Rotation | |



Analysis performed by
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Eagle Creek Watershed (0710000504)

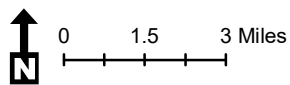
Agricultural Conservation Planning Framework Tile Drainage



Watershed Boundary **Percent Hydric Soils**

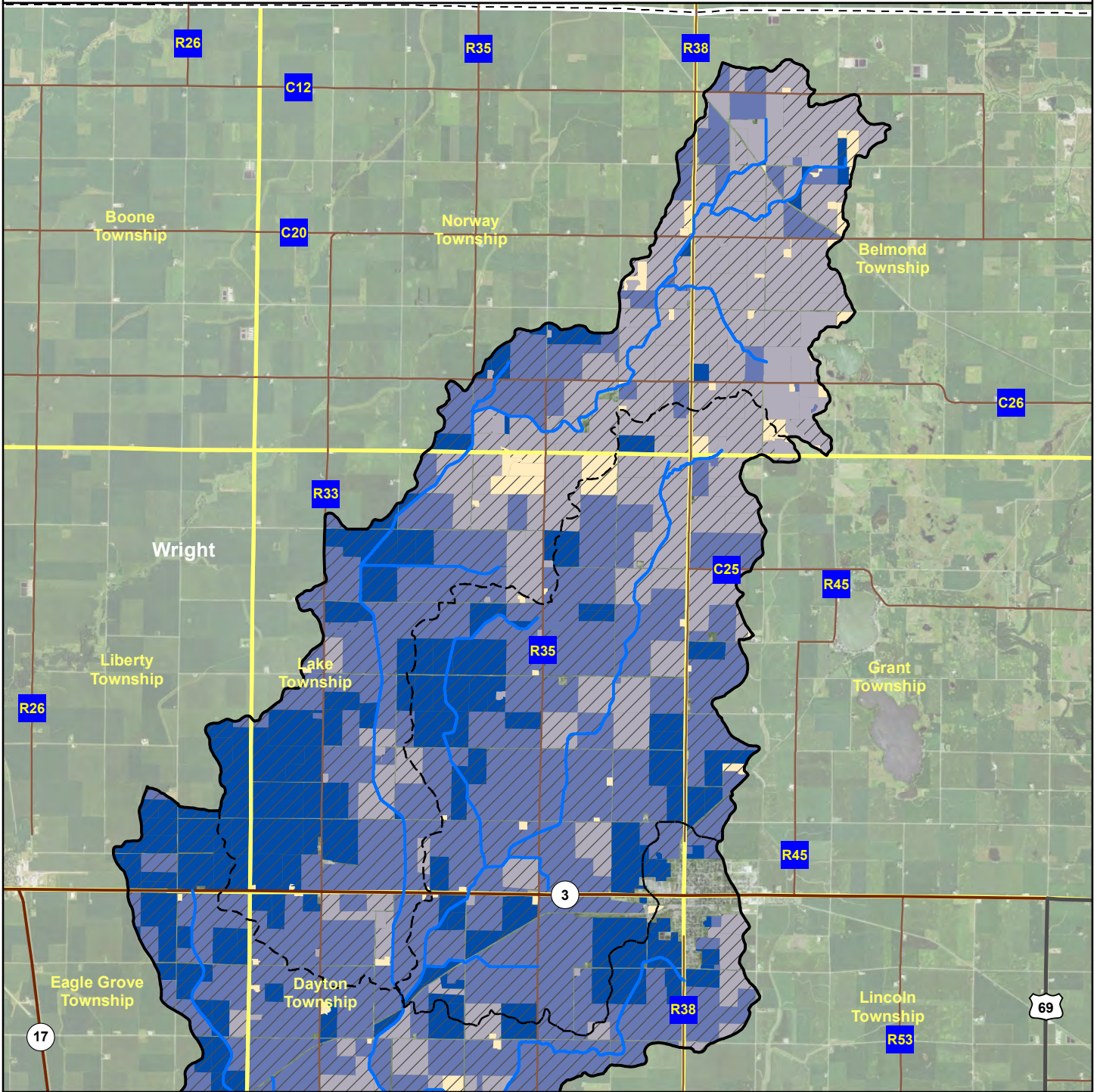
- Streams
- Tile Drainage Likely

| | |
|--|------------|
| | 75 to 100% |
| | 50 to 75% |
| | 25 to 50% |
| | 0 to 25% |



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Little Eagle Creek & Headwaters Eagle Creek (071000050401 & 071000050402) Agricultural Conservation Planning Framework Tile Drainage

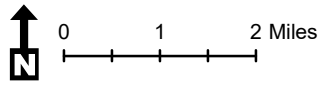


Watershed Boundary **Percent Hydric Soils**

Streams

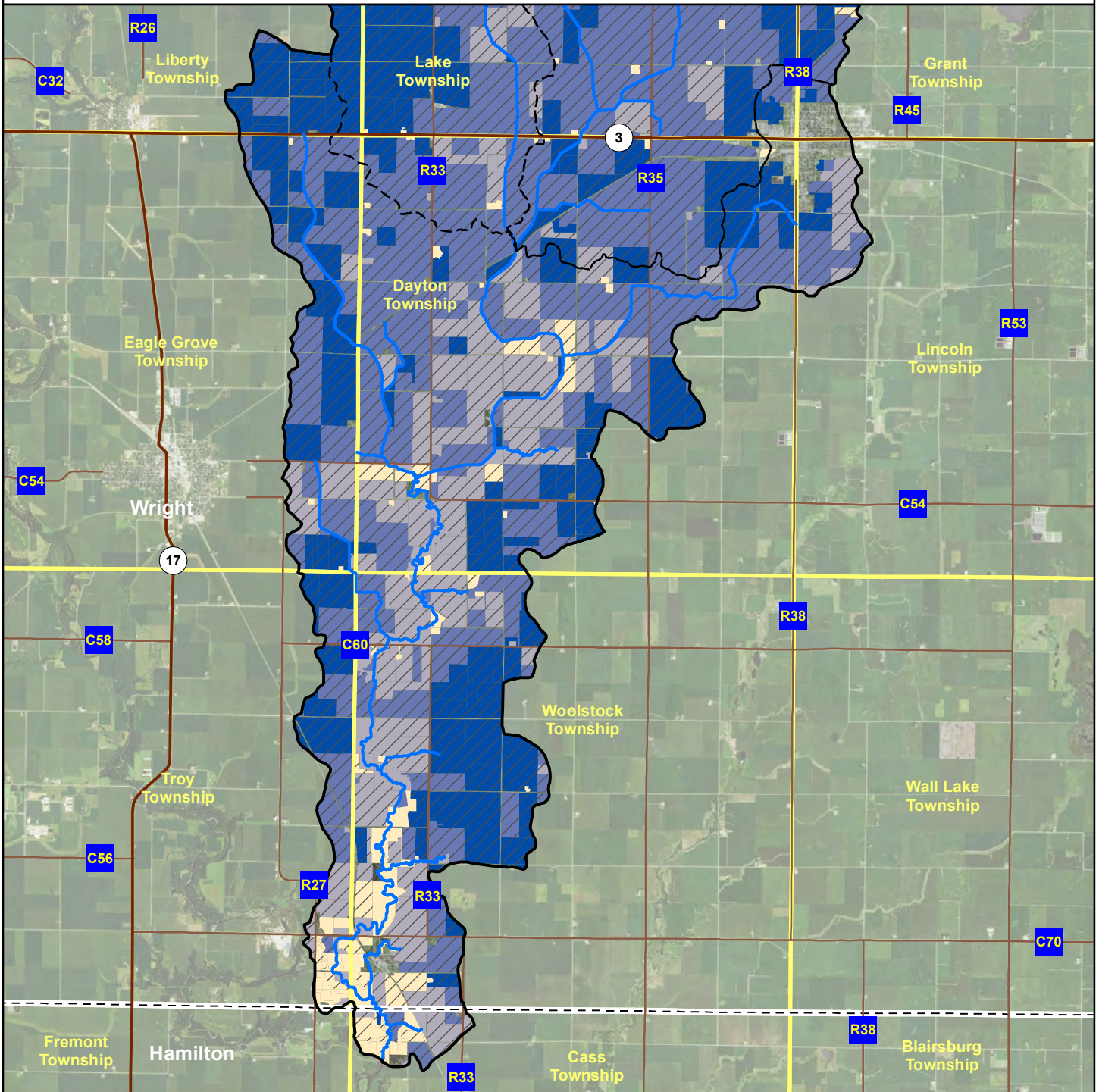
Tile Drainage Likely

| | |
|--|------------|
| | 75 to 100% |
| | 50 to 75% |
| | 25 to 50% |
| | 0 to 25% |

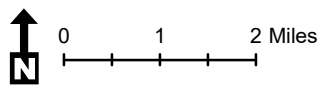


Analysis performed by
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Eagle Creek (071000050403) Agricultural Conservation Planning Framework Tile Drainage



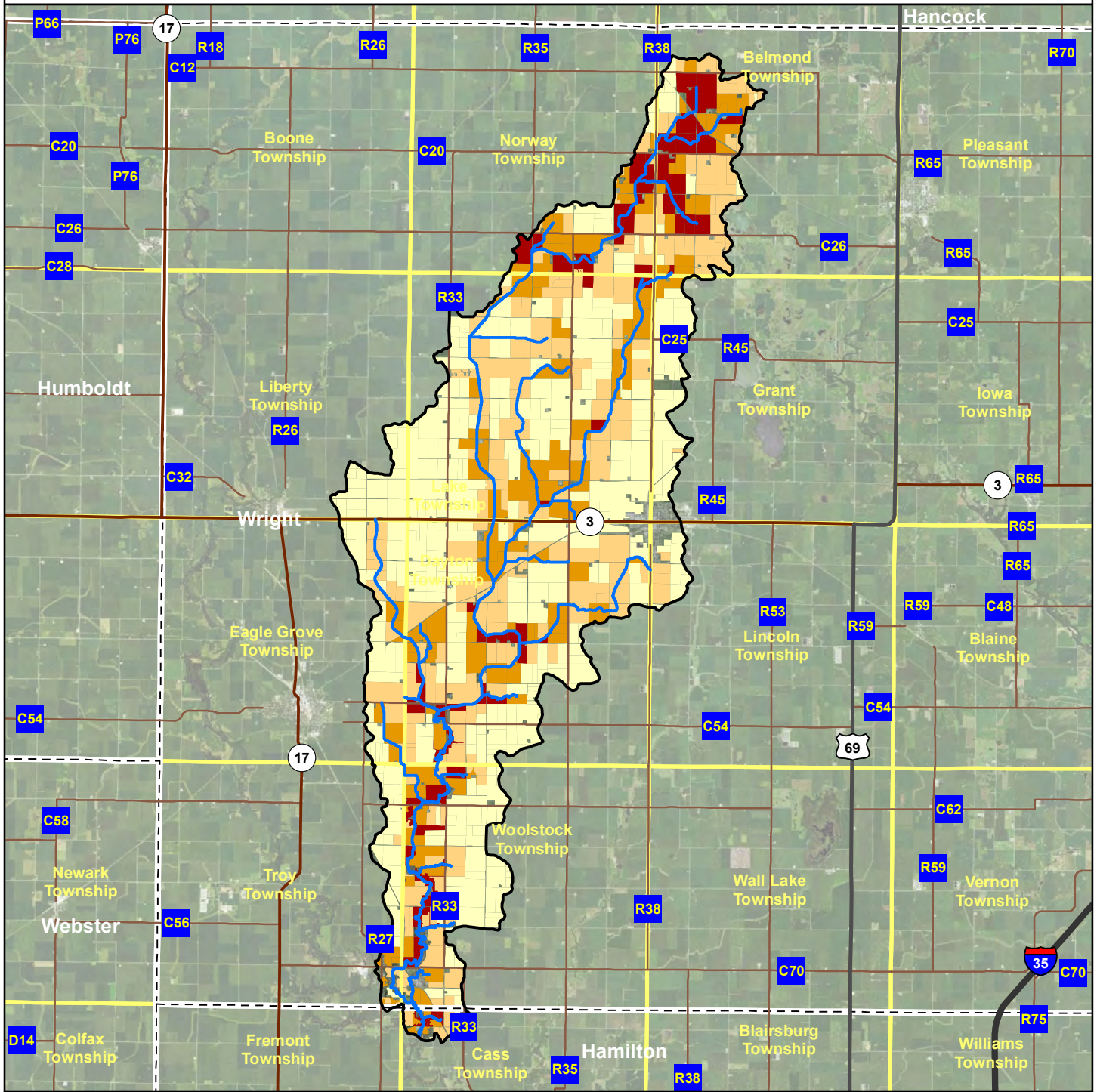
| | |
|----------------------|-----------------------------|
| Watershed Boundary | Percent Hydric Soils |
| Streams | 75 to 100% |
| Tile Drainage Likely | 50 to 75% |
| | 25 to 50% |
| | 0 to 25% |



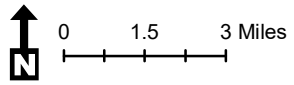
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Eagle Creek Watershed (0710000504)

Agricultural Conservation Planning Framework Runoff Risk

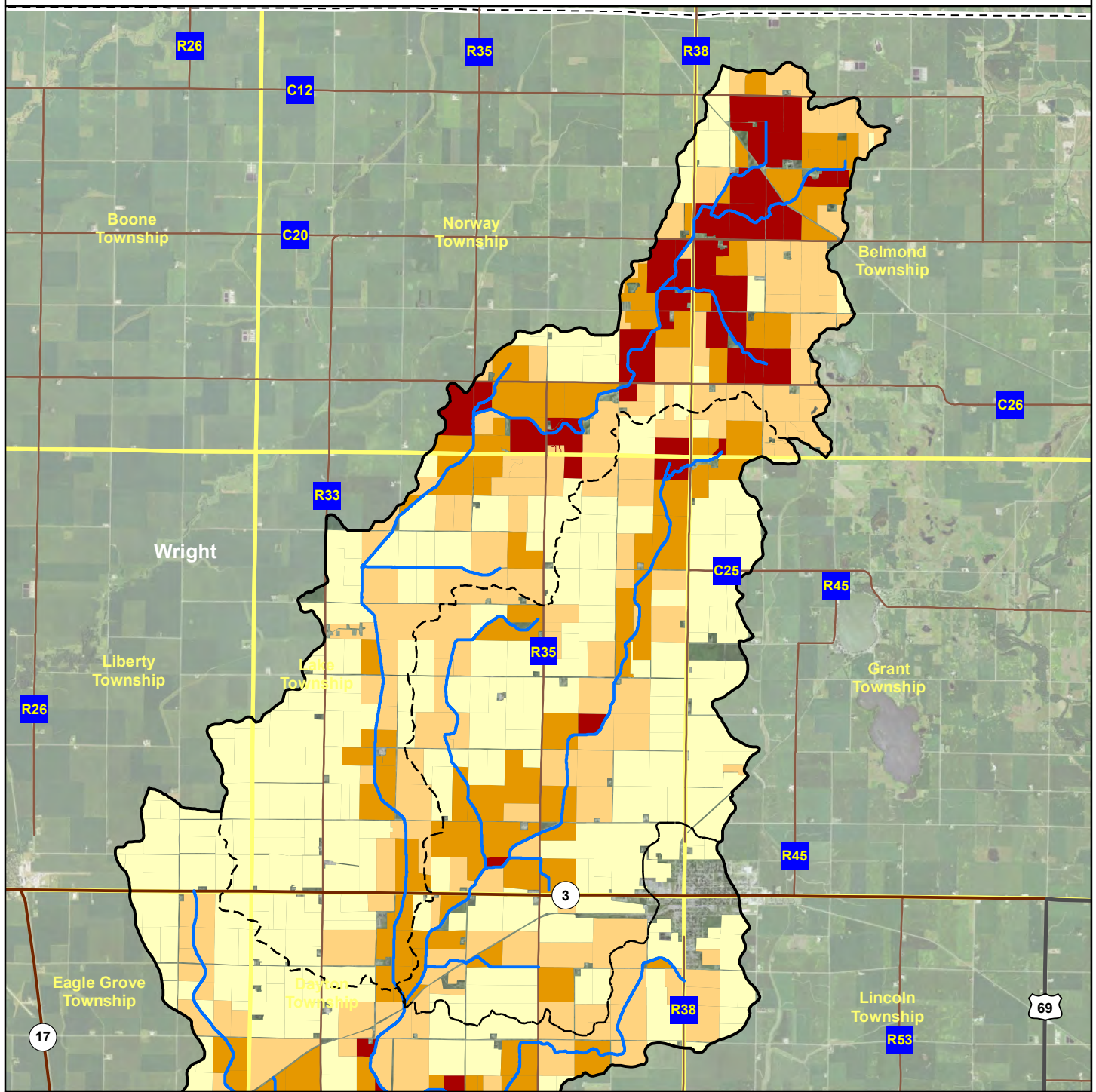








- Watershed Boundary
- Streams
- Runoff Risk**
- Critical
- Very High
- High
- Present

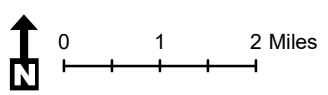


Analysis performed by
Environmental Programs & Services
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Little Eagle Creek & Headwaters Eagle Creek (071000050401 & 071000050402) Agricultural Conservation Planning Framework Runoff Risk

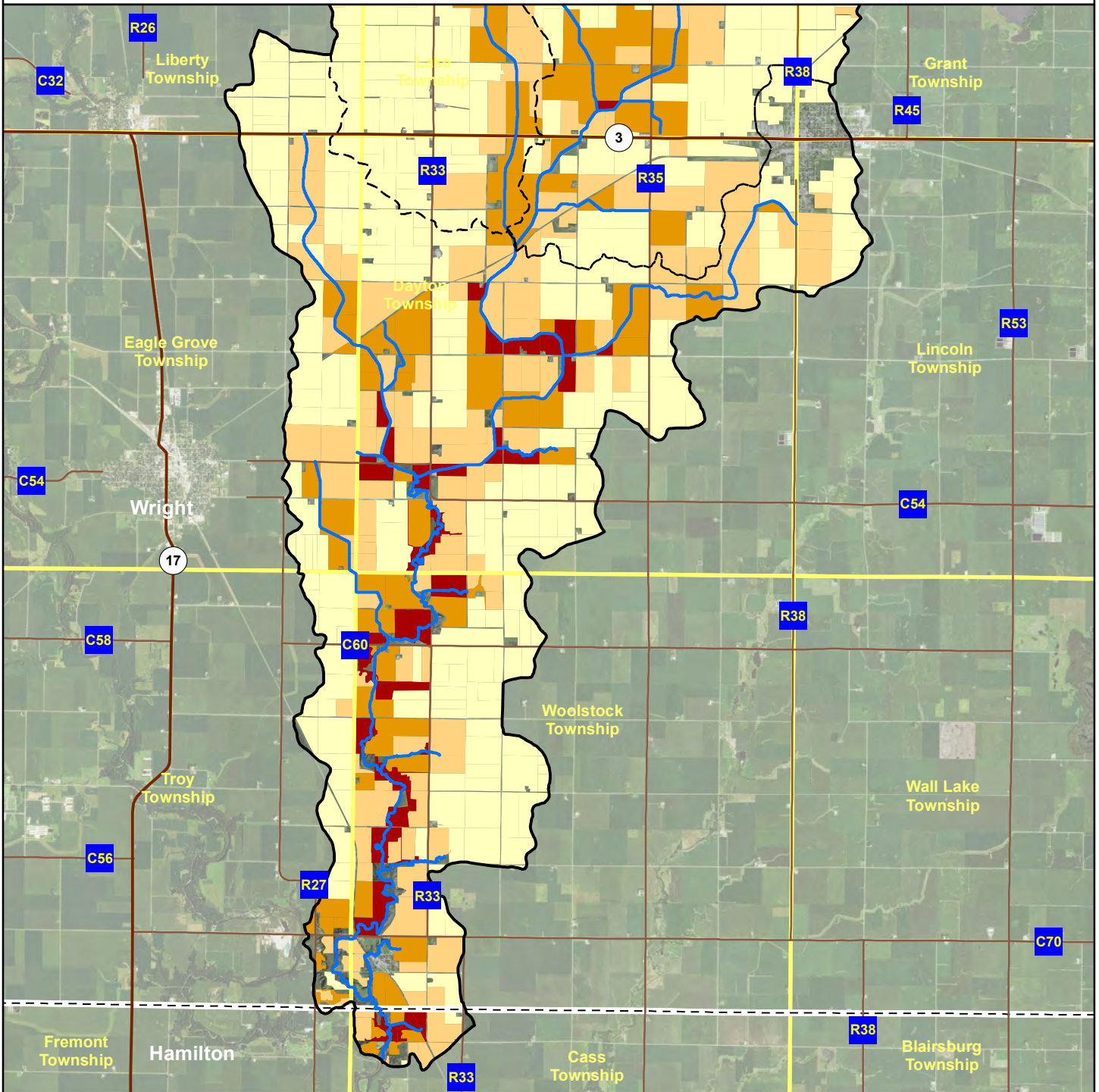








-  Watershed Boundary
-  Streams
- Runoff Risk**
-  Critical
-  Very High
-  High
-  Present

