ZION Development

KEITH CREEK WATERSHED-BASED PLAN

A Watershed-Based Guide for Protecting and Restoring Watershed Health

AUGUST 2022









KEITH CREEK
WATERSHED-BASED PLAN

Winnebago and Boone Counties, Illinois

A Watershed-Based Guide for Protecting and Restoring Watershed Health

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Christine Davis and David Souther acted as project manager for Illinois EPA's Bureau of Water while Bob Campbell (Executive Director) acted as Watershed Coordinator for the Steering Committee and worked closely with watershed partners and RES to produce the watershed planning document.

Watershed meetings were led by ZION Development Corporation in partnership with various governmental, private, and public organizations as well as many residents. Key partners include the City of Rockford, Region 1 Planning Council, Winnebago and Boone Counties, Rockford Park District, Studio GWA, the Lakota Group, Fehr Grahm, Hey & Associates, Four Rivers Sanitation Authority, Miracle Mile Rockford, Rockford Area Convention & Visitor's Bureau, and Patriot's Gateway Center. These partners played an important role in providing input on plan content, watershed goals & objectives, various planning approaches, and input on potential watershed projects and concurrent planning activities.

RES conducted analysis, presented at Watershed stakeholder meetings, summarized results, and authored the Keith Creek Watershed-Based Plan.

People from the following entities attended meetings and/or provided data:

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Fehr Graham: Pat Kesey, Jeff Macke
Four Rivers Sanitation Authority: Chris Baer, Greg Cassaro, Tim Hanson, Melanie Overman
Midway Village: Patrick O'Keefe
Miracle Mile Rockford: Paula Olson
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RES: Cecily Cunz, Steve Zimmerman
Rockford Park District: Tim Bragg, Dan Jacobson
Studio GWA: Gary Anderson, Ashley Sarver, Michael Smith
The Lakota Group: Scott Ruhland
Winnebago County: Christopher Dornbush, Karl Palmquist, Sean Von Bergen
ZION Development Corporation: Bob Campbell

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EXECUTIVE SUMMARY

AUGUST 2022

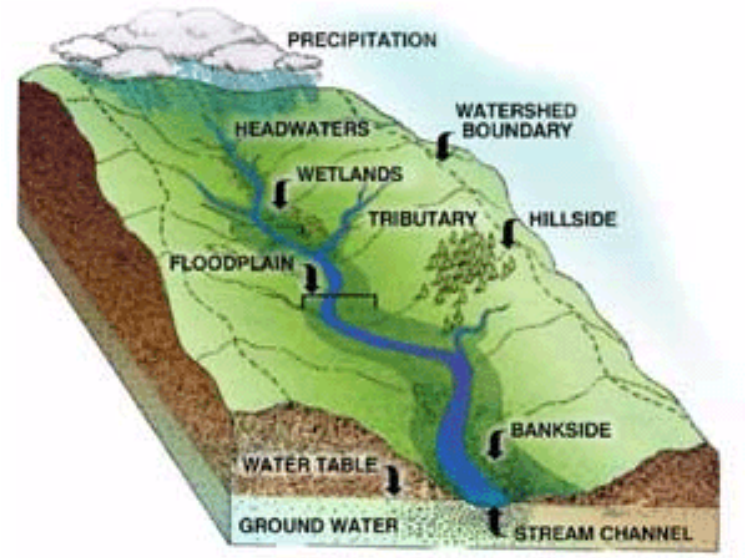








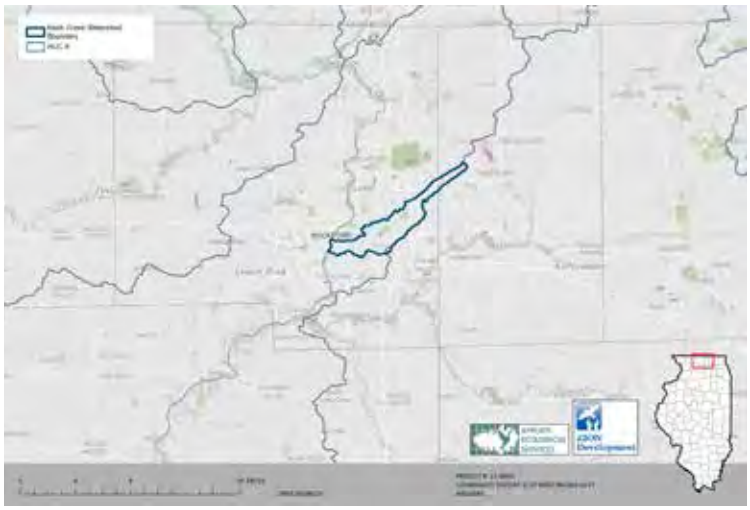
INTRODUCTION, PROCESS



Hypothetical watershed setting (Source: City of Berkley Public Works)

People live, work, and play in their watershed every day. A watershed is best described as an area of land where surface water drains to a common location such as a stream, river, lake, or other body of water. The source of groundwater recharge to streams, rivers, and lakes is also considered part of a watershed. Despite the simple definition, watersheds are complex as interaction between natural elements such as climate, surface water, groundwater, vegetation, and wildlife combine with human influences like urban development, agriculture, increases to impervious surfaces, altered stormwater flows, and degradation or fragmentation of natural areas. Depending on the size, other names for describing watersheds might include basins, sub-basins, and subwatersheds.

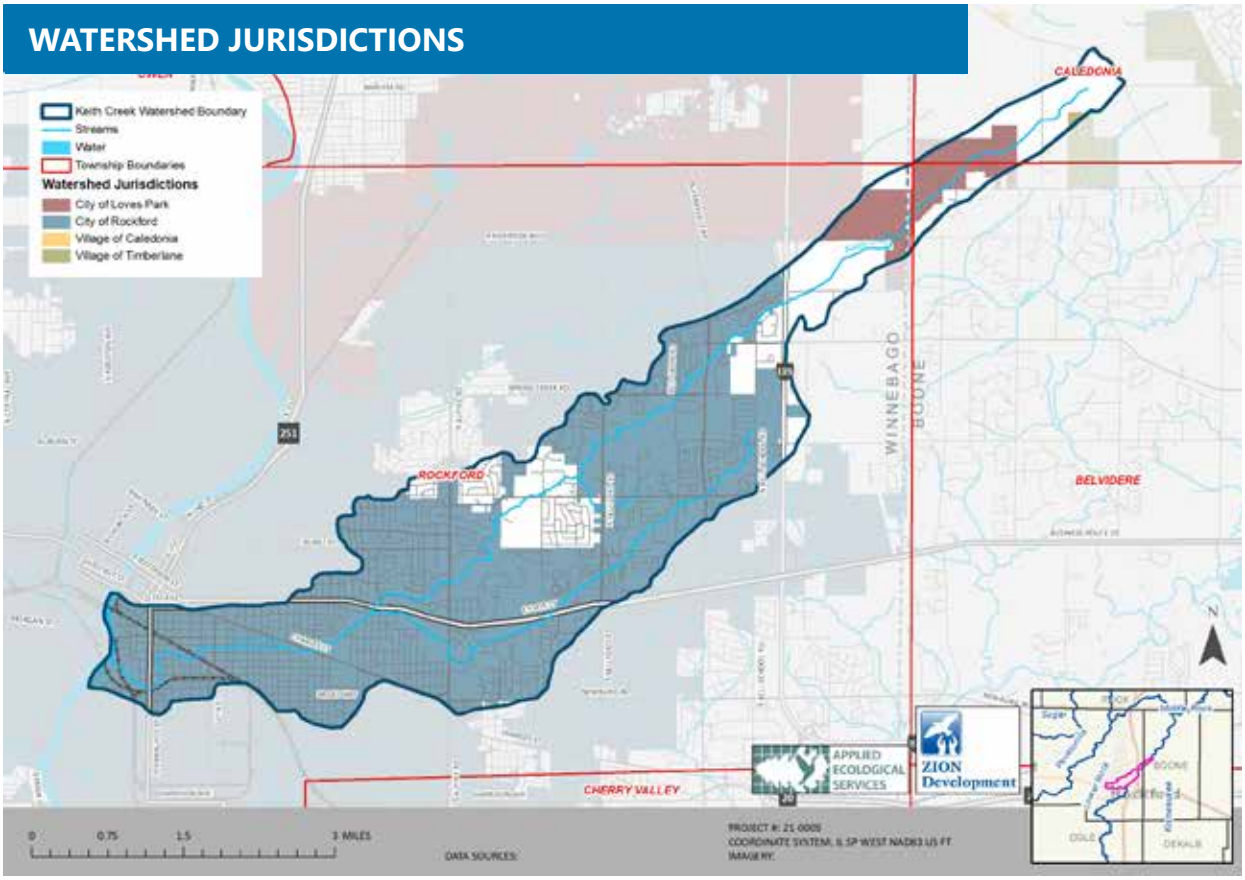
The Keith Creek watershed, at 14.2 square miles in size, is a small watershed located in the City of Rockford, across parts of Winnebago and Boone Counties, which outlets directly to the Rock River. It drains almost half of the Spring Creek-Rock Creek watershed (HUC 070900050107) and sits nested within the headwaters of the larger Lower Rock River Watershed. The Rock River then flows southwest to join the Mississippi at Rock Island, Illinois.



The watershed planning process is a collaborative effort involving voluntary stakeholders with the primary scope to restore impaired waters and protect unimpaired waters by developing an ecologically-based management plan for the Keith Creek watershed that focuses on improving



WATERSHED JURISDICTIONS



, & GOALS

water quality by protecting green infrastructure, creating protection policies, implementing ecological restoration, educating the public and improving the quality of life for people in the watershed for current and future generations. This plan, led by ZION Development, will complement the City of Rockford's Stormwater Management Program, addressing bank erosion, construction and industrial high-risk runoff such as the Joe Behr metal scrap yard, and Rockford Auto Parts junk yard, illegal dumping, and pesticide and fertilizer use.

Two additional planning efforts ran concurrent to the watershed-based planning process. The City of Rockford and Fehr Graham Engineering & Environmental led a flood study which detailed flood hazard area buyouts and hydrologic and hydraulic analysis of the Keith Creek corridor. Meanwhile, the Keith Creek Corridor Study: State of Keith Creek Summary was led by R1PC, The Lakota Group, Studio GWA, Hey and Associates, and Strand Associates. The study focused on planning and redevelopment projects, greenway, transportation, access to natural resources, infrastructure improvements, economic developments, coordinating efforts between local entities to control flooding, and an analysis of diversity, equity, and inclusion. The Corridor Study and the Watershed-Based Plan teams coordinated during plan development, collaborated efforts around stakeholder engagement, and aligned plan guidance and recommendations as applicable.

Goal 1: ***Manage and mitigate for existing and future structural flood problems.***

Goal 2: ***Improve surface water quality to meet applicable water quality standards.***

Goal 3: ***Protect, manage, and restore natural components of the Green Infrastructure Network and improve fish and wildlife habitat.***

Goal 4: ***Build stakeholder awareness of watershed issues or concerns through education and stewardship while increasing communication and coordination among stakeholders.***

Goal 5: ***Assess and improve policies and regulations to protect and support our natural resources.***



Keith Creek Reach 11

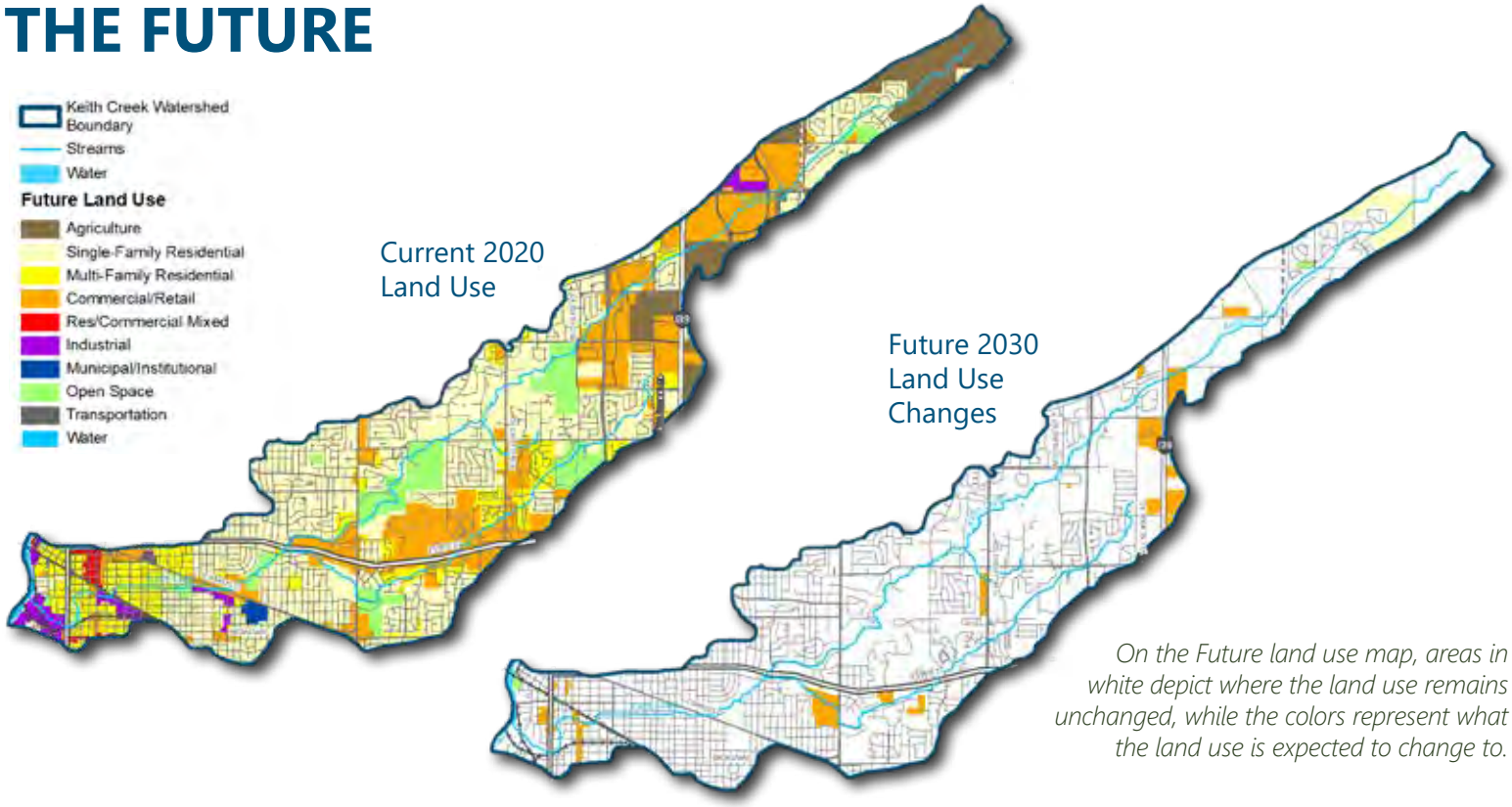




Rockford was originally called Midway as it was halfway between Chicago and Galena and early industry centered around manufacturing of farm-machinery and furniture with the extension of the Galena and Chicago Union Railroad to the Rock River in 1852. The surveyors detailed Keith Creek watershed as a nearly even split between prairie and woodland communities. Prior to settlement, the prairie-savanna landscape was maintained and renewed by frequent lightning strike fires, fires ignited by Native Americans, and grazing by bison and elk. Fires ultimately removed dead plant material, exposing the soils to early spring sun, and returning nutrients to the soil. Running through the prairie-savanna and woodland landscapes were meandering stream corridors and low wet depressions consisting of sedge meadow, marsh, and wet prairie. These streams only covered the lower two-thirds of the watershed as we know it today and had many more meanders. Areas of woodland stretched through the center of the watershed and across the northeastern corner and were comprised of white, red, pin, and burr oaks, interspersed with poplar, maple, butternut, black-walnut and hickory.

European settlement resulted in drastic changes to the fragile ecological communities. Fires no longer occurred as they threatened prairie homesteads, trees and woodlands were cut for fuel and to build the homes and businesses of early settlers, prairie and wetlands were tilled under or drained for farmland or developed, and many channels/ditches were excavated through wet areas to further drain the land for farming purposes.

THE FUTURE

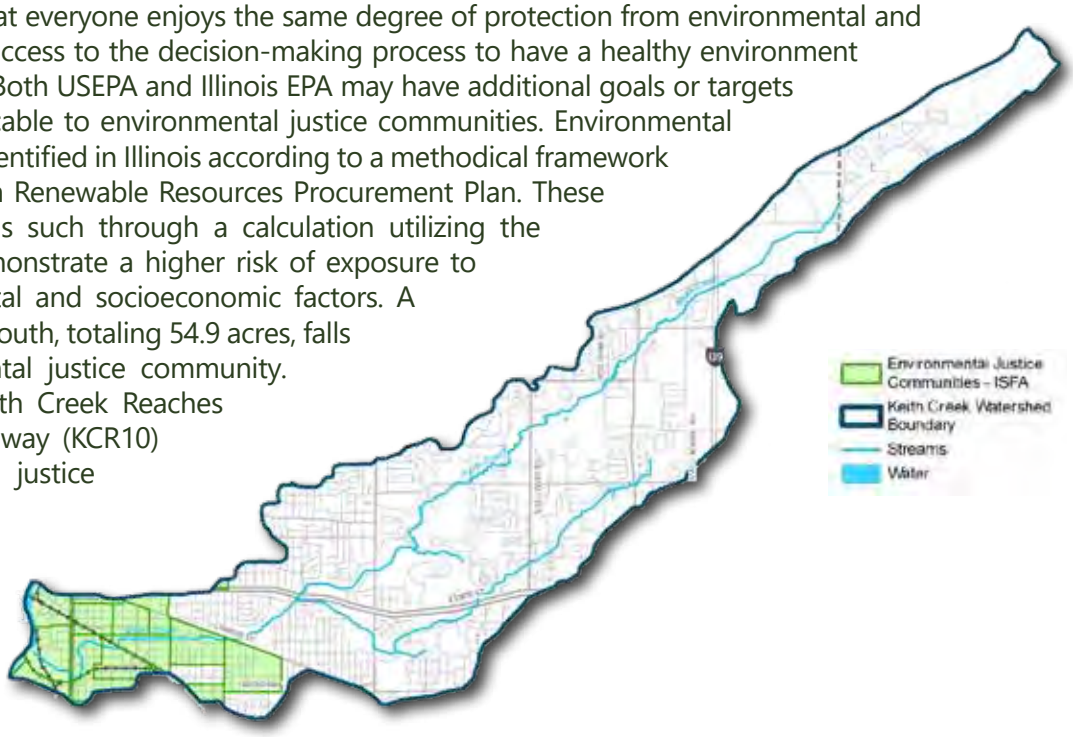


On the Future land use map, areas in white depict where the land use remains unchanged, while the colors represent what the land use is expected to change to.

The land use changes predicted for the watershed are relatively minor due to how built-out the watershed already is. The largest loss of a current land use is expected to occur on agricultural land where approximately 266.9 acres of the existing 716.3 acres (a loss of 2.9%) is expected to be converted other uses. The largest predicted increase to a current land use is in commercial/retail, which will add 278.7 acres (3.1%). Most of these changes are expected to occur near the headwaters to the northeast.

ENVIRONMENTAL JUSTICE

United States Environmental Protection Agency is committed to environmental justice which is the fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income, with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies. The goal of environmental justice is to see that everyone enjoys the same degree of protection from environmental and health hazards, as well as equal access to the decision-making process to have a healthy environment in which to live, learn, and work. Both USEPA and Illinois EPA may have additional goals or targets and funding opportunities applicable to environmental justice communities. Environmental justice communities have been identified in Illinois according to a methodical framework established under the Long-Term Renewable Resources Procurement Plan. These communities were designated as such through a calculation utilizing the US EPA tool, EJ Screen, and demonstrate a higher risk of exposure to pollution based on environmental and socioeconomic factors. A portion of Keith Creek near the mouth, totaling 54.9 acres, falls within an identified environmental justice community. It is important to note that Keith Creek Reaches 9-12 and the Keith Creek Greenway (KCR10) fall within the environmental justice community boundary.



CHALLENGES & THREATS

Surface Water Quality

- Water quality sampling and IEPA reports show moderate impairment from elevated total phosphorus, fecal coliform, alteration in stream-side or littoral vegetative covers, arsenic, methoxychlor, zinc, pH, and changes in stream depth and velocity patterns in Keith Creek.
- Elevated phosphorus levels are a problem in streams and can lead to a chain of undesirable events such as accelerated plant growth, algae blooms, low dissolved oxygen, and death of some aquatic organisms.
- Elevated fecal coliform levels impair potential recreational opportunities.

Stream Condition

- Approximately 74% (65,490 lf) of the total stream and tributary length exhibits high to moderate channelization.
- Moderate erosion is occurring along 46% (40,926 lf) of streambanks, while 6% (4,981 lf) are highly eroded.
- Approximately 67% (along 58,678 linear feet) of the riparian areas are in "Poor" condition or lacking entirely.
- Many of the stream reaches are heavily manipulated, often in concrete channels, and one reach is partially buried.

Land Use & Urban Development

- Most of the watershed is built out and urban land uses contribute by far the highest loads of nitrogen (49,017.4 lbs/yr; 76%) and phosphorus (7,542 lbs/yr; 58%) to streams, followed by septic systems.
- Infrastructure underlying Keith Creek within Rockford is deteriorating and causing additional water quality threats.
- The lowest portion of the watershed downstream of Charles St, including Keith Creek Reaches 9-12, is identified as an environmental justice community.



Alpine Park



Midway Village's Severin Lake





Keith Creek through Aldeen Park



PARKS & OPEN SPACE

Parks and open space provide large greenway corridors that interconnect land and waterways, support native species, maintain natural ecological processes, and contribute to the health and quality of life for the community. These open space areas are important keys to protecting water quality and habitat and need to be managed or restored in order to perform those functions optimally. Rockford Park District owns and maintains over 800 acres of parks and open space in the Keith Creek watershed, including 28 properties. There are also three privately-owned natural areas and a golf club.

Rockford College Woods

GREEN INFRASTRUCTURE & YOUR BACKYARD

A Green Infrastructure Network is a connected system of natural areas and other open space that conserves natural ecosystem values and functions, sustains clean air and water, and provides a wide array of benefits to wildlife and people. The network is made up of hubs and linking corridors. Hubs generally consist of the largest and least fragmented areas such as Aldeen Park, Alpine Park, and Rockford College Woods. Corridors are generally formed by private parcels along Keith Creek and its tributaries and the trail network. Corridors are extremely important because they provide habitat conduits between hubs. However, most parcels forming corridors are not ideal green infrastructure until landowners embrace the idea of managing stream corridors or creating backyard habitats.

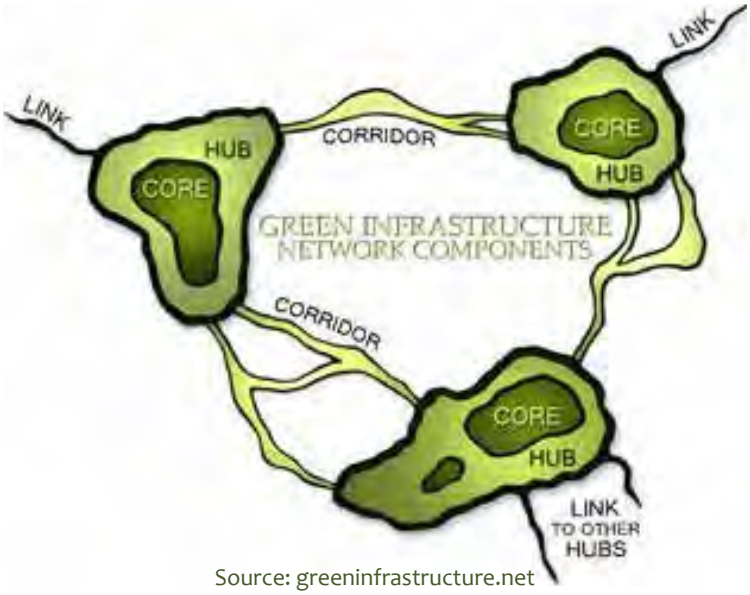
Any property owner can improve green infrastructure. Create a safe place for wildlife by providing a few simple things such as food, water, cover, and a place for wildlife to raise their young. The National Wildlife Federation's Certified Wildlife Habitat® and the Conservation Foundation's Conservation@Home programs can help you get started.

Creating a rain garden, or a small vegetated depression, to capture water is another way of promoting infiltration while beautifying your yard and providing additional habitat. Disconnecting your roof downspouts and capturing that runoff in rain barrels not only reduces the amount of runoff entering streams, but also serves as a great source of water for irrigating your yard.

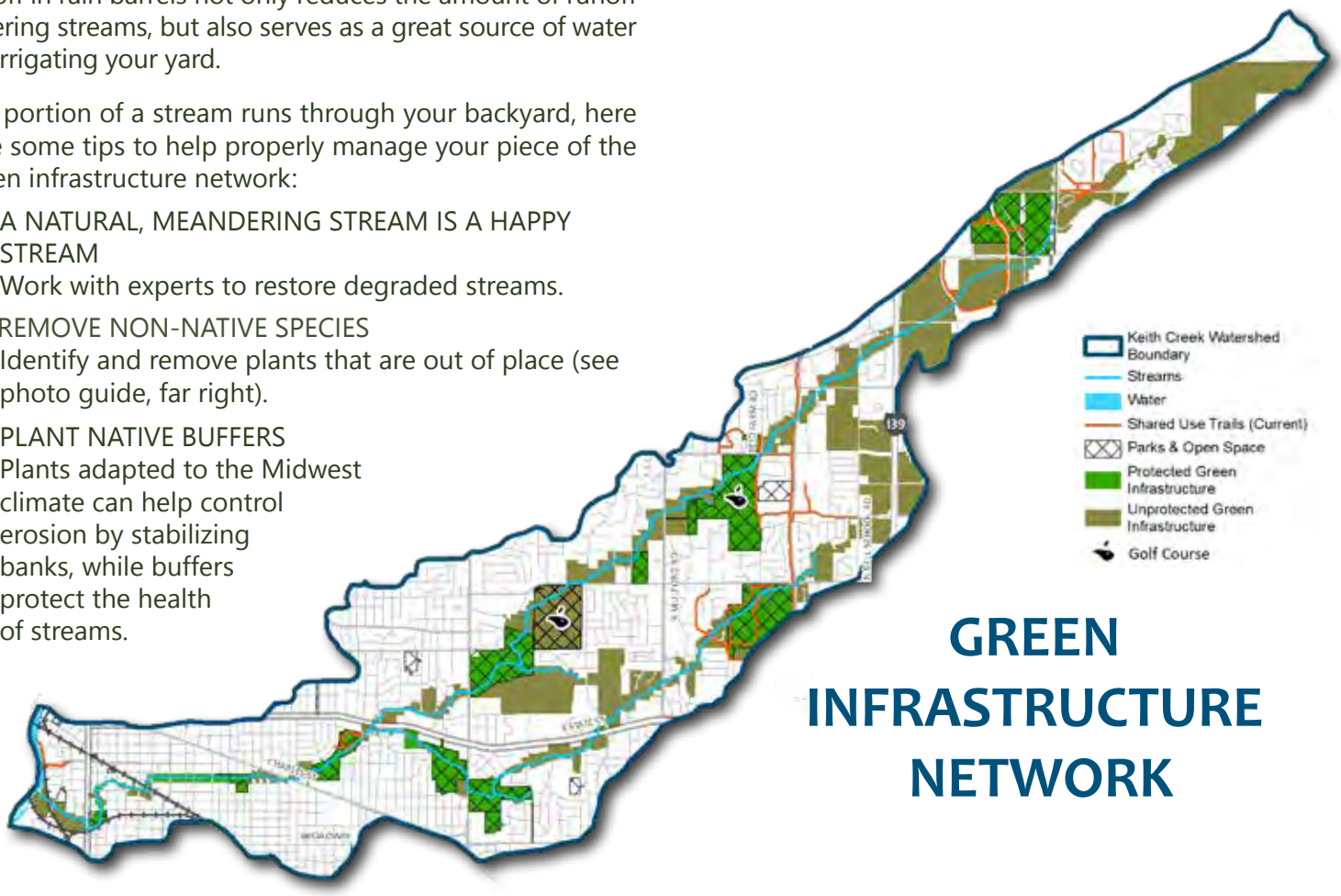
If a portion of a stream runs through your backyard, here are some tips to help properly manage your piece of the green infrastructure network:

1. A NATURAL, MEANDERING STREAM IS A HAPPY STREAM
   Work with experts to restore degraded streams.
2. REMOVE NON-NATIVE SPECIES
   Identify and remove plants that are out of place (see photo guide, far right).
3. PLANT NATIVE BUFFERS
   Plants adapted to the Midwest climate can help control erosion by stabilizing banks, while buffers protect the health of streams.
4. NO DUMPING
   Avoid dumping yard waste and clear heavy debris jams.
5. MANAGE CHEMICAL USE
   Avoid over fertilizing lawns or spilling/dumping chemicals near waterways.

For more detailed information, check out the Lake County Stormwater Management Commission's booklet, "Riparian Area Management: A Citizen's Guide," at www.lakecountyil.gov/stormwater.



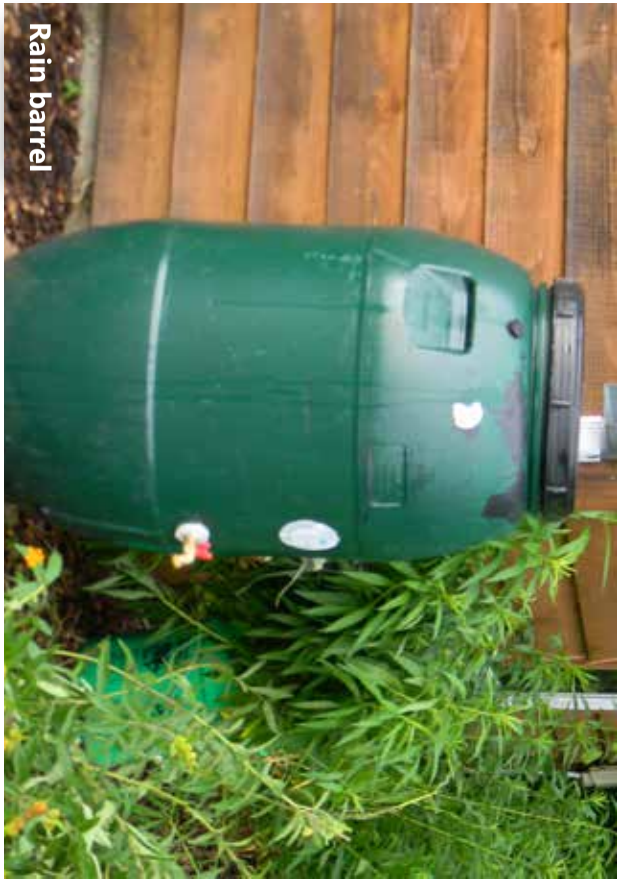
Source: greeninfrastructure.net



GREEN INFRASTRUCTURE NETWORK







REMOVE THESE NON-NATIVE AND INVASIVE SPECIES

TEASEL	GARLIC MUSTARD	PURPLE LOOSESTRIFE	REED CANARY GRASS	BUCKTHORN	COMMON REED
					

Source: Loras.edu.



Critical Area Keith Creek Reach 10, also known as the Keith Creek Greenway. This Critical Area falls within the Environmental Justice Area, is part of the Green Infrasturcture Network, and has driven additional studies such as the Keith Creek Corridor Study and the Keith Creek Flood Study.

ACTION PLAN

The Keith Creek Watershed-Based Plan includes an Action Plan developed to provide stakeholders with recommendations to address plan goals. The Action Plan includes programmatic and site-specific recommendations. Programmatic recommendations are general watershed-wide remedial, preventatitve, and regulatory actions. Site-specific recommendations include actual locations where projects could be implemented to improve water quality, green infrastructure, and aquatic and terrestrial habitats.

Programmatic recommendations include...

- Ordinance and Policy Best Practices
- Rainwater Harvesting & Re-use
- Septic System Maintenance
- Green Infrastructure Planning
- Conservation Design & Low Impact Development
- Water Quality Trading & Adaptive Management

Site-specific recommendations include...

- Detention Basin Retrofits
- Stream & Riparian Area Restoration
- Wetland Restoration
- Other Management Measures:
  - Natural Area Restoration
  - Vegetated Swales
  - Golf Course Retrofits

The recommended programmatic and site-specific management measures provide a solid foundation for protecting and improving watershed conditions over time, and should be tracked as projects are completed or other opportunities arise. Key implementation stakeholders are encouraged to organize partnerships and develop various funding arrangements to help delegate and implement the recommended actions. More details on the action plan can be found in the full watershed-based plan document.

MEASURING PROGRESS

The Information & Education Plan recommends campaigns that are designed to enhance understanding of the issues, problems, and opportunities within Keith Creek watershed. It promotes stakeholder buy-in and participation in selecting, designing, and implementing recommended Management Measures to improve watershed conditions. The goal of the Information & Education Plan is to equip stakeholders with the tools necessary to establish watershed-based practices

CRITICAL AREAS



Critical Areas are projects recommended as highest priority for IEPA Section 319 grant funding. Implementing these projects would create the most water quality improvement while also improving habitat and reducing flooding.

Detention Basin Retrofit

and create changes in behaviors that will improve the overall health of the watershed.

A water quality monitoring plan is an essential part of any watershed plan to evaluate plan implementation outcomes. Physical, chemical, and biological data will be collected over time to track progress towards achieving water quality improvements and will include monitoring of total phosphorus, total nitrogen, total suspended solids, and fecal coliform at a minimum. Monitoring partners include the City of Rockford, IEPA, and RiverWatch.

Milestones are essential in determining if Management Measures are being implemented and how effective they are at achieving plan goals over given time periods. Tracking milestones allows for periodic plan updates and changes that can be made if milestones are not being met. Report Cards for each plan goal were developed that include interim, measurable milestones linked to criteria that can be evaluated by the Steering Committee over time. More details on measuring plan progress can be found in the full watershed-based plan document.


Stream & Riparian Area Restoration

YOU CAN HELP KEITH CREEK WATERSHED!

The degradation of water resources seen today in the Keith Creek Watershed occurred over almost 200 years of landscape changes. Fortunately, there are actions outlined in the plan that can be taken to mitigate existing issues and improve water quality over time. The future health of the watershed is largely dependent on how stormwater and natural resources are managed. That includes implementing proven and environmentally-sensitive practices and approaches to restoration, such as those identified in this executive summary and the full watershed plan, to improve water quality and stream health in the watershed. You can help the Keith Creek watershed by starting in your own backyard and supporting local water quality improvement efforts.



Rockford College Woods

ZION Development

For more information, contact ZION Development Corporation:
Bob Campbell, Executive Director - bobcampbell@ziondevelopment.com
or visit https://ziondevelopment.org/keith-creek/

All photos by RES unless otherwise noted.

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1.0 INTRODUCTION

1.1 Keith Creek Watershed Setting

People live, work, and play in their "watershed" every day. A watershed is best described as an area of land where surface water drains to a common location such as a stream, river, lake, or other body of water (Figure 1). The source of groundwater recharge to streams, rivers, and lakes is also considered part of a watershed. Despite the simple definition for a watershed, they are complex in that there is interaction between natural elements such as climate, surface water, groundwater, vegetation, and wildlife as well as human elements such as agriculture and urban development that produce polluted stormwater runoff, increase impervious surfaces thereby altering stormwater flows, and degrade or fragment natural areas. Other common names given to watersheds, depending on size, include basins, sub-basins, subwatersheds, and Subwatershed Management Units (SMUs).

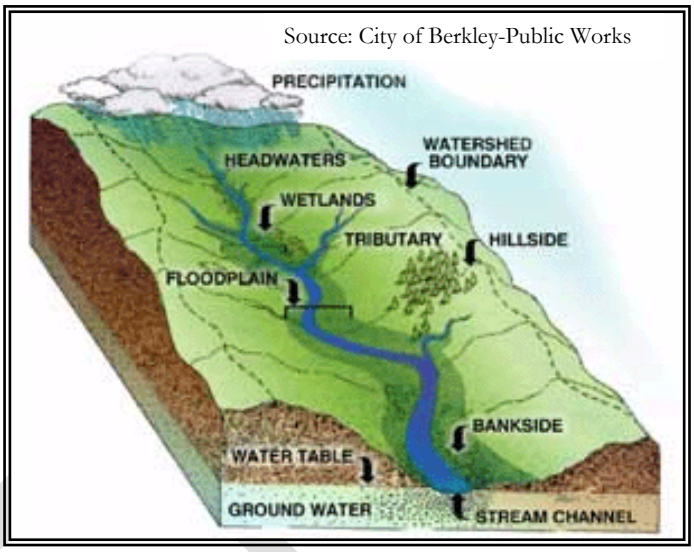


Figure 1. Hypothetical Watershed Setting.

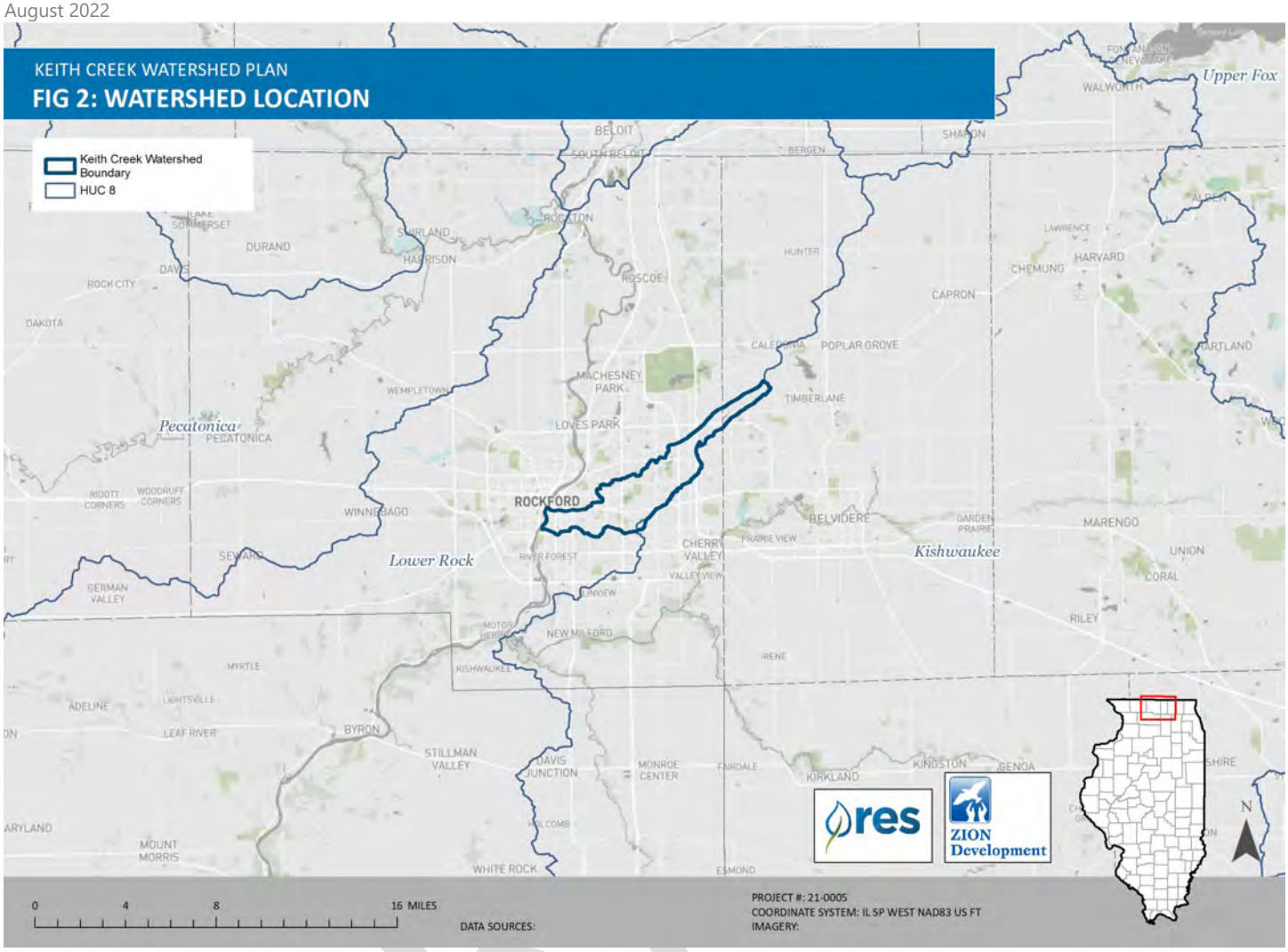
The Keith Creek watershed, at 14.2 square miles in size, is a small watershed located in the City of Rockford, across parts of Winnebago and Boone Counties (Figure 2). It drains almost half of the Spring Creek-Rock Creek watershed (HUC 070900050107). This watershed is near the headwaters of the Lower Rock River Watershed and Keith Creeks outlets directly to the Rock River. The Rock River then flows southwest to join the Mississippi at Rock Island, Illinois.

Pre-European settlement ecological communities in Keith Creek watershed and surrounding area were balanced ecosystems with clean water and diverse with plant and wildlife populations. The mosaic of open prairie, wetlands, and oak woodlands were largely maintained and shaped by frequent fires ignited by both lightning and the Native Americans that inhabited the area. Herds of bison and elk also helped maintain the ecosystem via large scale grazing. During these times most of the water that fell as precipitation was absorbed in prairie and wooded communities and within the wet prairies that likely existed where the upper stream and tributaries exist today.

Ecological conditions changed quickly and drastically following European settlement in the mid-1800s. Large scale fires no longer occurred, and bison and elk were extirpated. Significant portions of wooded communities and nearly all prairies were tilled, streams were channelized to accommodate development, and tile systems were installed to drain wetland areas as farming became the primary land use by the early 1900s. Development patterns continued to urbanize within Rockford and today most of the watershed is dominated by primarily residential and commercial uses.

With increasing development pressures and landscape changes in the watershed comes negative impacts to the environment. Impervious surfaces greatly reduce the ability of precipitation to infiltrate into the ground and instead cause stormwater runoff to quickly reach streams and tributaries. This in turn results in downcutting, widening, and bank erosion causing sediment and nutrient loading downstream. Meanwhile, streams were disconnected from their floodplains and invasive species established within the riparian areas causing loss of wildlife habitat and reduced floodplain function. Nutrients from urban sources and agricultural land are negatively impacting the biological communities in Keith Creek. Discharged water from various sources that flow overland and not from a permitted source are referred to as "non-point source pollution" - the primary focus of this plan.

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1.2 Project Scope & Purpose

The City of Rockford has been working to improve green infrastructure in and around the City for a number of years. Since the 1940s, Keith Creek has been used as a drainage ditch to funnel storm water as quickly as possible to the Rock River without taking nonpoint source pollution into account. In 2004, the Midtown Business Association initiated a study to develop a greenway between a community center and nearby 10th Avenue Park. The greenway concept was so well-received that it was expanded to encompass a 4.5-mile greenway vision that would connect the string of neighborhood parks along Keith Creek. The vision was to create a diverse and ecologically restored environment along a greenway separate from traffic.

In 2006 and 2007, two 100-year flood events occurred back-to-back along the creek. Over 100 homes were removed, which many saw as an opportunity to begin water quality and ecological restoration in the newly open land. Over half a decade later in 2014, an Army Corps of Engineers study addressed some creek infrastructure issues but lacked a holistic, ecologically sensitive approach to restore water quality. A citizen-led effort began in earnest in 2016 and recognized that urban creek projects were occurring around the country that had prioritized water quality improvement projects within the watershed. The intent of the citizen-led group was to add capacity to the City's efforts and to provide a skilled and diverse base of knowledge to what is needed to improve all aspects of the watershed.

In 2019, ZION Development Corporation, in partnership with the City of Rockford, applied for and received Illinois Environmental Protection Agency (IEPA) funding starting in 2020 through Section 319 of the Clean Water Act to undergo a watershed planning effort and produce a comprehensive "Watershed-Based Plan" to act as a "guidance document" for stakeholders in Keith Creek watershed that would meet requirements as defined by the United States Environmental

Protection Agency (USEPA). Ultimately, the intent of 319 funding is to develop and implement Watershed-Based Plans designed to achieve water quality standards through nonpoint source pollution control. ZION Development Corporation hired Resource Environmental Solutions (RES, previously known as Applied Ecological Services) in January 2021 to develop the plan.

The watershed planning process is a collaborative effort involving voluntary stakeholders with the primary scope to restore impaired waters and protect unimpaired waters by developing an ecologically-based management plan for the Keith Creek watershed that focuses on improving water quality by protecting green infrastructure, creating protection policies, implementing ecological restoration, and educating the public. Another important outcome is to improve the quality of life for people in the watershed for current and future generations. The planning will complement the City of Rockford's Stormwater Management Program that addresses bank erosion, construction, and industrial high-risk runoff such as the Joe Behr metal scrap yard, and Rockford Auto Parts junk yard, illegal dumping, and pesticide and fertilizer use.

The primary purpose of this plan is to spark interest and give stakeholders a better understanding of the Keith Creek watershed to promote and initiate plan recommendations that will accomplish the goals and objectives of this plan. This plan was produced via a comprehensive watershed planning approach that involved input from stakeholders and analysis of complex watershed issues by RES' watershed planners, ecologists, GIS specialists, and environmental engineers.

The Keith Creek Steering Committee, led by ZION Development Corporation in partnership with the City of Rockford, R1PC, and numerous other stakeholders, held regular, public meetings from March 2021 through August 2022 to guide the watershed planning process by establishing goals and objectives to address watershed issues and to encourage participation of stakeholders to develop planning and support for watershed improvement projects and programs.

Interests, issues, and opportunities identified by the Steering Committee were addressed and incorporated into the Watershed-Based Plan. The plan acknowledges the importance of protecting and restoring green infrastructure where necessary to meet many of the goals and objectives in the plan while providing scientific and practical rational for restoring lands, protecting appropriate green infrastructure, and encouraging partnerships amongst public, private, and non-profit entities to manage these properties and maximize watershed benefits. In addition, ideas and recommendations in this plan are designed to be updated through adaptive management that will strengthen the plan over time as additional information becomes available. It is important to note that all recommendations in this plan are for guidance only and not required by any federal, state, or local agency.

1.3 USEPA Watershed-Based Plan Requirements

In March 2013, the United States Environmental Protection Agency (USEPA) released watershed protection guidance entitled *Non-point Source Program and Grant Guidelines for States and Territories*. The document was created to ensure that Section 319 funded Watershed-Based Plans and projects make progress towards restoring waters impaired by non-point source pollution. RES consulted USEPA's *Handbook for Developing Watershed Plans to Restore and Protect Our Waters* (USEPA 2008) and Chicago Metropolitan Agency for Planning's (CMAP's) *Guidance for Developing Watershed Implementation Plans in Illinois* (CMAP 2007) to create this watershed plan. Having a Watershed-Based Plan will allow Keith Creek watershed stakeholders to access 319 Grant funding for watershed improvement projects recommended in this plan. Under USEPA guidance, "Nine Elements" are required for a plan to be considered a Watershed-Based Plan.

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Noteworthy- USEPA Nine Elements

Element A: Identification of the causes and sources or groups of similar sources of pollution that will need to be controlled to achieve the pollutant load reductions estimated in the watershed-based plan;

Element B: Estimate of the pollutant load reductions expected following implementation of the management measures described under Element C below;

Element C: Description of the BMPs (non-point source management measures) that are expected to be implemented to achieve the load reductions estimated under Element B above and an identification of the critical areas in which those measures will be needed to implement

Element D: Estimate of the amounts of technical and financial assistance needed, associated costs, and/or the sources and authorities that will be relied upon, to implement the plan;

Element E: Public information/education component that will be implemented to enhance public understanding of the project and encourage early and continued participation in selecting, designing, and implementing/maintaining non-point source management measures that will be implemented;

Element F: Schedule for implementing the nonpoint source management measures identified in this plan that is reasonably expeditious;

Element G: Description of interim, measurable milestones for determining whether non-point source management measures or other control actions are being implemented;

Element H: Set of environmental or administrative criteria that can be used to determine whether loading reductions are being achieved over time and substantial progress is being made towards attaining water quality standards;

Element I: Monitoring component to evaluate the effectiveness of the implementation efforts over time.

1.4 Planning Process

Watershed Steering Committee

The Keith Creek Watershed Steering Committee was led by ZION Development Corporation and comprised of members of representative municipalities, counties, economic development groups, Rockford Park District, and local consultants and residents. The Committee first met in March 2021 to kick off the watershed planning process. At this meeting, Resource Environmental Solutions (RES) provided stakeholders with an overview of the steps involved in the watershed planning process. The Watershed Coordinator engaged stakeholders by explaining how their input and participation would benefit the overall outcome of the project. Volunteer stakeholders representing Keith Creek's interests met 8 times throughout the planning process. The Steering Committee and stakeholders developed goals and objectives for the watershed and identified problem areas and opportunities. Meetings were initiated by the Watershed Coordinator and generally covered one or more watershed topics. Meetings were devoted to development of watershed assessment findings, goals and objectives, and action plan items. Local experts, those working on concurrent planning efforts, and watershed residents were also invited to give presentations on specific topics. A list of the meetings is summarized in Table 1. Meeting presentations are included in Appendix A.

Table 1. Keith Creek Watershed meeting schedule.

Date	Agenda	Summary
March 23, 2021	• Kickoff • Watershed Planning Summary • Stakeholder Involvement	The Watershed Coordinator detailed the background on why a watershed plan is needed and who helped make it happen. RES summarized the Nine Elements needed in a USEPA approved watershed plan and outlined the planning process.
May 25, 2021	• Watershed Background: Part 1 • Code & Ordinance Review	RES updated stakeholders with watershed information including geology, pre-settlement conditions, topography, wetlands, soils, jurisdictions, & demographics. RES also detailed the process for the Code & Ordinance review.
July 27, 2021	• Watershed Field Inventory Results	RES summarized the results of the "Watershed Resource Inventory" field investigation including the inventory methodology and survey results for the streams, riparian areas, detention basins, natural/open space areas, swales in subdivisions, and other potential restoration sites.
Sept. 28, 2021	• Watershed Background: Part 2	RES updated stakeholders with watershed information including the existing and future land use, impervious cover, parks and open space, open space parcel prioritization, the green infrastructure network, cropland data, and groundwater resources.
Nov. 30, 2021	• Designated Uses /Impairments • Water Quality Inventory • Pollutant Loading Model Results • Goals Workshop discussion	RES summarized the designated use impairments, point sources, water quality monitoring locations and results, the results of the pollutant loading model, "hot spot" SMU analysis, and water quality targets in the watershed. This was followed by a discussion on the potential goal topics and the process for the upcoming Goals Workshop.
Feb. 22, 2022	• Watershed-based Plan overview • Corridor Study overview • Goals Workshop	RES detailed the existing conditions in the Keith Creek watershed. Then R1PC, The Lakota Group, and Studio GWA summarized the concurrent planning work of the Keith Creek Corridor Study. This was followed by a series of stakeholder feedback exercises to help prioritize which opportunity areas were most important to stakeholders, prioritization of the goals, and follow-up questions gauging future stakeholder interest and participation in watershed education and outreach activities.
Apr. 26, 2022	• Programmatic Action Plan • Site Specific Action Plan • Critical Areas	RES summarized the programmatic and policy best practices recommended to improve water quality, the various site-specific action plan projects, and the critical areas most in need of restoration.
Jun. 28, 2022	• Water Quality Monitoring Plan • Report Cards • Implementation • Education and Outreach	RES presented a water quality monitoring plan for the watershed and reviewed the report cards developed for each plan goal/objective. This was followed by details of how the plan would best be implemented and a view of the draft executive summary. Finally, the Watershed Coordinator reviewed the Information and Education Plan.

1.5 Using the Watershed-Based Plan

The information provided in this Watershed-Based Plan is prepared so that it can be easily used as a tool by any stakeholder including elected officials, federal/state/county/municipal staff, and the general public to identify and take actions related to watershed issues and opportunities. The pages below summarize what the user can expect to find in each major "Section" of the Watershed-Based Plan. All recommendations in this plan are for guidance only and not required by any federal, state, or local agency.

Section 2.0: Mission, Goals, and Objectives

Section 2.0 of the plan contains the Keith Creek Watershed mission, goals, and objectives. Goal topics include surface water quality; education, stewardship, and communication; flooding; policy; and the green infrastructure network. In

addition, "Measurable Objectives" were developed where possible for each goal so that the progress toward meeting each goal can be measured in the future by evaluating information included in Section 9.0: Measuring Plan Progress & Success.

Section 3.0: Watershed Resource Inventory
An inventory of the characteristics, problem, and opportunities in Keith Creek watershed is examined in Section 3.0. Inventory results helped identify causes and sources of watershed impairment as required under USEPA's *Element A*. Section 3.0 includes summaries and analysis of existing watershed resources including geology, climate, soils, pre-European settlement ecological communities, topography, the watershed boundary, subwatersheds, jurisdictions, demographics, existing and future land use, the transportation network, impervious cover impacts, parks and open space, the green infrastructure network, a detailed examination of the drainage network, agricultural land, groundwater, permitted sources, septic systems, and environmental justice communities. The following watershed inventory topics are not covered in this plan either because the item is not found in the watershed or because the information was not readily available to document the information: levees, irrigation, drain tiles or ditches, drainage districts, livestock, combined sewer system and discharge locations, and air quality.

Section 4.0: Water Quality & Pollutant Modeling Assessment
A summary and analysis of the designated uses/impairments, available water quality data for the watershed and pollutant modeling assessment is included in its own section because of its importance in the watershed planning process. This section includes a detailed summary of all physical, chemical, and biological data available for Keith Creek. The pollutant loading assessment identifies pollutant loads and water quality data combined with pollutant loading data provides information that sets the stage for developing pollutant reduction targets outlined in Section 5.0.

Section 5.0: Causes/Sources of Impairment & Reduction Targets
This section of the plan includes a list of causes and sources of watershed impairment as identified in Section 4.0 that affect Illinois EPA "Designated Uses" for water quality and other watershed features. As required by USEPA, Section 5.0 also addresses all or portions of *Elements A, B, & C* including an identification of the "Critical Areas", pollutant load reduction targets, and estimate of pollutant load reductions following implementation of Critical Area Management Measures identified in Section 6.0.

Section 6.0: Management Measures Action Plan
A "Management Measures Action Plan" is included in Section 6.0. The Action Plan is divided into a Programmatic Action Plan and a Site-Specific Action Plan. Programmatic recommendations are described in paragraph format; site specific recommendations are presented in paragraph, figure, and table formats with references to entities that would provide consulting, permitting, or other technical services needed to implement specific measures. The site-specific tables also outline project priority, pollutant reduction efficiency, implementation schedule, sources of technical and financial assistance, and cost estimates. As required by Illinois EPA, this section also contains a watershed-wide summary table of specific information for all recommended site-specific management measures combined including "Units," "Cost," and "Estimated Pollutant Load Reduction". This section addresses all or a portion of USEPA *Elements C & D.* All recommendations in the Action Plan are for guidance only and not required by any federal, state, or local agency.

Section 7.0: Information & Education Plan
This section is designed to address USEPA *Element E* by providing an Information & Education component to enhance public understanding and to encourage early and continued participation in selecting, designing, and implementing recommendations provided in the Watershed-Based Plan. This is accomplished by providing a matrix that outlines each education objective followed by primary and secondary recommended education activities. For each activity, a target audience, package (vehicle and pathways for reaching audiences), priority/schedule, lead and supporting agencies, what the expected outcomes or behavior change will be, and estimated costs to implement is provided.

Sections 8.0 & 9.0: Plan Implementation & Measuring Plan Progress & Success
A list of key stakeholders and discussion about forming a Watershed Implementation Committee that forms partnerships to implement watershed improvement projects is included in Section 8.0, as well as details about the process to update

and amend the plan in the future. Section 9.0 includes two monitoring components: 1) a "Water Quality Monitoring Plan" that includes specific locations and methods where future monitoring programs should focus and a set of water quality "Criteria" that can be used to determine whether pollutant load reduction targets are being achieved over time and 2) "Report Cards" for each plan goal used to measure milestones and to determine if Management Measures are being implemented on schedule, how effective they are at achieving plan goals, and need for adaptive management if milestones are not being met. Sections 8.0 and 9.0 address USEPA *Elements F, G, H, and I*.

Sections 10.0 & 11.0: Literature Cited and Glossary of Terms
Section 10.0 includes a list of literature that is cited throughout the report. The Glossary of Terms (Section 11.0) includes definitions or descriptions for many of the technical words or agencies that the user may find useful when reading or using the document.

Appendix
The Appendix to this report is included on the attached CD (hard copies) or digitally only. It contains Steering Committee meeting presentations (Appendix A), Center for Watershed Protection local ordinance review summary (Appendix B), results of the watershed resource field inventory (Appendix C), the complete STEPL pollutant loading model and assumptions and Site-Specific Action Plan reduction calculations (Appendix D), and a list of potential funding opportunities (Appendix E).

1.6 Prior Studies and Projects
Various studies have been completed or ongoing describing and analyzing conditions within Keith Creek watershed. This Watershed-Based Plan uses existing data to analyze and summarize work that has been completed by others and integrates new data and information. A list of known studies or work that this report relied on is summarized below.

1. The 2005 Greenways Plan from Region 1 Planning Council (R1PC) mentions Keith Creek. R1PC's 2015 Greenways Plan also shows a Keith Creek Greenway identified in its overall planning document.
2. In 2006, IEPA published a study of the Rock River basin that supplied valuable geologic and groundwater data for the report. The study is titled *Rock River Basin Assessment: An Overview of the Rock River Watershed in Illinois*.
3. Illinois Tollway supplied studies and best practices guides related to road salt reduction, re-use, and recycling, studies on chlorides, and converting invasive species to energy. They are also developing additional biological water quality monitoring support and advanced research.
4. Comprehensive plans and development guidance are available for Winnebago County (2010), Boone County (2020), the City of Rockford (2020) and the City of Loves Park (2017); the Village of Timberlane adopted a Zoning Ordinance (2005) and Map (updated 2011) that guides development.
5. Existing Winnebago and Boone County, City of Rockford, and R1PC Geographic Information System (GIS) data for Keith Creek watershed was obtained and used to analyze various data related to wetlands, soils, land use, demographics, and other relevant information.
6. Rockford and Fehr Graham Engineering & Environmental led a flood study concurrent with the Watershed-Based Plan process to detail flood hazard area buyouts and hydrologic and hydraulic analysis of the Keith Creek corridor.
7. The Keith Creek Corridor Study: State of Keith Creek Summary was led by R1PC, The Lakota Group, Studio GWA, Hey and Associates, and Strand Associates and ran concurrent with the Watershed-Based Plan process. The study focused on planning and redevelopment projects, greenway, transportation, access to natural resources, infrastructure improvements, economic developments, coordinating efforts between local entities to control flooding, and an analysis of diversity, equity, and inclusion throughout the watershed. The Corridor Study and the Watershed-Based Plan teams coordinated during plan development, collaborated efforts around stakeholder engagement, and aligned plan guidance and recommendations as applicable.
8. Rockford has invested in many improvements in recent years related to Keith Creek including rehabilitation of Alpine Dam at Aldeen Park, bank stabilization at Fairview Ave. and at 7th St., bridge removal at 5th, 10th, 12th, and 13th Streets, culvert repair at Charles St. and 22nd St., and Seminary St. bridge reconstruction. Additionally, the 2022-2026 Capital Improvement Plan outlines improvements to the 8th Avenue bridge over Keith Creek ($800,000) and Phase 2 improvements to Alpine Dam ($1 million). The Rockford Park District has also made efforts to address creek bank stabilization at Alpine Park and are planning for additional stabilization at Alpine Hills Park.

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2.0 MISSION, GOALS, AND OBJECTIVES

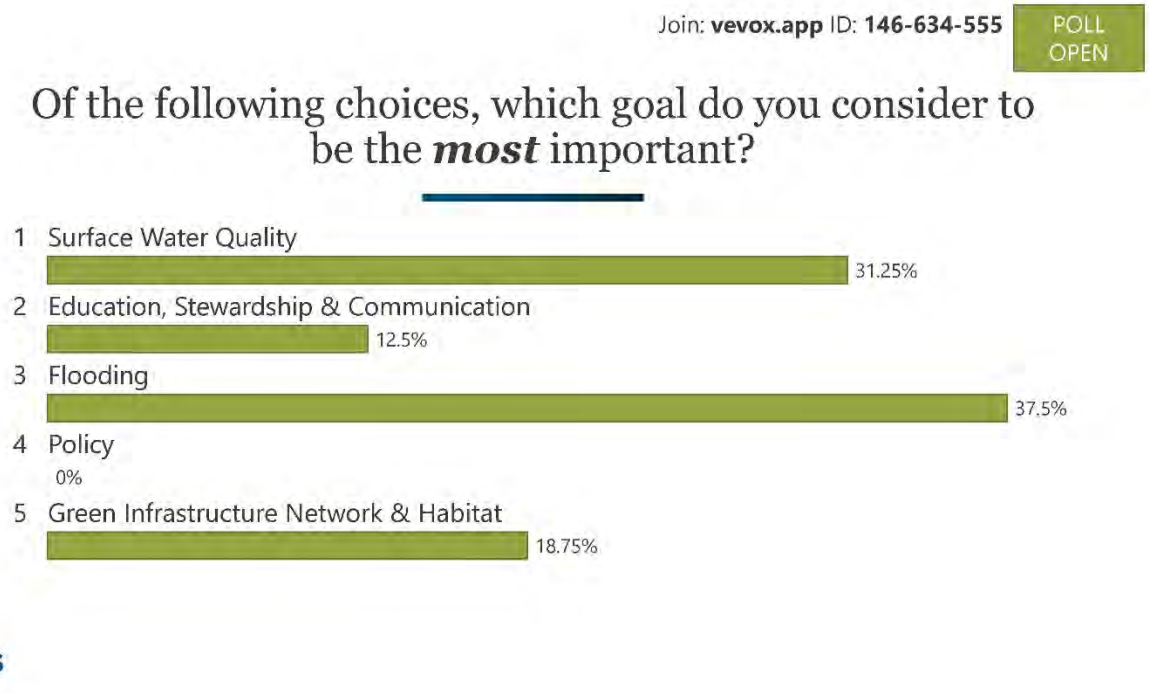
2.1 Keith Creek Watershed-Based Plan Mission

The Watershed Coordinator, Steering Committee, and stakeholders of the Keith Creek watershed developed a mission statement to guide the watershed plan. That mission is as follows:

"The mission of the watershed plan is to improve water quality by reducing nonpoint source pollution and flooding, while improving habitat, along with increasing our knowledge and educating our residents to help improve the health of the Keith Creek watershed."

2.2 Goals and Objectives

A virtual Goals Workshop was held on February 22, 2022, devoted to gathering feedback from the community on the development of the plan and goals. Watershed stakeholders were first presented with information about the character, existing conditions, and quality of watershed resources, followed by an update on the concurrent efforts of the Keith Creek Corridor Study led by Lakota Group and Studio GWA, which focused on diversity, equity, and inclusion and "meanwhile urbanism" – or what efforts could be done while waiting on the results of the other studies and implementation. Five general goal topics were chosen by the group to address issues that were brought up during those meeting and determined to be important in the Keith Creek watershed. Additionally, information was collected on what type of "meanwhile" activities were most important to stakeholders as well as a prioritization of five opportunity areas. Stakeholders were then given the opportunity prioritize the goals, meanwhile activities, and opportunity areas.



Goal Prioritization results captured during the February 22, 2022, virtual Goals Workshop

The voting process occurred during the Goals meeting held on February 22, 2022, and included approximately thirty stakeholders from the community and representing various local agencies. Each stakeholder was asked to prioritize the five goal topics from most important to least important. The voting process helped focus on goals that need to be adequately addressed in the planning process and within this watershed plan report. Each goal was then scored according to how each person ranked those topics with more highly ranked goals receiving a higher weighted result. Weighted results were as follows:

1) Flooding – *Received a weighted rank of 77% of the votes*
2) Surface Water Quality – *Received a weighted rank of 73% of the votes*

3) Green Infrastructure Network & Habitat – *Received a weighted rank of 64% of the votes*
4) Education, Stewardship, and Communication – *Received a weighted rank of 50% of the votes*
5) Policy – *Received a weighted rank of 35% of the votes*

The five topics were used as the basis for the goals for the Keith Creek Watershed-Based Plan. Objectives for each goal were also formulated and designed to be specific where feasible and measurable so that future progress toward meeting goals can be assessed. Goals and objectives ultimately lead to the development of action items. The goals reference various sections throughout the plan including Parks & Open Space (Section 3.11), the Green Infrastructure Network (Section 3.12), the Watershed Drainage System and inventory (Section 3.13), Jurisdictions (Section 3.5), Water Quality Assessment (Section 4.1), and the Management Measures Action Plan (Section 6.0). More detail can be found on each of these topics within the referenced sections.

Additionally, stakeholders were asked about whether they would be willing to participate in a stewardship event in the watershed and then whether they would be willing to help organize such an event. The full results of the survey are included in the Goals Workshop presentation slides in Appendix A.

The Management Measures Action Plan section of this report is geared toward addressing watershed goals by recommending programmatic and site-specific Management Measure actions to address each goal. The goals and objectives are examined in more detail in the discussion of the measurement of plan progress and success via milestones and "Report Cards" outlined in Section 9.2.

Goal 1: ***Manage and mitigate for existing and future structural flood problems.***
Objectives:
1) Implement impervious reduction measures on development predicted to occur within Subwatershed Management Units 4 and 6, which are Highly Vulnerable to future development changes and associated impervious cover.
2) Incorporate results of the Keith Creek Flood Study into site-specific action plan recommendations.
3) Restore 142.2 acres of potential wetland restoration sites and improve existing wetland connectivity to streams.
4) Continue to limit development in the identified FEMA 100-year floodplain.
5) Continue to mitigate structural flood problem areas within the FEMA floodplain on a case-by-case basis where feasible.

Goal 2: ***Improve surface water quality to meet applicable water quality standards.***
Objectives:
1) Continue existing water quality monitoring programs and implement the Water Quality Monitoring Plan outlined within the plan.
2) Restore all 94 acres of High Priority/Critical Area detention basin retrofit opportunities.
3) Restore 25,391 linear feet of stream and riparian area restoration along all High Priority/Critical Area stream reaches.
4) Implement all 142 acres of High Priority/Critical Area wetland restoration recommendations.
5) Implement all 510 acres of High Priority/Critical Area other management measures recommendations.
6) Track changes in water quality over time and make adaptive management changes to the plan as necessary to ensure water quality improvements toward meeting identified pollutant load reductions.

Goal 3: ***Protect, manage, and restore natural components of the Green Infrastructure Network and improve fish and wildlife habitat.***
Objectives:
1) Include the identified Green Infrastructure Network in all municipal and county comprehensive plans and development review maps.
2) Reconnect the stream to the floodplain within the Green Infrastructure Network where possible.
3) Encourage private landowners with parcels within the Green Infrastructure Network to manage their land for ecological and water quality benefits.

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4) Improve habitat in degraded stream reaches and along adjacent riparian areas using natural and ecological design approaches.
5) Develop and implement restoration and management plans for all Natural Area Restoration sites.
6) Implement conservation design or low impact development standards where new or redevelopment occurs.

Goal 4: ***Build stakeholder awareness of watershed issues through education and stewardship while increasing communication and coordination among stakeholders.***

Objectives:

1) Implement the Keith Creek Watershed-Based Plan Information & Education Campaign.
2) Inform public officials of the benefits of conservation design and low impact development and the importance of ordinance language changes that promote these developments.
3) Increase environmental stewardship opportunities and encourage stakeholders to participate in watershed plan implementation and restoration campaigns to increase activism in the watershed.
4) Work with schools at all levels within Keith Creek watershed to provide watershed and water quality educational opportunities and curriculum.
5) Leverage the various planning efforts occurring in and around the Keith Creek Greenway to create educational opportunities focused on improving water quality.

Goal 5: ***Assess and improve policies and regulations to protect and support our natural resources.***

Objectives:

1) Local governments adopt, support, and implement recommendations in the Keith Creek Watershed-Based Plan.
2) Local governments include the Green Infrastructure Network in their municipal comprehensive plans and development review maps.
3) Encourage local governments to incorporate Conservation Design or Low Impact Development standards where new/redevelopment is planned within the Green Infrastructure Network.
4) Encourage developers to protect sensitive natural areas, restore degraded natural areas and streams as part of the development process. Encourage donation of highly sensitive natural areas such as high-quality habitat, to a public agency or conservation organization for long term management with dedicated funding such as impact fees, Special Service Areas (SSA's) or a one-time donation.
5) Implement additional policy recommendations that focus on improving watershed conditions by preserving green infrastructure, sustainable management of stormwater, minimizing road salts, minimizing lawn fertilizer, protecting groundwater, and allowances for native landscaping.

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3.0 WATERSHED RESOURCE INVENTORY

3.1 Geology and Climate

Geology

The terrain of the Midwestern United States was created over thousands of years as glaciers advanced and retreated during the Pleistocene Era or "Ice Age". Some of these glaciers were a mile thick or more. The Illinois glacier extended to southern Illinois between 300,000 and 130,000 years ago. It is largely responsible for the flat, farm-rich areas in the central portion of the state that were historically prairie. Only the northeastern part of Illinois was covered by the most recent glacial episode known as the Wisconsin Glaciation that began approximately 70,000 years ago and ended around 14,000 years ago (Figure 3). During this period the earth's temperature warmed and the ice slowly retreated leaving behind moraines and glacial ridges where it stood for long periods of time (Hansel, 2005). A tundra-like environment covered by spruce forest was the first ecological community to colonize after the glaciers retreated. As temperatures continued to rise, tundra was replaced by cool moist deciduous forests and eventually by oak-hickory forests, oak savannas, marshes, and prairies.

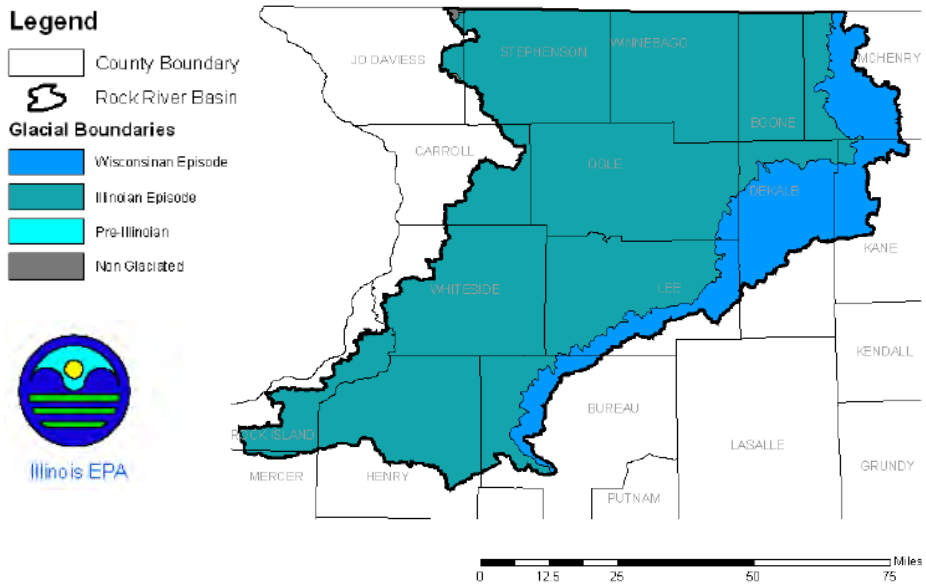


Figure 3. Glacial episodes in the Rock River Basin (Source: IEPA, 2006).

The terrain of Keith Creek watershed was formed during the next to last glaciation (Illinois Episode) and is quite flat but less so than areas covered by the Wisconsin Episode, since erosion by streams has been occurring for a longer period of time (Grimley, 2001). Winnebago County lies near "the crest of a very broad upwarping of the bedrock called the Wisconsin Arch" where erosion brings older and older rocks to the surface (ISGS, 1999). Glacial deposits left behind in Winnebago County include pebbly clay, silt, sand, gravel, and clay (ISGS, 1999).

Climate

The northern Illinois climate can be described as temperate with cold winters and warm summers where great variation in temperature, precipitation, and wind can occur daily. Surges of polar air moving southward or tropical air moving northward cause daily and seasonal temperature fluctuations. The action between these two air masses fosters the development of low-pressure centers that generally move eastward and frequently pass over Illinois, resulting in abundant rainfall. Prevailing winds are generally from the west but are more persistent and blow from a northerly direction during winter.

The US Climate Data website (www.usclimatedata.com) provides an excellent summary of climate statistics including monthly averages and records for many locations in Illinois. Data for Rockford is representative of the climate and weather patterns experienced in Keith Creek watershed (Figure 4). The winter months are cold averaging January highs around 29° F while winter lows are around 13° F. Summers are warm with average July high temperatures around 85° F and summer lows around 63° F. The highest recorded temperature was 112° F in July of 1936 while the lowest temperature was -31° F in January 2019 (Source: weather.gov). Fairly typical for the Midwest, the current climate of Keith Creek watershed consists of an average rainfall of around 36.2 inches and snowfall around 37 inches annually. According to data collected in DeKalb, the most precipitation on average occurs in June (4.65 inches) while January receives the least amount of precipitation with 1.37 inches on average (US Climate Data, 2021).

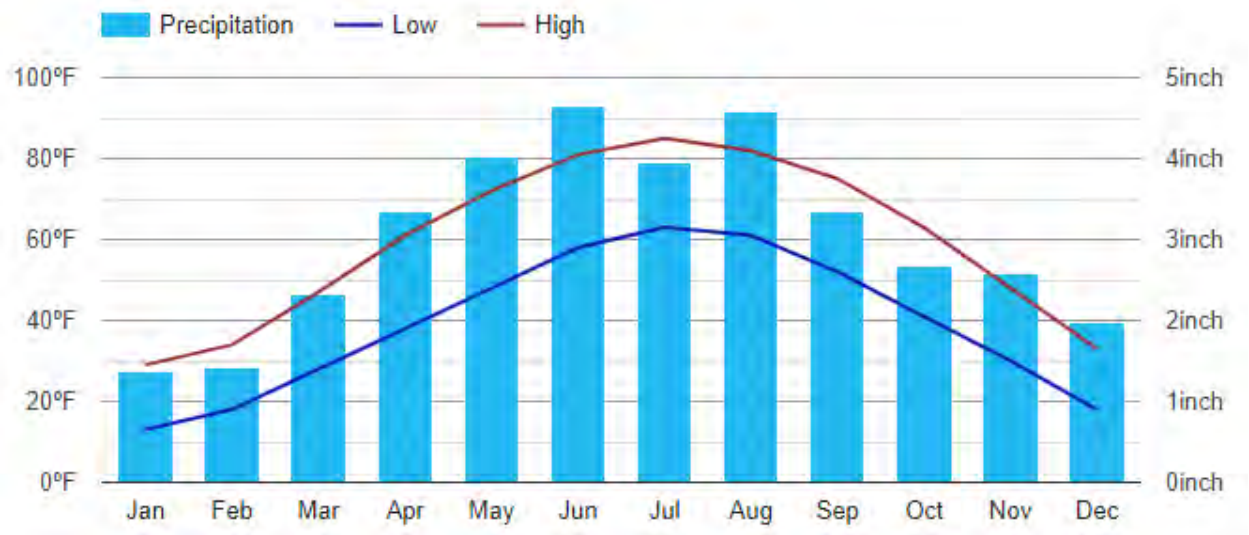


Figure 4. Climate records for Rockford, IL (Source: US Climate Data, 2021).

3.2 Pre-European Settlement Ecological Communities and Change

The last Native American Indian tribe to call the area home were the Winnebagoes, part of the Dakotas or Sioux nation, who ceded the territory to the United States in 1829. The area was first settled in June of 1835 by Germanicus Kent and Thatcher Blake near the junction of the Rock River and Kent Creek. An early settler detailed what the land looked like:

"'…A magnificent park from Kishwaukee Street to the river and from Walnut Street south to Keith's Creek.' The beauty of the countryside around the riverbank settlements impressed travelers who crossed the stream at this point. The river was nine feet lower in its banks than at present and perhaps sixty feet narrower. The water was clear as crystal and both shores were lined with trees. Since the banks were high, there was very little swampland. Indian trails extended along each side of the river through grass which in places grew six feet high. Wildflowers grew profusely throughout the region. One week the prairies would be white with blossoms; a fortnight later they would be blanketed in blue as another variety bloomed, and so on through a wide range of hues from early spring to fall." – Genealogy Trails, 2021



Example of pre-European settlement prairie-savanna landscape

Rockford was originally called Midway as it was halfway between Chicago and Galena and early industry centered around manufacturing of farm-machinery and furniture with the extension of the Galena and Chicago Union Railroad to the Rock River in 1852 (Encyclopaedia Britannica, 2019). Today the Rockford region is still known for manufacturing as well as health care and agriculture.

The original public land surveyors that worked for the office of U.S. Surveyor General in the early and mid-1800s mapped and described natural and man-made features and vegetation communities while creating the "rectangular survey system" for mapping and sale of western public lands of the United States (Daly & Lutes et. al., 2011). Ecologists know by interpreting survey notes and hand drawn Federal Township Plats of Illinois (1804-1891) that a complex interaction existed between several ecological communities including prairies, savannas, woodlands, and wetlands prior to European settlement in the 1830s.



Amos W. Woodward Millhouse is a replica of an operating water-powered machine shop located on the edge of Midway Museum's Severin Lake

The surveyors detailed Keith Creek watershed as a nearly even split between prairie and woodland communities (Figure 5). While north and south of the watershed there were large swathes of "swamp" or wetlands, Keith Creek watershed consisted of mostly upland communities. This mixture of "Prairie" and "Timber" across the landscape was widely described in the mid-1800s as the surveyors and early settlers moved west out of the heavily forested eastern portion of the United States and encountered a much more open environment that ecologists now refer to as "Savanna." Prior to settlement, the prairie-savanna landscape was maintained and renewed by frequent lightning strike fires, fires ignited by Native Americans, and grazing by bison and elk. Fires ultimately removed dead plant material, exposing the soils to early spring sun, and returning nutrients to the soil. Running through the prairie-savanna and woodland landscapes were meandering stream corridors and low wet depressions consisting of sedge meadow, marsh, and wet prairie. These streams only covered the lower two-thirds of the watershed as we know it today and had many more meanders. Areas of woodland stretched through the center of the watershed and across the northeastern corner and were comprised of white, red, pin, and burr oaks, interspersed with poplar, maple, butternut, black-walnut, and hickory.

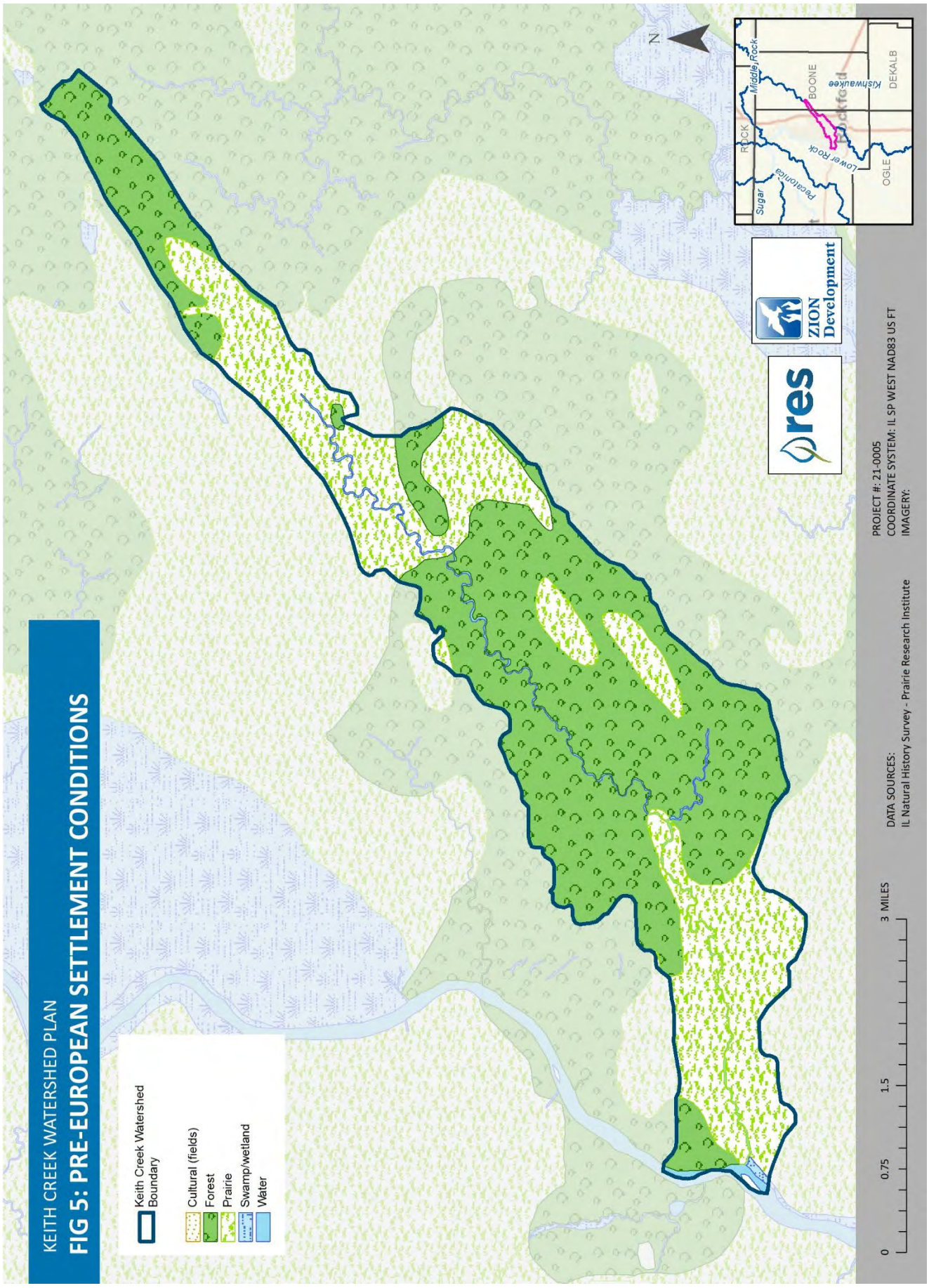


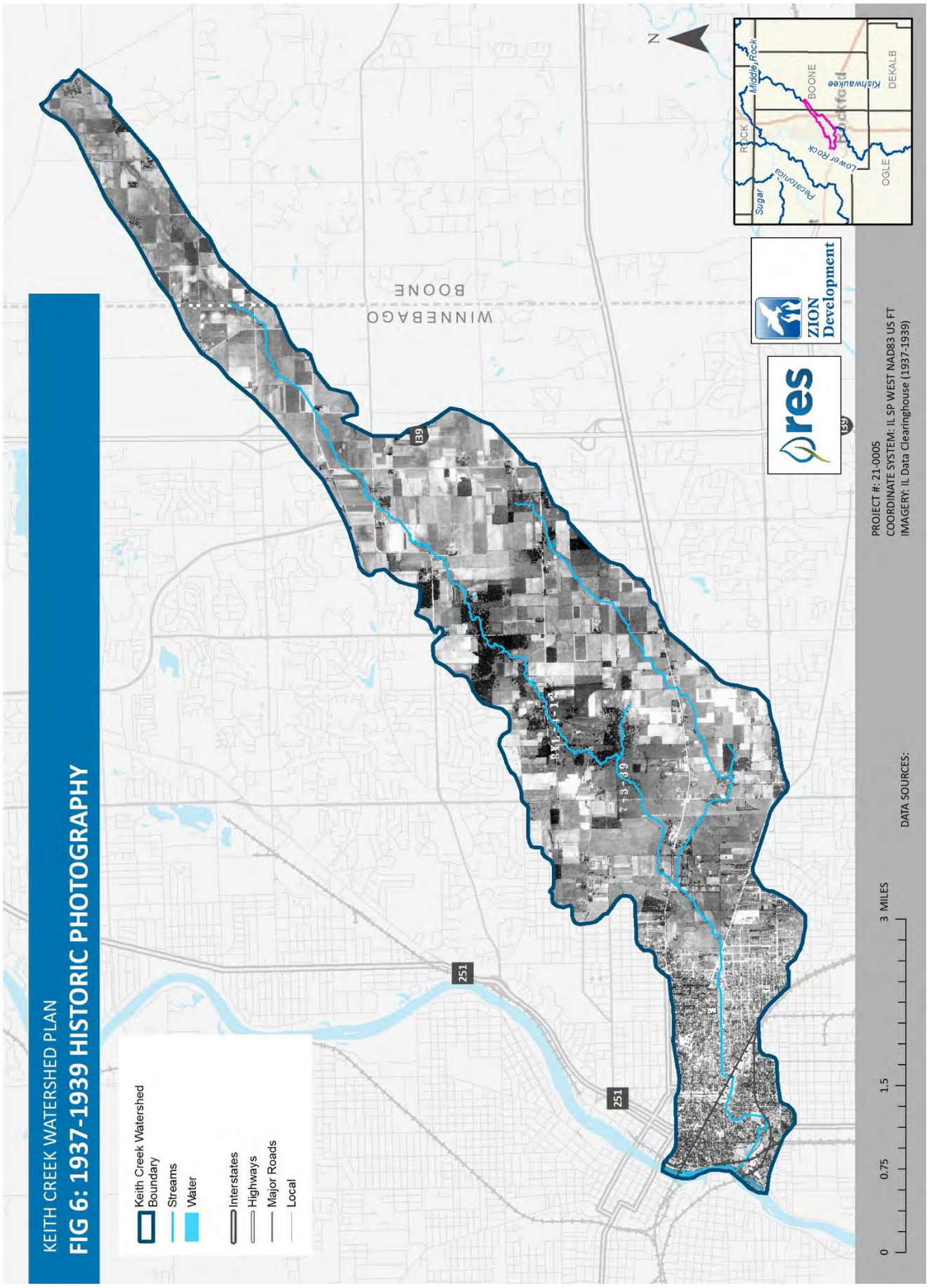
Over two-hundred-year-old maple at Rockford Arboretum

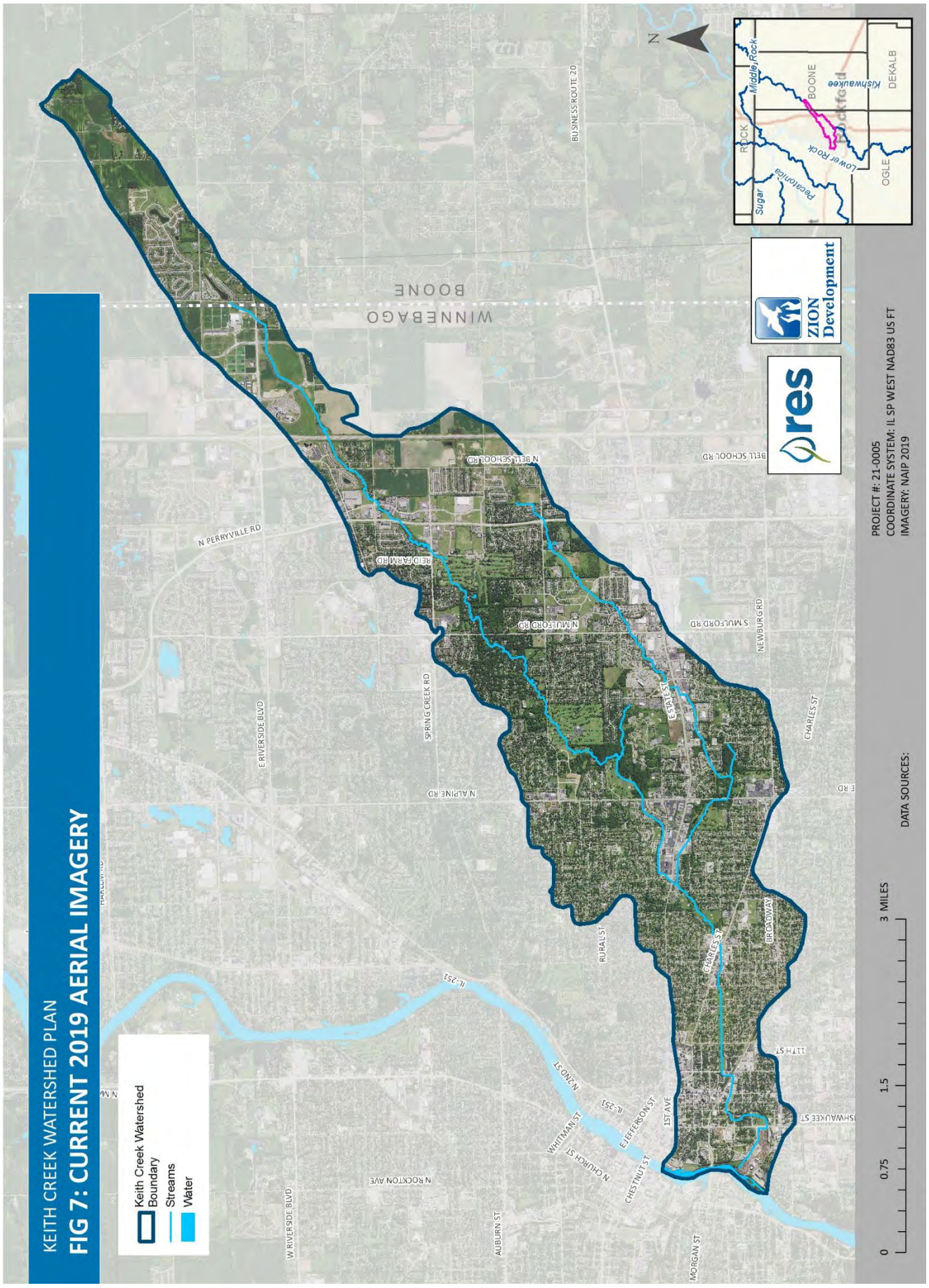
European settlement resulted in drastic changes to the fragile ecological communities. Fires no longer occurred as they threatened prairie homesteads, trees and woodlands were cut for fuel and to build the homes and businesses of early settlers, prairie and wetlands were tilled under or drained for farmland or developed, and many channels/ditches were excavated through wet areas to further drain the land for farming purposes.

