Mill Creek Watershed Plan

Rock Island County, Illinois

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Prepared by:
Northwater Consulting

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Table of Contents

Acronyms 6
Executive Summary 7
The Mill Creek Watershed 7
Key Recommendations 9
1.0 Introduction 10
2.0 Watershed History & Background 11
2.1 Watershed Management, Planning, Goals & Concerns 12
3.0 Watershed Resource Inventory 13
3.1 Location & Watershed Boundaries 13
3.2 Water Impairments, Standards 13
3.2.1 Water Quality Impairments 13
3.2.2 Relevant Standards & Guidelines 14
3.3 Water Quality Data 15
3.3.1 Total Phosphorus 16
3.3.2 Nitrogen 16
3.3.3 Total & Volatile Suspended Solids 17
3.3.4 Dissolved Oxygen 17
3.3.5 Aquatic Life 18
3.4 Watershed Jurisdictions & Demographics 18
3.4.1 Watershed Jurisdictions & Jurisdictional Responsibilities 18
3.4.2 Demographics 20
3.5 Geology, Hydrogeology, & Topography 21
3.5.1 Geology 21
3.5.2 Hydrogeology 22
3.5.3 Topography & Relief 23
3.6 Climate 25
3.7 Landuse 26
3.7.1 Landuse Change 28
3.8 Soils 28
3.8.1 Highly Erodible Soils 30
3.8.2 Cropped Highly Erodible Soils 32
3.8.3 Hydric Soils 32
3.8.4 Hydrologic Soil Groups 34
3.8.5 Septic System Suitability 36

3.9 Tillage 37
3.10 Existing Conservation Practices 38
3.11 Hydrology & Drainage System 40
3.11.1 Streams 41
3.11.2 Tile Drainage 42
3.11.3 Stream Channelization 43
3.11.4 Riparian Areas & Buffers 44
3.11.5 Wetlands 47
3.11.6 Floodplain 48
3.12 Streambank & Bed Erosion 49
3.12.1 Streambank Erosion 50
3.12.2 Streambed Erosion 53
3.13 Gully Erosion 54
3.14 Sheet & Rill Erosion 57
3.15 Point Source Pollution 58
3.15.1 NPDES Dischargers 58
3.16 Septic Systems & Sewer 59
4.0 Pollutant Loading 62
4.1 Introduction 62
4.2 Pollutant Loading 62
5.0 Sources of Watershed Impairments 68
5.1 Nitrogen & Phosphorus 68
5.1.1 Cropland 69
5.1.2 Non-Cropland Pasture & Livestock Feed Areas 70
5.2 Sediment 70
5.2.1 Cropland 71
5.2.2 Gullies & Streambanks 72
6.0 Nonpoint Source Management Measures & Load Reductions 73
6.1 Best Management Practices & Expected Load Reductions 74
6.1.1 Agricultural - In-Field BMP Summary 80
6.1.2 Structural BMP Summary 83
6.1.3 Urban BMPs & Habitat Improvements 90
7.0 Cost Estimates 91
7.1 Unit Costs 91
7.2 Total Cost 93
8.0 Water Quality Targets 97

9.0 Critical Areas ... 100
9.1 In-Field Management Measures ... 100
9.1.1 Nutrient Management ... 100
9.1.2 No-till or Strip-Till ... 102
9.1.3 Cover Crops ... 102
9.2 Structural BMPs ... 103
10.0 Technical & Financial Assistance ... 107
10.1 Financial Assistance ... 108
10.2 Technical Assistance & Strategic Partners ... 112
10.2.1 Government ... 113
10.2.2 Agricultural & Trade Organizations ... 113
10.2.3 Private Sector ... 114
10.2.4 Non-Governmental Organizations ... 114
10.2.5 Institutional ... 115
11.0 Implementation Milestones, Objectives & Schedule ... 115
12.0 Outreach & Education ... 119
12.1 Recommended Outreach & Education Campaigns ... 121
12.1.1 Goals & Objectives ... 122
12.1.2 Target Audiences ... 123
12.1.3 Public Input ... 124
13.0 Monitoring & Tracking Strategy ... 124
13.1 Programmatic Monitoring ... 124
13.2 Water Quality Monitoring ... 125
13.2.1 Water Quality & Biological Monitoring ... 125
References ... 129
Appendix A: Streambank Erosion Map Book ... 131

Figures

Figure 1 – Mill Creek Watershed ... 11
Figure 2 – Water Quality Sampling Stations ... 15
Figure 3 – Jurisdictional Boundaries ... 19
Figure 4 – Rural Homes ... 20
Figure 5 – Geology & Wells ... 23
Figure 6 – Surface Elevation in Feet ... 24
Figure 7 – Surface Slope in Percent ... 24
Figure 8 – Existing Landuse ... 28
Figure 9 – Soils ... 30
Figure 10 – HEL Soils ... 31

Figure 11 – Hydric Soils 34
Figure 12 – Soil Hydrologic Groups 35
Figure 13 – Tillage Types 38
Figure 14 – Existing BMPs 40
Figure 15 – Drainage System 42
Figure 16 – Channelized Streams 44
Figure 17 – Stream Buffers 46
Figure 18 – Wetlands 48
Figure 19 – 100-Year Floodplain 49
Figure 20 - Streambank Erosion 52
Figure 21 - Surveyed Stream – 8 of 15 53
Figure 22 – Gully Erosion 56
Figure 23 – Septic Systems & Sewer 61
Figure 24 – Annual Nitrogen Loading Per Acre from Direct Surface & Subsurface Runoff 66
Figure 25 – Annual Phosphorus Loading Per Acre from Direct Surface & Subsurface Runoff 67
Figure 26 – Annual Sediment Loading Per Acre from Direct Surface Runoff 67
Figure 27 – Proposed BMPs – In-Field Cover Crop/Tillage 78
Figure 28 – Proposed BMPs - In-Field Nutrient Management 79
Figure 29 – Proposed Structural BMPs 80
Figure 30 - Critical Areas - In-Field Nutrient Management 101
Figure 31 - Critical Areas - In-Field Cover Crop & No-Till/Strip-Till 103
Figure 32 – Critical Areas – Structural Practices 107

Tables

Table 1 – Stream & Watershed Characteristics & Problem Ranking 7
Table 2 –Mill Creek Water Quality Monitoring Locations 15
Table 3 – Total Phosphorus Concentrations - Mill Creek 16
Table 4 – Nitrogen (Nitrate + Nitrite) Concentrations - Mill Creek 16
Table 5 – TSS Concentrations - Mill Creek 17
Table 6 – VSS & NVSS Concentrations - Mill Creek 17
Table 7 – Dissolved Oxygen - Mill Creek 17
Table 8 – Townships by Subwatershed 19
Table 9 – Surficial Geology of the Mill Creek Watershed 21
Table 10 - Climate Normals (1991-2020) 25
Table 11 - Monthly Climate, 2005–2020 26
Table 12 – Watershed Landuse Categories & Area 27
Table 13 - Soil Types & Extent 29
Table 14 - HEL by Subwatershed 31
Table 15 - Cropped Acres by HEL Status 32
Table 16 - Hydric Soils 33
Table 17 – Hydric Soil Types 33
Table 18 – Hydrologic Soil Groups 35
Table 19 – Soil Septic System Suitability, Total Area & Home/Building Count 36

Table 20 – Tillage Types, Acres & Percent of Cropland 37
Table 21 – Known Existing Conservation Practices 39
Table 22 – Primary Tributary Peak Flow Data 40
Table 23 – Open Water Perennial Streams & Tributaries 41
Table 24 – Surface Water Inventory by Subwatershed 41
Table 25 – Length of Channelized Streams 43
Table 26 – Streambank Buffer Adequacy 45
Table 27 – Streambank Buffer Landuse Categories 45
Table 28 – Wetlands 47
Table 29 – Streambank Erosion & Loading 51
Table 30 - Gully Erosion & Pollutant Loading 55
Table 31 – Gully Erosion & Pollutant Loading by Landuse Category 56
Table 32 – Sheet & Rill Erosion Loading by Subwatershed 57
Table 33 – Sheet & Rill Erosion Loading by Tillage Type 57
Table 34 - NPDES Facilities & Pollutant Loading 59
Table 35 - Septic System Loading by Subwatershed 60
Table 36 – Pollutant Loading Summary 63
Table 37 – Pollutant Loading from Surface & Subsurface Runoff by Landuse 64
Table 38 – Loading from Surface & Subsurface Runoff by Landuse as Percentage of Watershed Load 65
Table 39 – Primary Nutrient Loading Sources 69
Table 40 – Cropland Nutrient Loading by Tillage Type 70
Table 41 – Sediment Loading from all Sources 70
Table 42 – Cropland Sediment Loading by Tillage Type 71
Table 43 – Cropland Sediment Loading by HEL/PHEL Soils & Tillage Type 72
Table 44 – Pollutant Reduction Efficiency Ranges by BMP for Surface Runoff 73
Table 45 – Pollutant Reduction Efficiency Ranges by BMP for Subsurface Runoff 74
Table 46 – Recommended BMPs & Load Reduction Summary – Town of Reynolds – Mill Creek 75
Table 47 – Recommended BMPs & Load Reduction Summary – Mud Creek – Mill Creek & Watershed Total 76
Table 48 - Unit Costs & Assumptions 91
Table 49 – BMP Cost Summary by BMP Type – Town of Reynolds 94
Table 50 – BMP Cost Summary by BMP Type – Mud Creek & Watershed Total 95
Table 51 – Mill Creek Water Quality Targets & Load Reductions – Town of Reynolds 97
Table 52 – Mill Creek Water Quality Targets & Load Reductions – Mud Creek & Watershed Totals 99
Table 53 - Critical Areas - Nutrient Management 101
Table 54 – Critical Area – Tillage & Cover Crop 102
Table 55 - Critical Area - Structural Practices 105
Table 56 - Strategic Partners & Stakeholders 112
Table 57 – Years 1-2 - Implementation Milestones 116
Table 58 – Years 3-5 - Implementation Milestones 117
Table 59 – Years 6-10 - Implementation Milestones 117
Table 60 – Implementation Objectives, Responsible Parties & Technical Assistance 118
Table 61 - Existing & Proposed Monitoring Sites & Description 126

Table 62 - Summary of Monitoring Categories & Recommendations........ 126
Table 63 - Baseline Water Quality Analysis Parameters........ 127
Table 64 - Stream Bioassessment Metrics........ 128

Acronyms

1. BMP – Best Management Practice
2. cfs – cubic feet per second
3. CIG – Conservation Innovation Grant
4. CRP – Conservation Reserve Program
5. CSP – Conservation Stewardship Program
6. CORPS - United States Army Corps of Engineers
7. CWS – Community Water Supply
8. DO – Dissolved Oxygen
9. EMC – Event Mean Concentration
10. FSA – Farm Service Agency
11. EQIP – Environmental Quality Incentive Program
12. fasl – feet above sea level
13. GIS – Geographic Information System
14. HEL – Highly Erodible Soil
15. PHEL – Potentially Highly Erodible Soil
16. gpm – gallons per minute
17. HUC – Hydrologic Unit Code
18. ICG – Illinois Corn Growers
19. IDNR – Illinois Department of Natural Resources
20. IDOA – Illinois Department of Agriculture
21. Illinois EPA – Illinois Environmental Protection Agency
22. ILICA – Illinois Land Improvement Contractors Association
23. INLRS – Illinois Nutrient Loss Reduction Strategy
24. INAI - Illinois Natural Areas Inventory
25. ISGS – Illinois State Geologic Survey
26. LRR – Lateral Recession Rate
27. MGD – Million Gallons per Day
28. MRTN – Maximum Return to Nitrogen
29. MS4 - Municipal Separate Storm Sewer System
30. NGRREC - National Great Rivers Research & Education Center
31. NFWF - National Fish & Wildlife Foundation
32. NCWS – Non-Community Water Supply
33. NO3 – Nitrate
34. NPDES – National Pollutant Discharge Elimination System
35. NPS– Nonpoint Source Pollution
36. NRCS – National Resource Conservation Service
37. NTCHS – National Technical Committee for Hydric Soils
38. NWI – National Wetlands Inventory
39. PFC – Partners for Conservation
40. PCM – Precision Conservation Management
41. RCPP – Regional Conservation Partnership Program
42. RISWCD – Rock Island Soil and Water Conservation District
43. STEPL – Spreadsheet Tool for Estimating Pollutant Loads
44. STP – Stone Toe Protection
45. SSRP – Streambank Stabilization and Restoration Program
46. SWCD – Soil and Water Conservation District
47. TMDL – Total Maximum Daily Load
48. TN – Total Nitrogen
49. TP – Total Phosphorus
50. TSI – Timber Stand Improvement
51. TSP – Technical Service Providers
52. TSS – Total Suspended Solids
53. USDA – U.S. Department of Agriculture
54. USEPA – U.S. Environmental Protection Agency
55. USFWS – U.S. Fish and Wildlife Service
56. USGS – United States Geological Survey
57. USLE – Universal Soil Loss Equation
58. VRT - Variable Rate Technology
59. NVSS – Nonvolatile Suspended Solids
60. VSS – Volatile Suspended Solids
61. WFF – Walton Family Foundation
62. WASCB – Water and Sediment Control Basin

Executive Summary

The Mill Creek Watershed

The Mill Creek Watershed Plan encompasses 40,194 acres from two Hydrologic Unit Code (HUC)-12 watersheds. The plan provides a road map to achieve water quality targets and stakeholder goals. Nutrient and sediment water quality targets are in alignment with the Illinois Nutrient Loss Reduction Strategy (INLRS). This plan is intended to be monitored, adapted and updated as cost-effective implementation activities achieve the highest load reductions. Priority or critical areas identified should serve as a starting point to guide implementation and outreach efforts by watershed managers and partners.

Managers and landowners in the Mill Creek watershed have been working diligently to improve water quality and promote conservation and stewardship. The Rock Island County Soil and Water Conservation District (RISWCD) have led efforts over the years supported by local stakeholders that include farmers, residents, government agencies, municipalities, and non-profit groups. These efforts and partnerships will continue and are further strengthened from the planning process. Complementary actions underway or initiated during plan development include conservation cost-share from the Natural Resources Conservation Service (NRCS) and RISWCD, discussion of new grant applications, education events, and landowner outreach. The watershed track record has laid the critical groundwork needed to accelerate implementation activities detailed in this plan.

The primary goal of this plan is to reduce sediment and nutrient delivery to the Rock River. The plan includes a detailed inventory and assessment of current conditions that inform strategic recommendations and projects. Table 1 summarizes and ranks stream and watershed characteristics that are contributing to water quality impairments followed by a summary of key recommendations.

Table 1 – Stream & Watershed Characteristics & Problem Ranking

Inventory/ Assessment	Summary	Ranking
Nutrient & Sediment Loading (Surface Runoff)	Sediment loading from crop ground exceeds other sources and is responsible for 70% of the total sediment load. Nutrient loading is also higher than urban and other land and is responsible for the greatest percentage of the nitrogen (76%), and phosphorus (63%). It is estimated that only 0.5% of the cropland nitrogen load is originating from subsurface flow or drain tiles. Agricultural Best Management Practices (BMPs) will be very effective in reducing nutrient and sediment loads, considering cost and feasibility. Little to no conversion of land into agriculture is expected to occur in the future. Prioritized in-field practices, especially those that treat surface runoff such as cover crops and nutrient management will significantly reduce nitrogen loading while edge-of-field and structural practices (e.g., filter strips, wetlands, and grassed waterways) will address higher-risk areas and further reduce loading, especially for phosphorus and sediment.	**High**

Inventory/ Assessment	Summary	Ranking
Streambank Erosion	Streambank erosion is responsible for the second largest portion of the watershed sediment load (18% or 11,611 tons/yr) and 15% of the phosphorus load. Although it is a natural process, bank erosion is severe at numerous locations, such as forested stream corridors. Access constraints and cost limit ability for stabilization. However, critically unstable and accessible segments identified in this plan should be addressed.	**High**
Water Quality & Stream Flow Monitoring	Water quality data is sparse in the watershed. There are large gaps in monitoring of streams with agency data only from 2011 and 2013. Very limited volunteer data was collected in 2019 and 2021. No stream flow information exists. Substantial data does exist for the Rock River however, this system is not representative of Mill Creek. Additional and regular monitoring of water chemistry and flow is needed at a minimum of 3 locations. This information is critical for establishing concrete estimates of sediment and nutrient loading and to evaluate the effectiveness of watershed management activities. Local academic institutions and volunteers can assist providing capacity and resources.	**High**
Gully Erosion	Gully erosion is responsible for a moderate portion of the watershed sediment load or 11%. Noncropland areas such as forest contribute 10% of this. Gully erosion is also 5% of the total phosphorus load. These areas can be addressed through structural practices, primarily ponds and constructed wetlands to trap and filter sediment.	**Medium**
Tillage & Highly Erodible Soils	No-till systems are common on 80% of all field acres and are responsible for approximately 76% of the annual cropland sediment (2 tons/ac/yr) and 78% of the nutrient load. Mulch-till is on 12% of all farm ground and delivers 19% of the sediment load from cropland or 3.3 tons/ac/yr. Conventional tillage is low overall but yields the greatest per acre sediment loads or 5.3 tons/ac/yr. The less than 1% of conventional tillage delivers 2% of the sediment load from cropland. Cover crops are found on only 2.6% in the watershed and yield very low nutrient and sediment loads. Highly erodible and potentially highly erodible soils exist on 60% and deliver 82% of the entire cropland sediment load. Most of these acres (80%) are in no-till and the limited area of mulch-till fields (11%) deliver 16% of the entire cropland sediment load and therefore, further increasing the percentage of no-till in the watershed and promoting cover crops will measurably reduce sediment and nutrient loading.	**Medium**
Livestock & Pasture	Although pasture makes up only 6.3% of total watershed area or 2,538 acres, it is likely responsible for 5.9% of the total nitrogen and 4.6% of the total phosphorus from surface runoff. More concentrated livestock feeding areas may be generating up to 4.5 lbs/ac per year and the highest of any other landuse category. The majority of pasture operations are found along or near stream channels and practices that limit livestock access to streams will help to improve water quality	**Medium**
Landuse Change & Urban Areas	The watershed does contain developed land especially in the lower reaches of Mill Creek. There is some evidence that development will increase adjacent to built-up areas south of Milan, Illinois. Much of the tillable acres are already converted to cropland and little to no transition from natural areas is likely. These locations should be conserved and improved to promote habitat quality. Urban areas contribute little to the overall sediment and nutrient load however opportunities do exist for practices such as detention, grade control in urban forested areas, and native prairie restoration.	**Low**

Inventory/ Assessment	Summary	Ranking
Septic Systems	There are an estimated 1,104 homes with septic systems in the watershed. It is possible that up to 15% or 116 of all systems may be failing. Failing systems are estimated to account for low portion of the overall nutrient load (1.4% nitrogen and 3.7% phosphorus). A septic system education program can prevent loading from failing systems in the future.	**Low**
National Pollutant Discharge Elimination System Dischargers	Six NPDES (National Pollutant Discharge Elimination System) permitted facilities discharge negligible amounts of nutrients and sediment. As these facilities are mostly for stormwater and permitted through the Illinois EPA and United States Environmental Protection Agency (USEPA), they are considered low priority. One landfill operates in the watershed and does not have a NPDES permit although it is regulated by the Illinois EPA.	**Low**

Key Recommendations

1. Conduct targeted outreach and one-on-one communication with producers and landowners identified as having critical areas outlined in Section 9.0. Develop a series of large-scale funding initiatives.
2. Initiate water quality monitoring efforts and measure progress. Consider a central data management system.
3. Utilize this plan to direct NRCS and SWCD conservation cost-share dollars and incorporate into existing ranking systems with an emphasis on cover crops, nutrient management, and stream buffers/filter strips.
4. Pursue conservation cost-share and incentives through the United State Department of Agriculture Regional Conservation Partnership Program (RCPP), Illinois EPA Section 319 grant program, and/or other private partnership grant funding such as the Fishers & Farmers Partnership Program or the National Fish and Wildlife Foundation Conservation Partners Program.
5. Stabilize critical and accessible streambank segments identified in this plan. Rock Stone Toe Protection is the most effective practice.

Mill Creek at Confluence with the Rock River

1.0 Introduction

The focus of this plan is the 40,194-acre Mill Creek watershed, located mostly in Rock Island County, Illinois. The area of two United States Geological Survey (USGS) Hydrologic Unit Code (HUC)-12 subwatersheds make up the project area: Town of Reynolds – Mill Creek (HUC12 – 070900051201) and Mud Creek - Mill Creek (HUC12 – 070900051202). Mill Creek drains to the Lower Rock River HUC8 basin (07090005) immediately before entering the Mississippi River. Figure 1 shows the watershed location.

This plan characterizes Mill Creek and defines an attainable implementation strategy to address water quality concerns, specifically, nutrients and sediment. It also expands ongoing Rock Island Soil and Water Conservation District (RISWCD) led efforts to improve water quality, identify, prioritize, and plan new projects following years of collaborative conservation activities. The plan will, therefore, provide a road map to achieve water quality targets as well as agency and stakeholder goals for an area important to the Lower Rock and Upper Mississippi River. This plan is intended to be adapted and updated as implementation activities progress to achieve the highest load reductions for the least possible investment.

Mill Creek has a limited history of water quality impairments compared to the Lower Rock River. The 2021 Illinois Nutrient Loss Reduction Strategy (INLRS) 2021 Biennial Report notes a 135% increase in nitrate-N loads in the Rock River between 2015 and 2019 compared to the baseline period of 1980 to 1996. Therefore, nitrogen reduction is the primary driver of this plan followed by phosphorus and sediment. The importance of nutrient and sediment reduction is critically important to maintain and improve current stream quality and help to address conditions in the Rock River. Water quality targets of a 45% reduction in nitrogen, phosphorus, and sediment are consistent with long-term goals stated in the INLRS. If all recommended projects are implemented and constructed, the sediment reduction target will be exceeded, and the phosphorus target likely met. The nitrogen target is likely not met without additional conversion of crop ground to permanent grass. This report includes the required Watershed Based Plan components and is organized into the following sections:

- Section 1 – Introduction
- Section 2 – Watershed History
- Section 3 – Watershed Resource Inventory
- Section 4 – Pollutant Loading
- Section 5 – Sources of Watershed Impairments
- Section 6 – Nonpoint Source Management Measures & Load Reductions
- Section 7 – Cost Estimates
- Section 8 – Water Quality Targets
- Section 9 – Critical Areas
- Section 10 – Technical & Financial Assistance
- Section 11 – Implementation Milestones, Objectives & Schedule
- Section 12 – Outreach & Education
- Section 13 –Monitoring & Tracking Strategy

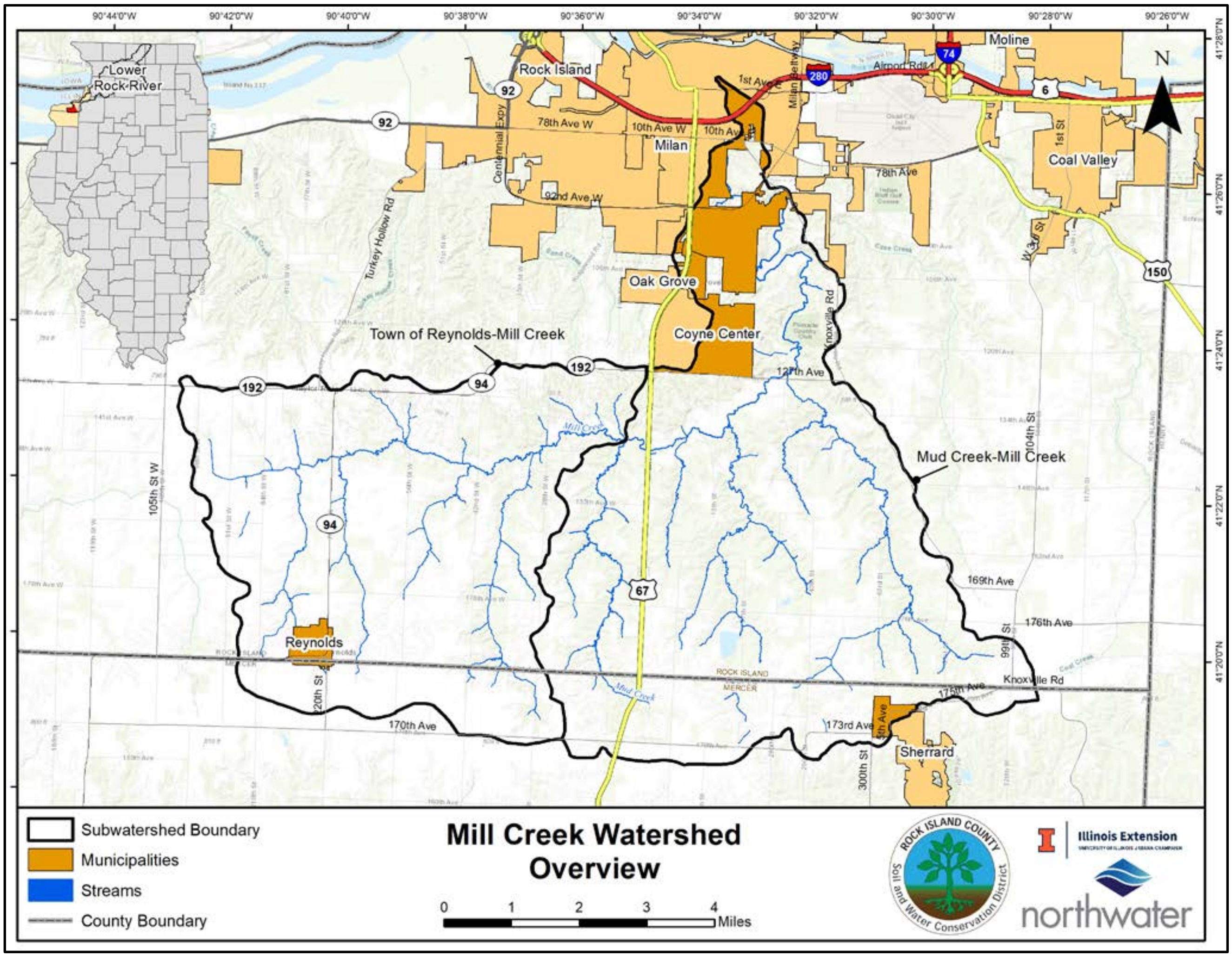


Figure 1 – Mill Creek Watershed

2.0 Watershed History & Background

Mill Creek enters the Lower Rock River in Milan, Illinois. It originates just south of Reynolds Village and drains North for approximately 3 miles before migrating east to its confluence with Mud Creek. It then begins to flow North again through the Village of Milan towards the Rock River. Mud Creek begins immediately to the south of the Rock Island, Mercer County line halfway between Reynolds and the Village of Sherrard. Mill Creek, especially in the lower reaches is a recreational resource for fishing, and other water-related activities such as kayaking. The watershed is largely rural with small towns and residential developments scattered throughout. The most densely developed urban areas in the watershed can be found near its confluence with the Rock River in Milan.

Little had been known about the watershed status or needs until recent stakeholder interest, combined with concerns over water quality in the Lower Rock River provided a stimulus for the development of this plan. In response to landowner concerns and staff interest, the RISWCD hosted a stakeholder meeting and over 30 people attended with the help of Illinois Extension in August 2019. From this meeting, a group of particularly interested stakeholders emerged to form the Mill Creek Watershed Planning Committee. On the recommendation from the planning committee, the Illinois Extension watershed coordinator and RISWCD made the decision to pursue funding for a watershed plan.

2.1 Watershed Management, Planning, Goals & Concerns

The RISWCD and other key partners have been engaged in watershed management for decades, primarily focusing on the greater Lower Rock River watershed and Copperas Creek watershed which lies to West of Mill Creek and flows to the Mississippi River. In 1997, the Lower Rock River Ecosystem Partnership was formed with support from the Illinois Department of Natural Resources (IDNR). The mission of this group was to work on natural resource concerns and leverage resources for the area. In 2000, a Lower Rock River Management Plan was developed. This plan identified stakeholder issues including concerns over water quality, habitat restoration and protections, flooding, and recreation and potential solutions of targeted education and outreach, urban stormwater management and ordinances, conservation practices on agricultural ground, wetland restoration, restoration of existing habitat (addressing invasive species), stream restoration, and data collection.

No formal watershed plan exists or has been prepared specific to Mill Creek. However, interest in planning from an adjacent watershed (Copperas Creek) spilled over and in 2019 a stakeholder meeting was held to identify resource concerns. A formal Steering Committee was established and began laying the groundwork for a watershed plan. Resource concerns prioritized in 2019 included:

1. Streambank erosion.
2. Gully erosion.
3. Sheet and rill erosion.
4. Log jams.
5. Wildlife/pollinator habitat.

In addition to the Steering Committee, the broader public, agencies/communities, and individual landowners were further engaged and surveyed by the RISWCD to help identify and validate or expand concerns and develop reasonable solutions and goals to guide the plan:

1. Reduce soil erosion and sediment, specifically from streambanks and gullies.
2. Improve water quality (sedimentation) and reduce flooding.
3. Improve availability of cost-share for non-cropland.
4. Revitalize pastureland.
5. Reduce invasive species and improve poor habitat quality.

3.0 Watershed Resource Inventory

The resource inventory summarizes characteristics specific to the Mill Creek watershed. It includes information on hydrology, landuse, soils, habitat and water quality, demographics, and other relevant information.

3.1 Location & Watershed Boundaries

Figure 1 shows the location of the watershed and the Lower Rock River. The Rock River is tributary to the Mississippi and is over 10,000 square miles in size, almost half of which is in Wisconsin. The Lower Rock River begins near Rockford, Illinois and is 2,169 square miles in size excluding the Green River Basin to its South. This plan encompasses the watershed area of Mill and Mud Creek from the Mercer/Rock Island County line North to Milan, Illinois and the confluence with the Rock.

3.2 Water Impairments, Standards

This section provides an overview of applicable and relevant water quality standards, pollutants of concern and impairments. Water quality standards are laws or regulations established to enhance water quality and protect public health and welfare. Standards consist of criteria necessary to support and protect a specific "designated use" of a waterbody and an antidegradation policy. Examples of designated uses are primary contact, fish consumption, aesthetic quality, protection of aquatic life, and public and food processing water supply. Criteria are expressed numerically for standards with a numeric limit (e.g., 10% of samples over a time period cannot exceed the standard expressed as a concentration), or as narrative description for qualitative standards without a numeric limit (e.g., increased algae growth, not meeting aesthetic standards). Antidegradation policies are adopted so that water quality improvements are conserved, maintained, and protected. Waterbodies are considered impaired when they exceed these standards, meeting the criteria to be defined as impaired. Section 303(d) of the 1972 Clean Water Act requires the States to define impaired waters and identify them on the 303(d) list. When no regulatory standards are relevant for a parameter, water quality guidelines are often applied to assess the condition of a waterbody.

3.2.1 Water Quality Impairments

No recent 2020/2022 303(d) impaired waterbodies or segments exist in the watershed. A very minor historical impairment is documented for Mill Creek (assessment ID IL_PA-01) beginning in 2004 and ending in 2014. No impairments have been recorded for Mud Creek (assessment ID IL_PAA). The only impairment for Mill is related to aquatic life with no cause or source identified. The next closest or relevant impaired waterbody is the Rock River (assessment ID IL_P-25) immediately downstream from the confluence with Mill. Looking back to 2006 and including 2020/2022, this segment has been impaired in all assessment years except for 2010. In each instance except for 2020/2022 with only fish consumption noted, the designated uses of aquatic life and fish consumption were considered "not supporting. Causes of the impairments include mercury, polychlorinated biphenyls, dieldrin, mirex, aldrin, toxaphene, endrin, heptachlor, and unknown (aquatic life).

3.2.2 Relevant Standards & Guidelines

Nitrogen: Nitrate-Nitrogen (NO3-N) is the inorganic form of nitrogen and when in high concentrations can be toxic to humans, wildlife and aquatic ecosystems. Excess nitrogen in surface waters also aid algal growth and blooms.

- The public and food processing water supply standard is 10 mg/L and although it only applies to stream segments designated as public and food processing water supplies, it can be used as a surrogate for Mill Creek.

Nitrogen: Total Nitrogen (TN) includes the sum of nitrate, nitrite, Total Kjeldahl Nitrogen (organic nitrogen) and ammonia or NH4. Nitrate + Nitrite is another common measure that refers to the inorganic component of nitrogen.

- There are no TN standards for lakes or rivers/streams in Illinois, however, The Illinois Nutrient Science Advisory Committee (INSAC) recommends 3.8 mg/L as a guideline for wadable streams in the northern ecoregion (INSAC, 2018). It should be noted that the INSAC recommended standards have not been finalized.

Total Phosphorus (TP) includes dissolved and particulate fractions and is often stored in aquatic biota such as algae. Dissolved factions are more readily available and can stimulate processes that are harmful to water quality and aquatic life. Phosphorus sources in the watershed context include fertilizers and to a lesser extent human and animal waste.

- There is no phosphorus standard for rivers and streams in Illinois, however, the standard for lakes states that TP shall not exceed 0.05 mg/L in any stream at the point where it enters any reservoir or lake with a surface area greater than 20 acres. Further, the INSAC recommends a guideline of 0.113 mg/L for rivers in the northern ecoregion (INSAC 2018). It should be noted that the INSAC recommended standards have not been finalized.

Dissolved Oxygen (DO) measurements determine the amount of oxygen in the water available for fish and other aquatic life. Warm water fish typically require at least 5 mg/L to survive. Dissolved Oxygen in waterbodies is affected by temperature, and various physical, chemical and biological processes.

- The DO standard states that to protect aquatic life, it shall not be less than 6 mg/L during at least 16 hours of any 24-hour period, nor less than 5 mg/L at any time. This applies to both rivers/streams and lakes in Illinois.

Total Suspended Solids (TSS) the fraction of total solids suspended in water as retained by a 1.5 µm filter. Concentrations vary temporally in rivers and lakes, typically increasing from erosion during runoff events, lake turnover, biological processes, and human disturbances. Total suspended solids can be differentiated between volatile suspended solids (VSS), organic materials such as algae and decomposing organic matter and nonvolatile suspended solids (NVSS), which includes non-organic "mineral" substances (Illinois EPA, 1998).

- As there are no regulatory standard for TSS in Illinois streams, a guideline of 116 mg/L has been applied in the past as an indicator of conditions to support aquatic life use. The analysis presented below will also compare VSS to the 116 mg/L guideline as a proxy. No NVSS data was available.

3.3 Water Quality Data

Relevant and available water quality data is very scarce within the Mill Creek watershed. Illinois EPA Intensive Basin Survey records of only one sampling event in 2011 and five in 2013 were found. There are an additional three volunteer sampling events from the Sierra Club, two in 2021 and one in 2019. No time-series data is available. Sampling station locations are shown in Figure 2.

Table 2 –Mill Creek Water Quality Monitoring Locations

Station Code	Latitude (dd)	Longitude (dd)	Waterbody	Parameters
PA-01 (Illinois EPA station)	41.42991	-90.55065	Mill Creek	NH_4, inorganic nitrogen, pH, Phosphorus, TSS, VSS
Sierra Club	41.44250	-90.55558	Mill Creek	pH, Phosphate, Nitrate, TSS, DO

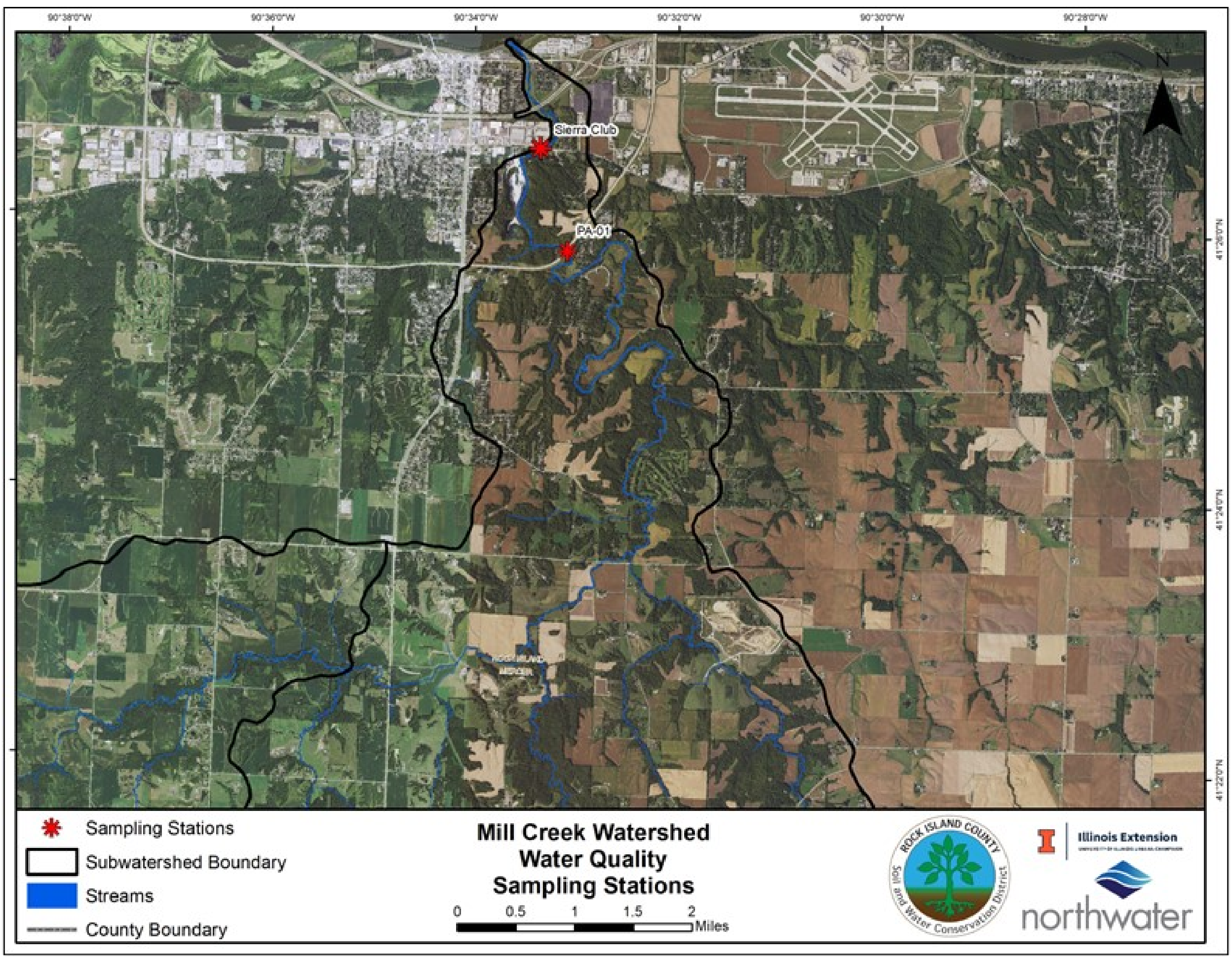


Figure 2 – Water Quality Sampling Stations

3.3.1 Total Phosphorus

Nine Illinois EPA samples have exceeded the INSAC recommended TP limit (0.113 mg/L) since 2011, however the median value is below (Table 3). The unusually high concentration measured on the 8th of July 2013 is the prime cause for the average exceeding the INSAC recommended maximum concentration. Although measured as phosphate, all Sierra Club volunteer data exceeded 0.113 mg/L.

Table 3 – Total Phosphorus Concentrations - Mill Creek

Date	Concentration (mg/L)	Above INSAC recommendation
07-11-2011	0.13	Yes
07-11-2011	0.096	No
06-07-2013	0.087	No
06-07-2013	0.155	Yes
07-08-2013	0.556	Yes
07-17-2013	0.095	No
07-17-2013	0.048	No
09-03-2013	0.158	Yes
10-10-2013	0.099	No
10-10-2013	0.069	No
07-26-2019*	0.28	Yes
07-23-2021*	0.37	Yes
09-25-2021*	0.25	Yes
Average	**0.149**	**Yes**
Median	**0.098**	**No**
1st quartile	**0.089**	**No**
3rd quartile	**0.149**	**Yes**
* - Sierra Club volunteer samples, phosphorus collected as phosphate concentration, not included in analysis		

3.3.2 Nitrogen

Three of the six Illinois EPA samples exceeded the INSAC recommended TN concentration of 3.98 mg/L (Table 4). No single sample was above the 10 mg/L standard. Only one volunteer data point exceeded the INSAC recommendation. No volunteer data exceeded the drinking water standard.

Table 4 – Nitrogen (Nitrate + Nitrite) Concentrations - Mill Creek

Date	Concentration (mg/L)	Above INSAC Recommendation	Above Drinking Water Quality Standard
07-11-2011	5.5	Yes	No
06-07-2013	7.17	Yes	No
07-08-2013	4.3	Yes	No
07-17-2013	2.38	No	No
09-03-2013	<0.055	No	No
10-10-2013	<0.055	No	No
07-26-2019*	4.0	Yes	No
07-23-2021*	2.7	No	No
09-25-2021*	1.0	No	No
Average	**3.24**	**No**	**No**
Median	**3.34**	**No**	**No**

Date	Concentration (mg/L)	Above INSAC Recommendation	Above Drinking Water Quality Standard
1st quartile	**0.64**	**No**	**No**
3rd quartile	**5.20**	**Yes**	**No**
* - Sierra Club volunteer samples, nitrogen collected as nitrate concentration, not included in analysis			

3.3.3 Total & Volatile Suspended Solids

Only one of the six samples exceeded the 116 mg/L TSS guideline and was recorded in July of 2013 (Table 5). Average VSS concentrations for the data set are 5.3 mg/L and NVSS, 17.3 mg/L (Table 6).

Table 5 – TSS Concentrations - Mill Creek

Date	Concentration (mg/L)	Above Guideline
07-11-2011	21	No
06-07-2013	61	No
07-08-2013	484	Yes
07-17-2013	44	No
09-03-2013	32	No
10-10-2013	15	No
07-26-2019*	8.7	No
07-23-2021*	11	No
09-25-2021*	36	No
Average	**110**	**No**
Median	**38**	**No**
1st quartile	**24**	**No**
3rd quartile	**57**	**No**
* - Sierra Club volunteer samples, not included in analysis		

Table 6 – VSS & NVSS Concentrations - Mill Creek

Date	VSS Concentration (mg/L)	NVSS Concentration (mg/L)
07-11-2011	4	17
09-03-2013	8	24
10-10-2013	4	11
Average	**5.3**	**17.3**
Median	**4**	**17**
1st quartile	**4**	**14**
3rd quartile	**6**	**20.5**

3.3.4 Dissolved Oxygen

There are no Illinois EPA data points for DO however, limited volunteer data from 2019 and 2021 indicates values not violating the standard (Table 7).

Table 7 – Dissolved Oxygen - Mill Creek

Date	DO (mg/L)
07-26-2019	8.7
07-23-2021	9.1
09-25-2021	7.2

3.3.5 Aquatic Life

Water quality can be evaluated using biological indicators such as fish and bugs or macroinvertebrates. In Illinois, aquatic life use assessments in streams are typically based on the interpretation of biological information, physicochemical water data, and physical-habitat information from the Intensive Basin Survey, Ambient Water Quality Monitoring Network, or Facility-Related Stream Survey programs.

Biological data is also very limited in the watershed, with the only information being a macroinvertebrate study conducted by Illinois EPA in July 2013 on Mill Creek. The study reported a total of 44 species. No indices of biological integrity were calculated.

3.4 Watershed Jurisdictions & Demographics

The Mill Creek watershed lies predominantly within Rock Island County - 84% or 33,915 acres. Only 16% or 6,279 acres is within Mercer County (Figure 3). There are four municipalities and one census designated place that cover less than 6% of the watershed: Coyne Center, Milan, Oak Grove, Reynolds and Sherrard. Reynolds is the only municipality contained entirely within the Town of Reynolds – Mill Creek subwatershed with 238 acres. All of the other four communities are in the Mud Creek – Mill Creek subwatershed. Milan has the greatest acreage within the watershed with 1,207 of its 4,363. Coyne Center CDP has 563 of its 1,043 acres within the watershed, Oak Grove has 145 of its 407, and Sherrard 145 of its 742 acres.

3.4.1 Watershed Jurisdictions & Jurisdictional Responsibilities

Figure 3 depicts most jurisdictional entities and areas. The Mill Creek watershed spans seven townships. Table 8 lists townships by subwatershed.

No federally owned properties exist in the watershed. One IDNR managed Illinois Natural Areas Inventory (INAI) site and one Illinois Nature Preserves Commission (INPC) site is in the watershed. This includes the Milan South Geological Area, with 21 acres located within the Mud Creek – Mill Creek subwatershed and the overlapping 20-acre Josua Lindahl Hill Prairie Nature Preserve. The nature preserve consists of loess (wind-blown) hill prairies and the geological area, a significant limestone cliff. Both sites are within the 67-acre Collinson Ecological Preserve, owned and managed by Augustana College.

The Illinois EPA Bureau of Water regulates wastewater and stormwater discharges to streams, rivers, and lakes through the National Pollutant Discharge Elimination System (NPDES). Six NPDES permits exist within the watershed (Section 3.15.1).

Table 8 – Townships by Subwatershed

Subwatershed Name	HUC-12 Code	Township Name	Area within Watershed (acres)
Mud Creek-Mill Creek	70900051202	Bowling	8,068
		Rural	8,929
		Blackhawk	2,021
		Richland Grove	1,953
		Preemption	2,357
Town of Reynolds-Mill Creek	70900051201	Edgington	4,971
		Bowling	9,325
		Perryton	642
		Preemption	1,928

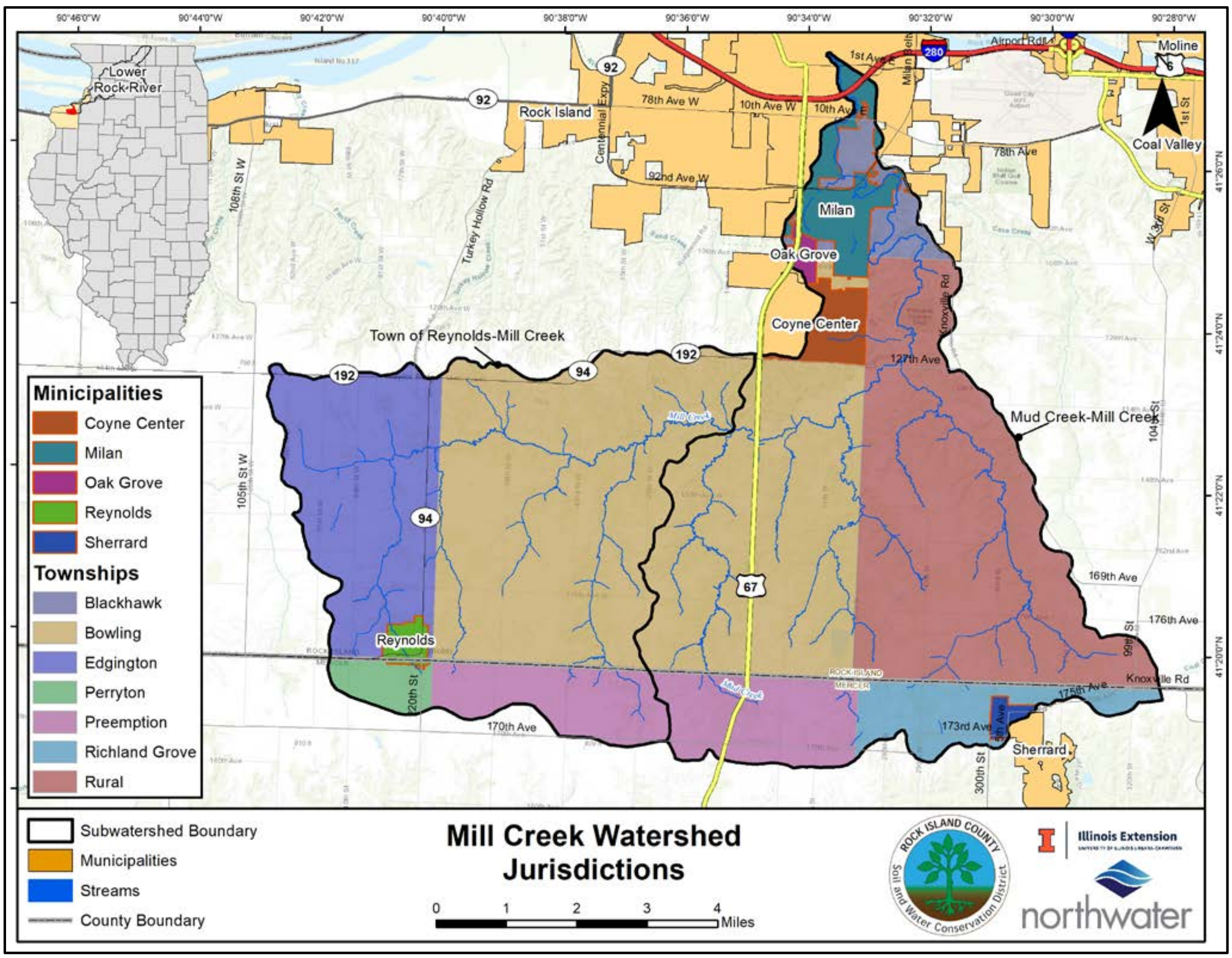


Figure 3 – Jurisdictional Boundaries

3.4.2 Demographics

According to the United States Census Bureau 2019 American Community Survey data, total population of the counties encompassing the watershed is 143,873 in Rock Island and 15,589 in Mercer. In Rock Island, median household income is $54,848 versus $59,787 in Mercer. There are 66,160 housing units in Rock Island and 7,420 in Mercer. Rock Island has a median age of 40 and Mercer, 45. In Rock Island County 19% of the population is above the age of 65 versus 21% in Mercer County. Using 2010 data by census tract, the area weighted population within the watershed is 3,876 with 1,677 housing units. Most of the watershed area itself is rural, containing all of Reynolds, a small portion of Sherrard, small portions of Rock Island's outlying municipalities Milan and Oak Grove, and Coyne Center (Figure 4).

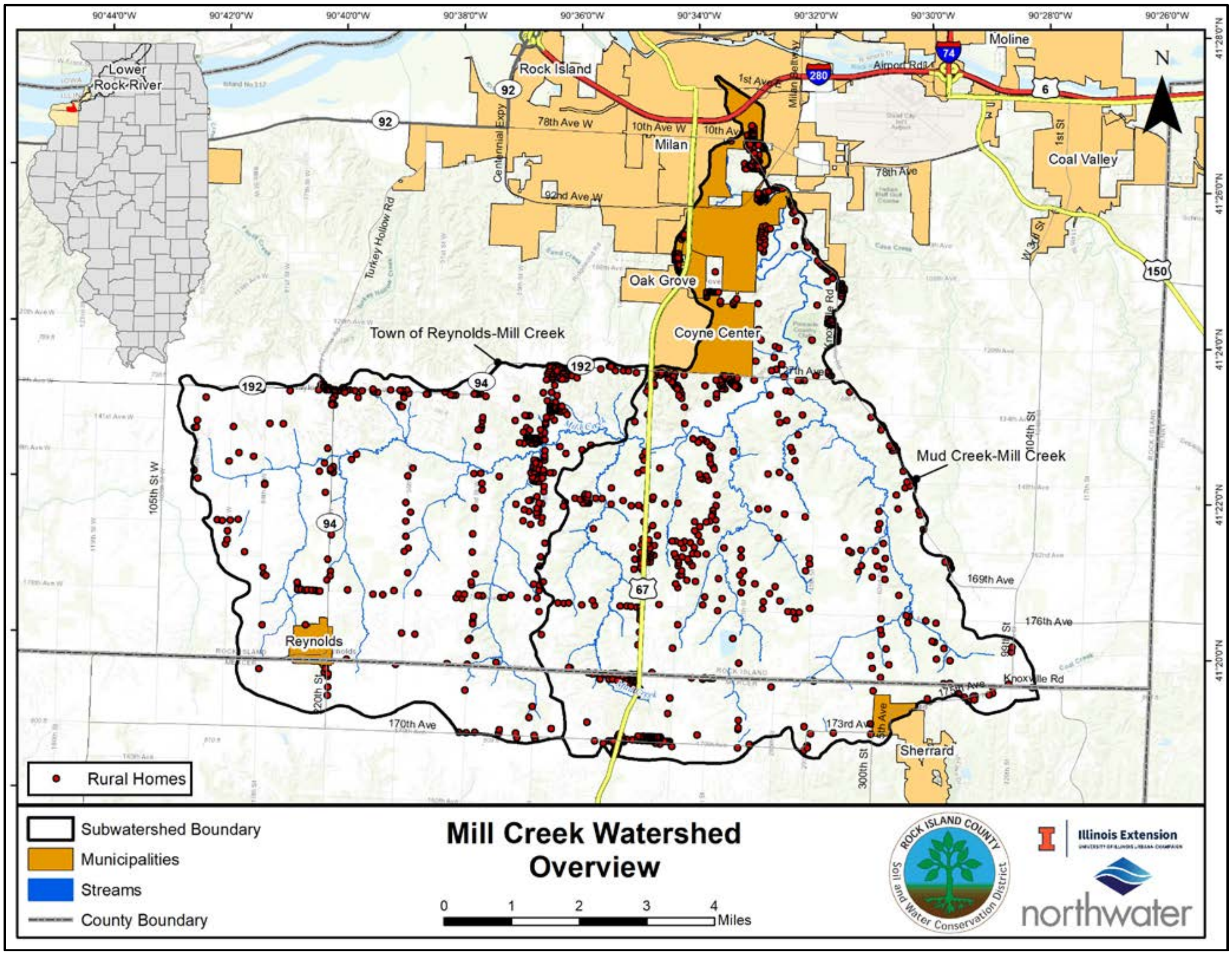


Figure 4 – Rural Homes

3.5 Geology, Hydrogeology, & Topography

This section includes information on surficial geology and hydrogeology, in addition to wells, surface elevation, and slope.