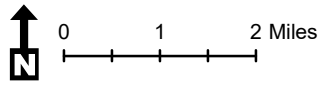



Analysis performed by
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Eagle Creek (071000050403) Agricultural Conservation Planning Framework Runoff Risk



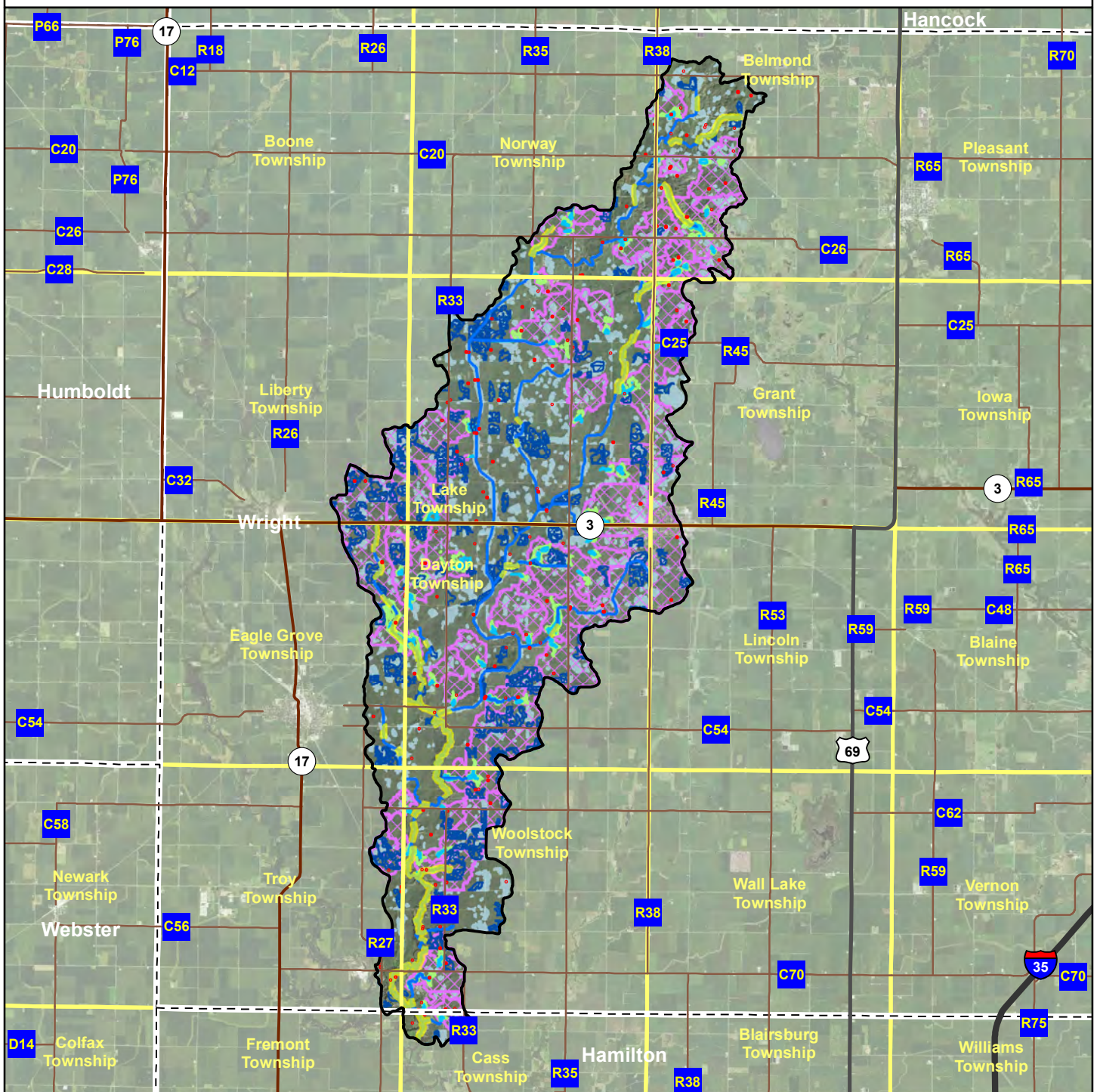
-  Watershed Boundary
-  Streams
- Runoff Risk**
-  Critical
-  Very High
-  High
-  Present



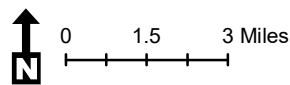
Analysis performed by

 Data and tools provided by USDA-ARS

Eagle Creek Watershed (0710000504)

Agricultural Conservation Planning Framework Drainage Treatment Practices



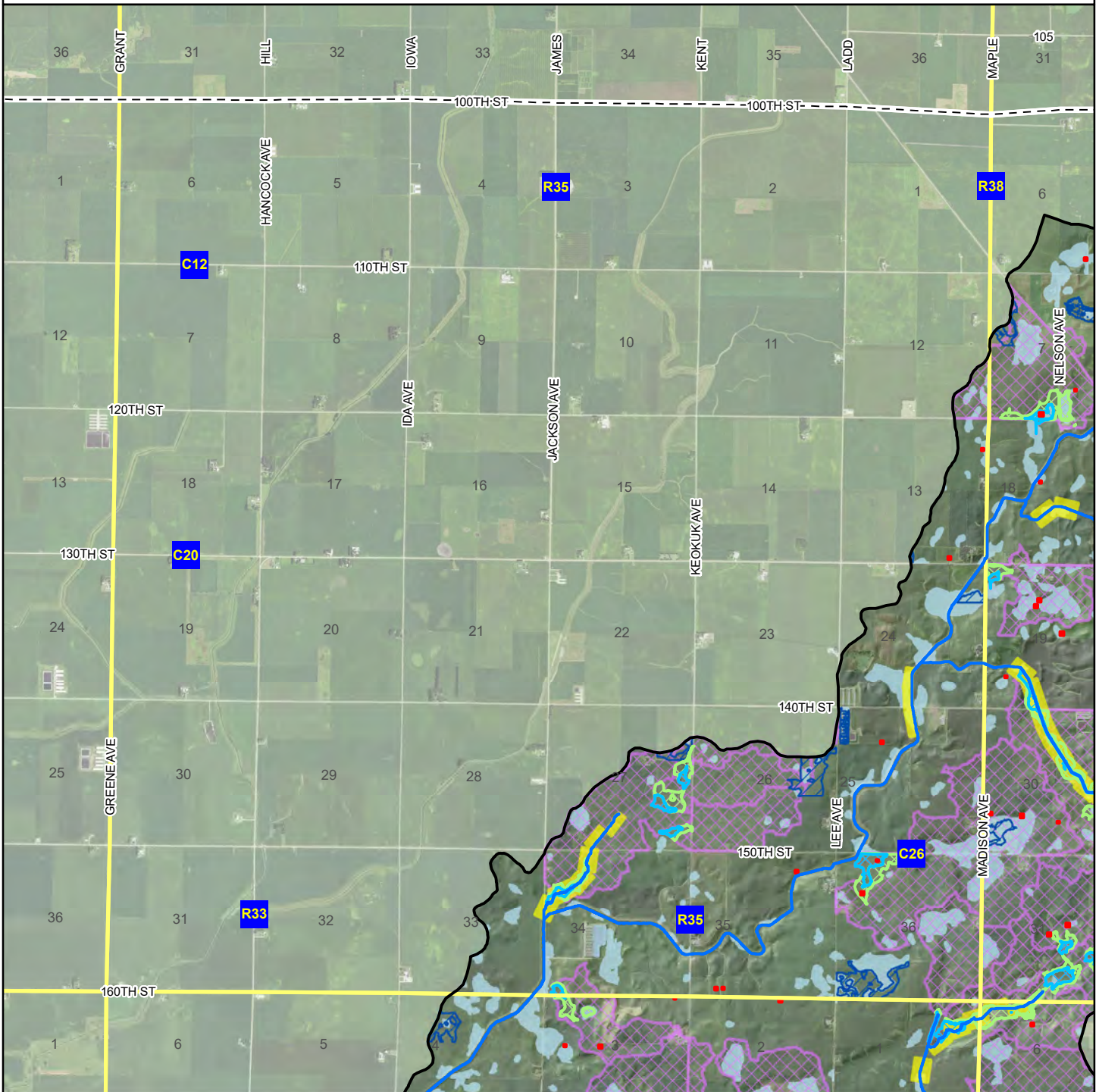
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|---------------------------|---|
| Watershed Boundary | Nitrate Removal Wetlands |
| Streams | Wetland Buffers |
| Bioreactors | Wetland Drainage Areas |
| Saturated Buffers | Depressions (Perennial Cover, Intake Buffers) |
| Drainage Water Management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



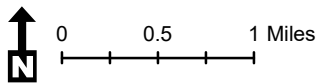
Analysis performed by
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Eagle Creek Watershed (0710000504) T93N R25W

Agricultural Conservation Planning Framework Drainage Treatment Practices

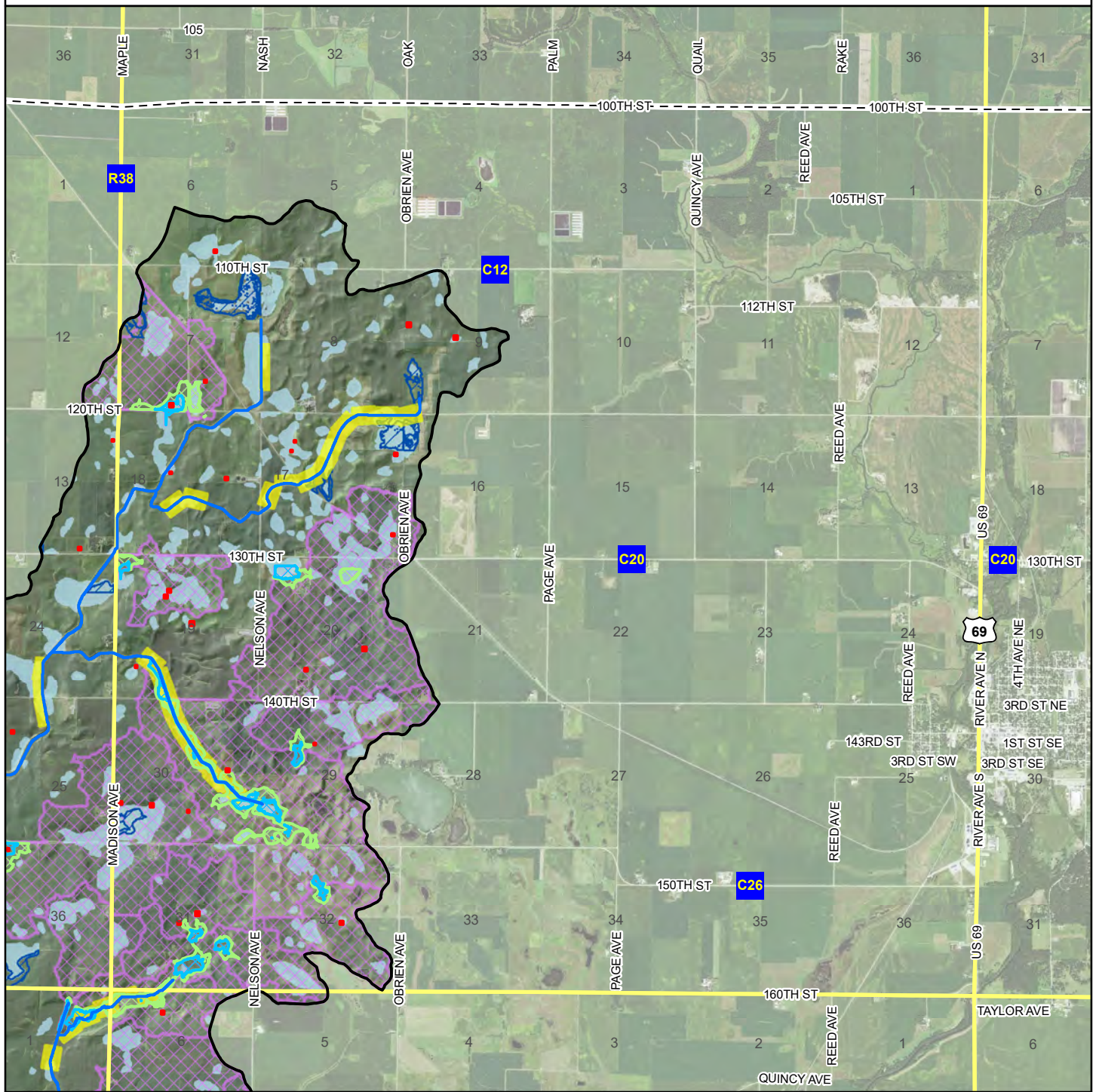


- | | |
|---------------------------|---|
| Watershed Boundary | Nitrate Removal Wetlands |
| Streams | Wetland Buffers |
| Bioreactors | Wetland Drainage Areas |
| Saturated Buffers | Depressions (Perennial Cover, Intake Buffers) |
| Drainage Water Management | |

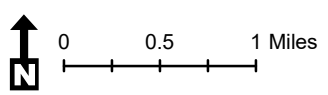


Eagle Creek Watershed (0710000504) T93N R24W

Agricultural Conservation Planning Framework Drainage Treatment Practices

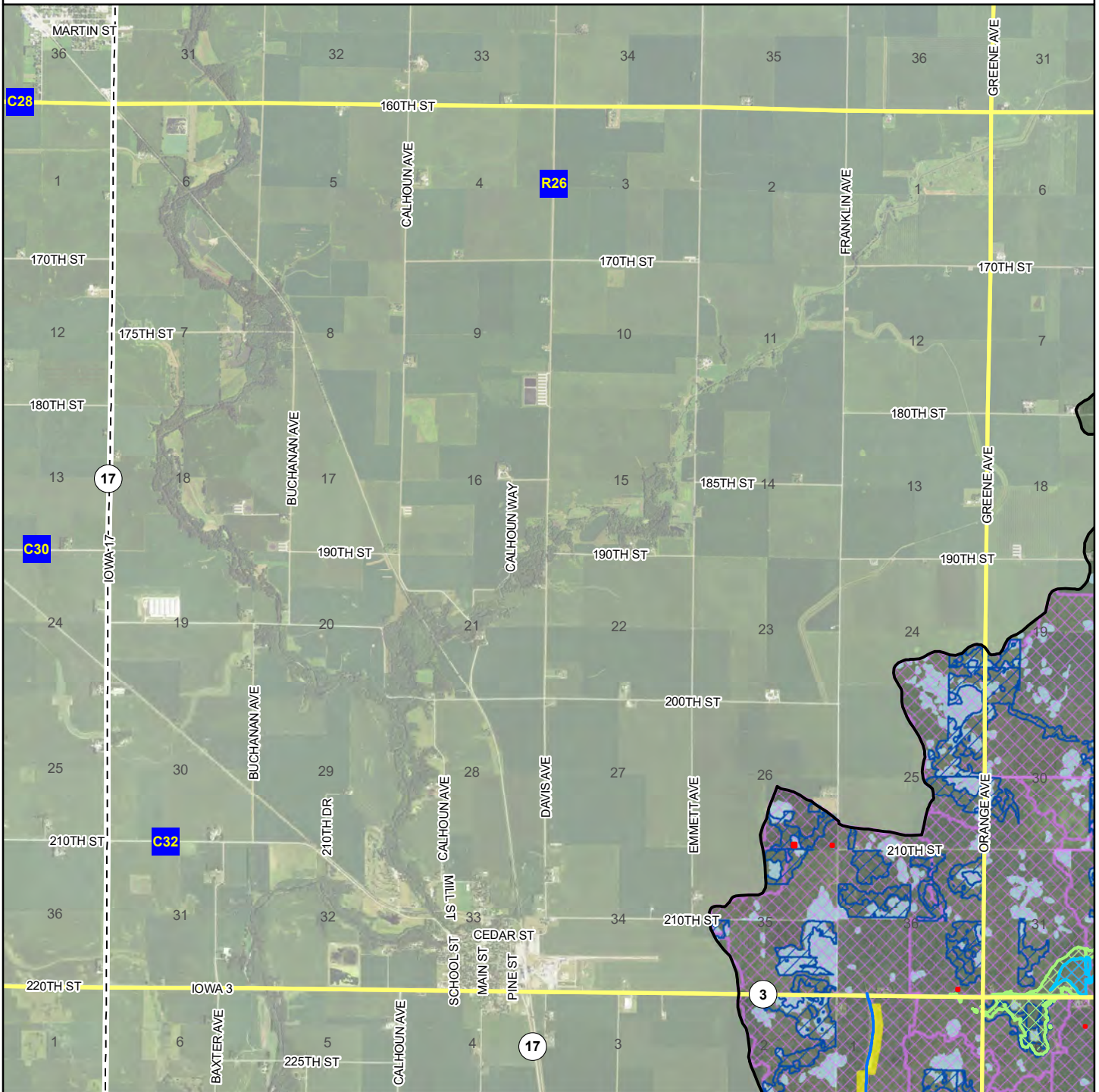


- | | |
|---------------------------|---|
| Watershed Boundary | Nitrate Removal Wetlands |
| Streams | Wetland Buffers |
| Bioreactors | Wetland Drainage Areas |
| Saturated Buffers | Depressions (Perennial Cover, Intake Buffers) |
| Drainage Water Management | |