The earliest aerial photographs, taken in 1937-1939 (Figure 6), depict the Keith Creek watershed when row crop farming was the primary land use outside of the Rockford itself. Some of the woodland communities described within the center of the watershed were still present at this time but farmland clearly replaced most of the prairie and woodland communities. With the advent of farming came significant changes in stormwater runoff. By 1939 defined stream channels had formed or were created throughout the watershed and many streams had been straightened and channelized to accommodate ongoing development. Figure 7 shows a 2019 aerial photograph of Keith Creek watershed. It depicts the extent to which the development of Rockford has expanded across most of the watershed with agriculture and other undeveloped areas found only along the eastern edges. Very few woodlands and virtually no prairie communities remain by 2019 compared to pre-settlement conditions. With degraded ecological conditions comes the opportunity to implement ecological restoration to improve the condition of Keith Creek watershed. Present day knowledge of how pre-European settlement ecological communities thrived and evolved provides a general template for developing present day natural area restoration and management plans. One of the primary goals of this watershed plan is to identify, protect, restore, and manage remaining natural areas.

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KEITH CREEK WATERSHED PLAN
FIG 5: PRE-EUROPEAN SETTLEMENT CONDITIONS
Keith Creek Watershed Boundary
Cultural (fields)
Forest
Prairie
Swamp/wetland
Water
N
0
0.75
1.5
3 MILES
DATA SOURCES:
IL Natural History Survey - Prairie Research Institute
PROJECT #: 21-0005
COORDINATE SYSTEM: IL SP WEST NAD83 US FT
IMAGERY:
res
ZION Development
Rockford
Middle Rock
Kishwaukee
Pecatonica
Sugar
Lower Rock
BOONE
DEKALB
OGLE
ROCK


KEITH CREEK WATERSHED PLAN
FIG 6: 1937-1939 HISTORIC PHOTOGRAPHY
Keith Creek Watershed Boundary
Streams
Water
Interstates
Highways
Major Roads
Local
WINNEBAGO
BOONE
251
251
139
N
ZION Development
res
Middle Rock
Kishwaukee
Pecatonica
Lower Rock
Sugar
ROCK
BOONE
OGLE
DEKALB
0
0.75
1.5
3 MILES
DATA SOURCES:
PROJECT #: 21-0005
COORDINATE SYSTEM: IL SP WEST NAD83 US FT
IMAGERY: IL Data Clearinghouse (1937-1939)


KEITH CREEK WATERSHED PLAN
FIG 7: CURRENT 2019 AERIAL IMAGERY
Keith Creek Watershed Boundary
Streams
Water
WINNEBAGO
BOONE
N
ZION Development
res
PROJECT #: 21-0005
COORDINATE SYSTEM: IL SP WEST NAD83 US FT
IMAGERY: NAIP 2019
DATA SOURCES:
0
0.75
1.5
3 MILES
BUSINESS ROUTE 20
N PERRYVILLE RD
BELL SCHOOL RD
N BELL SCHOOL RD
REID FARM RD
N MULFORD RD
S MULFORD RD
NEWBURG RD
SPRING CREEK RD
E RIVERSIDE BLVD
N ALPINE RD
E STATE ST
CHARLES ST
RURAL ST
BROADWAY
11TH ST
SHAWAUKEE ST
1ST AVE
E JEFFERSON ST
IL-251
N 2ND ST
WHITMAN ST
N CHURCH ST
CHESTNUT ST
N ROCKTON AVE
W RIVERSIDE BLVD
AUBURN ST
MORGAN ST
ROCK
BOONE
DEKALB
OGLE
Middle Rock
Kishwaukee
Lower Rock
Pecatonica
Sugar

3.3 Topography, Watershed Boundary, & Subwatershed Management Units

Topography & Watershed Boundary

The Illinois Episode glaciation that retreated 130,000 years ago formed much of the topography and defined the Keith Creek watershed boundary observed today. Topography refers to elevations of a landscape that describe the configuration of its surface and ultimately defines watershed boundaries. The specifics of watershed planning cannot begin until a watershed boundary is clearly defined. The Keith Creek watershed boundary reflects recent 2-foot topography data available from Winnebago and Boone Counties. The refined watershed boundary was then input into a GIS model (Arc Hydro) that generated a Digital Elevation Model (DEM) of the watershed (Figure 8). The Keith Creek watershed is 9,111.8 acres or 14.2 square miles in size.



Example of rolling topography of Keith Creek watershed at Aldeen Park

The Keith Creek watershed (AUIDs: IL_PR-01 and IL_PR-99) generally drains from northeast to southwest before entering the Rock River (at IL_P-23). Elevation within the watershed ranges from a high of 958.7 feet above sea level (ASL) to a low of 689.5 feet ASL for a total relief of 268.6 feet (Figure 8). The highest point is found in the northeastern portion of the watershed near the intersection of Ayrshire Ln and Castle Wynd Dr. Higher elevations also extend much of the eastern portions of the watershed, generally. The lowest elevation occurs near where Keith Creek outlets to the Rock River with lower elevations extending along the reaches of Keith Creek and adjacent to the Rock River.

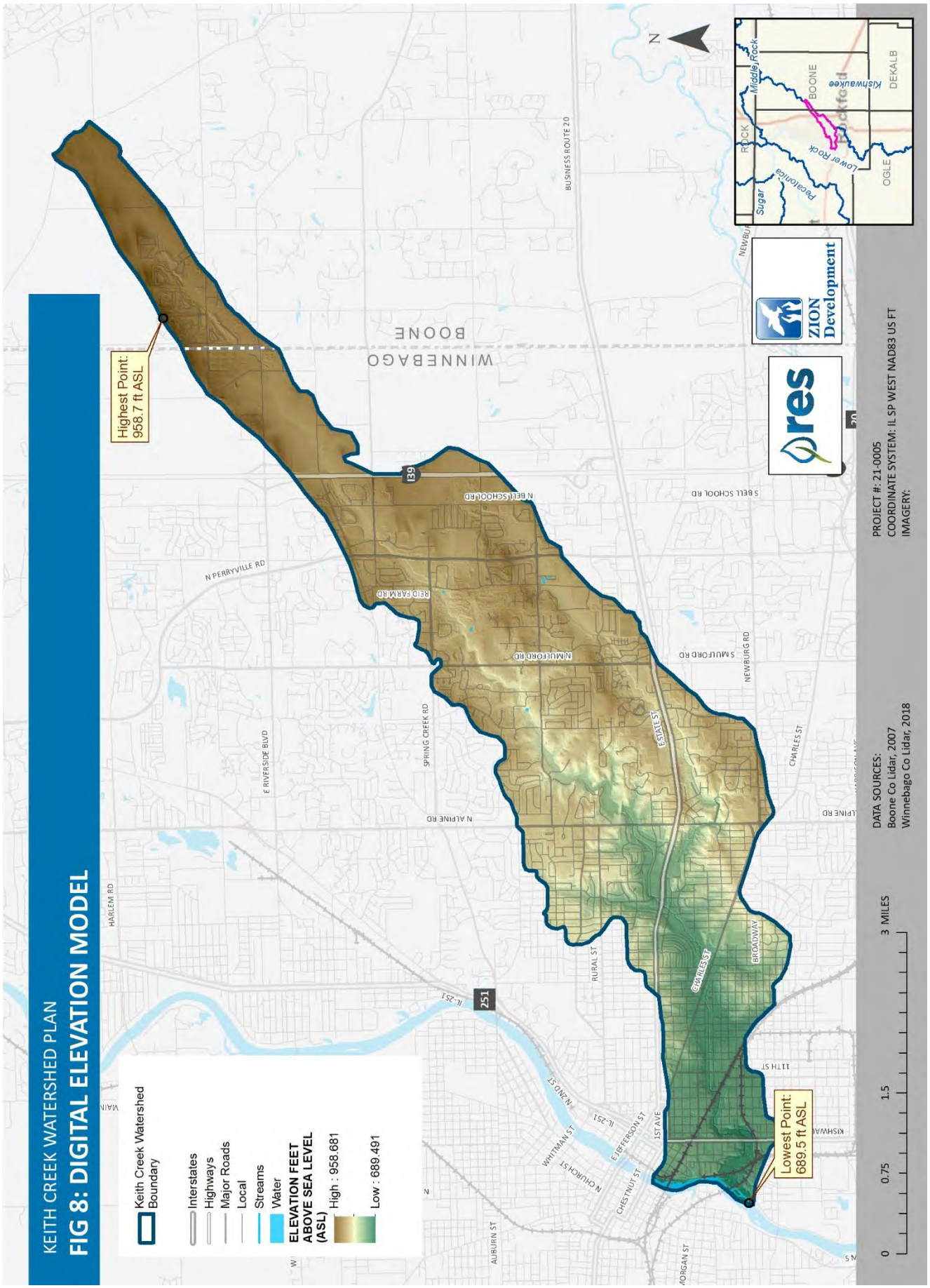
Subwatershed Management Units (SMUs)

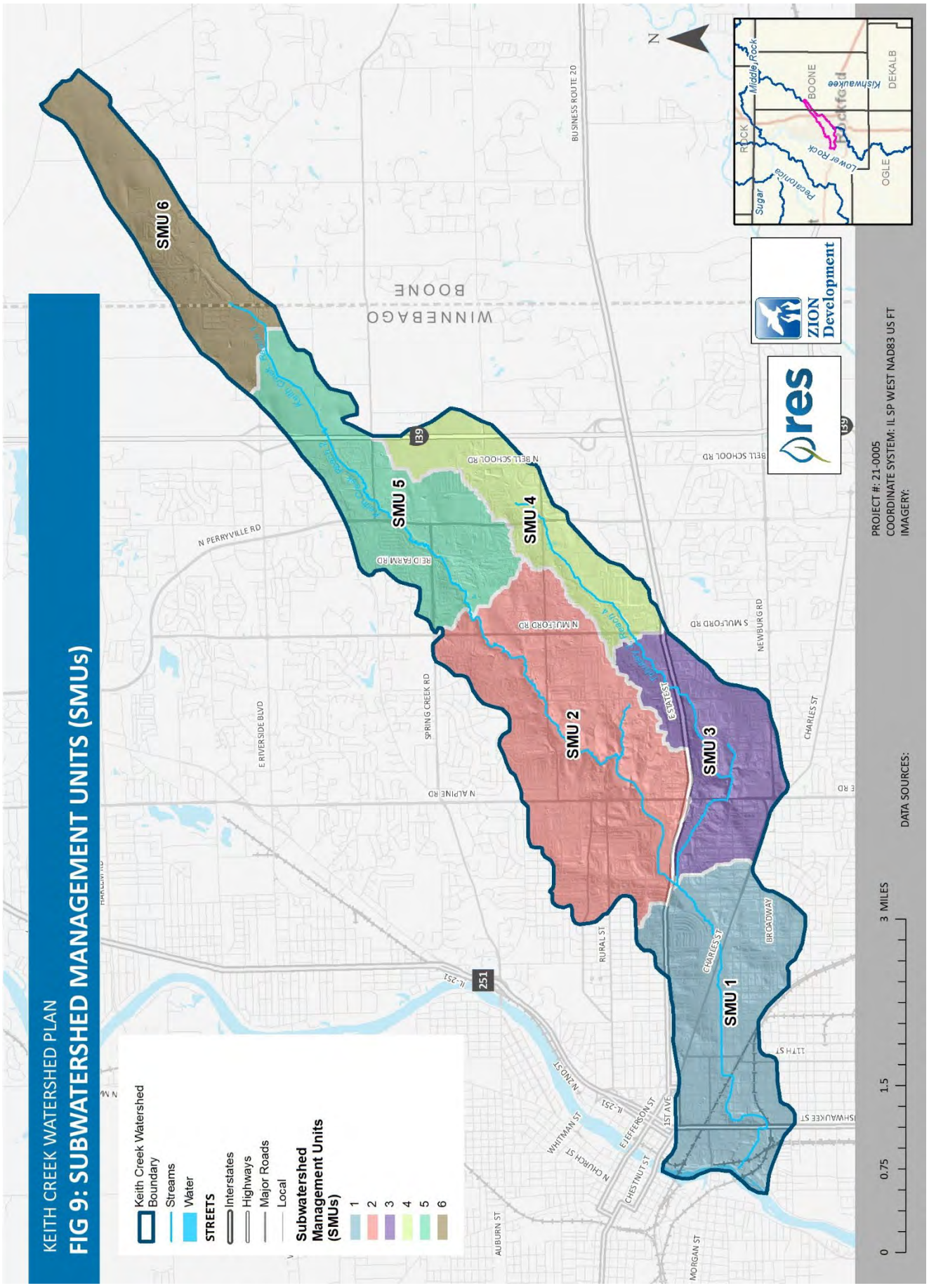
The Center for Watershed Protection (CWP) is a leading watershed planning agency and has defined watershed and subwatershed sizes appropriate to meet watershed planning goals. In 1998, the CWP released the "Rapid Watershed Planning Handbook" (CWP 1998) as a guide to be used by watershed planners when addressing issues within urbanizing watersheds. The CWP defines a watershed as an area of land that drains up to 100 square miles. Broad assessments of conditions such as soils, wetlands, and water quality are generally evaluated at the watershed level and provide some information about overall conditions. To address issues at a smaller scale, a watershed can be divided into subwatersheds called Subwatershed Management Units (SMUs). The Keith Creek watershed was delineated into 6 SMUs by using the Digital Elevation Model (DEM). Information obtained at the SMU scale allows for detailed analysis and better recommendations for site specific recommendations. Table 2 presents each SMU and size within the watershed. Figure 9 depicts the location of each SMU boundary delineated within the larger Keith Creek watershed.

Table 2. Subwatershed Management Units and size.

SMU #	Acres	Square Miles	Stream Reach
SMU 1	1,814.7	2.8	Keith Creek Reach 8, 9, 10, 11, and 12
SMU 2	2,523.4	3.9	Keith Creek Reach 4, 5, 6, and 7, and Tributary 1 Reach 1
SMU 3	1,151.0	1.8	Tributary 2 Reach 4, 5, 6, and 7, and Tributary A
SMU 4	981.4	1.5	Tributary 2 Reach 1, 2, 3, and 4
SMU 5	1,523.2	2.4	Keith Creek Reach 1, 2, and 3
SMU 6	1,118.1	1.7	Keith Creek Reach 1
Totals	9,111.7	14.2	

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KEITH CREEK WATERSHED PLAN
FIG 8: DIGITAL ELEVATION MODEL
Keith Creek Watershed Boundary
Interstates
Highways
Major Roads
Local
Streams
Water
ELEVATION FEET ABOVE SEA LEVEL (ASL)
High : 958.681
Low : 689.491
Highest Point: 958.7 ft ASL
Lowest Point: 689.5 ft ASL
WINNEBAGO
BOONE
N
0
0.75
1.5
3 MILES
DATA SOURCES:
Boone Co Lidar, 2007
Winnebago Co Lidar, 2018
PROJECT #: 21-0005
COORDINATE SYSTEM: IL SP WEST NAD83 US FT
IMAGERY:
res
ZION Development
Rockford
Kishwaukee
Middle Rock
Lower Rock
Pecatonica
Sugar
BOONE
DEKALB
OGLE
ROCK
BUSINESS ROUTE 20
N BELL SCHOOL RD
S BELL SCHOOL RD
REID FARM RD
N PERRYVILLE RD
N MULFORD RD
S MULFORD RD
NEWBURG RD
E RIVERSIDE BLVD
SPRING CREEK RD
N ALPINE RD
ESTATE ST
CHARLES ST
BROADWAY
RURAL ST
HARLEM RD
IL-251
251
11TH ST
N 2ND ST
WHITMAN ST
N CHURCH ST
E JEFFERSON ST
1ST AVE
CHESTNUT ST
AUBURN ST
139


KEITH CREEK WATERSHED PLAN
FIG 9: SUBWATERSHED MANAGEMENT UNITS (SMUs)
Keith Creek Watershed Boundary
Streams
Water
STREETS
Interstates
Highways
Major Roads
Local
Subwatershed Management Units (SMUs)
1
2
3
4
5
6
SMU 1
SMU 2
SMU 3
SMU 4
SMU 5
SMU 6
WINNEBAGO
BOONE
BUSINESS ROUTE 20
N PERRYVILLE RD
BELL SCHOOL RD
N BELL SCHOOL RD
REID FARM RD
N MULFORD RD
S MULFORD RD
NEWBURG RD
E RIVERSIDE BLVD
SPRING CREEK RD
N ALPINE RD
E STATE ST
CHARLES ST
RURAL ST
BROADWAY
11TH ST
SHAWAUKEE ST
1ST AVE
JEFFERSON ST
CHESTNUT ST
WHITMAN ST
N CHURCH ST
N MAIN ST
AUBURN ST
MORGAN ST
IL-251
251
139
N
ZION Development
res
Rock
Middle Rock
Kishwaukee
Sugar
Pecatonica
Lower Rock
BOONE
DEKALB
OGLE
0
0.75
1.5
3 MILES
DATA SOURCES:
PROJECT #: 21-0005
COORDINATE SYSTEM: IL SP WEST NAD83 US FT
IMAGERY:

3.4 Hydric Soils, Potential Erosion Hazard, & Hydrologic Soil Groups

Soils

Deposits left by the Illinois Episode glaciation 130,000 years ago are the raw materials of present soil types in the watershed. These raw materials include till (debris) and outwash. A combination of physical, biological, and chemical variables such as topography, drainage patterns, climate, and vegetation, have interacted over centuries to form the complex variety of soils found in the watershed. Most soils formed under prairie, woodland, and wetland vegetation. The most up to date soils mapping provided by the United States Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS) was used to summarize the extent of soil types, including hydric soils, potential erosion hazard, and hydrologic soil groups within Keith Creek watershed (Tables 3- 5; Figures 10-12).

Hydric Soils

Wetlands or "Hydric Soils" generally form over poorly drained clay material associated with wet prairies, marshes, and other wetlands and from accumulated organic matter from decomposing surface vegetation. Hydric soils are important because they indicate the presence of existing wetlands or drained wetlands where restoration may be possible. Most of the wetlands in Keith Creek watershed were intact until the late 1830s when European settlers began to alter significant portions of the watershed's natural hydrology and wetland processes. Where it was feasible wet areas were drained, streams channelized, and prairie and woodland cleared to ease development or to farm the rich soils.

Historically there were approximately 1,054 acres of wetlands (12% of the watershed; as hydric soils) in the watershed. The remaining 8,057 acres were not hydric. According to existing wetland inventories, 51 acres or 5% of the pre-European settlement wetlands remain. The location of hydric soils in the watershed is depicted in Figure 10. Existing wetlands and wetland restoration opportunities are discussed in detail in Section 3.13.3.

Potential Erosion Hazard

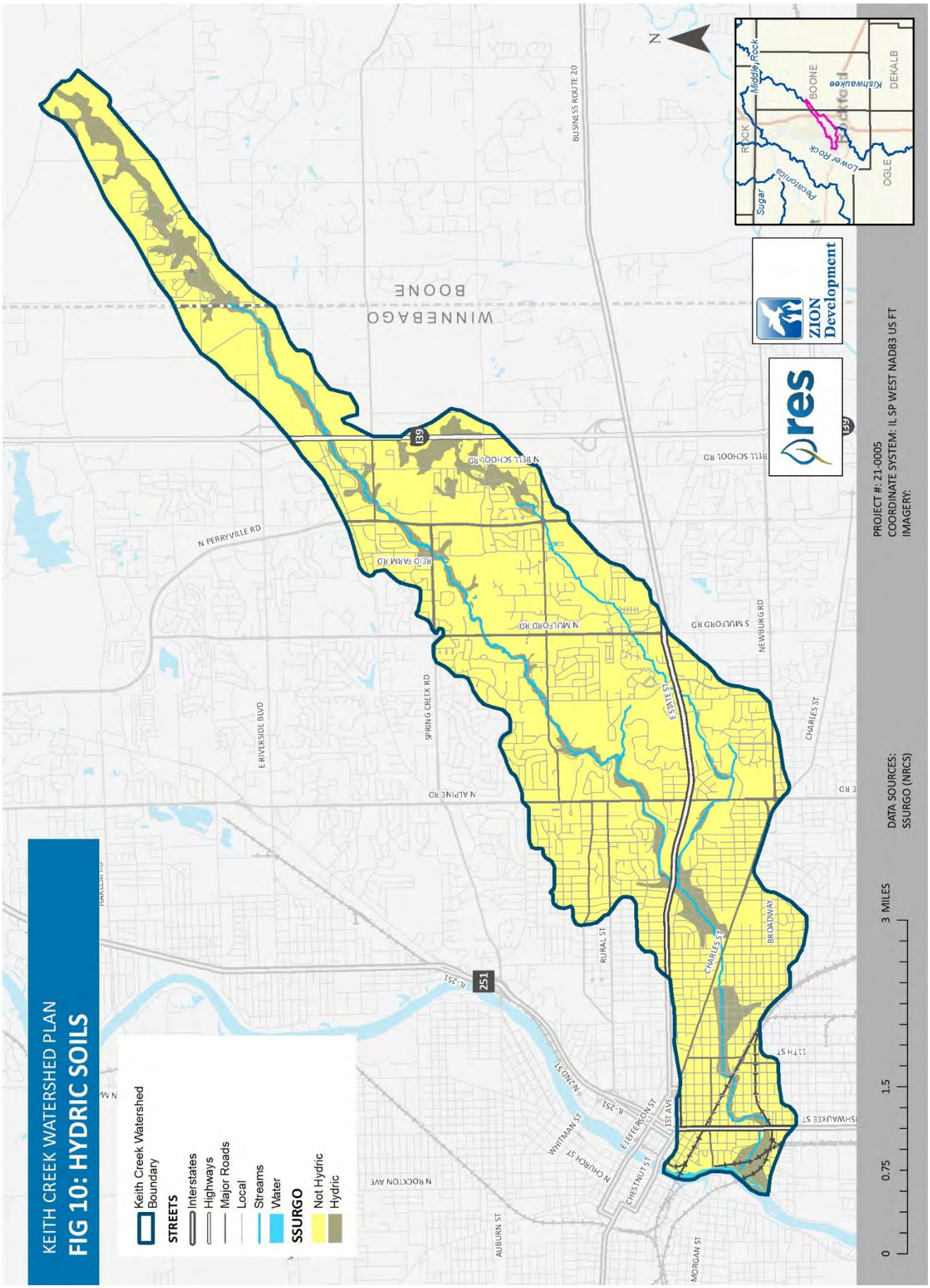
Soil erosion is the process whereby soil is removed from its original location by flowing water, wave action, wind, and other factors. Sedimentation is the process that deposits eroded soils on other ground surfaces or in bodies of water such as streams and lakes. Soil erosion and sedimentation reduces water quality by increasing total suspended solids (TSS) in the water column and by carrying attached pollutants such as phosphorus, nitrogen, and hydrocarbons. When soils settle in streams and lakes, they often blanket rock, cobble, and sandy substrates needed by fish and aquatic macroinvertebrates for habitat, food, and reproduction.

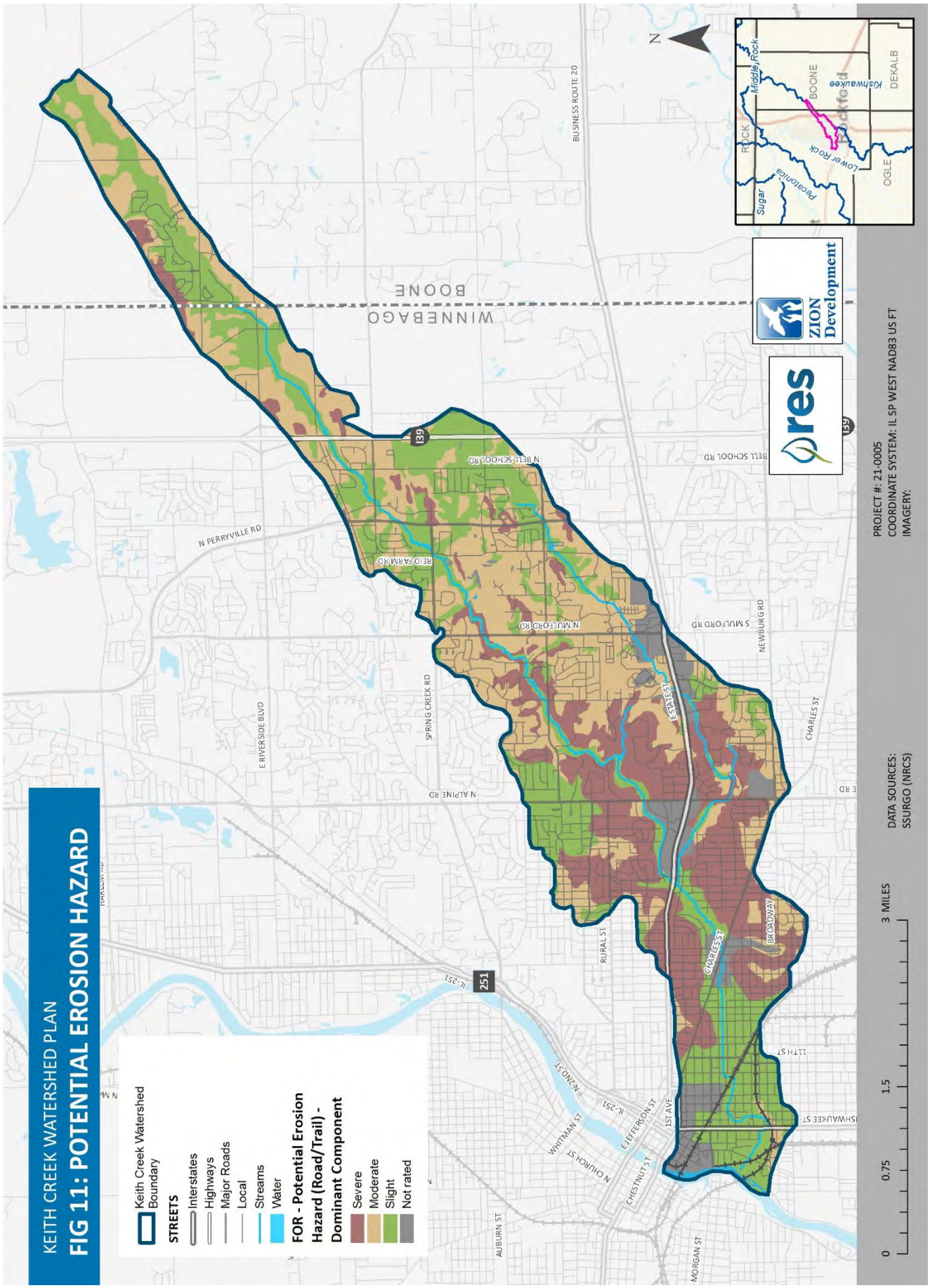
The potential erosion hazard of the soils is mapped in Figure 11 and detailed in Table 3; it is important to know the location of the most highly erodible soils because these areas have the highest potential to degrade water quality during farm tillage and development. Based on mapping, 2,154 acres (24%) were rated as having a severe potential erosion hazard and 3,317 acres (36%) were rated as a moderate potential erosion hazard. Most of the severe and moderate potential erosion hazard lies across the central portion of the watershed.

Table 3. Potential erosion hazard and percent of watershed area.

Potential Erosion Hazard	Acreage	Percent
Severe	2,154.1	23.6%
Moderate	3,316.6	36.4%
Slight	2,975.4	32.7%
Not rated	665.7	7.3%
Total	**9,111.8**	**100.0%**

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KEITH CREEK WATERSHED PLAN
FIG 10: HYDRIC SOILS
Keith Creek Watershed Boundary
STREETS
Interstates
Highways
Major Roads
Local
Streams
Water
SSURGO
Not Hydric
Hydric
WINNEBAGO
BOONE
BUSINESS ROUTE 20
N PERRYVILLE RD
REID FARM RD
N BELL SCHOOL RD
BELL SCHOOL RD
N MULFORD RD
S MULFORD RD
NEWBURG RD
E RIVERSIDE BLVD
SPRING CREEK RD
N ALPINE RD
ESTATE ST
CHARLES ST
RURAL ST
BROADWAY
11TH ST
IL-251
251
N CHURCH ST
WHITMAN ST
JEFFERSON ST
1ST AVE
CHESTNUT ST
N ROCKTON AVE
AUBURN ST
MORGAN ST
SHAWNEE ST
N
ROCK
BOONE
DEKALB
OGLE
Middle Rock
Kishwaukee
Lower Rock
Pecatonica
Sugar
ZION Development
res
PROJECT #: 21-0005
COORDINATE SYSTEM: IL SP WEST NAD83 US FT
IMAGERY:
DATA SOURCES:
SSURGO (NRCS)
0
0.75
1.5
3 MILES


KEITH CREEK WATERSHED PLAN
FIG 11: POTENTIAL EROSION HAZARD
Keith Creek Watershed Boundary
STREETS
Interstates
Highways
Major Roads
Local
Streams
Water
FOR - Potential Erosion Hazard (Road/Trail) - Dominant Component
Severe
Moderate
Slight
Not rated
WINNEBAGO
BOONE
N PERRYVILLE RD
REID FARM RD
N BELL SCHOOL RD
BELL SCHOOL RD
N MULFORD RD
S MULFORD RD
NEWBURG RD
E RIVERSIDE BLVD
SPRING CREEK RD
N ALPINE RD
ESTATE ST
CHARLES ST
BROADWAY
RURAL ST
11TH ST
SHAWNEE ST
1ST AVE
JEFFERSON ST
CHESTNUT ST
WHITMAN ST
CHURCH ST
N MAIN ST
AUBURN ST
MORGAN ST
BUSINESS ROUTE 20
IL-251
139
251
N
ZION Development
res
PROJECT #: 21-0005
COORDINATE SYSTEM: IL SP WEST NAD83 US FT
IMAGERY:
DATA SOURCES:
SSURGO (NRCS)
0
0.75
1.5
3 MILES

Hydrologic Soil Groups

Soils also exhibit different infiltration capabilities and have been classified to fit what are known as "Hydrologic Soil Groups" (HSGs). HSGs are based on a soil's infiltration and transmission (permeability) rates and are used by engineers and planners to estimate stormwater runoff potential. Knowing how a soil will hold water ultimately affects the type and location of recommended infiltration Management Measures such as wetland restorations and detention basins. More importantly however is the link between hydrologic soil groups and groundwater recharge areas. Groundwater is discussed in Section 3.15.

HSGs are classified into four primary categories; A, B, C, and D, and three dual classes, A/D, B/D, and C/D, as detailed in Table 4 below. Dual classes refer to areas where the water table is within 24" of the surface. In these cases, "the first letter applies to the drained condition and the second to the undrained condition (USDA, 2007)". Figure 12 depicts the location of each HSG in the watershed. The HSG categories and their corresponding soil texture, drainage description, runoff potential, infiltration rate, and transmission rate are shown in Table 4 while Table 5 summarizes the acreage and percent of each HSG. Group B soils are dominant throughout the watershed at about 67% coverage and are found throughout the watershed. Group B/D soils also make up a significant portion of the watershed at around 21%.

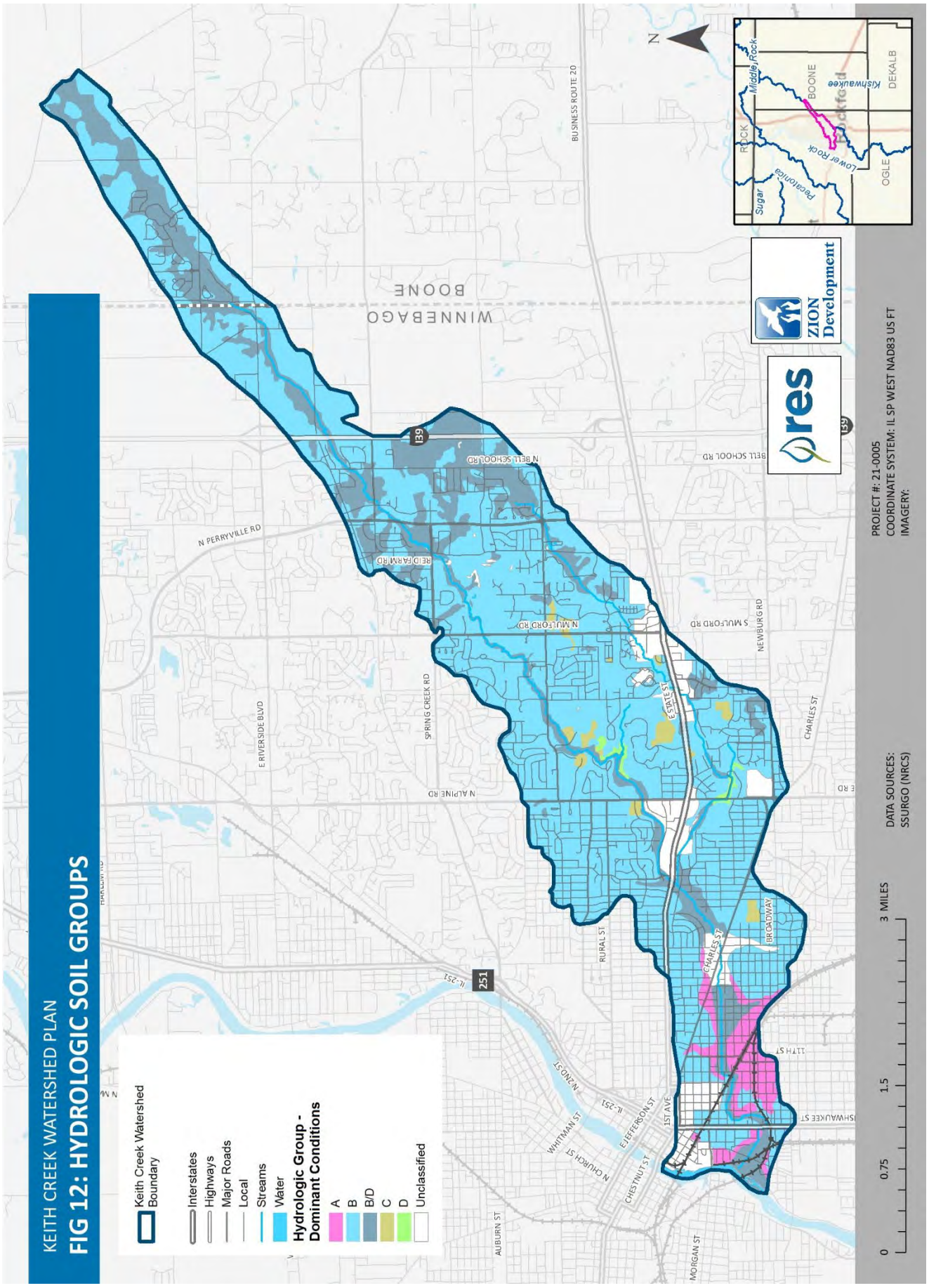
Table 4. Hydrologic Soil Groups and their corresponding attributes.

HSG	Soil Texture	Drainage Description	Runoff Potential	Infiltration Rate	Transmission Rate
A	Sand, Loamy Sand, or Sandy Loam	Well to Excessively Drained	Low	High	High
B	Silt Loam or Loam	Moderately Well to Well Drained	Moderate	Moderate	Moderate
C	Sandy Clay Loam	Somewhat Poorly Drained	High	Low	Low
D	Clay Loam, Silty Clay Loam, Sandy Clay Loam, Silty Clay, or Clay	Poorly Drained	High	Very Low	Very Low

Table 5. Hydrologic Soil Groups including acreage and percent of watershed.

Hydrologic Soil Group	Area (acres)	% of Watershed
A	294.4	3.2%
B	6,137.5	67.4%
B/D	1,866.8	20.5%
C	112.4	1.2%
D	35.0	0.4%
Unclassified	665.7	7.3%
Grand Total	9,111.8	100.0%

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KEITH CREEK WATERSHED PLAN
FIG 12: HYDROLOGIC SOIL GROUPS
Keith Creek Watershed Boundary
Interstates
Highways
Major Roads
Local
Streams
Water
Hydrologic Group - Dominant Conditions
A
B
B/D
C
D
Unclassified
WINNEBAGO
BOONE
BUSINESS ROUTE 20
N PERRYVILLE RD
REID FARM RD
N BELL SCHOOL RD
BELL SCHOOL RD
N MULFORD RD
S MULFORD RD
NEWBURG RD
E RIVERSIDE BLVD
SPRING CREEK RD
N ALPINE RD
E STATE ST
CHARLES ST
RURAL ST
BROADWAY
E CHARLES ST
IL-251
251
N MAIN ST
WHITMAN ST
N CHURCH ST
CHESTNUT ST
E JEFFERSON ST
1ST AVE
11TH ST
ISHWAUKEE ST
AUBURN ST
MORGAN ST
N
0
0.75
1.5
3 MILES
DATA SOURCES:
SSURGO (NRCS)
PROJECT #: 21-0005
COORDINATE SYSTEM: IL SP WEST NAD83 US FT
IMAGERY:
res
ZION Development
Rockford
Middle Rock
Kishwaukee
Sugar
Pecatonica
Lower Rock
ROCK
BOONE
DEKALB
OGLE

3.5 Jurisdictions, Roles, & Protections

The Keith Creek watershed is located in Winnebago and Boone Counties, portions of four townships, and four municipalities (Table 6, Figure 13). Almost 91% of the watershed falls in Winnebago County, while the remaining 9% in the northeast portion of the watershed is in Boone County. Most of the watershed falls within a municipal boundary as well: the City of Rockford makes up 6,738.7 acres (74%), the City of Loves Park includes 566.6 acres (6%), and the Village of Timberlane makes up 11.6 acres (less than 1%) of the watershed. Outside of municipal boundaries, the watershed includes portions of three townships: Rockford (1,304.8 acres; 14.3%), Caledonia (397.1 acres; 4.4%), and Belvidere (93 acres; 1%).

Table 6. County, township, unincorporated, and municipal jurisdictions.

Jurisdiction	Acres	Percent of Watershed
Counties	**9,111.8**	**100.0%**
Winnebago County	8,276.8	90.8%
Boone County	834.9	9.2%
Townships	**1,794.8**	**19.7%**
Unincorporated Rockford Township	1,304.8	14.3%
Unincorporated Caledonia Township	397.1	4.4%
Unincorporated Belvidere Township	93.0	1.0%
Municipalities	**7,316.9**	**80.3%**
City of Rockford	6,738.7	74.0%
City of Loves Park	566.6	6.2%
Village of Timberlane	11.6	0.1%

Jurisdictional Roles and Protections

Natural resources throughout the United States are protected to some degree under federal, state, and/or local law, also referred to as regulations. A regulation is a rule or directive made and maintained by an authority, such as a law, act, or municipal ordinance. Jurisdictional authority is a hierarchy (Table 7), starting at the federal level, with subsequent levels (state, county, local, etc.) needing to follow the regulations of all the levels above it. For example, the City of Rockford would need to follow all the Federal guidelines, all the guidelines provided by the State of Illinois, all Winnebago/Boone County regulations, and then can also create and maintain additional regulations or restrictions within the City limits. Lower levels of jurisdiction can be more restrictive, but not less restrictive. Watershed boundaries do not correlate with political boundaries and therefore, to properly protect water and other natural resources, cooperation and coordination among all these entities is essential.

Federal Government Roles and Protections

United States Army Corps of Engineers (USACE) - In the Rockford area, the U.S. Army Corps of Engineers (USACE) regulate wetlands through Section 404 of the Clean Water Act. Land development affecting water resources (rivers, streams, lakes, wetlands, and floodplains) is regulated by the USACE when "Waters of the U.S." are involved. These types of waters include any wetland or stream/river that is hydrologically connected to navigable waters. The USACE primarily regulates filling activities and requires buffers or wetland mitigation for developments that impact jurisdictional wetlands.

United States Department of Agriculture (USDA)- The United States Department of Agriculture, is the federal department responsible for developing and executing federal laws related to farming, forestry, rural economic development, and food. Agencies within the USDA include: Agricultural Marketing Service (AMS), Agricultural Research Service (ARS), Animal and Plant Health Inspection Service (APHIS), Center for Nutrition Policy and Promotion (CNPP), Economic Research Service (ERS), Farm Service Agency (FSA), Food and Nutrition Service (FNS), Food Safety and Inspection Service (FSIS), Foreign Agricultural Service (FAS), Forest Service (FS), National Agricultural Library (NAL), National Institute of Food and Agriculture (NIFA), Natural Resources Conservation Service (NRCS), Risk Management Agency (RMA), Rural Development (RD), Rural Utilities Service (RUS), Rural Housing Service (RHS), and Rural Business-Cooperative Service (RBS). The programs most relevant to the management of the Keith Creek Watershed are discussed further in the following paragraphs.

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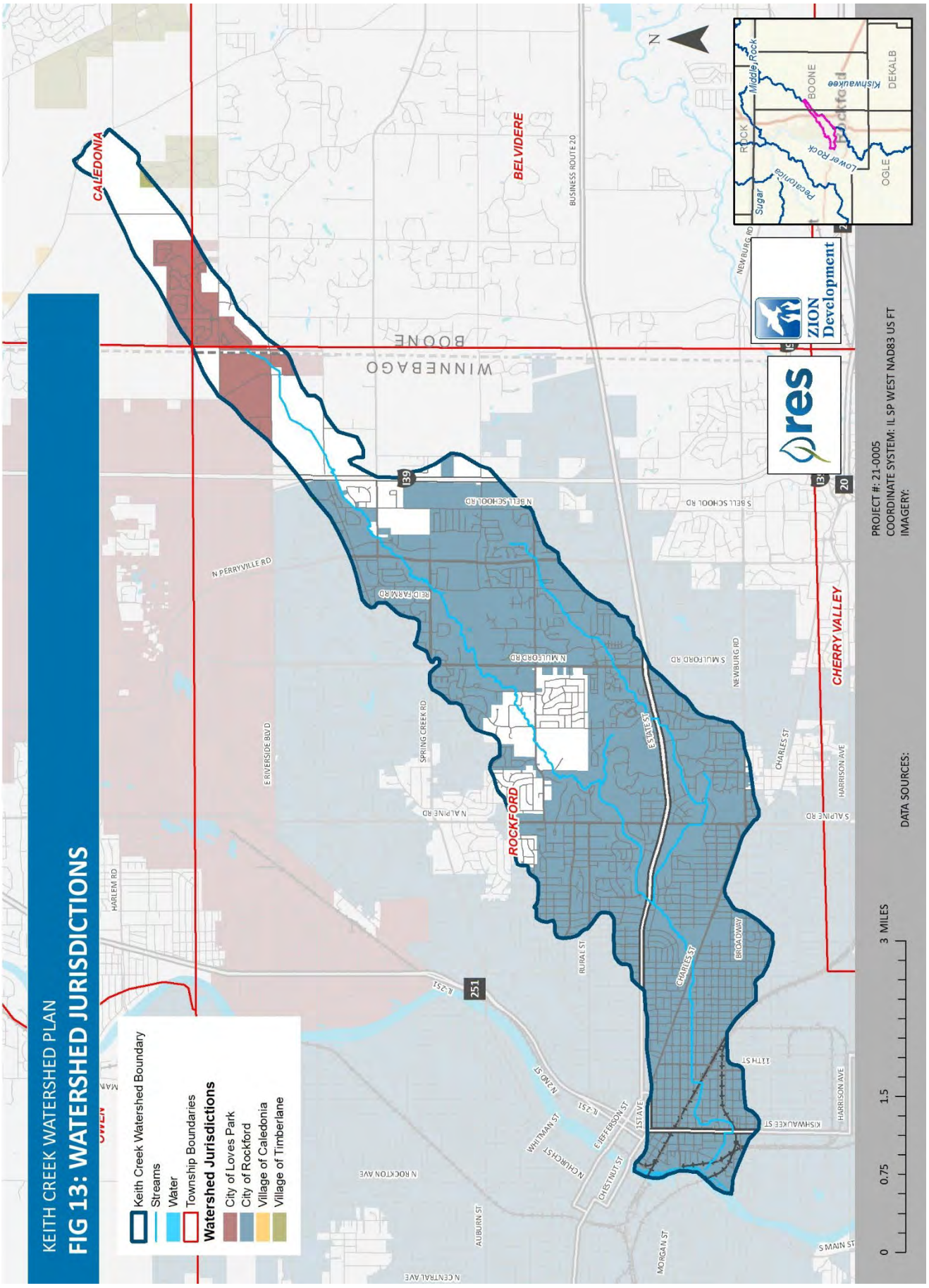

KEITH CREEK WATERSHED PLAN
FIG 13: WATERSHED JURISDICTIONS
Keith Creek Watershed Boundary
Streams
Water
Township Boundaries
Watershed Jurisdictions
City of Loves Park
City of Rockford
Village of Caledonia
Village of Timberlane
CALEDONIA
BELVIDERE
ROCKFORD
CHERRY VALLEY
WINNEBAGO
BOONE
BUSINESS ROUTE 20
N PERRYVILLE RD
N BELL SCHOOL RD
S BELL SCHOOL RD
REID FARM RD
N MULFORD RD
S MULFORD RD
NEWBURG RD
SPRING CREEK RD
E RIVERSIDE BLVD
N ALPINE RD
S ALPINE RD
E STATE ST
CHARLES ST
HARRISON AVE
HARLEM RD
RURAL ST
BROADWAY
11TH ST
KISHWAUKEE ST
1ST AVE
JEFFERSON ST
CHESTNUT ST
WHITMAN ST
N CHURCH ST
N 2ND ST
N ROCKTON AVE
AUBURN ST
MORGAN ST
S MAIN ST
N CENTRAL AVE
NEWBURG RD
251
139
20
ZION Development
res
Middle Rock
Kishwaukee
Pecatonica
Sugar
Lower Rock
ROCK
BOONE
OGLE
DEKALB
N
0
0.75
1.5
3 MILES
PROJECT #: 21-0005
COORDINATE SYSTEM: IL SP WEST NAD83 US FT
IMAGERY:
DATA SOURCES:

Table 7. Levels of jurisdiction.

Level of Jurisdiction	Entities
Federal	US Environmental Protection Agency (USEPA)
	- Office of Water
	US Army Corps of Engineers (USACE)
	US Department of Agriculture (USDA)
	- Natural Resources Conservation Service (NRCS)
	- Farm Service Agency (FSA)
	- Agricultural Research Service (ARS)
	- Forest Service (FS)
	- National Institute of Food and Agriculture (NIFA)
	- Rural Utilities Service (RUS)
	US Fish and Wildlife Service (USFWS)
	US Department of Transportation (USDOT)
	- Federal Aviation Administration (FAA)
State	Illinois Environmental Protection Agency (IEPA)
	- Bureau of Land
	- Bureau of Water
	Illinois Department of Natural Resources (IDNR)
	- Office of Water Resources (OWR)
	- Illinois Nature Preserves Commission (INPC)
	Illinois Department of Agriculture (IDOA)
	Illinois Tollway
Regional	Region 1 Planning Council (RPC)
County	Winnebago & Boone County Boards
	Winnebago County Planning & Zoning Division
	Boone County Planning Department
	Winnebago & Boone County Health Departments
	Winnebago & Boone County Highway Departments
	Winnebago & Boone County Soil and Water Conservation Districts
	Winnebago & Boone County Forest Preserve Districts
Local	City of Rockford
	City of Loves Park
	Village of Timberlane
Township	Unincorporated Rockford Township
	Unincorporated Belvidere Township
	Unincorporated Caledonia Township

USDA Agricultural Research Service (ARS)- ARS is USDA's principal in-house research agency studying agricultural research and information. National Research Programs such as Nation Program 211: Water Availability and Watershed Management serve to manage water resources while protecting the environment and human and animal health effectively and safely. This goal is pursued by characterizing potential hazards, developing management practices, strategies, and systems to alleviate problems, and providing practices, technologies, and decision support tools for the benefit of customers, stakeholders, partners, and product users.

USDA Farm Service Agency (FSA)- The Farm Service Agency implements agricultural policy, administers credit and loan programs, and manages conservation, commodity, disaster, and farm marketing programs through a national network of

offices. The FSA strives to support a market-oriented, economically, and environmentally sound American agriculture that delivers an abundant, safe, and affordable food and fiber supply while sustaining quality agricultural communities.

USDA Forest Service (FS)- The Forest Service works to sustain the health, diversity and productivity of America's forests and grasslands. The Forest Service seeks to support nature in sustaining life through their stewardship work. The Forest Service works in collaboration with communities and partners in providing access to resources and experiences that promote economic, ecological, and social vitality; and connecting people to the land and one another.

USDA National Institute of Food and Agriculture (NIFA)- The National Institute of Food and Agriculture (NIFA) provides leadership and funding for programs that advance agriculture-related sciences. NIFA's mission is to invest in and advance agricultural research, education, and extension to solve societal challenges. NIFA invests in and supports initiatives that ensure the long-term viability of agriculture. NIFA applies an integrated approach to ensure that discoveries in agriculture-related sciences and technologies reach the people who can put them into practice.

USDA Natural Resources Conservation Service (NRCS)- NRCS is the primary federal agency that works with private landowners to help them conserve, maintain and improve their natural resources to implement conservation practices that clean the air, conserve and clean the water, prevent soil erosion and create and protect wildlife habitat. They are also responsible for providing technical assistance to the USDA Farm Service Agency for sodbuster, wetland and highly erodible land determinations and compliance issues.

USDA Rural Utilities Service (RUS)- RUS provides much-needed infrastructure and infrastructure improvements to rural communities. This includes water and wastewater treatment, electric power, and telecommunications services. These services help to expand economic opportunities and improve the quality of life for rural residents. The Water and Environmental Programs (WEP) provides loans, grants and loan guarantees for drinking water, sanitary sewer, solid waste and storm drainage facilities in rural areas and cities and towns of 10,000 or less. Public bodies, non-profit organizations and recognized Indian tribes may qualify for assistance. WEP also makes grants to non-profit organizations to provide technical assistance and training to help rural communities with their water, wastewater, and solid waste problems.

United States Department of Transportation (USDOT)- USDOT's mission is to serve the United States by ensuring a fast, safe, efficient, accessible and convenient transportation system that meets our vital national interests and enhances the quality of life of the American people, today and into the future.

United States Environmental Protection Agency (USEPA)- The mission of the USEPA is to protect human health and the environment. The EPA works to ensure that Americans have clean air, land and water, and that National efforts to reduce environmental risks are based on the best available scientific information. They also work to ensure that Federal laws protecting human health and the environment are administered and enforced fairly and effectively.

As environmental stewardship is integral to U.S. policies concerning natural resources, human health, economic growth, energy, transportation, agriculture, industry, and international trade; these factors are similarly considered in establishing environmental policy. As well as ensuring that all parts of society have access to accurate information sufficient to effectively participate in managing human health and environmental risks. They also oversee that contaminated lands and toxic sites are cleaned up by potentially responsible parties and revitalized and chemicals in the marketplace are reviewed for safety.

United States EPA Office of Water (OW)- The Office of Water (OW) ensures drinking water is safe, and restores and maintains oceans, watersheds, and their aquatic ecosystems to protect human health, support economic and recreational activities, and provide healthy habitat for fish, plants, and wildlife. OW is responsible for implementing the Clean Water Act and Safe Drinking Water Act, and portions of the Coastal Zone Act Reauthorization Amendments of 1990, Resource Conservation and Recovery Act, Ocean Dumping Ban Act, Marine Protection, Research and Sanctuaries Act, Shore Protection Act, Marine Plastics Pollution Research and Control Act, London Dumping Convention, the International Convention for the Prevention of Pollution from Ships, and several other statutes.

United States Fish and Wildlife Service (USFWS)- USFWS and Illinois Department of Natural Resources (IDNR), along with Illinois Nature Preserves Commission (INPC) and Forest Preserve Districts, are responsible for protecting federal and state threatened and endangered species in the watershed--which are often found on land that contains wetlands, lakes, ponds, and streams. The USFWS and IDNR play a critical role in natural resource protection, particularly for rare or high-quality habitat and threatened and endangered species. They protect and manage land that often contains wetlands, lakes, ponds, and streams. Their programs function to enforce federal wildlife laws, protect endangered species, manage migratory birds, restore nationally significant fisheries, conserve and restore wildlife habitat such as wetlands, help foreign governments with their international conservation efforts, and distribute hundreds of millions of dollars, through their Wildlife Sport Fish and Restoration program.

Federal Aviation Administration (FAA)- FAA's mission is to provide a safe, efficient aerospace system. The Federal Aviation Administration (FAA) plays a role in land use planning through advisory circulars such as AC 150/5200-33C "Hazardous Wildlife Attractants on or near Airports" which provides guidance on certain land uses that have the potential to attract hazardous wildlife on or near public-use airports. It also discusses airport development projects (including airport construction, expansion, and renovation) affecting aircraft movement near hazardous wildlife attractants. In which they recommend land uses such as wetlands, landfills, or detention basins should be outside of a 1-5-mile buffer zone, depending on the types of aircraft serviced by the airport.

State Government Roles and Protections

Illinois Department of Agriculture (IDOA)- IDOA advocates for Illinois' agricultural industry and provides necessary regulatory functions to benefit consumers, agricultural industry, and Illinois' natural resources. The IDOA's vision is to promote and regulate agriculture in a manner which encourages farming and agribusiness while protecting Illinois' consumers and our natural resources. The IDOA regulates pesticides and pesticide applicators, as well as the siting and construction of livestock production facilities, reduction of soil erosion on agricultural land, and oversees the Illinois Groundwater Well Monitoring Network.

There is one Illinois Department of Agriculture Conservation Practices Program site in the watershed and two Illinois Department of Agriculture Well Decommissioning Program sites. The Conservation Practices Program seeks protect and enhance natural resources and outdoor recreation in Illinois, with the Illinois Department of Agriculture overseeing the agriculture-related components. The Well Decommissioning Program seeks to seal abandoned wells to protect groundwater from direct contamination.

Illinois Department of Natural Resources (IDNR)- IDNR works to manage, conserve, and protect Illinois' natural, recreational, and cultural resources, further the public's understanding and appreciation of those resources, and promote the education, science and public safety of Illinois' natural resources for present and future generations. Offices within IDNR include Architecture, Engineering and Grants; Compliance, Equal Employment Opportunity and Ethics; Grant Management & Assistance; Law Enforcement; Land Management (State Parks); Legal Affairs; Legislation; Mines & Minerals; Oil & Gas; Realty & Capital Planning; Resource Conservation; State Museums; Strategic Services; Water Resources; and World Shooting & Recreational Complex.

IDNR Office of Water Resources (OWR)- The Office of Water Resources is the lead state agency for water resources planning, navigation, floodplain management, the National Flood Insurance Program, water supply, drought, and interstate organizations on water resources. Interagency duties include the state water plan, drought response, flood emergency situation reports, and the comprehensive review of Illinois water use law. The Office of Water Resources consists of three Divisions: The Division of Capital Programs, the Division of Resource Management, and the Division of Regulatory Programs.

The Division of Capital Programs administers the Urban Flooding Mitigation program, water supply planning including water withdrawals from Federal reservoirs, stream gaging, and operation and maintenance of state facilities including Stratton Lock and Dam and Sinnissippi dam. The Division of Capital Programs is the Technical Liaison to the Illinois Emergency Management Agency and provides daily briefings on flood conditions of monitored streams throughout the

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state and its boundary waters during and following a flood or other disasters. The Division of Regulatory Programs administers regulatory programs over construction in the floodways of rivers, lakes, and streams; construction in the shore waters of Lake Michigan; construction and operation of dams; construction in public bodies of water; and diversion of water from Lake Michigan. Resource Management inspects dams, gives permits, coordinates the National Flood Insurance Program, and regulates floodplains.

IDNR Illinois Nature Preserves Commission (INPC)- The mission of the Illinois Nature Preserves Commission (INPC) is to assist private and public landowners in protecting high quality natural areas and habitats of endangered and threatened species, in perpetuity, through voluntary dedication or registration of such lands into the Illinois Nature Preserves System. The Commission promotes the preservation of these significant lands and provides leadership in their stewardship, management, and protection.

Illinois Environmental Protection Agency (IEPA)- IEPA works to safeguard the state's natural resources from pollution to provide a healthy environment for its citizens. Through partnership with businesses, local governments, and citizens, IEPA works to continue protection of the air we breathe and our water and land resources. IEPA Bureau of Air, Bureau of Land, Bureau of Water, and Office of Energy operate within their respective fields.

IEPA Bureau of Land (BOL)- The BOL protects human health and the environment by regulating the transfer, storage, and disposal of waste, and by overseeing the cleanup of contaminated properties. The BOL's permitting programs regulate a wide range of waste related activities, including those involving municipal waste, landscape waste, composted material, construction and demolition debris, potentially infectious medical waste, and hazardous waste.

IEPA Bureau of Water (BOW)- The BOW is committed to ensuring that Illinois' rivers, streams, and lakes will support all uses for which they are designated including protection of aquatic life, recreation, drinking water supply and fish consumption. The BOW works to ensure that every Illinois public water system provides water that is superior quality, meets all regulatory requirements, and that Illinois' groundwater resources are protected for designated drinking water and other beneficial uses. To accomplish this mission, the BOW monitors the quality of the state's surface and groundwater resources; runs a municipal, stormwater, and industrial effluent permitting program; administers a permit program for community water supplies; regularly inspects sources of water pollution and drinking water treatment facilities; responds to citizen complaints; ensures compliance with regulatory standards; and enforces applicable regulatory requirements. To assist, the BOW provides a number of loan and grant programs designed to upgrade or build new wastewater, stormwater treatment and public water supply infrastructure, reduce nonpoint source pollution, conduct green infrastructure projects, and protect and restore Illinois' inland lakes and streams.

The IEPA is the designated state agency in Illinois to receive 319 federal funds from U.S. EPA. The purpose of IEPA's 319 program 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 nonpoint source (NPS) pollution. The program includes providing funding to these groups to implement projects that utilize cost-effective best management practices (BMPs) on a watershed scale. Projects may include structural BMPs such as detention basins and filter strips, 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.

NPDES Phase II Stormwater Permit Program
The IEPA BOW regulates wastewater and stormwater discharges to streams and lakes by setting effluent limits, and monitoring/reporting on results. The BOW oversees the National Pollutant Discharge Elimination System (NPDES) program. The NPDES program was initiated under the federal Clean Water Act to reduce pollutants to the nation's waters. This program requires permits for discharge of 1) treated municipal effluent; 2) treated industrial effluent; and 3) stormwater from municipal separate stormsewer systems (MS4's) and construction sites.

The IEPA's NPDES Phase I Stormwater Program began in 1990 and applies only to large and medium-sized municipal separate stormsewer systems (MS4s), several industrial categories, and construction sites hydrologically disturbing 5 acres

of land or more. The NPDES Phase II program began in 2003 and differs from Phase I by including additional MS4 categories, additional industrial coverage, and construction sites hydrologically disturbing greater than 1 acre of land. More detailed descriptions can be viewed on the IEPA's web site.

Under NPDES Phase II, all municipalities with small, medium, and large MS4s are required to complete a series of Best Management Practices (BMPs) and measure goals for six minimum control measures:

1) Public education and outreach
2) Public participation and involvement
3) Illicit discharge detention and elimination
4) Construction site runoff control
5) Post-construction runoff control
6) Pollution prevention and good housekeeping

The Phase II Program also covers all construction sites over 1 acre in size. For these sites the developer or owner must comply with all requirements such as completing and submitting a Notice of Intent (NOI) before construction occurs, developing a Stormwater Pollution Prevention Plan (SWPPP) that shows how the site will be protected to control erosion and sedimentation, completing final stabilization of the site, and filing a Notice of Termination (NOT) after the construction site is stabilized.

Winnebago County, Rockford Township, and the City of Rockford all maintain active MS4 permits. There is one NPDES permit in the watershed, and it is held by Testor Corporation (IL0070513). For more detailed information regarding this permit see Section 3.16.

IEPA BOW also manages the states Total Maximum Daily Load (TMDL) program. The TMDL program determines the greatest amount of a given pollutant that a water body can receive without violating water quality standards and designated uses and also sets reduction goals necessary to improve impaired waters. Similar to a watershed-based plan, a TMDL takes a watershed approach in determining the pollutant loads that can be allowed in a given lake or stream but takes into account both point and non-point sources.

There are no CAFOs or TMDLs within the watershed.

Illinois Tollway - The Illinois Tollway builds, operates, and maintains toll roads throughout Illinois. The Tollway is committed to achieving the following goals: increasing collaboration with regional transportation and planning agencies; promoting the regional economy; maintaining financial integrity; fostering environmental responsibility and sustainability; maintaining the safety and efficiency of the Tollway system; furthering transparency and accountability; enhancing customer service; and maintaining public trust.

Regional Government Roles and Protections

Regional councils, such as Region 1 Planning Council (R1PC), are public organizations comprised of local elected officials that promote collaboration among local governments, working across the jurisdictional silos of states, counties, and municipalities. The regional planning model provides an efficient means to promoting a well-informed, comprehensive dialogue that holistically addresses regional issues by fulfilling the needs of government entities for long-range planning, securing funding, and analyzing and providing data in support of regional projects and initiatives (R1PC, 2021). R1PC provides a wide variety of services responsive to member and community needs, including community health, economic development assistance, geographic information system, grant services, regional transportation planning, and research and analytics.

The R1PC is designated as both an Economic Development District and a Metropolitan Planning Area and their service area includes Stephenson, Winnebago, Boone, McHenry, Ogle, and DeKalb Counties. Economic Development Districts (EDDs) are multi-jurisdictional entities, commonly composed of multiple counties and in certain cases even cross-state borders. They help lead the locally based, regionally driven economic development planning process that leverages the

involvement of the public, private and non-profit sectors to establish a strategic blueprint (i.e., an economic development roadmap) for regional collaboration. R1PC's Metropolitan Planning Organization designation is for making transportation-related policy in the region under the Federal-Aid Highway Act.

County and Local Government Roles and Protections

Winnebago County Board - Winnebago County operates under the township form of county government. The governing body is the County Board. As the legislative element, the County Board is responsible for developing all ordinances for the governance of Winnebago County and which laws are contained in the Winnebago County Code; establishing budget for several funds as well as levying taxes; circulating policies to the general public; and developing rules and regulations for the management of County operations. The County Board has eight (8) standing committees and 20 board members. Standing Committees are as follows: Economic Development; Finance; Operations & Administrative; Public Safety; Public Works; Zoning; Liquor; and Personnel & Policies. Each committee includes 1 chair and 6 additional board members, except for the Liquor Commission which includes a chairman and 3 other board members.

Boone County Board - Boone County operates under the Committee of the Whole (COTW) structure in which a legislative body or other deliberative assembly is considered one large committee. All members of the legislative body are members of such a committee. The board includes 12 elected members and has two standing COTW committees: Administrative & Legislative Committee and Finance, Taxation & Salaries Committee.

Winnebago County Planning & Zoning Division- Winnebago County Planning & Zoning Division provides interpretation, administration, and enforcement of the Winnebago County Unified Development Ordinance (Zoning and Subdivision Regulations) and provides information to elected officials and residents regarding all within the unincorporated portions of the county. Within municipal boundaries, that municipality has jurisdiction over planning and zoning decisions.

Boone County Planning Department- The mission of the Boone County Planning Department is to coordinate a vision of growth that incorporates the needs of the community for balanced, controlled, and smart growth and to communicate that vision to stakeholders while guiding the development community towards the goals of that vision. The main tools for bringing the long-term visions outlined in the various plans for the area to fruition are the zoning and subdivision ordinance. Additionally, the department maintains a comprehensive plan, a regional stormwater management plan, and land use planning for the County (Boone County, 2021).

Winnebago County Health Department- The mission of the Winnebago County Health Department (WCHD) is to "Prevent disease, promote health and enlist community efforts to improve the health of all Winnebago County residents." It provides services designed to protect, promote, and maintain the health of County residents. Services address three primary goals: improving the length of useful life, reducing health disparities, and assuring access to preventive health services for every person in Winnebago County (WCHD, 2021). The WCHD also provides environmental health services including a well and septic program, ground water protection program, and septic tank abandonment program.

Boone County Health Department - The mission of the Boone County Health Department is to serve the County by preventing the spread of disease, promoting optimal wellness & protecting the public's health. A volunteer, 11-member Board of Health is appointed by the county board chairman and approved by the county board. The Environmental Health Services section regulates a Private Sewage Program, Private Well Program, and a Well/Septic Evaluation Program.

Winnebago & Boone County Highway Departments- Highway Departments handle a wide variety of highway and road related issues within their counties, including maintenance of shoulders, ditches, drainage structures and pavement surfaces on county roads. The highway system in Winnebago County is under the ownership of a variety of agencies including one of 14 Townships, one of 12 Municipalities, the State of Illinois and the State Toll Highway authority or us here at the County (Winnebago County, 2021). They Cities of Rockford and Loves Park have ownership for most of the highway miles within the watershed. Highways in the rural area of Boone County are under the jurisdiction of several agencies. The townships have approximately 60 percent of rural mileage, county has approximately 18 percent of rural

mileage, state as around 14 percent, the Toll Highway Authority has approximately 2 percent, and the remaining rural mileage is private. The County maintains approximately 196 lane miles of road and fourteen bridges with a crew of five employees, a County Engineer, and an administrative assistant (Boone County, 2021).

Winnebago & Boone County Soil and Water Conservation Districts- Soil & Water Conservation Districts (SWCD) were established in 1937 under the Illinois Soil and Water Conservation District Act and are local units of government. The Act gives SWCD's the responsibility to provide technical information to individuals and groups on methods of soil and water conservation and to provide natural resource inventory information on properties slated for zoning changes. The Winnebago County SWCD purpose is to promote the protection, maintenance, improvement, and wise use of the soil, water, and related resources within the District (Winnebago County SWCD, 2014). The Boone County SWCD works to promote protection, maintenance, improvement, and wise use of the soil, water, and related resources. The Boone County SWCD provides multiple public services including Natural Resource Information Reports, soil borings for analysis of septic suitability, in cooperation with the Boone County Health Department, soil fertility testing, sediment and erosion control, public education, and technical assistance with both IDOA and USDA conservation programs (Boone County, 2021).

Townships and Municipalities- Municipalities in the watershed can provide additional watershed protection above and beyond existing watershed ordinances under local City or Village Codes. Municipal codes present opportunities for outlining and requiring recommendations in this plan such as conservation development, Special Service Area (SSA) or watershed protection fees, and native landscaping.

Planning and zoning within the City of Rockford is regulated under the City's 2020 Comprehensive Plan (Original, 2009, and 2011 Amendments). Meanwhile, planning and zoning within the City of Loves Park is guided by the City of Loves Park 2037 Comprehensive Plan (December 2017). The Village of Timberlane adopted a Zoning Ordinance (2005) and Map (updated 2011) that guides development.

Special Jurisdiction Roles and Protections

ZION Development Corporation- ZION Development is a nonprofit Christian community development organization formed as the result of outreach programs at Zion Lutheran Church, from which it draws vision and values. Since 1982, ZDC has been a good neighbor to thousands of people who live, work, worship and play in Midtown-seniors, people coming out of homelessness, families, employers, employees, business customers and churchgoers. Over the past 25 years, ZDC has invested more than $27 million in housing and economic development projects in the area.

ZION Development seeks to get out ahead of the problems and pain in the neighborhood by putting into place Six Elements which will help strengthen the neighborhood and help prevent the problems which might otherwise arise. Furthermore, ZION's strategy is to develop projects in the MidTown neighborhood which will be or become self-sufficient and which will make the neighborhood more economically sustainable. In this way gifts and donations from individuals and corporations can be used to help develop new projects and programs (ZION Development, 2021). ZION Development is also leading the watershed planning process for Keith Creek Watershed.

Rock River Water Reclamation District - The Rock River Water Reclamation District is located in Rockford and serves the City and its mission is "to effectively collect and treat wastewater, at the lowest long-term cost." The District protects public health and the environment through innovative and cost-effective management of wastewater and solid waste. Their 1,100-mile-long network of buried sewers carries wastewater from residences, industrial sites, and other businesses to the treatment plant in southeast Rockford, where we convert waste into resources such as recycled water, energy, fertilizer, and recycled materials.

Drainage Districts- According to Article III of Illinois Compiled Statute 70 ILCS 605, 3-1- "Drainage districts may be formed to construct, maintain, or repair drains or levees or to engage in other drainage or levee work for agricultural, sanitary or mining purposes." Drainage districts are local bodies formed for the purpose of draining, ditching, and improving land for agricultural and sanitary purposes.

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School Districts- Rockford Public Schools puts students first and includes 42 schools. There are four public high schools in Rockford, Illinois - Auburn High School, East High School, Guilford High School, and Jefferson High School, and seven middle schools.

3.6 Existing Policies and Ordinance Review

Protection of natural resources and green infrastructure during future urban growth and redevelopment will be important for the future health of Keith Creek watershed. To assess how future growth might further impact the watershed, an assessment of local municipal ordinances was performed to determine how development currently occurs in each municipality. In this way, potential improvements to local ordinances can be identified. As part of the assessment, municipal governments were asked to compare their local ordinances against model policies outlined by the Center for Watershed Protection (CWP) in a publication entitled "*Better Site Design: A Handbook for Changing Development Rules in Your Community"* (CWP, 1998) and complete *The Code & Ordinance Worksheet: A Tool for Evaluating Development Rules in Your Community* (CWP, 2017).

CWP's recommended ordinance review process involves assessments of four general categories including Residential Streets & Parking Lots, Lot Development, Conservation of Natural Areas, and Runoff Reduction. Various questions with point totals are examined under each category. The maximum score on the suburban form is 126 points and final scores are depicted as a percentage of the total. CWP also provides general rules based on scores. Scores between 60 and 80 suggest that it may be advisable to reform local development ordinances. Scores less than 60 generally mean that local ordinances are not environmentally friendly and serious reform may be needed. Loves Park completed the worksheet and scored 37.5 points for a score of 30%. Although this score is relatively low, it should be noted that this assessment is meant to be a tool to local communities to help guide development of future ordinances. Various policy recommendations are included in the Action Plan section of the report to address general ordinance deficiencies. The results of the review for each municipality that completed the survey can be found in Appendix B.

3.7 Demographics

According to the 2010 census, the total population of the Keith Creek watershed was 68,595 people (Figure 18), the total number of households was 27,624 (Table 8; Figure 19), and the total employed population was 32,120 (Figure 20) in 2010. Note: RES used GIS to overlay the Keith Creek watershed boundary onto the 2010 Census Block data. If any part of a census block fell inside the watershed boundary, the statistics for the entire quarter section were included. It is important to note that this methodology makes best use of the data limitations but likely increases estimates, especially for municipalities. Due to the nature of the census block and census block group data, these estimates represent a slight overestimation. The location and density of the total population, number of households, and employed populations depict similar patterns, with the densest areas close to the mouth of Keith Creek in the southwest portion of the watershed (Figures 14-16). This area also coincides with the earliest-settled portions of the watershed, with density diminishing gradually towards the northeast and headwaters.

Table 8. USCB 2010 Census and 2019 ACS Estimates.

Data Category	2010 Census	2019 ACS Estimate	Change 2010-2019	Percent Change
Population	68,595	68,272	-323	-0.5%
Household	27,624	28,272	648	2.3%
Employed Population	32,120	31,213	-907	-2.8%

Source: United States Census Bureau 2010 Census and 2019 American Community Survey 5 Year Estimates.

True population projections for the watershed were not available for this planning process; the City of Rockford was working through the early stages of a comprehensive plan update during the planning process and R1PC did not have population forecast data. Table 9 also depicts the 2019 American Community Survey population estimates and the expected change in population, households, and employee population between 2010 and 2019. The watershed has seen a

small population decline (-323 people; -0.5%) and a similar decline in the employee population (-907 people; -2.8%) during that time and had a modest household gain of 648 households (2.3%).

RES was able to locate population projections by county created by the Illinois Department of Public Health. The Illinois Department of Public Health (IDPH) provides 2025 population projections for Illinois to plan more effectively with growth forecasts using 2010 census data from the United States Census Bureau (USCB). IDPH's 2010 to 2025 forecasts of population was used to project how these attributes will impact Keith Creek watershed (Table 9). The IDPH does not forecast household or employment population and therefore the impact of household or employment growth cannot be calculated. IDPH develops these forecasts by using a demographic cohort-component projection model which calculates projections for each component of population change (birth, deaths, and net migration) separately for each five-year birth cohort and sex (IDPH, 2015). These projections are based on 2010 census data and on a specific set of assumptions, laid out in full in IDPH's *Population Projections: Illinois, Chicago and Illinois Counties by Age and Sex: July 1, 2010 to July 1, 2025 (2014 Edition)*. IDPH calculated an estimated population change for Winnebago County. According to IDPH, the population of Winnebago County is expected to increase from 295,266 in 2010 to 306,088 by 2025, a 3.7% increase – a relatively modest increase compared to other counties in the state.

Additionally, the *Northern Illinois Comprehensive Economic Development Strategy 2016-2020 (EDDNI, 2016)* depicts a population loss of 1.3% for the Northern Illinois Region between 2010-2014. A 2020 article published by WIFR Newsroom depicts Rockford as the city with the fastest-shrinking population in, losing 5% of its population between the 2010 census and the 2019 population estimate (WIFR, 2020). Lacking true population projections and considering the various data points on current population trends, it is likely that changes in the landscape and impervious cover of the Keith Creek watershed are unlikely to be dramatically shaped by substantial population changes over the next decade or so.

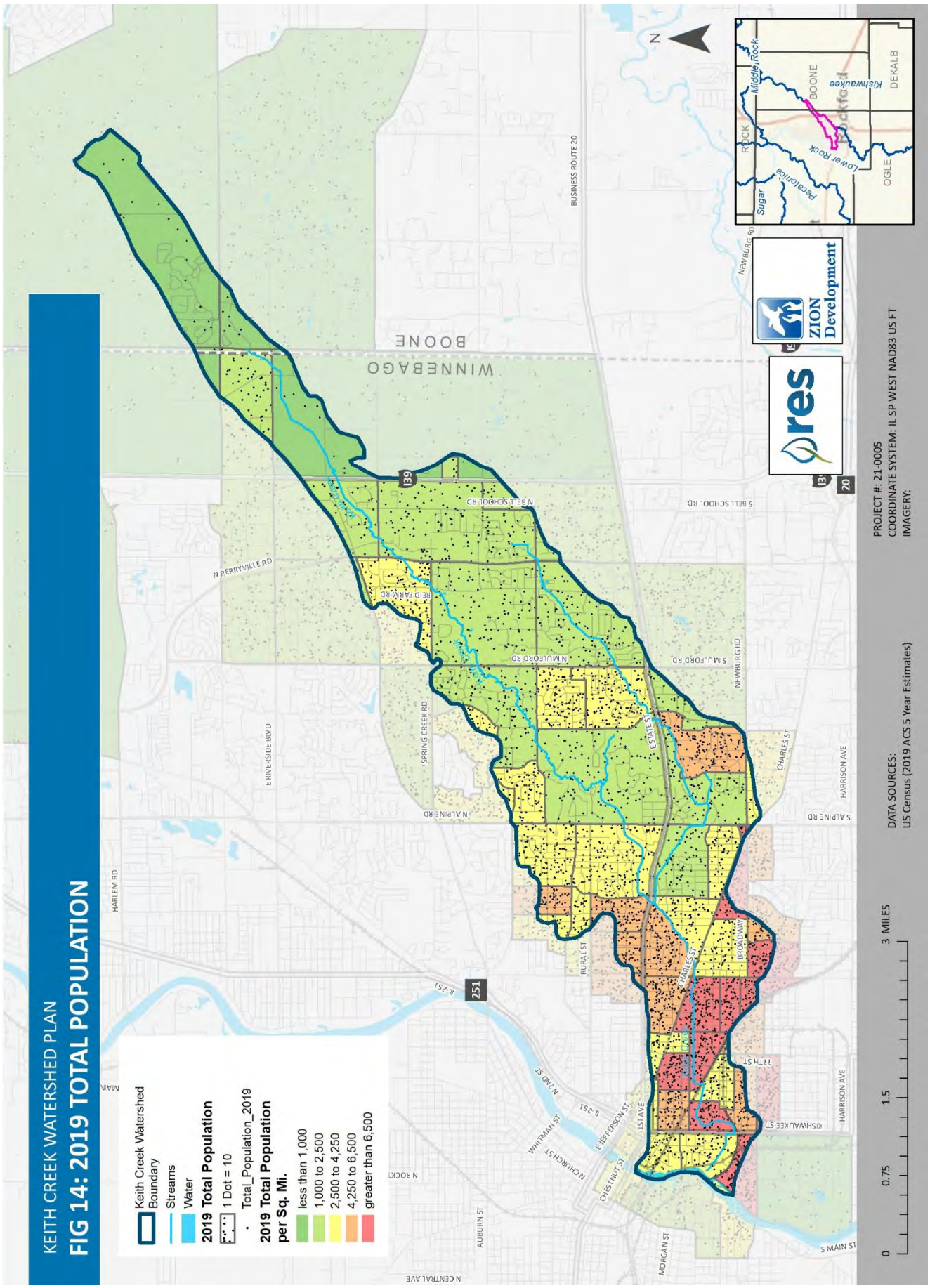
Socioeconomic Status

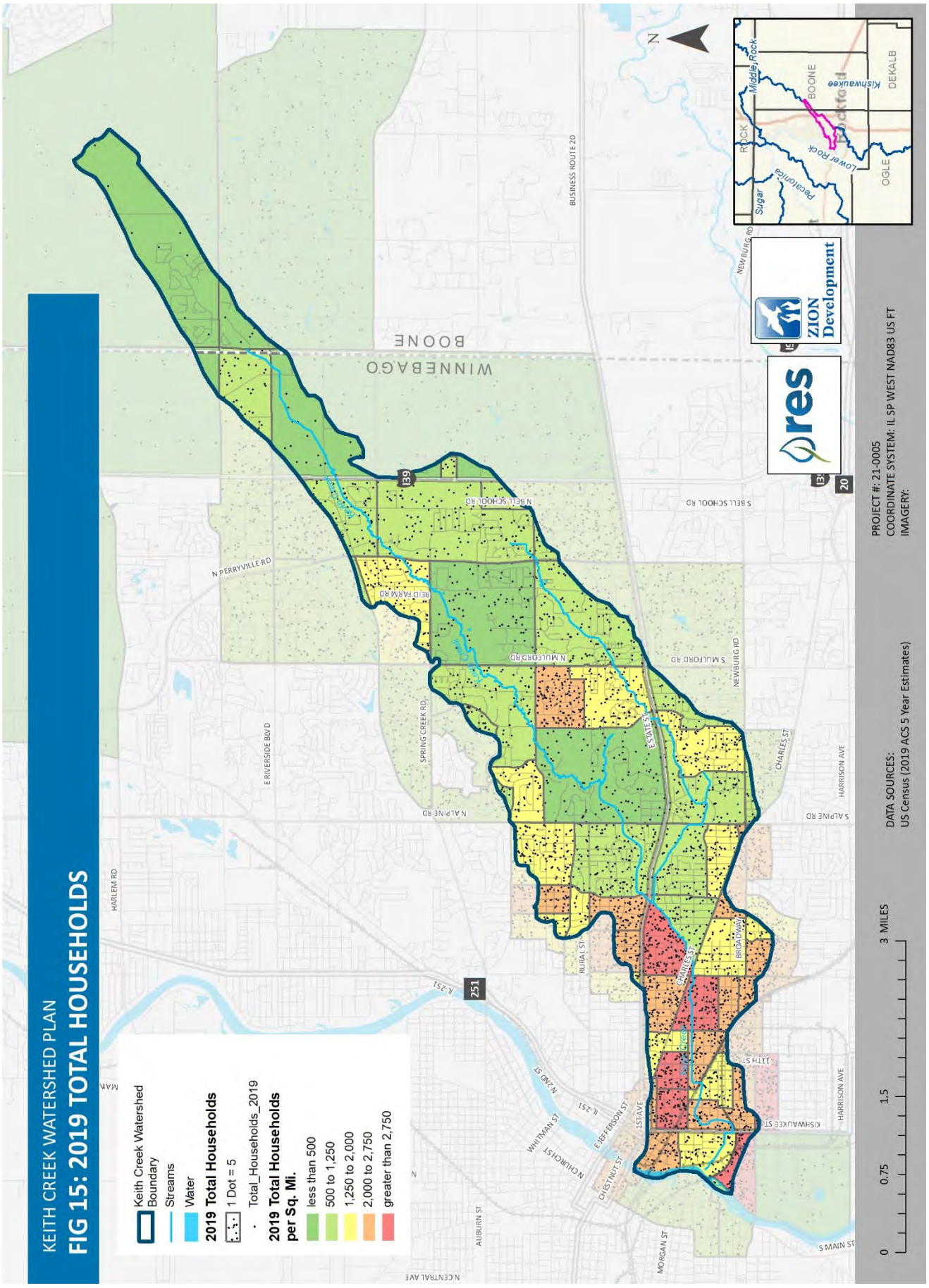
The City of Rockford is the largest municipality and representative of over 74% of the Keith Creek watershed, followed by the City of Loves Park at 6% of the watershed. Despite their proximity, they have differing demographics. Rockford has been known as a manufacturing city for most of the last century and has been working toward diversifying its economy. Approximately 67.7% of the population is white and 21.6% black or African American with 18.4% identifying as Hispanic or Latino. Rockford has a median income of about $44,252 a year with over 54% of the population living in owned occupied housing. Roughly 22% of Rockford's residents have a bachelor's degree or higher. Loves Park has struggled less economically. The City is approximately 87% white, with an average median income higher than that of Rockford ($59,059 annual income) and 12% of the population living below the poverty line. The two communities have a similar median age (37.2 for Rockford and 38.2 for Loves Park) and similar percentages of those with a bachelor's degree or higher (22.3% and 25.9%, respectively). The demographics of the watershed are detailed by location in Table 9.