3.5.1 Geology

The Mill Creek watershed is located along the northern edge of the Galesburg Plain region of Illinois. Surficial materials and hydrology have been fundamentally shaped by glacial processes of deposition and erosion. The watershed is primarily covered with loess, a fine-grained windblown glacial deposit which is highly erodible on steeper slopes. Beneath this veneer of loess is typically a silty and clayey glacial till with variable thickness and composition and several bedrock units composed primarily of shale and dolomite (Table 9). The spatial extents and statistics of each surficial deposit type are illustrated in Figure 5.

Surficial geology was adapted from Illinois State Geologic Survey (ISGS) 1995 Stack-Unit mapping of the top 50 ft of earth materials. Drift thickness varies from less than 25 ft in the northern portion to over 200 ft at the northwestern and southeastern edges and over 400 ft in a band running north-northeast along the central portion of the watershed. These zones of thicker drift material correspond to the buried bedrock valleys. The unconsolidated deposits are primarily underlain by Devonian to Lower Pennsylvanian-aged shale, siltstone, sandstone and limestone with thin coal, dolomite and conglomerate of the Racoon Group (Tradewater and Caseyville formations), New Albany formation and Muscatatuck Group.

The widespread veneer of highly erodible and fine-grained glacial loess is a major potential source of sediment.

Table 9 – Surficial Geology of the Mill Creek Watershed

Surficial Geology	Description[1]	Area (acres)	Percent of Watershed
Alluvium	Thin Cahokia alluvium underlain by silty and clayey sequences of Wedron till and Pennsylvanian age shale typically present between 20 and 50 feet below surface.	2,374	6%
	Thin Cahokia alluvium underlain by Henry Formation sand and gravels with Silurian or Devonian age dolomite typically present around 50 feet below surface.	22	0.1%
	Thin Cahokia alluvium underlain by Silurian or Devonian age dolomite typically present less than 20 feet below surface.	244	1%
Loess	Thin Peoria or Roxana loess underlain by thin silty and clayey sequences of Glasford till and Silurian or Devonian age dolomite typically present less than 20 feet below surface.	1,339	3%
	Thin Peoria or Roxana loess underlain by thin silty and clayey sequences of Glasford till and Pennsylvanian age shale typically present less than 20 feet below surface.	2,765	7%

Surficial Geology	Description[1]	Area (acres)	Percent of Watershed
	Thin Peoria or Roxana loess (less than 20 feet) underlain by thin silty and clayey sequences of Glasford till and Wolf Creek till.	18,118	45%
	Thick Peoria or Roxana loess (greater than 20 feet) underlain by thin silty and clayey sequences of Glasford till and Wolf Creek till.	15,371	38%
	Thick Peoria or Roxana loess with Pennsylvanian age shales typically present between 20 and 50 feet below surface	0.01	< 0.1%

[1] *Adapted from Illinois State Geological Survey Stack-Unit Mapping of Geologic Materials in Illinois to a Depth of 50 ft*

3.5.2 Hydrogeology

There are estimated to be at least 474 private water wells within the Mill Creek watershed based on the ISGS wells and borings database. There are 14 active and 7 inactive Community Water Supply (CWS), and 7 Non-Community Water Supply (NCWS) wells recorded in the state database. Average depth of the CWS wells is 576 ft, ranging from 250 to 1,729 ft.

Based on the available dataset of private wells, approximately 71% (n=210) were completed in bedrock while 29% (n=87) were completed in unconsolidated deposits. Of those in bedrock, all but 2 were completed in limestone (n=82) or dolomite (n=59). The average depth for all is 351 ft with a minimum of 22 and a maximum of 1,739 ft. The average depth completed in bedrock is 417 ft, with an inferred average depth to water bearing units of 326. The average depth completed in unconsolidated deposits is 128 ft, with an inferred average depth to water bearing units of 110. Well yield or pumping rate data was available for 157 wells in bedrock and 69 in unconsolidated deposits, with an average yield of 34 and 29 gpm, respectively. The maximum bedrock pumping rate recorded was 350 gpm, while for the unconsolidated deposits was 70. As stated above, a majority of private wells and nearly all CWS wells are completed in bedrock aquifers, primarily the Devonian-Silurian carbonate aquifer which underlies the Pennsylvanian shales.

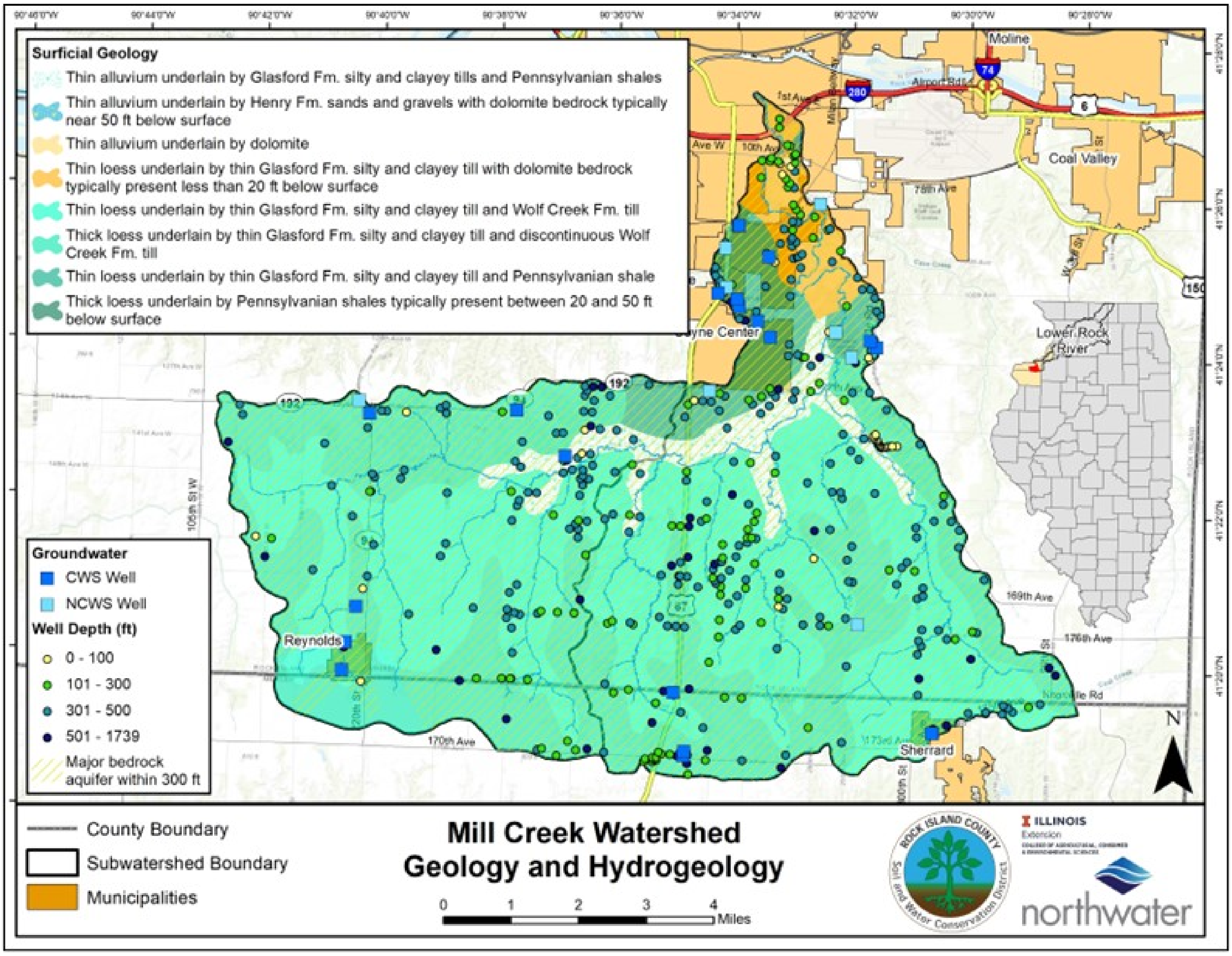


Figure 5 – Geology & Wells

3.5.3 Topography & Relief

Watershed elevation ranges from about 395 to 830 ft above sea level (fasl). The lowest elevation where Mill Creek enters the Rock River is at roughly 560 fasl. A quarry located just south of the confluence has a minimum elevation of 395. Most of the watershed is at 760 fasl or lower, with an average of about 749 fasl. The lowest elevations can be found near the Rock River confluence at the northeastern corner of the watershed and the quarry (Figure 6).

Watershed slopes are shown in Figure 7. The Town of Reynolds – Mill Creek subwatershed has a maximum slope of 205% (64°), versus a maximum of 1,430% (86°) for Mud Creek – Mill Creek. The Town of Reynolds – Mill Creek has an average of 8.0% (4.4°) versus Mud Creek – Mill Creek with 11.5% (6.0°), or 3.5% greater. Headwaters and upland areas are generally flatter, transitioning quickly to steeper slopes adjacent to stream corridors and major waterbodies.

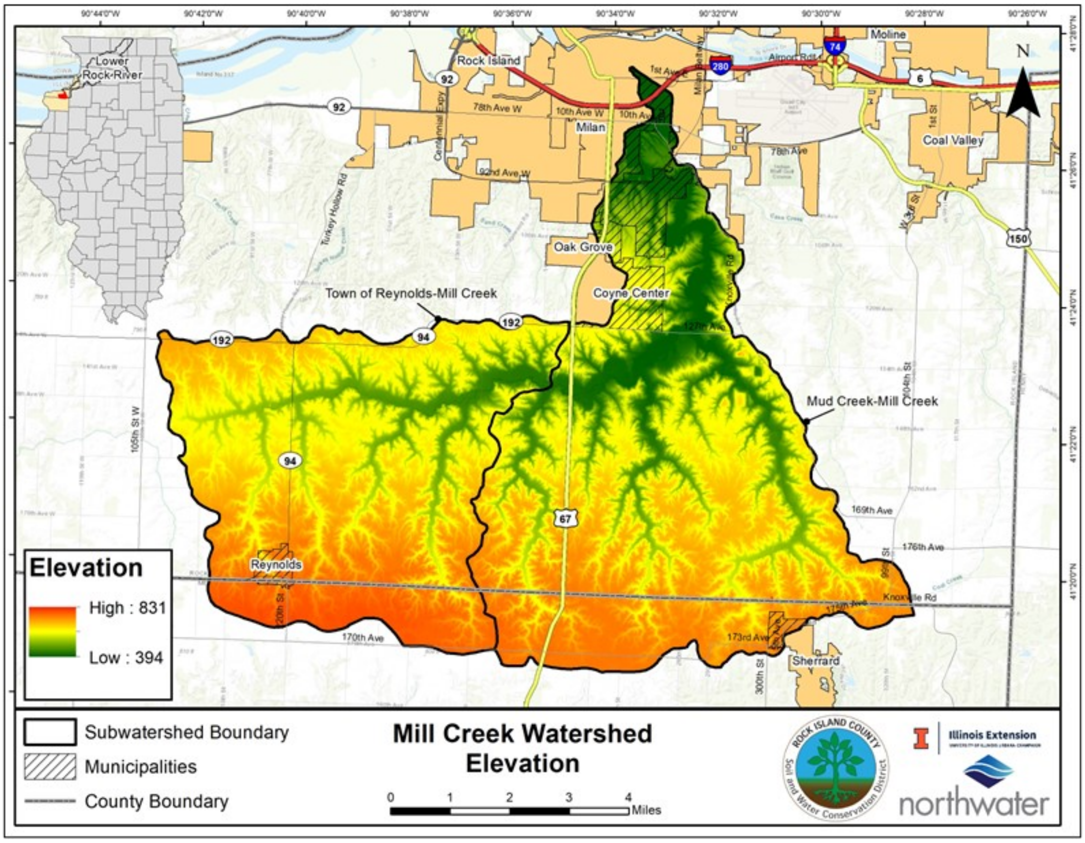


Figure 6 – Surface Elevation in Feet

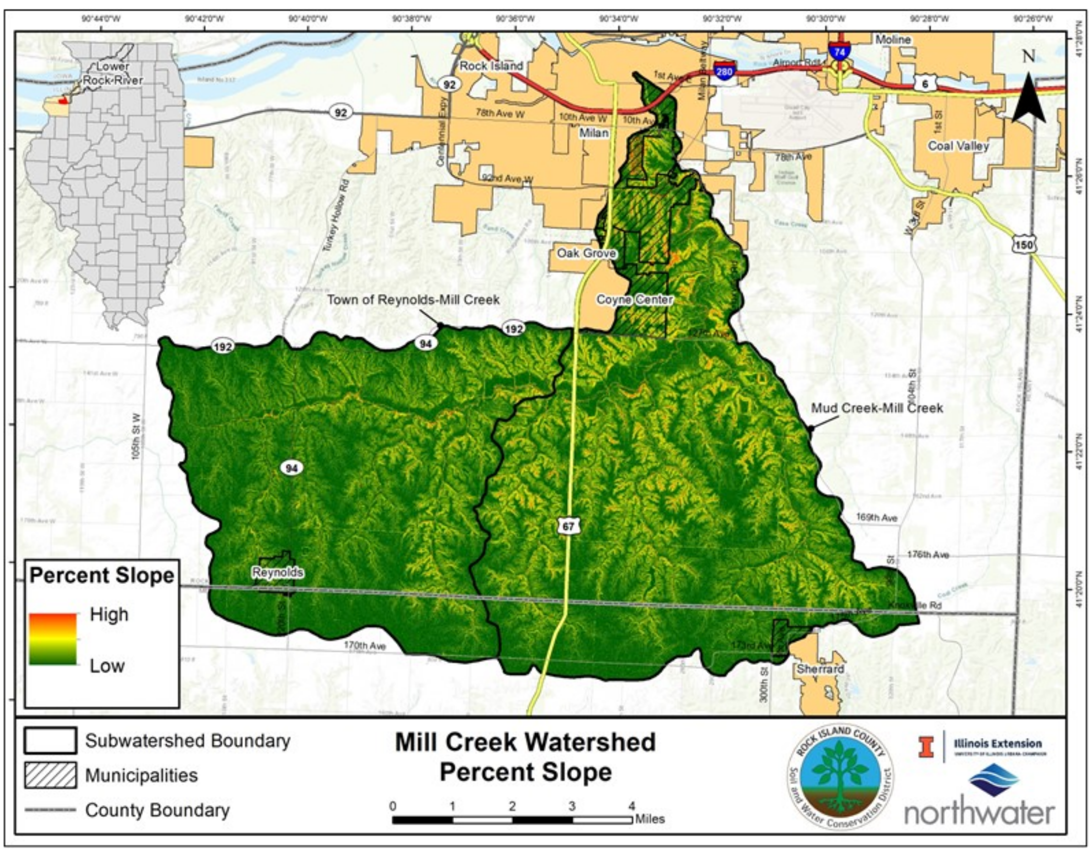


Figure 7 – Surface Slope in Percent

3.6 Climate

The State Climatologist Office for Illinois provides data from weather stations found across the state. Thirty-year normals for the watershed were acquired from a weather station in Rock Island. The data consists of averages summarized from 1991-2020 and are shown in Table 10. Temperatures are presented in degrees Fahrenheit and the precipitation in inches.

Average annual temperature is 50° F. June through August experience monthly averages greater than 70° F; the lowest are in January (22.2° F). The highest average maximum is 83.9° F in July and the average minimum is in January (13.4° F). In general, minimum and maximums follow the same monthly trends as average temperatures.

Average annual precipitation for the 30-year time span is 38.8 in. The month with the highest level is June with a mean of 5.22 in. The lowest average monthly rainfall occurs in January (1.49 in). Average precipitation levels of this time frame follow a similar trend to the averages in recent years past.

Table 10 - Climate Normals (1991-2020)

Month	Maximum Temp (°F)	Minimum Temp (°F)	Mean Temp (°F)	Mean Precipitation (in.)
Jan	31	13.4	22.2	1.49
Feb	36.3	17.9	27.1	1.78
Mar	48.4	28	38.2	2.62
Apr	61.4	39.3	50.3	3.81
May	72.3	50.8	61.6	5.12
Jun	81.2	61	71.1	5.22
Jul	83.9	64.9	74.4	4.22
Aug	82.4	63.1	72.7	4.03
Sep	76.7	55	65.8	3.31
Oct	63.7	42.9	53.3	2.89
Nov	48.7	30.2	39.4	2.3
Dec	36	19.7	27.8	2.02
Annual	**60.2**	**40.5**	**50**	**3.2 (38.8 Yearly)**

Data was also acquired from the PRISM climate group to summarize averages from the last 15 years (March 2006 - March 2021). The PRISM climate group is a part of the Northwest Alliance for Computational Science and Engineering based at Oregon State University and supported by the USDA Risk Management Agency. Temperatures are presented in degrees Fahrenheit and the precipitation in inches (Table 11).

The average annual temperature is 50.2° F. June through August experience monthly averages greater than 70° F; the lowest average temperatures are in January (22° F). The highest average maximum is 84.8° F in July and the average minimum is in January (13.8° F).

Average levels of this time frame follow a similar trend to those from a period of 1991-2020. The average annual precipitation for the most recent 15 years is 40.1 in. The month with the highest level is June with an average of 5.4. The lowest average monthly rainfall occurs in January (1.5 in). The wettest months of the year are May through September where the average annual precipitation exceeds 4. Regional studies indicate storm or rainfall intensity has been increasing making this watershed plan and associated recommendations even more relevant with respect to improving water quality.

Table 11 - Monthly Climate, 2005–2020

Month	Maximum Temp (°F)	Minimum Temp (°F)	Mean Temp (°F)	Mean Precipitation (in.)
Jan	30.2	13.8	22.0	1.5
Feb	32.2	14.6	23.4	2.1
Mar	48.6	28.9	38.8	2.7
Apr	61.2	38.9	50.1	3.9
May	72.7	51.3	62.0	4.7
Jun	81.7	61.4	71.5	5.4
Jul	84.4	64.9	74.6	4.1
Aug	82.7	62.7	72.7	4.2
Sep	77.0	54.9	65.9	4.0
Oct	63.2	42.4	52.8	3.1
Nov	49.4	30.3	39.8	2.1
Dec	36.0	20.3	28.2	2.4
Annual	**59.9**	**40.4**	**50.2**	**3.3 (40.1 Yearly)**

3.7 Landuse

To characterize watershed landuse and nonpoint source (NPS) pollution, a custom Geographic Information System (GIS) layer was developed from 2021 aerial imagery and verified to the extent possible through field surveys. Table 12 lists the results of classification.

As depicted in Figure 8, the predominant landuse in both subwatersheds is row crop agriculture which makes up 43% (10,035 acres) and 69% (11,555 acres) of each, respectively. Crops are primarily a corn-soy bean rotation.

Forest and grasslands are the second and third most prevalent in both subwatersheds. Forest comprises 26% and 9.2% of each respectively, with grasslands comprising 11% and 8.5%. Residential and urban areas (including all associated landuse categories) cover approximately 2.4% of the entire watershed. A combined 6.3% of pasture and small, open livestock feed areas also exist.

Two livestock confinement operations are in the watershed. Animal units from pasture operations are unknown. One landfill is also in the Mud Creek-Mill Creek subwatershed. The Millennium Waste, Inc. Quad Cities Landfill encompasses 123 acres along an Unnamed Tributary to Mill Creek. The landfill is regulated by the Illinois EPA and includes restored, inactive areas consisting of native prairie, as well as onside detention and erosion control.

Table 12 – Watershed Landuse Categories & Area

Subwatershed Name	Landuse Category	Area (ac)/ Percent Subwatershed Total	Subwatershed Name	Landuse Category	Area (ac)/ Percent Subwatershed Total
Mud Creek – Mill Creek	Row Crops and Hay	10,035/43%	Town of Reynolds-Mill Creek	Row Crops and Hay	11,555/69%
	Forest	6,065/26%		Forest	1,556/9.2%
	Grasslands	2,580/11%		Grasslands	1,434/8.5%
	Pasture	1,621/6.9%		Open Space	887/5.3%
	Open Space	1,511/6.5%		Pasture	869/5.2%
	Roads	290/1.2%		Roads	170/1%
	Residential	279/1.2%		Residential	114/0.7%
	Open Water Stream	156/0.7%		Farm Building	79/0.5%
	Landfill	123/0.5%		Open Water Stream	66/0.4%
	Golf Course	122/0.5%		Open Water Pond Reservoir	42/0.2%
	Open Water Pond Reservoir	122/0.5%		Feed Area	18/0.1%
	Farm Building	107/0.5%		Parking Lot	16/0.1%
	Parks And Recreation	88/0.4%		Nursery	15/0.1%
	Resource Extraction	52/0.2%		Cemetery	12/0.1%
	Parking Lot	30/0.1%		Parks And Recreation	8.9/0.1%
	Feed Area	30/0.1%		Warehouse	5.4/0.03%
	Warehouse	28/0.1%		Confinement	5.2/0.03%
	Wetlands	27/0.1%		Commercial	4.4/0.03%
	Mobile Home Park	24/0.1%		Institutional	3.3/0.02%
	Institutional	11/0.05%		Wetlands	2.7/0.02%
	Commercial	10/0.04%		Junkyard	0.5/0.003%
	Junkyard	8.0/0.03%		Utility	0.4/0.002%
	Cemetery	5.1/0.02%	***Total***		***16,866/100%***
	Confinement	3.3/0.01%	**Grand Total**		**40,194**
	Utility	1.7/0.007%			
	Industrial	0.3/0.001%			
	Wind Farm	0.02/0.00006%			
Total		***23,329***			

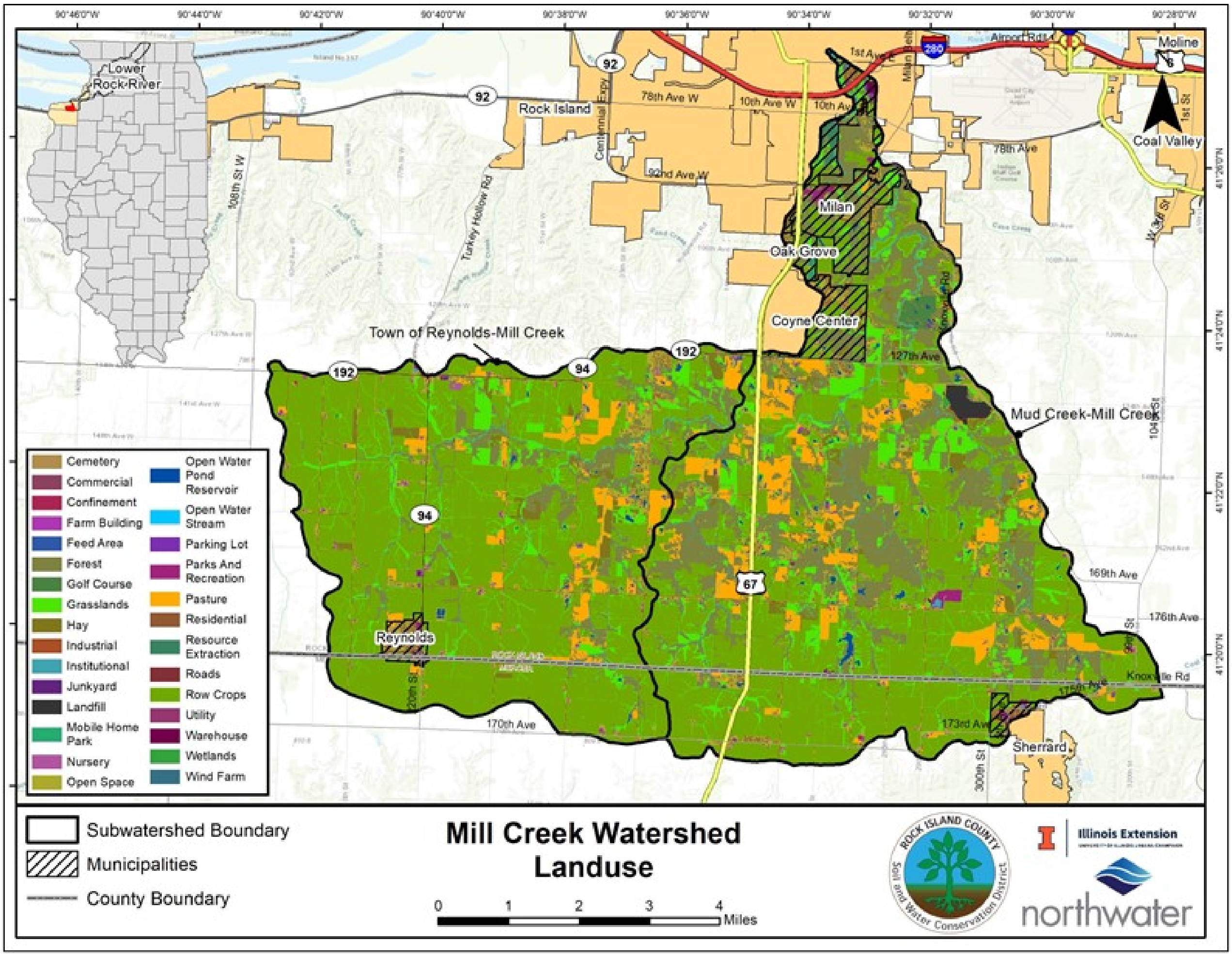


Figure 8 – Existing Landuse

3.7.1 Landuse Change

According to the 2020 Rock Island County Comprehensive Plan, modest future growth is desired and expected. A future landuse map projects mixed-use and rural residential expansion within Milan, Oak Grove, and Coyne Center, all concentrated to the northern portion of the watershed. This will likely include single-family and light industrial/institutional expansion within already incorporated boundaries, south of Milan and east of Oak Grove and Coyne Center. Very little if no additional change is expected around other population centers in the watershed including Reynolds and Sherrard.

3.8 Soils

Based on soils data from the NRCS National Cooperative Soil Survey, 70 types exist in the watershed (Table 13, Figure 9). The dominant soil in the Mud Creek – Mill Creek subwatershed is Hickory silt loam at 7,063 acres (30%), whereas Muscatune silt loam is dominant in the Town of Reynolds – Mill Creek with 3,487 acres (21%). Overall, however, Muscatune silt loam is most prevalent, accounting for about 15% of the entire watershed, or 6,123 acres. Osco silt loam is also prevalent and accounts for 7.7% (3,083 acres). Twenty-three other types combined account for 66%, while the remaining 45 together account for 11%.

The NRCS gives official soil series descriptions (NRCS, 2018b). The Muscatune series consists of very deep, somewhat poorly drained soils formed in loess or uplands and high stream benches, with slopes ranging from 0 to 5 percent The Hickory series consists of very deep, well drained, soils on dissected till plains. They formed in till that can be capped with up to 20 inches of loess. The Osco series consists of very deep, well drained soils formed in loess. These soils are on crests and shoulders of hills on loess covered till plains and on treads and risers of stream terraces in river valleys

Table 13 - Soil Types & Extent

Soil Type	Area (Acres)	Percent of Watershed
Muscatune silt loam, 0 to 2 percent slopes	6,123	15%
Osco silt loam, 2 to 5 percent slopes	3,083	7.7%
Fayette silt loam, glaciated, 2 to 5 percent slopes	2,761	6.9%
Sylvan silty clay loam, 10 to 18 percent slopes, severely eroded	2,090	5.2%
Radford silt loam, 0 to 2 percent slopes, frequently flooded	1,865	4.6%
Hickory silt loam, 18 to 35 percent slopes	1,840	4.6%
Greenbush silt loam, 2 to 5 percent slopes	1,659	4.1%
Osco silt loam, 5 to 10 percent slopes, eroded	1,621	4%
Orion silt loam, 0 to 2 percent slopes, frequently flooded	1,572	3.9%
Hickory-Sylvan-Fayette silt loams, 10 to 18 percent slopes, eroded	1,477	3.7%
Hickory-Sylvan-Fayette silt loams, 18 to 30 percent slopes	1,422	3.5%
Fayette silt loam, glaciated, 5 to 10 percent slopes, eroded	1,382	3.4%
Lawson silt loam, cool mesic, 0 to 2 percent slopes, frequently flooded	1,380	3.4%
Hickory-Atlas complex, 10 to 18 percent slopes, severely eroded	922	2.3%
Hickory clay loam, 18 to 35 percent slopes, severely eroded	771	1.9%
Atterberry silt loam, 0 to 2 percent slopes	729	1.8%
Hickory-Atlas complex, 18 to 35 percent slopes, severely eroded	718	1.8%
Hickory-Sylvan silt loams, 35 to 60 percent slopes	639	1.6%
Hickory clay loam, 10 to 18 percent slopes, severely eroded	601	1.5%
Hickory-Sylvan-Fayette complex, 10 to 18 percent slopes, severely eroded	584	1.5%
Fayette silt loam, 2 to 5 percent slopes, eroded	534	1.3%
Greenbush silt loam, 0 to 2 percent slopes	465	1.2%
Hickory silt loam, 10 to 18 percent slopes, eroded	456	1.1%
Elkhart silt loam, 5 to 10 percent slopes, eroded	448	1.1%
Sable silty clay loam, 0 to 2 percent slopes	434	1.1%
45 other soil types, > 4,700 acres, > 12% of the watershed	4,618	11%

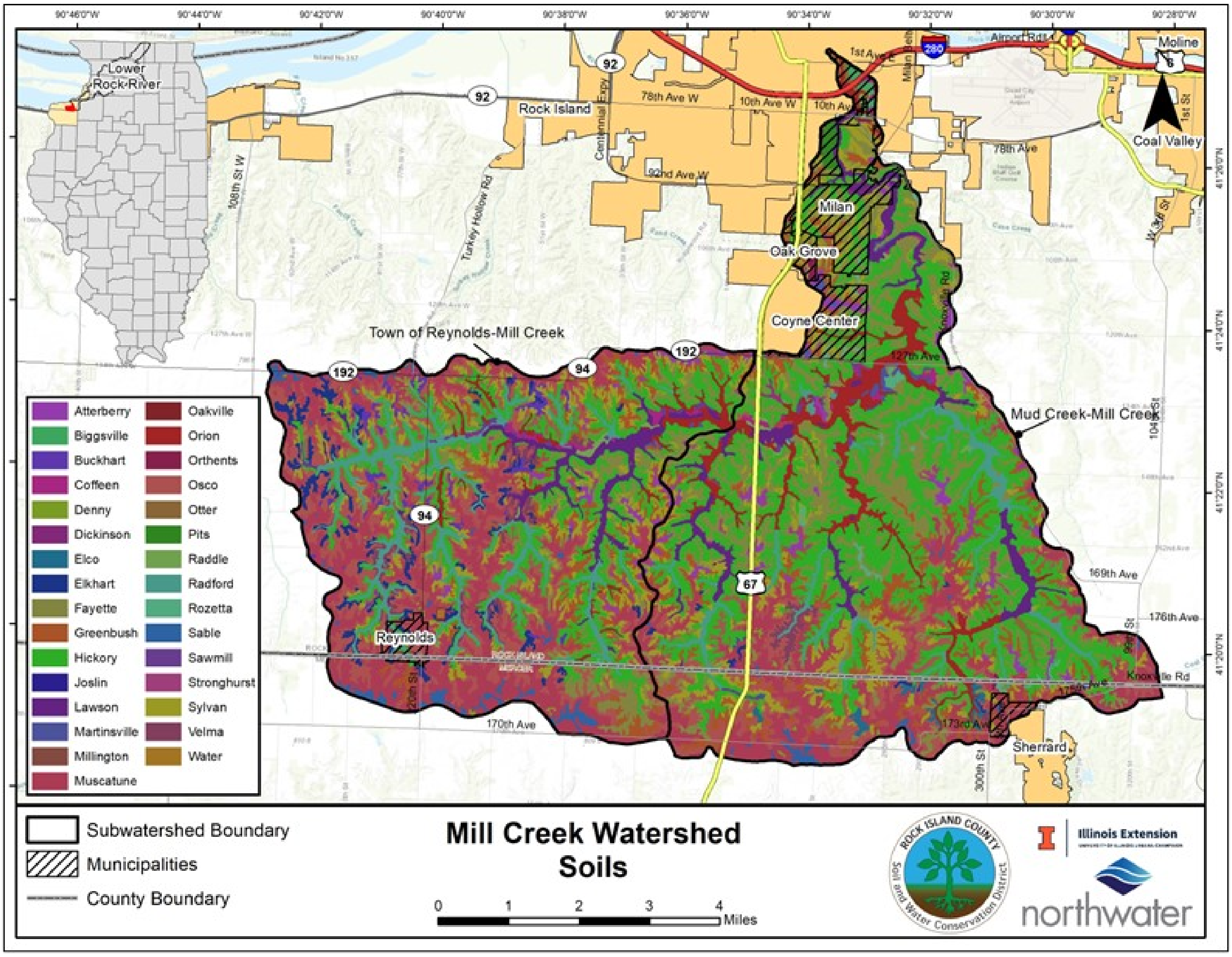


Figure 9 – Soils

3.8.1 Highly Erodible Soils

As defined by the NRCS, a highly erodible soil (HEL)/potentially highly erodible (PHEL), or soil map unit, has a maximum potential for erosion that is greater than eight times the tolerable erosion rate. The maximum erosion potential is calculated without consideration to crop management or conservation practices, which can markedly lower the actual erosion rate on a given field.

The location and extent of HEL and PHEL soils were identified using the USDA-NRCS SSURGO database and county frozen soils lists. A total of 17,011 acres of HEL and 9,247 acres of PHEL exist, representing 42% and 23% of the total watershed area respectively (Table 14). These soils are generally located immediately adjacent to streams and in steep forested or grassed areas. Non-HEL (NHEL) covers 13,936 acres, or 35%, of the watershed (Figure 10). The majority of HEL soils (60%) are found within the Mud Creek – Mill Creek subwatershed or 10,244 acres compared to 6,767 for Town of Reynolds – Mill Creek. Most HEL soils in Mud Creek – Mill Creek are forested or 4,079 acres versus 827 in the Town of Reynolds – Mill Creek where the greatest acreage is on crop ground.

Table 14 - HEL by Subwatershed

Subwatershed Name	HUC12	Subwatershed Area	Acres HEL	Percentage of Subwatershed HEL	Acres PHEL	Percentage of Subwatershed PHEL
Mud Creek-Mill Creek	070900051202	23,329	10,244	44%	5,904	64%
Town of Reynolds-Mill Creek	070900051201	16,866	6,767	40%	3,344	36%
Grand Total		**40,194**	**17,011**	**42%**	**9,248**	**23%**

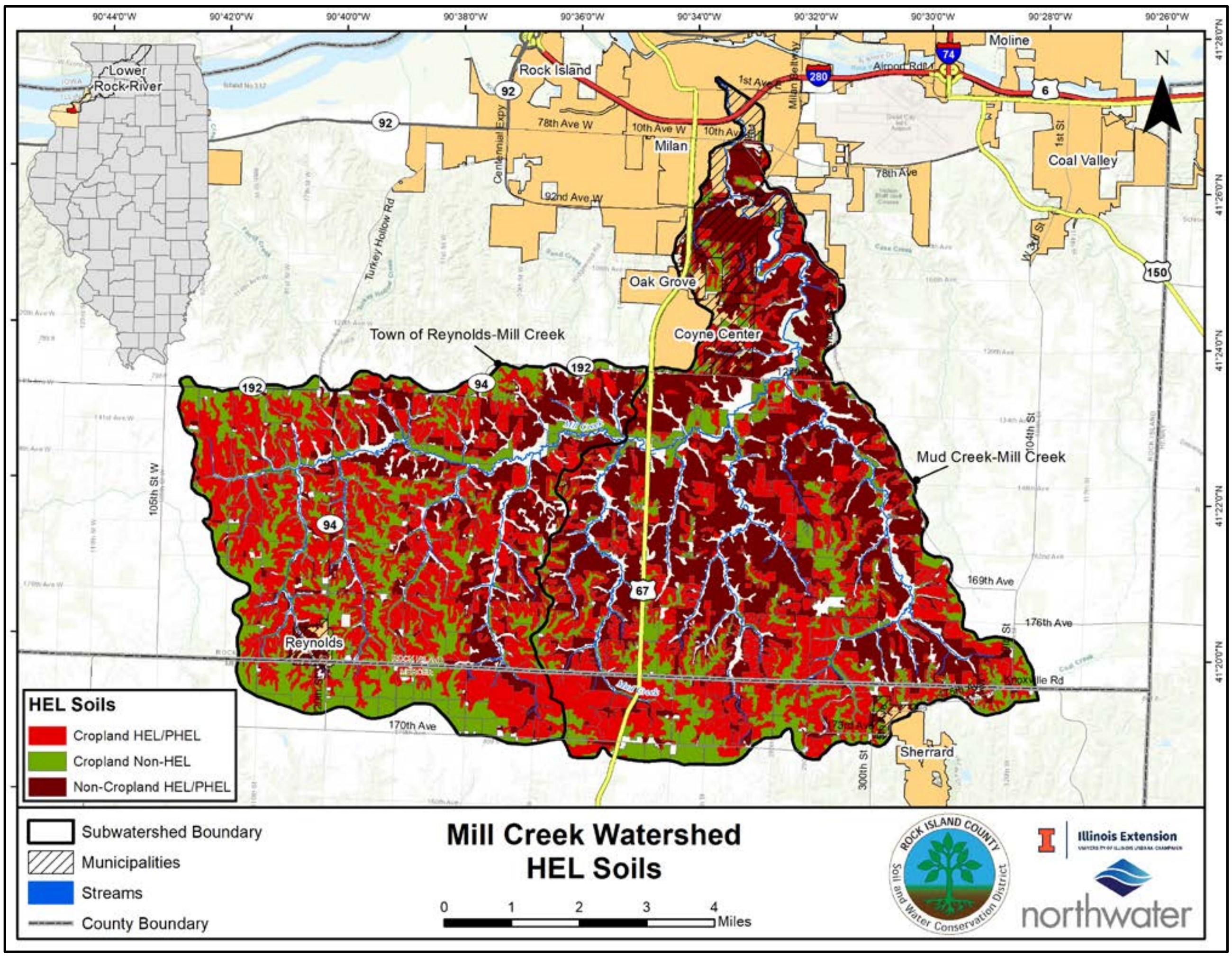


Figure 10 – HEL Soils

3.8.2 Cropped Highly Erodible Soils

If a producer has a field identified as HEL and wishes to participate in a voluntary NRCS cost-share program, that producer is required to maintain a conservation system of practices that maintains erosion rates at a substantial reduction of soil loss. Fields that are determined not to be HEL are not required to maintain a conservation system to reduce erosion.

Of the 21,590 acres of cropland, including hay, 33%, or 7,164 acres (18% of the watershed), are considered HEL and 5,854 acres or 27% (15% of the watershed) are PHEL and could be prioritized for erosion control measures (Figure 10). The Town of Reynolds – Mill Creek subwatershed contains 59% of all cropped HEL soils (4,238 acres) whereas Mud Creek – Mill Creek contains 58% of the cropped PHEL or 3,369 acres (Table 15). Cropped HEL soils and tillage practices are further discussed in Section 5.0.

Table 15 - Cropped Acres by HEL Status

Subwatershed Name	HUC12 Code	Cropped HEL Status	Cropped Acres	Percentage of Cropped Acres	Percentage of Watershed
Mud Creek – Mill Creek	070900051202	HEL	2,926	14%	7.3%
		NHEL	3,740	17%	9.3%
		PHEL	3,369	16%	8.4%
Town of Reynolds – Mill Creek	070900051201	HEL	4,238	20%	11%
		NHEL	4,832	22%	12%
		PHEL	2,485	12%	6.2%
Total			**21,590**	**100%**	**54%**

3.8.3 Hydric Soils

Hydric soils are defined by the National Technical Committee for Hydric Soils (NTCHS) as soils that formed under conditions of saturation, flooding, or ponding long enough during the growing season to develop anaerobic conditions in the upper part. These soils, under natural conditions, are either saturated or inundated long enough during the growing season to support the growth and reproduction of hydrophytic vegetation (NRCS, 2018). As an indicator of the potential for wetland development, understanding where hydric soils are located can inform wetland restoration and creation activities.

A total of 719 acres of hydric soils are scattered throughout the watershed, with 300 acres (1.3%) in the Mud Creek - Mill Creek subwatershed and 419 (2.5%) in the Town of Reynolds – Mill Creek (Table 16). Hydric soils are typically wet and will flood if overland or tile drainage is not present and represent 1.8% of total watershed area over eight different soil types (Table 17). Hydric soils are located primarily in flat areas around the periphery of the watershed and along tributaries (Figure 11). Drummer silty clay loam is the dominant at 1%.

Table 16 - Hydric Soils

Subwatershed Name	Hydric Rating	Acres (ac)
Mud Creek-Mill Creek	Unranked	140
	No	22,889
	Yes	300
Town of Reynolds-Mill Creek	Unranked	22
	No	16,424
	Yes	419

Table 17 – Hydric Soil Types

Soil Type	Area (Acres)	Percent of Watershed
Sable silty clay loam, 0 to 2 percent slopes	434	1.1%
Sawmill silty clay loam, 0 to 2 percent slopes, frequently flooded	109	0.3%
Denny silt loam, 0 to 2 percent slopes	69	0.2%
Otter silt loam, undrained, 0 to 2 percent slopes, frequently flooded	44	0.1%
Otter silt loam, 0 to 2 percent slopes, frequently flooded	39	0.1%
Sawmill silt loam, 0 to 2 percent slopes, frequently flooded, overwash	15	0.04%
Sawmill silty clay loam, undrained, 0 to 2 percent slopes, frequently flooded	6.7	0.02%
Millington silt loam, undrained, 0 to 2 percent slopes, frequently flooded	2.3	0.01%
Total	**719**	**1.8%**

Soil Erosion

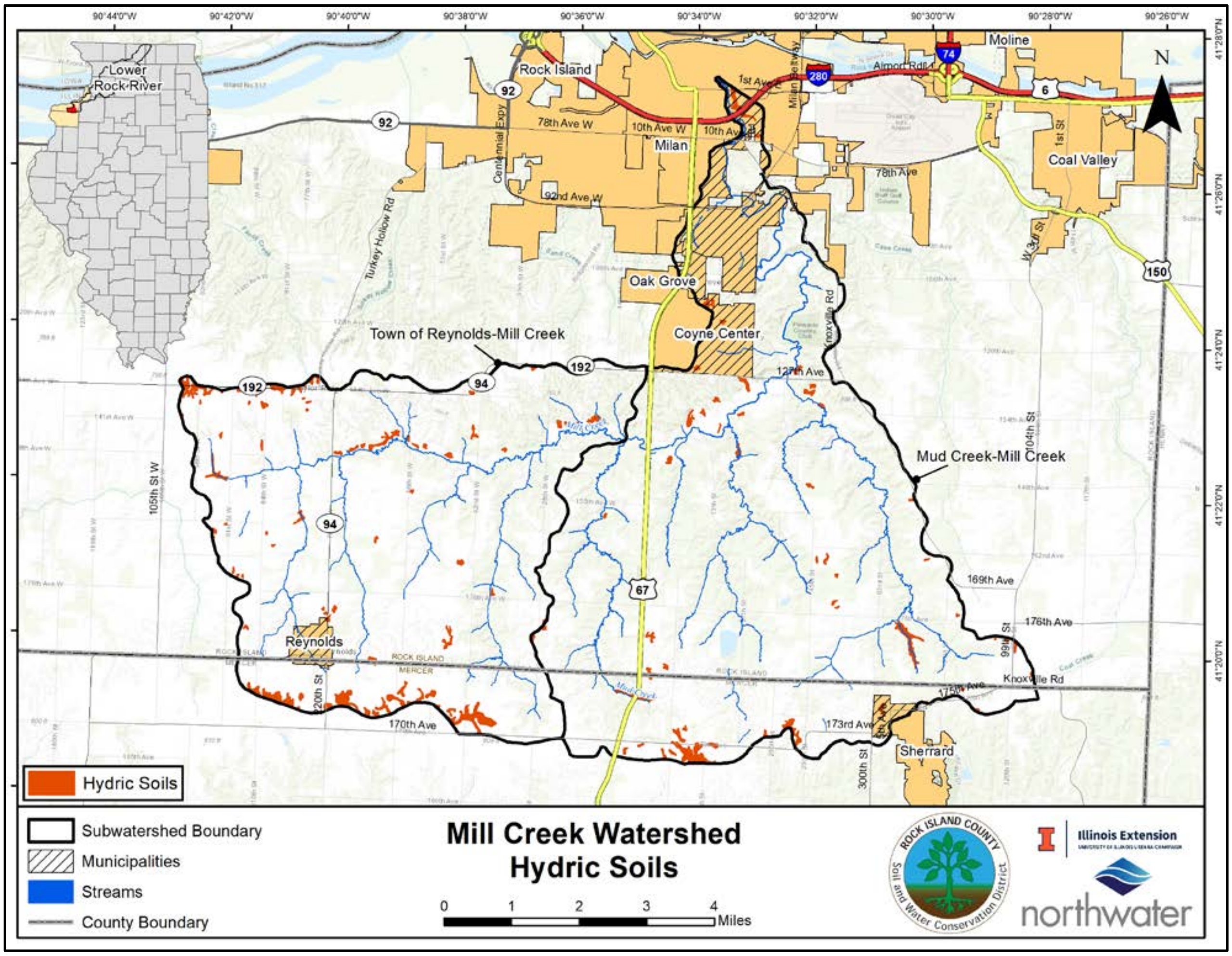


Figure 11 – Hydric Soils

3.8.4 Hydrologic Soil Groups

The NRCS has four hydrologic soil groups based on infiltration capacity and runoff potential. Group A has the greatest infiltration capacity and least runoff potential, while D has the least infiltration capacity and greatest runoff potential. A hydrologic soil group is determined by the water transmitting soil layer with the lowest saturated hydraulic conductivity and depth to an impermeable layer or to a water table (USDA, 2007). Certain wet soils are tabulated as D based solely on the presence of a water table within 24 inches of the surface, even though the saturated hydraulic conductivity may be favorable for water transmission. When adequately drained to a seasonal water table at least 24 inches below surface, dual hydrologic groups (A/D, B/D, C/D) are given, based on their saturated hydraulic conductivity and the water table depth when drained. The first letter applies to the drained condition and the second to the undrained condition (USDA, 2007). This section applies datasets disseminated by the USDA National Cooperative Soil Survey.

Figure 12 and Table 18 illustrate the hydrologic soil groups and statistics. The dominant group in both subwatersheds is B, which accounts for 16,539 acres (71%) in Mud Creek – Mill Creek and 10,313 acres (61%) in Town of Reynolds – Mill Creek. This group encompasses 67% of the entire watershed and have generally lower rates of runoff. Group B/D soils encompass 27% of Mud Creek – Mill Creek and 37% of

Town of Reynolds – Mill Creek and have high runoff potential given the low percentage of subsurface drainage. Group B encompasses 31% of the entire watershed.

Table 18 – Hydrologic Soil Groups

Hydrologic Groupings and Total Area						
Mud Creek-Mill Creek						
Group	Unclassified	A	B	B/D	C	C/D
Acres	140	18	16,538	6,415	189	28
Percent of Subwatershed	**0.6%**	**0.08%**	**71%**	**27.4%**	**0.81%**	**0.12%**
Town of Reynolds-Mill Creek						
Group	Unclassified	A	B	B/D	C	C/D
Acres	22	0	10,313	6,211	279	41
Percent of Subwatershed	**0.1%**	**0%**	**61%**	**37%**	**1.7%**	**0.2%**

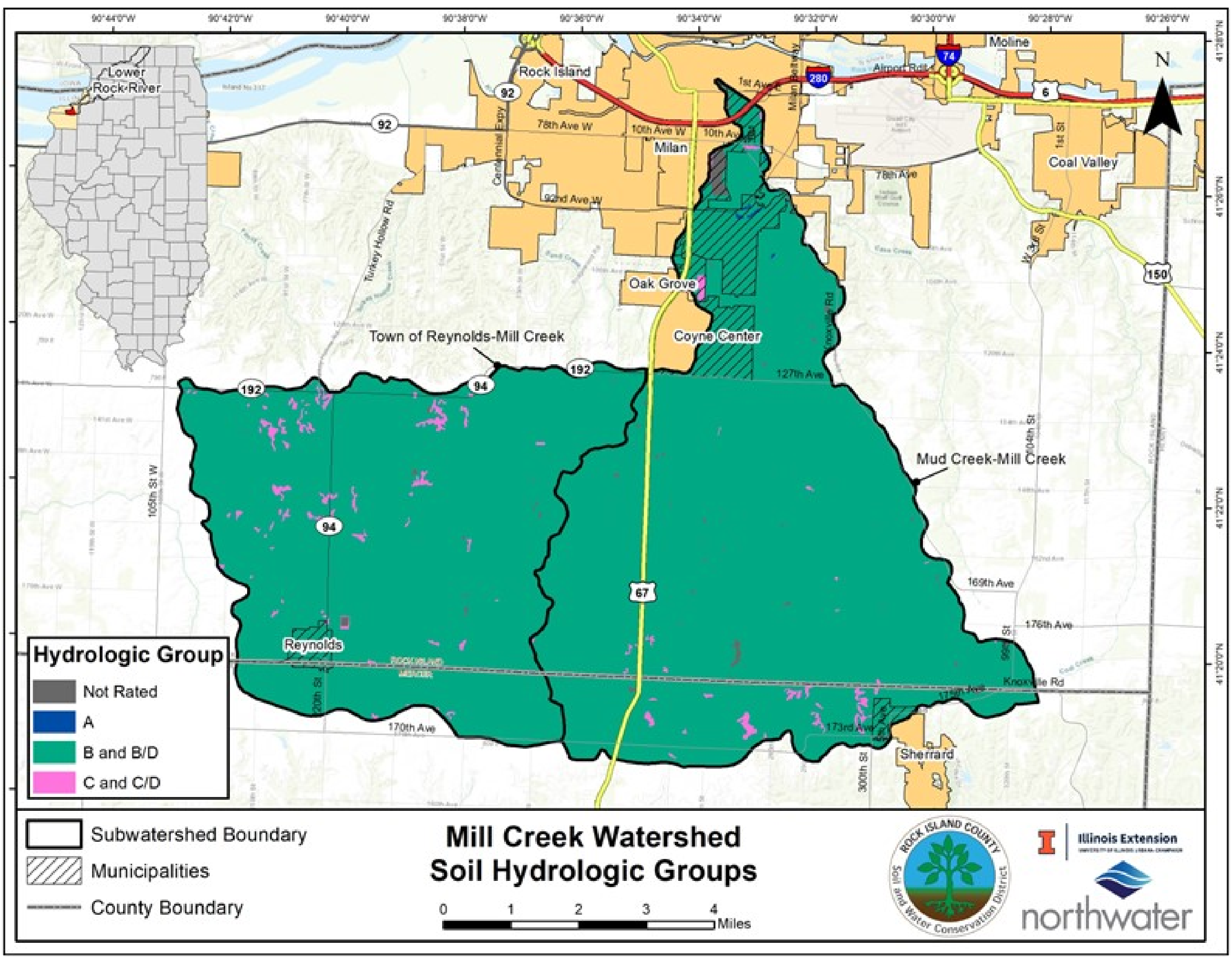


Figure 12 – Soil Hydrologic Groups

3.8.5 Septic System Suitability

Not all soil types support septic systems and improper construction can lead to failure and leaching of wastewater into groundwater and surrounding waterways. Leached pollutants can include bacteria, nitrogen and phosphorus. Soil data was analyzed for the ability to support septic systems. Results show that 48%, or 19,483 acres (Table 19), of the watershed contain soils classified as "very limited" with respect to septic suitability. This does not indicate that soils are unsuitable for septic systems, but special consideration is required when establishing them. A total of 402 homes/buildings believed to have septic systems are located on soils classified as very limited. This represents 36% of all systems.