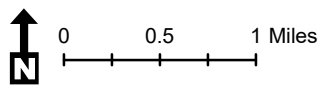


Eagle Creek Watershed (0710000504) T92N R26W

Agricultural Conservation Planning Framework Drainage Treatment Practices

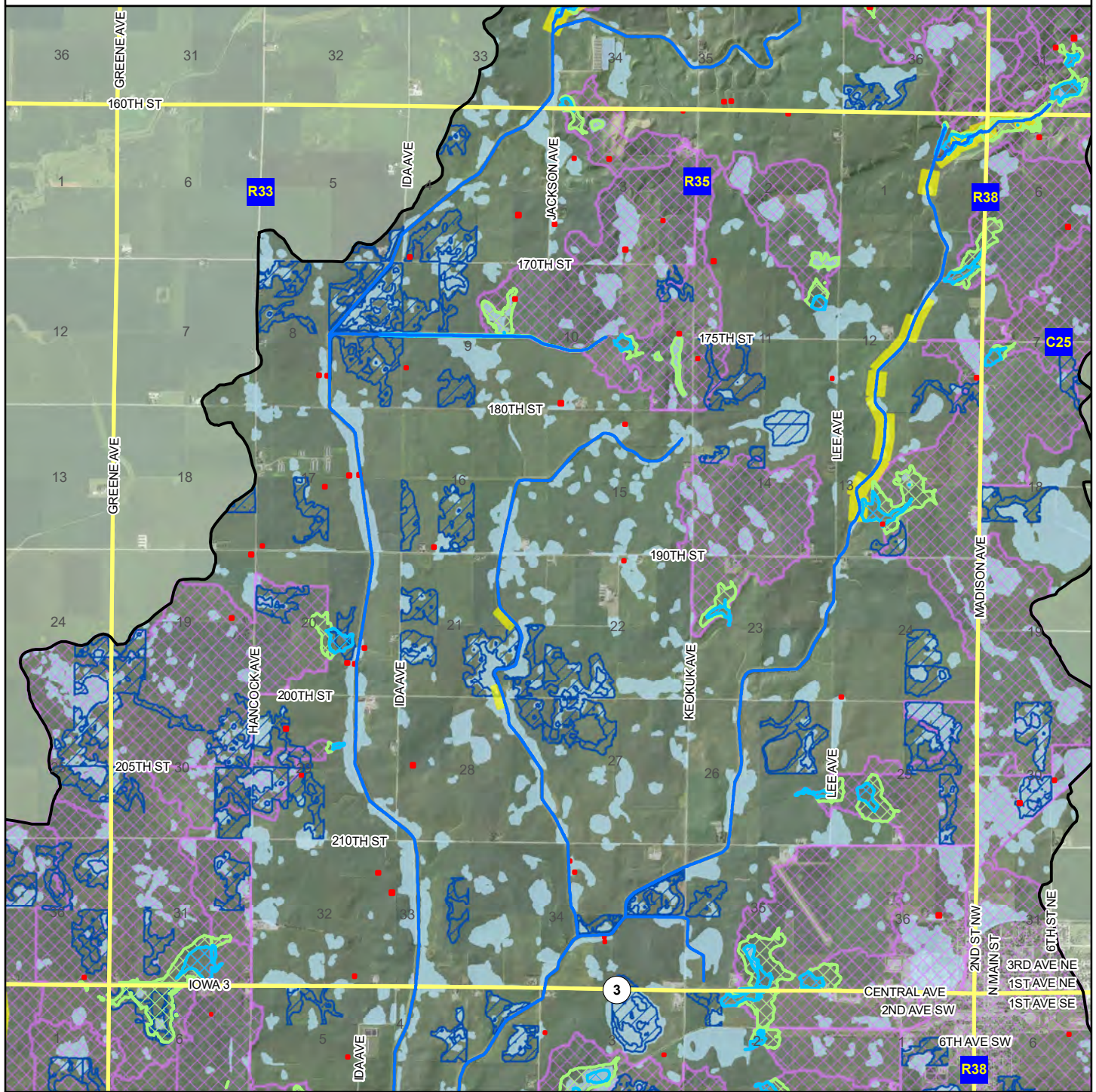


- | | |
|---------------------------|---|
| Watershed Boundary | Nitrate Removal Wetlands |
| Streams | Wetland Buffers |
| Bioreactors | Wetland Drainage Areas |
| Saturated Buffers | Depressions (Perennial Cover, Intake Buffers) |
| Drainage Water Management | |

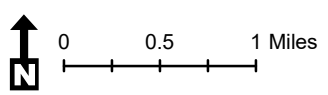


Eagle Creek Watershed (0710000504) T92N R25W

Agricultural Conservation Planning Framework Drainage Treatment Practices

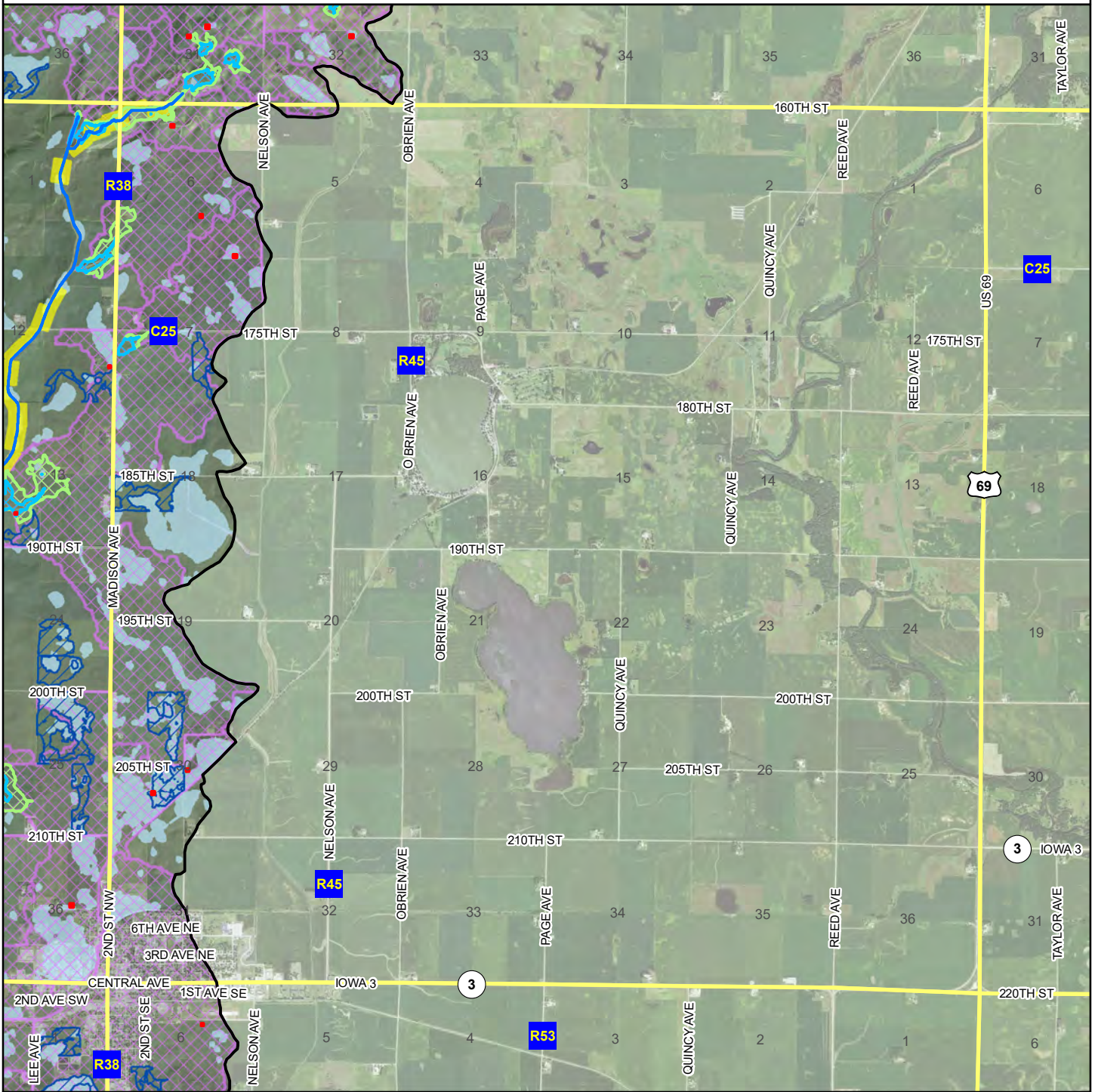


- | | |
|---------------------------|---|
| Watershed Boundary | Nitrate Removal Wetlands |
| Streams | Wetland Buffers |
| Bioreactors | Wetland Drainage Areas |
| Saturated Buffers | Depressions (Perennial Cover, Intake Buffers) |
| Drainage Water Management | |

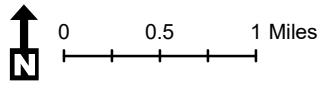


Eagle Creek Watershed (0710000504) T92N R24W

Agricultural Conservation Planning Framework Drainage Treatment Practices



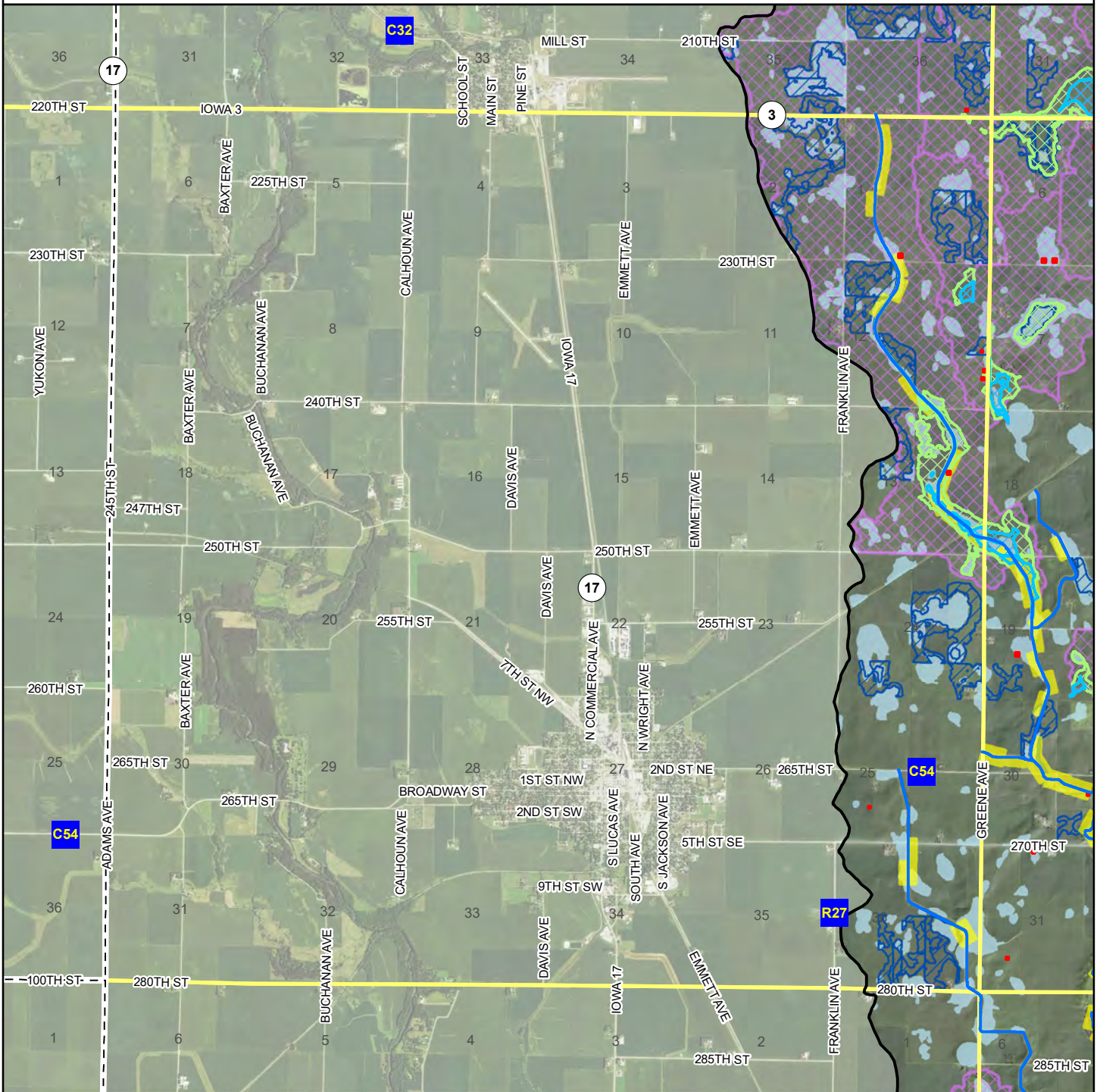
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|---------------------------|---|
| Watershed Boundary | Nitrate Removal Wetlands |
| Streams | Wetland Buffers |
| Bioreactors | Wetland Drainage Areas |
| Saturated Buffers | Depressions (Perennial Cover, Intake Buffers) |
| Drainage Water Management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



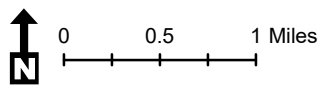
Analysis performed by
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Eagle Creek Watershed (0710000504) T91N R26W

Agricultural Conservation Planning Framework Drainage Treatment Practices

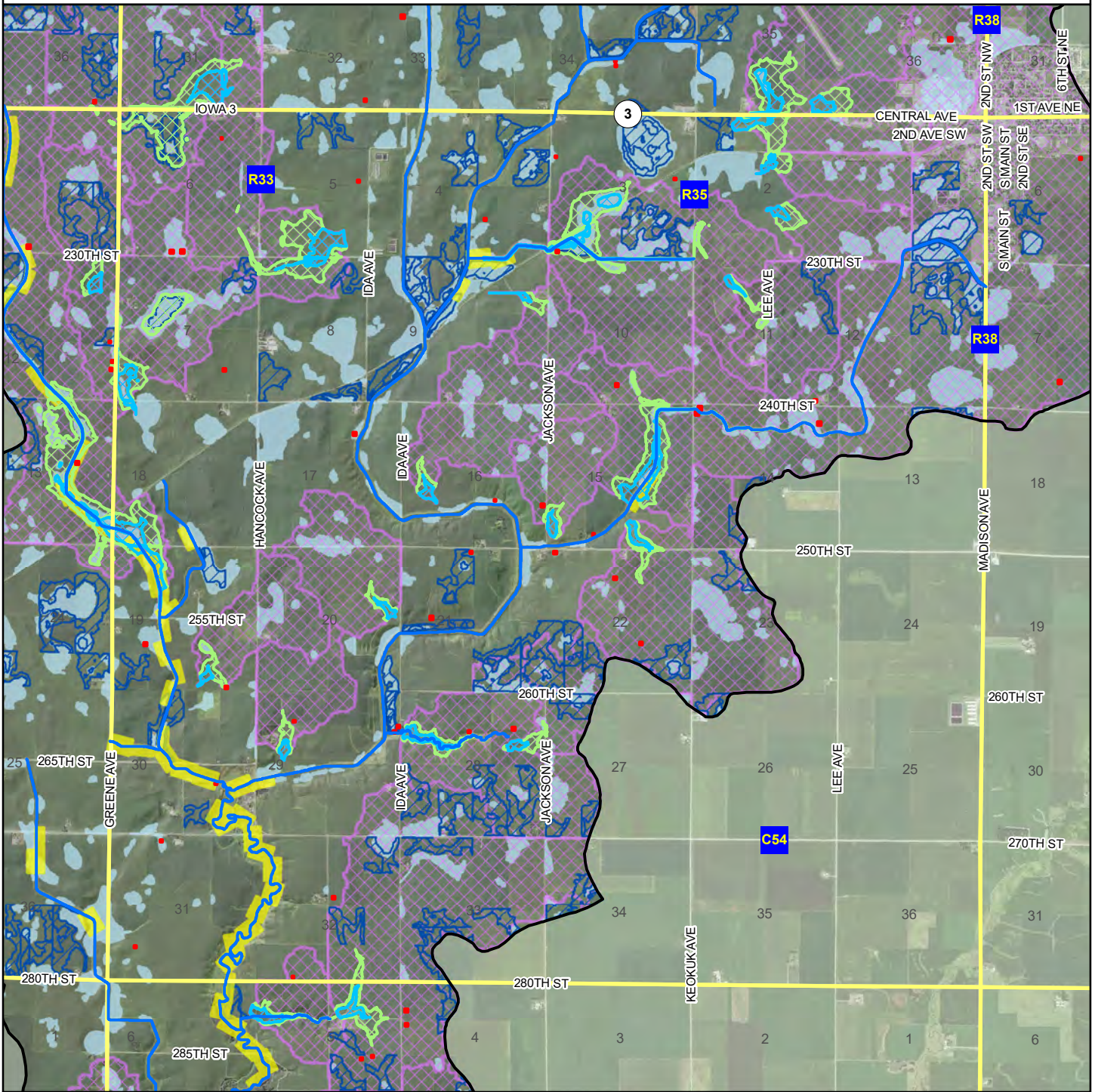


-  Watershed Boundary
-  Streams
-  Bioreactors
-  Saturated Buffers
-  Drainage Water Management
-  Nitrate Removal Wetlands
-  Wetland Buffers
-  Wetland Drainage Areas
-  Depressions (Perennial Cover, Intake Buffers)

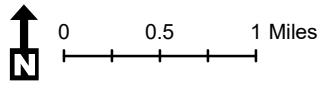



Eagle Creek Watershed (0710000504) T91N R25W

Agricultural Conservation Planning Framework Drainage Treatment Practices



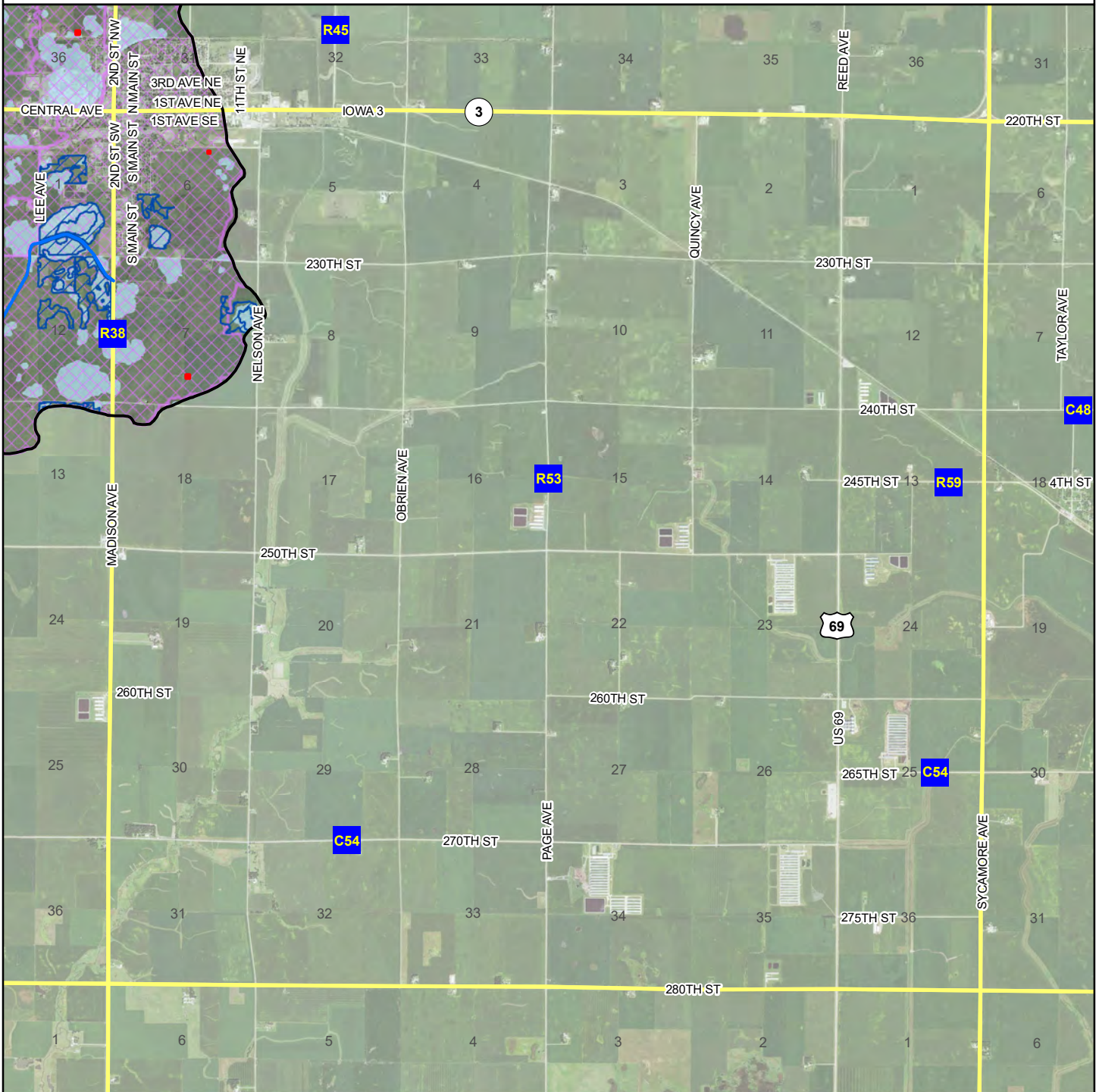
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|  Watershed Boundary |  Nitrate Removal Wetlands |
|  Streams |  Wetland Buffers |
|  Bioreactors |  Wetland Drainage Areas |
|  Saturated Buffers |  Depressions (Perennial Cover, Intake Buffers) |
|  Drainage Water Management | |