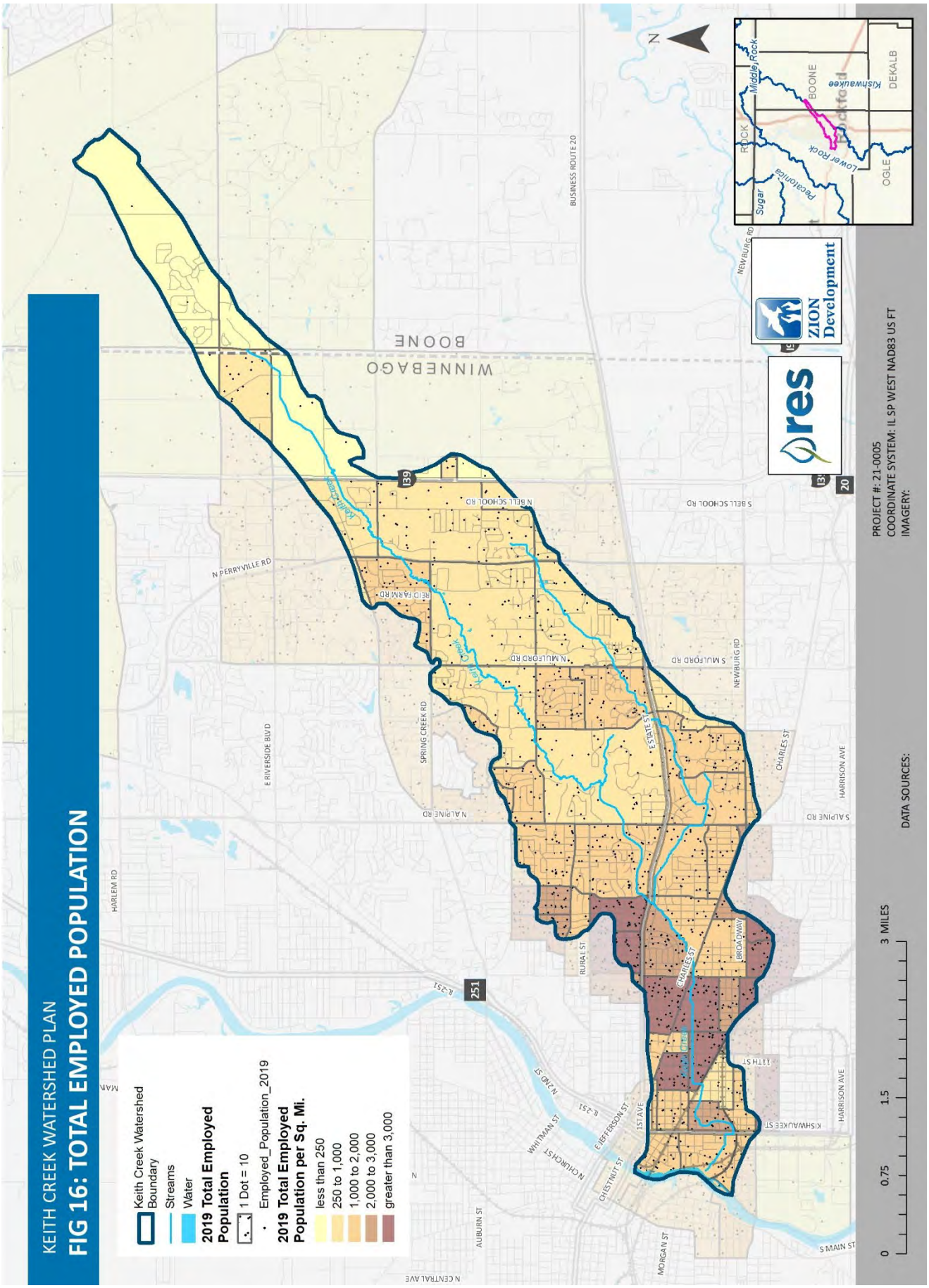
Table 9. Demographic data as provided by the U.S. Census Bureau by location.

Municipality/ Location	Median Age	Ethnicity (% White)	Median Household Income	% with Bachelor's or Higher	% Below Poverty Line	% Owner-Occupied Housing
City of Rockford	37.2	67.7 %	$44,252	22.3 %	22.3 %	54.2 %
City of Loves Park	38.2	87.0 %	$59,059	25.9 %	12.2 %	68.7 %

Additional demographic information and a detailed Diversity, Equity, and Inclusion (DEI) analysis. The DEI analysis takes a close look at certain demographic factors in specific census tracts located within the Keith Creek Study Area. For more information, please refer to the Keith Creek Corridor Study completed by R1PC, The Lakota Group, Studio GWA and partners.


KEITH CREEK WATERSHED PLAN
FIG 14: 2019 TOTAL POPULATION
Keith Creek Watershed Boundary
Streams
Water
2019 Total Population
1 Dot = 10
Total_Population_2019
2019 Total Population per Sq. Mi.
less than 1,000
1,000 to 2,500
2,500 to 4,250
4,250 to 6,500
greater than 6,500
WINNEBAGO
BOONE
N PERRYVILLE RD
E RIVERSIDE BLVD
HARLEM RD
SPRING CREEK RD
N ALPINE RD
S ALPINE RD
N MULFORD RD
S MULFORD RD
NEWBURG RD
BUSINESS ROUTE 20
S BELL SCHOOL RD
N BELL SCHOOL RD
REID FARM RD
ESMITE ST
CHARLES ST
HARRISON AVE
RURAL ST
BROADWAY
11TH ST
KISHWAUKEE ST
1ST AVE
E JEFFERSON ST
WHITMAN ST
N CHURCH ST
CHESTNUT ST
AUBURN ST
MORGAN ST
S MAIN ST
N CENTRAL AVE
N ROCK
N 2ND ST
IL 251
251
139
20
ZION Development
res
PROJECT #: 21-0005
COORDINATE SYSTEM: IL SP WEST NAD83 US FT
IMAGERY:
DATA SOURCES:
US Census (2019 ACS 5 Year Estimates)
0
0.75
1.5
3 MILES
ROCK
BOONE
DEKALB
OGLE
Middle Rock
Kishwaukee
Sugar
Pecatonica
Lower Rock
Rockford


KEITH CREEK WATERSHED PLAN
FIG 15: 2019 TOTAL HOUSEHOLDS
Keith Creek Watershed Boundary
Streams
Water
2019 Total Households
1 Dot = 5
Total_Households_2019
2019 Total Households per Sq. Mi.
less than 500
500 to 1,250
1,250 to 2,000
2,000 to 2,750
greater than 2,750
0
0.75
1.5
3 MILES
DATA SOURCES:
US Census (2019 ACS 5 Year Estimates)
PROJECT #: 21-0005
COORDINATE SYSTEM: IL SP WEST NAD83 US FT
IMAGERY:
WINNEBAGO
BOONE
ROCK
OGLE
DEKALB
Kishwaukee
Middle Rock
Lower Rock
Pecatonica
Sugar
ZION Development
res
N PERRYVILLE RD
N BELL SCHOOL RD
S BELL SCHOOL RD
REID FARM RD
N MULFORD RD
S MULFORD RD
NEWBURG RD
BUSINESS ROUTE 20
E RIVERSIDE BLVD
SPRING CREEK RD
N ALPINE RD
S ALPINE RD
HARLEM RD
HARRISON AVE
CHARLES ST
ESTATES ST
RURAL ST
BROADWAY
11TH ST
KISHWAUKEE ST
1ST AVE
JEFFERSON ST
CHESTNUT ST
WHITMAN ST
N CHURCH ST
N 2ND ST
AUBURN ST
MORGAN ST
S MAIN ST
N CENTRAL AVE
IL-251
251
39
20


KEITH CREEK WATERSHED PLAN
FIG 16: TOTAL EMPLOYED POPULATION
Keith Creek Watershed Boundary
Streams
Water
2019 Total Employed Population
1 Dot = 10 Employed_Population_2019
2019 Total Employed Population per Sq. Mi.
less than 250
250 to 1,000
1,000 to 2,000
2,000 to 3,000
greater than 3,000
WINNEBAGO
BOONE
BUSINESS ROUTE 20
N PERRYVILLE RD
N BELL SCHOOL RD
S BELL SCHOOL RD
REID FARM RD
N MULFORD RD
S MULFORD RD
NEWBURG RD
SPRING CREEK RD
E RIVERSIDE BLVD
N ALPINE RD
S ALPINE RD
HARLEM RD
ESTATE ST
CHARLES ST
HARRISON AVE
RURAL ST
BROADWAY
11TH ST
KISHWAUKEE ST
1ST AVE
E JEFFERSON ST
CHESTNUT ST
WHITMAN ST
N CHURCH ST
N 2ND ST
AUBURN ST
MORGAN ST
S MAIN ST
N CENTRAL AVE
MAIN
Keith Creek
Kishwaukee River
Il-251
39
251
20
Middle Rock
Lower Rock
Sugar
Pecatonica
Kishwaukee
ROCK
BOONE
OGLE
DEKALB
N
0
0.75
1.5
3 MILES
PROJECT #: 21-0005
COORDINATE SYSTEM: IL SP WEST NAD83 US FT
IMAGERY:
DATA SOURCES:
ZION Development
res

3.8 Transportation Network

Roads

There are approximately 210 miles of roads in the watershed. Two lane roads make up 184 miles and four lane roads make up the remaining 26 miles. Four lane roads include sections Interstate 39 and U.S. Route 20, among others. Interstate 39 was created to replace U.S. Route 51 and runs north/south from Wisconsin Highway 29 in Rib Mountain, Wisconsin to Interstate 55 in Normal, Illinois (Figure 17). U.S. Route 20 is designated as the General Ulysses S. Grant Highway and runs east/west across the state of Illinois from the Iowa border in East Dubuque to the Indiana border on the south side of Chicago.

Several other major roads are worth mentioning. Major north-south roads include Perryville Rd, Muilford Rd, Alpine Rd and Kishwaukee Street. Major east-west roads include Spring Creek Rd, Guilford Rd, Charles St, and Rural St. As discussed in Section 3.5, maintenance of roads in the watershed is within the purview of the County Highway Departments when they fall outside of municipal boundaries or are the responsibility of the municipal jurisdiction in which the roads exist.

Railroads

Three sections of railways run through the watershed near the mouth of Keith Creek - the Illinois Central Railroad; Chicago, Burlington, & Quincy; and the Chicago and Northwestern. The Illinois Central Railroad was completed in 1856 and was not only the first land-grant railroad in the country but was also the longest in the world (Brownson, 1967). It connected Galena, Cairo, and Chicago. The Illinois Central carries both passengers and freight and is currently owned by Canadian National Railway.



"Building Track for the Illinois Central Railroad." (Source: Midway Village Museum)

The Chicago, Burlington, & Quincy Railroad connected Chicago and Quincy, IL via Rockford and was completed just before 1856. It was originally chartered as the Aurora Branch Railroad, connecting Chicago with its western suburbs. Today the line is part of the BNSF Railway and owned by Berkshire Hathaway, Inc. and still carries both passengers and freight.

The Chicago and North Western Railway was chartered in 1859 and underwent multiple mergers to become one of the longest railroads in the United States, operating over 12,000 miles of track at one time and carrying both passengers and freight. Today the company is owned by Union Pacific.



The Chicago and North Western Railway near the mouth of Keith Creek

Trails/Bike Paths

Available data on the location of existing trails and bike paths in the watershed reveals a relatively robust network including approximately 12.6 miles of mostly paved foot paths and trails (Figure 17). Some of the existing trails include the Perryville Path, the Midway Village Loop, the Reid Farm Rd Path, and trails at Mercy Health, Dahlquist Park, and Sportscore 2. There are also 14.6 miles of existing bike paths (many of which also overlap with existing foot paths), including

shared paths, road connections, and multi-use paths with another 7.5 miles of additional planned bike paths of various types, including a 4.5 mile stretch of the Keith Creek Greenway between Aldeen Park and Davis Park.

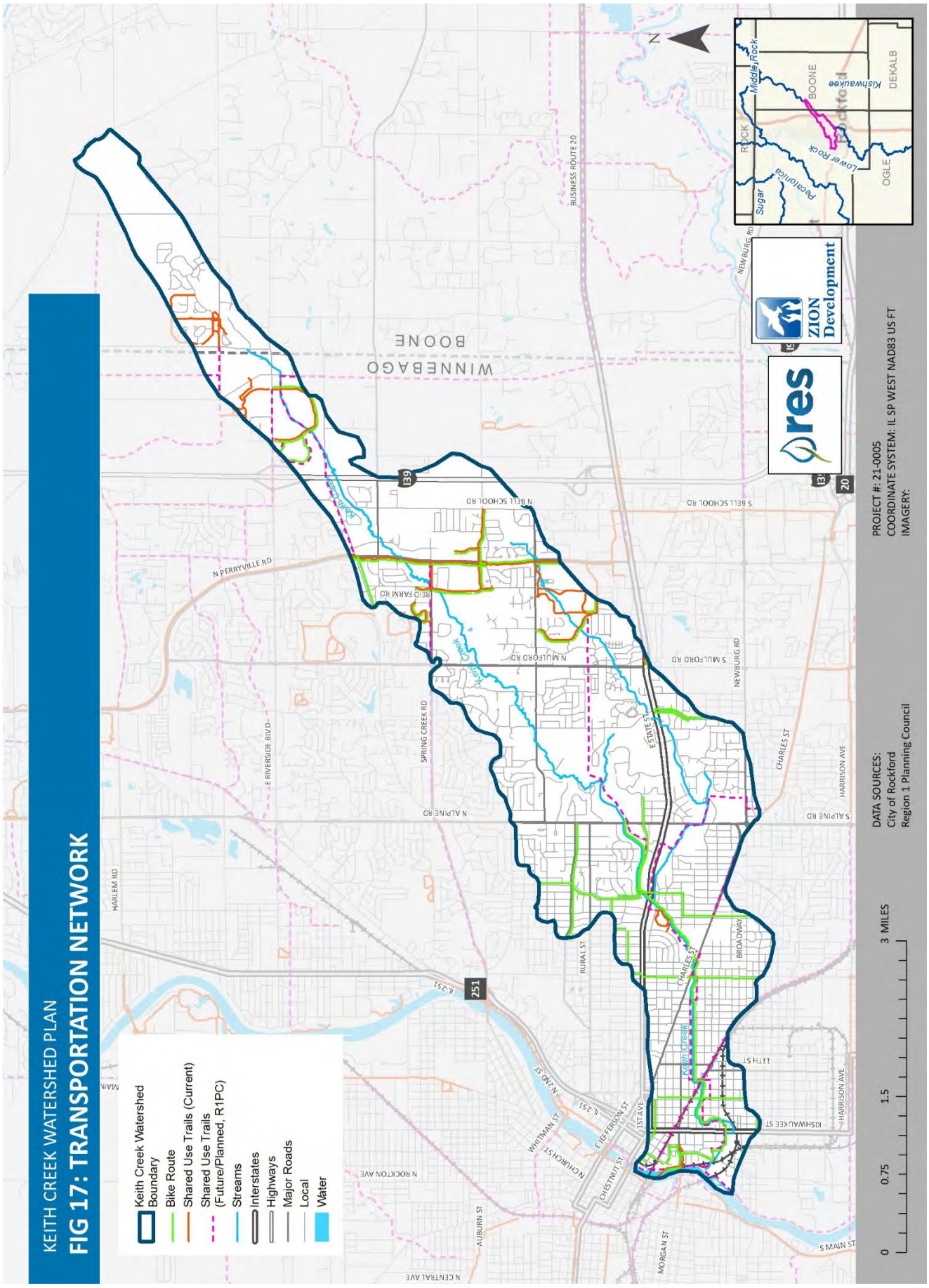


Woodland trail at Aldeen Park

The community has been working for years to expand the trail and bike network in the watershed with plans to create the Keith Creek Greenway not least among those. The Keith Creek Greenway might eventually run over six miles, following Keith Creek from its confluence with the Rock River east to the Midway Village Loop at the Midway Village Museum. The Keith Creek Greenway is still in early stages of planning, however important elements to be considered are beautification, flood control, and active transportation amenities that would ultimately connect the nearby neighborhoods to the Rails to Trails Bridge across the Rock River to Davis Park. The Keith Creek Greenway would also include now-vacant parcels acquired by the City of Rockford to remove properties from the Keith Creek floodplain. According to Bob Campbell of ZION Development Corp, "the idea is to create a greenway that would address the flooding issues Keith Creek has had for years but would also provide recreational opportunities and an alternative means of transportation for people who don't have vehicles to be able to travel east to west through the south part of the city."



Tenth Avenue Park section of proposed Keith Creek Greenway (Source: Arturo Fernandez)


KEITH CREEK WATERSHED PLAN
FIG 17: TRANSPORTATION NETWORK
Keith Creek Watershed Boundary
Bike Route
Shared Use Trails (Current)
Shared Use Trails (Future/Planned, R1PC)
Streams
Interstates
Highways
Major Roads
Local
Water
WINNEBAGO
BOONE
N
BUSINESS ROUTE 20
NEWBURG RD
N BELL SCHOOL RD
S BELL SCHOOL RD
N PERRYVILLE RD
REID FARM RD
N MULFORD RD
S MULFORD RD
SPRING CREEK RD
E RIVERSIDE BLVD
N ALPINE RD
S ALPINE RD
ESTATE ST
CHARLES ST
HARRISON AVE
HARLEM RD
RURAL ST
BROADWAY
11TH ST
KISHWAUKEE ST
IL 251
N 7TH ST
WHITMAN ST
N CHURCH ST
E JEFFERSON ST
1ST AVE
CHESTNUT ST
N ROCKTON AVE
AUBURN ST
MORGAN ST
S MAIN ST
N CENTRAL AVE
MAIN
Keith Creek
Kishwaukee
Middle Rock
Sugar
Pecatonica
Lower Rock
ROCK
BOONE
OGLE
DEKALB
Rockford
ZION Development
res
PROJECT #: 21-0005
COORDINATE SYSTEM: IL SP WEST NAD83 US FT
IMAGERY:
DATA SOURCES:
City of Rockford
Region 1 Planning Council
0
0.75
1.5
3 MILES

3.9 Existing & Future Land Use

2020 Land Use

Land use data was produced for Keith Creek watershed by compiling current land use from the City of Rockford, City of Loves Park, and Winnebago and Boone Counties. Several adjustments were made to land use categories for consistency purposes between sources. The 2020 land use data and map for Keith Creek watershed are included in Table 10 and depicted in Figure 18. Land use classifications are defined in the "Noteworthy: Land Use Definitions" text box.

Single-family residential land uses make up the largest share in the watershed at 3,355.4 acres and 36.8% of total land area; it is spread across most of the watershed but is concentrated toward the center portion between 11th Street and Interstate 39. Commercial/retail land uses make up the next largest share of the watershed at 1,780.4 acres (19.5%), followed by transportation land uses (1,605.5 acres; 17.6%). Commercial/retail is spread throughout the watershed, with concentrated corridors along U.S. Route 20 and along Interstate 39. Transportation land uses are comprised almost entirely of the road network and are discussed in more detail in Section 3.8.

Table 10. 2020 land use classifications and acreage.

Land Use	Acres	% of Watershed
Single-Family Residential	3,355.4	36.8%
Commercial/Retail	1,780.4	19.5%
Transportation	1,605.5	17.6%
Multi-Family Residential	734.7	8.1%
Agriculture	716.3	7.9%
Open Space	646.6	7.1%
Industrial	164.1	1.8%
Residential/Commercial Mixed	44.9	0.5%
Water	32.2	0.4%
Municipal/Institutional	30.9	0.3%
Total	9,111.0	**100.0%**

Remaining land uses in the watershed include multi-family residential (734.7 acres; 8.1%), agriculture at 716.3 acres (7.9%), and open space with 646.6 acres or 7.1%. Multi-family land use is concentrated near the mouth of Keith Creek and adjacent to much of the commercial/retail areas. Remaining agriculture in the watershed lies in the headwaters to the northeast and open space, made up of the many Rockford Park District properties, is concentrated in the center portions of the watershed along Keith Creek and its tributaries (for more detailed information on parks and open space see Section 3.11). Industrial land uses total 164.1 acres (1.8%) and are mostly found at the mouth of Keith Creek and along the adjacent railroad lines. Residential/commercial mixed use, water, and municipal/institutional all comprise less than 1% of total land uses across the watershed.

Noteworthy: Land Use Definitions

***Agriculture*:** Land for agricultural purposes including, but not limited to, farming, farmsteads, dairying, pasturage, agriculture, horticulture, floriculture, viticulture, and animal and poultry husbandry, as well as the accessory uses that are typically part of these activities. Single-family homes on 40-acre, quarter-quarter section lots are also part of this land use category.

Commercial/Retail: This land use category includes multiple types including retail, office overlay, recreation/entertainment/tourist, office, commercial mixed use and central business district areas. Examples include stores selling merchandise, office buildings, restaurants, hotels, mixes of commercial and retail, and the downtown districts.

***Industrial*:** Industrial land use includes light industry, tech industry, general industry, and heavy industry categories. Examples include research parks, manufacturing plants, technology-based employment centers, processing operations, and potentially hazardous or noxious uses that should be kept separate from non-industrial activities.

Open Space: Open space is land used for active and passive recreation as well as natural resource conservation land. Examples include public or private parks, golf courses, and natural areas.

Multi-Family Residential: Land use that includes multifamily residences. These include duplexes, townhouses, and apartments with typically more than 2 dwelling units per acre.

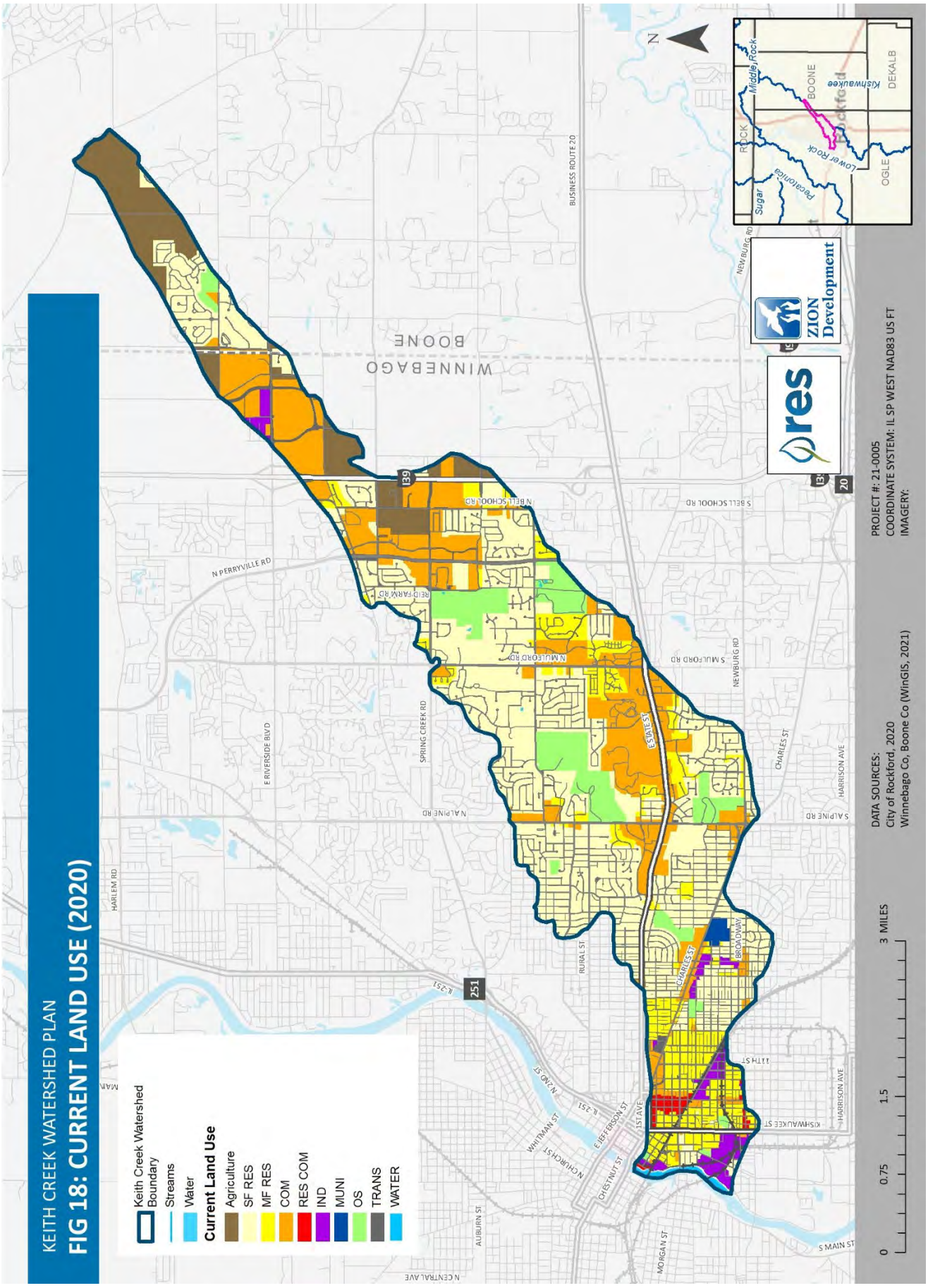
Municipal/Institutional: Land used for churches, schools, fairgrounds, airports, assisted living facilities, government or public safety buildings, public utilities, cemeteries, or other civic-oriented land uses.

Residential/Commercial Mixed: Allows a mixture of retail and office commercial with residential uses; roughly equivalent to the C-4 District in the Zoning Ordinance.

Single Family Residential: Includes a range of 2-7 dwelling units per acre of single-family homes.

***Transportation*:** Multiple land use types including freeway, arterial, collector, local street, railroad, and pedestrian pathways.

***Water*:** Open water areas including ponds and lakes.


KEITH CREEK WATERSHED PLAN
FIG 18: CURRENT LAND USE (2020)
Keith Creek Watershed Boundary
Streams
Water
Current Land Use
Agriculture
SF RES
MF RES
COM
RES COM
IND
MUNI
OS
TRANS
WATER
WINNEBAGO
BOONE
BUSINESS ROUTE 20
N PERRYVILLE RD
N BELL SCHOOL RD
S BELL SCHOOL RD
REID FARM RD
N MULFORD RD
S MULFORD RD
NEWBURG RD
E RIVERSIDE BLVD
SPRING CREEK RD
N ALPINE RD
S ALPINE RD
ESTATE ST
CHARLES ST
HARRISON AVE
HARLEM RD
RURAL ST
BROADWAY
11TH ST
KISHWAUKEE ST
1ST AVE
E JEFFERSON ST
CHESTNUT ST
WHITMAN ST
N CHURCH ST
N 2ND ST
AUBURN ST
MORGAN ST
S MAIN ST
N CENTRAL AVE
251
20
ROCK
BOONE
OGLE
DEKALB
Rockford
Kishwaukee
Pecatonica
Sugar
Middle Rock
Lower Rock
ZION Development
res
N
0
0.75
1.5
3 MILES
DATA SOURCES:
City of Rockford, 2020
Winnebago Co, Boone Co (WinGIS, 2021)
PROJECT #: 21-0005
COORDINATE SYSTEM: IL SP WEST NAD83 US FT
IMAGERY:

Future Land Use Predictions

Information on predicted future land use for the watershed was obtained primarily from the Winnebago (2030) and Boone (2029) County Comprehensive Plans and the City of Loves Park 2037 Comprehensive Plan; the City of Rockford was working through the early stages of a comprehensive plan update during the planning process. Since most of the watershed falls within Winnebago County, RES dated the future land use map as 2030. Available data was analyzed, and GIS used to map predicted land use changes. The results are summarized in Table 11 and Figure 19. On the future land use map, areas in white depict where the land use remains unchanged from the existing 2020 land use, while the colored areas represent what the land use is expected to change to.

Table 11 compares existing land use acreage to predicted future land use acreage. The land use changes predicted for the watershed are relatively minor due to how built-out the watershed already is. The largest loss of a current land use is expected to occur on agricultural land where approximately 266.9 acres of the existing 716.3 acres (a loss of 2.9%) is expected to be converted other uses. The largest predicted increase to a current land use is in commercial/retail, which will add 278.7 acres (3.1%). Most of these changes are expected to occur near the headwaters to the northeast.

Additional land use changes expected to occur between 2020 and 2030 include losses in multi-family residential (-70.8 acres; -0.8%) and industrial (-25.7 acres; -0.3%) and increases in single-family residential (69.6 acres; 0.8%), open space (12.8 acres; 0.1%), and transportation (4.3 acres; 0.0%).

Table 11. Comparison between 2020 and predicted future (2030) land use statistics.

Land Use	Current Area (acres)	Current % of Watershed	Predicted Area (acres)	Predicted % of Watershed	Change (acres)	Change in Percent
Single-Family Residential	3,355.4	36.8%	3,425.0	37.6%	69.6	0.8%
Commercial/Retail	1,780.4	19.5%	2,059.1	22.6%	278.7	3.1%
Transportation	1,605.5	17.6%	1,609.7	17.6%	4.3	0.0%
Multi-Family Residential	734.7	8.1%	663.9	7.3%	-70.8	-0.8%
Agriculture	716.3	7.9%	449.4	4.9%	-266.9	-2.9%
Open Space	646.6	7.1%	659.4	7.2%	12.8	0.1%
Industrial	164.1	1.8%	138.4	1.5%	-25.7	-0.3%
Residential/ Commercial Mixed	44.9	0.5%	42.9	0.5%	-2.0	0.0%
Water	32.2	0.4%	32.2	0.4%	0.0	0.0%
Municipal/ Institutional	30.9	0.3%	30.9	0.3%	0.0	0.0%

3.10 Impervious Cover Impacts

Impervious cover is defined as surfaces of an urban landscape that prevent infiltration of precipitation (Scheuler, 1994). Imperviousness is an indicator used to measure the impacts of urban land uses on water quality, hydrology and flows, flooding/depressional storage, and habitat related to streams (Figure 20). Based on studies and other background data, Scheuler (1994) and the Center for Watershed Protection (CWP) developed an Impervious Cover Model used to classify streams within subwatersheds into three quality categories: Sensitive, Impacted, and Non-Supporting (Table 12). In general, Sensitive subwatersheds have less than 10% impervious cover, stable channels, good habitat, good water quality, and diverse biological communities whereas streams in Non-Supporting subwatersheds generally have greater than 25% impervious cover, highly degraded channels, degraded habitat, poor water quality, and poor-quality biological communities. In addition, runoff over impervious surfaces collects pollutants and warms the water before it enters a stream resulting in a shift from sensitive species to ones that are more tolerant of pollution and hydrologic stress.

DRAFT

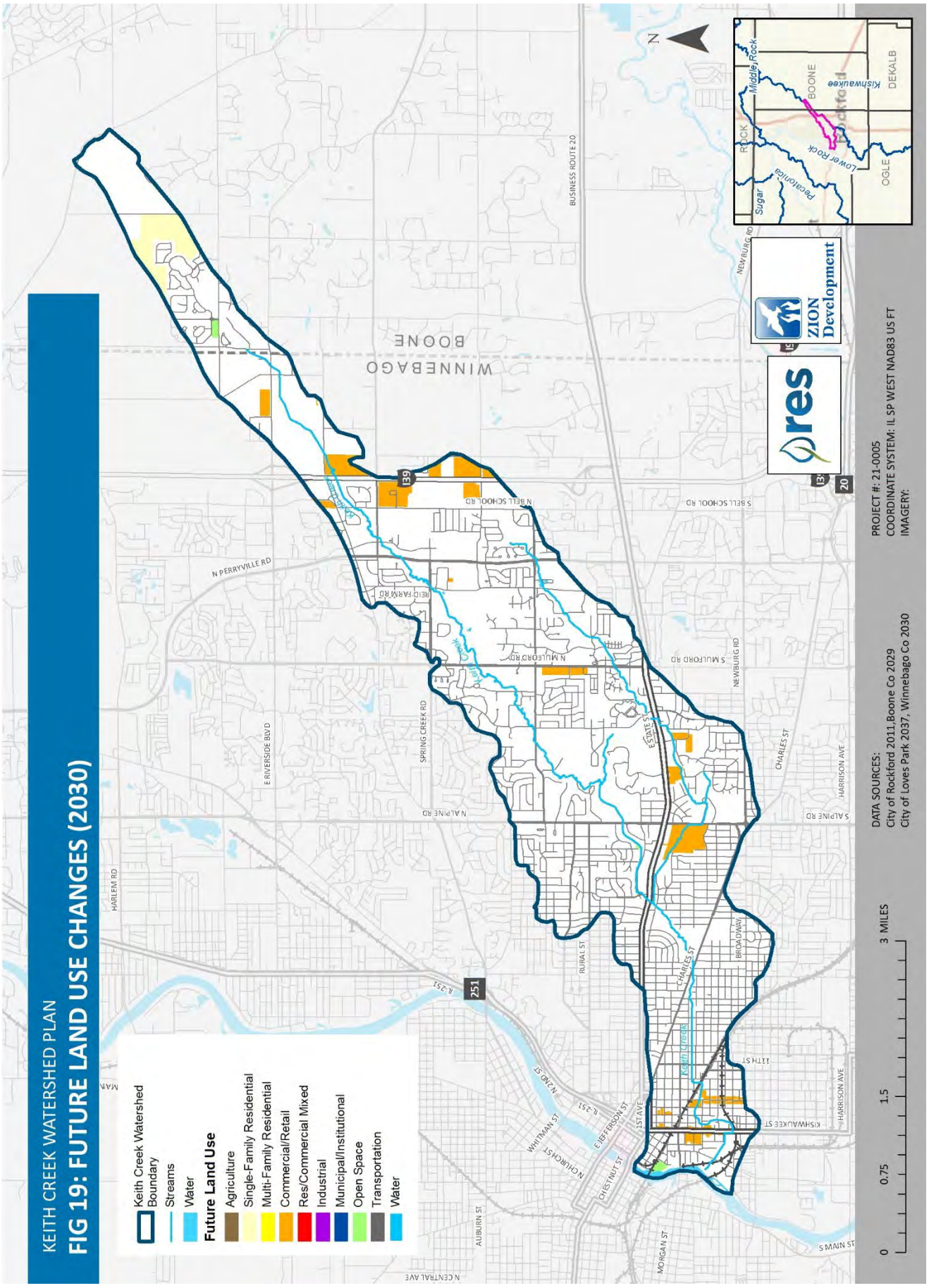
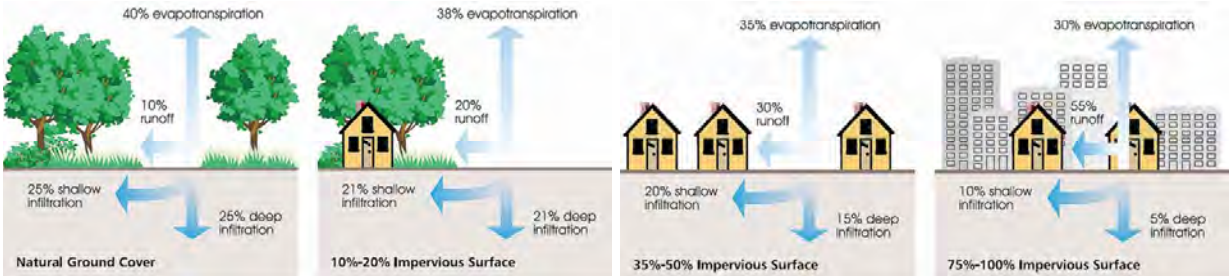

KEITH CREEK WATERSHED PLAN
FIG 19: FUTURE LAND USE CHANGES (2030)
Keith Creek Watershed Boundary
Streams
Water
Future Land Use
Agriculture
Single-Family Residential
Multi-Family Residential
Commercial/Retail
Res/Commercial Mixed
Industrial
Municipal/Institutional
Open Space
Transportation
Water
0
0.75
1.5
3 MILES
DATA SOURCES:
City of Rockford 2011,Boone Co 2029
City of Loves Park 2037, Winnebago Co 2030
PROJECT #: 21-0005
COORDINATE SYSTEM: IL SP WEST NAD83 US FT
IMAGERY:
WINNEBAGO
BOONE
ROCK
BOONE
DEKALB
OGLE
Middle Rock
Kishwaukee
Sugar
Pecatonica
Lower Rock
N
BUSINESS ROUTE 20
NEWBURG RD
N BELL SCHOOL RD
S BELL SCHOOL RD
N PERRYVILLE RD
REID FARM RD
N MULFORD RD
S MULFORD RD
SPRING CREEK RD
E RIVERSIDE BLVD
N ALPINE RD
S ALPINE RD
ESTATE ST
CHARLES ST
HARRISON AVE
HARLEM RD
RURAL ST
BROADWAY
11TH ST
KISHWAUKEE ST
1ST AVE
JEFFERSON ST
CHESTNUT ST
WHITMAN ST
N CHURCH ST
N 2ND ST
AUBURN ST
MORGAN ST
S MAIN ST
N CENTRAL AVE
MAIN
Keith Creek
251
20
139
IL-251
ZION Development
res

Figure 20. Relationship between impervious surfaces, evapotransporation, & infiltration.



Source: The Federal Interagency Stream Restoration Working Group, 1998 (Rev. 2001).

Table 12. Impervious category, percent impervious, & stream condition (Source: Zielinski 2002).

Category	% Impervious	Stream Condition within Subwatershed
Sensitive	<10%	Stable stream channels, excellent habitat, good water quality, and diverse biological communities
Impacted	>10% but <25%	Somewhat degraded stream channels, altered habitat, decreasing water quality, and fair-quality biological communities.
Non-Supporting	>25%	Highly degraded stream channels, degraded habitat, poor water quality, and poor-quality biological communities.



Sensitive Stream



Impacted Stream



Non-Supporting Stream

The following paragraphs describe the implications of increasing impervious cover:

Water Quality Impacts

Imperviousness affects water quality in streams and lakes by increasing pollutant loads and water temperature. Impervious surfaces accumulate pollutants from the atmosphere, vehicles, roof surfaces, lawns and other diverse sources. During a storm event, pollutants such as nutrients (nitrogen and phosphorus), metals, oil/grease, and bacteria are delivered to streams and lakes. According to monitoring and modeling studies, increased imperviousness is directly related to increased urban pollutant loads (Schueler, 1994). Furthermore, impervious surfaces can increase stormwater runoff temperature as much as 12 degrees compared to vegetated areas (Galli, 1990).

According to the Illinois Pollution Control Board (IPCB), water temperatures exceeding 90°F (32.2°C) can be lethal to aquatic fauna and can generally occur during hot summer months.

Hydrology and Flow Impacts

Higher impervious cover translates to greater runoff volumes thereby changing hydrology and flows in streams. If unmitigated, high runoff volumes can result in higher floodplain elevations (Schueler, 1994). In fact, studies have shown that even relatively low percentages of imperviousness (5% to 10%) can cause peak discharge rates to increase by a factor

of 5 to 10, even for small storm events. Impervious areas come in two forms: 1) disconnected and 2) directly connected. Disconnected impervious areas are represented primarily by rooftops, so long as the rooftop runoff does not get funneled to impervious driveways or a stormsewer system. Significant portions of runoff from disconnected surfaces usually infiltrate into soils more readily than directly connected impervious areas such as parking lots that typically end up as stormwater runoff directed to a stormsewer system that discharges directly to a waterbody.

Flooding and Depressional Storage Impacts
Flooding is an obvious consequence of increased flows resulting from increased impervious cover. As stated above, increased impervious cover leads to higher water levels, greater runoff volumes, and high floodplain elevations. Higher floodplain elevations usually result in more flood problem areas. Furthermore, as development increases, wetlands and other open space decrease. A loss of these areas results in increased flows because wetlands and open space typically soak up rainfall and release it slowly via groundwater discharge to streams and lakes. Detention basins can and do minimize flooding in highly impervious areas by regulating the discharge rate of stormwater runoff, but detention basins do not reduce the overall increase in runoff volume.

Habitat Impacts
A threshold in habitat quality exists at approximately 10% to 15% imperviousness (Booth and Reinelt, 1993). When a stream receives more severe and frequent runoff volumes compared to historical conditions, channel dimensions often respond through the process of erosion by widening, downcutting, or both, thereby enlarging the channel to handle the increased flow. Channel instability leads to a cycle of streambank erosion and sedimentation resulting in physical habitat degradation (Schueler, 1994). Streambank erosion is one of the leading causes of sediment suspension and deposition in streams leading to turbid conditions that may result in undesirable changes to aquatic life (Waters, 1995). Sediment deposition alters habitat for aquatic plants and animals by filling interstitial spaces in substrates important to benthic macroinvertebrates and some fish species. Physical habitat degradation also occurs when high and frequent flows result in loss of riffle-pool complexes.

2020 Impervious Cover Estimate & Future Vulnerability
In 1998, the Center for Watershed Protection (CWP) published the Rapid Watershed Planning Handbook. This document introduced rapid assessment methodologies for watershed planning. The CWP released the Watershed Vulnerability Analysis as a refinement of the techniques used in the Rapid Watershed Planning Handbook (Zielinski, 2002). The vulnerability analysis focuses on existing and predicted impervious cover as the driving forces impacting potential stream quality within a watershed. It incorporates the Impervious Cover Model described at the beginning of this subsection to classify Subwatershed Management Units (SMUs). SMUs are defined and examined in more detail in Section 3.3.

RES used a modified Vulnerability Analysis to compare each SMU's vulnerability to predicted land use changes across Keith Creek watershed. Three steps were used to generate a vulnerability ranking of each SMU. The results were used to make and rank recommendations in the Action Plan related to curbing the negative effects of predicted land use changes on the watershed. The three steps are listed below and described in detail on the following pages:

Step 1: Existing impervious cover classification of SMUs based on 2020 land use
Step 2: Predicted future impervious cover classification of SMUs based on predicted land use changes (2030)
Step 3: Vulnerability Ranking of SMUs based on changes in impervious cover and classification

Step 1: Existing Impervious Cover Classification
Step 1 in the Vulnerability Analysis is an existing classification of each SMU based on 2020 land use and measured impervious cover. 2020 impervious cover was calculated by assigning an impervious cover percentage for each land use category based upon the United States Department of Agriculture's (USDA) Technical Release 55 (TR55) (USDA 1986). Highly developed land such as commercial/retail for example is estimated to have over 70% impervious cover while a typical medium density residential development exhibits around 25% impervious cover. Open space areas such as forest preserves generally have less than 5% impervious cover. GIS analysis was used to estimate the percent impervious cover for each SMU in the watershed using 2020 land use data. Each SMU then received an initial classification (Sensitive, Impacted, or Non-Supporting) based on percent of existing impervious cover (Table 13; Figure 21). To summarize, all 6

SMUs were classified as Non-Supporting based on existing 2020 impervious cover estimates. Non-Supporting SMUs are associated with the densely populated urban and residential areas in and around Rockford and up through Loves Park.

Step 2: Predicted Future Impervious Cover Classification
Predicted future impervious cover was evaluated in Step 2 of the vulnerability analysis by classifying each SMU as Sensitive, Impacted, or Non-Supporting based on predicted (2030) land use changes. Table 13 and Figure 22 summarize and depict predicted future impervious cover classifications for each SMU. This step identifies the SMUs that are most vulnerable to future development pressure. All 6 SMUs were classified as Non-Supporting based on future 2030 impervious cover estimates, although increases in impervious cover did occur in most SMUs.

Step 3: Vulnerability Ranking
The vulnerability of each SMU to predicted future land use changes was determined by considering the following questions:

1. Will the SMU classification change?
2. Does the SMU classification come close to changing (within 2%)?
3. What is the absolute change in impervious cover from existing to predicted conditions?

Vulnerability to future development for each SMU was categorized as Low, Medium, or High:
Low = no change in classification; <2% change in impervious cover
Medium = classification close to changing (within 2%) and/or 2-4% change in impervious cover
High = classification change and/or >4% change in impervious cover

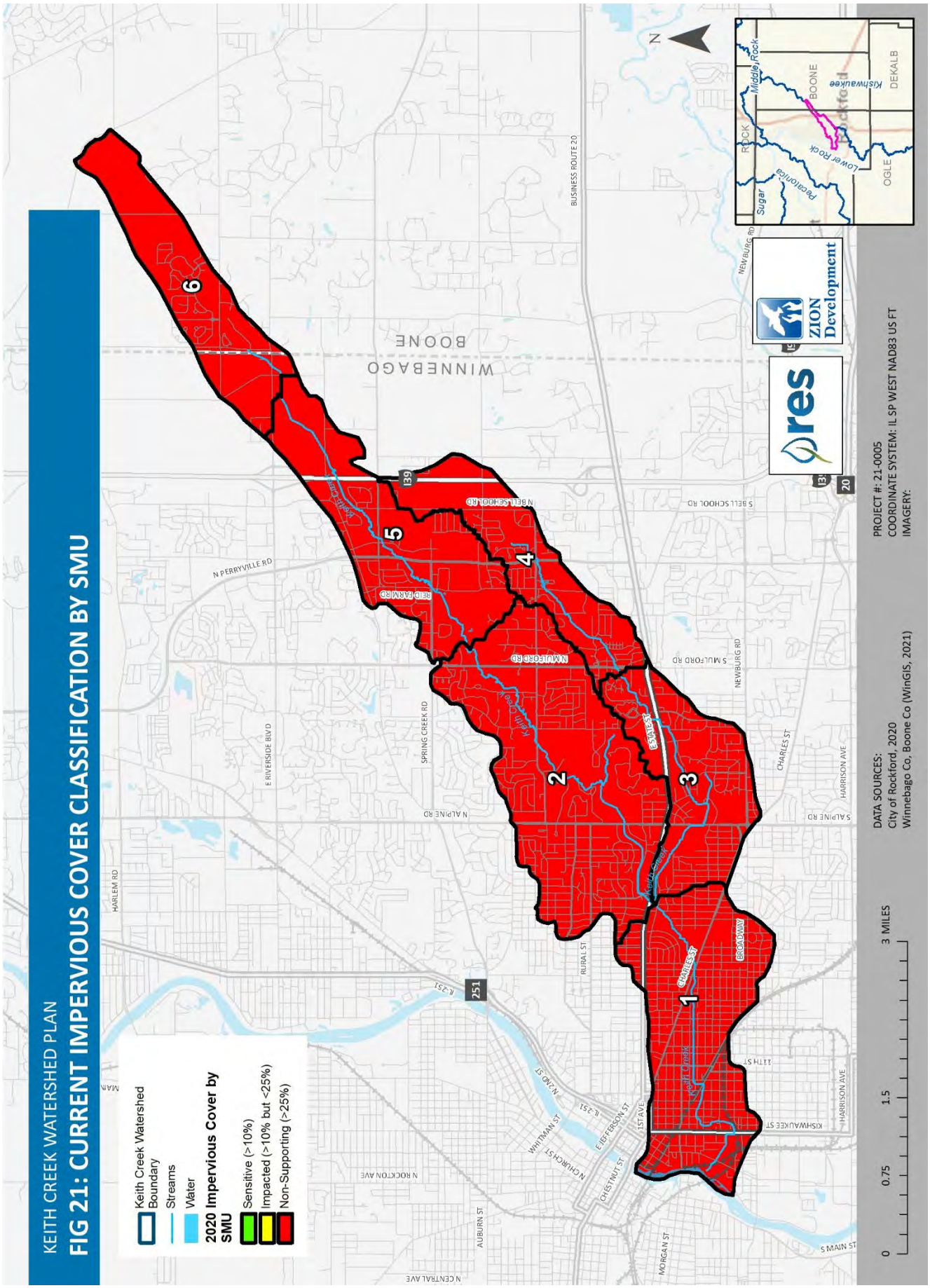
The vulnerability analysis resulted in 2 High, 2 Medium, and 2 Low ranked SMUs (Table 13; Figure 23). Subwatershed Management Units 4 and 6 are ranked as highly vulnerable to future problems associated with impervious cover because each is expected to undergo an increase of impervious cover of more than 4%. Planned commercial/retail growth and development near the edges of Rockford and surrounding Loves Park are the cause of the increases in impervious cover. These SMUs also coincide with the headwaters of both Keith Creek and Tributary 2. SMUs 3 and 5 are ranked as moderately vulnerable to predicted land use changes. SMUs 3 and 5 are areas that are generally already urbanized and will see continued increases in impervious cover in the future. The remaining SMUs are less vulnerable to predicted future land use changes.

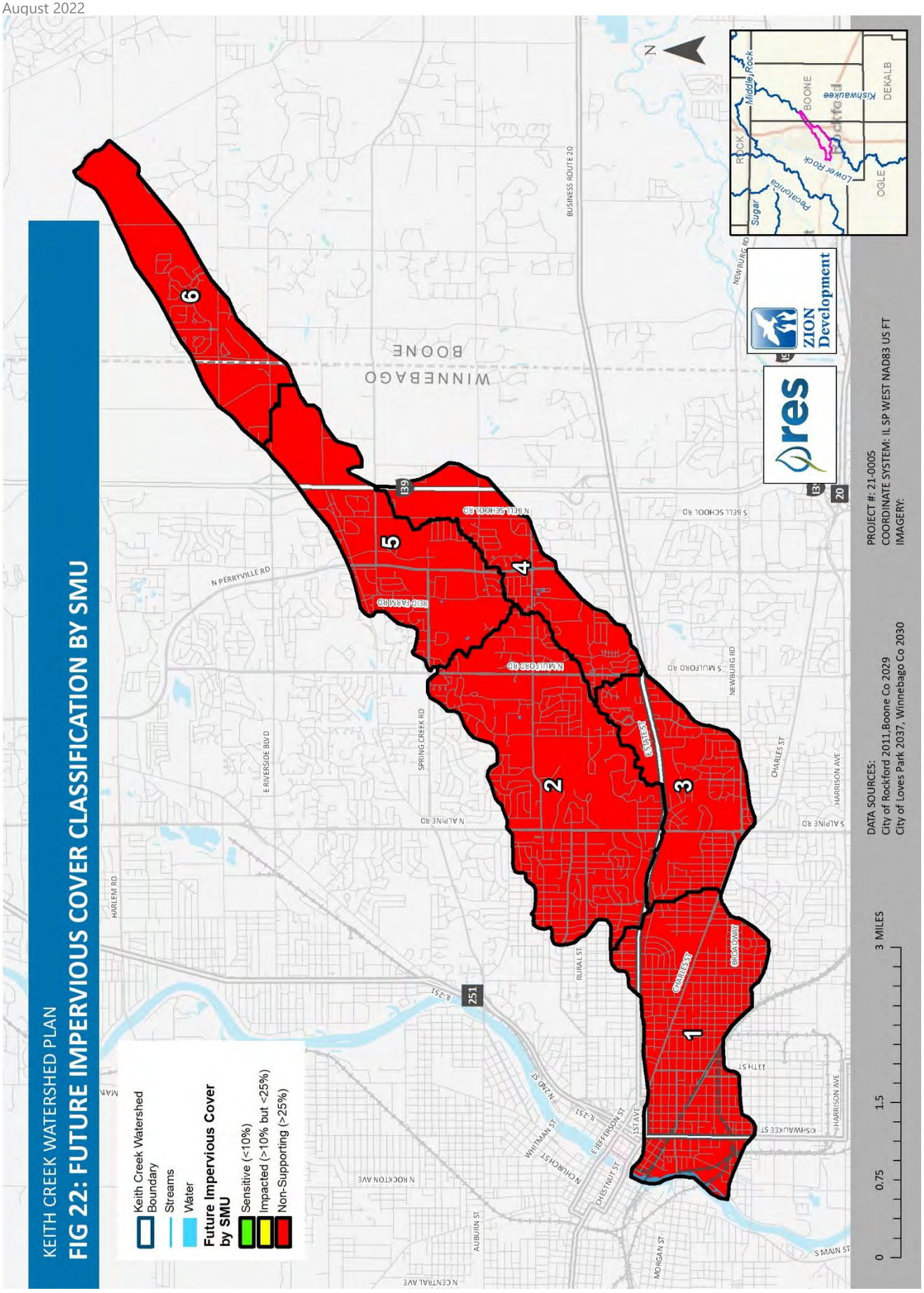
The results of this analysis point to the importance of mitigating the impacts of traditional commercial/retail and residential development in the future. It will be important to consider utilizing Conservation Design or Low Impact Development standards that incorporate the most effective and reliable Stormwater Treatment Train practices whereby stormwater is routed through various Management Measures prior to being released from the development site.

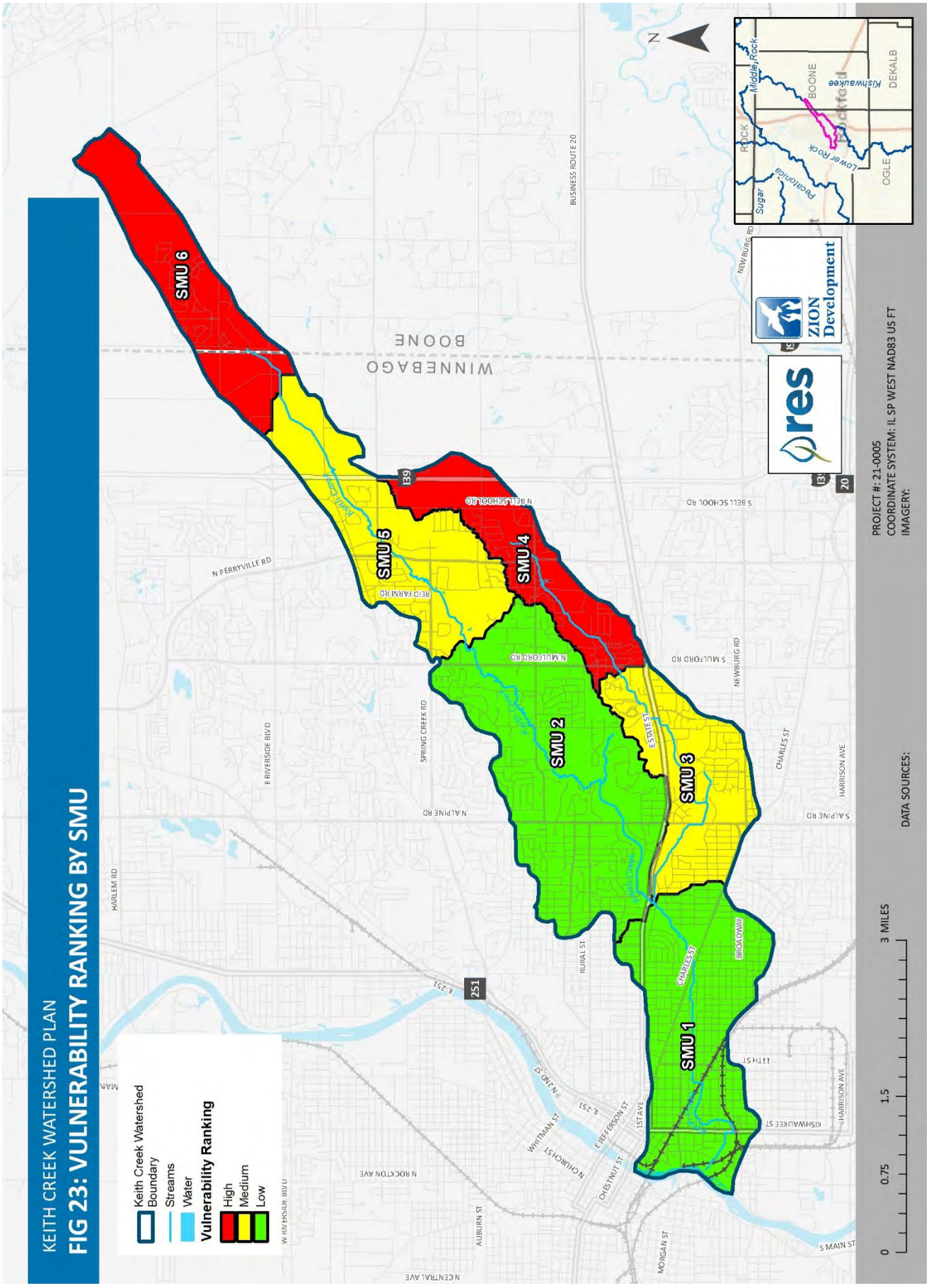
Table 13. Existing 2020, predicted (2030) impervious cover, and vulnerability by SMU.

SMU #	Acres	Step 1: Existing Impervious %	Existing Impervious Classification	Step 2: Predicted Impervious %	Future Impervious Classification	Percent Change	Step 3: Vulnerability
1	1,814.7	65.5%	Non-Supporting	65.8%	Non-Supporting	0.3%	Low
2	2,523.4	44.3%	Non-Supporting	44.6%	Non-Supporting	0.3%	Low
3	1,151.0	59.6%	Non-Supporting	63.5%	Non-Supporting	4.0%	Medium
4	981.4	52.5%	Non-Supporting	57.9%	Non-Supporting	5.4%	High
5	1,523.2	53.2%	Non-Supporting	56.7%	Non-Supporting	3.5%	Medium
6	1,118.1	30.5%	Non-Supporting	35.3%	Non-Supporting	4.8%	High

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KEITH CREEK WATERSHED PLAN
FIG 21: CURRENT IMPERVIOUS COVER CLASSIFICATION BY SMU
Keith Creek Watershed Boundary
Streams
Water
2020 Impervious Cover by SMU
Sensitive (>10%)
Impacted (>10% but <25%)
Non-Supporting (>25%)
1
2
3
4
5
6
WINNEBAGO
BOONE
BUSINESS ROUTE 20
N PERRYVILLE RD
N BELL SCHOOL RD
S BELL SCHOOL RD
REID FARM RD
N MULFORD RD
S MULFORD RD
NEWBURG RD
SPRING CREEK RD
E RIVERSIDE BLVD
N ALPINE RD
S ALPINE RD
HARLEM RD
RURAL ST
E STATE ST
CHARLES ST
BROADWAY
HARRISON AVE
11TH ST
KISHWAUKEE ST
1ST AVE
N 2ND ST
N CHURCH ST
WHITMAN ST
JEFFERSON ST
CHESTNUT ST
AUBURN ST
N ROCKTON AVE
N CENTRAL AVE
MORGAN ST
S MAIN ST
IL-251
251
20
ZION Development
res
ROCK
BOONE
DEKALB
OGLE
Sugar
Pecatonica
Middle Rock
Kishwaukee
Lower Rock
Rockford
N
0
0.75
1.5
3 MILES
DATA SOURCES:
City of Rockford, 2020
Winnebago Co, Boone Co (WinGIS, 2021)
PROJECT #: 21-0005
COORDINATE SYSTEM: IL SP WEST NAD83 US FT
IMAGERY:


KEITH CREEK WATERSHED PLAN
FIG 22: FUTURE IMPERVIOUS COVER CLASSIFICATION BY SMU
Keith Creek Watershed Boundary
Streams
Water
Future Impervious Cover by SMU
Sensitive (<10%)
Impacted (>10% but <25%)
Non-Supporting (>25%)
1
2
3
4
5
6
WINNEBAGO
BOONE
DATA SOURCES:
City of Rockford 2011,Boone Co 2029
City of Loves Park 2037, Winnebago Co 2030
PROJECT #: 21-0005
COORDINATE SYSTEM: IL SP WEST NAD83 US FT
IMAGERY:
0
0.75
1.5
3 MILES
N
ROCK
BOONE
DEKALB
OGLE
Middle Rock
Kishwaukee
Sugar
Pecatonica
Lower Rock


KEITH CREEK WATERSHED PLAN
FIG 23: VULNERABILITY RANKING BY SMU
Keith Creek Watershed Boundary
Streams
Water
Vulnerability Ranking
High
Medium
Low
SMU 1
SMU 2
SMU 3
SMU 4
SMU 5
SMU 6
WINNEBAGO
BOONE
BUSINESS ROUTE 20
N PERRYVILLE RD
REID FARM RD
N BELL SCHOOL RD
S BELL SCHOOL RD
N MULFORD RD
S MULFORD RD
NEWBURG RD
E RIVERSIDE BLVD
SPRING CREEK RD
N ALPINE RD
S ALPINE RD
HARLEM RD
RURAL ST
ESTATE ST
CHARLES ST
HARRISON AVE
BROADWAY
11TH ST
KISHWAUKEE ST
1ST AVE
JEFFERSON ST
CHESTNUT ST
WHITMAN ST
N CHURCH ST
N MAIN ST
S MAIN ST
MORGAN ST
AUBURN ST
N ROCKTON AVE
N CENTRAL AVE
W RIVERSIDE BLVD
251
20
ZION Development
res
ROCK
BOONE
OGLE
DEKALB
Sugar
Pecatonica
Middle Rock
Kishwaukee
Rock River
0
0.75
1.5
3 MILES
PROJECT #: 21-0005
COORDINATE SYSTEM: IL SP WEST NAD83 US FT
IMAGERY:
DATA SOURCES:

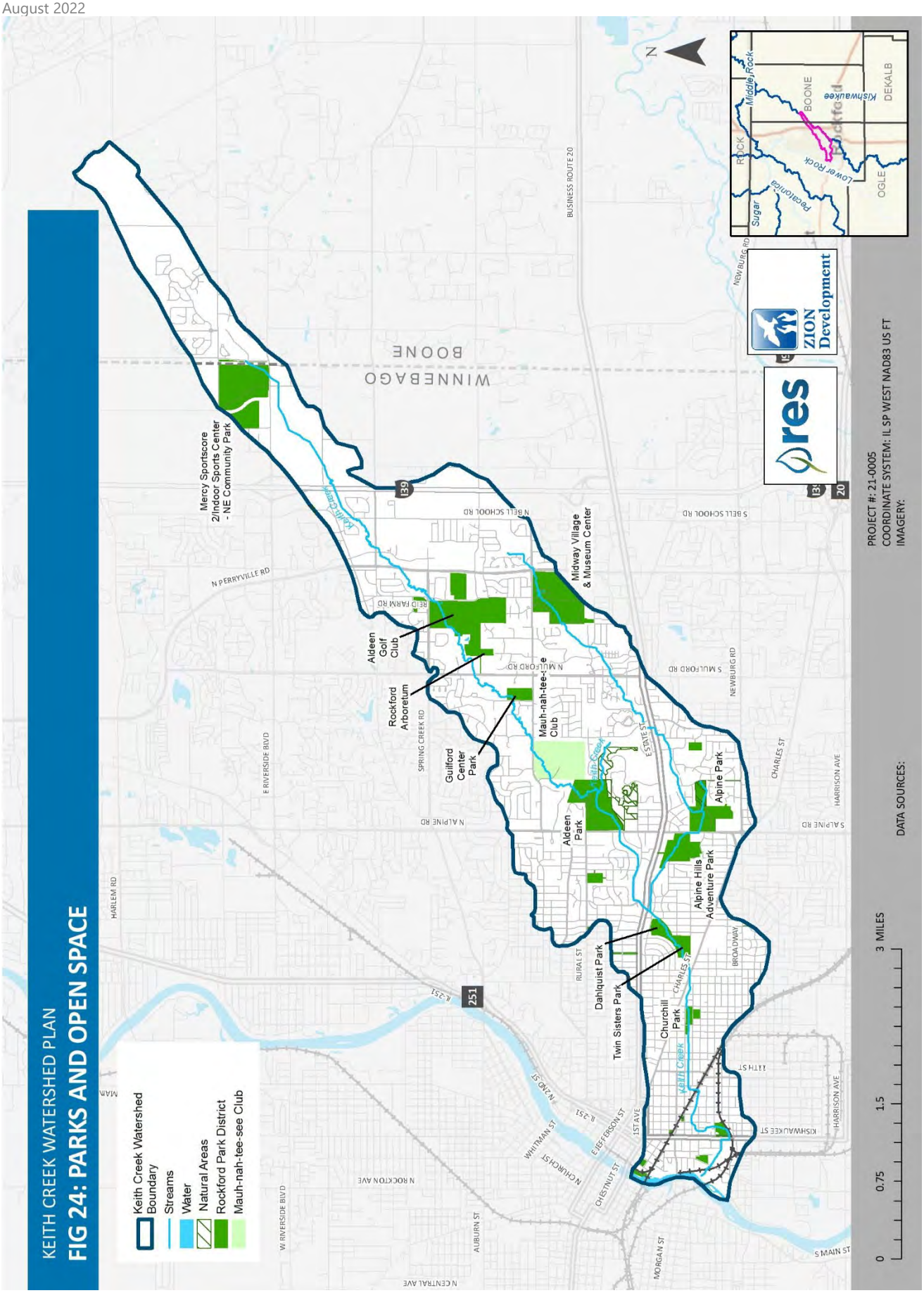
3.11 Parks and Open Space

Parks and open space provide large greenway corridors that interconnect land and waterways, support native species, maintain natural ecological processes, and contribute to the health and quality of life for communities and people. These open space areas are important keys to protecting water quality and habitat and need to be managed or restored in order to perform those functions optimally. Rockford Park District owns and maintains over 800 acres of parks and open space in the Keith Creek watershed, including 28 properties. There are also three natural areas and a private golf club in the watershed. Figure 24 depicts the sites and Table 14 details the park district properties greater than 10 acres in size.

Table 14. Parks and open space summary data.

Natural Area	Type	Size (ac or lf)
Rockford Park District		
Aldeen Golf Club	Special Use	168.4
Mercy Sportscore 2/Indoor Sports Center - NE Community Park	Special Use	159.7
Midway Village & Museum Center	Museum	124.0
Aldeen Park	Large Urban Park	103.6
Alpine Park	Large Urban Park	54.9
Alpine Hills Adventure Park	Special Use	52.0
Twin Sisters Park	Community Park	23.5
Guilford Center Park	Neighborhood Park	18.3
Dahlquist Park	Community Park	16.5
Alpine Pool	Special Use	12.8
Churchill Park	Community Park	12.2
Rockford Arboretum	Natural Resource Area	11.9
Other Open Space		
Rockford College Woods	Woods and prairie	55.9
Alpine Park Woods	Upland forest	14.1
Unitarian Universalist Church	Woods and prairie	5.7
Mauh-nah-tee-see Club	Private golf course	116.9

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KEITH CREEK WATERSHED PLAN
FIG 24: PARKS AND OPEN SPACE
Keith Creek Watershed Boundary
Streams
Water
Natural Areas
Rockford Park District
Mauh-nah-tee-see Club
Mercy Sportscore 2/Indoor Sports Center - NE Community Park
Midway Village & Museum Center
Aldeen Golf Club
Rockford Arboretum
Guilford Center Park
Mauh-nah-tee-see Club
Aldeen Park
Alpine Park
Alpine Hills Adventure Park
Dahlquist Park
Twin Sisters Park
Churchill Park
WINNEBAGO
BOONE
BUSINESS ROUTE 20
N PERRYVILLE RD
N BELL SCHOOL RD
S BELL SCHOOL RD
N ALPINE RD
S ALPINE RD
E RIVERSIDE BLVD
W RIVERSIDE BLVD
SPRING CREEK RD
NEWBURG RD
S MULFORD RD
N MULFORD RD
HARLEM RD
CHARLES ST
HARRISON AVE
BROADWAY
RURAL ST
E STATE ST
KISHWAUKEE ST
11TH ST
1ST AVE
JEFFERSON ST
CHESTNUT ST
MORGAN ST
AUBURN ST
N CENTRAL AVE
N ROCKTON AVE
S MAIN ST
WHITMAN ST
N CHURCH ST
251
139
20
Keith Creek
Kishwaukee
Middle Rock
Lower Rock
Pecatonica
Sugar
ROCK
BOONE
OGLE
DEKALB
Rockford
ZION Development
res
N
0 0.75 1.5 3 MILES
PROJECT #: 21-0005
COORDINATE SYSTEM: IL SP WEST NAD83 US FT
IMAGERY:
DATA SOURCES:

Rockford Park District

Rockford Park District owns a total of 28 properties within the Keith Creek watershed, the four largest of which include Aldeen Golf Course, Mercyhealth Sportscore Two, Midway Village & Museum Center, and Aldeen Park.

The Aldeen Golf Course is an upscale public course and rated the best municipal golf course in Illinois. The 18-hole course covers 7,131 yards set in 168 acres and is the largest park in the Keith Creek watershed. It features manicured greens, tees, and fairways, 62 sand bunkers, with water on 12 of the 18 holes; in fact, Keith Creek becomes a series of online detention ponds through the course. Mercyhealth Sportscore Two is a 160-acre facility that features soccer fields (grass and turf), sand volleyball courts, an outdoor stadium with turf, and Indoor Sports Center.

Midway Village & Museum Center sits on 124 acres on Tributary 2 and includes the open-air Victorian Village, Museum Center, Mill House, Old Doll's House and Museum Store, and 1.4-mile loop through prairie and second growth oak woodland areas. Aldeen Park was originally purchased by the Winnebago County Forest Preserve District for flood control in 1939 and an earthen core dam was constructed on the parcel. It was renamed Memorial Forest Preserve in 1961, sold to the Rockford Park District in 1965 and was later named Reuben Aldeen Park. Today the park covers almost 104 acres and offers maple and oak woodlands and prairie along portions of Keith Creek as well as an extensive trail network and recreational facilities.





Left: Amos W. Woodward Millhouse is a replica of an operating water-powered machine shop located on the edge of Midway Museum's Severin Lake, Right: Aldeen Park

Though much smaller in size relative to some of the Park District's other properties, Rockford Arboretum is home to some excellent native species. It is a 12-acre arboretum tucked in between homes and businesses off Mulford Rd. There are many large oak trees, a 200+-year-old maple, and white pine as well as excellent woodland understory species such as red and white trillium, jack-in-the-pulpit, and ferns.

Other Open Space

There are also three properties identified as Winnebago County Natural Areas that add to the dedicated open space with the watershed. Rockford College Woods is the largest at 56 acres and is nestled between Rockford University and Aldeen Park. It consists of mostly second-growth woodland and scrub-shrub species. Alpine Park Woods is a degraded upland forest along the eastern end of Alpine Park. Both Rockford College Woods and Alpine Park Woods house intermittent streams with moderate amounts of erosion. The smallest of the three, at just under 6 acres, is a woodland and prairie at Unitarian Universalist Church. There is also one private country club - Mauh-nah-tee-see, in the watershed. The club is home to a tree-lined, 18-hole golf course, along with driving and practice ranges. It also boasts event spaces, dining and social events and has been open since 1926. The club is also a Certified Audubon Cooperative Sanctuary, a program that helps organizations and businesses protect environmental resources.



The Mauh-nah-tee-see Club



Rockford Arboretum

3.12 Open Space Inventory, Prioritization, & Green Infrastructure Network

A major component of watershed planning includes an examination of open space to determine how it best fits into a "Green Infrastructure Network". Green infrastructure is best defined as an interconnected network of natural areas and other open space that conserves natural ecosystem values and functions, sustains clean air and water, and provides a wide array of benefits to people and wildlife (Benedict 2006). Natural features such as stream corridors, wetlands, floodplain, woodlands, and grassland are the primary components of green infrastructure. Working lands such as farms and partially developed areas including parks, ball fields, golf courses, school grounds, detention basins, large residential parcels, and any residential lot that includes a stream corridor are also considered components of a Green Infrastructure Network. A three-step process was used to create a parcel-based Green Infrastructure Network (GIN) for the Keith Creek watershed:

Step 1: All parcels of land in the watershed were categorized as open space, partially open space, or developed.
Step 2: All open and partially open parcels were prioritized based on a set of criteria important to green infrastructure.
Step 3: Prioritized open and partially open parcels were configured to form a GIN.

For this watershed plan, an "open space" parcel is generally defined as any parcel that is not developed such as a park, preserve, or agricultural field. "Partially open" parcels have been developed to some extent, but the parcels still offer potential green infrastructure opportunities. Examples of partially open parcels include golf courses, school grounds, and residential lots generally greater than two to three acres with minimal development. Parcels that are mostly built out such as commercial/retail areas and roads are considered "developed." Public versus private and protected versus unprotected status of open and partially open space parcels are other important green infrastructure attributes that are discussed in more detail below. Parcels range in size from less than 1 acre to 144 acres with a 0.6-acre average.

Open, Partially Open, & Developed Parcels

Step 1 in creating a Green Infrastructure Network was completed by categorizing all parcels in the watershed as "open," "partially open," or "developed." Figures 25 and 28 summarize and depict Step 1 results used to develop the GIN. Open space parcels comprise approximately 2,407 acres or 26% of the watershed. Most open parcels consist of park district and other open space properties or remaining agricultural land. Partially open parcels make up another 1,276 acres or 14% of the watershed. Developed parcels account for the remaining 5,428 acres or 60% of the watershed.

Public/Private Ownership of Open and Partially Open Parcels

The public or private ownership of each open and partially open parcel was determined from available parcel data. Developed parcels are not included in this summary. Publicly owned parcels include those owned by state, county, township, municipal government, or school districts. Public open and partially open parcels account for 21% and 3% of the open and partially open acreage respectively (Figures 26 & 29). Public open and partially open parcels are typically owned by the park district and municipalities. Private ownership types include agricultural, residential, homeowner/business associations, and commercial. Private open parcels comprise 44% of the open and partially open acreage whereas private partially open parcels comprise 32%.

Protected Status of Open and Partially Open Parcels

Preservation of open space is critical to maintaining and expanding green infrastructure and is an important component of sustaining water quality, hydrological processes, ecological function, and the general quality of life for both wildlife and people. Without preservation, open space can be converted to other less desirable land uses in the future. Protected open and partially open parcels account for about 24% of the open and partially open parcel acreage in the watershed while unprotected open and partially open parcels account for the remaining 76% (Figures 27 & 30). Most protected open or partially open parcels are owned by the park district or municipal government. The most critical unprotected open and partially open parcels include undeveloped agricultural areas, school or university grounds, hospital grounds and the private golf course. Most of the agricultural areas will likely be developed to residential, office, or commercial in the future. In these cases, future development that incorporates conservation design and/or Stormwater Treatment Train systems will be extremely important in these areas to improve water quality and reduce stormwater runoff volume to an already stressed Keith Creek.

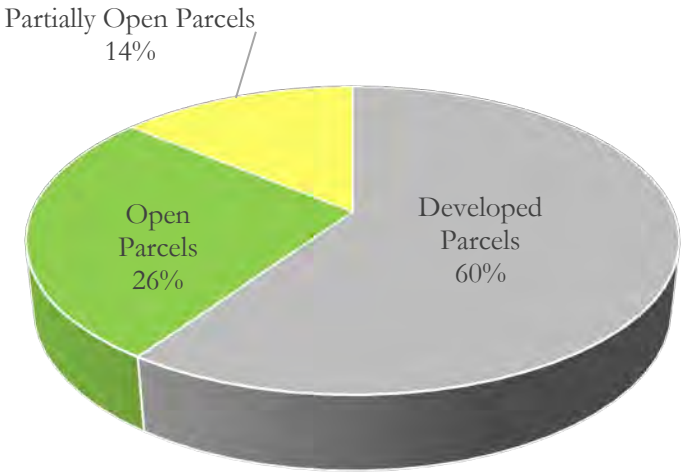


Figure 25. Distribution of open, partially open, and developed parcels.

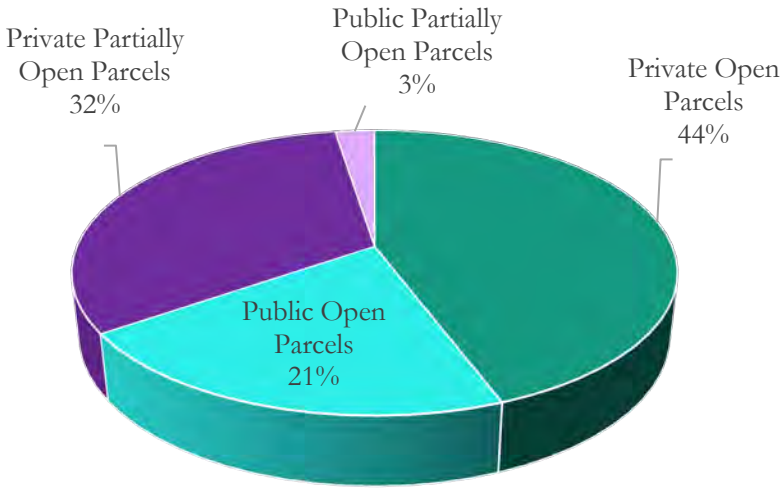


Figure 26. Distribution of private and public open and partially open parcels.

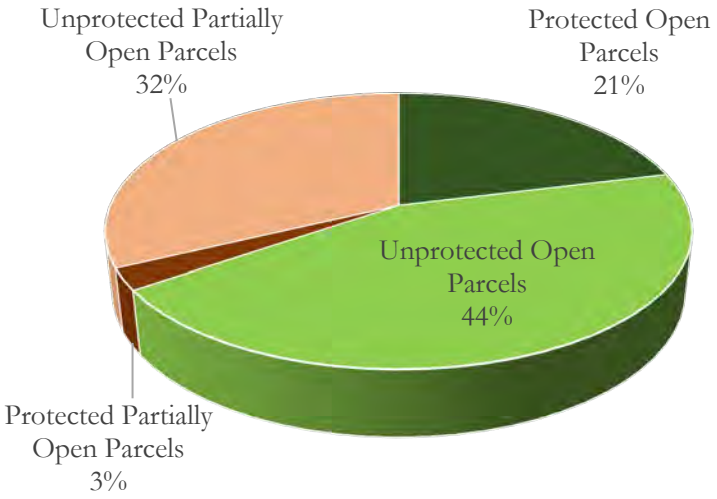
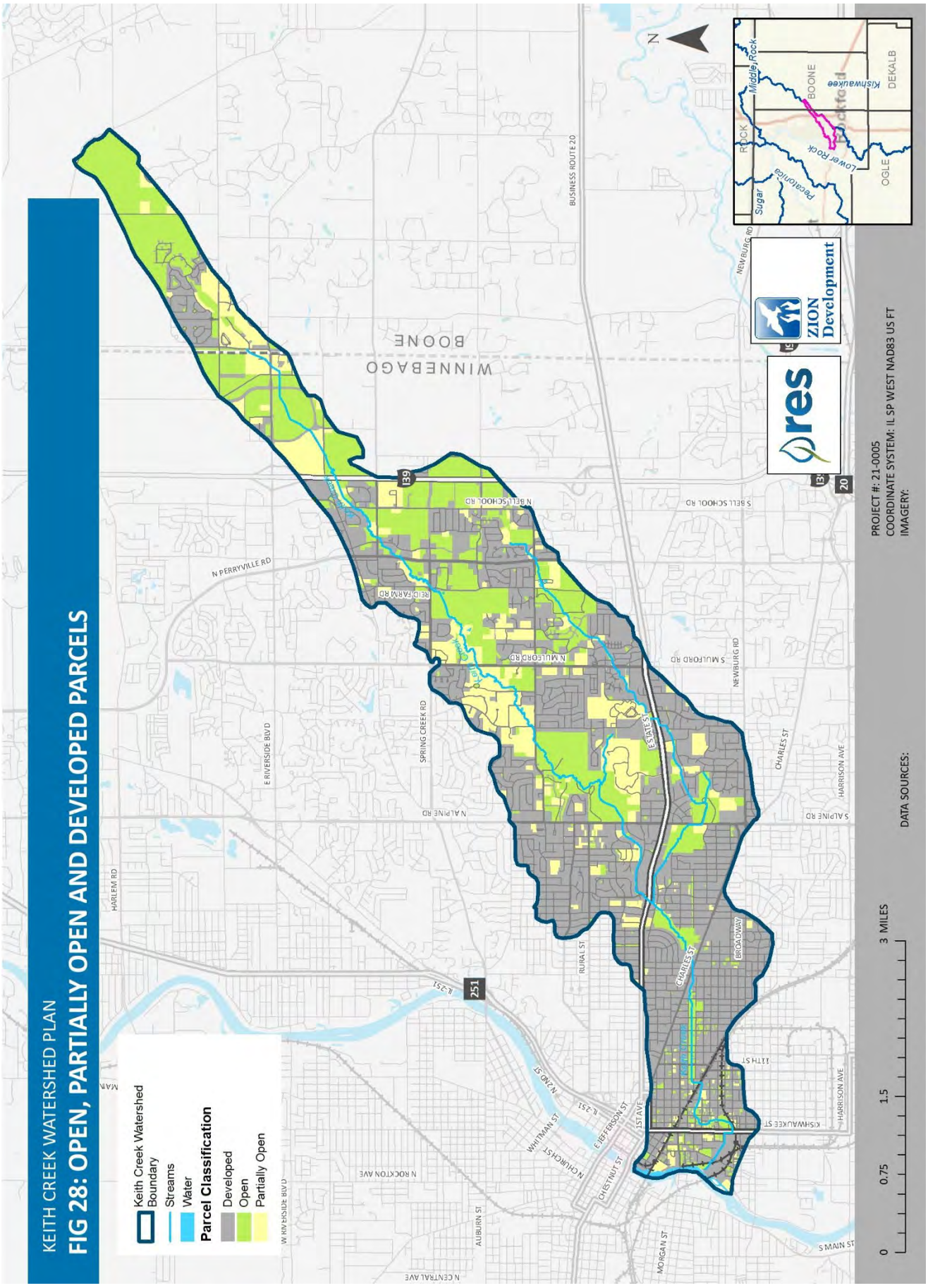
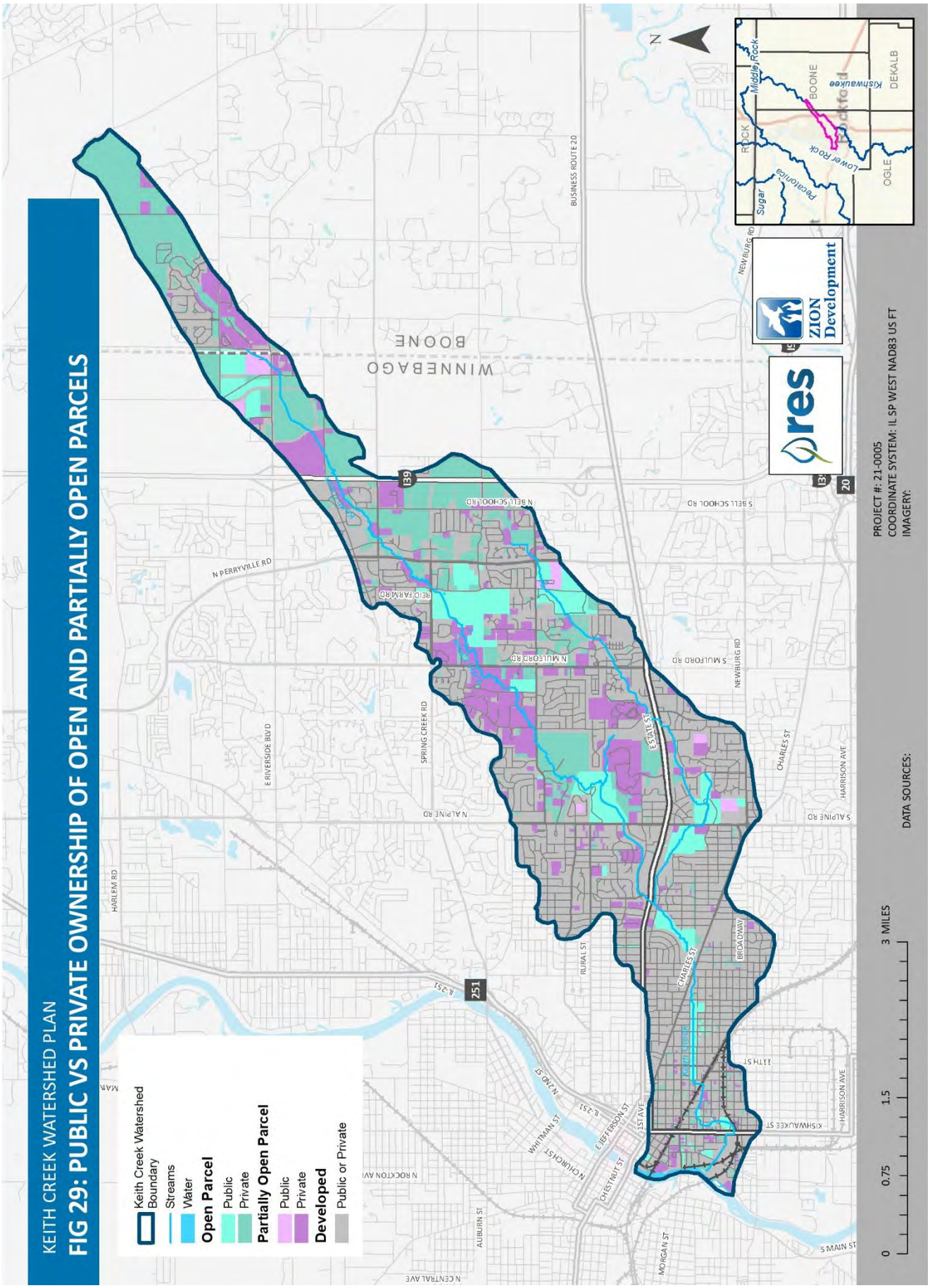
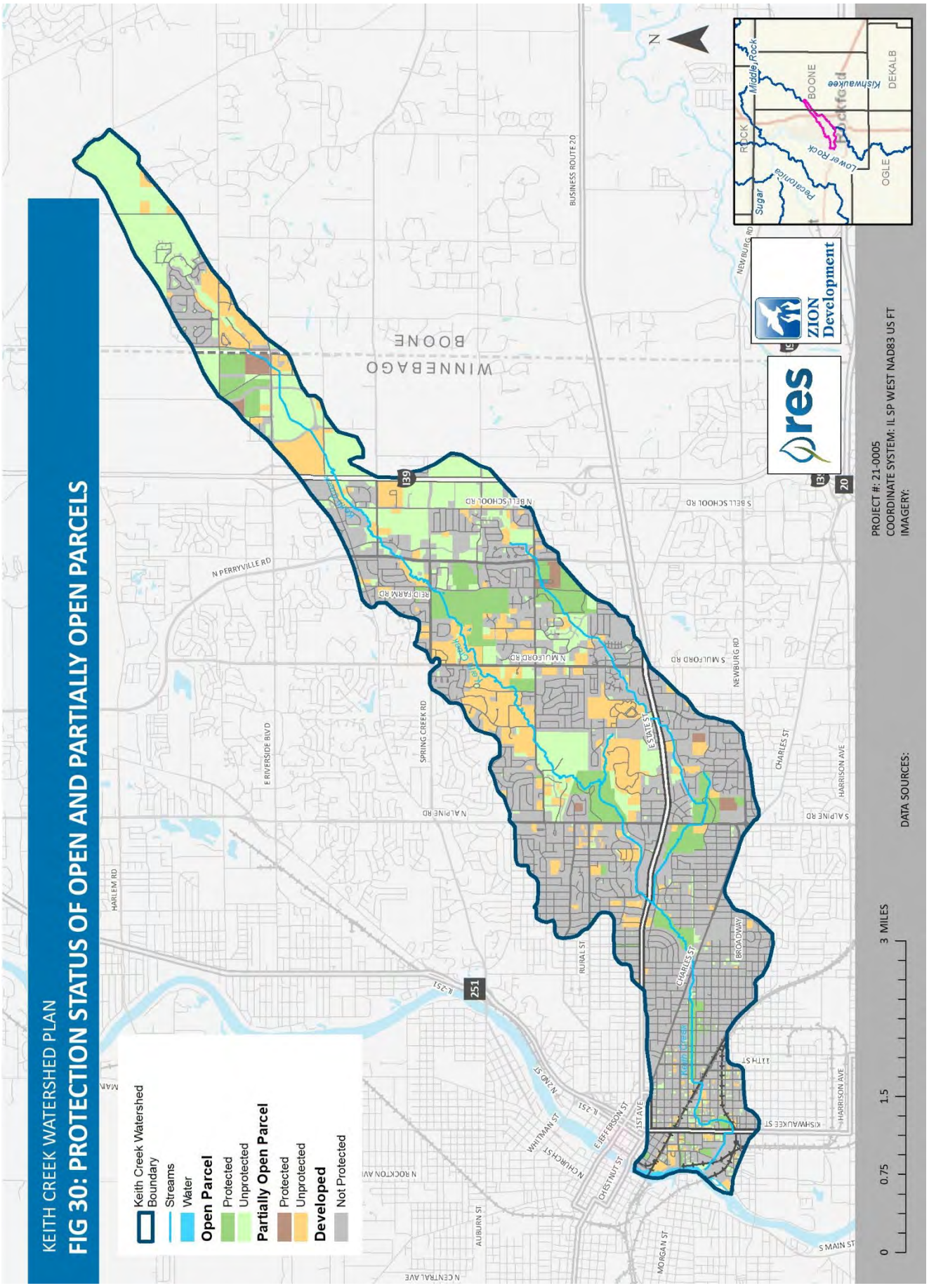


Figure 27. Distribution of protected and unprotected open and partially open parcels.