Table 19 – Soil Septic System Suitability, Total Area & Home/Building Count

Subwatershed	HUC12 Code	Total Area	Total Homes on Septic	"Very Limited"		"Somewhat Limited"		"Not Rated"	
				Area (ac)	Homes on Septic	Area (ac)	Homes on Septic	Area (ac)	Homes on Septic
Mud Creek – Mill Creek	070900051202	23,329	735	11,393	254	11,795	481	140	0
Town of Reynolds – Mill Creek	070900051201	16,866	369	8,090	148	8,754	221	22	0
Grand Total		**40,194**	**1,104**	**19,483**	**402**	**20,549**	**702**	**162**	**0**

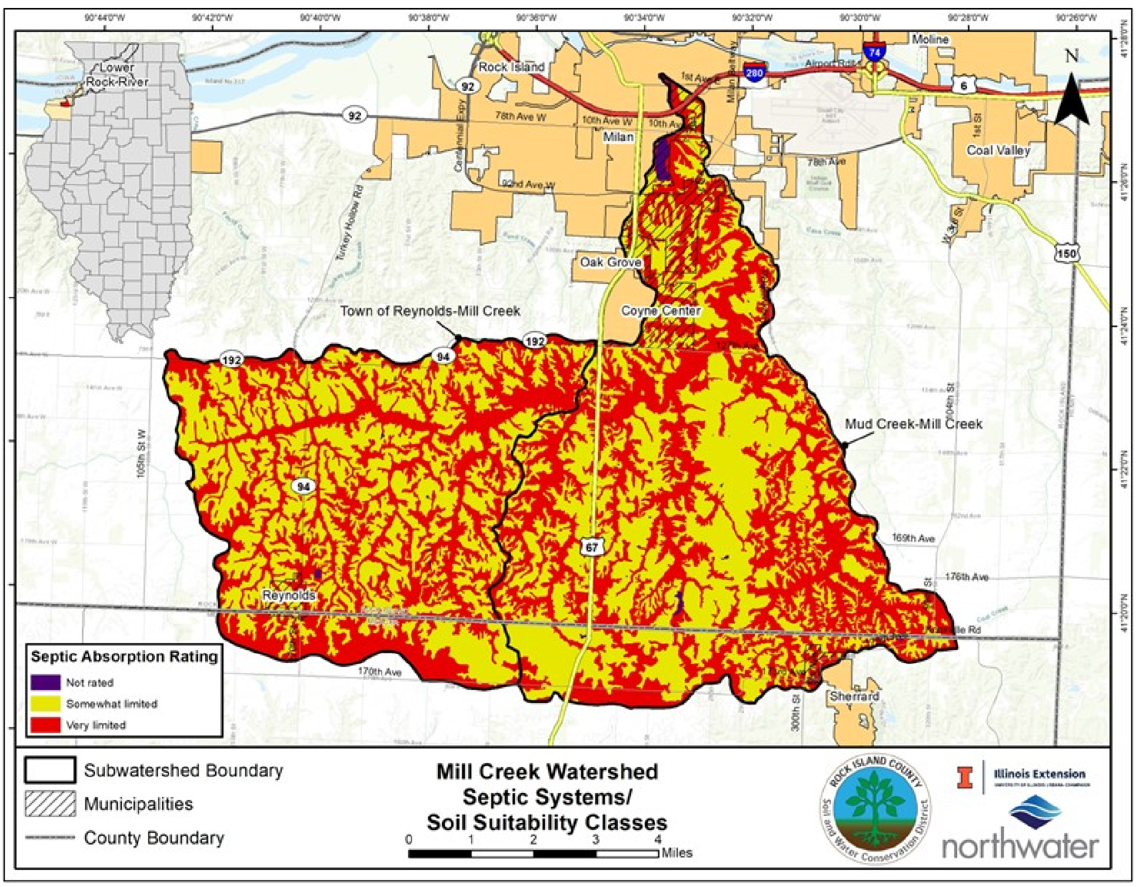


Figure 13 – Septic Suitability

3.9 Tillage

Conventional Tillage

According to a 2018 Illinois Department of Agriculture (IDOA) tillage transect survey completed for Mercer and Rock Island County, approximately 0.9% of the corn in Mercer and 8.3% in Rock Island use conventional tillage. In Mercer, 1.0% and Rock Island 1.2% of the soybean acreage uses conventional tillage methods which leave little or no residue on the surface. In Mercer, 18% and Rock Island, 19%, of corn acres and 6.2% (Mercer) and 3.6% (Rock Island) of soybean acres use reduced-till, which can decrease soil loss by 30% compared to conventional tillage. The remaining 81% (Mercer) and 73% (Rock Island) of corn and 93% (Mercer) and 95% (Rock Island) of soybean acres are mulch-till or no-till (44% no-till corn and 60% no-till beans in Mercer and 48% no-till corn and 72% no-till soybean in Rock Island). Mulch-till leaves 30% residue of the previous year's crop and can reduce soil loss by 75%.

A more detailed field-based assessment of tillage practices was performed in the spring of 2021 to better characterize current conditions, specifically within the watershed. Table 20 and Figure 13 show the acres of tillage types and distribution. Pollution loading by tillage is discussed in more detail in Section 5. Tillage is grouped into five primary categories plus two cover types: conventional, reduced-till, mulch-till, no-till, strip-till, and cover types consisting of hay and cover crop. Hay is also listed in the landuse and addressed in the pollution loading and sources section. Cover crops are also addressed in the existing BMP section as well as in sources.

Results show that no-till and mulch-till make up the largest portion of the both subwatersheds (80% and 12%, respectively) followed by reduced-till (1.3%). Conventional till accounts for 0.7%, cover crops are used on 572 acres or 2.7% of all cropland (including hay and cover crops).

Table 20 – Tillage Types, Acres & Percent of Cropland

Subwatershed Name	Conventional		Cover Crop[1]		Hay[1]		Mulch		No-Till		Reduced-Till		Strip-Till	
	Acres	%	Acres	%	Acres	%	Acres	%	Acres	%	Acres	%	Acres	%
Mud Creek - Mill/ (70900051202)	96	1.0%	176	1.8%	389	3.9%	1,609	16%	7,500	75%	181	1.8%	83	0.8%
Town of Reynolds - Mill/ (70900051201)	64	0.6%	396	3.4%	342	3%	944	8.2%	9,675	84%	102	0.9%	33	0.3%
Total	**159**	**0.7%**	**572**	**2.7%**	**730**	**3.4%**	**2,553**	**12%**	**17,175**	**80%**	**283**	**1.3%**	**117**	**0.5%**

[1] – not a tillage practice

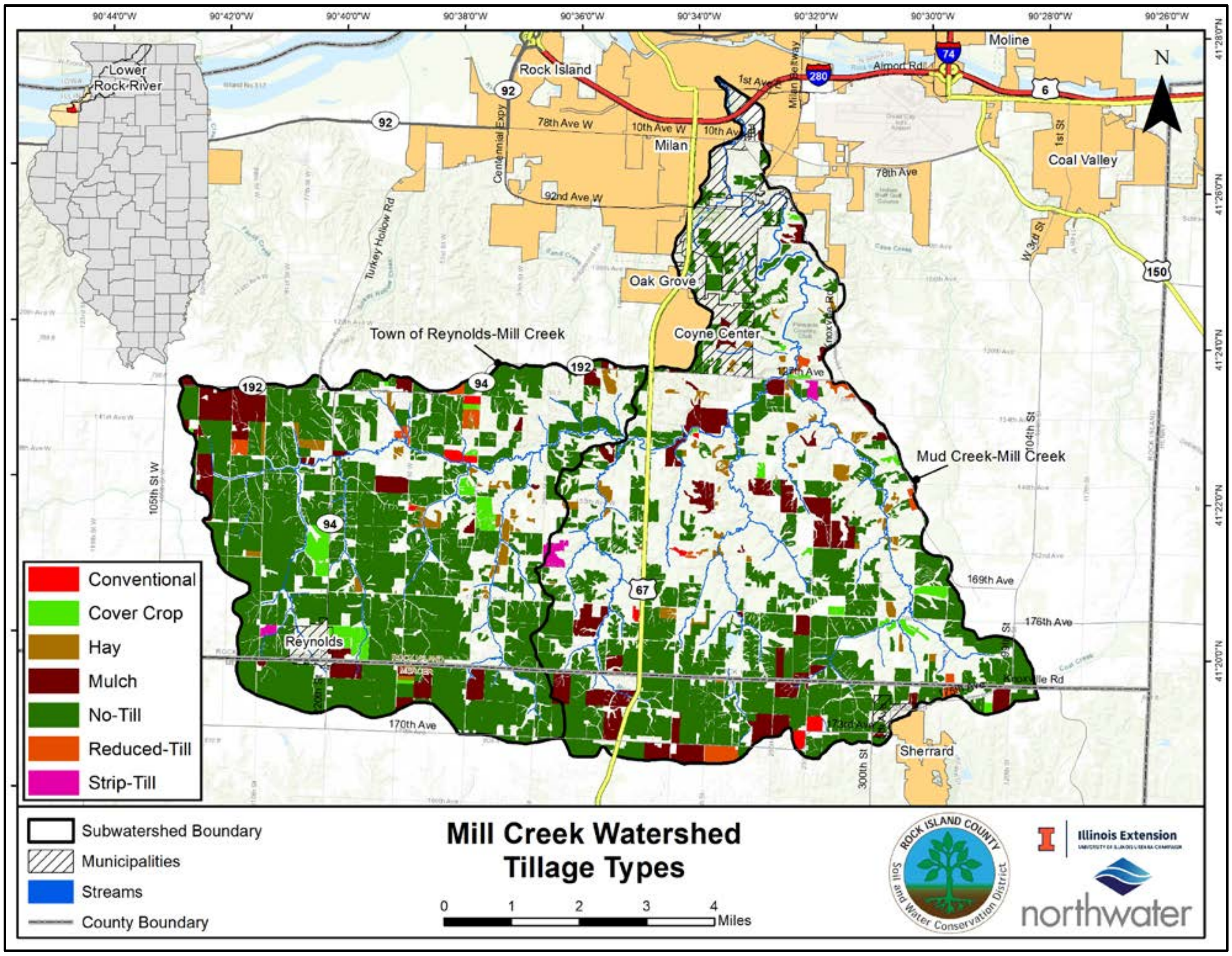


Figure 13 – Tillage Types

3.10 Existing Conservation Practices

Existing management practices within the watershed are extensive and include grass filter strips, grass waterways, field borders, ponds and basins, terraces, water and sediment control basins (WASCB), wetlands, streambank and bed stabilization, a saturated buffer, grade control structures (block chute), and cover crops. Table 21 below shows the total number or extent of each known management practice. Figure 14 shows most existing practices. Most waterways, WASCBs, cover crops, field borders, and filter strips are in the Town of Reynolds – Mill Creek subwatershed. Most ponds, streambank stabilization, terraces, sediment basins, and wetlands are in Mud Creek – Mill Creek. In addition to those listed, other relevant work has included numerous education and outreach events related to conservation and water quality.

With relatively large reductions still required to meet water quality goals stated in this plan, substantial opportunities exist to install new practices. This is especially true where nutrient loading is the greatest or where pollutants may bypass existing BMPs, such as tile water bypassing a filter strip. It is important to note that each practice varies in its ability to effectively remove pollutants, however, these practices are providing benefits to water quality and have been accounted for in the watershed pollutant loading estimates. Historical efforts to address water quality cannot be understated. The practices listed below reflect years of hard work by the RISWCD, NRCS, private landowners, and others.

Table 21 – Known Existing Conservation Practices

TYPE	Quantity Town of Reynolds -Mill Creek Subwatershed	Quantity Mud Creek – Mill Creek Subwatershed	Unit
Waterway	300	289	acres
Filter Strip[1]	202	148	acres
Field Border	6	4	acres
Sediment Basin	21	46	number
Terrace	16	35	number
WASCB	50	18	number
Cover Crop	396	176	acres
Wetland (open water)	3	27	acres
Pond	31	91	number
Streambank Stabilization (stone toe)	632	4,222	feet
Streambed Stabilization (rock riffle)	0	2	number
Grade Stabilization Structure (block chute)	3	1	number
Urban Detention Basin (dry and wet)	1	2	number
Saturated Buffer	1	0	number
Calculation of grass filter strips are an estimation and include grassed areas within 35 ft of a flowing stream. [1]			

Existing Streambank Stabilization

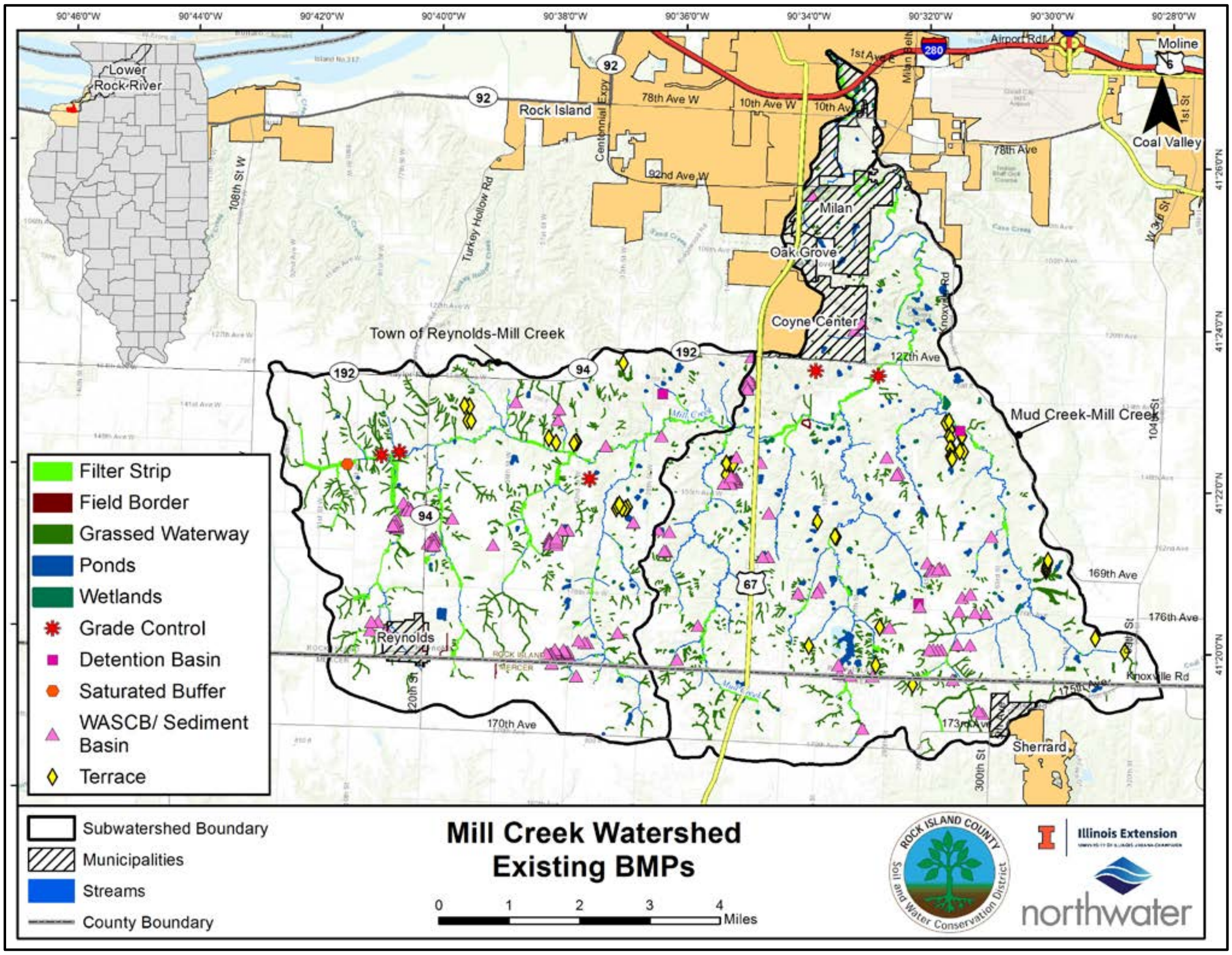


Figure 14 – Existing BMPs

3.11 Hydrology & Drainage System

Primary named streams in the watershed are Mill and Mud Creek. A USGS gauge station exists on Mill Creek at Milan with records dating back to 1940. Records indicate average annual streamflow of 49 cfs with April, on average the highest or 75.6 and August the lowest or 15.4 cfs. Due to a lack of flow records for Mud Creek, USGS StreamStats was used to retrieve peak flow data. Statistics are presented in Table 22.

Table 22 – Primary Tributary Peak Flow Data

Stream	Peak Flow Data (ft^3/s) by Recurrence Level Interval (yrs)					Drainage Area (mi^2)	Stream Slope (ft/mi)
	2	5	10	100	500		
Mill Creek	2,640	4,580	5,960	10,400	13,500	62.4	9.9
Mud Creek	676	1,200	1,600	2,970	4,030	6.9	22.2

3.11.1 Streams

Due to limitations with the accuracy of the National Hydrography Dataset (NHD), the custom landuse layer was used to better represent the actual wetted extent of streams in the watershed. Ponds and reservoirs total 164 acres or 0.4% of the Mill Creek watershed. They average just over an acre in size, with the largest being 22. The drainage system is depicted in Figure 15.

Table 23 shows perennial open water tributary stream length. Results show a total of 108 miles. The only two named tributaries in the watershed are Mill Creek and Mud Creek. The other unnamed tributaries in the watershed total 75 miles. Although accuracy is limited, the NHD indicates all perennial, intermittent or ephemeral tributaries, forested gullies, and subsurface drainageways totaling 139 miles (Table 24)

Table 23 – Open Water Perennial Streams & Tributaries

Tributary Name	Length (ft)	Length (mi)
Mill Creek	135,133	26
Mud Creek	42,678	8
Unnamed Tributary	395,413	75
Total	**573,224**	**109**

Table 24 – Surface Water Inventory by Subwatershed

Subwatershed	HUC12	Perennial Streams (mi)	NHD Waters* (mi)	Ponds and Lakes (ac)
Mud Creek	70900051202	67	79	122
Town of Reynolds	70900051201	41	60	42
Total		**108**	**139**	**164**

** = all NHD water sources including perennial streams, intermittent or ephemeral tributaries, forested gullies and subsurface drainageways*

Lower Mill Creek

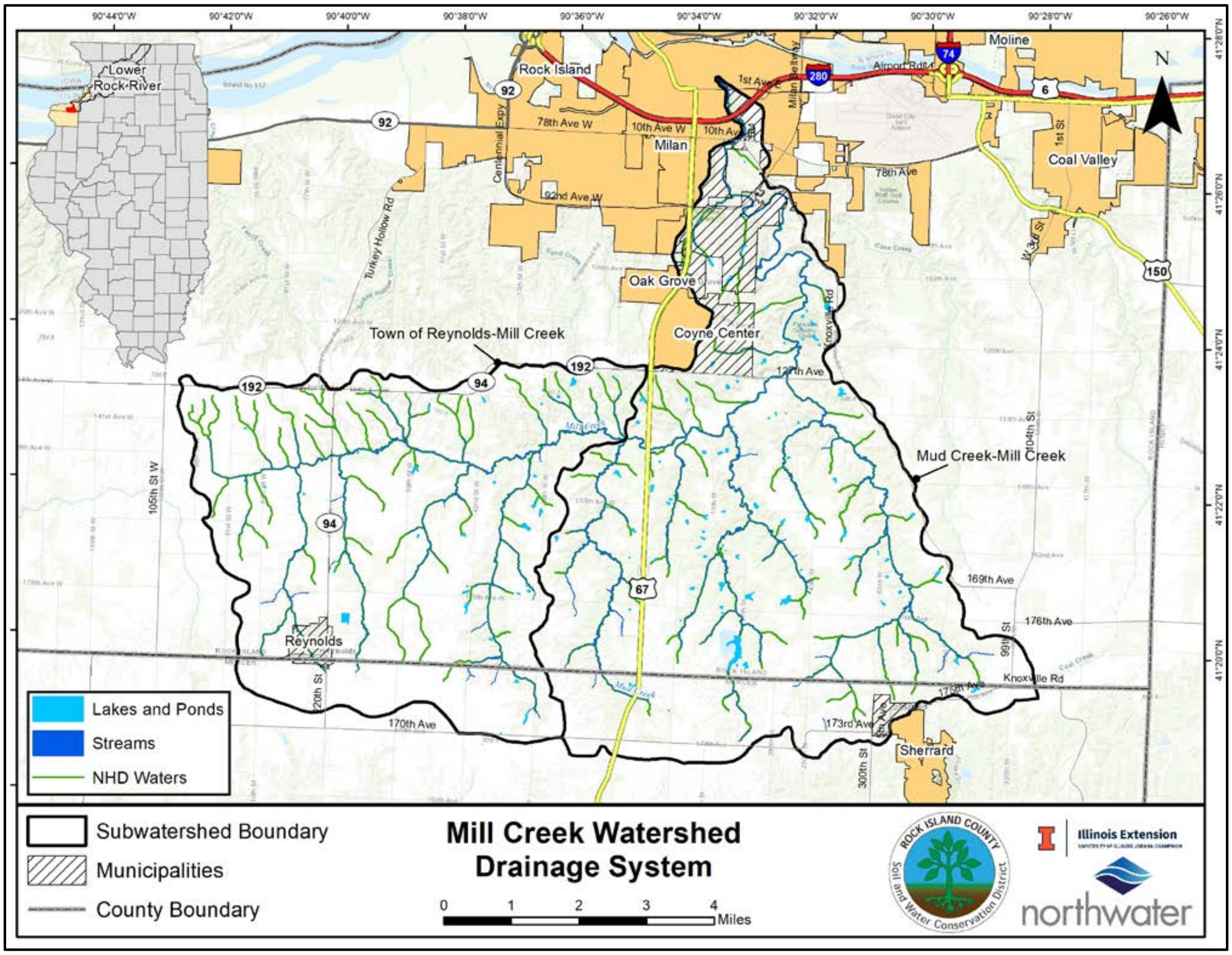


Figure 15 – Drainage System

3.11.2 Tile Drainage

Tile drainage in the watershed is believed to be minor. Methods used to estimate extent included direct observations performed during a watershed windshield and stream survey, knowledge of local agency staff and landowners, and analysis of soils, elevation, imagery, past research, and landuse.

It is estimated that 14 fields, or 622 acres in the watershed, are likely tile drained, with 20,914, not. This corresponds to 2.9% of all cropland or 1.5% of the watershed being tile drained. Mud Creek – Mill Creek has only 67 acres tiled, whereas Town of Reynolds – Mill Creek has the majority or 555 acres. Most other tile observed are in place to manage soil moisture for grassed waterways and are not indicative of the widespread use of subsurface drainage.

3.11.3 Stream Channelization

Stream channelization is the engineering of a river or stream by modifying channel cross section profiles into smooth and uniform trapezoidal or rectangular forms, and can include activities such as straightening, widening, or deepening the channel, clearing riparian and aquatic vegetation, and bank reinforcement. Typically, this causes increased volume and/or velocity of the water which disrupts stream equilibrium, causing conditions such as channel downcutting and bank erosion known as the Channel Evolution Model (Simon, 1989).

Channelized Stream

Aerial imagery from 2021 was evaluated to determine the extent of open water stream channelization. Results indicate that channelization is low. Out of 108 stream miles, 8.5% (9.3 miles) are channelized. The Town of Reynolds subwatershed is the more heavily channelized, at 4.9%, or 5.4 miles, compared to Mud Creek at 3.6%, or 3.9 miles. (Table 25 and Figure 16).

Table 25 – Length of Channelized Streams

Subwatershed Name	HUC12	Total (ft)	Total (mi)	Channelized (ft)	Channelized (mi)	% Length Channelized
Mud Creek	70900051202	354,467	67	20,774	3.9	3.6%
Town of Reynolds	70900051201	218,758	41	28,260	5.4	4.9%
Total		**573,224**	**108**	**49,034**	**9.3**	**8.5%**

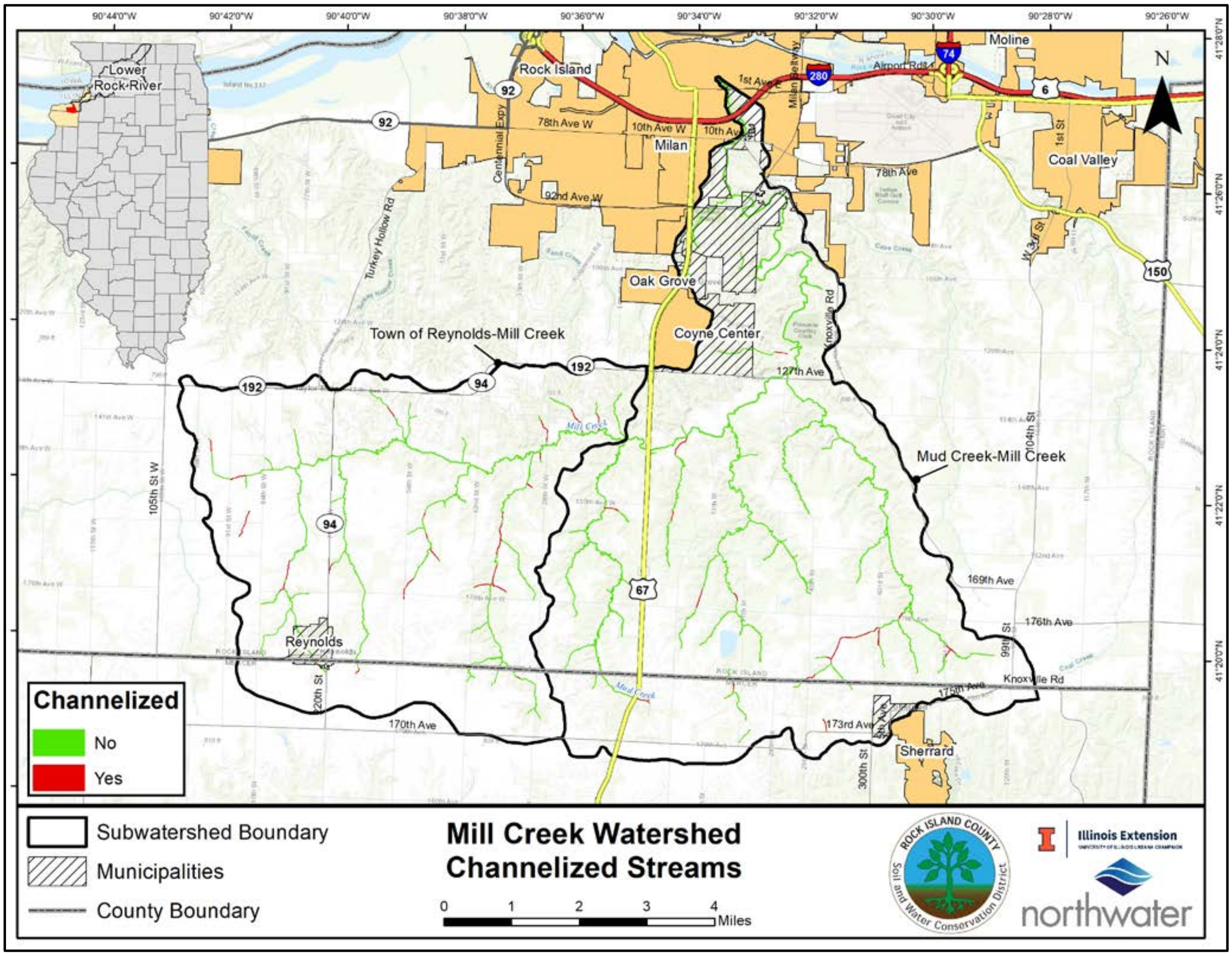


Figure 16 – Channelized Streams

3.11.4 Riparian Areas & Buffers

Riparian and buffer areas exist adjacent to streams and lakes in the watershed. A field assessment combined with analysis of recent aerial imagery was used to determine the adequacy and relative extent of natural stream and lake buffers.

Methods – A buffer quality ranking system was developed and applied to individual stream reaches. Stream reaches were organized into a sequential numbering system based on breaks at road crossings. Two categories of buffer quality include:

1. Adequate – greater than or equal to 35 ft of un-impacted riparian or buffer area, either forest grass, or wetland.
2. Inadequate – less than 35 ft riparian or buffer area impacted or degraded. Inadequate include row crops, moderately to highly overgrazed pasture, roads, buildings, and urban open space.

Existing literature was reviewed to determine the minimum adequate buffer with; 35 ft was selected based on the following references:

1. The USDA-NRCS requires a minimum of a 20-foot buffer to be eligible for the Conservation Reserve Program (NRCS, 2010).
2. A study performed in Kansas determined that buffers between 27 and 53 feet significantly removed nitrogen, phosphorus, and suspended solids from entering the stream (Mankin, et al. 2007).

Stream Buffers

Streams are generally well buffered or approximately 80% of all streambanks (Table 26). Although most are well buffered, areas exist where improvements can be made. Buffers can be expanded on over 20 miles (20%) of the watershed, or 40 miles of stream buffer (Figure 17). Buffer type varies with forest accounting for 56% of all miles. Grasslands makes up 22%, pasture (overgrazed) 10%, and row crops 7%; the 15 other categories combined make up roughly another 5.2% (Table 27). It should be noted that buffer length do not match exactly with streambank lengths due to the method of analysis and a 35 ft setback, reducing overall buffer length compared to length of stream.

Grass Buffer

Table 26 – Streambank Buffer Adequacy

Subwatershed Name	HUC12 Code	Total Buffer Length (ft)	Total Buffer Length (mi)	Inadequate (mi)	Adequate	Inadequate (%)	Adequate (%)
Mud Creek	70900051202	638,807	121	21	100	17%	83%
Town of Reynolds	70900051201	402,766	76	19	57	25%	75%
Total		**1,041,573**	**197**	**40**	**157**	**20%**	**80%**

Table 27 – Streambank Buffer Landuse Categories

Buffer Type	Total Buffer Miles	Buffer Length (%)
Forest	111	56%
Grasslands	43	22%
Pasture (overgrazed)	19	10%
Row Crops	14	7%
Open Space	5.0	2.5%
Hay	1.7	0.8%

Buffer Type	Total Buffer Miles	Buffer Length (%)
Pasture	1.6	0.8%
Roads	1.1	0.5%
Farm Building	0.2	0.1%
Parks & Recreation	0.2	0.1%
Golf Course	0.1	0.1%
Resource Extraction	0.1	0.1%
Wetlands	0.1	0.03%
Junkyard	0.05	0.02%
Residential	0.07	0.03%
Open Water Pond/ Reservoir	0.02	0.01%
Feed Area	0.03	0.01%
Cemetery	0.01	0.003%
Total	**197**	**100%**

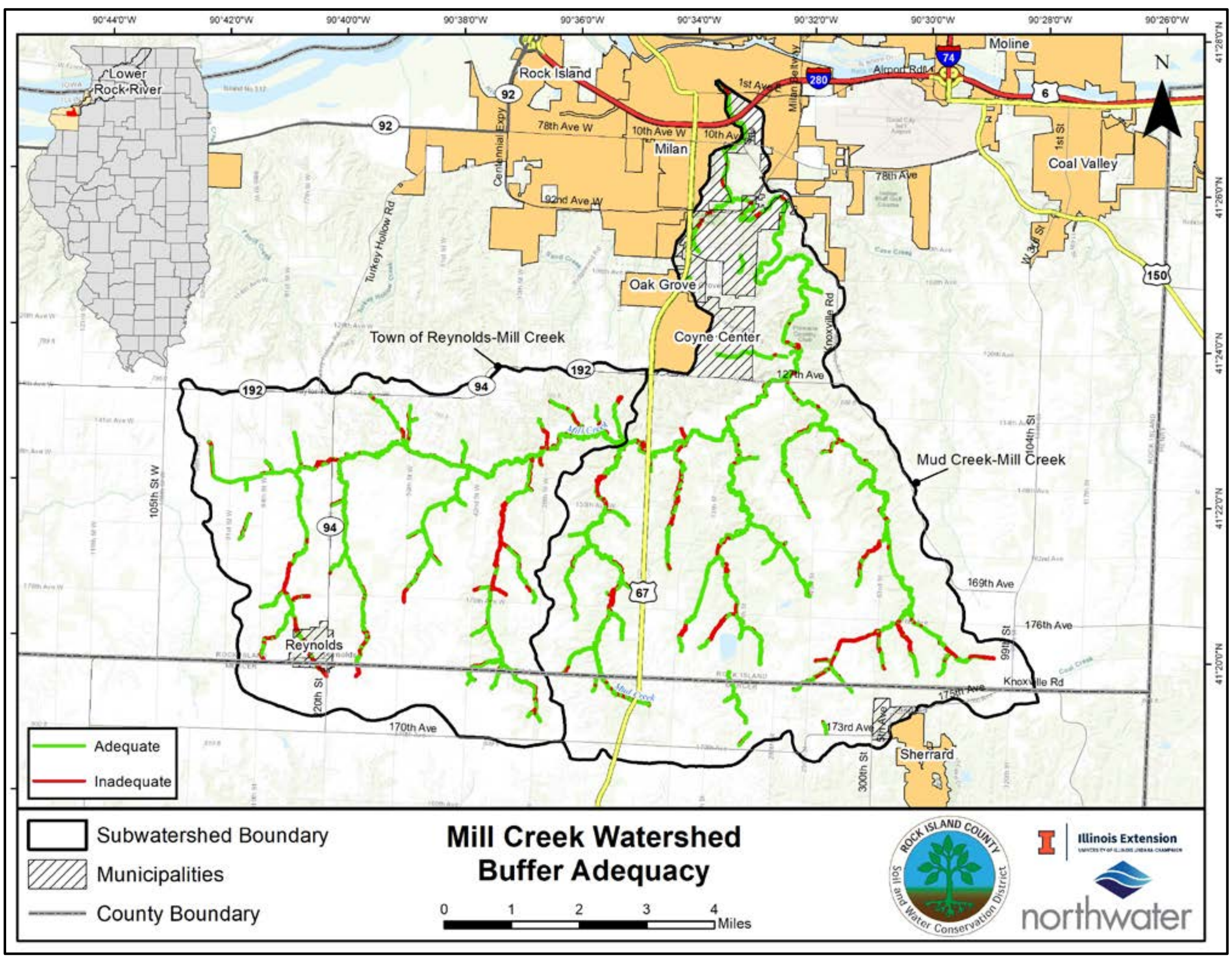


Figure 17 – Stream Buffers

3.11.5 Wetlands

Restored Wetland

Wetlands provide numerous valuable functions that are necessary for the health of a watershed. They play a critical role in protecting and moderating water quality through a combination of filtering and stabilizing processes. Wetlands remove pollutants through absorption, assimilation, and denitrification. This effective treatment of nutrients and physical stabilization leads to an increase in overall water quality. In addition, wetlands can increase stormwater detention capacity and attenuation, and moderate high flows. These benefits help to reduce flooding and erosion. Wetlands also facilitate groundwater recharge by allowing water to seep slowly into the ground, thus replenishing underlying aquifers. Groundwater recharge is also valuable to wildlife and stream biota during the summer months when precipitation is low, and the base flow of rivers/streams draw on the surrounding groundwater table.

Excluding stream, ponds, and lakes, United States Fish and Wildlife Service (USFWS) National Wetlands Inventory (NWI) indicates there is a total of 225 acres (0.5%) of wetlands. These are categorized as freshwater emergent and forested shrub wetlands. Results are shown in Table 28 and Figure 18.

Considering the outdated nature of the NWI dataset, an analysis of open water and forested wetlands was performed using 2021 aerial imagery to better understand their current extent. Results show only 144 acres (0.3%) of wetlands in the watershed; 30 of the 144 acres can be considered emergent or open water. Mud Creek – Mill Creek contains most acres (126) whereas Town of Reynolds – Mill Creek contains only 16 acres. Comparing to NWI data indicates up to 19 acres of previously delineated wetlands may have been drained or modified; therefore, opportunities exist to restore these areas.

Table 28 – Wetlands

Subwatershed	HUC12	Current Wetlands		NWI Wetlands			
		Area (ac)	% Total	Emergent (ac)	Forested/Shrub (ac)	Total (ac)	Converted (ac)
Mud Creek	070900051202	128	89%	46	130	176	15
Town of Reynolds	070900051201	16	11%	24	24	49	4
Total		**144**	**100%**	**70**	**154**	**225**	**19**

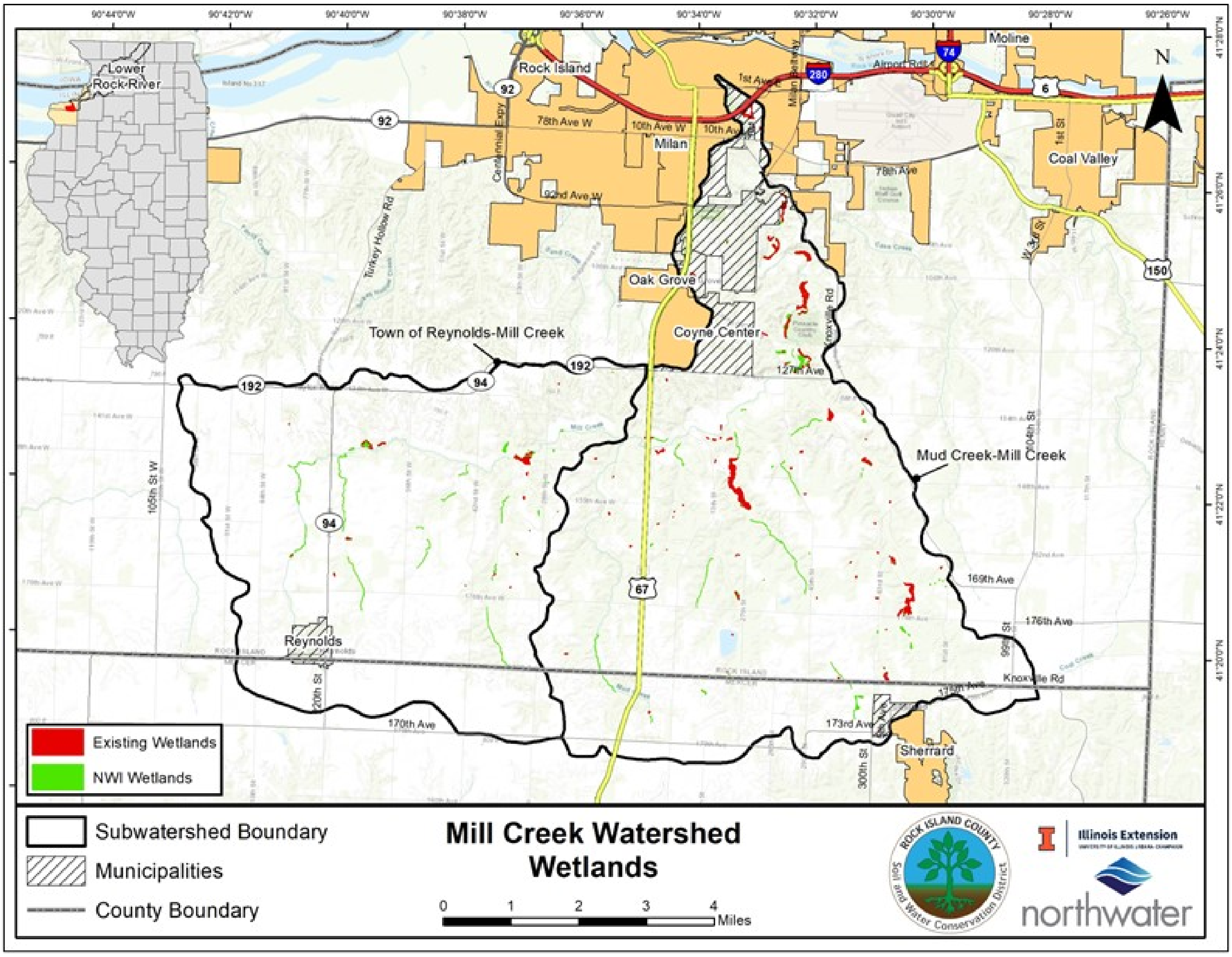


Figure 18 – Wetlands

3.11.6 Floodplain

A review and analysis of the most recent Federal Emergency Management Agency (FEMA) Digital Flood Insurance Rate Maps (DFIRM) indicates there are 1,931 acres of 100-year floodplain within the watershed, or 5% of total area (Figure 19). Of these, 737 acres (4.4%), are within the Town of Reynolds – Mill Creek subwatershed, whereas 1,194 acres, (5.1% of the subwatershed) are within Mud Creek – Mill Creek. Flood hazard areas on the Flood Insurance Rate Map are identified as a Special Flood Hazard Areas (SFHA). SFHA are defined as the area that will be inundated by the flood event having a 1-percent chance of being equaled or exceeded in any given year but are broken up into different zones based on severity of flood hazard risk. The 1-percent annual chance flood is also referred to as the base flood, or 100-year flood (FEMA, 2018).

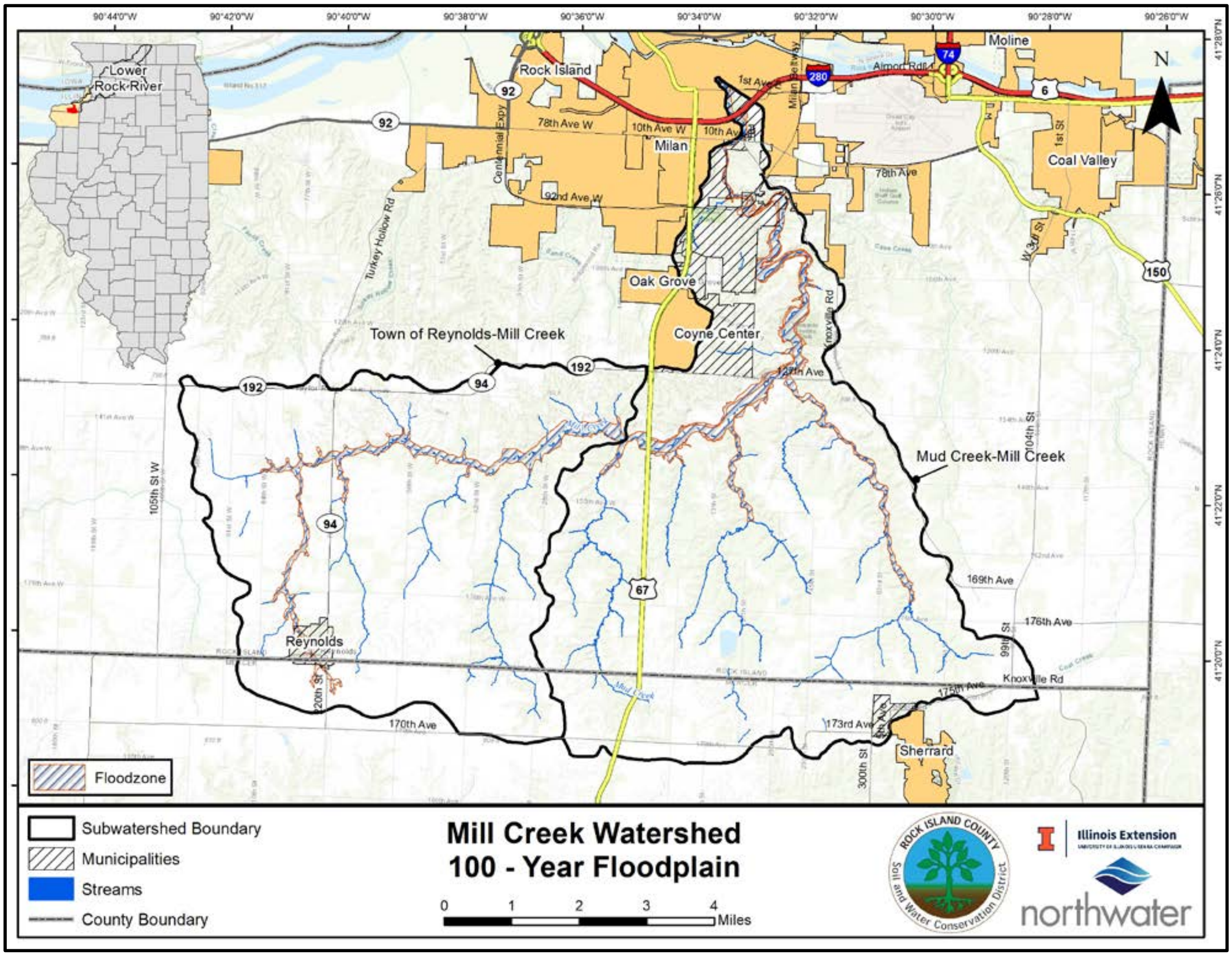


Figure 19 – 100-Year Floodplain

3.12 Streambank & Bed Erosion

Streambank erosion is a source of sediment and nutrients. This was determined as the prime natural resource concern for stakeholders thus an evaluation of the extent and severity of this source was performed to quantify sediment, nitrogen and phosphorus loading. Streambank erosion was estimated through direct observations during a windshield survey in the spring of 2021 followed by a more detailed assessment of high priority stream segments in the fall of 2021. During the windshield survey, data was captured with a GPS receiver at each road crossing to estimate average eroding bank height and annual recession rates. Results were extrapolated upstream and downstream from each crossing to the next observation point. Data was transferred into GIS to create a map layer representing general estimates of annual soil loss. The directly assessed segments included a stream walk with frequent measurements taken along each reach. Streambed erosion was only captured along these segments. Approximately 58 bank miles were measured. The watershed extent of assessed segments is depicted in Figure 20. For directly assessed reaches, a map book of 15 individual figures were developed and are included in Appendix A. One example is presented below (Figure 21).

Annual sediment, nitrogen and phosphorus loads were calculated using equations below and adjusted to account for the trapping efficiency of BMPs. Eroding bank height, bank length and lateral recession rates (LRR) estimated in the field were transferred to GIS. Bank soil nutrient concentrations were estimated from soil cores obtained from four representative locations. Samples were analyzed at an accredited lab. The following equations were used to estimate total annual loads:

$$Sy = L \times LRR \times H \times yd \times SDR \times STF$$

Sy – sediment yield in tons/yr
L – eroding bank length in feet
LRR – estimated lateral recession rate in feet per year
H – eroding bank height in feet
γd – Soil dry weight density (0.04 – 0.055 tons/ft^3)
SDR – Sediment Delivery Rate (1)
STF – Sediment Transport Factor (0.85)

$$TN = \left[Sy \times \frac{2000\ lbs}{1.0\ ton}\right] \times\ Nc\ x\ Cf$$

TN – Total nitrogen load from lake banks and streambanks in lbs/yr
Sy – Sediment yield in tons/yr
Nc – Nitrogen concentration in soil (0.00076 lbs/lb)
Cf – Correction factor, 0.85 - 1.0

$$TP = \left[Sy \times \frac{2000\ lbs}{1.0\ ton}\right] \times\ Pc\ x\ Cf$$

TP – Total phosphorus load from lake banks and streambanks in lbs/yr
Sy – Sediment yield in tons/yr
Pc – Phosphorus concentration in soil (0.000395 lbs/lb)
Cf – Correction factor, 1.0

3.12.1 Streambank Erosion

Streambank erosion is a natural process but the rate at which it occurs is often increased by anthropogenic (human) activities such as urbanization and agriculture. Bank erosion is typically a result of streambed incision and channel widening. Larger tributaries in the watershed such as Mill and Mud Creek have incised and appear to be widening whereas smaller tributaries are deepening as evidenced by unstable streambed conditions.

Streambank Erosion

Field observations indicate that the severity of streambank erosion is high throughout the watershed (Table 29). Results indicate it is responsible for delivering 11,611 tons of sediment, 17,644 lbs of nitrogen, and 9,170 lbs of phosphorus annually to the Rock River. Streams in the Mud Creek – Mill Creek subwatershed generate the greatest loads or 68% of total sediment, nitrogen and phosphorus. Mud Creek yields the greatest sediment per foot of bank or 39 compared to 29 for Mill Creek, 15.6 for all other tributaries and 20.5 for the watershed average. The lowest rates of bank erosion were observed in small, headwater channels and downstream of the Milan Beltway where Mill Creek intersects shale outcroppings prior to meeting the Rock River.

Many banks eroding at extremely high rates are generally accessible, making localized stabilization feasible yet costly. Addressing banks with the greatest rates of soil loss will yield results however the most cost-effective practices are still other upland treatments. These practices are described in Section 6.

Table 29 – Streambank Erosion & Loading

Stream	Sediment Load (tons/year)	Sediment Load (lbs/ft of stream)	Nitrogen Load (lbs/year)	Phosphorus Load (lbs/year)
Directly Assessed – Town of Reynolds – Mill Creek HUC 070900051201				
Mill Creek	1,828	34.7	2,779	1,444
Unnamed Tributary	1,097	12.3	1,668	867
Total	**2,925**	**20.6**[1]	**4,447**	**2,311**
Estimated – Town of Reynolds – Mill Creek HUC 070900051201				
Mill Creek	18	2.1	27	14
Unnamed Tributary	823	13	1,250	650
Total	**841**	**11.7**[2]	**1,277**	**664**
Subtotal HUC 070900051201	**3,766**	**17.6**	**5,724**	**2,975**
Directly Assessed - Mud Creek - Mill Creek HUC 070900051202				
Mill Creek	1,980	28.7	3,006	1,563
Mud Creek	1,515	56	2,302	1,197
Unnamed Tributary	2,018	28.5	3,067	1,594
Total	**5,513**	**33**[3]	**8,376**	**4,353**
Estimated - Mud Creek - Mill Creek HUC 070900051202				
Mud Creek	170	10.6	258	134
Unnamed Tributary	2,162	12.8	3,286	1,708
Total	**2,332**	**12.6**[4]	**3,544**	**1,842**
Subtotal HUC 070900051202	**7,845**	**22.3**	**11,920**	**6,195**
Grand Total	**11,611**	**20.5**	**17,644**	**9,170**

[1] - Value represents lbs/ft for all banks (5,850,982 lbs/283,439 ft), [2] - Value represents lbs/ft for all banks (1,680,878 lbs/143,649 ft), [3] – Value represents lbs/ft for all banks (11,025,420 lbs/333,745,260 ft) [4] – 6,344,540 lbs/513,651 ft

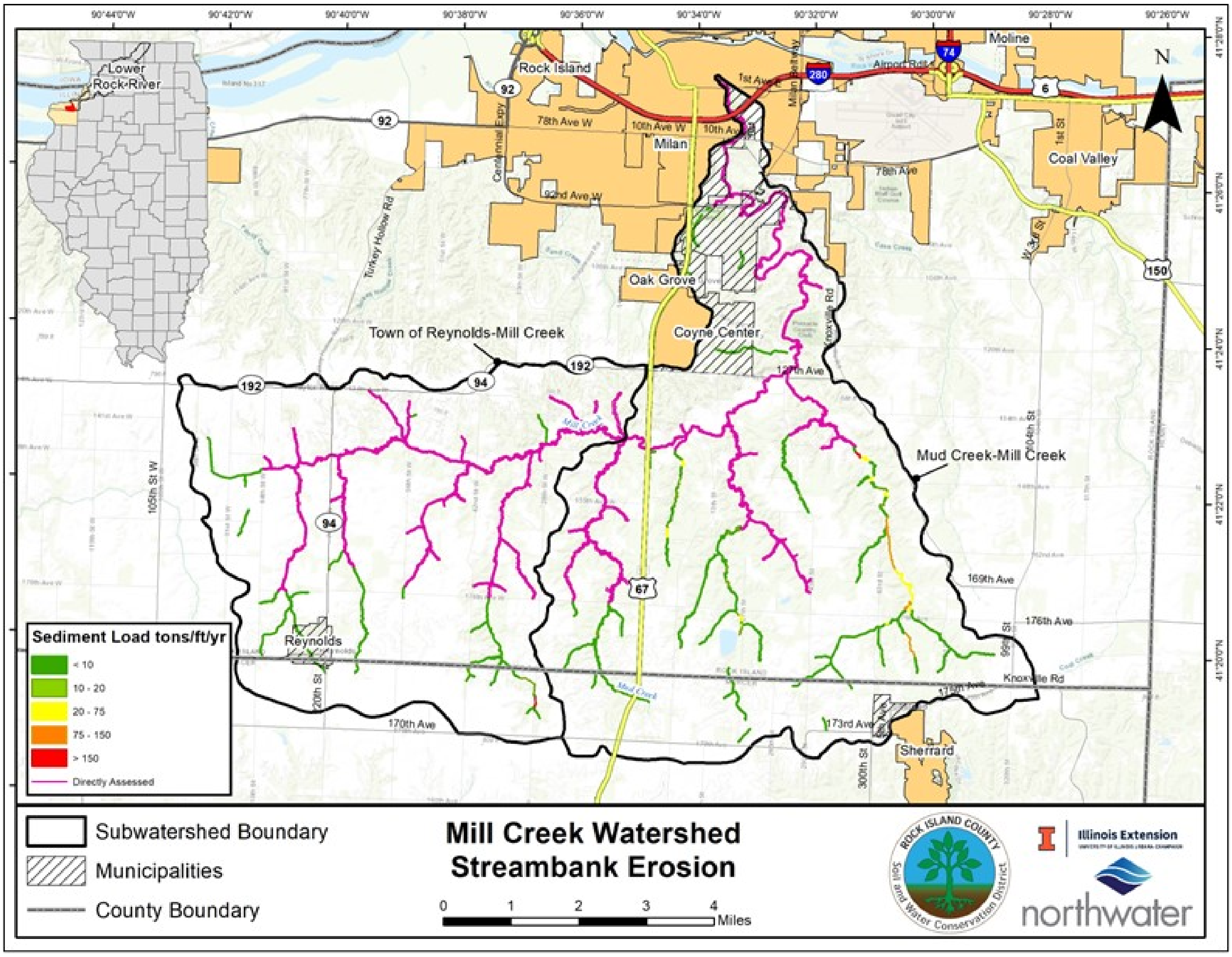


Figure 20 - Streambank Erosion

Streambank Erosion

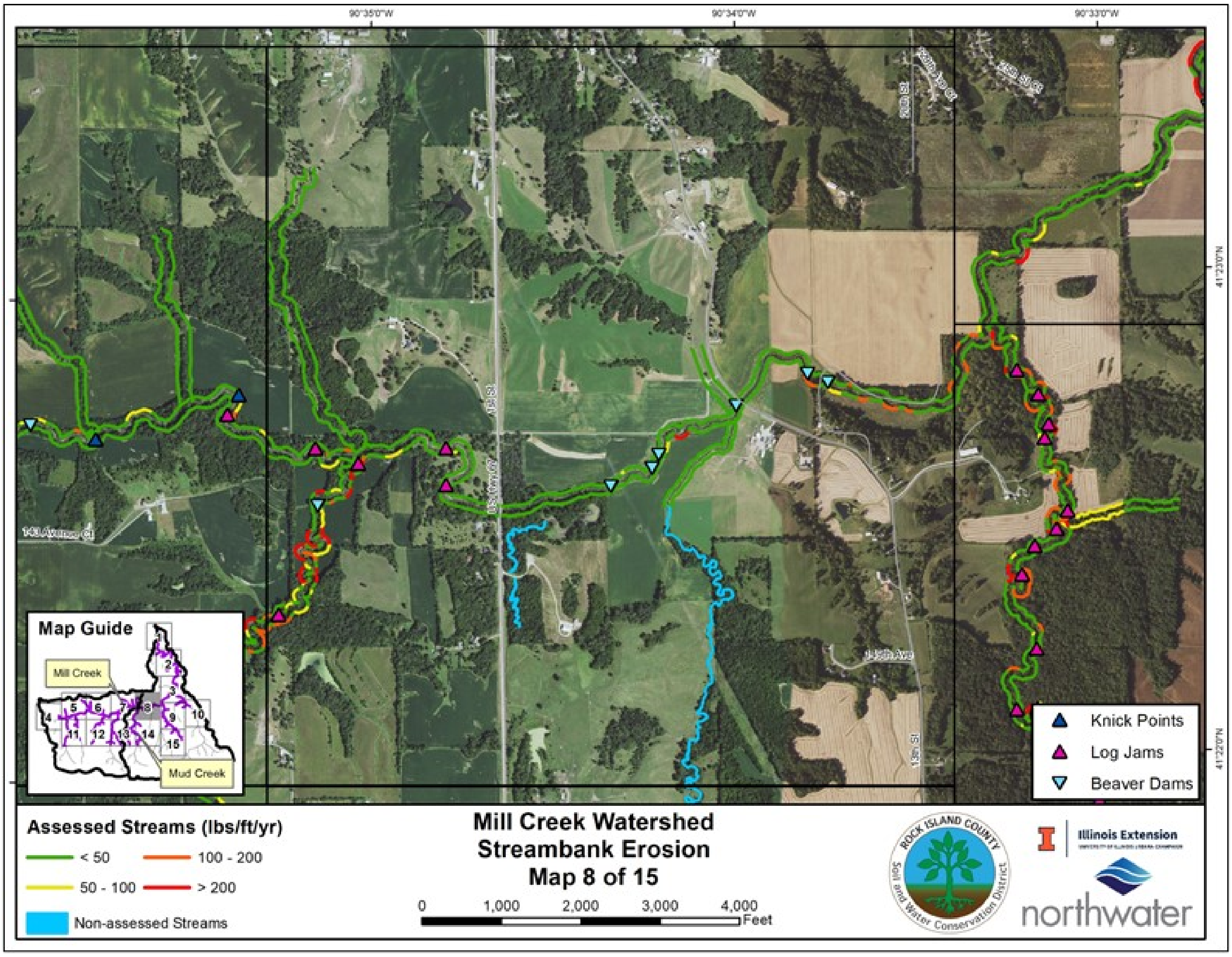


Figure 21 - Surveyed Stream – 8 of 15

3.12.2 Streambed Erosion

Bed erosion, degradation or lowering, is a process by which the bed of the stream is eroded to a new lower level at a much faster rate than occurs naturally. This bed lowering is indicated by the presence of "knickpoint's" or an abrupt change in a streams' longitudinal profile due to a change in base level, similar to a waterfall. Knickpoints migrate upstream and can be triggered by channel modification or changes in stream discharge. As knickpoints migrate upstream and the channel deepen, corresponding banks become steeper and more susceptible to failure. These features can be mitigated by installing stream riffles to stabilize grade.