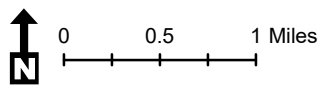
Analysis performed by

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 Data and tools provided by USDA-ARS

Eagle Creek Watershed (0710000504) T91N R24W

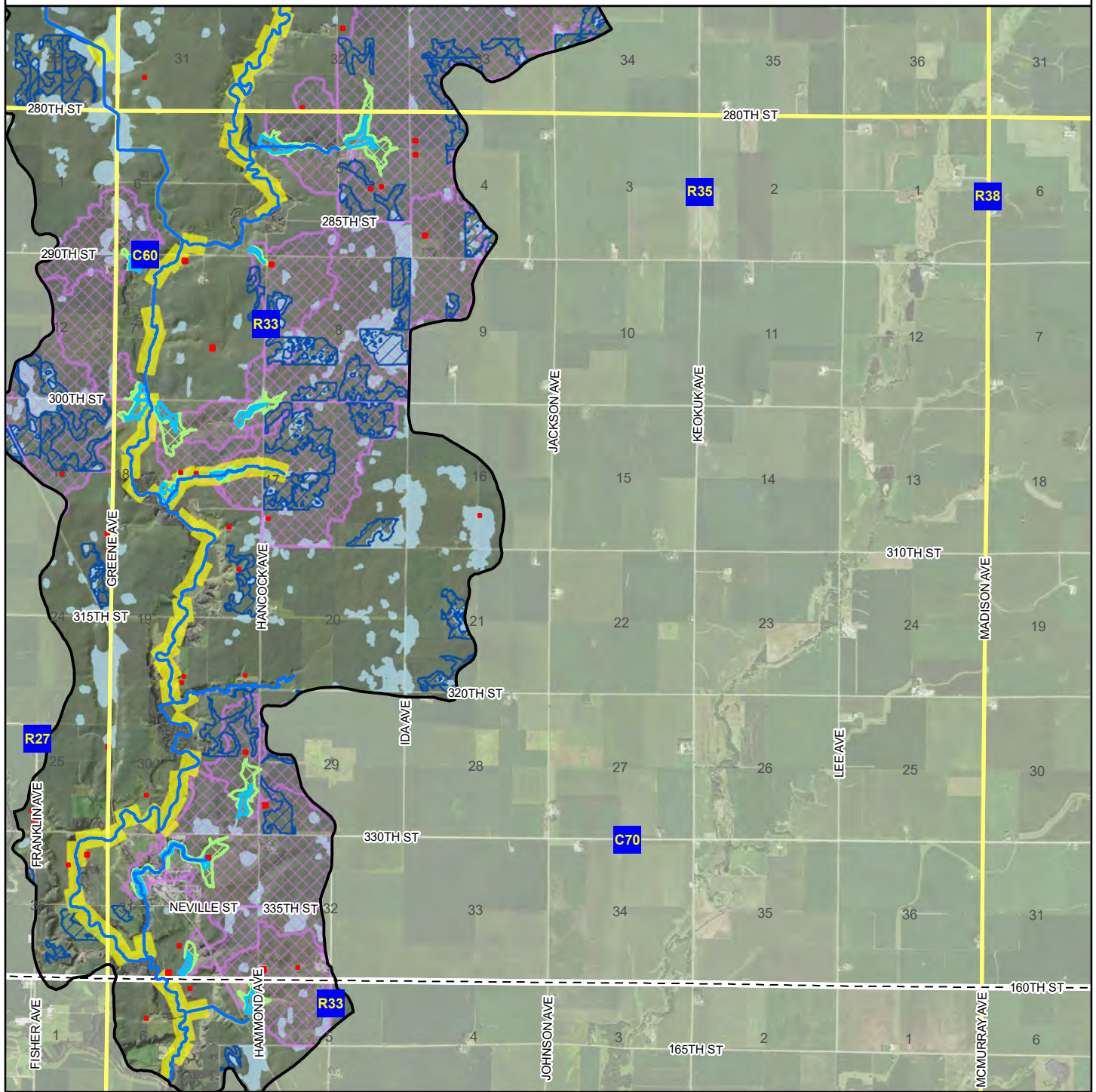
Agricultural Conservation Planning Framework Drainage Treatment Practices



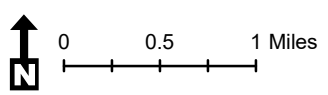
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| Watershed Boundary | Nitrate Removal Wetlands |
| Streams | Wetland Buffers |
| Bioreactors | Wetland Drainage Areas |
| Saturated Buffers | Depressions (Perennial Cover, Intake Buffers) |
| Drainage Water Management | |



Eagle Creek Watershed (0710000504) T90N R25W Agricultural Conservation Planning Framework Drainage Treatment Practices



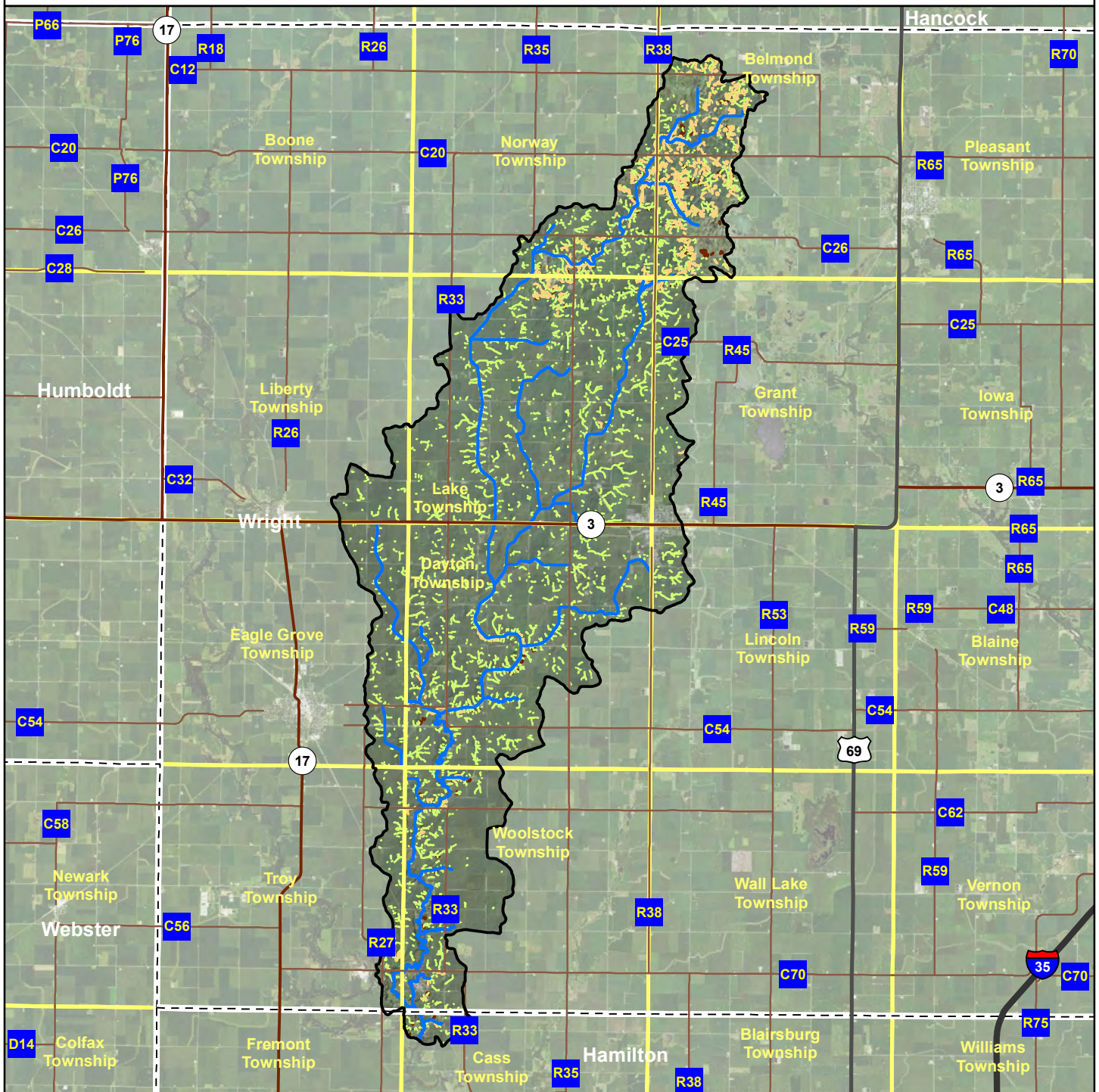
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|---------------------------|---|
| Watershed Boundary | Nitrate Removal Wetlands |
| Streams | Wetland Buffers |
| Bioreactors | Wetland Drainage Areas |
| Saturated Buffers | Depressions (Perennial Cover, Intake Buffers) |
| Drainage Water Management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



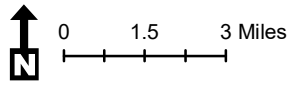
Analysis performed by
 Environmental Programs & Services
 Data and tools provided by USDA-ARS

Eagle Creek Watershed (0710000504)

Agricultural Conservation Planning Framework Runoff Control Practices



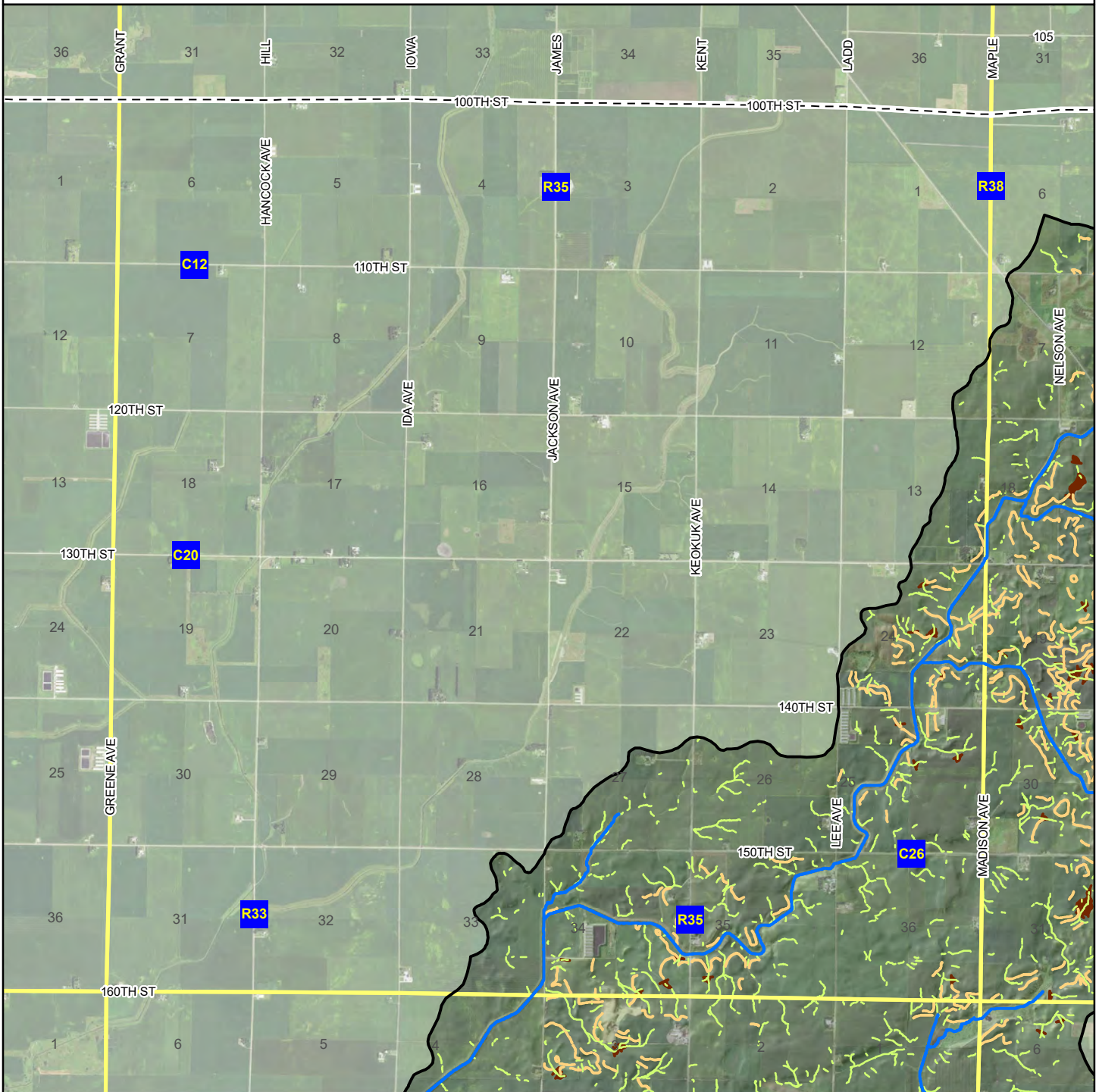
- Watershed Boundary
- Streams
- Contour Buffer Strips
- Grassed Waterways
- Water and Sediment Control Basins



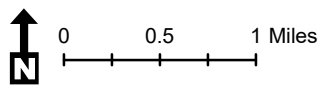
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Eagle Creek Watershed (0710000504) T93N R25W

Agricultural Conservation Planning Framework Runoff Control Practices



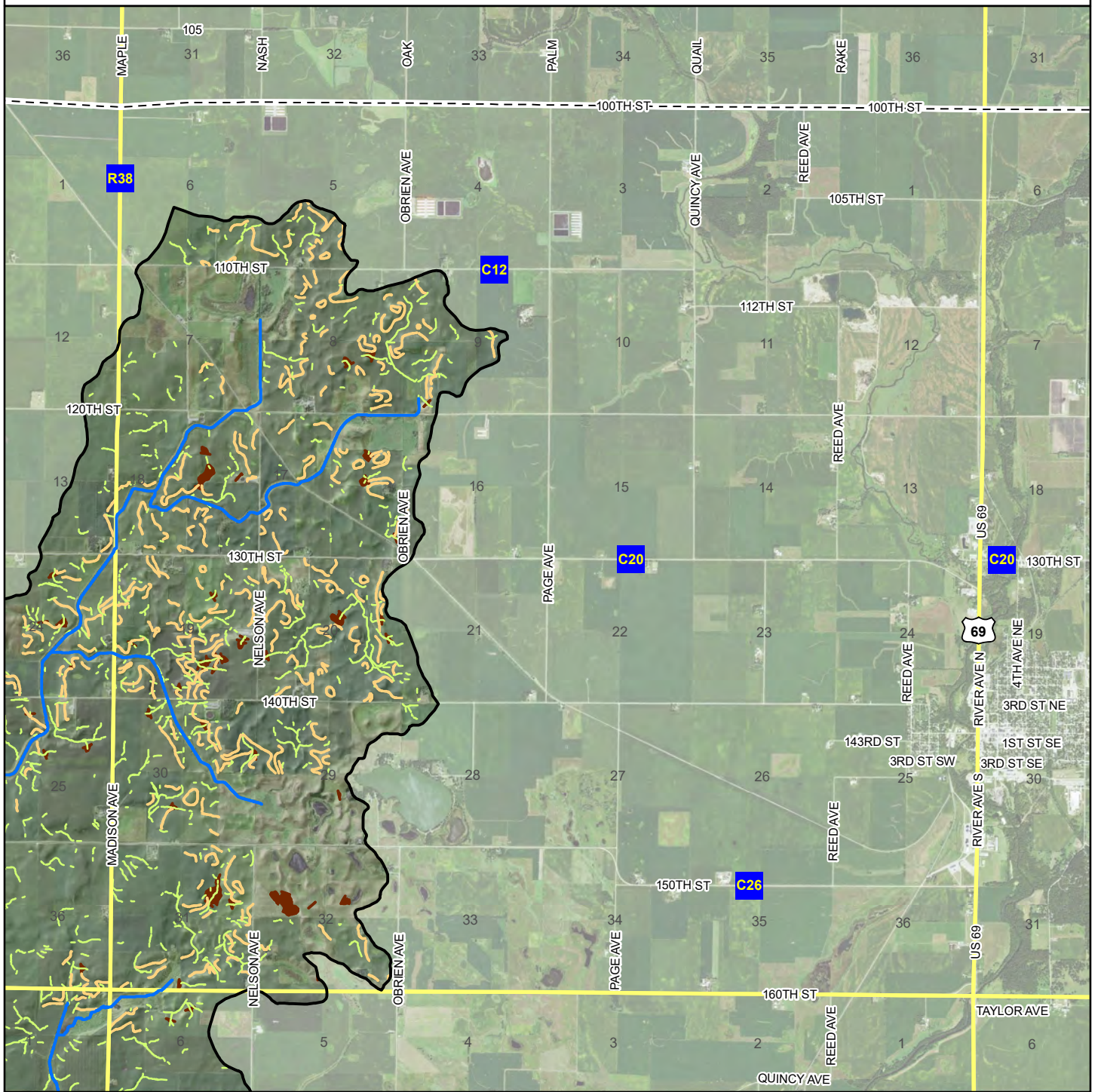
- Watershed Boundary
- Streams
- Contour Buffer Strips
- Grassed Waterways
- Water and Sediment Control Basins








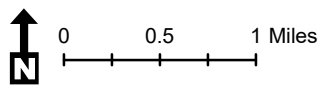
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Eagle Creek Watershed (0710000504) T93N R24W