KEITH CREEK WATERSHED PLAN
FIG 28: OPEN, PARTIALLY OPEN AND DEVELOPED PARCELS
Keith Creek Watershed Boundary
Streams
Water
Parcel Classification
Developed
Open
Partially Open
BOONE
WINNEBAGO
BUSINESS ROUTE 20
N PERRYVILLE RD
N BELL SCHOOL RD
S BELL SCHOOL RD
REID FARM RD
N MULFORD RD
S MULFORD RD
NEWBURG RD
SPRING CREEK RD
E RIVERSIDE BLVD
N ALPINE RD
S ALPINE RD
HARLEM RD
CHARLES ST
HARRISON AVE
RURAL ST
BROADWAY
IL-251
11TH ST
KISHWAUKEE ST
N 2ND ST
WHITMAN ST
N CHURCH ST
JEFFERSON ST
1ST AVE
CHESTNUT ST
N ROCKTON AVE
AUBURN ST
MORGAN ST
S MAIN ST
N CENTRAL AVE
Kishwaukee River
Keith Creek
251
139
20
Middle Rock
Sugar
Pecatonica
Lower Rock
Rockford
ROCK
BOONE
OGLE
DEKALB
Kishwaukee
N
0
0.75
1.5
3 MILES
PROJECT #: 21-0005
COORDINATE SYSTEM: IL SP WEST NAD83 US FT
IMAGERY:
DATA SOURCES:
res
ZION Development


KEITH CREEK WATERSHED PLAN
FIG 29: PUBLIC VS PRIVATE OWNERSHIP OF OPEN AND PARTIALLY OPEN PARCELS
Keith Creek Watershed Boundary
Streams
Water
Open Parcel
Public
Private
Partially Open Parcel
Public
Private
Developed
Public or Private
WINNEBAGO
BOONE
BUSINESS ROUTE 20
N PERRYVILLE RD
N BELL SCHOOL RD
S BELL SCHOOL RD
REID FARM RD
N MULFORD RD
S MULFORD RD
NEWBURG RD
E RIVERSIDE BLVD
SPRING CREEK RD
N ALPINE RD
S ALPINE RD
HARLEM RD
E STATE ST
CHARLES ST
HARRISON AVE
RURAL ST
BROADWAY
11TH ST
KISHWAUKEE ST
IL-251
N MAIN ST
WHITMAN ST
N CHURCH ST
E JEFFERSON ST
1ST AVE
CHESTNUT ST
AUBURN ST
MORGAN ST
S MAIN ST
N ROCKTON AVE
N CENTRAL AVE
251
39
20
N
ROCK
BOONE
DEKALB
OGLE
Middle Rock
Kishwaukee
Sugar
Pecatonica
Lower Rock
ZION Development
res
0
0.75
1.5
3 MILES
PROJECT #: 21-0005
COORDINATE SYSTEM: IL SP WEST NAD83 US FT
IMAGERY:
DATA SOURCES:


KEITH CREEK WATERSHED PLAN
FIG 30: PROTECTION STATUS OF OPEN AND PARTIALLY OPEN PARCELS
Keith Creek Watershed Boundary
Streams
Water
Open Parcel
Protected
Unprotected
Partially Open Parcel
Protected
Unprotected
Developed
Not Protected
WINNEBAGO
BOONE
BUSINESS ROUTE 20
N PERRYVILLE RD
N BELL SCHOOL RD
S BELL SCHOOL RD
REID FARM RD
N MULFORD RD
S MULFORD RD
NEWBURG RD
E RIVERSIDE BLVD
SPRING CREEK RD
N ALPINE RD
S ALPINE RD
HARLEM RD
E STATE ST
CHARLES ST
HARRISON AVE
RURAL ST
BROADWAY
IL-251
251
KISHWAUKEE ST
11TH ST
1ST AVE
E JEFFERSON ST
WHITMAN ST
N CHURCH ST
CHESTNUT ST
N ROCKTON AVE
AUBURN ST
MORGAN ST
S MAIN ST
N CENTRAL AVE
Keith Creek
20
0
0.75
1.5
3 MILES
PROJECT #: 21-0005
COORDINATE SYSTEM: IL SP WEST NAD83 US FT
IMAGERY:
DATA SOURCES:
ZION Development
res
N
ROCK
BOONE
DEKALB
OGLE
Middle Rock
Kishwaukee
Rockford
Sugar
Pecatonica
Lower Rock

Open Space Parcel Prioritization

Step 2 in creating a Green Infrastructure Network for Keith Creek watershed was completed by prioritizing open and partially open parcels. For this step, 9 prioritization criteria important to green infrastructure were examined via a GIS analysis (Table 15). If an open or partially open parcel met a criterion it received one point. If the parcel did not meet that criterion, it did not receive a point. This process was repeated for each open and partially open parcel and for all criteria. The prioritization process was not completed for developed parcels. The total points received for each parcel were summed to determine parcel prioritization within the Green Infrastructure Network - parcels with the highest number of points being more important to green infrastructure than parcels that met fewer criteria.

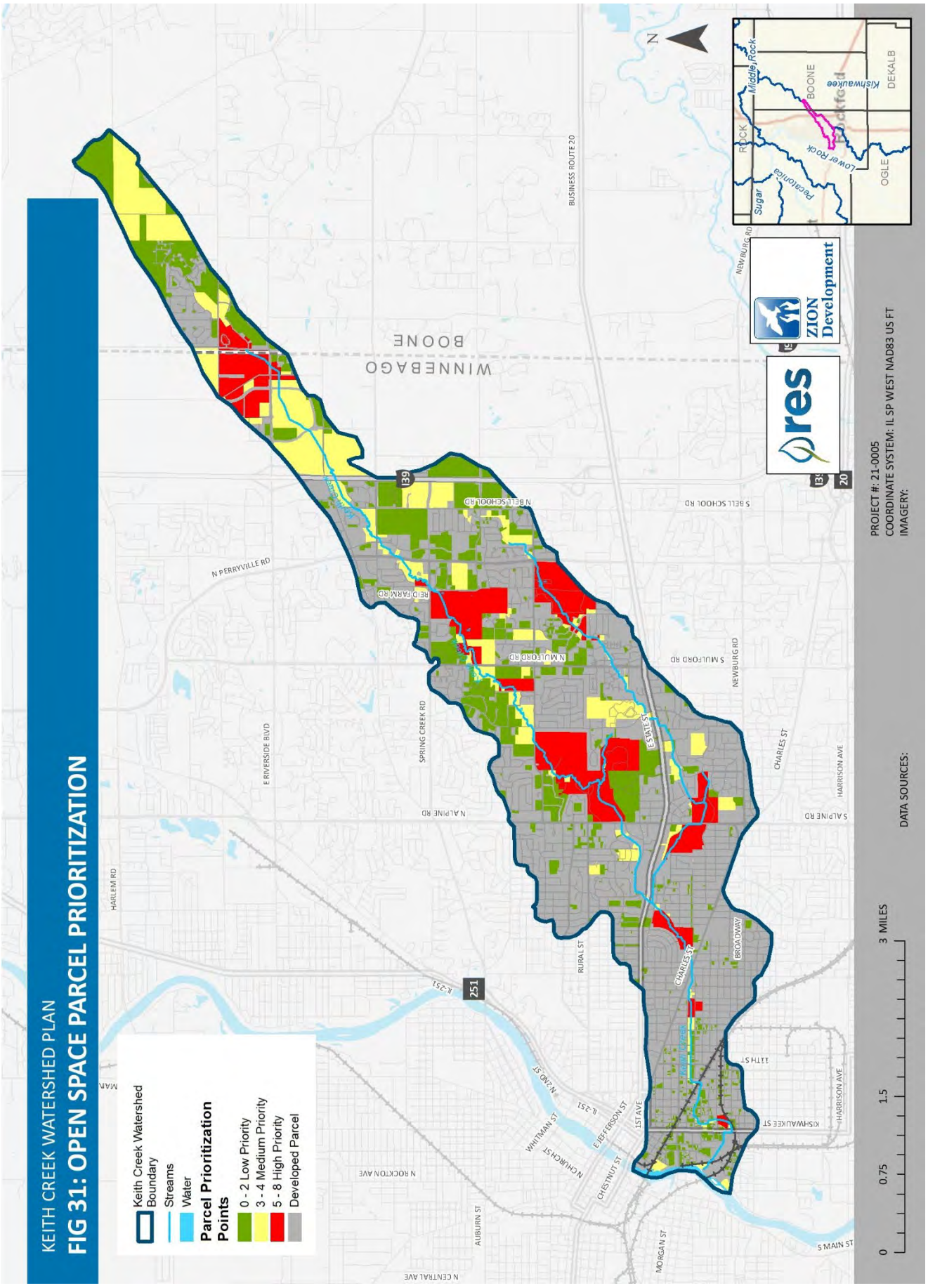
The combined highest possible total of points any one parcel could accumulate was 9 (9 of 9 total criteria met). The highest actual total value received by a parcel in the weighting process was 8 (having met 8 of the 9 criteria). After completion of the prioritization, parcels were categorized as "High Priority," "Medium Priority," or "Low Priority" based on point totals. Parcels meeting 5-8 of the criteria were designated High Priority for inclusion into the Green Infrastructure Network while parcels meeting 3-4 criteria were designated Medium Priority. Parcels with a combined value of 0-2 were categorized as Low Priority but were not necessarily excluded from the Green Infrastructure Network based on their location or position as linking parcels.

Figure 31 depicts the results of the parcel prioritization. The Green Infrastructure Network for the Keith Creek watershed follows both the existing streams and tributaries and upstream or headwater wetland areas. The High Priority parcels typically include parks, open areas, golf courses, school grounds, and private agricultural land near the headwaters of Keith Creek. Many of the Medium Priority parcels intersect streams or smaller park district properties. Low Priority parcels are generally isolated from other natural features and include privately-owned agricultural parcels in upland areas.

Table 15. Criteria used to prioritize parcels for a Green Infrastructure Network.

Green Infrastructure Criteria
1. Open or partially open parcels that intersect FEMA 100-year floodplain
2. Open or partially open parcels within 0.5-miles of any headwater stream
3. Open or partially open parcels that intersect a wetland
4. Open or partially open parcels that include a potentially restorable wetland
5. Open or partially open parcels equal to or greater than 5 acres
6. Open or partially open parcels that are within 100 feet of a stream or significant open water
7. Open or partially open parcels in a "Highly Vulnerable" Land use SMU
8. Open or partially open parcels adjacent to or including parks and open space properties
9. Open or partially open parcels that intersect planned or existing trails

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KEITH CREEK WATERSHED PLAN
FIG 31: OPEN SPACE PARCEL PRIORITIZATION
Keith Creek Watershed Boundary
Streams
Water
Parcel Prioritization Points
0 - 2 Low Priority
3 - 4 Medium Priority
5 - 8 High Priority
Developed Parcel
WINNEBAGO
BOONE
BUSINESS ROUTE 20
N PERRYVILLE RD
N BELL SCHOOL RD
S BELL SCHOOL RD
RED FARM RD
N MULFORD RD
S MULFORD RD
NEWBURG RD
SPRING CREEK RD
E RIVERSIDE BLVD
N ALPINE RD
S ALPINE RD
HARLEM RD
E STATE ST
CHARLES ST
HARRISON AVE
RURAL ST
BROADWAY
IL-251
251
11TH ST
KISHWAUKEE ST
1ST AVE
E JEFFERSON ST
CHESTNUT ST
WHITMAN ST
N CHURCH ST
N ROCKTON AVE
AUBURN ST
MORGAN ST
S MAIN ST
N CENTRAL AVE
N
ROCK
BOONE
DEKALB
OGLE
Middle Rock
Kishwaukee
Lower Rock
Sugar
Pecatonica
Rockford
ZION Development
res
PROJECT #: 21-0005
COORDINATE SYSTEM: IL SP WEST NAD83 US FT
IMAGERY:
DATA SOURCES:
0
0.75
1.5
3 MILES

Green Infrastructure Network

The final step (Step 3) in creating a Green Infrastructure Network for the Keith Creek watershed involves laying out the network by incorporating: 1) prioritized open space results from Steps 1 & 2, 2) information gathered during the watershed resource field inventory conducted by RES in 2021, and 3) stakeholder recommendations.

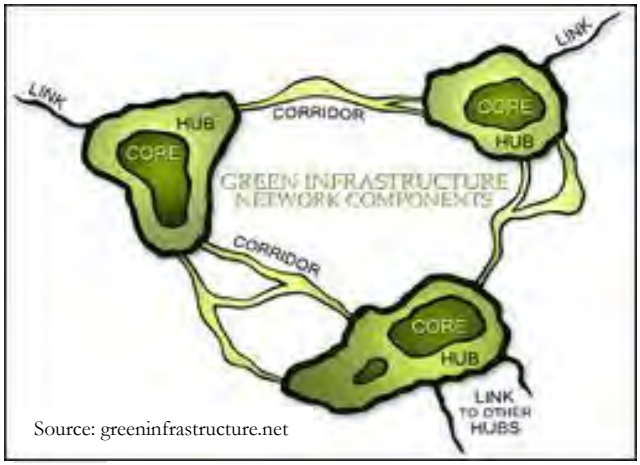
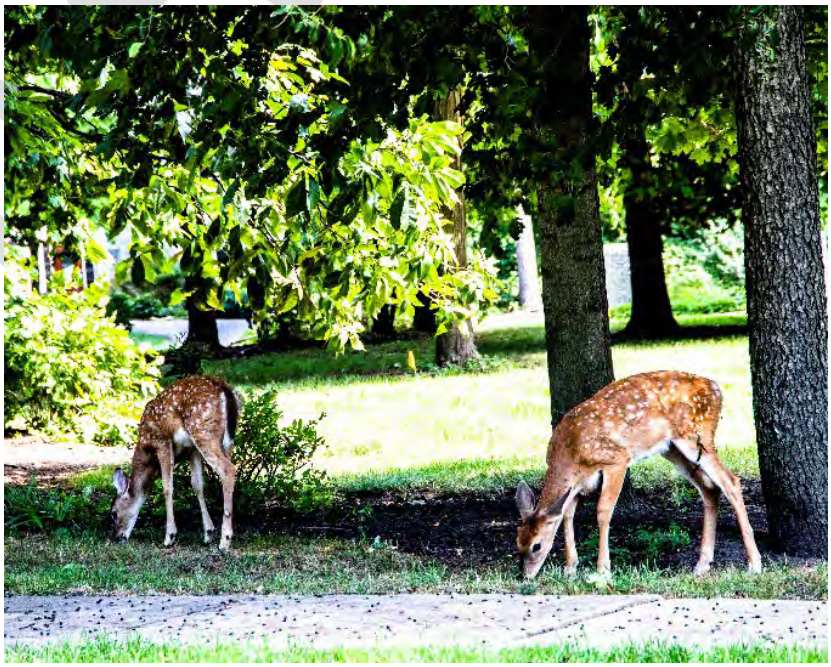


Figure 32. Green Infrastructure components.

A Green Infrastructure Network is a connected system of *Hubs* and linking *Corridors* (Figure 32). County and region-wide green infrastructure plans generally focus on natural features such as stream corridors, wetlands, floodplain, buffers, and other natural components. Hubs generally consist of the largest and least fragmented areas such as Aldeen Golf Course, Mercyhealth Sportscore Two, Midway Village & Museum Center, and Aldeen Park. Corridors are generally formed by smaller private/ unprotected parcels along Keith Creek and its tributaries. Corridors are extremely important because they provide biological conduits between hubs. However, most parcels forming corridors are not ideal green infrastructure until residents, businesses, and landowners embrace the idea of managing stream corridors.

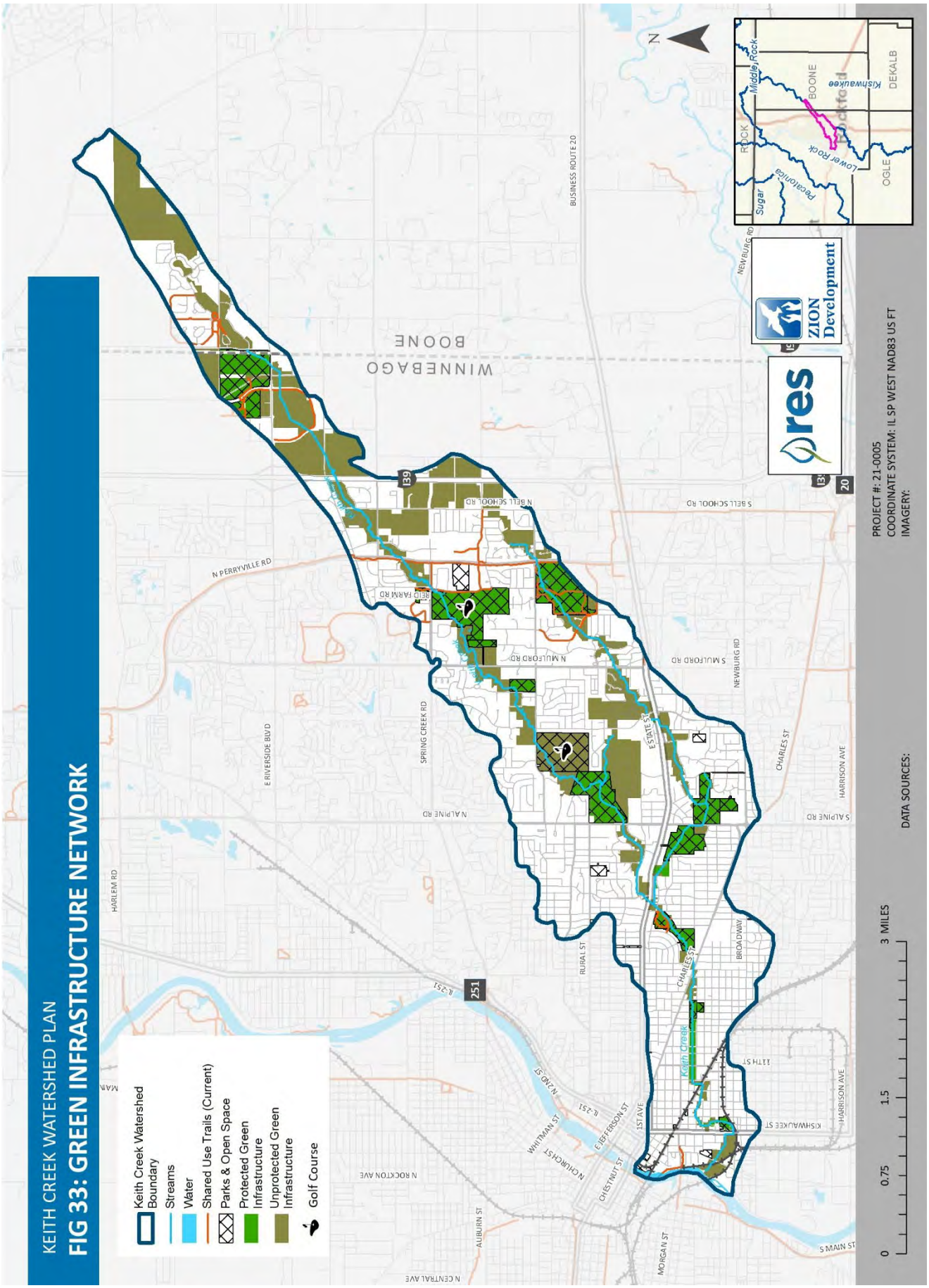
Perhaps the most important aspect of green infrastructure planning is that it helps communities identify and prioritize conservation opportunities and plan development in ways that optimize the use of land to meet the needs of people and nature (Benedict, 2006). Green infrastructure planning provides a framework for future growth that identifies areas not suitable for development, areas suitable for development but which should incorporate conservation/low impact design standards, and areas that do not affect green infrastructure. The Action Plan section of this report contains recommendations for implementing the Green Infrastructure Network.

The Green Infrastructure Network (GIN) created for the Keith Creek watershed captures all the natural components and other green infrastructure such as recreational parks, agricultural lots, school grounds, and golf courses at the parcel level. In some cases, developed or low priority parcels were added to the network to complete links and ensure that all GIN parcels were connected. Parcel level green infrastructure planning is important because land purchases, acquisitions, and land use changes almost always occur at the parcel level. The Green Infrastructure Network for the Keith Creek watershed is illustrated on Figure 33. It includes 568 parcels and a total of 2,640 acres, 769 acres (29%) of which are protected.



A green infrastructure network provides continuous habitat for wildlife

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KEITH CREEK WATERSHED PLAN
FIG 33: GREEN INFRASTRUCTURE NETWORK
Keith Creek Watershed Boundary
Streams
Water
Shared Use Trails (Current)
Parks & Open Space
Protected Green Infrastructure
Unprotected Green Infrastructure
Golf Course
WINNEBAGO
BOONE
BUSINESS ROUTE 20
N PERRYVILLE RD
N BELL SCHOOL RD
S BELL SCHOOL RD
REID FARM RD
N MULFORD RD
S MULFORD RD
NEWBURG RD
SPRING CREEK RD
E RIVERSIDE BLVD
N ALPINE RD
S ALPINE RD
ESTATE ST
CHARLES ST
HARRISON AVE
HARLEM RD
RURAL ST
BROADWAY
IL-251
N 2ND ST
WHITMAN ST
N CHURCH ST
E JEFFERSON ST
1ST AVE
CHESTNUT ST
KISHWAUKEE ST
11TH ST
Keith Creek
N ROCKTON AVE
AUBURN ST
MORGAN ST
S MAIN ST
N CENTRAL AVE
ZION Development
res
PROJECT #: 21-0005
COORDINATE SYSTEM: IL SP WEST NAD83 US FT
IMAGERY:
DATA SOURCES:
0
0.75
1.5
3 MILES
N
ROCK
BOONE
DEKALB
OGLE
Middle Rock
Kishwaukee
Lower Rock
Pecatonica
Sugar

3.13 Watershed Drainage System

3.13.1 Keith Creek & Tributaries

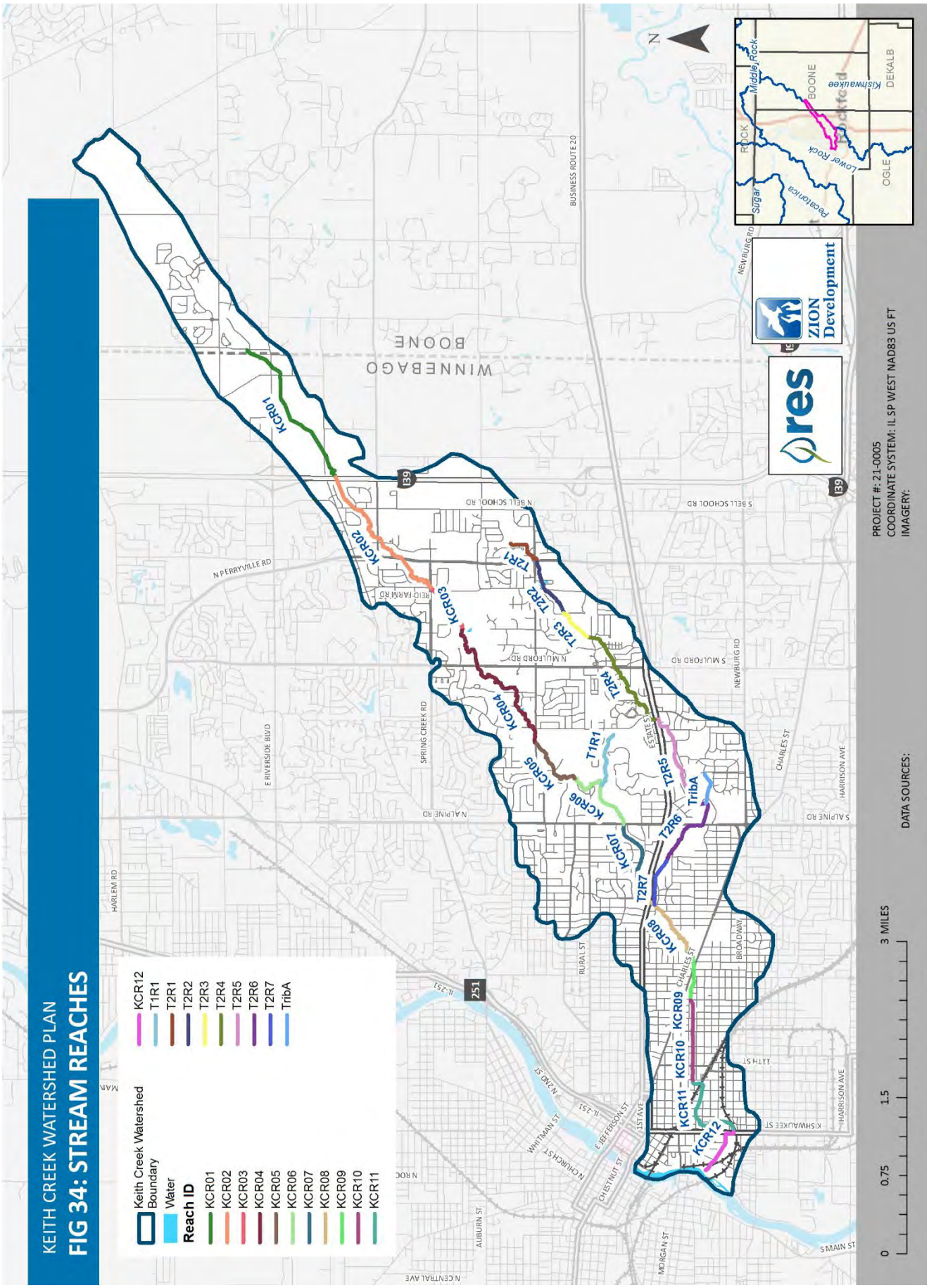
The main stem of Keith Creek (AUIDs: IL_PR-99 and IL_PR-01) is the primary stream draining the watershed. Two (2) tributary streams are also found in the watershed as well as one subtributary (Table 16; Figure 34). Keith Creek alone is 11.7 linear miles in length while the tributaries account for another 5.8 linear miles. In total, 21 stream reaches were assessed accounting for 92,658 linear feet or 17.5 linear miles. For the Keith Creek main stem, Reaches 1-7 are AUID IL_PR-01, while Reaches 8-12 are AUID IL_PR-99. No other streams or tributaries in the watershed have AUID codes and there are no lakes in the watershed.

Keith Creek officially begins as a channelized ditch on the Mercyhealth Sportscore Two property in Loves Park in the northeast portion of the watershed; upstream of that point Keith Creek is a series of detention basins and wetlands within residential development. From there, the stream flows southwest through agriculture until it passes under Interstate 39. The stream continues to flow southwest through residential and commercial areas until it crosses Spring Creek Rd and enters Aldeen Golf Club where it becomes a series of detention basins created by dams. From the golf course, it becomes a naturalized channel again through Rockford Arboretum and residential areas until it reaches Mauh-Nah-Tee-See Golf Club. The stream is channelized through the golf course and then again is natural again as it makes its way through Aldeen Park where it picks up Tributary 1. From North Alpine Rd to State St the stream is heavily channelized as it flows through a densely developed commercial and residential areas. Just south of State St Keith Creek picks up Tributary 2 and then is a more naturalized stream through Dahlquist and Twin Sister Hills Parks. From just before Charles St to the mouth of Keith Creek the stream is channelized and mostly confined to a concrete channel with the only exception being a restored stretch through Tenth Avenue Park. From Tenth Avenue Park to the mouth Keith Creek flows through a heavily industrialized area mostly occupied by an iron and metal recycling operation until it joins the Rock River south of the Morgan St bridge.

Table 16. Summary of Keith Creek and tributary reaches and length.

Stream or Tributary Name	Abbreviation	Stream Length Assessed (ft)	Stream Length Assessed (mi)
Keith Creek, Reach 1	KCR01	8,835.1	1.7
Keith Creek, Reach 2	KCR02	9,510.3	1.8
Keith Creek, Reach 3	KCR03	2,711.2	0.5
Keith Creek, Reach 4	KCR04	9,655.8	1.8
Keith Creek, Reach 5	KCR05	3,450.3	0.7
Keith Creek, Reach 6	KCR06	4,869.8	0.9
Keith Creek, Reach 7	KCR07	4,450.8	0.8
Keith Creek, Reach 8	KCR08	3,852.4	0.7
Keith Creek, Reach 9	KCR09	2,905.1	0.6
Keith Creek, Reach 10	KCR10	4,119.0	0.8
Keith Creek, Reach 11	KCR11	4,952.5	0.9
Keith Creek, Reach 12	KCR12	2,708.7	0.5
Tributary 1, Reach 1	T1R1	3,256.8	0.6
Tributary 2, Reach 1	T2R1	2,035.3	0.4
Tributary 2, Reach 2	T2R2	3,108.3	0.6
Tributary 2, Reach 3	T2R3	1,841.2	0.3
Tributary 2, Reach 4	T2R4	6,340.7	1.2
Tributary 2, Reach 5	T2R5	5,112.9	1.0
Tributary 2, Reach 6	T2R6	4,777.5	0.9
Tributary 2, Reach 7	T2R7	2,440.2	0.5
Tributary A (to Tributary 2)	TribA	1,724.4	0.3
Totals		**92,657.9**	**17.5**

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KEITH CREEK WATERSHED PLAN
FIG 34: STREAM REACHES
Keith Creek Watershed Boundary
Water
Reach ID
KCR01
KCR02
KCR03
KCR04
KCR05
KCR06
KCR07
KCR08
KCR09
KCR10
KCR11
KCR12
T1R1
T2R1
T2R2
T2R3
T2R4
T2R5
T2R6
T2R7
TribA
WINNEBAGO
BOONE
BUSINESS ROUTE 20
N PERRYVILLE RD
E RIVERSIDE BLVD
SPRING CREEK RD
N ALPINE RD
S ALPINE RD
N BELL SCHOOL RD
S BELL SCHOOL RD
N MULFORD RD
S MULFORD RD
NEWBURG RD
HARLEM RD
RURAL ST
CHARLES ST
HARRISON AVE
BROADWAY
11TH ST
KISHWAUKEE ST
1ST AVE
E JEFFERSON ST
N CHURCH ST
WHITMAN ST
CHESTNUT ST
AUBURN ST
MORGAN ST
S MAIN ST
N CENTRAL AVE
I-39
251
IL-251
ROCK
BOONE
DEKALB
OGLE
Middle Rock
Kishwaukee
Lower Rock
Sugar
Pecatonica
ZION Development
res
PROJECT #: 21-0005
COORDINATE SYSTEM: IL SP WEST NAD83 US FT
IMAGERY:
DATA SOURCES:
0
0.75
1.5
3 MILES
N

In early summer 2021, RES completed a field inventory of Keith Creek and its tributaries. All streams and tributaries were assessed based on divisions into "Stream Reaches" (Table 16; Figure 34). Reaches are defined as stream segments having similar hydraulic, geomorphic, riparian condition, and adjacent land use characteristics. Methodology included walking all or portions of the stream and tributary reaches, collecting measurements, taking photos, and noting channel, streambank, and riparian corridor conditions on Stream Inventory/BMP Data Forms as well as making map notations as appropriate. All completed data sheets and field maps can be found in Appendix C.

More specifically, RES Stream Data Forms have six primary categories to document stream reach conditions:

Channel/Streambank Conditions: Documentation of stream channelization, sinuosity, riffle-pool development, bank erosion, and bank height/width. Ditched streams are highly channelized while more natural streams are sinuous (meandering) and generally exhibit more riffles and pools. Bank erosion ranges from None-Low-Moderate-High. Low bank erosion is present when less than 33% of banks are eroded versus greater than 66% when banks are highly eroded. Streambank height and width measurements are also documented and important when determining channel incision and estimates of pollutant loading.

Debris Jams: Debris jams form in stream channels when debris accumulates and forms blockages that can lead to bank erosion and overbank flooding. Debris jams are classified as either Low, Moderate, or High depending how much and how many debris jams are present.

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. Streambed erosion is contributed to by a decrease in sediment supply, an increase in bed slope, an increase in velocity, and/or an increase in discharge due to channelization, increases in urban run-off, or upstream stream modifications.

Riparian Vegetation: The ecological condition of riparian areas is an important indicator of overall steam health. High quality riparian areas exhibit intact native plant ecosystems that are generally classified as being in good condition whereas degrading and degraded ecosystems are classified as average and poor respectively.

BMP Recommendations: Based on existing stream channel, bank, and riparian area conditions documented above, ecological restoration recommendations are made to stabilize eroded streambanks, improve channel conditions, and restore riparian areas.

BMP Priority: Ecological restoration recommendations are rated as Low, Medium, or High depending on the overall need for ecological restoration. Those areas requiring immediate attention are "Critical Areas".

<u>Keith Creek</u>

Keith Creek (Reach Code KC and totaling 11.7 miles) was divided into 12 distinct "Stream Reaches" beginning at the headwaters at the Mercyhealth Sportscore Two facility in Loves Park and ending at its confluence with the Rock River (Table 16; Figure 34).

Keith Creek Reach 1 (Reach code KCR01) begins on the Mercyhealth Sportscore Two facility in Loves Park as a channelized ditch that drains the sports complex and agricultural fields through drain tiles. Reach 1 flows southwest for 8,835 linear feet to Interstate 39.



Keith Creek Reach 1 through agricultural land at Paladin Parkway

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This reach is highly channelized with banks around two feet high and generally has little-to-no pools, riffles, or sinuosity. It exhibits low streambank erosion, moderate streambed erosion along the channel bottom, and moderate levels of debris jams. The immediate riparian area consists of a narrow buffer through agricultural land comprised of second growth trees and shrubs and old field vegetation.

Keith Creek Reach 2 (KCR02) continues southwest for 9,510 linear feet from Interstate 39 to the intersection of Spring Creek Rd and Reid Farm Rd. Reach 2 is moderately channelized and exhibits moderate levels of sinuosity, pool/riffle development, and streambank erosion as it makes its way through relatively new residential and commercial areas. Bank heights are roughly 3 feet on average and there are moderate amounts of debris jams and little streambed erosion. The riparian area is generally narrow and in poor condition throughout.



Keith Creek Reach 3 through Aldeen Golf Club

Reach 3 (KCR03) of Keith Creek is not a typical stream, but rather a series of online detention ponds over 2,711 linear feet created by a sequence of dams through the Aldeen Golf Club property. For this reason, Reach 3 was not assessed using the stream data sheet as it was not applicable. Both banks consist of highly manicured turf with large rock along the toe.

Keith Creek Reach 4 (KCR04) is more naturalized and extends for 9,656 linear feet from the Aldeen Golf Club to Guilford Rd through mostly residential land. The riparian area and immediate floodplain are a mix of native and second growth species in average ecological condition. Channelization is low, while sinuosity and pool/riffle development are moderate. Streambank erosion and debris jams are moderate with an average bank height of 3 feet, while streambed erosion along this reach is low. Keith Creek Reach 5 (KCR05) runs for 3,450 linear feet through the Mauh-nah-tee-see Country Club. Within the golf course the riparian area along both banks is in poor condition and consists primarily of mowed turf to the edge of the stream. Reach 5 exhibits moderate levels of channelization and pool/riffle development and low levels of sinuosity, streambank erosion, and debris jams. Streambed erosion is low and average bank height along Reach 5 is 3 feet.

Reach 6 (KCR06) runs for 4,870 linear feet from the Mauh-nah-tee-see Club to N Alpine Rd and most of this reach is within Aldeen Park. Channelization is low with moderate sinuosity and a moderate number of pools and riffles. Average bank height is four feet with moderate levels of streambank erosion and debris jams. Streambed erosion for Reach 6 is low and the riparian area condition is average as both banks consist of degraded floodplain species dominated by invasives such as reed canary grass and weedy trees and shrubs.

Keith Creek Reach 7 (KCR07) starts at N Alpine Rd and continues west and south for 4,451 feet to where it crosses E State





Keith Creek Reach 5 (left) through Mauh-nah-tee-see Club and Reach 6 (right) in Aldeen Park

St. The north bank is predominantly residential while the south bank is almost completely commercial/retal. The riparian area is in poor condition with either no buffer to speak of or a narrow one consisting of second growth invasive trees and shrubs primarily on slopes and an average bank height of 5 feet. Reach 7 is moderately channelized and exhibits moderate levels of streambank erosion and debris jams; sinuosity, pool/riffle development, and streambed erosion are all low.

From N State St through Dalquist Park and Twin Sister Hills Park is Keith Creek Reach 8 (KCR08). This reach is 3,852 linear feet long with an average bank height of 7.5 feet and low levels of streambank erosion. It is moderately channelized with low sinuosity and moderate amounts of pools and riffles. There are few debris jams along this stretch and little streambed erosion. The riparian area is in poor condition and both banks generally consist of second growth trees and shrubs and some open old field areas.



Keith Creek Reach 8 through Dalquist Park

Keith Creek Reach 9 (KCR09) starts where Keith Creek leaves Twin Sister Hills Park to the 18th Street bridge and totals 2,905 linear feet. This section is highly channelized through mostly paved and heavily urbanized commercial and retail areas and about half confined to a concrete channel. Where there is a riparian buffer, it is narrow and in poor condition consisting of old field and second growth trees and shrubs. Reach 9 has little-to-no sinuosity, pool/riffle development, streambank erosion, streambed erosion or debris jams.

Keith Creek Reach 10 (KCR10), also known as the Keith Creek Greenway, extends due west from 18th Street to 9th Street. This 4,119-linear-foot reach is highly channelized and completely confined by a 8-10-foot-high limestone rock wall or channel on both banks. Because of the concrete channel there is little-to-no sinuosity, pool/riffle development, streambank erosion, or streambed erosion. Both banks consist of a manicured turf park, making for a poor ecological condition. Debris jams along this reach are low. This reach has excellent potential at becoming a model restoration project if restored using ecological techniques.



Keith Creek Reach 10, also known as the Keith Creek Greenway

From 9th Street to Kishwaukee Street is Keith Creek Reach 11 (KCR11), totaling 4,953 linear feet. This stretch is predominantly residential with some commercial near 9th Street and 10th Avenue Park at the downstream end. The riparian area is narrow and in poor condition, comprised primarily of invasive trees and shrubs, old field, and sections of reed canary grass. The average bank

height is 10 feet, it is highly channelized, with low sinuosity. Pool and riffle development is moderate, as is streambank erosion, while debris jams and streambed erosion are low.

The final reach, Keith Creek Reach 12 (KCR12), continues west 2,709 linear feet from Kishwaukee Street to the confluence with the Rock River. The riparian area is in poor condition and very narrow through a heavily industrialized area and consists of second growth weedy trees and shrubs as well as concrete fill. Bank heights range from 20 to 24 feet high, and it is highly channelized with low sinuosity. There is no pool/riffle development and low streambed erosion, but moderate levels of streambank erosion and debris jams.



Keith Creek Reach 12 from the Kishwaukee bridge (Source: Gary Anderson)

Tributary Streams

Two (2) tributaries and one subtributary were found in the watershed, for a total of 5.8 linear miles (Table 16; Figure 34). A brief description of each tributary stream reach is included below.

Tributary 1 (T1R1) is an intermittent stream that begins in the woodlands adjacent Rockford University near Parliament Pl and Roxbury Rd and extends to where it joins up with Keith Creek Reach 6 in Aldeen Park. This tributary consists of just one reach and totals 3,257 linear feet. This reach is one of only two in the watershed with high levels of streambank erosion. While channelization is low along this reach, it exhibits moderate levels of sinuosity and pool/riffle development. The streambed is moderately eroded and there is a moderate amount of debris jams. The riparian area is in average ecological condition with a relatively intact floodplain with a mix of native and invasive species and bank heights average 3 feet.



Tributary 1 Reach 1 in the woodlands adjacent Rockford University

Tributary 2 totals 25,656 linear feet and is broken into seven reaches beginning in a residential area just northeast of Midway Village & Museum Center and extends to where it joins Keith Creek Reach 8 just south of State St. Tributary 2 also has one subtributary (Tributary A) that drains to Tributary 2 Reach 6 in Alpine Park.

Tributary 2 Reach 1 (T2R1) is 2,035 linear feet in length beginning in a residential area just northeast of Midway Village & Museum Center. This reach is moderately channelized, while sinuosity, pool/riffle development, streambank erosion, streambed erosion, and debris jams are all low. The average bank height is two feet high, and the riparian area is in

average ecological condition with a narrow buffer through a residential subdivision dominated by second growth trees and shrubs.

Tributary 2 Reach 2 (T2R2) falls entirely within the Midway Village & Museum Center property, totaling 3,108 linear feet. It is the only reach in the watershed with a riparian area in good ecological condition, part of which is wooded while another stretch opens into a wetland area. It appears that some restoration and maintenance has already occurred on this reach. Channelization and sinuosity are both low, as are streambank and streambed erosion. There are few pools, riffles, or debris jams along Tributary 2 Reach 2 and bank heights average 2 feet.




Tributary 2 Reach 2 (right) at Midway Village and Reach 3 swale (left)

Reach 3 of Tributary 2 (T2R3) extends for 1,841 linear feet from the Midway Village & Museum Center property through a partially built development. Reach 3 is not a typical stream, but a man-made swale with no distinct channel and dominated by reed canary grass. For this reason, T2R3 was not assessed using the stream data sheet as it was not applicable.

Tributary 2 Reach 4 (T2R4) is the longest reach of the tributary at 6,341 linear feet, extending from the end of the Reach 3 swale to E State St. It makes its way through a combination of multiple urban land uses with a mostly narrow riparian area dominated by reed canary grass and second growth invasive trees and shrubs in poor ecological condition. Portions of this reach also include a series of online dams creating detention ponds. T2R4 is moderately channelized with little sinuosity or pool/riffle development. Streambank erosion, debris jams, and streambed erosion are all low, and bank heights average 3 feet high.



Online detention along portion of Tributary 2 Reach 4

Tributary 2 Reach 5 is another highly urbanized reach that runs from E State St to Alpine Park. It has a narrow riparian area in poor condition consisting of second growth trees and shrubs and old field areas. This reach is 5,113 linear feet long with banks heights averaging 3 feet. Reach 5 is highly channelized with little sinuosity or pool/riffle development. Streambank erosion, debris jams, and streambed erosion are all low.



Tributary 2 Reach 6 through Alpine Park



Tributary A to Tributary 2 Reach 6 at Alpine Park

Reach 6 of Tributary 2 lies entirely within Alpine Park and Alpine Hills Adventure Park and totals 1,841 linear feet. This reach is moderately channelized with little sinuosity or pool/riffle development. The riparian area is in average ecological condition, consisting primarily of second growth invasive trees and shrubs. A low head dam sits at the entrance to Alpine Park off of S Alpine Rd. Streambank erosion, debris jams, and streambed erosion are all low and bank heights average 4 feet.

On the eastern portion of Alpine Park, Reach 6 also picks up one intermittent subtributary – Tributary A. Bearing the characteristics of a ravine, Tributary A is unchannelized with little sinuosity and no pool or riffle development and totals 1,724 linear feet. Streambank erosion and streambed erosion are both high and banks heights range from 5 to 7 feet, with few debris jams. Like Reach 6, the riparian area along Tributary A is of average ecological quality and includes a mesic woodland along both sides of the channel, which is highly incised and actively eroding.

The final reach of Tributary 2 is Reach 7, extending 2,440 linear feet from the Alpine Hills Adventure Park to its confluence with Keith Creek at Reach 8, just south of E State St. This is one of the most heavily urbanized and channelized reaches within the Keith Creek watershed. It includes little to no riparian area and where there is one it is narrow and full of second growth invasives and in poor ecological condition. Approximately half of this reach is buried underground through a mostly vacant parking lot. Bank heights average 10 feet high with little to no sinuosity or pool and riffle development. Debris jams are moderate while streambed erosion is low.



Buried section of Tributary 2 Reach 7

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Stream Channelization

Riffles and pools are generally associated with naturally meandering streams and benefit the system by providing various habitats while oxygenating the water during low flow or summer heat. Channelized or ditched streams are often void of or have low quality riffles and pools. Berms are also common along channelized streams where landowners typically piled soils excavated from the channel. These spoil piles often inhibit natural flooding into adjacent floodplains. All stream reaches in the watershed were characterized as having none to low channelization (highly sinuous, no human disturbance), moderate channelization (some sinuosity but altered), or high channelization (straightened by humans).

In many highly urbanized areas, all or portions of streams and tributaries were buried, covered, or forced into pipes underground rather than allowed to flow in their natural state. Typically, small streams might have been buried to help pave the way for development or to help expedite the flow of various wastes away from cities. It wasn't until more recently that the effects of burying streams on watershed hydrology were better understood; burying streams results in hydrological changes in the watershed, increased flooding, destruction of fish and wildlife habitat, and as much as 18 times higher levels of nitrogen being transported downstream (American Rivers, 2014 and Beaulieu, 2015). At least one section of Keith Creek, a portion of Tributary 2 Reach 7, is buried underground.

The location and severity of stream channelization in the watershed is summarized in Table 17 and depicted on Figure 35. Note: KCR03 and T2R3 were excluded from this portion of the assessment since they lack a true channel. Approximately 26% (22,885 lf) of the total stream and tributary length exhibits no or low channelization while moderate channelization is occurring along 39% (34,417 lf) of stream. Highly channelized streams are most common in the most urbanized, downstream portions of the watershed accounting for 35% (31,073 lf) of the total stream length.

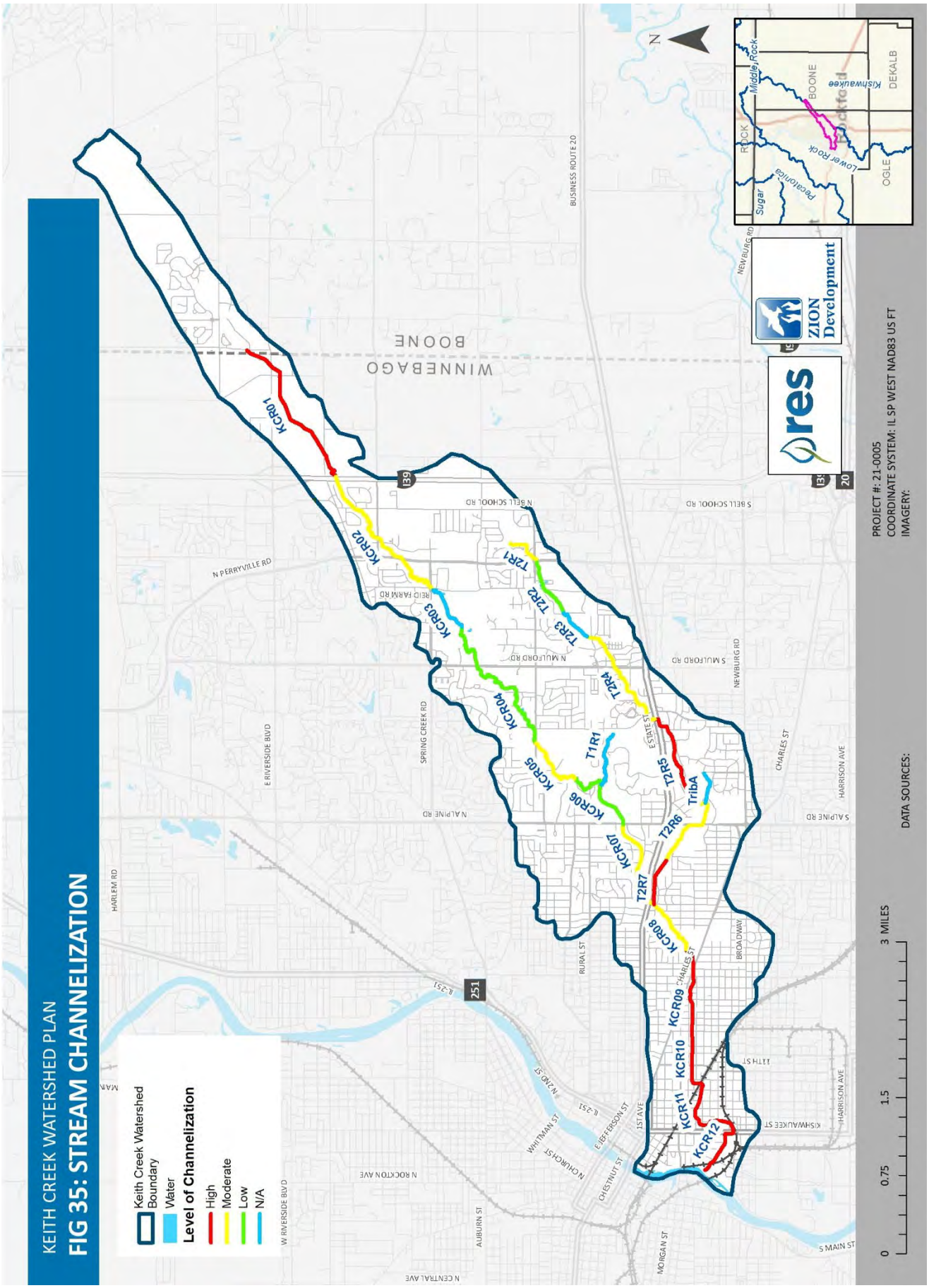
Channelized areas present opportunities for Management Measure projects such as artificial riffle and pool restoration and regrading or breaking of adjacent spoil piles for reconnection of the stream to adjacent floodplains. The Action Plan section of this report addresses opportunities for improving many of the channelized stream reaches.

Table 17. Summary of stream and tributary channelization.

Stream or Tributary Name	Abbreviation	Stream Length Assessed (ft)*	None or Low		Moderate		High	
			(feet)	(%)	(feet)	(%)	(feet)	(%)
Keith Creek	KC	59,310	14,526	24	21,264	36	23,520	40
Tributary 1	T1	3,257	3,527	100				
Tributary 2	T2	23,815	3,108	13	13,153	55	7,553	32
Tributary A	TribA	1,724	1,724	100				
Totals		**88,106**	**22,885**	26	**34,417**	39	**31,073**	35

* KCR03 and T2R3 were excluded from this assessment since they lack a true channel.

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KEITH CREEK WATERSHED PLAN
FIG 35: STREAM CHANNELIZATION
Keith Creek Watershed Boundary
Water
Level of Channelization
High
Moderate
Low
N/A
KCR01
KCR02
KCR03
KCR04
KCR05
KCR06
KCR07
KCR08
KCR09
KCR10
KCR11
KCR12
T1R1
T2R1
T2R2
T2R3
T2R4
T2R5
T2R6
T2R7
TribA
WINNEBAGO
BOONE
BUSINESS ROUTE 20
N PERRYVILLE RD
N BELL SCHOOL RD
S BELL SCHOOL RD
REID FARM RD
N MULFORD RD
S MULFORD RD
NEWBURG RD
SPRING CREEK RD
E RIVERSIDE BLVD
W RIVERSIDE BLVD
N ALPINE RD
S ALPINE RD
HARLEM RD
CHARLES ST
HARRISON AVE
ESTATE ST
RURAL ST
BROADWAY
11TH ST
KISHWAUKEE ST
1ST AVE
E JEFFERSON ST
N CHURCH ST
WHITMAN ST
CHESTNUT ST
AUBURN ST
N ROCKTON AVE
N CENTRAL AVE
MORGAN ST
S MAIN ST
IL-251
N 2ND ST
139
251
20
ROCK
BOONE
DEKALB
OGLE
Middle Rock
Kishwaukee
Pecatonica
Sugar
Lower Rock
Rockford
NEWBURG RD
ZION Development
res
N
0
0.75
1.5
3 MILES
PROJECT #: 21-0005
COORDINATE SYSTEM: IL SP WEST NAD83 US FT
IMAGERY:
DATA SOURCES:

Streambank Erosion

Unnatural streambank erosion generally results following an instability in flow rate or volume in the stream channel, due to human alteration such as channelization, or change in streambank vegetation. Resulting sediment accumulation and transportation downstream can cause significant water quality problems. Streambank erosion is low to moderate on average throughout the watershed and is a result of increased impervious cover and stormwater runoff as well as man-made stream channels. Some of the more urbanized stream sections exhibit low erosion due to being confined within a concrete channel, as opposed to a stable natural streambank.

The location and severity of streambank erosion in the watershed is summarized in Table 18 and depicted on Figure 36. Approximately 48% (42,199 lf) of the total stream and tributary length exhibits no or low bank erosion while moderate erosion is occurring along 46% (40,926 lf) of streambanks. Highly eroded streambanks occur on the two intermittent stream channels accounting for 6% (4,981 lf) of the total stream length. Many highly eroded reaches are considered "Critical Areas" because they are actively contributing significant sediment loads downstream. It is also important to note that while Keith Creek Reach 10 exhibits does not exhibit erosion, it is entirely confined within a concrete channel.



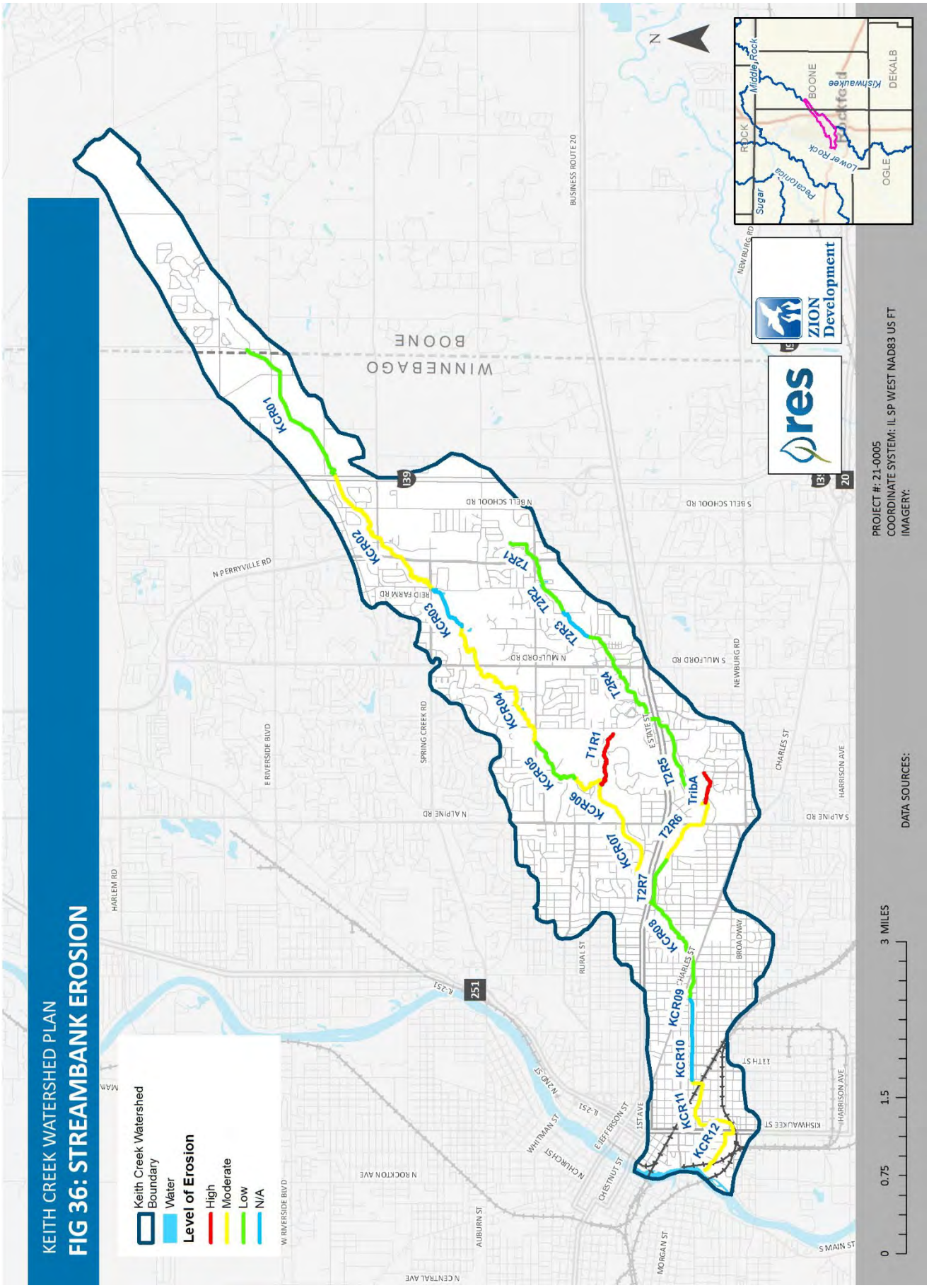
Erosion along Tributary 1 Reach 1

Highly and moderately eroded streambanks provide excellent opportunities for streambank stabilization projects. The Action Plan section of this report addresses and prioritizes opportunities for reducing streambank erosion.

Table 18. Summary of stream and tributary bank erosion.

Stream or Tributary Name	Abbreviation	Stream Length Assessed (ft)*	None or Low Erosion		Moderate Erosion		High Erosion	
			(feet)	(%)	(feet)	(%)	(feet)	(%)
Keith Creek	KC	59,310	23,162	39	36,148	61		
Tributary 1	T1	3,257					3,257	100
Tributary 2	T2	23,815	19,037	80	4,778	20		
Tributary A	TribA	1,724					1,724	100
Totals		**88,106**	**42,199**	**48**	**40,926**	**46**	**4,981**	**6**

* KCR03 and T2R3 were excluded from this assessment since they lack a true channel.


KEITH CREEK WATERSHED PLAN
FIG 36: STREAMBANK EROSION
Keith Creek Watershed Boundary
Water
Level of Erosion
High
Moderate
Low
N/A
KCR01
KCR02
KCR03
KCR04
KCR05
KCR06
KCR07
KCR08
KCR09
KCR10
KCR11
KCR12
T1R1
T2R1
T2R2
T2R3
T2R4
T2R5
T2R6
T2R7
TribA
WINNEBAGO
BOONE
BUSINESS ROUTE 20
N PERRYVILLE RD
N BELL SCHOOL RD
S BELL SCHOOL RD
REID FARM RD
N MULFORD RD
S MULFORD RD
NEWBURG RD
SPRING CREEK RD
E RIVERSIDE BLVD
W RIVERSIDE BLVD
N ALPINE RD
S ALPINE RD
HARLEM RD
ESTATE ST
CHARLES ST
HARRISON AVE
BROADWAY
RURAL ST
N CHURCH ST
WHITMAN ST
E JEFFERSON ST
1ST AVE
CHESTNUT ST
AUBURN ST
N ROCKTON AVE
N CENTRAL AVE
MORGAN ST
S MAIN ST
KISHWAUKEE ST
11TH ST
N 2ND ST
IL-251
251
139
20
N
ROCK
BOONE
DEKALB
OGLE
Middle Rock
Kishwaukee
Pecatonica
Sugar
Lower Rock
res
ZION Development
PROJECT #: 21-0005
COORDINATE SYSTEM: IL SP WEST NAD83 US FT
IMAGERY:
DATA SOURCES:
0
0.75
1.5
3 MILES

Riparian Area Condition

Riparian areas buffer streams by filtering pollutants, providing beneficial wildlife habitat, and connecting green infrastructure. Riparian areas along streams and tributaries were assessed during the stream inventory by noting the ecological "Condition" as it relates to function and quality of plant communities present. Areas in "Good" condition connect hydrologically with streams and tributaries during flood events and have remnant or restored wetland plant communities. These riparian areas are generally wider than 100 feet and consist of high-quality plant communities such as floodplain forest dominated by native species, marsh, sedge meadow, or wet prairie. "Average" condition riparian areas retain some hydrological connection to the adjacent stream with somewhat degraded plant communities. These areas are generally at least 50 feet wide and typically consists of native plant communities found in "Good" condition riparian areas but are degraded due to invasion by invasive species and lack of ecological management. Areas in "Poor" condition are usually found along channelized streams that have been heavily urbanized or farmed in the past causing degraded plant communities to establish or where riparian areas are virtually nonexistent. These riparian areas are generally less than 50 feet wide and usually consist of highly degraded plant communities such as woodlands dominated by second growth and invasive woody species, reed canary grass dominated wetlands, or old fields (previously disturbed areas left fallow and unmanaged).

The location and condition of riparian areas in the watershed is summarized in Table 19 and Figure 37. Approximately 67% (along 58,678 linear feet of streams) of the riparian areas are "Poor" quality. Of the remaining reaches, 26,320 linear feet or 30% of riparian areas are in "Average" condition and 3% (3,108 linear feet) are in good condition.



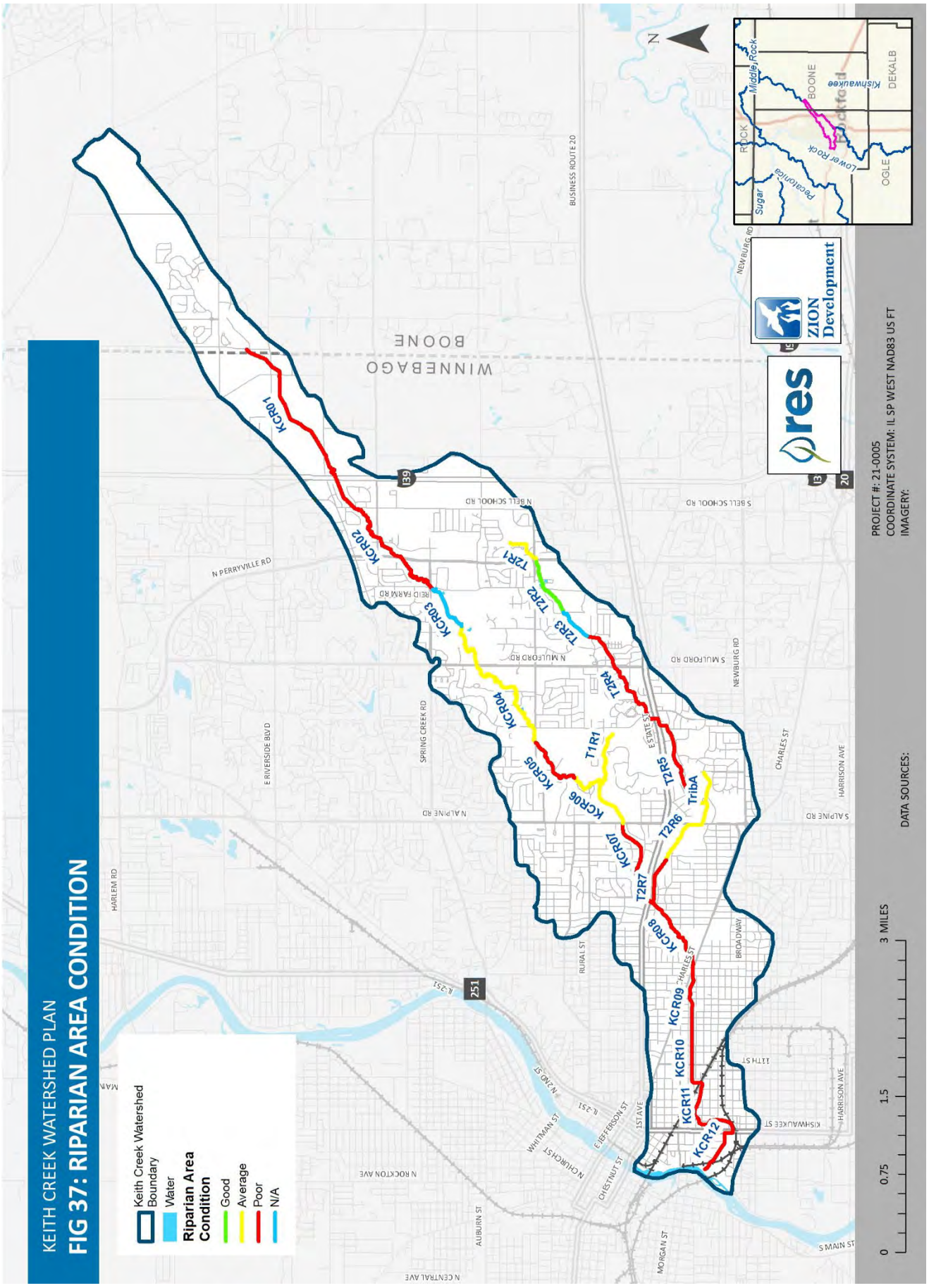
Virtually nonexistent riparian area along Keith Creek Reach 7

Riparian areas in "Good" condition include only Tributary 2 Reach 2 through Midway Village and Museum Center which includes a wide, naturalized buffer and well-connected floodplain. Riparian areas in "Average" ecological condition are typically found within less developed woodland corridors near the center of the watershed. "Poor" riparian areas are found throughout the watershed; these correlate closely with stream reaches that are highly channelized and typically are more heavily urbanized areas where development extends right up to the edge of the stream. Similarly, near the headwaters, agricultural lands or fields are planted right up to stream-edge. Invasive species including reed canary grass (*Phalaris arundinacea*), common reed (*Phragmites australis*), purple loosestrife (*Lysimachia salicaria*), common buckthorn (*Rhamnus catharitica*), sandbar willow (*Salix interior*), box elder (*Acer negundo*), and eastern cottonwood (*Populus deltoids*) are among the most abundant and problematic invasive plants. Fortunately, ecological restoration helps eradicate these species and encourages native plant establishment. The Action Plan lists and prioritizes opportunities for improving riparian areas.

Table 19. Summary of stream and tributary riparian area condition.

Stream or Tributary Name	Abbreviation	Stream Length Assessed (ft)*	Good Condition		Average Condition		Poor Condition	
			(feet)	(%)	(feet)	(%)	(feet)	(%)
Keith Creek	KC	59,310			14,526	34	44,784	76
Tributary 1	T1	3,257			3,257	100		
Tributary 2	T2	23,815	3,108	13	6,813	29	13,894	58
Tributary A	TribA	1,724			1,724	100		
Totals		**88,106**	**3,108**	**3%**	**26,320**	**30%**	**58,678**	**67%**

* KCR03 and T2R3 were excluded from this assessment since they lack a true channel.


KEITH CREEK WATERSHED PLAN
FIG 37: RIPARIAN AREA CONDITION
Keith Creek Watershed Boundary
Water
Riparian Area Condition
Good
Average
Poor
N/A
KCR01
KCR02
KCR03
KCR04
KCR05
KCR06
KCR07
KCR08
KCR09
KCR10
KCR11
KCR12
T1R1
T2R1
T2R2
T2R3
T2R4
T2R5
T2R6
T2R7
TribA
WINNEBAGO
BOONE
N
0
0.75
1.5
3 MILES
PROJECT #: 21-0005
COORDINATE SYSTEM: IL SP WEST NAD83 US FT
IMAGERY:
DATA SOURCES:
ZION Development
res

3.13.2 Detention Basins

Over time, the drainage system in the northeastern portion of the Keith Creek watershed has changed from farmland driven drain tiles, channels, and ditches to one that is driven by runoff from developed areas. Planners and engineers quickly realized the benefits of storing stormwater runoff in detention basins near development. A detention basin is a human-made structure for the temporary storage of stormwater runoff with a controlled release rate. For example, the required controlled release rate for detention basins in the watershed is regulated by the Winnebago County Surface Water Management Ordinance and shall not exceed 0.2 cfs/acre. Detention basins can also provide excellent wildlife habitat and improve water quality if designed with the proper configuration, slopes, and water depths then planted with native prairie and wetland vegetation and maintained. Today, detention basins capture runoff from about half of the watershed making the quality and quantity of water leaving these basins critically important to the health of Keith Creek.

Detention basins can be designed and constructed as wet bottom, wetland bottom, or dry bottom and planted with various types of natural or manicured vegetation. Wet and wetland bottom basins typically hold water that is controlled by the elevation of the outlet structure. This design promotes water quality treatment and supports wildlife. Wet bottom basins are usually greater than 3 feet deep and do not have emergent vegetation throughout whereas wetland bottom detention basins are shallow enough to be dominated by emergent wetland plants. Dry bottom basins are designed to drain completely after temporarily storing stormwater following rain events. They can be planted to either turf grasses (which provide little to no water quality benefits) or naturalized with native species.

RES completed a basic assessment of 31 detention basins in the Keith Creek watershed in early summer 2021 (Table 20, Figure 38). Assessment methodology included a visit to each site and collection of data relevant to existing conditions. Each basin was assigned an RES ID based on the inventory map on which it was located and the order in which it was identified. Detailed notes were recorded related to existing ecological/water quality improvement condition and potential retrofit Management Measures for eventual inclusion into the Action Plan section of this report. Results of the inventory and detailed summaries of each detention basin can be found in Appendix C. The inventory resulted in 23 dry-bottom basins with turf slopes, 7 wet bottom basins with turf slopes, and 1 naturalized wet bottom basin (Table 20). All but two of the detention basins in the watershed are located west of Mulford Rd. Additionally, all of the 31 basins (100%) likely provide "Poor" ecological and water quality benefits because most were designed simply to meet stormwater storage volume requirements. Designs that also improve water quality and wildlife habitat were not necessarily considered because they are not required under local regulations.

Dry bottom detention basins are the most common type of basin in the watershed and all of them are planted with turf grass, providing little to no water quality benefits, wildlife habitat, or infiltration to replenish groundwater. Dry bottom basins planted with turf grass hold water for shorter periods following rain events and infiltrate less water compared to dry



Dry bottom turf grass detention basin with concrete channel - 12D



Wet bottom detention basin with turf grass side slopes - 17A

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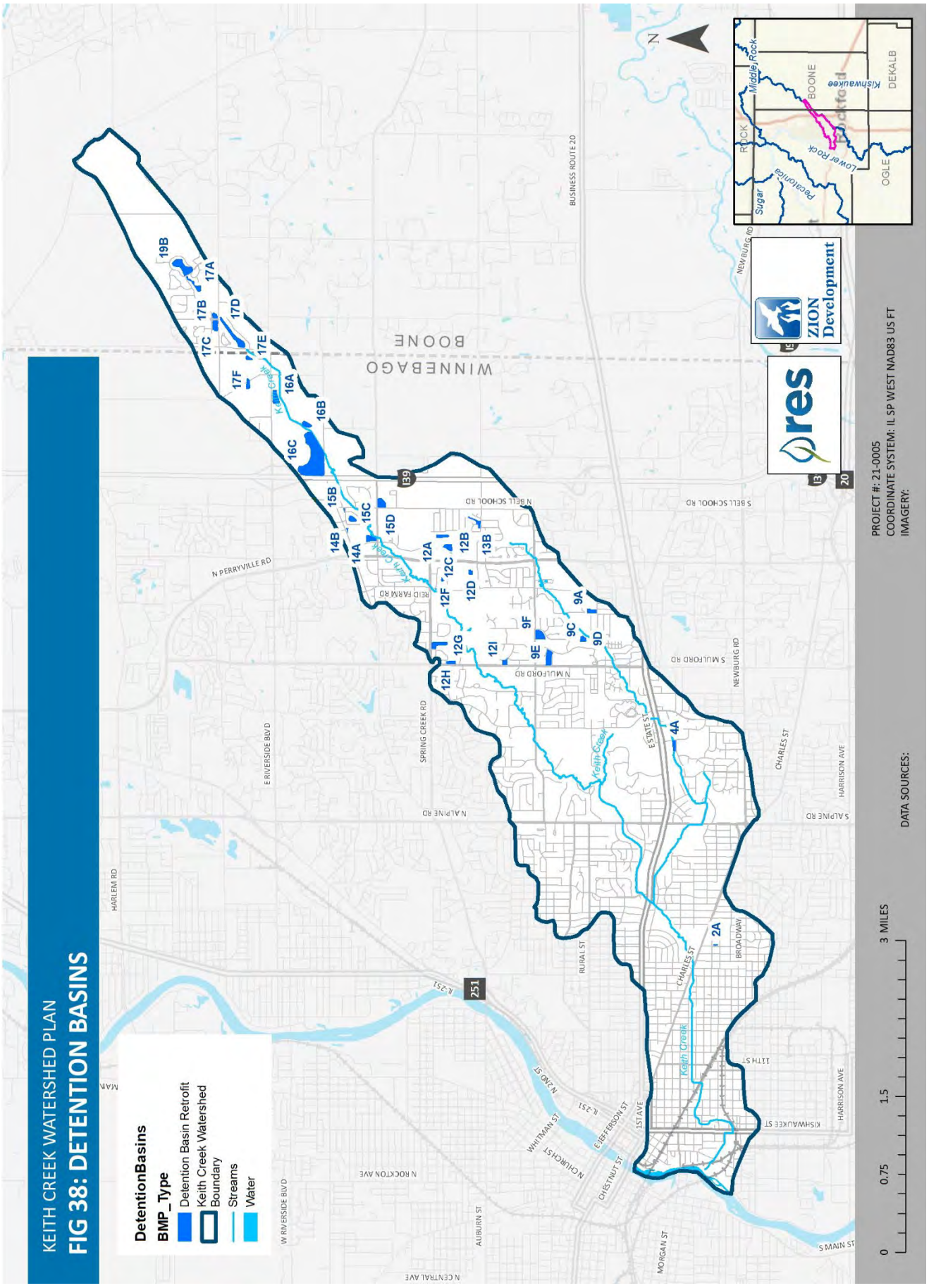
bottom basins naturalized with deep rooted vegetation. In addition, many of the dry bottom basins are constructed with either concrete low flow channels that run directly from the inlet to the outlet or have outlet drains flush with the bottom of the basin. In these cases, polluted stormwater runoff following smaller rain events travels directly through the basin without being stored, treated, or infiltrated. These designs should be avoided in the future. Many of the dry bottom basins in the watershed present excellent retrofit opportunities. Most dry bottom basins are relatively easy to naturalize with native plantings and concrete structures and drains can be manipulated to store and infiltrate water as desired.

There are also eight wet bottom detention basins in the watershed. Individual development sites or subdivisions tend to have basins that are all similarly planted. For example, most wet and wetland bottom basins in a development are planted with either turf grass along the basin slopes or are naturalized with native vegetation along the slopes and emergent edge. Basins planted with turf grass were designed with stormwater storage in mind and not necessarily the potential water quality and habitat benefits. Because of this, most homeowner and business associations will need to be persuaded to install water quality retrofits such as native plant buffers and they should be designed to look more formal and need minimal maintenance. Only one wet bottom detention basin in the watershed is naturalized with native vegetation, while the remainder have turf grass side slopes. Like most dry bottom basins, the side slopes and emergent areas of wet and wetland bottom basins can be retrofitted with native vegetation relatively easily.

Table 20. Summary of detention basin types, ecological condition, and acreage.

RES ID	Basin Type	Ecological Condition	Size (Acres)
2A	Dry	Poor	0.4
4A	Dry	Poor	2.2
9A	Dry	Poor	2.3
9C	Dry	Poor	0.5
9D	Wet	Poor	1.2
9E	Dry	Poor	5.1
9F	Dry	Poor	4.6
12A	Dry	Poor	2.4
12B	Dry	Poor	0.9
12C	Dry	Poor	3.0
12D	Wet	Poor	1.2
12F	Dry	Poor	4.5
12G	Dry	Poor	4.3
12H	Dry	Poor	1.8
12I	Dry	Poor	1.5
13B	Dry	Poor	2.4
14A	Dry	Poor	3.2
14B	Dry	Poor	0.4
15B	Dry	Poor	0.3
15C	Wet	Poor	2.3
15D	Dry	Poor	4.1
16A	Dry	Poor	4.5
16B	Dry	Poor	2.7
16C	Dry	Poor	40.0
17A	Wet	Poor	3.4
17B	Wet	Poor	1.5
17C	Wet	Poor	3.5
17D	Wet	Poor	8.8
17E	Dry	Poor	1.2
17F	Dry	Poor	2.2
19B	Wet	Poor	9.8

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KEITH CREEK WATERSHED PLAN
FIG 38: DETENTION BASINS
DetentionBasins
BMP_Type
Detention Basin Retrofit
Keith Creek Watershed Boundary
Streams
Water
19B
17A
17B
17D
17C
17E
17F
16A
16B
16C
15B
15C
15D
14B
14A
12A
12C
12B
13B
12F
12D
12G
12I
12H
9F
9A
9C
9D
9E
4A
2A
Keith Creek
WINNEBAGO
BOONE
BUSINESS ROUTE 20
NEWBURG RD
N PERRYVILLE RD
REID FARM RD
N BELL SCHOOL RD
S BELL SCHOOL RD
N MULFORD RD
S MULFORD RD
SPRING CREEK RD
E RIVERSIDE BLVD
W RIVERSIDE BLVD
N ALPINE RD
S ALPINE RD
HARLEM RD
ESTATE ST
CHARLES ST
HARRISON AVE
RURAL ST
BROADWAY
11TH ST
KISHWAUKEE ST
1ST AVE
JEFFERSON ST
CHESTNUT ST
WHITMAN ST
N CHURCH ST
N 2ND ST
AUBURN ST
N ROCKTON AVE
N CENTRAL AVE
MORGAN ST
S MAIN ST
MAIN
IL-251
251
39
20
13
N
ZION Development
res
Middle Rock
Kishwaukee
Pecatonica
Sugar
Lower Rock
ROCK
BOONE
DEKALB
OGLE
PROJECT #: 21-0005
COORDINATE SYSTEM: IL SP WEST NAD83 US FT
IMAGERY:
DATA SOURCES:
0
0.75
1.5
3 MILES

3.13.3 Wetlands & Potential Wetland Restoration Sites

A diverse network of wetlands and wet prairie remained intact along Keith Creek within the watershed until the late 1830s when European settlers began to alter significant portions of the watershed's natural hydrology and wetland processes. Where it was feasible, wet prairie, sedge meadow, and marsh communities were drained, streams channelized, and existing vegetation cleared to build settlements or farm the rich soils. There were approximately 1,054 acres of wetlands (12% of the watershed) prior to European settlement based on the most up to date hydric soils mapping provided by the USDA Natural Resources Conservation Service (NRCS). According to existing wetland inventories, about 51 acres or 5% of the pre-European settlement wetlands remain (Figure 39).



View of an existing wetland within a subdivision near Orth Rd and Ayrshire Ln

Functional wetlands do more for water quality improvement and flood reduction than any other natural resource. In addition, intact wetlands typically provide habitat for a wide variety of plant and animal species. They also provide groundwater recharge, filter sediments and nutrients, and slowly discharge to streams thereby maintaining water levels in streams during drought periods. General wetland information and mapping is available for the Keith Creek watershed via the United States Fish and Wildlife Service's (USFWS) National Wetland Inventory (NWI). Applied Ecological Services, Inc. reviewed the NWI wetland boundaries during a field inventory of the watershed conducted in 2021. The wetland data collected during the field inventory was used to map and describe the existing wetlands in the watershed and to help locate potential wetland restoration sites.

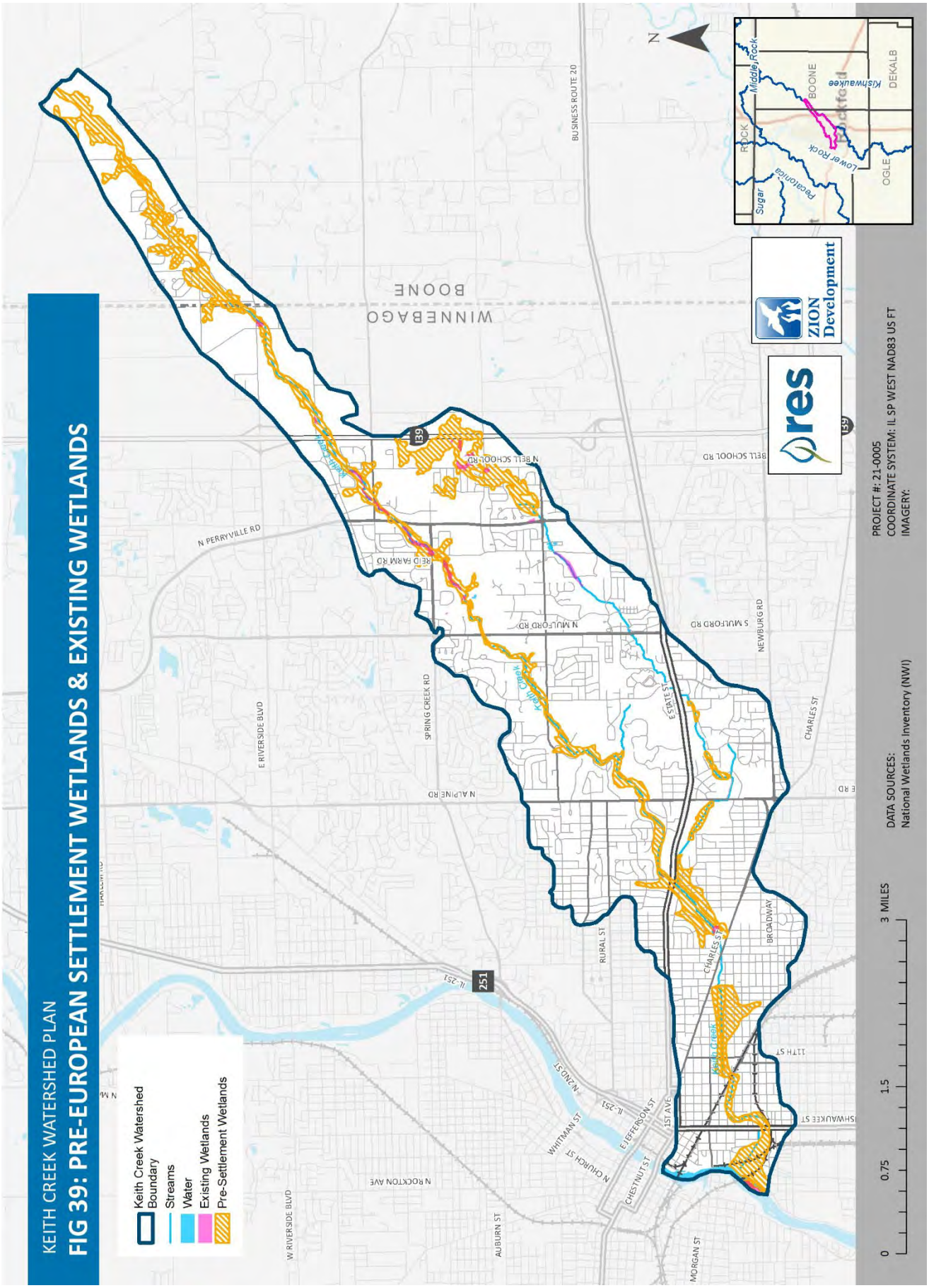
Very few wetlands exist within Keith Creek today and what wetlands do remain are narrow and found immediately adjacent the stream corridor. Invasive species such as purple loosestrife (*Lythrum salicaria*), common and glossy buckthorn (*Rhamnus sp.),* reed canary grass (*Phalaris arundinacea*), and common reed (*Phragmites australis*) now dominate these wetlands. Winnebago and Boone Counties do not identify high-quality or ADID wetlands within their jurisdiction and no high-quality wetlands were found during the field inventory.