Bed Erosion

A total of only 13 knickpoints were observed, generally localized and concentrated along unnamed tributary segments. Most were observed to be slight except for two locations where small unnamed streams enter Mill Creek. Seven knickpoints were noted in the Mud Creek – Mill Creek subwatershed, all on unnamed tributaries and 6 in the Town of Reynolds – Mill Creek with 3 on Mill Creek just upstream of Mud. Conversely, long reaches of exposed bedrock and very stable streambeds we observed along Mill Creek in its lower reaches near the Rock River. Of particular note are the presence of beaver dams and log jams observed during the stream assessment. A total of 22 beaver dams were recorded, mostly in Mill Creek upstream of its confluence with Mud. Seventy-six log jams were noted, 60% of which are concentrated along Mud Creek and an Unnamed Tributary east of Mud Creek.

3.13 Gully Erosion

Gully erosion is the removal of soil along drainage lines by surface water runoff. Once started, gullies will continue to move by headward erosion or by slumping of the side walls unless steps are taken to stabilize the disturbance. Gully erosion occurs when water is channeled across unprotected land and washes away the soil along the drainage lines. Under natural conditions, run-off is moderated by vegetation which generally holds the soil together, protecting it from excessive run-off and direct rainfall. To repair gullies, the object is to divert and modify the flow of water moving into and through the gully so that scouring is reduced, sediment accumulates, and vegetation can establish. Stabilizing the gully head is important to prevent damaging water flow and headward erosion. In most cases, gullies can be prevented by good land management practices (Water Resources Solutions, 2014).

Gully erosion was evaluated during a watershed windshield survey, during landowner meetings and field assessments, and estimated using GIS. Results presented in this section represent both ephemeral (those that form each year) and permanent (those that receive intermittent streamflow and expand over time such as a forested ditch or channel). For those ephemeral gullies not visible from a road or observed during the windshield survey or individual field assessment, GIS was used to estimate their location and extent. Gullies were delineated in GIS using aerial imagery and high-resolution elevation data, and a conservative average estimated width, depth, and years eroding were applied. For those observed in the field, dimensions were directly measured and transferred to GIS for analysis.

Total net erosion in tons/year and estimates of nitrogen and phosphorus loading were calculated using the equations below. A distance-based delivery ratio was applied to account for distance to a receiving waterbody. Sediment trapping efficiency was accounted for if the gully drained to a reservoir or other BMP. Soil nutrient concentrations were obtained from measured data in similar watersheds. The following equations were applied to estimate gully erosion and nutrient yields:

$$\boldsymbol{Sy} = \left\{\frac{\boldsymbol{L} \times \boldsymbol{W} \times \boldsymbol{H}}{\boldsymbol{Y}} \times \boldsymbol{\gamma d}\right\} \boldsymbol{DPS}^{0.2069} \times \boldsymbol{STF}$$

Sy – sediment yield in tons/yr
L – gully length in feet
W – gully width in feet
D -gully depth in feet
Y – years eroding
γd – Soil dry weight density (tons/ft^3)
DPS$^{0.2069}$- Distance to perennial stream, intermittent channel, or waterbody in feet, delivery ratio
STF – Sediment Transport Factor (0.85)

$$TN = \left[Sy \times \frac{2000\ lbs}{1.0\ ton}\right] \times\ Nc\ x\ Cf$$

TN – Total nitrogen load from gully in lbs/yr
Sy – Sediment yield in tons/yr
Nc – Nitrogen concentration in soil (lbs/lb)
Cf – Correction factor, 1.0

$$TP = \left[Sy \times \frac{2000\ lbs}{1.0\ ton}\right] \times\ Pc\ x\ Cf$$

TP – Total phosphorus load from gully in lbs/yr
Sy – Sediment yield in tons/yr
Pc – Phosphorus concentration in soil (lbs/lb)
Cf – Correction factor, 1.0

Gully Erosion

Gully erosion in the watershed occurs primarily at ephemeral water courses adjacent to major perennial drainage ways. It is also evident on crop ground especially on long slopes where subsurface drainage is occurring. Conservation practices observed in the watershed, such as WASCBs or grassed waterways and other grade control structures, have been implemented to address this specific type of erosion.

Results indicate that there are 139 miles of eroding gullies, with an average depth of 1.2 ft and an average width of 1.6 ft (Figure 22). Gullies are responsible for the annual delivery of 6,862 tons of sediment, 2,969 lbs of phosphorus and 5,671 lbs of nitrogen to the Rock River. The Mud Creek – Mill Creek subwatershed contains the greatest number and is responsible for the majority of the load or 76% of the sediment, 70% of the nitrogen, and 74% of the phosphorus (Table 30).

Table 30 - Gully Erosion & Pollutant Loading

Subwatershed	HUC12 Code	Gully Length (ft)	Gully Length (mi)	Average Gully Width (ft)	Average Gully Depth (ft)	Nitrogen (lb/yr)	Phosphorus (lb/yr)	Sediment (tons/yr)
Mud Creek – Mill Creek	070900051202	523,747	99	1.7	1.3	3,946	2,200	5,209
Town of Reynolds – Mill Creek	070900051201	212,077	40	1.5	1.1	1,725	769	1,653
Grand Total		**735,824**	**139**	**1.6 (avg)**	**1.2 (avg)**	**5,671**	**2,969**	**6,862**

An analysis of gully loading by landuse type is presented in Table 31. The highest sediment and nutrient loads are originating from forested areas or 78% of the sediment, 48% of the nitrogen, and 67% of the phosphorus. Cropland is responsible for 6% of the gully sediment load, 15% of the nitrogen, and 9% of the phosphorus. Pasture yields relatively high volumes of sediment and nutrients, more so than cropland. Forested areas contribute substantially more sediment due to a very high number of gullies, rapid rates of delivery and close proximity to receiving streams.

Table 31 – Gully Erosion & Pollutant Loading by Landuse Category

Landuse Category	Gully Length (ft)	Gully Length (miles)	Average Gully Width (ft)	Average Gully Depth (ft)	Sediment (tons/yr)	Nitrogen (lbs/yr)	Phosphorus (lbs/yr)
Forest	513,162	97	1.8	1.4	5,383	2,713	1,987
Row Crops	130,520	25	0.6	0.4	429	859	257
Grass/Open Space/Hay	50,002	9.5	1.3	1	432	863	171
Pasture	41,944	7.9	2.8	1.9	617	1,233	553
Developed/Recreation/Park	196	0.04	1.6	1.2	1.4	2.7	1.4
Grand Total	**735,824**	**139**	**1.6 (avg)**	**1.2 (avg)**	**6,862**	**5,671**	**2,969**

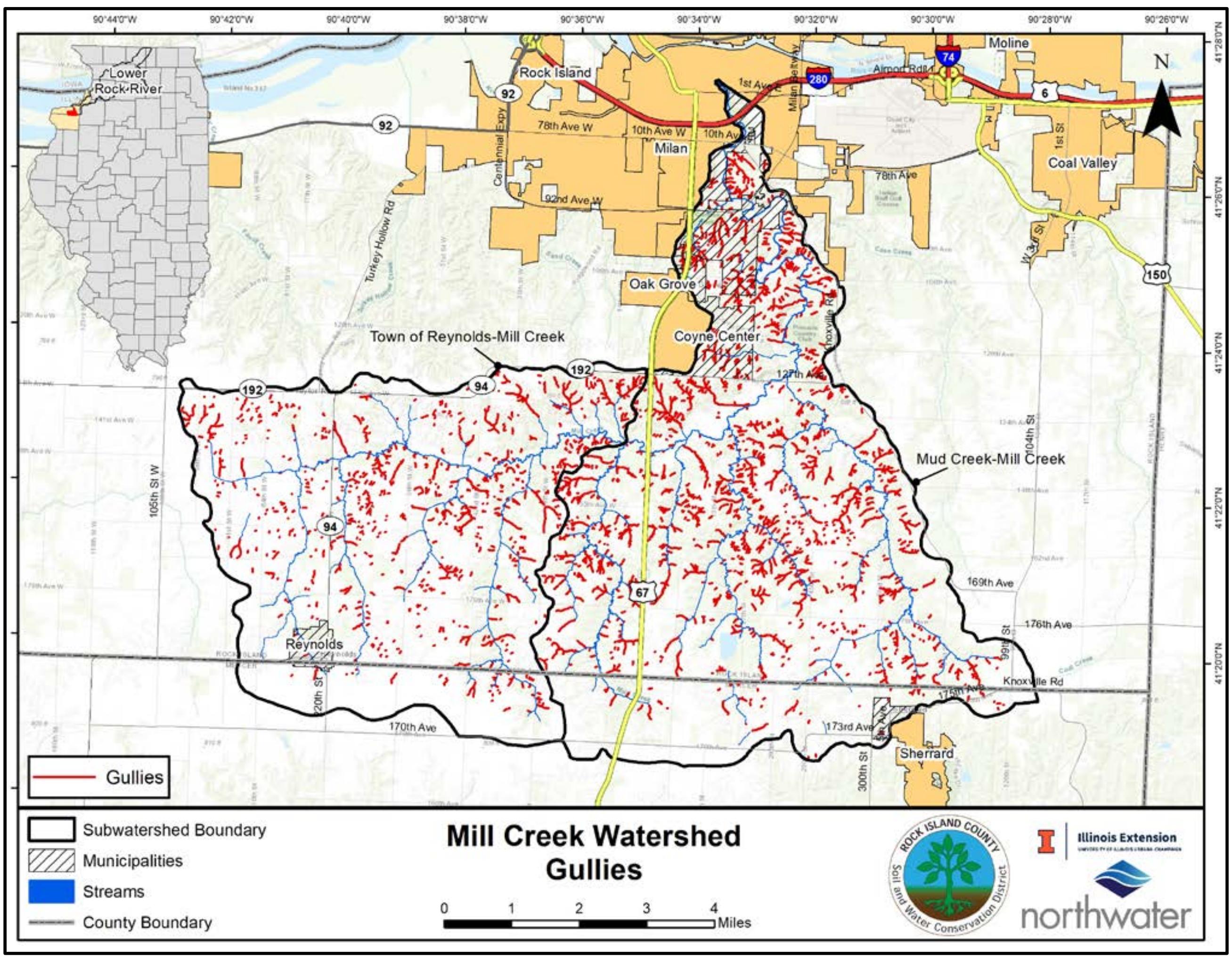


Figure 22 – Gully Erosion

3.14 Sheet & Rill Erosion

Through rain and shallow water flows, sheet erosion removes the thin layer of topsoil. When sheet flows begin to concentrate on the surface through increased water flow and velocity, rill erosion occurs. Rill erosion scours the land even more, carrying off rich nutrients and adding to the turbidity and sedimentation of waterways. The extent of sheet and rill erosion in the watershed was calculated using the Universal Soil Loss Equation (USLE), which is widely used to estimate rates caused by rainfall and associated overland flow. This method relies on soil properties, precipitation, slope, cover types and conservation practices (if applicable). A map based USLE model was developed for all cropped soils within the watershed and used to quantify sediment loading from agricultural ground and identify locations with the potential for excessive erosion.

Analysis shows sheet and rill erosion from cropland is responsible for the annual delivery of 45,057 tons of sediment and an average 2.1 tons/ac/yr delivered to watershed streams (Table 32). Mud Creek – Mud Creek and the Town of Reynolds – Mill Creek are roughly similar in loading, with each having comparable cropland area. Mud Creek has 10,035 acres of cropland and delivers 21,561 tons of sediment yearly, whereas Town of Reynolds has 11,555 acres of cropland and delivers 23,496 tons (Table 32). Modeled results indicate that the majority is originating from no-till fields, both HEL and non-HEL (Section 5) and those fields closest to a stream or other waterbody.

Conventional tillage, that on average delivers greater than 5 tons/ac/yr represents only 0.74% of all cropland and is responsible for the annual delivery of 2% of the entire cropland sediment load. Mulch-till is 12% of the acreage, delivers sediment at a rate of 3.3 tons/ac/yr and is 19% of the total sheet and rill erosion load. Although conventional and mulch-till fields yield the greatest per acre, no-till is responsible for 76% of the total delivered sediment (Table 33), primarily due to higher overall acreage or 80%. Cover crops are on 2.7% of all cropland and deliver only 1.1% of the sediment load at a yield 0.88 tons/ac/yr.

Table 32 – Sheet & Rill Erosion Loading by Subwatershed

Subwatershed Name	HUC12	Cropland Acres (ac)	Sediment Load (tons/yr)	Sediment Load (tons/ac/yr)
Mud Creek-Mill Creek	070900051202	10,035	21,561	2.1
Town of Reynolds-Mill Creek	070900051201	11,555	23,496	2.0
Total		**21,590**	**45,057**	**2.1**

Table 33 – Sheet & Rill Erosion Loading by Tillage Type

Tillage Type	Total Area (ac)	% Cropland Area (acres)	Sediment Load (tons/yr)	Sediment Load (tons/ac/yr)	% Total Sediment Load from Sheet & Rill Erosion
No-Till	17,175	80%	34,282	2	76%
Mulch-Till	2,553	12%	8,363	3.3	19%
Hay[1]	730	3.4%	234	0.32	0.5%
Cover Crop[1]	572	2.7%	503	0.88	1.1%
Reduced-Till	283	1.3%	621	2.2	1.4%

Tillage Type	Total Area (ac)	% Cropland Area (acres)	Sediment Load (tons/yr)	Sediment Load (tons/ac/yr)	% Total Sediment Load from Sheet & Rill Erosion
Conventional	159	0.74%	840	5.3	1.9%
Strip-Till	117	0.54%	214	1.8	0.47%
Grand Total	**21,590**	**100%**	**45,057**	**2.1**	**100%**

[1] – not a tillage practice

3.15 Point Source Pollution

Point source pollution in the watershed comes from NPDES permitted dischargers. Septic systems, although typically considered to be a nonpoint source issue, exist in the watershed and may be contributing to nutrient loading in certain areas. Failing septic systems can leach wastewater into groundwater and surrounding waterways. Point source pollution is defined by the United States Environmental Protection Agency (USEPA) as "any single identifiable source of pollution from which pollutants are discharged, such as a pipe, ditch, ship or factory smokestack" (Hill, 1997). The NPDES, a provision of the Clean Water Act, prohibits point source discharge of pollutants into waters of the U.S. unless a permit is issued by the USEPA or a state or tribal government. Individual permits are specific to individual facilities (e.g., water or wastewater treatment facilities), and general permits cover facilities with similar treatment types and effluent. Permits describe the allowed discharge of pollutant concentrations (mg/L) and loads (lbs/day). Permitted discharges contribute only a small portion of annual point source pollution. This can be expected, as there are many more people dependent on septic systems as discussed in Section 3.16.

3.15.1 NPDES Dischargers

The watershed contains six facilities permitted to discharge, 5 sewage treatment plants (STP), and 1 limestone quarry. All facilities reported nitrogen as ammonia as N. Phosphorus was not monitored or reported. For wastewater treatment plants without nutrient limits, average measured concentrations from other plants with similar treatment types were used.

Permitted NPDES dischargers account for a total of 2,696 lbs/yr nitrogen, 894 lbs/yr phosphorus, and 8 tons/yr sediment (Table 34). The Village of Reynolds STP is responsible for most of the watershed's point source phosphorus and sediment loads at 521 lbs/yr and 6.3 tons/yr respectively.

Point Source Discharge

Table 34 - NPDES Facilities & Pollutant Loading

Subwatershed	NPDES Permit Number	Facility Name	Outfall Type	Nitrogen Load (lbs/yr)	Phosphorus Load (lbs/yr)	Sediment Load (tons/yr)	Average Flow (MGD)
Mud Creek-Mill Creek	IL0062952	Sherrard JR SR High School STP	STP outfall	1.5	13	0.01	0.002
	IL0065200	Coyne Center Sanitary District - STP	STP outfall	850	n/a	0.3	0.045
	IL0024503	Pinnacle Country Club	STP outfall	0	0	0	0
	IL0026671	Woodland Mobile Home Park	STP outfall	1,714	361	1.0	0.055
	ILG840134, IL0026620	Milan Stone Quarry	Pit Pumpage and stormwater	0	n/a	0	0
Subwatershed Total				***2,566***	***374***	***1.4***	***0.1***
Town of Reynolds-Mill Creek	ILG580225, IL0021482	Village of Reynolds STP	STP outfall	130	521	6.3	0.079
Grand Total				**2,696**	**894**	**8**	**0.18**

3.16 Septic Systems & Sewer

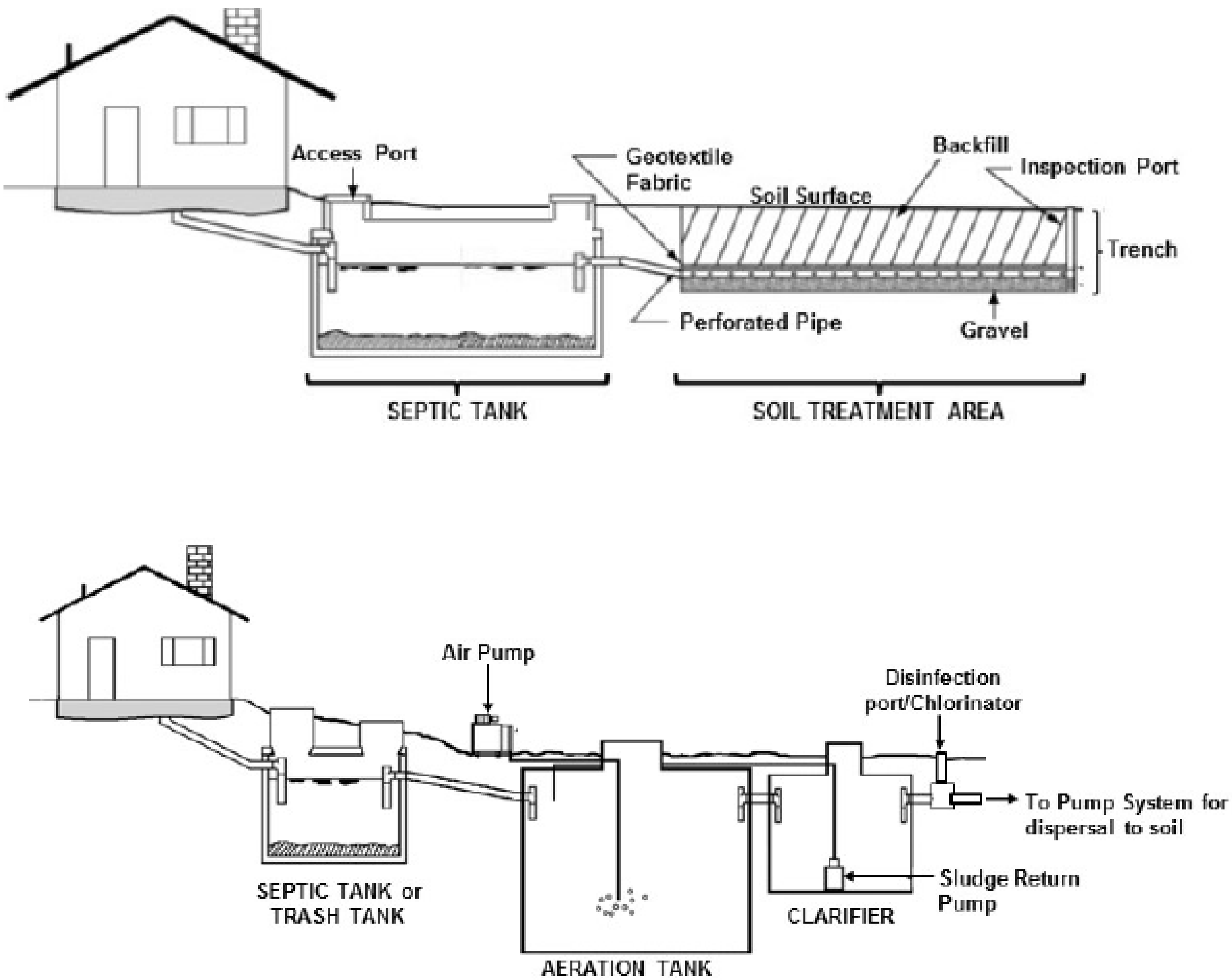
Outside of sewered areas, septic systems provide treatment of wastewater from individual properties and structures. When failing they can be an active source of pollutants. Faulty or leaking septic systems are sources of bacteria, nitrogen, and phosphorus. Typical national failure rates are 10-20% but vary widely depending on the local definition of failure; no rates are reported specifically for Illinois (USEPA, 2002). Fifteen percent was used for analysis, consistent with other watershed plans in Illinois and after confirming with the local county health department.

Every home and structure in the watershed not served by a sewer system were located and mapped using GIS to estimate the number of individual structures using septic systems. This data was then compared with known septic systems provided by the County Health Department and reconciled to get a more accurate count.

There are an estimated 1,104 septic systems in the watershed. Assuming a rate of 15%, it is possible that 166 structures have failing septic systems (Table 35). Due to the planning nature of this analysis, the exact number systems are unknown. Potentially failing systems contribute an estimated 5,589 lbs/yr of nitrogen and 2,188 lbs/yr of phosphorous. For the purposes of this report, it is assumed that these loadings do make it to waterways however, loading is a function of location, and it is possible that some portion of septic water may be absorbed or filtered prior. Systems range from 58 to 4,733 ft from a receiving water body. Average distance is 1,532 ft and the median is 2,275 ft. Approximately 40% of all systems are at or less than 1,000 ft from a receiving water body.

Table 35 - Septic System Loading by Subwatershed

Subwatershed Name	HUC12	Septic Systems	Nitrogen Load (lbs/load)	Phosphorus Load (lbs/load)
Mud Creek-Mill Creek	070900051202	735	3,588	1,405
Town of Reynolds-Mill Creek	070900051201	369	2,002	784
Total		**1,104**	**5,589**	**2,188**



Septic Systems: Conventional (above) and Aerobic Treatment (below)
Credit: OSU 2017

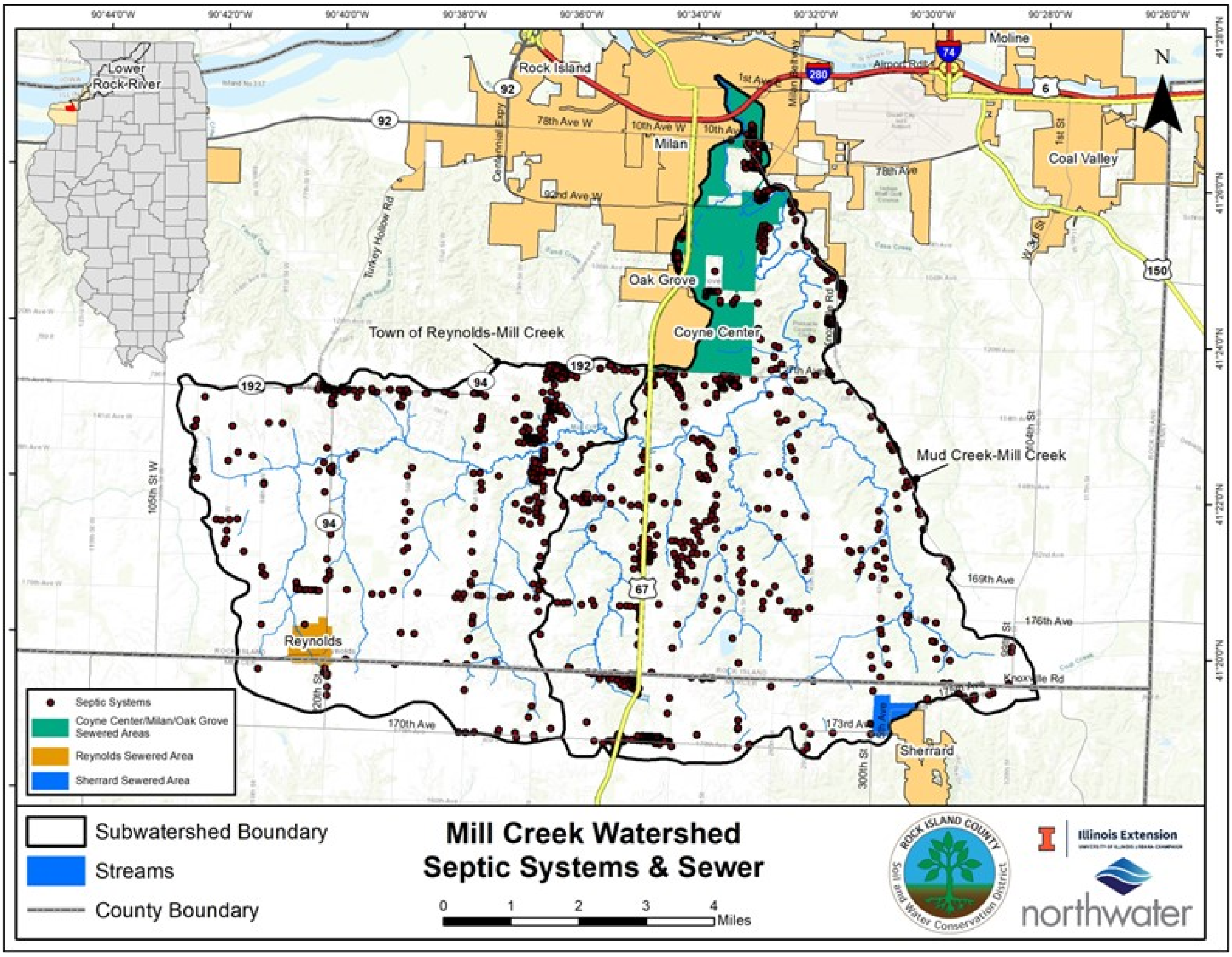


Figure 23 – Septic Systems & Sewer

4.0 Pollutant Loading

4.1 Introduction

A watershed survey was completed to gain an understanding of conditions and features and to collect field-specific data. This included: tillage practices, cover types, existing project (BMP) locations and site suitability, and sources of sediment and gully erosion. This survey, combined with interpretation of aerial imagery, resulted in the identification of site-specific BMP locations. Drainage areas were then delineated for each.

A spatially explicit GIS-based pollution loading model (SWAMM) was developed to estimate loading from direct runoff and tile or subsurface flow. The model simulates surface runoff and loading using the curve number approach, local precipitation, the USLE, and Event Mean Concentrations (EMCs) specific to landuse and soil types. In addition, field survey data was incorporated, such as tillage practices and existing BMPs. The model accounts for subsurface tile flow by allocating a percentage of annual rainfall. It was not directly calibrated due to a lack of watershed-specific measured water quality and streamflow data. Loads were compared to other similar watersheds and water quality modeling completed to ensure results are in the correct range.

4.2 Pollutant Loading

Pollutant load estimates are presented in this section and are provided for septic systems, NPDES dischargers, surface runoff and tile flow, gully and streambank erosion. Gully and streambank erosion were observed in the field to the extent it was visible. Loading from septic systems was estimated based on those homes not connected to a wastewater treatment system, and NPDES discharge data was acquired from the United States EPA and other sources. Results from the GIS-based direct surface runoff and tile flow pollution load model are illustrated in Figure 24, Figure 25, and Figure 26. Loading from direct, surface runoff and tile accounts for what is contributed from overland flow and tiles.

As presented in Table 36, total annual loading from all sources is 402,505 lbs of nitrogen, 59,267 lbs phosphorus, and 64,281 tons of sediment. Direct runoff and to a much lesser extent tile flow combined are responsible for 92% of the nitrogen, 74% of the phosphorus, and 71% of the sediment load. All other sources combined - streambank erosion, gully erosion, failing septic systems, and point source discharges account for 8% of the nitrogen, 26% of the phosphorus, and 29% of the sediment load.

Table 36 – Pollutant Loading Summary

Pollution Source	Nitrogen Load (lbs/yr)	Phosphorus Load (lbs/yr)	Sediment Load (tons/yr)	Nitrogen Load (% total)	Phosphorus Load (% total)	Sediment Load (% total)
Mud Creek-Mill Creek/70900051202						
Surface Flow & Tile	188,846	22,215	22,073	90%	69%	63%
Streambank Erosion	11,920	6,195	7,845	5.7%	19%	22%
Gully Erosion	3,946	2,200	5,209	1.9%	6.8%	15%
Septic Systems	3,588	1,405	0	1.7%	4.3%	0%
NPDES Discharge	2,566	374	1	1.2%	1.2%	0.004%
Subwatershed Total	***210,866***	***32,389***	***35,128***	***100%***	***100%***	***100%***
Town of Reynolds-Mill Creek/70900051201						
Surface Flow & Tile	182,057	21,831	23,728	95%	81%	81%
Streambank Erosion	5,724	2,975	3,766	3.0%	11%	13%
Gully Erosion	1,725	769	1,653	0.9%	2.9%	5.7%
Septic Systems	2,002	784	0	1%	2.9%	0%
NPDES Discharge	130	521	6	0.1%	1.9%	0.02%
Subwatershed Total	***191,638***	***26,879***	***29,154***	***100%***	***100%***	***100%***
Watershed Total						
Surface Flow & Tile	370,904	44,045	45,801	92%	74%	71%
Streambank Erosion	17,644	9,170	11,610	4.4%	15%	18%
Gully Erosion	5,671	2,969	6,862	1.4%	5%	11%
Septic Systems	5,589	2,188	0	1.4%	3.7%	0%
NPDES Discharge	2,696	894	7.7	0.7%	1.5%	0.01%
Grand Total	**402,505**	**59,267**	**64,281**	**100%**	**100%**	**100%**

Modeled pollution loading from surface runoff and subsurface tile flow is reported in Table 37, and depicted in Figure 24, Figure 25, and Figure 26. Per-acre results are calculated by dividing the total annual load of a given landuse category by the total number of acres. Results show that row crops have the highest per-acre sediment load. Streams and ponds have the highest per-acre nitrogen load. This is due high predicted concentrations and rapid delivery. Livestock feed areas are responsible for the third greatest per-acre nitrogen load, followed by crop ground. Feed areas deliver the highest per acre phosphorus loads.

Cropland, including hay, delivers 308,829 lbs/yr of nitrogen, or 14 lbs/ac/yr; 37,462 lbs/yr of phosphorus, or 1.7 lbs/ac/yr; 44,823 tons, or 2.1 tons/ac/yr of sediment. It is important to note that these results represent delivered loads for all fields in the watershed combined. Individual fields deliver soil and nutrients at different rates based on tillage practices, soil and slope characteristics, proximity to a waterbody, and whether a BMP is in place.

Other landuse categories such as forest and pasture areas are also relatively high contributors of the total nutrient and sediment budget. Although forest has low per-acre values compared to other categories, the watershed contains a higher percentage and, therefore, cumulative loading is higher.

Table 37 – Pollutant Loading from Surface & Subsurface Runoff by Landuse

Landuse Category	Area (ac)	Nitrogen Load		Phosphorus Load		Sediment Load	
		lbs/yr	lbs/ac/yr	lbs/yr	lbs/ac/yr	tons/yr	tons/ac/yr
Row Crops	20,860	307,387	15	37,192	1.8	44,823	2.1
Forest	7,621	10,202	1.3	1,160	0.2	202	0.03
Grasslands	4,014	2,246	0.6	343	0.09	33	0.01
Pasture	2,490	23,575	9.5	2,752	1.1	254	0.1
Open Space	2,398	4,094	1.7	331	0.1	36	0.01
Hay	730	1,442	2	271	0.4	234	0.3
Roads[1]	460	3,110	6.8	608	1.3	70	0.2
Residential on Septic[3]	264	1,049	4	202	0.8	21	0.08
Open Water Stream[2]	222	9,337	42	186	0.8	52	0.2
Farm Building	187	1,710	9.1	174	0.9	23	0.1
Open Water Pond / Reservoir[2]	164	3,360	21	106	0.6	2.8	0.02
Residential on Sewer	129	526	4.1	106	0.8	11	0.08
Landfill	123	384	3.1	70	0.6	10	0.08
Golf Course	122	530	4.3	104	0.9	4.8	0.04
Parks And Recreation	96	149	1.5	36	0.4	0.7	0.01
Resource Extraction	52	165	3.2	33	0.6	3.2	0.06
Livestock Feed Areas	48	777	16	213	4.5	7.9	0.2
Parking Lot	46	254	5.5	49	1.1	5	0.1
Warehouse	33	152	4.6	30	0.9	3.3	0.1
Wetlands	30	20	0.7	0.3	0.01	0.01	0.0003
Mobile Home Park	24	104	4.3	16	0.7	1.5	0.06
Cemetery	17	26	1.5	4	0.2	0.2	0.01
Nursery	15	52	3.4	4.9	0.3	0.4	0.03
Institutional	15	80	5.5	15	1	1.6	0.1
Commercial	14	76	5.3	15	1	1.5	0.1
Junkyard	8.5	22	2.6	4.1	0.5	0.7	0.09
Confinement	7.5	65	8.7	16	2.1	0.6	0.08
Utility	2.1	10	4.6	2.1	1	0.2	0.1
Industrial	0.3	1.1	3.2	0.2	0.6	0.02	0.07
Wind Farm	0.02	0.07	4.6	0.01	1	0.002	0.1
Total[4]	**40,194**	**370,904**	**9**	**44,045**	**1.1**	**45,801**	**1.1**

[1] – Roads yield high nutrient loads due to rapid rates of runoff and relatively high Event Mean Concentration values found in existing literature.

[2] – Very high nutrient yields for streams and to a lesser extent ponds and reservoirs are the result of legacy nutrients from the watershed already in the water column and therefor high measured event concentrations. When combined with high runoff rates and rapid delivery of water through the system, yield results exceed other landuse categories. This is a limitation of the model used for estimating surface runoff loading.

[3] - loading from the septic systems themselves are not included in this total. Table 36 quantifies septic system loading separately.

[4] – per acre values in this column represent total loading divided by the total watershed area and is an overall average.

Table 38 compares the loadings originating from direct runoff with all sources. Row crops are the greatest contributor, responsible for 76% of the total nitrogen, 63% of total phosphorus, and 70% of the sediment load. Pasture and hay are the next highest contributors of sediment at 0.4% each. Pasture and forest are the next highest for nitrogen, at 5.9% and 2.5%, respectively. Pasture and forest also contribute 4.6% and 2% of total phosphorus, respectively.

Table 38 – Loading from Surface & Subsurface Runoff by Landuse as Percentage of Watershed Load

Landuse Category	Area (ac)	Nitrogen Load		Phosphorus Load		Sediment Load	
		lbs/yr	% Total Watershed Load	lbs/yr	% Total Watershed Load	tons/yr	% Total Watershed Load
Row Crops	20,860	307,387	76%	37,192	63%	44,823	70%
Forest	7,621	10,202	2.5%	1,160	2%	202	0.3%
Grasslands	4,014	2,246	0.6%	343	0.6%	33	0.05%
Pasture	2,490	23,575	5.9%	2,752	4.6%	254	0.4%
Open Space	2,398	4,094	1%	331	0.6%	36	0.06%
Hay	730	1,442	0.4%	271	0.5%	234	0.4%
Roads	460	3,110	0.8%	608	1%	70	0.1%
Residential on Septic	264	1,049	0.3%	202	0.3%	21	0.03%
Open Water Stream	222	9,337	2.3%	186	0.3%	52	0.08%
Farm Building	187	1,710	0.4%	174	0.3%	23	0.04%
Open Water Pond Reservoir	164	3,360	0.8%	106	0.2%	2.8	0.004%
Residential on Sewer	129	526	0.1%	106	0.2%	11	0.02%
Landfill	123	384	0.1%	70	0.1%	9.6	0.01%
Golf Course	122	530	0.1%	104	0.2%	4.8	0.01%
Parks And Recreation	96	149	0.04%	36	0.06%	0.7	0.001%
Resource Extraction	52	165	0.04%	33	0.06%	3.2	0.005%
Livestock Feed Areas	48	777	0.2%	213	0.4%	7.9	0.01%
Parking Lot	46	254	0.06%	49	0.08%	5	0.01%
Warehouse	33	152	0.04%	30	0.05%	3.3	0.01%
Wetlands	30	20	0.005%	0.3	0.0004%	0.01	0.00001%
Mobile Home Park	24	104	0.03%	16	0.03%	1.5	0.002%
Cemetery	17	26	0.01%	4.0	0.01%	0.2	0.0003%
Nursery	15	52	0.01%	4.9	0.01%	0.4	0.001%
Institutional	15	80	0.02%	15	0.02%	1.6	0.002%
Commercial	14	76	0.02%	15	0.03%	1.5	0.002%
Junkyard	8.5	22	0.01%	4.1	0.01%	0.7	0.001%
Confinement	7.5	65	0.02%	16	0.03%	0.6	0.001%
Utility	2.1	9.7	0.002%	2.1	0.003%	0.2	0.0004%
Industrial	0.3	1.1	0.00%	0.2	0.0003%	0.02	0.00004%
Wind Farm	0.02	0.1	0.00002%	0.01	0.00003%	0.00	0.000003%

Landuse Category	Area (ac)	Nitrogen Load		Phosphorus Load		Sediment Load	
		lbs/yr	% Total Watershed Load	lbs/yr	% Total Watershed Load	tons/yr	% Total Watershed Load
Total	**40,194**	**370,904**	**92%**	**44,045**	**74%**	**45,801**	**71%**

Note: Percentages do not add up to 100% because direct runoff is not the only source of loading in the watershed. Streambank erosion, gully erosion, septic systems, and NPDES dischargers are responsible for the remaining percentage

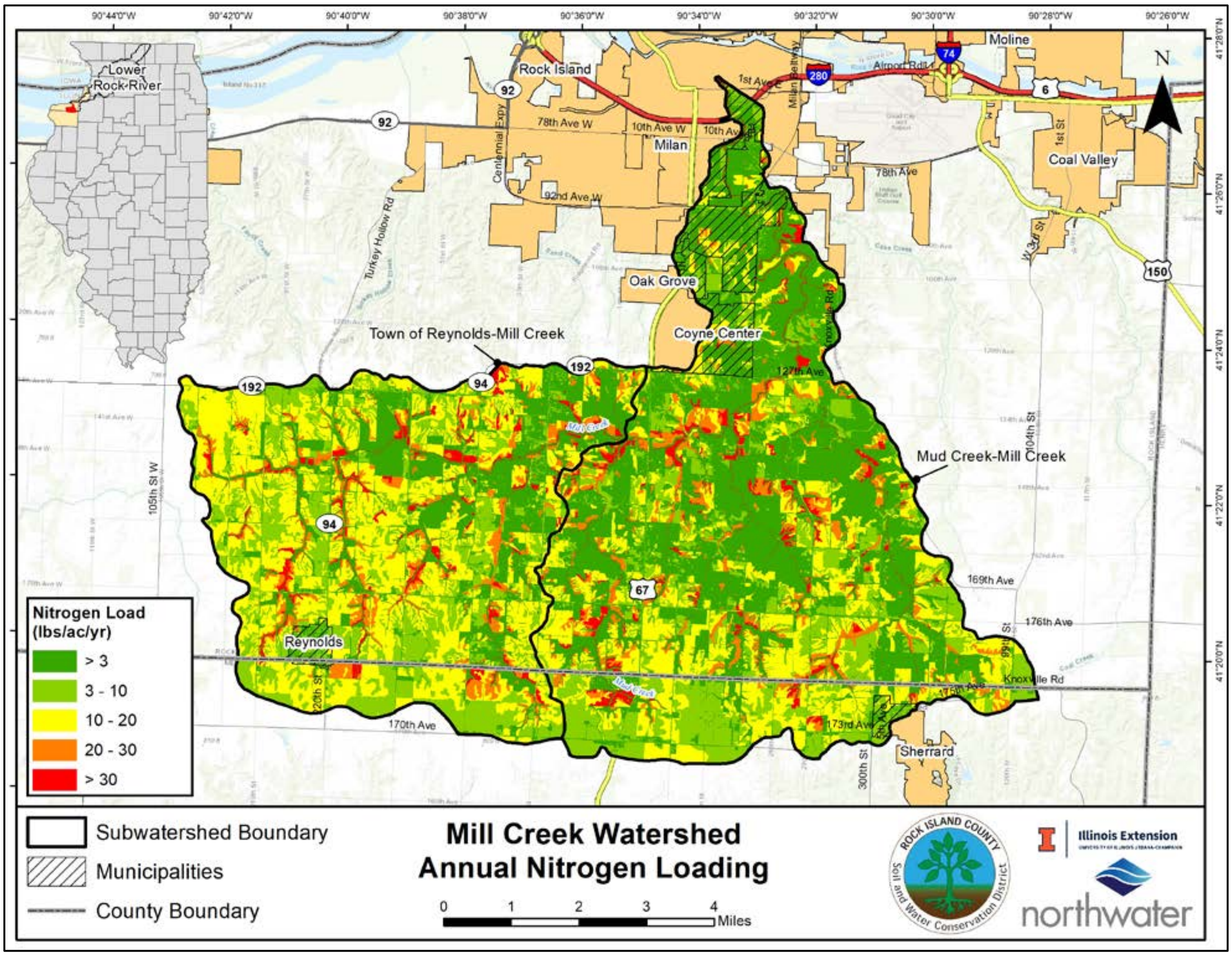


Figure 24 – Annual Nitrogen Loading Per Acre from Direct Surface & Subsurface Runoff

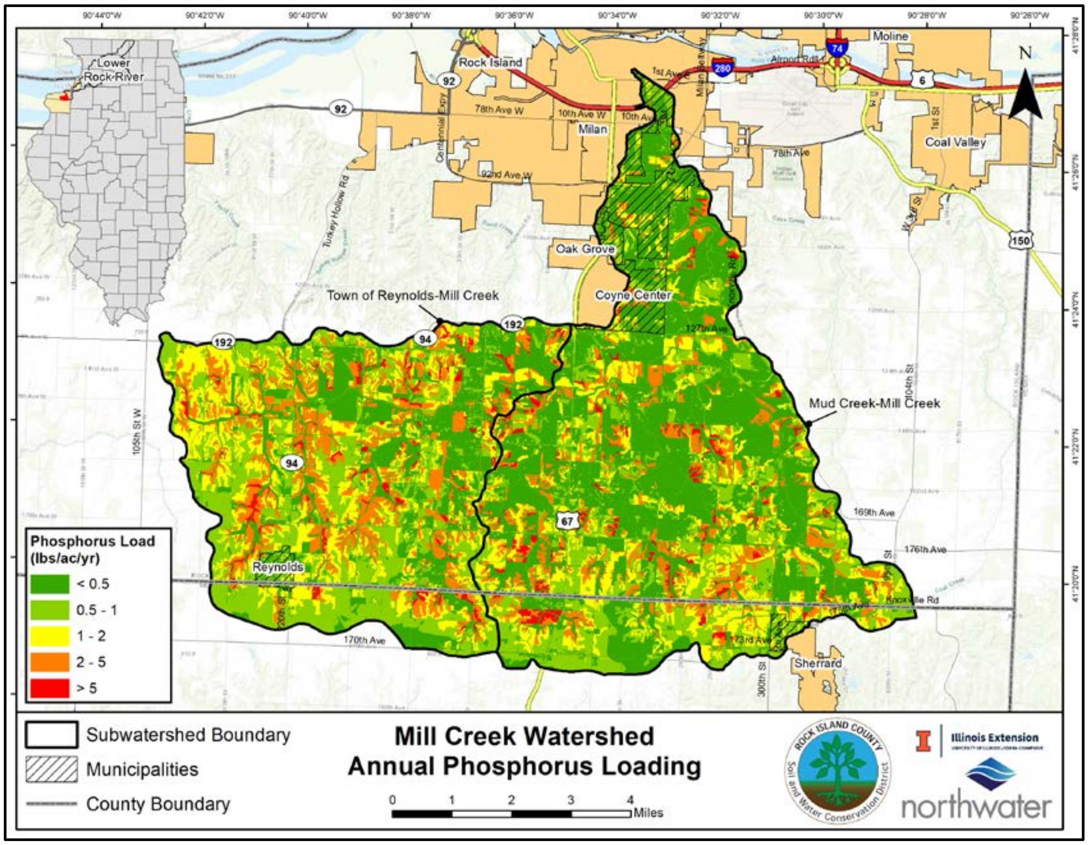


Figure 25 – Annual Phosphorus Loading Per Acre from Direct Surface & Subsurface Runoff

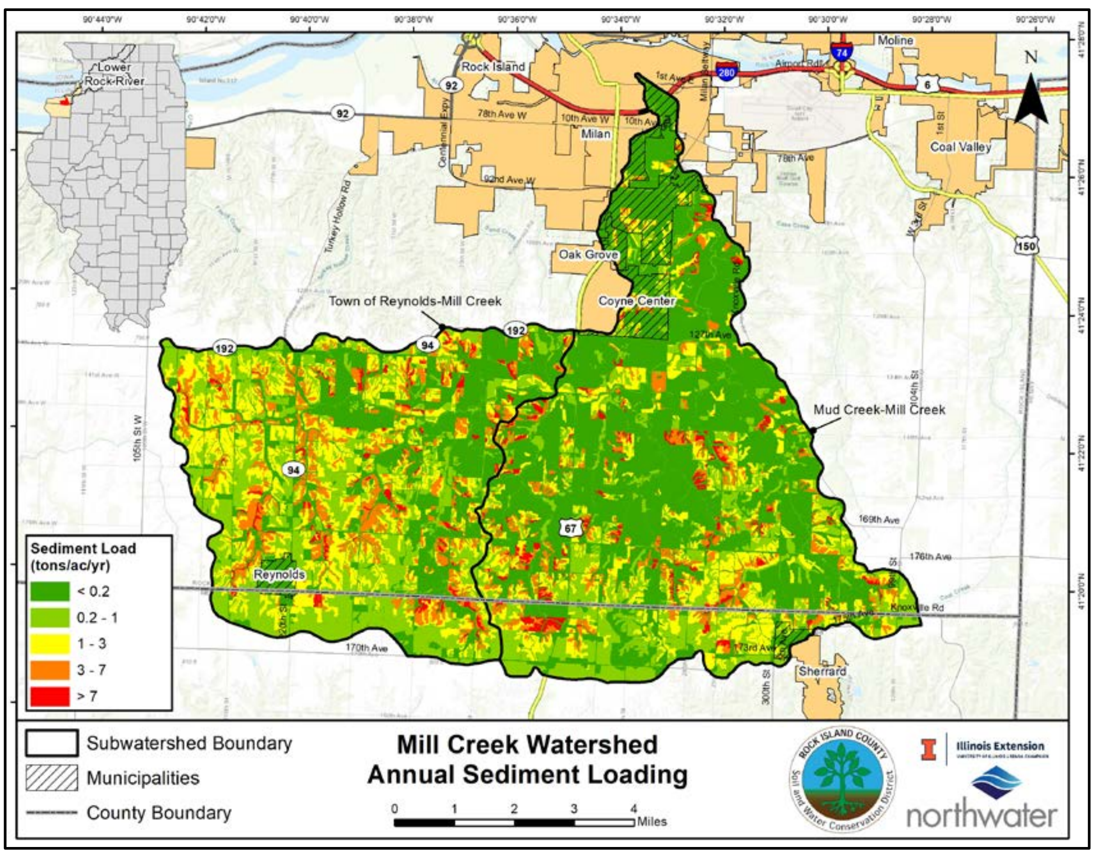


Figure 26 – Annual Sediment Loading Per Acre from Direct Surface Runoff

5.0 Sources of Watershed Impairments

Cropland Surface Erosion

Watershed impairments originate from either NPS or point source pollution. A description of point source pollution is given in Section 3.15. Nonpoint source pollution generally results from land runoff, precipitation, atmospheric deposition, drainage, seepage or hydrologic modification. The term "nonpoint source" is defined to mean any source of water pollution that does not meet the legal definition of "point source." Unlike pollution from point sources like industrial and sewage treatment plants, NPS comes from many diffuse sources and is caused by rainfall or snowmelt moving over and through the ground. The runoff picks up and carries away natural and human-made pollutants, finally depositing them into lakes, rivers, wetlands, coastal waters and ground waters (USEPA, 2018).

In the Mill Creek watershed, sources of sediment are thought to be originating primarily from cropland, streambank and gully erosion. Nutrients are thought to be originating primarily from cropland, non-cropland, streambanks and non-cropland gullies. Permitted point source discharges exist in the watershed however, their contributions are low.

The following section provides pollutant source descriptions identified at the significant subcategory level, along with estimates to the extent they are present. The section looks at the greatest contributions and spatial extent of loading by each major source.

5.1 Nitrogen & Phosphorus

The largest source of nitrogen in the watershed is surface runoff, specifically from cropland. Tile nitrogen is only responsible for 0.5% versus surface runoff from cropland at 76% of the total nitrogen load. The largest source of phosphorus is surface runoff from cropland which is responsible for 63% of the total. An additional 0.1% is believed to be originating from tile flow (Table 39). Other primary sources include surface runoff from non-cropland including pasture, eroding gullies (primarily non-agricultural), and streambank erosion. Septic systems are likely responsible for 3.7% of the total phosphorus.