Agricultural Conservation Planning Framework Runoff Control Practices

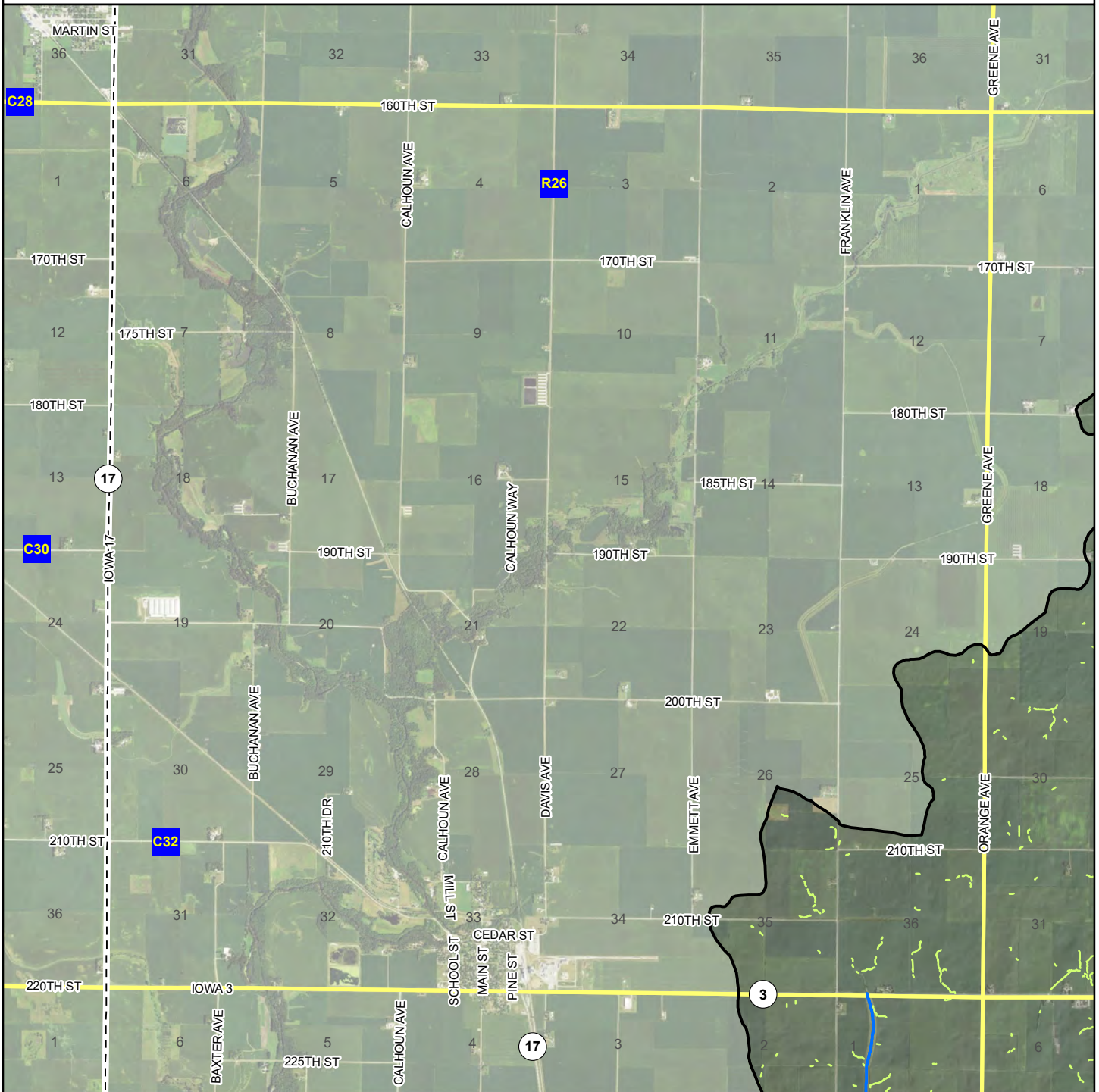


-  Watershed Boundary
-  Streams
-  Contour Buffer Strips
-  Grassed Waterways
-  Water and Sediment Control Basins

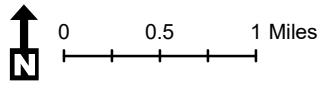


Eagle Creek Watershed (0710000504) T92N R26W

Agricultural Conservation Planning Framework Runoff Control Practices



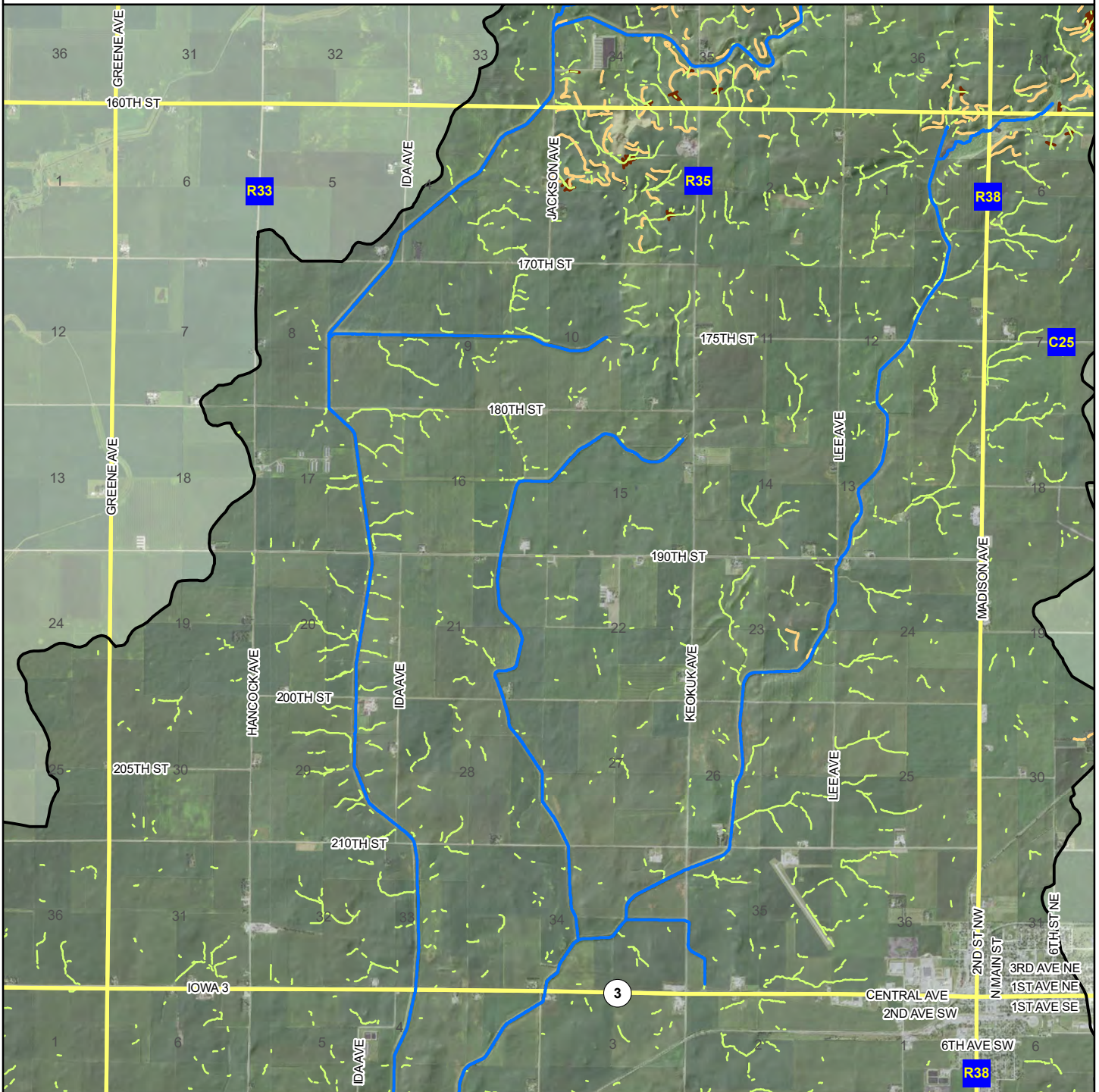
- Watershed Boundary
- Streams
- Contour Buffer Strips
- Grassed Waterways
- Water and Sediment Control Basins








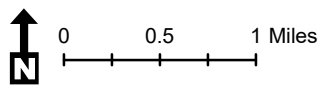
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Eagle Creek Watershed (0710000504) T92N R25W

Agricultural Conservation Planning Framework Runoff Control Practices

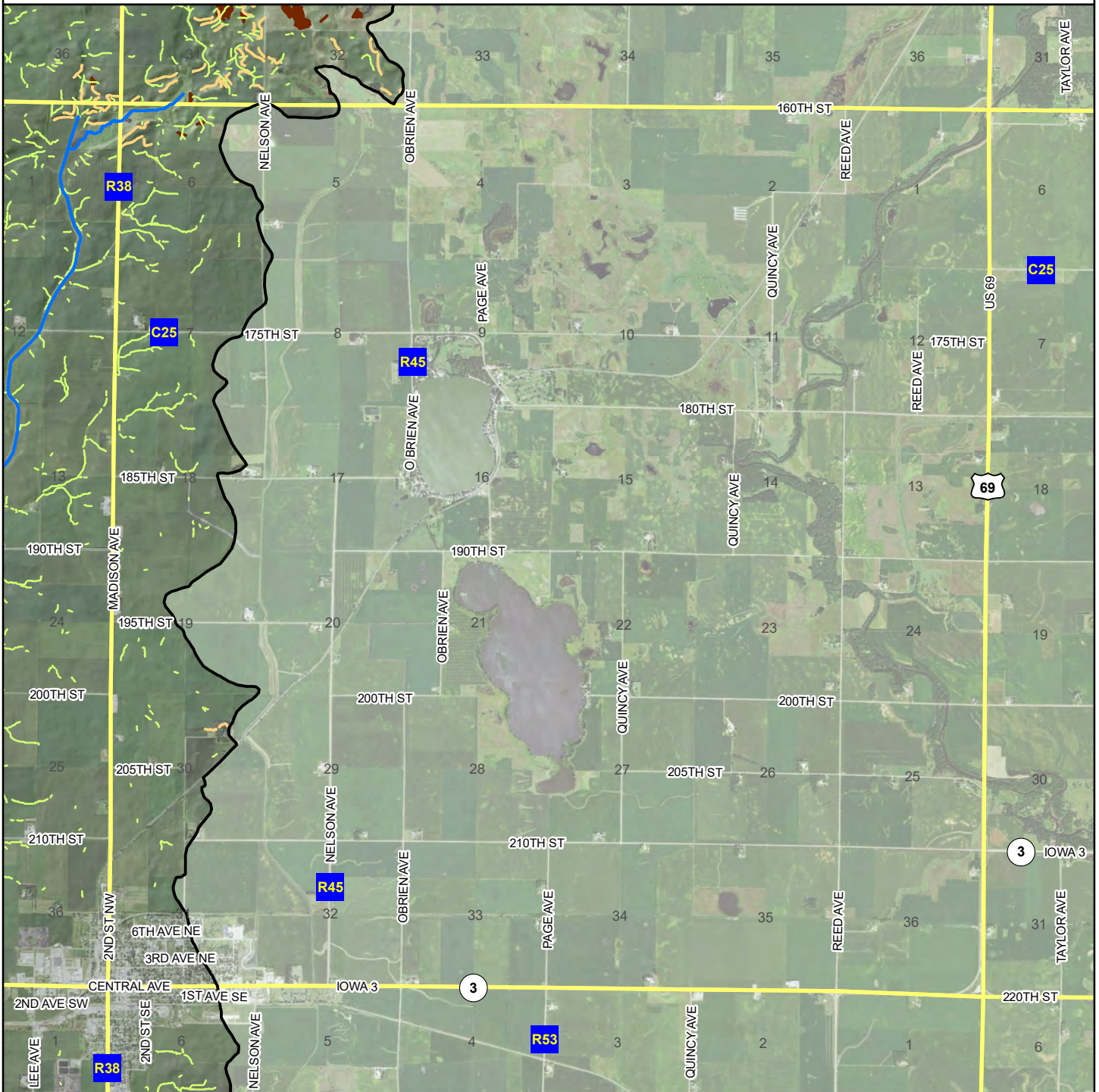


-  Watershed Boundary
-  Streams
-  Contour Buffer Strips
-  Grassed Waterways
-  Water and Sediment Control Basins

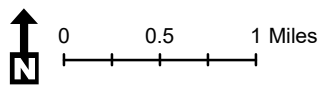


Eagle Creek Watershed (0710000504) T92N R24W

Agricultural Conservation Planning Framework Runoff Control Practices

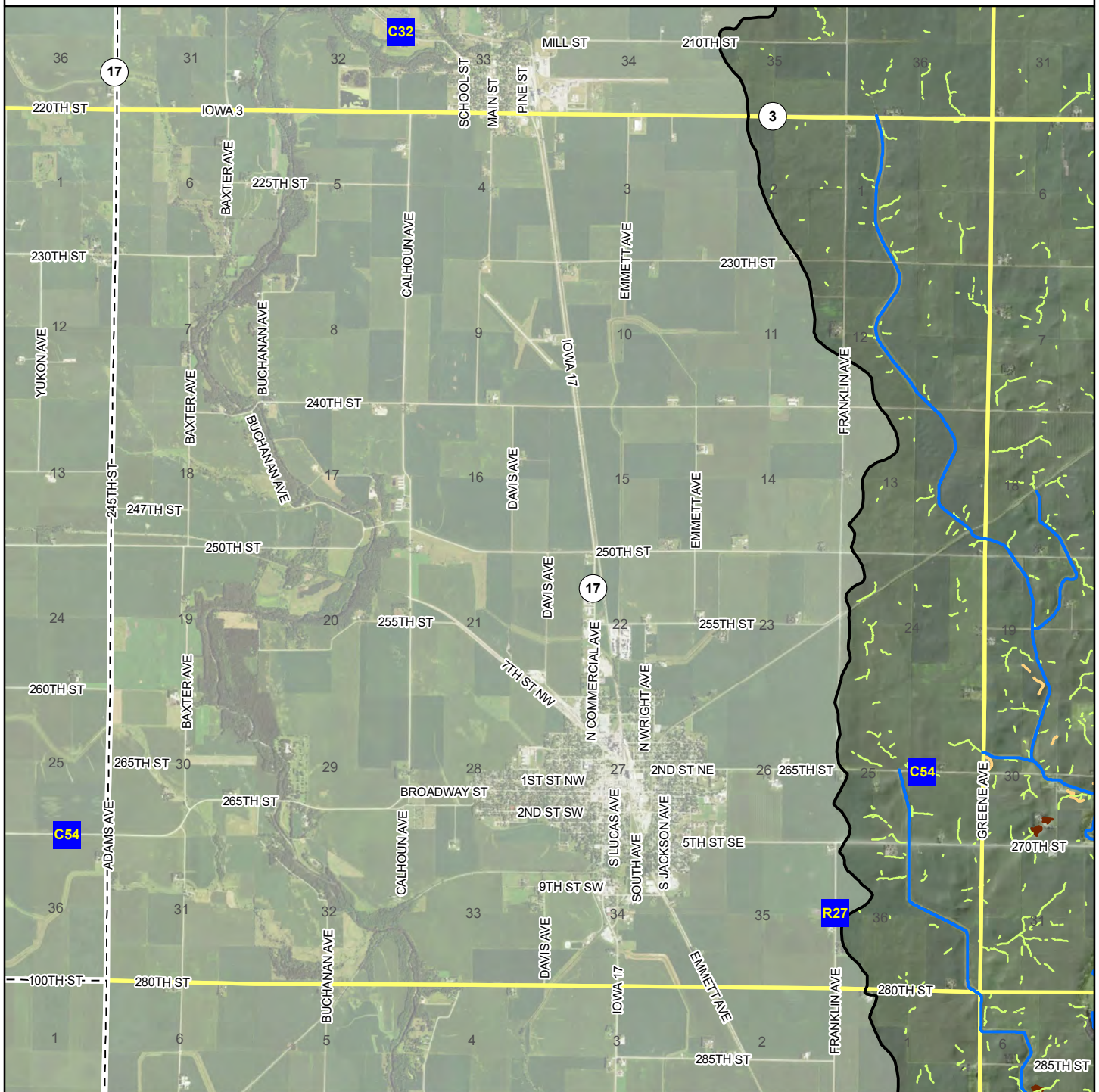







- Watershed Boundary
- Streams
- Contour Buffer Strips
- Grassed Waterways
- Water and Sediment Control Basins

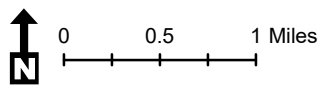


Analysis performed by
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Eagle Creek Watershed (0710000504) T91N R26W Agricultural Conservation Planning Framework Runoff Control Practices

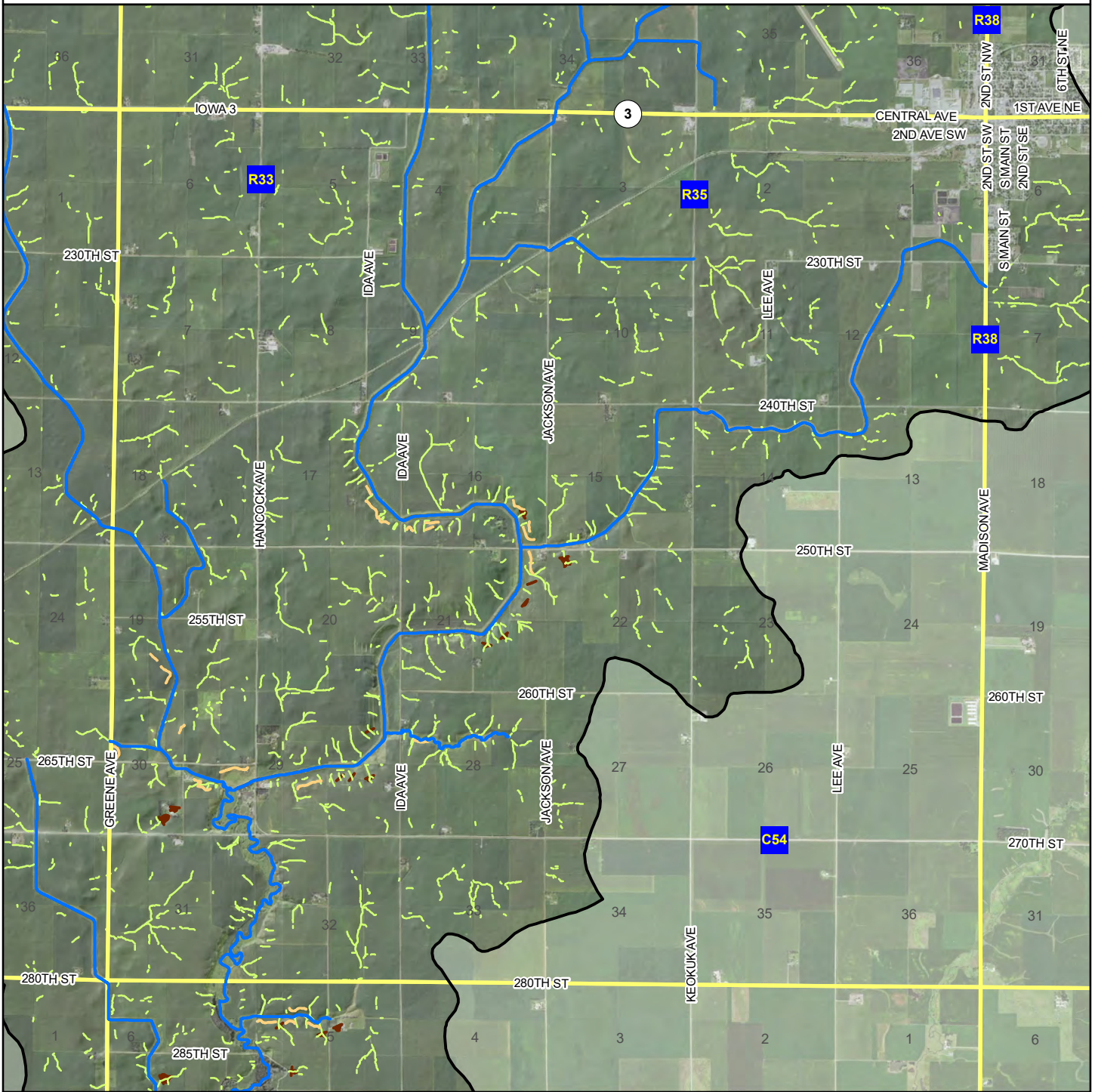


-  Watershed Boundary
-  Streams
-  Contour Buffer Strips
-  Grassed Waterways
-  Water and Sediment Control Basins