Noteworthy- Wetland Protection

Wetlands connected to "Waters of the United States" are protected in Winnebago and Boone Counties by the U.S. Army Corps of Engineers (USACE) - Rock Island District via section 404 of the Clean Water Act. The USACE will generally require an Individual Permit (IP) for modifications to high quality wetlands although most high-quality wetlands are generally considered unmitigable. In rare cases where mitigation is allowed, as much as a 5:1 mitigation ratio is required. Additionally, high quality wetlands located within developed areas require a 100-foot buffer to aid in protection. Mitigation for impacts to low quality wetlands is set at a 1.5:1 ratio.

The USACE does not have jurisdiction over "Isolated Wetlands." The counties and municipalities have jurisdiction over isolated wetlands via countywide ordinances. However, these ordinances do not prevent the net loss of isolated wetlands. It is recommended that local municipalities and counties pass local ordinances to protect isolated wetlands.

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KEITH CREEK WATERSHED PLAN
FIG 39: PRE-EUROPEAN SETTLEMENT WETLANDS & EXISTING WETLANDS
Keith Creek Watershed Boundary
Streams
Water
Existing Wetlands
Pre-Settlement Wetlands
WINNEBAGO
BOONE
N PERRYVILLE RD
BUSINESS ROUTE 20
N BELL SCHOOL RD
BELL SCHOOL RD
REID FARM RD
N MULFORD RD
S MULFORD RD
NEWBURG RD
SPRING CREEK RD
E RIVERSIDE BLVD
N ALPINE RD
ESTATE ST
CHARLES ST
BROADWAY
RURAL ST
11TH ST
IL-251
251
N 2ND ST
WHITMAN ST
N CHURCH ST
E JEFFERSON ST
1ST AVE
CHESTNUT ST
N ROCKTON AVE
W RIVERSIDE BLVD
AUBURN ST
MORGAN ST
Keith Creek
Kelly Creek
ROCK
BOONE
DEKALB
OGLE
Middle Rock
Kishwaukee
Sugar
Pecatonica
Lower Rock
N
0
0.75
1.5
3 MILES
DATA SOURCES:
National Wetlands Inventory (NWI)
PROJECT #: 21-0005
COORDINATE SYSTEM: IL SP WEST NAD83 US FT
IMAGERY:
res
ZION Development

Potential Wetland Restoration Sites

Wetland restoration projects are among the most beneficial in the context of improving watershed health. Wetlands are vitally important because they improve basic environmental functions such as storing floodwaters, increasing biodiversity, creating green infrastructure, and improving water quality. The wetland restoration process involves returning hydrology (water) and vegetation to soils that once supported wetlands but no longer do because of human impacts such as tile and ditch draining and/or filling. Potential wetland restoration sites were identified during the 2021 inventory by identifying hydrologic indicators such as sparse vegetation, geomorphic position, standing water and drift deposits.

The inventory resulted in 3 potential wetland restoration sites, ranging in size from 21 to 74 acres in size and totaling 142.2 acres (Table 21, Figure 40). A detailed summary of wetland restoration recommendations is included and prioritized in the Action Plan section of this report.



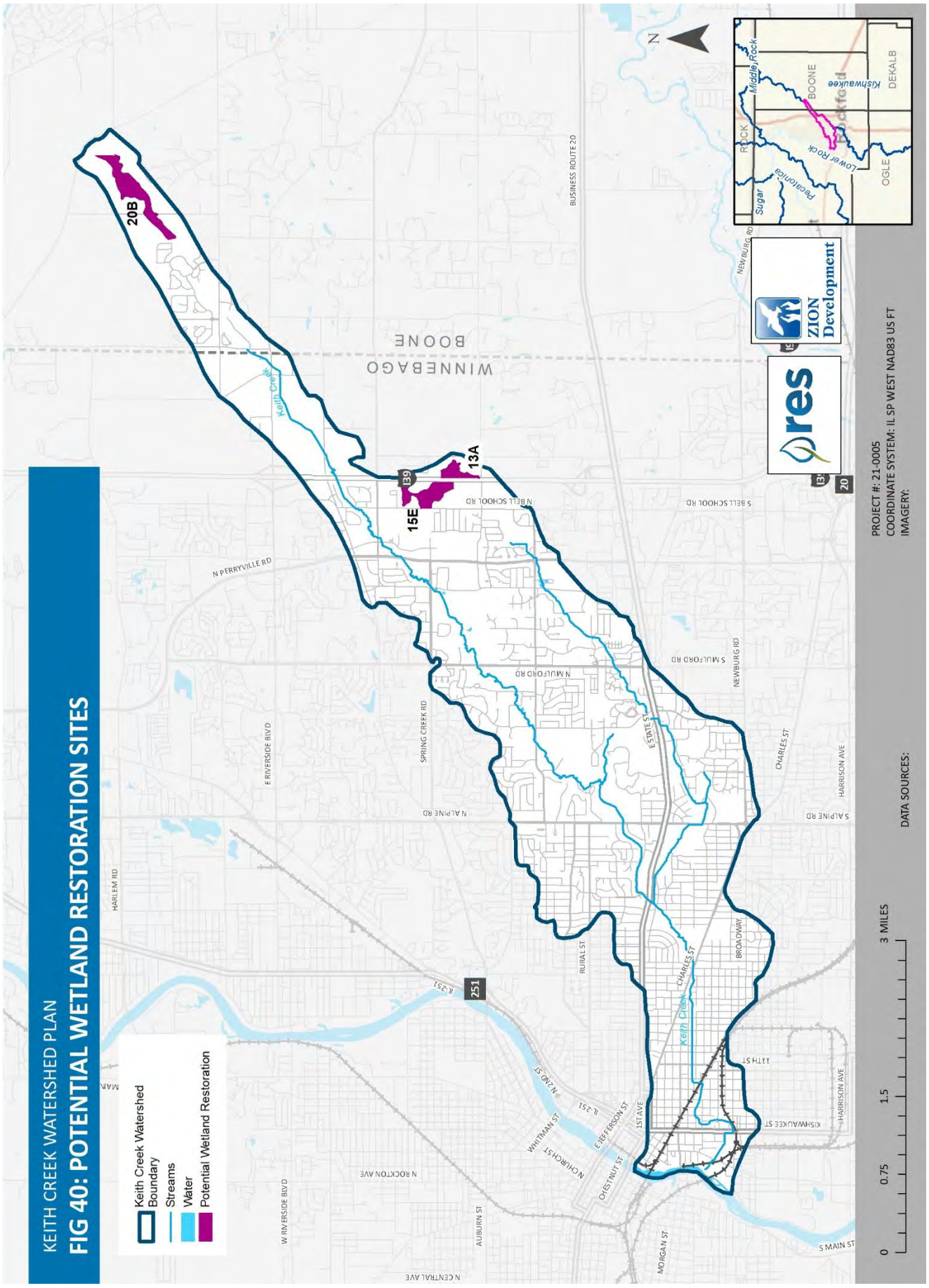
Potential wetland restoration site 20B near headwaters

Local governments should strongly consider "Conservation Design" that incorporates wetland restoration on parcels slated for future development and parks. Another potential option is to restore wetlands as part of a wetland mitigation bank. In this case, wetlands are restored on private or public land and must meet certain performance criteria before they become "fully certified." Following certification, developers can buy wetland mitigation credits from the wetland bank for wetland impacts occurring elsewhere in the watershed. A fully certified acre of restored wetland can sell between $40,000 and $100,000 thousand dollars. Although this may seem like an enormous expense to a developer, it is often cheaper than going through a long permitting process and providing mitigation for impacted wetlands on the development site. It is also possible that in the future Illinois EPA may require more strict nutrient policies for wastewater treatment plants. Wetland banks may increase the opportunity for WWTP owners, with older technology, to meet the new standards through the purchase of "water quality trading credits."

Note: A feasibility study will need to be completed prior to the planning and restoration of any potential wetland restoration.

Table 21. Site ID, size, and existing condition of potential wetland restorations.

RES ID	Size (Acres)	Site description
13A	21.4	Drained wetland in agricultural field, likely tiled
15E	46.9	Drained wetland in agricultural field, likely tiled
20B	74.0	Drained wetland in agricultural field, likely tiled


KEITH CREEK WATERSHED PLAN
FIG 40: POTENTIAL WETLAND RESTORATION SITES
Keith Creek Watershed Boundary
Streams
Water
Potential Wetland Restoration
20B
13A
15E
WINNEBAGO
BOONE
Keith Creek
BUSINESS ROUTE 20
N PERRYVILLE RD
N BELL SCHOOL RD
S BELL SCHOOL RD
N MULFORD RD
S MULFORD RD
NEWBURG RD
E RIVERSIDE BLVD
SPRING CREEK RD
N ALPINE RD
S ALPINE RD
E STATE ST
CHARLES ST
HARRISON AVE
HARLEM RD
RURAL ST
BROADWAY
IL-251
251
N CHURCH ST
WHITMAN ST
E JEFFERSON ST
1ST AVE
CHESTNUT ST
11TH ST
KISHWAUKEE ST
N ROCKTON AVE
W RIVERSIDE BLVD
AUBURN ST
MORGAN ST
S MAIN ST
N CENTRAL AVE
ZION Development
res
PROJECT #: 21-0005
COORDINATE SYSTEM: IL SP WEST NAD83 US FT
IMAGERY:
DATA SOURCES:
0
0.75
1.5
3 MILES
N
Rock
Middle Rock
Kishwaukee
Pecatonica
Lower Rock
Sugar
BOONE
DEKALB
OGLE

3.13.4 Floodplain & Flood Problem Areas

FEMA 100-Year Floodplain

Functional floodplains along stream and river corridors perform a variety of green infrastructure benefits such as flood storage, water quality improvement, passive recreation, and wildlife habitat. The most important function however is the capacity of the floodplain to hold water following significant rain events to minimize flooding downstream. The 100-year floodplain is defined by the Federal Emergency Management Agency (FEMA) as the area that would be inundated during a flood event that has a one percent chance of occurring in any given year (100-year flood). 100-year floods can and do occur more frequently, however the 100-year flood has become the accepted national standard for floodplain regulatory and flood insurance purposes and was developed in part to guide floodplain development to lessen the damaging effects of floods.

The 100-year floodplain also includes the floodway. The floodway is the portion of the stream or river channel that comprises the adjacent land areas that must be reserved to discharge the 100-year flood without increasing the water surface. Figure 41 depicts the 100-year floodplain and floodway in relation to a hypothetical stream channel.

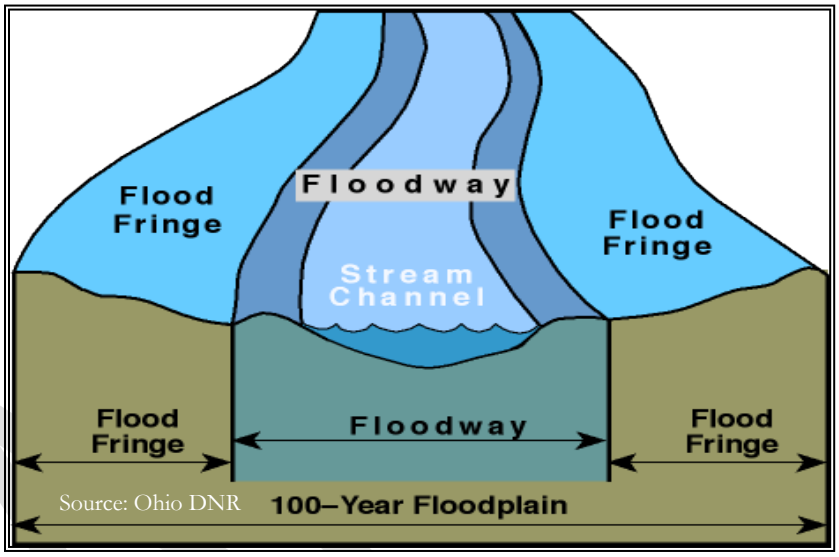


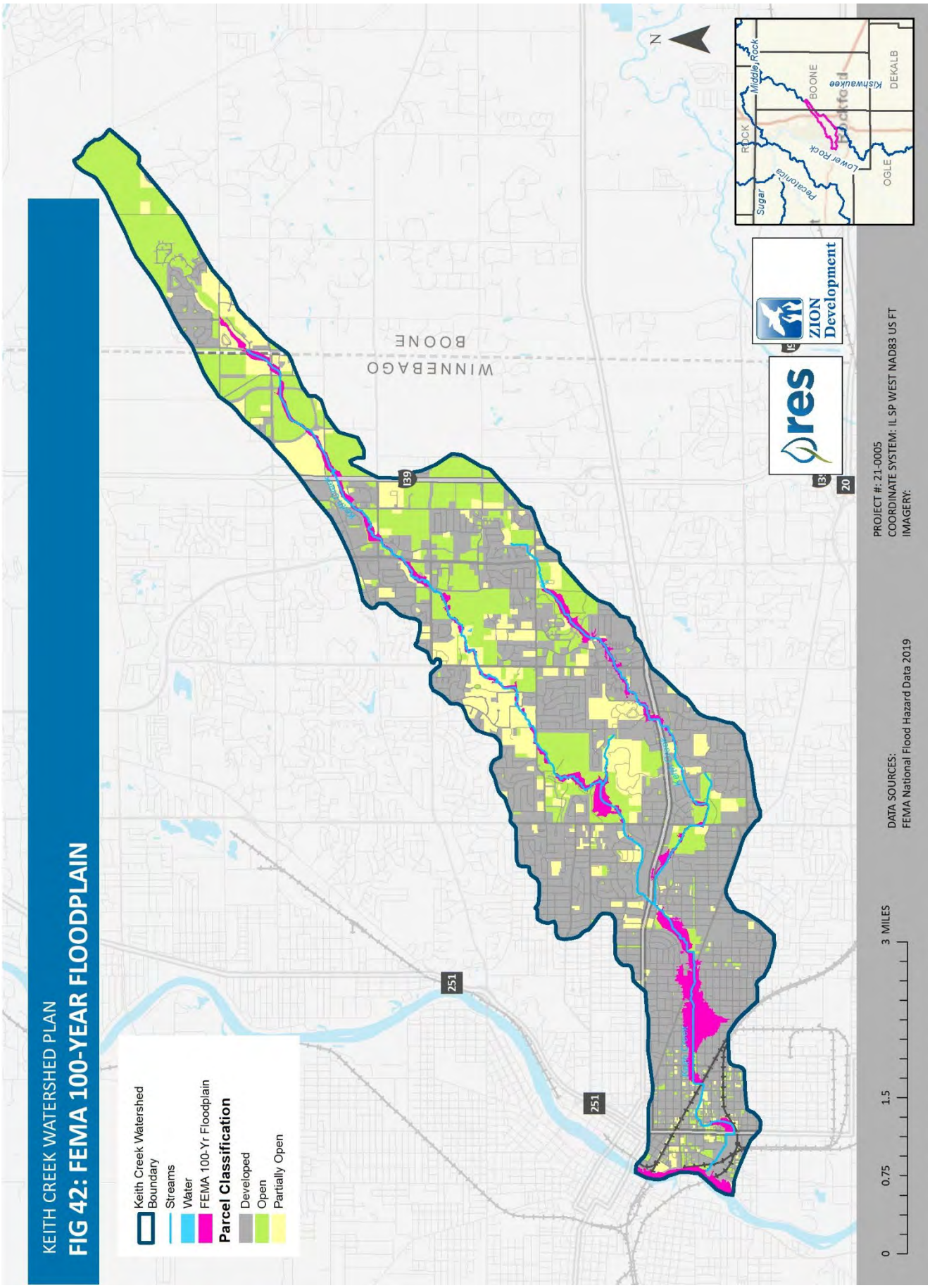
Figure 41. 100-year floodplain and floodway depiction.

As expected, the mapped floodplain in the watershed closely follows Keith Creek and some of its tributaries as well as a portion of the Rock River. Figure 42 depicts the 100-year floodplain which occupies 537.8 acres or about 6% of the watershed. The most extensive floodplain areas are surrounding the Keith Creek Greenway upstream to Dahlquist Park, in Aldeen, and upstream portions surrounding Keith Creek and Tributary 2.

Documented Flood Problem Areas

Keith Creek was urbanized, and the stream channelized long before floodplain and detention regulations were in place, making the area prone to flooding. Water moves quickly to the creek when it rains from steeper, higher elevations just upstream and within a matter of hours the creek can rise 8 feet, inundating properties in its wake. The area most susceptible to flash flooding includes Keith Creek surrounding Reaches 9 and 10 where the most urbanized portions of the watershed and a 130-acre depression straddles the creek, protruding in the shape of a triangle to the south. As a result, the Keith Creek watershed ranks highest for total flood insurance damage claims in the city. The City of Rockford has worked for years to buyout roughly 130 homes using FEMA Hazard Mitigation funds yet more than 300 structures remain vulnerable to flooding in the100-year floodplain and there is a lack of funding to address all needed improvements (Macke, 2022).

The combined efforts of the watershed-based plan, the Keith Creek Corridor Study, and Fehr Graham's flood study for the City are all targeting ways to bring additional dollars to this flood-prone area. The Corridor Study will provide greenway open space plans that can be funded in the future. Fehr Graham is completing an engineering and modeling study for the City of Rockford to determine how flood waters effect structures in the neighborhood and which Keith Creek improvements can be completed in conjunction with the grant programs focused on water quality, green infrastructure, and transportation to reduce flooding. This ensures that dollars targeted for grant-funded improvements are not isolated and that all investments are leveraged to create community assets and reduce flood risk (Macke, 2022).


KEITH CREEK WATERSHED PLAN
FIG 42: FEMA 100-YEAR FLOODPLAIN
Keith Creek Watershed Boundary
Streams
Water
FEMA 100-Yr Floodplain
Parcel Classification
Developed
Open
Partially Open
WINNEBAGO
BOONE
251
251
39
20
N
ROCK
BOONE
DEKALB
OGLE
Sugar
Pecatonica
Lower Rock
Middle Rock
Kishwaukee
ZION Development
res
0
0.75
1.5
3 MILES
DATA SOURCES:
FEMA National Flood Hazard Data 2019
PROJECT #: 21-0005
COORDINATE SYSTEM: IL SP WEST NAD83 US FT
IMAGERY:

3.14 Agricultural Land

Most of the Keith Creek watershed is developed, with only 17.5% still considered undeveloped agricultural land. While Illinois is known for its food production, how this land is managed can have a significant effect on water quality. According to the Environmental Protection Agency's (EPAs) National Water Quality Inventory for 2000, "agricultural nonpoint source (NPS) pollution was the leading source of water quality impacts on surveyed rivers and lakes… Agricultural activities that cause NPS pollution include…plowing too often or at the wrong time; and improper, excessive or poorly timed application of pesticides, irrigation water and fertilizer. (EPA, 2013)"

Summarizing agricultural land across the watershed can be difficult because not only do crops change from year to year on some fields, but each farm has unique agricultural practices and equipment at their disposal. The United States Department of Agriculture's (USDAs) National Agricultural Statistics Service produces a yearly, crop-specific inventory of land across the United States based on satellite imagery and the spectral signatures of various land cover types. The USDA 2020 Cropland data for the Keith Creek watershed (Figure 43, Table 22) shows that deciduous forest was the most abundant landcover type (466.6 acres; 5.1%), corn was the most abundant cropland type at 439.9 acres (4.8%), and grassland or pasture areas covered 317.7 acres (2.2%) of the undeveloped land. Soybeans covered 160.9 acres (1.8%) of the watershed, and fallow or idle land was less than one percent, with all other crop types combined covering 317.1 acres or 3.5%.

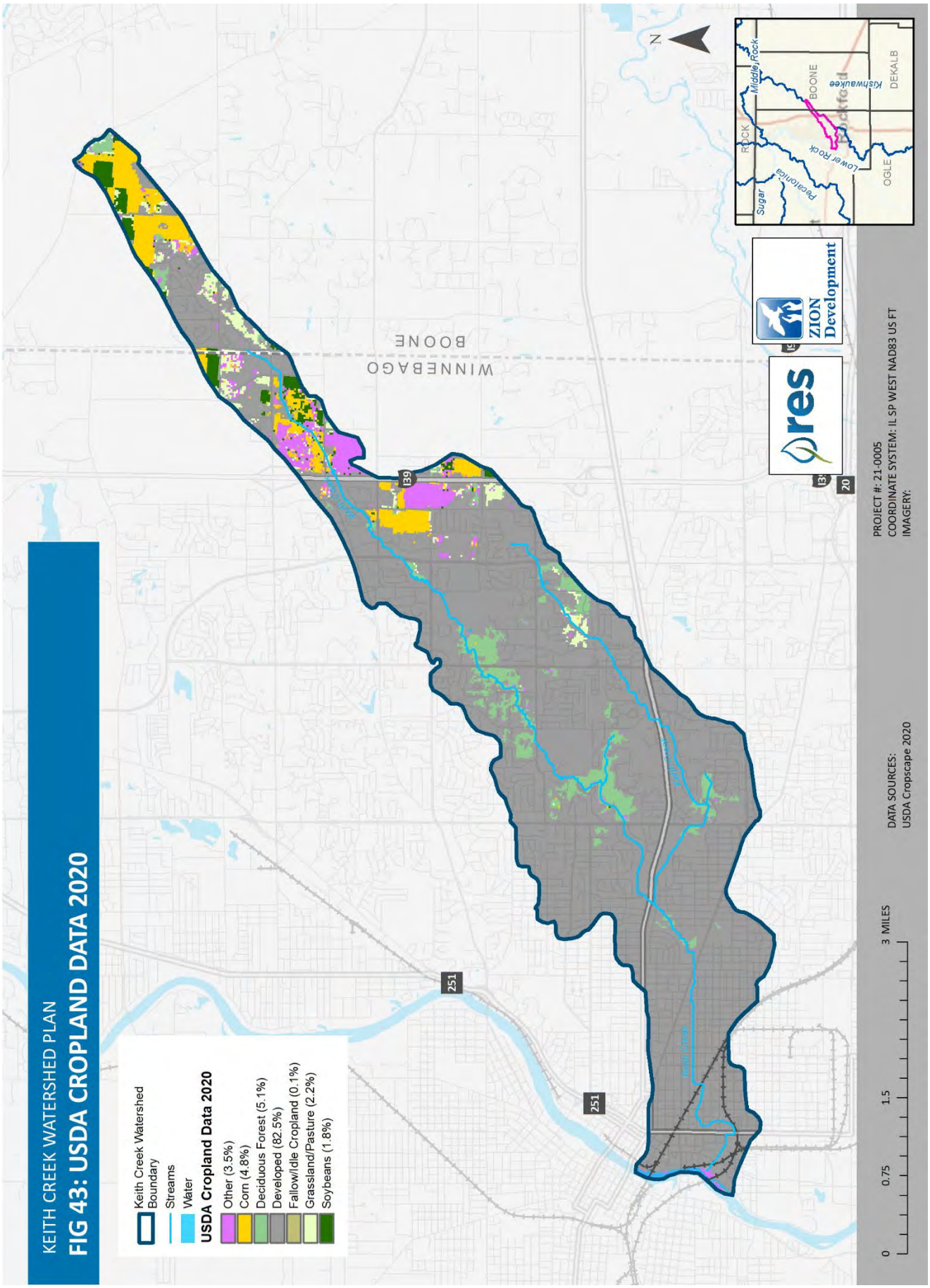
Table 22. USDA 2020 Cropland Data for land cover types.

Land Cover Type	Acres	Percent of Land Cover
Developed	7,518.7	82.5%
Deciduous Forest	466.6	5.1%
Corn	439.9	4.8%
Other	317.1	3.5%
Grassland Pasture	203.1	2.2%
Soybeans	160.9	1.8%
Fallow/Idle Cropland	8.0	0.1%
Total Cropland	**1,595.5**	**100.0%**

There are no combined animal feeding operations (CAFOs) in the watershed, almost no livestock of any kind, and no issues were identified involving livestock during the field inventory.

Conventional tillage is the standard practice in agriculture and involves plowing fields and removing all plant residue from previous crops before planting a new one; relative to other practices, conventional tillage involves the most soil disturbance. Conservation tilling or reduced tillage is an effective method of reducing non-point source pollution within agriculture areas. "Conservation tillage is an agricultural management approach that aims to minimize the frequency and intensity of tillage operations" (UC Davis, 2017). Conservation tillage has environmental benefits such as improving soil health, reducing runoff, and limiting the extent of erosion, as well as economic benefits such as less reliance on farm machinery and equipment and overall reduction in fuel and labor costs (UC Davis, 2017). Another tillage practice that can be effective at reducing pollution is mulch tilling which is "any other reduced tillage system that leaves at least one third of the soil surface covered with crop residue (Dunnum, 2016)." A related and even more effective method of reducing non-point source pollution from agricultural areas includes the practice of no-till in which tilling or disturbing the soil is eliminated between harvest of the previous crop to harvest of the current crop (Claassen, 2018).

In summer 2019, RES completed a windshield survey of the watershed, including agricultural land within the Keith Creek watershed. This included map notations of existing conservation practices (such as vegetated swales, contour cropping, no-till farming, etc.) as well as general agricultural land cover types (such as row crop, hay, or pasture). Areas where additional conservation practices could be implemented were also noted.


KEITH CREEK WATERSHED PLAN
FIG 43: USDA CROPLAND DATA 2020
Keith Creek Watershed Boundary
Streams
Water
USDA Cropland Data 2020
Other (3.5%)
Corn (4.8%)
Deciduous Forest (5.1%)
Developed (82.5%)
Fallow/Idle Cropland (0.1%)
Grassland/Pasture (2.2%)
Soybeans (1.8%)
WINNEBAGO
BOONE
Keith Creek
251
251
I39
20
N
ZION Development
res
0
0.75
1.5
3 MILES
DATA SOURCES:
USDA Cropscape 2020
PROJECT #: 21-0005
COORDINATE SYSTEM: IL SP WEST NAD83 US FT
IMAGERY:
ROCK
BOONE
DEKALB
OGLE
Middle Rock
Kishwaukee
Pecatonica
Lower Rock
Sugar

A few agricultural parcels within the watershed are already utilizing appropriate conservation practices such as reduced tillage practices to reduce nutrient and sediment loading to streams. Most farmers understand the inherent value in reducing soil and nutrient losses on their farms and consider it good business practice to do so. Results of the agricultural land inventory can be found in Appendix C.

While no entity regulates or maintains an inventory of drain tiles in the watershed, NRCS provides a map depicting the tile drainage probability of land in Illinois based on soil characteristics (Figure 44). This map was created using the assumption "that very poorly and poorly drained soils that are rapidly permeable to moderately slowly permeable would be very likely to be tile drained. Soils that are somewhat poorly drained, that are rapidly permeable to moderately slowly permeable are likely to be tile drained. Soils that are slowly or very slowly permeable are unlikely to be tile drained (NRCS, 2009)." This data has not been verified and is only for general guidance purposes, but it depicts the likely extent of drain tiles within the watershed. According to NRCS' map, portions of the Keith Creek watershed is likely to very likely tile drained.

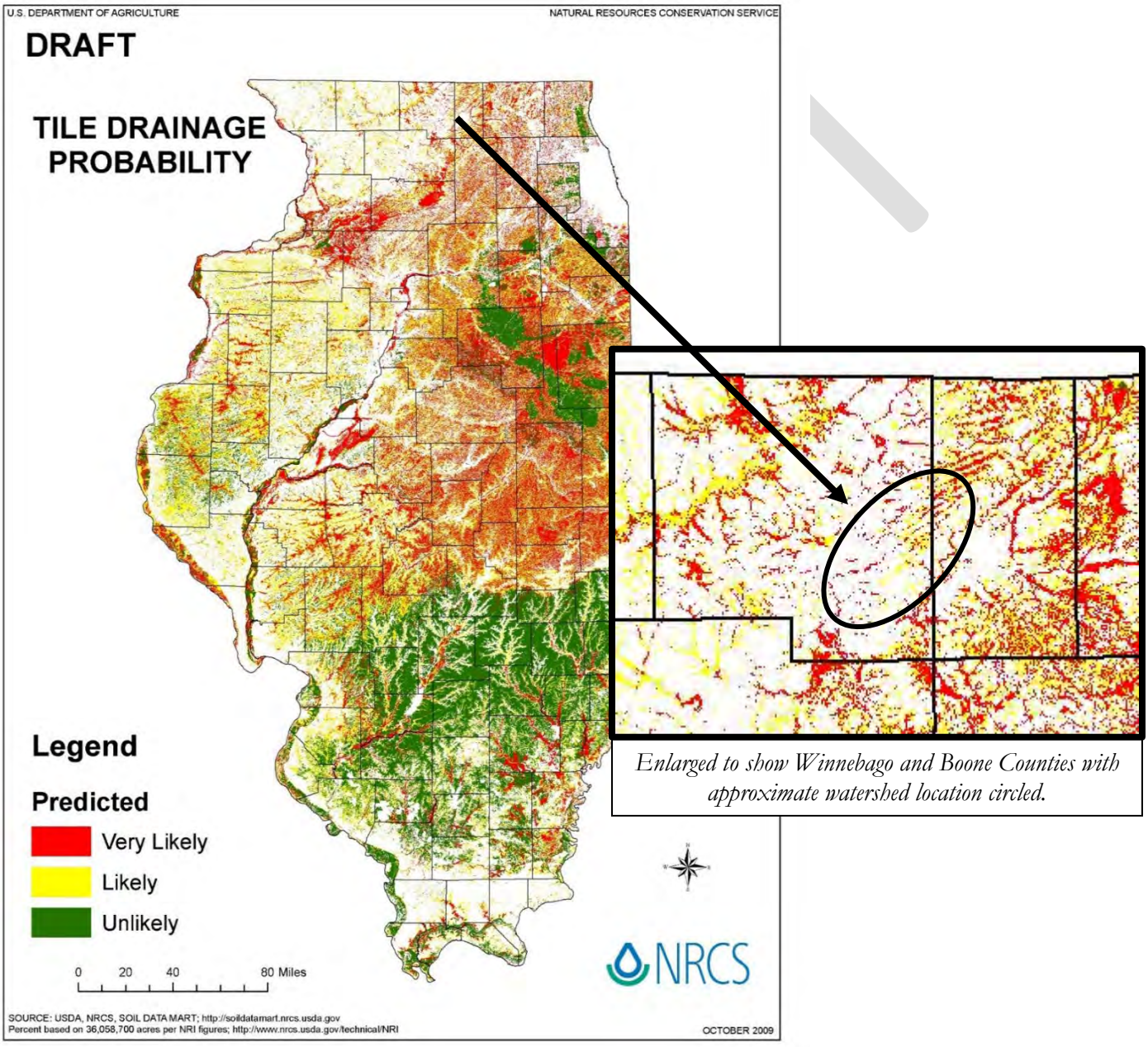


Figure 44. Tile drainage probability in Illinois (Source: NRCS, 2009).

3.15 Groundwater Aquifers & Community Water Supply

Groundwater Aquifers

Groundwater is water that saturates small spaces between sand, gravel, silt, clay particles, or crevices in underground rocks. Groundwater is found in aquifers or underground formations that provide readily available quantities of water to wells, springs, or streams. Groundwater sources available to Northwestern Illinois are found in shallow aquifer units and deep aquifer units (Figure 45). The bedrock underlying the Rock River basin consists mainly of deposits from the Cambrian, Ordovician and Silurian Periods. The Cambrian strata are mostly sandstone. The Ordovician strata consists of the Prairie du Chien Group, (predominantly dolomite and sandstone), the Ancell Group (mostly sandstone), the Galena-Platteville Group (almost entirely dolomite), and the Maquoketa Group (primarily shale). The Silurian Period bedrock is predominately dolomite. Most of the bedrock directly underlying the glacial sediments in the Rock River basin is of Ordovician age. Both shallow and deep aquifers are used by residences, farms, or entire communities.

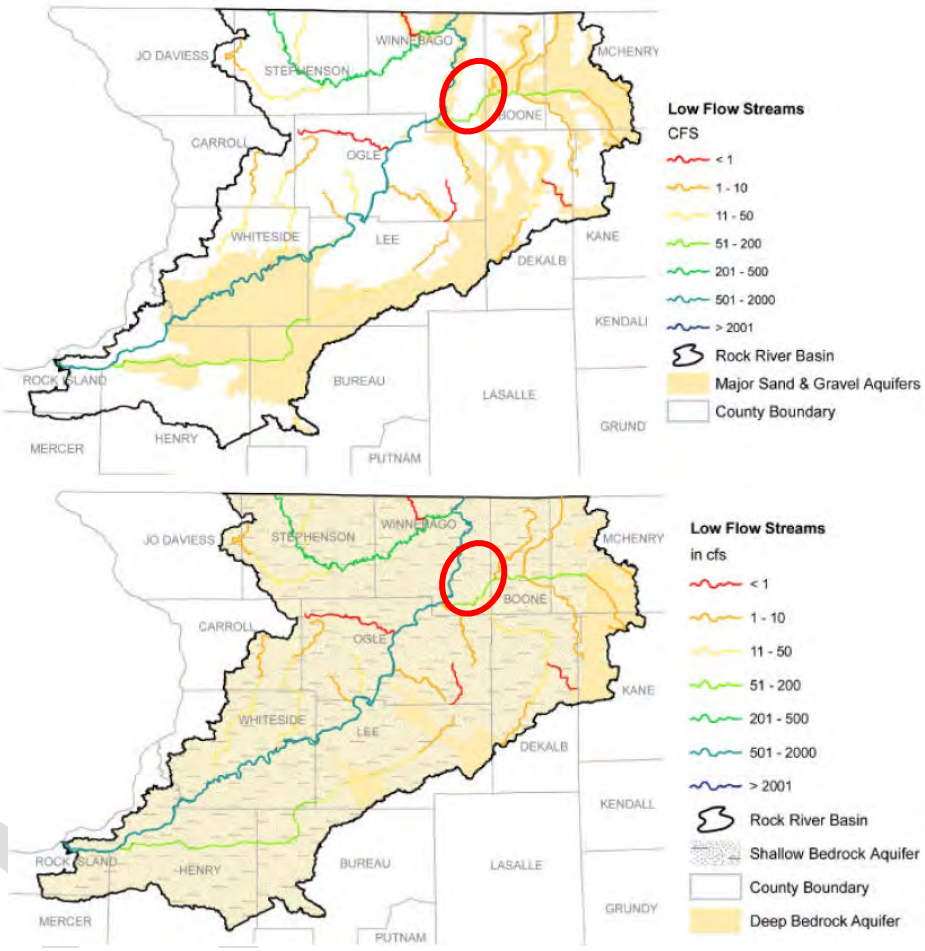


Figure 45. Major sand and gravel aquifers (top) and shallow and deep bedrock aquifers (below) in the Rock River Basin (IEPA, 2006).

Groundwater modeling studies conducted for Northern Illinois and Southern Wisconsin by the Illinois State Water Survey (ISWS) (ISWS, 2015) depict that drawdown in the deep Cambrian-Ordovician bedrock aquifers from predevelopment to 2014 is between 100 and 200 feet in the Keith Creek planning area (Figure 46). "The City of Rockford's pumping has steadily declined since records began being kept from 32 MGD in 1979 to 16 MGD in 2019. This reduction in pumpage may help to explain why water levels in the many wells assessed were found to either increase or remain stable despite ongoing pumping (ISWS, 2015)." This reduction in pumpage may help to explain why water levels in the many wells assessed were found to either increase or remain stable despite

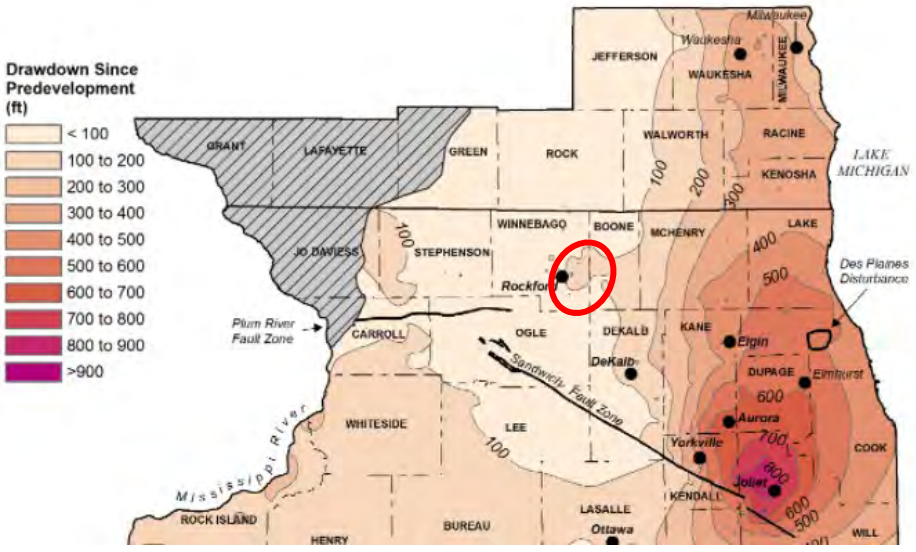


Figure 46. Drawdown in the Cambrian-Ordovician deep bedrock aquifers predevelopment to 2014 (ISWS, 2015).

ongoing pumping. Ultimately, models suggest that drawdown, changes in stream base flow, and/or changes in the depth of groundwater for deep wells are expected to remain relatively stable in the future relative to areas closer to the Chicagoland region (ISWS, 2015).

Groundwater Recharge

Groundwater recharge is the process by which precipitation reaches and re-supplies the groundwater. Generally, only a portion of precipitation will reach an aquifer. The groundwater recharge rate can be affected by a few factors, "including intensity and amount of precipitation, surface evaporation, vegetative cover, plant water demand, land use, soil moisture content, depth and shape of the water table, distance and direction to a stream or river, and hydraulic conductivity of soil and geologic materials. (IEPA, 2006)" According to a 2006 IEPA study of the Rock River Basin, the Keith Creek watershed area generally has a moderate potential for groundwater recharge (Figure 47). Additional recharge in the area may also be occurring from outside of the watershed (IEPA, 2006).

No data was available regarding potential groundwater contamination within the Keith Creek watershed, but there is a groundwater contamination and EPA Superfund Site (ILD981000417) in southeast Rockford about one mile south of Keith Creek watershed which was first discovered in 1981. Resulting studies found volatile organic compounds in groundwater and the site was listed as a state-lead, federally-funded Superfund site in 1989 and much investigation, cleanup and monitoring has occurred in the ensuing years. In 2020, EPA proposed a partial removal of the site from the Superfund list. Again, this site is outside of the watershed, but is included for context as it relates to groundwater. More information can be found by visiting EPA's website.

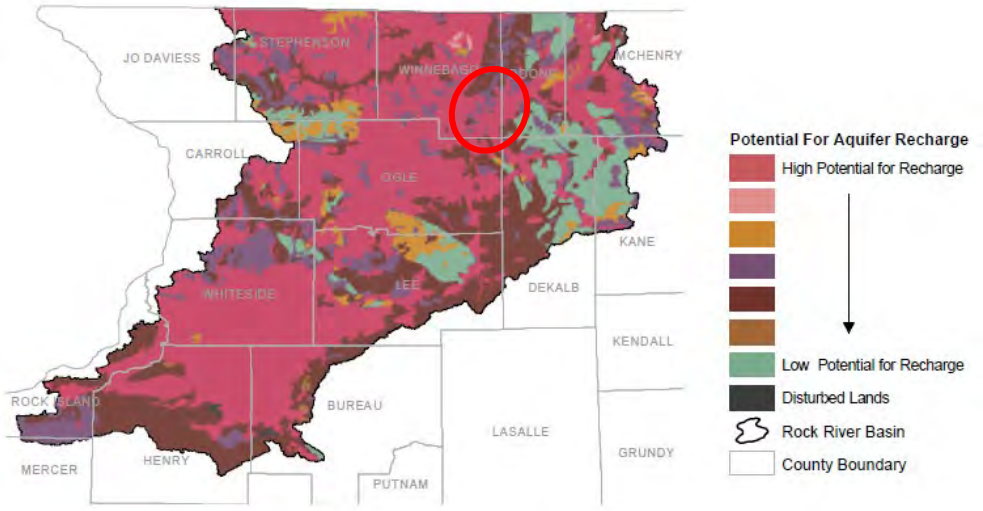


Figure 47. Aquifer recharge potential in the Rock River Basin (Source: IEPA, 2006).

Community Water Supply

Groundwater is an essential resource within the Keith Creek watershed as underlying aquifers provide the drinking water supply for many people. The water supply in communities within the watershed comes primarily from wells. Most of the watershed gets its water from community wells within the City of Rockford. Eleven (11) community water supply wells are located within Keith Creek watershed, 7 of which are active (Table 23). One well is owned by Loves Park, while all the others are owned by Rockford. Most shallow wells are drilled into the Quantenary Unit aquifer systems and most deeper wells are drilled into the Ordovician System. Only one of the seven active wells is a shallow well. It is important to note that future restoration and development projects that include infiltration best management practices will mostly benefit the shallow aquifers and not deep aquifers. There are no Illinois Department of Agriculture Well Decommissioning Program sites in the Keith Creek watershed.

Table 23. Community water supply wells in the watershed (Source: IEPA Source Water Assessment Protection Program).

Well ID	CWS Name	Depth (ft)	Status	Aquifer Depth
00818	Rockford	1,500	Active	Deep
11635	Rockford	1,600	Inactive	Deep
11636	Rockford	237	Active	Shallow
11637	Rockford	1,426	Active	Deep
11638	Rockford	245	Inactive	Shallow
11640	Rockford	1,457	Active	Deep
11654	Rockford	1,326	Active	Deep
11655	Rockford	1,280	Inactive	Deep
11660	Rockford	1,455	Active	Deep
11664	Rockford	235	Inactive	Shallow
01757	Loves Park	1,400	Active	Deep

3.16 NPDES Permits & Septic Systems

There are no wastewater treatment facilities that outlet within the Keith Creek watershed, but there is one NPDES permit, held by Testor Corporation (IL0070513). The Testor Corporation permit is for non-contact cooling water that discharges to four outfalls near the mouth of Keith Creek with an average discharge of 0.014 MGD. The facility must monitor and meet monthly limits for pH, temperature, and residual chlorine.

Septic Systems

Septic systems are common within more rural and unincorporated areas. When septic systems are not maintained or fail, they pose real threats to groundwater and surface water quality, especially when they are located near streams or other water bodies. Failing septic systems can contribute high levels of nutrients (phosphorus and nitrogen) and bacteria (fecal coliform) to the environment. The failure rate of septic systems in the watershed is unknown. However, literature sources across the nation indicate a failure rate of approximately 20% (Brown, 1998; Mancl, 1984; Stout, 2003; UKCE, 2012).

While no specific data was available regarding the number or condition of septic systems within the watershed, RES was able to estimate that based on the 2010 census data, there are approximately 893 septic systems in the watershed. This number was calculated based on the assumption that each household outside of a municipal boundary is likely to have a septic system. RES carefully reviewed and verified the validity of this estimating method and is confident it is a reasonably accurate estimate and used these estimates as part of the STEPL modeling (see Section 5.0). Note: For SMU 2, we calculated that there are 1,060 households that fall outside of a municipal boundary and based on the estimates made by Gregg Cassaro with Rock River Water Reclamation District approximately 75% of the households in SMU 2 are still on septic systems. Table 24 depicts the estimated number of non-municipal households/septic systems by subwatershed management unit (SMU). Septic systems in Winnebago County are regulated under the Sewers and Sewage Disposal section of the Winnebago County Code and run by the Winnebago County Health Department. Similarly, septic systems in Boone County are regulated by the Boone County Private Sewage Disposal Code and managed by the Boone County Health Department.

The United States Environmental Protection Agency (USEPA) provides an excellent guide for septic system owners called "A Homeowner's Guide to Septic Systems" (USEPA, 2005). The guide makes it clear that septic system maintenance is the responsibility of the owner. The guide also explains how septic systems work, why and how they should be maintained, and what makes a system fail.

Table 24. Estimated number of non-municipal households/septic systems by SMU.

SMU #	Estimated Number of Septic Systems (based on 2010 Census)
1	0
2	795
3	0
4	0
5	60
6	38
TOTAL	**893**

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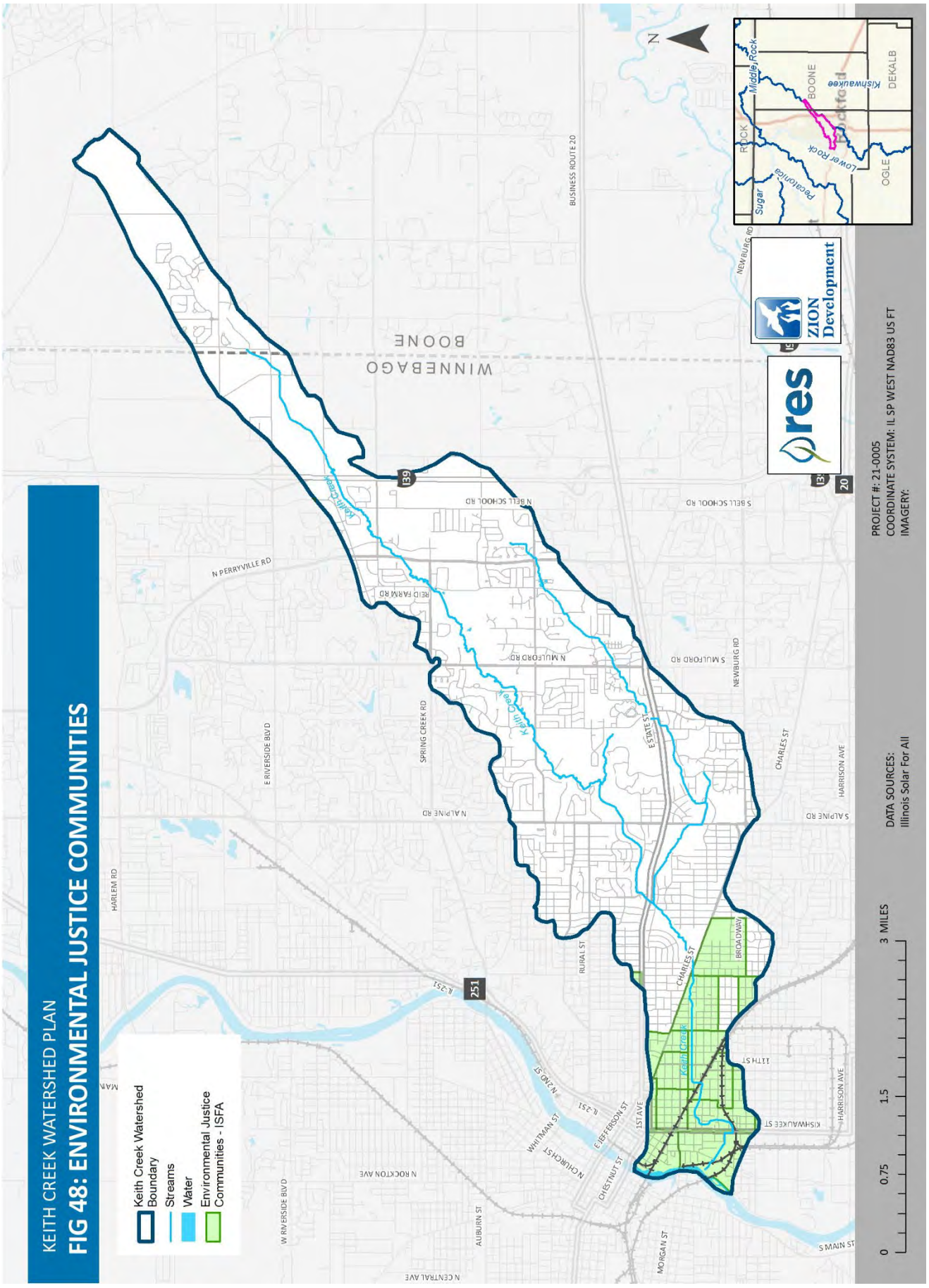
Septic system owners in Winnebago and Boone Counties can find more information about each county's program from their respective websites.

3.17 Environmental Justice Communities

The United States Environmental Protection Agency (USEPA) is committed to environmental justice which is the fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income, with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies. The goal of environmental justice is to see that everyone enjoys the same degree of protection from environmental and health hazards, as well as equal access to the decision-making process to have a healthy environment in which to live, learn, and work (USEPA, 2021).

Both USEPA and Illinois EPA may have additional goals or targets and funding opportunities applicable to environmental justice communities. Environmental justice communities have been identified in Illinois according to a methodical framework established under the Long-Term Renewable Resources Procurement Plan. These communities were designated as such through a calculation utilizing the US EPA tool, EJ Screen, and demonstrate a higher risk of exposure to pollution based on environmental and socioeconomic factors (IllinoisSFA, 2021); they are depicted in Figure 48, as mapped by Illinois Solar for All. A portion of Keith Creek near the mouth, totaling 54.9 acres, falls within an identified environmental justice community. It is important to note that the Keith Creek Greenway falls within the environmental justice community boundary.

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KEITH CREEK WATERSHED PLAN
FIG 48: ENVIRONMENTAL JUSTICE COMMUNITIES
Keith Creek Watershed Boundary
Streams
Water
Environmental Justice Communities - ISFA
0
0.75
1.5
3 MILES
DATA SOURCES:
Illinois Solar For All
PROJECT #: 21-0005
COORDINATE SYSTEM: IL SP WEST NAD83 US FT
IMAGERY:
WINNEBAGO
BOONE
ROCK
BOONE
DEKALB
OGLE
Middle Rock
Kishwaukee
Pecatonica
Sugar
Lower Rock
Keith Creek
BUSINESS ROUTE 20
N PERRYVILLE RD
N BELL SCHOOL RD
S BELL SCHOOL RD
REID FARM RD
N MULFORD RD
S MULFORD RD
NEWBURG RD
SPRING CREEK RD
E RIVERSIDE BLVD
W RIVERSIDE BLVD
N ALPINE RD
S ALPINE RD
HARLEM RD
ESTATE ST
CHARLES ST
HARRISON AVE
RURAL ST
BROADWAY
11TH ST
KISHWAUKEE ST
1ST AVE
JEFFERSON ST
CHESTNUT ST
WHITMAN ST
N CHURCH ST
N 2ND ST
N ROCKTON AVE
AUBURN ST
MORGAN ST
S MAIN ST
N CENTRAL AVE
MAIN
IL-251
251
139
20
ZION Development
res

4.0 WATER QUALITY & POLLUTANT MODELING ASSESSMENT

4.1 Water Quality

The primary goal of this watershed plan is to guide efforts to protect and restore surface water quality in Keith Creek watershed. Section 305(b) of the Federal Clean Water Act requires Illinois and all other states to submit to the USEPA a biennial report of the quality of the state's surface and groundwater resources called the *Illinois Integrated Water Quality Report and Section 303(d) List*. These reports must also describe how Illinois waters meet or do not meet water quality standards specific to each "Designated Use" as defined by the Illinois Pollution Control Board (IPCB). When a waterbody is determined to be impaired, Illinois EPA must list potential causes and sources for impairment in the 303(d) impaired waters list. There are seven "Designated Uses" in Illinois; Illinois EPA has assigned four of these uses to Keith Creek: *Aquatic Life, Fish Consumption, Primary Contact Recreation,* and *Aesthetic Quality*.

According to Illinois EPA's most recent 2018 *Integrated Water Quality Report and Section 303(d) List*, Keith Creek Reaches 1-7 (IEPA Assessment Unit ID: IL_PR-01) was not assessed for *Aquatic Life*, *Fish Consumption*, or *Aesthetic Quality*, and is not supporting for *Primary Contact Recreation*. The cause of the impairment is fecal coliform, and the source is urban runoff/storm sewers. Keith Creek Reaches 8-12 (IEPA Assessment Unit ID: IL_PR-99) is fully supporting for *Aesthetic Quality*, was not assessed for *Fish Consumption*, and not supporting for *Aquatic Life* and *Primary Contact Recreation*. The causes of impairment are alteration in stream-side or littoral vegetative covers, arsenic, methoxychlor, zinc, pH, and changes in stream depth and velocity patterns; while the sources of impairment are channelization, contaminated, sediments, and urban runoff/storm sewers (Table 25). None of the tributaries have Assessment Unit ID (AUID) codes or have been assessed for designated uses.

Table 25. Illinois EPA Designated Uses and impairments for Keith Creek.

Designated Use	Use Attainment	Impaired?	Cause of Impairment	Source of Impairment
Keith Creek: AUID IL_PR-01 (Reaches 1-7)				
Aquatic Life	Not Assessed	-	N/A	N/A
Fish Consumption	Not Assessed	-	N/A	N/A
Primary Contact Recreation	Not Supporting	Yes	Fecal Coliform	Urban Runoff/ Storm Sewers
Aesthetic Quality	Not Assessed	-	N/A	N/A
Keith Creek: AUID IL_PR-99 (Reaches 8-12)				
Aquatic Life	Not Supporting	Yes	Alteration in stream-side or littoral vegetative covers; Arsenic; Methoxychlor; Zinc; pH; Changes in Stream Depth and Velocity Patterns	Channelization; Contaminated Sediments
Fish Consumption	Not Assessed	-	N/A	N/A
Primary Contact Recreation	Not Supporting	Yes	Fecal Coliform	Urban Runoff/ Storm Sewers
Aesthetic Quality	Fully Supporting	No	None	N/A

Source: 2018 Illinois EPA 303(d) list

Water Quality Monitoring Sites

Keith Creek

A variety of water quality monitoring stations have been sampled in recent years in an attempt to document the baseline conditions of Keith Creek. Table 26 lists all known chemical/physical and biological water quality monitoring sites in the watershed, including the entities that conducted the sampling, a summary of the dates of sampling and sampled parameters, while Figure 49 depicts the location of each monitoring site where data was collected. In total there were six water quality monitoring sites.

RES pulled ten years of historical water quality data within the watershed and found three monitoring locations – PR-01, PR-02, and PR-99, all sampled by Illinois EPA (Table 29). Site PR-01 (IL_EPA_WQX-PR-01) was sampled 5 times in 2019 for fecal coliform and is located on Keith Creek at Route 20. Site PR-02 (IL_EPA_WQX-PR-02), located on Keith Creek at Tenth Avenue Park, had an Intensive Basin study completed in 2018 plus additional fecal coliform sampling in 2019. PR-99 (IL_EPA_WQX-PR-99) is the most downstream monitoring location on Keith Creek, located just upstream of the confluence with the Rock River, and it had both an Intensive Basin study and a Special Study completed in 2013. The parameters for the Special Study and Intensive Basin study included ammonia-nitrogen, chloride, DO, inorganic nitrogen, TKN, pH, total phosphorus, temperature, TSS, arsenic, methoxychlor, and zinc as well as up to 70 additional parameters not summarized within this planning effort.

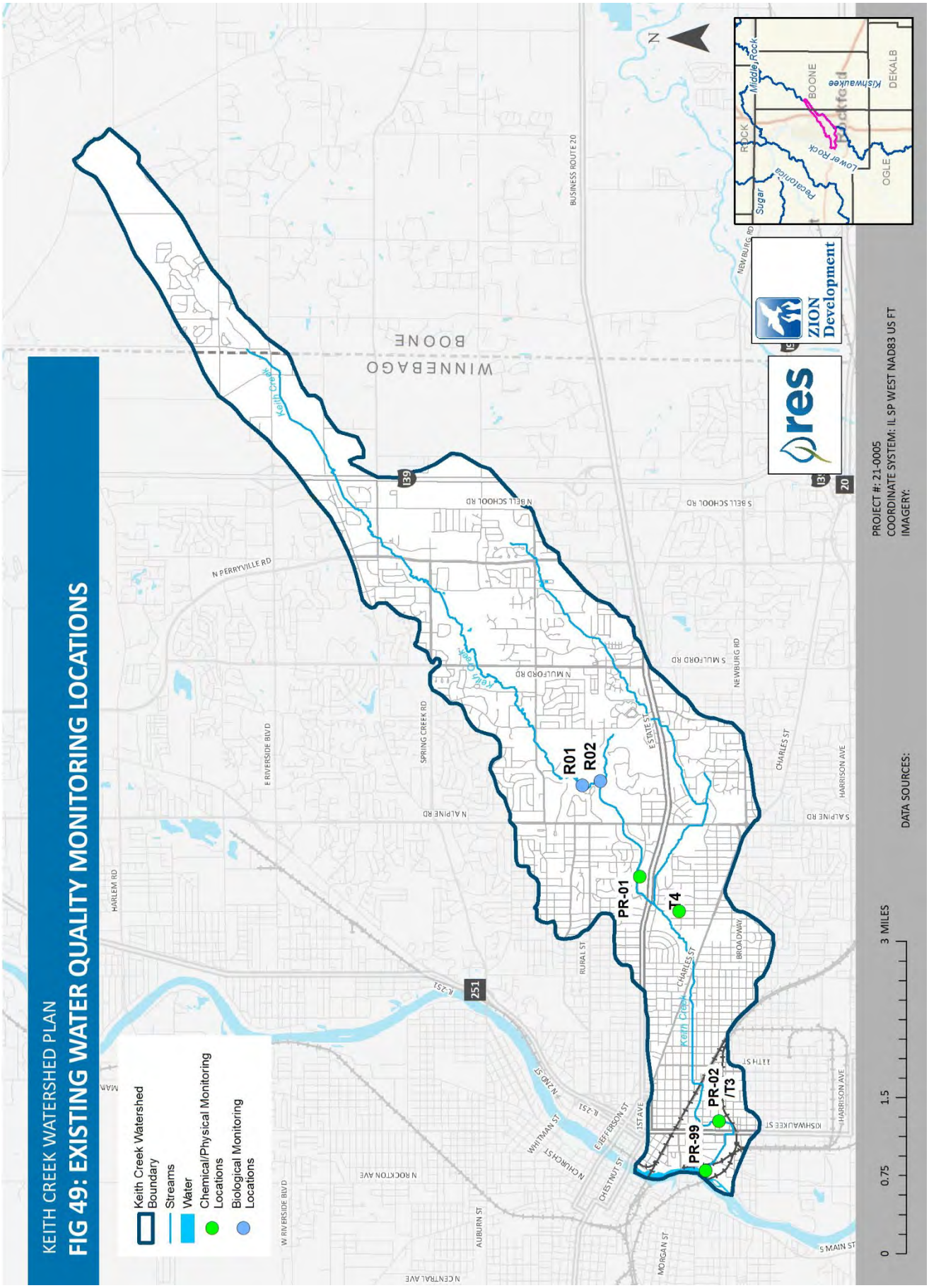
Two monitoring locations on Keith Creek have been monitored by the City of Rockford under their NPDES permit. They include T3 (also known as PR-02) at Tenth Avenue Park and T4 at Dahlquist Park. These two sites were monitored regularly between 2004 and 2020 for dissolved oxygen, pH, temperature, conductivity, fecal coliform, chemical oxygen demand (COD), total suspended solids (TSS), total dissolved solids (TDS), hardness, ammonia-nitrogen (NH_3-N), nitrate nitrogen (NO_3-N), total phosphorus, copper, cadmium, nickel, chromium, zinc, and lead.

Finally, Illinois RiverWatch Network conducted biological surveys for macroinvertebrates at two locations on Keith Creek in Aldeen Park. Site R01 (R0112301) was surveyed in 1996, 1997, 2000, and 2001, while site R02 (R0112302) was surveyed in 1998, 2000, and 2001.

Table 26. Summary of surface water quality monitoring sites.

Site ID	Site Name	Sampling Entity	Date Range	Sampled Parameters
PR-01	Keith Creek: Rt 20 Rockford	Illinois EPA	2019	Fecal coliform, temperature
PR-02 /T3	Keith Creek: 10th Ave at Tenth Avenue Park	Illinois EPA, City of Rockford	IEPA: 2018; Rockford: 2004-2020	IEPA: ammonia-nitrogen, chloride, DO, fecal coliform, inorganic nitrogen, TKN, total phosphorus, TSS, Intensive Basin parameters; Rockford: DO, pH, temperature, Cond, fecal coliform, COD, TSS, TDS, Hardness, NH_3-N, NO_3-N, phosphorus, Cu, Cd, Ni, Cr, Zn, Pb
PR-99	Keith Creek: Upstream confluence Rock River Rockford	Illinois EPA	2013	Ammonia-nitrogen, chloride, DO, inorganic nitrogen, TKN, pH, total phosphorus, temp, TSS, Intensive Basin parameters
T4	Keith Creek at Dahlquist Park	City of Rockford	2004-2020	DO, pH, temperature, Cond, fecal coliform, COD, TSS, TDS, Hardness, NH_3-N, NO_3-N, phosphorus, Cu, Cd, Ni, Cr, Zn, Pb
R01	Keith Creek at Aldeen Park (R0112301)	Illinois RiverWatch Network	1996-2001	macroinvertebrates
R02	Keith Creek at Aldeen Park (R0112302)	Illinois RiverWatch Network	1998-2001	macroinvertebrates

Sampling Abbreviations: Cd=cadmium, COD=chemical oxygen demand, Cond=conductivity, Cr=chromium, Cu=copper, DO=dissolved oxygen, Ni=nickel, NH_3-N=nitrogen, ammonia, NO_2-N=nitrite nitrogen, NO_3-N=nitrate nitrogen, Pb=lead, TDS=total dissolved solids, TKN=total Kjeldahl nitrogen, TSS=total suspended solids, Zn=Zinc


KEITH CREEK WATERSHED PLAN
FIG 49: EXISTING WATER QUALITY MONITORING LOCATIONS
Keith Creek Watershed Boundary
Streams
Water
Chemical/Physical Monitoring Locations
Biological Monitoring Locations
R01
R02
PR-01
T4
PR-02
T3
PR-99
WINNEBAGO
BOONE
Keith Creek
Keith Creek
Keith Creek
BUSINESS ROUTE 20
N PERRYVILLE RD
N BELL SCHOOL RD
S BELL SCHOOL RD
N MULFORD RD
S MULFORD RD
NEWBURG RD
SPRING CREEK RD
E RIVERSIDE BLVD
W RIVERSIDE BLVD
N ALPINE RD
S ALPINE RD
HARLEM RD
CHARLES ST
HARRISON AVE
BROADWAY
RURAL ST
ESTATE ST
1ST AVE
11TH ST
KISHWAUKEE ST
WHITMAN ST
N CHURCH ST
CHESTNUT ST
JEFFERSON ST
N 2ND ST
N 251
N ROCKTON AVE
AUBURN ST
MORGAN ST
N CENTRAL AVE
S MAIN ST
251
139
20
ROCK
BOONE
OGLE
DEKALB
Middle Rock
Kishwaukee
Pecatonica
Sugar
Lower Rock
Rockford
N
0
0.75
1.5
3 MILES
PROJECT #: 21-0005
COORDINATE SYSTEM: IL SP WEST NAD83 US FT
IMAGERY:
DATA SOURCES:
res
ZION Development

Water Chemistry Monitoring

Illinois EPA lists Keith Creek as being impaired for Aquatic Life and Primary Contact Recreation according to the 2018 *Integrated Water Quality Report and Section 303(d) List* (Table 25). Recent water quality data collected within the Keith Creek indicates likely overall impairment from elevated total phosphorus and fecal coliform.

Note: For the Keith Creek watershed, the PR-99 (IL_EPA_WQX-PR-99), as the most downstream water quality monitoring location in the watershed, is considered the most representative of watershed-wide water quality conditions and is therefore used as the measure of watershed-wide water quality results and summaries for all parameters except fecal coliform. The most downstream location with fecal coliform monitoring data is PR-02/T3 (IL_EPA_WQX-PR-02). The full water quality monitoring results performed by both IEPA (Table 27) and the City of Rockford (Table 28) depict elevated levels of phosphorus and fecal coliform in the watershed.

RES analyzed historical water quality for the Keith Creek available via EPA's WQP/Storet water quality database for the last ten years and found data for 2013, 2018, and 2019. Average sample results at PR-01, PR-02, and PR-99 for pH, dissolved oxygen, total suspended solids, chloride, total phosphorus, ammonia, inorganic nitrogen (NO2+NO3), total Kjeldahl nitrogen, and total nitrogen (calculated) are reported in Table 27. Site PR-99 is near the mouth of Keith Creek upstream of its confluence with the Rock River and is the most downstream sample location. As such, it is considered the most representative of watershed conditions. Monitoring results at PR-99 show that phosphorus is above the criteria at 0.095 mg/L. Fortunately, none of the other sampled parameters at Site PR-99 are above established threshold criteria. Average total nitrogen (calculated) at PR-99 is 1.263 mg/L, average total suspended solids are 11 mg/L, chlorides average 145 mg/L, pH averages 8.04 and dissolved oxygen averages 8.66. No fecal coliform monitoring was conducted at Site PR-99, although upstream fecal coliform sampling at both sites PR-01 and PR-02 show elevated fecal coliform; average fecal coliform results showed 3033 MPN/100mL and 961 MPN/100mL at PR-01 and PR-02, respectively.

The City of Rockford also provided water quality data they collected between 2004 and 2021 at two locations on Keith Creek. Monitoring locations included Keith Creek at 10th Avenue in Tenth Avenue Park (T3), which is identical to IEPA's PR-02 monitoring location, and Keith Creek at Dahlquist Park (T4). Average sample results at sites T3 and T4 for all monitoring between 2004 and 2021 for pH, dissolved oxygen, TSS, phosphorus, ammonia nitrogen, nitrate nitrogen, and fecal coliform are reported in Table 28. The most downstream monitoring location for the Rockford water quality sampling is at the T3 location, which is still upstream of the PR-99 site. The water quality averages at T3 show that pH averages 7.83, dissolved oxygen averages 11.17 mg/L, TSS averages 18.4 mg/L, total phosphorus is 0.188 mg/L, ammonia nitrogen averages 0.13 mg/L, nitrate nitrogen averages 1.13 mg/L, and fecal coliform averages 233 CFU/100mL. Consistent with the IEPA data, only phosphorus ad fecal coliform are above target criteria thresholds.

Additionally, the three other pollutants listed as causes of aquatic life impairment - arsenic, methoxychlor, and zinc, were sampled at PR-99 as part of the Intensive Basin water chemistry survey and all three were listed as either not detected or below the national recommended aquatic life criteria thresholds. However, these chemicals are likely still found in bottom deposits, which are not included as part of this study.

Keith Creek watershed-wide averages for TP, TN, and TSS were calculated by taking all individual sample results for these parameters at the PR-99 site and averaging them. The watershed-wide average reading was 0.095 mg/L of total phosphorus, 1.263 mg/L of total nitrogen, and 11 mg/L of total suspended solids. No fecal coliform data was collected at PR-99, so the next closest site was used, PR-02/T3 (IL_EPA_WQX-PR-02), at which the average fecal coliform reading was 2248 CFU/100mL. These watershed-wide averages will be used in the calculation of watershed-wide reduction targets.

Nutrients such as phosphorus and nitrogen are a necessary component of plant growth and are therefore included in many fertilizers. Unfortunately, both have adverse effects on water quality, with phosphorus being particularly detrimental to aquatic systems in excess quantities. These nutrients are applied as fertilizer, either in an agricultural setting or by applicators and the excess nutrients not absorbed by plants are then washed into waterways. Excess nutrients can cause algal blooms, accelerated plant growth, decreasing oxygen levels, and can lead to fish kills. While nitrogen levels in Keith Creek are below threshold criteria, buried streams can cause elevated nitrogen levels. According to research, nitrogen

generally travels 18 times further in a buried stream than in an open stream due to the lack of plants and other organic matter that could feed on those nitrates, keeping streams healthy and oxygenated (Bliss, 2015). One solution is to daylight or unbury streams. Currently there is no Illinois state standard for nitrogen or phosphorus; however, the USEPA recommends a concentration of less than 2.461 mg/l of total nitrogen and 0.0725 mg/L of total phosphorus in streams.

Table 27. Illinois EPA water chemistry data (averages) for sites on Keith Creek (2013-2019).

ID Code/ Parameter	Statistical, Numerical, or General Use Guidelines	PR-01	PR-02	PR-99
pH	>6.5 or <9.0*	-	8.17	8.04
Dissolved Oxygen (mg/L)	>5.0 mg/l*	-	8.32	8.66
TSS (mg/L)	<19 mg/l***	-	ND	11
Chloride (mg/L)	<500 mg/l*	-	222	145
Phosphorus (mg/L)	<0.0725 mg/l**	-	0.049	0.095
Ammonia (mg/L)	*see TN below*	-	ND	0.075
NO2+NO3	1.798 mg/L**	-	0.438	0.742
Total Kjeldahl Nitrogen (mg/L)	*see TN below*	-	ND	0.448
Total Nitrogen (TN) (mg/L), calculated	<2.461 mg/l**	-	0.438	1.263
Fecal coliform CFU/100mL	<200 CFU/100mL*	3033	961	-

Table 28. City of Rockford water chemistry data (averages) 2004-2021.

ID Code/ Parameter	Statistical, Numerical, or General Use Guidelines	T3	T4
pH	>6.5 or <9.0*	7.83	7.57
Dissolved Oxygen (mg/L)	>5.0 mg/l*	11.17	10.89
TSS (mg/L)	<19 mg/l***	18.4	23.9
Phosphorus, total (mg/L)	<0.0725 mg/l**	0.188	0.173
Ammonia (mg/L)	*N/A*	0.13	0.13
Nitrate (mg/L)	*N/A*	1.13	1.36
Fecal coliform (CFU/ 100mL)	<200 CFU/100mL*	2333	2224

-Cells highlighted in red exceed recommended statistical, numerical, or General Use guidelines
* Illinois EPA General Use Standard
** Ambient Water Quality Criteria Recommendations: Rivers and Streams in Nutrient Ecoregion VI (USEPA 2000)
*** Present and Reference Concentrations and Yields of Suspended Sediment in Streams in the Great Lakes Region and Adjacent Areas (USGS 2006)

The ability to control erosion and excess sediment in waterways, and thereby total suspended solids, can be linked to the control of how development is handled as well as the condition of streambanks in the watershed. The construction process generally involves significant land disturbance and ecosystem destruction. The grading of sites, removal of vegetation, rerouting of natural drainage systems, and the addition of impervious surfaces, such as roads and parking lots, all interfere with water quality both in the short and long term. Removing vegetation and trees near the stream or floodplain removes the stability of the soil and increases bank erosion and sedimentation to nearby waterways. Alteration of natural drainage patterns can also significantly reduce the ability of the ecosystem to compensate for such increase in contaminants and sedimentation. Eroding streambanks also contribute additional sediments, particularly during and after rain events as peak flows scour away banks. High suspended sediment levels are problematic when light penetration is reduced, oxygen levels decrease, fish and macroinvertebrate gills are clogged, visual needs of aquatic organisms is reduced, and when sediment settles out in streams and lakes. There is no Illinois state guideline for total suspended solids, but the United States Geological Survey (USGS) recommends TSS do not exceed 19 mg/l for streams in the Keith Creek watershed.

Fecal coliform or *E. coli* can be used as indicators that a waterbody is contaminated by improperly functioning septic systems, wildlife, or runoff from urban and agricultural areas, which could carry other possible pathogens such as bacteria, viruses, and protozoans. While potential pathogens are too numerous to test for individually, the USEPA recommends *E. coli* testing "as the best indicator of health risk from water contact in recreational waters (USEPA, 2012)." Not only does the presence of excessive *E. coli* counts suggest there is a possible health risk in recreational contact with those waters, but the bacteria "can also cause cloudy water, unpleasant odors, and an increased oxygen demand (USEPA, 2012)." The Illinois general use standard requires that *E. coli* or fecal coliform levels do not exceed 200 CFU (colony forming units) per 100 ml of sample.

Noteworthy: Numeric Water Quality Standards

USEPA expects states to establish *numeric* water quality standards for nutrients (phosphorus and nitrogen) in lakes and streams. Currently, Illinois EPA has a numeric phosphorus standard for lakes and is working on developing nutrient criteria for streams. To date, Illinois EPA has not developed *numeric* standards for turbidity/total suspended solids (TSS) in streams. *Numeric* criteria have been proposed by USEPA (USEPA, 2000) for nutrients based on a reference stream method for the Corn Belt and Northern Great Plains Ecoregion (Ecoregion VI) which includes Keith Creek watershed. The values presented in this document generally represent nutrient levels that protect against adverse effects of nutrient over enrichment. The USGS has published a document outlining recommended *numeric* criteria for sediment in streams for Ecoregion VI (USGS, 2006). These criteria are used in this report to assess the quality of Keith Creek and tributaries to develop pollution reduction targets and measure future successes, even though Illinois EPA has not adopted these criteria as standards.

Illinois EPA and others have developed *statistical* guidelines for various pollutants other than nutrients and suspended sediment. Illinois also provides General Use water quality standards that apply to almost all waters and are intended to protect aquatic life, wildlife, agriculture, primary contact, secondary contact, and most industrial uses. *Statistical* guidelines and General Use water quality guidelines are also used in this report to measure impairment and to determine pollutant reduction needs in Keith Creek watershed.

Biological Monitoring

Biological data provides the primary basis for determining the level of *Aquatic Life* support in streams and is a major source of information for Illinois EPA's *Illinois Integrated Water Quality Report and Section 303(d) List*. Illinois EPA utilizes two indices based on aquatic macroinvertebrate and fish communities in streams. The Macroinvertebrate Biotic Index (MBI) and fish Index of Biotic Integrity (fIBI) are used to evaluate water quality and biological health and to detect and understand change in biological systems that result from the actions of human society. The Illinois EPA uses MBI and fIBI data to determine the *Aquatic Life* support status of streams as shown in Table 29. In addition, the Illinois Department of Natural Resources (IDNR) uses a "Mussel Resource Value" to rate the value of the biotic community.

Table 29. Illinois EPA indicators of *Aquatic Life* impairment using MBI and fIBI scores.

Biological Indicator	**Score**		
MBI	> 8.9	5.9 < MBI < 8.9	≤ 5.9
fIBI	≤ 20	20 < fIBI< 41	≥ 41
Narrative Score	Poor	Fair	Good
Impairment Status - Use Support - Resource Quality			
Impairment Status	Severe Impairment	Moderate Impairment	No Impairment
Designated Use Support	Not Supporting	Dependent on Water Chemistry or Habitat Data	Fully Supporting
Resource Quality	Poor	Fair	Good

Source: 2018 *Illinois Integrated Water Quality Report and Section 303(d) List*

Macroinvertebrate Community Monitoring

Aquatic macroinvertebrates are insects that spend all or a portion of their life span in water. No macroinvertebrate monitoring data could be found for the watershed within the last ten years; however, Illinois RiverWatch Network performed a series of macroinvertebrate studies at two locations on Keith Creek within Aldeen Park between 1996 and 2001. Macroinvertebrate Biotic Index scores (MBI) were calculated based on the macroinvertebrate studies. The MBI is designed to rate water quality using the pollution tolerance of macroinvertebrates and human impacts as an estimate of the degree and extent of organic pollution and disturbance in streams. RiverWatch surveyed Keith Creek at Site R01 (R0112301) in 1996, 1997, 2000, and 2001 and all resulting MBI scores rated Keith Creek as "Fair." Keith Creek was sampled at Site R02 (R0112302) in 1998, 2000, and 2001 and was rated as "Good" in 1998 and "Fair" in 2000 and 2001. The Illinois EPA has determined that an MBI score greater than 8.9, or "Poor" condition, indicates a stream is not supporting of *Aquatic Life* and that scores between 5.9 and 8.9 are considered not supporting of *Aquatic Life* if water-chemistry data or habitat data indicate a potential for impairment. Overall, macroinvertebrate data for Keith Creek indicated that there was no impairment along the upstream reaches in 2001 and it was rated as being in "Fair" condition.



Volunteer macroinvertebrate sampling

Fish Community Monitoring

The fIBI assesses biological health and water quality through several attributes of fish communities found in streams. These attributes fall into such categories as species richness and composition, trophic composition, and fish abundance and condition. After data from sampling stations has been collected, values for the metrics are compared to high quality reference conditions and a rating is assigned to each metric. The sum of these ratings gives a total fIBI score for the site. The Illinois EPA uses fIBI scores to determine *Aquatic Life* impairments and has determined that a score less than 41 indicates a stream is not "Fully Supporting" *Aquatic Life*.

No fish community monitoring has occurred on Keith Creek.

NPDES Discharges

There are no wastewater treatment facilities that outlet within the Keith Creek watershed, and the one NPDES permit for Testor Corporation only includes monitoring for pH, temperature, and residual chlorine.

4.2 Pollutant Loading Analysis

The USEPA modeling tool called STEPL (Spreadsheet Tool to Estimate Pollutant Loads) was used to estimate the existing nonpoint source load of nutrients (nitrogen & phosphorus) and total suspended solids from Keith Creek watershed as a whole and by individual subwatershed management unit (SMU). The model uses land use/cover category types, precipitation, soils information, existing best management practices, and other existing conditions data information. The model outputs average annual pollutant load for each of the land use/cover types. The results of this analysis were used to estimate the total watershed load for nitrogen, phosphorus, and total suspended solids and to identify and map pollutant load "Hot Spot" SMUs. It is important to note that STEPL is not a calibrated model, although every effort was taken to include all current and available data. The STEPL model estimates pollutant loads for nitrogen, phosphorus, and total suspended solids, but not fecal coliform or *E. coli*.

The results of the STEPL model run at the watershed scale indicate that Keith Creek watershed produces approximately 64,205 lbs/yr of nitrogen, 13,018 lbs/yr of phosphorus, and 5,856 tons/yr of total suspended solids (Table 30; Figure 50).

Urban land uses contribute the highest loads of nitrogen (49,017.4 lbs/yr; 76%) and phosphorus (7,542 lbs/yr; 58%) and of the second highest total suspended solids loads (1,130 t/yr; 19%). Urban land uses are expected to be a significant pollutant contributor since they make up more than 90% of the watershed. Streambanks contribute the highest total suspended solids load at 3,955 lbs/yr (68%). Septic systems contribute the second highest nutrient loads after urban areas, with 5,552 lbs/yr (9%) of nitrogen and 2,175 lbs/yr (17%) of phosphorus loads. Streambanks contribute the third highest nutrient loads to Keith Creek, with 5,379 lbs/yr (8%) of nitrogen and 2,071 lbs/yr (16%) of phosphorus. Cropland is the third highest contributor to total suspended solids loading in the watershed, contributing 771 tons/yr (13%). Complete STEPL Model results and assumptions can be found in Appendix D.

Table 30. Estimated existing (2020) annual pollutant load by source at the watershed scale.

STEPL Source	N Load (lbs/yr)	% Of Total N Load	P Load (lbs/yr)	% Of Total P Load	TSS (tons/yr)	% of Total TSS Load
Urban	49,017.4	76.3%	7,542.2	57.9%	1,130.3	19.3%
Cropland	4,255.7	6.6%	1,230.0	9.4%	770.7	13.2%
Septic	5,552.4	8.6%	2,174.7	16.7%	0.0	0.0%
Streambanks	5,379.4	8.4%	2,071.1	15.9%	3,955.4	67.5%
Total	**64,204.8**	**100.0%**	**13,018.0**	**100.0%**	**5,856.4**	**100.0%**

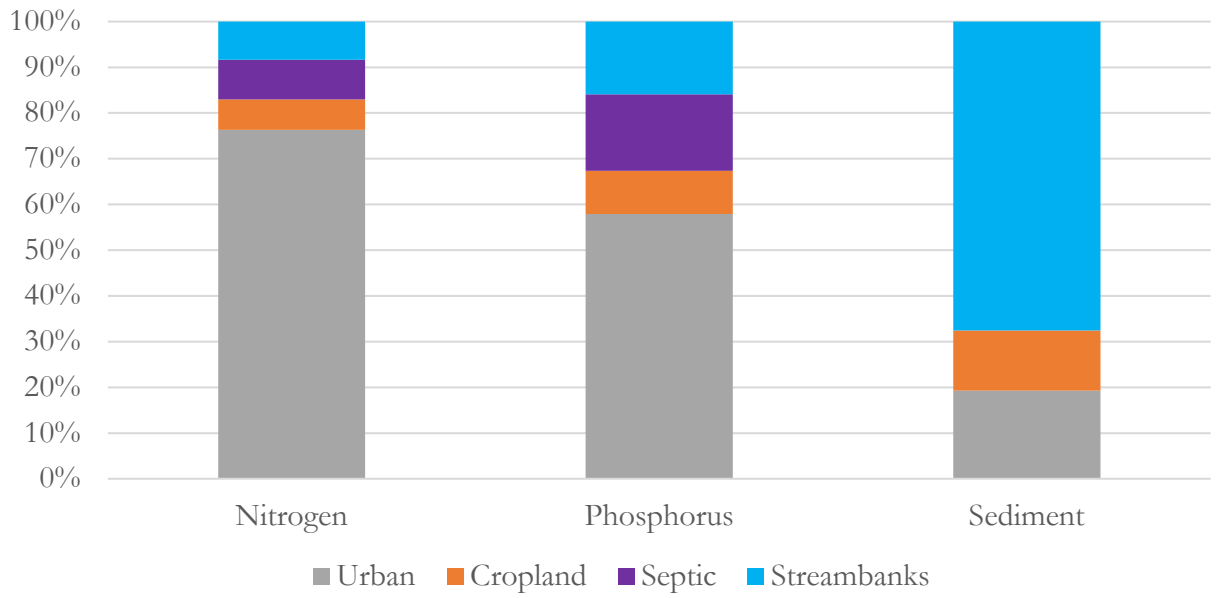


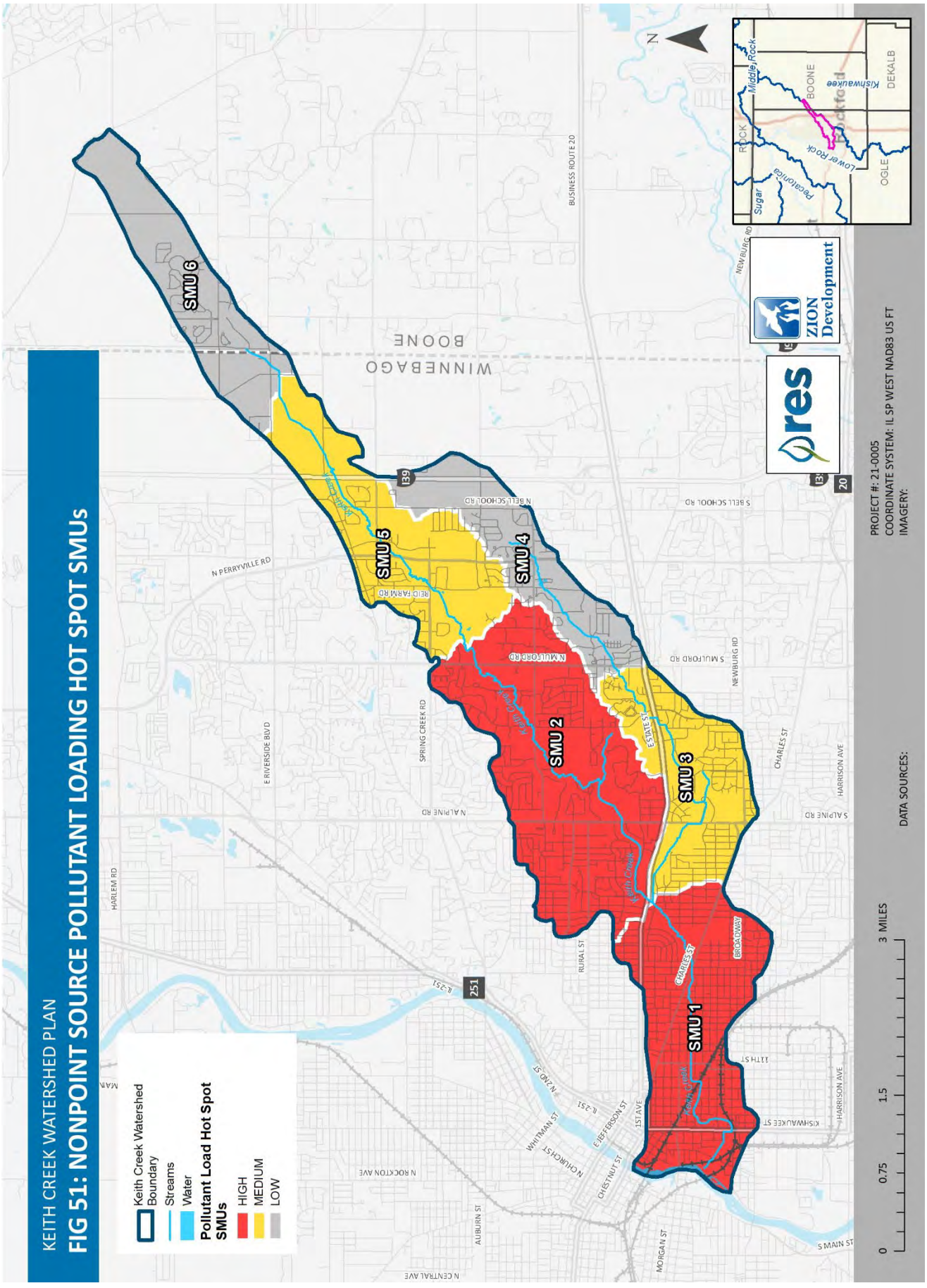
Figure 50. Estimated percent contributions to existing (2020) pollutant load by source.