Table 39 – Primary Nutrient Loading Sources

Pollutant Source	Nitrogen Load (lbs/ac)	Phosphorus Load (lbs/yr)	Nitrogen Load (% total)	Phosphorus Load (% total)
Surface Runoff: Cropland	306,869	37,391	76%	63%
Tile Flow: Cropland	1,959	72	0.5%	0.1%
Surface Runoff: Non-Cropland	62,075	6,583	15%	11%
Gully Erosion: Cropland	859	257	0.2%	0.4%
Gully Erosion: Non-cropland	4,812	2,712	1.2%	4.6%
Streambank Erosion	17,644	9,170	4.4%	15%
NPDES Discharges	2,696	894	0.7%	1.5%
Septic Systems	5,589	2,188	1.4%	3.7%
Grand Total	402,504	59,267	**100%**	**100%**

5.1.1 Cropland

The amount of nutrients originating from cropland depends on a whole host of complex factors and conditions including but not limed to weather, soil chemistry, nutrient application rates and timing, subsurface drainage or tiling, tillage practices, proximity to a receiving waterbody, or the presence or absence of conservation practices. To better understand the extent of nutrient loading from cropland, an analysis was performed on available and known watershed data. This includes an investigation of modeled loading from surface runoff and tile flow, and tillage types.

Nitrogen – a recent spike in the Rock River is a driver of this plan. It is believed that most of the Mill Creek watershed nitrogen load is surface runoff from cropland at 76%, with negligible tile flow at only 0.5%. (Table 39).

Phosphorus – Increased concentrations in a waterbody stimulates algae growth, which can lead to large populations, forming a bloom that can be harmful to water quality and aquatic life. Most of the phosphorus load is likely surface runoff from cropland at 63%.

Tillage

The very small percentage of conventional till has the highest annual yield or per-acre loading of nutrients, followed by reduced-till. Compared to other tillage systems, no-till is responsible for less nutrients per acre but is prevalent in the watershed at 80% of cropland, contributing 77% of the nitrogen and 78% of the phosphorus. Mulch-till covers a relatively large percentage of crop ground and contributes about 17% of the nitrogen and 16% of total phosphorus from cropland (Table 40).

Table 40 – Cropland Nutrient Loading by Tillage Type

Tillage Type	Area (% crop)	Acres	Nitrogen Load (lbs/yr)	Phosphorus Load (lbs/yr)	Nitrogen Load (% crop)	Phosphorus Load (% load)	Nitrogen Load per Acre (lbs/ac/yr)	Phosphorus Load per Acre (lbs/ac/yr)
No-Till	80%	17,175	238,249	29,342	77%	78%	14	1.7
Mulch	12%	2,553	53,133	6,123	17%	16%	21	2.4
Hay[1]	3.4%	730	1,442	271	0.5%	0.7%	2	0.4
Cover Crop[1]	2.6%	572	4,952	504	1.6%	1.3%	8.7	0.9
Reduced-Till	1.3%	283	5,048	509	1.6%	1.4%	18	1.8
Conventional	0.7%	159	4,182	523	1.4%	1.4%	26	3.3
Strip-Till	0.5%	117	1,823	192	0.6%	0.5%	16	1.6
Total	**100%**	**21,590**	**308,829**	**37,462**	**100%**	**100%**	**14**	**1.7**

[1] – not a tillage practice

5.1.2 Non-Cropland Pasture & Livestock Feed Areas

There are 2,538 acres of pasture in the watershed representing 6.3% of total land area. An additional 16 acres of feed areas containing more concentrated numbers of livestock exist. Pasture is believed to be responsible for 5.9% of the total annual nitrogen and 4.6% of the total phosphorus load generated from surface runoff. Per-acre this translates to 9.5 lbs nitrogen and 1.1 lbs phosphorus, primarily a result of proximity to a receiving stream. Although livestock feed areas are found on a small number of acres, it is estimated they yield 16 lbs/ac of nitrogen and 4.5 lbs/ac of phosphorus on average per year.

5.2 Sediment

The primary source of sedimentation in the watershed is cropland sheet and rill erosion, responsible for 70% of the entire sediment load (Table 41). Streambank erosion is also very high at 18% of the total. Other measurable sources include eroding gullies (primarily forest), and surface runoff from non-croplands. Point sources contribute a negligible amount of sediment.

Table 41 – Sediment Loading from all Sources

Pollutant Source	Sediment Load (tons/yr)	Sediment Load (% total)
Surface Runoff: Cropland	45,056	70%
Gully Erosion: Cropland	430	0.7%
Surface Runoff: Non-Cropland	745	1.2%
Gully Erosion: Non-cropland	6,432	10%
Streambank Erosion	11,610	18%
NPDES Discharge	8	0.01%
Grand Total	**64,281**	**100%**

5.2.1 Cropland

The amount of sediment originating from cropland depends on tillage practices, proximity to a receiving waterbody, the presence or absence of conservation practices, and land slope. To better understand the extent, an analysis was performed to investigate the total and per-acre loading by tillage practices and soil HEL/PHEL designation. Results are presented in Table 42 and Table 43.

Tillage

No-till fields contribute 76% of the annual cropland sediment with 80% of the cropland acres. This represents 53% of the total watershed load. Conventional tillage yields the highest per-acre or 5.3 tons/ac/yr. Conventional tillage only accounts for 0.7% of all cropland acres and delivers 1.9% of the sediment originating from farm ground. Reduced-till and mulch-till are also responsible for a relatively high percentage of the sediment load compared to total area. Cover crops are only responsible for 1.1% but cover 2.6% of cropland.

No-Till Corn in the Watershed

Table 42 – Cropland Sediment Loading by Tillage Type

Tillage Type	Area (% crop)	Area (ac)	Sediment Load (tons/yr)	Sediment Load (tons/ac/yr)	Sediment Load (% crop)
No-Till	80%	17,175	34,282	2.0	76%
Mulch	12%	2,553	8,363	3.3	19%
Hay	3.4%	730	234	0.3	0.5%
Cover Crop	2.6%	572	503	0.9	1.1%
Reduced-Till	1.3%	283	621	2.2	1.4%
Conventional	0.7%	159	840	5.3	1.9%
Strip-Till	0.5%	117	214	1.8	0.5%
Total	**100%**	**21,589**	**45,057**	**2.1 (avg)**	**100%**

Cropped HEL Soils

An analysis was performed to better understand the extent of sediment loading from sheet and rill erosion based on HEL and PHEL soils and tillage. Results are presented in Table 43.

Highly erodible and PHEL soils make up 60% of watershed cropland area and account for 37,001 tons or 82% of cropland sediment load and 59% of the entire sediment load. On average, cropped HEL soils deliver sediment at rates 211% higher than non-HEL.

No-till contributes the majority of the annual cropped HEL/PHEL sediment load at 80% followed by mulch-till. Mulch tillage of HEL/PHEL soils yields 4.8 tons/ac/yr. Most cropped HEL/PHEL are being no-tilled and yield 2.7 tons/ac/yr. A sizeable percentage of cover crops/hay, at 7.2%, are responsible for only 1.3% of the total cropland HEL/PHEL sediment load. Reduced, conventional, and strip tillage cover a just under 2% of cropped HEL/PHEL soils and are responsible for 2.3% of the total sediment load. Cover crops planted on HEL/PHEL soils lose far less soil, per acre, on an annual basis.

Table 43 – Cropland Sediment Loading by HEL/PHEL Soils & Tillage Type

Tillage Type	Area (ac)	% Cropped HEL/PHEL	Sediment Load (tons/yr)	Sediment Load (tons/ac/yr)	% Total Cropland Sediment Load
No-Till	10,364	80%	28,261	2.7	63%
Mulch	1,469	11%	7,062	4.8	16%
Hay	546	4.2%	198	0.4	0.4%
Cover Crop	396	3%	396	1	0.9%
Reduced-Till	117	0.9%	381	3.3	0.8%
Conventional	66	0.5%	546	8.3	1.2%
Strip-Till	60	0.5%	157	2.6	0.3%
Total	**13,018**	**100%**	**37,001**	**2.8 (avg)**	**82%**

5.2.2 Gullies & Streambanks

Streambank and gully erosion from non-crop ground are the next most significant sources of sediment.

Streambank Erosion - Streambank erosion delivers almost 18% of the total watershed sediment load or 11,611 tons per year. It is very severe on long stretches of streams in the watershed, especially Mud Creek where a direct assessment indicates a rate of 56 lbs/ft versus 20.5 for the entire watershed.

Gully Erosion – Non-cropland gully erosion which is more prevalent in forested areas delivers 10% of the total sediment and 94% of the entire gully contribution. Gully erosion on crop ground is only responsible for 0.7% of the total watershed load and 6% of all gully erosion. Forested gullies deliver 21 lbs/ft, cropland 6.6 lbs/ft, pasture 29 lbs/ft and all other 17 lbs/ft. Much of the forested and pasture contribution can be attributed to delivery rates as a relatively high percentage are very close to a receiving stream. Contributions from crop ground are relatively low due to low delivery rates and the presence of BMPs that either trap or filter sediment.

6.0 Nonpoint Source Management Measures & Load Reductions

This section details recommended BMPs for the watershed, their quantities and expected annual pollution load reductions. Although reductions presented below include nitrogen, phosphorus and sediment, special attention is given to sediment and nitrogen and should receive priority.

Best Management Practices can be described as a practice or procedure to prevent or reduce water pollution and address stakeholder concerns. They typically include treatment requirements, operating procedures, and practices to control surface runoff and mitigate pollution loading. This section describes all BMPs needed to achieve measurable reductions in nitrogen, phosphorus and sediment.

Expected reductions are calculated using average pollutant reduction efficiency percentages based on the INLRS, existing literature, and local expertise. Ranges of efficiencies used can be found in Table 44 and Table 45. It should be noted that addressing nutrient and sediment loading will take a substantial amount of effort and resources. Water quality improvements will not happen overnight, and time will be needed to realize results. Years of work by watershed landowners, the RISWCD and others have generated many positive water quality benefits. Building off these efforts will help to accelerate improvements.

Table 44 – Pollutant Reduction Efficiency Ranges by BMP for Surface Runoff

BMP	Nitrogen Reduction (%)	Phosphorus Reduction (%)	Sediment Reduction (%)
Cover Crop	30%	30%	40%
Field Border	10%	30 - 40%	38 - 65%
Filter Strip	10%	30 - 45%	35 - 65%
Floodplain Reconnection	15 - 20%	22 - 28%	28 - 32%
Grade Control - Block Chute[1]	1 - 8%	3 - 10%	4 - 12%
Grade Control – Riffles[1]	1 - 3%	4 - 8%	5 - 10%
Grade Control - Rock Checks[1]	2%	4 - 5%	5 - 8%
Grass Conversion - Perennial	90%	80%	90%
Grass Waterway[1]	1 - 30%	4 - 60%	5 - 70%
Livestock Feed Area Treatment	84%	83%	79%
Livestock Fencing	30%	40%	45%
Native Prairie Restoration	90%	80%	90%
Nutrient Management – Deep Placement Phosphorus	0%	20%	0%
Nutrient Management – Spring Application Nitrogen	6%	0%	0%
No-Till	10%	50%	70%
Pond	25 - 38%	40 - 60%	50 - 80%
Sediment Basin	10 - 60%	30 - 80%	35 - 75%
Strip-Till	10%	50%	70%
Terrace	20 - 40%	60%	70%

BMP	Nitrogen Reduction (%)	Phosphorus Reduction (%)	Sediment Reduction (%)
Timber Stand Improvement	5 - 8%	5 - 8%	5 - 8%
Urban Detention Basin	10%	25%	35%
WASCB[1,2]	18%	55%	65%
Wetland	28 - 38%	35 - 45%	45 - 55%
Wetland – Stair-Step	38%	45%	55%
[1] = Controls 100% of gully erosion. [2] = Reduction percentage includes maintenance of existing structures.			

Table 45 – Pollutant Reduction Efficiency Ranges by BMP for Subsurface Runoff

BMP	Nitrogen Reduction (%)	Phosphorus Reduction (%)
Bioreactor	40%	40%
Cover Crop	38%	10%
Floodplain Reconnection	15 - 20%	22 - 28%
Grade Control - Block Chute	1 - 8%	3 - 10%
Grade Control - Riffles	1 - 3%	4 - 8%
Grade Control - Rock Checks	2 - 2%	4 - 5%
Grass Conversion - Perennial	90%	80%
Native Prairie Restoration	90%	80%
Pond[1]	25 - 38%	40 - 60%
Saturated Buffer	55%	25%
Sediment Basin[1]	10 - 60%	30 - 80%
Nutrient Management Split Application Nitrogen	20%	0%
Urban Detention Basin[1]	10%	25%
Wetland[1]	28 - 38%	35 - 45%
Wetland – Stair-Step[1]	38%	45%
[1] = Assumes tile flow is routed through BMP		

6.1 Best Management Practices & Expected Load Reductions

Load reductions were calculated for each recommended BMP using the GIS-based loading model. Where applicable, a drainage area was delineated for each individual practice. Therefore, expected load reductions are spatially explicit and represent delivered pollutants. Agriculture subsections cover structural versus in-field practices. Recommended practices do not include those currently being implemented or in place in the watershed. To meet water quality targets, it is important that these existing practices continue. This is especially true for in-field practices such as no-till and cover crops that may be discontinued as economic conditions change or current funding support drops off.

Table 46 and Table 47 lists all proposed BMPs, quantities, area treated, and expected annual reductions. Locations are shown in Figure 27, Figure 28, and Figure 29. The largest total expected reductions in nitrogen, phosphorus and sediment can be achieved from cover crops, tillage and nutrient management, and a select number of structural practices. Although only feasible at certain locations, streambank stabilization will generate high reductions in sediment. All practices will require willing landowners to implement and large investments by partners. Further information on BMP costs, reductions, critical practices, technical and financial assistance and implementation goals can be found in Sections 7–11.

Table 46 – Recommended BMPs & Load Reduction Summary – Town of Reynolds – Mill Creek

BMP Class	BMP	Quantity	Area Treated (ac)	Nitrogen Reduction (lbs/yr)	Phosphorus Reduction (lbs/yr)	Sediment Reduction (tons/yr)
Town of Reynolds-Mill Creek/ 70900051201						
In-Field Practices	Cover Crop	10,920 (ac)	10,920	47,198	5,706	9,133
	Nutrient Management - Deep Placement Phosphorus	4,712 (ac)	4,712	0	1,859	0
	Nutrient Management – Spring/Split Application Nitrogen	4,058 (ac)	4,058	3,835	0	0
	Strip-Till	272 (ac)	272	599	246	369
	No-Till	1,535 (ac)	1,535	2,632	1,458	2,695
Subwatershed In-field Practices Subtotal			***21,378***	***54,263***	***9,269***	***12,197***
Structural Practices	Bioreactor	2 (locations), 3 (bioreactors)	60	78	0	0
	Field Border	34 (locations), 74 (ac)	725	913	343	511
	Filter Strip	34 (locations), 52 (ac)	1,066	1,971	852	1,523
	Floodplain Reconnection	1 (location), 5 (structures)	2,880	5,837	1,011	1,280
	Grade Control - Block Chute	4 (locations), 4 (structures)	26	20	11	27
	Grade Control - Riffles	3 (locations), 6 (structures)	n/a	86	32	46
	Grade Control - Rock Checks	3 (locations), 14 (structures)	187	81	36	86
	Grass Conversion - Perennial	54 (locations), 92 (ac)	92	1,636	200	285
	Grass Waterway	20 (locations), 28 (ac)	909	2,760	338	591
	Livestock Feed Area Treatment	18 (locations/systems)	14	246	74	4

BMP Class	BMP	Quantity	Area Treated (ac)	Nitrogen Reduction (lbs/yr)	Phosphorus Reduction (lbs/yr)	Sediment Reduction (tons/yr)
	Livestock Fencing	6 (locations), 28,218 (ft. fence), 14 (crossings), 1 (water system)	342	1,209	199	176
	Pond	14 (ponds)	524	2,139	591	703
	Saturated Buffer	2 (locations) 6,600 (ft. tile)	90	169	3	0
	Sediment Basin	8 (locations/basins)	228	307	96	122
	Streambank Stabilization – Stone Toe Protection	20 (locations), 4,193 (ft. STP)	n/a	868	451	571
	Terrace	22 (locations), 35 (terraces), 24,780 (ft. terrace), 9,920 (ft. tile)	259	933	387	597
	Timber Stand Improvement	3 (locations), 116 (ac)	116	13	1.4	0.3
	Urban Detention Basin	1 (location)	63	26	8	3
	WASCB	42 (locations), 109 (basins), 21,920 (ft. tile)	247	1,088	385	562
	Wetland	19 (locations), 27 (ac)	1,515	4,931	764	1,044
Subwatershed Structural Practices Subtotal			***9,343***	***25,310***	***5,782***	***8,134***
Subwatershed Total			**30,839**	**79,573**	**15,051**	**20,331**

Table 47 – Recommended BMPs & Load Reduction Summary – Mud Creek – Mill Creek & Watershed Total

BMP Class	BMP	Quantity	Area Treated (ac)	Nitrogen Reduction (lbs/yr)	Phosphorus Reduction (lbs/yr)	Sediment Reduction (tons/yr)
Mud Creek - Mill Creek HUC 070900051202						
In-Field Practices	Cover Crop	9,225 (ac)	9,225	41,267	4,979	8,044
	Nutrient Management - Deep Placement Phosphorus	3,123 (ac)	3,123	0	1,475	0
	Nutrient Management – Spring/Split Application Nitrogen	2,775 (ac)	2,775	3,138	0	0
	Strip-Till	1,074 (ac)	1,074	2,009	931	1,544
	No-Till	2,143 (ac)	2,143	4,274	2,468	4,693

BMP Class	BMP	Quantity	Area Treated (ac)	Nitrogen Reduction (lbs/yr)	Phosphorus Reduction (lbs/yr)	Sediment Reduction (tons/yr)
Subwatershed In-field Practices Subtotal			***18,438***	***50,689***	***9,853***	***14,281***
Structural Practices	Field Border	19 (locations), 52 (ac)	541	724	304	508
	Filter Strip	14 (locations), 17 (ac)	192	495	208	367
	Floodplain Reconnection	1 (location), 4 (structures)	2,761	4,329	798	1,197
	Grade Control - Block Chute	6 (locations), 10 (structures)	104	277	65	160
	Grade Control - Riffles	4 (locations), 18 (structures)	154	302	120	191
	Grade Control - Rock Checks	3 (locations), 11 (structures)	22	46	29	78
	Grass Conversion - Perennial	77 (locations), 174 (ac)	180	3,159	402	602
	Grass Waterway	3 (locations), 4 (ac)	173	526	66	100
	Livestock Feed Area Treatment	21 (locations/systems)	15	199	58	2
	Livestock Fencing	9 (locations), 40,492 (ft. fence) 16 (crossings)	421	1,416	228	170
	Native Prairie Restoration	3 (locations), 6 (ac)	6	6	1	0.03
	Pond	48 (ponds)	2,443	8,787	2,114	3,207
	Sediment Basin	10 (locations/basins)	108	222	79	121
	Streambank Stabilization – Stone Toe Protection	37 (locations), 8,653 (ft. STP)	n/a	2,014	1,047	1,324
	Terrace	9 (locations), 18 (terraces), 13,520 (ft. terrace), 5,730 (ft. tile)	109	545	238	399
	Timber Stand Improvement	2 (locations), 66 (ac)	66	8.6	0.8	0.1
	WASCB	32 (locations), 75 (structures), 14,786 (ft. tile)	166	592	206	302
	Wetland	21 (locations), 34 (ac)	82,481	6,380	992	1,307
	Wetland - Stair Step	1 (location), 3 (ac)	146	609	93	134
Subwatershed Structural Practice Subtotal			***90,087***	***30,636***	***7,048***	***10,169***
Subwatershed Total			**108,426**	**81,326**	**16,902**	**24,450**
Watershed Grand Total			**139,265**	**160,899**	**31,953**	**44,781**

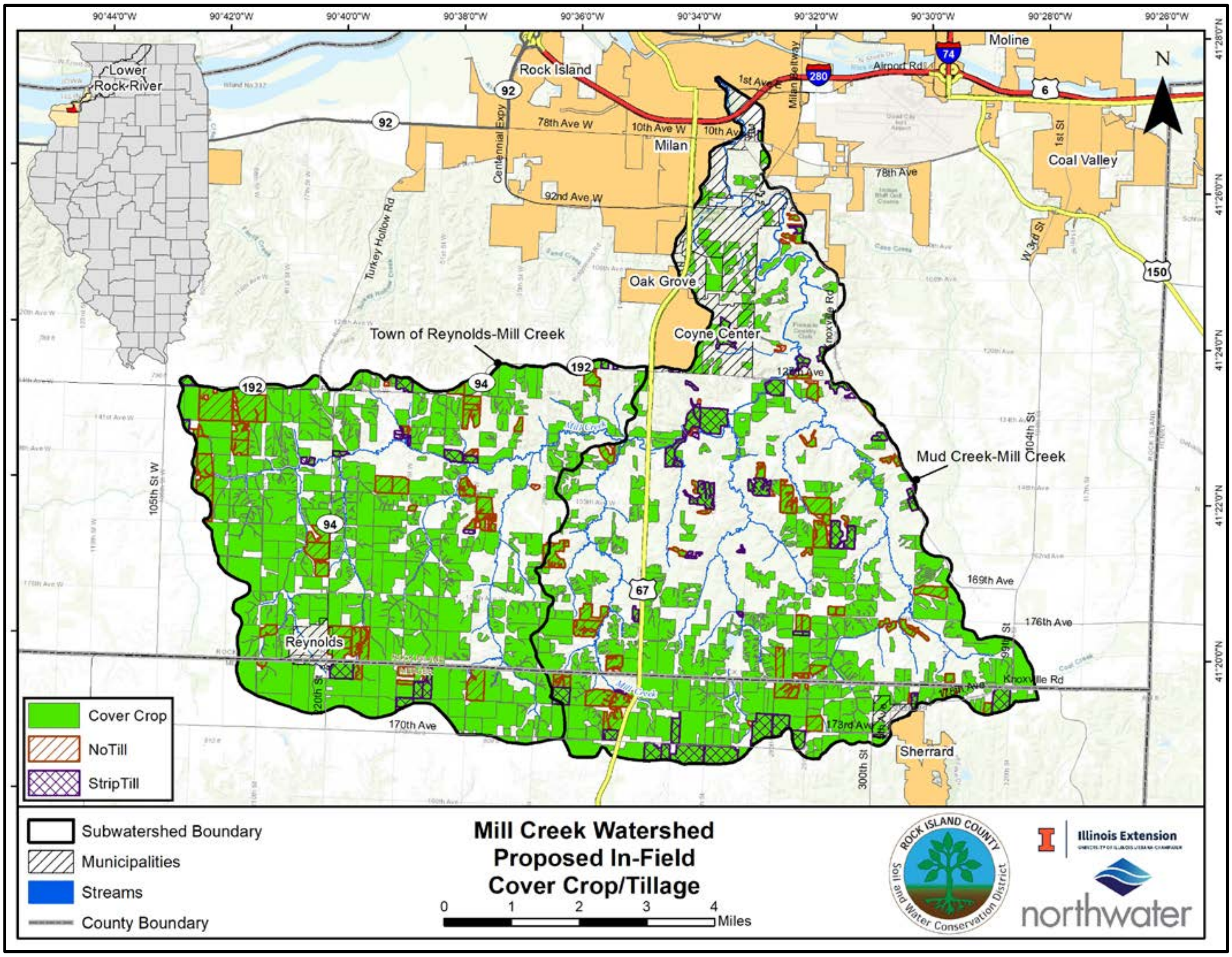


Figure 27 – Proposed BMPs – In-Field Cover Crop/Tillage

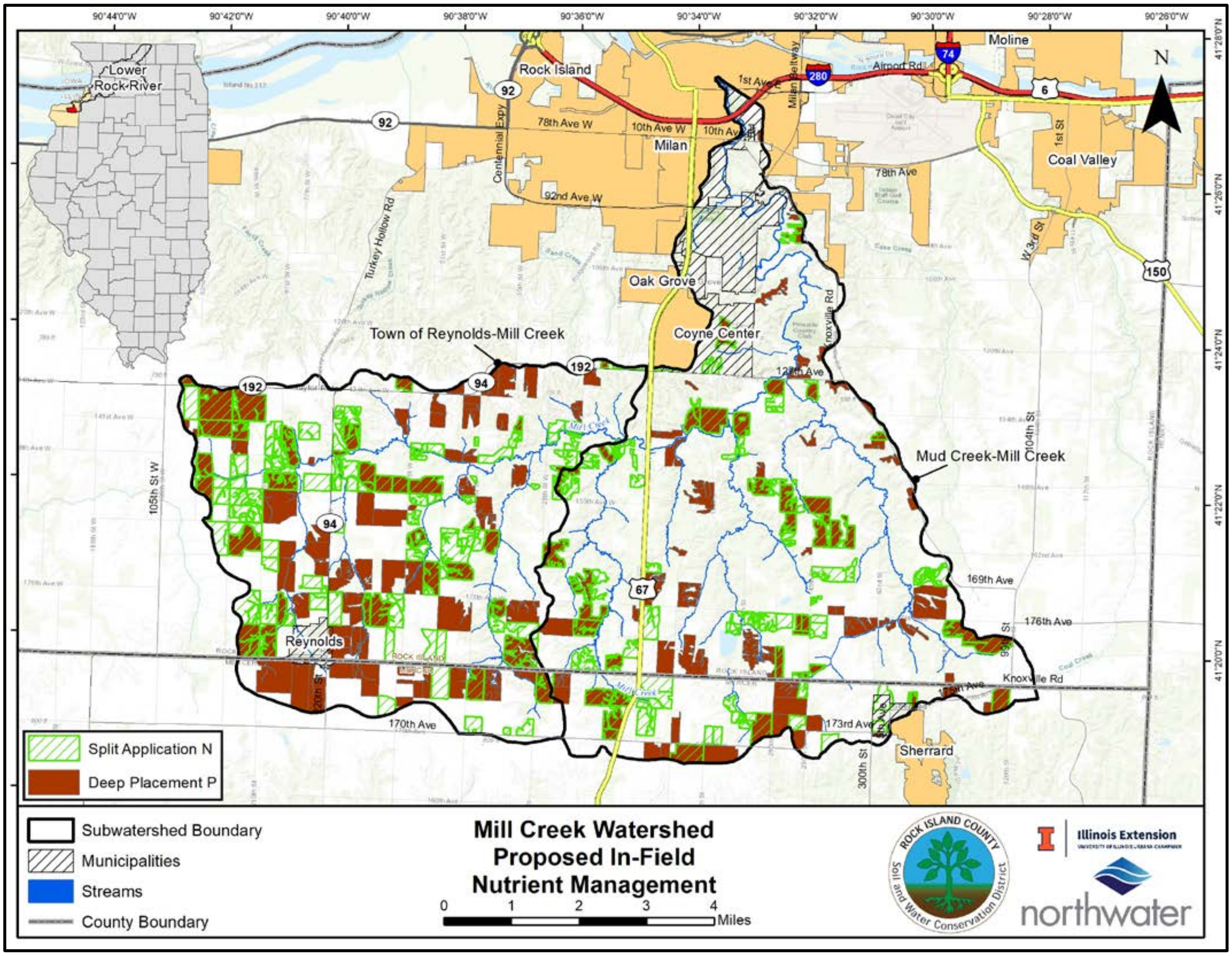


Figure 28 – Proposed BMPs - In-Field Nutrient Management

Cover Crop and Waterway in the Watershed

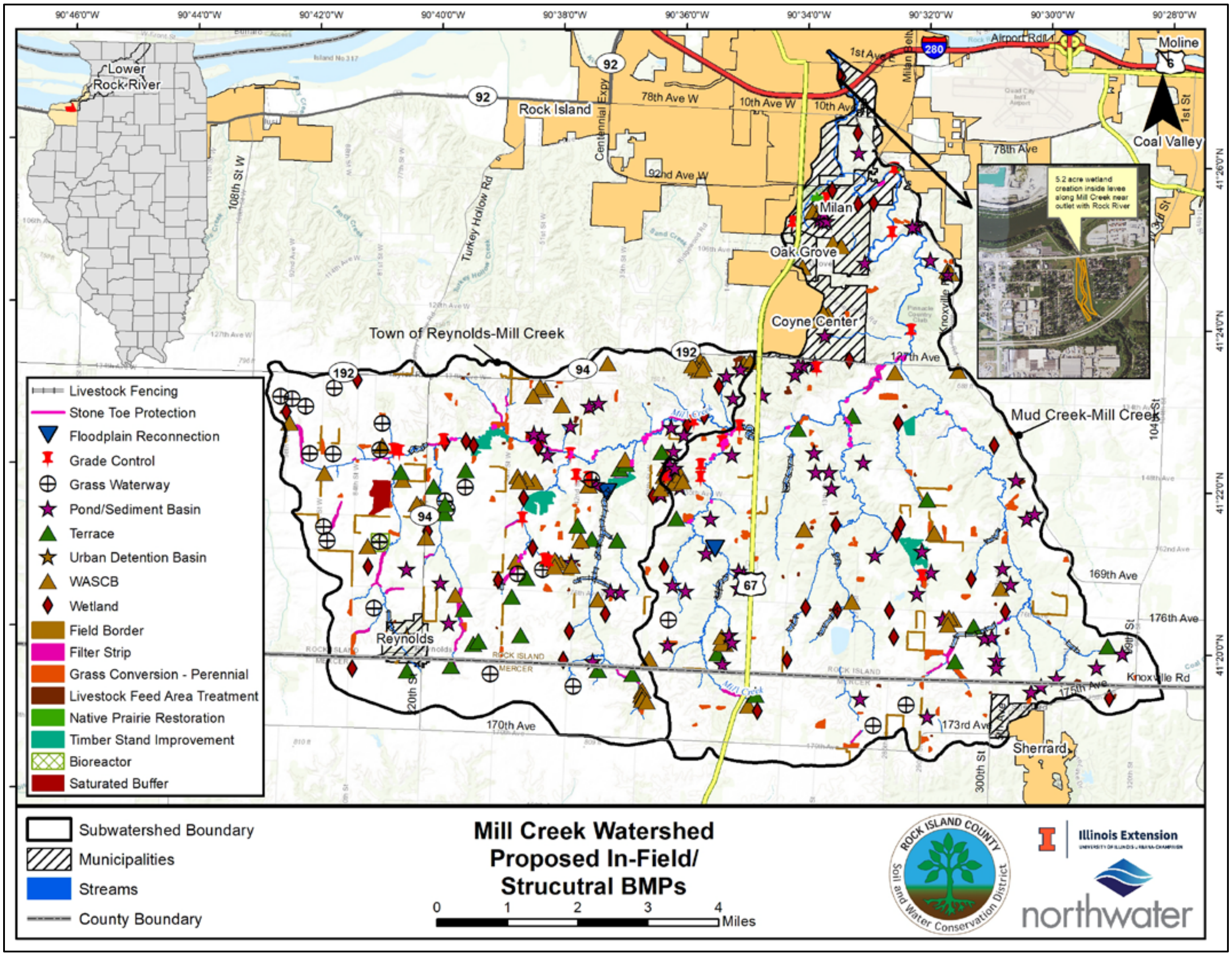


Figure 29 – Proposed Structural BMPs

6.1.1 Agricultural - In-Field BMP Summary

In-field management measures are critical to achieving water quality targets. These measures focus on nutrient and sediment loading coming from cropland. As noted in previous sections, cropland is the primary contributor of sediment and nutrients.

Cover Crops

A cover crop is a temporary vegetative cover that is grown to provide protection for the soil and improve soil conditions. Cover crops can be applied over a broad area in the watershed and are key to addressing nitrogen and sediment. There are many different types of cover crop, some species that terminate in the winter such as oats and others that are terminated in the spring using herbicide or mechanical methods such as cereal rye. All fields greater than 5 acres not currently in cover crops were selected and are proposed for 745 fields or 20,126 acres. If all acres are planted to cereal rye, the following annual load reductions are expected:

- 88,465 lbs nitrogen
- 10,685 lbs phosphorus
- 17,177 tons sediment

No-Till or Strip-Till

No-Till: corn residue

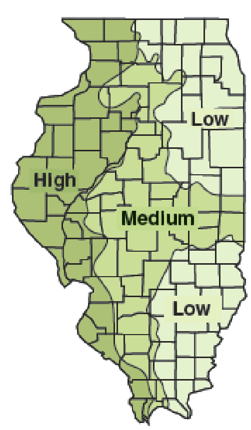
No-till can be defined as farming where the soil is left relatively undisturbed from harvest to planting. During the planting operation, a narrow seedbed is prepared, or holes are drilled in which seeds are planted. A switch from conventional tillage to no-till is often a prerequisite for the installation of cover crops. Strip-till is a good alternative to no-till, especially for those producers that are not willing to move to no-till and on flat ground. Strip-till is a minimum tillage system that combines the soil drying and warming benefits of conventional tillage with the soil-protecting advantages of no-till by disturbing only the portion of the soil that is to contain the seed row.

Although no-till is practiced on 80% of all fields in the watershed, it is proposed for those where conventional, reduced or mulch tillage is employed. Strip-till is proposed for fields greater than 5 acres in size and with low average slopes. A total of 200 fields are recommended for no-till covering 3,678 acres and 75 for strip-till covering 1,346 acres. If all acres are treated, the following annual reductions are expected:

- 9,514 lbs nitrogen
- 5,103 lbs phosphorus
- 9,301 tons sediment

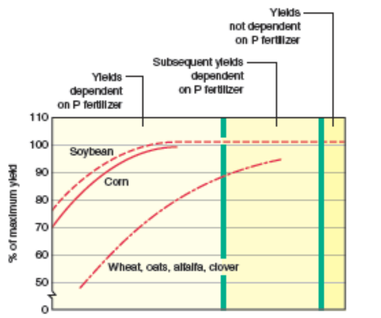
Nutrient Management

Nutrient management is the practice of using nutrients essential for plant growth such as nitrogen and phosphorus fertilizers in proper quantities and at appropriate times for optimal economic and environmental benefits. Nutrient management is a non-structural practice that can be applied to all fields in the watershed, primarily to address nitrogen; it is well-suited to the flat topography and productive nature of soils in the watershed although, if a field is being farmed, nutrient management should be practiced regardless of these factors. The nutrient management system now being promoted by the Illinois Council on Best Management Practices (ICBMP) utilizes the approach commonly called the “4Rs”:



- Right Source: Matches fertilizer type to crop needs.
- Right Rate: Matches amount of fertilizer to crop needs.
- Right Time: Makes nutrients available when crops need them.
- Right Place: Keeps nutrients where crops can use them.

Promoting smart soil testing is also important as the spatial variability of available nutrients in a field makes soil sampling the most common and greatest source of error in a soil test (University of Illinois, 2012). Proper soil testing is the foundation of good nutrient management as it relates to phosphorus.



P test (lb/A) for different subsoil phosphorus-supplying power regions

High	7	15	20	40	60
Medium	10	20	30	45	65
Low	20	30	38	50	70

As described in the Chapter 8 of the Illinois Agronomy Handbook, regional differences in P-supplying power shown in the adjacent figure were broadly defined primarily by parent material and degree of weathering factors. Within a region, variability in parent material, degree of weathering, native vegetation, and natural drainage cause differences in the soil's P-supplying power. For example, soils developed under forest cover appear to have more available subsoil P than those developed under grass.

Minimum soil test levels required to produce optimal crop yields vary depending on the crop to be grown and the soil's P-supplying power (see adjacent figure). Near maximal yields of corn and soybeans are obtained when levels of available P are maintained at 30, 40, and 45 lbs/ac for soils in the high, medium, and low P-supplying regions, respectively. Since these are minimal values, to ensure soil P availability will not restrict crop yield, it is recommended that soil test results be built up to 40, 45, and 50 lbs/ac for soils in the high, medium, and low P-supplying regions, respectively. This is a practical approach because P is not easily lost from the soil, other than through crop removal or soil erosion.

Several methods described in Chapter 8 of the Illinois Agronomy Handbook can be used to manage crop nutrient loss: variable rate technology (VRT) and deep fertilizer placement. Variable rate technology can improve the efficacy of fertilization and promote more environmentally sound placement compared to single-rate applications derived from the conventional practice of collecting a composite soil sample to represent a large area of the field. Research has shown that this technology often reduces the amount of fertilizer applied over an entire field. However, one of the drawbacks of this placement method is the expense associated with these technologies. Also, VRT can only be as accurate as the soil test information used to guide the application rate (University of Illinois 2012).

Shifting the fall application of nitrogen fertilizer to applications in the spring can reduce tile nitrate losses by 20% (David, 2018) and 6% for surface runoff (Iowa State, 2017). Split applying nitrogen involves two or more fertilizer applications during the growing season rather than providing all of the crop's nitrogen requirements with a single treatment. This makes nutrient uptake more efficient and reduces the risk of denitrification, leaching or volatilization.

The MRTN calculator provides a method to calculate optimum nitrogen application and to find the maximum return to nitrogen or MRTN at selected prices of nitrogen and corn directly from recent research data. The MRTN approach is the regional approach suggested for developing corn nitrogen rate guidelines in individual states. Nitrogen rate trial data is provided for six states (Illinois, Iowa, Michigan, Minnesota, Ohio, and Wisconsin) where an adequate number of research trials (sites) were available for corn following soybean and corn following corn. These trials were conducted with spring, sidedress, or split preplant/sidedress applied, and sites not irrigated (IFCA, 2022).

Deep fertilizer placement is where any combination of nitrogen, phosphorus, and potassium can be injected at a depth of 4 to 8 inches. Subsurface applications may be beneficial (if the subsurface band application does not create a channel for water and soil movement) is when the potential for surface water runoff is high (University of Illinois, 2012).

Deep Placement – P Fertilizer

All fields where no-till is recommended and loading is high were selected for the deep placement of phosphorus fertilizer. If applied to all 220 fields or 3,678 acres, expected annual load reductions are:

- 3,334 lbs phosphorus

Spring/Split Application – Nitrogen Fertilizer

Fields without a known nutrient management plan, those that are tiled and where fall application was observed were selected for split application of nitrogen fertilizer. If applied to all 316 fields or 7,834 acres expected annual load reductions are:

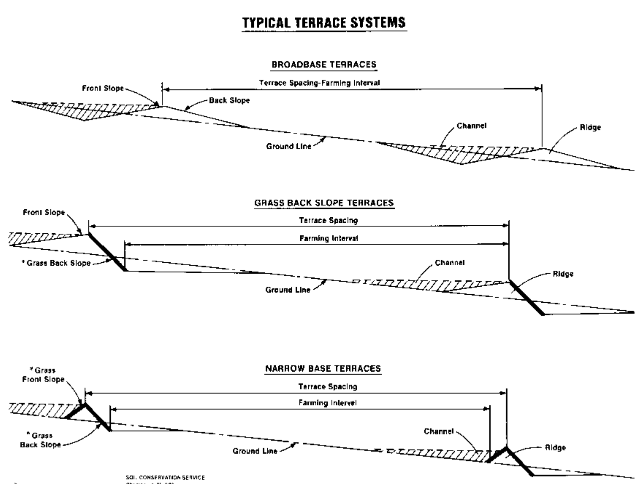
- 6,973 lbs nitrogen

6.1.2 Structural BMP Summary

This section provides a brief description of each structural BMP and their expected load reductions. Practices are primarily for agricultural areas but do include locations in urban and forested areas. For example, several practices are recommended in Milan and where landowners have expressed interest in forest management or poor timber conditions were observed.

Water and Sediment Control Basins (WASCB) / Terraces / Sediment Basins

These practices are earth embankments constructed across a drainage channel or along contours of a slope to intercept runoff water and trap soil. WASCBs are often constructed to mitigate gully erosion where concentrated flow is occurring and where drainage areas are relatively small. Multiple basins are often placed along a flow line or at each site depending on drainage area and cropping systems. Similar to a WASCB, a sediment basin will treat a large drainage area. A terrace is also similar to a WASCB but designed to follow contours of a slope where concentrated flow lines are less defined. Locations to apply these practices are widespread in the watershed.



NRCS Detail – Terrace/WASCB

WASCBs are recommended at 74 locations, for a total of 184 individual basins and 27,600 feet (150-foot average per WASCB). Terraces are recommended at 31 locations or 38,300 ft of terrace. Eighteen large sediment basins are also recommended. If all practices are installed, a total of 1,117 acres will be treated. Expected annual load reductions (including gully stabilization) will total:

- 3,687 lbs nitrogen

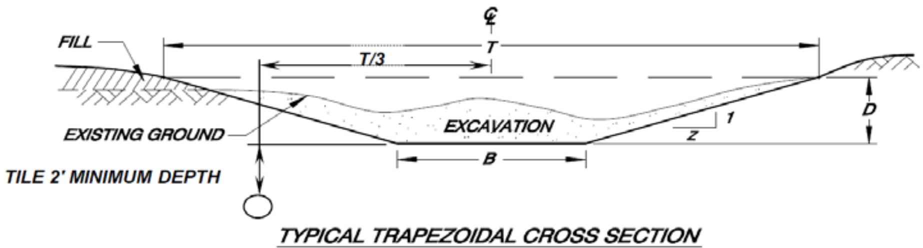
- 1,391 lbs phosphorus
- 2,103 tons sediment

Grassed Waterways

A grass waterway is a grassed strip in a field that acts as an outlet for water to control silt, filter nutrients and limit gully formation. Grassed waterways are applicable in areas with very large drainage areas and low-moderate slopes. These practices are already popular in the watershed.

New and maintenance of existing grassed waterways are recommended at 23 locations, for a total of 32 acres. If all are installed or maintained, a total of 1,082 acres will be treated. Expected annual load reductions (including gully stabilization) are:

- 3,286 lbs nitrogen
- 404 lbs phosphorus
- 691 tons sediment



NRCS Grassed Waterway Detail

Constructed Wetlands/Wetland Restoration

A constructed wetland is a shallow water area built by creating an earth embankment or excavation area. Constructed wetlands can include a water control structure and are designed to mimic natural hydrology, store sediment and filter nutrients. Wetland restoration on the other hand aims to improve existing structures or features by expanding their footprint. Wetlands have been identified in areas where soils support their establishment, where local topography does not allow for the construction of a pond, and where no substantial area of cropland is needed to be removed from production. Local watershed studies have shown that wetlands are reasonably efficient at treating nitrogen, especially from tile flow.

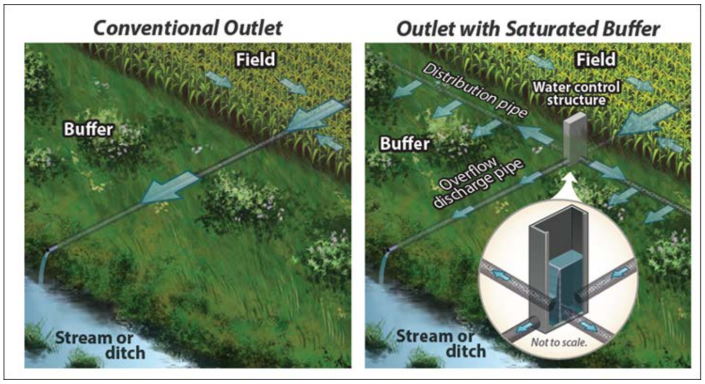
Wetlands are important practices in the watershed and will improve water quality. They are recommended at 41 locations, for a total of 64 acres. Of the total, "stair-step" wetlands or those with more than one in series are recommended at 1 location or 3 acres. If all are implemented, they will treat 84,142 acres. Expected load reductions (including gully and streambank stabilization) are:

Constructed Wetland

- 11,920 lbs nitrogen
- 1,849 lbs phosphorus
- 2,485 tons sediment

One proposed project includes 5.2 acres within the Milan levee near the confluence of Mill Creek and the Rock River and consists of excavation of a series of wetlands up to 4 feet deep to trap and filter floodwater. A map inset in presented in Figure 29.

Saturated Buffers



Saturated Buffer - *Credit: USDA*

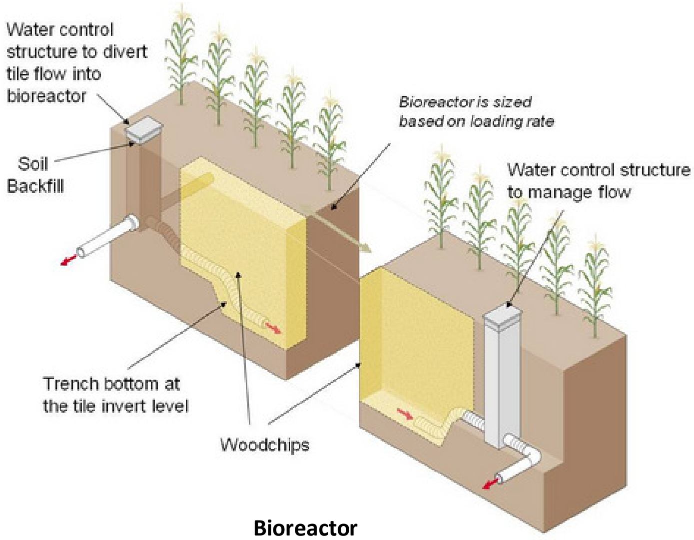
A saturated buffer is a BMP in which drainage water is diverted as shallow groundwater flow through a grass buffer specifically for nitrate removal. These systems can treat approximately 40 acres and consists of a control structure for diversion of drainage water from the outlet to lateral distribution lines that runs parallel to the buffer. Tiled areas adjacent to a stable stream segment or existing grass buffer where adequate slope and ideal soil characteristics are likely to exist were chosen. The potential for saturated buffers is limited in the watershed due to the low percentage of tiled crop ground. Saturated buffers only treat subsurface flow.

A total of 2 systems or sites and approximately 6,600 ft of tile are recommended, one system requiring installation of a filter strip. If installed 90 acres will be treated. Annual expected load reductions if both sites are implemented total:

- 169 lbs nitrogen
- 3 lbs phosphorus

Denitrifying Bioreactor

A denitrifying bioreactor is a structure containing a carbon source, usually woodchips, installed to reduce the concentration of nitrate nitrogen in subsurface agricultural drainage flow via enhanced denitrification. One bioreactor system can treat up to 50 acres, with 25 acres used in Mill Creek. Locations were identified by direct observation during the watershed windshield survey and by interpretation of aerial imagery and soils.



Bioreactor

Three bioreactors at 2 locations, can likely be applied effectively and will treat 60 acres. Annual load reductions expected if all are implemented total:

- 2,788 lbs nitrogen
- 8.4 lbs phosphorus

Filter Strips, Field Borders, & Conservation Cover or Grass Conversion

A filter strip is a band of grass or other permanent vegetation used to reduce sediment, nutrients, pesticides, and other contaminants. Only those areas directly adjacent to an openly flowing ditch or stream where existing buffer areas are either inadequate or nonexistent were selected for the placement of filter strips. Field borders are like filter strips but are located along field edges or adjacent to timbered areas; they can range in width from 30 – 120 feet. Grass conversion or conservation cover plantings consist of removing land from production and planting native perennial vegetation.

Field Border

Field borders are recommended at 53 locations for a total of 126 acres. If all borders are planted, they will treat 1,266 acres. Expected annual load reductions (including gully stabilization) are:

- 1,637 lbs nitrogen
- 647 lbs phosphorus
- 1,019 tons sediment

Filter strips are recommended at 48 locations for a total of 69 acres. If all strips are planted, they will treat 1,258 acres. Expected annual load reductions (including gully stabilization) are:

- 2,469 lbs nitrogen
- 1,060 lbs phosphorus
- 1,890 tons sediment

Grass Conversion or conservation cover planting to perennial grass is recommended at 131 locations totaling 266 acres of planting. If all are planted, expected annual load reductions (including gully stabilization) are:

- 4,975 lbs nitrogen
- 602 lbs phosphorus
- 887 tons sediment

Filter Strip

Grade Control Structures

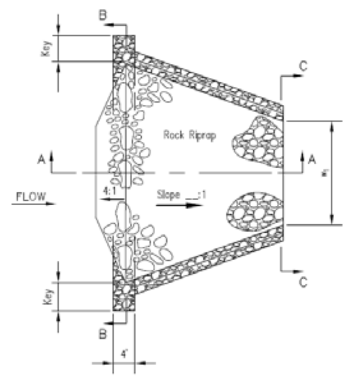
A grade control structure consists of a constructed berm, a rock check/riffle or modular block chute structure designed to address gully erosion and control vertical downcutting. Grade control structures are recommended at locations where slopes are very steep and gully erosion is considered very severe; areas where other practices are just not feasible. Block chutes are recommended primarily at the outlet of waterways or short ditch cuts immediately adjacent to streams. Rock riffles are proposed at locations where grade control is required, and rock checks are likely inadequate

Rock Chute

Grade control structures are recommended at 23 locations for a total of 14 block chutes, 24 riffles, and 25 rock checks. If all are installed, they will treat a total of 493 acres. Expected annual load reductions (including gully stabilization) are:

- 812 lbs nitrogen
- 293 lbs phosphorus
- 588 tons sediment

Riffle



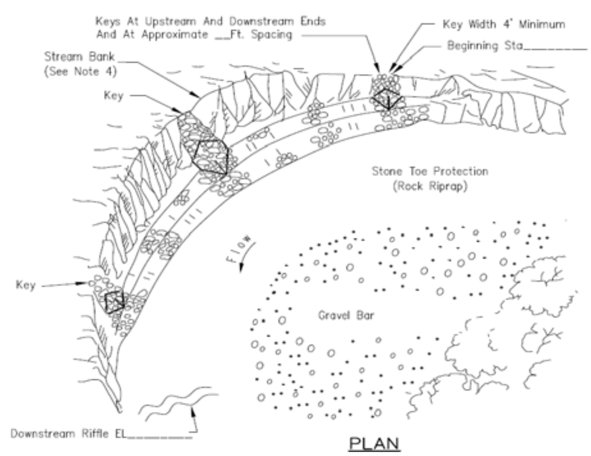
NRCS Riffle Detail

Streambank Stabilization: Stone-Toe Protection

Streambank stabilization consists of the placement of rock riffles and the installation of stone-toe protection (STP) to stabilize eroding streambanks and control stream grade, if necessary. Stream channel incision or deepening can lead to bank erosion and, oftentimes, grade control or rock riffles are needed in combination with STP however this is not the case in the Mill Creek watershed where only STP is recommended. A total of 12,846 ft of is proposed at 57 locations. Locations were selected based on sediment load, accessibility and cost effectiveness.

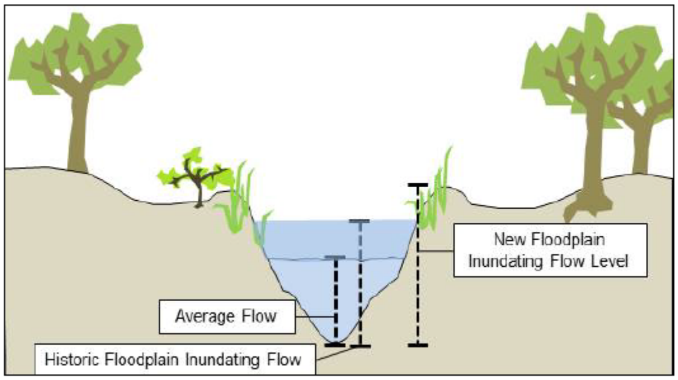
If all sites are addressed, annual expected load reductions are:

- 2,882 lbs nitrogen
- 1,498 lbs phosphorus
- 1,895 tons sediment



NRCS STP Detail

Floodplain Reconnection



Vertically Disconnected Floodplain

Source: American Rivers

Reconnecting rivers with their historical floodplains focus on installing grade control measures to raise a stream's bed elevation. The river will re-establish its natural course over time, eventually reconnecting it to its historical floodplain, or creating a new one. Doing this increases the river's channel capacity for floodwater, resulting in shallower water moving at a reduced speed, reducing the risk of erosion and flooding. Denitrification occurs within these floodplain wetlands, reducing nitrogen loads in downstream waterbodies, increasing water quality. (UNEP-DHI Partnership, 2017). Each recommended location includes wetland restoration in the floodplain.

Reconnecting to the floodplain is recommended at 2 locations utilizing 9 large grade control structures and wetland restoration. If all are installed 5,641 acres will be treated, resulting in expected load reductions of:

- 10,166 lbs/yr nitrogen
- 1,809 lbs/yr phosphorus
- 2,477 tons/yr sediment

Ponds

A pond is water impoundment made by constructing an earthen dam. A sediment basin is similar but designed to trap sediment and only hold water for a limited period. A total of 62 ponds are recommended to treat 2,967 acres. These structures will trap sediment and nutrients from runoff and will control gully erosion in steep forested draws.

If all ponds are installed, annual expected load reductions (including gully stabilization) are:

- 10,926 lbs nitrogen
- 3,798 lbs phosphorus
- 3,910 tons sediment

Pond

Pasture Management & Stream Fencing

Pasture management consists of stream fencing to exclude livestock from the stream, appropriate stream crossings for cattle use and an alternate water supply (if needed). Stream fencing is placed back from the stream edge to allow for a vegetated buffer to filter runoff.

Stream Fencing

Stream fencing is recommended at 15 pasture locations. Most locations include stream crossings and one includes a water system. A total of 68,710 ft of fence is recommended.