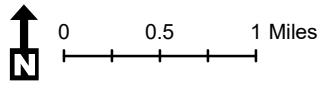


Eagle Creek Watershed (0710000504) T91N R25W

Agricultural Conservation Planning Framework Runoff Control Practices



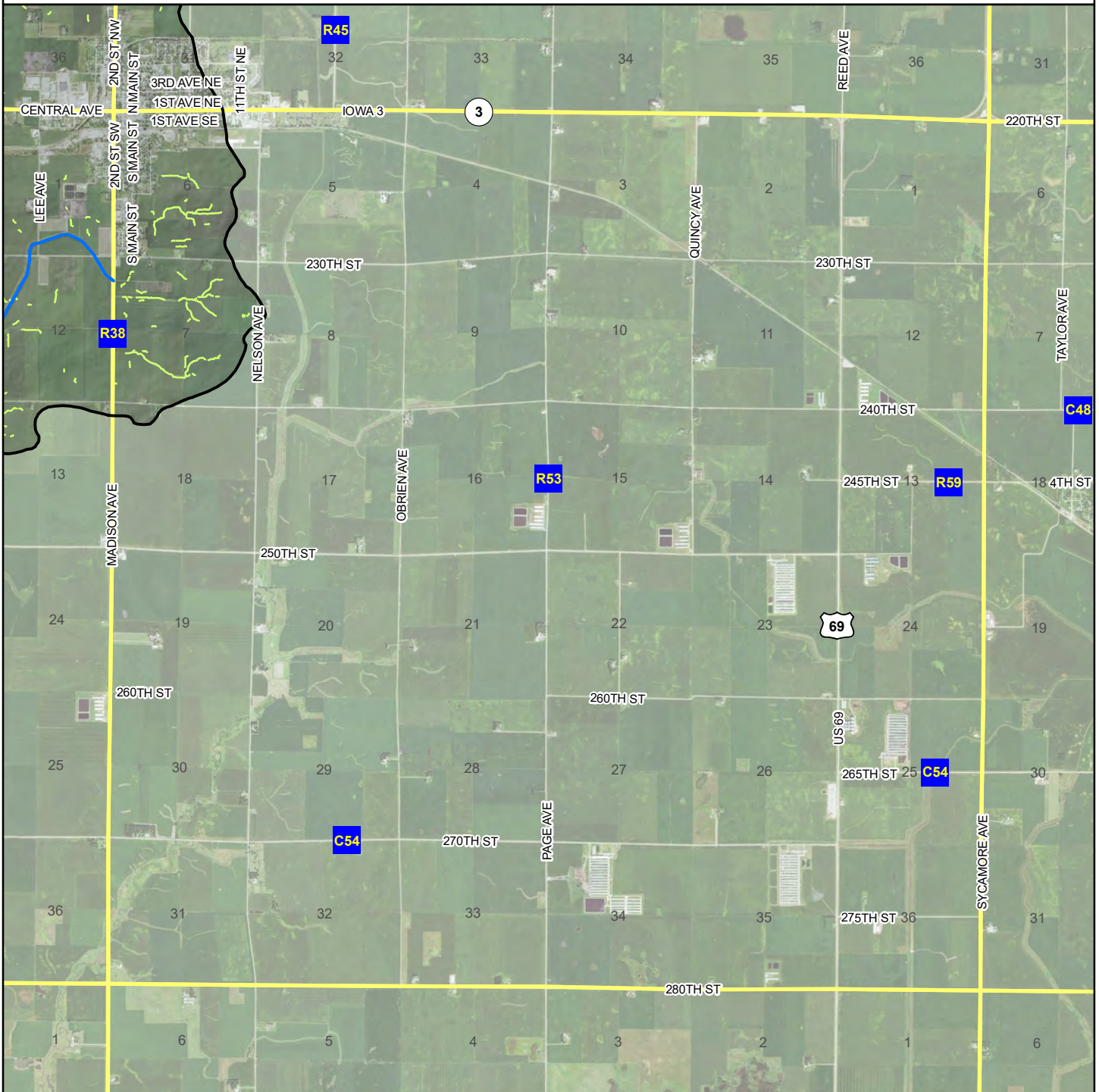
- Watershed Boundary
- Streams
- Contour Buffer Strips
- Grassed Waterways
- Water and Sediment Control Basins



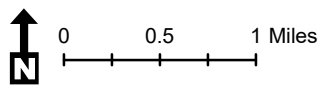
Analysis performed by
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Eagle Creek Watershed (0710000504) T91N R24W

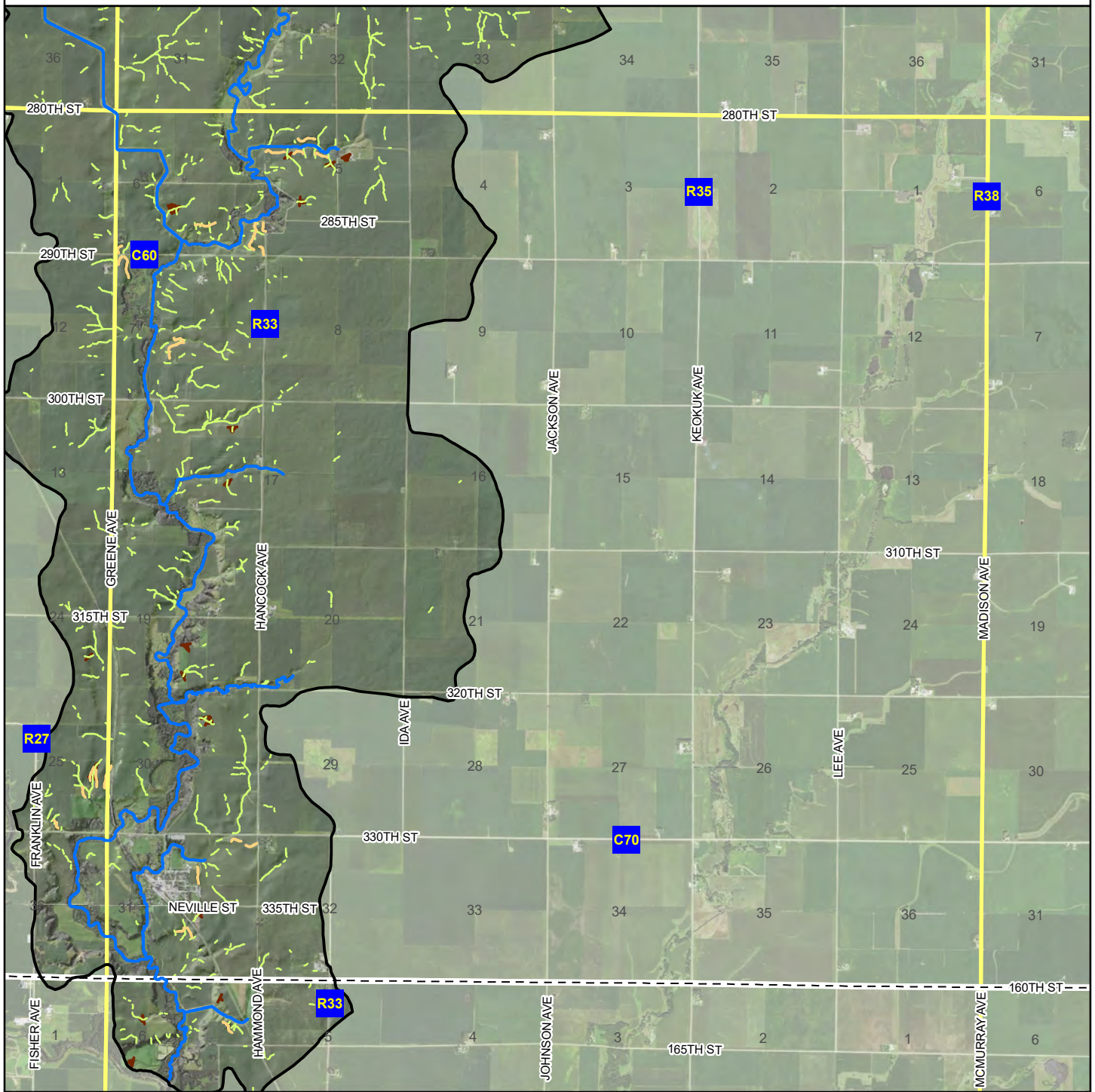
Agricultural Conservation Planning Framework Runoff Control Practices








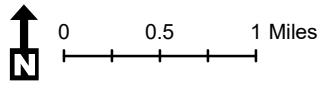
- Watershed Boundary
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- Water and Sediment Control Basins




Eagle Creek Watershed (0710000504) T90N R25W Agricultural Conservation Planning Framework Runoff Control Practices



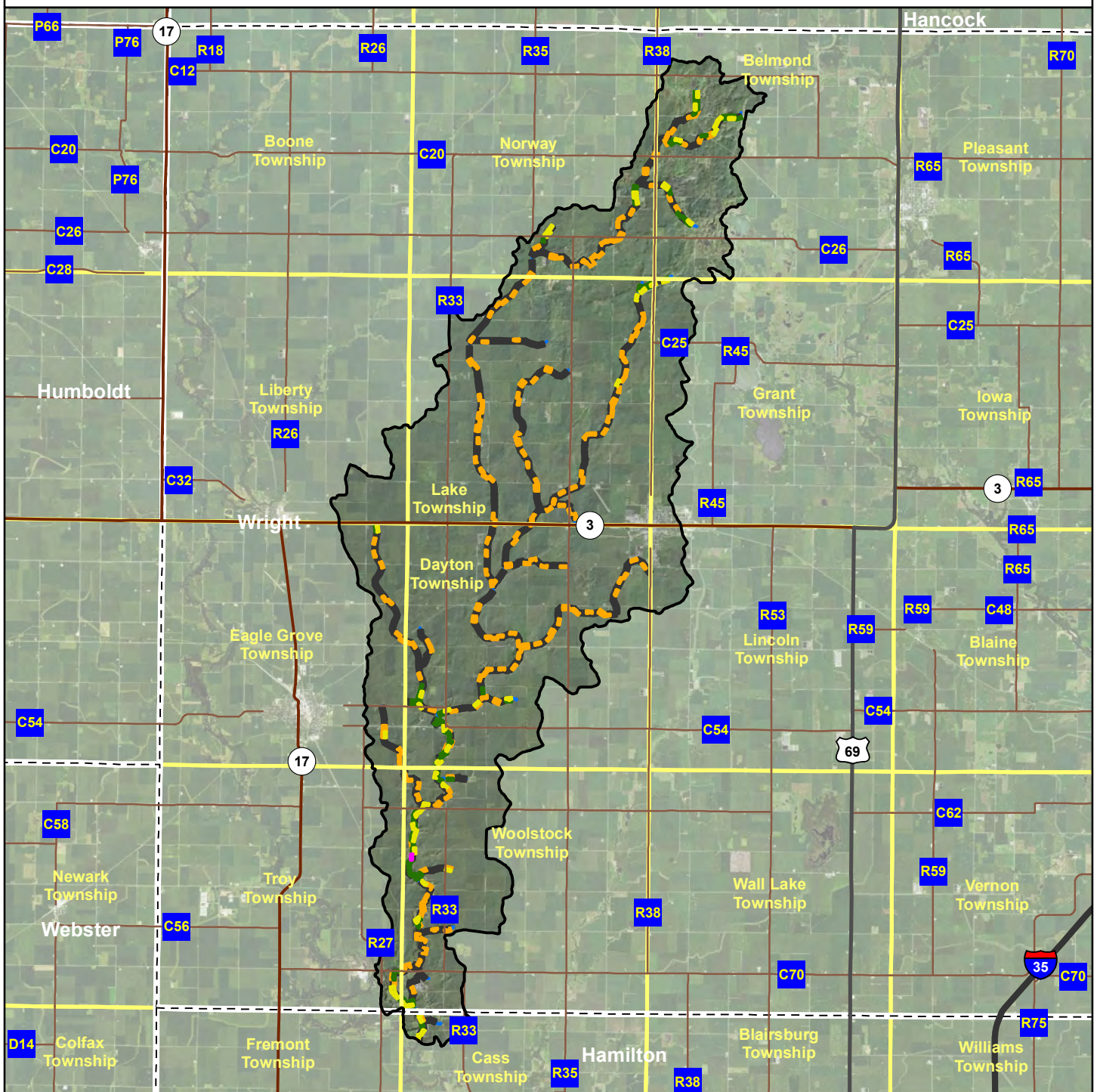
-  Watershed Boundary
-  Streams
-  Contour Buffer Strips
-  Grassed Waterways
-  Water and Sediment Control Basins



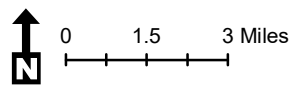
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Eagle Creek Watershed (0710000504)

Agricultural Conservation Planning Framework Riparian Management Practices

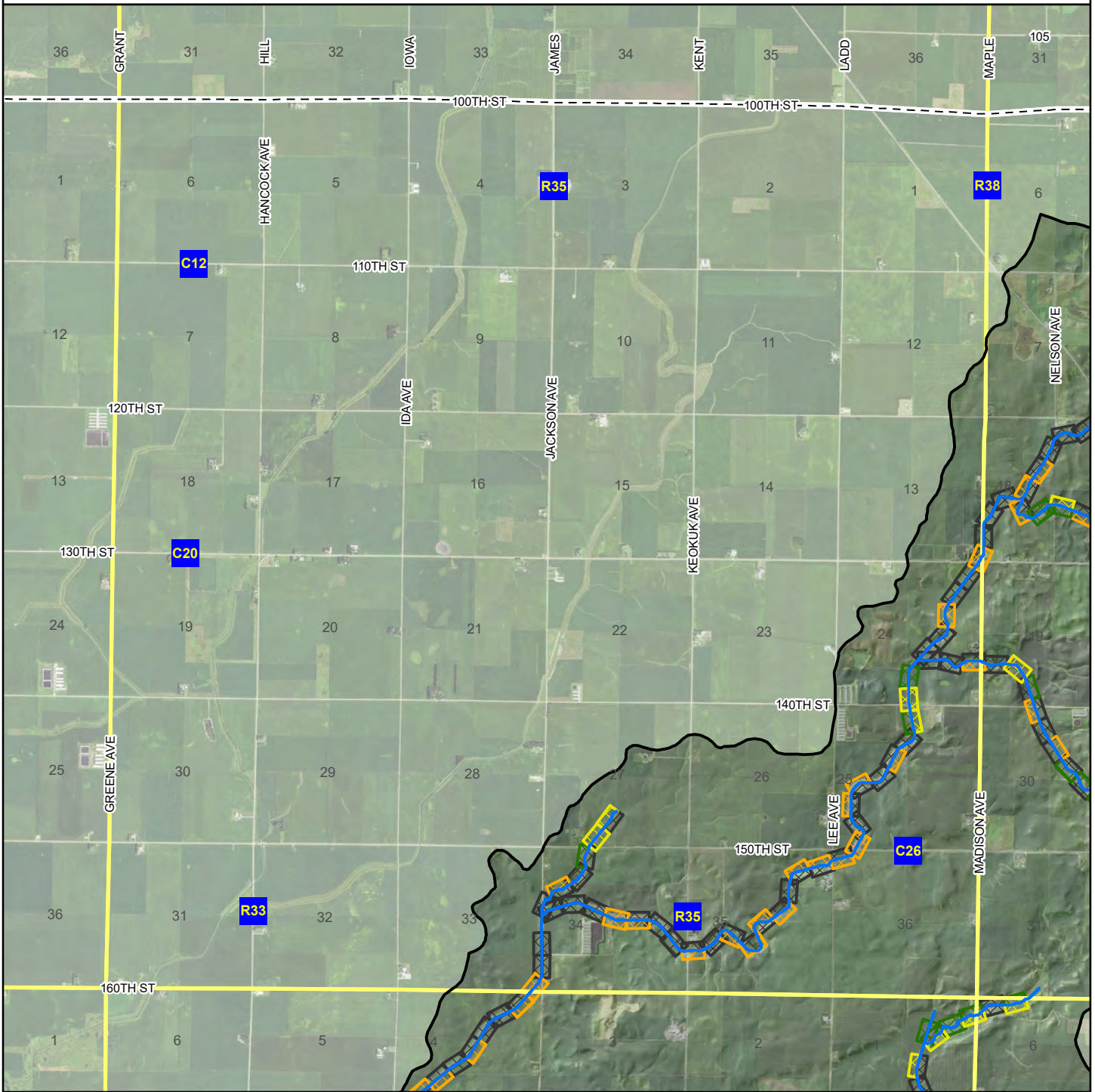


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|--|--------------------|---------------------------|
| | Watershed Boundary | Riparian Function |
| | Streams | Critical Zone |
| | | Multi Species Buffer |
| | | Deep Rooted Vegetation |
| | | Stiff Stemmed Grasses |
| | | Stream Bank Stabilization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