The results of the STEPL model were also analyzed for nonpoint source pollutant loads at the Subwatershed Management Unit (SMU) scale. This allows for a more refined breakdown of nonpoint pollutant sources and leads to the identification of pollutant load "Hot Spots". Hot Spot SMUs were selected by examining pollutant load concentration (load/acre) for each pollutant. Next, pollutant concentrations were calculated resulting in High, Moderate, and Low Concentration nonpoint source pollutant load Hot Spot SMUs and an aggregate pollutant contribution number was calculated based on each SMUs total load per acre (the sum of the load/acre of nitrogen, phosphorus, and sediment). SMUs with a total load concentration of 9.0 or higher were categorized as "High Concentration" pollutant load hot spots, while SMUs scoring a total load concentration between 8.0 and 9.0 were determined to be "Moderate Concentration pollutant load hot spots. Any SMU exhibiting pollutant load concentrations below 8.0 aggregate load concentration were determined to contribute a "Low Concentration" of pollutants relative to other SMUs. Table 31 and Figure 51 depict and summarize the results of the SMU scale pollutant loading analysis.

Table 31. Pollutant load "Hot Spot" SMUs.

Hot Spot SMU	Size (acres)	N Load (lbs/yr)	N Load (lbs/yr) /ac	P Load (lbs/yr)	P Load (lbs/yr) /ac	TSS Load (t/yr)	TSS Load (t/yr) /ac	Aggregate Load Concentration
High Concentration Hot Spot SMUs								
SMU 1	1,814.7	14,632.6	8.1	2,857.5	1.6	1,832.6	1.0	10.6
SMU 2	2,523.4	18,821.0	7.5	4,490.3	1.8	1,489.8	0.6	9.8
Moderate Concentration Hot Spot SMUs								
SMU 3	1,151.0	7,741.1	6.7	1,385.7	1.2	905.9	0.8	8.7
SMU 5	1,523.2	10,361.8	6.8	1,844.4	1.2	758.2	0.5	8.5
Low Concentration Hot Spot SMUs								
SMU 6	1,118.1	6,619.2	5.9	1,436.1	1.3	587.5	0.5	7.7
SMU 4	981.4	6,029.0	6.1	1,004.0	1.0	282.3	0.3	7.5

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KEITH CREEK WATERSHED PLAN
FIG 51: NONPOINT SOURCE POLLUTANT LOADING HOT SPOT SMUs
Keith Creek Watershed Boundary
Streams
Water
Pollutant Load Hot Spot SMUs
HIGH
MEDIUM
LOW
SMU 1
SMU 2
SMU 3
SMU 4
SMU 5
SMU 6
WINNEBAGO
BOONE
BUSINESS ROUTE 20
N PERRYVILLE RD
N BELL SCHOOL RD
S BELL SCHOOL RD
N MULFORD RD
S MULFORD RD
NEWBURG RD
SPRING CREEK RD
E RIVERSIDE BLVD
N ALPINE RD
S ALPINE RD
HARLEM RD
RURAL ST
CHARLES ST
HARRISON AVE
BROADWAY
11TH ST
KISHWAUKEE ST
1ST AVE
E JEFFERSON ST
CHESTNUT ST
WHITMAN ST
N CHURCH ST
N ROCKTON AVE
AUBURN ST
MORGAN ST
S MAIN ST
N CENTRAL AVE
ESTATE ST
Keith Creek
251
20
ROCK
BOONE
DEKALB
OGLE
Sugar
Pecatonica
Middle Rock
Lower Rock
Kishwaukee
ZION Development
res
N
0
0.75
1.5
3 MILES
PROJECT #: 21-0005
COORDINATE SYSTEM: IL SP WEST NAD83 US FT
IMAGERY:
DATA SOURCES:

5.0 CAUSES AND SOURCES OF WATERSHED IMPAIRMENT

5.1 Causes & Sources of Impairment

According to Illinois EPA's most recent 2018 *Integrated Water Quality Report and Section 303(d) List*, Keith Creek Reaches 1-7 (IEPA Assessment Unit ID: IL_PR-01) was not assessed for *Aquatic Life*, *Fish Consumption*, or *Aesthetic Quality*, and is not supporting for *Primary Contact Recreation*. The cause of the impairment is fecal coliform, and the source is urban runoff/storm sewers. Keith Creek Reaches 8-12 (IEPA Assessment Unit ID: IL_PR-99) is fully supporting for *Aesthetic Quality*, was not assessed for *Fish Consumption*, and not supporting for *Aquatic Life* and *Primary Contact Recreation*. The causes of impairment are alteration in stream-side or littoral vegetative covers, arsenic, methoxychlor, zinc, pH, and changes in stream depth and velocity patterns; while the sources of impairment are channelization, contaminated, sediments, and urban runoff/storm sewers. Recent water quality data collected within the Keith Creek indicates likely additional impairment from elevated total phosphorus levels. For more detailed information on water quality and designated uses and impairments, see Section 4.1.

There are also non-water quality related impairments in the watershed such as habitat degradation, hydrologic and flow changes, and structural flood damage. Many different causes and sources are related to these impairments. Table 32 summarizes all *known* or *potential* causes and sources of watershed impairment as documented by Illinois EPA, items identified via Applied Ecological Service's watershed resource inventory, and input from the watershed stakeholders who met during the planning process to discuss the potential causes and sources of impairments.

Table 32. *Known* and *potential* causes and sources of watershed impairment.

IEPA or other Impairment	Cause of Impairment	Known or Potential Source of Impairment
Water Quality: Aquatic Life	Phosphorus- *known impairment*	Failing septic systems Streambank erosion Residential and commercial lawn fertilizer Inadequate nutrient restrictions/policy Level of landowner education Agricultural land Large recreational fields/golf courses
Water Quality: Aquatic Life - Habitat Degradation	Alteration in stream-side or littoral vegetative covers; Invasive/non-native plant species - *known impairment*	Spread from existing and introduced populations Lack of maintenance and management Level of landowner education
Water Quality: Aquatic Life - Heavy metals, other contaminants	Arsenic; Methoxychlor; Zinc –*known impairment* Hyrdrocarbons – *potential impairment*	Contaminated sediments Runoff from existing and legacy industrial areas and scrap yards Parking lot runoff
Water Quality: Primary Contact Recreation	Fecal Coliform – *known impairment*	Urban runoff/storm sewers Failing septic systems Sewer line breaks Pet or waterfowl waste
Habitat Degradation	Loss and fragmentation of open space/natural habitat due to development - *known impairment*	Streambank, channel, and riparian area modification Wetland/open space loss Inadequate protection policy Traditional development design Lack of appropriate land management Lack of restoration and maintenance funds
Hydromodification and Flow Changes	Alteration of natural drainage channels; changes in stream depth and velocity patterns; impervious surfaces- *known impairment*	Historic channelization and ditching of streams Existing & future urban runoff Buried or piped stream sections Wetland loss Agricultural drain tiles

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IEPA or other Impairment	Cause of Impairment	Known or Potential Source of Impairment
Structural Flood Damage	Encroachment in 100-year floodplain- *known impairment*	Structures in floodplain Existing and future urban impervious surfaces Wetland loss Channelized streams Agricultural drain tiles

5.2 Critical Areas, Management Measures & Estimated Impairment Reductions

For this watershed plan a "Critical Area" is best described as a location in the watershed where existing or potential future causes and sources of an impairment or existing function are significantly worse than other areas of the watershed. Four Critical Area types were identified in Keith Creek watershed and include poorly designed/functional detention basins; highly degraded stream and riparian area reaches; large, drained wetland complexes; and other management measure recommendations. Short descriptions of each Critical Area type are included below. Table 33 includes summaries of the current condition at each Critical Area (by type) and recommended Management Measures with estimated nutrient and sediment load reductions expected. The list of Critical Areas identified in the following paragraphs is a subset of the full management measures as found in the Action Plan section of this report. Figure 52 maps the location of each Critical Area. Pollutant load reductions are evaluated for the Critical Area Management Measures based on efficiency calculations developed for the USEPA's Region 5 Model. Estimate of nutrient and sediment load reduction from implementation of *urban* Management Measures is based on efficiency calculations developed by Illinois EPA. Illinois EPA pollutant load reduction worksheets for each Management Measure, including Critical Areas, are in Appendix D.

Critical Detention Basins

Critical detention basins are generally defined as existing basins that provide poor ecological and water quality benefits in areas where these attributes are needed. Thirteen (13) detention basins meet the criteria of a Critical Area based of their ability to remove pollutants, location, function, and size. The most common recommendation is to naturalize basins that are currently turf grass with native vegetation to provide better water quality improvement, greater infiltration, and improve wildlife habitat. A summary of the detention basins in the watershed is included in Section 3.13.

Critical Streambank and Riparian Areas

Critical stream and riparian area reaches are those with higher levels of erosion and/or buffers adjacent to stream reaches are in poor ecological condition or areas lacking a buffer but with excellent ecological restoration and remediation potential to improve water quality and habitat conditions. Streambank stabilization using bioengineering where necessary, installation of artificial riffles in stream, and improved and expanded riparian areas on Critical Area stream reaches will greatly reduce phosphorus levels in streams. Eleven (12) stream reaches totaling 55,643 linear feet were identified as Critical Areas. Section 3.13 includes a complete summary of streams, tributaries, and riparian areas in the watershed.

Critical Wetland Restoration Sites

Critical wetlands restoration sites are generally associated with large areas that were historically wetland prior to European settlement in the 1830s but were drained for agricultural purposes. Many of these historic wetlands can be restored by breaking existing drain tiles and planting with native vegetation. Wetland restorations are among the most recommended projects to improve water quality, reduce flooding, and improve wildlife habitat. Three Critical Area wetland restoration recommendations were identified in the watershed. Critical Area status was assigned based on pollutant reduction potential, location, size, and restoration potential. A detailed summary of the extent of drained wetlands and restoration opportunities in the watershed is included in Section 3.13.

Other Critical Management Measures

Several potential Management Measure projects were identified that fit under miscellaneous other categories. In total there were 5 Critical Area projects that fell into the other management measures, including 4 Natural area restorations and 1 Golf course retrofit. These areas were typically determined to be Critical Areas due to existing or potential future causes and sources of an impairment or where existing function is significantly worse than other areas of the watershed. More information about other management measure recommendations can be found in Section 6.2.4.

Table 33. Critical Areas, existing conditions, recommended Management Measures, & estimated nutrient and sediment load reductions.

ID #	Existing Condition	Management Measure Recommendation	Pollutant Reduction Efficiency		
			TSS (tons/yr)	TP (lbs/yr)	TN (lbs/yr)
Detention Basin Retrofits					
4A	Dry detention basin with mowed turf bottom and slopes and concrete channel along bottom in poor ecological condition.	Design and implement project to break/disrupt concrete channel then naturalize basin and buffer with native vegetation to create wetland detention and maintain for 3 years to establish.	9	12	67
9D	Wet bottom turf grass basin in poor ecological condition, unmowed and draining future multi-family housing	Design and implement a project to remove turf, naturalize basin slopes with natives, and maintain for 3 years to establish.	8	9	33
9E	Dry detention basin with mowed turf bottom and slopes and concrete channel along bottom in poor ecological condition.	Design and implement project to break/disrupt concrete channel then naturalize basin and buffer with native vegetation to create wetland detention and maintain for 3 years to establish.	12	15	109
9F	Dry detention basin with mowed turf bottom and slopes and concrete channel along bottom in poor ecological condition.	Design and implement project to break/disrupt concrete channel then naturalize basin and buffer with native vegetation to create wetland detention and maintain for 3 years to establish.	17	20	73
12F	Dry detention basin with mowed turf bottom and slopes in poor ecological condition.	Design and implement a project to remove turf, naturalize basin slopes and bottom with natives, and maintain for three years to establish.	16	20	147
12G	Dry detention basin with mowed turf bottom and slopes and concrete channel along bottom in poor ecological condition.	Design and implement project to break/disrupt concrete channel then naturalize basin and buffer with native vegetation to create wetland detention and maintain for 3 years to establish.	13	15	55
14A	Dry detention basin with mowed turf bottom and slopes and concrete channel along bottom in poor ecological condition.	Design and implement project to break/disrupt concrete channel then naturalize basin and buffer with native vegetation to create wetland detention and maintain for 3 years to establish.	10	12	88
16A	Dry detention basin with mowed turf bottom and slopes and concrete channel along bottom in poor ecological condition.	Design and implement project to break/disrupt concrete channel then naturalize basin and buffer with native vegetation to create wetland detention and maintain for 3 years to establish.	10	13	55
16C	Dry detention basin with mowed turf bottom and slopes in poor ecological condition.	Design and implement a project to remove turf, naturalize basin slopes and bottom with natives, and maintain for 3 years to establish.	55	67	259
17A	Wet bottom turf grass, canal-like detention w/eroded turf edge in poor ecological condition.	Design and implement a project to install biolog at toe w/plugs, install minimum 10ft prairie buffer, and maintain for 3 years to establish.	4	12	42
17D	Large wet bottom turf grass detention at headwaters, mostly unmowed turf buffer, in poor ecological condition.	Design and implement a project to install 10ft prairie buffer and plugs at toe and maintain for 3 years to establish.	25	30	108
17F	Dry detention basin with mowed turf bottom and slopes and concrete channel along bottom in poor ecological condition.	Design and implement project to break/disrupt concrete channel then naturalize basin and buffer with native vegetation to create wetland detention and maintain for 3 years to establish.	54	65	233

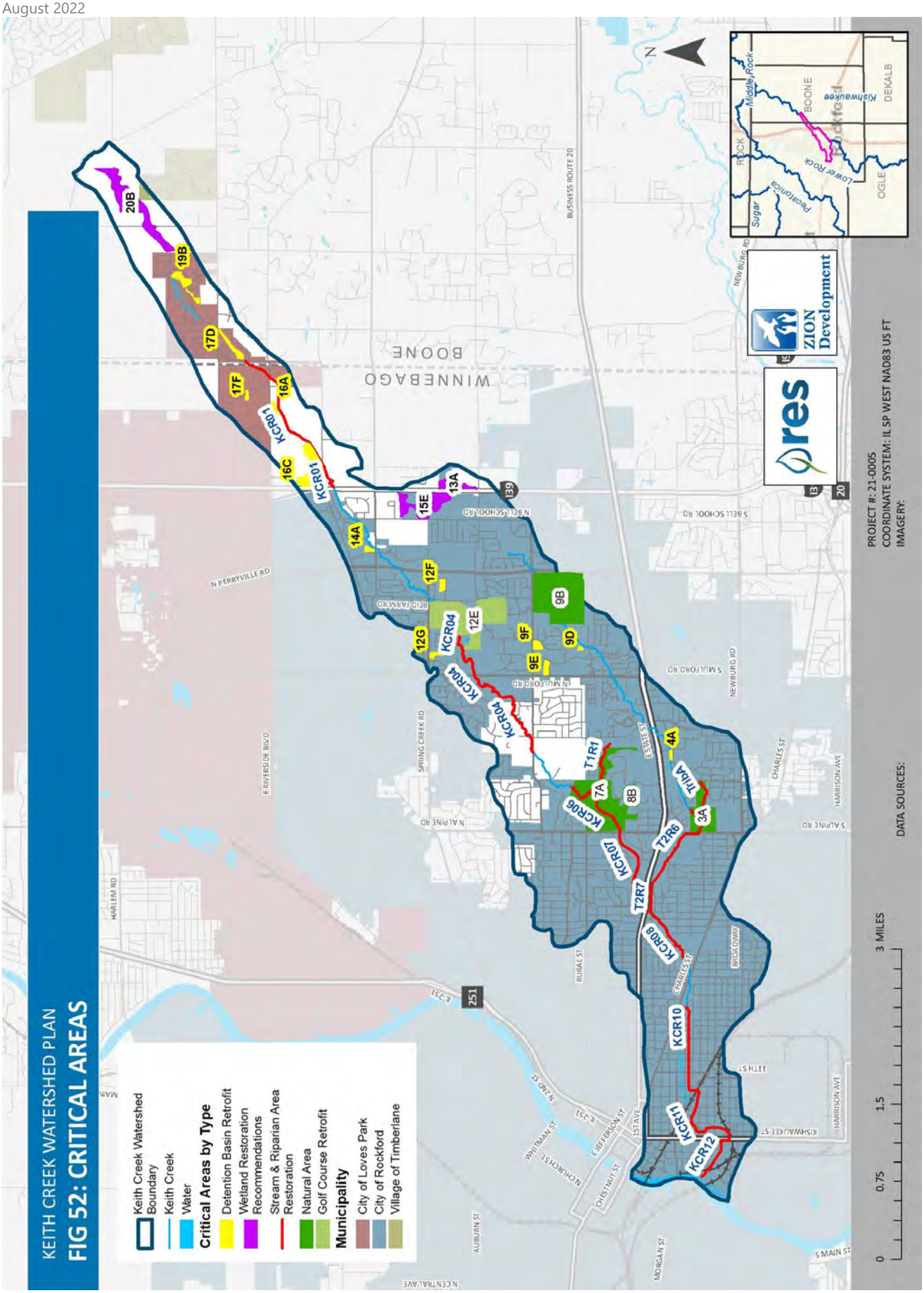
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ID #	Existing Condition	Management Measure Recommendation	Pollutant Reduction Efficiency		
			TSS (tons/yr)	TP (lbs/yr)	TN (lbs/yr)
19B	Wet bottom turf grass basin in poor ecological condition with riprap on HOA portions (third), eroded turf edge behind homes.	Design and implement a project to install biolog w/plugs at toe on residential portion and install minimum 10ft buffer along whole basin and maintain for 3 years to establish.	12	35	118
Streambank & Riparian Area Restorations					
KCR01	Keith Creek Reach 1 exhibits low levels of erosion, is highly channelized, and has a riparian area in poor ecological condition.	Design and implement a project to remove invasives, install 30' buffer on both banks, replant w/natives, and then maintain for 3 years to ensure establishment.	80	92	494
KCR04	Reach 4 exhibits moderate levels of erosion, low levels of channelization, and has a riparian area in average ecological condition.	Design, permit, and implement a project to remove invasives from floodplain, spot repair eroded sections and maintain for 3 years to ensure establishment	331	369	1,035
KCR06	Reach 6 exhibits moderate levels of erosion, low levels of channelization, and has a riparian area in average ecological condition.	Design, permit, and implement a project to remove invasives from riparian area, restore native floodplain, spot grade where necessary, and maintain for 3 years to ensure establishment.	238	251	720
KCR07	Reach 7 exhibits moderate levels of erosion, is moderately channelized, and has a riparian area in poor ecological condition.	Design and implement a project to remove invasives, replant w/natives and maintain for 3 years to ensure establishment.	273	289	1,006
KCR08	Reach 8 exhibits low levels of erosion, is moderately channelized, and has a riparian area in poor ecological condition.	Design and implement a project to remove invasives, install native buffer on both banks, replant w/natives, and then maintain for 3 years to ensure establishment.	98	111	418
KCR10	Reach 10 exhibits no erosion, is highly channelized, and has a riparian area in poor ecological condition.	Design, permit and implement a project to re-meander entire length of channel, excavate wide floodplain benches (both banks), install riffles, vegetate riparian area w/native prairie, and maintain for 3 years to ensure establishment.	50	62	427
KCR11	Reach 11 exhibits moderate levels of erosion, is highly channelized, and has a riparian area in poor ecological condition.	Design and implement a project limited to clean up of riparian areas, minimal restoration, replant w/natives, and maintain for 3 years to ensure establishment.	581	594	1,577
KCR12	Reach 12 exhibits moderate levels of erosion, is highly channelized, and has a riparian area in poor ecological condition.	Design, permit, and implement a project to remove invasive trees and shrubs, regrade banks as needed, remove concrete debris, replant slopes with natives, and maintain for 3 years to ensure establishment.	656	667	1,573
T1R1	Tributary 1, Reach 1 exhibits high levels of erosion, is not channelized, with a riparian area in average ecological condition.	Design, permit and implement a project to stabilize incised channel and highly eroded banks using combo of hard and soft armoring as necessary, install grade controls, plant with natives and maintain for 3 years to ensure establishment.	338	351	1,021

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ID #	Existing Condition	Management Measure Recommendation	Pollutant Reduction Efficiency		
			TSS (tons/yr)	TP (lbs/yr)	TN (lbs/yr)
T2R6	Tributary 2, Reach 6 exhibits moderate levels of erosion, is moderately channelized, and has a riparian area in poor ecological condition. There is a low head dam at the park entrance.	Design, permit, and implement a project to thin second growth invasive trees and shrubs, remove low head dam at park entrance, and maintain for three years.	234	252	754
T2R7	Tributary 2, Reach 7 exhibits low levels of erosion, is highly channelized, and has a riparian area in poor ecological condition. Much of this reach is buried underground.	Design, permit, and implement a project to thin second growth invasive trees and shrubs, daylight buried portion of stream, and maintain for three years.	80	88	423
TribA	Tributary A (to Tributary 2) exhibits high levels of erosion, is not channelized, and has a riparian area in average ecological condition.	Design, permit, and implement a project to pull back eroded banks, install grade controls throughout, thin invasives and maintain for 3 years to ensure establishment.	339	344	724
Wetland Restoration Sites					
13A	Farmed and/or tile-drained hydric soils confirmed in field as good candidate sight for potential wetland restoration and/or mitigation bank.	Design, permit, and construct a project to create wetland storage in farmed area by restoring hydrology via breaking drain tiles if necessary, excavating and installing water control structures for additional water storage, and revegetate with native vegetation.	5	13	116
15E	Farmed and/or tile-drained hydric soils confirmed in field as good candidate sight for potential wetland restoration and/or mitigation bank.	Design, permit, and construct a project to create wetland storage in farmed area by restoring hydrology via breaking drain tiles if necessary, excavating and installing water control structures for additional water storage, and revegetate with native vegetation.	28	51	597
20B	Farmed and/or tile-drained hydric soils confirmed in field as good candidate sight for potential wetland restoration and/or mitigation bank.	Design, permit, and construct a project to create wetland storage in farmed area by restoring hydrology via breaking drain tiles if necessary, excavating and installing water control structures for additional water storage, and revegetate with native vegetation.	23	49	482
Other Management Measures					
3A	Alpine Park - overgrown oak woodland along stream corridor.	Develop natural resource inventory and implement management plan.	79	125	1118
7A	Spillway area is mostly second growth woodland and scrub shrub with some (unused) turf areas in park.	Develop natural resource inventory and implement management plan.	31	58	353
8B	Spillway area is mostly second growth woodland and scrub shrub with some (unused) turf areas in park.	Develop natural resource inventory and implement management plan.	79	113	734
9B	Guilford County Forest Preserve/Midway Museum - second growth oak woodland, oldfield and mowed turf.	Develop natural resource inventory and implement management plan.	81	106	739
12E	Aldeen Golf Club is a typical golf course.	Design and implement a project to remove turf in rough areas and replace with native vegetation and maintain for three years to establish.	77	101	704

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KEITH CREEK WATERSHED PLAN
FIG 52: CRITICAL AREAS
Keith Creek Watershed Boundary
Keith Creek
Water
Critical Areas by Type
Detention Basin Retrofit
Wetland Restoration Recommendations
Stream & Riparian Area Restoration
Natural Area
Golf Course Retrofit
Municipality
City of Loves Park
City of Rockford
Village of Timberlane
WINNEBAGO
BOONE
20B
19B
17D
17F
16A
16C
KCR01
14A
15E
13A
12F
12G
12E
KCR04
9B
9D
9F
9E
T1R1
7A
8B
KCR06
T2R7
KCR07
T2R6
4A
T1R4A
3A
KCR08
KCR10
KCR11
KCR12
BUSINESS ROUTE 20
N PERRYVILLE RD
E RIVERSIDE BLVD
SPRING CREEK RD
N ALPINE RD
S ALPINE RD
S MULFORD RD
NEWBURG RD
CHARLES ST
HARRISON AVE
BROADWAY
RURAL ST
1ST AVE
11TH ST
KISHWAUKEE ST
S MAIN ST
AUBURN ST
MORGAN ST
CHESTNUT ST
WHITMAN ST
N CENTRAL AVE
HARLEM RD
S BELL SCHOOL RD
N BELL SCHOOL RD
251
139
20
ZION Development
res
ROCK
BOONE
OGLE
DEKALB
Sugar
Pecatonica
Middle Rock
Kishwaukee
Lower Rock
Rock
0
0.75
1.5
3 MILES
PROJECT #: 21-0005
COORDINATE SYSTEM: IL SP WEST NAD83 US FT
IMAGERY:
DATA SOURCES:

5.3 Watershed Impairment Reduction Targets

Establishing impairment reduction targets is important because these targets provide a means to measure how implementation of Management Measures at Critical Areas is expected to reduce watershed impairments over time. Table 34 summarizes the basis for *known* impairments and nonpoint source reduction targets. Reduction targets listed in Table 34 are based on documented information, STEPL modeling results, average water quality sampling results at the PR-02 (TP, TN, TSS) and T3 (fecal coliform) monitoring location, and water quality standards and criteria set by the Illinois Pollution Control Board (IPCB, 2011), USEPA (2000), and USGS (2006). It is important to note that the assumption is made that percent decrease in sample concentration (mg/l) needed correlates to the percent reduction in annual load (lbs/yr or tons/yr) for phosphorus, nitrogen, and total suspended solids reduction targets. In addition, Table 34 summarizes the load reduction of phosphorus and other known impairments expected from addressing Critical Areas.

Based on the results of the water quality inventory (as identified in Section 4.1), a 31% decrease in total phosphorus (TP) and a 1,024% decrease in fecal coliform is needed in Keith Creek from all sources combined to reach target levels based on recommended *numeric* criteria proposed by USEPA (USEPA 2000), USGS (USGS 2006) and IEPA (2011). No decrease in total nitrogen or total suspended solids is needed – TN and TSS are well within target criteria guidelines based on the water quality inventory.

Unfortunately, neither fecal coliform nor *E. coli* loading can be estimated via modeling, so a fecal coliform reduction target cannot be quantified. However, fecal coliform reductions will come as a result of implementing projects such as wetland restoration, vegetated swales, and septic/waste management systems. Wetland restorations or construction can reduce fecal coliforms by an average of 92% when installed between a field and a stream (Wolfson, 2015). In the case of septic systems, one study found that a full-scale septic tank/constructed wetland system reduced total coliforms by 37.4% with the septic tank alone and the constructed wetland reduced total coliforms by an additional 99.99% (Yelderman et. al, 2009). Vegetated swales reduce fecal coliform by 74% (Wolfson, 2015).

Watershed-Wide Reduction Targets

Watershed-wide phosphorus reduction targets could be attained by addressing Critical Areas alone according to the pollutant reduction calculations. Critical Areas alone would remove 4,410 lbs/yr (109% of the target) of phosphorus. **No estimate is shown for total nitrogen or total suspended solids because, based on IEPA data and the water quality inventory, these pollutants are below threshold limits;** however, Critical Area recommendations alone would remove approximately 16,403 lbs/yr of nitrogen and 3,947 tons/yr of total suspended solids from the watershed.

Additional watershed-wide reduction targets were established for habitat degradation, hydromodification and flow changes, and structural flood damage. Habitat degradation and hydromodification and flow changes targets could be met by implementing riparian area restoration and by restoring wetlands. Structural flood damage will continue to be addressed on a case-by-case basis within the flood problem area along Keith Creek.

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Table 34. Basis for *known* impairments, reduction targets, & impairment reduction from Critical Areas.

Impairment: Cause of Impairment	Basis for Impairment	Nonpoint Source Reduction Target	Reduction from Critical Area*	Target Attainable?
Watershed-Wide Reduction Targets				
Water Quality/Aquatic Life: Phosphorus in Keith Creek	13,018 lbs/yr of phosphorus loading based on STEPL model loading; 0.095 mg/l of total phosphorus average water quality samples	**>31% or 4,036 lbs/yr reduction in phosphorus** loading to achieve 0.0725 mg/l total phosphorus USEPA numeric criteria for streams in Ecoregion VI	325 lbs/yr or 8% reduction from critical detention basins 3,469 lbs/yr or 86% reduction from critical stream & riparian area reaches 113 lbs/yr or 3% reduction from critical wetland restorations 503 lbs/yr or 12% reduction from critical other management measures	
TOTAL			**4,410 lbs/yr or 109% total phosphorus reduction from all Critical Areas**	**Yes**
Water Quality/Primary Contact Recreation: fecal coliform in Keith Creek	Fecal coliform loading cannot be calculated via STEPL model & 2,248 CFU/100ml in water quality samples for Keith Creek (T3/PR-02)	**>1,024% reduction in fecal coliform** from all sources to achieve 200 CFU/100ml based on IEPA general use standard	Pollutant reduction cannot be assessed via modeling, but fecal coliform and pathogen reductions will occur by implementing programmatic recommendations, wetland restoration, vegetated swales, and septic/waste management systems	Cannot be calculated
Water Quality/Aquatic Life Habitat Degradation: Alteration in stream-side or littoral vegetative covers, invasive/non-native plant species in riparian areas and loss and fragmentation of open space/natural habitat	58,678 lf of riparian areas are currently in poor condition	**29,678 linear feet or 50% of riparian areas** ecologically restored	53,202 lf or 91% of riparian areas restored along critical riparian areas	**Yes**
Hydromodification and Flow Changes	Increase in flow and channel volumes; 1,003 acres (95%) of wetlands lost since pre-settlement	**3 critical wetlands restored** accounting for 142.2 acres	142.2 critical wetland acres restored	**Yes**
Structural Flood Damage	Structures in 100-year floodplain and flood problem area	flood problem areas addressed on case-by-case basis	Not Applicable*	**Yes**

* Addressed in Action Plan section of report

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6.0 MANAGEMENT MEASURES ACTION PLAN

Earlier sections of this plan summarized the Keith Creek watershed's characteristics and identified causes and sources of watershed impairment. This section includes an "Action Plan" developed to provide stakeholders with recommended "Management Measures" (Best Management Practices) to specifically address plan goals at both watershed-wide and site-specific scales. The Action Plan is divided into two subsections:

- *Programmatic Measures:* general remedial, preventive, and policy watershed-wide Management Measures that can be applied across the watershed by various stakeholders.
- *Site-Specific Measures:* actual locations where Management Measure projects can be implemented to improve surface and groundwater quality, green infrastructure, and flooding.

The recommended programmatic and site-specific Management Measures provide a solid foundation for protecting and improving watershed conditions and should be updated as projects are completed, or other opportunities arise. Lead implementation stakeholders are encouraged to organize partnerships and develop various funding arrangements to help delegate and implement the recommended actions. Key stakeholders in the watershed are listed in Table 35. Note: all recommendations in this Section are for guidance only and not required by any federal, state, or local agency.

Table 35. Key Keith Creek watershed stakeholders/partners.

Key Watershed Stakeholder/Partner	Abbreviation
Boone County	Boone
Boone County Conservation District	BCCD
Boone County Soil & Water Conservation District	BCSWCD
City of Loves Park	Loves Park
City of Rockford	Rockford
Four Rivers Sanitation Authority	FRSA
Golf Courses	GC
Illinois Department of Natural Resources	IDNR
Illinois Environmental Protection Agency	IEPA
Illinois Tollway	Tollway
Keith Creek Watershed Steering Committee	Steering
Midway Village	MV
Miracle Mile Rockford	Miracle Mile
Patriot's Gateway Center	Patriot
Region 1 Planning Council	R1PC
Rockford Area Convention & Visitor's Bureau	RACVB
Rockford Park District	Parks
United States Army Corps of Engineers	USACE
United States Fish & Wildlife Service	USFWS
Village of Timberlane	Timberlane
Winnebago County	Winnebago
Winnebago County Highway Department	WCHD
Winnebago County Soil & Water Conservation District	WCSWCD
ZION Development Corp.	ZION

6.1 Programmatic Management Measures Action Plan

Numerous types of programmatic Management Measures are recommended to address watershed objectives for each plan goal. The following pages include recommended measures that are applicable throughout the watershed and information needed to facilitate implementation of specific actions. A summary of the general programmatic measure types is included below:

Policy: Local, state, and federal government can help prevent watershed impairments in various ways through policy but specifically by adopting and/or supporting (via a resolution) the Keith Creek Watershed-Based Plan, implementing green infrastructure policy, requiring conservation developments for new developments, protecting groundwater, reducing road salt usage and lawn fertilizers, requiring natural detention basins and naturalization of existing basins, and allowing use of native vegetation/landscaping.

Non-Structural: This includes a broad group of practices that prevent impairment through maintenance and management of Management Measures or programs that are ongoing in nature and designed to control pollutants at their source. Such programs include the Audubon Cooperative Sanctuary Program (ACSP) for golf courses, many of the agricultural programs available to farmers, and street sweeping.

Structural: This includes a broad group of practices that prevent impairment via installation of in-the-ground measures. This plan focuses on implementation of stream and riparian area restoration, naturalized stormwater measures/retrofits, natural area restoration, wetland restoration, and use of rainwater harvesting devices.

Educational: Outreach is important to inform the public related to environmental impacts of daily activities and to build support for watershed planning and plan implementation. Topics typically address watersheds, water quality, land management, pet waste management, lawn fertilizer use, good housekeeping, etc.

6.1.1 Policy Recommendations

Various recommendations are made throughout this report related to how local governments can improve the condition of Keith Creek watershed through policy. Policy recommendations focus on improving watershed conditions by sustainable management of stormwater, preserving green infrastructure, protecting groundwater, minimizing road salts, minimizing lawn fertilizer, and allowances for native landscaping. To be successful, the Keith Creek Watershed-Based Plan would need to be adopted and/or supported by local communities. The process of creating and implementing policy changes can be complex and time consuming. And, although there are numerous possible policy recommendations for the watershed, the following policy recommendations are considered the most important and highest priority for implementation.

Plan Adoption & Implementation Policy Recommendations

- Watershed Partners adopt and/or support (via a resolution) the Keith Creek Watershed-Based Plan and incorporate plan goals, objectives, and recommended actions into comprehensive plans and ordinances.

Green Infrastructure Network Policy Recommendations

- Each municipality consider incorporating the identified Green Infrastructure Network (GIN) into comprehensive plans and development review maps.
- Utilize tools such as protection overlay zones, setbacks, open space zoning, conservation easements, conservation and/or low impact development, etc. in municipal comprehensive plans and zoning ordinances to protect environmentally sensitive areas within identified Green Infrastructure Network parcels.
- Utilize tools such as Development Impact Fees, Stormwater Utility Taxes, Special Service Area (SSA) Taxes, etc. to help fund implementation of plan and future management of green infrastructure components where new and redevelopment occurs.
- Require developers to protect sensitive natural areas, restore degraded natural areas and streams, and then encourage donation of all natural areas and naturalized stormwater management systems to a public agency or conservation organization for long term management with dedicated funding such as Development Impact Fees, Stormwater Utility Taxes, Special Service Area (SSA) Taxes, etc. In general, it is not recommended that these features be turned over to HOA's to manage, as they lack the resources and experience to do so effectively.
- Establish incentives for developers who propose sustainable or innovative approaches to implement the watershed-based plan, including priority for preserving green infrastructure and using naturalized stormwater treatment trains.
- Require mitigation for all wetlands lost prior to allowing development within the watershed.

Groundwater Policy Recommendations

- Encourage extensive stormwater management practices that clean and infiltrate water in any development or redevelopment.
- Limit impervious cover within new and redevelopments occurring within Subwatershed Management Units 4 and 6 which are ranked as highly vulnerable to future impervious cover.

Road Salt Policy Recommendations

- Each local government supplements existing programs with deicing best management practices such as utilizing alternative deicing chemicals, anti-icing or pretreatment, controlling the amount and rate of spreading, controlling the timing of application, utilizing proper application equipment, equipment calibration, and educating/training deicing employees.
- Establish additional new best management practice recommendations based on the results of various ongoing studies and research being produced by Illinois Tollway to reduce, re-use, and offset the impacts of winter roadway operations. These include converting invasives to energy, to harvest cattails for the purpose of removing excess nutrients, potentially quantifying chloride removal, re-using the plant mass for compost or compressed into an Energy product or potentially using the byproducts of the biomass as a replacement for beet juice on roadways (Illinois Tollway, 2019; Paap, 2019; and Wetlands Research, 2019).

Lawn Fertilizer and Paving Policy Recommendations

- Local governments extend phosphorus regulation to all non-commercial applicators, require soil testing pre-application, or ban out-right.
- Local governments ban coal tar sealants within their jurisdiction.
- Local governments permit the use of pavement alternatives such as permeable pavers in appropriate areas.

Stormwater Management Policy Recommendations

- Require new development and redevelopment to use stormwater management techniques/ facilities that serve multiple functions including storage, water quality benefits, infiltration, and wildlife habitat.
- Require reduced runoff volume from new and retrofitted detention basins.
- Local governments allow stormwater trees or create a stormwater tree program.

Native Landscaping/Natural Area Restoration

- Allow native landscaping within local ordinances.
- Ensure local "weed control" ordinances do not discourage or prohibit native landscaping.
- Include short- and long-term management with performance standards for restored natural areas and stormwater features within new and redevelopment.

6.1.2 Detention Basin Design/Retrofits, Establishment, & Maintenance

Detention basins are best described as human made depressions for the temporary storage of stormwater runoff with controlled release following a rain event. Thirty-one detention basins in Keith Creek watershed were assessed and most are associated with residential and urban development. Most existing dry bottom basins are planted with turf grass from end to end, and the majority of the wet bottom basins are similarly planted with turf grass along slopes and buffers. These attributes do not promote water quality improvement, good infiltration, or wildlife habitat capabilities. Studies conducted by several credible entities over the past two decades reveal the benefits of detention basins that serve multiple functions. According to USEPA, properly designed dry bottom infiltration basins reduce total suspended solids (sediment) by 58%, total phosphorus by 26%, and total nitrogen by 30%. Wet bottom basins designed to have wetland characteristics reduce total suspended solids (sediment) by 78%, total phosphorus by 44% and total nitrogen by 20% (MDEQ, 1999).

Detention Basin Recommendations

Future detention basin design within the watershed should consist of naturalized basins that serve multiple functions, including appropriate water storage, water quality improvement, natural aesthetics, and wildlife habitat. There are also

many opportunities to retrofit existing dry or wet bottom detention basins by incorporating minor engineering changes and naturalizing with native vegetation. Site-specific retrofit opportunities are identified in the Site-Specific Action Plan. Generalized location, design, establishment, and long-term maintenance recommendations for naturalized detention basins are included below. Note: local stormwater ordinance requirements, such as volume and release rates, will apply to the design recommendations included below.

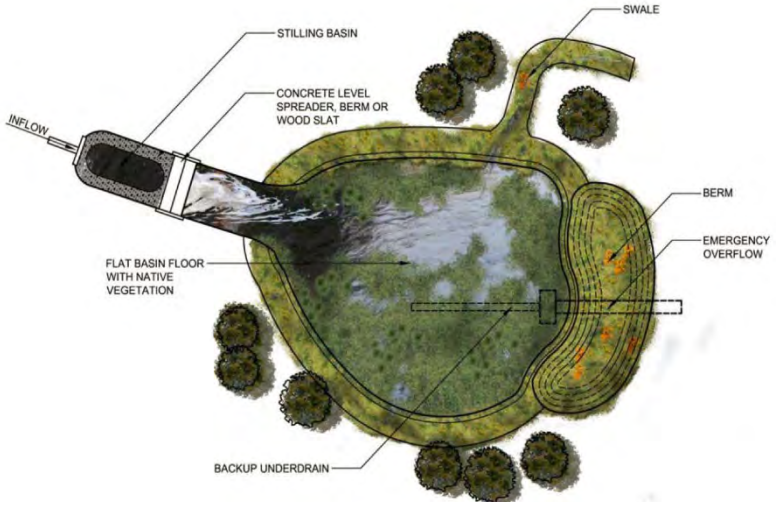


Figure 53. Naturalized dry bottom infiltration basin design.

Detention Location Recommendations

- Naturalized detention basins should be restricted to natural depressions or previously drained hydric soil areas and adjacent to other existing green infrastructure to aesthetically fit and blend into the landscape. Use of existing isolated wetlands for detention should be evaluated on a case-by-case basis.
- Basins should not be constructed in any average to high quality ecological community.
- Outlets from detentions should not enter sensitive ecological areas.

Detention Design Recommendations

- One appropriately sized, large detention basin should be constructed across multiple development sites rather than constructing several smaller basins.
- Side slopes should be no steeper than 4H:1V, at least 25 feet wide, planted to native mesic prairie, and stabilized with erosion control blanket. Native oak trees *(Quercus sp*.) and other fire-tolerant species should be the only tree species planted on side slopes.
- Dry bottom basins should be planted to mesic or wet-mesic prairie depending on site conditions.
- A minimum 5-foot-wide shelf planted to native wet prairie and stabilized with erosion control blanket should be constructed above the normal water level in wet and wetland bottom basins. This area should be designed to inundate after every 0.5-inch+ rain event.
- A minimum 10-foot-wide shelf planted with native emergent plugs should extend from the normal water level to 2 feet below normal water level in wet and wetland bottom basins.

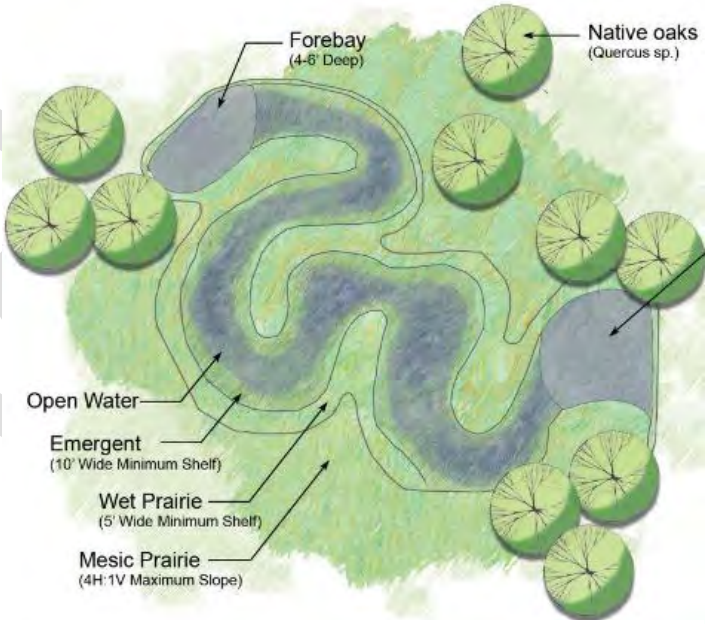


Figure 54. Naturalized wet bottom basin design.

- Permanent pools in wet and wetland bottom basins should be at least 4 feet deep.
- Irregular islands and peninsulas should be constructed in wet and wetland bottom basins to slow movement of water and should be planted to native mesic or wet prairie depending on elevation above normal water level.
- A 4-6-foot-deep forebay, accessible to maintenance crews, should be built at inlet(s) of wet/wetland bottom basins to capture sediment; a 4-6-foot-deep micropool should be constructed at the outlet to prevent clogging.

Short Term (3 Years) Native Vegetation Establishment Recommendations

In most cases, the developer or owner should be responsible for implementing short term management of detention basins and other natural areas to meet a set of performance standards. A minimum of three years of management is needed to establish native plant communities within detention basins. Measures needed include mowing during the first

two growing seasons following seeding to reduce annual and biennial weeds. Spot herbiciding is also needed to eliminate problematic non-native/invasive species such as thistle, reed canary grass, common reed, purple loosestrife, and emerging cottonwood, willow, buckthorn, and box elder saplings. In addition, the inlet and outlet structures should be checked for erosion and clogging during every site visit. Table 36 includes a three-year schedule appropriate to establish native plantings around naturalized detention basins.

Table 36. Three-year vegetation establishment schedule for naturalized detention basins.

Year 1 Establishment Recommendations
Mow prairie areas to a height of 6-12 inches in May, July, and September.
Spot herbicide non-native/invasive species throughout site in late May and again in August/September. Target thistle, reed canary grass, common reed, purple loosestrife, and all emerging woody saplings.
Check for clogging and erosion control at inlet and outlet structures during site visit & after >1" rain event.
Year 2 Establishment Recommendations
Mow prairie areas to a height of 12 inches in June and August.
Spot herbicide non-native/invasive species throughout site in May and again in August/September. Target thistle, reed canary grass, common reed, purple loosestrife, and all emerging woody saplings.
Plant additional emergent plugs if needed and reseed any failed areas in fall.
Check for clogging and erosion control at inlet and outlet structures during site visit & after >1" rain event.
Year 3 Establishment Recommendations
Spot herbicide non-native/invasive species throughout site in May and again in August/September. Target thistle, reed canary grass, common reed, purple loosestrife, and all emerging woody saplings.
Check for clogging and erosion control at inlet and outlet structures during site visit & after >1" rain event.

Long Term (3 Years +) Native Vegetation Maintenance Recommendations

Long term management of most detention basins associated with development should be the responsibility of the homeowner or business association or local municipality. Often, these groups lack the knowledge and funding to implement long term management of natural areas resulting in the decline of these areas over time. Future developers should be encouraged to donate naturalized detention basins and other natural areas to a local municipality or conservation organization for long term management who receive funding via a Special Service Area (SSA) tax. Table 37 includes a cyclical long-term schedule appropriate to maintain native vegetation around detention basins; this schedule starts in year 4 and should be repeated every three years.

Table 37. Three-year cyclical schedule for long-term maintenance of naturalized detention basins.

Year 1 of 3 of Maintenance Cycle
Conduct controlled burn in early spring. Mow to height of 12 inches in November if burning is restricted.
Spot herbicide problematic non-native/invasive species throughout site in mid-August. Specifically target thistle, reed canary grass, common reed, and emerging woody saplings such as willow, cottonwood, buckthorn, and box elder.
Check for clogging and erosion control at inlet and outlet structures during site visit & after >1" rain event.
Year 2 of 3 of Maintenance Cycle
Spot herbicide problematic non-native/invasive species throughout site in August. Specifically target thistle, reed canary grass, common reed, and emerging woody saplings such as willow, cottonwood, buckthorn, and box elder.
Mow prairie areas to a height of 6-12 inches in November.
Check for clogging and erosion control at inlet and outlet structures during site visit & after >1" rain event.
Year 3 of 3 of Maintenance Cycle
Spot herbicide problematic non-native/invasive species in August. Specifically target thistle, reed canary grass, common reed, and emerging woody saplings. Cutting & herbiciding stumps of some woody saplings may also be needed.
Check for clogging and erosion control at inlet and outlet structures during site visit & after >1" rain event.
Cycle begins again with Year 1 of Maintenance Cycle above

6.1.3 Rain Gardens

Rain gardens have become a popular way of creating a perennial garden that cleans and infiltrates stormwater runoff from rooftops and sump pump discharges. A rain garden is a small shallow depression that is typically planted with deep rooted native wetland vegetation. These small gardens can be installed in a variety of locations but work best when located in existing depressional areas or near gutters and sump pump outlets. Not only do rain gardens clean and infiltrate water, they also provide food and shelter for many birds, butterflies, and insects. Rain gardens are typically 100-300 square feet in size, should be installed outside of wetlands and floodplains, and planted with native plants to improve water quality and habitat benefits. They should be placed at least 10 feet away from any building or structure and need to be excavated to a depth of 18-24 inches below the exiting grade. Soil amendments are usually required to ensure support of native plants. After installation, rain gardens require ongoing maintenance to ensure they are performing properly.



Rain garden adjacent to single family home

The intent of a rain garden program for residents is to encourage and provide an incentive for applicants to install rain gardens on private property to "micro-manage" stormwater runoff as close to the source (like downspouts, driveways, sump pump discharges) as possible. Typically, this incentive comes in the form of a cost-share program designed to reimburse residents for a portion of the costs incurred by installing a rain garden on their property.

Rain Garden Recommendations

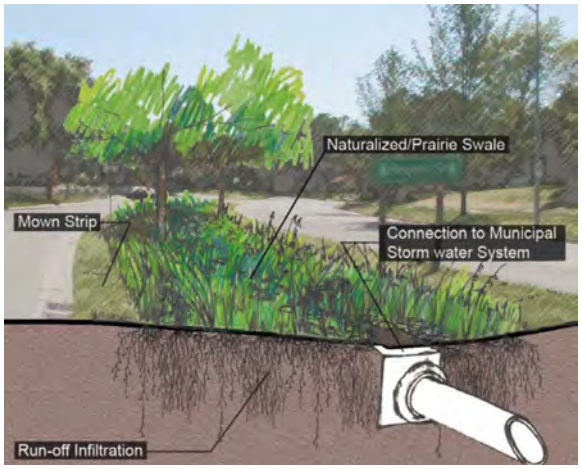
Information programs in the watershed should focus on teaching residents and businesses the beneficial uses of rain gardens and how to build and maintain them. Local governments and public agencies in the watershed should also install demonstration rain gardens as a way for the public to better understand their application. Local governments and agencies could hold rain garden training seminars and potentially provide partial funding to residents and businesses that install rain gardens.

6.1.4 Vegetated Swales (Bioswales)

Vegetated swales, also known as bioswales, are designed to convey water and can be modified slightly to capture and treat stormwater. Vegetated swales are designed to remove suspended solids and other pollutants from stormwater as it flows through. The type of vegetation can dramatically affect the functionality of the swale - turf grass is not recommended because it removes less suspended solids than native plants. Vegetated swales can also serve as aesthetic features along roads or trails and can be planted with wetland plants, or a mixture of rocks and plant materials to provide interest.

Swales can be designed as either wet or dry swales. Dry swales include an underdrain system that allows filtered water to move quickly through the stormwater treatment train. Wet swales retain water in small wetland like basins along the swale. Wet swales act as shallow, narrow wetland treatment systems and are often used in areas with poor soil infiltration or high-water tables.

Water quality is improved by filtration through engineered soils in dry swales and through sediment accumulation and biological systems in wet swales. According to USEPA, vegetated swales reduce total suspended solids (sediment) by 65%, total phosphorus by 25%, and total nitrogen by 10% (MDEQ, 1999).



Rendering of dry vegetated swale with engineered soils

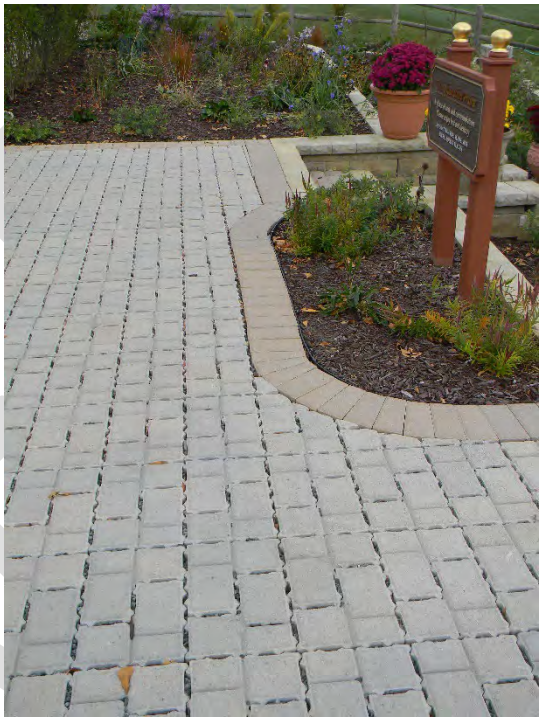
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Vegetated Swale Recommendations

Vegetated swales should be used in place of pipes or curbs in new and redevelopment where feasible. Swales can easily be integrated into various urban fabrics with curb cuts for water to access them from roadways, or they can be added between existing lots or in the grassy parkways between roads and sidewalks. Typically, swales are used in lower density settings where infiltration might be maximized. Dry swales should be used for smaller development areas with small drainages. Wet swales should be used along larger roadways, small parking areas, and commercial developments.

6.1.5 Pavement Alternatives

Pervious concrete, permeable asphalt, and paver systems are potential alternatives to conventional asphalt or concrete parking lots and roadways. These alternatives allow for natural infiltration of the water by allowing water that falls on the surface to flow to a storage gallery through holes in the pavement. Areas that are paved with pervious pavement produce less stormwater runoff than conventionally paved areas.



Pervious pavers installed adjacent to a park

Traditionally, the quantity and quality of water running off paved and other impermeable surfaces are the primary reason for the need for stormwater treatment. Pavement alternatives reduce runoff rates and volumes and can be used in almost every capacity in which traditional asphalt, concrete, or pavers are used.

Pavement alternatives capture first flush rainfall events and allow water to percolate into the ground. Pavement alternatives treat stormwater through soil biology and chemistry as the water slowly infiltrates. Groundwater and aquifers are recharged and water that might otherwise go directly to streams will slowly infiltrate, reducing flooding and peak flow rates entering drainage channels. Studies documented by USEPA show that properly designed and maintained pervious pavements reduce total suspended solids (sediment) by 90%, total phosphorus by 65%, and total nitrogen by 85% (MDEQ, 1999).

In recent years, concerns have been raised about the environmental effects of the use of coal-tar sealants. Coal-tar sealant is a surface treatment typically applied to protect asphalt on driveways and parking lots which contains polycyclic aromatic hydrocarbons (PAHs). PAHs are a group of chemicals that have been linked to cancer in humans and have been shown to be toxic to aquatic life and damaging to the environment (Needleman, 2015). According to studies, "PAHs are significantly elevated in stormwater flowing from parking lots and other areas where coal-tar sealcoats were used as compared to stormwater flowing from areas not treated with the sealant (USEPA, 2016a)." Pervious concrete, permeable asphalt, and paver systems are all potential alternatives to the need for coal-tar sealants. Additionally, several states and municipalities have banned the use and/or sale of coal-tar sealants to further protect their communities.

Pavement Alternatives Recommendations

Future development and redevelopment in the Keith Creek watershed should consider the use of pavement alternatives, particularly for parking lots that receive high levels of public use. Pavement alternatives can be used in a variety of settings including parking lots, parking aprons, private roads, fire lanes, alleys, residential driveways, sidewalks, and bike paths. It is important to note that there are limitations to using pavement alternatives based on subsoil composition and they do require annual maintenance to remain effective over time.

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6.1.6 Vegetated Filter Strips

Vegetated filter strips are shallowly sloped vegetated surfaces that remove suspended sediment, and nutrients from sheet flow stormwater that runs across the surface. This Management Measure is often referred to as a buffer strip. The type of vegetation can dramatically affect the functionality of the filter strip. Filter strips can either be planted or comprised of existing vegetation. Turf grass should be avoided as it removes less total suspended solids than filter strips planted with native vegetation.



Filter strip along municipal building in Algonquin, Illinois

The wider they are the more effective filter strips are because the amount of time water has for interception/ interaction with the plants and soil within the filter strip is increased. When installed and functioning properly, the USEPA has documented that filter strips can reduce total suspended solids (sediment) by 73%, total phosphorus by 45%, and total nitrogen by 40% (MDEQ, 1999).

Vegetated Filter Strip Recommendations

Vegetated filter strips work in a variety of locations. Vegetated filter strips in rural and urban areas should be installed along streams, lakes, or ponds. Additionally, they can be used adjacent to buildings and parking lots that sheet drain. The water would then pass through the vegetated filter strip and eventually into a waterway or other stormwater feature.

6.1.7 Natural Area Restoration & Native Landscaping

Natural area restoration and native landscaping are essentially one in the same but at different scales. Natural area restoration involves transforming a degraded natural area into one that exhibits better ecological health and is typically done on larger sites such as parks or nature/forest preserves. Native landscaping is done at smaller scales around homes or businesses and is often more formal in appearance. Both require the use of native plants to create environments that mimic historic landscapes such as prairie, woodland, and wetland. Native plants are defied as indigenous, terrestrial, or aquatic plant species that evolved naturally in an ecosystem. The use of native plants in natural area or native landscaping is well documented. They adapt well to environmental conditions, reduce erosion, improve water quality, promote water infiltration, do not need fertilizer, provide wildlife food and habitat, and have minimal maintenance costs.



Native landscaping near residential home

Several environmental agencies support the use of native plants including Illinois Nature Preserves Commission (INPC), Illinois Department of Natural Resources (IDNR), Winnebago County Soil & Water Conservation District, Boone County Conservation District, U.S. Department of Agriculture (USDA), Natural Resources Conservation Service (NRCS), National Wildlife Federation (NWF), and the Conservation Foundation (TCF).

Natural Area Restoration/Native Landscaping Recommendations

Large residential lots with existing natural components such as oak woodlands and wetlands and golf courses provide many of the best opportunities for natural area restoration and native landscaping at a larger scale. Homeowners interested in restoring natural areas or implementing native landscaping can find guidance through the agencies listed

above or by contacting a local ecological consulting company. Backyard habitats can be certified through the National Wildlife Federation's Certified Wildlife Habitat program or Conservation Foundation's Conservation@Home program.

There are two golf courses in the watershed, and both are situated along Keith Creek within the identified Green Infrastructure Network. These golf courses could improve their function as green infrastructure by implementing natural area restoration into existing designs (for example, in the rough areas). The Audubon Cooperative Sanctuary Program (ACSP) is an education and certification program that helps golf courses protect the environment by providing guidance for outreach and education, resource management, water quality and conservation, and wildlife habitat management. A golf course becomes certified under the program when implementing and documenting recommended environmental management practices. Annual program membership fees are $200. Mauh-Nah-Tee-See Club is already designated as a Certified Audubon Cooperative Sanctuary.

6.1.8 Wetland Restoration

Approximately 1,003 acres or 95% of the historic wetlands in Keith Creek watershed have been lost to development and or farming practices since European settlement in the 1830s. Wetlands are essential for water quality improvement and flood reduction in any watershed and provide habitat for a wide variety of plant and animal species.



Wetland restoration at Carrington Reserve Conservation Development in West Dundee, Illinois

Approximately 142 acres of drained wetlands were discovered in areas of the watershed where wetland restoration might be possible. These areas are located on land that is currently in agricultural production and in some cases, areas slated for future residential or commercial/retail development. The wetland restoration process involves returning hydrology (water) and vegetation to soils that once supported wetlands. The USEPA estimates that wetland restoration projects can reduce suspended solids (sediment) by 77.5%, total phosphorus by 44%, and total nitrogen by 20% (MDEQ, 1999).

Wetland Restoration Recommendations

Local governments should strongly consider requiring "Conservation Design" that incorporates wetland restoration on parcels slated for future development. Another potential option is to restore wetlands as part of a wetland mitigation bank where wetlands are restored on private land and become "fully certified." Then, developers are able to buy wetland mitigation credits from the wetland bank for wetland impacts occurring elsewhere in the watershed. It is also possible that in the future, Illinois EPA may require more strict nutrient policies for wastewater treatment plants. Wetland banks may provide an opportunity for WWTP owners to buy "water quality trading credits."

6.1.9 Stormwater Trees/Tree Planting Program

Trees provide extensive evapotranspiration and cooling benefits, improve water and air quality, provide habitat, increase property values, and improve aesthetics in urban landscapes (see Figure 55). Trees play a valuable role in trapping absorbing stormwater, reducing pollutants, and holding soils in place during rain events and help to recharge groundwater supplies. A 25-foot canopy diameter tree can process the runoff of a 2,400 square foot adjacent impervious surface (USEPA, 2016b). Depending on size and species, one tree can store 100 gallons or more of stormwater (Fazio, 2010).

Implementing a successful stormwater tree program can be complicated. Space and soil quality constraints can often be the limiting factors on whether a site is appropriate for installing stormwater trees. Other constraints include finding an

appropriate species of tree, steep slopes, utility lines, impervious surfaces, and pre-existing structures. With a little planning and engineering, many of these constraints can be overcome. In 2016, the USEPA produced a Technical Memorandum on Stormwater Trees that provides detailed information on the benefits and challenges to implementing an effective Stormwater Tree program and maintaining the trees over time. This report is available on the USEPA's website at https://www.epa.gov/green-infrastructure/stormwater-trees.

Municipalities in the watersheds should consider adopting a stormwater tree or tree planting program where these are not already in place.

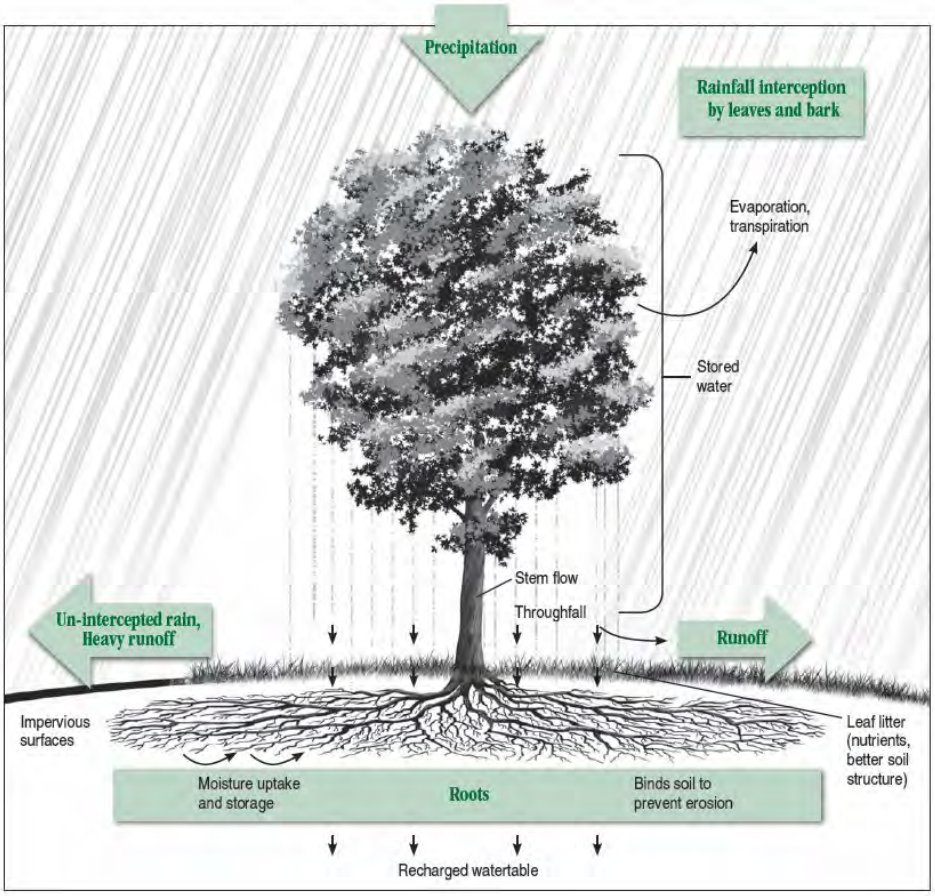


Figure 55. Illustration of how trees help with stormwater management (Source: Fazio, 2010).

6.1.10 Street Sweeping & Yard Waste Management

Street sweeping is often overlooked as a Management Measure option to reduce pollutant loading in watersheds. With over 1,605 acres dedicated to transportation and roads in the watershed, municipal street sweeping programs could significantly reduce non-point source pollutants from urban areas in Keith Creek watershed. Street sweeping works because pollutants such as sediment, trash, road salt, oils, nutrients, and metals that would otherwise wash into stormsewers and streams following rain events are gathered and disposed of properly. The USEPA and Center for Watershed Protection (CWP) report similar pollutant removal efficiencies for street sweeping; weekly street sweeping can remove between 9% and 16% of sediment and between 3% and 6% of nitrogen and phosphorus (MDEQ, 1999; CWP 2007).

Yard waste, such as grass clipping and leaf litter, can also impact water quality when not managed correctly. "Grasscycling and composting are two techniques homeowners can use to reduce waste disposal and possible water contamination as well as save time, money and energy while returning valuable nutrients back into their lawns and gardens. (Gibb, 2012)" Composting of yard waste and grasscyclying, or leaving grass clippings on a lawn, can keep nutrients such as nitrogen in place. When grasscycling or composting, it is important to keep clippings on the lawn and off sidewalks, driveways, or other impervious surfaces where they might otherwise get washed into adjacent drainage systems or become a safety hazard (Gibb, 2012).



Routine street sweeping is an effective Management Measure

Street Sweeping Recommendations

It is likely that several if not all of the municipalities in the watershed already implement street sweeping to some degree.

The frequency of street sweeping is a matter of time and budget and should be determined by each municipality. Weekly street sweeping would provide the best results but bi-weekly sweeping is cited as being sufficient in most cases. Homeowners should also compost yard waste and practice grasscycling at home.

6.1.11 Stream & Riparian Area Restoration & Maintenance

Streambank erosion is moderate to high in just over half of the watershed, mostly along Keith Creek upstream of the confluence with Tributary 2. Stream surveys reveal that about 52% (45,907 lf) of stream length in the watershed is moderate to highly eroded and 74% (65,490 lf) is moderately to highly channelized. Pollutant modeling indicates that over 3,955 tons/yr of sediment or 68% of sediment loading comes from eroded streambanks. In addition, riparian areas adjacent to streams are suffering as 67% are in poor ecological condition.



Stream restoration project in Barrington IL

Stream and riparian area restoration is one of the best Management Measures that can be implemented to improve degraded stream and riparian area conditions. This work involves improvements to a stream channel using artificial pool-riffle complexes, streambank stabilization using a combination of bioengineering with native vegetation and hard armoring with rock if needed, and adjacent riparian area improvements via removal of non-native vegetation and replacement with native species. These practices are typically done together to improve water quality by reducing sediment transport, increasing oxygen, and improving habitat. The USEPA cites that as much as 90% of sediment, phosphorus, and nitrogen can be reduced following stream restoration. The downside to stream restoration is that it is technical and expensive. Stream restoration projects include detailed construction plans, often complicated permitting, and construction that must be done by a qualified contractor.

With so many individual landowners with parcels intersecting Keith Creek and its tributaries, routine maintenance of stream systems is challenging. In many cases, landowners simply do not have the knowledge or are not physically capable of maintaining streams on their property. Stream maintenance includes an ongoing program to remove blockages caused by accumulated sediment, fallen trees, etc. and is a cost-effective way to prevent flooding and streambank erosion.

Riparian buffers are defined as land adjoining any water body including ponds, lakes, streams, and wetlands. In 2010 the Southeastern Wisconsin Regional Planning Commission

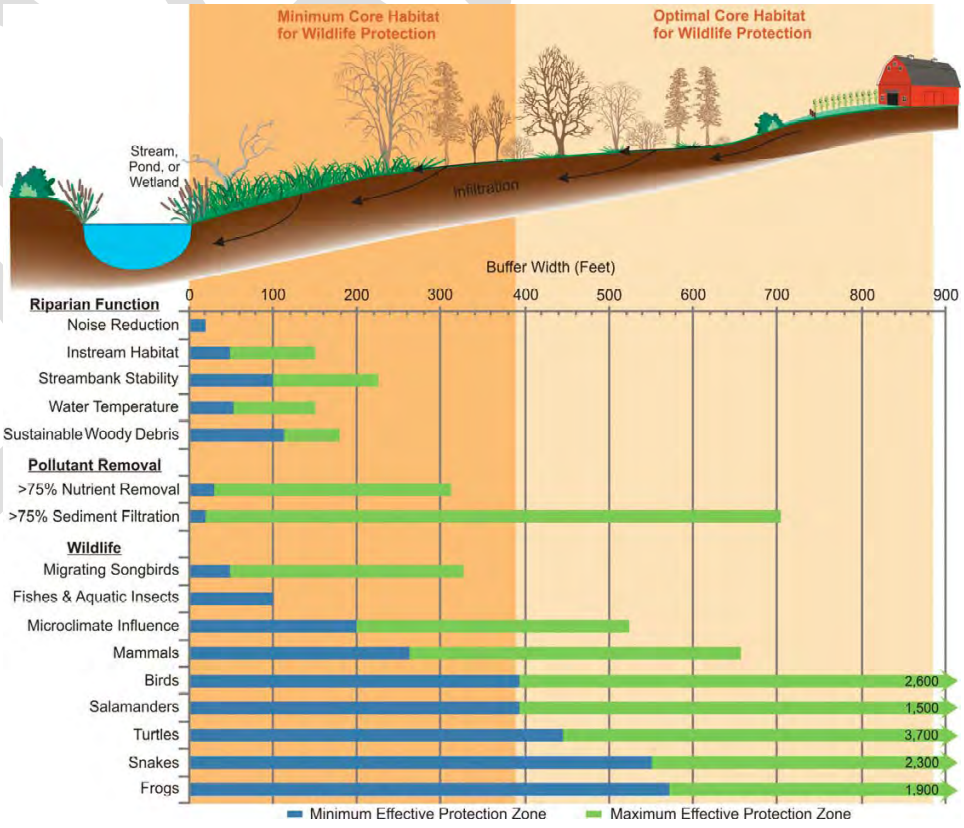


Figure 56. Riparian function, pollutant removal, and wildlife benefits for various buffer widths (Source: SEWRPC) 2010).

(SEWRPC) produced a document entitled "Managing the Water's Edge: Making Natural Connections" (SEWRPC, 2010). The research presented in SEWRPC's document was conducted to determine if an optimal riparian buffer design or width could be determined that effectively reduces pollutants, provides water quality protection, helps prevent channel erosion, provides adequate fish and wildlife habitat, enhances environmental corridors, augments baseflow, and moderates water temperature. Interestingly, no consensus of optimal buffer width could be determined but what is apparent is that many riparian corridors no longer fulfill their potential due to encroachment by agricultural and urban development. SEWRPC's document summarizes how to maximize both water quality protection and conservation of aquatic and terrestrial wildlife populations using buffers as shown in Figure 56.

As described in SERWPC's document, implementing the green infrastructure network to connect open space and other natural area features should be embraced, whereby 75% minimum of the total stream length should be naturally vegetated to protect the functional integrity of the water resource and 75-foot-wide minimum riparian buffers are recommended from the top edge of each stream bank that are naturally vegetated to protect water quality.

Stream & Riparian Area Recommendations
There are many opportunities to implement stream and riparian area restoration in the watershed. These opportunities are identified in the Site-Specific Action Plan. As far as stream maintenance goes, the Lake County Stormwater Management Commission (LCSMC) is a leader in the Chicago land area when it comes to managing stormwater and has developed an excellent guide for riparian owners called "Riparian Area Management: A Citizen's Guide." This short flyer can be found on Lake County's website and is intended to educate landowners about debris removal and riparian landscaping. It is also important to note that not all debris in streams is harmful. The American Fisheries Society has created a short document called "Stream Obstruction Removal Guidelines" which is meant to clarify the appropriate ways to maintain obstructions in streams to preserve fish habitat.

6.1.12 Septic System Maintenance
Septic systems are common within the more rural and unincorporated portions of the Keith Creek watershed; it is estimated that nearly 900 septic systems likely exist in the watershed. Septic systems in Winnebago County are regulated under the Wells and Septic Program of the Winnebago County Health Department and those in Boone County are regulated by the Boone County Health Department through their Environmental & Regulatory Services. When septic systems are not maintained and subsequently fail, they can contribute high levels of nutrients and bacteria to the surrounding environment. The failure rate of septic systems in the watershed is unknown. However, literature sources across the nation indicate a failure rate of approximately 20% (Brown, 1998; Mancl, 1984; Stout, 2003; UKCE, 2012). According to the pollutant loading analysis, septic systems are likely contributing 5,552 lbs/yr (9%) of total nitrogen loading and 2,175 lbs/yr (17%) of total phosphorus loading in the watershed.

Septic System Recommendations
Septic owners should contact the county health department to schedule a septic system inspection to ensure that they are designed and operating properly. More information and resources are available online for Winnebago County residents at https://www.wchd.org/environmental-health/wells-and-septic-program and https://www.boonecountyil.gov/government/departments/health_department/private_sewage_disposal.php in Boone County. USEPA also provides an excellent guide for septic system owners called "A Homeowner's Guide to Septic Systems (USEPA, 2005)." The guide explains how septic systems work, why and how they should be maintained, and what makes a system fail. Local governments should also conduct an inventory of septic systems within the watershed and the condition that they are in as well as hold educational workshops for septic system owners about proper maintenance techniques.

6.1.13 Agricultural Management Practices
The majority of the Keith Creek watershed is developed, with only 17.5% in agriculture. Pollutant loading estimates using USEPA's STEPL model point to cropland as contributing 4,256 lbs/yr of nitrogen (7% of total loads), 1,230 lbs/yr of phosphorus (9% of total loads), and 771 tons/yr of total suspended solids (13% of total loads). Watershed-wide changes to agricultural practices can have a substantial effect on pollutant loading in the watershed. Fortunately, there are numerous agricultural measures and funding sources that can be utilized by farmers to implement practices on their land

to improve water quality and soil health, while reducing soil and nutrient losses. Many recommended programs are offered through the Winnebago and Boone County Soil and Water Conservation Districts, U.S. Department of Agriculture (USDA) Natural Resource Conservation Program (NRCS), and Farm Service Agency (FSA). These agencies are discussed in depth in Section 3.5.

USDA NRCS- Environmental Quality Incentive Program (EQIP)
The NRCS's Environmental Quality Incentive Program (EQIP) is a voluntary conservation program that provides technical and financial assistance to individuals/entities to address soil, water, air, plant, animal, and other related natural resource concerns on their land. EQIP offers financial and technical help to assist participants to install or implement structural and management practices on eligible agricultural land. As the most popular and most utilized conservation program offered by NRCS, EQIP assists thousands of producers annually in working towards reducing contamination from agricultural sources such as animal feeding operations, efficiently utilizing nutrients and therefore reducing input costs and nonpoint source pollution, and increasing soil health to improve resiliency to drought and increasingly volatile weather.

This program is available to farmers, ranchers, and forest landowners who own or rent agricultural land. EQIP assistance can be used for agricultural operations such as: conventional and organic agriculture, specialty and commodity crops, forestry and wildlife, livestock operations, and historically underserved farmers. Historically underserved farmers including beginning farmers, farmers with limited resources or those in socially disadvantaged groups, as well as military veterans, are eligible for increased or advance payments following changes in the 2018 Farm Bill. Other expansions of EQIP under the 2018 Farm Bill include expanding eligibility regarding with whom NRCS can enter an EQIP contract. Under these expansions, NRCS can enter contracts with water management entities when they are in support of water conservation or an irrigation efficiency project. Eligible entities include States, irrigation districts, ground water management districts, or other similar entities.



Conservation Tillage (no till) farming

States may provide increased EQIP payment rates for high-priority practices. Eligible high-priority practices include those that address specific causes of ground or surface water impairment relating to excessive nutrients, address the conservation of water to advance drought mitigation and declining aquifers, meet other environmental priorities and other priority resource concerns identified in habitat or other area restoration plans, or is geographically targeted to address a natural resource concern in a specific watershed. NRCS State Conservationists may designate up to 10 practices to be eligible for increased payments. No-till is a land management option within the EQIP program and is the leading recommendation for farmers in Keith Creek watershed. With no-till, the land is left undisturbed from harvest through planting, preserving a canopy of crop residue on the surface to protect the soil from erosion. Along with soil conservation benefits, high fuel prices are driving a switch to no-till for many farmers. Eliminating tillage passes reduces both fuel and labor expenses (USDA, 2020).

Agricultural Conservation Easement Program (ACEP)
The Agricultural Conservation Easement Program (ACEP) was created in the 2014 Farm Bill through the combination of the previously separate Wetlands Reserve Program (WRP), Grassland Reserve Program (GRP), and Farm and Ranch Lands Protection Program (FRPP). These programs were originally ratified in 1990, 1996, and 2002 Farm Bills respectively. The

Agricultural Conservation Easement Program assists landowners, land trusts, and other entities protect, restore, and enhance wetlands, grasslands, and working farms and ranches through conservation easements. There are two components to ACEP, the Agricultural Land Easements component and the Wetland Reserve Easement component. The NRCS Agricultural Land Easements component helps American Indian tribes, state and local governments, and nongovernmental organizations protect working agricultural lands and limit non-agricultural uses of the land. NRCS Wetland Reserve Easements component, helps to restore, protect, and enhance enrolled wetlands through the purchase of easements and assistance in restoration (NSAC, 2019).

ACEP - Wetland Reserve Easements (WRE)
The Wetlands Reserve Easement program (WRE) is a voluntary program offering farmers the opportunity to protect, restore, enhance, and protect wetlands on their property. The NRCS provides technical and financial support to help landowners with their wetland restoration efforts. The goal of NRCS is to achieve the greatest wetland functions and values, along with optimum wildlife habitat, on every acre enrolled in the program. This program offers landowners an opportunity to establish long-term conservation and wildlife practices and protection. Land that's eligible for enrollment in ACEP as a Wetland Reserve Easement includes farmed or converted wetland that can be successfully restored as natural wetland habitat in a cost-effective manner. NRCS prioritizes applications for Wetland Reserve Easements based upon their potential for protecting and enhancing habitat for migratory birds and other wildlife. NRCS enters into purchase agreements with eligible landowners which include the right to develop and implement a wetland reserve restoration easement plan. These plans aim to restore, protect, and enhance the functions and value of the site's wetlands.

Landowners who choose to enroll land in a Wetland Reserve Easement may sell a conservation easement or enter into a cost-share restoration agreement with NRCS to restore and protect wetlands. These easement options include:

- Permanent Easements – These are conservation easements in perpetuity, with NRCS paying 100 percent of the value of the easement to purchase it, and 75 to 100 percent of the cost to restore it.
- 30-Year Easements – Under 30-year easements, NRCS pays 50 to 75 percent of the value of the easement to purchase it, and 50 to 75 percent of the cost to restore it.
- Term Easements – The length of term easements is determined by applicable state laws. NRCS pays 50 to 75 percent the value of the easement to purchase, and 50 to 75 percent of the cost to restore it.
- 30-Year Contracts – 30-year contracts are only available to enroll acreage owned by American Indian Tribes, and program payment rates are similar to that of 30-year easements.

Landowners and NRCS then develop a plan for the restoration and maintenance of the wetland. As a requirement of the program, landowners voluntarily limit future use of the land, yet retain private ownership. ACEP's wetlands component also includes a wetlands reserve enhancement partnership option (formerly known as the Wetlands Reserve Enhancement Program, WREP) through which NRCS partners with states, non-governmental organizations, or Native American Tribes to protect, restore, and enhance high priority wetlands. This partnership option is a voluntary program in which NRCS, and eligible partners sign an agreement to leverage resources in restoring high priority wetland protection, restoration, and enhancement to improve habitat for migratory birds and other wildlife. Benefits include wetland restoration and protection of critical areas, ability to cost-share restoration or enhancement beyond NRCS requirements through leveraging resources, and the ability to participate in the management and monitoring of projects with the support of the NRCS's expertise in restoration practices.

Wetland reserve easements enable landowners to reduce impacts from flooding, recharge groundwater, enhance and protect wildlife habitat and provide outdoor recreational and educational opportunities. As with the original WREP, producers can retain grazing rights as part of a wetland easement if the grazing activity is consistent with long-term wetland protection and enhancement goals for which the easement was established. The easement payment would be reduced by an amount equal to the grazing value (USDA, 2020).

ALE- Agricultural Land Easements (ALE)
The purpose of the Agricultural Land Easement (ALE) component is to protect farms and ranches from development, specifically to ensure farm viability for future generations, and to conserve grazing land, rangeland, pasture and shrub

land. NRCS provides financial assistance to eligible partners for purchasing Agricultural Land Easements that protect the agricultural use and conservation values of eligible land. In the case of working farms, the program helps farmers and ranchers keep their land in agriculture. The program also protects grazing uses and related conservation values by conserving grassland, including rangeland, pastureland and shrubland. Eligible partners include American Indian tribes, state and local governments and non-governmental organizations that have farmland, rangeland, or grassland protection programs. For Agricultural Land Easements, NRCS can contribute up to 50 percent of the fair market value of the agricultural land easement. Where NRCS determines that grasslands of special environmental significance will be protected, NRCS may contribute up to 75 percent of the fair market value of the agricultural land easement. Eligible entities can now include cash contributions, landowner contributions, or other non-USDA federal funding to satisfy the match requirements.

The 2018 Farm Bill removed the requirement that all agricultural land easement enrollments under ACEP must have a conservation plan, it is now required only for the portions of the agricultural land easement that are highly erodible cropland. Additionally, the 2018 Farm Bill adds a new priority in evaluating proposals for easements that maintain agricultural viability. This priority includes easements that allow a producer to productively operative a farm or ranch on the protected land; maintain the long-term affordability of the protected land; maintain an economically sustainable farm business on the land; and maintain the land in a way that enables its agricultural use for future generations. The 2018 Farm Bill also allows for entities holding an ALE to add deed terms that address mineral development. In instances when mineral development rights are reserved and exercised under ACEP, the activity should be consistent with the conservation and agricultural purposes of the land and all provisions of the program. Under the agricultural land easement component, ACEP funds are provided to non-profits (such as land trusts), state and local agencies, and Indian tribes to purchase easements. Agricultural land easements are permanent; in states that do not allow permanent easements, the easements will be as long-term as allowed by law.

To qualify for an ALE the easement must have prime, unique, or productive soil (or contain historical or archaeological resources, protect grazing uses by restoring and conserving land, or further a state or local policy consistent with program purposes.) The easement must also be either cropland, rangeland, or grassland; contain forbs or shrub land for which grazing is the predominant use; be located in an area which is historically grassland, forbs, or shrubs and could provide ecologically significant habitat; or be pastureland or non-industrial private forestland which contributes to economic viability of a parcel and serves as a buffer to protect such land from development (USDA, 2020).

Farm Service Agency (FSA)- Conservation Reserve Program (CRP)
The USDA Farm Service Agency's (FSA) CRP is a voluntary program that contracts with agricultural producers so that environmentally sensitive agricultural land is devoted to conservation benefits. The Food Security Act of 1985, as amended, authorized CRP. The program is implemented by FSA on behalf of USDA's Commodity Credit Corporation. 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.

CRP participants establish long-term, resource-conserving vegetative species, such as approved grasses or trees (known as "covers"), to control soil erosion, improve the water quality and enhance wildlife habitat. 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. CRP protects millions of acres of American topsoil from erosion and is designed to safeguard the nation's natural resources. By reducing water runoff and sedimentation, CRP protects groundwater and helps improve the condition of lakes, rivers, ponds and streams. The vegetative covers also make CRP a major contributor to increased wildlife populations in many parts of the country. Additionally, there is a CRP Grasslands program which helps landowners and operators protect grassland, rangeland, and pastureland while maintaining the areas as grazing lands. The program emphasizes support for grazing operations, plant and animal biodiversity, and grassland and land containing shrubs and forbs under the greatest threat of conversion.

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The following conservation practices are eligible under CRP, and thus land must be suitable for any of these practices: Grass Waterway, Shallow Water Area for Wildlife, Contour Grass Strip, Filter Strip, Riparian Buffer, Denitrifying Bioreactor on Filter Strip and Riparian Buffer, Saturated Filter Strip and Riparian Buffer, Habitat Buffers for Upland Birds, Wetland and Buffer SAFE Practices, Wetland Restoration on Floodplain and Non-Floodplain, Prairie Strips, Windbreaks, Shelterbelts, Living Snow Fences, Marginal Pastureland Wetland Buffer and Wildlife Habitat Buffers, Long Leaf Pine Establishment, Duck Nesting Habitat, Pollinator Habitat, Bottomland Timber Establishment on Wetlands, Farmable Wetlands Program (FWP) Constructed Wetland, FWP Aquaculture Wetland Restoration, FWP Flooded Prairie Wetland, Farmable Wetlands and Farmable Wetland Buffer, and Wellhead Protection Area Practices.