If each system is installed, 763 acres would be treated. Expected annual load reductions are:

- 2,625 lbs nitrogen
- 427 lbs phosphorus
- 346 tons sediment

Livestock Feed Area Treatment System

Once a site has been identified in the watershed, an integrated system can be constructed to manage livestock waste. The feed area system includes four individual practices working in series; a diversion (if needed), a settling basin to capture solids, a rock spreader and vegetated swale for initial waste treatment and, finally, a treatment wetland to capture and treat the remaining waste.

Waste Containment Area

Thirty-nine systems are recommended to treat 29 acres as some feed areas require more than one system due to drainage considerations. If these systems are implemented, the following annual load reductions are expected:

- 4,452 lbs nitrogen
- 132 lbs phosphorus
- 6 tons sediment

6.1.3 Urban BMPs & Habitat Improvements

Urban BMPs are those specific to residential areas. This includes native prairie restoration, detention basins, and septic systems. Timber stand improvement is also recommended throughout the watershed.

Urban Detention

Naturalized detention basins are designed to provide greater water quality and habitat benefits relative to standard dry-bottom (turfgrass) detention basins. They are stormwater control facilities that are planted with native vegetation to help improve stormwater quality. Selective dredging is recommended to remove a source of nutrients and increase storage capacity in one basin.

One is recommended to treat 63 acres. If implemented, annual expected load reductions are: 26 lbs nitrogen, 8 lbs phosphorus, and 3 tons sediment.

Naturalized Detention Basin

Native Prairie Restoration

Prairie restoration can help to filter sediment and nutrients more efficiently, provide habitat where little exists and is aesthetically pleasing. Prairie restoration has been identified in the Village of Milan. A total of 6 acres at 3 locations are proposed. Annual load reductions expected are:

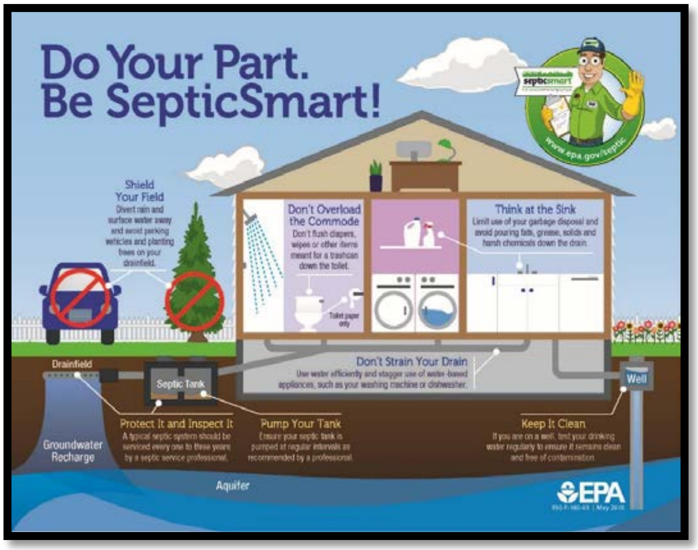
- 6 lbs nitrogen
- 1 lbs phosphorus
- 0.03 tons sediment

Timber Stand Improvement

Timber Stand Improvement or TSI involves actions the function and value of forests. Such activities include invasive species removal, selective harvesting to improve health and promote growth of desirable species, prescribed fire, and planting. A total of 182 acres of TSI are recommended at 5 sites, although more is likely needed. Modest annual load reductions are expected: 22 lbs nitrogen, 2.2 lbs phosphorus, and 0.4 tons sediment.

Floodplain Forest

Septic Systems



Septic Smart Brochure: *Credit: EPA*

Failing septic systems are likely a source of nutrients to waterbodies. It is not known which specific ones are failing and therefore actions taken to address them should focus on education programs for systems outside of sewered limits. The EPA for example has implemented a SepticSmart program (https://www.epa.gov/septic) consisting of tips for maintenance and educational materials that can be distributed or promoted to those homes in the watershed that are not on sewers. Reducing the number of failing systems will benefit water quality however the cost of connecting all residences to a sewer network far outweighs the water quality benefits.

7.0 Cost Estimates

Practice costs were calculated based on professional judgment and expertise, cost-share rates developed by the NRCS and SWCD, and unit costs used in other watershed plans. Many of the estimates are based on field visits and known quantities for a given practice. Costs should be considered as estimates only and revisited during implementation, as required. Totals can include costs for some level of planning and/or engineering as well as a contingency for future increases. Maintenance and land acquisition costs are not included.

7.1 Unit Costs

Unit estimates and assumptions are presented in the following table:

Table 48 - Unit Costs & Assumptions

BMP	Unit Cost	Unit	Notes/Assumptions
Bioreactor	$9,500	each	Estimated $63.67 per cubic yard to install, including labor and materials. Based on a surface area of 20' x 50' and a 4' depth, the cost is $9,423.16 for a system sized to treat 50 acres.
Cover Crop	$63.74	acre	Based on USDA-NRCS rates. Assumes 1 year of cereal rye including spring termination.
Field Border	$475	acre	Based on USDA-NRCS rates for native species with forgone income. Costs include land preparation, materials and seeding. Estimates do not include any reoccurring annual rental payments or land acquisition.

BMP	Unit Cost	Unit	Notes/Assumptions
Filter Strip	$508	acre	Based on USDA-NRCS rates for native species with forgone income. Costs include land preparation, materials and seeding. Estimates do not include any reoccurring annual rental payments or land acquisition.
Grass Conversion Including Perennial Grasses	$585	acre	Based on USDA-NRCS rates for Critical Area Planting. Includes land prep and seeding. Estimates do not include any annual rental payments or land acquisition costs.
Timber Stand Improvement	$700	acre	Based on professional judgement. Includes manual invasive species removal, and prescribed fire.
Native Prairie Restoration	$920	acre	Costs include land preparation, materials and seeding. Estimates do not include any annual rental payments or land acquisition costs.
Grade Control Structure - Block Chute	$10,600	each	Based on professional judgement and USDA-NRCS rates and assumes rock or earth berm structure. Assumes 35' x 35' area.
Grade control structure – Riffles, Small Stream/Gully	$3,417	each	Based on professional judgement and USDA-NRCS rates for “small” riffles.
Grade Control Structure - Rock Check	$3,020	each	Assumes 32 yd^3, based on USDA-NRCS cost share prices.
Grass Waterway	$4,200	acre	Based on USDA-NRCS rates for shaping and seeding.
Grass Waterway	$4.82	foot	Based on USDA-NRCS rates for waterway tile. Maintenance of existing waterways does not include tile.
Livestock Waste or Feed Area Treatment System	$69,000	each	Based on professional judgement. Includes basins, diversions (if needed) and seeding.
No-till/Strip-Till	$16.41	acre	Based on USDA-NRCS rates per acre for 1 year.
Nutrient Management – Deep placement P	$62.76	acre	Includes soil testing. Based on USDA-NRCS rates per acre for 1 year.
Nutrient Management – Split Application	$18.40	acre	Based on USDA-NRCS rates per acre for 1 year including soil testing.
Nutrient Management Plan	$10	acre	Based on USDA-NRCS rates up to a maximum of $1,200.
Pasture Stream Crossing	5,880	each	Based on professional judgement and USDA-NRCS rates. 30’ x 50’ ft.
Pasture Stream Fencing	$1.96	foot	Based on USDA-NRCS rates.
Pasture Watering System	$50,000	each	Based on professional judgement and includes a source of water (well) and watering infrastructure.
Pond	$57,500	each	Based on professional judgement and average 10,000 yd^3 soil. Cost can range depending on the size of the berm and primary spillway pipe, the extent of clearing needed, and size of rock at outfall structures.
Saturated Buffer	$7.60	foot	Based on USDA-NRCS rates.
Sediment Basin	$14,375	each	Based on NRCS rates of $5.75 per yd^3 and 2500 yd^3.
Streambed Stabilization - Riffle, Medium to Large Stream	$7,000	each	Based on professional judgement and USDA rates for “medium” riffles.

BMP	Unit Cost	Unit	Notes/Assumptions
Streambank Stabilization (STP)	$75	foot	Based on professional judgement and includes some engineering and permitting.
Floodplain Reconnection	$12,250	each	Based on professional judgement and 1.75 times the USDA rates for "medium" riffles assuming larger riffle structures, engineering and permitting.
Terrace	$4.05	foot length of terrace	Length of terrace based on USDA rates.
Terrace	$2.38	ft tile	Length of tile.
Terrace Maintenance	$1,000	each	Based on professional judgement.
Urban Detention Basin (Naturalized)	$92,000	each	Based on professional judgement.
Water and Sediment control basin	$1,920	each	Per basin and an average of 700 yd^3 soil. Based on professional judgement and USDA-NRCS rates.
Water and sediment control basin	$4.82	foot	Water and sediment control basin tile. Based on professional judgement.
Wetland Creation	$20,000	acre	Includes earthwork and seeding. Based on professional judgement and USDA-NRCS rates.
Wetland Creation	$3,000	each	For water control structure and tile. Based on professional judgement and USDA-NRCS rates.

7.2 Total Cost

Table 49 below provides a detailed breakdown of cost estimates for each BMP type and the cost per unit of loading reduced per year. The total of implementing all BMPs is estimated to be $16,128,198. Average annual per pound of nitrogen removed is $921, phosphorus $8,080, and the average cost for a ton of sediment is $18,577. Costs are for establishment of the practice and as noted in Table 48, cover crops, nutrient management, no-till, and strip-till are for 1 year. Structural practices have a high initial cost but provide reductions over their effective lifespan and this should be considered when interpreting results presented in this plan. It should also be noted that average cost increases substantially when very high value practices are incorporated as shown in Table 49.

Per pound of nitrogen reduction, no-till/strip-till, floodplain reconnection, filter strips, and cover crops are the most effective, followed grass conversion, field borders, and nutrient management. Conversion to no-till or strip-till, filter strips, floodplain reconnection, field borders and cover crops are the most cost effective for phosphorus reduction, followed by nutrient management and grass conversion. Conversion to no-till or strip-till, filter strips, floodplain reconnection, and field borders are the most effective for reducing sediment delivery. Although they are quite efficient at removing nutrients and sediment, they are also limited in terms of feasible locations and therefore total load reductions. Those structural practices that treat larger drainage areas such as wetlands and ponds and will generate higher volume reductions.

In addition to the costs presented in this section for BMP implementation, there will be costs associated with outreach and addressing septic systems through education campaigns. It is estimated that education and outreach could range from $20,000 – $40,000 per year, including staff time to contact and educate landowners, organize workshops, and develop grant applications.

Table 49 – BMP Cost Summary by BMP Type – Town of Reynolds

BMP Class	BMP	Quantity	Total Cost	Cost/lb Nitrogen Reduction	Cost/lb Phosphorous Reduction	Cost/ton Sediment Reduction
Town of Reynolds-Mill Creek HUC 70900051201						
In-Field	Cover Crop	10,901 (ac)	$694,807.92	$14.72	$121.77	$76.07
	Nutrient Management - Deep Placement Phosphorus	4,613 (ac)	$334,639.94	n/a	$180.05	n/a
	Nutrient Management - Spring Application Nitrogen	4,058 (ac)	$114,947.56	$29.97	n/a	n/a
	Strip-Till	272 (ac)	$4,456.50	$7.44	$18.09	$12.07
	No-Till	1,535 (ac)	$25,189.06	$9.57	$17.27	$9.35
In-field Practices Subtotal/ Av. BMP Reduction Cost			***$1,174,040.98***	***$15.43***	***$84.30***	***$32.50***
Structural	Field Border	34 (locations), 74 (ac)	$34,952.50	$38.29	$101.81	$68.39
	Filter Strip	34 (locations), 52 (ac)	$26,291.54	$13.34	$30.86	$17.26
	Floodplain Reconnection	1 (location)	$61,250.00	$10.49	$60.60	$47.84
	Grade Control - Block Chute	4 (locations), 4 (structures)	$42,400.00	$2,082.75	$3,939.38	$1,554.42
	Grade Control - Riffles	3 (locations), 6 (structures)	$20,502.00	$239.02	$650.64	$441.18
	Grade Control - Rock Checks	3 (locations), 14 (structures)	$42,280.00	$523.28	$1,183.51	$489.72
	Grass Conversion - Perennial	54 (locations), 92 (ac)	$53,732.55	$32.85	$268.19	$188.45
	Grass Waterway	20 (locations), 28 (ac)	$221,150.70	$80.14	$654.64	$374.03
	Livestock Feed Area Treatment	18 (locations)	$1,759,500.00	$7,164.16	$23,660.01	$440,283.14
	Livestock Fencing	6 (locations), 14 (crossings), 1 (water system)	$187,627.51	$155.15	$943.71	$1,066.71
	Pond	14 (locations)	$1,178,750.00	$551.12	$1,992.89	$1,677.58
	Saturated Buffer	2 (locations)	$50,920.00	$301.14	$17,804.62	n/a
	Sediment Basin	8 (locations)	$196,062.50	$639.06	$2,046.18	$1,601.47
	Streambank Stabilization – Stone Toe Protection	20 (locations), 4,193 (ft. STP)	$314,457.25	$362.27	$697.05	$550.66
	Terrace	22 (locations), 35 (terraces) 24,780 (ft. terrace), 9,920 (ft. tile)	$123,968.60	$132.84	$320.73	$207.59

BMP Class	BMP	Quantity	Total Cost	Cost/lb Nitrogen Reduction	Cost/lb Phosphorous Reduction	Cost/ton Sediment Reduction
	Timber Stand Improvement	3 (locations), 116 (ac)	$81,242.18	$1,930.69	$3,579.41	$1,404.00
	Urban Detention Basin	1 (location)	$92,000.00	$3,531.82	$11,463.57	$27,259.19
	WASCB	42 (locations), 109 (basins), 21,920 (ft. tile)	$319,934.40	$294.15	$831.08	$568.84
	Wetland	19 (locations), 27 (ac)	$597,000.00	$121.07	$781.35	$571.83
Structural Practices Subtotal/ Av. BMP Reduction Cost			***$5,432,521.74***	***$1,184.20***	***$6,535.83***	***$43,803.50***
Grand Total/ Av. BMP Reduction Cost			**$6,606,562.72**	**$980.94**	**$5,413.82**	**$37,550.50**

Table 50 – BMP Cost Summary by BMP Type – Mud Creek & Watershed Total

BMP Class	BMP	Quantity	Total Cost	Cost/lb Nitrogen Reduction	Cost/lb Phosphorous Reduction	Cost/ton Sediment Reduction
Mud Creek - Mill Creek HUC 070900051202						
In-Field	Cover Crop	9,225 (ac)	$587,988.14	$14.25	$118.10	$73.10
	Nutrient Management - Deep Placement Phosphorus	3,222 (ac)	$234,214.84	n/a	$158.74	n/a
	Nutrient Management - Spring Application Nitrogen	2,775 (ac)	$78,594.32	$25.04	n/a	n/a
	Strip-Till	1,074 (ac)	$17,627.50	$8.77	$18.93	$11.41
	No-Till	2,143 (ac)	$35,158.93	$8.23	$14.25	$7.49
In-field Practices Subtotal/ Av. BMP Reduction Cost			***$953,583.74***	***$14.07***	***$77.50***	***$30.67***
Structural	Field Border	19 (locations), 52 (ac)	$24,816.75	$34.26	$81.60	$507.71
	Filter Strip	14 (locations), 17 (ac)	$8,423.83	$17.03	$40.47	$367.22
	Floodplain Reconnection	1 (locations),	$49,000.00	$11.32	$61.37	$1,197.07
	Grade Control - Block Chute	6 (locations), 9.5 (structures)	$100,700.00	$363.68	$1,552.77	$160.24
	Grade Control - Riffles	4 (locations), 18 (structures)	$61,506.00	$203.48	$514.63	$190.61
	Grade Control - Rock Checks	3 (locations), 11 (structures)	$33,220.00	$724.47	$1,147.07	$78.15
	Grass Conversion - Perennial	77 (locations), 174 (ac)	$101,744.74	$32.21	$253.08	$602.21

BMP Class	BMP	Quantity	Total Cost	Cost/lb Nitrogen Reduction	Cost/lb Phosphorous Reduction	Cost/ton Sediment Reduction
	Grass Waterway	3 (locations), 4 (ac)	$37,161.00	$70.67	$560.68	$99.67
	Livestock Feed Area Treatment	21 (locations)	$1,897,500.00	$9,516.21	$32,703.56	$1.87
	Livestock Fencing	9 (locations), 16 (crossings), 0 (water systems)	$173,443.89	$122.49	$760.65	$170.28
	Native Prairie Restoration	3 (locations), 6 (ac)	$5,261.52	$828.13	$4,526.46	$0.03
	Pond	48 (locations)	$4,065,250.00	$462.66	$1,922.83	$3,206.82
	Sediment Basin	10 (locations)	$222,812.50	$1,003.26	$2,831.86	$120.94
	Streambank Stabilization – Stone Toe Protection	37 (locations), 8,653 (ft. STP)	$648,970.17	$322.31	$619.98	$1,324.41
	Terrace	9 (locations), 18 (terraces), 13,520 (ft. terraces), 5,730 (ft. tile)	$66,965.40	$122.97	$281.42	$399.29
	Timber Stand Improvement	2 (locations), 66 (ac)	$46,006.96	$1,364.30	$2,399.81	$49.94
	WASCB	32 (locations), 75 (structures), 14,786 (ft. tile)	$217,268.52	$366.80	$1,055.08	$301.89
	Wetland	21 (locations), 34 (ac)	$749,000.00	$117.40	$755.24	$1,306.72
	Wetland - Stair Step	1 (locations), 3 (ac)	$59,000.00	$96.93	$636.69	$133.53
Subwatershed Structural Practices Subtotal/ Av. BMP Reduction Cost			***$8,568,051.27***	***$1,039.61***	***$5,729.72***	***$535.20***
Subwatershed Grand Total/ Av. BMP Reduction Cost			**$9,521,635.01**	**$861.25**	**$4,746.73**	**$466.40**
Watershed Grand Total/ Av. BMP Reduction Cost			**$16,128,197.73**	**$921.10**	**$5,080.28**	**$18,577.24**

8.0 Water Quality Targets

This section describes water quality targets and those implementation actions required to meet them. The primary constituents of concern are sediment, phosphorus and nitrogen. Targets of a 45% reduction in sediment, phosphorus and nitrogen are consistent with the INLRS. The 45% sediment reduction is set to match the phosphorus target.

Table 51 compares BMPs to targets. Results indicate that widespread and overlapping in-field and structural BMP implementation will meet or exceed targets for sediment and phosphorus. The exception is nitrogen where additional reductions are needed. It is estimated that approximately 1,120 acres of farmland beyond what is recommended in this plan would need to be converted to grass to meet the nitrogen target. It should be noted that reductions do not account for the cumulative effect of upstream practices and, therefore, the totals achieved will likely be somewhat lower if all recommended practices are considered as a "system." It is estimated that this situation could reduce estimates by up to 30%. Despite this, it is still reasonable to assume that targets can be met or exceeded apart from nitrogen where relatively large sections of the watershed will also need to be converted from current uses to grassland.

Cover crops, conversion to no-till or strip-till, and large wetlands will likely provide the greatest potential for reductions. Combined, in-field practices will achieve slightly greater reductions in both sediment and nutrients compared to structural practices (Table 51). In-field management is less costly on an annual basis but requires a long-term commitment and landowner buy-in to ensure benefits are realized over multiple years. The importance of watershed management is even more important today as the Rock River has experienced increased nutrient loading, specifically nitrogen.

Table 51 – Mill Creek Water Quality Targets & Load Reductions – Town of Reynolds

BMP Class	BMP	Quantity	Area Treated (ac)	Nitrogen Reduction (% Total Load)	Phosphorus Reduction (% Total Load)	Sediment Reduction (% Total Load)
Town of Reynolds-Mill Creek HUC 70900051201						
In-Field	Cover Crop	10,901 (ac)	10,901	12%	9.6%	14%
	Nutrient Management - Deep Placement Phosphorus	4,613 (ac)	4,613	0%	3.1%	0%
	Nutrient Management - Spring Application Nitrogen	4,058 (ac)	4,058	0.1%	0%	0%
	Strip-Till	272 (ac)	272	0.1%	0.4%	0.6%
	No-Till	1,535 (ac)	1,535	0.7%	2.4%	4.2%
In-Field Practices Subtotal			***21,378***	***13%***	***16%***	***19%***
Structural	Field Border	34 (locations), 74 (ac)	725	0.2%	0.6%	0.8%
	Filter Strip	34 (locations), 52 (ac)	1,066	0.5%	1.4%	2.4%

BMP Class	BMP	Quantity	Area Treated (ac)	Nitrogen Reduction (% Total Load)	Phosphorus Reduction (% Total Load)	Sediment Reduction (% Total Load)
	Floodplain Reconnection	1 (locations)	2,880	1.5%	1.7%	2.0%
	Grade Control - Block Chute	4 (locations), 4 (structures)	26	0.01%	0.02%	0.04%
	Grade Control - Riffles	3 (locations), 6 (structures)	N/A	0.02%	0.1%	0.1%
	Grade Control - Rock Checks	3 (locations), 14 (structures)	187	0.02%	0.1%	0.1%
	Grass Conversion - Perennial	54 (locations), 92 (ac)	92	0.4%	0.3%	0.4%
	Grass Waterway	20 (locations), 28 (ac)	909	0.7%	0.6%	0.9%
	Livestock Feed Area Treatment	18 (locations)	14	0.1%	0.1%	0.01%
	Livestock Fencing	6 (locations), 14 (crossings), 1 (water system)	342	0.3%	0.3%	0.3%
	Pond	14 (locations)	524	0.5%	1.0%	1.1%
	Saturated Buffer	2 (locations)	90	0.04%	0.005%	0%
	Sediment Basin	8 (locations)	228	0.1%	0.2%	0.2%
	Streambank Stabilization – Stone Toe Protection	20 (locations), 4,193 (ft. STP)	N/A	0.2%	0.8%	0.9%
	Terrace	22 (locations), 35 (terraces), 24,780 (ft. terrace), 9,920 (ft. tile)	259	0.2%	0.6%	0.9%
	Timber Stand Improvement	3 (locations), 116 (ac)	116	0.00%	0.00%	0.0%
	Urban Detention Basin	1 (locations)	63	0.01%	0.01%	0.01%
	WASCB	42 (locations), 109 (basins), 21,920 (ft. tile)	247	0.3%	0.6%	0.9%
	Wetland	19 (locations), 27 (ac)	1,515	1.2%	1.3%	1.6%
Structural Practices Subtotal			***9,283***	***6.3%***	***9.7%***	***13%***
Town of Reynolds Grand Total			**30,661**	**20%**	**25%**	**32%**

Table 52 – Mill Creek Water Quality Targets & Load Reductions – Mud Creek & Watershed Totals

BMP Class	BMP	Quantity	Area Treated (ac)	Nitrogen Reduction (% Total Load)	Phosphorus Reduction (% Total Load)	Sediment Reduction (% Total Load)
Mud Creek - Mill Creek HUC 070900051202						
In-Field	Cover Crop	9,225 (ac)	9,225	10%	8.4%	13%
	Nutrient Management - Deep Placement Phosphorus	3,222 (ac)	3,222	0%	2.5%	0%
	Nutrient Management - Spring Application Nitrogen	2,775 (ac)	2,775	0.8%	0%	0%
	Strip-Till	1,074 (ac)	1,074	0.5%	1.6%	2.4%
	No-Till	2,143 (ac)	2,143	1.1%	4.1%	7.3%
In-Field Practices Subtotal			***18,438***	***13%***	***17%***	***22%***
Structural	Field Border	19 (locations), 52 (ac)	541	0.2%	0.5%	0.8%
	Filter Strip	14 (locations), 17 (ac)	192	0.1%	0.3%	0.6%
	Floodplain Reconnection	1 (locations),	2,761	1.1%	1.3%	1.9%
	Grade Control - Block Chute	6 (locations), 10 (structures)	104	0.07%	0.1%	0.2%
	Grade Control - Riffles	4 (locations), 18 (structures)	154	0.1%	0.2%	0.3%
	Grade Control - Rock Checks	3 (locations), 11 (structures)	22	0.01%	0.05%	0.1%
	Grass Conversion - Perennial	77 (locations), 174 (ac)	180	0.8%	0.7%	0.9%
	Grass Waterway	3 (locations), 4 (ac)	173	0.1%	0.1%	0.2%
	Livestock Feed Area Treatment	21 (locations)	15	0.05%	0.1%	0.003%
	Livestock Fencing	9 (locations), 16 (crossings), 0 (water systems)	421	0.4%	0.4%	0.3%
	Native Prairie Restoration	3 (locations), 6 (ac)	6	0.002%	0.002%	0.0001%
	Pond	48 (locations)	2,443	2.2%	3.5%	5.0%
	Sediment Basin	10 (locations)	108	0.1%	0.1%	0.2%
	Streambank Stabilization – Stone Toe Protection	37 (locations), 8,653 (ft. STP)	N/A	0.5%	1.8%	2.1%
	Terrace	9 (locations), 18 (terraces), 13,520 (ft. terrace), 5,730 (ft. tile)	109	0.1%	0.4%	0.6%
	Timber Stand Improvement	2 (locations), 66 (ac)	66	0.00%	0.00%	0.0%

BMP Class	BMP	Quantity	Area Treated (ac)	Nitrogen Reduction (% Total Load)	Phosphorus Reduction (% Total Load)	Sediment Reduction (% Total Load)
	WASCB	32 (locations), 75 (structures), 14,786 (ft. tile)	166	0.1%	0.3%	0.5%
	Wetland	21 (locations), 34 (ac)	82,481	1.6%	1.7%	2.0%
	Wetland - Stair Step	1 (locations), 3 (ac)	146	0.2%	0.2%	0.2%
Structural Practices Subtotal			***126,963***	***7.6%***	***12%***	***16%***
Mud Creek Grand Total			**145,401**	**20%**	**28%**	**38%**
Watershed Grand Total			**169,748**	**10% - 40% (target not met)[1]**	**24% - 54% (target likely met)[1]**	**40% - 70% (target likely exceeded)[1]**
[1] – A range is provided to account for the cumulative effects of BMPs implemented as a "system"						

9.0 Critical Areas

Critical areas are those BMP locations throughout the watershed where implementation activities should be prioritized. This includes locations targeted for in-field and structural practices. In-field management practices will provide the greatest "bang-for-the-buck" and benefit to water quality. They will improve soil structure and health, and overall farm profitability. Structural practices, although more costly upfront, will prove benefits over multiple years and address locations where other measures are infeasible. Critical areas focus on maximizing reductions primarily in nitrogen and sediment. Those that address phosphorus also maximize sediment reductions.

9.1 In-Field Management Measures

In-field practices recommended are nutrient management, no-till, strip-till, and cover crops. Critical areas are primarily based on expected sediment and nutrient load reductions. Specific selection criteria are provided by management practice type and are discussed in the following subsections.

9.1.1 Nutrient Management

Critical areas for nutrient management were selected based on the practices with lowest cost per pound reduced. As listed in Table 53 and depicted in Figure 30, critical areas are expected to achieve 19% of the total nitrogen and 25% of the total phosphorus reductions associated with these practices while only encompassing 11% of the recommended acres.

Deep placement of phosphorus fertilizer – fields that cost less than $100 per lb phosphorus reduced. This represents a total of 946 acres or 42 fields.

Split application of nitrogen fertilizer - fields that cost less than $18 per pound nitrogen reduced. This represents a total of 721 acres or 50 fields.

Table 53 - Critical Areas - Nutrient Management

Critical Practice	Quantity	Total Nitrogen Reduction (lbs/yr)	Total Phosphorus Reduction (lbs/yr)	Percent of Total Practice Load Reduction -Nitrogen	Percent of Total Practice Load Reduction - Phosphorus
Town of Reynolds-Mill Creek HUC 70900051201					
Nutrient Management Plan – Deep Placement P	482 (ac)	0	415	n/a	12%
Nutrient Management Plan – Split Application N	162 (ac)	308	0	4%	n/a
Mud Creek - Mill Creek HUC 070900051202					
Nutrient Management Plan – Deep Placement P	464 (ac)	0	426	n/a	13%
Nutrient Management Plan – Split Application N	559 (ac)	1,040	0	15%	n/a
Watershed Total		**1,348**	**841**	**19%**	**25%**

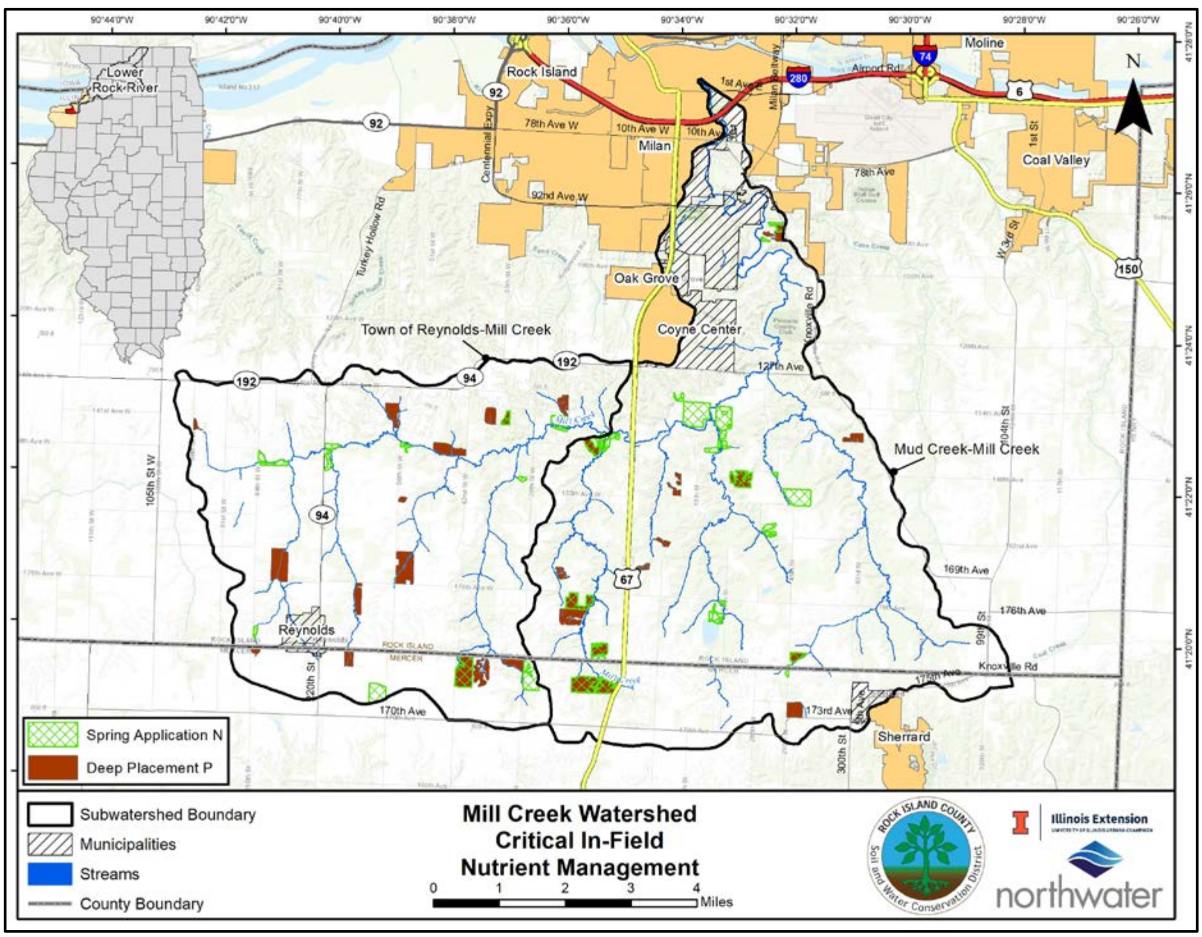


Figure 30 - Critical Areas - In-Field Nutrient Management

9.1.2 No-till or Strip-Till

Critical areas for no-till and strip-till were selected based on the practices with lowest cost per ton sediment reduced. As listed in Table 54 and depicted in Figure 31, critical areas for no-till are expected to achieve 22% of the total nitrogen, 29% of the total phosphorus reductions and 35% of the total sediment associated with these practices while only encompassing 13% of the recommended acres. Critical areas for strip-till are expected to achieve 18% of the total nitrogen, 25% of the total phosphorus reductions and 32% of the total sediment associated with these practices while only encompassing 10% of the recommended acres

No-Till – fields that cost less than $4 per ton sediment reduced. This represents a total of 460 acres or 37 fields.

Strip-Till - fields that cost less than $6 per ton sediment reduced. This represents a total of 136 acres or 12 fields.

9.1.3 Cover Crops

Cover crop critical areas were selected as those fields costing less than $40 per ton sediment reduced. A total of 138 fields, or 2,562 acres, were selected. If implemented, annual reductions of 19,174 lbs of nitrogen, 2,939 lbs of phosphorus, and 5,627 tons of sediment are expected. As listed in Table 54 and depicted in Figure 31, critical areas for cover crops are expected to achieve 22% of the total nitrogen, 27% of the total phosphorus and 32% of the total sediment reductions associated with these practices while only encompassing 13% of the total recommended acres.

Table 54 – Critical Area – Tillage & Cover Crop

Practice	Quantity	Total Nitrogen Reduction	Total Phosphorus Reduction	Total Sediment Reduction	% Total Practice Load Reduction Nitrogen	% Total Practice Load Reduction Phosphorus	% Total Practice Load Reduction Sediment
Town of Reynolds-Mill Creek HUC 70900051201							
Cover Crop	1,324 (ac)	9,741	1,502	2,830	11%	14%	16%
Strip-Till	41 (ac)	149	77	155	6%	7%	8%
No-Till	130 (ac)	432	333	774	6%	8%	10%
Mud Creek - Mill Creek HUC 070900051202							
Cover Crop	1,237 (ac)	9,433	1,437	2,797	11%	13%	16%
Strip-Till	95 (ac)	312	215	468	12%	18%	24%
No-Till	330 (ac)	1,072	829	1,864	16%	21%	25%
Watershed Total Cover Crops		**19,174**	**2,939**	**5,627**	**22%**	**27%**	**32%**
Watershed Total Strip-Till		**461**	**292**	**623**	**18%**	**25%**	**32%**
Watershed Total No-Till		**1,504**	**1,162**	**2,638**	**22%**	**29%**	**35%**

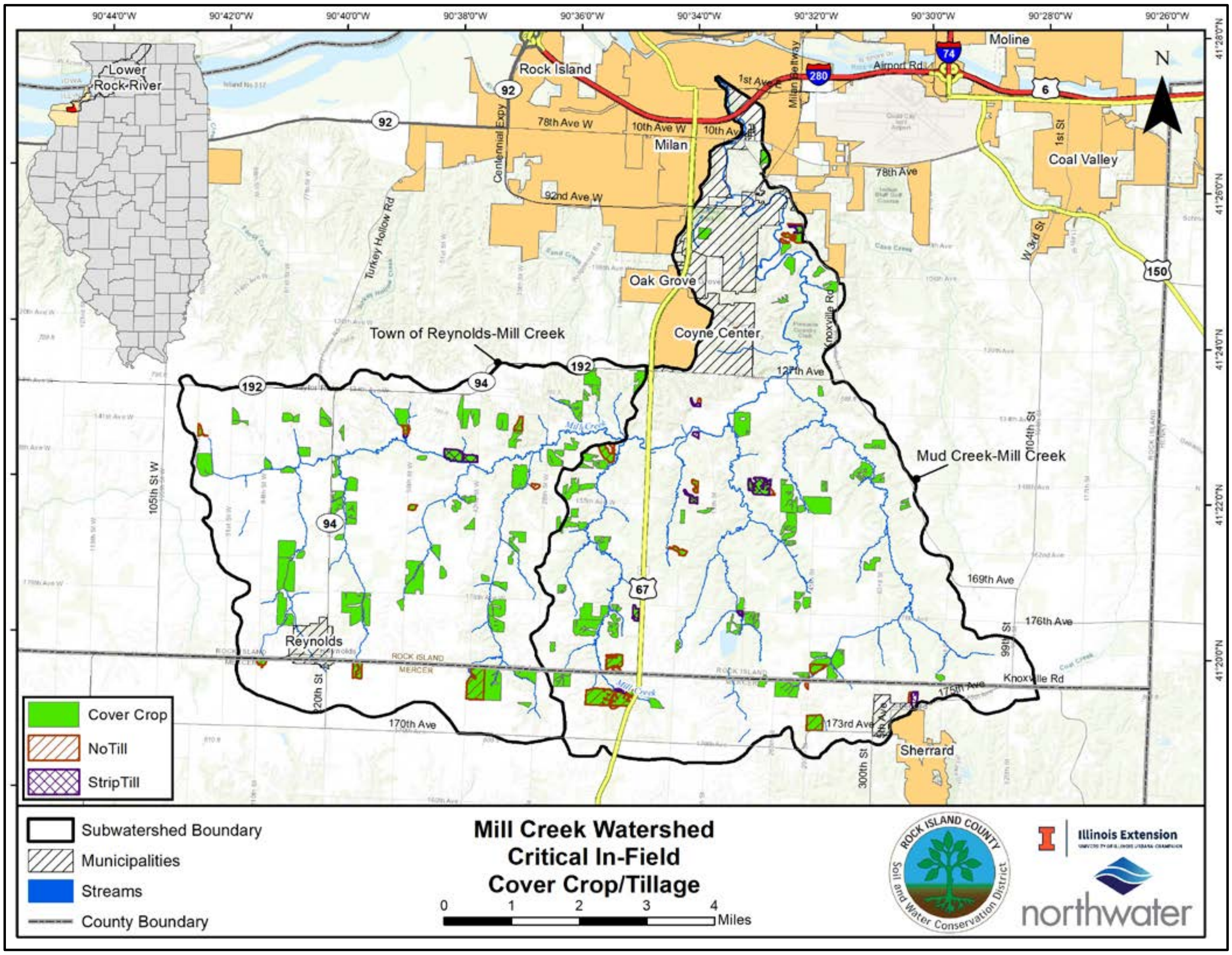


Figure 31 - Critical Areas - In-Field Cover Crop & No-Till/Strip-Till

9.2 Structural BMPs

A selection of structural practices are prioritized for implementation throughout the watershed and classified as critical (Table 55 and Figure 32). Selection criteria included cost/benefit, or the amount of sediment or nutrients reduced per dollar of expenditures, greatest total expected load reductions and feasibility for implementation. If all practices are implemented, 41% of the total nitrogen, 42% of the phosphorus, and 43% of the sediment reductions associated with all recommended structural practices will be achieved.

Critical bioreactors – the practice with the highest reduced nitrogen was chosen from the two proposed. The site selected has a total of 2 structures and treats approximately 38 acres.

Critical field borders and filter strips – for field borders, those fields that cost less than $35 per ton sediment reduced. Seven sites were selected for a total of 13 acres to treat 144 acres. For filter strips, those that cost $11 or less per ton of sediment reduced. A total of eight sites were selected or 13 acres to treat 534 acres.

Critical grade control - block chute – nine sites with 13 structures were chosen based on landowner willingness and expected total sediment reduction. If constructed, these sites will treat 120 acres.

Critical grade control - riffles – three sites with 13 structures were chosen based on landowner willingness and expected total sediment reduction. If constructed, these sites are expected to treat 154 acres.

Critical grade control - rock check – three sites with 15 structures were chosen based on landowner willingness and expected total sediment reduction. If constructed, these sites are expected to treat 193 acres.

Critical grass conversion – are those locations that cost less than $80 per ton sediment reduced. Seventeen fields for a total of 32 acres were selected.

Critical grass waterway – those practices that generate greater than 290 lbs of nitrogen reduction were selected. These 8 sites are 12 acres in total size and will treat 312 acres.

Critical livestock feed area management – eight locations to treat 16 acres were selected based on the lowest cost per pound of phosphorus reduced.

Critical livestock fencing – the 4 pastures that will generate the greatest total reductions were selected. It will treat 401 acres and generate over half of the total reductions associated with all 15 recommended sites.

Critical ponds – locations were chosen based on cost per ton sediment reduced, total sediment reductions, and landowner willingness. At a cost of less than $900/ton and total sediment loads of greater than 120 tons, or where a willing landowner has been identified, a total of 13 sites were selected to treat 1,138 acres.

Critical saturated buffers – the highest loading practice of the two proposed was selected. This site treats 69 acres.

Critical sediment basins – sites were selected primarily on cost per ton sediment reduced. At costs less than $925 per ton sediment reduced, 8 sites were selected.

Critical streambank stabilization - STP – stream segments were selected based on direct measurement and landowner willingness. Twenty-one segments were selected encompassing 3,403 ft of STP.

Critical terraces – sites were selected based on the greatest total reductions, low cost per ton sediment reduced, and landowner willingness. Fourteen locations were chosen, if implemented, these critical practices will treat 145 acres.

Critical timber stand improvement – existing timber ground was selected based on landowner willingness and professional experience. Eight locations were selected for a total of 70 acres.

Critical urban detention basin – the only site proposed is also critical.

Critical WASCB – sites were selected based on the greatest total reductions, low cost per ton sediment reduced, and landowner willingness. Twenty-one locations were chosen, if implemented, these critical practices will treat 119 acres.

Critical wetlands – are those that cost less than $65 per pound nitrogen reduced and professional opinion. A total of 9 sites and 12.4 acres are considered as critical. If implemented, these practices will treat 81,839 acres.

Table 55 - Critical Area - Structural Practices

Practice	Quantity	Total Nitrogen Reduction	Total Phosphorus Reduction	Total Sediment Reduction	% Total Practice Load Reduction Nitrogen	% Total Practice Load Reduction Phosphorus	% Total Practice Load Reduction Sediment
Town of Reynolds-Mill Creek HUC 70900051201							
Bioreactor	1 (locations), 38 (ac)	51	0	0	64%	64%	n/a
Field Border	5 (locations), 7 (ac)	185	82	152	11%	13%	15%
Filter Strip	7 (locations), 10 (ac)	816	329	585	33%	31%	31%
Grade Control - Block Chute	3 (locations), 3 (structures)	18	10	26	6.1%	13%	14%
Grade Control - Riffles	1 (locations), 2 (structures)	61	19	30	16%	13%	13%
Grade Control - Rock Checks	2 (locations), 11 (structures)	74	31	74	59%	48%	45%
Grass Conversion - Perennial	6 (locations), 6 (ac)	146	18	28	3.0%	3.0%	3.2%
Grass Waterway	8 (locations), 12 (ac)	1,010	127	243	31%	31%	35%
Livestock Feed Area Treatment	5 (locations)	204	62	4	46%	47%	61%
Livestock Fencing	2 (locations), 8 (crossings), 1 (water system)	1,040	175	173	40%	41%	50%
Saturated Buffer	1 (locations)	131	2.2	0	77%	77%	n/a
Sediment Basin	5 (locations)	241	76	97	46%	43%	40%
STP	3 (locations), 1,049 (ft. STP)	242	126	159	8.4%	8.4%	8.4%
Terrace	10 (locations), 18 (terraces), 8,145 (ft. terrace)	393	167	269	27%	27%	27%
Timber Stand Improvement	1 (locations), 52 (ac)	3.6	0.4	0.1	17%	17%	18%
Urban Detention Basin	1 (locations)	26	8.0	3.4	100%	100%	100%

Practice	Quantity	Total Nitrogen Reduction	Total Phosphorus Reduction	Total Sediment Reduction	% Total Practice Load Reduction Nitrogen	% Total Practice Load Reduction Phosphorus	% Total Practice Load Reduction Sediment
WASCB	15 (locations), 33 (basins), 7,735 (ft. tile)	555	179	243	33%	30%	28%
Wetland	3 (locations), 3 (ac)	1,660	222	274	14%	12%	11%
Subwatershed Total		***6,856***	***1,633***	***2,360***	***20%***	***20%***	***20%***
Mud Creek - Mill Creek HUC 070900051202							
Field Border	2 (locations), 6 (ac)	163	84	178	10%	13%	17%
Filter Strip	4 (locations), 2 (ac)	121	60	144	4.9%	5.6%	7.6%
Grade Control - Block Chute	6 (locations), 10 (structures)	277	65	160	93%	86%	85%
Grade Control - Riffles	2 (locations), 11 (structures)	223	96	151	58%	64%	63%
Grade Control - Rock Checks	1 (locations), 4 (structures)	34	22	58	27%	33%	35%
Grass Conversion - Perennial	11 (locations), 27 (ac)	832	121	202	17%	20%	23%
Livestock Feed Area Treatment	3 (locations)	84	25	0.9	19%	19%	15%
Livestock Fencing	2 (locations), 4 (crossings), 0 (water systems)	518	89	90	20%	21%	26%
Pond	13 (locations)	4,840	1,222	1,923	44%	45%	49%
Sediment Basin	3 (locations)	76	22	35	14%	13%	15%
STP	18 (locations), 3,789 (ft. STP)	1,069	555	703	37%	37%	37%
Terrace	1 (locations), 2 (terraces), 1,915 (ft. terrace)	97	37	56	6.5%	5.8%	5.7%
Timber Stand Improvement	1 (locations), 18 (ac)	4.0	0.3	0.1	18%	14%	13%
WASCB	6 (locations), 7 (structures), 1,515 (ft. tile)	98	35	60	5.8%	5.9%	6.9%
Wetland	4 (locations), 9 (ac)	3,393	512	695	28%	28%	28%
Subwatershed Total		***11,828***	***2,945***	***4,456***	***28%***	***28%***	***29%***
Watershed Total		**18,684**	**4,577**	**6,816**	**41%**	**42%**	**43%**

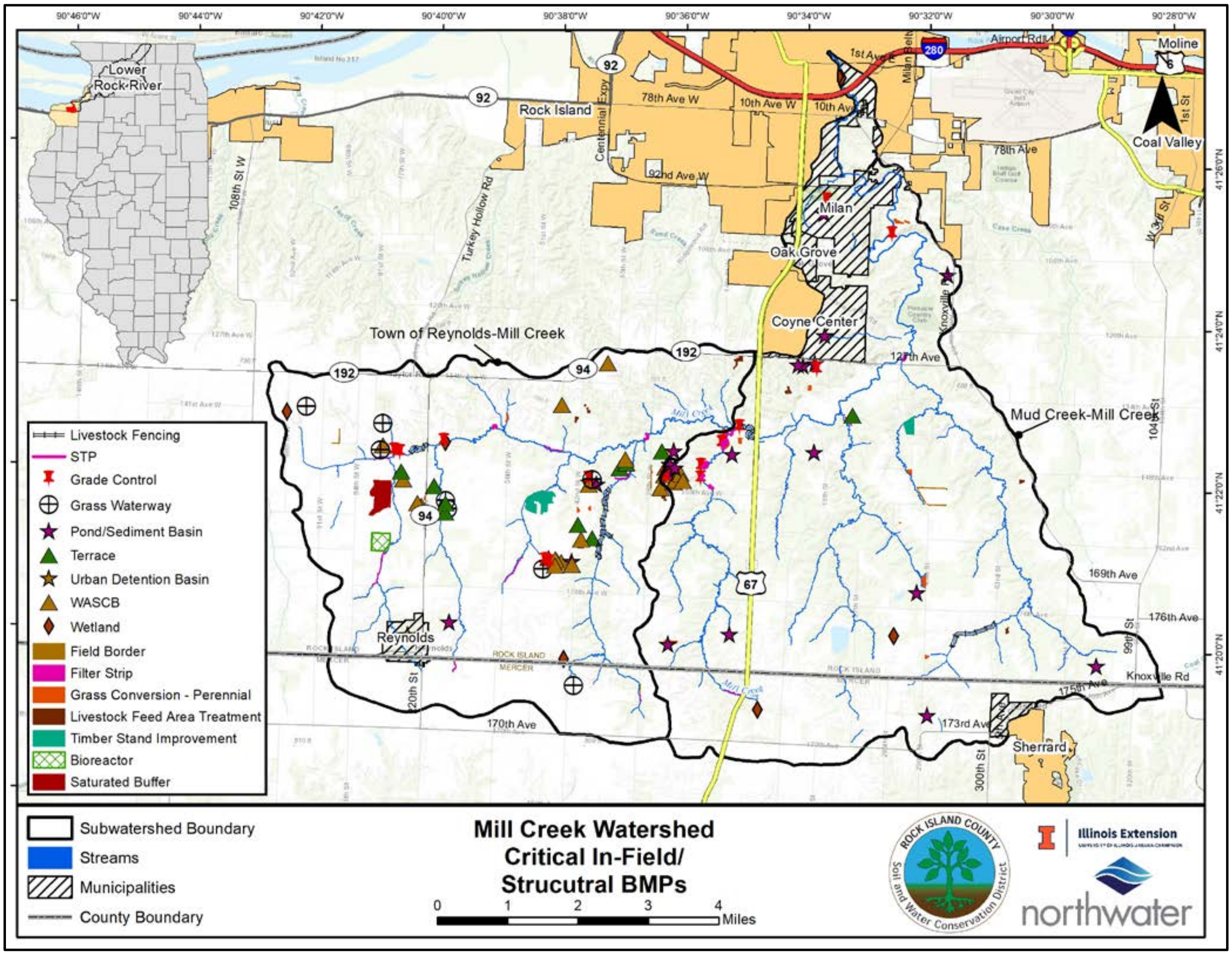


Figure 32 – Critical Areas – Structural Practices

10.0 Technical & Financial Assistance

Entities listed below are potentially available for plan implementation and funding. For those that can provide funding specific to the watershed, descriptions of the programs or financial assistance mechanisms are provided, with a separate section of those that may be able to provide funding or in-kind contributions to watershed efforts. Entities that may not have a direct avenue to a funding apparatus or a formal grant program are listed under the Section 10.2, Technical Assistance.

With implementation, primary responsibility lies with the owner of the land first. Any agency or entity providing a role in implementation will need to work with willing landowners but do not have the primary decision-making authority. All actions are completely voluntary.

10.1 Financial Assistance

Rock Island County – the County currently provides annual educational funding to Rock Island SWCD. Additional funding related to specific projects may be available upon request. Rock Island County has a tax incentive program in place for filter strips along creeks. The form must be completed and signed the SWCD. The tax reduction is 5/6 of current assessment.

Village of Milan – the village can support implementation of this plan, provide financial assistance benefit from improvements recommended within Village limits.

Farmers/Landowners - there are varying business arrangements on who farms the land and makes important conservation decisions. If the farmer is the landowner, then the farmer–landowner is considered the primary responsible party. If the person/entity who owns the land is an absentee owner, then it could be either the farmer-tenant or the absentee landowner who is responsible. In some cases, the conservation practice decisions are made together in a collaborative fashion by the tenant and landowner. Frequently, the lease terms will determine who makes conservation decisions on the agricultural parcel.

> **Financial Assistance:** Private funds can come from foundations, individual farmers, and landowners and can be used as cash match for grants or as private contributions to other conservation initiatives.

United States Department of Agriculture Natural Resources Conservation Service (USDA-NRCS) - the USDA has local offices in most Illinois counties which include the NRCS. One field office services the watershed. The NRCS provides both conservation technical assistance and financial assistance to farmers and landowners. Two of the static programs frequently used for financial assistance are the Environmental Quality Incentive Program (EQIP) and the Conservation Stewardship Program (CSP). The EQIP program provides technical and financial assistance to producers to address natural resource concerns and deliver environmental benefits such as improved water and air quality, conserved ground and surface water, increased soil health and reduced soil erosion and sedimentation, improved or created wildlife habitat, and mitigation against drought and increasing weather volatility. The CSP program is designed to compensate agricultural and forest producers who agree to increase their level of conservation by adopting additional conservation activities and maintaining their baseline level of conservation.

Several additional specialty programs administered by the NRCS include the Regional Conservation Partnership Program (RCPP)and the Conservation Innovation Grant (CIG) program.

> **Financial Assistance:**
>
> **NRCS EQIP** - is a cost-share program for farmers and landowners to share the expenses of implementation and maintenance of approved soil and water conservation practices on farmland for qualified entities and is a dedicated source of funding available in the watershed. The farmer/landowner applies for conservation program funds and are assisted by NRCS staff to complete the application process, followed by a ranking and determination process to authorize funding to projects. If selected, the farmer/landowner will enter into a contract with NRCS to receive financial assistance for the cost of implementing the approved conservation practices.