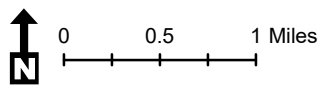


Eagle Creek Watershed (0710000504) T93N R25W

Agricultural Conservation Planning Framework Riparian Management Practices

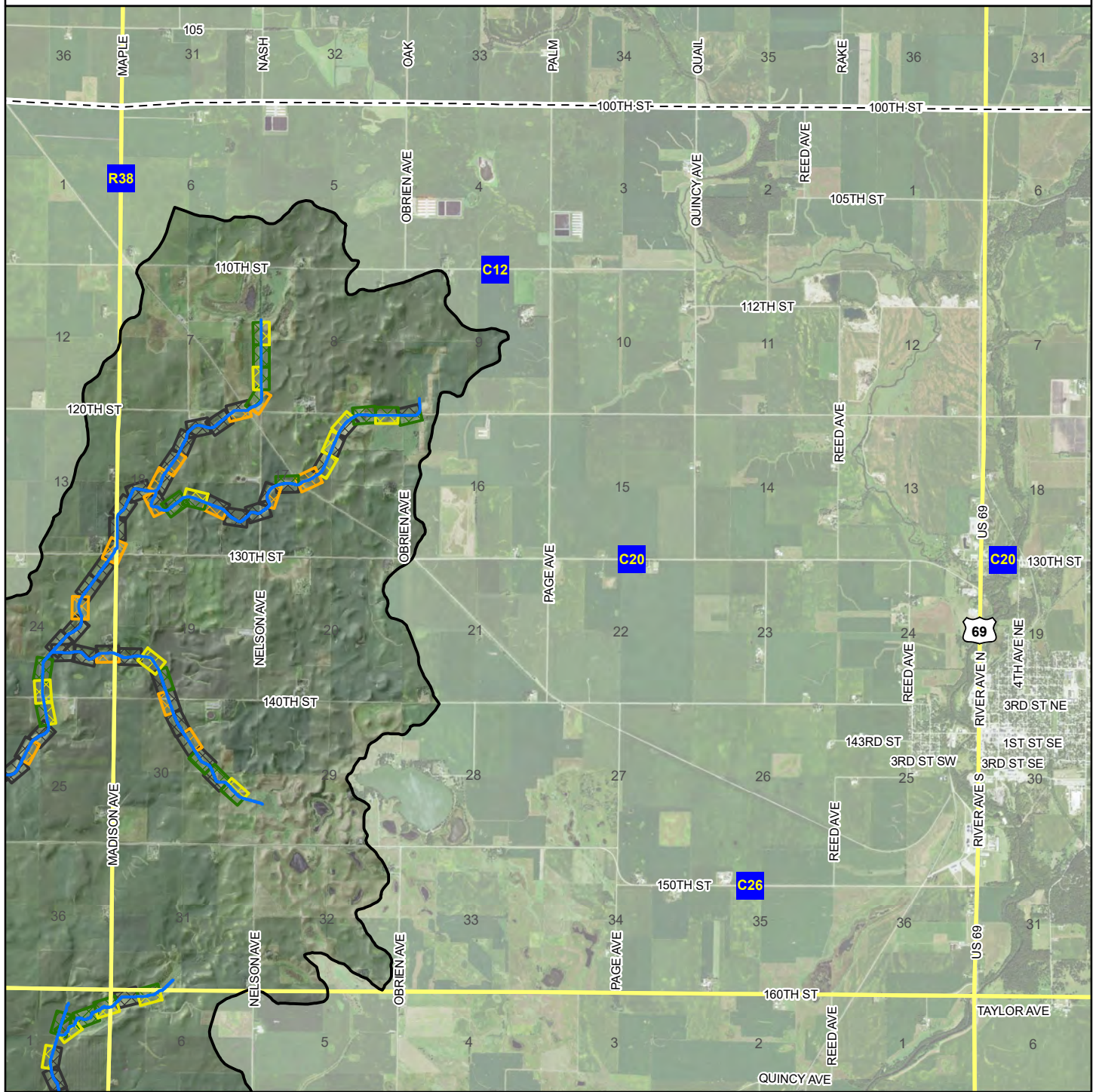


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|--------------------|---------------------------|
| Watershed Boundary | Riparian Function |
| Streams | Critical Zone |
| | Multi Species Buffer |
| | Deep Rooted Vegetation |
| | Stiff Stemmed Grasses |
| | Stream Bank Stabilization |



Eagle Creek Watershed (0710000504) T93N R24W

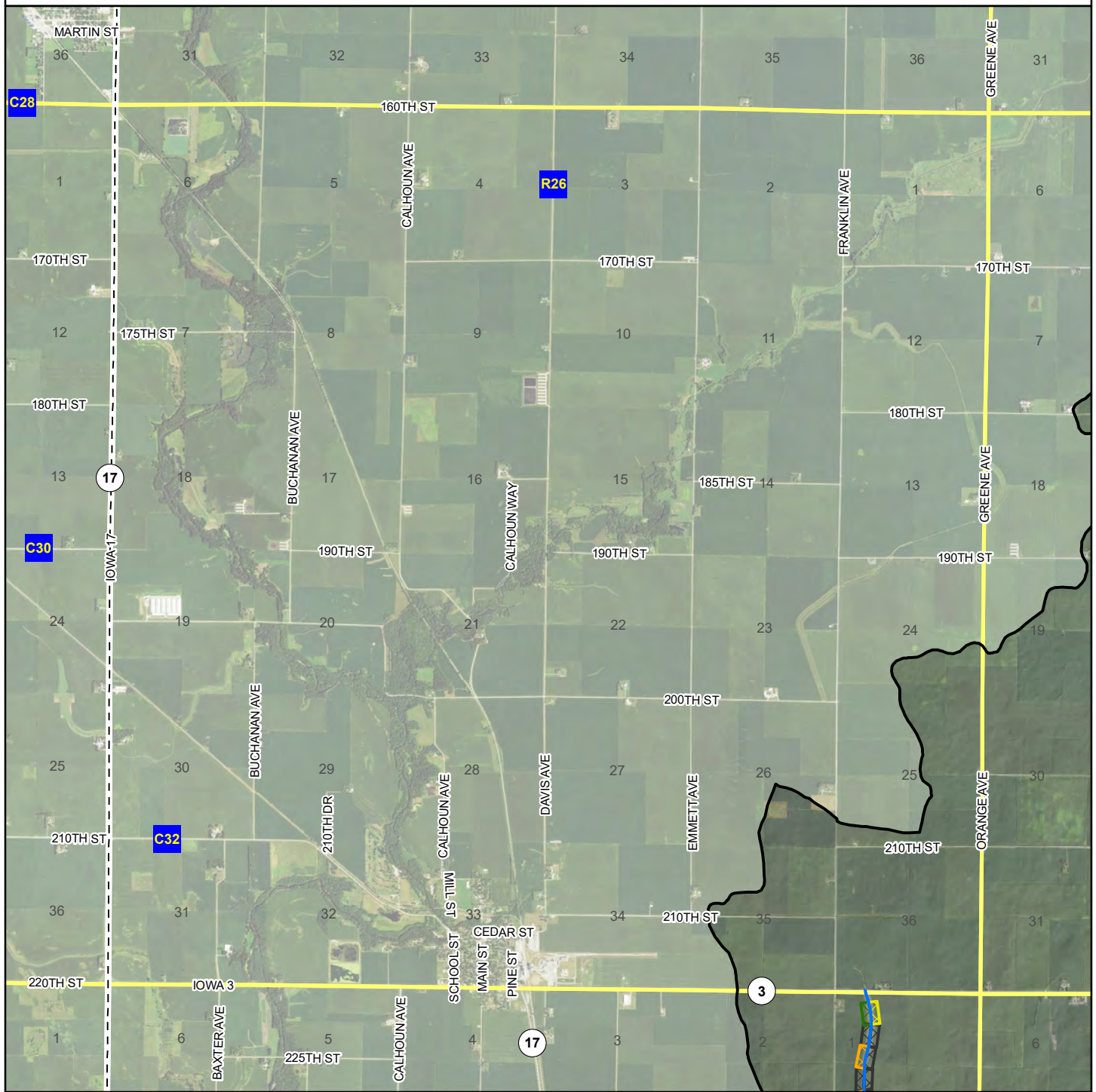
Agricultural Conservation Planning Framework Riparian Management Practices










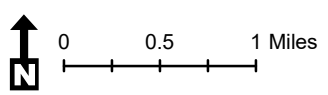
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|--------------------|---------------------------|
| Watershed Boundary | Riparian Function |
| Streams | Critical Zone |
| | Multi Species Buffer |
| | Deep Rooted Vegetation |
| | Stiff Stemmed Grasses |
| | Stream Bank Stabilization |

Eagle Creek Watershed (0710000504) T92N R26W

Agricultural Conservation Planning Framework Riparian Management Practices



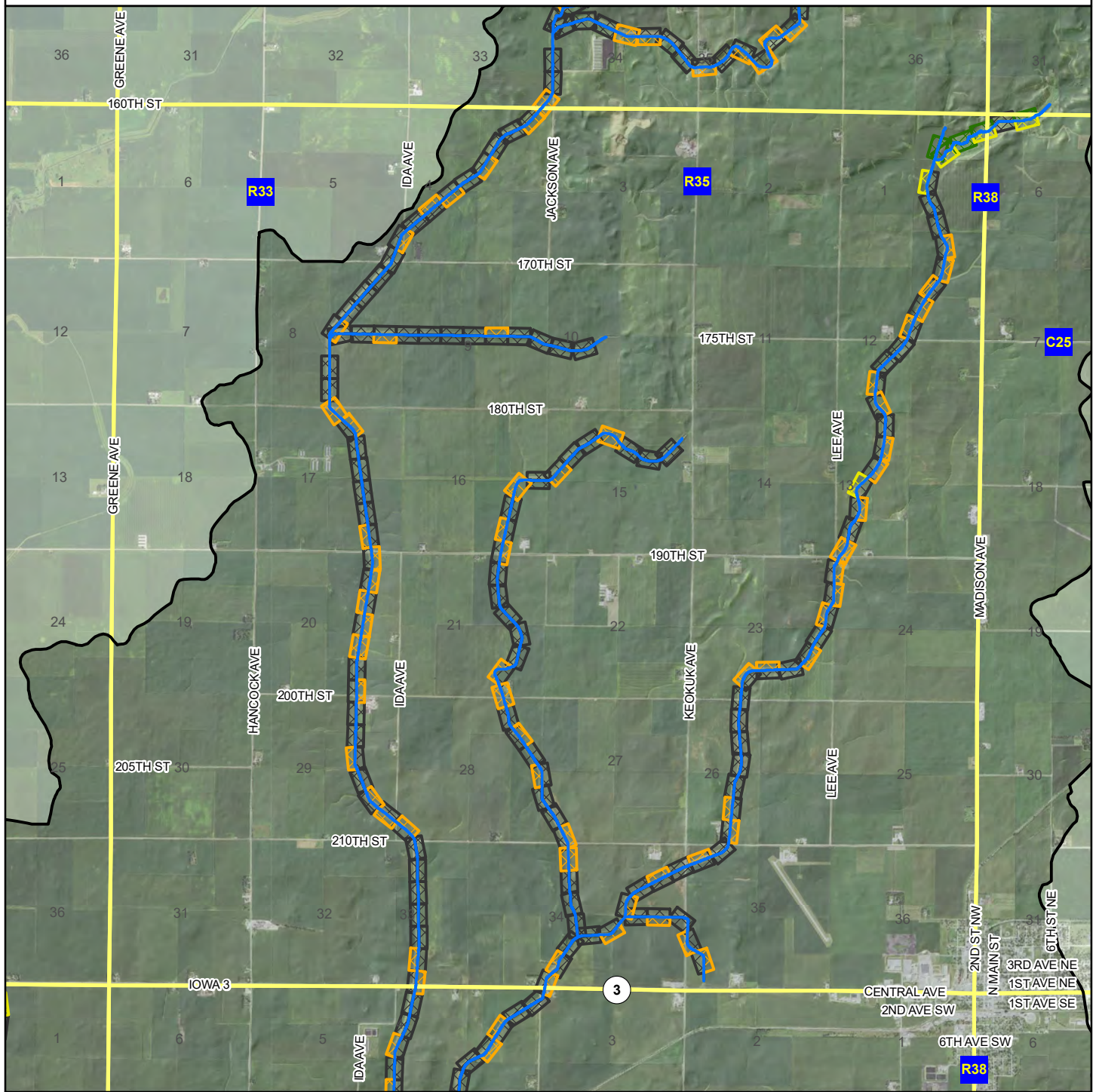
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|  Watershed Boundary | Riparian Function |
|  Streams |  Critical Zone |
| |  Multi Species Buffer |
| |  Deep Rooted Vegetation |
| |  Stiff Stemmed Grasses |
| |  Stream Bank Stabilization |



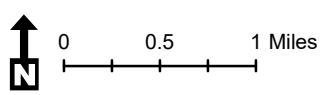
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Eagle Creek Watershed (0710000504) T92N R25W

Agricultural Conservation Planning Framework Riparian Management Practices

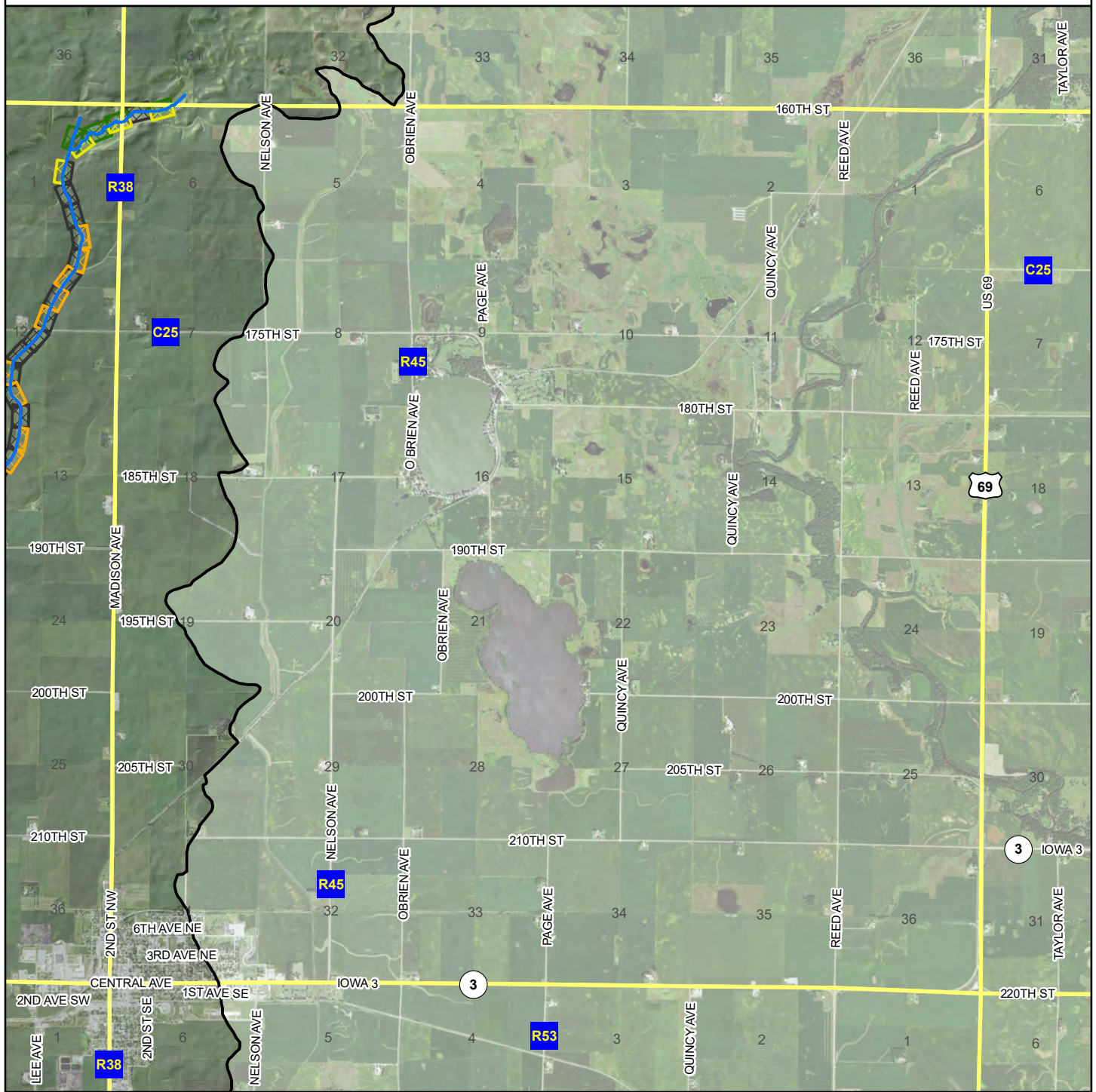









- Watershed Boundary**
- Riparian Function**
- Streams
 - Critical Zone
 - Multi Species Buffer
 - Deep Rooted Vegetation
 - Stiff Stemmed Grasses
 - Stream Bank Stabilization

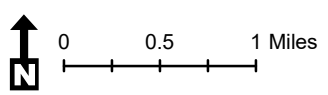


Eagle Creek Watershed (0710000504) T92N R24W

Agricultural Conservation Planning Framework Riparian Management Practices



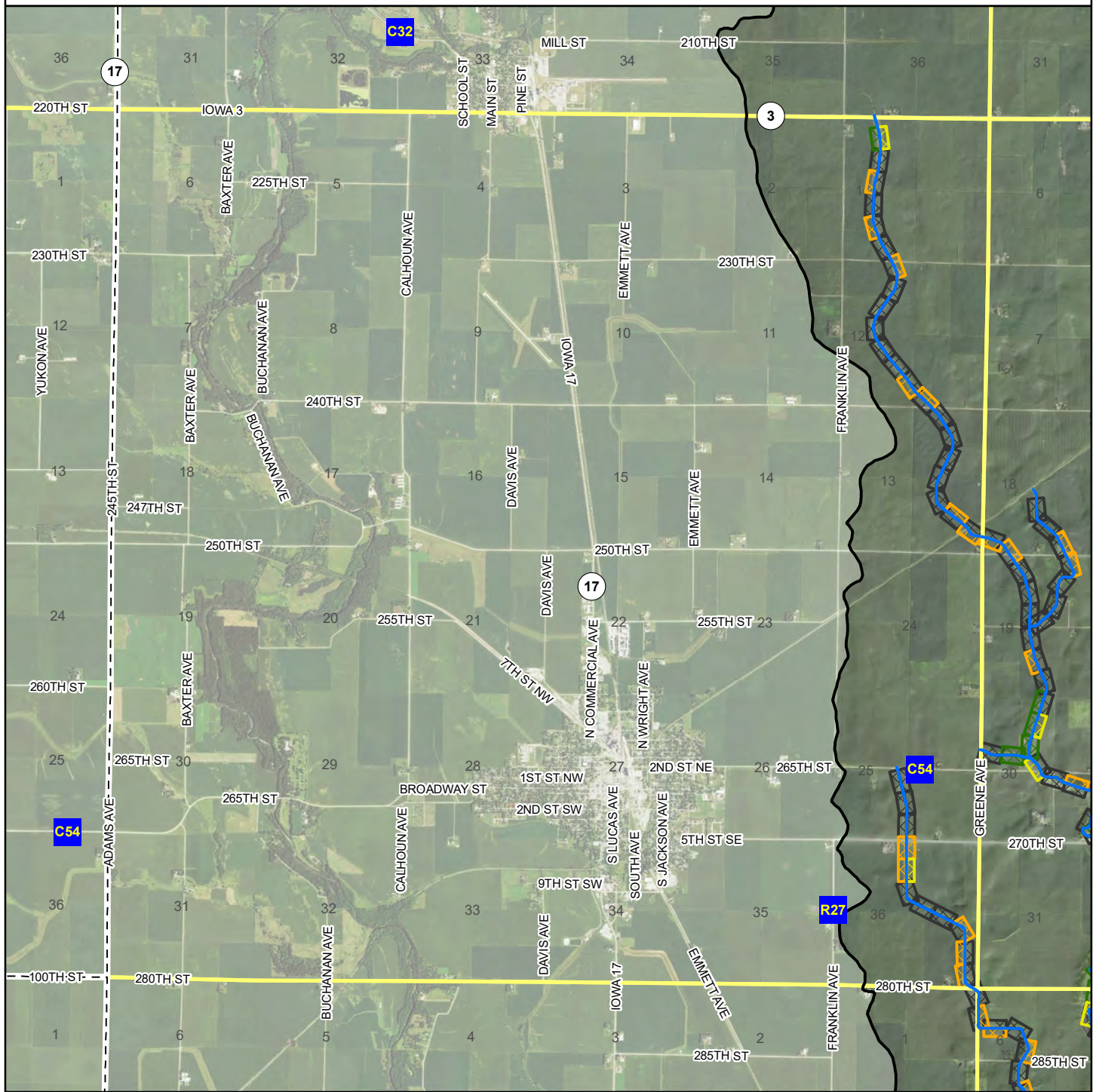
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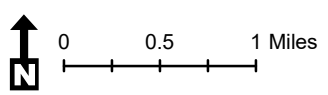
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Eagle Creek Watershed (0710000504) T91N R26W