Grass waterway on highly erodible agricultural land

To be eligible for the CRP, the landowner must have owned or operated the land for at least 12 months prior to submitting the offer (or there are certain extenuating circumstances). Cropland must be planted to an agricultural commodity, have a weighted average erosion risk of eight or higher, be enrolled in a CRP contract currently, or be in a CRP conservation priority area; there are no CRP conservation priority areas in the watershed. Enrollment in CRP is offered in the form of general enrollment or continuous enrollment. In general enrollment, during annual enrollment periods, producers can offer land for the program which is then ranked according to the factors of the Environmental Benefits Index. This index considers: wildlife habitat benefits resulting from covers on enrolled land, water quality benefits, on-farm benefits from reduced erosion, long-term benefits that will endure beyond the contract period, air quality benefits from reduced wind erosion, and cost. Under continuous enrollment, environmentally sensitive land may be enrolled at any time though is not subject to competitive bidding (FSA, 2019).

Other Agricultural Recommendations

Principles of Soil Health

Improving water quality in runoff from agricultural lands can often be achieved by maintaining soil health and following soil health principles. There are five principles of soil health; they include soil armor, minimizing soil disturbance, plant diversity, continual live plant/root, and livestock integration. Armoring the soil refers to cover for the soil and controls erosion and evaporation rates, maintains soil temperatures, reduces compaction, suppresses weed growth and provides habitats for species. Minimizing soil disturbance reduces erosion, increases infiltration, and helps keep organic matter in the soil. Diversifying crop rotations can improve biodiversity, improves infiltration and nutrient cycling, and reduces pests. Providing some type of live plant root on a year-round basis is important for building soil health, ensuring that there is food for the soil web continuously throughout the year. Finally, integrating animals or livestock in the form of grazing can help balance the carbon to nitrogen ration, manage crop rotation, and help suppress weeds by fulfilling the natural symbiotic relationships between plants, animals, and the soil web (Fuhrer, 2018). Landowners should work with their local USDA-NRCS representative and cropping consultant to implement a system that will work for them.

Regenerative Agriculture

Regenerative agriculture promotes a method of farming that encourages the regeneration of topsoil, improves water quality, increases biodiversity, and supports carbon sequestration in effort to mitigate the effects of climate change (Terra Genesis International, 2016). The practice is guided by a holistic approach of making appropriate, context-specific recommendations for farmers based on agroecology and restoration ecology methodologies with the goal of rebuilding quantity and quality of topsoil while creating equitable and just relationships amongst all stakeholders. By rebuilding soil organic matter and soil health, yields should increase, and fewer inputs should be needed over time. Simultaneously, the improved biomass helps to sequester carbon and offset greenhouse gases, while the reduced disturbance of the soil improves water quality (Regeneration International, 2019). Many of the practices involved are recommended by NRCS, the DeKalb County Soil and Water Conservation District, and the principles of soils health. Potential practices include "no-

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till/minimum tillage techniques, the use of cover crops, crop rotations, compost, and animal manures, the inoculation of soils with composts or compost extracts to restore soil microbial activity, and managed grazing (CSU Chico, 2017)."

The regenerative agriculture approach, research, and methodologies are ever evolving and need to be tailored to the context of individual farms. Many sources of additional information are available including online resources available from Regeneration International, Terra Genesis International, and California State University – Chico, among others.

Subsurface (Tile) Drainage Best Management Practices- Drainage Water Management
Subsurface drain tiles are a commonly used practice by farmers to help lower the water table of poorly drained fields and/or wet areas within fields. Unfortunately, nitrogen and phosphorus often find their way into tiles through cracks and macropores in the soil. The tiles then carry these nutrients to local streams.

Drainage Water Management, or management of the water table through control structures at drain tile outlets, is an approach to reduce the amount of nutrients that exit the tile lines. DWM is the process of managing the timing and the amount of water discharged from agricultural drainage systems. DWM is based on the premise that the same drainage intensity is not always required during the year. This is accomplished by adjusting the control structure so that the water table rises after harvest to limit drainage during the off-season. The water table can then be lowered a few weeks prior to planting in spring. The water table can also be raised in midsummer to store water for crops. With DWM, both water quality improvement and production benefits are possible. Water quality benefits are derived by minimizing unnecessary drainage, reducing the amount of nitrate that leaves farm fields. Producers who use DWM enjoy being able to better control their drainage water instead of the water controlling them (Cooke, 2004).

To ensure successful implementation of a DWM system on agricultural tile drainage, it is essential to have a DWM Plan. A properly prepared DWM plan considers landscape, soils, slope, and current or planned drainage systems as well as the size and location of water control structures and detailed sets of instructions for their operation and maintenance. This includes identification of the zones of influence for each water control structure and the target water elevations for each of the seasonal land uses. The Golden Rule of Drainage (as advocated by NRCS) is: Only release the amount of water necessary to ensure trafficable conditions for field operations and to provide an aerated crop root zone- any drainage in excess of this rule likely carries away nitrate and water that is no longer available for crop uptake (NRCS, 2020).

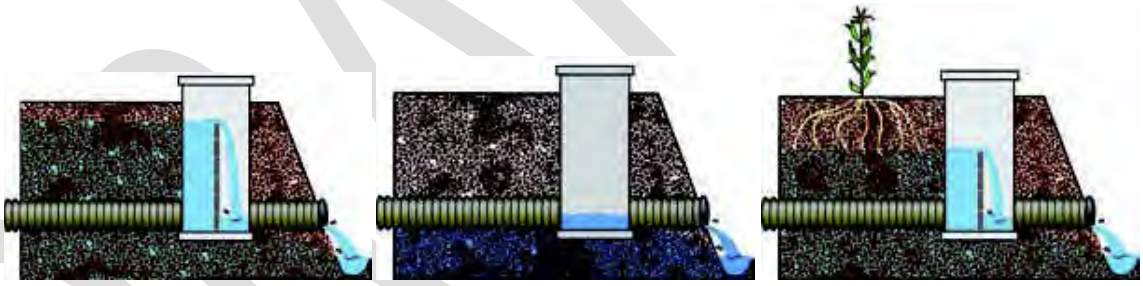


Figure 57. Use of tile control to raise water table after harvest (left), drawdown prior to seeding (middle), and raised again in midsummer (right) (Source: Purdue University)

Subsurface (Tile) Drainage Best Management Practices- Subsurface Bio-Reactors
While properly designed and installed subsurface drainage tiles can reduce sediment and phosphorus losses on fields, they can expedite the movement of nitrate-nitrogen to nearby surface waters. BMPs such as

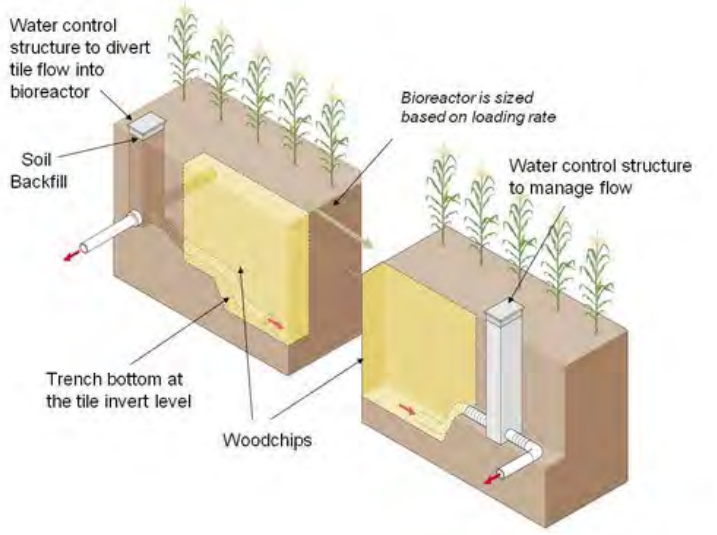


Figure 58. Subsurface Bioreactor (Source: Frankenberger.)

subsurface Bioreactors seek to mitigate this issue by providing a subsurface solution to a subsurface problem. Bioreactors consist of a substrate (gravel and a carbon source, typically woodchips, though alternative substrates are being researched) placed underground through which tile water flows. The systems are designed to maintain drainage effectiveness and once installed, do not require additional land to be taken out of production. The reactors are constructed such that during periods of high flow, the bioreactor is bypassed and water flows through the tile as usual. Bioreactors work by providing a carbon source on which soil organisms colonize. These colonies consume the carbon from the woodchips, and "breathe in" the nitrate from the water which is then "breathed out" as nitrogen gas which enters the atmosphere (similar to how humans breathe in oxygen and breathe out carbon dioxide; Frankenberger, 2020).

6.1.14 Downspout Disconnection/Rainwater Harvesting & Re-use

Downspout disconnection and rain barrel programs help reduce the amount of clean water that is used as well as reduce the amount of wastewater discharged to streams. Water harvesting and re-use via rain barrels and cisterns are important options to decrease the amount of stormwater runoff in a watershed. It is a simple, economical solution that can be done by any homeowner or business. On most homes and buildings, the water from roofs flows into downspouts and then onto streets, parking areas, or into storm sewers. Disconnecting downspouts and using either rain barrels or cisterns for re-use later can reduce the flood levels in local streams.



Rain barrel adjacent to residential home

Water re-use differs based on the type of storage and water treatment. A rain barrel is typically attached to a downspout and collects water for later use, such as irrigation purposes. In many areas, irrigation can account for almost 50 percent of residential water consumption. Re-using water collected in a rain barrel is a great way of minimizing outdoor water consumption and reduce water bills. A cistern also stores water from rooftop runoff to be used later. However, a cistern is often larger, sealed, and the water can be filtered for a wider variety of uses. Cistern water can be used many outdoor uses such as lawn and garden watering, irrigation, car washing, and window cleaning. The primary purpose of rain barrels and cisterns is water storage. Rain barrels typically store 55 gallons each. Cisterns can store greater amounts. Rain barrels and cisterns also reduce outdoor water demand in summer months by reducing the potable water used for irrigation or other outdoor household uses.

Rainwater Harvesting & Reuse Recommendations

Education programs in the watershed should focus on teaching residents and businesses the beneficial uses of downspout disconnection, rain barrels and cisterns. Local governments should aim to install demonstration projects as a way for the public to better engage in their water use and re-use around residential homes and businesses. Local governments and conservation organizations should sponsor programs where residents and businesses can purchase rain barrels.

6.1.15 Conservation & Low Impact Development

Conservation design facilitates development density needs while preserving the most valuable natural features and ecological functions of a site. It does this by reducing lot size, especially lot width, while increasing the available land area to allow for open space and natural resources (Figures 59 - 62). The open space is typically preserved or restored as natural areas that are integrated with newer natural Stormwater Treatment Train features and recreational trails and serve as an amenity to the entire development. The open space allows the residents to feel like they have larger or more private lots because most of the lots adjoin the open space system.

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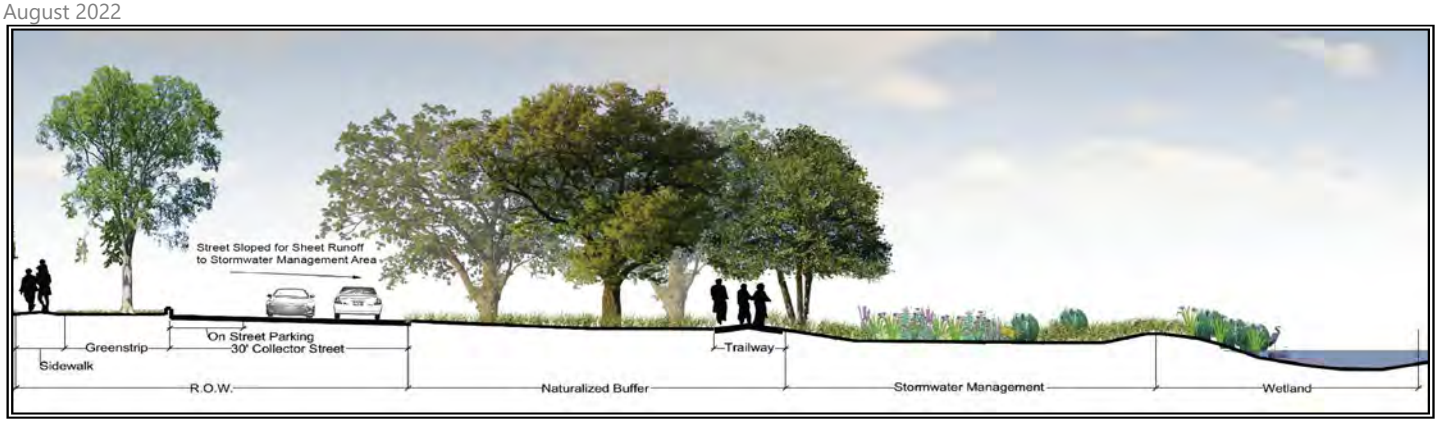


Figure 59. Stormwater Treatment Train within Conservation Development.

Such flexibility is intended to retain or increase the development rights of the property owner and the number of occupancy units permitted by the underlying zoning designation, while encouraging environmentally responsible development. Conservation design is most appropriate in areas having natural and open space resources to be protected and preserved such as floodplains, groundwater recharge areas, wetlands, woodlands, streams, wildlife habitat, etc. It can also be used to preserve and integrate agricultural uses into the land pattern. The approach first considers the natural landscape and ecology of a development site rather than determining design features based on pre-established density criteria. The general steps included below are generally followed when designing the layout of a development site:



Figure 60. Traditional vs. Conservation Development Design (Elkhorn, WI).

Step 1: Identify natural resources, conservation areas, open space areas, physical features, and scenic areas and preserve and protect these areas from any negative impacts generated because of the development.

Step 2: Locate building sites to take advantage of open space and scenic views by requiring smaller lots or cluster housing as well as to protect the development rights of the property owner and the number of occupancy units permitted by the underlying zoning of the property.

Step 3: Design the transportation system to provide access to building sites and to allow movement throughout the site and onto adjoining lands; roads should not traverse sensitive natural areas.

Step 4: Prepare engineering plans which indicate how each building site can be served by essential public utilities.



Figure 61. Example of Conservation Design or LID.

Low Impact Development (LID)

Low impact development (LID) focuses on the hydrologic impact of development and tries to maintain pre-development hydrologic systems, treating water as close to the source as possible (see Figure 62). LID principles

can be incorporated into development or stormwater ordinances and used in new development or retrofitting existing developments. Green infrastructure systems are created to mimic natural processes that promote water infiltration, native plant evapotranspiration, and stormwater reuse. LID seeks to keep stormwater out of pipes and instead keep the entire infrastructure more natural and above ground. Solutions start at the lot scale such as rain gardens and overflows to swales adjacent to roads. Larger impervious areas, such as a commercial development may utilize constructed wetlands for stormwater storage while adding value to the area by enhancing aesthetics, site interest and the ecology.

Economics of Conservation Developments and Low Impact Development

Both conservation design and low impact development (LID) are not only environmentally sound choices, but economical ones for both developers and municipalities. Conservation design can produce some of its biggest cost savings in infrastructure costs such as site preparation, stormwater management, site paving, and sidewalks (Conservation Research Institute, 2005). According to a study conducted by Applied Ecological Services, Inc., the average savings created by choosing conservation development over more traditional footprints is 24% (Table 38) (AES, 2007). Not only do lots in conservation developments typically cost less to install, but they also "carry a price premium … and sell more quickly than lots in conventional subdivisions (Mohamed, 2006)." Another study conducted in Concord, Massachusetts found that over an eight-year period, a cluster development with protected open space had a 2.6% higher annual appreciation rate over "residential properties with significantly larger private yards, but without the associated open-space (Lacy, 1990)."



Figure 62. Greener Streetscape using LID practices. Source: *"Greening the Code"* Washington County, OR

Table 38. Savings of Conservation Development over Traditional Subdivision Design for ten Midwestern conservation development projects.

Positive numbers are savings of Conservation Development over Traditional.
Negative numbers are costs of Conservation Development over Traditional.

Project:	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10	Average
ITEM											
Grading	-$214,740	$257,832	$1,813,726	$2,215,025	$1,856,206	$1,862,988	$796,705	$291,957	$302,497	$2,852,312	51.00%
Roadway	$84,702	$18,754	-$16,477	-$130,230	$1,464,599	$1,187,386	$205,168	$9,231	-$9,963	$801,484	18.00%
Storm Sewer	$181,611	$31,220	$6,648	$89,676	$974,689	$547,184	$210,289	$65,501	$110,021	$678,302	40.00%
Sanitary Sewer	$41,614	-$4,365	$0	-$203,064	$850,962	$224,776	$72,436	-$15,502	$5,960	$423,458	6.00%
Water	$44,483	-$4,671	-$63,680	-$215,881	$905,157	$240,064	$76,815	-$16,257	$5,973	$451,084	5.00%
Ecological	-$56,500	-$74,857	-$277,472	-$400,321	-$407,131	-$625,084	-$160,341	-$93,954	-$264,513	-$380,992	-154.00%
Amenities	$17,572	-$16,202	-$94,399	-$226,216	$552,667	$221,666	$7,825	-$15,749	-$39,274	$266,982	6.00%
Contingencies	$132,055	$51,928	$342,087	$282,247	$1,549,287	$914,745	$302,225	$56,307	$27,675	$1,273,157	24.00%
Total Savings	$660,277	$259,639	$1,710,433	$1,411,235	$7,746,436	$4,573,725	$1,511,124	$281,534	$138,377	$6,365,787	
Total Percent Savings	19.00%	20.00%	33.00%	15.00%	43.00%	32.00%	25.00%	15.00%	4.00%	37.00%	24.30%*
Cost Savings Per Lot	$8,725.00	$6,978.00	$147,012.00	$29,012.00	$7,904.00	$20,077.00	$7,346.00	$4,078.00	$4,959.00	$67,676.00	$30,376.70

* Total Savings Percentage is *not* the percentage savings of all individual Items added together, because dollar-values of Items are different.
Visit www.appliedeco.com for more detailed info.

While low impact development covers a range of stormwater practices, it has some of the same cost benefits as conservation design. Typically LID practices "can cost less to install, have lower operations and maintenance costs, and provide more cost-effective stormwater management and water-quality services than conventional stormwater controls (ECONorthwest, 2007)." Similar to conservation design, cost savings from utilizing LID practices can be found as a reduction in the amount of drainage infrastructure and land disturbance required; additionally, property values can be

increased by 12 - 16% (UNH Stormwater Center, 2011). There is also evidence that combining both conservation and LID practices through holistic site design can create deeper cost savings for developers as well as increased ecosystem benefits – particularly by combining clustered site designing and naturalized stormwater management systems (Conservation Research Institute, 2005). Not only do conservation and low impact development practices provide a more economical possibility for developers and municipalities, but they can improve water quality, habitat, and property values in the watershed.

6.1.16 Green Infrastructure Network Planning

A green infrastructure network provides communities with a tool to identify and prioritize open space land use or conservation opportunities and plan development that benefits both people and nature by providing a framework for future growth. It identifies areas not suitable for development, areas suitable for development but that should incorporate conservation or low impact design standards, and areas that do not affect green infrastructure. Park Districts, Conservation Districts, IDNR, and watershed stakeholders can use green infrastructure plans for trail routing, open space linkages, and natural area restoration decisions. Residents can use green infrastructure recommendations to reduce runoff from their properties and to see how their properties fit into the larger network. A Green Infrastructure Network for the watershed was developed in Section 3.12.

Green Infrastructure Network *implementation* has several actions:

- Protect specific unprotected green infrastructure parcels through acquisition, regulation, and/or incentives.
- Incorporate conservation or LID standards on green infrastructure parcels where development is planned.
- Limit future subdivision of green infrastructure parcels.
- Implement long-term management of green infrastructure.

Green Infrastructure Recommendations

A Green Infrastructure Network can only be realized by coordinated planning efforts of local municipalities, park districts, developers, and private landowners. Stakeholders should follow the recommended process below to implement the Green Infrastructure Network recommendations for the Keith Creek watershed.

1. Include all green infrastructure parcels in updated comprehensive plans and development review maps.
2. Utilize tools such as protection overlays, setbacks, open space zoning, conservation easements, conservation and/or low impact development, etc. on all green infrastructure parcels.
3. Utilize tools such as Development Impact Fees, Stormwater Utility Taxes, Special Service Area (SSA) Taxes, etc. to help fund future management of green infrastructure components where new and redevelopment occurs.
4. Identify important unprotected green infrastructure parcels not suited for development then protect and implement long term management.
5. Work with private landowners along stream corridors to manage their land for green infrastructure benefits.
6. Use the Green Infrastructure Network to identify new trails and trail connections.

6.1.17 Water Quality Trading & Adaptive Management

While Illinois has not yet set up policies or a system to implement water quality trading or adaptive management, nearby Wisconsin has developed policies and resources that could be used as a model for Illinois to follow. The following information is cited directly from a Wisconsin Department of Natural Resources (WDNR) document entitled "A Water Quality Trading How to Manual" (WDNR 2013).

Water Quality Trading presents a way for municipal and industrial NPDES permit holders to demonstrate compliance with water quality-based effluent limitations. Generally, trading involves a point source facing relatively high pollutant reduction costs compensating another party to achieve less costly pollutant reduction with the same or greater water quality benefit. In other words, trading provides point sources with the flexibility to acquire pollutant reductions from other sources in the watershed to offset their point source load so that they will comply with their own permit requirements, while simultaneously helping to fund water quality improvements nearby. Trading is not a mandatory program or regulatory requirement, but rather a market-based option that may enable some industrial and municipal

facilities within the watershed to meet regulatory requirements more cost-effectively. With ever-tightening water quality standards and restrictions going into effect, trading may become economically preferable to other compliance options.

There are many benefits to trading:

1. Permit compliance through trading may be economically preferable to other compliance options.
2. New and expanding point source discharges can utilize trading to develop new economic opportunities in a region, while still meeting water quality goals.
3. Permittees, and the point and nonpoint sources that work cooperatively with them, can demonstrate their commitment to the community and to the environment by working together to protect and restore local water resources.



Figure 63. Water quality trading components (source: WDNR).

Adaptive management is sometimes confused with trading, since both options allow permittees to work with nonpoint and point sources of phosphorus in a watershed to reduce the overall phosphorus load to a given waterbody. In Wisconsin, which has developed a numeric phosphorus criterion, adaptive management is solely focused on phosphorus compliance and improving water quality so that the applicable phosphorus criterion is met. Trading is not limited to phosphorus and may be used to meet limits for any pollutant for which a criterion has been established. Trading focuses on compliance with a discharge *limit* while adaptive management focuses on compliance with phosphorus *criteria*.

Water quality trading has seven components: pollutant, trading participants, pollution reduction credit, credit threshold, trade ratio, location, and timing (Figure 63). Each of these components must be adequately addressed in a trading strategy. The "pollutant" is simply the contaminant being traded. The "trading participants" are entities involved in the trade. "Credit" is the amount of a given pollutant that is available for trading. "Credit Threshold" is the amount of pollutant reduction that needs to be achieved before credits are generated. "Trade ratios" are put in place due to uncertainty margins. "Location" refers to the fact that the credit user and generator must discharge to the same waterbody. "Timing" is important because credits must be generated before they can be used to offsite the pollution. For more information and guidance on water quality trading and adaptive management, see Wisconsin Department of Natural Resources (WDNR) document entitled "A Water Quality Trading How to Manual" (WDNR, 2013).

6.2 Site-Specific Management Measures Action Plan

Site-Specific Management Measure recommendations (also known as best management practices or BMPs) identified in this section are backed by findings from the watershed field inventory, overall watershed resource inventory, and input from stakeholders. In general, the recommendations address sites where watershed problems and opportunities can best be addressed to achieve watershed goals and objectives. The Site-Specific Management Measures Action Plan is organized by the jurisdiction in which recommendations are located making it easy for users to identify the location of project sites and corresponding project details. It is important to note that project implementation is voluntary and there is no penalty or reduction in future grant opportunities for not following recommendations. Site-Specific Management Measures were identified within the City of Rockford, the City of Loves Park, Winnebago County, and Boone County and are included in the Action Plan. Management Measure categories in the Site-Specific Management Measures Action Plan include detention basin retrofits, stream and riparian area restoration, wetland restoration and other management measure recommendations. Descriptions and location maps for each Management Measure category follow. Table 41 includes useful project details such as site ID#, Location, Units (size/length), Existing Condition, Management Measure Recommendation, Pollutant Load Reduction Efficiency, Priority, Owner/Responsible Entity, Sources of Technical Assistance, Cost Estimate, and Implementation Schedule.

Project importance, technical and financial needs, cost, feasibility, and ownership type were taken into consideration when prioritizing and scheduling Management Measures for implementation. High, Medium, or Low Priority was assigned to each recommendation. "Critical Areas" as discussed in Section 5.2 are all High Priority and highlighted in red on project category maps and the Action Plan table. For this watershed plan a "Critical Area" is best described as a location in the watershed where existing or potential future causes and sources of an impairment or existing function are significantly worse than other areas of the watershed. Cost estimates were typically developed based on a per acre or per linear foot cost. Implementation schedule varies greatly with each project but is generally based on the short term (within 1-10 years) for High Priority/Critical Area projects and 10-20+ years for medium or low priority projects. Maintenance projects are ongoing.

The Site-Specific Management Measures Action Plan is designed to be used in one of two ways.

Method 1: The user should find the respective jurisdictional boundary (listed alphabetically in Table 41) then identify the Management Measure category of interest within that boundary. A Site ID# can be found in the first column under each recommendation that corresponds to the Site ID# on a map (Figures 64-67) associated with each category.

Method 2: The user should go to the page(s) summarizing the Management Measure category of interest then locate the corresponding map and Site ID# of the site-specific recommendations for that category. Next, the user should go to Table 41 and locate the jurisdiction where the project is located, then go to the project category and Site ID# for details about the project.

Pollutant Load Reduction Estimates

Where applicable, pollutant load reductions and/or estimates for total suspended solids (TSS), nitrogen (TN), and phosphorus (TP) were evaluated for each recommended Management Measure based on efficiency calculations developed for the USEPA's Region 5 Model. Estimate of total suspended solids and nutrient load reduction from implementation of *urban* Measures is based on efficiency calculations developed by Illinois EPA. This watershed-based plan is focused on nutrients and total suspended solids because of the models used for estimating pollutant loading and reductions and references total suspended solids in tons per year (not pounds) in all cases.

Estimates of pollutant load reduction using the Region 5 Model are measured in weight/year (tons/yr for total suspended solids and lbs/yr for nitrogen and phosphorus). The model was generally used to calculate weight of pollutant reductions for all recommended Management Measures where calculation of such data is applicable. In summary, pollutant reductions were calculated for 31 detention basin retrofit and maintenance projects, 21 stream & riparian area restoration projects, 3 wetland restoration projects, and 16 other management measure recommendations. Spreadsheets used to determine pollutant load reductions can be found in Appendix D.

For context and as a general guide, estimated percent removal of total suspended solids, nitrogen, and phosphorus based on the Region 5 Model are depicted for various Management Measures in Table 39.

Table 39. Region 5 Model percent pollutant removal efficiencies for various Management Measures.

Management Measures	TSS	TN	TP
Vegetated Filter Strips	73%	40%	45%
Wet Pond/Detention	60%	35%	45%
Wetland Detention	77.5%	20%	44%
Dry Detention	57.5%	30%	26%
Infiltration Basin	75%	60%	65%
Streambank/Lake Shoreline Stabilization	90%	90%	90%
Weekly Street Sweeping	16%	6%	6%
Porous Pavement	90%	85%	65%
Manure Waste Management	na	80%	90%

Watershed-Wide Summary of Action Recommendations

All Site-Specific Management Measures, Education Plan (Section 7.0), and Monitoring Plan (Section 9.1) recommendation information is condensed by Category in Table 40. This information provides a watershed-wide summary of the "Total Units" (size/length), "Total Cost," and "Total Estimate of Pollutant Load Reduction" if all the recommendations in the Site-Specific Management Measures Action Plan, Education Plan, and Monitoring Plan are implemented. Key points include:

- 1,337 acres of ecological restoration with a total cost of $8,905,000.
- 80,243 linear feet of stream and riparian area restoration costing $9,727,000.
- 4,621 tons/year of total suspended solids (TSS) would potentially be reduced each year, even though there is no TSS Reduction Target necessary, as detailed in Section 5.3.
- 5,357 pounds/year of phosphorus (TP) would potentially be reduced each year, which would far exceed the Reduction Target identified in Section 5.3.
- 21,891 pounds/year of nitrogen (TN) would potentially be reduced each year, even though there is no TN Reduction Target necessary, as detailed in Section 5.3.
- Education programs will cost at least $9,500 to implement (see Section 7.0).
- A monitoring plan will cost $5,000 per management measure to implement (see Section 9.1).

Table 40. Watershed-wide summary of Management Measures recommended for implementation.

Management Measure Category	Total Units (size/length)	Total Cost	Estimated Load Reduction		
			TSS (tons/yr)	TP (lbs/yr)	TN (lbs/yr)
Detention Basin Retrofits & Maintenance	126.3 acres	$2,924,000	451	639	2,680
Stream & Riparian Area Restoration	80,242.6 lf	$9,727,000	3,698	3,967	13,393
Wetland Restoration	142.2 acres	$1,280,000	56	113	1,195
Other Management Measures					
7 Natural area restorations	434.5 acres	$3,781,000	284	426	3,147
2 Golf course naturalizations	256.8 acres	$640,000	111	143	1,008
7 vegetated swale retrofits	377 acres	$280,000	21	69	468
Information & Education Plan	Entire Plan	>$9,500	na	na	na
Water Quality Monitoring Plan	Entire Plan	$5K/measure	na	na	na
TOTALS	**1,336.8 acres**	**$8,905,000**	**4,621 tons/yr**	**5,357 lbs/yr**	**21,891 lbs/yr**
	80,242.6 lf	**$9,727,000**			
	Education	**>$9,500**			
	Monitoring	**$5K/measure**			

6.2.1 Detention Basin Retrofit Recommendations

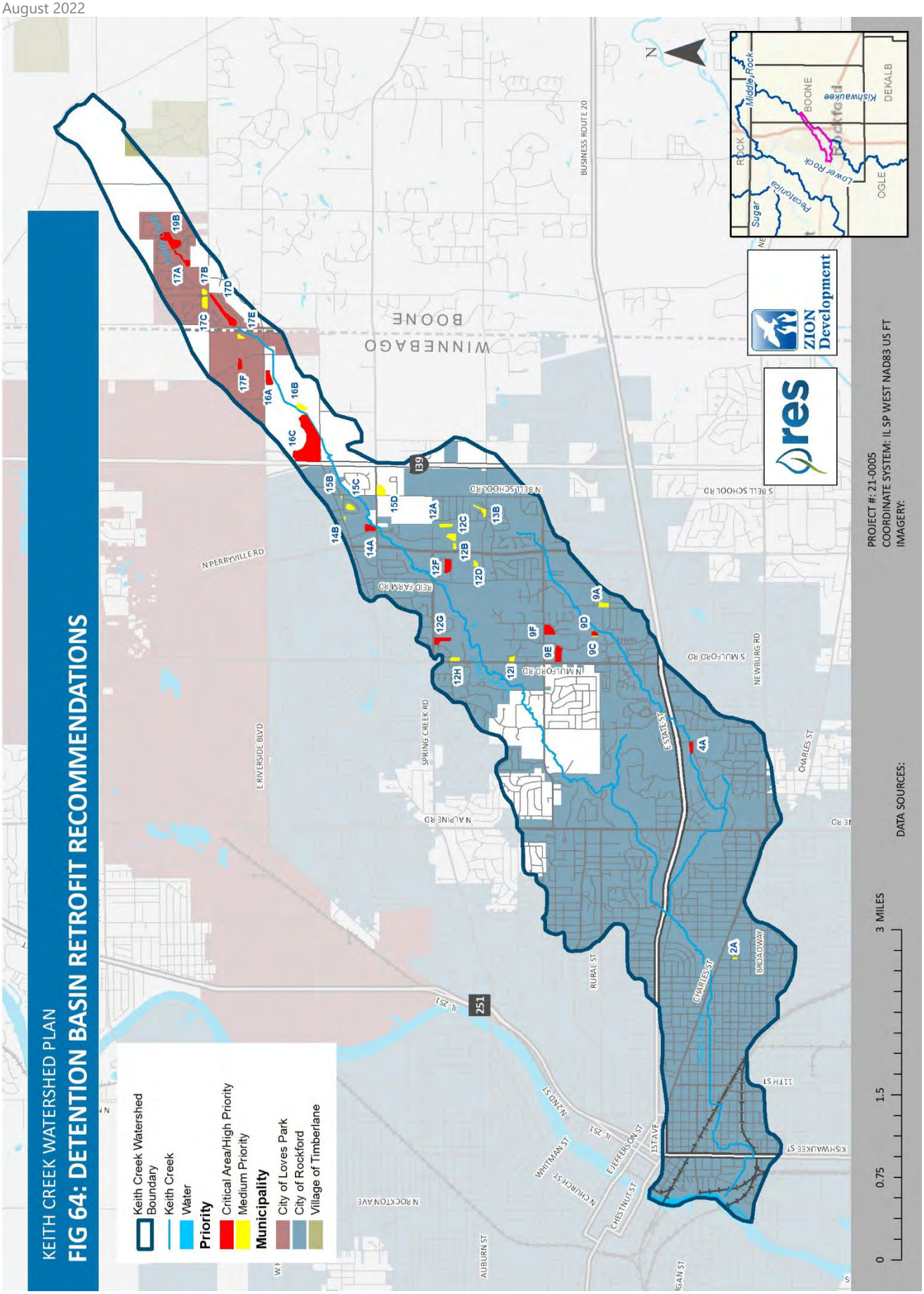
During the inventory, 31 detention basin retrofit opportunities were identified in Keith Creek watershed. Most detention basins provide little by way of water quality improvement, infiltration capability, and wildlife habitat. In the future it is recommended that new standards for detention basins be implemented in local and county development ordinances (see Section 6.1.2). RES conducted an inventory of detention basins in early summer of 2021. The results of the detention basin inventory are summarized in Section 3.13. Detailed field investigation datasheets and maps can be found in Appendix C.

The type of detention basins in the watershed varies. The inventory resulted in 23 dry-bottom basins with turf slopes, 7 wet bottom basins with turf slopes, and 1 naturalized wet bottom basin. All 31 basins (100%) likely provide "Poor" ecological and water quality benefits because most were designed simply to meet stormwater storage volume requirements.

Most of the wet and dry detention basins are planted with mown turf grass side slopes. In addition, some of the dry bottom basins are constructed with either concrete low flow channels that run directly from the inlet to the outlet or have outlet drains flush with the bottom of the basin. Many of the dry, wet, and wetland bottom basins in the watershed present excellent retrofit opportunities. Most would be relatively easy to naturalize with native plantings and concrete structures and drains in dry basins can be manipulated to store and infiltrate water as desired.

All recommended detention basin retrofits and/or maintenance recommendations are shown in Figure 64 by priority and Site ID# which correspond with the ID# used in the field investigation. Details about each recommendation can be found in the Action Plan Table (Table 41) within the appropriate jurisdictional boundary. All High priority recommendations are considered "Critical Areas." Most of these are basins were prioritized based on their location and/or ability to treat polluted stormwater runoff, have significant problems, or present a good opportunity for retrofitting. Low or Medium priority is generally assigned to smaller private basins and those with fewer problems or maintenance needs.

DRAFT


KEITH CREEK WATERSHED PLAN
FIG 64: DETENTION BASIN RETROFIT RECOMMENDATIONS
Keith Creek Watershed Boundary
Keith Creek
Water
Priority
Critical Area/High Priority
Medium Priority
Municipality
City of Loves Park
City of Rockford
Village of Timberlane
WINNEBAGO
BOONE
BUSINESS ROUTE 20
N PERRYVILLE RD
N BELL SCHOOL RD
S BELL SCHOOL RD
RED FARM RD
E RIVERSIDE BLVD
SPRING CREEK RD
N ALPINE RD
S MULFORD RD
N MULFORD RD
NEWBURG RD
ESTATE ST
CHARLES ST
RURAL ST
BROADWAY
11TH ST
KISHWAUKEE ST
1ST AVE
JEFFERSON ST
CHESTNUT ST
WHITMAN ST
N CHURCH ST
N 2ND ST
IL-251
N ROCKTON AVE
AUBURN ST
251
B9
ZION Development
res
ROCK
BOONE
DEKALB
OGLE
Middle Rock
Kishwaukee
Pecatonica
Sugar
Lower Rock
PROJECT #: 21-0005
COORDINATE SYSTEM: IL SP WEST NAD83 US FT
IMAGERY:
DATA SOURCES:
0
0.75
1.5
3 MILES

6.2.2 Streambank & Riparian Area Restoration Recommendations

RES completed a general inventory of Keith Creek and its tributaries in early summer of 2021. All streams and tributaries were assessed based on divisions into "Stream Reaches". Twenty-one (21) stream reaches were assessed accounting for 92,658 linear feet or 17.5 linear miles. Detailed notes were recorded for each stream reach related to potential Management Measure recommendations such as improving streambank and channel conditions, restoring riparian areas, and maintaining these reaches long term. The results of the stream inventory are summarized in Section 3.13; detailed field investigation datasheets can be found in Appendix C.

The condition of stream reaches in the watershed varies. According to the stream inventory, approximately 26% (22,885 lf) of the total stream and tributary length exhibits no or low channelization while moderate channelization is occurring along 39% (34,417 lf) of stream. Highly channelized streams are most common in the most urbanized, downstream portions of the watershed accounting for 35% (31,073 lf) of the total stream length. Roughly 48% (42,199 lf) of the total stream and tributary length exhibits no or low bank erosion while moderate erosion is occurring along 46% (40,926 lf) of streambanks. Highly eroded streambanks occur on the two intermittent stream channels accounting for 6% (4,981 lf) of the total stream length. On the other hand, approximately 67% (along 58,678 linear feet of streams) of the riparian areas are "Poor" quality. Of the remaining reaches, 26,320 linear feet or 30% of riparian areas are in "Average" condition and 3% (3,108 linear feet) are in good condition.

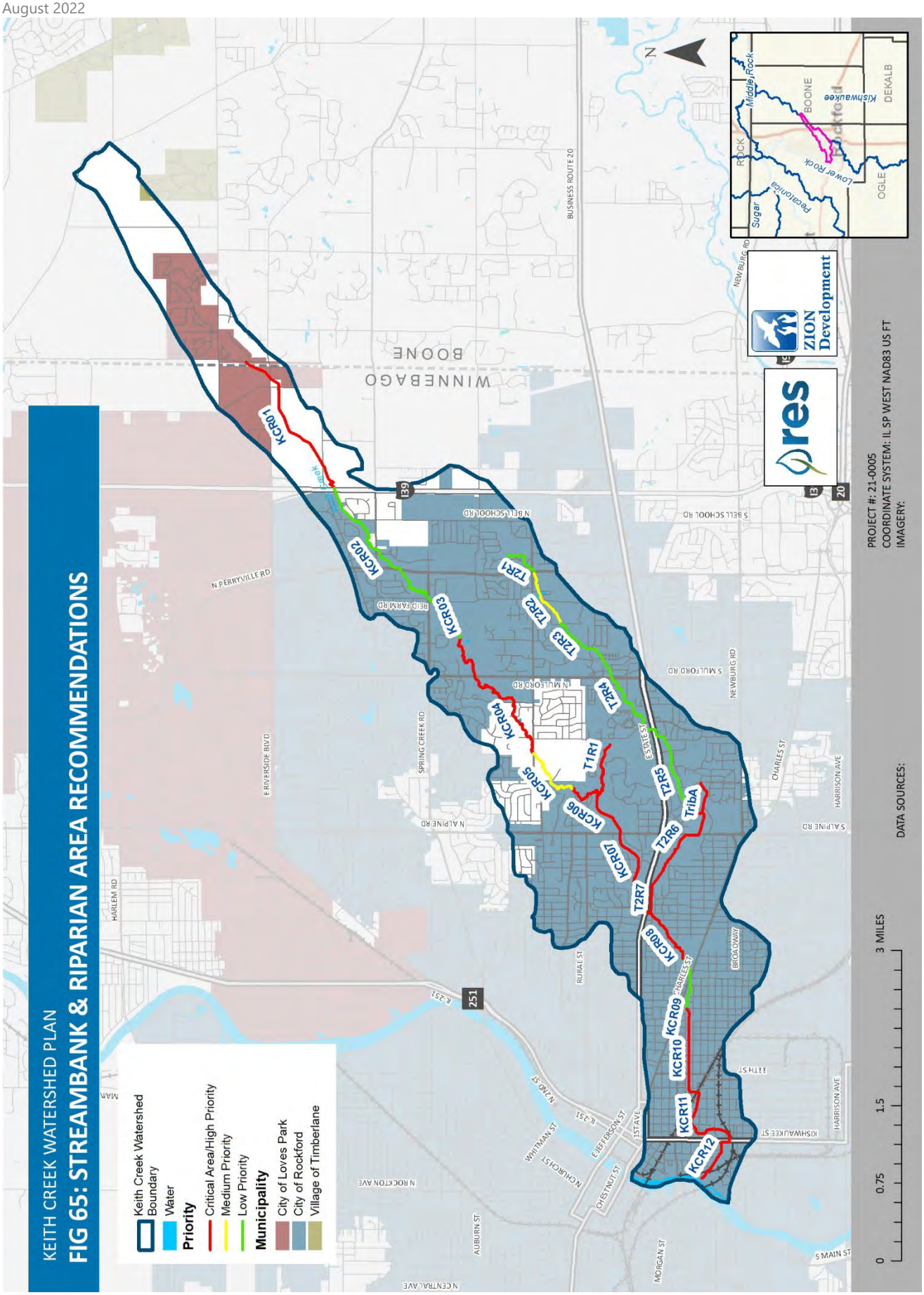
Most stream restoration projects include at least one of the following three water quality and habitat improvement components; 1) removal of existing invasive vegetation including trees and shrubs from the banks and extending buffers where none currently exists followed by; 2) spot stabilization of banks using bioengineering, regrading of banks, and installation of native vegetation where necessary; and 3) restored riffles/grade controls in the stream channel to simulate conditions found in naturally meandering streams and to improve in-stream habitat. Short- and long-term maintenance then follows and is critically important in the development process and to maintain restored conditions.

Figure 65 shows the location of all potential streambank and riparian area restoration projects by reach ID# and priority while Table 41 lists project details about each recommendation within the appropriate jurisdictional boundary. Potential streambank and riparian area restoration projects on public land and reaches exhibiting severe problems on private land are generally assigned as higher priority for implementation. Medium and Low priority was generally assigned to stream reaches exhibiting less urgent problems. Recommendations are not made for stream reaches where restoration is not needed. In total, 55,643 linear feet of stream restoration are considered High Priority/ Critical Area projects.



Example of stream restoration project at Dixie Creek

DRAFT


KEITH CREEK WATERSHED PLAN
FIG 65: STREAMBANK & RIPARIAN AREA RECOMMENDATIONS
Keith Creek Watershed Boundary
Water
Priority
Critical Area/High Priority
Medium Priority
Low Priority
Municipality
City of Loves Park
City of Rockford
Village of Timberlane
KCR01
KCR02
KCR03
KCR04
KCR05
KCR06
KCR07
KCR08
KCR09
KCR10
KCR11
KCR12
T1R1
T2R1
T2R2
T2R3
T2R4
T2R5
T2R6
T2R7
TribA
WINNEBAGO
BOONE
BUSINESS ROUTE 20
N PERRYVILLE RD
SPRING CREEK RD
NEWBURG RD
S MULFORD RD
N MULFORD RD
N BELL SCHOOL RD
S BELL SCHOOL RD
E RIVERSIDE BLVD
N ALPINE RD
S ALPINE RD
CHARLES ST
HARRISON AVE
BROADWAY
RURAL ST
11TH ST
KISHWAUKEE ST
1ST AVE
E JEFFERSON ST
N CHURCH ST
WHITMAN ST
CHESTNUT ST
AUBURN ST
N ROCKTON AVE
MORGAN ST
S MAIN ST
N CENTRAL AVE
HARLEM RD
251
139
20
ZION Development
res
PROJECT #: 21-0005
COORDINATE SYSTEM: IL SP WEST NAD83 US FT
IMAGERY:
DATA SOURCES:
0
0.75
1.5
3 MILES
ROCK
BOONE
DEKALB
OGLE
Middle Rock
Kishwaukee
Sugar
Pecatonica
Lower Rock

6.2.3 Wetland Restoration Recommendations

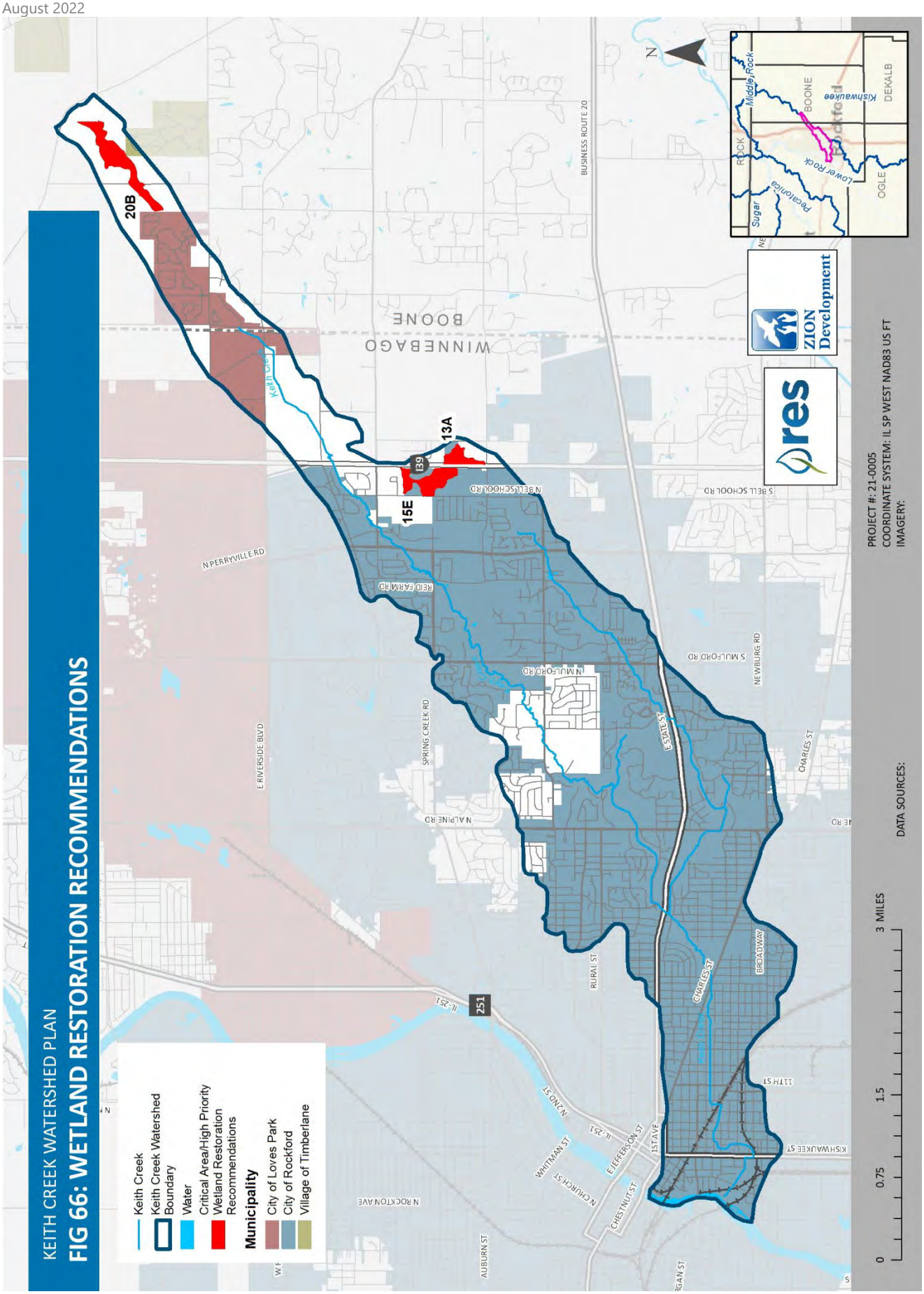
Wetland restoration is the process of bringing back historic wetlands in areas where they have been drained. This section does not include enhancement and maintenance for existing wetlands. Restoration can be important for mitigation purposes or done simply to benefit basic environmental functions that historic wetlands once served. Improvement in water quality is the greatest benefit provided by wetland restoration. Other benefits include reducing flood volumes/rates and improved habitat to increase plant and wildlife biodiversity. The wetland restoration process is generally the same for all sites. First a study must be completed to determine if restoration at the site is actually feasible. If it is, a design plan is developed, permits obtained, then the project is implemented by breaking existing drain tiles and/or regrading soils to attain proper hydrology to support wetland vegetation. Planting with native wetland species is the next step followed by short- and long-term maintenance and monitoring to ensure establishment.

Wetland restoration sites were identified in Section 3.13.3 using a GIS exercise and then confirmed in the field to meet specific criteria determined to be essential for restoration of a functional and beneficial wetland. The analysis resulted in 3 sites (totaling 142.2 acres) meeting the criteria and considered as potentially feasible wetland restoration sites.

Figure 66 includes the location of all the potential wetland restoration sites by site priority and site ID#. The site ID#s match those used in Section 3.13.3. All 3 sites were determined to be high priority/critical area restorations. Details about each recommendation can be found in the Action Plan Table (Table 41) within the appropriate jurisdictional boundary.



Example wetland restoration at RES wetland mitigation site


KEITH CREEK WATERSHED PLAN
FIG 66: WETLAND RESTORATION RECOMMENDATIONS
Keith Creek
Keith Creek Watershed Boundary
Water
Critical Area/High Priority Wetland Restoration Recommendations
Municipality
City of Loves Park
City of Rockford
Village of Timberlane
20B
13A
15E
251
N PERRYVILLE RD
E RIVERSIDE BLVD
SPRING CREEK RD
N ALPINE RD
N MULFORD RD
S MULFORD RD
NEWBURG RD
N BELL SCHOOL RD
S BELL SCHOOL RD
REID FARM RD
BUSINESS ROUTE 20
WINNEBAGO
BOONE
RURAL ST
CHARLES ST
BROADWAY
E STATE ST
1ST AVE
N CHURCH ST
WHITMAN ST
CHESTNUT ST
AUBURN ST
N ROCKTON AVE
11TH ST
KISHWAUKEE ST
N 2ND ST
IL-251
Keith Creek
ZION Development
res
PROJECT #: 21-0005
COORDINATE SYSTEM: IL SP WEST NAD83 US FT
IMAGERY:
DATA SOURCES:
0
0.75
1.5
3 MILES
N
ROCK
BOONE
DEKALB
OGLE
Middle Rock
Kishwaukee
Pecatonica
Lower Rock
Sugar

6.2.4 Other Management Measure Recommendations

While completing the general inventory of Keith Creek watershed, RES noted potential Management Measure projects that fit under miscellaneous other categories. In total there were 16 projects that fell into the other management measure category. Detailed field investigation datasheets for these projects can be found in Appendix C. Figure 67 shows the location of all "Other Management Measure" recommendations by ID# while Table 41 lists details about each recommendation within the appropriate jurisdictional boundary.

Potential projects include:

- 7 Natural area restorations
- 2 Golf course naturalizations
- 7 vegetated swale retrofits

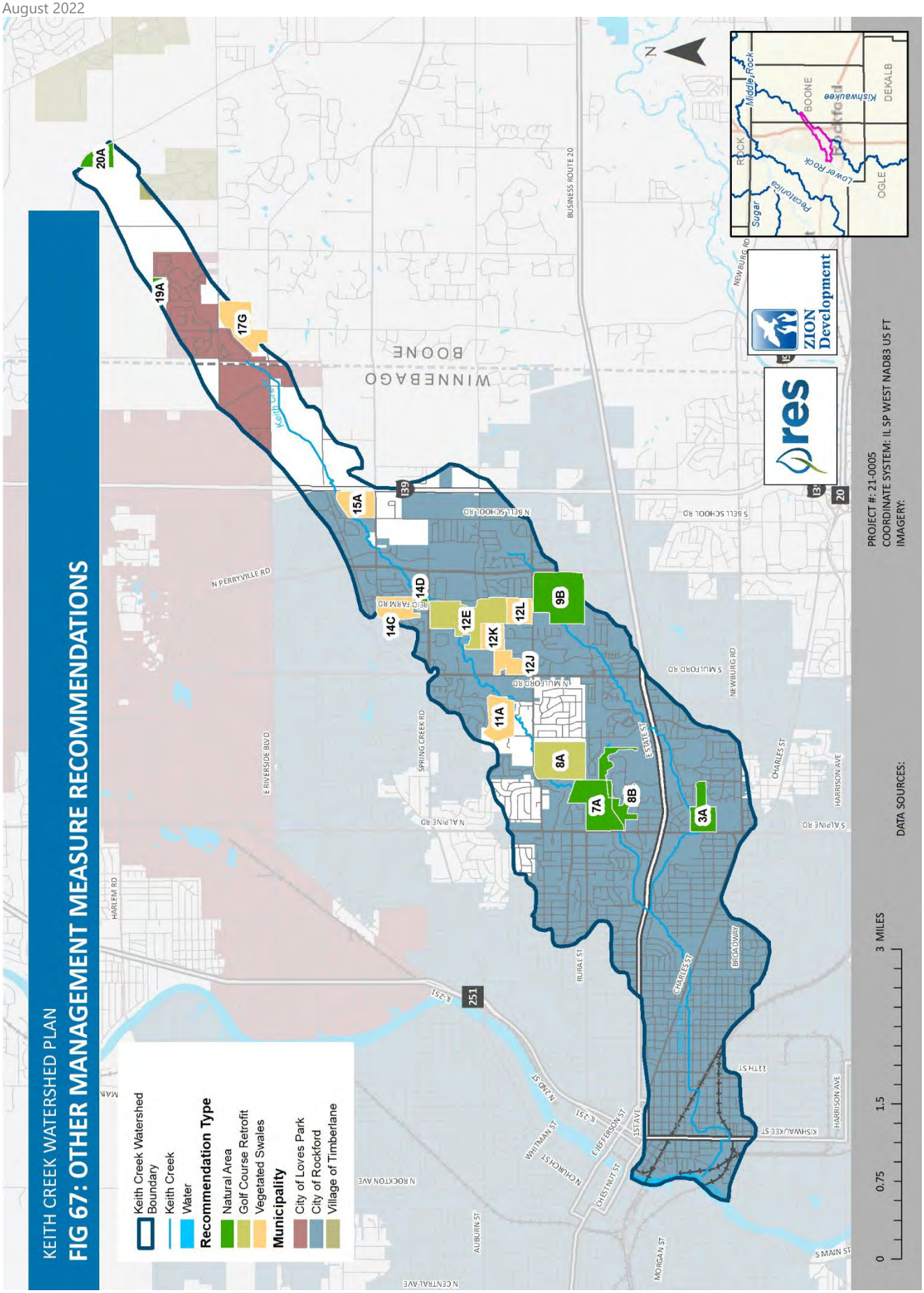
The natural area restoration recommendations are for areas that would benefit from a natural resource inventory and management plan and most commonly are for degraded woodland habitats. The recommendations for the two golf courses are to remove the turf grass in rough areas and replace with native vegetation. The vegetated swale retrofits are all recommendations to convert existing turf grass roadway swales in appropriate subdivisions to native wetland-bottomed swales or bioswales.







Natural Area Restoration opportunity at Guilford County Forest Preserve 9B (above left), golf course retrofit opportunity at Mauh-Nah-Tee-See Club 8A (above right), and an opportunity to retrofit swales at the Cross Creek subdivision 17G (right).


KEITH CREEK WATERSHED PLAN
FIG 67: OTHER MANAGEMENT MEASURE RECOMMENDATIONS
Keith Creek Watershed Boundary
Keith Creek
Water
Recommendation Type
Natural Area
Golf Course Retrofit
Vegetated Swales
Municipality
City of Loves Park
City of Rockford
Village of Timberlane
20A
19A
17G
15A
14C
14D
12E
12K
12L
12J
11A
9B
8A
7A
8B
3A
WINNEBAGO
BOONE
BUSINESS ROUTE 20
N PERRYVILLE RD
E RIVERSIDE BLVD
SPRING CREEK RD
N ALPINE RD
S ALPINE RD
HARLEM RD
N BELL SCHOOL RD
S BELL SCHOOL RD
N MULFORD RD
S MULFORD RD
NEWBURG RD
E STATE ST
CHARLES ST
HARRISON AVE
RURAL ST
BROADWAY
11TH ST
KISHWAUKEE ST
1ST AVE
E JEFFERSON ST
CHESTNUT ST
WHITMAN ST
N CHURCH ST
N ROCKTON AVE
AUBURN ST
MORGAN ST
S MAIN ST
N CENTRAL AVE
251
IL-251
Keith Creek
ZION Development
res
ROCK
BOONE
DEKALB
OGLE
Middle Rock
Kishwaukee
Sugar
Pecatonica
Lower Rock
N
0
0.75
1.5
3 MILES
PROJECT #: 21-0005
COORDINATE SYSTEM: IL SP WEST NAD83 US FT
IMAGERY:
DATA SOURCES:

6.2.5 Site-Specific Management Measures Action Plan Table

Table 41. Site-specific management measures action plan.

BOONE COUNTY

ID #	Location	Units (Ac. or LF)	Existing Condition	Management Measure Recommendation	Pollutant Reduction Efficiency			Priority	Owner & Responsible Entity	Sources of Technical Assistance	Cost Estimate	Implementation Schedule (Years)
					TSS (tons/yr)	TP (lbs/yr)	TN (lbs/yr)					
OTHER MANAGEMENT MEASURES (See Figure 67). Technical and Financial Assistance Needs: Technical and financial assistance needed to implement these projects varies depending on complexity.												
19A	See Figure 67 for project location	21.1	Degraded oak woodland.	Develop natural resource inventory and implement management plan.	5	8	94	Medium	Private owner	Ecological Consultant/ Contractor	$226K to assess, create plan and restore	10-20+ Years
20A	See Figure 67 for project location	34.4	Degraded headwater wetlands (reed canary grass) and dry-mesic oak woodland.	Develop natural resource inventory and implement management plan.	2	6	43	Medium	Private owner	Ecological Consultant/ Contractor	$360K to assess, create plan and restore	10-20+ Years
WETLAND RESTORATION RECOMMENDATIONS (See Figure 66). Technical and Financial Assistance Needs: Wetland restoration projects are typically complex and require high technical and financial assistance needs to protect land, design, construct, monitor, and maintain the restoration.												
20B	See Figure 66 for project location	74.0	Farmed and/or tile-drained hydric soils confirmed in field as good candidate sight for potential wetland restoration and/or mitigation bank.	Design, permit, and construct a project to create wetland storage in farmed area by restoring hydrology via breaking drain tiles if necessary, excavating and installing water control structures for additional water storage, and revegetate with native vegetation.	23	49	482	Critical Area /High	Private owner	USACE, IEPA, Environmental Consultant/ Contractor	$595K to design, permit, and construct	1-10 Years

LOVES PARK												
ID #	Location	Units (Ac. or LF)	Existing Condition	Management Measure Recommendation	Pollutant Reduction Efficiency TSS (tons/yr)	Pollutant Reduction Efficiency TP (lbs/yr)	Pollutant Reduction Efficiency TN (lbs/yr)	Priority	Owner & Responsible Entity	Sources of Technical Assistance	Cost Estimate	Implementation Schedule (Years)
DETENTION BASIN RETROFITS & MAINTENANCE (See Figure 64). Technical and Financial Assistance Needs: Technical assistance needed to implement detention basin retrofits is relatively low while financial assistance needs are moderate. Private landowners will need the greatest assistance.												
17A	See Figure 64 for project location	3.4	Wet bottom turf grass, canal-like detention w/eroded turf edge in poor ecological condition.	Design and implement a project to install biolog at toe w/plugs, install minimum 10ft prairie buffer, and maintain for 3 years to establish.	4	12	42	Critical Area /High	HOA	Ecological Consultant/ Contractor	$62K to design and construct; $31K for 3 years maintenance	1-10 Years
17B	See Figure 64 for project location	1.5	Wet bottom turf grass basin with minimal erosion on shoreline but all buffer is mowed turf in poor ecological condition.	Design and implement a project to naturalize entire buffer up to trail and maintain for 3 years to establish.	10	29	98	Medium	HOA	Ecological Consultant/ Contractor	$27K to design and construct; $13.5K for 3 years maintenance	10-20+ Years
17C	See Figure 64 for project location	3.5	Wet bottom turf grass basin in poor ecological condition with manicured w/riprap toe and limestone outcroppings w/mowed turf buffer and geese present.	Design and implement a project to install 10-15ft prairie buffer to deter geese improve nutrient reduction and maintain for 3 years to establish.	7	21	71	Medium	HOA	Ecological Consultant/ Contractor	$65K to design and construct; $32K for 3 years maintenance	10-20+ Years
17D	See Figure 64 for project location	8.8	Large wet bottom turf grass detention at headwaters, mostly unmowed turf buffer, in poor ecological condition.	Design and implement a project to install 10ft prairie buffer and plugs at toe and maintain for 3 years to establish.	25	30	108	Critical Area /High	HOA	Ecological Consultant/ Contractor	$132K to design and construct; $66K for 3 years maintenance	1-10 Years
17E	See Figure 64 for project location	1.2	Dry detention basin with mowed turf bottom and slopes and concrete channel along bottom in poor ecological condition.	Design and implement project to break/disrupt concrete channel then naturalize basin and buffer with native vegetation to create wetland detention and maintain for 3 years to establish.	38	46	163	Medium	Rockford Park District	Ecological Consultant/ Contractor	$18K to design and construct; $9K for 3 years maintenance	10-20+ Years
17F	See Figure 64 for project location	2.2	Dry detention basin with mowed turf bottom and slopes and concrete channel along bottom in poor ecological condition.	Design and implement project to break/disrupt concrete channel then naturalize basin and buffer with native vegetation to create wetland detention and maintain for 3 years to establish.	54	65	233	Critical Area /High	Rockford Park District	Ecological Consultant/ Contractor	$36K to design and construct; $18K for 3 years maintenance	1-10 Years
19B	See Figure 64 for project location	9.8	Wet bottom turf grass basin in poor ecological condition with riprap on HOA portions (third), eroded turf edge behind homes.	Design and implement a project to install biolog w/plugs at toe on residential portion and install minimum 10ft buffer along whole basin and maintain for 3 years to establish.	12	35	118	Critical Area /High	HOA	Ecological Consultant/ Contractor	$147K to design and construct; $74K for 3 years maintenance	1-10 Years

ROCKFORD												
ID #	Location	Units (Ac. or LF)	Existing Condition	Management Measure Recommendation	Pollutant Reduction Efficiency TSS (tons/yr)	TP (lbs/yr)	TN (lbs/yr)	Priority	Owner & Responsible Entity	Sources of Technical Assistance	Cost Estimate	Implementation Schedule (Years)
DETENTION BASIN RETROFITS & MAINTENANCE (See Figure 64). Technical and Financial Assistance Needs: Technical assistance needed to implement detention basin retrofits is relatively low while financial assistance needs are moderate. Private landowners will need the greatest assistance.												
2A	See Figure 64 for project location	0.4	Dry detention basin with mowed turf bottom and slopes in poor ecological condition.	Design and implement a project to remove turf, naturalize basin slopes and bottom with natives, and maintain for 3 years to establish.	17	20	73	Medium	East High School	Ecological Consultant/ Contractor	$18K to design and construct; $9K for 3 years maintenance	10-20+ Years
4A	See Figure 64 for project location	2.2	Dry detention basin with mowed turf bottom and slopes and concrete channel along bottom in poor ecological condition.	Design and implement project to break/disrupt concrete channel then naturalize basin and buffer with native vegetation to create wetland detention and maintain for 3 years to establish.	9	12	67	Critical Area /High	Rockford /Private owner	Ecological Consultant/ Contractor	$36K to design and construct; $18K for 3 years maintenance	1-10 Years
9A	See Figure 64 for project location	2.3	Dry detention basin with mowed turf bottom and slopes in poor ecological condition.	Design and implement a project to remove turf, naturalize basin slopes and bottom with natives, and maintain for three years to establish.	1	8	9	Medium	Rockford Park District	Ecological Consultant/ Contractor	$36K to design and construct; $18K for 3 years maintenance	10-20+ Years
9C	See Figure 64 for project location	0.5	Dry detention basin with mowed turf bottom and slopes in poor ecological condition.	Design and implement a project to remove turf, naturalize basin slopes and bottom with natives, and maintain for 3 years to establish.	8	10	51	Medium	Private owner	Ecological Consultant/ Contractor	$18K to design and construct; $9K for 3 years maintenance	10-20+ Years
9D	See Figure 64 for project location	1.2	Wet bottom turf grass basin in poor ecological condition, unmowed and draining future multi-family housing	Design and implement a project to remove turf, naturalize basin slopes with natives, and maintain for 3 years to establish.	8	9	33	Critical Area /High	Private owner	Ecological Consultant/ Contractor	$18K to design and construct; $9K for 3 years maintenance	1-10 Years
9E	See Figure 64 for project location	5.1	Dry detention basin with mowed turf bottom and slopes and concrete channel along bottom in poor ecological condition.	Design and implement project to break/disrupt concrete channel then naturalize basin and buffer with native vegetation to create wetland detention and maintain for 3 years to establish.	12	15	109	Critical Area /High	Private owner	Ecological Consultant/ Contractor	$77K to design and construct; $38K for 3 years maintenance	1-10 Years
9F	See Figure 64 for project location	4.6	Dry detention basin with mowed turf bottom and slopes and concrete channel along bottom in poor ecological condition.	Design and implement project to break/disrupt concrete channel then naturalize basin and buffer with native vegetation to create wetland detention and maintain for 3 years to establish.	17	20	73	Critical Area /High	Private owner	Ecological Consultant/ Contractor	$83K to design and construct; $42K for 3 years maintenance	1-10 Years
12A	See Figure 64 for project location	2.4	Dry detention basin with mowed turf bottom and slopes and concrete channel along bottom in poor ecological condition.	Design and implement project to break/disrupt concrete channel then naturalize basin and buffer with native vegetation to create wetland detention and maintain for 3 years to establish.	20	25	88	Medium	Private owner	Ecological Consultant/ Contractor	$45K to design and construct; $24K for 3 years maintenance	10-20+ Years
12B	See Figure 64 for project location	0.9	Dry detention basin with mowed turf bottom and slopes and concrete channel along bottom in poor ecological condition.	Design and implement project to break/disrupt concrete channel then naturalize basin and buffer with native vegetation to create wetland detention and maintain for 3 years to establish.	14	18	130	Medium	Private owner	Ecological Consultant/ Contractor	$18K to design and construct; $9K for 3 years maintenance	10-20+ Years
12C	See Figure 64 for project location	3.0	Dry detention basin with mowed turf bottom and slopes and concrete channel along bottom in poor ecological condition.	Design and implement project to break/disrupt concrete channel then naturalize basin and buffer with native vegetation to create wetland detention and maintain for 3 years to establish.	18	20	147	Medium	Private owner	Ecological Consultant/ Contractor	$54K to design and construct; $27K for 3 years maintenance	10-20+ Years
12D	See Figure 64 for project location	1.2	Wet bottom naturalized basin in poor ecological condition - once planted with natives but overrun w/invasives and moderately eroded toe.	Design and implement a project to re-establish native buffer and install biologs at toe with native plants and maintain for three years to establish.	20	24	120	Medium	Private owner	Ecological Consultant/ Contractor	$18K to design and construct; $9K for 3 years maintenance	10-20+ Years

ID #	Location	Units (Ac. or LF)	Existing Condition	Management Measure Recommendation	Pollutant Reduction Efficiency			Priority	Owner & Responsible Entity	Sources of Technical Assistance	Cost Estimate	Implementation Schedule (Years)
					TSS (tons/yr)	TP (lbs/yr)	TN (lbs/yr)					
12D	See Figure 64 for project location	1.2	Wet bottom naturalized basin in poor ecological condition - once planted with natives but overrun w/invasives and moderately eroded toe.	Design and implement a project to re-establish native buffer and install biologs at toe with native plants and maintain for three years to establish.	20	24	120	Medium	Private owner	Ecological Consultant/ Contractor	$18K to design and construct; $9K for 3 years maintenance	10-20+ Years
12F	See Figure 64 for project location	4.5	Dry detention basin with mowed turf bottom and slopes in poor ecological condition.	Design and implement a project to remove turf, naturalize basin slopes and bottom with natives, and maintain for three years to establish.	16	20	147	Critical Area /High	Private owner	Ecological Consultant/ Contractor	$83K to design and construct; $42K for 3 years maintenance	1-10 Years
12G	See Figure 64 for project location	4.3	Dry detention basin with mowed turf bottom and slopes and concrete channel along bottom in poor ecological condition.	Design and implement project to break/disrupt concrete channel then naturalize basin and buffer with native vegetation to create wetland detention and maintain for 3 years to establish.	13	15	55	Critical Area /High	First Free Rockford	Ecological Consultant/ Contractor	$76K to design and construct; $38K for 3 years maintenance	1-10 Years
12H	See Figure 64 for project location	1.8	Dry detention basin with mowed turf bottom and slopes in poor ecological condition.	Design and implement a project to remove turf, naturalize basin slopes and bottom with natives, and maintain for three years to establish	6	7	24	Medium	First Free Rockford	Ecological Consultant/ Contractor	$36K to design and construct; $18K for 3 years maintenance	10-20+ Years
12I	See Figure 64 for project location	1.5	Dry detention basin with mowed turf bottom and slopes in poor ecological condition.	Design and implement a project to remove turf, naturalize basin slopes and bottom with natives, and maintain for three years to establish.	10	29	98	Medium	HOA	Ecological Consultant/ Contractor	$27K to design and construct; $13.5K for 3 years maintenance	10-20+ Years
13B	See Figure 64 for project location	2.4	Dry detention basin with mowed turf bottom and slopes and concrete channel along bottom in poor ecological condition.	Design and implement project to break/disrupt concrete channel then naturalize basin and buffer with native vegetation to create wetland detention and maintain for 3 years to establish.	5	16	54	Medium	HOA	Ecological Consultant/ Contractor	$45K to design and construct; $24K for 3 years maintenance	10-20+ Years
14A	See Figure 64 for project location	3.2	Dry detention basin with mowed turf bottom and slopes and concrete channel along bottom in poor ecological condition.	Design and implement project to break/disrupt concrete channel then naturalize basin and buffer with native vegetation to create wetland detention and maintain for 3 years to establish.	10	12	88	Critical Area /High	Private owner	Ecological Consultant/ Contractor	$54K to design and construct; $30K for 3 years maintenance	1-10 Years
14B	See Figure 64 for project location	0.4	Dry detention basin with mowed turf bottom and slopes and concrete channel along bottom in poor ecological condition.	Design and implement project to break/disrupt concrete channel then naturalize basin and buffer with native vegetation to create wetland detention and maintain for 3 years to establish.	2	2	17	Medium	Private owner	Ecological Consultant/ Contractor	$18K to design and construct; $9K for 3 years maintenance	10-20+ Years
15B	See Figure 64 for project location	0.3	Dry detention basin with mowed turf bottom and slopes in poor ecological condition.	Design and implement a project to remove turf, naturalize basin slopes and bottom with natives, and maintain for 3 years to establish.	3	4	13	Medium	Private owner	Ecological Consultant/ Contractor	$18K to design and construct; $9K for 3 years maintenance	10-20+ Years
15C	See Figure 64 for project location	2.3	Wet bottom basin with turf grass slopes and fountain, highly formal, in poor ecological condition.	Design and implement a project to remove turf, install 15-foot native buffer, naturalize slopes with natives, and maintain for 3 years to establish.	12	15	53	Medium	HOA	Ecological Consultant/ Contractor	$36K to design and construct; $18K for 3 years maintenance	10-20+ Years
OTHER MANAGEMENT MEASURES (See Figure 67). Technical and Financial Assistance Needs: Technical and financial assistance needed to implement these projects varies depending on complexity.												
3A	See Figure 67 for project location	54.8	Alpine Park - overgrown oak woodland along stream corridor.	Develop natural resource inventory and implement management plan.	79	125	1118	Critical Area /High	Rockford Park District	Ecological Consultant/ Contractor	$460K to assess, create plan and restore	10-20+ Years
7A	See Figure 67 for project location	103.7	Spillway area is mostly second growth woodland and scrub shrub with some (unused) turf areas in park.	Develop natural resource inventory and implement management plan.	31	58	353	Critical Area /High	Rockford Park District	Ecological Consultant/ Contractor	$850K to assess, create plan and restore	1-10 Years

ID #	Location	Units (Ac. or LF)	Existing Condition	Management Measure Recommendation	Pollutant Reduction Efficiency			Priority	Owner & Responsible Entity	Sources of Technical Assistance	Cost Estimate	Implementation Schedule (Years)
					TSS (tons/yr)	TP (lbs/yr)	TN (lbs/yr)					
8B	See Figure 67 for project location	63.7	Spillway area is mostly second growth woodland and scrub shrub with some (unused) turf areas in park.	Develop natural resource inventory and implement management plan.	79	113	734	Critical Area /High	Rockford Park District	Ecological Consultant/ Contractor	$530K to assess, create plan and restore	1-10 Years
9B	See Figure 67 for project location	147.3	Guilford County Forest Preserve/Midway Museum - second growth oak woodland, oldfield and mowed turf.	Develop natural resource inventory and implement management plan.	81	106	739	Critical Area /High	Rockford Park District	Ecological Consultant/ Contractor	$1.2M to assess, create plan and restore	1-10 Years
14D	See Figure 67 for project location	9.5	Hunter Park - manicured park w/mature maple, oak, basswood, locust cypress tree.	Design and implement a project to restore understory to savanna/prairie; good site to create additional water quality education or trails.	7	10	66	Medium	Rockford Park District	Ecological Consultant/ Contractor	$155K to assess, create plan and restore	10-20+ Years
12E	See Figure 67 for project location	140.0	Aldeen Golf Club is a typical golf course.	Design and implement a project to remove turf in rough areas and replace with native vegetation and maintain for three years to establish.	77	101	704	Critical Area /High	Rockford Park District	Ecological Consultant/ Contractor	$300K to design and construct, $50K for 3 years maintenance	10-20+ Years
12J	See Figure 67 for project location	43.0	Non-sewered subdivision with turf swales along roadways.	Design and implement a project to convert grass swales to native wetland-bottomed swales or bioswales and maintain for three years to establish	2	8	53	Medium	Rockford	Ecological Consultant/ Contractor	$40K to design and construct	10-20+ Years
12K	See Figure 67 for project location	36.3	Non-sewered subdivision with turf swales along roadways.	Design and implement a project to convert grass swales to native wetland-bottomed swales or bioswales and maintain for three years to establish	2	7	45	Medium	Rockford	Ecological Consultant/ Contractor	$20K to design and construct	10-20+ Years
12L	See Figure 67 for project location	39.4	Non-sewered subdivision with turf swales along roadways.	Design and implement a project to convert grass swales to native wetland-bottomed swales or bioswales and maintain for three years to establish	2	7	48	Medium	Rockford	Ecological Consultant/ Contractor	$40K to design and construct	10-20+ Years
14C	See Figure 67 for project location	49.6	Non-sewered subdivision with turf swales along roadways.	Design and implement a project to convert grass swales to native wetland-bottomed swales or bioswales and maintain for three years to establish	3	9	62	Medium	Rockford	Ecological Consultant/ Contractor	$50K to design and construct	10-20+ Years
WETLAND RESTORATION RECOMMENDATIONS (See Figure 66). Technical and Financial Assistance Needs: Wetland restoration projects are typically complex and require high technical and financial assistance needs to protect land, design, construct, monitor, and maintain the restoration.												
15E	See Figure 66 for project location	46.9	Farmed and/or tile-drained hydric soils confirmed in field as good candidate sight for potential wetland restoration and/or mitigation bank.	Design, permit, and construct a project to create wetland storage in farmed area by restoring hydrology via breaking drain tiles if necessary, excavating and installing water control structures for additional water storage, and revegetate with native vegetation.	28	51	597	Critical Area /High	Private owner	USACE, IEPA, Environmental Consultant/ Contractor	$470K to design, permit, and construct	1-10 Years
STREAMBANK & RIPARIAN AREA RESTORATION RECOMMENDATIONS (See Figure 65). Technical and Financial Assistance Needs: Stream restorations are complex and require high technical and financial assistance needs to protect land, design, construct, monitor, and maintain the restoration. The project becomes more complex in areas that flow through several governing bodies or multiple private residences. Technical and financial assistance associated with stream maintenance is generally low for minor tasks such as removing debris.												
KCR03	See Figure 65 for project location	2,711.2	Reach 3 is a series of online ponds through golf course with turf grass planted to edge of banks.	Design, permit, and implement a project to remove dams and recreate stream channel, then restore former pond areas to wetlands and maintain for 3 years to ensure establishment.	64	85	589	Low	Rockford Park District/ Private Owners	USACE, Engineer, Environmental Consultant/ Contractor	$1.1M-Design & Construct; $34K 3 Year Maintenance	10-20+ Years
KCR06	See Figure 65 for project location	4,869.8	Reach 6 exhibits moderate levels of erosion, low levels of channelization, and has a riparian area in average ecological condition.	Design, permit, and implement a project to remove invasives from riparian area, restore native floodplain, spot grade where necessary, and maintain for 3 years to ensure establishment.	238	251	720	Critical Area /High	Rockford/ Rockford Park District	USACE, Engineer, Environmental Consultant/ Contractor	$200k-Design & Construct; $50K 3 Year Maintenance	10-20+ Years

ID #	Location	Units (Ac. or LF)	Existing Condition	Management Measure Recommendation	Pollutant Reduction Efficiency			Priority	Owner & Responsible Entity	Sources of Technical Assistance	Cost Estimate	Implementation Schedule (Years)
					TSS (tons/yr)	TP (lbs/yr)	TN (lbs/yr)					
KCR07	See Figure 65 for project location	4,450.8	Reach 7 exhibits moderate levels of erosion, is moderately channelized, and has a riparian area in poor ecological condition.	Design and implement a project to remove invasives, replant w/natives and maintain for 3 years to ensure establishment.	273	289	1,006	Critical Area /High	Rockford/ Private Owners	USACE, Engineer, Environmental Consultant/ Contractor	$100k-Design & Construct; $45K 3 Year Maintenance	10-20+ Years
KCR08	See Figure 65 for project location	3,852.4	Reach 8 exhibits low levels of erosion, is moderately channelized, and has a riparian area in poor ecological condition.	Design and implement a project to remove invasives, install native buffer on both banks, replant w/natives, and then maintain for 3 years to ensure establishment.	98	111	418	Critical Area /High	Rockford Park District/ Private Owners	USACE, Engineer, Environmental Consultant/ Contractor	$85k-Design & Construct; $40K 3 Year Maintenance	1-10 Years
KCR10	See Figure 65 for project location	4,119.0	Reach 10 exhibits no erosion, is highly channelized, and has a riparian area in poor ecological condition.	Design, permit and implement a project to re-meander entire length of channel, excavate wide floodplain benches (both banks), install riffles, vegetate riparian area w/native prairie, and maintain for 3 years to ensure establishment.	50	62	427	Critical Area /High	Rockford	USACE, Engineer, Environmental Consultant/ Contractor	$1.6M-Design & Construct; $45K 3 Year Maintenance	1-10 Years
KCR11	See Figure 65 for project location	4,952.5	Reach 11 exhibits moderate levels of erosion, is highly channelized, and has a riparian area in poor ecological condition.	Design and implement a project limited to clean up of riparian areas, minimal restoration, replant w/natives, and maintain for 3 years to ensure establishment.	581	594	1,577	Critical Area /High	Rockford Park District/ Private Owners	USACE, Engineer, Environmental Consultant/ Contractor	$80K-Design & Construct; $40K 3 Year Maintenance	10-20+ Years
KCR12	See Figure 65 for project location	2,708.7	Reach 12 exhibits moderate levels of erosion, is highly channelized, and has a riparian area in poor ecological condition.	Design, permit, and implement a project to remove invasive trees and shrubs, regrade banks as needed, remove concrete debris, replant slopes with natives, and maintain for 3 years to ensure establishment.	656	667	1,573	Critical Area /High	Alter Trading Corporation/ FRSA	USACE, Engineer, Environmental Consultant/ Contractor	$1.1M-Design & Construct; $35K 3 Year Maintenance	1-10 Years
T1R1	See Figure 65 for project location	3,256.8	Tributary 1, Reach 1 exhibits high levels of erosion, is not channelized, with a riparian area in average ecological condition.	Design, permit and implement a project to stabilize incised channel and highly eroded banks using combo of hard and soft armoring as necessary, install grade controls, plant with natives, and maintain for 3 years to ensure establishment.	338	351	1,021	Critical Area /High	Rockford Park District/ Rockford College/Private Owner	USACE, Engineer, Environmental Consultant/ Contractor	$975K-Design & Construct; $35K 3 Year Maintenance	1-10 Years
T2R1	See Figure 65 for project location	2,035.3	Tributary 2, Reach 1 exhibits low levels of erosion, is moderately channelized, with a riparian area in average ecological condition.	Design and implement a project to thin second growth invasive trees and shrubs and maintain for three years.	25	34	169	Low	Rockford School District/ Private Owners	USACE, Engineer, Environmental Consultant/ Contractor	$30K-Design & Construct; $15K 3 Year Maintenance	10-20+ Years
T2R2	See Figure 65 for project location	3,108.3	Tributary 2, Reach 2 exhibits low levels of erosion, low levels of channelization, with a riparian area in good ecological condition.	Continue existing maintenance.	28	40	168	Medium	Rockford Park District	USACE, Engineer, Environmental Consultant/ Contractor	N/A	10-20+ Years
T2R3	See Figure 65 for project location	1,841.2	Tributary 2, Reach 3 is a human-made swale with no defined channel, dominated by reed canary grass.	Design, permit, and implement a project to remove reed canary grass, convert to wet prairie swale, and maintain for 3 years to ensure establishment.	19	24	171	Low	Private Owners	USACE, Engineer, Environmental Consultant/ Contractor	$75K-Design & Construct; $23K 3 Year Maintenance	10-20+ Years
T2R4	See Figure 65 for project location	6,340.7	Tributary 2, Reach 4 exhibits low levels of erosion, is moderately channelized, with a riparian area in poor ecological condition.	Design, permit, and implement a project to remove dams, restore channel, thin invasives, replant with natives and maintain for 3 years to ensure establishment.	112	132	1,003	Low	Private Owners	USACE, Engineer, Environmental Consultant/ Contractor	$800K-Design & Construct; $50K 3 Year Maintenance	10-20+ Years
T2R5	See Figure 65 for project location	5,112.9	Tributary 2, Reach 5 exhibits low levels of erosion, is highly channelized, and has a riparian area in poor ecological condition.	Design and implement a project to thin second growth invasive trees and shrubs and maintain for three years.	89	106	703	Low	Private Owners/ Rockford	USACE, Engineer, Environmental Consultant/ Contractor	$60K-Design & Construct; $30K 3 Year Maintenance	10-20+ Years

ID #	Location	Units (Ac. or LF)	Existing Condition	Management Measure Recommendation	Pollutant Reduction Efficiency			Priority	Owner & Responsible Entity	Sources of Technical Assistance	Cost Estimate	Implementation Schedule (Years)
					TSS (tons/yr)	TP (lbs/yr)	TN (lbs/yr)					
T2R6	See Figure 65 for project location	4,777.5	Tributary 2, Reach 6 exhibits moderate levels of erosion, is moderately channelized, and has a riparian area in poor ecological condition. There is a low head dam at the park entrance.	Design, permit, and implement a project to thin second growth invasive trees and shrubs, remove low head dam at park entrance, and maintain for three years.	234	252	754	Critical Area /High	Rockford Park District	USACE, Engineer, Environmental Consultant/ Contractor	$250K-Design & Construct; $50K 3 Year Maintenance	10-20+ Years
T2R7	See Figure 65 for project location	2,440.2	Tributary 2, Reach 7 exhibits low levels of erosion, is highly channelized, and has a riparian area in poor ecological condition. Much of this reach is buried underground.	Design, permit, and implement a project to thin second growth invasive trees and shrubs, daylight buried portion of stream, and maintain for three years.	80	88	423	Critical Area /High	Rockford/ Private Owners	USACE, Engineer, Environmental Consultant/ Contractor	$975K-Design & Construct; $30K 3 Year Maintenance	10-20+ Years
TribA	See Figure 65 for project location	1,724.4	Tributary A (to Tributary 2) exhibits high levels of erosion, is not channelized, and has a riparian area in average ecological condition.	Design, permit, and implement a project to pull back eroded banks, install grade controls throughout, thin invasives and maintain for 3 years to ensure establishment.	339	344	724	Critical Area /High	Rockford Park District/ Private Owners	USACE, Engineer, Environmental Consultant/ Contractor	$525K-Design & Construct; $25K 3 Year Maintenance	1-10 Years

WINNEBAGO COUNTY

ID #	Location	Units (Ac. or LF)	Existing Condition	Management Measure Recommendation	Pollutant Reduction Efficiency TSS (tons/yr)	TP (lbs/yr)	TN (lbs/yr)	Priority	Owner & Responsible Entity	Sources of Technical Assistance	Cost Estimate	Implementation Schedule (Years)
DETENTION BASIN RETROFITS & MAINTENANCE (See Figure 64). Technical and Financial Assistance Needs: Technical assistance needed to implement detention basin retrofits is relatively low while financial assistance needs are moderate. Private landowners will need the greatest assistance.												
15D	See Figure 64 for project location	4.1	Dry detention basin with mowed turf bottom and slopes in poor ecological condition.	Design and implement a project to remove turf, naturalize basin slopes and bottom with natives, and maintain for 3 years to establish.	11	14	48	Medium	Private owner	Ecological Consultant/ Contractor	$74K to design and construct; $37K for 3 years maintenance	10-20+ Years
16A	See Figure 64 for project location	4.5	Dry detention basin with mowed turf bottom and slopes and concrete channel along bottom in poor ecological condition.	Design and implement project to break/disrupt concrete channel then naturalize basin and buffer with native vegetation to create wetland detention and maintain for 3 years to establish.	10	13	55	Critical Area /High	Private owner	Ecological Consultant/ Contractor	$81K to design and construct; $41K for 3 years maintenance	1-10 Years
16B	See Figure 64 for project location	2.7	Dry detention basin with mowed turf bottom and slopes in poor ecological condition.	Design and implement a project to remove turf, naturalize basin slopes and bottom with natives, and maintain for 3 years to establish.	4	6	36	Medium	Private owner	Ecological Consultant/ Contractor	$49K to design and construct; $24K for 3 years maintenance	10-20+ Years
16C	See Figure 64 for project location	40.0	Dry detention basin with mowed turf bottom and slopes in poor ecological condition.	Design and implement a project to remove turf, naturalize basin slopes and bottom with natives, and maintain for 3 years to establish.	55	67	259	Critical Area /High	Javon Bea Hospital	Ecological Consultant/ Contractor	$480K to design and construct; $180K for 3 years maintenance	1-10 Years
OTHER MANAGEMENT MEASURES (See Figure 67). Technical and Financial Assistance Needs: Technical and financial assistance needed to implement these projects varies depending on complexity.												
8A	See Figure 67 for project location	116.8	Muh-na-ta-see Country Club is a typical golf course.	Design and implement a project to remove turf in rough areas and replace with native vegetation and maintain for three years to establish.	34	42	304	Medium	Private owner	Ecological Consultant/ Contractor	$250K to design and construct, $40K for 3 years maintenance	10-20+ Years
11A	See Figure 67 for project location	67.2	Non-sewered subdivision with turf swales along roadways.	Design and implement a project to convert grass swales to native wetland-bottomed swales or bioswales and maintain for three years to establish	4	12	84	Medium	Rockford	Ecological Consultant/ Contractor	$40K to design and construct	10-20+ Years
15A	See Figure 67 for project location	54.5	Non-sewered subdivision with turf swales along roadways.	Design and implement a project to convert grass swales to native wetland-bottomed swales or bioswales and maintain for three years to establish	3	10	68	Medium	Rockford	Ecological Consultant/ Contractor	$40K to design and construct	10-20+ Years
17G	See Figure 67 for project location	87.0	Non-sewered subdivision with turf swales along roadways.	Design and implement a project to convert grass swales to native wetland-bottomed swales or bioswales and maintain for three years to establish	5	16	108	Medium	Rockford	Ecological Consultant/ Contractor	$50K to design and construct	10-20+ Years
WETLAND RESTORATION RECOMMENDATIONS (See Figure 66). Technical and Financial Assistance Needs: Wetland restoration projects are typically complex and require high technical and financial assistance needs to protect land, design, construct, monitor, and maintain the restoration.												
13A	See Figure 66 for project location	21.4	Farmed and/or tile-drained hydric soils confirmed in field as good candidate sight for potential wetland restoration and/or mitigation bank.	Design, permit, and construct a project to create wetland storage in farmed area by restoring hydrology via breaking drain tiles if necessary, excavating and installing water control structures for additional water storage, and revegetate with native vegetation.	5	13	116	Critical Area /High	Private owner	USACE, IEPA, Environmental Consultant/ Contractor	$215K to design, permit, and construct	1-10 Years
STREAMBANK & RIPARIAN AREA RESTORATION RECOMMENDATIONS (SEE FIGURE 65). Technical and Financial Assistance Needs: Stream restorations are complex and require high technical and financial assistance needs to protect land, design, construct, monitor, and maintain the restoration. The project becomes more complex in areas that flow through several governing bodies or multiple private residences. Technical and financial assistance associated with stream maintenance is generally low for minor tasks such as removing debris.												
KCR01	See Figure 65 for project location	8,835.1	Keith Creek Reach 1 exhibits low levels of erosion, is highly channelized, and has a riparian area in poor ecological condition.	Design and implement a project to remove invasives, install 30' buffer on both banks, replant w/natives, and then maintain for 3 years to ensure establishment.	80	92	494	Critical Area /High	Mercyhealth/ Rockford Mem. Hospital/ RPD/ Private Owners	USACE, Engineer, Environmental Consultant/ Contractor	$125K-Design & Construct; $55K 3 Year Maintenance	1-10 Years

ID #	Location	Units (Ac. or LF)	Existing Condition	Management Measure Recommendation	Pollutant Reduction Efficiency			Priority	Owner & Responsible Entity	Sources of Technical Assistance	Cost Estimate	Implementation Schedule (Years)
					TSS (tons/yr)	TP (lbs/yr)	TN (lbs/yr)					
KCR04	See Figure 65 for project location	9,655.8	Reach 4 exhibits moderate levels of erosion, low levels of channelization, and has a riparian area in average ecological condition.	Design, permit, and implement a project to remove invasives from floodplain, spot repair eroded sections and maintain for 3 years to ensure establishment	331	369	1,035	Critical Area /High	Rockford Park District/ Private Owners	USACE, Engineer, Environmental Consultant/ Contractor	$910k-Design & Construct; $60K 3 Year Maintenance	10-20+ Years
KCR05	See Figure 65 for project location	3,450.3	Reach 5 exhibits low levels of erosion, is moderately channelized, and has a riparian area in poor ecological condition.	Design and implement a project to install 10-15ft prairie buffer either side of stream and maintain for 3 years to ensure establishment.	62	77	416	Medium	Mauh-Nah-Tee-See Country Club/ Private Owners	USACE, Engineer, Environmental Consultant/ Contractor	$50k-Design & Construct; $25K 3 Year Maintenance	10-20+ Years

7.0 INFORMATION & EDUCATION PLAN

This Information & Education Plan (I&E Plan) recommends campaigns that are designed to enhance understanding of the issues, problems, and opportunities within Keith Creek watershed. The intention is to promote general acceptance and stakeholder participation in selecting, designing, and implementing recommended Management Measures to improve watershed conditions. The first step in understanding the issues, problems, and opportunities within Keith Creek watershed is to gain a better perspective of how the watershed evolved over time into what exists today.