Then they certify the practices and make payments. This program has an annual sign-up and enrollment period.

https://www.nrcs.usda.gov/programs-initiatives/eqip-environmental-quality-incentives

NRCS CSP - through CSP, NRCS offers opportunities for producers to expand on existing conservation efforts by applying new conservation practices, enhancements and bundles. These new activities will help enhance natural resources and improve the operation. Conservation Stewardship Program participants receive one-on-one consultation with the local NRCS conservation planner to determine the new CSP conservation activities based on management objectives for the operation. If the application is selected for funding, CSP offers annual payments for implementing these practices on the land while operating and maintaining existing conservation efforts. The program also offers bundles where the farmer/landowner can select a suite of enhancements and receive a higher payment rate. This 5-year program has an annual sign-up and enrollment period and does have potential to renew.

https://www.nrcs.usda.gov/programs-initiatives/csp-conservation-stewardship-program

USDA Conservation Innovation Grant Program (CIG) - is a competitive program that supports the development of new tools, approaches, practices, and technologies to further natural resource conservation on private lands. The Conservation Innovation Grant Program funds innovative, on-the-ground conservation projects, including pilot projects and field demonstrations. Proposed projects must conform to the description of innovative conservation projects or activities published in the annual funding notice. With its focus on innovation, CIG does not fund projects supporting technologies and approaches commonly used in the geographic area covered by the application, including those already eligible for funding through EQIP. All projects must have a 1:1 match requirement from non-federal funds and the grantee must provide the technical assistance required to successfully complete the project.

https://cig.sc.egov.usda.gov/

NRCS/USDA RCPP - RCPP promotes coordination of NRCS conservation activities with partners that offer value-added contributions to expand our collective ability to address on-farm, watershed, and regional natural resource concerns. Through RCPP, NRCS seeks to co-invest with partners to implement projects that demonstrate innovative solutions to conservation challenges and provide measurable improvements and outcomes tied to the resource concerns they seek to address. RCPP makes available a variety of NRCS conservation activities to help partners, ag producers, and private landowners address local and regional natural resource concerns. Partners apply to NRCS for RCPP project awards (available annually). Once projects are selected, NRCS works with partners to set aside a certain pool of funding for an awarded project. Producers, landowners, and partners then enter into producer contracts and supplemental agreements with NRCS to carry out agreed-to conservation activities and must be carried out on agricultural or nonindustrial private forest land. The lead partner for an RCPP project is the entity that submits an application, and if selected for an award is ultimately responsible for collaborating with NRCS to successfully complete the project. Eligible project activities include: land management/land improvement/restoration practices, land rentals, entity-held easements, U.S. held easements, and public works/watersheds.

https://www.nrcs.usda.gov/programs-initiatives/rcpp-regional-conservation-partnership-program

Illinois Environmental Protection Agency (Illinois EPA) - in Illinois, the Illinois EPA Bureau of Water's Watershed Management Section provides program direction and financial assistance for water quality protection through the Clean Water Act Section 319 program.

Financial Assistance: Administered by the Illinois EPA, the Section 319 program provides funds for addressing non-point source pollution (NPS). The purpose is to work cooperatively with units of local government and other organizations toward the mutual goal of protecting the water quality in Illinois through the control of NPS pollution. The program includes providing funding to these groups to implement projects that utilize cost-effective BMPs on a watershed scale. The Illinois EPA is the designated state agency in Illinois to receive 319 federal funds from U.S. EPA.

Projects may include structural BMPs, such as dry dams and streambank stabilization, non-structural BMPs, such as construction erosion control ordinances, and setback zones to protect community water supply wells. Technical assistance and information/education programs are also eligible. Funds are reimbursable at 60% and require a match of 40% either cash or in-kind services, or a combination of both.

https://www2.illinois.gov/epa/topics/water-quality/watershed-management/nonpoint-sources/Pages/section-319.aspx

Illinois Department of Agriculture (IDOA) - The IDOA's Bureau of Land and Water Resources distributes funds to Illinois' 98 soil and water conservation districts for programs aimed at reducing soil loss, enhancing habitat, and protecting water quality. Annual cost-share funding can be directed to the watershed through the Partners for Conservation (PFC) program and additional grants can be pursued for streambank stabilization under the Streambank Stabilization and Restoration Program (SSRP) as well as training for staff.

Financial Assistance:

PFC – the state allocates cost-share monies annually to SWCDs which is distributed to farmer/landowners to implement conservation practices on private land. The cost-share rate can be anywhere from 60 – 75%. Priorities for projects include no-till, cover crops, and pollinator habitat.

SSRP - Streambank Stabilization and Restoration Program or SSRP is designed to demonstrate effective, inexpensive vegetative and bio-engineering techniques for limiting stream bank erosion. Limited funds are allocated annually to projects on a competitive basis.

Training Funds Grant – available annually for SWCD staff to complete relevant specialized training or attend field day events up to $500.

Farm Service Agency (FSA) - included in the USDA local offices are officials of the FSA who also provide some conservation-oriented programs; specifically, they provide the administrative structure for the federal Conservation Reserve Program (CRP).

Financial Assistance:

USDA/FSA Conservation Reserve Program (CRP) - is a land conservation program administered by the FSA. In exchange for a yearly rental payment, farmers enrolled in the program agree to remove environmentally sensitive land from agricultural production and plant species that will improve environmental health and quality. Contracts for land enrolled in CRP are 10-15 years in length. The long-term goal of the program is to re-establish valuable land cover to help improve water quality, prevent soil erosion, and reduce loss of wildlife habitat. Land in the watershed is already enrolled in CRP and additional, eligible land is available for enrollment.

https://www.fsa.usda.gov/programs-and-services/conservation-programs/conservation-reserve-program/index

US Fish and Wildlife Service (USFWS) - provides technical assistance to local watershed groups. It also administers several grant and cost-share programs that fund habitat restoration. The USFWS also administers the federal Endangered Species Act and supports a program called Endangered Species Program Partners, which features formal or informal partnerships for protecting endangered and threatened species. These partnerships include federal partners, as well as states, tribes, local governments, nonprofit organizations, and individual landowners.

Financial Assistance: The **USFWS Partners program** restores, improves, and protects fish and wildlife habitat on private lands through alliances between the USFWS, other organizations and individuals, while leaving the land in private ownership. Opportunities may exist within the watershed to utilize financial assistance from the partners program for wetland or prairie restoration.

https://www.fws.gov/partners/

American Water Environmental Grant Program – provides annual grant funding of up to $10,000 for project activities and outcomes that address a watershed or source water protection need in the local community. Watershed protection projects should focus on activities that improve, restore, or protect one or more watersheds including reforestation efforts, watershed cleanup, streamside buffer restoration projects, surface or groundwater protection education, hazardous waste collection efforts, habitat restoration, and wellhead protection initiatives.

National Fish & Wildlife Foundation (NFWF) Conservation Partners Program – the NFWF manages the Conservation Partners Program in partnership with NRCS and General Mills. The program awards competitive grants that accelerate the adoption of regenerative agriculture principles and conservation practices on private working lands in priority geographic regions including the Upper Mississippi River Basin. Key objectives for this region include improving soil health and maximizing soil carbon on crop lands, pastures, and other grazing lands, reducing nitrogen/phosphorus/sediment runoff to local waterways and enhancing habitat for migratory birds, fish and other aquatic species. Priority strategies include grazing management, crop management, and habitat enhancement projects within NRCS's Mississippi River Basin Healthy Watersheds Initiative (MRBI).

Fishers & Farmers Partnership for the Upper Mississippi River Basin – awards National Fish Habitat Partnership funding to locally-led projects in upper Mississippi River Basin watersheds each year. Funded projects improve farms and fish habitat; address a root cause of watershed problems; support landowner engagement, communications, monitoring, science, or construction and align with the Fishers & Farmers Partnership Strategic Plan.

10.2 Technical Assistance & Strategic Partners

A series of potential partners and stakeholders were engaged to assist or contribute to lake and watershed management efforts. Many have committed to the program and are actively working in the larger watershed. Table 56 lists organizations and respective categories. The intent is to leverage this expansive list and build upon it to implement conservation practices throughout the watershed.

Table 56 - Strategic Partners & Stakeholders

Category	Organization
Landowners	N/A
National Government	USDA-Natural Resources Conservation Service (NRCS)
	United States Army Corps of Engineers (CORPS)
	United States Fish and Wildlife Service (USFWS)
	USDA-Farm Services Agency (FSA)
Local Government	Rock Island County
	Village of Milan
	Bi-State Regional Commission
Foundation	Walton Family Foundation
Media	WVIK
	Jim Taylor/WRMJ
	Erie Review (local newspaper)
	AGRI-NEWS
Educational	Illinois Sustainable Ag Partnership
	University of Illinois Extension
	Augustana University/Upper Mississippi Center
	Sherrard High School FFA
Non-Governmental Organization	Soil & Water Conservation Society
	American Farmland Trust (AFT)
	Association of Illinois Soil & Water Conservation Districts (AISWCD)
	Nahant Marsh
	River Action
	IL Land Improvement Contractors
	National Association of Conservation Districts (NACD)
State Government	Illinois Environmental Protection Agency (IEPA)
	Illinois Department of Agriculture (IDOA)
	Illinois Department of Natural Resources (IDNR)
Industry/ Private Sector	Quad Cities Landfill
	Pinnacle Golf Course
	Arrowhead Ranch
	Vildmark

Category	Organization
	BOS Farm Repair
	Nutrien
Trade Organization	Illinois Corn Growers Association
	Illinois Farm Bureau
	Rock Island County Farm Bureau

10.2.1 Government

Units of government will play key roles in watershed management. Descriptions of roles and responsibilities for primary governmental bodies include:

1. **Rock Island County SWCD** – will be the primary agency and lead partner for the watershed. In addition to financial and technical support, RISWCD will provide planning, project management, and overall guidance. Additionally, RISWCD will coordinate and administer educational and outreach efforts to stakeholders within the watershed. They will administer complimentary cost-share programs, direct state resources to the watershed, conduct targeted landowner outreach, conduct water monitoring efforts, participate in education events, provide technical assistance for design, and assist with conservation planning.
2. **Village of Milan** – the village will likely participate in mutually beneficial water quality practices within village limits such as native prairie restoration or erosion control/detention.
3. **Rock Island County** – county government can provide general support and participation in mutually beneficial water quality practices. A cooperative agreement for Natural Resource Information reports is currently in place between RISWCD and Rock Island County.
4. **Federal government** – Primary technical assistance will occur through the Milan USDA-NRCS Service Center to execute projects and programs on private farm ground in the Mill Creek watershed. Other federal agencies will assist with funding, monitoring, additional technical assistance, and permitting. This includes the United States Army Corps of Engineers for potential wetland creation and restoration projects identified in this plan.

10.2.2 Agricultural & Trade Organizations

Agricultural trade organizations such as state and county Farm Bureaus are critical to watershed management. A selection of strategic groups relevant to Mill Creek include:

1. **State and County Farm Bureau –** Illinois Farm Bureau is a non-profit, membership organization directed by farmers who join through their county Farm Bureau. Based in Bloomington, Illinois Farm Bureau serves a voting membership of more than 74,000. They represent three out of four Illinois farmers. Mill Creek watershed is serviced by Rock Island County Farm Bureau in Moline, IL. State and County Farm Bureau's will engage landowners and growers and conduct outreach, provide general support and perform education, host field days and coordinate with agribusiness.

2. **Illinois Land Improvement Contractors of America (LICA) –** a national association dedicated to encouraging high standards of workmanship in resource management, land improvement practices and to promote enterprises in the area of land improvement contracting. For over 60 years, Illinois LICA has been running strong, bringing people with similar interests and passions for improving natural resources together. Their contractors, throughout the state, are educated and committed to the professional conservation of our soil and water resources.

3. **Illinois Corn Growers (ICG)** – established in 1972, it is a grassroots membership organization with approximately 5,000 members. Corn Growers run the Precision Conservation Management Program which is a farmer-led effort developed to address natural resource concerns on a field-by-field basis by identifying conservation practices that effectively address environmental issues in a financially viable way. Staff work with farmers to identify conservation needs and use data from agronomic management practices, economic models, and sustainability metrics to develop customized solutions. IL Corn Growers houses a Precision Conservation Management (PCM) staff member at Rock Island County Soil & Water Conservation District office.

10.2.3 Private Sector

The private sector is uniquely positioned to both leverage substantial financial and technical resources and execute on-the-ground conservation in a timely fashion. Numerous public-sector partners have been tapped to help with the watershed management program and can be of assistance in the Mill Creek watershed. A selection is described in more detail below:

1. **Ag Retailers -** major ag retailers in the watershed such as FS and Nutrien help their farmer-owners and customers by providing products and technology. This includes harvesting and selling crops, custom fertility and crop protection solutions, soil testing, nutrient management, cover crop seed, variable rate fertilizer application, and can assist with outreach. Retailers will be key strategic partners moving forward with and will provide agronomic technical assistance, education, and outreach to forward key actions related to nutrient management and erosion control. Ag retailers also provide financial sponsorships for local educational events and outreach support.

2. **Crop advisors –** several locally based crop advisory companies exist and can provide technical assistance, landowner outreach and on-the-ground delivery of cost-share dollars.

3. **Agricultural engineering firms and drainage consultants –** a team of consultants operate in the watershed and can provide technical assistance for practice design and conduct targeted outreach.

10.2.4 Non-Governmental Organizations

Two primary NGOs operate in the watershed and work with the farming community and others to promote and forward conservation. Several key partnerships have been formed or are being pursued to leverage staff resources and technical assistance.

1. **Walton Family Foundation (WFF)** – a family-led foundation that tackles tough social and environmental problems with urgency and a long-term approach to create access to opportunity

for people and communities. The WFF have been engaging local Quad City leaders including RISWCD staff to participate in planning and guiding local funding opportunities to protect, engage and support the local community. This foundation may be able to engage as a partner in watershed efforts and assist with support for things like planning, monitoring, and outreach.

2. **Nahant Marsh –** the 305-acre preserve is the largest urban wetland on the Upper Mississippi River. Nahant Marsh is an educational partner on several collaborative community initiatives with RISWCD and will provide the use of a stream flow meter at no cost to support water quality monitoring.

10.2.5 Institutional

Institutions and other research-based entities will provide valuable in-kind services to help in measuring outcomes of the larger watershed program and in conducting education and outreach. They are expected to allocate resources to the watershed in coordination with the RISWCD.

1. **Upper Mississippi Center (Augustana College) –** faculty and students have expressed interest in watershed monitoring at a field station in lower Mill Creek. The RISWCD will coordinate to develop and execute a monitoring strategy.
2. **University of Illinois Extension –** already active, Extension will continue to assist with watershed efforts, including a leadership role in education and outreach campaigns.
3. **Sherrard High School FFA** – faculty and students have expressed interest in water quality SNAPSHOT testing at 3 locations along Mill Creek. RISWCD will coordinate with FFA staff to provide the training and monitoring strategy to the students. Tests will include chloride, turbidity, pH, dissolved oxygen, phosphorus, and nitrate/nitrite in conjunction with flow measurements.

11.0 Implementation Milestones, Objectives & Schedule

Implementation milestones and goals are intended to be measured by USDA-NRCS program contracts, Illinois EPA Section 319 and RISWCD funded cost-share measures largely because these represent the most common cost-share programs applicable to the watershed and plan recommendations. Goals are meant to be both measurable and realistic. Targeted outreach and on-farm visits with landowners are vital to the success of future activities and will be a component of every effort to ensure the adoption of the BMPs listed below. Communication and outreach will also help to ensure practices are maintained over time.

An implementation schedule is presented in Table 57 (short term, 1-2 years), Table 58 (medium term, 3-5 years), and Table 59 (long term, 6-10 years). The milestones or objectives presented are intended to be achievable and realistic over each period, though actual implementation will depend on interested landowners and funding availability. The schedule takes into consideration staff capacity and incorporates acres and practices necessary to make progress towards achieving water quality targets. A reasonable number of critical in-field and structural BMPs (Section 9.0) are considered prioritized for implementation within 5 years. The plan and milestones should be revisited and updated after 10 years. Consistent throughout each period is the need for outreach, communication, partnerships, grant applications, water quality monitoring, and tracking of progress.

Table 60 summarizes BMP milestones or objectives, those responsible entities and the primary technical/financial assistance available. The implementation milestones or objectives needed to meet water quality targets are those that are realistic within a 10-year period. Given the high cost and limited resources available, it is anticipated that more than 10 years will be required to fully meet water quality targets and maintain them over time. This plan, milestones and objectives should be revisited and updated after 10 years.

In the first 5 years of plan implementation, priorities focus on critical areas or those locations and practices in the watershed where management measures will achieve the greatest nutrient reductions.

Table 57 – Years 1-2 - Implementation Milestones

Timeframe	Milestone
Years 1–2	1. Initiate targeted outreach and one-on-one communication with producers identified during the planning process. 2. Develop a baseline water sampling program at a minimum of 3 sites. Conducting sampling and flow measurements monthly and during storm events for a period of 12 months. Work with Augustana College and/or Sherrard Highschool FFA to establish volunteer coordinators. Calculate annual loading of nutrients and sediment. Utilize partnership with Nahant Marsh for use of flow meter. 3. Establish a relationship with U.S. Army Corps of Engineers and Village of Milan to evaluate adding constructed wetlands along the levee. 4. Conduct targeted landowner outreach to 721 acres of nutrient management critical areas – nutrient management plans, split application N and deep placement P. 5. Plant 200 acres of critical area cover crops. 6. Convert conventional tillage to strip-till or no-till on 200 critical acres. 7. Install 1,000 ft of high priority or critical area streambank stabilization. 8. Install filter strips at 3 critical area locations. 9. Install 1 high priority or critical grassed waterway. 10. Develop forestry management plans on 2 critical areas for TSI. 11. Install 1 critical area urban detention basin. 12. Initiate a SepticSmart program consisting of tips for maintenance and educational materials to be distributed to all homes in the watershed not on the public sewer system. 13. Install 3 critical grade control structures. 14. Install 2 critical WASCB systems. 15. Establish a demonstration site for various practices including cover crops, pollinator habitat, and education center. 16. Install 1 saturated buffer. 17. Apply for program funding on a broader scale such as NRCS-RCPP or Illinois EPA 319. 18. Install 10 acres of grassland conversion (pollinator habitat).

In years 3-5 of plan implementation, priorities continue with a focus on critical areas or those locations and practices in the watershed where management measures will achieve the greatest nutrient reductions.

Table 58 – Years 3-5 - Implementation Milestones

Timeframe	Milestone
Years 3–5	19. Continue targeted outreach and one-on-one communication with producers. 20. Continue water quality monitoring. 21. Implement constructed wetlands along levee. 22. Implement nutrient management plans developed. 23. Plant 500 acres of critical area cover crops. 24. Convert conventional tillage to strip-till or no-till on 200 critical acres. 25. Install 2,500 ft of high priority or critical area streambank stabilization. 26. Install filter strips at 5 critical area locations. 27. Install 5 high priority or critical area grassed waterways. 28. Implement forestry management plans on 2 critical areas for TSI. 29. Install 5 critical grade control structures. 30. Install 8 critical WASCB systems. 31. Install a constructed wetland on the demonstration site. 32. Install 1 high priority or critical area livestock steam fencing system. 33. Install 1 high priority or critical area livestock feed area management system. 34. Complete 1 high priority or critical area wetland. 35. Install 3 high priority ponds. 36. Complete 20 acres of native prairie grass conversion.

In years 6-10, priorities continue to be both in-field management measures and critical or high priority structural practices such as streambank stabilization.

Table 59 – Years 6-10 - Implementation Milestones

Timeframe	Milestone
Years 6–10	37. Continue targeted outreach with landowners. 38. Continue water quality monitoring. 39. Apply for additional implementation funding. 40. Increase enrollments in nutrient management plans across the watershed by 5%. 41. Plant 1,000 acres of cover crops. 42. Convert conventional tillage to strip-till or no-till on 200 critical acres. 43. Install 3,000 ft of streambank stabilization. 44. Install filter strips at 3 high priority or critical area locations. 45. Install 5 high priority or critical area grassed waterways. 46. Develop and implement forestry management plans at 3 additional sites. 47. Install 5 grade control structures. 48. Install 8 critical or high priority WASCB systems. 49. Install field borders and prairie strips on demonstration site. 50. Install 2 high priority or critical area livestock steam fencing systems. 51. Install 1 high priority or critical area livestock feed area management system. 52. Complete 1 high priority or critical area wetland. 53. Install 3 high priority ponds. 54. Complete 50 acres of grass conversion or prairie restoration.

Beyond 10 years, broad implementation should continue, and the watershed plan and milestones should be revisited and updated to accommodate changes over time.

Table 60 – Implementation Objectives, Responsible Parties & Technical Assistance

BMP/Objective	Responsible Party	Primary Technical Assistance/Funding Mechanism
Watershed BMPs/Education and Outreach (1–10 years)		
BMP: Cover Crops **Objective:** Plant 1,700 acres	Landowner/SWCD/NRCS/ Ag Retailers	**Technical Assistance**: SWCD/NRCS/ICG-PCM/Ag Retailers **Funding Mechanism**: Private Funds/NRCS and IDOA Programs/Private Funds
BMP: No-Till/Strip-Till **Objective**: Convert 600 acres	Landowner/SWCD/NRCS/ Ag Retailers	**Technical Assistance**: SWCD/NRCS/AFT/PCM/Ag Retailers **Funding Mechanism**: NRCS and IDOA Programs/ Private Funds
BMP: Split Application N Fertilizer **Objective**: Complete 760 acres	Landowner/SWCD/NRCS/ Ag Retailers	**Technical Assistance**: SWCD/NRCS/ICG-PCM/Ag Retailers **Funding Mechanism**: 319 Grant/NRCS and IDOA Programs/Private Funds
BMP: Deep Placement P Fertilizer **Objective**: Complete 760 acres	Landowner/SWCD/NRCS/ Ag Retailers	**Technical Assistance**: SWCD/NRCS/ICG-PCM/Ag Retailers **Funding Mechanism**: 319 Grant/Private Funds/NRCS and IDOA Programs/Private Funds
BMP: Grassed waterway **Objective:** Install 11	Landowner/SWCD/NRCS	**Technical Assistance:** SWCD /NRCS /FSA/Consultants **Funding Mechanism**: 319 Grant/NRCS and IDOA Programs/ Private Funds
BMP: Wetlands **Objective:** Install 4	Landowner/SWCD/ NRCS	**Technical Assistance**: SWCD/NRCS/Consultants/ USFWS/LICA/CORPS/Village of Milan **Funding Mechanism**: 319 Grant/Private Funds/ USFWS/NRCS and USDA Programs
BMP: Filter strips **Objective:** Install 17 aces	Landowner/SWCD/NRCS/ FSA	**Technical Assistance:** SWCD/NRCS/FSA/Consultants **Funding Mechanism**: 319 Grant/NRCS and IDOA Programs/ County & Private Funds
BMP: Field Borders **Objective:** Install 2 acres	Landowner/SWCD/NRCS/ FSA	**Technical Assistance:** SWCD/NRCS/FSA/Consultants **Funding Mechanism**: 319 Grant/NRCS and IDOA Programs/State Cost Share/Private Funds
BMP: Saturated Buffer **Objective:** Install 1 system	Landowner/SWCD/NRCS	**Technical Assistance:** SWCD/NRCS/Consultants/ LICA **Funding Mechanism**: 319 Grant/NRCS and IDOA Programs/Private Funds
BMP: Pond **Objective:** Install 6	Landowner/SWCD/NRCS	**Technical Assistance:** SWCD/NRCS/Consultants/LICA **Funding Mechanism**: 319 Grant/NRCS and USDA Programs/ Private Funds
BMP: Grass Conversion **Objective:** Install 74 aces	Landowner/SWCD/NRCS/ FSA	**Technical Assistance:** SWCD/NRCS/FSA/Consultants **Funding Mechanism**: 319 Grant/NRCS and IDOA Programs/ Private Funds
BMP: Livestock Stream Fencing System **Objective:** Install 3	Landowners/NRCS	**Technical Assistance:** NRCS/Consultants **Funding Mechanism:** NRCS Programs/319 Grant
BMP: Livestock Feed Area Management System **Objective:** Install 2	Landowners/NRCS	**Technical Assistance:** NRCS/Consultants **Funding Mechanism:** NRCS Programs/319 Grant

BMP/Objective	Responsible Party	Primary Technical Assistance/Funding Mechanism
BMP: Streambank Stabilization **Objective:** 6,500 feet	Landowners/SWCD	**Technical Assistance:** SWCD/Consultants **Funding Mechanism:** 319 Grant/SSRP/Private Funds
BMP: WASCB **Objective:** Install 18 systems	Landowner/SWCD/NRCS	**Technical Assistance**: SWCD/NRCS/Consultant **Funding Mechanism:** NRCS and IDOA Programs/ Private Funds
BMP: Grade Control – block chute /riffle /rock check **Objective:** Install 13	Landowner/SWCD/NRCS	**Technical Assistance**: SWCD/NRCS/Consultant **Funding Mechanism:** NRCS and IDOA Programs/ Private Funds
BMP: Prairie Restoration **Objective:** 6 acres	Village of Milan/SWCD	**Technical Assistance:** SWCD/Extension/Consultants **Funding Mechanism**: 319 Grant/ Village of Milan Funds
BMP: Timber Stand Improvement **Objective:** 182 acres	SWCD/NRCS	**Technical Assistance**: NRCS/Consultant **Funding Mechanism:** NRCS programs/Private Funds
BMP: Water Quality Monitoring **Objective:** Initiate and maintain a water quality monitoring network	SWCD	**Technical Assistance**: Extension / Augustana / Nahant Marsh/ Sherrard Highschool **Funding Mechanism:** 319 Grant/Farm Bureau/Private Funds /WFF
BMP: Education & Outreach including SepticSmart and demonstration **Objective:** Stakeholder engagement	SWCD/Extension/ Landowners	**Technical Assistance:** SWCD/NRCS/Farm Bureau/ Illinois Sustainable Ag Partnership **Funding Mechanism:** 319 Grant/IDOA funds/WFF/ Private Funds

12.0 Outreach & Education

The health of the Mill Creek watershed faces challenges and threats from nutrient and sediment loading from surface runoff, erosion, and highly erodible soils. Since a significant portion of the watershed is held as private property, any efforts to improve the water quality and natural resources must include significant education and outreach efforts to those landowners and key stakeholders. This Outreach & Education Plan (O&E Plan) recommends campaigns that are designed to enhance understanding of the issues, problems, and opportunities within the Mill Creek watershed. The intention is to promote general acceptance and stakeholder participation in selecting, designing, and implementing recommended BMPs to improve current conditions. The first step in understanding the issues, problems, and opportunities is to gain a better perspective on how watersheds function.

The goal of the O&E Plan is to equip landowners, elected officials, local youth, and key stakeholders with the tools necessary to establish watershed-based practices and engrain these tools into their respective activities and procedures. The purpose of outreach and education is to foster community involvement in the implementation of the watershed plan and encourage stakeholders to be actively involved in protecting the creek and its tributaries. They will become aware of the factors that threaten surface waters of the watershed and adopt specific behaviors that contribute to improving overall conditions. Through these changes in behavior over time, the threats and challenges to the watershed will decrease and water quality will improve. Public information and stakeholder education efforts will ultimately inspire landowners and community members to adopt recommended implementation actions. The cumulative actions of individuals and communities' watershed-wide can accomplish the goals of this plan. When people begin to understand the issues related to water quality and natural resource protection, they begin to change their actions and activities, thereby improving the overall watershed health.

RISWCD has been involved in watershed planning for the greater Lower Rock River watershed in some capacity for over 20 years including participation in the creation of a comprehensive watershed management plan with the Lower Rock River Ecosystem Partnership in 2001. Beginning in 2019 and led by the University of Illinois Extension's newly created Watershed Outreach Coordinator position, a series of Lower Rock River watershed planning meetings were held. In August 2019, a series of stakeholder meetings were held in Mill Creek to discuss resource concerns with community members and determine the level of interest in developing a watershed plan to address those concerns. Over 30 stakeholders were present, and this meeting gave farmers and landowners the opportunity to rank and prioritize resource concerns, discuss possible options for improvements. The top concerns included streambank erosion, gully erosion, sheet and rill erosion, nutrient loss, and loss of wildlife/pollinator habitat. From this meeting, a group of particularly interested stakeholders emerged to form the Mill Creek Watershed Planning Committee. On the recommendation of the committee, the Watershed Outreach Coordinator and RISWCD proceeded with development of this plan.

Further engagement occurred during the creation of this plan. A stakeholder mailing list was created, and a letter was sent along with a watershed fact sheet and short survey, and a subsequent meeting was held in July 2021. At this meeting, attendees were presented with an overview of the planning process as well as a short survey, a summary of the watershed resource inventory components, potential agricultural conservation practices such as reduced tillage, cover crops, WASCBs, edge-of-field practices, and others, in addition to information about potential funding sources.

In partnership with the University of Illinois, a bioreactor installation field day was held in September 2021 to highlight this practice, discuss benefits and costs, and offer local contractors the opportunity to view the construction process. It is expected that increased public understanding of improved water quality through projects such as these will support landowner participation, beneficial policy action, and motivate future involvement in watershed improvement efforts.

Throughout the fall of 2021, direct calls to landowners living adjacent to the stream were made to gain permission for a comprehensive streambank survey. During this process, over 20 direct landowner meetings as well as several other stakeholder meetings with public officials and various planning committee meetings were held informing the parties of progress, opportunities for BMPs, and to provide necessary feedback to staff. Multiple newsletter articles were also used to keep stakeholders updated on the progress and opportunities to participate in education and outreach events. The feedback from all these meetings and outreach efforts were incorporated into the plan.

A second stakeholder meeting was held in December 2022 to discuss final results of the plan and recommended actions. Presentations were made to the stakeholders on current funding opportunities including USDA-NRCS, PFC, PCM, Pheasants Forever, and US Fish & Wildlife Service. A discussion on future goals and grants of the INLRS and RISWCD were also discussed. Thus far, participation from landowners has been moderate and without subsequent education and outreach to keep them engaged, it may be difficult to reach many of the goals and targets outlined in this plan.

Stakeholder Meeting in the Watershed

RISWCD engages partners to expand the reach of their education and outreach on the importance of watershed planning. In the fall of 2022, RISWCD partnered with a local farmer and Augustana College to host a conservation field day tour for a soil health class. The tour highlighted cover crops and soil health concepts, stream buffers, pollinator and wildlife habitat, and forestry management. Additionally, RISWCD is the lead planner in an annual educational conference for local stormwater professionals and contractors held in February each year. Known as the Quad Cities Stormwater Conference, this full day workshop and trade show is a partnership with all 5 local municipalities in the Quad Cities and provides much needed professional development on erosion/sediment control, NPDES permits and stormwater regulations. RISWCD staff also provide presentations to special interest groups on erosion control, watersheds and stormwater as opportunities arise. Most recently in late 2022, a presentation called "Soil Erosion: Home Edition" was given to around 40 members of the Silvis Garden Club and another presentation in early 2023 called "Engaging Communities to Improve Water Quality by Supporting Healthy Watersheds" was given to the Quad Cities Riverfront Council. Multiple staff also participated in the 2022 Scenario Planning – Preparedness Strategies for Multiple Futures Northwest Illinois Water Demand Scenario Planning for Lower Rock River coordinated by the Bi-State Regional Planning Commission.

Moving forward, the goal is to utilize the momentum of recent outreach and one-on-one landowner engagement, continue to engage partners listed in Section 10, and host and participate in education events, field days and workshops on a consistent basis. All these actions will aid implementation of this plan and management of the larger Rock River watershed by garnering awareness of the community to the socio-economic, environmental, and financial benefits of watershed planning. The continued engagement of our stakeholders is essential for the success of the Mill Creek Watershed Plan.

12.1 Recommended Outreach & Education Campaigns

A successful O&E Plan first raises awareness among stakeholders of watershed issues, problems, and opportunities. The next step is to provide stakeholders with information on alternatives to implement that will address issues, problems and opportunities.

12.1.1 Goals & Objectives

Development of an effective O&E Plan begins by defining goals and objectives. Goals were established for the Mill Creek watershed based on facilitated stakeholder engagement, guidance from the Mill Creek Planning Committee, and RISWCD's prior experience with watershed outreach and education. The goals and objectives are intended to be general in nature and it is expected that future funding opportunities will require more specific education and outreach components. These general goals and related objectives are intended to be a guide to educational topics and provide a focus of messages in relation to implementation goals (Table 57) so that future progress can be assessed, and outreach can be modified as needed.

Goal 1: Build stakeholder awareness of watershed issues through education and stewardship while increasing communication and coordination among stakeholders.

Objectives:

1. Engage in targeted outreach and one-on-one communication with producers with critical area practices identified in the plan.
2. Increase environmental stewardship opportunities and encourage stakeholders to participate in watershed plan implementation and restoration campaigns to increase activism in the watershed.
3. Inform public officials of the benefits of conservation within both the agricultural and urban settings and the functions and benefits of healthy watersheds.
4. Create targeted educational information to riparian landowners.
5. Create targeted educational information to agricultural landowners.
6. Install watershed interpretation signage at public access points, major roads, and installed management measures.
7. Provide educational workshops, field days and events to the public that encourage environmental stewardship, promote conservation practices and the connection to watersheds.

Goal 2: Encourage agricultural techniques and soil conservation practices that will protect and conserve topsoil, improve soil health, and protect our water resources.

Objectives:

1. Educate and inform landowners about federal and state cost-share programs, which provide incentives to enroll in conservation programs and implement conservation practices.
2. Encourage landowners to utilize existing programs and agencies such as NRCS, RISWCD, FSA, US Fish & Wildlife Service, Pheasants Forever, etc. to install conservation practices that protect soil loss and water quality.
3. Utilize the PCM Specialist (IL Corn Growers) to assist in promoting and implementation of in-field practices such as cover crops and no-till.
4. Increase support for and develop additional financial assistance programs targeted at specific efforts within the watershed to increase the installation of conservation practices.
5. Encourage landowners and farmers to follow the principles of soil health and/or regenerative agriculture on their land.

6. Encourage landowners and farmers to leave in place or install adequate buffers between agricultural land and waterways.
7. Encourage landowners and farmers to support the INLRS by implementing practices that reduce annual loading of nitrate-nitrogen, sediment and total phosphorus to the Rock River.

Goal 3: Protect groundwater quantity and quality.

Objectives:

1. Encourage Rock Island County Health Department to monitor the extent and current condition of septic tanks and wells in the watershed and to educate septic tank and well owners on how to properly maintain their systems.
2. Educate stakeholders about potential groundwater contamination issues and encourage private well testing.
3. Encourage landowners to install downspout disconnection practices such as rain gardens and utilize native plants in yards and gardens.
4. Assist with erosion and stormwater control site inspections and monitoring as well as professional development workshops throughout the county.
5. Encourage agricultural landowners and farmers to improve soil health, thereby increasing infiltration.

Goal 4: Reduce streambank and gully erosion.

Objectives:

1. Educate landowners on the benefits of stream buffers.
2. Create an educational campaign for livestock control fencing near streams.
3. Provide funding opportunities for streambank stabilization and waterway projects.

12.1.2 Target Audiences

The recommended target audience for each education campaign is selected based on the ability to attain objectives. The target audience is a group of people with a common denominator who are intended to be reached by a particular message. In the Mill Creek watershed this includes people of all demographics, locations, occupations, and watershed roles. There can be multiple target audiences depending on which topic is being presented. The overall umbrella target selected to meet watershed goals and objectives include residential and agricultural landowners, homeowners, general public, local government, elected officials, businesses, schools, and stakeholders/residents. Once the target audience is identified for a specific education campaign, existing local programs and communication vehicles should be leveraged to help distribute the message.

12.1.3 Public Input

Creating and distributing a message for each audience is done via campaigns that address educational goals and objectives. The O&E Plan objectives for the watershed were determined by RISWCD staff with guidance from the Mill Creek Watershed Planning Committee and feedback from stakeholder meetings and a survey.

For each educational campaign, the following information will be identified:

1. Target audience.
2. Communications vehicles.
3. Priority/schedule.
4. Lead & supporting organizations.
5. Outcomes/change in action.
6. Estimated cost.

13.0 Monitoring & Tracking Strategy

Four components comprise of the monitoring and tracking strategy described in this section:

1. Programmatic monitoring, tracking investments and progress towards goals.
2. Watershed water quality monitoring.

13.1 Programmatic Monitoring

Tracking watershed investments is one of the simplest and most effective means to monitor progress towards achieving plan goals. Keeping track of projects across diverse partners and stakeholders can be as simple as an organized system where each agency or responsible implementation entity monitors and reports what is happening related to their programs or expenditures. For example, the RISWCD could track and report state cost-share expenditures or practices funded through grant awards. Communicating and reporting progress towards goals is equally as important as tracking them in the first place.

The following recommendations are included to help track progress and achieve goals with plan implementation.

- Engage the existing steering committee at least quarterly to discuss activities and progress towards goals. A list of completed actions, proposed and in-progress actions should be tracked.
- The plan should be evaluated every five years to assess the progress made as well as to revise, if appropriate, based on the progress achieved. It should also undergo a comprehensive review and update after 10-years. As goals are accomplished and additional information is gathered, efforts may need to be shifted to issues of higher priority.
- The steering committee or RISWCD could request that each agency or project partner in the watershed provide an annual update, which could be in the form of a "scorecard" that tracks progress towards goal objectives via measurable milestones presented in Section 11. The scorecard system is an easy and effective way to compile and track progress and evaluate the effectiveness of

achieving short, medium, and long-term goals. They are an effective way to identify what needs attention and what stakeholders should focus on in the next year.

Regardless of the specific methodologies or programs applied, it is pertinent to establish a system of working with watershed partners and stakeholders to track actions and their water quality benefits.

13.2 Water Quality Monitoring

Water quality monitoring is an effective means to evaluate the health of Mill and Mud Creek, and to directly measure plan effectiveness and progress towards targets. This data also supports science and research enabling practitioners to better understand the watershed and stream dynamics to guide future investments and interventions.

The strategy is to build a sustainable monitoring program. Almost no water quality monitoring has occurred in the watershed. Some exceptions include a biological assessment for macroinvertebrates, a couple instances of Illinois EPA and two volunteer sampling runs for water chemistry.

The purpose of the water quality monitoring strategy is to commission three permanent stations necessary to establish a baseline for the watershed and continue to collect data in a consistent manner over time. One existing monitoring station will be utilized (Illinois EPA station – PA-01). Two additional locations should be added to isolate flows from Mud Creek, the other named tributary in the watershed and support and expand volunteer and education and research efforts at the Collinson Ecological Preserve, owned and managed by Augustana College.

13.2.1 Water Quality & Biological Monitoring

One Illinois EPA monitoring station exists on Mill Creek (Table 61). One additional site on Mill and Mud Creek is also proposed to evaluate watershed and stream conditions, establish a baseline and support local research and volunteer efforts. Given the lack of historical data, efforts should be coordinated with the Illinois EPA, Augustana College, and the Sierra Club. The proposed monitoring categories and associated recommendations are summarized in Table 62. Additional resources should be sought, such as the Sierra Club Illinois Chapter Eagle View Group responsible for volunteer sampling in 2019 and 2021, the RiverWatch program through the National Great Rivers Research and Education Center (NGRREC), other local volunteers and students and faculty from Augustana College. Outreach during plan development indicated interest from the College to collaborate with the RISWCD on a permanent monitoring site on Lower Mill Creek at the Collinson Ecological Preserve. Initial ideas included deployment of sensory technology followed by regular student sampling and laboratory work.

Example of Sensor Deployment: sensor placed inside PVC pipe and anchored to stream

Physical and biological data should be collected at the Illinois EPA station or Collinson site to augment 2013 efforts and at the Mud Creek site where no biological data exists.

Due to the uncertainty in securing resources for edge-of-field monitoring to measure the effectiveness of BMPs, it is recommended that a more detailed plan be developed alongside future implementation actions, if funding permits.

Table 61 - Existing & Proposed Monitoring Sites & Description

Station ID	Site Description	Notes
IL_PA-01	Mill Creek at the Milan Beltway crossing 1 mile east of 1st st	Existing Illinois EPA monitoring site
TBD	Mud Creek at 155th Ave West crossing 0.6 miles west of 1st st	New monitoring site on Mud Creek.
TBD	Mill Creek at Collinson Ecological Preserve approximately 0.2 miles upstream of Mill Creek and 10th ave east	New monitoring site on Mill Creek – consider deployment of sensor technology

Table 62 - Summary of Monitoring Categories & Recommendations

Monitoring Category	Summary of Recommendations
Stream flow	Measure stream flow during every sample event if conditions permit. Consider installation of a permanent staff gauge or level logger.
Ambient water quality	Utilize Illinois EPA and local volunteers or other agency staff to perform regular monitoring monthly or a minimum of 3 times per year for water quality at all stream sites.
Physical & biologic assessment	Perform stream monitoring once every 5 years for fish, macroinvertebrates, habitat, and channel morphology on Dudley Branch in coordination with Illinois EPA. Continue fish and macroinvertebrate monitoring on Mill and Mud Creek.
BMP effectiveness	Monitor BMP effectiveness of specific practices or cluster of practices. Develop a detailed monitoring plan in combination with implementation activities.
Storm event runoff monitoring	Conduct monitoring during storm event at each stream site between 3 and 8 times per year.
Trends in water quality	Establish baseline conditions for stream sites. Monitor/track changes and trends in water quality

Seasonal or monthly and storm-event water quality monitoring should be considered for all stations in the watershed. Efforts should focus initially on collecting base-flow and storm-event data, followed by a regular sampling program. Regular monitoring should occur at a minimum of three times per year to capture seasonal variations in water quality. Monthly monitoring is preferred if funding permits. Routine, sampling serves to document ambient water quality which captures climatic, land-use, and

In-Situ Sonde: sensors located inside protective silver cap

seasonal differences and effects on quality. Low- and high-flow events, known as base-flow and storm-event sampling, are critical conditions to document. Storm event samples should be collected between 3–8 times per year.

Sensor technology should be considered at one site and can include a sonde combined with up to four individual sensors anchored to the stream in a protective casing. The primary benefit of this technology is in the frequency of measurements and ability to capture real-time fluctuations in water chemistry. Primary drawbacks include calibration and maintenance challenges.

Table 63 includes the minimum parameters that should be considered. Quantitative benchmarks that indicate impairment conditions are also noted. The establishment of baseline conditions is important to evaluate trends and changes in water quality over time and resulting from implementation. Parameters, such as total phosphorus, total suspended sediment, and total nitrogen, should be analyzed considering flow volumes to make relative comparisons year to year, as concentrations vary with flow volumes. The water quality monitoring results may also be used to calibrate the nonpoint source pollution load model and make revised annual loading estimates throughout implementation.

Table 63 - Baseline Water Quality Analysis Parameters

Analyte	Benchmark Indicators
Total Phosphorus	Less than 0.05 mg/L (Illinois EPA standard) or 0.113 mg/L (INSAC guideline for streams)
Total Nitrogen	Less than 10 mg/L (Illinois EPA standard) or 3.8 mg/L (INSAC guideline for streams)
Fecal Coliform	Less than 200 CFU/100 mL (Illinois EPA standard)
Total Suspended Sediment (TSS)	116 mg/L (Illinois EPA guideline)
Turbidity	Less than 14 NTU (IL Lake Assessment Criteria)
Dissolved Oxygen	No less than 5.0 mg/L (Illinois EPA standard)
Temperature	Less than 90° F (Illinois EPA standard)
pH	Between 6.5 – 9.0 (Illinois EPA standards)
Flow	--

Quality assurance and control should be conducted as part of the sampling routine and through laboratory analysis. Field-based quality control consists of quarterly to semi-annual sample replicates. Sample blanks should be used to assess contamination potential from deionized water and sample processing equipment. All samples should be taken in accordance with and adhere to Illinois EPA laboratory requirements; laboratory quality control measures include procedures such as measuring precision and accuracy. This information should be compiled in a sampling plan or a more detailed Quality Assurance Project Plan.

Recommended data analysis deliverables:

1. Calculations of annual sediment, phosphorus, and nitrate loads from the discrete sample and streamflow data.

2. Basic statistical summaries of measured and sampled concentrations and loadings, including storm-event samples.

Aquatic stream monitoring should be considered at the Illinois EPA Mill Creek and Mud Creek site every 5 years in alignment with the Illinois EPA intensive basin survey schedule. Table 64 shows the typical stream bioassessment techniques that can be applied to the monitoring program.

Table 64 - Stream Bioassessment Metrics

Monitoring	Definition	Benchmark Indicators
Fish Index of Biologic Integrity (fIBI)[1]	Index based on presence and populations of non-native and native fish species and their tolerance to degraded stream conditions.	**No Impairment** (≥41) – good resource quality and fully supporting aquatic life **Moderate Impairment** (<41 and >20) – fair resource quality and not supporting aquatic life **Severe Impairment** (≤20) – poor resource quality and not supporting aquatic life
Macroinvertebrate Index of Biologic Integrity (mIBI)[1]	Index indicative of stream quality based on the macroinvertebrate species and populations.	**No Impairment** (≥41.8) – good resource quality and fully supporting aquatic life **Moderate Impairment** (<41.8 and >20.9) – fair resource quality and not supporting aquatic life **Severe Impairment** (≤20.9) – poor resource quality and not supporting aquatic life
Qualitative Habitat Evaluation Index (QHEI)[2]	Index indicative of habitat quality that incorporates substrate, in-stream cover, channel morphology, riparian zone, bank erosion and riffle/pool condition.	**Excellent** (>70) **Good** (55-69) **Fair** (43-54) **Poor** (30-42) **Very Poor** (<30)
Channel Morphology	Establish fixed cross-section and longitudinal profile of channel along a 1,500-foot-long fixed reach. Monitor regularly to assess changes in channel.	Entrenchment ratio Width/depth ratio bankfull Bed material Cross-sectional area Water slope

[1] – From: IEPA Illinois Integrated Water Quality Report and Section 303(d) List, 2016; Guidelines for using Biological Information

[2] – From: State of Ohio Environmental Protection Agency Methods for Assessing Habitat in Flowing Waters: Using the Qualitative Habitat Evaluation Index (QHEI)

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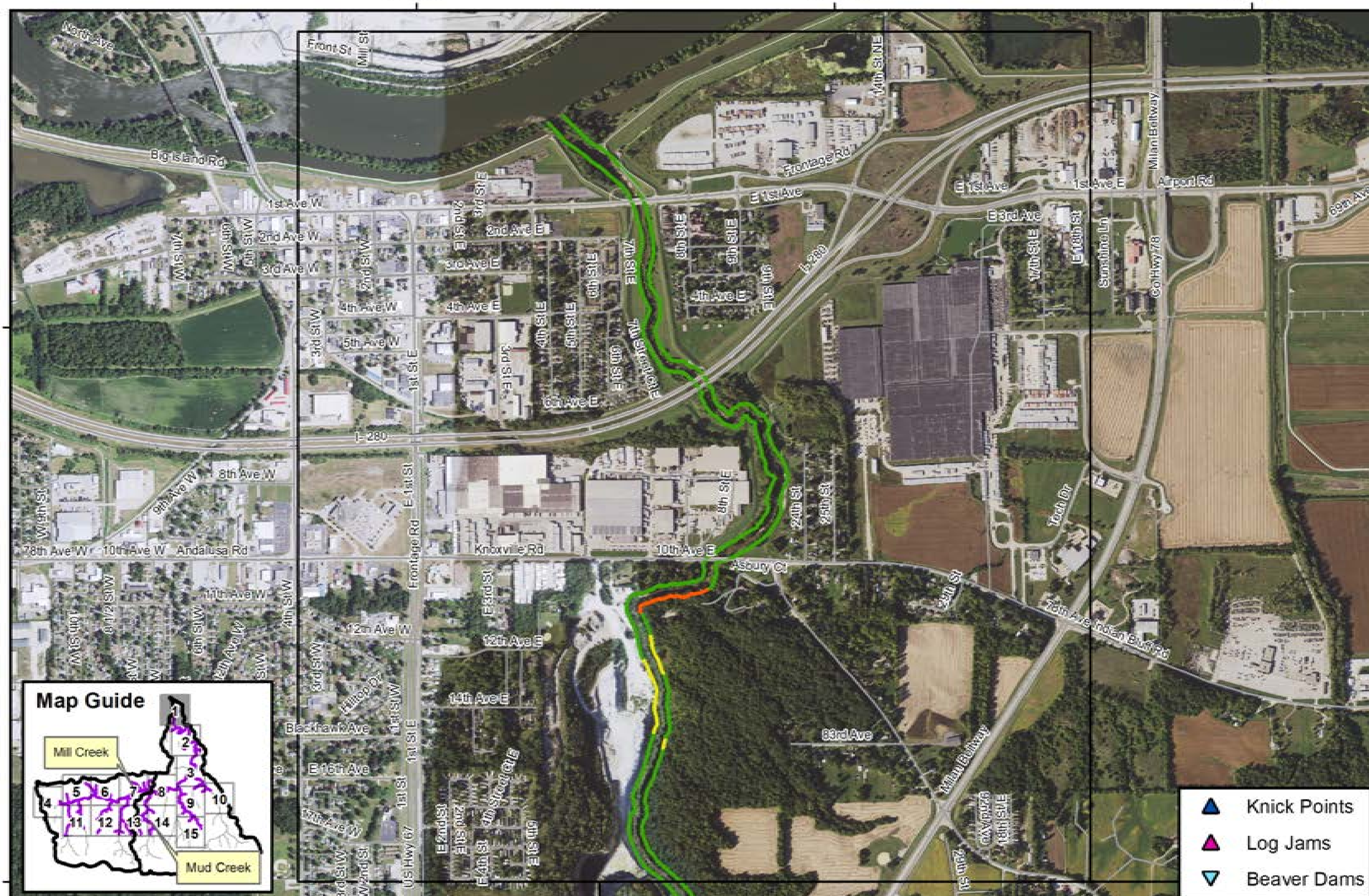
Appendix A: Streambank Erosion Map Book



Mill Creek Watershed
Streambank Erosion
Map 1 of 15

Assessed Streams (lbs/ft/yr)

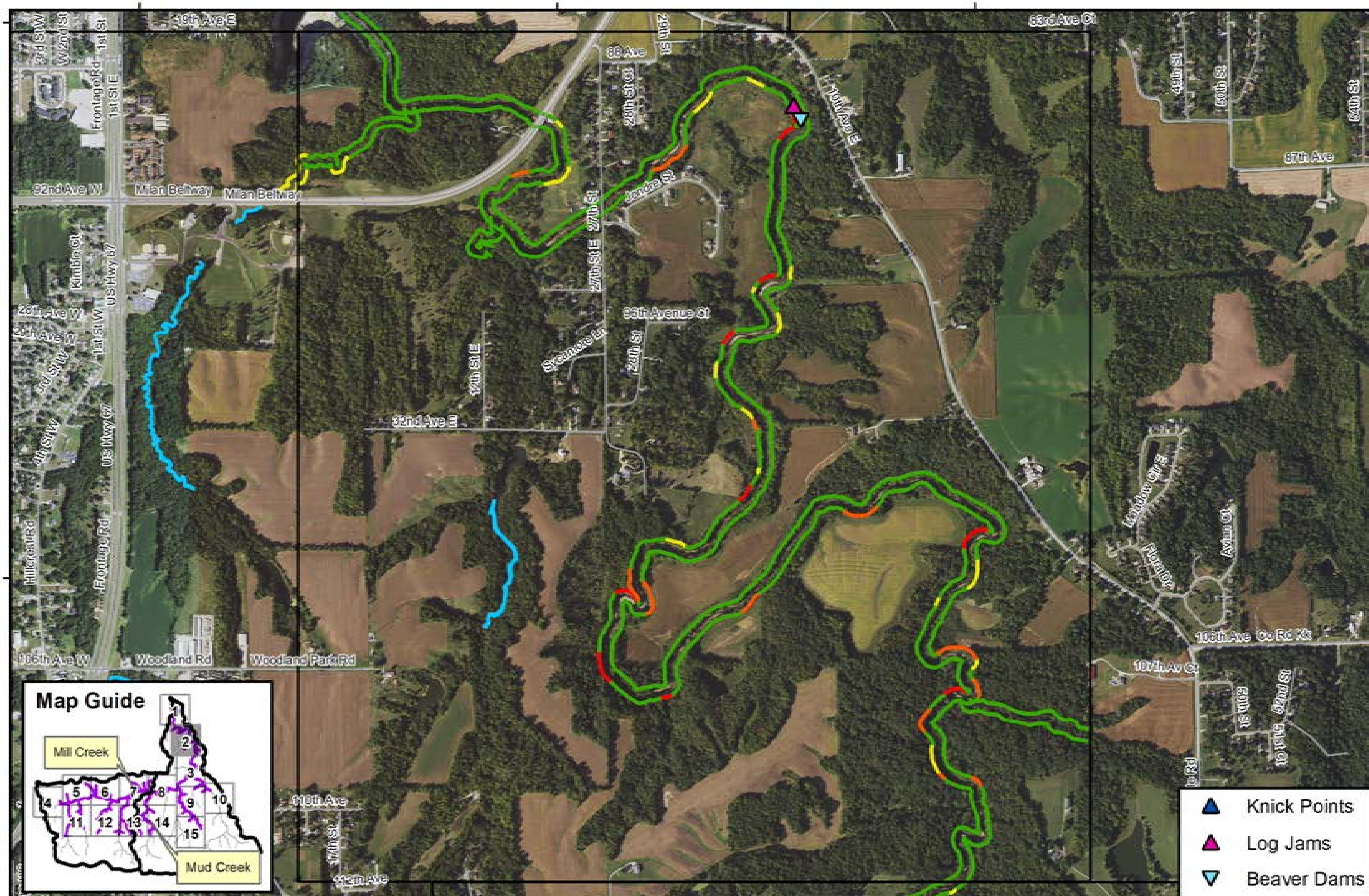
- < 50
- 50 - 100
- 100 - 200
- > 200
- Non-assessed Streams

0 1,000 2,000 3,000 4,000 Feet

Rock Island County Soil and Water Conservation District

Illinois Extension, University of Illinois Urbana-Champaign

northwater



Assessed Streams (lbs/ft/yr)