Agricultural Conservation Planning Framework Riparian Management Practices



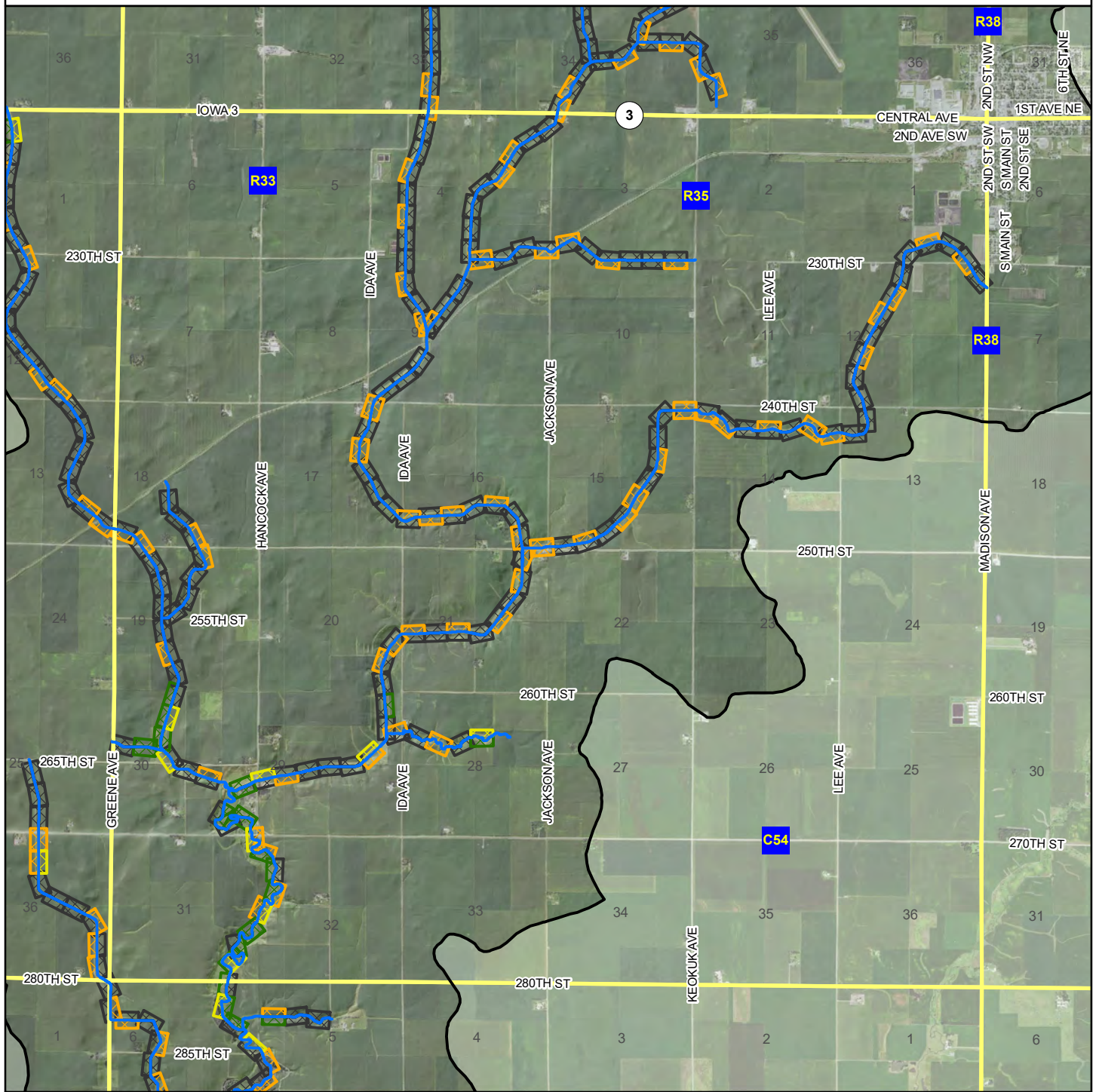
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| Watershed Boundary | Riparian Function |
| Streams | Critical Zone |
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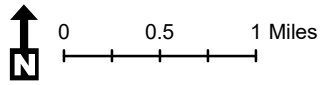
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Eagle Creek Watershed (0710000504) T91N R25W

Agricultural Conservation Planning Framework Riparian Management Practices



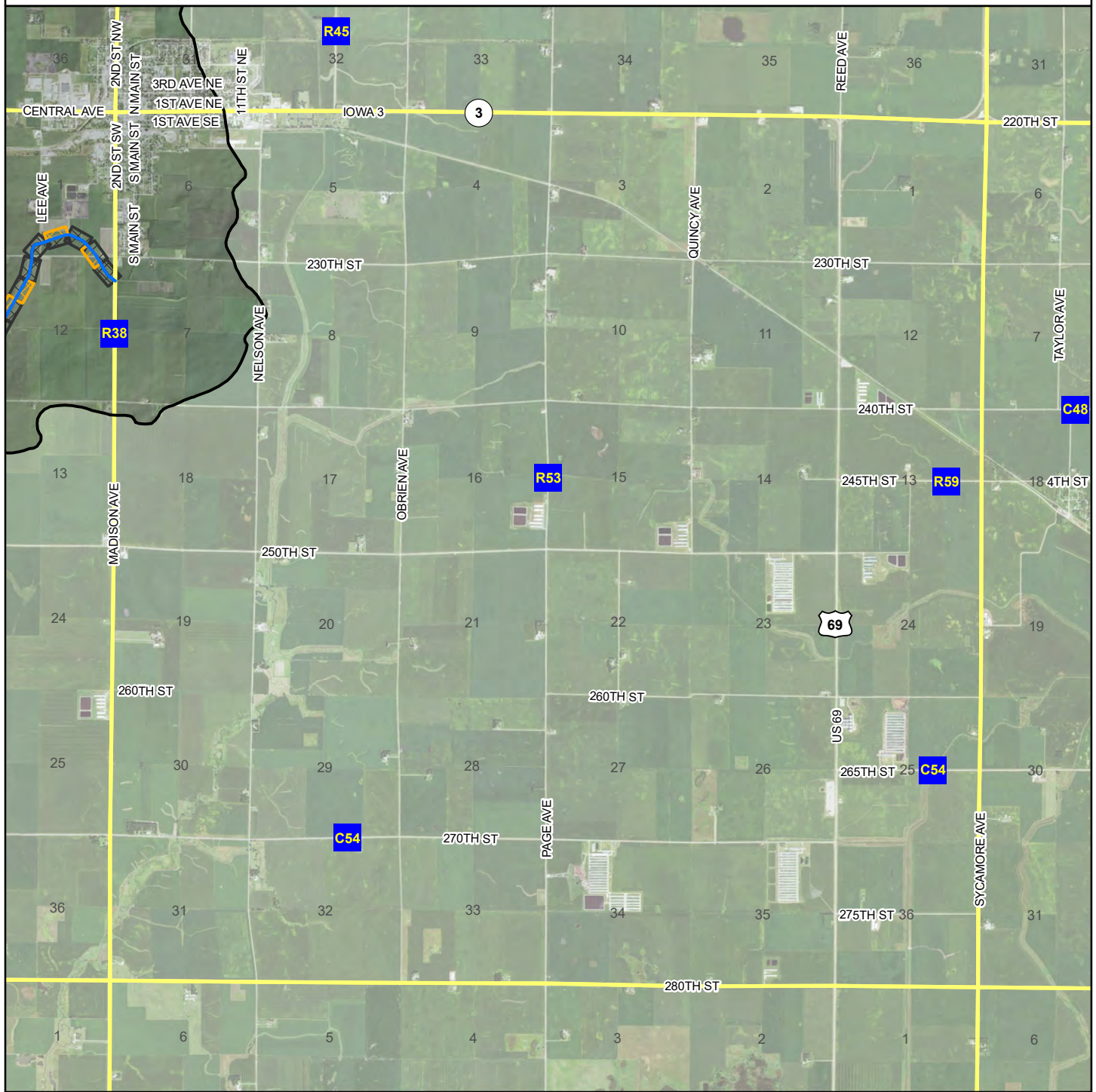
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|  Watershed Boundary | Riparian Function |
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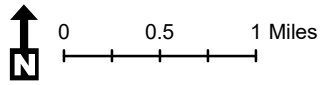
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Eagle Creek Watershed (0710000504) T91N R24W

Agricultural Conservation Planning Framework Riparian Management Practices



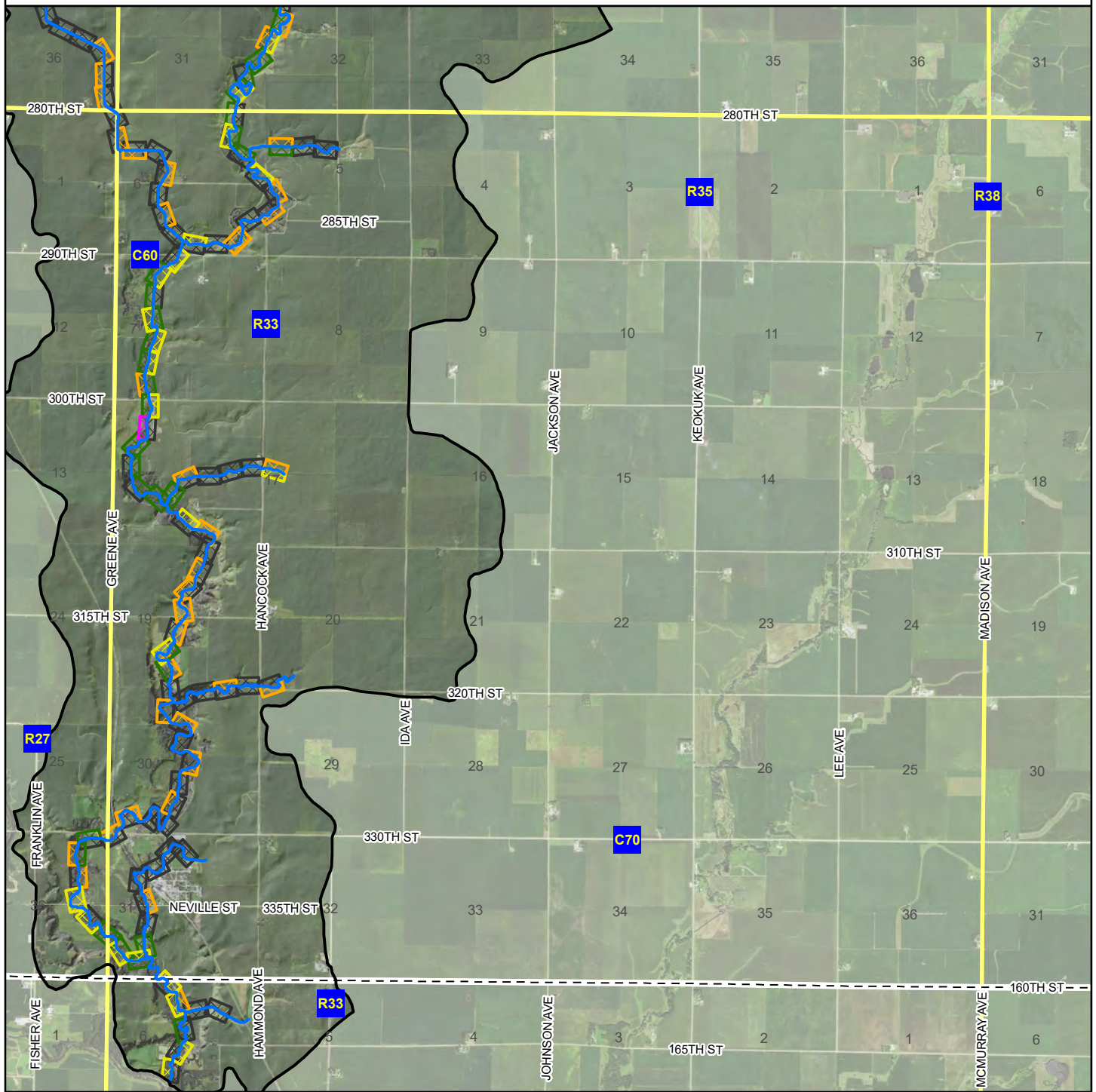
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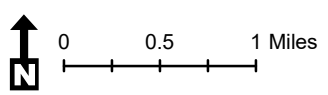
Analysis performed by

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Eagle Creek Watershed (0710000504) T90N R25W

Agricultural Conservation Planning Framework Riparian Management Practices



- | | |
|--|---|
|  Watershed Boundary | Riparian Function |
|  Streams |  Critical Zone |
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Appendix D: 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 E: Nitrogen Reduction Calculation Worksheet

This worksheet can be used to estimate nitrate load reduction at the watershed outlet based on the number of acres treated with best management practices (BMPs). Along with water monitoring results, this estimate can give an indication of water quality trends.

Instructions

1. Enter acres treated with or drained into BMPs into "Acres Treated" column for each BMP.
2. Multiply "Acres Treated" by "Multiplier" for each BMP and enter result into "N Load Reduction" column.
3. "Total N Load Reduction" equals the sum of the BMP rows in the "N Load Reduction" column.
4. Obtain "Baseline N Load" value from watershed plan document (Table 4.1).
5. Calculate "Percent N Reduction" as "Total N Load Reduction" divided by "Baseline N Load" multiplied by a factor of 100.

| Best Management Practice | Acres Treated | Multiplier | N Load Reduction |
|----------------------------------|---------------|------------|------------------|
| Cover crops, below EOF* | | 10.2 | |
| Cover crops, above EOF* | | 5.1 | |
| Nutrient management** | | 3.3 | |
| Prairie strips (Perennial cover) | | 28.1 | |
| Drainage water management | | 10.9 | |
| Bioreactors | | 14.2 | |
| Saturated buffers | | 16.5 | |
| Wetlands | | 17.2 | |
| Oxbow restorations | | 14.5 | |
| Total N Load Reduction | | | |
| Baseline N Load | | | |
| Percent N Reduction | | | |

*The location of cover crops relative to edge-of-field (EOF) practices is important. Cover crops "below", or downstream of, EOF practices result in greater nitrate-nitrogen reduction than cover crops located "above", or upstream of, EOF practices.

**Include only acres treated with nutrient management (e.g., MRTN application rate, nitrification inhibitor) that do not also have cover crops.

Appendix F: 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 Collaboration 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 the 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 septic systems, livestock, storm water and nonpoint source pollutants. Sponsored Projects can be used to leverage wastewater infrastructure investments to create additional funding for nonpoint source/agricultural water quality improvement. | 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 nine 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. | http://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. | http://www.nfwf.org |
| National Wildlife Foundation | Works to protect and restore resources and the beneficial functions they offer. | http://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. | http://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. | http://www.waltonfamilyfoundation.org/environment |

Appendix G: The Nitrogen Cycle

The nitrogen cycle is the set of processes that convert nitrogen between its various forms in the environment. These transformations are shown by the orange (inputs), green (outputs to plants and air) and blue (outputs to water) arrows in Figure G.1. These processes are explained in greater detail in the [Ten Ways to Reduce Nitrogen Loads from Drained Cropland in the Midwest](#) publication from University of Illinois Extension. Through fixation, atmospheric nitrogen gas is converted to plant usable forms (ammonium and nitrate) by atmospheric, biological or industrial processes. Mineralization converts organic forms of nitrogen (from soil organic matter and manure) into ammonium, and nitrifying bacteria convert ammonium into nitrate through the process of nitrification. Nitrate is the primary form of nitrogen that is lost through subsurface drainage tile in agricultural systems because it is easily dissolved and highly mobile. These losses are typically measured as nitrate as nitrogen (nitrate-nitrogen), which is commonly referred to as nitrate. Nitrate can also be expressed as the concentration of the entire nitrate molecule (rather than only the nitrogen component of nitrate). When evaluating nitrate levels, it is important to clarify the form (i.e., nitrate-nitrogen or nitrate) under consideration. Nitrate is also removed from agricultural soils through plant uptake and denitrification, and practices that encourage these processes will reduce the amount of nitrate lost through drainage.

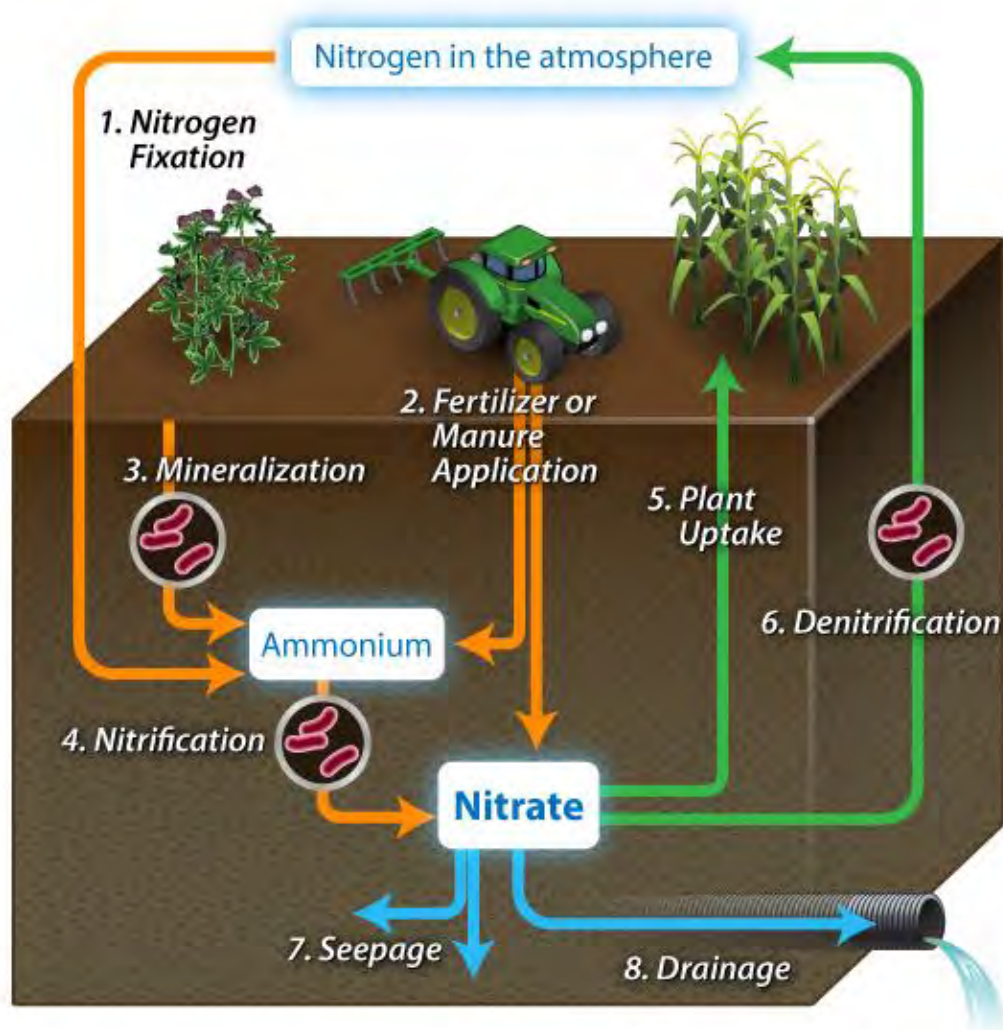


Figure G.1. The nitrogen cycle (University of Illinois Extension).



Not funded by the soybean checkoff.