Due to the current conditions of water quality within the watershed, it is imperative that the Management Measure recommendations are closely linked with watershed information and education programs. Thorough public information and stakeholder education efforts will ultimately inspire residents and community members to adopt recommended implementation actions. The cumulative actions of individuals and communities' watershed-wide can accomplish the goals of the watershed plan. Watershed health is of primary importance for the people of Keith Creek watershed. 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 health of the watershed.

The Keith Creek Steering Committee, led by ZION Development Corporation in partnership with the City of Rockford, R1PC, and numerous other stakeholders, believes that the process of creating and implementing this Watershed-Based Plan will unite stakeholders, help them understand issues and opportunities facing the watershed, and implement projects that improve watershed conditions. The Steering Committee is actively engaging the public in watershed activities such as coordinating efforts with the myriad partners also working within the Keith Creek watershed, educating landowners about how to manage their land for green infrastructure benefit, providing local groups with information about Keith Creek watershed to support ongoing educational opportunities and outdoor curriculums, and working to improve water quality and quality of life for all stakeholders along Keith Creek.

Recommended Information & Education Campaigns

A successful I&E Plan first raises awareness among stakeholders of watershed issues, problems, and opportunities. The second step is to provide stakeholders with information on alternatives to implement to address the issues, problems, and opportunities. This I&E Plan includes the following components as referenced in USEPA's *"Handbook for Developing Watershed Plans to Restore and Protect Our Waters"* (USEPA 2008):

- Define I&E goals and objectives.
- Identify and analyze the target audiences.
- Create the messages for each audience.
- Package the message to various audiences.
- Distribute the message.
- Evaluate the I&E program.



Keith Creek signage near the Keith Creek Greenway

Goals and Objectives

Development of an effective I&E Plan begins by defining goals and objectives. Goals were established for the Keith Creek watershed-based plan following the Goals Workshop. The goals and objectives were then further refined in coordination with the Steering Committee. Objectives assigned to each goal are intended to be measurable where appropriate so that future progress can be assessed. The following goals refer to education and communication goals and objectives only (*objectives unrelated to communications have been omitted from this section*).

Goal 4: Build stakeholder awareness of watershed issues through education and stewardship while increasing communication and coordination among stakeholders.

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Objectives:

1) Implement the Keith Creek Watershed-Based Plan Information & Education Campaign.
2) Inform public officials of the benefits of conservation design and low impact development and the importance of ordinance language changes that promote these developments.
3) Increase environmental stewardship opportunities and encourage stakeholders to participate in watershed plan implementation and restoration campaigns to increase activism in the watershed.
4) Work with schools at all levels within Keith Creek watershed to provide watershed and water quality educational opportunities and curriculum.
5) Leverage the various planning efforts occurring in and around the Keith Creek Greenway to create educational opportunities focused on improving water quality.

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. The target audience of the watershed 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 audiences 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.

Public Input

Creating and distributing a message for each audience is done via campaigns that address education goal objectives. The I&E Plan objectives for the Keith Creek watershed were determined by the Steering Committee with feedback from stakeholder. An I&E Plan matrix (Table 42) was developed as a tool to help implement the I&E Plan. Not only does the matrix include recommended education campaigns, it also includes columns for Target Audience, Communications Vehicles, Priority/Schedule, Lead & Supporting Organizations, Outcomes/ Change in Action, and Estimated Cost.

Evaluation

The I&E Plan should be evaluated regularly to provide feedback regarding the effectiveness of the outreach campaigns. Evaluation conducted early on in the effort will help determine campaigns that are successful and those that are not. Based on the evaluation, information, money, and time can be saved by focusing on the campaigns that work. Those that do not work should be ended and/or refined. Section 9.2 of this plan contains a Report Card with milestones related to watershed education that can be used to evaluate I&E Plan implementation efforts.

The plan will be made available electronically on the City of Keith website upon IEPA approval at: https://ziondevelopment.org/keith-creek/.

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Table 42. Information and Education Plan Matrix.

Education Action of Campaign	Target Audience	Communication Vehicles	Priority/ Schedule	Lead (Supporting) Organization	Outcomes, Change in Action	Estimated Cost
Educate homeowners in/around the watershed about the plan in general and practices that improve water quality (e.g., reducing phosphate through no pesticide/herbicide use)	Home/ property owners	Neighborhood association newsletter, monthly meetings	Upon plan rollout	Ideas: City of Rockford (Connect Rockford, neighborhood division), Transform Rockford/Great Neighborhoods	Reduce residential pollutants, such as pesticides, that make their way into the Keith Creek.	TBD
Provide teachers/students with curriculum that includes an overview of the watershed	School faculty and their students	An excerpt from the plan to be used as curriculum, or to be integrated into a field trip	Annually	Constance Lane, Lincoln Middle School, East High School, Gregory, Rockford Christian Schools, Rockford University (ZION Development)	Educate students close to the Creek about causes and management of Creek pollution.	TBD
Create design for Rockford Art Deli T-Shirt. Graphically depict creek and watershed improvement slogan.	General Public	Drive interest through project recognition.	Following plan completion	ZION Development (Hire or get donated labor from local graphic designer. Get buy-in from Rockford Art Deli to produce, promote, and sell t-shirts)	Raise awareness across community about project.	$2,000
Create 3d printed model of Keith Creek watershed and do flood demos with schools.	Students	Education at local schools. Promotion of school visits on social media.	Following plan completion	ZION Development (Local engineers/planners to volunteer time for demonstrations)	Raise awareness across community about project.	$5,000
Block parties in different neighborhoods within the Watershed	Community	Social gathering. Promotion on social media.	Annually after completion of plan	Transform Rockford-Great Neighborhoods (ZION Development, Residents in vicinity)	Community groups can make connections and continue momentum of plan.	$2,000
Raise awareness of general public of Keith Creek, issues surrounding, and plans in place	General public	Bike/walking tours	Quarterly	Gary Anderson historical tours (ZION Development/Studio GWA)	Spread awareness about the plan and its recommendations and encourage implementation by stakeholders	$250

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Education Action of Campaign	Target Audience	Communication Vehicles	Priority/ Schedule	Lead (Supporting) Organization	Outcomes, Change in Action	Estimated Cost
Northern Groundwater Protection Planning Region's Youth Groundwater Festival	Fourth and Fifth Grade Students	Groundwater Flow Model, Enviroscape model, "Dripial Pursuit", and Water Testing	Annually	Boone and McHenry Counties (Area Schools, Rock Valley College)	Outreach and education on regional groundwater protection and issues	N/A
Incorporate watershed and water quality education into existing nature-based programming at Rockford Park District	Kids 5-12	Nature Quest Program	Annually - summer	Rockford Park District (ZION Development)	Educate kids about watersheds and water quality	N/A
Promote Conservation at Home Program to encourage more resilient homes/places of business	Residents, businesses, organizations within watershed	Neighborhood meetings	Annually	Natural Land Institute (ZION Development)	Increase in resiliency, less damage to property	$25/ certification
Raise awareness and increase interaction with the creek/nature	Kids	Patriot's Gateway program/ curriculum	Quarterly/ Annually	Patriot's Gateway (ZION Development)	Educate kids about watersheds and water quality	N/A

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8.0 PLAN IMPLEMENTATION

8.1 Plan Implementation Roles and Coordination/Responsibilities

Identification of responsible entities for implementation of Management Measure recommendations was first mentioned in the Action Plan section of this report. These entities are key stakeholders that will be responsible in some way for sharing the responsibility required to implement the watershed plan. However, no single stakeholder has the financial or technical resources to implement the plan alone. Rather, it will require working together and using the strengths of individual stakeholders to successfully implement this plan. Key stakeholders are listed in Table 43.

There are a couple important first steps the Steering Committee will need to accomplish prior to plan implementation.

1. Watershed partners are encouraged to adopt the Keith Creek Watershed-Based Plan.
2. The Steering Committee will need to recruit a watershed "champion" and a Watershed Implementation Committee that actively implements the Watershed-Based Plan and conducts progress evaluations.

Table 43. Key Keith Creek watershed stakeholders/partners.

Key Watershed Stakeholder/Partner	Abbreviation
Boone County	Boone
Boone County Conservation District	BCCD
Boone County Soil & Water Conservation District	BCSWCD
City of Loves Park	Loves Park
City of Rockford	Rockford
Four Rivers Sanitation Authority	FRSA
Golf Courses	GC
Illinois Department of Natural Resources	IDNR
Illinois Environmental Protection Agency	IEPA
Illinois Tollway	Tollway
Keith Creek Watershed Steering Committee	Steering
Midway Village	MV
Miracle Mile Rockford	Miracle Mile
Patriot's Gateway Center	Patriot
Region 1 Planning Council	R1PC
Rockford Area Convention & Visitor's Bureau	RACVB
Rockford Park District	Parks
United States Army Corps of Engineers	USACE
United States Fish & Wildlife Service	USFWS
Village of Timberlane	Timberlane
Winnebago County	Winnebago
Winnebago County Highway Department	WCHD
Winnebago County Soil & Water Conservation District	WCSWCD
ZION Development Corp.	ZION

Early in the plan implementation process, the Steering Committee should assign or hire a Watershed Implementation Coordinator to lead the committee on plan implementation, call meetings, and track progress by way of the Report Cards (detailed in Section 9.2). If needed, adaptive management should be implemented accordingly by referencing the adaptive management recommendations on each Report Card then developing a strategy to either change the milestone(s) or decide how to implement projects or actions to achieve the milestone(s).

Report Cards can be evaluated at any time. However, it is recommended that they be evaluated *at least* every five years to determine if sufficient progress is being made toward achieving milestones or if adaptive management is needed.

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8.2 Implementation Schedule

The development of an implementation schedule is important in the watershed planning process because it provides a timeline for when each recommended Management Measure should be implemented in relation to others. Critical Area/High priority projects, for example, are generally scheduled for implementation in the short term. A schedule also helps organize project implementation evenly over a given time period, allowing a reasonable time frame for developing funding sources and opportunities.

For this plan, each Site-Specific Management Measure recommendation located in the Management Measures Action Plan (Section 6) contains a column with a recommended Implementation Schedule based on the short term for critical area (1-10 years) for high priority projects and 10-20+ years for medium and low priority project recommendations. Other recommendations such as maintenance activities have ongoing or as needed schedules. Some projects that are high priority could be recommended for long-term implementation based on selected practices, available funds, technical assistance needs, and time frame. In addition, the Information & Education plan (see Section 7.0) and the Monitoring Plan are designed to be conducted annually and evaluated at least every five years to determine if progress is being made toward achieving plan goals and objectives.

8.3 Funding Sources

Opportunities to secure funds for watershed improvement projects are widespread due to the variety and diversity of Management Measure recommendations found in the Action Plan. Public and private organizations that administer various conservation and environmental programs are often eager to form partnerships and leverage funds for land restoration, preservation, and environmental education. In this way, funds invested by partners in the Keith Creek watershed can be doubled or tripled, although actual dollar amounts are difficult to measure. A list of potential funding programs and opportunities is included in Appendix E.

Funds generally fall into two relatively distinct categories. The first includes existing grant programs, funded by a public agency or by other sources. These funds are granted following an application process. The Illinois EPA Nonpoint Source Management Program (Section 319 Grants) is one example: an applicant will submit a grant application to the program, and, if the proposed project meets the required criteria and if the funds appropriated have not been exhausted, a grant may be awarded.

The second category, one that can provide greater leverage, might be called "money to be found." The key to this money is to recognize that any given project may have multiple benefits. It is important to note and explore all the potential project benefits from the perspective of potential partners and to then engage those partners. Partners may wish to become involved because they believe the project will achieve their objectives, even if they have little interest in the specific objectives of the Watershed Plan. It is not uncommon for an exciting and innovative project to attract funds that can be allocated at the discretion of project partners. When representatives of interested organizations gather to talk about a proposed project, they are often willing to commit discretionary funds simply because the proposed project is attractive, is a priority, is a networking opportunity, or will help the agency achieve its mission. In this way, a new partnership is assembled.

Leveraging and Partnerships

It is critically important to recognize that no one program has been identified that will simply match the overall investment of the Keith Creek watershed partners in implementing the Watershed Plan. Rather, partnerships are most likely to be developed in the context of individual and specific land preservation, restoration, or education projects that are recommended in the Plan. Partners attracted to one acquisition may not have an interest in another located elsewhere for jurisdictional, programmatic, or fiscal reasons.

Almost any land or water quality improvement project ultimately requires the support of those who live nearby if it is to be successful in the long run. Local neighborhood associations, homeowner associations, and similar groups interested in protecting water resources, open space, preventing development, or protecting wildlife habitat and scenic vistas, make the best partners for specific projects. Those organizations ought to be contacted in the context of specific individual projects.

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It is equally important to note that the development of partnerships that will leverage funding or goodwill can be, and typically is, a time-consuming process. In many cases, it takes more time and effort to develop partnerships that will leverage support for a project than it does to negotiate with the landowners for use or acquisition of the property. Each protection or restoration project will be different; each will raise different ecological, political, and financial issues, and each will likely attract different partners. It is also likely that the process will not be fully replicable. That is, each jurisdiction or partner will have a different process and different requirements.

In short, a key task in leveraging additional funds is to assign responsibility to specific staff for developing relationships with individual agencies and organizations, recognizing that the funding opportunities might not be readily apparent. With some exceptions, it will not be adequate simply to write a proposal or apply; more often, funding will follow a concerted effort to seek out and engage specific partners for specific projects, fitting those projects to the interests of the agencies and organizations. Successful partnerships are almost always the result of one or two enthusiastic individuals or "champions" who believe that engagement in this process is in the interests of their agency. There is an adage in private fundraising: people give to other people, not to causes. The same thing is true with partnerships using public funds. Partnerships are also possible, and probably necessary, that will leverage assets other than money. By entering partnerships with some agencies, organizations, or even neighborhood groups, a stakeholder will leverage valuable goodwill, and relationships that have the potential to lead to funds and other support, including political support, from secondary sources.

8.4 Additional Investigations

Over the course of the planning process several instances were identified that were beyond the scope of the initial planning process where additional research or discovery in the future might further plan goals and implementation. Additional potential watershed investigations that the Steering Committee could pursue in the future include, but are not limited to, the following:

- Any new or ongoing research or implementation plans resulting from the Keith Creek Corridor Study
- Any new or ongoing research or implementation plans from the City of Rockford's Keith Creek flood study

These additional investigations are considered High Priority/Critical Areas for future funding should the Steering Committee decide to pursue them in the future.

8.5 Plan Amendments

Data, research, and methodologies are continuously updating and evolving. To accommodate new and updated information, the Steering Committee may decide to update the plan by way of Amendment, if necessary. The process for updating the plan will be led by the Steering Committee and include amendments as agreed to and documented during meetings and attached to the final watershed-based plan as an Amendment. Amendments should be written as stand-alone documents that reference the plan and appropriate plan sections. The process is outlined as follows:

- Steering Committee research and documents Amendment
- Steering Committee approves Amendment
- Steering Committee sends Amendment to IEPA for review and approval
- IEPA and Steering Committee agree to and make edits as necessary
- Steering Committee publishes Amendment

Amendments might include additional projects that were not identified during the planning process; new practices, methodologies, or programs that will improve implementation our watershed outcomes; the results or outcomes of any additional investigations (as identified in Section 8.4); updated Illinois State Water Survey groundwater research; or any similar findings that Steering Committee and IEPA agree to.

The Steering Committee will house a link to the approved watershed-based plan and any approved amendments on its website, currently available at https://ziondevelopment.org/keith-creek/.

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9.0 MEASURING PLAN PROGRESS & SUCCESS

It is essential to have a monitoring plan and evaluation component as part of any watershed plan to evaluate plan implementation progress and success over time. This watershed plan includes two monitoring/evaluation components:

1) The **"Water Quality Monitoring Plan"** includes methods and locations where monitoring should occur, and a set of criteria (indicators & targets) used to determine whether impairment reduction targets and other watershed improvement objectives are being achieved over time.
2) **"Report Cards"** for each plan goal were developed that include interim, measurable milestones linked to evaluation criteria that can be evaluated by the planning committee over time.

9.1 Water Quality Monitoring Plan & Evaluation Criteria

Background Information

This monitoring plan can be implemented to measure changes in watershed impairments related primarily to water quality. Water quality monitoring is performed by first collecting physical, chemical, biological, and/or social indicator data. This data is then compared to criteria (indicators & targets) related to established water quality objectives.

Available water quality data collected within the Keith Creek watershed is summarized in Section 4.1. According to Illinois EPA's most recent 2018 *Integrated Water Quality Report and Section 303(d) List*, Keith Creek Reaches 1-7 (IEPA Assessment Unit ID: IL_PR-01) was not assessed for *Aquatic Life*, *Fish Consumption*, or *Aesthetic Quality*, and is not supporting for *Primary Contact Recreation*. The cause of the impairment is fecal coliform, and the source is urban runoff/storm sewers. Keith Creek Reaches 8-12 (IEPA Assessment Unit ID: IL_PR-99) is fully supporting for *Aesthetic Quality*, was not assessed for *Fish Consumption*, and not supporting for *Aquatic Life* and *Primary Contact Recreation*. The causes of impairment are alteration in stream-side or littoral vegetative covers, arsenic, methoxychlor, zinc, pH, and changes in stream depth and velocity patterns; while the sources of impairment are channelization, contaminated, sediments, and urban runoff/storm sewers. Water quality monitoring data shows indicates moderate overall impairment from elevated total phosphorus and fecal coliform. Elevated phosphorus levels are a problem in streams and can lead to a chain of undesirable events such as accelerated plant growth, algae blooms, low dissolved oxygen, and death of some aquatic organisms, while elevated fecal coliform levels impair potential recreational opportunities.

The water quality monitoring plan is designed to: 1) capture snapshots of water quality within Keith Creek watershed over time; 2) assess changes in water quality following implementation of Management Measures, and 3) assess the public's social behavior related to water quality issues. It is crucial that representative water quality samples be carefully collected using method appropriate handling procedures. Unrepresentative samples or samples contaminated during collection or handling can prove useless. It is important that future monitoring be completed using protocol and methods used by the EPA for QAQC purposes**.** EPA Quality Assurance Project Plans (QAPPs) and Standard Operating Procedures (SOPs) can be found at https://www.epa.gov/sites/production/files/2015-06/documents/vol_qapp.pdf.

Physical, chemical, and biological water quality indicators in streams are typically measured during base flow and after significant (≥ 1.5 inches) storm events. Chemical parameters typically include nutrients (nitrogen and phosphorous) and total suspended solids. All samples should be analyzed by certified labs to ensure accurate results. Physical parameters, such as temperature, dissolved oxygen, pH, and water clarity (turbidity) should be collected in the field using properly maintained and calibrated field equipment. It is also important to obtain stream discharge calculations as a determination of potential pollutant loading. These calculations are easily obtained by measuring the stream width, average depth, and flow rate at the monitoring location. Biological (fish, macroinvertebrate, and pathogens such as fecal coliform) and habitat assessments may also be performed, site assessment criteria dependent.

When management measures are implemented, monitoring should ideally take place both before and after implementation to track the effectiveness of those projects. Management Measure implementation sampling locations should include points of water ingress and egress, such as the inflow and outflow points on a retrofitted detention basin as an example. To achieve the best results with respect to performance, Management Measure implementation monitoring should occur during or shortly after large rain events (≥ 1.5 inches). Biological and/or habitat assessments should also be included on any habitat improvement project, such as a stream restoration. Because funding for post

implementation monitoring is typically limited, money should be built into the initial Management Measures project budget.

Monitoring Plan Implementation

Existing and recommended water quality monitoring regimes, including recommended monitoring entity, monitoring locations, schedule/monitoring frequency, type of parameters sampled, and expected costs, are outlined in Table 44. Moving forward all physical, chemical, and biological (fecal coliform) sampling should continue following existing monitoring programs as outlined for each monitoring entity/program. One new monitoring program change is needed which would be to have the City of Rockford add the PR-99 site to their existing sampling regime. This monitoring will yield data over time that will help track changes in watershed water quality over time. Figure 68 includes the recommended monitoring location. Note: monitoring locations related to individual Management Measures are not described or mapped as this monitoring will come later when projects are implemented.

Table 44. Recommended water quality monitoring programs/locations.

Monitoring Entity/ Program	Monitoring Location (See Figure XX)	Schedule/ Monitoring Frequency	Parameters Sampled	Cost to Implement
Existing Monitoring Programs				
IEPA	PR-01, PR-02, PR-99	Every 5 years	Physical; Chemical	Not Applicable
City of Rockford	PR-02/T3, T4	As scheduled	Physical; Chemical; fecal coliform	Not Applicable
Illinois RiverWatch Network	R01, R02	Every 10 years	Macro-invertebrates	Not Applicable
New Monitoring Programs				
City of Rockford	PR-99 (add site to existing monitoring regime)	As scheduled	Physical; Chemical; fecal coliform	N/A
Project lead or landowner	Varies: Specific to each management measure	Pre and post implementation	Physical, Chemical	$5,000 for each project

Physical and Chemical Monitoring Methods & Recommendations

Physical and chemical monitoring of water can be time consuming and expensive depending on the complexity of the monitoring program. Usually the budget and/or personnel available for monitoring limit the amount of data that can be collected. Therefore, the monitoring program should be developed to maximize the usable data given the available funding and personnel. Any monitoring program should be flexible and subject to change to collect additional information or use newer equipment or technology when available while maintaining a link to past data.

Future physical/chemical monitoring should be collected per the location and schedule outlined in Table 45, and then compared to target water quality values. Chemical/biological parameters should generally include total phosphorus, total nitrogen, total suspended solids, and fecal coliform at a minimum. Many different parameters can be included in physical monitoring of water quality in streams. Measurements of temperature, pH, conductivity, dissolved oxygen, and turbidity should be collected in the field for any monitoring done on Keith Creek using portable instruments. The measurements can then be recorded on data sheets in the field, or the units can be taken back to the lab and the data downloaded.

Unlike physical monitoring, chemical monitoring requires grab samples be collected and taken to certified labs for analysis and collection needs to follow handling procedures for samples as outlined in Table 45. Unrepresentative samples or samples contaminated during collection or handling are often useless. The collected samples should be submitted for analysis to a laboratory certified by the National Environmental Laboratory Accreditation Conference (NELAC). Generally, the laboratory will work closely with the monitoring entity to assure that the samples are collected in the proper containers with preservatives for the parameter of interest.

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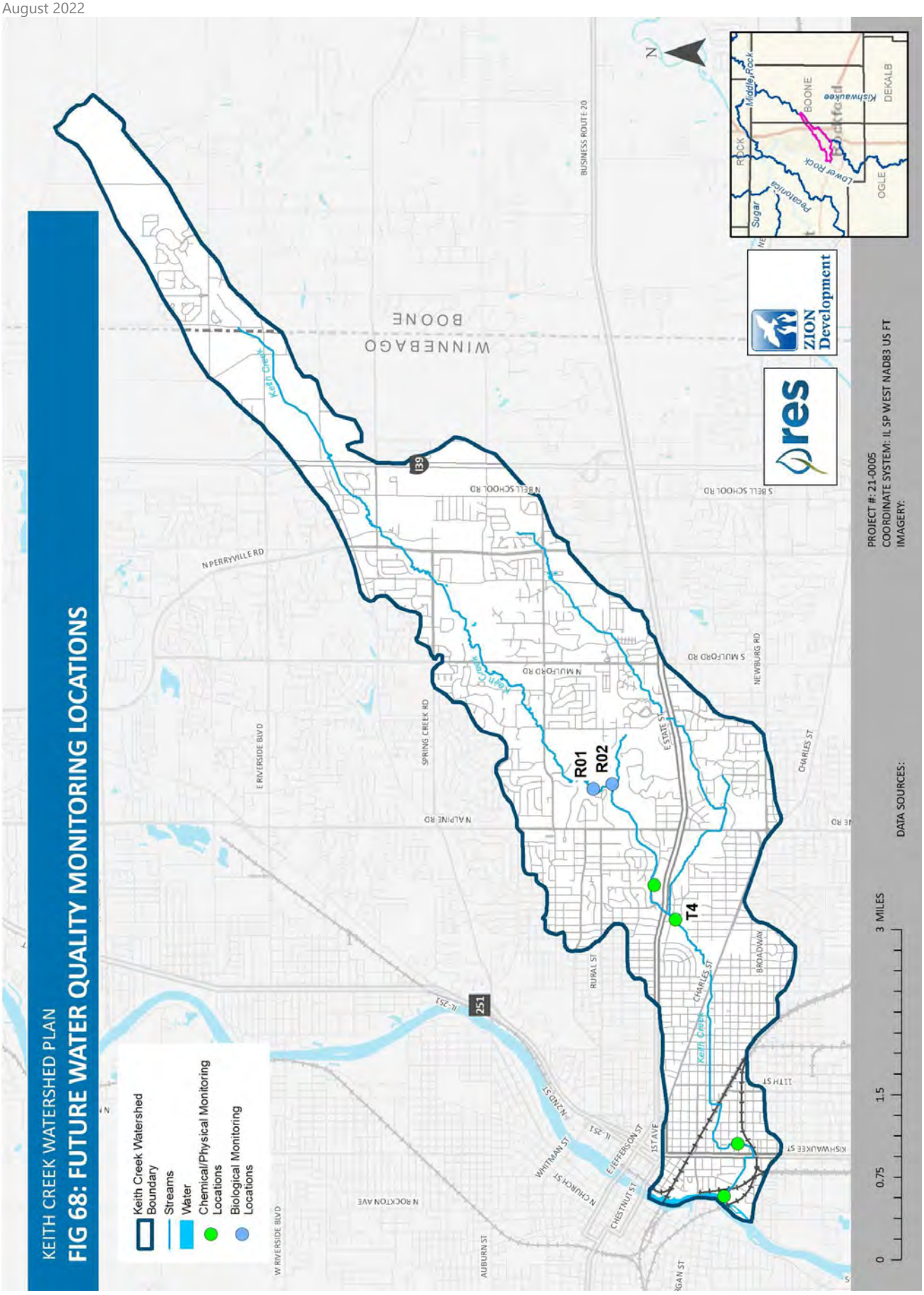

KEITH CREEK WATERSHED PLAN
FIG 68: FUTURE WATER QUALITY MONITORING LOCATIONS
Keith Creek Watershed Boundary
Streams
Water
Chemical/Physical Monitoring Locations
Biological Monitoring Locations
R01
R02
T4
WINNEBAGO
BOONE
N PERRYVILLE RD
E RIVERSIDE BLVD
W RIVERSIDE BLVD
SPRING CREEK RD
N ALPINE RD
N MULFORD RD
S MULFORD RD
NEWBURG RD
N BELL SCHOOL RD
S BELL SCHOOL RD
BUSINESS ROUTE 20
ESTATE ST
CHARLES ST
RURAL ST
BROADWAY
11TH ST
KISHWAUKEE ST
1ST AVE
E JEFFERSON ST
CHESTNUT ST
N CHURCH ST
WHITMAN ST
N 2ND ST
IL-251
N ROCKTON AVE
AUBURN ST
Keith Creek
Union
251
39
0
0.75
1.5
3 MILES
PROJECT #: 21-0005
COORDINATE SYSTEM: IL SP WEST NAD83 US FT
IMAGERY:
DATA SOURCES:
ZION Development
res
ROCK
BOONE
DEKALB
OGLE
Sugar
Pecatonica
Lower Rock
Middle Rock
Kishwaukee

Table 45. Stream monitoring water quality parameters, collection, and handling procedures.

Parameter	Statistical, Numerical, or General Use Guideline	Container	Volume	Preservative	Max. Hold Time
Physical Parameters Measured in Field					
pH	>6.5 or <9.0	These parameters are measured in the field			
Conductivity	<1,667 µmhos/cm				
Dissolved Oxygen	>5.0 mg/l				
Temperature	<90 F				
Turbidity	<14 NTU				
Chemical & Physical Parameters Analyzed in Lab					
Total Suspended Solids	<19 mg/l	Plastic	32 oz	Cool 4 °C	7 days
Biochemical Oxygen Demand	<5.0 mg/l	Plastic	32 oz	Cool 4 °C	48 hours
Ammonia Nitrogen, Nitrate-Nitrite, & Total Kjeldahl Nitrogen	Total Nitrogen (mg/L) *calculated* <2.461 mg/l	Plastic	32 oz	Cool 4 °C 20% Sulfuric Acid	28 days
Total Phosphorus	<0.0725 mg/l (streams)	Plastic	4 oz	Cool 4 °C	28 days
Chloride	<500 mg/l	Plastic	32 oz	Cool 4 °C	28 days
Fecal coliform	<200 MPN/100mL	Plastic	4 oz	Cool 4 °C	<6 hours

Biological Monitoring Methods and Recommendations

Biological monitoring methods should follow the guidance detailed in Section 4.1.

Habitat Monitoring Methods and Recommendations

Stream habitat assessments comprise a major component of physical water quality monitoring. Many habitat assessment methods are available for assessing streams such as those developed by Illinois DNR and Ohio EPA. The Qualitative Habitat Evaluation Index (QHEI) developed by the Ohio EPA is a quick, accurate, and straightforward analysis with dependable and repeatable results found to correlate well with biological integrity of streams in the Midwest. The QHEI is also used by the Illinois EPA to assess "*Aquatic Life*" Use Attainment in streams. It is composed of six criteria that are scored individually then summed to provide the total QHEI score. The best possible score is 100. QHEI scores from hundreds of stream segments indicate that habitat values greater than 60 generally support average quality warm-water fauna. Scores greater than 80 typify pristine habitat conditions that have the ability to support exceptional warm-water fauna (Ohio EPA 1999). Areas with habitat scores lower than 60 may support warm-water fauna but usually exhibit significant degradation. Table 46 summarizes QHEI score classifications. Stream restoration projects should strive to create conditions that produce QHEI scores of at least 60.

Table 46. QHEI score classes and characteristics.

QHEI	Class	Usual Characteristics
80-100	Excellent	Comparable to pristine conditions; exceptional assemblage of habitat types; sufficient riparian zone
60-79	Good	Impacts to riparian zone
30-59	Fair	Impacts to riparian zone; channelization; most in-stream habitat gone
0-29	Poor	All aspects of habitat in degraded state

The index should be used on any stream reach and for stream restoration projects to document improvements. Prior to stream restoration, a QHEI evaluation should be completed by the project watershed coordinator, ecologist, or engineer. A follow-up QHEI for comparison purposes should be conducted by the same individual at least 2-4 years following project implementation after plant material grows and in-stream structures have had time to perform. QHEI forms and a narrative explaining how to use the index can be located on the web at http://rock.geo.csuohio.edu/norp/qhei.htm.

Social Indicators of Water Quality

Quantifying social indicators of success in a watershed planning initiative is difficult. It is subjective to a large degree and complaints about poor conditions are often heard rather than compliments on improvements. The Great Lakes Regional Water Program (GLRWP), a leading organization that addresses water quality research, education, and outreach in Illinois, Indiana, Michigan, Minnesota, Ohio, and Wisconsin, defines social indicators as standards of comparison that describe the context, capacity, skills, knowledge, values, beliefs, and behaviors of individuals, households, organizations, and communities at various geographic scales. The GLRWP suggests that social indicators used in water quality management plans and outreach efforts are effective for several reasons including:

- Help watershed committee evaluate projects related to education and outreach;
- Help support improvement of water quality projects by identifying why certain groups install Management Measures while other groups do not;
- Measure changes that take place within grant and project timelines;
- Help watershed committee with information on policy, demographics, and other social factors that may impact water quality;
- Measure outcomes of water quality programs not currently examined.

GLRWP has developed a Social Indicators Data Management and Analysis Tool (SIDMA) to assist watershed stakeholders with consistent measures of social change by organizing, analyzing, and visualizing social indicators related to nonpoint source (NPS) management efforts. Detailed information about GLRWP's social indicator tool can be found at: http://35.8.121.111/si/Home.aspx. The SIDMA tool uses a seven-step process to measure social indicators as shown in Figure 69.



Figure 69. Steps to measure social indicators.

Several potential social indicators could be evaluated by the Steering Committee using different strategies to assess changes in water quality. For example, surveys, public meetings, and establishment of interest groups can give an indication of the public feelings about the water quality in the watershed. It is important to involve the public in the water quality improvement process at an early stage through public meetings delineating the plans for improvement and how it is going to be monitored. Table 47 includes a list of potential social indicators and measures that can be used by the watershed committee to evaluate the social changes related to water quality issues.

Monitoring social indicators in the watershed should be the responsibility of the Steering Committee. Online internet surveys are among the most popular method to gauge social behavior toward water quality. Demographic information on a county basis can be obtained from the U.S Census Bureau but will need to be modified based on the watershed boundary. This information is then followed by taking a randomized sample of individuals in the watershed from a phone directory or other means. Next, a survey should be developed that identifies citizens' perceptions of water quality problems and protection strategies. Citizens that respond to the survey should be given a chance to donate a small amount of money ($1 for example) to a non-profit environmental group then sent thank you letters while those that did not respond should be sent a second survey. The results of the survey can be used to develop appropriate media, citizen awareness, and watershed management activities to improve social behavior.

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Table 47. Social indicators and measures to understand behavior toward watershed issues.

Social Indicator	Measure
Media Coverage	• # of radio broadcasts related to watershed protection • # of newspaper articles related to watershed protection • # of press releases relate to watershed protection • # of social media posts related to watershed protection
Resident Awareness	• # of residents who are aware a watershed plan exists • # of informational flyers distributed per given time period • % of citizens who are able to identify where pollution is originating from • % change in volunteer participation to protect water quality • % change in attendance at water quality workshops and "Stewardship Days"
Watershed Management Activities	• # of watershed signage along roads • # of schools helping implement the watershed monitoring plan • # of residents that perform ecological restoration on their properties • # of stream miles cleaned up per year • # of linear feet or miles of trails created or maintained each year • # of watershed partners who adopt the watershed management plan • # of watershed groups implementing plan recommendations

Water Quality Evaluation Criteria

Water quality criteria (expressed as measurable indicators & targets) need to be developed so that water quality objectives can be evaluated over time. The criteria are designed to be compared against data gathered from the Water Quality Monitoring Plan as well as other data and analyzed to determine the success of the watershed plan in terms of protecting and improving water quality. These criteria also support an adaptive management approach by providing ways to reevaluate the implementation process if adequate progress is not being made toward achieving water quality objectives. Section 2.0 of this plan includes a water quality goal (Goal 2) with six objectives. Criteria are selected for each water quality objective to determine whether components of the water quality goal are being met (Table 48). Criteria are based on Illinois EPA water quality criteria, data analysis, reference conditions, literature values, and/or expert examination. Criteria are also designed to address potential or known sources of water quality impairment identified in Section 4.0. Future evaluation of the criteria will allow the Steering Committee to gauge plan implementation success or determine if there is a need for adaptive management. Note: evaluation criteria are included for the water quality goal only; criteria for other plan goals are examined within the appropriate progress evaluation "Report Cards" in Subsection 9.2.

Table 48. Set of criteria related to water quality goal and objectives.

GOAL 2: Improve surface water quality to meet applicable water quality standards.	
Water Quality Objective	**Criteria: Indicators and Targets**
1) Continue existing water quality monitoring programs and implement the Water Quality Monitoring Plan outlined within the plan.	• *Chemical Water Quality Standards:* <19 mg/L TSS, <0.0725 mg/L TP, <2.461 mg/L and <200 CFU/100mL fecal coliform in stream samples. • *Biotic Indexes:* Macroinvertebrate communities achieve at least "Fair" resource quality. • *Social Indicator:* >50% of surveyed stakeholders understand BMP benefits.
2) Restore all 94 acres of High Priority/Critical Area detention basin retrofit opportunities	• *# of Detention Basin Retrofits*: 100% (94 acres) of Critical Area detention basins retrofitted. • *Social Indicator:* >50% of surveyed stakeholders understand the water quality and habitat benefits created by naturalizing detention basins with native vegetation.
3) Restore 25,391 linear feet of stream and riparian area restoration along all High Priority/Critical Area stream reaches.	• *Linear Feet of Restored Stream:* 100% (25,391 lf) of Critical Area stream and riparian area restoration projects implemented. • *Chemical & Physical Water Quality Standards:* <19 mg/L TSS, <0.0725 mg/L TP, <2.461 mg/L and <200 CFU/100mL fecal coliform in stream samples. • *Biotic Indexes:* Macroinvertebrate communities achieve at least "Fair" resource quality. • *Social Indicator:* >50% of surveyed stakeholders understand BMP benefits.

Water Quality Objective	Criteria: Indicators and Targets
4) Implement all 142 acres of High Priority/Critical Area wetland restoration recommendations.	• *# of wetlands restored*: 100% (142 acres) of Critical Area wetlands restored. • *Social Indicator:* >50% of surveyed stakeholders understand BMP benefits.
5) Implement all 510 acres of High Priority/Critical Area other management measures recommendations.	• *# of Other Management Measures restored*: 100% (510 acres) of Critical Area other management measure recommendations restored. • *Social Indicator:* >50% of surveyed stakeholders understand BMP benefits.
6) Track changes in water quality over time and make adaptive management changes to the plan as necessary to ensure water quality improvements toward meeting identified pollutant load reductions.	• *Chemical Water Quality Standards:* <19 mg/L TSS, <0.0725 mg/L TP, <2.461 mg/L and <200 CFU/100mL fecal coliform in stream samples. • *Biotic Indexes:* Macroinvertebrate communities achieve at least "Fair" resource quality. • *Social Indicator:* >50% of surveyed stakeholders understand BMP benefits.

9.2 Goal Milestones/Implementation & Progress Evaluation "Report Cards"

Milestones are essential when determining if Management Measures are being implemented and how effective they are at achieving plan goals over given time periods. Tracking milestones allows for periodic plan updates and changes that can be made if milestones are not being met. Watersheds are complex systems with varying degrees of interaction and interconnection between physical, chemical, biological, hydrological, habitat, and social characteristics. Criteria that reflect these characteristics may be used as a measure of watershed health. Goals and objectives in the watershed plan determine which criteria should be monitored to evaluate the success of the watershed plan.

A successful watershed plan involves volunteer stakeholder participation to get projects completed and must include a feedback mechanism to measure progress toward meeting goals. Watershed "Report Cards", developed specifically for each goal in this plan, provide this information. Each Report Card provides:

1) Summaries of current conditions for each goal to set the stage for what efforts are needed
2) Most important performance criteria related to goal objectives (see Section 2.0)
3) Milestones to be met for various time frames
4) Monitoring needs and efforts required to evaluate milestones
5) Remedial actions to take if milestones are not met
6) Notes section

Report Cards were developed for each of the six plan goals and are located at the end of this section. The milestones are based on "Short Term" (1-10 years) and "Long Term" (10-20+ years) objectives. Grades for each milestone term should be calculated using the following scale:

- 80%-100% of milestones met = A
- 60%-79% of milestones met = B
- 40%-59% of milestones met = C
- < 40% of milestones met = failed

Report Cards should be used to identify and track plan implementation over time to ensure that progress is being made towards achieving the plan goals and to make corrections as necessary. Lack of progress could be demonstrated in factors such as monitoring that shows no improvement, new environmental problems, lack of technical assistance, or lack of funds. In these cases, the Report Card user should explain why other factors resulted in milestones not being met in the notes section of the Report Card.

Early on in the plan implementation process, the Steering Committee should assign or hire a Watershed Implementation Coordinator to update the committee on plan implementation progress by way of the Report Cards. If needed, adaptive management should be implemented accordingly by referencing the adaptive management recommendations on each Report Card then developing a strategy to either change the milestone(s) or decide how to implement projects or actions to achieve the milestone(s).

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Goal 1 Report Card
Manage and mitigate for existing and future structural flood problems.

Current Conditions:

- SMUs 4 and 6 determined to be Highly Vulnerable to future development and associated impervious cover.
- There are 142 acres of High Priority/Critical Area wetland restoration recommendations which are crucial in improving water quality and detaining stormwater upstream.
- There are many structural flooding issues within the identified FEMA floodplain for Keith Creek. The City of Rockford has been working on buyouts for years within the floodplain and continues to do so.
- Multiple partners are working to solve flooding issues downstream of Charles St.

Criteria/Targets to Meet Goal Objectives:

- % of new and re-development that incorporates impervious reduction stormwater BMPs within SMUs 4 and 6.
- % complete on High Priority/Critical Area wetland restoration sites.
- Number of stream projects that include floodplain reconnection.
- Number of structures removed from the 100-year floodplain.

Goal Milestones:	
1-10 Years (short term)	**Grade**
1) At least 25% of new and re-development that incorporates impervious reduction stormwater BMPs within SMUs 4 and 6. 2) Incorporate any additional recommendations resulting from Keith Creek Flood Study into site-specific action plan recommendations. 3) At least 50% complete on restoring High Priority/Critical Area wetland restoration sites. 4) At least 25% of restored streams reconnect stream to floodplain. 5) Mitigate flooding for on a case-by-case basis as funds allow.	
10-20+ Years (long term)	
1) At least 50% of new and re-development that incorporates impervious reduction stormwater BMPs within SMUs 4 and 6. 2) 100% complete on restoring High Priority/Critical Area wetland restoration sites. 3) At least 50% of restored streams reconnect stream to floodplain. 4) Mitigate flooding for on a case-by-case basis as funds allow..	

Monitoring Needs/Efforts:

- Track number of new and re-developments that incorporate impervious reduction stormwater BMPs.
- Track % complete on restoring High Priority/Critical Area wetland restoration sites.
- Track number of stream projects that include floodplain reconnection.
- Track number of structures removed from 100-year floodplain.

Remedial Actions:

- Reassess municipal policy related to requiring impervious reduction stormwater BMPs in SMUs 4 and 6.
- Target stream restoration where floodplain reconnection is most advantageous.
- Follow up with the City of Rockford and partners on the Keith Creek Flood Study and Keith Creek Corridor Study on flood remediation in Keith Creek flood problem area.

Notes:

Grade Evaluation: 80%-100% met = A; 60%-79% met = B; 40%-59% met = C; and < 40% = failed.

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Goal 2 Report Card

Improve surface water quality to meet applicable water quality standards.

Current Condition:

According to Illinois EPA's most recent 2018 *Integrated Water Quality Report and Section 303(d) List*, Keith Creek Reaches 1-7 (IEPA Assessment Unit ID: IL_PR-01) was not assessed for *Aquatic Life*, *Fish Consumption*, or *Aesthetic Quality*, and is not supporting for *Primary Contact Recreation*. The cause of the impairment is fecal coliform, and the source is urban runoff/storm sewers. Keith Creek Reaches 8-12 (IEPA Assessment Unit ID: IL_PR-99) is fully supporting for *Aesthetic Quality*, was not assessed for *Fish Consumption*, and not supporting for *Aquatic Life* and *Primary Contact Recreation*. The watershed-wide average water quality sampling results were 0.095 mg/L of total phosphorus, 1.263 mg/L of total nitrogen, 11 mg/L of total suspended solids, and 2,248 CFU/100mL.

Criteria/Targets to Meet Goal Objectives:

- Water Quality Standards: <19 mg/l TSS, <2.461 mg/l TN, <0.0725 mg/l TP, & <200 CFU/100mL in stream samples.
- Acres of High Priority/Critical Area Detention Basin Retrofits restored
- Linear Feet of High Priority/Critical Area Stream and Riparian Areas restored
- Acres of High Priority/Critical Area wetlands restored
- Acres of High Priority/Critical Area other management recommendations restored

Goal Milestones:	
1-10 Years (short term)	**Grade**
1) 50% (47 acres) of High Priority/Critical Area detention basins retrofitted. 2) 50% (12,696 lf) of High Priority/Critical Area stream & riparian area restoration projects implemented. 3) 50% (71 acres) of High Priority/Critical Area wetland restoration sites restored. 4) 50% (255 acres) of High Priority/Critical Area other management measure recommendations restored. 5) Track changes in TP, TN, TSS & fecal coliform and implement adaptive management if necessary.	
10-20+ Years (long term)	
1) 100% (94 acres) of High Priority/Critical Area detention basins retrofitted. 2) 100% (25,391 lf) of High Priority/Critical Area stream & riparian area restoration projects implemented. 3) 100% (142 acres) of High Priority/Critical Area wetland restoration sites restored. 4) 100% (510 acres) of High Priority/Critical Area other management measure recommendations restored. 5) Track changes in TP, TN, TSS & fecal coliform and implement adaptive management if necessary.	

Monitoring Needs/Efforts:

- Continue to track changes in TP, TN, TSS & fecal coliform indefinitely.
- Track quantity of detention basin, stream, wetland, and other management measure projects are restored.

Remedial Actions:

- Assess number of projects and actions that have been implemented versus water quality changes to determine if projects are effectively removing pollutants.
- Work with IEPA, SWCDs, and other identified partners to find funding for projects.
- Appropriate entities prepare budgets for implementing projects.
- Meet with applicable landowners to educate them on need for managing land for water quality benefits.

Notes:

Grade Evaluation: 80%-100% met = A; 60%-79% met = B; 40%-59% met = C; and < 40% = failed.

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Goal 3 Report Card

Protect, manage, & restore natural components of the Green Infrastructure Network & improve fish & wildlife habitat.

Current Conditions:

The surveyors detailed Keith Creek watershed as a nearly even split between prairie and woodland communities prior to European settlement in the 1830s. Following European settlement, fires rarely occurred, prairies were tilled for farmland or developed, wetlands were drained, and many streams were channelized. The Green Infrastructure Network for the Keith Creek watershed includes 568 parcels and a total of 2,640 acres, 769 acres (29%) of which are protected. Approximately 74% (65,490 lf) of the total stream and tributary length exhibits high to moderate channelization. Moderate erosion is occurring along 46% (40,926 lf) of streambanks, while 6% (4,981 lf) are highly eroded. Approximately 67% (along 58,678 linear feet) of the riparian areas are in "Poor" condition or lacking entirely. All of the 31 detention basins (100%) likely provide "Poor" ecological and water quality benefits.

Criteria/Targets to Meet Goal Objectives:

- GIN included in municipal and county comprehensive plans and development review maps.
- Number of landowners educated about how to manage their land for ecological and water quality benefits.
- Linear feet of stream restored that reconnects stream to floodplain within the GIN and improves habitat on degraded reaches using natural and ecological design approaches.
- Restoration and management occurring on all Natural Area Restoration sites.
- Number of new/redevelopment projects that utilize conservation design or low impact development (LID).

Goal Milestones:	
1-10 Years (short term)	**Grade**
1) GIN included in municipal and county comprehensive plans and development review maps. 2) >25% of landowners educated about managing their land for ecological and water quality benefits. 3) >25% of restored streams reconnect stream to floodplain within the GIN and improve habitat on degraded reaches using natural and ecological design approaches. 4) Restoration and management occurring on at least 50% of Natural Area Restoration sites. 5) 25% of new/redevelopment projects utilize conservation design or low impact development (LID).	
10-20+ Years (long term)	
1) >50% of landowners educated about managing their land for ecological and water quality benefits. 2) >50% of restored streams reconnect stream to floodplain within the GIN and improve habitat on degraded reaches using natural and ecological design approaches. 3) Restoration and management occurring on at least 50% of Natural Area Restoration sites. 4) >50% of new/redevelopment projects utilize conservation design or low impact development (LID).	

Monitoring Needs/Efforts:

- Track inclusion of GIN in municipal and county comprehensive plans and development review maps.
- Track number of landowners educated about how to manage their land for ecological and water quality benefits.
- Track linear feet of stream restored that reconnects stream to floodplain within the GIN and improves habitat on degraded reaches using natural and ecological design approaches.
- Track restoration and management occurring on Natural Area Restoration sites.
- Track number of new/redevelopment projects that utilize conservation design or low impact development (LID).

Remedial Actions:

- Meet with municipal and county representatives about importance of conservation design and LID practices.
- Locate and track grants that are being submitted for recommended stream, detention basin, and other management measure projects and determine success rate.
- Actively recruit stakeholders to attend education campaigns on ecological and water quality benefits.

Notes:

Grade Evaluation: 80%-100% met = A; 60%-79% met = B; 40%-59% met = C; and < 40% = failed.

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Goal 4 Report Card

Build stakeholder awareness of watershed issues or concerns through education and stewardship while increasing communication and coordination among stakeholders.

Current Condition:

The Keith Creek Steering Committee believes that the process of creating and implementing this Watershed-Based Plan will unite stakeholders, help them understand issues and opportunities facing the watershed, and implement projects that improve watershed conditions. The Steering Committee is actively engaging the public in watershed activities such as educating local governments and residents about how to manage their land to improve water quality by providing local schools with information about Keith Creek watershed to support outdoor curriculums and providing educational information about the Keith Creek Watershed-based Plan, Corridor Study, and Flood Study.

Criteria/Targets to Meet Goal Objectives:

- Number of Education Actions completed from Information & Education Campaign Matrix.
- Number of stakeholders who participate in outreach opportunities and implement restoration.
- Number of educational programs targeting watershed and water quality improvement in school curriculum.
- Number of outreach opportunities that leverage the combined work of the Keith Creek Watershed-based Plan, Corridor Study, and Flood Study.

Goal Milestones:	
1-10 Years (short term)	**Grade**
1) At least 50% of Education Actions completed from Information & Education Campaign. 2) At least 15 stakeholders attend Keith Creek watershed educational meetings. 3) At least 2 educational programs targeting watershed and water quality improvement in school curriculums. 4) At least 25% of outreach opportunities that leverage the combined work of the Keith Creek Watershed-based Plan, Corridor Study, and Flood Study.	
10-20+ Years (long term)	
1) 100% of Education Actions completed from Information & Education Campaign. 2) At least 30 stakeholders attend Keith Creek watershed educational meetings. 3) At least 4 educational programs targeting watershed and water quality improvement in school curriculums. 4) At least 50% of outreach opportunities that leverage the combined work of the Keith Creek Watershed-based Plan, Corridor Study, and Flood Study.	

Monitoring Needs/Efforts:

- Track number of Education Actions completed from Information & Education Campaign
- Track number of stakeholders attending Keith Creek watershed educational meetings.
- Track number educational programs targeting watershed and water quality improvement in school curriculum.
- Track number outreach opportunities that leverage the combined work of the Keith Creek Watershed-based Plan, Corridor Study, and Flood Study

Remedial Actions:

- Ask partners for additional help and/or funding to implement watershed plan and I&E Campaign.
- Actively recruit stakeholders to attend watershed education campaigns.
- Work with local schools to build watershed and water quality improvement lessons into school curriculums.
- Ensure continued partnership from Keith Creek Watershed-based Plan, Corridor Study, and Flood Study participants.

Notes:

Grade Evaluation: 80%-100% met = A; 60%-79% met = B; 40%-59% met = C; and < 40% = failed.

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Goal 5 Report Card

Assess and improve policies and regulations to protect and support our natural resources.

Current Condition:

Protection and restoration of natural resources and green infrastructure during future urban growth and redevelopment will be important for the future health of Keith Creek watershed. Loves Park completed the Center for Watershed Protection Ordinance Review worksheet to assess ordinances and determine where improvements might be made in protecting water quality and natural resources. Various general policy recommendations are included in the Action Plan section of the report to address general ordinance deficiencies. Where any new or redevelopment occurs, it should follow Conservation Design or Low Impact Development (LID) standards and guidelines to help maintain and improve water quality.

Criteria/Targets to Meet Goal Objectives:

- Number of local governments and partners that support and adopt the Keith Creek Watershed-Based Plan.
- GIN included in municipal and county comprehensive plans and development review maps.
- Number of new/redevelopment projects that utilize conservation design or low impact development (LID).
- Number of developers that protect and restore degraded natural areas during development process.
- Number of additional policy recommendations that focus on improving watershed conditions.

Goal Milestones:	
1-10 Years (short term)	**Grade**
1) All local governments and partners adopt the Keith Creek Watershed-Based Plan. 2) GIN included in both municipal and county comprehensive plans and development review maps. 3) At least 25% of new/redevelopment projects that utilize conservation design or LID. 4) At least 25% of developers that protect and restore degraded natural areas during development process. 5) Local governments adopt at least one additional policy recommendation focused on improving watershed conditions.	
10-20+ Years (long term) 1) At least 50% of new/redevelopment projects that utilize conservation design LID. 2) At least 50% of developers that protect and restore degraded natural areas during development process. 3) Local governments adopt more than one additional policy recommendation focused on improving watershed conditions.	

Monitoring Needs/Efforts:

- Track number of local governments and partners that support and adopt the Keith Creek WBP.
- Track number of municipalities and counties include GIN in comprehensive plans and development review maps.
- Track number of new/redevelopment projects that utilize conservation design or low impact development (LID).
- Track number of developers that protect and restore degraded natural areas during development process.
- Track number of local governments that adopt additional policy recommendation focused on improving watershed conditions.

Remedial Actions:

- Meet with public officials and municipal staff to discuss the importance of updating ordinances, conservation design, LID, and protection policies.
- Assess progress towards policy goals and target specific weak areas for additional education and outreach.

Notes:

Grade Evaluation: 80%-100% met = A; 60%-79% met = B; 40%-59% met = C; and < 40% = failed.

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11.0 GLOSSARY OF TERMS

100-year floodplain: A 100-year flood is a flood that has a 1-percent chance of being equaled or exceeded in any given year. A base flood may also be referred to as a 100-year storm and the area inundated during the base flood is called the 100-year floodplain.

303(d) Impaired Waters: The Federal Clean Water Act requires states to submit a list of impaired waters to the USEPA for review and approval using water quality assessment data from the Section 305(b) Water Quality Report. States are then required to develop total maximum daily load analyses (TMDLs) for waterbodies on the 303(d) list.

305(b): The Illinois 305(b) report is a water quality assessment of the state's surface and groundwater resources that is compiled by the IEPA as a report to the USEPA as required under Section 305(b) of the Clean Water Act.

ADID wetlands: Wetlands that were identified through the Advanced Identification (ADID) process. Completed in 1992, the ADID process sought to identify wetlands that should be protected because of their high functional value. The three primary functions evaluated were:

1. Ecological value based on wildlife habitat quality and plant species diversity;
2. Hydrologic functions such as stormwater storage value and/or shoreline/bank stabilization value; and
3. Water quality values such as sediment/toxicant retention and/or nutrient removal/transformation function.

Aquatic habitat: Structures such as stream substrate, woody debris, aquatic vegetation, and overhanging vegetation that is important to the survival of fish and macroinvertebrates.

Aquifer: A layer of permeable rock, sand, or gravel through which ground water flows, containing enough water to supply wells and springs.

Base flow: The flow that a perennially flowing stream reduces to during the dry season. It is often supported by groundwater seepage into the channel.

Bedrock: The solid rock that underlies loose material, such as soil, sand, clay, or gravel.

Best Management Practices (BMPs): See **Management Measures**

Biodiversity: The variety of organisms (plants, animals and other life forms) that includes the totality of genes, species and ecosystems in a region.

Bioengineering (or Soil Bioengineering): Techniques for stabilizing eroding or slumping stream banks that rely on the use of plants and plant materials such as live willow posts, brush layering, coconut logs and other "greener" or "softer" techniques. This is in contrast to techniques that rely on creating "hard" edges with riprap, concrete and sheet piling (metal and plastic).

Bio-infiltration: Excavated depressional areas where stormwater runoff is directed and allowed to infiltrate back into groundwater rather than allowing to runoff. Infiltration areas are planted with appropriate vegetation.

Center for Watershed Protection (CWP): Non-profit 501(c)3 corporation founded in 1992 that provides local governments, activists, and watershed organizations around the country with the technical tools for protecting some of the nation's most precious natural resources such as streams, lakes and rivers.

Certified Municipalities: A municipality that is certified to enforce the provisions of local stormwater ordinances. The municipality's designated Enforcement Officer enforces the provisions in the Ordinance.

Channelized stream: A stream that has been artificially straightened, deepened, or widened to accommodate increased stormwater flows, to increase the amount of adjacent land that can be developed or used for urban development, agriculture or for navigation purposes.

Conservation development: A development designed to protect open space and natural resources for people and wildlife while at the same time allowing building to continue. Conservation design developments sometimes designate half or more of the buildable land area as undivided permanent open space.

Conservation easement: The transfer of land use rights without the transfer of land ownership. Conservation easements can be attractive to property owners who do not want to sell their land now but would support perpetual protection from further development. Conservation easements can be donated or purchased.

Clean Water Act (CWA): The CWA is the basic framework for federal water pollution control and has been amended in subsequent years to focus on controlling toxics and improving water quality in areas where compliance with nationwide minimum discharge standards is insufficient to meet the CWA's water quality goals.

Debris jam: Natural and man-made debris in a stream channel including leaves, logs, lumber, trash and sediment.

Designated Use: Appropriate uses are identified by taking into consideration the use and value of the water body for public water supply, for protection of fish, shellfish, and wildlife, and for recreational, agricultural, industrial, and

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navigational purposes. In designating uses for a water body, States and Tribes examine the suitability of a water body for the uses based on the physical, chemical, and biological characteristics of the water body, its geographical setting and scenic qualities, and economic considerations

Detention basin: A man-made structure for the temporary storage of stormwater runoff with controlled release during or immediately following a storm.

Digital Elevation Model (DEM): Regularly spaced grid of elevation points used to produce elevation maps.

Discharge (streamflow): The volume of water passing through a channel during a given time, usually measured in cubic feet per second.

Dissolved oxygen (DO): The amount of oxygen in water, usually measured in milligrams/liter.

Downcutting: The action of a stream to deepen itself, often a result of channelization.

Downspout disconnection: The process of disconnecting the downspout from a pipe or the paved area. Water is then redirected to flow into a rain barrel or to a lawn or garden where it can soak into the ground.

Ecology: The scientific study between living organisms and their interactions with their natural or developed environment, other organisms, and their abiotic environment.

Ecosystem: An ecological community together with its environment, functioning as a unit.

Erosion: Displacement of soil particles on the land surface due to water or wind action.

European settlement: A period in the early 1800s when European settlers moved across the United States in search of better lives. During this movement, much of the historical communities were altered for farming and other types of development.

Eutrophic: A waterbody having a high level of biological productivity. A typical eutrophic waterbody either has many aquatic plants and is clear or has few plants and is less clear. Both situations have potential to support many fish and wildlife.

Federal Emergency Management Agency (FEMA): Government agency within the Department of Homeland Security that responds to, plans for, recovers from, and mitigates against disasters/emergencies, both natural and man-made.

Fee-in-lieu: Defined by the USACE and EPA as a payment "to a natural resource management entity for implementation of either specific or general wetland or other aquatic resource development projects" for projects that "do not typically provide compensatory mitigation in advance of project impacts."

Filamentous algae: Simple one-celled or multi-celled organisms (usually aquatic) capable of photosynthesis that are an indicator of high nutrient levels in the water column.

Filter strip: A long narrow portion of vegetation used to retard water flow and collect sediment for the protection of watercourses, reservoirs or adjacent properties.

Flash hydrology/flooding: A quickly rising and falling overflow of water in stream channels that is usually the result of increased amounts of impervious surface in the watershed.

Flood problem area (FPA): One or more buildings, roads or other infrastructure in one location that are repeatedly damaged by flooding.

Flow Regime: The pattern of flow variability for a particular river or region.

Floodplain (100-year): Land adjoining the channel of a river, stream, watercourse, lake or wetland that has been or may be inundated by floodwater during periods of high water that exceed normal bank-full elevations. The 100-year floodplain has a probability of 1% chance per year of being flooded.

Floodproofing: Any combination of structural and non-structural additions, changes or adjustments to structures or property which reduce or eliminate flood damage to real estate or improved real property, water and sanitary facilities, structures and contents.

Floodway: The floodway is the portion of the stream or river channel that includes the adjacent land areas that must be reserved to discharge the 100-year flood without increasing the water surface.

Geographic Information System (GIS): A computer-based approach to interpreting maps and images and applying them to problem-solving.

Geology: The scientific study of the structure of the Earth or another planet, especially its rocks, soil, and minerals, and its history and origins.

Global Positioning System (GPS): Satellite mapping system that enables locators and mapping to be created via satellite.

Green infrastructure network: An interconnected network of waterways, wetlands, woodlands, wildlife habitats, and other natural areas; greenways, parks and other conservation lands, farms, and forests of conservation value; and

wilderness and other open spaces that support native species, maintain natural ecological processes, sustain air and water resources and contribute to the health and quality of life.

Greenways: A protected linear open space area that is either landscaped or left in its natural condition. It may follow a natural feature of the landscape such as a river or stream, or it may occur along an unused railway line or some other right of way. Greenways also provide wildlife corridors and recreational trails.

Groundwater recharge: Primary mechanism for aquifer replenishment which ensures future sources of groundwater for commercial and residential use.

Headwaters: Upper reaches of streams and tributaries in a watershed.

HUC Code: A hydrologic unit code (HUC) that refers to the division and subdivision of U.S. watersheds. The hydrologic units are arranged or nested within each other, from the largest geographic area (regions) to the smallest geographic area (cataloging units).

Hydraulic and Hydrologic modeling: Engineering analysis that predicts expected flood flows and flood elevations based on land characteristics and rainfall events.

Hydraulic structures: Low head dams, weirs, bridges, levees, and any other structures along the course of the river.

Hydric soil: Soil units that are wet frequently enough to periodically produce anaerobic conditions, thereby influencing the species composition or growth, or both, of plants on those soils.

Hydrologic Soil Groups (HSG): Soils are classified by the Natural Resource Conservation Service into four Hydrologic Soil Groups based on the soil's runoff potential. The four Hydrologic Soils Groups are A, B, C and D. A's generally have the smallest runoff potential and D's the greatest.

Hydrology: The scientific study of the properties, distribution, and effects of water on the earth's surface, in the soil and underlying rocks, and in the atmosphere.

Hydrophytic vegetation: Plant life growing in water, soil or on a substrate that is at least periodically deficient in oxygen as a result of excessive water content; one of the indicators of a wetland.

Illinois Department of Natural Resources (IDNR): A government agency established to manage, protect and sustain Illinois' natural and cultural resources; provide resource-compatible recreational opportunities and to promote natural resource-related issues for the public's safety and education.

Illinois Department of Transportation (IDOT): The Illinois Department of Transportation focuses primarily on the state's policies, goals and objectives for Illinois' transportation system and provides an overview of the department's direction for the future.

Illinois Environmental Protection Agency (IEPA): Government agency established to safeguard environmental quality, consistent with the social and economic needs of the State, so as to protect health, welfare, property and the quality of life.

Illinois Natural Areas Inventory (INAI): A survey conducted by the Illinois Department of Natural Resources to catalogue high quality natural areas, threatened and endangered species and unique plant, animal and geologic communities for the purpose of maintaining biodiversity.

Illinois Nature Preserves: State-protected areas that are provided the highest level of legal protection and have management plans in place.

Illinois Pollution Control Board (IPCB): An independent agency created in 1970 by the Environmental Protection Act. The Board is responsible for adopting Illinois' environmental regulations and deciding contested environmental cases.

Impervious Cover Model: Simple urban stream classification model based on impervious cover and stream quality. The classification system contains three stream categories, based on the percentage of impervious cover that predicts the existing and future quality of streams based on the measurable change in impervious cover. The three categories include sensitive, impacted, and non-supporting.

Impervious cover/surface: An area covered with solid material or that is compacted to the point where water cannot infiltrate underlying soils (e.g., parking lots, roads, houses, patios, swimming pools, tennis courts, etc.). Stormwater runoff velocity and volume can increase in areas covered by impervious surfaces.

Incised channel: A stream that has degraded and cut its bed into the valley bottom; indicates accelerated and often destructive erosion.

Index of Biotic Integrity (IBI): An index used to evaluate the heath of a stream based on the fish community present.

Infiltration: Portion of rainfall or surface runoff that moves downward into the subsurface soil.

Integrated Report: A bi-annual report combining the **303(d) Impaired Waters** and **305(b)** reports.

Invasive vegetation/plant: Plant species that are not native to an area and tend to out-compete native species and dominate an area (e.g., European buckthorn or garlic mustard).

Low Impact Development: Comprehensive land planning and engineering design approach with a goal of maintaining and enhancing the pre-development hydrologic regime of urban and developing watersheds.

Macroinvertebrate (aquatic): Invertebrates that can be seen by the unaided eye (macro). Most benthic invertebrates in flowing water are aquatic insects or the aquatic stage of insects, such as stonefly nymphs, mayfly nymphs, caddisfly larvae, dragonfly nymphs and midge larvae. They also include such things as clams and worms. The presence of benthic macroinvertebrates that are intolerant of pollutants is a good indicator of good water quality.

Macroinvertebrate Biotic Index (MBI): Method used to rate water quality using macroinvertebrate taxa tolerance to organic pollution in streams.

Management Measures: Also known as Best Management Practices (BMPs) are non-structural practices such as site planning and design aimed to reduce stormwater runoff and avoid adverse development impacts - or structural practices that are designed to store or treat stormwater runoff to mitigate flood damage and reduce pollution. Some BMPs used in urban areas may include stormwater detention ponds, restored wetlands, vegetative filter strips, porous pavement, silt fences and biotechnical streambank stabilization.

Marsh: An area of soft, wet, low-lying land, characterized by grassy vegetation and often forming a transition zone between water and land.

Meander (stream): A sinuous channel form in flatter river grades formed by the erosion on one side of the channel (pools) and deposition on the other (point bars).

Mitigation: Measures taken to eliminate or minimize damage from development activities, such as construction in wetlands or Regulatory Floodplain filling, by replacement of the resource.

Moraine (terminal): A ridge-like accumulation of till and other types of drift that was produced at the outer margin or farthest advance, of a retracting glacier.

Municipal Separate Stormwater Systems (MS4's): A system that transports or holds stormwater, such as catch basins, curbs, gutters, ditches, man-made channels, pipes, tunnels, and or/storm drains before discharging into local waterbodies.

National Pollutant Discharge Elimination System (NPDES Phase II): Clean Water Act law requiring smaller communities and public entities that own and operate a Municipal Separate Storm Sewer System (MS4) to apply and obtain an NPDES permit for stormwater discharges. Permittees at a minimum must develop, implement, and enforce a stormwater program designed to reduce the discharge of pollutants from the MS4 to the maximum extent practicable. The stormwater management program must include these six minimum control measures:

1. Public education and outreach on stormwater impacts
2. Public involvement/participation
3. Illicit discharge detection and elimination
4. Construction site stormwater runoff control
5. Post-construction stormwater management in new development and redevelopment
6. Pollution prevention/good housekeeping for municipal operations

National Wetland Inventory (NWI): U.S. Fish and Wildlife Service study that provides information on the characteristics, extent, and status of U.S. wetlands and deep-water habitats and other wildlife habitats.

Native Landscaping: A landscape that contains plants or plant communities that are indigenous to a particular region.

Native vegetation/plants: Plant species that have historically been found in an area.

Nitrogen: A colorless, odorless unreactive gas that forms about 78% of the earth's atmosphere. The availability of nitrogen in soil is important for ecosystem processes.

Natural community/area: an assemblage of plants and animals interacting with one another in a particular ecosystem.

No-net-loss: A policy for wetland protection to stem the tide of continued wetland losses. The policy has generated requirements for wetland mitigation so that permitted losses due to filling and other alterations are replaced and the net quality wetland acreage remains the same.

Nonpoint source pollution (NPS pollution): Refers to pollutants that accumulate in waterbodies from a variety of sources including runoff from the land, impervious surfaces, the drainage system and deposition of air pollutants.

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Nutrients: Substances needed for the growth of aquatic plants and animals such as phosphorous and nitrogen. The addition of too many nutrients (such as from sewage dumping and over fertilization) will cause problems in the aquatic ecosystem through excess algae growth and other nuisance vegetation.

Open space parcel: Any parcel of land that is not developed and is often set aside for conservation or recreation purposes

Partially open parcel: Parcels that have been developed to some extent, but still offer some opportunities for open space and Best Management Practice (BMP) implementation.

Phosphorus: A nonmetallic element that occurs widely in many combined forms especially as inorganic phosphates in minerals, soils, natural waters, bones, and teeth and as organic phosphates in all living cells.

Point source pollution: Refers to discharges from a single source such as an outfall pipe conveying wastewater from an industrial plant or wastewater treatment facility.

Policy: A high-level overall plan embracing the general goals and acceptable procedures especially of a governmental body.

Pollutant load: The amount of any pollutant deposited into waterbodies from point source discharges, combined sewer overflows, and/or stormwater runoff.

Pool: A location in an active stream channel usually located on the outside bends of meanders, where the water is deepest and has reduced current velocities.

Prairie: A type of grassland characterized by low annual moisture and rich black soil characteristics.

Preventative measures: Actions that reduce the likelihood that new watershed problems such as flooding or pollution will arise, or that those existing problems will worsen. Preventative techniques generally target new development in the watershed and are geared toward protecting existing resources and preventing degradation.

Principles of Soil Health: The soil health foundation consists of five principles: 1) Soil armor; 2) minimizing soil disturbance; 3) plant diversity; 4) continual live plant/foot; and 5) livestock integration. These principles are intended to be applied in a systems approach, maximizing the soil building impact.

Programmatic Action: A series of steps to be carried out or goals to be accomplished.

Protection Area: Chicago Metropolitan Agency for Planning (CMAP) defines a "Protection Area" as an area that represents subsections of a watershed that have valuable characteristics; valuable either in the sense that (1) they contain resources and characteristics that may need to be protected and/or (2) property ownership or land use characteristics make the subsection a strong candidate for action (CMAP 2007).

Rain gage station: Point along a stream where the amount of water flowing in an open channel is measured. The USGS makes most streamflow measurements by current meter. A current meter is an instrument used to measure the velocity of flowing water. By placing a current meter at a point in a stream and counting the number of revolutions of the rotor during a measured interval of time, the velocity of water at that point is determined.

Rainwater Harvesting: The accumulation and storing of rainwater for reuse before it reaches an aquifer.

Recovering stream: A stream that is naturally regaining streambank equilibrium according to the Stream Evolution Model, wherein the stream naturally cycles through widening, deposition, and stabilization of its banks.

Regenerative agriculture: Farming and grazing practices that, among other benefits, reverse climate change by rebuilding soil organic matter and restoring degraded soil biodiversity – resulting in both carbon drawdown and improving the water cycle.

Regulatory floodplain: Regulatory Floodplains may be either riverine or non-riverine depressional areas. Projecting the base flood elevation onto the best available topography delineates floodplain boundaries. A flood prone area is Regulatory Floodplain if it meets any of the following descriptions:

1. Any riverine area inundated by the base flood where there is at least 640 acres of tributary drainage area.
2. Any non-riverine area with a storage volume of 0.75 acre-foot or more when inundated by the base flood.
3. Any area indicated as a Special Flood Hazard Area on the FEMA Flood Insurance Rate Map expected to be inundated by the base flood located using best available topography.

Regulatory floodway: The channel, including on-stream lakes, and that portion of the Regulatory Floodplain adjacent to a stream or channel as designated by the Illinois Department of Natural Resources-Office of Water Resources, which is needed to store and convey the existing and anticipated future 100-year frequency flood discharge with no more than a 0.1 foot increase in stage due to the loss of flood conveyance or storage, and no more than a 10% increase in

velocities. Where interpretation is needed to determine the exact location of the Regulatory Floodway boundary, the IDNR-OWR should be contacted for the interpretation.

Remnant: a small, fragmented portion of the former dominant vegetation or landscape which once covered the area before being cleared for human land use.

Resource Environmental Solutions (RES, formerly Applied Ecological Services, acquired by RES in 2021): A broad-based ecological consulting, contracting, and restoration firm whose mission is to restore a resilient earth for a modern world.

Retrofit: Refers to modification to improve problems with existing stormwater control structures such as detention basins and conveyance systems such as ditches and stormsewers. These structures were originally designed to improve drainage and reduce flood risk, but they can also be retrofitted to improve water quality.

Ridge: A line connecting the highest points along a landscape and separating drainage basins or small-scale drainage systems from one another.

Riffle: Shallow rapids, usually located at the crossover in a meander of the active channel.

Riparian: Referring to the riverside or riverine environment next to the stream channel, e.g., riparian, or streamside, vegetation.

Runoff: The portion of rain or snow that does not percolate into the ground and is discharged into streams by flowing over the ground instead.

Savanna: A type of woodland characterized by open spacing between its trees and by intervening grassland.

Sediment: Soil particles that have been transported from their natural location by wind or water action.

Sedimentation: The process that deposits soils, debris and other materials either on other ground surfaces or in bodies of water or watercourses.

Seep: A moist or wet place where groundwater reaches the earth's surface from an underground aquifer.

Socioeconomics: Field of study that examines social and economic factors to better understand how the combination of both influences something.

Special Service Area (SSA) Tax: Special taxing districts in municipalities that are established by ordinance, often at the request of developers of new housing subdivisions, in order to pass on costs of the streets, landscaping, water lines, and sewer systems to.

Stakeholders: Individuals, organizations, or enterprises that have an interest or a share in a project. (see also Watershed Stakeholders).

Stormsewershed: An area of land whose stormwater drains into a common storm sewer system.

Stormwater management: A set of actions taken to control stormwater runoff with the objectives of providing controlled surface drainage, flood control and pollutant reduction in runoff.

Stormwater Treatment Train: An alternative approach to managing stormwater that uses a series of natural Best Management Practices (BMPs) that are sized, engineered, and ecologically designed for low maintenance. The STT mimics the natural hydrologic cycle by basically creating a landscape design that slowly moves water through natural features that infiltrate, evaporate, filter and clean stormwater. STT elements include rooftop treatments, vegetated swales, parking-lot treatments, landscaping that utilizes stormwater, and open space systems such as parks and rights-of-way.

Stream corridor: The area of land that runs parallel to a stream.

Stream monitoring: Chemical, biological, and physical monitoring used to identify the causes and sources of pollution in the river and to determine the needs for reduction in pollutant loads, streambank stabilization, debris removal and habitat improvement.

Stream reach: A stream segment having homogenous hydraulic, geomorphic and riparian cover and land use characteristics (such as all ditched agriculture or all natural and wooded). Reaches generally should not exceed 2,000 feet in length.

Streambank stabilization: Techniques used for stabilizing eroding streambanks.

Substrate (stream): The composition of the bottom of a stream such as clay, silt or sand.

Subwatershed: Any drainage basin within a larger drainage basin or watershed.

Subwatershed Management Unit (SMU): Small unit of a watershed or subwatershed that is delineated and used in watershed planning efforts because the effects of impervious cover are easily measured, there is less chance for

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confounding pollutant sources, boundaries have fewer political jurisdictions, and monitoring/mapping assessments can be done in a relatively short amount of time.

Swale: A vegetated channel, ditch or low-lying or depressional tract of land that is periodically inundated by conveying stormwater from one point to another. Swales are often used in natural drainage systems instead of stormsewers.

Threatened and Endangered Species (T&E): An "endangered" species is one that is in danger of extinction throughout all or a significant portion of its range. A "threatened" species is one that is likely to become endangered in the foreseeable future.

Till: A heterogeneous mixture of clay, silt, sand, gravel, stones, and boulders deposited directly by and underneath a glacier without stratification.

Topography: The relative elevations of a landscape describing the configuration of its surface. Study and depiction (such as charts or maps) of the distribution, relative positions, and elevations of natural and man-made features of a particular landscape.

Total Maximum Daily Load (TMDL): A TMDL is the highest amount of a particular pollutant discharge a waterbody can handle safely per day.

Total suspended solids (TSS): The organic and inorganic material suspended in the water column and greater than 0.45 micron in size.

Treatment Train: Several Management Measures/Best Management Practices (BMPs) used together to improve water quality, infiltration and reduce sedimentation.

Trophic State Index (TSI): Trophic State is a measure of the degree of plant material in a body of water. It is usually measured using one of several indices (TSI) of algal weight (biomass): water transparency (Secchi Depth), algal chlorophyll, and total phosphorus.

Turbidity: Refers to the clarity of the water, which is a function of how much material including sediment is suspended in the water.

United States Army Corps of Engineers (USACE): Federal group of civilian and military engineers and scientists that provide services to the nation including planning, designing, building, and operating water resources and other Civil Works projects. These also include navigation, flood control, environmental protection, and disaster response.

United States Environmental Protection Agency Section 319 (Section 319): Section 319 of the Clean Water Act encourages and funds nonpoint source pollution control projects (any indirect pollution, like runoff, stormwater discharge, road salt, sediment, etc.) or NPS reduction at the source.

United States Geological Survey (USGS): Government agency established in 1879 with the responsibility to serve the Nation by providing reliable scientific information to describe and understand the Earth; minimize loss of life and property from natural disasters; manage water, biological, energy, and mineral resources; and enhance and protect our quality of life.

Urban runoff: Water from rain or snow events that runs over surfaces such as streets, lawns, parking lots and directly into storm sewers before entering the river rather than infiltrating the land upon which it falls.

USDA TR55 Document: A single event rainfall-runoff hydrologic model designed for small watersheds and developed by the USDA, NRCS, and EPA.

Vegetated buffer: An area of vegetated land to be left open adjacent to drainageways, wetlands, lakes, ponds or other such surface waters for the purpose of eliminating or minimizing adverse impacts to such areas from adjacent land areas.

Vegetated swale: An open channel drainageway used along residential streets and highways to convey stormwater and filter pollutants in lieu of conventional storm sewers.

Velocity (of water in a stream): The distance that water can travel in a given direction during a period of time expressed in feet per second.

Wastewater Treatment: Process that modifies wastewater characteristics such as its biological oxygen demand (BOD), chemical oxygen demand (COD), pH, etc. to meet effluent or water discharge standards.

Water Chemistry: The nature of dissolved materials (e.g., chlorides or phosphates) in water.

Water Quality Trading: An option for compliance with a water quality-based effluent limitation (WQBEL) in an NPDES permit. EPA's 2003 WQT Policy and 2007 WQT Toolkit for Permit Writers provide guidance to states, interstate agencies, and tribes on how to facilitate trading consistent with the CWA and its implementing regulations.

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Waters of the United States (WOUS): the term Waters of the United States refers to those water bodies and wetland areas that are under the U. S. Army Corps of Engineers jurisdiction.

Watershed: An area confined by topographic divides that drains to a given stream or river. The land area above a given point on a waterbody (river, stream, lake, wetland) that contributes runoff to that point is considered the watershed.

Watershed Based Plan: A document that provides assessment and management information for geographically defined watershed, including the analysis, actions, participants, and resources related to development and implementation of the plan.

Watershed partner(s): Key watershed stakeholders who take an active role in the watershed management planning process and implementing the watershed plan.

Watershed Vulnerability Analysis: Rapid planning tool for application to watersheds and subwatersheds that estimates future and impervious cover and provides guidance on factors that might alter the initial classification or diagnosis of a watershed or subwatershed.

Wet meadow/sedge meadow: A type of wetland away from stream or river influence with water made available by general drainage and consisting of non-woody vegetation growing in saturated or occasionally flooded soils.

Wetland: A wetland is considered a subset of the definition of the Waters of the United States. Wetlands are land that is inundated or saturated by surface or ground water at a frequency and duration sufficient to support, under normal conditions, a prevalence of vegetation adapted for life in saturated soil conditions (known as hydrophytic vegetation). A wetland is identified based upon the three attributes: 1) hydrology, 2) hydric soils and 3) hydrophytic vegetation.

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