- < 50
- 100 - 200
- 50 - 100
- > 200
- Non-assessed Streams

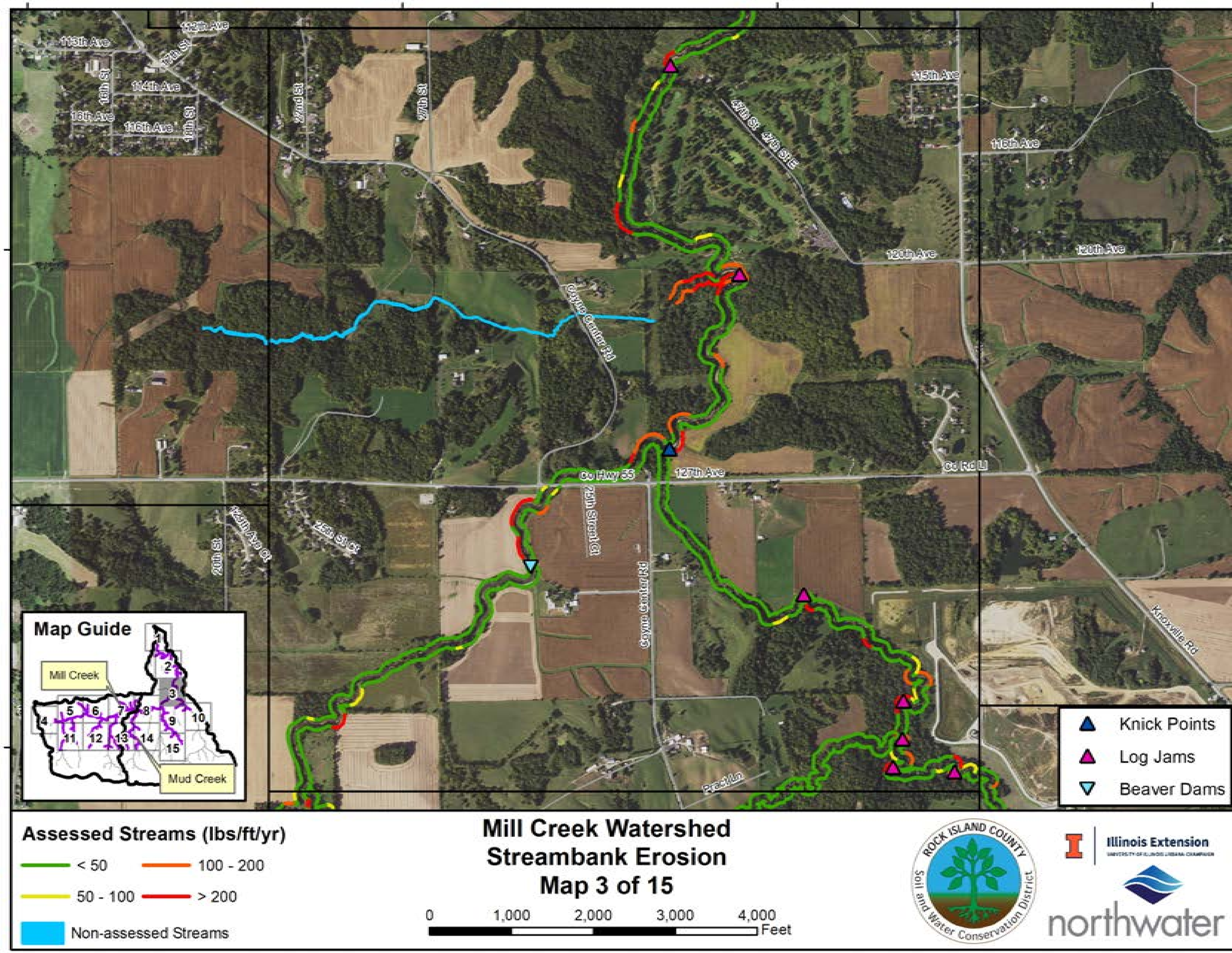
Mill Creek Watershed
Streambank Erosion
Map 2 of 15

0 1,000 2,000 3,000 4,000 Feet

ROCK ISLAND COUNTY Soil and Water Conservation District

Illinois Extension UNIVERSITY OF ILLINOIS URBANA-CHAMPAIGN

northwater


90°34'0"W
90°33'0"W
90°32'0"W
90°31'0"W
41°24'0"N
41°23'0"N
113th Ave
112th Ave
114th Ave
115th Ave
116th Ave
120th Ave
127th Ave
Co Hwy 55
Co Rd Ll
47th St
47th St E
22nd St
27th St
16th St
18th St
20th St
124th Ave Ct
25th St Ct
75th Street Ct
Coyne Center Rd
Knoxville Rd
Pract Ln
Map Guide
Mill Creek
Mud Creek
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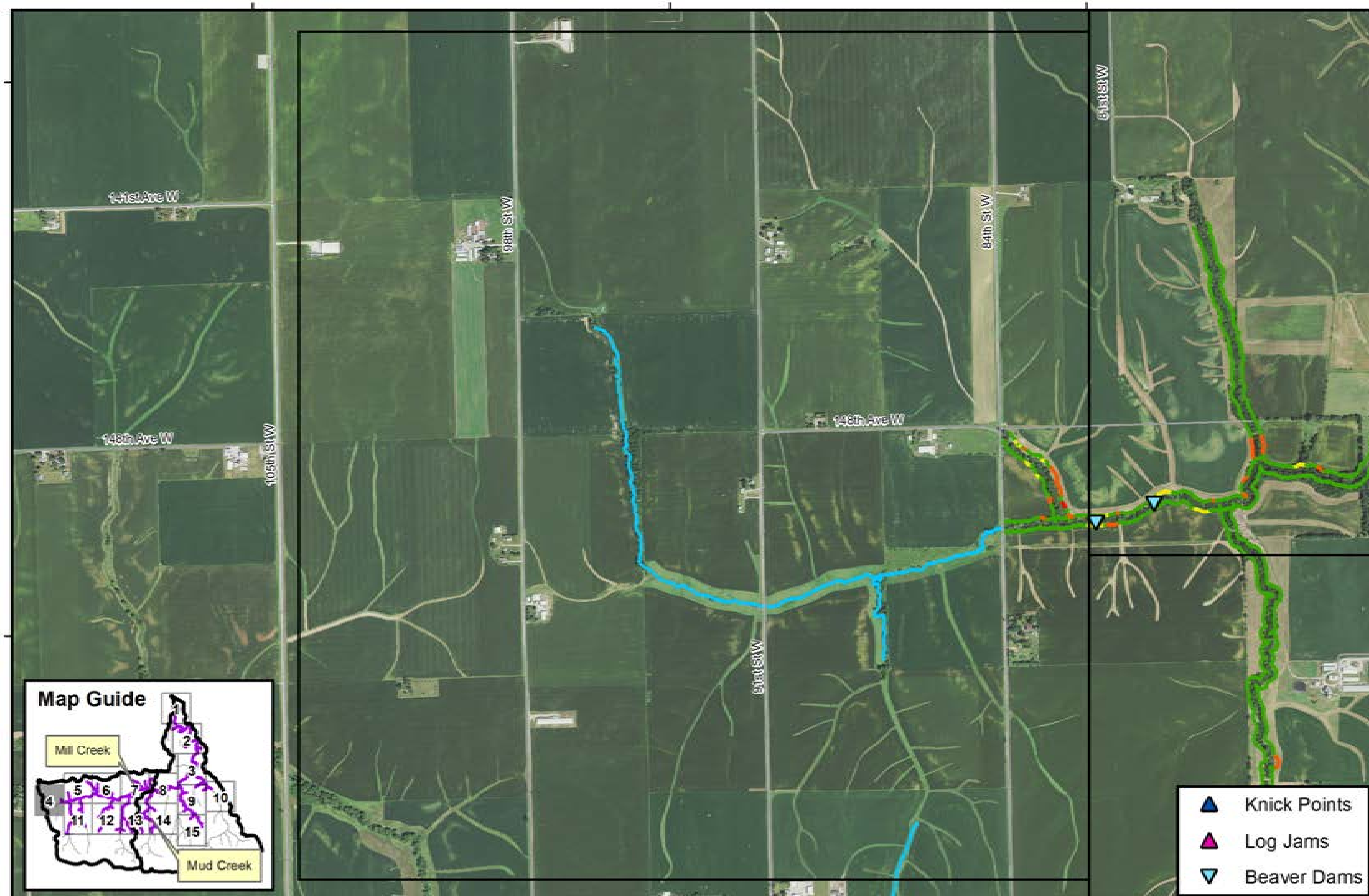
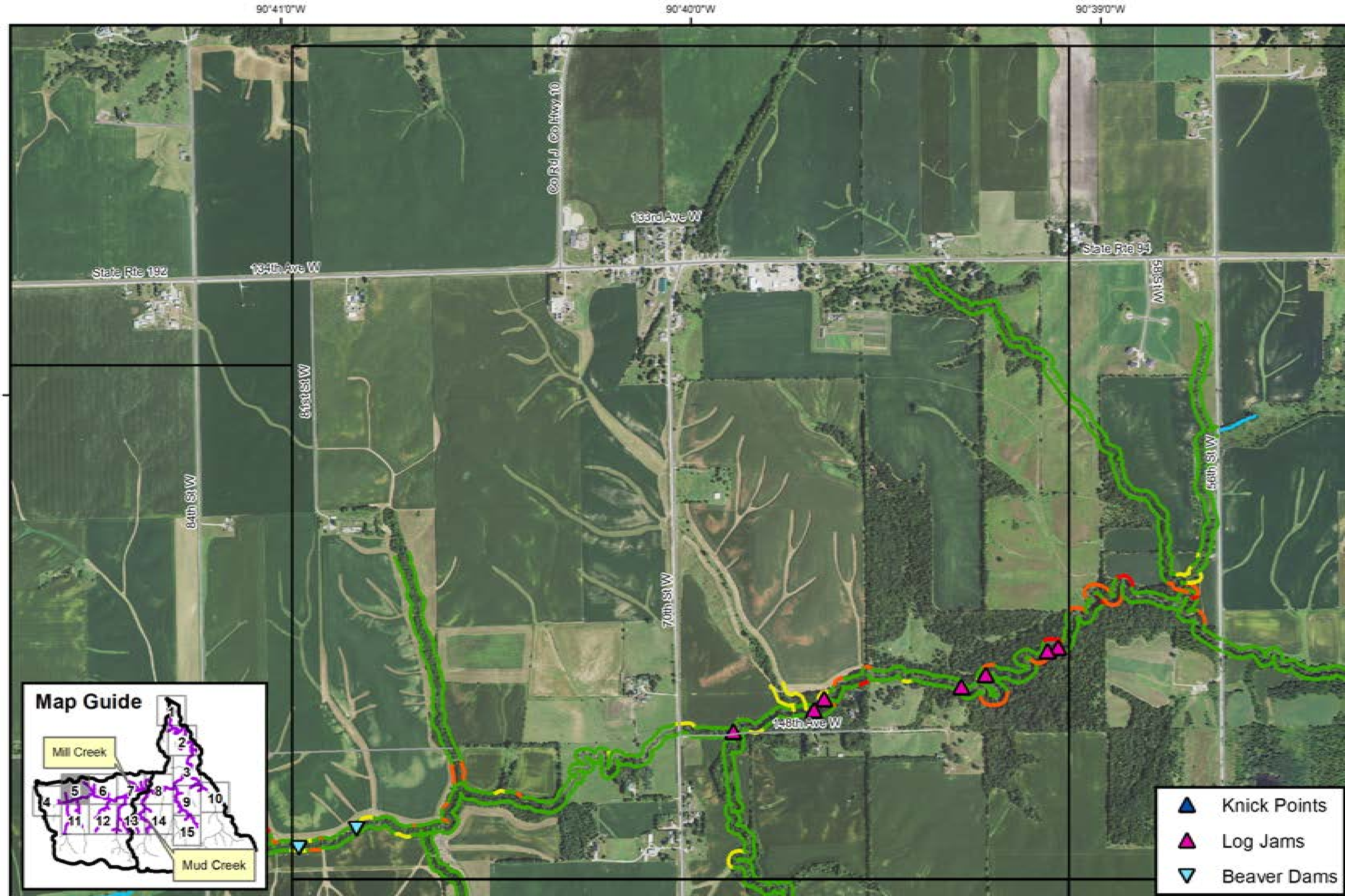
10
11
12
13
14
15
Knick Points
Log Jams
Beaver Dams
Assessed Streams (lbs/ft/yr)
< 50
100 - 200
50 - 100
> 200
Non-assessed Streams
Mill Creek Watershed
Streambank Erosion
Map 3 of 15
0
1,000
2,000
3,000
4,000
Feet
ROCK ISLAND COUNTY
Soil and Water Conservation District
Illinois Extension
northwater



Mill Creek Watershed
Streambank Erosion
Map 4 of 15



Assessed Streams (lbs/ft/yr)

< 50
100 - 200
50 - 100
> 200
Non-assessed Streams

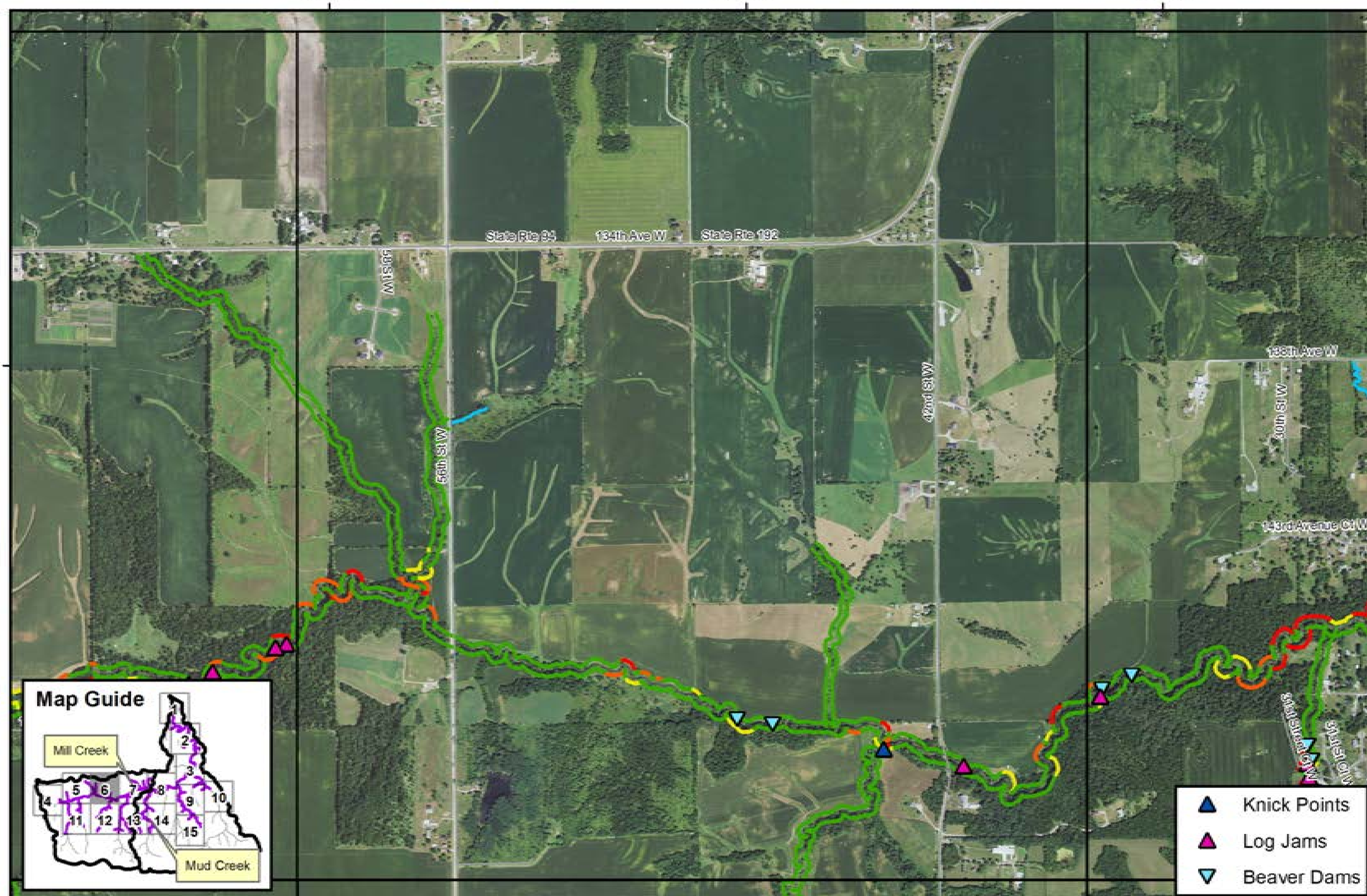
Mill Creek Watershed
Streambank Erosion
Map 5 of 15

0 1,000 2,000 3,000 4,000 Feet

ROCK ISLAND COUNTY Soil and Water Conservation District

Illinois Extension
UNIVERSITY OF ILLINOIS URBANA-CHAMPAIGN

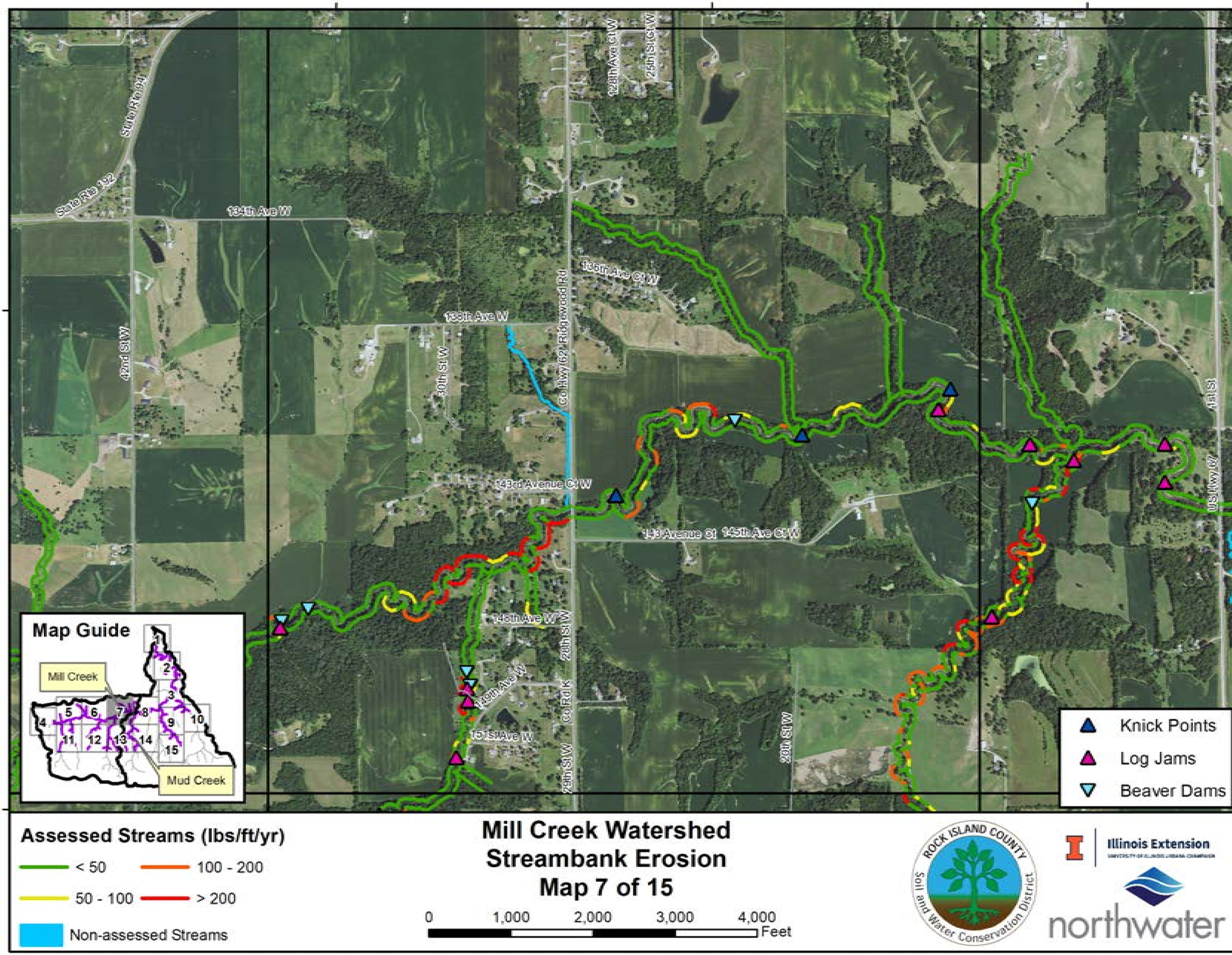
northwater



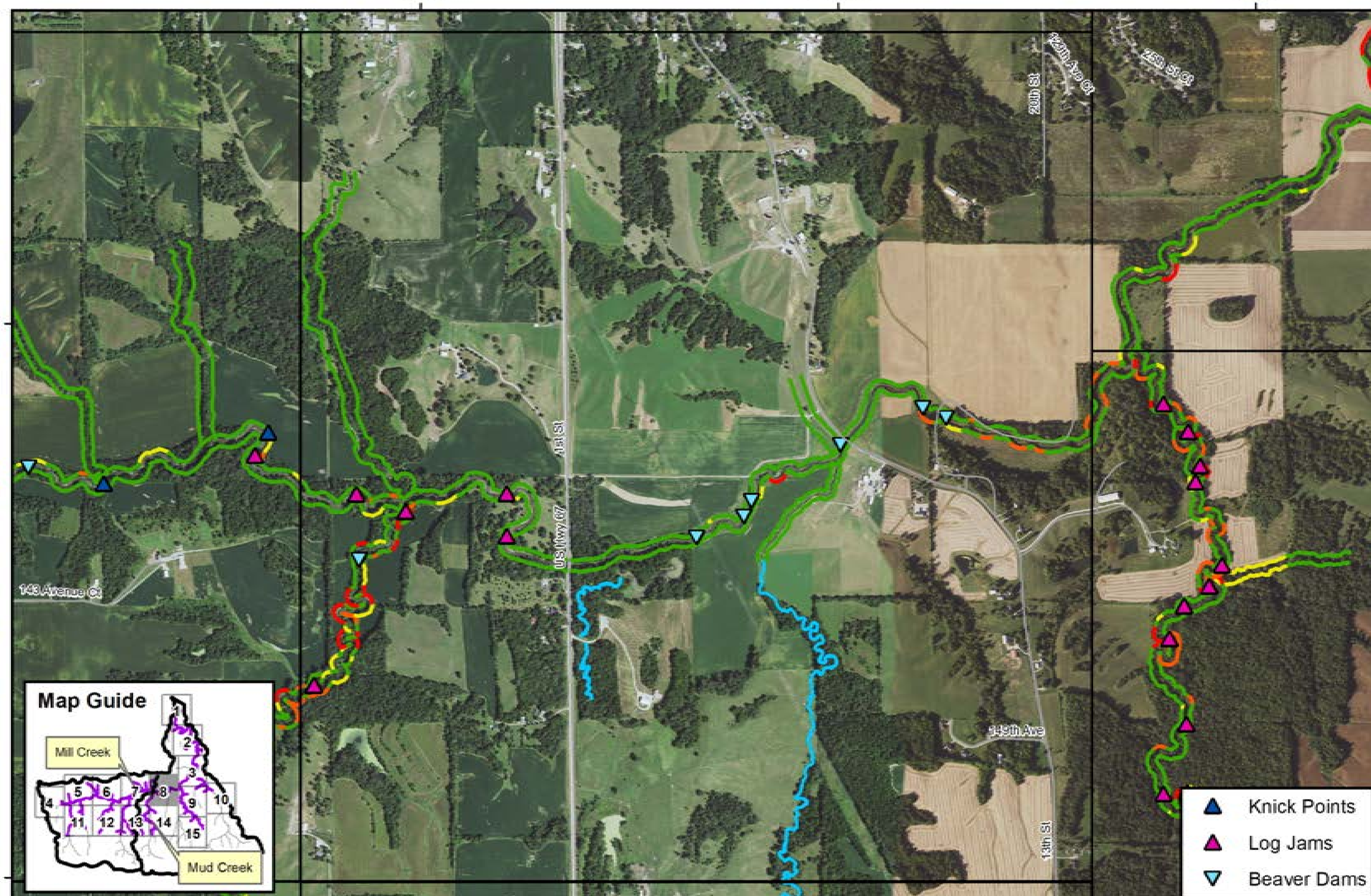
Assessed Streams (lbs/ft/yr)

- < 50
- 100 - 200
- 50 - 100
- > 200
- Non-assessed Streams

Mill Creek Watershed
Streambank Erosion
Map 6 of 15



Mill Creek Watershed
Streambank Erosion
Map 7 of 15



Assessed Streams (lbs/ft/yr)

< 50
100 - 200
50 - 100
> 200
Non-assessed Streams

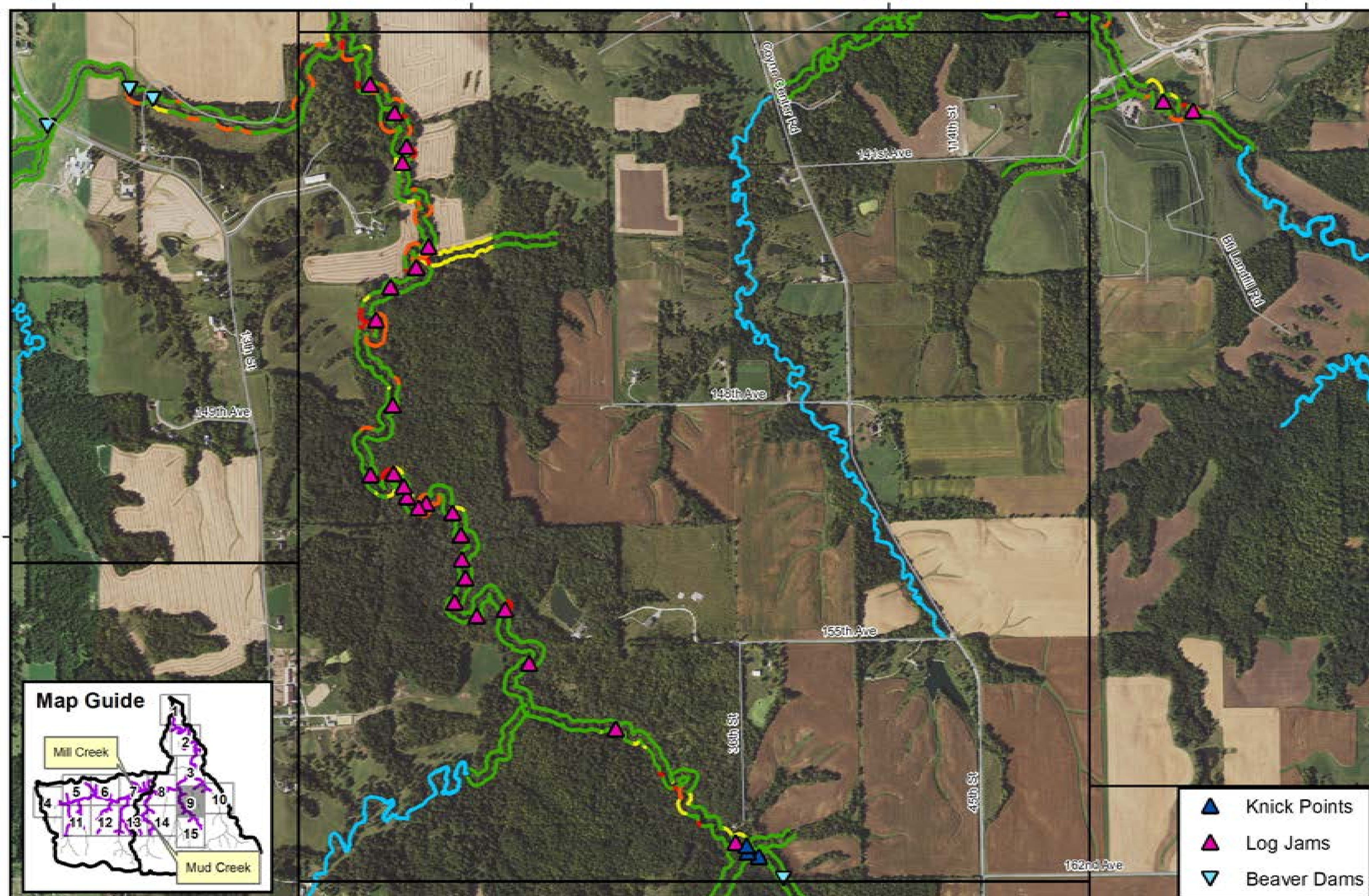
Mill Creek Watershed Streambank Erosion Map 8 of 15

0 1,000 2,000 3,000 4,000 Feet

ROCK ISLAND COUNTY Soil and Water Conservation District

Illinois Extension UNIVERSITY OF ILLINOIS URBANA-CHAMPAIGN

northwater



Assessed Streams (lbs/ft/yr)

- < 50
- 50 - 100
- 100 - 200
- > 200
- Non-assessed Streams

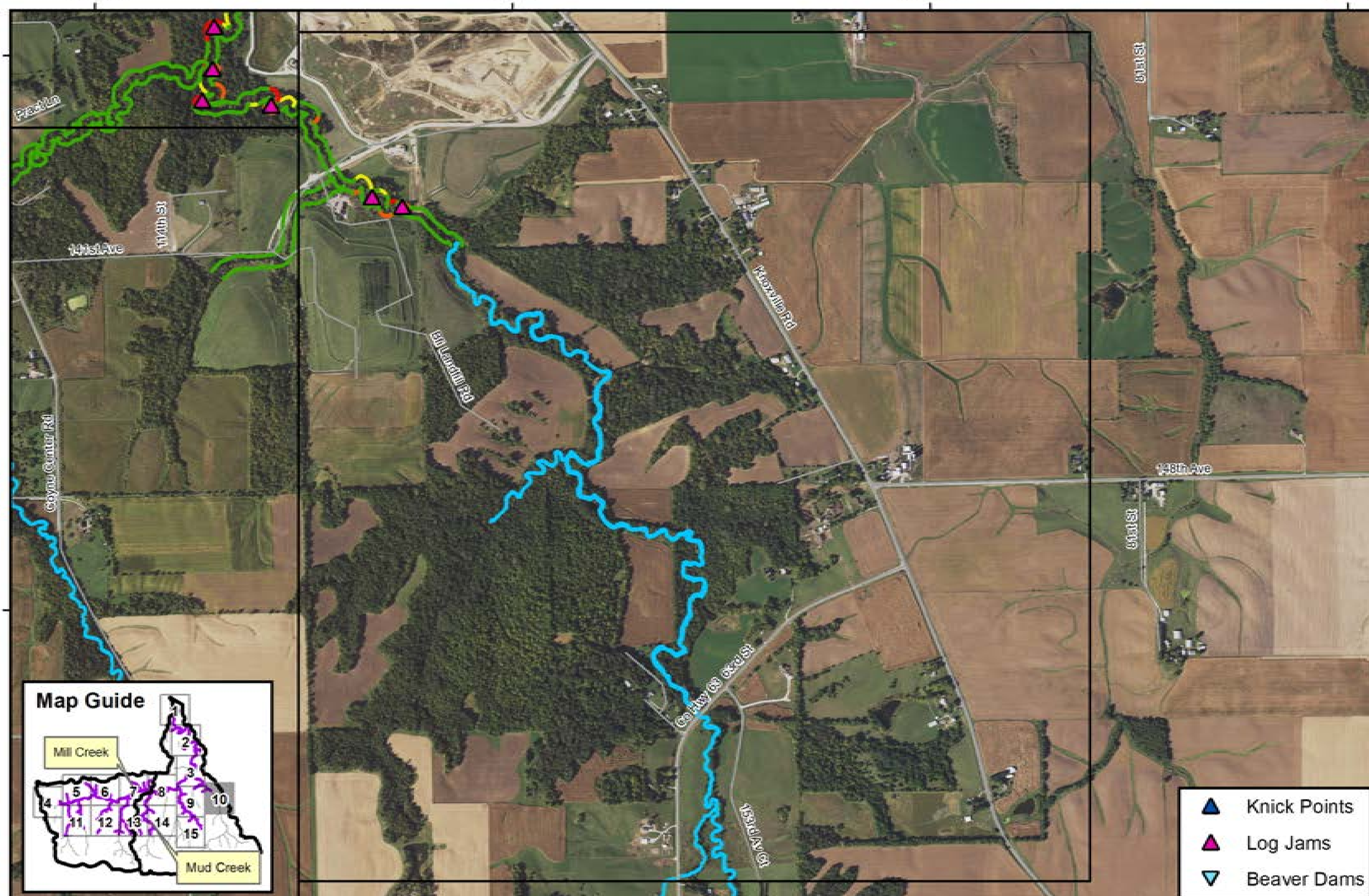
Mill Creek Watershed Streambank Erosion Map 9 of 15

0 1,000 2,000 3,000 4,000 Feet

Rock Island County Soil and Water Conservation District

Illinois Extension, University of Illinois Urbana-Champaign

northwater



Assessed Streams (lbs/ft/yr)

< 50

100 - 200

50 - 100

> 200

Non-assessed Streams

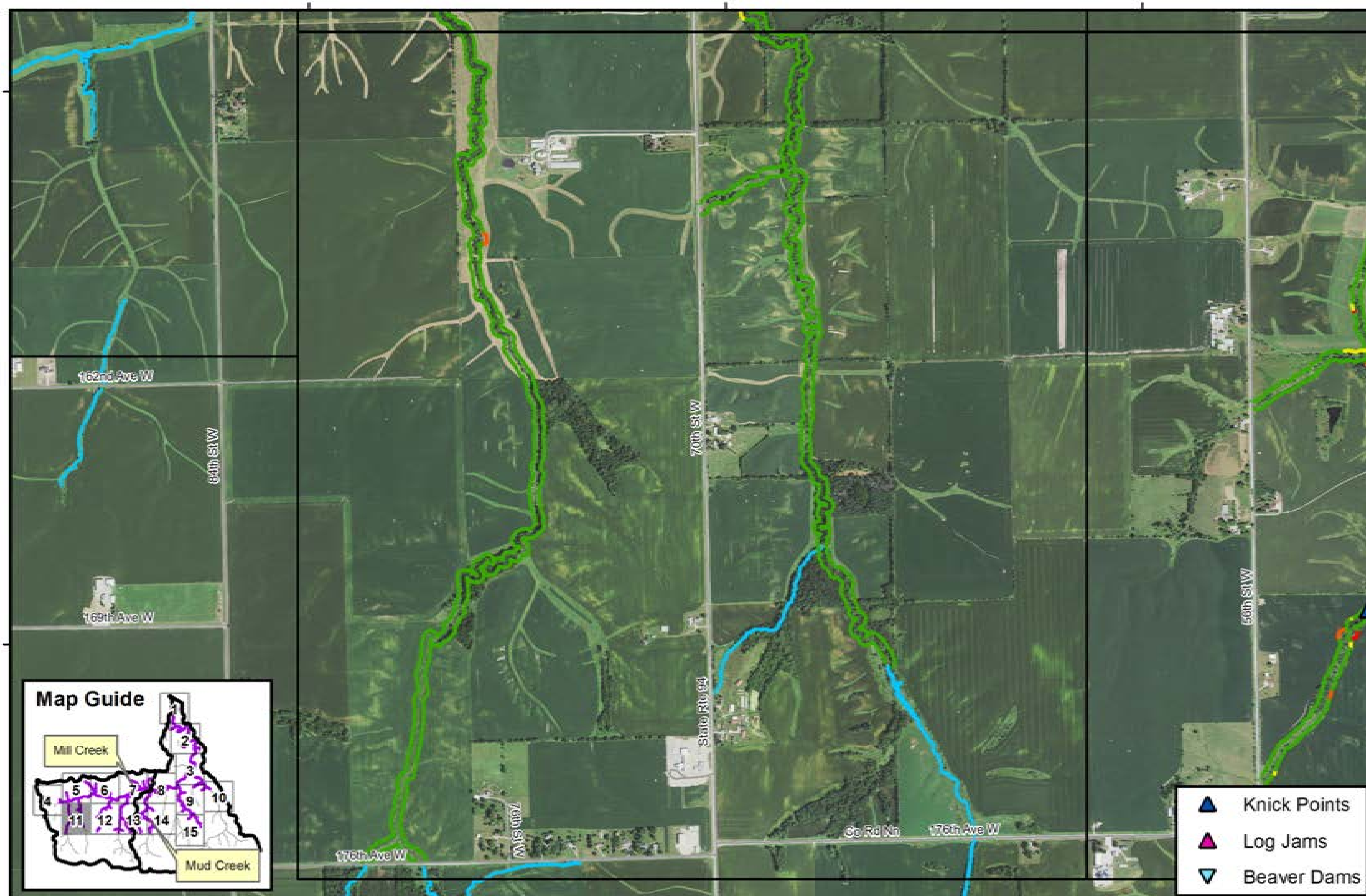
Mill Creek Watershed Streambank Erosion Map 10 of 15

0 1,000 2,000 3,000 4,000 Feet

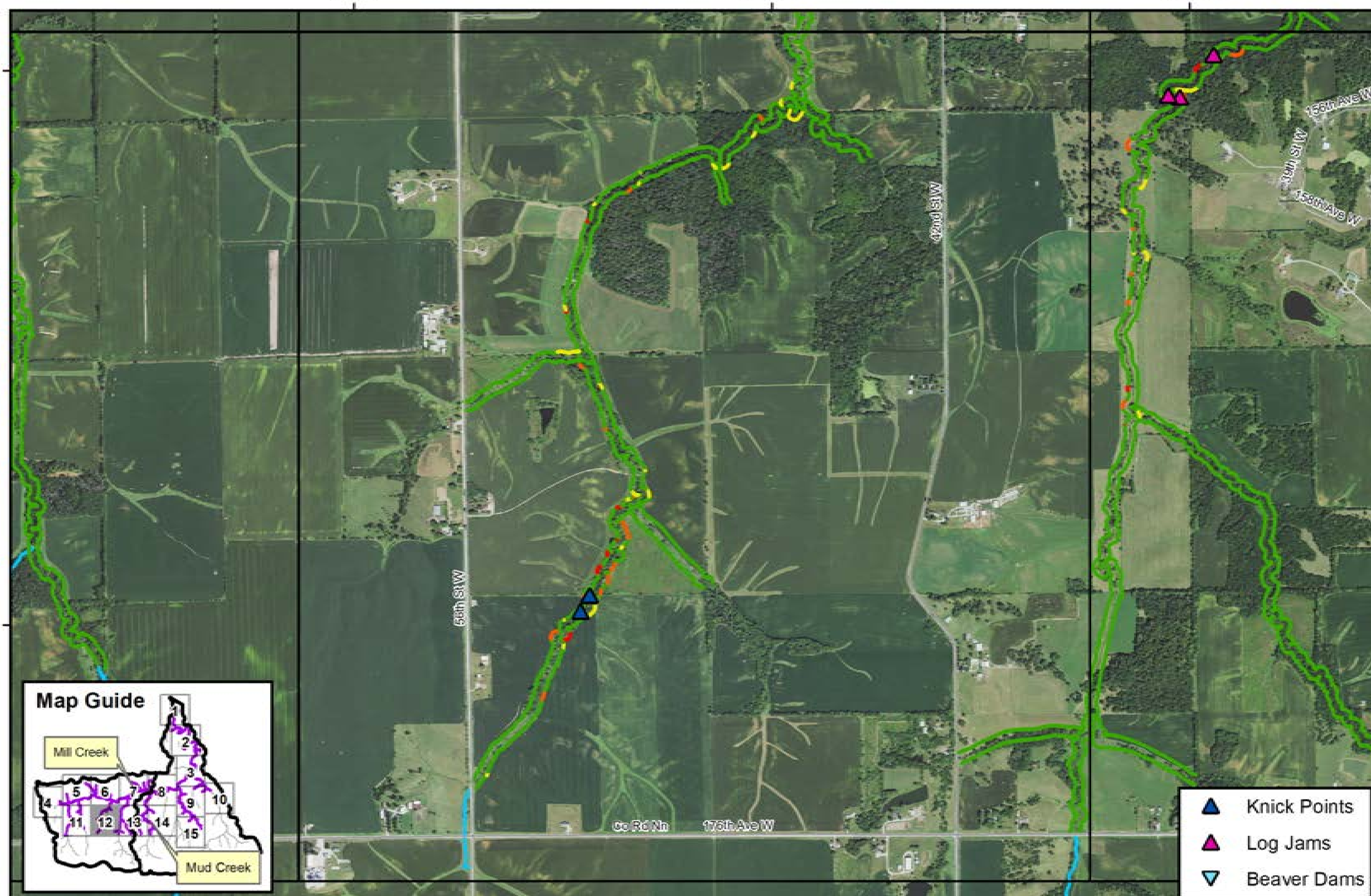
ROCK ISLAND COUNTY Soil and Water Conservation District

Illinois Extension UNIVERSITY OF ILLINOIS URBANA-CHAMPAIGN

northwater



Mill Creek Watershed Streambank Erosion Map 11 of 15

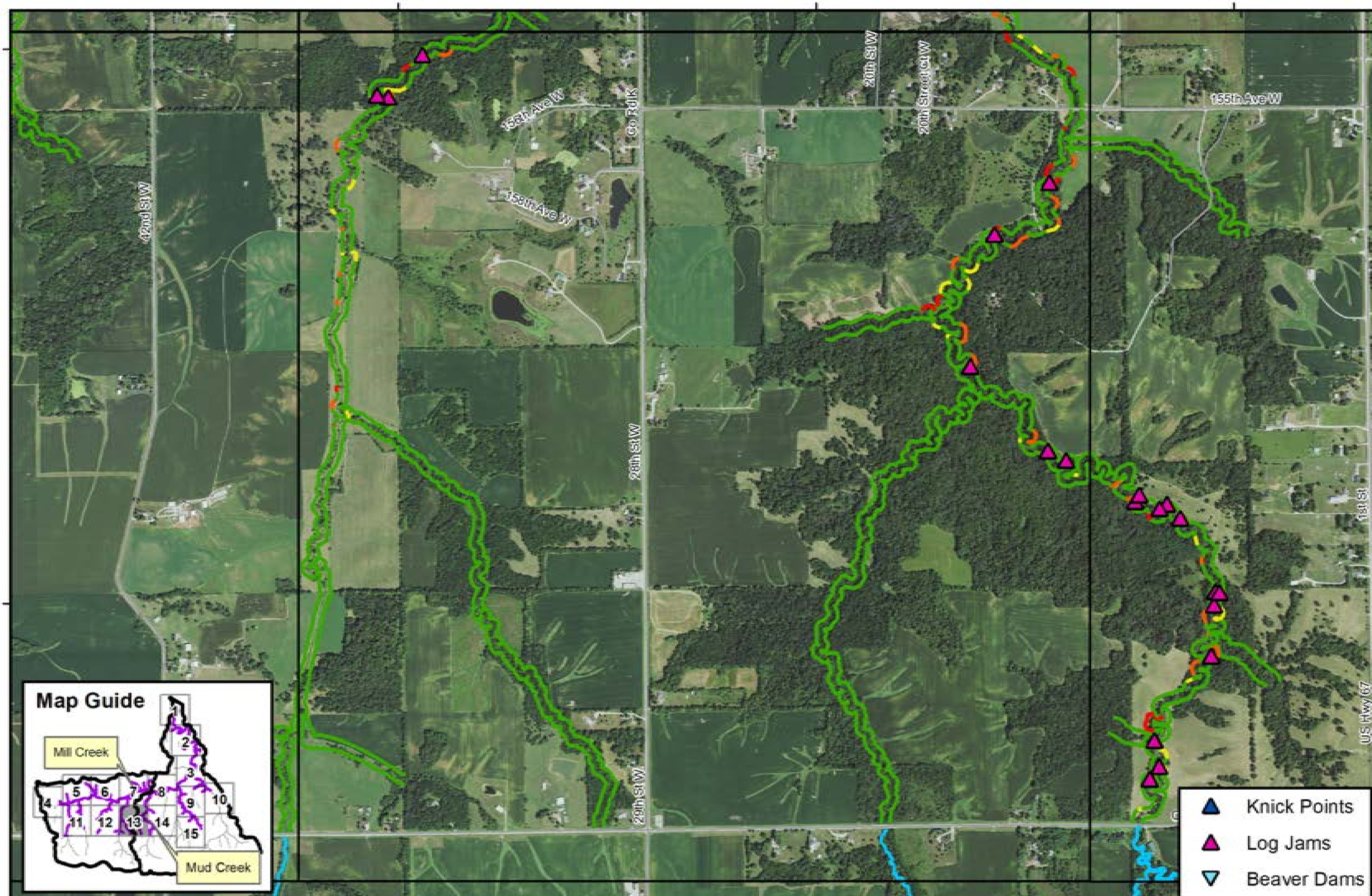


Mill Creek Watershed
Streambank Erosion
Map 12 of 15

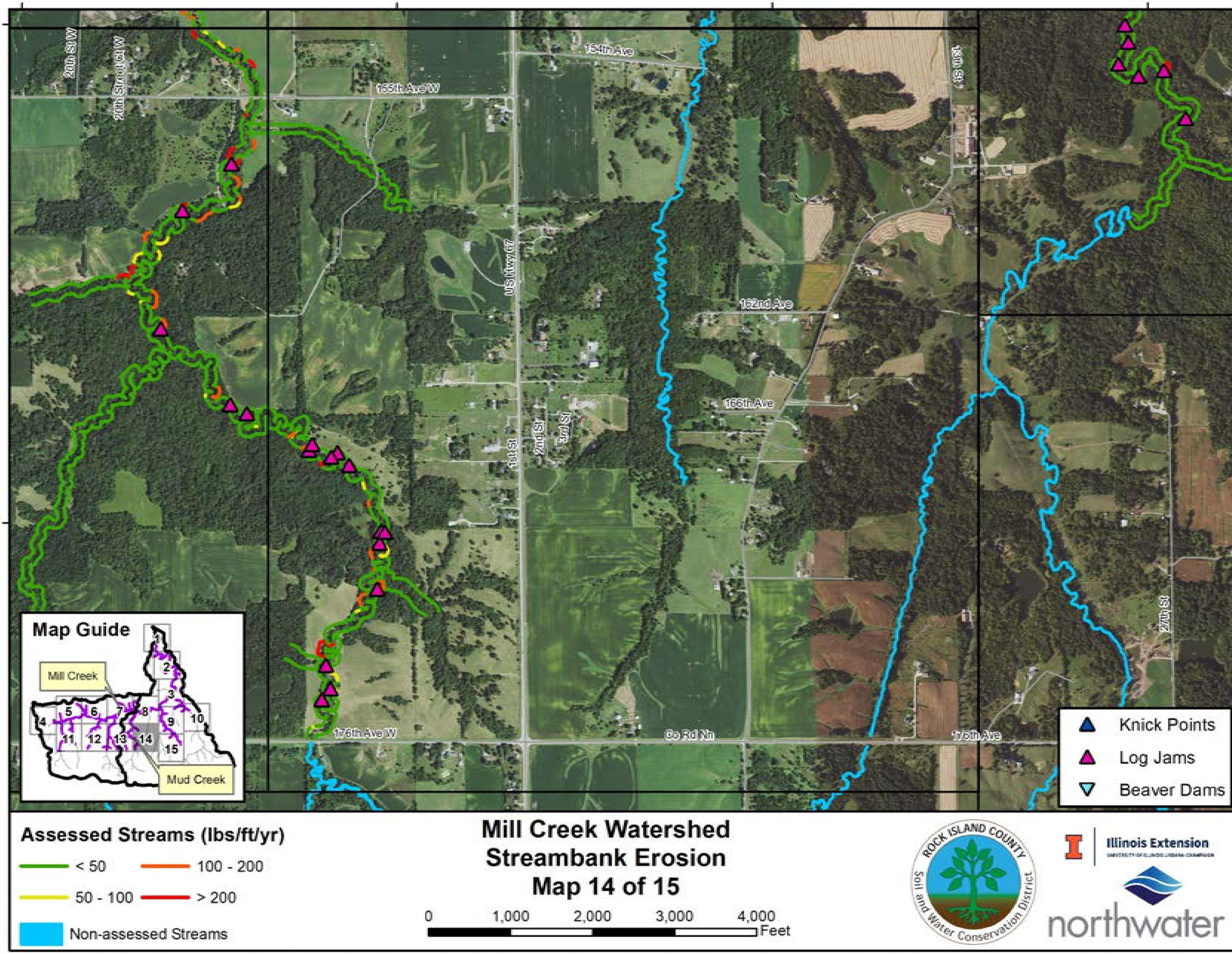
Assessed Streams (lbs/ft/yr)

- < 50
- 50 - 100
- 100 - 200
- > 200

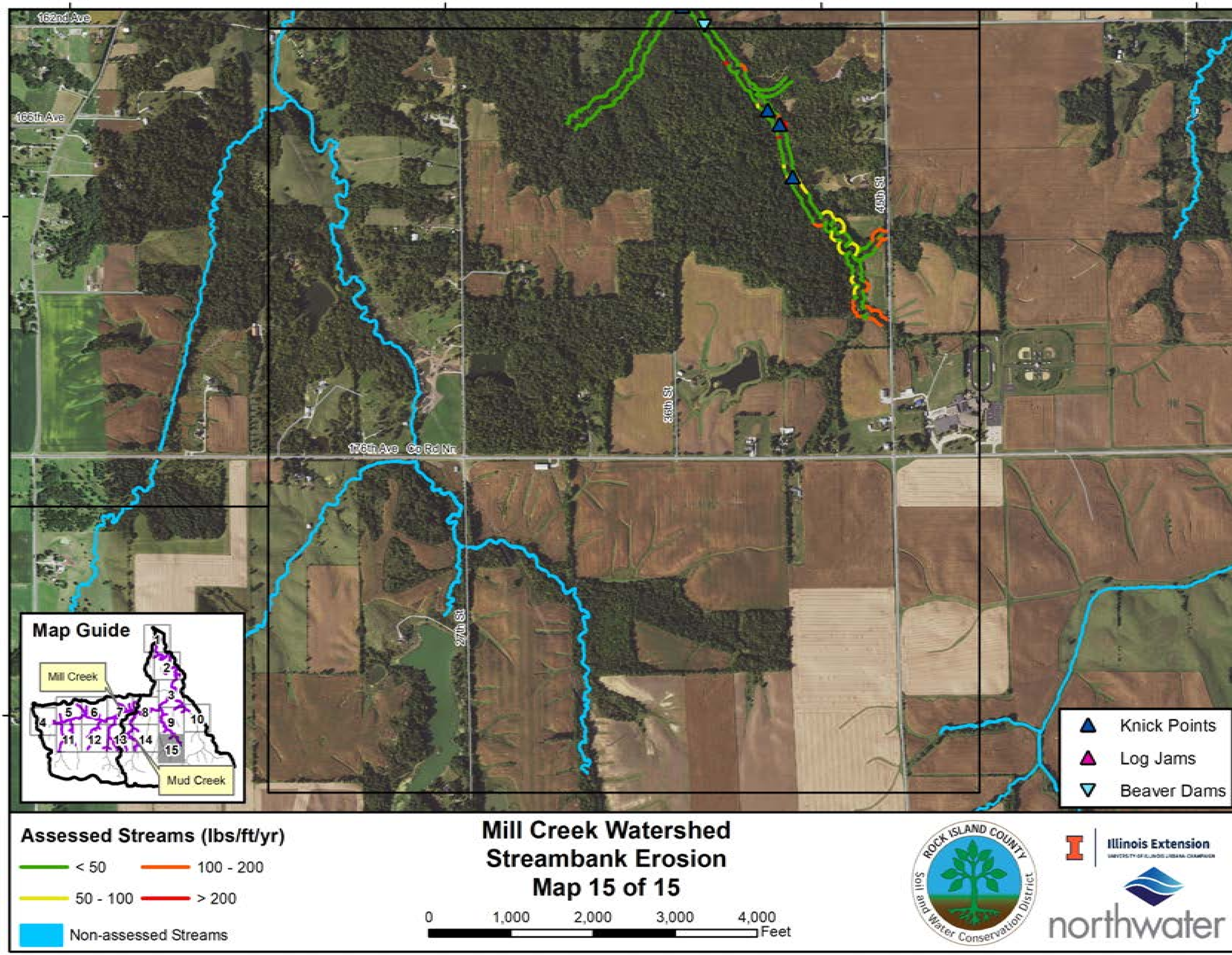
Non-assessed Streams



Mill Creek Watershed
Streambank Erosion
Map 13 of 15



Mill Creek Watershed
Streambank Erosion
Map 14 of 15



90°34'0"W
90°33'0"W
90°32'0"W
90°31'0"W
41°21'0"N
41°20'0"N
162nd Ave
166th Ave
176th Ave Co Rd Nn
36th St
27th St
Map Guide
Mill Creek
Mud Creek
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
Knick Points
Log Jams
Beaver Dams
Mill Creek Watershed
Streambank Erosion
Map 15 of 15
Assessed Streams (lbs/ft/yr)
< 50
100 - 200
50 - 100
> 200
Non-assessed Streams
0
1,000
2,000
3,000
4,000
Feet
Rock Island County Soil and Water Conservation District
Illinois Extension
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